rho 3

PHG Operation

Version 102

BOSCH

Automationstechnik

rho 3

PHG Operation

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Part 1 General rho3 PHG operation

Part 2 Testing BAPS2 programs with the PHG3

rho 3

PHG operation

Part 1

Part 1 General rho3 PHG operation

INTRODUCTION CONTENTS 0

TECHNICAL DESCRIPTION A

MENU STRUCTURE, HANDLING B

PHG FUNCTIONS C

ANNEX PHG MENU STRUCTURE D

Warning	Please take careful note of the following conditions/restrictions before placing the rho3 control into operation (e.g. with the PHG) since, otherwise, this could involve

- danger to life and limb (e.g. lethal accidents)

- risk to material (e.g. complete machine write-off, complete reject production)

- economic losses (e.g. downtimes, delays in delivery).

- If there are any points which are not clear, please consult your responsible Bosch servicing center (see last cover page).

1. AIM, PURPOSE

The aim of this manual is to provide a basic description of operation and programming of the rho3 control using the hand-held programming unit PHG.

2. TARGET GROUPS

Authorized machine fitters and setters with appropriate technical training and experience.

3. KNOWLEDGE, PRECONDITIONS

It is assumed that the reader has a sound basic knowledge of CNC and PLC techniques and all knowledge of the Bosch rho3 control as imparted in the following documents:

Document title	Sub−title
rho3 BAPS2	Programming instructions
rho3 ROPS3/IQpro	Robot online/offline programming system
rho3 Machine parameters	Description of the machine parameters
rho3 Signal	Signal description
rho3 Interface	Interface conditions

It is also assumed that the reader is familiar with the knowledge and skills imparted in the Bosch courses.

In addition, only authorized persons may work with the control.

4. WARNING, IMPORTANT, NOTE

Notes etc. occurring in the text have the following significance:

| **Note** | General hint |

| **Important** | Risk to material |

| **Warning** | Danger to life and limb and risk to material |

5. POSSIBLE ERRORS IN THE DOCUMENTATION

We constantly endeavor to provide documentation which is free of errors, complete and understandable. Should you nevertheless come across errors or incomplete descriptions or descriptions which you cannot understand, please inform your responsible servicing office of this.

6. SYSTEM DOCUMENTATION

The machine fitter/programmer is responsible and legally liable for writing/providing correct application documentation.

CONTENTS

PHG FUNCTIONS	**C**

The technical description covers the individual elements of the PHG at hardware level. The functional description is given in the following sections (B, C, D).

1. INDICATORS, DISPLAYS AND OPERATING CONTROLS, OVERVIEW

Display panel

Liquid-crystal display (LCD) with 4 lines of 20 characters each.

EMERGENCY-STOP

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Dead-man

Purpose: All movementes controlled by the PHG are aborted immediately if the key is no longer pressed.

Function: Enabling movements and special functions, only as long as Dead-man is pressed

Keypad

Keys are assigned up to three functions, dependent upon mode.

See documents "rho3 Machine parameters" and "rho3 Signal" for barring keys.

7	8	9	
4	5	6	
1	2	3	Shift
0	·	//	⇨

PHG 3   V 1.2/1

Keypad cover film

Purpose: Information on functional assignment of the individual keys.

Function: Can be turned and exchanged manually.

Identification: PHG3, keypad assignment for rho 3

Identification version of the keypad assignment

Fig. A–1 Indicators, displays and operating controls, overview

KEYPAD COVER FILM

Warning	Keys of different controls are assigned different functions. The keypad cover film must always match the control. Otherwise, there is a risk of unwanted and incorrect operator control actions etc., thus posing a danger to life and limb and a risk to material.

Keypad cover film, side 1
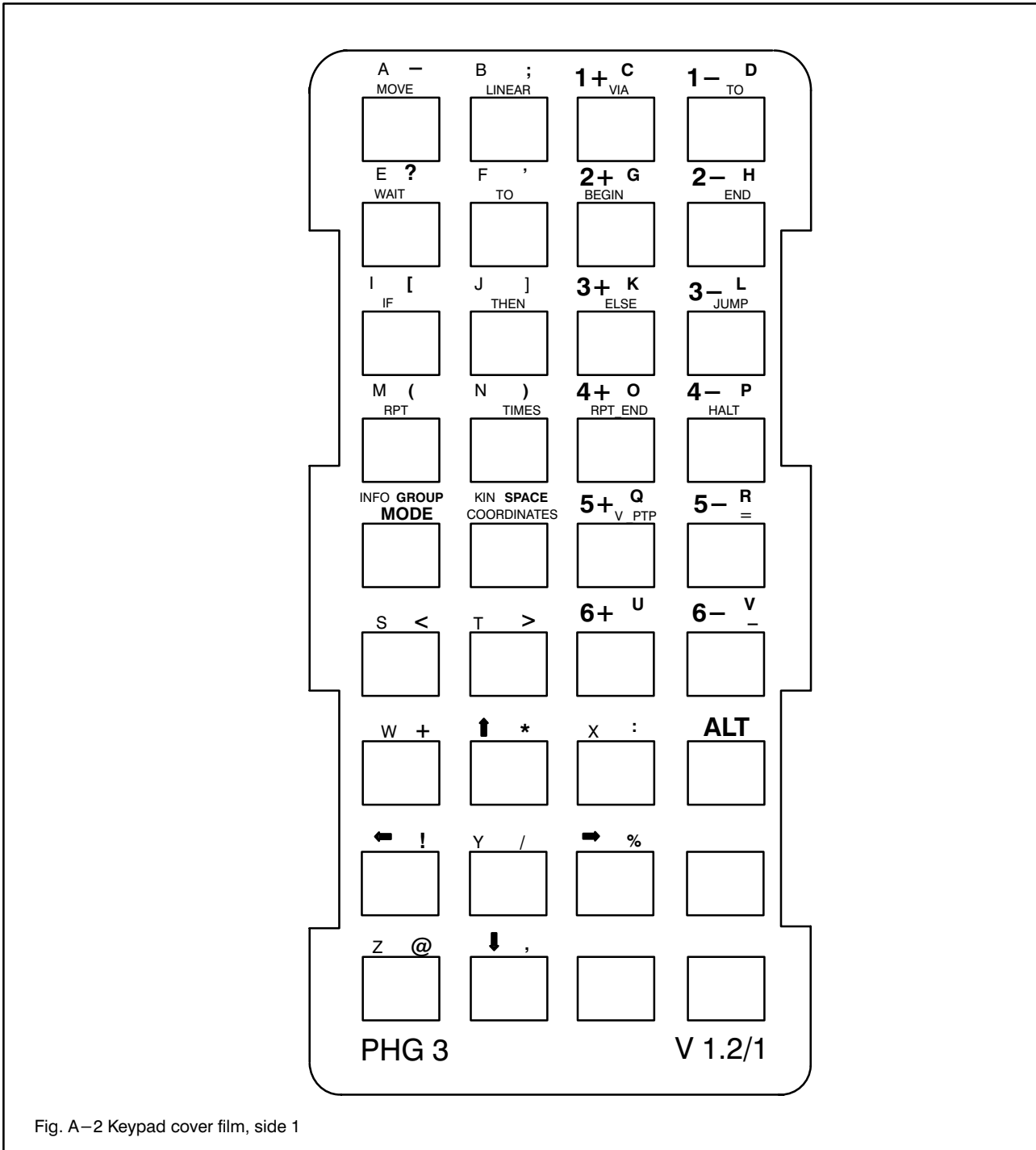
Fig. A−2 Keypad cover film, side 1

Keypad cover film, side 2

A	AN	I (Input)	

O	ON	O(Output)	

S	R	M(Marker)	

=	JC	EP	NOP1

INFO
MODE

PHG 3

V 1.2/2
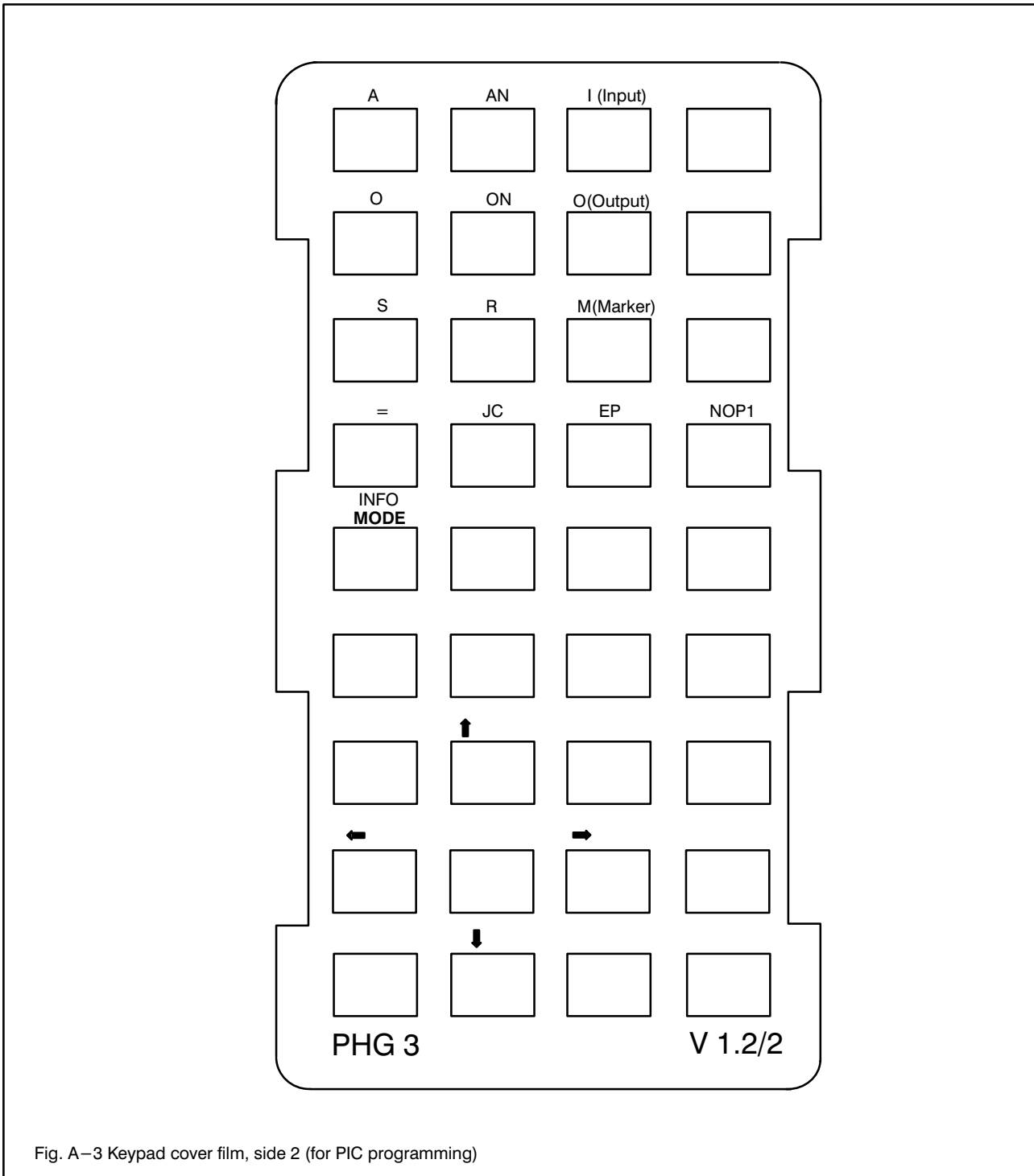
Fig. A–3 Keypad cover film, side 2 (for PIC programming)

EMERGENCY-STOP

Warning	Please note the information, instructions, notes and warnings in documents: rho3 BAPS 2.0, rho3 ROPS3/IQpro, rho3 Machine parameters, rho3 Signal, rho3 interface

Purpose: The activated robots are stopped immediately in the event of danger.

Function: EMERGENCY-STOP pressed -> Robot stop (Fig. A-4).

In the event of danger

Fig. A−4 EMERGENCY-STOP in the event of danger
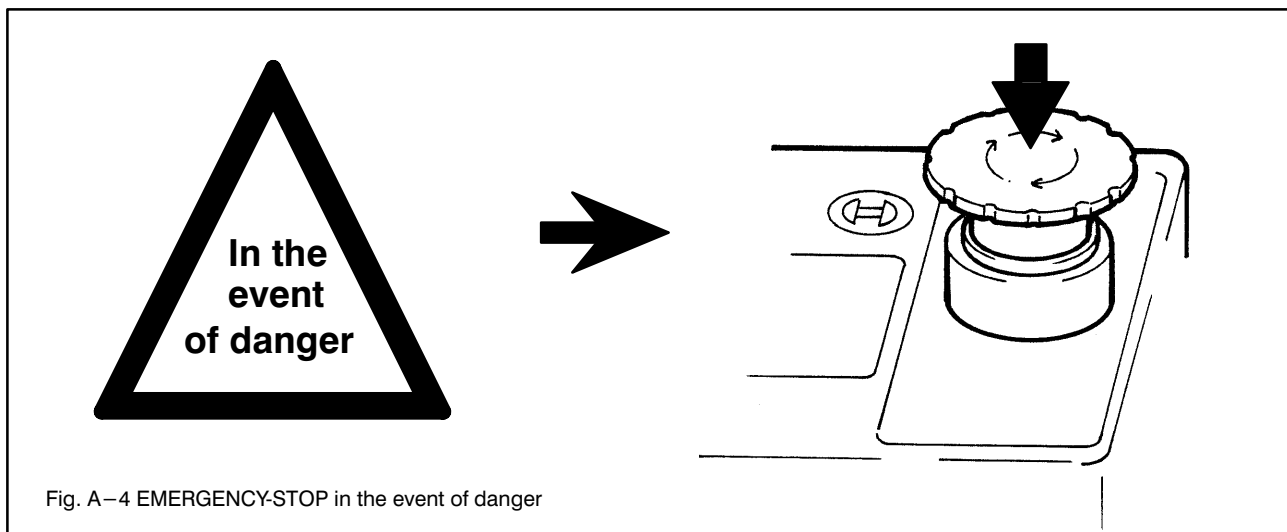
Placing back into operation of the EMER-GENCY-STOP

1. Unlock switch **EMERGENCY-STOP** (Fig. A-5): Turn the switch head clockwise until it pops out.

Fig. A−5 Unlocking EMERGENCY-STOP
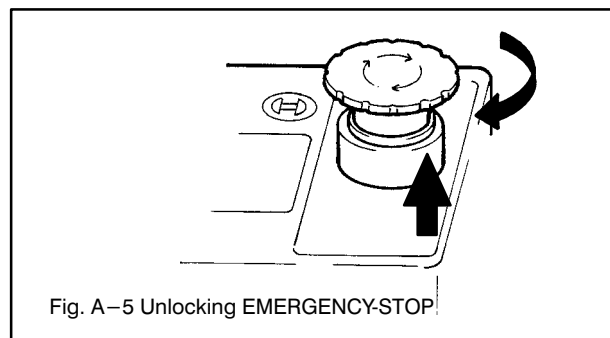
2. Triggering control reset (Fig. A-6).

Note	EMERGENCY-STOP is always pending internally after each start of the rho 3. This signal is reset by: −Control reset via PIC −Pushbutton on the control cabinet −PHG mode 11.1

Control reset

Fig. A−6 Reset on the control cabinet
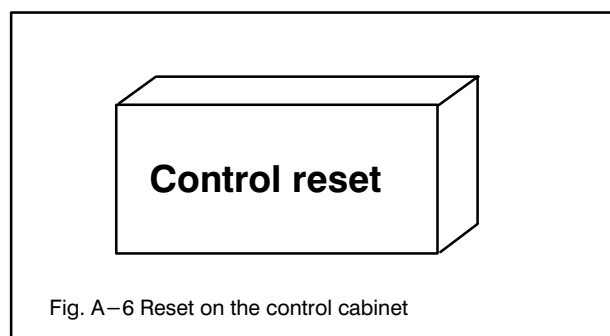
2. KEYPAD ASSIGNMENTS, PRINCIPLE

The keys of the PHG are assigned up to three different functions. The Annex provides an overview of this (Annex: PHG key assignments, overview), Fig. A-7 clearly shows the basic system used:

1. Basic assignment
   Assignment if only one key of the keypad is pressed at any one time.

2. Shift assignment
   The assignment applies if the **Shift** key is pressed.

3. ALT assignment
   The assignment applies if the **ALT** key is pressed.

   The Jog keys which trigger movements are, however, active only if
   a) Mode 1, 2 or 4.2 is active and
   b) **Dead-man** is pressed.

KEY ASSIGNMENT SYSTEM

*) Assignment active only in modes which trigger movements (modes 1, 2, 3.1.3, 4.2) with Dead-man key pressed

Fig. A−7 Key assignment system
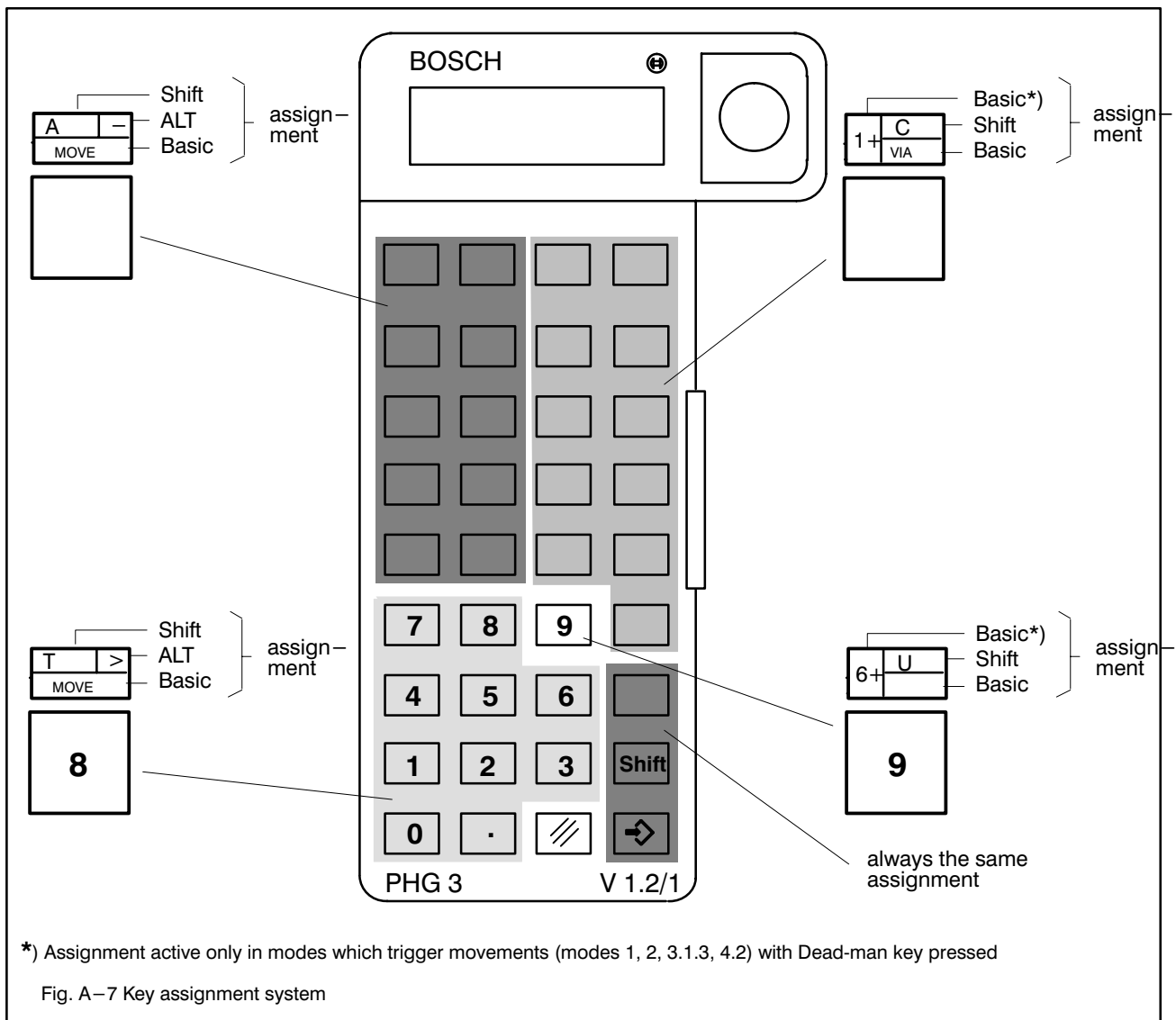
ACTIVE KEYS IN THE INDIVIDUAL MODES

BAPS editor and ASCII character entries

In the BAPS editor and in the case of all entry prompts which expect an ASCII character, the keys emphasized in Fig. A-8 are active.

Side 1 of the keypad cover film applies.

Fig. A−8 active keys: BAPS editor + ASCII entries
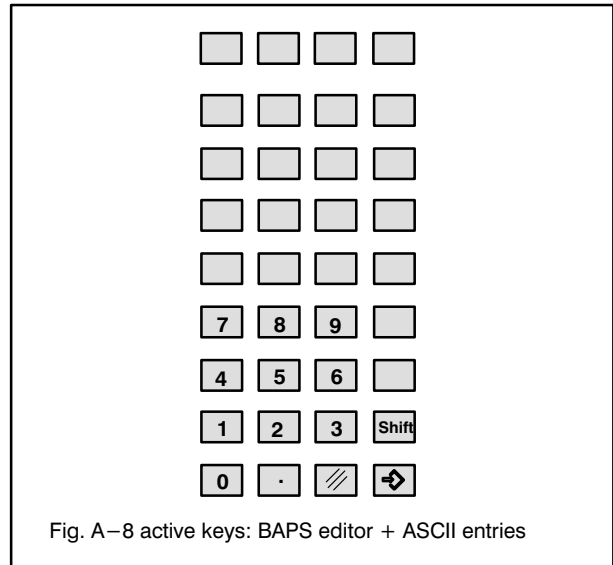
Modes apart from BAPS/PIC editor or ASCII character entries

In the other modes, the keys emphasized in Fig. A-9 are active.

Side 1 of the keypad cover film applies.

Fig. A−9 active keys: Modes apart from BAPS/PIC editor or ASCII entries
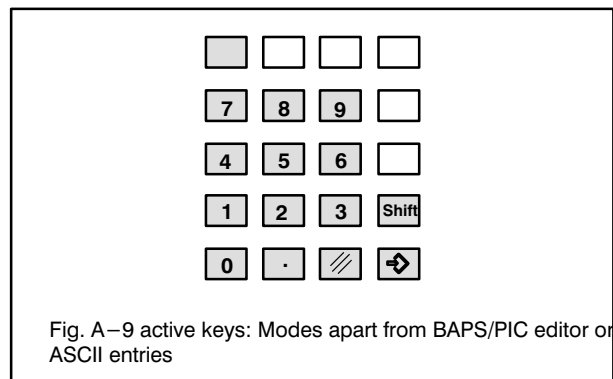
PIC editor

In the PIC editor, the keys emphasized in Fig. A-10 are active.

Side 2 of the keypad cover film applies.

Fig. A−10 active keys: PIC editor

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TECHNICAL DESCRIPTION
Keypad basic assignment

A

rho3
PHG
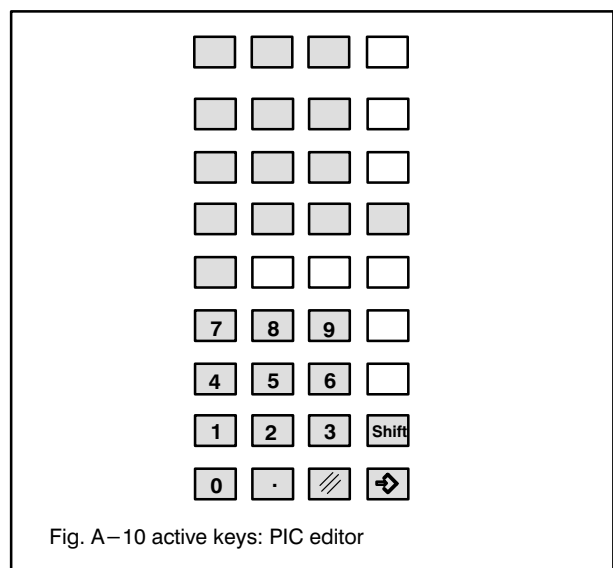
3. KEYPAD ASSIGNMENT

| Note |

The diagrams below contain information on the particular modes (or sides of the keypad cover film) to which the key assignment applies. The values in brackets correspond to the applicable side of the keypad cover film:

Figure Info	Availability of the key functions
(1)	all modes, apart from PIC editor
(2)	only PIC editor
(1+2)	all modes

3.1 BASIC ASSIGNMENT

Enter

Purpose: Accepting entries/proposals (e.g. entered values, displayed values, selected modes).

Fig. A−11 Enter (1 + 2)
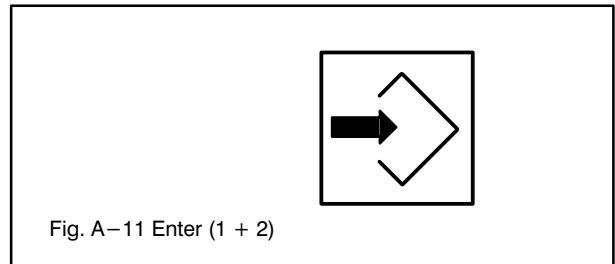
Delete

Purpose: Deleting the last character entered. Press several times consecutively if required.

Fig. A−12 Delete (1 + 2)
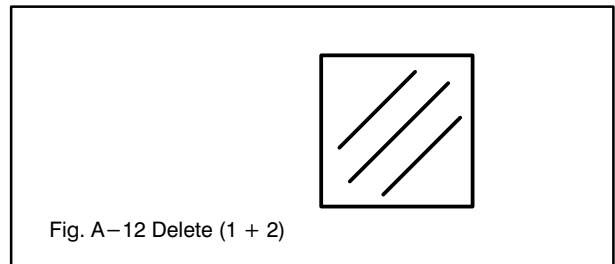
Mode

Purpose: Direct activation of a mode.

Syntax:

Mode No. **Enter**

No. Number of the required mode
(see Annex, Menu structure PHG)

MODE

Fig. A−13 Mode (1 + 2)

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Flexible Automation

TECHNICAL DESCRIPTION
Keypad basic assignment

A

rho3
PHG
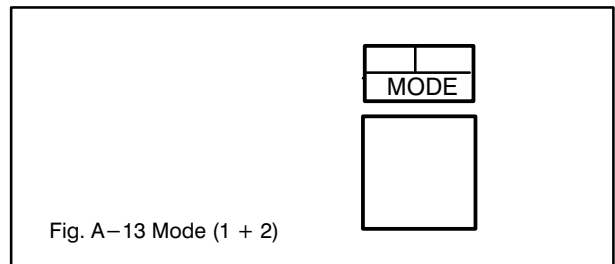
Coordinates

Note	Selection of the coordinate system refers to the currently active kinematic (see section "Shift assignment")
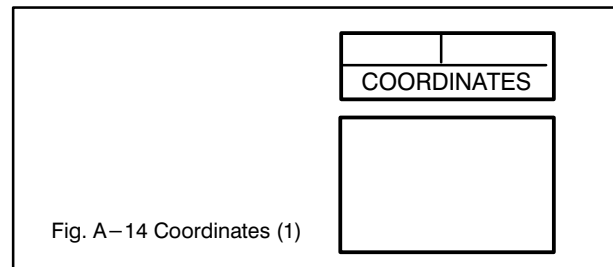
Fig. A−14 Coordinates (1)

Purpose: Selection of the coordinate system:

MK   Joint coordinates
RK   World coordinates *)
GK   Gripper coordinates *)

Selection: By pressing the key repeatedly.

*) optional

Figures

Purpose: Entering numbers (mode numbers, addresses etc.).

Fig. A−15 Figures (1 + 2)
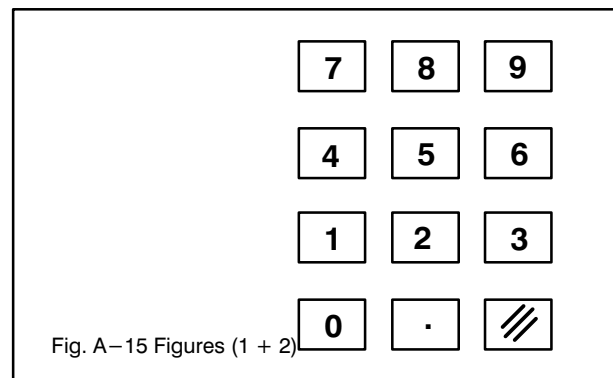
BAPS language elements

Purpose: More convenient editing of movement and sequential programs.

A BAPS language element does not need to be entered as a letter string. A key stroke suffices.

Fig. A−16 Basic assignment BAPS2 language elements
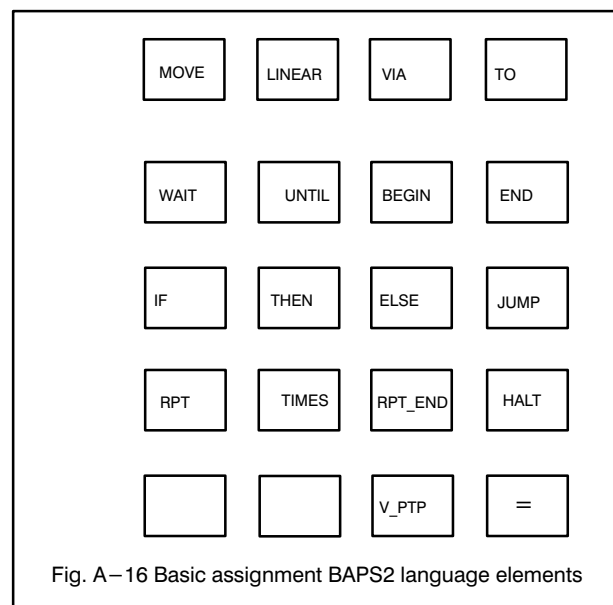
Jog

Purpose: Manual traversing of axes of the current group (Section 8.1) in the positive (e.g. 1+) or negative (e.g. 4-) direction.

Each pair of Jog keys (e.g. 2+, 2-) is assigned precisely to one axis of the current group.

Assignment of axis and key, see description Machine parameter P19 und PIC signal description.

Availability: Only if
a) mode 1, 2, 3.1.3 or 4.2 is active and
b) Dead-man key is pressed.

Coordinates: Selection of the coordinate system for the relevant kinematic
see coordinates (basic assignment).

Function: Up to 3 axes may be traversed simultaneously by simultaneously pressing the corresponding Jog keys.

Effect of pressing the key:

−   Press lightly once:
       Traversing by 1 increment

−   Keep pressed:
       First slow, continuous traversing,
       then rapid, continuous traversing

Fig. A−17 Jog (1)
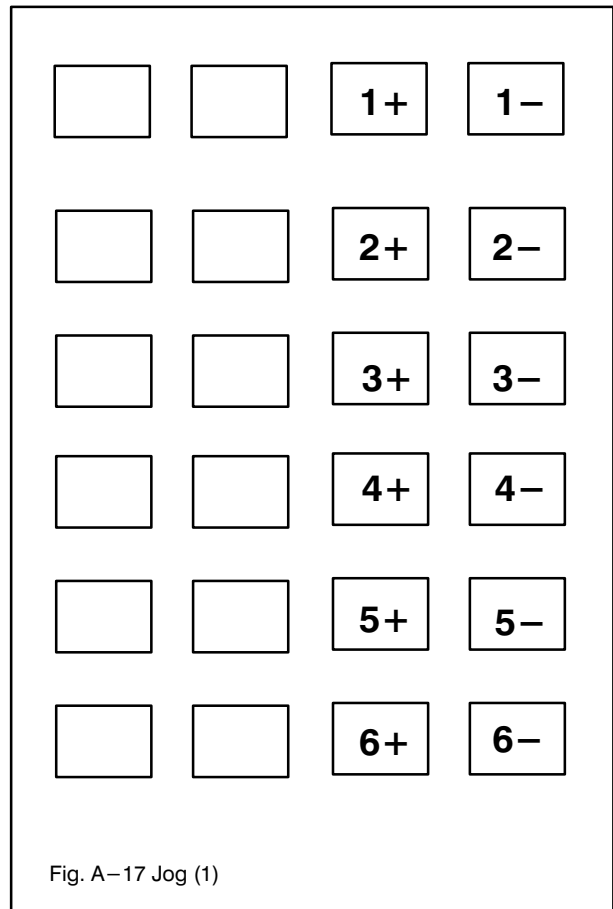
Important	If, when jogging an axis, this axis has reached its maximum speed owing to pressing the Jog key for a period and if a further axis is then jogged, this axis accelerates immediately to maximum speed.

PIC language elements

Purpose: More convenient editing of PIC programs.

A PIC language element does not need to be entered as a letter string. A key stroke suffices.

Note	The command set of PIC is implemented here, and not that of BAPS−PIC.

Fig. A−18 PIC language elements (2)

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TECHNICAL DESCRIPTION
Keypad Shift assignment

A

rho3
PHG
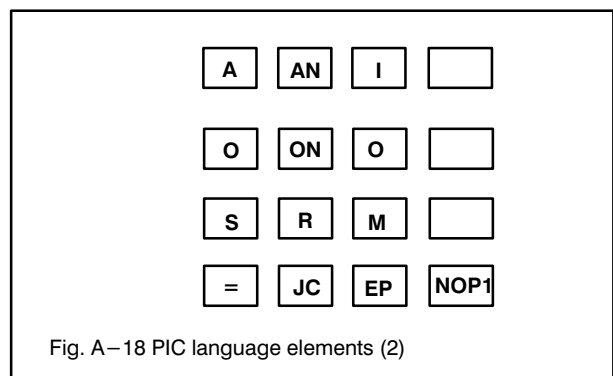
3.2 SHIFT ASSIGNMENT

Shift and key pressed simultaneously.

Info

Help text for active mode. You can page with
Cursor up and **Cursor down** (currently in preparation).
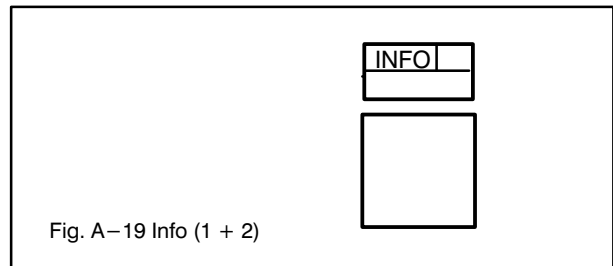
Fig. A−19 Info (1 + 2)

Kinematic

Purpose: Selection of a kinematic so as to permit the assigned coordinate system to then be selected (see Coordinates).

Selection: By pressing the key repeatedly.

Assignment: Assignment of kinematic No. and name, see Description
Machine parameters P1 and P301.
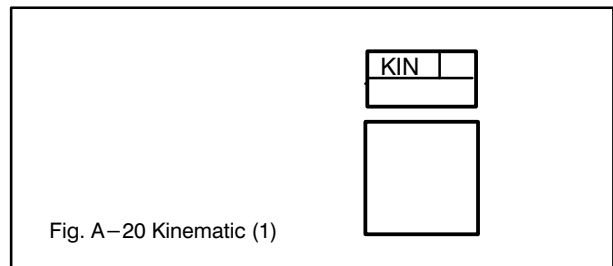
Fig. A−20 Kinematic (1)

Cursor

Cursor left Quit dialog and move one menu level up. In the editor: Moving cursor in the line/scrolling line horizontally.

Cursor right In the editor: Moving cursor in the line/scrolling line horizontally.

Cursor up Scrolling list vertically.

Cursor down Scrolling list vertically.
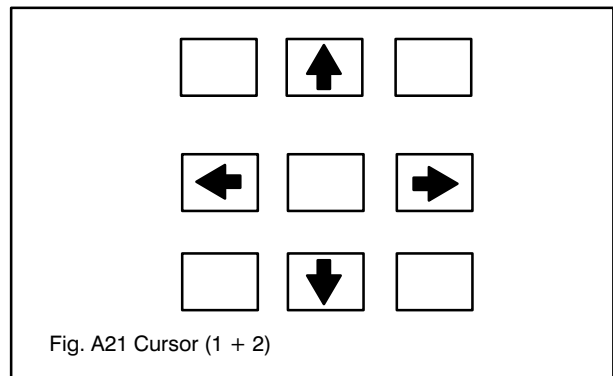
Fig. A21 Cursor (1 + 2)

Letters

Purpose: Entering letters (e.g. variable names, BAPS programs etc.)

Fig. A22 Letters (1)

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Flexible Automation

TECHNICAL DESCRIPTION
Keypad ALT assignment

A

rho3
PHG
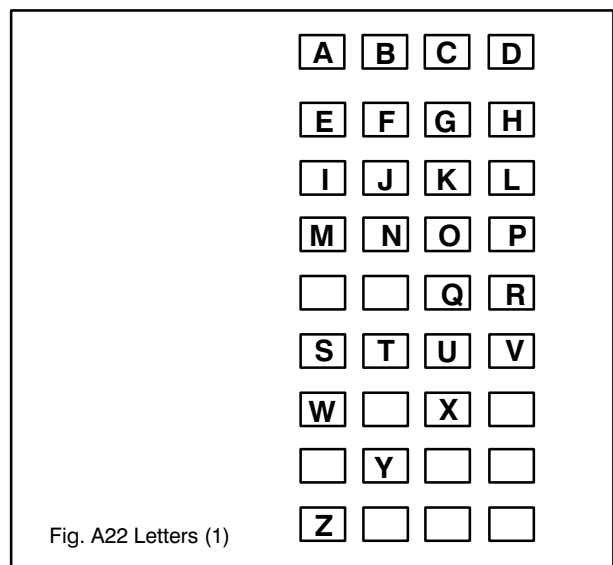
3.3 ALT ASSIGNMENT

ALT and key pressed simultaneously.

Group

Purpose: Selection of the group whose axes are to be traversed (for Group, see Description machine parameter P19 and PIC signal description).

Selection: By pressing the key repeatedly.
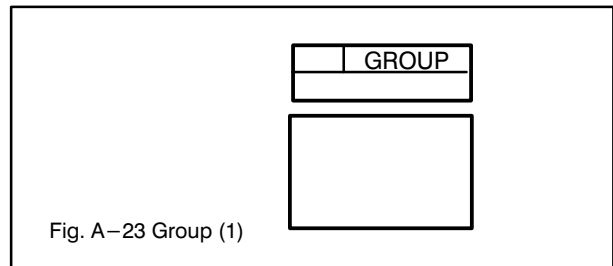
Fig. A−23 Group (1)

Special characters

Purpose: Entry of special characters (e.g. editing movement programs)
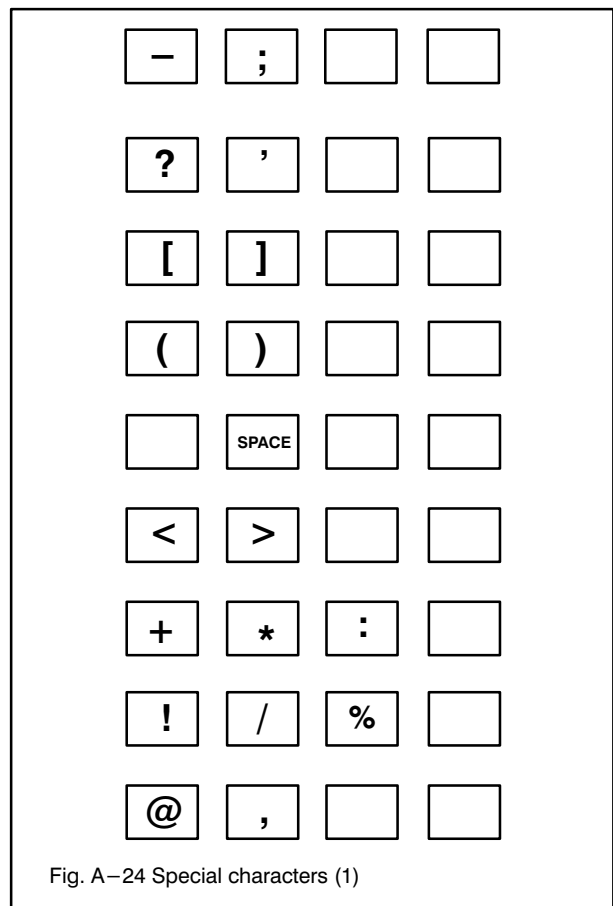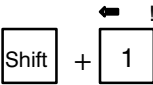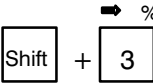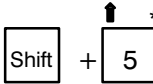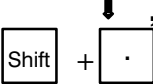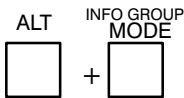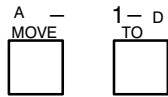
Fig. A−24 Special characters (1)

4. TEXT SYMBOLS TO KEY FUNCTIONS

For reasons of simplification, the corresponding text symbols and not the actual key captions are shown below.

Text symbols for key function	Implemented by key/combination	Comment
Enter	⟥➡⟩	Accept entry
Delete	▨	Delete character
Figures	Figure keys	Basic assignment
Letters	Letter keys	Shift assignment
Special characters	Special character keys	ALT assignment
Commands	Command keys	Basic assignment, editing
Cursor left	Shift + ⬅ ! 1	Abort dialog
Cursor right	Shift + ➡ % 3	
Cursor up	Shift + ⬆ * 5	Display upper entry
Cursor down	Shift + ⬇ , ·	Display lower entry

Examples:

Group	ALT + INFO GROUP MODE	Select axis group
+2	2+ G START	Move axis 2 positive
MOVE TO	A — MOVE 1— D TO	Command: MOVE TO

1. MAIN OPERATING MODES

1.1 GENERAL

The rho3 control has two main operating modes: **SET-UP** and **AUTOMATIC**. Only one of these operating modes may be active at any one time.

The Annex "Menu structure PHG" shows which modes are available in the two operating modes:

SET-UP: All modes are available; however, only user processes containing no traverse statements and which have been declared as "permanent" processes may be started (see BAPS2 programming instructions).

AUTOMATIC: All movement−triggering operator control actions with the PHG are barred.

1.2 SELECTING THE MAIN OPERATING MODE BEFORE SWITCHING ON

Warning	Please note the information, instructions, notes and warnings in documents: rho3 BAPS 2, rho3 Machine parameters, rho3 Signal, rho3 Interface.

1. Set the mode selector switch on the control cabinet to the required main operating mode.

Fig. B−1 Mode selector switch
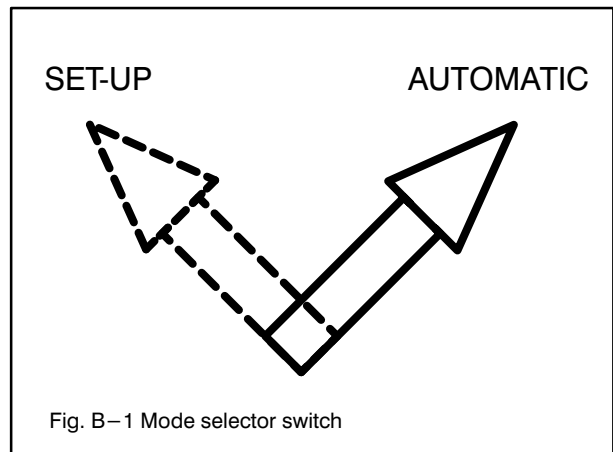
2. Switch on control.

XXXXX stands for current version

DD.MM.YYYY stands for the current date of the version

```
* * *        Set-up         * * *

XXXXX               DD.MM.YYYY
```
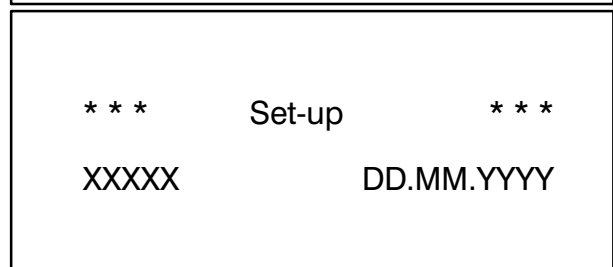
=> The control is in the selected main operating mode after an internal test has been conducted.

```
* * *        Automatic      * * *
XXXXX               DD.MM.YYYY
        − −  PHG deactivated  − −
```
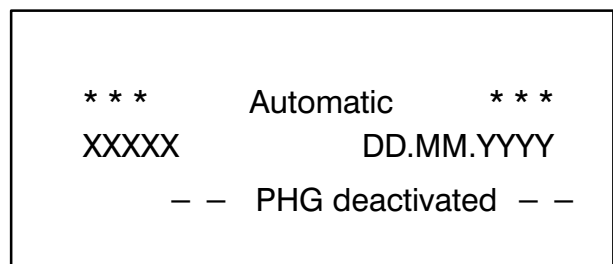
1.3   CHANGING THE MAIN OPERATING MODE AFTER SWITCHING ON

1.3.1   Changing from SET-UP to AUTOMATIC

For reasons related to safety, it is possible to switch over from set-up to automatic only if

−   the PHG has been deactivated (Mode 8) or

−   the PHG has not been connected (system without PHG).

Procedure with PHG connected:

1.   Deactivate PHG:

    Mode   8   Enter

```
* * *         Set-up          * * *

      − −  PHG deactivated  − −
```
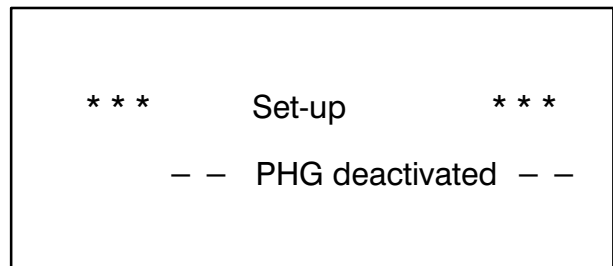
2.   Set the mode selector switch on the control cabinet to AUTOMATIC (Fig. B-2).

```
SET-UP                    AUTOMATIC
```


Fig. B−2 Mode selector switch

=> The control is in main operating mode AUTOMATIC.

```
* * *        Automatic        * * *

      − −  PHG deactivated  − −
```
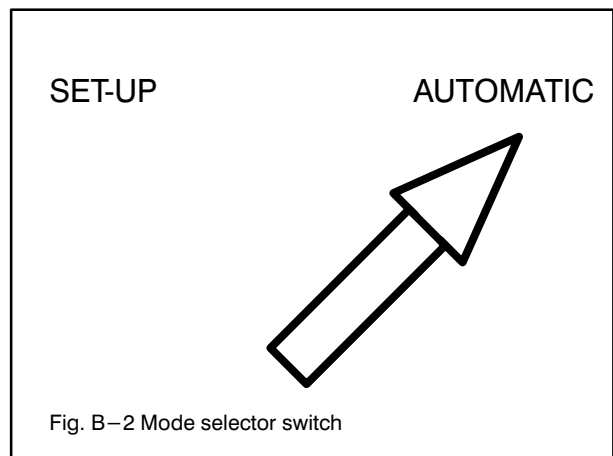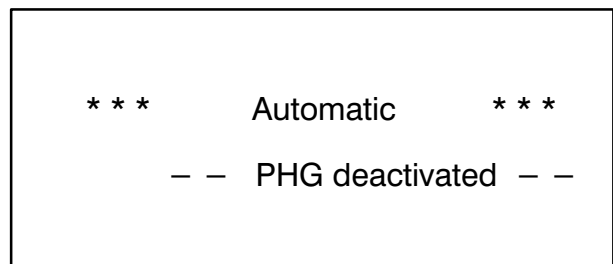
1.3.2 Changing from AUTOMATIC to SET-UP

❍ Set the mode selector switch on the control cabinet to SET-UP (Fig. B-3).

Fig. B−3 Mode selector switch

=> The control is in main operating mode SET-UP.


```
* * *        Set-up         * * *

      − −  PHG deactivated  − −
```
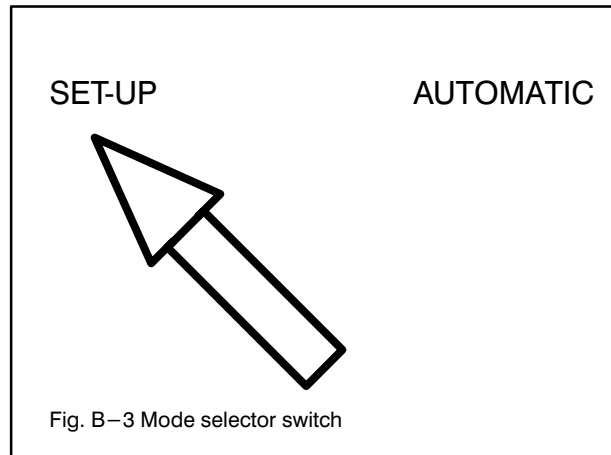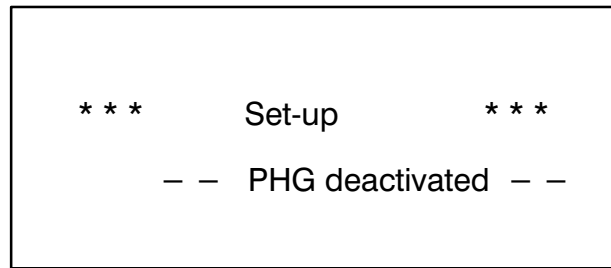
When you quit main operating mode AUTOMATIC, all non−permanent, active user processes are stopped.

Processes which have been declared permanent remain active if the RC input 61 ("Permanent processes are to remain active") is set.

2.   MENU STRUCTURE, EXPLANATION

The menu structure (see Annex "Menu structure PHG") provides information on all available modes ("Sub-modes") and how to find them in the menus.

In the form represented, the individual menu levels are arranged vertically, in hierarchically descending sequence from left to right.

Note

Chapter "PHG functions" is subdivided in such a way that the section numbers each correspond directly to the assigned entries (modes) of the menu structure.

Fig. B-4 explains this interrelationship on the basis of a specific example

7.3.2   Process statuses

7	Diagnosis

1	Axis displays
2	Errors/warnings
3	System statuses
4	Digital inputs
5	Digital outputs
6	RC inputs
7	RC outputs
8	Machine parameters
9	Test digital outputs
10	Display PHG keys
11	Version display
12	Machine status display

1	Control status
2	Process statuses
3	Current mode
4	Hardware configuration

| Positions |
| Lag |
| Offset |
| End point |

1	Display machine param.
2	Set machine param.
3	Presetting
4	Print

| 1 | MZA individual display |
| 2 | MZA automatic display |

Fig. B−4 Reference Section No. < − > Menu structure

For reasons of simplification, the individual modes/entries in the texts are referred to with their section number.

Example: Mode 7.3.2 means: Process statuses.

3.   DISPLAY FUNCTIONS/ENTRIES

The functions/entries of the active menu can be displayed with keys:

Cursor down   Display lower function/entry

Cursor up   Display upper function/entry

Fig. B−5 Display functions/entries, reference to menu structure

Fig. B−6 Display functions/entries, reference menu structure < − > display panel
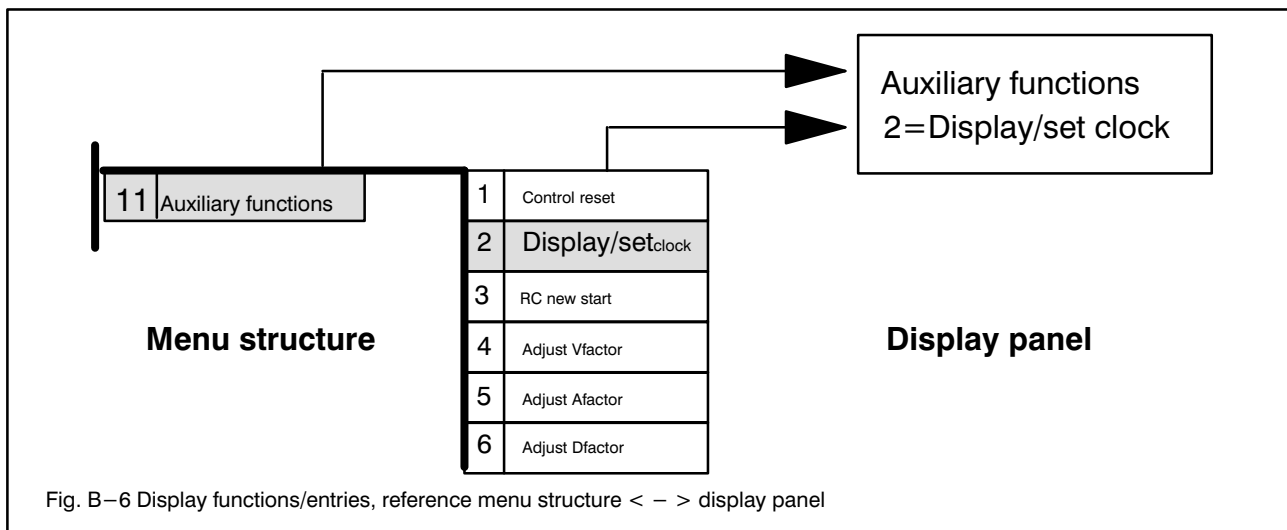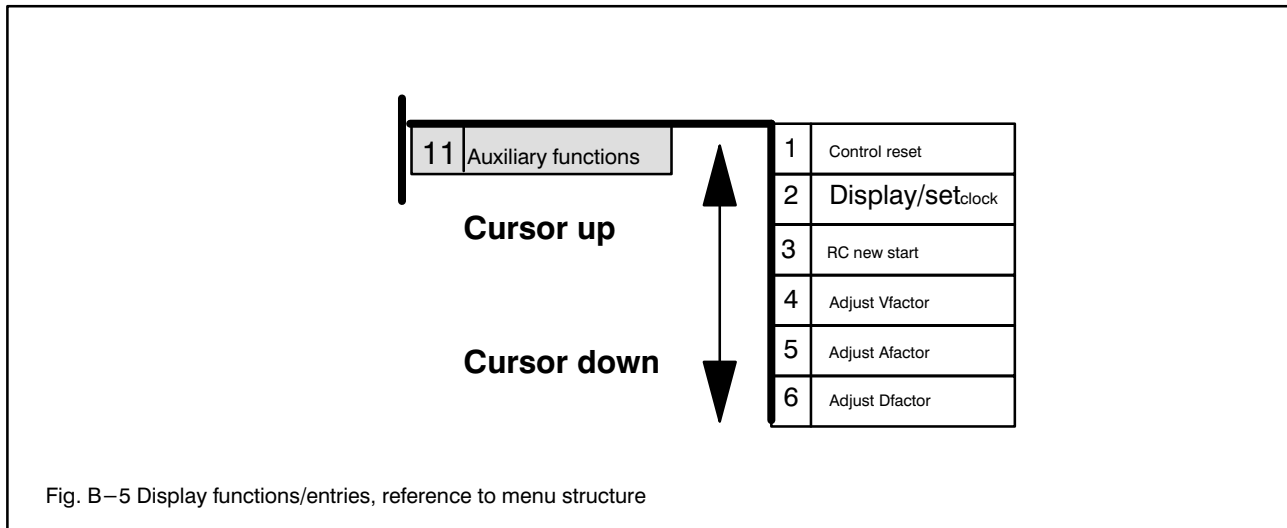
4.   ACTIVATE FUNCTIONS/ENTRIES

4.1   ACTIVATE DISPLAYED FUNCTIONS/ENTRIES

A function/entry displayed with **Cursor down** / **Cursor up** can be activated by pressing key **Enter**

Fig. B−7 Activate displayed functions/entries
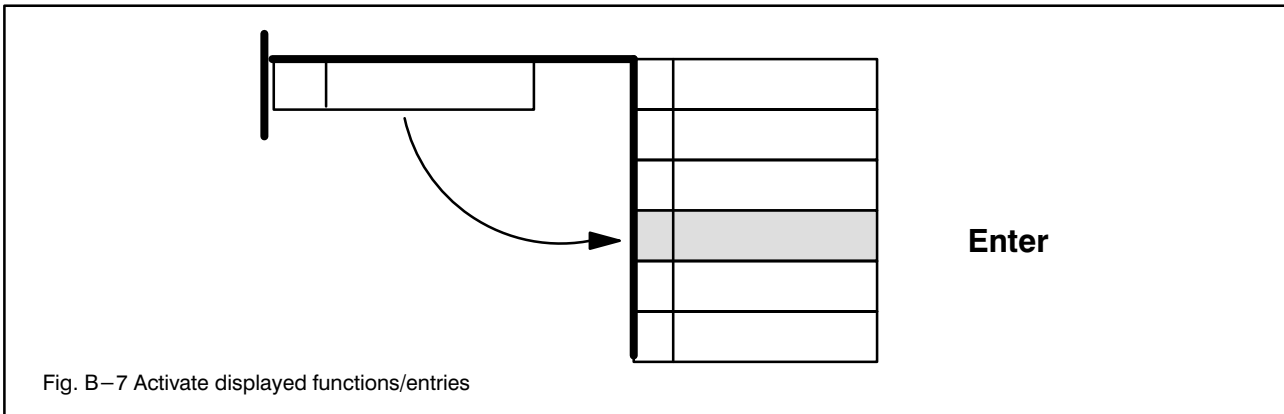
4.2   ACTIVATE FUNCTIONS/ENTRIES DIRECTLY

A function/entry of the active menu can be activated directly (i.e. without displaying it beforehand) by making the following entry:

Mode   No.   **Enter**

No.   Number of the required function/entry

Fig. B−8 Activate functions/entries directly
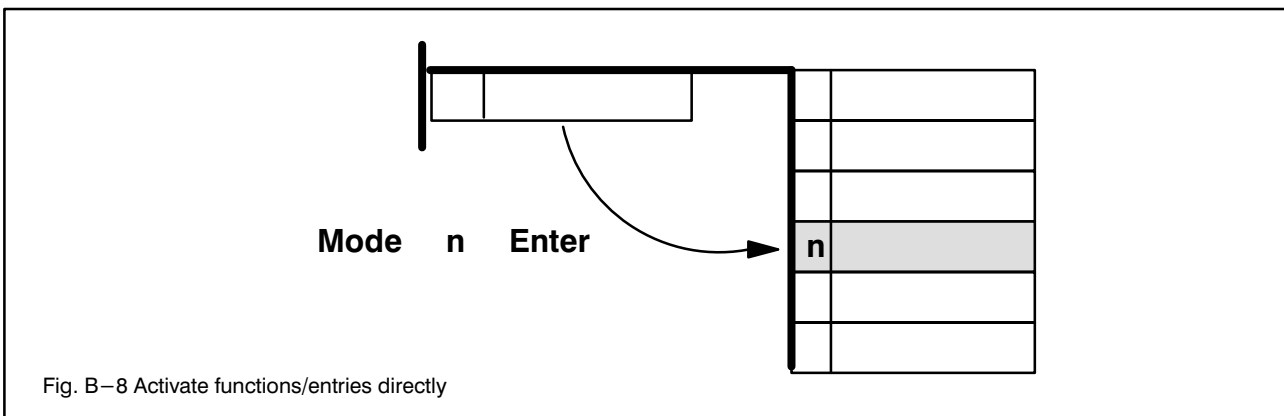
4.3   SELECT SUB-MENU LEVELS DIRECTLY

Currently in preparation.

5. QUIT DIALOGS

Dialogs can be quit at any time with **Cursor left** (Fig. B-9).

Fig. B−9 Quit dialogs
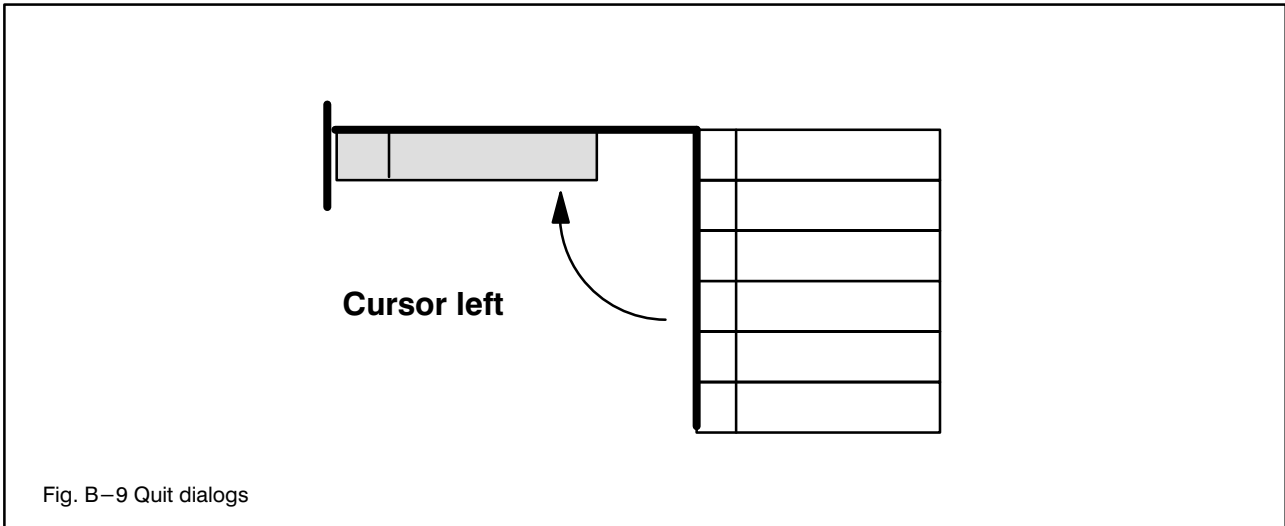
6. ENTRIES

'#' in the display panel means: The PHG awaits entry of a value or confirmation of the value displayed/pre-set.

Example:

Mode 11.2

Time and date

08.10.91   13.43.20

Hours:#

Option 1:

Accept displayed value (in this case: hours) un-changed (and continue to the next query, in this case: minutes).

Enter

Time and date

08.10.91   13.43.20

Minutes:#

Option 2:

Change displayed value:
Value **Enter**
Example: Change hours to 14:
1 4   Enter

Time and date

08.10.91   14.43.20

Minutes:#

Option 3:

Abort procedure: **Cursor left**

7. EXAMPLE

Activate Mode 7.3.2:   7 . 3 . 2

Mode   7   Enter
or

    Cursor down
    until display 7=Diagnosis
    Enter

Mode   3   Enter
or

    Cursor down
    until display 3=System statuses
    Enter

Mode   2   Enter
or

    Cursor down
    until display 2=Process statuses
    Enter

Diagnosis

  1=Axis Displays
  2=Errors warnings

System statuses

  1=Control status
  2=Process statuses

Norm. Process active: 0
Perm. Process active: 0
Sub. Process active: 0
Process error: 0

Fig. B−10 Example: Activate Mode 7.3.2

8. SUMMARY

Cursor left

Mode   n   Enter   **n**

Cursor up

Enter

Cursor down

Fig. B−11 Summary: Menu structure, handling

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Flexible Automation

PHG FUNCTIONS

Reference points

C
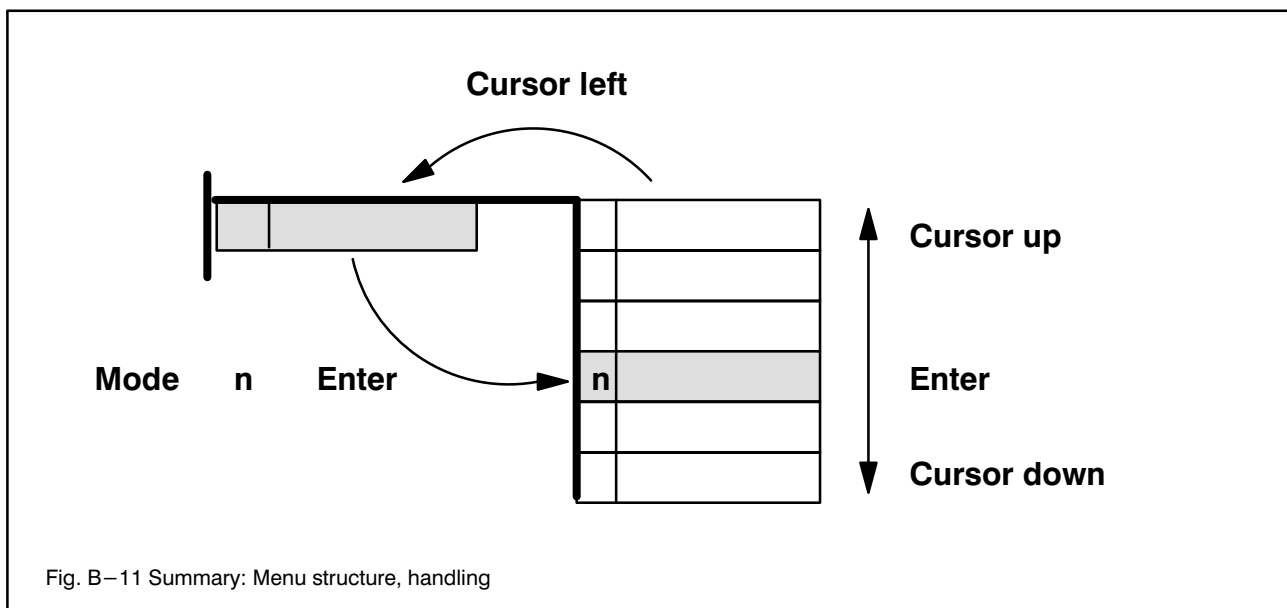
rho3
PHG

1.   REFERENCING

| **Warning** | Please note the information, instructions, notes and warnings in documents: rho3 BAPS 2.0, rho3 Machine parameters, rho3 Signal, rho3 Interface. |

| **Warning** | Before traversing axes, please ensure that |

- ○ there is no one in the working range/danger zone of the robot(s),
- ○ that the working range/danger zone has been adequately safeguarded
- ○ that the relevant accident prevention regulations of the employers' liability insurance associations
  have been followed.
- ○ Even at reduced speed, robot arms may apply considerable forces
  which may lead to serious injury or even death.

| **Important** | Before traversing axes, please ensure that there are no objects in the entire working range of the robot(s). |

Purpose

Manually approaching the (machine) reference points with Jog keys.

All axes with incremental path measuring system must be referenced (moved to their reference points) after each system new start (switching on the control) so that the control is familiar with the absolute axis positions. The axes can be traversed only manually with the Jog keys before this is done.

Referencing – yes/no

Axes with absolute path measuring system (e.g. angle encoders) do not need to be referenced. Referencing is required only if the following message is displayed in line 3 of the display panel after a system new start.

"No reference points!"

```
* * *        Set-up          * * *
VE05D                    05.02.1991
      No reference points!
```

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PHG FUNCTIONS

Reference points

C

rho3
PHG

Explanation of the display panel

```
   a      b        c   d    e

 ┌─────┐ ┌─────┐  ┌─────┐┌─┐┌─┐
 │K01│.│A_1│   │0.00││*││R│
  K01 . A_2     0.00  *  R
  K01 . A_3     0.00  *  R
 ┌─────┐               ┌──────┐
 │Gr.01│               │Posit.│
 └─────┘               └──────┘
   │                      │
   g                      f
```
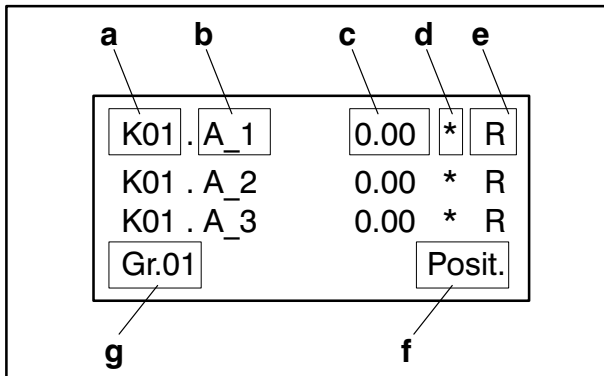
a)   **Kinematic name**

b)   **Axis name**

c)   **Value**

Absolute axis position in MK after reference point has been approached. The reference point may differ from the machine datum (always 0.00) by the so−called offset (see Description machine parameters).

d)   **Status position servo loop**

No display: Axis position not corrected

*:   Axis is within the "in-position range" defined via machine parameters;

e)   **Reference point to be approached**

R: Reference point yet to be approached

No display: Reference point already approached

f)   **Axis position**

Value c) refers to the axis position
(lag, offset and end point can be displayed with **Cursor right**.

g)   **Group**

Selection with **Group**

Scroll lines

Scrolling display of the axes of the active group vertically on the display panel:

Cursor down / **Cursor up**

Reference point approach

┌──────────┐
│ **Warning** │
└──────────┘

Please note the assignment of group / kinematic/ axis and Jog keys (see Description machine parameters).

Keep **Dead-man** pressed and briefly press corresponding **Jog key** => assigned axis automatically approaches reference point.

Example

Reference axis 1 of kinematic 1.

Dead-man + **1+** or **1-**

```
   K01.A_1      −180.00 *

   K01.A_2         0.00 * R

   K01.A_3         0.00 * R
   Gr. 01          Posit.
```

Display "R" disappears as soon as the reference point has been approached.

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PHG FUNCTIONS
Manual

C

rho3
PHG

2.   MANUAL OPERATION

Warning

Please note the information, instructions, notes and warnings in documents:
rho3 Machine parameters, rho3 Signal, rho3 Interface.

Warning

Before traversing axes, please ensure that
❍   there is no one in the working range/danger zone of the robot(s)
❍   that the working range/danger zones have been adequately safeguarded
❍   and that the relevant accident prevention regulations of the employers' liability insurance associations
have been complied with
❍   Even at reduced speed, robot arms may apply substantial forces
which may lead to serious injury or even death.

Note

Setting increments, speeds for continuous and
continuous fast traverse, see Description machine parameters P111..P117.

Purpose

Manual traversing of the axes with Jog keys and display of position, lag and offset at rest and during traversing.
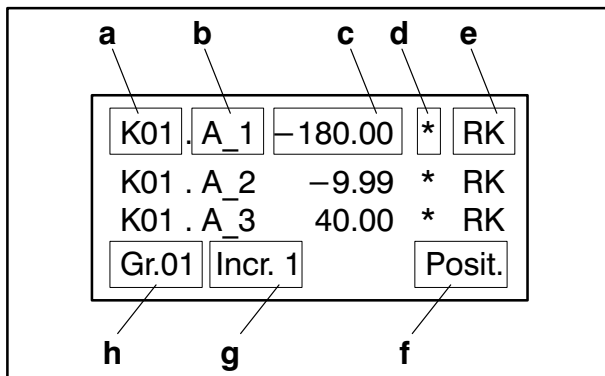
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Flexible Automation

PHG FUNCTIONS

Manual

C

rho3
PHG

Explanation of the display panel

```
    a       b        c    d    e

   ┌────┐┌────┐┌─────────┐┌─┐┌────┐
   │K01 │.│A_1 ││ −180.00 ││*││ RK │
   └────┘└────┘└─────────┘└─┘└────┘
     K01 . A_2    −9.99    *   RK
     K01 . A_3    40.00    *   RK
   ┌──────┐┌────────┐     ┌──────┐
   │Gr.01 ││ Incr. 1│     │Posit.│
   └──────┘└────────┘     └──────┘

      h        g             f
```

a)   Kinematic name

b)   Axis name

c)   Value

Referred to the displays in the other fields.

d)   Status position servo loop

No display: Axis position not corrected

*:   Axis is within the "in-position range" defined via machine parameters

e)   Active coordinate system

MK: Joint coordinates

RK: World coordinates

GK: Gripper coordinates

No display: No coordinate system active

Activating coordinate system:

1.   Select Kinematic with **Kinematic**

2.   Select coordinate system with **Coordinates**

f)   Significance of the values in field c)

Posit.: Axis position

Lag: Lag (display only)

Offset: Offset (display only),
see rho3 Machine parameters
P306 "Offset adjustment"

Selection with **Cursor right.**

g)   Traverse mode

Increment: Minimum traversing unit for Jog mode (press Jog keys only briefly). Display is not seen until after coordinate systems have been selected. See Description machine parameters P111..P116 for setting the increments.

Cont.L.: With Jog key pressed, initially continuously slow traversing

Cont.S.: If the Jog key is pressed slightly longer, continuously rapid traversing

h)   Group

Selection with **Group.**

Scrolling lines

Scrolling the display of the axes of the active group vertically in the display panel:

Cursor down / **Cursor up**

Manually traversing axes

Warning	Please note the assignment of axis traversing direction and Jog keys (+/-) and the assignment of group/ kinematic/axis and Jog keys (see Description machine parameters).

Preconditions

1.   In the case of RK and GK: Reference points must have been approached.

2.   Coordinate system selected:
     Kinematic / **Coordinates**

Coordinate and kinematic preselection is possible only with the "DEAD-MAN" key pressed.

Procedure:

Keep **Dead-man** pressed and press the corresponding **Jog key(s)** (it is possible to press up to three Jog keys simultaneously).

3. PROGRAMMING BAPS2/PIC

Note	Please note the information, instructions and notes in documents: rho3 BAPS2, rho3 ROPS3, rho3 Machine parameters, rho3 Signal, rho3 Interface.

3.1 PROGRAMMING BAPS2

Purpose

Writing, modifying, correcting and optimizing etc.

❍ BAPS2 programs via Editor

❍ Compiling them in IRDATA code via the compiler

❍ Defining points of compiled programs

❍ Teaching points of compiled programs

Program preselection

Programs are preselected with menu prompting. The preselected program remains active for the subordinate modes (Edit, Define, Teach, Compile) until Mode 3.1 is activated again after a level return (**Cursor left**).

There are two options for program preselection:

1. Cursor preselection
    Select the required file with
    Cursor down / **Cursor up**
    and preselect it with
    Enter.

2. Direct preselection
    Explicitly enter the file name including extension (.QLL for source file, .ERR for error file) and confirm with
    Enter.
    File name **Enter**

    If the file does not yet exist, you will see message:
    "Create new file: Enter"

    Enter : Create new file
    Cursor left : Return to menu of Mode 3
    Cursor up / **Cursor down** : Return to program preselection

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PHG FUNCTIONS
Programming BAPS/PIC

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3.1.1   Edit

Purpose

Writing, modifiying, correcting or optimizing etc. BAPS2 source files (.QLL) or ASCII files (.DAT).

Explanation of the display panel

```
      a                        b

      ┌ PROGRAM  ABCD
        START
      └ REP. 2  TIMES        #
      ┌COM┐ : #   Z :   3   S: 11

        f     e     d     c
```
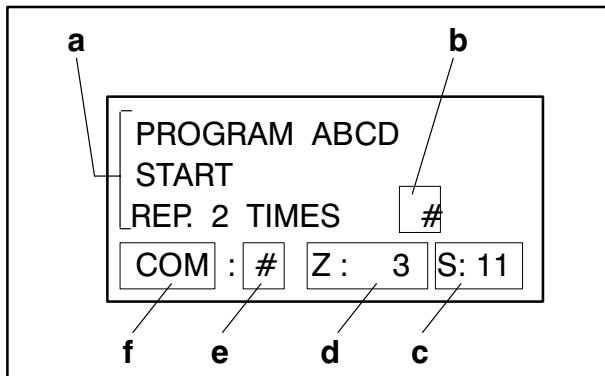
a)   **Source program text**

b)   **Cursor**

c)   **Current cursor column**

d)   **Current cursor line**

e)   **Input prompt**

is displayed after

Mode
L (line No.) or
Mode S (Search string)

(See below, Editor commands)

f)   **Editor command**

Editor commands always start with **Mode.**

COM: is displayed if key **Mode** has been pressed and prompts you to enter an editor command (E, C, Q, L, S).

(See below, Editor commands)

Editor functions

❍   Move cursor and, if applicable, scroll lines (line length is max. 80 characters):

Cursor keys

❍   Terminate line and start new line:

Enter

❍   Insert line:

Move cursor to start of line and

Enter

❍   Delete characters (to left of cursor, autorepeat function)

Delete

❍   Delete line with

Shift + Delete

Editor commands

❍   Exit

Mode   E

Store files. Original file is overwritten.

❍   Compile exit

Mode   C

Store and compile files. Original file is over-written.

In the case of compilation errors, the number of such errors is displayed in the display panel (see "Compile"). The compiler writes the error messages and warnings in plain text into a file of the same name (.ERR).

Read error file:

1. Preselect editor again

2. Switchover source/error file:

ALT + 6+

This change can be repeated as required, and the relevant cursor positions are retained.

Note	Print error file (.ERR), see Mode 9.

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PHG FUNCTIONS

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○ Quit

Mode Q

Quit editor without storing (any changes are lost, original files remain unchanged).

○ Line

Mode L No. **Enter**

Move cursor to start of line No.

○ Search

Mode S String Enter

Search for first occurrence of the character string String as of the current cursor position in the direction of the end of the file and set cursor to start of the character string.

Repeat search for same character string:

Enter

Search for new character string String:

String **Enter**

Quit search

Cursor left

Example

Creating new BAPS2 source file ABCD.QLL:

Program text	PHG entries
PROGRAM ABCD	PROGRAM **SPACE** ABCD **ENTER**
START	**START ENTER**
REP. 10 TIMES	**REP. SPACE** 10 **SPACE TIMES ENTER**
MOVE P1	**MOVE SPACE** P1 **ENTER**
MOVE P2	**MOVE SPACE** P2 **ENTER**
REP._END	**REP._END ENTER**
PROGRAM_END	PROGRAM_END **ENTER**
	Mode E **ENTER**

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PHG FUNCTIONS

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   PHG

3.1.2   Define

See Section 4.1

```
         a                    b

    Def.              APS

    P1

    X_A    120.000    #

         e        d    c
```

3.1.3   Teach

See Section 4.2.

```
         a                    b

    Teach             APS

    P1                           — +

    #

         e        d    c
```

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PHG FUNCTIONS
Programming BAPS/PIC

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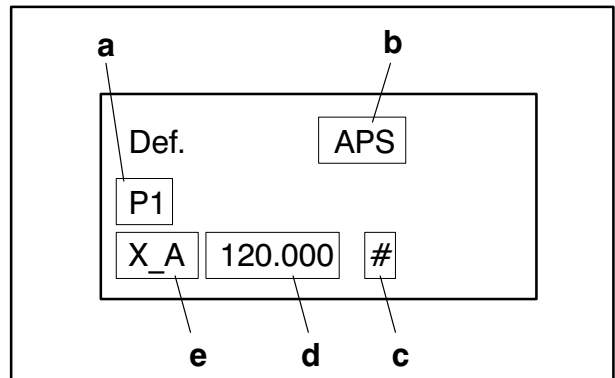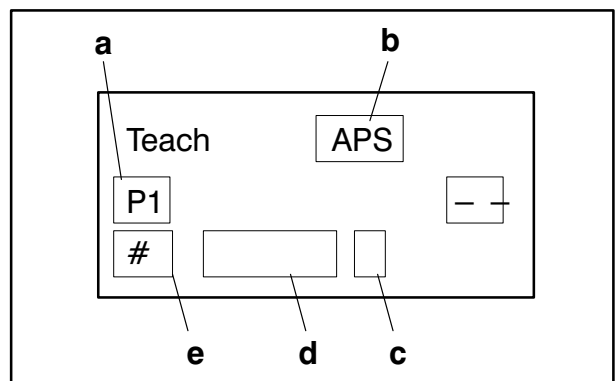
3.1.4   Compile

Purpose

Generating an executable IRDATA program (.IRD) from the preselected BAPS2 source program (.QLL) and testing for formal errors.

If program errors are detected, generation of an error file (.ERR).

Error display

The PHG displays the following if program errors are detected:

○   Number of errors and warnings

The compiler writes the errors and warnings in plain text (line length = max. 80 characters) into an error file of the same name (.ERR). In order to view this file, please preselect the editor again:

1. Preselect editor.
    If the editor is called directly after the compiler, the cursor will automatically be positioned at the first line with an error.

2. **ALT** + **6+**   (switchover source/error file and vice versa)

    Vertical/horizontal scrolling with

    Cursor down / **Cursor up**
    Cursor left / **Cursor right**

    You can change between source and error file in any direction and as frequently as required. The last cursor position in the two files is retained.

See the Annex for an explanation of the error messages.

If no errors have occurred, message ”No errors” is displayed.

Error

If there are errors in the program, no new .IRD file and no new .PKT file are created. The existing files (of an earlier, error−free compiler run) are retained unchanged.

Errors must be corrected in the source file.

Warnings

Warnings are messages of the compiler relating to possible errors.

Compiled programs which contain warnings can be started; however, you should check the significance of the warnings beforhand.

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PHG FUNCTIONS

Programming BAPS/PIC

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3.2   PROGRAMMING PIC

| Warning |

PIC statements, particularly if they use addresses which have already been defined/used, may substantially influence the function of the PIC program and may thus lead to malfunctions which, in turn, may result in machine damage or even lethal injury.

 Before making any changes, please inform yourself adequately as to whether and how the individual PIC addresses are assigned (see rho3 Signal description).

Keypad cover film, side 2 applies.

It is assumed that the reader has a sound basic knowledge of PLC programming with statement lists.

The last PIC statement of the PIC program must be PE since, otherwise, any statements following will also be executed cyclically.

3.2.1   PIC editor

Purpose
Subsequent modification of the PIC program stored on the EEPROM.

Preconditions
❍   **EMERGENCY-STOP** activated before preselection of Mode 3.2.1.

❍   EEPROM write-protect switch on the I/O board must be set to position 0 (see rho3 Interface conditions).

General
The PIC editor offers functions **"Search"** and **"Edit"**.

Search supports targeted preselection of a specific PIC address/PIC statement on the basis of various search criteria (address, operand, statement, JC, PE).

Editing permits actual editing of the PIC program. Precisely one PIC statement per line. End of program = PE.

Change to function "Search" with **Cursor left**. Repeat search with last search criterion: **Cursor down.**

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PHG FUNCTIONS
Programming BAPS/PIC

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PHG

Search

Explanation of the display panel

PIC editor
Max. PIC address = 4095
Search = ?

a
b
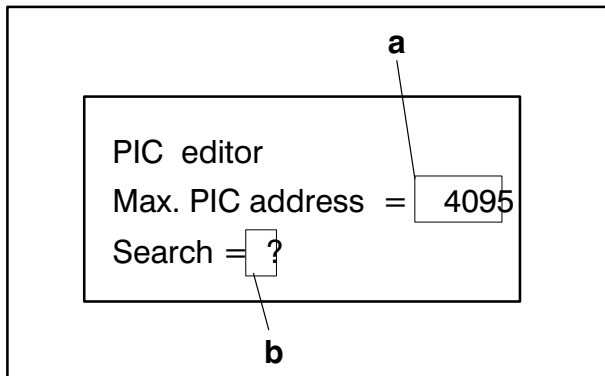
a)   Max. PIC address

Dependent upon configuration level.

b)   Enter search criterion

The following criteria are valid:

- PIC address
  0 .. max. PIC address
  0 = Start of program

- Operand (E/A/M)
  Exp.: M117.2

- PIC statments, complete
  Exp.: UN E107.4

- JC (without jump address)
  Exp.: SPB

- JC (with jump address)
  Exp.: SPB 1020

- NOP1 (dummy command)
  Exp.: NOP1

- PE (= End of program)
  Exp.: PE

After you enter the search criterion and terminate with **Enter**, the display changes to Edit, provided the search criterion was fulfilled.

Repeat last search:

Cursor down

Edit

Explanation of the display panel

PIC editor
Max. PIC address = 4095
4077 AN E107.4

a
b
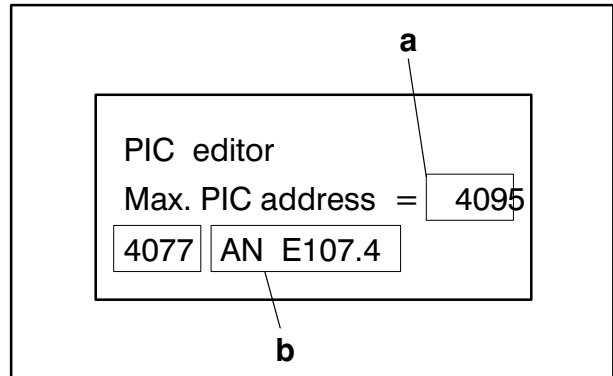
a)   Max. PIC address

Dependent upon configuration level.

b)   PIC statement

Precisely one PIC statement per line.

It is not possible to insert a line. It is only possible to overwrite a line (in the case of extensions: Reserve space with NOP1 commands).

Statements, see "Available PIC commands".
(Next page)

c)   Current PIC address

Increment/decrement addresses:

Cursor down / **Cursor up.**

Change to search:

Cursor left

Edit, continue

Available PIC commands

German	English	Significance	Notes/explanation
U	A	AND operation	These commands must be followed
			by an argument:
UN	AN	AND-NOT operation	Valid arguments:
O	O	OR operation	Inputs E0.0 to E127.7
ON	ON	OR-NOT operation	Outputs A0.0 to A127.7
S	S	Set (output or marker)	Markers M0.0 to M127.7
R	R	Reset (output or marker)	
=	=	Assign result	
SPB	JC	Conditional jumps	Jump address must lie
			between current and maximum
			PIC address (e.g. 4095)
NOP1	NOP1	No operation	Dummy operation
PE	PE	End of program	Following addresses
			have no effect

Interactions

Cursor down	Preselect next PIC address up
Cursor up	Preselect next PIC address down
Cursor left	Change the function **"Search"** The last statement edited remains unchanged unless it has been accepted with **Enter** w Continue edit: **Criterion Enter** w Repeat last search: **Cursor down** w Quit PIC editor completely: **Cursor left**
Delete	Overwrite current statement with NOP1
Enter	Accept current statement and store permanently in EEPROM

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Error messages

Entry error	Invalid PIC command key or invalid PIC address
Invalid E/A/M	Invalid argument for PIC commands A, AN, O, ON, S, R, or =. Valid arguments: E, A or M
Bit No. error	Byte/bit No. invalid. Invalid byte and/or bit No. Valid range: 0.0 to 127.7
Bit No. invalid	Invalid bit No. Valid range: 0 to 7
Format error	Input format invalid. Example: Only a character entered after an AND command as argument.
Entry illegal	set or reset command applied to input.
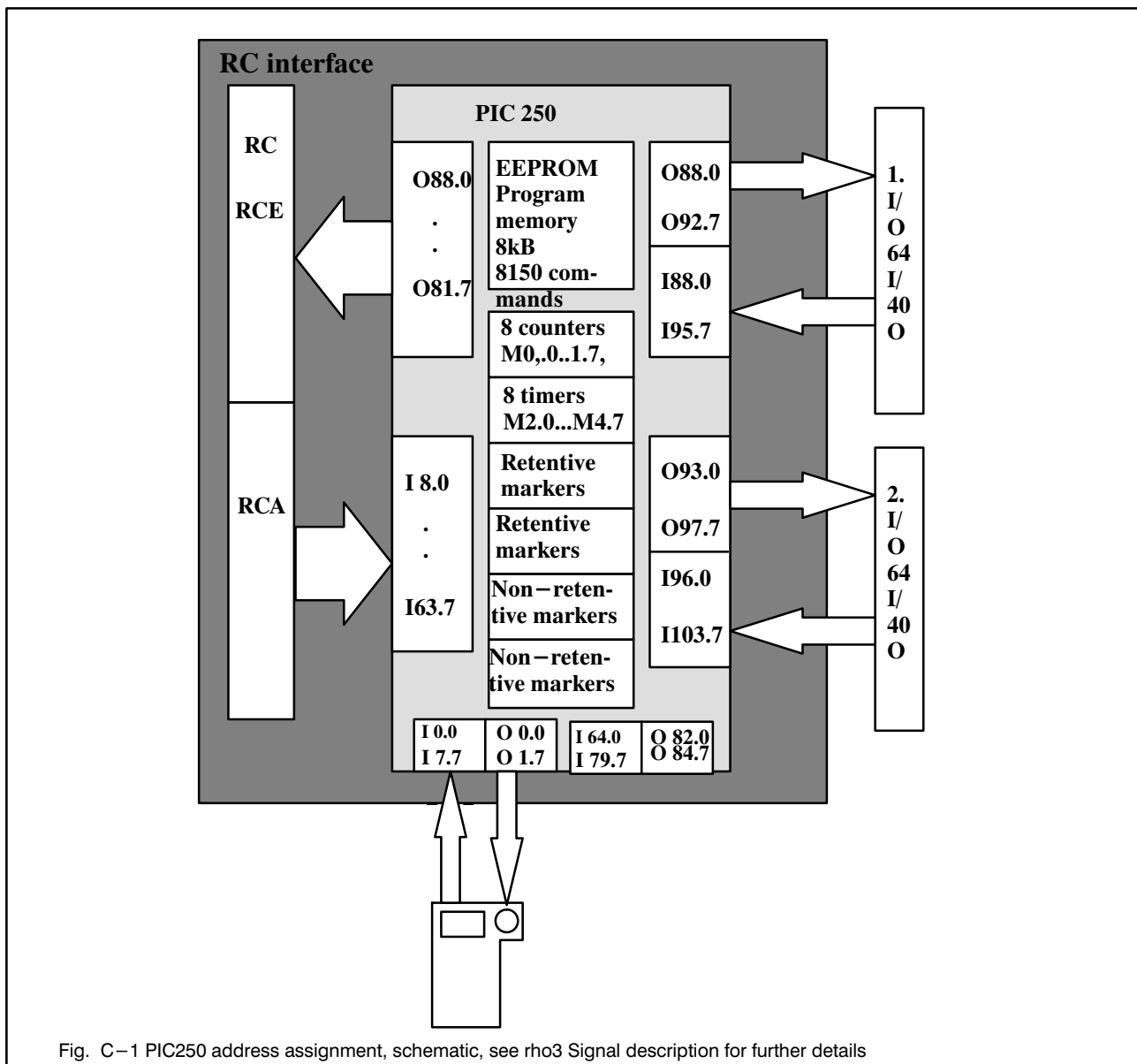
Fig. C−1 PIC250 address assignment, schematic, see rho3 Signal description for further details

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PHG FUNCTIONS
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PHG

3.2.2 Counters/timers0

Counters and timers can be set permanently via machine parameters (see Mode 7.8; see also rho3 Description machine parameters).

Purpose

Display or change counters and/or timers.

```
Counters (Z), Timers (T)
 1=Display timers, counters
 2=Change timers
```

3.2.2.1 Display timers/counters

Interactions

Page through timers (T) and counters (Z):
Cursor down / **Cursor up**

Quit display mode:
Cursor left

```
Timers, counters
T0=     10 T1=    10
T2=     10 T3=    10
```

3.2.2.2 Change timers

Preselect timer

Cyclic preselection with **Enter.**

Warning	Data are machine parameters. See rho3 Description machine parameters.

Change timer

Change value of the displayed timer and move automatically to next timer:

Value **Enter**

Valid range for value:
0 to 999999

```
Change (T)    timers
T0=     10    #
```

Store changes

○ Quit change mode

   Cursor left

○ Store changes temporarily in RAM until next system new start:

   Cursor left

○ Store changes permanently in EEPROM (overwrite machine parameters):

   Enter

```
Change (T)          Change
ENTER − −> MP   timers
```

3.2.2.3 Change counters

Preselect counters

Cyclic preselection with **Enter.**

Change counters

Change value of the displayed counter and move automatically to next counter:

Value **Enter**

Valid range for value:
0 to 999999

Store changes

○ Quit change mode

Cursor left

○ Store changes temporarily in RAM until next system restart:

Cursor left

○ Store changes permanently in EEPROM (overwrite machine parameters):

Enter

Warning	Data are machine parameters. See rho3 description Machine parameters.

```
Change  (Z)          timers
Z0=      10           #
```

```
Change  (Z)          change
ENTER  – – >  MP    counters
```

3.2.3   PIC program name

Purpose

Version check or comparison with version on offline programming unit on the basis of

- ○ creation date
- ○ creation date
- ○ file size.

In the case of modifications of the PIC program using the PIC editor, the system date and time are automatically stored as well (= Modification date and time).

Explanation of the display panel

```
   a            b              c
   |            |              |

   ┌────────┐
   │ PIC250 │  programs
   └────────┘
   ┌────────────┐      ┌──────┐
   │ R3_5D.P2X  │      │ 454W │
   └────────────┘      └──────┘
   ┌──────────────────────────┐
   │ 19.09.91        14:17     │
   └──────────────────────────┘
                  |
                  d
```
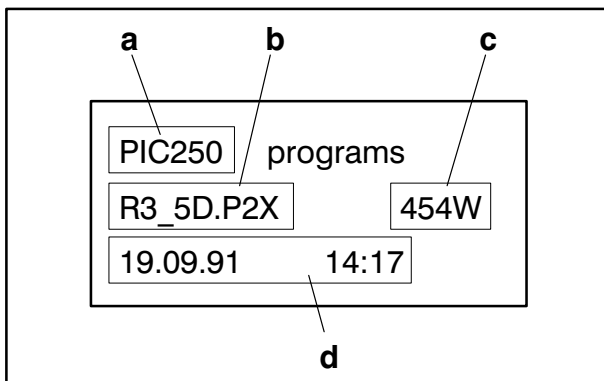
a)   PIC module

PIC250 = PIC for rho3

b)   Program name

c)   File size in words

1 word = 16 bits = 1 statement

d)   Creation or modification date and time

3.2.4   Erase PIC EEPROM

Important	All data in the PIC-EEPROM are erased (PIC program).

Purpose

Erasing entire EEPROM, i.e. overwriting it with NOP1 commands.

This is sometimes useful for extensive changes or modifications.

Precondition

EEPROM write-protect switch on the I/O board must be set to position 0 (see rho3 Interface conditions).

4.   DEFINE/TEACH

Purpose

Redefining/teaching points of a BAPS program.

Preselection point file (.PKT)

Cursor down / **Cursor up**

Enter

```
 * * *         Set-up        * * *
ABCD          .PKT            384
Byte         25.10.91       13:13
Preselect with:            ENTER
```

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PHG FUNCTIONS

Define/teach

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4.1 DEFINE

Purpose

Assigning (if applicable new) coordinate values to points by numerical entry.

Explanation of the display panel
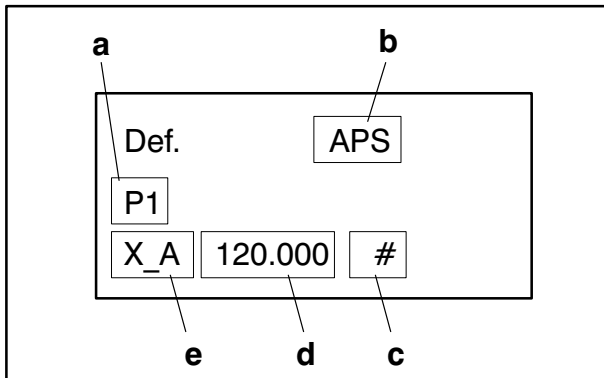
a) **Point name**

Preselect with

Cursor down / **Cursor up**

b) **Kinematic name**

c) **Entry prompt**

◯ Continue to next coordinate:
Enter

◯ Enter/change value: value
Enter

d) **Value**

e) **Axis coordinate**

4.2 TEACH

Purpose

Assigning the current axis coordinates (if applicable new axis coordinates) to points after the axes have been moved manually to the required position beforehand with Jog keys.

General

With **Cursor right** / **Cursor left,** you can change between two functions "Point preselection" and "Manual".

Point preselection:

Preselection of kinematic and point.

Kinematic

Cursor up / **Cursor down**

Enter

Manual

Display of the axis coordinate values of the selected point and manual traversing of the axes with Jog keys.

Assign the current coordinates to preselected point:

Enter

Reject current coordinates (which have not been confirmed with **Enter**) and return to point preselection:

Cursor left

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Flexible Automation

PHG FUNCTIONS

Define/teach

C

rho3
PHG

Point preselection (further to teach)		Manual (further to teach)

Explanation of the display panel

a   b

Teach   APS

P1   – –

\#

d   c
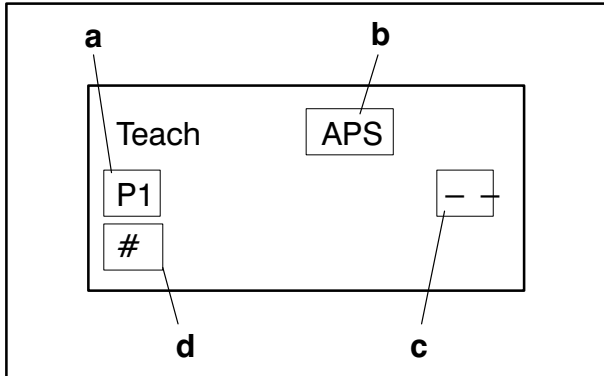
a)   Point name

Preselect point of the active kinematic to be taught with:

Cursor up / **Cursor down**

Enter

b)   Kinematic

c)   Definition status

++:Point has been overtaught in current session

--:   Point not taught/defined

No display:
Point taught/defined

d)   Direct point preselection

Point name **Enter**

Note	Advantageous in the case of large point files or fields (one and multi-dimensional). Exp.: PF1 (2,3,4) **Enter**

Change to manual:

Cursor right

Explanation of the display panel

a   b   c   d   e

K02 . X_A   0.00   *   RK
K02 . Y_A   0.00   *   RK
K02 . Z_A   0.00   *   RK
Gr.01   Incr. 1   Posit.

h   g   f
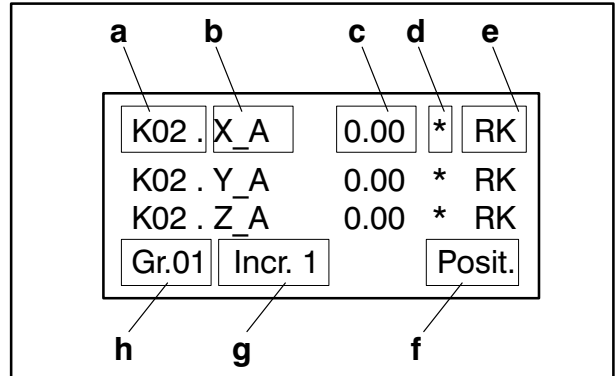
a)   Kinematic

Display only

b)   Axis coordinate

c)   Value

d)   Status position servo loop

*:   Axis is within the in-position range defined via machine parameters

No display: Axis not corrected

e)   Coordinate system

f)   Axis position

g)   Increment

Minimum traversing unit in Jog mode.

h)   Group

Change to point preselection:

Cursor left

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Flexible Automation

PHG FUNCTIONS

Test BAPS programs

C

rho3
PHG

5.   TEST BAPS PROGRAMS

Preparations

Preselect **BAPS program**

Cursor down / **Cursor up**

```
BAPS program            Test

ABCD           .IRD        440

Byte        25.10.91      18.20
Preselect with:          ENTER
```

Enter

```
ABCD           .IRD
Press          RC START
```

Press **RC-START** on the control cabinet.

```
ABCD            .IRD
1=Set oberservation
2=Delete observation
```

Reference

Please see Part 2 of this manual for further informa-
tion.

6. PIC MONITOR

Warning

Keypad cover film, side 2 applies.

6.1 PIC MONITOR ON

Purpose

Testing the active PIC program by observing the dynamic display of current PIC address, PIC statement, logic states of I/O/M etc. during the program run.

Function

The PIC program continues to run cyclically. After each PIC program run, the logic state of the operands involved in the selected PIC address and the current logic operation result (RLO) are determined, buffered and displayed. Determining the current logic state may be linked to fulfillment of a trigger condition (Modes 6.1.1 and 6.1.2)

General

The PIC monitor offers functions **"Search"** and **"Monitor"**.

Search assists targeted preselection of a specific PIC address/PIC statement on the basis of various search criteria (address, operand, statement, JC, EP).

Monitor is the actual monitor function.

Change to function "Search" with **Cursor left**. Repeat search with last search criterion:
Cursor down.

Search (further to PIC monitor)	**Monitor (further to PIC monitor)**

Explanation of the display panel
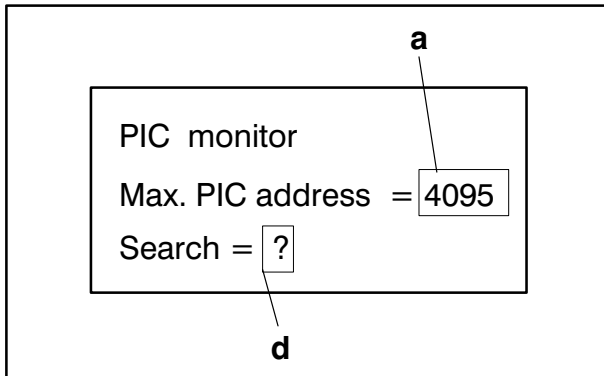
```
                            a
                            |
   ┌──────────────────────────────┐
   │  PIC  monitor                │
   │                              │
   │  Max. PIC address = │4095│   │
   │                              │
   │  Search = │?│                │
   └──────────────────────────────┘
                   |
                   d
```

a) Max. PIC address

dependent upon configuration level.

b) Enter search criterion

The following criteria are valid:

❍ PIC address
0 .. max. PIC address
0 = Start of program

❍ Operand (I/O/M)
Exp.: M117.2

❍ PIC statement, complete
Exp.: UN E107.4

❍ JC (without jump address)
Exp.: SPB

❍ JC (with jump address)
Exp.: SPB 1020

❍ NOP1 (dummy command)
Exp.: NOP1

❍ PE (=End of program)
Exp.: PE

After you enter the search criterion and terminate with **Enter**, the display changes to monitor, provided the search criterion was fulfilled.

Repeat last search:

Cursor down

Explanation of the display panel

```
                      a        b
                      |        |
   ┌──────────────────────────────┐
   │  PIC  monitor                │
   │                              │
   │                  │T│ │RLO│   │
   │                              │
   │  1 │AN   M127.0│  │HL│       │
   └──────────────────────────────┘
       |    |          |
       e    d          c
```
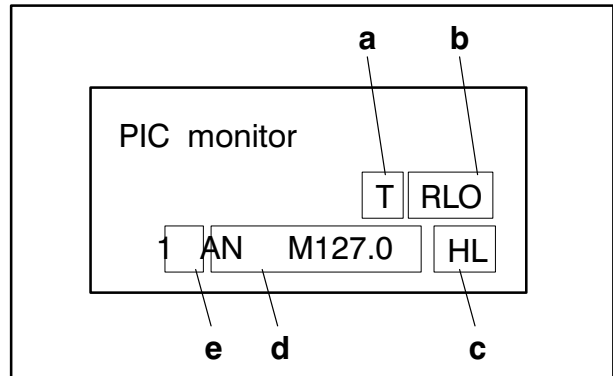
a) Trigger condition

T   Trigger condition of the freeze function fulfilled (see below)

b) Operand/logic operation result

E   Input: State of the operand (in this case marker M127.0)

V   Logic operation result:
Result of applying the command (operator) in current PIC statement to the operand and the logic operation result of the preceding PIC statement.

A   Output:
Assigned state at output or marker (command '=')

c) Logic states

H = High, L = Low, * = Statement skipped/not executed with JC.
Correspondence with RLO above

d) PIC statement

e) PIC address

Change to search:

Cursor left

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PHG FUNCTIONS

PIC Monitor

C

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PHG

Set trigger condition (freeze function)

The trigger condition can be set with Modes 6.1.1 and 6.1.2. You exit these modes with:

Cursor right

and then mode preselection (modes 1 or 2)

Signal evaluation dynamic, to:	Trigger instant	Set with I/O/M	Mode: RLO *)
Leading edge		6.1.1.1	6.1.2.1
Trailing edge		6.1.1.2	6.1.2.2
Positive pulse		6.1.1.3	6.1.2.3
Negative pulse		6.1.1.4	6.1.2.4

*) I Input, O Output, M Marker, Result (RLO) Logic operation result

6.2. PIC MONITOR OFF

Purpose

Switching off the monitor function running in the background (e.g. freeze function) if "New mode" (Mode 6.3) has been preselected. "Monitor off" is automatically defined when you quit the PIC monitor normally provided no trigger condition has been set.

6.3 NEW MODE

Currently in preparation.

Purpose

Combined test of BAPS and PIC programs.

You can change as required between operating modes "Mode 5, Test BAPS programs" and "Mode 6, PIC monitor" and vice versa with

Cursor right

For example, after each interrupt or, possibly, after each single-step of the BAPS program, you could view the logic states of PIC statements, timers and counters.

Precondition

PIC250 monitor must be active ("Mode 6.1, PIC monitor ON").

Quit new mode
Cursor left

6.4 TIMERS AND COUNTERS

See Section 3.2.2.

6.5 PRINT PIC STATUS

Currently in preparation

6.6 PIC PROGRAMS

See Section 3.2.3.

```
Counters (Z), Timers (T)
1=Display timers, counters
2=Change timers
```

```
        a            b              c

    PIC250   Programs
    R3_5D.P2X              454W
    19.09.91       14:17

                    d
```

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Flexible Automation

PHG FUNCTIONS

Diagnosis

C

rho3
PHG
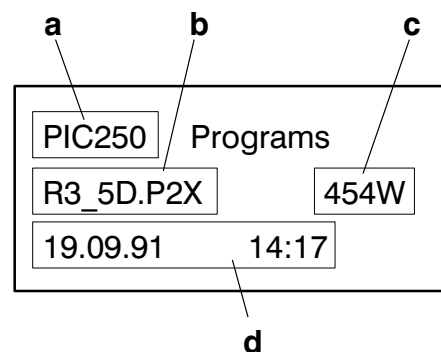
7.   DIAGNOSIS

Purpose

Inspection of the actual statuses, e.g. for the purpose of error diagnosis or for commissioning.

7.1   AXIS DISPLAYS

Explanation of the display panel
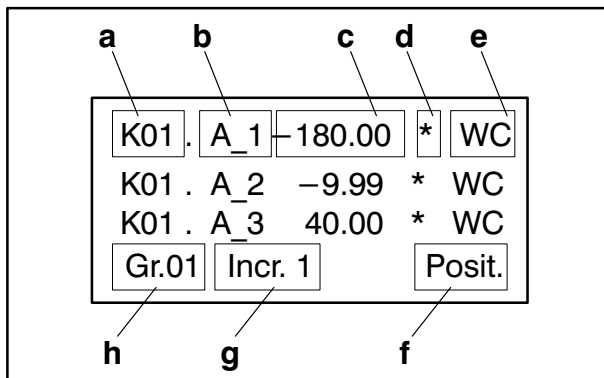
a)   Kinematics name

b)   Axis name

c)   Value

Referred to the displays in the other fields.

d)   Status position servo loop

No display: Axis position not corrected

*:   Axis is within the in-position range defined via machine parameters.

e)   Active coordinate system

JC: Joint coordinates

WC: World coordinates

GC: Gripper coordinates

No display: No coordinate system active

f)   Significance of the values in fields c)

Posit.: Axis position

Lag: Lag (display only)

Offset: Offset (display only),
see rho3 Machine parameter P306

Endp.: End point = Destination point of the current movement block. Display only in automatic mode since it is only relevant in this mode. If belts are applied, their position is displayed in automatic mode.

Selection with **Cursor right**.

g)   Traversing mode

Increment: Minimum traversing unit for Jog mode (press Jog keys only briefly). Display is not seen until after the coordinate system has been selected. Setting the increments, see Description machine parameters P111..P116.

Cont.L.: Continuously slow traversing

Cont.S.: Continuously rapid traversing

h)   Group

7.2   ERRORS/WARNINGS

Self−explanatory displays in plain text.

Display of all errors/warnings, apart from those of the compiler.

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Flexible Automation

PHG FUNCTIONS

Diagnosis

C

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PHG

7.3 SYSTEM STATUSES

7.3.1 Control status

Self−explanatory

7.3.2 Process statuses

Explanation of the display panel
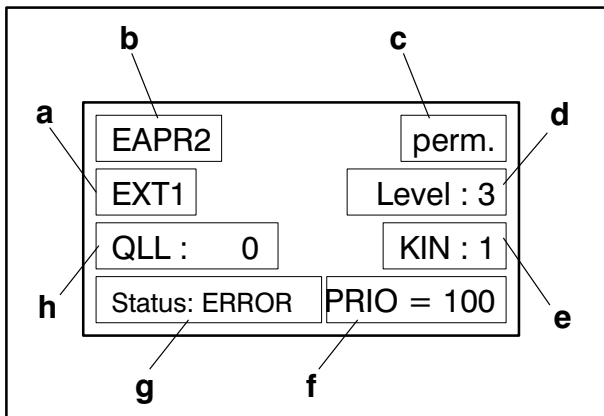
a) **Name of the active external program**

b) **Process name**

Selection with **Cursor down** / **Cursor up**

c) **Process type**

norm. = Normal process

perm. = Permanent process

sub. = Sub-process

d) **Nesting depth of the active external program**

(1 = No external program called)

See rho3 Description BAPS.

e) **Active kinematics**

f) **Process priority**

g) **Process status**

⭕ **INIT** = Process initialized (but not started)

⭕ **RUNNING** = Process started

⭕ **STOP** = Process has run to STOP command; process stops until it is restarted with key Start on the control cabinet.

⭕ **WAITING** = Process is waiting for occurrence of an event (e.g. timer, counter, end point reached, semaphore variable etc.)

⭕ **ERROR** = Process-related error (e.g. axis pre-selection incorrect, .PKT file incorrect etc.)

⭕ If status = Error:
Further information can be provided on the error with

   Info

   Display
   1. Process-related errors and
   2. errors and warnings as in Mode 7.2.

h) **Active line No. in BAPS source program (.QLL)**

7.3.3 Active mode

Self−explanatory

7.3.4 Hardware configuration

Self−explanatory

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PHG FUNCTIONS

Diagnosis

C

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PHG

7.4   DIGITAL INPUTS

The digital inputs correspond to the physical inputs on the I/O board.

Purpose

Dynamic display of the input signal states (high/low) of the I/O board.

```
Diagnosis Digital inputs
Byte/bit  12345678
   01     LLLLLLLL
```

7.5   DIGITAL OUTPUTS

The digital outputs correspond to the physical outputs on the I/O board.

Purpose

Dynamic display of the output signal state (high/low) of the I/O board.

```
Diagnosis Digital outputs
Byte/bit  12345678
   01     LHHLLLLL
```

7.6   RC INPUTS

RC and PLC (= PIC) are spatially integrated. Data are coupled via a common memory area in the RAM. This means that RC inputs and PLC outputs of the same address correspond in each case.

Purpose

Dynamic display of the RC input signal states as available to the operating system as the process image.

```
Diagnosis RC inputs
Byte/bit  12345678
   01     HHLLLLLL
```

7.7   RC OUTPUTS

RC and PLC (= PIC) are spatially integrated. Data are coupled via a common memory area in the RAM. This means that RC outputs and PLC inputs of the same address correspond in each case.

Purpose

Dynamic display of the RC output signal states as available to the operating system as process image.

```
Diagnosis RC outputs
Byte/bit  12345678
   01     HLLLHHLL
```

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PHG FUNCTIONS

Diagnosis

C

rho3
PHG

7.8   MACHINE PARAMETERS

Warning	See rho3 Description machine parameters for the significance and handling/application of the machine parameters.

7.8.1   Display machine parameters

P-No. **Enter**

Cursor down / **Cursor up**

7.8.2   Set machine parameters

Important	Make a back−up copy before-hand.

Warning	Bosch cannot be held liable for the consequences of incorrect-ly calculated machine date or non−observance of limit data.

Note	Access to machine parameters can be barred specifically (see rho3 Description machine parameters)

Warning	After each change: ◯ Document the change (Mode 9.4.3) ◯ Make a back-up copy

Precondition

EMERGENCY-STOP active.

Procedure

1. Make a back-up copy of the old machine parameters.

2. Plan the changes carefully and have them re-checked/approved.

3. Enter password

4. Change or confirm MP identification

5. P-No. **Enter**

6. P-value **Enter**
    Value is stored

7. If necessary, set other machine parameters

8. **Cursor left**
    The control programs the changed machine parameters in the EEPROM and automatically performs a system new start.

9. Document changes

10. Make a back-up copy of the modified machine parameters.

7.8.3   Presetting

See Section 9.1.

```
Change parameters
1=Coupling
2=Printer
```

7.8.4   Print machine parameters

Setting printer port, see Section 9.1.2.

```
Print machine parameters
```

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PHG FUNCTIONS

Diagnosis

C **rho3**
PHG

7.9 Test digital outputs

Purpose

Consecutively activating all physical outputs individually (Test 1) and group-by- group (Test 2) with test pulses so as to test their functions (LEDs on I/O board and control cabinet light briefly).

Installed CAN−Outputs are tested in company with the I/O−boards

Precondition

EMERGENCY-STOP active.

Set duration of test pulses

The default is 200 ms.

Accept 200 ms: **Enter**

Select different pulse duration [ms]:
Value **Enter**

```
Output signal test
Test waiting time     [ms]
        200 #
```

Test 1

Automatic test in which all outputs of the
I/O board can be

activated bit-by-bit

consecutively dependent upon the set pulse dura-
tion.

```
Output signal test
Test1
```

Test2

Automatic test in which all outputs of the I/O board are activated

byte-by-byte

consecutively dependent upon the set pulse dura-
tion.

```
Output signal test
Test2
```

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PHG FUNCTIONS

Diagnosis

C

rho3
PHG

7.10   DISPLAY PHG KEYS

Purpose

Testing function of the PHG keys.

Note	See rho3 Signal description "PHG3 key assignment" for the assignment of key addresses PHG3 (= Outputs PHG) and PLC-PHG inputs.

Explanation of the display panel
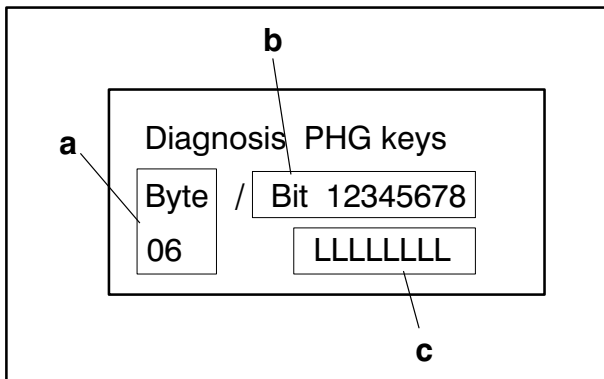
a)   Byte-key address PHG

Preselect with

Cursor down / **Cursor up**

b)   Bit-key address PHG

c)   Key status

H = Key pressed

L = Key not pressed

Note	A maximum of 4 keys may be pressed simultaneously.

7.11   VERSION DISPLAY

Purpose

Information about installed software and firmware versions with release date.

Note	Please quote this information with all enquiries.

7.12   MACHINE AND STATUS DISPLAY

Note	See rho3 Description configuration level and rho3 Signal description.

Purpose

On configuration level MZA, a specific text is assigned to each of the user inputs 1..99 (e.g. "Waiting for enable"). The PHG displays the texts whose assigned user inputs are set.

7.12.1 MZA individual display

Manual individual display, page with

Cursor down to end of file

and then to start of file with

Cursor up

7.12.2 MZA automatic display

Automatic, cyclic display. Display duration can be set by means of machine parameter options (accessible only to Bosch).

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PHG FUNCTIONS

Diagnosis

C

rho3
PHG

7.13   DISPLAY HIGH−SPEED−INPUTS

Purpose

Dynamic display of the High−Speed−Input states on the servo boards.

In a rho3 control, several servo board types can be installed. Depending on the type, these boards have 8,9 or no High−Speed−Inputs.
The number of HS−Inputs to be used must be declared in machine parameter P11.

Note	If at least 1 HS−Input is declared in P11, the state of all HS−Inputs of this servo board is displayed. Servo boards without installed HS−Inputs are skipped.

Indications:

Inp. SB	= Number of the servo board (1..3)
LLHH..	= State of the High−Speed−Inputs (L = inactive, H = active)
Byte/Bit 01	= Display of inputs 1..8
Byte/Bit 02	= Display of the 9th input
−	= No High−Speed−Inputs installed

In the following there are some examples of several servo board configurations:

Example 1:
1 Servo 6I installed (9 HS−Inputs available, 2 declared in P11).

Display of inputs 1..8

```
Diagnosis    Inp. SB  1
Byte/Bit   12345678
  01       LLHHHLLL
```

Display of input 9 (remaining display is filled with "−", because there is a maximum of 9 HS−Inputs per servo board available).

```
Diagnosis    Inp. SB  1
Byte/Bit   12345678
  02       L───────
```

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PHG FUNCTIONS

Diagnosis

C   rho3
PHG

Example 2:
1 Servo 6I installed (9 HS−Inputs available, none de-
clared in P11).

Display of inputs 1..8

```
┌─────────────────────────────┐
│                             │
│  Diagnosis    Inp. SB  1    │
│  Byte/Bit   12345678        │
│     01        ————————      │
│                             │
└─────────────────────────────┘
```

Display of input 9 (remaining display is filled with
"−", because there is a maximum of 9 HS−Inputs
per servo board available).

```
┌─────────────────────────────┐
│                             │
│  Diagnosis    Inp. SB  1    │
│  Byte/Bit   12345678        │
│     02        ————————      │
│                             │
└─────────────────────────────┘
```

Example 3:
1 modular servo board installed (8 HS−Inputs avail-
able, 5 declared in P11).

Display of inputs 1..8

```
┌─────────────────────────────┐
│                             │
│  Diagnosis    Inp. SB  1    │
│  Byte/Bit   12345678        │
│     01        LLHHHLLL      │
│                             │
└─────────────────────────────┘
```

Example 4:
2 Servo 6I installed (9 HS−Inputs in each case avail-
able, in P11 respectively 1 declared).

Display of inputs 1..8 on servo board 1

```
┌─────────────────────────────┐
│                             │
│  Diagnosis    Inp. SB  1    │
│  Byte/Bit   12345678        │
│     01        LLLLLLLL      │
│                             │
└─────────────────────────────┘
```

Display of input 9 on servo board 1 (remaining dis-
play is filled with "−", because there is a maximum
of 9 HS−Inputs per servo board available).

```
┌─────────────────────────────┐
│                             │
│  Diagnosis    Inp. SB  1    │
│  Byte/Bit   12345678        │
│     02        L————————     │
│                             │
└─────────────────────────────┘
```

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PHG FUNCTIONS

Diagnosis

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PHG

Display of inputs 1..8 on servo board 2

```
Diagnosis    Inp. SB  2
Byte/Bit   12345678
  01       HLLLLLLL
```

Display of input 9 on servo board 2 (remaining display is filled with "−", because there is a maximum of 9 HS−Inputs per servo board available).

```
Diagnosis    Inp. SB  2
Byte/Bit   12345678
  02       L———————
```

Example 5:
1 narrow servo board and 2 Servo 6I installed (the narrow board has none, each Servo 6I has 9 HS−Inputs, 4 declared in P11 in each case).

The display starts with servo board 2, because there are no HS−Inputs available on a narrow board.

Display of inputs 1..8 on servo board 2

```
Diagnosis    Inp. SB  2
Byte/Bit   12345678
  01       LLHHLLLL
```

Display of input 9 on servo board 2 (remaining display is filled with "−", because there is a maximum of 9 HS−Inputs per servo board available).

```
Diagnosis    Inp. SB  2
Byte/Bit   12345678
  02       L———————
```

Display of inputs 1..8 on servo board 3

```
Diagnosis    Inp. SB  3
Byte/Bit   12345678
  01       LHHLLLLL
```

Display of input 9 on servo board 3 (remaining display is filled with "−", because there is a maximum of 9 HS−Inputs per servo board available).

```
Diagnosis    Inp. SB  3
Byte/Bit   12345678
  02       L———————
```

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PHG FUNCTIONS

Diagnosis

C

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PHG

7.14   DIGITAL CAN−INPUTS

Display of the digital inputs on the CAN−I/O−Modules.
Selection with cursor up/down, confirm with ENTER if the corresponding bus and identifier appears in the display.

Dynamical display of the input signal states (High/Low) on the CAN−I/O-Modules.

```
          CAN input
Bus:1 Ident.No.:543
```

```
          CAN input
Bus:1 Ident.No.:543
Byte/Bit   12345678
    01     LHHLLLLL
```

7.15   DIGITAL CAN−OUTPUTS

Display of the digital outputs on the CAN−I/O−Modules.
Selection with cursor up/down, confirm with ENTER if the corresponding bus and identifier appears in the display.

Dynamical display of the output signal states (High/Low) on the CAN−I/O-Modules.

```
          CAN outp.
Bus:1 Ident.No.:471
```

```
          CAN outp.
Bus:1 Ident.No.:471
Byte/Bit   12345678
    01     LHHHHLLL
```

8. DEACTIVATE PHG

This is the precondition for being able to change from main operating mode SET-UP to main operating mode AUTOMATIC.

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PHG FUNCTIONS

Devices/file I/O

C

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PHG

9. DEVICES/FILE I/O

Purpose

Data transfer to devices, file handling and setting of interface data.

9.1 PRESETTING

Purpose

Intermatching the transmitter and receiver by means of parameters so as to permit data transfer.

The parameters can be modified

a) temporarily in the RAM until the next system new start. After this, the modifications are overwritten again by the default parameters in the machine parameters.

b) permanently in the EEPROM,
by overwriting the machine parameters (see rho3 Description machine parameters)

Interactions (applies to Modes 9.1.1 to 9.1.7)

9.1.1	Coupling	....
9.1.2	Printer	....
9.1.3	Read/write SERIAL 1	....
9.1.4	Read/write SERIAL 2	....
9.1.5	Read/write SERIAL 3	....
9.1.6	Read/write SERIAL 4	....

1	Coupling
2	Printer
3	Read/write SER_1
4	Read/write SER_2
5	Read/write SER_3
6	Read/write SER_4
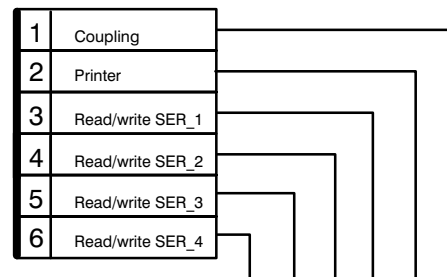
Display presettings:

Enter (if necessary, press repeatedly)

Change presettings:

○ Preselect presetting:
Enter until the required presetting is displayed.

○ Change presetting temporarily to value:
Value **Enter**

Protocol: :	1..7					
Interface:	0..4				1	0
Baud rate:		9600		9600	9600	
Number of stop bits:						
Parity (0,1,2) :						
Word length:						
Software-hardware hand-shake (0/1)						
Timeout for read−in:						
Timeout for output						

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Devices/file I/O

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◯ Quit change mode:

After one or more presettings have been changed temporarily, you are requested to specify whether changes are to be stored in MP (=Machine parameter) at the end of the parameter list or if you terminate beforehand with **Cursor left**:

Store changes temporarily in RAM: **Cursor left**

Store changes permanently in EEPROM: **Enter**

Reject changes

Changes made cannot be rejected (unless they have been stored temporarily with **Cursor left** and this is followed by a system new start). Rather, changes made must be rewritten explicitly.

9.2 LIST FILES

It is possible to page within the file list with **Cursor up** and **Cursor down** .

```
List files
ABCD           .IRD           440
Byte           24.10.91  18:20
Display: Arrow up/down
```

9.3 DELETE FILES

It is possible to page within the file list with **Cursor up** and **Cursor down** . The display file is deleted by entering **Enter**
.

```
Delete files
ABCD           .IRD           440
Byte           24.10.91  18:20
Delete ? (Yes) : ENTER
```

9.4 PRINT FILES

Preselect the file type to be printed.
The following file types can be printed:
- 1 = ASCII files with the extension
       DAT,.ERR and QLL
- 2 = Point files with the extension PKT
- 3 = Machine parameter file without
       extension

```
Print files
1=ASCII files
2=Point files
```

9.4.1 ASCII files (.QLL, ERR, DAT)

Enter file name, including extension, or page within the file list with **Cursor up** and **Cursor down**. The display file is printed via interface 1 (see 9.1 Presetting) by entering **Enter**.

```
Print ASCII file
ABCD           .QLL           100
Byte           24.10.91  18:19
Preselect with:  ENTER
```

9.4.2   Point files (.PKT)

Handling, as with 9.4.1

```
Print point file
ABCD           .PKT          384
Byte           16.12.91   13:33
Preselect with:  ENTER
```

9.4.3   Machine parameters (P...)

Print out all machine parameters.

```
Print machine parameters
```

9.5   Memory occupancy

Displays the current occupancy of the user memory

```
MEMORY : x x x x x x Byte
used           : y y y y y y Byte
free           : z z z z z z Byte
illuminated key − −>   C o n t i n u e
```

9.6   Memory − −> EEPROM

Store user programs/files in EEPROM.
Only available with corresponding memory option (128k EEPROM).

```
Memory − −> EEPROM
Files into EEPROM
Save
execute with : ENTER
```

9.7   EEPROM − −> Memory

Reload user programs/files from EEPROM.
Only available with corresponding memory option (128k EEPROM).

```
EEPROM − −> Memory
Files of EEPROM
Restore
execute with : ENTER
```

10.   PRESELECT PROGRAM

Programs are stored in files with the extension IRD. The terms program and process are used as synonyms.

10.1   PRESELECT PROCESSES

It is possible to page within the program list with **Cursor up** and **Cursor down** . Preselection is carried out by pressing key **Enter**.

```
┌─────────────────────────────────────┐
│                                      │
│   Program preselection/list.         │
│   ABCD          .IRD          440    │
│   Byte          24.10.91   18:20     │
│   Preselect with:  ENTER             │
│                                      │
└─────────────────────────────────────┘
```

10.2   STOP PROCESSES

Processes must be in state INIT in order for them to appear in the list.
You can page within the process list with **Cursor up** and **Cursor down** and the displayed process is stopped by pressing key **Enter**.

```
┌─────────────────────────────────────┐
│                                      │
│                                      │
│    No process                        │
│    Illuminated key  – – >  Continue  │
│                                      │
│                                      │
└─────────────────────────────────────┘
```

BOSCH
Flexible Automation

PHG FUNCTIONS

Auxiliary functions

C

rho3
PHG

11.　AUXILIARY FUNCTIONS

Selection of the individual functions with **Cursor down** or **Cursor up.**Preselection of the selected functions with **Enter.**

```
Auxiliary functions
1=Control reset
2=Display/set clock
```

11.1　CONTROL RESET (RESET)

Active processes which have not been declared as **permanent** are aborted. Any error messages pending are reset.

11.2　DISPLAY/SET CLOCK

This function serves to set and display the time

11.3　RC NEW START

Triggers a start-up .
Important:
All running processes are aborted and the system starts up again, as after pressing the
RESET key on the control power supply unit.

11.4　ADJUST VFACTOR

Function for changing the speed factor.
Important:
The changes act directly on the active processes and movements.

11.5　ADJUST AFACTOR

Function for changing the acceleration factor (UP-slope).

Important:
The changes act directly on the current movements.

11.6　ADJUST DFACTOR

Analogous to 11.5 for Down-slope.
Important:
The changes act directly on the current movements.

12. BACKUP FOR EEPROM AND EPROM

| Warning | **This may be carried out only by specially authorized qualified personnel !** |

BACKUP FOR EEPROM

| Warning | Make a back-up copy of the machine parameters beforhand since all machine parameters are overwritten with default values after execution of EEPROM backup. |

Overwrites current machine parameters in the EEPROM with default machine parameters of the system software (stored on EPROM).

Dead-man + **Alt** + **Mode** + **0**

+: means that keys must be pressed simultaneously.

BACKUP FOR EPROM

| Warning | READY contact drops out, control restarts again. |

Application

After exchanging the operating system software (EPROM module).

Dead-man + **Alt** + **Mode** + **Delete**

+: means that keys must be pressed simultaneously
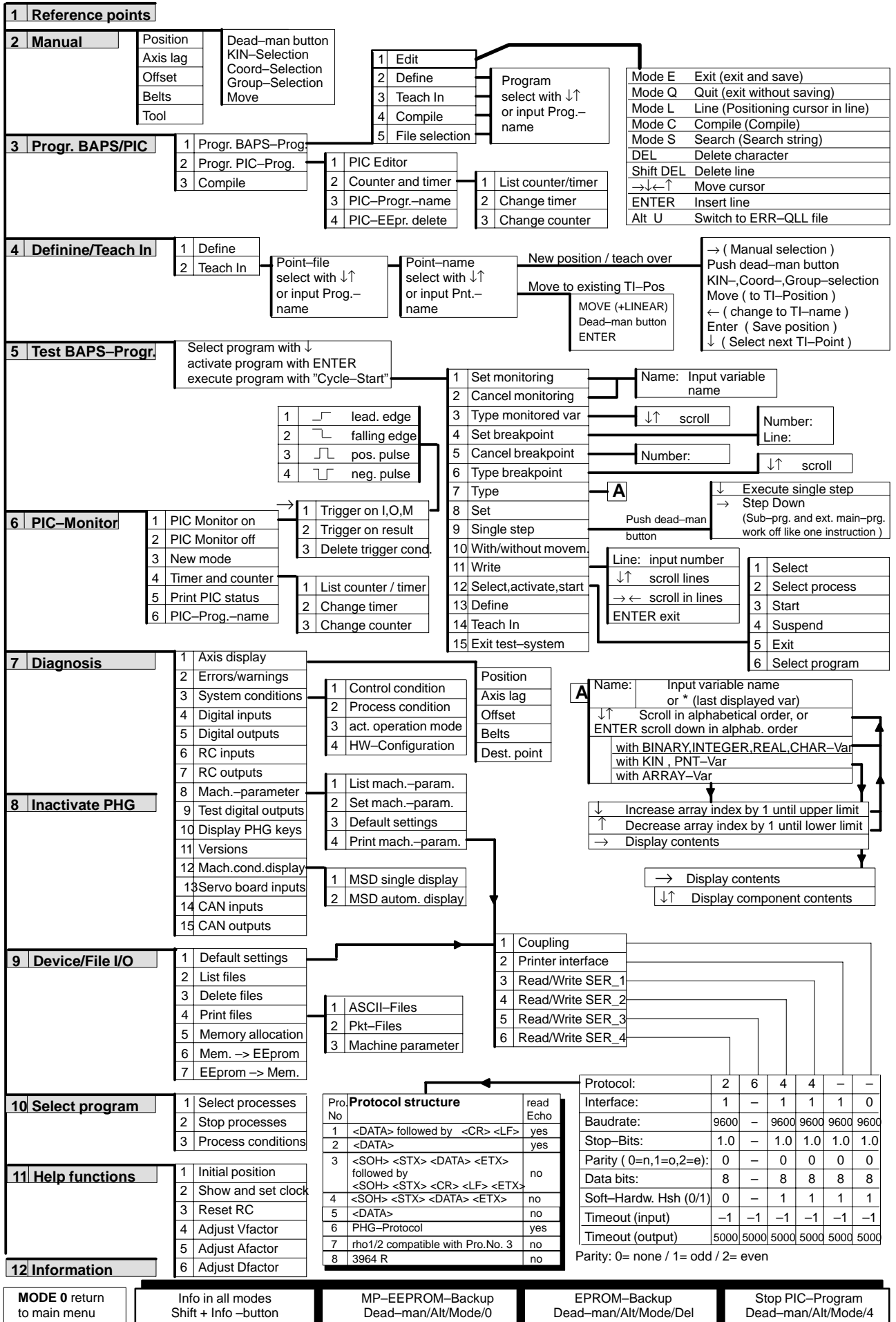
Erase PIC EEPROM

| Warning | Erases (using NOPs) the contents of the PIC-EEPROM. The PIC program can no longer be run after execution of the command. |

Application

ERASING PIC-EEPROM

Dead-man + **Alt** + **Mode** + **4**

+: means that keys must be pressed simultaneously

1 Reference points

2 Manual

| Position |
| Axis lag |
| Offset |
| Belts |
| Tool |

| Dead–man button |
| KIN–Selection |
| Coord–Selection |
| Group–Selection |
| Move |

1	Edit
2	Define
3	Teach In
4	Compile
5	File selection

Program select with ↓↑ or input Prog.– name

Mode E	Exit (exit and save)
Mode Q	Quit (exit without saving)
Mode L	Line (Positioning cursor in line)
Mode C	Compile (Compile)
Mode S	Search (Search string)
DEL	Delete character
Shift DEL	Delete line
→↓←↑	Move cursor
ENTER	Insert line
Alt U	Switch to ERR–QLL file

3 Progr. BAPS/PIC

1	Progr. BAPS–Prog.
2	Progr. PIC–Prog.
3	Compile

1	PIC Editor
2	Counter and timer
3	PIC–Progr.–name
4	PIC–EEpr. delete

1	List counter/timer
2	Change timer
3	Change counter

4 Definine/Teach In

| 1 | Define |
| 2 | Teach In |

| Point–file select with ↓↑ or input Prog.– name |

| Point–name select with ↓↑ or input Pnt.– name |

New position / teach over

Move to existing TI–Pos

| MOVE (+LINEAR) |
| Dead–man button |
| ENTER |

| → (Manual selection) |
| Push dead–man button |
| KIN–,Coord–,Group–selection |
| Move (to TI–Position) |
| ← (change to TI–name) |
| Enter (Save position) |
| ↓ (Select next TI–Point) |

5 Test BAPS–Progr.

Select program with ↓
activate program with ENTER
execute program with "Cycle–Start"

1	Set monitoring
2	Cancel monitoring
3	Type monitored var
4	Set breakpoint
5	Cancel breakpoint
6	Type breakpoint
7	Type
8	Set
9	Single step
10	With/without movem.
11	Write
12	Select,activate,start
13	Define
14	Teach In
15	Exit test–system

| Name: Input variable name |

↓↑   scroll

| Number: |
| Line: |

| Number: |

↓↑   scroll

1	⌐	lead. edge
2	¬	falling edge
3	⌐¬	pos. pulse
4	¬⌐	neg. pulse

A

| ↓ | Execute single step |
| → | Step Down (Sub–prg. and ext. main–prg. work off like one instruction) |

Push dead–man button

6 PIC–Monitor

1	PIC Monitor on
2	PIC Monitor off
3	New mode
4	Timer and counter
5	Print PIC status
6	PIC–Prog.–name

1	Trigger on I,O,M
2	Trigger on result
3	Delete trigger cond.

1	List counter / timer
2	Change timer
3	Change counter

| Line: input number |
| ↓↑   scroll lines |
| →← scroll in lines |
| ENTER exit |

1	Select
2	Select process
3	Start
4	Suspend
5	Exit
6	Select program

7 Diagnosis

1	Axis display
2	Errors/warnings
3	System conditions
4	Digital inputs
5	Digital outputs
6	RC inputs
7	RC outputs
8	Mach.–parameter
9	Test digital outputs
10	Display PHG keys
11	Versions
12	Mach.cond.display
13	Servo board inputs
14	CAN inputs
15	CAN outputs

1	Control condition
2	Process condition
3	act. operation mode
4	HW–Configuration

| Position |
| Axis lag |
| Offset |
| Belts |
| Dest. point |

A | Name: Input variable name or * (last displayed var) |

↓↑   Scroll in alphabetical order, or
ENTER scroll down in alphab. order

| with BINARY,INTEGER,REAL,CHAR–Var |
| with KIN , PNT–Var |
| with ARRAY–Var |

↓	Increase array index by 1 until upper limit
↑	Decrease array index by 1 until lower limit
→	Display contents

| → | Display contents |
| ↓↑ | Display component contents |

8 Inactivate PHG

1	List mach.–param.
2	Set mach.–param.
3	Default settings
4	Print mach.–param.

| 1 | MSD single display |
| 2 | MSD autom. display |

9 Device/File I/O

1	Default settings
2	List files
3	Delete files
4	Print files
5	Memory allocation
6	Mem. –> EEprom
7	EEprom –> Mem.

1	ASCII–Files
2	Pkt–Files
3	Machine parameter

1	Coupling
2	Printer interface
3	Read/Write SER_1
4	Read/Write SER_2
5	Read/Write SER_3
6	Read/Write SER_4

10 Select program

1	Select processes
2	Stop processes
3	Process conditions

Pro. No	**Protocol structure**	read Echo
1	<DATA> followed by <CR> <LF>	yes
2	<DATA>	yes
3	<SOH> <STX> <DATA> <ETX> followed by <SOH> <STX> <CR> <LF> <ETX>	no
4	<SOH> <STX> <DATA> <ETX>	no
5	<DATA>	no
6	PHG–Protocol	yes
7	rho1/2 compatible with Pro.No. 3	no
8	3964 R	no

	2	6	4	4	–	–
Protocol:	2	6	4	4	–	–
Interface:	1	–	1	1	1	0
Baudrate:	9600	–	9600	9600	9600	9600
Stop–Bits:	1.0	–	1.0	1.0	1.0	1.0
Parity (0=n,1=o,2=e):	0	–	0	0	0	0
Data bits:	8	–	8	8	8	8
Soft–Hardw. Hsh (0/1)	0	–	1	1	1	1
Timeout (input)	–1	–1	–1	–1	–1	–1
Timeout (output)	5000	5000	5000	5000	5000	5000

Parity: 0= none / 1= odd / 2= even

11 Help functions

1	Initial position
2	Show and set clock
3	Reset RC
4	Adjust Vfactor
5	Adjust Afactor
6	Adjust Dfactor

12 Information

| **MODE 0** return to main menu | Info in all modes Shift + Info –button | MP–EEPROM–Backup Dead–man/Alt/Mode/0 | EPROM–Backup Dead–man/Alt/Mode/Del | Stop PIC–Program Dead–man/Alt/Mode/4 |

Part 2 Testing BAPS2 programs with the PHG3

C O N T E N T S

1. GENERAL

Operating system function "**Testing BAPS2 programs with the PHG**" serves to test BAPS2 programs with the hand−held programming unit (PHG) on the control and to locate any programming errors.

The terms program and process are used a synonyms in this document.

The operator has the option of testing several processes simultaneously, starting new processes and terminating running processes without having to quit the test system.

When the test system is quit, all processes which have been started via the test system are aborted. This also applies to permanent processes if **RC input 61** (PIC ad-dress A7.5 , "Permanent processes are to remain active") is not set.

2. PRECONDITIONS

In order to permit a process to be tested, the following conditions must be fulfilled:

– Operating mode "SET−UP" must be preselected.
– The IRD program of the process must be present in the control.
  (The SYM, PKT and QLL file should also be present in the control in order to
  make testing practical.)

– In the case of processes with traverse movements and axes without absolute
  measuring system, the reference points must have been approached.

–The **RC input 22** (PIC address A2.6 , "Test/Manual, not") must be set.

– The control must be "READY", i.e. no errors may be pending (e.g. EMER−
  GENCY-STOP or EMERGENCY MODE WITHOUT RC).

> **Exception** : Permanent processes (processes without traverse state-
> ment) can be tested even if the control is not "READY" and
> if no reference point has been approached.

– The BAPS2 program part to be tested may not be
  masked with the compiler statement ";;**TESTINFO −**"
  or the test system (see Section 2.1).

2.1. The compiler statement

" **;;TESTINFO +/− "**

With this statement, it is possible to generate IRD programs with (**;;TESTINFO +**)
or without (**;;TESTINFO −**) information for the test system. An IRD program without
test information affords the advantage that it requires less user memory and can be
run faster. This program can, however, **no** longer be tested. The compiler statement
may also be used several times in a **BAPS2** program in order to permit the test sys-
tem access to only specific program parts.

2.2. Affiliation of files (COMMON ID)

Each user file (QLL, IRD, SYM, PKT) is provided with an internal identification (COMMON ID) in the rho−3. This additional distinction (besides the file name) can prevent non−interrelated files being tested. Different, COMMON IDs may occur if, for example, a QLL program is re−edited and then not compiled. In this case, IRD, SYM and, possibly, PKT would have an identification which differs from that of the changed QLL file. This difference between QLL and IRD may lead to major misunderstandings during testing.

If different COMMON IDs are found when starting the test system, the operator's attention is brought to this by means of a prompt on the PHG. Testing is then, admittedly, still possible, but access to the file with different identification is denied.

Example:

If the identifications between IRD and QLL do not correspond, the prompt

"**Wrong QLL file**"

is displayed in the 3rd PHG line.

3. PRESELECTION OF BAPS2 PROGRAMS FOR TESTING
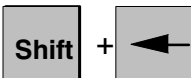
The test system is activated on the PHG in mode SET-UP by selecting mode 5. If testing is possible (see Section 2), all IRD programs present in the control are offered for preselection.

Display on the PHG:

```
BAPS program test
dana      .IRD  Size
Date, time
Select with : ENTER
```

dana : Program name

Operating options:

| Enter | | Preselect displayed program |

| Shift | + ↑ | Preselect further BAPS programs |

| Shift | + ↓ | |

| Shift | + ← | Quit testing, return to SET-UP |

After preselection of an IRD program with ENTER, the test system is activated by setting the **RC input 21** (PIC address A2.5 , "Program start").

Display on the PHG:

```
dana      .IRD



Confirm RC start
```

Operating options (via the interface)**:**

PROGRAM START   : Start process in test system.
CONTROL RESET   : Return to SET-UP.

4. ENTRY OF TEST SYSTEM COMMANDS VIA PHG

If all conditions specified in Point 2 are fulfilled, if an IRD program is preselected and if RC-START is pressed, the operator is then offered all test system commands for selection.
The current process name and the line number of the next executable command are displayed in the 1st PHG line. All errors detected when entering commands are indicated by means of the message in line 3 of the PHG. These error messages are retained until the next PHG key is pressed.
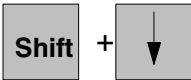
Display on the PHG:

```
dana          XXXXX
1=Set observation
2=Delete observation
```

xxxxx : Next executable program line

Operating options:

MODE   1..15 direct preselection of the test system command

Shift + ↓   Selection of test system commands with
Shift + ↑   arrow keys

Shift + ←   All processes activated by the test system are aborted and the test system is quit. The abort is not executed until after acknowledging with the ENTER key.

5. SIGNIFICANCE AND DISPLAY OF THE INDIVIDUAL TEST SYSTEM COMMANDS.

The following commands are possible in the test system:

5.1. Set observation (mode 1)

Set observation means that the running program is interrupted if the value of the variable is changed.
This command permits any variable defined in a BAPS program to be observed. If the command is selected, the variable name is then requested.

Display on the PHG:

```
dana           xxxxxx
Set observation

Name:
```

xxxxx : Next executable program line

**Operating options:**

Entry of the variable name (max. 12 letters)

| **Enter** | Execute command |

| **Shift** + ◄── | Select new test system command, observation is not set. |

If ENTER is entered, the test system acknowledges execution of the command with the following display.

Display on the PHG:

```
dana           xxxxx
Observation set
xyz
Illuminated  key  ––>
```
Continue

xyz   : Variable to be observed.
xxxxx   : Next executable program line

If the variable is written during the further sequence of the process, a corresponding prompt is displayed in the last line of the PHG and process execution is interrupted (see Section 6.1).

5.2. Delete observation (mode 2)

This command deletes an observation set previously. If the command is prese-lected, the variable name is then requested.

Display on the PHG:

```
dana            xxxxx
Delete observation

Name:
```

xxxxx : Next executable program line

Operating options:

Entry of the variable name (max. 12 letters)

| Enter | Execution of the command |

| * | Delete all observations |

| Shift | + ◄── | Select new test system command, observation is not de-leted. |
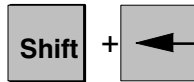
If no observations are set, this is indicated by means of a corresponding message.

5.3. Display observation (mode 3)

This command displays all observations existing in the currently selected process.

Display on the PHG:

```
dana              xxxxx
Display observation
Name
```

xxxxx : Next executable program line
name : Variable name

Operating options:
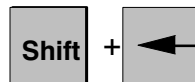
Shift	+	↓	
Shift	+	↑	Display further observed variables
Shift	+	←	Select new test system command.

If no observations are set, this is indicated by message:
No observation

5.4. Set interrupt (mode 4)

This command permits an interrupt point to be set in a BAPS program at each program line containing an executable command. When the corresponding line is reached, the process is stopped before the line is executed. After preselection of the command, the number of the interrupt is requested first, and then the program line number.

Display on the PHG:

```
dana              xxxxx
Set interrupt
Number:
Line   :
```

xxxxx : Next executable program line

Operating options:

Entry of the interrupt number (max. 32767, the number 1 is the default)

Entry of the program line number (max. 32767)

| Enter | Terminating the entry of the interrupt number or terminating the entry of the line and executing the command. |

| Shift + ◄ | Select new test system command, interrupt is not set. |
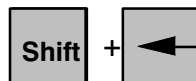
After entry of the line number and ENTER, the test system acknowledges execution of the command with the following display.

Display on the PHG:

```
dana              xxxxx
Interrupt set
z : abc
Illuminated   key   ––>
```

Continue

xxxxx   : Next executable program line
z   : Interrupt number
abc   : Program line number

If a program line at which an interrupt point has been set is reached during the further sequence of the process, a corresponding prompt is displayed in the last line of the PHG and process execution is interrupted (see Section 6.2).

5.5. Delete interrupt (mode 5)

This command deletes a previously set interrupt. When the command is selected, the interrupt number is then requested.

Display on the PHG:

```
dana            xxxxx
Delete interrupt

Number:
```

xxxxx : Next executable program line

Operating options:

Entry of the interrupt number (max. 32767, the number 1 is the default)

[*]　　　Delete all interrupts

[Enter]　　　Execute command
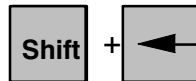
[Shift] + **[◄]**　　　Select new test system command, interrupt is not deleted.

If no interrupts are set, this is indicated by message:
no interrupt.

5.6. Display interrupts (mode 6)

This command displays all interrupts existing in the currently selected process.

Display on the PHG:

```
dana              xxxxx
List interrupt
x : z
```

xxxxx	: Next executable program line
x	: Interrupt number
z	: Program line number

Operating options:

Shift + ↓   Display further interrupts

Shift + ↑
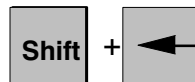
Shift + ←   Select new test system command

If no interrupts are set, this is indicated by message:
No interrupt.

5.7. Display of variables (mode 7)

This command permits contents of any variables to be displayed.

The display of the current contents depends upon the type of variable to be displayed.

In the case of variables of type **BINARY**, **INTEGER** or **DEC**, the value of the variable is displayed directly.

In the case of variables of type **CHARACTER**, the current contents are represented as characters (e.g. 'A') or as a three−digital decimal number (e.g. 000).
In the case of variables of type **TEXT**, the "TEXT" is displayed. The contents of the first character of the text are not displayed until you request more detailed information on the variable with SHIFT ARROW RIGHT. xyz[1] is then displayed as the variable name and the first character is then displayed as the current contents. Further operator control actions are described in Section 5.7.2. "Operation at the index level".

In the case of variables of type **FIELD**, "FIELD" and the lower and upper field limit are displayed, corresponding to the declaration in the BAPS program (e.g. FIELD[−2..2]). The contents of the first field element are not displayed until you request more detailed information on the variable with SHIFT ARROW RIGHT. xyz[Lower_field limit] is then displayed as the variable name and either the value of the field element is displayed as the currrent contents, dependent upon the type of field element, or, in the case of TEXT, FIELD or group, a corresponding display as just described. Further operator control actions are described in chapter "Operation at the index level".

In the case of variables of type group (**KINEMATIC**, **POINT** or **MK_POINT**), the (first) component names are displayed (e.g. X_K,Y_K,Z_K). The contents of the first component name are not displayed until you request more detailed information on the variable with SHIFT ARROW RIGHT. xyz.first_component name is then displayed as the variable name and either the value of the component is displayed as the current contents, dependent upon the type of component, or, in the case of TEXT, FIELD or group, a corresponding display as just described. Further operator control actions are described in Section 5.7.3. "Operation at the component level".

The variable name is requested after preselection of the command.

Display on the PHG:

```
dana            xxxxx
Display

Name:
```

xxxxx : Next executable program line

Operating options:

Variable name : Selection of a name; if necessary with index
or component name (max. 12 characters)

[*]   Preselection of the last displayed variable name

[*]   [Index]   : Direct preselection of a field index

[*]   .Component   : Direct preselection of a component

[Shift] + [◄]   Quitting display mode

Display on the PHG:

```
dana          xxxxx
xyz
Current contents
#
```

xxxxx   : Next executable program line
xyz   : Variable name

5.7.1. Operation at the name level

You will be at the name level if only a name without field index and/or component name is given as the variable name.

Operating options:

Shift + ↑	Variables before this in alphabetic order. A transition occurs to the alphabetically last variable of the next sub−area at the alphabetically first variable. The sub−areas are changed in the order kinematic variables, IRD variables, PKT variables and starting again with the kinematic variables.
Shift + ↓	Variables following this in alphabetic order. The transition to the alphabetically first variable of the next sub−area occurs at the alphabetically last variable. The sub−areas are changed in the order kinematic variables, PKT variables, IRD variables and starting again with the kinematic variables.
Shift + →	Jump to the index level at FIELD Jump to the component level at group (KINEMATIC,POINT,MK_POINT) Repetition of the display in the case of BINARY, INTEGER, DEC or CHARACTER (practical in the case of variables of type INPUT for instance).
Shift + ←	Quit display mode
Enter	As for **Shift** + ↓
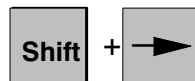
Variable name	: Direct preselection of another name if applicable with index or component name (max. 12 characters)
*[Index]	: Direct preselection of a field index
*.Component	: Direct preselection of a component

5.7.2. Operation at the index level

You will be at the index level if only a field index without component name occurs at the end of the variable name.

Operating options:

Shift + ↑	Decrement index by 1 to min. to the lower field limit, then return to FIELD level
Shift + ↓	Increment index by 1 to max. to the upper field limit then return to FIELD level
Shift + →	In the case of FIELD : Jump to the index level, in the case of group (KINEMATIC,POINT,MK_POINT): Jump to the component level, in the case of BINARY, INTEGER, DEC or CHARACTER Repetition of the display (practical in the case of variables of type INPUT for instance).
Shift + ←	Return to the FIELD level
Enter	as for **Shift** + ↓
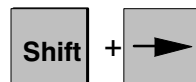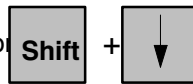
Variable name	: Direct preselection of another name if applicable with index or component name (max. 12 characters)
***[Index]**	: Direct preselection of a field index
***.Component**	: Direct preselection of a component

5.7.3. Operation at the component level

You will be at the component level if there is a component name at the end of the variable name.

Operating options:

| **Shift** + ↑ | Preceding component to min. to first component, then return to group level |

| **Shift** + ↓ | Next component to max. to last component, then return to group level |

| **Shift** + → | In the case of FIELD:
Jump to the index level
In the case of group (KINEMATIC,POINT,MK_POINT):
Jump to the component level
In the case of BINARY, INTEGER, DEC or CHARACTER :
Repetition of the display (practical in the case of variables of type INPUT for instance). |

| **Shift** + ← | Return to the group level |

| **Enter** | as for **Shift** + ↓ |

| **Variable name** | : Direct preselection of another name
if applicable with index or component name
(max. 12 characters) |

| ***[Index]** | : Direct preselection of a field index |
| ***.Component** | : Direct preselection of a component |
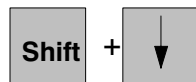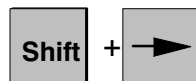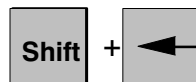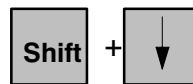
5.7.4. Example

Procedure for display of @IPOS of the KINEMATIC ROB1 with the axis names A_1, A_2, A_3, A_4 of program PROGNAME.
Current program line is 10.

Entry of MODE 7 in the test system

```
PROGNAME        10
DISPLAY


Name:#
```

Entry : ROB1

```
PROGNAME        10
ROB1
IPOS,@IPOS,LIMIT_M−>
#
```

Entry: SHIFT ARROW RIGHT

```
PROGNAME        10
ROB1.IPOS
X_K,Y_K,Z_K,U_K
#
```

ENTRY: SHIFT ARROW DOWN

```
PROGNAME        10
ROB1.@IPOS
A_1,A_2,A_3,A_4
#
```

ENTRY: SHIFT ARROW RIGHT

```
PROGNAME        10
ROB1.@IPOS.A_1
0.000
#
```

ENTRY : ENTER

```
PROGNAME        10
ROB1.@IPOS.A_2
−100.000
#
```

5.8. Set variables (mode 8)

This command permits the contents of any variables to be changed.

Operation and selection correspond to the descriptions of display mode (as described in Section 5.7).

It is not permitted to set input variables. They are skipped when "paging".

If you have selected a variable of type BINARY, INTEGER, DEC or CHARACTER by entering a name or with the arrow key, you will also see a question mark before character # on the fourth line.

The value can then be changed by entering a value. A value can be entered in the case of a variable of type CHARACTER by entering the character in quotes or by entering a decimal number.

A different variable can be selected without changing the value of the current variable instead of entering a value by entering a name or entering with the arrow keys, as described for display.

5.9. Single-step (mode 9)

When this command is preselected, any executable BAPS program statement can be executed individually.

After the command has been preselected, a line number is requested. The number of the next executable program statement is the default.

Display on the PHG:

```
dana            xxxxx
Single-step

Line:
```

xxxxx : Next executable program line

Operating options:

Entry of the line number (max. 32767 ; xxxxx is the default)

| Enter | The program line to be executed is preselected and displayed on the PHG in line 3.

For reasons of safety, the statement contained in the preselected line is not yet executed !!
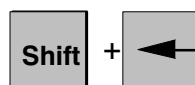
| Shift | + | ◄— | Select new test system command. Single-step operation does not yet occur.

After you enter the line number and acknowledge with ENTER, you can execute the program statement by pressing key SHIFT ARROW DOWN.

Display on the PHG:

```
dana              xxxxx
Single-step
Program line
```

xxxxx : Next executable program line

Operating options:

| Shift | + | ◀ |
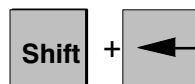
Enter new program line number
Single-step operation does not yet occur

| Shift | + | ↓ |

Execution of the selected program statement.

The next program statement is not displayed until after complete execution of the program statement. If several statements occur in one program line, the same program line is displayed until all statements of this line have been executed.

Note:
The program line is displayed if the control does not have a QLL file of the currently active program.

5.10. Test with/without robot movement (mode 10)

This command permits the currently selected process to be tested with or without robot movement.

Display on the PHG:

```
dana              xxxxx
Test  "With movement"

Switch over with ENTER
```

or

```
dana              xxxxx
Test "Without movement"

Switch over with ENTER
```

xxxxx : Next executable program line
The current status is displayed in the
2nd line.

Operating options:

Enter	Execution of the command Switchover occurs.
Shift + ◄	Select new test system command. Switchover does not occur.

5.11. Write a program line (mode 11)

This command permits QLL program lines to be displayed on the PHG. After prese-lection, the test system requests you to enter the line number to be displayed.

Display on the PHG:

```
dana            xxxxx
Write

Line :
```

xxxxx : Next executable program line

Operating options:

Entry of the program line number (max. 32767 ; xxxxx is the default)

Enter Execution of the command

Shift + ◄ Select a new test system command
Writing does not occur.

After you enter the required line number, the contents of the program line are dis-played on the PHG.

Display on the PHG:

```
dana            xxxxx
Write
Program line
```

 xxxxx : Next executable program line

Operating options:

Enter Quit display, enter new test system command.

Shift + ◄

Shift + ► Scrolling within a line
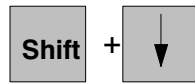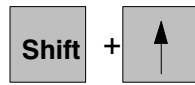
Shift	+	↑	
Shift	+	↓	Scrolling within the QLL program

When program lines are displayed, blanks between line number and the first character of the line are masked.
The next executable program line is identified with prefix ”– –>”.

5.12. Monitor BAPS processes (mode 12)

If mode 12 is preselected, the operator has the choice of 5 additional test system commands.
These 5 commands serve to prepare processes for the test system and to start, interrupt or terminate processes.

Display on the PHG:

```
dana              xxxxx
1= Preselect
2= Select
```

xxxxx : Next executable program line

Operating options:

MODE	1	Preselect process

MODE	2	Select process

MODE	3	Start process

MODE	4	Interrupt process

MODE	5	Terminate process

Shift + ↓

Shift + ↑   Preselection of modes 1−5 with the arrow keys

Shift + ◀   Enter new test system command.

Note: If no process is selected (see notes on 1st PHG line), you cannot quit this command level.

5.12.1 Preselect process

By preselecting this command, the operator can make processes available for the
test system without having to quit the test system. The precondition is that the pro-
cess not yet be accessible to the test system and that all conditions listed in Section
2 be fulfilled.
On the PHG, the operator is offered all processes for selection whose IRD pro-
grams are present in the user memory.

Display on the PHG:

```
Preselect
dana        .IRD  Size
Date, time
Preselect with: ENTER
```

Operating options:

Enter	The displayed process is started for the test system.
Shift + ↓	
Shift + ↑	Offering further processes for preselection.
Shift + ←	Enter new test system command. No preselection occurs.
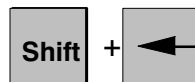
When the operator enters ENTER, he is prompted to press the PROGRAM-START
key in order to activate the process for the test system. When this key is pressed,
the process is selected automatically and all test system commands are available
for the newly preselected process.

5.12.2 Select process

In the rho 3 control, it is possible for several processes to be active simultaneously. If several processes are activated for testing, it is possible to switch over between the individual processes with "SELECT". The name of the currently selected process is always displayed on the 1st PHG line. The suffix 'Sxx' (xx is a 2−digit number) states that the process is a sub−process (see Section 7).

When this command is called, the operator is offered all processes to which he can switch over. A process can be selected if it has been made known to the test system by preselection (see Section 5.12.1) and if it is currently executing no program steps.

Display on the PHG:

```
Select
dana        .IRD  Size
Date, time
 Preselect with: ENTER
```

Operating options:

Enter	The displayed process is selected for the test system. All subsequent commands then refer to this process.
Shift + ↓	
Shift + ↑	Offering further processes for selection
Shift + ◄	Enter new test system command. No selection occurs.
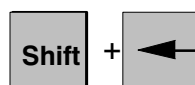
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5.12.3 Start process

When this command is preselected, the selected process can be started as of any program line.

The test system prompts you to enter a program line number as of which the BAPS program is to be executed. If no program line number is entered, the program is executed as of the next executable program statement.

Display on the PHG:

```
dana            xxxxx
Start

From line:
```

xxxxx : Next executable program line

Operating options:

Entry of the program line number (max. 32767; xxxxx is the default)

| Enter | Execution of the command
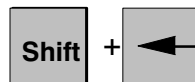
| Shift | + | ← | Select new test system command
No start occurs.

The process can now be influenced by the test system only if a previously set interrupt or observation is triggered or if it is stopped by an interrupt (see Section 5.12.4). Otherwise, the program runs to its programmed end or to an abort (e.g.: EMERGENCY-STOP).

When the operator enters ENTER, he is prompted to preselect or select a new process (see Sections 5.12.1 or 5.12.2).

5.12.4 Interrupt process

This command gives the operator the option of interrupting a running process. All running processes which have been activated by the test system and which are not selected can be interrupted. After preselection of the command, it is possible to use the arrow keys to search for the process to be interrupted.

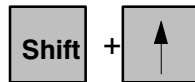**Display on the PHG:**

```
Interrupt
dana

Preselect with: ENTER
```

Operating options:

| Enter | Interrupting the displayed process. |
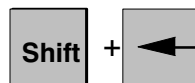
Shift + ←	Select new test system command No interrupt occurs
Shift + ↑	
Shift + ↓	For selection of further processes
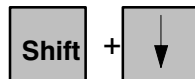
When ENTER is entered, the displayed process is stopped before the start of its next BAPS command. The interrupted process is then automatically selected.

5.12.5 Quit process

This command provides the operator with the option of aborting the currently selected process.

Display on the PHG:

```
Quit
Quit current process

Execute with ENTER
```

Operating options:

Enter   The selected process is aborted
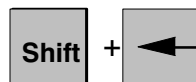
Shift + ◀   Select new test system command
                                                 No abort occurs

After aborting the selected process, the operator is prompted to select a new process (if present).
If no further process is active for testing, you return to **SET-UP**.

5.13. Define points (mode 13)

This command permits points to be defined using the PHG without having to quit the test system. The definition procedure is the same as when calling via MODE 4 (Define, Teach In), MODE 1 (Define).

5.14. Teach points (mode 14)

This command permits points to be taught using the PHG without having to quit the test system. The teaching procedure is the same as when calling via MODE 4 (Define, Teach In), MODE 2 (Teach In).

5.15. Quit test system (mode 15)

This command permits the operator to abort all processes and quit the test system again. If RC input 61 (PIC address A7.5 , "Permanent processes are to remain acti- ve") is not set at the instant at which the command is executed, all permanent pro- cesses are also aborted.

Display on the PHG:

```
dana            xxxxx
Quit test system

Continue : ENTER
```

xxxxx : Next executable program line

Operating options:

Enter	Abort all processes (see above) and return to SET-UP.
Shift + ◄—	Select new test system command No abort occurs.

6. MESSAGES FROM NON−SELECTED PROCESSES

Several processes can be tested simultaneously in the test system of the rho 3. Consequently, it is possible for the selected process to be tested whilst another non−selected process runs to an interrupt point or whilst an observed variable is being written. This is indicated to the operator in the last line of the PHG.

6.1. Observation reached

If a variable for which an observation has been set previously is written in a process, the operator will see a note in the last line of the PHG. The note may also be signalled by non−selected processes.

Display in the last PHG line:

Obs.rea.: dana1
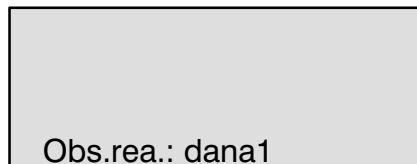
dana1   : Process which signals the interrupt.

The note in the last line is retained until the next PHG key is pressed.

6.2. Interrupt reached

If a process runs to a previously set interrupt, the operator will see a note in the last line of the PHG. The note may also be signalled by non-selected processes.

Display in the last PHG line:

Int.rea.: dana1
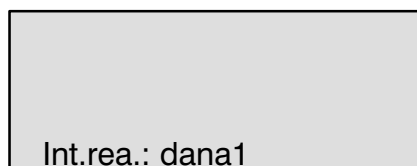
dana1   : Process signalling the interrupt.

The note in the last line is retained until the next PHG key is pressed.

7. PARALLEL PROGRAM BRANCHES (PARALLEL,PARALLEL_END)

Specially identified program parts can be executed in parallel, i.e. simultaneously, as of BAPS Version 2.1. The keywords "**PARALLEL**" , "**AND**" and "**PARALLEL_END**" are used for identification.

Example:

```
 1  ;;kinematic : (1 = ROBI1 )
 2  ;;kinematic : (2 = ROBI2 )
 3
 4  Program Test
 5
 6  Point : p0,p1,p2,p3,p4
 7
 8   Start
 9         Move ROBI1 to P0              ;Main process TEST
10         Move ROBI2 to P1
11
12         Parallel
13           Move ROBI1 to P2      ;Sub-process TEST S01
14         and
15           Move ROBI2 to P3      ;Sub-process TEST S02
16         Parallel_end
17
18         Move ROBI1 to P4              ;Main process TEST
19      Stop
20  End
```

When this example program is executed, the kinematic ROBI1 approaches point P0 and, then, kinematic ROBI2 approaches point P1. Kinematic ROBI2 does not start its movement until ROBI1 has reached point P0.
In the parallel branch, the traversing statements are executed simultaneously, i.e. ROBI1 moves to P2 whilst ROBI2 is moving to P3.
The test system handles the statements between "PARALLEL" and "PARALLEL_END" as independent processes (sub-processes). The name of a sub-process consists of the main process name, an 'S' and a consecutive number.
In the example, the sub-processes are designated TEST S01 and TEST S02.

7.1. Special features in the case of SINGLE-STEP (mode 9)

If a main process is executed in "SINGLE-STEP", the test system handles the statements of sub-processes (commands between "PARALLEL" and "PARALLEL_END") as one single command line.

Example:

A main process is tested and the next statement to be executed is "PARALLEL". If a "SINGLE-STEP" is now executed, new test system commands cannot be entered until **all** commands between "PARALLEL" and "PARALLEL_END" have been executed completely. (See also Section 5.9.)

If lines which belong to a sub-process are selected from a main process ("SINGLE-STEP" specifying a line number), the PARALLEL statement has no effect. When an "AND" statement is reached, the system branches to ""PARALLEL−END" without allowing for subsequent sub-processes.

Example:

In the above example, the main process (TEST) is preselected. The operator also specifies the line number 13 for SINGLE-STEP. This means that the command is executed in sub-process TEST S01. The next program line to be executed would be 18. Sub-process TEST S02 is not executed !!

7.2. Special features applicable to preselect, select etc. (mode 12)

Since sub-processes are processes without their own IRD program, it is **generally not** possible to preselect them.
Sub-processes can be selected only if the main process has executed a "PARALLEL" statement and "PARALLEL_END" has not yet been reached (see restrictions for "SINGLE-STEP").
In order to permit a sub-process to be selected, it must be interrupted by an interrupt point or an observation during execution.

Important:
The remaining sub-processes continue only if a sub-process has been stoppped owing to an interrupt point or observation!

Starting, interrupting and terminating a sub-process functions in the same way as with a main process. In the case of "START", the same special features must be allowed for as with "SINGLE-STEP" (see Section 7.1).

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