Tab. 11-7:RUN–mode– menu 1/2

	Test 1	Test 2	Test 3	Test 4	Test 5	AUTO	
							

Tab. 11-8:RUN–mode– menu 2/2

	Cal Sync	Ref Pos	Sync Pos	Start PLC	Test PLC	Test 6	
							

Tab. 11-9:COORD–mode– menu 1/3

	Robot Axis	Cart Base	Cart Tool	Cart Frame	Frame Chose	Peri Axis	
							

Tab. 11-10:COORD–mode– menu 2/3

	Mouse trans	Mouse rotat		Cart ETool	Peri Mode	Axis Chose	
							

Tab. 11-11:COORD–mode– menu 3/3

	PHG Mouse	Tool1 Mouse	Tool2 Mouse				
							

Tab. 11-12:INFO–mode– menu 1/5

	Axis actv	Cart actv	Incr actv	Vari able	Err enab	Chng stat	

Tab. 11-13:INFO–mode– menu 2/5

	Inp dig	Outp dig	PLC mark	Log book	CAN stat	CDev stat	
F0	F1	F2	F3	F4	F5	F6	F7

Tab. 11-14:INFO–mode– menu 3/5

	Safe I / O						
F0	F1	F2	F3	F4	F5	F6	F7

Tab. 11-15:INFO–mode– menu 4/5

	Send Set1	Send Set2	Send Set3	Send Set4	Send Set5	Send Set6	
F0	F1	F2	F3	F4	F5	F6	F7

Tab. 11-16:INFO–mode– menu 5/5

	Read rec1	Read rec2	Read rec3	Read rec4	Read rec5	Read rec6	
F0	F1	F2	F3	F4	F5	F6	F7

Tab. 11-17:CWIN–mode– menu 1/2

	Div hori	Div vert	Div undo				
F0	F1	F2	F3	F4	F5	F6	F7

Tab. 11-18:FUNCT–mode– menu 1/2

	Bckup new	Bckup write	Bckup read	Prog prot	Cal	Recal Mouse	
F0	F1	F2	F3	F4	F5	F6	F7

Tab. 11-19:FUNCT–mode– menu 2/2

	Con–trast	Date Time	DNC Reset	Order Reset	Quit SC		
							

11.2 COMMANDS - SUMMARY

Tab. 11-20:RSV-Commands - Survey

	CONTR	LOG	MATH	MOVE	PERI	PLC	POS	PROG	SPEC	VAR
F1	WAIT_BIT	WRITE_BIT	ADD	INTERPOL	ANA_OUTP	U	#N	PROGRAM	I	COPY
F2	TEST_BIT	INVERT	SUB	PTP_VELOC	ANA_INP	UN	#P	CALL	SEARCH_BIN	COPY_OFFS
F3	TEST	SHIFT_R	MUL	PTP_ACCEL		=		SELECT_PROG	PROC_CTRL	CONST
F4	WAIT	SHIFT_L	DIV	PATH_VELOC		O		COPY_PRG	TRAFO_6D	LOC_CONST
F5	BRANCH	OR	MODULO	PATH_ACCEL		ON		DELETE_PROG	STOP	LOC_VAR
F6	LABEL	AND	NEG	FLYBY		;		TEST_PROG	C	VAR
F1	PLIST	EXCL_OR	VEC_ADD	TOOL	SEND_PRG	S			OSCILLATE	
F2	SHOW_ERROR		VEC_SUB	PATH_RADIUS	LOAD_PRG	R			OSC_ANGLE	
F3	PDA		VEC_LENGTH	PATH_DIST	SET_PRG	L			SENSOR	
F4	PDA_INPUT		VEC_VALUE	PATH_TIME	DEL_PRG	T			TECHIPO	
F5	OUTPUT_VAR			PATH_SWITCH	SEND_VAR	LD			ARC_SENSOR	
F6	INPUT			AXIS	LOAD_VAR	TD			PALLET	
F1			ABS_VALUE	RELATIVE	SET_MODE	SU			MS_TRAFO_ON	
F2			TRIG_FUNC	CALC_REL		JP			MS_TRAFO_OFF	
F3			SQRT	ACTUAL_POS		M			CALIBRATION	
F4			INTERSECTION	VAR_POS		U(			MOUSE_CAL	
F5			CENTER	TRAFO_POS		OC			ROOTLAYER	
F6			CALC_TFRAME	EXTEND		)			TOPLAYER	
F1				MIN_PATH		+			WELDING	
F2						-			PULSE	
F3						MU(				
F4						DI				
F5						SH				
F6						RO				
F1						=?				
F2						><				
F3						>				
F4						>=				
F5						<				
F6						<=				
F1						K				
F2						ZR				
F3						ZV				
F4						TA				
F5						HD				

	CONTR	LOG	MATH	MOVE	PERI	PLC	POS	PROG	SPEC	VAR
F6						DH				
F1						XO				
F2						XON				
F3						XO(				
F4						ST				
F5										
F6										

12 EXPLANATION OF TERMS

A

additional axes

In addition to the 6 robot axes the control is able to administrate up to 18 further axes. Additional axes and robot axes can be moved at the same time or separately.

With multi-axes transformation being active the additional and robot axes are moved in the path movement modes in such way that overlapping of the movements of both systems will result in the path determined before (straight line, spline or circular path).

Path contour, path speed of the TCP and orientation of the tool are maintained with reference to the table coordinate system.

analog output

In the user program the analog outputs can be supplied by a direct voltage in the range from - 10 V to + 10. Peripheral units can be controlled with these direct voltages.

Example: Control of a connected weld power source or having influence on the pressure of a dosing system

analog input

It is possible to apply direct voltages to analog inputs of peripheral units. The max. admissible voltage range is between -10 and +10 V. These direct voltages can be further processed in the user program. Thus, e.g. the activated sensor function reacts on voltage modifications on the analog inputs and moves the TCP accordingly.

approximation

For PTP-movements (path approximation):

Programmed auxiliary positions, e.g. moving around an obstacle, are not exactly approached and with the corresponding position of the auxiliary positions the TCP traverses the programmed path distance without stop.

For path movements (speed approximation):

Two successive path movements are coinciding at an intermediate destination point without reduction of speed.

archival storage

Recording of programs resp. data from the memory of the robot control on floppy disk for data back-up.

C

coordinate system

A cartesian coordinate system (frame) consists of the three coordinates X,Y and Z. In programmed positions the destination coordinates of the TCP are stored in the unit 'millimeters'.

During movement of the robot in the manual operating mode 'Cartesian' the TCP can be moved in a linear way into X,Y or Z-direction of the selected coordinate system. Doing so, orientation remains constant.

CPU

Central Processing Unit

Central data processing unit of the robot control.

D

dead man operation

The robot and additional axes only move so long as the key the movement was introduced with will be kept operated. Those are the following ones:

- Movement keys in a manual operating mode
- Start key in a test operating mode.

Display

Display window in the teach pendant (PHG).

DNC

Direct Numeric Control

Operation of the robot control via a connected Personal Computer in which the corresponding DNC software is installed. Among others, the DNC software contains modules for:

- Data transfer from the control to the computer and vice-versa.
- Control over the controller on the computer and return to the PHG.

F

Frame

Coordinate system in which the robot can be manually moved and in which movement sequences can be programmed. Predefined are the 'Frames' $Base and $TOOL

$BASE is the basic coordinate system the origin of which for robots of the series RV is in the rotation axis 1 in level of the rotation axis 2.

$TOOL is the tool coordinate system the origin of which is in the center of the tool flange.

I

increment

The signals of the path measuring systems are prepared by the control and further processed as increments. The increments indicate the position actual value of an axis. They are transferred to the coordinate system for display and are converted to the units 'millimeter' and 'degree'.

Vice-versa, when processing a movement program, position and orientation values of the TCP are converted into position NOMINAL values of the unit 'increments'.

The corresponding conversion factors are defined in the machine data.

interface

Connecting point via which the data exchange between two separated systems is performed, e.g.:

control ROBOTstar - computer with corresponding software

control ROBOTstar - diecasting machine

control ROBOTstar - disk drive etc.

interlinkage

Signal exchange between robot control and peripheral equipment - e. g. lathe, casting machine etc.

Interlinkage is performed via user inputs and outputs.

interpolation

Definition how the TCP will approach the programmed position (see movement mode).

interpolation cycle

Time distance during which the control calculates support points for the TCP with path movement programmed.

M

machine data

The machine data describe the mechanic and electric configuration of the robot system. They are adapted during start-up of the system and are secured against user access.

movement mode

In the user program it is determined how the robot executes programmed movements. The following movement modes can be programmed:

#LINEAR

The TCP moves to the next position on a straight line.

#CIRC

The TCP moves on a circular path being calculated from three positions.

#SPLINE

The TCP moves on a path in which there are steadily executed direction changes (without corners).

#PTP

The axes move their shortest way, the TCP does not move a defined path.

O

offline-programming

With the corresponding software, robot programs can be generated and modified on a Personal Computer (PC). They can be transferred from the computer to the robot control via disk or DNC interface.

orientation

Position of the tool in space referring to the selected coordinate system. The tool orientation is defined by the three angles A, B, and C. The angles are 0 if the directions of the TOOL coordinates X, Y, and Z coincide with those of the selected coordinate system.

In the manual operating mode 'cartesian' the orientation angles can be modified via the movement keys. Doing so, the TCP is not moved.

override

Influencing the movement speed of the robot. The adjustment can be continuously set on the teach pendant (PHG) from 0 % (robot does not move) up to 100 % (robot moves with the programmed speed). The adjusted value is displayed on the teach pendant (PHG) as bar and as number.

oscillation

The oscillation movement overlays the path movement. The TCP is not guided on the programmed path, but oscillates around this path. Oscillation frequency and oscillation amplitude may be defined in order to determine the oscillation pattern.

Type of oscillation pattern is described in a definition program by means of positions.

oscillation coordinate system (OCS)

For preparation of the oscillation movement it is necessary to define an oscillation coordinate system (OCS). The control calculates this coordinate system from the programmed path and an auxiliary point (position of the type #P). Oscillation movements are made in the calculated coordinate system that is guided along with changes of the path direction.

The three coordinates are as follows:

binormal - stands square to the programmed path and square to the processing plane.

tangent - lies in the programmed path in the processing plane.

normal - lies in the processing plane square to the programmed path. It represents the oscillation direction.

The a.m. positions of the oscillation coordinates are valid for a not turned OCS and only for correctly programmed auxiliary point.

P

path control

The TCP is moved from the initial point to the destination point on a mathematically defined path (straight line, arc of a circle or spline movement). During CP movement there is continuously performed an orientation change of the tool.

peripheral equipment

The peripheral equipment includes all devices and machines which form a compound system together with the robot and which are connected with the robot control: weld power sources, casting machines, conveyors, lathes etc.

PHG

portable teach pendant

Portable operating panel that is connected with the control cabinet of the robot via a cable. The teach pendant is the interface between operator and robot control. The robot can be operated via keyboard of the teach pendant and the display shows operating states, error messages and requests for the necessary operations.

In dialogue between operator and control, it is possible to generate, modify and delete programs with the teach pendant.

position regulation cycle

Time distance during which the servo amplifiers are calculating position NOMINAL values for the robot and peripheral axes.

programmed limit switch

see software limit switch

PTP - movement

Point-to-Point Movement (PTP)

The robot and additional axes simultaneously start in the initial point and simultaneously reach their destination point, each axis moving on its shortest path. The axis with the longest movement path (control axis or guide axis) moves with programmed speed. The speeds of the other axes are calculated in such manner that the running times are the same for all axes.

The TCP moves a bent way resulting from the movements of the individual axes.

R

rotary axis

Thought line, around which one axis of the robot moves.

S

step coincidence

Current position of the TCP and programmed position in the current step of the user program are identical.

If a programmed movement is interrupted with 'STOP' and the TCP is moved out from the current program position in manual mode via the movement keys, after switch over to the operating mode 'AUTO' and operation of the key 'START' the TCP returns to the point of interruption (return positioning). Only then there is step coincidence again and the interrupted movement will be continued with the programmed speed.

The robot moves in the movement mode PTP with reduced speed until there will be step coincidence. Only then, the programmed speeds and movement modes will be valid.

Step coincidence will be canceled when if you scroll in the current program or if you change it.

Then, the current position, resp. the next following position in the user program will be approached with reduced speed. When the TCP has reached this position, there will be step coincidence again.

software limit switch

Software limit switches are only active with synchronized robot! They limit the traversing range of the robot and the additional axes.

In the machine data it is determined, how many degrees resp. millimeters each axis can be moved in positive and negative direction.

When moving beyond a software limit switch the axis movement is interrupted and the corresponding message is displayed on the teach pendant.

After acknowledgment of the error message the axis can be moved back again into the admissible traversing range.

T

TCP

Tool Center Point = operating point of the tool

The positions stored in a program include the destination coordinates of the TCP.

teach in

In the manual movement modes, positions and orientations of the TCP are approached with the movement keys and adopted into the user program as movement step (destination position).

tool data

The tool data define the position of theTCP referring to the tool flange (axis 6 for robots of the RH and RV series). They determine the operating point of the robot.

Tool data steps are stored in the tool variables.

tracking distance

Deviation of the position ACTUAL value from the position NOMINAL value during an axis movement.

Deviations are admissible in defined limits. The admissible limit values are defined in the machine data.

If the tracking distance exceeds the admissible value during a movement, the drives switch off and a corresponding error message will be given in the display of the portable teach pendant.

traversing range

Each axis has a defined traversing range. The center of the movement range is the so-called zero point of the axis (exception: axis 2 of the RV series robots). In the regular case the movement ranges in negative and positive direction are identical. The movement ranges are limited by the software limit switches.

U

user input

Binary (digital) signals from peripheral equipment can be put on user inputs and switch them to level 1 (the input is applied with + 24V) or to level 0 (the input is applied with 0V). Depending on the switched condition, program interruptions or conditional branches can be programmed in the user program.

user output

A user output consists of a contact that is closed (level 1) or opened (level 0) by programmed commands in the user program.

user program

The operation sequence of the robot system is defined in the user program. The user program describes movement sequences, administrates interface signals between the robot control and the peripheral units and contains control-internal operations (e. g. program branches, mathematical operations, logical operations etc.).

13 INDEX

7.1.2 Keyboard of the PHG (teach pendant)

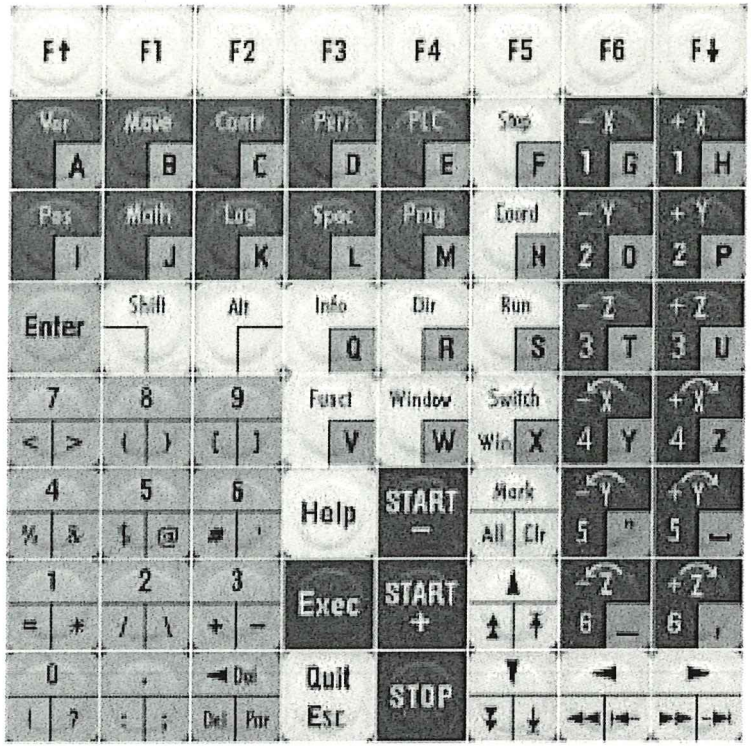

Fig. 7-1: Keyboard of the portable teach pendant

7.1.3 Change contrast of the display

The adjusted and acknowledged value is stored in the control.

- 
- 
-  "Contrast"

  Message: „Adjust the contrast at the override regulator and terminate with QUIT'
- Adjust contrast
- 

7.2 COORDINATE SYSTEM

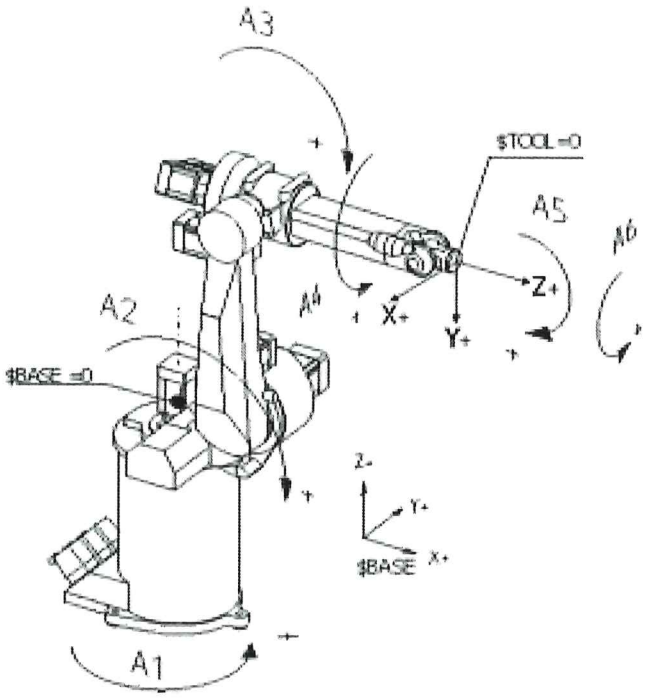

Fig. 7-2: RV series

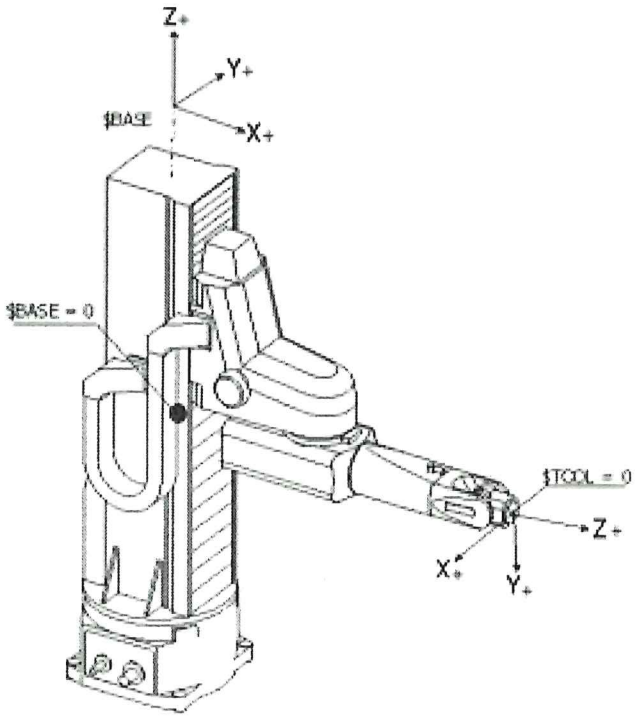

Fig. 7-3: RH series

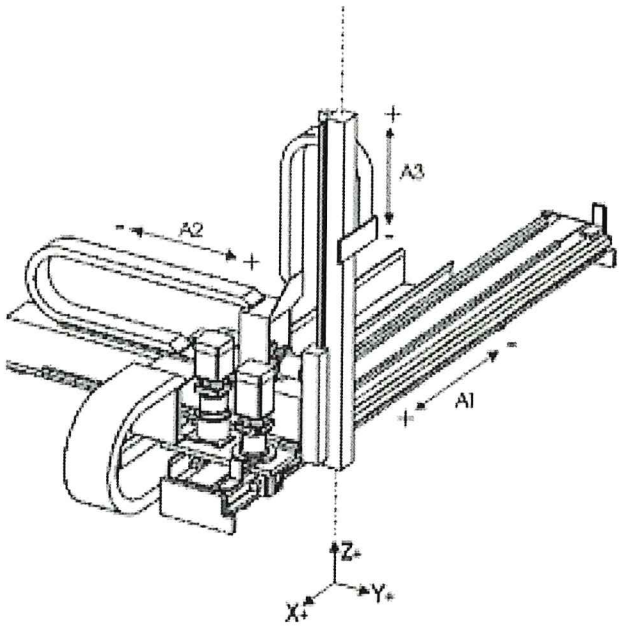

Fig. 7-4: RL series

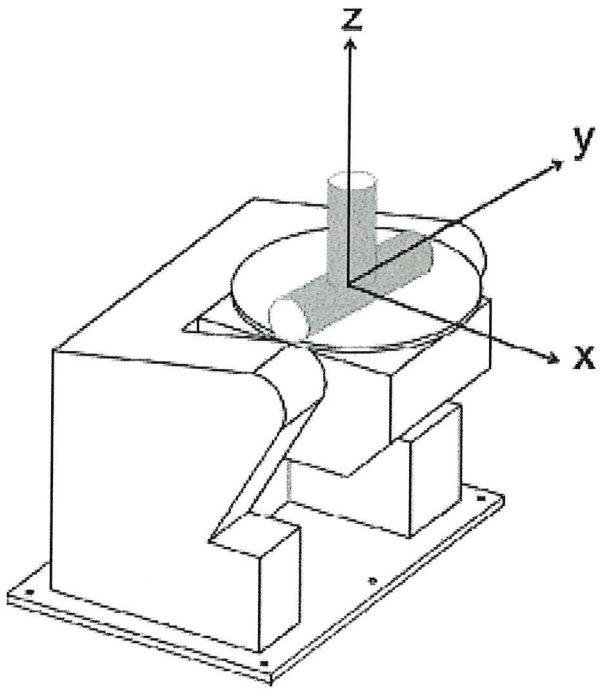

Fig. 7-5: table coordinate system

7.3 ACCESS AUTHORIZATIONS

The ROBOTstarV allows generation and administration of access authorizations for various user groups. The users are divided in four classes (levels) with different utilization rights each:

Tab. 7-2: User groups

Level	User group	Operations
1	Operator	Start automatic cycle Stop automatic cycle
2	Setter	Level 1 and • movement of the robot in hand-, test- and automatic mode. • Starting of predefined user programs • reading access to the range $CONFIG
3	Programmer	Level 2 and • Generation, modification and deletion of user programs • Modification of machine data • Writing to the range $CONFIG
4	Service REIS ROBOTICS	• like level 3, but with full access to the control system • Setting of safety equipment

The control after switch on always starts up in level 1.

The level is displayed in the blue status window.

Tab. 7-3: Login - Level 1

User administration
1 Login
0 or Quit abortion
Please enter (0 - 1):

7.3.1 Login for Level 2

Tab. 7-4: Login - Level 2

User administration
1 Login
2 Logout
3 Change password

0 or Quit abortion

Please enter (0 - 3):

The **login name** must at least consist of one character and may have 10 characters at maximum.

The personal **password** always consists of 8 characters.

For the login name and for the password all characters available on the PHG are allowed.

7.4 OPERATING MODES OF THE CONTROL

7.4.1 Display of the PHG

In the menu window in the last but one line the current operating mode of the control is displayed. In the various operating modes there are different possibilities for operation (see Chapter 11.1, Synoptical tables of the operating modes).

The two main modes are the DIR and the EDIT mode.

7.4.2 Activation of DIR mode

Selection of the possible operating functions is made by means of the function keys under the display. The arrow keys serve for switching-over between the menu levels.

Tab. 7-5: DIR mode / 1st menu

Prog new	Generate new program or subdirectory.
Prog mark	Mark program or directory next to the cursor or cancel its marking.
Prog del	Deletion of programs and / or directories. Directories to be deleted must be empty! By entering another name (perhaps with indication of path), an arbitrary other program can be deleted.
Prog copy	Copy programs. Directories cannot be copied! Marked programs (not directories!) can be copied into another directory or on disk.

Prog open	Program selection by entering the program or directory name. If the program to be selected is not in the current directory, the path has to be indicated. Indicate directories by„ /' (Slash). If only the slash is entered, change-over is made directly into the main directory.
Drive	Selection of the available drives. Drives S, R and A can be selected with the PHG.

Tab. 7-6: DIR mode / 2nd menu

Find repl	Search for a program or directory name only in the current directory. Replacement of character strings is not possible in DIR mode! If programs are marked, the indicated character string will be searched for in the marked programs. This character string may be replaced by another one, if it is not part of a program name, a command word, a describer or a system equate.
Code word	Passwords for the various user groups (levels) can be allocated in level 3. Change level
Disk open	Read-in programs from disk (drive A:). After selection of this menu item the programs in the main directory of the disk are displayed (no subdirectories!) The programs to be read in are marked and subsequently copied into the desired directory on the control. If a selected program name already exists in the destination directory, inquiry will be made whether the existing program shall be overwritten. **Overwriting is only possible for programs not being protected against deletion!**
Disk Eras	Delete contents of the disk in drive A:.

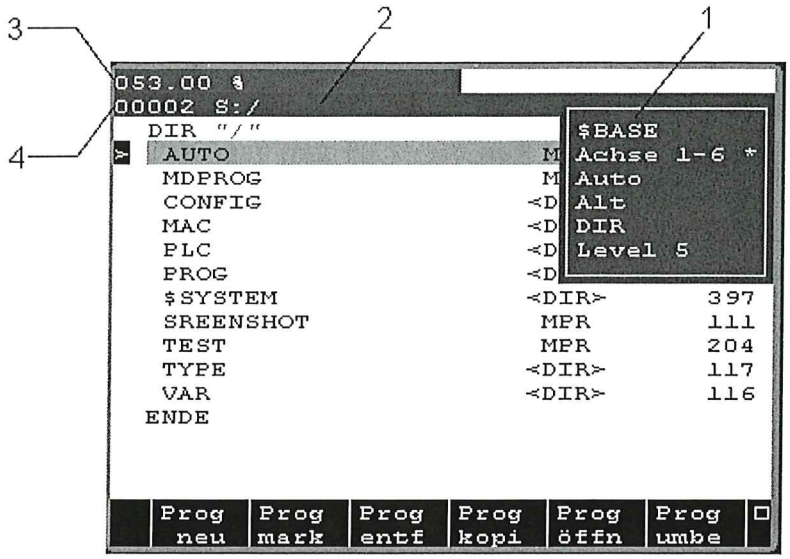

Fig. 7-6: Display in DIR mode

1 Status window with status indications

Display of manual operating mode and type of program treatment

2 Current path

3 Current override value (numerical and as bar)

4 Current step number

7.5 MOVE ROBOT

The robot can be moved via the keyboard, the function 'Position Control' or via the 6D-mouse being available as an option.

7.5.1 Movement via the keyboard

Robot and additional axes are moved via the teach pendant keyboard. Besides this, linear movement of the tool within the selected coordinate system is possible as well as rotation around the coordinates. This requires knowledge of the directions of the three coordinates in the selected system.

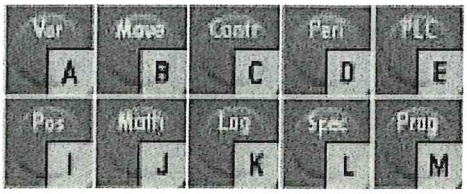

Fig. 7-7: Movement keys

Edit mem	Service REIS ROBOTICS!
Prog ren	Rename programs and directories The cursor is situated in the input line on the path and name of the program/directory. By input of another name (perhaps with indication of path) an arbitrary other program/directory can be renamed. For input without indication of path, the program/directory will be relocated to the current directory. After operation of the ENTER key select the type of the new program. Enter directory (with complete indication of path) where the marked programs/directories shall be relocated to.

Tab. 7-7: DIR mode / 3rd menu

Flsh read	Service REIS ROBOTICS!
Flsh frmt	Service REIS ROBOTICS!

⇨ 

The entries of a directory are displayed on the PHG.

2. Select calibration program.

   a. 

   b.  'Cal'

   c.  "Mouse"

   d. Select the desired calibration: 'Cal mouse 1', 'Cal mouse 2' or "Cal PHG mouse" .

3. 

4.  Select operating mode TEST2.

5. Fix 6D-mouse on the tool.

6. Set override to approx. 30 %.

7. Switch on drives with the permission key.

8. 

   Calibration program starts

9. Execute the offset measurement if this hasn't been done yet. During the offset measurement the 6D-mouse must not be touched; see instructions on the teach pendant display.

10. Bring back the 6D-mouse into zero position (let go shortly and then detain again).

11. Repeat the last two items for each movement direction.

7.6.4 Calibration at the PHG

The 6D-mouse is calibrated via the program MAUSPHG at the PHG.

This program is structured so that one movement each will be executed one after the other into the following directions respectively:

- Linear movement into world-X direction
- Linear movement into world-Y direction
- Linear movement into world-Z direction
- Rotation around the hand-X axis
- Rotation around the hand-Y axis
- Rotation around the hand-Z axis

The vectors for the world-Z direction and for the rotation around the hand-Z axis are calculated by the control.

REMARK: The data of the 6D-mouse will only be read-in at the end of the movement --> don't let go the mouse immediately!

1. Adjust the operation mode AUTO-TEST with the key-operated key on the PHG.
2. Select calibration program.

   a. 

   b.  'Cal'

   c.  "Mouse"

   d.  "Cal PHG mouse"

3. 

4.  Select operating mode TEST2.
5. Fix 6D-mouse on the tool.
6. Set override to approx. 30 %.
7. Switch on drives with the permission key or with the key 'drives on'.
8. Press the permission key and don't let it go during the complete calibration.
9. 

   Calibration program starts
10. Execute the offset measurement if this hasn't been done yet. During the offset measurement the 6D-mouse must not be touched; see instructions on the teach pendant display.
11. Don't move PHG any more. Follow-up the movement of the TCP with the 6D-mouse movement; direct 6D-mouse into that direction where the TCP is moving.
12. Bring back the 6D-mouse into zero position while the robot moves back to home position (let go shortly and then detain again).
13. Repeat the last two items for each movement direction.

14. Do the reference measurement for the recalibration.
    a. Select an arbitrary space direction and set the marking of the override regulator parallel to the selected space direction.
    b. 

7.6.5 Call calibration data

After having run one of the the calibration programs the corresponding calibration is activated automatically.

As long as the contents of the vector variable are still preserved, a simple call of the calibration data once determined is sufficient.

1. 

   COORD menu appears.
2. Select menu item 'PHG Mouse', 'Tool1 Mouse' or 'Tool2 Mouse' in the third function key menu.

   A macro belongs to each of these menu items that will be executed after selection of the menu item.

7.6.6 Recalibration of the 6D-mouse

If the 6D-mouse is fixed on the PHG, the robot even with correct calibration only moves into the correct direction if the PHG with reference to the reference direction is held exactly in the same way as it had been held during the calibration.

The control cannot automatically recognize a twist of the PHG and thus, of the 6D-mouse. In this case, calibration must be corrected as follows.

➪ Set override regulator parallel to the reference direction

➪ 

➪ 

'Recal Mouse'

Message: „'Recalibration finished'

8 PROGRAMMING

8.1 GENERAL

8.2 PROGRAMMING OF MOVEMENT SEQUENCES

8.2.1 Movement modes

The movement sequence of the robot is controlled via programmed space positions. During the program run the robot approaches the positions in the order as indicated in the user program. Doing so, it always moves from one position to the next one on the direct way.

There are two different movement modes by means of which the TCP (Tool Center Point = work point of the tool) moves from one programmed position to the next:

1. Point-to-Point Movements (PTP)

   The movement mode PTP is the standard default. The PTP movement depends only on the movement path of the axes. They start simultaneously and stop at the same time in the corresponding end position. As a consequence of this the TCP does not follow a straight line, but moves on a curved distance (only with articulated arm robots)

2. Path Movements (CP)

   CP means that the TCP approaches the next following position or positions on a mathematically defined path.

   Distinction is made between three movement modes :

   a. #LINEAR, straight

   b. #CIRC, circular path

   c. #SPLINE, connection of positions without corners

8.2.1.1 Adjustment of movement mode #LINEAR

For movements on a straight line the movement mode '#LINEAR' is selected. The TCP approaches the next following position(s) on a straight line.

If the orientation in the point of destination is different from the one in the start point, the tool will be readjusted continuously during the movement.

1. 

   MOVE menu is opened

2. 

'INTERPOL'

Menu of the operating modes is opened.

3. F2 "#LINEAR"
4. Approach point and define it as normal position.

8.2.1.2 Adjustment of movement mode #CIRC

For programming of circular movements the movement mode '#CIRC' (circular interpolation) is entered.

An auxiliary position on the circular path (circular auxiliary point) has to be entered after the command '#CIRC'.

After the auxiliary position the end point of the circular path is entered. Several circular segments can be programmed directly one after the other. After switch-on of the circular interpolation always an even number of positions must have been programmed before switching-over the movement mode.

After '#CIRC' the control interprets each first, third, fifth etc. position as circular auxiliary point, each second, fourth, sixth etc. position as end point of a circular path and simultaneously as start point of the next circular segment, until the movement mode will be switched over.

Tab. 8-1: Example for programming of a circular interpolation

Step	Command	Points and movement modes
S1	MPR	MOVEMENT
S2	TOOL	T
...	...	
S9	POSITION	A
S10	POSITION	B
S11	INTERPOL	#LINEAR
S12	POSITION	C
S13	INTERPOL	#CIRC
S14	POSITION	D
S15	POSITION	E
S16	POSITION	F
S17	POSITION	G
S18	INTERPOL	#PTP
S19	POSITION	H

If no movement mode is programmed at the beginning of a program, all following positions will be approached with the default adjustment #PTP.

In the example the TCP will approach the positions A and B in the movement mode PTP.

The position C in step 12 will be approached on a straight line.

#CIRC in step 13 effects that an arc of a circle will be calculated from the positions C, D, and E on which the TCP approaches position E in step 15.

Since circular interpolation is still active, another arc of a circle will be calculated from the positions E, F, and G which is directly attached to the first one.

Position G will be approached on this second arc of a circle. Position H and the following ones will be approached in movement mode PTP again.

1.  'INTERPOL'

   Menu of the operating modes is opened.

2. 

   MOVE menu is opened

3.  '#CIRC'

4. Define circular auxiliary point.
5. Define end point.
6. For another circular path enter the circular auxiliary point again and then the end point.

8.2.1.3 Adjustment of movement mode #SPLINE

In the movement mode #SPLINE the TCP moves on a path connecting the programmed positions without corners.

Further information: see programming manual

1. 

   MOVE menu is opened

2.  'INTERPOL'

   Menu of the operating modes is opened.

3.  Select "#SPLINE.

6 INSTALLATION

6.1 ENERGY SUPPLY

Establish energy supply acc. to the information on the type plate mounted on the control cabinet, resp. acc. to the information given in the circuit diagrams.

6.2 START-UP

6.2.1 Connect installation

➪ Connect the robot/the peripheral units with the delivered cables via the plug connections of the control cabinet.

➪ Connect teach pendant.

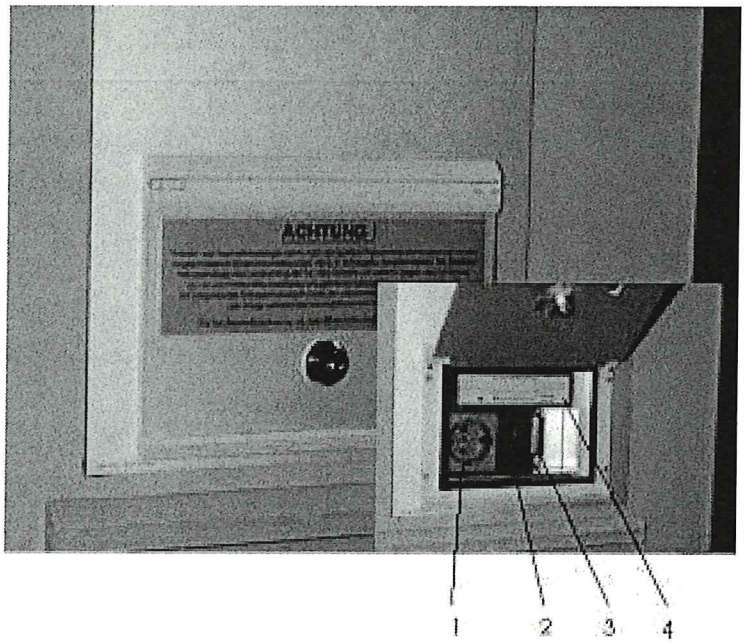

Fig. 6-1: Plug connections control cabinet - front side

1 Voltage supply for laptop (230 V)
2 DNC connection
3 PHG connection
4 disk drive

For further information about start-up of your installation please refer to the operating manuals of the robot and of the corresponding peripheral equipment.

6.3 SYNCHRONIZE ROBOT

see chapter „OPERATION“

7 OPERATION

7.1 OPERATION ELEMENTS

The robot control is operated via the keyboard of the portable teach pendant. Operating the 'Shift' key with individual keys allows access to additional functions being represented in the left bottom corner of the key, resp. in the right bottom corner for operation of the 'Alt' key.

7.1.1 Symbolism of the examples in the manual

Tab. 7-1: Symbolism of the examples

Action	Selection of a function	Symbol
Operate key		
	The function allocated to the function key in the current selection menu.	"Function"
Enter name (e. g. for a program)		<name>
Enter value (e.g. 1.0)		<1.0>

Samples of the symbolism

-  "CALL"
- <name of subprogram>

Movement is executed in dead man operation : The robot only moves if the key is pressed. In order to move several axes at the same time, several axes can be pressed at the same time.

Speed of the movement can be changed with the override regulator also during movement.

➪

7.5.2 Movement with the mouse

The 6D-mouse allows intuitive movement of the robot into any direction. The 6D-mouse, however, cannot completely replace movement of the robot via teach pendant keys.

Nothing changes with input of space points into a user program, consequently no contours are stored.

The robot can only be moved in the cartesian movement modes by means of the 6D-mouse.

By blocking the corresponding movement mode (either translatory or rotatory) an unintended change of the orientation angles or of the TCP coordinates during movement via 6D-mouse can be prevented. There are two menu items for this purpose: Mouse Trans and Mouse Rotat under the PHG-key„ Coord'.

For movement via the mouse, the same requirements must be met as for movement via “POSITION CONTROL”:

- Robot synchronous.
- Drives switched on.
- Cartesian movement mode selected.

➪ Move mouse into the desired direction

7.5.3 Change/enter positions

7.5.3.1 Edit position

➪ 

<Pos edit>

➪ 

7.6 CALIBRATION OF 6D-MOUSE

7.6.1 Preparations

The functionality for calibration of the 6D-mouse and movement of the robot axes with the 6D-mouse already exists in the RSV system software.

The change-over works only refer to fixation of the 6D-mouse fixtures at the tool and at the PHG. Besides this, the control PHG must be equipped with a 6D-mouse interface which is situated on the teach pendant reverse side in the form of a 5-pole jack.

7.6.2 Data safeguarding

As long as nothing is changed at the 6D-fixtures and as long as the content of the user program memory won't be destroyed, a unique calibration is sufficient for each existing 6D-mouse fixture. By buffering the user program memory the calibration data even won't be lost after switch-off of the control.

For reasons of safety, however, we recommend to safeguard the following file with the calibration data on disk:

S:/$CONFIG/$DATA/SYSDAT

7.6.3 Calibration at the tool

The 6D-mouse is calibrated via the following programs at the tool:

With these programs it is possible to store two different tool calibrations which can be activated when required (fixation of the mouse to fixture 1 or to fixture 2).

The program MAUSKAL2 has the same structure like MAUSKAL1 and is only required if a second 6D-mouse fixture is attached to the tool.

These calibration programs are structured so that one movement each is made into the following directions respectively one after the other: linear movement into hand-X direction, into hand-Y direction, into hand-Z direction and one rotation around the hand-X axis, around the hand-Y axis, and around the hand-Z axis.

For the linear movements the TCP moves a path of -15 mm. An angle change of -5 degrees is preset for rotations.

REMARK: The data of the 6D-mouse will only be read-in at the end of the movement --> don't let go the mouse immediately!

1. Adjust the operation mode AUTO-TEST with the key-operated switch on the PHG.

1 TABLE OF CONTENTS

2 DESCRIPTION

2.1 CONTROL CONCEPT

The control concept is based on the following components:

- VME-Bus-CPU
- Real-time operating system
- CAN-Bus technology
- Full digital servo-amplifier with integrated position, speed and current regulation
- Portable teach pendant (PHG) with graphical color display, ergonomic shape and easy to operate three-position permission key

Fig. 2-1: Portable teach pendant PHG

1 Emergency-off
2 Drives OFF
3 Drives ON
4 Key-operated switch with positions
4a Automatic
4b Setting
4c Automatic-Test
5 Override (speed)
6a Special key 'I'
(Execute macro; Position Control)
6b Special key 'O'
(Execute macro; Position Control)
7 Display

8 Selection menus for function keys
9 Function keys
10 General keyboard (LED's of active keys light)
11 Special keys (call macro)

3 QUALIFICATION OF THE PERSONNEL

The robot may only be operated by personnel that is trained and instructed accordingly:

Tab. 3-1: Qualification of the personnel

personell	minimum qualification	allowed operating modes
Operators	Instruction by trained programming or service personnel or Instruction by assemblers of REIS company or Participation in an operator training at REIS works.	Operation only from outside the safety grid. During operation safety devices have to be active, i.e. safety doors have to be closed. Staying inside the safety grid only when drives are switched off.
Programmers	Participation in an operating and programming training at Messrs. REIS ROBOTICS.	All operation modes as per EN 775 as described in the operating manual ROBOTstar.
Servicing staff	Participation in an operating and servicing training at Messrs. REIS ROBOTICS.	All operation modes as per EN 775 as described in the operating manual ROBOTstar.

4 GENERAL SAFETY INSTRUCTIONS

4.1 EXPLICATION OF TERMS AND SYMBOLS

This section explains and defines terms and symbols which are used for safety-relevant information always with the same meaning.

4.1.1 User

User is the entrepreneur who uses the installation for production purposes, or the person appointed vicariously responsible for the machine by the company, e. g. head of a department or foreman.

4.1.2 Insured

The insured is the person employed at the machine.

4.1.3 Warnings

Please observe all warnings in the operating manual.

These warnings consist of a warning word and a graphical symbol which may occur in various combinations. The individual warning words and graphical symbols are listed in the following.

Tab. 4-1: List of warning words

Warning word	Significance
Danger	A warning with the warning word 'Danger ' warns of danger to life and limb. If this warning is not observed, there is severe mortal danger.
Warning	A warning with the warning word 'Warning' warns of severe risk of injury. If this warning is not observed, severe injuries or severe material damage up to destruction of the machine and/or other components of the installation are threatening.
Attention	A warning with the warning word 'Attention' refers e. g. to relevant regulation and to the correct sequence of works. If this warning is not observed, the machine and/or other components of the installation may be damaged.

Tab. 4-2: List of graphical symbols

	Shearing off		Inflammable
	Ear protection		Hot surface
	Electrical current		Laser
	Entanglement		Squeezing
	Eye protection		General danger

4.1.4 Skilled personnel

Fig. 4-1: Symbol for skilled personnel

This symbol identifies works which must only be executed by skilled personnel.

4.2 INSTRUCTIONS CONCERNING SAFETY REGULATIONS

We are not liable for damgage and failures in operation resulting from disregard of the operating manual.

4.2.1 Maintenance

1. Insured who are employed at the machine have to inform the superior immediately of any irregularities in machine operation.
2. The user has to see to it that in case of irregularities in operation of the machine it will be checked if there is any defect. The machine must only be operated again after debugging of any defect that has been found.
3. Insured must switch off the drives for maintenance, inspection, and repair.

4.2.2 Instructions of the manufacturer

4.2.2.1 General remarks

1. Insured who are occupied with works related to assembly, operating, servicing and repair of the machine in the company of the user, must have read and understood the operating manual, particularly the present chapter 'General safety instructions'. The user is recommended to have this confirmed in each case by written evidence.
2. The machine may be operated by trained and authorized insured only. Competences for works related to and with the machine must be clearly fixed and kept so that no unclear competences occur with regard to safety.
3. In case of inappropriate use or use not complying with the application of the machine, or operation by unskilled personnel, the following dangers impend:
   - Danger to life and limb of the insured
   - Danger for the machine and other property assets of the user
   - as well as negative effects on the function and operational characteristics of the machine

   As a consequence of inappropriate use there may occur faults in functioning or the original quality of the machine may be reduced.
4. Arbitrary convertment and modifications at the machine - especially at its safety equipment - by the user, by the insured or by third parties are prohibited.
5. The user must issue a written operating and working instruction. For operation of the machine within the EC, this has to be done in the native language of the insured. Extracts from this operating manual can be taken for formulation.

6. When purchasing lubricants, the corresponding safety data sheets have to be requested from the lubricant manufacturer.

   These safety data sheets contain the complete information about handling, use and waste disposal of the lubricants.

4.2.2.2 Special safety instructions for the insured

1. Prior to repair or maintenance works in the production cells, switch off all drives and controls.
2. Prior to works at the machine, switch off the main switch and secure it against unauthorized switch-on!
3. The insured also must take care that only authorized persons work at the machine.
4. Any method of working which impairs the safety at the machine must be omitted, particularly the safe functioning of components of the
   - Mechanics
   - Hydraulics / Pneumatics
   - Electrics
5. The insured must inform the user immediately of changes at the machine which impair safety.
6. Never dismount or disable safety equipment.

   If safety devices are disabled while the machine is in a production cycle, the insured or third person is no longer sufficiently protected against operation dangers. The insured or third person is threatened by severe, in the extreme case lethal, risk of injury.
7. Prior to dismounting safety equipment for repair or maintenance works the machine must be switched off. The safety equipment must be remounted immediately after completion of the repair or maintenance works.
8. Works at the electric unit must only be executed by skilled personnel as a matter of principle. For all works at the electric unit observe the national safety regulations!
9. If hydraulic medium escapes under pressure there is risk of injury.
10. For operation of machines equipped with HFC hydraulic units (hydraulic oil) there is risk of fire breaking out if there are flames close to the machine.

11. Prior to works at hydraulic and pneumatic components (especially cylinders, pressure accumulators) it has to be ensured that those are no longer under pressure. Components under pressure must be switched pressureless.

4.2.2.3 Special safety instructions for the user

1. Condition for running the installation in automatic mode is an installed, closed, and controlled safety equipment, also around individual machines and equipments of this production unit, if necessary. The user must make sure that no person stays within this perimeter guarding during production.
2. The user must run the machine only in faultless condition.
3. If a complete screening of the machine with regard to the safety regulations is not part of the delivery of Messrs. Reis, the user must ensure that the working range of the machine is screened by appropriate measures. Doing so, the safety regulations in the user's country must be observed.
4. As far as required, the user must oblige the insured to wear protecting equipment.
5. The user must guarantee cleanness and clearness of the workshop place in the machine area by means of corresponding instructions and checks.

5 PREREQUISITES FOR OPERATION OF THE ROBOT INSTALLATION

5.1 OPERATING PERSONNEL (LEVEL 1)

Instruction by trained programming or service personnel of the operator or by personnel of REIS ROBOTICS.

5.2 SETTERS AND PROGRAMMERS (AS OF LEVEL 2)

see Chapter. 3, Qualification of the personnel