4. 

   The movement mode is programmed.

8.2.2 Storage of position

In order to enter a position, the TCP is moved to the desired position with one of the operating modes in the menu 'COORD'.

The position is entered with the following program steps:

1. Move TCP to the desired position.
2. 

3. 

   The position is taken over into the program as normal position in Frame 0.

8.3 CONTROL OF THE PERIPHERAL EQUIPMENT

The peripheral equipment and the robot control communicate with each other via digital signals.

User inputs provide the control with information about the peripheral conditions (e. g. finish message of a processing machine, rotary table in correct position, clamping device closed, deposit free etc.).

User outputs give information to the peripheral equipment and execute commutations (e. g. signal to a processing machine that the robot is moving into the operating range of the machine, switching on or off a conveyor, switching on a spindle, open/close gripper, feed out pallet etc.).

Also direct voltages coming from peripheral units can be interrogated in the user program.

8.3.1 Switching of digital outputs

Digital outputs are switched on and off by setting (level 1) or resetting (level 0) a bit. The corresponding CAN node switches the output corresponding to the programmed bit.

Programming is made with the command WRITE_BIT (write bit) from the command group LOG.

8.3.1.1 Switch on output

Example: Set output 0.1 (e.g. in order to start a conveyor belt)

1. F1

   Display:

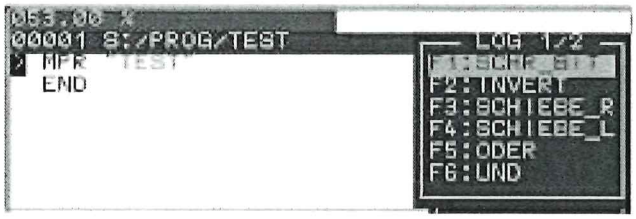

Fig. 8-1: Selection menu command group LOG

2. F1 "WRITE_BIT"

   Selection menu appears.

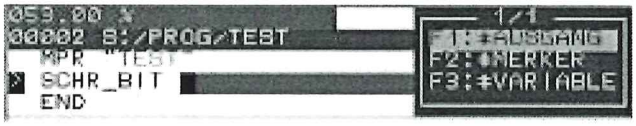

Fig. 8-2: Selection menu WRITE_BIT

3. F1 "#OUTPUT"

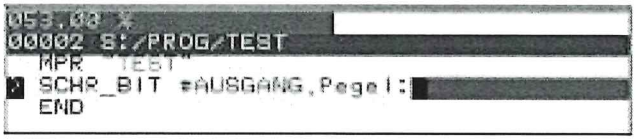

Fig. 8-3: Display after selection of the command #OUTPUT

4. ↑ / ↓

5. Enter

6. ← / →

7. Enter

8. ↑ / ↓

9. Enter

   Subsequently the command is contained in the program as follows:

WRITE_BIT #OUTPUT, level: 1, Byte: 0, Bit: 1

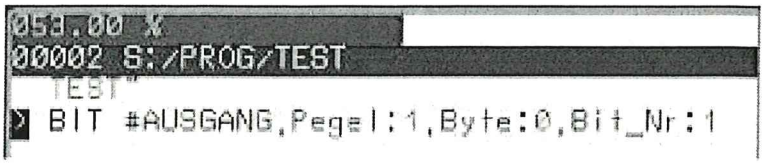

Fig. 8-4: Display of the command line

8.3.1.2 Switch off output

As example, the a. m. belt shall be stopped. For programming proceed as above, only a 0 has to be entered for the level.

1. 

   LOG menu appears.

2.  "WRITE_BIT"

   Selection menu appears.

3.  "#OUTPUT"

4. 

5. 

6. 

7. 

8. 

9. 

   Subsequently the command is contained in the program as follows:

   WRITE_BIT #OUTPUT, level: 0, Byte: 0, Bit: 6

8.3.2 Inquiry of digital input signals

The input signals are treated in the same manner like the output signals. Bits are set or reset via CAN-bus according to the node number. If 24 Volt are applied on a connection on the hardware side, the corresponding bit will be set, if 0 Volt is applied, it will be reset.

Different reactions to input signals are possible. In the program sequence, a signal may be waited for, or a conditional program branch may be executed depending on an input signal.

8.3.2.1 Waiting for input signal

The example program will stop at this command until 24 Volt are applied to input 0.5. Then program treatment will be continued with the next step. The parameter 'Max_Zeit' is indicated to be 0.0 seconds in this case, which means waiting without time limitation. Designation of the label is arbitrary, because the program will always continue with the next step.

If another value is programmed in the parameter 'Max_Zeit', for instance:

WAIT_BIT #INPUT, level: 1, Byte: 0, Bit_Nr: 5, Max_Zeit: 10.0, Label: "ABC"

the program will also stop and wait for the signal. If the signal is applied within the indicated time (in the example 10 seconds), processing will be continued with the next step. If the programmed time is exceeded without a signal being applied, the program will branch to the label indicated in the last parameter (in the example 'ABC').

Before a part can be extracted from the processing machine, the control waits until the signal 'processing finished' is applied. According to circuit diagram this signal is applied to input 0.5.

1. 

   CONTR menu appears.

2.  "WAIT_BIT"

   Selection menu appears.

3.  "#INPUT"
4. Level: <1>
5. Byte: <0>
6. Bit: <5>
7. Max_Zeit <0.0>

   a. 

   b. 

c. 

8. Label: <X>

Subsequently the command is contained in the program as follows:

WAIT_BIT INPUT, level: 1, Byte: 0, Bit_Nr: 5, Max_Zeit: 0.0, Label: X

8.3.2.2 Input signal as branch condition

Program branches can be programmed which will only be executed if level 1 or level 0 is applied to an input.

This branch is realized with the command TEST_BIT. Conditions for the branch are as follows:

#=0: the branch will be executed if 0 Volt is applied to the input.

#=1: the branch will be executed if 24 Volt is applied to the input.

If the branch condition is not fulfilled, processing of the program will be continued with the next step.

Example: Programming with a branch condition.

The subprogram CLEANING will be executed if 24 Volt are not applied to input 0.6. If 24 V are applied, the subprogram call will be skipped.

1.  'Contr'

   CONTR menu appears.

2. 

"TEST_BIT"

   Selection menu appears.

3. 

"#INPUT"

4. 

Branch condition: "#=1"

5. Byte: <0>

6. 

7. Bit: <6>

8. 

9. Label: <CDE>

10. 

11. 

12. 

"CALL"

13. Name <CLEANING>

14. Label: <CDE>

Subsequently the commands are contained in the program as follows:

TEST_BIT #INPUT, #=1, Byte: 0, Bit_No: 6, Label: 'CDE'

CALL Name: 'CLEANING'

LABEL 'CDE'

8.3.3 Control of analog outputs

Peripheral units are controlled by means of a variable direct voltage via analog outputs, e. g. speed of a machine, weld parameters etc.

In the command group PERI the output of a direct voltage to an analog output can be programmed with the command ANA_OUTP. After selection of the command first the voltage has to be indicated in Volt (-10 V to + 10 V), then the number of the analog output to which the voltage shall be applied.

The voltage can be entered with the numeral keys or taken from a real constant or real variable. In this case the name of the constant or variable has to be indicated as first parameter.

1. 

'Peri'

PERI menu appears.

2. 

"ANA_OUTP"

3. Enter nominal voltage in Volt or name of constant or variable.

4. 

5. Channel: <number of analog output>

6. Enter

8.3.4 Inquiry of analog inputs

The analog voltage applied to an analog input can be filed in a real variable for further treatment.

The command ANA_INP is selected from the function group PERI. After selection, first of all the number of the analog input has to be indicated from which the analog voltage shall be taken over, then the name of the variable where the voltage value will be stored.

1. Peri 0 'Peri'

   PERI menu appears.

2. F2 "ANA_INP"
3. Channel: <number of the analog input>
4. Enter
5. Variable: <name of the destination variable>
6. Enter

Tab. 8-2: Example for a program with inquiry of analog inputs

Step	Commands	Inputs
S1	MPR	ANALOG_TEST
S2	LOC_VAR	RDRUCK
S...		
S14	POSITION	
S15	WRITE_BIT	#OUTPUT, 1, 0, 4
S16	LABEL	REPEAT
S17	ANA_INP	2,RDRUCK
S18	TEST	VARIABLE,RDRUCK,#<,5.0,REPEAT
S19	CALL	COAT
S...		
S39	END	

In step 16 a dosing system is switched on via output 0.4 which gradually builds up the required operating pressure for coating. The current pressure is signalized to analog input 2 via an analog signal.

The applied analog voltage is loaded into the variable RDRUCK in step 17 and compared with the minimum value 5.0 Volt in step 18.

The subprogram for coating will only be called if this minimum voltage is applied to analog input 2, i. e. if the minimum pressure is reached.

8.4 COMMANDS FOR PROGRAM CONTROL

8.4.1 Program branches

Conditional and unconditional (absolute) branches can be programmed within a program. For all branch commands a branch destination must be indicated from where program treatment shall be continued. It does not matter whether the branch shall be executed forward or backward. Branches from one program into another one are not possible.

8.4.2 Input of the branch destination

The command for the branch destination is called LABEL. It is selected from the function group CONTR and after input of a freely selectable name (e. g. LABEL_1) is taken over into the program with the 'Enter' key. Within one program, another name must be entered for each LABEL command.

Since branches from one program into another one are impossible, identical names may be used in different programs.

Input of the command sequence for a branch destination:

1.  'Contr'

   CONTR menu appears.

2.  'LABEL'
3. <name of branch destination>
4. 

8.4.3 Input of an absolute branch

For programming of an absolute (unconditional) branch the command BRANCH has to be selected and the name of the label (branch destination) has to be entered (e. g. LABEL_1). The indicated label must be contained in the same program as the branch command.

When this command is processed in automatic or test mode, program treatment will be continued at the branch label with the same name.

If no label with the same name exists in the program, an error message will be displayed.

Input of command sequence for an absolute branch:

1.  'Contr'

   CONTR menu appears.

2.  "BRANCH"
3. <name of branch destination>
4. 

8.4.4 Input of a conditional branch

Contrary to the absolute branches, with the command for a conditional branch decision is made whether the branch will be executed or whether processing of the program is continued with the next step. The condition may be the status of a single bit or the content of a byte or of a variable.

- ⇨  'Contr'

  CONTR menu appears.

- ⇨  "TEST_BIT"
- ⇨ select operand
- ⇨ select conditons of branch
- ⇨ insert number of byte or variable
- ⇨ 
- ⇨ insert number of bit
- ⇨ 
- ⇨ <name of branch destination>
- ⇨ 

8.4.5 Programming of waiting times

The waiting time is the delay time before the program sequence will be continued with the next command.

This time is programmed with the command WAIT from the command group CONTR. As parameter, the time for which the program shall stop has to be entered in seconds. The waiting time is effective in automatic mode and in all test operating modes and is activated with the following program steps:

1.  'Contr'

   CONTR menu appears.

2.  "WAIT"
3. Enter time in seconds.
4. 

8.5 PROGRAM CALLS

The following program types are available: Main program, subprogram, macro, PLC program.

8.5.1 main program (MPR)

The command PROGRAM in the command group PROG is available for changing from one main program into another main program. It effects a branch from one main program to step 1 of another main program. After selection of the command the name of the main program to be changed to has to be entered. If the program with the indicated name doesn't exist or isn't a main program, corresponding error messages will be given during sequence in automatic or test operation.

8.5.1.1 Change into a main program

1.  'Prog'

   PROG menu appears.

2.  "PROGRAM"
3. <name of main program>
4. 

8.5.2 subprogram (SPR)

After selection of the command CALL from the command group PROG the name of the subprogram you want to branch to has to be entered. In automatic or test operation a branch to step 1 of the indicated subprogram will be made during processing. This subprogram is processed. After the last step of the subprogram, the calling program will be returned to. Program treatment here is continued with the command following the subprogram call.

8.5.2.1 Call of a subprogram

1.  'Prog'

   PROG menu appears.

2.  "CALL"
3. <name of subprogram>
4. 

8.5.3 macro (MAC)

A macro must not contain a position!

In a macro it is possible to call further macros and subprograms (up to nesting depth 12!).

8.5.3.1 Call of a macro

➪ see separate documentation about RobAssist

9 USER-ORIENTED DOCUMENTATIONS

10 ERROR MESSAGES RSV

10.1 GENERAL SURVEY

10.1.1 Survey of system errors

Error number	Message	Cause	Remedy
S000	External program stop		
S10	Sytem error		
S21	Drives off	The command AXIS is activated with drives being switched off.	Use the command only with drives being switched on.
S27	Programmed limit switch	The axes indicated in the message were displaced up to the software limit switch.	Move away the axes into the opposite direction. If possible, select another axis position. Limit the way of displacement.
S29	Inadmissible movement range	The robot wants to approach a position which it cannot reach.	Change settings. Perhaps the robot must be freed in axis-specific manual movement.
S44	Sensor error		
S45	<S 45> Wrong station selection	The PLC marker bit for station monitoring is not set.	Examine the PLC program and set the corresponding marker bit in the markers 936 ... 939.
S46	Step not defined	Structure error in the user command. Either the AXIS command or a variable used in it is concerned.	Delete the defective step and program anew.
S54	No transformer axis	An axis was entered in the group table for which there exists no transformation matrix.	Execute correct calibration. Check machine data IAXES_DESCR and ITOOLAXES_DESCR!

Error number	Message	Cause	Remedy
S56	No valid station marker recognized	There is more than one PLC marker bit set for station monitoring.	Examine the PLC program and make sure that a maximum of one single station is monitored.
S58	Movement range exceeded	The axes indicated in the message were displaced too much. The admissible range from _RFMOT_LIM_P and _RFMOT_LIM_N was exceeded.	Check the admissible range in the system variables _RFMOT_LIM_P and RFMOT_LIM_N and adapt, if necessary. Limit the way of displacement.
S61	PLC error		
S67	SPLINE neighbor point after step xx in the program not found	In the SPLINE movement mode the previous and the following point must be available for the path interpolation. The following point cannot be determined definitely, because a branch command follows (e. g. TEST_...-command).	Remove branch command or select other movement mode.
S100	Operating error	10.1.2 S100 / operating error	
S104	The command AXIS is only allowed in INTERPOL #PTP!	Wrong INTERPOL is active, e. g. #LIN	Change program. Insert the command INTERPOL #PTP before the command AXIS.
S108	A TOOL change can only be executed in INTERPOL #PTP.	At the moment of the TOOL command the movement mode PTP is not active.	Insert PTP mode.
S111	Programming error	10.1.3 S111 / Programming errors	
S112	Wrong device or wrong path	Selection of a program which doesn't exist	Enter correct program name

Error number	Message	Cause	Remedy
S113	definition not found	The variable used in the mathematical operation is not defined	Define variable e.g. by using the VAR or the LOC_VAR command.
S114	variable not initialized	The source operand contains a not initialized variable definition which, of course, must not be read-in	Initialization of the variable in the robot program memory
S117	Content beyond range of values	The argument violates the range of validity, e. g. with the SQRT command or trigonometric functions	The argument in the SQRT command must not be negative. The argument in ARCSIN and ARCCOS is only defined in the range -1 to +1.
S118	The operand is no variable	The destination operand in the COPY command does not represent a definition of a variable, but e. g. a definition of a constant	Change the destination operand to a definition of a variable.
S119	Wrong operand types	The types of source and destination don't match, a conversion of type is impossible. This error occurs e. g. during copy actions between structural components of different element groups	Adapt source and destination operands accordingly
S120	Transformation error	The position could not be transformed forward/back.	Check RELATIVE offset. In case of offline settings check POSITION step and check machine data adjustments. Consultation with manufacturer.
S126	Trafo_6D error		

Error number	Message	Cause	Remedy
S129	Maximum number of pulses already active!	The control is already processing eight pulses and cannot start another pulse.	Change program structure.
S137	Program doesn't exist	Access to a program which doesn't exist	Read-in program
S138	Program name invalid	Faulty program name	Correction of name
S140	Program memory is full	No storage location for programs available	Delete all programs which are not needed any more
S143	Wrong program types	Access to programs with faulty type indication	Correction of program type
S144	Definition already exists	Multiple definitions	Check definitions
S145	Program exists already	Transfer of a program to the control which exists already	Delete the old program
S155	Step not defined	Structure error in the user command. Either the AXIS command or a variable used in it is concerned.	Delete the defective step and program anew.
S156	No access authorization	Program or variable in the program memory is protected	Check access authorization and change, if necessary
S163	Process controller error arc doesn't ignite!	The acknowledge message „Welding on" has not been given within the requested time	Check weld source Set correct input/output ports
S164	Process controller error arc doesn't extinguish!	The acknowledge message „Welding off" has not been given within the requested time	Check weld source, set correct input/output ports

Error number	Message	Cause	Remedy
S165	Process controller error arc has broken!	Arc extinguished during weld monitoring	Check weld source and workpiece, then start anew
S166	Process controller error weld wire is stuck!	Weld wire is still connected with the weld seam	Loosen wire
S167	Process controller error time error in sensor preliminary correction!	Sensor preliminary correction was not terminated within the timeout time	Switch on sensor in the program or Switch off preliminary correction (_RT_SEN_START=0)
S168	Process controller error Range of values in variable was exceeded!	Inadmissible input/output channel, marker or _IPC_SWITCH or _RPC_TIME [X] < 0	Enter valid values
S169	Process controller error! Flame extinguished	The heating or cutting flame extinguished	Check torch and workpiece, then start anew
S181	Variable reading not allowed	Variable is protected against reading	
S182	Variable writing not allowed	Variable is write protected	Due to the system there must not be made any write access to this system variable
S183	No DNC order free	In the DNC order list there is no more space for another order	Execute DNC reset
S184	Addressee: Incorrect name length	Incorrect name length in the macro command	Check macro command
S185	DNC transmission error	Faulty check sum during data transmission	Repetition of telegram, check of connection
S186	Drives not switched on		Switch on drives

Error number	Message	Cause	Remedy
S190	Program doesn't exist	Access to a program which doesn't exist	Read-in program, check path
S197	Index variable not found	The array index was programmed with an integer variable. This integer variable, however, is not defined.	Define integer variable
S198	Index variable not initialized	The array index variable is not correctly initialized.	Initialize array index variable
S199	Index too big or too small	The array index used in the COPY command has the value zero or exceeds the value indicated in the variable definition	Adapt array index to the definition
S200	Definition is no array	The variable name used in the COPY command contains an array indication. The variable definition, however, doesn't represent an array.	Adapt the variable access accordingly
S201	Definition is an array	The variable name used in the COPY command doesn't contain any array indication. The variable, however, is defined as an array	Change-over variable access to array
S202	No storage location available	Program memory is full	Delete all programs which are not needed any more
S211	Program not inserted	Error in the program code, program defective	Check program code, perhaps store anew

Error number	Message	Cause	Remedy
S234	Path switch error	Error related to the PATH_SWITCH command	See documentation of path switch function
S266	String length too big/small		Correct string length
S267	Fatal error module: xx line: xx	Internal error in the control	Notify manufacturer.
S268	Internal pointer error	Internal error in the control	Notify manufacturer.
S269	Inadmissible operating mode		Set operating mode correctly
S270	Abortion by the user		
S272	No AUTO operating mode		
S273	AUTO operating mode		
S281	Multi-layer welding: Name of root layer program incorrect or too long		Abridge name of the root layer program.
S282	Multi-layer welding: Number of top layer too high	Top layer numbers up to 999 are allowed.	Correct number of top layer in the TOPLAYER command.
S283	Multi-layer welding: Error X during processing of sample program		
S284	Multi-layer welding: Error during generation of top layer program		
S285	Multi-layer welding: Sample program wrong	The sample program doesn't exist.	Adapt program name or generate sample program.
S286	Multi-layer welding: Root layer program not found	The root layer program doesn't exist.	Adapt program name or generate root layer program.

Error number	Message	Cause	Remedy
S291	Sensor recording mode: File name in the system variable _SSENFILE wrong or too long	Entry in _SSENFILE faulty.	Adapt system variable _SSENFILE.
S292	Wrong sensor mode in the system variable _ISENSPEC.	The sensor operation was incorrectly initialized.	Use one of the values 0 (standard), 1 (recording mode) or 2 (playback mode) for the system variable
S326	Function not implemented	Inadmissible variable types were programmed in the source/destination variable. The control word contains a not defined transformation mode.	Only VECTOR and POSITION are allowed as source variable types. A system variable of POSITION type must be used as destination variable type. Set the value of the control variable to the correct transformation mode.
S349	Robot is asynchronous		Synchronize robot
S364	Wrong OCS fine mode	The system variable _IOSC_SUBMOD was incorrectly programmed.	Select one of the following values: - 0: binormal= neg. Z-axis of the tool frame) - 1: binormal= neg. X-axis of the tool frame) - 2: binormal= neg. Y-axis of the tool frame)

Error number	Message	Cause	Remedy
S365	Wrong OCS mode	The system variable _IOSC_MODE was incorrectly programmed.	Select one of the following values: - 0: Programmed OCS - 1: Auto-OCS with path-specific constant binormal. - 2: Auto-OCS with variable binor-mal. - 3: Auto-OCS with OCS completely from the tool coordinate system.
S366	Oscillation auxiliary point and start point are identical	The oscillation auxiliary point must be at least 5mm away from the osci-llation start point - this is the last po-sition programmed before the oscillation auxiliary point.	Increase distance of oscillation auxi-liary point.
S367	Oscillation auxiliary point and start point in different frames	The oscillation auxiliary point and the oscillation start point - this is the last position programmed before the oscillation auxiliary point - are pro-grammed in different coordinate sy-stems.	Select identical coordinate systems. Change oscillation auxiliary point or oscillation start point.
S368	No oscillation auxiliary point pro-grammed	„programmed OCS“ is requested with the system variable _IOSC_MODE, but no oscillation auxiliary point was programmed.	Program oscillation auxiliary point or adapt oscillation mode IOSC_MODE.
S388	DNC connection interrupted	Bad transmission quality	Check communication interface

Error number	Message	Cause	Remedy
S389	Control not ready for reception	Program memory processing is active if a program shall be read-in via DNC	Repeat program transmission
S412	Conveyor error: Jump-on/-off only allowed in movement mode PTP and LINEAR.	For conveyor jump-on the programming of movement mode CIRC or SPLINE is useless, because anyway an interpolation matched for the conveyor movement and based on the LINEAR move mode is executed.	Program INTERPOL #PTP or #LINEAR prior to conveyor jump-on or jump-off.
S413	Conveyor error: Counter of conveyor axis was not reset.	A jump-on shall be executed without the synchronization pulse being given once since the last control start.	Release synchronization pulse before executing a conveyor jump-on.
S427	Physical connection disturbed	Timeout during data communication due to lack of connection	Check hardware components (cables, converters, ...) and correct, if necessary
S437	Backup could not be established	Defective program memory	Storage of the individual programs on disk Program memory must be completely restaured
S438	There hasn't been established any backup yet	Access to R: Device before a bakkup was established for the first time	Establish backup via Menu (Funct)
S439	Not sufficient memory available to establish a backup.	A CPU60 with 4MB dynamic RAM was used	Backup is only possible with use of a CPU60 with 32 MB DRAM
S443	Marking not possible	Attempt to mark program start, program end, „.“ and/or „..“ steps	These steps must not be marked.

Error number	Message	Cause	Remedy
S448	Directory is not empty	Deletion of a directory program which is not empty	Delete the directories and programs under this directory
S450	Program is invalid	Attempted access to an invalid program	Remove program and read-in anew
S506	Calibration error		
S507	Syntax error in the calibration program XXX XXX= 500 XXX= 501 - 507	The following is missing in the calibration program: Tool step Position step (1 - 7)	Insert missing element
S508	Distance of tool flange between pos. X and pos. Y too small	Distance between: Pos. 1 and 2 Pos. 1 and 3 Pos. 1 and 4 Pos. 2 and 3 Pos. 2 and 4 Pos. 3 and 4 Pos. 5 and 6 Pos. 5 and 7	Re-teach the corresponding positions correctly.
S509	The orientations of pos. 5- 7 are not identical.	The orientation of pos. 6 or 7 was changed	Re-teach the corresponding positions correctly.

Error number	Message	Cause	Remedy
S510	Internal calculation error XXX XXX= 508 XXX= 518 XXX= 519	Central point of the sphere cannot be calculated Error in transformation	Error during programming of the calibration positions: one or several of the positions 1 - 4 was programmed too inexactly

10.1.2 S100 / operating error

Error number	Message	Cause	Remedy
S100,4016	Operating error	Step preselection to„Search"-step is not allowed.	Step preselection to a position preceding the corresponding step or to the next step. Step preselection is only finished if a position in the program was approached.
S100,4018	Operating error	In the operating modes AUTO, TEST2, TEST3, TEST4 a step preselection to an oscillation auxiliary point or into a CIRC bracket is not allowed.	Approach of the position with step preselection is only possible in TEST1.
S100,4019	Operating error	In TEST1 more than one step backward was moved while oscillation is active, or the oscillation auxiliary point is not defined.	Start with step preselection to the first position before the oscillation auxiliary point.

Error number	Message	Cause	Remedy
S100,4030	Operating error	As destination program the program was indicated in which the TRAFO_6D command was called.	Check parameters of TRAFO_6D; rename destination program
S100,4031	Operating error	Storage and 6D-shifting must not be active at the same time.	Terminate storage prior to program start
S100,4032	Operating error	A constant was indicated as control variable.	Change definition of the control variable
S100,4125	Operating error	Transmission error in the CAN-bus. (connection)	Check connection cables; reduce line failures as far as possible; use shielded transmission cable
S100,4126	Operating error	Transmission error in the CAN bus. (M-module)	Test M-module; (only trained personnel; perhaps consultation with Reis service or Reis development department)
S100,4127	Operating error	Access to system variable _CAM_TCP with laser camera being switched on	Switch off camera via the LS_SERVICE command before making read access to the system variable
S100,4128	Operating error	Operating errors in conjunction with a laser camera calibration (see separate documentation 'LS_CALIB')	
S100,4129	Operating error	Operating errors in conjunction with a laser camera calibration (see separate documentation 'LS_CALIB')	

Error number	Message	Cause	Remedy
S100,4129	Operating error	Operating errors in conjunction with a laser camera calibration (see separate documentation 'LS_CALIB')	
S100,4130	Operating error	Operating errors in conjunction with a laser camera calibration (see separate documentation 'LS_CALIB')	
S100,4131	Operating error	Operating errors in conjunction with a laser camera calibration (see separate documentation 'LS_CALIB')	
S100,4132	Operating error	Operating errors in conjunction with a laser camera calibration (see separate documentation 'LS_CALIB')	
S100,4133	Operating error	Operating errors in conjunction with a laser camera calibration (see separate documentation 'LS_CALIB')	
S100,4134	Operating error	The command LS_SERVICE 0,7 doesn't work correctly (see separate documentation 'LS_SERVICE')	Check whether the processing edge has been programmed correctly- Check that the processing edge is situated in the shooting field of the laser camera.

10.1.3 S111 / Programming errors

Error number	Message	Cause	Remedy
S111,1201	Programming error	The path acceleration value transferred from the CP_V to the PTP_V exceeds the representable number range.	Reduce path acceleration.
S111,1202	Programming error	The axis speed resulting from the path speed for one or several axes is bigger than the maximum value defined in the machine data.	Reduce path speed and/or reduce path to the additional axes or increase path of the path-controlled axes.
S111,1203	Programming error	The axis acceleration resulting from the path acceleration for one or several axes is bigger than the maximum value defined in the machine data.	Reduce path speed and/or reduce path to the additional axes or increase path of the path-controlled axes
S111,1204	Programming error	Approximation with path zero steps is active.	Smaller values must be chosen for path acceleration resp. path speed.
S111, 4001	Programming error	(Technology data) Subprogram not found	The subprogram indicated in the 'OSC_PATTERN_E' command for execution of the 'oscillation amplitude controlled parameter output' (PAGA) could not be found. Please check the indications and generate the desired subprogram, if necessary.

Error number	Message	Cause	Remedy
S111, 4002	Programming error	Double key word	The code words for the PAGA function indicated in the (technology data) subprogram occur several times, however, the use is only permitted once according to the operating manual.
S111, 4003	Programming error	Invalid code word	A code word for the PAGA function indicated in the (technology data) subprogram is not known here, only code words acc. to the operating manual are allowed.
S111, 4004	Programming error	Inadmissible AWP_step in the (technology data) subprogram	A user command programmed in the (technology data) subprogram for the PAGA-function must not be used here. Only the commands acc. to operating manual are allowed.
S111, 4005	Programming error	(Technology data) subprogram is no subprogram	The program indicated in the 'OSC_PATTERN_E' command for execution of the 'oscillation amplitude controlled parameter output' (PAGA) must be a subprogram.
S111, 4006	Programming error	Output number is no number found	In the output commands of the (technology data) subprogram all indications must be registered as number constants, variables are not allowed here.

Error number	Message	Cause	Remedy
S111, 4007	Programming error	Output value is no number found	In the output commands of the (technology data) subprogram all indications must be registered as number constants, variables are not allowed here.
S111, 4010	Programming error	The total of oscillation partial phases in the 'OSC_PATTERN_E' command must be 100(%).	Please verify the indications and rectify the indicated values of the oscillation phase time, if necessary.
S111, 5000	Programming error	Step is not defined, delete! A not defined control step was recognized during processing of the program.	The program belongs to another machine type or is faulty. Further processing of the program should be omitted. Read-in program anew or adjust.
S111, 5001	Programming error	The command READ_PROG#WAIT_NOT is active at the same time with READ_PROG#WAIT.	Change the program in such way that first all #WAIT_NOT activities will be finished before #WAIT comes.
S111, 5002	Programming error	The command READ_PROG#WAIT_NOT was called more than 20 times within a very short time and therefore could not be processed.	The program must be changed in such way that the commands READ_PROG#WAIT_NOT have sufficient time for processing.
S111, 5006	Programming error	Image processing is still active and cannot take over the new command.	Program waiting loop.
S111, 5007	Programming error	Branch destination not found	Program branch destination

Error number	Message	Cause	Remedy
S111, 5011	Programming error	Nesting depth 12 for subprograms is reached.	Change program structure in such way that the nesting depth doesn't exceed 12
S111, 5012	Programming error	'SEN'-step or 'PEN'-step recognized, the oscillation plane not being defined.	Program oscillation auxiliary point.
S111, 5013	Programming error	Additional axes were moved during CP operation.	Program movement steps anew without moving additional axes. In software versions >V0805 the error message can only be given if the machine data or the user program don't belong to the robot.
S111, 5014	Programming error	No oscillation pattern defined.	
S111, 5015	Programming error	Inadmissible control step between a position and the oscillation auxiliary point resp. oscillation parameter.	Find out the inadmissible control step by means of the operating manual and remove it.
S111, 5017	Programming error	Switch-over to PTP while the sensor is active.	Switch off sensor.
S111, 5018	Programming error	More than one sensor control step is programmed between two positions.	Remove one sensor control step.
S111, 5040	Programming error	The user command AXIS... is in a CIRC bracket.	Select control mode PTP or CP_LIN before the command AXIS...
S111, 5041	Programming error	Between the commands AXIS#PASSIVE and AXIS#ACITIVE there is a position step.	Delete position step.

Error number	Message	Cause	Remedy
S111, 5043	Programming error	One of the axes which had been freed reached the software limit switch during free movement.	Move the machine in manual operation into the admissible area; modify installation.
S111, 5045	Programming error	Step preselection to the command INDEX was made.	Make step preselection to the position before INDEX.
S111, 5046	Programming error	The axis to be freed doesn't exist.	
S111, 5048	Programming error	The axis to be activated was moved over the software limit switch after the INDEX command.	Move axis in HAND/A mode back into the allowed area.
S111, 5051	Programming error	Position and oscillation auxiliary point are not filed in the same coordinate system.	File oscillation auxiliary point in the same coordinate system as the preceding position step.
S111, 5052	Programming error	Position types of a path don't match. - Two ZPOS steps are programmed on a path, but the station numbers of the steps are different. - In a CIRC bracket auxiliary point and end point are of same position type or have different station numbers.	Teach positions anew.
S111,5053	Programming error	The command MOVE_AXES was recognized during movement mode CP.	Switch-over to movement mode PTP prior to the command MOVE_AXES.

Error number	Message	Cause	Remedy
S111,5075	Programming error	A path movement mode is still active when leaving the root subprogram. Only PTP must be active.	
S111,5078	Programming error	When leaving the root subprogram the sensor functino must not be in recording mode. Also after 'SENSOR OFF' the sensor may still be active if the sensor offset couldn't be established yet.	
S111,5081	Programming error	The output text of the INPUT resp. OUTPUT field doesn't fit into the window.	
S111,5082	Programming error	Wrong format designator indicated for the INPUT or OUTPUT command!	
S111,5083	Programming error	Wrong format parameter indicated for the INPUT or OUTPUT command!	
S111,5101	Programming error	Tool change step is not allowed while dynamic corrections are active.	Switch off sensor, oscillation prior to tool change step.
S111,5103	Programming error	Search function is not allowed while dynamic corrections are active.	Prior to 'SEARCH' step sensor oscillation and conveyor.
S111,5106	Programming error	Tool change step is not allowed during control mode CP.	Remove tool change step or switchover to control mode PTP.
S111,5120	Programming error	The sample program was not found.	

Error number	Message	Cause	Remedy
S111,5121	Programming error		The sample program must be a main program.
S111,5122	Programming error	Wrong step sequence in the sample program during definition of OCS or invalidated step.	
S111,5123	Programming error	Wrong step sequence in the sample program during definition of top layer positions or invalidated step.	
S111,5124	Programming error	Distance between root and top layer too small.	The distance between root and top layer must be more than 0.1 mm.
S111,5125	Programming error	The name of the root layer program is too long.	Only 8 characters are allowed!
S111,5126	Programming error	The root layer program was not found.	
S111,5127	Programming error	Not enough free user program memory available.	Delete programs which are not needed any longer.
S111,5128	Programming error	An error occurred when opening the program.	
S111,5129	Programming error	The OCS data file was not found or it doesn't have the correct content. Has perhaps the root program been subsequently changed?	
S111,5130	Programming error	The data file is empty.	
S111,5131	Programming error	Error in step incrementation or the data in the OCS data file are not available in ascending order.	

Error number	Message	Cause	Remedy
S111,5132	Programming error	The recorded data are not suitable for the root layer program. Modifications were made in the root layer program after recording of data.	The root must be moved along anew.
S111,5133	Programming error	The root layer program contains position variables (command VAR_POS). Transformation is impossible.	Replace position variables by POSITION steps.
S111,5134	Programming error	The transformations TDW or TKR were terminated with an error.	
S111,5135	Programming error	When reaching the END command in the root layer, path or circular movement was active. .	Only the PTP movement mode must be active when leaving the root
S111,5136	Programming error	The positions in the sample program must all be of the same type.	
S111,5137	Programming error	The positions in the root layer program must be of the same type as those of the sample program.	
S111,5138	Programming error	When reaching the END command in the root layer subprogram, the ROOTLAYER command recognized that the sensor function is in recording mode.	Only either an active sensor or a playback sensor may be selected.
S111,5139	Programming error	The TOPLAYER command recognized that the sensor function is in recording mode.	Only either an active sensor or a playback sensor may be activated.

Error number	Message	Cause	Remedy
S111,5140	Programming error	Parallel operation storage / top layer generation is inadmissible.	
S111,5141	Programming error	In the sample programs, for the command OSC_ANGLE there must not be indicated any variables, but only numerical values as parameters.	
S111,5150	Programming error	The first position variable was not found.	
S111,5151	Programming error	The second position variable was not found.	
S111,5152	Programming error	The first position variable is not valid.	
S111,5153	Programming error	The second position variable is not valid.	
S111,5154	Programming error	The two position variables contain coordinates which are defined in different coordinate systems.	
S111,5155	Programming error	The selected operating mode and the coordinate systems of the position variable are incompatible.	If #WORLD was selected, the coordinates must not be registered in the table coordinate system.
S111,5156	Programming error	Transformation error in the not displaced position (working range exceeded)	

Error number	Message	Cause	Remedy
S111,5157	Programming error	Transformation error in the displaced position (working range exceeded)	
S111,5158	Programming error	One of the selected programs contains a tool change command the variable of which was not found.	
S111,5159	Programming error	One of the selected programs contains a tool change command the variable of which is invalid.	
S111,5200	Programming error	A PLC command was inserted in a robot program.	PLC commands must only be used in PLC programs.
S111,5300	Programming error	Division by 0 in operation 'DIV'	
S111,5308	Programming error	The program change from a subprogram into another program is not allowed.	

10.1.4 S597 / Storage errors

S597,1	Storage error File wasn't stored Error: 1	Reading from disk not possible	Insert disk, read-in directory anew
S597,2	Storage error File wasn't stored Error: 2	Writing on disk not possible	Remove write protection, insert disk

S597,3	Storage error File wasn't stored Error: 3	Disk defective	Use new disk
S597,4	Storage error File wasn't stored Error: 4	Formatting error	Format disk (only possible on separate PC)
S597,5	Storage error File wasn't stored Error: 5	Disk access error (volume already mounted)	Start new access, if necessary reset disk driver software via <Order><reset>
S597,6	Storage error File wasn't stored Error: 6	Disk access error (cannot unmount volume)	Reset disk driver via <Order><reset>
S597,7	Storage error File wasn't stored Error: 7	Disk access error (volume not mounted)	Reset disk driver software via <Order><reset>
S597,8	Storage error File wasn't stored Error: 8	Error in the file name	Read-in directory of the disk anew, repeat reading process
S597,9	Storage error File wasn't stored Error: 9	File name exists already	e.g. during storage of directories, change of directory name

S597,10	Storage error File wasn't stored Error: 10	Disk is full	Use new disk or delete files on the disk which are no longer needed
S597,11	Storage error File wasn't stored Error: 11	Disk access error (semaphore error)	Reset disk driver software via <Or-der><reset>
S597,12	Storage error File wasn't stored Error: 12	Disk access error (read error on disk)	Reset disk driver software via <Or-der><reset>
S597,13	Storage error File wasn't stored Error: 13	Disk access error (write error on disk)	Reset disk driver software via <Or-der><reset>

11 APPENDIX

11.1 SYNOPTICAL TABLES OF THE OPERATING MODES

Tab. 11-1:EDIT–mode– menu 1/3

	Step edit	Step mark	Step del	Step v/i	Prog open	Pos edit	
							

Tab. 11-2:EDIT–mode– menu 2/3

	cut	copy	paste	Blck valid	Blck inval	Drive	
							

Tab. 11-3:EDIT–mode– menu 3/3

	Find repl	Code word			Edit mem		
							

Tab. 11-4:DIR–mode– menu 1/3

	Prog new	Prog mark	Prog del	Prog copy	Prog open	Drive	
							

Tab. 11-5:DIR–mode– menu 2/3

	Find repl	Code word	Disk open	Disk Eras	Edit mem	Prog ren	
							

Tab. 11-6:DIR–mode– menu 3/3

	Upd init	Upd					

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)

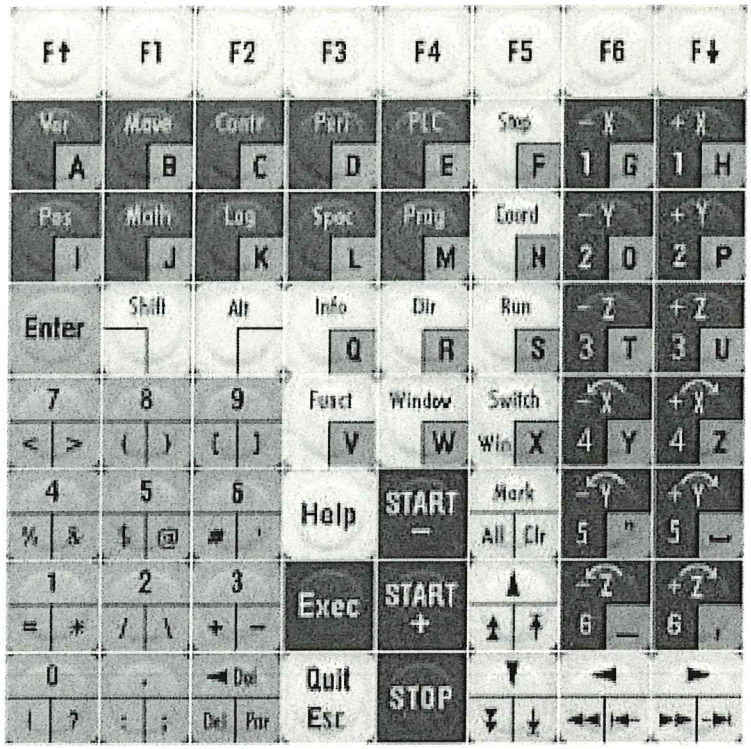

Fig. 7-1: Keyboard of the portable teach pendant

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

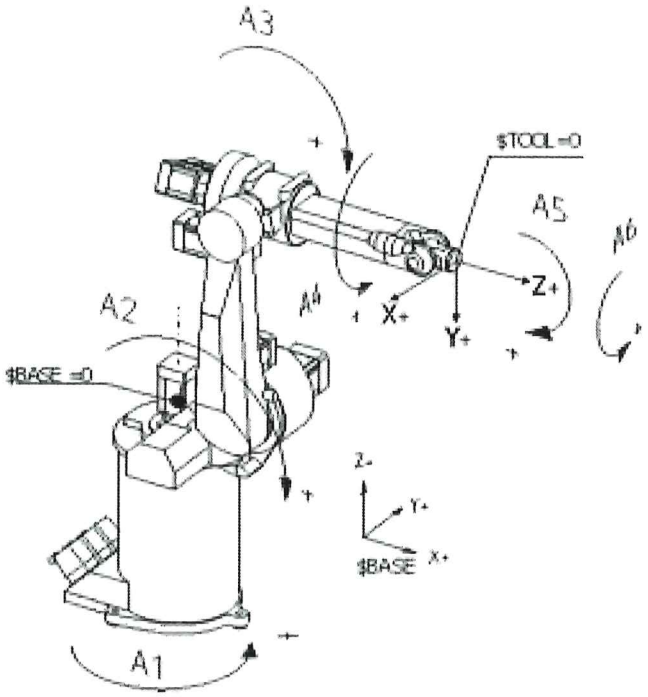

Fig. 7-2: RV series

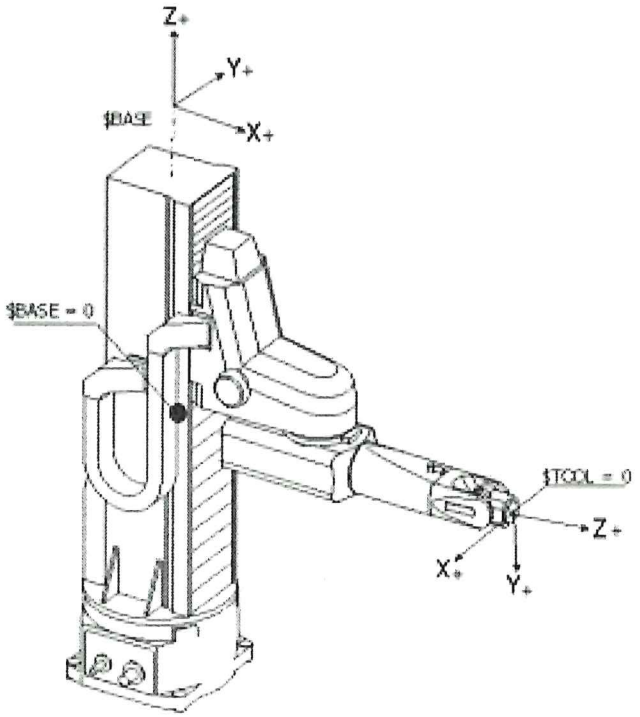

Fig. 7-3: RH series

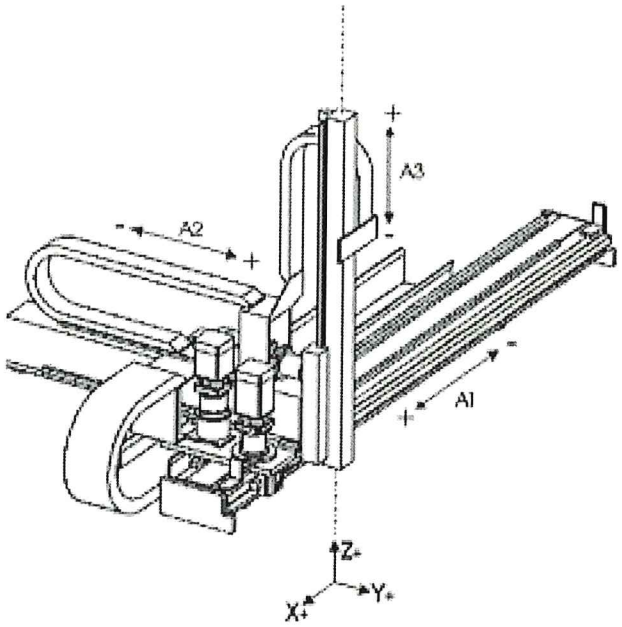

Fig. 7-4: RL series

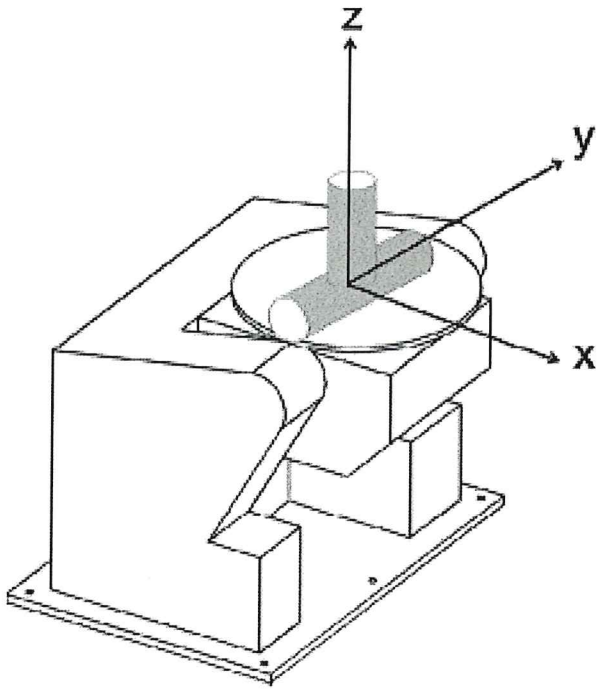

Fig. 7-5: table coordinate system

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:.

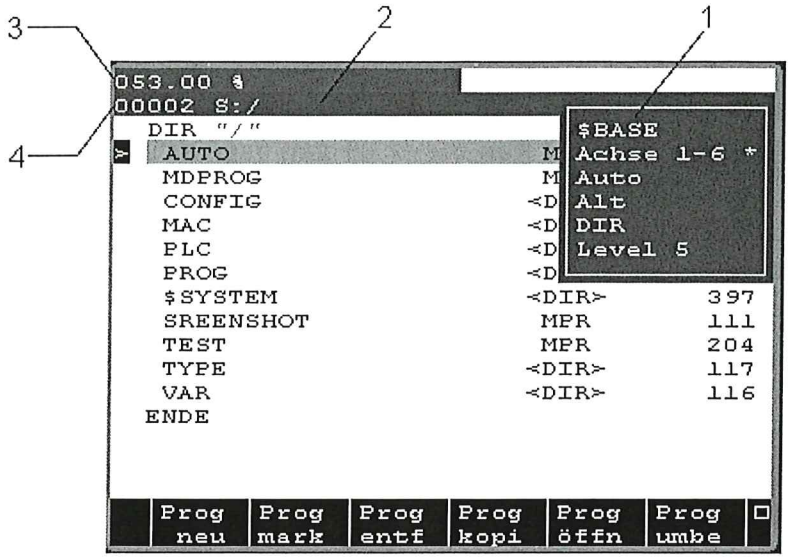

Fig. 7-6: Display in DIR mode

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.

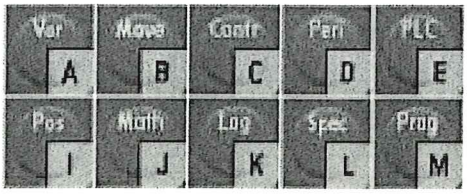

Fig. 7-7: Movement keys

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. Enter

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.

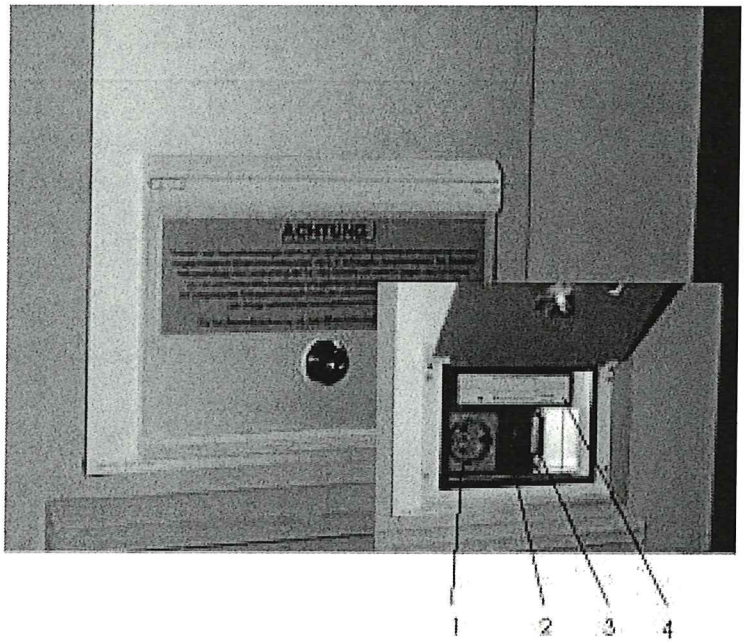

Fig. 6-1: Plug connections control cabinet - front side

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

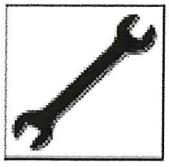

Fig. 4-1: Symbol for skilled personnel

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