

COSIROP 2.0

Programming Software for Mitsubishi Industrial Robots

First Steps

The screenshot displays the COSIROP 2.0 software interface. The main window is divided into several panes:

- 3D Viewport:** Shows a 3D model of a Mitsubishi industrial robot arm on a green grid floor, with red wireframe bounding boxes around it.
- Code Editor:** Contains the following program code:

```
10 ' My first robot
20 ' Author: Dipl.-
30 ' Date: 07.04.200
40 '
50 GETM 1
60 OVRD 10
70 FOR MCOUNT = 1 TO
80 MOV P1
90 HOPEN 1
100 MVS P2
110 HCLOSE 1
120 MOV P1
130 NEXT MCOUNT
140 RELM
150 END
```
- Debugger:** Shows the current program name '3', line number '50', and a 'Refresh [ms]' value of '100'. The program text is displayed with execution status indicators (green arrow for active, red stop for error).
- RCI Explorer:** A tree view on the left showing the project structure: Connection, Robot Type, Programs, Slots, System Variables, Monitors, Parameter, Error List, Workplace, Programs, and Tools.
- Error List:** A table listing errors with columns for Date, Time, Error No., and Message.

Date	Time	Error No.	Message
03-05-08	19:27:38	6080	Com msg is too long
03-05-08	17:33:10	6080	Com msg is too long
03-05-08	17:30:04	2000	The servo is OFF
03-05-08	00:38:18	6080	Com msg is too long
03-05-07	22:28:04	2000	The servo is OFF
03-05-07	22:20:56	6080	Com msg is too long
03-05-07	18:09:36	6080	Com msg is too long
03-05-07	17:27:22	4910	Robot Language is misr
03-05-07	17:26:16	4120	Too long program name
03-05-07	17:25:34	4120	Too long program name
03-05-06	23:04:50	4120	Too long program name
03-05-06	19:03:42	2602	Position data exceeds l
03-05-06	18:01:50	4220	Syntax error
03-05-05	18:55:44	6080	Com msg is too long
03-05-05	18:39:50	6080	Com msg is too long
03-05-02	20:41:22	2602	Position data exceeds l
- Messages:** A log of system messages, including:

```
QoK03-04-03;19:29:36;3282;Can't RUN(not select, attribute);2:
QoKThe program is not selected or the attribute is illegal;Se
QoK
QoK6080;3
QoK03-05-08;22:37:00;6080;Com msg is too long;3;;0;608000000
QoKCom msg is too long;Check the various settings(ex. Paramet
QoKCom msg is too long;Check the various settings(ex. Paramet
QoK
```
- Table:** A table with columns 'No', 'Position', 'Orientation', and 'Comment'.

No	Position	Orientation	Comment
P1	420.0,-260.0, 180.0	0, 0, 60,R	Position 1
P2	420.0,-260.0, 170.0	0, 0, 60,R	Position 2
- Status Bar:** Shows 'Stopped', '0.00 s', '15:31:57', and 'Copyright (C) 1992-2003 - EFR - IRF - GERMANY'.

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Welcome

Thank you for choosing the new COSIROP 2.0 programming software!

COSIROP 2.0 makes your programming life a lot easier. **COSIROP 2.0** is the tool for programming, online control, parameterization, and diagnosis of Mitsubishi MELFA Robots. Use COSIROP 2.0 to develop robot programs in MELFA BASIC or Movemaster Command. For each command you can get a detailed online help simply by pressing the F1 help key. Use **COSIROP's** jog operation tool to teach the robot and to insert positions directly into a position list. Exchange your programs between the PC and the robot controller via a serial interface or via an Ethernet connection.

The **RCI Explorer** (Robot Controller Interface) is the new information-processing center of **COSIROP 2.0**. With the RCI Explorer you can up- and download programs, simply by drag-and-drop. Start programs in any slot you want and keep track of the actual state of your robot parameters, error messages, system variables, etc.

It has never been so easy to test your programs in deep. The new **Debugger** supports a breakpoint-oriented online debugging of your robot programs. Set breakpoints wherever you want. Start your program in any line; use single stepping forward and backward. The online debugger is the ultimate test tool for detailed online testing of your programs.

COSIROP 2.0 offers a wide range of **Monitors** for basically every type of robot data available. Monitor the speed of single joints or the electrical current in each of the servomotors of your robot. Monitor and change the values of inputs and outputs, configure a CC-Link connection using the monitors for the input and output registers. It is possible to monitor variables in different slots with just one monitor. If the variable can be set, change its value, as you like.

The new features fully support the MITSUBISHI RV-A, RH-AH, and RP-AH robots. And still, you can use COSIROP 2.0 for your old RV-EN and RV-E robots.

The following chapters give a brief introduction of how to work with COSIROP 2.0. To get you started, it is best, to work through the following chapters with COSIROP 2.0 and your Mitsubishi robot. Afterwards, use your acquired knowledge to make your own robot projects.

We wish you a lot of fun with your first robot project with COSIROP 2.0 and good luck for your future robot projects.

How to Install COSIROP

- What kind of hardware is required?
- How to actually install COSIROP?
- Why do I need a dongle?
- How can I uninstall COSIROP?

Hardware Requirements

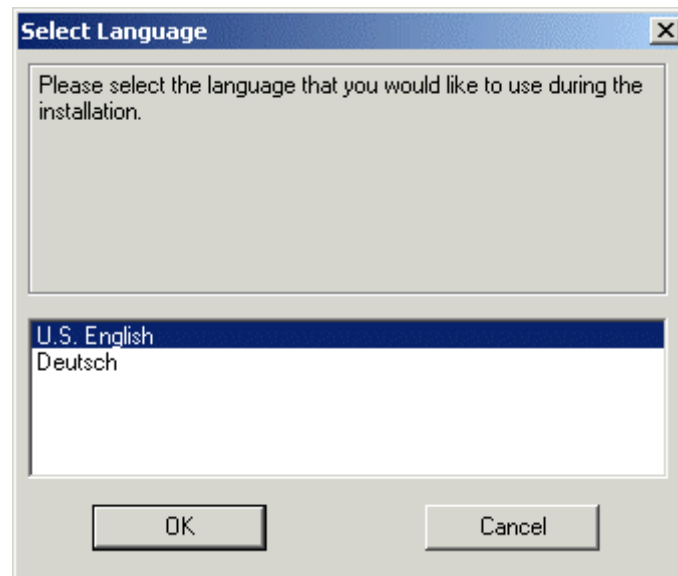
You should have at least the following hardware/software equipment for operating COSIROP:

- A PC with a Pentium II processor with 133 MHz
- 32 MBytes of working memory (RAM)
- 150 MBytes of free hard disk space
- CD ROM
- Mouse
- Windows 95 with Internet Explorer 4.0 or higher, Windows98/ME, Windows NT 4.0 with Internet Explorer 4.0 or higher, Windows 2000, or Windows XP
- One free serial interface (COM1 ... COM19) for connection to the robot controller (drive unit) or a network interface for the TCP/IP connection
- One parallel port or a USB port for the parallel or USB dongle

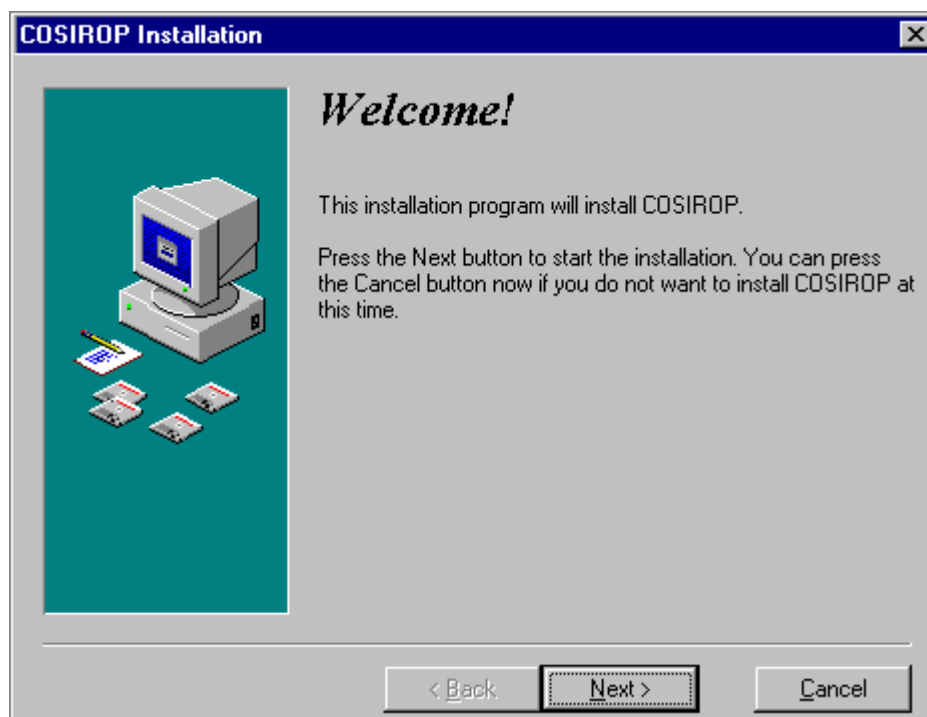
Installation

The setup program will create all necessary directories and copy all necessary files. To install COSIROP start "SETUP.EXE" from the root directory of the CD-ROM. Follow the instructions appearing on the screen.

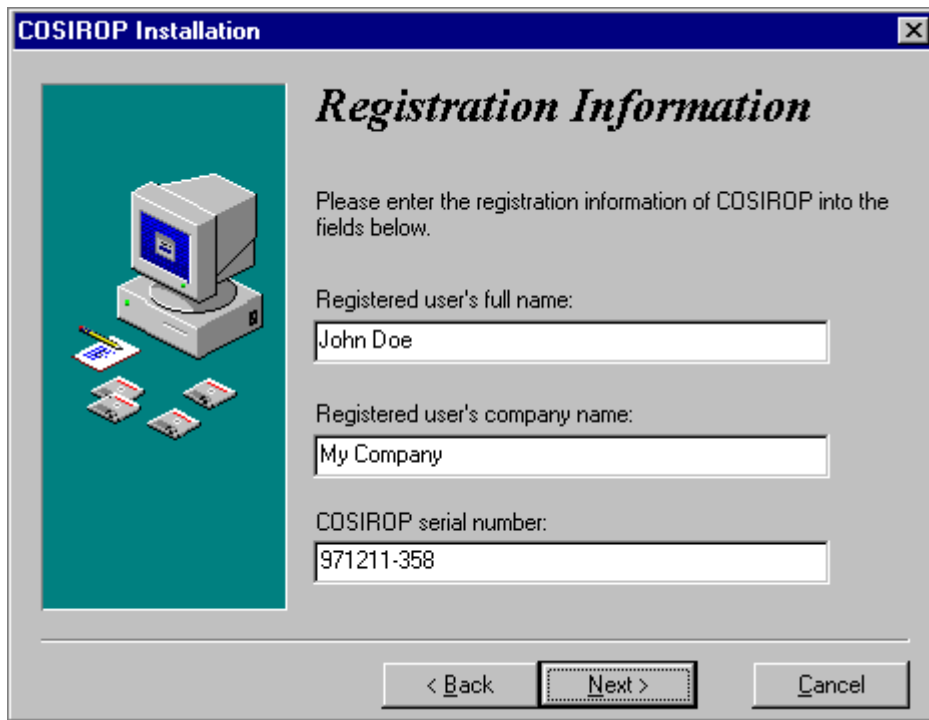
After the start of "SETUP.EXE" the following dialog will be displayed:



Select the COSIROP installation language. Select "U.S. English". The following dialog will appear:

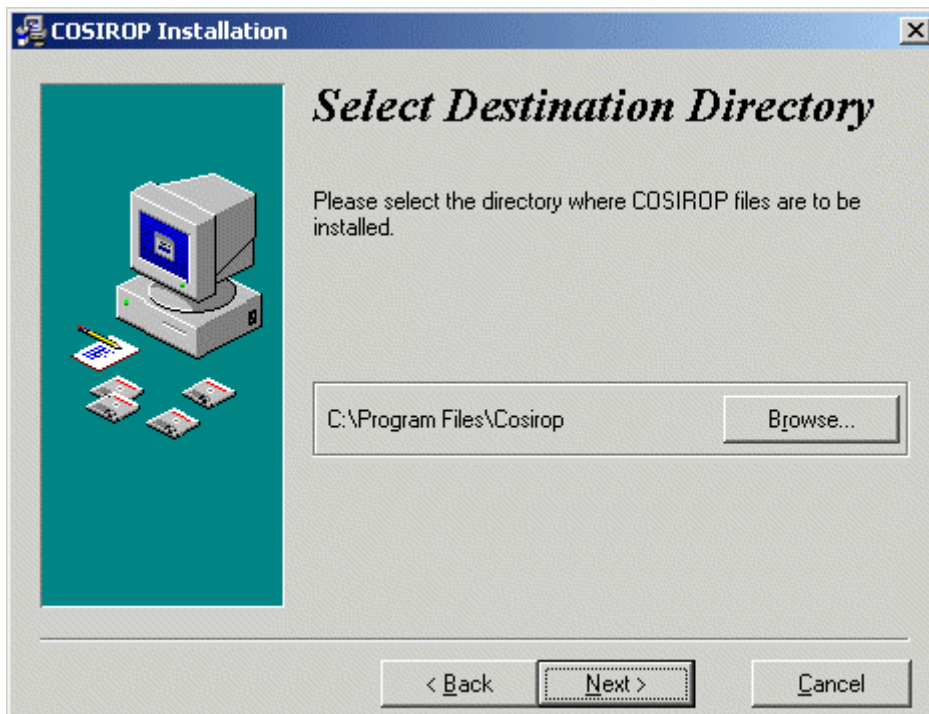


You can abort the installation by clicking "Cancel". To proceed, click "Next >", which will display the following screen:



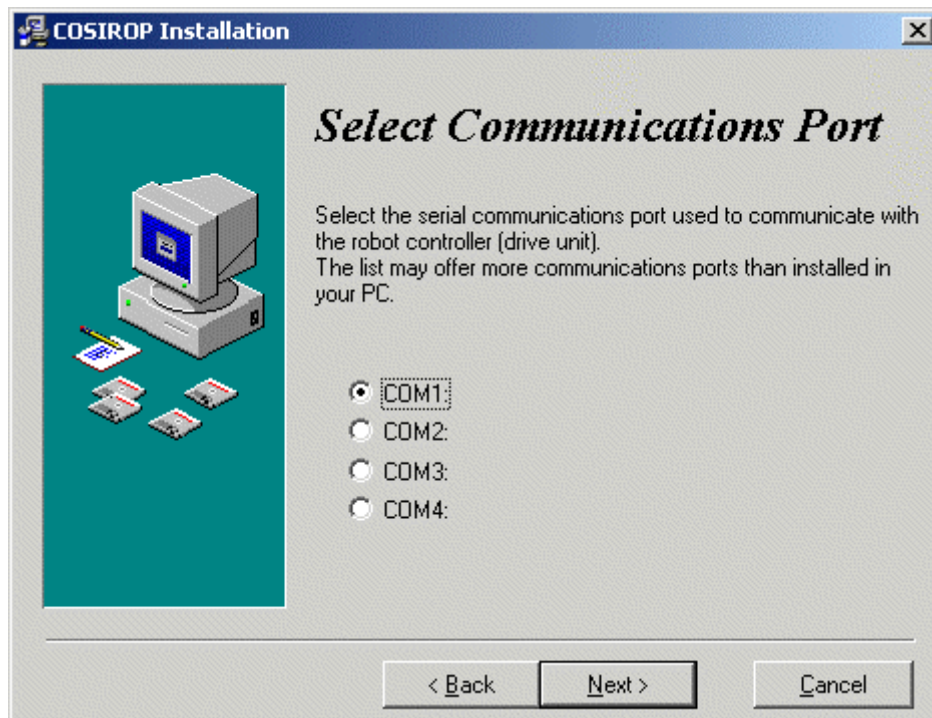
The screenshot shows a window titled "COSIROP Installation" with a close button in the top right corner. On the left side, there is a teal background with an illustration of a computer monitor on a base, a keyboard, and several floppy disks. The main title is "Registration Information". Below the title, the text reads: "Please enter the registration information of COSIROP into the fields below." There are three text input fields: "Registered user's full name:" containing "John Doe", "Registered user's company name:" containing "My Company", and "COSIROP serial number:" containing "971211-358". At the bottom, there are three buttons: "< Back", "Next >", and "Cancel".

Enter your name, the name of your company and press "**Next >**". If you have installed COSIROP before the registration information will be displayed only. In the next step the installation directory can be chosen:

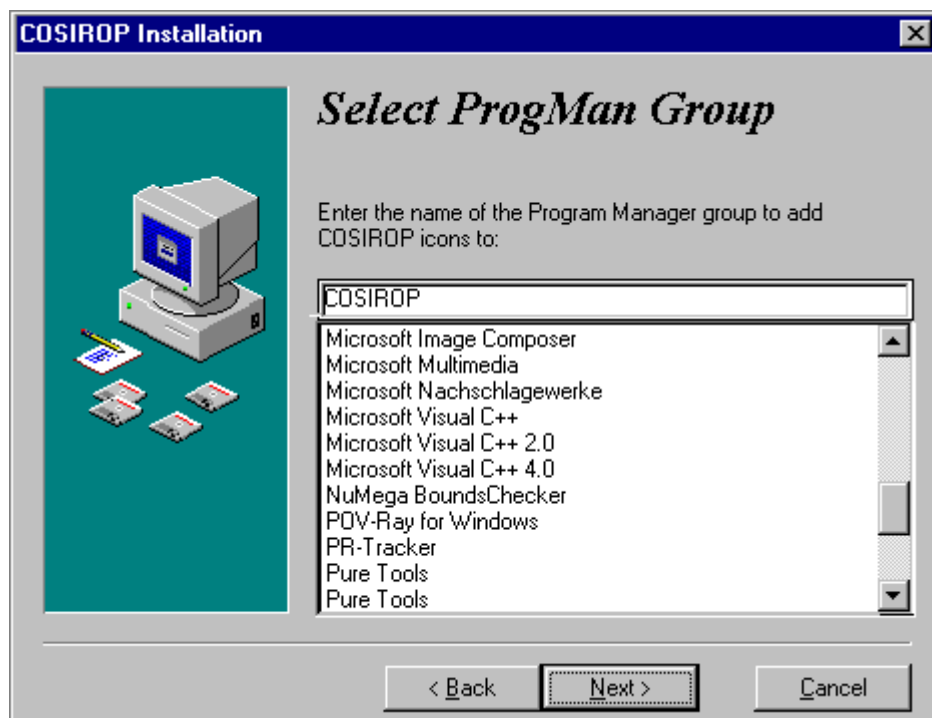


The screenshot shows a window titled "COSIROP Installation" with a close button in the top right corner. On the left side, there is a teal background with an illustration of a computer monitor on a base, a keyboard, and several floppy disks. The main title is "Select Destination Directory". Below the title, the text reads: "Please select the directory where COSIROP files are to be installed." There is a text input field containing "C:\Program Files\Cosiro" and a "Browse..." button to its right. At the bottom, there are three buttons: "< Back", "Next >", and "Cancel".

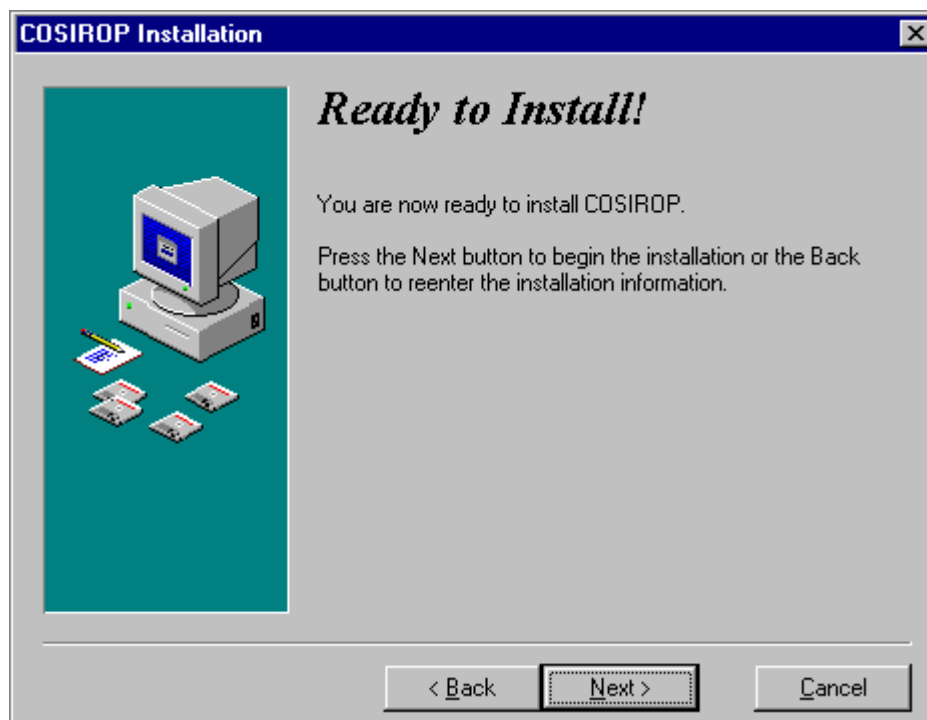
If you want to select a different directory press the "**Browse...**" button and select or enter the installation directory there. Proceed with "**Next >**" and specify the serial interface that you are going to use for robot communication.



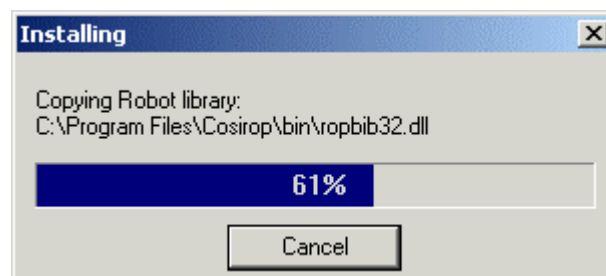
Proceed with "Next >" and select the program manager group respectively the entry in the "Start" menu:



Proceed with "Next >" again. Now, you are ready to install:



Up to this point no files have been copied to your hard disk and this is the last opportunity to cancel the installation by pressing "Cancel". To start the installation press "Next >". The installation will copy files to your hard disk and display a progress window:



After the installation you have to press "Finish" to terminate the setup program:



Now you are ready to start COSIROP for the first time. You can start COSIROP by selecting COSIROP in the Windows "Start" menu.

Dongle (Hardlock)

COSIROP requires a dongle(hardlock) for execution. Your software package contains either a dongle for the parallel port or for the USB port of your computer. Connect the dongle to the parallel port LPT1 resp. one of the USB ports of your PC.

Uninstallation

To uninstall **COSIROP** start "Add/Remove Programs" in the "Control Panel", select "COSIROP" and press the button "Add/Remove".

How to Prepare Robot Programming with COSIROP

Read and observe the safety instructions of the SAFETY MANUAL carefully before operating or programming the robot with COSIROP!

Before you can write robot programs and position lists with COSIROP you have to define your robot type and configuration by **Creating a Project**.

Start COSIROP and select the command File/Project Wizard that will display the first step of the Project Wizard:

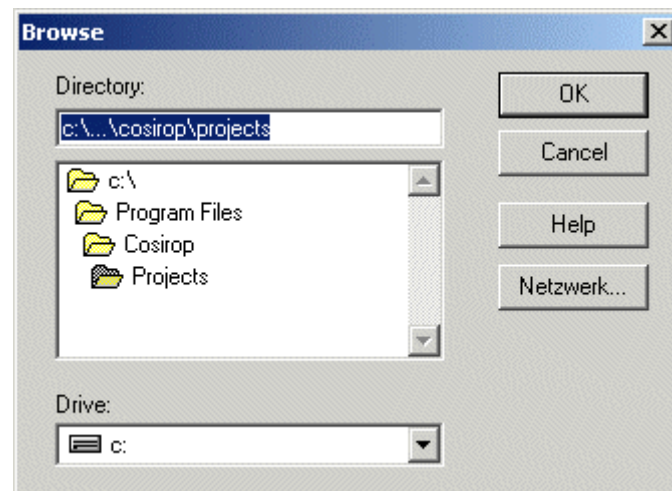
The screenshot shows a dialog box titled "Project Wizard - Step 1 of 3". It contains the following fields and controls:

- Project Name:** A text box containing "DEMO".
- Program Name:** A text box containing "3".
- Directory:** A text box containing "C:\Program Files\Cosiroop\Projects\DEMO" and a "Browse..." button.
- Created by:** A text box containing "Dipl.-Ing. F. Heinze".
- Initials:** A text box containing "hei".
- Description:** A large text area containing "Demo project with the RH-5AH55".
- Buttons:** "Help", "Cancel", "< Back", "Next >", and "Finish" are located at the bottom of the dialog.

Insert your desired "**Project Name**" into the appropriate field of the dialog box. The dialog box will come up with the project name "UNTITLED". In the example the project name is "**DEMO**". You can enter any valid file name (without file name extension) into this field. As "**Program Name**" insert e.g. "**3**".

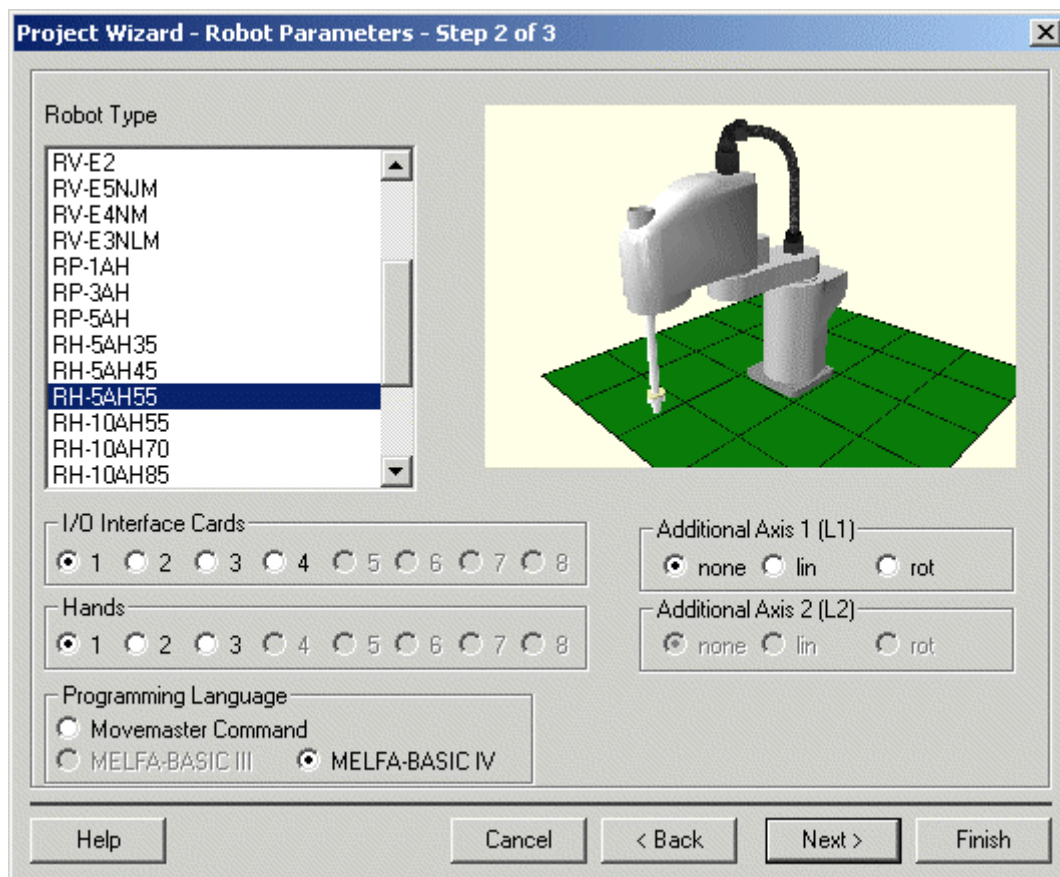
For each new project you create, COSIROP will create a new directory with the name of the project. COSIROP uses this directory to store all the programs that belong to your project. The program name is the name COSIROP uses to download the robot program into the robot controller.

The directory used for this project is displayed under "Directory". If you want to change the directory or if you want to create a new directory press the button "Browse..." which will open the browse dialog.



Insert your name into the text box "Created by", your initials into "Initials", and a short description of the project task into "Description".

Proceed to the second step of the project wizard by pressing the "Next >" button. This will display the second step of the Project Wizard.



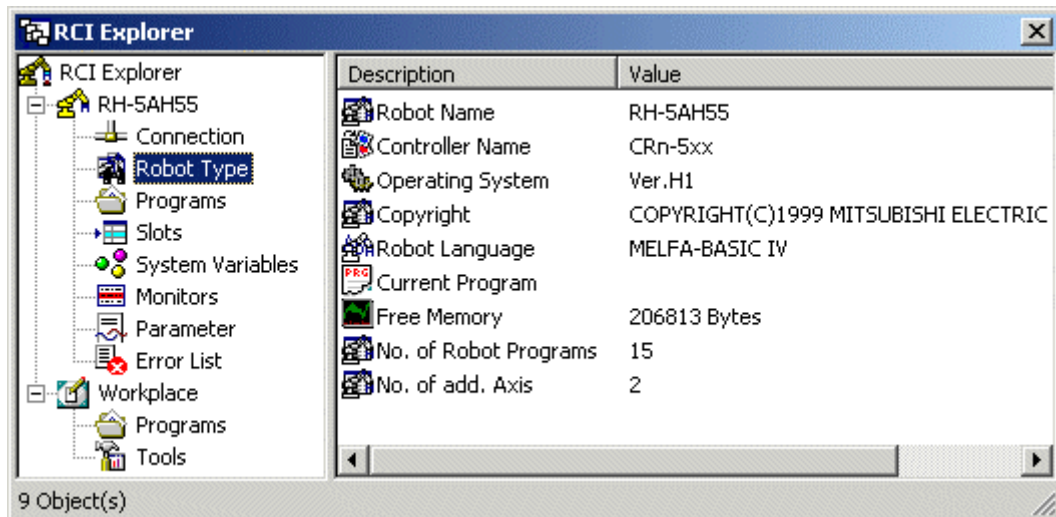
Select the robot type you are working with, from the list "**Robot Type**". Then, select the number of "**I/O Interface Cards**" (only required for the I/O Monitor), the number of "**Hands**" (only required for opening and closing hands in the Jog Operation), the number and type of "**Additional Axes**" (required for Jog Operation) and the "**Programming Language**", which is essential for opening of the correct program window. You can only choose between different programming languages for robots of the RV-EN and the A series (RV-A, RH-AH, RP-AH). Robots of the RV-M and RV-E series can only be programmed in **Movemaster Command (MRL)**.

Press the button "**Finish**", to create the project. A workcell window, the RCI Explorer, an empty robot program window, the associated position list window, and the message window will be opened and arranged on your monitor. Several files for the project itself, the program and the position list are created in the directory "**Project Name**".

First, have a look at the RCI Explorer (Robot Controller Interface).

How to Work with the RCI Explorer

The **RCI Explorer** is an information and data exchange center. It gives you an overview of the current state of the robot and provides an intuitive way to upload, download, start, debug, and monitor robot programs.



The RCI Explorer contains two folders. The first folder is the robot folder. The name of the folder matches the robot name, you have configured in the second step of the project wizard. This example makes use of the robot "RH-5AH55". The robot folder provides access to the data on the robot controller. The second folder is the "**Workplace**". It contains the data on your PC in the project directory.

In the robot folder you find information concerning

- the connection to the robot controller,
- the connected robot type,
- the programs, currently available on the robot controller,
- the contents of the program slots,
- the system variables,
- the state of the robot using a wide range of monitors,
- the robot parameters,
- and the most recent errors.

In the workplace folder you find

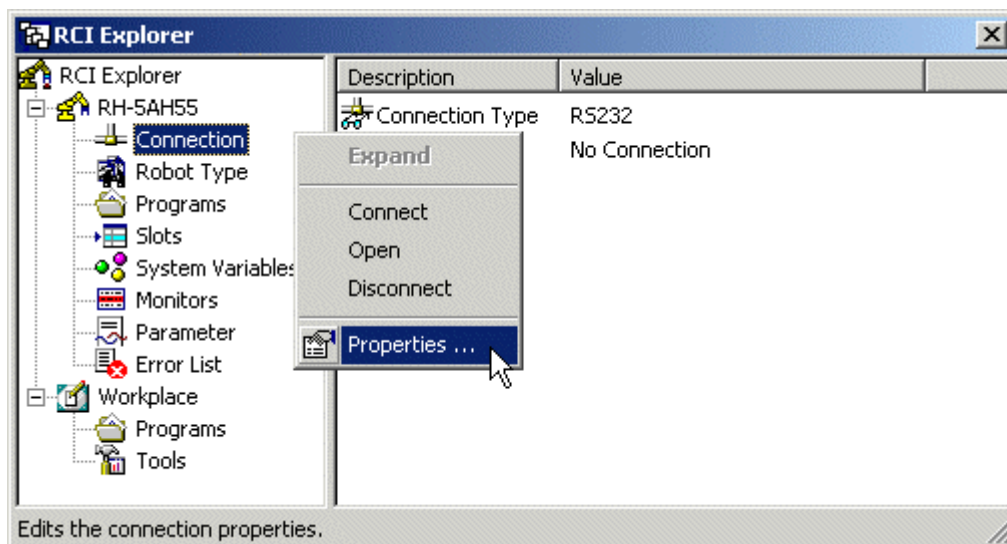
- the programs and position lists currently available in the COSIROP project directory on your PC,
- and the COSIROP tools.

Discover how to establish a connection to the robot controller.

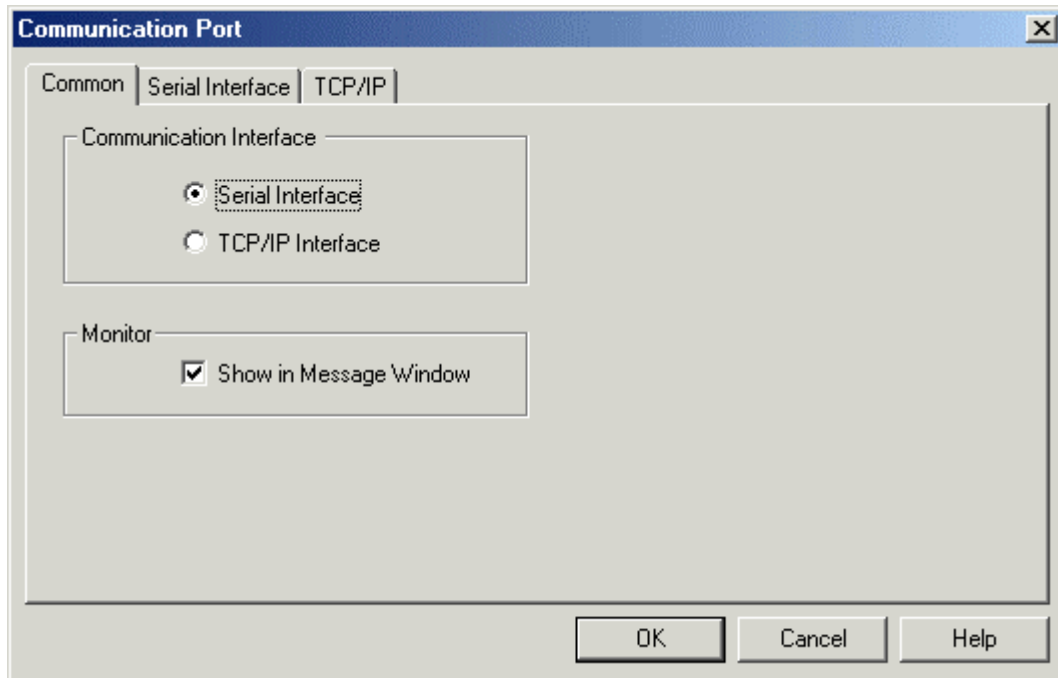
How to Establish a Connection to the Robot Drive Unit

Before you can exchange programs and position lists between the COSIROP PC and the robot drive unit the following you have to do the following steps.

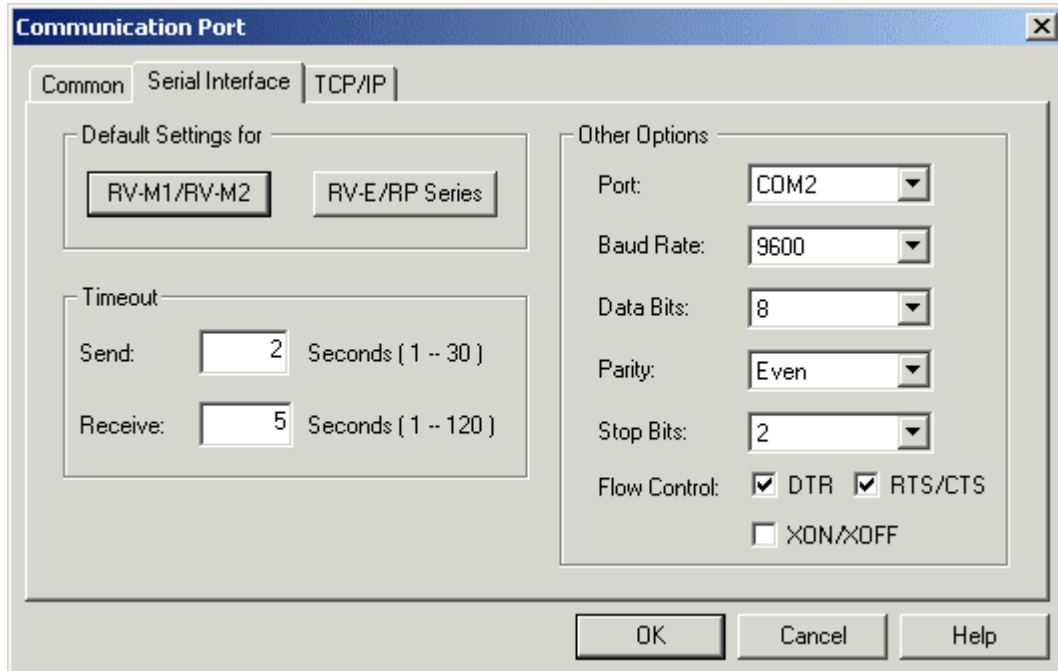
1. Connect a serial interface of the COSIROP PC to the RS-232 interface of the robot controller. Be sure to use a serial cable that connects the hardware handshake signals (DTR, RTS, CTS) of the serial interface, too. See the robot manual for details.
2. Use the **RCI Explorer** to check the connection properties. Open the context menu of the "Connection" by clicking with the right mouse button on the folder "Connection". Select "Properties" from the context menu.



3. Check if your **Communication Interface** is the **Serial Interface**.
Alternatively, you can open the dialog **Communication Port - Common** also with the command **Extras/Settings/Communication Port...** the command is only available if a workcell is loaded.



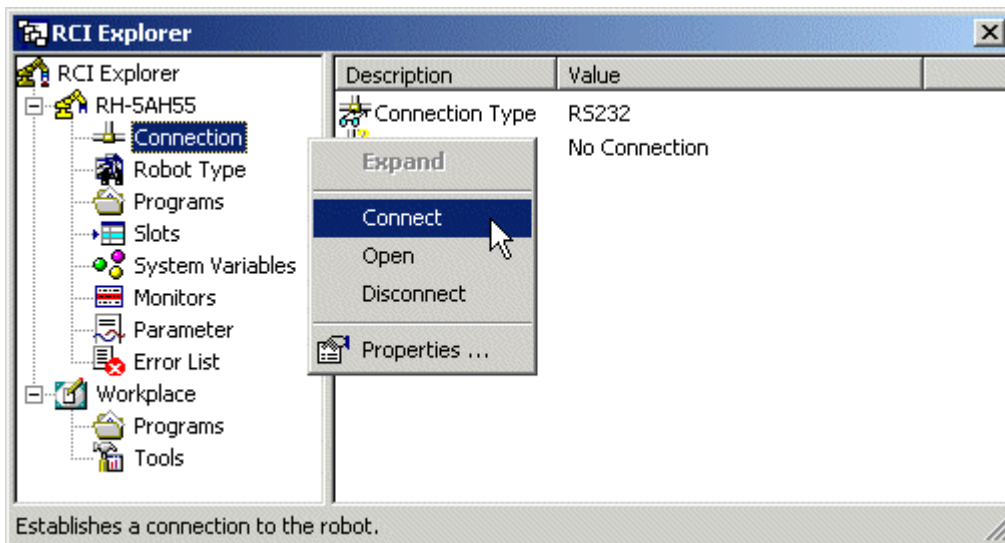
4. Switch to the property page Communication Port - Serial Interface to select the port and to set the communication parameter. **Select the correct port and set the communication parameters of the serial interface appropriately.**



These parameters will be stored together with your current project.

The command Extras/Settings/Communication Port is only available, if a workcell is loaded. **The default port is the serial port that has been selected during the installation.**

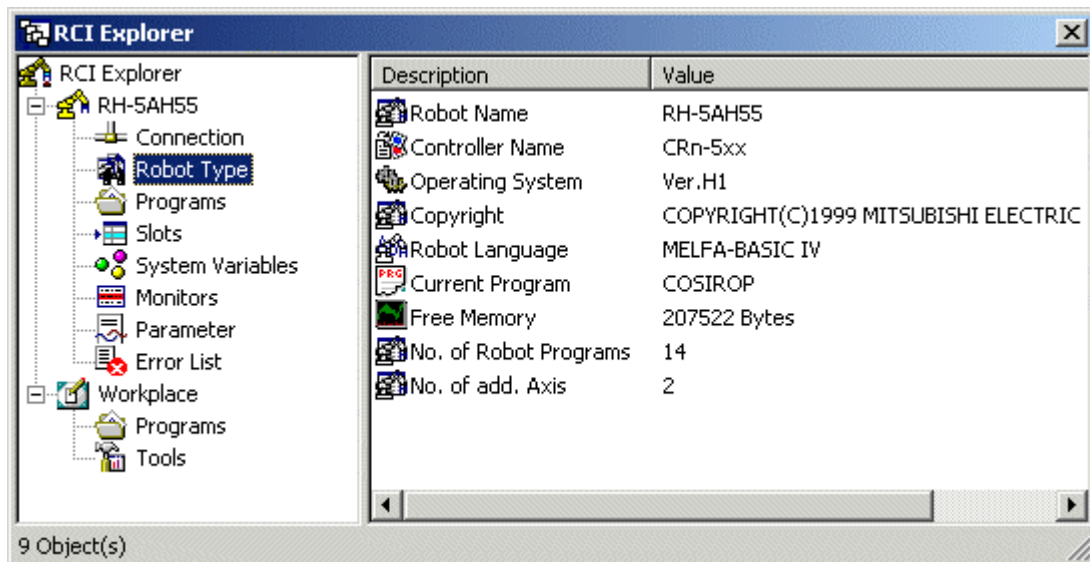
4. Disable the teaching box (set the switch to "Disable").
5. If you have a robot of the A series (RV-A, RH-AH, RP-AH), set the key switch on the robot controller to **Auto(Ext.)**.
6. Establish the logical connection between COSIROP and the robot drive unit by executing the command Execute/Init Connection, which will communicate with the robot and determine the type of the robot and some parameters of the robot and display them in the dialog box Robot Type. If this dialog box will be displayed the communication to the robot drive unit has been established and programs and position lists can be down- and uploaded.
7. Establish a connection between COSIROP and the robot controller. Use again the context menu of the **"Connection"**. Select **"Connect"** to establish the connection.



Alternatively, you can use the command Execute/Init Connection to establish a connection. If the connection initialization is successful, the dialog Robot Type displays information regarding the robot type, the robot programming language, and the amount of free memory.

How to Check the Robot Type

Check, if the configured robot type matches the actual type of the connected robot. In the RCI Explorer select the folder "Robot Type":



You get information concerning the type of the connected robot, the version of the operating system, the actual robot language, and the number of available robot programs on the robot controller.

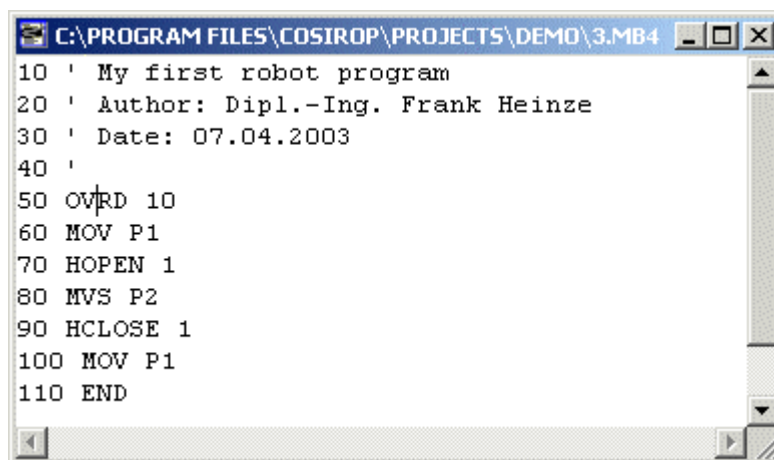
Now, you are ready to start out with your first robot program.

How to Write a Robot Program

You are now ready to write your first robot program. Activate the window with the robot program by clicking into the window or by selecting the window with the command Window/1,2,3.... Now can freely edit your program using the keyboard and the mouse.

The online help contains a detailed syntax description for every command. The **F1** key opens the help page of the command where the cursor is located. See the *Reference Manual* or the *Instruction Manual* to get further information.

A simple robot program in MELFA-BASIC IV might look like this:



```
C:\PROGRAM FILES\COSIROP\PROJECTS\DEMO\3.MB4
10 ' My first robot program
20 ' Author: Dipl.-Ing. Frank Heinze
30 ' Date: 07.04.2003
40 '
50 OVRD 10
60 MOV P1
70 HOPEN 1
80 MVS P2
90 HCLOSE 1
100 MOV P1
110 END
```

Use the context sensitive help to get help on the command **OVRD**. To open the help page place the cursor inside the **OVRD** command and press the **F1** key.

To renumber a program sequentially use the command Edit/Renumber. This command can be used to renumber the whole program (in this case no part of the program must be selected) or only the selected range of the program.

If you have added new program lines that should be inserted between other lines in the program according to their line numbers, use the command Edit/Sort to sort the whole program in ascending order according to the line numbers.

Save the program with the command File/Save.

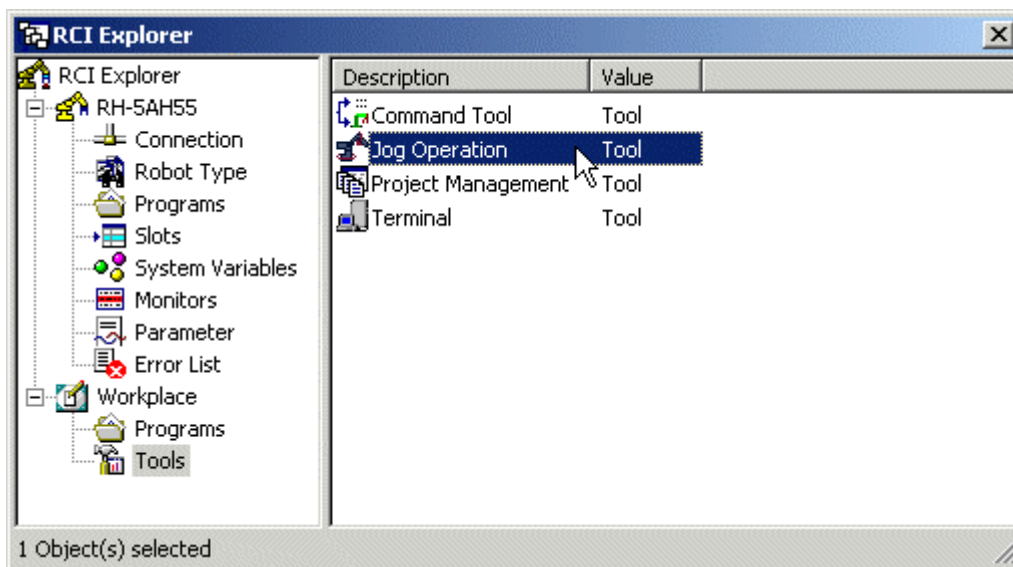
Create the associated position list next.

How to Create a Position List Using the Robot

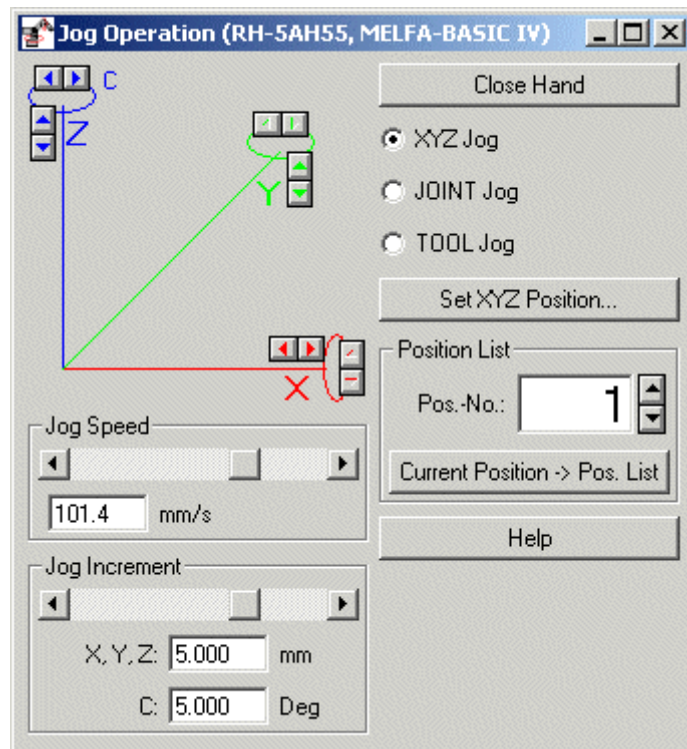
Read and observe the safety instructions of the SAFETY MANUAL carefully before operating or programming the robot with COSIROP! Nobody MUST be in the safeguarded area, when using the JOG operation.

Usually, you use the T/B (teach pendant) to create position data. Have a look at your **Instruction Manual** for a detailed description of how to create position data. Once you have created position data with the T/B it is easy to upload the position data into a position list on your PC. Simply use the program upload. You will get your position data as a position list and additionally any program lines you might have created with the T/B.

Alternatively, you can create and modify a position list interactively using COSIROP. Open the window Jog Operation by double clicking on the "Tool" "Jog Operation".



Optionally, you can also open the window Jog Operation by the command **Execute/Jog Operation**. Use this window to jog the robot in **JOINT**, **XYZ** and **TOOL** coordinates. Use the button "**Current Position-> Pos. List**" to insert the current robot position into the position list as position number "**Pos.-No.**". To override an existing position just enter the position number into the text box "**Pos.-No.**" or use the spin buttons next to the text box. Set the "**Jog Speed**" and the "**Jog Increment**" to appropriate values.



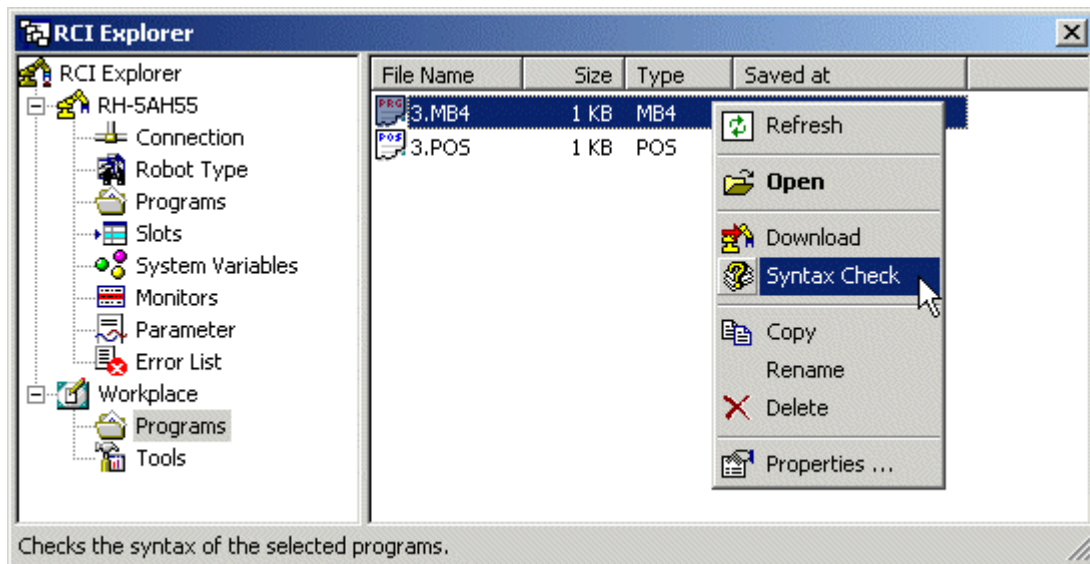
Create two positions P1 and P2 in your current position list and save the position list with the command File/Save. Your position list might look like this:

No	Position	Orientation	Comment
P1	420.0, -260.0, 180.0	0, 0, 60,R	Position 1
P2	420.0, -260.0, 170.0	0, 0, 60,R	Position 2

Discover next, how to check the syntax of your program.

How to Check the Syntax of your Program

Your first robot program and the associated position list are now located on the PC in the project directory. In the **RCI Explorer** they are accessible in the folder "**Programs**" in your "**Workplace**". Click with the right mouse button on the name of the robot program and open the context menu of the program. Select "**Syntax Check**" to check the syntax of your program.



You can check the syntax of your program also by using the command **Execute/check Syntax**. The syntax checker finds syntactical errors in your program and displays the errors in the message window.

Load the syntactically correct program and position list into the robot controller.

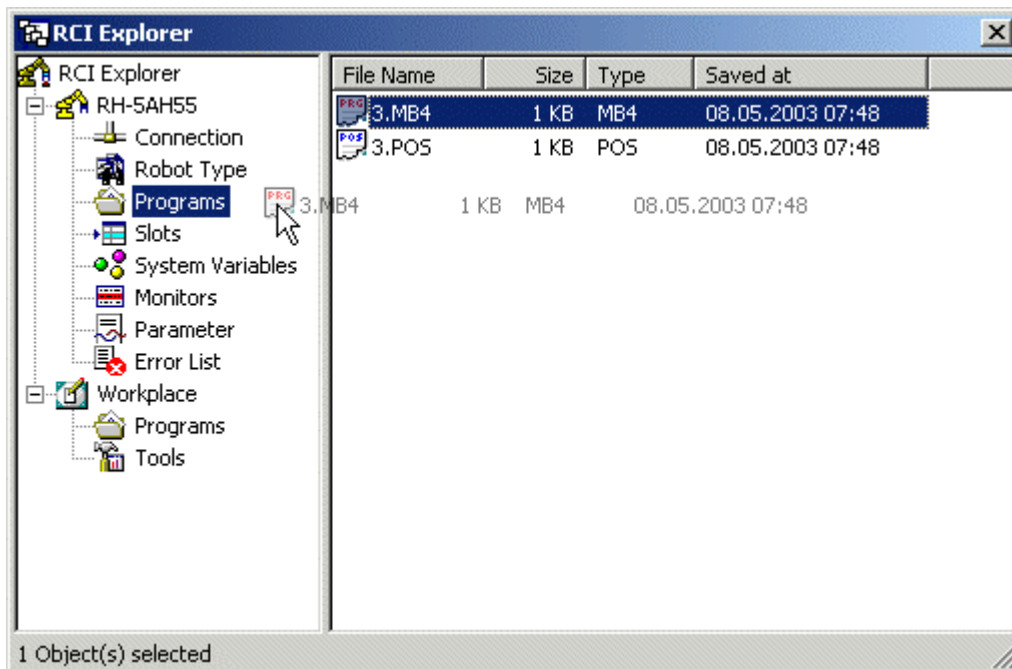
How to Exchange Programs and Position Lists with the Robot

Before you can exchange programs and position lists between the COSIROP PC and the robot controller the connection must have been established. If the connection is established, you can download programs and position lists from the PC into the robot controller and upload them from the robot controller into the PC.

- Download a program to the robot
- Download a position list to the robot
- Upload a program from the robot to the PC

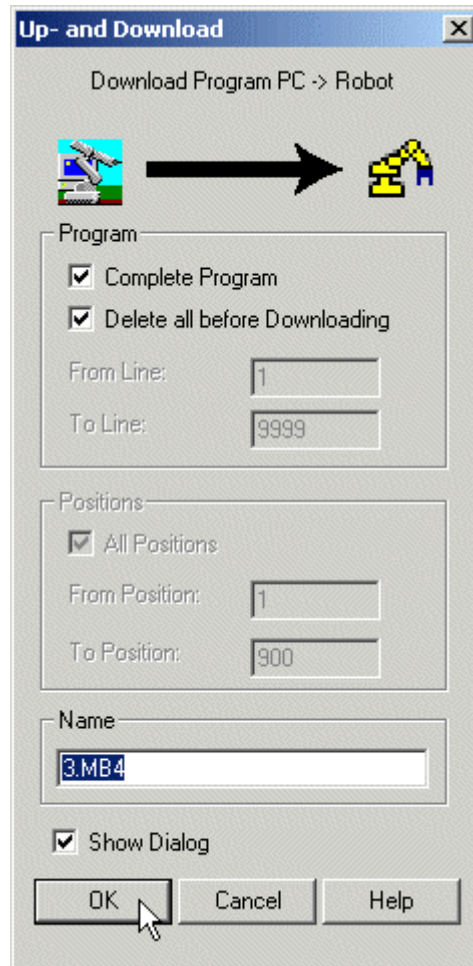
Downloading a program

The **RCI Explorer** offers a very easy and intuitive way to download a program from the PC to the robot controller. Select the program you want to download to the controller, in the folder **"Programs"** in your **"Workplace"**. In the example the program **"3.MB4"** is selected. Keep the left mouse button pressed and simply "drag and drop" the program into the folder **"Programs"** of the robot:



If you release the mouse button, the download starts. The download can also be started with the command **"Download"** from the context menu of the program. Click on the program **"3.MB4"** with the right mouse button to open the context menu.

Alternatively, you can download a program without the **RCI Explorer**, too. Activate the window with the robot program by clicking into the window or by selecting the window with the command Window/1,2,3.... Download the program by executing the command Download PC->Robot from the menu "**Execute**". The dialog box Up- and Download is displayed.



Usually, it is best to use the default values in the dialog "Up- and Download" and download the complete program. To download the complete program, select the option "**Complete Program**". If you want to download only a certain number of lines, switch off the option "**Complete Program**" and insert line number for "**From Line**" to "**To Line**". For MELFA-BASIC III and MELFA-BASIC IV the line numbers have to be in the range between 1 and 32767, for Movemaster Command between 1 and 9999. Before the download, the specified line range is cleared in the robot controller. Furthermore, insert the program "**Name**", that will be used for your program in the controller. This field is always initialized with the file name of the program on the PC.

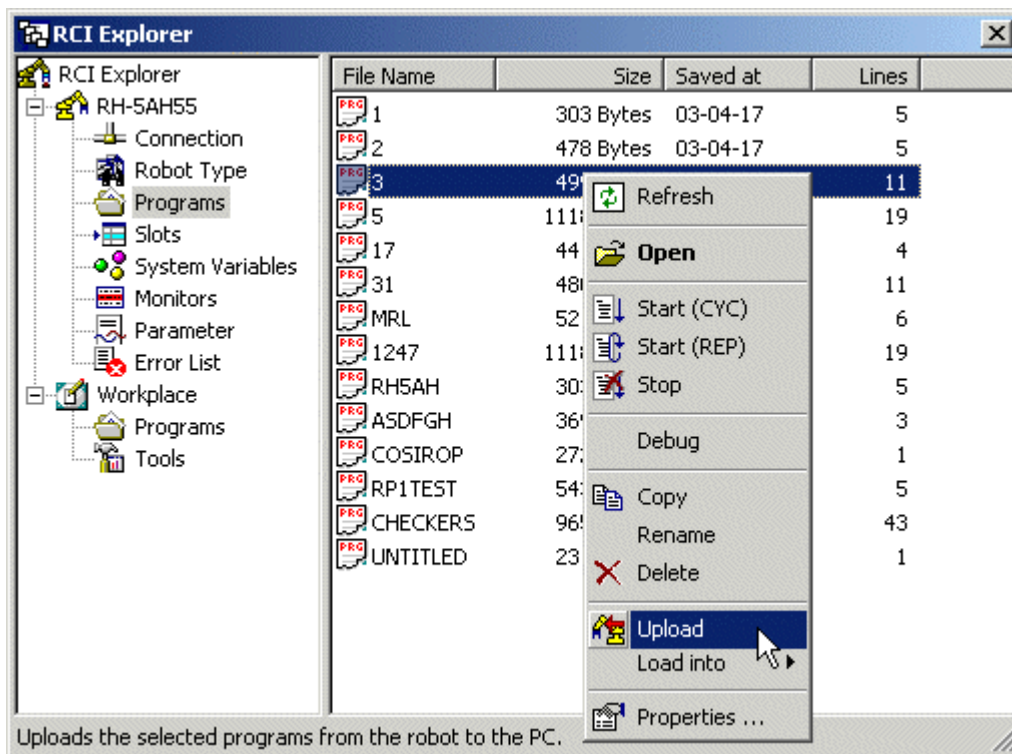
If you are programming in MELFA BASIC and you are using line numbers larger than 9999, be sure to check "**Delete all before Downloading**". If this option is chosen, a program in the Drive Unit will be deleted even if it contains line numbers larger than 9999. If this option is not selected, line numbers larger than 9999 will not be

erased, independent of the line number you specify in the "To Line" section. Position lists will not be deleted.

Press the "OK" button to start the download. All commands that are transmitted to the drive unit are displayed on the screen. After each command the alarm (error) status of the drive unit is checked. If an error should occurs the download will be aborted and the erroneous command is displayed.

If you are trying to download an empty program or an empty position list, a warning is issued and you are asked, if you really intend to download an empty program and delete the program on the robot controller. It is save to cancel the download at this point. The warning keeps you from destroying valuable programs on the controller, in all the cases, when you actually want to upload a file from the robot controller and you select the download by mistake.

If an error is reported during the deletion of the old program (command "DL..." for RV-E or RV-M robots), delete the program on the robot controller manually. Use the RCI Explorer to delete a program. Open the "Programs" folder on the robot. Open the context menu of the program that is going to be deleted, by clicking with the right mouse button on the program name. Select "Delete".

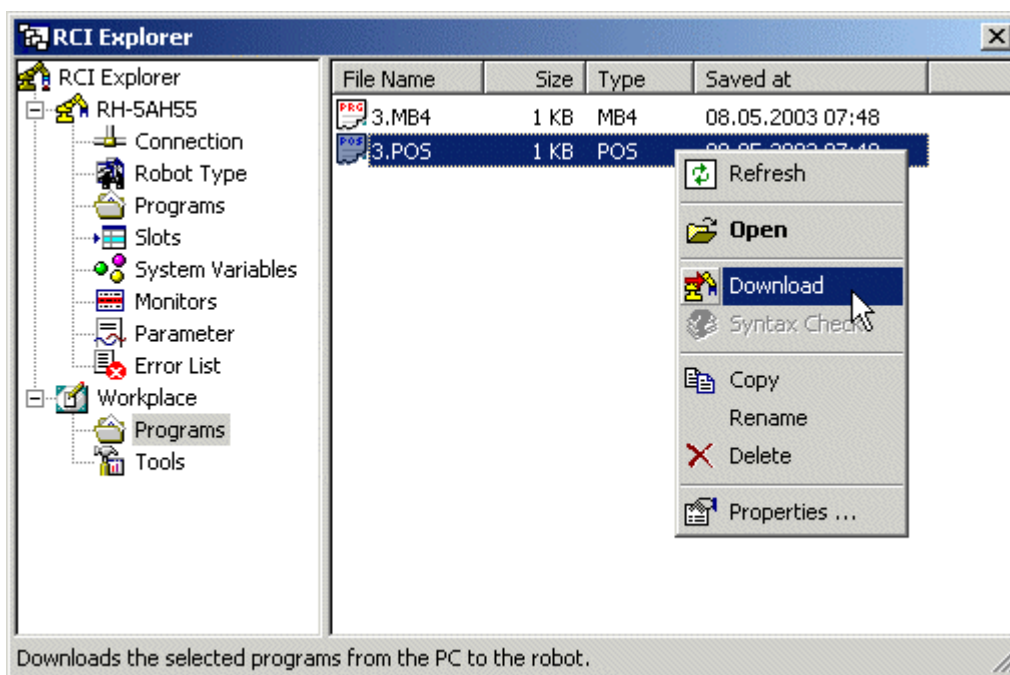


After the successful download of the robot program, discover how to download the position list to the robot controller.

Downloading a position list

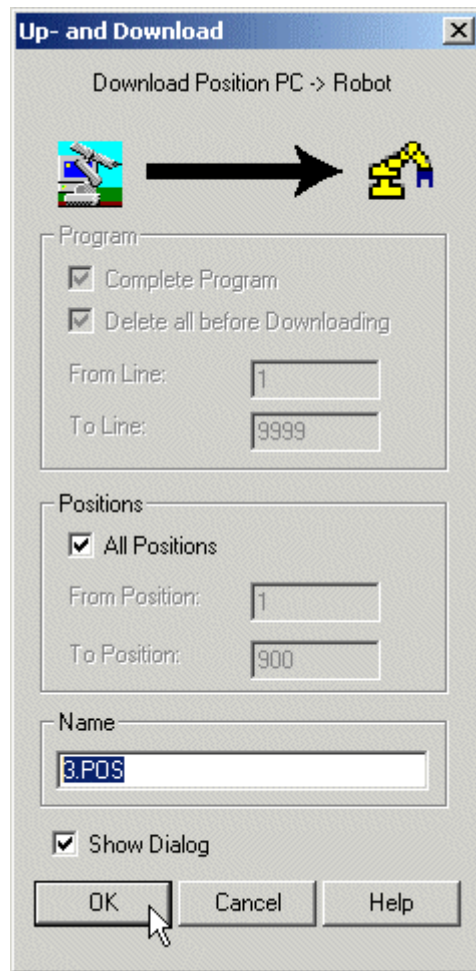
The steps required to download a position list are almost the same as for a program. The easiest way, to download a position list from the PC to the robot controller, is to use the **RCI Explorer**. Select the position list you are going to download to the robot controller, in the folder "**Programs**" on your "**Workplace**". Keep the left mouse button pushed and drag and drop it into the "**Programs**" folder on the robot.

The example demonstrates another way to download a position list. Select the position list "**3.POS**". Open the context menu with the right mouse button. In the context menu select "**Download**".



Alternatively, you can download a position list without the RCI Explorer. Activate the position list window and execute the command Download PC->Robot from the menu "**Execute**".

The dialog box Up- und Download is displayed. In most cases, it is best to can use the standard settings. Be sure that the option "**All Positions**" is selected. If you want to download only a special range of position numbers, switch off the option "**All Positions**" and insert values for "**From Position**" and "**To Position**". There are no limits for position numbers in MELFA-BASIC III and MELFA-BASIC IV. In Movemaster Command the position numbers are limited to 1 to 999, and for the RV-M1 the range is 1 to 629.



Before the download the old positions in the selected range are cleared. **Note, that the old positions are not cleared if you use MELFA-BASIC IV.**

Additionally, you can add a "Name". The default name is the name of the file position list on the PC.

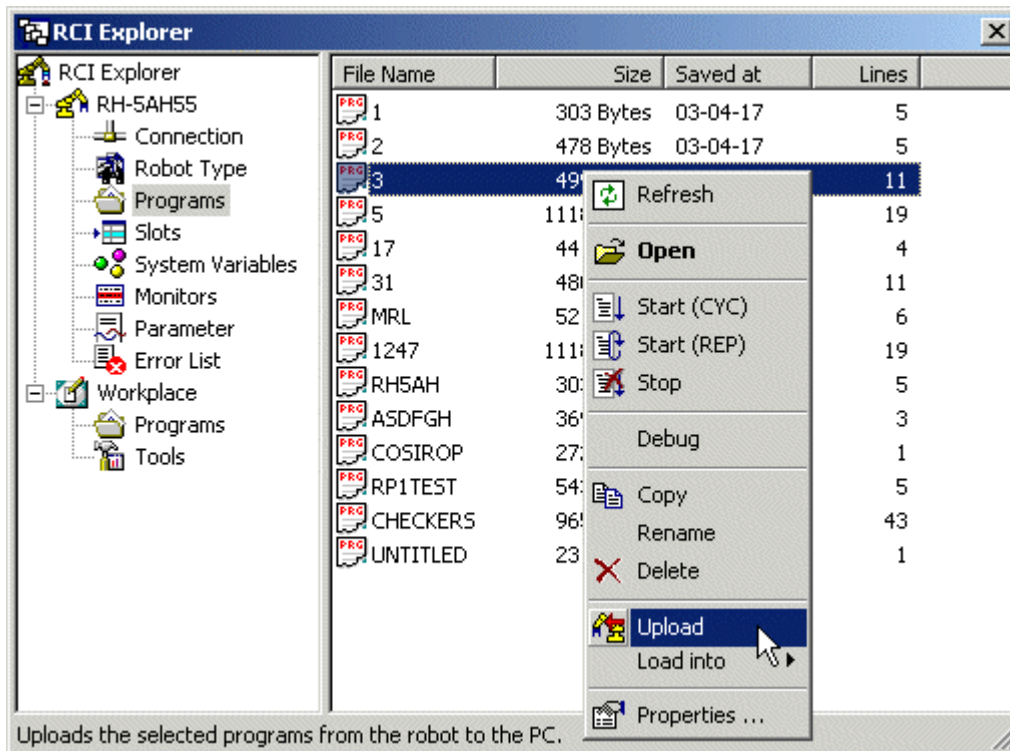
If you use a different name, be sure to use the same name that you have used for the program beforehand.

It is also very easy, to upload all the programs on the robot controller back to the PC.

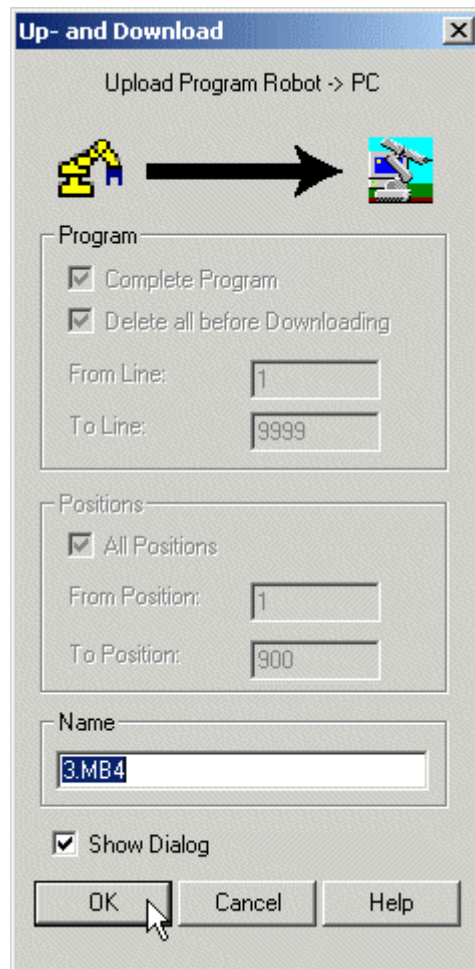
Uploading a program

The procedure for uploading is very similar to the downloading procedure. Again, it is best to use the **RCI Explorer**. Just drag and drop the program from the "Programs" folder of the robot to the "Programs" folder of your "Workplace". Optionally, you can use the context menu of the robot program. Right click with

the mouse on the program "3". Select "Upload" in the context menu to start the upload of a program and its associated position list. Note, that the program is uploaded into your Workplace folder, but it is not opened on your monitor. If you want to upload and open the program, select "Open" from the context menu or simply double click on the program name.



Alternatively, you can also upload programs and position lists without the **RCI Explorer**. Activate the program window that is to be used for the uploaded program. You can open a new program window with the command File/New, too. Then, execute the command Upload Robot->PC from the menu "Execute". This will again open the dialog box Up- and Download. After pressing the "OK" button the program will be uploaded line by line from the robot controller and finally displayed in the program window.



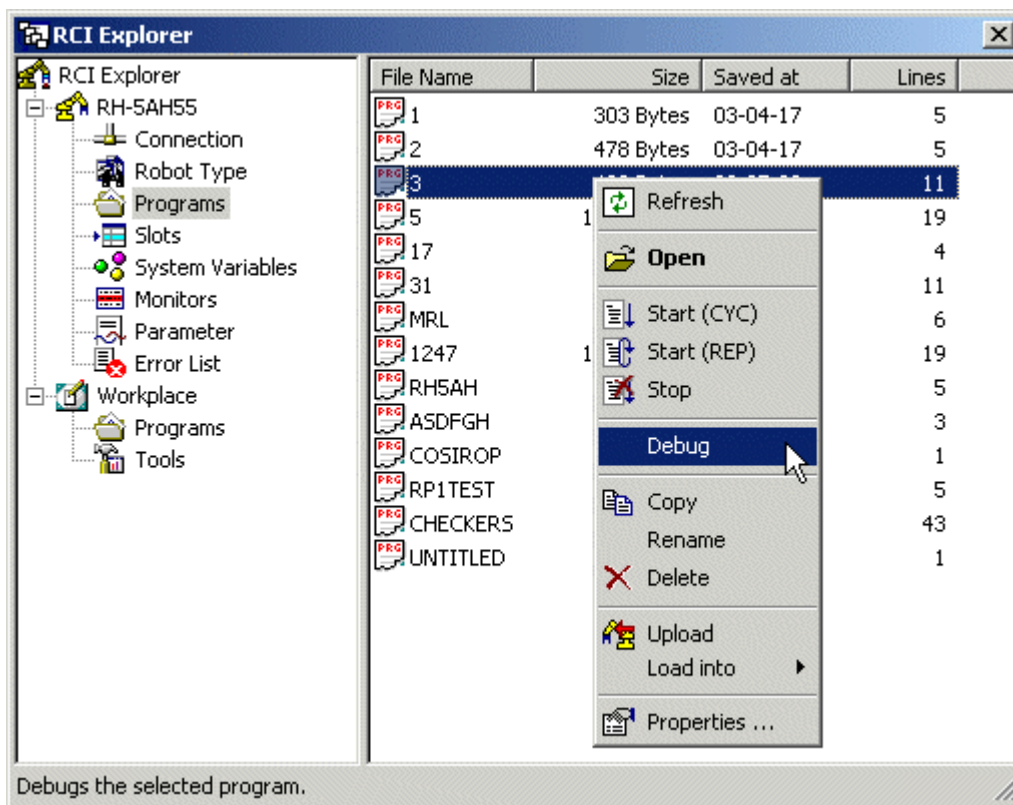
During this upload the original program file on the disk will be overwritten and there is no way to restore it.

You are now ready to debug your program directly on the robot controller.

How to Debug a Robot Program

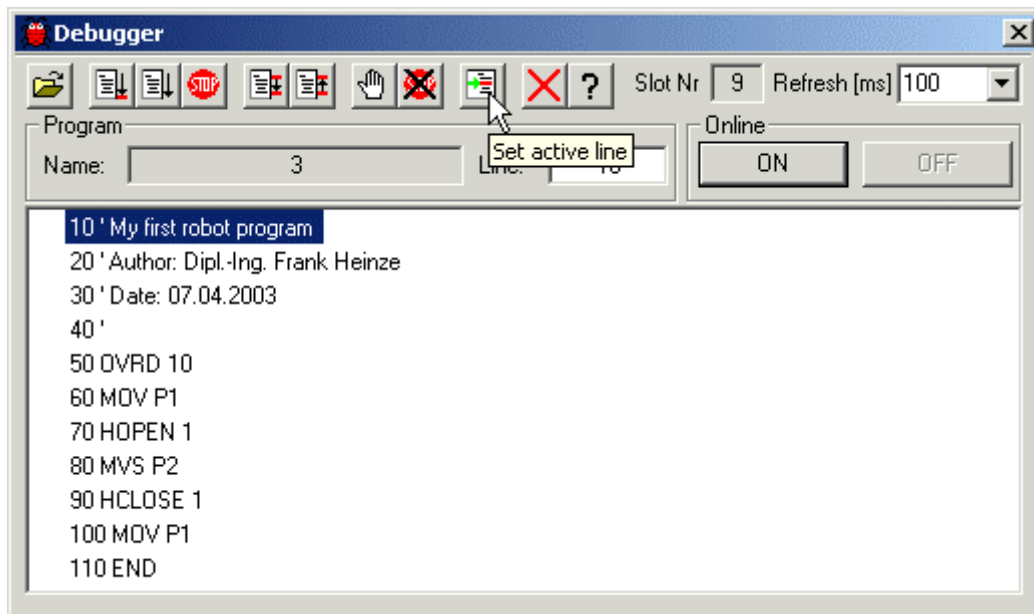
Read and observe the safety instructions of the SAFETY MANUAL carefully before operating or programming the robot with COSIMIR/COSIROP! Nobody MUST be in the safeguarded area, when debugging your program.

Now, as you have downloaded your robot program successfully to the robot controller, it is time to test your program online on the robot controller. Locate last errors with the online Debugger. Start the Debugger by using the context menu of your program. Right click with the mouse on the name of the program in the folder **Programs** inside the robot folder. Select "**Debug**". In the example the debugger for the program "3" is opened:

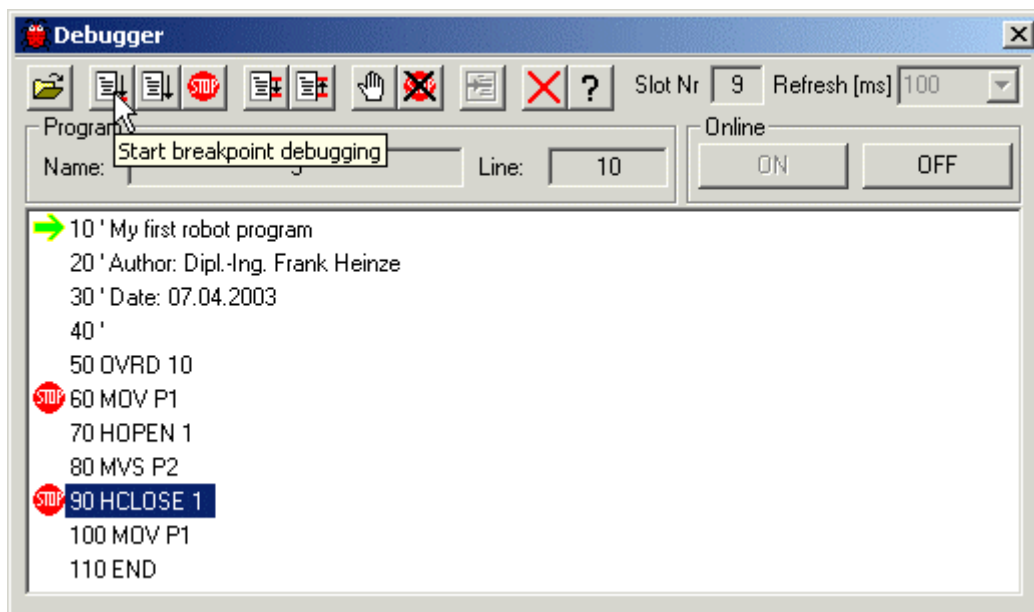


Note! In the debug mode, the robot actually moves according to the movement commands.

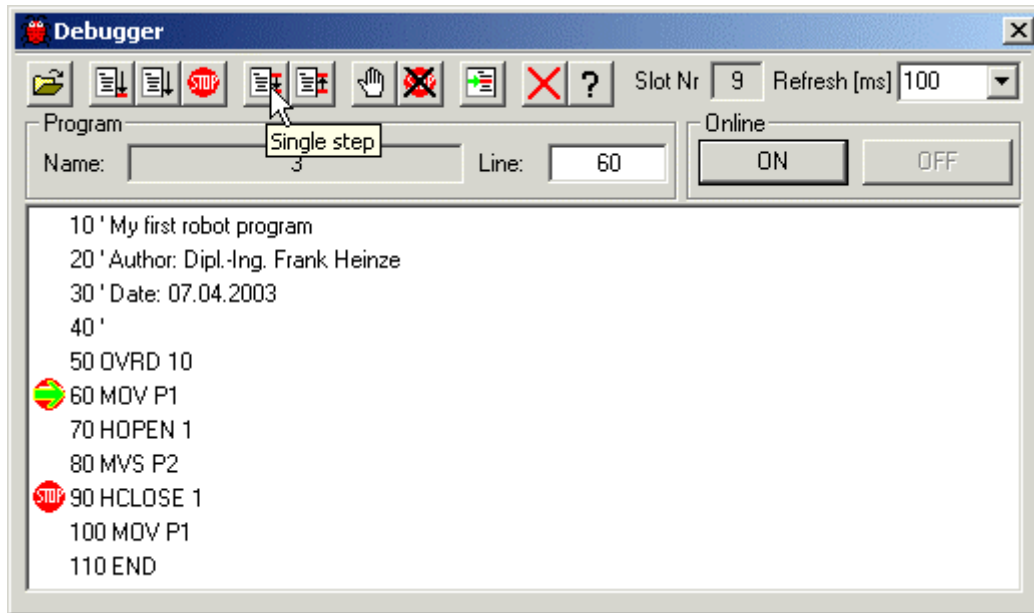
The Debugger opens with the selected program. Set the current line to the first program line. Select the first program line with the mouse and set it as currently active line by pressing the icon shown in the following picture:



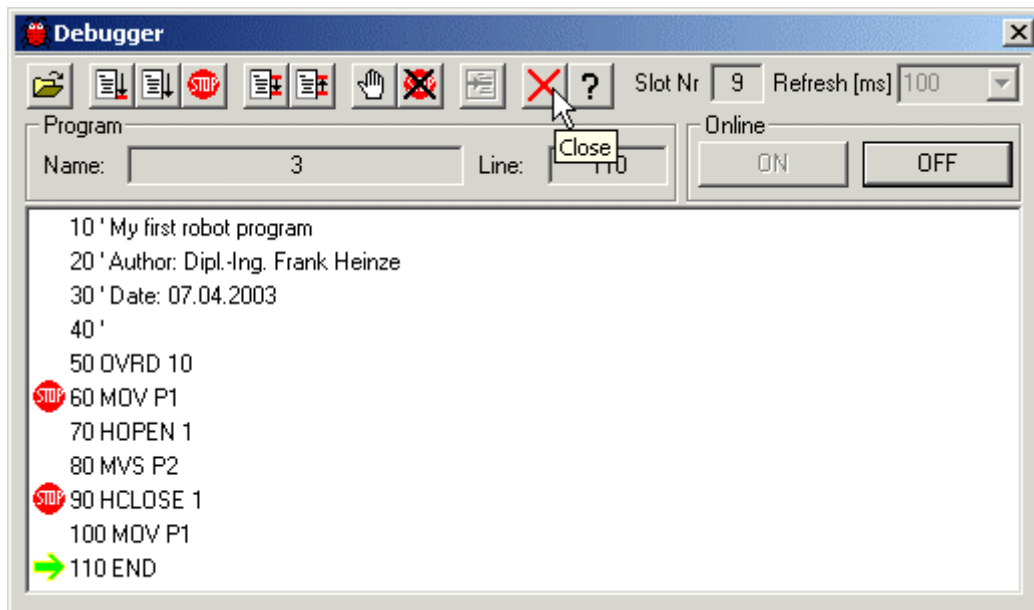
A small green arrow marks the currently active line. This is the line that will be executed next by the robot program. Now, set breakpoints by double clicking on the program lines, on which the program is supposed to stop during debugging. Press on the icon shown in the following picture and start the breakpoint debugging:



Program execution stops at the first breakpoint. Now, continue using the single step mode. In the single step mode, only the command in the currently active program line is executed. Afterwards the currently active line moves on to the next program line. Execute a single step by pressing the icon shown in the following picture:



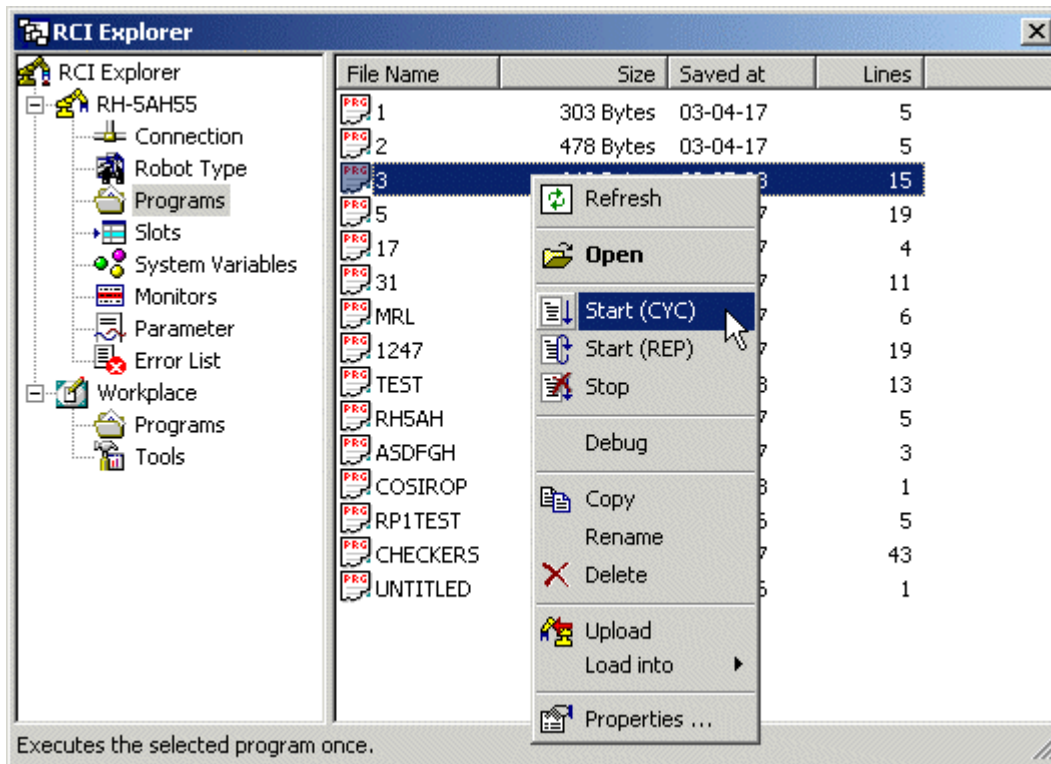
Stop debugging simply by closing the debugger. Close the debugger by pressing on the icon shown in the following picture:



After testing your program in detail with the online debugger, you can now continue to finally start the program.

How to Start and Stop a Robot Program

It is really easy to start programs using the **RCI Explorer**. Open the folder "Programs" in the robot folder, click with the right mouse button on the program you want to start and select "Start (CYC)" or "Start (REP)" in the context menu.



There are two commands to start a robot program. Use the command "Start (CYC)" (1 cycle) to start the program, once. Use the command "Start (REP)" (repeated) to start the program in a continuous loop. With the command "Start (REP)" the program continues until the program is stopped by a user command.

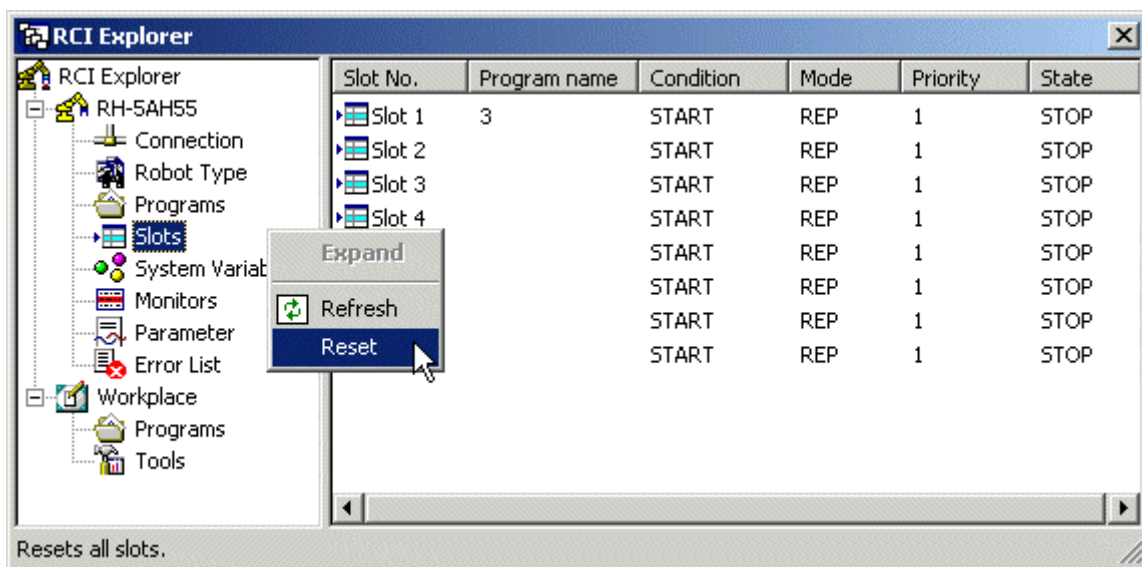
Stop the program with the command "Stop" from the context menu. It is also possible to stop the program without the RCI Explorer. Use the command Execute/Program Stop to stop the program without using the RCI Explorer.

If you start a program, the robot controller loads the program into the so-called slot 1 before it is actually executed. If you want to start the program in a slot different from slot 1, then you have to load the program into this slot, first.

How to Load a Robot Program into a Slot

Robots of the A series (RV-A, RH-AH, RP-AH) have so-called **slots**. In each of these slots a single robot program can run. Thus several robot programs can actually be executed in parallel. This type of program execution is called multitasking. All other robot types have only one slot for program executions. Thus, they cannot be used for multitasking. A-series types of robots can execute the program in any slot, but slot 1 is the default slot. In order to start a program in a slot different from slot 1, you have to explicitly load the program into the desired slot.

Open the folder "Slots". If your program "3" is already loaded into a slot (e. g. Slot 1), then reset the slots first. Open the context menu of the folder "Slots" and select "Reset".



If your parameter settings do not assign any programs to any slot (parameter SLT1 to SLT32), then all the slots should now be empty.

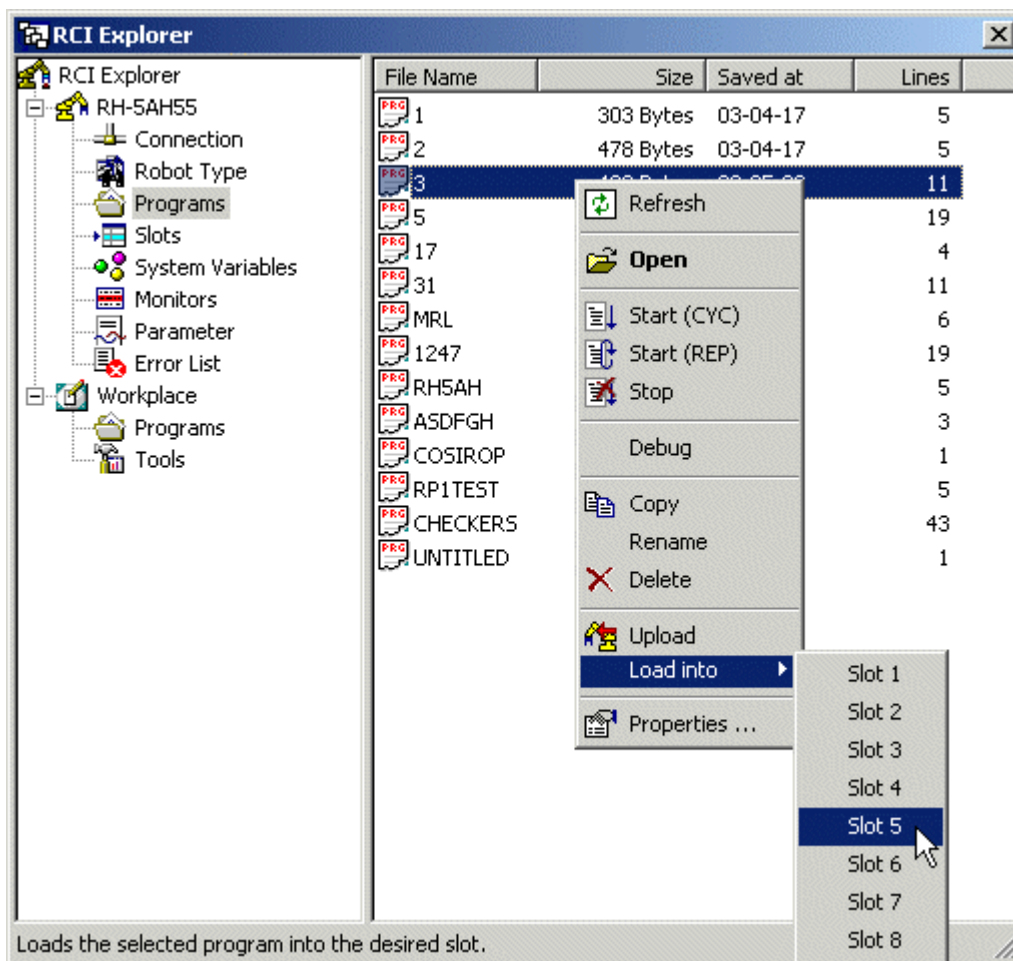
At the moment our program example is not designed to run in a slot other than slot 1. Thus, we have to modify our program first. Add the MELFA-BASIC IC commands **GETM 1** und **RELM**. GETM 1 reserves the robot for the current program. This is necessary, whenever a robot is to be moved by a program that is not running in slot 1. Only one single program can move the robot at any given time. The robot controller assumes that only the program running in slot 1 is moving the robot. Thus, the command GETM 1 is not necessary, if the program is only running in slot 1. But all other programs have to claim the robot first, before they can use it.

```

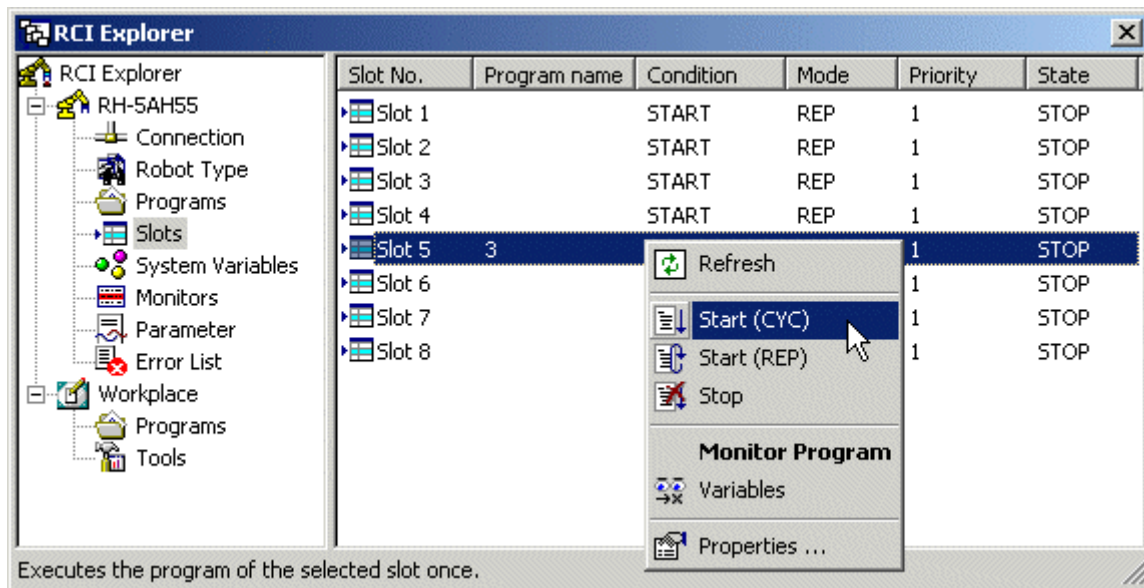
C:\PROGRAM FILES\COSIROP\PROJECTS\DEMO\3.MB4
10 ' My first robot program
20 ' Author: Dipl.-Ing. Frank Heinze
30 ' Date: 07.04.2003
40 '
50 GETM 1 ' Get robot 1 for this program
60 OVRD 10
70 MOV P1
80 HOPEN 1
90 MVS P2
100 HCLOSE 1
110 MOV P1
120 RELM ' Release robot 1
130 END

```

Check the syntax of the modified program and download it to the robot. If necessary, check the functionality of the program with the debugger. Load the modified and checked program into slot 5. Click with the right mouse button on the program name in the folder **Programs** in the robot folder. Select "Load to" -> "Slot 5". The program is loaded into slot 5.



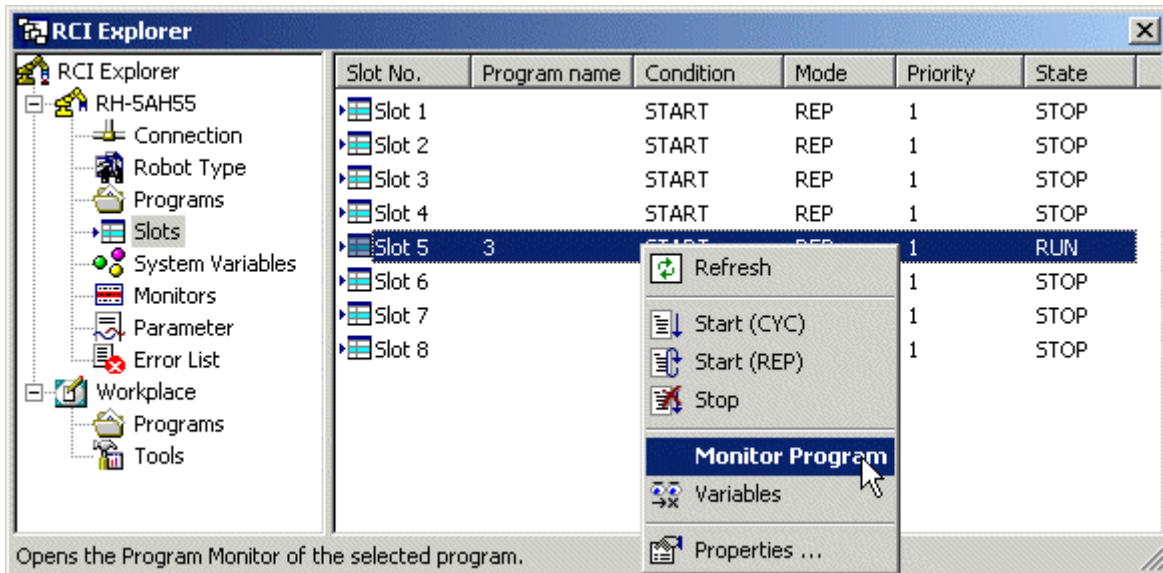
Now, open the folder **Slots**. Start your program in slot 5 with the command "Start (CYC)" from the context menu.



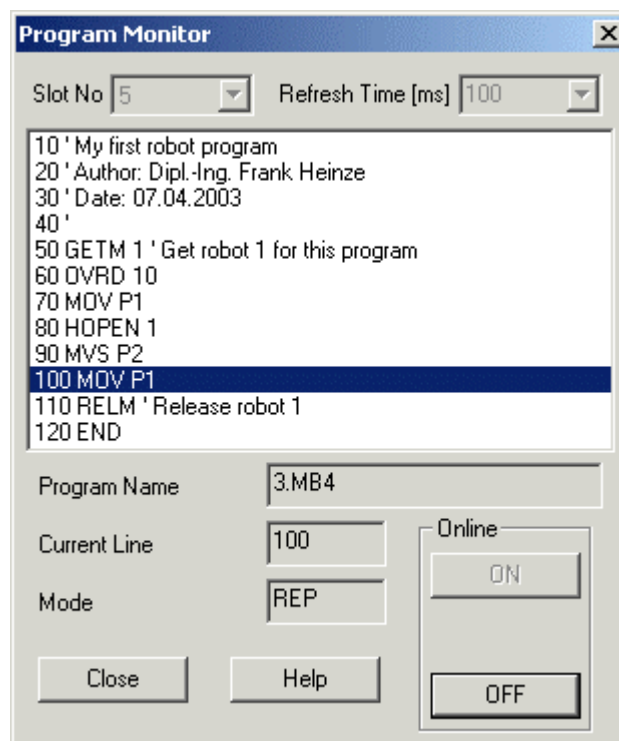
Stop the program execution with the command "Stop" from the context menu. Discover next, how to monitor your running program.

How to Monitor running Robot Programs

Monitor the execution of your programs. Open the context menu of a slot with the right mouse button and select "Monitor Program ...".



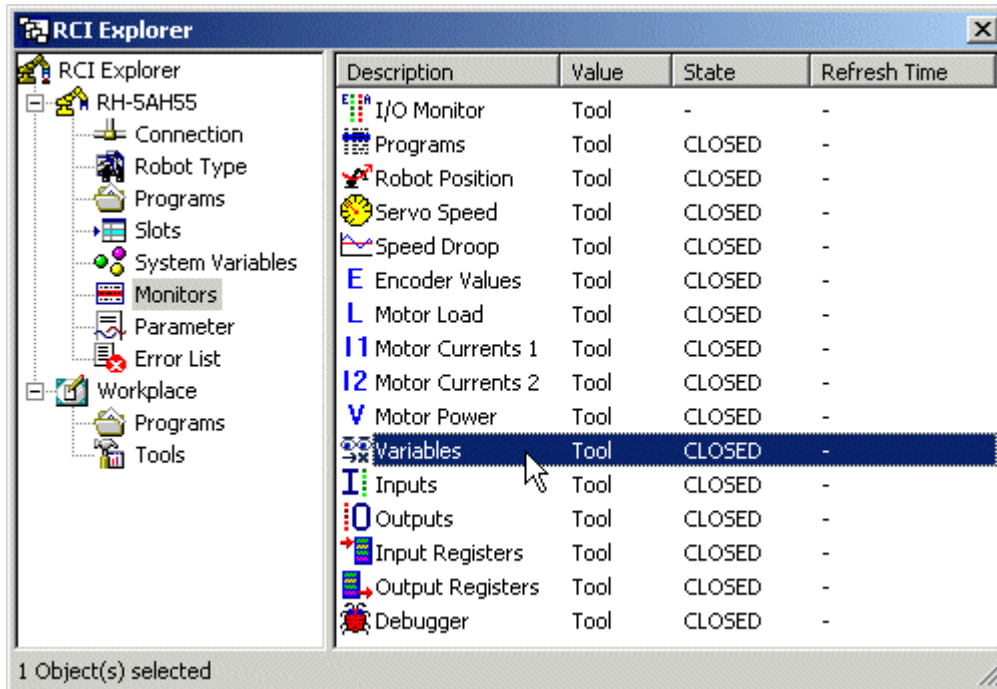
Optionally, double click on a slot to open the Program Monitor of the selected slot:



You can actually monitor a lot of different types of robot data. Discover how to monitor variable values.

How to Monitor Variable Values

COSIROP offers a wide range of different types of monitors. Use the Variables Monitor to monitor the current values of variables. Open the Variables Monitor by double clicking on "Variables" in the folder **Monitors**.



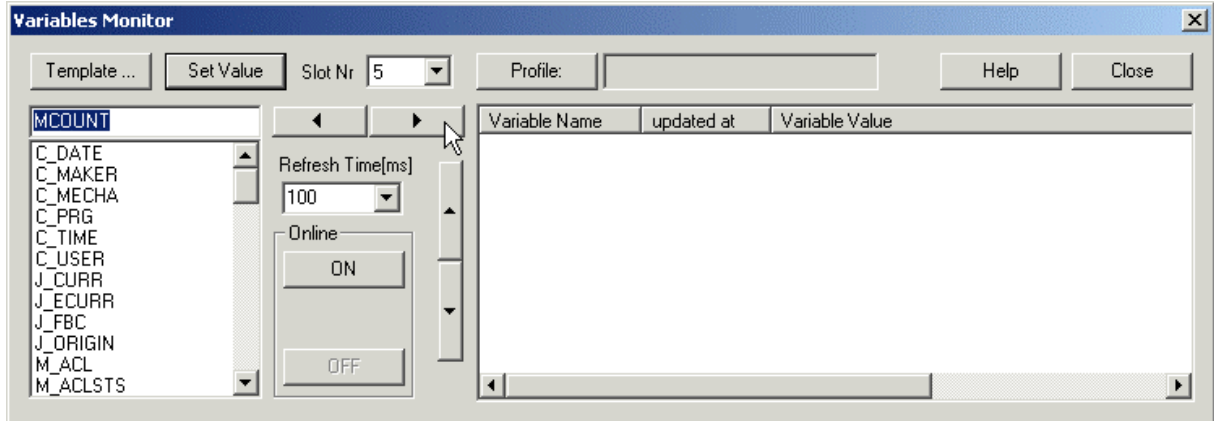
In order to monitor the value of a local variable, add the counter variable MCOUNT to your robot program.

```

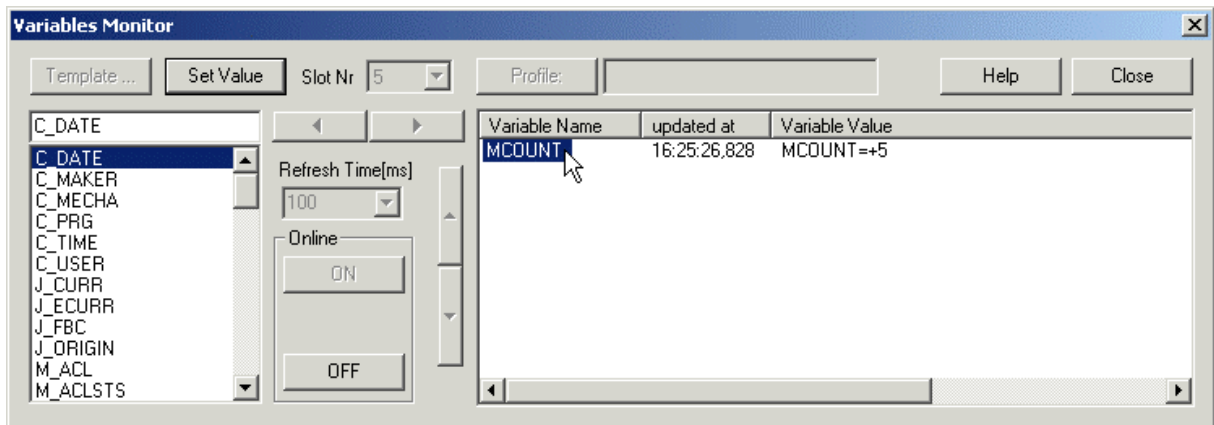
C:\PROGRAM FILES\COSIROP\PROJECTS\DEMO\3.MB4
10 ' My first robot program
20 ' Author: Dipl.-Ing. Frank Heinze
30 ' Date: 07.04.2003
40 '
50 GETM 1          ' Get robot 1 for this program
60 OVRD 10
70 FOR MCOUNT = 1 TO 100 ' Counter MCOUNT
80 MOV P1
90 HOPEN 1
100 MVS P2
110 HCLOSE 1
120 MOV P1
130 NEXT MCOUNT ' Increase counter
140 RELM          ' Release robot 1
150 END

```

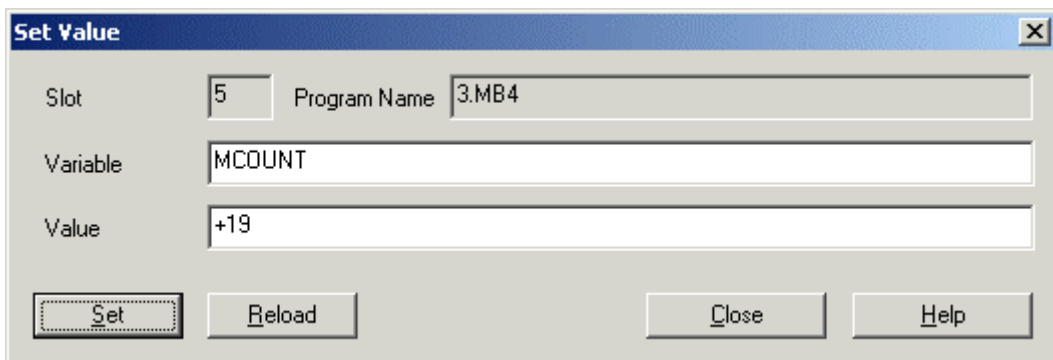
Download the modified program to the robot, load it into slot 5, and start the program. Select slot 5 in the Variables Monitor and add the variable MCOUNT to the list of the monitored variables with the arrow buttons.



Start the monitor by pressing "ON" and observe the changing value of MCOUNT.



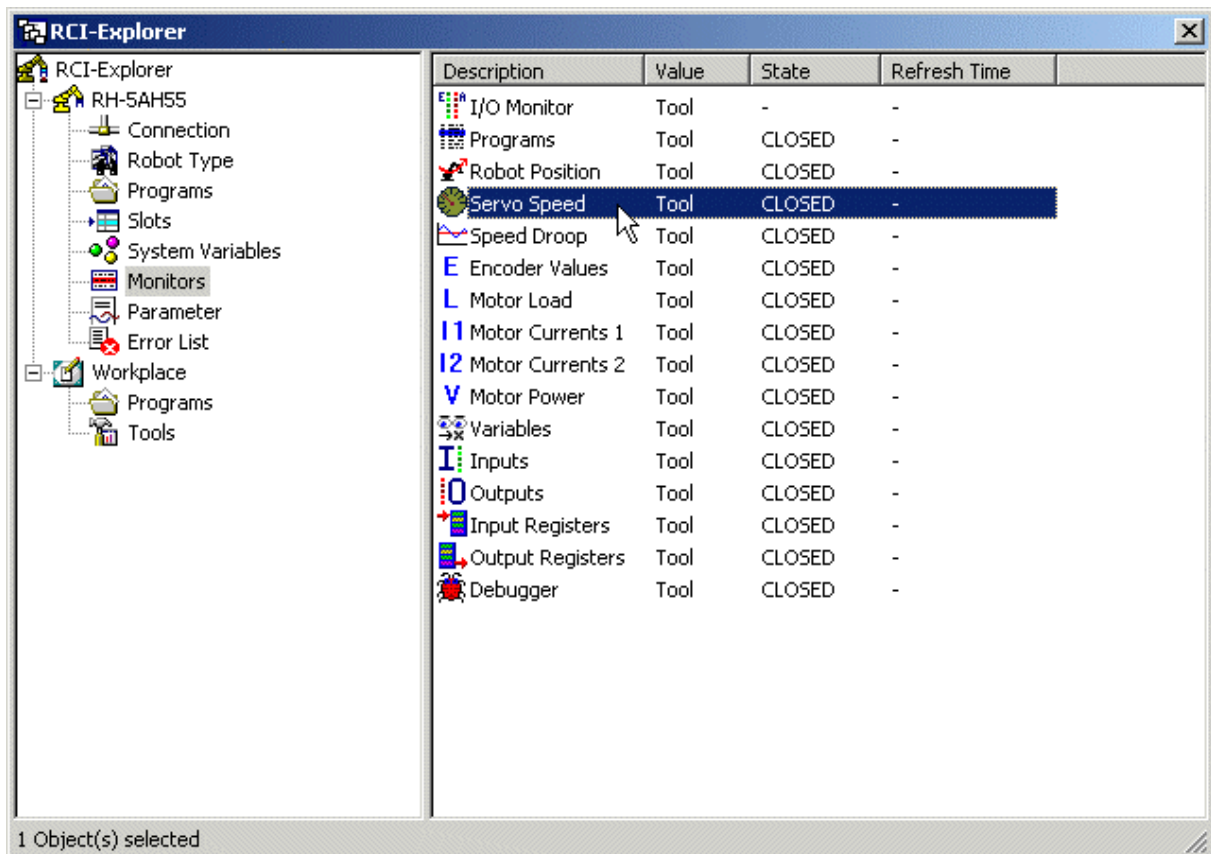
Double click on the variable name to open the dialog "Set Value". Use it to change the value of the variable MCOUNT. Observe the change in the Variables Monitor.



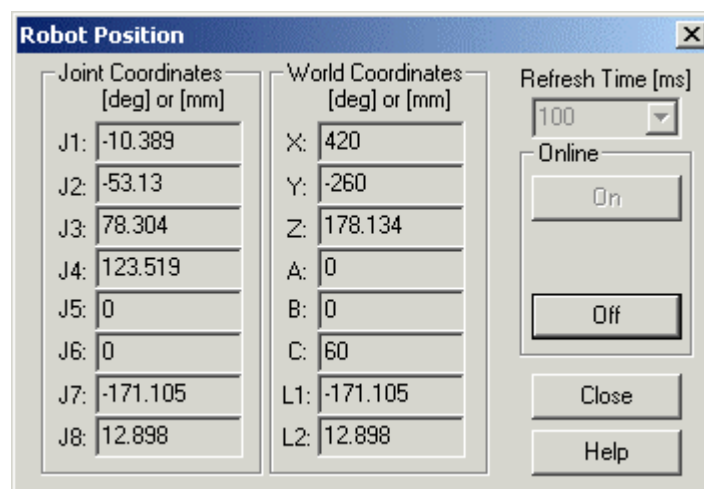
There are actually many more monitors available. Check the robot state with some of the other robot monitors.

How to Monitor Robot States

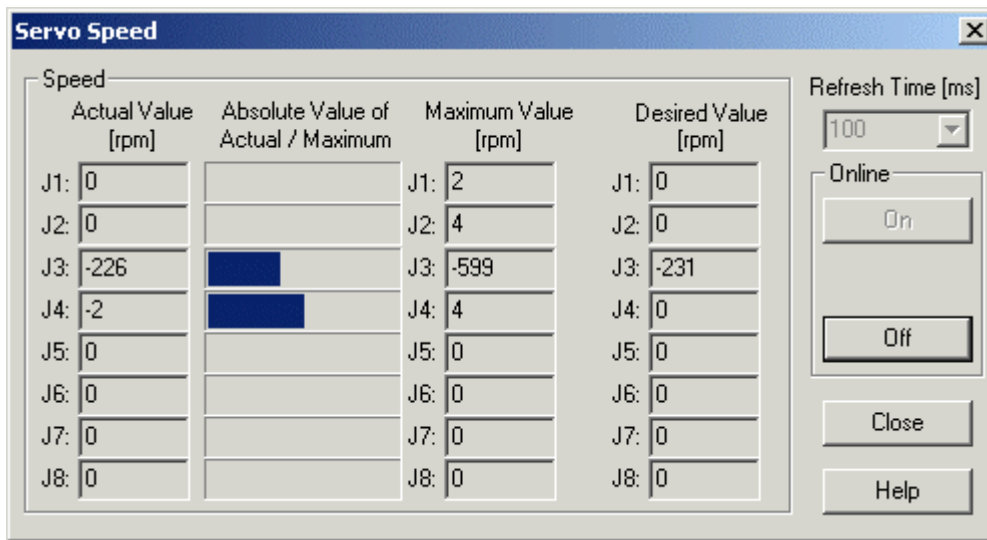
Start your program example and again and open some of the monitors. To open a monitor, double click on the monitor in the folder "Monitors".



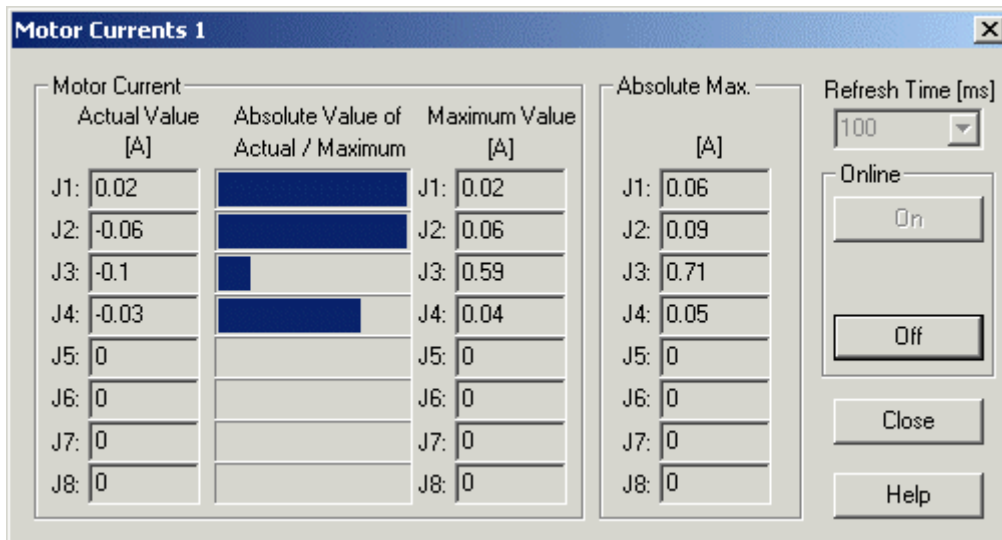
Open the monitor **Robot Position**. Watch the changing joint and world coordinates of the current position as the robot moves.



Open the monitor **Servo Speed**. Observe the changing joint velocities of the robot.



Open the monitor **Motor Current 1**. Observe the changing electric currents of each servomotor.

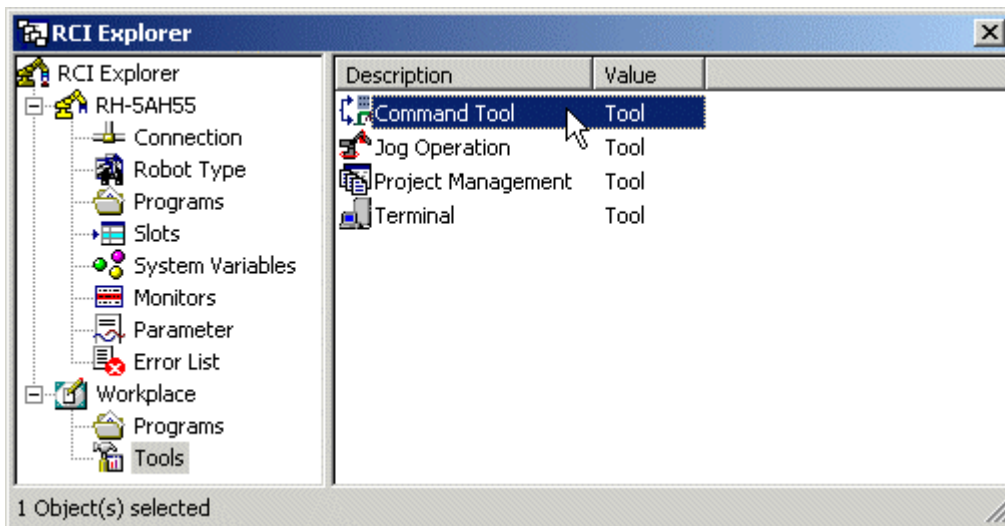


Stop the program. Discover how to send commands directly to the robot.

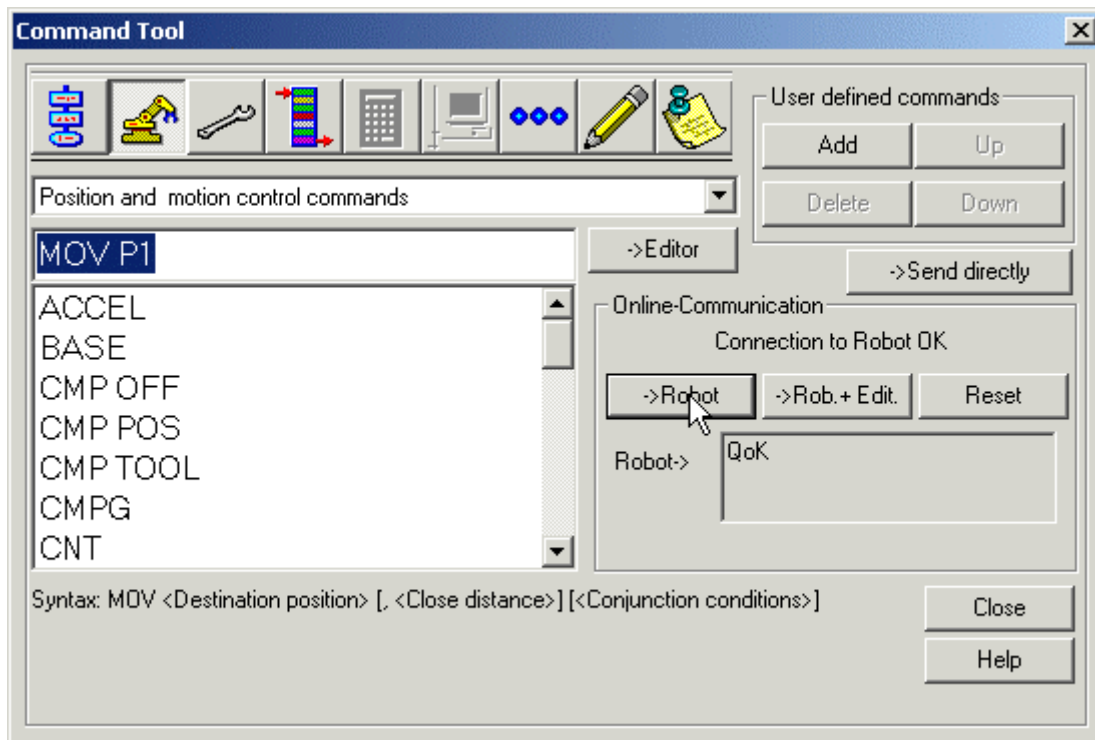
How to Send Commands to the Robot

Read and observe the safety instructions of the SAFETY MANUAL carefully before sending commands to the robot.

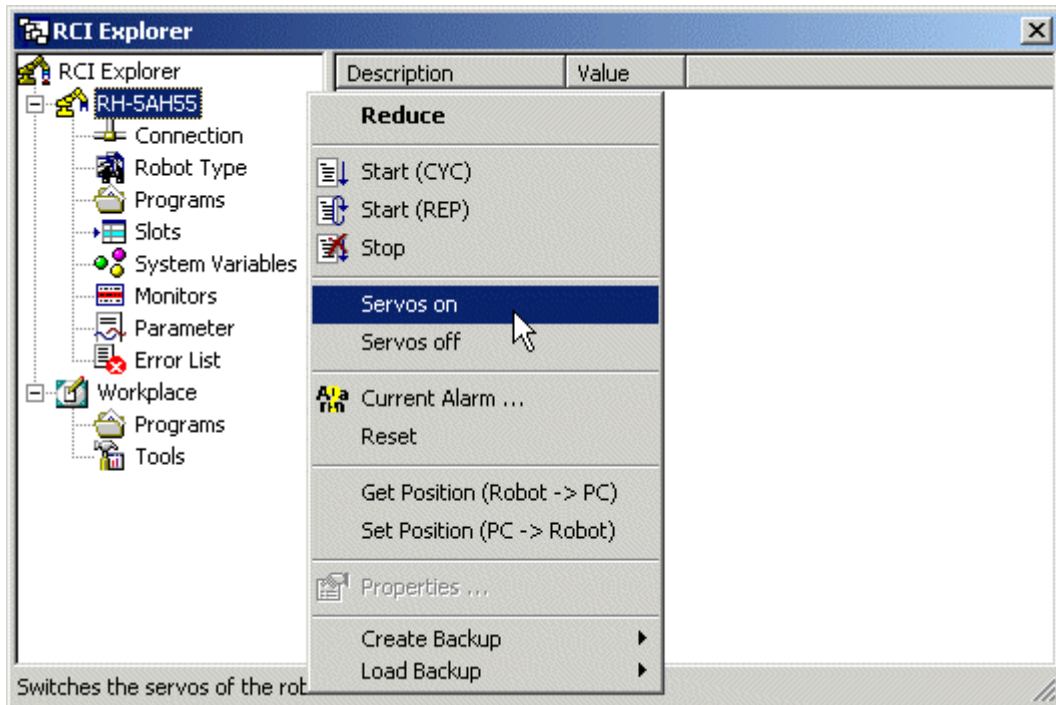
You can interactively send commands to the robot and display the reply of the robot controller with the Command Tool in the "Tools" folder of the RCI Explorer.



Alternatively, you can also open the **Command Tool** with the command **Edit/Command Tool**. Use the Command Tool to send commands to the robot as well as to insert robot commands into a robot program.



In order to test the functionality of the Command Tool, reset the slot contents, first. Then, load your example program "3" into slot 1. Switch on the servo motors of the robot with the command "Servos on" from the context menu of the robot.



Send the motion commands "MOV P1" and "MOV P2" to the robot. The robot will move to the desired positions.

The Command Tool offers a structured list of robot commands and displays a short syntax description for each command. Use the Command Tool to send commands to the robot using the button "->Robot". The current command can either be selected from the command list or entered using the keyboard. The Command Tool remembers the last 20 commands, which have been sent to the robot. Choose the class "Last commands" to display the least recently used commands.

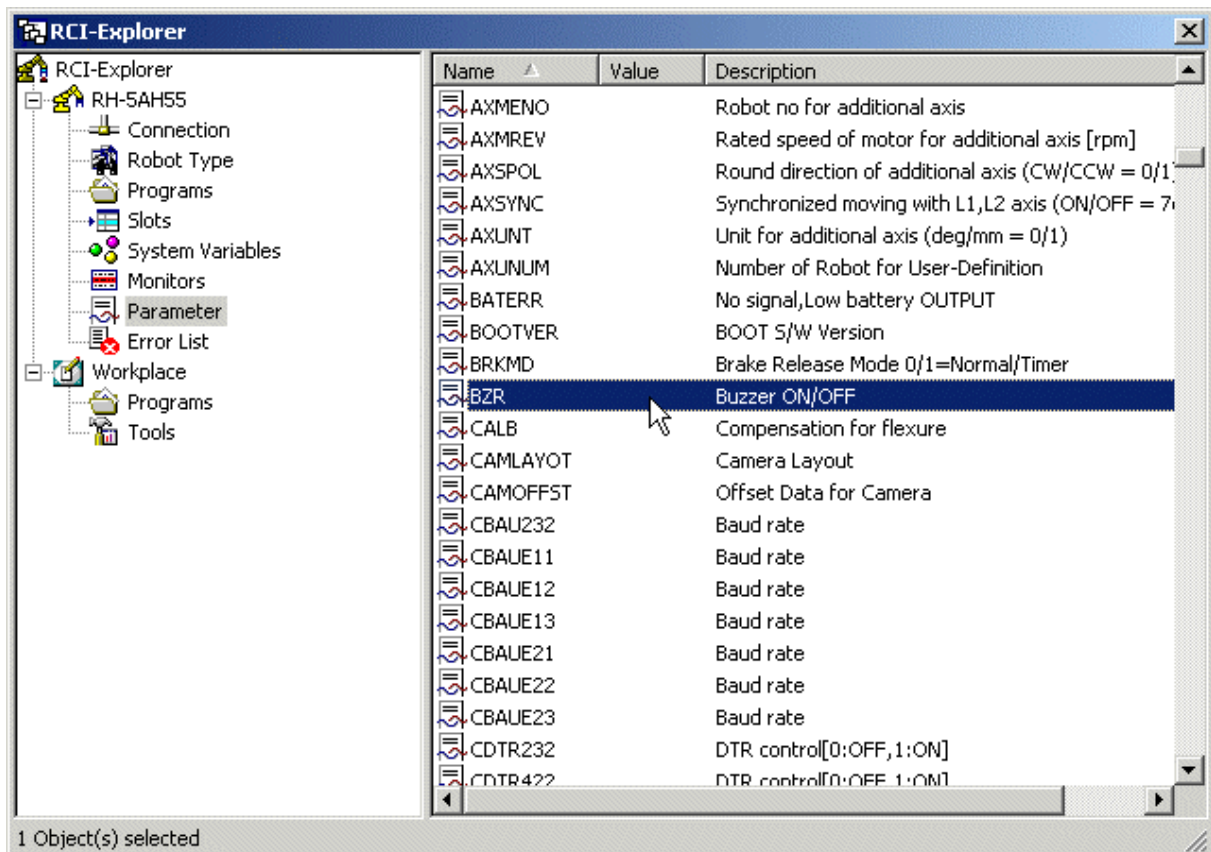
Use the button "->Send directly" only, to communicate with a robot program or if you have detailed knowledge about the communication protocol. This command does not add necessary modifications to the command. Instead, the command is sent as it is. To directly communicate with a running robot program, you can also use the Terminal.

Furthermore, you can build up your own list of favorite commands by using the button "Add" in the group "User defined commands". This list can be displayed by choosing the class "User defined commands". These commands will be stored together with the project.

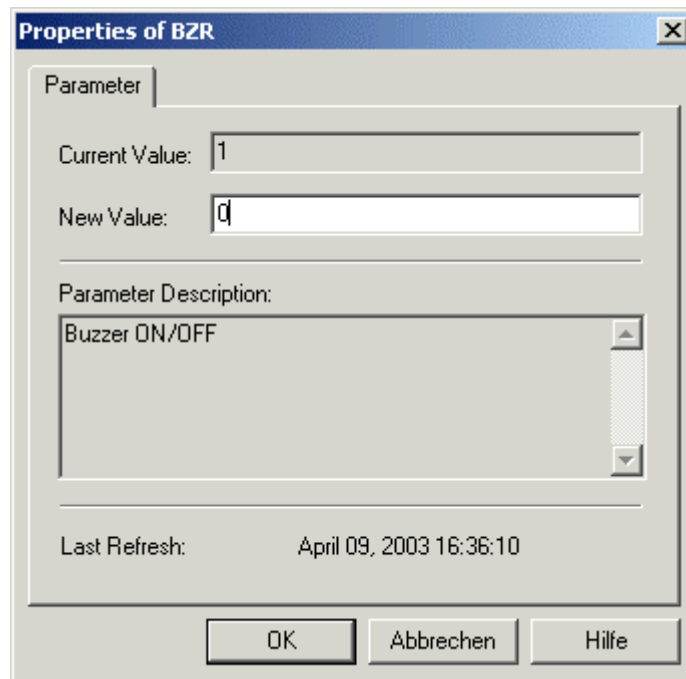
Sometimes, it might be necessary to change internal robot properties. Discover next, how to change robot parameter values.

How to Change Parameter Values

Select the folder "Parameter". If you are using an A series robot (RV-A, RH-AH, RP-AH), then the list of all available parameters is requested from the robot, first. COSIROP requests this parameter list only once. Afterwards it will be used in any further projects with your robot. To change a parameter, open the Properties dialog by double clicking on the parameter. Double click on the parameter "BZR"



Enter a new value for the parameter in the Properties dialog. If you are working with an A series robot (RV-A, RH-AH, RP-AH), be sure to switch the key switch on the robot controller to **Teach**. Set the value of "BZR" to 0 and press the "OK" button.



The setting of "BZR" to 0 switches off the acoustic error signal.

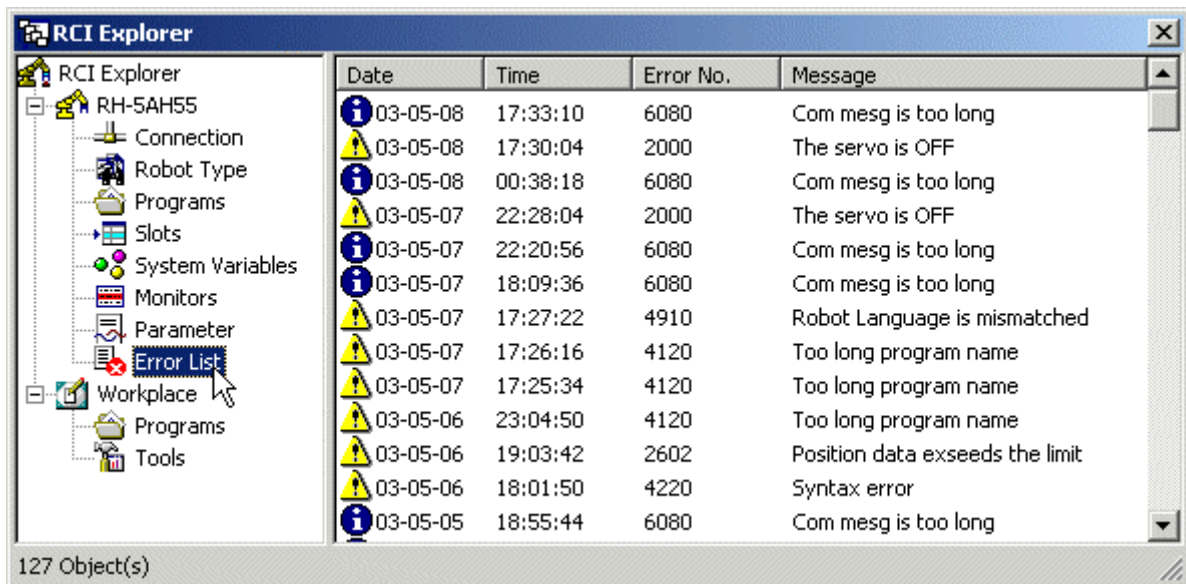
Note, that you have to switch the robot controller off and back on again to confirm the changes.

Change the parameter "BZR" back to 1, switch the controller off and on, and switch the key switch back to **Auto(Ext.)**.

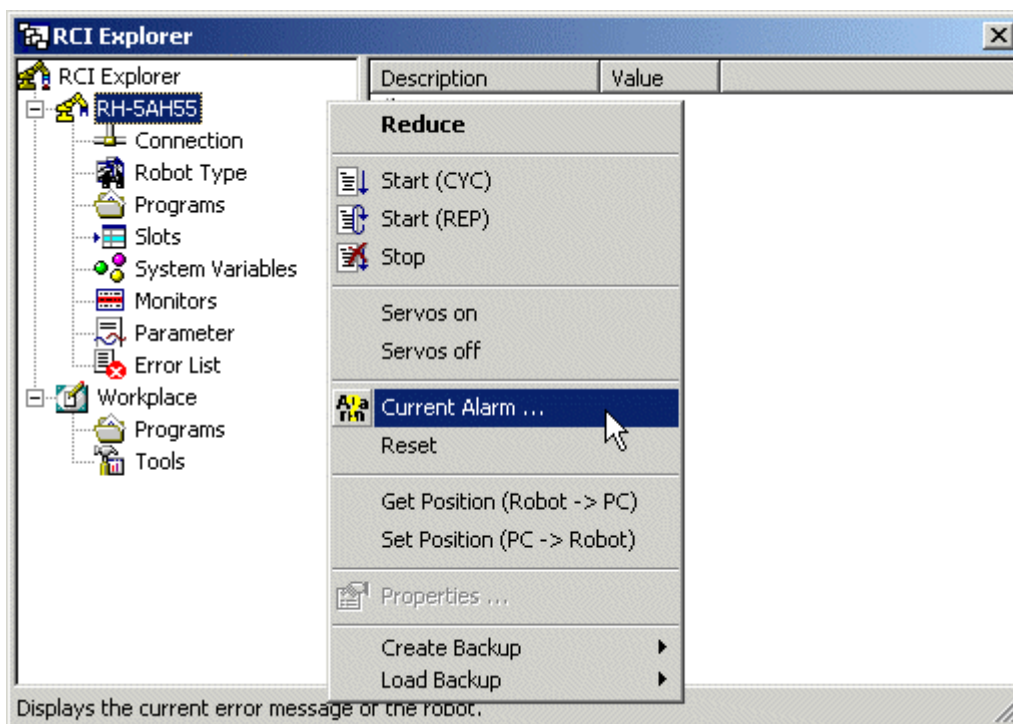
Discover in the next chapter, how to check the last error messages.

How to Check the latest Error Messages

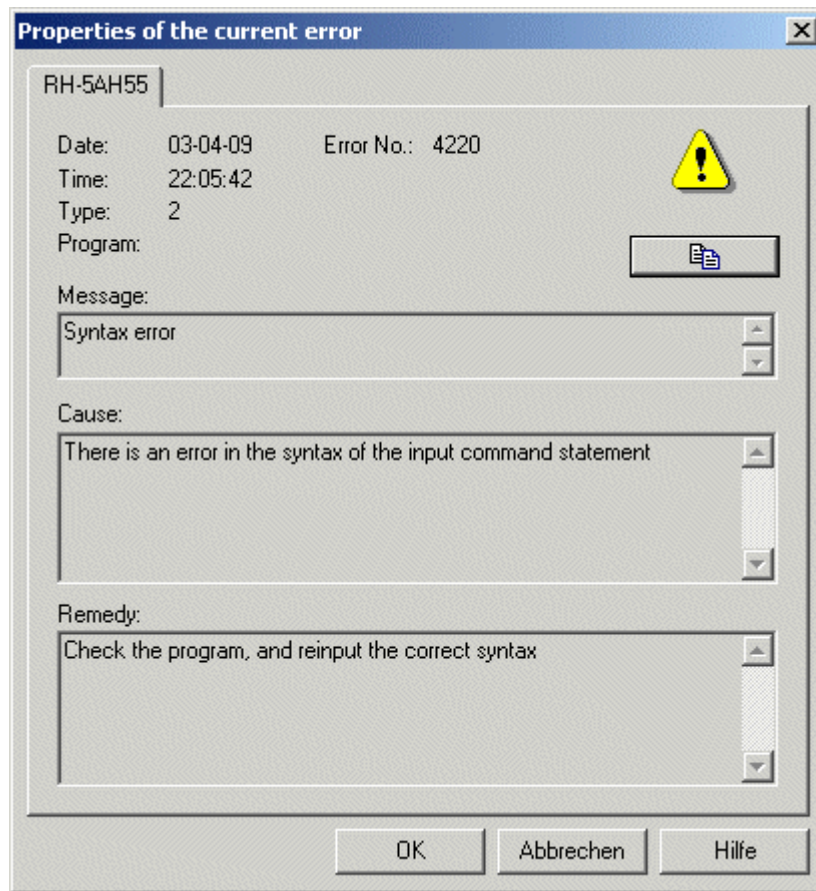
Check the last error messages by selecting the folder "Error List". COSIROP requests the error list from the robot.



Determine the cause of any current error. Select "Current Alarm ..." from the context menu of the robot.



Alternatively, you can determine the cause of any current error with the command Current Alarm in the menu "Execute".

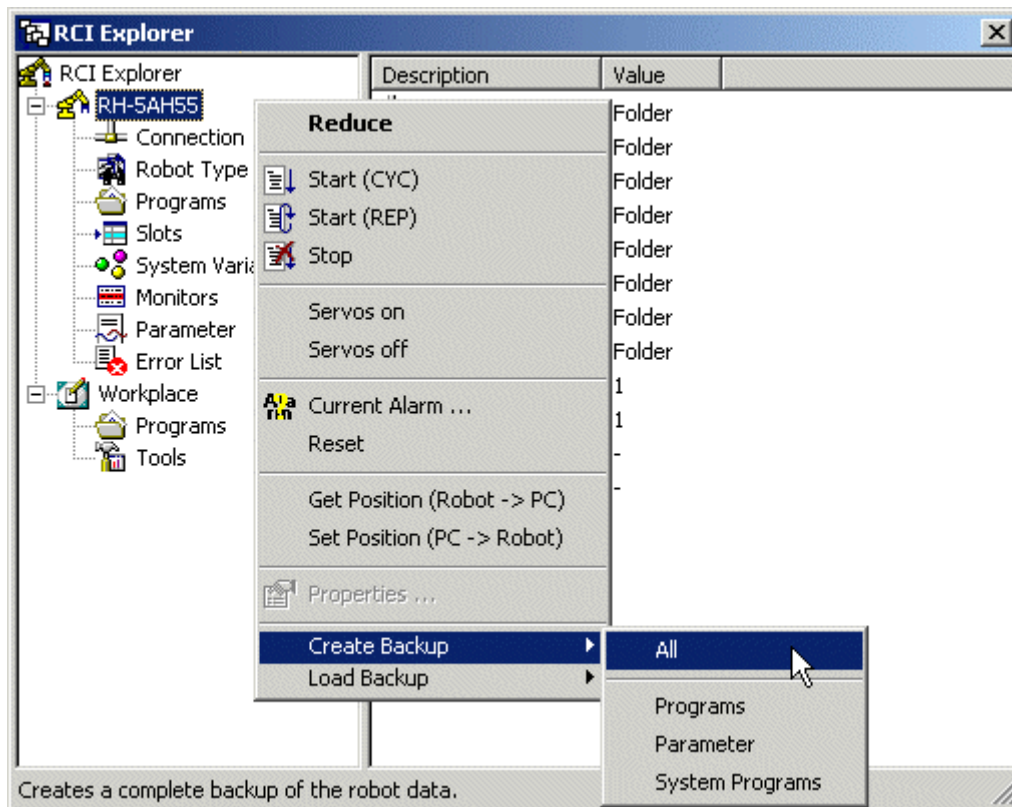


Closing the dialog box "Properties of the current error" with "OK" resets the current error.

Discover next, how to backup your robot controller.

How to Backup your Robot Controller

After you have created a robot project, written programs, and adapted the parameters according to your project, you want to backup your data for future use. Backup the complete data on the robot controller with any robot of the A series (RV-A, RH-AH, RP-AH). Select "Create Backup" -> "All" in the context menu of the robot.



A dialog box pops up. Select a folder for the backup. Be sure to select an **empty folder** for the backup. This backup folder will then contain only files necessary for the backup and none of your PC data will be overwritten during the backup. The backup can take several minutes, especially if there are a lot of programs on the robot controller and you are connected via a slow serial link with the robot.

Store the backup data in a safe place and use it, whenever you need to recover the state of the robot at the backup time. To load a backup, select "Load Backup" -> "All" in the context menu of the robot.

How to Import MELPRO Projects

COSIROP helps you to import existing MELPRO projects. To import MELPRO projects, please do the following:

- At first, create a new project.
- Open the MELPRO project, you would like to import with File/Open... In the dialog box File Open select the file type MELPRO-Program and switch to the directory where your MELPRO project is located. All MELPRO programs that are located in the chosen directory will be shown. Select the MELPRO project you would like to import and open it.
- Mark the complete MELPRO project by selecting either Edit/Select All or CTRL+A. Copy the whole project by selecting Edit/Copy or by using CTRL+C. Switch to the window with the robot program by clicking into the window or by selecting the window with the command Window/1,2,3.... Insert the whole MELPRO project by selecting Edit/Paste or by using CTRL+V. Finally save the robot program by selecting File/Save or by using CTRL+S.
- Afterwards open the MELPRO position list, you would like to import with File/Open... In the dialog box File Open select the file type MELPRO-Position List. All MELPRO position lists that are located in the chosen directory will be shown. Select the MELPRO position list you would like to import and open it.
- Mark the complete MELPRO position list by selecting either Edit/Select All or by using CTRL+A. Copy the whole position list by selecting Edit/Copy or by using CTRL+C. Switch to the window with the MRL position list by clicking into the window or by selecting the window with the command Window/1,2,3.... Insert the whole MELPRO position list by selecting Edit/Paste or by using CTRL+V. Finally save the position list by selecting File/Save or by using CTRL+S.
- You are done. Now you can use the imported project including the position list like any other COSIROP project.

How to Learn about Changes in Version 2.0

- **RCI Explorer:** The **RCI Explorer** is the new information center on the complete robot data. The RCI Explore makes your life easier. It has never been easier to up- and download programs and position lists, to start and stop programs, to change parameters, and to check the last error messages. And with the RCI Explorer it is now even possible to directly switch on and off the servo motors and to generate a complete backup of the controller data
- **Backup:** Generate a complete backup of all your valuable programs, parameter settings, and all robot system data. Save your valuable data and use it in case of an emergency to recover your robot system. (Only available for A series robots (RV-A, RH-AH, RP-AH))
- **Debugger:** Debug your programs online on the robot controller. (Only available for A series robots (RV-A, RH-AH, RP-AH))
- **Setting of Variable Values:** Change variable values with the Variables Monitor. (Only available for A series robots (RV-A, RH-AH, RP-AH))
- **CC-Link Support:** Use the new monitors for input registers, output registers, inputs, and outputs to configure CC-Link communications. (Only available for A series robots (RV-A, RH-AH, RP-AH))
- **Terminal:** Communicate directly with your robot program with the new Terminal. PRINT commands from your robot programs are output to the message window when you communicate via TCP/IP, too.

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