# ER-MicroCIM
# User's Manual

Second Edition

Catalog No. 100095 - Revision B

Catalog #100095 Rev.B

(June 2000) Reprinted/PDF version

# 1 Table of Contents

# 1 Introduction

*Read this manual thoroughly before you install or operate the **ER-MicroCIM**.*

## 1.1 About ER-MicroCIM

The **ER-MicroCIM** system demonstrates the integration of various educational disciplines which are usually taught independent of one another. These technologies include robotics, electronics, pneumatics, programmable logic controllers, sensors, machine vision, barcodes, software programming, manufacturing processes, and others.

The **ER-MicroCIM** system is a turn-key, hands-on training installation. It enables direct user access to each component in the integrated system, thus serving to teach the fundamentals of each individual subject.

The system has been designed for centrally controlled assembly of a cylinder within a base. Production orders are defined by the user. A machine vision system performs quality control inspections of the cylinders.

Based on the **Open-CIM** software package, the **ER-MicroCIM** system can be expanded to form a larger computer integrated manufacturing (CIM) system, thereby providing a greater number of applications, and a more comprehensive emulation of a modern manufacturing environment.

## 1.2 Safety

Before installing or operating the **ER-MicroCIM**, make sure you have read and understood **all safety guidelines and warnings in the user manuals supplied with the robot/controller** and other system devices.

*Make sure you heed safety warnings at all times!*

To immediate abort all **ER-MicroCIM** activities:

- Press the EMERGENCY button on the **ER-MicroCIM** Control Panel.

  This will abort the PLC and the ACL controller, thereby halting all conveyor and robot movement.

  *Note*: The program EMERG (which is activated automatically when the software is loaded) must be running in the background; otherwise, pressing the EMERGENCY switch will have no effect. (See Chapter 5.)

To immediate abort all robot programs and motion, do one of the following:

- Press the **Abort** key on the teach pendant, or
- Use the ACL command **A [Enter]** or **[Ctrl]+A**, or
- Press the controller's red EMERGENCY button.

## 1.3 About this Manual

This manual describes the components, installation, operation and maintenance of the **ER-MicroCIM** system.

This manual is organized into the following sections:

- Introduction
- Operation Scenario
- System Components
- Installation
- Preparation for On-Line Operation
- User System Operation
- Advanced System Operation
- Technical Data
- Maintenance and Repairs
- Suggested Study Topics

# 2 Operation Scenario

The **ER-MicroCIM** system is preprogrammed to perform the production sequence described below. Users can define the parts, machining processes, and orders, resulting in different production sequences. Robotic (ACL) programs can also be added and modified.

1. The robot takes a template holding a plexiglass base from the ASRS rack, and brings it to the barcode reader.
2. The template's identification code is scanned by the barcode reader.
3. The robot places the template on the loading buffer (Buffer 1).
4. The robot takes a cylinder from the parts feeder, and inserts it into the base on the template at the loading buffer/assembly jig.
5. The robot places the template onto a conveyor pallet. The pallet carries the template with the assembled product, CIM_PROD, to the vision station.
6. Without being removed from the conveyor, CIM_PROD is scanned by the vision system.
7. The vision (quality control) inspection has either of two results:
   - If the ✓ side of the cylinder is facing up, the assembly passes the inspection.

     The pallet is released from the vision station, and the template with CIM_PROD is returned to the ASRS/Assembly Station.
   - If the **x** side of the cylinder is facing up, the assembly fails the inspection.

     As soon as the system determines a failed assembly, production of a new CIM_PROD begins immediately. The pallet carrying the failed assembly is released from the vision station and travels around the conveyor until the robot is free. When the robot is free to unload the template, the pallet is halted at the ASRS/Assembly workstation.
8. The robot takes the template from the conveyor, and places it on the unloading buffer (Buffer 2).
9. Depending on the result of the the vision (quality control) inspection, either one of the following will occur:
   - If CIM_PROD has passed inspection, the robot takes the assembly from Buffer 2 to the palletizing (finished parts) rack.
   - If CIM_PROD has failed inspection, the robot takes the assembly from Buffer 2 to the trash bin.
10. The robot returns the empty template from Buffer 2 to the ASRS rack.
11. The robot takes a new template with plexiglass base, and begins another production cycle, if required by the production order.

# 3 System Components

## 3.1 Prerequisites

To install and operate the **ER-MicroCIM** system, your facility must provide the following items:

- CIM Manager PC
  - Hardware Requirements: 486, 66MHz, with at least 16MB RAM; at least 30MB available disk space; VGA display adapter; 2 RS232 ports; BUS mouse.
  - Software Requirements: DOS 6.2 or later; Windows for Workgroups 3.11. English versions recommended.
- Vision PC
  - Hardware Requirements: 486, 33MHz, with at least 4MB RAM; at least 4MB available disk space; VGA display adapter; 2 RS232 ports;
  - Software Requirements: DOS 6.2 or later
- 2 Monitor/Keyboard Desks: one desk must be large enough for two monitors (the Vision PC monitor and the video monitor).
- Compressed Air supply: 5-7 bar; 6mm inlet
- AC Power supply and power outlet strip with on/off switch and 6 outlets.

Make sure the voltage settings on the **ER-MicroCIM** equipment match your power supply.

*To ensure proper functioning of the CIM and vision software, be sure your PCs do not contain any additional expansion cards, particularly multimedia, sound and communication cards.*

## 3.2 Documentation

A number of publications are provided with the **ER-MicroCIM** system. The following is the list of publications you will need for working with the system:

- *ER-MicroCIM User's Manual* (Catalog #100095)
- *Open-Cim User's Manual* (Catalog #100094)
- *SCORBOT-ER Vplus User's Manual* (Catalog #100016)
- *ACL for Controller-A Reference Guide* (Catalog #100083)
- *ATS for Controller-A Reference Guide* (Catalog #100084)
- *ACLoff-line User's Manual* (Catalog #100051)
- *ROBOTVISIONpro User's Manual* (Catalog #100062)

- *SLC 500™ Module Hardware Style Installation and Operation Manual*, Allen-Bradley (U.S.A. only); or
  *CQM1 Programmable Controllers Operation Manua*l, OMROM (all countries except U.S.A.)

## 3.3 Software

The **ER-MicroCIM** system contains the following software:

- ER-OpenCIM version 1.4
  - Six 3.5" 1.44MB diskettes, including ATS and ACLoff-line software.
  - HASP-3 DEOAX white software protection plug.
- ROBOTVISIONpro version 2.4
  - One 3.5" 1.44MB diskette
  - Gray software protection plug.

## 3.4 Hardware

The **ER-MicroCIM** system contains the following hardware:

- Conveyor
  - Closed loop, monorail conveyor.
  - Pallet tracking devices; magnetic sensors, and pneumatic pistons for halting and releasing pallets at station.
  - Programmable Logic Controller (PLC).
  - 2 Pallets.
- Robot Station
  - SCORBOT-ER Vplus robot.
  - Controller-A: Advanced Control Language (ACL version 1.44) command environment (programmed onto an EPROM within the controller). Equipped with auxiliary RS232 communication card.
  - Teach pendant, connected to the controller, for immediate, hand-held access to the controller, especially useful for teaching positions.
  - 2 Buffers; Buffer 1 serves as an assembly jig.
  - ASRS Rack with 6 cells; 6 templates.
  - Palletizing Rack, for assembled parts.
  - Trash Bin, for rejected assemblies.
  - Barcode Reader, for template identification.
  - Parts Feeder; pneumatic-gravity operation.
  - 10 plexiglass bases and 10 aluminum cylinders.

- Vision Station
  - EV681  8-bit frame-grabber
  - RS170 video camera.
  - Composite RS170 video monitor.

# 4 Installation

The installation procedures will be performed in the following order:

- Hardware assembly
- Wiring
- Software installation
- Teaching robot positions
- Stand-alone testing and adjustment of devices.

## 4.1 Unpacking

Before installing the **ER-MicroCIM**, examine it for signs of shipping damage. If any damage is evident, contact your freight carrier, and begin appropriate claims procedures.

Make sure you have received all the items listed on the shipment's packing list. If anything is missing, contact your supplier.

## 4.2 Setup

Place the **ER-MicroCIM** table within reach of the power supply and the air supply.

For personal safety and sufficient access to the **ER-MicroCIM** from all sides, a free area of at least 1 meter around the table is recommended.

## 4.3 Hardware Assembly

Assemble and install the components in the order presented below. Refer to Figures 1 and 2.

*Be sure you comply with all safety guidelines and warnings in the user manuals supplied with the robot, controller and other devices.*

*Do not make any cable connections unless instructed to do so. Wiring procedures appear in the next section.*

### 4.3.1 Pneumatic Parts Feeder

The base of the feeder is pre-mounted on the **ER-MicroCIM** table. Four screws have been placed in this base.

1. Attach the feeder chute to the base by means of the four screws.
2. As you tighten the screws, adjust the spacing between the two sides of the chute, to allow the aluminum cylinders to fall freely into the base.

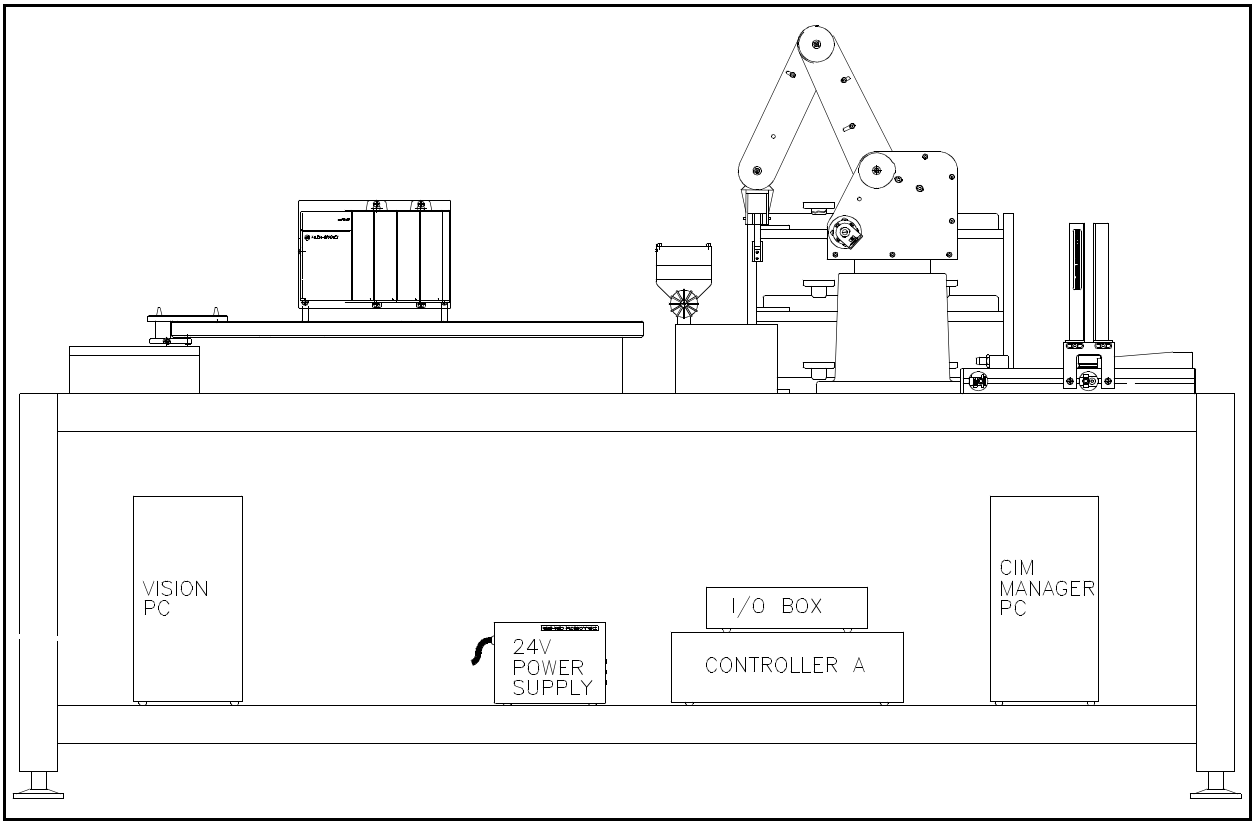



*Figure 1: Installation Layout - Side View*

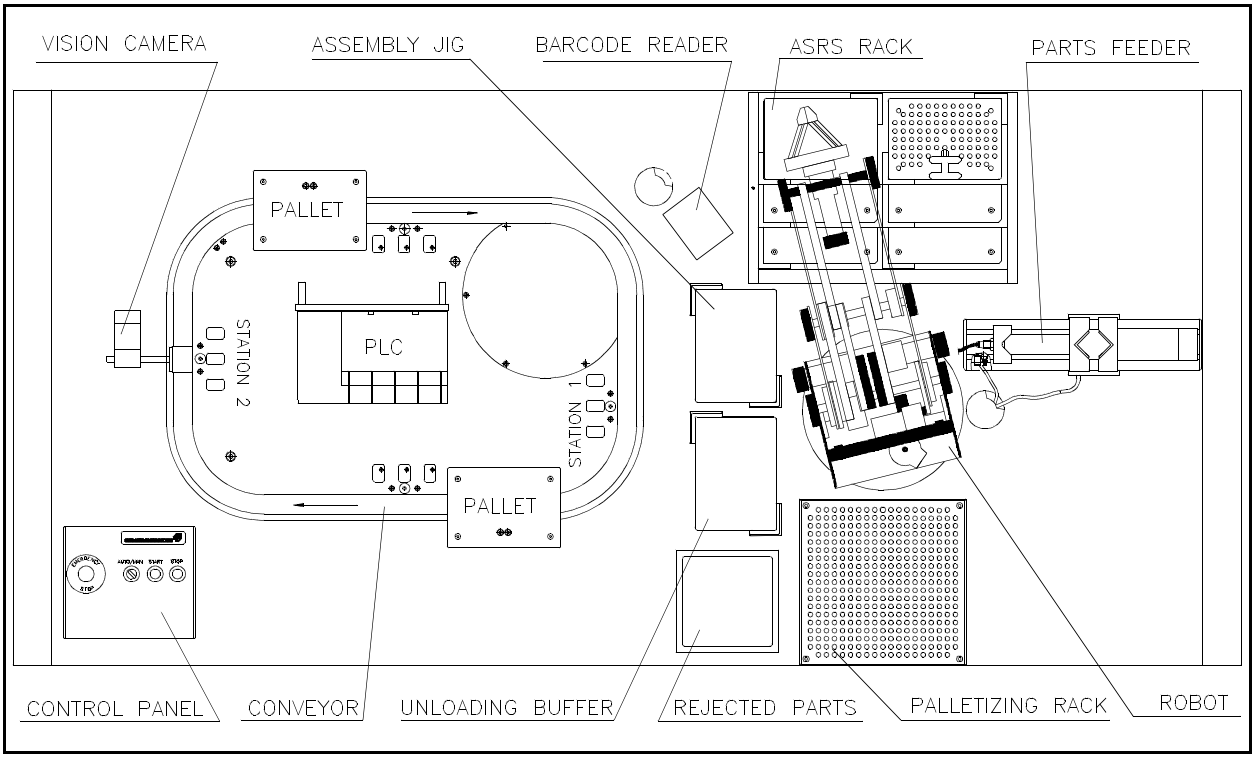



*Figure 2: Installation Layout - Top View*

### 4.3.2 SCORBOT-ER Vplus Robot

Six mounting holes for the robot are predrilled in the **ER-MicroCIM** table. Bolts and nuts have been placed in these holes.

1. Mount the robot on the **ER-MicroCIM** table, according to the installation instructions in the robot's *SCORBOT-ER Vplus User's Manual*.

   Position the robot with its cable facing towards the hole in the table.

2. Remove the D50 connector from the end of the robot cable. Insert the cable through the hole in the table. Reattach the D50 connector to the cable.

### 4.3.3 Controller-A

1. Remove the four screws on the controller cover, and lift it off.
2. Install the auxiliary (multi-port) communication card in the controller, according to the instructions in the *SCORBOT-ER Vplus User's Manual*.
3. Connect the I/O box to the ACL controller, as follows. Refer to Figure 7.
   - Make sure the ribbon cable is plugged into the connector marked "Controller (Type A)" in the I/O box.
   - Thread the ribbon cable from the I/O box through one of the open slots on the controller's rear panel.
   - Plug the ribbon cable connector into the I/O connector, which is located between the controller's power/motor switches and transformer.
4. Replace the cover of the controller and tighten the screws.
5. Place the controller on the shelf under the table.
6. Connect the robot and the controller, as follows:
   - Connect the robot's D50 connector to the controller.
   - Connect the teach pendant to the controller.

### 4.3.4 ASRS

Four mounting holes for the ASRS are predrilled in the **ER-MicroCIM** table. Four screws have been taped to the table next to these holes.

Align the ASRS rack with the mounting holes on the table. Using the four screws provided, attach the ASRS rack to the table.

### 4.3.5 Barcode Reader

Two mounting holes for the barcode reader are predrilled in the **ER-MicroCIM** table. Two bolts and nuts have been placed in the holes.

1. Align the holes and the barcode reader stand. Using the two bolts and nuts, attach the stand to the table.

2. Attach the barcode reader to its stand, using the four screws provided with the barcode reader.

   *Make sure the barcode scanner window faces the robot.*

3. Insert the barcode reader cable through the hole in the table.

### 4.3.6 Conveyor Pallets

The conveyor is pre-mounted on the **ER-MicroCIM** table.

Place the two pallets supplied with system anywhere along the conveyor with the arrow on the pallet pointing in the direction of movement of the conveyor.

### 4.3.7 Templates

1. Apply the barcode stickers to the templates, on the side opposite the handle.
2. Using the 11.4mm and 12.7mm metal pins supplied with the system, prepare the six templates for carrying the cylinder-in-base assemblies.

   Figure 3 shows the arrangement of the pins on a template. Make sure the pins are arranged identically on each template.

### 4.3.8 Palletizing (Finished Parts) Rack

Using the 10.1mm and 12.7mm metal pins supplied with the system, prepare the palletizing rack for holding the cylinder-in-base assemblies.

Make sure the pins are arranged identically for each grid.

Figure 4 shows the arrangement of the pins on the rack.

### 4.3.9 Computers

1. Install the frame grabber card in the Vision PC. Follow the instructions in the *ROBOTVISIONpro User's Manual*.
2. The computers may be placed on the shelf under the **ER-MicroCIM** table. The CIM Manager PC should be placed to the right of the ACL controller, and the Vision PC should be placed to the left of the controller.
3. Make sure the cables from the equipment on the **ER-MicroCIM** table can reach the computers.
4. Make sure the cables from the monitors and the inputs devices can reach the computers. Connect the monitor, keyboard and mouse for each computer.

### 4.3.10 Vision

Three mounting holes for the camera stand are predrilled in the **ER-MicroCIM** table. Three bolts and nuts have been placed in these holes.

1. Align the holes and the base of the camera stand, and attach.
2. Attach the lens to the camera.

3. Attach the camera to the stand.
4. Place the video monitor on the desk next to the Vision PC monitor.

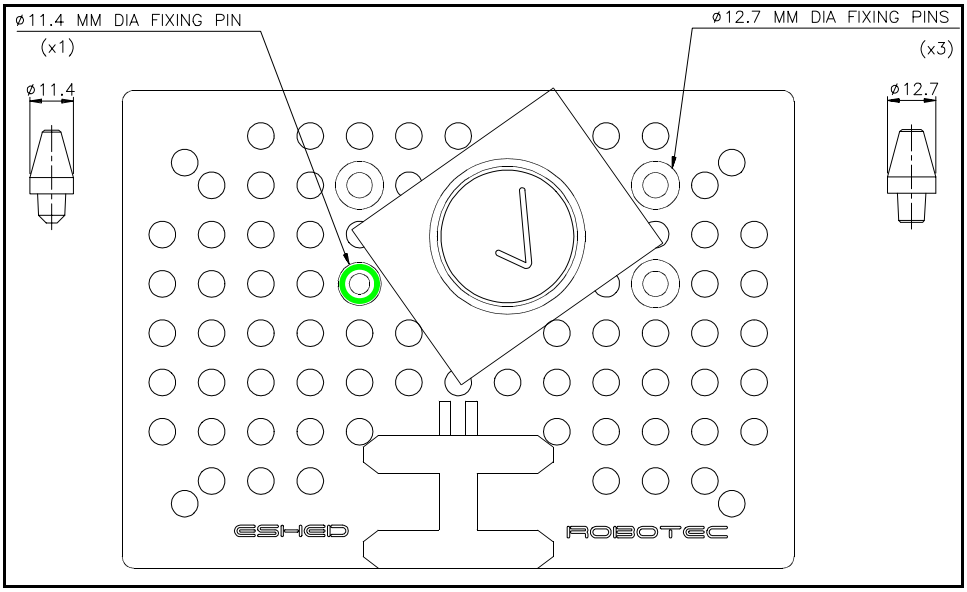



*Figure 3: Layout of Pins on Template*

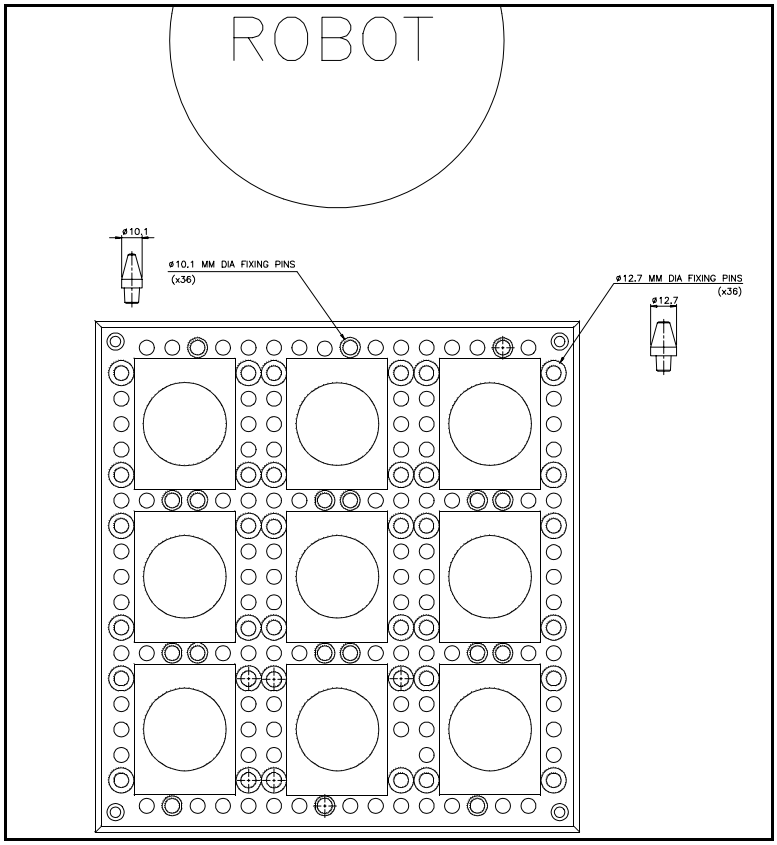



*Figure 4: Layout of Pins on Palletizing Rack*

## 4.4 Wiring

Refer to Figures 5, 6 and 7.

Refer also to Section 8.3, "Wiring, " for additional technical data.

1. Connect the HASP-3 (white) software protection plug to the parallel port on the CIM Manager PC.
2. Below the **ER-MicroCIM** table you will find the RS232 cable from the PLC. Connect the D25 female connector to COM1 on the CIM Manager PC.
3. Connect the RS232 cable (#ER40035) to the ACL controller's RS232 port and to COM2 on the CIM Manager PC.
4. Connect the braided RS232 cable (#ER40120) to the controller's auxiliary communication card connector.
5. Using the braided cable, connect COM1 from the controller communication card to COM2 on the Vision PC. (If COM1 on the Vision PC is available, use COM1 instead of COM2.)
6. Connect COM2 from the controller communication card to cable #ER40084. Connect this cable to the barcode reader.
7. Connect the DC cable from the barcode power supply unit to the round plug on the side of the barcode reader's D-type connector.
8. Connect the power cord from the barcode transformer to the ACL controller's power outlet.

   (If the barcode reader has not been setup by a service technician, refer to the instructions in the Section 8.5, "Barcode Reader Setup."
9. Under the table you will find wires with orange terminal blocks.
   Open the I/O Box and connect these terminals as follows. Refer to Figure 7.
   - Connect terminal J10 to Input (Block C) J10.
   - Connect terminal J11 to Input (Block C) J11.
   - Connect terminal J2 to Output (Block A) J2.
   - Connect terminal J1 to User Power Supply J1.
10. Connect the camera and the video monitor to the frame grabber card, according to the instructions in the *ROBOTVISIONpro User's Manual*.
11. Make the following power supply connections:
    - Connect the controller to the AC power supply.
    - Connect the conveyor transformer to the AC power supply.
    - Connect the computers to the AC power supply.
    - Connect the video monitor to the AC power supply.

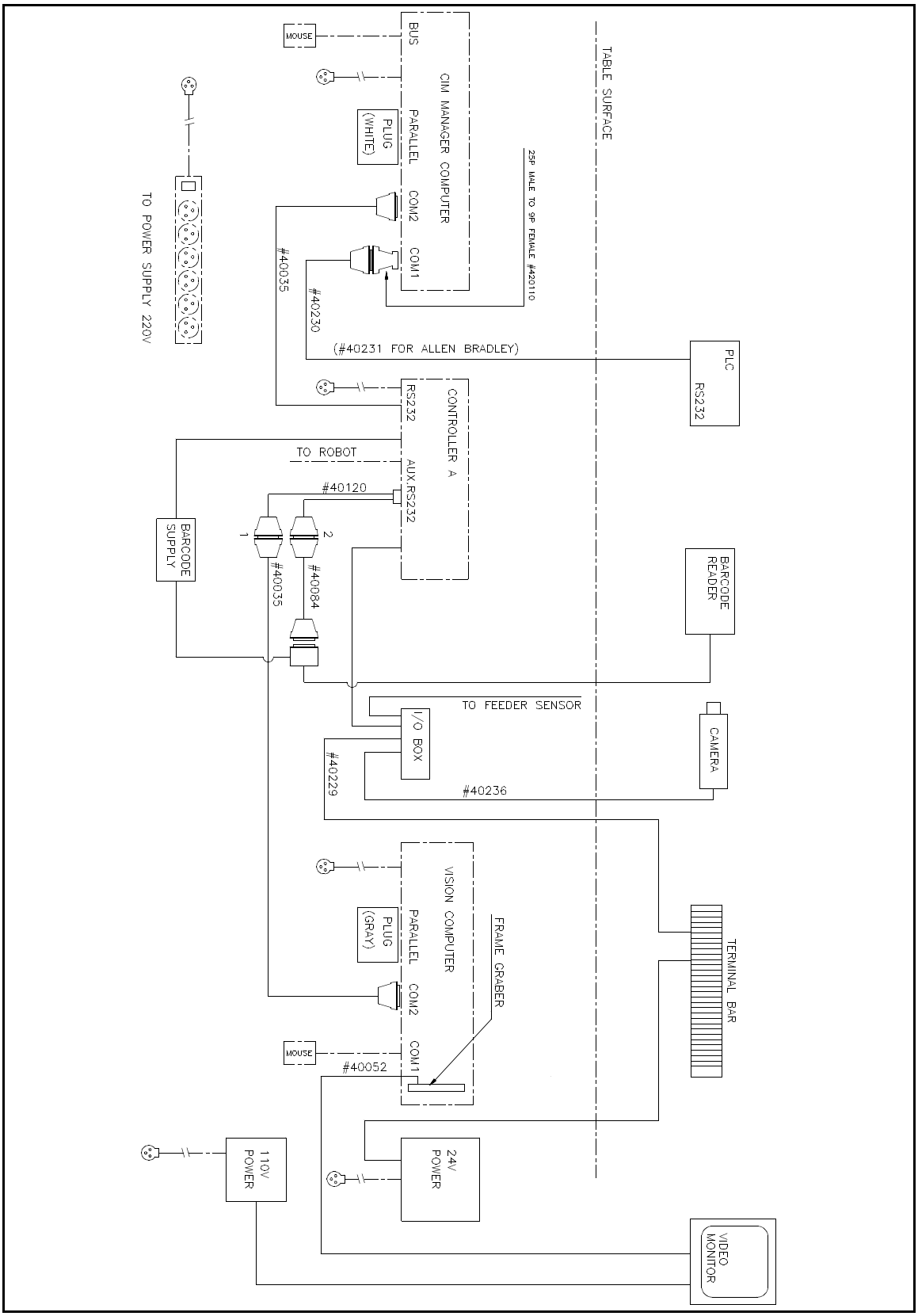



*Figure 5: ER-MicroCIM Wiring*

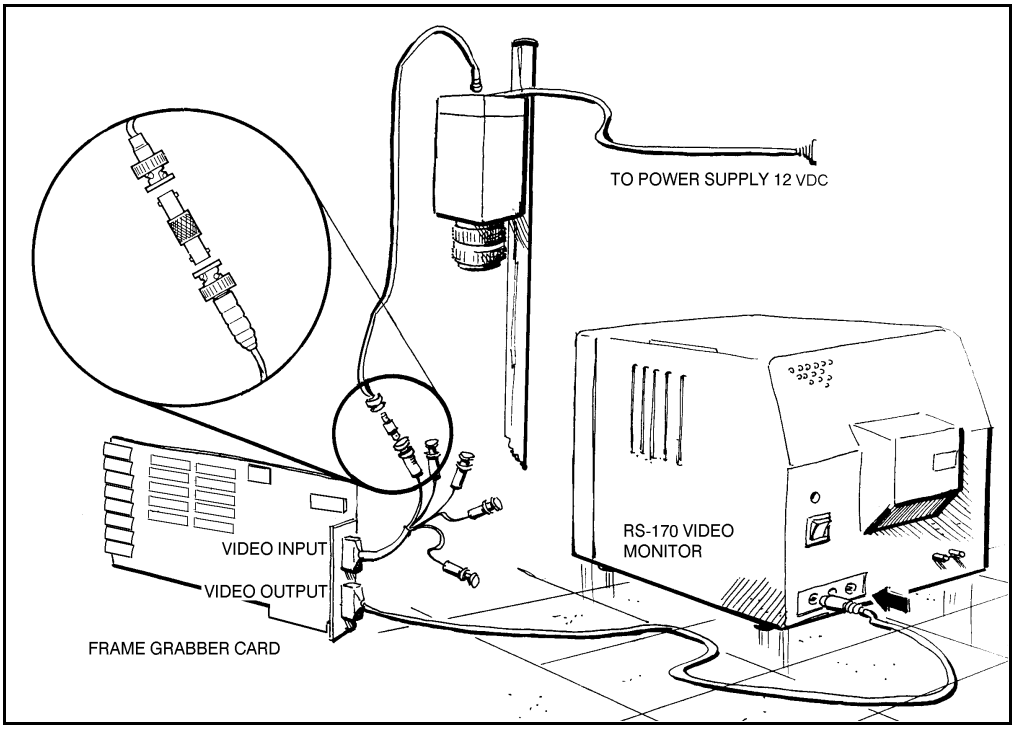



*Figure 6: Vision System Cable Connections*

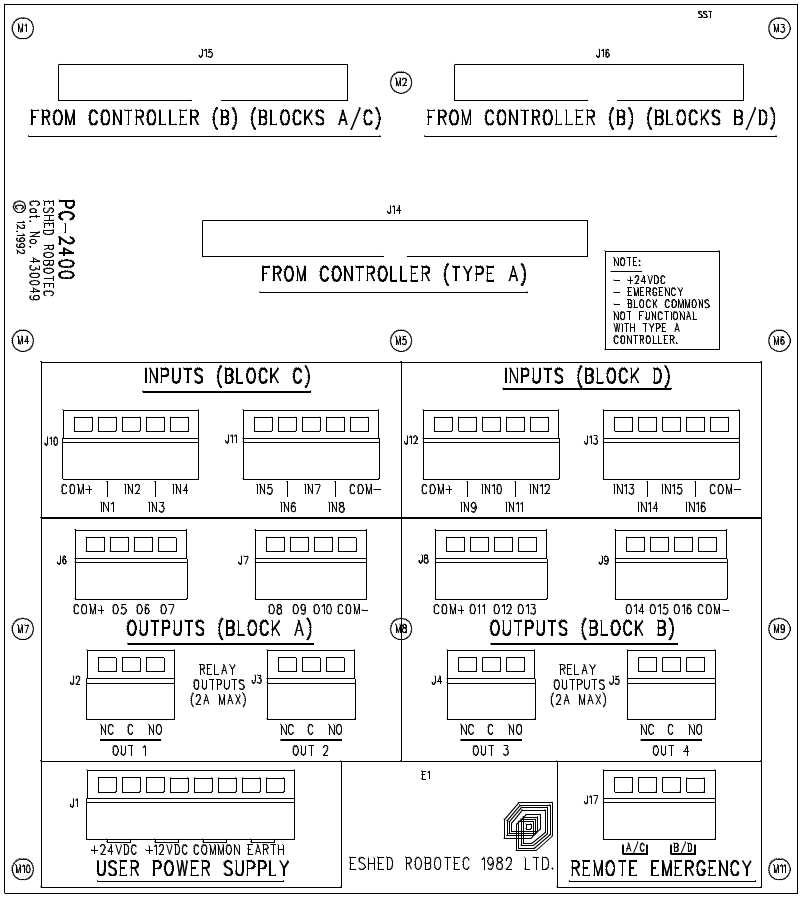



*Figure 7: I/O Box Connectors*

## 4.5 Software Installation

The software installation procedures will be performed in the following order:

- Installation of the **ER-MicroCIM** version of the **Open-CIM** software, on the CIM Manager PC.
- Installation of the **ROBOTVISIONpro** software, **ACL for ACL controller** version, on the Vision PC.
- Configuration of the ACL controller and downloading of data to controller.

### 4.5.1 ER-MicroCIM Installation

Perform the installation from the DOS environment.

*Note*: Software can only be installed to drive C:.

*Note*: During the installation a file named W.BAT is written to drive C:. If a file of that name already exists, rename it before you begin the installation.

1. Insert disk 1 of the **Open CIM** software into the floppy drive of the CIM Manager PC and type: `INSTALL [Enter]`

   You will be prompted to insert the remaining disks.

2. When the installation is complete, type: `C:\>W [Enter]`

   W.BAT is written to C:\ during the installation. This batch file will load Windows for Workgroups without network drivers.

3. From the Windows Program Manager, select File | New | Group in order to add seven new groups to your Program Manager. Be sure to include the complete path in the Group File field:

   | | |
   |---|---|
   | `C:\opencim\microcim\ws0\ws0.grp` | (manager for system supervisor) |
   | `C:\opencim\microcim\ws0\user.grp` | (manager for user) |
   | `C:\opencim\microcim\ws1\ws1.grp` | (activates workstation 1) |
   | `C:\opencim\microcim\ws1\ws1r.grp` | (robot programs at workstation 1) |
   | `C:\opencim\microcim\ws1\ws1sys.grp` | (system operation at workstation 2) |
   | `C:\opencim\microcim\ws2\ws2.grp` | (activates workstation 2) |
   | `C:\opencim\microcim\ws2\ws2sys.grp` | (system operation at workstation 2) |

   Do not enter any text in the Description field. It has already been defined.

4. Copy all the files in the subdirectory C:\OPENCIM\WIND! to C:\WINDOWS.

5. Find the **Computer Name** of the CIM Manager PC. It is defined in the Windows **Control Panel | Network | Computer Name** or in the string **ComputerName=** under the heading [Network] in the SYSTEM.INI file in the C:\WINDOWS\SYSTEM directory. If the Computer Name does not exist, you must create it by editing the SYSTEM.INI file.

6. In the files C:\OPENCIM\MICROCIM\SETUP*.MAP, change all instances of the string WUSER8 to the name of the CIM Manager PC.
7. Create two mailslots and send a message from one to the other. Make sure only one message is received. Refer to the *Open-CIM User's Manual*. (Note that you must use the format \MAILSLOT\NAME! when creating more than one mailslot on one PC.)

### 4.5.2 ROBOTVISIONpro Installation

Install the ROBOTVISIONpro software according to the instructions in the *ROBOTVISIONpro User's Manual*, and the following:

1. Accept the default path **C:\RVPRO** as the software directory for the installation.
2. When you are prompted for the **Robot Type**, select **ACL for ACL controller**.
3. When you are prompted to run the **SETUP** program, click on **No**. The installation will end and exit to DOS.
4. Copy the file C:\OPENCIM\MICROCIM\WS2\RVPWKS\MICROCIM.WKS from the CIM Manager PC to the directory C:\RVPRO in the Vision PC.

### 4.5.3 ACL Controller Configuration

1. From DOS in the CIM Manager PC, activate Windows for Workgroups without network drivers. Type:

   ```
   C:\>W [Enter]
   ```

2. Open the **Robot Programs WS1** group window. See Figure 8.

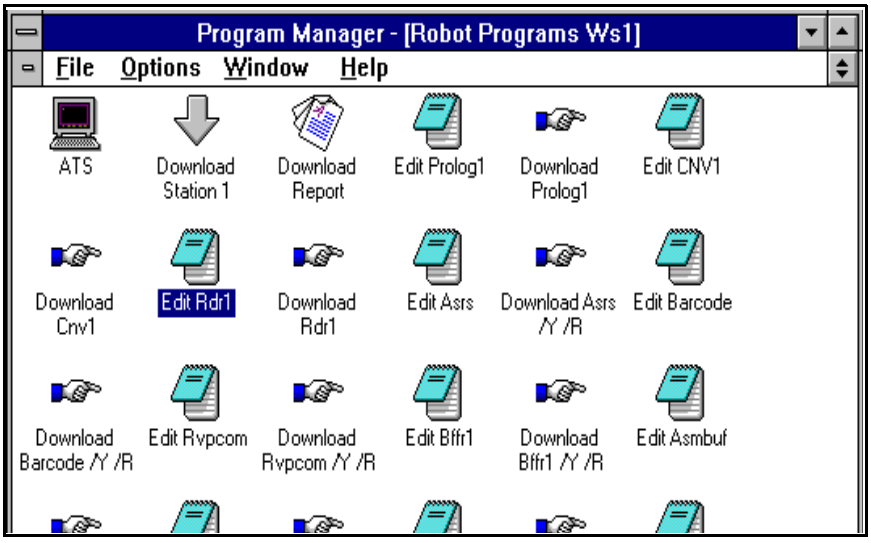



*Figure 8: Robot Programs at Workstation 1 Group Window*

Click on the **ATS** icon. The ATS main screen will open.

3. Press [Ctrl]+F1 to configure Controller-A.

   Press Y to confirm the prompt to configure the controller.

You are then prompted by a short series of Controller Configuration options. See Figure 9.

`Robot type: ER V / ER Vplus / ER VII / OTHER`

Make sure **ER-Vplus** is selected, and press [Enter].

`How many axes are installed (8)? ..`

Type **6** and press [Enter].

`Is expanded memory installed?(Y/N)?Y`

Press **Y** or [Enter].

`Does the controller have an auxiliary RS232 board?(Y/N)?N`

Press **Y**.

```
Working directory is: C:\opencim\microcim\ws1\robot1
Is this correct (Y/N)?Y
```

Press **Y** or [Enter].

```
WARNING! ...
ARE YOU SURE (Y/N)?N
```

Press **Y**.

ATS will now perform the configuration.

You can ignore the message about the missing SETUP.PAR parameter file.

4. When the > prompt appears, press [Shift]+F10.
   The ATS Backup Manager screen will open. Make the following selections and entries:

   `Backup directory:C:\opencim\microcim\ws1\robot1`

   Make sure the path correctly shows the working directory defined during the configuration, as shown here.

   `Backup / Restore: ALL`

   Use the arrow keys to highlight ALL and press [Enter].

   `During Restore: ERASE.`

   Use the arrow keys to highlight ERASE and press [Enter].

   `File name: all`

   Type **all** and press [Enter].

   Press [Enter] again. Press **F5** to **RESTORE from disk**.

   Press Y to confirm all prompts to overwrite and erase.

   This file named ALL.CBU will now be downloaded from the CIM Manager PC to the ACL controller. This file contains all programs, positions and parameters required for controller operation in the **ER-MicroCIM** environment.

## 4.6 Teaching Robot Positions

In this part of the installation, you will adjust the values (coordinates) of the positions which were downloaded to the controller.

*Note*: Downloading the ALL.CBU file changed the value of controller parameter PAR 52. The default PAR 52=0 is changed to PAR 52=4214. Before you record robot positions for the **ER-MicroCIM**, you should check the value of parameter 52 by entering the ACL command:

```
SHOW PAR 52
```

1. The teaching of robot positions is performed from **Robot Program WS1 | ATS**.
2. Enter the ACL command:

   ```
   RUN HOMES
   ```

   Wait until the robot has completed the homing twice.
3. All positions used in the **ER-MicroCIM** belong to the vector CIM[200]. To teach the robot the positions required for the application, you must attach this vector to the teach pendant.

   Enter the ACL command:

   ```
   ATTACH CIM
   ```

3. Figure 10 and the following Positions Table show the numbers of the positions which must be recorded before the assembly operation can be executed.

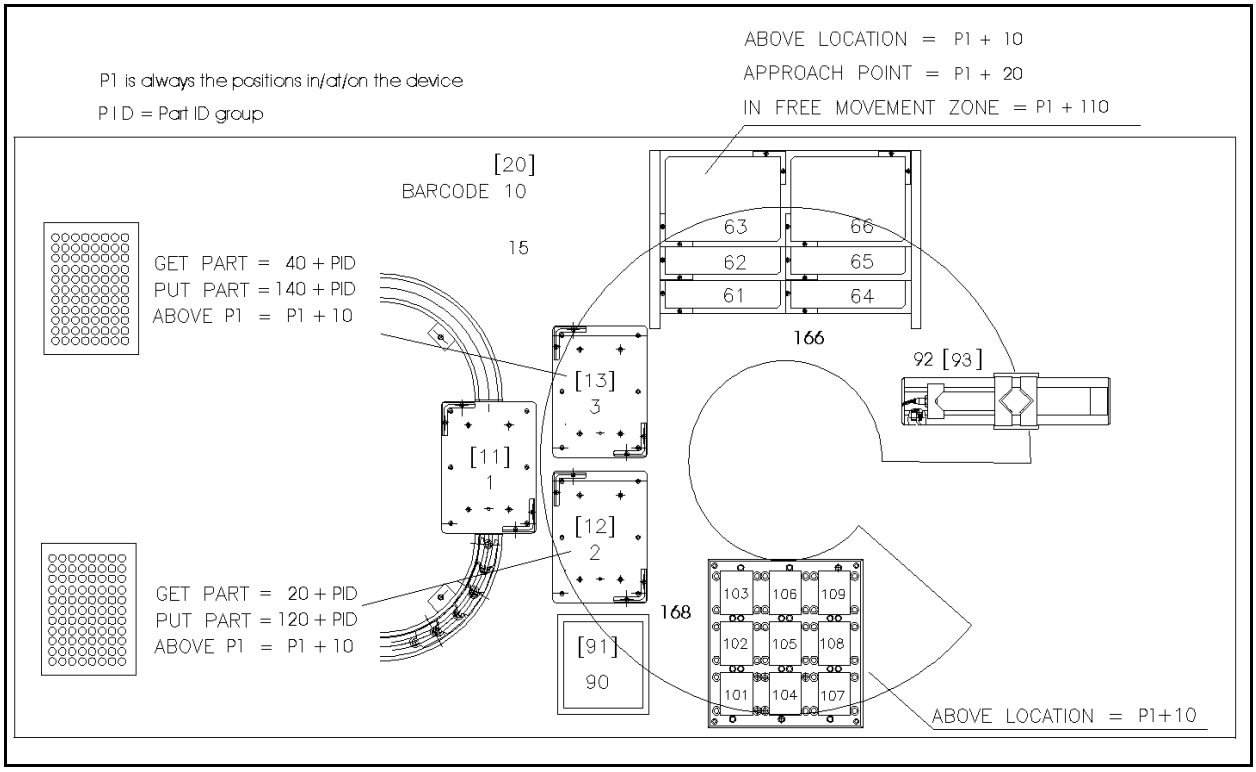



*Figure 9: Part Positions*

*Note the following part ID numbers:*

- The plexiglass base part ID number is 1
- The cylinder part ID number is 2.

The part ID numbers (*PID* in Figure 10) determine the name (number) of the various positions in the **ER-MicroCIM** cell.

Figure 11 illustrates the order in which positions should be taught.

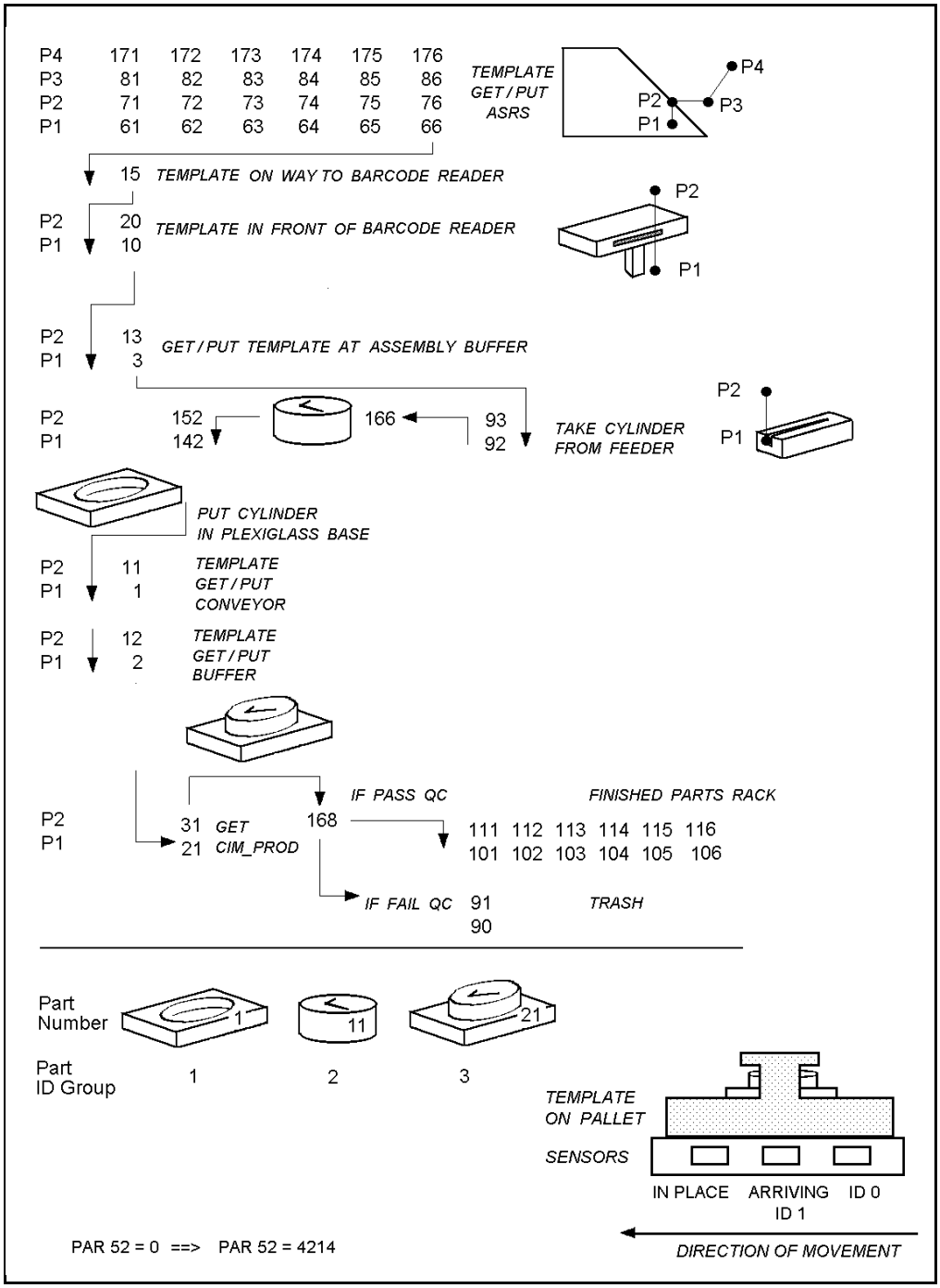



*Figure 10: Position Teaching Sequence*

| ER-MicroCIM Positions | | | | | | |
|---|---|---|---|---|---|---|
| **Description of Position** | **Device ID*** | **Device Index*** | **GET P1** | **Above GET P2** | **PUT P1** | **Above PUT P2** |
| Template on pallet at workstation | 1 | 1 | 1 | 11 | 1 | 11 |
| Template in front of barcode reader. (Movement between position 10 and position 20 must cross the laser beam.) | 9 | 1 | 10 | 20 | 10 | 20 |
| Template on buffer | 5 | 1 | 2 | 12 | 2 | 12 |
| Template on buffer/jig | 4 | 1 | 3 | 13 | 3 | 13 |
| Cylinder in base on template on buffer/jig | 4 | 1 | | | 142 | 152 |
| Plexiglass base on template on buffer | 5 | 1 | 21 | 31 | | |
| Feeder | 6 | 1 | 92 | 93 | | |
| Trash Bin | 7 | 1 | | | 90 | 91 |
| Assembled Cylinder-in-Base on Palletizing Rack | 8<br>8<br>8<br>8<br>8<br>8 | 1<br>2<br>3<br>4<br>5<br>6 | | | 101<br>102<br>103<br>104<br>105<br>106 | 111<br>112<br>113<br>114<br>115<br>116 |
| | | | **At P1** | **Above P2** | **Approach/ Retreat P3** | **In Free Movement Zone P4** |
| Template on ASRS Rack — Cell 1 ** | 3 | 1 | 61 | 71 | 81 | 171 |
| Template on ASRS Rack — Cell 2 | 3 | 2 | 62 | 72 | 82 | 172 |
| Template on ASRS Rack — Cell 3 | 3 | 3 | 63 | 73 | 83 | 173 |
| Template on ASRS Rack — Cell 4 | 3 | 4 | 64 | 74 | 84 | 174 |
| Template on ASRS Rack — Cell 5 | 3 | 5 | 65 | 75 | 85 | 175 |
| Template on ASRS Rack — Cell 6 | 3 | 6 | 66 | 76 | 86 | 176 |

* Refer to Section 8.2, "Device ID map."
** Cell 1 is on the bottom left side of the ASRS rack.

3. When you have finished recording the positions, use the ATS Backup Manager to save the programs, positions and parameters to disk. *Save each item as a separate file.*

   Make the following selections and entries:

   ```
   Backup directory:C:\opencim\microcim\ws1\robot1
   Backup / Restore: ALL
   File name: all
   ```

   Press [Enter] again. Press **F3** to **SAVE to disk**

   ```
   Backup / Restore: PROGRAMS
   File name: programs
   ```

   Press [Enter] again. Press **F3** to **SAVE to disk**.

   ```
   Backup / Restore: POSITIONS
   File name: position
   ```

   Press [Enter] again. Press **F3** to **SAVE to disk**.

   ```
   Backup / Restore: PARAMETERS
   File name: paramete
   ```

   Press [Enter] again. Press **F3** to **SAVE to disk**

## 4.7 Stand-Alone Testing and Adjustment of Devices

In this part of the installation, you will test each device individually to make sure it is functioning properly.

1. Turn on the **ER-MicroCIM** power supply.

   The conveyor will move for 60 seconds, and then stop.

   *If the Auto/Manual button on the conveyor's control panel is set to Manual when power is turned on, the conveyor will not move.*

2. Check the following:
   - Make sure all devices are turned on.
   - Make sure there is no movement of any other device in the system.
3. You may now proceed to check the devices in the following order:

### 4.7.1 Conveyor

Refer to Figure 12.

1. Switch the Auto/Manual button on the conveyor's control panel to Manual. Then press Start.

   Check the following:
   - The conveyor is moving clockwise.
   - The pistons at both stations on the conveyor extend and stop the pallets, and then retract and release the pallets.
   - The conveyor stops when you press Stop and restarts when you press Start. Stop and start the conveyor several times.

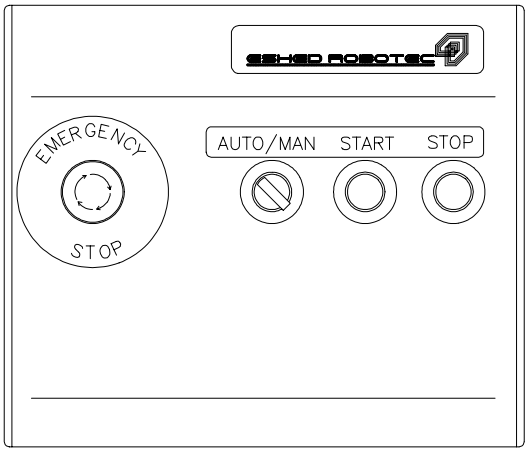



*Figure 11: Control Panel*

2. Make sure the Auto/Manual button on the conveyor's control panel to Manual. Then press Start.

   While the conveyor is moving, press the emergency button and check the following:
   - The emergency button remains locked.
   - The LED for input 1 on the ACL controller is lit.
   - The conveyor stops.

   Release the emergency button, and check the following:
   - The LED for input 1 on the ACL controller turns off.
   - The conveyor restarts, or can be restarted.

### 4.7.2 Barcode Reader

From the **Robot Programs WS1** window, activate ATS.

1. Enter the ACL command to turn on the barcode reader:

   ```
   RUN BCON
   ```

   Make sure the red light on the rear of the barcode reader is lit.

2. Make sure the robot has been homed, and is free to move to position 15.

   Enter the ACL commands:

   ```
   SPEED 30
   MOVE CIM[15]
   ```

3. When the robot reaches reaches position 15, take a template which has a barcode sticker and place it in the robot's grasp.

4. Enter the ACL commands:

   ```
   MOVE CIM[20]
   SPEED 5
   MOVE CIM[10]
   ```

   Make sure you hear the beep when the barcode is read.

5. Enter the ACL command to turn off the barcode reader:

   ```
   RUN BCOFF
   ```

   Make sure the red light on the rear of the barcode reader goes off.

### 4.7.3 Parts Feeder

From the **Robot Programs WS1** window, activate ATS.

1. Make sure output 1 is turned off. Enter the ACL command:

   ```
   SET OUT[1]=0
   ```

2. Place at least one aluminum cylinder in the parts feeder chute.

3. Enter the ACL command which causes the cylinder to drop down from the chute:

   ```
   SET OUT[1]=1
   ```

4. Enter the ACL commmand to push the cylinder out of the feeder:

   ```
   SET OUT[1]=0
   ```

5. As the cylinder is pushed out of the feeder, make sure it activates the proximity sensor switch, by checking the following:

   - The LED near the sensor cable lights up.
   - The LED for input 2 on the ACL controller lights up.

   If the switch has not been activated, adjust the position of the sensor by turning it.

   If the sensor LED lights up, but the input LED does not, make sure both the sensor and the controller input are operating in the same logic mode (PNP or NPN).

### 4.7.4 OpenCIM Device Drivers and Vision

1. Open the **System Station 1** group window. See Figure 13.

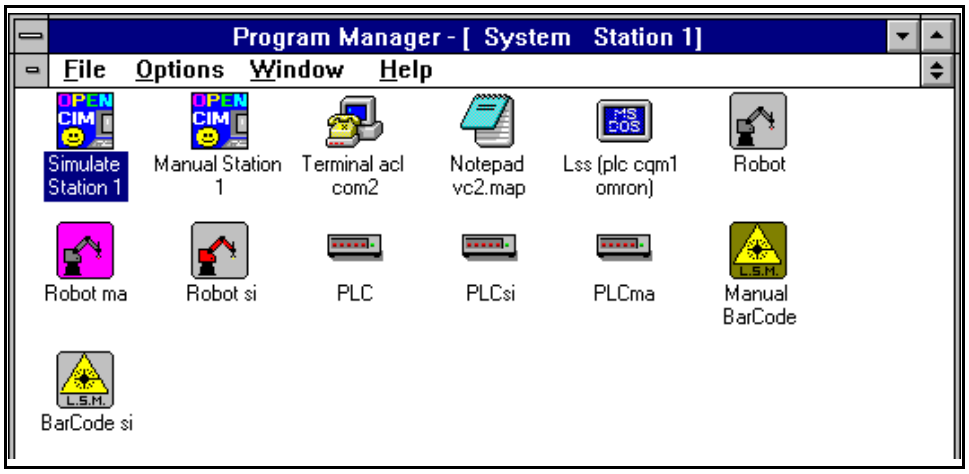



*Figure 12: System at Station 1 Group Window*

This group allows you to operate each of the **ER-MicroCIM** device drivers in each of three modes (except for the barcode, which has two modes).

- Real Mode: on-line operation.
- Manual Mode: off-line step-by-step software operation; the item description has the suffix **ma**.
- Simulation: off-line software operation; the item description has the suffix **si**.

You will now activate the device drivers in Real Mode, and check whether they actually operate the devices.

2. Click on the **PLC** icon to load the **PLC Device Driver**.

   From the **PLC Control Panel**, send an empty pallet to workstation 1.

   - Select **Station 1** and click on [**GetFree**].

3. Make sure there is a template with a plexiglass base in Cell 1 of the ASRS.

   Make sure there is at least one cylinder in the parts feeder.

   Click on the **Terminal ACL** icon to load the **ACL Device Driver**.

   You will now check whether the robot can perform all pick and place operations required for assembly and loading in the preprogrammed production sequence.

   Click on [**Enter P/P Cmd**] to open the **Run 'Pick and Place'** window. Now make the following selections:

| | A | B | C | D |
|---|---|---|---|---|
| **Part ID** | template (0) | template (0) | cylinder_sup (11) | template (0) |
| **Source ID** | asrs (3) | barcode (9) | feeder (6) | assembly buffer (4) |
| **Source Index** | 1 | 1 | 1 | 1 |
| **Target ID** | barcode (9) | assembly buffer (4) | assembly buffer (4) | conveyor (1) |
| **Target Index** | 1 | 1 | 1 | 1 |
| **Note** | 0 | 0 | 0 | 0 |
| | **OK** | **OK** | **OK** | **OK** |
| **Result:** | Robot takes a template with base from ASRS rack, and brings it to the barcode reader. | Robot places the template on the assembly jig. | Robot takes a cylinder from the feeder and places it on the base. | Robot places the loaded template on the conveyor. |

4. From the **PLC Control Panel**, send the loaded pallet to workstation 2.
   - Select **Station 1** and click on [**Deliver**].
   - Select **Station 2** and click on [**Release**].

   The pallet will stop under the camera at the Vision/QC workstation.
5. In the Vision PC activate **ROBOTVISIONpro** (RVPRO.EXE) .
   - Select **OPTIONS | Workspace**.
   - Click on [**Load ...** ].
   - Select the file **MICROCIM.WKS** and click on [**Ok**] to load the file.

   Select **IMAGE |Setup | Define Frames**.
   - Press **Snap** and watch the video monitor to check the camera's field of view. Adjust the position of the camera so that the assembly is within the camera's field of view. Select **Frame 1** and adjust the size of the frame around the cylinder.
   - Select **Save** to save the frame information in a file. Use the name **MICROCIM.FRA**.
   - Click on [**Ok**] to exit this screen.

   Select **IMAGE | Setup | Image Histogram.**

   Select **IMAGE | Setup | Image Histogram.**
   - Do not do anything. Simply let the software automatically adjust the offset and the gain.
   - Click on [**Ok**] to exit this screen.

   Select **IMAGE | Binary | Binary Level**.
   - Click on [**Binarization**]. Move the line cursor on the histogram until you see a clearly defined black and white image of the mark on the cylinder.

Select **PATTERN | Identification**

- Click on [**Identify**] and check whether the vision system can identify the ✓ and the **x** sides of the cylinder.

  ✓ Object name = QCPASS

  **x** Object name = QCFAIL.

- Turn the cylinder over. Click on [**Start New Cycle**]. You will see the other marking. Check whether the correct object name is displayed.

*Note*: If the system is unable to identify the ✓ or **x**, do the following:

- Select **OPTIONS | Image Options.**
  Change the value of **Min. Area** to 1000.
  Change the value of **Min. Perimeter** to 500.
- Again select **PATTERN | Identification**, and click on [**Identify**] to check whether the vision system can identify the ✓ and the **x**. When successful, proceed to save the workspace.

Save the current workspace.

- Select **OPTIONS | Workspace**.
- Click on [**Save ...** ].
- Select **VISION.WKS** and click on [**Ok**] to save the file.

Exit the **ROBOTVISIONpro** software.

6. Now return to the CIM Manager PC.

   From the **PLC Control Panel**, send the loaded pallet back to workstation 1.

   - Select **Station 1** and click on [**Deliver**].
   - Select **Station 2** and click on [**Release**].

   The pallet will stop at the robot workstation.

7. Select the **Run 'Pick and Place'** window at the CIM Manager PC.

   You will now check whether the robot can perform all pick and place unloading operations required in the preprogrammed production sequence.

   In the **Run 'Pick and Place**' window make the following selections:

| | E | F | G | H |
|---|---|---|---|---|
| **Part ID** | template (0) | plexiglass_sup (1) | plexiglass_sup (1) | template (0) |
| **Source ID** | conveyor (1) | buffer (5) | buffer (5) | buffer (5) |
| **Source Index** | 1 | 1 | 1 | 1 |
| **Target ID** | buffer (5) | rack (8) | trash bin (7) | ASRS (3) |
| **Target Index** | 1 | 1 | 1 | 1 |
| **Note** | 0 | 0 | 0 | 0 |
| | **OK** | **OK** | **OK** | **OK** |
| | Robot takes template from conveyor and places it on buffer. | Robot takes assembled part from buffer to finished parts rack. | Robot takes assembled part from buffer to trash bin. | Robot returns the empty template to Cell 1 in ASRS. |

8. Close the **Virtual ACL Driver** window. This will close the **ACL Control Panel**.
   Close the **Virtual PLC Driver** window. This will close the **PLC Control Panel**.

### 4.7.5 CIM Manager

The modules and functions in the **CIM Manager** are explained in Chapter 7, "Advanced System Operation."

1. From the **MicroCIM System Manager** window, do the following:
   - Click on **VC2SIMAP**. A DOS box will appear for a few seconds.
   - Click on **Storage Refresh**. A DOS box will appear for a few seconds.
   - Click on **Start CIM (simulation)**. Device drivers will be loaded and the **OpenCIM System Manager** screen is displayed. See Figures 14 and 15.

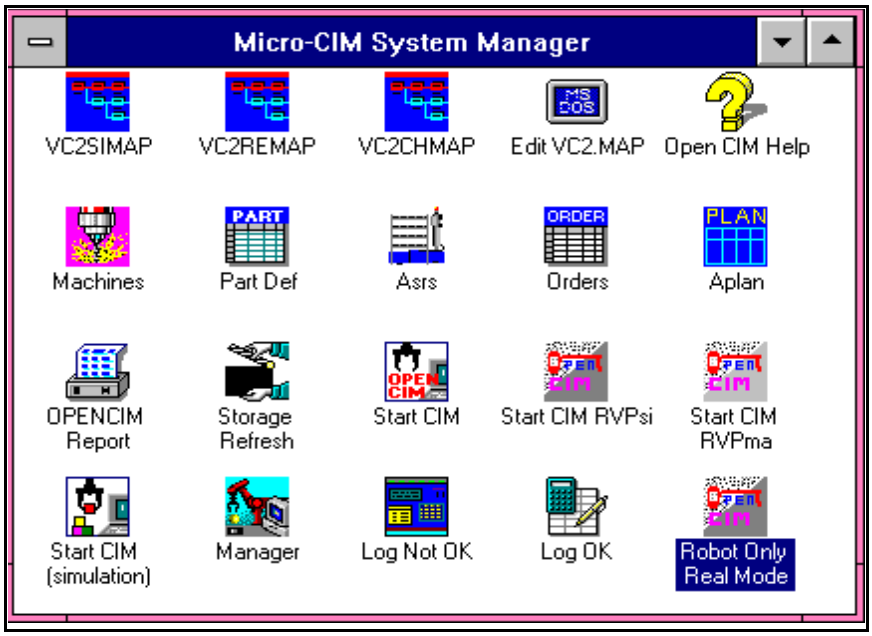



*Figure 13: System Manager Group Window*

2. From the **Open-CIM Manager** window, do the following:
   - Click on the yellow lightning bolt. This sends a command to reset (INIT) all device drivers. The run arrow will now turn green. Three windows also cascade onto the screen:
     - Program View
     - Log View
     - Order View

     These windows show the status of work in progress; they are for viewing only.
   - Click on the green run arrow. The || pause button will now turn blue. The **Leaf View** window will now also appear.
   - Watch the screen and wait until a box appears with the message:

     ```
     CIM_PROD HAS BEEN FINISHED
     ```

     Click on [**Ok**]. Another message appears:

     ```
     ORDER HAS BEEN FINISHED
     ```
3. Close the **Open-CIM Manager** and all drivers which appear in the **Task List**.
4. Click on **MicroCIM System Manager | VC2RE.MAP**. A DOS box will appear for a few seconds. This will prepare system for on-line operation (as detailed the following chapters.)

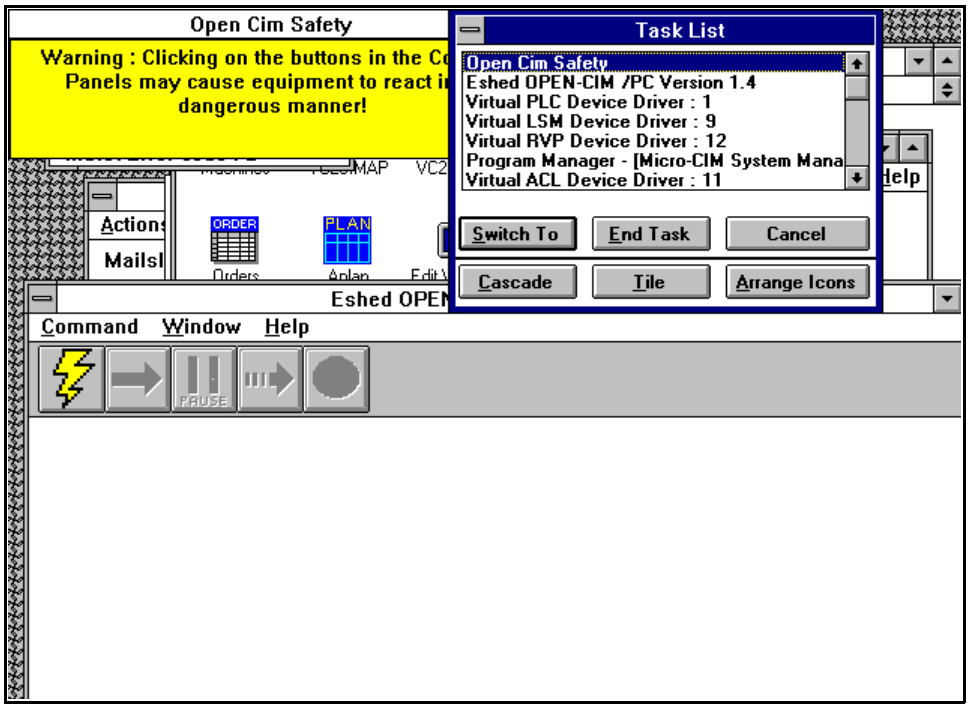



*Figure 14: Open-CIM Manager*

# 5 Preparation for On-Line Operation

At the start of every on-line work session, the following procedures must be performed.

1. Turn on the power supply. Make sure all devices, computers, and the controller are turned on and ready for operation.
2. Activate the **Open-CIM** software:

   On the CIM Manager PC, do the following:

   - From the DOS prompt, type: **w [Enter]**.
     (This is the same as activing Windows by means of the command WIN /n).
   - Open the **Program Manager-System Station 1** group window.
   - Click on **Terminal ACL** to load the **ACL Device Driver**.
3. Home the robot:
   - Make sure the controller is in the CON state (Control Enabled). From the **ACL Control Panel**, enter the command: **CON**
   - Using the teach pendant, bring the robot to the area above the buffers (Free Movement Zone), so that the homing operation can safely begin.
   - Home the robot: From the **ACL Control Panel**, enter the command: **RUN HOMES**.
   - Make sure the teach pendant is set to **Joint** Mode.
4. Check controller status:
   - Maximize the the **Virtual ACL Driver** window.
   - From the **ACL Control Panel**, enter the command: **STAT**
   - Make sure the system displays the response:

     ```
     Job Name   Priority    Status
     RVP        000005      Delay
     EMERG      000005      Trigger
     ```
   - Close the **ACL Virtual ACL Driver** window.

5. Send a loaded pallet to workstation 2
   - Place a template with an assembled part, CIM_PROD, on pallet closest to the vision station:
   - Click on **PLC** to load the **PLC Device Driver**. See Figure 16.
   - Select Station **2** and click on [**GetFree**]. This will send the pallet to the vision station.

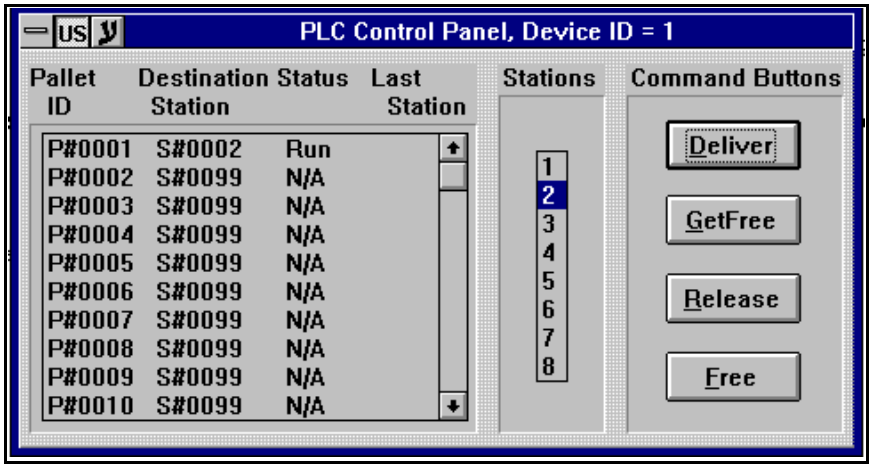



*Figure 15: PLC Device Driver Control Panel*

6. Prepare the vision station:
   - From the ROBOTVISION directory (C:\>RVPRO) in the Vision PC, activate **ROBOTVISIONpro**, type: RVP [Enter].
   - Select **IMAGE | Setup | Image Histogram.**

     Do not do anything. Simply let the software automatically adjust the offset and the gain. Click on [**Ok**] to exit this screen.
   - Select **IMAGE | Binary | Binary Level**.

     Click on [**Binarization**]. Move the line cursor on the histogram until you see a clearly defined black and white image of the mark on the cylinder.
   - Select **PATTERN | Identification**

     Click on [**Identify**] and check whether the vision system can identify the ✓ and the **x** sides of the cylinder.

     ✓ Object name = QCPASS

     **x** Object name = QCFAIL.
   - Turn the cylinder over. Click on [**Start New Cycle**]. You will see the other marking. Check whether the correct object name is displayed.
   - Select **ROBOT | Automatic Mode**.
     - Press [Enter].

     *Make sure you see the ACL prompt, >, in the upper text box*. See Figure 17.

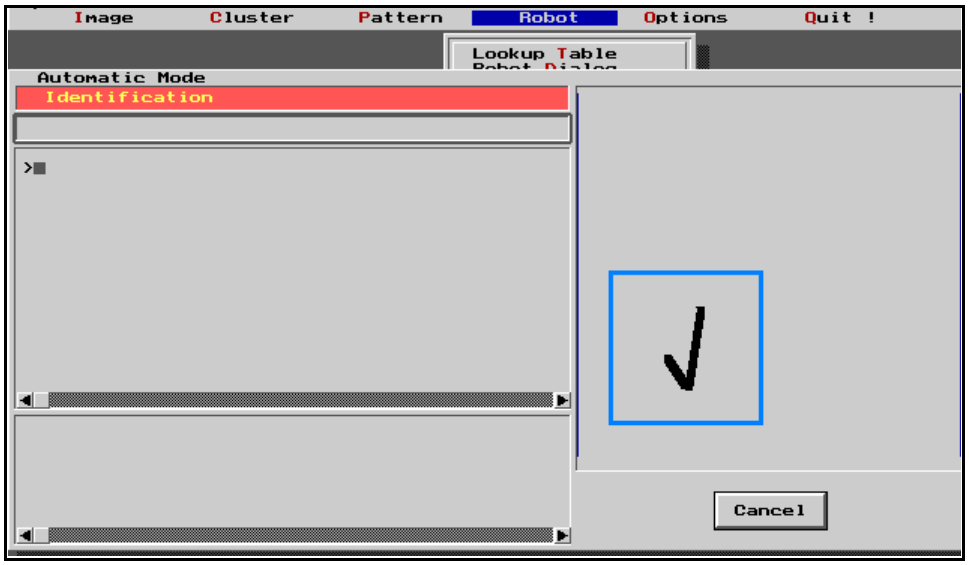



*Figure 16: ROBOTVISIONpro Automatic Mode Screen*

7. Templates and Parts
   - Place a plexiglass base on each of the six templates .
   - Place the six loaded templates into the six cells on the ASRS rack. Make sure the barcode on the template faces away from the robot, and the handle faces the robot.
   - Fill the parts feeder with the cylinders.
   - Make sure there are no parts or templates anywhere in the cell (except in the feeder and ASRS rack).
8. Pallets and Buffers
   - Place the two pallets anywhere along the conveyor. Make sure the arrow on the pallet is facing in the same direction as the movement of the conveyor.
   - Make sure the two buffers are empty.

# 6 User System Operation

This chapter provides basic instructions for activating the **ER-MicroCIM** system and running the preprogrammed production sequence.

## 6.1 System Overview

Open the **User** group window. See Figure 18.

This group contains basic applications required for on-line operation of the **ER-MicroCIM** system. The following is a brief description of the modules and features which are available in this group.

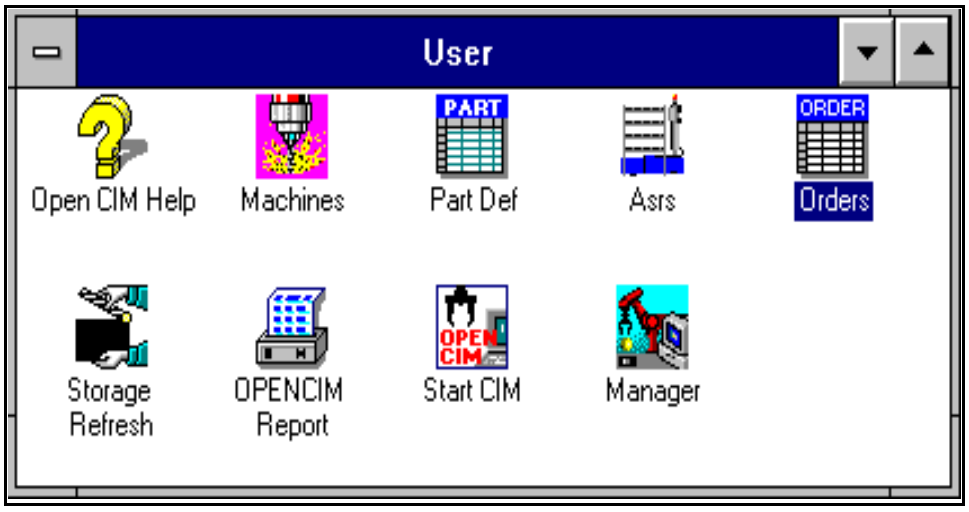



*Figure 17: User Operations Group Window*

| Icon | Description |
|---|---|
| OpenCIM Help | On-line help file. |
| Machines | Defines the machines and processes. |
| PartDef | Defines the materials which will be used and the parts which will be produced. |
| Asrs | Defines the contents of the ASRS. |
| Orders | Defines the production order. |
| Storage Refresh | Initializes the storage database of the entire system. |
| OpenCIM Reports | Generates reports. |
| Start CIM | Loads all device drives, including CIM Manager. |
| Manager | Loads CIM Manager only. |

Complete descriptions of the modules can be found in the *Open-CIM User's Manual*.

## 6.2 Activating the System

1. Make sure you have clicked on **MicroCIM System Manager | VC2RE.MAP** and the DOS box appeared for a few seconds.
2. From the **User** group window, do the following:
   - Click on **Storage Refresh**. A DOS box will appear for a few seconds.

     This serves to clear the buffers, pallets and robot of all parts and templates. In addition, it resets the ASRS cells to the status required for the start of production.
   - Click on **Order**. The **Order Definition** screen will appear showing an order for the CIM_PROD cylinder-in-base assembly.
     - Bring the cursor to the **Total Qty** field, and from the keyboard enter the number of items you want to produce.
     - Click on [**Submit**]. You will see the message:

       ```
       Done
       ```
     - Close the **Order Definition** window.
   - Click on **Start CIM**. Device drivers will be loaded and the **Open-CIM Manager** screen will appear. A small **Debug** window also opens (hidden behind the **Open CIM Safety** message box) which serves to display data which is being communicated.
3. From the **Open-CIM Manager** window, do the following:
   - Click on the yellow lightning bolt. This sends a command to reset (INIT) all device drivers. The run arrow will now turn green. Three windows also cascade onto the screen:
     - Program View
     - Log View
     - Order View

     These windows show the status of work in progress; they are for viewing only. They are described in detail in the *Open-CIM User's Manual*.

     Figure 19 shows the Program View window for CIM_PROD before the green run button is pressed; Figure 20 shows the same window after the button is pressed. Note that lines scroll up from bottom to top.
   - Click on the green run arrow. The || pause button will now turn blue. The **Leaf View** window will now also appear.
4. While the order is being manufactured, you can track production by looking at the four different **View** screens. Again, refer to the *Open-CIM User's Manual*.)

   You can also observe the quality control inspections on the Vision PC monitor.

   Watch the CIM Manager PC monitor and wait until a box appears with the message:

   ```
   CIM_PROD HAS BEEN FINISHED
   ```

   Click on [**Ok**]. Another message appears:

```
ORDER HAS BEEN FINISHED
```

5. To produce additional CIM_PRODs, do the following:
   - Close the **Open-CIM Manager.**
   - Click on **Storage Refresh**.
   - Click on **Order** to open the **Order Definition** screen. Change the total quantity, if desired, and click on [**Submit**], and close the window.
   - Click on **Manager** to open the **Open-CIM Manager** screen. Start production as you did previously.

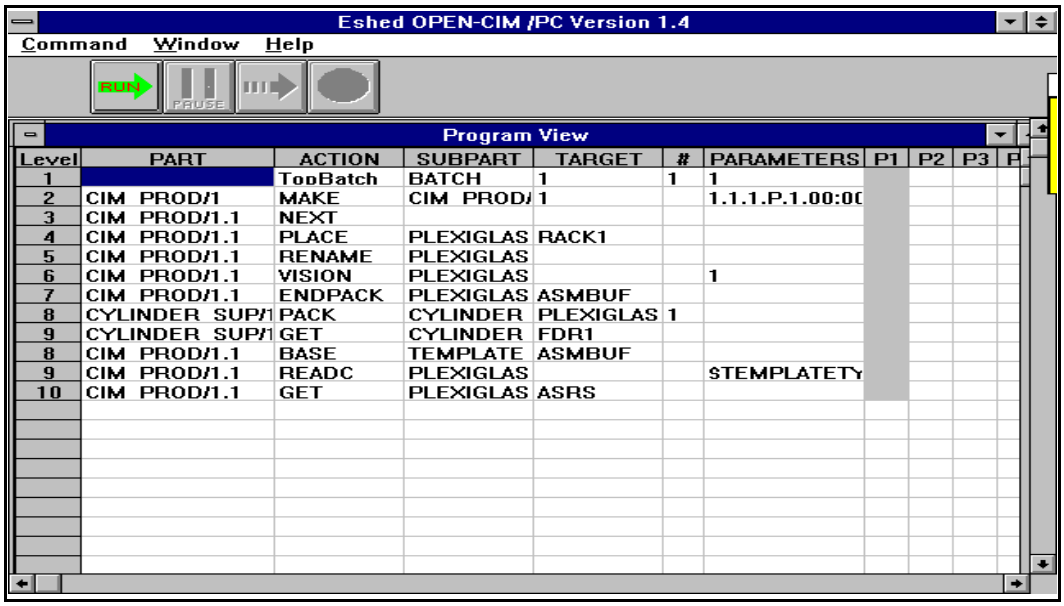



*Figure 18: Program View Window for CIM_PROD*

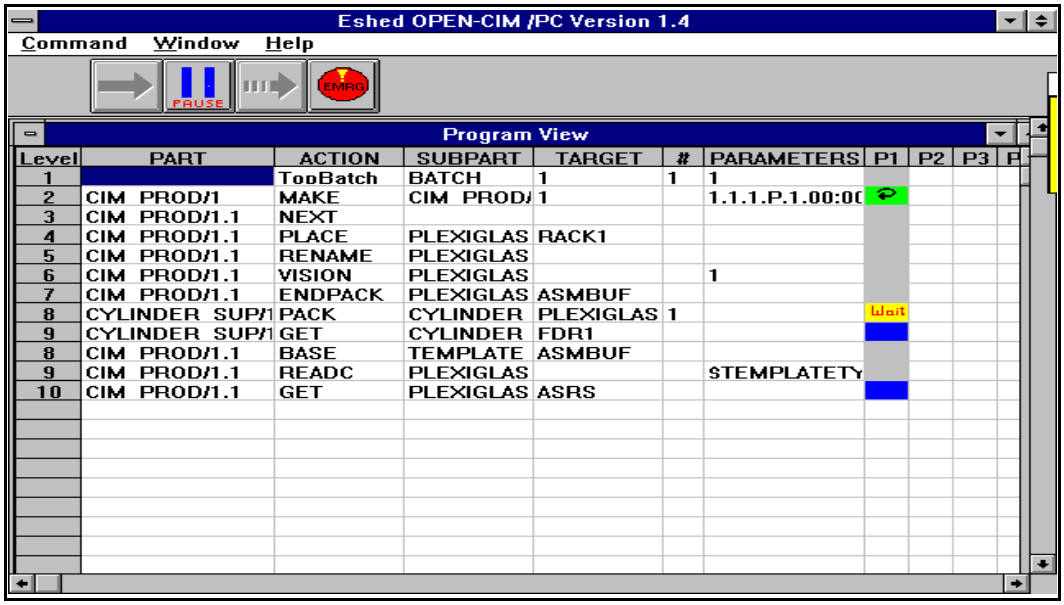



*Figure 19: Program View Window for CIM_PROD*

# 7 Advanced System Operation

This chapters provides descriptions and instructions for advanced level operating procedures in the **ER-MicroCIM** system.

## 7.1 System Overview

Open the **MicroCIM System Manager** group window. See Figure 21.

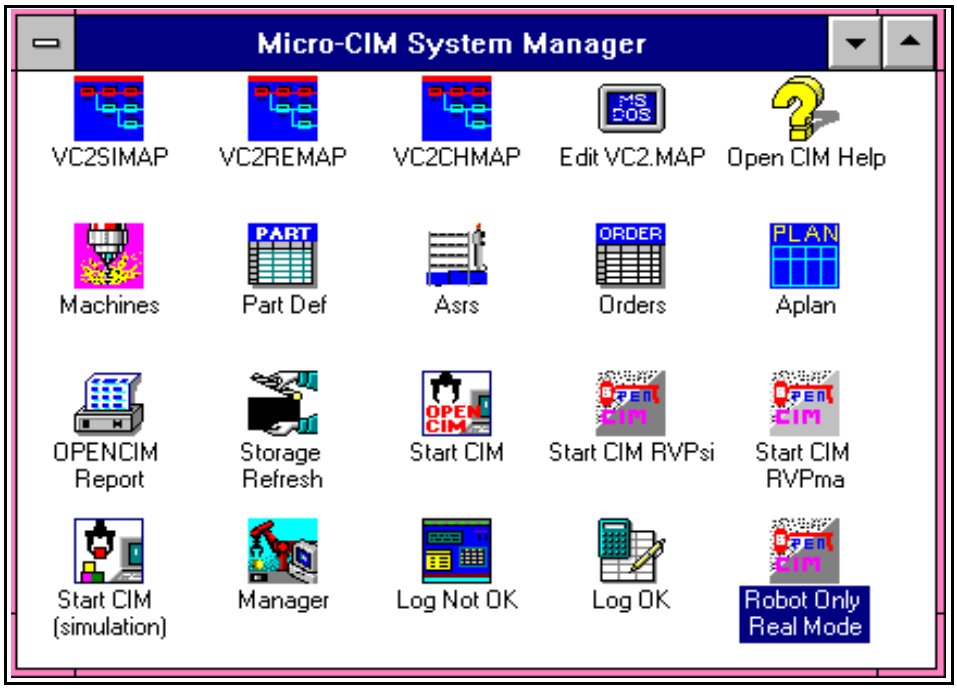



*Figure 20: System Manager Group Window*

This group contains the modules and features which enable advanced level on-line operation of the **ER-MicroCIM** system. The following is a brief description of the modules and features which are available in this group.

| Icon | Description |
|---|---|
| OpenCIM Help | On-line help file. |
| Machines | Defines the machines and processes. |
| PartDef | Defines the materials which will be used and the parts which will be produced. |
| Asrs | Defines the contents of the ASRS. |
| Orders | Defines the production order. |
| Storage Refresh | Initializes the storage database of the entire system. |

| | |
|---|---|
| OpenCIM Reports | Generates reports. |
| Start CIM | Loads all device drives, including CIM Manager. |
| Manager | Loads CIM Manager only. |
| VC2SIMAP | Produces a listing of all device drivers used in simulation mode and writes it to the file VC2.MAP. |
| VC2REMAP | Produces a listing of all device drivers used in on-line mode and writes it to the file VC2.MAP. |
| VC2CHMAP | Produces a listing of all device drivers used when workstation 1 is in on-line mode, and workstation 2 is in either simulation or manual mode, and writes it to the file VC2.MAP. |
| Edit VC2MAP | Opens Notepad for editing VC2.MAP file. |
| PNP | Generates pick and place reports and writes them to the subdirectory LOG. |
| Start CIM RVPsi | Loads CIM Manager and all device drivers; vision device driver is in simulation mode. |
| Start CIM RVPma | Loads CIM Manager and all device drivers; vision device driver is in manual mode. |
| Start CIM (simulation) | Loads CIM Manager and all device drivers in simulation mode. |
| Robot Only Real Mode | Loads CIM Manager and all device drivers in simulation mode; except robot device driver which loads in on-line mode. |
| Log OK | Generates pick and place reports and writes them to the subdirectory LOG. |
| Log Not OK | Generates pick and place and database reports and writes them to the subdirectory LOG. |

Complete descriptions of the modules can be found in the *Open-CIM User's Manual*.

## 7.2 Modes of Operation

The **ER-MicroCIM** system can be operated in numerous ways. Following are five possible modes of operation.

### 7.2.1 Total Simulated Production

All device drivers operate in simulation mode. No equipment is used. No product is actually manufactured.

The procedure for activating this mode of operation is detailed in Section 4.7.5, "Stand-Alone Testing/ CIM Manager."

### 7.2.2 Total On-Line Production

All device drivers operate in on-line mode. All equipment is used. Products are actually manufactured.

The procedure for activating this mode of operation is detailed in Section 6.2, "Activating the System."

### 7.2.3 Production with Simulated Vision

Robot, barcode reader, and conveyor device drivers operate in on-line mode.

The vision device driver operates in simulation mode.

The production takes place normally, but when the template reaches the vision station, it will stop for a moment, and then continues as if it has passed or failed the quality control inspection, according to a failure rate which has been predefined in the file RVPRSI.INI.

The procedure for activating this mode of operation is as follows:

- **VC2CHMAP**
- **Storage Refresh**
- **Order**
- **Start CIM RVPsi**

To produce additional CIM_PRODs in this mode, do the following:

- Close the **Manager** window
- **Storage Refresh**
- **Order**
- **Manager**

### 7.2.4 Production with User (Manual) Vision

Robot, barcode reader, and conveyor device drivers operate in on-line mode.

The vision device driver operates in software manual mode.

The production takes place normally, but when the template reaches the vision station, it will stop and wait for the user to determine whether the assembly passes (succeeds) or fails the quality inspection.

The procedure for activating this mode of operation is as follows:

- **VC2CHMAP**
- **Storage Refresh**
- **Order**
- **Start CIM RVPma**
- When the CIM_PROD is at the vision station, look to see which side is facing the camera. From the CIM Manager PC, bring up the **Virtual RVP Device Driver**.
- From the RVP Control Panel click on either [**Success**] or [**Fail**] according to the ✓ or **x** .

To produce additional CIM_PRODs in this mode, do the following:

- Close the **Manager** window
- **Storage Refresh**
- **Order**
- **Manager**
- From the RVP Control Panel click on either [**Success**] or [**Fail**] according to the ✓ or **x** .

### 7.2.5 Robot Only Real Mode

Loads CIM Manager and all device drivers in simulation mode, except robot device driver which loads in on-line mode.

Barcode reader, vision and conveyor device drivers operate in simulation mode.

Only the robot operates on-line, but without handling any parts.

*Remove an empty pallet from the conveyor, and place it at Workstation 1.*

The procedure for activating this mode of operation is as follows:

- **VC2SIMAP**
- **Storage Refresh**
- **Order**
- **Robot Only Real Mode**

To produce additional CIM_PRODs in this mode, do the following:

- Close the **Manager** window
- **Storage Refresh**
- **Order**
- **Manager**

## 7.3 Stand-Alone Operation

Each workstation can be operated individually or as a stand-alone system.

### 7.3.1 Stand-Alone Operation - Station 1

Open the **Open CIM Station 1** group window. See Figure 22.


*Figure 21: Workstation 1 Group Window*

This group contains the modules and features which enables students to operate Workstation 1 as a stand-alone system.

Workstation 1 contains the following elements:

- Robot
- Parts Feeder
- Barcode Reader
- Conveyor (PLC)

The procedure for activating this mode of operation is as follows. See Figure 23.

- Double click on **Start Station 1**. The **ACL Control Panel** and the **PLC Control Panel** will open.
- In the **ACL Control Panel**, enter the ACL command:

  ```
  RUN HOMES
  ```

  Wait until the robot has completed the homing twice.
- Click on [**Enter P/P Cmd**].

  The **Run 'Pick and Place'** window will open.

All robot operations can now be activated from the **Run 'Pick and Place'** window.

The **PLC Control Panel** monitors and controls the movement of all pallets on the conveyor.

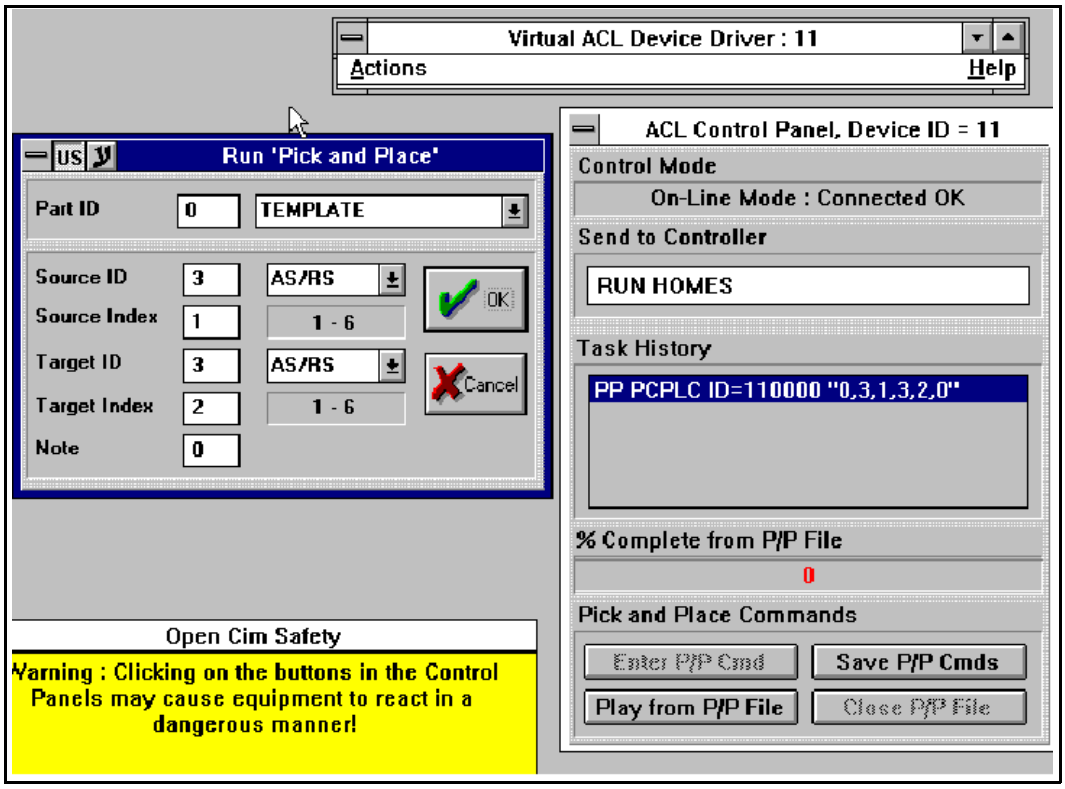



*Figure 22: Workstation 1 - Stand-Alone Operation*

### 7.3.2 Stand-Alone Operation - Station 2

Workstation 2 is a complete vision system. To operate Workstation 2 as a stand-alone system, you will work directly on the Vision Computer, and perform all operations as described in the *ROBOTVISIONpro User's Manual*.

Place a light table or a small board on the conveyor, under the camera. Be sure that the conveyor will not be moved during.

Alternately, you can turn the camera away from the conveyor and work on another table-top. Be certain you can and will return the camera to its proper position in order to resume integrated use of the **ER-MicroCIM** system.

## 8.1 Reports

From either the **User** or **System Manager** group window, click on the **OpenCIM Report** icon to open the **Open-CIM Report Generator** menu. See Figure 24.

The Report Generator allow you to view all data and definitions in the **ER-MicroCIM** environment.

Figures 25 through 31 show the reports which result from the sample application supplied with the system.

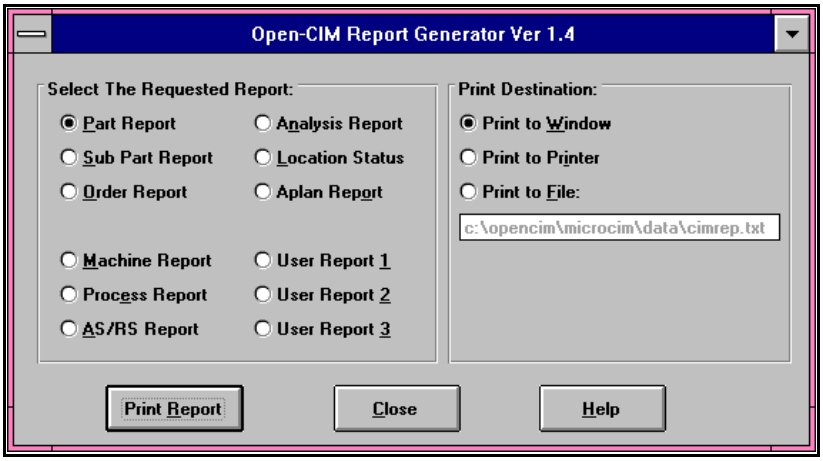



*Figure 23: Report Generator Menu*

### 8.1.1 Machine Report

The Machine Report lists the names of all machines in the **ER-MicroCIM** environment.

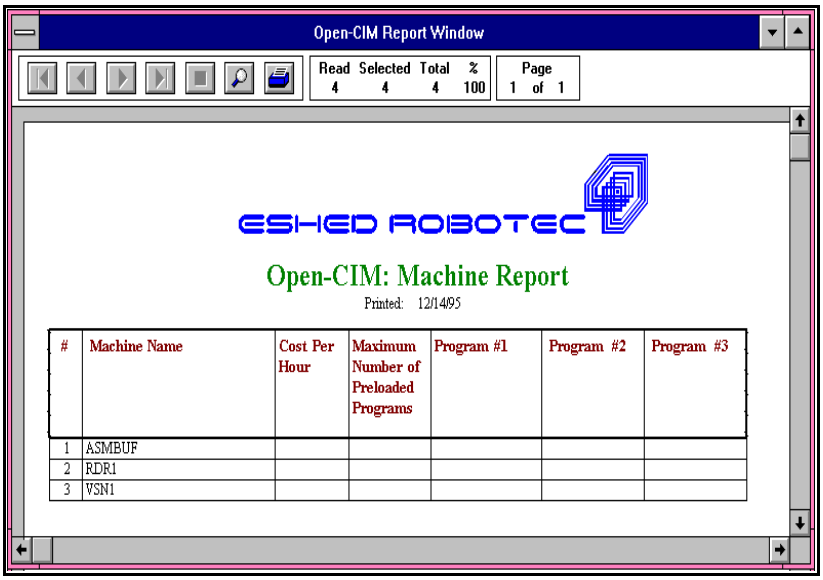



*Figure 24: Machine Reports*

### 8.1.2 Process Report

The Process Report shows the user defined name (Process Name field) of each machines and the process performed by the machine.

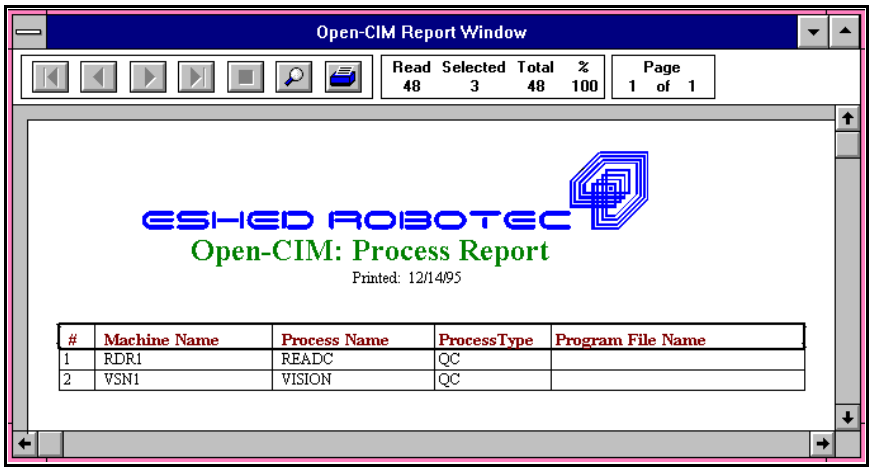



*Figure 25: Process Report*

### 8.1.3 ASRS Report

The ASRS Report shows the contents of the ASRS automatical storage and retrieval system.

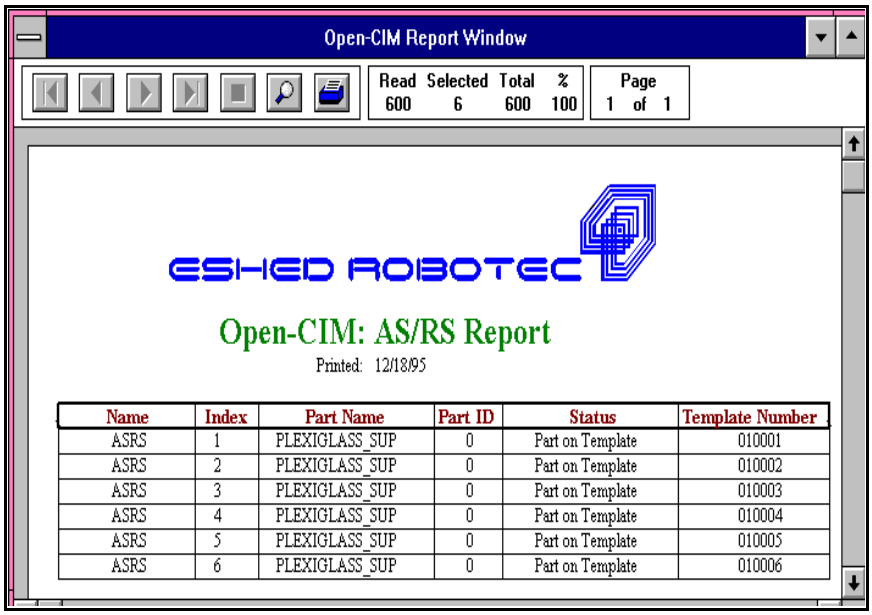
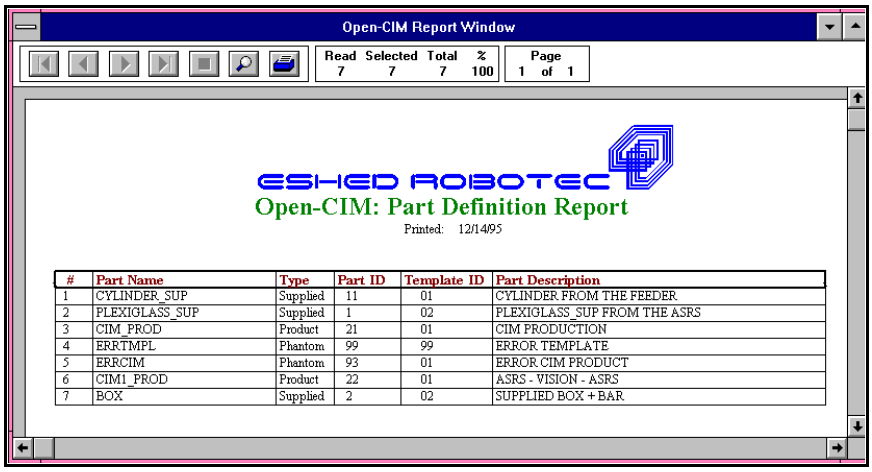



*Figure 26: ASRS Report*

### 8.1.4 Part Definition Report

The Part Definition Report shows the names and descriptions of all parts used in the **ER-MicroCIM**. It lists parts in all stages of production.

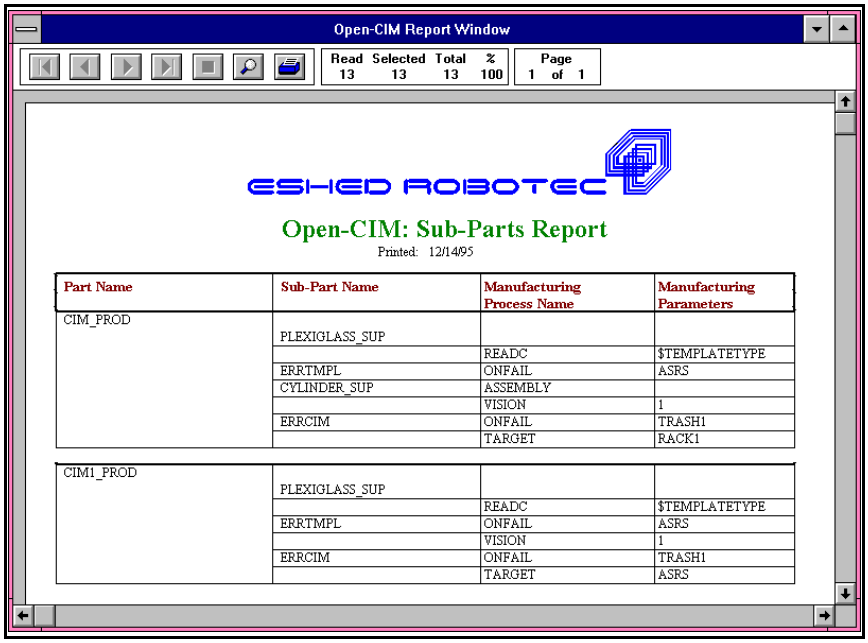



| # | Part Name | Type | Part ID | Template ID | Part Description |
|---|---|---|---|---|---|
| 1 | CYLINDER_SUP | Supplied | 11 | 01 | CYLINDER FROM THE FEEDER |
| 2 | PLEXIGLASS_SUP | Supplied | 1 | 02 | PLEXIGLASS_SUP FROM THE ASRS |
| 3 | CIM_PROD | Product | 21 | 01 | CIM PRODUCTION |
| 4 | ERRTMPL | Phantom | 99 | 99 | ERROR TEMPLATE |
| 5 | ERRCIM | Phantom | 93 | 01 | ERROR CIM PRODUCT |
| 6 | CIM1_PROD | Product | 22 | 01 | ASRS - VISION - ASRS |
| 7 | BOX | Supplied | 2 | 02 | SUPPLIED BOX + BAR |

*Figure 27: Part Definition Report*

### 8.1.5 Sub-Part Report

The Sub-Parts Report is a Bill of Material. It shows all the sub-parts which comprise the finished product.




| Part Name | Sub-Part Name | Manufacturing Process Name | Manufacturing Parameters |
|---|---|---|---|
| CIM_PROD | | | |
| | PLEXIGLASS_SUP | | |
| | | READC | $TEMPLATETYPE |
| | ERRTMPL | ONFAIL | ASRS |
| | CYLINDER_SUP | ASSEMBLY | |
| | | VISION | 1 |
| | ERRCIM | ONFAIL | TRASH1 |
| | | TARGET | RACK1 |
| CIM1_PROD | | | |
| | PLEXIGLASS_SUP | | |
| | | READC | $TEMPLATETYPE |
| | ERRTMPL | ONFAIL | ASRS |
| | | VISION | 1 |
| | ERRCIM | ONFAIL | TRASH1 |
| | | TARGET | ASRS |

*Figure 28: Sub-Part Report*

### 8.1.6 Order Entry Report

The Order Entry Report displays the production order which is currently on the shop floor. This order will be put into production whenever the CIM Manager issues a command to start production.

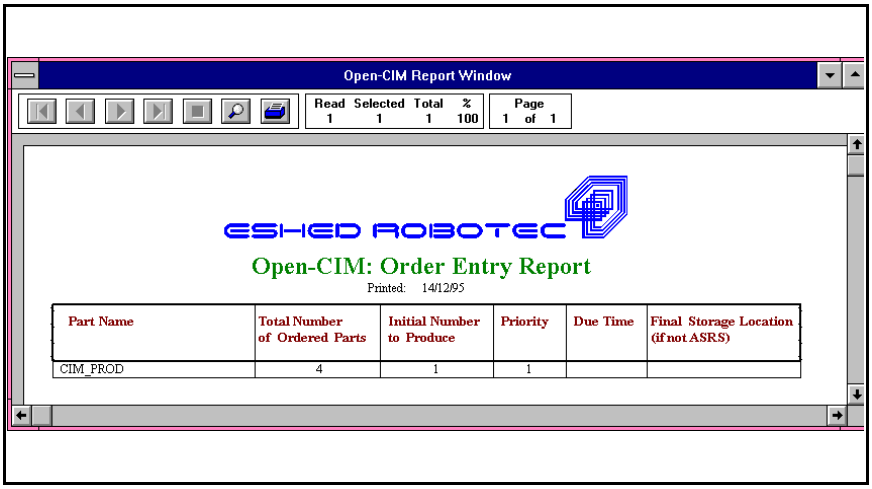



*Figure 30: Order Report*

### 8.1.7 Aplan Report

The file APLAN.DBF in the WORK directory is a production task list which is created by the system when an order is submitted. It shows the sequence of operations to make each component and/or assemble components into a final product.

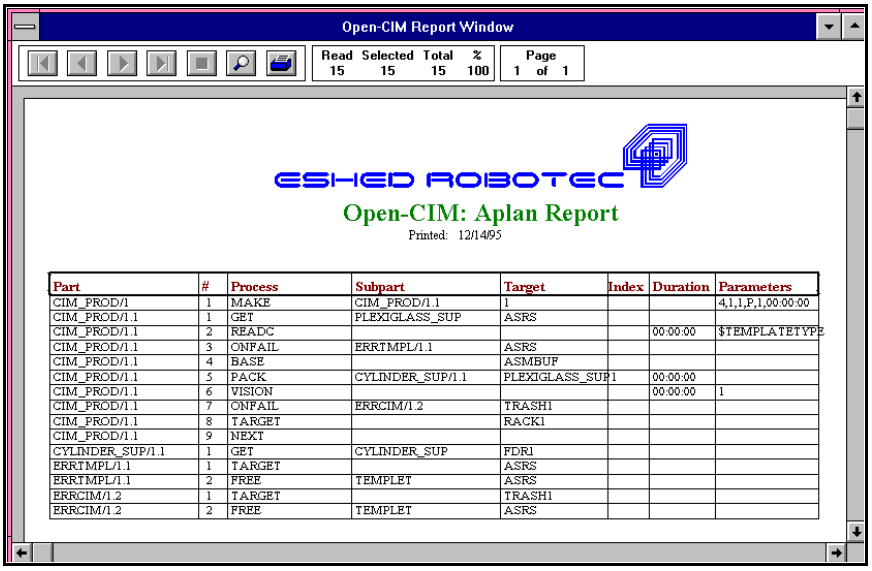



*Figure 29: Aplan Report*

### 8.1.8 User Report

The User Report resembles the Part Definition Report, except that it is organized according to the Part ID numbers.

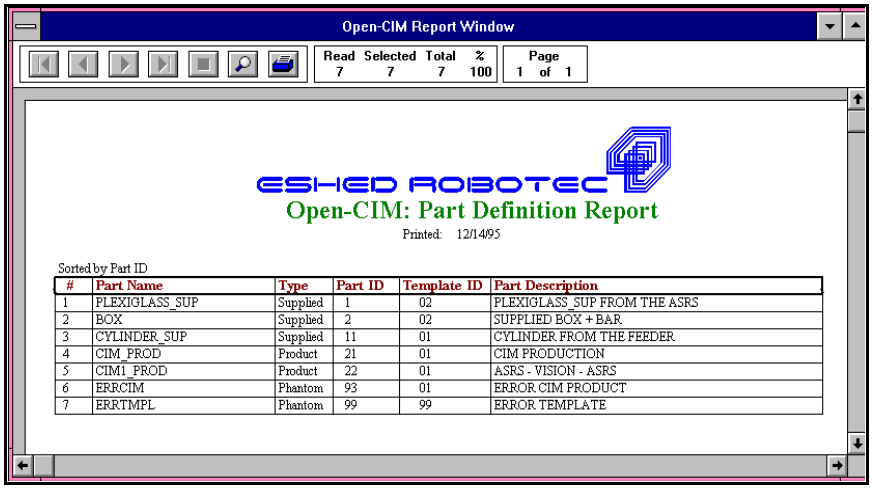



*Figure 31: User Report*

## 8.2 Device ID Map

The file DEVICE.DMC in the SETUP directory contains the device names and ID numbers which you will need when creating or modifying applications.

The following list and Figure 33 show the devices defined for the sample application supplied with the system.

| Definition | | Description |
|---|---|---|
| CNV1 | 001 | 1 Conveyor |
| ASRS | 003 | 3 ASRS Rack |
| ASMBUF | 004 | 4 Assembly Jig |
| BFFR1 | 005 | 5 Unloading Buffer |
| FDR1 | 006 | 6 Parts Feeder |
| TRASH1 | 007 | 7 Trash Bin |
| RACK1 | 008 | 8 Palletizing Rack |
| RDR1 | 009 | 9 Barcode Reader |
| ROBOT1 | 011 | 11 Robot |
| VSN1 | 012 | 12 Vision System |

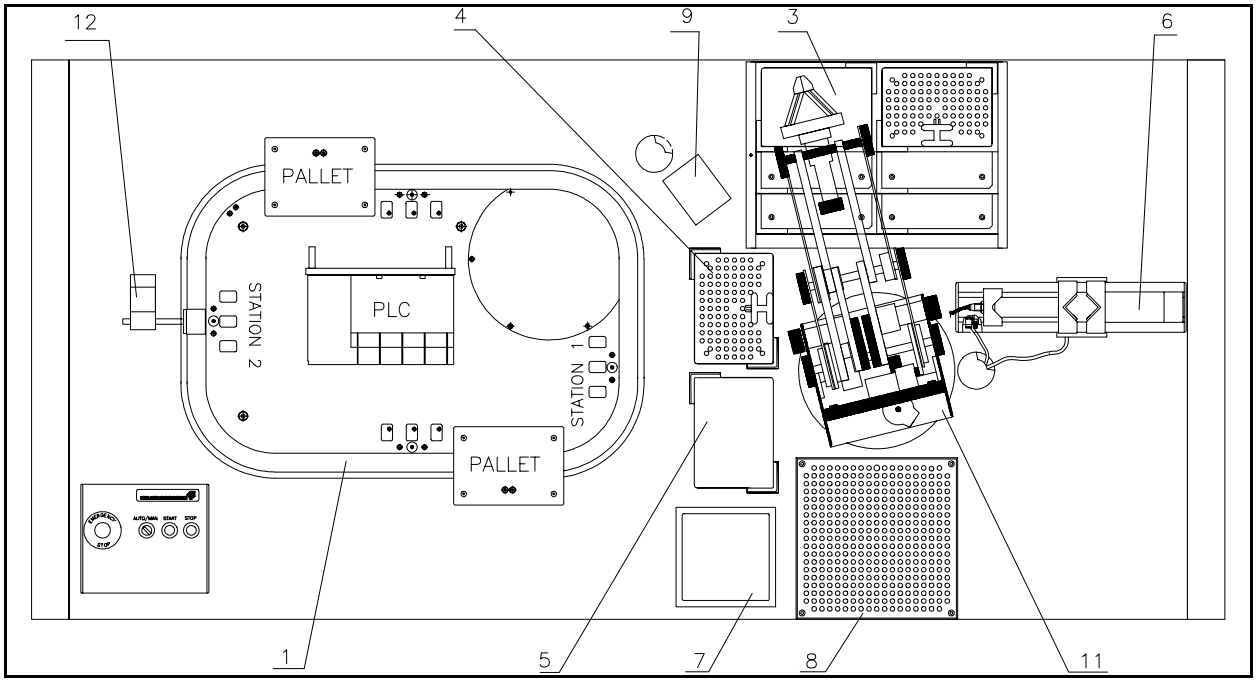



*Figure 32: Device ID Map*

## 8.3 Wiring

Figure 34 is a schematic diagram of the system wiring; these wires are located within the conveyor. The table which follows is a wiring list of the entire **ER-MicroCIM** system. (This list does not include the communication wiring performed during the installation procedures.)

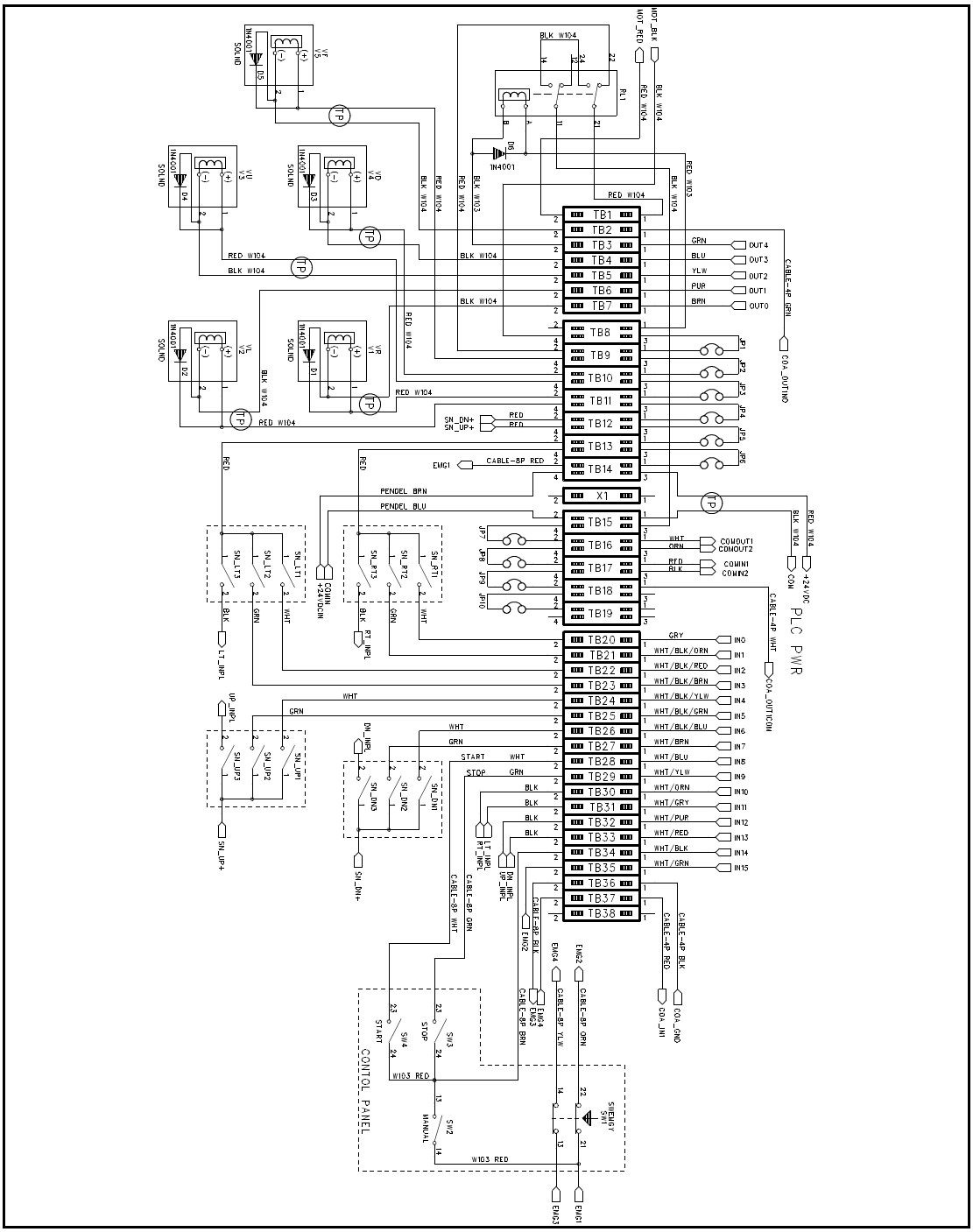



*Figure 33: System Wiring*

# MICRO CIM INTERCONNECTION WIRE LIST

| END1 | END2 | CABLE | LENGTH (mm) | DESCRIPTION |
|---|---|---|---|---|
| CON PNL START- 23 | TB28-2 | #D40228-WHT | | START |
| CON PNL STOP-25 | TB29-2 | #D40228-GRN | | STOP |
| CON PNL AUTO/MAN-13 | TB34-2 | #D40228-BRN | | AUTO/MAN |
| CON PNL EMG-13 | TB36-2 | #D40228-BLK | | EMG3(COA) |
| CON PNL EMG-14 | TB37-2 | #D40228-YLW | | EMG4(COA IN1) |
| CON PNL EMG-22 | TB35-2 | #D40228-ORN | | EMG2(PLC IN15) |
| CON PNL EMG-21 | TB14-2 | #D40228-RED | | EMG1(+24VDC) |
| D6-A | RL1-A | | | |
| D6-B | RL1-B | | | |
| I/O CARD J1-COMMON | TB36-1 | #D40229-BLK | | CONT A COMMON |
| I/O CARD J10-IN1 | TB37-1 | #D40229-RED | | CONTA IN1 |
| I/O CARD J2-C | TB18-1 | #D40229-WHT | | CONT A OUT 1 COM |
| I/O CARD J2-NO | TB2-1 | #D40229-GRN | | CONT A OUT 1 NO |
| MOTOR 1 RED | TB1-2 | W104 RED | (#D40225) | MOTOR 1 |
| MOTOR 2 BLK | TB8-4 | W104 BLK | (#D40225) | MOTOR 2 |
| PLC IN 0 | TB20-1 | #D411823-GRY | 500 | STA1-ID0 |
| PLC IN 1 | TB21-1 | #D411823-WHT/BLK/ORN | 500 | STA1 ARID1 |
| PLC IN 2 | TB22-1 | #D411823-WHT/BLK/RED | 500 | STA2-ID0 |
| PLC IN 3 | TB23-1 | #D411823-WHT/BLK/BRN | 500 | STA2 ARID1 |
| PLC IN 4 | TB24-1 | #D411823-WHT/BLK/YLW | 500 | STA3-ID0 |
| PLC IN 5 | TB25-1 | #D411823-WHT/BLK/GRN | 500 | STA3 ARID1 |
| PLC IN 6 | TB26-1 | #D411823-WHT/BLK/BLU | 500 | STA4-ID0 |
| PLC IN 7 | TB27-1 | #D411823-WHT/BRN | 500 | STA4 ARID1 |
| PLC IN 8 | TB28-1 | #D411823-WHT/BLU | 500 | START |
| PLC IN 9 | TB29-1 | #D411823-WHT/YLW | 500 | STOP |
| PLC IN 10 | TB30-1 | #D411823-WHT/ORN | 500 | RT-INPLACE |
| PLC IN 11 | TB31-1 | #D411823-WHT/GRY | 500 | LT-INPLACE |
| PLC IN 12 | TB32-1 | #D411823-WHT/PUR | 500 | UP-INPLACE |
| PLC IN13 | TB33-1 | #D411823-WHT/RED | 500 | DN-INPLACE |
| PLC IN14 | TB34-1 | #D411823-WHT/BLK | 500 | MANUAL |
| PLC IN15 | TB35-1 | #D411823-WHT/GRN | 500 | EMGCY |
| PLC COM IN1 | TB17-1 | #D411823-RED | 500 | GND BUS |
| PLC COM IN2 | TB17-3 | #D411823-BLK | 500 | GND BUS |
| PLC OUT 0 | TB7-1 | #D411823-BRN | 500 | PISTON 1 |
| PLC OUT 1 | TB6-1 | #D411823-PUR | 500 | PISTON 2 |
| PLC OUT 2 | TB5-1 | #D411823-YLW | 500 | PISTON 3 |
| PLC OUT3 | TB4-1 | #D411823-BLU | 500 | PISTON 4 |
| PLC OUT 4 | TB3-1 | #D411823-GRN | 500 | MOTOR |
| PLC COM OUT 1 | TB16-1 | #D411823-WHT | 500 | GND BUS |
| PLC COM OUT 2 | TB16-3 | #D411823-ORN | 500 | GND BUS |
| PLC PWR +24VDC | TB14-3 | W104 RED (TWISTED P.) | (#D40227) | +24DVC BUS |
| PLC PWR COM | TB15-1 | W104 BLK (TWISTED P.) | | GND BUS |
| PLC CHASSIS GND | CHASSIS GND | #D40224 | 350 | CHASSIS GND |
| PWR SPLY-BRN | TB14-4 | PENDEL | | +24DVC |
| PWR SPLY-BLU | TB15-2 | PENDEL | | COM |
| RL1-A1 RED | TB8-1 | W103 RED | | +24DVC |
| RL1-A2 BLK | TB3-2 | W103 BLK | | PLC OUT4 |
| RL1-11 BLK | TB15-3 | W104 BLK | | MOT (+) |
| RL1-14 BLK | RL1-24 | W104 BLK | | |
| RL1-21 RED | TB1-1 | W104 RED | | MOTOR 1 |
| RL1-22 RED | TB9-2 | W104 RED | | MOT(-) |
| RL1-24 BLK | RL1-14 | W104 BLK | | |

| END1 | END2 | CABLE | LENGTH | DESCRIPTION |
|---|---|---|---|---|
| SNSR FDR BRN | I/O CARD J1-+12VDC | SENSOR CABLE | | CONTA 12VDC |
| SNSR FDR BLU | I/O CARD J1-COMMON | SENSOR CABLE | | CONT A COMMON |
| SNSR FDR BLACK | I/O CARD J10-IN2 | SENSOR CABLE | | CONT A IN2 |
| SNSR RT-RED | TB13-4 | #D40223-RED | | SNSR RT+ |
| SNSR RT-WHT | TB20-2 | #D40223-WHT | | STA1-ID0 |
| SNSR RT-GRN | TB21-2 | #D40223-GRN | | STA1 AR ID1 |
| SNRS RT-BLK | TB30-2 | #D40223-BLK | | RT INPLACE |
| SNSR LT-RED | TB13-2 | #D40222-RED | | SNSR LT+ |
| SNSR LT-WHT | TB22-2 | #D40222-WHT | | STA2-ID0 |
| SNSR LT-GRN | TB23-2 | #D40222-GRN | | STA2 AR ID1 |
| SNSR LT-BLK | TB31-2 | #D40222-BLK | | LT INPLACE |
| SNSR UP-RED | TB12-4 | #D40223-RED | | SNSR UP+ |
| SNSR UP-WHT | TB24-2 | #D40223-WHT | | STA3-ID0 |
| SNSR UP-GRN | TB25-2 | #D40223-GRN | | STA3 AR ID1 |
| SNSR UP-BLK | TB32-2 | #D40223-BLK | | UP INPLACE |
| SNSR DN-RED | TB12-2 | #D40222-RED | | SNSR DN+ |
| SNSR DN-WHT | TB26-2 | #D40222-WHT | | STA4-ID0 |
| SNSR DN-GRN | TB27-2 | #D40222-GRN | | STA4 AR ID1 |
| SNSR DN-BLK | TB33-2 | #D40222-BLK | | DN INPLACE |
| TB8-3 | TB9-1 | WAGO 260-402 | | JP1 |
| TB9-3 | TB10-1 | WAGO 260-402 | | JP2 |
| TB10-3 | TB11-1 | WAGO 260-402 | | JP3 |
| TB11-3 | TB12-1 | WAGO 260-402 | | JP4 |
| TB12-3 | TB13-1 | WAGO 260-402 | | JP5 |
| TB13-3 | TB14-1 | WAGO 260-402 | | JP6 |
| TB15-4 | TB16-2 | WAGO 260-402 | | JP7 |
| TB16-4 | TB17-2 | WAGO 260-402 | | JP8 |
| TB17-4 | TB18-2 | WAGO 260-402 | | JP9 |
| TB18-4 | TB19-2 | WAGO 260-402 | | JP10 |
| VF1-RED | TB9-4 | #D40226-RED | | +24DVC |
| VF2-BLK | TB2-2 | #D40226-BLK | | COA OUT1 |
| VR1-RED | TB11-2 | #D40226-RED | | +24DVC |
| VR2-BLK | TB7-2 | #D40226-BLK | | PLC OUT0 |
| VL1-RED | TB11-4 | #D40226-RED | | +24DVC |
| VL2-BLK | TB6-2 | #D40226-BLK | | PLC OUT1 |
| VU1-RED | TB10-4 | #D40226-RED | | +24DVC |
| VU2-BLK | TB5-2 | #D40226-BLK | | PLC OUT2 |
| VD1-RED | TB10-2 | #D40226-RED | | +24DVC |
| VD2-BLK | TB4-2 | #D40226-BLK | | PLC OUT3 |

## 8.4 Technical Drawings of Parts

### 8.4.1 Plexiglass Base

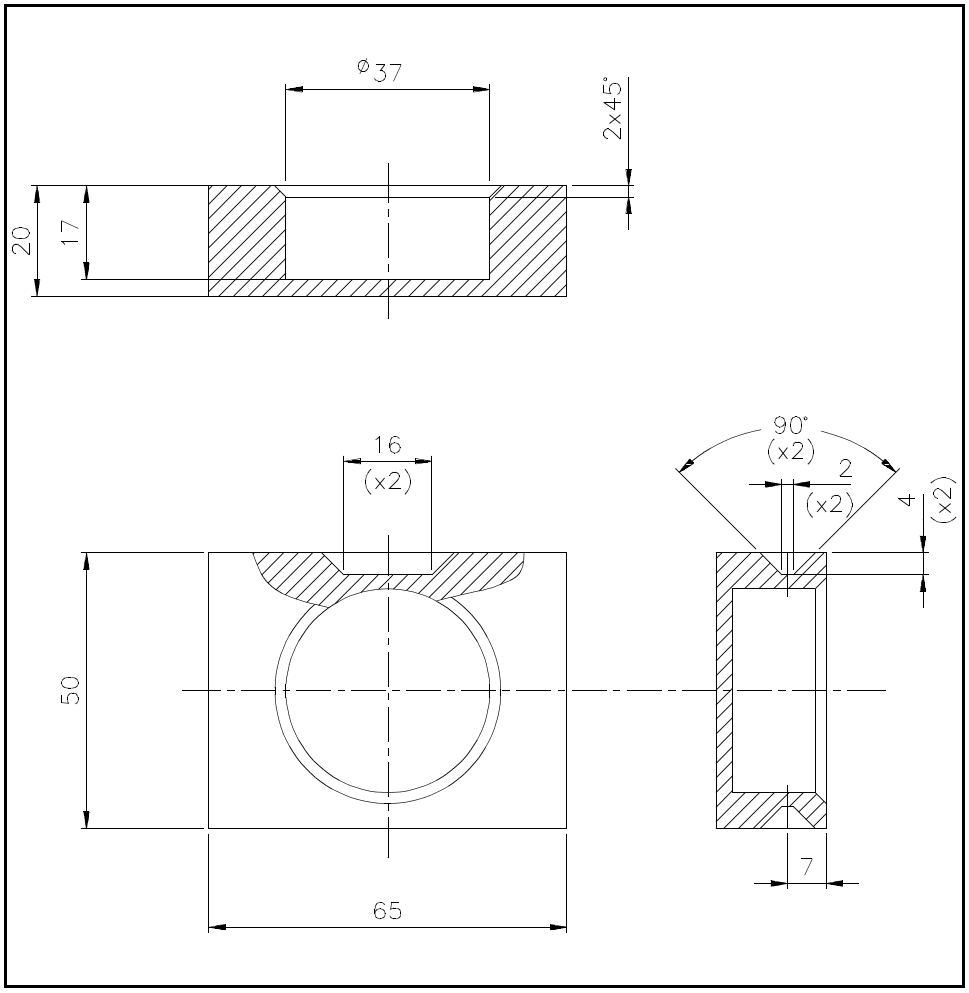



*Figure 34: Plexiglass Base*

| | |
|---|---|
| **Material:** | PLEXIGLASS 113072 |
| **Surf.Rough.:** | N9 |
| **Fillet Rad.:** | 0.2 |
| **Break Edges:** | 0.2 X 45° |
| **Dimensions:** | MM |

## 8.4.2 Aluminum Cylinders

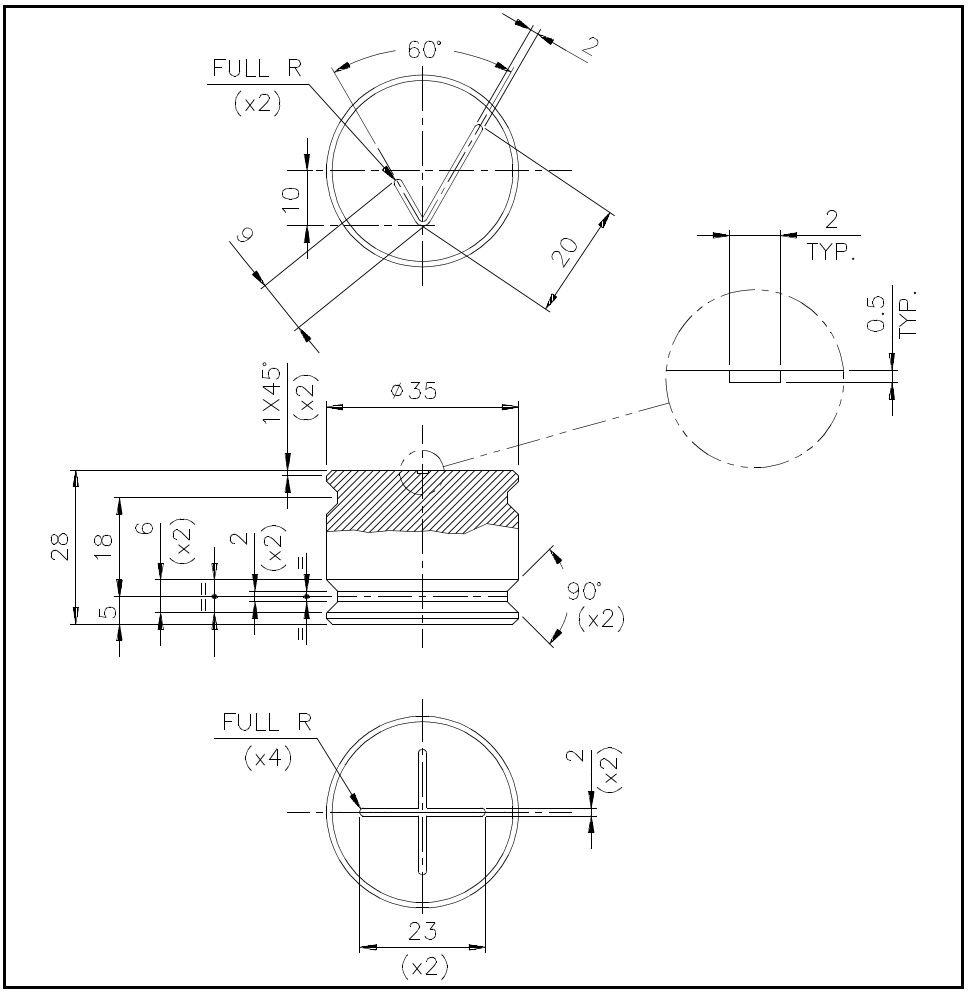



*Figure 35: Aluminum Cylinder*

| | |
|---|---|
| **Material:** | ALUMINUM 6061 |
| **Surf.Rough.:** | N9 |
| **Fillet Rad.:** | 0.2 |
| **Break Edges:** | 0.2 X 45° |
| **Dimensions:** | MM |

## 8.5 Barcode Reader Setup

To set up the LS 6x20 barcode scanner for operation in the **ER-MicroCIM** cell, it must be programmed using the barcodes listed in the following table. These barcodes can be found in the section, "Programmer's Guide," of the *Product Reference Guide* for the LS 6x20 scanner. The barcodes must be scanned in the order in which they appear in the table.

*Note*: To prevent interference from adjacent barcodes on the same page, it may be useful to cut a hole in a blank sheet of paper and place it over the barcode before scanning. If you make a mistake when scanning, you must repeat the entire sequence from Step 1.

| Step # | Name of Barcode to Scan | Pg. # in *LS6x20 Reference Guide* |
|---|---|---|
| **1** | SET DEFAULT | 19 |
| **2** | INTERLEAVED 2 OF 5 LENGTH 1 (Range 01–31) | 22 |
| **3** | 0 | 23 |
| **4** | 6 | 23 |
| **5** | ENTER | 23 |
| **6** | PARITY | 28 |
| **7** | SPACE | 28 |
| **8** | ENTER | 28 |

This procedure sets the barcode scanner for the following setup:

RS232 parameters: Baud rate 9600
8 data bits
2 stop bits
No parity
No handshake

Barcode type: Interleaved 2 of 5, first length = 6

## 8.6 Known Problems

### 8.6.1 Bug: Incorrect Status in Controller for ACL Program RVP

The controller sometimes reports the status for program RVP as PEND (response to ACL command STAT). When this occurs, do the following from the ACL Control Panel:

- Enter the command A to abort all programs.
- Enter the command: RUN INITC.
- Enter the command STAT to make sure RVP now has the status DELAY.

### 8.6.2 Order Limitation

Only one buffer at the ASRS/Assembly Station is available for an assembly task. Thus, in the Order Definition screen (Order Entry icon), you must enter 1 (one) both in the Initial Quantity column and in the Subsequent Quantity column. This will enable the system to properly handle a template which is returning to the ASRS/Assembly Station with a failed assembly.

In addition, the value in the Total Quantity column should not be greater than 4 (four). Although the ASRS can handle six parts, limiting the quantity to four will enable the system to complete the order even if two parts fail the quality control inspection.

# 9 Maintenance and Repairs

The devices in the **ER-MicroCIM** have few maintenance requirements. Preventive maintenance is limited mostly to visual inspection and simple adjustments.

## 9.1 Hardware

### 9.1.1 Conveyor

No preventive maintenance is required.

For troubleshooting and repair procedures, refer to the *Programmable Controllers Operation Manual*.

### 9.1.2 Robot and Controller

For maintenance, troubleshooting and repair procedures, refer to the *SCORBOT-ER Vplus User's Manual*.

### 9.1.3 Pneumatic System

Make sure air pipes are securely fastened, and do not leak.

Make sure nominal pressure is 5-7 bar.

### 9.1.4 Electrical Wiring

Make sure cables and wires are securely fastened and do not show signs of abrasion or wear.

## 9.2 Software and PCs

### 9.2.1 OpenCIM Software

For troubleshooting, refer to the *OpenCIM User's Manual.*

### 9.2.2 Vision System

For troubleshooting, refer to the *ROBOTVISIONpro User's Manual*.

# 10 Suggested Study Topics

The individual devices in the **ER-MicroCIM** can be used for short study units, while the entire system itself can provide the basis for an extended course of study.

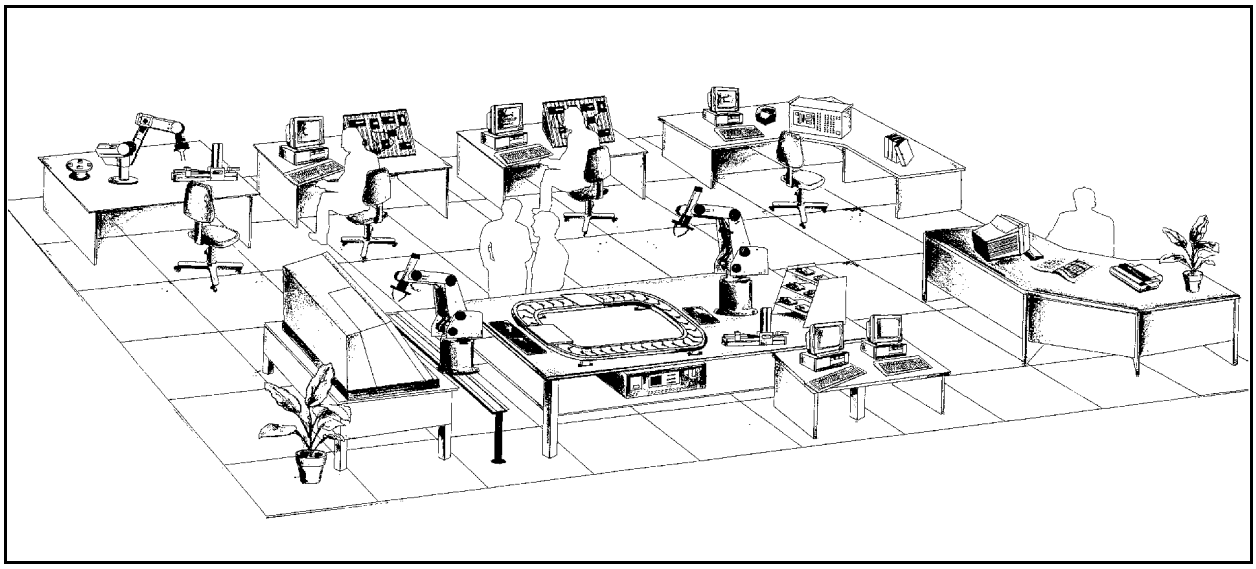


*Figure 36: MicroCIM Laboratory*

## 10.1 Modules

### 10.1.1 Robot

Robot structure

Robot arm movements

Teach pendant control of robot arm

Point definition

Robot programming

### 10.1.2 Robot Mechanisms

Motors

Encoders

Microswitches

Gears and transmissions

End effectors

### 10.1.3 PID Control

Degrees of freedom
Open-loop control
Position and speed control
Linear and circular path control
PID control parameters
"Ziglaer-Nicholas" method of control

### 10.1.4 Computer Communication

Baud rate
Data bits
Parity
Stop bits
Flow control
Port address
Interrupt request

### 10.1.5 Pneumatic Systems

Pneumatic power supply
Pneumatic cylinder and piston
Pneumatic logic control

### 10.1.6 Sensors and PLC Control

PLC digital input and output
Magnetic, infrared and distance sensors
DC motor control
Step motor control
Ladder diagram design
PLC control of pneumatic system

### 10.1.7 Identification Systems

Binary to decimal code
Decimal to binary code
Magnetic code
Barcode
ASCII and binary data transmission on RS232 channel
CIM template and pallet identification system

### 10.1.8 Vision and Quality Control

Lighting and optics

Image acquisition

Image processing

Pattern recognition

Applications: product identification, inspection, robot guidance

### 10.1.9 Manufacturing Software

Part definition

Order entry

Machine definition

Storage management

Logs

## 10.2 Courses

Eshed Robotec has developed a method for teaching modern manufacturing technologies, known as **AMT**: Advanced Manufacturing Technology Laboratory.

**AMT** is a four-semester academically based program, designed to provide high school students with a broad-based competency in modern manufacturing technologies. The program is designed with a modular and flexible curriculum, which systematically covers a variety of subjects and develops the students' knowledge and experience in these areas.

Each subject, or module, can be covered in 16 classroom hours. Students are divided into groups which concurrently study the various subjects, and simultaneously rotate to the next module. An instructor managment system ensures that all students complete all material by the end of the semester.

Each semester begins with a 2-4 hour introductory presentation, and concludes with a 6-8 hour final project.

### 10.2.1 AMT: Semester I

- Introduction to the **ER-MicroCIM** (system components, stations, software).
- Introduction to CAD (when included in installation)
- Introduction to CNC (when included in installation)
- Materials Testing and Evaluation
- Pneumatic / Hydraulic Systems
- Introduction to Robotics

### 10.2.2 AMT: Semester II

- Introduction to CAD (when included in installation)
- Sensors and PLC Control
- Mechanical Measurement and Quality Control
- Pneumatic / Hydraulic Systems
- Robot Mechanisms and Computer Communication

### 10.2.3 AMT: Semester III

- Manufacturing Software
- Vision and Quality Control
- Introduction to FMS (when CNC included in installation)
- Identification Systems
- PID Control

### 10.2.4 AMT: Semester IV

- Guided Project: Based on a set of projects developed by Eshed Robotec, the student will consider engineering, industrial and economic factors, and will design and produce several products. 30 hours
- Final Project: The student will be encouraged to take an entrepreneurial approach to design and produce an item. 60 hours.