commonplace robotics GmbH

User Guide

Integrated Robot Control for DIN-Rail Installation

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Software Version TinyCtrl	V980-04-031
Software Version CPRog	V902-10

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Content

1. Safety Instructions

- Always ensure personal safety when operating a robot arm or commissioning a robot cell! Ensure that there are no persons within reach of the arm or other danger places!

- CE marking: Robot arm and control unit are only part of a system which must be assessed for risks in its entirety and comply with the current safety regulations. The commissioning engineer of the plant is responsible for this.

- The robot controller does not have any safety components. To ensure the necessary personal safety, suitable components, e.g. safety relays and door switches, must be connected.

- Always disconnect the power supply before plugging in or unplugging connectors such as the display with joystick, emergency stop, digital I/Os or external relays. No hot plugging!

- Do not install or remove any modules during operation, nor plug or unplug any connections during operation. Always switch off the system and unplug it from the wall outlet.

- Use and store the system only in a dry, clean environment.

- Use the system only at room temperature (15° to 32°C).

2. Introduction

The integrated controller consists of an Embedded Linux board in DIN rail format and an operating device with 3.5" touch display and 3-way joystick. The robot controller software TinyCtrl runs on the Linux board. It can be used to control various robot types, such as robot arms or portal robots.

The integrated control is an additional device for modular robot control on DIN rails. This manual is a supplement to the CPRog and Robot manuals.

2.1 Specification

Type	Integrated control for DIN rail
Controller Module	Phytec Regor or similar
Power Supply	24V
Communication	CAN fieldbus 500 kBaud External communication via Ethernet
Operating System	Linux
Software	TinyCtrl Robot Control Software
Control Unit	3.5" capacitive touch display 3-way joystick Communication via RS232

3. Ports

3.1 Ports

Figure 1: Side view of the Linux board phytec Regor.

Socket	Function	Pin Assignment
ETH0 Primary Ethernet Port	Connection with PC for programming via CPRog	Standard Ethernet IP 192.168.3.11
ETH1 Secondary Ethernet Port	Usually none. Can be used to connect a camera	Standard Ethernet IP 192.168.4.11
Power supply 24V Plug bottom left	Supplies the Linux board with 24V supply voltage	Pin 1 (left): 24V Pin 2: GND Pin 3: NC Pin 4: NC Pin 5: NC
CAN Connection Plug top right	Establishes the CAN connection to the motor modules. To be connected with the support module	Pin 1 (left): CAN-L Pin 2: CAN-H Pin 3: NC Pin 4: NC Pin 5: NC
Control Unit Plug right middle	Establishes the RS232 connection to the operator interface.	Pin 1 (left): UART2-TX Pin 2: UART-2-RX Pin 3: NC Pin 4: NC Pin 5: NC
Plug bottom right	Not used	Pin 1 (left): NC Pin 2: GND Pin 3: NC Pin 4: NC Pin 5: NC

4. Commissioning

Do not connect or disconnect any electrical connections to the robot while it is connected to the power supply.

The cable to the control unit must be equipped with a cable strain relief, such as cable ties as shown in the picture above.

4.1 Mounting the Linux Board

The Linux board is mounted on the DIN rail next to the support module.

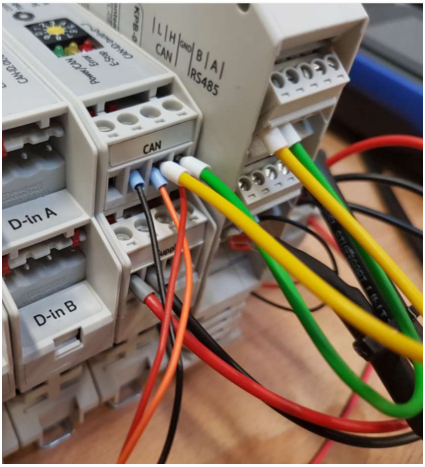
The Linux board must not be placed on one of the bus connectors of the other control modules. This would destroy the board!
The corresponding opening is sealed with adhesive tape on delivery. Do not remove this.

4.2 Power Supply

The enclosed connector has a red (24V) and a black (GND) wire, it is inserted into the power supply socket below the Ethernet ports.
The wires are connected to the power supply, e.g. via the distributor blocks.

Check the correct polarity of the connection before switching on!

4.3 CAN Connection



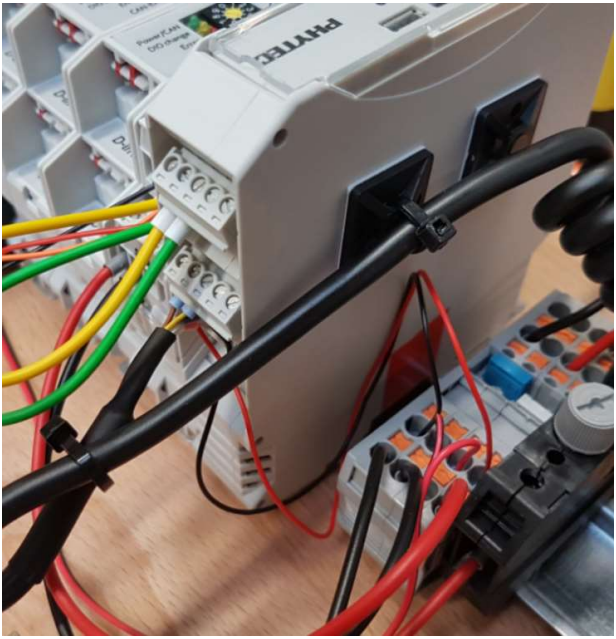
The enclosed plug has a yellow (CAN-L) and a green wire (CAN-H), it is plugged into the upper right socket.
The wires are connected to the CAN connector of the support board.

In the test phase: The cable for the USB-CAN adapter can remain connected for testing purposes.

Production: After completion of the tests and settings, the wires should sit alone in the CAN block.

Yellow wire: 3rd contact from left
Green wire: 4th contact from left

4.4 Control Unit



The enclosed plug has a brown (RX of the control unit) and a yellow wire (TX of the control unit).

It is plugged into the middle right socket.

The power supply of the display also runs via this cable:
Red wire: 24V
Black wire: GND
These wires are also plugged into the distributor block.

5. Operation

The integrated control and the direct CPRog control via the USB CAN adapter must not be active at the same time!

After all electrical connections to the robot are made, the robot is switched on and the emergency stop is released, it must first be enabled.

When moving the robot, always leave one hand at the emergency stop to stop it if it unexpectedly collides with an object such as the table.

5.1 Reset Errors / Enable Robot

In the upper menu, press the "Enable" button to go to the Enable menu.

Now press "Reset": The status changes to "MNE" (Motor Not Enabled).

Press "Enable": The status changes to "No Error". "Not ref ' d!" stands for not referenced. We will come back to this later.

5.2 Manual Operation of the Robot

As soon as the robot is enabled, as described in the previous step, the axes of the robot are moved.

1. To do this, press the "Jog" button at the top of the display.

2. Press A1. Then move and rotate the joystick. You can now move axes 1, 2 and 3.

3. Press A4. Now axes 4 and 5 can be moved by moving and rotating the joystick.

Repeat steps 2 and 3 until the robot is roughly in a "gallow position" and one of the "IK" marks on the round flange points from axis 5 towards the robot base.

5.3 Referencing the Robot

The robot electronics must be referenced to enable automatic program execution.

1. Press the "Enable" button at the top of the display.
2. Now press "Ref All". The robot now performs searches for each axis. The referencing is finished when Ref A1-A5 is followed by a 1 (before referencing a 0 is displayed for each axis).

   With a 4-axis robot, Ref A5 remains at 0. Ref E1 is not active and can be ignored. It is intended for additional external axes.

1. Now press the round "Reset" button, followed by the round "Enable" button. The robot is now referenced.

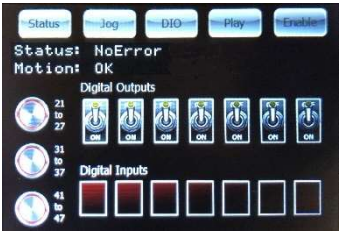
5.4 Starting and Stopping a Program

After referencing, the robot is ready to play a program.

1. Press the "Play" button at the top of the display and select the program *Igus5DOF_TestMotion with* the "prev" and "next" buttons.
2. Load the program using the "Load" button.
3. Play the program once using "Single Play".
4. "Cont. Play" plays the loaded program continuously.
5. "Stop" Stops the movement.
6. The slider "Override" can be moved to the right to increase the speed of the movement or to the left to decrease it.

5.5 Setting the Digital Inputs/Outputs

The digital outputs can be activated and deactivated by pressing the switches shown.

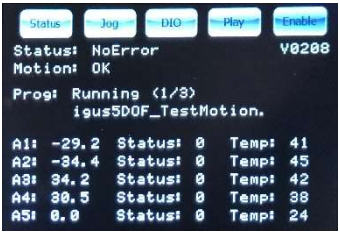


If, for example, a gripper is connected to the digital I/O module, it can be activated or deactivated by flipping the switches shown.
If a signal is present at the digital input, this is indicated in the Digital Inputs area at the bottom of the display.

By pressing the three buttons on the left side you can switch between several DIO modules.

5.6 Display of Status Information

Status information can be displayed by pressing the "Status" button at the top left of the display.



While a program is running, the name of the program, for example, is displayed here.

The axis positions of axes 1-5 (or 1-4 for 4-axis robots) are displayed (A1-A5).

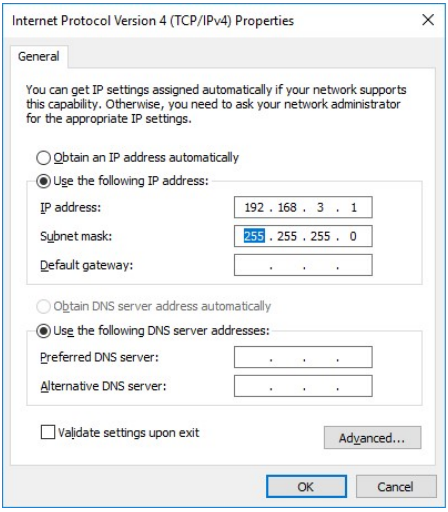
The temperature of the motor modules is also displayed. Due to the different loads on the individual axes, different holding currents are applied, which lead to different temperatures of the motor modules.

6. Programming

The robolink-DCi is programmed with the help of the 3D robot control software CPRog on a Windows computer. Install the CPRog software as described in the CPRog user guide.

6.1 Establish Connection

- Cable connection Ethernet. Connect the robot to a Windows PC via LAN cable.
- Set the IP of the PC to 192.168.3.1. (The robot has IP 192.168.3.11)



- Start the robot and CPRog on the PC. As soon as the green LEDs on the motor modules flash the connection can be established (see chapter4).
- Press "Connect" (plug symbol in the menu of CPRog).

Now you see the view of the robot in the CPRog interface. If you move the robot using the joystick on the control unit, the graphics adapt.

However, you can also use the functions of the CPRog software to move the robot, for example, downwards in the Z direction.

6.2 Creating a Program

The program is created as described in the CPRog user guide.

6.3 Uploading a Program

Before a program newly created in CPRog can be run on the robot, it must be uploaded to the robot's internal computer. After that it can be used as described in chapter 5.4.

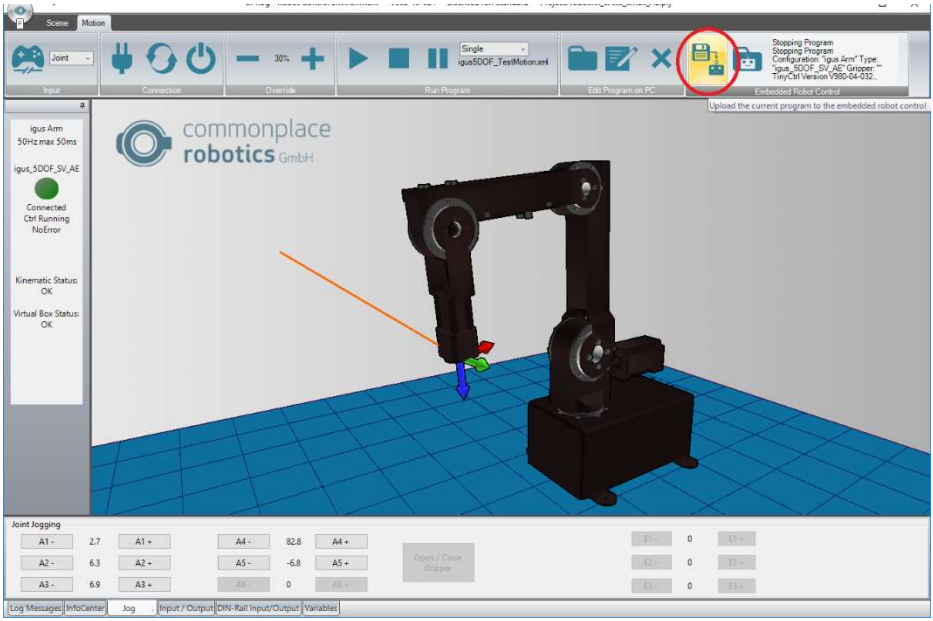


Figure 2: CPRog Windows Software. After the robot is connected by clicking on Connect, the currently active program can be uploaded by clicking on the red marked icon. The currently active program named in the "Run Program" area next to the Play/Stop/Pause buttons.

7. Interfaces

7.1 Hardware Interfaces: Digital Inputs and Outputs

The simplest connection, e.g. to a PLC, is possible via digital inputs and outputs. Each robolink controller is supplied with a DIO module. This provides 7 inputs and 7 outputs. A total of 3 modules can be controlled.

The outputs are controlled via reed relays and can switch up to 500 mA. This value must not be exceeded during the switching process (e.g. by charging currents of capacitors) as otherwise the relays may stick together.

7.2 Software Interfaces

Various interfaces are available from the robot controller:

- PLC interface for controlling the robot via a PLC, in particular for starting and stopping programs
- Plugin interface to integrate e.g. cameras. The plugin then transmits target positions to the robot controller.
- CRI interface to enable further interaction. This interface can be used, for example, to generate workpiece-specific programs from a database.
- ROS interface to integrate the robot into the Robot Operating System www.ros.org

Further information on the interfaces can be found in the CPRog documentation and in our wiki at wiki.cpr-robots.com.

8. Error Handling and Support

If you have any problems, you can find help here:

- Wiki-Page: wiki.cpr-roboter.de with many instructions and articles
- Mail: support@cpr-robots.com
  Please give a brief description of the problem and send the file "logMessages.log" from the folder c:\CPRog\.

8.1 CAN-Bus and CPRog Status Information

Error	Bit in error byte	Meaning	Measures
Bus dead		The CAN bus is not available. Reasons are missing power supply or missing plug connections.	Check the plug connections of the power supply and the CAN line. Restart the controlling computer.
Temp	Bit 1	The temperature of the motor modules is too high.	Check that the ventilation is installed and working.
E-Stop / Supply	Bit 2	Emergency stop or voltage too low	Check that the emergency stop switch is released.
MNE Motor Not Enabled	Bit 3	No fault. The motors are not released yet.	Press the "Enable motors" button.
COM Comm Watch Dog	Bit 4	The period without CAN command from the controller was too long.	The position commands via the CAN bus must be sent at short intervals. Turn off other programs or update / virus scan functions.
LAG Position Lag	Bit 5	Position lag error. The robot cannot maintain the target position.	Decrease the speed of movement.
ENC Encoder Error	Bit 6	Error in motor encoder or absolute encoder	Check the encoder cables
OC Over Current	Bit 7	Overcurrent in the motors	Reduce the motor current
DRV	Bit8	Error in motor driver or motor algorithm	Drive specific

After an "Error Reset" the normal status of the axes is 0x04 (motor not enabled).
After releasing the motors the status is 0x00, now the axes are ready for operation.

8.2 Software

The software running on the robot's internal controller is called TinyCtrl. A simple updater for the control software can be found on the wiki.