IO EXPANSION AND ADVANCED SAFETY WIRING

INOVO ROBOTICS MODULAR ARM

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Audience	User Documentation	Date	28 Jun 2023
Classification	Public	Version	0.3
Owner	Henry Wood	Status	DRAFT

Product version 5.2.0

Min Software versions

| RCU	V8.5.7
UI	V2.6.6
PSUC	V0.0.6

CONTENTS

1.   Introduction

The PSU1004 robot control unit contains the robots power supply, safety controller, embedded computer and IO. This manual describes the process for removing the case and accessing the internal IO, it also describes the advanced safety IO features.

2. Opening the case

The top part of the case can be removed to access the internal IO modules and safety IO without invalidating the warranty.

IMPORTANT: First power down the robot, the controller and disconnect the mains supply.
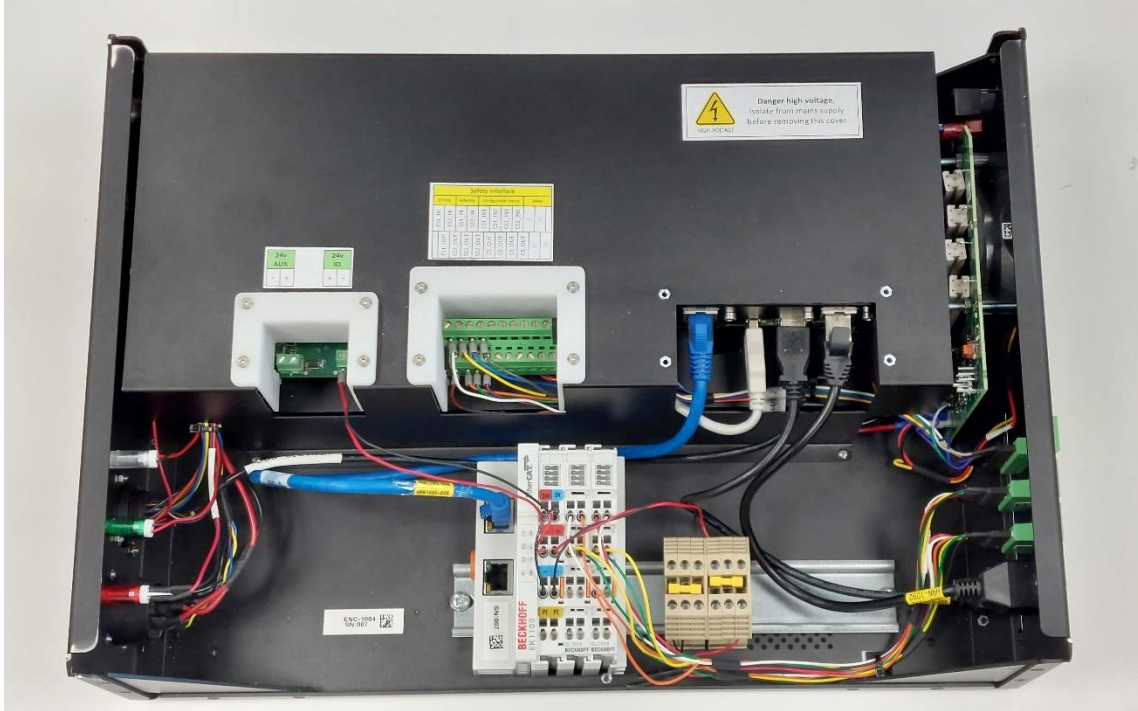
Using a 2mm hex bit remove the six countersunk screws on the bottom of the case shown below, avoid using a ball head key as these can easily round the screws head:
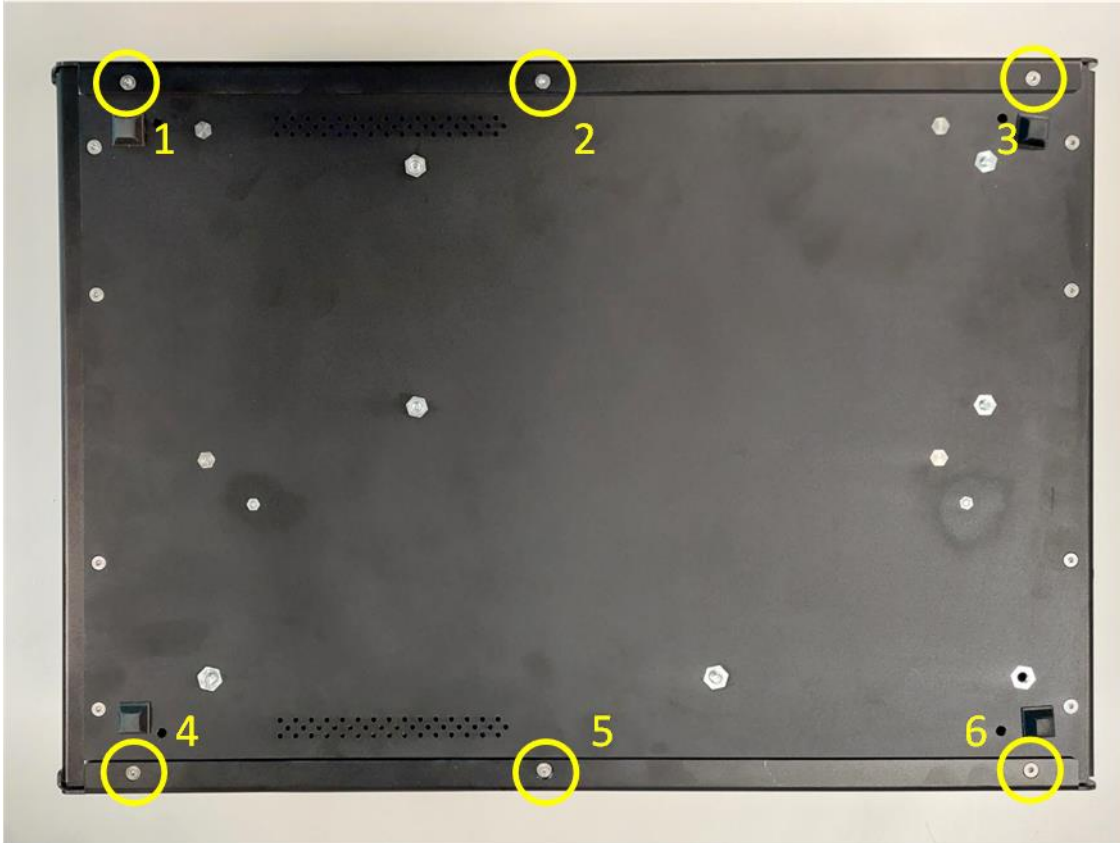
Next remove the four screws on the rear panel shown below using a 2.5mm hex bit:

Carefully slide the top part of the case off the base toward the rear to expose the internal terminals.

Do not attempt to remove the internal cover over the embedded computer and safety controllers as this will invalidate your warranty.

3. Safety IO

Inside the controller you will find a set of screw terminals labelled safety IO. By default, the dual channel E-Stop and Protective Stop circuits are wired to the 8-way phoenix terminal connector on the back panel. If you wish to replace the connector plate on the back panel you will need to disconnect the E-Stop and protective stop wiring and replace with your own wiring.

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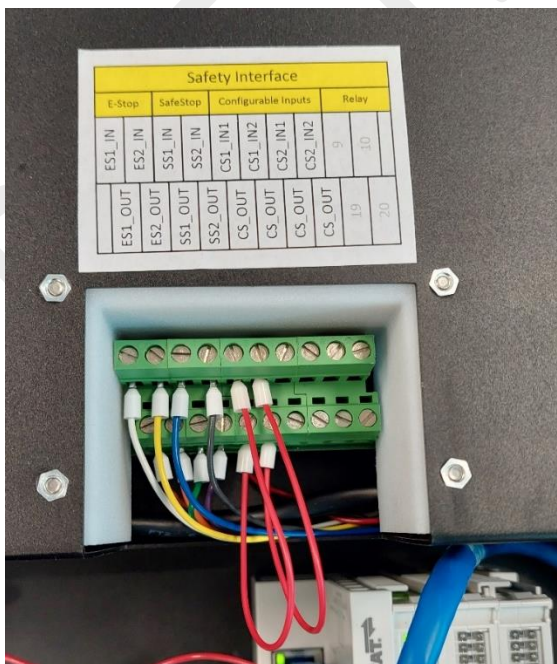
The internal safety IO terminal provides the following connections:

Terminal		Description	Type
	ES1_IN	E-Stop Channel 1 return	24v Input
ES1_OUT		E-Stop Channel 1 out	24v source
	ES2_IN	E-Stop Channel 2 return	24v Input
ES2_OUT		E-Stop Channel 2 out	24v source
	SS1_IN	Safe Stop Channel 1 return	24v Input
SS1_OUT		Safe Stop Channel 1 out	24v source
	SS2_IN	Safe Stop Channel 2 return	24v Input
SS2_OUT		Safe Stop Channel 2 out	24v source
	CS1_IN1	Configurable Input 1 Channel 1 return	24v Input
CS_OUT		Configurable Input 1 Channel 1 output	24v source
	CS1_IN2	Configurable Input 1 Channel 2 return	24v Input
CS_OUT		Configurable Input 1 Channel 2 output	24v source
	CS2_IN1	Configurable Input 2 Channel 1 return	24v Input
CS_OUT		Configurable Input 2 Channel 1 output	24v source
	CS2_IN2	Configurable Input 2 Channel 2 return	24v Input
CS_OUT		Configurable Input 2 Channel 2 output	24v source
	RELAY1	E-Stop slave relay Channel 1	Relay contact
RELAY1		E-Stop slave relay Channel 1	Relay contact
	RELAY2	E-Stop slave relay Channel 2	Relay contact
RELAY2		E-Stop slave relay Channel 2	Relay contact

3.1. E-Stop inputs

The dual channel E-Stop inputs allow one or more external E-Stop switches to be connected to the system. When either E-Stop channel becomes open circuit, the robot will stop moving and power will be removed from the arm within 300ms, applying mechanical brakes in each joint. The E-stop state will latch in the robot controller and can only be reset when both E-Stop circuits are complete, and the e-stop state is cleared in the user interface via the pendant or PC. This E-Stop interface is not compatible with OSSD, if you wish to connect a safety sensor that has an OSSD output you will need an OSSD compatible relay to connected it to this input otherwise OSSD test pulse will trigger and latch a false E-Stop state disabling the robot when not intended.

3.2. Safe-Stop inputs

The dual channel Safe-Stop (or 'protective-stop') inputs allow an external safe stop switch to be connected to the system. When either Safe-Stop channel becomes open circuit, the robot will stop moving and the motor drive circuits will be disabled in hardware within 300ms, the mechanical brakes will be applied to each joint but power will remain to the arm. The Safe-stop state will latch in the robot controller and can only be reset when both Safe-Stop circuits are complete again, and the safe-stop state is cleared in the user interface via the pendant or PC.

Note: This Safe-Stop interface is not compatible with OSSD, if you wish to connect a safety sensor that has an OSSD output you will need an OSSD compatible relay to connected it to this input otherwise OSSD test pulse will trigger and latch a false Safe-Stop state disabling the robot when not intended.

3.3.   Configurable Input 1

Configurable input 1 can be used to slow the robot to a preset speed limit when the input is open circuit and return to the normal speed when both circuits are closed again. These inputs are typically connected to a safety scanner or pressure mat which is triggered when people come within a preset range of the robot. If your sensor only has a single channel output the second configurable input should be bridged with a wire link.

To enable this feature and configure the speed limit, go the 'settings' tab in the main user interface and select advance at the bottom.
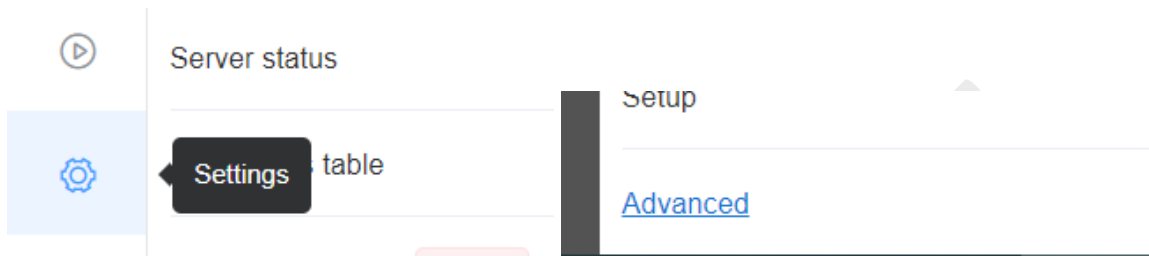
Select the 'robot' and 'scaled_joint_trajectory_controller' submenu
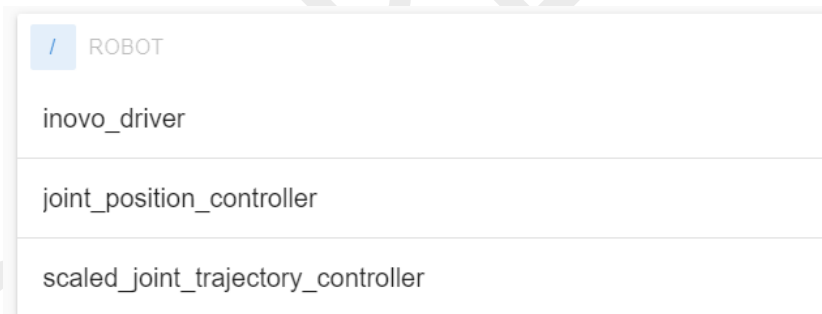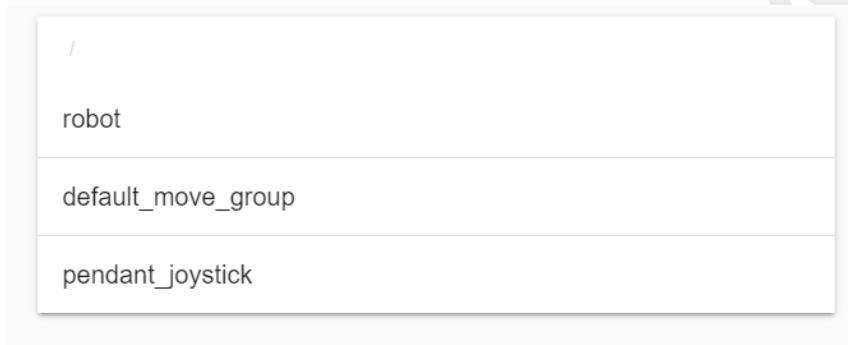
Tick the 'enable_speed_limit' checkbox to enable the input and set the required limit speed when the speed limit is active. This value can be set between 0-1 which represents 0-100% speed scalling.
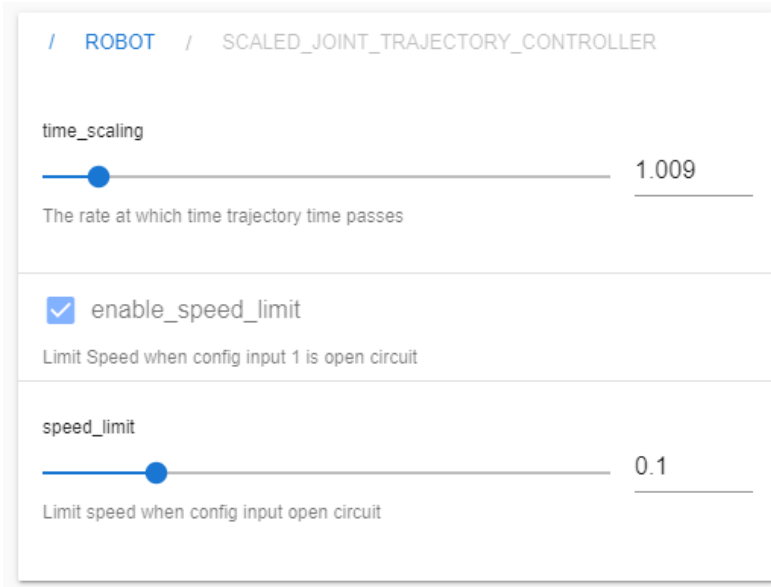
When the speed limit is active, ie either of the configurable input 1 channels are open circuit or low, the robots speed scaling will be set to the preset value. When both inputs are closed circuit or high the speed scaling will return to the value set in the main UI.

3.4.   The E-stop Slave relay

The E-stop slave relay can be used to disable external equipment when the robots E-stop system is triggered. The relay contacts are rated for 10A at 48v. The circuit is closed when the system is active and go open circuit when the system is in the E-Stop state, it latches until both E-Stop inputs become high or and closed circuit and the E-Stop state is cleared in the user interface on the pendant or PC.

4. 24v Aux Power

The 24v DC Aux power connector can be used to power external equipment. The maximum current that can be drawn from this output is 2A or 50W.

5. 24v IO Power

There is a dedicated 24v DC power output for the Beckhoff IO modules. This has a max current limit of 2A or 50W.

6. Expanding the modular IO

The IO in the control box is based on the Beckhoff EtherCAT system. The standard robot controller is fitted with one Beckhoff Terminal EL1100, one EL1008 8 channel digital input terminal and one EL2008 8 channels digital output terminal. If you require additional input or output channels these can be fitted by opening the case as described in section 2 and fitting more terminals to the internal DIN rail, you must group similar terminals together so the EtherCAT controller will correctly identify all available channels.

Compatible modules include:

- EL1002 – 2 channel digital input
- EL1004 – 4 channel digital input
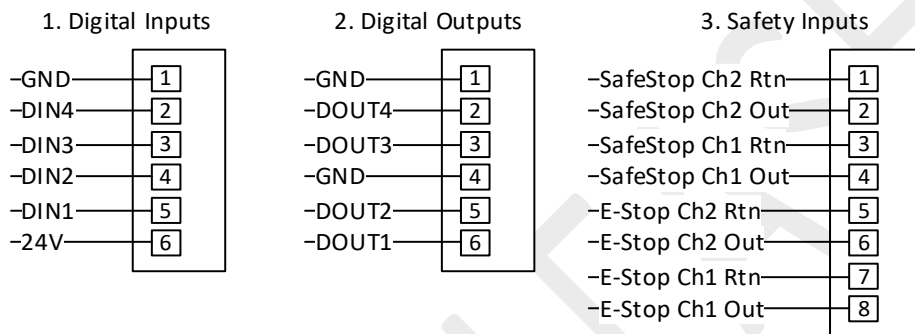- EL1008 – 8 channel digital input

- EL2002 – 2 channel digital input
- EL2004 – 4 channel digital input
- EL2008 – 8 channel digital input

Contact support@inovorobotics.com to check compatibility if you would like to use other modules.

Please see https://www.beckhoff.com/en-en/products/i-o/ethercat-terminals/ for full specifications of the modules.
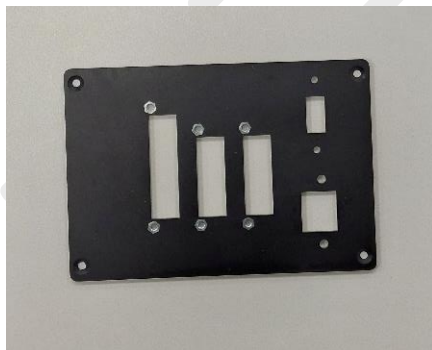
7. Connector plate.

The robot controller unit is fitted with a standard connector plate at the factory, this provides easy access to the e-stop and protective stop circuits as well as four digital input and output channels.

| 1. Digital Inputs	2. Digital Outputs	3. Safety Inputs
GND — 1	GND — 1	SafeStop Ch2 Rtn — 1
DIN4 — 2	DOUT4 — 2	SafeStop Ch2 Out — 2
DIN3 — 3	DOUT3 — 3	SafeStop Ch1 Rtn — 3
DIN2 — 4	GND — 4	SafeStop Ch1 Out — 4
DIN1 — 5	DOUT2 — 5	E-Stop Ch2 Rtn — 5
24V — 6	DOUT1 — 6	E-Stop Ch2 Out — 6
		E-Stop Ch1 Rtn — 7
		E-Stop Ch1 Out — 8

This uses Phoenix Contact pluggable terminal blocks, MPN MSTB2,5/6-ST-5,08 and MSTB 2,5/ 8-ST-5,08 BD:1-8, which can be sourced from most major electronics suppliers.

Depending on your specific application you may need to breakout other connections so Inovo provides a blank panel plate that you can drill to fit your own connectors or cable glands as required.

Fitted plate with:
1 x RJ45, 1 x USB,
2 x 6-way phoenix for 4 Dig In, 4 Dig Out
1 x 8-way phoenix for E-Stop & Safe-Stop
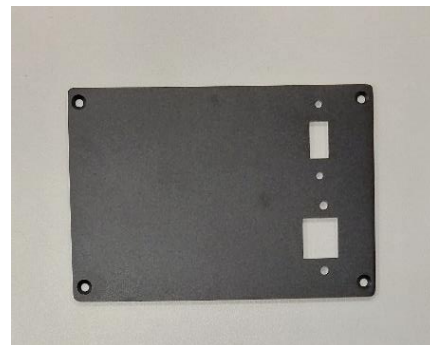
Blank plate with:
1 x RJ45, 1 x USB
Space for user connectors and glands