



user manual

T GEAR

PLC TRAINER & HMI



TGEAR



Read this manual before use to get to know the details about the usage, installation, specifications and safety instructions for using the product. For the most recent information and more in-depth information about the *PLC Trainer*, the *HMI* and other expansion modules go to www.tgear.eu

**Figures and illustrations in this User Manual are provided for reference only and may differ from the actual product appearance. Product design and specifications may change without notice.*

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www.detechniekschool.nl





1 GENERAL INFORMATION

DEFINITIONS

PLC Trainer

Programmable Logic Controller

This is the main device as shown in figure 1.

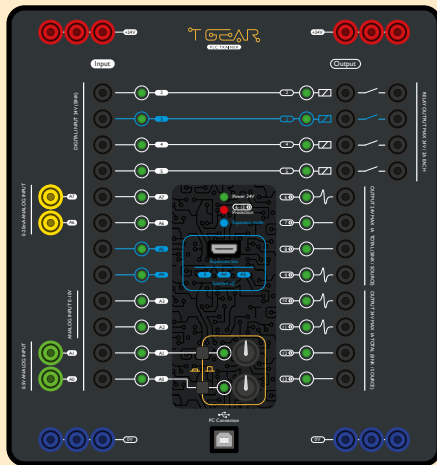


figure 1 PLC Trainer

HMI

Human Machine Interface

This is an expansion module that can be connected to the *PLC Trainer*, see figure 2.



figure 2 HMI

0V

In this manual, *0V* means the 0 Volt connections on the *PLC Trainer*. The *0V* of the external 24V DC power supply (not included) must be connected to this connection.

IN THE BOX

PLC Trainer

| Amount | Part |
|--------|--------------------------|
| 1x | PLC Trainer (PLC0001001) |
| 1x | Test lead blue |
| 1x | Test lead red |
| 1x | Test lead black |
| 1x | USB cable |

HMI

| Amount | Part |
|--------|-------------------------|
| 1x | HMI module (HMI0002001) |
| 1x | Expansion cable |

not included

T Gear Power Supply (PSU0009001)

GENERAL DESCRIPTION

The T Gear PLC Trainer is a 24V DC PLC training device that is built around an original *Arduino*. The T Gear PLC Trainer is designed for educational purposes only.

Arduino is a trademark of Arduino AG. For more information about Arduino or the Arduino IDE go to www.arduino.cc



2 INITIAL SETUP AND FIRST USE

HOW TO POWER UP

Use a 24V DC power supply as specified in chapter 5. Attach the test leads as shown in figure 3. All red 24V power connectors on the *T Gear PLC Trainer* are interconnected. The blue 0V connectors are also interconnected.

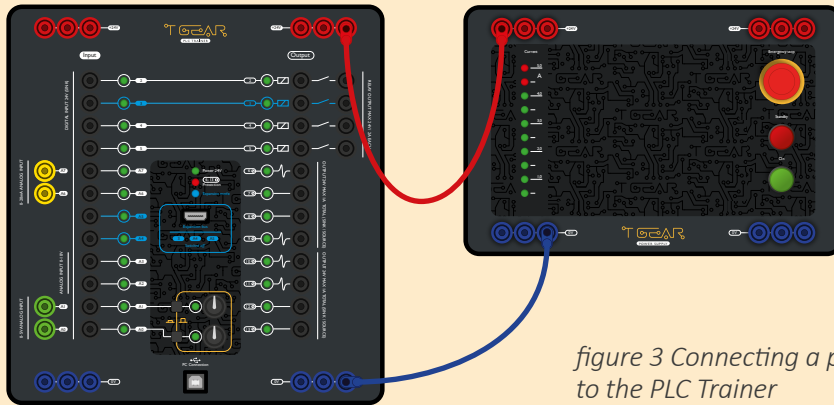
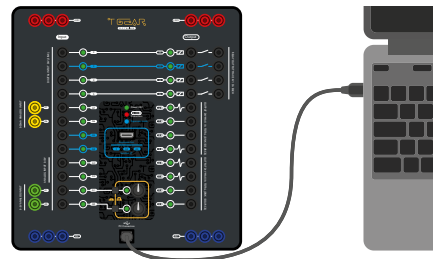


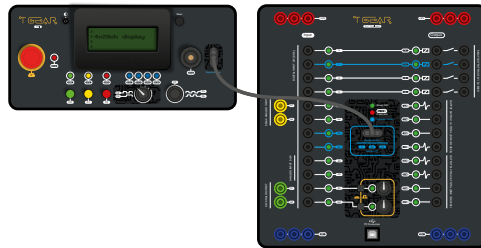
figure 3 Connecting a power supply to the PLC Trainer

To program the *PLC Trainer*, connect the included USB cable.

figure 4 Connecting a computer to the PLC Trainer



The *PLC Trainer* uses an *Arduino*. Use software that is compatible with *Arduino*.



In addition to the *T Gear PLC Trainer*, various modules can be connected by using the expansion bus and the expansion cable.

figure 5 Connecting the HMI to the PLC Trainer



Only connect compatible *T Gear modules* to the expansion bus. Connecting other equipment can cause defects!

HOW TO CONNECT

On the following pages you can find the pinouts of the *PLC Trainer* and the *HMI* module. There are various T Gear modules that can be connected to the *PLC Trainer* by using the *expansion bus connector*. See page 14 for information about the *expansion mode*.

PROGRAMMING

The *PLC Trainer* can be programmed with the Arduino IDE or with use of Ladderino. Ladderino has been specially developed for use with this *PLC Trainer*. For a more detailed explanation about programming the *PLC Trainer* and the *HMI* go to www.tgear.eu.

When you are programming the *PLC Trainer*, or when uploading a program, it is not mandatory to have the 24V power supply switched on. When using the *PLC Trainer* after you uploaded your program, you don't need to keep the USB cable connected. However you may keep both connected when in use and when programming.

QUICKSTART TO RUN A PROGRAM

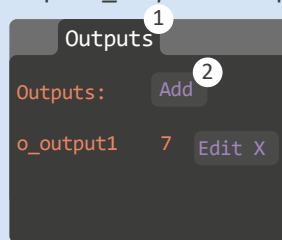
Preferably program the *PLC Trainer* with *Ladderino*. Here is an example to illustrate how to make a simple program and upload it to the PLC Trainer. You will need to successively install the Arduino IDE and Ladderino.

Download and install Arduino IDE from www.arduino.cc/download
Download and install Ladderino from www.tgear.eu/software

Start Ladderino

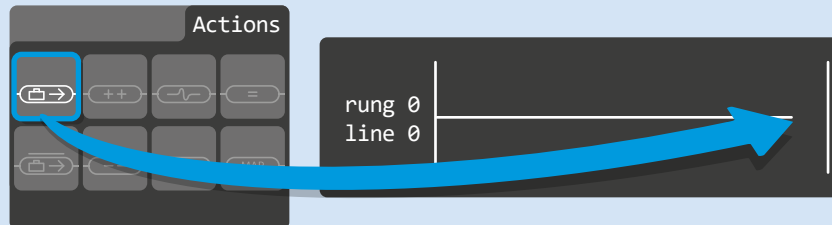
Create the following program

Create an output `o_output1` with pin 7.




- 1 Click on the *Outputs* tab in the menu at the bottom left
- 2 Add the output: click on *Add*
- 3 Type in the pop-up window:
Name: `output1`
Pin: `7`
- 4 Click on

Click on the *Actions* tab in the menu at the top left.



Drag a *write to* block from the *Actions* tab to (behind) the end of the line of the ladder diagram. Select `o_output1` in the pop-up window.

Save the program and upload it to the Arduino IDE by pressing on the icon:  in the menu bar. Arduino IDE will open.



Arduino IDE

Select the correct board

Go to *Tools* in the menu bar, and go to *Board* in the pull-down menu.

Select the correct board: *T Gear PLC Trainer*

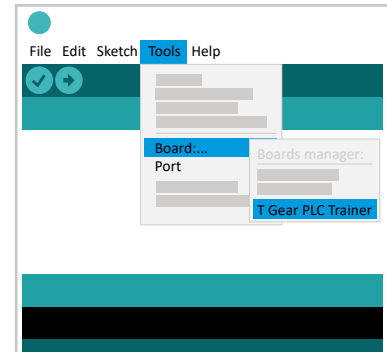


figure 6 Select correct Board

Select the correct port

Now go to *Tools* again in the menu bar, and go to *Port* in the pull-down menu.

Now select the correct COM port*.

*TIP for selecting the correct port

If you see multiple ports in the list and find it difficult to choose the right one: disconnect the usb cable and see which port is missing. Reconnect the cable and choose this port.

Upload the program

Click on the upload icon  in the menu bar.

Wait a few seconds for the code to upload.
The LED next to output 7 will now light up: output 7 is on.

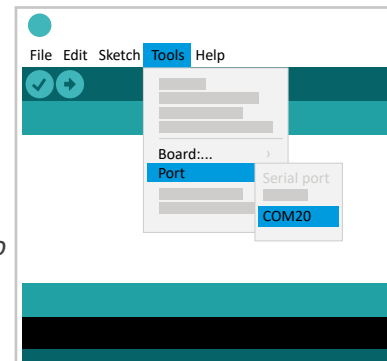


figure 7 Select correct Port

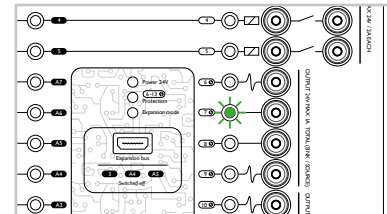


figure 8 LED next to output 7 lights up

3 INPUTS & OUTPUTS

PLC TRAINER PINOUT

| icon | description |
|------|--|
| | digital input pins 24V sink |
| | digital output pins 24V |
| | relay connection pins |
| | 0-24V PWM analog output pins (output pins 6, 9, 10, 11) |
| | pins with current protection (output pins 6-13) |

| icon | description |
|------|---|
| | pins that will be disabled in expansion mode (input pin 3, A4, A5, output pin 3) |
| | button alternates between pin input and potentiometer (input pin A0, A1) |
| | potentiometer |

Advanced
input interrupts:

- int0
- int1

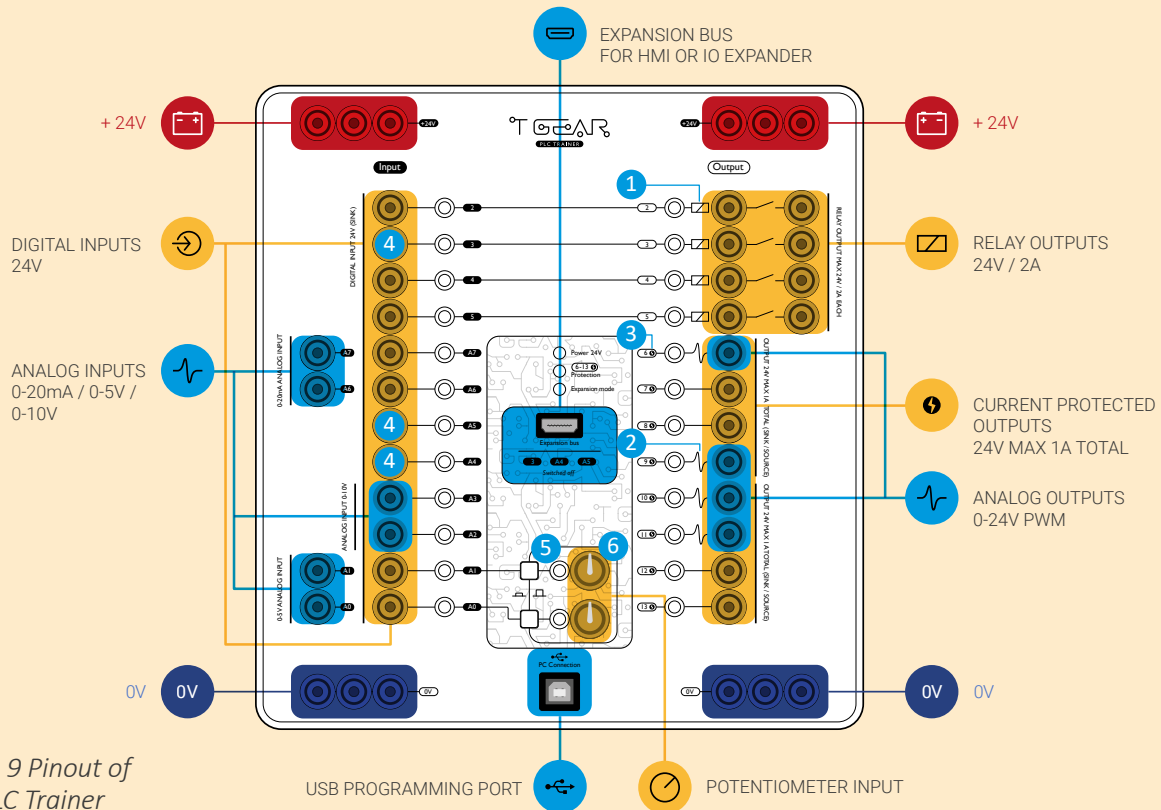


figure 9 Pinout of the PLC Trainer



HMI PINOUT

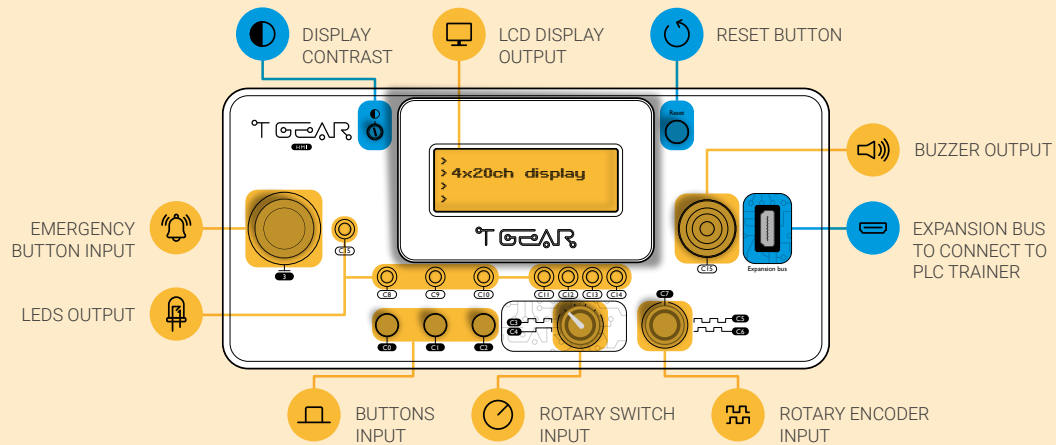
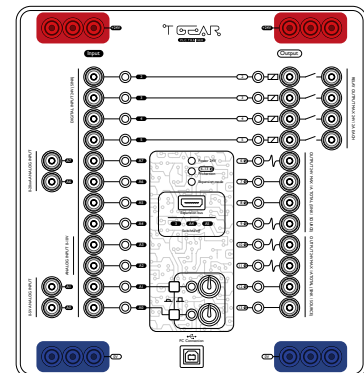


figure 10 Pinout HMI

As you can see the T Gear PLC Trainer consists of a wide variety of inputs and outputs, digital and analog. You can use them with a minimum of configuration. In this chapter we explain the possibilities and show you how to use them.

24V AND 0V

Inputs for connecting to a 24V DC power supply, for specifications on the power supply see chapter 5.



MULTIFUNCTIONAL INPUTS A0 - A7

Overview of the functions of each input.

Input Ports A0 and A1

Digital input 24V
Analog input 0 -5V
Digital input 5V
Built-in potentiometer

Input Ports A2 and A3

Digital input 24V
Analog input 0 - 10V

Input Ports A4 and A5

Digital input 24V
Disabled when using expansion bus

Input Ports A6 and A7

Digital input 24V (works only when you use our library)
Analog input 0 - 20mA

How to configure Inputs A0 - A7

Inputs A0 - A7 are capable of handling different kind of analog and digital signals. There are no special settings that need to be made to select the signal type, just use the right input connector for your signal. Each port can only be used for 1 type of input signal at the same time.

Using the potentiometer

To select the built-in potentiometer, use the switch next to the potentiometer.

All analog inputs

Please note that the T Gear PLC trainer is not a calibrated measuring instrument. As a result, analog measurements may have some degree of inaccuracy. Also some crosstalk may occur when measuring analog signals.



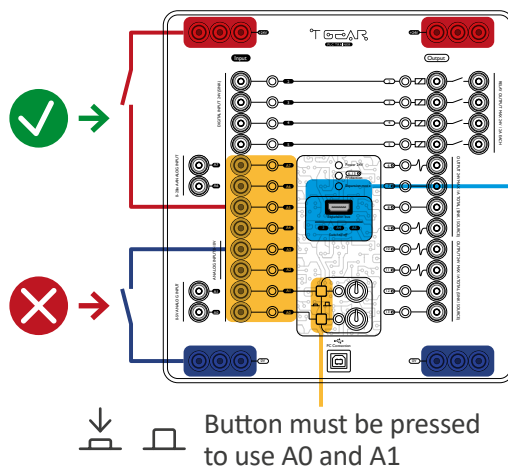


Digital input 24V (sink) A0 - A7

All input pins are sink and they are internally pulled-down.

Keep this into consideration when connecting:

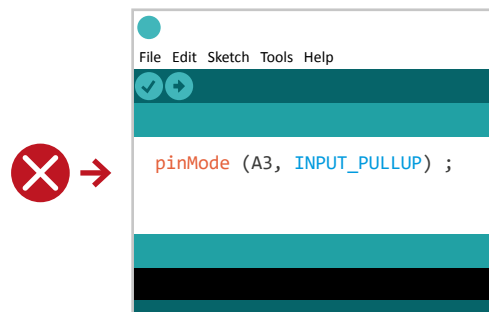
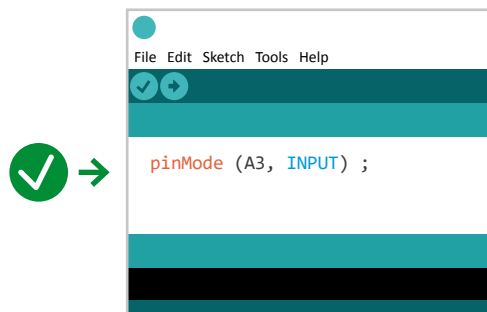
1. When connecting



Expansion mode must be OFF to use A4 and A5

Using A6 and A7 digitalRead
The digitalRead function can only be used when the library is included which comes with the Ladderino software.

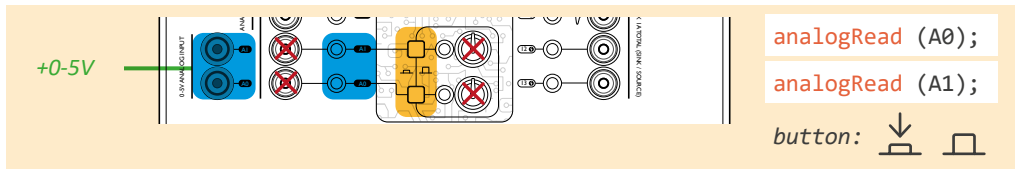
2. When programming



Because the input pins are all internally pulled-down, you should not activate an internal pull-up on the input pins. A pin will lose its function as long as it is pulled-up.

0 - 5V analog inputs A0 and A1

The green A0 and A1 input ports can be used as a 0 - 5V analog input to the Arduino 10 bit ADC. Where 0V returns ADC value 0 and 5V returns ADC value 1023.

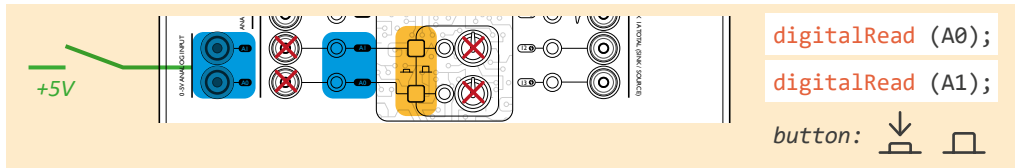


Use `[analogRead (A0);]` to measure 0 - 5V analog signals with A0

Use `[analogRead (A1);]` to measure 0 - 5V analog signals with A1

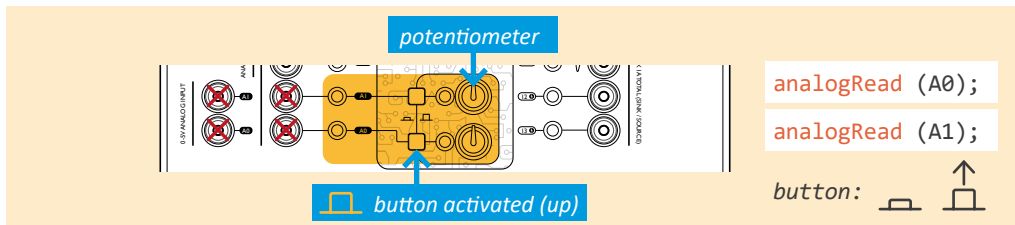
5V digital inputs A0 and A1

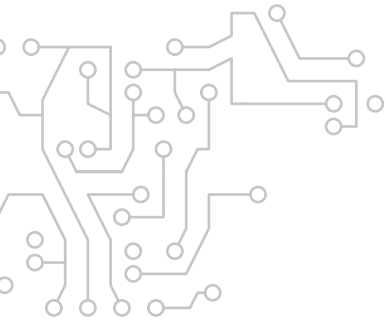
The green A0 and A1 input ports can also be used as a 5V digital input. Where 0V is low and 5V is high.



Use of the potentiometer A0 and A1

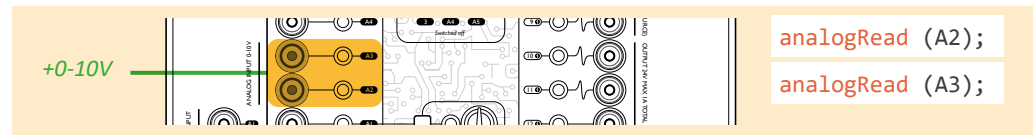
Using the potentiometers of the A0 and A1 input ports.





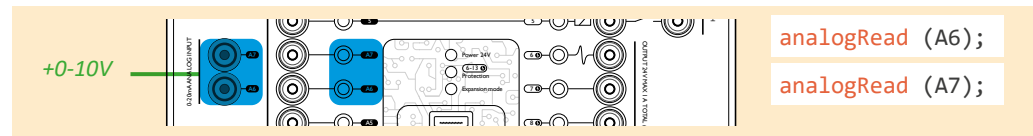
0 - 10V analog inputs A2 and A3

The A2 and A3 input port can be used as a 0 - 10V analog input to the Arduino 10 bit ADC. Where 0V returns ADC value 0 and 10V returns ADC value 1023.



0 - 20mA analog inputs A6 and A7

The A6 and A7 yellow input port can be used as a 0 - 20mA analog input to the Arduino 10 bit ADC. Where 0mA returns ADC value 0 and 20mA returns ADC value 1023. If you want to use A6 or A7 as a 4 – 20mA input, 4mA returns +/- 205 and 20mA returns 1023.



Protection

All input ports are protected against reverse polarity. In addition, all analog input ports are protected against wrong connections up to 24V DC.

MULTIFUNCTIONAL INPUTS/OUTPUTS 2 - 5

Overview of the functions of each input/output.

Input/output port 2

Digital input 24V
Digital input with interrupt function 24V
Relay output

Input/output port 3

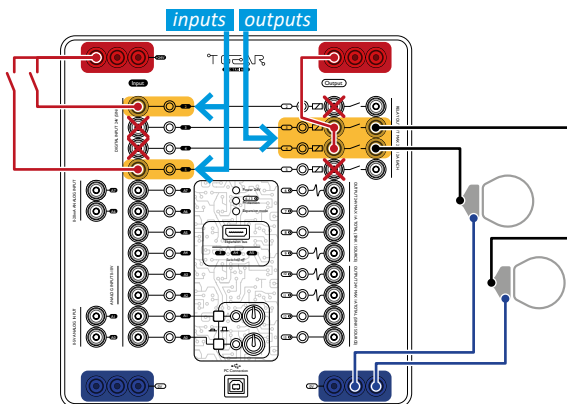
Digital input 24V
Digital input with interrupt function 24V
Relay output
Disabled when using expansion bus

Input/output ports 4 and 5

Digital input 24V
Relay output

How to configure port 2 - 5 as an input or output

The pins 2 to 5 can be used as input (2 to 5) or as output (2 to 5). When a pin is driven as output, the pin will control the relay on that pin (pins 2 to 5). Each pin can be set individually to be input or output within Ladderino or Arduino IDE.



```
File Edit Sketch Tools Help
void setup(){
  pinMode (2, INPUT) ;
  pinMode (3, OUTPUT) ;
  pinMode (4, OUTPUT) ;
  pinMode (5, INPUT) ;
}
```

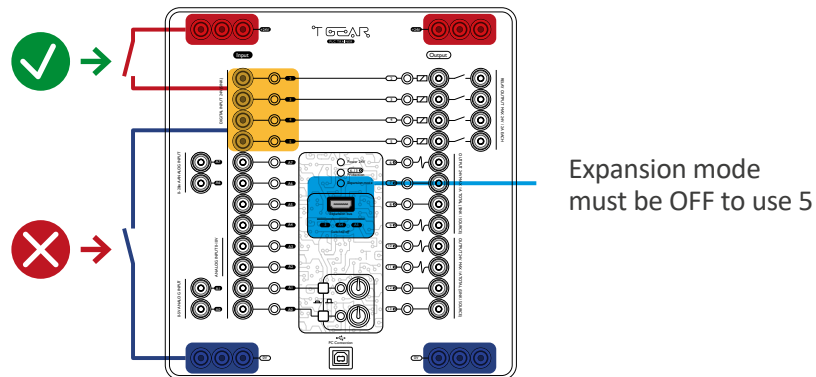
In this example pin 2 and 5 are set as input pins and pins 3 and 4 are set as output pins.



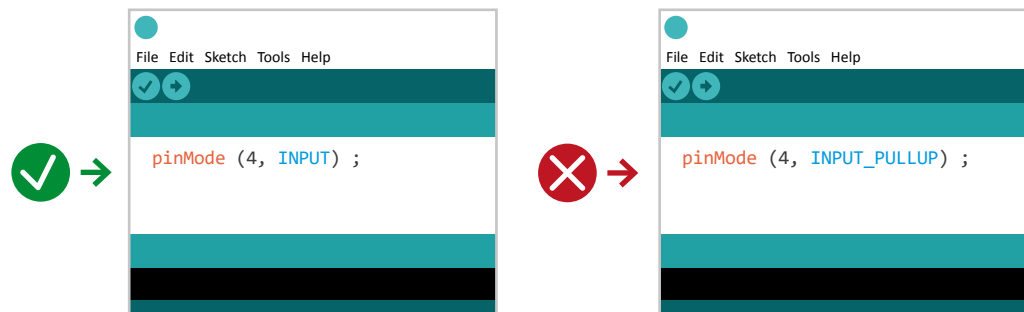
Digital input 24V (sink) 2 - 5

All input pins are sink and they are internally pulled-down.
Keep this into consideration when connecting:

1. When connecting



2. When programming



Because the input pins are all internally pulled-down, you should not activate an internal pull-up on the input pins. A pin will lose its function as long as it is pulled-up.



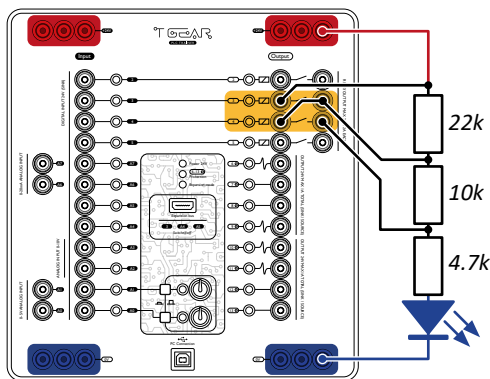
Digital input 24V (sink) 2 and 3 interrupt

It is possible to assign an interrupt function to input port 2 and 3 within Arduino sketch. For more information about working with interrupts, please refer to the Arduino website: www.arduino.cc

Relay output

The relay contacts are electronically isolated from all other electronics. Each can handle 24V/2A max. See figure below.

When a pin is configured as output and writes a high value, it will activate the corresponding output relay and the output LED will light up.



The relay contacts are electrically isolated. Without any problem you can connect the contacts of different relays together.

This example shows a LED dimmer, where you can change the LED current by controlling the relays.

Protection

All input ports are protected against reverse polarity. The relay output ports are protected against large inrush currents, preventing the relay contacts against wear. The relay outputs are protected with a self-resetting circuit breaker for currents greater than 2A. These circuit breakers recover after approximately 10 minutes after the PLC Trainer has been turned off and the circuit breaker has cooled down.

MULTIFUNCTIONAL OUTPUTS 6 - 13

Overview of the functions of each output.

Output port 7, 8, and 12

24V Digital output

Output port 13

24V Digital output

Output flickers during startup to indicate booting

Output port 6, 9, 10 and 11

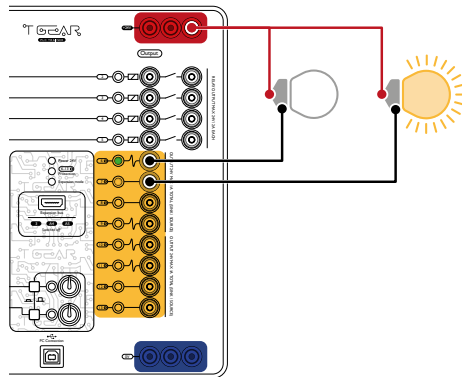
24V Digital output

24V PWM (analog) output

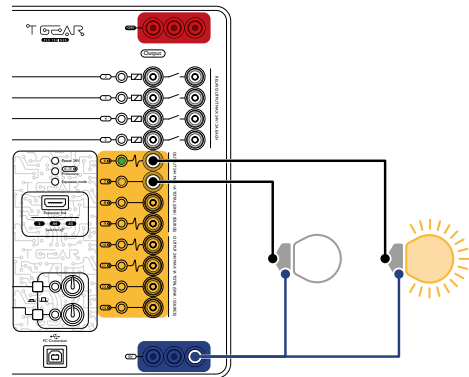
Digital outputs 6 to 13: sink or source

Digital outputs 6 to 13 have a push/pull output stage so that they can be used as a sink or source output. Keep this in consideration when programming and connecting peripherals.

PLC Trainer output used as sink



PLC Trainer output used as source





PWM (analog) outputs 6, 9, 10 and 11

Output ports 6, 9, 10 and 11 can be used as a 8 bit PWM (analog) 24V output. Be aware that although PWM is often referred to as analog, it is not a true analog signal but in fact a fast switching 24V pulse whose result is comparable to an analog signal.

When writing an analog value 0 to a PWM output this returns a PWM output with 0% duty cycle. Writing an analog value 255 to a PWM output this returns a PWM output with 100% duty cycle.

Output 13

When the *T Gear PLC Trainer* starts or resets, output 13 will pulse multiple times.

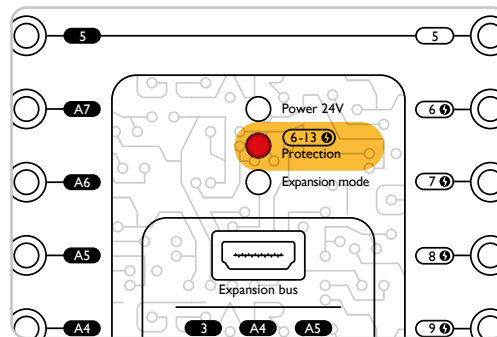
Protection

All digital outputs are protected against large sink or source currents.

The digital outputs are divided into two output groups (group 1: port 6, 7, 8 and 9) (group 2: port 10, 11, 12 and 13) Each output group is capable of handling 1A of sink or source current continuously.

If one of the output groups exceeds 2A sink or source current the electronic protection is activated which disables output port 6 - 13 of the PLC Trainer. The “current protection” LED will light up, see figure on the right.

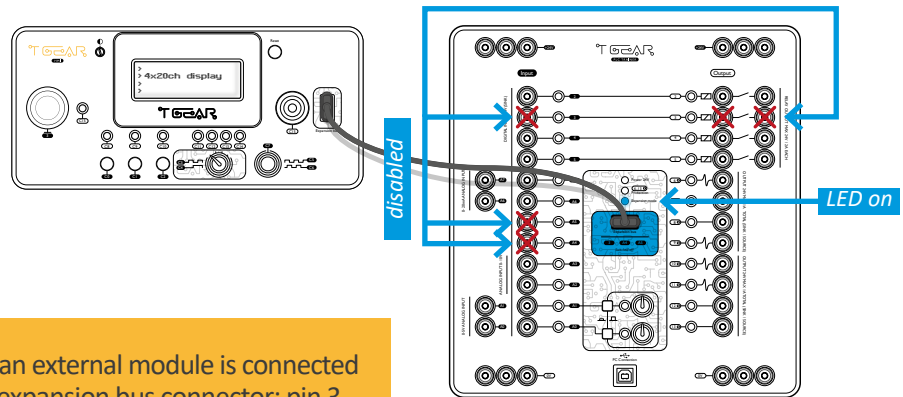
To recover your PLC Trainer, switch off the 24V power supply, wait 10 seconds while removing the short circuit of overload circuit, and turn the power supply back on.





EXPANSION BUS

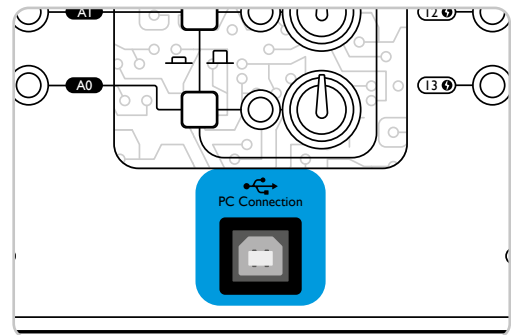
Connector input pins 3, A4 and A5 and output pin 3 are disabled when an external module is connected to the *expansion bus connector*. And the *expansion mode* LED will light up. See figure below.



When an external module is connected to the expansion bus connector: pin 3, A4 and A5 are disconnected and the *expansion mode* LED will light up.

PC CONNECTION

The PLC Trainer is equipped with a USB B connection. You can upload your PLC program to the PLC Trainer via this USB connection. It is also possible to let your PLC Trainer communicate with your PC during use. You also use the USB connection for this.



When using the supplied USB A to USB B cable you can make a connection between your computer and the PLC Trainer. Plug the USB A plug into an available female USB 2.0 or USB 3.0 connection on your computer.

In most cases it doesn't matter which USB port on your computer you are using. If you use the Ladderino software to write your programs, you must have a computer with Windows 7 or higher. If you only use the Arduino IDE, you can also use other operating systems. More information about the operating systems supported by Arduino can be found on the arduino website. www.Arduino.cc

Note

If you want to use all functions and IO of the PLC Trainer, the PLC Trainer must be powered via the 24V connection. To exchange data between your PLC Trainer and your computer, the USB connection is also necessary during use. Although allowed, in all other cases the PLC Trainer does not need to remain connected to your computer during use.



4 MAINTENANCE

The device should be cleaned with a dry cleaning cloth. Turn the device off before cleaning.

TROUBLESHOOTING AND MAINTENANCE

Troubleshooting



If a problem persists even after performing the prescribed steps, contact your supplier!

The device does not respond anymore and the current protection LED is on

- Turn off the power source, wait a few seconds and turn the power source back on

The display on the HMI does not respond anymore

- Check the display contrast (see page 12 for the location of the display contrast knob)
- Turn off the power source, wait a few seconds and turn the power source back on

The device does not respond and the power LED is not lit

- Check that the test leads are connected as described on page 7
- Check if the power supply is on

A1 or A0 does not respond

- Check if the potentiometer is switched on. If the button next to the potentiometer is up, the inputs A1 and A0 will be disabled

Pins A4, A5 or 3 do not work

- Check if the blue *expansion mode* LED is lit (see page 11). If this LED is lit (when an expansion module is connected to the expansion bus), the input pins A4, A5, 3 and output pin 3 are disabled. If you want to use those pins: disconnect the expansion module. If there is no expansion module connected but the LED is still on: contact your supplier
- Check if the *HMI* module is enabled in Ladderino

Output relay 2, 3, 4 or 5 does not work

- If one of these input connectors gets a high signal, the corresponding relay cannot be controlled anymore and is shut off

The port of the *T Gear PLC Trainer* is not shown in Arduino IDE

- Connect the *T Gear PLC Trainer* according to the instructions in chapter 2 *Initial setup and first use*
- Reconnect the USB cable
- Use a different USB port on your computer
- Use a different USB cable, make sure it is one with data line
- Update Arduino IDE to the latest version
- Restart your computer

Repairs

Repairs should only be done by an authorized supplier.

STORAGE AND TRANSPORT

The top of the devices is fragile due to the components that protrude the top surface. Ensure that the device and all the protruding components are protected during transport and storage.



5 SPECIFICATIONS

PLC TRAINER

GENERAL SPECIFICATIONS

| | |
|---------------------------------------|---|
| Body dimensions (W x H x D) | 251 x 266 x 94 mm |
| Weight | 1.56 kg |
| Enclosure | Body & frontpanel: Anodized aluminium |
| Required electric power supply | 24V DC min 2A - max 6,3A <i>(use power supply with circuit breaker, fuse or current protection)</i> We strongly recommend using the dedicated T Gear Power Supply |
| Permissible voltage range | 22V - max 26V DC |
| Power consumption | 125W at maximum load |

CONNECTIONS & CABLES

| | |
|-----------------------------------|---|
| Power supply 24V DC | 6 (for input and distribution) |
| Total IO | 24 user-configurable IO ports, of which 6 - 12 input ports and 8 - 12 output ports. *) 15 - 20 ports can be used simultaneously *) |
| Total input ports | Max 12 *), of which usable as: Digital input 24V (sink): 12 Digital input 5V (sink): 2 Analog input 5V: 2 Analog input 0 - 10V: 2 Analog input 0/4 - 20mA: 2 Internal potentiometers: 2 |
| Relay outputs (NO) | Max 4, max 24V / 2A each *) |
| Total digital output ports | 8 outputs divided into 2 groups of 4 outputs Max 1A total for each group, of which usable as: Digital output 24V (sink or source): 8 PWM output 24V (sink or source): 4 |
| USB port | 1 USB 2.0 port (for uploading and serial monitoring) |
| Expansion bus | 1 (for connecting T Gear expansion modules and HMI) |
| Included test leads | Maximum allowed voltage 26V DC, maximum allowed current 6,3A |
| Maximum cable length | To avoid the risk of electromagnetic interference (EMC), we recommend using test leads with a maximum length of 1 meter. |

*) depending on user configuration.



CORE

| | |
|---------------------------|---|
| Processor platform | Arduino Nano with Atmega 328 processor |
| Operating voltage | 5V |
| Clock Speed | 16 MHz |
| Flash Memory | 32 KB of which 2 KB used by bootloader |
| SRAM | 2 KB |
| EEPROM | 1 KB |
| ADC resolution | 10 bit (<i>Analog Digital Converter resolution</i>) |
| PWM resolution | 8 bit (<i>Pulse Width Modulation resolution</i>) |
| Serial port (COM) | Through USB connection |
| I2C bus | Through Expansion bus |

PROTECTION

| | |
|---|--|
| Reverse voltage protection | Yes (electronic) |
| Short-circuit protection digital outputs | Yes (electronic) |
| Short-circuit protection relay outputs | Self resetting fuse and inrush current limiter |

ENVIRONMENTAL REQUIREMENTS

| | |
|------------------------------|-----------------------------------|
| Operating temperature | 10°C to 40°C |
| Operating humidity | 10% to 80% (non-condensing) |
| Storage temperature | -20°C to 45°C |
| Storage humidity | 5%-95% (non-condensing) |
| Vibration | 10-500Hz, 5G 10min/1 cycle, 60min |

The design and specifications are subject to change without prior notice.

HMI

GENERAL SPECIFICATIONS

| | |
|------------------------------------|---|
| Body dimensions (W x H x D) | 251 x 116 x 85 mm |
| Weight | 0.70 kg |
| Enclosure | Body & frontpanel: Anodized aluminium, other enclosure parts: ABS, PC |
| Power supply | Through expansion bus |

FEATURES

| | |
|--------------------------------|---|
| Controls (inputs) | 9 (3 push buttons, 1 emergency button, 1 4 position binary switch, 1 rotary encoder with push button) |
| Display | 1 LCD display (4 lines 20 characters) |
| Indicators (outputs) | 8 (1 green LED, 1 red LED, 1 yellow LED, 4 blue LEDs, 1 alarm (buzzer + red LED), LCD Display) |
| Expansion bus connector | 1 |

INTERFACE

| | |
|-------------------------|-------------------------------|
| Display | I2C; address 0x3F |
| Controls | I2C; address 0x27 |
| Emergency button | Arduino interrupt input pin 3 |
| Reset | Arduino reset pin |

ENVIRONMENTAL REQUIREMENTS

| | |
|------------------------------|-----------------------------------|
| Operating temperature | 10°C to 40°C |
| Operating humidity | 10% to 80% (non-condensing) |
| Storage temperature | -20°C to 45°C |
| Storage humidity | 5%-95% (non-condensing) |
| Vibration | 10-500Hz, 5G 10min/1 cycle, 60min |

The design and specifications are subject to change without prior notice.



6 IMPORTANT SAFETY INSTRUCTIONS

For safety, follow the instructions below before using *T Gear* devices:

- Use a suitable power supply, see below: *Power supply*.
- The *T Gear PLC Trainer* should only be programmed with the included software (see page 8).
- We recommend the official *T Gear peripherals* for *T Gear* devices. When using other peripherals safety can not be guaranteed.
- Do not connect any devices other than the official *T Gear* devices to the expansion bus connector, this may damage the *T Gear* device or the external device.
- Use *T Gear* devices only in educational environments.

T Gear devices are designed for educational purposes only. They are designed to teach the principle of using PLC's, of programming a PLC and how to connect peripherals. Do not use *T Gear* devices for application in industrial environments.

Power supply

T Gear devices should only be used with a stable and safe DC 24V ($\pm 2V$) max 6,3A power supply. Never plug the device in higher voltage power supplies. Always connect the +24V plug from the power supply to one of the red 24V connectors on the device and the 0V plug to one of the blue 0V connectors. The USB connector is for data communication only. Always use power supplies with a circuit breaker, a fuse or a current protection. Power supplies like batteries can provide large amounts of currents, which could damage the *T Gear* devices if not used properly.

Hazards

Electric discharges could activate the overload protection or cause *T Gear* devices to stop functioning. When a device is malfunctioning due to an electric discharge, disconnect the device from all power sources and disconnect the USB connector. Reconnect it.



Danger!

Never connect to an AC power supply!

Never connect to an unfused power supply!

When connecting to a DC adapter, make sure that the DC adapter's voltage output matches the specified range of the device. Never connect the device directly to a 110/120/220/230/240/400 volt outlet. Ensure that the specified input voltage of the connected peripherals matches the voltage from the output to which they are connected.



Danger!

Do not expose *T Gear* devices to water or other liquids. If liquid makes its way inside a device, immediately disconnect it and contact the supplier.

Keep liquids away from *T Gear* devices. Don't use aerosol sprays directly on the devices. If liquid makes its way inside the devices, it can cause malfunctions, fire or electric shock. Do not expose these devices to rain, dripping or splashing.

Do not overload wall outlets, extension cords, or power supplies beyond their capacity, since this can result in fire or electric shock.

All cords must be positioned so that they cannot be walked on or be punctured by objects placed on them. Pay special attention to the plug ends, at wall sockets and at the point where they leave the *T Gear* devices.

To prevent damage to *T Gear* devices due to lightning and power-line surges, or when the devices are not used for a long time, disconnect them from the power supply to prevent damage.

To prevent electric shock, never insert anything into the openings of *T Gear* devices except the aforementioned cables.

To prevent electric shock, never touch the inside of *T Gear* devices. *T Gear* devices may only be opened by a qualified technician.

Be sure to connect all cables so that they are securely in place. Never pull the plug out of the socket by pulling on the power cord, but pull the plug itself. Do not touch the power cord with wet hands.





The supplied test leads are only for the T Gear practica, for use in applications with a maximum of 24V and 6A.

If *T Gear* devices do not work properly - *particularly if unusual noises or odors are detected* - immediately disconnect from the power supply and contact an authorized dealer or service center.

If you are to leave the room for a long time or when *T Gear* devices are not used for a long time, disconnect them from the power supply. Accumulated dust can cause an electric shock, an electric leak, or fire.

Switch off the power supply when connecting power leads.

Do not use *T Gear* devices in locations with a lot of dust, large temperature differences, high humidity or in the presence of chemicals.

To completely switch off *T Gear* devices, disconnect them from the power supply. To ensure that you can quickly disconnect if necessary, ensure that the power outlet, power plug or power supply is easily accessible.

Do not throw or drop *T Gear* devices. Dropping or throwing *T Gear* devices may damage the product or the environment. If a *T Gear* device is damaged, unplug the power cord and contact the supplier.

Never connect two or more *T Gear devices* to each other when connected to separate power supplies. Use the same power supply for all *T Gear* devices when connecting two or more *PLC Trainers*.

To clean *T Gear* devices, first disconnect them from the power supply. Use only a soft, lint-free cloth. Avoid abrasive cloths, towels, paper towels, and similar items that might cause damage. Don't use solvents, abrasives, or cleaners containing hydrogen peroxide that might damage the finish.

Do not expose to fire.

Do not short-circuit, disassemble or overheat the devices.

Only use the ports for the specified voltages and currents. The Techniekschool is not liable for any damage caused by the devices or the software.

Electrical static discharge can interfere with the LCD displays on the devices and can activate the protection circuits. If this happens, restart the device.



Beware!

Applying wrong voltages on pins could cause harm to the *T Gear devices*.

Safety in design

The next safety measures are built into the product:

- EMI filter on power line
- Reverse current protection from the USB port to the 24V input ports.
- Inrush current protection on the relay ports.
- Current overload protection on the relay ports. Reset will take place within several minutes, after power connection.
- All inputs and outputs are designed to withstand incorrect connection (max 26V).
- Reverse voltage protection on input ports and power supply.
- Current protection on ports 6-9 and 10-13 will be activated if currents exceed the 2A limit. To reset the *T Gear PLC Trainer*, the device must be disconnected from the power supply for a minimum of 5 seconds. When the current protection is activated the current protection LED will light up.



Beware!

Be careful with sensitive surfaces such as oiled wood, the rubber feet may leave prints.



