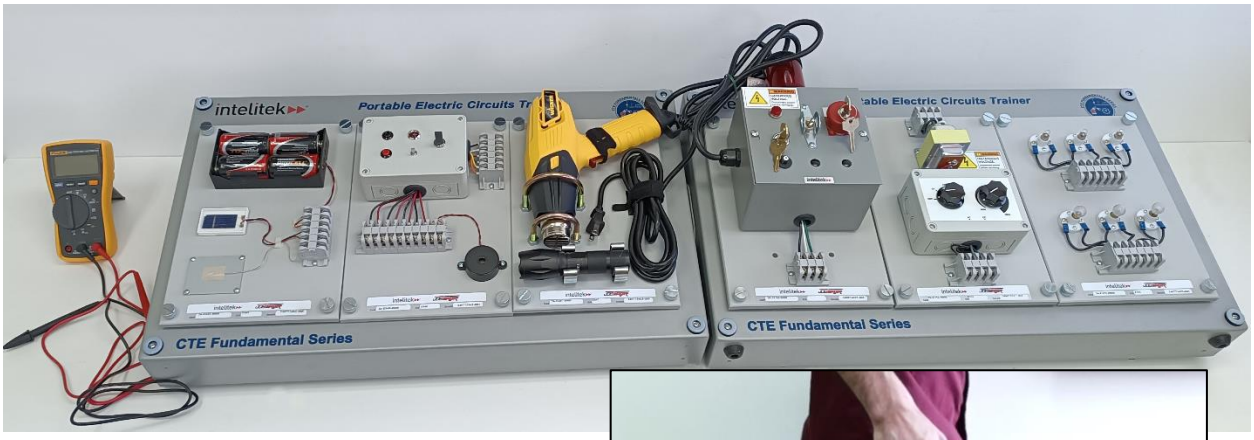
CTE Portable Electric Circuits Trainer



SETUP GUIDE

Part #34-8000-0028 v1.2.0

intelitek

CTE Portable Electric Circuits Trainer Setup Guide

Part #34-8000-0028 v1.2.0

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Intelitek Inc.

Toll Free: 800-221-2763

Phone: 603-413-2600

Fax: 603-437-2137

Email: info@intelitek.com

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1. Introduction

1.1. INTRODUCING THE PORTABLE ELECTRIC CIRCUITS TRAINER

Electrical systems are the backbone of all industrial systems. Intelitek's new CTE (Career and Technical Education) *Portable Electric Circuits Trainer* (part #00-1800-005), in conjunction with the LearnMate curriculum (part #88-EA01A-0000), gives students a solid foundation of knowledge in electricity and its practical applications.

The *Portable Electric Circuits Trainer* is a compact and scalable training system for students of industrial electrical maintenance. Trainees can add and remove various electrical panels to practice lesson-specific tasks.

1.2. ABOUT THIS GUIDE

This guide discusses the procedures necessary to unpack and set up the Trainer. It also includes processes on how to connect, dismantle, and store the JobMaster Flexponent electrical panels within the Trainer frames.

1.3. ELECTRICAL SAFETY

As some of the panels of the Trainer can be connected to AC voltage, it is important to follow the electrical safety guidelines. In addition to those listed in this guide in Section 2, pay attention to the activity-specific guidelines that are noted in the courseware.

2. Safety Guidelines

Always follow these safety guidelines:

- Only perform operations with the Trainer (such as setup, panel mounting, and storage) on a large, flat surface.
- Use caution when lifting or moving the Trainer frames to avoid injury and damage to the product.
- Read and follow the manufacturer's safety and operating instructions for any test equipment you use.
- Verify test points before connecting the multimeter to a circuit.
  - Do not cause short circuits or grounds with the probe tips.
  - Do not connect the meter to a voltage higher than the meter is rated to measure.
- Verify test equipment condition and set up before using.
- Install the test probes in the correct multimeter jacks before using the meter.
- Do not use any test instrument that has broken, cracked, or worn insulation on the leads or probe tips.
- Verify the multimeter is working by measuring a known voltage source before and after placing it on an unknown voltage source. A multimeter that is defective or has a blown fuse will indicate no voltage on a high voltage test point, leading to an unsafe condition.
- Do not wear jewelry when using electrical test equipment.
- Use only one hand to hold a test probe inside an equipment cabinet or on a test point while keeping your other hand away from grounded surfaces. This eliminates the electrical path across your body from hand-to-hand.
- Know the maximum voltage that may be encountered on the equipment you are testing.
- Wear appropriate safety equipment for the shock hazards that may be present.
- Always wear shoes. Do not wear sandals or other open-toed shoes. Footwear must cover the entire foot.
- Do not wear loose-fitting clothing or gloves. Tie back long hair.
- Do not operate any equipment unless you are familiar with its operation and have been authorized to operate it.
- Use tools for their intended purpose only. Follow all safety and operating instructions.
- Keep your work area clean and orderly to prevent accidents.
- Return equipment to the proper location before finishing. Take responsibility for the equipment you use.

3. Included Materials

3.1. OVERVIEW

This section details the materials included in the Trainer. One of each of the following are included in the package:

- Trainer base (two frames)
- PC04: Single-phase power panel
- E040: Switch and Lamp panel
- E045: Sources of Electricity panel
- E047: Heat and Light Source panel
- E151: Series/Parallel Lamp Circuits panel
- E152: Variable Power Supply panel
- Digital multimeter
- Lockout/Tagout equipment
- Conductive wires for circuit building
- Head screws (M6) for panel mounting
- Thumbnuts for panel storage

3.2. TRAINER BASE

The trainer base consists of two tabletop mounting frames. Up to three electrical panels can be equipped onto each frame, and each frame has a storage capacity for three electrical panels. The two frames can be connected to form a travel case (below, inset).

The specifications of the trainer are:

- Frame dimensions: 26" x 15.5" x 7.5" (66 cm × 39.4 cm × 19 cm)
- Storage dimensions: 26" x 15.5" x 11" (66 cm × 39.4 cm × 28 cm)
- Weight: approximately 15 lbs (6.8 kg)

3.3. ELECTRICAL PANELS

The standard Trainer includes 6 JobMaster Flexponent panels. The panels are described in this section.

3.3.1. PC04: Single-Phase Power Panel (120V)

The PC04 panel provides the connection from the learning station to your facility power. PC04 also provides the lockout/tagout point, emergency stop button, and on/off switch for all learning station components wired to it.

PC04 supplies single-phase 120V alternating current (AC) to the learning station components. The electrical connection is made through the terminal strip.

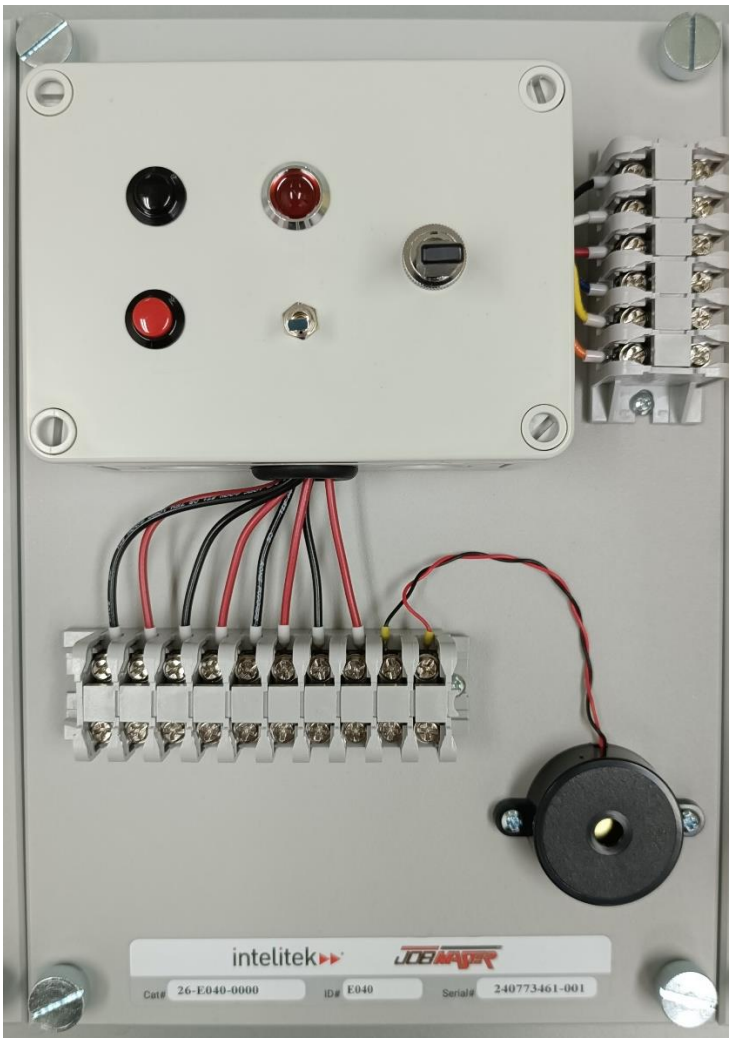
- The power lock switch must be activated using the key before power can flow through the PC04 panel.
- Once the power lock switch is engaged, indicated by the power indicator light, the on/off toggle switch serves as the power switch to any components wired to the PC04 panel.
- The emergency stop switch, when pressed, disconnects power to the system. Once engaged, both the e-stop and the power lock switch must be reset using the respective keys.
- The PC04 panel also includes overload protection via the breakers. If tripped because of a circuit overload, the e-stop will also automatically engage. When this happens, the breakers, e-stop, and power lock switch all must be reset.

3.3.2. E040: Switch and Lamp Panel

Panel E040 consists of the following components:

- 87dB Piezo pulse buzzer
- 12V lamp
- SPST toggle switch
- DPDT toggle switch
- Normally open (NO) pushbutton switch
- Normally closed (NC) push button switch

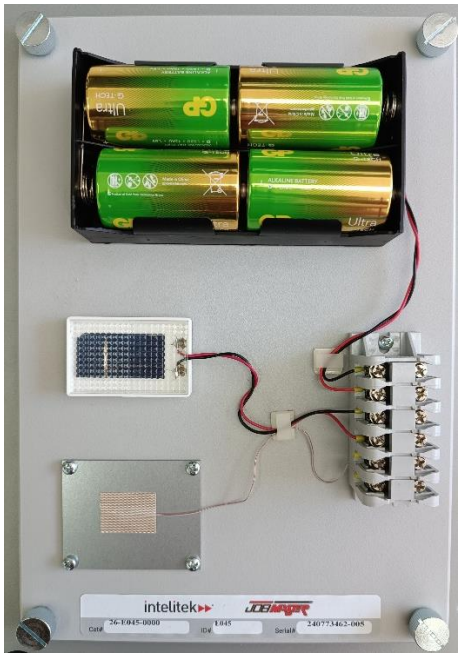
Connection to each individual component is provided at the terminal strips.



3.3.3. E045: Sources of Electricity Panel

Panel E045 consists of three sources of DC voltage:

- Battery holder with four D-size alkaline batteries
- Thermocouple
- Photovoltaic cell



3.3.4. E047: Heat and Light Source Panel

Panel E047 consists of the following:

- Heat gun
- Flashlight

3.3.5. E151: Series/Parallel Lamp Circuits

E151 contains six lamps that can be wired in series or in parallel. The specifications of the lamps are as follows:

- Three 3.7V @ 0.30 A bulbs
- Three 6.3V @ 0.30 A bulbs

3.3.6. E152: Variable Power Supply Panel

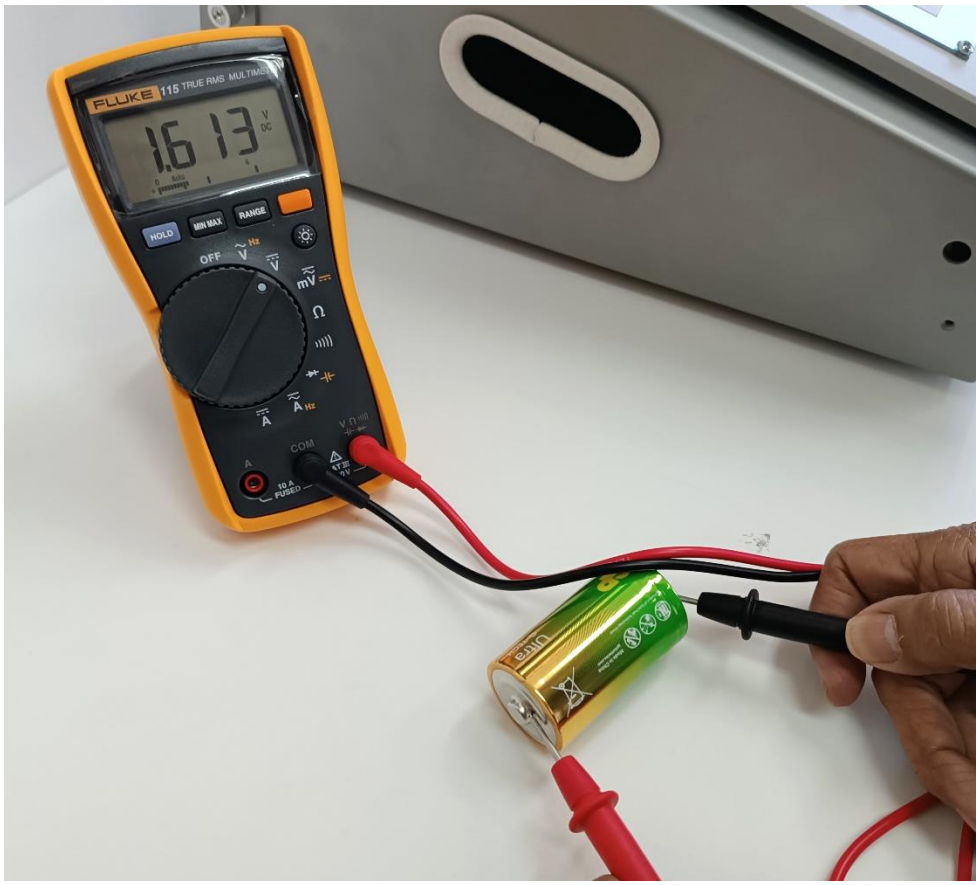
Panel E152 consists of a step-down transformer that outputs AC or DC at either 8V or 24V. The output level is selected via the power switch and can be adjusted using the potentiometer from zero to maximum output.

The two lefthand terminals at the bottom of the panel output AC power. The two righthand terminals output DC power.

3.4. DIGITAL MULTIMETER

The digital multimeter allows you to take measurements of various elements of the electrical circuits that are built in the course activities. The multimeter is CAT III 600V safety rated and can take the following measurements:

- Voltage (AC/DC)
- Current (AC/DC)
- Resistance
- Continuity
- Diode test
- Capacitance
- Frequency



4. Assembly

4.1. UNPACKING THE TRAINER BASE

If your Portable Electric Circuits Trainer has been secured for travel, perform the procedure below to unpack the frames and panels for use in laboratory activities.

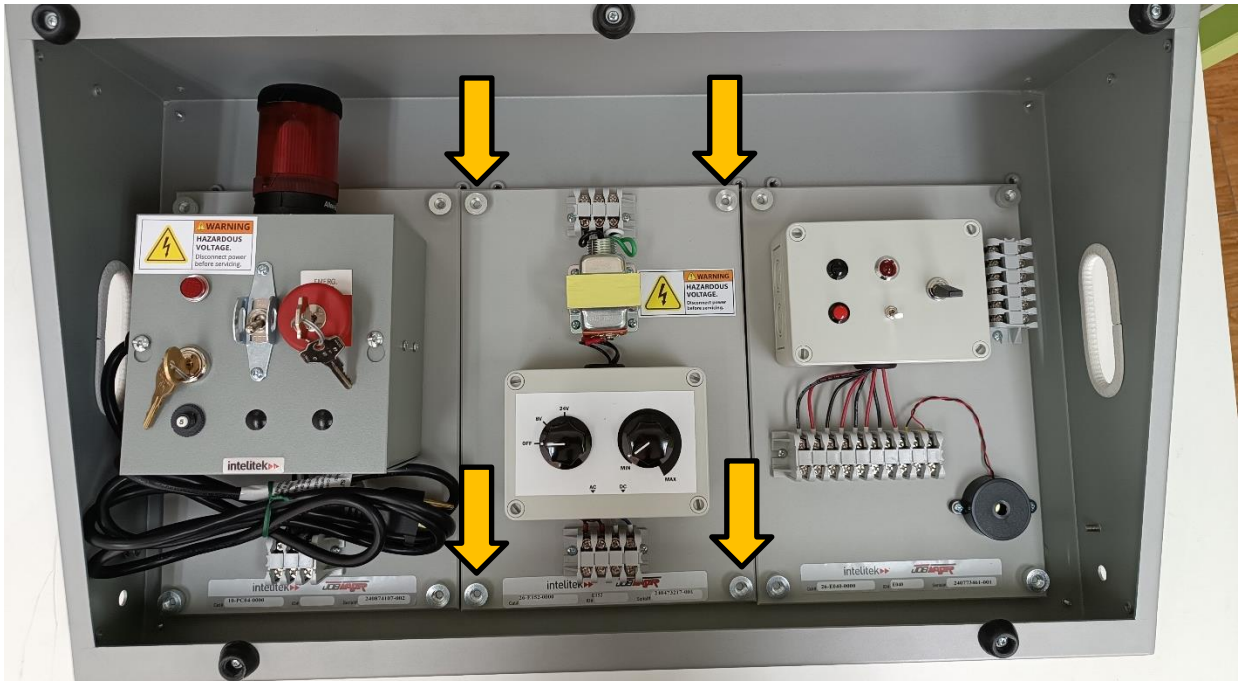
To unpack the Trainer:

1. Place the Trainer on large and flat surface. Preferably, this surface should have at least twice the length of the Trainer base.
2. Manually unscrew the captive screws that secure the frames to each other. There are four (4) of these screws in total on the sides of the frames.

3. Rotate the brackets towards the origin frames and secure them to the frames using the screws.

4. Place the frames on a flat surface with their insides facing upwards. One of the frames is shown in the image below.

5. Manually unscrew the thumbnuts that secure the electrical panels to the frame. Each panel is secured with four (4) thumbnuts.



6. Remove the panels and the thumbnuts from the frame. For instructions on how to mount the panels for laboratory activities, see Section 4.2 below.

7. Optionally, screw the thumbnuts back onto bolts of the inside of the frame. This is a good storage option for the thumbnuts and will prevent them from getting lost.

4.2. MOUNTING ELECTRICAL PANELS

Three (3) Flexponent panels can be mounted onto each frame (section) of the Trainer base for a total of six (6) panels. The panels are mounted on the outside of the Trainer frames for training during lab activities (Skill Drills). They are secured to the inside of the Trainer frames during storage. Storage of the panels is covered in Section 5.

Materials needed: *Attachment of each electrical panel requires four (4) M6 head screws.*

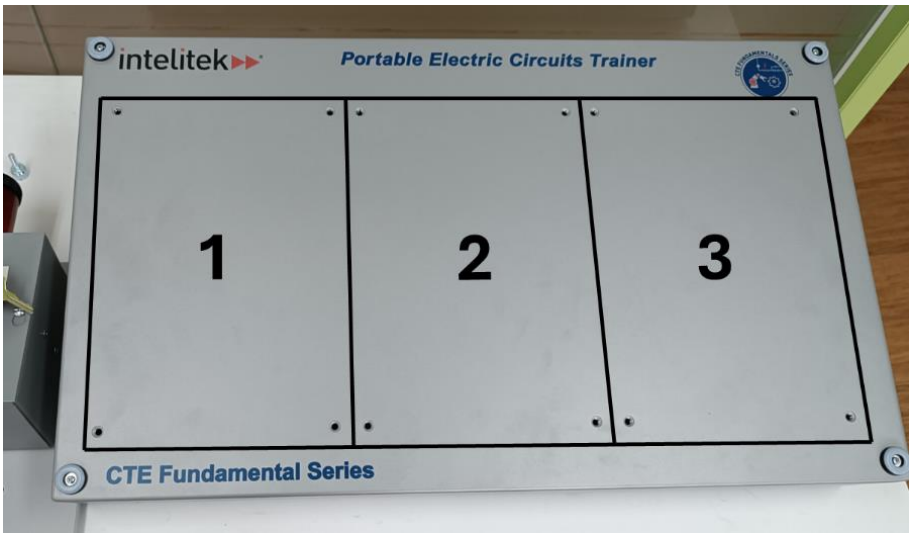
To mount a panel:

1. Place a frame onto a flat surface such as a table.

Note: *If you are planning to mount panel PC04 onto the frame, ensure that you have placed the frame with the green ground wire on the inside. For more information, see Section 4.4.2.*

2. Position the panel:

   a. Align the electrical panel with one of the three designated mounting areas on the frame.



   b. Ensure the panel's four mounting holes line up with four threaded holes on the Trainer frame.

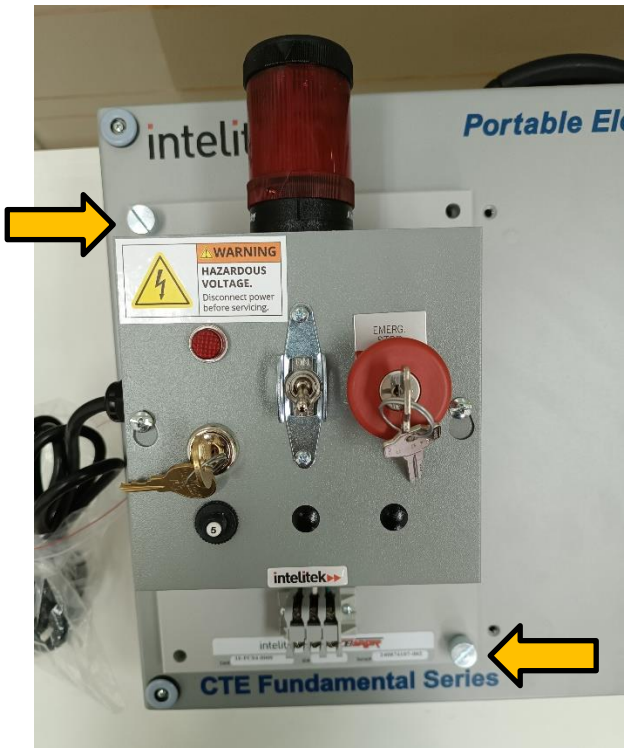
3. Insert the first screw:

   a. Place a screw into one of the holes near a corner of the panel.

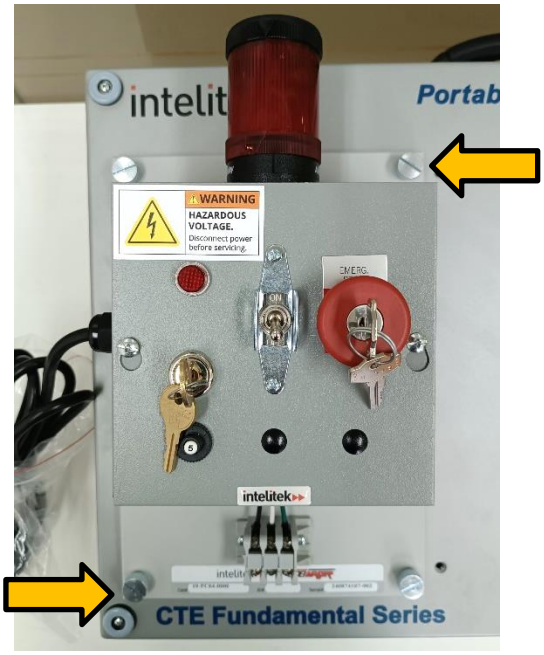
   b. Lightly tighten it to hold the panel in place but to allow for slight adjustments later.

4. Insert the remaining screws:

   a. Insert the second screw diagonally across from the first one.



b. Repeat for the last two screws in the remaining holes.



5. Secure the panel:

   a. Fully tighten all four screws. If desired, use a flat-head screwdriver to tighten the screws.

   b. Ensure the panel is firmly attached.

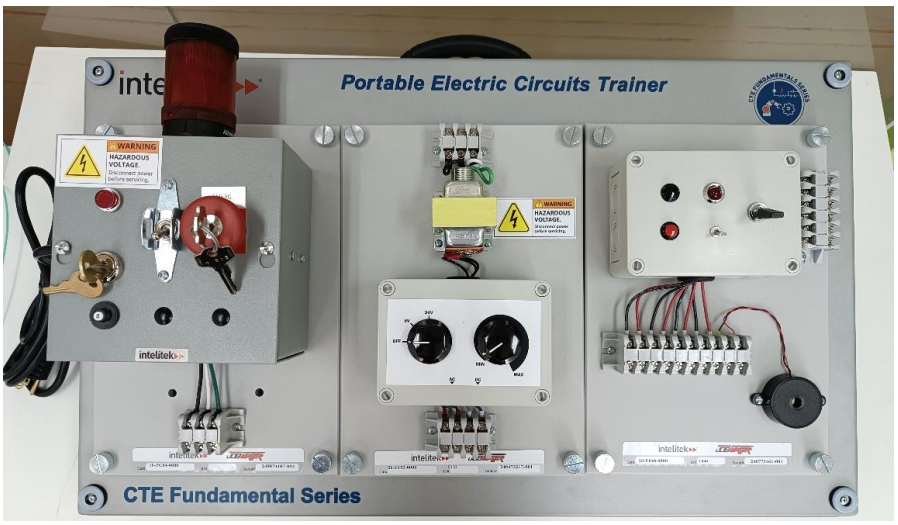
ⓘ ***Note:*** *Avoid overtightening to prevent damage to the panel or Trainer.*

6. Perform a final check:

   a. Verify that the panel is securely mounted and does not shift.

   b. Confirm all screws are properly tightened.

7. If desired, attach up to two more panels onto the frame.



8. If desired, repeat this procedure with additional panels on the second frame of the Trainer base.

4.3. WIRING ELECTRICAL PANELS

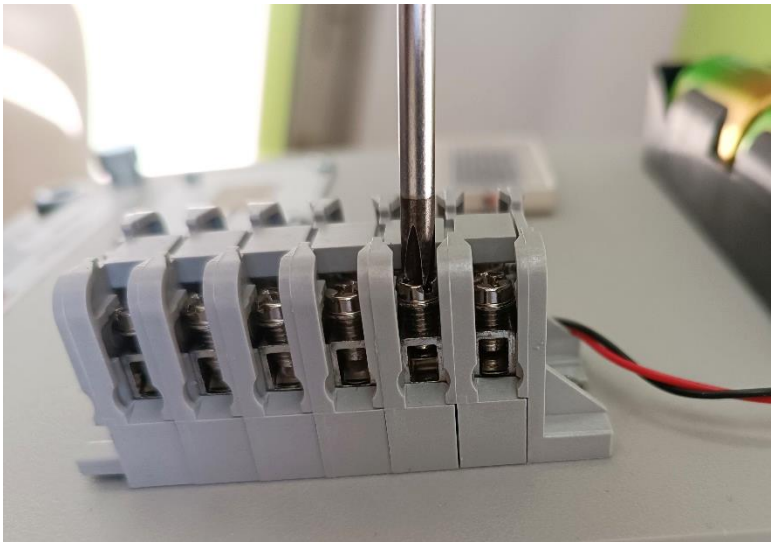
Components of each of the electrical panels can be connected to one another by attaching conductive wires to the various panel terminals.

Materials required:

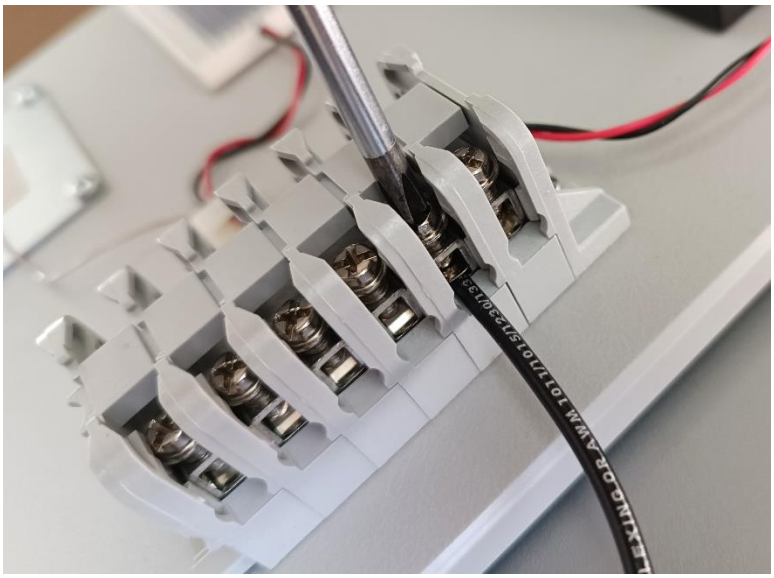
- Phillips-head screwdriver (not included in Trainer)
- Wires

To connect a wire to a terminal:

1. Using a Phillips-head screwdriver, turn the desired terminal's screw counterclockwise to raise the electrical contact.



2. Slide the exposed tip of the wire under the contact.
3. Using the screwdriver, turn the terminal's screw clockwise to lower the contact and to secure the wire.



4.4. INITIAL SETUP FOR POWER CONTROL PANEL PC04

4.4.1. Safety and Access Management for PC04

While the Power Control panel, PC04, panel provides the connection from the learning station to your facility power, the panel also provides several components that promote a safe work environment. These are displayed below.

1 – Power indicator lamp

2 – Power toggle switch

3 – Emergency stop button

4 – Power lock switch

5 – Breaker reset button

To enable instructors to control access to the learning station, PC04 includes two keys:

- The power lock switch key
- The emergency stop (e-stop) key

No circuits on the learning station can be energized until the power lock switch is activated using the power lock switch key.

If the e-stop button is engaged, power to the learning station is immediately shut off. Power remains off until both the e-stop and the power lock switch are reset using the keys.

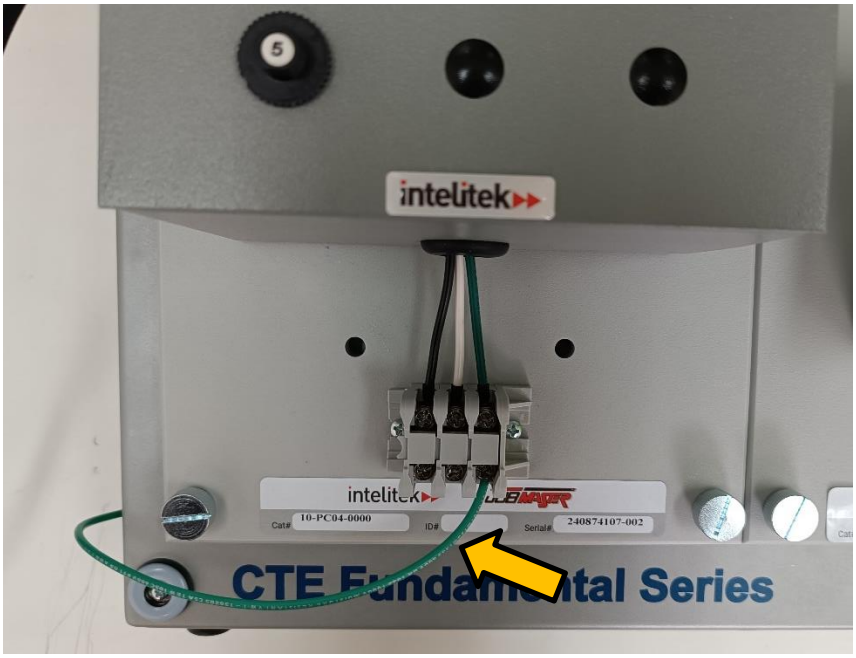
Both keys should be kept by the instructor.

- By keeping the power switch key, you can control when the learning station is live and ensure proper safety and lockout/tagout procedures are always followed.
- By keeping the emergency stop key, you can prevent students from overriding the e-stop and continuing to work in unsafe conditions.

4.4.2. PC04 Initial Setup

Perform the following to set up PC04 for use in the laboratory:

1. Verify that the panel is not connected to the wall voltage.
2. Verify that the power lock switch is in the OFF (vertical) position.
   - If the power lock switch is not in the off position, insert the power lock key and turn the power lock switch counterclockwise to the vertical position.
3. Verify that the power toggle switch is in the OFF (down) position. If necessary, place the toggle switch in the down position.
4. Connect the frame's ground wire to the ground (rightmost) terminal of the panel. The ground wire is connected to the inside of the frame. For instructions on how to connect a wire to a terminal, see Section 4.3.



5. Verify that the emergency stop button is not pressed.
   - If the emergency stop is activated, insert the emergency stop key and turn clockwise.
6. Connect the panel to your facility's power receptacle (a wall socket, for example).
7. Insert the power key switch and turn it clockwise to the **Enable** (horizontal) position.

   The power indicator light turns on.
8. Turn the power lock key switch counterclockwise to the vertical position.
9. Remove all keys from the panel.

5. Storage

5.1. STORING ELECTRICAL PANELS

Electrical panels are stored on the inside of the Trainer base.

Materials needed: *Storage of each panel requires four (4) thumbnuts. To store all panels in the Trainer, 24 thumbnuts are needed.*

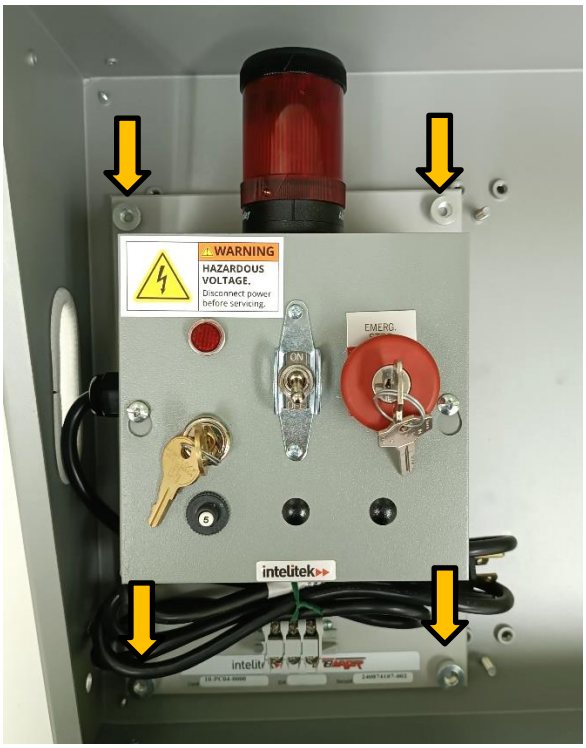
To store an electrical panel:

1. Carefully disconnect and remove all panels from the outside of the frame. Temporarily place them on a separate surface.
2. Place the M6 bolts that you removed into their dedicated resealable plastic pouch.
3. Flip the frame and place it flat onto a large, flat surface so that the inside of the frame is facing upwards.

   The inside of the frame has three designated storage areas, each with four bolts pointing upwards.

4. Place a panel onto one of the three designated storage areas. Ensure that the panel's four mounting holes slide onto the four screws of the storage area.

5. Manually screw the four thumbnuts onto the bolts to secure the panel to the inside of the frame.



6. If desired, repeat Steps 4 and 5 for up to two additional electrical panels.

7. If desired, repeat this procedure for the second frame of the Trainer base.
8. Place the plastic pouch with the M6 screws into either of the Trainer base frames.

5.2. STORING THE ACCESSORIES

5.2.1. Storing the Multimeter

The multimeter is stored on the inside wall of one of the frames.

To store the multimeter:

1. Place the multimeter into its protective case.
2. Use the Velcro strap to secure the case to the inside of the frame.

5.2.2. Storing the Conductive Wires

The conductive wires included with the Trainer can be placed anywhere inside of the base during storage.

- Place the wires into their dedicated resealable plastic pouch and place them into one of the frames.

5.3. CLOSING THE TRAINER FOR TRAVEL

The two frames of the Trainer base can be secured one on top of the other to create a travel case.

To build the travel case:

1. Ensure that there are no electrical panels on the outside of either of the two Trainer frames.
2. Place one of the frames onto a flat surface with the inside of the frame facing upwards.

3. Place the second frame on top of the first frame. The outside of the top frame should be facing upwards as shown.

4. Secure the top frame to the bottom frame using the four (4) screws and brackets on the sides of the frames:

   a. Disconnect the screw from the origin frame.

   b. Rotate the bracket and connect the screw to the opposite frame.

5. Use the handle to carry the case from place to place.

6. Example Training Setups

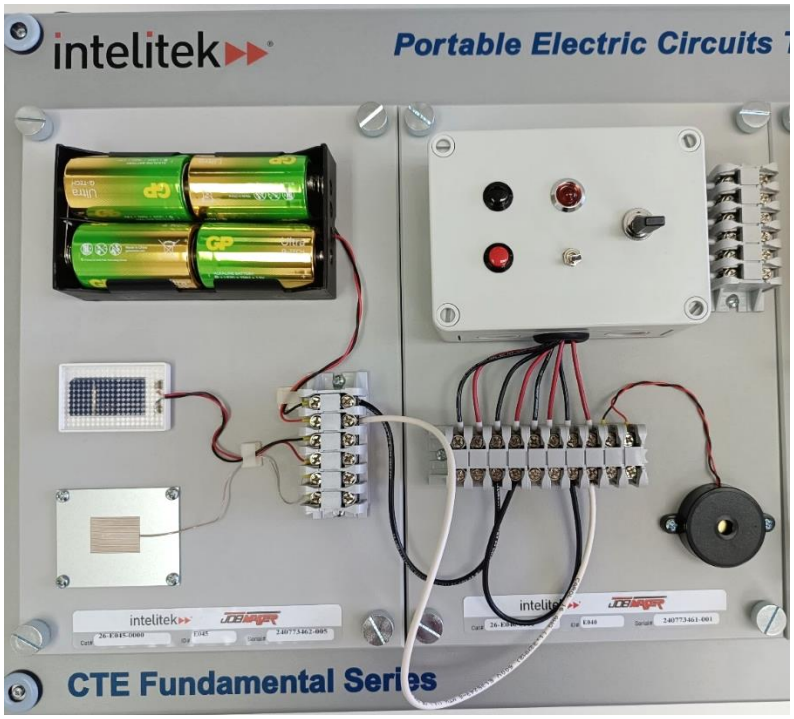
6.1. A SIMPLE DC CIRCUIT

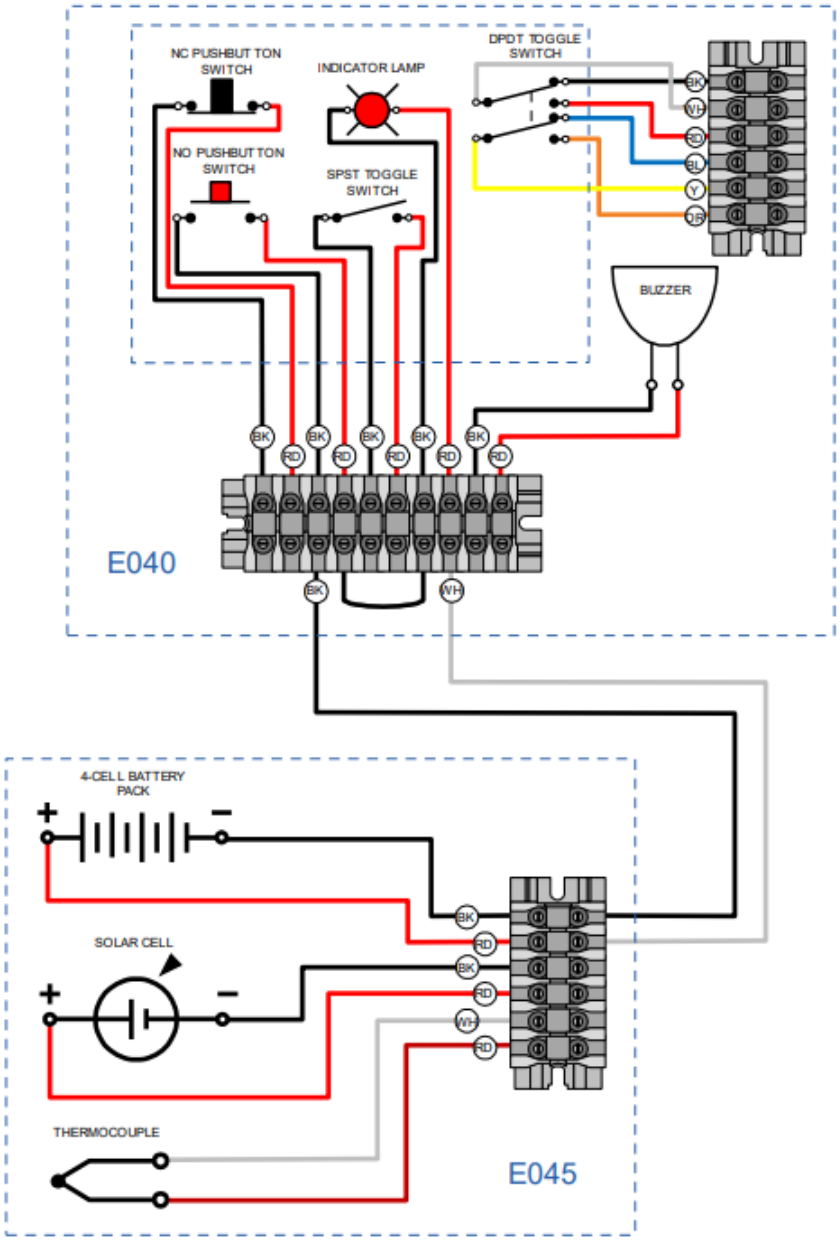
This example Trainer setup involves the building of a simple DC circuit with a power source, a push button switch, and a lamp.

- ***Materials required:***
  - Portable Electric Circuits Trainer
  - Panel E040
  - Panel E045 (includes batteries)
  - Conductive wires
  - Phillips-head screwdriver

Perform the following:

1. Place one of the Trainer frames down on a flat surface such as a table.
2. Connect panel **E045** to the left-most mounting area. See Section 4.2 for the full procedure of how to mount an electrical panel.
3. Connect panel **E040** to the central mounting area.
4. Wire the circuit as shown in the image below. A wiring diagram is given on the next page. For instructions on how to connect a wire to a terminal, see Section 4.3.





5. Press and hold the red button to close the switch and to turn on the lamp.
6. Shut down and clean up the system:
   a. Disconnect and store the wires.
   b. If desired, disconnect the electrical panels and store them on the inside of the Trainer frame.

6.2. A SERIES CIRCUIT WITH 3 LAMPS

In this sample setup, three 3.7 V lamps are wired in series.

Materials required:

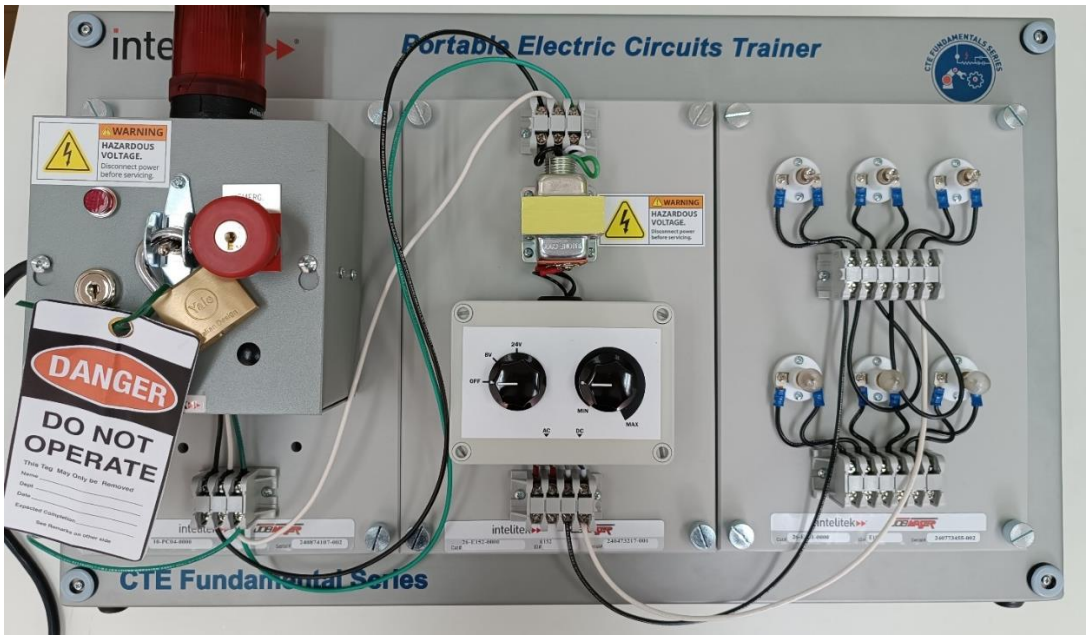
- Portable Electric Circuits Trainer
- Panel PC04
- Panel E151
- Panel E152
- Conductive wires
- Phillips-head screwdriver

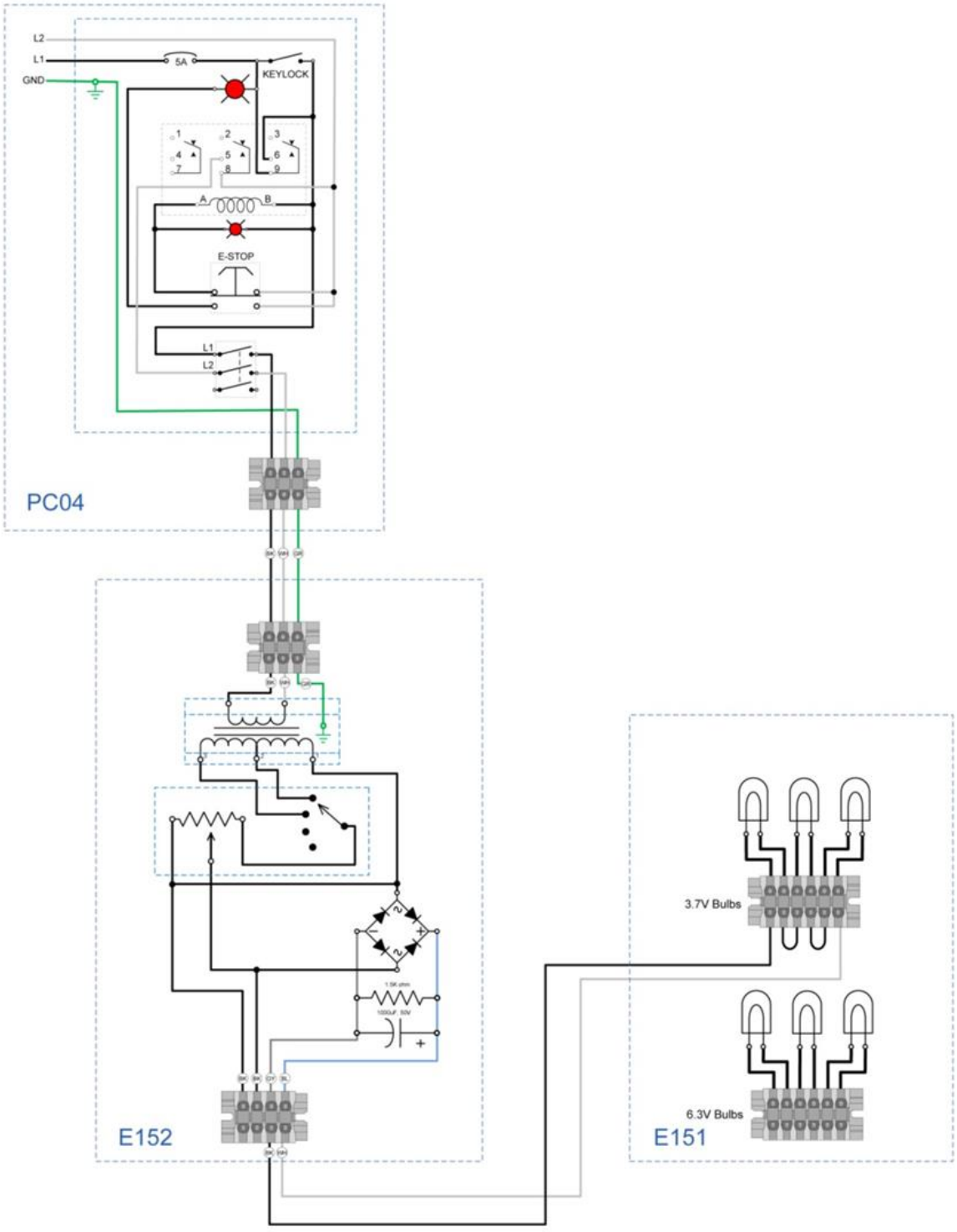
Perform the following:

1. Place the Trainer frame with the ground wire down onto a flat surface such as a table.
2. Connect panel **PC04** to the left-most mounting area. See Section 4.2 for the full procedure of how to mount an electrical panel. See Section 4.4 for more information about PC04 setup.
3. Connect the Trainer frame's ground wire to panel PC04's ground terminal.
4. Ensure that PC04's power toggle switch is set to the OFF (down) position.
5. Connect panel **E152** to the central mounting area.
6. Connect panel **E153** to the right-most mounting area.
7. Lock out and tag out panel **PC04**.

Note: *See Section 4.4.2 for more information about the initial PC04 setup.*

8. Wire the circuit as shown in the image below. A wiring diagram is given on the next page. For instructions on how to connect a wire to a terminal, see Section 4.3.





9. Perform a LOTO release of **PC04**:
    a. Ensure PCO4 is connected to your facility's power (i.e. to a wall socket).
    b. Remove the lock and tag, if present.
    c. If the power indicator lamp on the panel is off, insert the power lock key and turn the power lock switch clockwise to the horizontal position. After the lamp turns on, turn the key counterclockwise to the vertical position and remove the key.
    d. Flip the power toggle switch upwards to the **ON** position.
10. On panel **E152**, turn the left knob to **8V**.
11. Slowly turn the right knob clockwise until the lamps are illuminated.

Note: *Exceeding 11V of output voltage from E152 will burn out the bulbs.*

12. Shut down and clean up the system:
    a. On panel E153, turn the right knob all the way to the left.
    b. Turn the left knob to **OFF**.
    c. Flip the power toggle switch on panel PC04 to the **OFF** position.
    d. Lock out and tag out PC04.
    e. Disconnect and store all wires.
    f. If desired, disconnect the electrical panels and store them onto the inside of the Trainer frame.