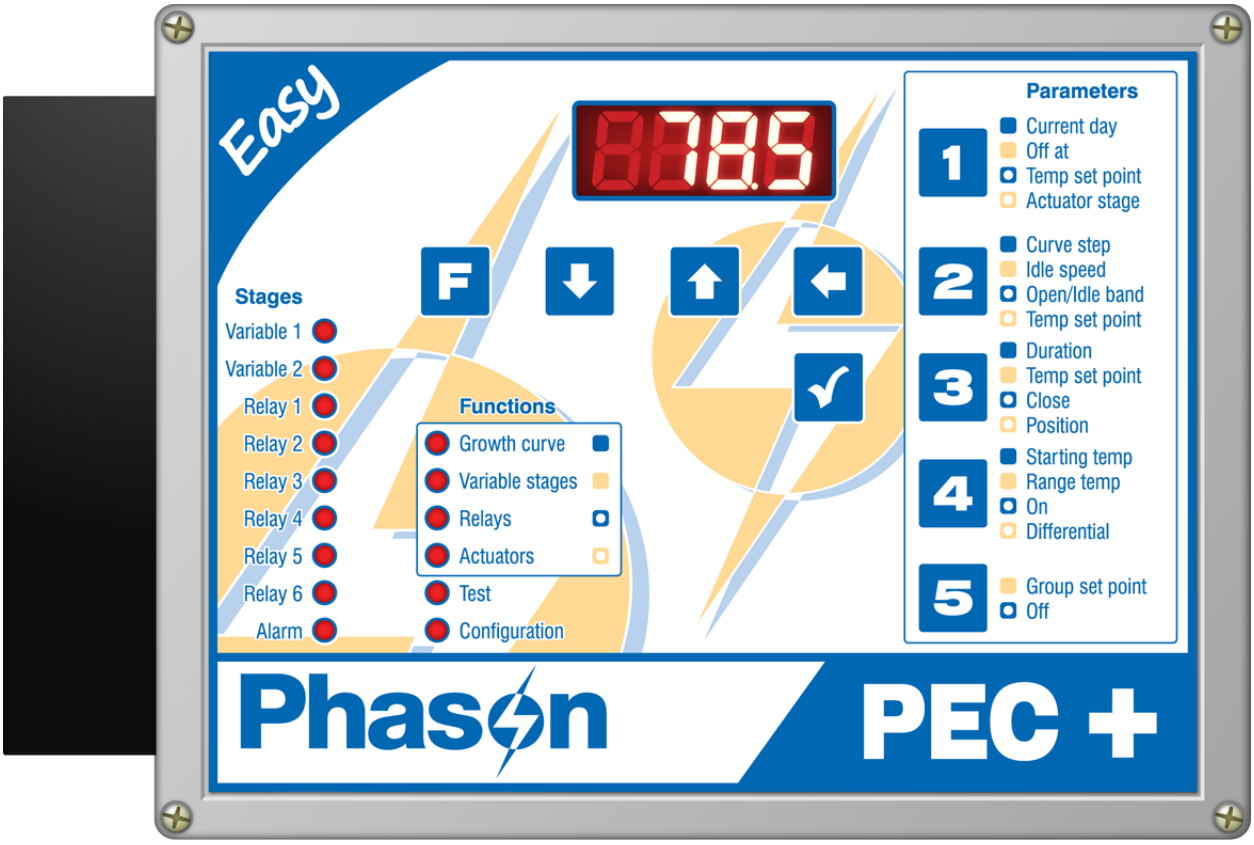


User manual and installation guide

Printed in Canada
31040006

About the manual

The manual describes the features of your PEC Plus and how to use them; it does not describe ventilation strategies.

- All buttons and menu commands are **bolded**.
  For example, "Press **Function** until the CONFIGURATION indicator is lit"

- All LED display examples are in an LED font.
  For example, "Press **Up** or **Down** until rly is displayed and then press **Select**."

This is a hint or tip. It contains helpful information that might make it easier for you to set up or use your PEC Plus.

This is a note. It contains information that may help you better understand your PEC Plus.

This is a **caution**. It contains important information that you must follow when installing or servicing your PEC Plus. Failure to follow this information can lead to damaged controls or equipment.

This is a **warning**. It contains important safety information that you must follow when installing or servicing your PEC Plus. Failure to follow this information can lead to damaged controls or equipment, electrical shocks, or severe injury.

How to use this manual

This section is a "quick-reference guide". The chart on the next page can you find what you are looking for. If you are not sure where to find something specific, look in the **Table of contents** on page v, or the **Index** on page 83.

Below are some helpful suggestions.

- If you have not installed and configured your PEC Plus, read **Chapter 2: Installing your PEC Plus** on page 6 and **Chapter 3: Configuring your PEC Plus** on page 20.
- If you are ready to install, configure, or program your PEC Plus, use the worksheets starting in **Appendix D** on page 73.
- If you are not sure how to use the keypad or how to read the display and menus, read **Becoming familiar with the PEC Plus** on page 2.
- If you need to program your PEC Plus or adjust settings (set points, growth curves, fan speeds, etc.), read **Chapter 4: Programming the PEC Plus** on page 32.
- If you have an alarm condition or warning displayed and are not sure what it means, look at **Appendix B: Troubleshooting** on page 66.
- If you are not sure of the meaning of a term, look it up in the **Glossary** on page 62.

Quick reference guide

◇ PEC Plus overview, features, and accessories ◇ Manual overview	**Chapter 1** Starting on page 1

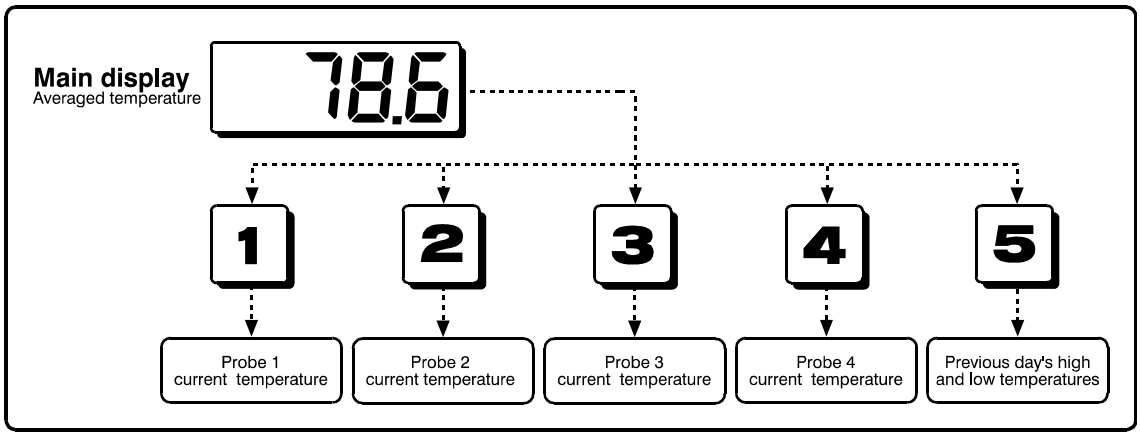
◇ Installation instructions ◇ Equipment installation (probes, fans, actuators, and so on) ◇ Electrical ratings ◇ PEC Plus layout (map of the inside and outside of your PEC Plus)	**Chapter 2** Starting on page 6

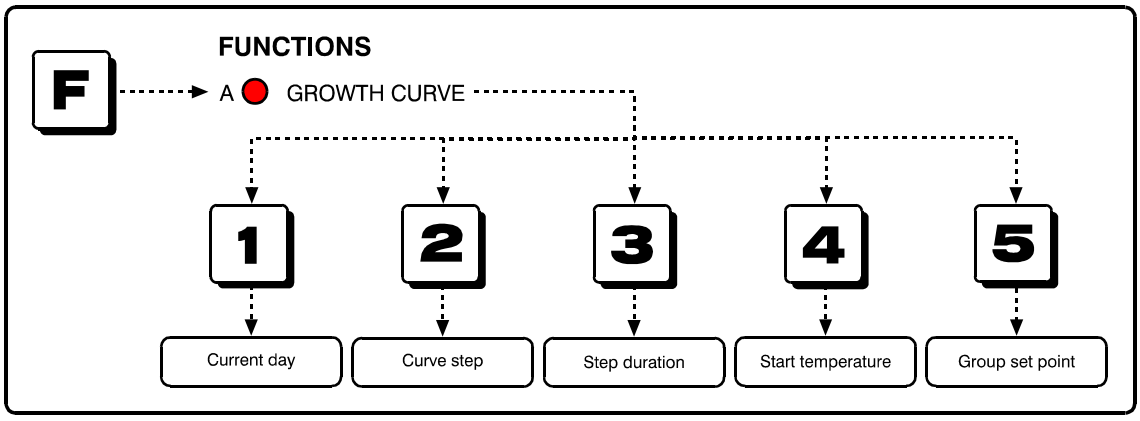
◇ Configuration instructions ◇ Zone, probe, and sensor assignments ◇ Variable and relay stage assignments	**Chapter 3** Starting on page 20

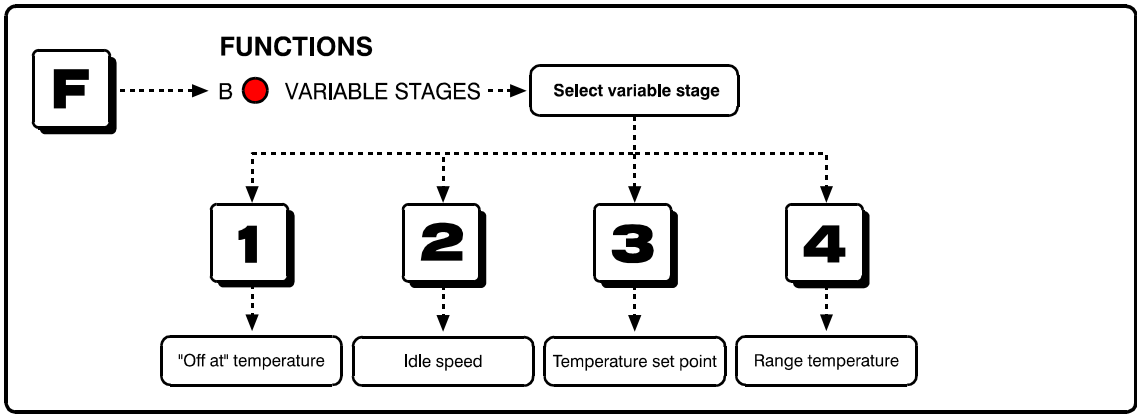
◇ Programming instructions ◇ Group settings (set points and growth curves) ◇ Equipment settings (set points, fan speeds, and so on) ◇ Alarm settings	**Chapter 4** Starting on page 32

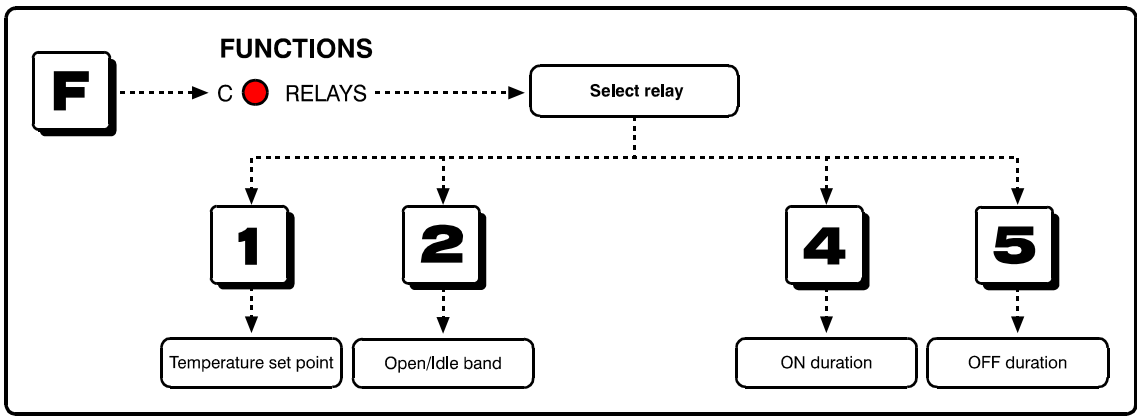
◇ Status display ◇ Diagnostic tests ◇ PIN security ◇ Service and maintenance	**Chapter 5** Starting on page 51

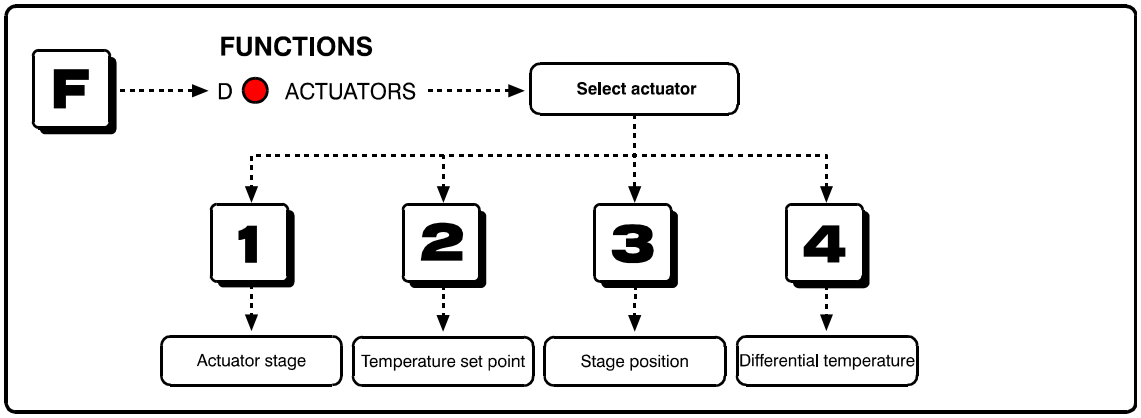
◇ Glossary ◇ Troubleshooting ◇ Factory settings ◇ Installation worksheets ◇ Configuration worksheets ◇ Settings worksheets	**Appendixes** Starting on page 62

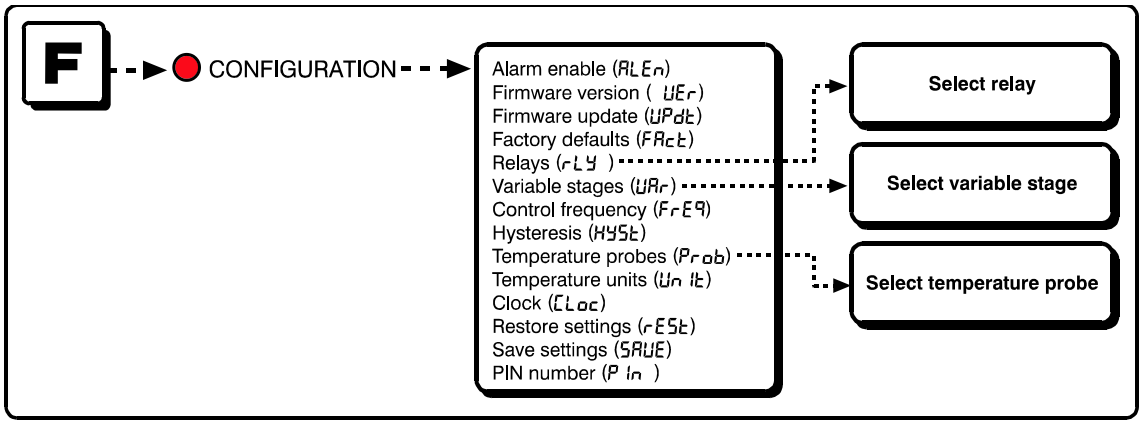

Main display
Averaged temperature
78.6
1
2
3
4
5
Probe 1 current temperature
Probe 2 current temperature
Probe 3 current temperature
Probe 4 current temperature
Previous day's high and low temperatures


F
FUNCTIONS
A
GROWTH CURVE
1
2
3
4
5
Current day
Curve step
Step duration
Start temperature
Group set point


F
FUNCTIONS
B
VARIABLE STAGES
Select variable stage
1
2
3
4
"Off at" temperature
Idle speed
Temperature set point
Range temperature


FUNCTIONS
F
C
RELAYS
Select relay
1
2
4
5
Temperature set point
Open/Idle band
ON duration
OFF duration


FUNCTIONS
F
D
ACTUATORS
Select actuator
1
2
3
4
Actuator stage
Temperature set point
Stage position
Differential temperature


F
CONFIGURATION
Alarm enable (ALEn)
Firmware version (UEr)
Firmware update (UPdt)
Factory defaults (FAct)
Relays (rLY)
Variable stages (UAr)
Control frequency (FrE9)
Hysteresis (HYSt)
Temperature probes (Prob)
Temperature units (Un it)
Clock (CLoc)
Restore settings (rESt)
Save settings (SAUE)
PIN number (P in)
Select relay
Select variable stage
Select temperature probe

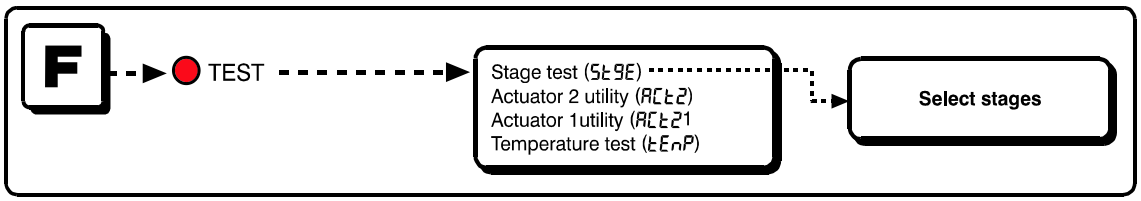

F
TEST
Stage test (St9E)
Actuator 2 utility (ACt2)
Actuator 1utility (ACt21
Temperature test (tEnP)
Select stages

Table of contents

Chapter 1: Introducing the PEC Plus

Introducing the PEC Plus

The PEC Plus is designed to control ventilation equipment for a single room. The eight-stage control has two variable cooling stages for controlling fans and six relay stages for controlling equipment such as actuators, curtain machines, single-speed fans, and heaters.

The control comes with a 30-foot temperature probe that is extendable to 500 feet. Automatic four-zone temperature averaging and outdoor temperature monitoring are available with additional temperature probes.

The PEC Plus automatically monitors and controls the temperature by operating ventilation equipment such as fans, heaters, inlet actuators, curtain machines, or other equipment according to your programmed settings.

The seven-step growth curve is a powerful feature that allows you to program the control to automatically adjust the temperature set points over time to control the temperature in a room or zone. This is an ideal feature to use as your animals grow and their temperature requirements change.

The PEC Plus is ideal for poultry, livestock, greenhouse, or light-industrial buildings and is compatible with most ventilation strategies: natural, forced, tunnel, and chimney ventilation.

Easy to use and program

The PEC Plus's display shows the ambient temperature and any alarm messages. During normal operation, the status LEDs show when the stages are on.

When in programming mode, the LEDs indicate which stage you are programming. The easy-to-use keypad and menu system make the PEC Plus one of the easiest controls to program. The PEC Plus' advanced and powerful features are never more than a few keystrokes away.

Security and peace of mind

The PEC Plus has a PIN (personal identification number) security system. When you enable security, users must enter the PIN before they can access a specific menu or function. This allows you to control who makes changes to your system and its settings.

The PEC Plus is compatible with most alarm systems. You can connect your PEC Plus to an alarm siren or other external alarm system. The customizable list of alarm settings allows you to choose which alarm conditions you want to be notified about.

Features

- Two variable stages for controlling fans
- Six relay stages (heat, cool, duty cycle, curtain, or actuator control)
- One alarm relay (for external alarm siren or alarm system)
- Temperature monitoring and control, with up to four-probe averaging
- Adjustable temperature settings, range: -13 to 125°F (-25 to 51.7°C)
- Configurable seven-step growth curve
- Customizable alarm settings
- **Easy System** compatible—edit and store configuration and settings on a computer. For more information, visit **www.phason.ca**.
- Three-second full-power-turn-on for minimizing fan ice-up
- Actuator deicing
- Daily high and low temperature display
- Selectable motor curves
- Power-failure memory protection
- PIN security
- Four-character LED display and individual stage LEDs
- On-board diagnostics and self-tests
- Temperature probe, 30 feet, extendable to 500 feet (additional probes available)
- Rugged enclosure (corrosion resistant, water resistant, and fire retardant)
- CSA approval
- Limited warranty (two years)

Becoming familiar with the PEC Plus

The PEC Plus has a four-character LED display, status LEDs for each variable stage and relay, function LEDs, and 10 buttons for programming and interacting with the control.

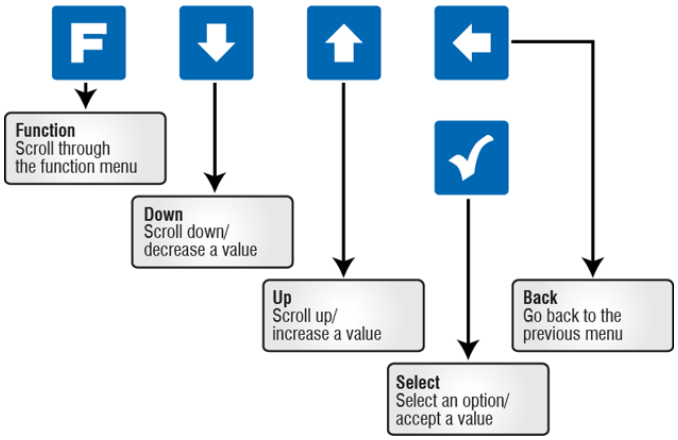
Main display

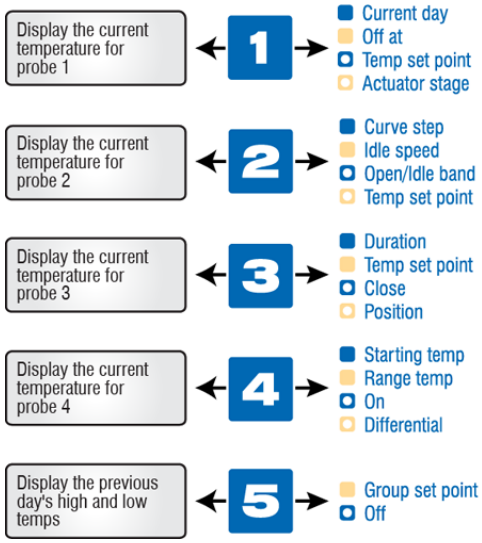
The four-character, seven-segment LED display shows ambient temperatures, alarm messages, and programming information.

> **NOTE** If you leave the PEC Plus in a menu or display other than the main display, the control returns to the main display after five minutes without any key presses. The only exceptions are stage test mode and temperature test mode; the control remains in these modes until you manually exit them.

Buttons

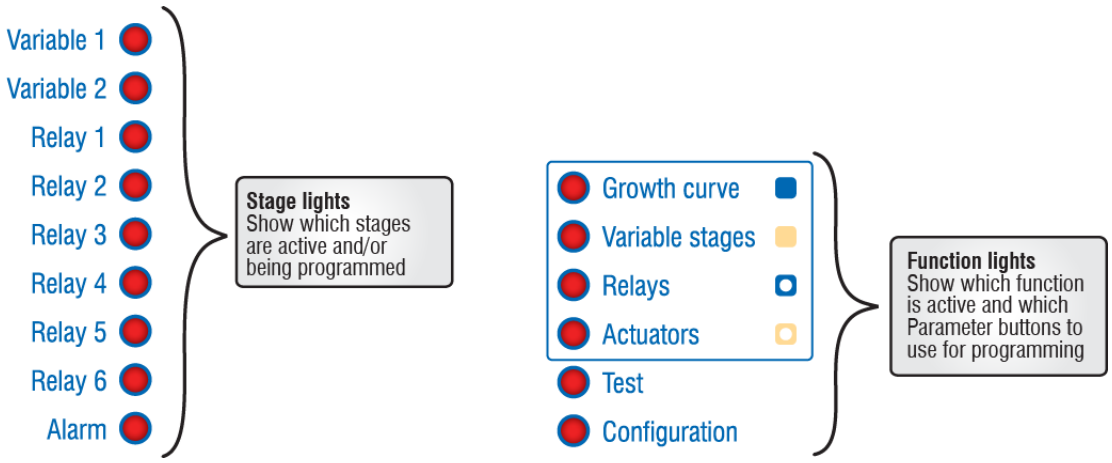
The five main control buttons (**Function**, **Down**, **Up**, **Back**, and **Select**) allow you to scroll through the function menus and enter programming information.





The Parameter buttons (**1** to **5**) display temperature information and allow you to select which settings, or parameters, you want to program.

Status LEDs



Menu layout

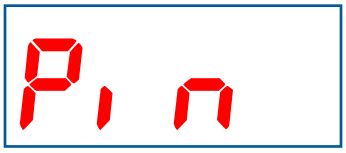
The table below shows the layout of the PEC Plus menu system.

Growth curve **>>Parameter A<<**	**Configuration**
1 Current day **2** Curve step **3** Step duration **4** Start temperature **5** Group set point	Alarm enable (ALEn) High temperature (H, EN) Low temperature (LoEn) Probe damage (PdEn) Probe deviation (PdEu) Actuator 1 jam (Ac 1E) Actuator 2 jam (Ac2E) Firmware version (UEr) Firmware update (UPdt) Factory defaults (FACt) Relays (r1 y) *Select relay 1 to 6* Always off (OFF) Advanced duty cycle (dtC2) Actuator 1 (Act 1) – only for relays 1 and 2 Actuator 2 (Act2) – only for relays 3 and 4 Duty cycle heat (dtyH) Duty cycle cool (dtyC) Heat (HEAt) Cool (Cool) Curtain (Curt) Always on (On) Variable stages (uAr) *Select variable stage 1 or 2* Always off (OFF) Cool (Cool) Heat(hEAt) Frequency (FrE9) Hysteresis (HY5t) Temperature probes (Prob) *Select probe 1 to 4* Probe disabled (P#oF) Probe enabled (P#on) Probe enabled for outdoor temp (Pyot) – only for probe 4 Temperature units (uni t) Clock (Cl oc) Restore settings (rE5t) Save settings (SAUE) PIN number (P, n)
Variable stages **>>Parameter B<<**	
Select variable stage 1 or 2 **1** "Off at" temperature **2** Idle speed **3** Temperature set point **4** "On full at" temperature	
Relays **>>Parameter C<<**	
Select relay 1 to 6 **1** Temperature set point **2** Idle band **4** ON duration **5** OFF duration	
Actuators **>>Parameter D<<**	
Select actuator 1 or 2 **1** Actuator stage **2** Temperature set point **3** Position **4** Differential	
Test	
Stage test mode (St9E) *Select variable stage or relay* Actuator 2 utility (ACt2) Actuator 1 utility (ACt 1) Temperature test mode (tEnP)	

Entering a PIN

If security is enabled, users must enter the PIN (personal identification number) before they can access the control's functions. After entering a PIN, the control will not ask again until five minutes have passed since the last key press. For more information, read **Using PIN security** on page 55.

When you are required to enter a PIN, the display shows



To enter a PIN

When prompted, enter the four-digit PIN using the parameter buttons.

The display does not show the PIN as you enter it.
If you enter the PIN incorrectly, the display shows FAIL.

Chapter 2: Installing your PEC Plus

What you need to know before installing your PEC Plus

1. Read **Understanding power surges and surge suppression** below.

- ◇ If you do not install external surge suppression devices, you risk damage to the electronics inside your PEC Plus, which may cause your PEC Plus to fail.
- ◇ Because it is not possible to **completely** protect this product internally from the effects of power surges and other transients, we **highly recommend** that you install external surge suppression devices. For specific recommendations, see your electrical contractor.
- ◇ If you do not take these precautions, you acknowledge your willingness to accept the risk of loss or injury.

2. List all the equipment you want to control using this PEC Plus on the **Installation worksheet** on page 73. Install the equipment and make your electrical connections according to the sheet.

3. Use the **Configuration worksheets** starting on page 74. List which relays and variable stages you want to use for each piece of equipment, and how you want the equipment configured. You can connect more than one piece of equipment to a single relay or stage **as long as the total current draw does not exceed** the relay or stage's limit. For more information, read

4. on page 9.

Understanding power surges and surge suppression

Power surges can be caused by external influences (influences outside the barn; for example, lightning or utility distribution problems) or they can be caused internally (inside the barn; for example, starting and stopping inductive loads such as motors).

One of the most common causes of power surges is lightning. When lightning strikes the ground, it produces an enormously powerful electromagnetic field. This field affects nearby power lines, which transmit a surge to any device connected to it, such as lights, computers, or environmental controls like your PEC Plus. Lightning does not have to actually strike a power line to transmit a surge.

Surge suppression devices offer some protection from power surges. Because it is not possible to internally protect this product completely from the effects of power surges and other transients, Phason **highly recommend** that you install external surge suppression devices. For specific recommendations, see your electrical contractor. If you do not take these precautions, you acknowledge your willingness to accept the risk of loss or injury.

Reducing electrical noise using filters

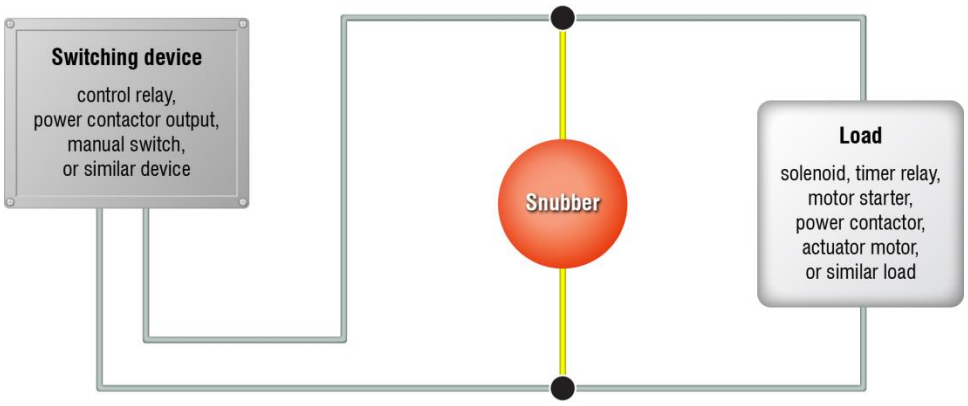
Electrical noise is caused by high voltage transients created when inductive loads, such as power contactors, are switched on or off. The strength of the transients can be over 1000 volts and can vary with the type of equipment and wiring, as well as several other factors.

Visible symptoms of electrical noise include erratic control operation, cycling inlets, communication problems, and more. However, the **effects of electrical noise are not always visible**. Over time, electrical noise can cause electronic circuits, relay contacts, and power contactors to deteriorate.

Installing filters helps extend the life of equipment

Filters help prevent electrical noise problems by absorbing the transient energy. Even if you do not have *visible* symptoms of electrical noise, filters help keep controls operating reliably and can extend the life of the controls and equipment connected to them.

Phason's snubber filters (part number 127-0) are for use with solenoids, timer relays, DC motors, furnaces, and other equipment connected to the control's relays. You can also use the filters with loads connected to power contactors (part number 129-0).
Install a filter in parallel with the load, as shown in the following example.



- ◇ Do not use Snubber filters with variable stages.
- ◇ Some power contactors include snubber filters. For more information, read **Using power contactors to increase the capacity of relays** on page 8.
- ◇ For more information about snubber filters or other Phason accessories, see your dealer or visit **www.phason.ca**.

Electrical ratings

Input power	120/230 VAC, 50/60 Hz
Variable stages ① (2: VARI-1, VARI-2)	10 A at 120/230 VAC, general-purpose (resistive) 7 FLA at 120/230 VAC, PSC motor 1/2 HP at 120 VAC, 1 HP at 230 VAC, PSC motor
Fuses (2: F1and F2)	15 A, 250 VAC ABC-type ceramic
Relay stages ① (6: STG-1 to STG-6)	10 A at 120/230 VAC, general-purpose (resistive) 1/3 HP at 120 VAC, 1/2 HP at 230 VAC 360 W tungsten at 120 VAC
Alarm relay	0.4 A at 125 VAC; 2 A at 30 VDC, resistive load 0.2 A at 125 VAC; 1 A at 30 VDC, inductive load

① You can connect more than one piece of equipment to a variable stage or relay as long as they are the same type (for example, two fans) and the total current draw does not exceed the stage's limit.

The FLA (full load ampere) rating accounts for the increase in motor current draw when the motor operates at less than full speed. Make sure the motor/equipment connected to the variable stage does not draw more than 7 FLA.

Using power contactors to increase the capacity of relays

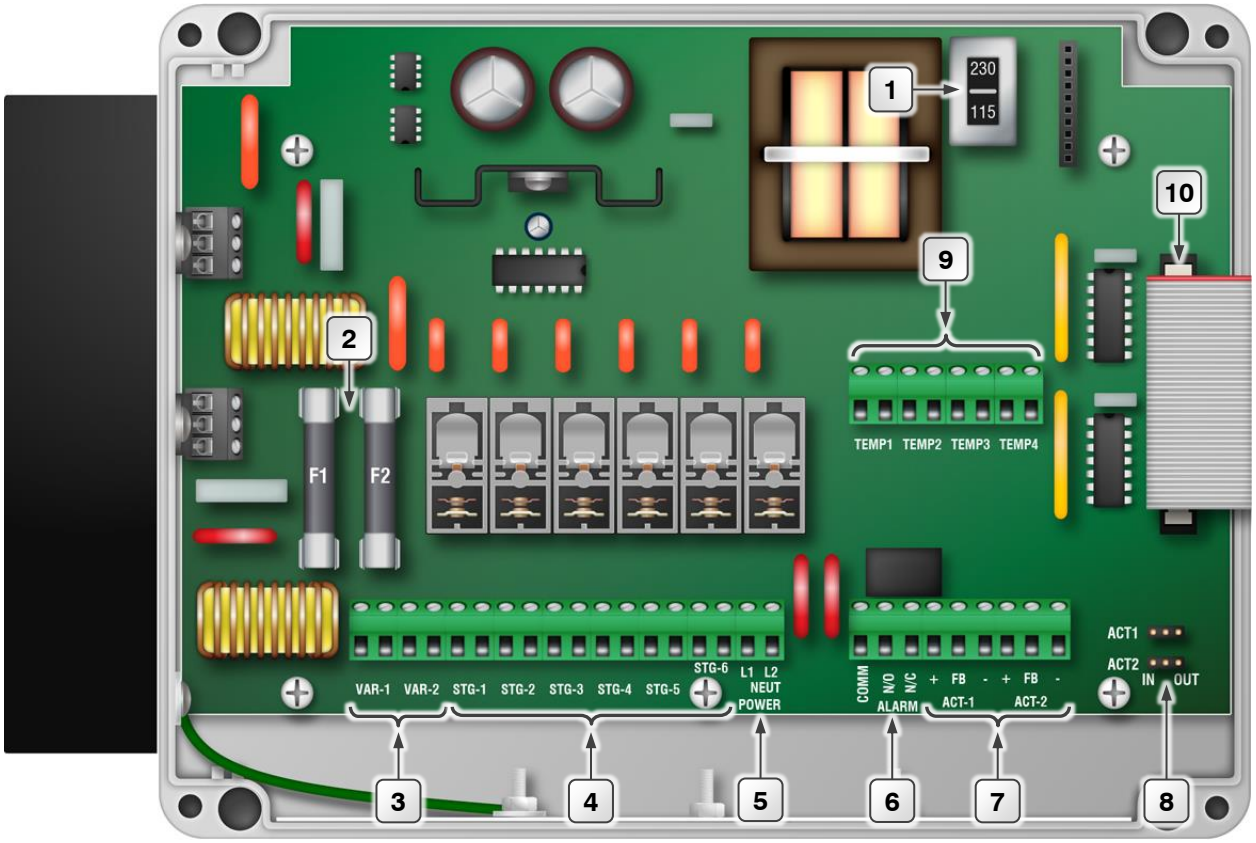
Phason's 240-volt power contactors are heavy-duty relays that allow you to increase the load handling capability of control relays. Power contactors are ideal for secondary ventilation fans and electric heaters.

Phason's power contactor relays have the following electrical ratings.

- Coil: 10.2 mA at 240 VAC
- Contact: 25 A at 240 VAC; resistive
  2 HP at 240 VAC, 1 HP at 120 VAC; motor, power factor 0.4
  1300 W at 120 VAC; tungsten

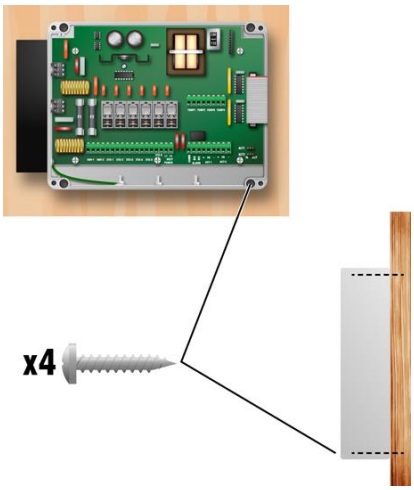
Phason offers three power contactor options. For more information, read **Replacement kits and optional accessories** on page 60 .

PEC Plus layout



1	**Voltage selection switch** – set this switch to the correct voltage before installing your PEC Plus.
2	**Variable stage fuses (F1, F2)** – 15 A, 250 VAC ABC-type ceramic; F1 variable stage 1, F2 for stage 2.
3	**Variable stage terminals (VAR1, VAR2)** – connect variable speed fans to these terminals.
4	**General-purpose relay terminals (RLY1 to RLY6)** – connect single stage (on/off) equipment to these terminals. You can configure these relays as heat, cool, duty cycle, curtain, or actuator control.
5	**Incoming power terminal** – connect the incoming power (120/230 VAC, 50/60 Hz) to this terminal.
6	**Alarm relay terminal** – connect an external alarm system or alarm siren to this terminal.
7	**Actuator feedback terminals (ACT1 and ACT2)** – connect the feedback from the actuators to these terminals.
8	**Actuator present pins (ACT1 and ACT2)** – place the jumpers on the IN pins to enable, or on the OUT pins to disable actuator control for the corresponding actuator.
9	**Temperature probe terminals (TEMP1 to TEMP4)** – connect the temperature probes to these terminals. If monitoring outdoor temperatures, connect the outdoor probe to the TEMP4 terminal.
10	**Display cable** – make sure the ribbon cable from the display is properly connected to the socket.

Mounting your PEC Plus



1. Select a location for your PEC Plus. Make sure you have enough cable and wire to reach all the equipment (fans, heaters, misters, curtains, etc.) that you want to control.
2. Remove the screws from the front cover and then gently lift it off.
3. Mount the enclosure to a wall using the four screws provided with the control. Insert the screws into the large holes in each corner of the box and tighten.

Connecting equipment to your PEC Plus

Follow these instructions when installing your PEC Plus and connecting equipment to it.

Use the electrical knockouts for bringing wires or cables into or out of your PEC Plus enclosure. Do not make additional holes in the enclosure; this can damage the watertight seal or control components and void the warranty.

- ◇ Your PEC Plus' test modes are useful for testing your equipment after installing and configuring it. For more information, read **Testing settings and equipment** on page 53.
- ◇ Refer to **Appendix D: Installation worksheet** on page 73 and **Appendix E: Configuration worksheets** on page 74 when installing equipment.

Connecting actuators

You can connect up to two actuators to a PEC Plus. Actuators are used for control elements that are not OFF or ON. Instead, they vary by a percentage. For example, inlets can be opened various distances from 0 percent to 100 percent.

Typically, linear actuators are connected directly to the inlets, or by cables and pulleys. Inlets are generally located in the ceiling or walls. Inlet systems are usually spring loaded to aid in closing the inlet, or counter weighted to aid in opening the inlets.

Feedback potentiometers

Each actuator you connect must have a feedback potentiometer. The feedback potentiometer, which you connect to one of your PEC Plus' two corresponding feedback terminals, lets the control know how far the actuator's arm is extended.

Most linear actuators are available with potentiometer feedback and internal adjustable limit switches. A 10,000 ohm, 10 turn feedback potentiometer is preferred, but the internal feedback potentiometer can range between 1000 and 20,000 ohms. Potentiometers outside of this range will affect the precision to which your PEC Plus can control the actuator.

Actuator present pins

The actuator present pins are for enabling and calibrating the actuators. For more information, read **Calibrating actuators** on page 28.

Each actuator requires two relays: one for extending the actuator arm (opening the inlet), and one for retracting the arm (closing the inlet).

- Actuator 1 (**ACT1**) uses relay 1 to open (extend) the actuator and relay 2 to close (retract) the actuator.
- Actuator 2 (**ACT2**) uses relay 3 to open and relay 4 to close the actuator.

Actuator is enabled

Actuator is NOT enabled

- ◇ A system operates more precisely when using the largest amount of stroke that is feasible with the actuator. The stroke is the distance the actuator arm extends or retracts.
- ◇ If you are unsure of the potentiometer wiring for your actuator, read **Determining correct actuator feedback wiring** on page 71.
- ◇ When routing the actuator feedback wires, do not run them in or along the same conduit as AC-power lines. Follow the guidelines in the **Control fundamentals guide**.
- ◇ If you are measuring AC power with a digital multimeter (DMM), note that if a limit switch opens the circuit, the DMM measures voltage after the relay switch even if the relay is open.

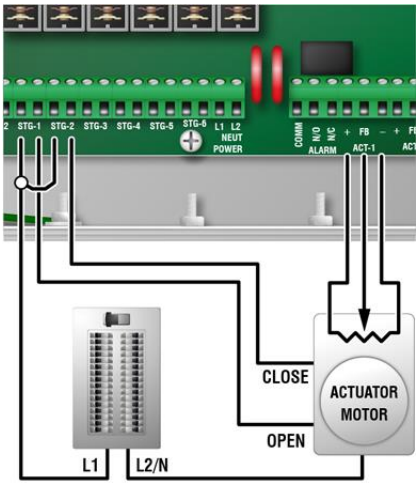
The ratings of the actuator must not exceed the ratings of the PEC Plus.

PEC Plus relay ratings: 10 A at 120/230 VAC, general-purpose (resistive)
1/3 HP at 120 VAC, 1/2 HP at 230 VAC
360 W tungsten at 120 VAC

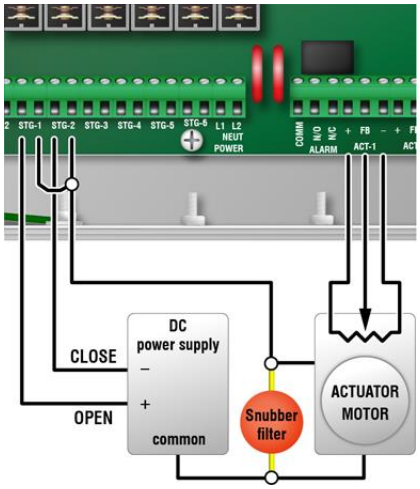
To connect actuators

Connect actuators to your PEC Plus as shown below. Refer to your actuator's installation guide for information about its power supply requirements.

AC-powered actuators



DC-powered actuators



Connecting single-stage heating or cooling elements

Heating or cooling elements include equipment such as electric heaters, furnaces, and single-speed fans.

The ratings of the equipment must not exceed the ratings of your PEC Plus' relays.

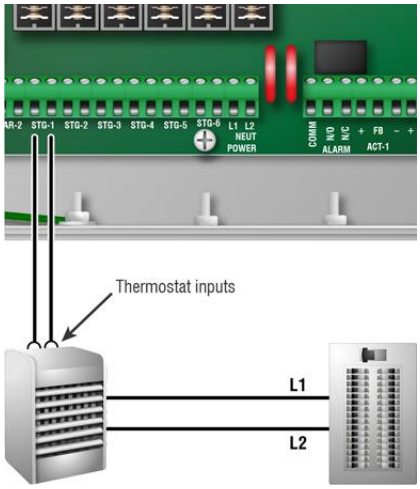
PEC Plus relay ratings: 10 A at 120/230 VAC, general-purpose (resistive)
1/3 HP at 120 VAC, 1/2 HP at 230 VAC
360 W tungsten at 120 VAC

Gas furnaces using hot-surface ignition or glow plug can draw more current than indicated on their nameplate and require power contactors. For more information, read your furnace dealer.

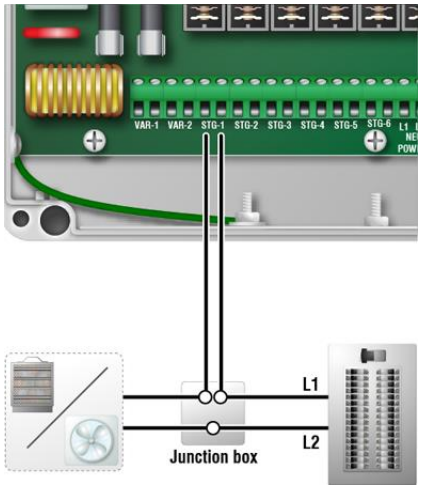
To connect single-stage heating or cooling elements

Connect single-speed heating or cooling elements to your PEC Plus as shown below.

Gas-fired furnace or brooder



All other single-speed heating or cooling elements



Connecting curtain machines

Curtains are usually controlled by equipment called curtain machines (sometimes referred to as winches). Curtains are opened and closed to let in more air or less air, the idea being more air cools the building.

You can connect up to three curtain machines to your PEC Plus. Each curtain machine you connect requires two relays: one for opening the curtain, and one for closing the curtain. The relays must be side-by-side pairs. In other words, Relay 1 and 2, Relay 3 and 4, or Relay 5 and 6. The first relay will be the "open relay"; the second relay will be the "close relay".

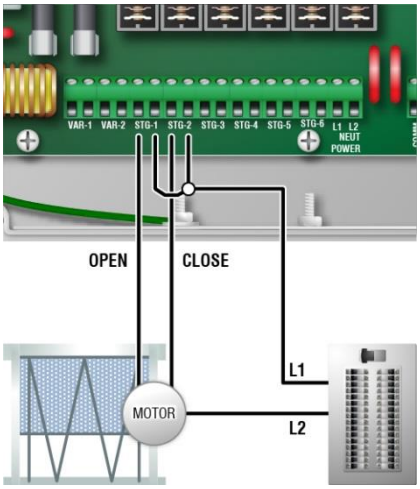
The ratings of the equipment must not exceed the ratings of your PEC Plus' relays.

PEC Plus relay ratings

- ◇ 10 A at 120/230 VAC, general-purpose (resistive)
- ◇ 1/3 HP at 120 VAC, 1/2 HP at 230 VAC
- ◇ 360 W tungsten at 120 VAC

To connect curtain machines

Connect curtain machines to your PEC Plus as shown.



Connecting variable heating or cooling elements

Variable cooling elements include equipment such as variable-speed fans. Variable heating elements include equipment such as heat mats and heat lamps.

- ◇ **Only permanent split capacitor motors appropriate for variable speed control, or shaded pole motors, can be used on the variable stages.**
- ◇ If you are using three-phase power, connect the PEC Plus and the variable cooling equipment to the same phase. For more information, read **Using three-phase power** on page 15.
- ◇ The ratings of the equipment must not exceed the ratings of your PEC Plus' variable stages.

Variable stage ratings

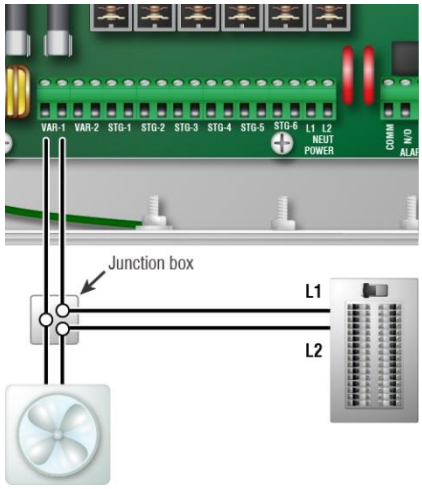
- ◇ 10 A at 120/230 VAC, general-purpose (resistive)
- ◇ 7 FLA at 120/230 VAC, PSC motor
- ◇ 1/2 HP at 120 VAC, 1 HP at 230 VAC, PSC motor

Variable stage fuses

- ◇ 15 A, 250 VAC ABC-type ceramic

To connect variable heating or cooling elements

Connect variable heating or cooling elements to your PEC Plus as shown below.

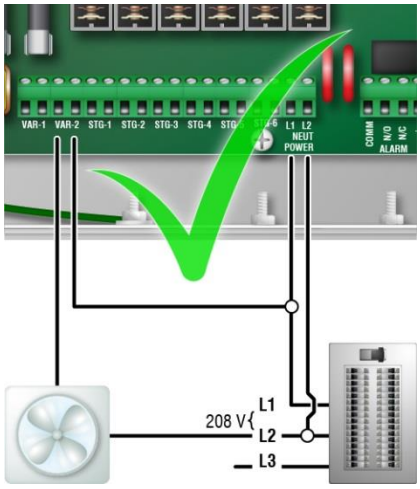


Using three-phase power

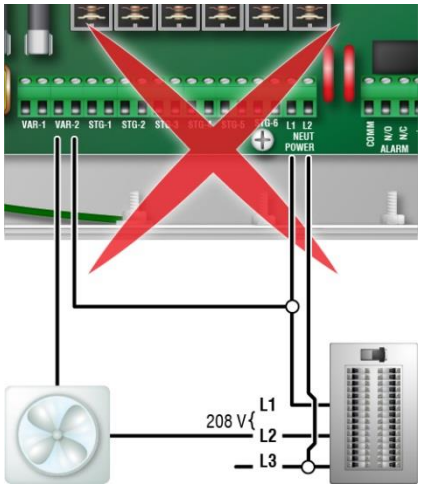
If you are connecting your PEC Plus to a three-phase system, make sure to connect the control power and the variable cooling equipment to the same phase.

Your PEC Plus must be powered from the same phases that supply the equipment. If your PEC Plus power and the variable stages are wired to different phases, the equipment will operate erratically.

Correct three-phase wiring



Incorrect three-phase wiring



Connecting an alarm system

You can connect an alarm system to your PEC Plus' alarm terminal. An alarm system can be a siren, alarm panel, or auto-dialer. Read your system's installation guide for installation instructions and information about the type of system: **normally open** or **normally closed**. Below are the descriptions for the alarm terminal.

- **COMM**: common connection
- **N/O**: normally open; closes during alarm conditions
- **N/C**: normally closed; opens during alarm conditions

For the alarm system to sound (or dial out) during an alarm condition, you must enable the alarms. For more information, read **Programming alarm settings** on page 49.

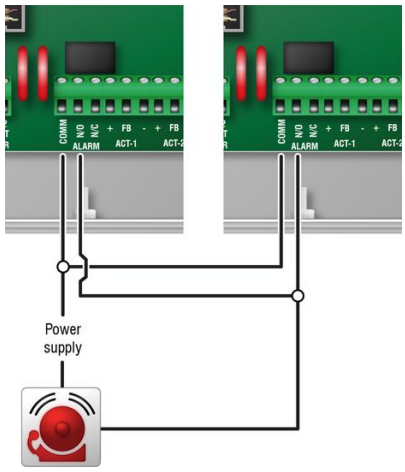
The ratings of the siren or alarm system must not exceed the ratings of your PEC Plus' alarm relay.

Alarm relay ratings: 0.4 A at 125 VAC; 2 A at 30 VDC, resistive load
0.2 A at 125 VAC; 1 A at 30 VDC, inductive load

To connect a normally open alarm system

If you are connecting the alarm system to a network of PEC Plus control and your system uses a **normally open connection** (closes on alarm), connect the system as shown in the normally open diagram.

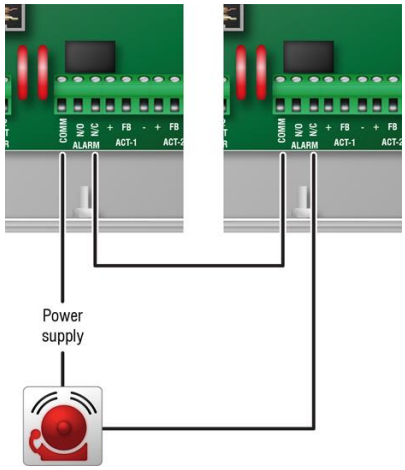
Join all the COMM connections together and all the N/O connections together. Your PEC Plus alarm relays must be in parallel with each other so any PEC Plus can trigger the alarm system when an alarm condition occurs.



To connect a normally closed alarm system

If you are connecting the alarm system to a network of PEC Plus controls and your system uses a **normally closed connection** (opens on alarm), connect the system as shown in the normally closed diagram.

Join the alarm relays in a continuous loop. Your PEC Plus alarm relays must be in series with each other so any PEC Plus can trigger the alarm system when an alarm condition occurs.



Connecting temperature probes

The PEC Plus has four temperature probe terminals, TEMP1 to TEMP4. You can connect any of Phason's standard 3K temperature probes to any of the probe terminals.

All enabled probes are averaged to provide a more balanced temperature reading in the room. Probe 4 (TEMP4) can be used to monitor outdoor temperatures. When probe 4 is configured for monitoring outdoor temperatures, it is not used for temperature averaging.

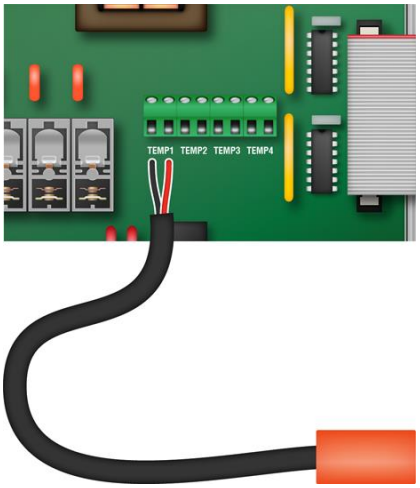
- ◇ Replace damaged probes as soon as possible If there are no probes present or working properly, the PEC Plus controls the stages for a temperature half-way between the previous day's high and low temperatures.
- ◇ When routing the temperature probe cables, do not run them in or along the same conduit as AC-power lines.
- ◇ If you are connecting more than one probe, you must enable the additional probes. By default, probe 1 (TEMP1) is enabled and probes 2, 3, and 4 are not enabled. For more information, read **Configuring temperature probes** on page 23.

You can extend probe cables up to 500 feet. For more information, read the **Control Fundamentals** guide that came with your control.

To connect temperature probes

Follow these guidelines and connect the temperature probe as shown below.

- Do not run the probe cable in the same conduit as AC power cables
- Do not run the sensor cable beside AC power cables or near electrical equipment.
- When crossing other cables or power lines, cross them at a 90-degree angle.

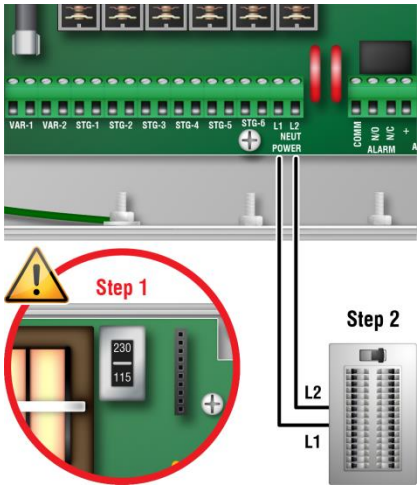


Connecting the power source

- ◇ Before connecting the incoming power, switch OFF the power at the source.
- ◇ Do not switch ON the power until you have finished all wiring and verified all equipment is properly connected and free of obstructions.

- ◇ Before connecting the power, set the voltage selection switch to the correct voltage.
- ◇ If you are using three-phase power, make sure the control power and the variable speed fans are connected to the same phase. For more information, read **Using three-phase power** on page 15.

You can connect your PEC Plus to 120 or 230 VAC, 50 or 60 Hz power.



To connect the incoming power source

1. Set the voltage select switch to the correct voltage setting.
2. Connect the incoming power source as shown below.

Finishing the installation

After installing and connecting equipment to your PEC Plus, you are ready to finish the installation. Before you start configuring your PEC Plus, you need to verify the connections and close the PEC Plus.

Make sure the configuration worksheets in **Appendix E** correspond to the way the equipment is connected to your PEC Plus. It is very important that the connections and the worksheets are the same, because the next step after closing the cover is to tell your PEC Plus which equipment is connected to each terminal. It is important so you can be sure you are controlling the equipment you think you are controlling.

1. Make sure all the wires are properly connected to the correct terminals.
2. Make sure the voltage selection switch is in the correct setting, 115 or 230 VAC.
3. Make sure the display cable is properly connected. For more information, read **PEC Plus layout** on page 9.
4. Place the cover on the control.

5. Switch on the power to your PEC Plus.
   When you switch on the power to your PEC Plus, the display should show the temperature. If the PEC Plus display does not come on, go back to step 1. If the display shows an alarm message and or the ALARM indicator is lit, read **Programming alarm settings** on page 49.
6. Insert the four screws into the cover and then tighten them.

Do not over tighten the screws. Avoid using power screwdrivers or drills.

Chapter 3: Configuring your PEC Plus

Chapter 3 explains how to configure your PEC Plus. Configuring your PEC Plus includes telling it which equipment is connected to each terminal.

Topics in chapter 3 include:

What you need to know before configuring your PEC Plus

Configuring your PEC Plus means telling it what equipment it will be controlling and how it will be controlling that equipment. For example, your PEC Plus has 6 relay stages. You need to tell the stages if they will be controlling curtains, heating or cooling elements, or actuators.

Before you begin configuring your PEC Plus, make sure:

- It has power
- All equipment has been properly connected to the correct terminals.
- You know which equipment is connected to which relays and variable stages

This chapter does not explain set points, idle speeds, or other settings. For information about those settings, read **Chapter 4: Programming the PEC Plus** on page 32.

Configuration checklist

Because some items need to be configured before others, we recommend configuring your PEC Plus in following order. If you do not have elements of a particular type, skip that step. For example, if you do not have actuators, skip to the next step.

Configuring main control functions

- ☐ Setting the clock
- ☐ Selecting the temperature units
- ☐ Configuring temperature probes
- ☐ Configuring hysteresis

Configuring variable and relay stages

- ☐ Configuring variable stages
- ☐ Configuring relays for actuators
- ☐ Calibrating actuators
- ☐ Configuring relays for single-speed heating and cooling or duty cycles
- ☐ Configuring relays for curtains

Testing the configuration

- ☐ Testing the configuration

- ◇ We recommend configuring *all* your control elements before programming the settings (temperature set points, idle speeds, and so on). Use the **Appendix E: Configuration worksheets** on page 74 to help you keep track of which equipment is connected to which relays and variable stages.
- ◇ If you receive an error message during configuration, look it up in **Appendix B: Troubleshooting** on page 66 and then follow the instructions for correcting the problem.
- ◇ Your PEC Plus' built-in diagnostic tests are useful for testing your equipment after installing and configuring it. For more information, read **Testing settings and equipment** on page 53.

Configuring the main control functions

Before configuring the variable and relay stages, you need to configure the main control functions. Main control functions include items such as temperature units that the PEC Plus needs to know before you configure the variable and relay stages.

Main control functions include:

- **Clock/time** – the PEC Plus has a clock that counts time
- **Temperature units** – degrees Fahrenheit or Celsius
- **Temperature probes** – how many and where they are connected
- **Hysteresis** – the number of degrees above or below the set point that equipment switches on or off

Setting the clock

The PEC Plus has a clock that keeps track of the time for the daily high and low temperatures and the growth curves. If there is a power failure, or you need to adjust for daylight savings time, you will have to change the clock.

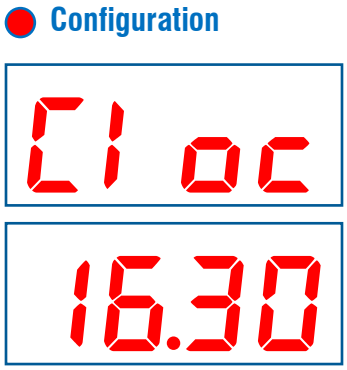
The PEC Plus uses 24-hour time. The table below shows some common standard times and their 24-hour equivalents.

Standard time	24-hour time
12:00 AM	00:00
01:00 AM	01:00
02:00 AM	02:00
03:00 AM	03:00
04:00 AM	04:00
05:00 AM	05:00
06:00 AM	06:00
07:00 AM	07:00
08:00 AM	08:00
09:00 AM	09:00
10:00 AM	10:00
11:00 AM	11:00

Standard time	24-hour time
12:00 PM	12:00
01:00 PM	13:00
02:00 PM	14:00
03:00 PM	15:00
04:00 PM	16:00
05:00 PM	17:00
06:00 PM	18:00
07:00 PM	19:00
08:00 PM	20:00
09:00 PM	21:00
10:00 PM	22:00
11:00 PM	23:00

The PEC Plus starts counting time as soon as it is connected to an incoming power supply.

To set the clock

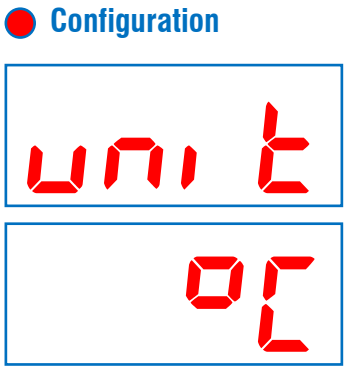


1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until Clock is displayed and then press **Select**. The display shows the current time.
3. Press **Up** or **Down** to adjust the hours and then press **Select**.
5. Press **Up** or **Down** to adjust the minutes and then press **Select**. The control saves the time and returns to the Configuration menu
6. Press **Back** to return to the main display.

Selecting the temperature units

Your PEC Plus can display temperatures in either degrees Fahrenheit (°F) or degrees Celsius (°C), but not both at the same time. The factory default is °F. If you want to change the temperature units, follow the steps below.

To select the temperature unit



1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until unit is displayed and then press **Select**. The display shows the current temperature unit.
3. Press **Up** or **Down** to toggle between °F and °C and then press **Select**.
   The control returns to the Configuration menu.
4. Press **Back** to return to the main display.

Configuring temperature probes

The PEC Plus has four temperature probe terminals, TEMP1 to TEMP4. You can connect any of Phason's standard 3K temperature probes to any of the probe terminals.

By default, probe 1 (TEMP1) is enabled and probes 2, 3, and 4 are not enabled. When enabled, probes 2, 3, and 4 can be averaged to provide a more balanced temperature reading in the room. Probe 4 can be used to monitor outdoor temperatures. When probe 4 is configured for monitoring outdoor temperatures, it is not used for temperature averaging.

Averaging temperature probes

When you connect and enable more than one temperature probe to the PEC Plus, the control automatically averages the temperature readings it receives from each probe. Temperature averaging

give a more balanced 'overall' temperature for a room. For example, if you have a long room, you can place one probe near each end, and one in the center of the room.

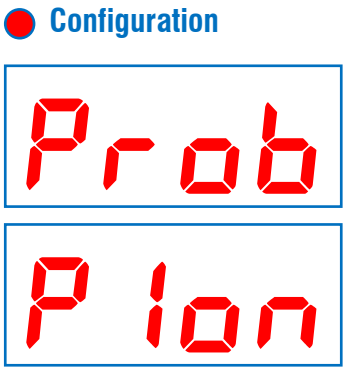
Temperature probe defaults and options

Probe	Default configuration	Optional configuration	Function
Probe 1	on/enabled (P 1on)	off (P 1oFF)	Automatically averages with other enabled probes.
Probe 2	off/disabled (P2oF)	on (P2on)	Automatically averages with other enabled probes.
Probe 3	off (P3oF)	on (P3on)	Automatically averages with other enabled probes.
Probe 4	off (P4oF)	on (P4on)	Automatically averages with other enabled probes.
		outdoor (P4ot)	Monitors outdoor temperatures. Does not average with other probes.

- ◇ There must be at least one probe configured as "on".
- ◇ Replace damaged probes as soon as possible. If a probe is damaged, disable it until you can replace it with a new probe.
- ◇ If there are no probes present or working properly, the PEC Plus controls the stages for a temperature half-way between the previous day's high and low temperatures.

To configure temperature probes

1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until Prob is displayed and then press **Select**.
3. Press **Up** or **Down** to select the probe you want to configure and then press **Select**.
   The display shows the current configuration.
4. Press **Up** or **Down** to select a different configuration and then press **Select**.
   The control returns to the Probe menu.
5. Repeat steps 3 and 4 for each probe you want to configure.
6. Press **Back** once to return to the Configuration menu, or twice to return to the main display.



Configuring hysteresis

Hysteresis helps prevent damage to the relays, variable stages, and the equipment connected to them by preventing the stages from switching on and off rapidly when the temperature is hovering close to the set point.

Hysteresis is the number of degrees above the set point that a heating stage or relay switches off, and the number of degrees below the set point that a cooling stage or relay switches off. For example, a household thermostat might switch on a furnace at 68 °F when the house is cooling down, but switch it off at 70 °F when the house is warming up. The difference between these two values is the hysteresis.

Default: 1.0 °F (0. 5°C) *Range:* 0.3 to 5.0°F (0.2 to 2.8°C)

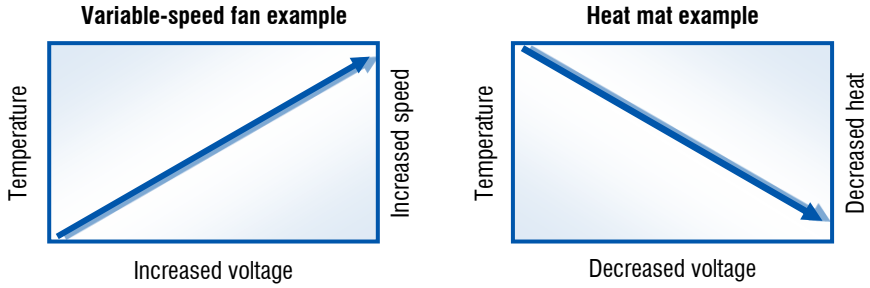
Curtains are not affected by the general hysteresis configuration; the hysteresis for curtains is fixed at 0.5°F (0.3°C).

To configure the hysteresis

1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until HYSt is displayed and then press **Select**. The display shows the current hysteresis.
3. Press **Up** or **Down** to adjust the hysteresis and then press **Select**. The control returns to the Configuration menu.
4. Press **Back** to return to the main display.

Configuring variable stages

Your PEC Plus' two variable stages (**VAR1** and **VAR2**) control elements that operate with gradually increasing voltage, such as variable speed fans, or gradually decreasing voltage, such as heat mats.



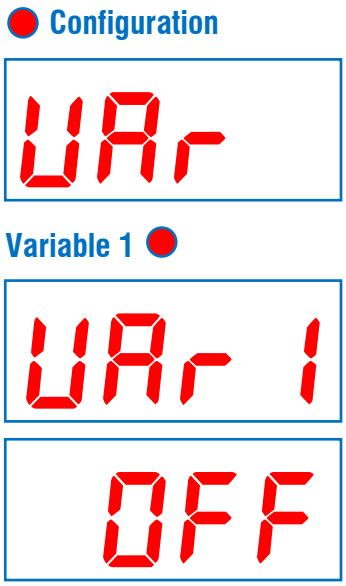
There are four configuration options.

- **Off** (OFF) – the variable stage is always off.
- **Cooling 1** (CL 1) – the stage controls a variable speed fan using motor curve 1. Use motor curve 1 for most fans.
- **Cooling 2** to **Cooling 4** (CL 2, and so on) – the stage controls a variable speed fan using selected motor curve. Use one of motor curves 2 to 4 *only if* one of the following problems occur when using manual override to test.
  - The fan changes speed *only within* a small portion of the 0 to 100% range
  - The fan runs at full speed regardless of the 0 to 100 percent range
- **Heat** (HEAt) – the stage controls a heating element such as a heat mat or heat lamp.

- ◇ For more information about motor curves, including a table with fan motors and recommended curves, read **Appendix G: Motor curves** on page 81.
- ◇ For more information about how variable stages work, read **Programming variable stages** on page 37.
- ◇ Use the **Variable stage configuration worksheet** on page 74 when configuring variable stages.

To configure variable stages

1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until uAr is displayed and then press **Select**.
   The display shows UAr 1.
3. Press **Up** or **Down** until the stage you want to configure is displayed and then press **Select**.
   The display shows the current configuration.
4. Press **Up** or **Down** until the configuration you want is displayed and then press **Select**.
   The control returns to the Variable stage menu.
5. Press **Back** once to return to the Configuration menu, or twice to return to the main display.



Configuring relays

Your PEC Plus has six relays that can be configured for several options.

- **Off** – the relay is always open (off). This is the default.
- **On** – the relay is always closed (on). This can be used as an override.
- **Actuator** – the relay controls a cooling element called an actuator. Actuators require one relay for opening and one for closing.
- **Curtain** – the relay controls a cooling element called a curtain machine. Curtains require one relay for opening and one for closing.
- **Cooling** – the relay controls a cooling element and switches on when the temperature rises above the temperature set point. An example of a cooling element is a single-speed fan.
- **Heating** – the relay controls a heating element and switches on when the temperature falls below the temperature set point. An example of a heating element is an electric heater.
- **Duty cycle (cooling)** – the relay controls a cooling element and switches on when the temperature rises above the temperature set point. Instead of remaining on constantly when the temperature is above the set point, the relay switches on for a duration, then off for a duration before repeating the process. An example of a duty cycle cooling element is a mister.
- **Advanced duty cycle (cooling only)** – the relay controls a cooling element and switches on when the temperature rises above the temperature set point. Advanced duty cycles have two set points. Set point 1 is the same as in a normal duty cycle; set point 2 is higher than set point 1. When the temperature is above the set point 2, the duty cycle remains on, regardless of the on/off durations. When the temperature drops below set point 2, the duty cycle starts again.
- **Duty cycle (heating)** – the relay controls a heating element and switches on when the temperature falls below the temperature set point. Instead of remaining on constantly when the temperature is below the set point, the relay switches on for a duration, then off for a duration before repeating the process.

Configuring relays for actuators

You can connect up to two actuators to a PEC Plus. Each actuator you connect requires two relays: one for extending the actuator arm (opening the inlet), and one for retracting the arm (closing the inlet).

◇ Actuator 1 uses relay 1 to open (extend) the actuator and relay 2 to close (retract) the actuator.

◇ Actuator 2 uses relay 3 to open (extend) the actuator and relay 4 to close (retract) the actuator.

Use the **Relay configuration worksheet** on page 75 when configuring relays.

- ◇ The following steps use Actuator 1 (ACt 1). If you are configuring a second actuator, follow the same steps using ACt2.
- ◇ You only need to configure one of the relay pairs. For example, if you configure relay 1 for actuator 1, the control automatically configures relay 2.

To configure relays for actuators

1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until rly is displayed and then press **Select**. The display shows rly1.
3. Press **Up** or **Down** until the first relay you want to configure is displayed and then press **Select**. The display shows the current configuration.
4. Press **Up** or **Down** until ACt 1 is displayed and then press **Select**. The control returns to the Relay menu.
5. Press **Back** once to return to the Configuration menu, or twice to return to the main display.

Calibrating actuators

After configuring the actuator relays, you need to calibrate the actuators. Calibrating the actuator lets the PEC Plus know the position of the actuator when it is fully extended and fully retracted. The PEC Plus uses the limits to define the range of motion it uses to position the inlets. These limits tell the control how much to adjust when you want the actuators, for example, only 25% extended.

Because cables can stretch and equipment can come out of alignment (similar to tires on your car), we recommend resetting the limit switches and calibrating your actuators at least once each year.

Each time you place the jumper on the actuator present **IN** pins, the PEC Plus calibrates the actuator. During calibration, the actuator opens, pauses, and then closes. If the actuator is operating properly, the inlet should open completely and then close completely. After closing completely, the actuators should position according to the temperature and default settings.

- ◇ Before calibrating actuators, make sure the limit switches are set and the cable and counter weights can move freely.
- ◇ If the calibration procedure stops after closing the first time, or fails to position properly, the feedback signal is not connected properly. Verify that the potentiometer wiring is correct. For more information, read **Determining correct actuator feedback wiring** on page 71.

To calibrate actuators

1. Loosen the four screws in the PEC Plus enclosure and then gently remove the cover. Make sure not to disconnect the ribbon cable.
2. Remove and then replace the actuator present jumper on the **IN** pins for the actuator (ACT1 for actuator 1 and ACT2 for actuator 2).
   The inlet opens completely, pauses, and then closes completely. If the procedure does not work properly, read the note above.
3. Replace the cover and then tighten the four screws.

Configuring relays for curtains

Curtains are usually controlled by equipment called curtain machines. Curtains are opened and closed to let in more air or less air, the idea being more air cools the building. Each curtain machine you connect requires two relays: one for opening the curtain, and one for closing the curtain.

Use the **Relay configuration worksheet** on page 75 when configuring relays.

- ◇ Some curtain machines use a feedback potentiometer to indicate curtain position. If your curtain machine has a potentiometer, configure it as an actuator.
- ◇ The relays must be side-by-side pairs. In other words, Relay 1 and 2, Relay 3 and 4, or Relay 5 and 6. The first relay will be the *open relay*; the second relay will be the *close relay*.
- ◇ You only need to configure one of the relay pairs. For example, if you configure relay 4 for curtain control, the control automatically configures relay 3.

To configure relays for curtain control

1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until `rly` is displayed and then press **Select**.
   The display shows `rly1`.
3. Press **Up** or **Down** until the relay you want to configure for opening the curtain is displayed and then press **Select**.
   The display shows the current configuration.
4. Press **Up** or **Down** until `Curt` is displayed and then press **Select**.
   The control returns to the Relay menu.
5. Press **Back** once to return to the Configuration menu, or twice to return to the main display.

Configuring relays for single-speed heating and cooling or duty cycles

Relays configured for cooling can control single-speed fans, misters, or other cooling equipment that can be either on or off. The relays switch on when the temperature rises above the set point and off when it drops below.

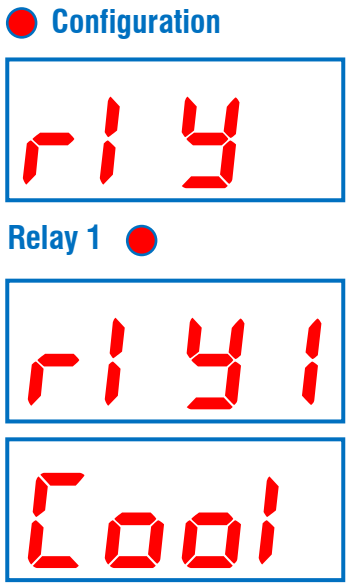
Relays configured for heating can control equipment such as electric or gas heaters that can be either on or off. The relays switch on when the temperature drops below the set point and off when it rises above.

For more information about duty cycles, read **How normal duty cycles work** on page 46.

- If you need to connect more cooling elements than you have relays available, and you are not using both variable stages, you can use an available variable stage as an ON/OFF stage (for 120/230 VAC-powered equipment only). For more information, read **Programming variable stages** on page 37.
- Use the **Relay configuration worksheet** on page 75 when configuring relays.

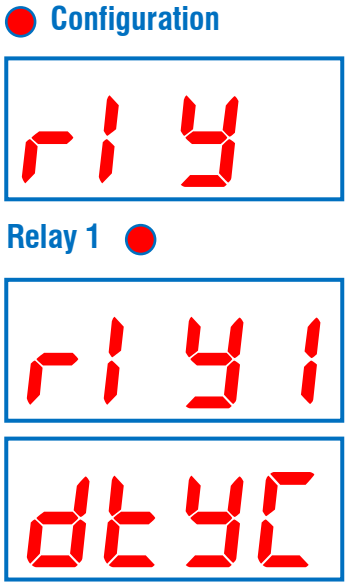
To configure relays for single-stage heating or cooling (no duty cycle)

1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until `rly` is displayed and then press **Select**. The display shows `rly1`.
3. Press **Up** or **Down** until the first relay you want to configure is displayed and then press **Select**. The display shows the current configuration.
4. Press **Up** or **Down** until `Cool` or `HEAt` is displayed and then press **Select**. The control returns to the Relay menu.
5. Press **Back** once to return to the Configuration menu, or twice to return to the main display.



To configure relays for single-stage heating or cooling (with duty cycle)

1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until `r1 y` is displayed and then press **Select**. The display shows `r1 y 1`.
3. Press **Up** or **Down** until the first relay you want to configure is displayed and then press **Select**. The display shows the current configuration.
4. Press **Up** or **Down** until `dtyC` (duty cycle cooling), `dtyH` (duty cycle heating), or `dtC2` (advanced duty cycle cooling) is displayed and then press **Select**. The control returns to the Relay menu.
5. Press **Back** once to return to the Configuration menu, or twice to return to the main display.



Testing the configuration

After configuring all the control elements (variable stages relays, and so on), test your PEC Plus to make sure the configuration is correct. In other words, make sure what you think is connected to a particular relay or stage *is* actually connected to that relay or stage.

You can test the configuration using the PEC Plus' test mode. Test mode allows you to operate the equipment, regardless of temperature or time. As you operate each piece of equipment, visually check to see if that equipment is doing what you tell it.

For example, when you switch on relay 1 at the PEC Plus, does the equipment you think is connected to that relay switch on?

For more information about test mode, read **Testing settings and equipment** on page 53.

Chapter 4: Programming the PEC Plus

Chapter 4 discusses how to program your PEC Plus with the settings it uses to control your equipment.

Topics in chapter 4 include:

What you need to know before programming your PEC Plus

Programming your PEC Plus basically means telling the equipment what you want it to do and when you want it done. For example, for a single-speed fan set for cooling, you might say: "Switch on when the temperature reaches 80°F."

Programming checklist

Because some settings must be programmed before others, we recommend programming your PEC Plus in the following order. If you do not have elements of a particular type, skip that step. For example, if you do not have curtains, skip that step.

Programming target temperatures

- ☐ Programming the group set point
- ☐ Programming the growth curve

Programming the stages

- ☐ Programming variable stages
- ☐ Programming actuators
- ☐ Programming curtain control relays
- ☐ Programming heating and cooling elements and duty cycles
- ☐ Programming alarm settings

Before you begin programming your PEC Plus, make sure:

- It has power
- All equipment has been properly connected to the correct terminals.
- You know which equipment is connected to which relays and variable stages
- All variable and relay stages have been properly configured and tested. For more information, read **Chapter 3: Configuring your PEC Plus** on page 20.

Use **Appendix F: Settings worksheets** on page 76 when programming your PEC Plus.

Programming target temperatures

There are two options for the target temperatures:

- Growth curve
- Group set point

The PEC Plus uses one or the other. If the growth curve is enabled, the control uses the growth curve settings. If the growth curve is not enabled, the control uses the group set point.

Programming the group set point

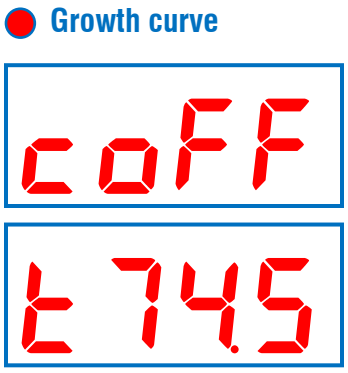
A group set point is the target or desired temperature for the room or zone. This is the temperature that will be tracked by the individual stages. The individual set points for each variable and relay stage will be adjusted relative to the group set point for that zone. **Make sure you set the group set point before setting the individual set points.**

For example, let's say the group set point is 80°F, a variable-stage fan set point is 5 degrees higher (85°F), and a single-stage heater set point is 7 degrees lower (73°F). If you lower the group set point by 5 degrees to 75°F, the set points for the fan and heater will also be lowered by 5 degrees to 80°F and 68°F respectively.

Once a group set point is set, it remains at that temperature until you change it, or until an enabled growth curve makes an adjustment to it.

To program the group set point

1. Press **Function** until the GROWTH CURVE indicator is lit. The display shows PArA (parameter A).
2. Press **1**. The display shows the current day. If the growth curve is not enabled (if the display shows coFF), go to step 4.
3. Press **Up** or **Down** to set the current day to 0 and then press **Select**. The control returns to the Parameter menu.
4. Press **5**. The display shows the current group set point.
5. Press **Up** or **Down** to change the setting and then press **Select**. The control returns to the Parameter menu.
6. Press **Back** to return to the main display.



Programming the growth curve

A growth curve is an extension of the group set point concept. The growth curve automatically adjusts the temperature set points over time to control the temperature in a room. It is called a 'growth' curve because it adjusts the set-points as the animals 'grow'.

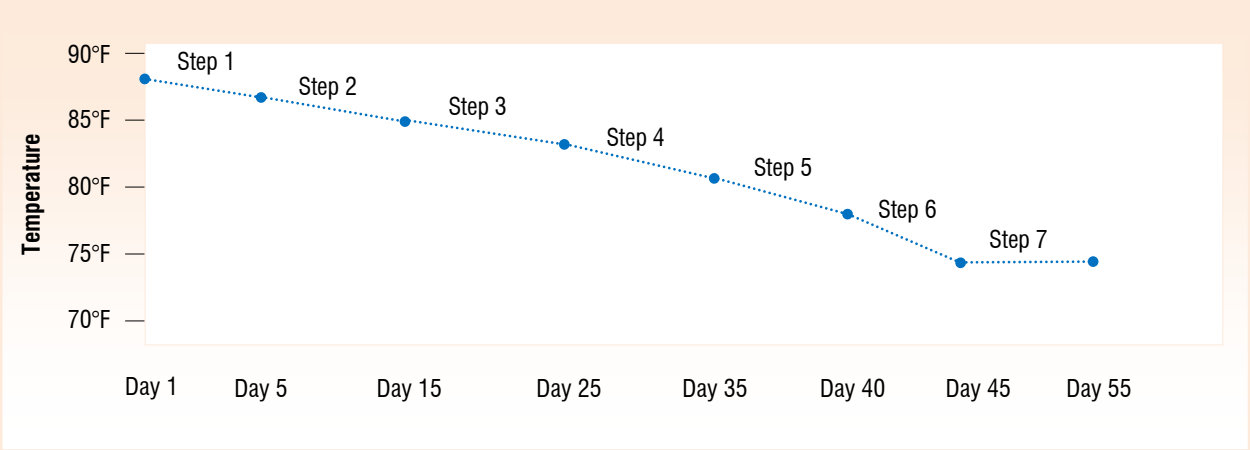
For example, in hog production, newborn piglets require a high temperature for comfort and health. As they grow older, they need a steadily lower temperature. Using the growth curve, you can have your PEC Plus automatically adjust the temperatures. For example, start at 76°F for 1 day, drop to 74°F for 1 day, then to 71°F for 21 days, 68°F for 14 days, and so on.

You can have up to seven steps in a growth curve. Each step has a starting temperature set point and a duration. Your PEC Plus automatically calculates the set points for the days between the steps and adjusts the set points at midnight each day. Individual set points for the variable and fixed stages are adjusted relative to the growth curve temperature for that particular day. This is an extremely powerful feature because it lets you put fan and heating strategies in place once, and then adjust them automatically over time.

For example, in the table on the right, the duration of step 2 is 10 days. The difference between the starting set point (86.5°F) and the starting set point for the next step (85°F) is 1.5°F.

The PEC Plus divides the temperature difference by the duration 1.5 ÷ 10=0.15 and then automatically adjusts the set point by 0.15°F each day for 10 days.

Step	Temperature (°F)	Duration (days)
1	88.0	5
2	86.5	10
3	85.0	10
4	83.5	10
5	81.0	5
6	78.0	5
7	74.0	10

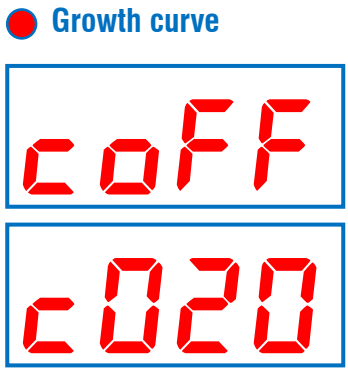


Use the **Growth curve worksheet** on page 76 when programming the growth curve.

The temperature set point must decrease as the steps increase.

Parameter	Description	Options/range	Displayed as
1 – Current day	The current day of the growth curve	0 to 365	coFF to c365
2 – Step	The step of the growth curve you are programming	1 to 7	StP1 to StP7
3 – Duration	The duration of the step you are programming	0 to 365	d 0 to d365
4 – Start temperature	The starting temperature for the step you are programming	-13 to 125°F (-25 to 51.7°C)	t -13 to t125 t -25 to t517
5 – Group set point	If the growth curve is not enabled, the control uses this as the target temperature.	-13 to 125°F (-25 to 51.7°C)	t -13 to t125 t -25 to t517

To enable, disable, or change the current day of the growth curve



1. Press **Function** until the GROWTH CURVE indicator is lit.
   The display shows PArA (parameter A).
2. Press **1**.
   The current day of the growth curve is displayed.
   - To enable (when it is disabled) or change the current day of the growth curve, press **Up** or **Down** to set the current day.
   - To disable the growth curve, press **Down** to set the current day to off.
3. Press **Select** to return to the Parameter menu.
4. Press **Back** to return to the main display.

To program the growth curve

1. Press **Function** until the GROWTH CURVE indicator is lit.
   The display shows PArA (parameter A).
2. To view the current step, press **2**.
   The display shows the current step.
3. To choose the step you want to program, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu
4. To view the step duration, press **3**.
   The display shows the current setting.
5. To change the duration, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
6. To view the start temperature, press **4**.
   The display shows the current setting.
7. To change the start temperature, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
8. Repeat steps 2 to 7 for each step you want to program.
9. Press **Back** to return to the main display.

To view the settings for a step, select the step (read steps 2 and 3 above) and then press the Parameter buttons for the settings you want to view. Repeat this for each step you want to view.

Programming the stages

Programming the stages means entering the settings such as temperature set points, idle speeds, ON/OFF times and durations, and so on. Programming the stages involves programming the settings for:

- Variable stages (below)
- Relay stages
  - Actuators (on page 41)
  - Curtains (on page 44)
  - Heating and cooling stages, including duty cycles (on page 46)
- Alarms (on page 49)

Programming variable stages

Before setting up the variable stages, make sure you have properly configured them. For more information, read **Configuring variable stages** on page 25.

There are four settings to program for each variable stage.

Cooling stages

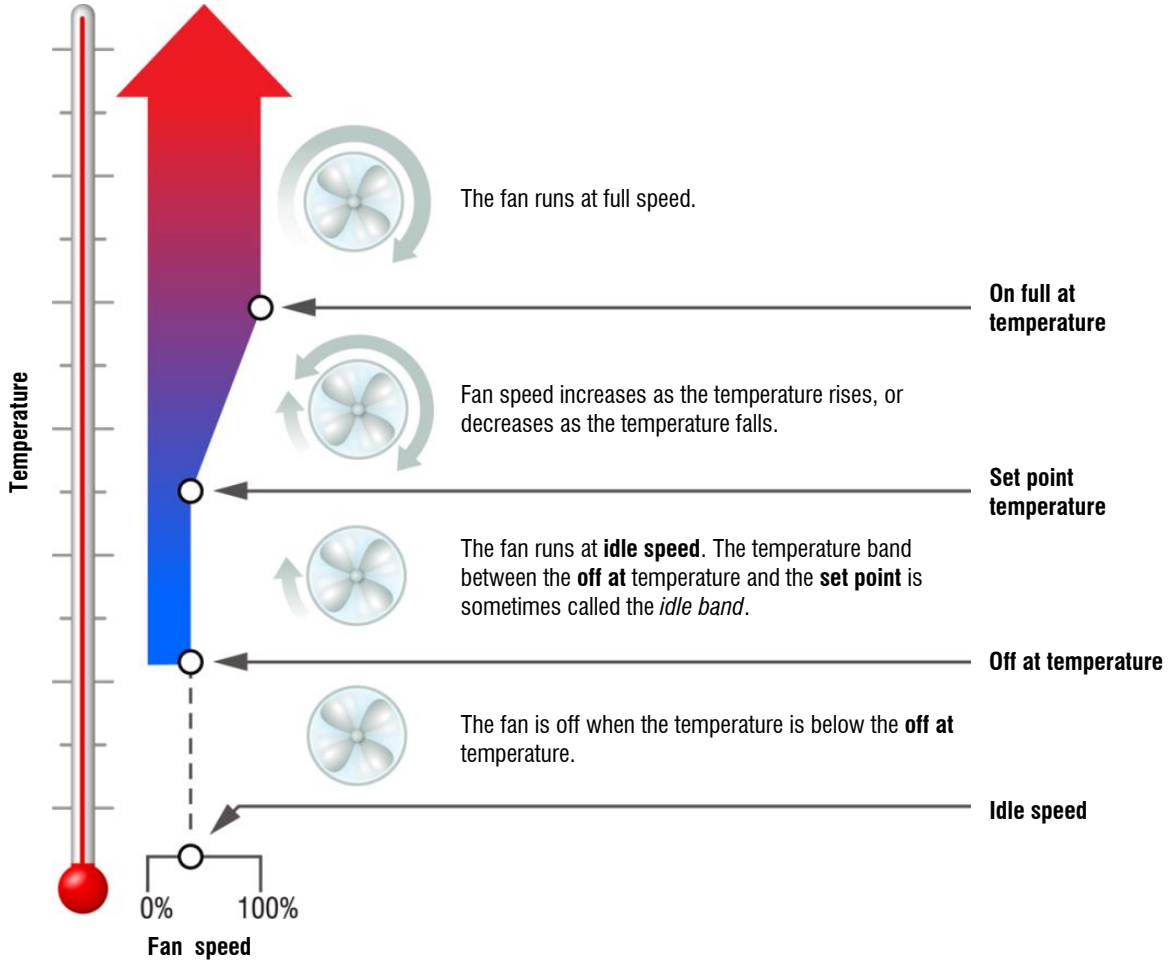
- **Idle speed**
- **Off at** temperature
- **Set point** temperature
- **On full at** temperature

Heating stages

- **Minimum heat**
- **Off at** temperature
- **Set point** temperature
- **On full at** temperature

How variable stage cooling works

- When the temperature is below the **off at** temperature, the fan is off.
- When the temperature reaches the **off at** temperature, the fan runs at the **idle speed**. The fan continues to run at the **idle speed** until the temperature rises to the ***s*et point** temperature.
- When the temperature is between the **set point** and **on full at** temperatures, fan speed increases or decreases proportionally with the temperature.
- When the temperature is at or above the **on full at** temperature, the fan runs at full speed.

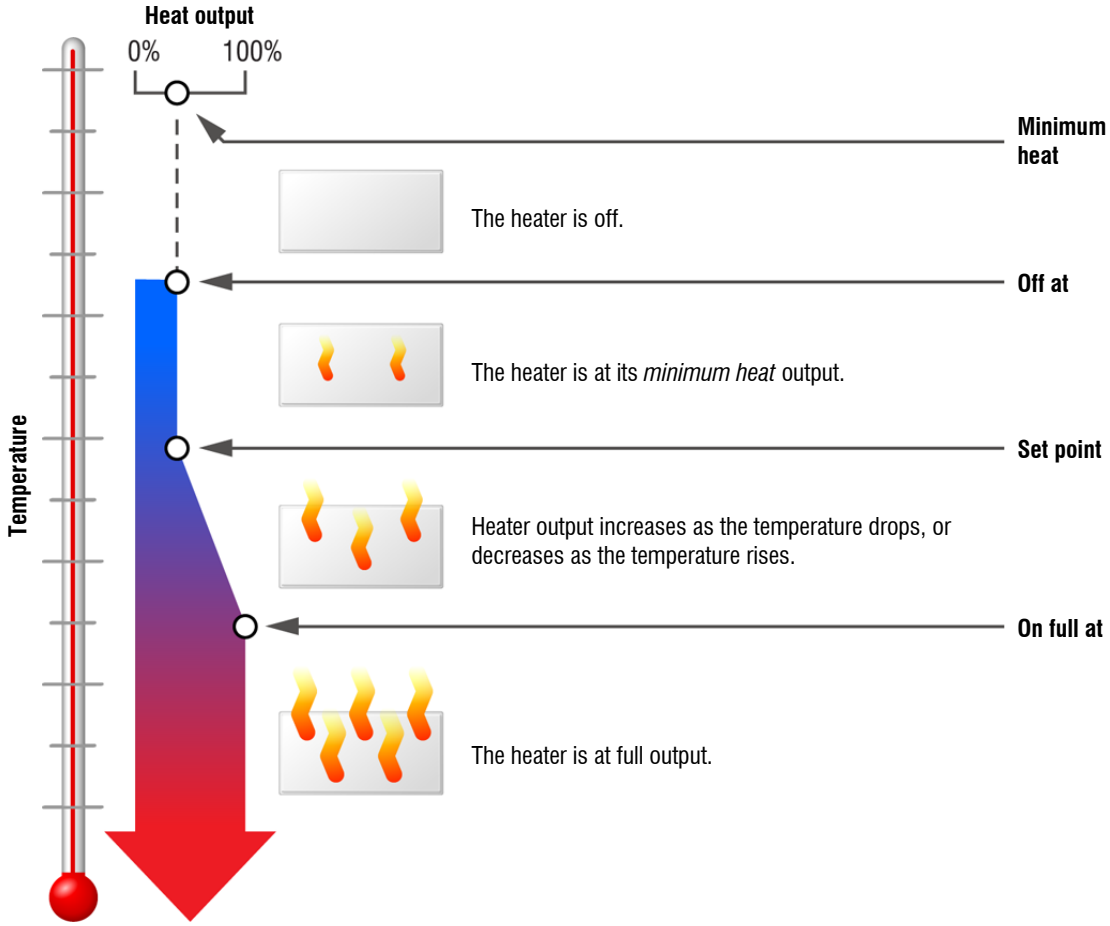


TIP

- ◇ If you need to connect more cooling elements than you have relays available, and you are not using both variable stages, you can use an available variable stage as an ON/OFF stage (for 120/230 VAC-powered equipment only).
- ◇ Set the **idle speed** to 100% and **off at** to the temperature at which you want the stage to switch on/off. You no longer have *variable* speed or power; you have either full on or full off, the same as a regular cooling element. The **set point** and **on full at** settings have no effect when you use a variable stage this way.
- ◇ The **set point** and **on full at** settings must be greater than the **off at** setting.

How variable heating stages work

- When the temperature is above the **off at** temperature, the heater is off.
- When the temperature drops below the **off at** temperature, the heater is at the **minimum heat**. The heater continues to operate at **minimum heat** until the temperature drops to the **set point**.
- When the temperature is between the **set point** and the **on full at** temperatures, heater output increases or decreases proportionally with the temperature.
- When the temperature is below the **on full at** temperature, the heater is at full output.



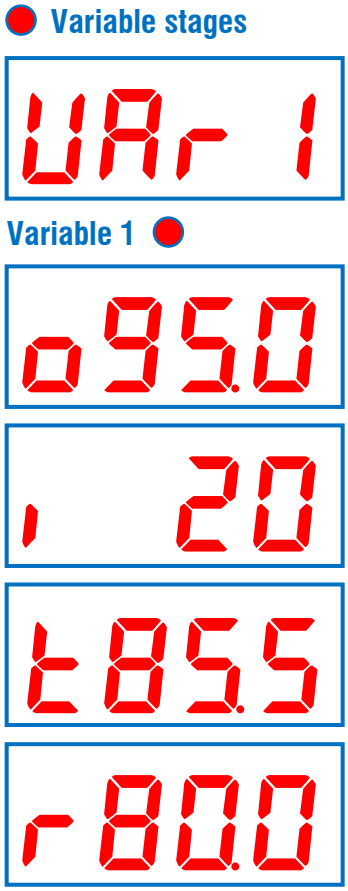
TIP

- If you need to connect more heating elements than you have relays, and you are not using all the variable stages, you can use any available variable stage as an ON/OFF stage.
- Set **minimum heat** to 100% and **off at** to the temperature you want the stage to switch on/off. You no longer have *variable* speed or power; you have either *full on* or *full off*, the same as a regular heating element. The **set point** and **on full at** settings have no effect when you use a variable stage this way.
- The **set point** and **on full at** settings must be greater than the **off at** setting.

Use the **Variable stage settings worksheet** on page 77 when programming variable stages.

To program variable cooling stages

1. Press **Function** until the VARIABLE STAGES indicator is lit.
   The display shows UAr 1 (variable stage 1).
2. Press **Up** or **Down** to toggle between programming variable stage 1 and variable stage 2 and then press **Select**.
   The display shows PArb (parameter B). The STAGES indicators show which stage you are programming.
3. To view the **off at** temperature, press **1**.
   The display shows the current setting.
4. To change the setting, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
5. To view the **idle speed**, press **2**.
   The display shows the current setting.
6. To change the setting, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
7. To view the **set point**, press **3**.
   The display shows the current setting.
8. To change the setting, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
9. To view the **on full at** temperature, press **4**.
   The display shows the current setting.
10. To change the setting, press **Up** or **Down** and then press **Select**.
    The control returns to the Parameter menu.
11. Press **Back** once to return to the Variable stage menu, or twice to return to the main display.



To view the settings for a step, select the step (read steps 2 and 3 above) and then press the Parameter buttons for the settings you want to view. Repeat this for each step you want to view.

To program variable heating stages

1. Press **Function** until the VARIABLE STAGES indicator is lit. The display shows UAr 1 (variable stage 1).
2. Press **Up** or **Down** to toggle between programming variable stage 1 and variable stage 2 and then press **Select**. The display shows PArb (parameter B). The STAGES indicators show which stage you are programming.
3. To view the **off at** temperature, press **1**. The display shows the current setting.
4. To change the setting, press **Up** or **Down** and then press **Select**. The control returns to the Parameter menu.
5. To view the **idle speed**, press **2**. The display shows the current setting.
6. To change the setting, press **Up** or **Down** and then press **Select**. The control returns to the Parameter menu.
7. To view the **set point**, press **3**. The display shows the current setting.
8. To change the setting, press **Up** or **Down** and then press **Select**. The control returns to the Parameter menu.
9. To view the **on full at** temperature, press **4**. The display shows the current setting.
10. To change the setting, press **Up** or **Down** and then press **Select**. The control returns to the Parameter menu.
11. Press **Back** once to return to the Variable stage menu, or twice to return to the main display.

To view the settings for a step, select the step (read steps 2 and 3 above) and then press the Parameter buttons for the settings you want to view. Repeat this for each step you want to view.

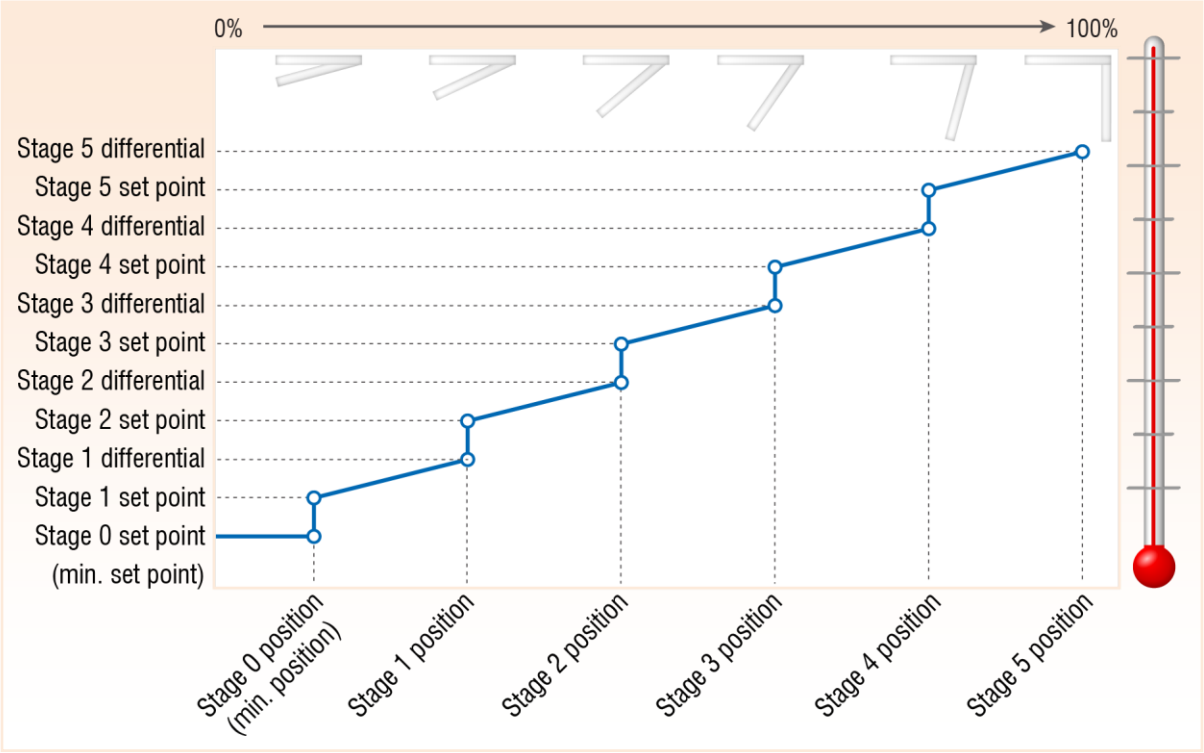
Programming actuators

Before programming the actuator relays, make sure you have properly configured the relays and calibrated the actuators. For more information, read **Configuring relays for actuators** on page 27 and **Calibrating actuators** on page 28.

Each actuator has six stages. The settings for the stages include the set point temperature, position, and differential temperature.

How actuators work

- When the temperature is below the minimum set point, the actuator is closed.
- When the temperature rises to the minimum set point, the actuator moves to the minimum position.
- As the temperature rises, the actuator moves through the stages until it reaches its maximum open position. This method lets you gradually open inlets instead of fully opening them when the temperature rises above a single set point.



For example, you might decide to have the actuator open to 40 percent at stage 1, 60 percent at stage 2, 80 percent at stage 3, 90 percent at stage 4, and 100 percent at stage 5.

However, you don't want the actuator to open directly to 40 percent. That is why there are two temperature settings for each stage. The first setting is the stage set point. This is where the actuator starts opening. The second setting is the differential. This is where the actuator reaches the stage position.

In other words, "when the temperature is here (stage set point), I want the actuator to start opening. When the temperature reaches here (stage differential), I want the actuator to be at this position (stage position) percent."

TIP

- ◇ If you press a parameter button that has no function for the relay, the display shows - - - - . Press **Back** to return to the previous display.
- ◇ Use the **Actuator settings worksheet** on page 77 when setting up actuators.

NOTE

- ◇ You can use actuator control for curtain machines only if they have feedback potentiometers.
- ◇ Do not use actuator control for curtain machines without potentiometers. This can burn out the curtain machines. For information about programming the PEC Plus to control curtain machines without potentiometers, read **Programming curtain control relays** on page 44.

To program actuator stages

1. Press **Function** until the ACTUATORS indicator is lit.
   The display shows ACt 1 (Actuator 1).
2. Press **Up** or **Down** to toggle between programming actuator 1 and actuator 2 and then press **Select**.
   The display shows PArd (parameter D). The STAGES indicators show which relays you are programming. Relays 1 and 2 indicate actuator 1, relays 3 and 4 indicate actuator 2.
3. To view the current actuator stage, press **1**.
   The display shows the current actuator stage.
4. To choose the stage you want to program, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
5. To view the temperature set point, press **2**.
   The display shows the current setting.
6. To change the set point, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
7. To view the stage position, press **3**.
   The display shows the current setting.
8. To change the stage position, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.

NOTE

The minimum stage (stage 0) does not have a differential temperature setting. Skip steps 9 and 10 for the minimum stage.

9. To view the differential temperature, press **4**.
   The display shows the current setting.
10. To change the differential, press **Up** or **Down** and then press **Select**.
    The control returns to the Parameter menu.
11. Repeat steps 3 to 10 for the remaining stages.
12. Press **Back** once to return to the Actuator menu, or twice to return to the main display.

Programming curtain control relays

Curtains control the temperature by adjusting air flow into the facility. Each curtain has six settings.

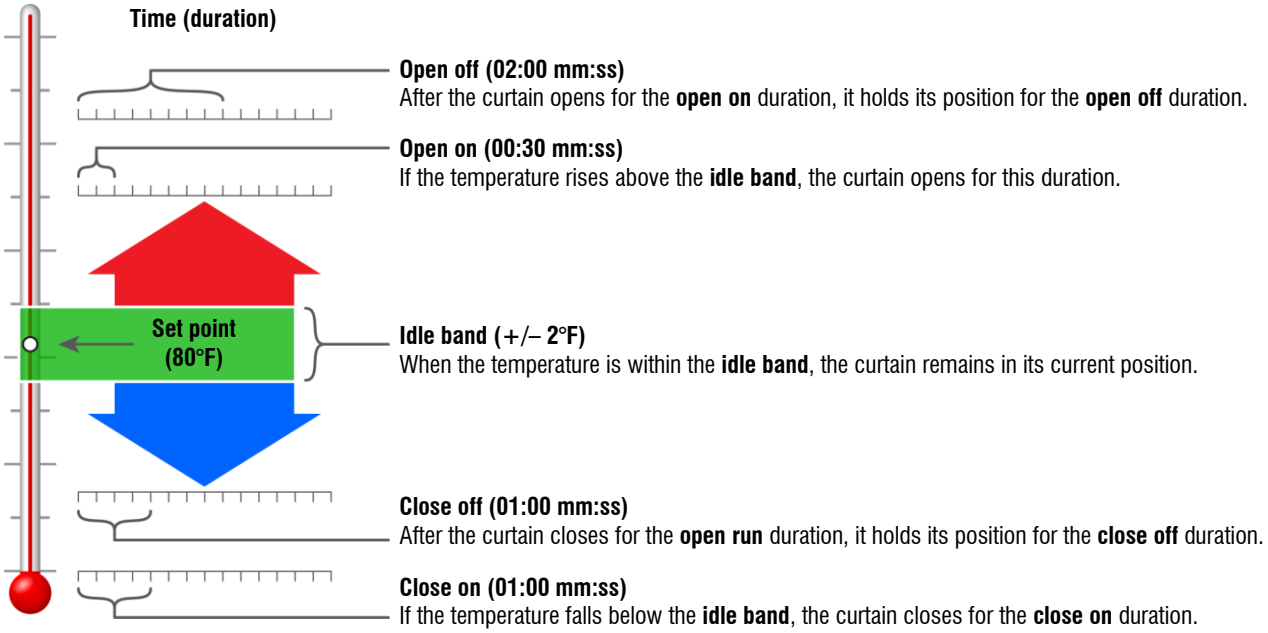
- **Set point** – the temperature at which the curtain holds its position.
- **Idle band** – the buffer around the set point within which the curtains hold their position.
- **Open on** – the duration the curtains open during the open cycle
- **Open off** – the duration the curtains hold their position during the open cycle
- **Close on** – the duration the curtains close during the close cycle
- **Close off** – the duration the curtains hold their position during the close cycle

How curtains work

Curtains hold their position while the temperature is within the **idle band** of the **set point**. For example, if the **set point** is 80°F and the **idle band** is 4°F (+2°/–2°), the curtain holds its position when the temperature is between 78°F and 82°F.

If the temperature rises above the **idle band** (above 82°F in our example), the curtain opens for the **open on** duration. After opening, the curtain holds its position for the **open off** duration. If the temperature is still above the **idle band**, the curtain again opens for the **open on** duration and the process repeats.

If the temperature drops below the **idle band** (below 78°F in our example), the curtain closes for the **close on** duration. After closing, the curtain holds its position for the **close off** duration. If the temperature is still below the **idle band**, the curtain again closes for the **close on** duration and the process repeats.

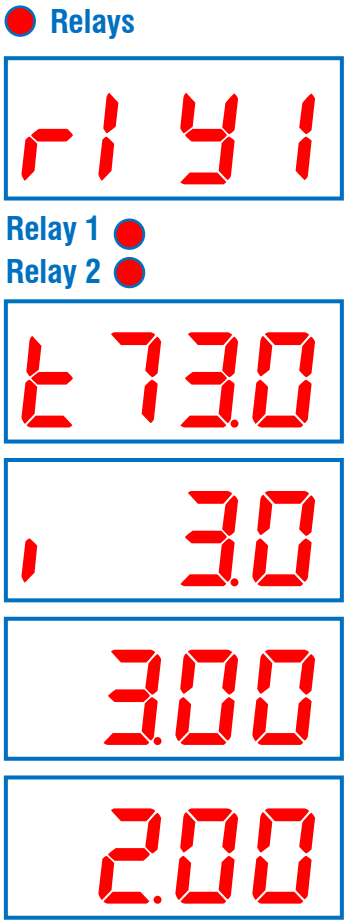


- If you press a parameter button that has no function for the relay, the display shows - - - - . Press **Back** to return to the previous display.
- Use the **Curtain worksheet** on page 79 when setting up curtains.

- Before programming the curtains, make sure you have properly configured the relays. For more information, read **Configuring relays for curtains** on page 29.
- The **set point** and **idle band** for both the open and close relays are programmed at the same time. Both the open and close relay LEDs will be lit while programming these items.
- The ON and OFF durations are in minutes and seconds. For example, 1 30 would be 1 minute and 30 seconds.

To program curtain relays

1. Press **Function** until the RELAYS indicator is lit.
   The display shows r1 Y1 (Relay 1).
2. Press **Up** or **Down** to scroll to the open relay and then press **Select**.
   The display shows PArC (parameter C). The STAGES indicators show which relays (the open and the close) you are programming.
3. To view the **set point**, press **1**.
   The display shows the current setting.
4. To change the **set point**, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
5. To view the **idle band**, press **2**.
   The display shows the current setting.
6. To change the **idle band**, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
7. To view the **open on** duration, press **4**.
   The display shows the current setting.
8. To change the **open on** duration, press **Up** or **Down** and then press **Select**. Repeat to change the seconds.
   The control returns to the Parameter menu.
9. To view the **open off** duration, press **5**.
   The display shows the current setting.
10. To change the **open off** duration, press **Up** or **Down** and then press **Select**. Repeat to change the seconds.
    The control returns to the Parameter menu.
11. Press **Back** to return to the relay menu and then select the close relay.
12. Repeat steps 7 to 10 for the close relay.
13. Press **Back** once to return to the Relay menu, or twice to return to the main display.



Programming heating and cooling elements and duty cycles

Heating and cooling elements control the temperature by switching single-stage heating equipment such as electric heaters, or cooling equipment such as misters ON or OFF. Before setting up the elements, make sure you have properly configured the relays. For more information, read **Configuring relays for single-speed heating and cooling** on page 30.

There are three types of heating and cooling element setups: standard, duty cycle, and advanced duty cycle. Programming a standard element means setting the temperature set point. Programming a duty cycle means setting the temperature set point(s) and the ON and OFF durations.

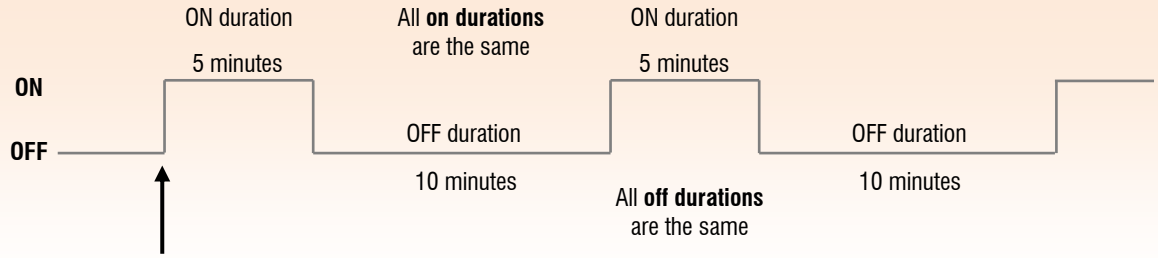
How normal duty cycles work

For heating elements

When the temperature is above the **set point**, the heating element is **off**. When the temperature drops below the **set point**, the element switches on for the **on duration** and then off for the **off duration**. If the temperature rises above the **set point**, the duty cycle switches off and will not switch on again until the temperature drops below the **set point**.

For cooling elements

When the temperature is below the **set point**, the cooling element is **off**. When the temperature rises above the **set point**, the element switches on for the **on duration** and then off for the **off duration**. If the temperature drops below the **set point**, the duty cycle switches off and will not switch on again until the temperature rises above the **set point**.



The relay does not switch ON until a temperature condition has been met. For example, if the temperature rises above 85°F, switch on a mister for 5 minutes and then OFF for 10 minutes. Repeat this until the temperature is below 85°F.

How advanced duty cycles work

Advanced duty cycles are for cooling only. Advanced duty cycles function similar to normal duty cycles. Instead of having one set point, advanced duty cycles have two set points.

- Set point 1 is the same as the set point in a normal duty cycle.
- Set point 2 is a set point that is higher than set point 1.

When the temperature is above the set point 2, the duty cycle remains on, regardless of the on/off durations. When the temperature drops below set point 2, the duty cycle starts again.

- ◇ If you press a parameter button that has no function for the relay, the display shows - - - -. Press **Back** to return to the previous display.
- ◇ Use the **Heating and cooling elements worksheet** on page 79 when setting up heating and cooling elements or based duty cycles.
- ◇ If you need to connect more heating or cooling elements than you have relays, and you are not using both variable stages, you can use a variable stage as an ON/OFF stage. For more information, read **Programming variable stages** on page 37.

The ON and OFF durations are in minutes and seconds. For example, 1 30 would be 1 minute and 30 seconds.

To program normal duty cycles

1. Press **Function** until the RELAYS indicator is lit.
   The display shows r1 Y1 (Relay 1).
2. Press **Up** or **Down** to change between programming relays 1 to 6 and then press **Select**.
   The display shows PArC (parameter C). The STAGES indicators show which relays you are programming.
3. To view the **set point**, press **1**.
   The display shows the current setting.
4. To change the set point, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
5. To view the **ON duration**, press **4**.
   The display shows the current setting.
6. To change the duration, press **Up** or **Down** and then press **Select**.
   Repeat to change the seconds.
   The control returns to the Parameter menu.
7. To view the **OFF duration**, press **5**.
   The display shows the current setting.
8. To change the duration, press **Up** or **Down** and then press **Select**.
   Repeat to change the seconds.
   The control returns to the Parameter menu.
9. Press **Back** once to return to the Relay menu, or twice to return to the main display.

To program advanced duty cycles

1. Press **Function** until the RELAYS indicator is lit.
   The display shows r1 y1 (Relay 1).
2. Press **Up** or **Down** to change between programming relays 1 to 6 and then press **Select**.
   The display shows PArC (parameter C). The STAGES indicators show which relays you are programming.
3. To view temperature **set point 1**, press **1**.
   The display shows the current setting.
4. To change the setting, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
5. To view temperature **set point 2**, press **2**.
   The display shows the current setting.
6. To change the setting, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
7. To view the **ON duration**, press **4**.
   The display shows the current setting.
8. To change the duration, press **Up** or **Down** and then press **Select**.
   Repeat to change the seconds.
   The control returns to the Parameter menu.
9. To view the **OFF duration**, press **5**.
   The display shows the current setting.
10. To change the duration, press **Up** or **Down** and then press **Select**.
    Repeat to change the seconds.
    The control returns to the Parameter menu.
11. Press **Back** once to return to the Relay menu, or twice to return to the main display.

To program standard heating or cooling relays (no duty cycle)

1. Press **Function** until the RELAYS indicator is lit.
   The display shows r1 y1 (Relay 1).
2. Press **Up** or **Down** to change between programming relays 1 to 6 and then press **Select**.
   The display shows PArC (parameter C). The STAGES indicators show which relay you are programming.
3. To view the temperature **set point**, press **1**.
   The display shows the current setting.
4. To change the setting, press **Up** or **Down** and then press **Select**.
   The control returns to the Parameter menu.
5. Press **Back** once to return to the Relay menu, or twice to return to the main display.

Programming alarm settings

In addition to the power-failure alarm, there are six other alarms. For a complete list and descriptions, read the **Alarm settings worksheet** on page 80.

- High temperature
- Low temperature
- Probe damage
- Probe deviation
- Actuator 1 jam
- Actuator 2 jam

The alarm settings for your PEC Plus determine which alarm conditions are enabled, which are disabled, and their settings. All these work together to determine how and when the alarm relay activates (in other words, signals an alarm condition).

The alarm relay activates if an alarm condition (one that is enabled) is present for longer than the minimum duration of one minute. The one minute minimum duration prevents alarms from occurring when the temperature rises or drops for just a few seconds.

When an alarm occurs, the ALARM indicator switches on and the alarm message flashes on the display. For more information, read **Acknowledging alarms** on page 52.

How alarm settings work

If the High Temp alarm setting is 85.0°F and the temperature rises to 86 degrees, but drops below 85 degrees 30 seconds later (before the minimum duration of 1 minute), the alarm relay does not activate.

If the temperature rises to 86 degrees and stays there for 1 minute, the alarm relay activates. The alarm relay remains active until the temperature drops below the High Temp setting.

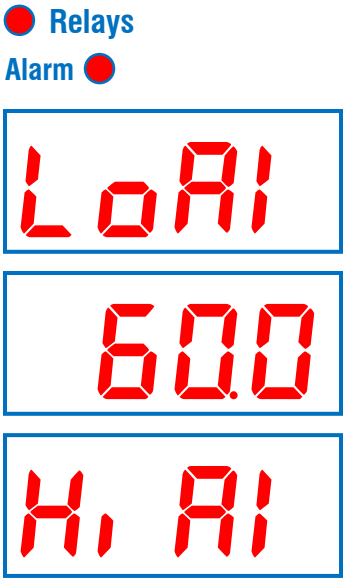
Use the **Alarm settings worksheet** on page 80 when programming alarms. The worksheet contains descriptions of each setting.

To enable or disable alarms

1. Press **Function** until the CONFIGURATION indicator is lit and AI En displays.
2. Press **Select**.
   The display shows Hi En (high temperature alarm).
3. Press **Up** or **Down** to select the alarm you want to enable or disable and then press **Select**.
   The display shows the current setting.
4. Press **Up** or **Down** to toggle between yes and no and then press **Select**.
   The control returns to the Alarm enable menu.
5. Repeat steps 3 and 4 for each alarm you want to enable or disable.
6. Press **Back** once to return to the Configuration menu, or twice to return to the main display.

To program high and low temperature alarm settings

1. Press **Function** until the RELAYS indicator is lit.
   The display shows r1 y1 (Relay 1).
2. Press **Down** until the display shows LoAL (low temperature alarm) and then press **Select**.
   The current setting flashes.
3. Press **Up** or **Down** to change the setting and then press **Select**.
   The control returns to the Alarm/Relay menu.
4. Press **Down** until the display shows Hi AL (high temperature alarm) and then press **Select**.
   The current setting flashes.
5. Press **Up** or **Down** to change the setting and then press **Select**.
   The control returns to the Alarm/Relay menu.
6. Press **Back** to return to the main display.



Chapter 5: Monitoring and maintaining your PEC Plus

Chapter 5 explains how to monitor the PEC Plus after you have installed, configured, and programmed it. Topics in chapter 5 include:

Monitoring your PEC Plus

Your PEC Plus displays temperature, alarm, and status information. Monitoring the control regularly gives you a better idea of what is going on in your facility.

When in normal operation, the display shows the ambient temperature. The displayed temperature is the average from all probes connected. If probe 4 is configured for outdoor temperature monitoring, its temperature is not included in the average.

For more information about probe configuration and temperature averaging, read **Configuring temperature probes** on page 23.

Displaying individual probe temperatures

The main display shows the average temperate of all probes that are connected and configured, except for outdoor probes. You can display the current temperature for any individual probe by pressing its corresponding number key. For example, to display the temperature for probe 4, press **4**.

- If an indoor probe is damaged or missing, the display shows PbRd.
- If an outdoor probe is damaged or missing, the display shows - - -.
- If a probe is not configured, the display shows PoFF.

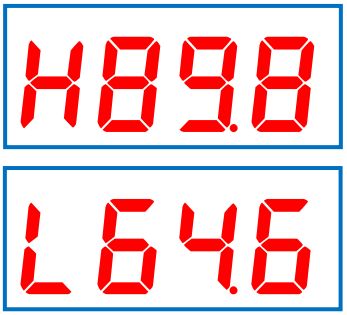
To display individual probe temperatures

1. When the main display is showing, press the number of the probe you want to display. The display shows the temperature.
2. Repeat step 1 for each probe temperature you want to view.
3. Press **Back** to return to the main display.

Displaying high and low temperatures

You can display the previous day's high and low temperatures. The display shows the high temperature for two seconds, followed by the low temperature for two seconds.

If the temperature is above 99.9 degrees, the temperature drops the decimal and rounds off. For example, 103.2 would be 103; 103.5 would be 104.



To display high and low temperatures

1. When the main display is showing, press **5**.
   The display shows the high and low temperatures.
2. Press **Back** to return to the main display.

Acknowledging alarms

The alarm relay activates if an alarm condition (one that is enabled) is present for longer than the minimum duration of one minute. The one minute minimum duration prevents alarms from occurring when the temperature rises or drops for just a few seconds.

The exceptions to the one minute minimum are the actuator 1 jam and actuator 2 jam alarms. Actuator jam alarms activate immediately after the PEC Plus detects an actuator jam.

When an alarm occurs, the alarm relay activates, the LED for ALARM switches on, and the alarm message displays. If there is more than one message, after acknowledging the first alarm, the next one displays.

For example, if you had a high temperature and a probe damage alarm, the display would show H_A1 . After acknowledging the high temperature alarm, the display would show PdEu. When all alarms have been acknowledged, the display shows the temperature.

To acknowledge alarms

Press **Select**.
If there was only one alarm message, the PEC Plus clears the message and returns to the main display. If there are additional alarm messages, the PEC Plus displays the next message.

For a list of alarm messages, their descriptions, and possible resolutions, read **Alarm and error messages** on page 66.

- ◇ Acknowledging alarms clears the alarm message; it does not deactivate the alarm relay. To deactivate the alarm relay, resolve the problem causing the alarm condition.
- ◇ If you acknowledge the alarm, but do not resolve the problem causing the alarm condition, the alarm message displays again after five minutes without any key presses.
- ◇ If the condition causing the alarm returns to normal (for example, the temperature drops below the high alarm setting), the alarm relay and LED deactivate, but the alarm message remains.

Testing settings and equipment

There are four test utilities.

- Stage test mode
- Temperature test mode
- Actuator 1
- Actuator 2

Using stage test mode

Stage test mode allows you to test each variable stage or relay individually.

When you enter stage test mode, all variable stages and relays switch off. You can change the output of variable stages or state of relays. Variable stages and relays (that are not assigned to actuators or curtains) remain at the state you set them until you leave stage test mode.

For example, if relay 5 is assigned as a cooling duty cycle and you switch it ON, it remains on until you leave stage test mode. If relay 1 is configured as an actuator or curtain and you switch it ON, it remains on until you change the state or you press **Back** or **Select**.

When you leave stage test mode, the variable stages and relays return to normal, programmed operation.

- ◇ When the PEC Plus is in stage test mode, it does not operate the equipment according to the measured temperature.
- ◇ The PEC Plus does not exit test mode on its own. When you are finished testing, press **Back** until the control exits test mode.

To test equipment using stage test mode

1. Press **Function** until the TEST indicator is lit.
   The display shows StgE.
2. Press **Select**.
   All variable stages and relays switch off and the display shows VAr 1.
3. Press **Up** or **Down** to scroll through the variable stages and relays.
   To test a variable stage or relay, press **Select**.
   - For variable stages, the display shows the output percentage. Press **Up** or **Down** to adjust the output.
   - For relays, the display shows the relay state (on or off). Press **Up** or **Down** to change the relay state.
4. Press **Back** to return to the list of variable stages and relays.
5. Repeat steps 2 to 4 for each item you want to test.
6. When done, press **Back** twice to return to the main display.
   The control returns to normal operation.

Using temperature test mode

Temperature test mode allows you to test your equipment and programmed settings by simulating the temperature. Instead of adjusting the output of a variable stage or state of a relay, you adjust the "test temperature".

As you increase or decrease the test temperature, the stages and relays operate according to their programmed settings and the test temperature. This gives you an idea of how your system performs over a full range of temperatures. The variable stages and relays remain operating according to the test temperature until you exit temperature test mode.

- ◇ When the PEC Plus is in temperature test mode, it does not operate the equipment according to the measured temperature.
- ◇ The PEC Plus does not exit test mode automatically. When you are finished testing, press **Back** until the control exits test mode.

To test equipment using temperature test mode

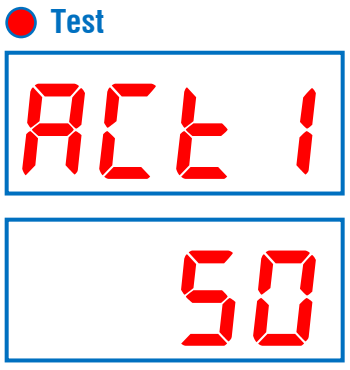
1. Press **Function** until the TEST indicator is lit.
   The display shows StSE.
2. Press **Up** or **Down** until the display shows tEnP and then press **Select**.
   The display shows the last ambient temperature (now the "test temperature").
3. Press **Up** or **Down** to adjust the test temperature.
   The variable stages and relays operate using their programmed settings according to the test temperature. When a stage or relay switches on, its LED switches on.
4. When done, press **Back** twice to return to the main display.
   The control returns to normal operation.

Using the actuator 1 and 2 test utilities

The actuator 1 and actuator 2 test utilities display the position of the actuator, according to the feedback received from the feedback potentiometer. Actuator 1 shows the value for the potentiometer connected to terminals ACT-1 on the control board and actuator 2 shows the value for the potentiometer connected to ACT-2.

If the actuator has not been calibrated, the display shows uCAl .

To display the actuator position



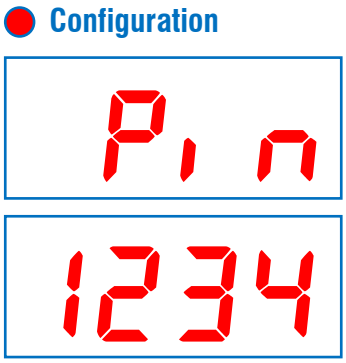
1. Press **Function** until the TEST indicator is lit.
   The display shows StSE.
2. Press **Up** or **Down** until the display shows ACt 1 (for actuator 1) or ACt2 (for actuator 2) and then press **Select**.
   The display shows the position of the actuator, according to the feedback received from the potentiometer.
3. Press **Back** once to return to the Test menu or twice to return to the main display.

Using PIN security

The PEC Plus has a PIN security feature you can use to control who makes changes to your system and its settings.

When you enable security, users must enter the PIN (personal identification number) before they can access the control's functions. After entering a PIN, you will not be asked again until five minutes have passed since the last key press.

By default, security is not enabled. When security is not enabled, the PIN is 1111. To enable security, change the PIN to a different number. The PIN can be any four-digit number, consisting of the numbers 1 to 5.



To change the PIN

1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until PIn is displayed and then press **Select**. The display shows the current PIN.
3. Press **Up** or **Down** to change the digits. Press **Select** to accept the number and move to the next digit. After the fourth digit, the control returns to the Configuration menu.

If the PIN has been forgotten and nobody can access the control, you will have to reset the PIN security.

To reset PIN security

1. Switch OFF the power to the PEC Plus.
2. Switch ON the power and hold the **Function** and **1** buttons during startup while the - - - - is displayed.
3. When the control displays the temperature, release the buttons. The PIN resets to 1111.

Servicing and maintaining your PEC Plus

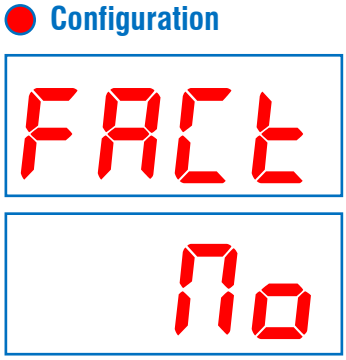
Restoring the factory defaults

When your PEC Plus leaves the factory, it comes with default settings and configuration. When you program your PEC Plus, you change its configuration and settings. Resetting your PEC Plus erases all the configuration and settings you programmed and restores them to what they were when the control left the factory.

For a list of the factory defaults, read **Appendix C: Factory defaults** on page 72.

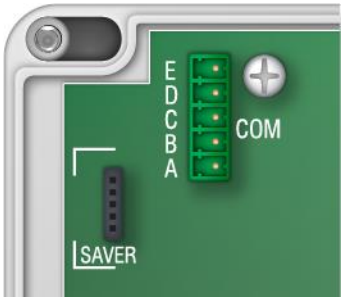
- ◇ **Restore the factory defaults only as a last resort. It erases ALL your configuration and settings and you will have to reconfigure the control.**
- ◇ If you restore your PEC Plus to its factory defaults, disconnect the power to all loads and then reconfigure the control before restoring power to the loads.

To restore the factory defaults



1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until FACt is displayed and then press **Select**. The display shows no.
3. Press **Up** or **Down** to change the no to YES and then press **Select**. The control restores its factory settings. When complete, the display shows donE.
4. Press **Back** twice to return to the main display.

Saving and restoring settings



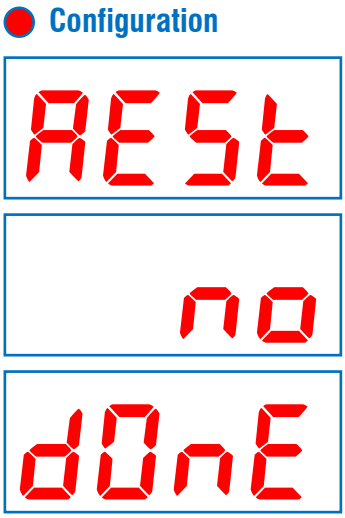
The PEC+ Saver is an innovative and easy-to-use product that allows you to store your PEC Plus configuration and settings.

The PEC+ Saver stores a complete copy of all a PEC Plus' configuration and settings. You can restore them any time, or even use them to set up new PEC Plus' in seconds!

To save your settings

1. Loosen the four screws in the PEC Plus enclosure and then gently remove the cover. Make sure not to disconnect the ribbon cable.
2. Insert the PEC+ Saver into the connector marked SAVER on the inside top-left of the cover.
3. Press **Function** until the CONFIGURATION indicator is lit.
4. Press **Up** or **Down** until SAVE is displayed and then press **Select**. The display shows no. If the PEC+ Saver is not in correctly, the display shows Err3.
5. Press **Up** or **Down** to change the no to YES and then press **Select**. The control saves the settings to the PEC+ Saver. When complete, the display shows donE.
6. Press **Back** twice to return to the main display.
7. Remove the PEC+ Saver.
8. Replace the cover and then tighten the four screws.

To restore your settings



1. Loosen the four screws in the PEC Plus enclosure and then gently remove the cover. Make sure not to disconnect the ribbon cable.
2. Insert the PEC+ Saver into the connector marked SAVER on the inside top-left of the cover.
3. Press **Function** until the CONFIGURATION indicator is lit.
4. Press **Up** or **Down** until `rESt` is displayed and then press **Select**. The display shows `no`. If the PEC+ Saver is not in correctly, the display shows `Err3`.
5. Press **Up** or **Down** to change the `no` to `YES` and then press **Select**. The control restores the settings from the PEC+ Saver. When complete, the display shows `dOnE`.
6. Press **Back** twice to return to the main display.
7. Remove the PEC+ Saver.
8. Replace the cover and then tighten the four screws.

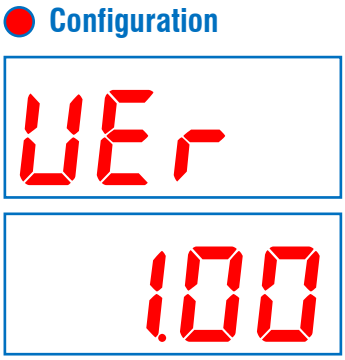
Displaying the firmware version

Firmware is similar to operating system software for a computer. Firmware contains instructions that tell the PEC Plus how it operates. Just like computer operating systems (such as Windows™ XP) have version numbers, the firmware has a version number.

If you need to contact Phason Customer Support about your PEC Plus, you might need to provide them with the firmware version of your control. For more information about technical support, read **Service and technical support** at the back of the manual.

The PEC Plus displays the firmware version as a number in the format #.##.

To display the firmware version



1. Press **Function** until the CONFIGURATION indicator is lit.
2. Press **Up** or **Down** until `UEr` is displayed and then press **Select**. The display shows the firmware version.
3. Press **Back** twice to return to the main display.

Updating the firmware

The optional PEC+ Updater is an innovative and easy-to-use product that allows you to upgrade your PEC Plus's firmware. Phason constantly improves and adds new features to their products. With the PEC+ Updater, you can upgrade the firmware in your PEC Plus as these features become available. The PEC+ Updater takes only seconds to use and can upgrade all the PEC Plus controls at your site.

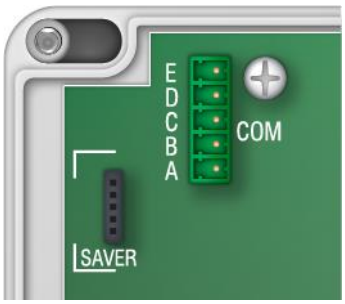
There are two methods for updating the PEC Plus firmware: **power on** and **power off**.

- **Power on** – the power on method allows you to update the PEC Plus firmware using the menu system, without having to switch the incoming power off and then on. If the power on method fails, use the power off method.
- **Power off** – the power off method allows you to update the PEC Plus firmware by switching the incoming power off and then on. Use the power off method if the power on method fails.

The PEC+ Updater works with PEC Plus controls that have a serial number starting with 2006-10-01 or later. The updater will **not** work with serial numbers before that date.

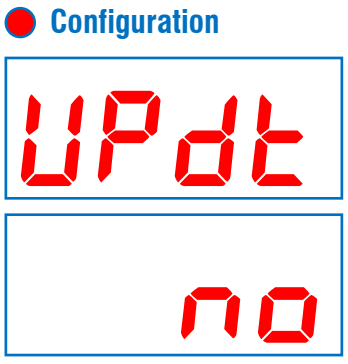
The inside of the PEC Plus cover is where you connect the PEC+ Updater. The cover label must face the right when you plug the updater into the socket.

To update the firmware using the *power on* method



1. Loosen the four screws in the PEC Plus enclosure and then gently remove the cover. Make sure not to disconnect the ribbon cable.
2. Insert the PEC+ Updater into the connector marked SAVER on the inside top-left of the cover.
3. Press **Function** until the CONFIGURATION indicator is lit.
4. Press **Up** or **Down** until `uPdt` is displayed and then press **Select**. The display shows `no`.
5. Press **Up** or **Down** to change the `no` to `YES` and then press **Select**. The PEC Plus updates its firmware. During the update, the display is blank and the control beeps.

   When the update is complete, the display shows `----` for a couple seconds and then shows the ambient temperature.
6. Remove the PEC+ Updater.
7. Verify that the control functions properly.
8. Replace the cover and then tighten the four screws.



To update the firmware using the *power off* method

1. Loosen the four screws in the PEC Plus enclosure and then gently remove the cover. Make sure not to disconnect the ribbon cable.
2. Insert the PEC+ Updater into the connector marked SAVER on the inside top-left of the cover.
3. Switch off the power to the PEC Plus for at least five seconds.
4. Switch on the power to the PEC Plus.
   The PEC Plus updates its firmware. During the update, the display is blank and the control beeps.

   When the update is complete, the display shows `----` for a couple seconds and then shows the ambient temperature.
5. Remove the PEC+ Updater.
6. Verify that the control functions properly.
7. Replace the cover and then tighten the four screws.

Replacement kits and optional accessories

Replacement kits and several optional, convenient accessories are available to enhance and extend your PEC Plus.

Parts and kits

Display kit

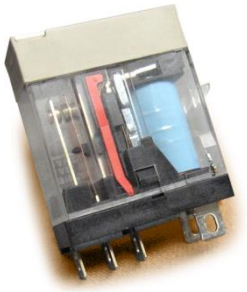
If the display of your PEC Plus control fails, you can replace it with a kit. After replacing the display, you will need to reconfigure and program control. The display kit is model **K310003**.

Control kits

If the bottom circuit board of your PEC Plus control fails, you can replace it with a kit. The control kit is model **K170048-RS**. The control kit has socketed, pluggable relays.

Replacement relays

If you have a PEC Plus with a socketed relay control board, you can buy packages of replacement relays. Each relay package has five relays. The package is model number **PKG-R52**.



PEC+ Saver

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PEC+ Updater

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With the PEC+ Updater, you can upgrade the firmware in your PEC Plus as these features become available. The PEC+ Updater takes only seconds to use and can upgrade all the PEC Plus controls at your site.

Power contactors

Phason's 240-volt power contactors are heavy-duty relays that increase the load handling capability of control relays. Power contactors are ideal for secondary ventilation fans and electric heaters.

- **Power contactor relay** (PC-240): includes power contactor relay and mounting hardware for easy mounting in an enclosure.
- **Power contactor kit** (122-1): includes power contactor relay, on-off-auto switch and label, snubber filter (reduces electrical noise), and mounting hardware for easy mounting in an enclosure.
- **Power contactor unit** (129-0): includes two power contactor relays, two on-off-auto switches, and two snubber filters, mounted in a large enclosure. The enclosure has room for two additional contactor relays or kits.

Temperature probes and extension cable

Temperature probes monitor temperatures ranging from –49 to 122°F (-45 to 50°C). The probes are available in 1, 6, 30, 75, or 150-foot cable lengths and can extended up to 500 feet using extension cable. Extension cable is available in 500-foot lengths.

Appendixes

This section contains reference information that is useful when installing, configuring, setting up, or troubleshooting your PEC Plus.

Appendix A: Glossary

actuator set point	When the temperature is below the **minimum set point**, the actuator is closed. When the temperature rises to the **minimum set point**, the actuator moves to the minimum position. As the temperature rises, the actuator has four stages it moves through until it reaches its maximum open position. This lets you gradually open inlets instead of fully opening them when the temperature rises above a single set point. In other words, "when the temperature is here (**stage set point**), I want the actuator to start opening. When the temperature reaches here (**stage differential**), I want the actuator to be at this position (**stage position**) percent." For more information, read **Programming actuators** on page 41.
control elements	Control elements are devices connected to your PEC Plus, such as fans, heaters, actuators, and so on.
curtain idle band	Curtain **idle band** is a temperature buffer around the curtain **set point**. When the temperature is within the **idle band**, the curtains hold their position. When the temperature is outside the band, the curtains cycle open or closed. For more information, read **Programming curtain control relays** on page 44.
curtain set point	Curtain **set point** is the target temperature for the curtains. When the temperature is between the curtain **set point** and **idle band** limits, the curtains hold their position. For more information, read **Programming curtain control relays** on page 44.

differential See **on full at**.

duty cycle Duty cycles are a temperature-based style of controlling heating or cooling elements using **on** and **off** durations. There are two types of duty cycles, **normal** and **advanced**.

For cooling elements, when the temperature is below the **set point**, the cooling element is off. When the temperature rises above the **set point**, the element switches on for the **on duration** and then off for the **off duration**. If at any time the temperature drops below the **set point**, the duty cycle relay switches off and will not switch on again until the temperature rises above the **set point**.

For heating elements, when the temperature is above the **set point**, the heating element is off. When the temperature drops below the **set point**, the element switches on for the **on duration** and then off for the **off duration**. If at any time the temperature rises above the **set point**, the duty cycle relay switches off and will not switch on again until the temperature drops below the **set point**.

Advanced duty cycles are for cooling only. Advanced duty cycles function similar to normal duty cycles, but have two set points.

Set point 1 is the same as the set point in a normal duty cycle. **Set point 2** is a set point that is higher than s**et point 1**. When the temperature is above **set point 2**, the duty cycle remains on, regardless of the on/off durations. When the temperature drops below **set point 2**, the duty cycle starts again.

For more information, read **Programming heating and cooling elements** on page 46.

firmware The internal program instructions of your PEC Plus.

You can update the firmware version of your PEC Plus to the latest version using a PEC+ Updater. For more information, read **Updating the firmware** on page 59.

group set point The group set point is the desired temperature for the zone.

For more information, read **Programming the group set point** on page 33.

growth curve A growth curve is an extension of the **group set point** *c*oncept. The growth curve automatically adjusts the temperature set points over time to control the temperature in a room or zone. It is called a growth curve because it adjusts the set points as the animals grow.

For more information, read **Programming the growth curve** on page 34.

hysteresis **Hysteresis** is the number of degrees above the set point that a heating stage or relay switches off, and the number of degrees below the set point that a cooling stage or relay switches off.

For example, a household thermostat might switch on a furnace at 68 °F when the house is cooling down, but switch it off at 72 °F when the house is warming up. The difference between these two values is the hysteresis.

For more information, read **Configuring hysteresis** on page 25.

idle speed	**Idle speed** is a percentage setting for variable cooling stages. **Idle speed** is the percentage speed a variable speed fan is at when the temperature is between the **off at** and **set point** temperatures. For more information, read **Programming variable stages** on page 37.
minimum duration	Minimum duration is the minimum amount of time an alarm condition must be present before the PEC Plus signals an alarm. The minimum duration, one minute, prevents alarms from activating when the temperature rises or drops for just a few seconds. For more information, read **Programming alarm settings** on page 49.
minimum heat	**Minimum heat** is the percentage output a heater is at when the temperature is between the **off at** and **set point** temperatures. For more information, read **Programming variable stages** on page 37.
minimum idle	See **idle speed**.
minimum position	**Minimum position** is the percentage an actuator will be open when the temperature is at the **minimum set point**. For more information, read **Programming actuators** on page 41.
minimum set point	**Minimum set point** is the temperature at which an actuator is at its **minimum position**. When the temperature is below the set point, the actuator closes the inlet completely. For more information, read **Programming actuators** on page 41.
off at	**Off at** is a temperature setting for variable stages. For cooling stages, when the temperature is below the **off at** temperature, the fan is off. When the temperature rises above the **off at** temperature, the fan runs at the **idle speed** until the temperature rises to the **set point** temperature. For heating stages, when the temperature is above the **off at** temperature, the heater is off. When the temperature falls below the **off at** temperature, the heater operates at **minimum heat** until the temperature falls to the **set point** temperature. For more information, read **Programming variable stages** on page 37.
on full at	**On full at** is a temperature setting for variable stages. For cooling stages, when the temperature is at or above the **on full at** temperature, the fan speed is 100%. For heating stages, when the temperature is at or below the **on full at** temperature, the heater is at 100% output. For more information, read **Programming variable stages** on page 37.

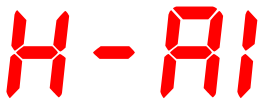
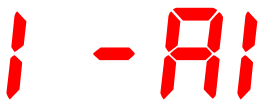
PIN	Personal identification number. A PIN is a unique four-digit number similar to a password. When security is enabled, users must enter the PIN before changing any configuration or settings. This prevents unauthorized access to the control. For more information, read **Using PIN security** on page 55.
set point temperature	*Set point* is the temperature at which a relay stage switches on or off. For more information, read **Programming heating and cooling elements** on page 46. See also **actuator set point** and **curtain set point**.
spikes	Short-term deviations or changes from a desired voltage level or signal. These deviations can cause damage to electronic devices, or cause them to malfunction. Spikes are often caused by sudden excess power, also known as 'power surges', or by drops in power, knows as "brown outs". For more information, read **Understanding power surges and surge suppression** on page 6.
terminal block	The part of your PEC Plus where you connect the wires for incoming power, control elements, and so on. For more information, read **PEC Plus layout** on page 9.

Appendix B: Troubleshooting

- If you see an alarm message and are not sure what it means, look it up in the **Alarm and error messages** table below and then follow the instructions for resolving the alarm condition.
- If you are having a problem using your PEC Plus, see if the problem is described in the **Troubleshooting** table on page 68 and then follow the directions for correcting the problem.

Alarm and error messages

The following table lists the alarm and error messages, the possible causes, and their possible solutions. If you see a message and are not sure what it means, look it up in the table and then follow the instructions for resolving the condition.

Alarm message	Possible cause	Possible solution
 High temperature alarm	The temperature has gone above the high temperature alarm point.	◇ Try to lower the temperature by turning heaters down or off, or by increasing or turning on cooling elements (such as fans or misters), or by a combination of both. ◇ Check the temperature probes. ◇ Check to see if a fan has failed. ◇ Check the alarm settings. For more information, read **Programming alarm settings** on page 49.
 Low temperature alarm	The temperature has gone below the low temperature alarm point.	◇ Try to raise the temperature by turning heaters up or on, or by decreasing or turning off cooling elements (such as fans or misters), or by a combination of both. ◇ Check the temperature probes. ◇ Check to see if a heater has failed. ◇ Check the alarm settings. For more information, read **Programming alarm settings** on page 49.
 Probe damage alarm	A temperature probe is damaged or disconnected.	◇ Replace or reconnect the temperature probe. The control should recover automatically. ◇ If another probe is available, the control uses it. If probe averaging is on, the defective probe is excluded from the average. For more information, read **Configuring temperature probes** on page 23.

Alarm message	Possible cause	Possible solution
 Probe deviation alarm	The difference in measured temperatures between averaged probes is greater than 18°F (10°C).	◇ Check the temperature probes. ◇ Check to see if a cooling or heating element has failed. ◇ Check the alarm setting. For more information, read **Programming alarm settings** on page 49.
 Actuator jam alarm The third digit shows which actuator (1 or 2) the alarm is for.	The control is attempting to open or close an inlet or other element operated by an actuator, and has not received the correct response from the positioning motor.	◇ Check the element controlled by the actuator to see if it is mechanically stuck. ◇ Check feedback wires for damage or improper installation. For more information, read **Determining correct actuator feedback wiring** on page 71. ◇ Recalibrate the actuator. For more information, read **Calibrating actuators** on page 28.
 Error 1 - Growth curve error	The temperature set points for the growth curve are increasing or overlapping. Temperature set points must decrease as the curve steps increase.	◇ Change the temperature set points so that they decrease. For more information, read **Programming the growth curve** on page 34.
 Error 2 - Actuator error	The temperature set points for one of the actuators are overlapping. The differential for step 1 must be lower than the set point for step 2, and so on.	◇ Check the actuator settings and make sure they do not overlap. For more information, read **Programming actuators** on page 41.
 Error 3 - SAVER error	The PEC+SAVER is not in place when trying to save or restore settings	◇ Make sure the PEC+SAVER is inserted correctly and then try again.

Troubleshooting

The following table lists some problems, possible causes, and possible solutions. If you are having a problem using your PEC Plus, see if the problem is described in the Troubleshooting table and then follow the directions for correcting the problem.

Problem	Possible cause	Possible solution
The display shows P I n when trying to program the control	PIN security is enabled	◇ Enter the correct PIN. For more information, read **Entering a PIN** on page 5.
Power supply components blown out Burn marks on boards and components Motors and fans slow down or stop	Power surge, brownout, or power outage	◇ Avoid the problem in future by providing proper voltage and protection for the control.
No power and/or display	A circuit breaker at service panel is off or tripped.	◇ Reset the circuit breaker.
	Incorrect wiring	◇ Correct the wiring.
	The display board connect cable is not plugged into the control board properly.	◇ Plug in the display board cable. For more information, read **PEC Plus layout** on page 9.
	The 115/230 VAC switch is in the wrong position	◇ Switch off the power, set the switch to the correct setting, and then switch on the power. For more information, read **PEC Plus layout** on page 9.
Temperature does not change	There are no working temperature probes enabled or connected	◇ Make sure at least one working probe is enabled. For more information, read **Configuring temperature probes** on page 23.
	The control is in temperature test mode.	◇ If the TEST LED is on, the control is in test mode. Exit test mode. For more information, see **Using temperature test mode** on page 54.
Display showing unusually high or low temperature		◇ If you have more than one probe connected, press buttons **1** to **4** to determine which probe is causing the high or low reading.
	The probe is not a Phason probe.	◇ Remove the probe and then install a Phason probe.
	The extension cable connected to the temperature probe is providing a poor connection	◇ Check the extension cable connection. Resolder it if necessary.
	Damaged probe	◇ Replace the temperature probe.

Problem	Possible cause	Possible solution
Variable fan runs at maximum	Incorrect wiring	◇ Correct the wiring. For more information, read **Connecting variable heating or** cooling elements on page 14.
	The minimum idle speed is too high.	◇ Decrease the minimum idle speed setting. For more information, read **Programming variable stages** on page 37.
	The on full at setting is the same as the temperature set point.	◇ Adjust the temperature set point to the desired temperature. For more information, read **Programming variable stages** on page 37.
	Incorrect motor curve	◇ Configure the stage to use the other motor curve. For more information, read **Configuring variable stages** on page 25.
Variable fan not running	Incorrect wiring	◇ Correct the wiring. For more information, read **Connecting variable heating or** cooling elements on page 14.
	The fuse is open or blown.	◇ Check why the fuse was blown and repair any problems. Replace the fuse.
	The variable stage is configured as OFF	◇ Configure the variable stage for cooling. For more information, read **Configuring variable stages** on page 25.
	The idle speed setting is too low.	◇ Increase the idle speed setting. For more information, read **Programming variable stages** on page 37.
	The off at temperature setting is too high.	◇ Decrease the off at temperature setting. For more information, read **Programming variable stages** on page 37.
	The temperature set point is above room temperature.	◇ Adjust the temperature set point to the desired temperature. For more information, read **Programming variable stages** on page 37.
	There is no power to the fan.	◇ Switch on the power.
	Faulty fan/heater	◇ Replace the equipment.
	Circuit breaker open	◇ Reset the breaker.
Variable speed 1 or variable speed 2 fan switches on, runs at full speed, and then turns off. Keeps cycling.	The hysteresis is not high enough. The outside temperature is rising and falling quickly. This happens most often in the spring and fall.	◇ Adjust the hysteresis setting or overlap the variable speed 1 or variable speed 2 fan settings.
Variable speed fan responds to only a small portion of the 0 to 100% range	Incorrect motor curve	◇ Configure the stage to use the other motor curve. For more information, read **Configuring variable stages** on page 25.
Relay does not switch load off	The relay is configured as ON.	◇ Configure the relay properly. For more information, read **Configuring relays** starting on page 27.

Problem	Possible cause	Possible solution
Curtain opens when it should close or closes when it should open	Incorrect wiring, the close and open wires are reversed.	◇ Correct the wiring. For more information, read **Connecting curtain machines** on page 13
Staged heater cycles on and off	The heater set points are too close together with variable speed fans.	◇ Adjust the hysteresis setting. ◇ Move the temperature probe closer to the heater. ◇ Widen the set points.
	The heater is too large for the room	◇ Replace the heater with a smaller output unit.
	The stage is set up as a duty cycle	◇ Remove the duty cycle from the stage's settings
Alarm relay not operating alarm system	Incorrect wiring	◇ Correct the wiring. For more information, read **Connecting an alarm system** on page 16
Relay does not switch load on	Incorrect wiring	◇ Correct the wiring. For more information, read the appropriate installation section.
	The relay is configured as OFF.	◇ Configure the relay properly. For more information, read **Configuring relays** starting on page 27.
	The set point is incorrect	◇ Adjust the setting. For more information, read the appropriate programming section.
	The relay is configured as cool for a heater.	◇ Change the configuration for the relay to heat. For more information, read the on page 30.
	The relay is configured as heat for a fan.	◇ Change the configuration for the relay to cool.
	No power to the load	◇ Switch on the power.
	Faulty equipment	◇ Replace the equipment.
	Circuit breaker open	◇ Reset the breaker.
	Blown relay	◇ Solve the problem that caused the relay to blow and then replace the circuit board or use a different relay.

Determining correct actuator feedback wiring

After installing a new actuator or potentiometer, or due to age-related potentiometer wear, the actuator might not move correctly. Common symptoms include:

- The actuator oscillating back and forth
- The actuator not traveling the full stroke during calibration

The feedback potentiometer wiring must be properly connected to the control. Determining the correct wiring can be difficult on some actuators or potentiometers.

Potentiometers have three wires: positive (+), negative (–), and feedback (FB). If the feedback wire is not connected to the FB terminal on the control, the actuator will not function properly.

Because the wires are often different colors and are not always labeled the same as above, measuring the resistance between the wires is the best way to determine which wire is the feedback wire. Follow the steps below to measure the resistance and determine the correct wiring.

- ◇ Before checking the potentiometer wires, verify that the power wires are properly connected.
- ◇ Test the actuator using stage test mode.

1. Manually move the actuator away from the end of its stroke by at least a quarter of its total stroke.
2. Disconnect all three potentiometer wires from the control.
3. Number the wires 1, 2, and 3, in any order.
4. Set your ohmmeter to measure the potentiometer's maximum resistance, normally 20,000 Ω.
5. Measure and record the resistance between wires 1 and 2. _____ Ω
6. Measure and record the resistance between wires 1 and 3. _____ Ω
7. Measure and record the resistance between wires 2 and 3. _____ Ω
8. The pair of wires with the highest measured value are the positive and negative wires. Connect the wires to the positive and negative actuator terminals on the control. At this time, do not be concerned with which wire you connect to which terminal.
9. Connect the remaining wire to the feedback terminal.
10. Test the actuator using automatic mode to see if the control moves it properly. If the actuator moves in the opposite direction than it is supposed to, switch the positive and negative wires on the control.

Appendix C: Factory defaults

When your PEC Plus leaves the factory, it comes with default settings and configuration.

Resetting your PEC Plus erases all the configuration and settings you programmed and then restores the settings to what they were when the control left the factory. For more information, read **Restoring the factory defaults** on page 56.

The table below lists the factory defaults.

Configuration		**Variable stage settings (VAR1 and 2)**	
Relays 1 to 6	Off [1]	Range (on full at)	86.0°F
Variable stages 1 and 2	Off	Set point	80.0°F
Temperature units	°F	Off at	75.0°F
Probe 1	On	Idle speed/min heat	20%
Probe 2	Off		
Probe 3	Off		
Probe 4	Off		
Security	Off		
Hysteresis	1.0		
[1] *If the actuator present pins are in place, the defaults for the relays are: RLY1 – actuator 1 open, RLY2 – actuator 1 close, RLY3 – actuator 2 open, RLY4 – actuator 2 close.*			
Group set point/growth curve defaults		**Alarm settings**	
Current day	0/off	High temp	Disabled/95.0°F
Step 1, 4 days	85.0°F	Low temp	Disabled/60.0°F
Step 2, 10 days	80.0°F	Probe damage	Disabled
Step 3, 10 days	75.0°F	Probe deviation	Disabled/5°F
Step 4, 10 days	70.0°F	**Other setting defaults**	
Step 5, 10 days	65.0°F	Actuator settings	None assigned
Step 6, 10 days	60.0°F	Curtain settings	None assigned
Step 7, 20 days	60.0°F	Duty cycle settings	None assigned
Group set point	75.0°F	Heat/cool settings	None assigned

Appendix D: Installation worksheet

Use the worksheet on the next page to list all the equipment (fans, heaters, curtains, and so on that you want your PEC Plus to control. We recommend you make a copy of the worksheet before filling it in incase you need more than one sheet or you make a mistake.

Use the **Installation worksheet** when you fill in the **Configuration worksheets** (starting on page 74).

Input power	120/230 VAC, 50/60 Hz
Variable stages ① (2: VARI-1, VARI-2)	10 A at 120/230 VAC, general-purpose (resistive) 7 FLA at 120/230 VAC, PSC motor 1/2 HP at 120 VAC, 1 HP at 230 VAC, PSC motor
Fuses (2: F1and F2)	15 A, 250 VAC ABC-type ceramic
Relay stages ① (6: STG-1 to STG-6)	10 A at 120/230 VAC, general-purpose (resistive) 1/3 HP at 120 VAC, 1/2 HP at 230 VAC 360 W tungsten at 120 VAC
Alarm relay	0.4 A at 125 VAC; 2 A at 30 VDC, resistive load 0.2 A at 125 VAC; 1 A at 30 VDC, inductive load
① You can connect more than one piece of equipment to a variable stage or relay as long as they are the same type (for example, two fans) and the total current draw does not exceed the stage's limit.	

The FLA (full load ampere) rating accounts for the increase in motor current draw when the motor operates at less than full speed. Make sure the motor/equipment connected to the variable stage does not draw more than 7 FLA.

Stage/relay	Equipment to connect
Example: *VAR1*	*36-inch variable speed fan, 2.5 FLA, 3/4 HP*
VAR1	
VAR2	
RELAY1	
RELAY2	
RELAY3	
RELAY4	
RELAY5	
RELAY6	
ALARM	

Appendix E: Configuration worksheets

Use the **Installation Worksheet** on page 73 when completing the configuration worksheets.

Main control function worksheet

For each item, circle or write in the configuration.

Item	Description	Configuration
Units	The unit of measure for temperature	°C °F *Default: °F*
Probes	The configuration for each temperature probe terminal	P1: on off P2: on off P3: on off P4: on off outdoor *Default: P1-on, P2 to P4-off*
Hysteresis	The number of degrees above the set point that a heating stage or relay switches off, and the number of degrees below the set point that a cooling stage or relay switches off.	_____ degrees *Range: 0.3 to 5.0°F (0.2 to 2.8°C)* *Default: 1.0 °F*

Variable stage configuration worksheet

For each variable stage, enter a description (for reference only) and put a check mark in the appropriate column for how to configure the variable stage. The first two lines are an example.

For more information, read **Configuring variable stages** on page 25.

Stage	Description	Off	Cool 1	Cool 2	Heat
1	*Stage 1 fan*		✓		
2	*Heat mat*				✓
1					
2					

Relay configuration worksheet

For each variable stage, enter a description (for reference only) and put a check mark in the appropriate column for how to configure the relay. The first table is an example.

For more information, read **Configuring relays** on page 27.

Relay	Description	Actuator 1 open	Actuator 1 close	Actuator 2 open	Actuator 2 close	Curtain open	Curtain close	Heat	Cool	Duty cycle (cool)	Duty cycle (heat)	Adv. duty cycle (cool)	Off	On
1	*Inlet open*	✓												
2	*Inlet close*		✓											
3	*36-inch fan*								✓					
4	*Electric heat*							✓						
5	*Curtain open*					✓								
6	*Curtain close*						✓							

Relay	Description	Actuator 1 open	Actuator 1 close	Actuator 2 open	Actuator 2 close	Curtain open	Curtain close	Heat	Cool	Duty cycle (cool)	Duty cycle (heat)	Adv. duty cycle (cool)	Off	On
1														
2														
3														
4														
5														
6														

Appendix F: Settings worksheets

Appendix F contains worksheets for you to use when programming your PEC Plus settings. Each worksheet contains a brief explanation of the information required. For more information about programming your PEC Plus, see **Chapter 4: Programming the PEC Plus** on page 32.

Growth curve worksheet

A growth curve is an extension of the group set point concept. The growth curve automatically adjusts the temperature set points over time to control the temperature in a room. It is called a growth curve because it adjusts the set points as the animals grow.

You can have up to seven steps in a growth curve. Each step has a starting temperature set point and a duration. The PEC Plus automatically calculates the set points for the days between the steps and adjusts the set points at midnight each day. Individual set points for the variable and fixed stages are adjusted relative to the growth curve temperature for that particular day.

For more information, read **Programming the growth curve** on page 34.

Step	Temperature①	Duration②
Step 1		
Step 2		
Step 3		
Step 4		
Step 5		
Step 6		
Step 7		

① Temperature in °F/°C, range: -25 to 51.7°C (-13 to 125°F)
② The duration in days; range: 001 to 365, not more than 365 total for all steps

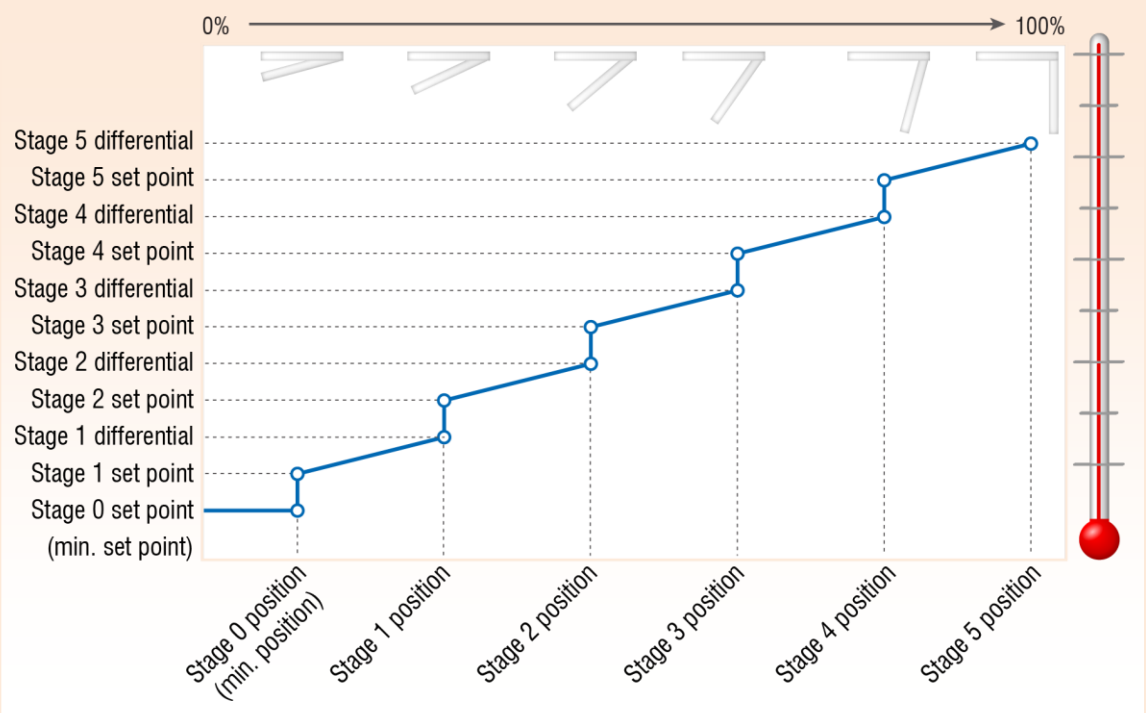
The temperature set point must decrease as the steps increase.

Variable stage settings worksheet

Setting	Variable 1	Variable 2
On full at ①		
Set point ①		
Off at ①		
Idle speed or minimum heat ②		
① Temperature in °F/°C, range: -25 to 51.7°C (-13 to 125°F) ② Idle speed or minimum heat in %; range: 1 to 100 %		

Actuator settings worksheet

The settings for the actuator stages include the set point temperature, position, and differential temperature.



- When the temperature is below the **stage 0 set point**, the actuator is closed.
- When the temperature rises to the **stage 0 set point**, the actuator moves to the **stage 0 position**.
- As the temperature rises, the actuator moves through the stages until it reaches its maximum open position. This method lets you gradually open inlets instead of fully opening them when the temperature rises above a single set point.

In other words, "when the temperature is here (stage set point), I want the actuator to start opening. When the temperature reaches here (stage differential), I want the actuator to be at this position (stage position)." For more information, read **Programming actuators** on page 41.

Setting	Actuator 1	Actuator 2	Description
Minimum (stage 0)			
Set point ①			The temperature below which the actuator is closed
Position ②			The percentage the actuator is open when the temperature is at or above the minimum set point
Stage 1			
Set point ①			The temperature at which the actuator starts opening for stage 1
Differential ①			The temperature at which the actuator is open to stage 1 position
Position ②			The percentage the actuator is open when the temperature is at the differential
Stage 2			
Set point ①			The temperature at which the actuator starts opening for stage 2
Differential ①			The temperature at which the actuator is open to stage 2 position
Position ②			The percentage the actuator is open when the temperature is at the differential
Stage 3			
Set point ①			The temperature at which the actuator starts opening for stage 3
Differential ①			The temperature at which the actuator is open to stage 3 position
Position ②			The percentage the actuator is open when the temperature is at the differential
Stage 4			
Set point ①			The temperature at which the actuator starts opening for stage 4
Differential ①			The temperature at which the actuator is open to stage 4 position
Position ②			The percentage the actuator is open when the temperature is at the differential
Stage 5			
Set point ①			The temperature at which the actuator starts opening for stage 5
Differential ①			The temperature at which the actuator is open to stage 5 position
Position ②			The percentage the actuator is open when the temperature is at the differential
① Temperature in °F/°C, range: -25 to 51.7°C (-13 to 125°F) ② Position in %, range: 0 to 100 %			

Curtain worksheet

Curtains control the temperature by adjusting the air flow into the facility. Each curtain has six settings.

- **Set point** – the temperature at which the curtain holds its position.
- **Idle band** – the buffer around the set point within which the curtains hold their position.
- **Open on** – the duration the curtains open during the open cycle
- **Open off** – the duration the curtains hold their position during the open cycle
- **Close on** – the duration the curtains close during the close cycle
- **Close off** – the duration the curtains hold their position during the close cycle

For more information, read **Programming curtain control relays** on page 44.

Curtain	Set point①	Idle band②	Open ON duration③	Open OFF duration③	Close ON duration③	Close OFF duration③
			:	:	:	:
			:	:	:	:
			:	:	:	:

① Temperature in °F/°C, range: -25 to 51.7°C (-13 to 125°F)
② Temperature in °F/°C, range: 0.6 to 5.5°C (1.0 to 10.0°F)
③ Duration in mm:ss, range: 0 to 59 minutes in 1 second increments

Heating and cooling elements worksheet

Heating and cooling elements control the temperature by switching single-stage heating equipment such as electric heaters, or cooling equipment such as misters ON or OFF.

There are three types of heating and cooling element setups: standard, duty cycle, and advanced duty cycle. Programming a standard element means setting the temperature set point. Programming a duty cycle means setting the temperature set point(s) and the ON and OFF durations.

For more information, read **Programming heating and cooling elements and duty cycles** on page 46.

Relay	Type		Set point①	Duty cycle		
				ON duration②	OFF duration②	Set point 2 ①③
Relay 1	*Heat*	*Cool*		*01:30*	*03:00*	*75*
Relay 1	Heat	Cool		:	:	
Relay 2	Heat	Cool		:	:	
Relay 3	Heat	Cool		:	:	
Relay 4	Heat	Cool		:	:	
Relay 5	Heat	Cool		:	:	
Relay 6	Heat	Cool		:	:	

① Temperature in °F/°C, range: -25 to 51.7°C (-13 to 125°F)
② Duration in mm:ss, range: 0 to 59 minutes in 1 second increments
③ Advanced duty cycles only, must be lower than set point 1.

Alarm settings worksheet

The alarm settings for your PEC Plus determine which alarm conditions are enabled, which are disabled, and their settings. All these work together to determine how and when the alarm relay activates (in other words, signals an alarm condition).

The alarm relay activates if an alarm condition (one that is enabled) is present for longer than the minimum duration of one minute. The one minute minimum duration prevents alarms from occurring when the temperature rises or drops for just a few seconds. For more information, read **Programming alarm settings** on page 49.

Alarm	Status		Setting	Description
High temperature① H-AI	ON	OFF		The highest temperature to which you can safely allow your facility to rise – cannot be lower than low temperature alarm.
Low temperature① L-AI	ON	OFF		The lowest temperature to which you can safely allow your facility to fall – cannot be higher than high temperature alarm.
Probe damage PbAd	ON	OFF		Damaged or disconnected temperature probe
Probe deviation PdEu	ON	OFF		The difference in measured temperatures between averaged probes is greater than 18°F (10°C).
Actuator 1 Ac1J	ON	OFF		Actuator 1 jammed
Actuator 2 Ac2J	ON	OFF		Actuator 2 jammed

① Temperature in °F/°C, range: -25 to 51.7°C (-13 to 125°F)

Appendix G: Motor curves

Motor curves provide a way to proportionally increase or decrease speed, regardless of motor manufacturer. For example, a Multifan motor might require 130 VAC to run at 50% RPM, while a Marathon motor might need 100 VAC to run at 50% RPM. Without a motor curve, the Multifan motor would run at a slower RPM than the Marathon motor at the same settings.

Selecting the correct motor curve allows you to set, for example, 50 on the control, and get much closer to 50% RPM on the motor then you would otherwise.

Use manual override or test mode to test and evaluate the operation and performance of your fan motors. For more information, read **Testing settings and equipment** on page 53.

- If your fan motors are not running at approximately the correct RPM for the control settings, find your fan in the following table, and then select the motor curve for your fan manufacturer and model/specification.
- If your fan motor is not listed, use the default motor curve (curve 1). If the default motor curve does not operate your fan motor correctly, test the motor using manual override or test mode while selecting the different curves.

Manufacturer	Diameter (inches)	Model	Specifications	Recommended curve
Aerotech	09	AT09Z2	3350 RPM	2
	36	AT36Z1		4
Airstream	12	APP12F	1/4 HP, 1765 RPM	3
	36	APP36		4
Baldor	14		1/4 HP, 1700 RPM	4
	18		1/3 HP, 1700 RPM	4
	24		1/3 HP, 1140 RPM	4
Canarm	09	PLF9	1/5 HP	4
	12	PLF12		2
	14	PLF14		2
	16	PLF16	1/4 HP	2
	18			2
Choretime (GE)	12		1/3 HP, 1140 RPM	1
Emerson	12		1/6 HP, 3400 RPM	2
Exafan	10		1/4 HP, 1700 RPM	2
	14		1/4 HP, 1700 RPM	2
	16		1/3 HP, 1700 RPM	2
	18		1/3 HP, 1700 RPM	2

Manufacturer	Diameter (inches)	Model	Specifications	Recommended curve
	20		0.53 HP, 1700 RPM	2
	24		0.63 HP, 1700 RPM	2
Franklin	10		1/6 HP, 3450 RPM	2
Leeson	14		1/4 HP, 1625 RPM	2
	18		1/3 HP, 1625 RPM	2
	24		1/3 HP, 1140 RPM	2
	24		1/2 HP, 1625 RPM	2
	36		3/4 HP, 1625 RPM	2
Magnetek	12		1/6 HP, 3300 RPM	2
	12		1/6 HP, 1725 RPM	2
	36		1/2 HP, 840 RPM	4
Marathon	12		1/4 HP, 1625 RPM	2
	24		1/2 HP, 1625 RPM	2
Multifan	18	4E45	1600 RPM	4
	20	4E50		4

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Limited warranty

This warranty applies only to the Phason PEC Plus. If you need warranty service, return the product and original proof of purchase to your dealer.

Phason Inc. (Phason) warrants the PEC Plus subject to the following terms and conditions.

This warranty is valid only to the original purchaser of the product, for two years from the manufacturing date. The manufacturing date is stated in the first eight digits of the serial number in the form year-month-day.

Phason hereby warrants that should the PEC Plus fail because of improper workmanship, Phason will repair the unit, effecting all necessary parts replacements without charge for either parts or labor.

Conditions

- Installation must be done according to our enclosed installation instructions.
- The product must not have been previously altered, modified, or repaired by anyone other than Phason.
- The product must not have been involved in an accident, misused, abused, or operated or installed contrary to the instructions in our user and/or installation manuals. Phason's opinion about these items is final.
- The person requesting warranty service must be the original purchaser of the unit, and provide proof of purchase upon request.
- All transportation charges for products submitted for warranty must be paid by the purchaser.

Except to the extent prohibited by applicable law, no other warranties, whether expressed or implied, including warranties of merchantability and fitness for a particular purpose, shall apply to the PEC Plus. Any implied warranties are excluded.

Phason is not liable for consequential damages caused by the PEC Plus.

Phason does not assume or authorize any representatives, or other people, to assume any obligations or liabilities, other than those specifically stated in this warranty.

Phason reserves the right to improve or alter the PEC Plus without notice.

Service and technical support

Phason will be happy to answer all technical questions that will help you use your PEC Plus. Before contacting Phason, check the following:

- Read this manual for information about the feature with which you are having trouble.
- If you see an alarm message and are not sure what it means, look it up in the **Alarm and error messages** table on page 66 and then follow the instructions for resolving the alarm condition.
- If you are having a problem using your PEC Plus, look in the **Troubleshooting** table on page 68 and then follow the directions for correcting the problem.
- If you still have a problem with your PEC Plus, collect the following information:
  - The serial number
  - Any messages displayed by your PEC Plus
  - A description of the problem
  - A description of what you were doing before the problem occurred

- ◇ Phason controls are designed and manufactured to provide reliable performance, but they are not guaranteed to be 100 percent free of defects. Even reliable products can experience occasional failures and the user should recognize this possibility.
- ◇ If Phason products are used in a life-support ventilation system where failure could result in loss or injury, the user should provide adequate back up ventilation, supplementary natural ventilation, or an independent failure-alarm system. The user's lack of such precautions acknowledges their willingness to accept the risk of such loss or injury.

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