

## PLC case study (incandescent lamps)

The PLC case study is an overview of the features of Phason's PLC-1 and PLC-2 Programmable Lighting Controls. The case study briefly explains the features and electrical ratings of the controls and then shows an example of how to create a lighting program. This document is not meant as a replacement for following the instructions in the user manual.

### PLC overview

The PLC allows you to control light duration and intensity and automatically adjust them during the birds' life cycle.

Designed primarily for poultry barns, the PLC is loaded with powerful and useful features. With multiple outputs and programs, the PLC allows you to easily design a lighting program that works for your operation.



PLC controls have variable AC outputs for dimming incandescent lights, general-purpose relays for turning lights on and off or operating devices such as feed augers, and variable 0 to 10 VDC outputs for operating DC-controlled fluorescent lights. Each control also includes an alarm relay for signaling power failures.

The LCD display shows status and setting information and the four-button keypad allows you to easily scroll through the information and program the control. The PLC's real-time clock and power-failure memory retention means you will never lose your settings and program status because of a power failure.

There are two models of Programmable Lighting Controls: the PLC-1 and the PLC-2.

## Features

- ◆ Programmable lighting operation
  - Multiple lighting programs (multiple output staging)
  - Up to 365 days per program
  - Up to 20 segments (groups of days) per program
  - Up to 32 triggers (light/relay state changes) per day
- ◆ Two variable AC outputs (PLC-1), one variable AC output (PLC-2)
- ◆ Two variable DC outputs
- ◆ Two general-purpose relay outputs (PLC-1), one general-purpose relay output (PLC-2)
- ◆ One alarm relay
- ◆ Expandable capacity using slaves
- ◆ Sixteen character, two-line backlit LCD display
- ◆ Four-button keypad
- ◆ Real-time clock
- ◆ Power-fail memory protection
- ◆ Rugged enclosure (corrosion resistant, water resistant, and fire retardant)
- ◆ Two-year limited warranty

## PLC-1 electrical ratings

- ◆ Input: 115/230 VAC, 50/60 Hz, 1 A
- ◆ Variable AC outputs: 10 A, 1150 W at 115 VAC  
10 A, 2300 W at 230 VAC
- ◆ Relay outputs: 1/3 HP at 115 VAC, 1/2 HP at 230 VAC
- ◆ Variable DC output: 0 to 10 V, 30 mA
- ◆ Alarm relay: 0.2 A at 250 VAC, 0.4 A at 24 VAC, 2.0 A at 30 VDC
- ◆ Fuses: Input – 250 V, 1 A, fast-acting glass  
Variable AC outputs – 250 V, 15 A, slow-blow ceramic  
Relay outputs – 250 V, 12 A, slow-blow ceramic

## PLC-2 electrical ratings

- ◆ Input: 115 VAC, 50/60 Hz, 1 A
- ◆ Variable AC output: 20 A, 2300 W at 115 VAC
- ◆ Relay output: 1 HP at 115 VAC, 2 HP at 230 VAC  
20 A at 115 V tungsten, 20 A at 230 V ballast
- ◆ Variable DC output: 0 to 10 V, 30 mA
- ◆ Alarm relay: 0.2 A at 250 VAC, 0.4 A at 24 VAC, 2.0 A at 30 VDC
- ◆ Fuse: Input – 250 V, 1 A, fast-acting glass

## Example

You operate a broiler barn. You want to automatically adjust the light intensity and hours of light as the birds age. What do you do?

Your lighting requirements are as follows:

Bird age (days)	Light intensity	
	Foot-candles	lux
0 to 3	2.0	21.52
4	1.8	19.37
5	1.6	17.22
6	1.4	15.06
7	1.0	10.76
8	0.5	5.38
9	0.2	2.15
10 to end	0.1	1.08

**Table 1:** Light intensity requirements

Bird age (days)	Photo period	Schedule	
0 to 1	24 hours of light		
2 to 7	23 hours of light 1 hour of dark	Midnight to 5:00 AM	Light
		5:00 AM to 6:00 AM	Dark
		6:00 AM to midnight	Light
8 to 14	16 hours of light 8 hours of dark	Midnight to 4:00 AM	Dark
		4:00 AM to noon	Light
		Noon to 4:00 PM	Dark
		4:00 PM to midnight	Light
15 to 21	18 hours of light 6 hours of dark	Midnight to 3:00 AM	Dark
		3:00 AM to noon	Light
		Noon to 3:00 PM	Dark
		3:00 PM to midnight	Light
22 to end	24 hours of light		

**Table 2:** Photoperiod requirements

## Step 1: Convert the light intensities to PLC light levels

For the PLC, light intensity is a number between 0 and 100, not a percentage. Zero is off, 100 is fully on. The PLC's system make every change in light level equal.

For example, if you change the light intensity from 1% to 2%, you have doubled the intensity. Likewise, if you change the intensity from 50% to 100%, you have doubled the intensity. If you were to use percentage as a scale, there would only be 1 level between 1 and 2 percent, but 50 levels between 50 and 100 percent.

With the PLC's light levels, every doubling (or halving) of the light intensity has ten equal levels. This makes changes in light intensity almost undetectable.

The best way to convert a light intensity to a light level is to manually adjust the lights using the control and then read the light intensity using an ambient light meter. When the light meter reads the desired light intensity, check the PLC display and write down the light level.

For your lights, when the light intensity is 2.0 foot-candles, we will use a PLC light level of 95. The table below lists what the light levels would be for the remaining days.

Bird age (days)	Light intensity		
	Foot-candles	lux	PLC light level
0 to 3	2.0	21.52	95
4	1.8	19.37	93
5	1.6	17.22	91
6	1.4	15.06	89
7	1.0	10.76	85
8	0.5	5.38	75
9	0.2	2.15	60
10 to end	0.1	1.08	50

**Table 3:** Light intensity converted to PLC light levels

Notice that when the intensity is half of your maximum value, the light level is 10 levels below the maximum. (2.0 foot candles=95, 1 foot-candle=85)

Now that you know your light levels, you are ready for the next step.

## Step 2: Designing your lighting program

A lighting program is the settings the PLC uses to control the lights. The settings consist of segments and triggers. A program can be up to 365 days long.

Segments are parts of the lighting program where all the days have the same triggers. In other words, all days during a segment will have the same amount of light and dark hours and the same light levels. There can be up to 20 segments per lighting program.

Triggers are events in the lighting program that cause the light level to increase or decrease, or a relay to change position (ON/OFF). There can be up to 32 triggers per segment.

### Segments

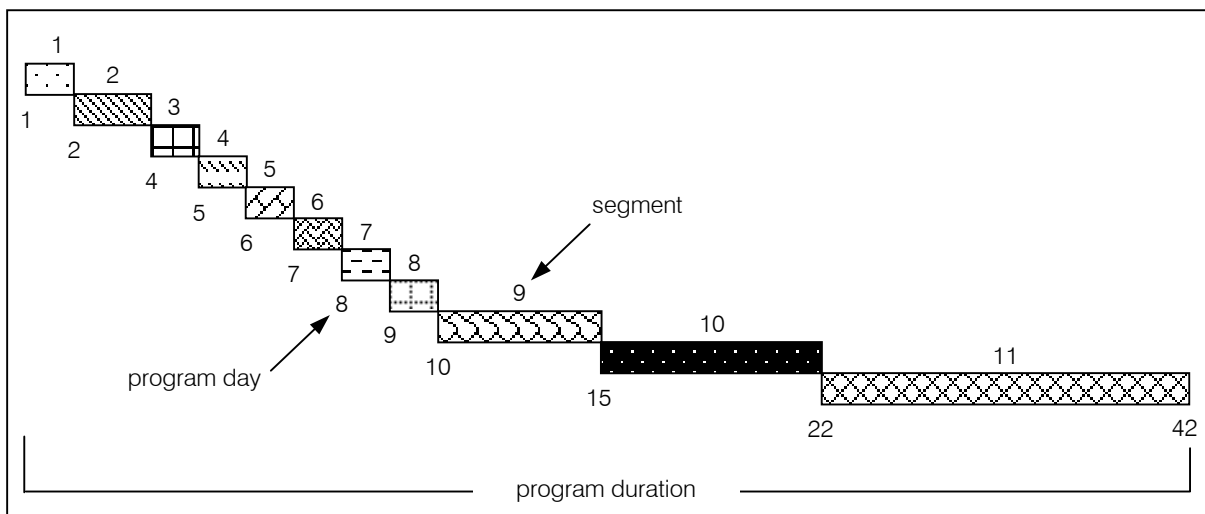
The only setting for a segment is the start day. A segment begins on the start day and lasts until the start day of the next segment. When the last segment ends, the lighting program is over.

In your lighting program, there are eight different light levels: starting at 2.0 foot-candles when the birds arrive, and ending at 0.1 foot-candles from the tenth day onward. In addition, you have five different photoperiods (light/dark schedules).

Since all the light periods and light levels must be the same for a segment, you have to combine the eight light level periods with the five different photoperiods. This gives you 11 different segments.

Segment	1	2	3	4	5	6	7	8	9	10	11
Start day	1	2	4	5	6	7	8	9	10	15	22

**Table 4:** Segments in your lighting program



**Figure 1:** Segments in a lighting program

## Triggers

Each segment has its own triggers. The settings for a trigger include start time, ramp time, and light level.

Start time is the time at which the PLC starts to change the light level. The PLC use 24-hour time.

Light level is the intensity to which the PLC needs to adjust the lights.

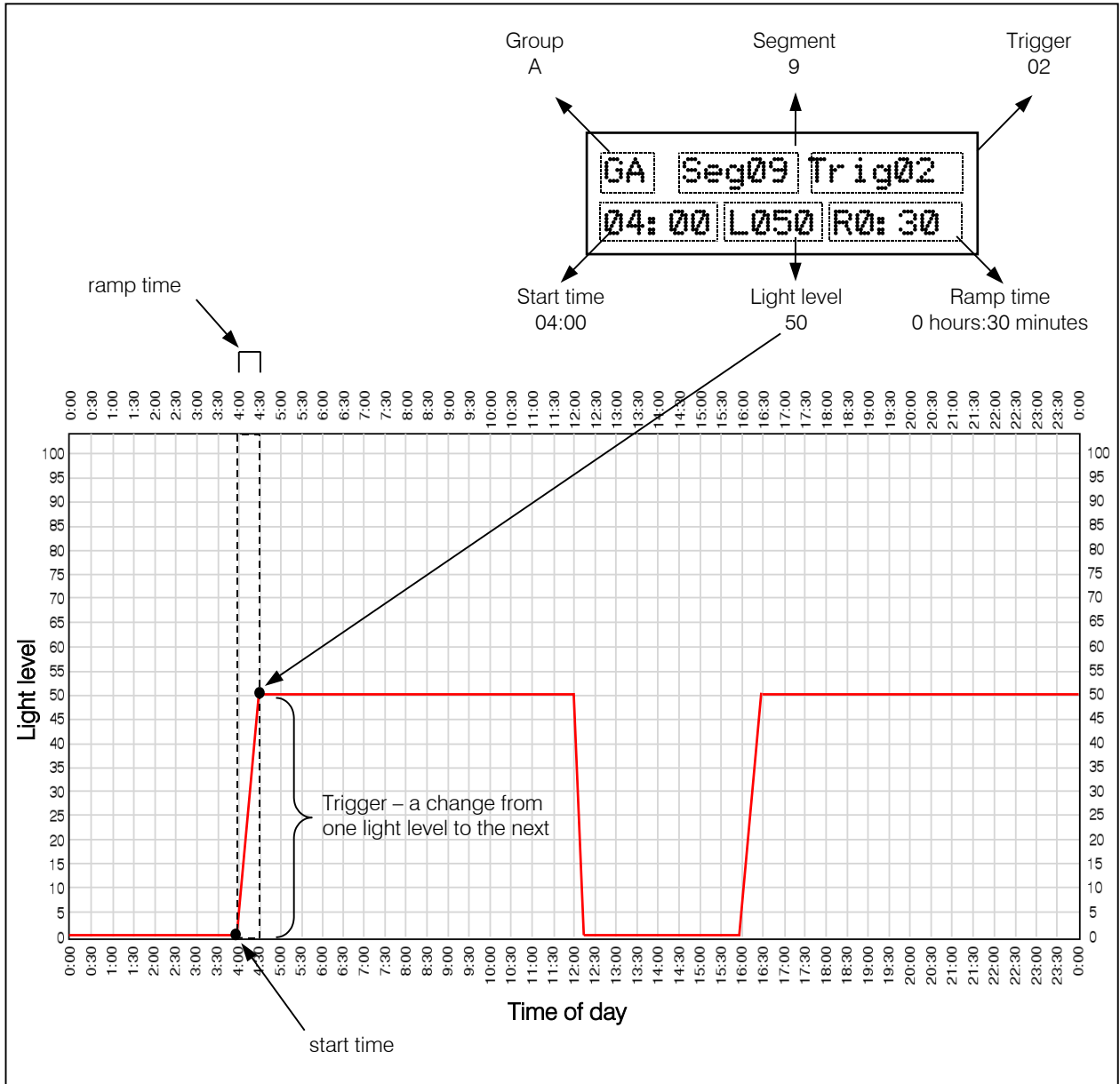
Ramp time is the amount of time the PLC takes to adjust from one light level to the next. For your ramp times we are using 30 minutes for increases in light levels and 15 minutes for decreases in light levels.

If you write down your light intensity and photoperiod requirements for each day, you will get a lighting program like the one in table 5.

Segment	Start day	Trigger	Start time (hh:mm)	Light level (0 to 100)	Ramp time (h:mm)
<b>1</b>	1	<b>1</b>	00:00	95	0:30
<b>2</b>	2	<b>1</b>	05:00	0	0:15
		<b>2</b>	06:00	95	0:30
<b>3</b>	4	<b>1</b>	05:00	0	0:15
		<b>2</b>	06:00	93	0:30
<b>4</b>	5	<b>1</b>	05:00	0	0:15
		<b>2</b>	06:00	91	0:30
<b>5</b>	6	<b>1</b>	00:00	0	0:15
		<b>2</b>	06:00	89	0:30
<b>6</b>	7	<b>1</b>	05:00	0	0:15
		<b>2</b>	06:00	85	0:30
<b>7</b>	8	<b>1</b>	00:00	0	0:15
		<b>2</b>	04:00	75	0:30
		<b>3</b>	12:00	0	0:15
		<b>4</b>	16:00	75	0:30
<b>8</b>	9	<b>1</b>	00:00	0	0:15
		<b>2</b>	04:00	60	0:30
		<b>3</b>	12:00	0	0:15
		<b>4</b>	16:00	60	0:30
<b>9</b>	10	<b>1</b>	00:00	0	0:15
		<b>2</b>	04:00	50	0:30
		<b>3</b>	12:00	0	0:15
		<b>4</b>	16:00	50	0:30
<b>10</b>	15	<b>1</b>	00:00	0	0:15
		<b>2</b>	03:00	50	0:30
		<b>3</b>	12:00	0	0:15
		<b>4</b>	15:00	50	0:30
<b>11</b>	22	<b>1</b>	00:00	50	0:01

**Table 5:** Your lighting program

Below is an image showing the PLC display and the lighting schedule for segment 9 (days 10 to 14).

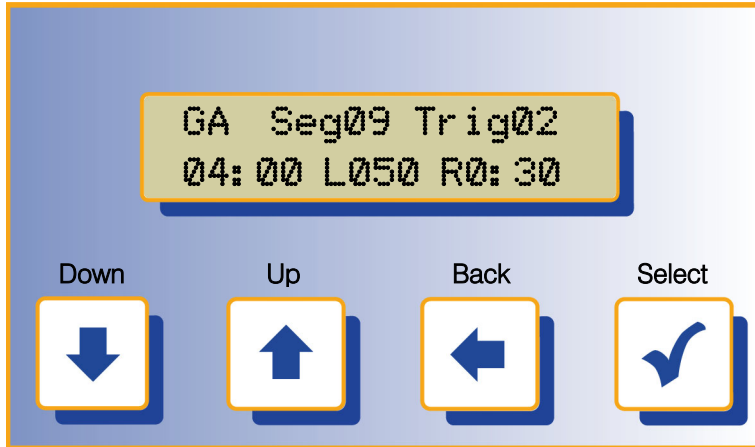


**Figure 2:** Triggers in a lighting program

Now that you have designed your lighting program, you are ready for the next step.

### Step 3: Programming the PLC

You have designed your lighting program and written down the information on the PLC worksheets (included in the PLC user manual). The final step is to program your settings into the PLC. The PLC's LCD display, simple menu structure, and 4-button keypad make this easy to do.



**Figure 3:** The PLC display area

#### To program the segments

1. Scroll to the Light Programs menu and then press **Select** twice.
2. Scroll to the group you want to set up and then press **Select**.
3. Scroll to the segment you want to set up and then press **Select**.
4. Press **Up** or **Down** adjust the start day and then press **Select**.
5. Repeat steps 2 to 4 for each segment you want to add or edit and then press **Back** twice to return to the main menu.

```
GroupA Segment01
Start Day      01
```

**To program the triggers**

1. Scroll to the Light Programs menu and then press **Select**.
2. Scroll to **Set Triggers** and then press **Select**.
3. Scroll to the group you want to set up and then press **Select**.
4. Scroll to the segment you want to set up and then press **Select**.
5. Scroll to the trigger you want to set up and then press **Select**.
6. Press **Up** or **Down** to adjust the start hour (in 24-hour time) and then press **Select**.
7. Press **Up** or **Down** to adjust the start minute and then press **Select**.
8. Press **Up** or **Down** to adjust the light level and then press **Select**.
9. Press **Up** or **Down** to adjust the ramp time (duration) and then press **Select**.
10. Repeat steps 3 to 9 for each trigger you want to set up and then press **Back** twice to return to the main menu.

GA Seg09 Trig02 04: 00 L050 R0: 30
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Your PLC is now ready to control your lights!

For information about stopping and starting your lighting program and other PLC features, see the PLC user manual.

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If you have questions about the PLC, or any Phason product, contact us. We will be happy to answer your questions and provide the solution that is right for you.

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