

# CI00/CI20

Series **II**  
Programmable Controller

PROGRAMMING, INSTALLATION, AND APPLICATION MANUAL



PRICE: \$2.00

**INDEPENDENT ENERGY INC.**

P. O. Box 860, 42 Ladd St., East Greenwich, RI 02818 Tel (401)884-6990

## C100/C120 PROGRAMMING INSTRUCTIONS

I.	<u>How to Use This Manual</u> .....	2
II.	<u>Non-Programmable Options</u> .....	3
	A. Number of Outputs	
	B. C100/C120	
	C. LCO (Line Cord and Outlets)	
	D. 230 VAC (230 VAC input/output power)	
III.	<u>How to Program a Control</u> .....	4
IV.	<u>Detailed Instructions</u> .....	5
	A. <u>Output 1</u> (C100 and C120).....	5
	1. -1S on/off differential; 20/5 thresholds	
	2. -1S(8/3) on/off differential; 8/3 thresholds	
	3. -1P proportional control; 16/5 thresholds	
	4. -1P(8/4) proportional control; 8/4 thresholds	
	5. H high limit (fixed or adjustable threshold)	
	6. N nocturnal cooling	
	7. L recirculate freeze protection	
	B. <u>Output 2</u> (C100 and C120).....	11
	1. A "aux 2" storage sensor reference	
	2. -2S on/off differential; 20/5 thresholds	
	3. -2S(8/3) on/off differential; 8/3 thresholds	
	4. -2P proportional control; 16/5 thresholds	
	5. -2P(8/4) proportional control; 8/4 thresholds	
	6. H High limit (fixed or adjustable threshold)	
	7. W wood stove "aux 1" safety high limit	
	8. -2F draindown freeze protection	
	9. -2FH draindown on freeze or high limit	
	C. <u>Output 3</u> (C100 only).....	17
	1. -3F draindown freeze protection	
	2. -3FH draindown on freeze or high limit	
	3. -3E backup element interlock	
	D. C120 Control Type (-31-4B or -3D-4D).....	19
	E. °C Temperature Display.....	21
V.	<u>High Limit Thresholds</u> .....	22
	Model H(ADJ) Kit	
	Resistance/Temperature Chart	
VI.	<u>Programming Examples</u> .....	24
VII.	<u>C100/C120 Installation</u> .....	27
VIII.	<u>C100/C120 Application Examples</u> .....	30
IX.	<u>Short Form Programming Reference</u> .....	inside back cover

**I. HOW TO USE THIS MANUAL**

This manual is intended to serve the experienced C100/C120 control installer as well as the first time user.

**IMPORTANT**

Programming Instructions apply only to C100/C120 Series II Programmable Controllers designated as Models **C100-P1, C100-P2, C100-P3, C120-P3, and C120-P4**. Earlier models are pre-programmed at the IE factory and have the program options designated in the model number (e.g. **C100-1SH(ADJ), C120-1S-2SA-3I-4D**).

For the first time user it is very important to read this entire manual before trying to program your C100/C120 control. Ideally, this should be done before you design your solar system in order to ensure that your system requirements match the C100/C120 capabilities. Once you have determined your system control needs, read Section III, How to Program a Control, and then proceed to Section IV, Detailed Instructions on the specific options desired.

Experienced control installers should read the entire manual at least once. After that, refer to Short Form Programming Reference on the inside back cover, which should serve as a handy reminder for all pertinent data.

**II. NON-PROGRAMMABLE OPTIONS****IMPORTANT**

Programming Instructions apply only to C100/C120 Series II Programmable Controllers designated as Models **C100-P1**, **C100-P2**, **C100-P3**, **C120-P3**, and **C120-P4**. Earlier models are pre-programmed at the IE factory and have the program options designated in the model number (e.g. **C100-1SH(ADJ)**, **C120-1S-2SA-3I-4D**).

The C100/C120 control offer a wide range of capabilities to cover most systems' control needs. While most of these capabilities are field programmable (can be enabled or disabled) the following exceptions are important to note.

**A. Number of Outputs**

The number of control outputs ranges from 1 to 4 and must be specified at the time of order. Specify as follows:

Model	Differential/ Freeze Protection Outputs	Heat Distribution Outputs
<b>C100-P1</b>	1	none
<b>C100-P2</b>	2	none
<b>C100-P3</b>	3	none
<b>C120-P3</b>	1	2
<b>C120-P4</b>	2	2

**B. C100/C120**

As implied above, a C100 cannot be converted to a C120. Likewise a C120 cannot be converted to a C100.

**C. -LCO (Line Cord and Outlets)**

Standard C100/C120 controls (e.g. C100-P1) are designed for "hard wiring". If line cord and outlets (the number of outlets depends on the number of line voltage control outputs) are desired, then specify **-LCO** in the model number (e.g. **C100-P1-LCO**, **C120-P4-LCO**).

**D. 230 VAC (230 VAC input/output power)**

Standard C100/C120's are rated for 115 VAC  $\pm$  10%, 60 Hz input power. For applications requiring 230 VAC  $\pm$  10%, 50/60 Hz power specify **230 VAC** in the model number (e.g. **C100-1S-230VAC**).

**E. (1 HP) One Horsepower Relay Option**

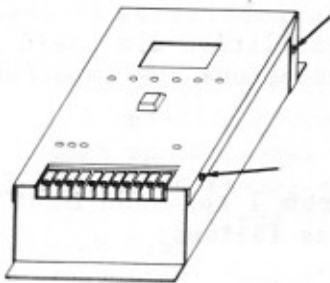
Standard C100/C120 outputs are rated for 1/10 HP, 3A at 115VAC (1.5A at 230VAC). For 1 HP rating specify in the model number when ordering (e.g. **C100-P2 (1 HP on Output 2)**).

**III. HOW TO PROGRAM A CONTROL**

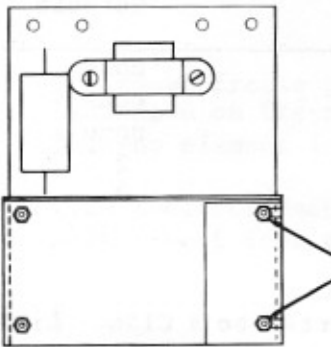
The C100/C120 control options are programmable via 16 small switches (called dip switches). To gain access to these switches:

**WARNING**

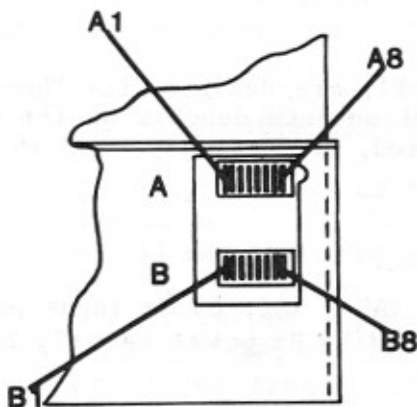
**DISCONNECT POWER BEFORE  
PROCEEDING WITH PROGRAMMING.**



1. Remove 4 screws at locations shown. Remove cover/printed circuit card assembly. Be sure to save the plastic transformer support.



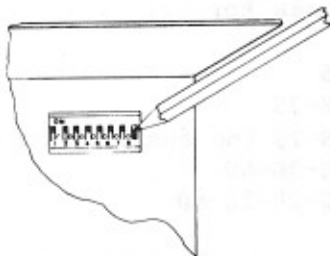
2. Remove the two nuts that secure the dip switch access cover.



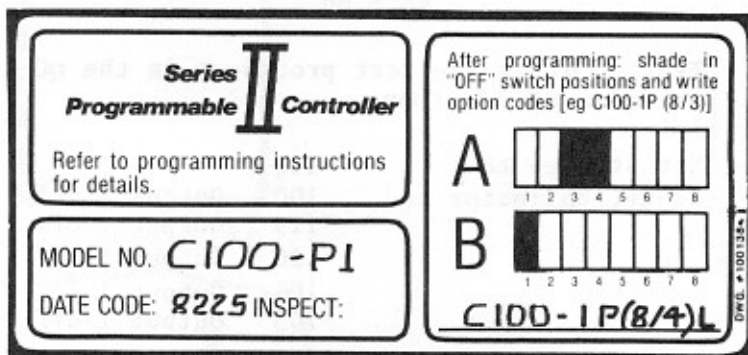
3. Note that there are two rows of switches labeled A1 through A8 and B1 through B8. The "on/off" positions are marked on the adjacent label. The "off" position may be marked "open" on the switch. As shipped from the factory, all switches should be in the "on" position.

4. Before changing any switches - READ the appropriate part of Section VI, Detailed Instructions.

5. Adjust the switch positions as required.



6. If a high limit or nocturnal cooling function is programmed: Set the high limit thresholds with the fixed resistors shipped with the C100 or with the **H(ADJ)** kit which must be ordered separately. Note that C120 controls come standard with the "stor min" adjustable from 65 to 120 and the "stor max" adjustable from 80 to 212+.
7. Mark the switch positions and model number (e.g. **C100-1P(8/4)L**) on the model number label on the right side of the control. Shade the switches that are in the "off" position. Use a pencil so that this program can be updated at a later time. Example:



8. To reassemble the control:
- Replace the dip switch access cover & tighten 2 nuts.
  - Replace cover assembly. Make sure that the plastic transformer support is in place.
  - Install and tighten 4 cover screws.
9. Test the control functions. Use an **SS-15** Sensor Simulator or a **QC-1** Quick Check (both available from IE) to test every control function that you have programmed. A suitable test is included with each program option in Section IV, Detailed Instructions.

**IV. DETAILED INSTRUCTIONS**

All controls are shipped from the IE factory with all programming switches in the "on" position. This corresponds to:

C100-P1 = C100-1S  
 C100-P2 = C100-1S-2S  
 C100-P3 = C100-1S-2S (no function on 3rd output)  
 C120-P3 = C120-1S-3D-4D  
 C120-P4 = C120-1S-2S-3D-4D

Outputs 1 and 2 offer the same options on both C100 and C120 models.

**A. Output 1 (C100 & C120)****1. -1S On/Off Differential with 20/5°F Thresholds**

- a) Functional Description: On/Off control is based on the temperature differential between the "collector" and "storage" sensors. Output 1 turns on when the "collector" is 20°F hotter than "storage", and turns off when the difference is 5°F.
- b) Programming: A3 = on  
A4 = on
- c) Test: Follow the test procedure in the QC-1 Manual, or if using an SS-15, then:

Set storage to	100	
Adjust collector to	100	Output 1 off
	119	Output 1 off
	120	Output 1 on
	106	Output 1 on
	105	Output 1 off

Note if a high limit is programmed and the threshold is 100 or less then the test will have to be performed at a lower storage temperature.

**2. -1S(8/3) On/Off Differential with 8/3°F Thresholds**

- a) Functional Description: On/Off control is based on the temperature differential between the "collector" and "storage" sensors. Output 1 turns on when the "collector" is 8°F hotter than "storage", and turns off when the difference is 3°F.
- b) Programming: A3 = off  
A4 = on

- c) Test: Follow the test procedure in the QC-1 Manual, or if using an SS-15, then:

Set storage to	100	
Adjust collector to	100	Output 1 off
	107	Output 1 off
	108	Output 1 on
	104	Output 1 on
	103	Output 1 off

Note if a high limit is programmed and the threshold is 100 or less then the test will have to be performed at a lower storage temperature.

### 3.-1P Proportional Control with 16/5°F Thresholds

- a) Functional Description: The pump speed is varied proportionally to the temperature difference between the "collector" and "storage" sensors. Minimum speed (flow) starts at 5° and full speed (flow) is achieved at a 16° differential.

#### IMPORTANT

This control function can ONLY be used with permanent split capacitor or shaded pole motors. Suitable pumps include Grundfos UPS20-44SF, UPS20-48F, UPS20-42FA, UPS20-42, UPS25-42SF and Taco 006, 007, 008 and 009. Permanent damage to the C100/C120 control and/or the pump can occur if the wrong type of pump motor is used. Be safe: Consult with the pump supplier if you are not sure of the motor type.

DO NOT connect a relay to this output. IE does not recommend proportional control for loads larger than the C100/C120 standard 1/10 HP, 3A output rating.

- b) Programming: A3 = on  
A4 = off
- c) Test: Follow the test procedure in the QC-1 Manual, or if using an SS-15, then:

Set storage at	100	
Adjust collector to	104	Output 1 off
	105	Output indicator begins to flash (dimly)
	115	Output indicator flashing (bright)
	116	Output on

Note if a high limit is programmed and the threshold is 100 or less then the test will have to be performed at a lower storage temperature.

4. -1P(8/4) Proportional Control with 8/4°F Thresholds

- a) Functional Description: The pump speed is varied proportionally to the temperature difference between the "collector" and "storage" sensors. Minimum speed (flow) starts at 4° and full speed (flow) is achieved at a 8° differential.

## IMPORTANT

This control function can ONLY be used with permanent split capacitor or shaded pole motors. Suitable pumps include Grundfos UPS20-44SF, UPS20-48F, UPS20-42FA, UPS20-42, UPS25-42SF and Taco 006, 007, 008 and 009. Permanent damage to the C100/C120 control and/or the pump can occur if the wrong type of pump motor is used. Be safe: Consult with the pump supplier if you are not sure of the motor type.

DO NOT connect a relay to this output. IE does not recommend proportional control for loads larger than the C100/C120 standard 1/10 HP, 3A output rating.

- b) Programming: A3 = off  
A4 = off
- c) Test: Follow the test procedure in the QC-1 Manual, or if using an SS-15, then:

Set storage at	100	
Adjust collector to	103	Output 1 off
	104	Output indicator begins to flash (dimly)
	107	Output indicator flashing (bright)
	108	Output on

Note if a high limit is programmed and the threshold is 100 or less then the test will have to be performed at a lower storage temperature.

5. H High Limit (fixed or adjustable threshold)

- a) Functional Description: When the "storage" sensor exceeds the threshold set at the "aux 4" position output 1 is forced off regardless of the differential functions described above. Normal function returns when "storage" falls 3°F less than "aux 4".
- b) Program: (enable H for output 1) B4 = off  
(disable H for output 1) B4 = on

- c) Thresholds: Use the fixed resistors supplied with the C100 or the model **H(ADJ)** kit (purchased separately) to set the high limit threshold at the "aux 4" terminals. See Section V for details.
- d) Test: Follow the test procedure in the **QC-1** Manual, or if using an **SS-15** then:

Verify the threshold has been correctly set by displaying the "aux 4" position.

Set "Collector" to	212	
Set "Storage" to "aux 4"	-10°	Output 1 on
	"aux 4" -1°	Output 1 on
	"aux 4"	Output 1 off
	"aux 4" -2°	Output 1 off
	"aux 4" -3°	Output 1 off

## 6. **N** Nocturnal Cooling

- a) Functional Description: This function is for cooling when passive solar gain overheats the pool. The turn-on/turn-off thresholds from 1-4 above apply also to nocturnal cooling. Hence, when the "collector" is cooler than "storage" by the turn-on threshold (e.g. 20° if -1S is programmed) and the "storage" is greater than "aux 4" then output will turn on. In most instances, the **H** high limit option should also be programmed to prevent the active solar system from overheating the pool.
- b) Program: (enable **N**) B5 = off  
(disable **N**) B5 = on
- c) Thresholds: The minimum "storage" temperature for nocturnal must be set at "aux 4". If you have selected the **H** high limit function then this threshold is already set. If not, use the fixed resistors supplied with the C100 or the **H(ADJ)** kit (purchased separately). See Section V for details.
- d) Test: This function cannot be tested with a **QC-1**, use an **SS-15** as follows:

Set storage to	200	
Set collector to	200	Output 1 off
	180	Output 1 on
	197	Output 1 off
Set collector to	50	
Set storage to	"aux 4"	Output 1 on
	"aux 4"-3°	Output 1 off
	"aux 4"-1°	Output 1 off
	"aux 4"	Output 1 on

6. L Recirculate Freeze Protection

- a) Functional Description: When the "collector" sensor drops to 40° or less Output 1 turns on and remains on until the "collector" sensor rises to 45° or above. Note that if a GC-1 snap switch is wired in series with the "collector" sensor, it will simulate a very cold temperature when it opens at 44 +4°F. This recirculate freeze protection overrides all other control logic for Output 1.
- b) Program: A5 = on  
           B1 = off  
           B2 = on
- c) Test: Follow the procedure in the QC-1 Manual, or if using an SS-15 then:

Set "storage" at	100	
Set "collector" at	45	Output 1 off
	41	Output 1 off
	40	Output 1 on
	44	Output 1 on
	45	Output 1 off