MODELS C100 and C120

C100 and C120 models have many factory options to allow their use in a wide variety of system applications. It is important that the serviceman or installer be completely familiar with any options provided with the control being tested. Each control option is designated in the model number affixed to the top panel of your control. The model QC-1 Solar Control Tester may be used to test most all standard C100/120 options with a few exceptions as indicated in the pertinent section. Custom options (designated in model number suffix by (X-###) eg. (X-053)) may cause test results to be erroneous. Be sure to check operation of models with custom options before suspecting a control malfunction.

When using the model QC-1 to test C100/120 control operation, make adjustments s-l-o-w-l-y. The C100/120 display is updated only two times per second and by making fast adjustments you may overshoot the actual threshold being measured.

IMPORTANT: Check the model number (on top panel of control) and test each option code using the following index. C100/C120 controls shipped after Jan. 1982 have changes which include additional features and some deletions of less popular options. For these models, a date code (8201) or higher is stamped on the model number label. All controls shipped before Jan., 1982 do not have a date code marking.

All factory options are indicated in the model number. However if the control internal programming has been changed in the field without revising the model number, results in the tests that follow may be erroneous. If there is any doubt about how the control is programmed consult local IE representative or factory.

A. BASIC POWER TESTS FOR C100 AND C120 MODELS

1. Disconnect all sensor wiring from the C-100/120 and verify proper sensor temperatures and wiring by using the procedure described on page 46 of this guide. Some C100 models may be programmed with one or two fixed high limit functions for output 1 and/or output 2. For these models **DO NOT** remove resistors installed on the "AUX 3" and/or "AUX 4" sensor terminals.

2. POWER" light: When AC power is applied to the C100/120, the "POWER" light should illuminate, if not:

   *Check AC power connections:
   Black & White leads--115VAC
   Black & Red leads--230VAC

   *If the circuit breaker "opens" then the wiring or pump is most likely shorted. Make sure the problem is corrected before reapplying power--repeated current surges can permanently damage your C100/C120.

   *If all of the above are normal and "POWER" light does not illuminate, then the C100/C120 is defective.

B. DISPLAY TESTS FOR C100 AND C120 MODELS

1. Verify that when the "SENSOR SELECT" button is depressed the "SENSOR" display indicators scan from left to right and that all sensor channels without sensors connected indicate 32°F flashing (0°C for "C" model suffix).

2. Verify that models with fixed or adjustable high limit thresholds display the correct thresholds on the "AUX 3" and/or "AUX 4" ("STOR MAX" for C120 models) sensor display. Fixed thresholds may typically be 140, 160, 180, ±2°F. Adjustable high limit thresholds have two adjustment ranges, 70 - 180 for DHW, and 65 - 120 °F for POOL/SPA applications. For C120 models verify that the "STOR MIN" sensor display indicates the correct storage minimum threshold. Standard C120 models have an internally fixed 95 ± 2°F threshold. Models with -3I(adj) or -3D(adj) have an adjustable (70 - 180 °F) "STOR MIN" threshold.

3. Verify that when each sensor channel input is "shorted" (use short jumper wire) the corresponding "SENSOR" display flashes 212°F (100 °C for models with "C" suffix).

4. Each sensor channel may be optionally tested for accuracy using fixed 1% tolerance resistors with values that match the resistance to temperature chart on page 46. (eg. a 10,000 ohm 1% resistor connected to a sensor input will result in a display reading of 77 ± 1°F). Control accuracy may also be tested by using the model SS-15 sensor simulator.

C. OUTPUT OPERATION, RATINGS AND PRECAUTIONS

C100/120 controls have up to three (3) line voltage SOLID STATE (triac) outputs (outputs 1 thru 3). All C120 models have one (1) class II 24 VAC output (Output 4, "W2" terminal).

Outputs 1 through 3 are LINE VOLTAGE outputs (120VAC, 240VAC for 240V models). Output 4 (C120 model only) switches the externally applied 24VAC power from the "R" terminal to the "W" terminal when the Output 4 indicator is on.

Controls shipped after Jan. 1982 have a built in self test mode to check output turn on/off operation. To activate this test mode, add a jumper wire across the "AUX 2" sensor terminals. By using the "SENSOR SELECT" pushbutton, each output may be turned ON individually by scanning sensor channels from left to right (outputs 1 through 4 correspond to sensor channel indicators 1 through 4. For controls shipped before Jan. 1982, Each output and load may be checked for correct on/off operation while using the QC-1 in the following tests.

Triac outputs are very reliable when used in applications that are within specified design limits. Check to be sure that all output loads meet the following requirements.

*Output 1, 2 or 3 load ratings must not exceed 1/10 HP, 3A @ 120vac, 1.5A @ 240v (outputs with (1HP) option have maximum rating of 1 HP, 16A @ 120vac. Output 4 load rating must not exceed 24VA, 1A @ 24vac.

*Do not connect loads with built in solid state speed control to the C100/C120.

*NEVER short output wiring --- permanent output damage will result.

*Each output circuit has a "Snubber" network connected across the output triac. This network is necessary to provide reliable output turn off operation. The network supplies a small leakage current to the output load even when the output is off. This leakage current will not present any problem when the output is connected to typical pump loads. However, when a light duty load rated less than 10 watts is connected, the leakage current may not allow the load to turn off (relay chatter) when the C100 output turns off. If only a light duty load (eg. small relay) is connected to an output, install a 2500 ohm, 10watt resistor (5000 ohm, 10 watt for 240v models) across the load terminals.

*Proportional outputs (ie. C100-1P-2S) may only be connected only to permanent split capacitor or shaded pole motor loads.

D. C100 FUNCTIONAL TESTS (SEE SECTION E FOR C120 TESTS)

Refer to the following chart to perform tests for each C100 option included with the control to be tested.

C100 OUTPUT 1 TESTS

OPTION DESIGNATION	DESCRIPTION	PAGE
-1S, -1P, -1S(8/3 etc.) -1P(8/3 etc.)	Differential turn ON/OFF	20
-1...H, H(140 etc.) H(ADJ), H(PADJ)	Storage high temperature limit	21
-1...L	Recirculate freeze protection	22
-1...N	Nocturnal cooling (Reverse differential)	xx

C100 OUTPUT 2 TESTS (for models **without "A"** option (eg. -2S(8/3)

OPTION DESIGNATION	DESCRIPTION	PAGE
-2S, -2P, -2S(8/3 etc.) -2P(8/3 etc.)	Differential turn ON/OFF	23
-2...H, H(140 etc.) H(ADJ), H(PADJ)	Storage high temperature limit	24
-2F, -2FH	Drain-down freeze protection and high limit drain	21,22
-2W	Woodstove/fireplace grate high temperature limit	25

C100 OUTPUT 2 TESTS (For models **with "A"** option eg. -2S(8/3)**A**)

OPTION DESIGNATION	DESCRIPTION	PAGE
-2SA, -2PA, -2S(8/3 etc.)A -2P(8/3 etc.)A	Differential turn ON/OFF	26
-2...**H**A, H(140 etc.)A H(ADJ)A, H(PADJ)A	Storage high temperature limit	27
-2WA	Woodstove/fireplace grate high temperature limit	28

C100 OUTPUT 3 TESTS

OPTION DESIGNATION	DESCRIPTION	PAGE
-3F, -3FH	Drain-down freeze protection and high limit drain	21,22

-1Ⓢ

C100 OUTPUT 1 FUNCTIONAL TESTS (SEE SECTION E FOR C120 FUNCTIONAL TESTS)

-1Ⓟ DIFFERENTIAL TESTS, OUTPUT 1

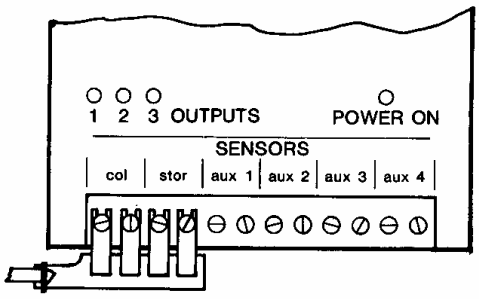

FIGURE 5

QC-1 SETUP: Connect QC1 per fig. 5
"TEST" switch --------"DIFFERENTIAL"
"MODEL" switch -------"C100/C120"
"DIFFERENTIAL" knob —"0" (full CCW)

CONTROL SETUP: For models with **H(PADJ)** option, adjust C100 high limit control to its warmest setting (full Clockwise position).

ADJUST THE QC-1: "DIFFERENTIAL" knob.

The C100/C120 "COLLECTOR" sensor channel should read 95 $\pm$1°F and the QC-1 "DIFFERENTIAL" knob is used to vary the C100 "STORAGE" sensor from 95° to 65°F.

Adjust the QC-1 "DIFFERENTIAL" knob to check the C100 differential thresholds (Output 1 turn on/off points).

For on/off controls ("-1S"), check the Output 1 turn-on and off points. The C100/C120 standard differential thresholds are 20 on/5 off (optional thresholds are indicated in the model number; e.g. C100-1S(8/3). For proportional controls (e.g."-1P") note the point where flow starts ("OUTPUT 1" indicator light begins to flash) and full flow (indicator stops flashing and remains constantly on). C100/C120 standard proportional differential thresholds are 16 full flow/5 begin flow (optional thresholds are indicated in the model number; e.g. C100-1P(8/4). In both cases, the differentials can be double checked using the C100/C120 display (subtract the "STORAGE" sensor temperature from the "COLLECTOR"). The QC-1 QUICK CHECK calibration marks should approximate the C100/120 indicated differential thresholds.

HIGH LIMIT TEST, OUTPUT 1

This test applies only to models with a storage high temperature limit programed for the Output 1 differential channel (eg. C100-1SH(adj)-2S).

QC-1 SETUP: Connect QC1 per fig. 5
"TEST" switch-------"HIGH LIMIT" (select correct range)
"MODEL" switch -------"C100/C120"

CONTROL SETUP: For models with **H(PADJ)** option, adjust C100 high limit control to its warmest setting (full Clockwise position).

ADJUST THE QC-1: "HIGH LIMIT" knob.

The Output 1 channel high limit threshold is determined by a fixed resistor externally connected, or a variable resistor internally connected to the "AUX" 4" sensor terminals and is displayed on the "AUX 4" sensor display. Fixed thresholds may typically be 140, 160, 180, $\pm 2^{o}$F. Adjustable high limit thresholds have two adjustment ranges, 70 - 180, and 65 - 120 ^{o}F for DHW and POOL/SPA applications respectively.

The C100 "COLLECTOR" temperature display should flash 212 and the "STORAGE" display should approximate ($\pm 5^{o}$) the Quick Check high limit scale markings.

Adjust the QC-1 "HIGH LIMIT" knob (the position of the other two knobs is irrelevant) and check that Output 1 turns off when the QC-1 is adjusted up to the high limit temperature threshold (indicated on "AUX 4" sensor channel) and turns back on 2^{o} lower than the threshold (3^{o}F for models produced after 1/82). For models with drain on high limit function included (eg. C100-1SH-**2FH** or -**3FH**), Output 1 turns back on 15^{o}F lower than the high limit threshold. See "HIGH LIMIT DRAIN TEST".

HIGH LIMIT DRAIN TEST

This test applies only to models with the high limit drain option (eg. C100-1SH-**2FH**, C100-1SH-**3FH**).

Check that the drain-down output (either output 2 or 3 as indicated in the model number) coincidently turns off with Output 1 during the high limit test previously described.

-1Ⓗ

-2FⒽ

RECIRCULATE FREEZE, PROTECTION, OUTPUT 1

-3FⒽ This test applies only to models with Recirculate Freeze Protection (e.g. C100-1SL). Place the QUICK CHECK "TEST" switch in the "FREEZE" position and the "MODEL" switch to "C100/C120".

QC-1 SETUP: Connect QC1 per fig. 5
"TEST" switch --------"FREEZE"
"MODEL" switch -------"C100/C120"
"DIFFERENTIAL" knob --"0" (full CCW)

CONTROL SETUP: None

ADJUST THE QC-1: "FREEZE" knob.

Adjust the QC-1 "FREEZE" knob. The C100 "COLLECTOR" sensor display should correspond to the QUICK CHECK freeze scale markings ($\pm 2^{o}$F). While monitoring the C100 "Collector" sensor display note the points where Output 1 turns on and off.

On C100/C120's produced before January, 1982 recirculation should start when the temperature falls to 38°F and stop when the temperature rises to 43°F. On later models the thresholds are 40° and 45° respectively. A major deviation ($\pm 5^{o}$) from these thresholds indicates a control problem.

DRAIN-DOWN FREEZE PROTECTION

This test aplies only to models with drain-down freeze protection (e.g. C100 models with **-2F** or **-3F** in the nomenclature).

Set up QC-1 the same as for Recirculate freeze test above.

Adjust the QC-1 "FREEZE" knob. The C100 "COLLECTOR" sensor display should correspond to the QUICK CHECK freeze scale markings ($\pm 2^{o}$F). On C100/C120's produced before January 1982, the drain output (output 2 or 3 depending on model)should turn off at 38° and on at 43°F. On C100/C120's produced after January 1982, these thresholds changed to 44°F and 64°F respectively.

D. C100 FUCTIONAL TESTS (cont.) - OUTPUT 2 (MODELS **WITHOUT** **"A"** OPTION.

IMPORTANT: The following tests in this section are for C100 models **without the "A"** option. For models with the "A" option (eg C100-1S-2S**A**) next section.

DIFFERENTIAL TEST, (OUTPUT 2)

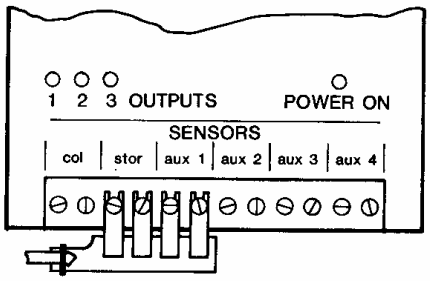

FIGURE 6

QC-1 SETUP: Connect QC1 per fig. 6
"TEST" switch --------"DIFFERENTIAL"
"MODEL" switch --------"C30/C35" **NOT "C100/C120"**
"DIFFERENTIAL" knob --"0" (full CCW)

CONTROL SETUP: For models with **H(PADJ)** option, adjust C100 high limit control to its warmest setting (full Clockwise position).

ADJUST THE QC-1: "DIFFERENTIAL" knob.

The C100 "AUX 1" (aux heat source sensor) sensor display should indicate 95 ± 2°F. The QC-1 "DIFFERENTIAL" knob is adjusted to vary the C100 "STORAGE" sensor channel from 95 to 65 °F as indicated on the "STORAGE" sensor display.

Adjust the QC-1 "DIFFERENTIAL" knob to check the Output 2 turn on and turn off points.

For on/off controls, check the turn-on and off points. The C100 standard is 20 on/5 off (optional thresholds are indicated on the model number; e.g. C100-1S-2S(8/3). For proportional controls (e.g."-2P") note the point where flow starts (output 2 indicator light begins to flash) and full flow (indicator stops flashing and remains constantly on). The C100/C120 standard is 16 full flow/5 begin flow (optional thresholds are indicated in the model number; e.g. C100-1S-2P(8/4). In both cases, the differentials can be double checked using the C100 display and also the QUICK CHECK calibration marks.

2. HIGH LIMIT TEST, OUTPUT 2

IMPORTANT: The Output 2 high limit function cannot be tested using the QC-1 for controls produced before Jan. 1982 (controls produced after Jan. 1982 have Date Code on Model No. label) or any control with the "W" option (eg. C100-1S-2SW).

This test applies only to models with a storage high temperature limit programed for the Output 2 differential channel (eg. C100-1S-2SH).

QC-1 SETUP: Connect QC1 per fig. 6
"TEST" switch-------"HIGH LIMIT" (selectcorrect range)
"MODEL" switch -------"C30/C35" **NOT "C100/C120"**

CONTROL SETUP: None

ADJUST THE QC-1: "HIGH LIMIT" knob.

The Output 2 channel high limit threshold is determined by a fixed resistor externally connected, or a variable resistor internally connected to the "AUX" 4" sensor terminals and is displayed on the "AUX 4" sensor display. Fixed thresholds may typically be 140, 160, 180, $\pm 2^{o}$F. Adjustable high limit thresholds have two adjustment ranges, 70 - 180, and 65 - 120 ^{o}F for DHW and POOL/SPA applications respectively.

The C100 "AUX 1" temperature display should flash 212 and the "STORAGE" display should approximate ($\pm 5^{o}$) the Quick Check high limit scale markings.

Adjust the QC-1 "HIGH LIMIT" knob (the position of the other two knobs is irrelevant) and check that Output 2 turns off when the QC-1 is adjusted up to the high limit temperature threshold (indicated on "AUX 4" sensor channel) and turns back on 3^{o} lower than the threshold.

For models with the drain on high limit option (C100-1S-2SH-3FH) temporarily "short circuit" the C100 "COLLECTOR" sensor terminals and verify that Output 3 turns on and off coincidently with output 2 during the high limit test above.

WOOD STOVE/FIREPLACE GRATE HIGH LIMIT (-2SW OPTION)

This control function is used to prevent cold storage water from being circulated through a fireplace grate heat exchanger that is above 210°F ("AUX 1" sensor).

Controls shipped before Jan. 1982 have this feature as standard even though it was not indicated in the models number. Controls shipped after Jan. 1982 have this function only as ordered (eg. C100-1S-2SW).

QC-1 SETUP: Connect QC1 per fig. 6
"TEST" switch-------"DIFFERENTIAL"
"MODEL" switch -------"C30/C35" **(NOT "C100/C120")**

CONTROL SETUP: For models with **H(PADJ)** option, adjust C100 high limit control to its warmest setting (full Clockwise position).

ADJUST THE QC-1: "DIFFERENTIAL" knob to turn Output 2 ON.

The QC-1 will **NOT** test this threshold for accuracy however a basic check may be accomplished by the following method.

Output 2 shall turn off when the "AUX 1" sensor terminals are "shorted" with a jumper wire (simulates a grate temperature above 210 °F).

-2(S)A

-2(P)A D. C100 FUNCTIONAL TESTS (cont.) - OUTPUT 2 TESTS, MODELS **WITH A OPTION.**

> **IMPORTANT:** The following tests in this section are for C100 models **with** the "A" option (eg. C100-1S-2S**A**). For models without the "A" option see page 23.

DIFFERENTIAL TEST, (OUTPUT 2)

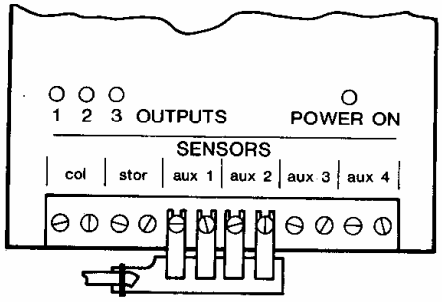

FIGURE 7

QC-1 SETUP: Connect QC1 per fig. 7
"TEST" switch --------"DIFFERENTIAL"
"MODEL" switch -------"C100/C120"
"DIFFERENTIAL" knob --"0" (full CCW)

CONTROL SETUP: For models with **H(PADJ)** option, adjust C100 high limit control to its warmest setting (full Clockwise position).

ADJUST THE QC-1: "DIFFERENTIAL" knob.

The C100 "AUX 1" (aux heat source sensor) sensor display should indicate 95 $\pm$ 2°F. The QC-1 "DIFFERENTIAL" knob is adjusted to vary the C100 "AUX 2" sensor channel from 95 to 65 °F as indicated on the "AUX 2" sensor display.

Adjust the QC-1 "DIFFERENTIAL" knob to check the Output 2 turn on and turn off points.

For on/off controls, check the turn-on and off points. The C100 standard is 20 on/5 off (optional thresholds are indicated on the model number; e.g. C100-1S-2S(8/3)A. For proportional controls (e.g."-2P") note the point where flow starts (output 2 indicator light begins to flash) and full flow (indicator stops flashing and remains constantly on). The C100/C120 standard is 16 full flow/5 begin flow (optional thresholds are indicated in the model number; e.g. C100-1S-2P(8/4)A. In both cases, the differentials can be double checked using the C100 display and also the QUICK CHECK calibration marks.

2. HIGH LIMIT TEST, OUTPUT 2

IMPORTANT: The Output 2 high limit function cannot be tested using the QC-1 for controls produced before Jan. 1982 (controls produced after Jan. 1982 have Date Code on Model No. label) or any control with the "W" option (eg. C100-1S-2SW).

This test applies only to models with a storage high temperature limit programed for the Output 2 differential channel (eg. C100-1S-2SHA).

QC-1 SETUP: Connect QC1 per fig. 7
"TEST" switch-------"HIGH LIMIT" (select correct range)
"MODEL" switch -------"C100/C120"

CONTROL SETUP: None

ADJUST THE QC-1: "HIGH LIMIT" knob.

NOTE: Do not adjust the QC-1 "HIGH LIMIT" knob above 212°F, otherwise the C100 "AUX 2" sensor channel input resistance will be low enough to initiate the self test mode (as explained on page 17) and cause erroneous results.

The Output 2 channel high limit threshold is determined by a fixed resistor externally connected, or a variable resistor internally connected to the "AUX" 3" sensor terminals and is displayed on the "AUX 3" sensor display. Fixed thresholds may typically be 140, 160, 180, ±2°F. Adjustable high limit thresholds have two adjustment ranges, 70 - 180, and 65 - 120 °F for DHW and POOL/SPA applications respectively.

The C100 "AUX 1" temperature display should flash 212 and the "AUX 2" display should approximate (±5°) the Quick Check high limit scale markings.

Adjust the QC-1 "HIGH LIMIT" knob (the position of the other two knobs is irrelevant) and check that the C100 Output 2 turns off when the QC-1 is adjusted up to the high limit temperature threshold (indicated on "AUX 3" sensor channel) and turns back on 3° lower than the threshold.

-2 Ⓦ A

WOOD STOVE/FIREPLACE GRATE HIGH LIMIT (-2SAW OPTION)

This control function is used to prevent cold storage water from being circulated through a fireplace grate heat exchanger that is above 210°F ("AUX 1" sensor).

Controls shipped before Jan. 1982 have this feature as standard, Controls shipped after Jan. 1982 have this function as ordered (eg. C100-1S-2SW). if the option

QC-1 SETUP: Connect QC1 per fig. 7
"TEST" switch-------"DIFFERENTIAL"
"MODEL" switch -------"C100/C120"

CONTROL SETUP: For models with -2SH(PADJ) option, adjust C100 high limit control to its warmest setting (full Clockwise position).

ADJUST THE QC-1: "DIFFERENTIAL" knob to turn Output 2 ON.

The QC-1 will **NOT** test this threshold for accuracy however a basic check may be accomplished by the following method.

Output 2 shall turn off when the "AUX 1" sensor terminals are "shorted" with a jumper wire (simulates a grate temperature above 210 °F).