E. FUNCTIONAL TESTS - C120 MODELS

The model C120 is designed for use with solar space heating applications. It may be factory programmed for two basic system configurations, for solar systems that heat the space with stored heat only (models with -3I-4B option) or systems that heat the space from either storage (indirect heating) or from the collector array (direct heating), (models with -3D-4D option).

Output 1 and 2 operate similar to, and may be ordered with most all the options offered with the C100 model.

Output 1 is used to control solar collection based on the "Collector" minus "Storage" sensor differential temperature.

Output 2 may optionally be used for controlling collection from a second heat source to the main storage (ie. fireplace grate) based on the "Aux 1" minus "Storage" sensor differential temperature. Models with the Output 2 "A" option specified (eg. C120-1S-2SA-3I-4B)" may be used for performing a heat transfer function based on the "AUX 1" minus "AUX 2" differential temperature (ie. heating a DHW tank from the main storage system). Output 2 options were not provided with -3I-4B models produced before Jan. 1982.

Output 3 and 4 on all C120 models are used for control of space heating functions and do not operate unless the thermostat "W1" input is activated (space thermostat calling for heat).

Output 3 on all C120 models is used to to perform a heat distribution function. When the thermostat calls for heat (C120 "W1" input activated) and the storage temperature is above the "Stor Min" threshold, Output 3 activates the heat transfer system (pump/valves or fan/dampers).

Output 4 is a CLASS II 24 vac output used to perform two entirly different functions dependent on the model ordered. For -3I-4B models output 4 is used to turn on a backup heat source when the "W1" thermostat input is activated and there is insufficient heat in solar storage. For -3D-4D models output 4 is used to control a diversion valve or damper when the "W1" input is activated and the "Collector" sensor temperature is greater than the "Stor Min" threshold (direct solar heating mode). Actual thresholds will be described in each pertient section.

Output 4 is an isolated solid state (triac) output. When output 4 is on, the triac connects the "R" and "W2" terminals together. This switches the 24 Vac input (applied to the "R" terminal) to the output 4 ("W2") terminal.

IMPORTANT: The following tests are for all C120 models manufactured **AFTER** Jan., 1982. Previuosly manufactured C120 models can **NOT** be tested using the QC1. See model label on top of control. Models manufactured after Jan., 1982 have a date code number 8201 (1st week of 1982) or later. Previous models did not have a date code marking.

1. Output 1 tests, all C120 models shipped after Jan. 1982.
2. Output2tests, all C120 models **WITHOUT "A"** option.
3. Output 2 tests, C120 models **WITH "A"** option (eg. C120-1S-2S**A**-3I-4B
4. Output 3 and 4 space heating functional tests.

-1Ⓢ

1. OUTPUT 1 TESTS, ALL C120 MODELS SHIPPED AFTER JAN., 1982.

-1Ⓟ

IMPORTANT: The following tests are for all C120 models manufactured after Jan., 1982. See model label on top of control. Models manufactured after Jan., 1982 have a date code number 8201 (1st week of 1982) or later. Previous models did not have a date code marking.

DIFFERENTIAL TESTS, OUTPUT 1

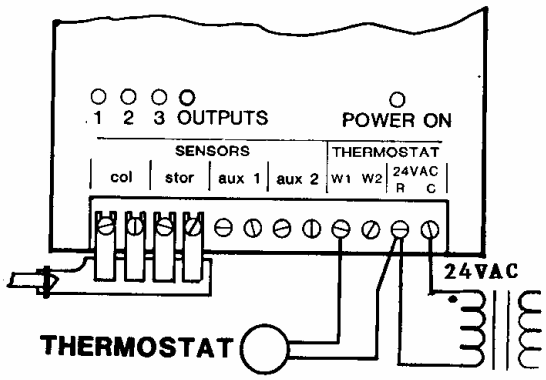

FIGURE 8

QC-1 SETUP: Connect QC1 per fig. 8
"TEST" switch --------"DIFFERENTIAL"
"MODEL" switch -------"C100/C120"
"DIFFERENTIAL" knob --"0" (full CCW)

CONTROL SETUP: For models with **H(PADJ)** option, adjust C120 high limit control to its warmest setting (full Clockwise position).

ADJUST THE QC-1: "DIFFERENTIAL" knob.

The C120 "Collector" sensor display should indicate 95 ± 2°F. The QC-1 "DIFFERENTIAL" knob is adjusted to vary the C120 "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 1 turn on and turn off points.

For on/off controls, check the turn-on and off points. The C120 standard is 20 on/5 off (optional thresholds are indicated on the model number; e.g. C120-1S(8/3)-3I-4B. 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). The C100/C120 standard is 16 full flow/5 begin flow (optional thresholds are indicated in the model number; e.g. C120-1S(8/4)-3I-4B. In both cases, the differentials can be double checked using the C100 display and also the QUICK CHECK calibration marks.

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. C120-1SH(adj)-3I-4B).

QC-1 SETUP: Connect QC1 per fig. 8
"TEST" switch-------"HIGH LIMIT" (select correct range)
"MODEL" switch -------"C100/C120"

CONTROL SETUP: For models with **H(PADJ)** option, adjust C120 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 or a variable resistor internally connected to and displayed on the "Stor Max" sensor channel.

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.

The C120 "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 "Stor Max" sensor channel) and turns back on 3^{o} lower than the threshold. For models with drain on high limit function included (eg. C120-1SH-2F-3I-4B), 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 (e.g. C120-1SH-**2FH**-3I-4B)

Check that the drain-down output (output 2) coincidently turns off with Output 1 during the high limit test previously described.

C120

-1Ⓛ

RECIRCULATE FREEZE, PROTECTION, OUTPUT 1

-2Ⓕ This test applies only to models with Recirculate Freeze Protection (e.g. C120-1SL). Place the QUICK CHECK "TEST" switch in the "FREEZE" position and the "MODEL" switch to "C100/C120".

QC-1 SETUP: Connect QC1 per fig. 8
"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 C120 "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.

Recirculation should start (output 1 on) when the "Collector" sensor temperature falls to $40^{o}F$ and stop when the temperature rises to $45^{o}F$.A major deviation ($\pm 5^{o}$) from these thresholds indicates a control problem.

DRAIN-DOWN FREEZE PROTECTION

This test applies only to models with drain-down freeze protection (e.g.C120-1S-2F-3I-4B).

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

Adjust the QC-1 "FREEZE" knob. The C120 "COLLECTOR" sensor display should correspond to the QUICK CHECK freeze scale markings ($\pm 2^{o}F$).

Output 2 should turn off (system drains) when the C120 "Collector" sensor temperature falls to 44 and turn back on (system refills) when the "Collector" temperature rises to $64^{o}F$. A major deviation ($\pm 2^{o}$ for drain, or $\pm 5^{o}F$ for refill) indicates a control problem.

2. C120 FUCTIONAL TESTS (cont.) - OUTPUT 2 (MODELS **WITHOUT** **"A"** OPTION).

> **IMPORTANT:** The following tests in this section are for C120 models **without the "A"** option. For models with the "A" option (eg C120-1S-2SA) see next section (section 3).

DIFFERENTIAL TEST, (OUTPUT 2)

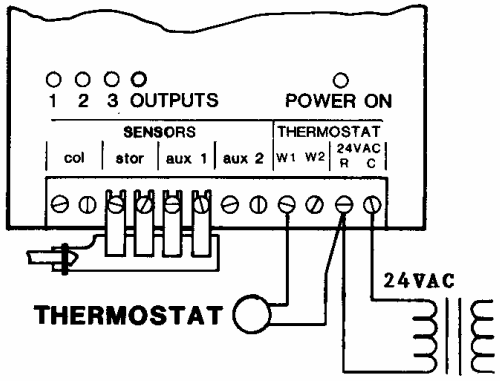

FIGURE 9

QC-1 SETUP: Connect QC1 per fig. 9
"TEST" switch --------"DIFFERENTIAL"
"MODEL" switch -------"C30/C35" **NOT "C100/C120"**
"DIFFERENTIAL" knob --"0" (full CCW)

CONTROL SETUP: For models with **H(PADJ)** option, adjust C120 high limit control to its warmest setting (full Clockwise position).

ADJUST THE QC-1: "DIFFERENTIAL" knob.

The C120 "AUX 1" (aux heat source sensor) sensor display should indicate 95 ± 2°F. The QC-1 "DIFFERENTIAL" knob is adjusted to vary the C120 "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 C120 standard is 20 on/5 off (optional thresholds are indicated on the model number; e.g. C120-1S-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 C120 display and also the QUICK CHECK calibration marks.

HIGH LIMIT TEST, OUTPUT 2

IMPORTANT: The Output 2 high limit function cannot be tested using the QC-1 for any C120 control with the "W" option (eg. C120-1S-2SW).

This test applies only to models with a storage high temperature limit programed for the Output 2 differential channel (eg. C120-1S-2SH)-3I-4B).

QC-1 SETUP: Connect QC1 per fig. 9
"TEST" switch--------"HIGH LIMIT" (select correct 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 or variable resistor internally connected to, and displayed on, the "Stor Max" sensor channel. Fixed thresholds may typically be 140, 160, 180, ±2°F. Adjustable high limit thresholds have two adjustment ranges, 70 - 180, and 65 - 120 °F.

The C120 "AUX 1" temperature display should flash 212 and the "STORAGE" 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 Output 2 turns off when the QC-1 is adjusted up to the high limit temperature threshold (indicated on "Stor Max" sensor channel) and turns back on 3° lower than the threshold.

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 after Jan. 1982 have this function if ordered (eg. C120-1S-2SW-3I-4B).

QC-1 SETUP: Connect QC1 per fig. 9
"TEST" switch-------"DIFFERENTIAL"
"MODEL" switch -------"C30/C35" **(NOT "C100/C120")**

CONTROL SETUP: For models with **H(PADJ)** option, adjust C120 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

3. C120 - OUTPUT 2 TESTS (MODELS WITH "A" OPTION, eg. C120-1S-2SA-3I-4B).

-2(P)A

IMPORTANT: The following tests in this section are for C120 models **with the "A"** option (eg C120-1S-2SA). For models without the "A" option see previous section (page 33).

DIFFERENTIAL TEST, (OUTPUT 2)

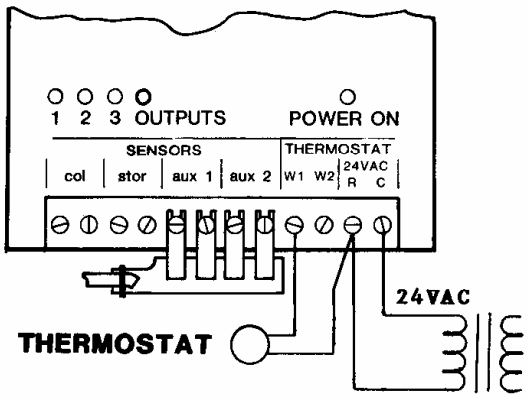

FIGURE 10

QC-1 SETUP: Connect QC1 per fig. 10
"TEST" switch --------"DIFFERENTIAL"
"MODEL" switch -------"C100/C120"
"DIFFERENTIAL" knob --"0" (full CCW)

CONTROL SETUP: none

ADJUST THE QC-1: "DIFFERENTIAL" knob.

The C120 "AUX 1" (aux heat source sensor) sensor display should indicate 95 ± 2°F. The QC-1 "DIFFERENTIAL" knob is adjusted to vary the C120 "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 C120 standard is 20 on/5 off (optional thresholds are indicated on the model number; e.g. C120-1S-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 C120 display and also the QUICK CHECK calibration marks.

HIGH LIMIT TEST, OUTPUT 2

IMPORTANT: The Output 2 high limit function cannot be supplied for C120 models with the -2S**"A"**

WOOD STOVE/FIREPLACE GRATE HIGH LIMIT (-2SWA 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 after Jan. 1982 have this function if ordered (eg. C120-1S-2SWA-3I-4B).

QC-1 SETUP: Connect QC1 per fig. 10
"TEST" switch-------"DIFFERENTIAL"
"MODEL" switch -------"C100/C120")

CONTROL SETUP: None

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).

4. OUTPUT 3 AND 4 FUNCTIONAL TESTS

-3I-4B MODELS (See page 40 for -3D-4D models)

Outputs 3 and 4 perform space heating control functions when the space thermostat calls for heat (C120 "W1" input activated). Output 3 activates the system heat distribution function to transfer heat from storage to the space when the storage temperature is above the C120 "stor min" threshold. Output 4 turns on the back up heat (ie. furnace, electric heat etc.) if the storage temperature is below the "Stor Min" threshold.

The storage temperature is measured at the top of the storage tank (Minimizes errors due to stratafication). The actual C120 sensor used to measure the top storage temperature is dependent on the control model. Standard C120 models utilize the "AUX 2" sensor for this function. C120 models with the "A" option (eg. C120-1S-2SA) utilize the "AUX 1" sensor.

Connection to the C120 is dependent on the control model. Connect the QC-1 as indicated below.

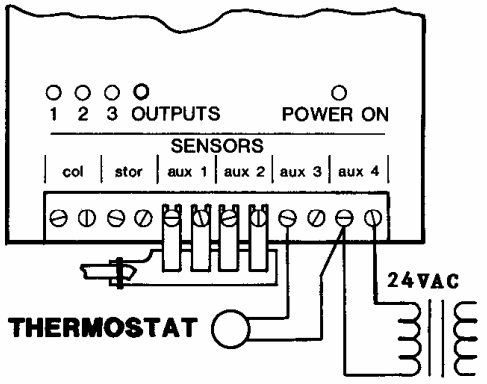

FIGURE 11

C120 MODELS WITHOUT "A" OPTION

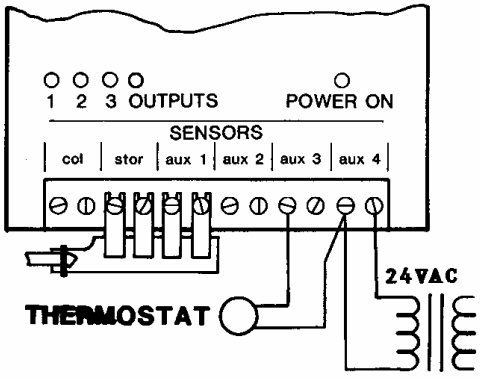

FIGURE 11A

C120 MODELS **WITH** "A" OPTION
(eg. C120-1SH-2PA-3I-4B)

QC-1 SETUP: Connect QC1 per fig. 11
"TEST" switch-------"HIGH LIMIT" (select80 - 110 range)
"MODEL" switch -------"C100/C120"

CONTROL SETUP: Check "Stor Min" threshold. For models with -3I**(ADJ)** or 3D**(ADJ)** option, set the "Stor Min" threshold to an even value (eg. 100 °F).

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

OUTPUT 3 AND 4 TEST

The following test checks output 3 and 4 operation. To perform this test, the thermostat input and 24Vac transformer must be connected to the C120 as shown in figure 11 above.

For models with the "A" option, the "Storage" display shall indicate flashing 212°F and the "AUX 1" display will approximate the QC-1 high limit scale markings. For all other models the "AUX 1" sensor channel indicates flashing 212°F and that when the QC-1 "HIGH LIMIT" knob is adjusted, the C120 "AUX 2" sensor display approximates the QC-1 high limit scale markings.

Turn off the C120 thermostat input by setting the thermostat below room temperature or by disconnecting the wire at the C120 "W1" terminal.

Verify that Output 3 and 4 indicators are off and that loads connected to outputs 3 and 4 are de-activated.

Turn the C120 thermostat input on by adjusting the thermostat above the room temperature or connect a jumper wire from the "R" terminal to the "W1" terminal. **Be careful not to make contact between sensor input terminals and 24Vac wiring —— permanent control damage will result.**

The following test checks the C120 response to a call for heat by the thermostat. The test also verifies that when the storage reference sensor ("AUX 2" for standard models, "AUX 1" for models with "A" option) temperature is greater than the "Stor min" threshold, Output 3 turns on to transfer heat from storage to the space to be heated and when the storage reference sensor temperature falls below the "Stor Min" threshold, output 4 turns on to activate back up heat.

Adjust the QC-1 "HIGH LIMIT" knob while monitoring the C120 "AUX 2" ("AUX 1" for models with "A" option) sensor display and verify that when the "Storage" display is increased to the "Stor Min" threshold, Output 3 turns on. Now decrease the C120 "Storage" sensor temperature to 5°F below the "Stor Min" threshold and verify that output 3 turns off and Output 4 turns on.

Verify that all loads such as pumps, dampers, or relays connected to output 3 and 4 respond correctly

-3D-4D MODELS (For -3I-4B models see page 38)

The C120...-3D-4D model is used for solar space heating systems that are heated both "INDIRECTLY" by stored solar heat, or "DIRECTLY" by solar heat colllected at the solar panels.

Outputs 3 and 4 perform space heating control functions when the space thermostat calls for heat (C120 "W1" input activated). Output 3 activates the system "INDIRECT" heat distribution function to transfer heat from storage to the space. When the "Collector" temperature is above the C120 "stor min" threshold Output 4 turns on to activate a diversion valve or damper to divert collected solar heat directly to the heated space. In this mode (DIRECT heating) output 1 turns on coincidently with output 4 regardless of the "STORAGE" sensor temperature. To take advantage of higher system efficiency while operating in the "DIRECT" heating mode, the C120 control logic causes the "DIRECT" heating mode to have priority over the "INDIRECT" mode.

The storage temperature is measured at the top of the storage tank (Minimizes errors due to stratafication). The actual C120 sensor used to measure the top storage temperature is dependent on the control model. Standard C120 models utilize the "AUX 2" sensor for this function. C120 models with the "A" option (eg. C120-1S-2SA) utilize the "AUX 1" sensor.

OUTPUT 3 FUNCTIONAL TEST

Connection to the C120 is dependent on the control model. Connect the QC-1 as indicated below.

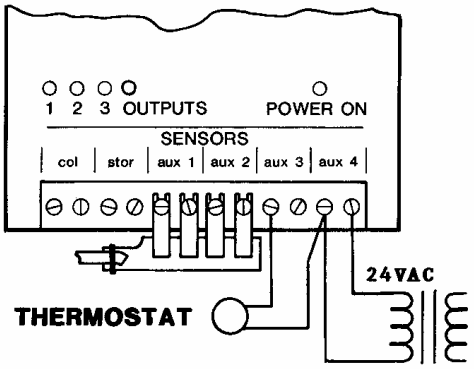

FIGURE 12

C120 MODELS WITHOUT "A" OPTION

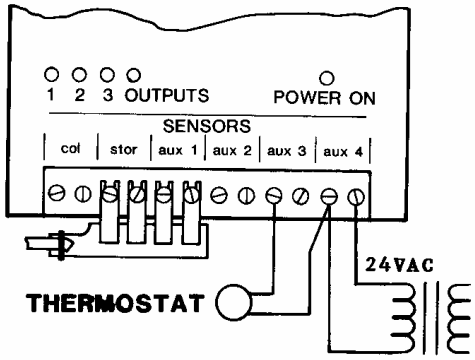

FIGURE 12A

C120 MODELS **WITH** "A" OPTION

(eg. C120-1SH-2PA-3D-4D)

QC-1 SETUP: Connect QC1 per fig. 12
"TEST" switch-------"HIGH LIMIT" (select80 - 110 range)
"MODEL" switch -------"C100/C120"

CONTROL SETUP: Check "Stor Min" threshold. For models with -3D**(ADJ)** set the "Stor Min" threshold to an even value (eg. 100 ^{o}F).

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

The following test checks output 3 operation. To perform this test, the thermostat input and 24Vac transformer must be connected to the C120 as shown in figure 12.

For models with the "A" option, the "Storage" display shall indicate flashing 212^{o}F and the "AUX 1" display will approximate the QC-1 high limit scale markings. For all other models the "AUX 1" sensor channel indicates flashing 212^{o}F and that when the QC-1 "HIGH LIMIT" knob is adjusted, the C120 "AUX 2" sensor display approximates the QC-1 high limit scale markings.

Turn off the C120 thermostat input by setting the thermostat below room temperature or by disconnecting the wire at the C120 "W1" terminal.

Verify that Output 3 and 4 indicators are off and that loads connected to outputs 3 and 4 are de-activated.

Turn the C120 thermostat input on by adjusting the thermostat above the room temperature or connect a jumper wire from the "R" terminal to the "W1" terminal. **Be careful not to make contact between sensor input terminals and 24Vac wiring —— permanent control damage will result.**

The following test checks the C120 response to a call for heat by the thermostat. The test also verifies that when the storage reference sensor ("AUX 2" for standard models, "AUX 1" for models with "A" option) temperature is greater than the "Stor min" threshold, Output 3 turns on to transfer heat from storage to the space to be heated.

Adjust the QC-1 "HIGH LIMIT" knob while monitoring the C120 "AUX 2" ("AUX 1" for models with "A" option) sensor display and verify that when the display is increased to the "Stor Min" threshold, Output 3 turns on. Now adjust the QC-1 "HIGH LIMIT" knob and verify that Output 3 turns off when the display is 5^{o}F less than the "Stor Min" threshold.

Verify that all loads such as pumps, dampers, or relays connected to output 3 respond correctly.

C120

-3D

OUTPUT 4 FUNCTIONAL TEST

-4D To test the "DIRECT" heating mode (OUTPUT 4 operation) connect the QC-1 as shown.

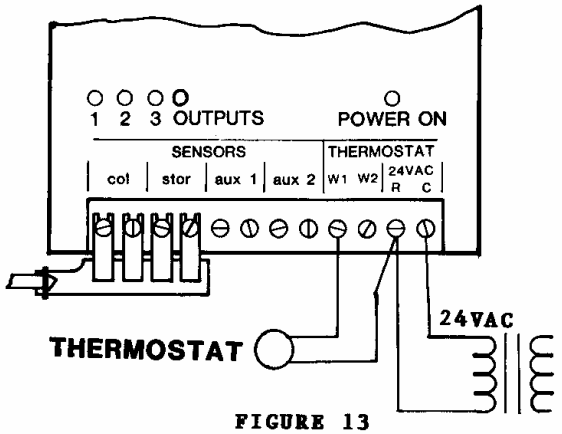

FIGURE 13

QC-1 SETUP: Connect QC1 per fig. 13
"TEST" switch--------"HIGH LIMIT" (select80 - 110 range)
"MODEL" switch -------"C30/C35" **NOT "C100/C120"**

CONTROL SETUP: Check "Stor Min" threshold. For models with -3D**(ADJ)** set the "Stor Min" threshold to an even value (eg. 100 ^{o}F).

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

Turn the thermostat ON (C120 "W1" input activated).

The C120 "Collector display should approximate the QC-1 high limit scale markings. Adjust the QC-1 "HIGH LIMIT" knob and verify that when the "Collector" temperature is increased to 5^{o}F above the "Stor Min" threshold, Output 1 and 4 turn ON. Outputs 1 and 4 should turn off when the "Collector" temperature is decreased to 5^{o}F below the "Stor Min" threshold or if the thermostat is turned off.

Verify that loads connected to output 4 respond correctly.

****

This completes all tests for C120 models. If you still suspect a problem exists but no problems were identified by using the previous test procedure (did you check sensor wiring and sensors per page 46) then contact either the wholesaler from whom you purchased the control, the nearest IE representative, or the IE factory for additional troubleshooting assistance.