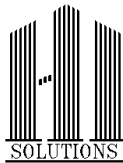


M8036000A-02  
September 10, 1998  
Rev. 6/1/09

# *Field Commander*

# UNITARY CONTROLLER



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Kennesaw, GA 30144  
(770) 423-1150



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## 1.0 General Description

Unitary controllers have a feature set which is associated with the program ROM. Most controllers have a U series ROM. The X series ROMs can be used with UUC-4, UUC-8 and UUC-0 controllers to have some additional functions. (At the present time there is no X series ROM for UTC controllers.) Unitary controllers with X and U series ROMs can be intermixed on the unitary network. The basic controller functions of X and U series ROMs are the same. The X ROMs have a few additional functions.



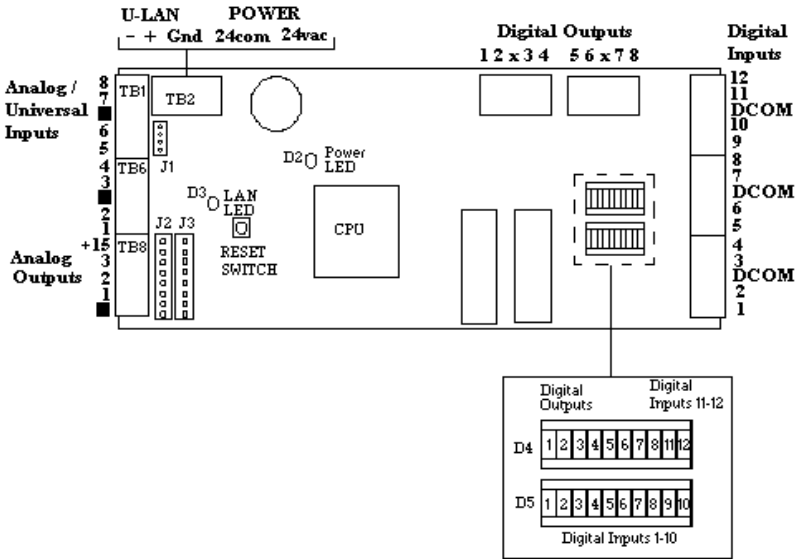
This document uses the ICON shown to the left to denote features that are new to the X series ROM and that are different from the U series ROM.

### 1.1 General (UUC-8)

The unitary controller board (4038) can be ordered with four configuration options. They are 4038-TF, 4038-RF, 4038-TG, and 4038-RG. The 'T' signifies that TRIACS are installed on the boards for controlling 24vac loads. The 'R' denotes that relays are present on the boards for controlling AC or DC loads. The 'F' means that if AC power is used, a floating 24vac power source should be used, whereas the 'G' indicates that the 24vac source must have one side of the secondary grounded. Any configuration can be used with 24vdc power. Since the 4038-TG board is used in almost all installations, it will be the primary focus of this document. For information on the 4038-TF, 4038-RF and 4038-RG, see Appendix A.

The unitary controller board (Figure 1) may be mounted directly on the equipment being controlled or in a separate control box. In either case standard 3-1/4" PVC track is used to mount the board. An optional control box is available with the track installed. This box may also be supplied with a 24vac isolation transformer or a 115vac to 24vac transformer.

All power and device wiring on the unitary controller is done via quick disconnect terminal blocks in groups of 5 terminals. Connection to controller thermostats is made using eight pin cable connector(s).



**FIGURE 1**

The power termination block (TB2) contains the input power and LAN connection. The digital output terminal blocks (TB3, TB4) contain four outputs each and a common. The 12 digital inputs are connected on three terminal blocks (TB5, TB7, TB9). These terminal blocks each have a common on the center terminal. Two blocks of LEDs (D4 and D5) display the status of digital outputs and inputs. The 8 analog/universal inputs are located on two terminal blocks (TB1, TB6), each with a ground on the center terminal. The three analog outputs are located on a terminal block (TB8) along with a ground and a +15vdc output. The controller supports one of two thermostats that are connected to J2 and J3. The four-pin connector (J1) is used to connect a PC to the unitary LAN. The board also includes a manual RESET switch and lights to indicate controller power and unitary LAN receive data.

## 1.2 UUC-4

The UUC-4 (016-4047) is a version of the UUC-8 designed to control smaller devices or individual A/C units. The UUC-4 looks like a UUC-8 that has been "chopped off" on the digital input end of the board. It has 4 digital outputs (instead of 8) and only analog/universal inputs (no dedicated digital inputs).

Two advantages of the UUC-4 are 1) it is more cost efficient than a UUC-8 for equipment that doesn't require as many control points, and 2) as an alternative to controlling two A/C units from one UUC-8, controlling each unit separately with a UUC-4 requires less wiring and allows the possibility of mounting the UUC-4 within the unit housing.

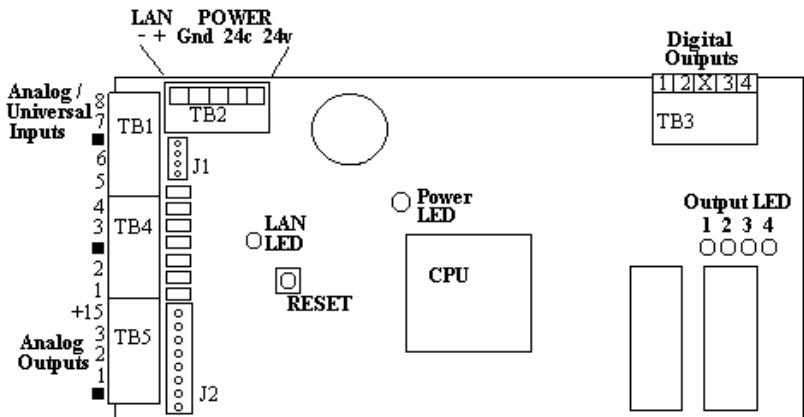


FIGURE 2

The power termination block (TB2) contains the input power and LAN connection. The UUC-4 has four digital outputs which may be either relay or TRIAC. These four output points along with a common are located on TB3. The wiring and operation are identical to the UUC-8 digital outputs. Each of the four outputs has an LED status light. The eight analog / universal inputs located on TB1 and TB4 are identical to the analog inputs

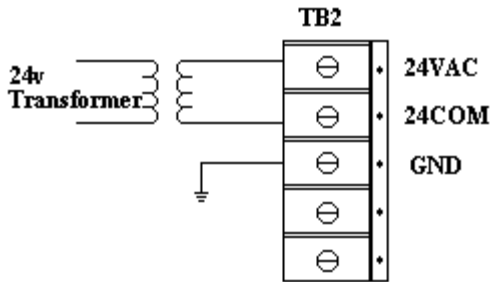
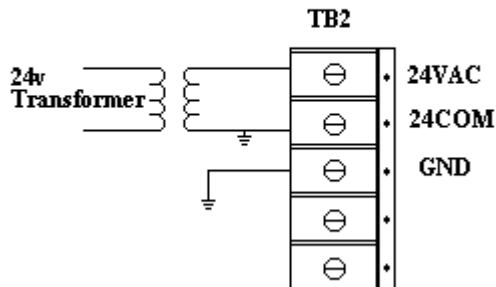
on the UUC-8. The three analog outputs located on TB5 are identical to the analog outputs found on the UUC-8. The controller supports one thermostat that is connected to J2. The four-pin connector (J1) is used to connect a PC to the unitary LAN. The board also includes a manual RESET switch and lights to indicate controller power and unitary LAN receive data.

The inputs and outputs of the UUC4 are identical to the UUC-8. The remainder of this document will reference the UUC-8 connector numbers.

### **1.3 Power**

The unitary controller may be powered using a 24volt AC or DC power source (See Appendix A, Figure 2, for wiring using a DC power source). The controller requires approximately 400ma plus any additional power needed by external connections (+15vdc output, 24v unregulated power used for digital inputs). The 24v transformer should be at least 10VA. The 24vac input terminal is fused but the 24com terminal is not.

**CAUTION:** Be sure that the center terminal (GND) is connected to a chassis ground to avoid any ground differential problems.

**24VAC Connection (4038-TF)****Floating Secondary****24VAC Connection (4038-TG)****Grounded Secondary**

Note: 24COM and GND are tied together internally on the board.

**FIGURE 3**

## 1.4 U-LAN

The unitary controller LAN operates at 9600 baud on a pair of wires using standard RS-485 drivers. A U-LAN up to 4000 (Figure 4) feet can be wired with a single telephone pair (24 AWG). A shielded pair is recommended. A U-LAN may consist of one or more segments with each segment limited to approximately 4000 feet and 30 controllers. Each segment should be point to point with 120 ohm termination resistors on each end. When considering wiring, it should be remembered that the LAN is extended from each controller to its thermostat(s).

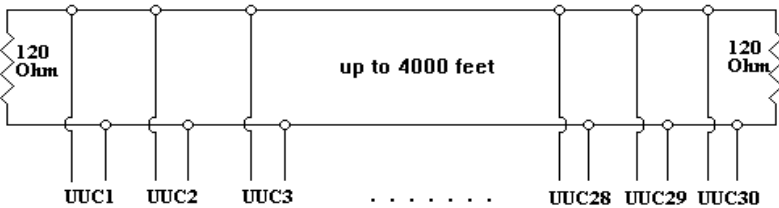


FIGURE 4

An RS-485 Repeater should be used when more than 4000 feet is required, more than 30 unitary controllers are needed, or physical wiring considerations require a long branch run off the main point-to-point run (Figure 5). An opto-isolated RS-485 repeater should be used if the LAN extends outside of a building where lightning could be a problem. In addition to providing the repeater function, the repeaters also provide for signal conditioning (biasing) and over-voltage/transient protection. The repeater uses the +15VDC output from TB8 if it is available.

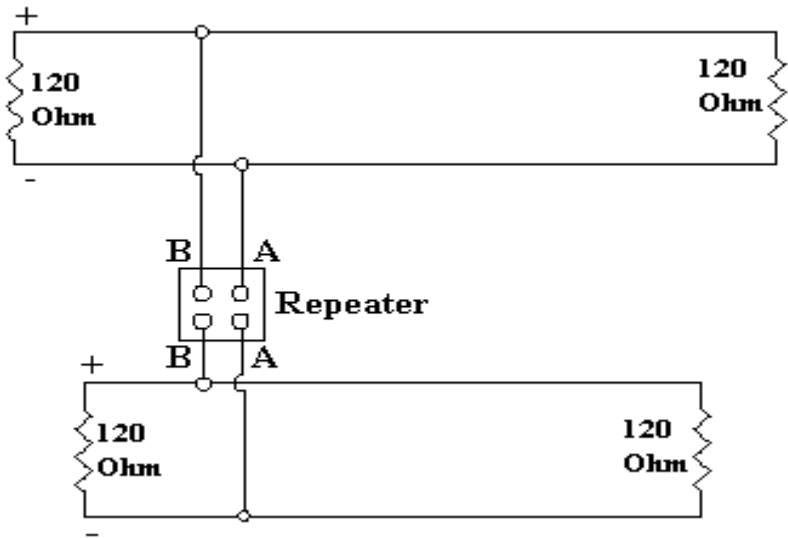


FIGURE 5

When a shielded pair is used, it should be connected to ground at one location (usually at the Field Commander). If the shield is to be connected at each unitary controller, a 100 ohm resistor should be used to connect the shield to ground at each controller (Figure 6). This should avoid problems associated with ground differentials over the LAN.

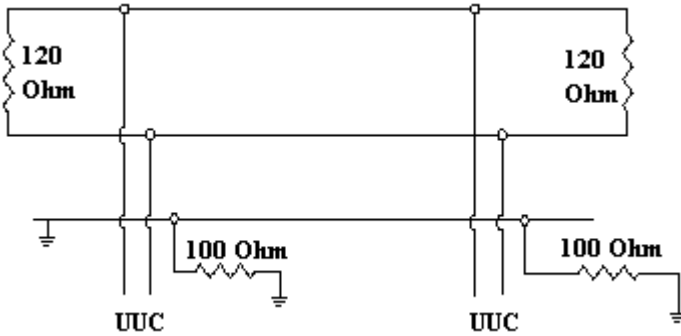


FIGURE 6

The U-LAN is connected to the + and - terminals on TB2. On the network all + terminals and all - terminals should be connected. If a repeater is used, the repeater 'B' terminal should be connected to the U-LAN + terminal and the 'A' terminal connected to the U-LAN - terminal.

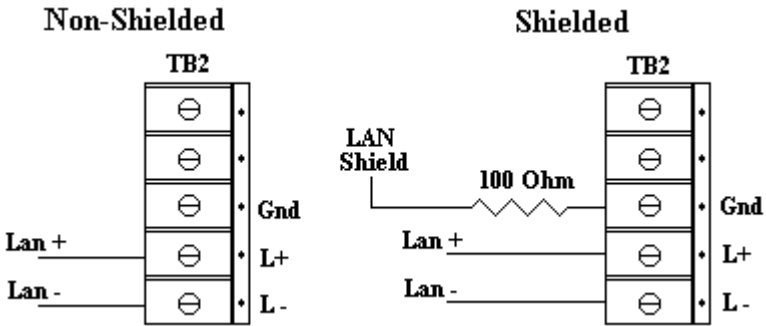


FIGURE 7

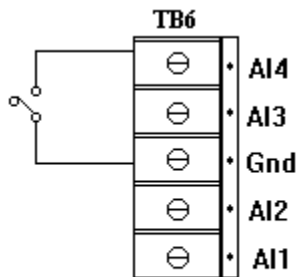
## 1.5 Analog/Universal Input



There are eight analog/universal inputs on a unitary controller. The input terminals are located on TB1 and TB6. Each of these terminal blocks has a ground on the center terminal and accepts a 0-5 vdc input on the other four terminals. Each of the inputs has a high frequency filter and over/undervoltage protection diodes. A pull-up resistor is used to bias an open input to +5 volts.

Note that if thermostats are connected to the controller, these thermostats may use analog inputs. Analog inputs 1 and 2 are associated with thermostat number 1 and analog inputs 3 and 4 are associated with thermostat number 2. Thermostats use the analog inputs for an analog value as well as for thermostat override switches. Override switches can be disabled for inputs 2, 3 and 4. However, since the override switch for input 1 cannot be disabled, this input should only be used for an analog input which does not normally range to 0 volts (like a 10k thermistor).

When used as a digital input, an ON condition is indicated by less than approximately 0.2 volts on the input. Since the input normally is pulled up to 5 volts, an input switch (normally open) simply needs to connect the input to ground. A universal input may be inverted by a database definition if it is desired that an input should be considered normally closed (ON = open). A universal input may be connected directly to a 0-5 volt digital signal.

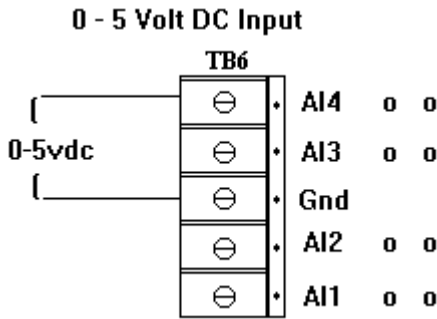


Universal input as a digital switch input

**FIGURE 8**

When used for analog input, the unitary controller expects a 0-5 volt input (Figure 9). A jumper is associated with each analog input. When the jumper is connected, the input is pulled up to +15V to allow the direct connection of a 10k thermistor. (Figure 10). Each input channel may have offset/gain adjustment and correction for non-linearity programmed in the unitary controller database. Inputs of 0-10 volts can be accommodated by using two external resistors to divide the input to 0-5 volts (Figure 11). The resistors in this voltage divider should be selected as small as can be handled by the source (1-5K) so that the internal pull-up resistor is not a factor. Current input may be handled by using an external resistor to ground (Figure 12). If a transmitter device requires power (up to 100ma), the 15v output on TB8 may be used (Figure 13). See Figure 14 for an externally powered transmitter. The input conversion is 10 bits, which corresponds to approximately 5 mv in the least significant bit. Additional input filtering may be required if the sensing device or input wiring is noisy. If this becomes a problem, an external filtering capacitor (like 10uf) may be used.

Note: For Unitary Controller Rev. C, connect jumper on any channel that is connected to a 10k thermistor or a thermostat. For controllers prior to Rev. C, unused inputs should be connected to ground.



**FIGURE 9**

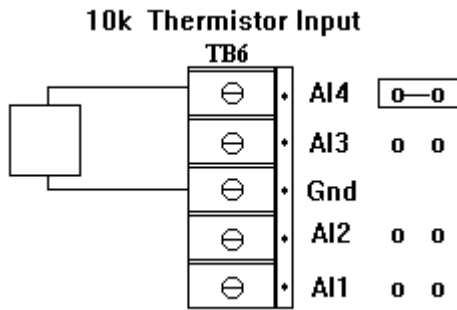


FIGURE 10

**0-10vdc Input**

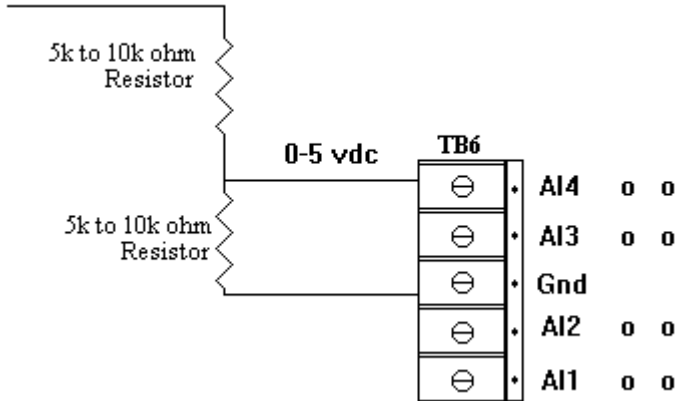


FIGURE 11

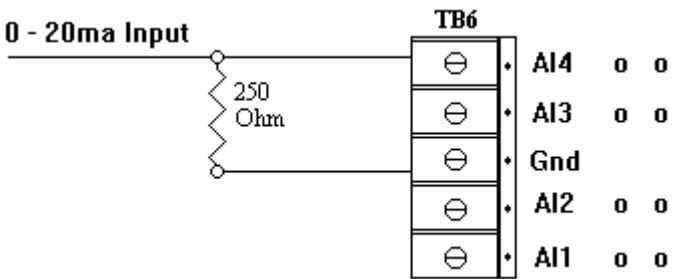


FIGURE 12

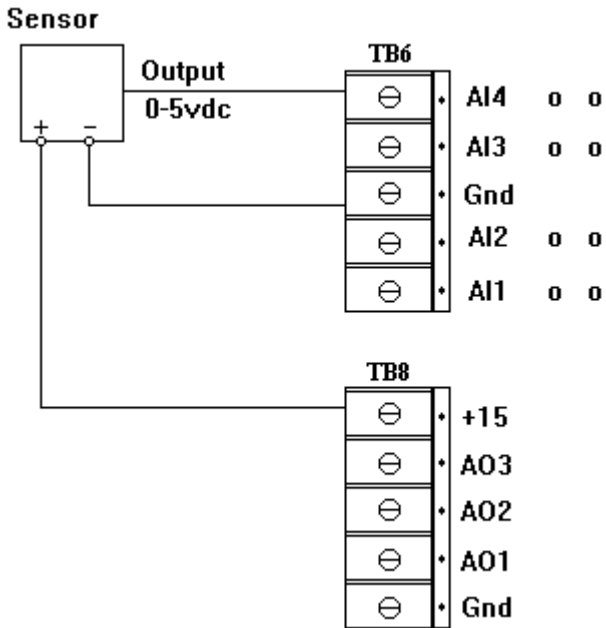
**Transmitter (controller powered)**

FIGURE 13

**Transmitter (externally powered)**

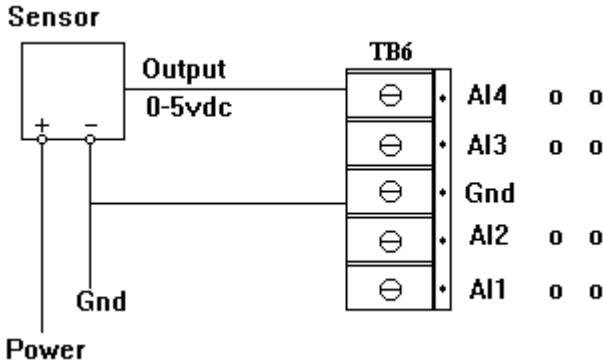


FIGURE 14

## 1.6 Digital Input

The 12 digital inputs on the unitary controller are connected to terminal blocks TB5, TB7, and TB9. Each of these terminal blocks has four digital inputs and a common on the center terminal. The common for each block is connected to ground through a PTC (overcurrent protection). Note that this digital input common should NOT be used for an analog/reference ground. Each digital input is opto-isolated from the processor and is protected using a current limiting resistor and overvoltage protection diode. An LED displays the status of each input (LED 'on' when connected to common). Switch input devices should be connected between the digital input and common (normally open). See Figure 15. A closure to common is input as ON status. Each input may be inverted (normally closed) by a database definition. Inputs 11 and 12 (with ROM U1 & later) may be interpreted by the unitary controller as counter inputs. In this case, the controller counts the number of transitions from open to closed. When used with alarms, inputs are latched by the unitary controller so that no change greater than 10 milliseconds is lost. The digital inputs are pulled up using unregulated 24vdc power in the unitary controller. This

unregulated power may vary from 20 to 40 volts, so any switches used for digital input should allow at least 40 volts (8ma). Note that the digital inputs may not be directly connected to a 0-5 volt digital signal.

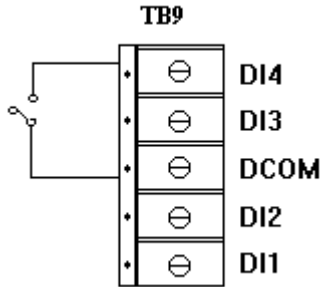


FIGURE 15

## 1.7 Digital Output

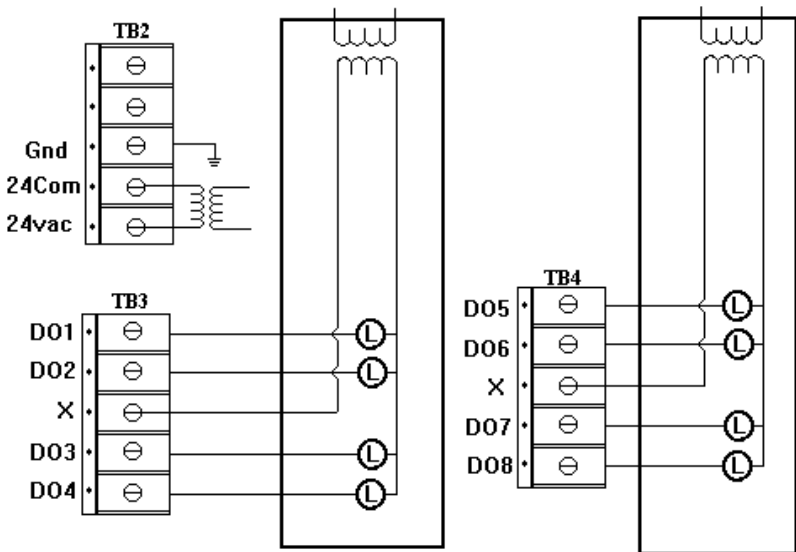
The unitary controller has eight digital outputs. There are two groups of four outputs. Each group shares a terminal block and a common (center terminal). An LED for each output indicates if the controller has the output active. The common on one terminal block is not connected to the common on the other terminal block. Furthermore the common is isolated from the unitary controller power. This allows the unitary controller to control devices which power by more than one source (control two roof top units). The unitary controller is configured to switch the voltage from the common through the load to ground. The digital outputs operate as normally open. (With U3 or later firmware, the unitary outputs may be logically inverted to normally closed operation.)

The 4038-TG uses opto-isolated TRIAC outputs to switch AC (maximum 2 amps at 200vac). If the TRIACs are being used to switch 24v control relays associated with the unitary controller 24VAC power source, the 24VAC power input can be wired externally to the power at TB2 (Figure





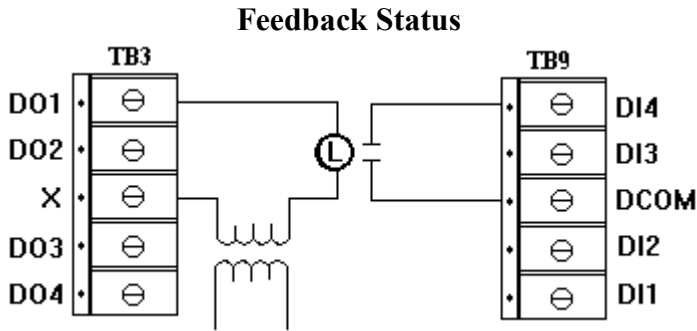
### External 24V Supply (4038-TG)



Note: Grounding of the transformer secondary is required.

**FIGURE 17**

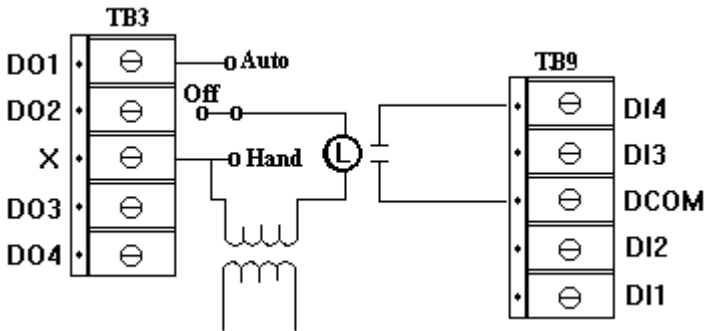
The digital outputs of a unitary controller may be associated with actual device status feedback (Figure 18). If not associated with a feedback status input, the unitary controller will report the last commanded status as the current ON/OFF status. If the unitary controller has a feedback status input defined, the feedback status input is reported as the device status. In this case, the status is checked every minute and a feedback advisory message is generated if the feedback status does not agree with the commanded state (after the feedback delay time). Note that any ON/OFF device or condition can be associated with the feedback status, including flags that are set based upon analog input or computed values. For example, the feedback status of the boiler enable output may be a boiler temperature greater than 120 °F after 15 minutes.



**FIGURE 18**

There are no manual override switches on the unitary controller. If an override is required, an external hand-off-auto switch may be wired (Figure 19). With an external override switch, a feedback status input can be used to report the override condition.

**Hand-off auto (with status feedback)**



**FIGURE 19**

Some devices (like GE/RR7 relays) need to be pulsed on and pulsed off. The unitary controller allows a pair of outputs to be defined as pulse on and pulse off. When the device is turned on, the odd numbered output is pulsed. When the device is turned off, the even numbered device is pulsed. See Figure 20.

### Pulse On/Pulse Off (GE/RR7)

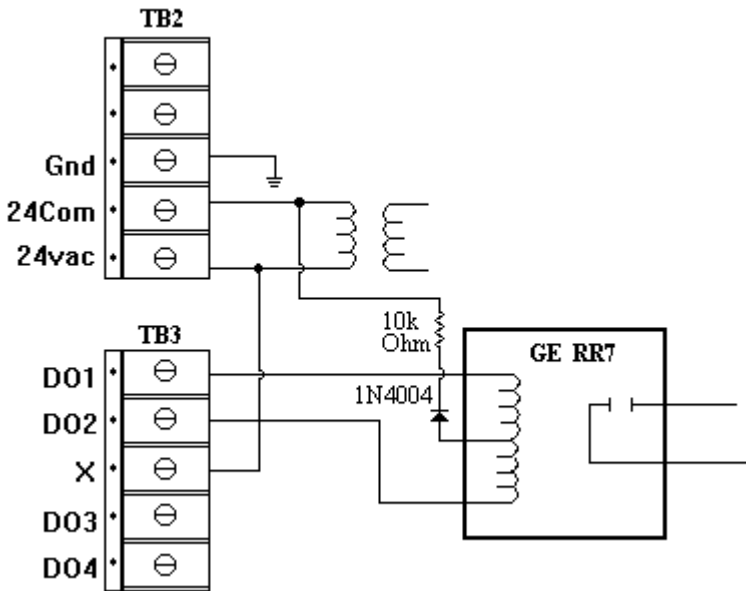


FIGURE 20

Another type of pulse output is also supported. If the feedback status indicates that the device is in the opposite state from that desired, the output is pulsed. In this configuration a single output can be pulsed to turn the device on or off. However, a feedback status input is required.

## 1.8 Analog Output

The unitary controller supports three analog outputs. Each output is 0 to 20 ma (Figure 21). With external resistors, the outputs can be 0-2.5 volts, 0-5.0 volts, or 0-10 volts (Figure 22). The terminal block which contains the three analog outputs (TB8) also has a ground and a +15vdc power terminal. Analog outputs provide 10 bit output accuracy and are normally controlled by commanding 0-100% open for 0-20ma outputs. Each out output may also have offset/gain adjustments and linearity adjustments to allow output control in engineering units. Figure 23 shows a damper actuator with position feedback with a separate power source, and Figure 24 shows the same actuator with a common power source.

### 0-20ma Output

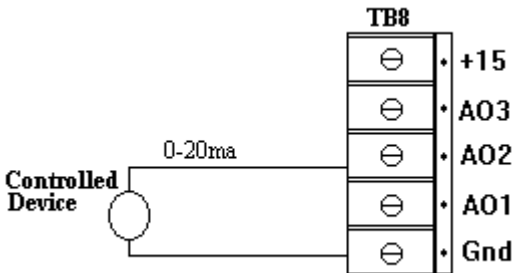
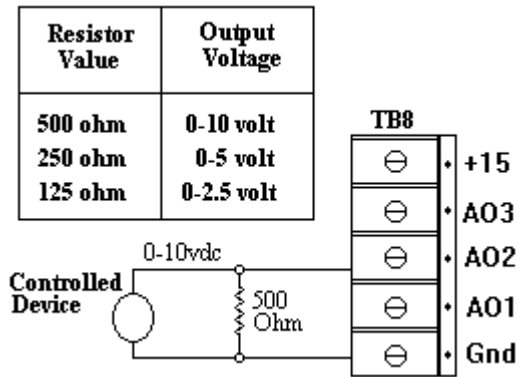
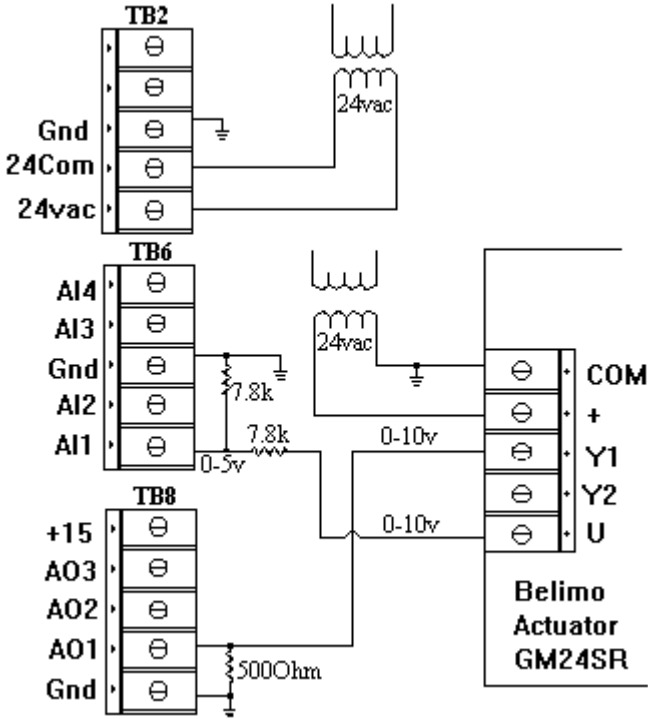


FIGURE 21

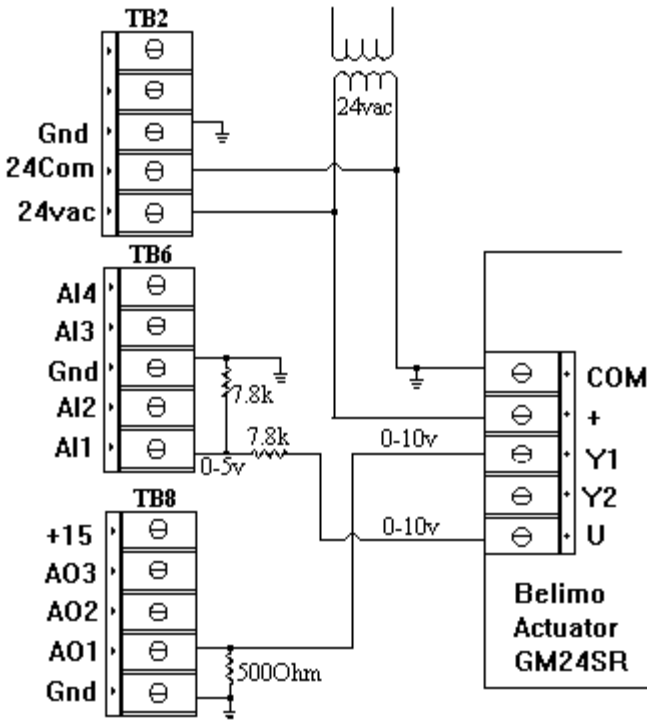
**0-10 volt output****FIGURE 22**

**Damper Actuator with Position Feedback**



**FIGURE 23**

## Damper Actuator with Position Feedback (Common 24v Control Transformer)



**FIGURE 24**

The analog output points may also be used to control external pilot relays. If the relay has a sensitive coil which responds to 20ma or less at 10 volts, the analog output can turn the relay on with a maximum analog output. This could be used when an application configuration requires an additional digital output.

## **1.9 +15VDC Power**

The unitary controller can supply a small amount of power for external devices. The analog output terminal block has a +15vdc terminal that can supply an external sensor with up to 100ma.

## **1.10 Thermostats**

Connections are provided for one or two thermostat units (J2 and J3). Each thermostat has a 10k thermistor temperature sensor, a setpoint adjustment slide switch, an override switch, and an override light. The first thermostat is connected to J2 (using analog input 1 and 2 for the temperature and adjust inputs). The second thermostat is connected to J3 (using analog inputs 3 and 4 for the temperature and adjust inputs). The thermostats may be located up to 50 feet from the unitary controller. Each thermostat connector is an eight-pin crimp connector. For field installation, the thermostat can be ordered with a crimp connector to terminal strip converter or crimp connector to pigtails. Alternatively, the installer can order a crimper so that cables can be terminated in the field. The connector on the unitary controller and the thermostat have the same pin-outs so the cable should connect pin to pin. See Figure 25 below.



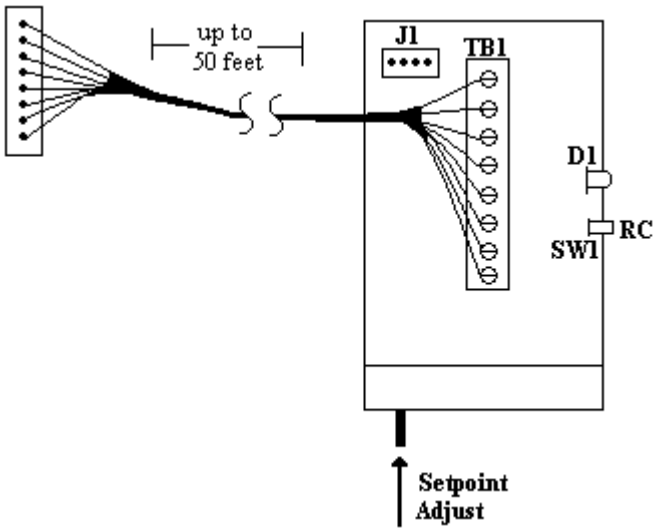


FIGURE 25

## **2.0 INSTALLATION / TEST**

### **2.1 *Installation***

- 1) Install the unitary controller board in the desired location. The controller may be mounted directly on the equipment being controlled, or in a separate control box. A standard Augat 3-1/4" PVC track (part number 1016-6081A) is used to mount the board, whether it is in a control box or mounted on the equipment. The control box may also be supplied with a 24VAC isolation transformer or a 115VAC to 24VAC transformer.
- 2) Install all LAN wiring. Using a VOM, verify that the LAN wires are not shorted to each other or to ground. There should not be any voltage on the LAN wires, unless you are connecting to an existing installation. Do not connect the LAN wiring to any unitary controller at this time.
- 3) If thermostats are to be used, install them in single-gang boxes. Eight conductor, 22 gauge, jacketed wire is recommended to connect the thermostat to the unitary controller. The length of the wire from the thermostat to the controller should not exceed 50 feet. Connect the wire to the thermostat(s) (see Figure 25) and mount thermostat(s) to the wall. Terminate wires to the eight conductor connector at the controller. Do not connect to J2 or J3 at this time.
- 4) Remove power from the equipment to be controlled and/or the power to the unitary controller.
- 5) Route all wiring through appropriate knockout(s) in control box(if used). All power and device wiring on the unitary controller is connected to quick-disconnect terminal blocks in groups of 5 terminals.

- 6) Connect the power wiring, using the following steps:
  - a) Insure that the power is turned off.
  - b) Connect the middle pin on the 5-pin quick-disconnect terminal block for TB2 to chassis ground.
  - c) Connect the leads from the transformer to the 24vac and 24com pins on the terminal block (see Figure 3). Do not connect the terminal block to the controller yet. Turn the power on. Measure the voltage across the 24vac and 24com pins. This voltage should be in the range of 24 to 28vac. Once this reading is verified, turn the power off.
  - d) Install the connector block on TB2 on the unitary controller.
  - e) Turn the power on. The power LED D2 should light and stay lit. LAN LED D3 and the bargraph LED D4 may flash momentarily and then go out. LED D2 should be the only LED on after the initial power-up (with the default database). Turn power off to the controller.
  
- 7) Remove TB2 from the controller and connect the U-LAN wires to the + and - pins of the connector block. Be sure to observe polarity (see Figure 7). Up to 30 unitary controllers can be connected on a U-LAN, with a maximum wire length of 4000 feet using 24 gauge wire. A 120 ohm terminating resistor should be installed on each end of the U-LAN (see Figure 4). If more than 4000 feet is required, or more than 30 unitary controllers need to be connected to one LAN, an RS-485 Repeater must be used (see Figure 5). If the U-LAN extends outside the building where lightning could be a problem, an opto-isolated RS-485 repeater should be used. If a shielded pair is used, it should be grounded at one location on the LAN (usually at the Field Commander). If the shield is to be connected at each controller, it will be necessary to connect the shield to ground through a 100 ohm resistor at each controller (see Figures 6 and 7).

You may want to wait until all controllers are programmed before connecting the U-LAN wires. Always turn the power off before removing connector TB2 to add the U-LAN wires.

- 8) Connect up to 8 analog/universal inputs to 2 quick-disconnect terminal blocks. The center pin of each terminal block is ground (see Figures 1 and 8). Do not use the digital commons on TB5, TB7, or TB9 (digital inputs) for analog/universal inputs. The grounds on TB1 and TB6 (analog/universal inputs), and TB8 (analog outputs) are not the same as the digital common on TB5, TB7, and TB9. If thermostats are used, analog inputs 1 and 2 are associated with thermostat number 1 (J2) and analog inputs 3 and 4 are associated with thermostat number 2 (J3).

Install these terminal blocks on TB1 and TB6 on the controller. Also install thermostat connectors J2 and/or J3 if thermostats are used. If the unitary controller is Rev. C., install jumper on any channel to which a 10k thermistor or thermostat is connected. On unitary controllers prior to Rev. C., unused analog inputs should be jumped to ground.

- 9) There are 12 digital inputs on TB5, TB7, and TB9. Connect the input devices between digital common (center pin) on each disconnect block and the respective inputs 1-12 (see Figures 1 and 15). Inputs 11 and 12 (on TB5) may alternately be used as counters and/or demand meter inputs with UUC ROMS U1 and later.

Install these terminal blocks on TB5, TB7, and TB9 on the controller.

- 10) Connect up to 8 digital output devices to connector blocks. The center pin (X) is common to the four outputs on the connector (+24v). See Figure 1 for pin numbers. The outputs are set up to switch the common (X) voltage through the load to ground. Install these terminal blocks on TB3 and TB4.

An external hand-off-auto switch may be used as shown if Figure 19 if an override is required, since there are no manual override switches on the unitary controller.

- 11) If analog outputs are to be used, connect them to connector block TB8 on outputs labeled 1, 2, and 3 (see Figure 1). These outputs may be

either voltage or current, depending on the application (see Figures 21 and 22). The return of the output should be connected to the ground on TB8.

The fifth pin on TB8 can be used to supply +15VDC to external devices (up to 100 ma). If needed, connect the + lead of the device to the connector block ( marked +15 on the controller) and the - lead to the remaining pin of the connector block (Common/Ground). See Figure 1

Install the terminal block on TB8.

- 12) Apply power to the unitary controller. Power LED D2 indicates power on the controller (see step 6e above).

## ***2.2 Testing the Unitary***

The primary test tool for the unitary is a PC. In addition to the proper PC software (UT03253A), the unitary connection requires an RS-485 interface board (016-4036) and cable (016-2146). The cable may be connected directly on the unitary controller on connector J1 (four pin) or it may be connected to either thermostat attached to the unitary.

### ***2.2.1 Connect***

Once the PC is connected and the 'Connect' menu function is selected, the PC is ready to communicate with unitary controllers. The 'Connect' program displays the connected controller number as part of the user command prompt. Initially with no connected controller, the prompt is 'U126>'. To connect to the desired unitary controller, the connect command is used. This command is a 'C' followed by the desired unitary controller number (1-120). The controller responds by identifying itself. For example, if the controller number is 5, 'C 5' is the connect command.

```
U126> C 5
Connected to Unitary Controller CHIL (addr=005) config=001/000 (rev U03 )
U005>
```

This controller response identifies the controller as address number 5 with a name of CHIL. It has a database configuration of 001 and controller firmware of revision U3. The 'U005>' command prompt indicates that the next controller command will be directed to unitary 5.

If the controller number is not known (or it fails to respond to the expected number), the command 'C 126' can be used. This command is a general connect to any controller that will respond. There are two ways to get a controller to respond to this general connect request. For approximately 15 seconds following a power fail or depression of the controller reset switch, a controller will respond to the general connect request. In addition, if the

controller is in the thermostat override mode (depress override switch on the thermostat or short analog input 1 to ground for approximately 10 seconds), a controller will also respond to a general connect request.

U126> **C 126**

Connected to Unitary Controller CHIL (addr=005) config=001/000 (rev U03 )  
U005>

or

U126> **C 126**

Connected to Unitary Controller CHIL (addr=005) config=065/000 (rev U03 )  
Controller is in the thermostat override mode.  
U005>

Unless specifically requested on the order, all unitary controllers are shipped from the factory with a default database that does not have a name and has an address of 000. With the address of 000, the general request of 'C 126' must be used to establish a connection. Once connected to a controller using a 'C 126', its name and address number can be changed using the Modify System command.

**NOTE:** The PC can connect to unitary controllers from any controller or thermostat on the U-LAN. When you are programming controllers via the U-LAN, or connected to a controller that has its U-LAN wires connected, care must be taken to insure that you are communicating with the intended unitary controller. Care should be taken to avoid numbering two controllers on the same U-LAN with the same number. If this should happen, one controller must be removed from the U-LAN before the address of the other controller can be changed.

### **2.2.2 Load Database**

Each controller needs a database which configures the unitary for the desired control functions. The database defines the device names, types of desired analog input and output conversions, alarm conditions and desired control operations. Although it is possible to test a unitary controller

without loading a database by referencing physical point addresses, it is usually much better to load the desired database before testing.



A database written for a U ROM controller will load into an X ROM controller (following a restart blank) and function like a U ROM controller. A database generated for an X ROM will not run properly on a U ROM controller. To use X ROMs the SP2 release of Windows PC Central must be used.

A database may be loaded from the PC disk by using the 'IN' command. The IN is followed by the disk file name which contains the desired database. For example, the file RTU might contain a standard roof top database or the file HP might contain a standard heat pump database. The database may be a standard database prototype supplied from the factory or a customer specific database. During the IN command processing, progress information is displayed on the PC screen as database records are read from the PC disk and sent to the controller. Following the load, the controller is reset. This reset will make the controller unable to respond to additional commands for a couple of seconds. Note that the load of a database may change the controller address. This will be reflected in the next 'Uxxx' prompt. If the address of the controller changes, a '??' will be displayed indicating that the initial controller address did not respond properly to the reset command (the reset response came from the new controller address).

```
U005> IN RTU
.
.
.
finished - controller reset
U005>
```

or

```
U005> IN RTU
.
.
.
finished - controller reset
??
U126>
```



NOTE: You cannot download a database from the 'C 126' prompt unless that particular controller is in the thermostat override mode, or has an address of 0 and has recently been powered up or reset. It is not recommended to download a database to a controller that has an address of 0 using the 'C 126' command. You should change the name and address first, using the Modify System command.

Following the download of a standard database, the modify commands should be used to make any minor modifications that may be needed. These changes are normally things like the controller name, schedule zone flag names, or perhaps the name of the air handler or central plant associated with the controller.

### 2.2.3 Test Inputs/Outputs

The first step in checking the installation of the controller is to use the 'DISPLAY STATUS' command. This displays the physical status of all unitary inputs and outputs. The digital inputs and outputs are displayed with an O for OFF (open) and an X for ON (closed). The analog values are displayed as percent of full scale (no engineering unit conversions). The display is periodically updated. To terminate the display, depress the ESC key.

U048> **D S**

```

048: RTU1   Uni tary Cont rol l er
              DI SPLAY STATUS
-----
      DO          DI          UI          FLAGS
      1-8        1-8        9-16       17-24    1/33    9/41    17/49    25/57
OXOXOXOX OXOXOXOX OOXOXOXO OOOOOOOO OOOOOOOO OOXOOOOO OOOOOOOO OOOOOOOO
              AO
              1          2          3          4          5          6          7          8
              10.75 % 10.26 % 10.75 % 11.34 % 10.65 % 10.75 % 99.90 % 99.90 %
              AO
              1          2          3
              86.50 % 0.29 % 0.01 %
              14:13 WED    07-06-94
=====
    
```

Using this status display and some simple output commands, the input and output connections to the unitary controller can be tested.

### **Digital and Universal Inputs**

Close the contacts associated with the connected devices and verify that the corresponding Digital Input or Universal Input flags change from O to X on the display. For Digital Inputs the LEDs on the controller should reflect the input status.

### **Analog Inputs**

Analog inputs connected to 10k thermistor or other temperature sensors should probably not show 0% or 100% for the input. By varying the sensor input, the displayed value should change.

### **Thermostats**

The thermostat temperature thermistor should be reflected in analog input 1 (or input 3 for the second thermostat). The stat adjustment should be connected to analog input 2 (input 4 for the second thermostat) and vary between approximately 5 and 95 %. The override switch on the thermostat should be reflected in digital input 13 (digital input 15 for the second thermostat).

### **Digital Outputs**

To test digital outputs, exit the status display by depressing the ESC key. Command the digital output to be tested. Verify physical device operation and the LED corresponding to the digital output should reflect the commanded state. Use the status display to check that the unitary believes that the device is commanded. Following testing issue 'RESTORE' commands to devices that were tested (1:1 RES , 1:3 RES).

```
U048> 1:1 ON  
U048> 1:3 OFF
```

U048> **D S**

### **Analog Outputs**

To test the analog outputs, exit the status display by depressing the ESC key. Command the analog output to be tested (may need to disable any monitor or setpoint control which is also commanding the analog output). The output is set using the appropriate engineering units defined in the database. If no engineering units are defined in the database, the output is commanded in percent of full scale output. Verify that the physical device is properly controller (actuator moves). Use the status display to check that the analog output displayed is correct. Following testing restore operation of any monitor or setpoint which was disabled during testing.

U048> **1O = 90**

U048> **3O = 47**

U048> **D S**

### **Time and Date**

If the Time and Date information on the Display Status screen is incorrect, they can be changed using the SET commands. If the controller is to be connected to a Field Commander (or Universal Modem Interface), the time and date will be updated automatically and does not need to be changed during initial testing.

## 2.2.4 Test Operation

If a database has been loaded, the unitary controller should be tested for proper operation.

- 1) Use the REPORT MESSAGE to check for any diagnostic messages. After checking messages, clear all messages using the REPORT MESSAGE ERASE command.

```
U005> RE ME
```

```
16:15 06-16 Tower pump 2 failure
16:15 06-17 Tower pump 1 failure
00:00 06-26 8 FEEDBACK STATUS ERROR 1 : 3
07:00 06-27 8 Loop water pump 1 failure
09:01 06-27 8 FEEDBACK STATUS ERROR 1 : 2
16:15 06-27 Tower pump 1 failure
15:58 06-28 POWERFAIL / RESTART
16:15 06-28 Tower pump 2 failure
16:15 06-29 Tower pump 1 failure
```

```
U005> RE ME E
```

- 2) Request the status of all named points in the unitary controller with the 'ALL STATUS' command. Verify analog values are in proper engineering units and digital feedback status is correct.

```
U005> ALL STA
```

```
GYM1 DO1 1:1 ON: ON IN SERVICE SINCE 2 09:16 RUN = 2471
GYM1 AO1 10 50.00
GYM1 AI8 1:8A 74.60 *F
```

- 3) Based upon the database definitions, force the controller into operation. This could be by overriding operation with the thermostat, setting the zone schedule flag or occupied flag. Verify the device functions properly in heating and cooling operations. A manual test box is available from the factory which can be connected to a

thermostat input on the unitary to manually force 'normal' heating and cooling operations.

### **2.2.5 System Test**

Once all unitarys are checked out, they can be connected to U-LAN. When the U-LAN is connected to the Field Commander (or Universal Modem Interface), the unitary is ready for system testing. The Field Commander is connected to the PC using PC Central Menu software (ME03253A) and an 016-2144A cable. The Site Selection or Terminal Emulation menu functions can be used to connect the Field Commander.

- 1) Use the DISPLAY LAN function to display a list of all connected unitary controllers. Verify that all controllers are responding.
- 2) Use commands directed to selected unitary controllers to check for proper operation. Set Field Commander building schedule flags and verify proper building start up and shut down operation. Commands can be directed to unitary controllers by preceding the command with the controller number and an exclamation. If a command is directed to '0!', it is broadcast to all unitary controllers. The following are examples of commands which can be entered from the Field Commander.

**Command**

**Result**

**3!ALL STATUS UPDATE**

Display the status of all named points in unitary 3. Continue displaying the status until an ESC key (or timeout) is entered.

**0!1:1 ON**

All unitary controllers with a digital output device of 1:1 will be turned on and taken out of service.

**2!ALL OFF**

Controller number 2 will have all named digital output devices and named flags turned off and taken out of service.

**6!D?? STATUS**

Will give the status of all devices that have 3-letter names and begin with a 'D' on controller number 6.

**10!1:2I STATUS**

Will show the status of digital input 2 on controller 10.

**8!S??? RESTORE**

All devices on controller 8 that have 4-letter names and begin with an 'S' will be restored to UUC control.

**7!1O = 50**

Analog output device 1 on controller 7 will be set to 50.

- 3) Using the REPORT MESSAGE command, check for any diagnostic messages.

If LAN operation is unusually slow or connection to controllers is generating error messages, the unitary TEST command and / or LAN monitor program can be used to look at LAN traffic. There are also LAN test boards and bias plugs available from the factory to help identify and correct any LAN problems.

In addition to device commands directed to specific unitary controllers, the Field Commander has a UNITARY command which allows a direct connection to the U-LAN. When in the UNITARY mode, the operations are the same as if the PC were connected directly to the unitary using the unitary interface board and cable. For example, 'C 5' would be used to connect to unitary 5.

## 3.0 OPERATION

Unitary controller support is handled using a PC. The support package contains PC software, a U-LAN interface board and a cable. The interface board may be connected to either COM1: or COM2: on the PC. Connection to the LAN may be made at the thermostat, unitary controller or Field Commander. The PC software is installed on any PC which already has the PC Central Menu program. The three unitary programs consist of a monitor program, an off-line data base modification program and a connect program. The monitor program monitors the LAN and displays information about LAN activity. The data base program provides a Field Commander style screen edit format for data base changes. The connect program allows the PC to connect to a specific unitary controller and provides a Field Commander style user interface.

### 3.1 *Menu*

The unitary programs may be run on a wide variety of PC configurations. A minimum of 512K of RAM is required. A high density floppy disk or hard disk is required. The PC must have a standard serial port (COM1: or COM2:). The display may be either monochrome or color. The PC may be any standard CPU (186, 286,386,...). A 4Mhz CPU clock should function, but a higher speed clock may be needed to monitor a very active LAN.

The distribution disk (UT03253A) contains all unitary support programs as well as a working subset of the Field Commander PC Central Menu programs. The unitary support programs are linked into a unitary maintenance menu. To activate the unitary maintenance menu, the distribution floppy is placed into an available drive (A:) and the "UNIT" command is entered.

```
> A:  
A> UNIT
```



The menu contains three programs and is configured to use the COM1: serial port. The monitor program (ULAN.EXE) may be used to look at data being sent over the U-LAN. The connect program (UTALK.EXE) is used directly connect the PC to the U-LAN at a specific unitary controller or thermostat. Once connected the PC can command unitary devices or make database modifications. The modify database program (UUC.EXE) is used to modify a unitary controller data base located on the disk. The unitary maintenance disk also contains two data bases of interest. The "BLANK" database (BLANK.UUC) contains a data base with no device, monitor, alarm, or schedule definitions. The "TEST" database (TEST.UUC) contains parameters which allow simple functional testing of unitary inputs and outputs.

The unitary maintenance programs may be run from a hard disk by simply copying the distribution disk (and all subdirectories) to the hard drive. The menu may be linked to an existing Field Commander Menu by copying the UNIT.MNU definition to the existing Field Commander Menu directory and moving the "\U" subdirectory programs to a "\U" subdirectory on the Field Commander Menu directory.

### **3.2 Monitor U-LAN**

The monitor program (ULAN.EXE) continuously displays activity on the LAN. On the left side of the display is general information about LAN activity like number of packets sent, number of retries and controllers presently on-line and responding. The right side of the display contains packets. The packets displayed may selectively include token pass packets, all controller packets, global packets or packets for a selected controller.

Once activated, the monitor program is controlled using the following keys.

- ESC - exit program
- SPACE - suspend/resume packet display
- ALT - C - clear display and reset packet totals
- ALT - T - toggle display of all token pass packets
- ALT - A - display all packets
- ALT - G - display only global destination packets
- number - display packets for selected party - number is entered (1-126) followed by ENTER
- ALT - ? - display command help information

The monitor program is activated from the menu by selecting the MONITOR item or from the DOS prompt by entering ULAN followed by the desired communication port on the PC. If no COM port is specified, COM1: is used.

```
>ULAN
or
>ULAN COM2:
```

The packets displayed are presented on the right side of the display. The first three entries are the destination party (preceded by a minus sign), the sending party and the length of the packet. Each number is presented in hexadecimal format with 80 hex added. 81 is controller 1, 82 is controller 2, 83 is controller 3. 80 is a broadcast message sent to all controllers. fc is controller 124 which identifies the Field Commander (or UMI). Following the length of the packet is the packet contents. This can be the actual packet in hexadecimal or a text description of the packet. At the end of a packet sent to a specific controller is an ACK or NAK. This indicates if the controller acknowledged the receipt. The NAK is a request by the controller for the sending party to try again.

**MONITOR DISPLAY**

```

PORT = COM2 -80 8a 86 LITS ON ACK
ADDR = -fc 8a 88 !4C = 67.40 ACK
GOOD = 20 -fc 8a 84 62c08000d0 ACK
NAK = 0 -8a fc 95 628080002020202020202020000000=700002020 ACK
000:0 -fc 8a 9d !message to field commander ACK
010:0 -fc 8a 89 SETC = 71.00 ACK
020: -80 fc 89 SETC = 71.00
030: -80 8a 86 LITS ON ACK
040: -fc 8a 88 !4C = 67.40 ACK
050: -fc 8a 84 62c08000d0 ACK
060: -8a fc 95 628080002020202020202020000000c700002020 ACK
070: -fc 8a 9d !message to field commander ACK
080: -80 fc 82 FCMD A Controller
090: -fc 8a 89 SETC = 72.00 ACK
100: -80 fc 89 SETC = 72.00 ACK
110 -ba fc 80 TOKEN
120: 4 -80 80 80 TOKEN
      -bd fc 80 TOKEN
      -80 8a 86 LITS ON ACK
      -fc 8a 88 !4C = 67.40 ACK
      -fc 8a 84 62c08000d0 ACK
      -8a fc 95 628080002020202020202020000000c700002020 ACK
      -fc 8a 9d !message to field commander ACK
      -80 80 80 TOKEN

```

**3.3 Connect U-LAN**

The connect program (UTALK.EXE) provides a means to talk with a specific controller directly connected to the U-LAN. Using the LAN interface module and a cable the PC can be attached to any unitary, Field Commander, or thermostat on the U-LAN. If the LAN already has activity due to Field Commander control, the connect program will not interfere with other LAN activity. The connect program is designed to allow the user to communicate to a specific unitary controller. The selected controller may be any controller connected to the U-LAN. Once connected, the keyboard and display of the PC function like a terminal connected to a Field Commander which is operating in the UNITARY mode. Using Field Commander like commands, the user can control points and check status.

The program uses a command prompt which consists of the selected unitary controller number followed by a '>'. Commands are entered in response to the prompt and are terminated by an ENTER key. All lower case letters in commands are automatically converted to upper case. Most commands may be abbreviated to enough letters to distinguish the command from other possible commands. A '??' response to a command indicates that the command was not properly processed for some reason.

ESC	-	abandon command
F1	-	repeat character from last command
F3	-	repeat remaining characters from last command
ENTER	-	process command
BACKSPACE	-	delete last character entered

The top line of the display is used to display packet data sent by the connected unitary controller to another party on the U-LAN. For example, the Field Commander may be requesting data or the unitary has issued a command or global value change. These packets may not always be displayed in a user readable fashion (may be a string of hex numbers) but will serve to indicate that something is being sent to another LAN party.

### **3.3.1 Commands**

Once connected to a specific controller, all commands entered are directed to that controller. Commands may be entered following the prompt (Uxxx>). Once a command is entered an ESC key can be used to abort further activity related to the command and return to the command prompt. However, any queued up activity related to the command may not be aborted. Note that sometimes with other LAN activity the controller response may be slow. Also in the case of a long response (report trend or all status request) an attempt to abort the request may be delayed waiting for queued up response packets to be sent.

Commands may be either direct device commands or general commands directed to the controller. Device commands may be directed to a physical point address (1:1, 1:3A) or to named points in the unitary controller. In

addition to direct device commands, there are several other commands which are processed by the controller. In the following command descriptions lower case letters indicate a field which must be entered as part of the command. Brackets ( [ ] ) indicate optional parameters on the command. Command key words need not be entered completely. Enough letters of the key words are required to distinguish the command from other commands.

### **CONNECT xxx**

Connect to unitary controller xxx. Controller numbers may range from one to 120. Controller 126 may be used to connect to a controller which has just been powered-up or overridden (using a thermostat). If the connect is successful, a line of controller information is displayed including the controller address, name, software/hardware configuration and controller program software release code. Controllers which have a valid controller number and have not been overridden by the thermostat switch will respond to address 126 connect request but will not respond to other commands sent to address 126.

U126> **C 5**

Connected to Unitary Controller CHIL (addr=005) config=001/000 (rev U03 )  
U005>

### **RESTART [ROM] [BLANK] [COLD]**

The restart command will cause the controller to reset. As a result of the reset, the packet may not be properly acknowledged (if the controller address changes) resulting in a '??' response to the command. The command option of ROM causes a load of any database which has been encoded in the controller program ROM. The BLANK option clears the database. The COLD option clears all history and current status. A RESTART with no option simply restarts the controller and continues operation.

## GLOBAL

Requests the controller to broadcast any global status points.

## DISPLAY STATUS

Presents a refreshed status display which contains digital status, flag status, analog input, analog output and time/date. The information presented is the physical status of the input or output. For analog inputs and outputs, the value is presented in 0-100% of full scale. Note that this displayed value is not in engineering unit values. To terminate the status display, the ESC key can be depressed.

```
005: RTU1   Uni tary  Cont rol l er
                DI SPLAY STATUS
-----
      DO          DI          UI          FLAGS
      1- 8       1- 8       9- 16      17- 24    1/ 33    9/ 41    17/ 49    25/ 57
OXOXOXOXO OXOXOXOXO OOXOXOOO OOOOOOOO OOOOOOOO OOXOOOOO OOOOOOOO OOOOOOOO OOOOOOXO

                AI
      1          2          3          4          5          6          7          8
10. 75 % 10. 26 % 10. 75 % 11. 34 % 10. 65 % 10. 75 % 99. 90 % 99. 90 %

                AO
      1          2          3
86. 50 % 0. 29 % 0. 01 %

                14: 13 WED    07- 06- 94
=====
```

**SET TIME hh:mm**  
**SET DAY xxx [HOLIDAY]**  
**SET DATE xx-xx-xx**

These commands may be used to change the unitary controller time and date. In most cases these commands are not required because the unitary time and date will automatically be synchronized with the Field Commander (or UMI) clock.



When operating in a standalone situation or when communication with the host Field Commander is lost, the unitary controller can

be set up to automatically enter and exit daylight savings time on specified dates.

## REPORT MESSAGES [ERASE]

This function will present a list of unitary controller messages. The ERASE option may be used to erase the message from the history table after it is displayed. These are messages which directed to the unitary controller. If the controller directs a message to its host Field Commander or another unitary controller, those redirected messages will not appear in the controller message table. Usually, the messages found on a specific controller are of an advisory nature. Messages are logged with the day of the month and the time. In controller with U3 or later firmware, messages older than one month are automatically removed from the history table.

REPORT MESSAGES      14:12 WED    07-06-94

15:45 06-10    Tower pump 2 failure  
16:15 06-16    Tower pump 2 failure  
16:15 06-17    Tower pump 1 failure  
00:00 06-26 8    FEEDBACK STATUS ERROR 1 : 3  
00:00 06-26 8    FEEDBACK STATUS ERROR 1 : 4  
00:00 06-26 8    FEEDBACK STATUS ERROR 1 : 7  
00:00 06-26 8    FEEDBACK STATUS ERROR 1 : 8  
03:20 06-27 2    POWERFAIL / RESTART  
07:00 06-27 8    Loop water pump 1 failure  
09:01 06-27 8    FEEDBACK STATUS ERROR 1 : 2  
16:15 06-27    Tower pump 1 failure  
15:58 06-28    POWERFAIL / RESTART  
16:15 06-28    Tower pump 2 failure  
16:15 06-29    Tower pump 1 failure  
16:15 07-04    Tower pump 2 failure  
16:15 07-05    Tower pump 1 failure

**REPORT TREND [addr] [ERASE]**

This function will present a list of trend samples for each trended point in the unitary controller. The ERASE option may be used to erase the data from the history table after it is displayed. The **addr** option allows the reporting of trend for a specific point.

TREND REPORT	1:1A	PNL1	OSA
13:00	07-01	88.30	
14:00	07-01	89.20	
15:00	07-01	90.10	
16:00	07-01	91.90	
17:00	07-01	100.20	
18:00	07-01	95.60	
19:00	07-01	91.50	
20:00	07-01	92.40	
21:00	07-01	86.50	
22:00	07-01	83.20	
23:00	07-01	82.30	
00:00	07-02	79.60	
01:00	07-02	77.30	
02:00	07-02	75.00	
03:00	07-02	74.10	
TREND REPORT	1:1A	PNL1	OSA
04:00	07-02	73.20	
05:00	07-02	72.60	
06:00	07-02	71.70	
07:00	07-02	70.90	
08:00	07-02	72.60	
09:00	07-02	75.00	
10:00	07-02	79.10	
11:00	07-02	82.80	
12:00	07-02	86.90	
13:00	07-02	90.60	
14:00	07-02	92.40	
15:00	07-02	94.20	



16:00	07-02	97.00		
17:00	07-02	99.70		
18:00	07-02	101.50		
TREND REPORT	1:1A	PNL1	OSA	
19:00	07-02	97.90		
20:00	07-02	91.50		
21:00	07-02	87.30		
22:00	07-02	85.50		
23:00	07-02	81.40		
00:00	07-03	79.10		
01:00	07-03	76.40		
02:00	07-03	75.60		
03:00	07-03	75.60		
04:00	07-03	74.10		
05:00	07-03	72.90		
06:00	07-03	72.90		
07:00	07-03	73.20		
08:00	07-03	73.20		
09:00	07-03	73.50		

## DEVICE COMMANDS

Any valid unitary controller command may be entered. This includes device commands for ON, OFF, STATUS, SILENCE, ENABLE, RESTORE, COMMAND, and set (=). Commands may be on physical point address or name. Commands may also include messages. If commands are preceded by an '!', the unitary controller will redirect it to the proper LAN party.

U126> **C 6**

Connected to Unitary Controller ADM1 (addr=006) config=001/010 (rev U02)

U006> **HT? RES**

U006> **SETC = 75**

U006> **1F ON**

U006> **ALL S**

ADM1 FAN	1:1	ON	: ON	IN SERVICE	SINCE 6	07:30	run = 10531
ADM1 CL1	1:2	ON	: ON	IN SERVICE	SINCE 6	07:30	run = 2250
ADM1 CL2	1:3	OFF	: OFF	IN SERVICE	SINCE 6	09:06	run = 8709
ADM1 HT1	1:4	OFF	: OFF	IN SERVICE	SINCE 7	18:01	run = 1331
ADM1 HT2	1:5	OFF	: OFF	IN SERVICE	SINCE 7	18:01	run = 4

## UNITARY CONTROLLER

---

```
ADMI OSAD 1:6 ON : ON IN SERVICE SINCE 7 07:30 run = 9192
ADMI TEMP 1:1A 75.80 *F
ADMI 1:2A 0.00 *F
ADMI SAT 1:6A 66.40 *F
ADMI SETC 1C 75.00
ADMI SETH 2C 70.00
ADMI OSA 1G 81.90
ADMI SC1 1F ON run = 9187
ADMI EMGY 10F OFF run = 0
ADMI SCHD 11F OFF run = 0
ADMI SHED 12F OFF run = 0
ADMI SHDA 13F OFF run = 0
ADMI SHDL 14F OFF run = 0
ADMI OCC 61F ON run = 9188
```

### **IN filename [BLANK]**

Loads the database from the PC disk file specified. A restart (cold) is processed following the load. During the load, records are displayed as they are sent to the controller. If the controller address changes as a result of the load, a ‘??’ may appear after the load because the original controller number did not properly respond (its address changed looking like another controller responded). The BLANK option allows the load to skip loading blank database records (monitors or schedule which are not defined). This can be used to speed up a load but should be preceded by a RESTART BLANK to make sure that the starting database is blank.

```
U005> IN RTU
```

```
.
```

```
.
```

```
finished - controller reset
```

```
U005> C 6
```

```
U006> RESTART BLANK
```

```
U006> IN AHU BLANK
```

```
.
```

```
.
```

```
finished - controller reset
```

```
U006>
```

## **OUT filename**

Copies the database to the specified PC disk file. During the upload, records are displayed as they are received.

```
U005> OUT RM13
.
.
.
U005>
```

## **TEST**

Sends test packets to the unitary controller and receives the echo responses. The display shows the total number of packets sent, received, and types of errors encountered since the last connect request. This can be used to test a LAN or controller which may be having communications errors.

## **LAN**

The display shows the total number of packets sent, received, and types of errors encountered since the last connect request.

## **MODIFY type [item]**

The Modify command is used for on-line modification for unitary controller data base parameters. The program presents a header line followed by the present data base parameters and status. Using the cursor, pageup and pagedown keys, the user can then step through the parameter fields and select the one to be modified. When a new value is entered, it is checked against expected entry values and then it is sent to the unitary. The new value then immediately affects control. Help information is provided in pop-up screens located at the bottom of the display. Help information may be requested using the 'F1' key or help information may be automatically presented upon an entry error. Any key on the keyboard will clear a help pop-up. While on-line physical device

addresses rather than names must be used to specify points (device feedback, monitor conditions, alarms, setpoints). If extensive parameter changes are required, the off-line modification program should be used. For display format and modification operation, refer to the programmers reference (section 3.5). The **type** parameter identifies which group of parameters is to be modified. Type may be selected from the following list :

- SYSTEM
- DEVICES
- MONITORS
- SCHEDULES
- HOLIDAYS
- ALARMS
- POINTS
- TYPES
- SETPOINTS

The optional **item** parameter allows the modification screen to begin at the desired item. For example, to modify schedule 25, entry of the 25 for the item would avoid the need to step past the first 24 schedules with the cursor keys.

**PRINT type [PRINTER] [FILE filename]**

The database parameters are output to the display, printer or a text file in a printable format. While on-line references to devices are presented in physical device address format. Because the off-line version of database printing uses device names, the off-line version is normally use to print. The optional PRINTER and FILE parameters are used to redirect output to a printer connected to the PC or a PC disk file. The **type** parameter identifies which group of parameters is to be modified. Type may be selected from the following list :

- SYSTEM
- DEVICES
- MONITORS
- SCHEDULES

HOLIDAYS  
ALARMS  
POINTS  
TYPES  
SETPOINTS

**QUIT**  
**EXIT**

Terminate program operation

The control program may be activated by menu selection or directly from the DOS prompt by entering UTALK followed by the desired communication port on the PC. If no COM port is specified COM1: is used.

>UTALK  
or  
>UTALK COM2:

### **3.4 Database Modification (off-line)**

The off-line database modification program (UUC.EXE) is used to create unitary controller databases and handle extensive modifications. Once activated the program allows the user to load, modify and save databases. The screen presentation is a screen edit format similar to that used for the Field Commander. Help information is provided in pop-up screens located at the bottom of the display. Help information may be requested using the 'F1' key or help information may be automatically presented upon an entry error. Any key on the keyboard will clear a help pop-up.

The off-line database modification program is usually used for extensive modifications while the on-line version is used to check on current operational parameters or make simple changes. The off-line program loads databases from the PC disk into memory. Modifications can then be done quickly as there is no waiting for data to be sent over the LAN. Furthermore, when editing off-line device references can use names rather than the device physical addresses which are used on-line. The off-line program also allows blocks of parameters to be moved by inserting and deleting in the monitor and schedule tables. Since off-line changes do not immediately go into operation, a logical function requiring several parameter changes does not have any funny operational consequences which might occur if the changes were entered into an operational controller. The off-line modification program does not present modification fields which reflect current operational activity like the current device status or active schedule flag.

Once the program is activated the screen is cleared and the '>' prompt is presented. Initially the program has a blank database. The commands available are limited to the following:

**EXIT**

**QUIT** Terminate program

**IN filename** Load data base found in the specified file

**OUT filename** Save data base into the specified file

**MODIFY type [item]**

Present a screen edit for the type of parameter specified. The program presents a header line followed by the database parameters. Using the cursor, pageup and pagedown keys, the user can then step through the parameter fields and select the one to be modified. For display format and modification operation, refer to the programmers reference (section 3.5). The optional **item** parameter allows the modification screen to begin

at the desired item. For example, to modify schedule 25, entry of the 25 for the item would avoid the need to step past the first 24 schedules with the cursor keys. The **type** is selected from the following:

SYSTEM  
DEVICES  
MONITORS  
SCHEDULES  
 HOLIDAYS  
ALARMS  
POINTS  
TYPES  
SETPOINTS

**PRINT type [item1] [item2] [PRINTER] [FILE filename]**

Output to the display, printer or text file in printable format. The database parameters are output to the display, printer or a text file in a printable format. The optional PRINTER and FILE parameters are used to redirect output to a printer connected to the PC or a PC disk file. The **type** parameter identifies which group of parameters is to be modified. Type may be selected from the following list :

SYSTEM  
DEVICES  
MONITORS  
SCHEDULES  
ALARMS  
POINTS  
TYPES  
SETPOINTS

### **3.4.1 MODIFY OPERATION**

The modify commands are used to make changes to the unitary controller database. Once the modify command is entered, the display is changed to a screen oriented edit format. In this edit screen, the arrow keys, pageup and pagedown may be used to move to the desired field. The ESC key is used to exit the modification and return to the prompt. ALT-D (hold down ALT and push D) can be used to delete an item, moving all higher numbered item down in the table. ALT-I (hold down ALT and push I) can be used to insert an item, moving higher numbered item up in the table. These insert and delete item functions are only available on some of the larger tables like monitors.

The F1 key may be used to obtain help information related to current entry field. If an entry error is encountered, help information is automatically presented at the bottom of the display. A help information box may be removed by entering any key. If an entry field is larger than may be displayed on the entry line, a longer entry line is presented at the bottom of the screen.

The modification program can be activated from the menu item or from the DOS prompt by entering UUC.

>UUC



### **3.5 Programmer Reference**

Unitary controllers are very flexible and fully programmable. It is rare that any installation would required a unitary to be programmed from scratch. It is more likely that a standard database which is similar is selected as the base for a particular application. With a few minor modifications the standard database becomes the base database for a given site. The site standard database is then loaded in the controllers at the site with only the controller name and address differing from controller to controller. For example, a site might need 100 VAV controllers. The distributor would select a factory standard database for a similar VAV. The distributor would then adjust the standard database to meet the specific site requirements ( temp setpoints, add second stage heating, configure for continuous fan operation). The result is a site specific base database which is then loaded in each of the 100 VAV controllers.

The factory standard database prototypes each come with database, installation drawing, sequence of operation, point definition list for PC Central programs, and basic color graphic display. Each of these standard configurations is also assigned a software configuration number. For the most part normal customer options are configured into the SYSTEM PARAMETER database constants. The SOFTCONF.HLP file contains the configuration parameters text for the SYSTEM PARAMETERS screen. The UNITxx.PNT text files contain a point list corresponding to configurations. The factory uses low configuration numbers for its standard configurations. Specific customer configurations should be assigned higher numbers (70-99).

The TYPECONF.HLP file contains type curve fit definitions for standard sensors and actuators. Additional types can be defined and added to this text file by the distributor to reflect any special sensors.

It is possible for a unitary controller to swamp the LAN with useless activity. For example, a monitor could be set up running several times a second (freq = -1) which sends a message to the host Field Commander. In general care should be taken to avoid such useless LAN activity. There are a few rules which will assist in reducing LAN activity.

- 1) avoid repeating messages which have already been sent
- 2) when commanding a device in another unitary, send the command when the state changes and then maybe repeat it once every few minutes
- 3) have any value being tested in a monitor in the unitary which is doing the testing (either connect the input to the correct unitary or pass the point to a global located in the unitary doing the test)
- 4) use global points where possible rather than broadcasting commands to set values

Unitary controller digital output devices may be ‘in service’ or ‘out of service’. The basic concept is that a device directly commanded over the LAN by another party is placed ‘out of service’ until it is restored. When ‘out of service’ the unitary controller does not command the device on or off based upon schedule, alarm, or monitor action. The unitary simply keeps track of how the point would have been commanded. When the point is restored, the unitary commands the point to the state would have last been commanded. In short, ‘out of service’ means that the point is not under unitary control.



Analog input and output points, which are defined in the point table, can be set to a value and placed out-of-service by a network command. The restore command can be used to restore the point to local unitary control. Digital Input points, which are defined in the point table, may also be set to a value and placed out-of-service.

In general commands on the LAN should be limited to unitary flags. The flags could then be tested to determine if a particular device should be turned on or off. This limits the LAN activity and allows most points in unitary controllers to remain ‘in service’ (under unitary control). For example, the Field Commander might schedule flags for normal building operation (BLDG) and zone 9 operation (ZON9). In addition, there may be a manual override flag (MANL) controlled from a unitary located in the

security office. A specific unitary may have local override on its thermostat(59F) and a smoke detector (SMOK) which causes a local emergency shutdown. The unitary can easily look at the logical flags and determine if its fan should be on with the following monitor.

```

if (BLDG ON @ ZON9 ON @ MANL ON @ 59F ON) & SMOK OFF
then FAN ON
else FAN OFF
    
```

### 3.5.1 Modify System Parameters

Controller Name: RM13	Override Adjust Time	(1k): 30
Address: 56	Override Time Max	(2k): 1200
Digital In Invert: . . . . . DDDD		(3k): 0
Universal In Invert: . . . . .		(4k): 0
Software config # : 12		(5k): 0
Analog In Calibrate (21K): 1.00		(6k): 0
Analog Out Calibrate (22K): 1.00		(7k): 0
(23K): 0.00		(8k): 0
(24K): 0.00		(9k): 0
(25K): 0.00		(10k): 0
(26K): 0.00		(11k): 0
(27K): 0.00		(12k): 0
(28K): 0.00		(13k): 0
(29K): 0.00		(14k): 0
(30K): 0.00		(15k): 0
(31K): 0.00		(16k): 0
(32K): 0.00		(17k): 0
(33K): 0.00		(18k): 0
(34K): 0.00		(19k): 0
(35K): 0.00		(20k): 0

#### Controller Name

Four character name for controller (used as the first four characters of device names in the controller). A blank name (all spaces) will cause no change to the controller name upon download.

### **Address**

Controller U-LAN address (0-120). A 127 will cause no change to the controller number upon download.

### **Digital In Invert**

Mask used to identify digital inputs which need to be logically inverted. A period in the mask indicates that no inversion is desired (open is OFF). An 'I' in the mask indicates the input is inverted (open is ON). The leftmost position in the mask is digital input 1. The rightmost four positions must contain a 'D' to disable thermostat override switch operation. There are two switches per thermostat. If thermostats are not used, a 'D' should be typed in positions 13 and 14 for THERMOSTAT 1 and in positions 15 and 16 for THERMOSTAT 2. If thermostats are used, a 'D' should be placed in fields 14 and 16 only.

### **Universal In Invert**

Mask used to identify universal inputs which need to be logically inverted. A period in the mask indicates that no inversion is desired (open is OFF). An 'I' in the mask indicates the input is inverted (open is ON). The leftmost position in the mask is universal input 1.

### **Software Configuration #**

Number used to identify predefined standard database configurations. Numbers range from 0 to 99. Lower numbers should be reserved for factory defined standard database configurations.

### **Analog In Calibrate**

Floating point number used for a controller wide analog input gain (default = 1.00)

### **Analog Out Calibrate**

Floating point number used for a controller wide analog output gain (default = 1.00)

### **Override Adjust Time**

Number of seconds to add to override timer for each push of the thermostat override switch (integer)

**Override Time Max**

The maximum number of seconds allowed in the override timer (integer)

The data base constants (1K to 35K) have meanings based upon software configuration. When the configuration number is changed, the labels on the database constant fields are changed as defined in the SOFTCONF.HLP file. Constants 1K to 20K are integer values. Constants 21K to 35K are floating point values. The only constants which are not user configurable are 21K, 22K, 1K and 2K. The meaning of all other constants depend upon user definitions. These values may be used for normal heating or cooling setpoints, stage timing, fan timing, thermostat adjustment range, or any other constant which may be needed by a monitor. By convention the factory defined standard databases use 1K thru 10K for standard zone controller definitions. For example, 6K and 7K are always used for the heating and cooling setpoints while 4K is related to fan operation. This allows local zone controls to be globally commanded from the Field Commander. For example, '0!4K = -1' causes all zones to use continuous fan operation no matter if the zone is a roof top, heatpump, or fan coil unit.

### 3.5.2 Modify Devices

#	Name	Type	Load(KW)	Feedback	Feedtime	Min ON	Min OFF	Status	Last
1	DO1		0	1:11	2	0	0	OFF IN	2 10:15
2	DO2		0			1	0	ON OUT	5 11:33
3	FAN		0			0	0	ON IN	1 13:42
4			0					OFF IN	0 00:00
5	LITS	P	0					OFF OUT	7 08:30
6		P	0						
7									
8									

**Name** 4 character device name (complete name is formed by using the controller name as the first four character name). The name field is changed by naming the device on the modify points screen. (this field is display only)

**Type** This field defines the type of output device which is connected to the point. A 'P' indicates a pulse on/off pair of points (odd number device is used to pulse on the device, even number device is used to pulse off the device). An 'S' indicates a pulse on/off point with feedback (if commanded on and the point is off, the output is pulsed). An 'I' is used for a digital output point which is logically inverted (normal output points are normally open, an 'I' changes the point to normally closed).

**Load** KW load of device (not presently used) (0-65535)

**Feedback** Input point associated with control point for actual feedback status. This is normally a digital input. However, any logical or arithmetic expression could be evaluated into a flag which provides the logical feedback. For example, the feedback for a boiler enable could be that after 20 minutes the boiler temperature is greater than 110 \*F.

**Feedtime** Minutes after turn on before feedback status is tested (an advisory message is issued if the feedback status does not match the commanded state after this time) (0-255)

**Min ON** Minimum on time in minutes (0-255). This should be used with caution as once the device is turned on, it cannot be commanded off until the minimum on time has expired.

**Min OFF** Minimum off time in minutes (0-255). This should be used when short cycling of equipment is to be prevented.

**Status** Current command state (on/off in/out). This field is used for status while using the on-line modification program. (display only)

**Last** Last command change (date hh:mm) - The day of the month and time of day when the command state last changed. The field is used for status while using the on-line modification program. (display only)



Feedback advisory messages can be automatically redirected to the host Field Commander as either advisory messages or alarm messages. The message contains the controller name and point name (if defined and unique). The feedback time field of the device table has been split into a feedback time (0-63 minutes) and a redirect flag. A blank in the redirect flag leaves the advisory message on the unitary (like U series). An 'H' sends the advisory feedback message to the host Field Commander. An 'A' sends an alarm feedback message to the host Field Commander. An 'N' causes no feedback message to be generated. (Note that the maximum feedback time is 63 with the X series and 255 with the U series ROMs. )

### 3.5.3 Modify Alarms

#	Point	Status	Low	Hi	Action
1	TEMP	Enabled	55.0	95.0	A"Temperature Limit" FAN ON
2	SMOK	Silenced			A"Smoke Alarm" DMPR = 100 FAN ON
3	1:3I	Enabled			1F ON
4					
15					

**Point** Point associated with the alarm. If the alarm point is a digital output with feedback assigned in the device table, the alarm is active if a feedback status error is detected: for all other digital points (including digital outputs without feedback), the alarm is active whenever the point is ON. If the alarm point is an analog point, the limits are used to check for an alarm condition. Note that alarms may be set on logical points (4F) or computed values (13C). This allows alarms to be associated with any logical or arithmetic expression. If the alarm point is a digital output, the alarm is active if a feedback status error is detected.

**Status** Points may be Silenced, Enabled, or in ALARM.

**Low**

**Hi** The low and high limits for an analog value

**Action** action(s) to take when alarm becomes active and not silenced.

Note that the action is taken once when the alarm changes state into the enabled and active status. This can be because the point status changed or the point was enabled while the point status was active.

Alarm testing frequency depends on the level of other controller activity. For example, if the controller was temporarily busy sending or receiving on the LAN, alarm testing may be delayed for a second or two.



Alarms are tested after each monitor or LAN command is processed. Digital input points are automatically latched upon input (tested every 10 ms). Alarm testing on a digital output which has a feedback status point is actually done on the status of the feedback (i.e., the alarm is activated at the same time that the device table determines that there is a feedback status error.

### 3.5.4 Modify Points

#	Name	Address	Flag	Type	Freq	Slope	Intercept	Value
1	DO1	1:1		0	15			123.0
2	TEMP	1:1A		1	60	1.00	0.00	75.4
3		5F		0	0			513.0
.								
.								
.								
75								

**Name** 4 character device name (complete name is formed by using the controller name as the first four character name). If a name is specified with no address, the name is substituted for the first four characters of the complete name for subsequent defined points.

For Example, on Controller ABCD:

Name	Addr	Complete Name
DO1	1:1	ABCD DO1
DO2	1:2	ABCD DO2
WEST		
TEMP	1:1A	WEST TEMP
FAN	1:3	WEST FAN
EAST		
TEMP	1:2A	EAST TEMP

**Address** Point address (1:1,1:1A,1:1I,1S,1O,1T,1F,1C,1G)- see device address formats section

**Flag** A 'G' indicates that any analog value change should be broadcast on the LAN. Global analog points are broadcast with the specified four character name.



If the global flag is set on a digital point, a broadcast is sent whenever a status change is detected (or another controller requests globals). If flagged as a global, the point can only be changed over the network by a direct point address command (a named network command will not change the point).

**Type** Conversion type for analog points 0-15 or point type for digital points (1-8). An analog type of 0 is 0-100% of full scale input or output. (see Modify Types)

**Freq** Frequency of periodic trend sample: 15 for every 15 minutes, 30 for every 30 minutes, 60 for every hour, and 0 indicates no periodic trend.

**Slope** The slope and intercept may be used to make individual offset/range adjustments for input or output points. If no such adjustments are required a slope of 1.0 and intercept of 0.0 should be specified. The order of adjustment for an input is as follows:

- 1) Input value
- 2) Use constant 1K to adjust system input range
- 3) Convert to 0-100%
- 4) Use point slope and intercept
- 5) Use engineering unit conversion specified by point type



There are now 16 control groups for digital points. The point table Intercept and Slope fields are used to define the control groups. Operation of the groups is the same as the groups in the U series ROMs. Control groups are only available on UUC-0 type controllers (MROB, lighting panels, controllable breakers).

**Value** For an analog point, the value is the most recent input or output value. For a digital point, the value is the accumulated runtime in minutes of on time (modulo 32768). When online, this field reflects the last value.



Digital point runtime value may be either runtime in minutes or the number of cycles from OFF to ON. A 'C' field has been added to the point table to define if the runtime is actually a cycle count.



The point table now contains a field for up to 20 characters of device description.

### 3.5.5 Modify Setpoints

#	FREQ	DEAD	P	I	D	F	BASE	MIN	MAX	IN	OUT	SETPOINT	OUTPUT
1	60	0.3	1.75	0.12	0.10	F	70.0	10.0	90.0	1:1A	1O	80.4	78.9
2	0	0.0	0.00	0.00	0.00		0.0	0.0	0.0		2O	0.0	0.0
3	0	0.0	0.00	0.00	0.00		0.0	0.0	0.0		3O	0.0	0.0
4	0	0.0	0.00	0.00	0.00		0.0	0.0	0.0			0.0	0.0
5	0	0.0	0.00	0.00	0.00		0.0	0.0	0.0			0.0	0.0
6	0	0.0	0.00	0.00	0.00		0.0	0.0	0.0			0.0	0.0
7	0	0.0	0.00	0.00	0.00		0.0	0.0	0.0			0.0	0.0

**Freq** Frequency of control loop in seconds (in 5 second steps). 0 indicates no setpoint control is desired.

**Dead** Deadband for control. If input is within the deadband of the desired setpoint, no further control action is taken.

**P I D** Proportional, integral and differential terms for the control loop (output change in response to an engineering unit change in error). The error adjustment for the new output is found using the following formula:

$$\text{error adjust} = P * ((\text{setpoint} - \text{input}) + I * (\text{integral} * \text{freq}) + D * (\text{differential} / \text{freq}))$$

The integral and differential terms are set to 0 whenever the setpoint changes.

**F** Set to 'F' for a fixed base type of control loop (output = base + error adjust). If blank, a floating output type control loop is used (output = last output + error adjust).

**Base** The initial output upon a cold start or the control base output for fixed base control.

- Min**  
**Max**      The minimum and maximum output value range.
- In**        Controlled point. Note that this may be any analog value including a computed point. The use of a computed point allows for a wide range of control options: from control based upon a weighted average to fuzzy logic.
- Out**       Point to receive output value. Note that this may be any analog value including a computed point or the input of another PID control loop. This allows for cascading of PID loops as well as fuzzy logic control.
- Setpoint** Control loops are associated with the analog output points on the unitary controller. The setpoint timers (76D, 77D, 78D, 79D, 80D, 81D and 82D) are updated every five seconds. If a setpoint loop is to be temporarily disabled, the setpoint may be set to -30000. The integral and differential errors are reset whenever the setpoint is changed. When a setpoint is enabled by changing the setpoint from -30000, the last output value used in floating base output mode is initialized to the present output value (or minimum or maximum established for the setpoint).
- Output**    When used online, this is the last output value. (display only)

### 3.5.6 Modify Types

#	Type	Unit	D	Input/Output (% of full scale)	Engineering	Unit	Value
1			0	0.00 0.00 0.00	0.000	0.000	0.000
2	WALL *F		1	0.00 21.20 26.00	166.500	107.300	95.500
3	DUCT *F		1	0.00 3.41 7.37	225.000	140.000	102.300
4	ADJUST		3	0.00 100.00 100.00	1.000	-1.000	-1.000
5							
.							
.							
.							
15							

**Type** Name of a predefined curve. Various factory defined curves are available in the TYPECONF.HLP file. For example, WALL is for a standard thermostat temperature, ADJUST is for a thermostat adjustment slide, and DUCT is for a standard 10K thermistor. This field is not stored as part of the database. It is simply used to input standard values into the other fields.

**Unit** Engineering units (up to four characters) Note that some PC Central programs only support 2 character engineering units.

**D** Number of digits to the right of the decimal point (0,1,2,3). When the value is converted, it is rounded to this number of decimal digits.

**Input/Output (% of full scale)** Group of eight points used in a simple linear curve fit

**Engineering Unit** Group of eight points used in a simple linear curve fit

**NOTE: The curve fit may be used on either input or output. If less than eight points are used for the conversion, the last values**

**should be repeated to complete the eight points. If the value is outside the range specified, the value is undefined ("???"). For example, a 4-20ma signal would have conversions for 20% to 100% of full scale. However if the actual input is less than 4 ma, the reported value would be '????'. To avoid these unable to convert values, the conversion table should extend from 0 to 100% even if 0 and 20% input values have the same conversion engineering value.**

The TYPECONF.HLP file may be used to provide standard curves. The WALL curve fit is used with a unitary controller wall thermostat. The DUCT curve fit is used for a 10K thermistor connected directly to an analog input. The ADJUST curve fit is used with the unitary controller wall thermostat to convert the adjustment slide to + or - one. There are also curves fits available in the TYPECONF.HLP file for relative humidity, air flow, CO2, and a host of other types of sensors.



### 3.5.7 Modify Schedules

#	A	BXYZ	Day	From	Until	Action
1			4-12	7:53	22:10	OCC ON
2			.M.W.F.	9:00	14:00	GYM ON
3			.T.T.	8:30	15:00	GYM ON
4		B	.MTWTF.	8:00	17:00	ADM ON
5			.MTWTF.	7:33		WATR ON
6		B	SMTWTFSH	15:00	7:00	SMOK ENA
.						
.						
.						
50						

- A** When on-line, an 'A' in this field indicates that the schedule is currently active (display only)
- B** A 'B' in this field enables the schedule only if communication with the host Field Commander (or UMI) has been lost for more than 10 minutes. (B causes a test on flag 64F which is set when communication has been lost.)
- X** An 'X' in this field enables the schedule whenever flag 63F is ON
- Y** A 'Y' in this field enables the schedule whenever flag 62F is ON (62F is set when the delay timer for thermostat 2 becomes 0. 62F is normally associated with occupied for the zone controlled from thermostat 2.)
- Z** A 'Z' in this field enables the schedule whenever flag 61F is ON (61F is set when the delay timer for thermostat 1 becomes 0, 61F is normally associated with occupied for the zone controlled from thermostat 1.)
- Day** The date (month-day) or periodic day of week when the schedule is active. The day of week mask has a letter for each day of the week (same as is used in the Field Commander)

**From** The time of day (24 hour format) when the action is to take place

**Until** The time of day (24 hour format) when the action is to be reversed. If the Until time is blank, the action is not reversed by the schedule. If the Until time is less than or equal to the From time, the schedule is assumed to be active across midnight. Reverse actions will not be taken if there is another active schedule with an identical action definition.

**Action** The action(s) to be taken at the specified From time and reversed at the Until time. Note that the reverse of ON is OFF (not restore).



Astronomical scheduling has been added to the unitary. The host Field Commander (R6 and later) includes the location information as part of its time sync packet. For standalone controller situations, a Set Location command is used to establish the Latitude, Longitude, and hours offset from GMT. (See the Field Commander manual). The unitary schedule From and Til times can be entered as relative to the computed sunrise ( R ) and sunset ( S ) times. For example, S+1:00 would be sunset plus one hour. The computed relative From time cannot cross a day boundary (limit at 0:00). (To extend across a day boundary, two schedules may be used with the same action. One schedule has a Til time of 0:00 and the other has a From time of 0:00. For example, to extend LITS ON from sunset until sunrise, use two schedules with From S+0:00 Til 0:00 LITS ON and From 0:00 Til R+0:00 LITS ON. ) A relative schedule cannot extend for more than 24 hours. The computed Til time cannot occur before the computed From time on the From date. Note that this Astro feature is only available in a ROM which does not have smart thermostat support.

### 3.5.8 *Modify Holidays*



For standalone control situations or backup controls, the unitary has a holiday table. If the host Field Commander defines the current day as a holiday or the controller holiday table defines the day as a holiday, the unitary schedules holiday activities. Note that the holiday table entries can be specified as backup, in which case they are only used if communication with the host Field Commander is lost.

### 3.5.9 *Modify Monitors*

#	BXYZCD	Freq	Condition	Then	Else
1		60	TEMP > 78	COOL ON	FAN ON
2	D	-1	TEMP < (SETC - 2.5)	COOL OFF	
3					
4					
5	B	-1	20F ON	"COMMUNICATIONS LOST"	
6	C	10	DO1 SIL & 23F OFF	DO2 ON	DO2 OFF
.					
.					
50					

**B** A 'B' in this field enables the monitor only if communication with the host Field Commander has been lost for more than 10 minutes. (B causes a test on flag 64F which is set when communication has been lost.)

**X** An 'X' in this field enables the monitor whenever flag 63F is ON

**Y** A 'Y' in this field enables the monitor whenever flag 62F is ON (62F is set when the delay timer for thermostat 2 becomes 0. 62F is

normally associated with occupied for the zone controlled from thermostat 2.)

**Z** A 'Z' in this field enables the monitor whenever flag 61F is ON (61F is set when the delay timer for thermostat 1 becomes 0. 61F is normally associated with occupied for the zone controlled from thermostat 1.)

**C** A 'C' in this field indicates that the then or else action is only taken when the monitor condition changes. A change is either a transition of TRUE to FALSE or FALSE to TRUE. If a monitor is modified or downloaded, the next condition test is considered to be a change and an action will be taken. When a dependent monitor is enabled, the next condition test is considered a change.

**D** A 'D' in this field indicates that the monitor is dependent upon a previous monitor (the most recent non-dependent monitor). When the base monitor is false all dependent monitors are skipped (timers reset). When the base monitor is true, all dependent monitors begin to run.

**Freq** The frequency of monitor testing in seconds (5 second update). If 0, the monitor is disabled. If -1, the monitor is tested as often as possible. If -2, the monitor is tested whenever its timer expires (some other action command sets/resets the timer). Monitors can be disabled by actions by periodically setting the corresponding timer such that the timer never expires. Timers 26D-75D correspond to the monitor timers.

**Condition** The expression is evaluated into a true (not 0) or false (0). If the condition can not be evaluated (no global value available, unknown input value, unable to talk with another unitary to obtain a value), the monitor is skipped. It is neither true or false and no action is taken.

**Then**

**Else** Action(s) to be taken when the monitor is evaluated as true (then) or false (else)

A monitor condition test may reference a point or value in another unitary controller. This is done by using the LAN address and point address (not name) for the point to be tested. 43!1:4A would use the fourth analog input point in unitary controller 43 on the U-LAN. This should be used sparingly since U-LAN activity will tend to slow down monitor operations. If no LAN value is returned in 10 seconds, a zero, OFF or ENABLED condition is substituted. It is far better to have the value passed as a global. This allows the monitor to test a local global value rather than slowing down monitors to wait on the value over the LAN.

There is a maximum size of 63 characters in a message and total of 127 bytes in a monitor description (condition and both actions). The program will not allow entry of an action or condition which exceeds this maximum size.

### **3.5.10 LAN Address / Redirection**

The action commands which are allowed in schedules, monitors, and alarms follow the same basic structure as is used in the Field Commander. Multiple actions may be specified by separating them with a space. If an action is preceded by an '!', the action is to be processed as a LAN action by the Field Commander. If the '!' is preceded by a letter, the action is only processed by a specific peer-net Field Commander. A double exclamation (!! ) indicates that the action is to be processed by the host Field Commander only. If the '!' is preceded by a number, the action is only processed on the specified unitary controller. A unitary controller number of zero (0!) is a broadcast to all unitary controllers on the U-LAN. A controller number of 124 (124!) sends the command to the host Field Commander.

LAN actions header:

- ! executed on all Field Commanders
- !! executed on host Field Commander
- a! executed on the Field commander specified by the letter (A-O)

## UNITARY CONTROLLER

---

- 0! executed on all unitary controllers on the U-LAN (1-120)
- n! executed on the unitary controller specified by the number (1-120)

### 3.5.11 Condition Values

integer constants  
floating point constants  
analog device values  
logical device values  
    device ON  
    device OFF  
    device SIL  
    device ENA  
time values  
    %TIME present time of day  
    %DAY present day of week  
    %DATE present date  
    %xx,xx,xx date value  
    %smtwtfsh day of week mask  
    %hh:mm time value

### 3.5.12 Monitor Condition Tests

>	greater than	^	logical not
<	less than	@	logical or
=	equal	@@	bit wise or
<=	less than or equal	&	logical and
>=	greater than or equal	&&	bit wise and
<>	not equal	&@	bit wise exclusive or
/	division	~	changed (store the computed value with the last computed value. changed is true if the values are different)
*	multiplication		
+	addition		
-	subtraction	<<	minimum of two values
sqrt()	square root	>>	maximum of two values
log()	natural log	ENTH	Enthalpy operator (TEMP ENTH RH)
exp()	natural exponentiation		

### **3.5.13 Device Address Formats:**

xF	flag
[x:]x	digital output
[x:]xA	analog input
x:xS or [x:]xI	digital input
[x:]xT	trend (counter on digital input 11 or 12)
xC	computed value
xG	global value (received from some other controller)
xS	setpoint
xO	analog output
xD	timer
xK	database constant
x:xP	parallel input (Field Commander only)



**3.5.14 Action Summary:**

device	ON	(for a unitary the reverse of ON is OFF)
	OFF	(for a unitary the reverse of OFF is ON)
	STATUS	(when entered in a monitor or schedule action a status command creates a trend sample for the present value)
	RESTORE	
	COMMAND	
	SILENCE	
	ENABLE	
	PAUSE	(delay 1 second)
device =	value	(for a unitary the reverse of set of a setpoint is no action)
device =	~	(monitor action only, sets device to the value computed in the monitor condition)
device =	variable	(variable may be any addressed analog point)
	REPORT number	(valid for Field Commander only)
	ENTER x METER y	(valid for Field Commander only)
	EXIT x METER y	(valid for Field Commander only)
"message"		(message text limited to 63 characters)
Ax"message"		(message text limited to 63 characters)

Any message containing "::::" will have the controller name substituted for the "::::". Messages will not be duplicated if the message has already occurred on the same day. If a message begins with "+", duplicate messages are allowed.

### **3.5.14 Modify Controls**



A special control table has been added to handle higher speed response times than can be provided in monitors. The controls are processed after alarms but before monitors. The result is better response time for simple controls like override switches. Note that monitor processing will appear to slow down as more controls are defined. It is recommended that the Windows PC Central software be used when defining controls. This software provides popup screens to define specific types of functions using controls. Please see the Windows PC Central documentation for the SP2 release for available functions.

### **3.5.16 Special Points Summary**

While most unitary points are available for general use, there are several points that have predefined uses in the unitary controller.

- 1T - counter associated with digital input 11
- 9T - counter associated with digital input 12
- 17I - 24I digital inputs corresponding to universal inputs 1A - 8A
- 13I - override switch on thermostat 1
- 14I - reserved for second switch on thermostat 1
- 15I - override switch on thermostat 2
- 16I - reserved for second switch on thermostat 2
- 1A - thermostat 1
- 2A - adjust input thermostat 1
- 3A - thermostat 2
- 4A - adjust input thermostat 2
- 1K - override adjust time
- 2K - max override adjust time
- 21K - controller analog input gain adjustment (1.0)
- 22K - controller analog output gain adjustment (1.0)
- 26D - 75D timers associated with monitors 1-50
- 76D - timer associated with setpoint loop 1
- 77D - timer associated with setpoint loop 2
- 78D - timer associated with setpoint loop 3

- 79D - timer associated with setpoint loop 4
- 80D - timer associated with setpoint loop 5
- 81D - timer associated with setpoint loop 6
- 82D - timer associated with setpoint loop 7
- 86D - override timer thermostat 1
- 87D - override timer thermostat 2  
when the override timer is non-zero,  
the thermostat override LED is on
- 88D - delay timer thermostat 1
- 89D - delay timer thermostat 2  
when the delay timer expires, flag 61F or 62F is set
- 57F - OverrideLED on thermostat 1 (LED on when 57F is ON)
- 58F - Override LED on thermostat 2 (LED on when 58F is ON)
- 59F - Override on thermostat 1 status  
on when 57F is ON or override timer is non-zero
- 60F - Override on thermostat 2 status  
on when 58F is ON or override timer is non-zero
- 61F - thermostat 1 occupied flag  
set when delay timer expires  
Z enable flag for monitors and schedules
- 62F - thermostat 2 occupied flag  
set when delay timer expires  
Y enable flag for monitors and schedules
- 63F - X enable flag for monitors and schedules
- 64F - communication with host Field Commander lost  
set when the Field Commander has been inactive for 10 minutes  
reset when Field Commander becomes active  
B enable flag for monitors and schedules



Since the analog outputs are frequently used for controlling additional digital points through sensitive relays, these analog output points can now be referenced as digital points 1:9-1:11. Turning the point on sets the analog output to 100%. Turning the point off set the analog output to 0%. Although these points can be used like digital points, they do not have all the features of digital points like out-of-service, minimum on/off times and feedback status. Analog output points can be referenced as either an analog point or a digital point.

## 4. Universal Unitary Controller 0

### 4.1 *General Overview*

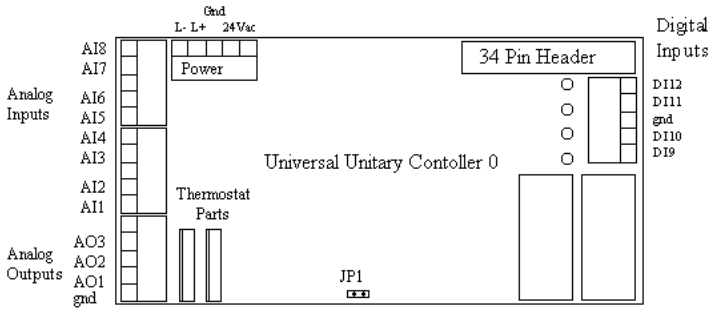
The Universal Unitary Controller 0, or UUC-0, is like a Unitary Controller 8 but it has special digital input/output capabilities. The UUC-0 has 4 direct Digital Inputs (1:9I, 1:10I, 1:11I, & 1:12I), 8 Analog Inputs, 3 Analog Outputs and 2 Thermostat Ports.

The 4 digital inputs are linked with four pulse counters (1:17T, 1:25T, 1:1T, and 1:9T respectively – these addresses are non-sequential to support reverse compatibility with UUC-8 applications where only two counters are available). A unitary pulse counter increments on the rising edge of its associated digital input; pulse counts roll over to 0 after reaching the maximum of 65535.

The 8 digital outputs and 8 of the digital inputs usually on a UUC-8 are replaced with a 34-pin header. This connector allows the UUC-0 to be used to control the following HIS peripheral devices:

- 1) Controllable Breaker Board
- 2) Multiple Relay Output Board

Like the UUC-8 and UUC-4, the UUC-0 is compatible with the HI Solutions Universal Unitary Controller Network (U-LAN) and can be configured on a system with up to 120 UUC nodes.



Note: Jumper for controllable Breaker Board – Remove jumper for a multiple relay output board

Figure 1 – UUC-0

## 4.2 Controllable Breaker Board

The Controllable Breaker commands up to 42 pulse on/off circuit breakers with status feedback while the Multiple Relay Output commands up to 64 relay outputs with status feedback. These boards are connected to the UUC-0 via a 34-pin ribbon cable.

The Controllable Breaker 42 additional points are addressed 1:1-1:6, 2:1-2:6, 3:1-3:6, 4:1-4:6, 5:1-5:6, 6:1-6:6, 7:1-7:6. Likewise, the 64 relay outputs on the Multiple Relay Output are addressed 1:1-1:8, 2:1-2:8, 3:1-3:8, 4:1-4:8, 5:1-5:8, 6:1-6:8, 7:1-7:8, and 8:1-8:8.

A jumper must be in JP1 of the UUC-0 for the Controllable Breaker Board to work properly.

## **4.3 Multiple Relay Output Board**

### **4.3.1 General Overview**

The Multiple Relay Output Board (Figure 1) is used to add up to 64 latching relay outputs with manual control switches to the Universal Unitary Controller 0, or UUC-0. The relays are rated for 1A @24VDC and there are 16 relays per Multiple Relay Output Board, or MROB. Up to 4 MROBs can be cascaded together to provide 64 total relay outputs.

The relays have normally-open (NO) contacts, which can be configured as normally-closed (NC) contacts by inverting the point in the unitary program. There is also status feedback for each relay. A jumper switch for each relay controls whether the status feedback is external to the board or sensed from the relay contacts. There is an indication LED for each relay to give visual feedback. In addition, there are indicator LEDs for the 15-volt and 5-volt power lines.

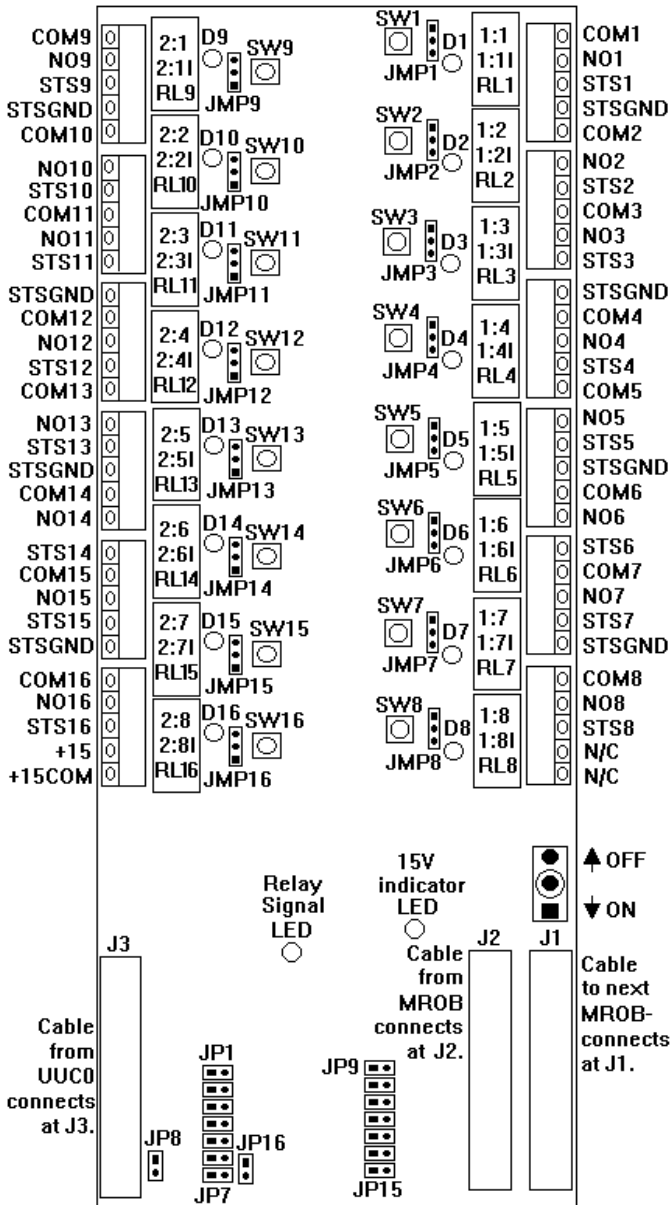
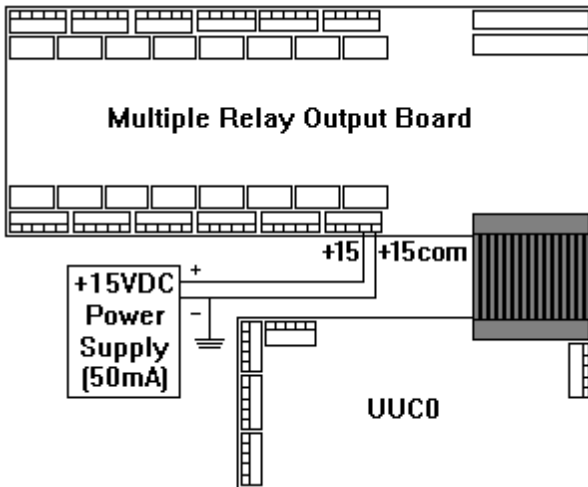


Figure 1: Multiple Relay Output Board

### 4.3.2 Installation

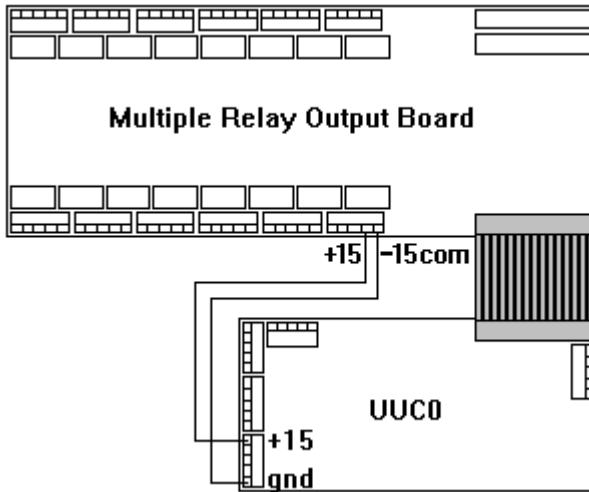
#### 4.3.2.1 Power

The MROB has to be powered by an external 15 VDC supply that can supply at least 20mA per MROB (Figure 2). This 15 volts could be wired straight off the 15V supply from the UUC-0 (Figure 3) provided that the total current of external devices powered off the unitary is 100mA or less. The 15 volts is available from pins 1 and 5 of TB8 of the UUC-0. If an external supply is used, both the UUC-0 power supply and the 15V power supply should be chassis grounded at the same point.



**Figure 2**  
MROB powered by external 15VDC supply.



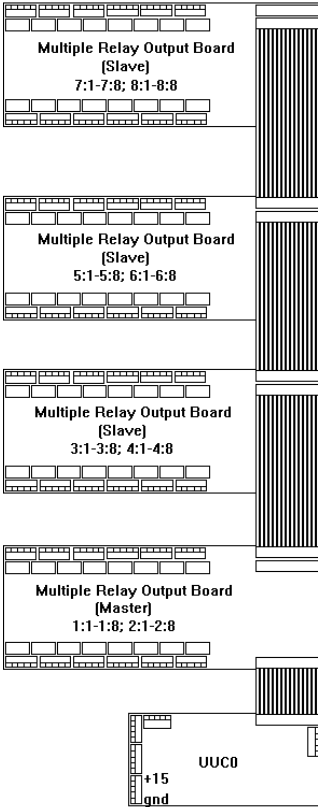


**Figure 3**  
MROB Powered by a UUC-0.

#### **4.3.2.2 Board to Board Connections**

The boards are connected via 34-pin flat connector cables. There are three 34-pin input headers on the MROB. One header connects to the UUC-0. The other two are for cascading to additional MROBs. The Multiple Relay Output board directly connected to the UUC-0 is called the “Master” MROB. Any MROBs cascaded to the “Master” are called “Slaves.”

From the UUC-0, a 34-conductor cable is connected from J4 to J3 of the Multiple Relay Output Board. To cascade additional MROBs, another 34-pin cable is needed. To cascade a second MROB, the cable is connected from J1 of the master MROB to J2 of the second, or “Slave,” MROB. If a third or fourth board is needed, a similar connection is made. J1 of the previous board is connected to J2 of the next MROB (Figure 4).

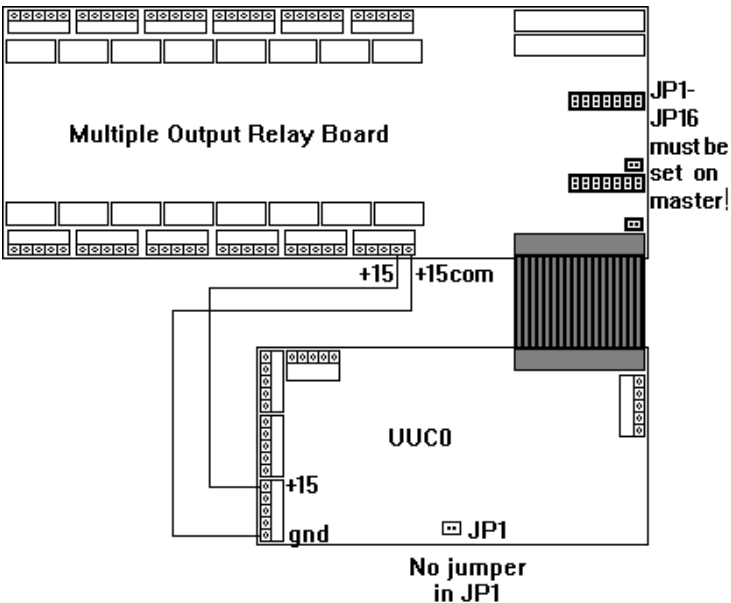


**Figure 4**  
Board to Board Connections

### 4.3.2.3 Jumpers

In addition, there are 16 jumpers that must be set on the Master MROB. These same jumpers must be left open on any Slave MROBs. Note that these jumpers are labeled JP1-JP16 and are 2 pin jumpers. Do not confuse these jumpers with the three pin feedback control jumpers labeled JMP1-JMP16 located next to each relay.

A UUC-0 connected to a MROB should not have a jumper in JP1. The jumper should be left open (See Figure 5).



**Figure 5:** Jumper Settings.

### **4.3.3 Operation**

#### **4.3.3.1 Normal Operation**

The relays operate similarly to the ones on the UUC4 or UUC8. They are programmed on and off in the same way; however, the addressing is different and the relays are latching relays. The first board contains outputs 1:1 – 1:8 and 2:1 – 2:8, corresponding to relays 1-16 on the MROB. The second MROB contains outputs 3:1 – 3:8 and 4:1- 4:8 while the third MROB contains outputs 5:1 – 5:8 and 6:1 – 6:8. The final MROB has output addresses 7:1 - 7:8 and 8:1 - 8:8 (See Figure 1).

When modifying an MROB database using the UUC program, the command BLANK MRC should be used so the database will allow for 64 points in the device table (MO DE). If the database does not need to be blanked, the command CONFIG MRC should be used instead.

#### **4.3.3.2 Manual Operation**

To manually turn on a relay, flip the two-way switch labeled SW17 to the On position. Then press the switch associated with the relay to be turned ON. The relay should turn ON. See switch location in Figure 1.

To manually turn off a relay, the simply flip the two-way switch to the OFF position and then press the switch associated with the relay to be turned OFF. The relay should turn off.

#### **4.3.3.3 Feedback Status**

The feedback status can be either external or sensed from the second set of relay contacts. The jumper switches JMP1 through JMP16 determine the nature of the status (Figure 1). Each relay has its own jumper so feedback for each relay is determined independently. In order to have feedback external to the board, place the jumper of JMP1-16 across pins 2 & 3.

Likewise, for feedback off the secondary relay contacts, place the jumper across pins 1 & 2.

If the status is external to the board, the feedback should be a dry contact from STS to STSGND. It is imperative to the proper operation of the device that the connections across STS and STSGND are dry contact connections. When the device controlled by the relay is on, STS should be connected to STSGND through the status contact

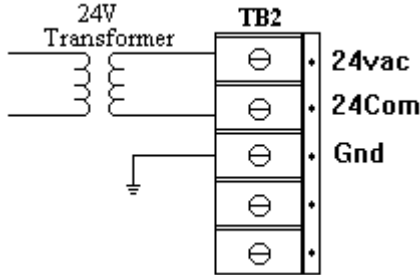
The points for the status feedback are 1:1I – 1:8I and 2:1I – 2:8I for the first board, corresponding to outputs 1:1 – 1:8 and 2:1 – 2:8. For the second, third and fourth MROB the status inputs are addressed 3:1I – 3:8I, 4:1I – 4:8I, 5:1I – 5:8I, 6:1I – 6:8I, 7:1I – 7:8I, and 8:1I – 8:8I (Figure 1).

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## **APPENDIX A - POWER CONNECTIONS**

If a 24v transformer is used for power with the 4038-TF or 4038-RF unitary controller, it should be at least 10 VA and should be floating (neither leg connected to ground). See Figure A-1. If a floating transformer is not available in the controlled equipment, a 24 volt isolation transformer may be used. For DC power input, the voltage may range from +24 to +35 vdc (Figure A-2).

### 24VAC Connection (4038-TF or 4038-RF)



**NOTE:** Before connecting power to the unitary controller, verify that the secondary of the transformer is floating (neither side connected to ground).

FIGURE A-1

### DC Power Connection (any configuration)

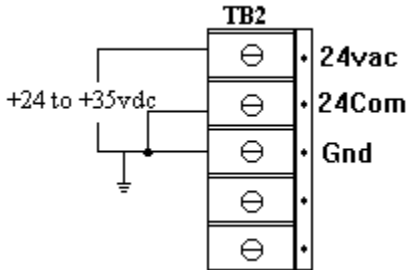


FIGURE A-2

### Multiple Unitary Controllers with Shared Power



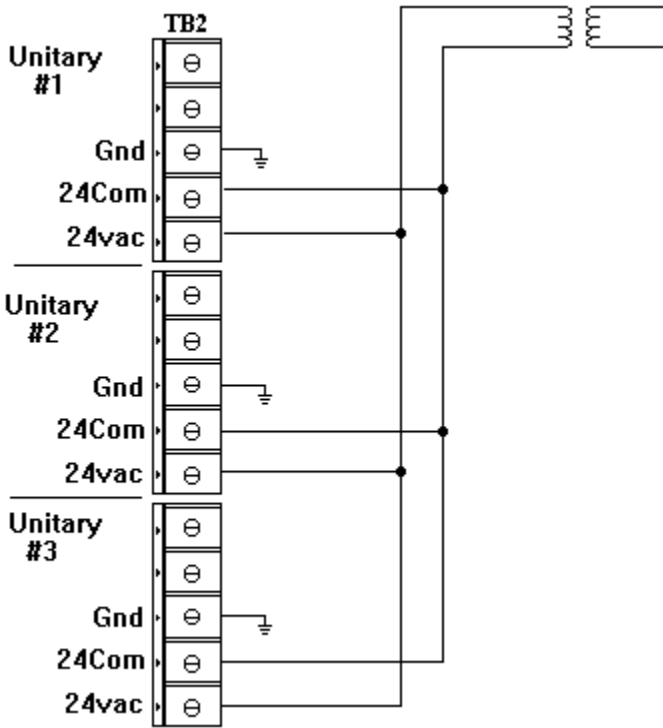


FIGURE A-3

**Note:** 24v control transformer should have at least 10va per unitary. Distribution wiring should be capable of handling the current.

### A.1 DIGITAL OUTPUT

**Common 24v supply  
(4038-TF or 4038-RF)**

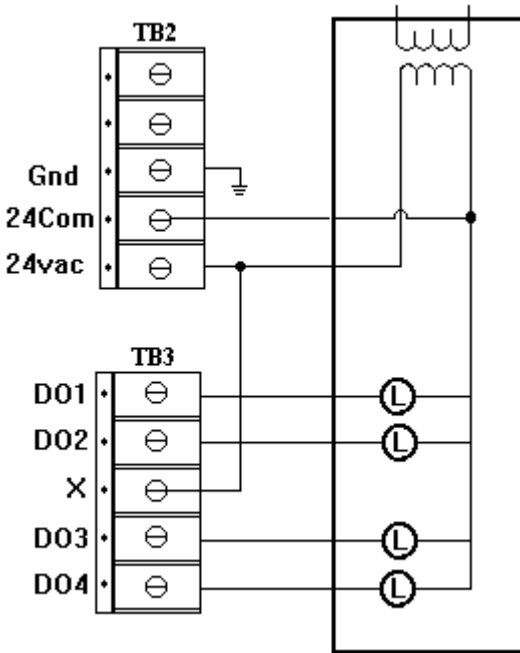
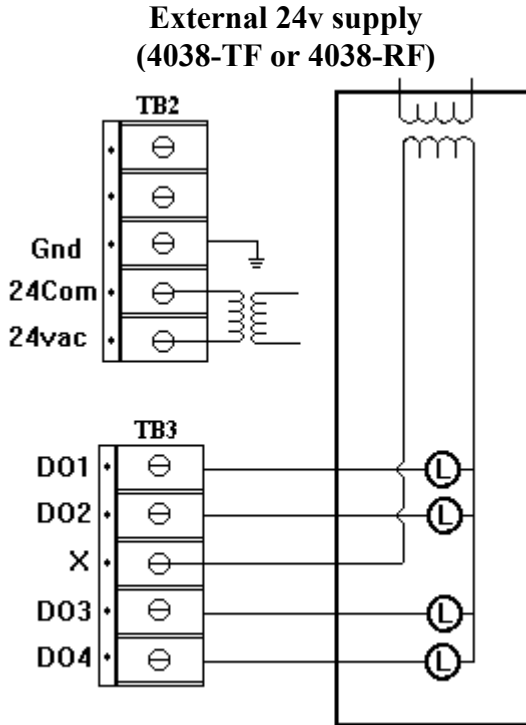


FIGURE A-4

**Note:** The secondary of the transformer must not be grounded.



**Note:** The secondary of the transformer must not be grounded.

**FIGURE A-5**

(Left blank intentionally)

## **APPENDIX B - Digital I/O Converter Board**

The unitary controller has up to 12 digital inputs. These digital inputs are opto-isolated and are designed to be connected to dry contacts of a relay or switch. The unitary has internal pullups to +24v unregulated on the digital input lines which are switched to the digital in common (ground) by the external switch or relay contacts. On occasion an application may require a connection to something other than the dry contacts of a relay or switch. Although a universal input could be used to directly connect a 0-5v digital signal, there are a limited number of analog / universal inputs. The Digital I/O Converter board can handle the connection of other types of digital signals to the unitary controller digital inputs.

The Digital I/O Converter board handles the digital signal conversion for four digital inputs. The board measures approximately 1-1/4" by 3-1/4" and mounts in the same snap track used for the unitary controller. The four outputs are connected directly to four unitary controller inputs. The four inputs can be connected to a variety of digital signal types. All digital input signals are relative to the unitary controller ground. The board can handle digital DC voltage signals from 5vdc to 35vdc. When the input signal is ground (less than 0.8 vdc), the corresponding digital output (and unitary controller digital input) is open. When the DC voltage on the digital signal is a positive voltage (greater than 3.0vdc), the corresponding digital output (and unitary controller digital input) is closed.

The input signal conditioning allows for a digital pulse input or half wave rectified signal. It can also be used on an AC signal up to 24vac. As long as the input signal is referenced to the unitary controller ground and does not exceed 35volts, there is a good chance that the converter board could be used to adapt the signal to the unitary controller digital inputs.

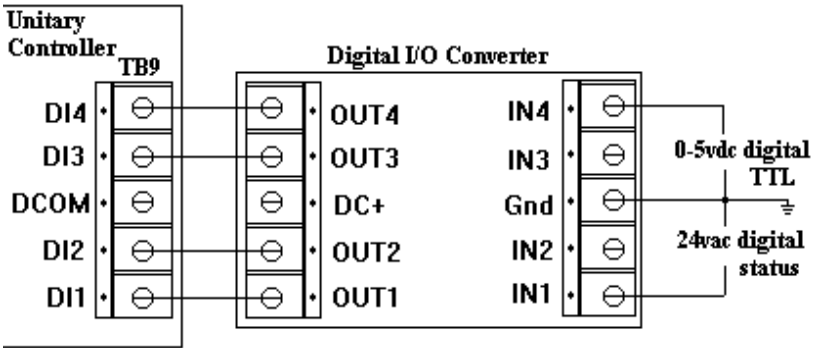


FIGURE B-1

The Digital I/O Converter board can also be used to convert the unitary controller TRIAC outputs to a DC digital output signal. The unit to be controlled supplies a DC voltage ( less than 35vdc) referenced to the unitary ground. When the unitary output is off, the converter board output is pulled up to the supplied DC voltage. When the unitary output is on, the converter output is connected to ground through a FET switch.

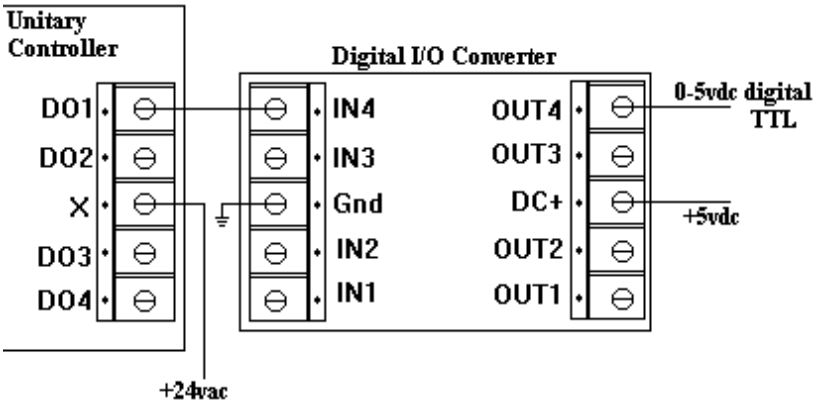
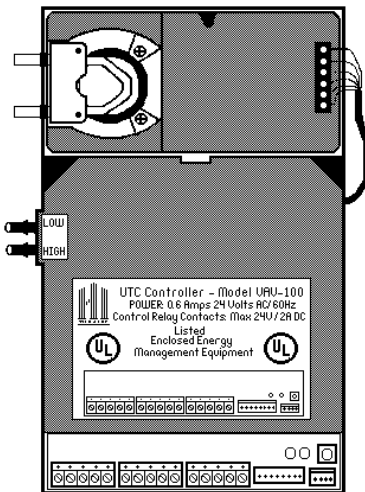


FIGURE B-2

## Appendix C - Universal Terminal Controller (UTC)

### C.1 UTC Overview

The Universal Terminal Controller, or UTC, is essentially a Unitary Controller with specialized input and output capabilities. The UTC has 1 thermostat connection, 4 universal inputs, 3 outputs (which are factory installed as analog or digital) and an optional pressure port. In addition, there is an option for factory installation of an actuator, an additional PC board which has 2 relay outputs and 1 analog input or an E-P controller. The UTC has its own special housing which allows these additional devices to be factory installed as part of the UTC package (see Figure C-1).



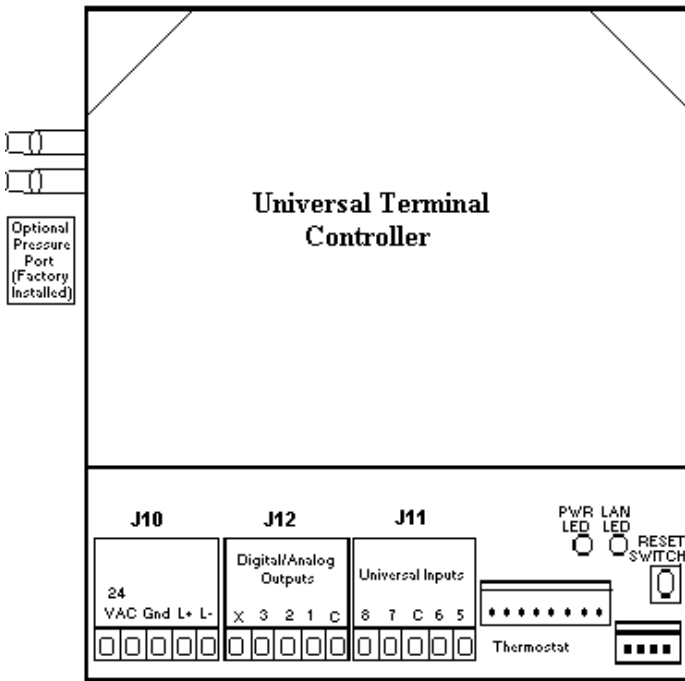
**FIGURE C-1**

(This is a UTC with a pressure port (on left side) and an actuator at the rear of the device.)

The UTC programming and operation is very similar to the UUC. However, the UTC has fewer inputs and outputs and the operation of some of these inputs and outputs are different. This appendix will mainly concentrate on the ways the UTC differs from the UUC.

### C.1.1 Power

The power requirements and configuration for the UTC are functionally the same as a UUC-RG or TG. However, a floating ground version of the UTC is not available. The UTC is powered from 24VAC (one side grounded) or 24 VDC and requires 10VA of power. See Figure C-2 for location of the power input. Whenever the power is on, the LED labeled D5 on the UTC will light up.



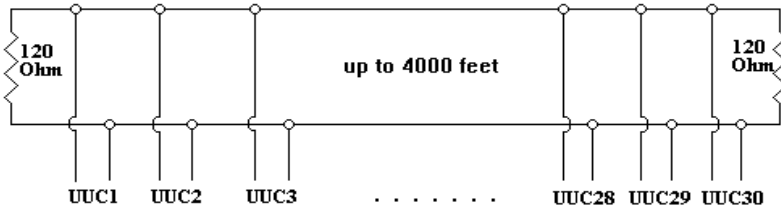


**FIGURE C-2**  
(UTC INPUTS AND OUTPUTS DIAGRAM)

### C.1.2 U-LAN

The UTC can link directly into the Unitary LAN or U-LAN. The LANs for the two devices are interchangeable. The U-LAN operates at 9600 baud on a pair of wires using standard RS-485 drivers. A U-LAN of up to 4000 feet can be routed with a single pair of 24AWG shielded wire.

A U-LAN may consist of one or more segments with each segment limited to approximately 4000 feet and 30 controllers. Each segment should be point to point with 120 ohm termination resistors on each end. See Figure C-3. For more details on wiring the LAN consult page 1-3 of the Unitary Manual.



**FIGURE C-3**  
(UTC LAN connections)

The LAN+ and LAN- connections are on J10 of the UTC right next to the power input and are labeled L+ and L-. There is also a 4 pin plug labeled J1 which allows for a PC direct connect to the LAN. A PC to U-LAN cable (HIS part #016-2156) is necessary for this connection. See Figure C-2 for the location of the LAN.

There is a LAN Led which blinks when there is communication on the LAN. It is labeled D6 and is the LED furthest to the right near the reset button. It is shown in Figure C-2.

### **C.1.3 Reset Switch**

The UTC has a reset switch located on the front right of the circuit board. See Figure C-2. This switch is used to reset the device.

### C.1.4 Outputs

The UTC has three outputs which are factory installed as either digital (relays) or analog (0-20 mA) outputs. A UTC-100 has one relay output and 2 analog outputs while a UTC-200 has two relay outputs and 1 analog input. Similarly, a UTC-300 has 3 relay outputs and no analog inputs.

Whether analog or digital, the outputs are similar to UUC outputs. For the digital relay outputs, the common leg (X) is switched to the output when the relay control point is ON. The relay can handle resistive loads up to 2A/30 VDC and 0.4A/125VAC. As an analog output, the output supplies 0-20 mA at up to 500 ohms (0-10v).

The addressing of the outputs is similar to the UUC except for the overlap of points. Output 1 is always a digital point controlled by point 1:1. If output 2 is a digital point, it is controlled by 1:2, but if it is an analog point it is controlled by 2O. Likewise, if output 3 is a digital point, it is controlled by 1:3 and if it is an analog point, it is controlled by 3O.

For a UTC-100, since the first output is a relay, 1O should be set to zero periodically through a monitor so 1O will not interfere with 1:1. In the same way, since the second and third outputs are analog, there should be a monitor setting 1:2 and 1:3 OFF to prevent programming interference. The following monitor needs to be included in the UTC-100 database:

<u>#</u>	<u>BXYCD</u>	<u>Freq.</u>	<u>Condition</u>	<u>Then</u>	<u>Else</u>
1		5	1	1O=0 1:2 OFF 1:3 OFF	

Likewise for a UTC-200, the following monitor needs to be included:

<u>#</u>	<u>BXYCD</u>	<u>Freq.</u>	<u>Condition</u>	<u>Then</u>	<u>Else</u>
1		5	1	1O=0 2O=0 1:3 OFF	

Finally for a UTC-300, the following monitor should be included:

# BXYCD	Freq.	Condition	Then	Else
1	5	1	1O=0 2O=0 3O=0	

The different output configurations are summarized in the following table:

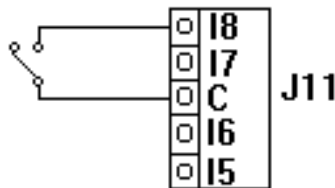
UTC Description	Relay Outputs	Analog Outputs
UTC-100	1:1	2O 3O
UTC-200	1:1 1:2	3O
UTC-300	1:1 1:2 1:3	

**Table C-1**

### **C.1.5 Digital/Analog Inputs**

The UTC has four universal inputs that correspond to Unitary inputs 5-8. The inputs can be used as digital inputs or analog inputs.

When used as a digital input, an ON condition is indicated by less than approximately 0.2 volts on the input. Since the input normally is pulled up to 5 volts, an input switch (normally open) simply needs to connect the input to ground. An ON condition is a closed input switch.



**FIGURE C-4**  
(UNIVERSAL INPUT AS A DIGITAL SWITCH INPUT)

The addresses for the Universal inputs when used as digital inputs are 1:21I-1:24I corresponding to inputs 5 - 8.

When used as an analog input, the UTC expects a 0-5 volt input. Inputs 5 and 6 are special in that these inputs can allow for a 10k thermistor to be directly connected to the UTC. Inputs 7 and 8 do not. However, all the inputs will allow for a 0-5 volts input. The programming addresses are 1:5A - 1:8A.

When using the thermistor setup, the conversion curve called UTCDUCT from the TYPECONF.HLP file must be used. Refer to page 1-5 of the Unitary Manual for further instructions on configuring universal inputs.

### ***C.1.6 Thermostat Input***

The UTC has one thermostat connection J-2 which is identical to the 8-pin connector J-2 on the UUC. When a thermostat is connected to J-2 the jumpers across JP9 and JP10 should be set across pins 2 and 3. To get to these jumpers the cover must be taken off the board by squeezing the sides of the cover and lifting up. The jumpers are shown in Figure C-5.

Refer to the Thermostat section of the Unitary Manual for the proper termination of the thermostat connector.



of an Autotran pressure transducer within the UTC housing. The transducer comes in various different pressure ranges (i.e. 0-1" W.C., 0-4" W.C. or 0-10" W.C.). Analog point 1:4A is the voltage input from the sensor corresponding to the differential pressure across the pressure port. For the Autotran 600 0-1" W.C. transducer, an input of 1-5 volts corresponds to 0-1" W.C.

This port can be used to attach to a differential pressure flow sensor mounted in an air duct. Using the flow sensor combined with the pressure transducer, air flow velocity can be calculated. The 1-5 volt output of the pressure transducer is converted to air flow in ft/min using type conversion curves in the TYPECONF.HLP file.

The air flow in cubic feet per minute (cfm) can then be calculated by multiplying the velocity (ft/min) by the duct cross sectional area (ft<sup>2</sup>). This air flow is then used in controlling the HVAC system. The cross sectional area can be set up in a database as a system constant.

Conversion curves are available for the Kreuter SSS-1000 series air flow sensors (KELE SSS-1003 and SSS-1004) in the standard release TYPECONF.HLP file. The curves are called SSS1003 and SSS1004. The difference in these two sensors is their sensing length. When using these curves, the Autotran 0-1" pressure transducer must be used.

The transducer is factory adjusted. However, the transducer might need calibration after installation. See the UTC Pressure Transducer Calibration Procedure.

### **C.1.8 Actuator**

The UTC can be ordered with a factory installed Belimo actuator motor for controlling a terminal damper unit. The actuator is mounted straight to the available slot on the exterior housing of the UTC ( see figure C-1).

The actuator is controlled using digital outputs 1:7 and 1:8. Output 1:7 drives the actuator down or counterclockwise; 1:8 drives it up or clockwise. The feedback position of the actuator arm is provided through analog input three (1:3A). A feedback of 0 means the damper is closed while 100 means the damper is completely open. The H I Solutions standard database uses a computed point to determine the desired actuator position and then uses monitors to control the outputs so that they match the desired position.

The arm of the Belimo actuator should not be driven up and down at the same time. To prevent this from happening there is protection built into the database. Commanding outputs 1:5 and 1:6 (which do not control real outputs) OFF prevents outputs 1:7 and 1:8 from being ON at the same time. If both 1:7 and 1:8 are ON under the protection conditions, neither point actually turns ON and the actuator arm remains static. The following monitor should be in the database to protect the actuator:

<u>#</u>	<u>BXYCD</u>	<u>Freq.</u>	<u>Condition</u>	<u>Then</u>	<u>Else</u>
1		5	1	1:5 OFF	1:6 OFF

If either 1:5 or 1:6 or both points are commanded ON, then outputs 1:7 and 1:8 are independent of each other and they can be ON simultaneously.

## **C.2 Additional Devices**

There are two alternative optional control devices that can be factory installed instead of the actuator. These devices use the same input and outputs as the Belimo actuator and they fit into the same slot on the UTC as the actuator. The two devices are a relay board and an E-P controller.



### ***C.2.1 UTC Relay Expansion Board***

The UTC Relay Board is an expansion board for the Universal Terminal Controller (UTC) which provides the UTC with two additional digital outputs and one additional analog input. The relay board screws into the side slot of the UTC enclosure and has a protective cover. The relays provide one SPDT set of contacts each rated at loads up to 7A/24V.

The UTC Relay Expansion Board is useful in an HVAC system where more outputs are necessary than the three provided by the UTC. For example, this board could be used to control additional exhaust fans, heating and cooling stages, lighting or actuators.

The UTC Relay Expansion Board connects to the UTC via an 8-conductor cable which comes with the device (see Figure C6). The digital outputs for addressing the relays are 1:7 (O7) and 1:8 (O8). The universal input, labeled I3, is 1:3A.

In some applications, such as pulse on / pulse off devices, it would be harmful for the device being controlled if both outputs were ON simultaneously. Thus, protection is built into the software so that the status of points 1:5 and 1:6 determine if 1:7 and 1:8 are dependent or independent of each other. Commanding outputs 1:5 and 1:6 (which do not control real outputs) OFF prevents outputs 1:7 and 1:8 from being ON at the same time. If both outputs 1:7 and 1:8 are ON under the protection conditions, neither point actually turns ON. To enable this protection, the following monitor should be included in the database.

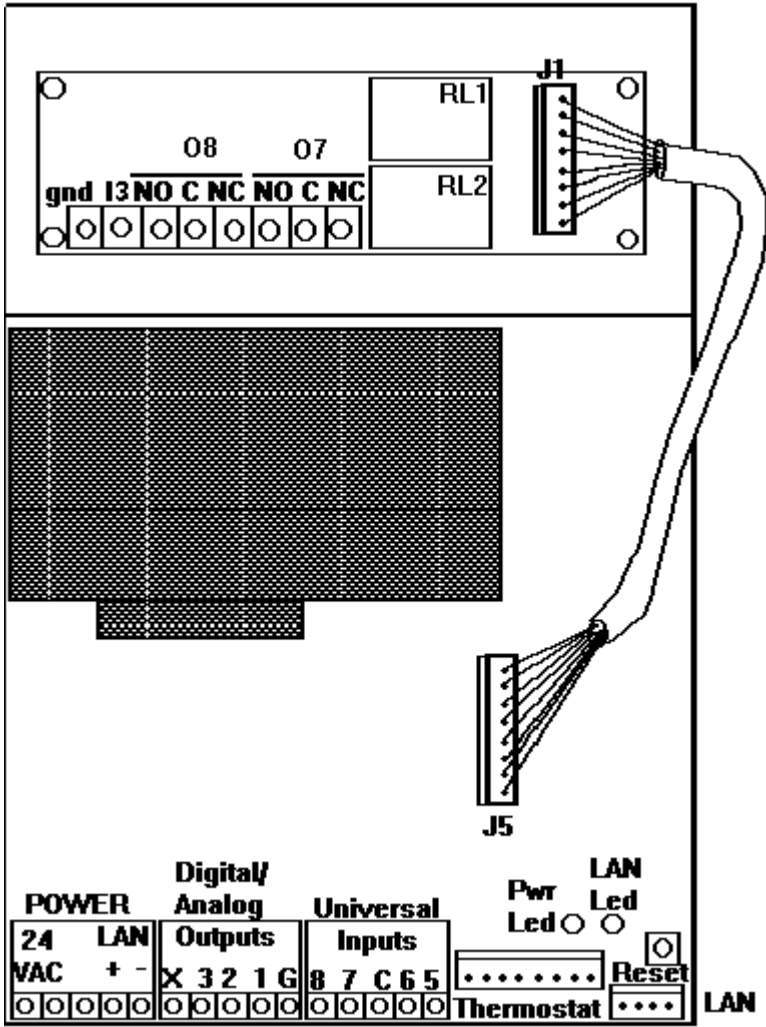


FIGURE C-6  
 (UTC with Relay Expansion Board without covers)

<u># BXYCD</u>	<u>Freq.</u>	<u>Condition</u>	<u>Then</u>	<u>Else</u>
1	5	1	1:5 OFF 1:6 OFF	

If either 1:5 or 1:6 or both points are commanded ON, then outputs 1:7 and 1:8 are independent of each other and the outputs can be ON simultaneously. To ensure the independence of the outputs, the following monitor should be included in the database.

<u># BXYCD</u>	<u>Freq.</u>	<u>Condition</u>	<u>Then</u>	<u>Else</u>
1	5	1	1:5 ON	

The universal input, I3, is located at pin 7 of TB1 on the UTC relay board. Pin 8 is the analog ground. Like other universal inputs, 1:3A accepts a 0 to 5 VDC input or dry contact digital input. However, it cannot be used directly with a 10K thermistor.

### ***C.2.2 UTC E-P Controller***

The UTC Electro-Pneumatic controller is used to control pneumatic systems. The E-P device is used to convert an electric signal to a pneumatic output.

There are two pressure ports called MAIN and BRANCH. MAIN is the supply and BRANCH is the output pressure regulated by the E-P. The BRANCH pressure range is 0-15 PSI and the MAIN pressure must be at least 2 PSI above the desired BRANCH pressure. However, the maximum MAIN pressure is 30 PSI.

To control the BRANCH pressure, digital outputs 1:7 and 1:8 are used. To increase the output pressure 1:8 is set ON, and to decrease the output pressure 1:7 is set ON. It is better for 1:7 and 1:8 not to be ON simultaneously, so 1:5 and 1:6 should be controlled OFF in a monitor as

## UNITARY CONTROLLER

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shown below. For further explanation of the role of outputs 1:5 and 1: 6, read section Actuator above.

<u># BXYCD</u>	<u>Freq.</u>	<u>Condition</u>	<u>Then</u>	<u>Else</u>
1	5	1	1:5 OFF	1:6 OFF

The status feedback of the pressure is captured by analog input 3 (1:3A). The analog input ranges from 0 to 100 percent which corresponds to a BRANCH pressure of 0 to 15 PSI. This signal is used to control the digital outputs, whether the pressure should be increased or decreased.

The UTC E-P controller can come with a gauge. This is factory installed and it gives a direct reading of BRANCH pressure.

### **C.3 UTC System Summary**

This is a listing of the hardware inputs and outputs on the UTC.

- 1 Relay Outputs
- 2 Analog Outputs -may be converted to relay outputs at factory
- 4 Universal Inputs -two of which may be used for direct thermistor input
- 1 Thermostat Connection
- 1 Actuator Interface -may be used to add relay expansion board or to add an E-P Controller
- 1 Transducer Interface
- 1 RS-485 LAN interface

This is a listing of the input/output points on the UTC.

- 1:1A Thermostat temperature input
- 1:2A Thermostat adjust input
- 1:3A Actuator feedback status, analog input for expansion relay board or E-P feedback status (optional)
- 1:4A Pressure transducer feedback status (optional)
- 1:5A Universal Input (Can be used for 10K thermistor input)
- 1:6A Universal Input (Can be used for 10K thermistor input)
- 1:7A Universal Input (Cannot be used for 10K thermistor input)
- 1:8A Universal Input (Cannot be used for 10K thermistor input)
- 1:1 Output 1 - Relay
- 1:2 Output 2 - Relay (optional)
- 1:3 Output 3 - Relay (optional)
- 2O Output 2 - Analog 0-20mA (optional)
- 3O Output 3 - Analog 0-20mA (optional)
- 1:7 Digital Output - Control actuator input down, relay 2 of the expansion board or decrease pressure in E-P device.
- 1:8 Digital Output - Control actuator input up, relay 1 of the expansion board or increase pressure in E-P device.

## **C.4 Software/Programming**

The UTC software is identical to that used with the UUC except for the control overlap of the first three digital/analog outputs. There are 50 Monitors, 25 Timers, 50 Flags, 50 Schedules, 7 PID Loops, 15 Alarms and 15 Types and 75 Points. For information on programming the UTC, see Section 3 of the Unitary Controller Manual.

## Appendix D - Smart Thermostat

### D.1 General Overview

The HIS Smart Thermostat is an HIS Thermostat with a three digit display and enhanced input/output capabilities. The Smart Thermostat, or “Smartstat” communicates to the HIS network through a Unitary Controller.

The Smartstat has three LED numeric displays, seven LEDs and five switches. Although all LEDs and switches can be programmed through database definitions, under Normal Operation Mode there are predefined thermostat functions for most of the LEDs and switches. Two LEDs and one switch remain available for user functions under Normal Operation Mode.

The Smartstat is compatible with Unitary Controller Models UUC8 and UUC4, RevC or later. A Universal Terminal Controller, UTC, can support a Smartstat as well.

**The ROM labeled U3+ or later is necessary for SmartStat operation.** The UUC4 can support one Smartstat and the UUC8 can support up to two Smartstats. For one Smartstat,

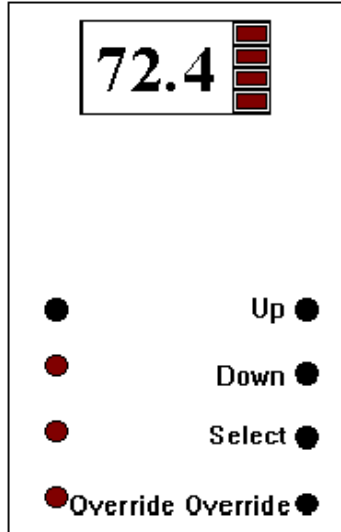


Figure 1: Smartstat under normal operation

UUC analog input 1:1A is used for temperature input and override switch. When supporting two Smartstats, analog inputs 1:1A and 1:3A are each used for temperature input and override switch. Since the Smartstat has no slide temperature adjustment, the analog inputs normally reserved for thermostat slide adjustments are available for other uses (1:2A & 1:4A).

There are three different modes of operation- Normal, Programmable and Maintenance Modes. The mode of operation determines how the LEDs and keys are defined as well as what is shown on the display.

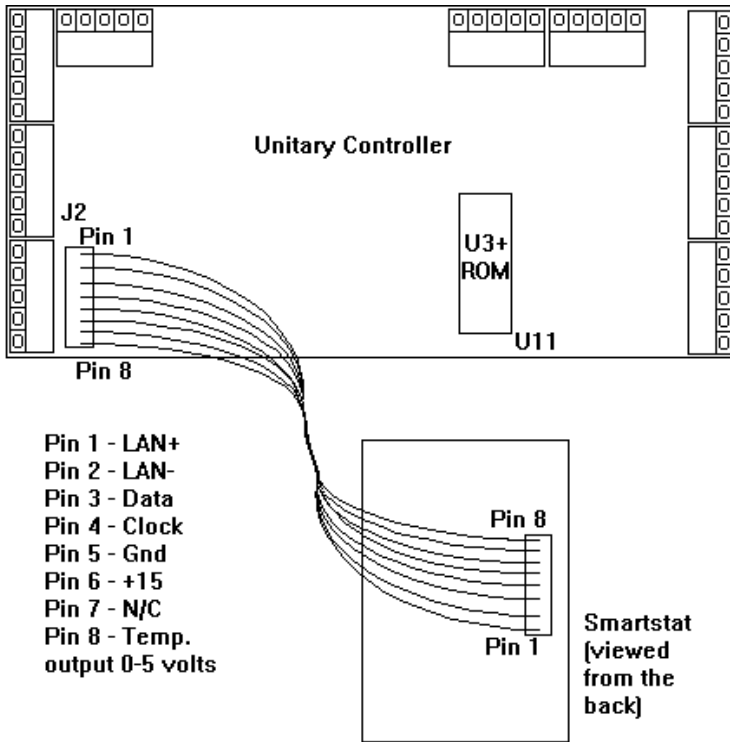
### ***D.2 Installation***

The Smartstat is connected to the UUC using the 8-pin thermostat connector. Another 8-pin thermostat connector is located in an opening on the back of the Smartstat (see Figure 2). All the electronics of the Smartstat are attached to the cover. When the Smartstat cover is removed, the 8-pin connector and the 4 pin LAN connector may be accessed. The piece of insulation on the back of the Smartstat helps to eliminate airflow from the wall cavity around the wire. The temperature sensor is secured with a wire clamp at the bottom of the housing. Try to avoid bumping or handling the sensor.

Special care should be taken when determining where the Smartstat should be mounted. The Smartstat should be placed on the wall away from heavy drafts but at the same time where there is some air movement. The temperature of the air around the Smartstat should be close to the air temperature of the room. The Smartstat should be mounted about 4 to 5 feet off the floor.

Make sure the ROM is a U3+ or later ROM. If the ROM needs to be replaced, make sure you save the database before inserting the new ROM. After inserting the U3+ ROM, blank out the unitary and then reload its database.





**Figure 2:** Smartstat Connections.

### **D.3 Temperature Output**

The Smartstat has a thermistor temperature sensor with an output resistance of 10,000 ohms at 77°F. The sensor range is from 32°F to 104°F. The temperature output of Smartstat 1 is unitary analog point 1:1A. For a second Smartstat, when a UUC8 is used, the temperature output is analog point 1:3A. The output is shown on the Unitary display screen as 0 to 100 percent, which corresponds to an input of 0 to 5 volts from the Smartstat. This percentage is converted to a temperature with the following standard WALL type curve.

```
:WALL
°F 1
0 28.61 49.58 65.27 76.49 84.51 93.76 100
32.65 48.2 60.8 71.6 80.6 87.8 96.8 104.5
```

The top line is the percent which corresponds to the temperature in degrees Fahrenheit below it. This curve should be entered into the Type Table in the Unitary database. The type number for this curve should be placed in the column labeled Type in the Points Table for 1:1A and 1:3A. This curve is found in the TYPECONF.HLP file.

## ***D.4. Normal Operation Mode***

### ***D.4.1 General Operation***

Normal Operation Mode is the mode easiest for the user to implement. Under Normal Operation Mode, the four buttons on the right side of the thermostat, the lower left LED, the four LEDs to the right of the display and the display digits all have factory defined functions. The lower right button is the override button. The lower left LED corresponds to the override button so that in override operation, this LED is lit.

The remaining three switches on the right of the thermostat are used to display and modify selected values. In order to turn on the display, press the select button. The first value in the defined point sequence will be displayed. In order to display the next value in the sequence; press the select button again. The select key will always display the next value in the defined point sequence that will be explained later. The LEDs located the right of the display correspond with the select button. They indicate which point in the sequence is being displayed.

The Up and Down buttons are used to modify point values shown on the display. The Up button will increase the value and the Down button will decrease the value. If the Up or Down button remains depressed for a few seconds, the values will change faster. A digital point is displayed as Off or On. In this case, the Up button will turn a digital point On and the Down button will turn it Off. Once all points have been sequenced or after 15 seconds with no button activity, the display turns off.

### ***D.4.2 Points Sequence - The Select Key***

For Normal Operation Mode, the sequence of points to be displayed is defined in the points table. For Smartstat 1, the initial point displayed is 1C or 1G depending on which one is entered first in the Points Table. If 1C is defined first, 1C will be displayed. If 1G is defined first, 1G will be displayed. If only one of the two points is defined, that point will be displayed.

If 1C or 1G is displayed and the select button is pressed, the display changes to 2C, 2G, or 2F depending on which point is defined first in the points table. As before, if only one of these points is defined, it will be displayed. Furthermore if none of the points are defined, 2C, 2G, or 2F, the sequence ends there. The end of the sequence is defined by having xC, xG and xF undefined in the point table.

If there is a second Smartstat, the initial point displayed is 11C or 11G depending on which one is defined first in the Points Table. If the select button is pressed, the display changes to 12C, 12G or 12F and if none of these points is defined, the sequence ends there. Again, the end of the sequence is defined by having xC, xG and xF undefined in the Points Table. Note that when a second Smartstat is present, the first Smartstat will only sequence through to 10C, 10G or 10F.

### **D.4.2. Example**

Take, for example, the following Points Table.

<u>#</u>	<u>Name</u>	<u>Address</u>	<u>Flag</u>	<u>Type</u>	<u>Freq.</u>	<u>Slope</u>	<u>Intercept</u>	<u>Value</u>
1	TMP	1C		1				72.0
2	OSA	2G		1				56.2
3	PT1	2C		0				878
4	TMPA 1G			0				74.0
5	PT2	3F		0				ON
6	RHA	3C		0				65.0
7	PT3	4F						ON
8	PT4	5F						OFF
9	TMPB	4C						71.0
10	OSRH 10G			3				90.0

The select button is pressed and the display turns on. The first point displayed is 1C. So a value of 72.0 would be shown on the display. If the select key is pressed again while the display is still on, 2G would be displayed and a value of 56.2 would be seen on the display. If the select key is pressed again, 3F would be displayed and ON would be shown on the display. When the select key is pressed again, 4F is displayed and another press of the select key displays 5F. If the select key was pressed another time, the display would turn off since there is no 6C, 6G or 6F defined in the points table. If a UUC8 has a second thermostat, the display sequence of the second thermostat begins with 11C and continues until a computed point in the sequence is not defined.

### **D.4.3 Display of Decimal Points**

The number of digits after the decimal point displayed is determined by the **Type** definition of the point. For example, 1C is defined in the Points Table as Type 1 and if the Type Table established Type 1 as one decimal digit, the displayed value will

show one decimal digit. If the type defined in the Point Table is 0, the display automatically adjusts to display as many decimal digits as possible. Any number greater than can be displayed will be presented as three 9's. If the value is a computed or global point that has not yet been defined, "Err" is displayed.

#### **D.4.4 Modifying Points**

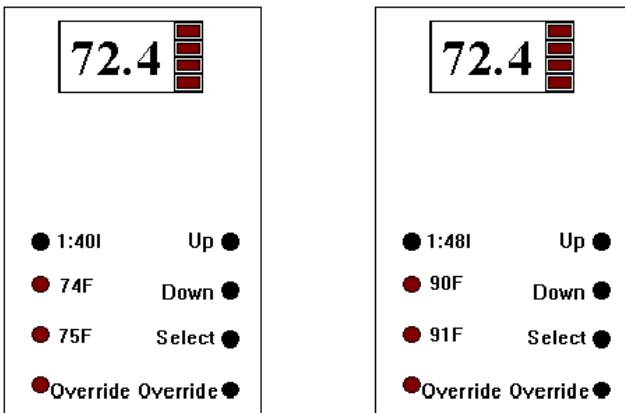
When a value is modified, the increment for each push of up is one least significant digit of the display. For example, if up is depressed and the display is 1.02, the value would change to 1.03. If the display is 23, the value would change to 24.

If the point displayed is xG, the value will not change using the Up and Down keys. However, if xC and xG are both defined and the xC value is displayed, the xG value is changed. If xC is displayed and xG is not in the Points Table, it can be altered by the Up and Down keys. If xF is displayed, it can be changed using the up and down buttons if the type in the point table is 0.

Back to the previous example. When the first point, 1C, is displayed, pushing the Up or Down keys, modifies 1G. 1C does not change. 2G, the second point displayed, is not changed when pressing the Up or Down keys. The third point displayed is 3F and it can be turned on and off using the Up/Down keys because there is a 0 in the Type column for 3F in the Points Table. The fourth point displayed is 4F and it cannot be altered. Its Type column in the Points Table does not have a 0. 5F is the last point displayed. Like 4F, it cannot be altered. 10G is not displayed because it does not follow 5F numerically.

### D.4.4 Controllable Buttons and LEDs

In this normal operation mode, the remaining button (top left) and LEDs (middle left) may be controlled directly. The button is 1:40I. The LED above the override LED is 75F and the one above that is 74F. On the second Smartstat of a UUC8, the button is 1:48I and the LEDs are 90F and 91F. This configuration is shown in Figure 3.



**Figure 3:** Smartstat under normal operation with inputs and flags.





## **D.6 Maintenance Mode**

The Smartstat Maintenance Mode allows the user to see any point in the Unitary Point Table on the Smartstat Display. Before entering this mode, the Smartstat must be operating under Normal Operation Mode. The Maintenance Mode is entered by first placing the Smartstat into a special LAN override mode by holding the override button down for 15 seconds. Then to enter Maintenance Mode the select button should be pressed within 30 seconds of entering the LAN override mode.

The select button is used to scroll through the points in the Points Table. The display shows the point number in the Point Table preceded by an '=' for one second and then shows the value of the point. Pressing the select button again will scroll to the next point in the Points Table. Digital inputs, digital outputs and flag points are displayed as ON or OFF. Analog points including analog inputs, analog outputs, setpoints, global points, and computed points, have their value displayed. The Up and Down buttons can be used to modify the point value. Note that points such as analog or digital outputs may also be controlled by monitors or by setpoint functions so that any changed value may not stay changed for very long. The override button exits the maintenance display mode.

To enter Maintenance Mode, the Unitary database has to be configured for Override. That is in the System Table of the Unitary database, under Dig. In. Invert, the last 4 digits must be **. D . D .** This is necessary for Override Operation or Maintenance Mode Operation.

## **D.7 Calibration**

The Smartstat may have to be calibrated during installation. Before calibration, make sure there is no air movement around the Smartstat and have another accurate temperature sensor to compare temperatures. In order to calibrate the Smartstat, the temperature must be displayed. This can be done several different ways depending in what mode the Smartstat is operating. In Normal Mode, the temperature analog point 1:1A or 1:3A can be set equal to 1C or 11C in a monitor. In Maintenance Mode, the point 1:1A or 1:3A can be shown directly on the display. In Programmable Mode, 1:1A or 1:3A is set equal to 100C or 101C in a monitor.

Once the temperature is displayed, remove the cover of the Smartstat and notice the electronics located on the cover. The yellow resistor pot is used to calibrate the device. Use a small flat head screwdriver to turn the pot very slowly until a correct reading is shown on the display. Clockwise increases the temperature and counterclockwise decreases the temperature.

Turning the resistor pot can only change the temperature by about 8 degrees total. If the temperature is further off, the Smartstat could be installed improperly or damaged. Note that the select button might have to be pressed more than once during this process because the display could time out.

**FCC Notice**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.