–METASYS®

Unitary Controller (UNT)

* Indicates those sections where changes have occurred since the last printing.

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Introduction

Description

The Unitary Controller (UNT) is an electronic device for digital control of packaged air handling units, unit ventilators, fan coils, heat pumps, and other terminal units serving a single zone or room. It also can be configured as a generic Input/Output (I/O) device for basic point monitoring applications when used within a Metasys® Network.

You can easily configure point inputs and outputs, and software features to control a wide variety of Heating, Ventilation, and Air Conditioning (HVAC) equipment applications. The UNT may be used as a standalone controller or connected to the Metasys Network through a Network Control Module (NCM) or Companion™.

When connected to the Metasys Network, the UNT provides all point control information to the rest of the network. The devices communicate through an N2 Bus. For a smaller facility, the UNT can function as a standalone controller. Figure 1 illustrates the UNT.

unt-110
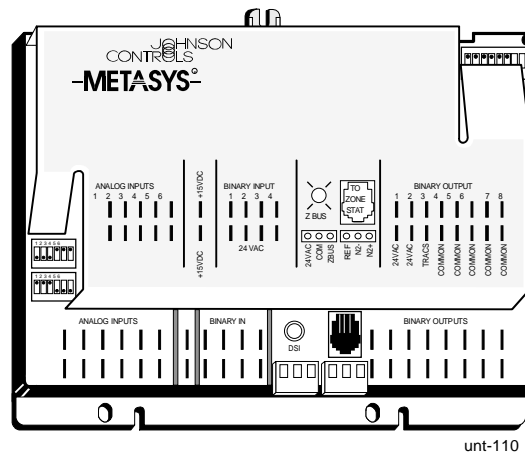
Figure 1: Unitary Controller (UNT)

You may use the UNT for unit ventilator, rooftop, heat pump, or fan coil applications, or as a generic I/O multiplexer and I/O sideloop control. Each has a different sequence of operation, all of which are covered in the *HVAC PRO for Windows User's Manual (FAN 637.5)*.

The Unitary Controller is available in different hardware sets to suit different environmental and application needs. Table 1 lists the common features of the different hardware sets. Table 2 lists the differences by model.

Table 1: Unitary Controller Hardware Characteristics--*Similarities*

Characteristic	Description
6 Analog Inputs	RTD temperature elements (1000 ohm nickel, platinum, or silicon) Adjustable 0 to 2k ohm setpoint potentiometers 0 to 10 VDC or 0 to 2 VDC transmitters
4 Binary Inputs	(4) 24 VAC input only (24 VAC provided) (1) Momentary pushbutton from Zone Sensor for temporary occupancy mode (BI 5) BI 4 may be used as an accumulator input for frequencies less than 2 Hz.
N2 Bus	Isolated
Zone Bus (see Table 2)	Removable screw terminal block, Light-Emitting Diode (LED) Indication, 8-pin phone jack on controller
24 VAC Power in Termination	Removable screw terminal block
N2 Terminations	Removable screw terminal block

Table 2: Unitary Controller Hardware Characteristics--*Differences*

Characteristic	UNT110-1	UNT111-1	UNT120-1	UNT121-1	UNT140-1	UNT141-1
Operating Temperature Rating	0 to 52°C (32 to 125°F)	0 to 52°C (32 to 125°F)	-40 to 52°C (-40 to 125°F)	-40 to 52°C (-40 to 125°F)	0 to 52°C (32 to 125°F)	0 to 52°C (32 to 125°F)
Analog Outputs: 0 to 10 VDC @ 10 mA	None	2	None	2	None	2
Binary Outputs: 24 VAC Triacs @ 0.5A or 0.8A if total power is limited. Low or High side common selectable	8	6	8	6	8	6
Zone Bus (see Table 1)					Additional 6-pin Phone Jack	Additional 6-pin Phone Jack
I/O Terminations	Quick Connects (Spade Lugs)	Quick Connects (Spade Lugs)	Quick Connects (Spade Lugs)	Quick Connects (Spade Lugs)	Fixed Screw Terminal Block	Fixed Screw Terminal Block
Available Premounted in EWC10, with 24 VAC, 50 VA Transformer	UNT110-101	UNT111-101			UNT140-101	UNT141-101

Standards Compliance

The UNT complies with the following standards:

- FCC Part 15, Subpart B, Class A
- IEEE 472
- IEEE 587 Category A
- UL 916, UL 864

Configuring the Controller

All UNTxxx-1 models require HVAC PRO for Windows. HVAC PRO for Windows also works with previously released UNT models. This software tool configures, commissions, uploads, and downloads the UNT database. Refer to the *HVAC PRO for Windows User's Manual (FAN 637.5)* for more information on configuring the UNT.

*Defining a UNT
Control Device
Object*

In a Metasys Network System, enter data into the Attribute menu to define a UNT device object.

1. Go to the Network Map on the Operator Workstation (OWS).

2. Double-click the system name to which the new UNT object is to be added.

3. On the Item menu, click New.

4. Select Type/N2 devices in the Item New dialog box.

```
┌──────────────────────────────────────────────────────────┐
│                    UNT - Item New                        │
│                                                          │
│  ┌Type──────────────────────────────────┐   ┌────────┐  │
│  │ ○ Accumulator          ○ MS output   │   │   OK   │  │
│  │ ○ Analog data          ○ Control system│  └────────┘  │
│  │ ○ Analog input         ○ DL/LR group  │   ┌────────┐  │
│  │ ○ Analog output digital ○ LC group    │   │ CANCEL │  │
│  │ ○ Analog output setpoint ○ PID loop   │   └────────┘  │
│  │ ○ Binary data          ○ Fire Zone    │              │
│  │ ○ Binary input         ○ L2 devices   │              │
│  │ ○ Binary output        ● N2 devices   │              │
│  │ ○ MS data              ○ S2 devices   │              │
│  │ ○ MS input             ○ Card Reader  │              │
│  └──────────────────────────────────────┘              │
│                                                          │
│   Hardware system name:   [          ]                  │
│                                                          │
│   Hardware object name:   [          ]                  │
│                                                          │
│  Copy of (System\Object): [          ]                  │
│                                                          │
│                                            itemnew       │
└──────────────────────────────────────────────────────────┘
```
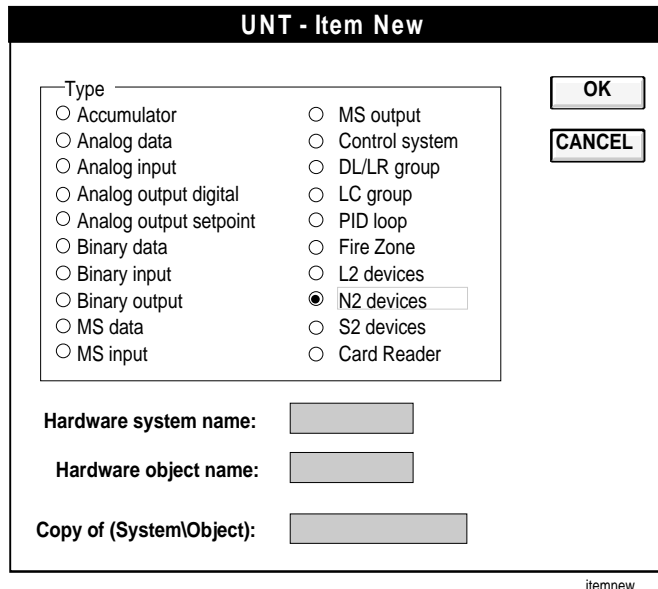
Figure 2: Item New Dialog Box

Note: The Hardware System and Hardware Object text fields are not used for this object type.

5. Click OK.

6. Highlight UNT in the Add N2 Device dialog box as shown in Figure 3.

n2dvc
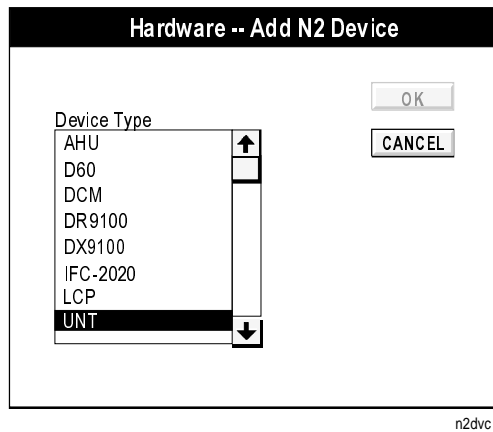
Figure 3: Add N2 Device Dialog Box

7. Click OK.

8. Complete the attribute fields in the UNT Definition window (see Figure 4).

windobj
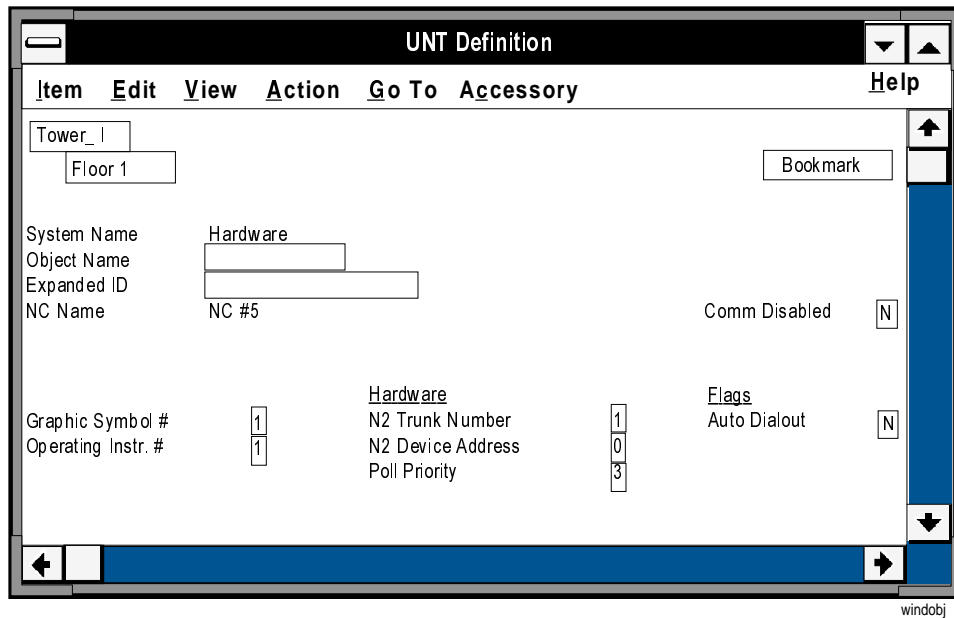
Figure 4: UNT Control-Device Object Definition Window

Note: Fill in the blank UNT Definition attribute fields as required. Specify an N2 Device Address from 1 to 255. Default values in the remaining attribute fields may be accepted or changed.

Table 3 explains the blank attribute fields. The *Operator Workstation User's Manual (FAN 634)* describes the general procedures for entering and modifying data.

Table 3: Blank UNT Object Attributes

Attribute	Description	Entry Values . . .
Object Name	Identifies the object (i.e., UNT1). The object name cannot be duplicated in the system.	1 to 8 alphanumeric characters
Expanded ID	Further identifies the object (i.e., Garage Level Heater)	0 to 24 alphanumeric characters (optional)

9. On the Item menu, select Save to save the new UNT object and add the object to the NCM database.

10. Upload the NCM to make an archive copy of the new object. Refer to the *Operator Workstation User's Manual (FAN 634), Uploading from the NCM.*

Defining a UNT Control Device in Companion Software

To define a UNT control device in Companion, refer to the *Metasys Companion Technical Manual (FAN 628.1)*.

Installation Procedures

Design Considerations

Instructions for installing the UNT and its accessories are detailed in this section. The number and types of components (sensors and actuators) used with the UNT will vary according to application. Analyze the proposed installation for logical locations to place these devices and draw an inventory based on that study. Information on available accessory devices is in the *Ordering Information* section of this technical bulletin.

Decide how close the UNT can be to the air handling equipment while still allowing adequate room for installation and maintenance accessibility. Also take into consideration any existing power sources or communication lines. The UNT must be secured to a solid wall and not to any vibrating surface.

IMPORTANT: Do not mount the UNT near high voltage or electrically noisy devices. Refer to *Appendix A: Precautions for Rooftop Installations*.

Tools Needed

For a typical installation, you need the following:

- HVAC PRO for Windows software, current release

- IBM® PC-compatible laptop computer

- Microsoft® Windows® (3.xx or 95)

- AS-CBLPRO-2 (for Zone Bus downloading, uploading, and commissioning) or MM-CVT101-0 (for N2 downloading, uploading, and commissioning)

- two screwdrivers (1/8 in. and 1/4 in. flat-blade)

- drill

- (optional) AS-ZTU100-1 (Zone Terminal unit)

  Note: The AS-ZTU100-**1** supports both AS-UNTxxx-0 and AS-UNTxxx-**1** models. The AS-ZTU100-**0** supports AS-UNTxxx-**0** models only.

Environmental Information

The installation site of the UNT must meet the following environmental standards:

- The atmosphere must be free of explosive vapors and escaping gases.

- The atmosphere must be free of exposure to corrosive chemical or salt vapors that might damage electrical equipment.

- For UNT100/101, UNT110/111, and UNT140/141 series controllers, the temperature must be maintained between 0 and 52°C (32 and 125°F) with relative humidity (non-condensing) maintained between 10 and 90 percent.

- For UNT120/121 series controllers used with outdoor rooftop applications, the temperature must be maintained between -40 and 52°C (-40 and 125°F) with relative humidity maintained between 10 and 90 percent. Some intermittent condensation is tolerable. This operating temperature range is possible in the UNT120/121 series controllers due to the heater, coated circuit board, and BZ-1000-7 size enclosure.

Mounting the Controller

Physical Dimensions

The UNT is commonly packaged either in an enclosure provided by the installation contractor, or in an AS-ENC100-0 or EN-EWC10-0 enclosure. The UNT140/141-101 and UNT110/111-101 come mounted in an EWC10 enclosure with a 50 VA transformer. The controller requires a flat mounting surface area to match its dimensions.

The UNT controller has the following dimensions:

- 165 x 163 x 56 mm (6.5 x 6.4 x 2.2 in.) H x W x D without enclosure

- 173 x 185 x 119 mm (6.8 x 7.3 x 4.7 in.) H x W x D with the AS-ENC100-0 enclosure

- 229 x 406 x 191 mm (9.0 x 16.0 x 7.5 in.) H x W x D with the EWC10 or UNTxxx-101 version

Allow enough room to install the enclosure and conduit for wiring terminations to the controller.

Enclosures for Mounting a UNT 120/121

The UNT120/121 low temperature rated controller must be installed in an enclosure as suggested below, unless it is mounted within the enclosed, low voltage electrical compartment of the mechanical unit being controlled. The BZ-1000-7 enclosure is the common package for a UNT120/121 mounted in the air stream or in the mixed air chamber of a mechanical unit.

The BZ-1000-7 enclosure is the recommended size for optimum performance of the UNT120/121. Venting the BZ-1000 enclosure (possibly removing unused knockouts), using the AS-ENC100-0 or EN-EWC10-0, or using a larger enclosure is recommended for environments that regularly exceed 32°C (95°F).

The UNT120/121 series controller has the following dimensions:

- 165 x 163 x 56 mm (6.5 x 6.4 x 2.2 in.) H x W x D without enclosure

- 259 x 249 x 76 mm (10.2 x 9.8 x 3 in.) H x W x D with the BZ-1000-7 enclosure

- 229 x 406 x 191 mm (9.0 x 16.0 x 7.5 in.) H x W x D with the EWC10 or UNTxxx-101 version

Positioning

Before installation, position the controller and enclosure on the proposed mounting surface to ensure that the calculated mounting area is correct. Precise distance measurements can be made between controller terminals and sensor/actuator mounting points on the air handling equipment if the equipment is in place. Confirm electrical power source and conduit requirements at this time.

Note: You can install a UNT100/101, UNT110/111, or UNT140/141 series controller in a control panel, or in an AS-ENC100-0 or EN-EWC10-0 enclosure. You must enclose the UNT120/121 series controller in a BZ-1000-7 enclosure or another enclosure of comparable dimensions.

Mount the UNT in a convenient location using the predrilled mounting holes. The controller must be mounted vertically on a wall or panel where it can be easily wired through the enclosure cover. This also applies to remote location packages.

Do not use this knockout.
Otherwise, controller will
be in the way of wiring.

Top / Bottom

Side

③

④

④

②

⑤

①

UNT

UNT Enclosure (Cover)

untencl
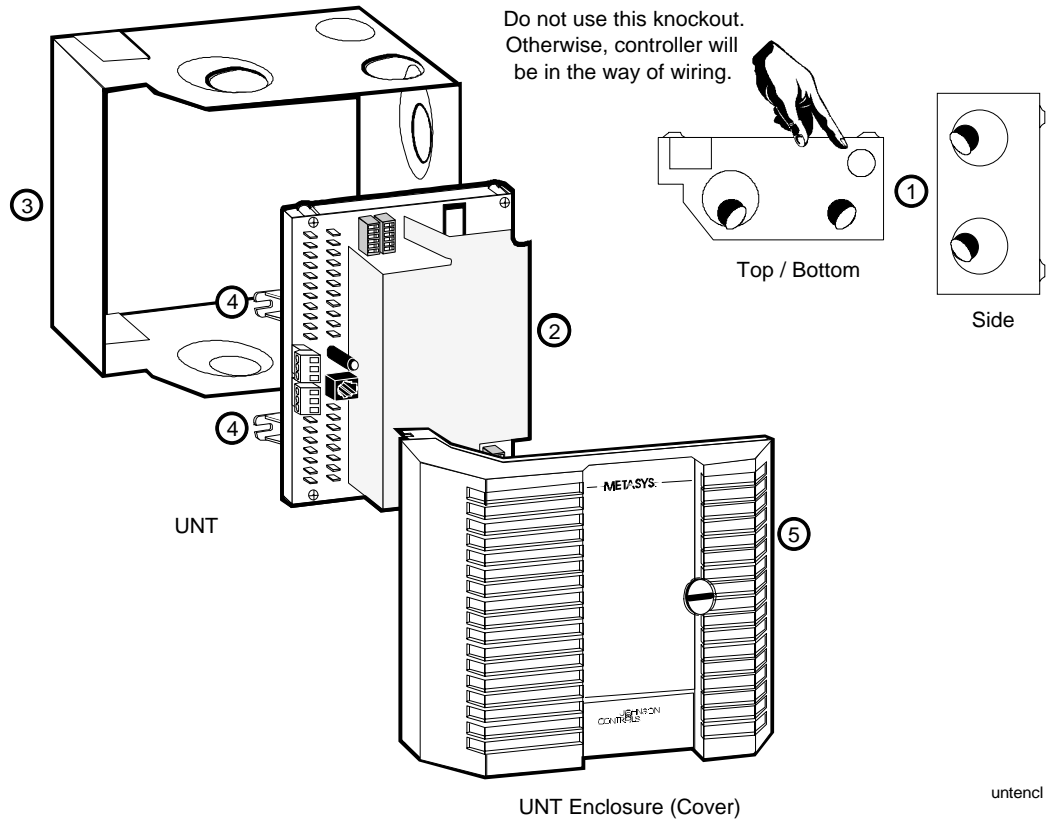
Figure 5: Installing the UNT Controller in ENC100 Enclosure Kit

**Installing the UNT
in a ENC100
Enclosure Kit**

To install the UNT in an ENC100 enclosure kit (see Figure 5), use the
following procedure:

1. Use a flat-blade screwdriver and pliers to remove the necessary wire
    passage knockouts ①.

2. Position the enclosure firmly against the mounting surface and mount
    it with the appropriate screws.

3. Secure the UNT ② inside the enclosure kit ③, using the
    three mounting tabs ④ on the sides of the controller board base.

4. Attach the enclosure cover ⑤ after installing the wiring.

UNTxxx-101

The UNT can be directly mounted into an EWC10 enclosure. You may also purchase the UNT110/111 or UNT140/141 premounted in an EWC10 enclosure with a 24 VAC 50 VA transformer. When the UNT is premounted in an EWC10 enclosure with a 50 VA transformer, the model number will be UNTxxx-101 rather than UNTxxx-1. For instructions on mounting the enclosure to a wall, see the *Application Specific Controllers Technical Manual (FAN 636.3),* the *Accessories* tab, the *Universal Packaging Module Technical Bulletin (LIT-6363070).*

Low Voltage
Wiring Trough

untpwer2
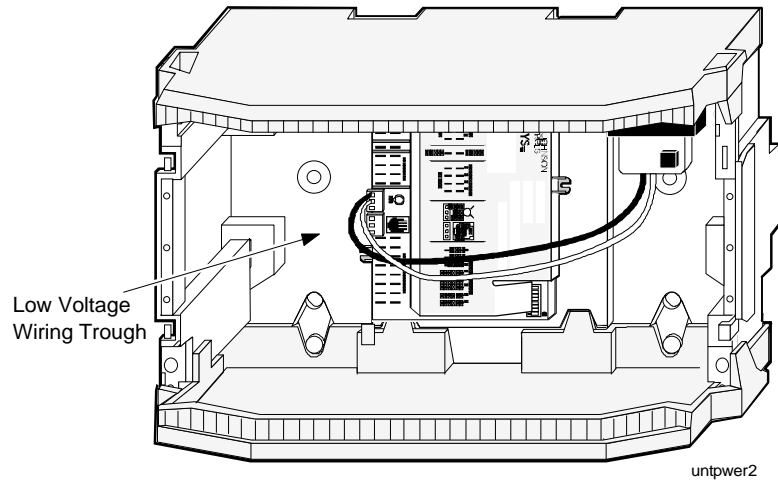
**Figure 6: UNT Premounted in EWC10, with
50 VA Transformer (UNTxxx-101)**

Mounting a UNT in a EWC10

To mount the UNT in the EWC10, use the following procedure:

1. Position the terminals of the UNT toward the low voltage wiring trough located on the left side of the enclosure (see Figure 6).

2. Align the three mounting holes in the base of the controller with the holes in the backbone of the enclosure. On the side with four mounting holes, use the two outside holes for mounting in the EWC.

3. Secure the controller with three No. 8 x 1 in. screws. For best results, use a plastite type thread. A thread forming or sheet metal type thread may also be used.

Power Line Wiring Transient Noise Precautions

The standard UNT, when powered by any typical separate isolation transformer or stepdown transformer, operates reliably in an electrical environment defined as Location Category A by the IEEE 587 Standard; that is, when installed **more than 30 feet** from electrical distribution panels or major bus and feeder systems in industrial plants.

IEEE 587 Location Category A power line surge/noise level is specified at 6 kV, 500 A (Normal Mode Ringwave).

Surge Levels

The UNT exceeds the Category A specification by meeting these surge levels as well:

IEEE-587 style Common Mode Pulse	3 kV
IEEE-587 style Normal Mode Pulse	1.5 kV
IEEE-472 style Common Mode Ringwave	1.5 kV
IEEE-472 style Normal Mode Ringwave	500 V

When the controller is installed within 9 m (30 ft) of electrical distribution panels or major bus and feeder systems in industrial plants, you **must** take further precautions to prevent unwanted binary output cycling, resetting, or other possible controller malfunctions. This electrical environment is defined as Location Category B by the IEEE 587 Standard.

You can use the following method to prevent electrical noise from adversely affecting the controller:

•   Connect an MOV (Metal Oxide Varistor) across the UNT supply transformer primary. The MOV must be rated appropriately for the line voltage. Use the list in Table 4 to select the correct MOV sold through your electronics parts distributor.

The UNT meets the following power line surge/noise standards when you correctly apply the MOV as described.

IEEE-587	Common Mode Pulse	1.5 kV
	Normal Mode Pulse	6 kV
	Normal Mode Ringwave	6 kV
IEEE-472	Common Mode Ringwave	1.5 kV
	Normal Mode Ringwave	500 V

Note: The 50 VA split bobbin transformer in the EWC15 or -101 model UNT provides additional surge/noise immunity.

For more information, refer to *Appendix A: Precautions for Rooftop Installations* in this technical bulletin.

Table 4: MOV Selection Table

Power Transformer Primary Voltage				
	120 VAC	**208 to 240 VAC**	**277 VAC**	**347 VAC**
Minimum Continuous Voltage Rating	130 to 135 VRMS	250 to 280 VRMS Only 250V types listed	300 to 320 VRMS	385 VRMS
Minimum Energy Rating	30 Joules	55 Joules	80 Joules	85 Joules
Minimum Peak Current (8 x 20 micro second pulse)	4,000 Amperes	4,000 Amperes	4,000 Amperes	4,000 Amperes
UL Recognized	Required	Required	Required	Required
Harris	V130LA10A V130LA20A* V130LA20B*	V250LA20A V250LA40A* V250LA40B*	None	None
Iskra	V130K14 V130K20*	V250K14 V250K20*	V300K14 V300K20*	V385K14 V385K20*
Malda	D6321ZOV131RA15* D6521ZOV131RA20* D6921ZOV131RA09	D6321ZOV251RA90* D6521ZOV251RA130* D6921ZOV251RA72	D6321ZOV301RA105* D6521ZOV301RA150* D6921ZOV301RA80	None
Mallory®	VSAC14DK201U VSAC20DK201U*	VSAC14DK391U VSAC20DK391U*	VSAC14DK471U VSAC20DK471U*	VSAC14DK621U VSAC20DK621U*
Marcon	TNR15G211KM TNR23G201KM* TNR23G211KM*	TNR15G391KM TNR23G391JM* TNR23G391KM*	TNR15G471K TNR23G471K*	None
Oneida® (CKE)	OZ130LA10A OZ130LA20A* OZ130LA20B* OZ21L221 0216NR14-3 0216NR20-4*	OZ250LA20A OZ250LA40A* OZ250LA40B*	OZ21L471	None
Panasonic	ERZ-C14DK201U ERZ-C20DK201U*	ERZ-C14DK391U ERZ-C20DK391U*	ERZ-C14DK471U ERZ-C20DK471U*	ERZ-C14DK621U ERZ-C20DK621U*
Phillips	2322-595-51316	2322-595-52516	2322-595-53016	2322-595-53816
Siemens	S14K130 S20K130*	S14K250 S20K250*	S14K300 S20K300*	S14K385 S20K385*
Stetron	0216NR14-3 0216NR20-4* 0216NR20DB*	0390NR14-3 0390NR20-4* 0416NR14-3 0416NR20-4*	0620NR14-3 0620NR20-4*	0620NR14-3 0620NR20-4*
Thomson	VE17M00131K VD24M00131K	VE17M00251K VD24M00251K	VE17M00301K VD24M00301K	None

* Indicates the preferred model if several are listed.

I/O and Communications Wiring Transient Noise Precautions

The I/O wiring and N2 Bus must be "clean," without electrical noise transients from nearby lighting, heavy equipment switching, or inductive loads being driven.

For the N2 Bus, the Transient Eliminator®, model TE/JC04C12, made by Advanced Protection Technologies (APT) is recommended. Refer to the *Metasys Network Technical Manual (FAN 636),* the *N2 Communications Bus Technical Bulletin (LIT-636018),* for more information.

Wiring Details

This section details the special precautions and grounding procedures you must observe when installing the UNT.

> ⚠ WARNING: **Possible Equipment Damage or Electrical Shock**.
> To avoid damaging equipment or suffering electrical shock, ensure that all power supplies to the system have been disconnected prior to wiring installation.
>
> The Complementary Metal Oxide Semiconductor (CMOS) circuits used in the controller are static sensitive. Use static protection (anti-static) mats and/or grounding straps when working on or near internal circuitry.

Power Source and Loads

The power transformer used must comply with:

- CSA 22.2 No. 205

- NEMA ICS 2, Part 2, 230

The power to each UNT must be limited to 3 amperes or less. However, **if you use one low voltage power trunk to power multiple controllers, follow these precautions**:

- Ensure that polarity is maintained at each 24 VAC connection.

- Enclose 24 VAC power trunks with greater than 4 amperes (100 VA) in conduit as required by the National Electric Code (NEC).

- Do not share a UNT's power transformer with a Companion Panel or any other device with a full-wave rectifier in its power supply. (UNTs use "half-wave" rectification. Half-wave circuitry and full-wave circuitry must not share the same transformer.)

- Consider all the actual loads as well as the basic load of the controller when determining the system load.

Notes: Some local electrical codes require that the secondary common of the stepdown transformer be connected to earth ground (typically on units which are powered by greater than 150 VAC).

The M100 draws 20 VA if using common power for the controller and the M100 actuator. It is recommended that each M100 use its own 24 VAC isolation transformer.

IMPORTANT:	Any individual binary output (triac) can drive up to 800 mA when you limit the total 24 VAC power draw. You must limit the power draw of a controller and its load to avoid heat dissipation problems.

The total 24 VAC power draw of a UNT installed in an ENC100 or similar size box must be limited to a maximum of 40 VA.

The total 24 VAC power draw of a UNT mounted in an open air environment must be limited to a maximum of 75 VA. |

Tables 5 and 6 will assist you in determining the total 24 VAC power draw of your system.

Table 5: UNT Power and Load Specifications

System Loads	Power Draw
UNT with Sensors/Transmitters	10 VA (400 mA)
	25 VA for UNT120/121 (due to heater)
BO Load **Relay, Contactor, Solenoid, Incremental Actuator*** **Maximum allowable load for any individual binary output (triac) is 19 VA** (800 mA at 24 VAC).** **Minimum required load for each binary output (triac) used is 1.2 VA (50 mA at 24 VAC).** **Relay loads less than 50 mA may cause triac/relay chattering. If necessary, use a 1k ohm, 2 watt resistor across the relay coil.** **Triac BOs cannot drive loads which use DC currents, such as a device which has a full-wave rectifier. Triacs can drive only AC resistive or inductive loads, i.e., AC relays, contactors, and actuator motors. If the driving of a DC device is required, a pilot relay must be used to isolate the triac.**	Refer to specific product documentation.
AO Load **Actuator** **Maximum allowable load for each AO is 10 mA @ 10 VDC with a minimum load resistance of 1,000 ohms.**	See Table 6.
Zone Terminal or CBLPRO	1.2 VA (50 mA)

* Actuator VA requirements found in Table 6.

**With total controller power limited as described previously.

Table 6: Actuator VA Requirements

Actuator	Type	VA Requirements
EDA-2040 (ATP-2040)	Incremental	3 VA
VA-7150		2.7 VA
VA-7152		4.7 VA
VA-7153	Incremental or 0-10 VDC	2.7 VA
VA-7200	Proportional	5.5 VA
VA-7202		7.5 VA
VA-7203		5.5 VA
VA-8020	Incremental	4 VA
VA-8050	Incremental	6 VA
VA-8022	Voltage (0 to 10 VDC)	4 VA
VA-8052	Voltage (0 to 10 VDC)	6 VA
M120, M140, M150	Non-spring Return	20 VA
M110, M130	Spring Return	25 VA
M9100	Non-spring Return Voltage (0 to 10 VDC)	7.5 VA
M9200	Spring Return Voltage (0 to 10 VDC)	12 VA

***Wiring Precautions***

Follow these precautions when wiring:

- Make all wiring connections in accordance with the NEC as well as in accordance with local regulations.

- Locate equipment and route the wiring so that signal wiring is a twisted pair, and separated from power wiring as much as possible.

- Make all wiring connections to the UNT using only copper conductors.

- Daisy chain the N2. The use of "Y" or "T" bus topologies without a repeater installed in the "T" may cause a loss of communications. Do not use wire smaller than 22 AWG.

- Do not run N2 Bus, Zone Bus, Analog Input (AI), Binary Input (BI), Analog Output (AO), or Binary Output (BO) wiring in the same conduit or bundle as line voltage wiring (30 VAC or above), or wiring that switches power to highly inductive loads such as contactors, coils, motors, or generators.

Notes: **Shielded** N2 Bus wiring can be run in the same conduit or bundle as 24 VAC power wiring.

Zone Bus, AI, AO, and BI wiring can be run in the same bundle or conduit, where convenient. If the binary output wiring is not wired through other switches or contacts, you may also bundle it with the other I/O wiring, where convenient.

You may have either no earth ground connection, or one earth ground connection which **must** be at the transformer secondary common, whether one or multiple controllers are powered by the same transformer.

Grounding and Isolation UNT110/111, 120/121, 140/141
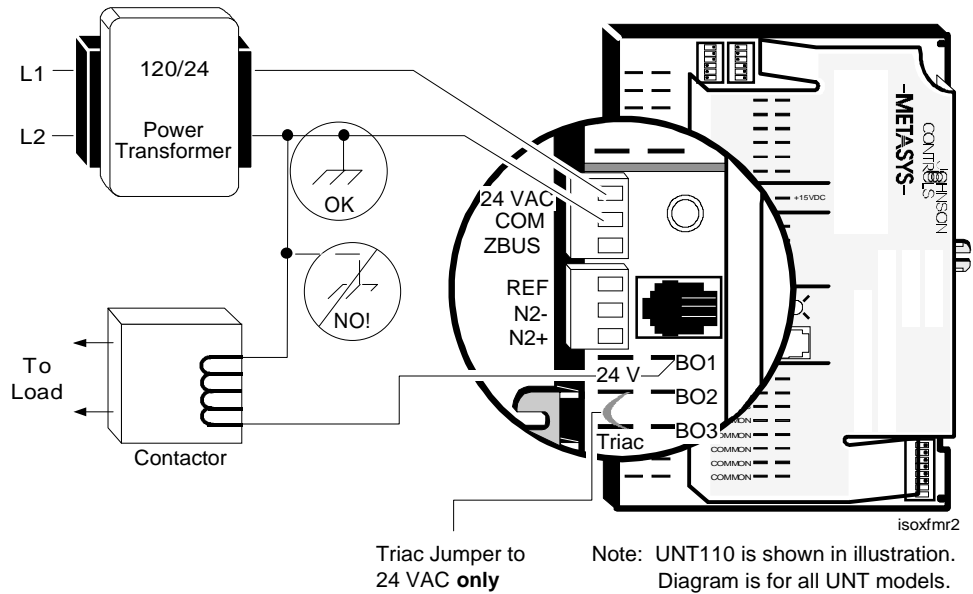
Figure 7: Transformer Wiring Diagram for UNT110/111, UNT120/121, and UNT140/141 Series Controllers

You may connect the UNT power transformer secondary directly to earth ground. If you elect to do so, the grounded side must connect to the common power input terminal of the controller.

⚠️ CAUTION: You may have a maximum of **one** single earth ground connection, which **must** be at the transformer secondary common, whether one or multiple controllers are powered by the same transformer.

When grounding one side of the transformer secondary, the grounded side must connect to the common power input terminal.

Connecting the grounded side of the transformer to the 24 VAC power input terminal will damage a CBLPRO-1(-0) or laptop.

Power Transformer Isolation

24 VAC to 24 VAC isolation transformers for UNT110/111, UNT120/121, and UNT140/141 series controllers are not mandatory.

Load Isolation

UNT110/111, UNT120/121, and UNT140/141 series controllers do not require an isolation relay. However, you must connect the jumper wire from the triac terminal to 24 VAC if the contact or coil loads are grounded (via the single earth ground connection at the transformer secondary common; see Figure 7). In this case, all loads are configured for "high side switching" (see Figure 13). For the UNT140/141, you must move the jumper block to the appropriate position rather than use a jumper wire.

Grounding and Isolation UNT110/111, UNT120/121, and UNT140/141 with Separate Load Transformer
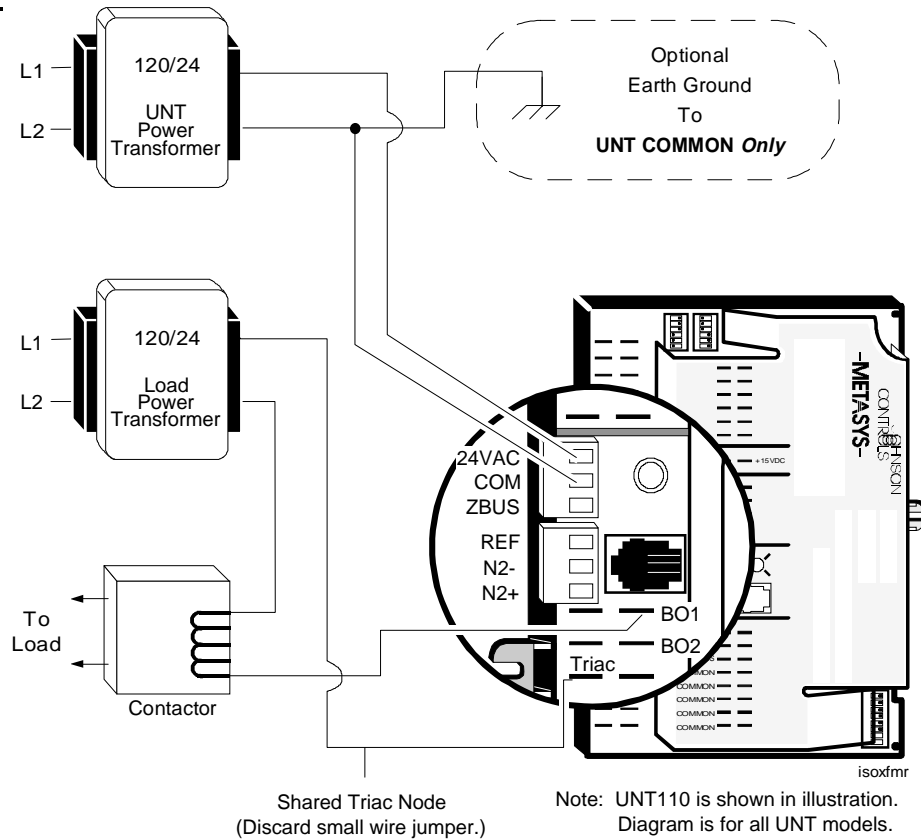
Figure 8: Transformer Wiring Diagram for UNT110/111, UNT120/121, and UNT140/141 Series Controllers with a Separate Load Transformer

⚠ CAUTION: **Equipment damage hazard**. When separate transformers are used, it is very important to **remove** the jumper that otherwise connects the triacs terminal to 24 VAC (high side) or common (low side). This prevents possible controller damage.

A separate load transformer may be necessary because of transformer VA limitations, or may be desirable to completely isolate loads from the UNT digital circuitry for better noise immunity.

You may connect the UNT110, UNT120, or UNT140 power transformer secondary directly to earth ground. If you elect to do so, the grounded side must connect to the common input terminal of the controller.

⚠ CAUTION: **Equipment damage hazard**. You may have a maximum of **one** single earth ground connection, which **must** be at the transformer secondary common, whether one or multiple controllers are powered by the same transformer.

When grounding one side of the transformer secondary, the grounded side must connect to the common power input terminal.

Connecting the grounded side of the transformer to the 24 VAC power input terminal will damage a CBLPRO-1(-0) or laptop.

You may connect the separate load power transformer secondary to earth ground as long as doing so is compatible with the equipment being controlled.
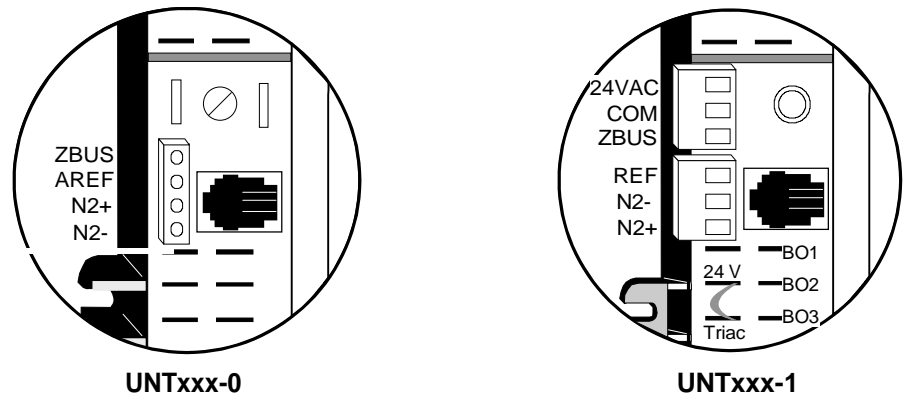
Terminal
Designations

The UNT terminal designations that identify sensor, actuator, and power connection points are illustrated in Figures 10, 11, and 41. Terminal functions are listed in Tables 7, 8, and 42.

You may make connections to the UNT by connecting single wires to the individual screw or spade terminals.

Note: The N2 terminal connectors on the new UNTxxx-1 series controllers are different from the UNTxxx-0 series. The REF, N2-, and N2+ terminations are arranged in different order (see Figure 9).

UNTxxx-0   **UNTxxx-1**

compare

Figure 9: N2 Terminal Connector Comparison
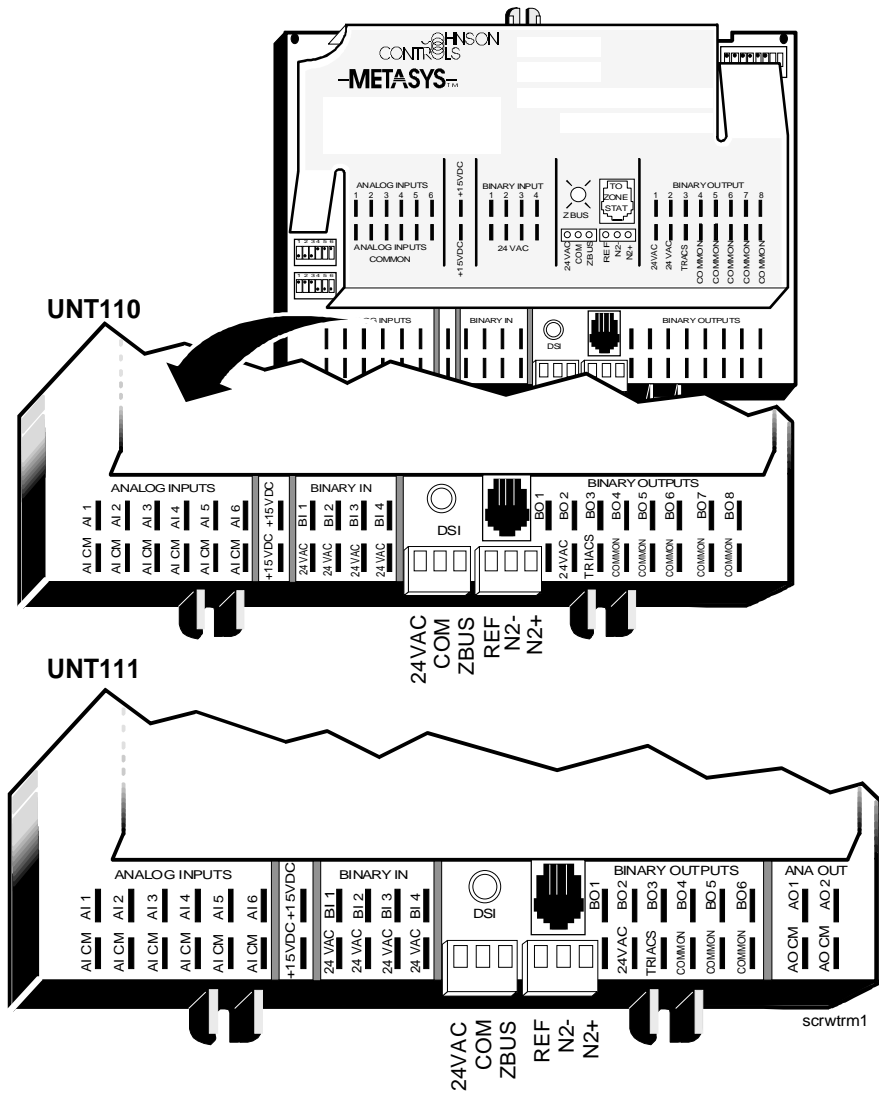
UNT110

UNT111

Note: UNT110/111 is shown in illustration.
Diagram is for UNT110/111 and
UNT120/121.

Figure 10: UNT110/111 and UNT120/121 Terminal Designations

Table 7: UNT110/111 and UNT120/121 Terminal Identification

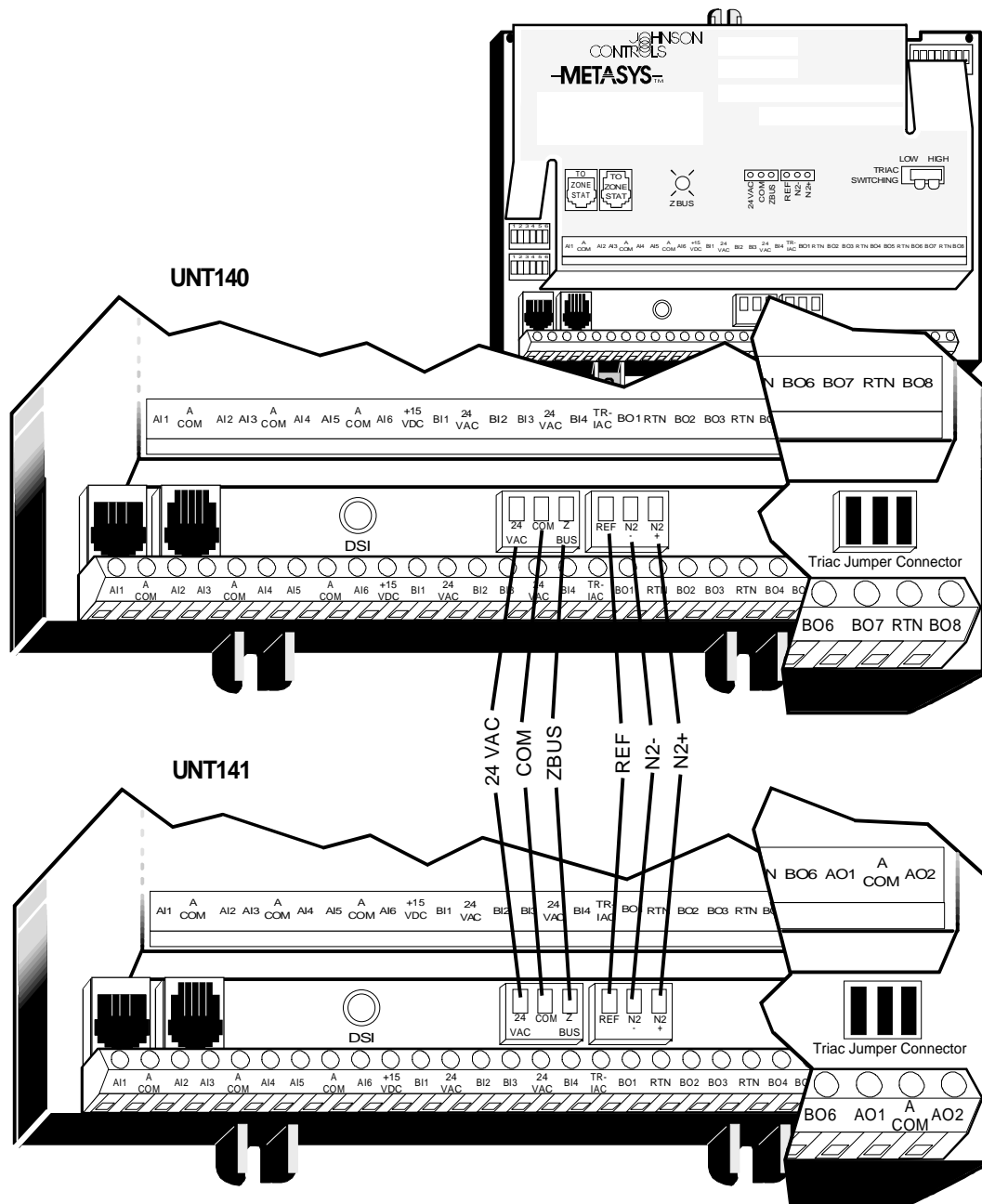| Terminal	Description	Terminal	Description
AI CM	Analog Input Common	AI 1	Analog Input 1
AI CM	Analog Input Common	AI 2	Analog Input 2
AI CM	Analog Input Common	AI 3	Analog Input 3
AI CM	Analog Input Common	AI 4	Analog Input 4
AI CM	Analog Input Common	AI 5	Analog Input 5
AI CM	Analog Input Common	AI 6	Analog Input 6
+15 VDC	+15 Volts DC supply	+15 VDC	+15 Volts DC Supply
24 VAC	24 Volts AC	BI 1	Binary Input 1
24 VAC	24 Volts AC	BI 2	Binary Input 2
24 VAC	24 Volts AC	BI 3	Binary Input 3
24 VAC	24 Volts AC	BI 4	Binary Input 4
24 VAC POWER	Transformer High Side		
COMMON	Transformer Low Side		
ZBUS	Zone Bus		
REF	N2 Reference		
N2-	N2 Bus -		
N2+	N2 Bus +		
24 VAC	24 Volts AC	BO 1	Binary Output 1
24 VAC	24 Volts AC	BO 2	Binary Output 2
TRIACS	Shared Triac Node	BO 3	Binary Output 3
COMMON	Common	BO 4	Binary Output 4
COMMON	Common	BO 5	Binary Output 5
COMMON	Common	BO 6	Binary Output 6
COMMON/AOCM	Common/ AO Common	BO 7 / AO 1	Binary Output 7 Analog Output 1
COMMON/AOCM	Common/ AO Common	BO 8 / AO 2	Binary Output 8 Analog Output 2

Figure 11: UNT140/141 Terminal Designations

Table 8: UNT140/141 Terminal Identification

Terminal	Description
AI1	Analog Input 1
A COM	Analog Input Common
AI2	Analog Input 2
AI3	Analog Input 3
A COM	Analog Input Common
AI4	Analog Input 4
AI5	Analog Input 5
A COM	Analog Input Common
AI6	Analog Input 6
+15 VDC	+15 Volts DC Supply
BI1	Binary Input 1
24 VAC	24 Volts AC
BI2	Binary Input 2
BI3	Binary Input 3
24 VAC	24 Volts AC
BI4	Binary Input 4
TRIAC	Shared Triacs Node
BO1	Binary Output 1
RTN	Return (24 VAC or Common)*
BO2	Binary Output 2
BO3	Binary Output 3
RTN	Return (24 VAC or Common)*
BO4	Binary Output 4
BO5	Binary Output 5
RTN	Return (24 VAC or Common)*
BO6	Binary Output 6
BO7 or AO1	Binary Output 7 or Analog Output 1
RTN or A COM	Return (24 VAC or Common)* or Analog Output Common
BO8 or AO2	Binary Output 8 or Analog Output 2
24 VAC	24 VAC Power--Transformer High Side
COM	Common--Transformer Low Side
Z Bus	Zone Bus
REF	N2 Reference
N2-	N2 Bus -
N2+	N2 Bus +

* Depends on triac switching jumper setting: If high, return is "Common."
  If low, return is "24 VAC."

Analog Inputs

The six analog input terminals, their power supply, and their common points occupy the lower left corner of the terminal strip. These inputs may be of two types: resistive or voltage. The UNT processes and controls the configured control strategy. It reads the analog inputs through the analog input DIP switches located directly above the analog input terminals.

Use these switches and HVAC PRO for Windows to select the type of analog input. Use the T position for all temperature sensors and setpoint potentiometers. Use the V position for all active voltage transmitters. For humidity applications using 3-wire voltage transmitters, such as the HE-6300 Series, use the 15 VDC power supply terminals next to the inputs for AI 6. Table 9 shows each configuration.

Table 9: Analog Input Configurations

AI Type	Range	Switch Position
Voltage (V)	0 to 2 VDC	SW1 to Position V and SW2 to Position 2V
Voltage (V)	0 to 10 VDC	SW1 to Position V and SW2 to Position 10V
Resistance / Temperature (T)	1,000 ohm Nickel, Platinum, Silicon, 2k ohm potentiometer	SW1 to Position T and SW2 to Position 2V

Setting the Analog DIP Switches

The UNT has two sets of DIP switches. One set is for configuring the analog input points, and the other set is for setting the controller address. Use Table 10 to set analog input DIP switches. Instructions for setting the N2 Address DIP switches are in the *Networking the Controller* section of this technical bulletin.

Analog Input Switches
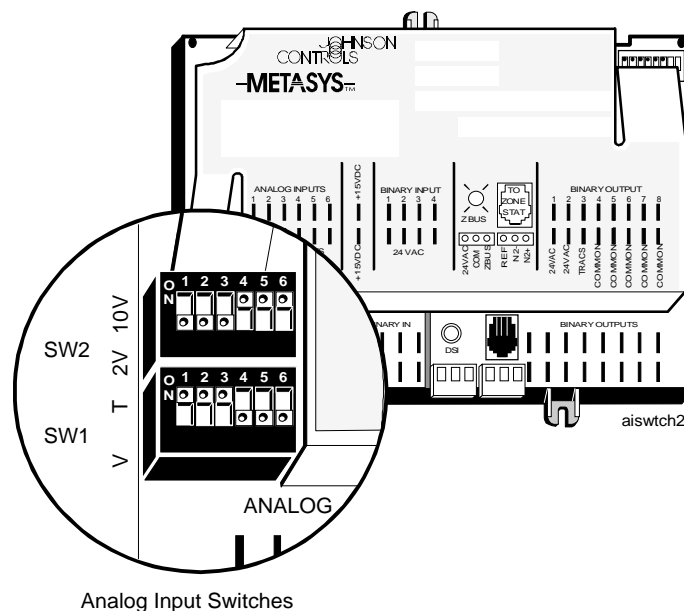
Figure 12: Setting the Analog Input DIP Switches

The AI switches should be factory set with AI 1, 2, and 3 as resistive inputs, and AI 4, 5, and 6 as 0 to 10 VDC inputs. You may reconfigure the switches by using the following table. For example, if you connect a 10 VDC input to AI 4, set SW1-4 to Off and SW2-4 to On.

Table 10: Analog Input DIP Switch Settings

Hardware Point	Temp (Resistive Input)		2 VDC (0 to 2 VDC Input)		10 VDC (0 to 10 VDC Input)	
Switch	SW1	SW2	SW1	SW2	SW1	SW2
AI 1	ON	OFF	OFF	OFF	OFF	ON
AI 2	ON	OFF	OFF	OFF	OFF	ON
AI 3	ON	OFF	OFF	OFF	OFF	ON
AI 4	ON	OFF	OFF	OFF	OFF	ON
AI 5	ON	OFF	OFF	OFF	OFF	ON
AI 6	ON	OFF	OFF	OFF	OFF	ON

Binary Inputs

Four binary inputs on the controller are located in the center of the terminal strip.

The binary inputs on the UNT110/111, 120/121, and 140/141 series controllers are inactive when open or connected to UNT common. When a binary device closes to complete a binary circuit, the binary input provides the 24 VAC which, in turn, activates the input. Binary inputs have a threshold between 5 VAC and 18 VAC. BI 4 may be used as an accumulator input for frequencies less than 2 Hz.

Binary Outputs (Triac Jumper Information)

Binary outputs are triacs on the controller hardware. The controller has either six or eight binary outputs. These outputs switch 24 VAC to the output.

For the UNT110/111, UNT120/121, and UNT140/141 series controllers, use the terminal labeled TRIACS when using a separate load transformer. Remove the high side/low side triac jumper on the UNT110/111, UNT120/121, and UNT140/141 for this application (see Figure 8). For important power and load specifications, see Table 5.

UNT110/111 and UNT120/121

The terminal labeled TRIACS on the UNT110/111 and UNT120/121 series controllers is the internal shared node of each triac output (see Figure 13). When connecting this terminal (via the wire jumper) to 24 VAC for high side switching, each load must be connected between the binary output terminal and any common terminal. When connecting this terminal to common for low side switching, each load must be connected between the binary output terminal and any 24 VAC terminal.

UNT140/141

On the UNT140/141 series controller, terminals labeled RTN (Return) are associated with the binary outputs, and a jumper block sets high side or low side switching. Setting the jumper block to Low Side BO sets the RTN terminals to 24 VAC. Setting the jumper block to High Side BO sets the RTN terminals to common.

Analog Outputs

The UNT101, UNT111, UNT121, and UNT141 controllers have two analog outputs. The load connects between the analog output and analog output common terminals. Each output generates a proportional voltage output of 0 to 10 VDC to common. The maximum load for each output is 10 mA with a minimum 1000-ohm load resistance.

Zone Bus

The Zone Bus provides UNT connections for M100C series actuators, CBLPRO (for HVAC PRO for Windows commissioning), and the Zone Terminal (ZT). The Zone Bus is available for connection at the Zone Temperature Sensor, Zone Humidity Sensor, M100C series actuators, UNT Controller Board, and CBLPRO.

Wiring to Unit Mounted Controls-- UNT110/111 and UNT120/121

⚠ CAUTION: Some local electrical codes require the secondary common of stepdown transformers be connected to earth ground (typically on units which are powered by greater than 150 VAC). You may have a maximum of **one** single earth ground connection, which **must** be at the transformer secondary common, whether one or multiple controllers are powered by the same transformer.
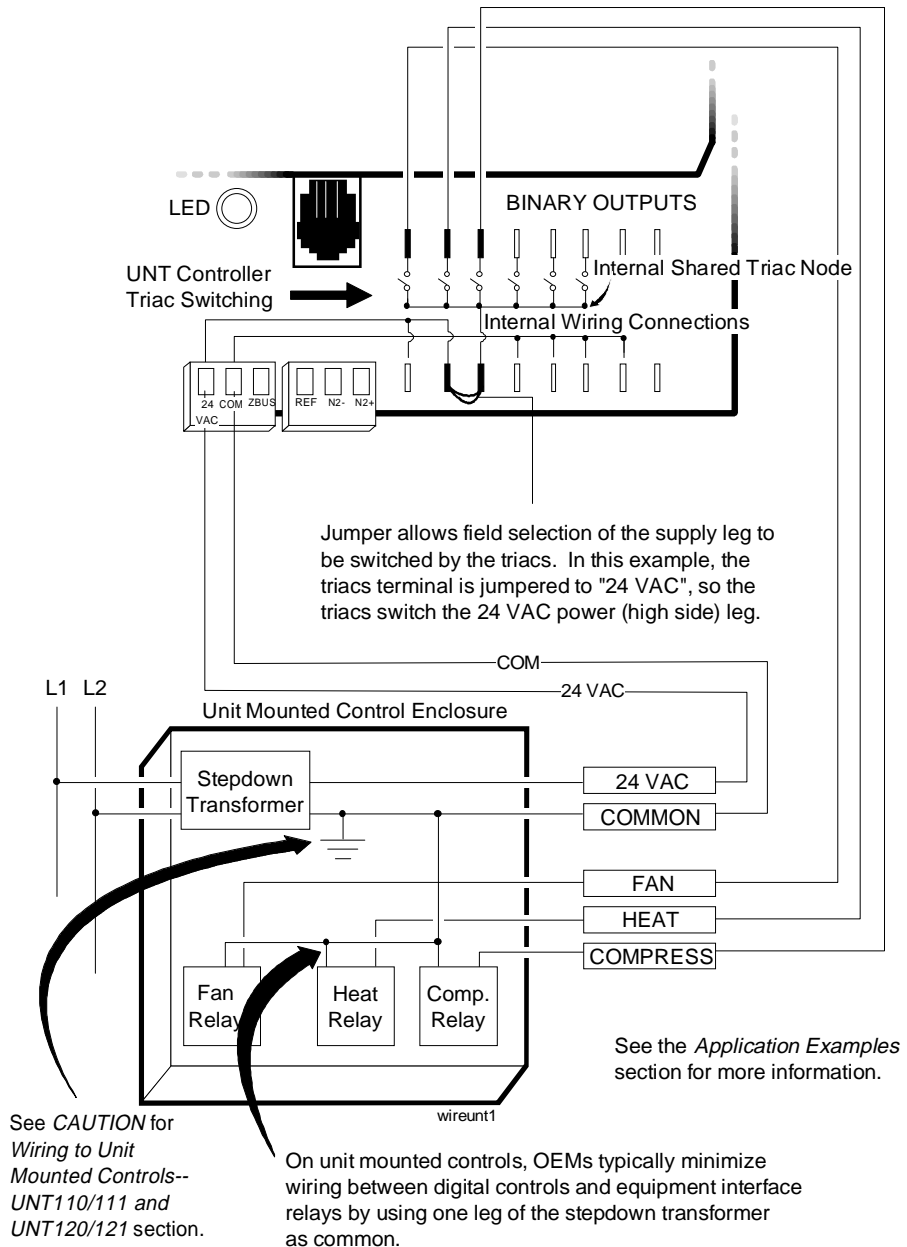
Figure 13: Binary Output Triac Connections on "Quick Connect" Versions of the UNT110/111 and UNT120/121
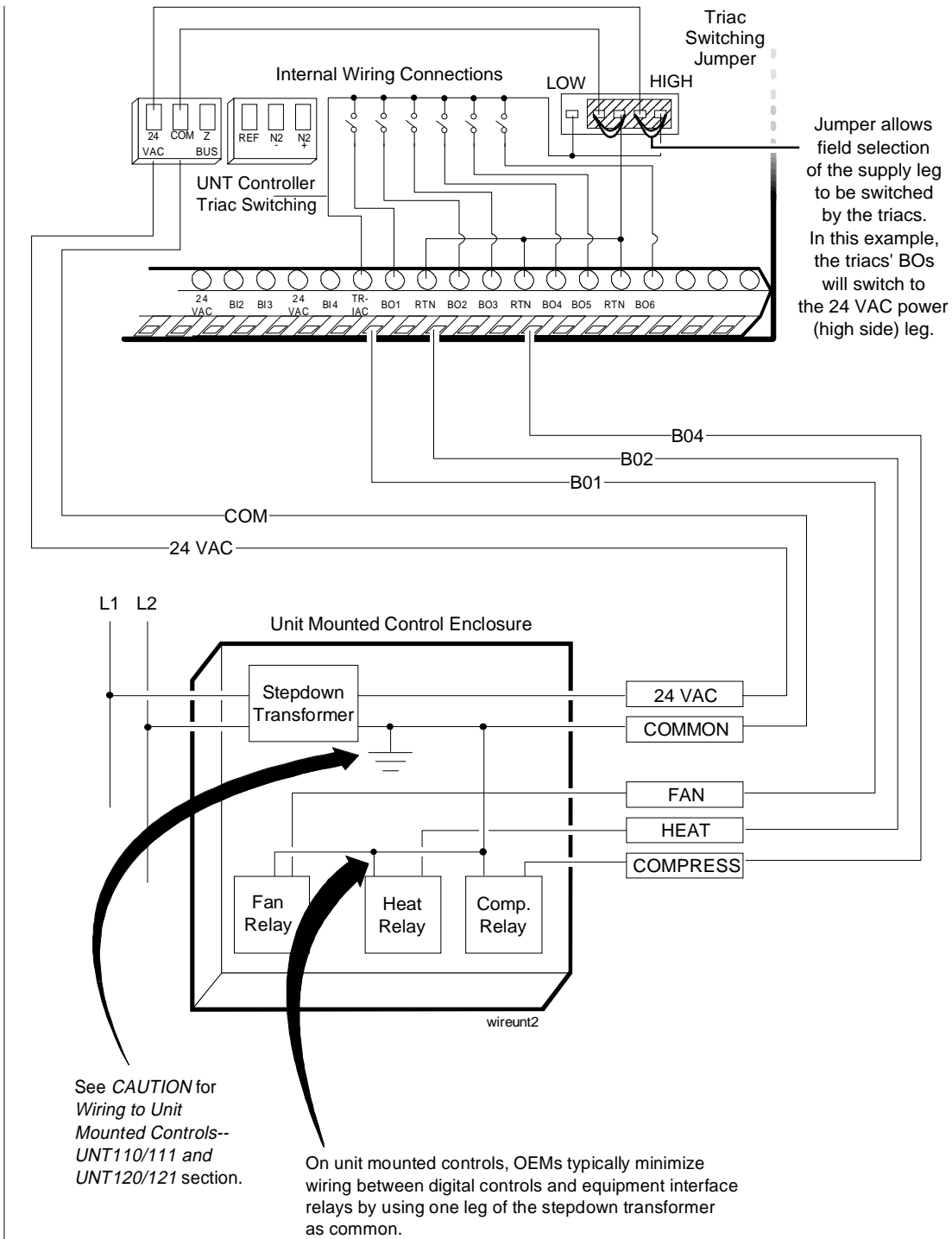
**Figure 14: Binary Output Triac Connections on Terminal Strip Versions
of the UNT140/141**

Connect power to the relay module and the transformer through the
conduit knockouts in each box. Wire the module according to the
following diagrams. For a schematic diagram of the relay module, see the
Application Specific Controllers Technical Manual (FAN 636.3), the
AHU Controller tab, the *AHU Controller Technical Bulletin
(LIT-6363010)*, the *AHU Tower Wiring Details* section.

> ⚠ WARNING: **Possible equipment damage or electrical shock**.
> Disconnect power circuit before wiring relay kit.

Figure 15 shows a UNT110/111 wired to an RLY050/002 with no BOs
isolated from earth ground.
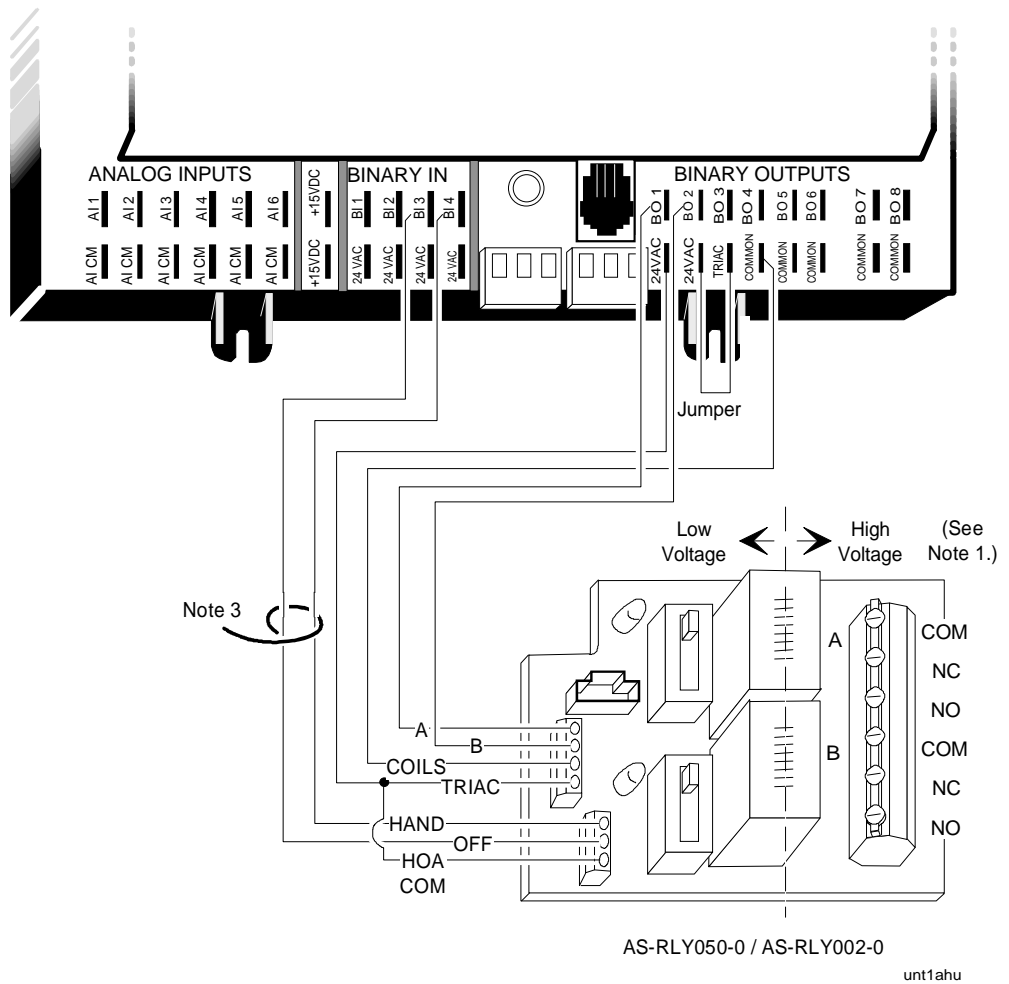
AS-RLY050-0 / AS-RLY002-0

unt1ahu

Note 1: Separate low voltage wiring on the left from line voltage wiring on the right.
Note 2: Hand operation using the H/O/A switch requires common to the COILS
terminal and 24 VAC to the TRIAC terminal to energize the relay.
Note 3: The Hand or Off position signals the binary input connected to those terminals.
These switches can be hardwire "OR"ed and connected to one BI. This
switch uses the HOA COM terminal, which is isolated from the relays.
Note 4: Your application will determine exact connections to UNT.

Figure 15: UNT110/111 Wired to RLY050/002

Figure 15 shows a jumper between 24 VAC and the triac. If the jumper is between the triac and common make the following changes:

1. Disconnect TRIAC from HOA COM.

2. Reverse the COILS and TRIAC wires from RLY050 to the UNT.

3. Run a separate wire from HOA COM to 24 VAC at the Binary In terminal section.

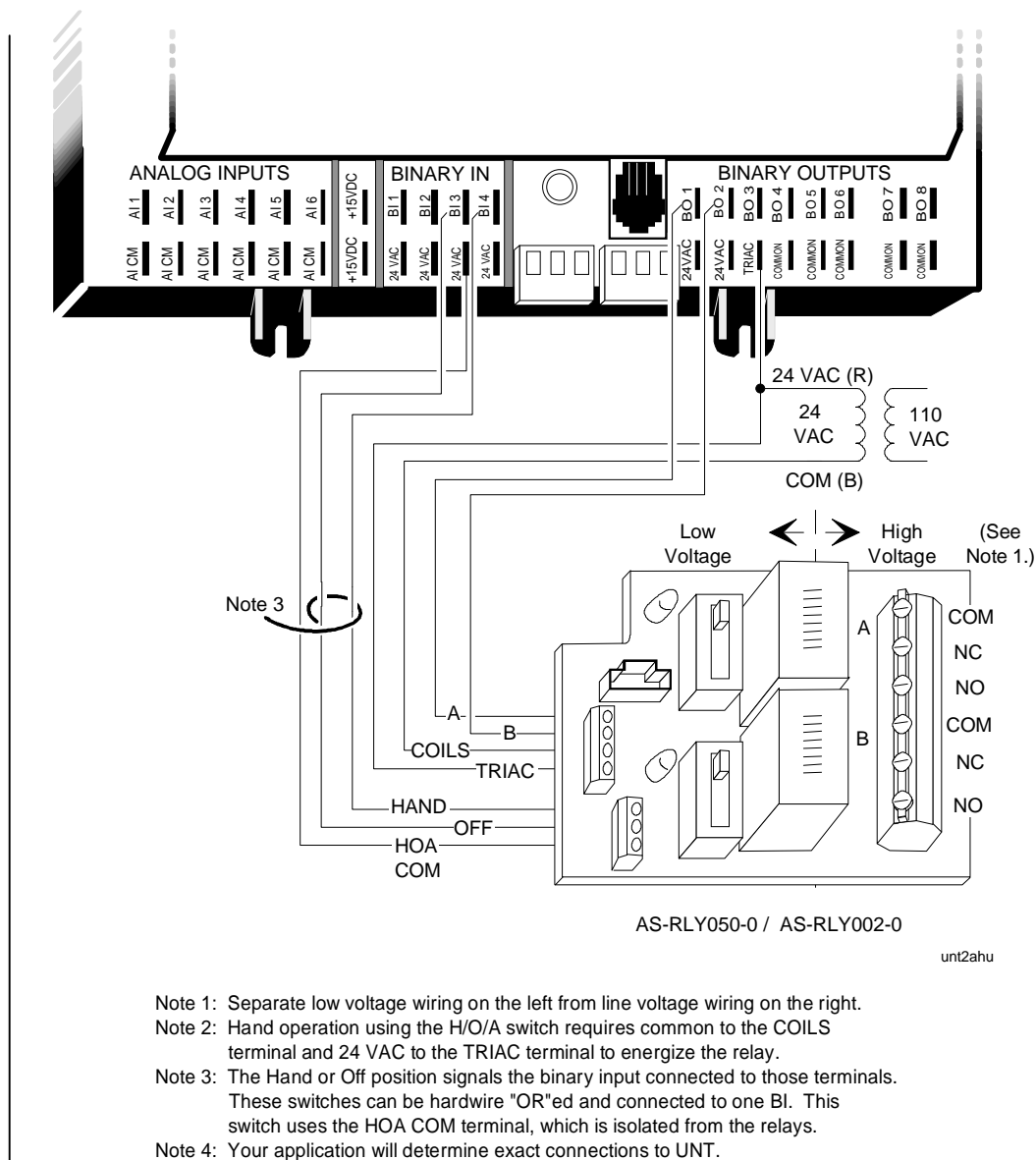Figure 16 shows a UNT110/111 wired to an RLY050/002 with all BOs isolated from earth ground.

Note 1: Separate low voltage wiring on the left from line voltage wiring on the right.
Note 2: Hand operation using the H/O/A switch requires common to the COILS terminal and 24 VAC to the TRIAC terminal to energize the relay.
Note 3: The Hand or Off position signals the binary input connected to those terminals. These switches can be hardwire "OR"ed and connected to one BI. This switch uses the HOA COM terminal, which is isolated from the relays.
Note 4: Your application will determine exact connections to UNT.

Figure 16: UNT110/111 Wired to RLY050/002 with Isolated BOs

You can obtain a Double-Pole, Double-Throw (DPDT) relay configuration by connecting the BO signal to two terminals on the relay kit terminal block (e.g., B and C). If you require a phone jack at a remote relay kit, add an AS-CBLCON-0.

For additional information, refer to the grounding and isolation information in the *Wiring Details* section of this technical bulletin.

Wiring Sensors and Actuators

Use 18 AWG twisted pair wire for all sensor and output wiring. Shielding is not required. However, if you decide to use it, earth ground the shield at the transformer. You may also use 24 AWG wire in some applications, but maximum wire length will be reduced due to the increased resistance. To minimize sensor error caused by field wiring, the total resistance of all resistive sensor wiring should be less than 3.0 ohms.

⚠ CAUTION: Do not run AI, BI, AO, BO, ZBUS, or N2 Bus wiring in the same conduit as line voltage wiring (30 VAC or above) or wiring that switches power to highly inductive loads such as contactors, coils, motors, or generators.

The insulator on the +15 VDC terminal prevents inadvertent shorting to the adjacent 24 VAC terminal. To prevent damage to the controller, remove and discard this insulator only when you need to use that specific terminal.

Table 11: Input and Output Load Impedances

| Function	Range	DC Input Impedance	Sensor or Load Impedance
DC Supply	14.6-17 VDC at 90 mA	N/A	162-10M ohm
Inputs			
AI Voltage	0-2V or 0-10 VDC	470k ohm	0-5k ohm
AI Temperature/ Potentiometer	1000 ohm Si, Ni, Pt, or 0-2k ohm Potentiometer	3540 ohm	0-2k ohm
BI VAC 60 Hz	0-24 VAC, 2.5V	470k ohm	0-5k ohm
Outputs			
AO Voltage	0-10 VDC @ 10 mA maximum	N/A	1k-10M ohm
BO VAC Triac	24 VAC @ 50-800 mA*	N/A	*30-480 ohm

* With total controller power draw limited as described previously.

Table 12: Sensor Wire Sizes and Maximum Lengths

Sensor Type	18 AWG Wire Size Run Length In Meters (Feet)	24 AWG Wire Size Run Length In Meters (Feet)
AI Temperature (Resistive)	152.4 m (500 ft)	30.5 m (100 ft)
AI Voltage	152.4 m (500 ft)	30.5 m (100 ft)
BI Voltage/Contact	152.4 m (500 ft)	152.4 m (500 ft)
Single BO at 0.1 A	152.4 m (500 ft)	3.0 m (10 ft)
Single BO at 0.5 A	30.5 m (100 ft)	6.1 m (20 ft)
Zone Bus	152.4 m (500 ft)	15.2 m (50 ft)
Zone Thermostat	*30.5 m (100 ft)	Eight Conductor Phone Cable

*Note: If a CBLPRO-2 and a Zone Terminal are used, the cable length must be limited to 15 m (50 ft).

M100/R81CAA-2
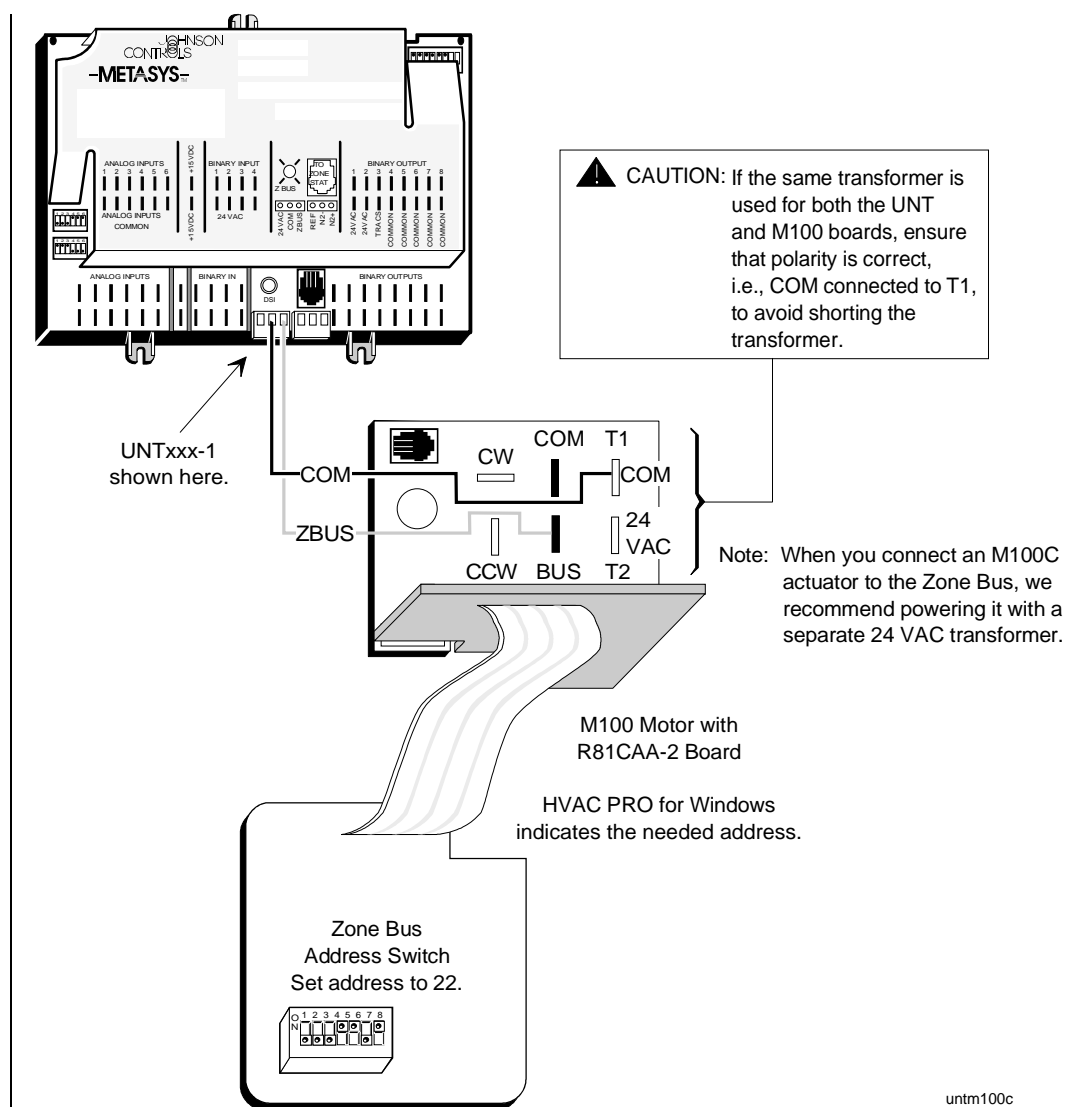
Figure 17: M100C Motor Zone Bus Connection Using an R81CAA-2 Board

When you connect an M100C actuator to the Zone Bus, we recommend powering it with a separate 24 VAC transformer. However, you may use the UNT's transformer if it is sized to provide the required additional 20 VA and connected with the correct polarity. See Figure 17 for terminal locations when wiring an M100C actuator.

M100/R81EAA-2
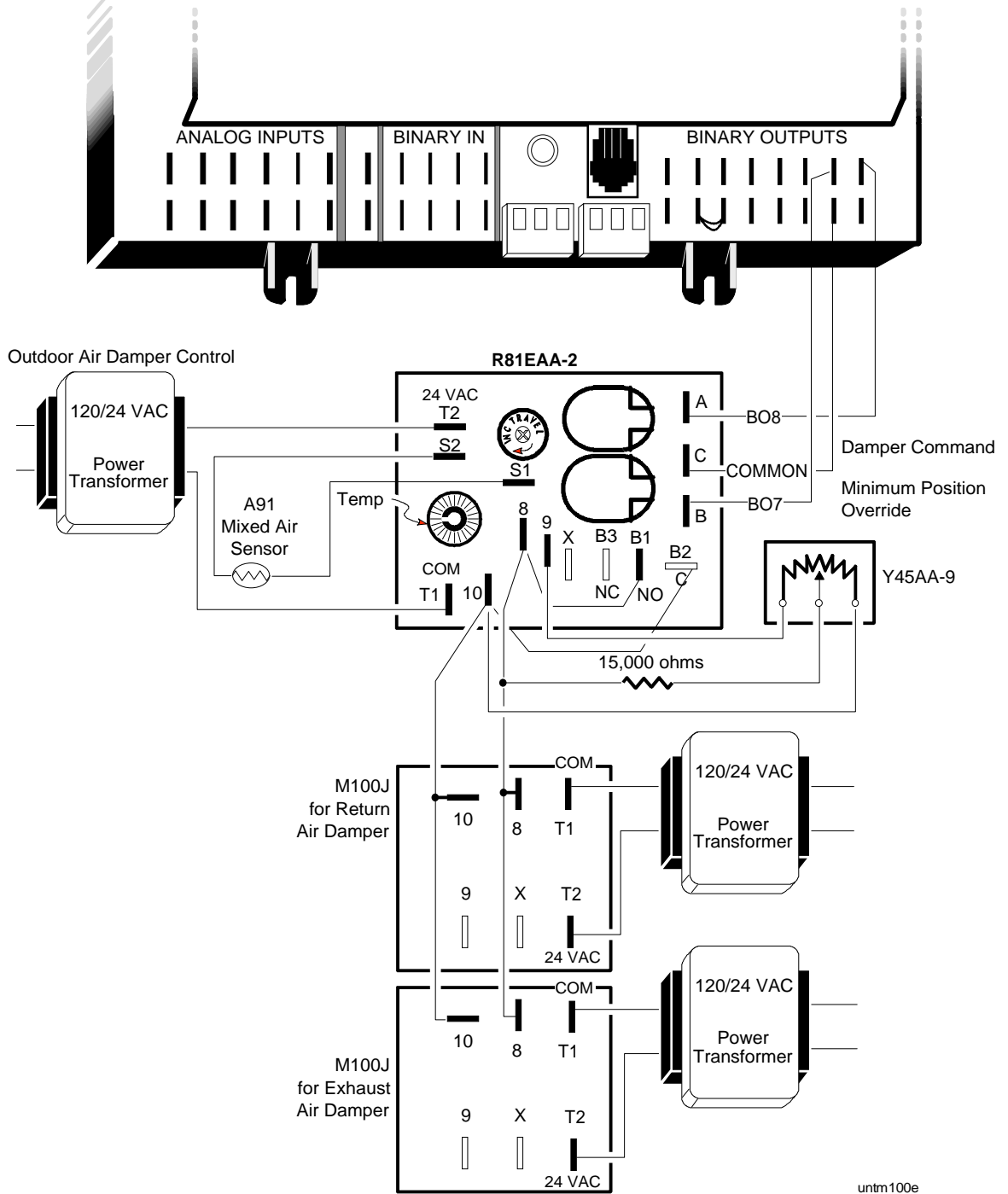
Figure 18: R81EAA-2 UNT Controller Interface

HE-6300 Humidity Sensor

Perform the following steps to connect an HE-6300 Humidity Sensor to the UNT (see Figure 19):
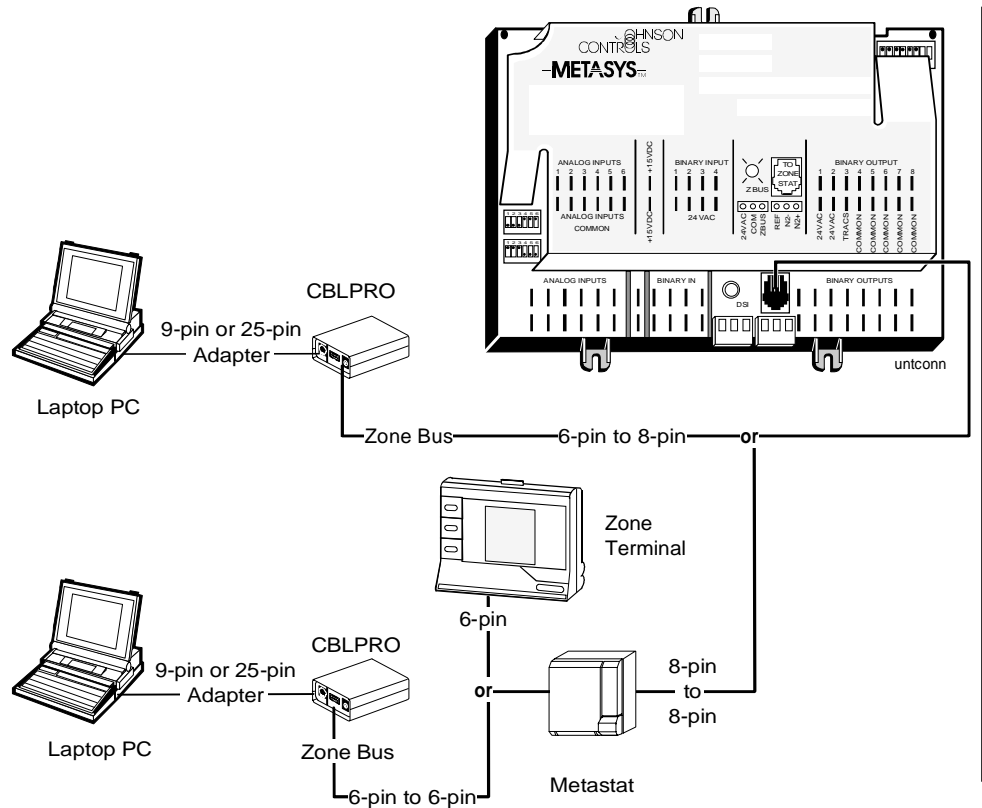
1. Set the analog input DIP switches on the AS-UNTxxx board to 10 volts:

    Switch 1 = OFF

    Switch 2 = ON

2. Enter the range of the humidity sensor through HVAC PRO for Windows (0 to 10 VDC is equal to 0 to 100% RH).
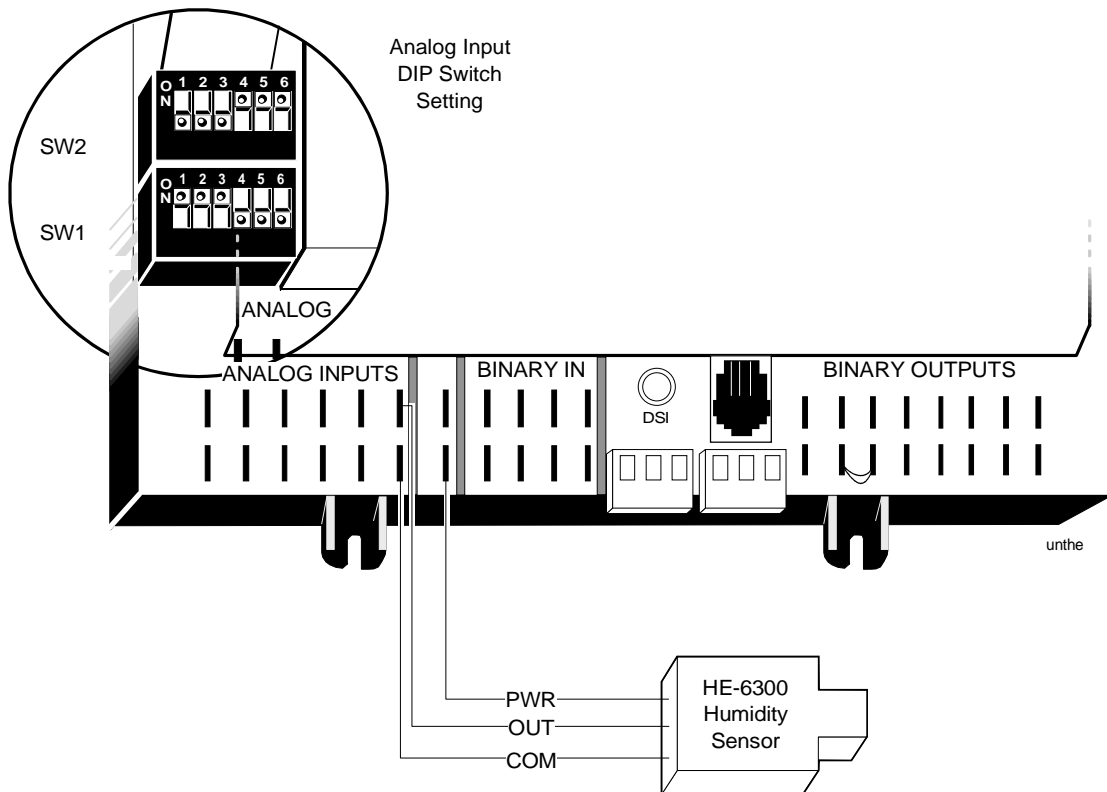
Figure 19: Example of HE-6300 Humidity Sensor Connection

**Temperature
Sensors**

Figure 20: Example of Temperature Sensor Connection

To make all necessary wiring terminations between the UNT and TE-6400 series Metastat™, use phone cable that has preterminated 8-pin RJ-45 connectors. For cable ordering information, refer to *Vendor Code Numbers* in the *Ordering Information* section of this technical bulletin.

Connect one end of the cable to the Zone Bus connector on the controller and the other end to the 8-pin connector on the back of the sensor as shown in Figure 20.

In addition to the 8-pin RJ-45 connection, the TE-6410 sensor also has a 6-pin, RJ-12 connection under its cover. This allows remote connection of the CBLPRO or the Zone Terminal (used for system monitoring.)

For UNT140/141 series controllers, there is an additional 6-pin jack for Zone Bus communication. You may permanently connect a Metastat to the 8-pin jack of the controller and simultaneously connect a laptop PC/CBLPRO or Zone Terminal to the Zone Bus via the 6-pin jack.

Phone Jack Polarization

Figure 21 illustrates the polarization of the 6-pin and 8-pin phone jacks on the UNT or Metastat. Terminal 1 is to the extreme left as you face the jack opening, tab notch down.
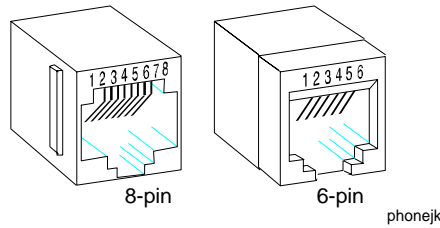
Figure 21: Phone Jack Polarization

The following table defines the pin usage for each jack.

Table 13: Phone Jack Pin Identification

8-Pin Jack (UNT to Temperature Sensor)		6-Pin Jack (UNT140 Controller to CBLPRO or ZT and CBLPRO or ZT to Temperature Sensor)	
Pin	Signal	Pin	Signal
1	AI 3 Heating Setpoint	1	Not Used
2	AI 2 Warmer/Cooler, or Cooling Setpoint	2	24 VAC
3	AI 1 Temperature Sensor	3	24 VAC/ZnBs Common
4	AI 1 Sensor Common	4	Not Used
5	24 VAC	5	Zone Bus
6	24 VAC / ZnBs Common	6	Not Used
7	AI 2/3 Common		
8	Zone Bus		

Notes: When using the Metastat, do not move the hardware point assignments in HVAC PRO for Windows.

For information on cables, refer to the *Vendor Code Numbers* section in this technical bulletin.

Sharing a Sensor   You may use one sensor as a master input to multiple UNTs, instead of mounting and wiring separate Zone Sensors for each controller. This application is especially beneficial when you have a mechanical system that uses more than one terminal unit to serve the same area; for example, a classroom with two unit ventilators, or an open office space with multiple water source heat pumps.

Figure 22 shows the wiring and analog input switch settings for two controllers using one Zone Sensor. When sharing a sensor, both controllers **must** be set to the same temperature sensor type (the default is resistive nickel) on the HVAC PRO for Windows Analog Input Modify screen. To ensure the noise immunity of the UNTs, pull the N2 Bus wiring with the sensor wiring between controllers that share the same sensor.

Set the HVAC PRO for Windows software for both controllers for the temperature sensor used.
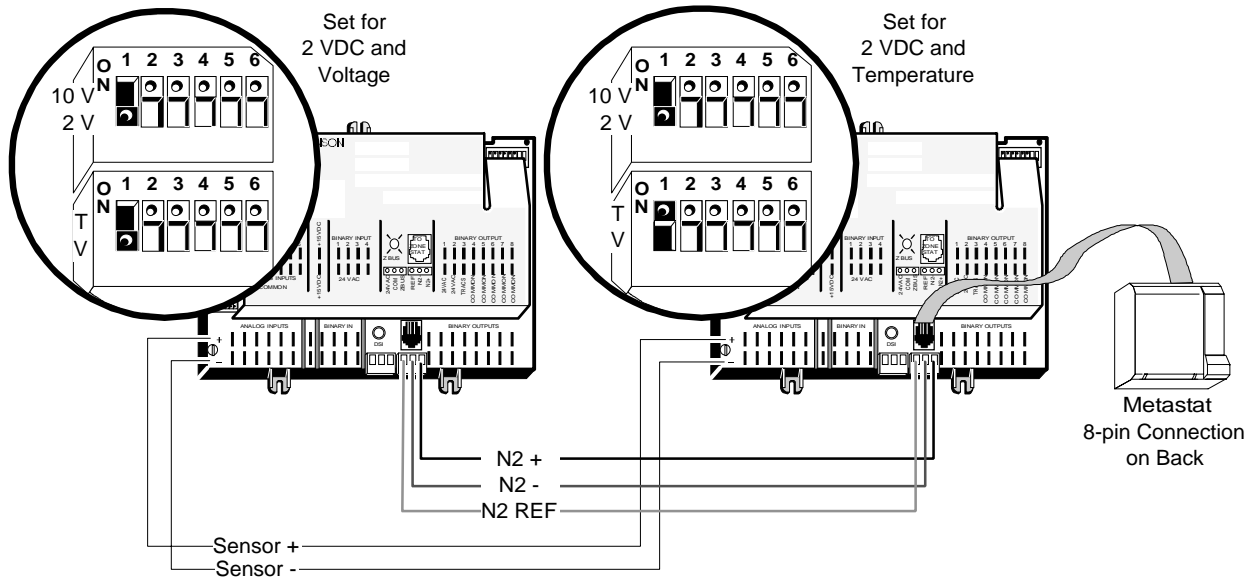
Figure 22: Example of Sharing a Sensor Among UNT Controllers

⚠ CAUTION: Multiple controllers sharing a sensor may only have **one** single earth ground connection among them. Even if separate transformers are used, only **one** may be physically tied to earth ground and that connection **must** be at the transformer secondary common.

Note: If the master Zone Sensor uses the Zone Bus connection, only the master controller can be loaded and commissioned from the sensor connection. The AI offset feature in HVAC PRO for Windows will have to adjust 1°F at the slave AIs to compensate for each additional controller sharing a sensor.

Networking the Controller

N2 Bus Overview

If you are already familiar with the N2 Bus, go to *Installing the N2 Bus*.

Wiring the Controller to an NCU

A hardware connection between the N2 Communications Bus and the Network Control Module (NCM) of the Network Control Unit (NCU) is required if the NCM is to communicate with N2 devices. On the NCM200 and NCM300, the specific connection point for the Metasys Network is the built-in N2 Submodule. On the NCM100 and NCM101/401, install this submodule into one of the submodule slots.

N2 Bus Characteristics

When installed in a Metasys Network, the UNT receives commands from the NCM or Companion on the N2 Bus, and transmits status reports in return. The maximum electrical limit on the N2 Bus is 255 devices. However, the number of controllers on the N2 Bus is a database memory issue at the NCU or Companion. Refer to the database generation documents in either the *Metasys Companion Technical Manual (FAN 628.1)* or the *Operator Workstation User's Manual (FAN 634)* to determine practical limitations to the number of controllers on the N2 Bus.

The N2 Bus connections are electrically isolated from other UNT110/111, UNT120/121, and UNT140/141 circuitry to 500V by optical and magnetic coupling.

For runs up to 1,520 m (5,000 ft), use stranded 18 AWG or heavier, twisted 3-conductor wire (electrically, lighter gauge wire works, but it is fragile and prone to nicks and breaks). Avoid using solid wire when possible, as it is prone to break when pulled. Runs longer than 5,000 feet require use of a bus repeater. An N2 network may be extended to a maximum length of 4,568 m (15,000 ft) using two repeaters.

The N2 Bus is a daisy chain communications line. It consists of three wires carrying three signals: N2+, N2-, and REF. The N2+ and N2- lines carry the data signals. The REF line provides a reference so that each connected device is capable of electrically receiving and transmitting data by creating a common voltage reference among all the devices connected together by the N2 lines. Three lines are required.

The configuration of the UNT can be uploaded, downloaded, and commissioned over the N2 Bus using an Operator Workstation (OWS) with HVAC PRO for Windows and an NCM, or a PC with HVAC PRO for Windows and an MM-CVT101-0. This can also be accomplished with Controller Access and Companion directly or remotely connected. Refer to the *Controller Access Technical Bulletin (LIT-6364013)* in the *HVAC PRO for Windows User's Manual (FAN 637.5).*

> IMPORTANT: The N2+ and N2- lines *must be twisted pair lines*. This allows most induced noise (common mode noise) from external sources to affect both lines equally, thereby canceling the noise.

Notes: Do not run N2 Bus wiring in the same conduits as line voltage wiring (30 VAC or above) or wiring that switches power to highly inductive loads (such as contactors, coils, motors, or generators).

For more N2 Bus overview information, refer to the *Application Specific Controllers Technical Manual (FAN 636.3),* the *Introduction* tab*,* the *ASC and N2 Bus Networking and Troubleshooting Guide Technical Bulletin (LIT-6363003).*

Installing the N2 Bus

> IMPORTANT: When setting the N2 Address, do not use Address 0.

Setting the N2 Address

Set the N2 address and test for N2 voltage, polarity, and isolation before actually wiring the UNT for operation. The factory default address is 3.

The switches located in the upper right corner of the UNT must be set to the same number as the software assigned to the module. The Metasys (or Companion) Facility Management System (FMS) uses this address for polling and commanding. The numbers are in binary format and horizontally arranged, with the least significant digit on the right.

For example, if the controller address is 17 (decimal), the binary representation is 00010001. Switches "1" and "16" must be set to the "on" position (1 + 16 = 17), as shown in Figure 23.
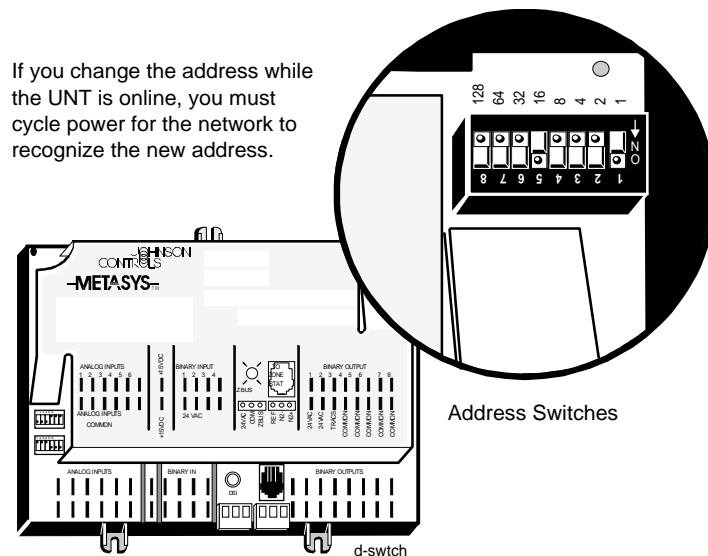
Figure 23: Setting the N2 Address DIP Switches

**N2 Wiring to the
Network Control
Module**

Note: Since the UNT is a self-terminating device, end-of-line termination
for the N2 Bus is not required.

n2wire-a
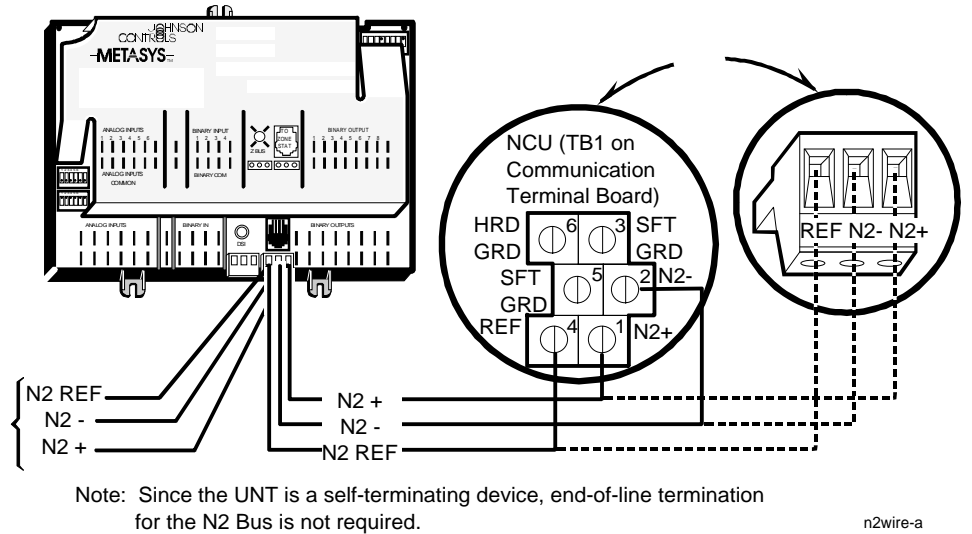
Figure 24: Connecting the UNT Controller to an NCM

Table 14: Terminal Locations

TB1 Terminal Function	Number	UNT Connection
Chassis Ground	6	None
Soft Ground	5	None
N2 Ref	4	REF
Soft Ground	3	None
N2B -	2	N2 Bus: N2-
N2B +	1	N2 Bus: N2+

N2 Wiring to Companion

A hardware connection between the N2 Communications Bus and the Companion PC/Panel/*LTD* is required to communicate with N2 devices. An MM-CVT101-0 Communications Converter is required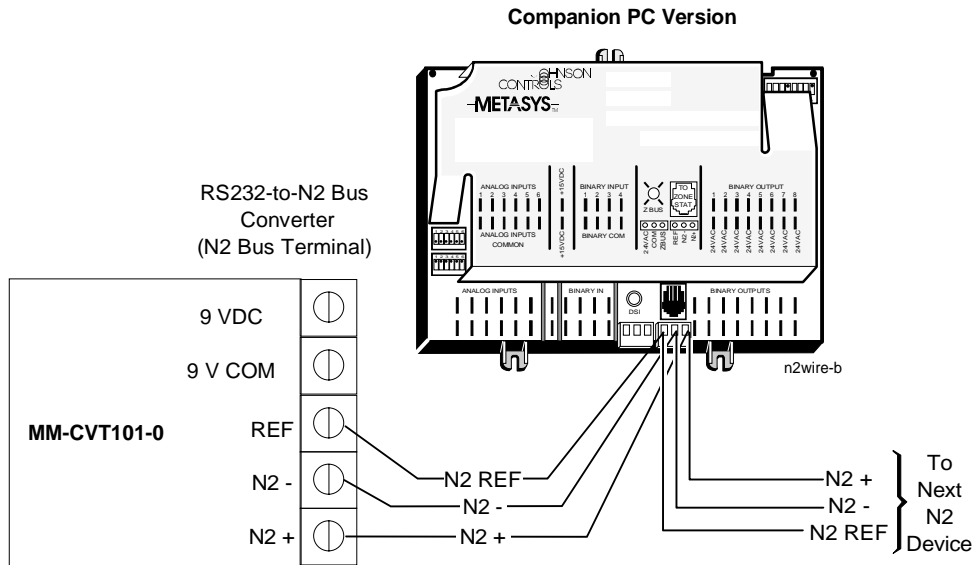 to network to the PC Companion. See Figure 25 for terminal locations. Refer to the *Metasys Companion Technical Manual (FAN 628.1)* for information specific to the MM-CVT101 or Companion Panel/*LTD.*

Figure 25: Connecting the UNT Controller to Companion

Note: For more information on installing the N2 Bus, refer to the *Application Specific Controllers Technical Manual (FAN 636.3),* the *Introduction* tab*,* the *ASC and N2 Bus Networking and Troubleshooting Guide Technical Bulletin (LIT-6363003).*

Zone Bus Communications

Zone Bus Description

The Zone Bus is a 2-wire communications bus that allows a computer to communicate with the UNT, to download the UNT's database, and to communicate with the Zone Terminals and M100 actuators. A third wire is used for 24 VAC power to the CBLPRO, Zone Terminal, and AS-CBLCON. The bus interface sustains no damage in the presence of fault voltages of 24 VAC or less.

M100 actuators should be powered with separate transformers; therefore, only the Zone Bus and common wires need to be pulled.

See Table 15 for Zone Bus specifications.

Table 15: Zone Bus Specifications

Specification	Description
Type	Multidrop serial communications bus
Speed	1200 baud (bits per second)
Recommended Cable Type	18 AWG with shield (Beldon 8760) or 24 AWG with no shield (unshielded telephone cord)
Maximum Bus Length	150 m (500 ft) with 18 AWG cable or *30 m (100 ft) with 24 AWG cable
Range of Addresses	0 to 63
Voltages	
Logic High-Voltage Logic Low-Voltage	4 VDC minimum (approximately) 1 VDC maximum (approximately)
Data Transmission	1 Start Bit (low level) 8 Data Bits (least significant bit first) 1 Stop Bit (high level)

*Note: If a CBLPRO-1 and a Zone Terminal are used, the cable length must be limited to 15 m (50 ft).

The UNT110/111, UNT120/121, and UNT140/141 series controllers contain an LED that blinks to indicate Zone Bus activity with or without external connection. During power up, there is a brief delay while the UNT undergoes a diagnostic reset. The LED will blink once, turn off for approximately 10 seconds, and turn on again. When a PC communicates with the UNT via CBLPRO, the blink rate may appear to change; that is, it may appear to be more steady.

Table 16: Zone Bus LED

Green LED	Cause
Off	No power to ASC
On	Zone Bus shorted to common or 24 VAC
Blinking	Normal Communication

CBLPRO Description

The AS-CBLPRO is an interface device used between a computer running HVAC PRO for Windows and Application Specific Controllers (ASCs). It is used for database downloading, uploading, or commissioning via the Zone Bus communication port.

When used with a Zone Bus device, such as the UNT or ZT, the CBLPRO is strictly an electrical interface between the serial RS-232 port of the computer and the Zone Bus. CBLPRO operates on 24 VAC drawn from a UNT over the wire used to make the Zone Bus connections. The data transfer rate on both the RS-232 and the Zone Bus is 1200 baud.

The connection to the RS-232 COM port of the computer is through a DB9 or DB25 connector supplied with the CBLPRO. After connecting it, make sure the CBLPRO is more than 30 cm (1 ft) away from the computer monitor and system unit.

IMPORTANT: In some cases, a computer monitor or PC will emit electromagnetic noise that may disturb CBLPRO communications. Therefore, do not position the CBLPRO near the monitor or PC.

Zone Bus communications to the application specific controllers or ZT may also be monitored with an AS-CBLCON-0. This device has red and green LEDs whose purposes are described in Table 17.

Table 17: CBLCON LED Description

Red LED Power	Green LED Comm	Cause
Off	Off	No power to UNT
On	Off	Zone Bus wire open
On	On	Zone Bus wire shorted to common or CBLCON-0 switch in download position
On	Blinking	Normal communications

Refer to the *Application Specific Controllers Technical Manual (FAN 636.3)*, the *Zone Terminal* tab, *Zone Terminal Technical Bulletin (LIT-6363014),* for proper cabling between the ZT, ASC, and CBLCON.

Application Examples

All of the following examples were created by answering configuration questions using HVAC PRO for Windows to identify terminal locations of the inputs and outputs. Refer to the *HVAC PRO for Windows User's Manual (FAN 637.5),* the *UNT Controller* section, for detailed information regarding controller configuration. The UNT110/111 series controller was used in all examples.

Fan Coil Applications

Table 18: Fan Coil Parameters and Configuration Selections

HVAC PRO for Windows Parameters	Configuration Selections
Heating Type	Common Heating/Cooling Coil
Lighting Integration	Yes

FCMECH
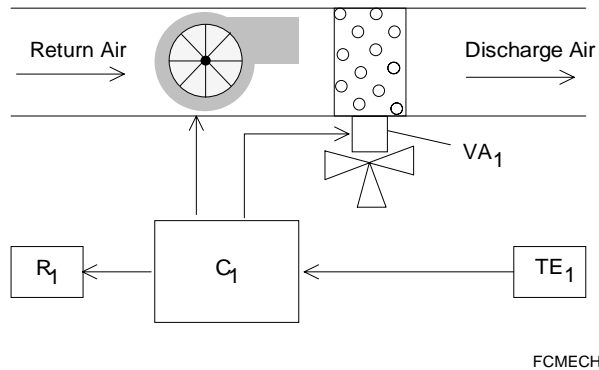
Figure 26: Fan Coil Mechanical Flow Diagram
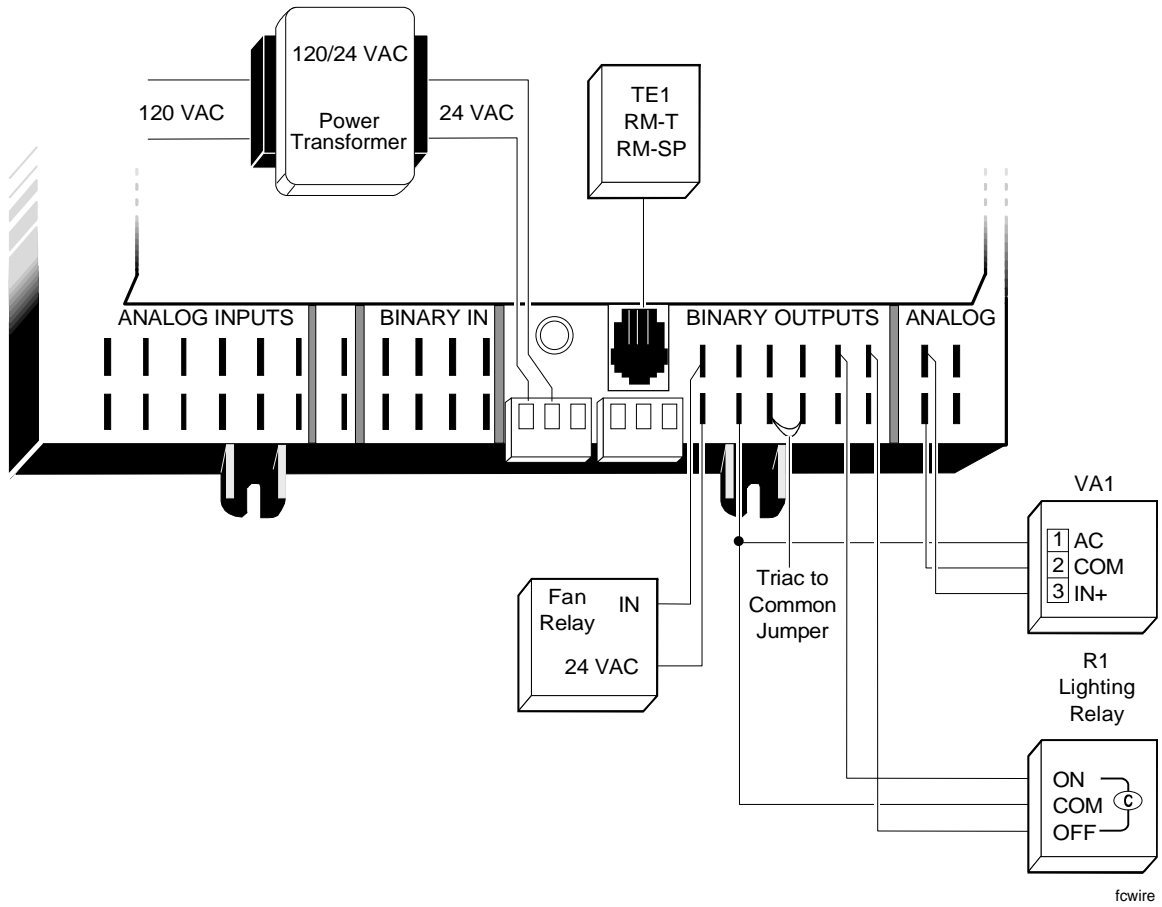
Figure 27: Fan Coil Wiring Example

Bill of Materials

Table 19: Fan Coil Bill of Materials

Component		Part Number
C1	**Digital Controller**	AS-UNT111-1
TE1	**Zone Temperature Sensor**	TE-6400 Metastat
VA1	**Valve Actuator**	VA-8052 Valve Actuator Assembly
R1	**Lighting Relay**	GE-RR7

Table 20 lists the selections made through HVAC PRO for Windows for the example in Figure 28.

Table 20: Unit Vent Parameters and Configuration Selections

HVAC PRO for Windows Parameters	Configuration Selections
Control Cycle	ASHRAE Cycle II
Economizer Changeover	Dry Bulb
Heating Type	Proportional
Unoccupied Override of Heating Valve	Yes
Cooling Type	None
Lighting Integration	None
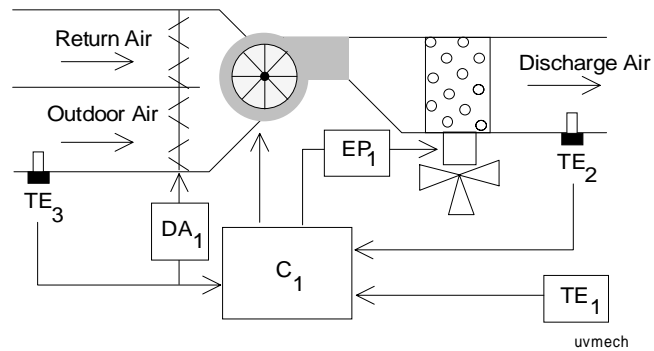
Figure 28: Unit Vent Mechanical Flow Diagram
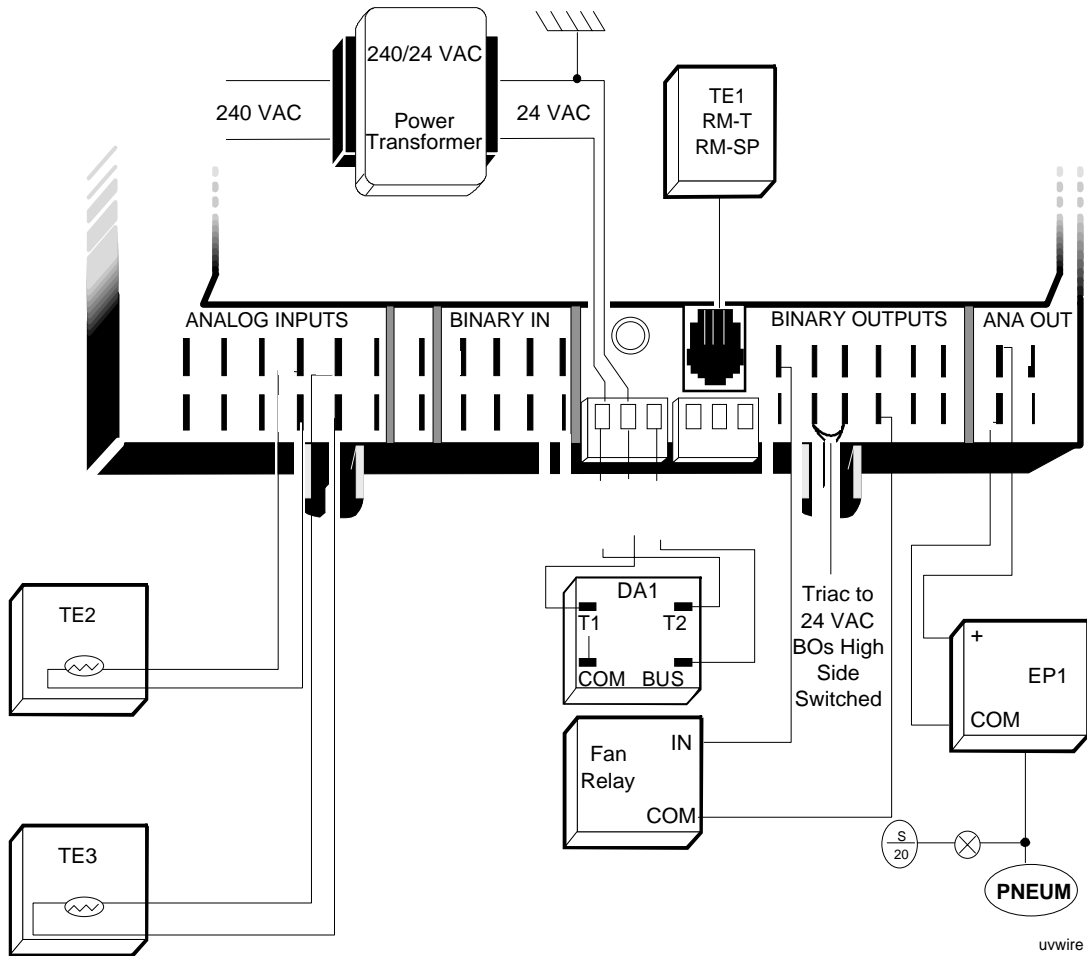
Figure 29: Unit Vent Wiring Example

Bill of Materials

Table 21: Unit Vent Bill of Materials

Component Description		Part Number
C1	Digital Controller	AS-UNT111-1
TE1	Zone Temperature Sensor	TE-6400 Series
TE2	Outdoor Air Sensor	TE-6300 Series
TE3	Discharge Air Sensor	TE-6300 Series
EP1	Electric to Pneumatic Interface	EP-8000 Series
DA1	Zone Damper Actuator	M100CGA-2

Table 22 lists the selections made through HVAC PRO for Windows for the example in Figure 30. Johnson Controls recommends that packaged rooftop applications have separate transformers for controller and loads. Sharing of transformers for controller and loads for packaged rooftop wiring is not recommended.

Table 22: Packaged Rooftop Parameters and Configuration Selections

HVAC PRO for Windows Parameters	Configuration Selections
Economizer Output Type	Zone Bus
Economizer Changeover Type	Dry Bulb
Heating Type	Two Stages
Cooling Type	Two Stages
Outdoor Air Lockout of Heating/Cooling	Yes
Zone Reset from Humidity	No
Heating/Cooling Diagnostics	Yes
Lighting Interface	No
Air Flow Interlock	Yes
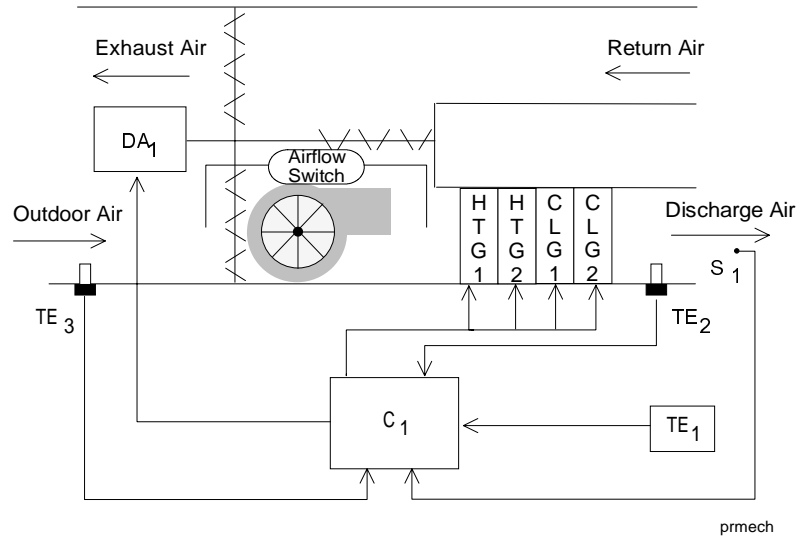
Figure 30: Packaged Rooftop Mechanical Flow Diagram
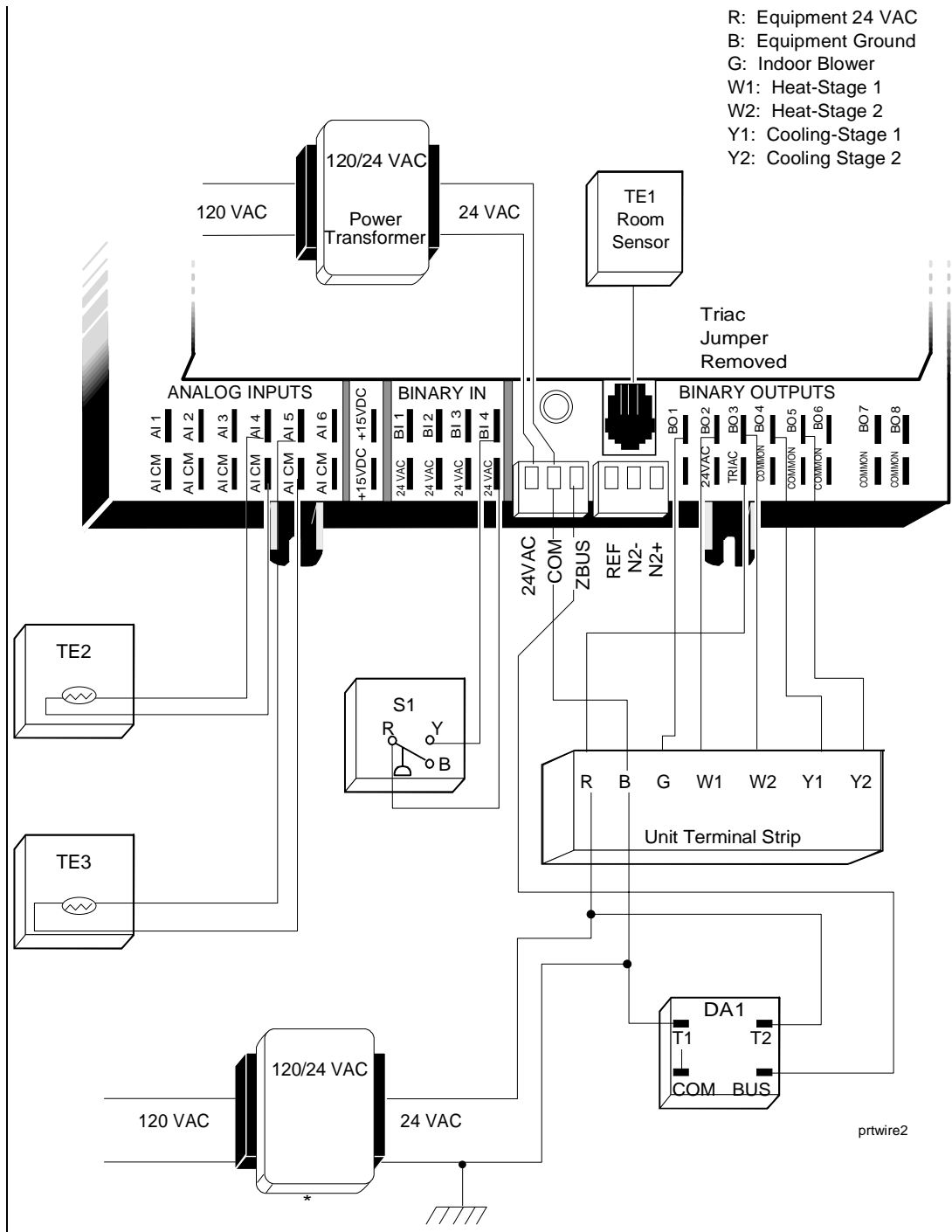
R: Equipment 24 VAC
B: Equipment Ground
G: Indoor Blower
W1: Heat-Stage 1
W2: Heat-Stage 2
Y1: Cooling-Stage 1
Y2: Cooling Stage 2

120/24 VAC

120 VAC

Power
Transformer

24 VAC

TE1
Room
Sensor

Triac
Jumper
Removed

ANALOG INPUTS

AI 1   AI 2   AI 3   AI 4   AI 5   AI 6

AI CM   AI CM   AI CM   AI CM   AI CM   AI CM

+15VDC   +15VDC

BINARY IN

BI 1   BI 2   BI 3   BI 4

24 VAC   24 VAC   24 VAC   24 VAC

+15VDC   +15VDC

BINARY OUTPUTS

BO 1   BO 2   BO 3   BO 4   BO5   BO6   BO 7   BO 8

24VAC   TRIAC   COMMON   COMMON   COMMON   COMMON

24VAC   COM   ZBUS   REF   N2-   N2+

TE2

TE3

S1

R   Y

B

R   B   G   W1   W2   Y1   Y2

Unit Terminal Strip

DA1

T1   T2

COM   BUS

120/24 VAC

120 VAC

24 VAC

prtwire2

*

* Phase correctly and size the transformer to include 20 VA for the M100C series actuator.

**Figure 31: Packaged Rooftop Wiring Example with Separate Transformers
for Controller and Loads**

Table 23: Packaged Rooftop Bill of Materials

Component		Part Number
C1	**Digital Controller**	AS-UNT110-1
TE1	**Zone Temperature Sensor**	TE-6400 Series
TE2	**Discharge Air Sensor**	TE-6300 Series
TE3	**Outdoor Air Sensor**	TE-6300 Series
S1	**Air Flow Switch**	P32 Series
DA1	**Damper Actuator**	M110CGA-2

For more information on rooftop installations, refer to *Appendix A: Precautions for Rooftop Installations* in this technical bulletin.

Heat Pump Applications

Table 24 lists the selections made through HVAC PRO for Windows for the example in Figure 32.

Table 24: Heat Pump Parameters and Configuration Selections

HVAC PRO for Windows Parameters	Configuration Selections
Heat Pump Type	Water to Air
Reversing Valve Action	On for Heating
Supplemental Heat	Two Stages
Lighting Integration	None
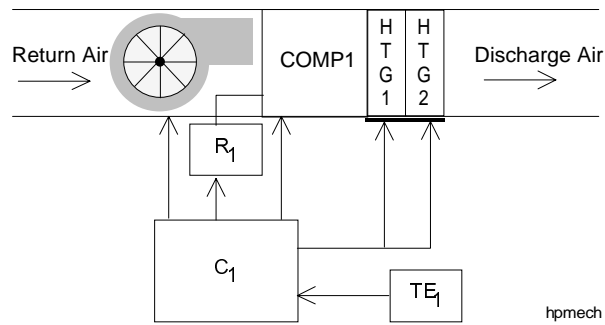
Figure 32: Heat Pump Mechanical Flow Diagram
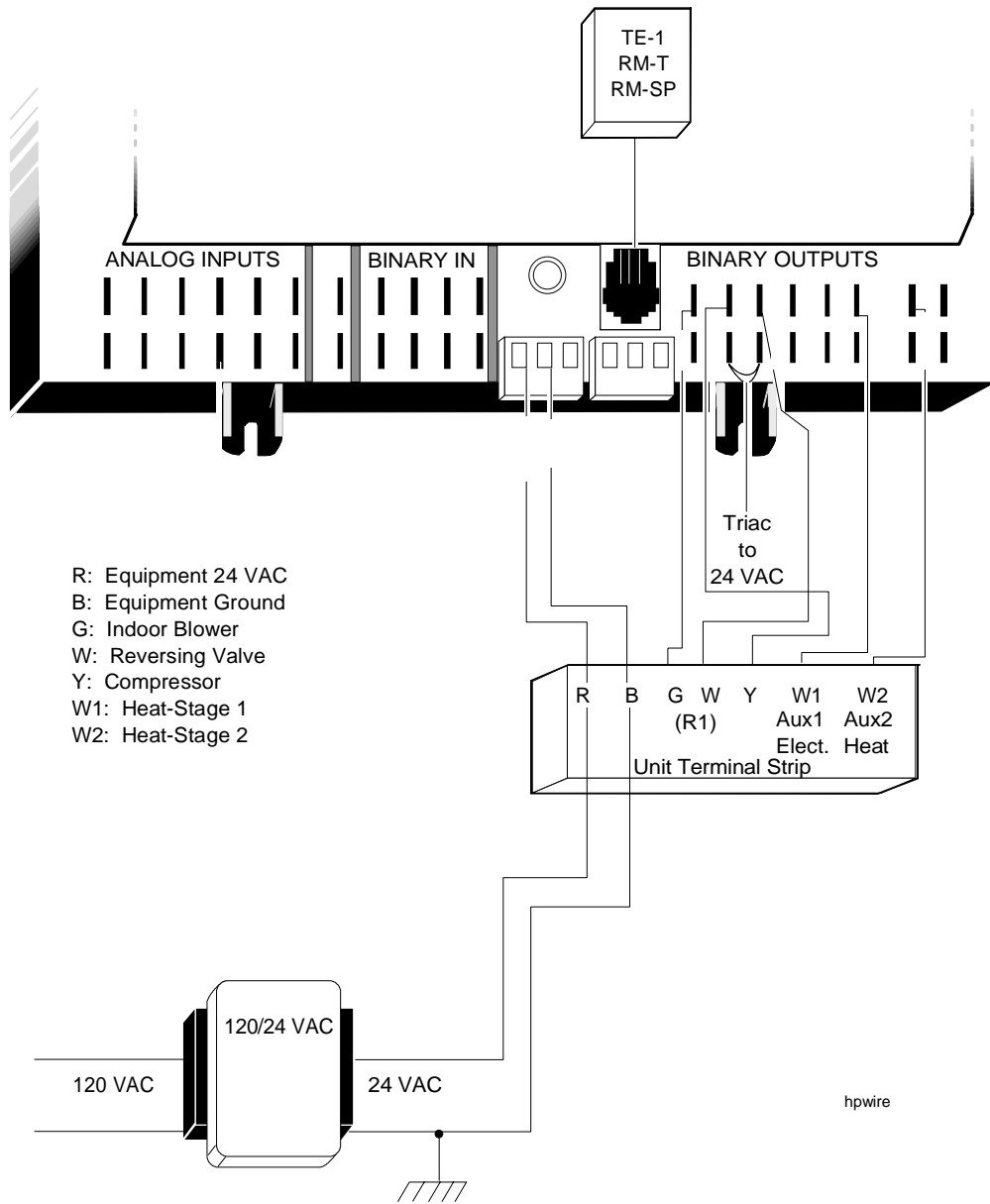
Figure 33: Heat Pump and External Transformer Wiring Example

Diagram labels:

TE-1
RM-T
RM-SP

ANALOG INPUTS   BINARY IN   BINARY OUTPUTS

Triac
to
24 VAC

R: Equipment 24 VAC
B: Equipment Ground
G: Indoor Blower
W: Reversing Valve
Y: Compressor
W1: Heat-Stage 1
W2: Heat-Stage 2

| R | B | G | W | Y | W1 | W2 |

(R1)   Aux1   Aux2
        Elect. Heat

Unit Terminal Strip

120/24 VAC

120 VAC   24 VAC

hpwire

Bill of Materials

Table 25: Heat Pump Bill of Materials

Component		Part Number
C1	Digital Controller	AS-UNT110-1
TE1	Zone Temperature Sensor	TE-6400 Series

Downloading/Commissioning

Commissioning Procedures

Commissioning a UNT begins after the unit is mounted and wired, and the control and hardware/software features have been defined through HVAC PRO for Windows. Refer to the *HVAC PRO for Windows User's Manual (FAN 637.5)* for complete controller configuration and commissioning information. A Zone Terminal or laptop PC with HVAC PRO for Windows is recommended to perform a complete system startup procedure. However, these accessories are not required for the basic procedure detailed in this section.

Via Zone Bus

Downloading and commissioning via the Zone Bus requires using the CBLPRO interface and a laptop or PC running the HVAC PRO for Windows software. You can connect to the Metastat 6-pin connector or directly at the controller. UNT140/141 models have a spare 6-pin connector so that the connection from a Metastat or Zone Sensor would not need to be disconnected during download/commissioning. Communication rate is 1200 baud over the Zone Bus. See Figure 20.

Via N2 Bus

HVAC PRO for Windows, release 5.00 or higher, allows you to perform downloading and commissioning over the N2 Bus using MM-CVT101-0, Metasys OWS Release 6.0 or higher, or Companion Release 6.00 and Controller Access. Because the communication rate is 9600 baud, performing this process over the N2 Bus saves a great deal of time when loading the initial configuration files and parameters into the controller.

Troubleshooting

*Hardware Installation Inspection*

Once the mechanical contractor starts receiving delivery of the UNTs with factory mounted controls, we recommend that arrangements be made to pull a sample of the shipment for bench testing. This can be done by loading a job configuration before all the controllers are mounted in the unit cabinets.

Tools Needed for Troubleshooting

Tools needed for typical troubleshooting include:

- *ASC and N2 Bus Networking and Troubleshooting Guide Technical Bulletin (LIT-6363003)*

- Digital Multimeter (DMM)

- 100k ohm resistor

- (optional) Double banana plug (see Figure 34; available from a local electronics store or ITT Pomona Stock No. 34F856 or 34F845), 100k ohm 1/4-watt resistor for earth ground voltage tests

100k ohm, 1/4-watt
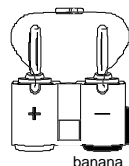
Use double banana plug for all tests that require a 100k ohm resistor placed in parallel with DMM.
Steps:
1. Connect 100k ohm resistor under plug's prongs.
2. Insert banana plug into DMM.
3. Connect leads of DMM into banana plug.

banana

Figure 34: Double Banana Plug Used with 100k ohm Resistor

Installation Checkout

Review the mounted UNT and compare it with the appropriate illustrations in the *Installation Procedures* section of this technical bulletin to ensure proper installation. Also refer to the engineering drawings supplied for the individual site.

1. Ensure that the mounting screws holding the subassembly onto the base frame are secure.

2. Ensure that accessory equipment is connected and labeled correctly.

3. Ensure that the controller terminal connections are secure.

4. Ensure that the N2 connections are secure and labeled correctly.

5. Ensure that the UNT switches are appropriately positioned. (Refer to the *Wiring Details* and *Networking the Controller* sections of this technical document.)

6. Ensure that there are no unwanted earth ground connections to the controller.

Although a single earth ground connection to the common terminal of UNT110/111, UNT120/121, and UNT140/141 series controllers is allowed, you may not intend to have one. The procedures described in the following directions may be used **when no earth ground connections to the UNT are intended or to ensure that there is only one earth ground connection**.

Isolation and Grounding UNTs without an Earth Ground Connection

This section will help you ensure proper isolation within your system. These procedures are not required, but are recommended to reduce installation errors. To ensure proper isolation, test the following:

- field device wiring for proper isolation
- transformer for isolation and correct polarity termination
- connected field devices, transformer, and UNT for proper isolation

Field Device Wiring Isolation-- UNTs without an Earth Ground Connection

This section assists you in measuring field wiring which will be terminated to the UNT. If you are confident that the field wiring has no earth grounds, you may go to the following section, *Power Transformer Isolation--UNTs without an Earth Ground Connection*. A field device that is earth grounded may become apparent when you test the entire controller.

- **Before you terminate the field wires to the UNT**, measure the resistance of each wire to earth ground using an LED test circuit (preferred) or a DVM. For the LED test circuit, assemble the test circuit illustrated in Figure 35. Then, connect the circuit from each input to earth ground and then from each output to ground. For the DVM test, connect the DVM from each input to earth ground and then from each output to ground (see Figure 35).

  If the LED turns On (or you read a value less than 1 Megohm at any input or output), the circuit is improperly isolated. Replace or repair the wiring or the field device; or, for a binary output, add an isolation relay. Repeat the test until the LED does not turn on.

  If the LED does not turn On (or you read a value greater than 1 Megohm), the circuit may be properly isolated. (It will not be isolated if there are earth grounds that exist at higher voltages.) A value of infinite ohms indicates a completely isolated circuit at approximately zero volts. Connect this wire to the appropriate UNT terminal and check the next wire.
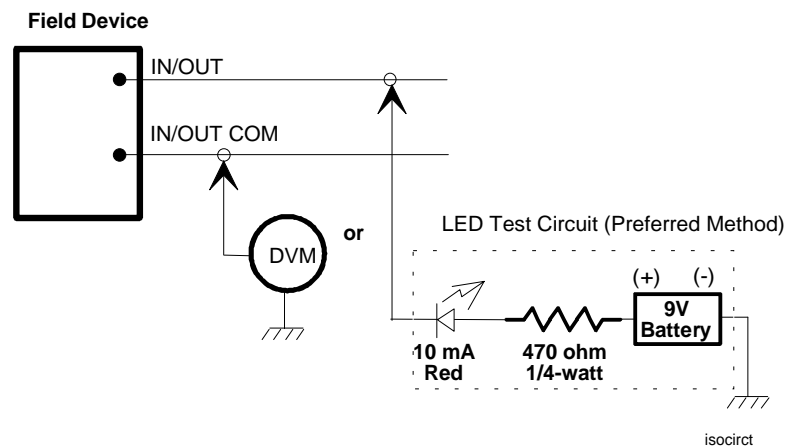

**Figure 35: Testing for an Isolated Circuit**

Power Transformer Isolation-- UNTs without an Earth Ground Connection

This section will assist you in determining if the supply transformer is properly isolated.

- Before connecting the transformer to the UNT, connect the input power to the primary leads of the 24 VAC transformer.

- Measure the voltage of each secondary transformer lead to earth ground with the DVM in parallel with a 100k ohm 1/4-watt resistor (see Figure 36; if using a double banana plug, insert the plug into the DVM).

  If you read 5 VAC/VDC or greater, the transformer is earth grounded. You need an isolation transformer in order to isolate the connections from earth ground and protect system components. Wire a separate 24 VAC to 24 VAC isolation transformer (such as the Y65G13) to the UNT.

  If you read less than 5 VAC/VDC, the circuit is properly isolated. Usually a value less than 0.10 VAC/VDC indicates a completely isolated circuit.
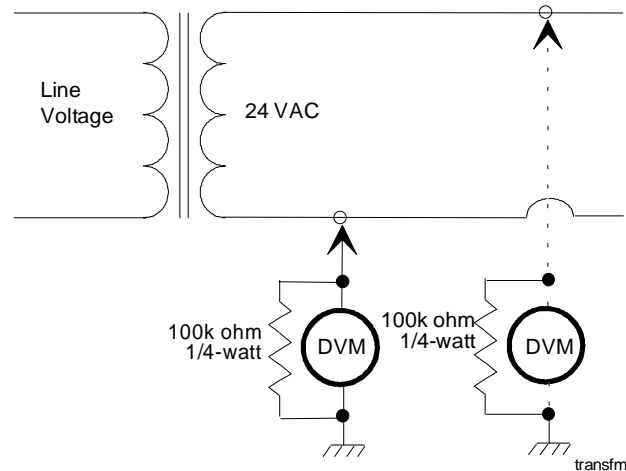
Figure 36: Testing the Transformer

- Determine the polarity of the transformer's leads by using a DVM referenced to earth ground **without** the 100k ohm resistor (see Figure 36). Connect the transformer's secondary lead with the higher voltage potential to the 24 VAC terminal on the UNT. Connect the transformer's secondary lead with the lower potential to the 24 VAC common terminal on the UNT.

**Load Isolation--
UNTs without an
Earth Ground
Connection**

If the field wires are not yet connected (the *Field Device Wiring Isolation--UNTs without an Earth Ground Connection* section was skipped), disconnect one 24 VAC wire and terminate the field wires. Reconnect the 24 VAC wire.

- Connect the leads of the DVM in parallel with the 100k ohm resistor from the DC power supply (+15 VDC) output terminal of the UNT to earth ground (see Figure 37). This tests whether the field devices, the UNT, and the transformer "assembly" are properly isolated.

   If you read 5 VDC/VAC or greater indicates the circuit is improperly isolated. Follow these steps to correct this:

Note: Binary outputs are often the cause of ground loops; therefore, we recommend that you test the binary outputs of the UNT before testing other points.

1. Remove all the field wires and N2 Bus wires from the UNT, but leave the transformer wires attached.

2. With the DVM still connected, reconnect each set of field wires one at a time until you read 5 VDC/VAC or greater. At this point, you have discovered one cause of the ground loop. Correct the problem. If you check all the field wires and you still read greater than 5 VDC/VAC, the transformer secondary is earth grounded. In this case, wire a 24 VAC to 24 VAC isolation transformer to the UNT and measure again. If the value is still 5 VDC/VAC or greater, replace the UNT.

3. Continue to reconnect each set of field wires until all ground loops are found and corrected. You'll know that all grounds are corrected when you read less than 5 VDC/VAC on the DVM.

   If you read less than 5 VDC/VAC, the circuit is properly isolated. A value of less than 0.10 VDC/VAC indicates a completely isolated circuit.
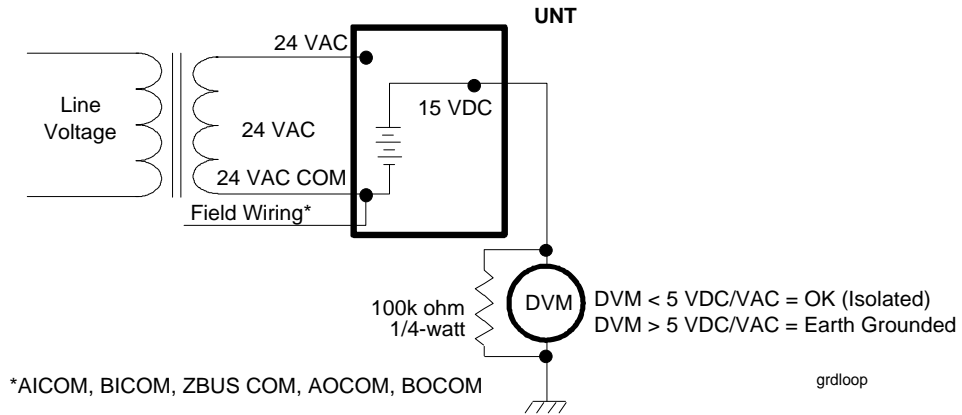
Figure 37: Testing for Ground Loops

- Connect the DVM across the 24 VAC and the 24 VAC common terminal of the UNT. Read the voltage with all typical loads energized.

  A reading of 24 VAC is required when the line voltage is nominal.

  If you read a value less than 20 VAC, make sure the primary voltage matches the transformer's voltage rating. For details, refer to the *Power Source and Loads* section of this technical bulletin and recalculate the VA requirements for the UNT.

You have completed the UNT isolation tests. If you plan to connect this UNT to the N2 Bus for communication to other devices, refer to the *Application Specific Controllers Technical Manual (FAN 636.3),* the *Introduction* tab, the *ASC and N2 Bus Networking and Troubleshooting Guide Technical Bulletin (LIT-6363003)*.

Grounding UNT110/111, UNT120/121, and UNT140/141 with an Earth Ground Connection

An earth ground connection to the common terminal of the UNT110/111, UNT120/121, and UNT140/141 series controllers is allowed for the 24 VAC power supply and the binary output/triacs (when set up for high side switching). If this earth ground connection exists, it must be at the transformer secondary common terminal only. There should be 0 VAC measured from a common terminal to earth ground and over 20 VAC from a 24 VAC terminal to earth ground, when power is applied. If no earth ground connections were planned for the power supply and/or triacs, and you suspect that an earth ground may exist, use the procedure described above for the UNT100/101 controller to test for the presence of a ground loop condition.

> ⚠ CAUTION: You may have a maximum of **one** single earth ground connection, which **must** be at the transformer secondary common, whether one or multiple controllers are powered by the same transformer.

Troubleshooting the UNT Controller with HVAC PRO for Windows

Table 26 indicates symptoms and corrections for possible controller malfunctions. We recommend the use of HVAC PRO for Windows Commissioning mode during all troubleshooting procedures.

Note: While in the commissioning program, you are actively viewing the controller's inputs and outputs. The screens will automatically refresh the data values when the controller senses a change in value.

Table 26: Troubleshooting the UNT with HVAC PRO for Windows

Symptom	Possible Cause	Corrective Action
Indoor Fan Does Not Run	Unit not in Occupied mode.	Use the Commissioning mode to force the controller into Occupied mode or insert a jumper across the defined, occupied BI if the UNT is already configured to Occupied mode.
	Unit does not need heating or cooling.	Check the configuration to verify if the fan was to cycle during Occupied mode.
	Fan off due to air flow loss.	Check air proving switch. Restart by breaking and making unit power.
M100C/Zone Bus Economizer Actuator Does Not Open to Minimum Position	Indoor fan not proven.	See above.
	Actuator or linkage	Remove actuator cover and check for 24 VAC across T1 and T2. Insert jumper CW to COM. Actuator should fully open outdoor dampers. Remove jumper.
	Wiring problem	Check that wire from Zone Bus on UNT is connected to bus terminal on actuator. Check address of the M100C actuator; it should be 22.
Heating or Cooling Will Not Turn On Automatically	Zone Sensor not connected.	Ensure Zone Sensor is properly connected with an 8-pin plug to the UNT.
	Zone temperature not above/below setpoint.	Simulate a load at the sensor using HVAC PRO for Windows.
	Heating or cooling lockout from outdoor temperature.	Simulate a value at the OA sensor using HVAC PRO for Windows Commissioning.
	Delay timers present.	Wait until time delays have expired (approximately five minutes).
ZT Display Contains Dots	Configuration mismatch between the controller and the ZT (a ZTU100-0 is used with a UNTxxx-1 controller).	Upgrade the ZTU100-0 to a ZTU100-1. Refer to the *Zone Terminal Technical Bulletin* in this manual for more information.
Binary Output Will Not Turn On or Chatters	TRIAC Jumper is not set correctly.	Set jumper so that triacs are switching proper side of transformer.
	Load is not drawing 50 mA (minimum load for triac).	Add a 1k ohm, 2-watt resistor across the relay coil.

Troubleshoot the N2 Bus if the Companion system is not properly communicating with the UNTs. Tables 26 and 27 cover many UNT or N2 communication problems and suggest which actions to take.

Specific troubleshooting tests are also given in this section. Before trying one of these tests, you may be able to determine the cause of the problem by asking yourself the following questions:

- Are the N2 Bus wires securely terminated to each UNT?

- Is the N2 polarity correct?

- Is the UNT powered and ready to respond?

- Have you cycled power on a UNT after changing its address? (Refer to *Installing the N2 Bus* in this technical bulletin).

- Are the UNTs configured properly with the correct number of points?

> ⚠ WARNING: **Electrical shock hazard**. When troubleshooting, always measure the REF to earth ground voltage with the DMM. If line voltage is measured, have a qualified electrician locate the fault.

Table 27: Troubleshooting the N2 Bus

Symptom	Possible Cause	Action
N2 Bus is Offline	EOL jumpers and/or W3 jumper on MM-CVT101 or Companion Panel/*LTD* are not installed.	Install EOL jumpers and W3 jumper properly.
	MM-CVT101 is not plugged into PC or 9 VDC source.	Plug MM-CVT101 into PC or into a 9 VDC source.
	N2 Bus polarity is incorrect.	Rewire N2 Bus wires for proper polarity.
UNT Does Not Come Online	Two or more UNTs have the same address.	Change each duplicate UNT address to a unique number.
	The address of the UNT was changed without its power being cycled afterward.	Cycle power on the UNT.
	The 10-second delay after downloading the UNT has not yet expired (HVAC PRO™ Revision 1.0 or earlier).	Wait until the delay expires.
	Someone is commissioning over the Zone Bus.	Wait until the Zone Bus is clear, then try again.

Notes: For more N2 Bus troubleshooting information, refer to the *Application Specific Controllers Technical Manual (FAN 636.3),* the *Introduction* tab*,* the *ASC and N2 Bus Networking and Troubleshooting Guide Technical Bulletin (LIT-6363003).*

For NCM troubleshooting information, refer to your NCM technical bulletin.

Zone Bus Troubleshooting– HVAC PRO for Windows

There are some errors that may occur while using the HVAC PRO for Windows commissioning tool with the UNTs over the Zone Bus. The cause of the error is often a loose or improper connection between the CBLPRO (AS-CBLPRO), laptop PC, and the controller. A defective COM port on the laptop, or a defective controller could also be at fault.

Note: It takes ten seconds for a UNT to reset and resume communication after being downloaded.

An effective troubleshooting technique is to use a CBLCON and observe its LEDs, which will indicate the problem (see Table 17 for a description of LEDs and their meanings). You may also try exchanging the component that you believe is defective with a working component of the same type.

A noisy wire adjacent to the Zone Bus can also cause communication errors. Noise can be periodically induced into the Zone Bus, thereby causing sporadic communication failures between the laptop and the UNT. Most often, noisy lines cause intermittent disruption, not total loss of communication.

For more information on HVAC PRO for Windows, refer to the *HVAC PRO for Windows User's Manual (FAN 637.5).*

Ordering Information

Controllers

Tables 28 - 31 list code numbers and descriptions for the UNTs and accessory equipment.

Table 28: UNT Controllers and Accessory Equipment

Code Number	Description
AS-UNT110-1	UNT with eight binary outputs, N2 Isolation, and triac--high or low side selectable
AS-UNT111-1	UNT with six binary outputs, two analog outputs, N2 Isolation, and triac--high or low side selectable
AS-UNT120-1	UNT110 controller with heater (for low temperature use)
AS-UNT121-1	UNT111 controller with heater (for low temperature use)
AS-UNT140-1	UNT110 controller with screw terminals for field terminations and spare 6-pin Zone Bus phone jack
AS-UNT141-1	UNT111 controller with screw terminals for field terminations and spare 6-pin Zone Bus phone jack
AS-UNT110-101	UNT110 mounted in EN-EWC10-0 enclosure with 50 VA transformer
AS-UNT111-101	UNT111 mounted in EN-EWC10-0 enclosure with 50 VA transformer
AS-UNT140-101	UNT140 mounted in EN-EWC10-0 enclosure with 50 VA transformer
AS-UNT141-101	UNT141 mounted in EN-EWC10-0 enclosure with 50 VA transformer

Sensors/ Transmitters

Table 29: UNT Sensors and Transmitters

Code Number	Description	Type
EP-8000 Series	Electro-Pneumatic Transducer 0.5 to 19 psig	0 to 10 VDC, High Volume (relay)
HE-6300 Series	Wall Mount Humidity Transmitter	12-30 VDC Supply
HE-6310 Series	Duct Mount Humidity Transmitter	18-30 VDC Supply
HE-6400 Series	Metastat Humidity/Temperature Transmitter (Wall Mount)	Various
TE-6100-11, -12 Series	Zone Temperature Sensor	Nickel, 1000 ohm with Phone Jack
TE-6300 Series	Temperature Sensor	Nickel, Platinum, Silicon
TE-6400 Series	Metastat Zone Temperature Sensor Series	Resistance

Dampers and Valve Actuators

Table 30: UNT Dampers and Valve Actuators

Code Number	Description	Type
VA-715x Series	Valve Actuator	Incremental or 0 to 10 VDC Proportional
VA-7200 Series	Valve Actuator	Incremental or 0 to 10 VDC Proportional
VA-8020 Series	Valve Actuator Assemblies 1/2 in.	24 VAC Triac/Incremental
VA-8022 Series	Valve Actuator Assemblies 1/2 in.	0 to 10 VDC
VA-8050 Series	Valve Actuator Assemblies 1/2 in., 3/4 in., 1 in., and 1-1/2 in.	24 VAC Triac/Incremental
VA-8051 Series	Valve Actuator Assemblies 1/2 in., 3/4 in., 1 in., and 1-1/2 in.	24 VAC Triac/Incremental/ with Feedback
VA-8052 Series	Valve Actuator Assemblies 1/2 in., 3/4 in., 1 in., and 1-1/2 in.	0 to 10 VDC
EDA-2040 Series	Damper Actuator	24 VAC Triac/Incremental
M100C Series	Zone Bus Damper Actuators	Zone Bus Addressable
M100E Series	Standalone Economizer Actuators	24 VAC Triac
M100G Series	Proportional Damper Actuators	0 to 10 VDC
M9000-500 Series	Valve Linkage Assembly for M9100 and M9200 Direct Mount Actuators	0.5- through 2-in. Globe style Valve Bodies
M9100	Direct Mount Proportional Damper Actuator	0 to 10 VDC
M9200	Direct Mount Proportional Damper Actuator, Spring Return	0 to 10 VDC

Accessories

Table 31: UNT Accessories

Code Number	Description	Type
AS-CBLPRO-2	HVAC PRO Cable	N/A
AS-ENC100-0	Enclosure for UNT (optional)	Sheet Metal
AS-RLY002-0	Relay, 2 SPDT, 5 A, 240 VAC	
AS-RLY050-0	Relay Kit, 2 SPDT, 5 A, 240 VAC with enclosure	
AS-RLY100-1	Relay Kit, 4 SPDT, 5 A, 240 VAC with enclosure	
AS-TBKIT-0	Replacement N2 Bus and Power Terminal Block Connectors	Five N2 Bus and Five Power Terminal Blocks
EN-EWC10-0	Enclosure for UNT (optional)	UPM Plastic
EN-EWC15-0	Enclosure with 50 VA Transformer	UPM with 50 VA
TE-6001-961	Momentary Button Kit for Temporary Occupancy or Boost Modes (for TE-6100-11, 12 only)	N/A
MM-CVT101-0	RS-232/RS-485 Converter for N2 Download/Commissioning with HVAC PRO for Windows	N/A
WS-WINPRO-0	HVAC PRO for Windows Software	N/A
WS-WINPRO-6	HVAC PRO for Windows Software Upgrade	N/A
Y65XX-X Series	Transformer	24/120/220/277-480 VAC to 24 VAC
AS-XFR050-0	Transformer	50 VA
P32 Series	Air Flow Switch	N/A
AS-ZTU100-1	Zone Terminal **	N/A

Note: The AS-ZTU100-1** supports both AS-UNTxxx-0 and AS-UNTxxx-**1** models.
The AS-ZTU100-**0** supports AS-UNTxxx-**0** models only.

Vendor Code Numbers

Tables 32 and 33 list preconfigured cables and cable components available from:

Southwest Wire
5950 Office Blvd
Albuquerque, NM 87109

Phone: 1-800-334-2150
Fax: (505) 344-3400

Use Table 32 to order preconfigured cables from Southwest Wire.

Table 32: Preconfigured Cables, Southwest Wire

Description	Cable Length	Part Number
RJ45 Straight-through Cable Assembly Plenum	7.62 m (25 ft)	CBL-STAT25-SW
• **Non keyed plugs**	15.24 m (50 ft)	CBL-STAT50-SW
• **24 AWG**	22.86 m (75 ft)	CBL-STAT75-SW
• **8 Conductor**	30.48 m (100 ft)	CBL-STAT100-SW
• **Solid Wire**		

Use Table 33 to order cable components available from Southwest Wire for creating your own cables.

Table 33: Cable Components, Southwest Wire

Description	Part Number
304.8 m (1000 ft) Roll of Plenum Rated	CMP-00424SAS-3
• **24 AWG**	
• **8 Conductor**	
• **Solid Wire**	
RJ45 Modular Plugs	S100710
Premium/Economy Crimp Tool	S104012
Twisted Pair Easy Strip	S104020

Tables 34 and 35 list preconfigured cables and cable components available from:

Windy City Wire
832 S. Central Ave
Chicago, IL 60644

Phone: 1-800-379-1191
Fax: (773) 379-1243

Use Table 34 to order preconfigured cables from Windy City Wire.

Table 34: Preconfigured Cables, Windy City Wire

Description	Cable Length	Part Number
RJ45 Straight-through Cable Assembly Plenum	7.62 m (25 ft)	CBL-STAT25-WC
• **Non keyed plugs**	15.24 m (50 ft)	CBL-STAT50-WC
• **24 AWG**	22.86 m (75 ft)	CBL-STAT75-WC
• **8 Conductor**	30.48 m (100 ft)	CBL-STAT100-WC
• **Solid Wire**		

Use Table 35 to order cable components from Windy City Wire for creating your own cables.

Table 35: Cable Components, Windy City Wire

Description	Part Number
304.8 m (1000 ft) Roll of Plenum Rated • **24 AWG** • **8 Conductor** • **Solid Wire**	CBL-24/8STAT-WC
RJ45 Modular Plugs	S100710
Premium/Economy Crimp Tool	S104012
Twisted Pair Easy Strip	S104020

Tables 36 and 37 list preconfigured cables and cable components available from:

Anixter
4701 W. Schroeder Drive
Brown Deer, WI 53223

Phone: (414) 355-0222
            1-800-447-8565
Fax: (414) 355-8601

Use Table 36 to order preconfigured cables from Anixter.

Table 36: Preconfigured Cables, Anixter

Description	Cable Length	Part Number
RJ45 Straight-through Cable Assembly Non-plenum	7.62 m (25 ft)	Q1093-307-25
• **Non keyed plugs**	15.24 m (50 ft)	Q1093-307-50
• **24 AWG**	30.48 m (100 ft)	Q1093-307-100
• **8 Conductor** • **Solid Wire**		
RJ45 Straight-through Cable Assembly Plenum	7.62 m (25 ft)	Q0893-404-25
• **Non keyed plugs**	15.24 m (50 ft)	Q0893-404-50
• **24 AWG**	30.48 m (100 ft)	Q0893-404-100
• **8 Conductor** • **Solid Wire**		

Use Table 37 to order cable components from Anixter for creating your own cables.

Table 37: Cable Components, Anixter

Description	Part Number
304.8 m (1000 ft) Roll of Non-plenum Rated • **24 AWG** • **8 Conductor** • **Solid Wire**	CM-00424BAG-3
304.8 m (1000 ft) Roll of Plenum Rated • **24 AWG** • **8 Conductor** • **Solid Wire**	CMP-00424SAS-3
8 Position Non-keyed Plugs for Solid Cable (bag of 25)	074683 Stewart
Hand Tool with 8 Position Die Set for Solid 24 AWG Wire	060612

Specifications

Table 38: Specifications

Product	AS-UNT110-1 / AS-UNT111-1 AS-UNT120-1 / AS-UNT121-1 AS-UNT140-1 / AS-UNT141-1
Power Requirements - System	24 VAC, 50/60 Hz at 40 VA (per typical system)
Power Draw	UNT with sensors/transmitters: 10 VA (400 mA) 25 VA for UNT120/121 (due to heater)
Ambient Operating Conditions	0 to 52°C (32 to 125°F) and -40 to 52°C (-40 to 125°F) for UNT12n-1 10 to 90% RH
Ambient Storage Conditions	-40 to 70°C (-40 to 158°F) 10 to 90% RH
Dimensions (H x W x D)	165 x 163 x 56 mm (6.5 x 6.4 x 2.2 in.) without enclosure (ENC) 173 x 185 x 119 mm (6.8 x 7.3 x 4.7 in.) with enclosure
Shipping Weight	0.64 kg (1.4 lb)
Processor	80C652
Memory	32K RAM 64K ROM 8K EEPROM
Interfaces	N2 and Zone Bus
Standards Compliance	IEEE 472 IEEE 518 IEEE 587 Category A FCC Part 15, Subpart J, Class A UL 916 UL 864
Agency Listings	UL Listed and CSA Certified as part of the Metasys Network.

Appendix A: Precautions for Rooftop Installations

Environmental Information

Mount the UNT within the rooftop unit or some other enclosure to protect it from rain, snow, etc. We recommend venting for small enclosures in environments that regularly exceed 32°C (90°F). The installation site of the UNT must meet the following environmental standards:

- The atmosphere must be free of explosive gases, or corrosive chemical or salt vapors.

- The relative humidity (noncondensing) must be between 10 and 90%.

- The temperature for the UNT110/111 series controllers must be between 0 and 52°C (32 and 125°F).

- The temperature for the UNT120/121 series controllers must be between -40 and 52°C (-40 and 125°F).

Use the UNT120/121 series controllers in extremely cold environments or where some condensation is possible. The UNT120/121 series controllers have built-in heaters and conformally coated circuit assemblies. You must mount the UNT120/121 series controller within a relatively small enclosure, such as a BZ-1000-7, or within the confined area of the rooftop unit's wiring cabinet for optimal heater efficiency.

Installation Requirements

Instructions for installing a UNT in a rooftop unit are detailed in this section:

1. **Mount the UNT inside the rooftop unit or some other enclosure** to protect it from outside elements, such as rain, snow, etc.

2. **Install a separate transformer** (**not** the rooftop unit's power transformer) to provide 24 VAC power to the UNT. You may use a line voltage to 24 VAC transformer or a 24 VAC to 24 VAC isolation transformer. We recommend using one of the following transformer types:

   Note: Unless the UNT has a separate transformer, the UNT is prone to resetting due to electrical noise within the rooftop unit.

Table 39: Recommended Transformers

Transformer Type	Power	Description
Johnson Controls Y65 Series	40 VA	120 VAC to 24 VAC
Johnson Controls Y65G13-0	40 VA	24 VAC to 24 VAC
Johnson Controls AS-XFR050-0	50 VA	120 VAC to 24 VAC (insulated windings, high noise immunity, resettable breaker)

3. **Drive rooftop unit loads via pilot relays** (see Figure 40) if **any** of the following conditions exists:

   - The rooftop unit contains any contactor/relay coils that might be energized by some means **other than directly by the UNT's binary outputs**. A common example of this is a time delay relay contact closure in a BO circuit.

   - An individual BO load exceeds 800 mA.

   - All loads together will cause the UNT to require more than 40 VA of 24 VAC power when mounted in an enclosure, or more than 75 VA when mounted in a well-vented open area.

   - Voltages other than 24 VAC need to be switched.

   Note: Install pilot relays for isolation between the UNT and the rooftop unit contactors/relays.

4. **You may drive rooftop unit contactor/relay loads directly** (see Figure 39) if **all** of the following conditions exist:

   - Under normal operation, the UNT binary outputs directly drive all contactor/relay coils within the rooftop unit.

   - Individual BO loads exceed 50 mA. (Required to keep the triac on.)

   - Individual BO loads do not exceed 800 mA.

   - The UNT and all its loads together draw less than 40 VA of 24 VAC power when mounted in an enclosure, or less than 75 VA when mounted in a well-vented open area.

   - Triac load voltage is 24 VAC ±5%.

   Note: Connect the UNT binary outputs (triacs) to the rooftop unit terminal strip.

IMPORTANT: **When using pilot relays to ensure electrical isolation between the binary outputs and their loads, pilot relays must be used on *all* BOs**. This ensures that electrical noise created by contact closure or opening of a pilot relay cannot travel back through the BO wiring, or any other BO, and adversely affect the UNT's other binary outputs that are not relay isolated. A pilot relay to the economizer is an exception to this because it drives a circuit, not a relay/contactor load.

Ensure that relays have adequate isolation between coil and contacts.
Many relays on the market do not provide suitable isolation. Capacitance between the coil and contacts must be less than 3 pico-farads. As manufacturers do not specify this parameter, remember that smaller relays generally have more capacitance. (RLY100 and RLY050 relays provide suitable isolation.)

Ensure that relays provide a minimum of 50 mA load to the UNT binary output.
If the selected relays draw less than 50 mA, you must add appropriately rated resistors in parallel with the relay coil to avoid possible relay chattering. We recommend using 1k ohm, 2 watt resistors.

Electrical Noise in Rooftop Units

Rooftop air handling units may be very "noisy" from an electrical standpoint. This is due to contacts switching inductive loads and electrical spark ignition devices. You must take precautions to prevent electrical noise from causing false BO triggering, resetting of UNTs, or interference with N2 communication.

There is wide variation in relays, contactors, and gas ignition control devices. Some are much noisier than others. Electromagnetic fields can radiate from wires carrying spark or coil current, as well as from the spark or contact arc itself. Electromagnetic fields are also present around wires carrying power to the ignition control. These are "noisy" wires.

For more information, refer to the *Power Line Wiring Transient Noise Precautions* section of this technical bulletin.

| **Nuisance Resets in Rooftop Units** | Rooftop units experiencing nuisance resets require an application upgrade. Use HVAC PRO for Windows, Version 6.05 or greater, and the following procedure: |

1. Run HVAC PRO for Windows, 6.05 or greater.

2. Go to the Upload menu.

3. Select Upgrade Controllers.

4. Select Multiple Controllers.

5. Highlight the rooftop controllers experiencing the nuisance resets.

6. Select OK.

7. Save each configuration when prompted.

Note: Factory downloaded applications in all UNT controllers have been upgraded effective December 15, 1997; however, even on the new units, if controller applications are modified, the modifications must be performed using HVAC PRO for Windows, Version 6.05 or greater.

Rooftop units with 460 VAC or greater primary voltage require additional changes under the following conditions:

• If the controller Date Code is less than 9618, perform the following procedure:

 a. Loosen the 24 VAC and COM screws of the input power connector.

 b. Insert the terminals of a Harris V47ZA7 Transient Voltage Suppressor into the 24 VAC and COM slots of the input power connector.

 c. Tighten the 24 VAC and COM screws of the input power connector.

• **If a separate transformer is used to supply the binary output voltage**, install a Metal Oxide Varistor (MOV) according to the following procedure (see Figure 38):

 a. Order an AS-MOVKIT-0 as needed. Each kit contains 12 Metal Oxide Varistor (MOV) assemblies.

 b. Remove the field wire that currently connects to the triacs terminal.

 c. Attach the field wire to the male terminal of the MOV assembly.

d. Attach the female terminal with two wires to the TRIACS terminal.

e. Attach the female terminal with one wire to the common terminal immediately adjacent to the TRIACS terminal.

Note: The MOV assembly will be factory installed on UNT220-1 controllers mounted in York rooftop units beginning March 16, 1998.

The MOV assembly will **not** be factory installed on UNT120-1 controllers.

- **For units meeting both conditions,** install transient voltage protectors in both locations as described above.
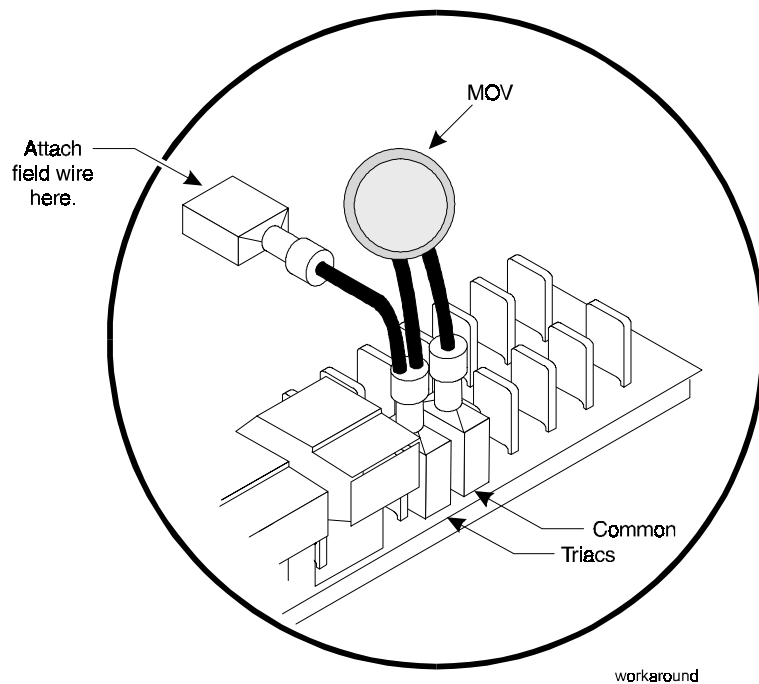
Figure 38: Installation of MOV

Considerations for Gas Ignition

Rooftop Units containing Gas Ignition Control (see Figure 39 or Figure 40.)

> IMPORTANT: If the gas valve or ignition controller has a full-wave bridge rectifier, you **must** install a relay between the BO and the gas valve and ignition controller. Note that in this case you do not need a relay on every BO unless isolating noise with relays (see the *Important* preceding this one).

- You must use a line filter between the binary output of the UNT and the control input of the ignition device for direct spark ignition systems. Many pilot ignition systems do not require this filtering. However, we recommend its use if you are not familiar with your rooftop unit's particular ignition device. Pilot ignition devices light small pilot flames and generate small amounts of electrical noise. Direct ignition devices generate large amounts of noise by creating hot sparks with enough energy to ignite main gas valve burners.

- You must also filter any wires connected to the gas valves that you route with other wires leaving the gas heating section. An individual line filter can filter two wires, but it is acceptable to use only half of it if you need to filter a single wire. Mount the filters on the metal wall between the ignition chamber and the fan chamber. We recommend the filters listed in Table 40:

Table 40: Recommended Filters

Vendor	Type	Newark Stock Number
Corcom	3VB1	81F4523
Corcom	3B1	15F2410
Corcom	3VK1	81F4542
Corcom	3K1	15F2439

Note: These filters are all rated 3A, 120/250V, and are available from Newark Electronics. These models are specified for derating with an unbalanced load. No other models are authorized.

- You must use a pilot relay to isolate the UNT binary output from any gas valve containing a full-wave bridge rectifier. The bridge rectifier causes a DC current to flow through the triac which can prevent it from turning off. If you are unfamiliar with the gas valve in your rooftop unit, a pilot relay is recommended.

- Keep the length of the high voltage wire from the ignition control to the spark bundled, and as *short* as possible. Bundle the spark wire to itself if it is too long. Keep the ignition control and the UNT as *far apart* as possible. Route the power wires to the ignition control along the metal mounting surface.

- Ensure that you physically separate the wires on the line side of the filter from those on the load side of the filter. Route noisy wiring so that its path is as short as possible, and *always* **avoid routing noisy wires close to quiet wires**. We recommend a 30 cm (1 ft) or greater separation between parallel noisy and quiet wires.

  - **Never** mount the UNT in the same compartment as the ignition device.

  - If you must install noisy wiring near quiet wiring, have the wires cross at right angles and as far apart as possible. Route both near the metal mounting surface.

  Note: For specific information regarding noisy and quiet wiring, refer to the *Application Specific Controllers Technical Manual (FAN 636.3),* the *Introduction* tab*, the *ASC and N2 Bus Networking and Troubleshooting Guide Technical Bulletin (LIT-6363003).*
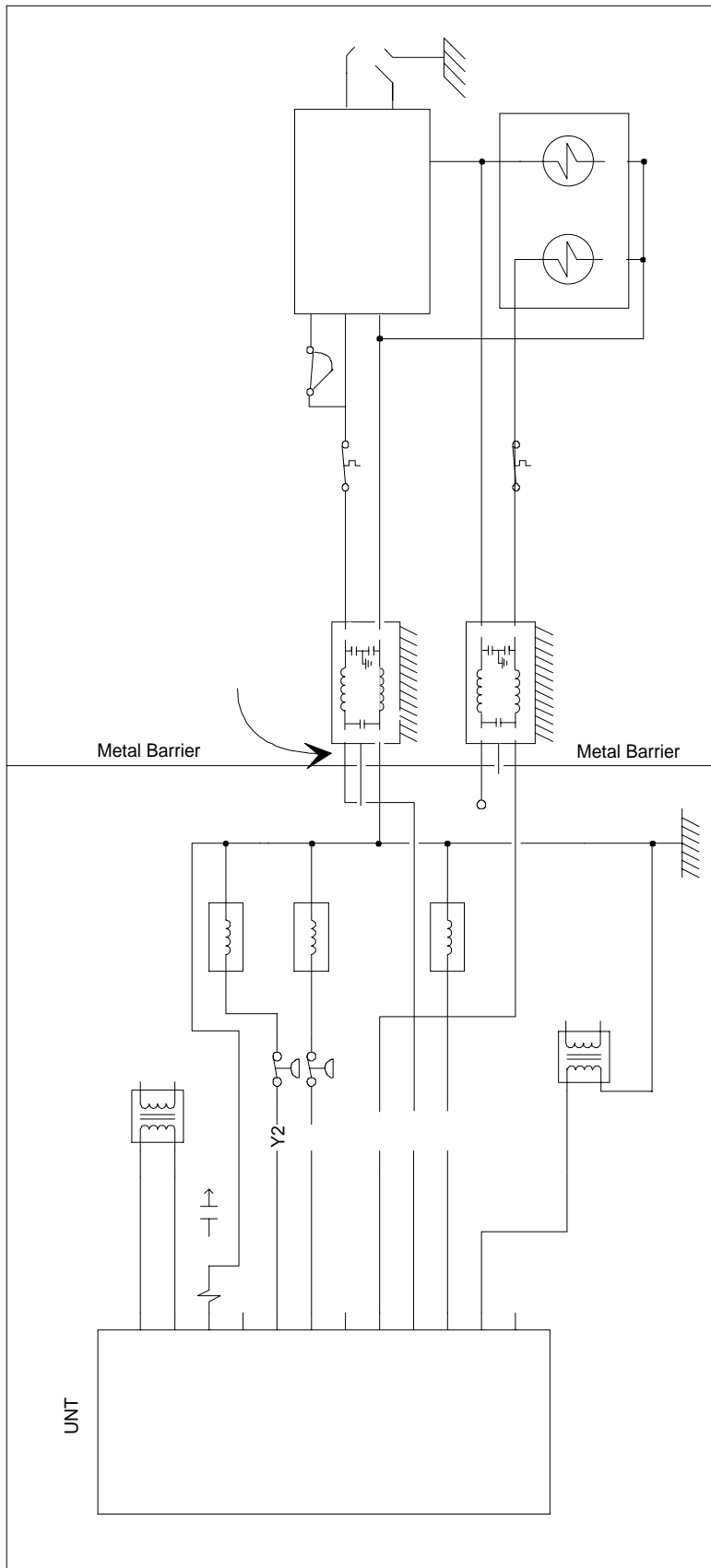
Figure 39: UNT Directly Driving Loads
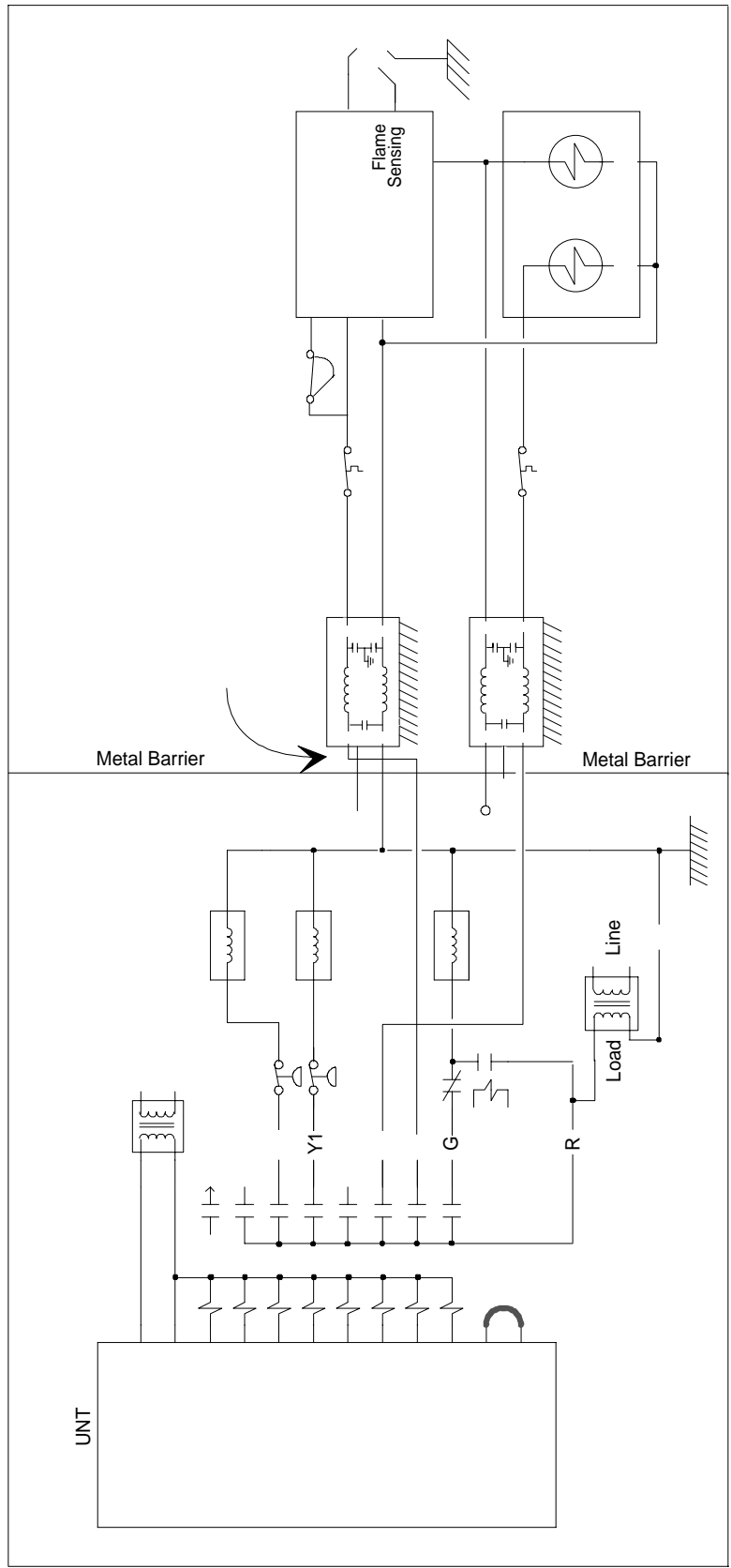
Figure 40: UNT with Pilot Relays

Considerations for Specific Rooftop Units

The following information should be taken into consideration for specific rooftop units:

1. **Lennox GCS16 Series Rooftop Units**
   For Lennox GCS16 series rooftop units, bypass the K25 blower/fan delay relay (TDR) by disconnecting the K25 coil power wire. Lennox provides K25 blower control for use with electromechanical thermostats. The reason for disconnecting this when a UNT provides the blower control functions is that the K25 causes unnecessary contactor cycling. This creates additional electrical noise. On some Lennox models, it may also cause blower fan dropout or cycling that appears as abnormal operation to the customer. Lennox has authorized bypassing K25 blower control when you use Johnson Controls UNTs.

2. **York® Rooftop Units**
   UNT120-1 and UNT220-1 controllers, when installed in rooftop units, may experience nuisance resets. This is evidenced by numerous unexplained offline conditions with durations of less than one minute. To alleviate this situation in York rooftop units, bypass or disable the supply fan relay according to the following procedure:

   Note: These modifications apply only to those units described below. Units built after the dates indicated have already been modified by York and do not require this change.

   The date of manufacture of York rooftop units can be determined from the second and third digits of the serial number, as shown in Table 41.

   - **On 3 to 6 ton units built before February 17, 1997**, the K3 relay must be disabled by disconnecting the wire that connects the time delay relay contacts to the relay board. This is typically the 234/BLUE wire.

   - **On 3 to 6 ton units built between February 17, 1997 and May 30, 1997**, York implemented a different relay interface board. On this new relay board the K5 relay must be bypassed by moving the wire currently connected to the G terminal on the York relay board to the A2 terminal.

   - **On 7 to 25 ton units built before February 28, 1997**, the K5 relay must be bypassed by moving the wire currently connected to the G terminal on the York relay board to the A2 terminal.

Table 41: York Rooftop Unit Serial Number/Date Conversion

Second Digit	Month	Third Digit	Year
A	1	A	92
B	2	B	93
C	3	C	94
D	4	D	95
E	5	E	96
F	6	F	97
G	7	G	98
H	8	H	99
K	9		
L	10		
M	11		
N	12		

Appendix B: UNT100/101

This section contains information specific to the discontinued UNT100/101. To troubleshoot the UNT100/101, refer to the *Troubleshooting* section of this technical bulletin.

What's Different About the UNT100/101

The following list contains features of the UNT100/101 which differ from the other UNT types.

- **No earth ground connections are allowed** when wiring a UNT100/101 series controller.

- The N2 bus is not isolated. The secondary of the 24 VAC transformer cannot be grounded.

- The BIs can accept dry contacts **only**, not 24 VAC. They can also accept 100 Hz as accumulator input.

- The BO is not jumper selectable. The triac switches to the common side of 24 VAC only.
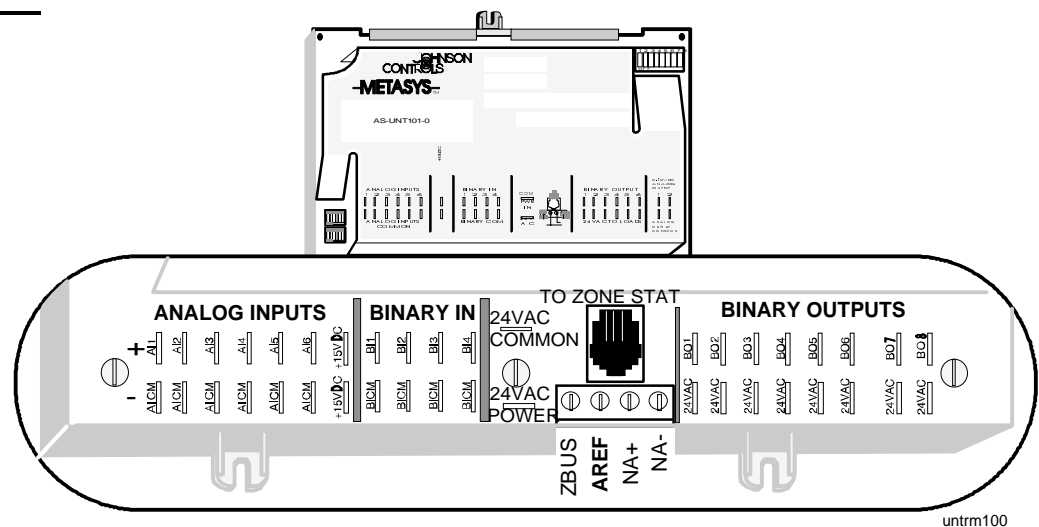
UNT100/101 Terminal Designations

untrm100

Figure 41: UNT100 Terminal Designations

Table 42: UNT100/101 Terminal Identification

UNT100 Series Controller			
Terminal	**Description**	**Terminal**	**Description**
AI CM	Analog Input Common	AI 1	Analog Input 1
AI CM	Analog Input Common	AI 2	Analog Input 2
AI CM	Analog Input Common	AI 3	Analog Input 3
AI CM	Analog Input Common	AI 4	Analog Input 4
AI CM	Analog Input Common	AI 5	Analog Input 5
AI CM	Analog Input Common	AI 6	Analog Input 6
+15 VDC	+15 Volts DC	+15 VDC	+15 Volts DC Supply
BI CM	Binary Input Common	BI 1	Binary Input 1
BI CM	Binary Input Common	BI 2	Binary Input 2
BI CM	Binary Input Common	BI 3	Binary Input 3
BI CM	Binary Input Common	BI 4	Binary Input 4
24 VAC POWER	Transformer High Side	24 VAC COMMON	Transformer Low Side
ZBUS	Zone Bus	AREF	N2 Reference and ZBUS Common
N2A+	N2 Bus +	N2A-	N2 Bus -
24 VAC	24 Volts AC	BO 1	Binary Output 1
24 VAC	24 Volts AC	BO 2	Binary Output 2
24 VAC	24 Volts AC	BO 3	Binary Output 3
24 VAC	24 Volts AC	BO 4	Binary Output 4
24 VAC	24 Volts AC	BO 5	Binary Output 5
24 VAC	24 Volts AC	BO 6	Binary Output 6
24 VAC/AOCM	24 Volts AC/ AO Common	BO 7/AO 1	Binary Output 7 Analog Output 1
24 VAC/AOCM	24 Volts AC/ AO Common	BO 7/AO 2	Binary Output 7 Analog Output 2
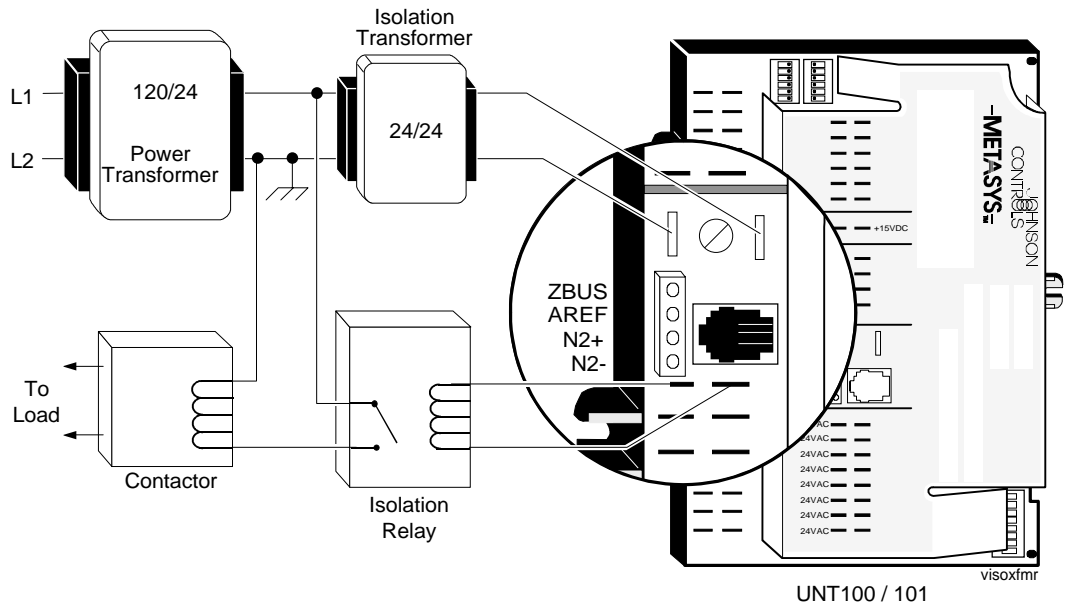
Figure 42: Transformer and Relay Isolation Wiring Diagram for Series 100/101 UNT Controllers

All UNT100/101 connections must be isolated from earth ground to protect the CBLPRO, laptop PC, or other system components from damage. Due to OEM system designs and/or electrical codes, the UNT100/101 may become earth grounded unless you take isolation measures.

⚠ CAUTION: **Potential equipment damage and improper functioning.** Do not earth ground the 24 VAC high side of the UNT transformer or any of the UNT "BO" terminals. If you do, the UNT N2 Bus communications will cycle online and offline. You will also damage all of the interface components that are connected, including the CBLPRO, laptop PC, Companion PC, and MM-CVT101.

Depending on the primary voltage of the power transformer and the prevailing electrical code, the 24 VAC secondary might be earth grounded. Earth ground on the 24 VAC side of the secondary destroys hardware by creating a short circuit path through the CBLPRO and laptop PC serial card during a download. Earth ground on either side of the secondary can disrupt the isolation required for N2 communication integrity.

In some OEM systems, the contactor solenoid coils driven by the UNT may also be earth grounded. This also disrupts the isolation required for N2 communication integrity.

Note: The *Troubleshooting* section of this technical bulletin contains a detailed process that will reduce installation errors by ensuring proper isolation.

Power Transformer Isolation UNT100/101

If the secondary of the power transformer is grounded, you must use a separate 24 VAC to 24 VAC isolation transformer such as the Y65G13 (see Figure 42).

Load Isolation UNT100/101

If UNT output loads, such as driven contactor or solenoid coils, are grounded, you must use a separate isolation relay for each load (see Figure 42).

Binary Inputs

The binary inputs on the UNT100/101 series controllers are inactive when open or a 5 VDC logical high is supplied. They are active when a contact closure to UNT common or a logical low is applied. BI 4 may be used as an accumulator input for frequencies less than 100 Hz.

Binary Outputs

Each UNT100 series controller's binary outputs must be connected between the BO terminal and 24 VAC terminal since it is low side switching.

Notes

Notes