



Basyx RFC

Programmable System Controller

Installation Manual

RFC-IM Revision 1.1
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BASYX RFC

Programmable System Controller

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Warning (For your Safety)

All electrical connections must be in agreement with local codes, ordinances or the National Electric Code (NEC).

Do not install in areas that experience high levels of electrical interference, moisture or exposure to water.

BEFORE INSTALLING

Check contents for any sign of damage. If the RFC is damaged in any way, contact the dealer or seller immediately.

The Basyx RFC comes complete with a Snap-Track mounting channel, and may be installed in a NEMA type enclosure, equipment control section or other NEC approved enclosure.



Figure 1: Basyx RFC programmable system controller

The RFC controller is designed for use on new construction projects or retrofit of existing HVAC equipment or lighting systems. The RFC is ideal for control of air handlers, chillers, boilers and lighting control and is a stand-alone unit which contains all logic and algorithms for complete control of selected equipment. The RFC utilizes standard RS485 communications bus wiring.

Contact Triangle MicroSystems or your local dealer/distributor if unsure about the compatibility of any existing equipment or application.

NOTE: For descriptive purposes, all references to location of components on the board described herein are based on the board positioned as shown in Figure 1 and Figure 2.

RFC BOARD LAYOUT

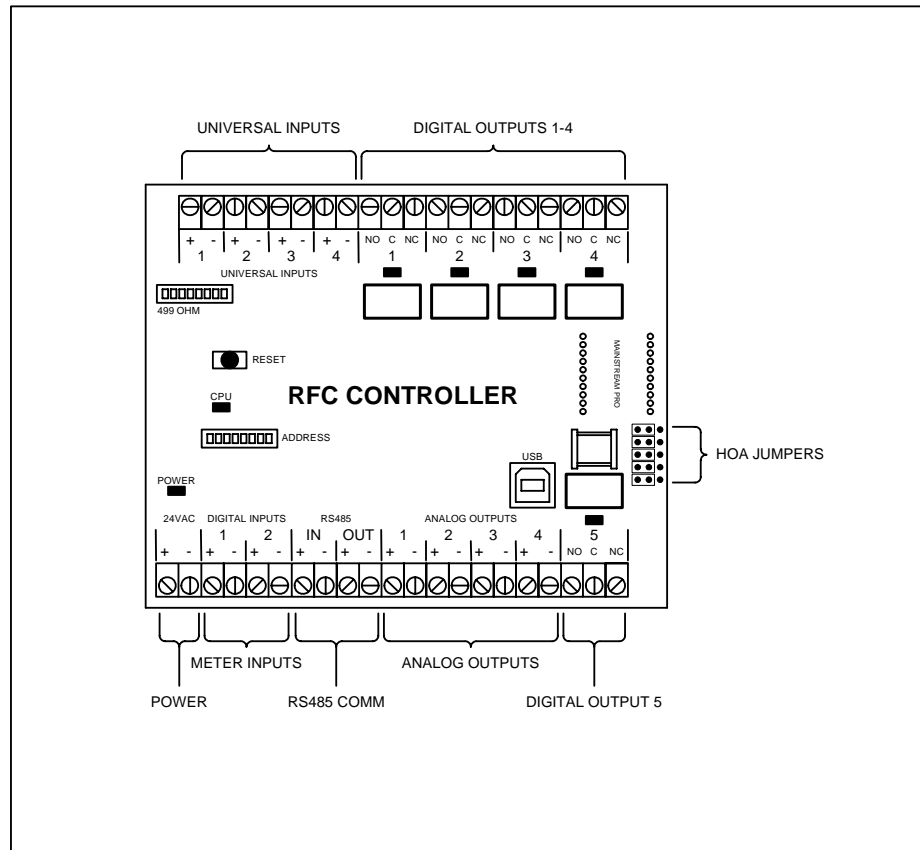


Figure 2: RFC Board Layout

The RFC controller contains four (4) universal inputs, five (5) digital outputs with SPDT relays and HOA jumpers, two (2) digital/meter inputs and four (4) 0-10vdc or 4-20ma outputs.

No remote communications are available with the RFC controller. If remote communications is required, a minimum of one (1) PSC controller with modem or internet module is required.

The board contains a 499 OHM DIP switch for integration of a 499 ohm resistor for 4-20mA current sensors.

MOUNTING THE CONTROLLER

The RFC must be mounted in a relatively clean environment, free from major airborne dust and contaminants (moisture, oil, etc). Keep the board away from high voltage equipment that might disrupt communications and away from high vibration equipment. Do not mount the unit near any sources of electromagnetic interference (EMI) or flammable vapors.

Mount the RFC by attaching the Snap-Track mounting channel into the desired location. Attach the Snap-Track by inserting proper type screws through the slots in the base of the channel. Make sure that the screw is tightened sufficiently to hold the track, but do not over-tighten to the point of bowing the track. Insure that the board will not touch the head of the mounting screw.

The Basyx RFC may be mounted in any orientation, and mounting should be such that there is easy access to the wiring terminals.

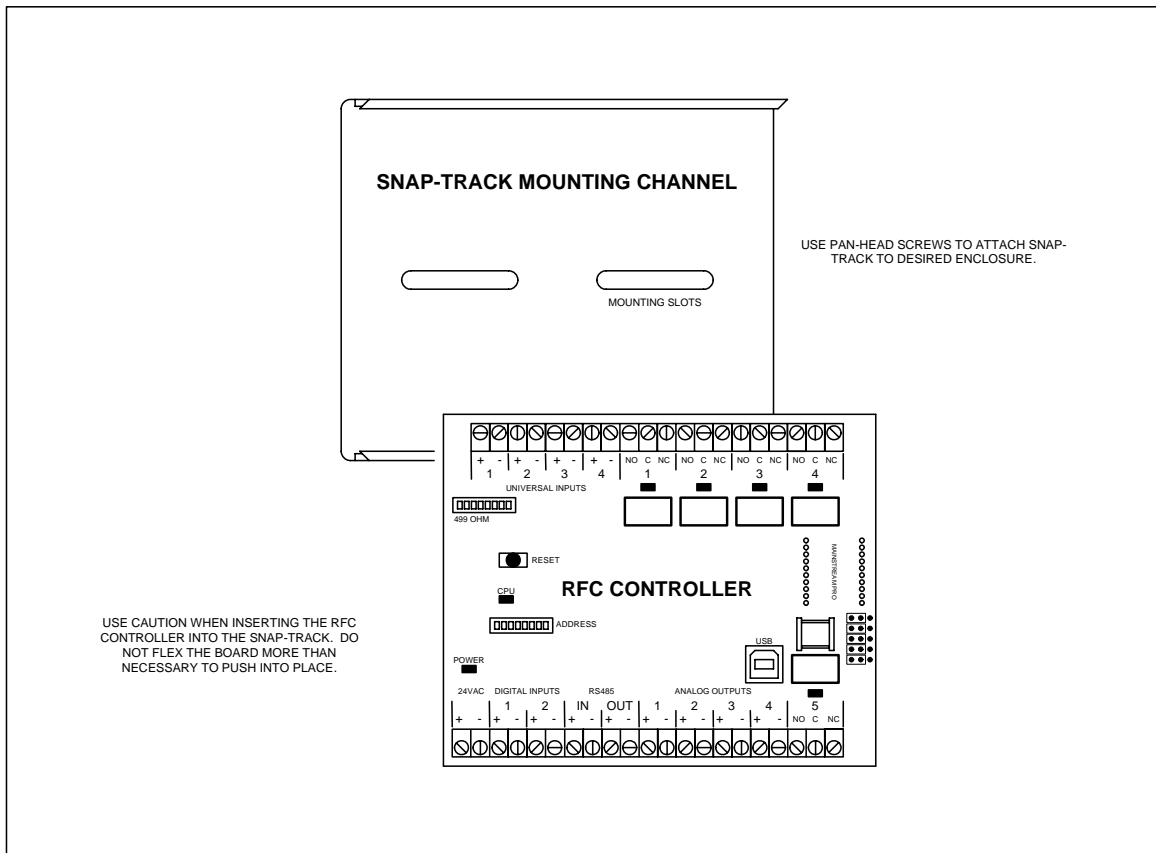


Figure 3: RFC Snap-Track Mounting Channel

Figure 3 shows the mounting channel and RFC controller. After mounting the channel, carefully snap the board into place by inserting 1 side into the groove of the Snap-Track, and gently pressing on the opposite side of the board until it snaps into place.

CONNECTING THE POWER

The RFC must be powered by a 24VAC Class 2 low voltage transformer. To connect the power wiring to the RFC board, locate the terminals along the bottom edge of the board marked "24VAC" and connect to the power source. **Figure 4** illustrates the RFC showing the location of the 24VAC terminal Block.

NOTE: For 24 VAC power, use only power supplies with a Class 2 transformer rating.

Do not power with any voltage other than the 24VAC low voltage listed. Connect power to the RFC by connecting wires from the transformer to the 24VAC terminals (+) and (-). The terminals are labeled on the board above the terminal strip. The red indicator LED above the terminal strip will illuminate when the power is properly connected and turned on.

For connections to the RFC, strip the wire back approximately 3/16" and insert into the terminal block. Back out the screw on the terminal block until the bare wire inserts fully, and turn the screw back down until there is firm tension on the wire. Make sure that the clamp secures the stripped portion of the wire, and that no insulation is under the clamp.

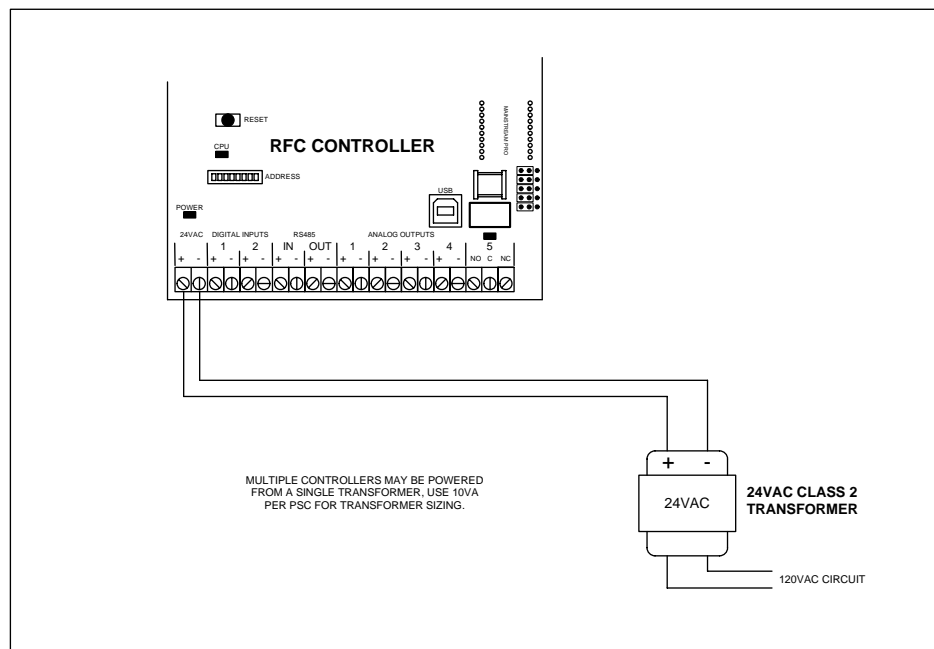


Figure 4: Basyx PSC Power Connections

NOTE: Multiple RFC controllers may be powered from a single transformer. Use 7VA for transformer sizing when designing power configurations.

COMMUNICATIONS BUS WIRING

The Basyx RFC can be used in a wired stand-alone configuration or in an array utilizing hundreds of units. If used in a large array, the BASYX IPR repeater must be used if controller count exceeds 32 total controllers. In addition, multiple non-addressed channels or loops may be used for physical separation of channels (See **Figure 5**) in order to eliminate a continuous loop in a large or multi-story building. The BASYX system will support a total controller count of 256 PSC, RFC or VAV controllers.

All communication wiring consists of a 1 pair, shielded cable (See **Figures 5 & 6**). Use 18 AWG, twisted pair stranded, shielded, plenum rated cable (Recommended Belden 6300FE) for all communications wiring. When connecting a channel of controllers from an IPR repeater, connect communications in a daisy chain configuration.

Communication is via EIA RS-485 protocol. This requires that the system be wired according to the following methods and rules:

- Communications cable must be 1 twisted pair (Belden 6300FE), 18 AWG, plenum rated.
- The total distance of any channel or loop must not exceed 4000 feet.
- The drain wire of the communication cable must **NOT** be connected to the PSC, RFC or VAV controller. Twist drain wires from the incoming and outgoing cables together to create single shield for the entire daisy chain, and connect to ground at one end only (suggest the IPR or first controller location).
- Each controller in the system must have a unique address, regardless of configuration of channel. Refer to the instructions in the next section for setting the Device Address (ADDR) dip switch.

Connect the communications wiring to the terminal blocks on the edge of the RFC controller marked + and - as shown in **Figure 6**.

CAUTION: All communication wiring must be connected such that the plus (+) terminal is wired to a plus terminal and the minus terminal (-) is wired to a minus terminal. Do not install communications cables near power cables or in power conduits. Isolate all communications wiring from large motors, fluorescent lighting fixtures or other sources of high intensity electromagnetic interference (EMI).

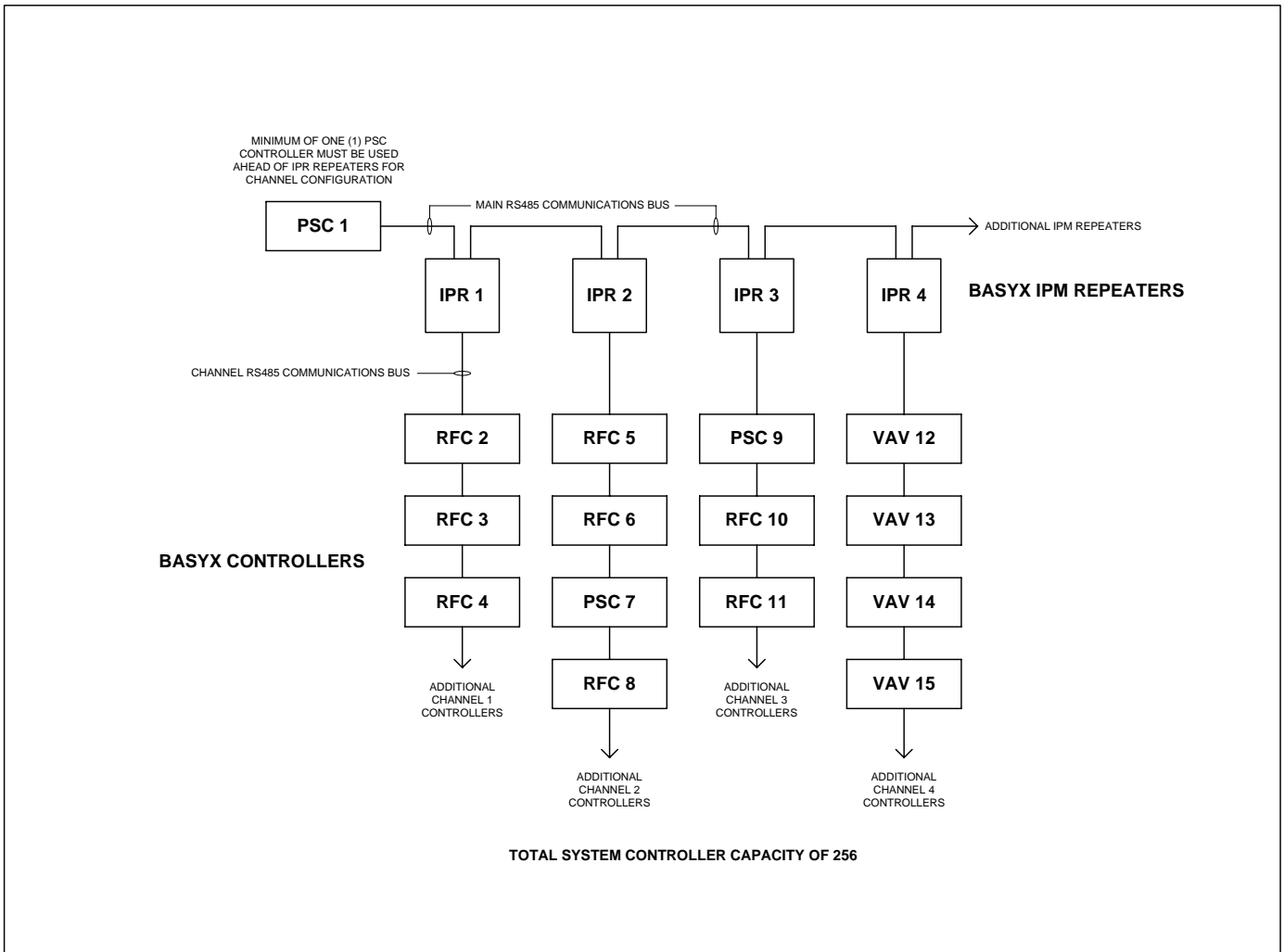


Figure 5: Basyx Typical Communications Loop Configuration

As shown, communications loops may contain any mixture of Basyx controllers. Each controller must have a unique address setting for proper operation.

A single loop containing a minimum of one (1) PSC and up to 31 additional PSC, RFC or VAV controllers may be used.

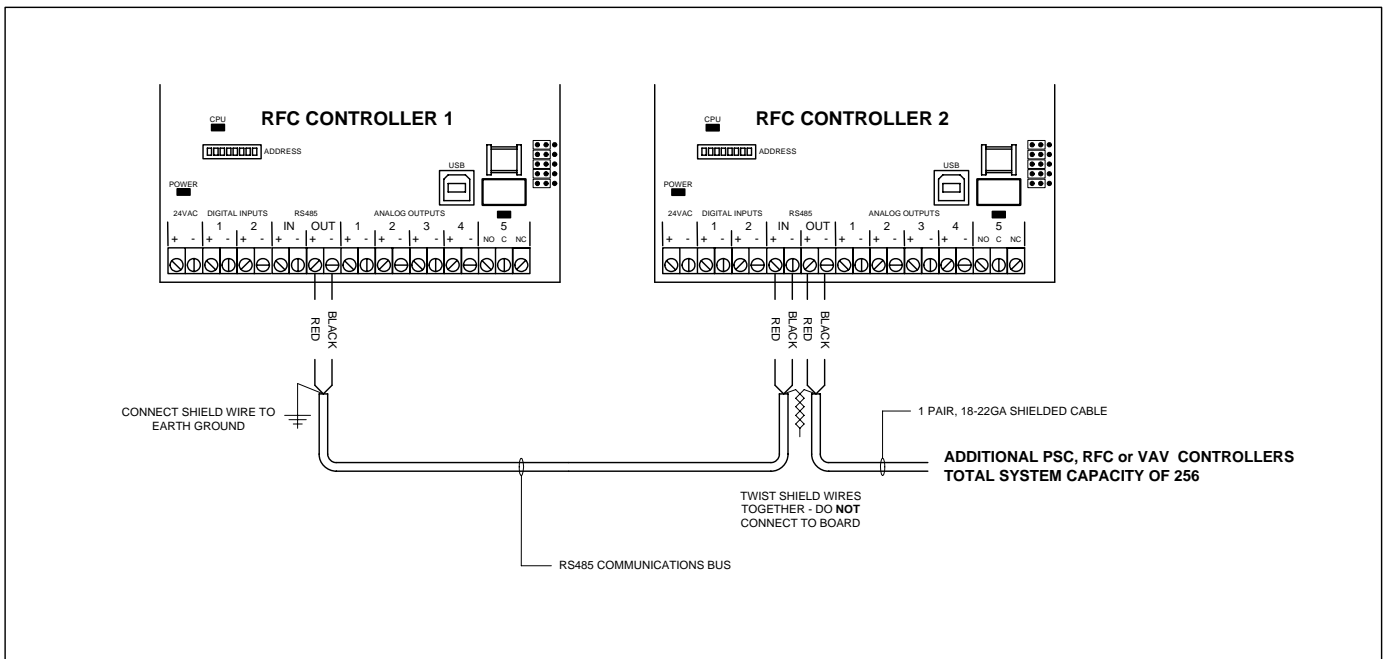


Figure 6: Typical RFC Communications Connection Details

SETTING THE DEVICE ADDRESS

If the RFC is used as a stand alone controller make sure that the address is set to #1.

If more than one RFC is used on the same communications bus, whether wired or wireless, each device must have a different address for proper communication. The address switch is located towards the left end of the board about ½ way up. Refer to **Appendix 1** for setting the device address to a number between 1 and 256. The communication address for each device must be unique.

NOTE: Do not skip addresses in a daisy chain; begin at 1 and count up. The boards do not have to be in consecutive order, however all addresses must be included.

To set the address, refer to appendix 1 and push any of the eight (8) switches required UP (towards universal inputs) to set to **ON**.

CONNECTING THE UNIVERSAL INPUTS

The Basyx RFC provides four (4) universal inputs which may be used for thermistors, resistance, 0-10VDC, 4-20mA or digital contact closures. Typical applications include temperature, humidity, pressure and other analog or digital devices.

All input cables should be 18 AWG, and must consist of stranded, twisted pairs (as required), shielded type with less than 20 pF capacitance per foot.

NOTE: Connect all sensor cable drain wires to earth ground.

CAUTION: Do not run sensor wires near power cables or in power conduits. Isolate all sensor wires from large contactors or motors, fluorescent light fixtures and other sources of high intensity electromagnetic interference (EMI).

SETTING THE INPUT DIP SWITCHES

The RFC contains one eight (8) position DIP switch immediately below universal input terminal strip.

The switches are numbered 1-8 left to right, and correspond to the input used i.e. switch 1 = input 1, switch 2 = input 2 etc. through switch 4 (4 inputs). Switches 5-8 are not used on the RFC board.

Figure 7 illustrates the operation of the universal input DIP switch.

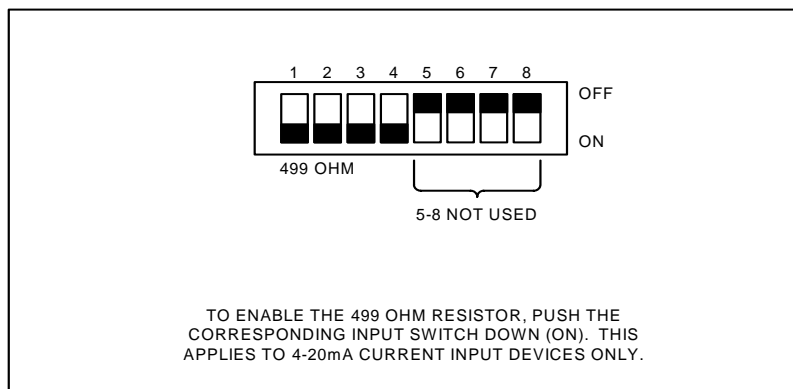


Figure 7: Universal Input DIP Switches

The 4-20mA set of switches inserts a 499 ohm resistor in circuit for use with 4-20mA current devices. The switch is factory set to OFF, and must be set to **ON** when using current sensors.

CONNECTING A TEMPERATURE SENSOR (THERMISTOR)

Temperature sensors are type II thermistors, and are available from a variety of suppliers. Make sure that type II sensors are used to insure proper temperature monitoring and control.

Thermistors are not polarity sensitive, and cannot be connected backwards. It is recommended that any color coding pertaining to the + and - connections on the board be consistent within the system. The 499 OHM DIP switch as outlined above must be set to **OFF**.

Figure 8 indicates a typical thermistor connection, and shows a duct temperature sensor installation.

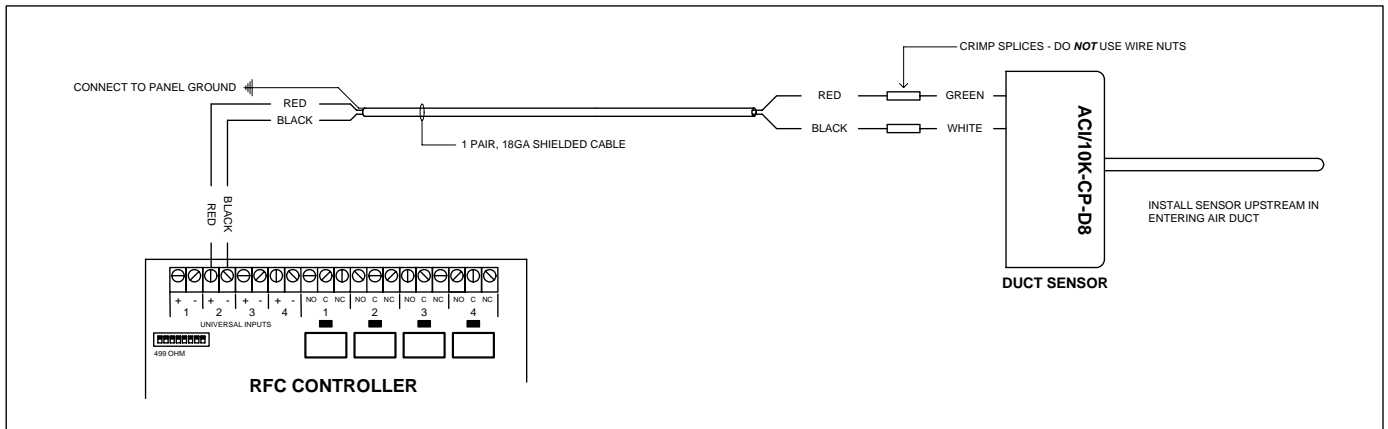


Figure 8: Typical Thermistor (Temperature) Connection

CONNECTING A VOLTAGE SENSOR

The RFC can accept any 0-10VDC sensor input, and typical applications include humidity, pressure or other analog type sensors. The sensor is powered by an external 24VDC power supply. The 499 OHM DIP switch as outlined above must be set to **OFF**.

Figure 9 illustrates a voltage sensor and shows a differential duct static pressure sensor.

NOTE: Voltage sensors normally require 3 wires for proper connection. The specific manufacturers labeling may vary from that shown on the typical drawings. It is imperative that the power and signal wires be connected properly, or serious damage to the RFC board may occur. Refer to your device installation instructions for exact wiring and termination labeling.

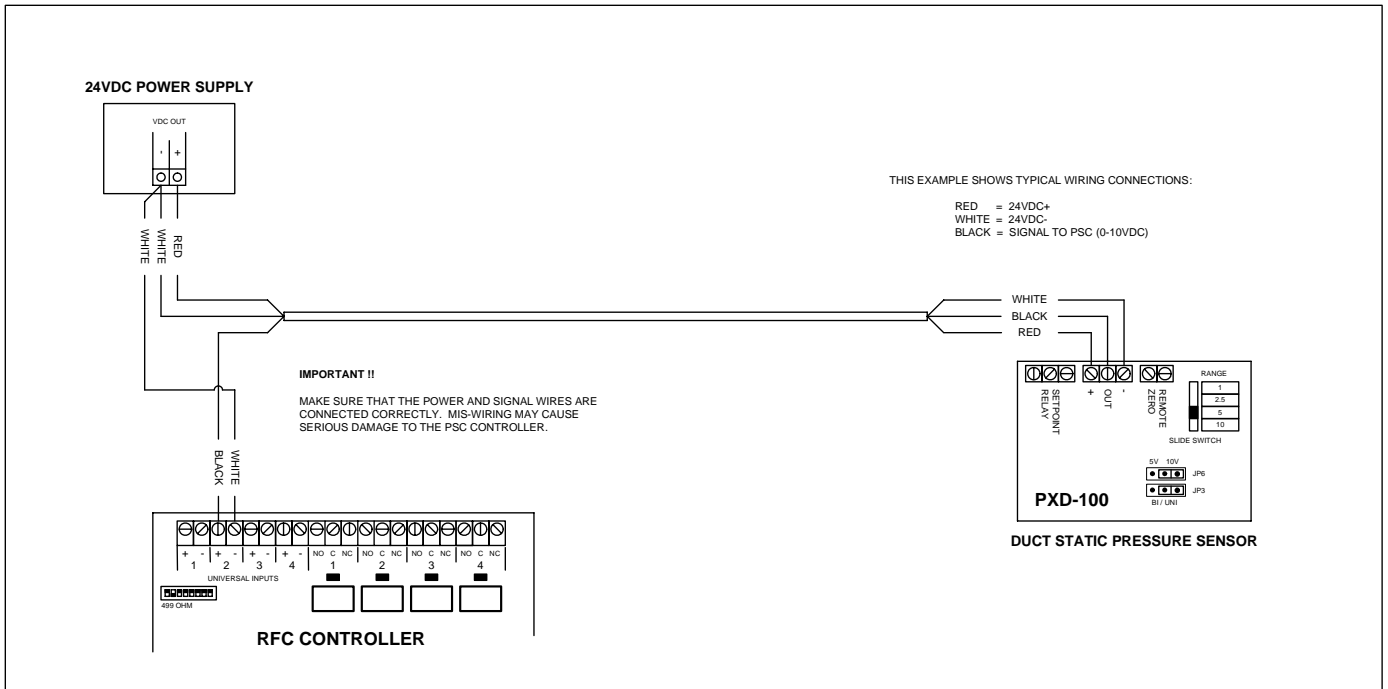


Figure 9: Voltage Input Wiring

CONNECTING A CURRENT SENSOR

The RFC can accept any 4-20mA sensor input, and typical applications include humidity, pressure or other analog type sensors. The sensor is powered by an external 24VDC power supply and the 499 OHM DIP switch as outlined above must be set to **ON**.

Figure 10 illustrates a current sensor powered by an external power source, and shows a typical humidity sensor.

NOTE: Current sensors typically require 2 wires for proper connection. The specific manufacturers labeling may vary from that shown on the typical drawings. It is important that the power and signal wires be connected properly, or serious damage to the RFC controller may occur. Refer to your sensor installation instructions for exact wiring and termination labeling.

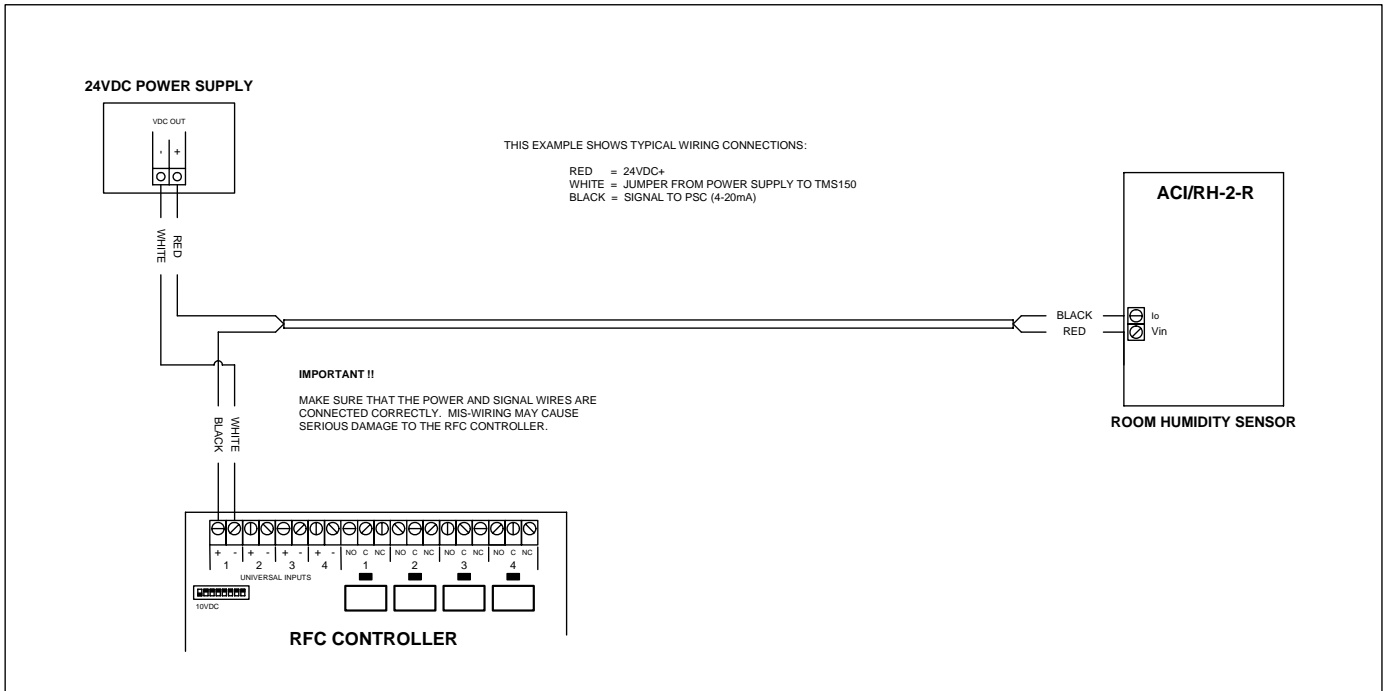


Figure 10: Current Input Wiring

IMPORTANT: When using a 4-20mA current sensor on the RFC, the 499 OHM DIP switch must be set to **ON** for proper reading.

CONNECTING A DIGITAL DEVICE

Digital inputs connected to the universal inputs are 2 position status points only, and will not accumulate closures or pulse counts. If using an electric or flow type pulse meter, use the METER input connections as described in the next section.

Digital inputs are used for binary indication (on/off) of a toggle switch, pressure differential switch, current switch, flow switch or other 2 position contact closure. Make sure that the contact is a dry closure, and that no external voltage is applied through this circuit. Digital inputs are not polarity sensitive, and can not be connected backwards. It is recommended that any color coding pertaining to the + and - connections on the board are consistent within the system. The 499 OHM switch must be set to **OFF**.

CONNECTING THE METER INPUTS

The Basyx RFC provides two (2) meter inputs which may be used for electric, flow or other pulse generating digital devices used for consumption monitoring. These inputs are also ideal for connection of override switches or momentary contact pushbuttons.

All input cables should be 18 AWG, and must consist of stranded, twisted pairs (as required), shielded type with less than 20 pF capacitance per foot.

NOTE: Connect all the input cable drain wires to earth ground.

CAUTION: Do not run meter input wires near power cables or in power conduits. Isolate all input wires from large contactors or motors, fluorescent light fixtures and other sources of high intensity electromagnetic interference (EMI).

Make sure that the contact is a dry closure, and that no external voltage is applied through this circuit. Digital inputs are not polarity sensitive, and cannot be connected backwards. It is recommended that any color coding pertaining to the + and - connections on the board be consistent within the system. The 499 OHM DIP switch as outlined above must be set to **OFF**.

Figure 11 illustrates the meter input wiring, and shows a typical flow transmitter for monitoring liquid flow.

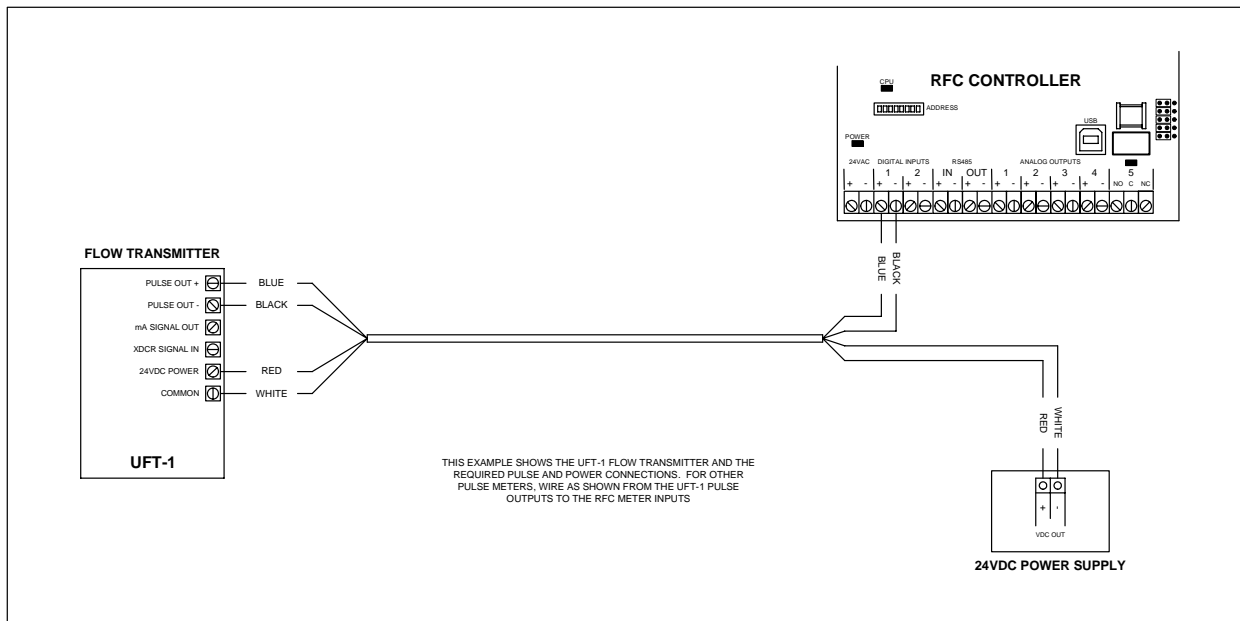


Figure 11: Typical Meter Input Wiring Detail

CONNECTING THE DIGITAL OUTPUTS

The Basyx RFC contains five (5) digital outputs for binary (on/off) control of HVAC, lighting or other system equipment. Each output is a form C SPDT contact closure through an on-board pilot duty relay. Each output is controlled through a hand-off-auto toggle jumper for local override of any system output point.

CAUTION: Relay outputs on the RFC board are designed for pilot duty only. Do not attempt to switch line voltage through these contacts, as serious damage to the board or connected system may occur. Switch low voltage 24VAC/VDC circuits only.

All input cables should be 18 AWG, and must consist of stranded, twisted pairs (as required), shielded type with less than 20 pF capacitance per foot.

NOTE: Connect all input cable drain wires to earth ground. Do not run output wires near power cables or in power conduits. Isolate all input wires from large contactors or motors, fluorescent light fixtures and other sources of high intensity electromagnetic interference (EMI).

Figure 12 shows connection of a field relay powered from an exterior transformer.

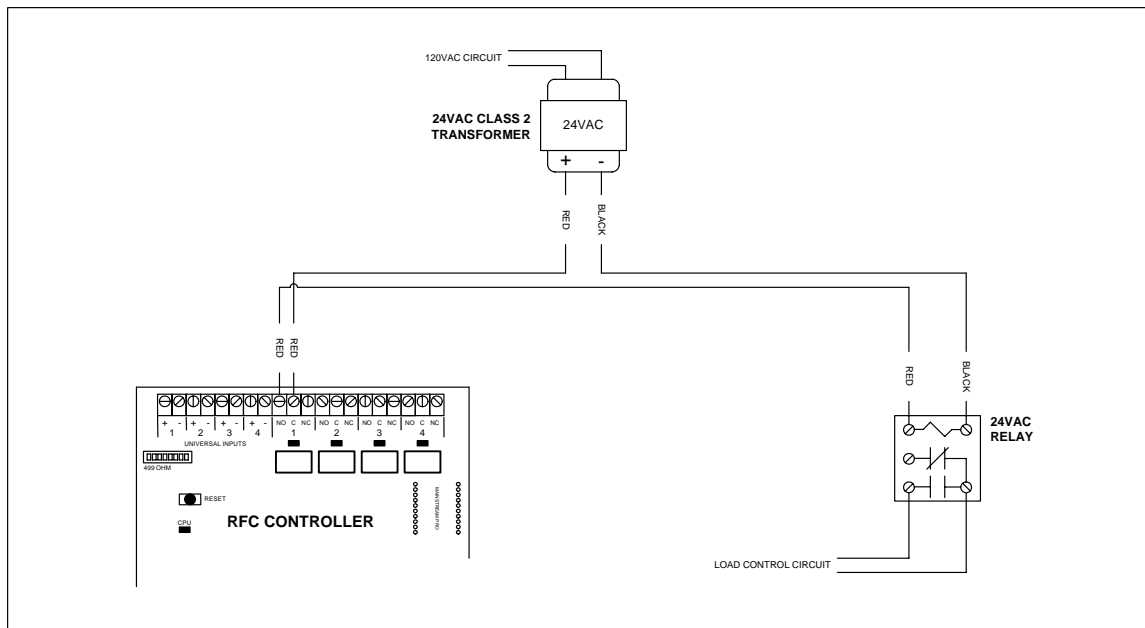


Figure 12: Typical Output Wiring with Relay Control

Figure 13 shows typical rooftop unit connections.

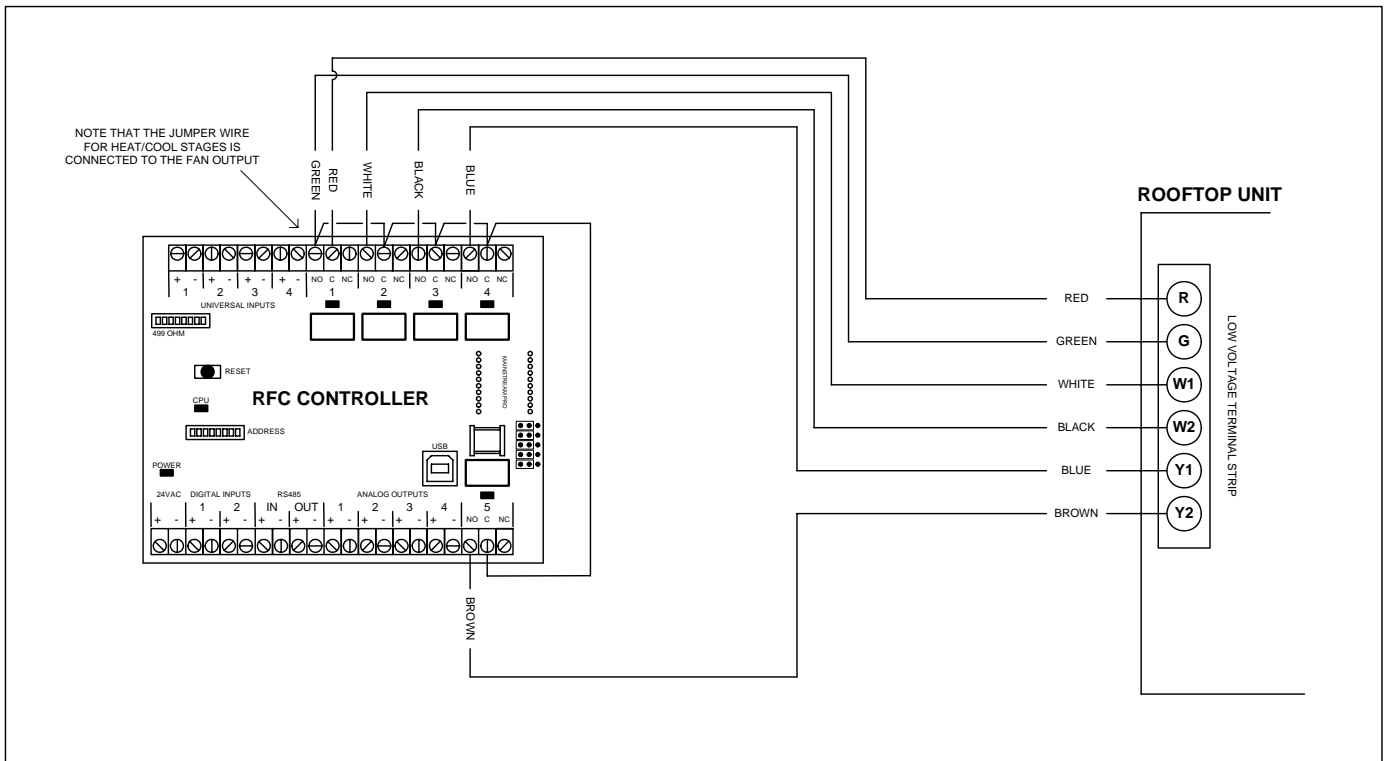


Figure 13: Typical Rooftop Unit Output Wiring

Note that the jumper wire connecting all of the output commons initiates at the Fan output. This is highly recommended and insures that compressors and heat will not operate if the fan is disabled, either by the RFC or the manual HOA jumper.

OPERATING THE HAND-OFF-AUTO (HOA) JUMPERS

The Basyx RFC contains five (5) hand-off-auto jumpers for local override of the individual outputs. The position of these switches is a follows:

- Manual ON** Insert the jumper on the **RIGHT 2** pins of the jumper header. This will energize the relay and turn the output ON.
- Manual OFF** Completely **REMOVE** the jumper from the jumper header. This will de-energize the relay and turn the output OFF.
- Automatic** Insert the jumper on the **LEFT 2** pins of the jumper header. This places the outputs in the automatic mode, which is under control of the computer programming.

CONNECTING ANALOG OUTPUTS

The RFC board contains four (4) analog outputs for control of modulating devices such as dampers, valves, variable speed drives and other items using a modulating input signal.

The analog outputs on the RFC board output a 0-10VDC output signal only.

The examples shown indicate typical wiring. Consult your specific device manufacturer's instructions for exact wiring and interface requirements. Contact TMS if unsure about the compatibility of any selected device.

CONNECTING ANALOG DEVICE

Figure 14 illustrates connection of a standard damper or valve actuator to the PSC controller. This application shows a 0-10VDC input actuator and requires that the actuator be powered from the SAME transformer which is powering the PSC controller. When connecting the actuator, make sure to maintain the L1 (HOT) and L2 (COMMON) connections within the system.

DANGER: The RFC analog output is designed for use with an actuator using full-wave power. Serious damage will occur to the board if connected to a half-wave device. If unsure about your selected actuator, call Triangle MicroSystems technical support.

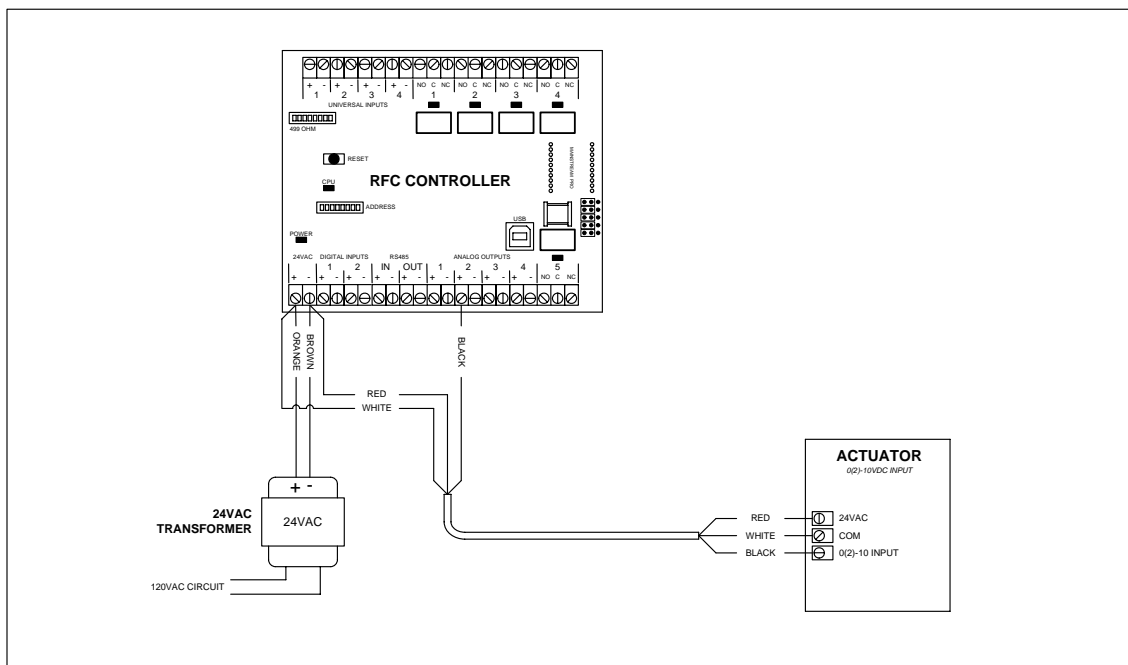


Figure 14: Typical Actuator Wiring with Common Transformer

OPERATION

The red indicator light next to the 24VAC terminal block illuminates solid when the power is on. When the unit is operating properly, the CPU light next to the address switch will blink intermittently to indicate proper CPU operation.

BASIC TROUBLESHOOTING

If the RFC does not operate properly, perform the necessary troubleshooting as described below.

SYMPTOM

ACTION

Failure to communicate:

Check that the power is on and that the red indicator light is on.
If it is on, measure voltage at the 24VAC power terminals of the RFC to ensure that the unit is getting 24VAC (-10% / +5%).
Check the continuity and connection of the communication wires.
Check that the device address is correctly set.

Faulty Communication:

Check that all communication cables are connected as required, with drain wires connected to a solid earth ground.
Check that all communication cable wires are connected “+” terminal to “+” terminal and “-” terminal to “-” terminal.
Check for continuity on all communication signal lines.
Isolate sensor wiring from large contactors, fluorescent light fixtures, and other sources of high-intensity electromagnetic interference (EMI).

Digital outputs not responding:

Disconnect the device wiring and check for continuity at the between common (C) and normally open (NO) terminals based on output position.
Check to see that exterior voltage source is present if used to switch pilot relays.

Analog or digital inputs are jumpy:

Isolate sensor wiring from large contactors, motors, fluorescent light fixtures, and other sources of high-intensity electromagnetic interference (EMI).

SPECIFICATIONS

Communication:	EIA RS-485 at 9600 baud on 18AWG shielded, plenum rated cable (recommended Belden 6300FE or equivalent)		
Power Requirements:	24VAC (-10% / 5%), 50/60/Hz Current: 3.2VA Recommend 5VA transformer sizing for AC power		
Universal Inputs:	(4) Universal inputs	Thermistor 0-10vdc 0-20ma Resistance Dry contact	10,000 ohm type II material >= 100 ohm input impedance <= 500 ohm input impedance 0-10,000 ohms >= 50ms timing
Digital Inputs:	(2) Meter inputs	Dry contact	>= 50ms timing
Digital Outputs:	(5) Dry contacts	SPDT pilot duty rated at 1 amp at 24VAC or 24VDC	
Analog Outputs:	(4) 0-10VDC with >= 1K ohm drive impedance		
Ports:	RS-485 Communications bus USB Direct connection port		
Environmental Limits:	Temperature:	32°F to 125°F.	
	Humidity (non-condensing):	95%	
Enclosure:	4" Snap-track mounting channel		
UL Listing:	ANSI/UL 916		
Dimensions:	5.0"W x 4.0"H x 1.25"D		
Shipping Weight:	Approx. 0.75 lbs.		

ABOUT THE Basyx PRODUCT LINE

The RFC is one product in a line of Basyx control products. The TriComm interface software package is a Windows based human interface used with the Basyx automation and control system. Tricomm will operate on any personal computer with the Windows 98,ME,NT,2000, XP or VISTA operating system.

The program provides a simple interface through direct connect, modem or internet to setup, operate and modify the operating parameters of the Basyx system, using easy to understand point-and-click commands. The drop-down system menus allow access to all system functions, and requires minimal computer experience for normal daily interaction with the system.

The Basyx system is designed specifically to meet today's building automation, facility and energy management needs. Triangle MicroSystems, Inc. develops and provides application support for control systems around the world. The company has a continuing commitment to research and development in order to provide new and improved products to the building automation market.

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The technical contents of this document, while accurate as of publication, are subject to change without notice. No responsibility is assumed for its use.

APPENDIX 1 - Basyx ADDRESS SWITCH SETTINGS

ADDRESSES 1-32

ADDRESS	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8
1	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
5	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF
6	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF
7	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
8	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
9	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF
10	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF
11	ON	ON	OFF	ON	OFF	OFF	OFF	OFF
12	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF
13	ON	OFF	ON	ON	OFF	OFF	OFF	OFF
14	OFF	ON	ON	ON	OFF	OFF	OFF	OFF
15	ON	ON	ON	ON	OFF	OFF	OFF	OFF
16	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
17	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
18	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF
19	ON	ON	OFF	OFF	ON	OFF	OFF	OFF
20	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF
21	ON	OFF	ON	OFF	ON	OFF	OFF	OFF
22	OFF	ON	ON	OFF	ON	OFF	OFF	OFF
23	ON	ON	ON	OFF	ON	OFF	OFF	OFF
24	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF
25	ON	OFF	OFF	ON	ON	OFF	OFF	OFF
26	OFF	ON	OFF	ON	ON	OFF	OFF	OFF
27	ON	ON	OFF	ON	ON	OFF	OFF	OFF
28	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
29	ON	OFF	ON	ON	ON	OFF	OFF	OFF
30	OFF	ON	ON	ON	ON	OFF	OFF	OFF
31	ON	ON	ON	ON	ON	OFF	OFF	OFF
32	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF

ADDRESSES 33-64:

ADDRESS	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8
33	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF
34	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
35	ON	ON	OFF	OFF	OFF	ON	OFF	OFF
36	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF
37	ON	OFF	ON	OFF	OFF	ON	OFF	OFF
38	OFF	ON	ON	OFF	OFF	ON	OFF	OFF
39	ON	ON	ON	OFF	OFF	ON	OFF	OFF
40	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF
41	ON	OFF	OFF	ON	OFF	ON	OFF	OFF
42	OFF	ON	OFF	ON	OFF	ON	OFF	OFF
43	ON	ON	OFF	ON	OFF	ON	OFF	OFF
44	OFF	OFF	ON	ON	OFF	ON	OFF	OFF
45	ON	OFF	ON	ON	OFF	ON	OFF	OFF
46	OFF	ON	ON	ON	OFF	ON	OFF	OFF
47	ON	ON	ON	ON	OFF	ON	OFF	OFF
48	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF
49	ON	OFF	OFF	OFF	ON	ON	OFF	OFF
50	OFF	ON	OFF	OFF	ON	ON	OFF	OFF
51	ON	ON	OFF	OFF	ON	ON	OFF	OFF
52	OFF	OFF	ON	OFF	ON	ON	OFF	OFF
53	ON	OFF	ON	OFF	ON	ON	OFF	OFF
54	OFF	ON	ON	OFF	ON	ON	OFF	OFF
55	ON	ON	ON	OFF	ON	ON	OFF	OFF
56	OFF	OFF	OFF	ON	ON	ON	OFF	OFF
57	ON	OFF	OFF	ON	ON	ON	OFF	OFF
58	OFF	ON	OFF	ON	ON	ON	OFF	OFF
59	ON	ON	OFF	ON	ON	ON	OFF	OFF
60	OFF	OFF	ON	ON	ON	ON	OFF	OFF
61	ON	OFF	ON	ON	ON	ON	OFF	OFF
62	OFF	ON	ON	ON	ON	ON	OFF	OFF
63	ON	ON	ON	ON	ON	ON	OFF	OFF
64	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF

APPENDIX 2 - RECOMMENDED CABLE

This document lists the recommended cable types and part numbers for the various connections to the Basyx building automation and control system hardware. TMS recommends the New Generation product line from Belden Wire & Cable, and suggests that any substitutions meet or exceed the technical specifications of those cables listed.

Communications Cable

Belden 6300FE	1 twisted, shielded pair 18 AWG, Plenum rated	Communications
Belden 6541FE	2 twisted pairs w/overall shield 22 AWG, Plenum rated	Communications

Sensor & Output Cable

Belden 6300FE	1 twisted pair w/overall shield 18 AWG, Plenum rated	Sensors & Outputs
Belden 6342FE	3 twisted pairs w/overall shield 18 AWG, Plenum rated	Sensors & Outputs
Belden 6343FE	4 twisted pairs w/overall shield 18 AWG, Plenum rated	Sensors & Outputs
Belden 6345FE	6 twisted pairs w/overall shield 18 AWG, Plenum rated	Sensors & Outputs
Belden 6347FE	9 twisted pairs w/overall shield 18 AWG, Plenum rated	Sensors & Outputs

Specialty Cable

Belden 6541FE	2 twisted pairs w/overall shield 22 AWG, Plenum rated	Room Sensor RJ11 Jack
Belden 6542FE	3 twisted pairs w/overall shield 22 AWG, Plenum rated	Room Sensor R / RS / RO / RSO

Multi-paired cable should be used for ALL connections to the Basyx system, multi-conductor cable should be avoided due to capacitance issues. ALL cables should be shielded type, and drain wires should be connected to solid earth ground.