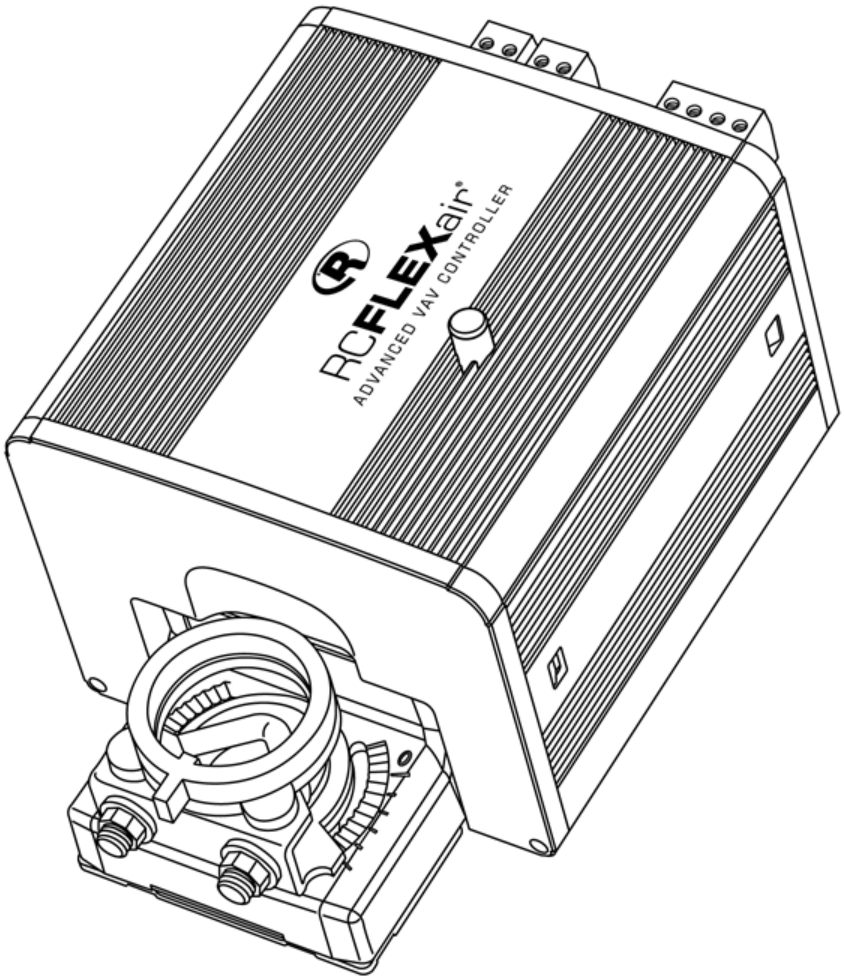
RCFLEXair®

Advanced VAV Controller



Better by design™

User Guide

Reliable® controls

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Compliance

This device complies with FCC Rules, Part 15 and Industry Canada's ICES-003 for a Class B Digital Device.

Operation is subject to two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference that may cause undesired operation.

Cet Apparreil numerique de la Classe B respecte toutes les exigences du Reglement sur le material broilleur du Canada.

Open source software components

To obtain a copy of the source code being made publicly available by Reliable Controls Corporation related to software used in this RC-FLEX product, you can send a request in writing by email to opensource@reliablecontrols.com.

Contents

RC-FLEXair overview

Designed to evolve with your building and accommodate a wide range of variable air volume (VAV) and room control applications, the Reliable Controls RC-FLEXair® is a BACnet Building Controller (B-BC) loaded with data-processing power that will inspire confidence in your built environment for years to come. With its generous database, triple-core processor, and several high-speed communication options, the RC-FLEXair advanced VAV controller can handle the most demanding programmed sequences and data analysis with ease. Configurable with multiple input/output options, the RC-FLEXair is a truly dynamic controller that will empower you to be better by design.

RC-FLEXair models and accessories

For the most complete, up-to-date information, click your product on the Products page to access the submittal sheet.

RCFA-12-F

- RC-FLEXair with dual Ethernet and USB communications, one universal input, one FLEX output, one solid-state relay output, and flow sensor.

RCFA-M-12-F

- RC-FLEXair with MS/TP and USB communications, one universal input, one FLEX output, one solid-state relay output, and flow sensor.

RCFA-12-A-F

- RC-FLEXair with dual Ethernet and USB communications, one universal input, one FLEX output, one solid-state relay output, actuator, and flow sensor.

RCFA-M-12-A-F

- RC-FLEXair with MS/TP and USB communications, one universal input, one FLEX output, one solid-state relay output, actuator, and flow sensor.

RCFA-33-A

- RC-FLEXair with dual Ethernet and USB communications, three universal inputs, three universal outputs, and actuator.

RCFA-M-33-A

- RC-FLEXair with MS/TP and USB communications, three universal inputs, three universal outputs, and actuator.

RCFA-33-A-F

- RC-FLEXair with dual Ethernet and USB communications, three universal inputs, three universal outputs, actuator, and flow sensor.

RCFA-M-33-A-F

- RC-FLEXair with MS/TP and USB communications, three universal inputs, three universal outputs, actuator, and flow sensor.

RCFA-34-A

- RC-FLEXair with dual Ethernet and USB communications, three universal inputs, one universal output, three solid-state relay outputs, and actuator.

RCFA-M-34-A

- RC-FLEXair with MS/TP and USB communications, three universal inputs, one universal output, three solid-state relay outputs, and actuator.

RCFA-34-A-F

- RC-FLEXair with dual Ethernet and USB communications, three universal inputs, one universal output, three solid-state relay outputs, actuator, and flow sensor.

RCFA-M-34-A-F

- RC-FLEXair with MS/TP and USB communications, three universal inputs, one universal output, three solid-state relay outputs, actuator, and flow sensor.

RCFA-35-F

- RC-FLEXair with dual Ethernet and USB communications, three universal inputs, three universal outputs, two solid-state relay outputs, and flow sensor.

RCFA-M-35-F

- RC-FLEXair with MS/TP and USB communications, three universal inputs, three universal outputs, two solid-state relay outputs, and flow sensor.

RCFA-36-F

- RC-FLEXair with dual Ethernet and USB communications, three universal inputs, one universal output, five solid-state relay outputs, and flow sensor.

RCFA-M-36-F

- RC-FLEXair with MS/TP and USB communications, three universal inputs, one universal output, five solid-state relay outputs, and flow sensor.

Accessories

Options

- -CC adds factory-installed conduit cover.

ACC-RCFA-CC

- Accessory kit to retrofit your RC-FLEXair with a conduit cover.

LM24E5 RCC

- Replacement actuator. Contact Reliable Controls Customer Care for ordering options.

CC-MULTI-XP2

- Cables for connecting X-Port-2 to controller SMART-Net, MS/TP terminal blocks, and SMART-Sensor micro-USB (-J) option connection.

Build your order

To create the order number, add your options to the base model.

For example:

- RCFA-12-A-F-CC is the order number for an RC-FLEXair with dual Ethernet and USB communications, one universal input, one FLEX output, one solid-state relay output, actuator, flow sensor, and conduit cover.
- RCFA-M-12-A-F-CC is the order number for an RC-FLEXair with MS/TP and USB communications, one universal input, one FLEX output, one solid-state relay output, actuator, flow sensor, and conduit cover.

Related information

RC-FLEXair specifications 101

RC-FLEXair features

For the most complete, up-to-date information, click your product on the Products page to access the submittal sheet.

Sustainable hardware

- Reliable Controls rigorously engineers its products to minimize their impact on the environment and provide years of dependable, high-performance service. The RC-FLEXair is manufactured in an ISO 9001 and 14001-certified facility and features an industry-recognized 5-year warranty. Made from highly recyclable materials, it also complies with RoHS 3, WEEE, and R2 directives to ensure easy, clean disposal at the end of its useful life.

Ideal for terminal control

- The RC-FLEXair features an optional precision-airflow sensor and a brushless DC damper actuator, making it ideal for many types of terminal control applications. The pressure sensor ports are highly resilient and made from die-cast aluminum; combined with the aluminum enclosure and steel baseplate, this controller is rugged and built to last.

Ultimate flexibility

- With many available models and options, the RC-FLEXair is suited to a wide variety of projects. You can order models with one or three universal inputs and up to six outputs with a mix of universal or solid-state relay outputs. Better still, the RC-FLEXair can communicate with up to eight Reliable Controls SMART-Net™ devices and expand the controller's capability without consuming inputs or outputs. You can connect temperature, humidity, gas detection, or occupancy sensors; a SMART-Sensor™ EnOcean Accesspoint; or even the SMART-Net Relay with up to five heavy-duty mechanical relays.

Database? More like data*beast*

- With tons of nonvolatile memory, the RC-FLEXair has enough space to handle the most challenging applications now and in the future. It automatically logs all input, output, value, calendar, loop, and schedule objects, which can each store more than 2,000 records. That's enough for over 1 million data points! It also has space for 64 control programs, each large enough to run advanced energy sequencing, integrated fault detection and diagnostics, and much more.

Better by design

- The RC-FLEXair is equipped with a versatile USB application port that provides convenient access to a technician today and extended capabilities tomorrow. You can power the controller via USB from a laptop to permit configuration, firmware updates, programming, and graphics creation. You can also use the USB port to access the entire BACnet network.
- All input, output, and communication ports are hardware-protected against transient surges and spikes, which hardens the controller against field-wiring mistakes and improves resilience.

Network resilience

- To improve Ethernet network resilience and safeguard against common failures, all RC-FLEX family controllers come standard with Copper Switch™ technology and support for Rapid Spanning Tree Protocol (RSTP). Copper Switch ensures that data can still pass through if a controller loses power, maintaining uptime. RSTP lets you connect controllers in a ring topology, which provides inherent redundancy with a duplicate network path; controllers can maintain communications even if one part of the ring is severed.

Backward compatible, future ready

- Reliable Controls tests every product it manufactures to ensure compatibility with previous-generation controllers. The RC-FLEXair is no different! You can add it to networks that host previous-generation controllers without the need to purchase costly third-party gateways or accessories. To further future-proof your investment, the RC-FLEXair features an open-source Linux operating system renowned for its cybersecurity resilience and global community of programming support.

Certifications

- BTL Listed (B-BC).
- CE.
- CFR 47 Part 15/B Class B.
- UL 60730-1 Open Energy Management.
- WEEE.
- EN 60730-1.
- Canada ICES-003(B)/NMB-003(B).

Standard applications

Standard applications for Reliable Controls products are available in the **Engineer** tab in the Reliable Controls Support Center.

Each standard application contains the elements needed to deploy an application, such as:

- Control-BASIC code.
- Panel Files.
- System Groups.
- Annotated sequences of operation.

Standard applications can also serve as useful learning tools to increase your knowledge of different product applications and Control-BASIC programming.

Search the library of existing standard applications or use the Standard App Builder to find a standard application that meets your section criteria. If you cannot find a standard application that suits your needs in the Standard App Builder, you can request it by clicking the **Submit a request** button.

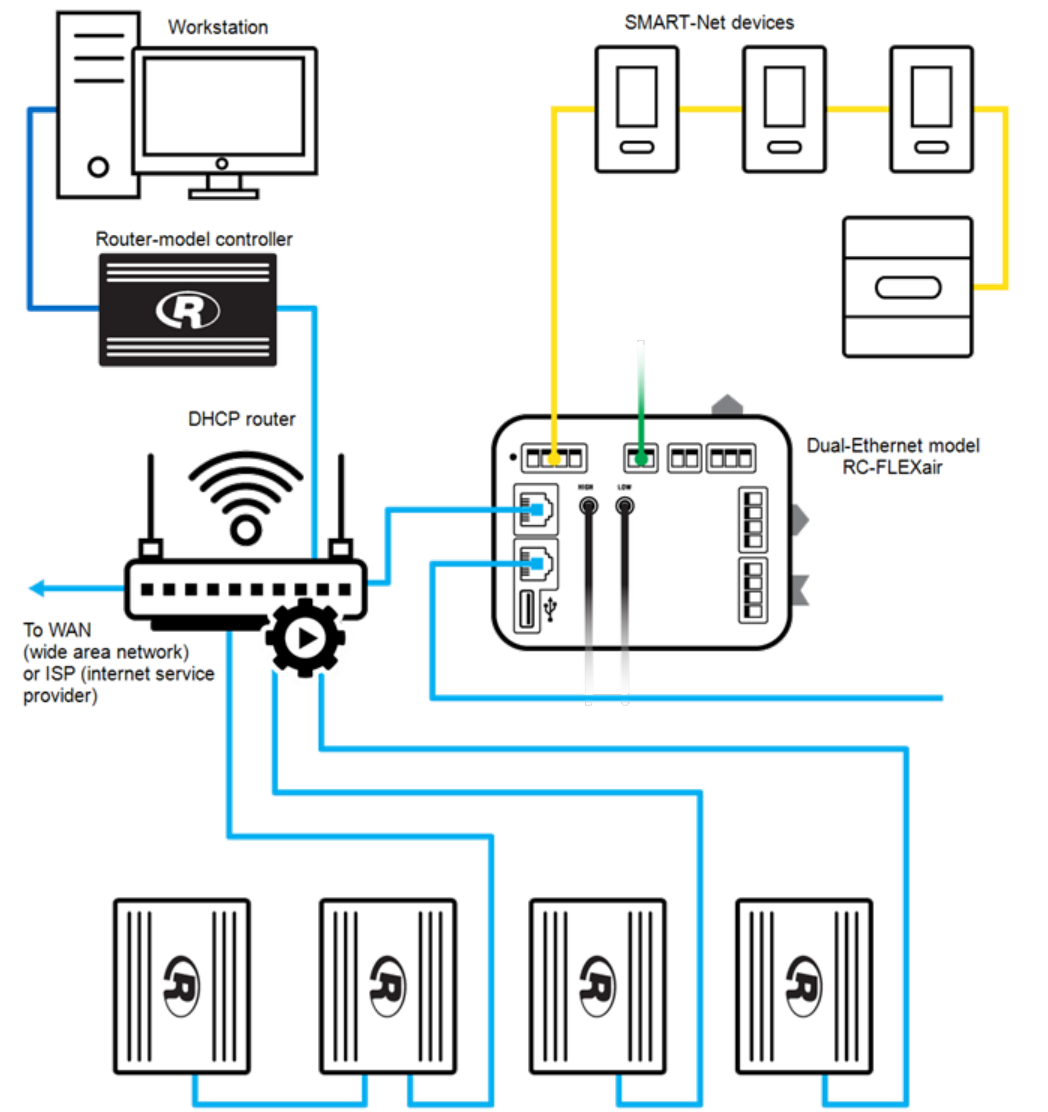
Download and install the standard application and modify as necessary for your specific implementation.

RC-FLEXair applications

RC-FLEXair applications range from variable volume, temperature, and standard pressure-independent control to dual-duct and full-demand control ventilation.

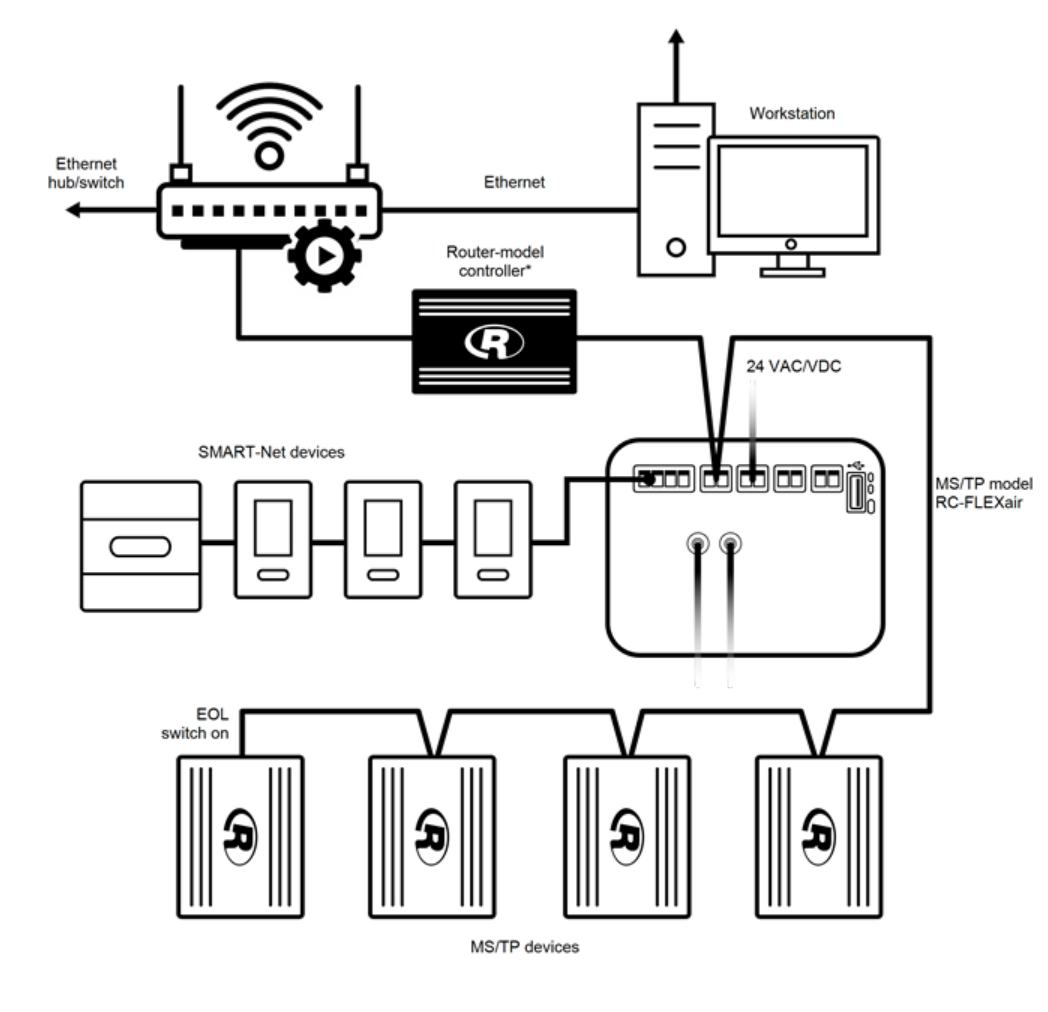
Dual Ethernet model RC-FLEXair application

This application diagram shows the dual Ethernet RC-FLEXair supporting a network of SMART-Net devices. The network contains RC-FLEXair controllers managed by a router-model controller that provides the primary data connection to a workstation running RC-Studio and other Reliable Controls software. If the router-model controller includes an onboard web server, you can configure system information to view in a browser.



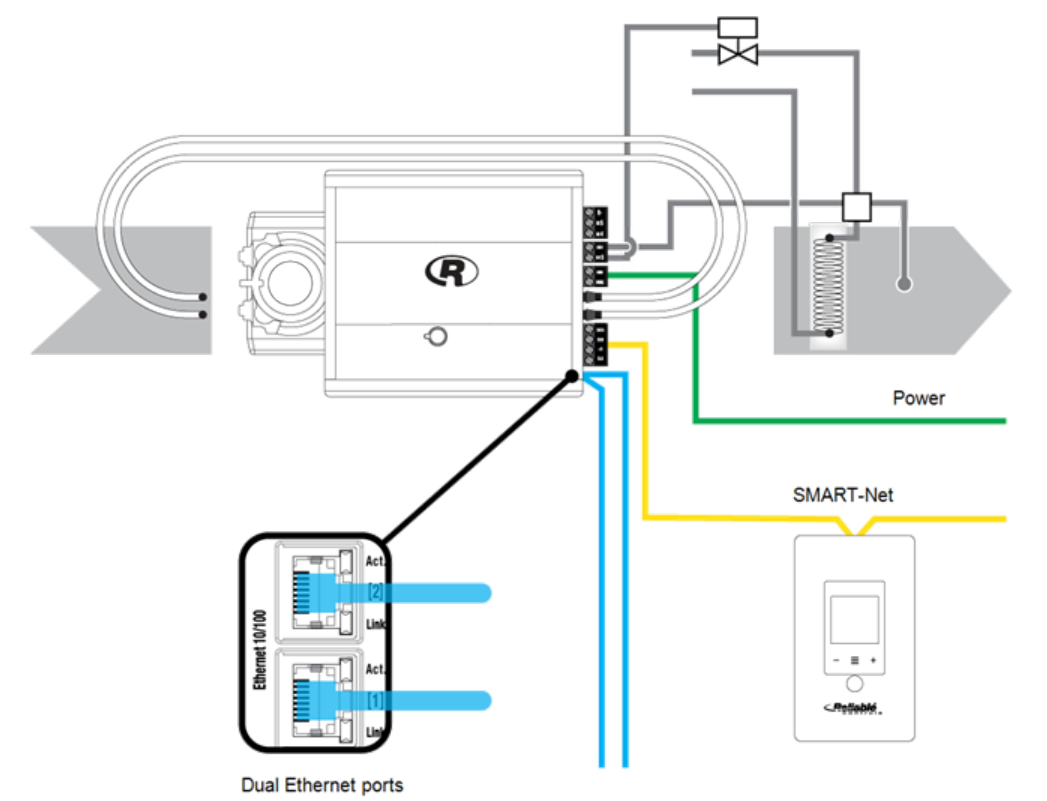
MS/TP (-M) model RC-FLEXair application

This application diagram shows the MS/TP model RC-FLEXair (RCFA-M) supporting a network of SMART-Net devices. A router-model controller (host controller) manages the RCFA-M and all the other controllers connected on the same MS/TP communications bus. The host controller provides the primary data connection to the workstation running RC-Studio and other Reliable Controls software.



RC-FLEXair control application

This application diagram shows the typical installation of an RC-FLEXair as an air-terminal unit controller. It is mounted on the side of a variable air volume unit with the actuator controlling the damper based on the measured airflow, with temperature sensing and user input through a SMART-Sensor EPD.



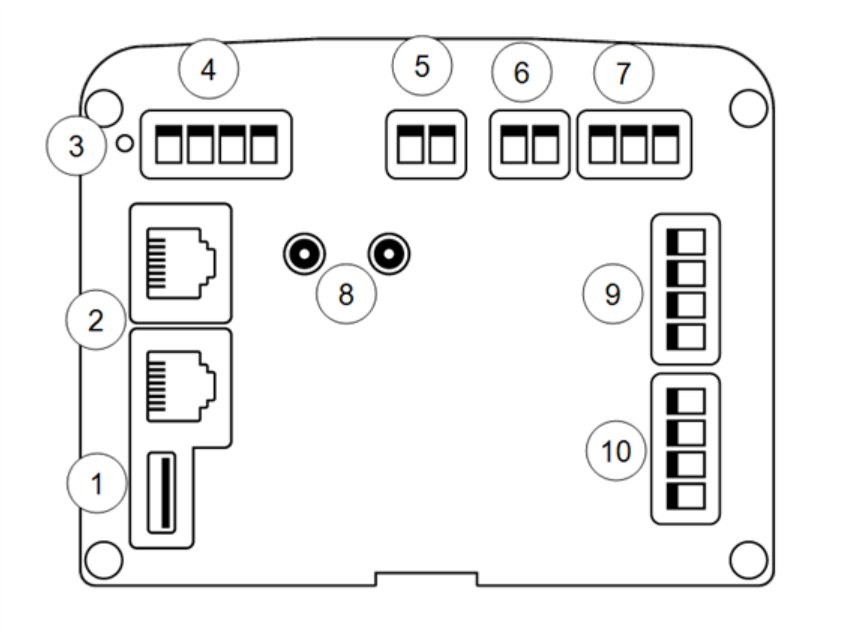
RC-FLEXair hardware overview

The RC-FLEXair has communication and input/output connections as well as an optional flow sensor and actuator.

Depending on the model, the RC-FLEXair has either dual Ethernet ports, or a single EIA-485 MS/TP port:

- "Dual Ethernet model RC-FLEXair" on the facing page
- "MS/TP (-M) model RC-FLEXair" on page 17

Dual Ethernet model RC-FLEXair



① USB port

② Ethernet ports (two)

③ Status LED and access to Reset button

④ SMART-Net

⑤ Power

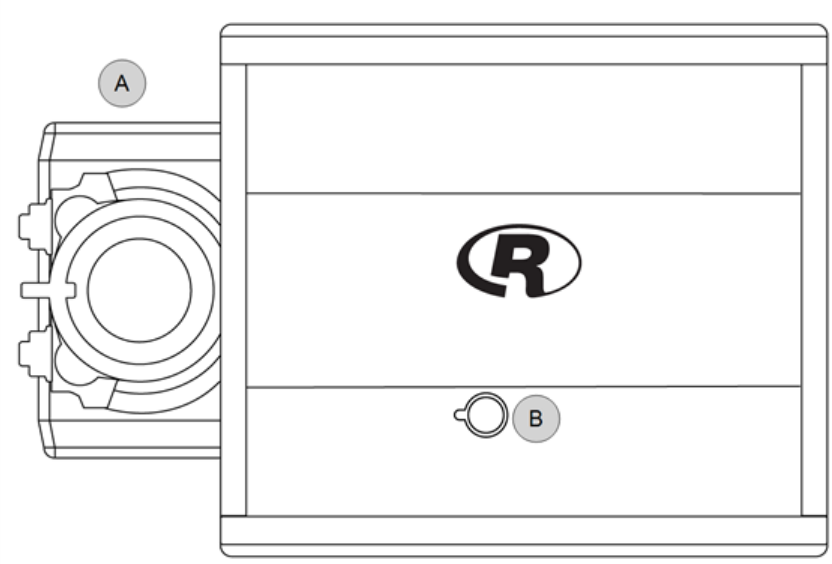
⑥ Universal outputs or analog inputs depending on model

⑦ Solid-state relay outputs or analog outputs depending on model

⑧ Optional flow velocity sensor high/low ports (-F models only)

⑨ Inputs

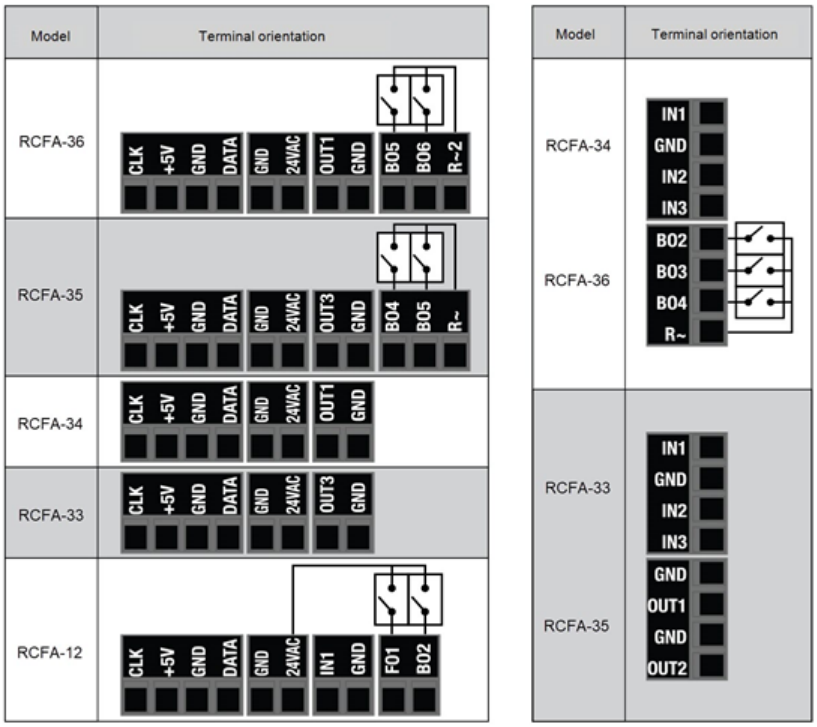
⑩ Universal or solid-state relay outputs depending on model



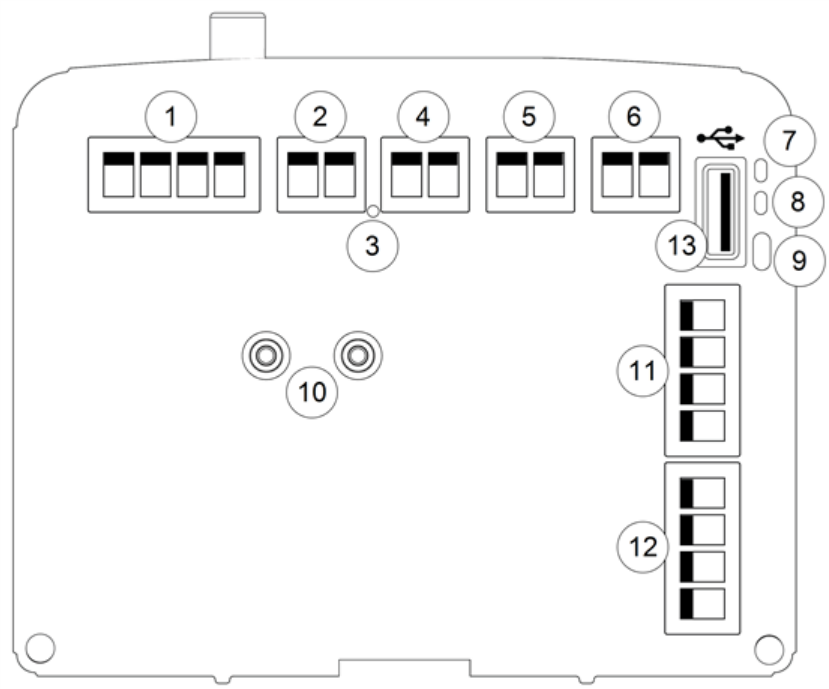
- (A) Optional damper actuator (-A models only)
- (B) Damper actuator clutch (-A models only)

Dual Ethernet model RC-FLEXair terminal layouts

The following diagram shows the terminal layouts for the different dual Ethernet models of the RC-FLEXair:



MS/TP (-M) model RC-FLEXair



① SMART-Net

② MS/TP port (EIA-485)

③ MS/TP LED

④ Power

⑤ Universal outputs or analog inputs depending on model

⑥ Solid-state relay outputs or analog outputs depending on model

⑦ EOL (End-of-Line) LED

⑧ Status LED

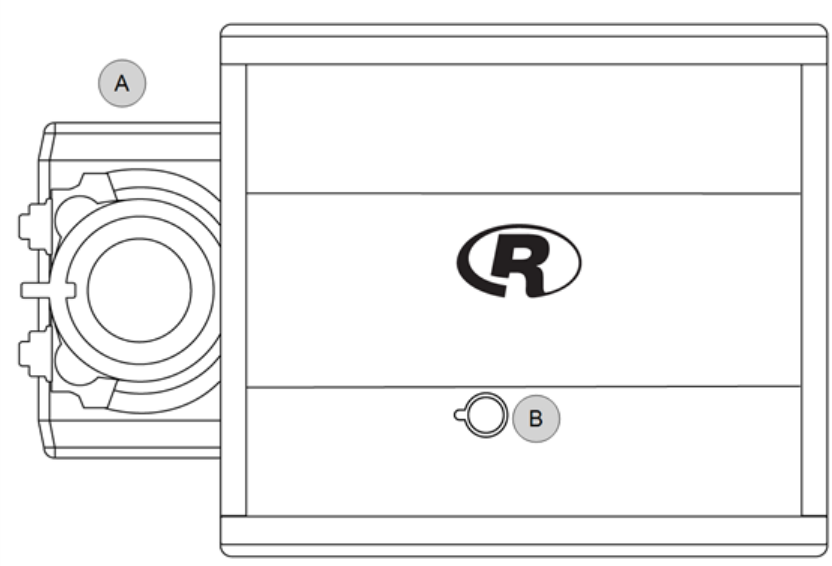
⑨ Reset switch

⑩ Optional flow velocity sensor high/low ports (-F models only)

⑪ Inputs

⑫ Universal or solid-state relay outputs depending on model

⑬ USB port

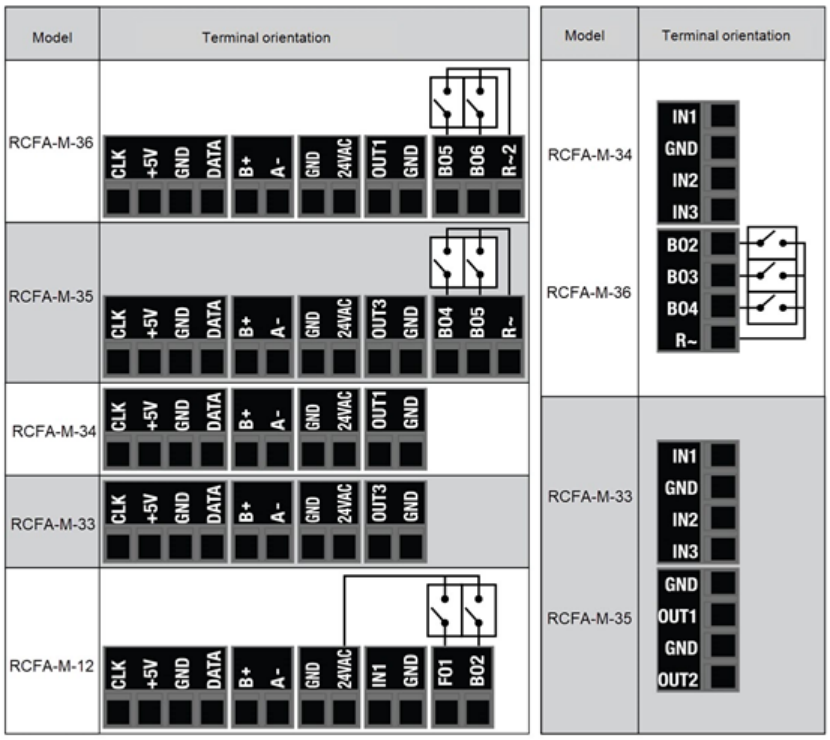


Ⓐ Optional damper actuator (-A models only)

Ⓑ Damper actuator clutch (-A models only)

MS/TP (-M) model RC-FLEXair terminal layouts

The following diagram shows the terminal layouts for the different RC-FLEXair MS/TP (-M) models:



Additional resources

Additional resources are available on the Reliable Controls Support Center.

Click any of the following in the menu bar:

Products

View all product documentation, manuals, and marketing material.

Technical

View Release Notes, Bulletins, Product and Security Alerts, and the DDC (Direct Digital Control) Glossary.

eHelpDesk

Click the eHelpDesk link in the Support Center banner and search or browse solutions, application support articles, and the community forum, or create a support ticket to connect with an agent.

Training

Use the Learning Center to view and register for training courses, access eLearning courses and videos, view webcasts, and download manuals.

RC-FLEXair wiring and installation

The wiring and installation section describes how to connect the power, inputs and outputs of your controller as well as the overall installation process and important considerations.

For more information about wiring and installing Reliable Controls products, refer to the product documentation and the *Hardware Installation Manual*, available in the Reliable Controls Support Center.

For more information about best practices and recommendations for Ethernet networks, refer to the *Ethernet Best Practices Guide*, available in the Reliable Controls Support Center.

Installation considerations

All Reliable Controls devices must be installed in accordance with the National Electrical Code (NFPA 70), the Canadian Electric Code Part 1 (CSA C22.1-12), or the International Electrical Code (IEC 60730-1) as applicable and in a manner acceptable to the local authority having jurisdiction.

This device is for use in UL Class 2 and Class 3 ELV circuits only.

Follow these guidelines when you install Reliable Controls products:

- Ground yourself before you touch any electronics by touching a grounded metal surface to discharge static electricity.
- Use copper conductors only.
- Choose wires and cables appropriate for your application or installation requirements, for example, plenum-rated material.

RC-FLEXair power

The RC-FLEXair must be correctly wired to an appropriate power supply.

Supply Voltages

- 24 VAC ±10% 32 VA maximum, 50/60 Hz.
- 24 VDC ±10% 12 W maximum.

Wiring Terminals

- 16–24 AWG (1.31–0.21 mm^2).
- Stranded or solid core.
- Copper conductors only.
- 5 mm (0.20") rising-cage screw terminal blocks.

To determine the size of the AC transformer or DC power supply required for your installation, use the power calculator at reliablecontrols.com/support/engineer/calculator.php.

Grounded power

Follow these guidelines when you select and wire the grounded power supply:

- Use a UL Class 2 or Class 3 ELV 24 VAC/VDC power supply for the controller.
- Ensure that all controllers are connected to earth ground.
- To determine the size of the AC transformer or DC power supply required for your installation, use the power calculator at reliablecontrols.com/support/engineer/calculator.php.

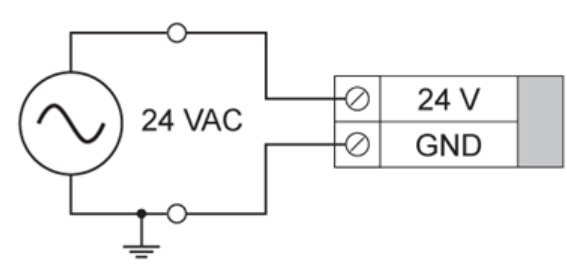


Figure 1: 24 VAC grounded power supply wiring

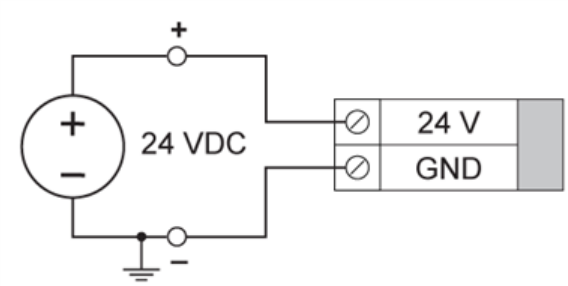


Figure 2: 24 VDC grounded power supply wiring

RC-FLEX device Status LED

The controller has an LED to indicate its operating status.

Status LED	Status
One flash per second	Normal operation.
Two quick flashes on and one second off	Controller is in Quick Connect mode.
Off	Unpowered. Controller is not operational.
On solid	No operation. Defective controller.

RC-FLEXair Ethernet

The RC-FLEXair dual Ethernet model has two Ethernet ports to allow for easy network connection.

Ethernet Communications

The RC-FLEXair is a non-routing, unitary controller that requires a network host controller.

- Two IEEE 802.3 Ethernet 10/100BASE-T ports, with a maximum distance of 50 m (164 ft) between Ethernet connections using Category 5, 5e, or 6 cabling. Each device uses one IP address. The second Ethernet port is a switched port; use it to line-connect additional devices.
- Automatic hardware coupling of Ethernet dual ports when controller loses power.
- Routing host controllers support up to 74 additional BACnet/IP-connected devices.
- RSTP protocol allows ring topology of up to 40 devices isolated by a managed network switch.
- LLDP protocol provides details of up to five of the most recently discovered neighboring devices.

The controller cannot route between two separate Ethernet networks. The second port functions as an Ethernet switch for connecting additional devices to the network. This is an active switch. The controller must be powered for network connections.

Use a star or straight-line Ethernet network topology. The controller supports an Ethernet ring or loop topology for an isolated network whose traffic is controlled by a properly configured managed switch.

The controller automatically internally corrects for crossover and straight-through connections, so you can use either cable for network connections.

Refer to the *Ethernet Best Practices Guide*, available from the Reliable Controls Support Center, for Ethernet network examples, recommended topologies, network and device numbering conventions, and troubleshooting.

Related information

Connect to an existing BACnet/IP network 53

Ethernet connections

Your controller only supports one IP address and cannot route between two separate Ethernet networks. The second port functions as an Ethernet switch for connecting additional devices to the network. To maintain network operation, if the controller loses power or goes offline, the Ethernet ports bridge to make the Ethernet network segments before and after the controller into one continuous Ethernet network segment.

Your controller is intended for installation in a new or existing BACnet/IP network with a host controller, but you can also directly connect to the controller over Ethernet or USB. Your controller ships as a DHCP client by default and requires a DHCP server to automatically acquire an IP address. Networks require at least one router-model controller such as a MACH-ProCom located on the same local area network. You can have up to 74 devices per BACnet/IP network in addition to the router-model controller.

Your controller supports star and straight-line Ethernet topologies. Your controller automatically internally corrects for crossover and straight-through connections, so you can use either cable for network connections. Your controller also supports ring or network loop topologies when the network is correctly configured and rapid spanning tree protocol (RSTP) is enabled.

Important: Ring topologies require a specific procedure for wiring the network and enabling RSTP. Failure to follow this procedure causes loss of Ethernet network communications.

Use a line topology to provide a longer Ethernet network with controllers located at increasing distances from the Ethernet switch. This topology allows you to span longer distances but is less robust as the loss of one controller connection can affect other controller network connections.

Use a star topology to provide a robust Ethernet network that does not create network loops. If you connect each controller to the Ethernet switch instead of using a daisy chain, if one controller loses its network connection, it does not affect the other Ethernet devices.

Use an Ethernet ring or loop topology to create a managed network loop for improved network resilience.

Refer to the *Ethernet Best Practices Guide*, available from the Reliable Controls Support Center, for Ethernet network examples, recommended topologies, network and device numbering conventions, and troubleshooting.

Ethernet line network topology

Use a line topology—similar to the daisy-chain architecture used in MS/TP networks—to create an Ethernet network, as shown below.

Because each device is connected to only the previous device, this topology can cause your network to be taken offline by a single faulty segment. Reliable Controls recommends you add a network recovery link to line topologies.

Note: Do not connect the network recovery link on a working network. It creates an unsupported ring topology and causes network communications to fail. Connect the network recovery link on a broken network to help recover from the bad connection.

Note: RC-FLEX controllers ship with DHCP enabled. To use DHCP, the network where the device is installed requires a DHCP server.

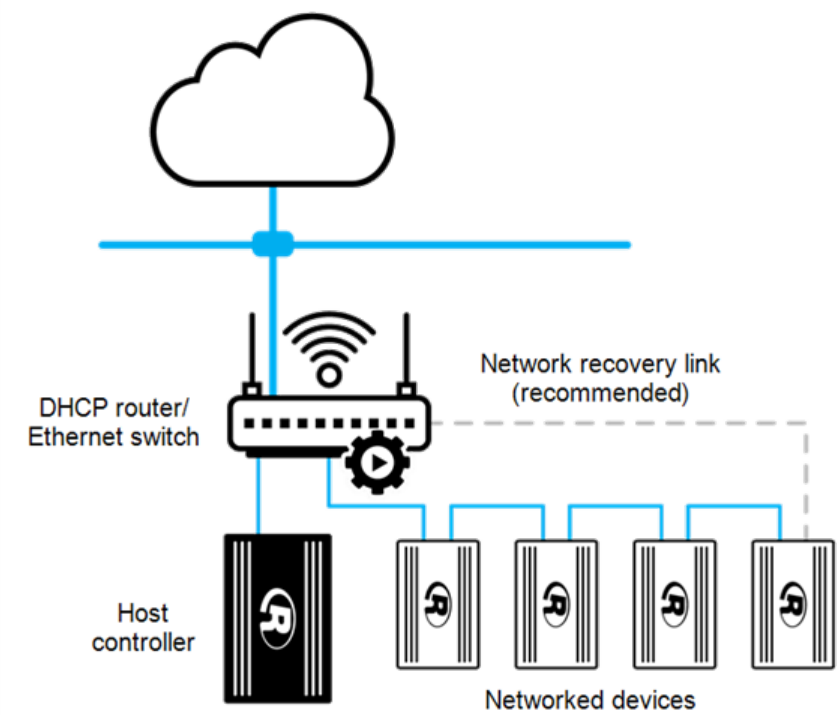


Figure 3: Line network topology

Note: Make sure the network recovery link does not exceed the maximum Ethernet segment length. Consider using a line topology with alternating connections if that is more suited to your installation.

Ethernet star network topology

In an Ethernet star topology, each controller is individually connected to a dedicated Ethernet port, as shown below.

This topology helps prevent your network being taken offline by a single faulty device.

Note: RC-FLEX controllers ship with DHCP enabled. To use DHCP, the network where the device is installed requires a DHCP server.

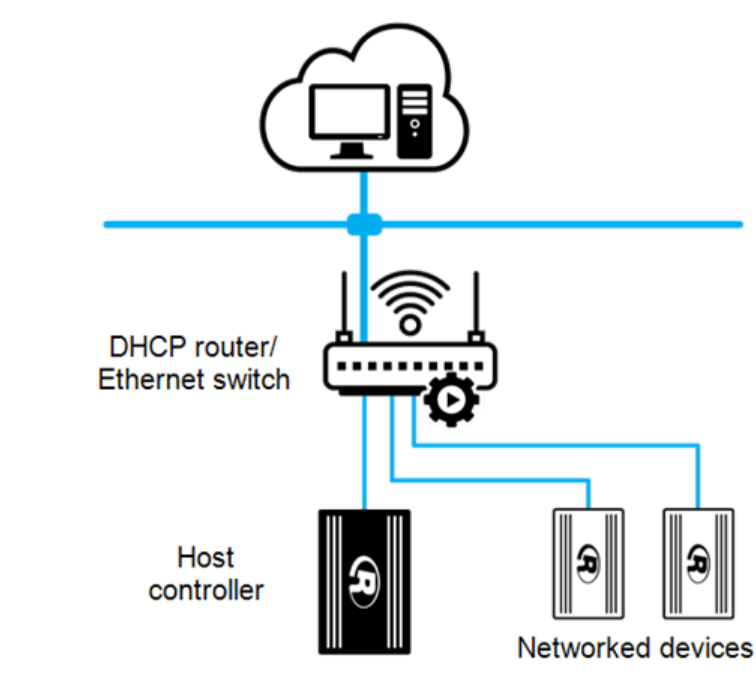


Figure 4: Star network topology

Ethernet ring or loop topology

An Ethernet ring or loop topology is where the last Ethernet device on a straight-line Ethernet topology connects back to the dedicated managed network switch, to improve network resilience.

An Ethernet ring can contain up to 40 devices, in addition to the managed switch.

Requirements:

- The Ethernet ring network must be isolated by a dedicated managed network switch.
- The dedicated managed network switch must be configured to isolate ring bridge protocol data unit (BPDU) traffic from the rest of the network.
- All Ethernet devices must support rapid spanning tree protocol (RSTP). RSTP must be enabled for each device using RC-Toolkit.

Follow the specified process to implement an operating Ethernet ring topology to avoid the loss of Ethernet communications.

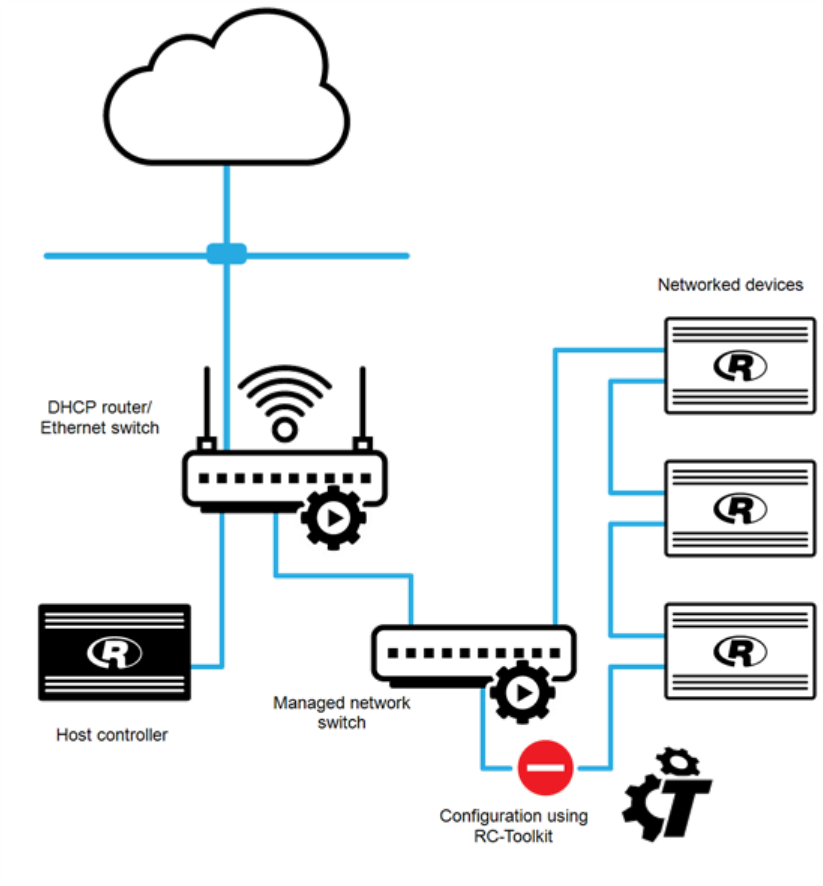


Figure 5: Ethernet ring or loop topology

Related information

Set up an Ethernet ring with RSTP..... 54

Dual Ethernet port

The RC-FLEX controller's dual Ethernet ports allow you to use either straight-through or crossover Ethernet cables interchangeably.

Reliable Controls recommends you consistently use Ethernet standard TIA/EIA-568A or TIA/EIA-568B terminated cables.

Do not exceed 50 m (164 ft) Ethernet segment length between any two RC-FLEX Ethernet network nodes.

RC-FLEX Ethernet Copper Switch

If the controller loses power, Copper Switch technology helps maintain Ethernet communications by internally connecting the dual Ethernet ports to bypass the controller.

Copper Switch is a physical hardware component of the dual Ethernet ports on RC-FLEX controllers, and does not require configuration. It is supported on all RC-FLEX dual Ethernet controllers that are revision D or later. The revision level is indicated by the fifth character in the serial number.

To maintain the maximum Ethernet network segment length specification of 100 m (328 ft), the recommended maximum segment length between networked RC-FLEX controllers with the Copper Switch is 50 m (164 ft).

Do not exceed 50 m (164 ft) Ethernet segment length between any two RC-FLEX Ethernet network nodes.

The following Ethernet line topology network diagrams show before and after a controller loses power. After the power loss, the controller's Copper Switch connects the dual Ethernet ports, preventing loss of communications on the Ethernet network:

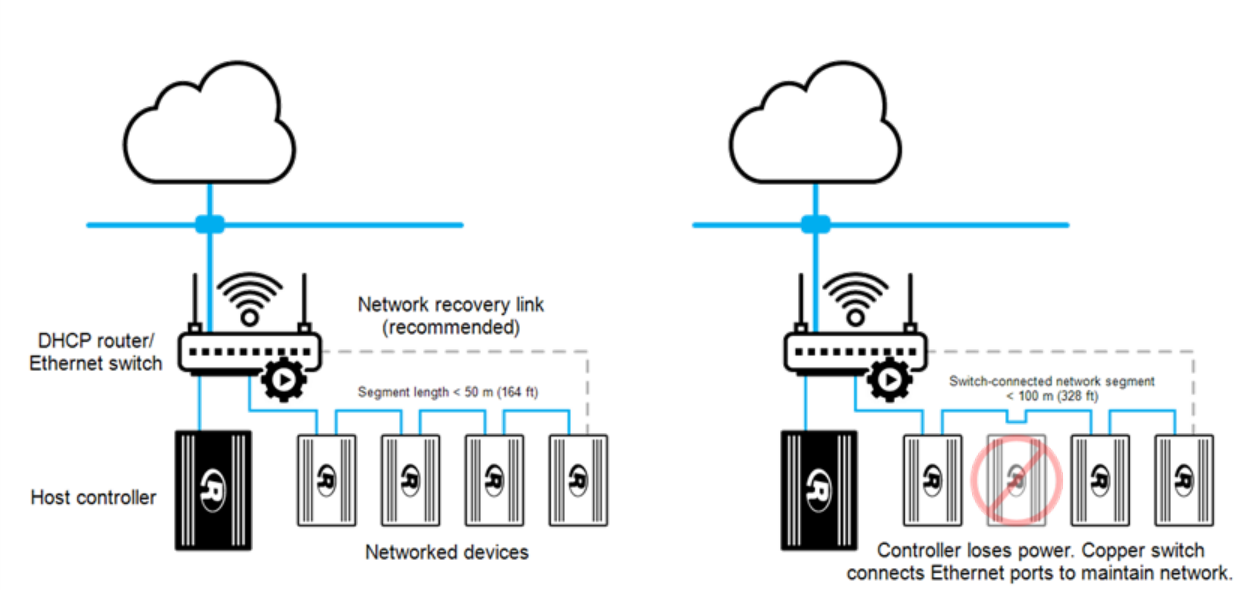


Figure 6: Before and after Copper Switch operation

Ethernet status LEDs

The controller has two Ethernet status LEDs, **Act** and **Link**, located next to the Ethernet port.

Act: The Act (activity) LED illuminates when the controller is actively transmitting over Ethernet.

Link: The Link LED illuminates when there is a physical connection between the controller and a valid, powered switch, hub, or controller. This LED indicates only a physical connection, not communication or configuration status.

RC-FLEXair EIA-485 (-M model only)

The RC-FLEXair -M model has one EIA-485 two-pole terminal block you can use to connect to a BACnet MS/TP network that is typically hosted by a router-model controller.

MS/TP Communications (-M Models)

The RC-FLEXair is a non-routing, unitary controller that requires a network host controller.

- One EIA-485 port that supports a baud rate up to 76.8 kbps. Auto-baud detection.
- 24 VAC overvoltage protection with built-in resettable fuses.
- Software-switched End-of-Line termination (EOL) with amber LED indicator.
- Status LED illuminates green to indicate MS/TP network operation and red to indicate miswired MS/TP.

Connect MS/TP devices only in a straight-line (daisy-chain) topology. Methods such as star or T topologies are not supported and will cause communication problems.

Wiring Terminals

- 16–24 AWG (1.31–0.21 mm^2).
- Stranded or solid core.
- Copper conductors only.
- 5 mm (0.20") rising-cage screw terminal blocks.

Maximum EIA-485 segment length: 1,220 m (4,000 ft).

EIA-485 wiring for grounded controllers

The grounded controller's EIA-485 port is a two- or three-pole terminal block used for BACnet MS/TP communication. The EIA-485 transceiver is non-isolated and internally references the controller's power ground. The ground connection helps keep all networked devices at the same reference to each other which works to improve communications by making sure that signals are at the same level at all nodes throughout a distributed system.

All devices on the same EIA-485 network must communicate using the same protocol and baud rate, and each node must have a unique address. EIA-485 devices are connected using a line topology.

Note: Maximum EIA-485 segment length: 1,220 m (4,000 ft).

The grounded controller's EIA-485 terminal block has either two terminals: A(-) and B(+), or three terminals: A(-), B(+), and REF. To connect multiple grounded controllers, use the EIA-485 connector to wire terminal A(-) to A(-), and B(+) to B(+). Connect the bare shield wires at each junction to help suppress noise along the cable length.

The REF terminal is internally connected to the controller's power ground and can be used to connect isolated devices that use a three-wire MS/TP network.

Installation guidelines:

- Use a good quality, low-impedance, twisted two-conductor shielded communications cable with capacitance less than 82 pF/m (25 pF/ft).
- EIA-485 cable shields should be continuous, electrically connected, and grounded at one end only.
- End-of-Line (EOL) must be set to on for the two devices located at the physical extremities.
- REF terminal is intended to connect isolated devices that use a three-wire MS/TP network.

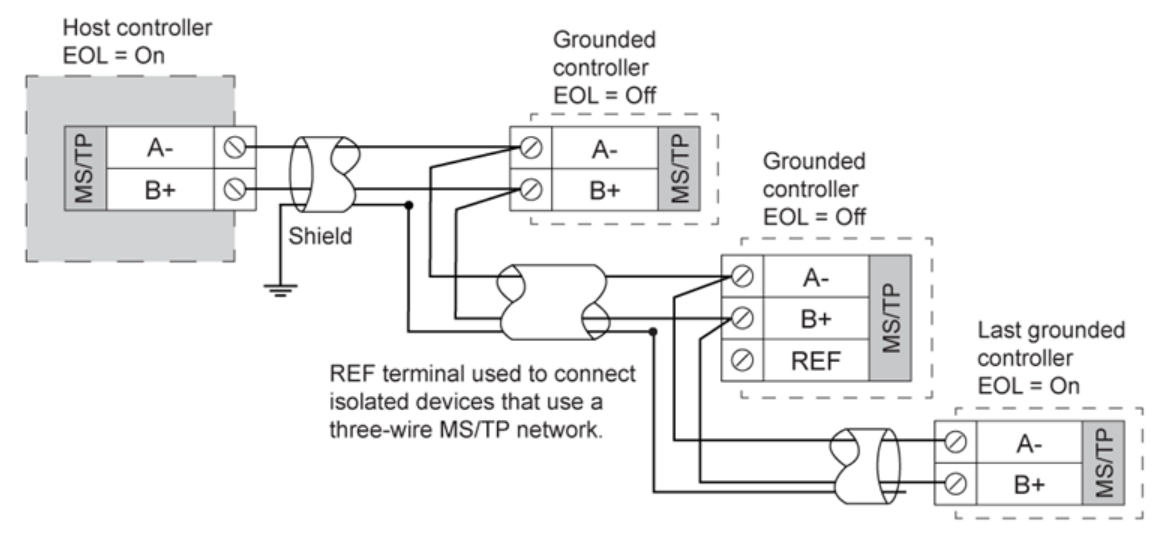


Figure 7: EIA-485 wiring for grounded controllers

MS/TP-Net LED and protection

The MS/TP-NET LED on the MS/TP (-M) model RC-FLEX device provides the following information for its EIA-485 communications port:

MS/TP-Net LED behavior	Status description
Off	Device unpowered or is not communicating.
Green Flicker	Normal MS/TP communications.
Green On 0.5 sec / Off 0.5 sec	MS/TP configured but not communicating.
Green On 1 sec / Off 1 sec	Device has factory default settings. Configure device using RC-Toolkit MSet tool or SMART-Sensor EPD in MSet Mode.
Red On solid	EIA-485 network issue detected. Common EIA-485 issues are: • Power polarity (24 VAC/VDC and ground) have been reversed. • Floating ground or different ground potential between two network devices. • Device is not connected to earth ground. • 24 VAC/VDC incorrectly applied to the EIA-485 network.

EIA-485 protection

The controller uses automatically resetting polyfuses for EIA-485 network protection.

End-of-Line (EOL) switch and LED

The End-of-Line (EOL) switch for the two devices located at the physical extremities of the EIA-485 cable run must be set to On, and all other devices on this network must be set to Off. This is to provide proper biasing for the EIA-485 network.

Proper biasing optimizes communications performance by bringing the network voltage to a known value if communications are idle. This prevents communications problems such as signal reflections that might occur when networked controllers are improperly terminated.

The End-of-Line switch for the MS/TP RC-FLEX device (-M model) is a soft switch you can set using one of the following methods:

- Connect the SETUP-Tool (or a SMART-Sensor EPD in MSet Mode) to the controller, then set **Last Panel** to Yes if the controller is the last device on the network. Otherwise, make sure **Last Panel** is set to No.
- Use the RC-Toolkit MSet screen and toggle the switch On or Off by clicking the End-of-Line cell for the device.
- Press the controller reset button twice in quick succession on a powered controller to toggle the End-of-Line switch.

If the device at the end of the line is not a Reliable Controls controller, you can install an End of Line terminator (NA-EOL), available from eBusiness at the Reliable Controls Support Center website.

EOL LED

The yellow EOL LED indicates the End-of-Line status of the device:

- EOL LED on: End-of-Line on
- EOL LED off: End-of-Line off

RC-FLEXair USB

The RC-FLEXair controller has a USB-A port for Direct Connect communications.

USB

- USB-A port with maximum cable length of 5 m (16.4 ft).

Connect a local workstation's USB-A port to the controller's USB-A port to temporarily access the controller and BACnet networked devices without impact to existing network connections and functions.

Important: Always route USB connections through a USB hub with a good quality USB cable to help protect equipment and resolve protocol differences.

You can make a connection from your workstation to provide both power and communications to configure the device using the RC-Toolkit MSet tool. USB-powered controllers cannot power outputs and inputs. Do not use a USB connection to power a networked controller.

Important: The USB connection is for short-term configuration or troubleshooting. Leaving the USB connected to the workstation can cause network issues.

Related information

Set up a new RC-FLEX controller using USB 50

RC-FLEXair SMART-Net

Your controller has a SMART-Net four-pin terminal block to support a network of SMART-Net devices.

SMART-Net Communications

- SMART-Net port with four-wire terminal block supports up to eight devices.

Wiring Terminals

- 16–24 AWG (1.31–0.21 mm^2).
- Stranded or solid core.
- Copper conductors only.
- 5 mm (0.20") rising-cage screw terminal blocks.

The maximum tested SMART-Net cable length from the host controller to the last SMART-Net device on the SMART-Net bus is 45 m (147 ft). With an externally powered SMART-Net Expansion Board or SMART-Sensor Expansion Board located at the network midpoint, the maximum tested SMART-Net cable length from the host controller to the last SMART-Net device on the SMART-Net bus is 75 m (246 ft).

SMART-Net four-pin terminal

Use the removable SMART-Net four-pin terminal block to wire and connect a network of SMART-Net devices.

Note: The maximum tested SMART-Net cable length from the host controller to the last SMART-Net device on the SMART-Net bus is 45 m (147 ft). With an externally powered SMART-Net Expansion Board or SMART-Sensor Expansion Board located at the network midpoint, the maximum tested SMART-Net cable length from the host controller to the last SMART-Net device on the SMART-Net bus is 75 m (246 ft).

The SMART-Net network provides power and communications for SMART-Net devices. Reliable Controls recommends 24 AWG (0.21 mm^2), low capacitance < 82 pF/m (25 pF/f), solid core minimum Category 3 cabling for SMART-Net networks.

Directly connect the SMART-Net four-pin terminals from the controller to the four-pin terminal block on a SMART-Net device, matching the terminals.

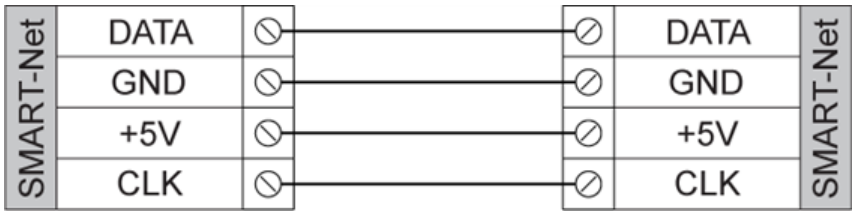


Figure 8: SMART-Net four-pin connection

For detailed information about SMART-Net networks, sensors, and controllers, refer to the SMART-Net device documentation available in the Reliable Controls Support Center.

RC-FLEXair inputs

The controller can have up to three universal inputs.

RC-FLEXair actuator model has a fixed-motor end-stop binary input and an actuator-position feedback with a range of 0 - 100%.

Note: Analog inputs promptly detect faults when you set the D column in the Inputs worksheet to Y, or decommissioned; otherwise, fault detection is slightly delayed to help prevent false alarms caused when a user presses a button on a connected SPACE-Sensor Temperature.

Universal Inputs

- Standard 16-bit A/D converter; 12-bit A/D converter on -12 Models and all -M Models.
- Software selectable 0–10 VDC, 4–20 mA, or thermistor/dry-contact.
- Impedance:
  - 3 MΩ on 0-10 VDC range.
  - 249 Ω on 4-20 mA range.
  - 20 kΩ on thermistor range.
- Pulse counting up to 150 Hz. Supports flow meters.
- 24 VAC overvoltage protection.

Inputs

Connect a dry-contact digital, thermistor, 0–10 VDC analog, or 4–20 mA analog input to the controller input terminals as shown in the following input-type schematics.

Note: You can also use dry-contact inputs for pulse-counting applications such as flow meters and energy meters.

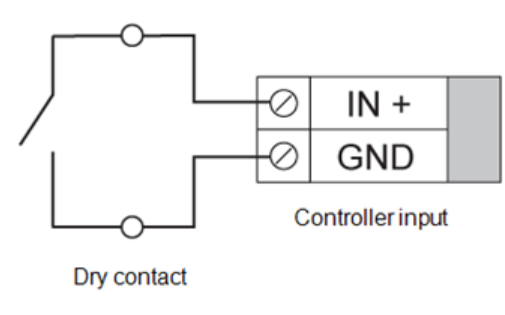


Figure 9: Dry-contact digital input wiring

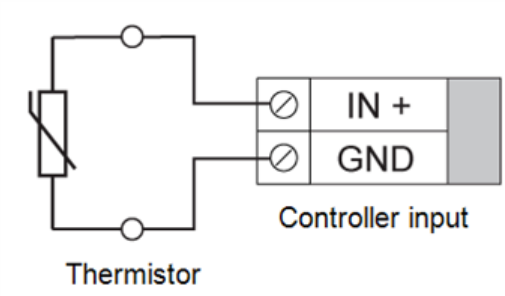


Figure 10: Thermistor wiring

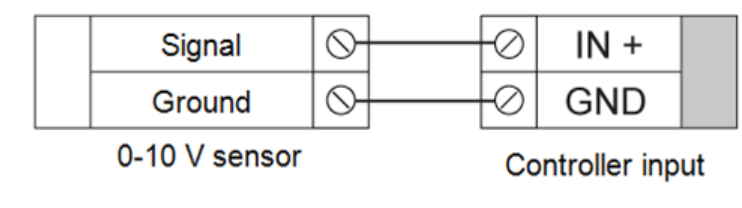


Figure 11: 0–10 VDC analog input wiring

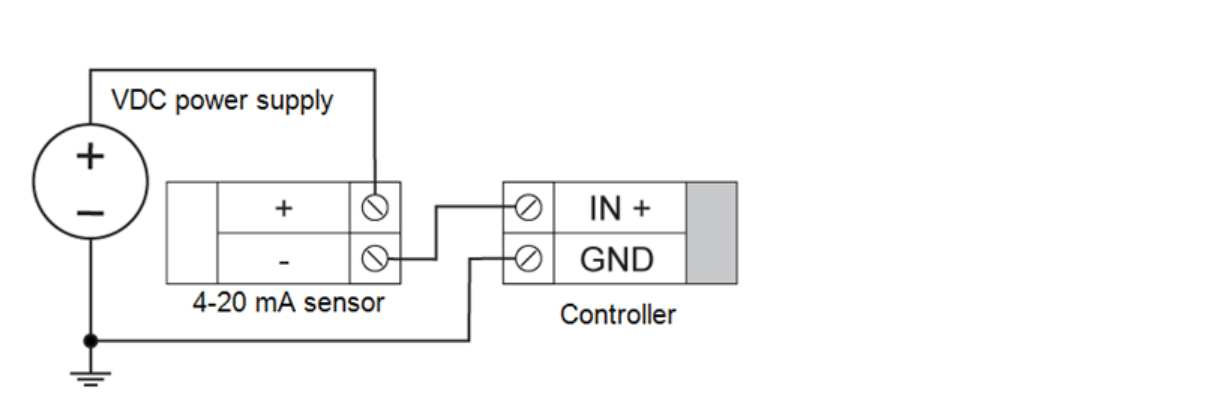


Figure 12: 4–20 mA analog input with external DC power supply wiring

Note: 4–20 mA loop-powered sensors require a DC voltage power supply to operate. The controller converts this input to a 1-5 VDC signal. If you scale this input in RC-Studio, the input range of the table is 1-5 VDC.

RC-FLEXair outputs

The controller has solid-state relay and universal outputs.

The universal outputs can sink or source current.

Outputs go to zero when you power cycle the controller, then return to normal values as programs resume operation.

Solid-State Relay Output

- Switches 24 VAC/VDC.
- 500 mA maximum.

Universal Outputs

- 16-bit D/A converter.
- Analog: 0-12 VDC.
- Binary: Software configurable between 0–12 VDC.
- Output power: 75 mA at 12 VDC source, -10 mA sink
- 24 VAC overvoltage and short protection.

Universal outputs

Connect a relay, digital, or analog output device to your controller's output terminals.

Use software to configure universal outputs as digital or analog.

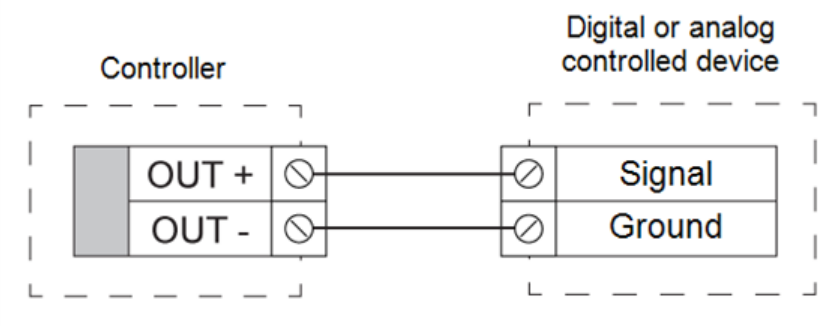


Figure 13: Universal output wiring

Solid-state relay outputs with R~ terminal

Connect the required external 12–24 VAC/VDC power source to the load and complete the wiring to the output terminals as shown.

The voltage supplied at the R~ terminal is transferred to the BO terminals to power the output loads. The R~ terminal connection is specific to the BO terminals on that output terminal block. If your device has multiple terminal blocks with R~ terminals, you must connect each R~ terminal to power the BO terminals for that terminal block.

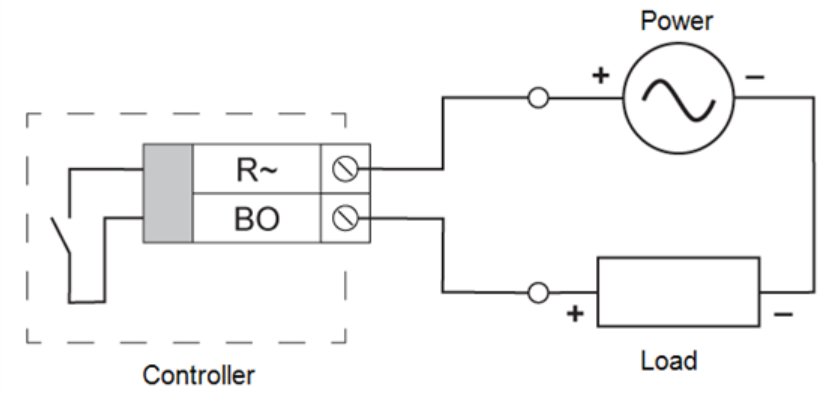


Figure 14: Solid-state relay wiring

RC-FLEXair -12 model outputs

RC-FLEXair -12 models have a solid-state relay output internally connected to the controller's power supply along with a FLEX output that is software configurable to operate as either a solid-state relay or universal output.

By default, the FLEX output (FO) operates as a solid-state relay.

FLEX Output

- Use software to select as universal or solid-state relay.

The following wiring diagram applies to the -12 model solid-state output and to the FLEX output (FO) when it is configured as a solid-state output:

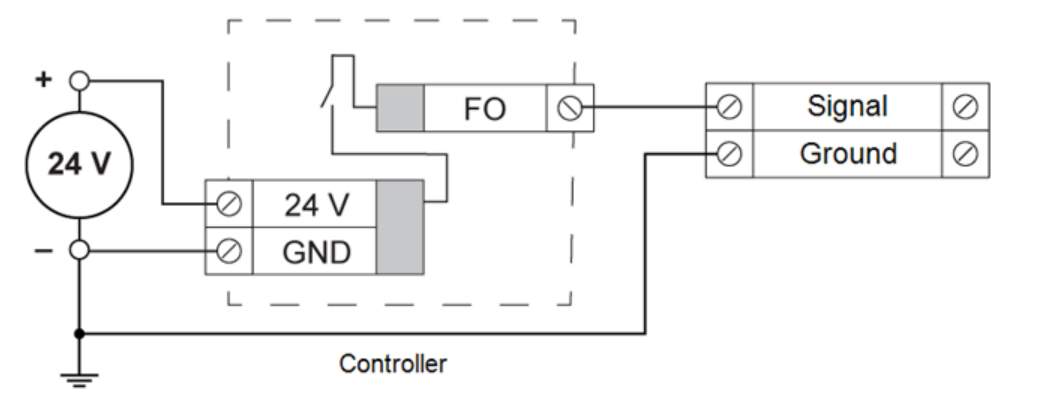


Figure 15: Solid-state relay wiring for -12 models

The universal outputs wiring diagram applies to the -12 model FLEX output (FO) when configured as a universal output, with the ground connection going to the controller's power ground (GND) terminal.

Related information

Configure the FLEX output on RC-FLEXair -12 models 73

Velocity sensor

RC-FLEXair -F models have a flow sensor that measures pressure differentials to calculate airflow.

Flow Sensor (-F Models)

- ±0-500 Pa (0"–2" WC).
- Maximum zero point accuracy 0.2 Pa (0.0008" WC).
- Resolution: 0.122 Pa (0.0005" WC).
- Span accuracy 3% of reading.
- 5.2 mm (0.2") OD fittings.
- Suitable for 1/4" OD standard pneumatic control tubing.

Connect the high-pressure or upstream tube to the controller's high flow-sensor port and the low-pressure or downstream tube to the controller's low flow-sensor port.

Always use freshly cut tubing, and press-fit the tubing directly in line with the controller's flow sensor port. Do not apply diagonal or vertical force.

Flow sensor tube material must be:

- Pneumatic-compounded polyethylene tubing.
- Flame retardant and stress-, crack-, and kink-resistant.
- Designed for pneumatic flow-control applications.

Flow sensor tube routing must be:

- Less than 1 m (3') in length.
- Directly routed.

- Free from kinks and tight bends.
- Relieved from strain and twisting.

If you remove flow-sensor tubing, cut the tubing at least 2 cm (1") away from the nearest part of the flow sensor, or you may permanently damage the controller.

Damper actuator

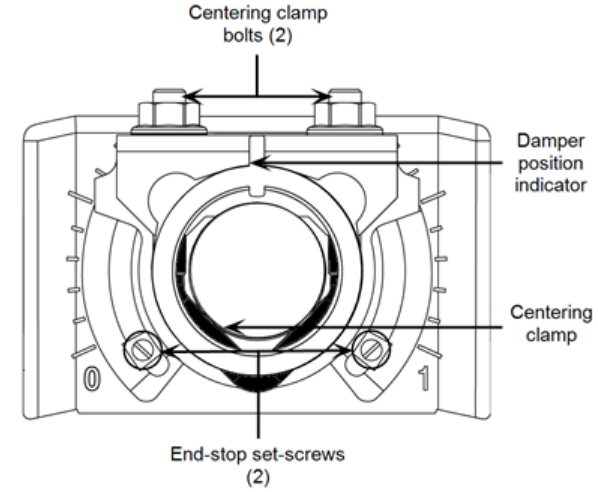
-A model controllers include an integral, direct-coupled, brushless DC actuator for damper control.

Electric Actuator (-A Models)

- Torque 5 Nm (45 in-lb).
- Damper shaft minimum length 48 mm (1 7/8").
- Rotation/stroke: Maximum 95 degrees for dampers with 90 degrees of rotation.
- Actuator speed of 1 degree of rotation per second.
- Impedance-protected brushless DC motor.
- Compatible with 10–13 mm (3/8"–1/2") diameter round or square damper shafts.

The actuator is suitable for mounting on 10-13 mm (3/8 - 1/2") diameter round or square damper shafts. The minimum damper shaft length is 48 mm (1 7/8").

The total stroke of the actuator is controlled by two (2) mechanical end-stop-set-screws. These screws must be adjusted in order to prevent the actuator from driving the damper mechanism past its limits.



If your installation has an inadequate shaft, the following accessories are available from eBusiness:

- K-LM20 coupling to accommodate up to 20 mm (3/4”) damper shafts.
- K-AM25 coupling to accommodate up to 25 mm (1”) damper shafts.
- ZG-LMSA damper shaft extender for 13 mm (1/2”) damper shafts.
- ZG-LMSA-1 damper shaft extender for 10 mm (3/8”) damper shafts.

Install the damper actuator

Verify the following before mounting the damper actuator onto the damper shaft:

- Damper shaft diameter.
- Damper shaft length.
- Damper shaft rotation direction—clockwise by default.
- Damper shaft rotation stroke.

To mount the VAV controller:

1. Insert the universal shaft coupling over the damper shaft and hold the controller so the back of the housing is flush against the air terminal unit or ductwork.
2. Rotate the damper shaft until the damper is open.
3. Finger tighten the centering clamp bolts.
4. Mount the controller using the screws provided.

To set the end stops on the actuator:

1. Loosen the centering clamp bolts.
2. Set the end-stops to match the damper shaft rotation for fully open and fully closed positions.
3. Hold the declutch button and rotate the actuator to verify the coupling cannot drive the damper past a fully open and fully closed position.

   Release the declutch button.

   Important: Press the declutch button only 80 percent of the way in to help prevent damage to the button and the circuit board it is mounted on.

4. Firmly tighten the centering clamp bolts.

To verify the installation:

1. Hold the declutch button and verify the actuator and damper rotate freely from fully open to fully closed without binding. Release the declutch button. If binding occurs, make adjustments as necessary and retest.
2. Verify the end-stop set screws are properly positioned according to the damper rotation from fully open to fully closed. Make adjustments as necessary and retest.
3. Replace the plastic damper position indicator so that the pointer aligns with the damper position in the duct.

The damper actuator is now installed on the damper shaft. When you perform the installation, leave all air terminal unit dampers fully open to maintain neutral pressure in the air system.

Open the optional conduit cover

You can order the controller with an optional conduit cover that encloses the controller's terminal blocks in protective housing for plenum-rated installations.

You can also order the conduit cover as an accessory item that includes installation instructions in the box.

ACC-RCFA-CC

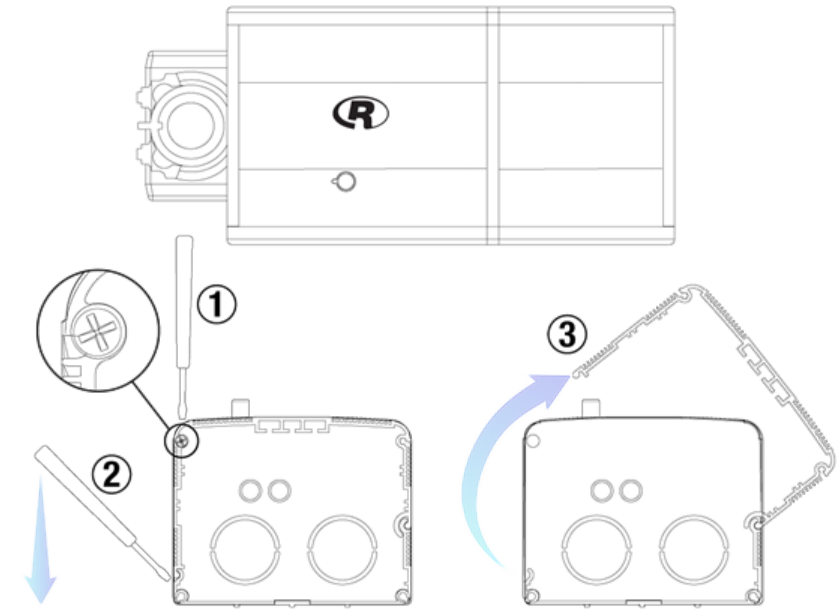
- Accessory kit to retrofit your RC-FLEXair with a conduit cover.

Optional Conduit Cover

- 75 mm conduit cover for low-voltage wires.
- Provides plenum rating to controller.
- Encloses and protects all wires.
- Accessible top cover for service.
- Two 3/4" NPT knockouts.

Follow these steps to open the conduit cover:

1. Unscrew the single screw on the backplate.
2. Gently pry the cover bottom to disengage.
3. Open the conduit cover using the hinge action or by sliding it along its runner.



Close the conduit cover and replace the screw before you put the controller into service.

Install the RC-FLEXair

The RC-FLEXair has some specific installation requirements for its unique features and accessories.

RC-FLEXair -A models are designed to be secured to the damper shaft. The RC-FLEXair should be installed indoors in a dry, relatively clean environment free from corrosive fumes. If you install the RC-FLEXair outdoors, it must be within a NEMA 4X (IP66) protective enclosure.

RC-FLEXair -A model installation

Before you mount and install an RC-FLEXair -A model, the damper actuator must be securely attached to the damper shaft as described in this manual.

RC-FLEXair -F model installation

Once you have securely mounted an RC-FLEXair -F model, connect the airflow pickup tubing to the velocity sensor ports as described in this manual. Ensure the high flow and low flow ports (total pressure and static pressure) are connected to the correct ports.

RC-FLEXair communications

This section describes how to connect to and communicate with your RC-FLEX device, from initial connection at factory-default state to when the device is configured and integrated into your building's BACnet network.

Reliable Controls offers dedicated training exercises in the Support Center to help you set up communications for your RC-FLEX device.

RC-Toolkit and your controller

Use RC-Toolkit to configure your controller's communications features and to upgrade controller firmware.

Upgrade RC-Toolkit to the latest release to support new features, improvements, and fixes.

RC-Toolkit has several tools for basic controller setup and troubleshooting:

- **MSet**: Use to set your controller's network and communication parameters.
- **OS Send**: Use to update your controller's firmware.
- **Network Diagnostics**: Use to view diagnostics for your controller to troubleshoot network issues.

RC-Toolkit includes the Panel File Utility, a separate program used to read and edit Panel Files and to rapidly duplicate and modify Panel Files to load to your controller.

Default user access settings

The factory-default user access settings used to log in to the system are stored in the host controller:

- **User**: longview.
- **Password**: Empty, no entry.

For BACnet network security best practices, refer to the *Reliable Controls Hardening Guide*, available in the Engineer tab in the Reliable Controls Support Center.

Default communications settings

This topic summarizes the factory-default communications settings and properties for RC-FLEX devices.

Default Ethernet settings

The controller ships with the following default Ethernet settings:

- **DHCP**: Enabled.
- **Device ID**: Unconfigured.

If no DHCP server is available, the controller assigns itself a link-local address using the standard link-local range of 169.254.0.0 to 169.254.255.255 with a subnet mask of 255.255.0.0.

Default MS/TP settings

The controller ships with the following default EIA-485 MS/TP settings:

- **BACnet device ID**: Not set.
- **EIA-485 baud rate**: Auto-detect.
- **End-of-Line switch**: Off.

Default USB settings

The controller ships with the following default USB port properties:

- **Quick Connect mode**: Enabled for Direct Connect connection using USB-A male-to-male cable.
- **USB driver**: Microsoft Windows Network Control Mode (NCM) driver.

Unconfigured RC-FLEX device discovery

When you connect unconfigured RC-FLEX controllers to existing networks, RC-Toolkit discovers them and applies a teal, or greenish-blue row highlight in Network view in MSet. The highlight allows you to quickly identify all discovered unconfigured RC-FLEX devices on the network.

Note: Unconfigured RC-FLEX controllers that are Direct Connect connected to the computer using a USB-A male-to-male cable are automatically put into Quick Connect mode, indicated by an orange row highlight in MSet.

When RC-Toolkit discovers unconfigured RC-FLEX controllers, the controllers display in the Local Network node and also in compatible networks in the System Tree, for example a BACnet/IP network for an Ethernet-connected RC-FLEX controller. You can then configure their Device ID and other network properties as applicable.

RC-Toolkit software version 3.4.2 and later can discover unconfigured RC-FLEX controllers running version 1.5 or later using remote connection methods such as RC-RemoteAccess. Otherwise, a local BACnet/IP connection is required to discover unconfigured RC-FLEX controllers.

Set up a new controller using RC-Toolkit

Upgrade to the latest version of RC-Toolkit to take advantage of new software features and improvements.

To set up the unconfigured RC-FLEX controller:

1. Connect the RC-FLEX controller to your network.
2. Run RC-Toolkit and connect to your network.
3. Click **MSet** to highlight the MSet tool, then click the network in the System Tree to select it and display the MSet network view worksheet.

   Unconfigured controllers have a teal, or greenish-blue row highlight in the MSet network view worksheet.
4. Enter the required information in the MSet network view worksheet to configure the controller.

   For detailed descriptions of all the MSet settings, refer to the "MSet network view worksheet" topic.

Table 1: MS/TP configuration settings

Address	Enter a unique address for the controller.
Device ID	Automatically filled if the **Device ID Auto Fill** check box is selected, otherwise enter a unique device ID.
End-of-Line	If this controller is the last physical device on the EIA-485 bus, set it to **On**. Otherwise, leave it in the default **Off** setting.
Device Name	You have the option to enter a more descriptive name for the controller.

Table 2: BACnet/IP configuration settings

IP Address	Enter the assigned static IP address if the network does not use DHCP. You must set **DHCP** to **No** to enter a static IP address.
DHCP	Select **Yes** if the network has a DHCP server assigning IP addresses. Select **No** if you are assigning a static IP address.
RSTP	Select **No**, unless you are adding the controller to an existing RSTP network.
Device ID	Enter a unique device ID.
Device Name	You have the option to enter a more descriptive name for the controller.
BACnet/IP Settings	Enter the host controller's B/IP network settings.

5. Click Send to save the device settings.
6. Wait until the save operation is complete before closing the **Device Configuration** dialog box.
7. Click or rediscover the network node to view the newly-configured RC-FLEX controllers. They are highlighted orange to indicate they are in Quick Connect mode, which allows you to reconfigure the devices if necessary. Quick Connect mode times out after 10 minutes.

Tip: You can print the MSet network view worksheet to get a complete list of devices and connection information for future network maintenance and troubleshooting.

MSet network view worksheet

Use the MSet network view worksheet to discover, view, and configure MS/TP- and BACnet/IP–networked devices in network mode.

To open the MSet network view worksheet, select the network node for a BACnet/IP or MS/TP network in the System tree.

Clicking a non-router controller in the system tree opens a version of this worksheet that shows only that single device.

The MSet network view worksheet has different options for IP-based and MS/TP networks:

- "IP-based network MSet worksheet" below
- "MS/TP network MSet worksheet" on page 47

IP-based network MSet worksheet

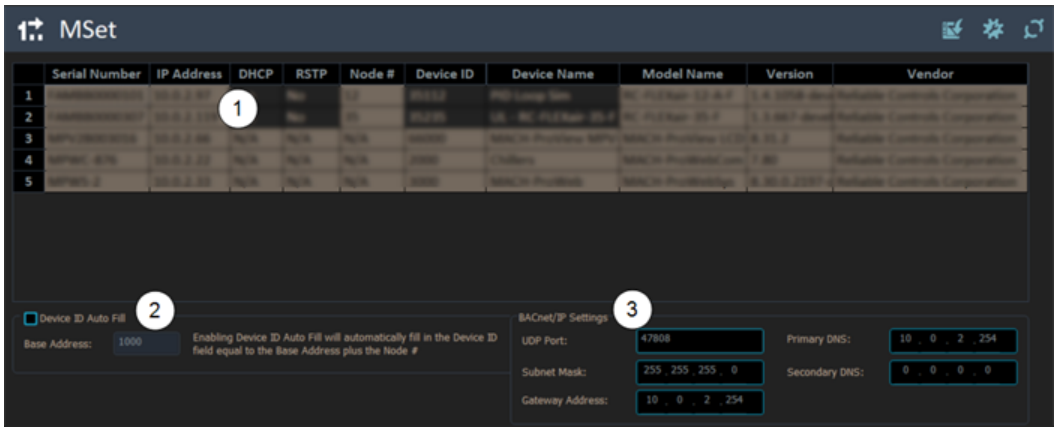


Figure 16: MSet network view worksheet for an IP-based network

Click the non-router controller in the System tree to open a version of this worksheet that shows only that single device.

Actions

Print

Prints the IP network configuration worksheet to a document or printer.

Clear Device ID

Changes the device network state to Unconfigured by clearing its saved Device ID and Address information. This option is available only when a single device is selected in the System tree.

Network Configuration

Opens the BACnet Network Configuration dialog box.

Broadcast Host Number to Subnetwork

Opens the Broadcast Host Number to Subnetwork dialog box, where you enter the host number and destination subnetwork.

Set Master Password

Changes the default master password stored in all Reliable Controls system controllers. This option is only available when you sign on with the Master Password.

① IP-based network devices

Serial number

The device serial number. This is for information only and cannot be configured.

IP address

The version 4 IP address that RC-Toolkit reads from the device. If the IP address is configurable in the MSet network view worksheet, this is the local IP address of the device. If the IP address is not configurable, go to the device's specific MSet configuration screen to confirm the device's local IP address. Because of technical limitations, devices on networks that communicate via methods other than BACnet/IP or MS/TP may display incorrect information in the IP Address column. This includes devices on BACnet Ethernet networks hosted by router-model controllers. The IP address can be a manually entered static IP address or dynamically assigned if DHCP is supported on the network and enabled for that device.

DHCP

Displays whether Dynamic Host Configuration Protocol (DHCP) is enabled or disabled and can be configured in the MSet network view worksheet for some devices. If enabled, the LAN's DHCP server automatically sets the device's IP address, subnet mask, gateway, and DNS information. If there is no DHCP server, the controller retains its last known assigned address or assigns itself a link-local address.

Note: You can use DHCP for IP-connected devices that are not configured as BBMDs.

RSTP

Displays whether Rapid Spanning Tree Protocol (RSTP) is enabled or disabled on the Ethernet port. RSTP must be disabled for Ethernet line or star topologies. There is a specific process to wire and configure Ethernet loop topologies where RSTP is enabled. Refer to the device user guide or the *Ethernet Best Practices Guide*, available in the User Guides page on the Reliable Controls Dealer Support Center, for requirements and instructions.

Node #

The setup address of an RC-FLEX device, ranging from 1 to 255. If the controller is not configured with a value in the Device ID column and you select **Device ID Auto Fill** and edit the Node # column, RC-Toolkit generates the Device ID using the value in the Node # column and the value entered in the Base Address box. Use Node # and Device ID Auto fill to generate sequential device IDs for the BACnet/IP terminal devices hosted on a single network. This property is not applicable to other IP-based network devices.

Device ID

The BACnet device ID must be a unique number on the BACnet internetwork, limited to between 1 and 4,194,302, and is configurable in the MSet network view worksheet for some devices. If the controller is not configured with a value in the Device ID column and you select **Device ID Auto Fill** and edit the Node # column, RC-Toolkit generates the device ID using the value in the Node # column and the value entered in the Base Address box. Delete the device ID on a configured controller to put the controller in an unconfigured state and enable the default configuration port.

Note: Do not use device ID 0. Using zero can cause issues with older BACnet software and zero is not supported by RC-Studio.

Device Name

The name of the device. This is the device model name by default; you can edit it to be more descriptive.

Model Name

The device model name. This is for information only and cannot be configured.

Version

The version of firmware currently running on the device. This is for information only and cannot be configured. Use OS Send to upgrade Reliable Controls device firmware.

Vendor

The BACnet device vendor. Use RC-Toolkit to configure Reliable Controls devices only.

② Device ID Auto Fill

To assign automatic device IDs to your controllers, select **Device ID Auto Fill**, and change the value in the Base Address box from the default value. Edit the value in the Node # column for an IP-based network device to automatically generate the device ID.

Base Address

Enter the base address used to automatically generate device IDs.

③ BACnet/IP Settings

The BACnet/IP Settings area is displayed when you select an IP-based network that contains devices that are configurable using MSet network view. Click a network node to display and configure the devices on that network and assign device IDs. Once a device is given a device ID in network mode, you can open it in single device mode from the System Tree.

The following settings are by default, from the first configured device read on the network. To configure a single device, click on it in the System Tree.

Use the following options to configure the network settings:

Important: RC-Toolkit sends the updated BACnet/IP network settings only to devices that are configurable using MSet network view and have a Device ID.

UDP Port

The network BACnet/IP UDP port. Every BACnet/IP network requires a unique port number.

Subnet Mask

Defines the range of IP addresses used in the BACnet/IP network. A common subnet mask value is 255.255.255.0.

Gateway Address

The internal IP address of the router used by the BACnet/IP network to connect to other networks or the internet. This is required if the controller is configured on a wide-area network across multiple subnetworks. If all devices are on the same subnet, Gateway Address can be left blank.

Primary DNS

The IP address of a valid DNS accessible to the BACnet/IP network. A DNS allows you to use domain names instead of IP addresses.

Secondary DNS

The IP address of a valid DNS accessible to the BACnet/IP network, used if the primary DNS is not available.

MS/TP network MSet worksheet

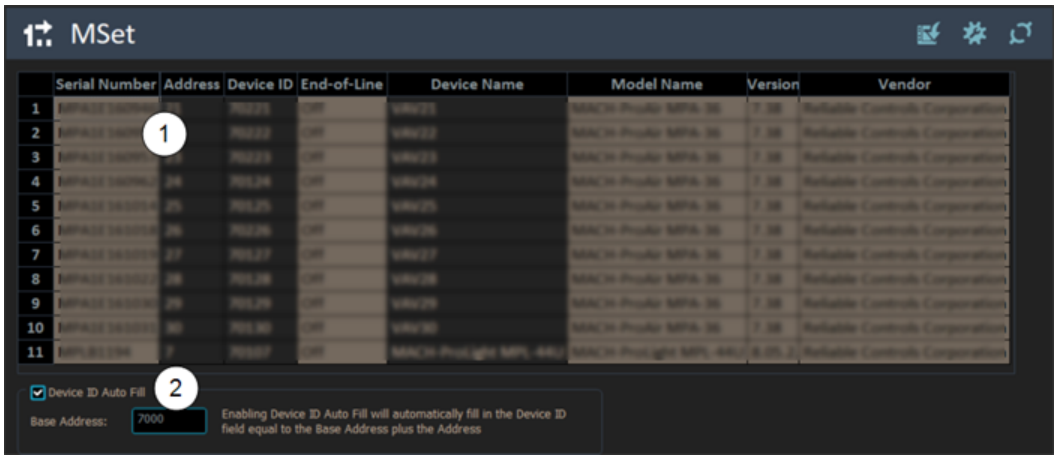


Figure 17: MSet network view worksheet for a BACnet MS/TP network

Click the non-router controller in the System tree to open a version of this worksheet that shows only that single device.

Actions

Print

Prints the IP network configuration worksheet to a document or printer.

Clear Device ID

Changes the device network state to Unconfigured by clearing its saved Device ID and Address information. This option is available only when a single device is selected in the System tree.

Network Configuration

Opens the BACnet Network Configuration dialog box.

Broadcast Host Number to Subnetwork

Opens the Broadcast Host Number to Subnetwork dialog box, where you enter the host number and destination subnetwork.

Set Master Password

Changes the default master password stored in all Reliable Controls system controllers. This option is only available when you sign on with the Master Password.

(1) MS/TP networked devices

Serial number

The device serial number. This is for information only and cannot be configured.

Address

The MS/TP address, also referred to as the MAC #, of the device on the network. The address must be unique for each device on the MS/TP network and range from 1 to 127, except for the SMART-Space Controller, where the range is 1–254. Devices that do not have an assigned address temporarily use the value entered in the Configuration MAC box.

Device ID

The BACnet device ID must be a unique number on the BACnet internetwork, limited to between 1 and 4,194,302. When you select **Device ID Auto Fill**, the device ID defaults to the base address plus the address.

Note: Do not use device ID 0. Using zero can cause issues with older BACnet software and zero is not supported by RC-Studio.

End-of-Line (EOL switch)

Displays the status of the device's End-of-Line (EOL) switch. The EOL switch for all devices communicating on the same MS/TP network should be Off, except for the last device at the physical end of the EIA-485 network—that device's EOL switch should be the only one that is On. For RC-FLEX MS/TP devices, click the End-of-Line cell to toggle the switch On or Off. N/A indicates the End-of-Line property for that device is unknown or not available.

Device Name

By default, the device name is the device model name. You can change the device name to be more useful for your implementation. For example, name the device according to the building area or room number where it is located.

Model Name

The device model name. This is for information only and cannot be configured.

Version

The version of firmware currently running on the device. This is for information only and cannot be configured. Use OS Send to upgrade Reliable Controls device firmware.

Vendor

The BACnet device vendor. Use RC-Toolkit to configure Reliable Controls devices only.

(2) Device ID Auto Fill

For controllers not configured with a value in the Device ID column, if you select **Device ID Auto Fill**, RC-Toolkit generates the device ID based on the value in the Address column and the value entered in the Base Address box.

Base Address

Enter the base address used to automatically generate device IDs.

Direct Connect with B/IP (USB/Ethernet)

Connect your RC-FLEX device directly to a computer port using a USB-A male-to-male cable or an Ethernet cable. Direct Connect B/IP (USB/Ethernet) is intended as a temporary connection method—for example, to configure an unconfigured RC-FLEX device in RC-Toolkit, or to troubleshoot a configured RC-FLEX device.

Direct Connect B/IP (USB/Ethernet) uses the default configuration port to establish connection between the computer and the RC-FLEX device. This configuration port is enabled by default on unconfigured RC-FLEX controllers. For configured RC-FLEX controllers, you can temporarily enable the default configuration port by putting the controller in Quick Connect mode. Controllers in Quick Connect mode display in orange highlight on the RC-Toolkit MSet screen.

The recommended Direct Connect B/IP (USB/Ethernet) method for RC-Toolkit is to use a USB-A male-to-male cable, as it provides a fast local connection when you have easy access to the physical RC-FLEX device. RC-Toolkit immediately connects to the device, whether it is configured or unconfigured.

To make a Direct Connect B/IP (USB/Ethernet) connection to a controller:

1. Connect the computer to the unconfigured RC-FLEX device. If the RC-FLEX device is already configured, put it in Quick Connect mode.
2. Start RC-Toolkit or RC-Studio.
3. In the Systems List toolbar, click **Direct Connect** ⇄, then click **BIP (USB/Ethernet)** to make the Direct Connect with BIP (USB/Ethernet) connection.

Default USB settings

The controller ships with the following default USB port properties:

- **Quick Connect mode**: Enabled for Direct Connect connection using USB-A male-to-male cable.
- **USB driver**: Microsoft Windows Network Control Mode (NCM) driver.

USB connections in RC-Toolkit

Quick Connect mode is automatically set on the RC-FLEX device when you connect its USB-A port to a USB-A port on the computer running RC-Toolkit.

Note: This feature is available on RC-FLEX controllers with firmware version 1.5 or later and RC-Toolkit software version 3.4.2 or later.

The USB-connected device is highlighted orange in MSet Network view to indicate it is in Quick Connect mode. The device remains in Quick Connect mode as long as the USB cable is connected.

Quick Connect mode and the highlight remain active for a few minutes after you disconnect the USB cable, then the highlight and Quick Connect mode turn off.

After you connect the USB cable between the RC-FLEX controller and the computer, start RC-Toolkit, click the **Direct Connect** ⇌ icon, then click **B/IP (USB/Ethernet)**.

Unconfigured RC-FLEX controller

An unconfigured USB direct-connected RC-FLEX controller displays by itself in the Local Network node and also in all available networks in the System Tree.

Note: This behavior is unique for unconfigured RC-FLEX devices using the Direct Connect USB connection method.

Configured RC-FLEX controller

RC-Toolkit displays the MSet Network view where the configured USB direct-connected RC-FLEX controller resides. The network is expanded in the System Tree with the USB direct-connected RC-FLEX icon automatically selected. If you click **Local Network**, RC-Toolkit automatically selects the USB direct-connected RC-FLEX controller and displays it in its home network in the MSet Network view.

Set up a new RC-FLEX controller using USB

This describes how to use the USB-A port of a computer running RC-Toolkit to configure the network settings for a brand-new, factory-default RC-FLEX controller. Quick Connect mode is automatically set on the RC-FLEX device when its USB-A port is connected to the computer's USB-A port.

Important: The USB connection is for short-term configuration or troubleshooting. Leaving the USB connected to the workstation can cause network issues.

To configure a new RC-FLEX controller:

1. Connect the computer's USB-A port to the RC-FLEX controller's USB-A port using a USB-A cables and a USB-A hub.

Important: Always route USB connections through a USB hub with a good quality USB cable to help protect equipment and resolve protocol differences.

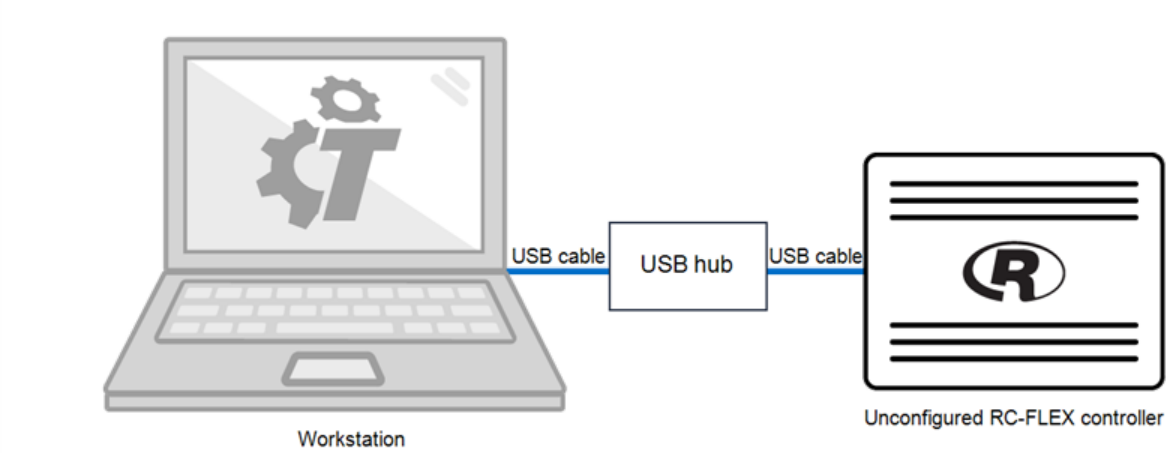


Figure 18: Typical USB direct connection from workstation to RC-FLEX controller

2. Start RC-Toolkit.
3. Click **Direct Connect** then click **B/IP (USB/Ethernet)**.
   The RC-FLEX controller displays by itself in the Local Network node. The controller is highlighted orange to indicate it is in Quick Connect mode.
4. Configure the controller's communications settings:
   - For the dual Ethernet model RC-FLEX controller, enter a unique device ID in the **Device ID** column, then fill in the Ethernet communications settings under **BACnet/IP Settings**.
   - For the MS/TP only (-M) model RC-FLEX controller, enter a unique device ID in the **Device ID** column.
5. Click Send.

Related information

RC-FLEXair USB 30

RC-FLEX USB driver information

The required USB driver is defined by the controller's firmware version:

- Firmware version 1.5 or later: The controller's USB port uses the Microsoft Windows Network Control Mode (NCM) driver. NCM is included in Windows 10 version 1903 (build 18362) or later, and Windows 11 version 21H2 (build 22000) or later.
- RC-FLEXair firmware versions 1.4.1 or earlier: The controller's USB port driver uses the Remote Network Driver Interface Specification (RNDIS) driver. Refer to the "USB support for older firmware" topic for instructions on how to download and install this driver.

Note: For optimum USB support we recommend you update the controller to the latest firmware.

USB support for older firmware

The following information applies only to controllers with firmware version 1.4.1 or earlier.

If your computer has trouble communicating with the RC-FLEX controller through USB, you may need to install or update the RNDIS driver.

Note: The Remote Network Driver Interface Specification (RNDIS) is a Microsoft proprietary protocol used mostly on top of USB to provide a virtual Ethernet link to most versions of Windows or Linux over USB.

To install or update the USB driver:

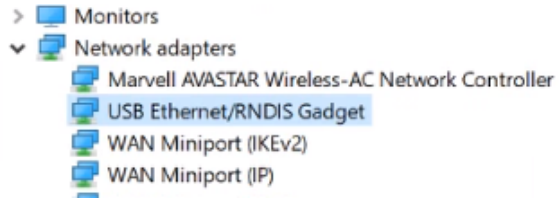
1. Go to the **Reliable Controls Support Center > Technical > Troubleshooting**: https://www.reliablecontrols.com/support/technical/troubleshooting.php
2. Click **USB Driver** to download the zip file that contains the RNDIS USB driver.

   Note: The RNDIS USB driver is also available from Microsoft.

3. Extract the contents of the downloaded zip file to a folder.
4. Navigate to the folder, right-click RNDIS.inf, and click **Install**. Click **Yes** to allow the app to make changes to the device.
5. Connect the workstation USB port to the RC-FLEX controller USB port.

   Important: Always route USB connections through a USB hub with a good quality USB cable to help protect equipment and resolve protocol differences.

6. Go to Device Manager on your workstation to confirm the USB connection to the controller. The driver is listed as a network adapter with a name that contains RNDIS.



You should now be able to use Reliable Controls software to connect to the RC-FLEX controller using Direct Connect > B/IP (USB/Ethernet).

Dual Ethernet RC-FLEXair communications

This section describes how to connect to and communicate with the dual-Ethernet model RC-FLEX controller.

The controller ships from the factory unconfigured, with default settings designed for easy BACnet/IP network installation. To configure the controller, enter a unique device ID for the controller and the BACnet network's UDP port number. By default the controller ships with DHCP enabled, but can be configured with a static IP address.

Refer to the *Ethernet Best Practices Guide*, available from the Reliable Controls Support Center, for Ethernet network examples, recommended topologies, network and device numbering conventions, and troubleshooting.

Ethernet network requirements

Unitary dual Ethernet RC-FLEX devices are designed to be installed on a BACnet/IP network hosted by a router-model controller such as a MACH-ProCom, not as standalone Ethernet devices.

The controller ships with DHCP enabled by default for easy installation into a local area network with a DHCP server. The RC-FLEX device must be hosted on a BACnet/IP network managed by a router-model host controller such as a MACH-ProCom. You can also manually enter a static IP address if needed.

You cannot configure the RC-FLEXair or RC-FLEXone as a BACnet Broadcast Management Device (BBMD).

You must use a local BACnet/IP connection to make the initial connection to a factory-default RC-FLEX controller.

Default Ethernet settings

The controller ships with the following default Ethernet settings:

- **DHCP**: Enabled.
- **Device ID**: Unconfigured.

If no DHCP server is available, the controller assigns itself a link-local address using the standard link-local range of 169.254.0.0 to 169.254.255.255 with a subnet mask of 255.255.0.0.

Connect to an existing BACnet/IP network

This procedure describes how to use RC-Toolkit to discover the RC-FLEX controller by connecting it to an existing BACnet/IP network.

1. Connect the RC-FLEX controller's Ethernet port to the local BACnet/IP network.
2. Run RC-Toolkit and connect to the system.
3. Click **MSet** to highlight the MSet tool, then click the network in the System Tree to select it and display the MSet network view worksheet.
    - If the RC-FLEX controller is unconfigured, it appears with a teal, or greenish-blue highlight in the network view worksheet. The highlighting does not turn off until after the controller is configured.

- If the RC-FLEX controller is already configured and does not appear in RC-Toolkit, place the controller in Quick Connect mode, then rediscover the network. RC-FLEX controllers in Quick Connect mode appear with an orange highlight in the network view worksheet. Quick Connect mode and the highlighting automatically turns off after 10 minutes.

4. Use the **MSet** tool to select the controller and configure its communications settings.
5. Click **Send** to save the changes to the controller.

You can now connect to your controller using RC-Studio to manage, program, and view your controller information.

Set up an Ethernet ring with RSTP

Rapid spanning tree protocol (RSTP) allows devices in a managed Ethernet network to be connected in a ring or loop topology. This communications methodology provides Ethernet redundancy, so if one device in the Ethernet ring loses communication, all other devices before or after that lost device maintain Ethernet communications.

The Ethernet ring network can contain up to a maximum of 40 RC-FLEX devices, in addition to the dedicated managed network switch.

Required equipment: A dedicated managed network switch to isolate the ring bridge protocol data unit (BPDU) traffic from the rest of the Ethernet network.

1. Identify and label the managed switch ports to be used for uplink port, ring port 1, and ring port 2.
2. Connect the managed switch uplink port to the DHCP router or switch that links to the rest of the Ethernet network.
3. Connect ring port 1 to the first Ethernet ring network device, then connect the rest of the Ethernet ring network devices in a straight-line topology.

   Note: Do not connect ring port 2 until you have configured all the networked devices in the Ethernet ring.

4. Configure the managed network switch ports. Refer to "Set up the managed network switch" for more information:
   - Uplink port: Block ring BPDU traffic.
   - Ring ports: RSTP/STP.
5. Configure all the Ethernet ring networked devices using the MSet tool in RC-Toolkit:
   a. Select the network that contains the Ethernet ring.
   b. Set the RSTP cell on all devices in the Ethernet ring to **Yes**. Double-click the RSTP cell for the controller to toggle between Yes (RSTP enabled) or No (RSTP disabled).
6. Connect the other end of the Ethernet network ring to the managed switch ring port 2.

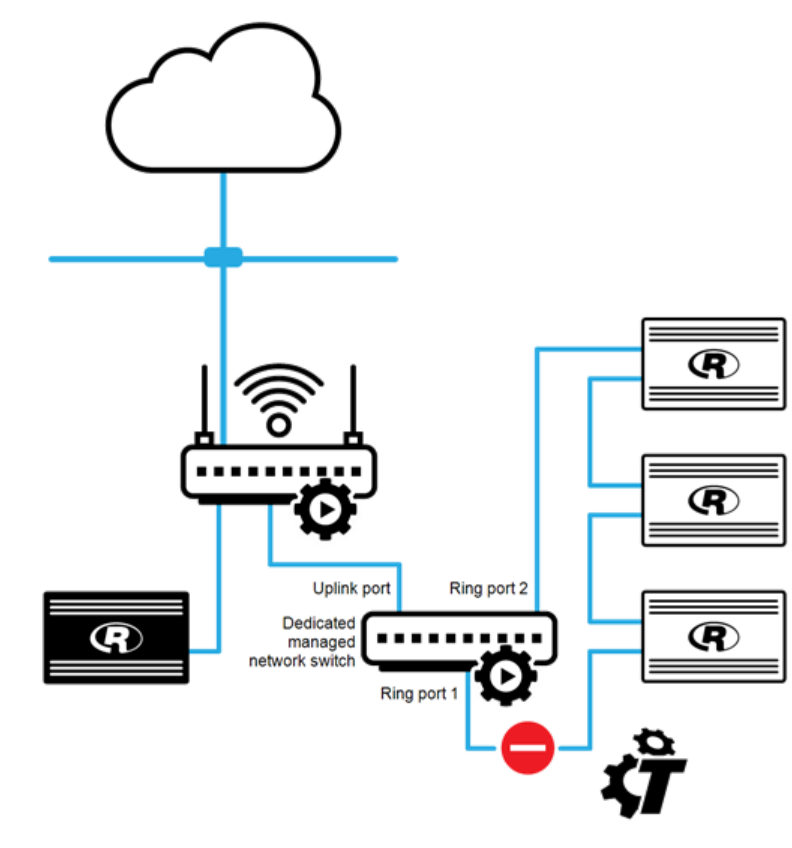


Figure 19: Ethernet ring topology with a dedicated managed network switch

Related information

Ethernet ring or loop topology 25

RSTP and RC-FLEX controllers

Enable rapid spanning tree protocol (RSTP) to configure RC-FLEX controllers in an Ethernet ring topology.

The Ethernet ring topology improves network resilience by providing connection redundancy. Because each Ethernet port is connected into the ring, if the ring is broken in one location, the controller can access the network through the other part of the ring.

You must follow the specific process to implement an operating Ethernet ring topology network, which involves configuring the Ethernet devices using RC-Toolkit. If you do not follow the correct process, you will lose Ethernet communications.

Each Ethernet ring can support 40 RC-FLEX controllers in addition to the managed network switch. The managed network switch is critical to isolate the RSTP network's ring bridge protocol data unit (BPDU) traffic from the rest of the network.

Neighbor detection, or link layer discovery, is part of the RSTP implementation on RC-FLEX controllers. Network tools used by IT specialists can access this information to identify broken links or device offline issues without needing knowledge of BACnet.

IT specialists can use third-party network troubleshooting tools to identify broken link or device offline issues

RC-FLEX controllers have additional proprietary BACnet properties you can use in a System Group to manage, maintain and troubleshoot your network. These properties include the RC-FLEX controller's Ethernet ports status and information about neighboring devices.

Set up the managed network switch

For an Ethernet network ring, you must have a dedicated managed network switch to isolate ring BPDU traffic from the rest of the network.

Many managed network switches perform this function.

Reliable Controls does not recommend a specific managed network switch. Contact the Application Engineering team for information about managed network switches that they have successfully implemented in the field.

To configure the dedicated managed network switch:

1. Select STP switching.
2. Enable two ports, one for ring port 1 and one for ring port 2.
3. Disable all other outgoing ports.
4. Enter the following Classic Spanning Tree (CST) protocol settings:
   - **Bridge Priority**: 0
   - **Bridge Max Age (secs)**: 40
   - **Bridge Forward Delay (secs)**: 30
   - **Spanning Tree Max Hops**: 40
5. Enter the following Spanning Tree Protocol (STP) settings:
   - **Spanning Tree State**: Enable
   - **STP Operation Mode**: RSTP

Example for reference only

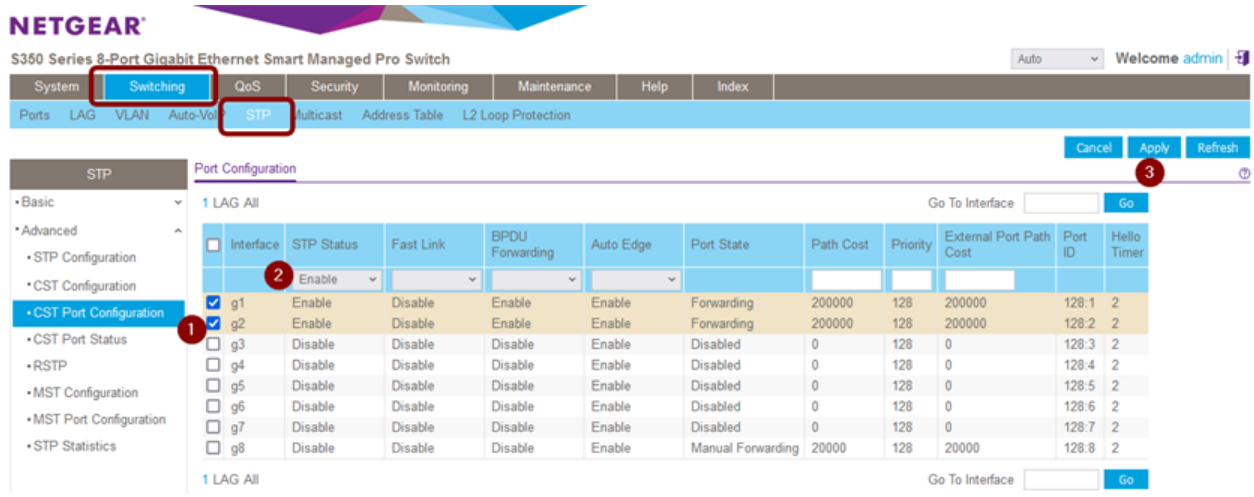
Reliable Controls used this example to configure a Netgear GS308T managed switch. This process is intended to only provide guidance when configuring managed network switches. Consult the manufacturer's documentation for setup instructions for your managed network switch.

1. Connect to the Netgear switch configuration webpage.
   Refer to Netgear switch STP configuration.
2. Select **Switching > STP** in the top menu tabs.
3. Select **Advanced > CST Port Configuration** is the left-hand **STP** menu.
4. Enable the two physical ports used for ring port 1 and ring port 2.
5. Disable all other ports.
6. Click **Apply**.
7. Select **Advanced > CST Configuration** in the left-hand **STP** menu.

8. Enter the following settings in the **CST Configuration** screen and click **Apply**:
   Refer to Netgear switch CST configuration.
   - **Bridge Priority**: 0
   - **Bridge Max Age (secs)**: 40
   - **Bridge Forward Delay (secs)**: 30
   - **Spanning Tree Max Hops**: 40
9. Select **Advanced > STP Configuration** in the left-hand **STP** menu.
10. Enter the following settings in the **Global Settings** area, and click **Apply**:
    Refer to Netgear switch Global Settings configuration.
    - **Spanning Tree State**: Enable
    - **STP Operation Mode**: RSTP
    - **Forward BPDU while STP Disabled**: Disable

STP configuration

Configuration screens may display differently for different products and product revisions.

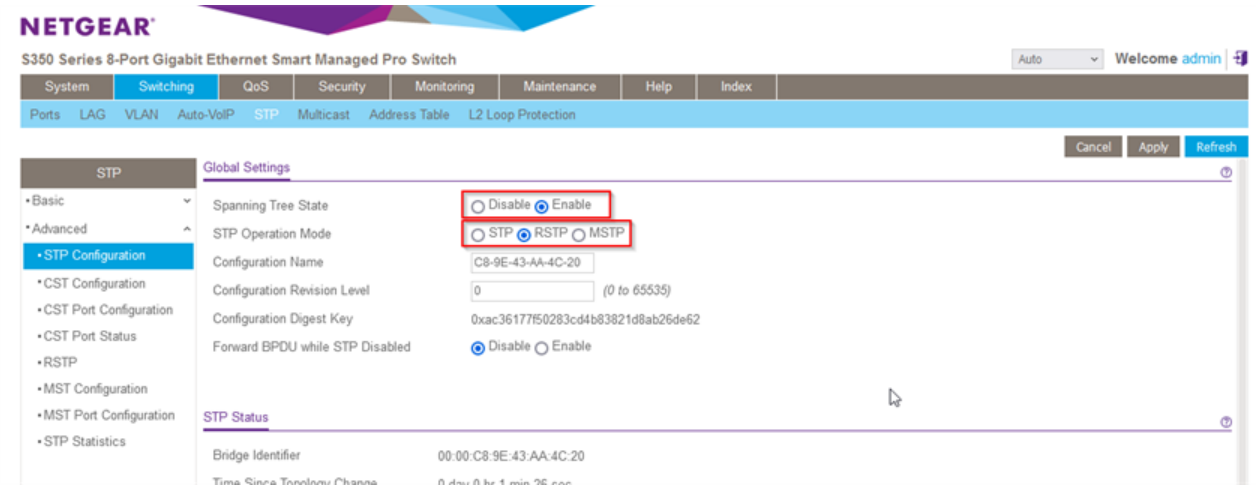


CST configuration

Configuration screens may display differently for different products and product revisions.

Global settings configuration

Configuration screens may display differently for different products and product revisions.



RC-FLEX Ethernet ring alarms

All devices with Rapid Spanning Tree Protocol (RSTP) enabled in a managed Ethernet ring monitor the network for communications problems such as an unplugged or broken cable in the Ethernet ring. When this happens, RC-Studio triggers an alert about the broken communications link.

The following examples show how RSTP monitors the state of the Ethernet network:

Example 1: RSTP normal operation

The System Group below shows the normal state of the Ethernet ports, where 1 = working properly and 2 = blocked by RSTP:

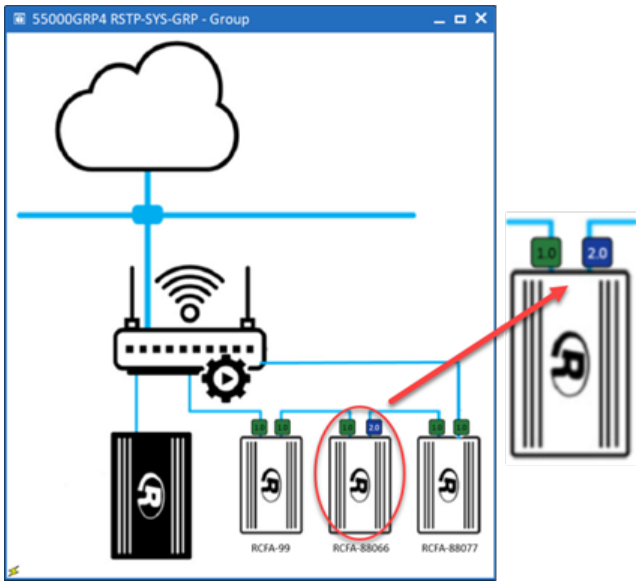


Figure 20: RC-Studio System Group with RSTP blocked state

Example 2: Ethernet cable unplugged or broken

The System Group below shows the states of the Ethernet ports when the cable that connects the first and second RC-FLEX devices is disconnected or broken, as indicated by port state 0 = Ethernet port is down or communications link is not working:

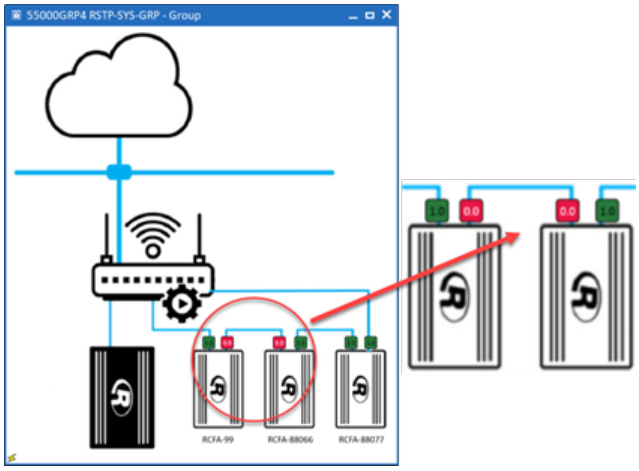


Figure 21: RC-Studio System Group with a broken Ethernet link

The RC-FLEX devices alert the system about the broken communications link status and send alarms. In this example, the first device reports its Ethernet port 2 has lost communications, and the second device reports its Ethernet port 1 has lost communications:

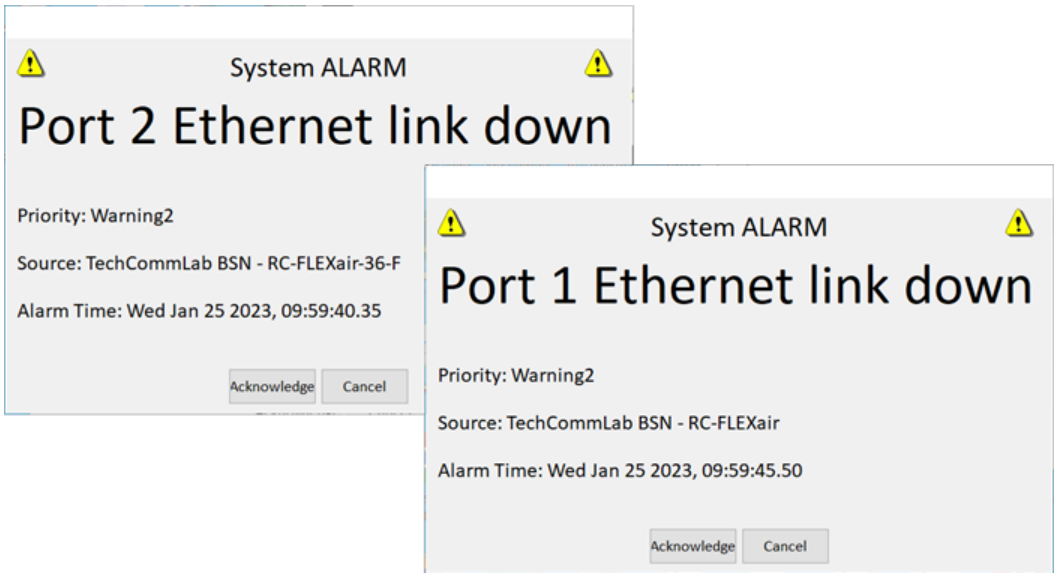


Figure 22: RC-Studio alarm messages show device and Ethernet port information for the broken link

MS/TP (-M) model RC-FLEXair communications

This section describes how to connect and communicate with the MS/TP model RC-FLEXair (-M) controller.

The MS/TP model RC-FLEXair controller uses BACnet protocol to communicate over its EIA-485 port. The controller ships from the factory unconfigured. Use one of the following connection methods to configure the controller:

- A computer running RC-Toolkit.
- The SETUP-Tool or a SMART-Sensor EPD in MSet mode.

EIA-485 networking requirements

MS/TP (-M) model RC-FLEX devices and other BACnet MS/TP devices are designed to be wired to the EIA-485 port of a router-model controller such as a MACH-ProCom, which hosts and manages all BACnet communications on its MS/TP-Net port..

Default MS/TP settings

The controller ships with the following default EIA-485 MS/TP settings:

- **BACnet device ID**: Not set.
- **EIA-485 baud rate**: Auto-detect.
- **End-of-Line switch**: Off.

Baud rate configuration

The controller is factory-set with the baud rate set to auto-detect so you can easily add it to an existing MS/TP network.

When you configure your controller over an MS/TP network, part of that configuration should include setting a fixed baud rate. Use the MSet tool in RC-Toolkit to set the baud rate for all devices on the network. Some devices allow you to set the baud rate on each device individually.

Note: You cannot set the baud rate on an individual MS/TP-only controller; instead you must use the MSet tool in RC-Toolkit to set the baud rate for all devices on the MS/TP-Net network.

How auto-detect works

When the controller powers up in auto-detect mode, it listens on the default baud rate of 76800 for valid MS/TP communication.

- If the controller detects a valid MS/TP frame, which indicates an active, functioning MS/TP network, it starts normal MS/TP communications at that baud rate.
- If the controller detects invalid network activity, it waits for a period of time, then goes back through the auto-detect process of listening on the different baud rates for valid MS/TP network communications.
- If the controller does not detect valid MS/TP communications, the controller goes to the next lowest baud rate to listen for valid MS/TP communications.
  - If the controller cycles through all the baud rates and does not detect any valid MS/TP communication, it returns to the default baud rate and listens to determine its next action.
  - If the controller does not detect any network activity for a set period of time, it assumes it is the only manager on the network. The controller generates its own token and communicates over MS/TP at the default baud rate.

Why set a fixed baud rate?

If you have a simple MS/TP network, with short cable runs and devices with similar power-up durations that operate at the default baud rate of 76800, you may not have any issues with leaving your device's baud rate in auto-detect.

If you have a complex MS/TP network, with subnetworks, long cable runs, and devices with different power-up durations from different manufacturers that do not operate at the default baud rate of 76800, setting a fixed baud rate helps your MS/TP network recover from a power cycle or reset.

Auto-detect can cause MS/TP network issues if the following conditions are present:

- If the device that defines the network's baud rate—the baud manager—has a long power-up duration, during the delay the other devices on the network define the network's baud rate and start communicating. If the baud rates are different, the baud manager can't communicate on the MS/TP network.
- If the network has long and noisy cable runs, devices in auto-baud always detect network errors. This can put auto-baud devices in a condition where they continuously cycle through the different baud rates, but because they do not find any valid MS/TP communications, they cannot detect the correct network baud rate.

For more information, refer to *Application Notice 14, EIA-485 Wiring Types*, and *Application Notice 20, Troubleshooting EIA-485 Networking Problems*, available on the Reliable Controls Support Center.

For these reasons, Reliable Controls recommends setting a specific baud rate on all MS/TP networked devices.

Note: Use RC-Toolkit to send a network configuration message that sets the baud rate for all devices on the MS/TP network.

Identify and troubleshoot auto-detect baud rate issues

Observe the controller's status LED. If it is flickering green, it is communicating normally on the MS/TP network. If it is green and blinking on/off, there is a network communication issue.

Connect an MSet Tool to the controller to view the current baud rate.

Connect to your network using RC-Toolkit, select an MS/TP device, and select the Network Diagnostics tool. In the Network Diagnostics tool, click **Advanced**, and select **MS/TP** to view information about the MS/TP network. The following list of values can help you identify issues related to auto-detect baud rate settings:

- **Link speed**: The baud rate, which should be the same value for all devices on the MS/TP network.
- **Baud changes** : The number of times the baud rate has changed. If this value is increasing, it could indicate an auto-detect race condition.
- **Total UART errors**: The total number of UART errors. If this value is increasing, it could indicate data at other baud rates on the network.

Refer to RC-Toolkit online help for detailed information about the Network Diagnostics tool.

Connect to an existing MS/TP network

This procedure describes how to use RC-Toolkit to discover the new controller after connecting it to the MS/TP port of a host controller in an existing BACnet MS/TP network.

The following features let you add one or more new controllers to an existing MS/TP network without causing network conflicts:

- **Auto-Baud**: The controller senses the network baud rate and automatically configures itself to communicate at the same rate.
- **Undefined device ID**: The controller ships with undefined BACnet device ID and MAC, so you can add new units to an MS/TP network without creating address conflicts.

To connect to the new controller:

1. Run RC-Toolkit, and connect to the BACnet network that contains the host controller.
2. In the System Tree, right-click the top node, then click **Rediscover Network**.
   Any new devices are populated as nodes in the System Tree.
3. Use the **MSet** tool to select the controller and configure its communications settings.
4. Click **Send** to save the changes to your controller.

You can now connect to your controller using RC-Studio to manage, program, and view your controller information.

Set up MS/TP communications using the SMART-Sensor MSet Tool

Use the SETUP-Tool or a SMART-Sensor EPD (SS3-E) in MSet Tool mode to configure communications on a Reliable Controls controller.

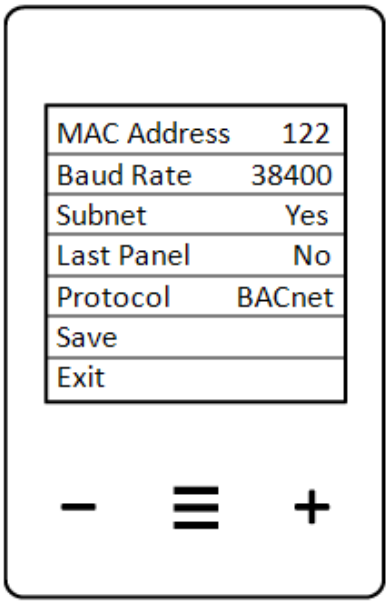


Figure 23: SMART-Sensor EPD in MSet Tool mode

To put a SMART-Sensor EPD in MSet Tool mode and configure your controller:

1. Connect the SMART-Sensor to the controller's SMART-Net port.
2. Hold − and + for 5 seconds and then release.
3. Wait for 2 seconds.
4. Tap −.
   The Dealer Menu appears.
5. In the Dealer Menu, use **list** ☰ to select the **MSet** row.
6. Tap + to enter the MSet Tool menu.
7. In the MSet Tool menu, tap **list** ☰ to select the next configurable parameter. Use − and + to modify parameters.
8. Tap **list** ☰ to select the **Save** row.
9. Tap + .
   The SMART-Sensor sends the modified parameters to the controller.
10. Tap **list** ☰ to select the **Exit** row.
11. Tap + to return the SMART-Sensor to normal operation.

Note: For more information about the SMART-Sensor and MSet Tool, see the SMART-Sensor product documentation, available from the Reliable Controls Support Center.

Direct connect to controller using X-Port-2

Use the X-Port-2™ Converter to establish MS/TP-Net communications between a workstation running Reliable Controls software and the controller.

Figure 24: Computer connection to the controller's SMART-Net and MS/TP ports using the X-Port-2

1. Determine the cable you need, based on the type of SMART-Net port available on your controller:

Controller SMART-Net port type	eBusiness part #	Controller connections
RJ11 socket	SS-VC-C	RJ11 connector to the controller's SMART-Net RJ11 socket
5.0 mm 4-pin terminal socket	CC-MULTI-XP2	2-wire 5.0 mm connector to the controller's MS/TP-Net 2-pin terminal socket 4-wire 5.0 mm connector to the controller's SMART-Net 4-pin terminal socket
3.5 mm 4-pin terminal socket	CC-MULTI-XP2	2-wire 3.5 mm connector to the controller's MS/TP-Net 2-pin terminal socket 4-wire 3.5 mm connector to the controller's SMART-Net 4-pin terminal socket

2. Insert the cable's RJ11 plug to the X-Port-2 Converter's SMART-Net port, then connect the other end to the controller.
   The Network Status LED flashes.
3. Wait until the PC/Modem Status LED on the X-Port-2 flashes once per second.
   This indicates the communications connection from controller to X-Port-2 is established.
4. Connect the workstation's USB port to the X-Port-2 Converter's PC/Modem port using the CNV-USB-232 (USB to DB9) adapter cable, CC-C1-B (DB9 to RJ11) adapter base and CC-C1-C (RJ45 data) cable.

5. Open Microsoft Windows Device Manager and identify the COM port number corresponding to the USB port that is connected to the adapter cable.
6. Open RC-Toolkit, click **Options > Communications Preferences**.
7. Under Direct set the **Port** to the same COM port number as above.
8. Click Direct Connect ⇌ to initiate communications between RC-Toolkit and the controller.

Note: You can purchase adapters, cables and accessories from eBusiness.

Reset button

To prevent unintended activation, the reset button is recessed within a small opening in the controller's housing. Use a small screwdriver to reach the reset button.

The reset button:

- Clears the controller database, or clears the controller database and resets the controller network settings to factory defaults.
- Places the controller in Quick Connect mode.
- Turns on or turns off the End-of-Line function on the MS/TP (-M model) RC-FLEX controller.
- Identifies the controller with an orange highlight in the RC-Toolkit MSet network view.

Reset the controller

Use the reset button to clear the controller database or reset the controller to its original factory default settings:

- Clearing the database: Deletes the controller's Panel File and stored database information, such as trend log data, alarm buffers, Net Ins and Net Outs and programs. Controller network settings, such as device ID, are retained.
- Resetting the controller to factory defaults: In addition to deleting the controller's database, all network configuration for the controller are deleted and reset to factory defaults.

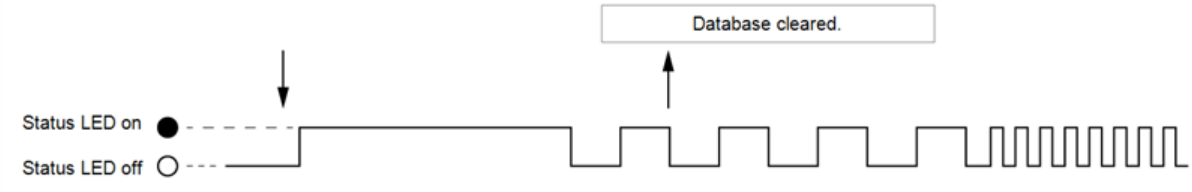
The controller's firmware is not affected by resets.

Important: Before you begin, back up the controller's Panel File. If resetting the controller to factory defaults, make note of the controller's network settings or print the controller's MSet setting in RC-Toolkit.

Clear the controller database

1. Disconnect or remove power from the controller.
2. Press and hold the reset button.
3. Keep holding the reset button while you reconnect power to the controller.
   The Status LED lights up.

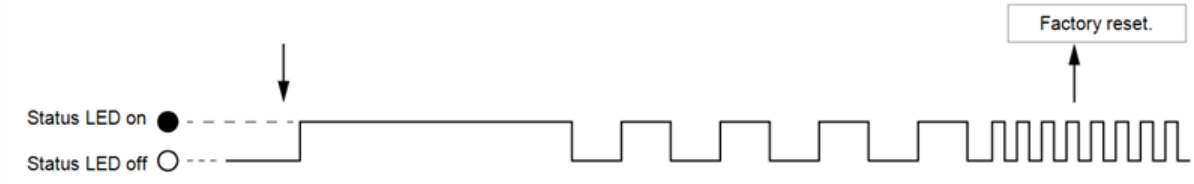
4. Continue holding the reset button and observe the Status LED behavior change from solid on to a slow two-seconds on and two-seconds off blink pattern: this indicates that the controller database has been cleared. The blink pattern transition can occur anytime between approximately 10 to 25 seconds.



5. Release the reset button.

Reset to factory default settings

1. Disconnect or remove power from the controller.
2. Press and hold the reset button.
3. Keep holding the reset button while you reconnect power to the controller.
   The Status LED lights up.
4. Continue holding the reset button and observe the Status LED behavior change from solid on to a slow two-seconds on and two-seconds off blink pattern. Keep holding the reset button.
5. Observe the Status LED behavior change to a rapid two flashes per second pattern: this indicates that the controller has been reset to factory defaults. This could take over 35 seconds.



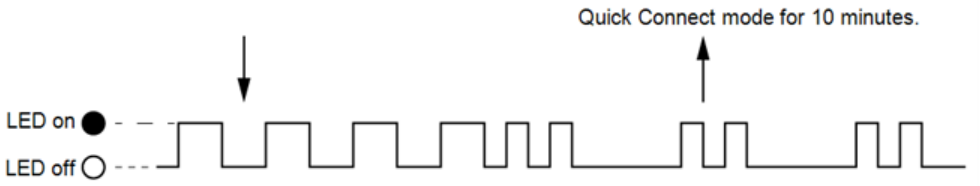
6. Release the reset button.

Quick Connect mode using the reset button

You can use the RC-FLEX controller reset button to place the controller in Quick Connect mode for 10 minutes:

1. Confirm the controller is powered on and the status LED indicates normal operation.
2. Press and hold the reset button on the powered controller for at least three seconds.
3. Release the reset button when the LED blink pattern changes to two rapid flashes every two

seconds. This flash pattern indicates the controller is in Quick Connect mode.



While in Quick Connect mode, the controller appears with an orange highlight in the RC-Toolkit MSet network view. Quick Connect mode and the orange highlighting turns off after 10 minutes.

See the "Quick Connect mode" topic for a detailed description of this feature.

Turn on or turn off the End-of-Line function

The End-of-Line function controls a soft switch that connects or disconnects a biasing resistor across the EIA-485 terminals. The EOL LED is on if the biasing resistor is connected, and off if the resistor is not connected.

If the MS/TP (-M model) controller is the last physical device on the EIA-485 network, turn End-of-Line on. You can use RC-Toolkit, a SETUP-Tool, a SMART-Sensor in MSet mode, or the controller's reset button to turn End-of-Line on or off. The default setting for End-of-Line is off.

To turn on End-of-Line using the reset button:

1. Ensure the controller is powered on.
2. Insert a small screwdriver in the hole where the recessed reset button is located.
3. Double-press the reset button.
4. Confirm the EOL LED illuminates to indicate that End-of-Line is on.

Use this same procedure to turn off End-of-Line and confirm that the EOL LED is off.

Identify an RC-FLEX controller using RC-Toolkit

You can temporarily highlight a controller in the RC-Toolkit MSet network view worksheet with a short press of the reset button. This feature can help troubleshoot or validate the physical location of a networked RC-FLEX controller. The orange highlight turns off after 10 minutes.

Note: This procedure does not enable Quick Connect mode.

1. Connect to the system with RC-Toolkit.
2. Select the appropriate network to display the MSet network view worksheet.
3. Go to the physical RC-FLEX controller.
4. Confirm that the controller is powered on.
5. With the controller powered, press the RC-FLEX controller reset button with a single, quick one-second press and release.

This applies an orange highlight to that controller in the RC-Toolkit MSet network view worksheet for 10 minutes.

Quick Connect mode

Quick Connect mode enables an additional factory-default communication port on the controller's Ethernet and USB ports. This allows you to connect to the controller without needing to disconnect the controller's Ethernet or MS/TP network connections.

When Quick Connect mode is enabled, the controller's status LED shows the Quick Connect blink pattern (two blinks per second), and the controller appears with an orange highlight in the RC-Toolkit MSet network view worksheet. The LED blink pattern and orange highlighting continues as long as the controller is in Quick Connect mode.

The Quick Connect mode duration depends on how it is enabled:

Quick Connect activation method	Quick Connect duration
Reset button is pressed and held for three seconds.	10 minutes.
RC-FLEX controller transitions from unconfigured to configured state.	10 minutes.
RC-FLEX controller is connected to the computer USB port using a USB-A male-to-male cable.	While the USB cable is connected.

Note: Quick Connect through a USB direct connection applies to RC-FLEX controllers running firmware 1.5.1 or later, and RC-Toolkit version 3.4.2 or later.

Disable Quick Connect mode

For security hardening, it may be necessary to disable Quick Connect mode on your controller.

The BACnet device property Allow_Quick_Connect_Mode (:1329) controls whether or not you are allowed to put the RC-FLEX controller into Quick Connect mode. By default, Quick Connect mode is allowed (Allow_Quick_Connect_Mode (:1329) is set to **True**).

Set the BACnet device property Allow_Quick_Connect_Mode (:1329) to **False** to disable Quick Connect mode:

1. In RC-Studio, go to **Main > Data > Read/Write BACnet Properties** to open the Read/Write BACnet Properties dialog box.
2. Enter the controller information to enable or disable the Quick Connect operation:
   - **Device ID**: Device ID
   - **Object**: 8 (device)
   - **Instance**: Device ID
   - **Property**: 1329

3. Click **Read Property**.
4. To disable Quick Connect, set the value to **False**, then click **Write Property**.

To allow Quick Connect mode, repeat the procedure, set the value to **True**, then click **Write Property**.

Connect to a configured RC-FLEX controller

Connect to a configured RC-FLEX controller using a Systems List connection or Direct Connect > B/IP (USB/Ethernet).

Systems List connection

To make a Systems List connection, you must know the connection details to access your BACnet/IP network, such as the host controller's IP address and device ID, and the BACnet UDP port. You must also know the network access username and password. To communicate to a specific controller on the hosted BACnet/IP network, you need to know its device ID and subnet. If you know the IP address, enter that information to make a Systems List connection for that controller.

Systems List connections allow you to consistently connect to all devices on the BACnet network and allow for routing over RC-RemoteAccess B/SN connections. The Systems List on your workstation is used by both RC-Toolkit and RC-Studio.

To connect using the Systems List, run RC-Toolkit or RC-Studio, select a Systems List entry, click **Connect**, and enter network access credentials.

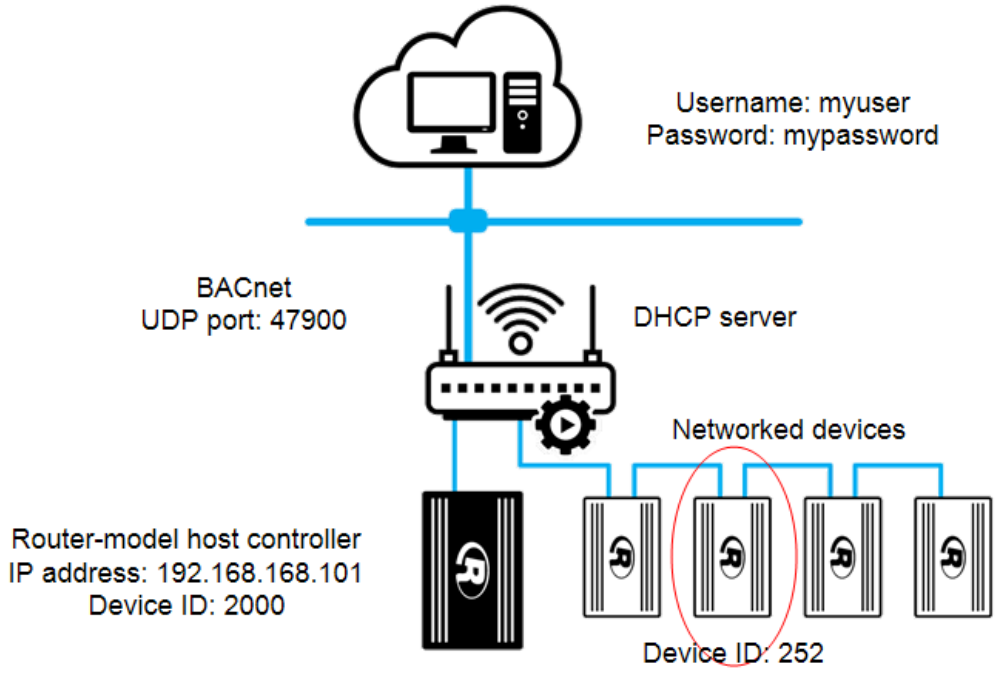


Figure 25: Systems List connection to host controller and its networked devices

Direct Connect connection

To make a Direct Connect connection, you need local access to an RC-FLEX controller in Quick Connect mode. Quick Connect opens a default configuration port on the controller to communicate without affecting existing connections.

For a Direct Connect connection, you do not need connection information such as IP addresses or network access credentials.

You can use USB or Ethernet to make a Direct Connect connection.

USB connection

Connect to the RC-FLEX controller's USB port to automatically put the controller in Quick Connect mode.

Important: Always route USB connections through a USB hub with a good quality USB cable to help protect equipment and resolve protocol differences.

Important: The USB connection is for short-term configuration or troubleshooting. Leaving the USB connected to the workstation can cause network issues.

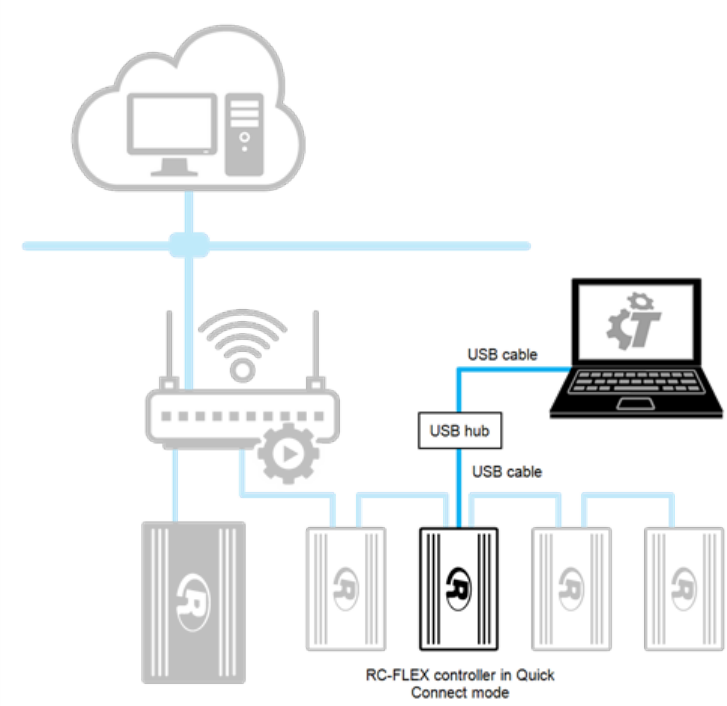


Figure 26: Direct USB connection to temporarily verify or troubleshoot a networked RC-FLEX controller

Ethernet connection

Press the reset button on a powered RC-FLEX controller for more than 3 seconds to put the controller in Quick Connect mode for 10 minutes. Connect the Ethernet ports of the RC-FLEX controller and a workstation to the local network switch.

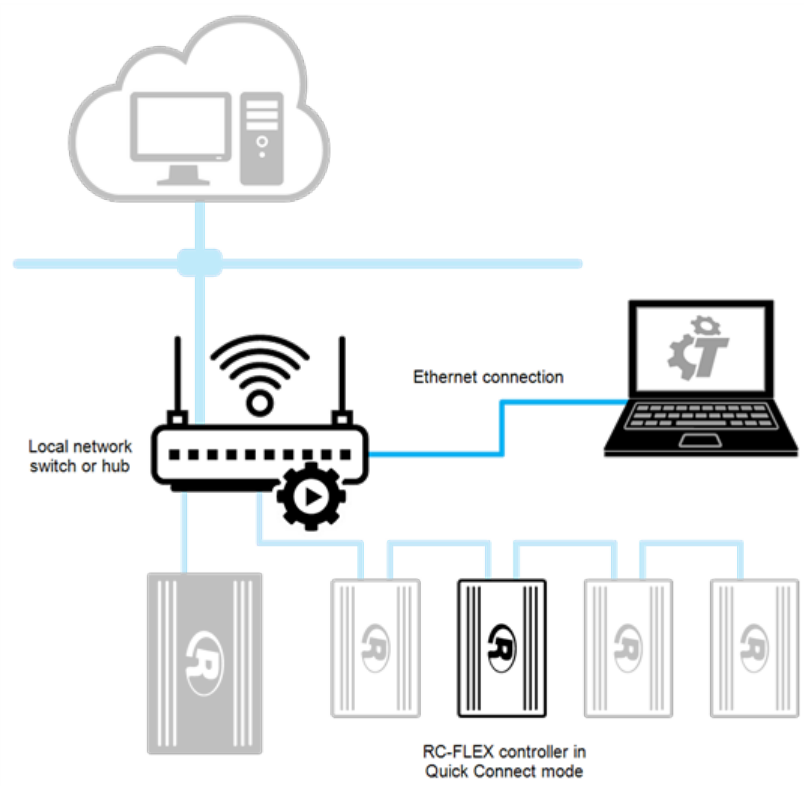


Figure 27: Ethernet connection to detect an RC-FLEX controller in Quick Connect mode

Once you have made the physical connections, run RC-Toolkit or RC-Studio on your local workstation and click **Direct Connect** > **B/IP(USB/Ethernet)** to connect to the RC-FLEX controller in Quick Connect mode.

Configure and program the RC-FLEXair

RC-FLEXair has pre-programmed actuator control and flow measurement algorithms that are hard coded. In addition the RC-FLEXair ships with a sample standard application program for VAV.

Use RC-Studio to configure the operation of your controller.

RC-Studio and your controller

Use RC-Studio to configure the functions available on your controller. Upgrade to the latest software release for new features, improvements, and fixes.

Use the worksheets in RC-Studio to configure your controller's input and output characteristics and any connected SMART-Net devices. You can also define the controller's objects, such as values, trend logs, loops, and calendars, in RC-Studio worksheets. Create System Groups and write programs in the software to provide a graphical interface to your Reliable Controls system.

The RC-Studio System Tree includes a Network Status worksheet for each network that displays controller information, including the firmware version and available memory.

For more information, refer to the RC-Studio online help. eLearning courses are available through the Reliable Controls Learning Center.

Configure pulse counting inputs

Use the Inputs worksheet in RC-Studio to configure inputs for pulse counting applications. This feature is supported on controllers with firmware version 1.4 and later.

The controller firmware includes algorithms that can improve pulse counting accuracy with filtering options and an anticipated input pulse profile.

In addition, FLEX I/O features improved input hardware to help detect pulses and debounce mechanical switch inputs to reduce false readings. If your controller supports FLEX I/O, we recommend you configure the FLEX I/O as an input and use it for your pulse counting application.

Note: The original pulse counting **Range** of **0-2^32** has been renamed to **Pulse Count**.

To configure pulse counting inputs in RC-Studio 3.9.2 or later:

1. Open the Inputs worksheet for your controller.
2. Select the input being used for pulse counting.
3. Select a **Range** that matches your pulse counting application. We recommend you set the Range and Unit to **Pulse Count S0** or **Pulse per Minute S0**.

   An **S0 Range** counts pulses based on the following input profile:

   - Minimum off time: 30 ms
   - Minimum on time (pulse width): 30 ms
   - Frequency: 16 Hz

4. Set **Sensor Type** to **Pulse Counting** if you are using FLEX I/O as pulse counting inputs. Otherwise, **Sensor Type** is automatically set to **Thermistor**.

Note: For S0 compliant pulse counting, use a FLEX I/O input configured with **Sensor Type** as **Pulse Counting** and an **S0 Range**.

Use these **Range** and **Sensor Type** settings in the Inputs worksheet for the following pulse counting applications:

Application	Range	Sensor Type
Fast CT flow meter with fast pulse rate.	Pulse Count	0-10 V
Dry contact with fast pulse rate. Susceptible to electrical noise, which might affect accuracy.	Pulse Count	Thermistor
Slow pulse rate with ambient noise.	Pulse Count S0	Thermistor
Slow pulse rate with noisy switch (FLEX I/O inputs only).	Pulse Count S0	Pulse Counting*
Fast pulse rate with ambient noise (FLEX I/O inputs only).	Pulse Count Filtered	Pulse Counting*
Fast CT flow meter with slow pulse rate.	Pulse Count Filtered	0-10 V
*The Pulse Counting Sensor Type is only available on FLEX I/O inputs.		

Configure the FLEX output on RC-FLEXair -12 models

Output 1 of the RC-FLEXair is a FLEX output that can be soft configured as a solid-state relay or a universal output.

Use the Type column in the Outputs worksheet to set the FLEX output to operate as a universal or solid-state relay output.

Important: When you switch the FLEX output type on RC-FLEXair -12 models, make sure the connected device is compatible with the selected output type.

The FLEX output is software configurable and does not require physical jumper settings.

FLEX outputs default to solid-state relay type.

Use the Outputs worksheet to set the type of the FLEX output. For outputs that are not software configurable, the Type column is grayed out.

Related information

RC-FLEXair -12 model outputs 35

Automatic trend logs

The controller automatically creates Single-point Trend Logs for the following primary BACnet objects:

- Inputs, outputs, and values
- Loops
- Schedules and calendars

The controller generates the log name for an automatically created Single-point Trend Log by adding -TL or -RTL to the object's name. You cannot delete an automatically created Single-point Trend Log or change the associated object.

The automatically created Single-point Trend Log is the object BACnet property Auto_Log_Reference (:1330). You can use this BACnet property to access the object's automatic trend log in a System Group instead of specifying the Single-point Trend Log instance.

If you change the object's name or type, the controller updates the automatically created Single-point Trend Log to reflect the change. If you delete the object, the controller automatically deletes the trend log.

If you configure the controllers using Panel File Templates, Single-Point Trend Log instances may vary from controller to controller to prevent overwriting the automatic Single-Point Trend Logs.

Automatically created Single-point Trend Logs for binary and multistate objects, and calendars have the following default configuration:

- Name: Object name-RTL. Example: AH1-HCP**-RTL**
- Log Type: COV (change of value)
- Length: 1,000 records
- Increment: 1

Automatically created Single-point Trend Logs for calendars have the following default configuration:

- Name: Object name-RTL. Example: AH1-HCP**-TL**
- Log Type: COV (change of value)
- Length: 1,000 records
- Increment: 1

Automatically created Single-point Trend Logs for schedules have the following configuration:

- Name: Object name-RTL. Example: AH1-SCHED1**-TL**
- Log Type: COV (change of value)
- Length: 1,000 records
- Increment: 0.0001

Automatically created Single-point Trend Logs for analog objects and loops have the following default configuration:

- Name: Object name-TL. Example: AH1-MAD**-TL**
- Log Type: Polled

- Length: 1000 records
- Interval: 00:05:00 (5 minutes)

Advanced settings for these logs have the following default configuration:

- Always Start: Selected
- Never Stop: Selected
- Stop When Full: Not selected
- Clear Log Data: Not selected

Supported Control-BASIC statements and functions

The RC-FLEX controller supports a subset of the Control-BASIC statements and functions. Reliable Controls protocol (RCP) statements and functions are not supported.

Note: If the controller's runtime interpreter encounters a statement or function it does not support, the program exits at that line and sets the Exit status for that program to Yes.

Supported Control-BASIC statements

The controller supports the following Control-BASIC statements:

Alarm/Print	Execution control	Point command	Miscellaneous
ALARM	END	CLEAR	REM
ALARM-TYPE	FOR	CLOSE	
DALARM	IF / IF+ / IF-	ENABLE / DISABLE	
ON-ALARM	GOSUB	IDLE	
	GOTO	LET	
	NEXT	OPEN	
	ON	RELINQUISH	
	RETURN	SET-PRIORITY	
	CALL	START	
	DECLARE	STOP	
		WRITE	

The controller does not support the following Control-BASIC statements:

Alarm/print	Point command
APDIAL	
HANGUP	
ON-ERROR	
PHONE	
PRINT	
PRINT-AT	
SET-PRINTER	

The controller does not support the following RCP statements and functions:

STATUS	UNACK
USER-A	USER-B
WS-ON	WS-OFF

Supported Control-BASIC functions

The controller supports the following Control-BASIC functions:

Math		System access	Time
ABS	LSEL	CONPROP	DOM
ARCCOS	MAX	CONRATE	DOW
ARCSIN	MAX-ITEM	CONRESET	DOY
ARCTAN	MIN	POWER-LOSS	INTERVAL
AVG	MIN-ITEM	RAMP	TIME
BIT-SET	SELECT	SCANS	TIME-OFF
BIT-TEST	SIN	SCHED	TIME-ON
COS	SLIDE	SENSOR-OFF	WAIT
ENTHALPY	SQR	SENSOR-ON	
FLOAT	SWITCH	SHARE	
HSEL	TAN	SHARE-NET	
INT	LIMIT	TBL	
LN	LN-1		

Point Status BACnet property

Use the Point Status BACnet property to read an object's status as a number value for Control-BASIC programming. The Reliable Controls proprietary BACnet property piPP_Point_Status (:1338) returns an enumerated value based on the object and the object's state.

Reliable Controls proprietary BACnet properties are available in eForum on the Reliable Controls Support Center.

This property is included on the following version 8 hardware and firmware controllers:

- MACH-ProAir, MACH-ProZone, MACH-ProLight
- MACH-Pro1, MACH-Pro2
- MACH-ProView
- MACH-Pro(Web)Com/Sys
- RC-FLEX controllers

The following table lists the objects and the enumerated values that describe the object state:

Object type	Enumerated values	Notes
Calendar, programs, inputs, loops, schedules	0: Auto 1: Timed override 2: Manual	Write 0 to this property to return the object to automatic mode.
Outputs, values (all types)	0: Auto 1: Timed override 2: Manual 3: Priority override (priority other than 8 or 10) 4: Out of service (outputs only) 5: Overridden HOA off 6: Overridden HOA hand	Write 0 to this property to return the object to automatic mode, clear out of service, and relinquish all priorities except: • 1: Life safety • 6: Minimum off/on time • 10: Auto

Ethernet diagnostics BACnet properties

Additional BACnet properties are available on RC-FLEX devices to help diagnose Ethernet communications problems.

Ethernet diagnostics properties are in the device BACnet object and also available in port instance BACnet objects.

Device object global Ethernet diagnostic properties

The following diagnostic properties apply to all Ethernet ports on the device. Do not enter a value in the **Array Index** field:

- **Object Type**: 8 (Device)
- **Instance**: Same as Device ID

Property name	Property ID	Property type	Supported values or range
Redundancy Alarm Enable	1369	Boolean	False = Link down alarm is disabled. True = Link down alarm is enabled Note: When rapid spanning tree protocol (RSTP) is enabled, the link down alarm is enabled by default.

Property name	Property ID	Property type	Supported values or range
LLDP Enable	1368	Boolean	This property enables or disables neighbor detection. It is set to 1 (Enabled) by default. 0 = Disabled. No neighbor detection. 1 = Enabled. Device is broadcasting and receiving link layer discover protocol (LLDP) information.

Device object port-specific Ethernet diagnostic properties

The following Ethernet diagnostics properties are available for the device BACnet object:

- **Object Type**: 8 (Device)
- **Instance**: Same as Device ID
- **Array Index**: The assigned value for the physical Ethernet connector on the device, where 1 = port ETH1, and 2 = port ETH2

Property name	Property ID	Property type	Supported values or range
Port State	1364	Enumerated	0 = Down (not working or not connected) 1 = Up (working properly) 2 = Blocked by RSTP
Port Speeds	1366	Real number	10000000.0 = 10 Mbps 100000000 = 100 Mbps 0 = Unknown
Port STP State (STP = Spanning Tree Protocol)	1367	Enumerated	0 = Disabled 1 = Listening 2 = Learning 3 = Forwarding 4 = Blocking
Neighbor Name*	1372	Character string	Object Name property of the neighbor device.

Property name	Property ID	Property type	Supported values or range
Neighbor ID*	1371	Character string	Device ID of the neighbor device
Neighbor Description*	1376	Character string	For RC-FLEX controllers: "Reliable Controls RC-FLEX Advanced Controller" For other devices, this displays the product identification information.
Neighbor Location*	1373	Character string	Location property of the neighbor device
Neighbor IP Addr*	1374	Character string	IP address property of the neighbor port object
Neighbor MAC Addr*	1375	Character string	MAC address property of the neighbor port object
* The BACnet property LLDP Enabled must be set to 1 (enabled) to read the Ethernet neighbor properties. If multiple neighbors are detected, a comma-separated list of the five most recently detected neighbors is displayed. The last known neighbor data is retained when power or communications is lost. To clear or refresh the neighbor data, perform the Initialize Network function in RC-Studio.			

Create Ethernet diagnostic System Groups

Use BACnet Ethernet diagnostic properties to create System Groups on the network's host controller and use the System Groups to monitor the Ethernet network status of your dual Ethernet devices in a ring-topology RSTP network.

This is best used for monitoring ring topology networks that use RSTP as devices remain online and update their values after an initial network break. If a device goes offline its values do not update, so the System Group appears unchanged but you will get a device offline message. Refer to the instructions to correctly set up a ring-topology RSTP network.

Note: Ethernet diagnostic BACnet properties are available in RC-FLEX firmware version 1.4 or later.

To create Ethernet diagnostic System Groups, you must:

1. Create and program analog values to show the Ethernet port status for each port on each device, as described in "Create and program port status values:" below.
2. Create a network System Group and add Landing Pads to show each Ethernet port's status, as described in "Create a System Group with Landing Pads" below.
3. Create System Groups to display information about the neighboring Ethernet devices, as described in "Create a System Group with neighbor information" on the next page.

Link the network System Group and the neighbor information System Groups to move between the System Groups and identify issues.

Create and program port status values:

1. Connect to the system using RC-Studio.
2. Open the **Values** worksheet on the host controller.
3. Create analog values for each Ethernet port on each device. Refer to the example.

   Important: Analog values retain their last known value; the values are not updated if the devices go offline.

4. Open the **Programs** worksheet on the host controller.
5. Create a new program.
6. Open the new program in the Control-BASIC editor.
7. Program the analog values with the Ethernet Port_Status (:1364) BACnet property. Refer to the example.

A example of analog values and Control-BASIC code for device ID 15101:

- Analog values: `RCFA-15101-ETH1, RCFA-15101-ETH2`
- Control-BASIC code:
  ```
  10 RCFA-15101-ETH1 = {15101}15101:1364[1] : RCFA-15101-ETH2 = {15101}15101:1364[2]
  ```

Create a System Group with Landing Pads

1. Connect to the system using RC-Studio.
2. Open the **System Groups** worksheet on the host controller.
3. Create a new System Group with a background graphic that shows your dual Ethernet device network.
4. Open the new System Group.
5. Insert one of the Ethernet port status analog values.
6. In the **Edit Object** dialog box:

a. Enable **High/Low**.
b. Set **High Limit** to `2` and **Low Limit** to `0`.

7. In the **Edit Object** dialog box, click **Landing Pad** to open the **Landing Pad** dialog box.
8. In the **Landing Pad** dialog box:
   a. Enable the Landing Pad by selecting **Enabled**.
   b. Set the **Background Color** to a color that indicates Ethernet port normal operation, such as green.
   c. Set the **Width** and **Height** to represent a single Ethernet port on a dual Ethernet device on the System Group background graphic.
   d. Enable **High/Low**.
   e. Set the **Background Hi/On Color** to a colour that indicates non-standard but still-functional Ethernet port status, for instance the port being blocked by the RSTP protocol on a ring network.
   f. Set the **Background Low/Off Color** to a colour that indicates the Ethernet port is not working, such as red.
   g. Click **OK** to save the Landing Pad settings and return to the **Edit Object** dialog box.
9. Click **OK** to close the Edit Object dialog box.
10. Move the Landing Pad to the Ethernet port location.
11. Insert the rest of the analog values that correspond to an Ethernet port status.

Create a System Group with neighbor information

1. Connect to the system using RC-Studio.
2. Open the **System Groups** worksheet on the host controller.
3. Create a new System Group with a background that shows one or more dual Ethernet devices.
4. Clear the **Auto Update** check box for the new System Group.

   Important: Neighbor properties do not display if **Auto Update** is selected.

5. Open the new System Group.
6. Insert a dual Ethernet device into the System Group.
   For example, for device ID 15101, enter `15101DEV15101` in the **Insert Point or Keyword** dialog box.
7. In the **Edit Object** dialog box:
   a. Enter a neighbor property into **Property**.
   b. Enter **Array Index** of `1` for Ethernet port 1, or `2` for Ethernet port 2.
   c. Click **OK** to close the **Edit Object** dialog box.

8. Repeat inserting devices into the System Group and setting neighbor properties until all the neighbor information is added to your System Group.

   Note: An initialize network operation is required to update neighbor information on the controller. Right-click the network and select **Initialize Network** to update neighbor information.

Net Ins and Net Outs BACnet properties

Use these BACnet properties to monitor and control some aspects of Net Ins and Net Outs.

- **Object Type**: 8 (Device)
- **Instance**: Device ID

These properties are available in firmware version 8.31 or later.

COV_Notification_Mode (:1360)

This property is not available for the MACH-Pro1 and MACH-Pro2.

0: Default Unique Net Outs are created for every local BACnet/IP device that requests that point.

1: Net Outs are consolidated into a single Net Out for local BACnet/IP devices that request that point. This setting is recommended for large RC-FLEX networks.

Net_Ins_Error_Count (:1362)

Returns the number of Net Ins in error. Type: Unsigned integer. Refer to the Control-BASIC example.

Net_Outs_Error_Count (:1363)

Returns the number of Net Outs in error. Type: Unsigned integer. Refer to the Control-BASIC example.

Control-BASIC example

The following Control-BASIC example uses the Net Ins property to generate a delayed alarm when problems occur. Specify a 2-minute (120 second) delay to prevent nuisance alarms that may occur in situations such as system recovery after a power cycle.

```
10 DALARM MYCONTROLLER123:1362 > 0 , 120 , "Error retrieving values on the network"
```

Alarm count BACnet property

A BACnet property is available to count the number of times an input, output or value transitioned from normal to alarm state for diagnostics and reporting.

- **Object Type**: Binary, analog, and multi-state inputs, outputs, and values.
- **Instance**: Enter the row number from the Inputs, Outputs or Values worksheets.

BACnet property	Description
Event_Transition_Count (:1382)	The returned value is the number of times the object has gone into alarm. Write 0 to this property to reset the object alarm count value.

Alarm recurrence delay BACnet property

RC-FLEX controllers firmware version 1.5 and later have a BACnet property that allows you to delay the recurrence of a BACnet intrinsic alarm. An object with this property delays the recurrence of a triggered BACnet intrinsic alarm for a set number of seconds.

- **Object Type**: Binary, analog, and multi-state inputs, outputs, values, and loops.
- **Instance**: Enter the row number from the Inputs, Outputs, Loops, or Values worksheets.

BACnet property	Description
Alarm_Recurrence_Delay (:1390)	Enter the delay period, in seconds, before a BACnet intrinsic alarm can reoccur. The default value is zero, which causes no delay after an alarm is triggered.

Start and Stop Loop BACnet properties

BACnet properties are available to modify the default behavior for Loop objects being commanded by Control-BASIC.

- **Object Type**: 12 (Loop)
- **Instance**: Enter the row number from the Loops worksheet

BACnet property	Setting description
Reset_on_Start (:1378)	True: Default. The internal integral sum is reset. False: The internal integral calculations resume as normal.
Reset_on_Stop (:1379)	True: The internal integral sum is reset, and the Loop Value is set to 0. False: Default. Internal integral calculations are paused.

Loops can now be controlled by changing these BACnet properties. For example:

- To automatically turn off equipment or close a valve when Control-BASIC runs STOP on a loop, change the default setting of Reset_on_Stop (:1379) to **True**.
- To pause and resume a loop without resetting the internal integral sum calculations, change the default setting of Reset_on_Start (:1378) to **False** and make sure Reset_on_Stop (:1379) is set to **False**.

Object instance BACnet property

The Object_Instance (:1395) BACnet property returns the instance number of an object. You can use this property to determine the device number.

This BACnet property is available in firmware version 1.5.1 or later.

This property is available for reference in System Groups, Control-BASIC, and anywhere else that supports BACnet properties.

Note: The SMART-Sensor EPD is limited to displaying values between 1 and 65535.

The following example code stores the device number of the local device in variable A:

```
10 A = DEV4194303:1395
```

Automatic objects

The controller's firmware automatically creates special inputs, outputs, and values that are used for VAV functions.

These objects have limited configuration to ensure they are usable by firmware, and they are always in specific rows in the worksheet indicated by colored row numbers.

The first part of the name for all automatic objects is the controller's device ID (for example, VAV1001).

Note: Changing the differential pressure (-VP) input's units from metric to imperial changes the units of all automatic objects. You do not need to recalibrate the controller after changing units.

Automatic inputs

The number of automatically generated input objects depends on whether the controller model includes an actuator (-A), flow sensor (-F), or both (-A-F):

Row number	Name (without device ID)	Object	Models	Description
4	-VP	AI4	-A-F, -F	Velocity pressure (VP) — Velocity pressure is the total pressure minus the static pressure. Velocity = 4005 SQR(VP)
5	-DMP-POS	AI5	-A-F, -A	Damper position — A value from 0%-100% that shows the measured position of the damper actuator motor.
6	-DMP@END	BI6	-A-F, -A	Damper at end — A binary value that is Yes when the damper actuator is at a physical end stop, fully open or fully closed, and No when the damper actuator is somewhere in between.

Automatic outputs

Only actuator (-A) models have automatically generated output objects:

Row number	Name (without device ID)	Object	Models	Description
7	-DMP	MO7/AO7	-A-F, -A	Damper control — Controls the damper position by moving the motor; can be either multistate (Open/Closed/Idle) or analog (0%-100%). Default is MO7. Set FLO-CTRL (BV6) to No in order to change object type.
8	-CW-CLS	BO8	-A-F, -A	Damper clockwise to close — Controls the direction the motor turns to close the damper: Yes = clockwise; No = counter-clockwise.

Automatic values

Automatically generated value objects depend on whether the controller has an actuator (-A), flow sensor (-F), or both (-A-F):

Only flow sensor (-F) models have automatically generated value objects that are primarily used for airflow measurement calibration:

Row number	Name (without device ID)	Object	Models	Description
1	-DIAM	AV1	-A-F, -F	Duct diameter — The duct or box diameter.
2	-FLO-CAL	AV2	-A-F, -F	Flow calibration — The airflow measured by an independent source by test and balance. This value is automatically reset to zero once the calibration constant K is automatically calculated.
3	-CAL-K	AV3	-A-F, -F	Calibration constant K — The scaling factor calculated based on the difference between the measured airflow and the independently measured flow calibration value. This value should not be changed after calibration.
4	-FLO	AV4	-A-F, -F	Volumetric flow — The airflow rate, by volume, calculated from the measured pressure (-VP) and the duct diameter (-DIAM).
5	-FLO-SP	AV5	-A-F	Flow setpoint — The desired airflow value.
6	-FLO-CTRL	BV6	-A-F	Flow control — Controls whether the internal flow control code algorithm is turned on. This value must be set to Yes when a controller with damper actuator and flow sensor is installed on a VAV unit and used for VAV flow control.
7	-FLO-DB	AV7	-A-F	Flow deadband — A deadband around the flow setpoint (-FLO-SP), used to prevent the damper actuator from constantly running to achieve the exact flow setpoint. This is automatically calculated as a percentage of the flow setpoint (-FL-SP).

VAV flow control

Connect a Reliable Controls VAV controller with actuator and flow sensor to a VAV unit for VAV flow control.

Note: You must enable VAV flow control in the controller's Values worksheet.

The VAV main flow control loop works to maintain the measured flow at the airflow setpoint by sequentially cycling through the following three subcontrol loops:

- **Damper actuator loop (loop A)** — Drives the damper actuator to open or close the damper if the measured flow does not match the airflow setpoint.
- **Flow stabilization loop (loop B)** — Waits for a stable flow measurement to use in change rate calculations.
- **Change rate loop (loop C)** — Calculates how much the airflow has changed based on the damper drive duration. The controller's firmware uses this value to determine how long to drive the damper actuator to get the desired change in flow rate.

The automatic objects in the Values worksheet that begin with FLO are the operating values for VAV flow control.

VAV main flow control loop

The controller's actuator motor control is controlled by firmware and uses the procedure outlined in this flow chart to maintain the measured airflow (AV4; FLO) at the provided airflow setpoint (AV5: FLO-SP).

Error is calculated by the difference between measured airflow and effective airflow setpoint as follows:
Error = FLO (AV4) – FLO-SP (AV5)

Important considerations:

- Motor control application is executed only on -A-F models with FLO-CTRL (BV6) set to **Yes**.
- Default airflow deadband, FLO-DB (AV7), is 10 percent of the flow setpoint FLO-SP(AV5).
- Minimum motor drive time is 500 ms.

The following is the VAV main flow control loop:

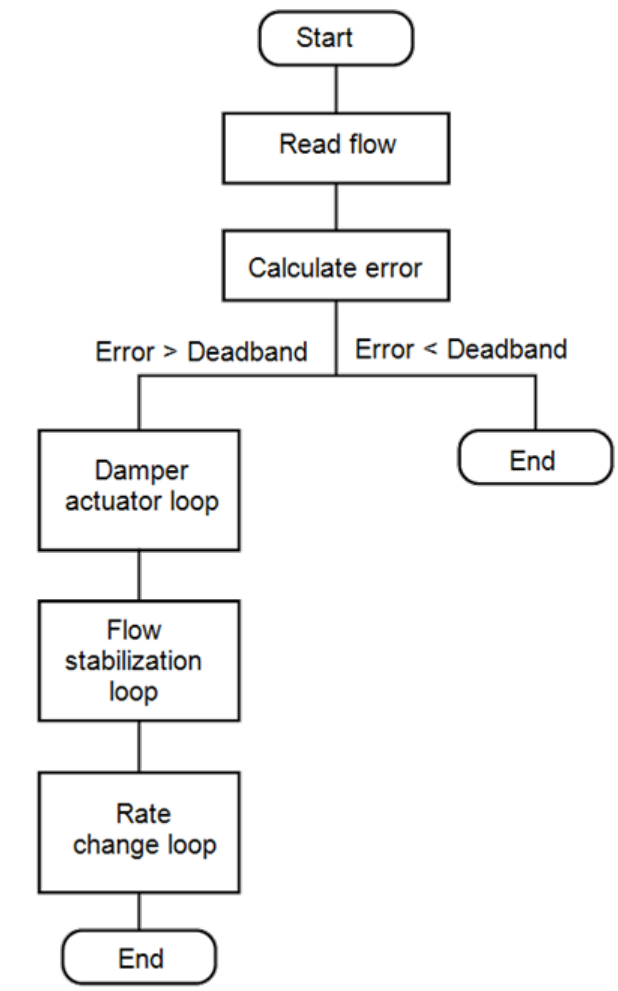


Figure 28: VAV main flow control loop

Damper actuator loop

The damper actuator loop determines whether the damper needs to open or close based on whether the flow is greater or less than the flow setpoint as follows:

- **Open** — FLO (AV4) < FLO-SP (AV5) - (FLO-DB (AV7) * 0.5)
- **Close** — FLO (AV4) > FLO-SP (AV5) - (FLO-DB (AV7) * 0.5)

The following is the damper actuator loop:

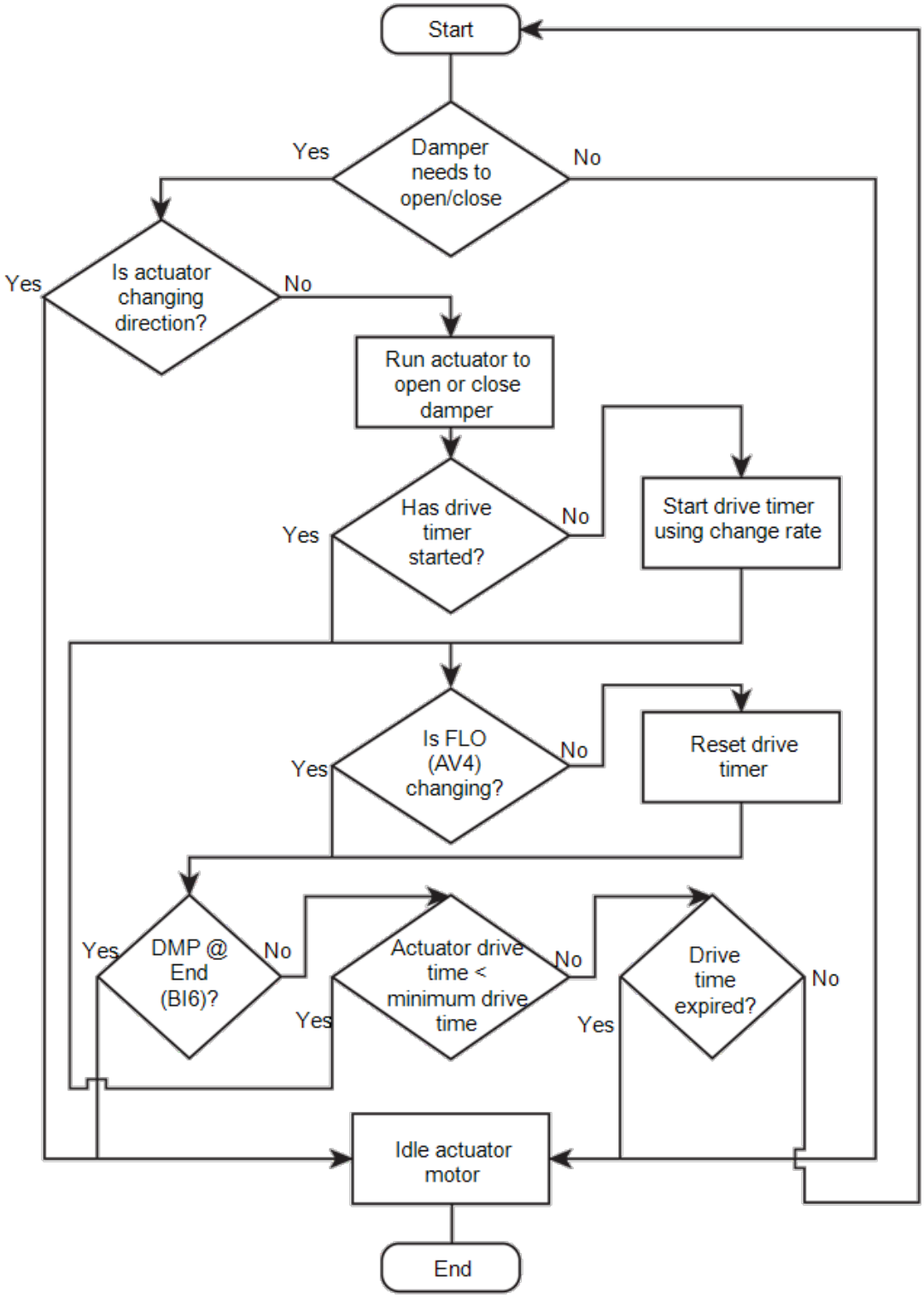


Figure 29: Damper actuator loop

Flow stabilization loop

This loop measures the flow rate and lets the flow stabilize for up to 1 minute after the damper is repositioned.

The following is the flow stabilization loop:

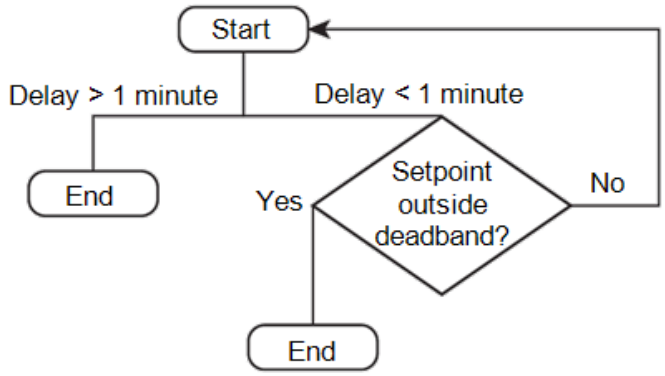


Figure 30: Flow stabilization loop

Change rate loop

The airflow change rate is calculated in different ways depending how much the airflow has changed and how long the damper was driven. The change rate determines how long the actuator will operate before the measured airflow returns to the effective airflow setpoint.

The following is the change rate loop:

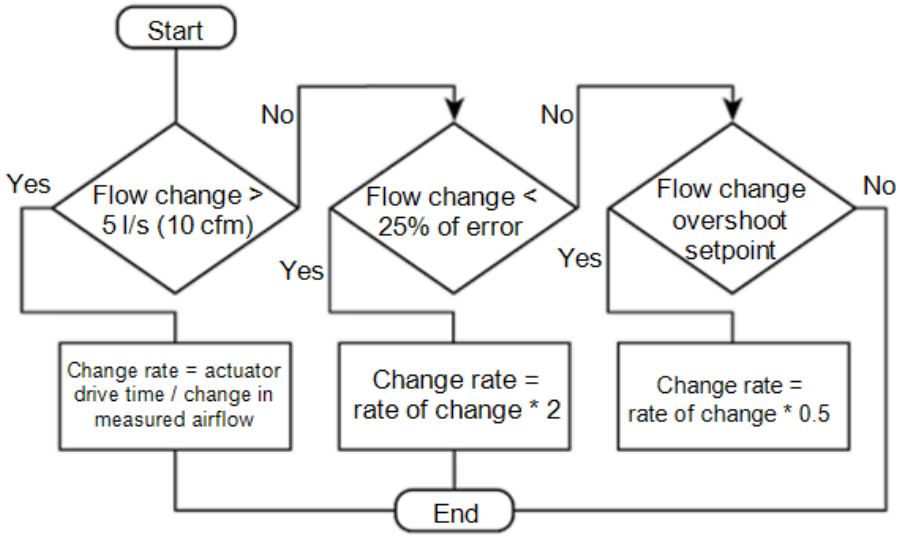


Figure 31: Change rate loop

Airflow calibration overview

Measure the airflow and enter the value in the controller to calculate the correction (K) factor used to calibrate the controller's airflow measurements.

Airflow measurement calibration is also referred to as test and balance or flow balancing, where balancing technicians use flow hoods or other airflow measurement tools to measure the airflow.

The controller ships from the factory loaded with a standard application Panel File developed by the Application Engineering department that contains the programming required for airflow calibration.

Suggested calibration procedure

The following general procedure is suggested for VAV airflow calibration, regardless of whether you use RC-Studio worksheets or a SMART-Sensor EPD configured as a SETUP-Tool:

Note: The SMART-Net worksheet used for the SETUP-Tool is the last SMART-Net node located under the controller in the System Tree in RC-Studio.

1. Calibrate at maximum flow.
2. Confirm maximum airflow measurement, and calibrate again if required.
3. Calibrate at a secondary point, such as 50 percent of maximum flow, if required.
4. Verify airflow measurements, such as minimum airflow, if required.
5. Record the K factor and save the controller's Panel File to restore calibration if necessary.

Note: For more information about RC-Studio worksheets, refer to the *RC-Studio Software Manual*. For more information about the SMART-Sensor EPD, refer to the SMART-Sensor product documentation. Both are available in the Reliable Controls Support Center.

Before you calibrate your VAV controller

The controller must have a standard application installed, you must enter the duct diameter and airflow setpoints, and you must understand and follow calibration best practices before you calibrate your controller.

The controller ships from the factory loaded with a standard application Panel File that contains the programming required for airflow calibration. This calibration programming is included in all VAV controller standard applications developed by the Application Engineering department, available on the eForum area of the Reliable Controls Support Center.

Required parameters

You must enter parameters to define the airflow system and airflow setpoints.

On the controller's Values worksheet in RC-Studio:

- Duct diameter (AV1).
- Minimum airflow setpoints.
- Maximum airflow setpoints.
- Flow control (BV6) must be set to **Yes**.
- Flow deadband (AV7).
- Other application setpoints if applicable.

On the controller's Outputs worksheet in RC-Studio:

- Set clockwise to close to reflect the rotation to close the damper (BO8). You can also set this in the Flow tool's SMART-Net worksheet.

Use one of the following methods to enter your airflow setpoint values:

- Enter the airflow setpoint values in the controller's Values worksheet (typically rows 29 to 35) in RC-Studio.
- Enter the airflow setpoint values in the Flow tool's SMART-Net worksheet in RC-Studio.
- Enter the airflow setpoint values in the Flow tool manually using the buttons on the SMART-Sensor.

Calibration best practices

The following are calibration best practices:

- Always calibrate at high airflow rates, as flow measurements are less accurate at lower flow rates.
- Let the central system stabilize, or isolate the system being calibrated, to obtain consistent flow measurements.
- Always let the system stabilize before you obtain airflow measurements or perform airflow calibration.
- After you calibrate, record the K factor for future reference and back up the controller's Panel file.

Calibrate actuator position feedback

Recalibrate your actuator by confirming the total rotations in a full-stroke to enable the rotation tracking to begin from a known position.

By default, the actuator automatically calibrates upon power up.

Tip: By default, the actuator is MO7 with an object name ending in -DMP.

You can incorporate a controlled recalibration into your controller's schedule, for instance on the transition from occupied to unoccupied, using the proprietary BACnet property Motor_Calibration (:1111). You should also monitor if a recalibration is in progress in order to pause other control routines that may interfere with the calibration process.

Motor_Calibration (:1111) has the following values:

- Trigger calibration — -1
- Calibration disabled — 0

  Note: Unless the damper is clockwise close and positioned at 100% , or the damper is not clockwise close and positioned at 0%, the actuator calibrates upon power up even with calibration disabled.

- Calibration automatic — 1
- Calibration in progress — 2

After calibration, the Motor_Calibration BACnet property returns to its previous value of 0 or 1.

The following Control-BASIC code sample triggers recalibration on a local controller when the occupancy schedule (OCC) goes unoccupied:

```
100 IF- OCC THEN MO7:1111 = -1 : REM CAL WHEN OCC GOES UNOCC
```

The following Control-BASIC code sample monitors if a calibration is in process on controller VAV15101. If a calibration is in progress, it suspends control (HVAC-MODE) and loading (TERM-LOAD):

```
100 IF VAV15101-DMP:1111 = 2 THEN VAV15101-HVAC-MODE = 5 , VAV15101-TERM-LOAD = 0 :
REM IF CAL, HVAC-MODE INIT, TERM-LOAD SUSPEND
```

Airflow calibration control and setpoint overrides

Set the airflow calibration method to define the airflow measurement used for calibration.

To perform airflow calibration, take an external measurement and apply it to a specific controller measurement object to calculate the K factor required to correct the airflow measurement values.

The damper override value (D-OVR) is in the SMART-Sensor Flow Tool worksheet or in the controller Values worksheet DMP-CTRL-OVR (AV28).

This value is configured in the controller's default Panel File and the standard application Panel File created by Application Engineering. It is not automatically created by the controller.

Depending on the damper override value, the controller behaves as follows:

Number	Damper control mode	Description
1	Automatic control mode	The controller automatically controls the damper based on its programming and is not in calibration mode.
2	Minimum airflow	The controller controls the damper to maintain flow at the minimum flow setpoint.
3	Maximum flow	The controller controls the damper to maintain flow at the maximum flow setpoint.
4	Manual setpoint	The controller controls the damper to maintain flow at the air flow volume entered in either the SMART-Sensor Flow Tool worksheet (FL-OVR) or the controller Values worksheet (DMP-SP-OVR) (AV29) (liters/sec or cfm).
5	Flow Setpoint %	The controller controls the damper to maintain flow at the percentage of maximum air flow entered in either the SMART-Sensor Flow Tool worksheet (FL-OVR) or the controller Values worksheet (DMP-SP-OVR) (AV29) (percentage).
6	Manual Position %	The controller moves the damper to the percentage of fully open entered in either the SMART-Sensor Flow Tool worksheet (FL-OVR) or the controller Values worksheet (DMP-SP-OVR) (AV29) (percentage).
7	Close damper	The controller fully closes the damper according to the direction to close setting.
8	Open damper	The controller fully opens the damper, moving opposite to the direction to close setting.

Airflow calculations

You may need to calculate the equivalent duct diameter for a rectangular duct, but your controller automatically calculates the airflow calibration. It is provided here for reference only.

The controller ships with standard application programming that automatically calculates the airflow correction (K) factor during the calibration procedure. Any standard application for the VAV controller also has this programming as part of the controller's Panel File.

You can view the K factor using a SMART-Sensor in Flow tool mode or using RC-Studio to view the controller's Values worksheet or the SETUP-Tool Smart-Net worksheet. You can edit the K factor directly in RC-Studio.

The controller's internal measured airflow calculation in metric units is as follows:

Calculated flow = square root (differential pressure measurement) x 4005 x box area x K factor

Where:

- Differential pressure measurement is AI4
- Box area is calculated from the duct diameter (AV1)

The airflow calibration procedure calculates the K factor required for the controller's calculated flow to match the external airflow measurement.

Typical K factor values range from 0.5 to 1.0. If the K factor calculated by the controller exceeds this range, you should investigate your system for issues. Because most flow pickups amplify the differential pressure to improve measurement, K is usually less than 1 to remove the amplification.

If your K factor is greater than 1, it could be caused by:

- Insufficient direct ducting — Ensure there is sufficient straight ducting, without bends or curves, before the flow sensor's location.
- Balance damper setting — Ensure the balance damper does not impede or disrupt the air flowing over the flow sensor.
- Test port T-caps — Ensure the test port T-caps are clean and tightened over the test ports.
- Duct quality — Ensure the ducting is clean and unclogged, and nothing impedes or disrupts the air flowing over the flow sensor.

Equivalent duct diameter for a rectangular duct

The duct diameter is required for airflow calculations.

The duct diameter is usually provided as part of the project documentation and may be part of the VAV specifications that include information on several different models of VAV.

If the duct diameter is not provided for a rectangular duct, the equivalent diameter is calculated as follows:

Equivalent diameter = 2 * square root ((width * height) / 3.14)

Where the width and height are the rectangular duct's dimensions.

SMART-Sensor Flow Tool worksheet

The SMART-Sensor Flow Tool worksheet is available on Reliable Controls variable air volume (VAV) controllers and is used by a SMART-Sensor in Flow Tool mode to calibrate airflow measurements.

The VAV controller must have a Standard Application Panel File loaded in order to perform airflow calibration. All Reliable Controls VAV controllers ship from the factory with a default Standard Application. Additional Standard Applications are available from the eForum on the Reliable Controls Dealer Support Center on the Reliable Controls website.

Airflow measurement calibration is performed by balancing technicians who calibrate the controller's airflow measurement against an external airflow measurement such as a balancing hood.

The SMART-Sensor Flow Tool worksheet is the last SMART-Net worksheet available under the VAV controller node in the RC-Studio System Tree.

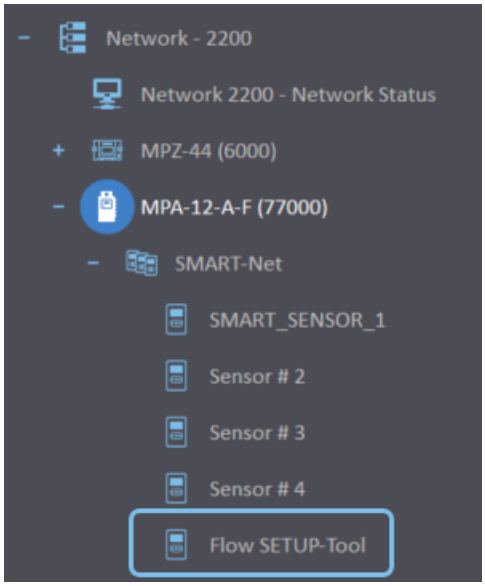
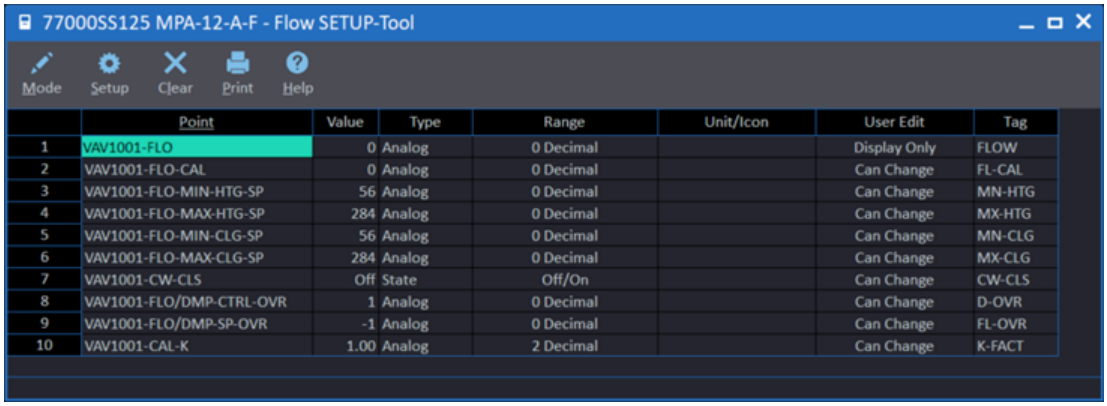


Figure 32: The Flow SETUP Tool occupies the last position in the SMART-Net list

All of the rows in the SMART-Sensor Flow Tool worksheet correspond to entries defined in the Values and Outputs worksheet of the Standard Application Panel File.



	Point	Value	Type	Range	Unit/Icon	User Edit	Tag
1	VAV1001-FLO	0	Analog	0 Decimal		Display Only	FLOW
2	VAV1001-FLO-CAL	0	Analog	0 Decimal		Can Change	FL-CAL
3	VAV1001-FLO-MIN-HTG-SP	56	Analog	0 Decimal		Can Change	MN-HTG
4	VAV1001-FLO-MAX-HTG-SP	284	Analog	0 Decimal		Can Change	MX-HTG
5	VAV1001-FLO-MIN-CLG-SP	56	Analog	0 Decimal		Can Change	MN-CLG
6	VAV1001-FLO-MAX-CLG-SP	284	Analog	0 Decimal		Can Change	MX-CLG
7	VAV1001-CW-CLS	Off	State	Off/On		Can Change	CW-CLS
8	VAV1001-FLO/DMP-CTRL-OVR	1	Analog	0 Decimal		Can Change	D-OVR
9	VAV1001-FLO/DMP-SP-OVR	-1	Analog	0 Decimal		Can Change	FL-OVR
10	VAV1001-CAL-K	1.00	Analog	2 Decimal		Can Change	K-FACT

Figure 33: SMART-Sensor Flow SETUP Tool worksheet

The SMART-Sensor Flow Tool worksheet rows are defined by their Tag and are described as follows:

FLOW

The current airflow as measured by the VAV controller.

FL-CL

The external airflow measurement to be used for airflow calibration is entered here. This value resets to zero once the airflow calibration calculations are complete.

MN-HTG / MX-HTG

(Optional) The setpoint values for flow minimums and maximums for units with optional reheat.

MN-CLG / MX-CLG

The setpoint values for cooling flow minimums and maximums.

CW-CLS

The closing direction for the damper actuator, set to **Yes** or **On** if the damper is clockwise to close.

D-OVR

The damper control override, set to 1 for automatic based on the controller's programming, or enter an airflow calibration control and setpoint override value to set the damper for airflow calibration.

FL-OVR

The manual flow control setpoint, either as a specific airflow value or as a percentage of maximum airflow, depending on the airflow calibration control and setpoint override value in **D-OVR**.

K-FACT

The K-factor used to correct the controller's airflow measurements and automatically calculated by the controller during the airflow calibration process.

Calibrate VAV controller airflow measurements using RC-Studio

Use an external airflow measurement method, and enter the value in the controller's Values worksheet in RC-Studio to calculate the correction (K) factor used to calibrate the controller's airflow measurements.

Before you calibrate, you must have installed the VAV controller, connected the flow sensor and actuator, and entered the necessary information in the controller's Values worksheet.

Note: To increase the number of displayed decimal places in RC-Studio, go to **Main > System Setup > Units > Decimal Points**.

You must have an external airflow measurement system such as a balancing hood.

To calibrate the VAV controller's airflow measurements using RC-Studio:

1. Connect to the controller using RC-Studio.
2. Open the **Values** worksheet. Go to **DMP-SP-OVR** (AV28) and enter the numeric value that matches the airflow calibration method.
3. Click **Mode** to put the **Values** worksheet in Update mode.
4. Wait until the airflow has stabilized so you see consistent airflow values displayed in **FLO** (AV4).
5. Measure the airflow with an external airflow measurement method such as a balancing hood.
6. Click **Mode** to put the **Values** worksheet in Edit mode.
7. Enter the external airflow measurement into **FLO-CAL** (AV2). Click **Mode** to put the **Values** worksheet in Update mode.

   The controller calculates the K factor based on difference between the controller's measured airflow and the external airflow measurement value. When the calculation is complete, the external airflow measurement in **FLO-CAL** (AV2) is reset to zero, and the **CAL-K** (AV3) value updates with the calculated K factor.
8. Repeat steps 4 and 5. If the difference between the external airflow measured and the controller's airflow value is not acceptable, repeat steps 6 and 7 to adjust the controller's K factor.
9. If additional airflow calibration is required, enter the appropriate control and setpoint override value into **DMP-SP-OVR** (AV28), and repeat the calibration process.
10. If additional airflow verification is required, enter the appropriate control and setpoint override value into **DMP-SP-OVR** (AV28), and verify the controller's airflow measurement with an external airflow measurement method.
11. When calibration is complete, set **DMP-SP-OVR** (AV28) to automatic (1) to return the controller to automatic control.

After you calibrate, record the K factor for future reference and back up the controller's Panel File. Ensure there is a trend log that tracks changes to this value to have a complete record for maintenance purposes

Calibrate VAV controller airflow measurements using a SMART-Sensor in Flow Tool mode

Calculate the correction (K) factor used to calibrate the controller's airflow measurements using an external airflow measurement method and a SMART-Sensor in Flow Tool mode.

You must have installed the VAV controller, connected the flow sensor and actuator, and entered the necessary information in the controller's Values worksheet. The controller must have either the factory default standard application or another standard application Panel File installed.

You must have an external airflow measurement system such as a balancing hood.

To put a SMART-Sensor EPD into Flow Tool mode, selecte **Flow Tool** in the Dealer menu when the SMART-Sensor is connected to the controller.

Note: To access the Dealer menu on a SMART-Sensor EPD, press and hold the + and - buttons for 5 seconds, release, wait for 2 seconds, then tap the - button.

To calibrate the VAV controller's airflow measurements using the Flow tool:

1. With the SMART-Sensor in Flow Tool mode, press the ☰ button until **D-OVR** is displayed.
2. Use the ✚ button to enter the numeric value that matches the airflow calibration control and setpoint override.
3. Press the ☰ button until the **FLOW** screen displays, which shows the controller's measured airflow.
4. Wait until the airflow has stabilized so you see consistent airflow.
5. Measure the airflow with an external airflow measurement method such as a balancing hood.
6. Press the ☰ button to display the **FL-CAL** screen.
7. Use the ✚ and ━ buttons to enter the external airflow measurement value.
   The controller calculates the K factor based on difference between the controller's measured airflow and the external airflow measurement value. When the calculation is complete, the value entered in the **FL-CAL** screen is reset to 0.
8. Repeat steps 3 through 5. If the difference between the external airflow measurement and the controller's airflow value is not acceptable, repeat steps 6 and 7 to adjust the controller's K factor.
9. If additional airflow calibration is required, press the ☰ button until **D-OVR** displays.
10. Use the ✚ button to enter the numeric value that matches the control and setpoint override, and repeat the calibration process.
11. If additional airflow calibration is required, press the ☰ button until **D-OVR** displays.
12. Use the ✚ button to enter the numeric value that matches the control and setpoint override, and verify the controller's airflow measurement with an external airflow measurement method.
13. When calibration is complete, set **D-OVR** to 1 to return the controller to automatic (1) control.

After you calibrate, record the K factor for future reference and back up the controller's Panel File. Ensure there is a trend log that tracks changes to this value to have a complete record for maintenance purposes.

RC-FLEXair specifications

For the most complete, up-to-date information, click your product on the Products page to access the submittal sheet.

Processor and Memory

- Three cores, two 500 MHz high-performance, one 125 MHz, 32-bit embedded microcontroller.
- All nonvolatile flash memory with 10 years of data retention.
- Operating system firmware can be upgraded at any time over network.
- 2 GB database memory available; each trend log can support more than 2,000 records.
- Device status LED indicates operational modes for field service.

Supply Voltages

- 24 VAC ±10% 32 VA maximum, 50/60 Hz.
- 24 VDC ±10% 12 W maximum.

Ethernet Communications

The RC-FLEXair is a non-routing, unitary controller that requires a network host controller.

- Two IEEE 802.3 Ethernet 10/100BASE-T ports, with a maximum distance of 50 m (164 ft) between Ethernet connections using Category 5, 5e, or 6 cabling. Each device uses one IP address. The second Ethernet port is a switched port; use it to line-connect additional devices.
- Automatic hardware coupling of Ethernet dual ports when controller loses power.
- Routing host controllers support up to 74 additional BACnet/IP-connected devices.
- RSTP protocol allows ring topology of up to 40 devices isolated by a managed network switch.
- LLDP protocol provides details of up to five of the most recently discovered neighboring devices.

MS/TP Communications (-M Models)

The RC-FLEXair is a non-routing, unitary controller that requires a network host controller.

- One EIA-485 port that supports a baud rate up to 76.8 kbps. Auto-baud detection.
- 24 VAC overvoltage protection with built-in resettable fuses.
- Software-switched End-of-Line termination (EOL) with amber LED indicator.
- Status LED illuminates green to indicate MS/TP network operation and red to indicate miswired MS/TP.

USB

- USB-A port with maximum cable length of 5 m (16.4 ft).

SMART-Net Communications

- SMART-Net port with four-wire terminal block supports up to eight devices.

The maximum tested SMART-Net cable length from the host controller to the last SMART-Net device on the SMART-Net bus is 45 m (147 ft). With an externally powered SMART-Net Expansion Board or SMART-Sensor Expansion Board located at the network midpoint, the maximum tested SMART-Net

cable length from the host controller to the last SMART-Net device on the SMART-Net bus is 75 m (246 ft).

Universal Inputs

- Standard 16-bit A/D converter; 12-bit A/D converter on -12 Models and all -M Models.
- Software selectable 0–10 VDC, 4–20 mA, or thermistor/dry-contact.
- Impedance:
  - 3 MΩ on 0-10 VDC range.
  - 249 Ω on 4-20 mA range.
  - 20 kΩ on thermistor range.
- Pulse counting up to 150 Hz. Supports flow meters.
- 24 VAC overvoltage protection.

Flow Sensor (-F Models)

- ±0-500 Pa (0"–2" WC).
- Maximum zero point accuracy 0.2 Pa (0.0008" WC).
- Resolution: 0.122 Pa (0.0005" WC).
- Span accuracy 3% of reading.
- 5.2 mm (0.2") OD fittings.
- Suitable for 1/4" OD standard pneumatic control tubing.

Universal Outputs

- 16-bit D/A converter.
- Analog: 0-12 VDC.
- Binary: Software configurable between 0–12 VDC.
- Output power: 75 mA at 12 VDC source, -10 mA sink
- 24 VAC overvoltage and short protection.

Solid-State Relay Output

- Switches 24 VAC/VDC.
- 500 mA maximum.

FLEX Output

- Use software to select as universal or solid-state relay.

Electric Actuator (-A Models)

- Torque 5 Nm (45 in-lb).
- Damper shaft minimum length 48 mm (1 7/8").
- Rotation/stroke: Maximum 95 degrees for dampers with 90 degrees of rotation.
- Actuator speed of 1 degree of rotation per second.
- Impedance-protected brushless DC motor.
- Compatible with 10–13 mm (3/8"–1/2") diameter round or square damper shafts.

Eight System Groups

- Group related objects on one display.
- System Groups accommodate up to 320 objects.
- Host custom user interfaces for integrated fault detection and diagnostics.

16 Loops

- Standard P, PI, or PID controllers for closed loop control.

256 Values

- Select standard and custom ranges as well as fixed or program-driven values. Some values are automatically added by firmware.

Four Calendars

- Designate days of the year as holidays.

16 Schedules

- Up to 7 on/off cycles for each weekday or exception.

562 Single-point Trend Logs

- 306 Automatically generated Single-point Trend Logs for all input, output, value, calendar, schedule, and loop objects.
- 256 Manually defined logs.

16 Multipoint Trend Logs

- Store up to eight objects in each trend log.
- Record values by polling or change of value.
- User assigned.

256 Notification Classes

- Specify broadcast destinations.

16 Arrays

- Up to 128 elements in a one-dimensional array.

Custom Units

- Eight analog engineering units.
- Eight binary engineering units.
- Eight multistate units with eight states.

64 Programs

- Freely programmable control strategy in a readable, BASIC-like language.
- 6,400 bytes per program.

Eight Tables

- For creating custom scaling functions.

256 Net Ins

- Maximum number of shares from other devices.

128 Net Outs

- Maximum number of writes to other devices.

Optional Conduit Cover

- 75 mm conduit cover for low-voltage wires.
- Provides plenum rating to controller.
- Encloses and protects all wires.
- Accessible top cover for service.
- Two 3/4" NPT knockouts.

Dimensions

- Base model:
  15.4 cm L x 10.8 cm W x 8.6 cm H
  (6 1/16" L x 4 1/4" W x 3 3/8" H).
- With actuator:
  16.9 cm L x 10.8 cm W x 8.6 cm H
  (6 5/8" L x 4 1/4" W x 3 3/8" H).
- With conduit cover:
  23.7 cm L x 10.8 cm W x 8.6 cm H
  (9 15/16" L x 4 1/4" W x 3 3/8" H).

Mounting

- Supplied with #8 self-tapping shoulder screw.

Weight

- 0.7 kg (1.8 lb).

Wiring Terminals

- 16–24 AWG (1.31–0.21 mm^2).
- Stranded or solid core.
- Copper conductors only.
- 5 mm (0.20") rising-cage screw terminal blocks.

Ambient Limits

- Operating: -20°C to 55°C
  (-4°F to 131°F).
- Shipping: -40°C to 60°C
  (-40°F to 140°F).
- Humidity: 10%–90% RH noncondensing.

Enclosure

- 6063-T6 aluminum extrusion with steel base plate and powder-coated die-cast aluminum end caps.

Certifications

- BTL Listed (B-BC).
- CE.
- CFR 47 Part 15/B Class B.
- UL 60730-1 Open Energy Management.
- WEEE.
- EN 60730-1.
- Canada ICES-003(B)/NMB-003(B).

Certification details

- Purpose and action of control: Type 1 Operating Control
- Pollution degree: 2.
- Impulse voltage: 330 V.

Related information

RC-FLEXair models and accessories 7