Automatic Temperature Control
Operation and Maintenance Manual For

SMCCCD Cañada
Facility Maintenance Center

Redwood City, California

T.A.C. Job Number
IC08C1031

For any questions contact
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July 16, 2009

SECTION 1

Warranty Letter

SMCCCD Cañada Facility Maintenance Center

JOB # IC08C1031

Quality Management Document	
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Pages	1 of 1

SI Pac-Atlantic

Certificate of Substantial Completion

TAC Americas, Inc. hereby submits our Substantial Completion submission indicating the completion of our work or designated portion thereof, in accordance with the terms and conditions specified in the Contract Documents. At this time, the system is operational and providing beneficial use to the owner. The designated date of Substantial Completion, listed below, establishes the commencement of applicable warranties required by the Contract Documents.

Site Information

Job Name	Canada College Facilities Maintenance Center	TAC Job#	IC08C1031
Address	Canada College 4200 Farm Hill Blvd, Redwood City, Ca. 94061		

Project Information

Our Contract is with	WKW Mechanical	Contractor Job#	
Contact	Phil Enfantino	Phone	4087799779

Substantial Completion Date(s) 7/31/09 Submitted On 7/16/09

Area/Equipment	Warranty Start Date
First floor/all equipment	7/31/09

Please forward, in writing, a list of any remaining issues, punch list items, or paperwork required by TAC so we may address such items in an expedient manner. We have attached a log of outstanding change orders for your review. Please forward the appropriate paperwork so we may bill for the work performed and close out our contract.

Please sign this agreement and forward to TAC. Should TAC not receive a signed agreement on or before 15 working days from the date of this notice, the Substantial Completion date shall be deemed acceptable and the warranty start date will be established.

Thank you for the opportunity to work with you on this project. TAC hopes to have future projects with your company.

Accepted by: By _____

CONTRACTOR or OWNER Date _____

Signed: By J. Baza

TAC Americas, Inc. Date 7/16/09

FAQ'S FOR THE NEW CONTROL SYSTEM OWNER AND OPERATOR

Under the contract for this project your new control system includes a warranty. To better serve you, we want to answer some common questions about what is included in your control system warranty.

WHAT IS THE WARRANTY PERIOD?

Our warranty period is indicated on the warranty form, and is usually one year from acceptance. Acceptance is defined in the contract documents and usually occurs when the system is placed into service for the owner.

WHAT DOES MY CONTROL SYSTEM WARRANTY COVER?

Your warranty is defined in the contract documents, either in the prime contract or in the supporting specifications. Your warranty provides that all materials are free of defects and that should a defect occur during the warranty period, the item will be repaired or replaced. Warranty does not include routine operation and maintenance. You operate the system as you see fit and maintain it according to the instructions in your Operation and Maintenance manuals and good maintenance practices. Failures of components or systems that result from a lack of care and maintenance will not be covered under the warranty.

WHO DOES THE CONTROL SYSTEM MAINTENANCE?

As the owner and operator of the system you must operate and maintain the system. You may want to have some or all of these services performed under a service and maintenance contract. Contact TAC to learn about several service agreement options. Contact information is at the end of this document.

HOW DO I DETERMINE IF IT IS A WARRANTY PROBLEM?

A few brief checks will quickly tell you if you have a warranty problem. First, review the sequence of operation to determine what function or feature is not operating. Next, check the adjustments and settings (thermostats, etc.) to be sure they are set properly according to your control diagrams. Finally, be sure that electrical power, water, gas or other utilities are turned on and available for the equipment. Remember that the control contractor is only responsible for the controls. The mechanical equipment, electrical hardware and other parts of the system are covered by the mechanical or electrical contractor's warranty. Determine where the problem exists so your warranty call can be directed appropriately. Most contractors will present a bill for services if the problem is not within their warranty obligation.

WHO DO I CALL IF I HAVE A CONTROL WARRANTY PROBLEM?

It is important that the prime or general contractor (the party the owner selected to handle the project) is aware of warranty problems. He can direct the problem to the appropriate contractor and has names, addresses and telephone numbers for all that worked on the project. A written memo describing the trouble is better than a phone call. If the control contractor is directed to handle the problem, we will contact you if we need additional information to evaluate what we need to make repairs. This saves time and gets repairs completed much faster.

WHAT ABOUT SOFTWARE PROBLEMS ON MY HOST COMPUTER?

Most software problems are related to software installed after the original system was set up. Remember that the software that was originally installed on your system was working properly and checked out thoroughly. If you have added software, utilities or other programs it is likely that the software problem is related to conflicts between these programs. Restore the software to the original conditions and remove any utilities or programs installed since the original installation and see if the problem persists. As a part of your routine maintenance you should keep a current backup of your software. We recommend that you keep an archive copy of the original working configuration, safely stored away from other routine software, and then keep routine periodic backup sets for the software as you go along. Remember that you will be billed for a service call if the problems are related to software or utilities that have been installed by others.

ALL THE CONTRACTORS SAY IT'S SOMEONE ELSE'S PROBLEM, WHAT NOW?

Inform the general contractor if you are not satisfied with results from the contractors. He will assemble representatives of all of the involved disciplines and seek a resolution.

WHAT HAPPENS AFTER THE WARRANTY EXPIRES?

The control system represents a significant investment for your facility. The system should be kept in good working order to protect that investment, and assure correct operation, energy efficiency, and a healthy environment. When your warranty has expired you become responsible for repairs that may be needed for your systems. Good maintenance practices will minimize failures and save time and trouble in the long run. We strongly recommend a service agreement so you can be sure the system is performing as it should and that your vulnerability to failures is kept at a minimum. Several types of agreements are available. When you think that a continuing maintenance agreement is desirable, contact the TAC office at the location given at the end of this document.

WHERE DO I GET REPAIR AND REPLACEMENT PARTS?

All repair and replacement parts for your control system are available from the TAC office at the location given at the end of this document. Most common parts are available from stock.

IF I NEED SOME EXTRA TRAINING, WHO CAN I TALK TO?

Continuing training on your control system is also available through TAC. Several approaches are available, i.e. scheduling a service technician for a few hours of additional instruction, formal classroom training held periodically in the area, factory training schools, instructional tapes, and manuals. Contact the TAC office at the location given at the end of this document.

T.A.C.
1555 Bayshore Highway, Suite 200
Burlingame, CA 94010
(650) 616-7400
(650) 616-7408 fax

SECTION 2

Network Materials

Part #	Description	Manufacturer
UNC-520-2	NETWORK CONTROLLER 10/100 MBIT	TAC AUTOMATION
IA-ENT-N	SW FOR ADDITIONL UNC'S	TAC AUTOMATION
LON-TERM2	LON TERMINATION, DOUBLE	TAC AUTOMATION

SMCCCD Cañada Facility Maintenance Center

JOB # IC08C1031

TAC
1354 Clifford Avenue
P. O. Box 2940
Loves Park, IL 61132-2940
www.tac.com

Overview

This document covers the mounting, installation and initial start-up of the UNC-520. It applies to the following products:

North American Model	International model
UNC-520	UNC-520-N

These models are collectively known as the UNC-520.

This document is targeted at engineers, technicians, and service personnel who are involved in control system installation and start-up using the Niagara Framework®. These are the main topics included in this document:

Also included in this document are several appendixes, as follows:

This document does not cover station configuration. For more information about this topic, please refer to the "Related Documentation" section on page 19.

Product Description

The UNC-520 is a compact embedded processor platform with Flash Memory for backup. It provides integrated control, supervision, and legacy device integration. When connected over an Ethernet network, the UNC-520 can communicate with BACnet™ devices or systems and share data between LonWorks™ devices and BACnet exposed system data. A complete set of Java-based control, application, logging, and user interface "objects" are included in a library for the Systems Integrator to create a robust monitor and control system for any size building. With the Web User Interface option (factory ordered as UNC-520-WEB), the UNC-520 can directly serve live data and dynamic displays over the Internet to any standard web browser such as Internet Explorer.

Included in this Package

Included in this package you should find the following items:

- A UNC-520.
- *UNC-520 Installation Instructions*, F-27391-2 (this document).
- A packing slip, which lists the factory settings for IP address, machine name, and host logon.
- A hardware bag containing the following items:
  - Four 3-position RS-485 screw terminal connector plugs.
  - Two wire nuts (North American model only).
  - One 2-position LON screw terminal connector plug
- Optional items (if ordered):
  - Factory-installed modem.
  - RJ-45 to DB-9 adapter (for the RS-232 port).
  - Silver satin patch cable (used between the adapter and serial port).

Precautions

This document uses the following warning and caution conventions:

Caution Cautions remind the reader to be careful. They alert readers to situations where there is a chance that the reader might perform an action that cannot be undone, might receive unexpected results, or might lose data. Cautions contain an explanation of why the action is potentially problematic.

Warning **Warnings alert the reader to proceed with extreme care. They alert readers to situations where there is a chance that the reader might do something that can result in personal injury or equipment damage. Warnings contain an explanation of why the action is potentially dangerous.**

Safety Precautions

The following items are warnings of a general nature relating to the installation and start-up of the UNC-520 controller. Be sure to heed these warnings to prevent personal injury or equipment damage.

Warning

- **A 120Vac (North American model) or 230Vac (international model) circuit powers the UNC-520 controller. Disconnect power before installation or servicing to prevent electrical shock or equipment damage.**
- **Make all connections in accordance with national and local electrical codes. Use copper conductors only.**
- **To reduce the risk of fire or electrical shock, install in a controlled environment relatively free of contaminants.**
- **This device is only intended for use as a monitoring and control device. To prevent data loss or equipment damage, do not use it for any other purpose.**

Static Discharge Precautions

Static charges produce voltages high enough to damage electronic components. The microprocessors and associated circuitry within a UNC-520 controller are sensitive to static discharge. Follow these precautions when installing, servicing, or operating the system:

Caution

- **Work in a static-free area.**
- **Discharge any static electricity you may have accumulated. Discharge static electricity by touching a known, securely grounded object.**
- **Do not handle the printed circuit board (PCB) without proper protection against static discharge. Use a wrist strap when handling PCBs, with the wrist strap clamp secured to earth ground.**

Installation and Start-up

There are four major steps to installing and starting the UNC-520, as outlined below:

1. Unpack the UNC-520.
2. Install the UNC-520.
3. Upgrade, License, and Configure the Host.
4. Install the Station Database and Start the Station.

Please read through the entire document before beginning the installation procedure.

Unpack the UNC-520

Unpack the UNC-520 and inspect the contents of the package for damaged or missing components. If damaged, notify the appropriate carrier at once and return any damaged components for immediate repair or replacement.

Install the UNC-520

Installing the UNC-520 has four major phases, as outlined below:

1. Physical Installation.
2. Make Connections.
3. Power Up and Initial Checkout.
4. Connect to the UNC-520.

Physical Installation

Tools Required

The following tools and supplies may be required for installation:

- 1/4-inch nut driver: used to remove the transformer shield.
- Small flat-blade screwdriver: used for RS-485 connectors (all models) and power terminal connections (UNC-520-N only).

Note If removing or installing the circuit board from the enclosure, a 1/4-inch thin-walled ***socket*** is required (***do not use a nut driver***). See "Replacing the UNC-520 Circuit Board," page 25.

Mounting

Mount the UNC-520 controller in a location that allows clearance for wiring, servicing, and module removal. For mounting details refer to Figure 3 on page 18.

Pay attention to the following recommendations and precautions when mounting and installing the unit.

- This product is intended for indoor use only. The unit should not be exposed to ambient conditions outside of the range of 32° to 122° F (0° to 50° C) and relative humidity outside the range 5% to 95%, non-condensing.
- If the controller is mounted inside an enclosure, that enclosure should be designed to keep the unit within its required operating range considering a 20-watt dissipation by the controller. This is especially important if the controller is mounted inside an enclosure with other heat producing equipment.
- See Figure 3 on page 18 for proper mounting clearances. Minimum clearance from the wall on which the unit is mounted is 0.2 inch (5 mm), provided by the dimpled mounting feet. Ensure that this space is not compromised and that airflow is not blocked behind the unit.
- Do **not** mount the unit:
  - in an area where excessive moisture, corrosive fumes, or explosive vapors are present.
  - where vibration or shock is likely to occur.
  - in a location subject to electrical noise. This includes the proximity of large electrical contactors, electrical machinery, welding equipment, spark igniters, and other equipment of this nature.
- The unit is designed to be wall mounted with the battery situated towards the bottom of the unit. For proper airflow at temperature extremes, do not mount the unit oriented in any other way.

Removing and Replacing the Cover

The UNC-520 cover is removable. The cover is secured in place with a knurled-edge, *slotted-head* screw.

Note If you need a more secure installation for the cover, you can use a padlock through the security tab that protrudes through the cover.

Procedure 1 Removing the cover of a UNC-520.

Step 1	Loosen the cover screw and open the cover. (You may need a flat-blade screwdriver to loosen the cover screw, if previously tightened this way.)
Step 2	On the inside of the door, loosen and remove the nut and locking washer that secures the green grounding strap to the cover.
Step 3	Pull the grounding strap off the screw post.
Step 4	Replace the locking washer, then the nut on the screw post and tighten.
Step 5	Close the door about half way.
Step 6	Slide the cover toward the top of the unit until the tops of the hinge tabs on the cover hit the top of the hinge slots on the left wall of the metal enclosure.
Step 7	Slide the hinge tabs out of the slots.

Procedure 2 Replacing the cover of a UNC-520.

Step 1	Align the hinge tabs on the cover with the hinge slots on the left wall of the metal enclosure.
Step 2	Slide the hinge tabs into the slots and slide the door toward the bottom of the unit, until the bottom of the hinge tabs hit the bottom of the slots.
Step 3	Loosen and remove the nut and locking washer on the grounding strap post on the door.
Step 4	Slide the ground strap onto the screw post and replace the locking washer, then the nut and tighten.
Step 5	Close the door and tighten the cover screw.

Make Connections

Make connections to the UNC-520 in the following order. For specific details on each step, refer to the "Wiring Details" section on page 13.

1. With the 6-position power connector disconnected from the board, wire the power to the transformer (North American model) or the power terminal block (International model). See "Power Wiring," page 13.
2. Connect the Ethernet cable.
3. Connect any other communication cables.

See Figure 2 on page 17 to locate connectors and other components on the UNC-520 controller.

Power Up and Initial Checkout

Ensure power wiring to the transformer has been completed before proceeding (see the "Power Wiring" section on page 13). The UNC-520 controller does not include an on/off switch. To apply power, insert the 6-position power connector to the board.

Refer to Figure 2 for the locations of status LEDs on the UNC-520 controller.

Checking the Heartbeat LED

When power is first supplied to the controller, the red heartbeat LED comes on solid for approximately 10 seconds, then begins to blink. The blink pattern of the heartbeat LED under normal operation differs for each installation (depending on station activity); but, in general, the LED should blink about once per second. The rate will be slower when the control engine is executing the station database and as more objects are added.

After applying power to the controller, if the heartbeat LED comes on (steady) and stays lit longer than two minutes, contact TAC Product Support for technical assistance. See also the "Using Status LEDs" section on page 19.

About the Battery

The UNC-520 is provided with a sealed lead acid battery. The sealed lead acid battery is automatically charged during normal operation. The UNC-520 monitors the battery's backup capability and generates battery trouble messages accordingly. After allowing the battery to charge for at least 12 hours following initial installation, investigate any battery trouble messages. Check the battery voltage level and connections before contacting TAC Product Support

Caution In the event of battery trouble messages, ensure the station database is backed up to removable storage so that it can be restored in the event of a power failure and loss of data.

For more information on the use and replacement of the battery, refer to the “Required Battery Maintenance” section on page 21.

Connect to the UNC-520

Notes
- These instructions assume that you have a PC installed with the TAC I/A Series Enterprise Server software, which includes the Java Desktop Environment (JDE) and the host administration tool (Admin Tool). This PC will be referred to as “your PC”.
- You should use the same Niagara release level on your PC that you want to run in the UNC-520.

Once the UNC-520 has powered up, you should connect to it with the Admin Tool to assign it a unique IP address and other network settings to be used for communications. In addition, you must set current host date, time, and time zone since the UNC-520 is shipped with the battery disconnected.

Note It is strongly recommended that you change the password for the default administrator-level host user account (tac)—see the related Caution on page 8 for more details.

The UNC-520 controller is pre-configured with an IP address in the range 192.168.1.14*x*, and a default subnet mask of 255.255.255.0.

Notes
- The IP address is listed on the packing slip that accompanies the unit.
- Make sure the PC that you use to access the UNC-520 during installation is assigned an address in the range: 192.168.1.1 to 192.168.1.254, with a subnet mask of 255.255.255.0.

Changing Networking Properties

You can use the Admin Tool from your PC to access all Niagara hosts including a remote UNC-520. In addition to station-related operations (that is, starting and stopping stations, archiving station data, importing and exporting configuration databases, and so on), the Admin Tool allows you to change operating system parameters on the UNC-520.

These changes include editing host name, TCP/IP networking properties, and setting time, date, and time zone. The reboot function allows you to restart a UNC-520 remotely to implement changes.

The right half of the Admin Tool window provides access to operating system parameters for the selected host. Six tabs are available: the **Summary** tab, the **Network Settings** tab, the **Users** tab, the **System Time** tab, **DbAdmin** tab, and the **Installation** tab.

The Networks Settings tab provides access to the selected host’s networking properties, including host name (computer name) and the TCP/IP properties listed below (each property must be obtained from your Network Administrator). Use the **Apply** button to store any changes you make (note that changes are not effective until the host is rebooted). The **Reset** button restores changes since the last **Apply**.

- **Computer Name**—The name you want to use for this host.
- **DNS Domain**—The TCP/IP Domain Name System (DNS) domain this host belongs to, if used.
- **IP Address**—The unique Internet Protocol (IP) address for this host.
- **Subnet Mask**—The IP subnet mask used by this host.
- **Default Gateway**—The IP address for the device that forwards packets to other networks or subnets.
- **Hosts File**—A text file used by TCP/IP to associate host names with IP addresses.

- **DNS Servers**—The IP address for one or more DNS servers, each of which can automate associations between host names and IP addresses. The Add, Delete, Modify, and Up/Down buttons in the Admin Tool window can be used as needed to reference the DNS server IP addresses and set DNS search order.

Note If you specify a DNS server, you must provide a domain name for this host in the DNS Domain field. Otherwise, the DNS function will not work.

Use the following procedure to change the network settings of the new UNC-520.

Procedure 3 Setting the IP address on a new UNC-520.

Step 1 If not already installed, install the TAC **I/A Series Enterprise Server** (release 2.3.4 or later) software on your PC.

Step 2 Attach one end of a standard Category-5 Ethernet unshielded twisted pair (UTP) patch cable to the RJ-45 connector on the UNC-520.

Step 3 Attach the other end of the patch cable to a network port or directly to an Ethernet hub.

Tip If you do not have access to a hub, use an Ethernet crossover cable to connect the UNC-520 controller directly to your PC's network port. For more details about crossover cables, see the "About Ethernet Straight Through and Crossover Cables" section in the *Niagara Networking & Connectivity Guide*.

Step 4 Power up the UNC-520.

Step 5 Assign the IP address of your PC in the range of 192.168.1.1 to 192.168.1.254; however, do not duplicate the IP address already assigned the UNC-520 or another host on the LAN.

Step 6 From your PC, start the R2.3.4 (or later) **Admin Tool**.

a. Click the **Start** button on the **Taskbar** and expand the **Programs** menu to view the **Niagara** folder.

b. Click the **Admin Tool** icon to launch the **Admin Tool**.

Step 7 In the **Admin Tool** view, click **File** on the menu, and click **Open**.

A connection dialog is displayed.

Step 8 Type the pre-assigned IP address of the UNC-520 and click **OK** (see the previous section "Connect to the UNC-520").

Step 9 Log on to the UNC-520 controller with default logon user name and password, as it appears on the packing list. Typical defaults are: user name = **tac** and password = **niagara**. Click **OK**.

The UNC-520 controller (IP address) appears in the Admin Tool view as an open host.

Note By default, the **Summary** tab is shown first. Among the items listed is an **AC Power Status**, which shows "ok" if the power is good. If the UNC loses power (and is running on its battery), this status shows "failed." See also "Configure Power Shutdown Options," page 10.

Step 10 Click the **Network Settings** tab.

Step 11 Assign the UNC-520 a unique IP address and other network settings to be used for communications, as described above.

Note Once you have made changes to one or more network settings, you must reboot the host for those changes to be implemented.

Step 12 From the menu, select **Admin Tool > Host > Reboot** to implement your changes.

The UNC is now accessible using the IP address you assigned it (and not the default IP address).

Note An **ipchanges.txt** file is created or updated in the **<*x*>:\niagara\<release>\nre\user** directory on your PC whenever you change the IP address of a host using the Admin Tool. If needed, you can refer to this file to see the new (and previous) IP address. Ensure that you do not change the IP to an illegal IP address such as xx.xx.xx.255, xx.xx.xx.0, or 224.xx.xx.xx or higher.

Setting Host Date and Time

Use the **System Time** tab of the Admin Tool to access the host's system time, date, and time zone. To change the settings, click on the information you want to change and type the new information. When finished, click **Apply**. Changes you make in these settings become immediately effective on the host.

Configuring Host Users

Use the **Users** tab of the Admin Tool to access host user accounts on the UNC-520. The top area shows current user accounts, which you select by clicking on the user name. A selected user can be deleted, or have password and/or groups assignments modified (available user groups are accessed in the lower area).

Caution It is strongly recommended that you **change the password** for the default, administrator-level, *host* user account (tac) upon installation. This account cannot be deleted. Signing on as the "tac" administrator allows you to modify *all* host user accounts.

Note Be aware that once this user is modified, TAC cannot provide you with an alternative means of accessing the unit should the new password be lost or forgotten! The UNC must be returned to TAC for re-commissioning.

You can also add a new user. This produces a New User dialog to establish the User Name and Password. By default, a new user is not assigned to any user group(s); you need to check the Administrator group assignments in order for the user to use the JDE Admin Tool.

Use the **Apply** button to store any modifications, which become effective immediately. The **Reset** button restores changes since the last Apply.

Upgrade, License, and Configure the Host

This step consists of three main tasks:

1. Install the Software.
2. Configure Power Shutdown Options.
3. Configure the Serial Ports.

Install the Software

Each UNC-520 controller is shipped with the Wind River VxWorks™ operating system and the appropriate Java™ virtual machine (JVM) installed. However, the Niagara Runtime Environment (NRE) software, and the Niagara service (**`niagarad`**) are not installed and you must install them.

Use the following procedures to install the software. Consult the *Niagara Release 2.3.4 Installation and Upgrade Instructions* for more information.

These procedures assume that you have successfully tested connectivity to the UNC-520 and can access the unit over the Ethernet LAN.

Procedure 4 Installing the software.

Step 1 If not previously installed by selecting the **emb** and **nt** selections within the Niagara installer, use Window s® Explorer to manually copy the **emb** and **nt** directories. Copy the **emb** and **nt** directories from the R2.3.4 (or later) installation CD to the following directory on the hard drive of your PC:

<*x*>:\niagara\<*release*>

where **<*x*>:** is the drive where you installed TAC I/A Series Niagara, and **<*release*>** is the TAC I/A Series Niagara release you installed in Step 1 of Procedure 3.

Step 2 Using the R2.3.4 (or later) **Admin Tool,** connect to the UNC-520 as described in Procedure 3.

Step 3 Click the **Installation** tab.

Step 4 On the **Installation** view, click the **Installation Wizard** button.

Step 5 In the **Select Distribution Directory** dialog, select **emb** and click the **Install** button.

Step 6 In the **Niagara Remote Installation** dialog, click the radio button next to **Upgrade**, then click **Next**.

Step 7 In the **Upgrade** dialog box, click the check boxes for **Upgrade OS** and **Upgrade NRE**, then click **Next**.

Note You must upgrade **`niagarad`** when you upgrade the OS.

Step 8 In the **Configure Modules** dialog box, click inside the **Upgrade/Add** column for each module licensed for installation on the UNC-520.

A red check mark appears for each selected module.

Note The UNC-520 has finite memory resources (software modules run out of flash memory rather than a hard disk). Therefore, select only those modules that are required for station operation. If you are unsure about the software modules that have been purchased and licensed for the UNC-520, check the license by clicking **View License** on the **Installation** tab of the **Admin Tool** view.

Step 9 Click **Next** to continue.

Step 10 On the **Database Backup** dialog box, click the red check mark next to the database name and click **Next** to continue. You do not need to back up the pre-installed “test” database on the UNC-520.

The **Niagara License** dialog box opens.

Note The UNC-520 controller is shipped with the license file already installed.

Step 11 On the **Niagara License** dialog box, click **Finish**.

A text box displays the tasks selected for the software upgrade.

Step 12 Click **OK** to continue.

A dialog displays each task as it is performed. Depending on the number of tasks to be performed, the process may take from one to three minutes.

Step 13 When complete, click **OK**.

Configure Power Shutdown Options

If desired, you can change the operation of UNC-520's "power monitoring/shutdown" mechanism by editing the **drivers.properties** file. Any changes to this file requires a station restart (host reboot) to become effective.

Table 1 lists power parameters for the UNC-520 found in **drivers.properties**. For additional information, please refer to the Engineering Notes document *Niagara System and Power Monitoring*.

Table 1 UNC-520 power parameters in the drivers.properties file.

Parameter, Default Value	Description
`power.enabled=true`	Enables the power driver, which provides graceful shutdown of the UNC on A/C power loss. When set to false: • the UNC does not monitor the A/C power. • on power loss, the UNC runs on battery backup until the battery is drained or A/C power is restored. **Note:** You should leave this value set to true, the default.
`power.pollRate=15`	The rate (in seconds) that the power monitor of the UNC waits before checking for A/C power loss. The monitor wakes up every `pollRate` seconds, checks the A/C power status, then goes back to sleep (if the power status is OK). However, if the UNC has lost A/C power, the monitor generates a station alarm and starts the shutdown timer. Default is 15 seconds. Station alarms are sent to the Station object's notificationClass.
`power.shutdownDelay=60`	Number of seconds the UNC waits between detecting the loss of A/C power and performing a graceful shutdown (where the UNC does a database backup and turns the board off). Typically, the default value is recommended. You can increase this time, however, this means more time running on battery power. In this case, if multiple lengthy power failures occur in succession, the battery may become completely discharged. Default is 60 seconds. If a station is not running, the UNC runs from the battery for 5 minutes before shutdown.
`power.batteryTestRate=15`	Number of minutes between the periodic testing of the backup battery under a simulated load. Default (and ***minimum*** recommended) value is **15** minutes. When the test runs, a 900mA load is placed on the battery for less than one second. If the voltage drops below a predefined value, then the "battery test failed." If the voltage is higher, then the "battery test passed." A station alarm is generated *only* when the new outcome is different than the previous test. If a battery is marginal, the test may go from "failed" to "passed," and then "failed" again.

Use the following procedure to view or edit the **drivers.properties** file.

Procedure 5 Viewing or editing the drivers.properties file.

Step 1 Using the R2.3.4 (or later) **Admin Tool,** connect to the UNC-520 as described in Procedure 3.

Step 2 Click the **Installation** tab.

Step 3 Click **Edit drivers.properties**.

The drivers.properties file opens in a text editor.

Step 4 Make any changes to the text of the file.

Step 5 From the file menu, choose **File > Close**.

If you made any changes, you are prompted to save them, otherwise the window closes.

Step 6 If prompted to save your changes, click one of the following:

- **Yes** to save your changes. The file saves and the window closes.
- **No** to discard your changes. The window closes.
- **Cancel** to return to the editing window, then refer to Step 4.

Step 7 From the menu, select **Admin Tool > Host > Reboot** to implement your changes.

Configure the Serial Ports

The UNC-520 has six serial ports (two RS-232 and four RS-485) and one optional on-board 56K modem. However, only six of these serial channels can be active at any one time.

If the optional 56K modem is installed, it is always COM2. COM1 is assigned to the first RS232 port and COM2 is assigned to the second RS232 port if no modem is installed. Changes to these assignments can be made using the R2.3.4 (or later) Admin Tool.

You can choose from one of the following options for configuring your serial ports:

Table 2 Serial port configuration options.

Option 1 (default)	COM2=232
Option 2	COM2=MODEM

Use the following steps to configure the serial ports.

Procedure 6 Configuring serial ports.

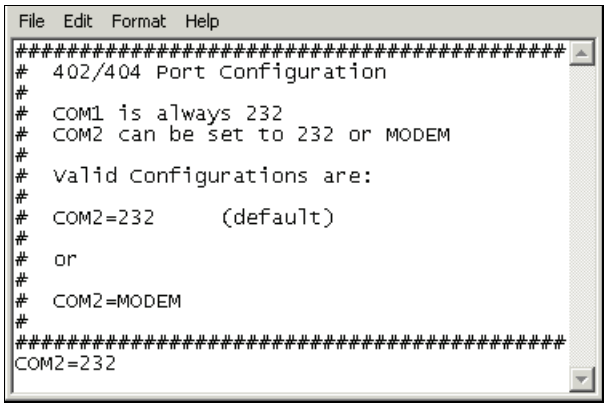
Step 1 As described in Procedure 3, open the R2.3.4 (or later) **Admin Tool** and connect to the UNC-520.

Step 2 Click the **Network Settings** tab.

Step 3 On the **Network Settings** tab, click **Edit Port Properties**.

The port.properties file opens in a text editor (see Figure 1).

Figure 1 port.properties file opened for editing.



Step 4 Make any changes to the text of the file, using any of the options from Table 2.

Step 5 From the file menu, choose **File > Close**.

If you made any changes, you are prompted to save them, otherwise the window closes.

Step 6 If prompted to save your changes, click one of the following:

- **Yes** to save your changes. The file saves and the window closes.
- **No** to discard your changes. The window closes.
- **Cancel** to return to the editing window, then refer to Step 4.

Step 7 From the menu, select **Admin Tool > Host > Reboot** to implement your changes.

Install the Station Database and Start the Station

This step assumes that you have created a station database on your PC and need to install that database onto the UNC-520. Use the following procedure to install a previously created station on the new UNC-520.

Note Installing a station from your PC places everything in your local station database folder (**<*x*>:\niagara\<*release*>\stations\<*stationname*>**) onto the UNC-520. Since the UNC-520 has limited memory resources, you should limit what is in your local station database folder so you do not exhaust the resources on the UNC.

Procedure 7 Installing and starting a station.

Step 1 As described in Procedure 3, open the **Admin Tool** and connect to the UNC-520.

Step 2 Click the **Installation** tab.

Step 3 On the **Installation** tab, click the **Install Station** button.

Step 4 From the list of available stations on your PC, choose the desired station and click **OK**.

Step 5 Verify your intent to overwrite the existing database by clicking **Yes**.

Step 6 If more than one version or format of the station database exists on your PC, select the one that you intend to install and click **OK**.

A progress dialog displays tasks as it completes them. These messages indicate when the installation wizard is converting the database, starting maintenance, and reconnecting to the station.

Step 7 When the installation wizard indicates that it is complete, click **OK**.

The installation wizard automatically starts the station. Therefore, you should not have to perform this step separately. However, if the status of the station shows “idle”, use the next step to start the station on the UNC controller.

Step 8 From the **Admin Tool** view, click the station name and click the **Start** button  on the tool bar.

Verify that after showing a status of “starting,” the selected station’s status updates to **running**.

Wiring Details

The following section provides details on:

- Power Wiring
- Communications Wiring including:
  - Ethernet
  - Serial
  - LonWorks (LON)
  - Modem (Optional)

Power Wiring

Building power is wired directly to the transformer supplied with the UNC-520. There is no disconnect switch in the unit, therefore you should wire the UNC to an external switch or breaker. Some local codes require the switch to be in sight of the unit. Also, conduit or similar is typically required for Class 1 wiring.

About the Transformer

The UNC-520 ships with a 120Vac, 50/60 Hz transformer and 12V battery. The UNC-520-N ships with a 230Vac, 50/60 Hz transformer and a 12V battery.

The transformer provides power to the controller in a 14-CT-14 configuration (28Vac center tapped). The power connector has been disconnected for shipping.

The following things should be noted about the UNC-520 transformer:

Warning

- **Wiring is to be made to the supplied transformer. All connections should be made in accordance with national and local electrical codes. Use copper conductors only.**
- **Do not power other devices from the transformer of the UNC. The transformer should be dedicated to running the UNC.**
- **Do not attempt to use any other power source or otherwise defeat the isolation provided by the integral transformer. A two-wire power source, including a 24V transformer, can cause permanent damage or greatly shorten the life of the unit.**
- **Verify that neither side of the transformer's secondary winding is connected to earth ground or building neutral.**

Making the Power Connection to the Transformer

With the 6-position power connector disconnected from the PCB, unscrew the nut and locking washer and remove the metal enclosure of the transformer.

Note As typically required by code, high voltage “Class 1” wiring must be confined behind the transformer’s enclosure divider. Be sure to replace this barrier after completing the wiring. Do not pinch wires underneath the barrier when re-installing the barrier.

For UNC-520—Using the provided wire nuts, connect **120Vac 50/60 Hz** power to the transformer and power connector using the information in Table 3.

Table 3 UNC-520—Building Power Termination.

Building Power Source		
Type of Wire	**Typical Color of Wire**	**Termination point**
Ungrounded—Hot	Black	Either wire of the 120V transformer
Grounded—Neutral	White	Other wire of the 120V transformer
Grounding—Ground (Earth)	Green or bare copper	Grounding stud

For UNC-520-2-N —Connect **230Vac, 50/60 Hz** power to the power terminal block using the information in Table 4.

Table 4 UNC-520-N—Building Power Termination.

Building Power Source (International)		
Type of Wire	**Typical Color of Wire**	**Termination point**
Ungrounded—Hot	Brown	Either empty terminus of the terminal block
Grounded—Neutral	Blue	Other empty terminus of the terminal block
Grounding— Ground (Earth)	Green/yellow or bare copper	Grounding stud

Communications Wiring

All communications wiring is made through knockouts adjacent to the communication ports. Prior to connecting cables, ensure that the grommet bushing has been installed for each knockout. Employ strain relief on the communication wiring to prevent damage to the controller.

Ethernet

A single, female 10/100-Mbit Ethernet connection is provided on the controller. This connection is capable of running at either 10 Mbps or 100 Mbps—it automatically adjusts to either speed. This means the UNC-520 can exist on the same network with a mixture of 10BaseT and 100BaseTX hardware connected to a smart 10/100 hub capable of adjusting to the devices it supports.

Connection is made via a standard male RJ-45 (8-wire) connector. Using a Category 5 unshielded twisted pair (UTP) cable, connect one end of the cable through the knockout adjacent to the RJ-45 connector on the UNC, and the other end to a hub on the Ethernet LAN.

The maximum end-to-end distance from the controller to the hub is 328 feet (100m).

Serial

There are six serial ports on the UNC-520, located at the bottom of the board (see Figure 2 on page 17). From left-to-right, ports are two RS-485 (COM3 and COM4), two RS-232 (COM1 and COM2), and two more RS-485 (COM5 and COM6). All RS-485 ports are optically-isolated; the RS-232 ports are not isolated.

RS-485

RS-485 multi-point connections are made to the 3-position, screw terminal connectors on the board. Wire to this connector with shielded 18-22 AWG wiring (refer to the TIA/EIA-485 standard). The screw terminals (from left to right) are shield, plus (+), and minus (–).

RS-232

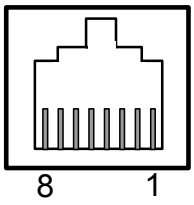
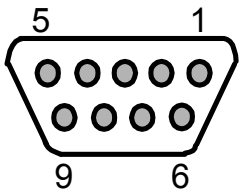
RS-232 serial port connections can be made to the female (socket) RJ-45 connectors using an 8-conductor flat silver satin stranded cable with standard male (plug) RJ-45 connectors. Connect the flat satin cable (maximum distance 50 feet) through the enclosure knockout nearest the port. This “straight-through” cable is then connected to a socket-to-socket type RJ-45 to DB-9 adapter.

The UNC-520 is a serial DTE device, such that another DTE device (PC, for example) requires a “null modem” adapter (UNCC-405). If connecting the UNC-520 to a DCE device (modem, for example), a straight-through adapter is used. Table 5 provides pinouts for both types of RJ-45 to DB-9 adapters.

Notes

- Silver satin cable is not standard Ethernet UTP cable, in which the pairs are twisted around each other. The twisting of the pairs may cause undesirable effects on the serial communication, therefore we recommend the use of flat silver satin cable instead.
- Flat silver satin cable is unshielded. If installing this cable in a noisy electrical environment, run the cable through conduit, ***with no other wires in that conduit***.

Table 5 RJ-45 to DB-9 adapter pinouts.

RJ-45 and DB-9 Pinout References	Type of Adapter	RJ-45 Socket Pin	Signal		DB-9 Socket Pin
RJ-45 Socket (female)  	**Null Modem** (for connecting to another DTE device) **Part number UNCC-405**	5	DCD	Data carrier detect	1
		3	TXD	Transmit data	2
		6	RXD	Receive data	3
		8	DSR	Data set ready	4
		4	GND	Ground	5
		1	DTR	Data terminal ready	6
		7	CTS	Clear to send	7
		2	RTS	Request to send	8
		—	Not used on the UNC-520		9
DB-9 Socket (female)  	**Straight-through** (for connecting to a DCE device)	5	DCD	Data carrier detect	1
		6	RXD	Receive data	2
		3	TXD	Transmit data	3
		1	DTR	Data terminal ready	4
		4	GND	Ground	5
		8	DSR	Data set ready	6
		2	RTS	Request to send	7
		7	CTS	Clear to send	8
		—	Not used on the UNC-520		9

LonWorks (LON)

A single, two-pin, male LonWorks FTT-10A Weidmuller connection is provided on the controller. This connection supports twisted pair, unshielded, polarity-insensitive, peer-to-peer communications at 78 Kbps.

Refer to the *LonWorks FTT-10A Free Topology Transceiver User’s Guide* (078-0156-01F) for technical guidelines associated with free topology restrictions and the *Junction Box and Wiring Guidelines for Twisted Pair LonWorks Networks* (005-0023-01) for more detailed information on wiring specifications. These documents are available on the Echelon® web site (www.echelon.com).

Modem (Optional)

The female RJ-11 connection for the modem is located near the internal modem. Connect one end of a standard flat satin telephone cable (6-position/4-connector) through the adjacent knockout to the modem's RJ-11 connector and the other end to an analog telephone port.

This modem is approved for US use only, and must be tested for use in other countries.

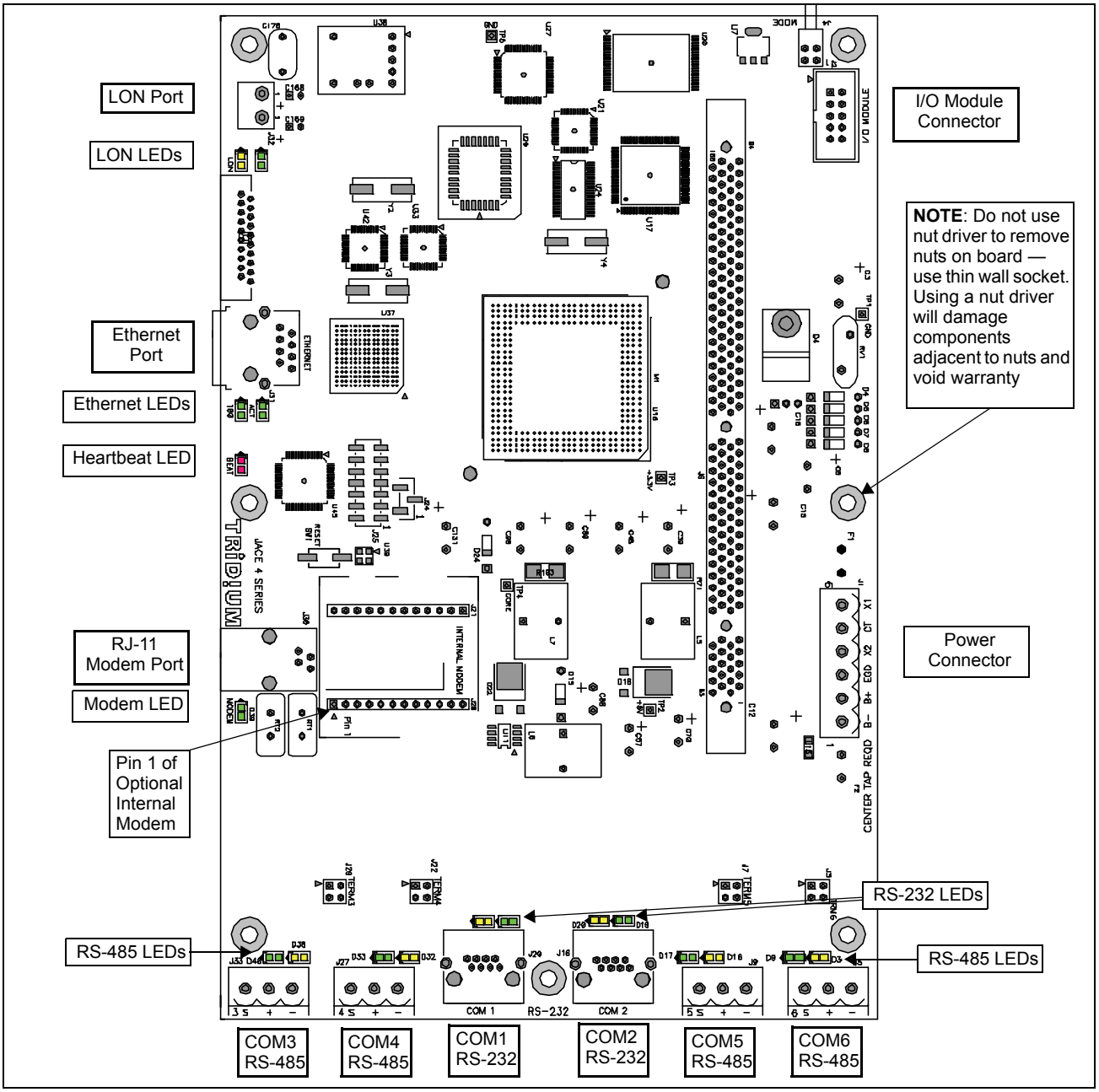
Note The modem option is not available for UNC-520-2-N or international applications. Use an external modem for international applications.

Figures

The following figures provide details for component layout and mounting dimensions for the UNC-520.

Board Layout

Figure 2 Board layout details.

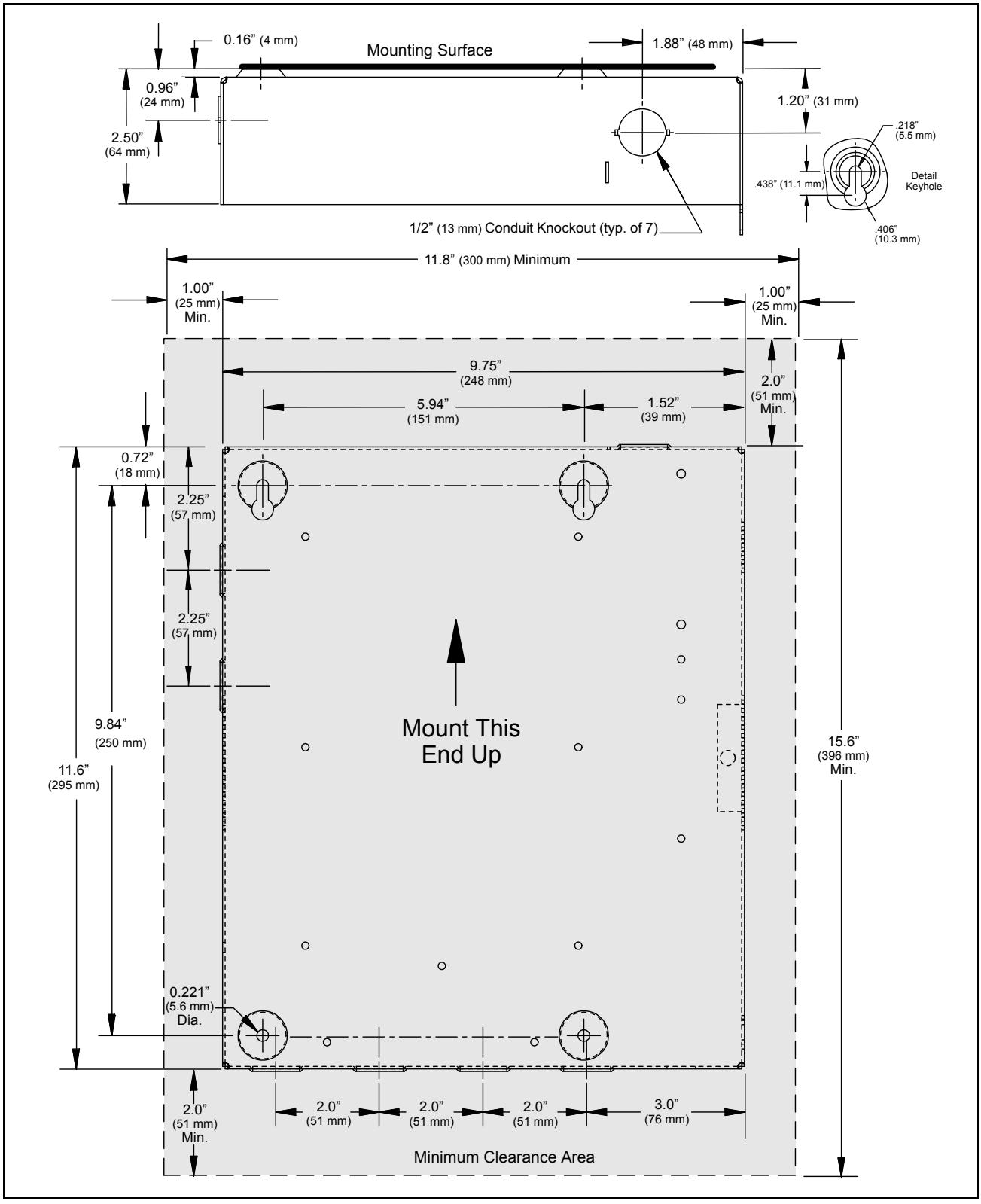


Mounting Guide

Figure 3 on page 18 provides a mounting guide for the UNC-520.

Mounting Details

Figure 3 Mounting Details.



Related Documentation

For more information on configuring and using the UNC-520 controller, consult the following documents included in the TAC I/A Series Enterprise Server CD:

- *Niagara Release 2.3.5 Installation and Upgrade Instructions*
- *Niagara System and Power Monitoring, Engineering Notes*
- *Niagara Networking & Connectivity Guide*
- *Niagara Standard Programming Reference, Release 2.3.5*

Using Status LEDs

The UNC-520 controller includes a series of LEDs that can be used to determine the status of a variety of normal operating parameters for the unit. They are located on the circuit board. From the top of the board to the bottom, these include the following:

- LON (LonWorks) Port
- Ethernet Port
- Heartbeat
- Modem
- Serial Ports

Refer to Figure 2 on page 17 for the exact locations of status LEDs on the UNC-520 controller.

LON (LonWorks) Port

Two LEDs are located below the LON port and show transmit and receive activity.

The **yellow** transmit LED (TxD) indicates that the UNC is *transmitting* a message on the LonWorks trunk.

The **green** receive LED (RxD) indicates that *another* LonWorks device is transmitting a message on the LonWorks trunk.

Ethernet Port

The Ethernet port has two green LEDs, located below the Ethernet connector.

The LED marked “100” indicates whether the UNC-520 is operating at 10 Mbps (Ethernet) or 100 Mbps (Fast Ethernet). If the 100 LED is on, the network connection is operating at 100 Mbps. Otherwise, the port is communicating at 10 Mbps.

The “ACT” LED indicates activity on the port as follows:

- **Off**—No Ethernet link is made
- **On**—Ethernet link is present, but no activity on the LAN
- **Blinking**—Ethernet link is present with data activity on the LAN.

Heartbeat

The Heartbeat LED is located below the Ethernet status LEDs, and is red. Under normal operation, this LED should blink about once per second. Blink patterns differ as station activity varies, but any pulse rate from once per second to 10 blinks per minute usually indicates normal operation. If the heartbeat LED stays *on constantly*, *does not light*, or blinks *very fast* (more than once per second), contact TAC Product Support.

Modem

The modem LED is located below the RJ-11 connector for the optional internal modem. When the modem LED is lit, it indicates that the modem is connected to another modem (a carrier is detected). In this case, the serial port LEDs for COM2 should indicate transmit and receive activity—see "Serial Ports" below.

Serial Ports

Status LEDs for the serial ports are located directly above each respective RS-485 and RS-232 port. They show transmit and receive activity for the serial ports and optional modem (see "Configure the Serial Ports," page 11).

The **yellow** transmit LED indicates that the UNC-520 is *sending* data out the serial port over a communications line to a connected device.

The **green** receive LED indicates that the UNC-520 is *receiving* data from a connected device.

These LEDs are driven by pulse detectors that provide a fixed on-time when data is detected on the port. If these LEDs are on constantly, this indicates a problem with the communications channel, such as a shorted wire or reversed wiring.

Maintaining the UNC-520

This section provides information on the following topics:

Cleaning

If dust or metal filings are present inside the unit, clean with vacuum or compressed air. Otherwise, no cleaning inside the unit is required. Optionally, if the outside of the metal enclosure becomes dirty, you can wipe it with a damp cloth and mild detergent.

Required Battery Maintenance

Battery life expectancy is a function of its discharge cycles (the number of discharges and their depth) and the ambient temperature of the battery during normal operation. In most applications, the battery should see relatively few discharges. Therefore, ambient temperature has more to do with determining the life expectancy of the battery than does any other factor. If the UNC-520 is installed in a conditioned space, the battery should provide dependable service for approximately three years (average). In an environment where the operating temperature is higher (122ºF or 50ºC), you should only expect the battery to last approximately one year.

The sealed lead acid battery in the UNC-520 controller is automatically float-charged during normal operation (while power is applied to the unit). The UNC-520 monitors the battery and periodically loads the battery to test its ability to maintain battery-backed functions. After allowing the battery to charge for at least 12 hours following initial installation, investigate any battery trouble messages. Check the voltage level and its connections to the unit. Replace the battery as required.

To order a new battery, see the "Standard Replacement Parts" section on page 22.

Replacing the Battery

Warning **When replacing the battery or harness, maintain proper polarity as marked on the label inside the unit. Although the UNC-520 is fully protected against shorted battery terminals, the battery itself is not internally protected. Use extreme care to not short circuit the battery. A shorted battery may overheat rapidly and damage the power wiring harness or cause other physical harm to the hardware.**

To replace the battery, proceed as follows:

Procedure 8 Replacing a UNC-520 battery.

Step 1 Unplug the 6-position power connector. Do not remove the male connector from the wiring harness.

Step 2 Using a 1/4-inch nut driver, unscrew the lock nut from the bracket that is holding the battery.

Step 3 Hold the battery in place while you remove the bracket that secures it to the bottom of the unit.

Step 4 Disconnect the two quick connect terminals on the battery.

Note The UNC-520 will lose its time and date settings if it is disconnected from both battery and AC power for more than one hour.

Step 5 Remove the old battery and recycle as defined by your regional codes. For recycling within the US, see the labelling on the battery.

Step 6 Connect the quick connect terminals to the new battery. Make sure the RED (+) wire is connected to the positive terminal of the battery and the BLACK (–) wire is connected to the negative terminal.

Step 7 Secure the new battery to the bottom of the unit with the bracket and tighten the lock nut.

Step 8 Plug the power connector in and verify normal operation.

Replacement Parts

Servicing the UNC-520 may call for replacement parts. There are three categories of parts:

- Non-replaceable Parts
- Standard Replacement Parts
- Field Replacement Units

Non-replaceable Parts

Other than the parts listed in the replacement parts sections, there are no serviceable components on the base assembly.

Memory

Any addition, modification, or replacement of memory components requires software configuration and is not a field upgrade.

Fuses

The UNC has two 250V, 2.5A delay (series 372) fuses on the printed circuit board. These fuses are Wickman F015-2.5A250V fuses. However, on-board power circuit protection is not user-serviceable. If this circuitry is suspect, contact TAC Product Support.

Standard Replacement Parts

Standard replacement parts are listed in Table 6 and can be ordered from stock without restriction.

Table 6 Standard replacement parts.

Part Number	Description
UNC-400-BAT	Battery, 12 Vdc, 1.2 AH (see “Replacing the Battery,” page 21.)
E24-1555-2	LON Plug, 2-position
E24-1604-3	RS-485 connector plug, 3-position
UNC-400-HRN	Battery/ground harness (also includes 6-position power connector)
UNCC-405	Adapter, RJ-45 to DB-9 null modem, for serial port to connect to DTE device
CBL-RJ45-4	Silver satin patch cable, 4 feet (used between adapter and serial port)
CBL-RJ45-10	Silver satin patch cable, 10 feet (used between adapter and serial port)
CBL-RJ45-25	Silver satin patch cable, 25 feet (used between adapter and serial port)
UNC-410-MDM	On-board auto dial/auto answer 56k modem (see “Replacing the Modem”, below)

Replacing the Modem

Caution Be sure to discharge any accumulated static by touching the metal surface of the UNC before handling board components. For more information, see the “Static Discharge Precautions” section on page 3.

To replace the modem, proceed as follows:

Procedure 9 Replacing the on-board modem.

Step 1 Open the cover of the unit.

Step 2 Unplug the 6-position power connector. Do not remove the male connector from the wiring harness.

Step 3 Unplug the RJ-11 telephone wire from the modem's RJ-11 connector.

Step 4 Remove the old modem as follows:

a. Locate the on-board modem (see Figure 2) and note the following:

- Orientation of the sockets for the pins on the modem. The sockets are two parallel lines. The socket for pin 1 (noted on Figure 2) is the left-most pin on the bottom line.
- Orientation of the writing on the modem. Writing on the replacement modem will be the same.

b. Place the blade of a flat-blade screwdriver under the left end of the modem, between the pin sockets.

c. Gently pry the modem up about 1/8th inch (3 mm).

Caution Do **not** try to completely remove the modem with this step. Doing so may damage the pins.

d. Place the blade of the screwdriver under the right end of the modem and gently pry the modem up about 1/8th inch (3 mm).

e. Repeat steps b–d until the modem is out of its socket.

Step 5 Insert a new modem as follows:

a. Locate pin 1 on the modem. If you are reading the writing on the modem, pin 1 is the first pin in the lower left corner. It is marked with a small black dot on the top of the modem.

b. Locate the socket for pin 1 on the board (see Figure 2).

c. Orient the modem so that pin 1 of the modem is over the socket for pin 1.

Tip Use the white trace lines on the board to help you align the modem. When the modem is correctly aligned, the trace lines will outline the modem completely.

d. Push the modem into the sockets using your thumbs. All pins should be properly inserted.

Step 6 Plug the RJ-11 telephone wire into the modem's RJ-11 connector.

Step 7 Plug the power connector in and verify normal operation.

Field Replacement Units

To obtain repair or replacement of unit (Advance Warranty Replacement, In-Warranty Repair and Return, or Out-of-Warranty Repair and Return), obtain the information listed in Table 7 prior to contacting TAC Product Support at 888-444-1311.

Table 7 Information for Repair and Return

Factory Order Number [1]	
Reason for Return	
UNC Part Number	
UNC Serial Number	
Project ID	
Network Settings (IP, Subnet, Name)	
UNC Username and Password	
Station DB Username and Password	

1. Factory order number prefixes include INT, SLS, DNP, TIP, QWK, 961, 963, 964, 965, 967, 968, 969 and 977

Replacing the UNC-520 Circuit Board

Caution

- Be aware of small surface-mounted components on the circuit board near each mounting point! Use a 1/4" thin-walled **socket**, ***not a nut driver***, to **carefully** loosen or tighten the nuts that secure the UNC-520 circuit board to the 7 mounting studs. A ***nut driver*** invariably ***causes board damage*** to adjacent components, while a socket (if used carefully) typically does not.
- Retain and reuse metal spacers on all mounting studs (between the board's back and enclosure).
- Before handling circuit boards, discharge any accumulated static by touching the metal surface of the UNC-520. For details, see the "Static Discharge Precautions" section on page 3.

To replace the UNC-520 circuit board in the field, proceed as follows:

Procedure 10 Replacing a UNC-520 circuit board.

Step 1 Using the **Admin Tool**, back up the station database to your PC.

Step 2 Open the cover of the unit.

Step 3 Turn off building power to the unit. The unit should power down automatically.

Step 4 Unplug the 6-position power connector from the board.

Step 5 Note positions of all communications connectors going to the circuit board.
If necessary, label connectors to avoid mis-connection later (after circuit board is replaced).

Note The software that runs on the unit expects the terminal positions to be the same to collect data from or to control the attached devices.

Step 6 Unplug all Ethernet, serial, LON, and modem connectors from the circuit board.

Step 7 Using a 1/4" socket (see previous Caution), carefully remove and retain the seven 1/4" nuts securing the circuit board. Be mindful of small surface-mount components located near board mounting points.

Step 8 Remove the circuit board.
Make sure that the metal spacers (behind the board) remain on the seven mounting studs.

Step 9 Replace the FRU circuit board on the mounting studs and spacers, carefully securing with the seven 1/4" nuts. Again, be mindful of small surface-mount components located near board mounting points.

Step 10 Turn on building power to the unit.

Step 11 Plug the 6-position power connector in and verify normal operation.

Step 12 Reconnect any Ethernet, serial, LON, and modem connectors.

Step 13 Using the **Admin Tool**, re-commission the UNC-520, including the following:

a. Install the correct Niagara release and set the date and time.

b. Install the new license file.

c. Restore the station database and start the station.

Certifications

Federal Communications Commission (FCC)

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference with radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference, in which case, users at their own expense will be required to take whatever measures may be required to correct the interference. Any unauthorized modification of this equipment may result in the revocation of the owner's authority to continue its operation.

Canadian Department of Communications (DOC)

Note This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Note Cet appareil numerique de la classe A respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

If you have any questions regarding this publication or the operation of the UNC-520 please contact TAC Product Support at 888.444.1311.

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TAC I/A Series® R2.301.522
Installation Instructions

This document discusses the installation and database upgrade for TAC I/A Series Release 2.3.5. These instructions assume that you are upgrading from a previous release R2.x version of the Niagara Framework (any release that includes the Station Administration Tool). *If you are upgrading from a release prior to R2.x, consult TAC Product Support before proceeding.*

This document discusses the following topics:

Licensing

New Workstation PC and UNC licenses will not be required when upgrading from previous Release 2.301.514.

Caution **A new license is required on any platform licensed to releases prior to 2.3.5 (e.g. Release 2.301.431 or below).** It is recommended that the user review the existing workstation PC and UNC licenses prior to upgrade and purchase the appropriate license upgrade accordingly. The license's release level is specified by release=. Upgraded workstations and UNCs will not run without this new license file. Upgrading workstations and UNCs prior to 2.3.5 with 2.3.5 will cause them to not run without a valid 2.3.5 license installed.

License File Naming Conventions

Enterprise Server license files: Enterprise Server license files are named: **license.properties**.

UNC license files: UNC license properties files are typically shipped using a file-naming convention that identifies the unit on which they are to be installed by serial number. For example:

license[1].properties.<serial number.orgId.projectId.UNC-xxx.hostId>

You do not need to rename this license file. The Admin Tool automatically installs it in the UNC controller as "license.properties".

There are two options for installing a UNC license file:

1. Install the new license as part of the software upgrade on the UNC controller (refer to Procedure 9)
2. Install the new license as a separate procedure (refer to Procedure 10). Use this method if you are upgrading, reinstalling or otherwise changing your license but do not need to perform a software upgrade.

Installation Overview

The installation process includes the following procedures:

1. Convert the existing Enterprise Server station database using the current Niagara software release.

   Before installing the new TAC I/A Series Niagara software, use the currently installed software release to open the Admin Tool and back up the station database to .xml format.

   Note Make sure this backup is done using the same version of software used to create the Niagara station. Also, convert the .db version of the database, as it contains the latest changes.

2. Install the TAC I/A Series Release 2.3.5 software on the Enterprise Server PC.
3. Review the other materials available on the Installation CD.
4. Copy the Enterprise Server station to the new installation directory.

   You must copy the existing Niagara station that you converted to xml format in Step 1 to the new release directory and upgrade it before you can start it using R2.3.5.

5. Install the new Enterprise Server license file.

   New license files are required for any platform that is running TAC I/A Series Release 2.3.5. Copy your new license files to a convenient location for installation.

6. Copy new UNC license files to the R2.3.5 installation root directory
7. Upgrade the Enterprise Server station database.

   With the original Enterprise Server station database (now in xml format) in the R2.3 **\stations** folder, use the R2.3.5 **dbadmin** utility to upgrade it.

8. Convert the upgraded Enterprise Server station database from xml to db format.
9. Upgrade the software on the UNC controller.

   Use Procedure 9 to upgrade each UNC controller on the network. Be sure to have new license files available for every UNC that you are going to upgrade as required. The procedure for installation is similar for all platforms (UNC-4xx/5xx or UNC-6xx). Differences are noted as appropriate.

Notes

- Procedure 9 assumes that all UNC controllers are installed, operational, and are accessible over the Ethernet LAN.
- The Installation wizard automatically upgrades each remote station database (on the UNC controller) as it upgrades the NRE (Niagara Runtime Environment) and any modules that it needs to.

10. Install a new license file to the UNC controller.

    This procedure may be performed before or independently from Procedure 9. If you install the license in Procedure 9, you do not need to perform this procedure. Procedure 10 can be used with both UNC-4xx/5xx and UNC-6xx controllers.

11. Determine required file space for upgrading UNC-500-1 or UNC-500-2.

    If you are upgrading a UNC-500-1 or UNC-500-2 controller, make sure that there is enough room on the controller before you begin the upgrade process. Newer release file sizes are typically larger.

Installation Procedures

Note Please read through the entire document before beginning the installation process.

Procedure 1 Convert the existing Enterprise Server station database using the current Niagara software release.

Step 1 At the Enterprise Server PC, from the Windows **Start** menu, select **Programs > Niagara 2.xxx.xxx > Java Desktop Environment**.

Where **xxx.xxx** is any previously installed version of the Niagara software.

Step 2 In the tree view, expand **Tools** and double-click **Admin Tool**.

The Admin Tool view displays.

Step 3 From the **Admin Tool** menu, select **File > Open**.

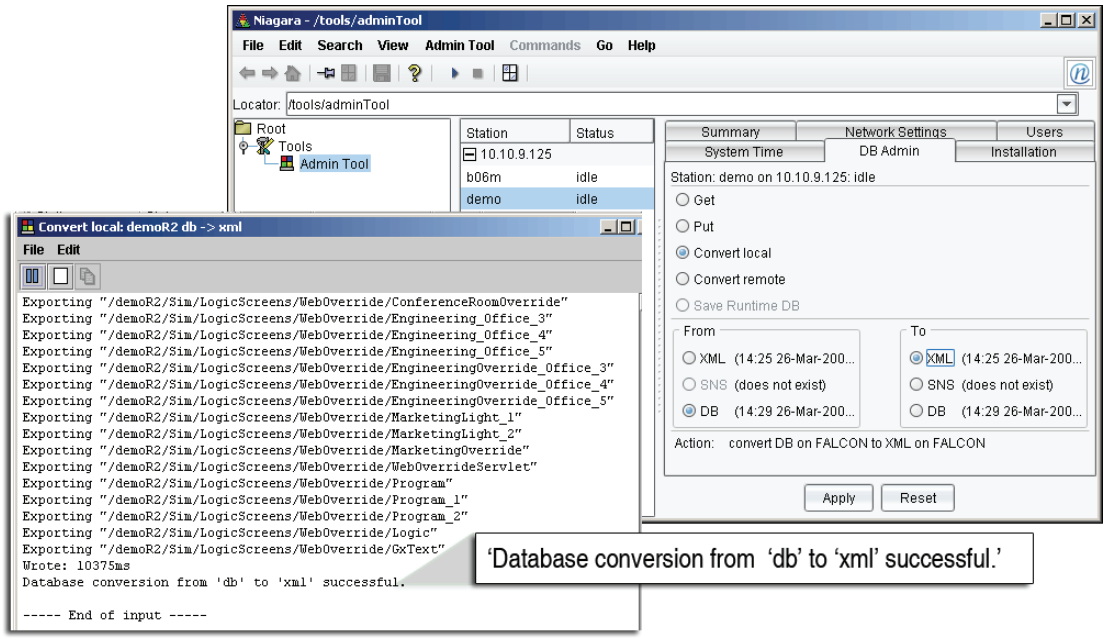
Step 4 In the **Connect To Host** dialog box, type the name or IP address of the local host (or simply type 'localhost'). Click **OK**.

Step 5 In the **Logon to** dialog box, type a hardware user name and password for the local host. Click **OK**.

Step 6 Select the Niagara station. Stop the station (if it is running).

Step 7 Click the **DbAdmin** tab as shown in Figure 1.

Figure 1 Use the Admin Tool to convert the Enterprise Server station database.



Step 8 Choose **Convert Local**.

Step 9 Under **From**, choose **DB** and under **To**, choose **XML**. Click **Apply**. The Standard Output window displays.

Step 10 In the Standard Output window (shown in Figure 1), verify that the database export function converts the station properly.

The message, **'Database conversion from 'db' to 'xml' successful.'** should be displayed. If the window appears blank, scroll up, as necessary, to see the text area. If there are any problems converting the Enterprise Server database, consult TAC Product Support before proceeding.

Step 11 Close the Standard Output window and the JDE.

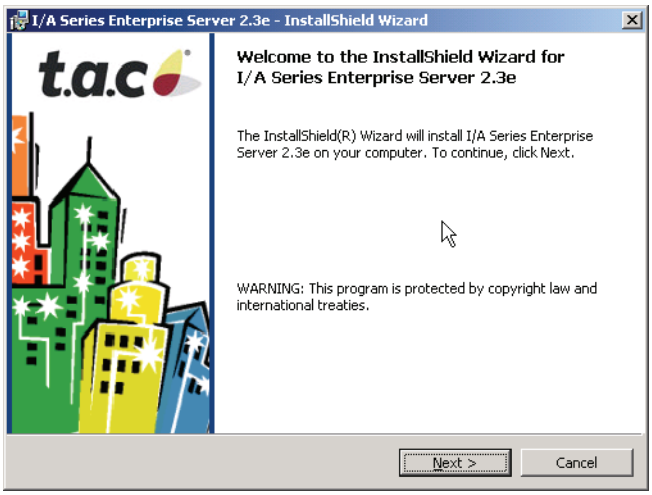
Procedure 2 Install the TAC I/A Series Release 2.3.5 software on the Enterprise Server PC.

Step 1 Use the Task Manager to terminate all other Windows applications that are running on the target workstation (where you want to install the TAC I/A Series software).

Step 2 Insert the TAC I/A Series Release 2.3.5 Installation CD into the workstation's CD drive.

Step 3 If the autorun feature is enabled on the workstation, the TAC I/A Series Enterprise Server 2.3d - InstallShield Wizard dialog box automatically appears, as shown in Figure 2.

Figure 2 TAC I/A Series Enterprise Server 2.3e - InstallShield Wizard dialog box.



If the autorun feature is not enabled on the workstation:

a. Click the Windows **Start** button, then select **Run**.

b. In the **Run** dialog box, type the drive letter designation of the CD drive and **`setup.exe`**, for example: **`e:setup.exe`**

c. Click **OK**.

Step 4 Read and follow the prompts in the dialog screens. When done, click the **Finish** button.

Step 5 The Niagara setup dialog box will appear (Figure 3). Click **Install Niagara**.

The Niagara Install dialog box opens, as shown in Figure 4.

Figure 3 Niagara setup dialog box.

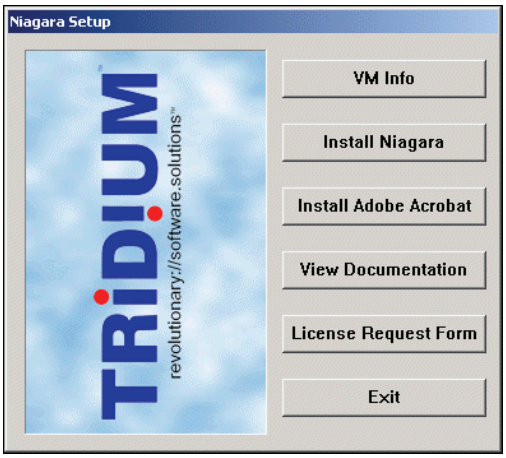
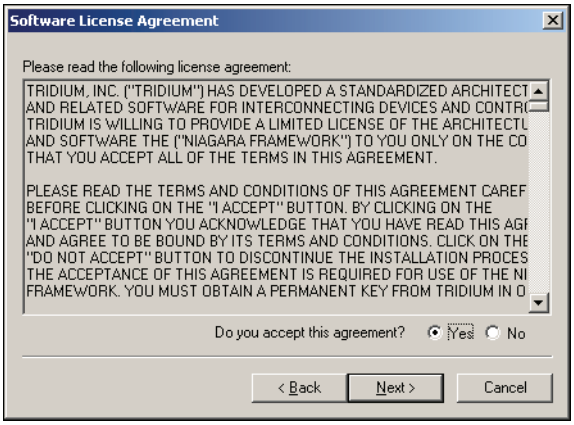


Figure 4 Niagara Install dialog box.

Step 6 Click **Next** to begin the install process.

Step 7 In the Software License Agreement dialog box, shown in Figure 5, carefully read the software licensing agreement, then click **Yes** to agree to it.

Figure 5 Software Licensing Agreement dialog box.



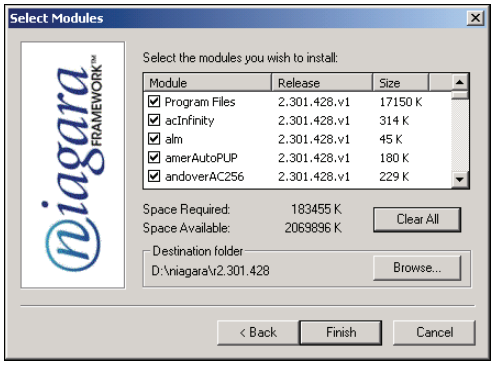
Step 8 Click **Next**.

Step 9 In the Select Modules dialog box, shown in Figure 6, click the check box next to each module you need to install, or click **Select All** to select all of the modules at once.

- You must select the **Program Files** check box to install the core Niagara modules.
- Select only those modules that are licensed on the Enterprise Server PC or UNC.
- The on-line help files are no longer installed automatically. You must select the **docs** module in order for them to be installed on the workstation.
- The module called **videos** (available in release 2.3.4 and newer) contains instructional demonstrations for several Niagara services and integrations.
- The contents of both the **docs** and **videos** modules is also available on the installation CD if you choose not to install them on the workstation or UNC controller.

Tip If you are not sure about the software modules that have been purchased and licensed for the Enterprise Server PC, click **View License** on the **Installation** tab of the Admin Tool view.

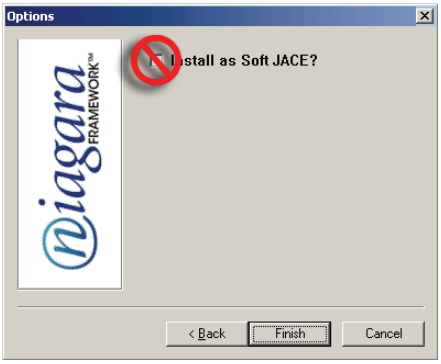
Figure 6 Select Modules dialog box.



Step 10 When you have selected all of the appropriate modules, click **Next**. If you are installing on a Windows XP system, the Soft Jace option dialog box appears. Do not select this option; click **Cancel** instead. To install a SoftJACE, see the *SoftJACE Installation and Configuration Instructions* document.

Note The following Soft Jace dialog box appears ONLY if you are installing the software upgrade on a Windows XP system. Installations on other operating systems will not display the following dialog box.

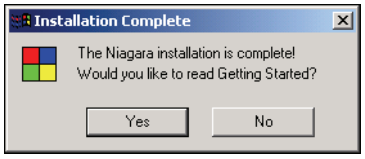
Figure 7 Soft Jace installation dialog box (Windows XP only).



Step 11 Select **Finish** to complete the installation process.

The software installs. When the installation is complete, the Installation Complete dialog box appears, shown in Figure 8.

Figure 8 Installation Complete dialog box.



Step 12 Click **Yes** to read the *Getting Started* text file.

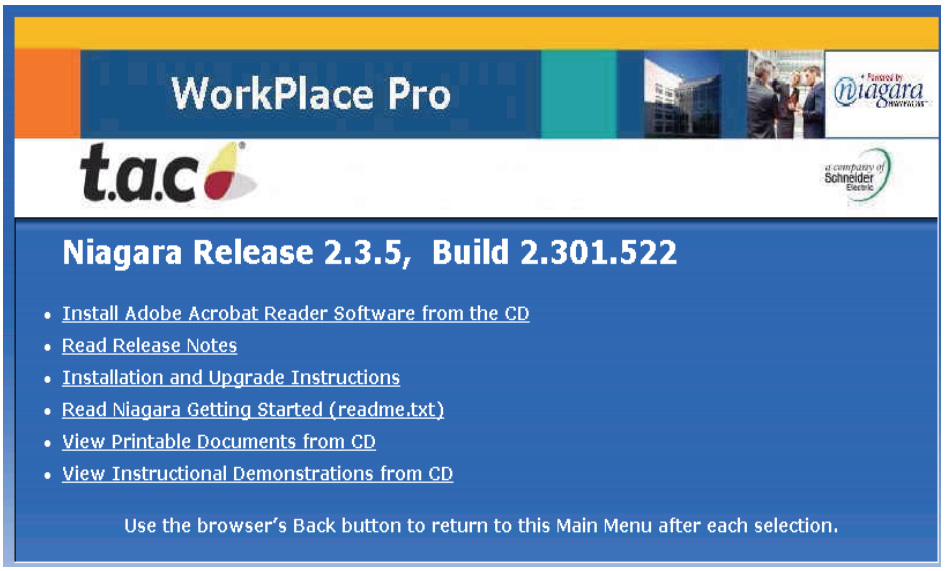
Procedure 3 Review the other materials available on the Installation CD.

Step 1 With the Installation CD still in the workstation's CD drive, select **Start > Accessories > Windows Explorer**.

Step 2 Navigate to the CD drive root directory and double-click the **`index.html`** file.

This opens the CD interface file in a web browser. This file shows you all of the CD's additional contents in a useful interface, as shown in Figure 9.

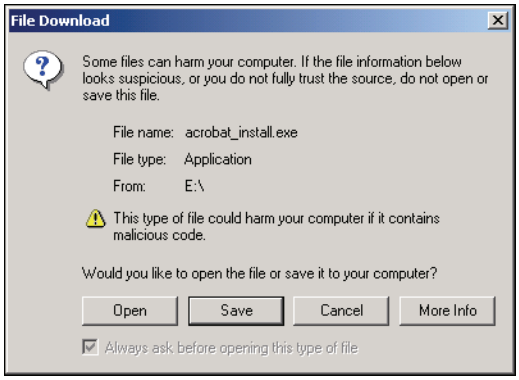
Figure 9 CD Browser Interface.



Step 3 If Adobe Acrobat Reader software is not already installed on the workstation, click Install Adobe Acrobat Reader Software.

A **File Download** dialog for the **`acrobat_install.exe`** file opens, as shown in Figure 10.

Figure 10 acrobat_install.exe File Download dialog box.



Step 4 Click **Open** to start the Acrobat Reader installer.

Note If you see a different dialog box with an option that reads **Run** instead of **Open**, select **Run**.

Note Some browsers may have the security settings set so high that a message appears saying that "**The publisher cannot be determined due to problems below Authenticode Signature not found.**" This does not indicate that there is a real problem. TAC does not provide security signatures through the web browser, so this message results when TAC installs software through the browser. TAC software does not contain viruses or malicious code of any kind and is safe to install through this manner. Click **Yes** to continue with the installation.

Step 5 Follow the instructions in the installer wizard to install the Adobe Acrobat Reader software on the workstation. You can now view PDF files on the workstation.

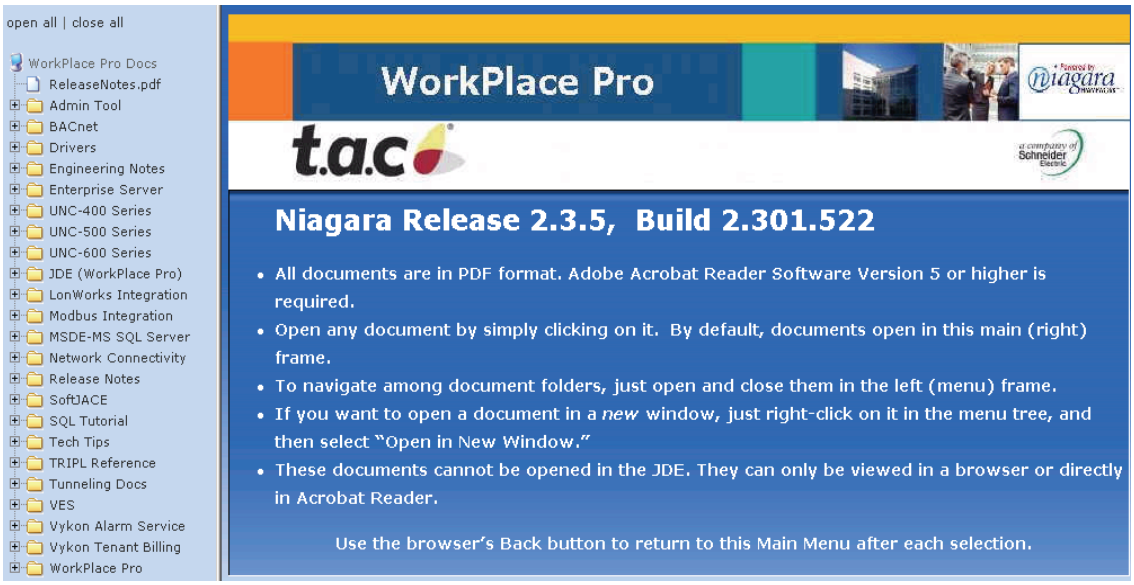
Step 6 Click Read "Release Notes" to view the TAC I/A Series Release 2.3.5 Release Notes document as a PDF file. Review the issues in this document very carefully before proceeding with installation of the TAC I/A Series Release 2.3.5 software.

Step 7 Click Read "Niagara Release 2.3.5 Installation and Upgrade Instructions" to read this document in PDF format.

Step 8 Click "Read Niagara Getting Started" to view a text file that contains additional information about the default Niagara installation directory, licensing the Niagara Framework, running the demo, getting additional information, and providing feedback to TAC.

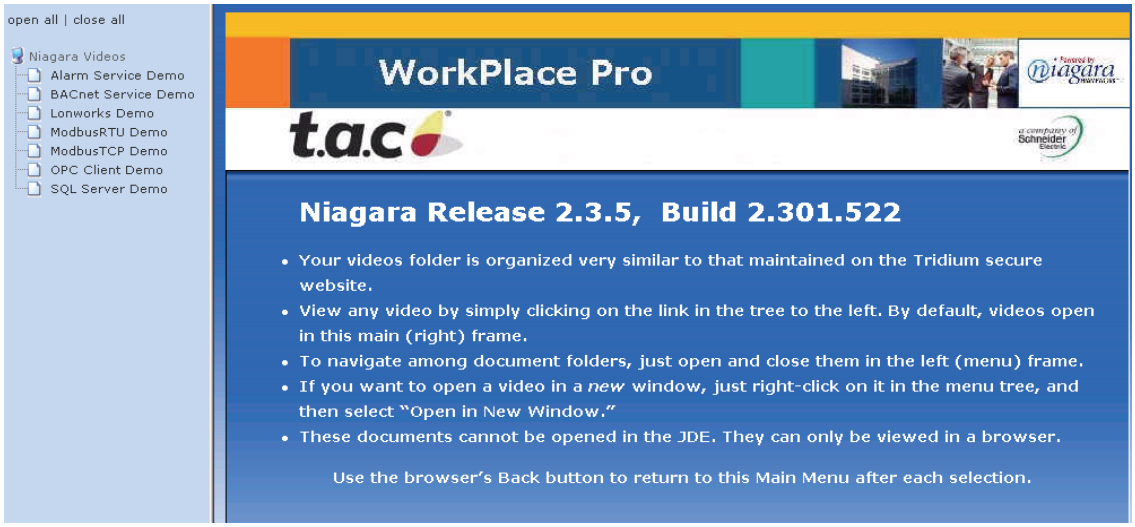
Step 9 Click View Printable Documents From CD to open an HTML interface that allows you browse the TAC documentation library, as shown in Figure 11. If you did not choose the option to install these documents during the installation process, they are always available on the CD.

Figure 11 Documentation Library interface.



Step 10 Click View Instructional Demonstrations From CD to open an HTML interface that allows you to browse the TAC instruction video library, as shown in Figure 12. If you did not choose the option to install these documents during the installation process, they are always available on the CD.

Figure 12 Video Library interface.



Procedure 4 Copy the Enterprise Server station to the new installation directory.

Step 1 With Windows Explorer open on the Enterprise Server PC, expand **My Computer** to display the local disk drives.

Step 2 Locate the **\stations** directory in your previous R2.x installation root directory (for example, r2.301.*xxx*).

A typical directory structure looks like this:

\\Local Disk (C:)\niagara\r2.301.xxx**\stations**

Each archived station database is stored in the **\stations** folder.

Step 3 Right-click the folder that contains the Enterprise Server station database and click **Copy**.

Step 4 Locate the **\stations** directory in the new installation root (**r2.301.522**).

A typical directory structure looks like this:

\\Local Disk (C:)\niagara\r2.301.522\stations

Step 5 Right-click the R2.3 **\stations** folder and click **Paste**.

Verify that the Enterprise Server station folder properly copied from your old **\stations** folder to the new **\stations** folder.

Note **A new license is required on any platform licensed to releases prior to 2.3.5 (e.g. Release 2.301.431 or below).** It is recommended that the user review the existing workstation PC and UNC licenses prior to upgrade and purchase the appropriate license upgrade accordingly. The license's release level is specified by release=. Upgraded workstations and UNCs will not run without this new license file. Upgrading workstations and UNCs prior to 2.3.5 with 2.3.5 will cause them to not run without a valid 2.3.5 license installed.

Procedure 5 Install the new Enterprise Server license file.

Step 1 Using Windows Explorer, locate your new Enterprise Server license file (**`license.properties`**).

Step 2 **Copy** and **paste** the **`license.properties`** file into the **\nre\lib** directory under the new R2.3.5 installation root (**r2.301.522**).

A typical directory structure looks like this:

`\\Local Disk (C:)\niagara\r2.301.522\nre\lib`

Step 3 In the **Confirm File Replace** box, click **Yes**, if necessary.

Step 4 Verify that the new license file is copied to the R2.3.5 **`\nre\lib`** folder and close Windows Explorer.

Procedure 6 Copy new UNC license files to the R2.3.5 installation root directory

Step 1 Using Windows Explorer, locate your new UNC license file(s). Refer to the "License File Naming Conventions" section on page 1, if necessary.

Step 2 **Copy** and **paste** the license file(s) into the new R2.3.5 installation root (**r2.301.522**) directory.

A typical directory structure looks like this:

`\\Local Disk (C:)\niagara\r2.301.522`

Step 3 In the **Confirm File Replace** box, click **Yes**, if necessary.

Step 4 Verify that all files were copied to the root folder and close Windows Explorer.

Procedure 7 Upgrade the Enterprise Server station database.

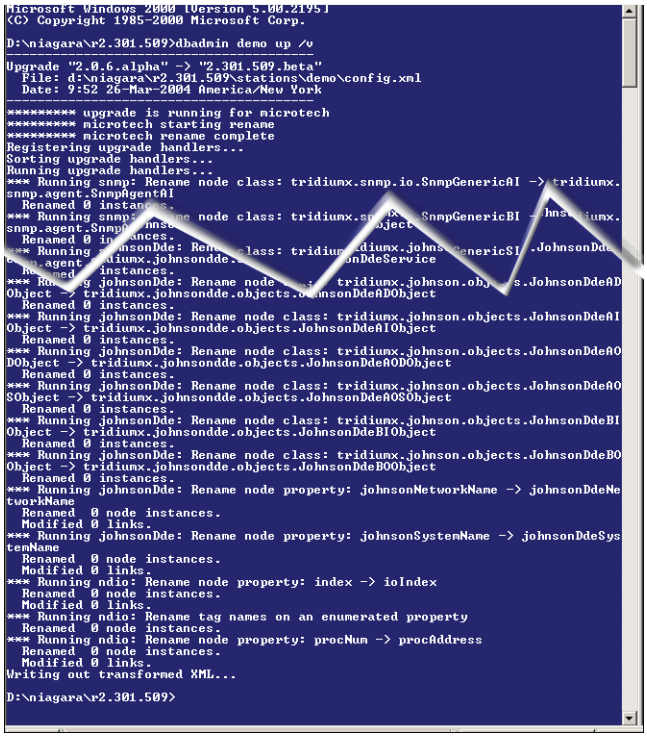
Step 1 At the Enterprise Server PC, from the Windows **Start** menu, select **Programs > Niagara 2.301.522 > Console**.

Note Be sure to perform this procedure using the newly installed TAC I/A Series Release 2.3.5 software.

Step 2 Type **`dbadmin <station name> up /v`** and press **Enter**.

Step 3 Verify that the **dbadmin** utility properly upgrades the Enterprise Server station database as shown in Figure 13.

Figure 13 Console view.



The message, '**Writing out transformed XML...**' should be displayed. If there are any problems converting the station database, consult TAC Product Support before proceeding.

Step 4 Close the Console view.

Procedure 8 Convert the upgraded Enterprise Server station database from xml to db format.

Step 1 At the Enterprise Server PC, from the Windows **Start** menu, select **Programs > Niagara 2.301.522 > Java Desktop Environment**.

Step 2 In the tree view, expand **Tools** and double-click **Admin Tool**.

The Admin Tool view displays.

Step 3 From the **Admin Tool** menu, select **File > Open**.

Step 4 In the **Connect to Host** dialog box, type the name or IP address of the local host (or simply type 'localhost'). Click **OK**.

Step 5 In the **Logon to** dialog box, type a hardware user name and password for the local host. Click **OK**.

Step 6 Select the Enterprise Server station. It should not be running.

Step 7 Click the **DbAdmin** tab.

Step 8 Click **Convert Local**.

Step 9 In the **From** pane, choose **XML** and in the **To** pane, choose **DB**. Click **Apply**.

Step 10 In the Standard Output window, verify that the database export function converts the station properly.

The message, **'Database conversion from 'xml' to 'db' successful.'** should be displayed. If there are any problems converting the Enterprise Server database, consult TAC Product Support before proceeding.

Step 11 Close the Standard Output window.

You are now ready to start the station on the Enterprise Server PC.

Procedure 9 Upgrade the software on the UNC controller.

Step 1 Verify that you have completed Procedure 2 to install TAC I/A Series Release 2.3.5 software on the Enterprise Server PC.

Step 2 If the JDE is not running, start it as follows. Otherwise, skip this step.

From the Windows **Start** menu, select **Programs > Niagara 2.301.522> Java Desktop Environment**.

Step 3 In the tree view, expand **Tools** and double-click **Admin Tool**.

The Admin Tool view displays.

Step 4 From the **Admin Tool** menu, select **File > Open**.

Step 5 In the **Connect to Host** dialog box, type the name or IP address of the UNC controller to be upgraded. Click **OK**.

Note The default (factory-assigned) IP address of a UNC controller can be found on the packing list that is shipped with the unit.

Step 6 In the **Logon to** dialog box, type a hardware user name and password for the UNC controller. Click **OK**.

Note The default user name and password can be found on the packing list that is shipped with the unit.

Step 7 Select the UNC controller host in the Admin Tool view.

Step 8 Click the **Installation** tab.

Step 9 On the Installation tab, click **Installation Wizard**.

Note The **emb** and **nt** folders are located in the **r2.301.522** root directory on your Station. They were copied there during the install process.

Step 10 In the **Select Distribution Directory** dialog box:

- If you are upgrading the software on a UNC-4xx/5xx controller, select (but do not open) the **emb** folder.
- If you are upgrading the software on a UNC-6xx controller (with either Windows Embedded NT or a full version of Windows NT), select (but do not open) the **nt** folder.

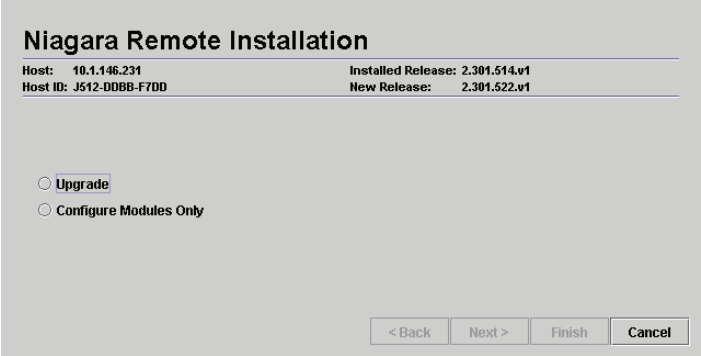
Step 11 Click **Install**.

Step 12 In the **Niagara Remote Installation** dialog box, select **Upgrade**. Click **Next**.

Step 13 In the **Upgrade** dialog box:

- If you are upgrading software on a UNC-4xx/5xx controller, select **Upgrade OS** (operating system) and **Upgrade NRE** (Niagara Run-time Environment).
- If you are upgrading software on a UNC-6xx controller, select **Upgrade NRE**.

Figure 14 Upgrade dialog box.



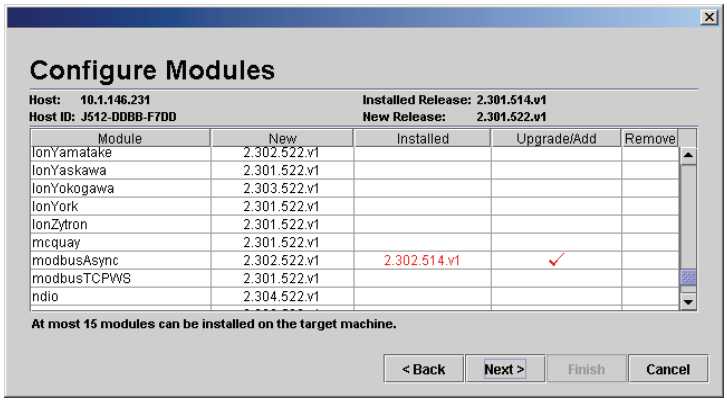
Note The **Upgrade niagarad** (Niagara service) option (see Figure 14) is automatically selected.

Step 14 Click **Next**.

Step 15 In the **Configure Modules** dialog box (as shown in Figure 15) click the **Upgrade/Add** column for each module licensed for installation on the UNC controller.

A red check mark appears next to each installed module to be upgraded.

Figure 15 Configure Modules dialog box.



Notes

- Unlike the UNC-6xx/6xx, the UNC-4xx/5xx has limited memory resources. On a UNC-4xx/5xx, software modules are loaded into flash memory and execute from there rather than from the hard drive (as on a UNC-6xx). Therefore, when you are installing software modules on a UNC-4xx/5xx controller, select only those modules that are required for station operation.
- Although hard drive space is not an issue when loading modules on a UNC-6xx, extra modules consume an unnecessary amount of RAM and can affect station startup time.
- Module names may change from one release to another. Remove the older modules and upgrade/add the newer modules, as needed.

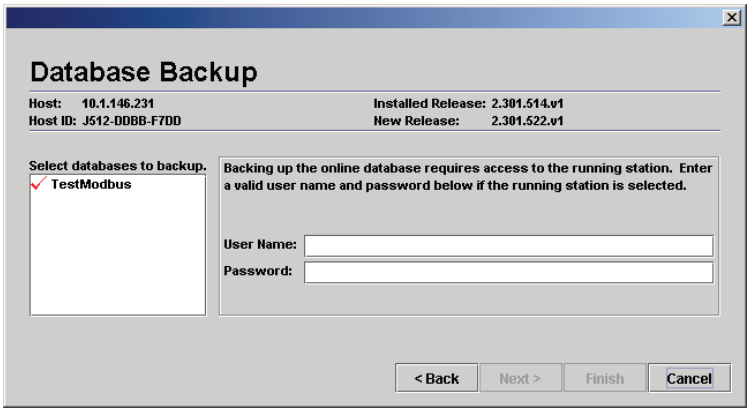
Tip If you are not sure about the software modules that have been purchased and licensed for the UNC controller, click **View License** on the **Installation** tab of the Admin Tool view.

Step 16 Click **Next** to continue.

Step 17 In the **Database Backup** dialog box, as shown in Figure 16, select the database to be backed up.

Step 18 Enter a valid, administrative-level station user name and password. Click **Next** to continue.

Figure 16 Database Backup dialog box.



Notes
- It is not necessary to back up the test station database that is pre-installed on new UNC controllers.
- The installation wizard makes a backup copy of the original R2.x station database that is running on the UNC controller (prior to applying any upgrade handlers) and stores it in the appropriate location in the new R2.3.5 **stations** folder.
- The filename of the (R2.x) backup copy looks like: `config.xml.orig_040309_1449`. This example reflects a backup made on March 9, 2004 at 2:49PM.

Step 19 In the **Niagara License** dialog box, click **Install New License**.

Step 20 From the **Niagara License** dialog box, select the license file for your installation and click **OK**. The **Upgrade Summary** dialog box appears.

Step 21 In the **Upgrade Summary** dialog box, click **OK** to continue.

A dialog box displays each task as it is performed. Depending on the number of tasks to be performed, the process may take a few moments or several minutes.

Step 22 When the upgrade is complete, click **OK**.

License properties files are typically shipped using a file-naming convention that identifies the unit on which they are to be installed by serial number. For instance:

license[1].properties.<serial number.orgId.projectId.UNC-xxx.hostId>

You do not need to rename this file. The Admin Tool automatically installs it in the UNC controller as license.properties.

Notes
- You do not need to perform the following procedure if you installed the new license file as part of Procedure 9.
- The following procedure can be used with both UNC-4xx/5xx and UNC-6xx controllers.

Procedure 10 Install a new license file to the UNC controller.

Step 1 Copy the new **license.properties** file to the `\niagara\r2.301.522` directory on the hard drive of the Enterprise Server PC.

Step 2 From the Windows **Start** menu, select **Programs > Niagara 2.301.522 > Java Desktop Environment**.

Step 3 In the tree view, expand **Tools** and double-click **Admin Tool**. The Admin Tool view displays.

Step 4 From the **Admin Tool** menu, select **File > Open**.

Step 5 In the **Connect to Host** dialog box, type the name or IP address of the UNC controller. Click **OK**.

Note The default (factory-assigned) IP address of a UNC controller can be found on the packing list that is shipped with the unit.

Step 6 In the **Logon to** dialog box, type a hardware user name and password for the UNC controller. Click **OK**.

Note The default user name and password can be found on the packing list that is shipped with the unit.

Step 7 Select the UNC controller host in the Admin Tool view.

Step 8 Click the **Installation** tab.

Step 9 On the Installation tab, click **Install New License**.

Step 10 In the **Select License** dialog box, select the new license file (copied in Step 1, above). Click **Install**.

A text box displays indicating that the file was installed successfully.

Step 11 Click **OK** to continue.

Step 12 Click **View License** and verify that the new license.properties file was installed on the UNC controller.

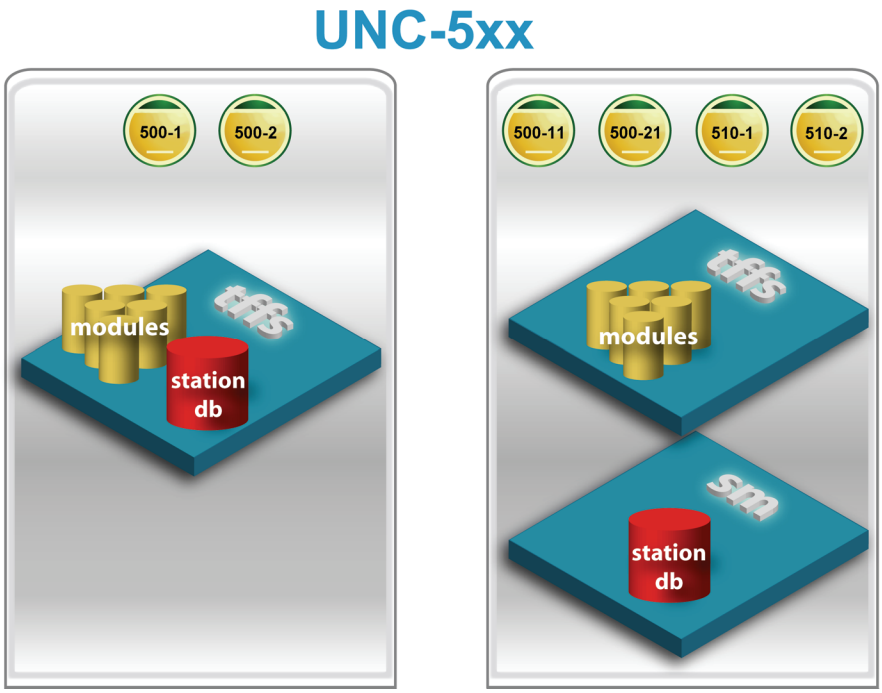
Upgrade Considerations for the UNC-5xx Platform

This section helps you evaluate file size when considering the TAC I/A Series software upgrade for an existing job. File space needed for module storage may vary with new releases of the TAC I/A Series software. When a station database is upgraded, the database size may also increase. Different UNC-5xx controller models have different amounts of free file space. Make sure that you have enough free space on your UNC-5xx controller before beginning a software upgrade.

About file space allocation

The UNC-5xx controller may have one or two flash memory chips (also referred to as “drives” or “disks”), depending on the UNC-5xx model number. The TAC I/A Series software application modules and the station database are installed in different drive locations on the two-disk models, as shown in Figure 17.

Figure 17 UNC-5xx Controller file space allocation.



The flash chip(s) associated with the UNC provide the following drives with associated file system types:

tffs drive

The **tffs** drive is located on a flash disk that is present on **all** UNC-5xx controllers. Modules are **always** installed on the **tffs** drive. On the UNC-500-1 and UNC-500-2 the station db is also located on the **tffs** drive.

sm drive

The **sm** drive is located on a flash disk that is present on some UNC-5xx controllers (500-11, 500-21, 510-1, 510-2). The station database and related files are installed on the **sm** drive.

File Space

To calculate the total space required for your installation, you must consider the space required for the station database and for modules that you plan to install. UNC-5xx controllers with no **sm** drive require that you have space on the **tffs** drive for the station database plus all modules. UNC-5xx controllers that have the additional **sm** drive installed, require that you have room on that **sm** drive for the station database and related files.

When determining the required free space in the UNC-5xx, it is important to ensure that there is plenty of extra space. The station needs three times the size of the station sns file to properly backup. Ensure that there is enough available disk space for backup, as well as file growth.

Using the AdminTool

You can use the AdminTool to look at the available free space on the UNC-5xx controller at any time. On the AdminTool Summary tab, choose the Free File Space tab to display the amount of file space remaining on the UNC-5xx (**/sm** and **/tffs**). You may also use the following procedures to calculate the required file space for installing or upgrading the software on the UNC-5xx.

Estimating required installation space

To estimate the amount of space that is needed for an installation, three basic file types must be totaled:

- Module files (all those that need to be installed)
- Station database file (three times the file size to allow for backups)

- Additional station-related files (images, pdf, autocad, html, etc.)

Procedure 11 and Procedure 12 provide instructions for estimating the required free file space for each model of UNC-5xx controller.

Table 1 shows the base installed free space on UNC-5xx controllers with the operating system and TAC I/A Series r2.301.522 installed but with no additional modules installed.

Table 1 Approximate free space available (in kilobytes) on UNC-5xx platform controllers.

r2.301.522	500-1	500-2	500-11	500-21	510-1	510-2
After base installation, free space on: **/sm**	n/a	n/a	7,631 KB	7,631 KB	7,631 KB	7,631 KB
After base installation, free space on: **/tffs**	2,534 KB	2,534 KB	2,267 KB	2,267 KB	24,810 KB	24,810 KB

Procedure 11 Determine required file space for upgrading UNC-500-1 or UNC-500-2.

Step 1 Using Windows Explorer, view details of the **/emb** directory of the TAC I/A Series Release 2.3.5 Installation CD. Calculate the sum of the file sizes of all modules that you want to install on the UNC-5xx.

Step 2 The station needs three times the size of the station sns file to properly perform a backup. Multiply the file size of the station database (sns file) by 3 and add the product to the sum you calculated in Step 1.

Step 3 Calculate the sum of all other station-related files that reside on your UNC-5xx host (e.g., graphics, html, pdf, dwg, etc.) and add this to the total you calculated in Step 2. This is the minimum amount of free space that is required for installation.

Step 4 Compare the minimum required free space calculated in Step 3 to the free space available, as listed in Table 1 to determine if there is enough free space for your upgrade.

Procedure 12 Determine required file space for upgrading UNC-500-11, UNC-500-21, UNC-510-1, or UNC-510-2.

Step 1 Using Windows Explorer, view details of the **/emb** directory of the TAC I/A Series Release 2.3.5 Installation CD. Calculate the sum of the file sizes of all modules that you want to install on the UNC-5xx. This total is the amount of free space that you need to have available on your **tffs** drive.

Step 2 Compare the minimum required **tffs** free space calculated in Step 1 to the **tffs** free space listed as available in Table 1 to determine if there is enough free space for your upgrade.

Step 3 The station database resides on the **sm** drive and needs three times the size of the station sns file to properly perform a backup. Multiply the file size of the station database (sns file) by 3.

Step 4 Calculate the sum of all other station-related files that reside on your UNC-5xx host (e.g., graphics, html, pdf, dwg, etc.). Add this sum to the total you calculated in Step 3. This is the minimum amount of **sm** free space that is required for installation.

Step 5 Compare the minimum required **sm** free space calculated in Step 4 to the free space available, as listed in Table 1 to determine if there is enough free space for your upgrade.

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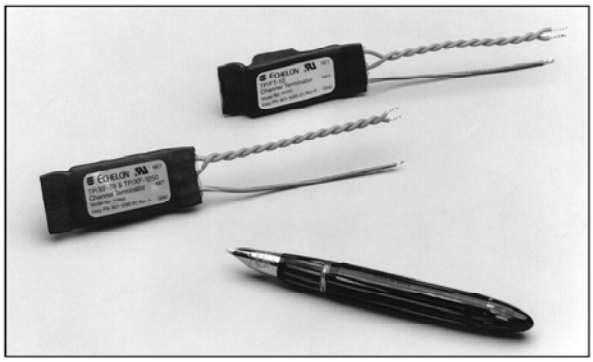
ECHELON®

Terminators
Models 44100, 44101, and 44200



- Model 44100 for free topology TP/FT-10 channel—one required
- Model 44101 for bus topology TP/FT-10 channel—two required
- Model 44200 for bus topology TP/XF-78 and TP/XF-1250 channels—two required
- Flying wire leads with earth ground wire for electrostatic discharge
- Small size fits easily in junction box or equipment enclosure
- U.L. Recognized, cU.L. Recognized, CE Mark

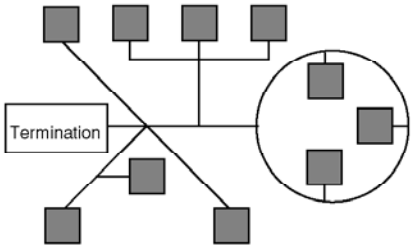
LonPoint™ Modules

The LonPoint Modules are products designed to integrate new and legacy sensors and actuators, as well as LONMARK® devices, into cost-effective, interoperable, control systems for building and industrial applications. In contrast to traditional control networks, which use closed islands of control linked with proprietary gateways, the LonPoint Modules offer an open distributed system architecture in which every device performs some control processing and can be accessed from any location in the network. Distributing the processing throughout the network and providing open access to every device lowers the overall installation and life cycle costs, increases reliability by minimizing single points of failure, and provides the flexibility to adapt the system to a wide variety of applications.

The system consists of the LonPoint Interface, Scheduler, Data Logger, Router Modules, LonPoint Application Programs, LNS™ based LonMaker™ Integration Tool, LonPoint Plug-In, and LNS DDE Server.

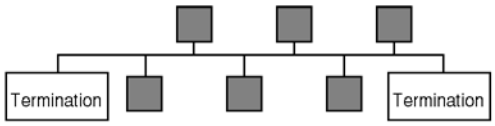
Terminator Modules

The Terminator modules are designed to provide electrical termination for twisted pair channels. In a free topology TP/FT-10 segment, one Model 44100 Terminator is required, and may be placed anywhere on the segment.



Free Topology

In a bus topology TP/FT-10 channel, two Model 44101 Terminators are required—one at each end of the bus. Bus topology TP/XF-78 and TP/XF-1250 channels require two Model 44200 terminators. The location of bus topology terminators is shown below.



Bus Topology

The insulated covering over the terminators permits them to be mounted behind LonPoint Type 1 or Type 2 Base Plates, in junction boxes, or in electrical enclosures. The terminators are passive devices and do not require electrical power.

Specifications

Function	Description
Network connector	Flying wire leads: 2 orange leads for network connection, 1 green lead for earth ground
Input power	None
Packaging	PCB with heat shrink tubing
Temperature	-40 to +85°C, operating and non-operating
Humidity	10 to 95% RH @ 50°C
Safety agency	U.L. and cU.L. Recognized
Dimensions	2.2″ x 0.9″ x 0.5″ (5.7cm x 2.3cm x 1.3cm) excluding wire leads

Note: These Terminators may not be used with shielded cables. Contact Echelon for Terminator schematics for use with shielded cable.

Part # 003-0139-01D

SECTION 3

Panel Materials

Part #	Description	Manufacturer
MNL-15RS3	MN 150 CONT. WITH LONMARK ROOF	TAC AUTOMATION
MNL-20RS3	MN 200 CONT. WITH LONMARK ROOF	TAC AUTOMATION
G-100	CONTROL SERVER	ENFLEX
A24N20ALP	24"x20"x6" NEMA 1 ENCLOSURE	HOFFMAN
A24N20MP	24"H x 20"W BACKPLATE	HOFFMAN
A36N24ALP	36"x24"x6" NEMA 1 ENCLOSURE	HOFFMAN
A36N24MP	36"H x 24"W BACKPLATE	HOFFMAN
VER-PXPLX01S	DIFF PRES SEN DRY MEDIA PNL MT	VERIS
T-203	TRANSFORMER 170 VA, 120V-P, 24	CORE
T-204	TRANSFORMER 240 VA, 120V-P, 24	CORE
T-208	TRANSFORMER 96 VA 120P-24VS U	CORE

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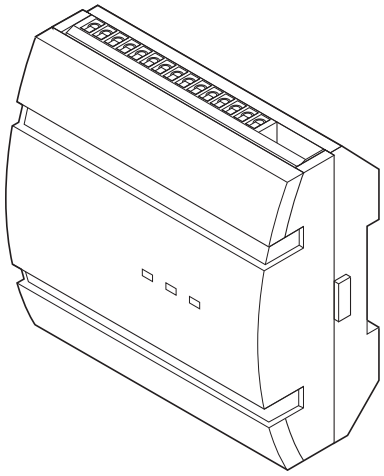
MNL-10Rxx Series
MNL-15Rxx Series
MNL-20Rxx Series

TAC I/A Series® MicroNet™ MN 100, MN 150, and MN 200 Controllers Installation Instructions

Application

The TAC I/A Series MicroNet MNL-10Rxx, MNL-15Rxx, and MNL-20Rxx (MN 100, MN 150, and MN 200) Controllers are interoperable devices designed in accordance with LONMARK® guidelines and equipped with LONMARK HVAC profiles. These controllers support MN-Sx digital sensors. LED indicators, a wiring subbase with removable electronics, field wiring terminal blocks, as well as DIN rail or panel mounting ability are other features of these controllers. They function in standalone mode or as part of a TAC MicroNet LONWORKS® Network using the integral FT 3150® Free Topology communications transceiver. A direct connection to a WPA-LON WorkPlace Communication adapter and a PC with WorkPlace Tech Tool (WP Tech) software is necessary to download and modify applications.



Model Chart

Model	Description	Inputs/Outputs
MNL-10RFx	MN 100 Controller with Fan Coil Profile (8020)	1 Digital Input (DI) 2 Universal Inputs (UI) 4 Digital Outputs (DO)
MNL-10RHx	MN 100 Controller with Heat Pump Profile (8051)	
MNL-10RRx	MN 100 Controller with Rooftop Profile (8030)	
MNL -10RSx	MN 100 Controller with Satellite Profile (8030)	
MNL-15RFx	MN 150 Controller with Fan Coil Profile (8020)	3 Universal Inputs (UI) 2 Digital Outputs (DO) 2 Analog Outputs (AO)
MNL-15RHx	IMN 150 Controller with Heat Pump Profile (8051)	
MNL-15RRx	MN 150 Controller with Rooftop Profile (8030)	
MNL-15RSx	MN 150 Controller with Satellite Profile (8030)	
MNL-20RFx	MN 200 Controller with Fan Coil Profile (8020)	2 Digital Inputs (DI) 3 Universal Inputs (UI) 6 Digital Outputs (DO) 2 Analog Outputs (AO)
MNL-20RHx	MN 200 Controller with Heat Pump Profile (8051)	
MNL-20RRx	MN 200 Controller with Rooftop Profile (8030)	
MNL-20RSx	MN 200 Controller with Satellite Profile (8030)	

Printed in U.S.A. 9-06

Applicable Documentation

F-Number	Description	Audience	Purpose
F-26277	TAC I/A Series MicroNet MN-Sx Series Sensors General Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step installation and checkout procedures for TAC I/A Series MicroNet MN-Sx Series Sensors. Also contains instructions for sensor operation.
F-26303	TAC I/A Series MicroNet System Overview	– Application engineers – Installers – Start-up technicians – Service personnel	Provides an overview of the TAC I/A Series MicroNet System. It includes brief descriptions of the hardware and software components, and how they may be combined to create TAC MicroNet networks and stand-alone systems.
F-27254	WorkPlace Tech Tool 4.0 Engineering Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides engineering and technical information for applying and using all aspects of WorkPlace Tech Tool.
F-26507	TAC I/A Series MicroNet Systems Engineering Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides engineering and technical information to assist in designing a complete TAC MicroNet controller system using different architectures, components, and software.
F-27255	WorkPlace Tech Tool 4.0 User's Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step instructions for using WorkPlace Tech Tool.
F-26363	EN-206 Guidelines for Powering Multiple Full-Wave and Half-Wave Rectifier Devices from a Common Transformer	– Application Engineers – Installers – Service Personnel	Offers guidelines for avoiding equipment damage associated with improperly wiring devices of varying rectifier types. Contains instructions for identifying device rectifier type, guidelines for correctly powering devices of varying rectifier types, and examples illustrating proper power wiring techniques.

Installation

Inspection

Inspect carton for damage. If damaged, notify carrier immediately. Inspect controllers for damage upon receipt.

Requirements

(These items not provided)

- Installer must be a qualified, experienced technician.
- Job wiring diagrams
- Tools:
  - Drill and bits for panel mounting screws
  - Digital Volt-ohm meter (DVM)
  - Static protection wrist strap
- MNA-FLO-1 enclosure for connecting to conduit (optional)
- Class 2 power transformer supplying a nominal 24 Vac (20.4 to 30 Vac) with a minimum rating of 15 Va, 50/60 Hz per controller plus Digital Output (DO) loads (if same transformer is used). In European Community, transformer must conform to EN 60742
- Terminators:
  - One LON-TERM1 terminator required for each free topology segment
  - Two LON-TERM2 terminators required for each bus topology segment
- Two #6 pan head panel mounting screws or 35mm DIN rail for mounting

Precautions

General

Warning: Electrical shock hazard! Disconnect power before installing or removing the cover.

- Follow Static precautions when installing this equipment.
- Use copper conductors that are suitable for 167°F (75°C).
- Make all connections according to electrical wiring diagram, national and local electrical codes.

Static Precautions

Static charges damage electronic components. The microprocessor and associated circuitry are extremely sensitive to static discharge. Use the following precautions when installing, servicing, or operating the system.

- Work in a static-free area.
- Discharge static electricity by touching a known, securely grounded object.
- Use a wrist strap connected to earth ground when handling the controller's printed circuit board.

Federal Communications Commission (FCC)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy and may cause harmful interference if not installed and used in accordance with the instructions. Even when instructions are followed, there is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception—which can be determined by turning the equipment off and on—the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

Canadian Department of Communications (DOC)

This class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

European Community Directives

This equipment meets all requirements of European Community Directives for Low Voltage (72/23/EEC), General Safety (92/59/EEC), and Electromagnetic Compatibility (89/336/EEC).

Location

These controllers are suitable for indoor use only.

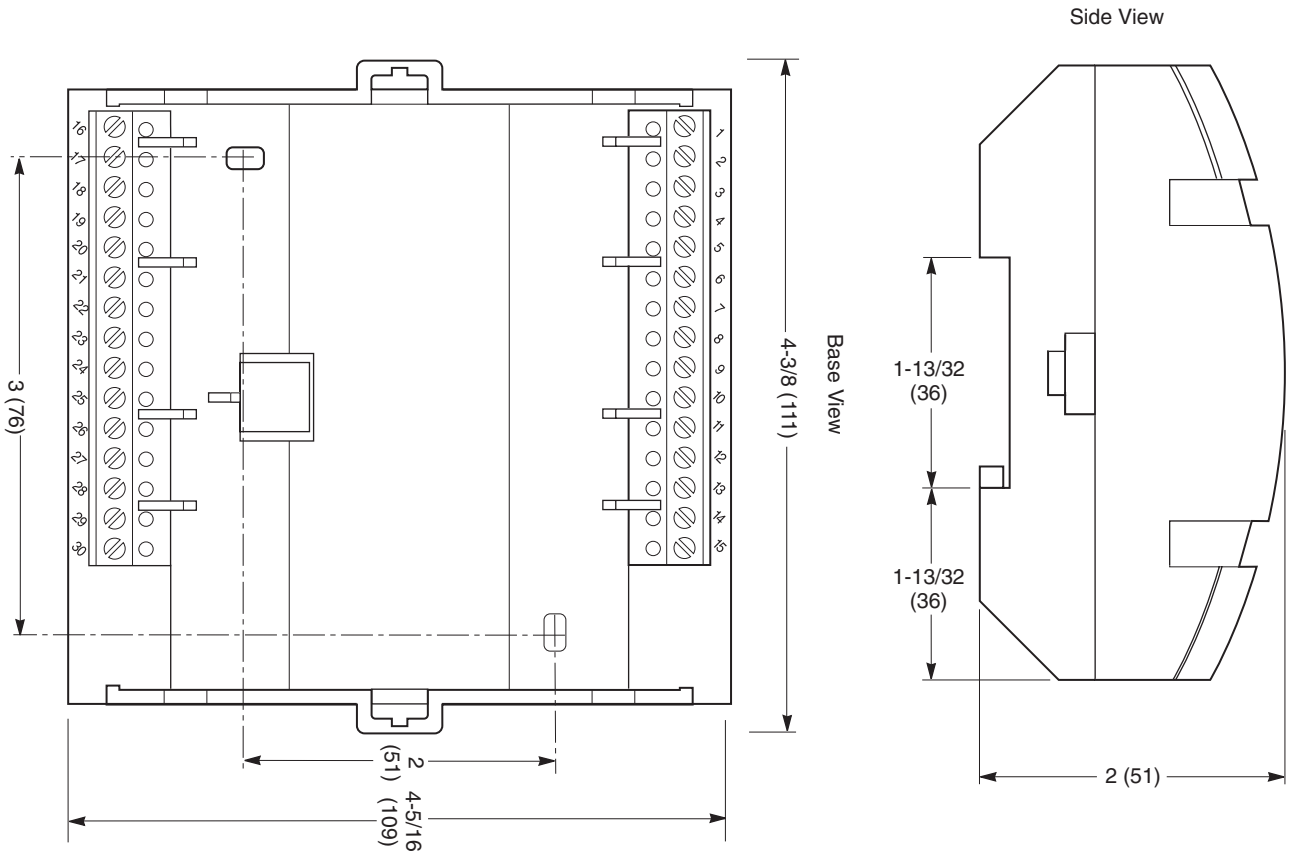
Caution:

- Avoid locations where excessive moisture, corrosive fumes, vibration, or explosive vapors are present.
- Avoid electrical noise interference. Do not install near large contactors, electrical machinery, or welding equipment.
- Locate where ambient temperatures do not exceed 140°F (60 °C) or fall below -40°F (-40 °C) and relative humidity does not exceed 95% or fall below 5%, non-condensing.

Mounting

Panel or DIN Rail Mounting

1. Select mounting location. Enclosure mounting is recommended.
2. Do one of the following:
   a. Using two #6 pan head screws, mount base of controller to a panel (Figure-1).
   b. Snap controller base on a 35mm DIN mounting rail (not provided). Multiple units can be mounted side by side on a DIN mounting rail.
3. Wire controller base (See Wiring section).
4. After wiring, insert cover tabs into brackets on base of the controller and gently push until cover snaps into place.



Dimensions shown are in inches (mm).

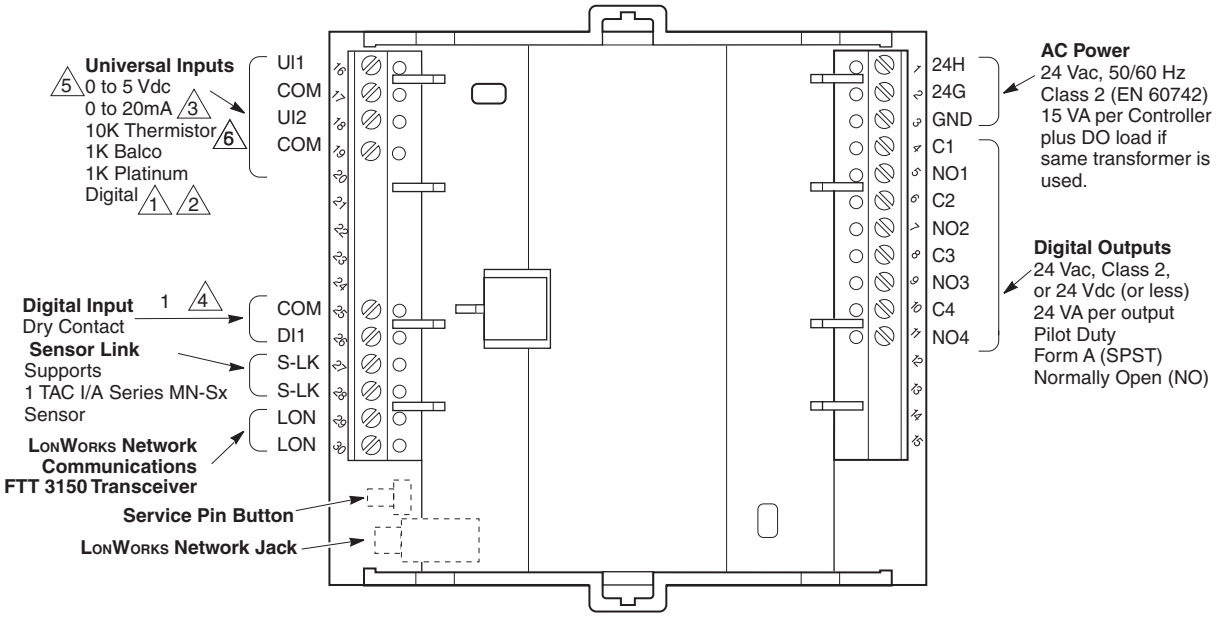
Figure-1 Mounting Dimensions.

Wiring

Review Figures 2, 3, and 4 when making electrical connections to controller.

The following electrical connections can be made to the controllers:

- Sensor Link (S-Link) connection to TAC I/A Series MicroNet Sensor (MN-Sx).
- TAC MicroNet LONWORKS network (LON®) connection.
- I/O connections including Universal Inputs, Digital Inputs (MN 100 and MN 200), Analog Outputs (MN 150 and MN 200), and Digital Outputs.
- Power connection to a 24 Vac nominal Class 2 power source and earth ground.



1 To detect a closed switch, maximum resistance must be less than 300 ohms .

2 To detect an open switch, minimum resistance must be greater than 1.5K ohms.

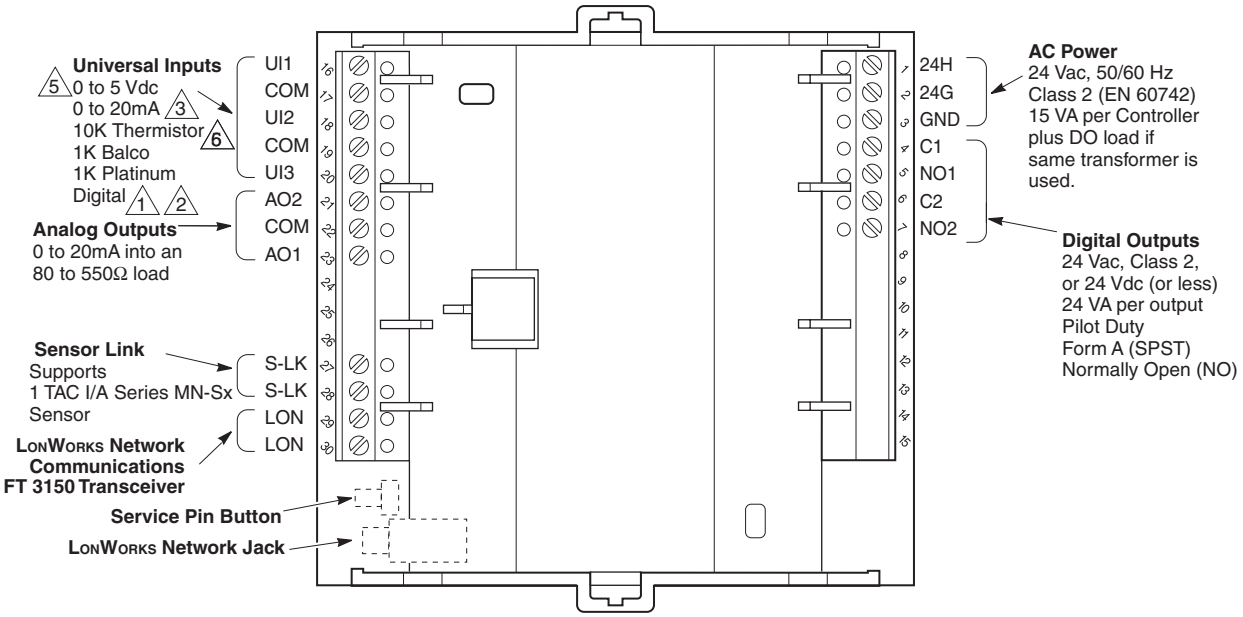
3 Applications which use 0 to 20 mA analog inputs require a 250 ohm shunt resistor kit, AD-8969-202. Install resistor across universal input and common.

4 To detect an open switch, minimum resistance must be greater than 100K ohms.

5 Input signals of 1 to 11 Vdc must be converted to 0.45 to 5 Vdc with a voltage divider, AD-8961-220.

6 Applications which use a 10K Thermistor Sensor (non-850 series) universal input require an 11K ohm shunt resistor kit, AD-8969-206. Install resistor across universal input and common.

Figure-2 MN 100 Terminal Connections.



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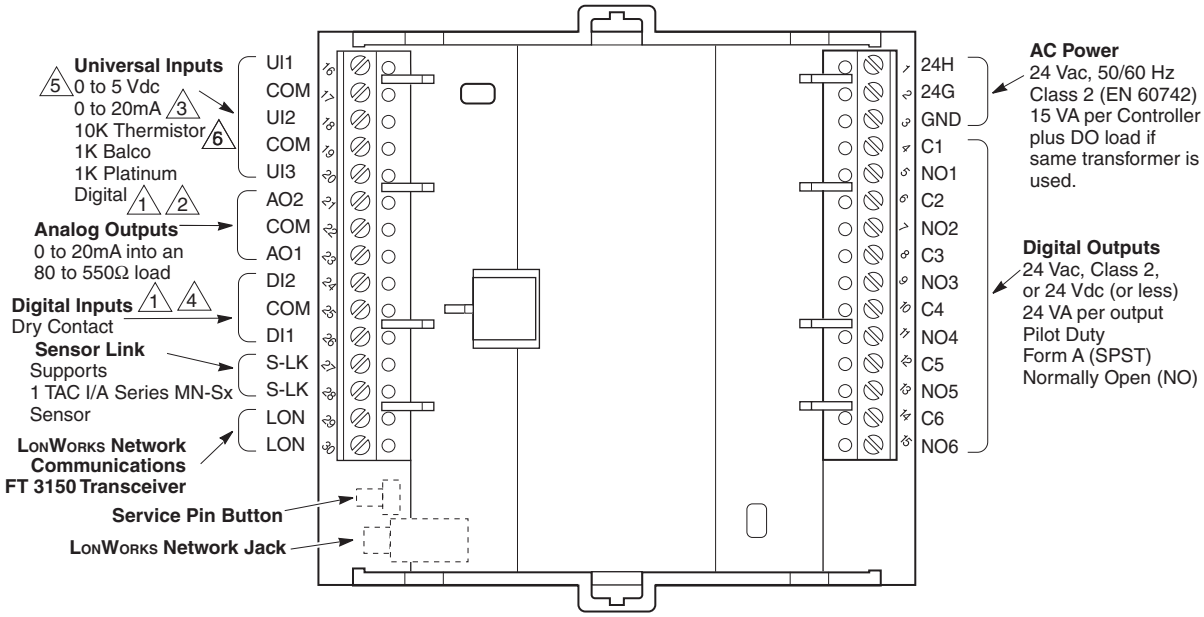
4 To detect an open switch, minimum resistance must be greater than 100K ohms.

5 Input signals of 1 to 11 Vdc must be converted to 0.45 to 5 Vdc with a voltage divider, AD-8961-220.

6 Applications which use a 10K Thermistor Sensor (non-850 series) universal input require an 11K ohm shunt resistor kit, AD-8969-206. Install resistor across universal input and common.

Figure-3 MN 150 Terminal Connections.



1 To detect a closed switch, maximum resistance must be less than 300 ohms .

2 To detect an open switch, minimum resistance must be greater than 1.5K ohms.

3 Applications which use 0 to 20 mA analog inputs require a 250 ohm shunt resistor kit, AD-8969-202. Install resistor across universal input and common.

4 To detect an open switch, minimum resistance must be greater than 100K ohms.

5 Input signals of 1 to 11 Vdc must be converted to 0.45 to 5 Vdc with a voltage divider, AD-8961-220.

6 Applications which use a 10K Thermistor Sensor (non-850 series) universal input require an 11K ohm shunt resistor kit, AD-8969-206. Install resistor across universal input and common.

Figure-4 MN 200 Terminal Connections.

Communications Wiring

Caution:

- Communication wire pairs must be dedicated to MN-Sx (S-Link) and TAC MicroNet LONWORKS network (LON) communications. They cannot be part of an active, bundled telephone trunk.
- Shielded cable is not required for S-Link or LON wiring.
- If the cable is installed in areas of high RFI/EMI, the cable must be in conduit.
- If shielded wire is used, the shield must be connected to earth ground at one end only by a 470K ohm 1/4 watt resistor. Shield must be continuous from one end of the trunk to the other.

Communications wiring includes a connection between the controller and a TAC I/A Series MicroNet Sensor via the S-Link and a connection between the controller and the TAC MicroNet LONWORKS Network (LON). An optional LONWORKS Network connection between the controller and one TAC I/A Series MicroNet Sensor is also possible.

Sensor Link (S-Link) Wiring

S-Link wiring powers and enables the MN-Sx sensor. The S-Link needs at least 24 gage (0.51mm), twisted pair, voice grade telephone wire. The capacitance between conductors cannot be more than 32 pF per foot (0.3m). If shielded cable is used, the capacitance between any one conductor and the others, connected to the shield, cannot be more than 60 pF per foot (0.3m). Maximum wire length is 200 ft. (61m).

Note:

- Controller supports one TAC I/A Series MicroNet Sensor (MN-Sx).
- S-Link wiring is polarity insensitive.
- If conduit is used between a TAC I/A Series Sensor and a controller, the TAC MicroNet LONWORKS network and S-Link wiring can be in the same conduit, however, they must be separate cables.
- S-Link wiring can be in the same conduit with UI, AO, and DI Wiring.

TAC MicroNet LONWORKS Network (LON) Wiring

An approved Category 4 or 5, twisted-pair (two conductors) cable may be used for both connecting to the TAC MicroNet LONWORKS Network and the optional LONWORKS Network connection between the controller and MN-Sx sensor. LONWORKS Network wiring is polarity insensitive.

Caution: Do not mix with UI, AO, DI or DO types of wiring. If conduit is used between a TAC I/A Series Sensor and a controller, LONWORKS Network wiring and S-Link wiring can be in the same conduit, however, they must be separate cables.

MN 100, MN 150, and MN 200 controllers use LONWORKS Free Topology Transceiver (FT 3150) and support polarity insensitive bus (daisy-chain) and free (all combinations of star, tee, and loop) wiring topologies. A maximum of 62 nodes can be connected per segment.

Note: See *TAC I/A Series MicroNet System Engineering Guide,* F-26507 to design a TAC MicroNet LONWORKS TP/FT-10 network, including recommended topologies and approved cable types.

- Use of the LON terminals to connect to the MN-Sx sensor permits use of the sensor's built-in LON Jack.
- To preserve the integrity of the network, the LON wiring connecting a TAC I/A Series MicroNet controller to an MN-Sx sensor must be run to the sensor and back, in daisy-chain fashion. A wire "spur" must not be used to connect the sensor to the controller.
- While the MN-Sx sensor is not counted as a "node" in the LonWorks network (LON), all LON wiring to the sensor must be counted when determining the length of the FTT wiring segment.

I/O Wiring

I/O connections include universal inputs, analog outputs, digital inputs, and digital outputs. See Figure-2, Figure-3, and Figure-4 for proper wire terminal information.

Caution: If shielded cable is used, connect only one end of the shield to earth ground at controller.

Universal Inputs (UI), Analog Outputs (AO), and Digital Inputs (DI)

Caution:

- Input and output devices cannot share common wiring. Each connected device requires a separate signal and return conductor.
- Power wiring cannot share conduit with UI, AO, S-Link, LON, or DI wiring.

Note:

- If maximum closed switch voltage is not more than 1.0 V *and* minimum open switch voltage is at least 4.5 V, then solid state switches may be used for a UI or a DI.
- UI, AO, DI, and S-Link wiring can share a single conduit.

UI, AO, DI, wiring needs at least 24 gage (0.51mm), twisted pair, voice grade telephone wire. The capacitance between conductors cannot be more than 32 pF per foot (0.3m). If shielded cable is used, the capacitance between any one conductor and the others, connected to the shield, cannot be more than 60 pF per foot (0.3m). Table-1 provides wiring specifications.

Table-1 UI, AO, and DI Wiring Specifications.

Connection	Gage AWG (mm)	Maximum Distance ft. (m)
UI, AO, and DI	18 (1.02)	300 (91)
	20 (.81)	200 (61)
	22 (.65)	125 (38)
	24 (.51)	75 (23)

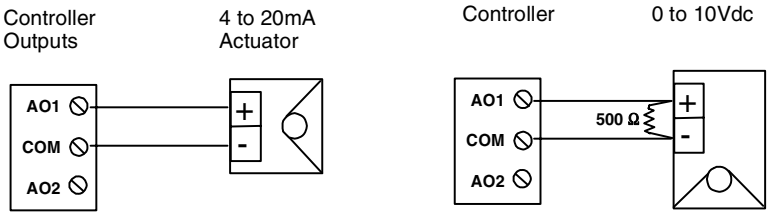


Figure-5 Analog Output Connections for 4 to 20mA and 0 to 10Vdc Actuators.

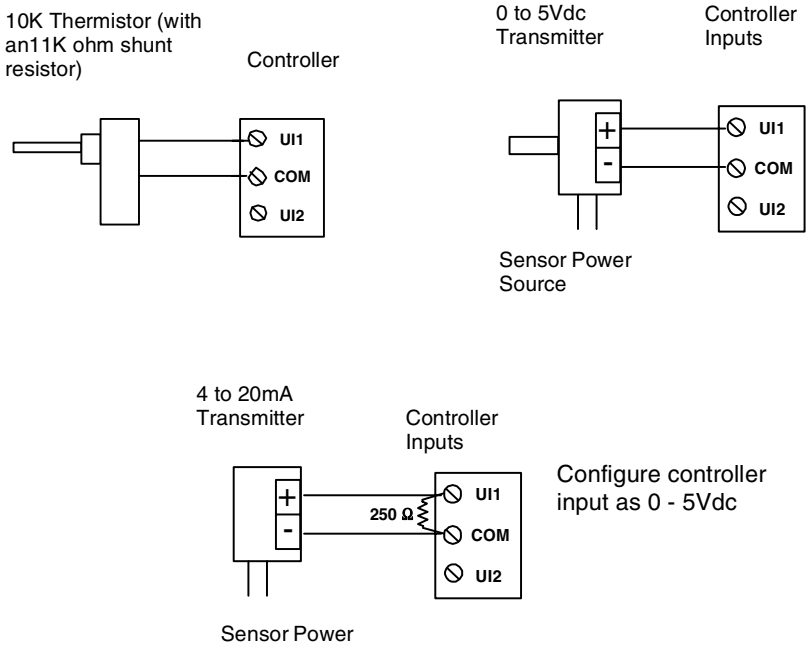


Figure-6 Universal Input Connections for 10K (with 11K ohm shunt) Thermistor Sensor, 4 to 20mA Transmitter, and 0 to 5 Vdc Transmitters.

Digital Outputs (DO)

Caution:

- DO terminals accept one 16 gage (1.29mm) wire or two 18 gage (1.02mm) wires. The selected wire gage must be consistent with the load current rating.
- DO wiring cannot be intermixed with DI, UI, S-Link, LON and AO wiring.
- MN 100, MN 150, and MN 200 controllers are Class 2 devices. Each digital output can support up to 24 Vac/Vdc at 1.0 amp (24 VA) pilot duty.

Note: Digital Output wiring can be intermixed with class 2 power wiring.

Each DO is an isolated Form A (SPST) relay. If the transformer is sized correctly, the 24 Vac Class 2 Controller power source (Figure-7) may be used for load power.

Table-2 Relay Output Load Specifications.

Specification	Value
Maximum Relay Contact Switched Output Voltage	voltage at 24H terminal[a]
Maximum Output Load @ 24 VAC, Pilot Duty	24 VA
Minimum Permissible Load	10.0 mA at 5Vdc
Maximum Off-state Leakage Current	3.5 mA
Minimum Cycles at Rated Load @ 0.4 Power Factor	300,000 cycles

[a]Switched output voltage is equivalent to value of input voltage.

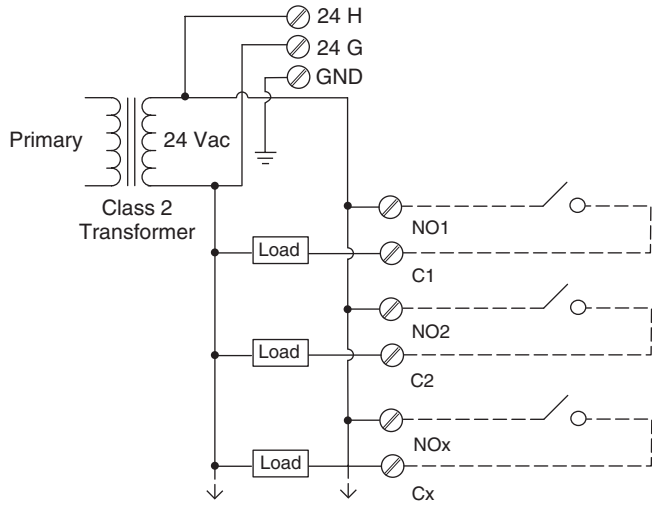


Figure-7 DO Loads and Controller Power Sharing Common Transformer.

Power Supply Wiring

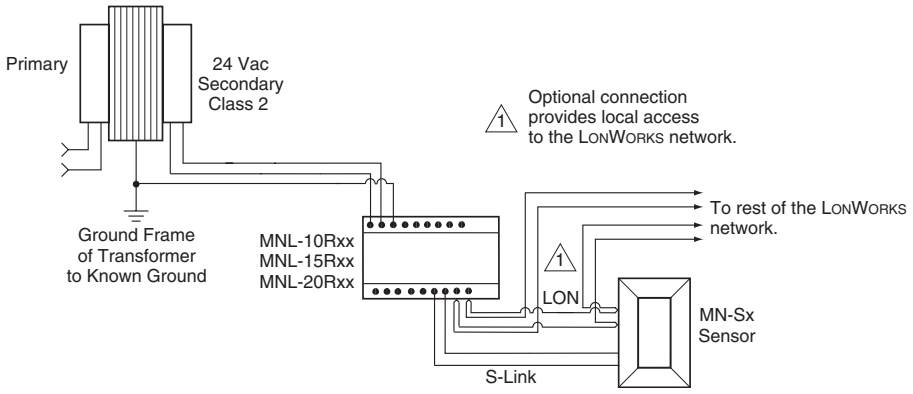
Caution:

- TAC MicroNet I/A Series Controllers are Class 2 only devices and must be connected to a Class 2 source. Class 2 circuits must not intermix with Class 1 circuits.
- This product contains a non-isolated half-wave rectifier power supply and must not be powered by transformers used to power other devices containing non-isolated full-wave rectifier power supplies. Refer to *EN-206, Guidelines for Powering Multiple Devices from a Common Transformer,* F-26363, for detailed information.
- Power wiring cannot be intermixed with LON, S-Link, UI, AO, or DI wiring.
- Use a Class 2 power transformer supplying a nominal 24 Vac (20.4 to 30 Vac) with a minimum rating of 15 VA at 50/60 Hz plus digital output loads (144VA using 6 DOs or 96VA using 4 DOs if same transformer is used). The supply to the transformer must be provided with a breaker or disconnect. In European Community, transformer must conform to EN 60742.
- The Class 2 power transformer may be used to power multiple Class 2 powered devices provided that the transformer is properly sized to power all equipment simultaneously and all devices contain the same type of rectifier power supplies or internal isolation.
- The transformer frame must be grounded.
- When powering multiple Class 2 devices from the same Class 2 power transformer, polarity must be observed (24H connected to 24H and 24G connected to 24G).

Note:

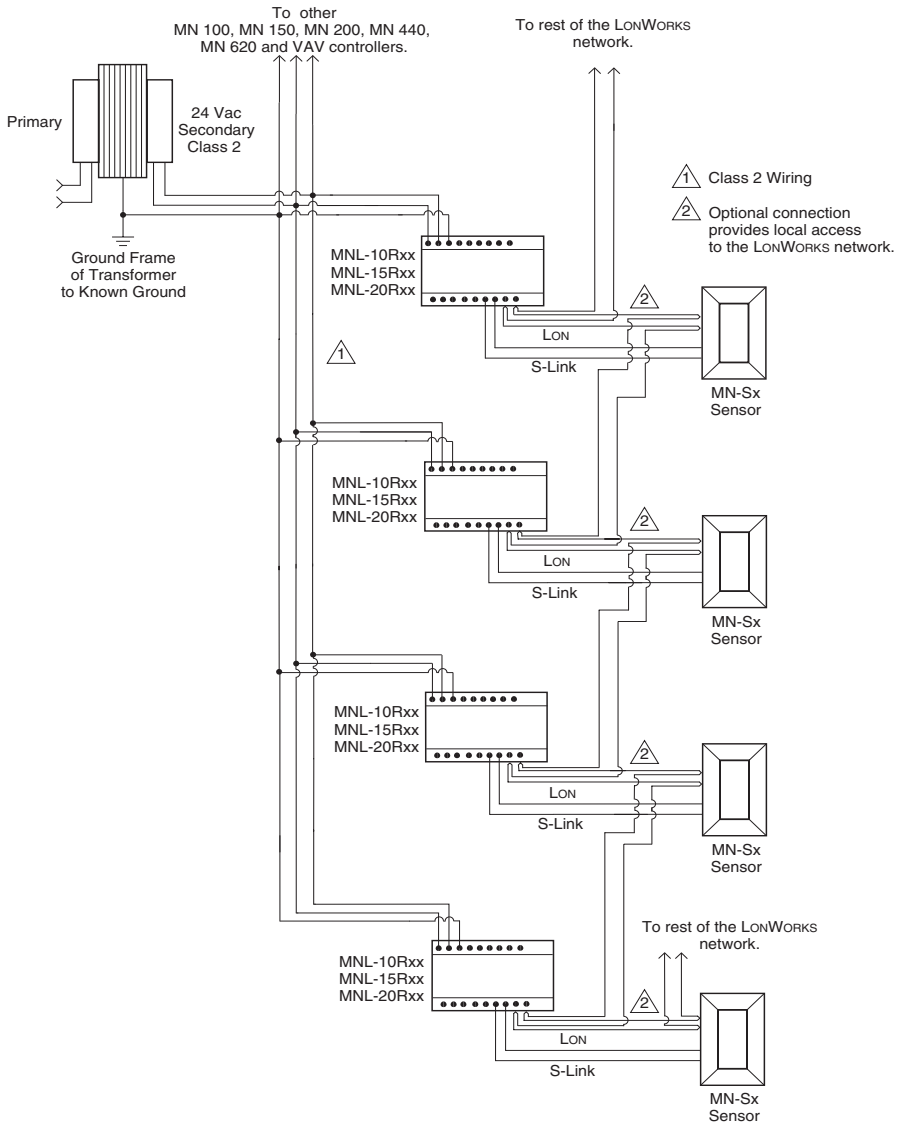
- Power wiring terminals accept one 16 gage (1.29mm) or two 18 gage (1.02mm) wires.
- Power wiring can be intermixed with DO wiring.
- Twisted or untwisted cable can be used for power wiring.
- To preserve the integrity of the network, the LON wiring connecting a TAC I/A Series MicroNet controller to an MN-Sx sensor must be run to the sensor and back, in daisy-chain fashion. A wire “spur” must not be used to connect the sensor to the controller.

Figure-8 and Figure-9 are acceptable wiring configurations.



Observe Free or Daisy chain topology when making connection to rest of network.

Figure-8 Single Controller Powered from a Separate Class 2 Power Source.



Observe Free or Daisy chain topology when making connection to rest of network.

Figure-9 Multiple Controllers Powered from a Single Class 2 Power Source and Sharing Communications in a Free Topology Segment.

Checkout

Mechanical Hardware Checkout

1. Verify wiring between TAC I/A Series MicroNet Sensor and controller is installed according to job wiring diagram and national and local wiring codes.

Note: Wiring of the S-Link and TAC MicroNet LONWORKS network between the sensor and the controller is not polarity sensitive.

2. If controller is part of a TAC MicroNet LONWORKS network, verify the TP/FT-10 LONWORKS network wiring between controller and other devices is installed according to job wiring diagram and national and local electrical codes.
3. Verify 24 Vac power is provided from a Class 2 power transformer and wiring is installed according to job wiring diagrams and national and local electrical codes.
4. If multiple devices are powered from the same transformer, verify wiring polarity has been maintained between all connected devices (24H connected to 24H and 24G connected to 24G).
5. If multiple devices are powered from a common transformer, verify all issues associated with powering multiple devices from a common transformer have been addressed.

Note: For more information, refer to *EN-206, Guidelines for Powering Multiple Full-Wave and Half-Wave Rectifier Devices from a Common Transformer,* F-26363.

6. Verify digital outputs are wired according to job wiring diagram and national and local electrical codes.
7. Make certain current requirements of the controlled device do not exceed rating of controller's digital outputs.

Communications Hardware Checkout

1. Verify controlled equipment is in a manually controlled, safe state.
2. Place controller power breaker in the ON position. See job wiring diagrams.
3. Observe green Data Transmission LED (Figure-10) and do the following:
   a. If green Data Transmission LED is steady on or blinking, go to step 4.
   b. If green Data Transmission LED is off, check power.
4. Observe red Service LED (Figure-10) and do the following:
   a. If the red Service LED is off or flashing, proceed with downloading an application using WorkPlace Tech Tool and configuring the controller with a third party network management tool. Refer to *WorkPlace Tech Tool 4.0 Engineering Guide,* F-27254, for details on downloading applications.
   b. If red Service LED is steady on, turn power to controller OFF, wait five seconds, and turn power ON. If red Service LED is still steady on, turn power OFF and replace controller.

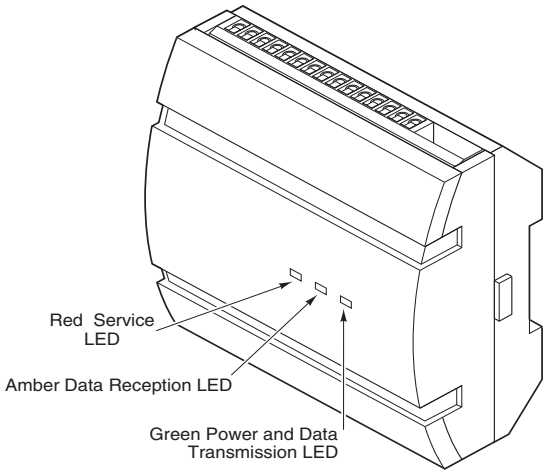


Figure-10 Location of Controller LEDs.

Table-3 LED Indication.

Indicator	Context	Status	Corrective Action
Data Reception LED – amber	Anytime	Blinks when the controller receives data from the LONWORKS Network.	None required.
		On indicates a possible network connection problem, or a large amount of network traffic is present.	Remove the LONWORKS Network connections from the controller and determine if the LED goes off. If the LED does not go off, replace the controller. If the LED does go off, check the network topology (connections to each node, routers, terminators, etc.) and the amount of traffic on the network.
		Off indicates that data reception is not taking place.	None Required
Data Transmission LED – Green	Anytime	Blinks when the controller transmits data to the LONWORKS Network.	
		On indicates that the controller is not transmitting data. On also indicates that power is being applied to the controller.	
		Off indicates no power to controller.	Check power
Service LED – Red	Power-up	The LED blinks once to indicate successful power-up.	None Required
	Wink mode	Blinks (3 seconds on, 1 second off) three times to indicate physical location of the controller. If a sensor (MN-Sx) is connected, its red occupancy LED will flash (1/sec) during the wink period.	
	Anytime	On indicates that the neuron application is not running. Neuron applications are not field replaceable.	Replace the controller.
	Anytime	Blinks (1/sec) to indicate that the neuron application is loaded, but the neuron's communication parameters are not loaded, are being reloaded, or have been corrupted. Neuron is considered unconfigured. Communication parameters cannot be configured by field personnel.	Use a third party network management tool to commission the controller, or use the change state tool in WorkPlace Tech Tool (version 4.0 or greater) to set the Neuron® to the configured/on-line state. While the controller is unconfigured, WP Tech can be used to download an application, but at the completion of the download, WP Tech versions 4.0 and higher will restore the Neuron to the unconfigured state.
	Anytime	Off may indicate that the neuron application is loaded but the device is off-line. In this state, a pre-loaded HVAC application will not run.	Use a third party network management tool to commission the controller, or use the change state tool in WorkPlace Tech Tool (version 4.0 or greater) to set the Neuron to the configured/on-line state. While the controller is off-line, WP Tech can be used to download an application, but at the completion of the download, WP Tech versions 4.0 and higher will restore the Neuron to the off-line state.
	Anytime	Off usually indicates a normal state. In this state, the controller operates normally, and you can download and/or run HVAC applications.	If the controller is able to accept and/or run a downloaded HVAC application, no action is required.

Controller Selection

Identical pairs of factory barcode labels are attached to each controller. The labels can be used to select controllers for application downloading purposes. Each pair of labels contains a unique Neuron ID. One of the labels remains on the controller permanently; the other label can be placed on a job site plan.

The Neuron ID may be entered into the WorkPlace Tech Tool. The WorkPlace Tech Tool (must be version 4.0 or greater) can then download an application to the selected controller. See *WorkPlace Tech Tool 4.0 Users Guide*, F-27255, for additional information.

Caution: Do not hold service pin button when selecting a controller. Holding the service pin button for 6 seconds or longer will completely unconfigure controller. See *WorkPlace Tech Tool 4.0 Engineering Guide,* F-27254, for additional information.

The service pin button is also used to select controllers. When this button is pressed, the controller sends a broadcast message containing its Neuron ID to the online or connected WorkPlace Tech Tool. After the message is received, the controller can be selected for application downloading. See *WorkPlace Tech Tool 4.0 Users Guide*, F-27255, for additional information.

Service

Components within MN 100, MN 150, and MN 200 controllers cannot be field repaired. If there is a problem with a controller, follow the steps below before contacting your local TAC office.

1. Make sure controllers are connected and communicating to desired devices.
2. Check all sensors and controlled devices are properly connected and responding correctly.
3. If controller is operating, make sure the correct profile and application is loaded by checking the LONMARK Program ID and the nvoDeviceInfo using Work PLace Tech Tool. For more information, see *WorkPlace Tech Tool 4.0 Engineering Guide,* F-27254.
4. Record precise hardware setup indicating the following:
   - Version numbers of applications software.
   - Controller firmware version number.
   - Information regarding the WorkPlace Tech Tool.
   - A complete description of difficulties encountered.

TAC
1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL 61132-2940

F-26266-5

EnFlex Corp.
1040 Whipple Street, Suite 225
Prescott, AZ 86305
Tel (928) 776-7101
www.enflex.net

Product Description

Pub. No. 91G100PRDESC_1-1

EnFlex G-100 Control Server

EnFlex has raised the performance and versatility bar with its G-100 Control Server. This Linux network server enables a user to integrate and connect multiple existing facility systems and devices to a common enterprise network. The G-100 is a cost-effective platform that will network enable and extend the life of legacy facility control systems that presently depend on proprietary serial communications. The G-100 also connects to and consolidates information from other "network" enabled devices to fully integrate facility management and reporting. Users at the enterprise and/or local level now have the ability to easily monitor and control building systems through web pages and eliminate the need for extensive training on proprietary software interfaces.

The software on the G-100 is fully compatible with the EnFlex software on other EnFlex control servers as well as SNMP capable hosts on the network. Multiple EnFlex control servers, each connected to local systems and devices, can be linked via a local or wide area network to provide unlimited expansion, configuration, and reporting capabilities.

The G-100 also has keyboard and video monitor connections to support local control functions, status display, troubleshooting, configuration, and troubleshooting of connected devices. The G-100 can also be configured to accommodate 3 pulse inputs, as well as unique user requirements such as touch screen applications, a hard disk drive, parallel port connection, floppy disk, and PC104 bus devices. Contact EnFlex for unique user requirements.

G-100 Control Server

Features

- **Embedded EnFlex software, Web server, and TCP/IP Networking**
- **Linux operating system**
- **586 class processor with 64 MB RAM**
- **32 MB Flash with space for user programs and data**
- **10/100 Mbps Ethernet port**
- **2 serial ports for connecting to external devices**
- **Video and keyboard ports**
- **Additional RAM, data storage, and PC104 options available**
- **Optional 3 pulse counter inputs**

The G-100 is shipped with the complete EnFlex Application Software environment, including EnFlex Script®, EnFlex Connect™, and an embedded Web Server. Through the extensive library of EnFlex device drivers, the G-100 supports a large number of third party systems and devices. Additional interfaces may be developed by users for 3rd party equipment that communicate over RS-232, RS-485, Ethernet, or other proprietary networks (e.g.

LonWorks). The G-100 provides a complete implementation of TCP/IP networking, including HTTP, SLIP, PPP, NFS, etc. It also supports a range of TCP/IP services such as FTP, Telnet, etc.

The G-100 is powered by an external 5 VDC regulated power supply that plugs into any 120VAC outlet. The DC power supply, included with the G-100, facilitates faster field installation of the controller.

The G-100 control server is enclosed in a rugged and compact 5.8" X 8.1" X 2.4" aluminum case that can be mounted in any position. The G-100 is designed to operate in a 60°C environment and can thus be located outdoors if protected from direct exposure to weather.

EnFlex software provides connectivity to a number of enterprise software and facility information systems. Contact EnFlex for a list of interfaces, device drivers, and facility management solutions.

Device Interfaces

Type	Media	Connector	Protocols
Ethernet	10/100 Base T	RJ-45	TCP/IP
RS-232 (COM1)	Seven-wire serial	DB-9	Modem, User Defined
RS-232/485 (COM2)	Seven wire RS-232 or 2 wire RS-485	DB-9 / Terminals	Modem, User Defined
PC104	ISA/PCI Bus	PC104	Modem, User Defined
Pulse Counters (Optional)	3 inputs, 5 VDC	Terminals	Contact closure
Optional USB	Serial	USB	USB
Video Port		DB-15	VGA
Keyboard Port		Miniature DIN	

Applications

- Third-party device integration
- Linking disparate Energy Management Systems
- Distributed Generation monitoring and control
- Intelligent demand limiting and load curtailment
- Facility alarm and exception reporting
- Common Enterprise facility gateway
- Local web enabling of facility controls
- Real-time metering and sub-metering
- Environmental and tank monitoring
- Advanced lighting and HVAC control
- Data logging and trending
- Wireless network management

.

Medium Type 1 Enclosures

Application

Designed for use in control and instrumentation applications in areas which do not require oil-tight and dust-tight specifications.

Features

- Doors have butt hinges
- Collar studs provided for mounting optional panel
- Slotted flush latches. Optional latches available (see next page).

Construction

- 16 or 14 gauge steel
- Mounting holes on back of enclosure

Finish

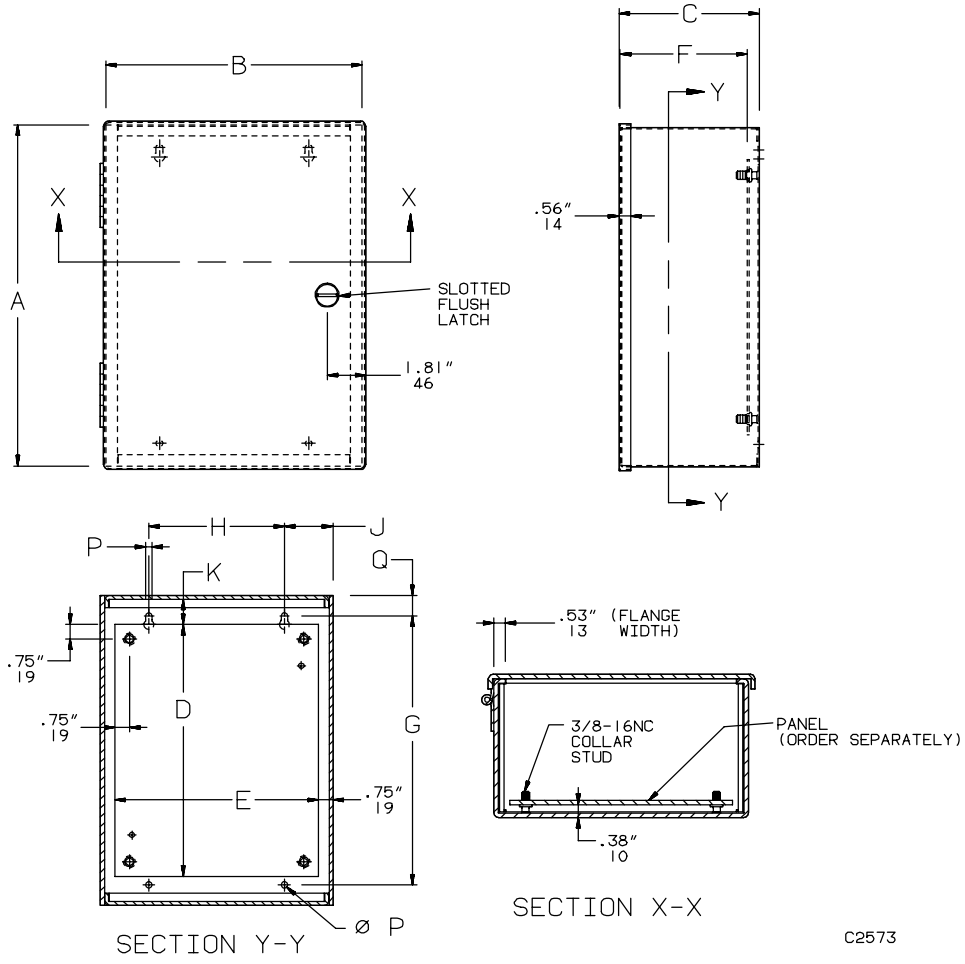
ANSI 61 gray polyester powder paint finish inside and out over phosphatized surfaces. Optional solid panels are white and optional perforated panels are gray.

Industry Standards

UL 50, File No. E27567: Type 1 (see Table)
NEMA/EEMAC Type 1
CSA, File No. LL42184: Type 1
IEC 60529, IP30

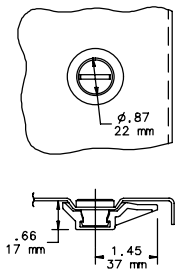
Accessories

Cylinder Lock Kit
Electric Heater
Electrical Interlock
Grounding Device
Panels (see Table)
Rack Mounting Angle Kit
"T" Handle Latch Kit
Touch-Up Paint (ATPPY61)
Window Kit

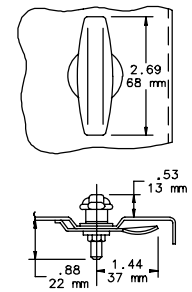


C2573

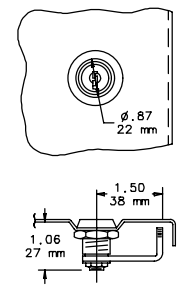
Standard Slotted Flush Latch



Cylinder Lock Kit AL12AR (optional)



"T" Handle Latch Kit AL7A (optional)



C2596-2

Medium Type 1 Enclosures

Standard Sizes Medium Type 1 Enclosures

Enclosure Catalog Number	Enclosure Size A x B x C	Panel Catalog Number [a]	Perf. Panel Catalog Number [a]	Panel Size D x E	Panel Gauge	Mounting G	H	J	Q	P	F	K
A16N12ALP	16.00 x 12.00 x 6.62 (406 x 305 x 168)	A16N12MP	A16N12MPP	13.00 x 10.50 (330 x 267)	14	13.88 (353)	7.00 (178)	2.50 (64)	1.06 (27)	0.31 (8)	6.00 (152)	1.50 (38)
A16N16ALP	16.00 x 16.00 x 6.62 (406 x 406 x 168)	A16N16MP	A16N16MPP	13.00 x 14.50 (330 x 368)	14	13.88 (353)	11.00 (279)	2.50 (64)	1.06 (27)	0.31 (8)	6.00 (152)	1.50 (38)
A16N20ALP	16.00 x 20.00 x 6.62 (406 x 508 x 168)	A16N20MP	A16N20MPP	13.00 x 18.50 (330 x 470)	14	13.88 (353)	15.00 (381)	2.50 (64)	1.06 (27)	0.31 (8)	6.00 (152)	1.50 (38)
A20N16ALP	20.00 x 16.00 x 6.62 (508 x 406 x 168)	A20N16MP	A20N16MPP	17.00 x 14.50 (432 x 368)	14	17.88 (454)	11.00 (279)	2.50 (64)	1.06 (27)	0.31 (8)	6.00 (152)	1.50 (38)
A20N20ALP	20.00 x 20.00 x 6.62 (508 x 508 x 168)	A20N20MP	A20N20MPP	17.00 x 18.50 (432 x 470)	14	17.88 (454)	15.00 (381)	2.50 (64)	1.06 (27)	0.31 (8)	6.00 (152)	1.50 (38)
A24N16ALP	24.00 x 16.00 x 6.62 (610 x 406 x 168)	A24N16MP	A24N16MPP	21.00 x 14.50 (533 x 368)	14	21.88 (556)	11.00 (279)	2.50 (64)	1.06 (27)	0.31 (8)	6.00 (152)	1.50 (38)
A24N20ALP	24.00 x 20.00 x 6.62 (610 x 508 x 168)	A24N20MP	A24N20MPP	21.00 x 18.50 (533 x 470)	14	21.88 (556)	15.00 (381)	2.50 (64)	1.06 (27)	0.31 (8)	6.00 (152)	1.50 (38)
A24N24ALP	24.00 x 24.00 x 6.62 (610 x 610 x 168)	A24N24MP	A24N24MPP [b]	21.00 x 22.50 (533 x 572)	12	21.88 (556)	19.00 (483)	2.50 (64)	1.06 (27)	0.31 (8)	6.00 (152)	1.50 (38)
A30N24ALP	30.00 x 24.00 x 6.62 (762 x 610 x 168)	A30N24MP	A30N24MPP [b]	26.00 x 22.50 (660 x 572)	12	27.50 (699)	16.75 (425)	3.62 (92)	1.25 (32)	0.44 (11)	6.00 (152)	2.00 (51)
A36N24ALP	36.00 x 24.00 x 6.62 (914 x 610 x 168)	A36N24MP	A36N24MPP [b]	32.00 x 22.50 (813 x 572)	12	33.50 (851)	16.75 (425)	3.62 (92)	1.25 (32)	0.44 (11)	6.00 (152)	2.00 (51)
A36N30ALP	36.00 x 30.00 x 6.62 (914 x 762 x 168)	A36N30MP	A36N30MPP [b]	32.00 x 28.50 (813 x 724)	12	33.50 (851)	22.75 (578)	3.62 (92)	1.25 (32)	0.44 (11)	6.00 (152)	2.00 (51)
A16N12BLP	16.00 x 12.00 x 8.62 (406 x 305 x 219)	A16N12MP	A16N12MPP	13.00 x 10.50 (330 x 267)	14	13.88 (353)	7.00 (178)	2.50 (64)	1.06 (27)	0.31 (8)	8.00 (203)	1.50 (38)
A20N12BLP	20.00 x 12.00 x 8.62 (508 x 305 x 219)	A20N12MP	A20N12MPP	17.00 x 10.50 (432 x 267)	14	17.88 (454)	7.00 (178)	2.50 (64)	1.06 (27)	0.31 (8)	8.00 (203)	1.50 (38)
A20N16BLP	20.00 x 16.00 x 8.62 (508 x 406 x 219)	A20N16MP	A20N16MPP	17.00 x 14.50 (432 x 368)	14	17.88 (454)	11.00 (279)	2.50 (64)	1.06 (27)	0.31 (8)	8.00 (203)	1.50 (38)
A20N20BLP	20.00 x 20.00 x 8.62 (508 x 508 x 219)	A20N20MP	A20N20MPP	17.00 x 18.50 (432 x 470)	14	17.88 (454)	15.00 (381)	2.50 (64)	1.06 (27)	0.31 (8)	8.00 (203)	1.50 (38)
A24N20BLP	24.00 x 20.00 x 8.62 (610 x 508 x 219)	A24N20MP	A24N20MPP	21.00 x 18.50 (533 x 470)	14	21.88 (556)	15.00 (381)	2.50 (64)	1.06 (27)	0.31 (8)	8.00 (203)	1.50 (38)
A24N24BLP	24.00 x 24.00 x 8.62 (610 x 610 x 219)	A24N24MP	A24N24MPP [b]	21.00 x 22.50 (533 x 572)	12	21.88 (556)	19.00 (483)	2.50 (64)	1.06 (27)	0.31 (8)	8.00 (203)	1.50 (38)
A30N20BLP	30.00 x 20.00 x 8.62 (762 x 508 x 219)	A30N20MP	A30N20MPP [b]	26.00 x 18.50 (660 x 470)	12	27.50 (699)	15.00 (381)	2.50 (64)	1.25 (32)	0.44 (11)	8.00 (203)	2.00 (51)
A30N24BLP	30.00 x 24.00 x 8.62 (762 x 610 x 219)	A30N24MP	A30N24MPP [b]	26.00 x 22.50 (660 x 572)	12	27.50 (699)	16.75 (425)	3.62 (92)	1.25 (32)	0.44 (11)	8.00 (203)	2.00 (51)
A30N30BLP	30.00 x 30.00 x 8.62 (762 x 762 x 219)	A30N30MP	A30N30MPP [b]	26.00 x 28.50 (660 x 724)	12	27.50 (699)	22.75 (578)	3.62 (92)	1.25 (32)	0.44 (11)	8.00 (203)	2.00 (51)
A36N24BLP	36.00 x 24.00 x 8.62 (914 x 610 x 219)	A36N24MP	A36N24MPP [b]	32.00 x 22.50 (813 x 572)	12	33.50 (851)	16.75 (425)	3.62 (92)	1.25 (32)	0.44 (11)	8.00 (203)	2.00 (51)
A36N30BLP	36.00 x 30.00 x 8.62 (914 x 762 x 219)	A36N30MP	A36N30MPP [b]	32.00 x 28.50 (813 x 724)	12	33.50 (851)	22.75 (578)	3.62 (92)	1.25 (32)	0.44 (11)	8.00 (203)	2.00 (51)
A18N18CLP	18.00 x 18.00 x 10.62 (441 x 441 x 270)	A18N18MP	A18N18MPP	15.00 x 16.50 (381 x 419)	14	15.88 (403)	13.00 (330)	2.50 (64)	1.06 (27)	0.31 (8)	10.00 (254)	1.50 (38)
A24N20CLP	24.00 x 20.00 x 10.62 (610 x 508 x 270)	A24N20MP	A24N20MPP	21.00 x 18.50 (533 x 470)	14	21.88 (556)	15.00 (381)	2.50 (64)	1.06 (27)	0.31 (8)	10.00 (254)	1.50 (38)
A30N24CLP	24.00 x 24.00 x 10.62 (610 x 610 x 321)	A30N24MP	A30N24MPP [b]	21.00 x 22.50 (533 x 572)	12	21.88 (556)	19.00 (483)	2.50 (64)	1.06 (27)	0.31 (8)	12.00 (305)	1.50 (38)
A24N24DLP	24.00 x 24.00 x 12.62 (610 x 610 x 321)	A24N24MP	A24N24MPP [b]	21.00 x 22.50 (533 x 572)	12	21.88 (556)	19.00 (483)	2.50 (64)	1.06 (27)	0.31 (8)	12.00 (305)	1.50 (38)
A30N24DLP	30.00 x 24.00 x 12.62 (762 x 610 x 321)	A30N24MP	A30N24MPP [b]	26.00 x 22.50 (660 x 724)	12	27.50 (699)	16.75 (425)	3.62 (92)	1.25 (32)	0.44 (11)	12.00 (305)	2.00 (51)
A36N30DLP	36.00 x 30.00 x 12.62 (914 x 762 x 321)	A36N30MP	A36N30MPP [b]	32.00 x 28.50 (813 x 724)	12	33.50 (851)	22.75 (578)	3.62 (92)	1.25 (32)	0.44 (11)	12.00 (305)	2.00 (51)

Millimeter dimensions are in ( ).

[a] Purchase panels separately. See page 15 for perforated panels.

[b] Flanged on all four sides

PX SERIES

NOTICE

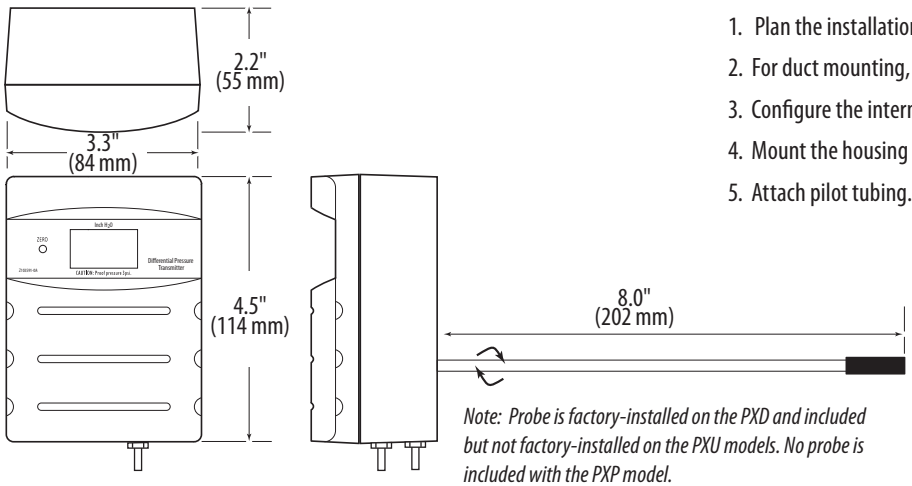
- This product is not intended for life or safety applications.
- Do not install this product in hazardous or classified locations.
- Read and understand the instructions before installing this product.
- Turn off all power supplying equipment before working on it.
- The installer is responsible for conformance to all applicable codes.

PRODUCT IDENTIFICATION

	Enclosure	Local Display	NIST	Range	Response
PX	☐	☐	☐	☐	☐
	D = Duct **P** = Panel	**L** = LCD Display **X** = No Display	**N** = NIST **X** = None	**01** = 0-1"W.C./0-250Pa **02** = 0-10"W.C./0-2.500kPa	**S** = Selectable **F** = Selectable

	Local Display	NIST	Range	Response
PXU	☐	☐	05	S
	L = LCD Display **X** = No Display	**N** = NIST **X** = None	= 0-10"/0-2.500kPa	= Selectable

DIMENSIONS



Note: Probe is factory-installed on the PXD and included but not factory-installed on the PXU models. No probe is included with the PXP model.

PX SERIES

Digital Pressure Transducer Dry Media

Installer's Specifications

Media Compatibility	Dry air or inert gas
Input Power	12-30VDC, or 24VAC nominal
Output	Field-selectable: 2-wire, loop-powered 4-20mA (DC only, clipped and capped), or 3-wire 0-5V/0-10V
Pressure Ranges:	
PX: 01	Unidirectional: 0.1/0.25/0.5/1.0" W.C. F.S., switch selectable Bidirectional: ±0.1/±0.25/±0.5/±1.0" W.C. F.S., switch selectable Unidirectional: 25 Pa/50 Pa/100 Pa/250 Pa, F.S., switch selectable Bidirectional: ±25 Pa/±50 Pa/±100 Pa/±250 Pa, F.S., switch selectable
PX: 02	Unidirectional: 1.0/2.5/5.0/10" W.C. F.S., switch selectable Bidirectional: ±1.0/±2.5/±5.0/±10" W.C. F.S., switch selectable Unidirectional: 0.250 kPa/0.500 kPa/1.000 kPa/2.500 kPa, F.S., switch selectable Bidirectional: ±0.250 kPa/±0.500kPa/±1.000 kPa/±2.500 kPa, F.S., switch selectable
PXU: 05	Unidirectional: 0.1/0.25/0.5/1.0/2.5/5/10" W.C. F.S., switch selectable Bidirectional: ±0.1/0.25/0.5/1.0/2.5/5/10" W.C. F.S., switch selectable Unidirectional: 25Pa/50Pa/100Pa/250Pa/0.5kPa/1kPa/2.5kPa F.S., switch selectable Bidirectional: ±25Pa/50Pa/100Pa/250Pa/0.5kPa/1kPa/2.5kPa F.S., switch selectable
Response Time	Standard: T95 in 20 sec, Fast: T95 in 2 sec, jumper selectable
Mode	Unidirectional or bidirectional, jumper selectable
Display (option)	Signed 3-1/2 digit LCD, indicates pressure, overrange indicator
Proof Pressure	3 psid (20.6kPa)
Burst Pressure	5 psid (34.5kPa)
Accuracy	±1% F.S. (Combined linearity and hysteresis)
Temperature Effect	1" (250Pa) models: 0.05%/°C; 10" (2.5kPa) models: 0.01%/°C (Relative to 25°C) 0° to 50°C (32° to 122°F)
Zero Drift (1-year)	1" (250Pa) models: 2.0% max.; 10" (2.5kPa) models: 0.5% max.
Zero Adjust	Pushbutton auto-zero and digital input (2-pos terminal block)
Operating Environment	0°- 60°C (32° to 140°F); 0 to 90% RH non-condensing
Fittings	Brass barb; 0.24" (6.1mm) o.d.
Physical	UL 94 V-0 Fire Retardant ABS

EMC Conformance: EN 61000-6-3:2001 Class B, EN 61000-6-1:2001, EN 61000-3-2:2000, EN 61000-3-3:2001, EMC Test Methods: CISPR 22:1997 (Amended A1:2000, Class B A2:2002), IEC 61000-4-2:2002, IEC 61000-4-3:2006, IEC 61000-4-4:2004, IEC 61000-4-5:2001, IEC 61000-4-6:2004, IEC 61000-4-8:2001, IEC 61000-4-11:2004. EMC Special Note: Connect this product to a DC distribution network or an AC/DC power adaptor with proper SURGE PROTECTION (EN 61000-6-1:2001 specification requirements).

QUICK INSTALL

1. Plan the installation. Panel or duct mount?
2. For duct mounting, thread the probe into the rear of the device housing.
3. Configure the internal tubing for the selected installation method.
4. Mount the housing vertically.
5. Attach pilot tubing.

ACCESSORIES

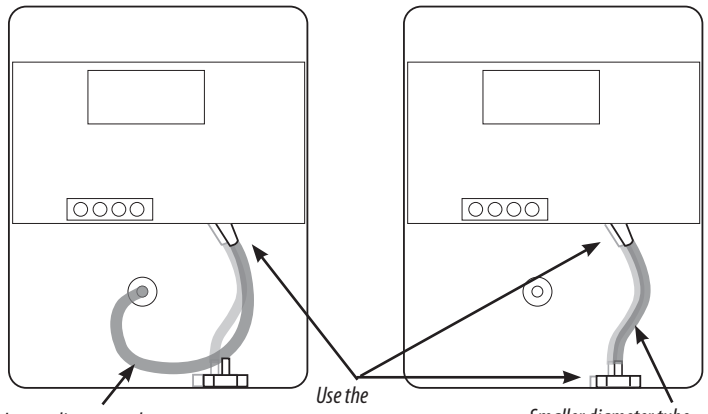
AA54 Duct Probe Replacement Kit.

  USA 800.354.8556 or 503.598.4564 / support@veris.com

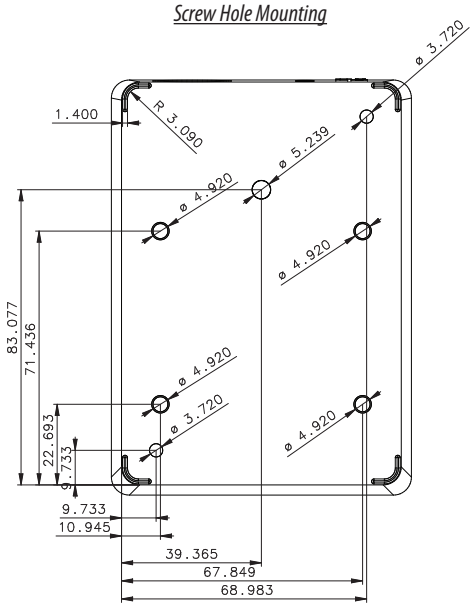
INSTALLATION

1. Plan the installation. Panel or duct mount?
2. For duct mount applications, thread the probe into the back of the device housing.
3. Configure the internal tubing for the selected installation method as shown below. Use the larger diameter tubing for the duct mount configuration.

Tubing for Duct Mount *Tubing for Panel Mount*



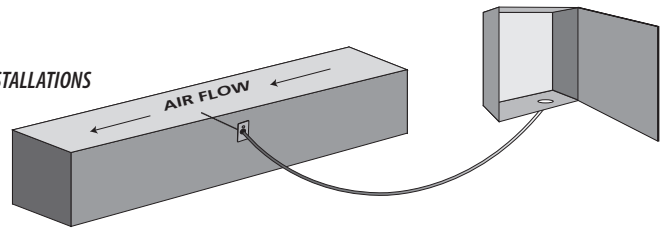
Screw Hole Mounting



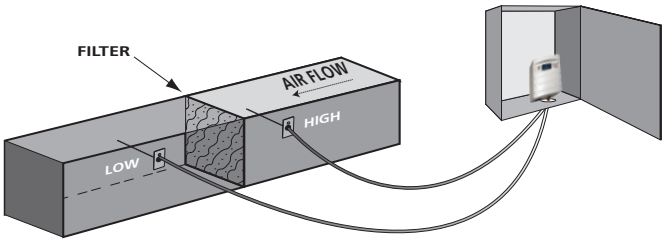
4. Mount transducer (see the screw hole diagram, right). Position transducer vertically.

PANEL INSTALLATIONS

Static Pressure

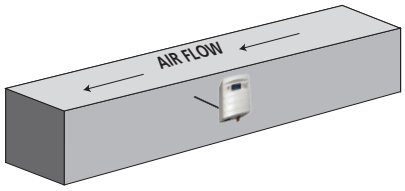


Differential Pressure

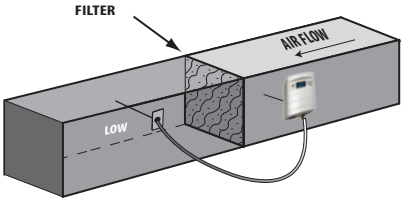


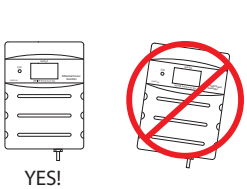
DUCT INSTALLATIONS

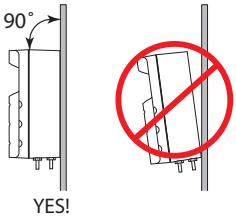
Static Pressure



Differential Pressure







5. Determine length of pilot tubing needed.

WIRING & CONFIGURATION

Connect transmitter to control system and power supply as indicated below.
Optional: Connect ZERO terminals to digital output (contact closure) of control system.
Use switch to select voltage (V) or current (mA) mode.
Jumper JP4: select 0-10V or 0-5V output span. (Voltage mode only).
Jumper JP5: select bidirectional or unidirectional mode.
Jumper JP7: select inches W.C. or Pascal scale
Jumper JP8: select fast or standard response time.
Align the arrow (not the slot) on the rotary switch to desired full-scale range. LCD models will momentarily indicate selected range.

OPERATION

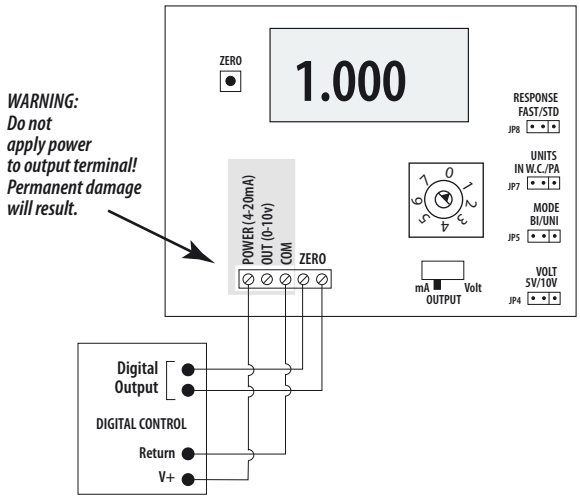
IMPORTANT: *PX Series employ ceramic capacitive sensors and sophisticated temperature compensation circuitry. Sensor achieves best accuracy after initial warm-up period. During the first few minutes of operation, readings at zero pressure and lowest pressure ranges will appear erroneous. Following this initial warm-up period, PX Series will maintain specified accuracy and stability.*

LCD DISPLAY: Display momentarily indicates range "SET" when selection is made. Pressure is normally indicated on display. Units are in inches water column (in. W.C.), Pascals (Pa) or kilopascals (kPa) as indicated on the display. Display shows OVER when pressure is over range.

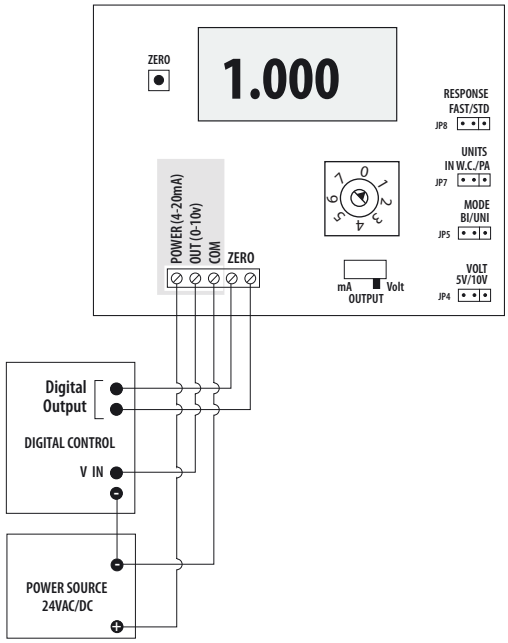
ZERO: Press and hold the ZERO pushbutton for 2 seconds or provide contact closure on 'AUX ZERO' terminal to automatically reset output and display to zero pressure. To protect the unit from accidental zero, this feature is enabled only when detected pressure is within about 0.1 in. W.C. (25Pa) of factory calibration.

Wiring Diagrams

2-wire, 4-20mA



3-wire, 0-5V/0-10V



Range Selection Guide

	PX01		PX02		PX05	
Rotary Switch Position	*Inches W.C.*	*Pascal*	*Inches W.C.*	*Pascal*	*Inches W.C.*	*Pascal*
0	0.1	25	1	250	0.1	25
1	0.25	50	1	250	0.25	50
2	0.5	100	1	250	0.5	100
3	1	250	1	250	1	250
4	1	250	2.5	0.5kPa	2.5	0.5kPa
5	1	250	5	1kPa	5	1kPa
6	1	250	10	2.5kPa	10	2.5kPa
7	1	250	10	2.5kPa	10	2.5kPa

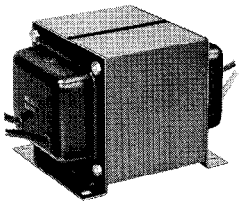
Invensys Building Systems
1354 Clifford Avenue (Zip 61111)
P.O. Box 2940
Loves Park, IL 61132-2940
United States of America

T-200 Series

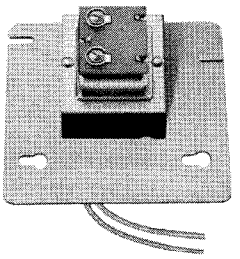
Transformers — Installation Warehouse General Instructions

T-201 ☐
T-202 ☐
T-203 ☐
T-204 ☐
T-205 ☐
T-206 ☐
T-223 ☐
T-249 ☐
T-255 ☐

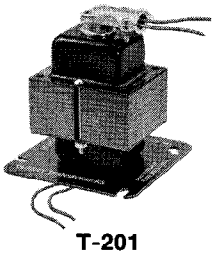
Transformers



T-203-223-202
T-204
T-205



T-206



T-201
T-249
T-255

For supplying low voltage power to operate control equipment. Primarily for mounting in control centers in conjunction with disconnect switch and overload circuit breaker. **Device:** T-206, T-201, T-255 and T-249 are provided with a plate on the primary side for mounting on standard 4-inch outlet box. Secondary connection is screw terminals for T-206 and provision for flexible conduit connection on the T-201 and T-249. 85 VA and 170 VA transformers are provided with mounting feet for panel mounting, and wire leads.

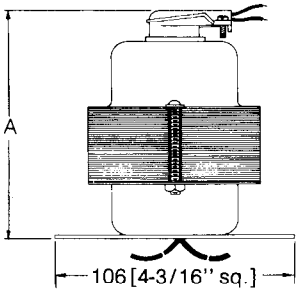


Figure 1

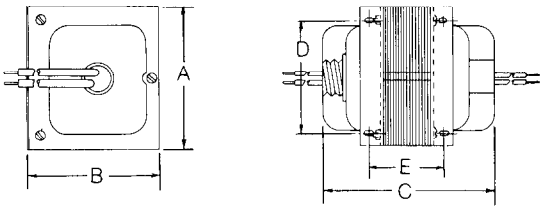


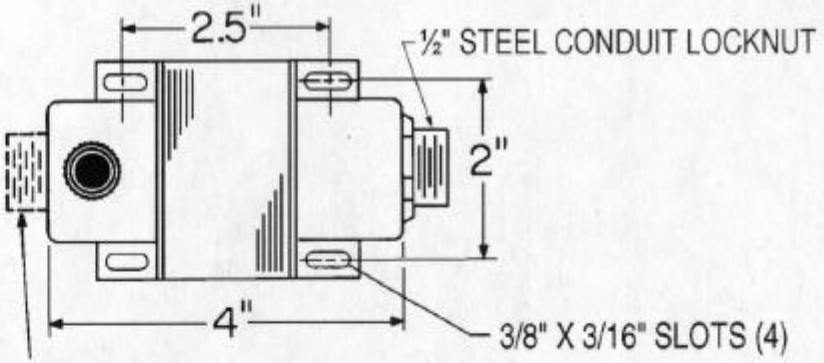
Figure 2

Part No.	Capacity VA	Primary Voltage	Secondary Voltage	Frequency (Hz)	Figure No.	Dimensions: mm (inches)				
						A	B	C	D	E
T-201	50	120	24	60	1	111[4-3/8]	—	—	—	—
T-202	85	120	24	60	2	95[3-3/4]	80[3-1/8]	83[3-1/4]	83[3-1/4]	46[1-13/16]
T-203	170	120	24	60	2	95[3-3/4]	80[3-1/8]	108[4-1/4]	83[3-1/4]	71[2-13/16]
T-204	240	120	24	60	2	115[4-1/2]	95[3-3/4]	118[4-5/8]	95[3-3/4]	82[3-7/32]
T-205	375	120	24	60	2	115[4-1/2]	95[3-3/4]	150[5-7/8]	95[3-3/4]	114[4-15/32]
T-206	10	120	24	60	1	48[1-7/8]	—	—	—	—
T-223	170	208 240	24	60	2	95[3-3/4]	80[3-1/8]	108[4-1/4]	83[3-1/4]	71[2-13/16]
T-249	50	480 240 277 208	120	60	1	111[4-3/8]	—	—	—	—
T-255-120	20	120	24	50/60	1	54[2-1/8]	—	—	—	—
T-255-277	30	277	24	50/60	1	54[2-1/8]	—	—	—	—

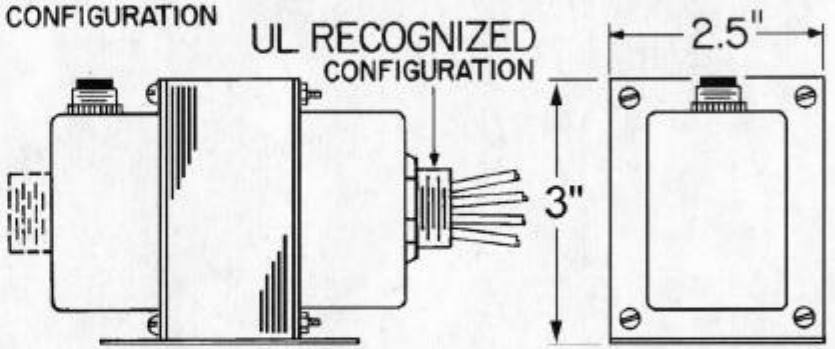
120-024-100-tf-cb.bmp

120-024-100-2TF-CB
LE120

120-024-100-TF-CB
LE121



UL LISTED
CONFIGURATION



Specifications
Input: 120VAC, 60Hz.
Output: 24VAC
Configuration:
Metal End Bells
Certification: Class 2
Single threaded hub:
UL Recognized
Dual threaded hub:
UL Listed
Safety: Circuit Breaker

CORE COMPONENTS, INC.
Carol Stream, IL 60188

UNLESS OTHERWISE SPECIFIED,
DIMENSIONS ARE IN INCHES. DO NOT SCALE
TOLERANCE: .XX ±.030
.XXX ±.010

DRWN BY	SIZE A
CHKD BY	
APPD BY	
DATE: 11/09/94	SCALE: 1:1

PART NAME
TRANSFORMER—100VA
Multimount

CUSTOMER

DRAWING NO.
120-024-100-TF-CB

REV.

Publication 95-1910-1

SECTION 4

Field Materials

Part #	Description	Manufacturer
MN-S3	IA MICRONET S-LINK SENSOR W/OV	TAC AUTOMATION
TSMN-90220-850	10K THRMSTR 11K SHNT&PRGM JACK	TAC COMPONENTS
MS40-7043	DURADRV ACT ELEC SR 0-10 VDC	TAC COMPONENTS
BAP-10K-3(11K)-D-8	DUCT UNIT 8"	BLDG AUTOMATION PRODUCTS
BAP-10K-3(11K)-O-WP	OUTSIDE AIR SENSOR IN WEATHER	BLDG AUTOMATION PRODUCTS
FUN-RIBX24BA	ENC INTRNL ADJ CUR SENS&RELAY	FUNCTIONAL DEVICES
FUN-RIBXLCA	RELAY & CURRENT SENSOR COMBO,	FUNCTIONAL DEVICES
AMX24-MFT US A03	NON-SPRING RETURN ACTUATOR, 180 IN-LB	BELIMO
NMX24-MFT US A03	NON-SPRING RETURN ACTUATOR, 90 IN-LB	BELIMO
LMB24-MFT US A03	NON-SPRING RETURN ACTUATOR, 45 IN-LB	BELIMO
DMPR-KC001	Support Bracket with bearing	DELTA
DMPR-KC203	Drive arm & u-bolt kit	DELTA
MAC-A520-2A1	STATIC PRESSURE SENSOR, 8" ALU	MAMAC SYSTEMS
H300	CURRENT SWITCH; 0.1-135A; N.0.	VERIS
E112-908	SPLIT CORE CURRENT SWITCH; 1-1	VERIS
VER-CWLSXX	WALL MTD CO2 TRAN/LCD DISP & A	VERIS
VER-GWMXS	CO2 SENSOR - WALL MTD 4-20MA	VERIS
VER-H8036-0400-3	MODBUS NETWORK POWER METER	VERIS

TAC
1354 Clifford Avenue
P. O. Box 2940
Loves Park, IL 61132-2940
www.tac.com

MN-Sx, MN-SxHT, MN-S4-FCS, and MN-S4HT-FCS

TAC I/A Series® MicroNet™ Sensors General Instructions

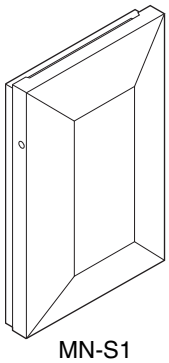
Application

TAC I/A Series MicroNet Sensors are wall-mounted digital temperature and humidity sensors for use with TAC I/A Series MicroNet Controllers. These sensors feature Sensor Link (S-Link) communication protocol that provides a simple two wire interface for power and exchange of sensor and subbase information. Available in twelve models, these TAC I/A Series MicroNet Sensors provide integral analog to digital conversion for elimination of electrical interference between sensor and controller. An optional wiring connection allows access to the TAC MicroNet LONWORKS® network (LON®) via a LONWORKS network jack on the left side of each sensor. This jack allows direct connection to a PC running WorkPlace Tech Tool (WP Tech) or a third party Network Management Tool. Each sensor also provides an S-Link jack on the right side for connecting to a PDA running Pocket TAC I/A software.

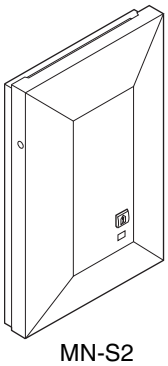
TAC I/A Series MicroNet Sensors are suitable for direct-wall, 2 x 4 electrical box, 1/4 DIN electrical box, or surface box mounting.

Model Chart

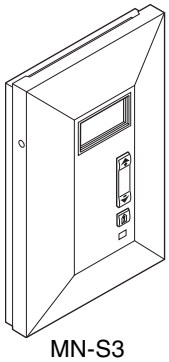
See Table-1 on page 2 for a chart of the models.



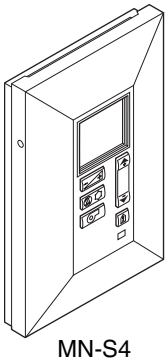
MN-S1
MN-S1HT



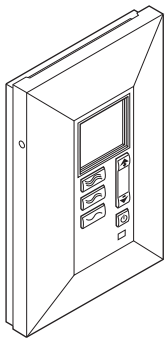
MN-S2
MN-S2HT



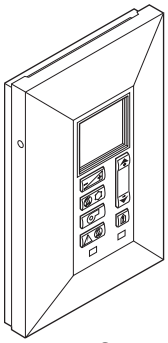
MN-S3
MN-S3HT



MN-S4
MN-S4HT



MN-S4-FCS
MN-S4HT-FCS



MN-S5
MN-S5HT

Printed in U.S.A. 8-06

Table-1 MN-Sxxx Model Chart.

Model		Description	Keypad	Display
Temperature Sensor	Temperature and Humidity Sensor			
MN-S1	MN-S1HT	Sensor only	None	None
MN-S2	MN-S2HT	Sensor with override	One-button	LED Override Status Indication
MN-S3[b]	MN-S3HT[b]	Sensor with setpoint adjustment and override	Three-button	Digital LCD[a] and LED Override Status Indication
MN-S4[b]	MN-S4HT[b]	Sensor with setpoint, override, and controller mode functions	Six-button	Digital LCD[c] and LED Override Status Indication
MN-S4-FCS[b]	MN-S4HT-FCS[b]	Sensor with setpoint, On/Off and Fan speed functions	Six-button	Digital LCD[c] and LED Fan Status Indication
MN-S5[b]	MN-S5HT[b]	Sensor with setpoint, override, controller mode functions, and emergency heat key	Seven-button	Digital LCD[c], LED Override Status, and Emergency Heat Indication

[a] LCD displays value and setpoint.
[b] Allows viewing of alarms and diagnostics.
[c] LCD displays values, setpoints, and controller mode functions.

Applicable Documentation

F-Number	Description	Audience	Purpose
F-26266	TAC I/A Series MicroNet 100, 150, and 200 Series Controllers Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the TAC I/A Series MicroNet 100, 150, and 200 Series Controllers. Also includes checkout and LED indication sections.
F-26617	TAC I/A Series MicroNet 50 Series Controllers Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the TAC I/A Series MicroNet 50 Series Controller. Also includes checkout and LED indication sections.
F-26282	TAC I/A Series MicroNet VAV Series (MNL-V1RVx and MNL-V2RVx) Controllers Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the TAC I/A Series MicroNet MNL-V1RVx and MNL-V2RVx VAV Controllers. Also includes checkout and LED indication sections.
F-26284	TAC I/A Series MicroNet VAV Series (MNL-V3RVx) Controller Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the TAC I/A Series MicroNet MNL-V3RVx VAV Controller. Also includes checkout and LED indication sections.
F-26887	TAC I/A Series MicroNet Fan Coil Controllers with High Voltage Relay(s) Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step mounting and installation instructions for the TAC I/A Series MicroNet MNL-11RF2 and MNL-13RF2 Controllers. Includes instructions for network wiring, installation on a LONWORKS network, checkout, and LED indication.
F-26580	TAC I/A Series WorkPlace Tech Tool Engineering Guide (for version 3.1)	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides engineering and technical information for applying and using all aspects of WorkPlace Tech Tool, version 3.1 software.
F-26988	TAC I/A Series WorkPlace Tech Tool 3.2 Engineering Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides engineering and technical information for applying and using all aspects of WorkPlace Tech Tool, version 3.2 software.
F-27254	TAC I/A Series WorkPlace Tech Tool 4.0 Engineering Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides engineering and technical information for applying and using all aspects of WorkPlace Tech Tool, version 4.0 software.
F-26507	TAC I/A Series MicroNet System Engineering Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides engineering and technical information to assist in designing a complete TAC MicroNet controller system using different architectures, components, and software.
F-26304	TAC I/A Series WorkPlace Tech Tool User's Guide (for version 3.1)	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step instructions for using WorkPlace Tech Tool, version 3.1 software.
F-26987	TAC I/A Series WorkPlace Tech 3.2 Tool User's Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step instructions for using WorkPlace Tech Tool, version 3.2 software.
F-27255	TAC I/A Series WorkPlace Tech 4.0 Tool User's Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides step-by-step instructions for using WorkPlace Tech Tool, version 4.0 software.

Installation

The TAC I/A Series MicroNet Sensor is packaged disassembled in one box and consists of three major parts:

- A pre-wirable base plate for wiring to the controller S-Link and TAC MicroNet LONWORKS network (LON) connections
- An electronic assembly containing the sensors and associated circuitry
- A removable cover

Inspection

Inspect carton for damage. If damaged, notify carrier immediately. Inspect sensors for damage upon receipt.

Requirements

(These items not provided)

- Installer must be a qualified technician
- Job wiring diagrams
- Tools:
  - Drill and bits for mounting screws
  - Level
  - Static protection wrist strap
- Two mounting screws (dry-wall anchors for direct-wall mount)
- Accessories (if required)
  - AT-1104 Cast aluminum guard with steel base plate
  - AT-1155 Clear plastic guard with solid and ring base, tumbler type key lock
  - AT-1163 Wire guard with steel base plate
  - MNA-STAT-1 Replacement covers (qty. 12)
  - MNA-STAT-2 Designer inserts for MN-S1 model (qty. 25)

Precautions

General

Caution: Disconnect power before installing or removing the cover.

Failure to observe this warning can damage the sensor.

- Follow Static Precautions when installing this equipment.
- Use copper conductors that are suitable for 167 °F (75 °C).
- Make all connections according to electrical wiring diagram, national and local electrical codes.

Static Precautions

Static charges damage electronic components. The microprocessor and associated circuitry are extremely sensitive to static discharge. Use the following precautions when installing, servicing, or operating the system.

- Work in a static-free area.
- Discharge static electricity by touching a known, securely grounded object.
- Use a wrist strap connected to earth ground when handling the controller's printed circuit board.

Federal Communications Commission (FCC)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy and may cause harmful interference if not installed and used in accordance with the instructions. Even when instructions are followed, there is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception—which can be determined by turning the equipment off and on—the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

Canadian Department of Communications (DOC)

This class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Location

TAC I/A Series MicroNet Sensors are suitable for indoor use only.

Caution:

- Avoid locations where excessive moisture, corrosive fumes, vibration, or explosive vapors are present.
- The humidity sensing element of MN-SxHT and MN-S4HT-FCS models will recover from short term exposure to liquid water or condensation. Repeated exposure will degrade the performance of the sensor.
- Avoid electrical noise interference. Do not install near large contactors, electrical machinery, or welding equipment.
- Locate where ambient temperatures do not exceed 122 °F (50 °C) or fall below 32 °F (0°C) and relative humidity does not exceed 95% or fall below 5%, non-condensing.

Failure to observe these precautions can damage the sensors.

Locate the TAC I/A Series MicroNet Sensor on an inside wall where the sensor is exposed to at least 30 feet (9 meters) per minute of unrestricted air circulation. The location should represent the average temperature in the room or space. Make certain sensor is located out of direct sunlight, away from sources of heat or cold, and away from concealed ducts or pipes.

Mounting

TAC I/A Series MicroNet Sensors can be direct-wall, 2 x 4 electrical box, 1/4 DIN electrical box, or surface box mounted. See Figure-1 and Figure-2 for appropriate mounting dimensions.

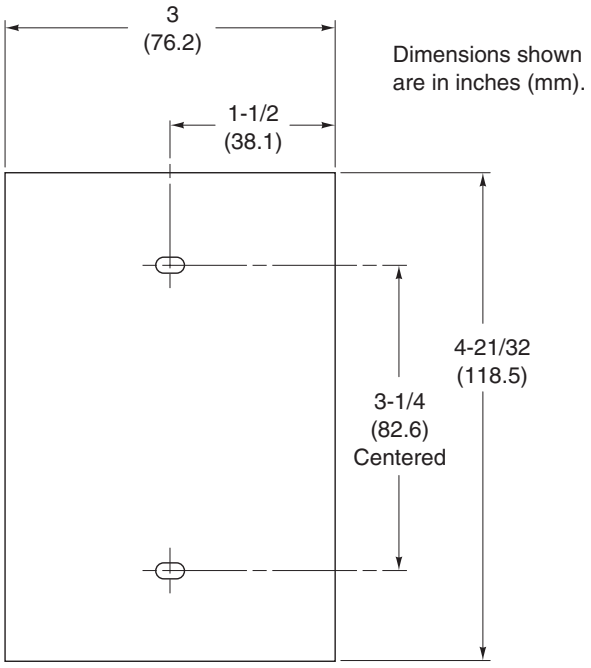


Figure-1 Mounting Dimensions for Direct-wall, 2 x 4 Electrical Box, and Surface Box Mounting.

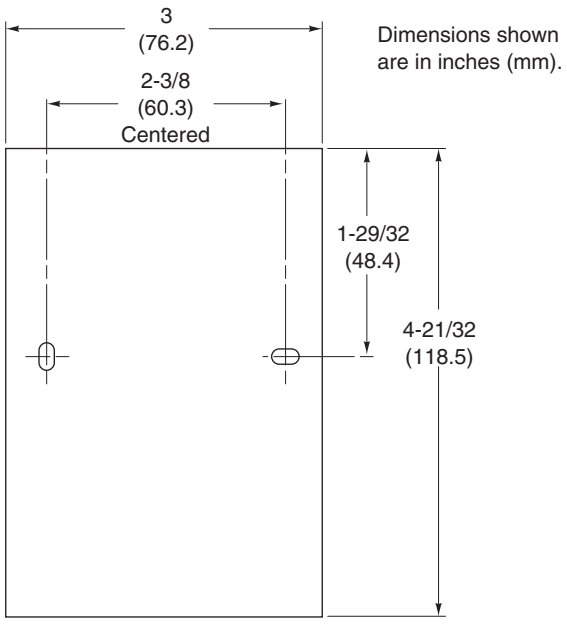


Figure-2 Mounting Dimensions for 1/4 DIN Electrical Box Mounting.

Direct-wall Mount

1. Use mounting dimensions shown in Figure-1.
2. Feed S-Link wires through base plate.
3. If required, feed LON wires through base plate.
4. Using two appropriate screws (use drywall anchors as necessary), mount base plate to wall (Figure-3).

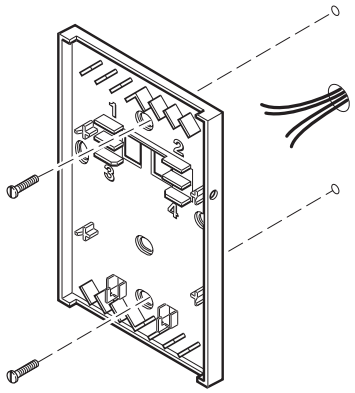


Figure-3 Direct-wall Mounting.

2 x 4 Electrical Box Mount

1. Use mounting dimensions shown in Figure-1.
2. Feed S-Link wires from electrical box through base plate.
3. If required, feed LON wires through base plate.
4. Using two 6-32 x 5/8 in. flat head screws (not provided), mount base plate to electrical box (Figure-4).

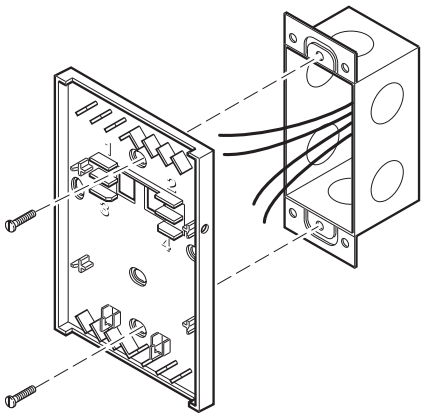


Figure-4 2 x 4 Electrical Box Mounting.

1/4 DIN Electrical Box Mount

1. Use mounting dimensions shown in Figure-2.
2. Feed S-Link wires from electrical box through base plate.
3. If required, feed LON wires through base plate.

Caution: Failure to use vertical mounting holes as shown in Figure-5 may cause a short of the LONWORKS network.

4. Using two appropriate screws (not provided), mount base plate to electrical box using vertical mounting holes indicated in Figure-5.

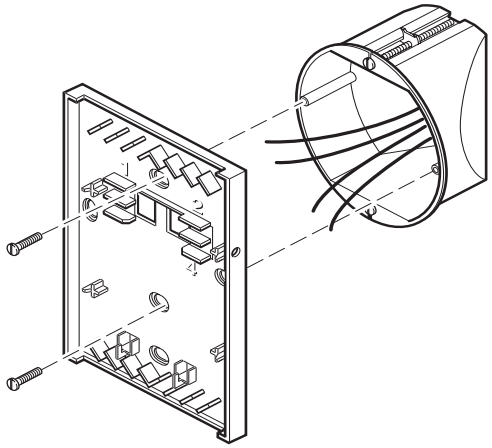


Figure-5 1/4 DIN Electrical Box Mounting.

Surface Box Mount

1. Use mounting dimensions shown in Figure-1.
2. Feed S-Link wires from electrical box through base plate.
3. If required, feed LON wires through base plate.
4. Using two 6-32 x 5/8 in. flat head screws (not provided), mount base plate to surface box (Figure-6)

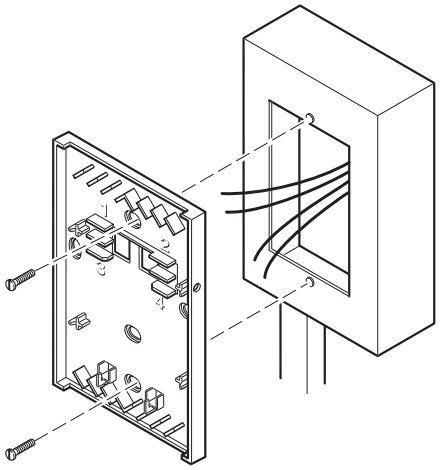


Figure-6 Surface Box Mounting.

Wiring

The following electrical connections can be made to the TAC I/A Series MicroNet Sensors:

- Sensor Link (S-Link) Wiring
- TAC MicroNet LONWORKS network (LON) Wiring

Caution: Do not connect any power wiring to the TAC I/A Series MicroNet Sensor.

Failure to observe this precaution will damage the sensor.

Communications Wiring

Communications wiring includes a connection between the controller and an TAC I/A Series MicroNet Sensor via the S-Link and an optional connection between the sensor and the TAC MicroNet LONWORKS network (LON). Figure-7 shows S-Link and LON wiring terminations.

Sensor Link (S-Link) Wiring

S-Link wiring powers and enables the MN-Sxxx sensor. The S-Link needs at least 24 gage (0.205 mm^2), twisted pair, voice grade telephone wire. The capacitance between conductors cannot be more than 32 pF per foot (0.3 m). If shielded cable is used, the capacitance between any one conductor and the others, connected to the shield, cannot be more than 60 pF per foot (0.3m). Maximum wire length is 200 ft. (61 m).

Note:

- S-Link wiring is polarity insensitive.
- Shielded cable is not required for S-Link wiring.
- If conduit is used between an TAC I/A Series Sensor and a controller, the TAC MicroNet LONWORKS network and S-Link wiring can be in the same conduit.
- S-Link wiring can be in the same conduit with UI, AO, and DI Wiring.
- S-Link wiring must be dedicated to S-Link communications. It cannot be part of an active, bundled telephone trunk.
- If the cable is installed in areas of high RIF/EMI, the cable must be in conduit.

Connect the S-Link to TAC I/A Series MicroNet Sensor

1. Strip 1/4 in. (6mm) of insulation from S-Link wires.
2. Connect wires to screw terminals 1 and 2 (Figure-7). The S-Link terminals are polarity insensitive.
3. Push excess wire back through the base plate to minimize air flow restriction.

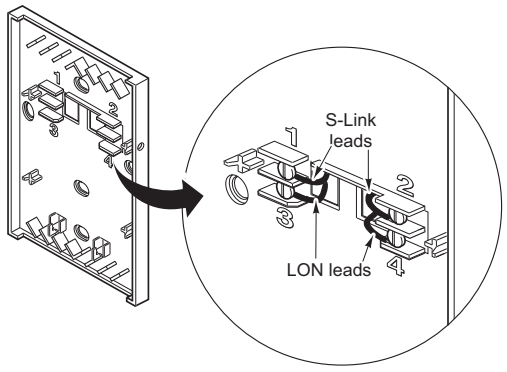


Figure-7 S-Link and LON Connections.

TAC MicroNet LONWORKS Network (LON) Wiring

An approved Category 4 or 5, twisted-pair cable may be used for the optional LONWORKS network connection between the controller and MN-Sx sensor. LONWORKS network wiring is polarity insensitive.

Note:

- LONWORKS network wiring is polarity insensitive.
- Shielded cable is not required for LONWORKS network wiring.
- If conduit is used between a TAC I/A Series Sensor and a controller, the TAC MicroNet LONWORKS network and S-Link wiring can be in the same conduit.
- Do not mix LONWORKS network wiring with UI, DI, AO, DO, or power types of wiring.
- LONWORKS network wiring must be dedicated to TAC MicroNet LONWORKS network communications. It cannot be part of an active, bundled telephone trunk.
- If the cable is installed in areas of high RFI/EMI, the cable must be in conduit.
- If shielded wire is used for the LONWORKS network, the shield must be connected to earth ground at only one end by a 470 K ohm 1/4 watt resistor. The shield must be continuous from one end of the trunk to the other.
- To preserve the integrity of the network, the LONWORKS network wiring connecting a TAC I/A Series MicroNet controller to an MN-Sxxx Sensor must be run to the sensor and back, in daisy-chain fashion. A wire “spur” must not be used to connect the sensor to the controller.
- While the MN-Sxxx Sensor is not counted as a “node” in the TAC MicroNet LONWORKS network, all LONWORKS network wiring to the sensor must be counted when determining the length of the LONWORKS network wiring segment.

TAC I/A Series MicroNet Controllers use LONWORKS Free Topology Transceivers and support polarity insensitive bus (daisy-chain) and free (all combinations of star, tee, and loop) wiring topologies. See *TAC I/A Series MicroNet System Engineering Guide*, F-26507 to design a TAC MicroNet LONWORKS TP/FT-10 network, including recommended topologies and approved cable types.

Connecting the LONWORKS network to a TAC I/A Series MicroNet Sensor provides local access to the network via the sensor’s LONWORKS network jack. Four wires (a daisy chain connection) must be used to connect a TAC I/A Series MicroNet Sensor to a LONWORKS network. This connection is optional.

Connect LONWORKS Network to TAC I/A Series MicroNet Sensor

1. Strip 1/4 in. (6 mm) of insulation from LON wires.
2. Connect wires to screw terminals 3 and 4 (Figure-7). The LON terminals are polarity insensitive.
3. Push excess wire back through the baseplate to minimize air flow restriction.

Wiring Checkout

Verify wiring between TAC I/A Series MicroNet Sensor base plate and the TAC I/A Series MicroNet Controller is installed according to job wiring diagram, national and local wiring codes.

Electronic Assembly and Cover Installation

Caution:

- Observe static precautions when handling electronic assemblies.
- Handle electronic assemblies with care to prevent damage to the temperature and humidly sensing elements.
- Do not touch humidity sensing element on the MN-SxHT and MN-S4HT-FCS models. The element is located beneath a small plastic housing on the back of the electronic assembly.

Failure to observe these precautions can damage the sensor.

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1. Set electronic assembly onto bottom hooks of base plate.
2. Secure electronic assembly to base plate by tightening two screws at top of assembly (Figure-8).

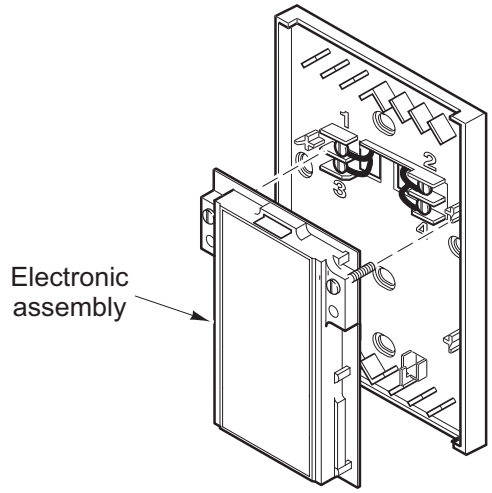

Figure-8 Electronic Assembly Installation.

3. Insert bottom tabs of cover and then snap top into place.

Note: To remove sensor cover, place thumb in middle of sensor, grasp top edge of cover with fingers and pull firmly.

Features

TAC I/A Series MicroNet Sensor Model	Description	Features								
		Zone Temp Sensing	Zone Humidity Sensing	Override Key and LED	Setpoint Adjustment	Fan Operation and Speed	Mode (Heat/Cool Auto/Off)	Emergency Heat Key and LED	LONWORKS Network Jack	Display Screen
MN-S1	MN-S1 has no display or keypad. Its primary function is to provide zone temperature to the controller via the S-Link. Provides a LONWORKS Network Jack for commissioning, testing, and monitoring.	X							X	
MN-S1HT	MN-S1HT adds humidity sensing functionality to the MN-S1.	X	X						X	
MN-S2	The MN-S2 provides zone temperature to the controller via the S-Link and features an Override Key, with LED indicator, which forces the controller into timed occupied mode. Provides a LONWORKS Network Jack for commissioning, testing, and monitoring.	X		X					X	
MN-S2HT	MN-S2HT adds humidity sensing functionality to the MN-S2.	X	X	X					X	
MN-S3	The MN-S3 provides the same functionality and features as the MN-S2. In addition, the MN-S3 has a digital liquid crystal display and allows controller setpoint adjustment. The MN-S3 offers one setpoint and one default display screen.	X		X	X				X	X
MN-S3HT	MN-S3HT adds humidity sensing functionality to the MN-S3.	X	X	X	X				X	X
MN-S4	The MN-S4 provides the same functionality and features as the MN-S3. In addition, the MN-S4 includes a Fan Key, a Mode Key, and a Setpoint Key. The keypad allows you to select controller modes, fan modes, and fan speeds. The MN-S4 offers four setpoints and four display screens.	X		X	X	X	X		X	X
MN-S4HT	MN-S4HT adds humidity sensing functionality to the MN-S4.	X	X	X	X	X	X		X	X
MN-S4-FCS	The MN-S4-FCS has a digital liquid crystal display and allows adjustment of one controller setpoint and display of one controller value. In addition, the keypad includes a Fan Key for On/Off/Auto settings and three Fan Speed keys for Low, Medium, High adjustment.	X			X	X			X	X
MN-S4HT-FCS	MN-S4HT-FCS adds humidity sensing functionality to the MN-S4-FCS.	X	X		X	X			X	X
MN-S5	The MN-S5 provides the same functionality and features as the MN-S4. In addition, the MN-S5 features an Emergency Heat Key and LED for heat pump applications. The MN-S5 offers four setpoints and four display screens.	X		X	X	X	X	X	X	X
MN-S5HT	MN-S5HT adds humidity sensing functionality to the MN-S5.	X	X	X	X	X	X	X	X	X

TAC MicroNet LONWORKS Network (LON) Jack

A LONWORKS Network Jack is located on the left side of each sensor model. The mating plug for this Jack is a 1.3 mm DC power plug. Figure-9 shows its location.

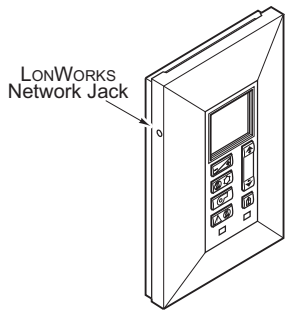

Figure-9 Location of the LONWORKS Network Jack.

Sensor Operation Diagnostics

Note: The following applies to an MN-S3, MN-S3HT, MN-S4, MN-S4HT, MN-S4-FCS, MN-S4HT-FCS, MN-S5, or MN-S5HT sensor connected to a TAC I/A Series MicroNet controller.

In the Diagnostics Mode, the sensor times out and returns to the default screen if left idle for forty seconds. Subnet Address, Node Address, Alarms, and Errors are view only frames. Values displayed in the Temperature Offset and Relative Humidity Offset frames are adjustable.

The TAC I/A Series MicroNet MN-S3, MN-S3HT, MN-S4, MN-S4HT, MN-S4-FCS, MN-S4HT-FCS, MN-S5, or MN-S5HT Sensors provide the following types of diagnostic data.

- Subnet Address
- Node Address
- Errors
- Alarms
- Temperature Offset
- Relative Humidity Offset

To access view only diagnostics:

View the Subnet Address, Node Address, Errors, and Alarms in this mode.

1. Press and hold both ends of Up/Down Key for four seconds. The Subnet Address frame appears.
2. Press Up/Down Key to scroll through Node Address frame, Errors frame, and Alarms frame.

To access adjustable diagnostic data:

Access Temperature Offset frame and Relative Humidity Offset frame in this mode. Skip step 1 if you are already in the Diagnostics Mode.

1. Press and hold Up/Down Key for four seconds. The Subnet Address frame appears.
2. Press Override Key. (Press On/Off/Auto key on MN-S4-FCS or MN-S4HT-FCS.) The Temperature Offset frame appears.
3. Use Up/Down Key to adjust value.
4. To access Relative Humidity Offset frame, press Override Key (On/Off/Auto key on MN-S4-FCS or MN-S4HT-FCS) again and use Up/Down Key to adjust value.
5. To return to the Subnet Address frame, Node Address frame, Errors frame, and Alarms frame, press Override Key (On/Off/Auto key on MN-S4-FCS or MN-S4HT-FCS).

Subnet Address and Node Address: Subnet Address frames and Node Address frames display subnet and node addresses of the connected TAC I/A Series MicroNet Controller. The LCD alternates between Subnet Address frame, numerical value of subnet address, Node Address frame, and numerical value of node address. The values displayed reflect the subnet/node address assigned to domain table index 0.

Errors: The Error frames display a value of 1, 2, 4, 8, 16, 32, or a combination of any of these values. The value may indicate one or more errors as described in Table-2. For example, an Error frame display value of 17 indicates two errors (1 = EEPROM write or read error and 16 = Analog output writing error) since 1 + 16 = 17. The LCD alternates between the Error frame and the numerical error value. An error screen displaying dashes (---) indicates no errors.

Table-2 Error Code Descriptions.

Error Code	Controller		
	MNL-xxRxx	MNL-VxRVx	MNL-800
1	EEPROM write or read error		
2	Out of range universal input (UI1)		Out of range universal input (any)
4	Out of range universal input (UI2)	High velocity pressure	N/A
8	Out of range universal input (UI3)	Low velocity pressure	N/A
16	Analog output writing error		N/A
32	Calibration data checksum error or unit is uncalibrated		
64	N/A		Invalid RTC

Alarms: The Alarm frames display the last four alarms of the connected TAC I/A Series MicroNet Controller. The LCD alternates between Alarm frame and numerical alarm value. If the controller is sending more than one alarm, the numerical alarm value will update every four to five seconds. Alarms are defined by controller application. For information regarding specific alarm definitions, consult the controller application documentation.

Temperature Offset. The Temperature Offset frame displays the connected TAC I/A Series MicroNet Controller's temperature offset value. Adjust the value using the Up/Down Key.

Humidity Offset. The Humidity Offset frame displays the connected TAC I/A Series MicroNet Controller's humidity offset value. Adjust the value using the Up/Down Key.

Display Screen Functions

The MN-S3, MN-S3HT, MN-S4-FCS, and MN-S4HT-FCS models have one display screen slot. The MN-S4, MN-S4HT, MN-S5, and MN-S5HT models have four display screen slots. The connected controller's application defines what is visible in each slot. The first display screen slot always shows the sensor's default display.

To scroll through display screens (MN-S4, MN-S4HT, MN-S5, and MN-S5HT):

1. Press either end of the Up/Down Key to change from the first display screen slot to the second display screen slot. Before the second display screen slot appears, "-2-" will appear to indicate you are about to view the second slot.
2. Press either end of the Up/Down Key to scroll through the four display screen slots. Before the third display screen slot appears, "-3-" will appear to indicate you are about to view the third slot. Before the fourth display screen slot appears, "-4-" will appear to indicate you are about to view the fourth slot.

Emergency Heat Functions

The Emergency Heat Key activates emergency heat in heat pump applications equipped with this feature. To activate, press the Emergency Heat Key. The LED indicator is lit when Emergency Heat is activated. (Applies only to MN-S5 and MN-S5HT.)

Fan Functions

To display and adjust the fan (MN-S4, MN-S4HT, MN-S5, and MN-S5HT):

1. Press the Fan Key to change from the current display to the first fan display screen slot. The sensor displays the first fan, corresponding speed icon (Table-3). and "-1-".

Note:

- There are two fan display screen slots. The fan assigned to each slot depends on the controller application and sensor configuration.
- If the sensor displays three dashes when pressing the Fan Key, all fan slots are unassigned or not active.

---

2. Continue to press Fan Key to scroll through the fan slots. Before the second fan appears, "-2-" will appear to indicate you are about to view the second fan.
3. Press Up/Down Key as necessary to change fan setting.
4. To enter new selection, press any key besides the Up/Down Key or wait for 5 seconds.

To activate fan speed (MN-S4, MN-S4HT, MN-S5, and MN-S5HT):

If the controller is equipped for multiple fan speeds, the Up/Down Key activates one of three selected fan speeds. Multiple speed fans are indicated by wavy lines next to fan icon in LCD (To see fan speed icons, refer to Table-3).

To display and adjust the fan (MN-S4-FCS and MN-S4HT-FCS):

1. Press the On/Off/Auto Key to select On, Off, or Automatic fan control. (Auto is optional and must be activated using WP Tech.)
2. Press the low, medium, or high key to adjust fan speed. (Speed indicated by 1, 2, or 3 wavy lines on key.)

General Functions

Sensor time-out

The TAC I/A Series MicroNet Sensor times out and returns to the default display if left idle for 30 seconds. If sensor is in diagnostics mode, then time out is 40 seconds.

To enter a selection or setpoint:

Press any key besides the Up/Down Key or wait five seconds for the change to be accepted automatically.

To fast scroll toggle for increasing or decreasing values:

Press and hold either end of the Up/Down Key and tap and release Override Key. To terminate fast scroll, release Up/Down Key.

Mode Functions

To display and adjust modes (MN-S4, MN-S4HT, MN-S5, and MN-S5HT):

1. Press Mode Key to change from current display to first mode slot. The sensor displays the first mode, corresponding icon (Table-3). and “-1-”.

Note:

- There are two mode slots. The mode assigned to each slot depends on the controller application and sensor configuration.
- If the sensor displays three dashes when you press the Mode Key, all mode slots are unassigned or not active.

---

2. Continue to press Mode Key to scroll through mode slots. Before the second mode appears, “-2-” will appear to indicate you are about to view the second mode.
3. Press Up/Down Key as necessary to change mode.
4. To enter new mode selection, press any key besides the Up/Down Key or wait for five seconds.

Override Functions

The Override Key allows override of unoccupied mode setting within the controller in applications equipped with this feature.

- The override LED indicator is lit if the TAC MicroNet controller is overridden to the occupied mode from the unoccupied mode.
- The override LED indicator flashes when timed override has less than 5 minutes remaining.
- If the override time is left to expire, the controller returns to the unoccupied mode.

To override the unoccupied mode:

Press (for not more than four seconds) and release Override Key. The controller goes into the occupied mode for override time specified by controller.

To Re-initialize override time:

If override time has not expired, press (for not more than four seconds) and release Override key. Override time resets to override time specified by controller.

To cancel override:

Press and hold Override Key for four seconds. Override is cancelled and controller returns to unoccupied mode.

Service Pin

To command controller to send controller service pin to the LONWORKS Network:

Press and hold Override key (On/Off/Auto Key on MN-S4-FCS or MN-S4HT-FCS) for eight seconds. The service pin of the connected controller is sent out on the LONWORKS Network.

Setpoint Functions

To display and adjust setpoints (MN-S3, MN-S3HT, MN-S4, MN-S4HT, MN-S4-FCS, MN-S4HT-FCS, MN-S5, and MN-S5HT):

1. Press Setpoint Key to change from current display value to first setpoint slot. (Press Up/Down key on MN-S3, MN-S3HT, MN-S4-FCS, and MN-S4HT-FCS. Key must be released and pressed again to change setpoint.) The sensor displays first setpoint and corresponding icon (heat, cool, unoccupied heat, or unoccupied cool). MN-S3 or MN-S3HT will not display icon.

Note:

- The MN-S3, MN-S3HT, MN-S4-FCS, and MN-S4HT-FCS models have one setpoint slot, and the MN-S4, MN-S4HT, MN-S5, and MN-S5HT models have four setpoint slots. The setpoint assigned to each slot depends on controller application and sensor's configuration.
- If sensor does not respond when you press the Setpoint Key, all setpoints slots are unassigned or not active.

---

2. Continue to press Setpoint Key to scroll through the setpoint slots. Before the next setpoint appears, "-2-" will appear to indicate you are about to view the second setpoint ("-3-" indicates the third setpoint, "-4-" indicates the fourth setpoint).
3. Press Up/Down Key as necessary to adjust any setpoint. (On MN-S3, MN-S3HT, MN-S4-FCS, and MN-S4HT-FCS, Key must be released and pressed again to change setpoint.)
4. To enter new setpoint, press any key besides Up/Down Key or wait five seconds. (On MN-S4-FCS and MN-S4HT-FCS do not press any keys. Simply wait five seconds and the setpoint will be entered.)

Wink

The MN-Sx sensors will flash the red Override Status LED (½ second ON, ½ second OFF) while the connected controller is in the wink mode (approximately 12 seconds).

Note:

- This feature is available with the MN-S1 through MN-S5 and MN-S1HT through MN-S5HT sensors, but not the MN-S4-FCS or MN-S4HT-FCS sensors.
- This feature is supported by TAC I/A Series MicroNet Controllers beginning with the following versions: MNL-11RF3, MNL-13RF3, MNL-5Rx3, MNL-VxRV3, MNL-10Rx3, MNL-10RH3-702, MNL-15Rx3, MNL-20Rx3.

LCD Icon Descriptions

Table-3 TAC I/A Series MicroNet Sensor LCD Icon Descriptions[a]

Icon	Name	Description	Icon	Name	Description
°F	Degrees Fahrenheit	Units are displayed in °F.		Heat	The Heat Icon indicates that the controller is in heat mode, or the heating setpoint is being displayed.
°C	Degrees Celsius	Units are displayed in °C.		Cool	The Cool Icon indicates that the controller is in cool mode, or the cooling setpoint is being displayed.
%	Relative Humidity	Units are displayed in % of relative humidity.		Fan	The Fan Icon, along with the appropriate Fan Speed Icon, indicates that the fan is on.
	Outdoor Air	The Outdoor Air Icon indicates that outdoor air temperature is displayed.		Fan Speed (1-Speed Fan)	The Fan Speed Icons indicate the speed of the fan. If the fan has one speed, the appearance of three wavy lines indicates that the fan is on.
	Unoccupied	The Unoccupied Icon indicates that the unoccupied mode is active, or unoccupied setpoints are displayed. This icon is not displayed in the occupied mode.		Fan Speed (2-Speed Fan)	The Fan Speed Icons indicate the speed of the fan. If the fan has a two speed selection, the appearance of three wavy lines indicates high speed. The bottom wavy line indicates low speed.
AUTO	Auto	The Auto Icon indicates that the controller is in the auto mode.			
	Off	The Off Icon indicates OFF for a mode or fan selection.		Fan Speed (3-Speed Fan)	The Fan Speed Icons indicate the speed of the fan. If the fan has a three speed selection, the appearance of three wavy lines indicates high speed. The middle and lower wavy lines indicates medium speed, and the bottom wavy line indicates low speed.
	On	The On Icon indicates ON. For example, the On Icon may indicate that a connected device is operating manually or that room lights are on. The On Icon may represent auxiliary heat during normal heat pump operation or a possible selection in the fan selection list.			

[a] LCD icons and icon definition vary depending on connected TAC I/A Series MicroNet Controller and its application. Refer to application documentation for more information.

Service

Table-4 Troubleshooting.

Sensor Condition	Corrective Action
LCD remains blank.	• Check sensor and controller wiring and correct, if necessary. • If wiring is okay, check to see if power is being applied to the sensor by pushing the Override Key for less than four seconds. If the Override LED lights up, the sensor is powered. If the Override LED does not light up, the sensor may not be receiving power. Check controller power to verify presence. • If the above measures do not address the problem, download a new application to the controller.
Sensor displays “Abn” indefinitely.	• Check the documentation to make sure the sensor model is compatible with the controller application and then choose one of the following options. • If the sensor and application are compatible, download a new application to the controller. • If the sensor and application are incompatible, download an application that is compatible with the sensor. Or, install a sensor that is compatible with the controller application.
All LCD icons light up and remain lit.	• Check to see if the controller is constantly resetting and correct, if necessary. • Check sensor and controller wiring and correct, if necessary. • If reset and wiring are okay, download a new application to the controller. • If the above measures do not address the problem, the controller may need to be configured. For configuration instructions, consult documentation associated with the network management tool.

Components within TAC I/A Series MicroNet Sensors can not be field repaired. If there is a problem with a sensor, follow the steps below before contacting your local TAC office.

1. Make sure sensors are connected and communicating to desired devices.
2. Record precise hardware setup indicating the following:
   - Version numbers of applications software.
   - Controller firmware version number.
   - Information regarding the WorkPlace Tech Tool application program.
   - A complete description of difficulties encountered.

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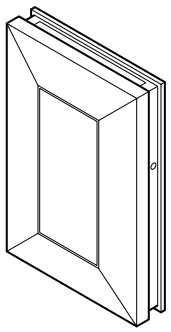
TSMN-90xxx Series
TSMN-57011-850-0-01
TSMN-58011-000-0-01
TSMN-81011-000-0-01

Electronic Room Temperature Sensor
General Instructions

Application

The Electronic Room Temperature Sensor is a resistance-temperature device (RTD) available in thirteen models. See Table-1 below for model variations and options.



Features

- Contemporary, low-profile packaging
- Easily installed base plate and electronic assembly
- High-impact cover
- Suitable for direct-wall, 2 x 4 electrical box, 1/4 DIN electrical box, and surface box mounting
- UL 916 Listed

Table-1 Model Chart.

Model No.	Function	Base Plate Terminals							
		ASD+	ASD-	SETPT	SP+	COM	SPACE		PSI
		1	2	3	4	5	6	7	8
TSMN-90110-000-0-01	10K thermistor no shunt, ASD jack	X	X			X	X		X
TSMN-90220-850-0-01	10K thermistor w/11K shunt, ASD jack	X	X			X	X		X
TSMN-90221-850-0-01	10K thermistor w/11K shunt, ASD jack, F temp ind	X	X			X	X		X
TSMN-90230-850-0-01	10K thermistor w/11K shunt, ASD jack, ovrd	X	X			X	X		X
TSMN-90231-850-0-01	10K thermistor w/11K shunt, ASD jack, F temp ind, ovrd	X	X			X	X		X
TSMN-90250-850-0-01	10K termistor w/11K shunt, ASD jack, F setpt, ovrd	X	X	X	X	X	X		X
TSMN-90250-852-0-01	10K thermistor w/11K shunt, ASD jack, C setpt, ovrd	X	X	X	X	X	X		X
TSMN-90251-850-0-01	10K thermistor w/11K shunt, ASD jack, F temp ind, F setpt, ovrd	X	X	X	X	X	X		X
TSMN-90256-852-0-01	10K thermistor w/11K shunt, ASD jack, C temp ind, C setpt, ovrd	X	X	X	X	X	X		X
TSMN-90261-850-0-01	10K thermistor w/11K shunt, ASD jack, F temp ind, F setpt	X	X	X	X	X	X		X
TSMN-57011-850-0-01	10K thermistor with 11K shunt	6” Pigtail leads							
TSMN-58011-000-0-01	1K Platinum element	6” Pigtail leads							
TSMN-81011-000-0-01	1K BALCO element	6” Pigtail leads							

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SPECIFICATIONS

Sensing Element: See Table-1 and Table-2.
Mounting: Direct-wall, 2 x 4 electrical box, 1/4 DIN, or surface box.
Ambient Temperature Limits:
Shipping & Storage, -40 to 160 °F (-40 to 71 °C)
Operating, 40 to 140 °F (4 to 60 °C)
Humidity: 5 to 95%, non-condensing.
Locations: NEMA.

Table-2 Temperature Versus Resistance.

	Nominal Resistance Value			
Temperature °F (°C)	**TSMN-90110 Series** Ω	**TSMN-90xxx-85x Series TSMN-57011-850** Ω	**TSMN-58011** Ω	**TSMN-81011** Ω
40 (4)	—	7596	1017	935.9
50 (10)	18790	6938	1039	956.9
68 (20)	12260	5798	1077.9	995.6
77 (25)	10000	5238	1097.3	1015.4
86 (30)	8194	4696	1116.7	1035.4
104 (40)	5592	3707	1155.4	1076.2
122 (50)	3893	2875	1194	1118.0
140 (60)	2760	2206	1232.4	1160.9
Sensor Type	Thermistor, 10ΩK at 77°F (25°C)	Thermistor, 10ΩK at 77°F (25°C), *with 11ΩK shunt resistor	Platinum, 1000 Ω at 32°F (0°C)	Balco, 1000 Ω at 70°F (21.1°C)

*TSMN-90110 does not have a shunt resistor.

INSTALLATION

The electronic room temperature sensor is packaged, in disassembled form, in one container. It consists of three major parts: a pre-wirable base plate; an electronic assembly containing the sensor and its associated circuitry; and a removable cover.

Inspection

Inspect the package for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the package and inspect the device for obvious damage. Return damaged products.

Requirements

- Job wiring diagrams
- Tools (not provided):
  - Digital volt-ohm meter (DVM)
  - Appropriate drill and drill bit for mounting screws
  - Appropriate screwdrivers for mounting screws and terminal connections
- Training: Installer must be a qualified, experienced technician
- Appropriate accessories
  - Communication adapter
- For use of this product with TAC System 8000, refer to the **Environmental Controls Application Manual, F-21335**

Precautions

WARNING
Electrical shock hazard! Disconnect power before installation to prevent electrical shock or equipment damage.

Mounting

Locate the sensor where it will be exposed to an unrestricted circulation of air which represents the average temperature of the controlled space. Do not locate the sensor near sources of heat or cold such as lamps, motors, sunlight, or concealed ducts or pipes. The sensor is designed for service in any normally encountered human environment.

The electronic room temperature sensor may be installed directly onto a wall, or onto a 2 X 4 electrical box, a 1/4 DIN electrical box, or a surface box. Refer to Figure 1.

Note: Although the TSMN-Series Sensors share the same base plate with the MN-Series MicroNet™ Sensors, they are not for use with MicroNet U-Link or TAC NETWORK 8000-Link. However, no damage will result if, by mistake, MicroNet communications are attempted with a TSMN-Series Sensor.

General Mounting Instructions (Screw Terminal Version)

1. Pull the system's wires from the wall or box.
2. Pass the wires through the base plate feedthrough and fasten the base plate onto the wall or box. Refer to Figure 2 for direct-wall mounting dimensions.

▼CAUTION

The Electronic Room Temperature Sensors are Class 2 *only* devices and must be connected to Class 2 wiring. Class 2 circuits must not intermix with Class 1 circuits.

3. Connect the wires to the appropriate screw terminals on the base plate. Make all connections in accordance with the job wiring diagram and in compliance with national and local electrical codes. Refer to Table-1 and Figure-3 for base plate terminal identification.
4. Push any excess wire back through the base plate to minimize air flow restriction.
5. Set the electronic assembly onto the hooks on the base plate.
6. Secure the electronic assembly to the base plate by tightening all screws.

Note: Start all screws one to two turns before tightening.

7. Install the cover by engaging the bottom tabs first and snapping the top end into place. Note that the top end of the cover is identified on its back surface.

Note: To remove the sensor cover, once installed, simultaneously press the middle of the sensor with your thumb and pull firmly on the top edge of the cover with your fingers.

General Mounting Instructions (Pigtail Lead Version)

1. Pull the system's wires from the wall or box.
2. Attach the system's wires from the wall to the pigtails from the TSMN unit. These leads are not polarity sensitive. Make all connections in accordance with the job wiring diagram and in compliance with national and local electrical codes.

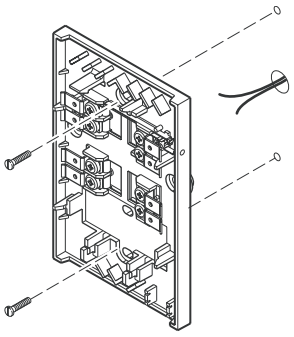
Note: The pigtail leads from the TSMN unit should not have excessive stress applied when connected to the system's wires.

▼CAUTION

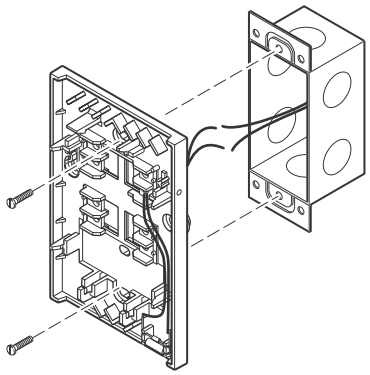
The Electronic Room Temperature Sensors are Class 2 *only* devices and must be connected to Class 2 wiring. Class 2 circuits must not intermix with Class 1 circuits.

3. Fasten the base plate onto the wall or box. Refer to Figure-2 for mounting dimensions.
4. Set the faceplate assembly onto the hooks on the base plate.
5. Secure the faceplate assembly to the base plate by tilting the assembly down, locking it under the latching tab. Pull up slightly on the assembly to ensure it is secure.
6. Install the cover by engaging the bottom tabs first and snapping the top end into place. Note that the top end of the cover is identified on its back surface.

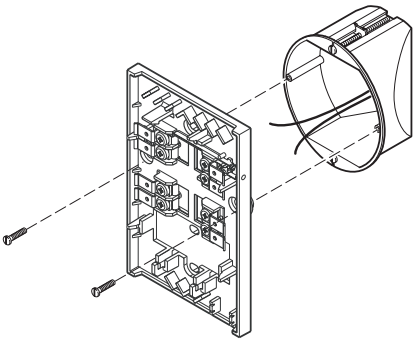
Note: To remove the sensor cover, once installed, simultaneously press the middle of the sensor with your thumb and pull firmly on the top edge of the cover with your fingers.



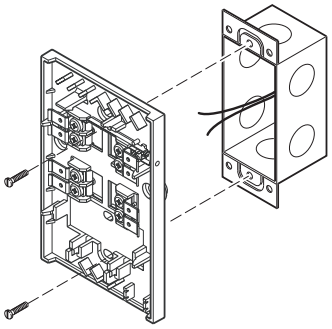
Direct-Wall Mounting.



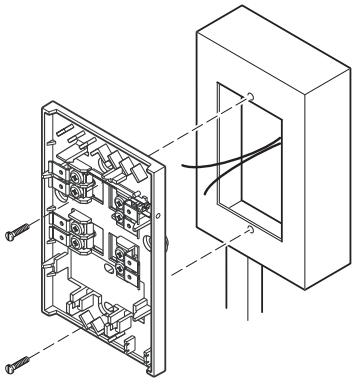
2 X 4 Electrical Box Pigtail Mounting.



1/4 DIN Electrical Box Mounting.



2 X 4 Electrical Box Mounting.



Surface Box Mounting.

Figure-1 Mounting Options for Electronic Room Temperature Sensor.

CHECKOUT

1. Remove wires from the temperature sensor.
2. Using a DVM, measure the appropriate resistance between terminals SPACE and COM. Refer to Table-1 and Figure-3 for base plate terminal identification and Table-2 for the appropriate resistance for the unit being checked out.
3. Press the override button (if applicable) and observe meter reading. When the button is pressed, the reading should be less than 200Ω.
4. Connect the DVM between COM and SP+ (if applicable). The meter reading should be approximately 1100 ohms.
5. Connect the DVM between COM and SETPT (if applicable) and move the temperature setpoint knob. The meter reading should be no less than 2500Ω (11,000Ω is typical), at the scale end points and no more than 29,000Ω at the mid scale point.
6. Reconnect the wires to the temperature sensor and replace cover.

MAINTENANCE

Periodically inspect the temperature sensors for dirt or blockage of air.

FIELD REPAIR

The sensor has no user serviceable parts and is not field repairable. Replace the sensor with a functional unit.

DIMENSIONAL DATA

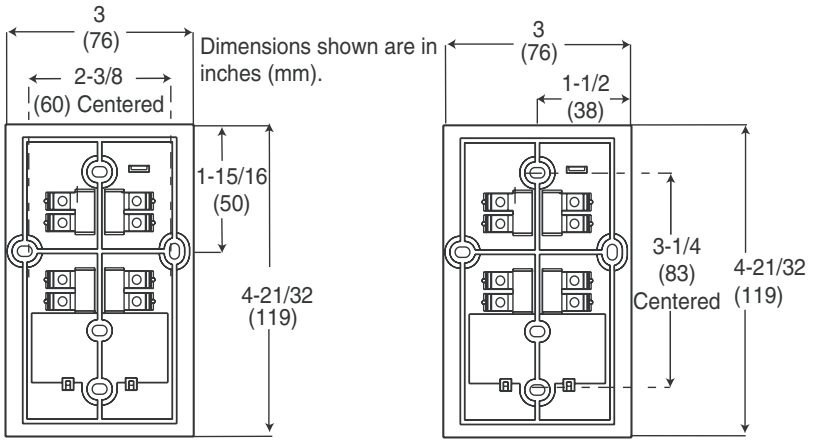


Figure-2 Mounting Dimensions.

Note: The rating label on the base plate covers an additional mounting hole. If it is necessary to use this mounting hole, simply press the screw through the label. A cross hair on the label identifies the location of the mounting hole.

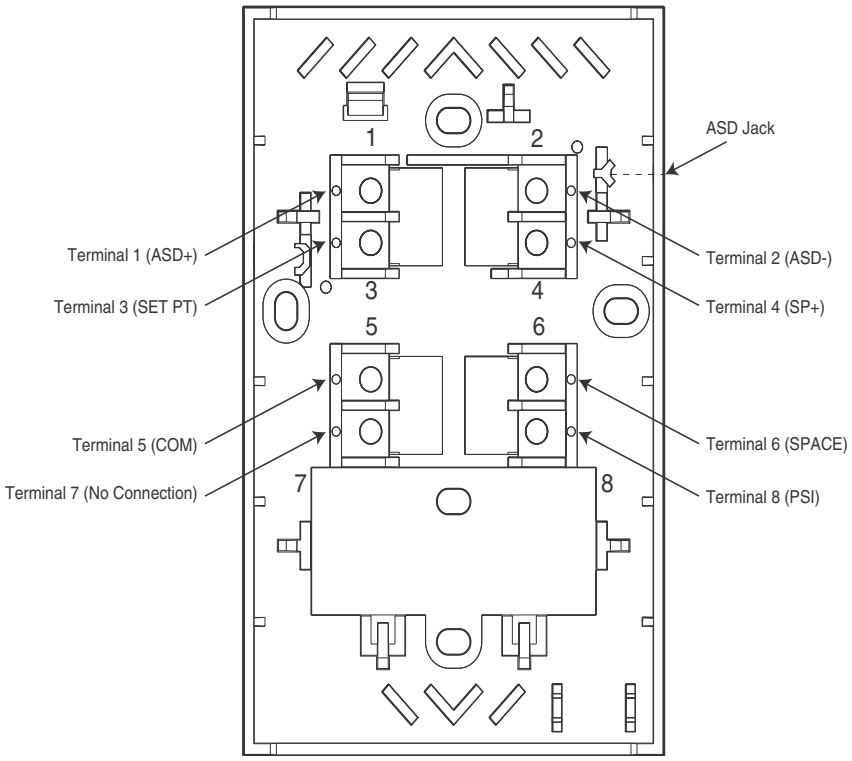


Figure-3 Base Plate Terminal Identification.

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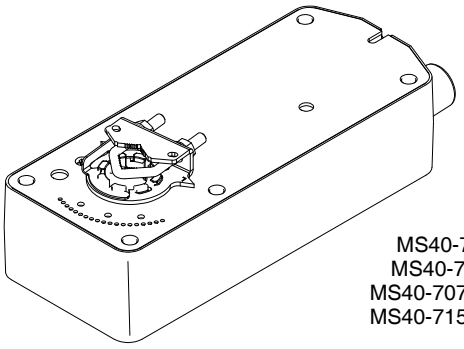
MS40-7043 Series
MS4X-7073 Series
MS4X-7153 Series

TAC DuraDrive™ Series Spring Return Proportional Actuator General Instructions

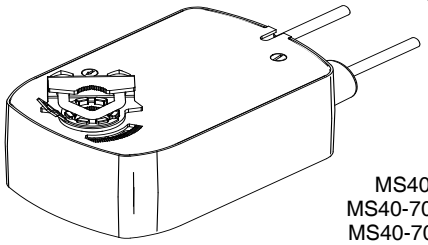
Application

TAC DuraDrive Direct Coupled Actuators are designed to be used in both damper and valve control applications. The following general instructions are for damper applications. Refer to the Applicable Literature table for valve literature.

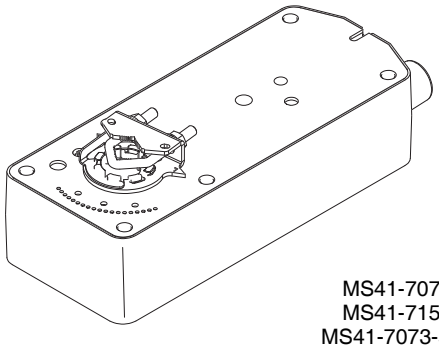
The MS4X-7XX3 series spring return actuators provide proportional modulation control of dampers and valves in HVAC systems.



MS40-7073
MS40-7153
MS40-7073-502
MS40-7153-502



MS40-7043
MS40-7043-501
MS40-7043-MP
MS40-7043-MP5



MS41-7073
MS41-7153
MS41-7073-502
MS41-7153-502

Features

- Proportional models controlled by 6-9 Vdc, 2-10 Vdc, or 4-20 mA with the addition of a 500 ohm resistor
- 133 lb-in (15 N-m), 60 lb-in (7 N-m) or 35 lb-in (4 N-m) of torque
- Rugged die-case housings rated for NEMA 2 / IP54
- Optional built-in auxiliary switch to provide for interfacing or signaling
- Provides 95° of rotation
- Visual position indicator provided
- Provides true mechanical clockwise or counterclockwise spring return operation for reliable fail safe application and positive close-off in air tight damper applications
- MS40-7043-MPX models controlled by 6-9 Vdc with auxiliary 20 Vdc power supply provides power to controllers, replacing MP-5XXX/MPR-5XXX electrohydraulic actuators
- Direct mount to round or square damper shafts
- Switch provided for selection of direct or reverse acting control mode
- Rotation limiting available
- MS4X-7153 series actuators can be double-mounted (gang mounting) to accommodate high torque application requirements
- Five year warranty
- MS41-7073 and MS41-7153 equipped with manual override

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Applicable Literature

F-Number	Description	Audience	Purpose
F-26750	MA4X-XXXX-2XX, MF4X-XXXX-2XX, MS4X-XXXX-2XX Series Actuator/Linkage Assemblies General Instructions	– Sales Personnel – Application Engineers – Installers – Service Personnel – Start-up Technicians	Describes the globe valve actuator/linkage assembly's features, specifications, and possible applications. Provides step-by-step mounting instructions.
F-26751	VX-2000 Series Ball Valve Assembly Installations Instructions	– Sales Personnel – Application Engineers – Installers – Service Personnel – Start-up Technicians	Describes the actuator/linkage/ball valve assembly's features, specifications, and possible applications. Provides step-by-step mounting instructions.
F-26646	MX4X-7XXX, MX40-6XXX Series TAC DuraDrive Actuator Selection Guide	– Sales Personnel – Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides actuator specifications and part number cross referencing of phased out actuators with the new TAC direct-coupled actuators.
F-26752	VX-2000, VX-7000 Series MX4X-7XXX, MX40-6XXX Series Ball/Linked Globe Valve Assemblies Actuator/Linkage Assemblies Selection Guide	– Sales Personnel – Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides part number cross referencing of phased out globe and ball valve assemblies with the new TAC direct-coupled actuators.
F-26080	EN-205 Water System Guidelines	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Describes TAC approved water treatment practices.
F-13755	CA-28 Control Valve Sizing	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides charts, equations, and diagrams to assist in the configuration of valve system applications. TOOL-150, valve sizing slide rule may be purchased separately.
F-11080	Valve Selection Chart Water		
F-11366	Valve Selection Chart Steam (two-way valves only)		

SPECIFICATIONS

Actuator Inputs

Control Signal: See Table-1.
Power Input: See Table-1. All 24 Vac circuits are Class 2.
Connections: 3 ft. (91 cm) plenum rated cable for MS40-7043-XXX and 3 ft. (91 cm) appliance cables for MS4X-7153-XXX and MS4X-7073-XXX, 1/2" (13 mm) conduit connectors. For M20 Metric conduit, use AM-756 adaptor.

Actuator Outputs

Electrical:

Position Feedback Voltage "AO",

MS40-7043, MS4X-7153 and MS4X-7073 2 to 10 Vdc (max. 0.5 mA) output signal for position feedback or to operate up to four additional slave actuators.

Auxiliary Switches,

MS40-7043-MP5 and MS40-7043-501 One SPDT 6A (1.5A) @ 24 Vac, adjustable 0 to 95° (0 to 1 scale).

MS4X-7153-502 and MS4X-7073-502 Two SPDT 7A (2.5A) @ 250 Vac, one fixed @ 5° and one adjustable 25 to 85°.

Auxiliary Power Supply:

MS40-7043-MP and MS40-7043-MP5 +20 Vdc @ 25 mA (max).

Mechanical:

Stroke, Angle of rotation 95° ±5°. Adjustable 30° to 95° with AM-689 installed on MS4X-7153-XXX or MS4X-7073-XXX. MS40-7043-XXX models are adjustable 40° to 95° by adjusting the stop block position on the actuator.

Damper Shaft Clamp,

MS40-7043-XXX The factory installed universal clamp is used for shafts up to 5/8" (15 mm) diameter or up to 1/2" (13 mm) square. AM-710 accessory clamp is required when mounting actuators to shafts up to 3/4" (19 mm) diameter or up to 1/2" (13 mm) square.

MS4X-7153-XXX or MS4X-7073-XXX The factory installed universal clamp is used for shafts up to 3/4" (19 mm) diameter or up to 1/2" (13 mm) square. AM-687 accessory clamp is required when mounting actuators to shafts up to 1.05" (27 mm) diameter or up to 5/8" (15 mm) square.

Position Indicator, Visual indicator.

MS4X-7153 and MS4X-7073, -5 to 90° (-5° is spring return position).

MS40-7043, 0 to 1 (0 is spring return position).

Nominal Damper Area, Actuator sizing should be done in accordance with damper manufacturer's specifications.

Direction of Rotation, Clockwise or counterclockwise rotation determined by actuator mounting.

Manual Override, MS41-7073 and MS41-7153 are equipped with a manual rotation adjustment from -5° to 85°.

Right/Left Switch, Permits reverse acting/direct acting rotation.

Environment

Ambient Temperature Limits:

Shipping & Storage, -40 to 160°F (-40 to 71°C).

Operating, -22 to 140°F (-30 to 60°C).

Humidity: 15 to 95% RH, non-condensing.

Location:

MS4X-7153-XXX and MS4X-7073-XXX, NEMA 1 (IEC IP30). NEMA 2 (IEC IP54) with conduit connector in the down position.

MS40-7043-XXX, NEMA 2 (IEC IP54) no restrictions.

Agency Listings

UL 873: Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CUL: UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22.2 No. 24-93.
European Community: EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC)
Australia: This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.

Table-1 Specifications.

Part Number	Actuator Power Input							Approximate Timing in Seconds @ 70°F (21°C)[a]		Auxiliary Switch	Output Torque Rating lb.-in. (N-m)		Auxiliary Power Supply	Input
	Voltage	Running				DC Amps	Holding 50/60 Hz	Powered	Spring Return		Min.[b]	Max. Stall		
		50 Hz		60 Hz										
		VA	W	VA	W		W							
MS40-7043	24 Vac ± 20% 22-30 Vdc	5.6	4.2	5.6	4.2	0.15	2.4	<130	<25	No	35 (4)	150 (17)	None	2-10[c] Vdc or 4-20[d] mA w/ 500 Ω
MS40-7043-501										One[e]				
MS4X-7073		5.8	4.6	5.8	4.6	0.17	2.3	<195	<30	No	60 (7)	250 (28)		
MS4X-7073-502										Two[f]				
MS4X-7153		9.8	7.4	9.7	7.4	0.28	2.9	<190	<30	No	133 (15)	350 (40)		
MS4X-7153-502										Two[f]				
MS40-7043-MP	24 Vac ± 20% 22-30 Vdc	6.6	5.0	6.6	5.0	0.17	3.2	<130	<25	No	35 (4)	150 (17)	+20 Vdc 25 mA Max.	6-9[c] Vdc
MS40-7043-MP5										One				

[a] Timing was measured with no load applied to the actuator.
[b] De-rating is required at low temperatures.
[c] 2-10 Vdc or 6-9 Vdc input impedance 80 k ohms.
[d] 4-20 mA with 500 ohm input impedance 500 ohms.
[e] One adjustable from 0° to 95° rotation (0 to 1 scale).
[f] One adjustable from 25° to 85° rotation and one set to operate @ 5° fixed.

ACCESSORIES

AM-671	Universal Mounting Bracket, AM-693 is required
AM-672	Universal Mounting Bracket, AM-693 is required
AM-673	Multiple Actuator Mounting Bracket (MA40-7153 series)
AM-674	Weather Shield
AM-675	Base Mounting Plate for AM-674
AM-676	Universal Shaft Extension, AM-710 required
AM-703	Input Rescaling Module, adjusts signals to 2-10 Vdc, zero and span adjustment
AM-704	Interface, pulse width modulation
AM-705	Positioner (NEMA 4 housing)
AM-706	Min and/or Manual Positioner for flush panel mount
AM-708	500Ω resistor for 0 to 20 mA control signal
AM-714	Weather Shield (polycarbonate)
AM-756	Metric Conduit Adapter M20 x 1.5 to 1/2” NPT
AM-761	7-inch replacement anti-rotation bracket
AM-762	9-inch replacement anti-rotation bracket

MS4X-7153-XXX and MS4X-7073-XXX

AM-686	Damper Position Indicator
AM-687	Universal Clamp for up to 1.05" (27 mm) diameter shafts
AM-688	Replacement Universal Clamp
AM-689	Rotation Limiter
AM-690	Crank Arm for round shafts up to 3/4" (19 mm)
AM-691	Crank Arm for jackshafts up to 1.05" (27 mm)
AM-692	V-bolt Kit for AM-690 and AM-691 Crank Arms
AM-693	Damper Linkage Kit
AM-758	Short “U” mounting bracket for replacing Honeywell Mod III type actuators and new installations, AM-690 or AM-691 is required
AM-759	Tall “U” mounting bracket for replacing Honeywell Mod IV type actuators and new installations, AM-690 or AM-691 is required
AM-760	Slotted “L” mounting bracket, AM-690 or AM-691 is required
AM-763	Crank for manual override

MS40-7043-XXX

AM-709	Damper Position Indicator
AM-710	Universal Clamp for up to 3/4" diameter shafts
AM-711	Crankarm for up to 1/2" round shaft
AM-712	Crankarm Adaptor Kit
AM-713	Mounting Bracket for Honeywell Mod IV, M6415 type actuators, and new installations
AM-715	Crankarm Adaptor Kit for Honeywell Mod IV M6415 type actuators, and new installations
AM-717	Replacement Universal Clamp

Table-2 Auxiliary Power Supply.

Model #	Rating	
MS40-7043-MP or MS40-7043-MP5	+ 20 Vdc, 25 mA Maximum	
Control Wires	Blue (+)	Grey (-)

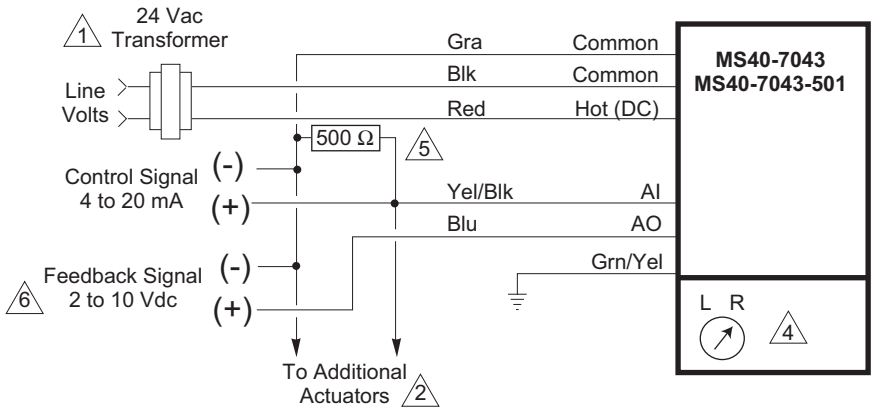
TYPICAL APPLICATIONS (wiring diagrams)

Figure-1 and Figure-2 illustrate typical wiring diagrams for spring return proportional actuators. See Table-1 for model selection and control signal specifications.

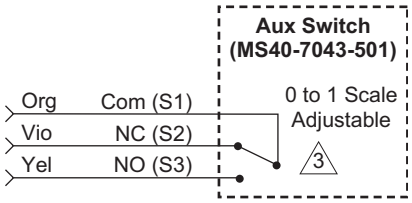
Caution: This product contains a half-wave rectifier power supply and must not be powered off transformers used to power other devices utilizing non-isolated full-wave rectifier power supplies. Refer to *EN-206, Guidelines for Powering Multiple Devices from a Common Transformer, F-26363* for detailed information.

Note: DC operation is applicable to models manufactured after date code 0212.

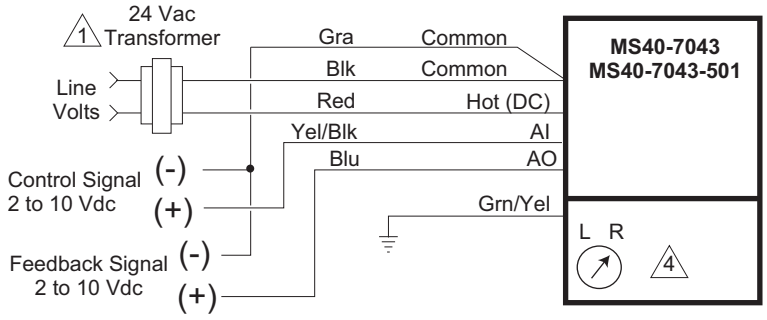
4 to 20 mAdc Proportional Control



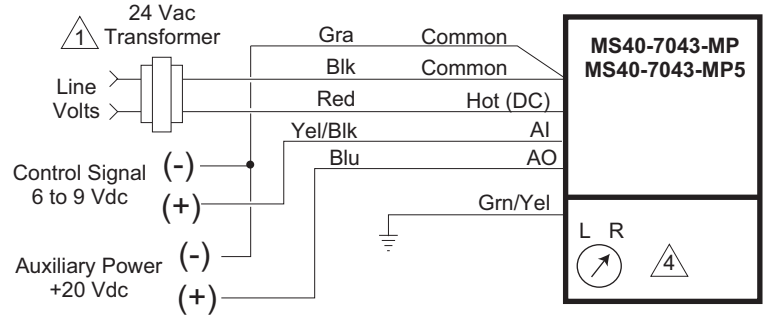
Optional Auxiliary Switch



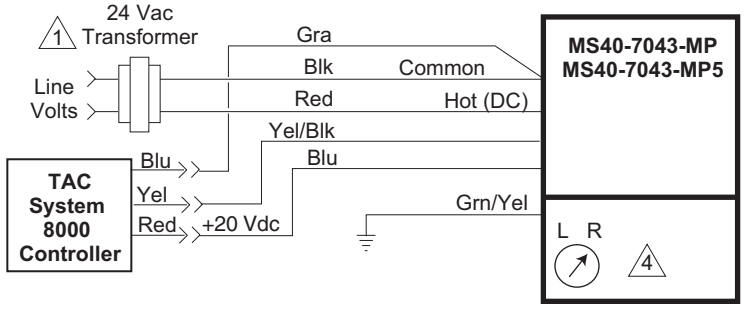
2 to 10 Vdc Proportional Control



6 to 9 Vdc Proportional Control with 20 Vdc Power Output



TAC System 8000 6 to 9 Vdc Room Temperature Control



1. Provide overload protection and disconnect as required.
2. For parallel operation in 4 to 20 mA applications, actuators may be wired in series and mounted on separate shafts. Also, up to four actuators, mounted on separate shafts, may be wired in parallel. With four actuators wired to one 500 ohm resistor, a +2% shift of the control signal may be required. Power consumption and input impedance limits must be observed. Actuator input impedance is 80 kohm.
3. For end position indication, interlock control, fan startup, etc., MS40-7043-501 model incorporates one built-in auxiliary switch.
4. To reverse actuator rotation, use the reversing switch.
5. A field-supplied 500 ohm resistor (AM-708) is required between the gray and yellow/black leads to convert the 4 to 20 mAdc control signal to 2 to 10 Vdc.
6. Only connect common to negative (-) leg of control circuits.

Figure-1 Proportional Control of TAC System 8000 Room Temperature Controller Application of MS40-7043-XXX Actuator.

MS4X-7073-XXX and MS4X-7153-XXX

Caution: This product contains a half-wave rectifier power supply. It must not be powered with transformers that are used to power other devices utilizing non-isolated full-wave rectifier power supplies. Refer to *EN-206, Guidelines for Powering Multiple Devices from a Common Transformer, F-26363* for detailed information.

MX40-707X-502 and MX40-715X-502 units manufactured prior to the date code 0141 (October 6, 2001) used different color coding for the auxiliary switches.

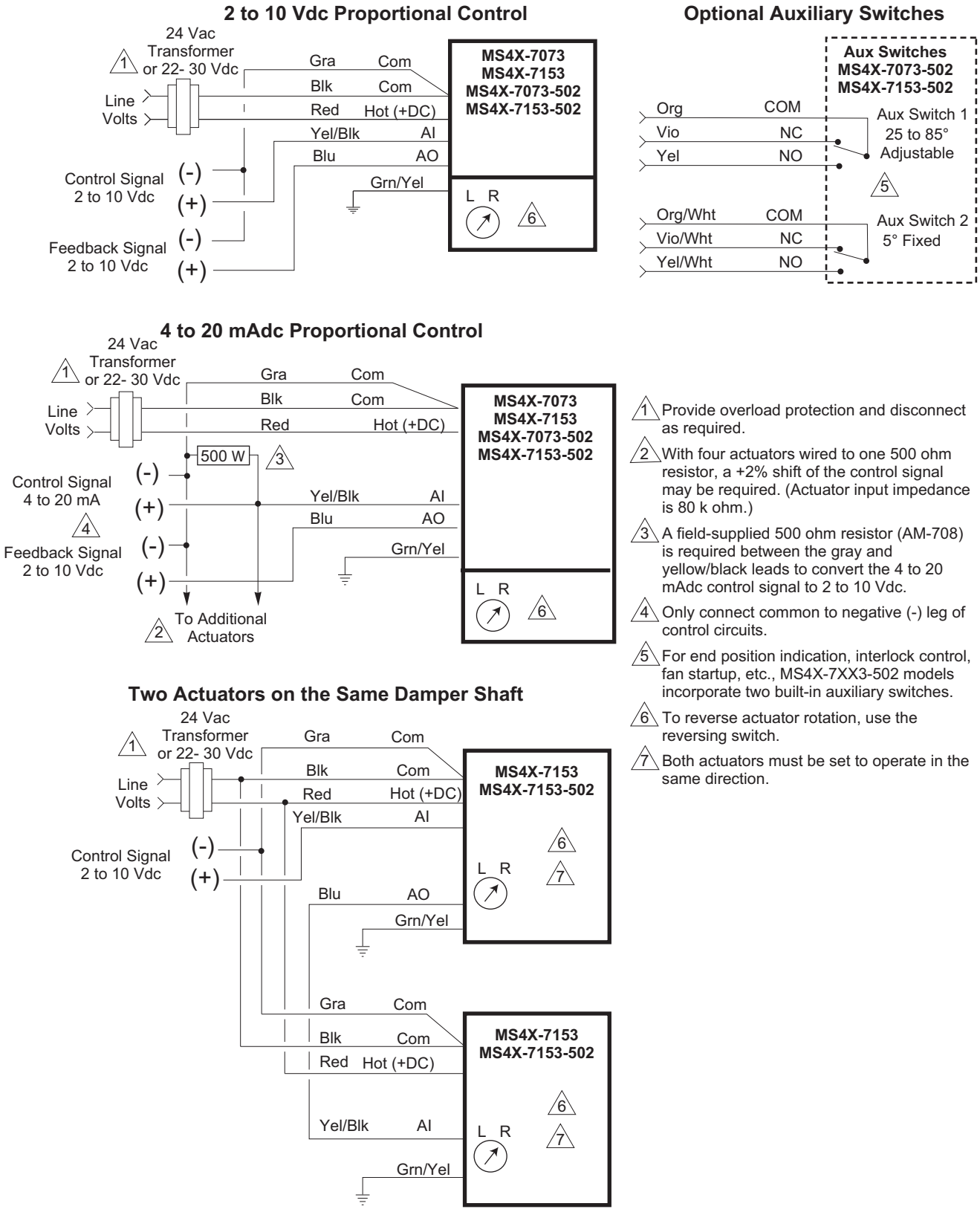
Auxiliary Switch 1

Orange:	Fixed auxiliary switch common (com)
Yellow:	Fixed auxiliary switch normally closed (NC)
Violet:	Fixed auxiliary switch normally open (NO)

Auxiliary Switch 2

Orange/white:	Adjustable auxiliary switch common (com)
Violet/white:	Adjustable auxiliary switch normally closed (NC)
Yellow/white:	Adjustable auxiliary switch normally open (NO)

The label information on these units is incorrect. If replacing these units, the auxiliary switch operation of the replacement actuator will be per the product label and Figure-2.



1. Provide overload protection and disconnect as required.
2. With four actuators wired to one 500 ohm resistor, a +2% shift of the control signal may be required. (Actuator input impedance is 80 k ohm.)
3. A field-supplied 500 ohm resistor (AM-708) is required between the gray and yellow/black leads to convert the 4 to 20 mAdc control signal to 2 to 10 Vdc.
4. Only connect common to negative (-) leg of control circuits.
5. For end position indication, interlock control, fan startup, etc., MS4X-7XX3-502 models incorporate two built-in auxiliary switches.
6. To reverse actuator rotation, use the reversing switch.
7. Both actuators must be set to operate in the same direction.

Figure-2 Typical Wiring Diagrams for Proportional Control 24 Vac Basic and Double Auxiliary Switch Models.

INSTALLATION

Inspection

Inspect the package for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the package and inspect the device for obvious damage. Return damaged products.

Requirements

- Job wiring diagrams
- Tools (not provided):
  - #8 sheet metal screws (Universal Bracket)
  - 10mm open end wrench or socket wrench (Universal V-clamp)
  - 1/8 inch, allen wrench (Aux. Switch)
  - Appropriate screwdriver(s)
  - Drill and appropriate bits
- Appropriate accessories
- Training: Installer must be a qualified, experienced technician

Precautions

General

Warning:

- Electrical shock hazard! Disconnect the power supply (line power) before installation to prevent electric shock and equipment damage.
- Make all connections in accordance with the job wiring diagram and in accordance with national and local electrical codes. *Use copper conductors only.*

Caution:

- Avoid electrical noise interference. Do not install near large contactors, electrical machinery, or welding equipment.
- MX41-707X and MX41-715X Manual override to be used only when power is not applied to unit.
- When operating manual override, back off 5° from full open mechanical stop to ensure proper release.
- MX41-707X and MX41-715X Do not attempt to use the manual override with actuators mounted in tandem. Damage to the gear train may occur.
- Do not drill holes in actuator body. Six pre-drilled holes are located on each side, under the label, to accept #10-24 thread forming screws for mounting accessories.

Federal Communications Commission (FCC)

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy and may cause harmful interference if not installed and used in accordance with the instructions. Even when instructions are followed, there is no guarantee that interference will not occur in a particular setting—Which can be determined by turning the equipment off and on—the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

Canadian Department of Communications (DOC)

Note: This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

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

European Standard EN 55022

Warning: This is a Class B digital (European Classification) product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Location

Caution: Avoid locations where excessive moisture, corrosive fumes, vibration, or explosive vapors are present.

Mounting

Caution: To remain in NEMA 2/IP54 compliance, the MS4X-715X and MS4X-707X series actuators should be mounted with conduit end down.

Mount the TAC DuraDrive Actuator directly on the damper shaft in locations that clear the maximum dimensions of the actuator case and allow the actuator to be mounted flush to the surface of the terminal box and perpendicular to the damper shaft.

MX41-707X and MX41-715X If the universal clamp is not set to 0° on the position indicator, manually wind the actuator in the direction indicated with hex wrench from -5° to 0° and lock with a screwdriver.

Note: Some terminal boxes have sheet metal screw heads or other protrusions near the damper shaft. In these cases, a spacer or shim may be added under the anti-rotation bracket of the actuator to make the actuator perpendicular to the shaft.

Damper Actuator Sizing

Correct sizing of the actuator is necessary for proper control of dampers. The area of damper that can be controlled by a given actuator is dependent upon the type of damper, the quality of the damper, the pressure drop across the damper in the closed position, and the velocity of the air flow through the damper. To obtain actual damper torque requirements, contact the damper manufacturer.

Damper Shaft Sizing

Use the “Long Damper Shaft” mounting instructions if the damper shaft is at least 3-1/2" (90 mm) long.

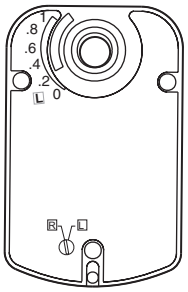
Use the “Short Damper Shaft” mounting instructions if the damper shaft is shorter than 3-1/2" (90 mm) or the area around the damper shaft is too narrow to allow standard mounting, as described in the “Short Damper Shaft” mounting section.

Changing Direction of Rotation

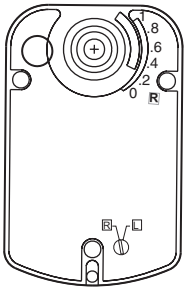
The MS40-7043, MS4X-7074, and MS4X-7153 actuators are equipped with a switch to control the direction of rotation. The switch can be set to "L” (left) or “R” (right) rotation. An actuator set to “L” will have a clockwise rotation when viewed from the left side. When viewed from the right side the rotation will be counterclockwise. Refer to Figure-3.

Caution: These are spring return actuators. It is possible to switch to a direction that moves the actuator against the -5° positive stop. Example: Viewing the actuator from the left side with the switch set to “R” and an increasing signal. The actuator will attempt to rotate beyond the -5° stop and will stall.

MS40-704X

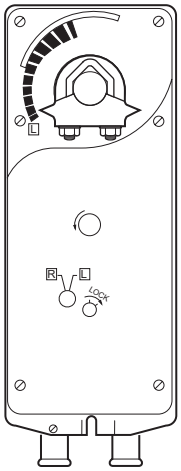


Viewed from L side:
Switch on [L] – Clockwise rotation on increasing signal
Switch on [R] – Counterclockwise rotation on increasing signal

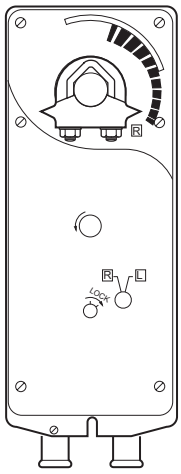


Viewed from R side:
Switch on [R] – Counterclockwise rotation on increasing signal
Switch on [L] – Clockwise rotation on increasing signal

MS4X-707X, MS4X-715X-XXX



Viewed from L side:
Switch on [L] – Clockwise rotation on increasing signal
Switch on [R] – Counterclockwise rotation on increasing signal



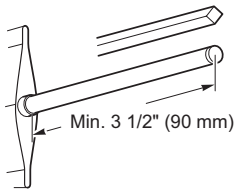
Viewed from R side:
Switch on [R] – Counterclockwise rotation on increasing signal
Switch on [L] – Clockwise rotation on increasing signal

Figure-3 Rotation Switch Settings.

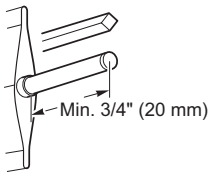
MS40-704X Series Installation

Note: The MS40-704X series actuator comes equipped with standard universal mounting clamp. For damper shafts larger than 5/8" (16 mm) in diameter, the AM-710 universal mounting clamp is required (order separately). The AM-710 clamp accommodates shafts sizes up to 3/4" (19 mm) diameter shafts.

Long Shaft



Short Shaft



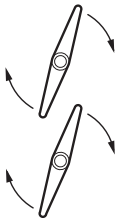
3/8" to 3/4" Diameter (10 mm to 20 mm)
3/8" to 1/2" Square (10 mm to 13 mm)

Move the damper to its normal position. Verify the controller action is set to match the damper application.

Normally closed damper: when damper is closed, actuator position indicator should be at 0°. When damper is open, actuator position indicator should be at 90°.

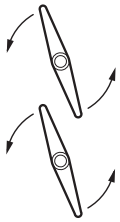
Normally opened damper: when damper is open, actuator position indicator should be at 0°. When damper is closed, actuator position indicator should be at 90°.

A - Left



Shaft Rotates Clockwise To Open

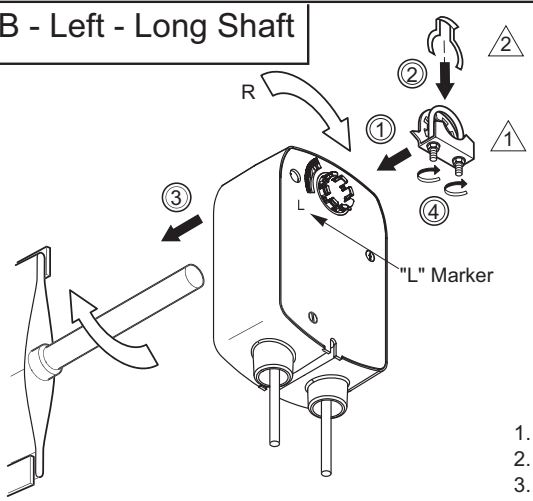
A - Right



Shaft Rotates Counterclockwise To Open

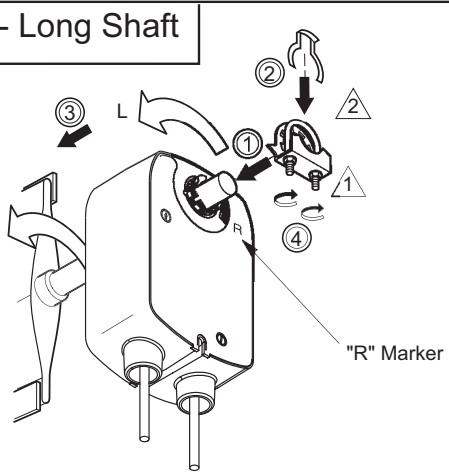
This step determines shaft rotation. Linkage may change damper direction.

B - Left - Long Shaft



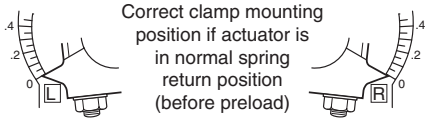
1. Universal mounting clamp.
2. Retaining clip.

B - Right - Long Shaft

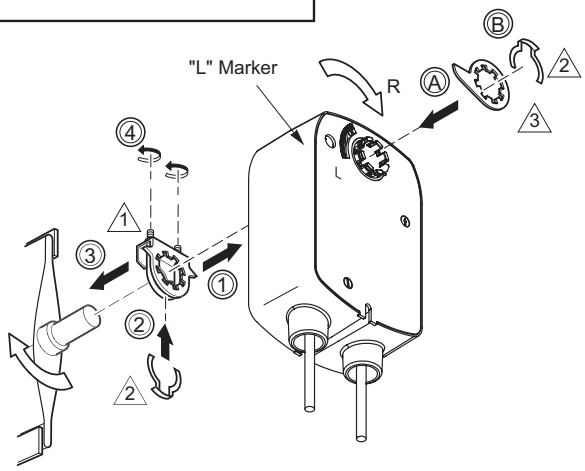


1. Universal mounting clamp.
2. Retaining clip.

1. Assemble mounting clamp.
2. Assemble retaining clip.
3. Place actuator over shaft.
4. Hand tighten clamp nuts.

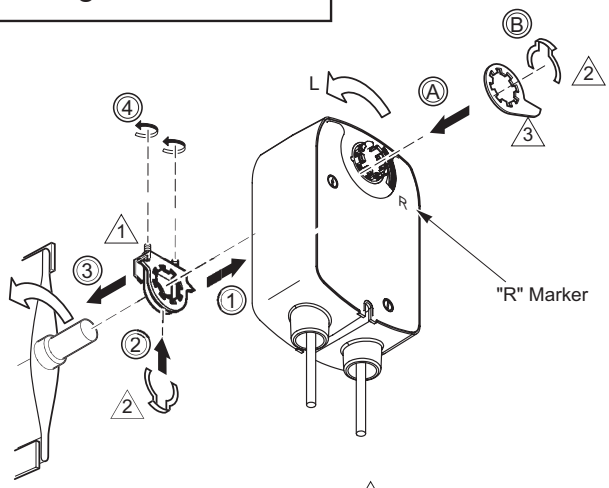


B - Left - Short Shaft



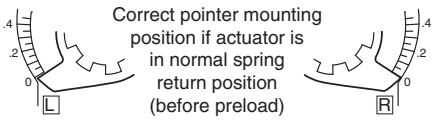
1. Universal clamp.
2. Retaining clip.
3. Damper position indicator.

B - Right - Short Shaft

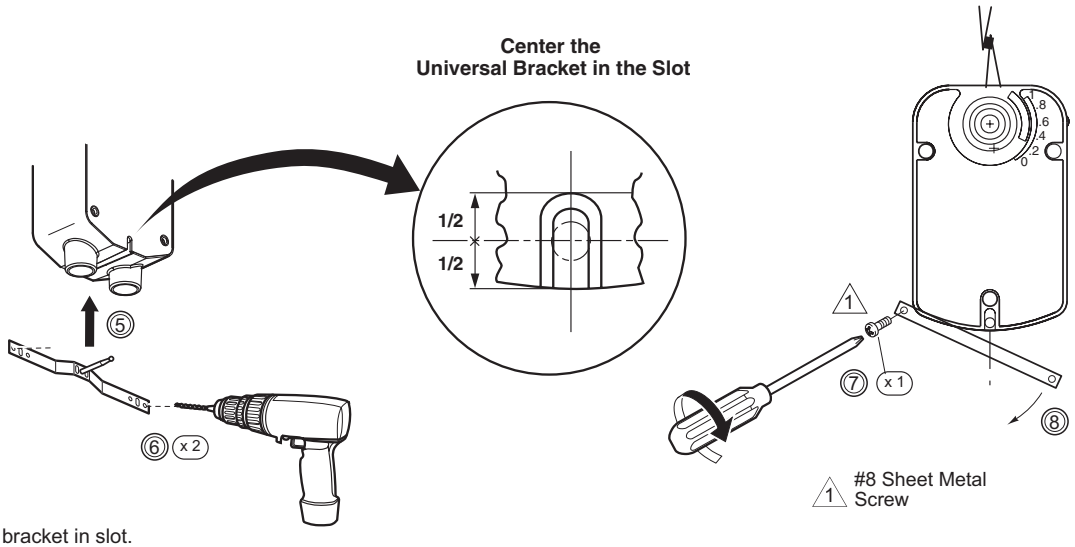


1. Universal clamp.
2. Retaining clip.
3. Damper position indicator.

A. Assemble damper position indicator.
B. Assemble retaining clip.
1. Position mounting clamp.
2. Assemble retaining clip.
3. Slide actuator over shaft.
4. Hand tighten clamp nuts.

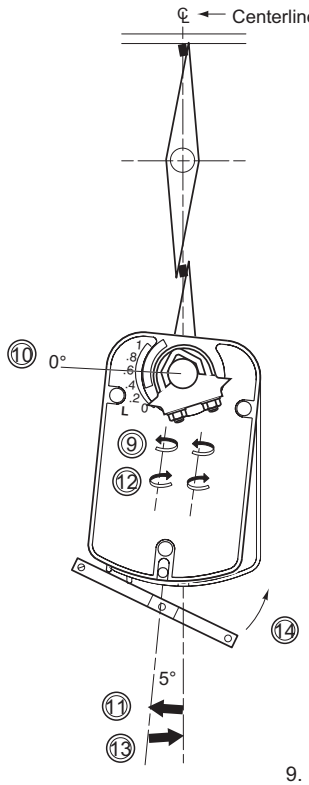


C - Left and Right

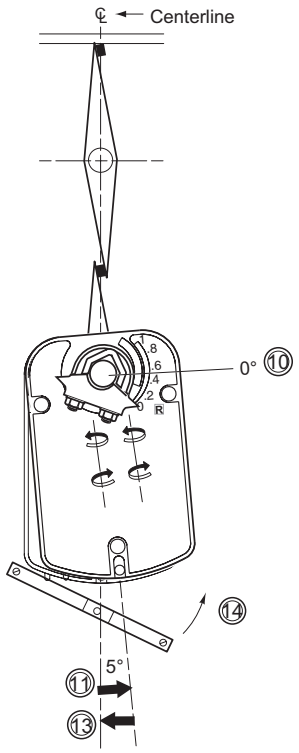


5. Center bracket in slot.
6. Drill two holes.
7. Start one screw.
8. Swing bracket down.

D- Left

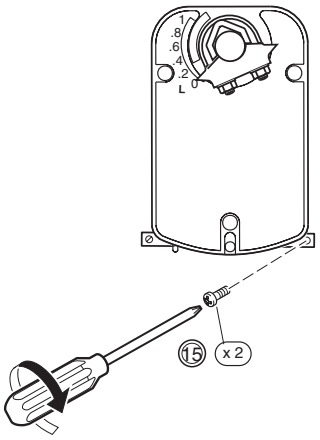


D- Right

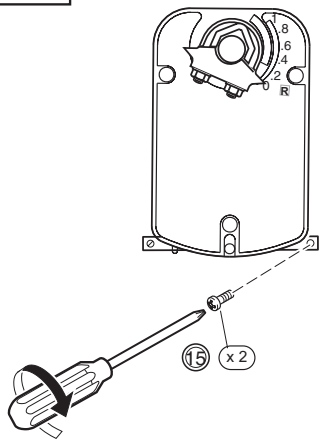


9. Loosen clamp nuts.
10. Check that the shaft is in full zero position.
11. Swing actuator 5° in the direction of travel. Do not move shaft.
12. Tighten clamp nuts to 4 to 6 lb-ft (5.4 to 8.2 N-m) of torque.
13. Move bottom of actuator back into position.
14. Pivot bracket back into position.

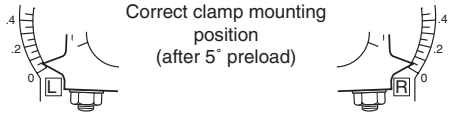
E- Left



E - Right



15. Tighten bracket screws.



MS4X-707X and MS4X-715X Series Installation

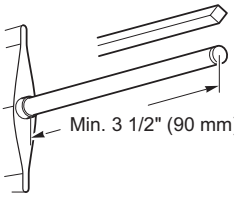
Caution: Do not drill additional holes in the actuator body. Six pre-drilled holes are located on each side, under the label, to accept #10-24 thread-forming screws for mounting accessories.

Note: The MS4X-707X and MS4X-715X series actuators come equipped with standard universal mounting clamp installed. For damper shafts larger than 3/4" (19 mm) in diameter, the AM-687 universal mounting clamp is required (order separately). The AM-687 clamp accommodates round shaft sizes up to 1.05" (27 mm) in diameter or 5/8" (16 mm) square shafts.

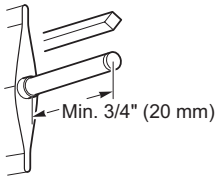
Caution: The MS41-707X and MS41-715X actuators are equipped with a manual override.

- The manual override to be used only when power is not applied to the unit.
- If the universal clamp is not set to 0° on the position indicator, manually wind the actuator in the direction indicated with hex wrench from -5° to 0° and lock with a screwdriver.
- When operating manual override, back off 5° from full open mechanical stop to ensure proper release.
- Do not attempt to use the manual override with actuators mounted in tandem. Damage to the gear train could occur.
- Using power tools to adjust the manual override will cause damage to the gears.
- To unlock manual override without power, crank the manual override in the direction indicated a minimum of 5°.

Long Shaft



Short Shaft



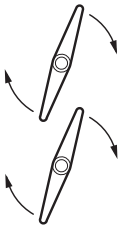
3/8" to 3/4" Diameter (10 mm to 20 mm)
3/8" to 1/2" Square (10 mm to 13 mm)

Move the damper to its normal position. Verify the controller action is set to match the damper application.

Normally closed damper: when damper is closed, actuator position indicator should be at 0°. When damper is open, actuator position indicator should be at 90°.

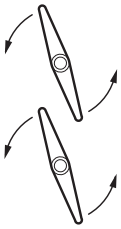
Normally opened damper: when damper is open, actuator position indicator should be at 0°. When damper is closed actuator position indicator should be at 90°.

A - Left



Shaft Rotates Clockwise To Open

A - Right



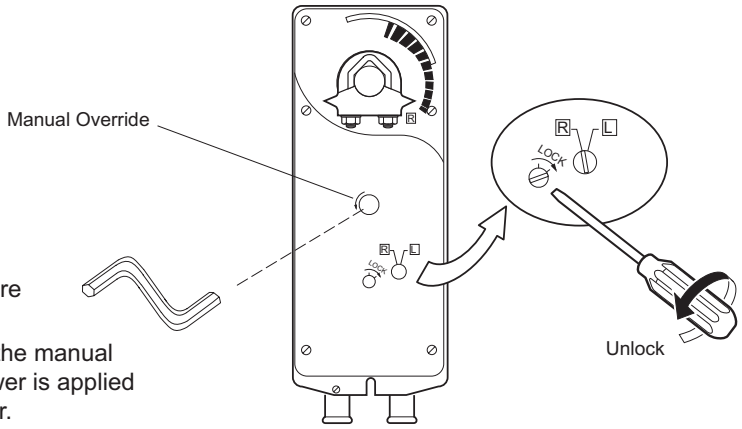
Shaft Rotates Counterclockwise To Open

This step determines shaft rotation. Linkage may change damper direction.

B

For MS41-707X and MS41-715X only (manual override).
For MS40-707X and MS40-715X, proceed to step C.

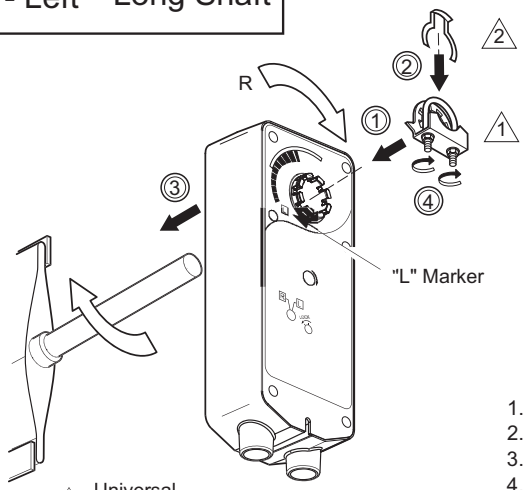
If position indicator does not point to zero: Unlock the actuator.
Insert hex wrench into manual override.
Crank the actuator so the indicator points to 0°.
Lock the actuator.



Fully engage hex wrench into manual override before winding.

Caution: Do not crank the manual override if power is applied to the actuator.

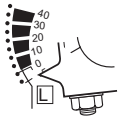
C - Left - Long Shaft



1. Universal mounting clamp.
2. Retaining clip.

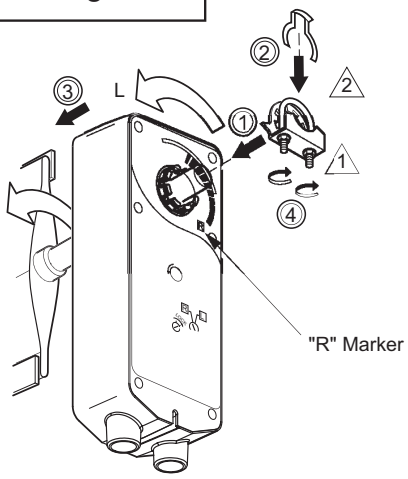
1. Assemble mounting clamp.
2. Assemble retaining clip.
3. Place actuator over shaft.
4. Hand tighten clamp nuts.

For MS40-707X and MS40-715X actuators:



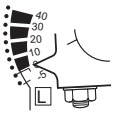
Correct clamp mounting position if actuator is in normal spring return position

C - Right - Long Shaft



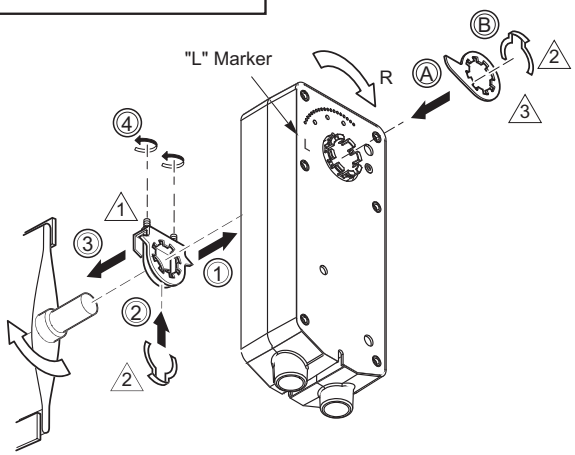
1. Universal mounting clamp.
2. Retaining clip.

For MS41-707X and MS41-715X actuators:



Correct clamp mounting position if actuator is locked with 5° preload.

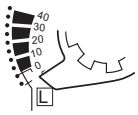
C - Left - Short Shaft



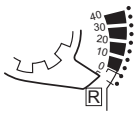
1. Universal clamp.
2. Retaining clip.
3. Damper position indicator.

A. Assemble damper position indicator.
B. Assemble retaining clip.
1. Position mounting clamp.
2. Assemble retaining clip.
3. Slide actuator over shaft.
4. Hand tighten clamp nuts.

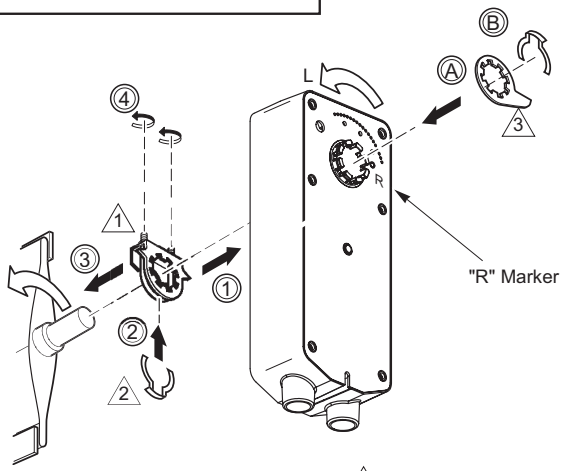
For MS40-707X and MS40-715X actuators:



Correct pointer mounting position if actuator is in normal spring return position

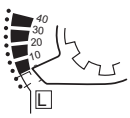


C - Right - Short Shaft

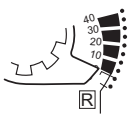


1. Universal clamp.
2. Retaining clip.
3. Damper position indicator.

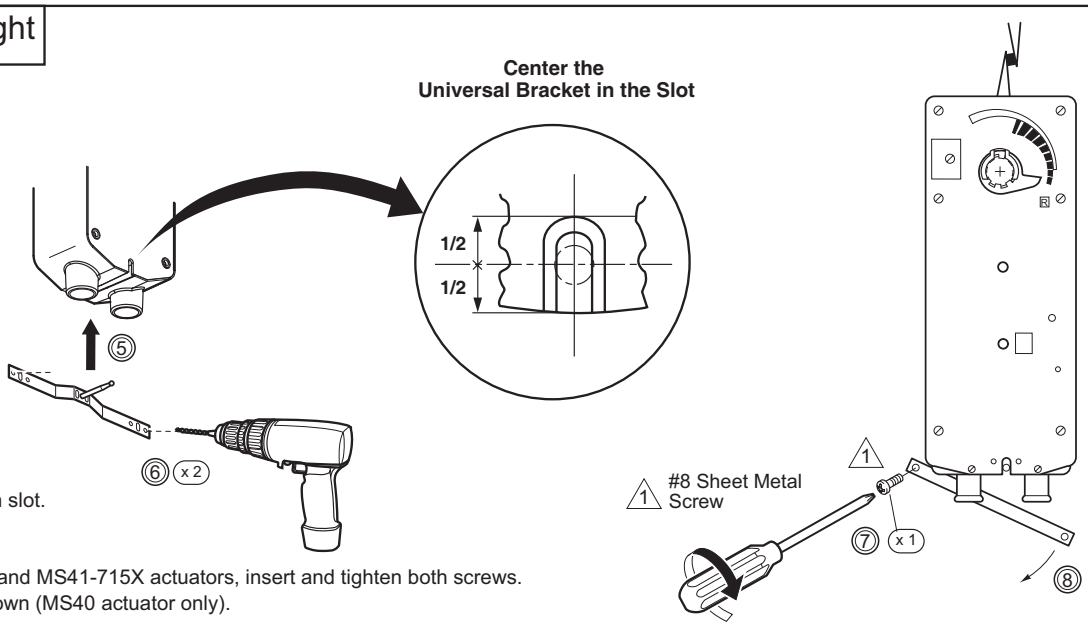
For MS41-707X and MS41-715X actuators:



Correct pointer mounting position if actuator is locked at 5° preload.

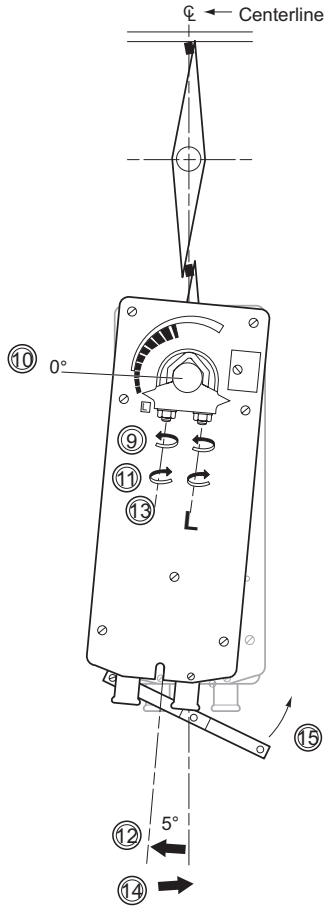


D - Left and Right

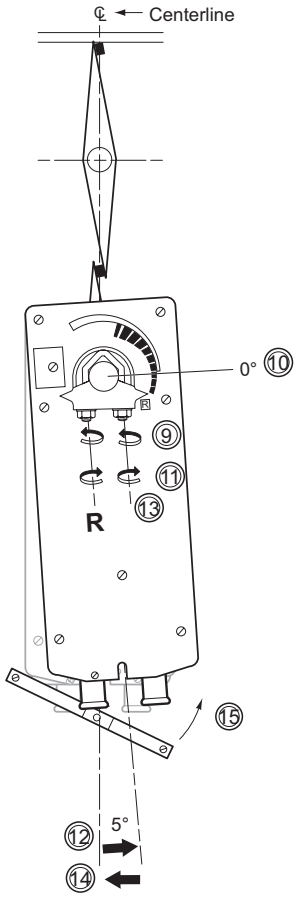


5. Center bracket in slot.
6. Drill two holes.
7. Start one screw.
   For MS41-707X and MS41-715X actuators, insert and tighten both screws.
8. Swing bracket down (MS40 actuator only).

E- Left



E- Right



9. Loosen clamp nuts.
10. Check that the shaft is in full zero position.

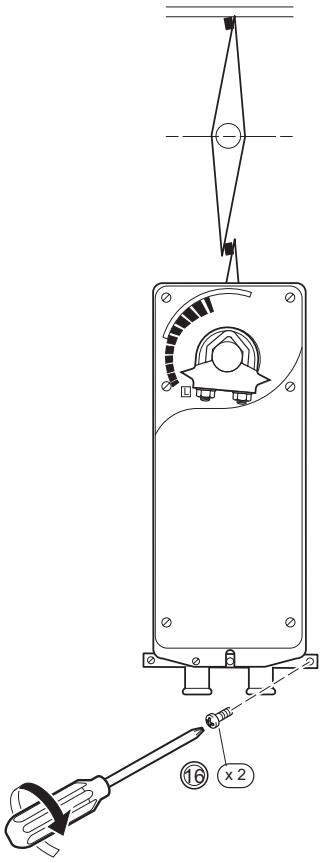
For MS41-707X and MS41-715X only:

11. Tighten clamp nuts to 8 - 10 ft-lb (11 - 14 Nm). This completes the installation for MA41-704X and MA41-715X.

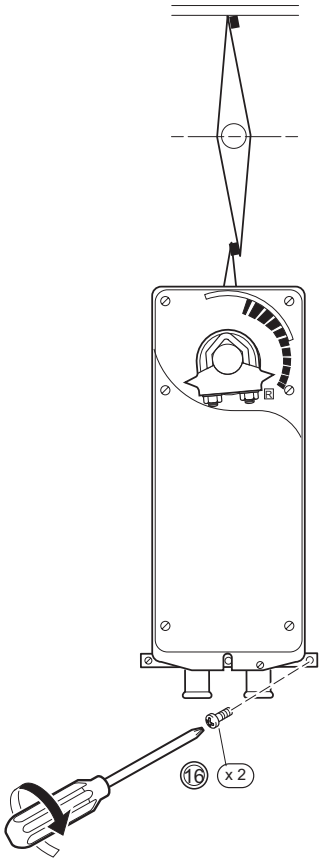
For MS40-707X and MS40-715X only:

12. Swing actuator 5° in the direction of travel. Do not move shaft.
13. Tighten clamp nuts to 8 - 10 ft-lb (11 - 14 Nm).
14. Move bottom of actuator back into position.
15. Pivot bracket back into position.

F- Left



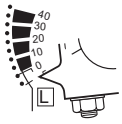
F- Right



For MS40-707X and MS40-715X only:

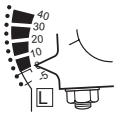
16. Tighten bracket screws.

For MS40-707X and MS40-715X actuators:

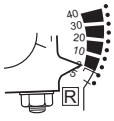


Correct pointer position after mounting.

For MS41-707X and MS41-715X actuators:



Correct pointer position after mounting.



The lock on MS41-707X and MS41-715X will release on first power-up.

Jackshaft Installation

(MS40-7043 Series)

The MS40-7043 actuator is designed for use with jackshafts up to 3/4" (19 mm) in diameter. In most applications, the MS40-7043 actuator may be mounted in the same manner as a standard damper shaft application. If the jackshaft diameter is larger than 5/8" (16 mm) in diameter, the optional AM-710 universal clamp must be used.

(MS4X-7153 and MS4X-7073 Series)

The MS4X-7153 and MS4X-7073 actuators are designed for use with jackshafts up to 1.05" (27 mm) in diameter. In most applications, the actuator may be mounted in the same manner as a standard damper shaft application. If the jackshaft diameter is larger than 3/4" (19 mm) in diameter, the optional AM-687 universal clamp must be used.

Multiple Actuator Mounting (MS4X-7153 only)

If more torque is required than one actuator can provide, a second actuator may be mounted to the jackshaft or standard damper shaft, using the AM-673 multiple mounting bracket. See Figure-4.

Caution: MX41-707X, 715X - Do not attempt to use the manual override with actuators mounted in tandem. Damage to the gear train may occur.

Multiple actuators may be powered from one transformer provided the following rules are followed:

- The total current draw of the actuators (VA rating) is less than, or equal to, the rating of the transformer.
- Polarity on the secondary of the transformer is strictly followed.
  - All Black wires from all actuators are connected to the common lead on the transformer.
  - All Red wires from all actuators are connected to the hot lead.

Caution: Mixing the Black and Red wires on one lead of the transformer may result in erratic operation or failure of the actuator and/or controls.

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

- The transformers are properly sized.
- All Black wires from all actuators are tied together and tied to the negative lead of the control signal.

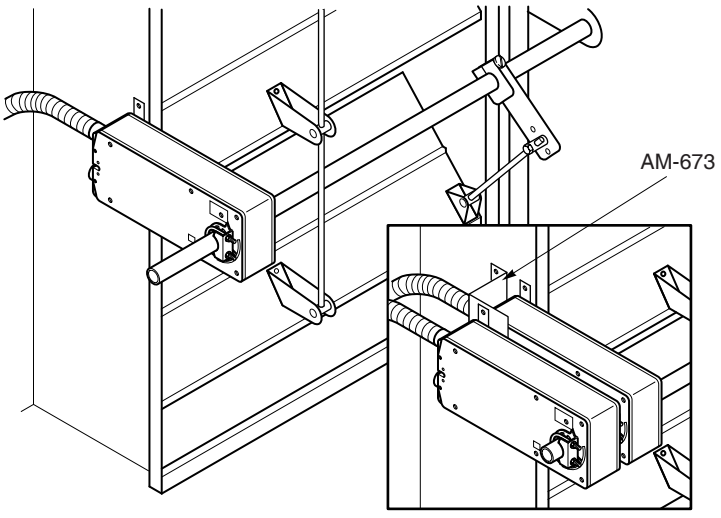


Figure-4 Mounting Multiple Actuators.

Wiring Requirements

Control Leads

See Table-3 for power wiring data. Refer to Figure-1 and Figure-2 for typical wiring.

Table-3 Power Wiring.

Actuator Voltage	Part Number	Maximum Wire Run in ft. (m)					
		12 AWG	14 AWG	16 AWG	18 AWG	20 AWG	22 AWG
24 Vac 22-30 Vdc	MS40-7043 (-MP)	1100 (335)	700 (213)	430 (131)	270 (82)	170 (52)	110 (34)
	MS40-7043-501 (MP5)						
	MS4X-7073	1000 (305)	640 (195)	400 (122)	250 (76)	160 (49)	100 (30)
	MS4X-7073-502						
	MS4X-7153	600 (183)	380 (116)	240 (73)	150 (46)	90 (27)	60 (18)
	MS4X-7153-502						

Auxiliary Switch

The MS40-7043-501(-MP5) series actuators include one built-in SPDT auxiliary switch which can be used for interfacing or signaling (e.g., for fan start-up). The switch is adjustable between 0° and 95° of rotation (0 to 1 scale).

The MS4X-7153-502 and MS4X-7073-502 series actuators include two built-in SPDT auxiliary switches which can be used for interfacing or signaling (e.g., for fan start-up). The switch position near the normal (spring return) position is fixed at 5°. The other is adjustable between 25° and 85° of rotation.

Adjusting the Switching Point

Refer to Table-4 for auxiliary switch rating.

Adjusting the switching point for MS40-7043-501 (-MP5)

1. The actuator must be in its normal (spring return) position.
2. Use a flat screw driver to rotate the switch pointer until it is at the desired switch position on the 0 to 1 scale.

Adjusting the switching point for MS4X-7153-502 or MS4X-7073-502

1. The actuator must be in its normal (spring return) position.
2. Insert a 1/8" allen wrench into the hex hole located in the center of the adjustable switch pointer.
3. Rotate the wrench until the switch pointer is at the desired switch position in degrees, from 25 to 85°.

Table-4 Auxiliary Switch Rating.

Part Number	Voltage	Resistive Load	Inductive Load
MS40-7043-501 (MP5)	24 Vac	6A	1.5A
MS4X-7073-502	250 Vac	7A	2.5A
MS4X-7153-502			

Rotation Limitation

Rotation Limitation for MS40-7043 Series

The Stop Block is used in conjunction with the tab on the universal clamp or the AM-709 position indicator. In order to function properly, the clamp or indicator must be mounted correctly.

The Stop Block controls the rotational output of the MS40-7043 and MF40-7043-501 actuators. It is used in applications where a damper has a designed rotation that is less than 90°, for example with a 45° or 60° rotating damper. It can also be used to provide a minimum damper position which is easily set, or changed, without removing the actuator from the damper.

1. Determine the amount of damper rotation required. The actuator stop block provides limited rotation from 40° to 95°.
2. Loosen the screw securing the stop block to the actuator.

Note: The actuator is shipped with the Stop Block mounted to the “L” side. If the damper application requires the “R” side face the installer, simply remove the Stop Block and screw and move it to the new location.

---

3. Slide the stop block into position, so that its edge lines up with the degree graduation on the actuator face which corresponds with the required rotation. See Figure-5.
4. Secure the stop block in place.
5. Test the damper rotation by applying power and the required control signal. Re-adjust if necessary.

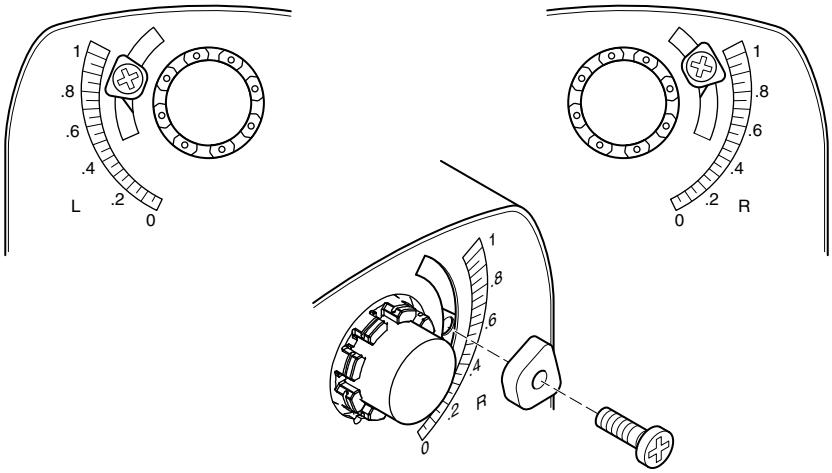


Figure-5 Adjusting Stop Block for Limited Rotation.

Rotation Limitation for MS4X-7153 and MS4X-7073 Series

The AM-689 rotation limiter is used in conjunction with the tab on the universal clamp or the AM-686 position indicator which comes with the AM-689. In order to function properly, the clamp or indicator must be mounted correctly.

The AM-689 rotation limiter controls the rotational output of the MS4X-7153, MS4X-7153-502, MS4X-7073, and MS4X-7073-502 actuators. It is used in applications where a damper has a designed rotation that is less than 90°, for example with a 45° or 60° rotating damper. It can also be used to provide a minimum damper position which is easily set, or changed, without removing the actuator from the damper.

1. Determine the amount of damper rotation required.
2. Locate the AM-689 rotation limiter on the actuator so that its edge lines up with the degree graduation on the actuator face which corresponds with the required rotation. See Figure-6.
3. Find the appropriate cross-hair location through the slot of the rotation limiter. This is the mounting location for the retaining screw.
4. Pierce through the label material to allow easy fastening of the retaining screw.
5. Position the rotation limiter back to the desired position, making sure the locating “teeth” on the rotation limiter are engaged into the locating holes on the actuator.
6. Fasten the rotation limiter to the actuator using the self-tapping screw provided.
7. Test the damper rotation by applying power and the required control signal. Re-adjust if necessary.

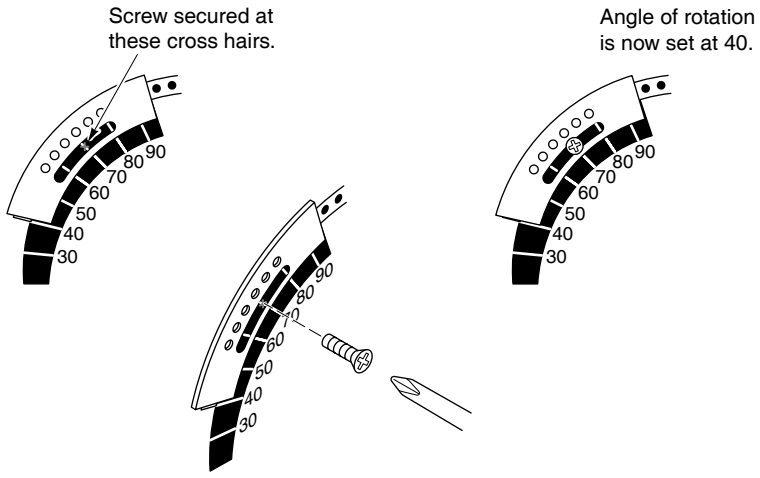


Figure-6 Securing the AM-689 Rotation Limiter.

Minimum Damper Positioning

Note: When using the AM-689 rotation limiter with an MS4X-7073 or MS4X-7153 actuator to provide a minimum damper position, the short shaft mounting procedure must be used to mount the actuator.

Caution:

- The AM-689 rotation limiter should not be used with an MS4X-7073 or MS4X-7153 actuator to provide a minimum damper position in outdoor air damper applications. The rotation limiter prevents the damper from reaching the full-closed position. This may cause coils to freeze or may cause other system problems to occur.

1. Position the damper to its minimum position by providing the appropriate control signal to the MS4X-7073 or MS4X-7153.
2. Place the position indicator onto the actuator spline in the approximate position shown in Figure-7. Fasten it with the retaining clip.
3. Place the AM-689 rotation limiter on the actuator so that it either makes contact with, or is as close as possible to, the edge of the indicator. See Figure-8.
4. Make sure that the locating teeth are engaged into the locating holes on the actuator. If all of the mounting teeth do not align with the holes, the mounting location of the indicator to the spline may have to be moved. The rotation limiter would then be remounted to get the best position match of both parts.
5. Find the cross-hair location through the slot of the rotation limiter. This is the mounting location for the retaining screw.
6. Pierce through the label material to allow easy fastening of the retaining screw.
7. Fasten the rotation limiter to the actuator using the self tapping screw provided.
8. Test the damper operation by applying power and the required control signal. Re-adjust if necessary.

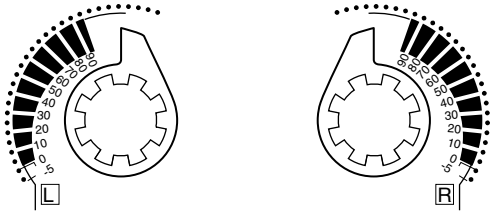


Figure-7 Installing the Position Indicator.

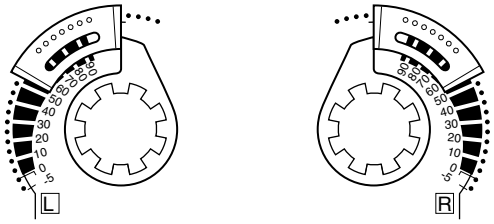


Figure-8 Positioning the Rotation Limiter.

CHECKOUT

After the entire system has been installed and the actuator has been powered up, the following check can be made for proper system operation. Check for correct operation of the damper while actuator is being stroked.

1. Apply power to the actuator. Actuator and damper should be driven to their powered position as determined by the control signal.
2. On the MS4X-7XXX-50X models, check for correct auxiliary switch operation.
3. Break power to the actuator. Actuator and damper should return to the spring return position.

Note: Check that the transformer(s) are sized properly.

- If a common transformer is used with multiple actuators, make sure that polarity is observed on the secondary. This means connecting all Black wires to one leg of the transformer and all Red wires to the other leg of the transformer.
- If multiple transformers are used with one control signal, make sure all Black wires are tied together and tied to control signal negative (-).
- Controllers and actuators must have separate 24 Vac power sources.

Go, No Go Test

1. Turn 24 Vac power to actuator off.
2. Disconnect and temporarily insulate the yellow/black input wire.
3. With “L” side of the actuator facing the installer, set the L/R switch to “R.”
4. Turn actuator power back on.
5. Switch the L/R switch to the “L” position.
6. The actuator should drive to the full counterclockwise position.

THEORY OF OPERATION

The actuators are mounted directly onto a damper shaft using a universal V-clamp. When the actuator is powered and a Vdc or mAdc control signal is applied to the actuator by the controller, the actuator rotates to a position determined by the control signal. At the same time the spring return mechanism is tensed. When power is removed from the actuator, the spring returns the actuator to its normal position. The actuators provide true mechanical spring return operation for reliable, positive close-off on air tight dampers.

The MS40-704X-501 models are provided with one built-in auxiliary switch. The SPDT switch is provided for interfacing or signaling, for example, fan startup. The switching function is adjustable between 0° and 95° rotation (0 to 1 scale).

All MX4X-7XX3-XXX series actuators use a brushless DC motor which is controlled by a microprocessor. The microprocessor supplies intelligence to provide a constant rotation rate and to know the actuator’s exact normal position. The microprocessor monitors and controls the brushless DC motor’s rotation and provides a digital sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need for mechanical end switches.

The MS4X-707X-502 and MS4X-715X-502 models are provided with two built-in auxiliary switches. The SPDT switches are provided for interfacing or signaling, for example, fan startup. The switching function is adjustable on one switch between 25° and 95° rotation, and the other switch is fixed to operation at 5° rotation.

All MS4X-7XX3 and MS4X-7XX3-5XX actuators provide a 2 to 10 Vdc feedback signal corresponding to the actuator position as determined by the control signal. MS40-7043-MP and MS40-7043-MP5 models provide a 20 Vdc, 25 mA power supply used to power TAC System 8000 controllers in lieu of position feedback.

The MS41-707X-XXX and MS41-715X-XXX actuators are equipped with a manual override mechanism. This allows the actuator to be manually positioned at any point between -5° and 85° rotation. This mechanism is accessible on both sides of the actuator and can be used to ensure tight close-offs for valves and dampers. The manual override should not be used while a unit is powered or on units that are mounted in tandem.

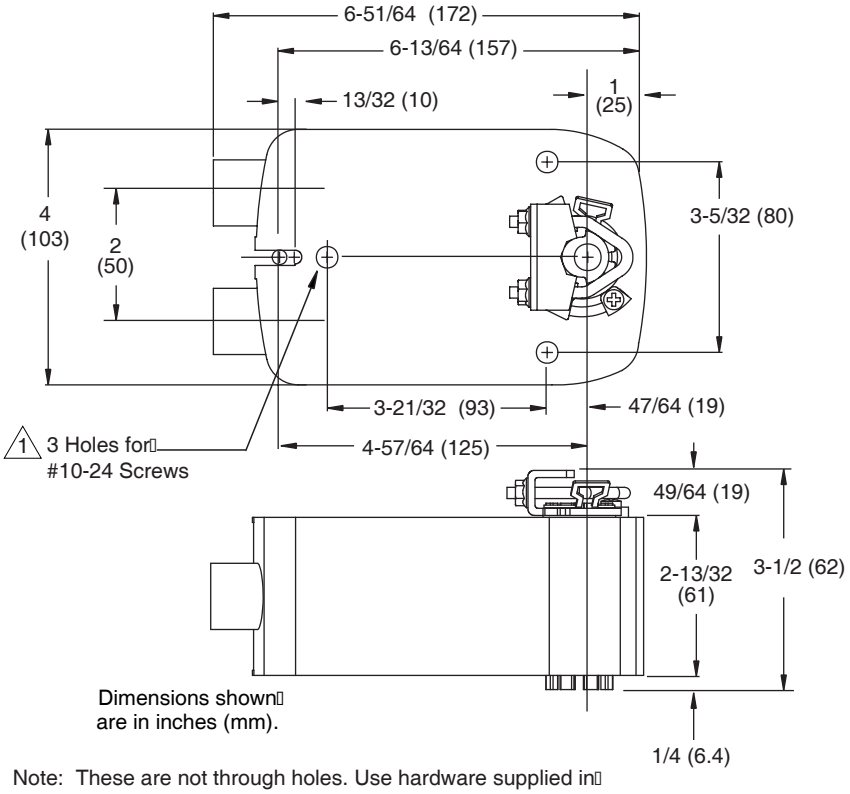
MAINTENANCE

Regular maintenance of the total system is recommended to assure sustained optimum performance. The MS4X series actuators are maintenance free.

FIELD REPAIR

None. Replace with a functional actuator.

DIMENSIONAL DATA



1 Note: These are not through holes. Use hardware supplied in TAC approved AM kits.

Figure-9 MS40-7043 Spring Return Damper Actuator Dimensions.

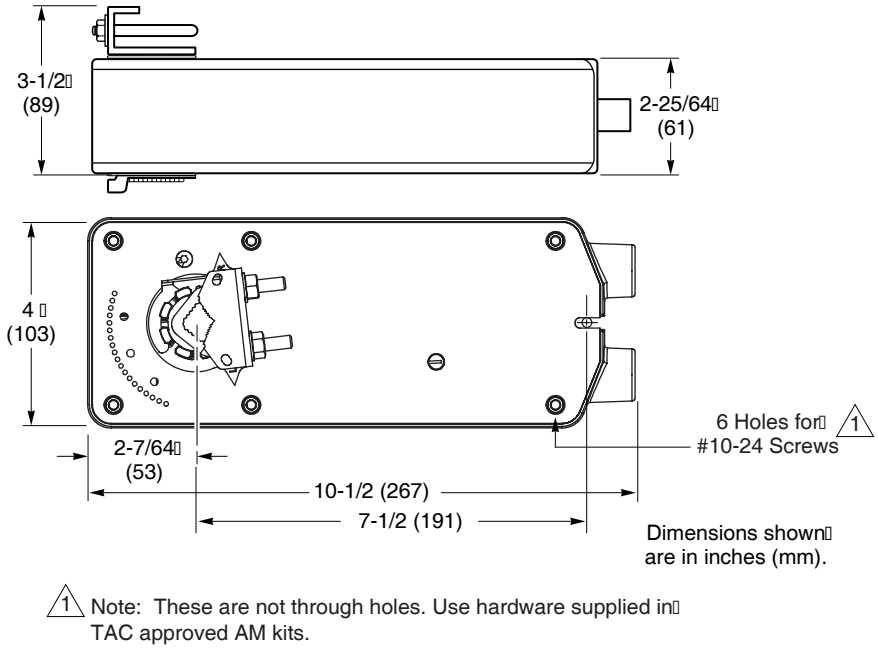


Figure-10 MS4X-7073 and MS4X-7153 Spring Return Damper Actuator Dimensions.

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Non-Room Thermistors and RTDs

Installation and Operation Instructions

9502_ins_therm_rtd_nrm rev. 5/05/06

Termination

BAPI recommends using twisted pair of at least 22AWG and sealant filled connectors for all wire connections. Larger gauge wire may be required for long runs. All wiring must comply with the National Electric Code (NEC) and local codes.

Do NOT run this device's wiring in the same conduit as AC power wiring of NEC class 1, NEC class 2, NEC class 3 or with wiring used to supply highly inductive loads such as motors, contactors and relays. BAPI's tests show that fluctuating and inaccurate signal levels are possible when AC power wiring is present in the same conduit as the signal lines. If you are experiencing any of these difficulties, please contact your BAPI representative

STOP

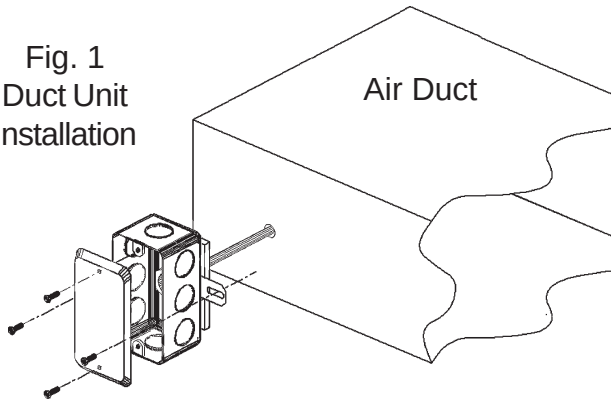
BAPI does not recommend wiring the sensor with power applied as accidental arcing may damage the product and will void the warranty

Temperature Sensor Lead Wire Colors				
Thermistors				
3K	Yellow/Black		**20K**	White/White
10K-2	Yellow/Yellow		**100K**	Yellow/White
10K-3	Yellow/Red		**2KΩ**	Brown/Brown
10K-4	Black/Blue		**2K-2**	Brown/Orange
10K3(11K)	Yellow/Blue			
Platinum RTDs				
Single Point Two Wire			**Single Point Three Wire**	
100Ω	Red/Red		**100Ω**	Red/Red/Black
1KΩ	Orange/Orange		**1KΩ**	Orange/Orange/Black

Installation BA/Temp-D (DUCT) (Figure 1)

Position the sensor so that the tip of the probe is as close as possible to the center of the duct. Drill a 7/16 inch hole for the probe and use two number 8 sheet metal screws to attach the sensor to the duct. Place the probe in its mounting hole, be sure that the blue plastic fitting holding the probe is centered in the hole. Be sure that the foam seals the hole, do not over tighten the screws.

Fig. 1
Duct Unit
Installation



Installation BA/Temp-PP, -RPP, RPFEP, -RPFEP2 (Remote probes) (Figure 2)

Strap the sensor in place using cable ties, waxed linen string or similar device. Fix the probe so that the silver probe body end does not vibrate due to airflow or machine vibration. Secure the lead wire so that it does not flop around. Connect the end of the wire to the correct inputs on your controller.

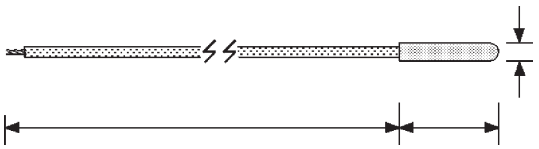


Fig. 2
Remote Probe Installation

*Some items may not be CE compliant, call BAPI for additional information.

Specifications subject to change without notice.

Building Automation Products, Inc., 750 North Royal Avenue, Gays Mills, WI 54631 USA
Tel:+1-608-735-4800 • Fax+1-608-735-4804 • E-mail:sales@bapihvac.com • Web:www.bapihvac.com

Installation BA/Temp-S (Strap) (Figure 3)

Place the clamp on strap sensor on bare pipe, or a section of pipe with insulation removed. Make sure that the copper pad on the foam is in good physical contact with the pipe. Snug the clamp so that the assembly does not rotate around the pipe when moderate pressure is applied to the junction box. Do not over tighten. Pipe insulation may be placed over the whole assembly. The BA/Temp-S is sized for bare pipes of 2 to 4.5 inches in diameter.

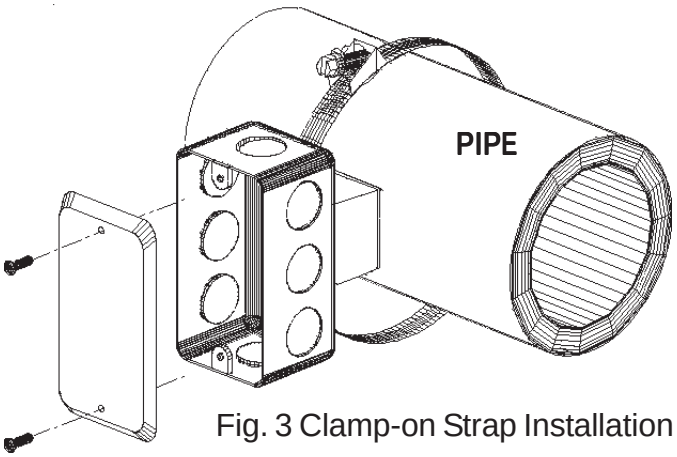


Fig. 3 Clamp-on Strap Installation

Installation BA/Temp-STP (Spring-Loaded Strap) (Figure 4)

The BA/Temp-STP sensor is used when a large section of insulation cannot be removed from a pipe. Insulation of up to two inches thick is accommodated by the BA/Temp-STP. Cut a hole of 1 1/4 inch diameter in the insulation and remove the insulation from the hole down to the bare pipe. Be sure to remove all insulation and debris from the hole. Place the copper pad on the end of the spring mounted foam into the hole, making sure it makes good physical contact with the pipe. Tighten the straps until the strap mounting bracket contacts the insulation. The BA/Temp-STP is sized for overall pipe diameters of 5 to 12.5 inches, including the insulation.

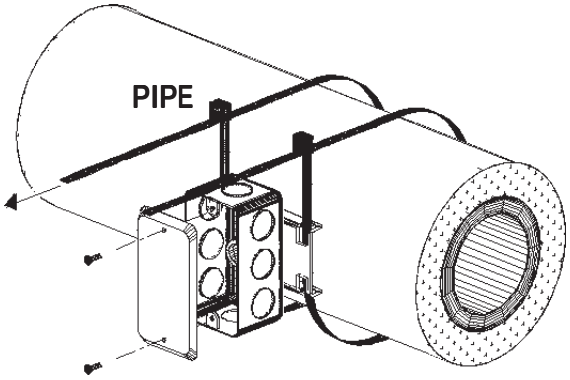


Fig. 4 Spring-Loaded Strap Installation

Installation BA/Temp-O (Outside) (Figure 5) and BA/Temp-O-EU (Outside IP66Rated) (Figure 6)

Do not mount in direct sunlight. Mount with the sensor probe pointed down. Drill a hole large enough for your sensor cable through your mounting surface. Mount the unit to the surface with a wiring knock out centered over the wiring hole. Pull the wiring into the unit and terminate using sealant filled connectors. Best practice is to caulk the wiring hole after the wiring is installed. Be sure that the foam on the back of the unit makes a good weather tight connection.

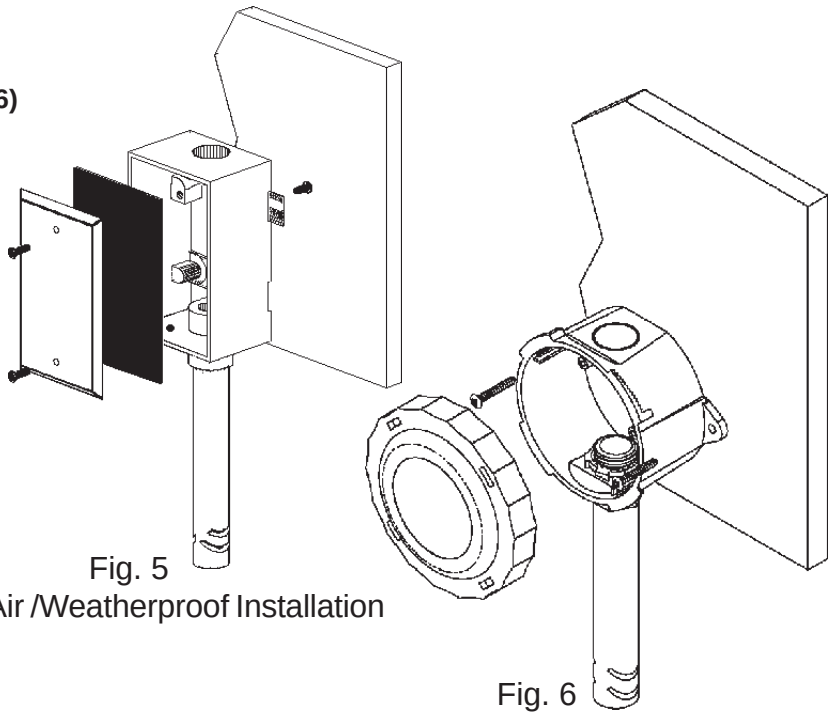


Fig. 5
Outside Air /Weatherproof Installation

Fig. 6
Outside Air/ IP66Rated Installation

Building Automation Products, Inc., 750 North Royal Avenue, Gays Mills, WI 54631 USA
Tel:+1-608-735-4800 • Fax+1-608-735-4804 • E-mail:sales@bapihvac.com • Web:www.bapihvac.com

Installation BA/Temp-I (Immersion) (Figure 7)

Place the thermowell into the nipple using teflon tape and pipe dope. Tighten securely but do not over torque. The immersion sensor is then inserted into the well with the blue plastic fitting screwing into the opening on the well. Only tighten the immersion sensor by hand and then snuggly without too much torque. Make sure that the tip of the immersion sensor is in contact with the bottom of the well. The unit is designed so that the temperature probe moves slightly into the junction box as the sensor hits the bottom of the well.

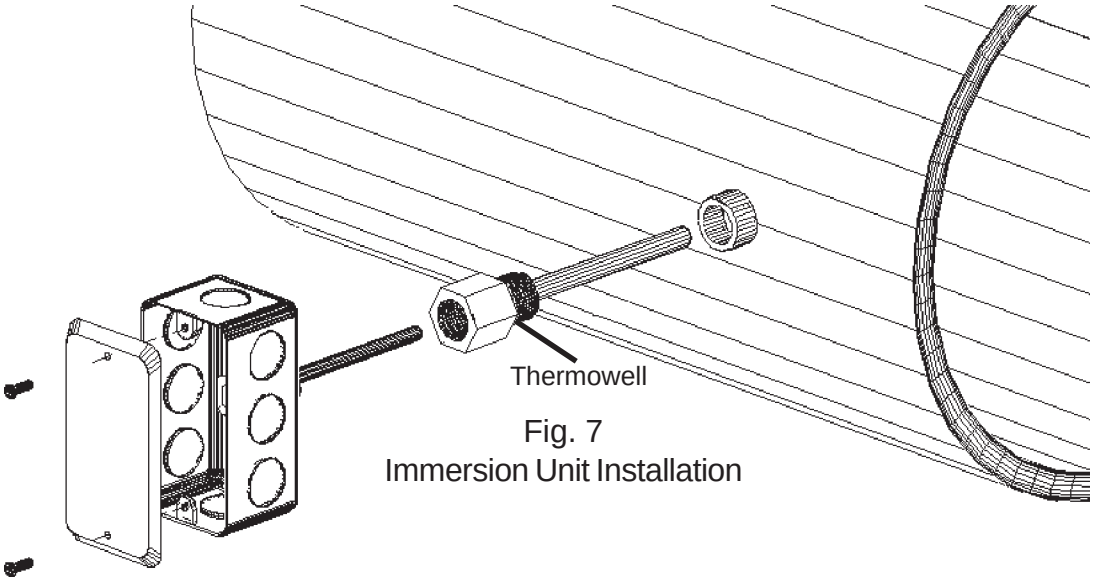


Fig. 7
Immersion Unit Installation

Troubleshooting Temperature

Problems:	**Possible Solutions:**
Controller reports higher than actual temperature	- Confirm the input is set up correctly in the front end software - Verify that the wires are not physically shorted or open - Check wiring for proper termination - Disconnect wires and measure sensor resistance with an Ohm meter - Verify the “Sensor” output is correct (See note below)
Controller reports lower than actual temperature	- Confirm the input is set up correctly in the front end software - Verify that the thermistor is not physically open or shorted - Check wiring for proper termination - Disconnect wires and measure sensor resistance with an Ohm meter - Verify the “Sensor” output is correct (See note below)

Note: Measure the temperature at the temperature sensor’s location using an accurate temperature standard. Disconnect the temperature sensor wires and measure the temperature sensor’s resistance with an ohmmeter. Compare the temperature sensor’s resistance to the appropriate temperature sensor table on the BAPI web site. If the measured resistance is different from the temperature table by more than 5%, call BAPI technical support. BAPI’s web site is found at www.bapihvac.com; click on the button labeled SENSORS on the left of the screen and then click on the type of sensor you have.

Thermowells

For guidelines about thermowell pressure rating versus temperature and maximum fluid velocity versus insertion length please contact your BAPI representative.

Fig. 8
Two Part (Welded)
Thermowell
2", 4" or 8"
(BA/Length")

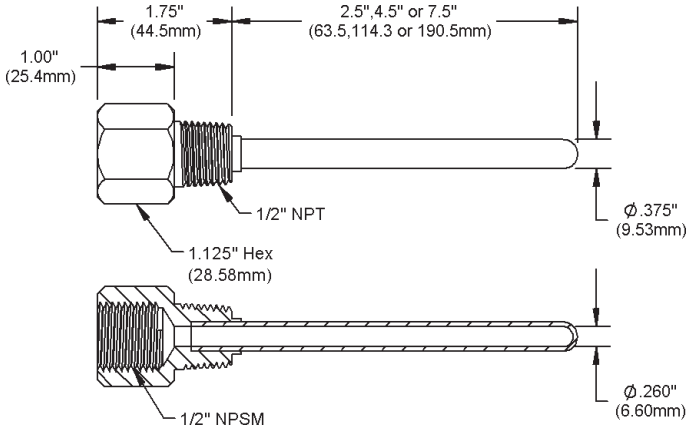
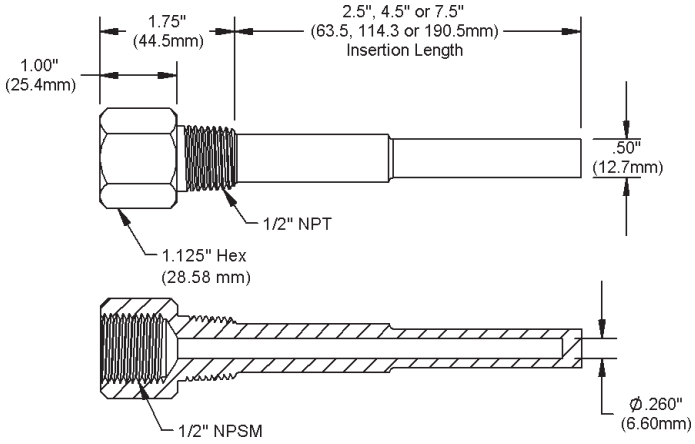


Fig. 9
Machined Thermowell
2", 4" or 8"
(BA/Length"MB)
(BA/Length"MB304)
(BA/Length"MB316)



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Office: (765) 883-5538
Sales: (800) 888-5538
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Email: sales@functionaldevices.com

Manufacturing quality products in the United States of America since 1969

RIBX24SBA

Enclosed Internal Adjustable .50-20 Amp Current Sensor + Relay 20 Amp SPST + Override with 24 Vac/dc Coil

Functional Devices, Inc. A600C 2005

c UL us LISTED

MADE IN USA

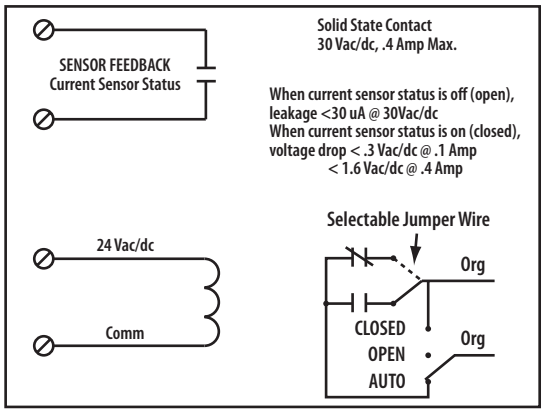
 # Relays & Contact Type: One (1) SPST Continuous Duty Coil
Expected Relay Life: 10 million cycles minimum mechanical
Operating Temperature: -30 to 140° F
Operate Time: 18mS
Relay Status: LED On = Activated
Dimensions: 4.00" x 4.00" x 1.80" with .50" NPT Nipple
Wire Length: 16", 600V Rated
Approvals: UL Listed, UL916, UL864, C-UL Canada
California State Fire Marshal, CE Approved
Housing Rating: Plenum, NEMA 1
Gold Flash: No
Override Switch: Yes

Contact Ratings:
20 Amp Resistive @ 277 Vac
20 Amp Ballast @ 277 Vac N/O
10 Amp Ballast @ 277 Vac N/C
10 Amp Tungsten @ 120 Vac N/O
1,110 VA Pilot Duty @ 277 Vac
770 VA Pilot Duty @ 120 Vac
240 Watt Tunsgten @ 120 Vac N/C
2 HP @ 277 Vac
1 HP @ 120 Vac

Coil Current:
45 mA @ 18 Vac
75 mA @ 24 Vac
30 mA @ 22 Vdc
32 mA @ 24 Vdc
42 mA @ 30 Vdc

Coil Voltage Input:
24 Vac/dc ; 50-60 Hz
Drop Out = 3 Vac / 3.8 Vdc
Pull In = 18 Vac / 22 Vdc

Notes:
» Normally Open or Normally Closed selected by yellow jumper wire

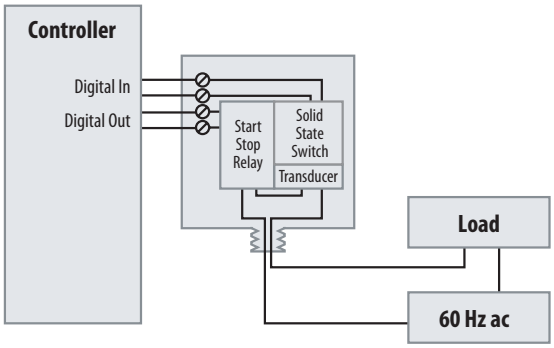


Sensor Type: Internal, with contact status
Sensor Threshold: Adjustable, .50-20 Amps
Sensor Range: .50-20 Amps
Sensor Output: Solid State Contact 30 Vac/dc, 0.4 Amp

Notes:

RELAY & CURRENT SENSOR IN ONE

Directly start/stop load and current sensing all in one package (no external ring is needed). Wire colors to "Load" and "60 Hz ac" differ depending on the model being used. Configurations are either YELLOW & ORANGE, BLUE & YELLOW, or ORANGE & ORANGE.



INTERNAL 20 AMP	INTERNAL 10 AMP	INTERNAL 5 AMP
RIBX24BF	RIBXLCF	RIBXLCEA
RIBX24SBF	RIBXLSF	RIBXLSEA
RIBX24BA	RIBXLCA	
RIBX24SBA	RIBXLSA	

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Email: sales@functionaldevices.com

Manufacturing quality products in the United States of America since 1969

RIBXLCA

Enclosed Internal Adjustable .50-10 Amp Current Sensor + Relay 10 Amp SPDT with 10-30 Vac/dc Coil

Functional Devices, Inc. A600C 2005

c UL us LISTED

MADE IN USA

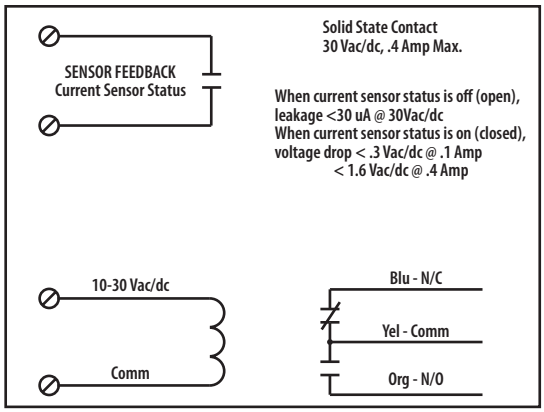
 # Relays & Contact Type: One (1) SPDT Continuous Duty Coil
Expected Relay Life: 10 million cycles minimum mechanical
Operating Temperature: -30 to 140° F
Operate Time: 20mS
Relay Status: LED On = Activated
Dimensions: 4.00" x 4.00" x 1.80" with .50" NPT Nipple
Wire Length: 16", 600V Rated
Approvals: UL Listed, UL916, UL864, C-UL Canada
California State Fire Marshal, CE Approved
Housing Rating: Plenum, NEMA 1
Gold Flash: Yes
Override Switch: No

Contact Ratings:
10 Amp Resistive @ 120-277 Vac
10 Amp Resistive @ 28 Vdc
480 VA Pilot Duty @ 240-277 Vac
480 VA Ballast @ 277 Vac
600 Watt Tungsten @ 120 Vac N/O
240 Watt Tungsten @ 120 Vac N/C
1/3 HP for N/O @ 120-240 Vac
1/6 HP for N/C @ 120-240 Vac
1/4 HP for N/O @ 277 Vac
1/8 HP for N/C @ 277 Vac

Coil Current:

30 mA @ 10 Vac	12 mA @ 10 Vdc
32 mA @ 12 Vac	14 mA @ 12 Vdc
42 mA @ 24 Vac	16 mA @ 24 Vdc
50 mA @ 30 Vac	18 mA @ 30 Vdc

Coil Voltage Input:
10-30 Vac/dc ; 50-60 Hz
Drop Out = 2.1 Vac / 2.8 Vdc
Pull In = 9 Vac / 10 Vdc

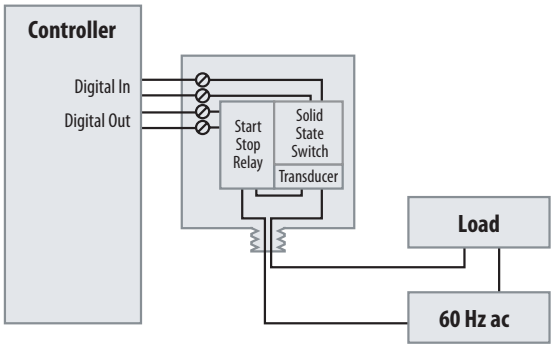


Sensor Type: Internal, with contact status
Sensor Threshold: Adjustable, .50-10 Amps
Sensor Range: .50-10 Amps
Sensor Output: Solid State Contact 30 Vac/dc, 0.4 Amp

Notes:

RELAY & CURRENT SENSOR IN ONE

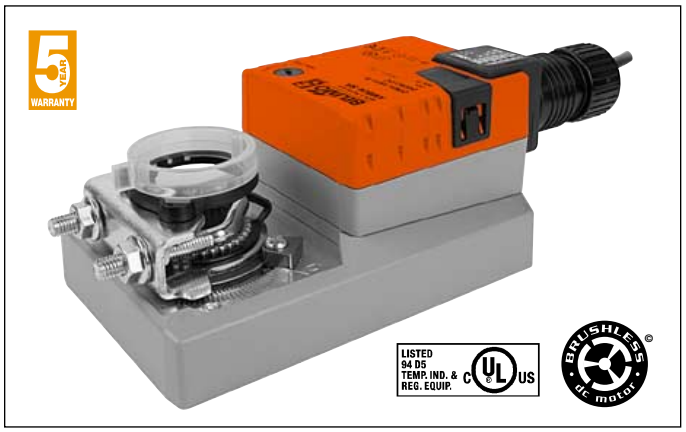
Directly start/stop load and current sensing all in one package (no external ring is needed). Wire colors to "Load" and "60 Hz ac" differ depending on the model being used. Configurations are either YELLOW & ORANGE, BLUE & YELLOW, or ORANGE & ORANGE.



INTERNAL 20 AMP	INTERNAL 10 AMP	INTERNAL 5 AMP
RIBX24BF	RIBXLCF	RIBXLCEA
RIBX24SBF	RIBXLSF	RIBXLSEA
RIBX24BA	RIBXLCA	
RIBX24SBA	RIBXLSA	

AMX24-MFT

Proportional Control, Non-Spring Return, Direct Coupled, 24V, Multi-Function Technology®



Torque min. 180 in-lb for control of damper surfaces up to 45 sq ft.

Technical Data	AMX24-MFT
Power Supply	24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power Consumption	4 W (1.25 W)
Transformer Sizing	6 VA (Class 2 power source)
Electrical Connection	18 GA plenum rated cable 1/2" conduit connector ❑ 3 ft [1m] ❑ 10 ft [3m] ❑ 16 ft [5m]
Overload Protection	electronic throughout 0 to 95° rotation
Operating Range Y	2 to 10 VDC, 4 to 20 mA (default) Variable (VDC, PWM, Floating Point, On/Off)
Input Impedance	100 kΩ (0.1 mA), 500Ω 1500 Ω (PWM, Floating Point, On/Off)
Feedback Output U	2 to 10 VDC, 0.5 mA max VDC Variable
Angle of Rotation	max. 95°, adjust. with mechanical stop electronically variable
Torque	180 in-lb [20 Nm]
Direction of Rotation	reversible with ↷/↶ switch
Position Indication	reflective visual indicator (snap-on)
Manual Override	external push button
Running Time	150 seconds (default) Variable (90 to 350 secs)
Humidity	5 to 95% RH non condensing (EN 60730-1)
Ambient Temperature	-22°F to +122°F [-30°C to +50°C]
Storage Temperature	-40°F to +176°F [-40°C to +80°C]
Housing	NEMA 2/IP54
Housing Material	UL94-5VA
Agency Listings	cULus acc. to UL 60730-1/-2-14 and CAN/CSA C22.2 No.24, CE according to 73 / 23 / EEC
Noise Level	<45dB(A)
Servicing	maintenance free
Quality Standard	ISO 9001
Weight	2.6 lbs [1.2 kg]

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp, 1/2" self-centered default. A crankarm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The default parameters for 2 to 10 VDC applications of the …MFT actuator are assigned during manufacturing. If necessary, custom versions of the actuators can be ordered. The parameters can be changed by two means: pre-set and custom configurations from Belimo or on-site configurations using the Belimo PC-Tool software.

Operation

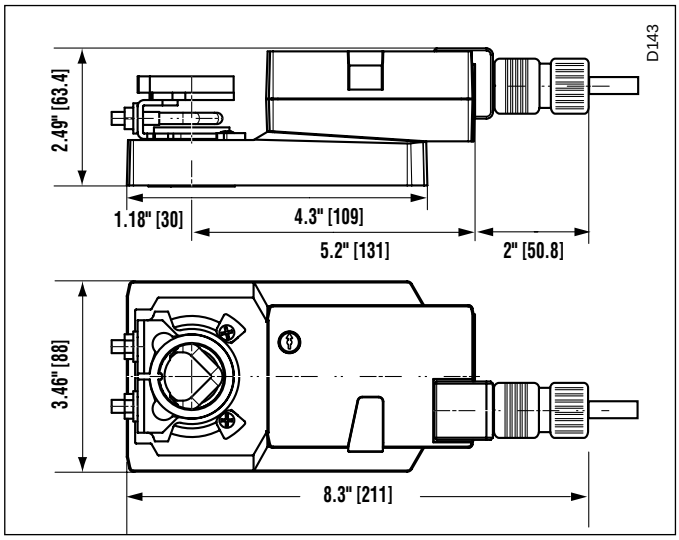
The actuator is not provided with and does not require any limit switches, but is electronically protected against overload. The anti-rotation strap supplied with the actuator will prevent lateral movement.

The AMX series provides 95° of rotation and a visual indicator indicates position of the actuator. When reaching the damper or actuator end position, the actuator automatically stops. The gears can be manually disengaged with a button on the actuator cover.

The AMX24-MFT actuators use a Brushless DC motor, which is controlled by an Application Specific Integrated Circuit (ASIC). The ASIC monitors and controls the actuator's rotation and provides a digital rotation sensing (DRS) function to prevent damage to the actuator in a stall condition. Power consumption is reduced in holding mode.

Add on auxiliary switches or feedback potentiometers are easily fastened directly onto the actuator body for signaling and switching functions

Dimensions (All numbers in brackets are in millimeters.)



Accessories

K-SA	Reversible Clamp
ZG-100	Universal Mounting Bracket
ZG-101	Universal Mounting Bracket
ZG-103	Universal Mounting Bracket
ZG-104	Universal Mounting Bracket
Z-SMA	AM/SM to AM Retrofit Mounting Bracket
ZG-AMA	Crankarm Adaptor Kit
AV8-25	Universal Shaft Extension
ZG-JSA (-1, 2, 3)	Jackshaft Adaptors for Hollow Jackshafts
ZS-100	Weather Shield - Steel
ZS-150	Weather Shield - Polycarbonate
ZS-260	Explosion Proof Housing
ZS-300 (-1) (-5)	NEMA 4X Housing
Tool-06	8 mm & 10 mm Wrench
S1A, S2A	Auxiliary Switch (es)
P370	Shaft Mount Auxiliary Switch
P…A	Feedback Potentiometers
SGA24	Min positioners in NEMA 4 housing
SGF24	Min positioners for flush panel mounting

ADS-100	Analog to Digital Switch
ZG-R01	Resistor for 4 to 20 mA Conversion
NSV24 US	Battery Back-Up Module
ZG-X40	Transformer

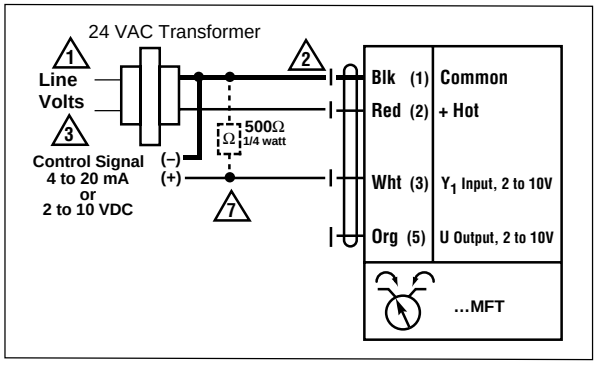
Note: When using AMX24-MFT… actuators, only use accessories listed on this page.

AMX24-MFT - Typical Specification:
Proportional control damper actuators shall be electronic direct-coupled type, which require no crankarm and linkage and be capable of direct mounting to a shaft up to 1.05" diameter. Actuators must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. Actuators shall have Brushless DC motor technology and be protected from overload at all angles of rotation. Actuators shall have reversing switch and manual override on the cover. Run time shall be constant and independent of torque. Actuators shall be cULus listed, have a 5-year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

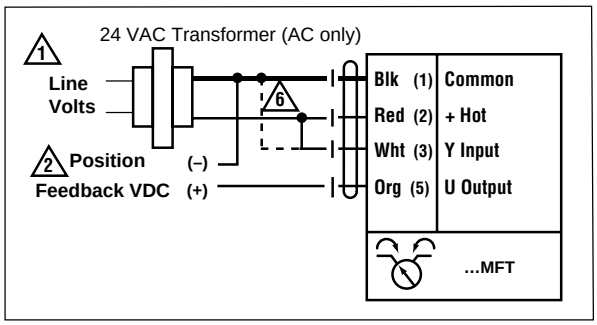
AM

Wiring

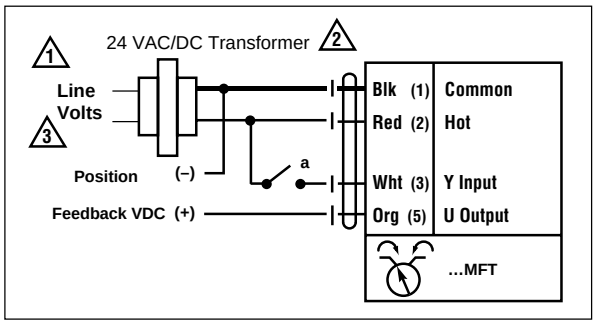
VDC/4-20 mA



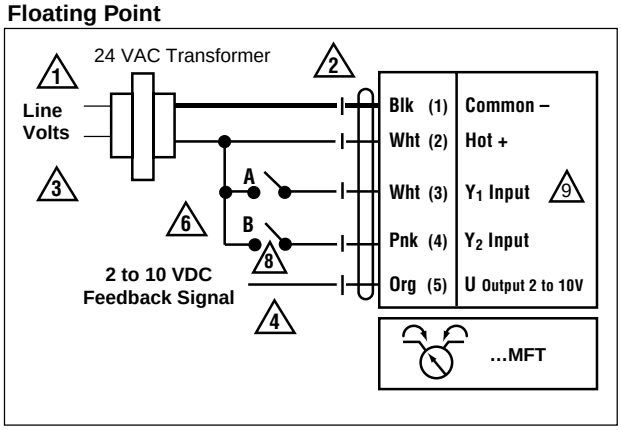
PWM



On/Off



Floating Point



W399

Notes:

1. Provide overload protection and disconnect as required.
2. Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
3. Actuators may also be powered by 24 VDC.
4. Position feedback cannot be used with a Triac sink controller. The actuator internal common reference is not compatiable.
6. Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.
7. ZG-R01 may be used.
8. Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.
9. For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

Ordering example – Non-Spring Return

The ordering process for the new Flexible non-spring return actuators is simple. First select a base actuator that meets the needs of the application and then add the desired options.

1. Base actuator **LMX24-MFT (LM100)**

Select a base actuator

- Torque or linear force, control input, position feedback, power supply…
- See page 40 for complete list of non-spring base actuators.

2. Clamp option **3/4" dia. universal clamp (6)**

Select clamp that accommodates the damper shaft

- LM defaults to a 5/8" dia. clamp, but the 3/4" option can be selected as seen in this example.
- NM and AM default to a 1/2" dia. clamp that also accommodates 3/4" and 1.05" dia. shafts.
- GM accommodates a 1.05" dia. shafts. A 3/4" dia. clamp is available for retrofits of past GM and SM types.

3. Electrical Connection option **16 ft. [5m] 18 GA, plenum rated cable (C5)**

- Default connection is a 3 ft. [1m] long cable. 10 ft [3m] or 16ft [5m] cables are also available.
- Actuators with a "-T" in the model number have a screw terminal strip, which default to a NEMA 1 enclosure rating. A NEMA 2 cover for the terminal strip can be selected.

4. Programming **P-20003 (W03)**

- For –3 and –SR type actuators only the running time can be changed. This is a one-time factory setting.
- For –MFT type actuators refer to page 41 for available configurations.

5. Total **LMX24-MFT (LM100 6 C5 W03)**

Ordering example – Spring Return

1. Base actuator **AF24-MFT-S US**

Select a base actuator

2. Programming **P-10003 (A03)**
2 – 10 VDC input / 0 – 5 VDC feedback

Select pre-set programming code

- P-100xx (Axx) Control voltage applications
- P-200xx (Wxx) Pulse width modulation applications
- P-300xx (Fxx) Floating point applications
- P-400xx (Jxx) On/Off applications
- Or create custom MFT configuration codes, see page 41
- Or create custom MFT configurations in the field with MFT-Actuate PC software.

3. Total **AF24-MFT-S US + P10003**

Order confirmation and invoice example for spring return actuators:

Line Item	Model	Qty
10	AF24-MFT US **P-10003**	10
20	LF24-MFT US **P-20002**	10
30	AF24-MFT US **P-10006**	5
40	**99981-00100**	25

The part number 99981-00100 is a requirement for Belimo as a designation for all the configurations in an order. This product's description will read "MFT CONFIGURATION CHARGE, (P-…/ V-…)". It is used to confirm the correct quantities and to invoice the proper fee for the MFT configurations. The total quantity of configurations is represented in this one line item.The product line item will list the specific configuration below the actuator ordered. If you have more than one model with multiple configurations, each change in configuration will be shown on separate line items. As an example lines 10 and 30 are the same model actuator with different configurations.

Non-Spring Return Actuators

Model Description — Reorder # for actuator

LMX — 24 — –MFT — LM 100 6 C5 W03

The reorder# is a complete description of the flexible actuator, including all custom options.

Power Supply

24	24 VAC/DC
120	100 to 240 VAC

Electrical Connection

Blank	Cable
–T	Screw terminal strip

Actuator family and torque/force output

Actuator	Torque
LM...	45 in-lb
NM...	90 in-lb
AM...	180 in-lb
GM...	360 in-lb
LH...	34 lbf
AH...	101 lbf
LU...	27 in-lb

Control Type

–MFT	Multi-Function technology
–MFT95	0 to 135 Ω
–3	On/Off-Floating Point
–SR	2 to 10 VDC Proportional
–PC	0 to 20V Phasecut

Reorder number break-down

Base actuator
LM 100

See Base Actuators Page 260

Clamp options
6

Code	Description
1	Default universal clamp
6	LM, 3/4" diameter universal clamp
7	NM/AM, reversible clamp for short shaft mounting

Electrical connector options
C5

Code	Description*
C1	Default, 3 ft [1m] cable
C3	10 ft [3m] cable
C5	16 ft [5m] cable
T1	Default, terminal strip NEMA 1/IP20
T2	Covered terminal strip NEMA 2/IP54

*24V actuators supplied with 18GA plenum rated cable.
120 to 240V actuators supplied with 18GA appliance cable.

Running time and programming codes
W03

Codes	Description (-3 & -SR Only)
005	35s (LM only)
004	45s (LM/NM only)
002	95s all, Default on LM/NM/AM
000	150s all, Default on GM/LU/LH/AH
Codes	**Description (MFT Only)**
A01	P-10001
A02	P-10002
A03	P-10003
A28	P-10028
W02	P-20002
W03	P-20003
F02	P-30001

Common or default configurations are configured at no charge. Uncommon or custom codes will be configured by Belimo for a $30.00 list add to each actuator. See page 41 for an extended list of MFT programming codes.

Flexible Products – Non-Spring Return Actuators

BELIMO

	Non-Spring Return Base Actuator								
	Model	Base Actuator Codes	Control Input	Feedback	Running Time	Angle of Rotation/Stroke	Power Supply	VA Rating	Weight (lb)
45 in-lb [5 Nm]	LMX24-3	LM000	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	3	1.1
	LMX24-3-T	LMT00	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	3	1.1
	LMX24-SR	LM030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	3	1.1
	LMX24-SR-T	LMTW0	2-10 VDC (4-20mA*)	----	95 (Default)	95 deg	24 VAC/DC	3	1.1
	LMX24-PC	†	0-20 V Phasecut	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	3	1.5
	LMX24-MFT	LM100	2-10 VDC (Default)	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	3	1.5
	LMX24-MFT95	†	0 to 135 Ohm	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	3	1.5
	LMX120-3	LM060	On/Off, Floating Point	----	95 (Default)	95 deg	100-240 VAC	3	1.1
	LMX120-SR	LM450	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	100-240 VAC	3	1.1
90 in-lb [10 Nm]	NMX24-3	NM000	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	5	1.7
	NMX24-3-T	NMT00	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	5	1.7
	NMX24-SR	NM030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	5	1.7
	NMX24-SR-T	NMTW0	2-10 VDC (4-20mA*)	----	95 (Default)	95 deg	24 VAC/DC	5	1.7
	NMX24-PC	†	0-20 V Phasecut	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	5	2.
	NMX24-MFT	NM100	2-10 VDC (Default)	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	5	2.1
	NMX24-MFT95	†	0 to 135 Ohm	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	5	2.1
	NMX120-3	NM060	On/Off, Floating Point	----	95 (Default)	95 deg	100-240 VAC	5	1.7
	NMX120-SR	NM450	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	100-240 VAC	5	1.7
180 in-lb [20 Nm]	AMX24-3	AM000	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	5	2.2
	AMX24-3-T	AMT00	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	5	2.2
	AMX24-SR	AM030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	5	2.2
	AMX24-SR-T	AMTW0	2-10 VDC (4-20mA*)	----	95 (Default)	95 deg	24 VAC/DC	5	2.2
	AMX24-PC	†	0-20 V Phasecut	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	5	2.6
	AMX24-MFT	AM100	2-10 VDC (Default)	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	5	2.6
	AMX24-MFT95	†	0 to 135 Ohm	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	5	2.6
	AMX120-3	AM060	On/Off, Floating Point	----	95 (Default)	95 deg	100-240 VAC	5	2.2
	AMX120-SR	AM450	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	100-240 VAC	5	2.2
360 in-lb [40 Nm]	GMX24-3	GM540	On/Off, Floating Point	----	150	95 deg	24 VAC/DC	7	3.4
	GMX24-SR	GM560	2-10 VDC (4-20mA*)	2-10 VDC	150	95 deg	24 VAC/DC	7	3.4
	GMX24-PC	†	0-20 V Phasecut	2-10 VDC	150	95 deg	24 VAC/DC	7	3.4
	GMX24-MFT	GM110	2-10 VDC (Default)	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	7	3.4
	GMX24-MFT95	†	0 to 135 Ohm	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	7	3.4
	GMX120-3	GM580	On/Off, Floating Point	----	150	95 deg	100-240 VAC	7	3.4
34 lbf [150 N]	LHX24-3/100	LH000	On/Off, Floating Point	----	95 (Default)	4 in [100 mm]	24 VAC/DC	3	0.81
	LHX24-3/200	LH010	On/Off, Floating Point	----	95 (Default)	8 in [200 mm]	24 VAC/DC	3	0.86
	LHX24-3/300	LH170	On/Off, Floating Point	----	95 (Default)	12 in [300 mm]	24 VAC/DC	3	0.93
	LHX24-SR/100	LH030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	4 in [100 mm]	24 VAC/DC	3	0.81
	LHX24-SR/200	LH040	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	8 in [200 mm]	24 VAC/DC	3	0.86
	LHX24-MFT/100	LH100	2-10 VDC (Default)	2-10 VDC	150 (Default)	4 in [100 mm]	24 VAC/DC	3	0.81
	LHX24-MFT/200	†	2-10 VDC (Default)	2-10 VDC	150 (Default)	8 in [200 mm]	24 VAC/DC	3	0.86
	LHX24-MFT/300	†	2-10 VDC (Default)	2-10 VDC	150 (Default)	12 in [300 mm]	24 VAC/DC	3	0.93
101 lbf [450 N]	AHX24-3/100	AH000	On/Off, Floating Point	----	95 (Default)	4 in [100 mm]	24 VAC/DC	5	2.6
	AHX24-3/200	AH010	On/Off, Floating Point	----	95 (Default)	8 in [200 mm]	24 VAC/DC	5	2.7
	AHX24-3/300	AH170	On/Off, Floating Point	----	95 (Default)	12 in [300 mm]	24 VAC/DC	5	2.9
	AHX24-SR/100	AH030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	4 in [100 mm]	24 VAC/DC	5	2.6
	AHX24-SR/200	AH040	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	8 in [200 mm]	24 VAC/DC	5	2.7
	AHX24-MFT/100	AH100	2-10 VDC (Default)	2-10 VDC	150 (Default)	4 in [100 mm]	24 VAC/DC	5	2.6
	AHX24-MFT/200	†	2-10 VDC (Default)	2-10 VDC	150 (Default)	8 in [200 mm]	24 VAC/DC	5	2.7
	AHX24-MFT/300	†	2-10 VDC (Default)	2-10 VDC	150 (Default)	12 in [300 mm]	24 VAC/DC	5	2.9
27 in-lb	LUX24-3	LU000	On/Off, Floating Point	----	95 (Default)	360 deg	24 VAC/DC	3	1.43
	LUX24-SR	LU030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	360 deg	24 VAC/DC	3	1.43
	LUX24-MFT	LU100	2-10 VDC (Default)	2-10 VDC	150 (Default)	360 deg	24 VAC/DC	3	1.43

† For correct code please call Belimo customer service at 800-543-9038.

Pre-set MFT Configurations

DC Voltage Control, P-1000… (A…)

Spring Return

AF24-MFT(-S) US 133 in-lb	LF24-MFT(-S) US 35 in-lb
NF24-MFT US 60 in-lb	LF24-MFT(-S)-20 US 35 in-lb

Non-Spring Return

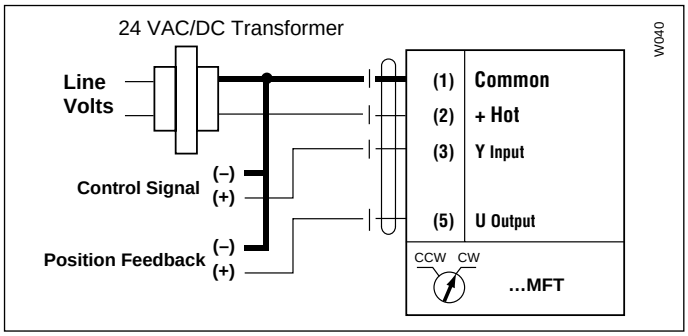
GMX24-MFT 360 in-lb	NMX24-MFT 90 in-lb
AMX24-MFT 180 in-lb	LMX24-MFT 45 in-lb

Application

P-1000… configuration types are used for VDC control applications. Pre-set configurations are listed which offer solutions for standard control applications.
Additional pre-set configurations are listed which offer solutions for non-standard control application for:

- Adjustable Start and Stop points
- Sequencing actuators
- Combination for master slave

Wiring – VDC



Select a Configuration

	Configration Description	Code	Input Range	Position Feedback	Running Time	Torque %	Adaptation
VOLTAGE	**P-10001***	**A01**	**2.0 to 10.0 VDC**	**2.0 to 10.0 VDC**	**150**	**100**	**MANUAL**
	P-10002	A02	0.5 to 10.0 VDC	0.0 to 10.0 VDC	150	100	MANUAL
	P-10003	A03	2.0 to 10.0 VDC	0.0 to 5.0 VDC	150	100	MANUAL
	P-10004	A04	4.0 to 7.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10005	A05	6.0 to 9.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10006	A06	10.5 to 13.5 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10007	A07	0.5 to 5.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10008	A08	0.5 to 5.0 VDC	0.0 to 10.0 VDC	150	100	MANUAL
	P-10009	A09	5.0 to 10.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10010	A10	5.0 to 10.0 VDC	0.0 to 10.0 VDC	150	100	MANUAL
	P-10013	A13	0.5 to 10.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10015	A15	2.0 to 5.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10016	A16	2.0 to 6.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10017	A17	6.0 to 10.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10018	A18	14 to 17 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10020	A20	9.0 to 12.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10028	A28	0.5 to 10.0 VDC	0.0 to 10.0 VDC	100	100	MANUAL
	P-10031	A31	0.5 to 4.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10063	A63	0.5 to 4.5 VDC	0.5 to 4.5 VDC	150	100	MANUAL
	P-10064	A64	5.5 to 10.0 VDC	5.5 to 10.0 VDC	150	100	MANUAL
	P-10091	A91	2.0 to 10.0 VDC	2.0 to 10.0 VDC	95	100	MANUAL

* P-10001 (A01) is the default configuration code.

Spring Return

AF24-MFT(-S) US 133 in-lb	LF24-MFT(-S) US 35 in-lb
NF24-MFT US 60 in-lb	LF24-MFT(-S)-20 US 35 in-lb

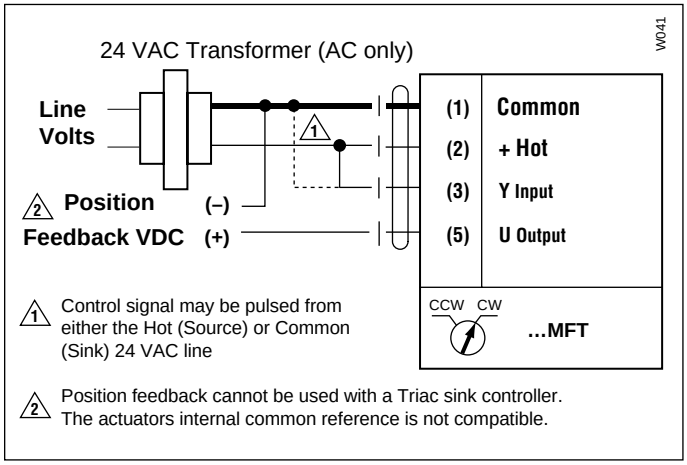
Non-Spring Return

GMX24-MFT 360 in-lb	NMX24-MFT 90 in-lb
AMX24-MFT 180 in-lb	LMX24-MFT 45 in-lb

Application

P-2000... configuration types are used for Pulse Width Modulation control outputs. Most D.D.C. controllers have digital outputs which incorporate a default PWM range. This enables a D.O. to be used as a proportional output when needed. Simply select the appropriate configuration code according to your application.

Wiring – PWM, triac source and sink



Select a Configuration

PULSE WIDTH MODULATION

Configration Description	Code	Input Range	Position Feedback	Running Time	Torque %	Adaptation
P-20001	W01	0.59 to 2.93 sec	2.0 to 10.0 VDC	150	100	MANUAL
P-20002	W02	0.02 to 5.00 sec	2.0 to 10.0 VDC	150	100	MANUAL
P-20003	W03	0.10 to 25.50 sec	2.0 to 10.0 VDC	150	100	MANUAL
P-20004	W04	0.10 to 25.60 sec	2.0 to 10.0 VDC	150	100	MANUAL
P-20005	W05	0.10 to 5.20 sec	0.0 to 5.0 VDC	150	100	MANUAL
P-20012	W12	0.50 to 25.50 sec	0.0 to 10.0 VDC	150	100	MANUAL
P-20013	W13	0.50 to 2.93 sec	0.0 to 5.0 VDC	150	100	MANUAL
P-20014	W14	0.10 to 10.00 sec	2.0 to 10.0 VDC	150	100	MANUAL

Pre-set MFT Configurations

Floating Point Control, P-3000… (F…)

Spring Return

AF24-MFT(-S) US 133 in-lb	LF24-MFT(-S) US 35 in-lb
NF24-MFT US 60 in-lb	LF24-MFT(-S)-20 US 35 in-lb

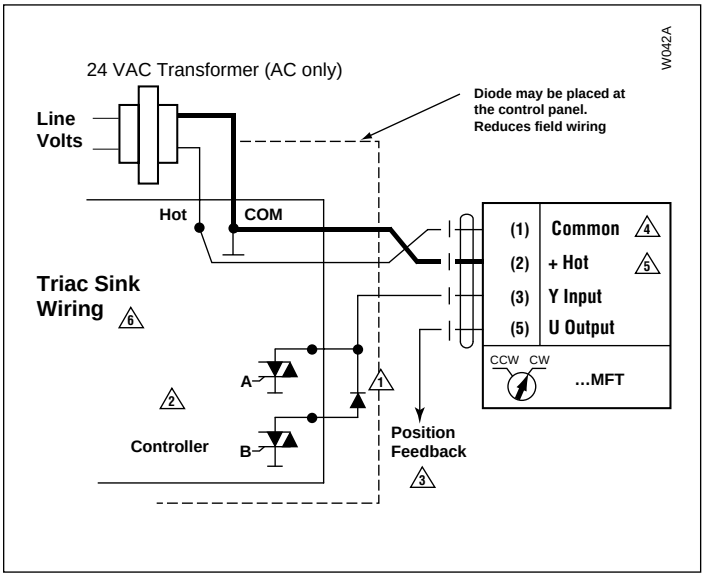
Non-Spring Return

GMX24-MFT 360 in-lb	NMX24-MFT 90 in-lb
AMX24-MFT 180 in-lb	LMX24-MFT 45 in-lb

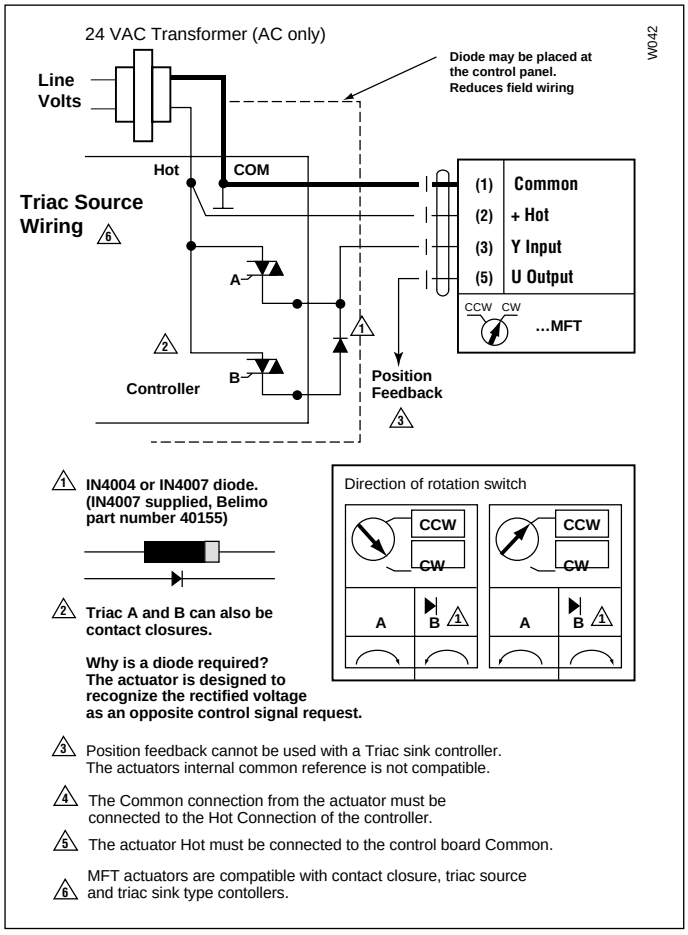
Application

P-3000… configuration types are used for floating point control outputs. In this application MFT actuators offer constant running time and standard feedback options. A IN4004 or IN4007 diode is required for spring return actuators only.

Wiring – Floating Point



Note: Diode is internal on non-spring return type actuators, connect to controller using wires 3 and 4.



Note: Diode is internal on non-spring return type actuators, connect to controller using wires 3 and 4.

Select a Configuration

	Configration Description	Code	Input Range	Position Feedback	Running Time	Torque %	Adaptation
FLOATING POINT CONTROL	P-30001	F01	Floating Point	2.0 to 10.0 VDC	150	100	MANUAL
	P-30002	F02	Floating Point	0.0 to 10.0 VDC	150	100	MANUAL
	P-30003	F03	Floating Point	2.0 to 10.0 VDC	100	100	MANUAL
	P-30004	F04	Floating Point	0.0 to 5.0 VDC	100	100	MANUAL
	P-30005	F05	Floating Point	0.0 to 10.0 VDC	100	100	MANUAL
	P-30006	F06	Floating Point	0.0 to 5.0 VDC	150	100	MANUAL
	P-30007	F07	Floating Point	2.0 to 10.0 VDC	300	100	MANUAL
	P-30008	F08	Floating Point	2.0 to 10.0 VDC	75	100	MANUAL
	P-30009	F09	Floating Point	2.0 to 10.0 VDC	85	100	MANUAL
	P-30010	F10	Floating Point	0.0 to 2.5 VDC	150	100	MANUAL

Spring Return

AF24-MFT(-S) US 133 in-lb	LF24-MFT(-S) US 35 in-lb
NF24-MFT US 60 in-lb	LF24-MFT(-S)-20 US 35 in-lb

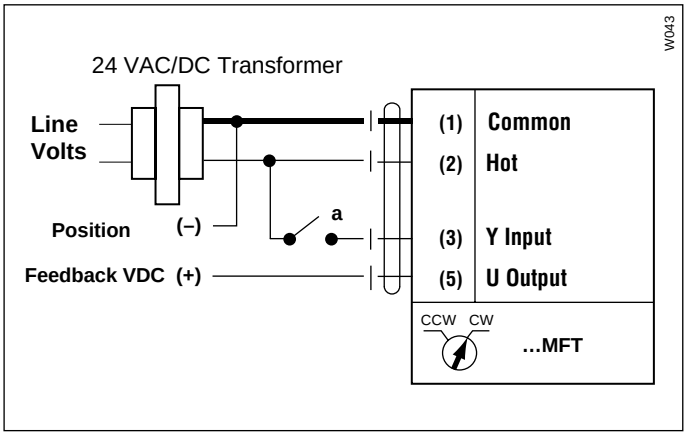
Non-Spring Return

GMX24-MFT 360 in-lb	NMX24-MFT 90 in-lb
AMX24-MFT 180 in-lb	LMX24-MFT 45 in-lb

Application

P-4000… configuration types are used for on/off control outputs. The configuration allows for service replacement of on/off actuators when a true on/off actuator is not available. In addition the MFT actuator offers additional functionality in the on/off mode, such as configuration P-40003 with minimum position and 2 to 10 VDC feedback.

Wiring – Two Position



Select a Configuration

	Configration Description	Code	Input Range	Position Feedback	Running Time	Torque %	Adaptation
ON/OFF CONTROL	P-40001	J01	On/Off	2.0 to 10.0 VDC	75	100	MANUAL
	P-40002	J02	On/Off	2.0 to 10.0 VDC	150	100	MANUAL
	P-40003	J03	On/Off	2.0 to 10.0 VDC	75	100	MANUAL
	P-40004	J04	On/Off	0.0 to 5.0 VDC	100	100	MANUAL
	P-40005	J05	On/Off	0.0 to 10.0 VDC	100	100	MANUAL

Multi-Function Technology® Specifications

For all MFT Type Actuators.

Control

Specifications		Parameter Variables	Description
INPUT	**VDC**	• Start: 0.5 to 30 VDC • Stop: 2.5 to 32 VDC (Minimum 2 VDC between start and stop required)	P-100…(A…) configuration types are used for VDC control applications. Pre-set configurations are listed which offer solutions for standard control applications. Additional pre-set configurations are list which offer solutions for non-standard control application for: • Sequencing Actuators • Adjustable Start and Stop Points • Combination for Master Slave
	Pulse Width Modulation (PWM)	PWM Range • 0.02 to 50 sec. range minimum interval • 20 [ms] between pulses • Minimum cycle duration 520 [ms]	P-200… (W…) configuration types are used for pulse width modulation control outputs with four standard ranges. There must be at least one second between the min pulses allowed (0.02 sec.) and the max pulse allowed (50 sec.). (eg: 0.02 to 1.02 sec.)
	Floating Point		P-300… (F...) configuration types are used for floating point control outputs. In this application MFT actuators offer constant running time and standard feedback options. A 1N4004 diode is required for spring return actuators. The actuator is designed to recognize the rectified voltage as an opposite control signal request.
	On/Off		P-400… (J…) configuration types are used for on/off control outputs. The configuration allows for service replacement of on/off actuators when a true on/off actuator is not available. In addition the MFT actuator offers additional functionality in the on/off mode, such as configuration P-40003 (J03) with minimum position and 2 to 10 VDC feedback.
FEEDBACK	**Position Feedback**	Position Feedback Range • Start: 0.5 to 8 VDC Selectable • Stop: 2 to 10 VDC Selectable	The default-operating mode of the U5 output is 2 to 10 VDC for position feedback. Matching the controllers feedback input voltage is possible by selecting a pre-set configuration (page 278) or by creating a custom configuration (page 279).
SENSITIVITY	**Control Sensitivity**	Normal (Default)	MFT actuators are designed with a unique non-symmetrical dead band. The actuator follows an increasing control signal with a 80 mV resolution. If the signal changes in the opposite direction, the actuator will no respond until the control signal changes by 200 mV. This allows the MFT actuator to track even the slightest deviation very accuratly, yet allowing the actuator to "wait" for a much larger change in control signal. *See figure 2.*
		Reduced	Upon detecting an un-stable control loop, the "reduced" setting can be manually selected via the PC software. This will reduce the sensitivity of the actuator by 50%. Meaning, control accuracy will now be 160 mV for signal changes in the same direction. And a 400 mV signal change in the opposite direction is needed for the actuator to change direction. Once driving in the opposite direction the actuator will respond in 160 mV increments. Upon improving the control loop stability you can return the actuator to the "Normal" mode.

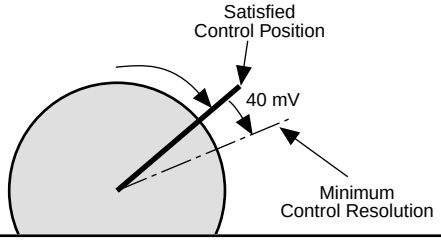
Figure 2

Control Accuracy and Stability (AF / NF / LF)

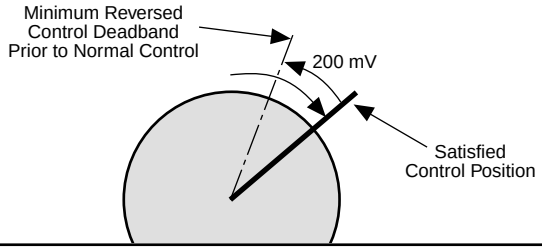
All MFT actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The …MFT US actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 40 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

AF / NF / LF Actuators responds to a 40 mV signal when not changing direction from stop position.



AF / NF / LF Actuators responds to a 200 mV signal when reversing direction from stop position.

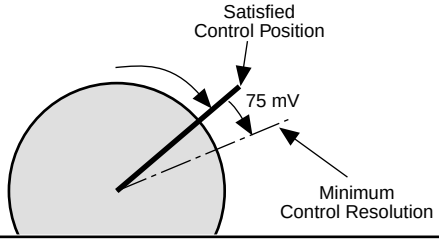


Control Accuracy and Stability (GM / AM / NM / LM / AH / LH / LU)

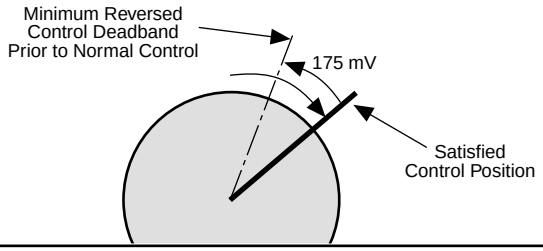
All Belimo actuators have built-in brushless DC motors which provide better accuracy and longer service life.

Belimo non-spring return actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 75 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 175 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

Actuator responds to a 75 mV signal when not changing direction from stop position.



Actuator responds to a 175 mV signal when reversing direction from stop position.



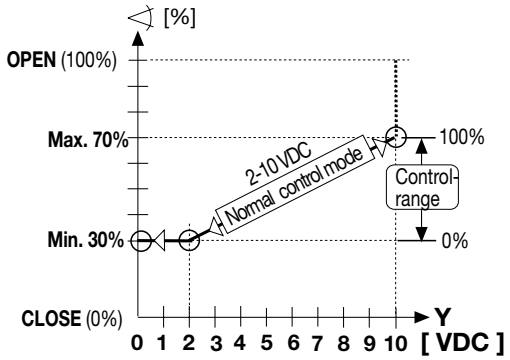
Multi-Function Technology® Specifications

For all MFT Type Actuators.

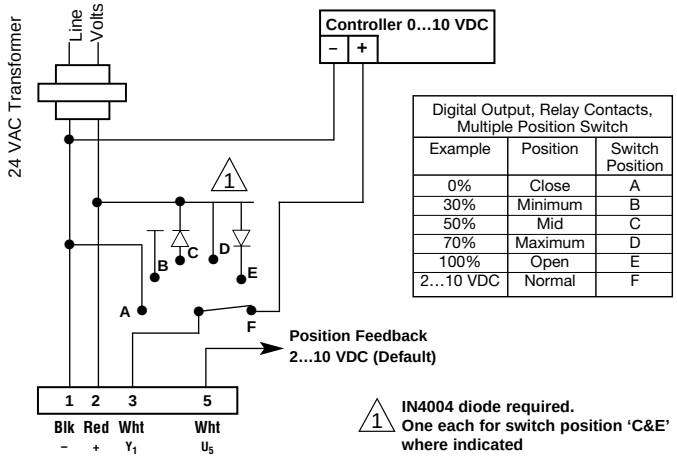
Motion

	Specifications	Parameter Variables	Description
RUNNING TIME	**AF / NF / LF**	75 to 300 seconds	Running time is selectable allowing for customizing the actuator for the application at hand. Adjustable running time allows for: • Matching HVAC system sequence of operation. • Improving control loop stability. • Reducing actuating noise (slower running). • Retrofit applications The running time is constant and independent of load.
	GM	70 to 280 seconds	
	AM	90 to 350 seconds	
	NM	45 to 170 seconds	
	LM	35 to 150 seconds	
ROTATION	**Direction of Rotation**	Default or Reversed	The direction of rotation can be "Direct" or "Reverse" acting of the control signal. The direction of rotation is selected from a CW and CCW switch located on the actuator. An alternative method of changing the direction of rotation is to use the PC-Tool software. This option allows you to make remote set-up corrections without having the need to be at the actuator. Selection of the direction of rotation is only possible via the PC-Tool software or manually with the switch on the actuator. Selection via a preset configuration is not an option.
	Intermediate Position Control (Override Control)	• Minimum Position (Default 0%) • Intermediate Position (Default 50%) • Maximum Position (Default 100%) Intermediate Positions are achieved through 'forced override' positions. ***See Figure 3 – Forced Overrides.***	All intermediate settings are adjustable from 0 to 100%. Programmed as default, these control positions are possible by using the wiring diagram in Figure 3. The override functions can be sued as a means to test the actuator's functionality during equipment servicing or troubleshooting. Intermediate positions can also be integrated into the control circuit as a part of the sequence of operation. The Min, Mid, and Max positions can be used in any MFT control mode. • VDC: For stand-alone controllers where a minimum position is needed. • PWM: Eliminate add-on accessories. • Floating Point: New functionality to a common application. • On/Off: New functionality to a common application. – Satisfy combustion air requirements or boiler sequencing with O/A damper. – Eliminates secondary minimum position dampers.

Figure 3 - Forced Overrides



Full control signal range is maintained between min and max rotation positions.
i.e.: AM24-MFT on Belimo CCV, adjusting actuator to damper flow characteristics.



Digital Output, Relay Contacts, Multiple Position Switch

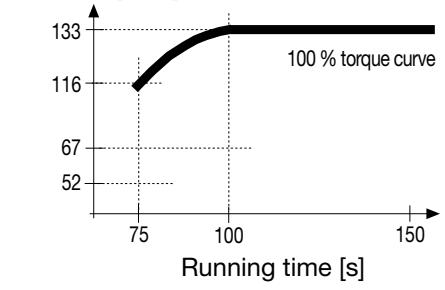
Example	Position	Switch Position
0%	Close	A
30%	Minimum	B
50%	Mid	C
70%	Maximum	D
100%	Open	E
2...10 VDC	Normal	F

Motion

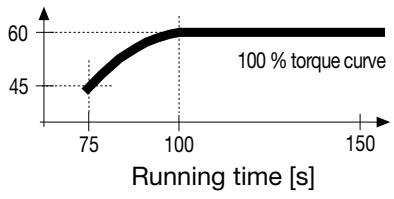
Specifications		Parameter Variables	Description
	Adaptation	OFF	When the manual override button is depressed, and released, the actuator will perform synchronization. The actuator will simply drive to the mechanical zero position and return to its last control position.
		ON – Manual	The default setting for adaptation is “ON – Manual”. When the ON-Manual setting is selected, adaptation is initiated by: • Pressing the manual override button twice (GM / AM / NM / LM). • Clicking the manual override crank twice (AF). • Clicking the CW/CCW switch twice (NF and LF). When adaptation is selected, (On-Manual or Automatic) the actuator will drive one full cycle to its mechanical end stops OR the valves mechanical seats. Upon completion of this cycle the actuators working range (input, feedback and running time) will be adapted to the actual mechanical angle of rotation.
		ON – Automatic	When the ON-Automatic setting is selected at every power-up the actuator will automatically adapt to the mechanical angle of rotation. Also upon pressing the manual override button or CW/CCW switch, adaptation is initiated (See above).
Mechanical Relationship	**Sound and Running Time**	All Actuators	As the speed of the actuator increases, there is an increase in the sound power level.
	Torque and Running Time	Spring Return (AF / NF / LF)	Though the running time remains constant, at approximately the 100-second range there is a loss in output torque. This is due to the association of runtime to torque. To gain a faster running time there is a loss in torque. ***See figure 4***

Figure 4

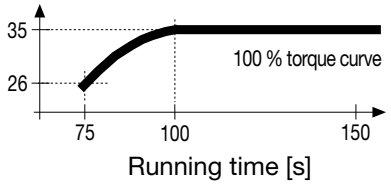
Torque and Run Time, AF24-MFT US



Torque and Run Time, NF24-MFT US



Torque and Run Time, LF24-MFT US



Multi-Function Technology® Specifications

For all MFT Type Actuators.

Sevice

Specifications		Parameter Variables	Description
DISPLAYS	**Identification**	Serial Number	Displays the actuators internal serial number. The serial number is also printed on a label at the side of the actuator.
		Actuator Type / Software Version	Displays the actuator nomenclature (AF24-MFT US) and MFT software version.
		Assembly Location	Displays the where the actuator was assembled.
		Setpoint	Displays the actual control input position as a percentage. As signal input changes you will see the setpoint percentage change accordingly.
	Actual Values	Actual	Displays the actual position as a percentage. As the setpoint changes the actual position percentage will increase or decrease accordingly. If the actuator is capable of rotating the damper or valve, this can be of benefit when troubleshooting an application.
	Function	Control Type & Setting	Displays the actual control type and operating range.
		Feedback Type & Setting	Displays the actual feedback signal type and operating range.
		Torque % Setting	Displays the actual torque setting.
		Running Time	Displays the actual running time as programmed.
		Direction of Rotation	Displays the status of the direction of rotation option (Normal or Reversed).
		Min, Mid, Max Position	Displays the actual position setting of the Intermediate position control. See page 270 for more details.
		Adaptation	Displays the actual setting of the adaptation function (OFF, ON-Manual, ON-Automatic). See page 271 for more information.
		Sensitivity / Hysteresis	Displays the actual setting of the sensitivity button (Normal or Reduced).
		Synchronization	Displays the actual setting of the synchronization function (Normal, Sync at 0%, Sync at 100%).
	Data Log	Total Time / Operating Time	Total number of hours the actuator is connected to a power supply.
		Active Time	Total number of hours the actuator is in mechanical motion.
		Stop / Go Ratio (Hunting %)	Displays a percentage the total number of hours the actuator has spent in mechanical motion, comparing the total time to the active time.
	Sensitivity	Normal, Reduced	Displays the setting of the sensitivity function. See page 268 for more information.
FUNCTIONS	**Messages**		Displays all messages present. Messages can be deleted as well.
	Function Test		This function enables you to check for complete opening and closing of the actuator. The test report contains: • Information on the Project • Identification on the Actuator • A list of fault messages pending before the start of the test • The test steps and results • The current actuator settings This is of benefit when troubleshooting an application, as the actuator will drive the damper or valve. This gives an opportunity to observe the installation to identify any possible problems.
	Adaptation	See Adaptation on page 271.	Initiates the adaptation feature of the MFT actuator. The actuators working range (input, feedback, and running time) will be adapted to the actual angle of rotation. This is of benefit when troubleshooting an application, as the actuator will drive the damper or valve. This gives you an opportunity to observe the installation to identify any possible problems.
	Synchronization	Normal	At initial commissioning, when the manual override button is pressed, the actuator runs to a default position defined by the position of the CW/CCW direction of rotation switch.
		Sync at 0%	At each power-up (includes power failures), the actuator runs to a default position defined by the position of the CW/CCW direction of rotation switch.
		Sync at 100%	At each power-up (includes power failures), the actuator runs to a default position of the CW/CCW direction of rotation switch.

ATTENTION

Please note the method of wiring multiple Belimo …MFT US actuators to a single control shaft for damper and valve applications.

MFT= Master-Slave

Applications which require more torque than one actuator is a very common installation. The current Belimo solution is to mount multiple actuators onto the damper or valve. In the past this required the installer to wire the actuators in a "master-slave" arrangement. This was typical for the AF24-SR US actuator.

By adding more actuators you can effectively increase the torque proportional to the minimum specified torque times the number of actuators. This is a normal installation typically seen on the following installations.

- **Large dampers or valves**
- **Large multiple section dampers**
- **Rack and Pinion style globe valves**
- **Ball or Butterfly valves**

For retro-fit of an existing AF24-SR US which is wired in "Master-Slave", rewire the installation so the remaining AF24-SR US is now the "Master" and the new AF24-MFT US is the "Slave".

Multiple actuators mounted to one control shaft

Model	Max. Qty Per Shaft	Torque Generated
AF24-MFT(-S) US	4	532 in-lb
NF24-MFT(-S) US	1	60 in-lb
LF24-MFT(-S) US	1	35 in-lb
GMX24-MFT	2	720 in-lb
AMX24-MFT	1	180 in-lb
NMX24-MFT	1	90 in-lb
LMX24-MFT	1	45 in-lb

The wiring method for multiple actuators mounted to shafts which are ***not*** mechanically connecting other actuators is to wire the control signal in parallel with each actuator

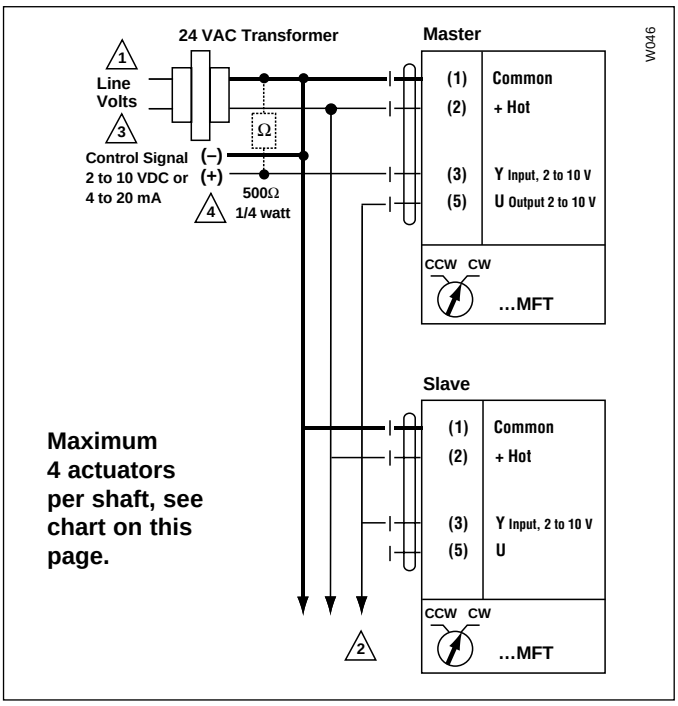
Multiple XM24-MFT95…

Exception: No mechanical dual mounting of AF24-MFT95 US is possible. Electrical parallel wiring of AF24-MFT95 US is possible only for mechanically separate applications.

Solution: For increased torque requirement use AF24-MFT95 US as a master and the slave must be an AF24-MFT US. The masters feedback must match the slaves input signal. (Both are default 2-10 VDC.)

Notes

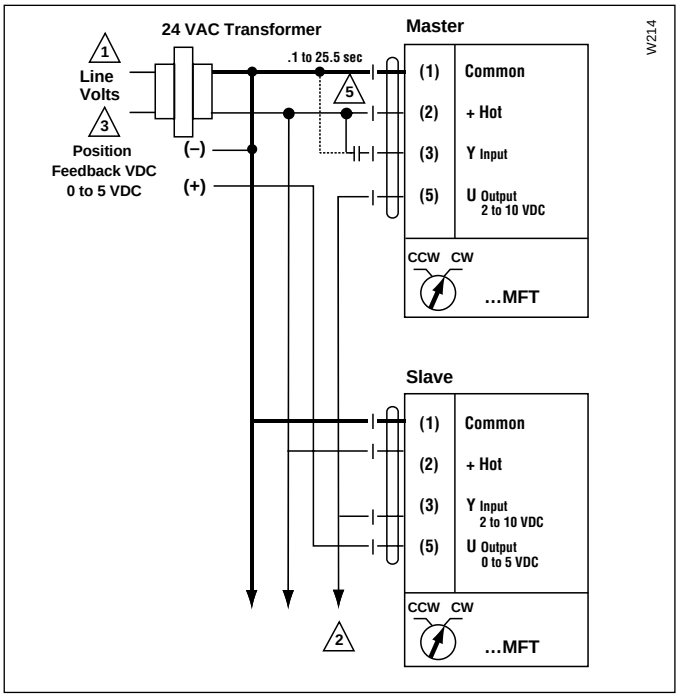
1. Provide overload protection and disconnect as required.
2. Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
3. Actuator may also be powered by 24 VDC.
4. ZG-R01 may be used.
5. Control signal may be pulsed from either the Hot or Common 24 VAC line.



Wiring multiple …MFT actuators to one shaft. All MFT actuators are wired in master-slave configuration.

Wiring of multiple …MFT actuators on valves must be master-slave (wires 3-5).

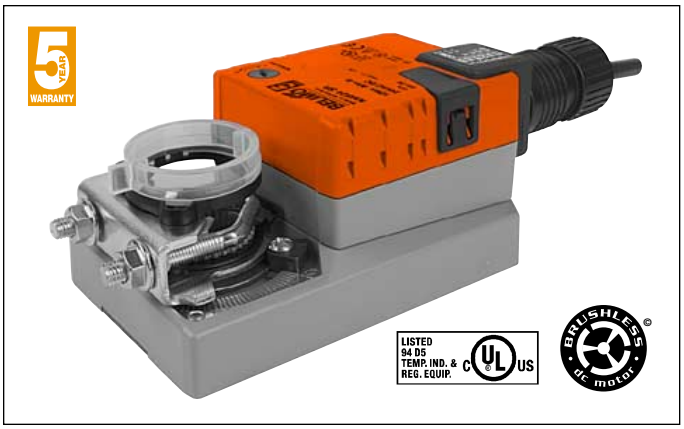
MFT actuator configurations should also co-ordinate with each other. Meaning the master input = controllers output. Master output = slave input. Slave output = controller input.



Controller Output	Master Feedback	Slave Input	Slave Feedback
0.1 to 25.5 sec	2 to 10 VDC	2 to 10 VDC	0 to 5 VDC

NMX24-MFT

Proportional Control, Non-Spring Return, Direct Coupled, 24V, Multi-Function Technology®



Technical Data	NMX24-MFT
Power Supply	24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power Consumption	3.5 W (1.25 W)
Transformer Sizing	5.5 VA (Class 2 power source)
Electrical Connection	18 GA plenum rated cable 1/2" conduit connector ❑ 3 ft [1m] ❑ 10 ft [3m] ❑ 16 ft [5m]
Overload Protection	electronic throughout 0 to 95° rotation
Operating Range Y	2 to 10 VDC, 4 to 20 mA (default) Variable (VDC, PWM, Floating Point, On/Off)
Input Impedance	100 kΩ (0.1 mA), 500Ω 1500 Ω (PWM, Floating Point, On/Off)
Feedback Output U	2 to 10 VDC, 0.5 mA max, VDC Variable
Angle of Rotation	max. 95°, adjust. with mechanical stop electronically variable
Torque	90 in-lb [10 Nm]
Direction of Rotation	reversible with ↷/↶ switch
Position Indication	reflective visual indicator (snap-on)
Manual Override	external push button
Running Time	150 seconds (default) Variable (45 to 170 secs)
Humidity	5 to 95% RH non condensing (EN 60730-1)
Ambient Temperature	-22°F to +122°F [-30°C to +50°C]
Storage Temperature	-40°F to +176°F [-40°C to +80°C]
Housing	NEMA 2/IP54
Housing Material	UL94-5VA
Agency Listings	cULus acc. to UL 60730-1/-2-14 and CAN/CSA C22.2 No.24, CE according to 73 / 23 / EEC
Noise Level	<45dB(A)
Servicing	maintenance free
Quality Standard	ISO 9001
Weight	2.1 lbs [0.95 kg]

Torque min. 90 in-lb for control of damper surfaces up to 22 sq ft.

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp, 1/2" self centered default. A crankarm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The default parameters for 2 to 10 VDC applications of the …MFT actuator are assigned during manufacturing. If necessary, custom versions of the actuators can be ordered. The parameters can be changed by two means: pre-set and custom configurations from Belimo or on-site configurations using the Belimo PC-Tool software.

Operation

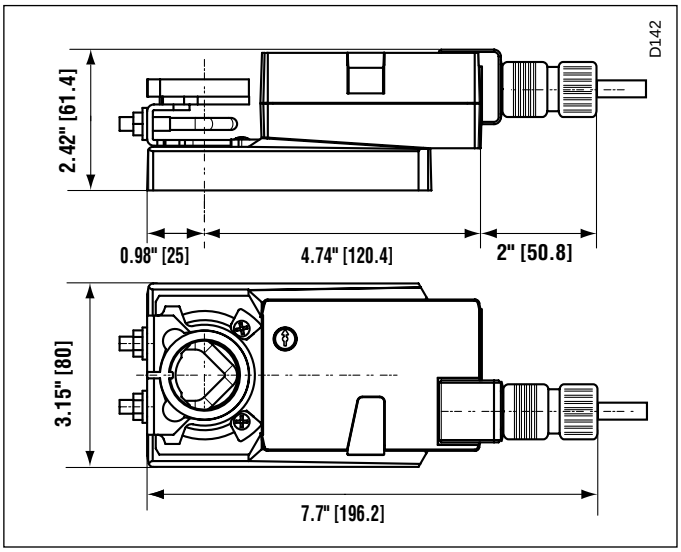
The actuator is not provided with and does not require any limit switches, but is electronically protected against overload. The anti-rotation strap supplied with the actuator will prevent lateral movement.

The NMX series provides 95° of rotation and a visual indicator indicates position of the actuator. When reaching the damper or actuator end position, the actuator automatically stops. The gears can be manually disengaged with a button on the actuator cover.

The NMX24-MFT actuators use a Brushless DC motor, which is controlled by an Application Specific Integrated Circuit (ASIC). The ASIC monitors and controls the actuator's rotation and provides a digital rotation sensing (DRS) function to prevent damage to the actuator in a stall condition.Power consumption is reduced in holding mode.

Add on auxiliary switches or feedback potentiometers are easily fastened directly onto the actuator body for signaling and switching functions

Dimensions (All numbers in brackets are in millimeters.)



Accessories

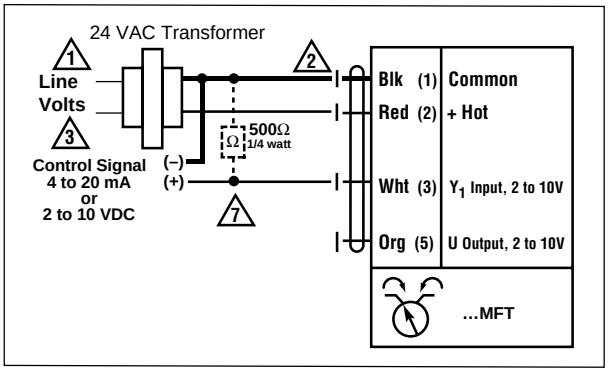
K-NA	Reversible Clamp
ZG-100	Universal Mounting Bracket
ZG-101	Universal Mounting Bracket
ZG-103	Universal Mounting Bracket
ZG-104	Universal Mounting Bracket
ZG-NMA	Crankarm Adaptor Kit
AV8-25	Universal Shaft Extension
ZG-NMSA-1	Shaft Adaptor
ZS-100	Weather Shield - Steel
ZS-150	Weather Shield - Polycarbonate
Tool-06	8 mm & 10 mm Wrench
S1A, S2A	Auxiliary Switch (es)
P370	Shaft Mount Auxiliary Switch
P…A	Feedback Potentiometers
SGA24	Min positioners in NEMA 4 housing
SGF24	Min positioners for flush panel mounting
ADS-100	Analog to Digital Switch
ZG-R01	Resistor for 4 to 20 mA Conversion
NSV24 US	Battery Back-Up Module
ZG-X40	Transformer

Note: When using NMX24-MFT actuators, only use accessories listed on this page.

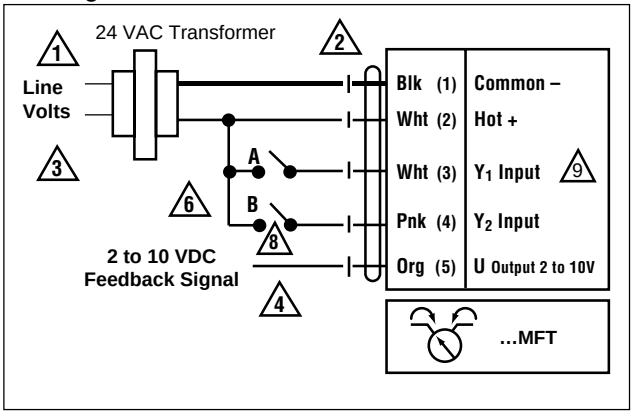
NMX24-MFT - Typical Specification:
Proportional control damper actuators shall be electronic direct-coupled type, which require no crankarm and linkage and be capable of direct mounting to a shaft up to 1.05" diameter. Actuators must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. Actuators shall have Brushless DC motor technology and be protected from overload at all angles of rotation. Actuators shall have reversing switch and manual override on the cover. Run time shall be constant and independent of torque. Actuators shall be cULus listed, have a 5-year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring

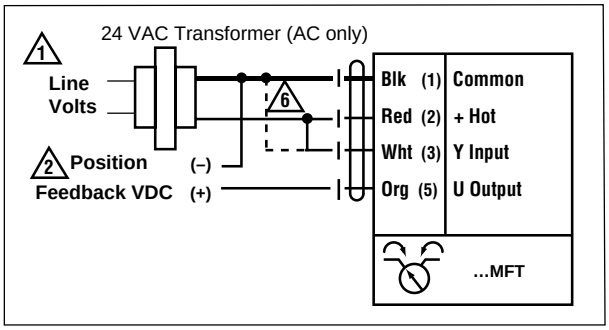
VDC/4-20 mA



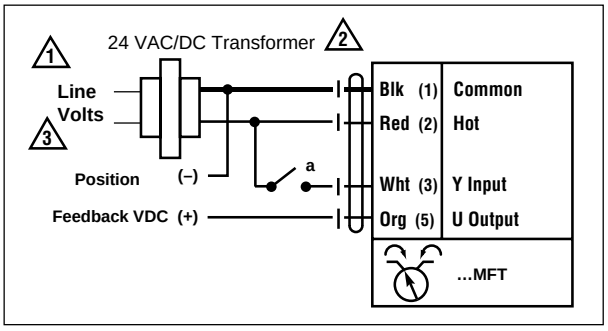
Floating Point



PWM



On/Off



Notes:

1. Provide overload protection and disconnect as required.
2. Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
3. Actuators may also be powered by 24 VDC.
4. Position feedback cannot be used with a Triac sink controller. The actuator internal common reference is not compatiable.
6. Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.
7. ZG-R01 may be used.
8. Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.
9. For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

W399

NM

Ordering example – Non-Spring Return

The ordering process for the new Flexible non-spring return actuators is simple. First select a base actuator that meets the needs of the application and then add the desired options.

1. Base actuator **LMX24-MFT (LM100)**

Select a base actuator

- Torque or linear force, control input, position feedback, power supply…
- See page 40 for complete list of non-spring base actuators.

2. Clamp option **3/4" dia. universal clamp (6)**

Select clamp that accommodates the damper shaft

- LM defaults to a 5/8" dia. clamp, but the 3/4" option can be selected as seen in this example.
- NM and AM default to a 1/2" dia. clamp that also accommodates 3/4" and 1.05" dia. shafts.
- GM accommodates a 1.05" dia. shafts. A 3/4" dia. clamp is available for retrofits of past GM and SM types.

3. Electrical Connection option **16 ft. [5m] 18 GA, plenum rated cable (C5)**

- Default connection is a 3 ft. [1m] long cable. 10 ft [3m] or 16ft [5m] cables are also available.
- Actuators with a "-T" in the model number have a screw terminal strip, which default to a NEMA 1 enclosure rating. A NEMA 2 cover for the terminal strip can be selected.

4. Programming **P-20003 (W03)**

- For –3 and –SR type actuators only the running time can be changed. This is a one-time factory setting.
- For –MFT type actuators refer to page 41 for available configurations.

5. Total **LMX24-MFT (LM100 6 C5 W03)**

Ordering example – Spring Return

1. Base actuator **AF24-MFT-S US**

Select a base actuator

2. Programming **P-10003 (A03)**
2 – 10 VDC input / 0 – 5 VDC feedback

Select pre-set programming code

- P-100xx (Axx) Control voltage applications
- P-200xx (Wxx) Pulse width modulation applications
- P-300xx (Fxx) Floating point applications
- P-400xx (Jxx) On/Off applications
- Or create custom MFT configuration codes, see page 41
- Or create custom MFT configurations in the field with MFT-Actuate PC software.

3. Total **AF24-MFT-S US + P10003**

Order confirmation and invoice example for spring return actuators:

Line Item	Model	Qty
10	AF24-MFT US **P-10003**	10
20	LF24-MFT US **P-20002**	10
30	AF24-MFT US **P-10006**	5
40	**99981-00100**	25

The part number 99981-00100 is a requirement for Belimo as a designation for all the configurations in an order. This product's description will read "MFT CONFIGURATION CHARGE, (P-…/ V-…)". It is used to confirm the correct quantities and to invoice the proper fee for the MFT configurations. The total quantity of configurations is represented in this one line item.The product line item will list the specific configuration below the actuator ordered. If you have more than one model with multiple configurations, each change in configuration will be shown on separate line items. As an example lines 10 and 30 are the same model actuator with different configurations.

Non-Spring Return Actuators

Model Description — Reorder # for actuator

LMX — 24 — –MFT — LM 100 6 C5 W03

The reorder# is a complete description of the flexible actuator, including all custom options.

Power Supply

24	24 VAC/DC
120	100 to 240 VAC

Electrical Connection

Blank	Cable
–T	Screw terminal strip

Actuator family and torque/force output

Actuator	Torque
LM...	45 in-lb
NM...	90 in-lb
AM...	180 in-lb
GM...	360 in-lb
LH...	34 lbf
AH...	101 lbf
LU...	27 in-lb

Control Type

–MFT	Multi-Function technology
–MFT95	0 to 135 Ω
–3	On/Off-Floating Point
–SR	2 to 10 VDC Proportional
–PC	0 to 20V Phasecut

Reorder number break-down

Base actuator
LM 100

See Base Actuators Page 260

Clamp options
6

Code	Description
1	Default universal clamp
6	LM, 3/4" diameter universal clamp
7	NM/AM, reversible clamp for short shaft mounting

Electrical connector options
C5

Code	Description*
C1	Default, 3 ft [1m] cable
C3	10 ft [3m] cable
C5	16 ft [5m] cable
T1	Default, terminal strip NEMA 1/IP20
T2	Covered terminal strip NEMA 2/IP54

*24V actuators supplied with 18GA plenum rated cable.
120 to 240V actuators supplied with 18GA appliance cable.

Running time and programming codes
W03

Codes	Description (-3 & -SR Only)
005	35s (LM only)
004	45s (LM/NM only)
002	95s all, Default on LM/NM/AM
000	150s all, Default on GM/LU/LH/AH
Codes	**Description (MFT Only)**
A01	P-10001
A02	P-10002
A03	P-10003
A28	P-10028
W02	P-20002
W03	P-20003
F02	P-30001

Common or default configurations are configured at no charge. Uncommon or custom codes will be configured by Belimo for a $30.00 list add to each actuator. See page 41 for an extended list of MFT programming codes.

Flexible Products – Non-Spring Return Actuators

BELIMO

	Non-Spring Return Base Actuator								
	Model	Base Actuator Codes	Control Input	Feedback	Running Time	Angle of Rotation/Stroke	Power Supply	VA Rating	Weight (lb)
45 in-lb [5 Nm]	LMX24-3	LM000	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	3	1.1
	LMX24-3-T	LMT00	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	3	1.1
	LMX24-SR	LM030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	3	1.1
	LMX24-SR-T	LMTW0	2-10 VDC (4-20mA*)	----	95 (Default)	95 deg	24 VAC/DC	3	1.1
	LMX24-PC	†	0-20 V Phasecut	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	3	1.5
	LMX24-MFT	LM100	2-10 VDC (Default)	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	3	1.5
	LMX24-MFT95	†	0 to 135 Ohm	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	3	1.5
	LMX120-3	LM060	On/Off, Floating Point	----	95 (Default)	95 deg	100-240 VAC	3	1.1
	LMX120-SR	LM450	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	100-240 VAC	3	1.1
90 in-lb [10 Nm]	NMX24-3	NM000	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	5	1.7
	NMX24-3-T	NMT00	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	5	1.7
	NMX24-SR	NM030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	5	1.7
	NMX24-SR-T	NMTW0	2-10 VDC (4-20mA*)	----	95 (Default)	95 deg	24 VAC/DC	5	1.7
	NMX24-PC	†	0-20 V Phasecut	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	5	2.
	NMX24-MFT	NM100	2-10 VDC (Default)	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	5	2.1
	NMX24-MFT95	†	0 to 135 Ohm	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	5	2.1
	NMX120-3	NM060	On/Off, Floating Point	----	95 (Default)	95 deg	100-240 VAC	5	1.7
	NMX120-SR	NM450	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	100-240 VAC	5	1.7
180 in-lb [20 Nm]	AMX24-3	AM000	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	5	2.2
	AMX24-3-T	AMT00	On/Off, Floating Point	----	95 (Default)	95 deg	24 VAC/DC	5	2.2
	AMX24-SR	AM030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	5	2.2
	AMX24-SR-T	AMTW0	2-10 VDC (4-20mA*)	----	95 (Default)	95 deg	24 VAC/DC	5	2.2
	AMX24-PC	†	0-20 V Phasecut	2-10 VDC	95 (Default)	95 deg	24 VAC/DC	5	2.6
	AMX24-MFT	AM100	2-10 VDC (Default)	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	5	2.6
	AMX24-MFT95	†	0 to 135 Ohm	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	5	2.6
	AMX120-3	AM060	On/Off, Floating Point	----	95 (Default)	95 deg	100-240 VAC	5	2.2
	AMX120-SR	AM450	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	95 deg	100-240 VAC	5	2.2
360 in-lb [40 Nm]	GMX24-3	GM540	On/Off, Floating Point	----	150	95 deg	24 VAC/DC	7	3.4
	GMX24-SR	GM560	2-10 VDC (4-20mA*)	2-10 VDC	150	95 deg	24 VAC/DC	7	3.4
	GMX24-PC	†	0-20 V Phasecut	2-10 VDC	150	95 deg	24 VAC/DC	7	3.4
	GMX24-MFT	GM110	2-10 VDC (Default)	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	7	3.4
	GMX24-MFT95	†	0 to 135 Ohm	2-10 VDC	150 (Default)	95 deg	24 VAC/DC	7	3.4
	GMX120-3	GM580	On/Off, Floating Point	----	150	95 deg	100-240 VAC	7	3.4
34 lbf [150 N]	LHX24-3/100	LH000	On/Off, Floating Point	----	95 (Default)	4 in [100 mm]	24 VAC/DC	3	0.81
	LHX24-3/200	LH010	On/Off, Floating Point	----	95 (Default)	8 in [200 mm]	24 VAC/DC	3	0.86
	LHX24-3/300	LH170	On/Off, Floating Point	----	95 (Default)	12 in [300 mm]	24 VAC/DC	3	0.93
	LHX24-SR/100	LH030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	4 in [100 mm]	24 VAC/DC	3	0.81
	LHX24-SR/200	LH040	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	8 in [200 mm]	24 VAC/DC	3	0.86
	LHX24-MFT/100	LH100	2-10 VDC (Default)	2-10 VDC	150 (Default)	4 in [100 mm]	24 VAC/DC	3	0.81
	LHX24-MFT/200	†	2-10 VDC (Default)	2-10 VDC	150 (Default)	8 in [200 mm]	24 VAC/DC	3	0.86
	LHX24-MFT/300	†	2-10 VDC (Default)	2-10 VDC	150 (Default)	12 in [300 mm]	24 VAC/DC	3	0.93
101 lbf [450 N]	AHX24-3/100	AH000	On/Off, Floating Point	----	95 (Default)	4 in [100 mm]	24 VAC/DC	5	2.6
	AHX24-3/200	AH010	On/Off, Floating Point	----	95 (Default)	8 in [200 mm]	24 VAC/DC	5	2.7
	AHX24-3/300	AH170	On/Off, Floating Point	----	95 (Default)	12 in [300 mm]	24 VAC/DC	5	2.9
	AHX24-SR/100	AH030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	4 in [100 mm]	24 VAC/DC	5	2.6
	AHX24-SR/200	AH040	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	8 in [200 mm]	24 VAC/DC	5	2.7
	AHX24-MFT/100	AH100	2-10 VDC (Default)	2-10 VDC	150 (Default)	4 in [100 mm]	24 VAC/DC	5	2.6
	AHX24-MFT/200	†	2-10 VDC (Default)	2-10 VDC	150 (Default)	8 in [200 mm]	24 VAC/DC	5	2.7
	AHX24-MFT/300	†	2-10 VDC (Default)	2-10 VDC	150 (Default)	12 in [300 mm]	24 VAC/DC	5	2.9
27 in-lb	LUX24-3	LU000	On/Off, Floating Point	----	95 (Default)	360 deg	24 VAC/DC	3	1.43
	LUX24-SR	LU030	2-10 VDC (4-20mA*)	2-10 VDC	95 (Default)	360 deg	24 VAC/DC	3	1.43
	LUX24-MFT	LU100	2-10 VDC (Default)	2-10 VDC	150 (Default)	360 deg	24 VAC/DC	3	1.43

† For correct code please call Belimo customer service at 800-543-9038.

Pre-set MFT Configurations

DC Voltage Control, P-1000… (A…)

Spring Return

AF24-MFT(-S) US 133 in-lb	LF24-MFT(-S) US 35 in-lb
NF24-MFT US 60 in-lb	LF24-MFT(-S)-20 US 35 in-lb

Non-Spring Return

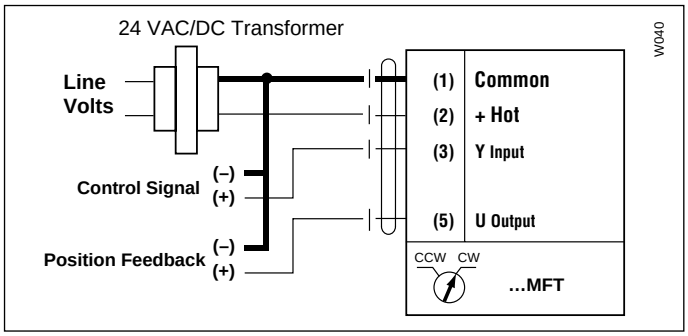
GMX24-MFT 360 in-lb	NMX24-MFT 90 in-lb
AMX24-MFT 180 in-lb	LMX24-MFT 45 in-lb

Application

P-1000… configuration types are used for VDC control applications. Pre-set configurations are listed which offer solutions for standard control applications.
Additional pre-set configurations are listed which offer solutions for non-standard control application for:

- Adjustable Start and Stop points
- Sequencing actuators
- Combination for master slave

Wiring – VDC



Select a Configuration

	Configration Description	Code	Input Range	Position Feedback	Running Time	Torque %	Adaptation
VOLTAGE	**P-10001***	**A01**	**2.0 to 10.0 VDC**	**2.0 to 10.0 VDC**	**150**	**100**	**MANUAL**
	P-10002	A02	0.5 to 10.0 VDC	0.0 to 10.0 VDC	150	100	MANUAL
	P-10003	A03	2.0 to 10.0 VDC	0.0 to 5.0 VDC	150	100	MANUAL
	P-10004	A04	4.0 to 7.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10005	A05	6.0 to 9.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10006	A06	10.5 to 13.5 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10007	A07	0.5 to 5.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10008	A08	0.5 to 5.0 VDC	0.0 to 10.0 VDC	150	100	MANUAL
	P-10009	A09	5.0 to 10.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10010	A10	5.0 to 10.0 VDC	0.0 to 10.0 VDC	150	100	MANUAL
	P-10013	A13	0.5 to 10.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10015	A15	2.0 to 5.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10016	A16	2.0 to 6.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10017	A17	6.0 to 10.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10018	A18	14 to 17 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10020	A20	9.0 to 12.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10028	A28	0.5 to 10.0 VDC	0.0 to 10.0 VDC	100	100	MANUAL
	P-10031	A31	0.5 to 4.0 VDC	2.0 to 10.0 VDC	150	100	MANUAL
	P-10063	A63	0.5 to 4.5 VDC	0.5 to 4.5 VDC	150	100	MANUAL
	P-10064	A64	5.5 to 10.0 VDC	5.5 to 10.0 VDC	150	100	MANUAL
	P-10091	A91	2.0 to 10.0 VDC	2.0 to 10.0 VDC	95	100	MANUAL

* P-10001 (A01) is the default configuration code.

Spring Return

AF24-MFT(-S) US 133 in-lb	LF24-MFT(-S) US 35 in-lb
NF24-MFT US 60 in-lb	LF24-MFT(-S)-20 US 35 in-lb

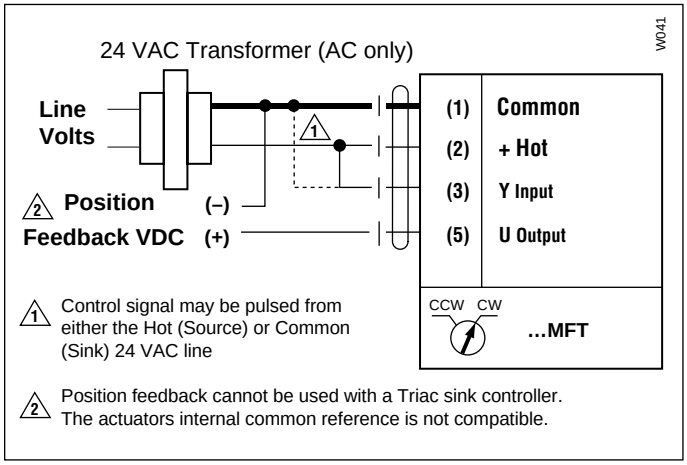
Non-Spring Return

GMX24-MFT 360 in-lb	NMX24-MFT 90 in-lb
AMX24-MFT 180 in-lb	LMX24-MFT 45 in-lb

Application

P-2000... configuration types are used for Pulse Width Modulation control outputs. Most D.D.C. controllers have digital outputs which incorporate a default PWM range. This enables a D.O. to be used as a proportional output when needed. Simply select the appropriate configuration code according to your application.

Wiring – PWM, triac source and sink



Select a Configuration

PULSE WIDTH MODULATION

Configration Description	Code	Input Range	Position Feedback	Running Time	Torque %	Adaptation
P-20001	W01	0.59 to 2.93 sec	2.0 to 10.0 VDC	150	100	MANUAL
P-20002	W02	0.02 to 5.00 sec	2.0 to 10.0 VDC	150	100	MANUAL
P-20003	W03	0.10 to 25.50 sec	2.0 to 10.0 VDC	150	100	MANUAL
P-20004	W04	0.10 to 25.60 sec	2.0 to 10.0 VDC	150	100	MANUAL
P-20005	W05	0.10 to 5.20 sec	0.0 to 5.0 VDC	150	100	MANUAL
P-20012	W12	0.50 to 25.50 sec	0.0 to 10.0 VDC	150	100	MANUAL
P-20013	W13	0.50 to 2.93 sec	0.0 to 5.0 VDC	150	100	MANUAL
P-20014	W14	0.10 to 10.00 sec	2.0 to 10.0 VDC	150	100	MANUAL

Pre-set MFT Configurations

Floating Point Control, P-3000… (F…)

Spring Return

AF24-MFT(-S) US 133 in-lb	LF24-MFT(-S) US 35 in-lb
NF24-MFT US 60 in-lb	LF24-MFT(-S)-20 US 35 in-lb

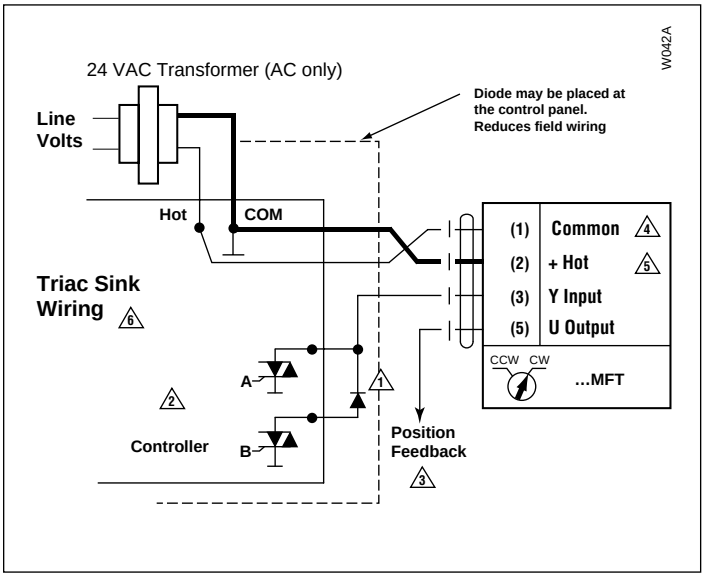
Non-Spring Return

GMX24-MFT 360 in-lb	NMX24-MFT 90 in-lb
AMX24-MFT 180 in-lb	LMX24-MFT 45 in-lb

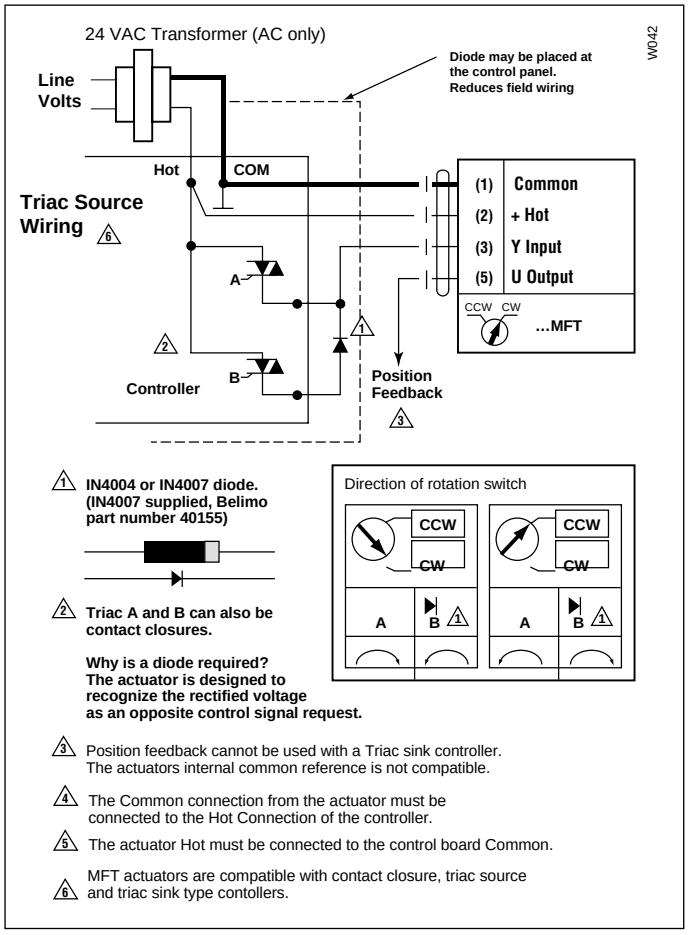
Application

P-3000… configuration types are used for floating point control outputs. In this application MFT actuators offer constant running time and standard feedback options. A IN4004 or IN4007 diode is required for spring return actuators only.

Wiring – Floating Point



Note: Diode is internal on non-spring return type actuators, connect to controller using wires 3 and 4.



Note: Diode is internal on non-spring return type actuators, connect to controller using wires 3 and 4.

Select a Configuration

	Configration Description	Code	Input Range	Position Feedback	Running Time	Torque %	Adaptation
FLOATING POINT CONTROL	P-30001	F01	Floating Point	2.0 to 10.0 VDC	150	100	MANUAL
	P-30002	F02	Floating Point	0.0 to 10.0 VDC	150	100	MANUAL
	P-30003	F03	Floating Point	2.0 to 10.0 VDC	100	100	MANUAL
	P-30004	F04	Floating Point	0.0 to 5.0 VDC	100	100	MANUAL
	P-30005	F05	Floating Point	0.0 to 10.0 VDC	100	100	MANUAL
	P-30006	F06	Floating Point	0.0 to 5.0 VDC	150	100	MANUAL
	P-30007	F07	Floating Point	2.0 to 10.0 VDC	300	100	MANUAL
	P-30008	F08	Floating Point	2.0 to 10.0 VDC	75	100	MANUAL
	P-30009	F09	Floating Point	2.0 to 10.0 VDC	85	100	MANUAL
	P-30010	F10	Floating Point	0.0 to 2.5 VDC	150	100	MANUAL

Spring Return

AF24-MFT(-S) US 133 in-lb	LF24-MFT(-S) US 35 in-lb
NF24-MFT US 60 in-lb	LF24-MFT(-S)-20 US 35 in-lb

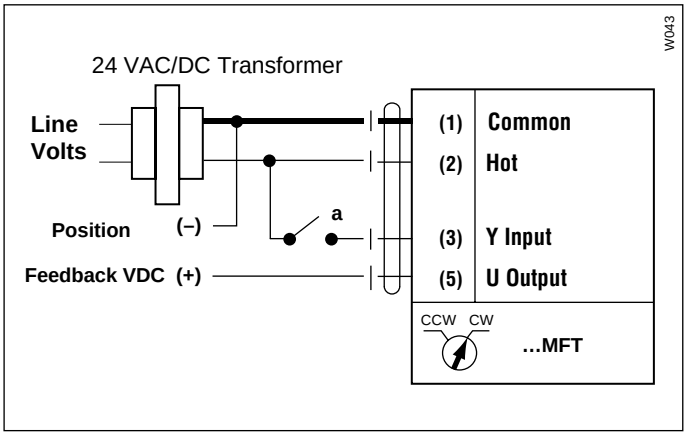
Non-Spring Return

GMX24-MFT 360 in-lb	NMX24-MFT 90 in-lb
AMX24-MFT 180 in-lb	LMX24-MFT 45 in-lb

Application

P-4000… configuration types are used for on/off control outputs. The configuration allows for service replacement of on/off actuators when a true on/off actuator is not available. In addition the MFT actuator offers additional functionality in the on/off mode, such as configuration P-40003 with minimum position and 2 to 10 VDC feedback.

Wiring – Two Position



Select a Configuration

	Configration Description	Code	Input Range	Position Feedback	Running Time	Torque %	Adaptation
ON/OFF CONTROL	P-40001	J01	On/Off	2.0 to 10.0 VDC	75	100	MANUAL
	P-40002	J02	On/Off	2.0 to 10.0 VDC	150	100	MANUAL
	P-40003	J03	On/Off	2.0 to 10.0 VDC	75	100	MANUAL
	P-40004	J04	On/Off	0.0 to 5.0 VDC	100	100	MANUAL
	P-40005	J05	On/Off	0.0 to 10.0 VDC	100	100	MANUAL

Multi-Function Technology® Specifications

For all MFT Type Actuators.

Control

Specifications		Parameter Variables	Description
INPUT	**VDC**	• Start: 0.5 to 30 VDC • Stop: 2.5 to 32 VDC (Minimum 2 VDC between start and stop required)	P-100…(A…) configuration types are used for VDC control applications. Pre-set configurations are listed which offer solutions for standard control applications. Additional pre-set configurations are list which offer solutions for non-standard control application for: • Sequencing Actuators • Adjustable Start and Stop Points • Combination for Master Slave
	Pulse Width Modulation (PWM)	PWM Range • 0.02 to 50 sec. range minimum interval • 20 [ms] between pulses • Minimum cycle duration 520 [ms]	P-200… (W…) configuration types are used for pulse width modulation control outputs with four standard ranges. There must be at least one second between the min pulses allowed (0.02 sec.) and the max pulse allowed (50 sec.). (eg: 0.02 to 1.02 sec.)
	Floating Point		P-300… (F...) configuration types are used for floating point control outputs. In this application MFT actuators offer constant running time and standard feedback options. A 1N4004 diode is required for spring return actuators. The actuator is designed to recognize the rectified voltage as an opposite control signal request.
	On/Off		P-400… (J…) configuration types are used for on/off control outputs. The configuration allows for service replacement of on/off actuators when a true on/off actuator is not available. In addition the MFT actuator offers additional functionality in the on/off mode, such as configuration P-40003 (J03) with minimum position and 2 to 10 VDC feedback.
FEEDBACK	**Position Feedback**	Position Feedback Range • Start: 0.5 to 8 VDC Selectable • Stop: 2 to 10 VDC Selectable	The default-operating mode of the U5 output is 2 to 10 VDC for position feedback. Matching the controllers feedback input voltage is possible by selecting a pre-set configuration (page 278) or by creating a custom configuration (page 279).
SENSITIVITY	**Control Sensitivity**	Normal (Default)	MFT actuators are designed with a unique non-symmetrical dead band. The actuator follows an increasing control signal with a 80 mV resolution. If the signal changes in the opposite direction, the actuator will no respond until the control signal changes by 200 mV. This allows the MFT actuator to track even the slightest deviation very accuratly, yet allowing the actuator to "wait" for a much larger change in control signal. *See figure 2.*
		Reduced	Upon detecting an un-stable control loop, the "reduced" setting can be manually selected via the PC software. This will reduce the sensitivity of the actuator by 50%. Meaning, control accuracy will now be 160 mV for signal changes in the same direction. And a 400 mV signal change in the opposite direction is needed for the actuator to change direction. Once driving in the opposite direction the actuator will respond in 160 mV increments. Upon improving the control loop stability you can return the actuator to the "Normal" mode.

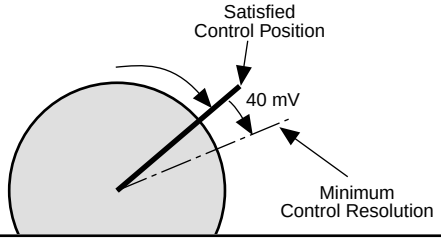
Figure 2

Control Accuracy and Stability (AF / NF / LF)

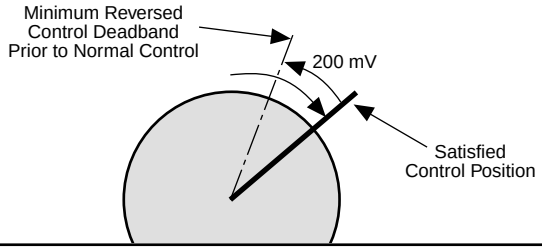
All MFT actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The …MFT US actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 40 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

AF / NF / LF Actuators responds to a 40 mV signal when not changing direction from stop position.



AF / NF / LF Actuators responds to a 200 mV signal when reversing direction from stop position.

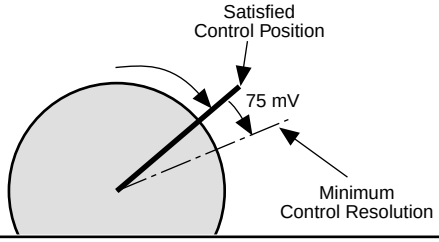


Control Accuracy and Stability (GM / AM / NM / LM / AH / LH / LU)

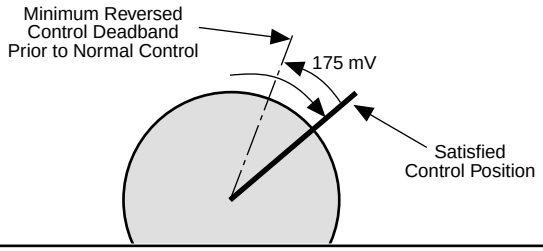
All Belimo actuators have built-in brushless DC motors which provide better accuracy and longer service life.

Belimo non-spring return actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 75 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 175 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

Actuator responds to a 75 mV signal when not changing direction from stop position.



Actuator responds to a 175 mV signal when reversing direction from stop position.



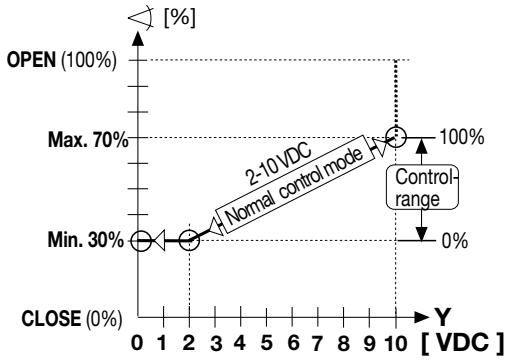
Multi-Function Technology® Specifications

For all MFT Type Actuators.

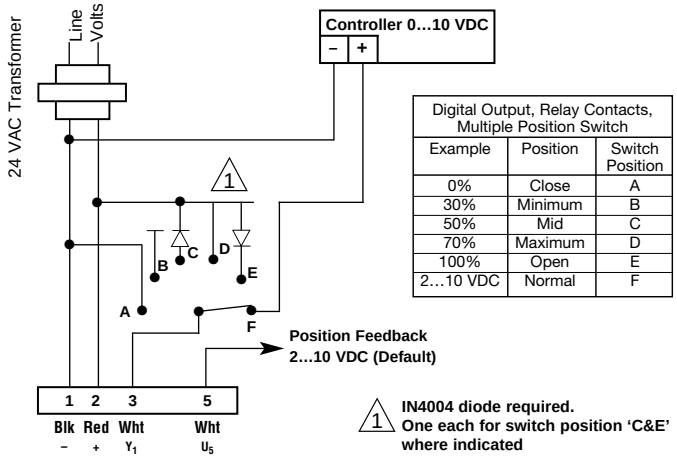
Motion

	Specifications	Parameter Variables	Description
RUNNING TIME	**AF / NF / LF**	75 to 300 seconds	Running time is selectable allowing for customizing the actuator for the application at hand. Adjustable running time allows for: • Matching HVAC system sequence of operation. • Improving control loop stability. • Reducing actuating noise (slower running). • Retrofit applications The running time is constant and independent of load.
	GM	70 to 280 seconds	
	AM	90 to 350 seconds	
	NM	45 to 170 seconds	
	LM	35 to 150 seconds	
ROTATION	**Direction of Rotation**	Default or Reversed	The direction of rotation can be "Direct" or "Reverse" acting of the control signal. The direction of rotation is selected from a CW and CCW switch located on the actuator. An alternative method of changing the direction of rotation is to use the PC-Tool software. This option allows you to make remote set-up corrections without having the need to be at the actuator. Selection of the direction of rotation is only possible via the PC-Tool software or manually with the switch on the actuator. Selection via a preset configuration is not an option.
	Intermediate Position Control (Override Control)	• Minimum Position (Default 0%) • Intermediate Position (Default 50%) • Maximum Position (Default 100%) Intermediate Positions are achieved through 'forced override' positions. ***See Figure 3 – Forced Overrides.***	All intermediate settings are adjustable from 0 to 100%. Programmed as default, these control positions are possible by using the wiring diagram in Figure 3. The override functions can be sued as a means to test the actuator's functionality during equipment servicing or troubleshooting. Intermediate positions can also be integrated into the control circuit as a part of the sequence of operation. The Min, Mid, and Max positions can be used in any MFT control mode. • VDC: For stand-alone controllers where a minimum position is needed. • PWM: Eliminate add-on accessories. • Floating Point: New functionality to a common application. • On/Off: New functionality to a common application. – Satisfy combustion air requirements or boiler sequencing with O/A damper. – Eliminates secondary minimum position dampers.

Figure 3 - Forced Overrides



Full control signal range is maintained between min and max rotation positions.
i.e.: AM24-MFT on Belimo CCV, adjusting actuator to damper flow characteristics.



Digital Output, Relay Contacts, Multiple Position Switch

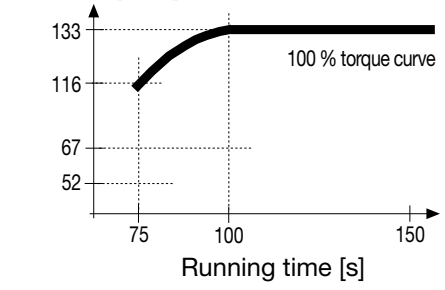
Example	Position	Switch Position
0%	Close	A
30%	Minimum	B
50%	Mid	C
70%	Maximum	D
100%	Open	E
2...10 VDC	Normal	F

Motion

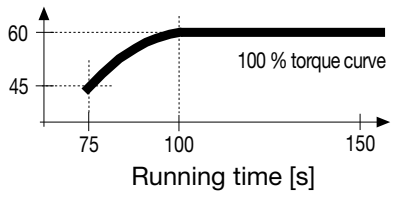
Specifications		Parameter Variables	Description
	Adaptation	OFF	When the manual override button is depressed, and released, the actuator will perform synchronization. The actuator will simply drive to the mechanical zero position and return to its last control position.
		ON – Manual	The default setting for adaptation is “ON – Manual”. When the ON-Manual setting is selected, adaptation is initiated by: • Pressing the manual override button twice (GM / AM / NM / LM). • Clicking the manual override crank twice (AF). • Clicking the CW/CCW switch twice (NF and LF). When adaptation is selected, (On-Manual or Automatic) the actuator will drive one full cycle to its mechanical end stops OR the valves mechanical seats. Upon completion of this cycle the actuators working range (input, feedback and running time) will be adapted to the actual mechanical angle of rotation.
		ON – Automatic	When the ON-Automatic setting is selected at every power-up the actuator will automatically adapt to the mechanical angle of rotation. Also upon pressing the manual override button or CW/CCW switch, adaptation is initiated (See above).
Mechanical Relationship	**Sound and Running Time**	All Actuators	As the speed of the actuator increases, there is an increase in the sound power level.
	Torque and Running Time	Spring Return (AF / NF / LF)	Though the running time remains constant, at approximately the 100-second range there is a loss in output torque. This is due to the association of runtime to torque. To gain a faster running time there is a loss in torque. ***See figure 4***

Figure 4

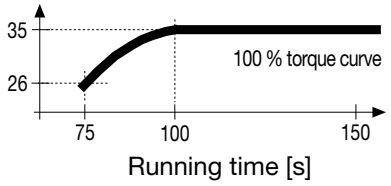
Torque and Run Time, AF24-MFT US



Torque and Run Time, NF24-MFT US



Torque and Run Time, LF24-MFT US



Multi-Function Technology® Specifications

For all MFT Type Actuators.

Sevice

Specifications		Parameter Variables	Description
DISPLAYS	**Identification**	Serial Number	Displays the actuators internal serial number. The serial number is also printed on a label at the side of the actuator.
		Actuator Type / Software Version	Displays the actuator nomenclature (AF24-MFT US) and MFT software version.
		Assembly Location	Displays the where the actuator was assembled.
		Setpoint	Displays the actual control input position as a percentage. As signal input changes you will see the setpoint percentage change accordingly.
	Actual Values	Actual	Displays the actual position as a percentage. As the setpoint changes the actual position percentage will increase or decrease accordingly. If the actuator is capable of rotating the damper or valve, this can be of benefit when troubleshooting an application.
	Function	Control Type & Setting	Displays the actual control type and operating range.
		Feedback Type & Setting	Displays the actual feedback signal type and operating range.
		Torque % Setting	Displays the actual torque setting.
		Running Time	Displays the actual running time as programmed.
		Direction of Rotation	Displays the status of the direction of rotation option (Normal or Reversed).
		Min, Mid, Max Position	Displays the actual position setting of the Intermediate position control. See page 270 for more details.
		Adaptation	Displays the actual setting of the adaptation function (OFF, ON-Manual, ON-Automatic). See page 271 for more information.
		Sensitivity / Hysteresis	Displays the actual setting of the sensitivity button (Normal or Reduced).
		Synchronization	Displays the actual setting of the synchronization function (Normal, Sync at 0%, Sync at 100%).
	Data Log	Total Time / Operating Time	Total number of hours the actuator is connected to a power supply.
		Active Time	Total number of hours the actuator is in mechanical motion.
		Stop / Go Ratio (Hunting %)	Displays a percentage the total number of hours the actuator has spent in mechanical motion, comparing the total time to the active time.
	Sensitivity	Normal, Reduced	Displays the setting of the sensitivity function. See page 268 for more information.
FUNCTIONS	**Messages**		Displays all messages present. Messages can be deleted as well.
	Function Test		This function enables you to check for complete opening and closing of the actuator. The test report contains: • Information on the Project • Identification on the Actuator • A list of fault messages pending before the start of the test • The test steps and results • The current actuator settings This is of benefit when troubleshooting an application, as the actuator will drive the damper or valve. This gives an opportunity to observe the installation to identify any possible problems.
	Adaptation	See Adaptation on page 271.	Initiates the adaptation feature of the MFT actuator. The actuators working range (input, feedback, and running time) will be adapted to the actual angle of rotation. This is of benefit when troubleshooting an application, as the actuator will drive the damper or valve. This gives you an opportunity to observe the installation to identify any possible problems.
	Synchronization	Normal	At initial commissioning, when the manual override button is pressed, the actuator runs to a default position defined by the position of the CW/CCW direction of rotation switch.
		Sync at 0%	At each power-up (includes power failures), the actuator runs to a default position defined by the position of the CW/CCW direction of rotation switch.
		Sync at 100%	At each power-up (includes power failures), the actuator runs to a default position of the CW/CCW direction of rotation switch.

ATTENTION

Please note the method of wiring multiple Belimo …MFT US actuators to a single control shaft for damper and valve applications.

MFT= Master-Slave

Applications which require more torque than one actuator is a very common installation. The current Belimo solution is to mount multiple actuators onto the damper or valve. In the past this required the installer to wire the actuators in a "master-slave" arrangement. This was typical for the AF24-SR US actuator.

By adding more actuators you can effectively increase the torque proportional to the minimum specified torque times the number of actuators. This is a normal installation typically seen on the following installations.

- **Large dampers or valves**
- **Large multiple section dampers**
- **Rack and Pinion style globe valves**
- **Ball or Butterfly valves**

For retro-fit of an existing AF24-SR US which is wired in "Master-Slave", rewire the installation so the remaining AF24-SR US is now the "Master" and the new AF24-MFT US is the "Slave".

Multiple actuators mounted to one control shaft

Model	Max. Qty Per Shaft	Torque Generated
AF24-MFT(-S) US	4	532 in-lb
NF24-MFT(-S) US	1	60 in-lb
LF24-MFT(-S) US	1	35 in-lb
GMX24-MFT	2	720 in-lb
AMX24-MFT	1	180 in-lb
NMX24-MFT	1	90 in-lb
LMX24-MFT	1	45 in-lb

The wiring method for multiple actuators mounted to shafts which are ***not*** mechanically connecting other actuators is to wire the control signal in parallel with each actuator

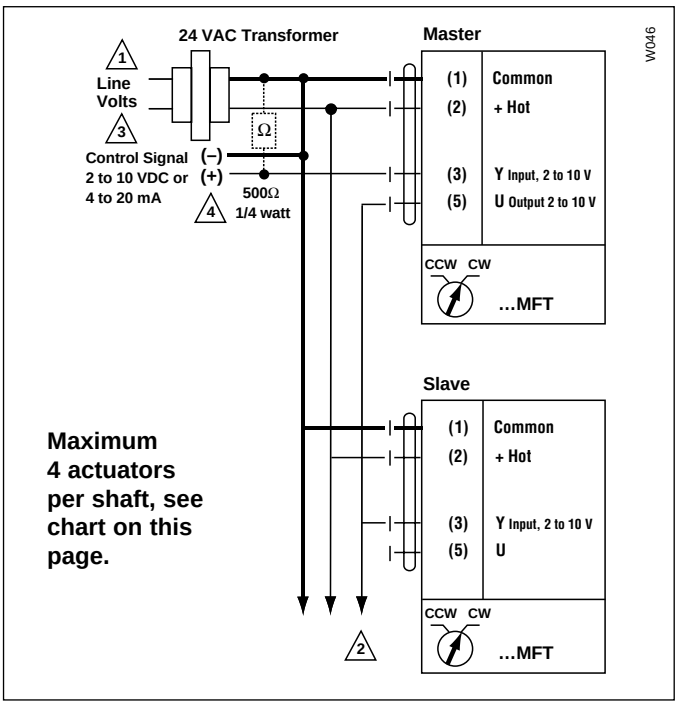
Multiple XM24-MFT95…

Exception: No mechanical dual mounting of AF24-MFT95 US is possible. Electrical parallel wiring of AF24-MFT95 US is possible only for mechanically separate applications.

Solution: For increased torque requirement use AF24-MFT95 US as a master and the slave must be an AF24-MFT US. The masters feedback must match the slaves input signal. (Both are default 2-10 VDC.)

Notes

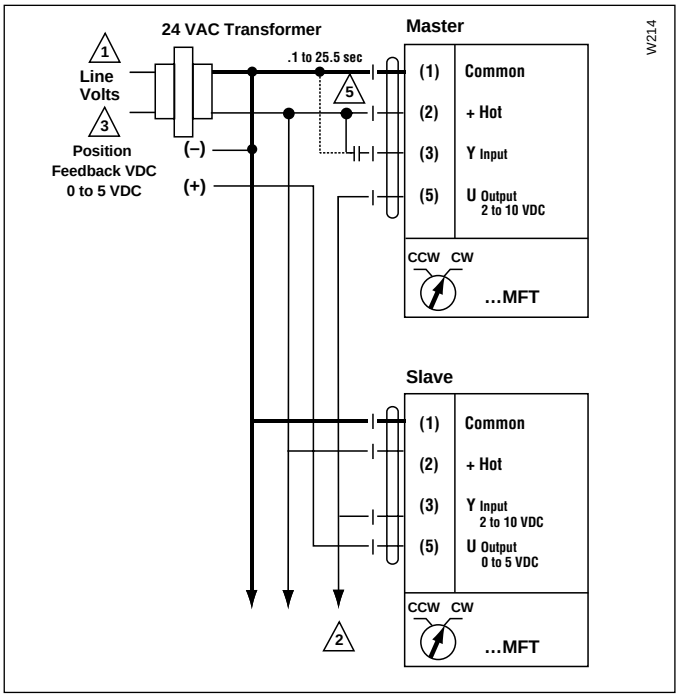
1. Provide overload protection and disconnect as required.
2. Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
3. Actuator may also be powered by 24 VDC.
4. ZG-R01 may be used.
5. Control signal may be pulsed from either the Hot or Common 24 VAC line.



Wiring multiple …MFT actuators to one shaft. All MFT actuators are wired in master-slave configuration.

Wiring of multiple …MFT actuators on valves must be master-slave (wires 3-5).

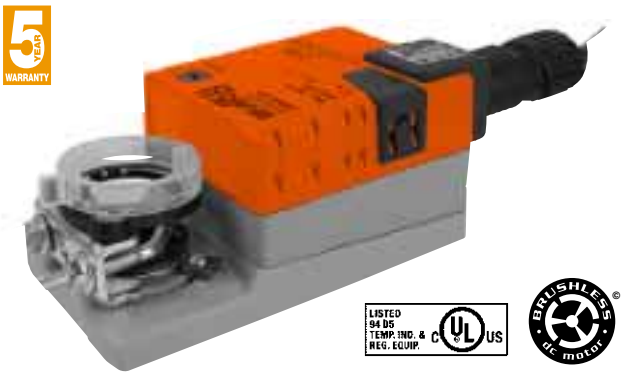
MFT actuator configurations should also co-ordinate with each other. Meaning the master input = controllers output. Master output = slave input. Slave output = controller input.



Controller Output	Master Feedback	Slave Input	Slave Feedback
0.1 to 25.5 sec	2 to 10 VDC	2 to 10 VDC	0 to 5 VDC

LMB (X) 24-MFT

Proportional Control, Non-Spring Return, Direct Coupled, 24V, Multi-Function Technology®



Torque min. 45 in-lb for control of damper surfaces up to 11 sq ft.

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft from 1/4" up to 5/8" in diameter by means of its universal clamp. Shafts up to 3/4" diameter can be accommodated by an accessory clamp.

The default parameters for 2 to 10 VDC applications of the …MFT actuator are assigned during manufacturing. If necessary, custom versions of the actuators can be ordered. The parameters can be changed by two means: pre-set and custom configurations from Belimo or on-site configurations using the Belimo PC-Tool software.

Operation

The actuator is not provided with and does not require any limit switches, but is electronically protected against overload. The anti-rotation strap supplied with the actuator will prevent lateral movement.

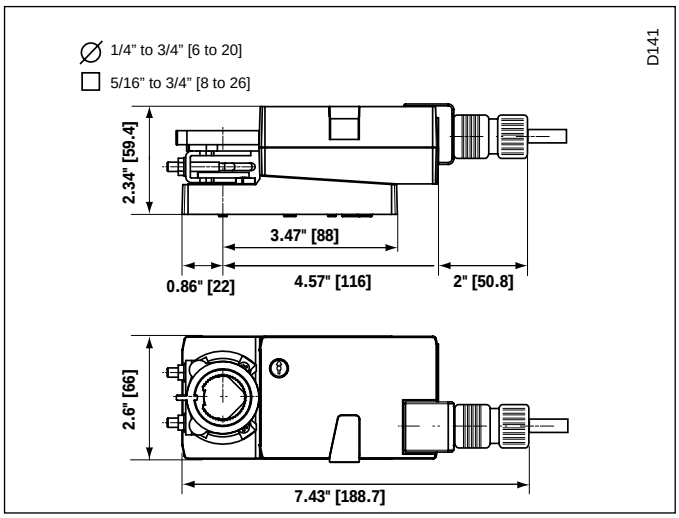
The LMB(X) series provides 95° of rotation and a visual indicator indicates position of the actuator. When reaching the damper or actuator end position, the actuator automatically stops.
The gears can be manually disengaged with a button on the actuator cover.

The LMB(X)24-MFT… actuators use a Brushless DC motor, which is controlled by an Application Specific Integrated Circuit (ASIC). The ASIC monitors and controls the actuator's rotation and provides a digital rotation sensing (DRS) function to prevent damage to the actuator in a stall condition. Power consumption is reduced in holding mode.

Add on auxiliary switches or feedback potentiometers are easily fastened directly onto the actuator body for signaling and switching functions.

Technical Data	LMB(X)24-MFT
Power Supply	24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power Consumption	2 W (1.2 W)
Transformer Sizing	3.5 VA (Class 2 power source)
Electrical Connection	18 GA plenum rated cable 1/2" conduit connector ❑ 3 ft [1m] ❑ 10 ft [3m] ❑ 16 ft [5m]
Overload Protection	electronic throughout 0 to 95° rotation
Operating Range Y	2 to 10 VDC, 4 to 20 mA (default) Variable (VDC, PWM, Floating Point, On/Off)
Input Impedance	100 kΩ (0.1 mA), 500Ω 1500 Ω (PWM, Floating Point, On/Off)
Feedback Output U	2 to 10 Vdc, 0.5mA max VDC Variable
Angle of Rotation	max. 95°, adjust. with mechanical stop electronically variable
Torque	45 in-lb [5 Nm]
Direction of Rotation	reversible with ↷/↶ switch
Position Indication	reflective visual indicator (snap-on)
Manual Override	external push button
Running Time	150 seconds (default) Variable (35 to 150 secs)
Humidity	5 to 95% RH non condensing (EN 60730-1)
Ambient Temperature	-22°F to +122°F [-30°C to +50°C]
Storage Temperature	-40°F to +176°F [-40°C to +80°C]
Housing	NEMA 2/IP54
Housing Material	UL94-5VA
Agency Listings	cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1, CSA C22.2 No. 24-93, CE acc. to 89/336/EEC
Noise Level	<35dB(A)
Servicing	maintenance free
Quality Standard	ISO 9001
Weight	1.5 lbs [0.7 kg]

Dimensions (All numbers in brackets are in millimeters.)



Accessories

K-LM20	3/4” [20 mm] Shaft Clamp
AV6-20	Shaft Extension
ZG-LMSA	Shaft Adaptor for 1/2” Diameter Shafts
ZG-LMSA-1	Shaft Adaptor for 3/8” Diameter Shafts
ZS-100	Weather Shield - Steel
ZS-150	Weather Shield - Polycarbonate
Tool-06	8 mm & 10 mm Wrench
S1A, S2A	Auxiliary Switch (es)
P370	Shaft Mount Auxiliary Switch
P…A	Feedback Potentiometers
SGA24	Min positioners in NEMA 4 housing
SGF24	Min positioners for flush panel mounting
ADS-100	Analog to Digital Switch
ZG-R01	Resistor for 4 to 20 mA Conversion
NSV24 US	Battery Back-Up Module
ZG-X40	Transformer

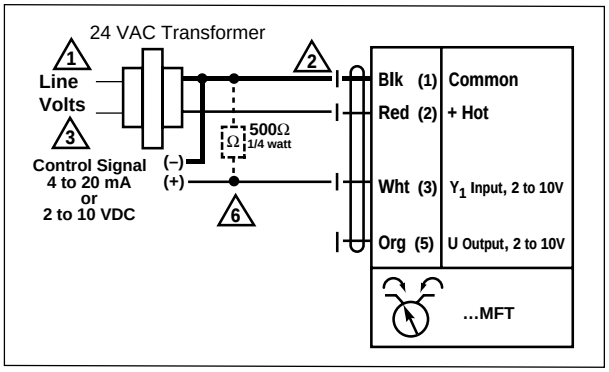
Note: When using LMB(X)24-MFT actuators, only use accessories listed on this page.

LMB(X)24-MFT - Typical Specification:

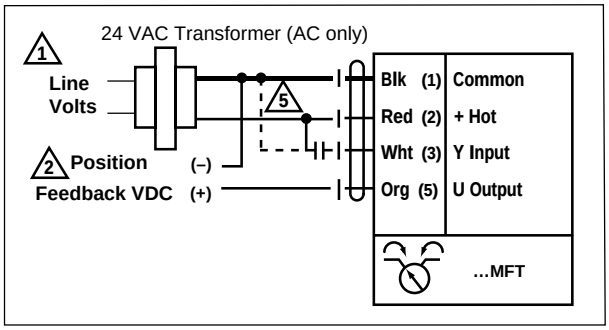
Proportional control damper actuators shall be electronic direct-coupled type, which require no crankarm and linkage and be capable of direct mounting to a shaft from 1/4” to 5/8”. Actuators must provide control in response to a control input from an electronic controller or positioner. Actuators shall have Brushless DC motor technology and be protected from overload at all angles of rotation. Actuators shall have reversing switch and manual override on the cover. Run time shall be constant and independent of torque. Actuators shall be cULus listed, have a 5-year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams

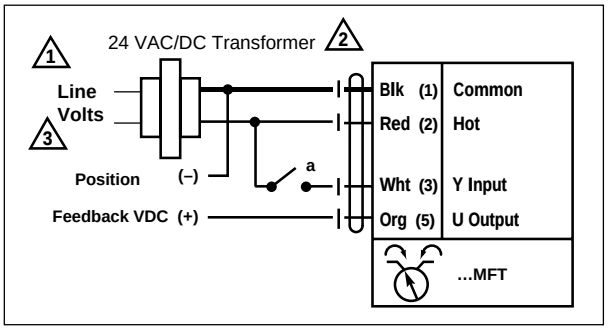
VDC/4-20 mA



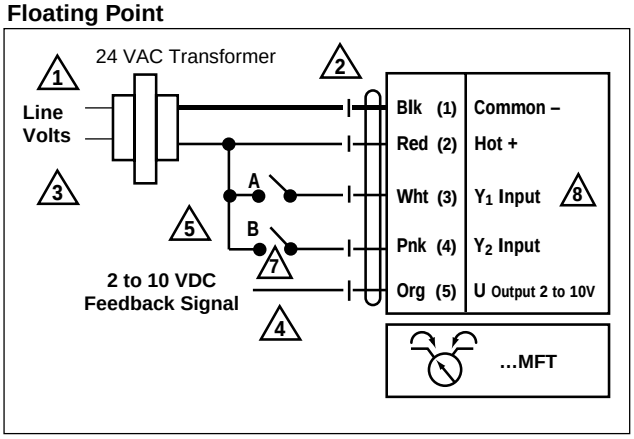
PWM



On/Off



Floating Point



W369

LM

Notes:

1. Provide overload protection and disconnect as required.
2. Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
3. Actuators may also be powered by 24 VDC.
4. Position feedback cannot be used with a Triac sink controller. The actuator internal common reference is not compatiable.
5. Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.
6. ZG-R01 may be used.
7. Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.
8. For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

Table of Contents **Page**

General Information

Preliminary Steps

1. Belimo actuators with NEMA 1 or NEMA 2 ratings should be mounted indoors in a dry, relatively clean environment free from corrosive fumes. If the actuator is mounted outdoors, a protective enclosure must be used to shield the actuator.
2. For new construction work, **order dampers with extended shafts**. Instruct the installing contractor to allow space for mounting the Belimo actuator on the shaft.

For replacement of existing gear train actuators, there are two options:

A. From a performance standpoint, it is best to mount the actuator directly onto the damper shaft.

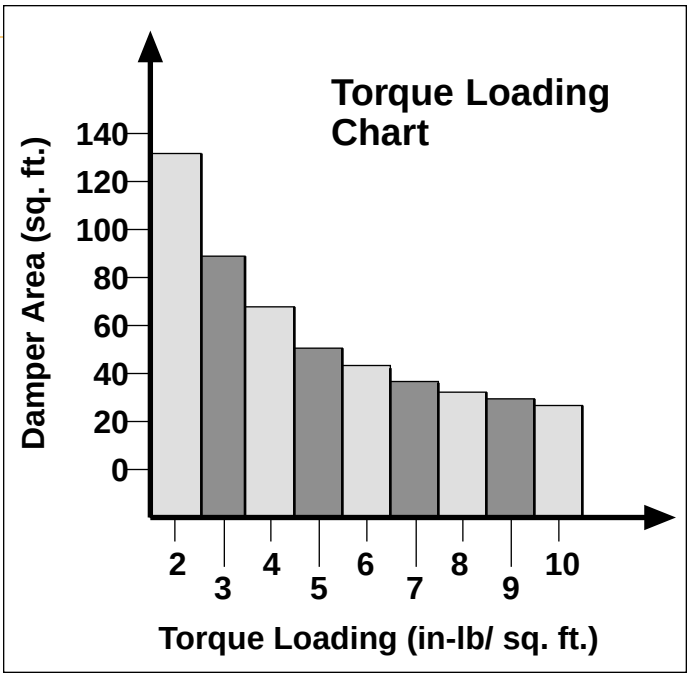
B. If the damper shaft is not accessible, mount the non-spring return actuator with a ZG-NMA or ZG-GMA crankarm kit, and a mounting bracket (ZG-100, ZG-101, ZG-103, ZG-104)

Determining Torque Loading and Actuator Sizing

Damper torque loadings, used in selecting the correct size actuator, should be provided by the damper manufacturer. If this information is not available, the following general selection guidelines can be used.

Damper Type	Torque Loading
Opposed blade, without edge seals, for non-tight close-off applications	3 in-lb/sq. ft.
Parallel blade, without edge seals, for non-tight close-off applications	4 in-lb/sq. ft.
Opposed blade, with edge seals, for tight close-off applications	5 in-lb/sq. ft.
Parallel blade, with edge seals, for tight close-off applications	7 in-lb/sq. ft.

The above torque loadings will work for most applications under 2 in. w.g. static pressure or 1000 FPM face velocity. For applications between this criteria and 3 in. w.g. or 2500 FPM, the torque loading should be increased by a multiplier of 1.5. If the application calls for higher criteria up to 4 in. w.g. or 3000 FPM, use a multiplier of 2.0.

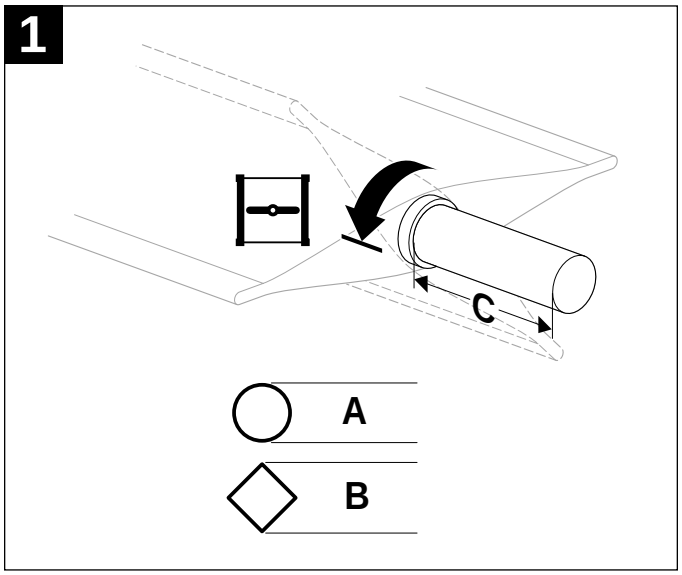


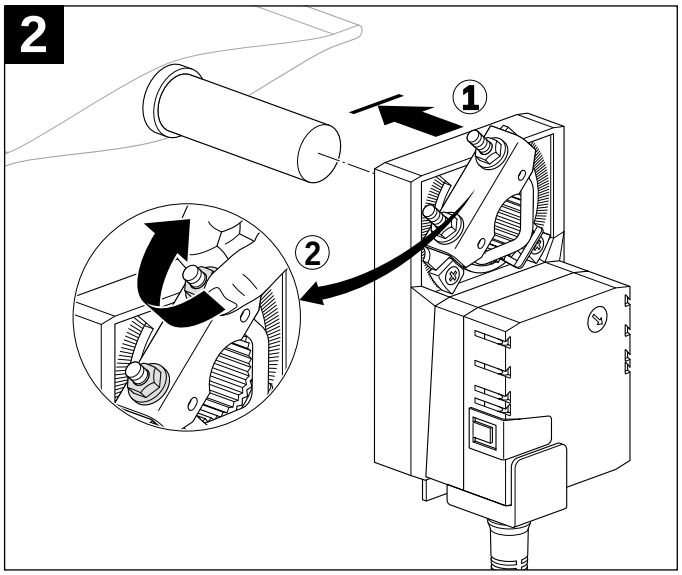
Multiple Actuator Mounting

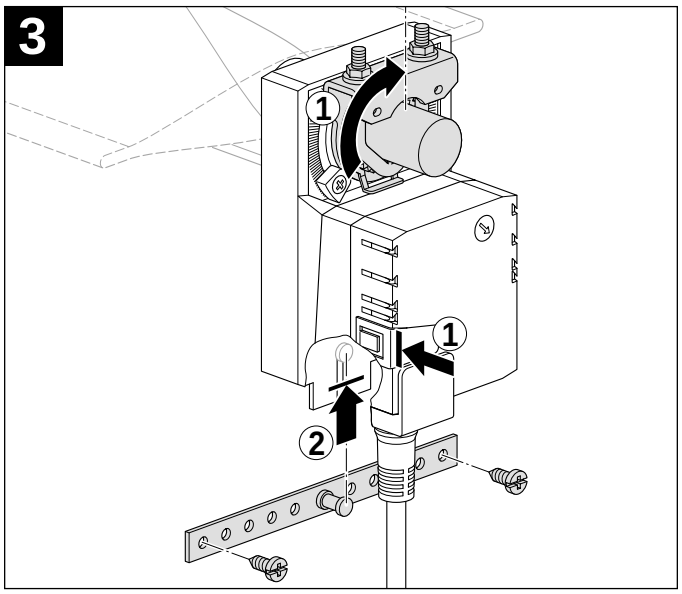
If more torque is required than one GM can provide, GM24B, GMB24-SR or GMX24-MFT may be installed on the same shaft.

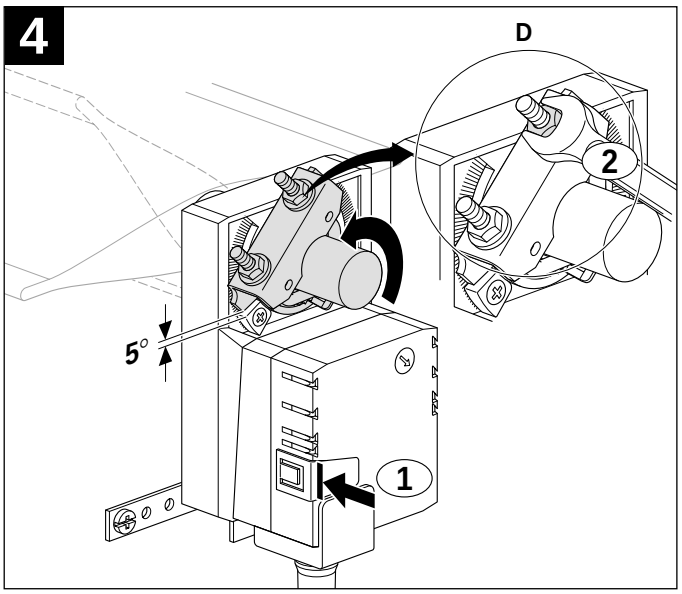
Installation Instructions

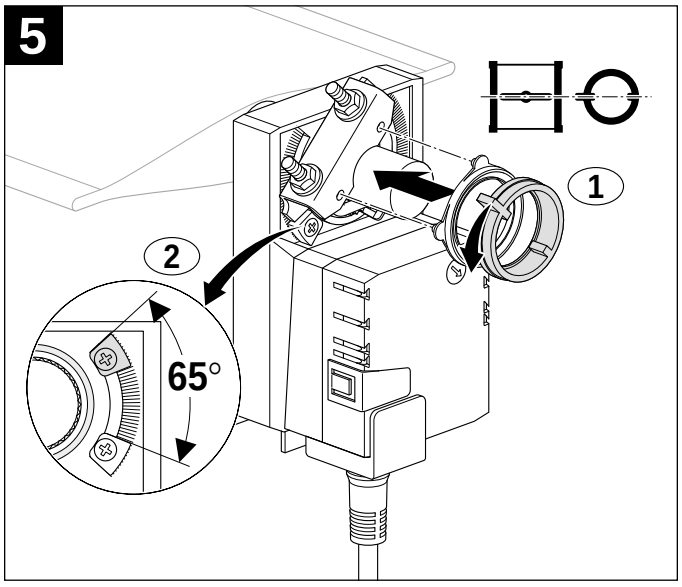
Quick-Mount Visual Instructions for Mechanical Installation









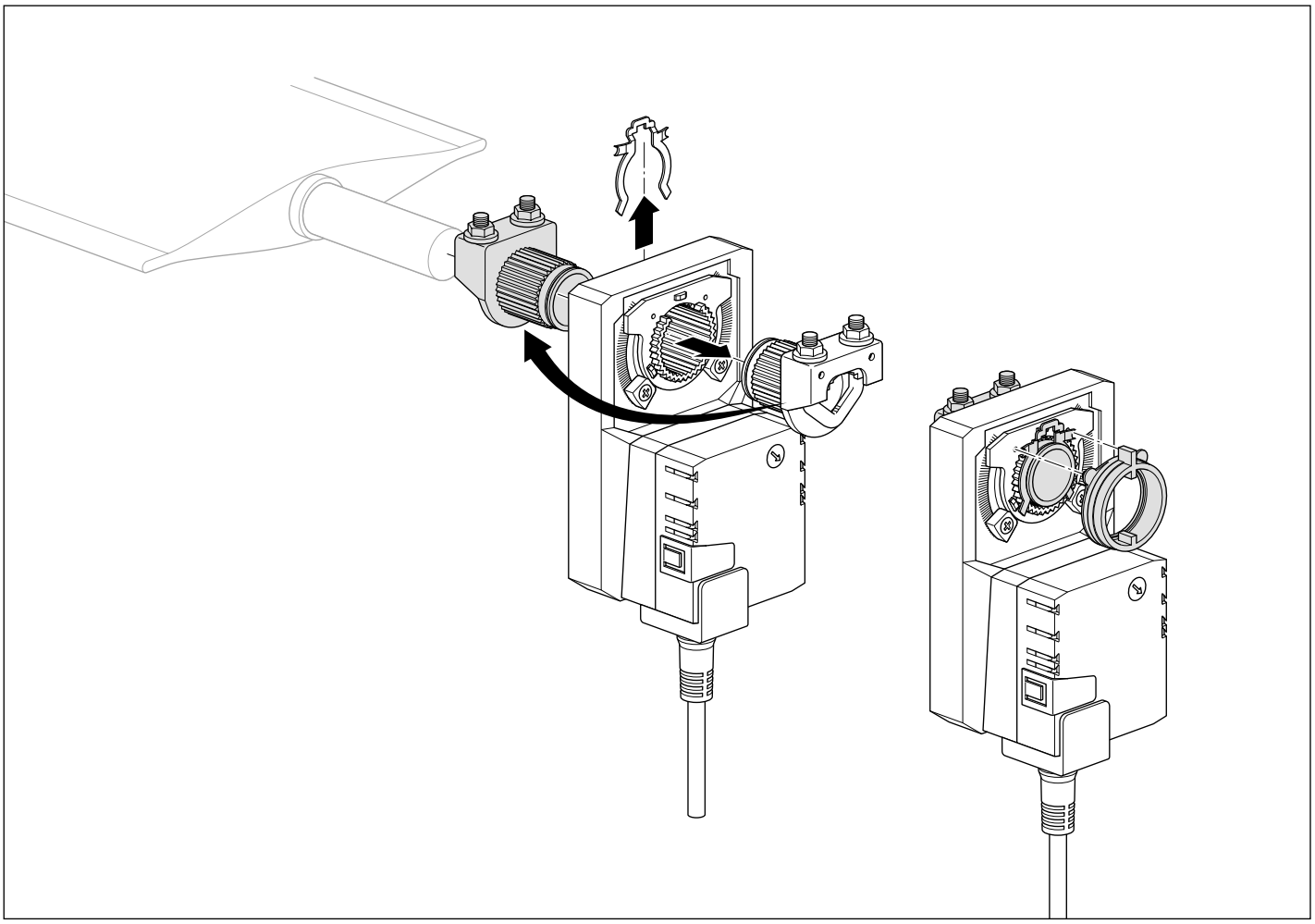


See next page for standard mounting instructions.

	A*	B	C**	D
LM	1/4” to 3/4”	5/16” to 3/4”	1.5”	4 to 5 ft-lb
NM	1/2” to 1.05”	2/5” to 1.05”	1.5”	6 to 7 ft-lb
AM	1/2” to 1.05”	2/5” to 1.05”	1.5”	6 to 7 ft-lb
GM	1/2” to 1.05”	2/5” to 1.05”	1.5”	6 to 7 ft-lb

*LM standard clamp has max 5/8” diameter. Accessory clamp K-LM20 can be mounted for sizes up to 3/4” diameter.
NM, AM and GM clamps have an insert that self-centers on the following diameter shafts: 1/2” (default), 3/4” and 1.05”.

**Shorter with reversible clamp for NM, AM, and GM



Standard Mounting

1. Turn the damper shaft until the blades are fully closed.
2. ① Slip the actuator's universal clamp over the damper shaft. Make sure that the duct and the controls on the cover are accessible. Place the actuator in the desired mounting position.
   ② Hand tighten the two nuts on the actuators universal clamp.
3. ① Disengage the actuator gear train by pressing the manual override button and rotate the clamp until centered.
   ② Slide the anti-rotation strap up under the actuator so it engages the actuator at the center cutout. Bend the bracket as needed to support the rear of the actuator. Secure to ductwork with self-tapping screws (No. 8 recommended).
4. ① Loosen the nuts on the universal clamp. Press the manual override button and rotate the clamp to about 5° from the closed position (1/16 to 1/8" between stop and clamp).
   ② Tighten the two nuts on the universal clamp with a 10 mm wrench (see table for required torque).
5. ① Snap on the reflective position indicator.
   ② Adjust end-stops, if required
6. Mount actuators indoors. If mounted outdoors, use approved protective enclosure.

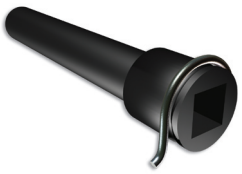
The damper is now fully closed but the actuator is 5° from fully closed. This is called "pre-loading" the actuator. When the actuator is powered and sent to the closed position: it will put its full torque on the shaft compressing the edge and blade seals. This ensures that the damper will meet its leakage rating. The actuator is electronically protected from overload and will not be damaged.

Testing the Installation Without Power

1. Disengage the gear train with the manual override button and move the shaft from closed to open to closed. Ensure that there is no binding and that the damper goes fully open and closes with 5° of actuator stroke left.
2. Correct any problems and retest.

Damper Linkage Kits

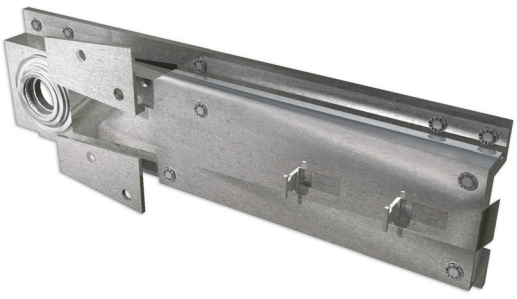
DMPR-KC002, 1/2" Dia., 6-1/2 inch long Blade Pin Extension. Standard with every control damper.



DMPR-KC003, 1/2" Dia., 3-1/2 inch long Blade Pin Extension.

DMPR-KC051 Crank Arm, 3/8 Inch Diameter Shaft.
This provides a connection from the actuator to the damper blade pin extension with a 3/8 inch diameter drive shaft, adjustable from 1 to 2-3/4 inch radius.

DMPR-KC053 Crank Arm, 1/2 Inch Diameter Shaft.
This provides a connection from the actuator to the damper blade pin extension with a 1/2 inch diameter drive shaft, adjustable from 1 to 2-3/4 inch radius.



DMPR-KC055 Blade Arm for D-70,140, 210, 280 Series.
This Blade Arm is used to link the damper actuator rod hardware directly to the damper blades. Actuators.

DMPR-KC005 Blade Pin Extension with Coupler.
This is a 7-inch-long blade pin extension with a coupler to be attached to another blade pin extension. It should be used on the preferred driving blade.

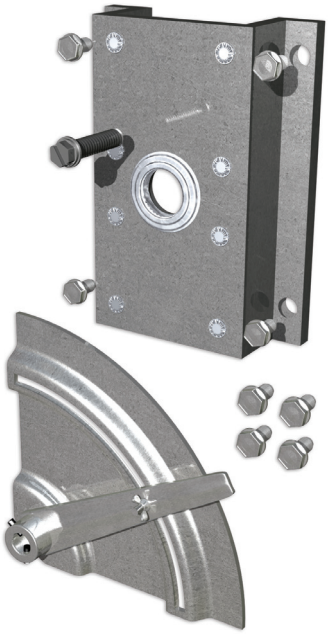
DMPR-KC006 Blade Pin Extension Coupler.
This is a coupler used to join two blade pin extensions to accommodate separations between two panels.

DMPR-KC001 Blade Pin Extension Support Bracket.
This Kit includes a bracket with a bearing that attaches to the end channel to provide additional support when the universal mounting bracket is not used.

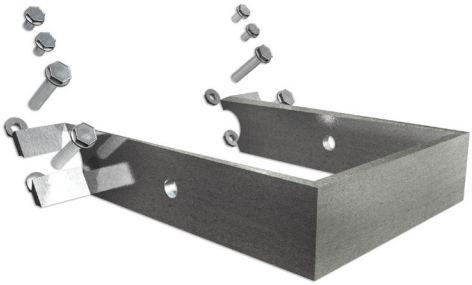
DMPR-KC008 Blade Pin Extension Support Bracket with Blade Pin Extension.
This Kit includes a blade pin extension and a bracket with a bearing that attaches to the end channel to provide additional support for the blade pin extension Use this kit for support when the universal mounting bracket is not used.

DMPR-KC203 Drive Arm and U-Bolts.
This provides an additional drive arm and U-bolts for jackshaft-driven dampers.

DMPR-KC102 Linkage Rod, 48 Inches Long.
This is a 48-inch-long, 5/16 inch diameter connecting rod for linkage kits.



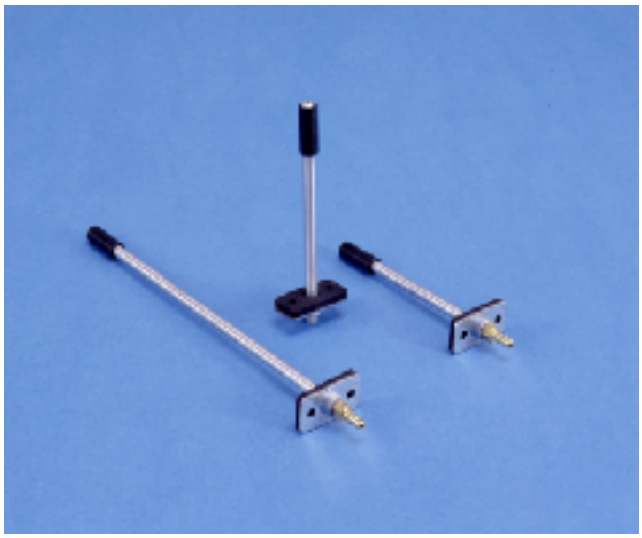
DMPR-KC250 Manual Locking Quadrant.
This provides for manual positioning and locking.



DMPR-KC151 Blade-to-Blade Bracket.
This horizontally couples two panels with the blades operating in the same direction. One kit is required for every 24 inches of panel height.

DMPR-KC300 Swivel Ball Joint.
This provides a connection between the blade arm, crank arm, etc. and the linkage rod. Each Kit includes 10 swivel ball joints. Sold in quantities of 10.

Static Pressure Probe
Model A-520



- **Unique dual orifice design to eliminate air flow error**
- **Gasketed flange for ease of installation**
- **1/4" brass hose barb connection for transducer/switch**
- **Available in 4" and 8" probe lengths**
- **6061T-6 aluminum alloy**
- **Gasketed mounting flange, brass connector and mounting holes guarantee quick and easy installation**

The A-520 Static Pressure Probe is designed to pick up static pressure in a duct, plenum, air handler or other HVAC equipment. The Probe has two orifices vertically opposite each other to cancel out any air flow induced errors. If a bent tube with a single orifice at the end is used to pick up static pressure in a duct, the air flowing across the probe may cause a small low pressure within the probe. This low pressure acts against the duct static pressure and hence induces an error which is exponentially proportional to the air flow. As the air flow increases, this error will increase also and as the flow decreases, the error decreases in an exponential relationship.

The engineers at MAMAC Systems resolved this problem with a unique design which incorporates two orifices diametrically opposing each other in a vertical plane. When the air flows across an orifice, it creates a suction towards that orifice. Similarly, when the same air flows across the other orifice, it creates an opposing suction which cancels out the first pressure drop. Regardless of the velocity, the flow error is constantly cancelled out and the A-520 provides an accurate,

The A-520 Static Pressure Probe is available in 6061T-6 aluminum alloy or 304 stainless steel material. In this way, for standard HVAC applications, the aluminum probe can be used. However, in exhaust applications where corrosive gases are present, the 304 stainless steel is recommended. The A-520 is available in two probe length options: 1) 4" aluminum/stainless steel; 2) 8" aluminum/ stainless steel. The Probe is attached to a 2" O.D. flange with two conveniently located mounting holes for ease of attachment to the sheet metal. The flange also has a neoprene gasket to seal off the mounting holes. An industry standard 1/4" hose barb or 1/8" NPT female swivel brass fitting is provided for PVC/copper tubing connection. The A-520 is designed to substantially reduce the installation time required and to provide a convenient method to pick up static pressure in HVAC equipment.

Installation is completed by drilling a 1/4" hole in the sheet metal, inserting the Probe and securing the assembly by using the mounting flange as a template to mark and drill two holes for the self tapping sheet metal screws. A label is provided to correctly position the mounting holes during installation to insure that the two orifices are perpendicular to the air flow.

MAMAC SYSTEMS®
MONITOR • DECISION • CONTROL
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Tel 08-232-4551 • Fax 08-232-4715

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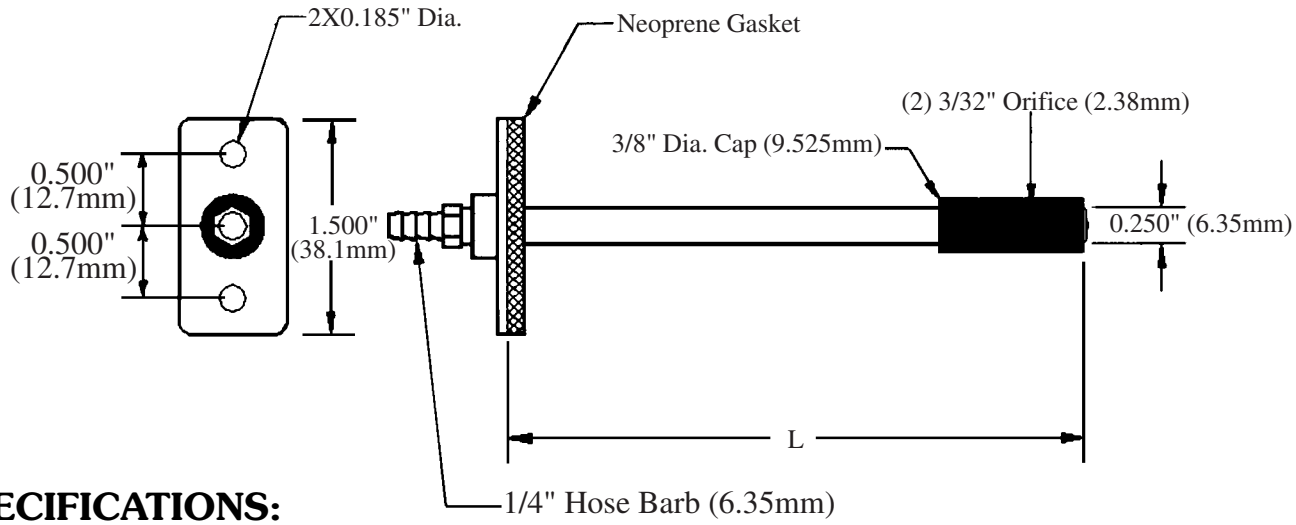
Ontario • L3R 0N6 • Canada
Tel 905-474-9215 • Fax 905-474-0876

5611 North Bridge Road
03-06 • Eng Cheong Tower
Singapore • 911901
Tel 65-3927273 • Fax 65-3927276

A-520



SPECIFICATIONS:

Material: 6061T-6 Aluminum Alloy or 304 Stainless Steel
Port Connections: 1/4" brass hose barb or 1/8" NPT female
Gasket Material: Neoprene
Maximum Pressure: 10 psig
Maximum Temperature: 250° C
Maximum Air Flow: Unlimited
Weight: 1.5 oz.

ORDERING INFORMATION:

A-520	PROBE LENGTH	MATERIAL	CONNECTOR
	1) 4"	A) Aluminum	1) 1/4" hose barb
	2) 8"	B) Stainless Steel	2) 1/8" NPT female

The MAMAC Systems warranty covers parts and labor for 2 years from date of shipment. MAMAC Systems reserves the right to change any specifications without notice to improve performance, reliability, or function of our products.

A Complete Line of Control Peripherals From a Single Source

MAMAC Systems is the only manufacturer offering more than fifty products to satisfy all temp, humidity, pressure, flow, light, speed or any other DDC controls application. MAMAC's complete line of control peripherals is available in over two thousand different configurations of supply voltage, output, range and enclosure type to make our products guaranteed compatible to all HVAC controls, industrial automation and COGEN systems worldwide.

Single source accountability, liberal 2 year warranty, worldwide service and technical support, competitive pricing, accumulated experience of more than 10,000 installations are some of the benefits offered by MAMAC Systems which are second to none in the HVAC DDC controls industry.

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Ontario • L3R 0N6 • Canada
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5611 North Bridge Road
03-06 • Eng Cheong Tower
Singapore • 911901
Tel 65-3927273 • Fax 65-3927276

H300

Hawkeye®300

Micro Split-Core Go/No Go Current Switch

c UL us CE

Installer's Specifications

Amperage Range	0.15 - 60A Continuous
Sensor Supply Voltage	Induced from monitored conductor
Isolation	600VAC rms (UL), 300VAC rms (CE), insulated conductors only
Temperature Range	-15º to +60º C
Humidity Range	10-90% RH non-condensing
Status Output Ratings	N.O. 1.0A@30VAC/DC non-polarity sensitive
Off State Leakage	Open switch represents 1+ MEG ohms of resistance
Terminal Block AWG Range	16-22 AWG
Terminal Block Torque Range	7 in-lb

Specification Note: For CE compliance, conductor shall be insulated according to IEC 61010-1:2001, Installation Category III or equivalent. The product design provides for functional insulation only.

⚠ DANGER ⚠

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

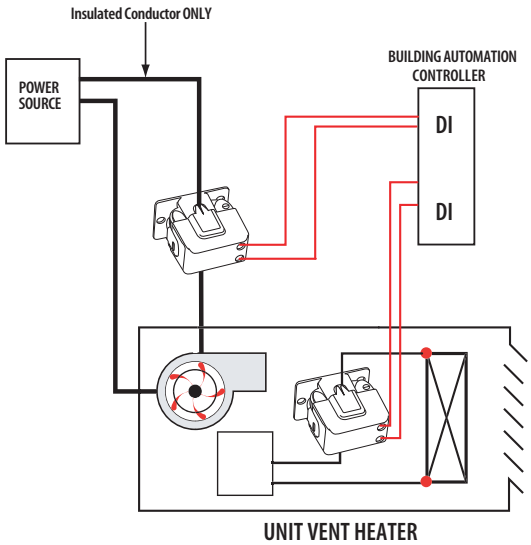
- Follow safe electrical work practices. See NFPA 70E in the USA, or applicable local codes.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Read, understand and follow the instructions before installing this product.
- Turn off all power supplying equipment before working on or inside the equipment.
- Use a properly rated voltage sensing device to confirm power is off.
  DO NOT DEPEND ON THIS PRODUCT FOR VOLTAGE INDICATION
- Only install this product on insulated conductors.

Failure to follow these instructions will result in death or serious injury.

NOTICE

- This product is not intended for life or safety applications.
- Do not install this product in hazardous or classified locations.
- The installer is responsible for conformance to all applicable codes.
- Mount this product inside a suitable fire and electrical enclosure.

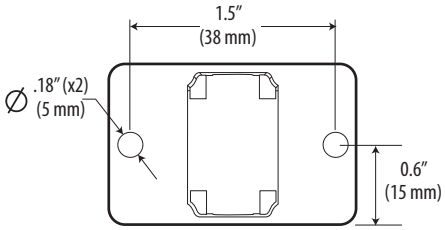
Wiring Example

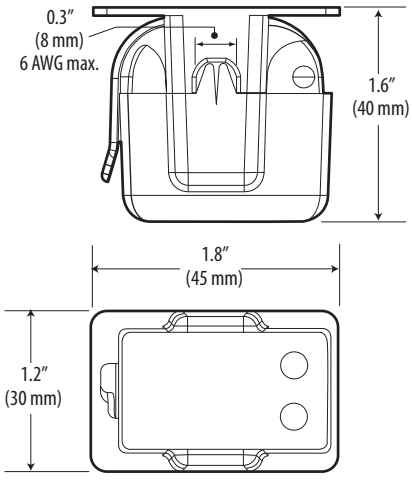


QUICK INSTALL

1. Plan the installation:
   Locate a mounting surface for the removable mounting bracket that will allow the monitored conductor to pass through the iris, or "window" when it is installed and keep the product at least ½" from any uninsulated conductors (CE). Determine cable routing for the controller connection, allowing wiring to reach the mounting location.
2. Install mounting bracket
   Drill holes to mount the bracket to the chosen surface using the included screws.
3. Wire the output connections between the sensor and the controller (solid-state contact).
4. Snap the sensor over the wire to be monitored and clip the assembly to the mounting bracket.
5. Close up and power up!

DIMENSIONS





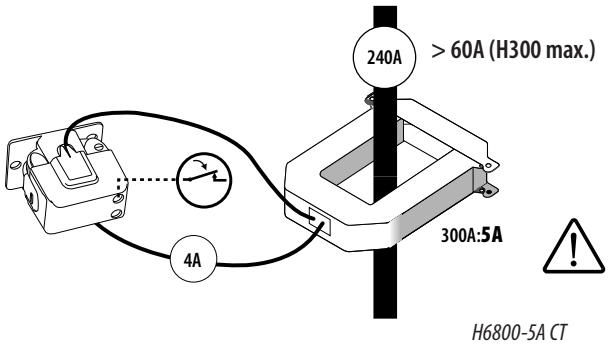
OPERATION

The H300 is a current-sensitive switching device which monitors current (amperage) in the conductor passing through it. A change in amperage in the monitored conductor which crosses the switch threshold will cause the resistance of the FET status output to change state, similar to the action of a mechanical switch. In this model, the threshold is fixed at 150mA AC max. The status output is suitable for connection to building controllers, or other appropriate data acquisition equipment operating at up to 30 volts. The H300 requires no external power supply to generate its output.

NOTES

For load currents greater than sensor maximum rating:

Use a 5 Amp (H681x series) Current Transformer (CT) as shown.



H6800-5A CT

DANGER: 5A CTS CAN PRESENT HAZARDOUS VOLTAGES. INSTALL CTS IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. TERMINATE THE CT SECONDARY BEFORE APPLYING CURRENT.

CAUTION

RISK OF EQUIPMENT DAMAGE

- **Derate the product's maximum current for the number of turns through the sensing window using the following formula.**

  Rated Max. Amps ÷ Number of Turns = Max. monitored Amps

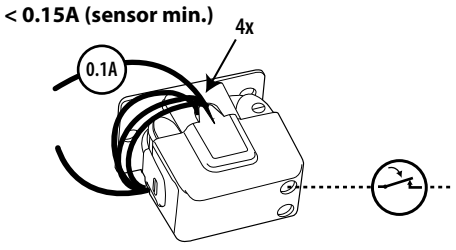
  e.g. : 100A ÷ 4 Turns = 25 Amps max. in monitored conductor

- **Failure to follow these instructions can result in overheating and permanent equipment damage.**

For load currents less than sensor minimum rating:

Wrap the monitored conductor through the center hole and around the sensor body to produce multiple turns through the "window." This increases the current measured by the transducer.

• Controller must be programmed to account for the extra turns. e.g., if four turns pass through the sensor (as shown) the normal threshold current must be divided by 4.



TROUBLESHOOTING

Problem	Solution
No Reading at Controller	• Check for control voltage at sensor (<30V) • Check for amperage in monitored conductor (> 0.15A) • Assure that sensor core mating surfaces are clean and that the core clamp is completely closed

H908

Hawkeye® 908

Adjustable Current Switch

Split-Core, Self-Powered, Status Output

Installer's Specifications

Amperage Range	2.5 - 135A Continuous
Output	N.O. 1.0A@30VAC/DC, polarity insensitive
Hysteresis	10% of setpoint, typical
Off-State Leakage	1+ MΩ
Isolation	600VAC rms (UL), 300VAC rms (CE)
Frequency	50/60Hz.
Temperature Range	-15º to 60º C
Humidity Range	10-90% RH non-condensing
Safety	UL 508, IEC 61010-1: 2001 CAT III

Specification Note: For CE compliance, conductor shall be insulated according to IEC 61010-1:2001, Installation Category III or equivalent.
The product design provides for basic insulation only.

⚠ DANGER ⚠

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

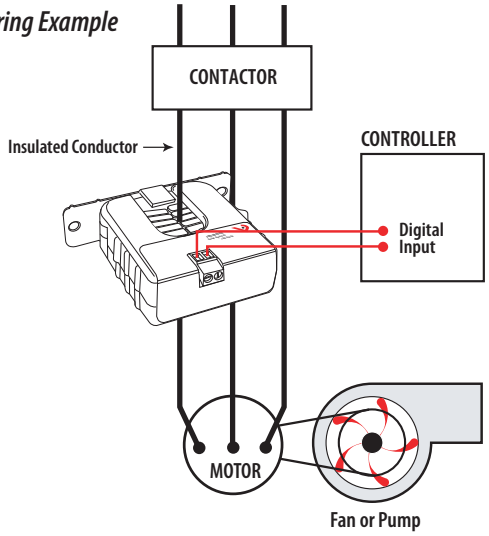
- Follow safe electrical work practices. See NFPA 70E in the USA, or applicable local codes.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Read, understand and follow the instructions before installing this product.
- Turn off all power supplying equipment before working on or inside the equipment.
- Use a properly rated voltage sensing device to confirm power is off.
  DO NOT DEPEND ON THIS PRODUCT FOR VOLTAGE INDICATION
- Only install this product on insulated conductors.

Failure to follow these instructions will result in death or serious injury.

NOTICE

- This product is not intended for life or safety applications.
- Do not install this product in hazardous or classified locations.
- The installer is responsible for conformance to all applicable codes.
- Mount this product inside a suitable fire and electrical enclosure.

Wiring Example



QUICK INSTALL

1. Plan the installation:
   Locate a mounting surface for the removable mounting bracket that will allow the monitored conductor to pass through the iris, or "window" when it is installed and keep the product at least ½" (13mm) from any uninsulated conductors (CE). Determine cable routing for the controller connection, allowing wiring to reach the mounting location.

2. Install mounting bracket
   Drill holes to mount the bracket to the chosen surface using the included screws.

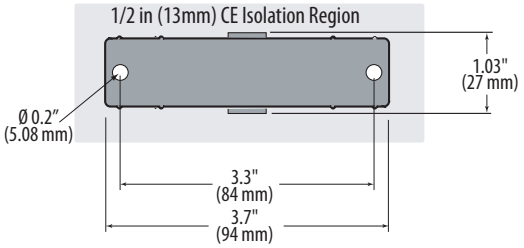
3. Wire the output connections between the sensor and the controller (solid-state contact).

4. Snap the sensor over the wire to be monitored and clip the assembly to the mounting bracket.

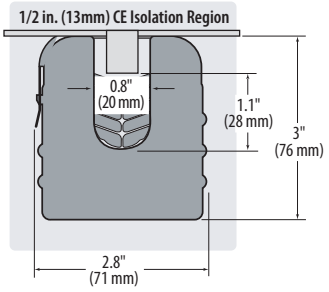
5. Calibrate the sensor (see page 2) with the load running normally.

6. Close up and power up!

Install Mounting Bracket



DIMENSIONS



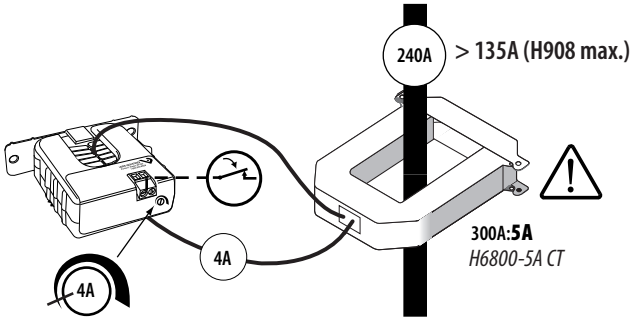
OPERATION

The H908 is a current-sensitive switching device which monitors current (amperage) in the conductor passing through it. A change in amperage in the monitored conductor which crosses the switch (setpoint) threshold plus the hysteresis value will cause the resistance of the FET status output to change state, similar to the action of a mechanical switch. In this model, the setpoint is adjustable through the action of a twenty (20) turn potentiometer (see the CALIBRATION section). The status output is suitable for connection to building controllers, or other appropriate data acquisition equipment operating at up to 30 volts. The H908 requires no external power supply to generate its output.

NOTES

For load currents greater than sensor maximum rating:

Use a 5 Amp (H681x series) Current Transformer (CT) as shown.



DANGER: 5A CTS CAN PRESENT HAZARDOUS VOLTAGES. INSTALL CTS IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. TERMINATE THE CT SECONDARY BEFORE APPLYING CURRENT.

CAUTION

RISK OF EQUIPMENT DAMAGE

- **Derate the product's maximum current for the number of turns through the sensing window using the following formula.**

  Rated Max. Amps ÷ Number of Turns = Max. monitored Amps

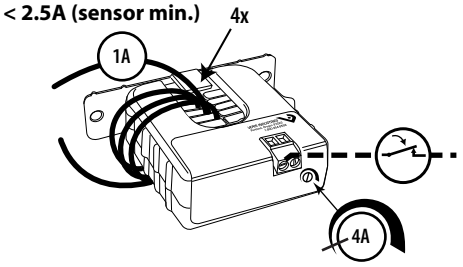
  e.g. : 100A ÷ 4 Turns = 25 Amps max. in monitored conductor

- **Failure to follow these instructions can result in overheating and permanent equipment damage.**

For load currents less than sensor minimum rating:

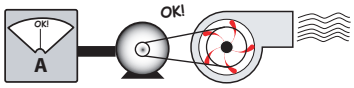
Wrap the monitored conductor through the center hole and around the sensor body to produce multiple turns through the "window." This increases the current measured by the transducer.

• Controller must be programmed to account for the extra turns. e.g., if four turns pass through the sensor (as shown) the normal controller reading must be divided by 4.

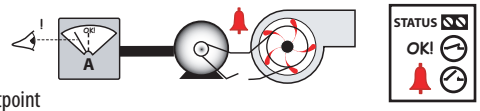


CALIBRATION

Establish normal load conditions.

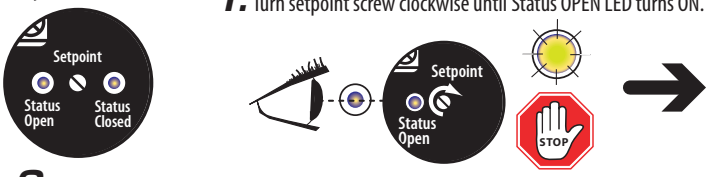


A. To monitor under-current (belt loss, coupling shear, status)



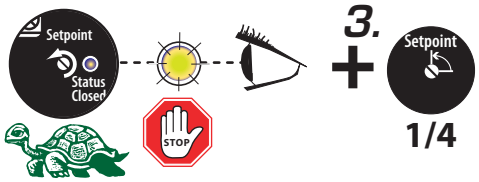
Find Setpoint adjustment screw

1. Turn setpoint screw clockwise until Status OPEN LED turns ON.

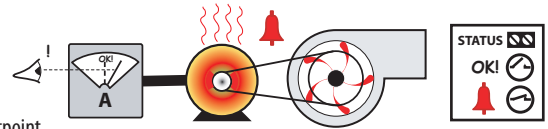


2. S-l-o-w-l-y turn the screw counter-clockwise until the Status CLOSED LED just turns ON.

3. Turn the screw an additional ¼ turn counter-clockwise for operational margin.

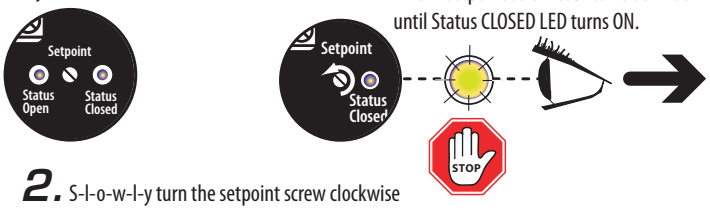


B. To monitor over-current (mechanical problems, seized impeller)



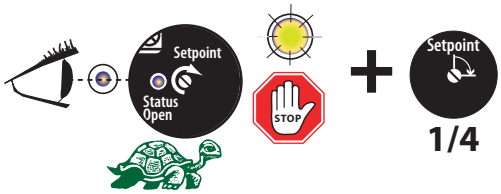
Find Setpoint adjustment screw

1. Turn setpoint screw counter-clockwise until Status CLOSED LED turns ON.



2. S-l-o-w-l-y turn the setpoint screw clockwise until the Status OPEN LED just turns ON.

3. Turn the setpoint screw an additional ¼ turn clockwise for operational margin.



TROUBLESHOOTING

Problem	Solution
No Reading at Controller	• Check sensor calibration (see above) • Check for control voltage at sensor (<30V) • Check for amperage in monitored conductor (> 2.5A) • Assure that sensor core mating surfaces are clean and that the core clamp is completely closed
Setpoint screw has no stops	The setpoint screw has a slip-clutch at both ends of its travel to avoid damage. Twenty turns CCW will reset the sensor to be most sensitive. Repeat calibration above.
Both LEDs are lit	Setpoint screw is too far clockwise. See solution above.

CW SERIES

CWL

CWE

CW SERIES

Environmental CO_2 Sensors Wall Mounting

Installer's Specifications

Input Voltage	20 to 30VDC, 24AC
Analog Output	4-20mA, 0-10VDC (selectable) CWE models; 4-20mA, (clipped and capped)/0-5VDC/0-10VDC (selectable) CWL models
Sensor Current Draw	100mA Maximum
Operating Temperature Range	0° to 50°C(32° to 122°F)
Housing Material	High impact ABS plastic

CO_2 Transmitter:

Sensor Type	Non-dispersive infrared (NDIR), diffusion sampling
Measurement Range	0-2000 ppm or 0-5000 ppm, user selectable on CWL models, 0-2000 ppm on CWE models
Accuracy	±30 ppm ±5% of measured value
Repeatability	±20 ppm ±1% of measured value
Response Time	<60 seconds for 90% step change

RH Transmitter:

HS Sensor	Digitally profiled thin-film capacitive (32-bit mathematics); U.S. Patent 5,844,138
Accuracy	±2% from 10 to 80% RH; Multi-point calibration NIST
Stability	±1% @ 20°C (68°F) annually, for two years
Operating Humidity Range	0 to 100% RH, noncondensing
Operating Temperature Range	10° to 35°C (50° to 95°F)
Temperature Coefficient	±0.1% RH/°C above or below 25°C (typical)

Temperature (Transmitter):

Sensor Type	Solid-state, integrated circuit
Accuracy	±0.5°C (±1°F) typical
Resolution	0.1°C (0.2°F)
Range	10° to 35°C (50° to 95°F)

Relay Contacts:

1 Form C	1A@30VDC, resistive; 30W max

Note: RTD/Thermistors in wall packages are not compensated for internal heating of product.

EMC Conformance: EN 61000-6-3:2001 Class B, EN 61000-6-1:2001, EN 61000-3-2:2000, EN 61000-3-3:2001

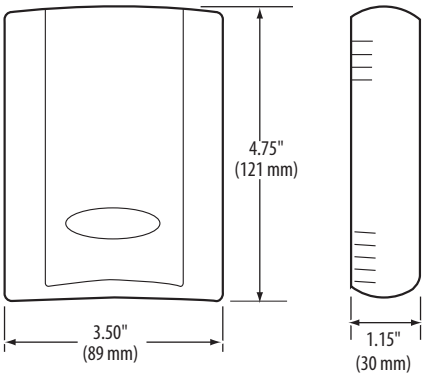
EMC Test Methods: CISPR 22:1997(Amended A9:2000, A2:2002), IEC 61000-4-2:2001, IEC 61000-4-3:2002, IEC 61000-4-4:2004, IEC 61000-4-5:2001, IEC 61000-4-6:2004, IEC 61000-4-8:2001, IEC 61000-4-11:2004.

EMC Special Note: Connect this product to a DC distribution network or an AC/DC power adaptor with proper SURGE PROTECTION (EN 61000-6-1:2001 specification requirements)

NOTICE

- This product is not intended for life or safety applications.
- Do not install this product in hazardous or classified locations.
- Read and understand the instructions before installing this product.
- Turn off all power supplying equipment before working on it.
- The installer is responsible for conformance to all applicable codes.

DIMENSIONS



PRODUCT IDENTIFICATION

WALL DELUXE MODELS:

CWL [S] (RH Option) [ ] (Temp.) [ ] (Sensor Type) [ ]

(RH Option)
- **H** = RH 2%
- **X** = No RH

(Temp.)
- **T** = Temp
- **X** = No *(stop here)*

(Sensor Type)
- **A** = Transmitter
- **B** = 100R Platinum, RTD
- **C** = 1k Platinum, RTD
- **D** = 10k T2, RTD, Thermistor
- **E** = 2.2k, Thermistor
- **F** = 3k, Thermistor
- **G** = 10k CPC, Thermistor
- **H** = 10k T3, Thermistor
- **J** = 10k Dale, Thermistor
- **K** = 10k w/11k shunt, Thermistor
- **M** = 20k NTC, Thermistor
- **N** = 1800 ohm, Thermistor
- **R** = 10k US, Thermistor
- **S** = 10k 3A221, Thermistor
- **T** = 100k, Thermistor

WALL ECONOMY MODELS:

CWE [S] (Sensor Type) [ ]

(Sensor Type)
- **B** = 100R Platinum, RTD
- **C** = 1k Platinum, RTD
- **D** = 10k T2, RTD, Thermistor
- **E** = 2.2k, Thermistor
- **F** = 3k, Thermistor
- **G** = 10k CPC, Thermistor
- **H** = 10k T3, Thermistor
- **J** = 10k Dale, Thermistor
- **K** = 10k w/11k shunt, Thermistor
- **M** = 20k NTC, Thermistor
- **N** = 1800 ohm, Thermistor
- **R** = 10k US, Thermistor
- **S** = 10k 3A221, Thermistor
- **T** = 100k, Thermistor

Options Available

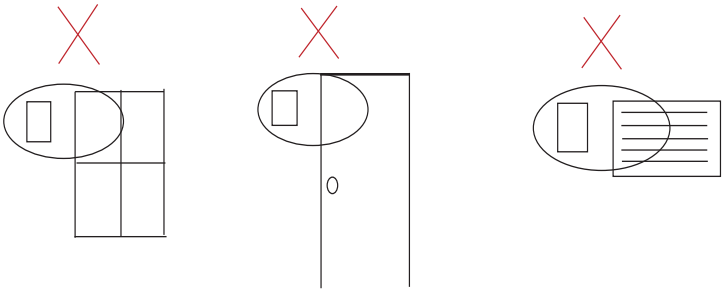
(Temp Cal Cert)	(Option)	(Slide Pot Value)
X = No	**1** = Push Button Override *	-
1 = 1pt Temp Cal	**2** = Set Point Slider	**A** = 1k
2 = 2pt Temp Cal	**3** = Push Button Override*+Set Point Slider	**F** = 10k
		G = 20k
		K = 50k
		M =100k

CE

**Note: the Push Button Override feature is not available with temperature transmitter models. Only resistive temperature models qualify for this feature.*

  USA 800.354.8556 or 503.598.4564 / support@veris.com

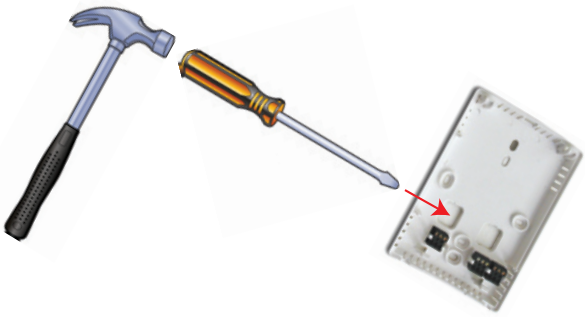
1. Choose a location to mount the sensor, away from ventilation sources.



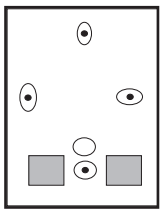
2. Position the sensor vertically on the wall, 4 1/2 feet above the floor.

correct incorrect incorrect

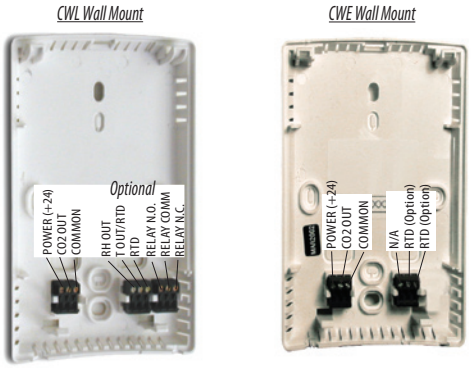
3. Punch out openings in the backplate.



4. Mount the backplate onto the wall using the screws provided.



5. Wire the backplate.



6. Install the sensor.

7. Install the cover.

CONFIGURATION - CWL ONLY

RUN MODE:

P	P	M		1	0	0	0
C	0	2					

CO2 ONLY MODEL
**INDICATES RELAY STATUS*

P	P	M		1	0	0	0
%	R	H		5	0	.	0

CO2/RH COMBO MODEL

P	P	M		1	0	0	0
º	F			7	0	.	0

CO2/T COMBO MODEL

P	P	M		1	0	0	0
X	X	X		X	X	.	X

CO2/RH/T COMBO MODEL
TOGGLE %RH AND DEGREES

CONFIGURATION MODE:

PRESS [ENTER] FOR CONFIGURATION MODE.
PRESS PLUS OR MINUS TO CHANGE SETTING.

S	E	T	P	O	I	N	T
C	0	2			8	0	0

RANGE 500 TO 1500
50PPM INCREMENT

D	E	A	D	B	A	N	D
C	0	2			1	0	0

RANGE 10 TO 500
5 PPM INCREMENT

R	A	N	G	E			
C	0	2		X	X	X	X

OPTIONS ARE 2000 OR 5000

A	B	C		M	O	D	E
–		X	X	X			+

OPTIONS ARE ON, LOW, OFF
SEE NEXT PAGE FOR EXPLANATION

U	N	I	T	S			
–			º	X			+

(TEMP MODELS ONLY)
OPTIONS ARE ºF or ºC

	0	U	T	P	U	T	
–	0	–	1	0	V		+

(VOLTAGE MODE ONLY)
OPTIONS: 0-10V OR 0-5V
DEFAULT IS 0-10V

CALIBRATION MODE:

PUSH AND HOLD PLUS AND MINUS FOR 5 SECONDS TO ENTER MODE. PRESS ARROW TO CHANGE OPTION. PUSH ENTER FOR NEXT SELECTION.

	S	E	R	I	A	L	
X	X	X	X	X	X	X	X

DISPLAYS SERIAL NUMBER

		X	X	X			
	X	X	X	X	X		

DISPLAYS MODEL NUMBER

O	F	F	S	E	T		
º	C				X	.	X

RANGE IS -5 TO 5ºC
.1ºC INCREMENT

O	F	F	S	E	T		
%	R	H		X	X	.	X

RANGE -10 TO 10%
.1% INCREMENT

C	O	2		C	A	L	?
–			X	X	X		+

OPTIONS ARE YES, NO

C	A	L		G	A	S	?
–			X	X	X	X	+

OPTIONS ARE NONE, 0, 400

W	O	R	K	I	N	G	
	*			5	:	0	0

Unit will automatically return to run mode when calibration is complete.

NOTE: This product is factory calibrated. The typical CO^2 sensor calibration interval is 5 years, dependent on specific site installation factors. As of the date of this document, compliance with ANSI/ASHRAE 62-2001 requires minimum on-site accuracy verification intervals of 6 months, or per the building operation and maintenance manual. Accuracy verification should be performed using a comparison to a known reference, or the CO^2 gas calibration kit available from Veris Industries as model AA01.

WARNING: CO^2 sensor calibration requires gas calibration kit. Performing calibration without gas kit will cause erroneous readings. Consult factory for calibration kit.

ABC CALIBRATION ALGORITHM

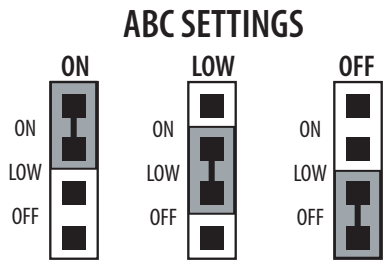
ABC (Automatic Baseline Calibration) is a patented self-calibration feature, which automatically adjusts the CO2 sensor to compensate for drift. When ABC is enabled, the lowest reading within every 24-hour period is recorded and analyzed over a running 7 day or 28-day period. If a statistically significant amount of drift is detected, an automatic correction factor is applied. This enables the sensor to operate within specifications for the 5-year calibration interval.

ON POSITION. Recommended Setting! Use the "ON" Setting for applications where the building is unoccupied within a 24 hr. timeframe.

LOW POSITION. Use the "LOW" setting for buildings occupied 24hrs a day.

OFF POSITION. Not Recommended!

Refer to Calibration Mode procedures on previous page to set desired ABC mode for CWL models.



ON POSITION. Recommended Setting! Use the "ON" Setting for applications where the building is unoccupied within a 24 hr. timeframe.

LOW POSITION. Use the "LOW" setting for buildings occupied 24hrs a day.

OFF POSITION. Not Recommended!

OUTPUT SCALING

CO2 - Carbon Dioxide Sensor

Output scaling: 0-2000ppm

	CO2 PPM	0-5 VOLT OUTPUT	0-10 VOLT OUTPUT	mA OUTPUT
Outside	300-500	.75 to 1.25	1.5 to 2.5	6.4 to 8
Over Ventilated	Under 600	under 1.5	Under 3	Under 8.8
Ideal Ventilation	600-900	1.5 to 2.25	3 to 4.5	8.8 to 11.2
Under Ventilated	Over 900	over 2.25	Over 4.5	Over 11.2

RH - Relative Humidity Sensor

Output scaling: 0-100%

T - Temperature Transmitter

Output scaling: 50/95ºF (10-35ºC)
To determine temperature from output reading:

1) Compute Total Span from Temperature Range:
Maximum range - Minimum range = Total span
ex. 50/95º range: 95 - 50 = 45 Total span

2) Compute Output % of Span from Reading:
(Reading - Minimum Output) / (Maximum output - Minimum output
ex. 11.10mA reading on 4-20mA output: (11.10-4)/(20-4)=7.10/16=0.444=44.4%
ex. 4.44v reading on 0-10v output: (4.44-0)/(10-0)=4.44/10=0.444=44.4%

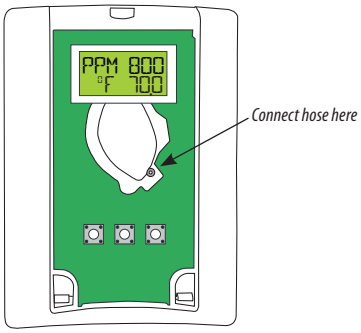
3) Compute Temperature:
(Total span x Output % of Span) + Minimum range
ex. 44.4% Output, Total Span = 45, range = 50/95: (0.444 x 45) + 50 = 20 + 50 = 70˚
Example outputs for selected temperatures:

Temp	4-20mA	0-10v	0-5v
65	9.33mA	3.33v	1.67v
70	11.10mA	4.44v	2.22v
75	12.89mA	5.56v	2.78v

CALIBRATION PROCESS: CWL MODELS

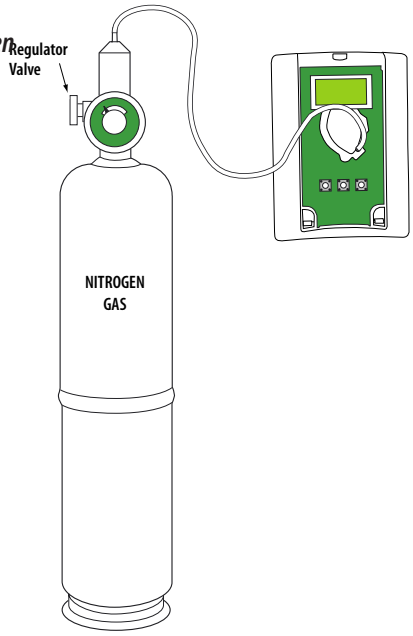
1. Remove cover to the device.
2. Hook up hose to plastic port located on sensing module
3. Enter Calibration mode by following instructions on previous page.
4. Select 0 ppm Cal Gas option
5. Flow gas (Nitrogen) 0 ppm CO2 gas through the sensor until the unit returns to its run mode. Estimated calibration time is 30 seconds to five minutes.

Step One - Calibration Port

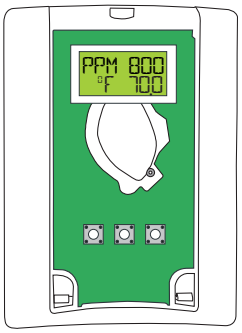


Step Two - Enter Calibration Mode menu per directions on page 2. Choose 0 ppm calibration gas option.

Step Three - Flow Nitrogen



Step Four - Calibrate 5 minutes. Unit will return to run mode when calibration is complete.



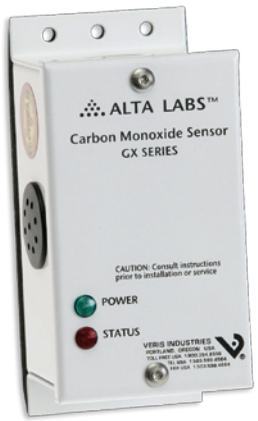
CALIBRATION PROCESS: CWE MODELS

1. Remove cover to the device.
2. Hook up hose to plastic port located on sensing module.
3. Start flowing (nitrogen) 0 ppm Gas (0 ppm only)
4. Push and hold down until the RED LED illuminates
5. Continue flowing gas until the RED LED is off.

STANDARD RTD AND THERMISTOR VALUES (Ohms)

°C	°F	100 Ohm	1000 Ohm	3k	10k Type 2	10k Type 3	10k Dale	10k 3A221	10k "G" US	20k	100k	TAC 1.8k
-50	-58	80.306	803.06	205,800	692,700	454,910	672,300	-	441,200	1,267,600	-	63,880
-40	-40	84.271	842.71	102,690	344,700	245,089	337,200	333,562	239,700	643,800	3,366,000	35,680
-30	-22	88.222	882.22	53,730	180,100	137,307	177,200	176,081	135,300	342,000	1,770,000	20,720
-20	-4	92.160	921.60	29,346	98,320	79,729	97,130	96,807	78,910	189,080	971,200	12,460
-10	14	96.086	960.86	16,674	55,790	47,843	55,340	55,252	47,540	108,380	553,400	7,733
0	32	100.000	1000.00	9,822	32,770	29,588	32,660	32,639	29,490	64,160	326,600	4,940
10	50	103.903	1039.03	5,976	19,930	18,813	19,900	19,901	18,780	39,440	199,000	3,240
20	68	107.794	1077.94	3,750	12,500	12,272	12,490	12,493	12,260	24,920	124,900	2,177
25	77	109.735	1097.35	3,000	10,000	10,000	10,000	10,000	10,000	20,000	100,000	1,800
30	86	111.673	1116.73	2,417	8,055	8,195	8,056	8,055	8,194	16,144	80,580	1,496
40	104	115.541	1155.41	1,598	5,323	5,593	5,326	5,324	5,592	10,696	53,260	1,049
50	122	119.397	1193.97	1,081	3,599	3,894	3,602	3,600	3,893	7,234	36,020	750
60	140	123.242	1232.42	747	2,486	2,763	2,489	2,486	2,760	4,992	24,880	545
70	158	127.075	1270.75	527	1,753	1,994	1,753	1,751	1,990	3,512	17,510	403
80	176	130.897	1308.97	378	1,258	1,462	1,258	1,255	1,458	2,516	12,560	302
90	194	134.707	1347.07	-	919	1,088	917	915	1,084	1,833	9,164	230
100	212	138.506	1385.06	-	682	821	679	678	816.8	1,356	6,792	177
110	230	142.293	1422.93	-	513	628	511	509	623.6	1,016	5,108	139
120	248	146.068	1460.68	-	392	486	389	388	481.8	770	3,894	109
130	266	149.832	1498.32	-	303	380	301	299	376.4	591	3,006	87

G SERIES



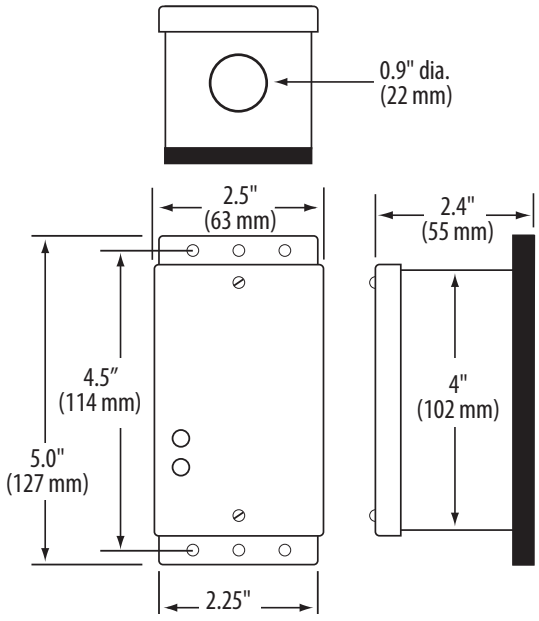
NOTICE

- ***This product is not intended for life or safety applications.***
- **Do not install this product in hazardous or classified locations.**
- **Read and understand the instructions before installing this product.**
- **Turn off all power supplying equipment before working on it.**
- **The installer is responsible for conformance to all applicable codes.**

PRODUCT IDENTIFICATION

	Enclosure	*Output*	*Auxiliary Alarm Output*	*US or EU*
G	☐	☐	☐	S
	D = Duct mount **W** = Wall mount	**V** = Field-selectable, 0-5/0-10VDC **M** = 4-20mA **R** = Relay only	**A** = Auxiliary Contact **X** = None	= Standard

DIMENSIONS



G SERIES

Carbon Monoxide Transmitter and Fan Controller

Installer's Specifications

Sensor	Digitally profiled Metal Oxide Semiconductor (MOS)
Sensor Life	5-year expected sensor element life, replaceable
Supply Power	15-30VDC, 24VAC, 250mA
Detection Range	0 to 200 ppm
Analog Output	User selectable 100 ppm F.S. or 200ppm F.S.
Relay Setpoint	35ppm
Relay Output	N.O. Form A (SPST) 8A@30VAC/VDC; (Use with N.C. contactor)
High Limit Setpoint	100ppm for 30 minutes
High Limit Alarm	Audible, 85dB, resets below 100ppm (solid-state contact for A ver)
LED Indicators	Normal=Green LED; Call for ventilation = Red LED; High-limit alarm = Flashing Red LED; Sensor life has expired = Flashing Green LED
Operating Environment	-20° to 50°C (-4° to 122°F); 0 to 90% RH non-condensing
Coverage	5000 sq ft typical

QUICK INSTALL

1. Select a location for the sensor in a secure area where it will be accessible only to qualified service personnel.
2. Lock out all power supplies prior to installation.
3. Connect wiring as shown in the Wiring Diagram.
4. Apply power to the unit. A green LED on the circuit board indicates proper operation of the power supply.

OPERATION

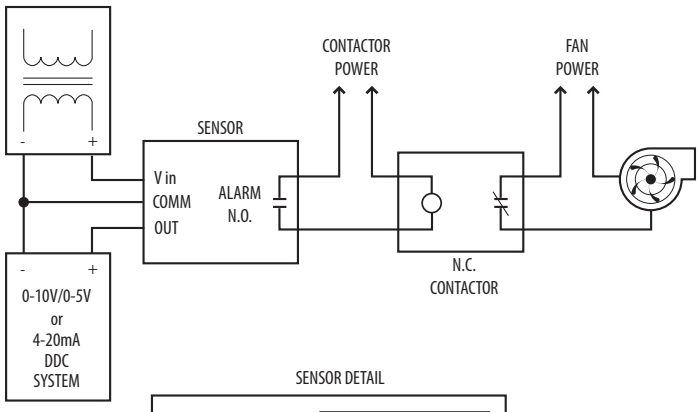
The G Series carbon monoxide detectors measure CO levels and signal control systems to provide an inlet of fresh air optimal for the space at a given time. The G Series devices are equipped with a relay contact that closes when CO level is below 35ppm and opens when the CO level is above 35ppm (when used with a normally closed contactor). Removal of the sensor, interruption of power, or cut wires cause the relay circuit to open and start the fan. Minimum relay cycle time is 3 minutes to prevent fan short-cycling.

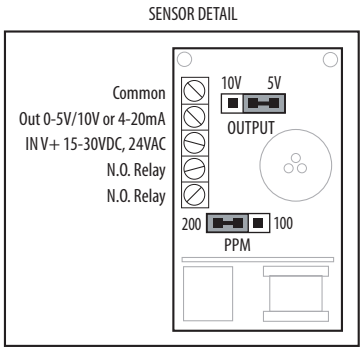
Audible Alarm: 85dB alarm sounds if CO level rises above 100ppm for 30 minutes.

LED Indicators:

Green	Normal operation
Flashing Green	Sensor life has expired
Red	Call for ventilation
Flashing Red	CO level above 100ppm for 30 minutes

WIRING DIAGRAM





TROUBLESHOOTING

Problem	Solution
4-20 output does not function	• Verify that the unit is a 4-20 model. • Verify that the unit is wired for sourcing output.
Output is half or twice what is expected	• Verify span jumper is set to desired scale. • For voltage units, verify jumper is set to desired voltage output scale.
Output is inaccurate or unstable	• Allow 96 hours for sensor to burn in and stabilize.

SERVICE

For any service or installation, consult qualified service personnel. To assure continued reliable operation, the sensor module should be replaced every five years with a Veris Industries CO sensor replacement module.

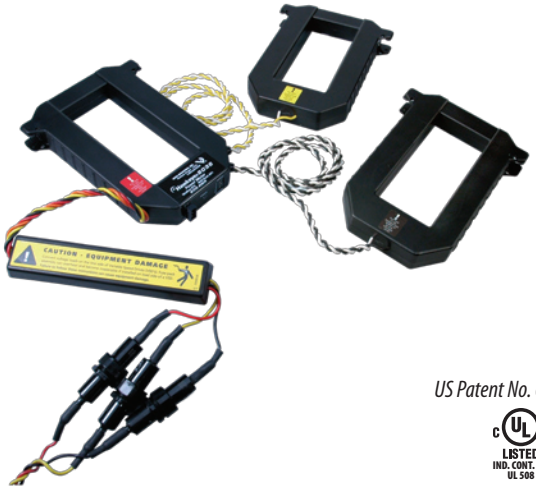
Replacement instructions:

1. Disconnect power from the unit.
2. Carefully remove the old sensor module.
3. Install the new module firmly into the socket.
4. Reconnect power to the unit.
5. The replacement sensor requires 72 hours after initial power application to stabilize.

The sensor module is factory calibrated. No field calibration is required or possible. Verify proper operation by observing LED indicators.

ENERCEPT® H8035/H8036

Modbus Energy Meter
Networked kW/kWh Transducers



US Patent No. 6,373,238

c UL us LISTED IND. CONT. EQ. UL 508

Installer's Specifications

Input Voltage	208 to 480 VAC
Number of Phases Monitored	1 or 3
Frequency	50/60 Hz
Maximum Primary Current	100/300/400/800/1600/2400 A continuous per phase
CT case isolation	600 VAC
Internal isolation	2000 VAC rms
Operating temp. range	0° to 60°C (32° to 122°F) (<95%RH, non-condensing)
Storage temp. range	-40° to 70°C (-40° to 158°F)
Accuracy	±1% of reading from 10% to 100% of the rated current*
Output Type	RS-485, 2-wire plus common
Baud Rate	9600
Protocol	Modbus RTU

** Meter accuracy specified with conductors centered in the CT window.*

⚠ DANGER ⚠

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Follow safe electrical work practices. See NFPA 70E in the USA, or applicable local codes.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Read, understand and follow the instructions before installing this product.
- Turn off all power supplying equipment before working on or inside the equipment.
- Use a properly rated voltage sensing device to confirm power is off.
  DO NOT DEPEND ON THIS PRODUCT FOR VOLTAGE INDICATION
- Only install this product on insulated conductors.

Failure to follow these instructions will result in death or serious injury.

NOTICE

- This product is not intended for life or safety applications.
- Do not install this product in hazardous or classified locations.
- The installer is responsible for conformance to all applicable codes.

FCC PART 15 INFORMATION

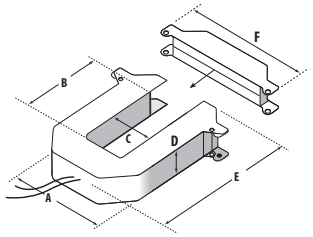
NOTE: This equipment has been tested by the manufacturer and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Modifications to this product without the express authorization of Veris Industries nullify this statement.

QUICK INSTALL

Disconnect and lock out power before installation.

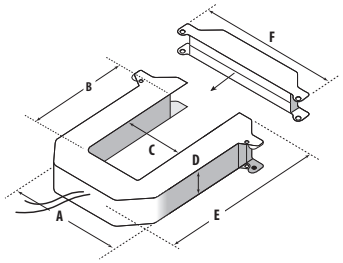
1. Set the address switches located on the bottom of the CT.
2. Connect the voltage leads to the source to be monitored.
3. Snap the CT onto the conductor (observe color matching).
4. Connect the Modbus wires (observe polarity).

DIMENSIONS



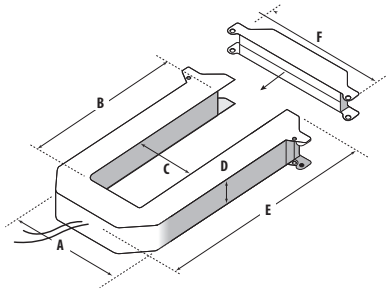
SMALL
100/300 Amp

A =	3.8"	(96 mm)
B =	1.2"	(30 mm)
C =	1.3"	(31 mm)
D =	1.2"	(30 mm)
E =	4.0"	(100 mm)
F =	4.8"	(121 mm)



MEDIUM
400/800 Amp

A =	4.9"	(125 mm)
B =	2.9"	(73 mm)
C =	2.5"	(62 mm)
D =	1.2"	(30 mm)
E =	5.2"	(132 mm)
F =	5.9"	(151 mm)



LARGE
800/1600/2400 Amp

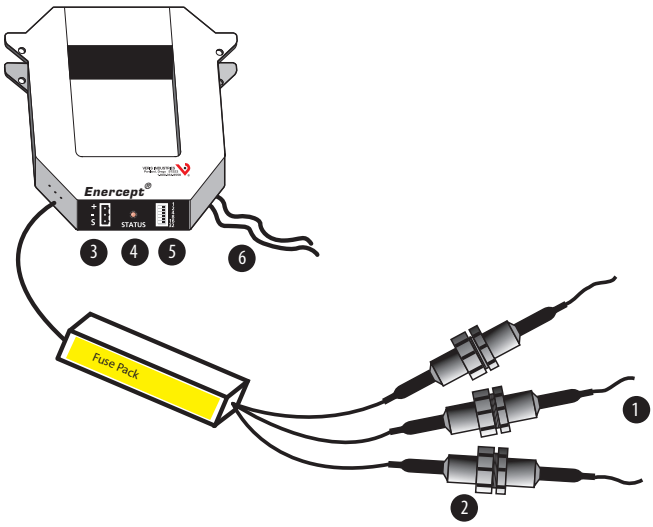
A =	4.9"	(125 mm)
B =	5.5"	(139 mm)
C =	2.5"	(62 mm)
D =	1.2"	(30 mm)
E =	7.9"	(201 mm)
F =	6.0"	(151 mm)

OPERATION

The H8035 and H8036 three-phase power transducers monitor energy parameters from aggregate kW (real power) and kWh (consumption) to power factor per phase. Integration of electronics lowers hardware and installation costs. The sensors automatically detect phase reversal, so CT load orientation is not a concern. The CTs and meters are calibrated as a set, so it is necessary to color-match the CTs and voltage leads when installing. These devices monitor up to 63 loads at a time on a single RS-485 drop.

With two platforms to choose from (H8035 Energy Only or H8036 Enhanced Data Stream), the applications for these devices are diverse, including aggregate billing, tenant submetering, energy management, performance contracting, demand limiting and cooling plant optimization. The 1% total system accuracy conforms to ANSIC12.1 metering standards.

PRODUCT DIAGRAM



1. Voltage Leads: input range is 208 to 480V.
2. Fuses: maximum current draw 60mA. Fuses provided by the factory are rated ½A, 600VAC, 200 KAIC. Replace only with fuses of the same type and rating.
3. Pulse Output connector
4. Status LED: blink codes: slow green for normal operation; slow red for incorrect wiring or low power factor (less than 0.5); fast red for max. current exceedance.
5. Pulse Rate Switches: used to set the pulse output rate.
6. External CTs: permanently attached; do not disconnect or use with other power meters.

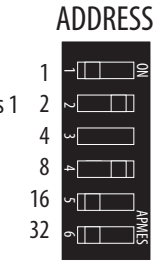
Color match CTs and voltage leads! Example: clamp the red labeled CT around the power conductor connected to the red voltage wire.

INSTALLATION

Connecting H8000 Series meters to the load side of a variable frequency drive will permanently damage the electronics. Connect only to the line side of a VFD.

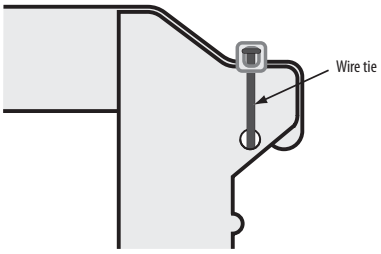
Disconnect and lock out power before installation.

1. Choose a unique address and set the switches for that address as shown in the Address Selection Switches section. Only addresses 1 to 63 can be used.

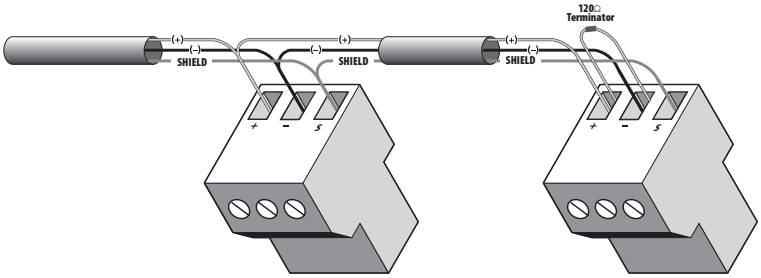


2. Connect the voltage leads to the phase conductors, at a location that is not normally turned off. Connect voltage leads on the Line side of the conductor to ensure constant power to the meter. For a 3-phase system, connect the red lead to phase A, black to phase B, and yellow to phase C. See the Wiring section on the following page.

3. Snap the CT onto the conductor. Connect CTs to the correspondingly colored voltage lead. If the application can exceed 20 times the rated CT current, use wire ties to secure the I-bar to the CT housing. This CT automatically detects phase reversal, so CT load orientation is not important.



4. Remove the terminal block and attach the RS-485 wires. Observe (+), (-), and Shield polarity. Insulate any exposed wiring.



5. For information regarding software setup, see the Modbus protocol specifications available at www.veris.com/Modbus/.
6. Check power reading (these calculations are approximations only).

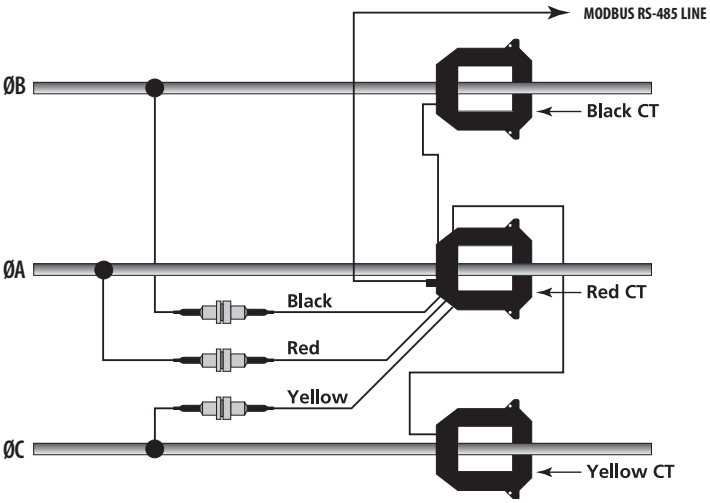
Expected power:

kW = Volts x Amps x 1.732 x PF / 1000

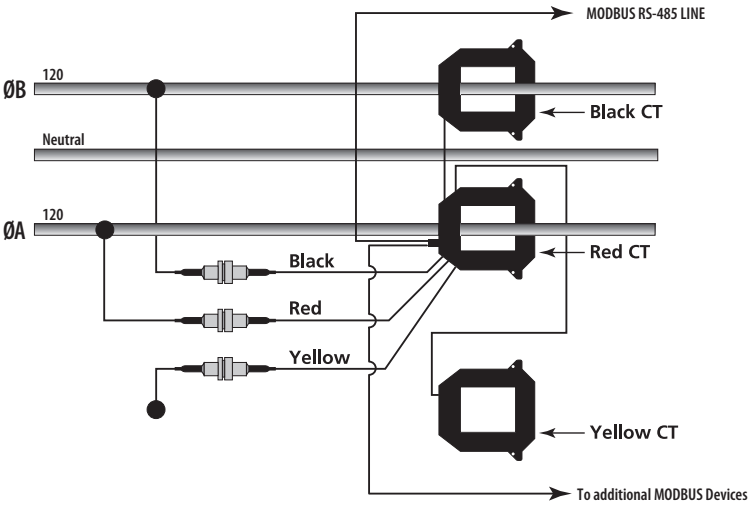
kW = Horsepower x 0.746

WIRING

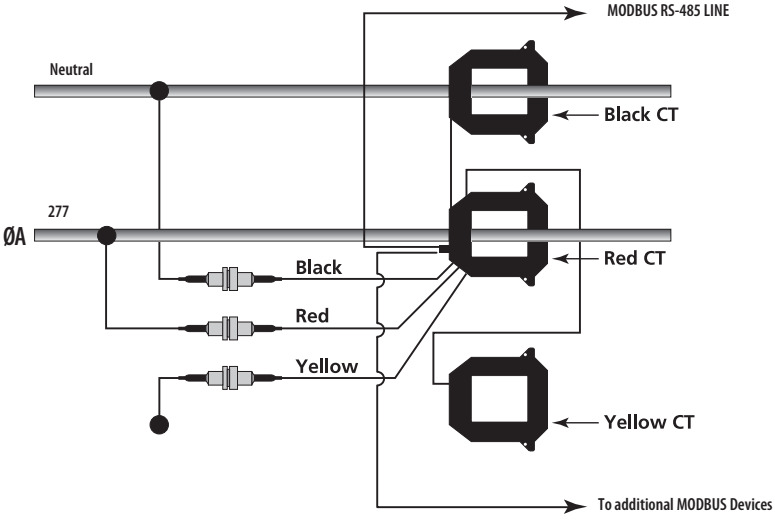
Typical 208/480 VAC 3Ø, 3- or 4- Wire Installation



Typical 240/120 VAC 1Ø, 3-Wire Installation



Typical 277 VAC 1Ø, 2-Wire Installation



NOTES

1. DO NOT GROUND THE SHIELD INSIDE THE ELECTRICAL PANEL. All Modbus wires, including the shield, should be insulated to prevent accidental contact with high voltage conductors.
2. The Modbus cable should be mechanically secured where it enters the electrical panel.
3. All Modbus devices should be connected together in a daisy-chain fashion. The first and last devices in the chain should have a 120Ω terminating resistor between (+) and (-).
4. The Modbus cable should be shielded twisted pair wire BELDEN 1120A or similar.

WARNING: After wiring the N2 BUS cable, remove all scraps of wire or foil shield from the electrical panel. This could be DANGEROUS if wire scraps come into contact with high voltage wires!

OUTPUT

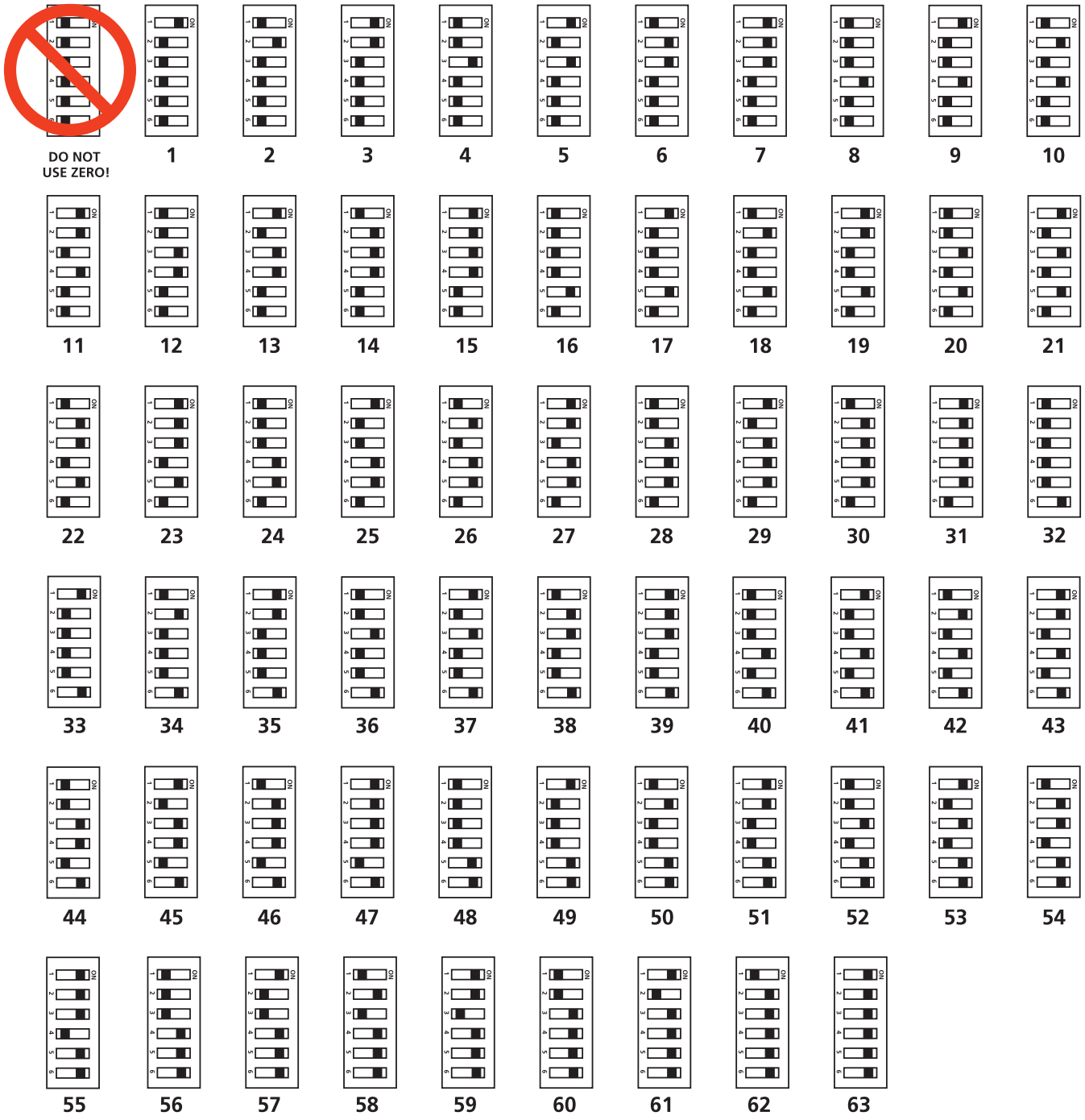
H8035
kWh, consumption
Reset kWh
kW, demand

H8036
kWh, consumption
kW, demand
VAR, reactive power
VA, apparent power
Power factor
Average demand
Minimum demand
Maximum demand
Voltage, line-to-line
Voltage, line-to-neutral
Amps, average current
kW, demand ØA
kW, demand ØB
kW, demand ØC
Power factor ØA
Power factor ØB
Power factor ØC
Voltage, ØA to ØB
Voltage, ØB to ØC
Voltage, ØAto ØC
Voltage, ØA to Neutral
Voltage, ØB to Neutral
Voltage, ØC to Neutral
Amps, Current ØA
Amps, Current ØB
Amps, Current ØC

Note: The meter cannot communicate on the network bus without power. Therefore, it is best to connect the voltage leads ahead of switching devices.

ADDRESS SELECTION SWITCHES

Each Modbus device must have a unique address. These switches must be set to assign a unique address before the device is connected to the Modbus RS-485 line. If an address is selected which conflicts with another device, both devices will be unable to communicate.



MODBUS REGISTER ADDRESSING

This table lists the addressed assigned to each data point. Registers are read MostSignificant Byte (MSB) first. 32 bit floating point values are encoded per IEEE Standard 754. For floating point format variables, each data point appears twice because two 16-bit addresses are required to hold a 32-bit float value. The 16 bit Most Significant Word (MSW) is in the lower address of the register pair, while the least Significant Word (LSW) is in the upper address.

Modbus RTU function codes supported: 3=read holding registers; 6=preset single register; 17=report Slave I.D.

Quick Reference of the Most Common Data Points

Modbus Addr	Typical Offset	Units	Description	INTEGER: multiplier required	FLOAT: UPPER 16 bits	FLOAT: LOWER 16 bits
40001	0	KWH	Energy Consumption, LSW	X		
40002	1	KWH	Energy Consumption, MSW	X		
40003	2	KW	Demand (power)	X		
40257	---	KWH	Energy Consumption		X	
40258		KWH	Energy Consumption			X
40259	0	KWH	Energy Consumption (same 40257)		X	
40260		KWH	Energy Consumption (same 40258)			X
40261	2	KW	Demand (power)		X	
40262		KW	Demand (power)			X

Complete Listing of Data Points

Modbus Addr	Typical Offset	Units	Description	INTEGER: multiplier required	FLOAT: UPPER 16 bits	FLOAT: LOWER 16 bits
40001	0	KWH	Energy Consumption, LSW	X		
40002	1	KWH	Energy Consumption, MSW	X		
40003	2	KW	Demand (power)	X		
40004	3	VAR	Reactive Power	X		
40005	4	VA	Apparent Power	X		
40006	5	---	Power Factor	X		
40007	6	VOLTS	Voltage, line to line	X		
40008	7	VOLTS	Voltage, line to neutral	X		
40009	8	AMPS	Current	X		
40010	9	KW	Demand (power), phase A	X		
40011	10	KW	Demand (power), phase B	X		
40012	11	KW	Demand (power), phase C	X		
40013	12	---	Power Factor, phase A	X		

Complete Listing of Data Points, cont.

Modbus Addr	Typical Offset	Units	Description	INTEGER: multiplier required	FLOAT: UPPER 16 bits	FLOAT: LOWER 16 bits
40014	13	---	Power Factor, phase B	X		
40015	14	---	Power Factor, phase C	X		
40016	15	VOLTS	Voltage, phase A-B	X		
40017	16	VOLTS	Voltage, phase B-C	X		
40018	17	VOLTS	Voltage, phase A-C	X		
40019	18	VOLTS	Voltage, phase A-N	X		
40020	19	VOLTS	Voltage, phase B-N	X		
40021	20	VOLTS	Voltage, phase C-N	X		
40022	21	AMPS	Current, phase A	X		
40023	22	AMPS	Current, phase B	X		
40024	23	AMPS	Current, phase C	X		
40025	24	KW	Average Demand	X		
40026	25	KW	Minimum Demand	X		
40027	26	KW	Maximum Demand	X		
40257	---	KWH	Energy Consumption		X	
40258		KWH	Energy Consumption			X
40259	0	KWH	Energy Consumption (same 40257)		X	
40260		KWH	Energy Consumption (same 40258)			X
40261	2	KW	Demand (power)		X	
40262		KW	Demand (power)			X
40263	4	VAR	Reactive Power		X	
40264		VAR	Reactive Power			X
40265	6	VA	Apparent Power		X	
40266		VA	Apparent Power			X
40267	8	---	Power Factor		X	
40268		---	Power Factor			X
40269	10	VOLTS	Voltage, line to line		X	
40270		VOLTS	Voltage, line to line			X
40271	12	VOLTS	Voltage, line to neutral		X	
40272		VOLTS	Voltage, line to neutral			X
40273	14	AMPS	Current		X	
40274		AMPS	Current			X
40275	16	KW	Demand (power), phase A		X	
40276		KW	Demand (power), phase A			X
40277	18	KW	Demand (power), phase B		X	
40278		KW	Demand (power), phase B			X

Complete Listing of Data Points

Modbus Addr	Typical Offset	Units	Description	INTEGER: multiplier required	FLOAT: UPPER 16 bits	FLOAT: LOWER 16 bits
40279	20	KW	Demand (power), phase C		X	
40280		KW	Demand (power), phase C			X
40281	22	---	Power Factor, phase A		X	
40282		---	Power Factor, phase A			X
40283	24	---	Power Factor, phase B		X	
40284		---	Power Factor, phase B			X
40285	26	---	Power Factor, phase C		X	
40286		---	Power Factor, phase C			X
40287	28	VOLTS	Voltage, phase A-B		X	
40288		VOLTS	Voltage, phase A-B			X
40289	30	VOLTS	Voltage, phase B-C		X	
40290		VOLTS	Voltage, phase B-C			X
40291	32	VOLTS	Voltage, phase A-C		X	
40292		VOLTS	Voltage, phase A-C			X
40293	34	VOLTS	Voltage, phase A-N		X	
40294		VOLTS	Voltage, phase A-N			X
40295	36	VOLTS	Voltage, phase B-N		X	
40296		VOLTS	Voltage, phase B-N			X
40297	38	VOLTS	Voltage, phase C-N		X	
40298		VOLTS	Voltage, phase C-N			X
40299	40	AMPS	Current, phase A		X	
40300		AMPS	Current, phase A			X
40301	42	AMPS	Current, phase B		X	
40302		AMPS	Current, phase B			X
40303	44	AMPS	Current, phase C		X	
40304		AMPS	Current, phase C			X
40305	46	KW	Average Demand		X	
40306		KW	Average Demand			X
40307	48	KW	Minimum Demand		X	
40308		KW	Minimum Demand			X
40309	50	KW	Maximum Demand		X	
40310		KW	Maximum Demand			X

Note: Modbus addresses in the 4xxxx format follow the Modicon protocol specification for point addressing. The actual address sent is the value shown, minus 40001. In other words, the leading "4" is omitted, and the remaining 4-digit number is decremented so that point 40001 is requested with a value of zero in the actual Modbus communication. Some Modbus implementations require point addresses to be specified beginning at zero or 40000, instead of 40001. Programing code may also require addresses which correspond to actual values transmitted, so a value of zero is used to request data beginning at modbus address 40001.

In many applications, a single Modbus command is used to read all of the data available from the meter. For integers, the beginning address is 40001 (or zero in the actual Modbus command), and for floats the first address used would typically be 40259 (or 258 in the actual Modbus command). Although the first float appears at address 40257, it is not necessary to read this value because it is a duplicate copy of the kWh value (required by the product firmware). When a block of data is read, the "typical offset" values index to the data within the block.

"Multiplier required" indicates that a multiplication is required to properly scale the integer value. See Using Integer Data Types section.

USING INTEGER DATA TYPES

Unlike the floating-point data type, the integer data type can only represent whole numbers between zero and 65535. To convert a data point value into the number it represents, the value must be multiplied by a constant, as indicated in the table below.

Please note: some data points require different multipliers for each amperage range, while others, e.g. volts and power factor, use the same multiplier regardless of the amperage range of the product. The latter are indicated by single row values.

Addr	Units	100A	300/400A	800A	1600A	2400A
40001	kWh	7.81E-03	0.03125	0.0625	0.125	0.25
40002	kWh	512	2048	4096	8192	16384
40003	kW	0.004	0.016	0.032	0.064	0.128
40004	VAR	0.004	0.016	0.032	0.064	0.128
40005	VAR	0.004	0.016	0.032	0.064	0.128
40006	---	3.0518E-5				
40007	VOLTS	0.03125				
40008	VOLTS	0.015625				
40009	AMPS	3.906E-03	0.015625	0.03125	0.0625	0.1250
40010	kW	0.001	0.004	0.008	0.016	0.032
40011	kW	0.001	0.004	0.008	0.016	0.032
40012	kW	0.001	0.004	0.008	0.016	0.032
40013	---	3.0518E-5				
40014	---	3.0518E-5				
40015	---	3.0518E-5				
40016	VOLTS	0.03125				
40017	VOLTS	0.03125				
40018	VOLTS	0.03125				
40019	VOLTS	0.015625				
40020	VOLTS	0.015625				
40021	VOLTS	0.015625				
40022	AMPS	3.906E-03	0.015625	0.03125	0.0625	0.1250
40023	AMPS	3.906E-03	0.015625	0.03125	0.0625	0.1250
40024	AMPS	3.906E-03	0.015625	0.03125	0.0625	0.1250
40025	kW	0.004	0.016	0.032	0.064	0.128
40026	kW	0.004	0.016	0.032	0.064	0.128
40027	kW	0.004	0.016	0.032	0.064	0.128

As an alternative to the table on the previous page, it can be convenient to invert the values for use as divisors, where the integer value returned by the meter is divided by a number from the table below. In most cases, the divisors are a more compact number.

Addr	*Units*	*100A*	*300/400A*	*800A*	*1600A*	*2400A*
40001	kWh	128	32	16	8	4
40002	kWh	1.9531E-3	4.8828E-4	2.4414E-4	1.2207E-4	6.1035E-5
40003	kW	250	62.5	31.25	15.625	7.8125
40004	VAR	250	62.5	31.25	15.625	7.8125
40005	VA	250	62.5	31.25	15.625	7.8125
40006	---	32768				
40007	VOLTS	32				
40008	VOLTS	64				
40009	AMPS	256	64	32	16	8
40010	kW	1000	250	125	62.5	31.25
40011	kW	1000	250	125	62.5	31.25
40012	kW	1000	250	125	62.5	31.25
40013	---	32768				
40014	---	32768				
40015	---	32768				
40016	VOLTS	32				
40017	VOLTS	32				
40018	VOLTS	32				
40019	VOLTS	64				
40020	VOLTS	64				
40021	VOLTS	64				
40022	AMPS	256	64	32	16	8
40023	AMPS	256	64	32	16	8
40024	AMPS	256	64	32	16	8
40025	kW	250	62.5	31.25	15.625	7.8125
40026	kW	250	62.5	31.25	15.625	7.8125
40027	kW	250	62.5	31.25	15.625	7.8125

TROUBLESHOOTING

Problem	Solution
Status LED does not blink	Check fuses and voltage connections. Status LED should blink regardless of CTs, Modbus connections, and DIP switch setting.
Power meter interferes with another device on the Modbus	Set DIP switches to a different Modbus address not in use.
Readings seem highly inaccurate.	• Check that each CT is installed on the conductor with the corresponding color voltage input lead attached. In most cases, incorrect wiring will cause the STATUS LED to blink RED (slowly). However, a power factor lower than 0.5 could cause the LED to blink this way, even if the unit is installed properly. • It does not matter which side of the CT faces towards the load. • If current is below 7% of full scale maximum for the CT, use a smaller CT or wrap each wire through the CT multiple times • Check current with an amp-clamp. Expected power: kW = Volts x Amps x 1.732 x PF / 1000 kW = Horsepower x 0.746 PF is usually 0.7 to 0.95, depending on the load.
Meter goes offline when load is switched off.	Voltage leads must be connected on the Line side of the conductor. The power meter cannot communicate on the Modbus without voltage.
Status LED blinks red.	• If the LED blinks quickly (i.e., about 5 blinks in two seconds), then the use a CT with a higher amp rating. • If the LED blinks slowly (i.e., about 1 blink in two seconds) the CTs are not installed on the correct conductors, or the power factor is less than 0.5. The meter can accurately measure these low PFs, but few loads operate normally at such a low power factor.

SECTION 5

Checkout Sheets

SMCCCD Cañada Facility Maintenance Center

JOB # IC08C1031

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center
System: FURNACE UNIT TCP
Controller: F&CU-1
Neuron ID: 0412DF9B0200
Address:
SIM:

Model No.: MNL-20RS3
Software:
Subnet:

LNC / UNC No.:
Cir. No.:
Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
												When Required		
					Energ'd	De-ener	0%	50%	100%	Scaled Range	System	Actual	Diff.	Offset
AO1					☐	☐	☐	☐	☐					
AO2					☐	☐	☐	☐	☐					
DI1	DI	CT1	FAN STS	Digital (Form A)	☑	☑	☐	☐	☐					
DI2	DI	EF3	Ef3STS	Digital (Form A)	☑	☑	☐	☐	☐					
NO1	DO	UNIT1	FAN S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2	DO	UNIT1	COOL S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO3	DO	UNIT1	HEAT S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO4	DO	EF3	Ef3SS	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO5					☐	☐	☐	☐	☐					
NO6					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		55.91	56.8	0.9	
UI1	AI	DTS1	SaT	10K Thermistor (Curve 3) w/11K Shunt	☐	☐	☐	☐	☐		58.1	59	0.9	
UI2	AI	MD-1	MDmp1Pos	0-5VDC	☐	☐	☐	☐	☐		97.6	100	2.4	
UI3	AI	OATS	OaT	10K Thermistor (Curve 3) w/11K Shunt	☐	☐	☐	☐	☐		53.53	52.7	0.8	

Comments: OAT calibration value taken from 'wunderground.com'.

Checkout Performed By: Shadow Moyer

Date Completed: 5/7/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center
System: FURNACE UNIT TCP
Controller: F&CU-2
Model No.: MNL-20RS3
LNC / UNC No.:
Neuron ID: 045C1BC90200
Cir. No.:
Address:
Software:
SIM:
Subnet:
Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
					Energ'd	De-ener	0%	50%	100%	Scaled Range	System	When Required Actual	When Required Diff.	When Required Offset
AO1	AO	MD-1	MD1 CMD	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2	AO	MD-2	MD2 CMD	4-20mA (Out)	☐	☐	☑	☑	☑					
DI1	DI	CT2	FAN STS	Digital (Form A)	☑	☑	☐	☐	☐					
DI2	DI	EF4	Ef4STS	Digital (Form A)	☑	☑	☐	☐	☐					
NO1	DO	UNIT2	FAN S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2	DO	UNIT2	COOL S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO3	DO	UNIT2	HEAT S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO4	DO	EF4	Ef4SS	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO5					☐	☐	☐	☐	☐					
NO6					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		56.3	56.9	0.6	
UI1	AI	DTS2	SaT	10K Thermistor (Curve 3) w/11K Shunt	☐	☐	☐	☐	☐		56.9	56	0.9	
UI2	AI	DPT	DuctDP	0-5VDC	☐	☐	☐	☐	☐		0.2	0.19	0.01	
UI3	AI	MD-2	MDmp2Pos	0-5VDC	☐	☐	☐	☐	☐		98.2	100	1.8	

Comments: DPT zeroed and calibrated with manometer

Checkout Performed By: Shadow Moyer

Date Completed: 5/7/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-2

Controller: IRH-1

Neuron ID: 04B6159B0200

Address:

SIM:

Model No.: MNL-15RS3

Software:

Subnet:

LNC / UNC No.:

Cir. No.:

Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
												When Required		
					Energ'd	De-ener.	0%	50%	100%	Scaled Range	System	Actual	Diff.	Offset
AO1	AO	C-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2	AO	C-LOUVER	Pos CMD-2	4-20mA (Out)	☐	☐	☑	☑	☑					
NO1	DO	IH	IH-1 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		56.4	56.5	0.1	
UI1	AI	C-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	49.1	0.9	
UI2	AI	C-LOUVER	Pos FdBck-2	0-5VDC	☐	☐	☐	☐	☐		50	47.3	2.7	
UI3					☐	☐	☐	☐	☐					

Comments:

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-2

Controller: IRH-2

Neuron ID: 048D159B0200

Address:

SIM:

Model No.: MNL-15RS3

Software:

Subnet:

LNC / UNC No.:

Cir. No.:

Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
							0%	50%	100%	Scaled Range	System	When Required		
					Energ'd	De-ener.						Actual	Diff.	Offset
AO1	AO	C-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2	AO	C-LOUVER	Pos CMD-2	4-20mA (Out)	☐	☐	☑	☑	☑					
NO1	DO	IH	IH-2 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		58.6	59	0.4	
UI1	AI	C-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	48.2	1.8	
UI2	AI	C-LOUVER	Pos FdBck-2	0-5VDC	☐	☐	☐	☐	☐		50	48.2	1.8	
UI3					☐	☐	☐	☐	☐					

Comments:

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-2

Controller: IRH-3 | Model No.: MNL-15RS3 | LNC / UNC No.:

Neuron ID: 043A119B0200 | Cir. No.:

Address: | Software:

SIM: | Subnet: | Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
												When Required		
					Energ'd	De-ener.	0%	50%	100%	Scaled Range	System	Actual	Diff.	Offset
AO1	AO	C-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2	AO	C-LOUVER	Pos CMD-2	4-20mA (Out)	☐	☐	☑	☑	☑					
NO1	DO	IH	IH-3 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		57.5	57.5	0	
UI1	AI	C-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	48.7	1.3	
UI2	AI	C-LOUVER	Pos FdBck-2	0-5VDC	☐	☐	☐	☐	☐		50	48	2	
UI3	AI	CO2	Rm121CO2	4-20mA	☐	☐	☐	☐	☐		497	494	3	-25

Comments:

Offset of -25 ppm applied to CO2 sensor to synch up sensor display with TAC software displays.

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-2

Controller: IRH-4 | Model No.: MNL-15RS3 | LNC / UNC No.:

Neuron ID: 049F8A8B0200 | Cir. No.:

Address: | Software:

SIM: | Subnet: | Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
							0%	50%	100%	Scaled Range	System	When Required		
					Energ'd	De-ener						Actual	Diff.	Offset
AO1	AO	W-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2	AO	W-LOUVER	Pos CMD-2	4-20mA (Out)	☐	☐	☑	☑	☑					
NO1	DO	IH	IH-4 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		58.1	58.5	0.4	
UI1	AI	W-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	47.4	2.6	
UI2	AI	W-LOUVER	Pos FdBck-2	0-5VDC	☐	☐	☐	☐	☐		50	48.2	1.8	
UI3					☐	☐	☐	☐	☐					

Comments:

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-2

Controller: IRH-5 | Model No.: MNL-15RS3 | LNC / UNC No.:

Neuron ID: 043B119B0200 | Cir. No.:

Address: | Software:

SIM: | Subnet: | Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
												When Required		
					Energ'd	De-ener.	0%	50%	100%	Scaled Range	System	Actual	Diff.	Offset
AO1	AO	C-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2	AO	C-LOUVER	Pos CMD-2	4-20mA (Out)	☐	☐	☑	☑	☑					
NO1	DO	IH	IH-5 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		58.4	58	0.4	
UI1	AI	C-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	48.2	1.8	
UI2	AI	C-LOUVER	Pos FdBck-2	0-5VDC	☐	☐	☐	☐	☐		50	47.5	2.5	
UI3					☐	☐	☐	☐	☐					

Comments:

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-2

Controller: IRH-6 | Model No.: MNL-15RS3 | LNC / UNC No.:

Neuron ID: 04A08A8B0200 | Cir. No.:

Address: | Software:

SIM: | Subnet: | Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
												When Required		
					Energ'd	De-ener	0%	50%	100%	Scaled Range	System	Actual	Diff.	Offset
AO1	AO	W-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2	AO	W-LOUVER	Pos CMD-2	4-20mA (Out)	☐	☐	☑	☑	☑					
NO1	DO	IH	IH-6 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		58.5	58	0.5	
UI1	AI	W-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	47.9	2.1	
UI2	AI	W-LOUVER	Pos FdBck-2	0-5VDC	☐	☐	☐	☐	☐		50	47.6	2.4	
UI3					☐	☐	☐	☐	☐					

Comments:

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-3

Controller: IRH-7 | Model No.: MNL-20RS3 | LNC / UNC No.:

Neuron ID: 04BAD29A0200 | Cir. No.:

Address: | Software:

SIM: | Subnet: | Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
												When Required		
					Energ'd	De-ener	0%	50%	100%	Scaled Range	System	Actual	Diff.	Offset
AO1	AO	C-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2	AO	W-LOUVER	Pos CMD-2	4-20mA (Out)	☐	☐	☑	☑	☑					
DI1	DI	EF5	EF5 STS	Digital (Form A)	☑	☑	☐	☐	☐					
DI2	DI	EF6	EF6 STS	Digital (Form A)	☑	☑	☐	☐	☐					
NO1	DO	IH	IH-7 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2	DO	EF5	EF5 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO3	DO	EF6	EF6 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO4					☐	☐	☐	☐	☐					
NO5					☐	☐	☐	☐	☐					
NO6					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		60.7	60	0.7	
UI1	AI	C-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	48.3	1.7	
UI2	AI	W-LOUVER	Pos FdBck-2	0-5VDC	☐	☐	☐	☐	☐		50	48.7	1.3	
UI3	AI	CO2	Rm126CO2	4-20mA	☐	☐	☐	☐	☐		412	408	4	

Comments:

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-3

Controller: IRH-8 | Model No.: MNL-15RS3 | LNC / UNC No.:

Neuron ID: 04EE5EA90200 | Cir. No.:

Address: | Software:

SIM: | Subnet: | Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
							0%	50%	100%	Scaled Range	System	When Required		
					Energ'd	De-ener.						Actual	Diff.	Offset
AO1	AO	C-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2					☐	☐	☐	☐	☐					
NO1	DO	IH	IH-8 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		60.3	61	0.7	
UI1	AI	C-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	48.5	1.5	
UI2					☐	☐	☐	☐	☐					
UI3					☐	☐	☐	☐	☐					

Comments:

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-3

Controller: IRH-9 | Model No.: MNL-20RS3 | LNC / UNC No.:

Neuron ID: 04F4A38A0200 | Cir. No.:

Address: | Software:

SIM: | Subnet: | Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
												When Required		
					Energ'd	De-ener	0%	50%	100%	Scaled Range	System	Actual	Diff.	Offset
AO1	AO	C-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2	AO	W-LOUVER	Pos CMD-2	4-20mA (Out)	☐	☐	☑	☑	☑					
DI1	DI	EF7	EF7 STS	Digital (Form A)	☑	☑	☐	☐	☐					
DI2					☐	☐	☐	☐	☐					
NO1	DO	IH	IH-9 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2	DO	EF7	EF7 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO3					☐	☐	☐	☐	☐					
NO4					☐	☐	☐	☐	☐					
NO5					☐	☐	☐	☐	☐					
NO6					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		61.5	62.5	1	
UI1	AI	C-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	49.3	0.7	
UI2	AI	W-LOUVER	Pos FdBck-2	0-5VDC	☐	☐	☐	☐	☐		50	48.2	1.8	
UI3	AI	CO2	Rm128CO2	4-20mA	☐	☐	☐	☐	☐		502	504	2	-10

Comments:

Offset of -10 ppm applied to CO2 sensor to synch up sensor display with TAC software displays.

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-3

Controller: IRH-10 Model No.: MNL-20RS3 LNC / UNC No.:

Neuron ID: 04A03D7B0200 Cir. No.:

Address: Software:

SIM: Subnet: Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
												When Required		
					Energ'd	De-ener.	0%	50%	100%	Scaled Range	System	Actual	Diff.	Offset
AO1	AO	C-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2					☐	☐	☐	☐	☐					
DI1	DI	EF10	EF10 STS	Digital (Form A)	☑	☑	☐	☐	☐					
DI2	DI	EF9	EF9 STS	Digital (Form A)	☑	☑	☐	☐	☐					
NO1	DO	IH	IH-10 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2	DO	EF10	EF10 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO3					☐	☐	☐	☐	☐					
NO4					☐	☐	☐	☐	☐					
NO5					☐	☐	☐	☐	☐					
NO6					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐					
UI1	AI	C-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	48.2	1.8	
UI2	AI	CO	Rm125CO	4-20mA ** see notes below	☐	☐	☐	☐	☐		0.46			
UI3	AI	CO2	Rm125CO2	4-20mA	☐	☐	☐	☐	☐		360	354	6	-35

Comments: Unable to measure CO level's when commissioning. CO item will be revisited.

Offset of -35 ppm applied to CO2 sensor to synch up sensor display with TAC software displays.

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: TCP-3

Controller: IRH-11

Model No.: MNL-15RS3

LNC / UNC No.:

Neuron ID: 046E948B0200

Cir. No.:

Address:

Software:

SIM:

Subnet:

Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
												When Required		
					Energ'd	De-ener	0%	50%	100%	Scaled Range	System	Actual	Diff.	Offset
AO1	AO	C-LOUVER	Pos CMD-1	4-20mA (Out)	☐	☐	☑	☑	☑					
AO2	AO	W-LOUVER	Pos CMD-2	4-20mA (Out)	☐	☐	☑	☑	☑					
NO1	DO	IH	IH-11 S/S	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2					☐	☐	☐	☐	☐					
S-LK	AI	RTS	RTS	S-LNK	☐	☐	☐	☐	☐		52.9	53.5	0.6	
UI1	AI	C-LOUVER	Pos FdBck-1	0-5VDC	☐	☐	☐	☐	☐		50	47.9	2.1	
UI2	AI	W-LOUVER	Pos FdBck-2	0-5VDC	☐	☐	☐	☐	☐		50	47.2	2.8	
UI3	DI	EF12	EF12 STS	Digital (Form A)	☑	☑	☐	☐	☐					

Comments:

Checkout Performed By: Shadow Moyer

Date Completed: 4/13/2009

CONTROLLER POINT TO POINT CHECKOUT

Area: Canada Facilities Maintenance Center

System: FURNACE UNIT TCP

Controller: MITSUB

Model No.: MNL-20RS3

LNC / UNC No.:

Neuron ID: 04D1618C0200

Cir. No.:

Address:

Software:

SIM:

Subnet:

Node:

Point	I/O Type	Device	Software Tag	Point Type	Digital I/O		Analog Output				Analog Input			
					Energ'd	De-ener	0%	50%	100%	Scaled Range	System	When Required Actual	When Required Diff.	When Required Offset
AO1					☐	☐	☐	☐	☐					
AO2					☐	☐	☐	☐	☐					
DI1	DI	EF1	Ef1STS	Digital (Form A)	☑	☑	☐	☐	☐					
DI2	DI	CT-1	Ef2Sts	Digital (Form A)	☑	☑	☐	☐	☐					
NO1	DO	EF1	Ef1SS	Digital (Form A) (Out)	☑	☑	☐	☐	☐					
NO2					☐	☐	☐	☐	☐					
NO3					☐	☐	☐	☐	☐					
NO4					☐	☐	☐	☐	☐					
NO5					☐	☐	☐	☐	☐					
NO6					☐	☐	☐	☐	☐					
S-LK	AI	RTS	EF1 RmT	S-LNK	☐	☐	☐	☐	☐		56.52	56	0.5	
UI1	AI	RTS	FC1 RmT	10K Thermistor (Curve 3) w/11K Shunt	☐	☐	☐	☐	☐		59.3	60	0.7	
UI2	DI	CT	FC1STS	Digital (Form A)	☑	☑	☐	☐	☐					
UI3					☐	☐	☐	☐	☐					

Comments:

Checkout Performed By: Shadow Moyer

Date Completed: 5/7/2009

SECTION 6

Control Drawings

SMCCCD Cañada Facility Maintenance Center

JOB # IC08C1031