

## FX05 (Advanced) Field Controller

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# Introduction



**Figure 1: FX05 (Advanced)**

The FX05 (Advanced) Field Controller is the compact field controller of the Facility Explorer system. The controller is designed specifically for commercial Heating, Ventilating, Air Conditioning, and Refrigeration (HVACR) applications. In this document, the term FX05 stands for FX05 (Advanced) Field Controller.

The FX05 is a high performance controller with a powerful 16-bit microprocessor and state-of-the-art software that supports the precise control of a wide variety of mechanical and electrical equipment. The FX05 controller has 16 physical inputs and outputs and supports a wide range of temperature sensors and actuating devices. A series of converter modules extends the range of inputs to active sensors for the measurement of humidity, pressure, and other variables.

The FX05 controller is fully programmable or configurable, using the FX Tools Pro software package, for a wide range of commercial control applications. The FX05 controller can be fitted with an optional communication card for integration into an N2 Open or LONWORKS® compatible building automation system.

For stand-alone applications a real-time clock plug-in card is also available to support the start-stop scheduling of equipment and real-time based control sequences.

The FX05 can be integrated, as a slave device, in a distributed control application managed by a master controller (FX16 Master Controller or Master Display).

Optional accessories make the FX05 controller the state of the art solution for the HVACR market:

- Real-time Clock plug-in card
- N2 Open plug-in communication card
- LON plug-in communication card
- Input Converter Modules to interface active sensors

# Installation

This chapter describes how to install an FX05 Field Controller. See Figure 2 for FX05 dimensions in millimeters (mm) and inches (in.).

Two different types of terminal connectors are available: spring clamp or screw connectors. The screw connectors are included, while the spring clamp connectors must be ordered separately.

## North American Emissions Compliance

### ***United States***

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when this 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/her own expense.

### ***Canada***

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

Cet appareil numérique de la Classe (A) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

## Detailed Procedures

Follow these step-by-step instructions for each task to properly install and connect the FX05 controller.



**WARNING: Risk of Electric Shock.** Disconnect power supply before making electrical connections. Contact with components carrying hazardous voltage can cause electric shock and may result in injury or death.

**AVERTISSEMENT: Risque de décharge électrique.** Débrancher l'alimentation avant de réaliser tout branchement électrique. Tout contact avec des composants conducteurs de tensions dangereuses risque d'entraîner une décharge électrique et de provoquer des blessures graves, voire mortelles.

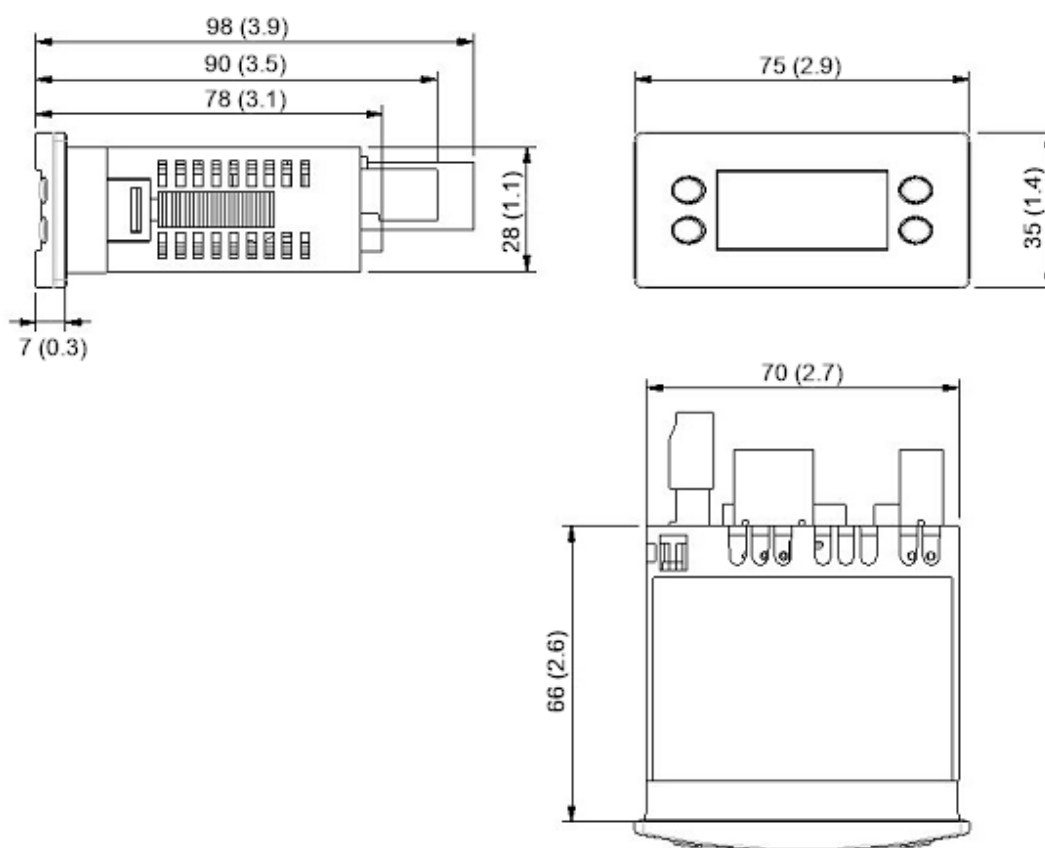


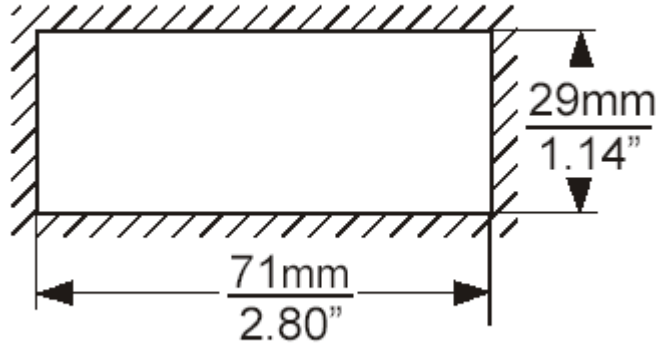
Figure 2: FX05 Dimensions – millimeters (inches)

## Mounting Instructions

### ***Mounting a Panel***

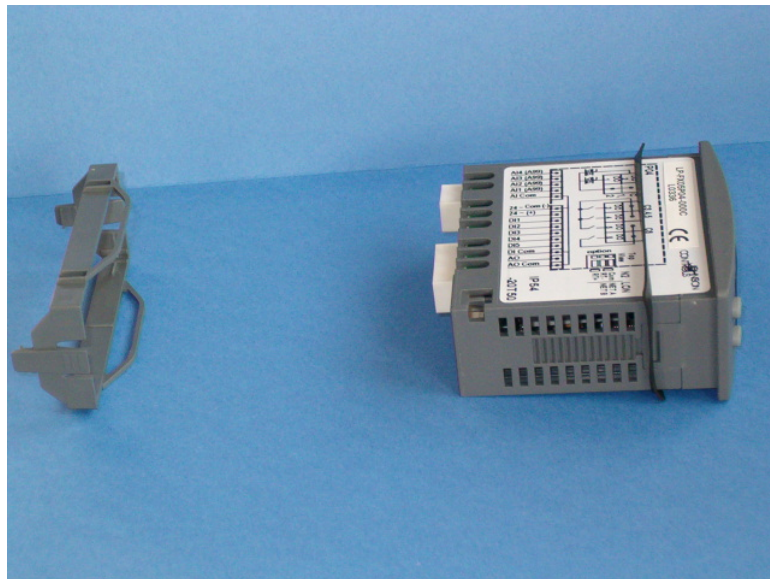
To mount an FX05 in a panel:

1. FX05 panel mounting requires a panel cut-out with the dimensions shown in Figure 3.



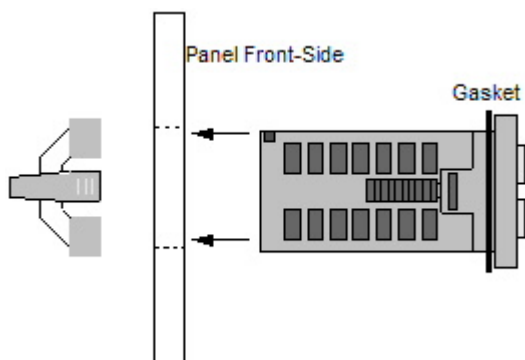
**Figure 3: Panel Cut-out**

2. Remove the mounting clip from the back of the FX05 by pressing the tabs. Make sure to keep the gasket around the FX05 enclosure.



**Figure 4: Panel Mount Instructions**

3. Insert the FX05 into the panel cut-out from the front side of the panel, and lock it by re-inserting the mounting clip from the back.



**Figure 5: Panel Mounting**

4. Wiring terminations are made by detachable Molex® connectors. Preassembled wiring harnesses are also available for ordering (see *Ordering Codes*).

**Table 1: Wiring Harness Details**

Color	FX05P11	FX05P12/13
Pink	Not Used	DO2
White	Not Used	DO1-DO2 COM
Light Blue	DO1 COM	DO1
Yellow	DO1	DO1-DO2 COM
Green	DO2	DO3-DO6 COM DO6 (Red) is isolated from DO3,4,5
Violet	DO2-DO6 COM	
Black		
Red		
Grey	DO3	DO3
Brown	DO4	DO4
Orange	DO5	DO5
Blue/Black	DO6	DO6



**Table 2: Preamsembled .5mm2 Cables Details**

<b>Color</b>	<b>FX05P1x Models</b>
<b>Yellow/Green</b>	AI4
<b>Red/Black</b>	AI3
<b>Orange/Black</b>	AI2
<b>White/Black</b>	AI1
<b>Blue</b>	AI5 Com
<b>Light Blue</b>	24Vac Com
<b>Pink</b>	24Vac
<b>White</b>	DI1
<b>Yellow</b>	DI2
<b>Green</b>	DI3
<b>Red</b>	DI4
<b>Grey</b>	DI5
<b>Brown</b>	DI Com
<b>Orange</b>	AO
<b>Violet</b>	AO Com

5. Verify that the wiring has been correctly installed, and that voltage levels are appropriate for the various input signals according to the application.

## Connection Details

The following drawings show the wiring details for the different models of FX05. Note that **AI** = Analog Input; **AO** = Analog Output; **DI** = Digital Input; and **DO** = Digital Output.

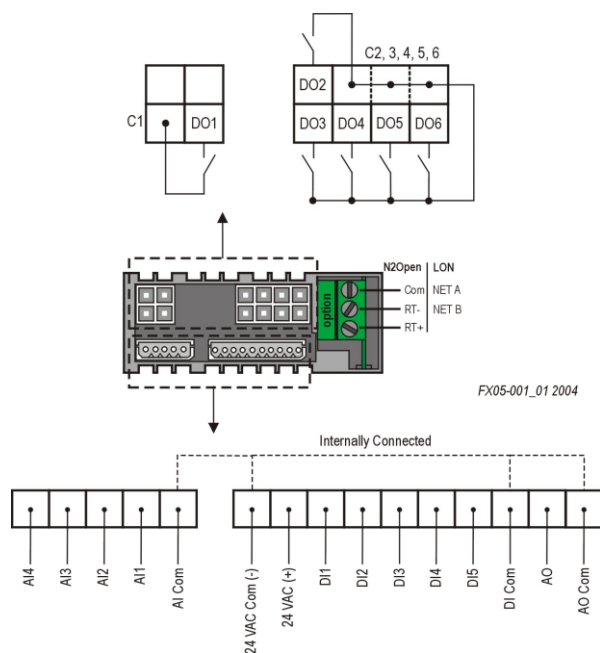


Figure 6: LP-FX05P11-xxx Wiring Diagram

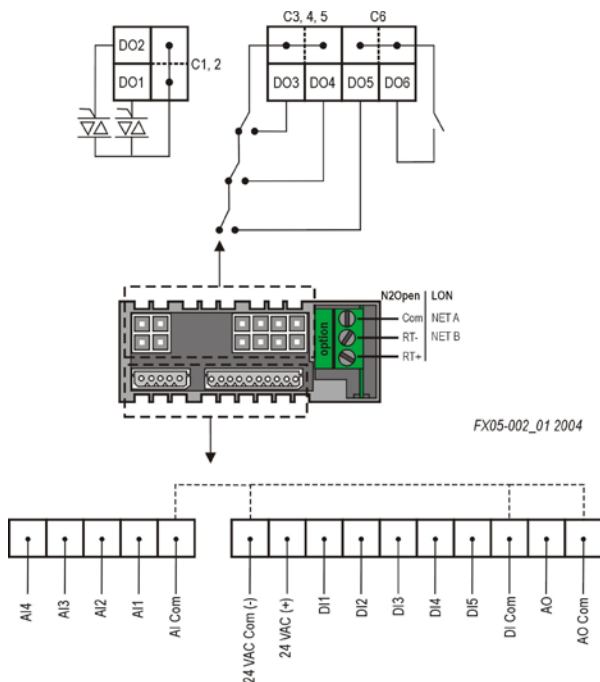


Figure 7: LP-FX05P12-xxx Wiring Diagram

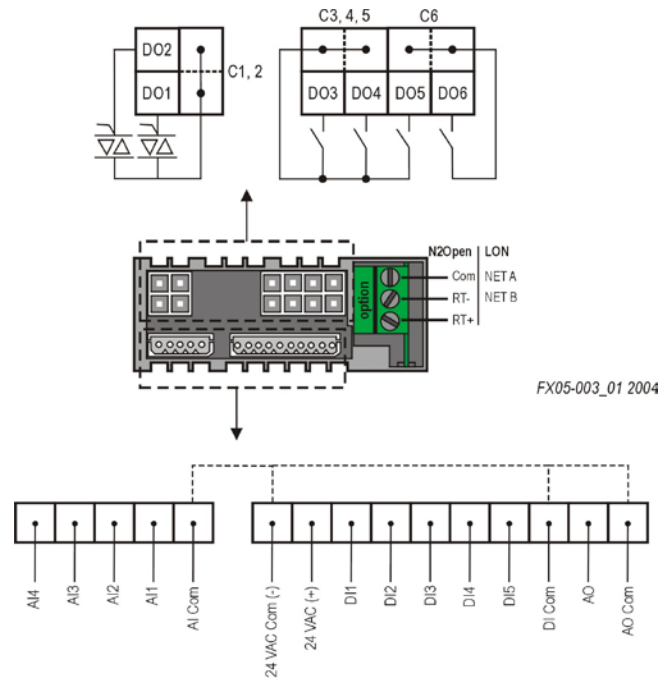


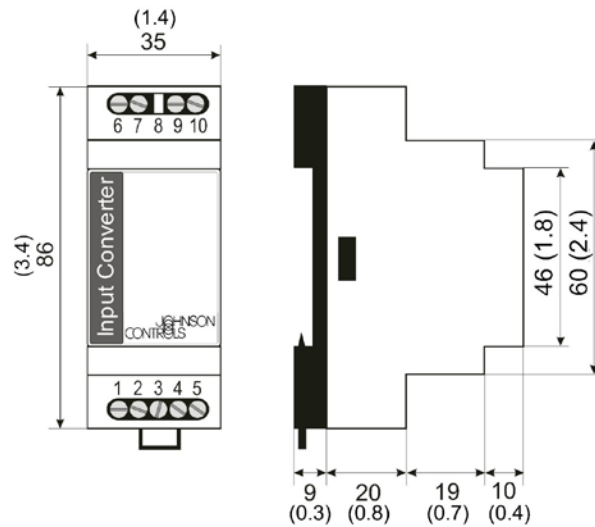
Figure 8: LP-FX05P13-xxx Wiring Diagram

## Connection Details for Input Converter Modules



Figure 9: Input Convert Module

Optional Input converting modules can be used together with the FX05 for added possibility to use active sensors. Several models of Input Converters are available depending on the active sensor used.



**Figure 10: Input Converter Dimensions – mm (in)**

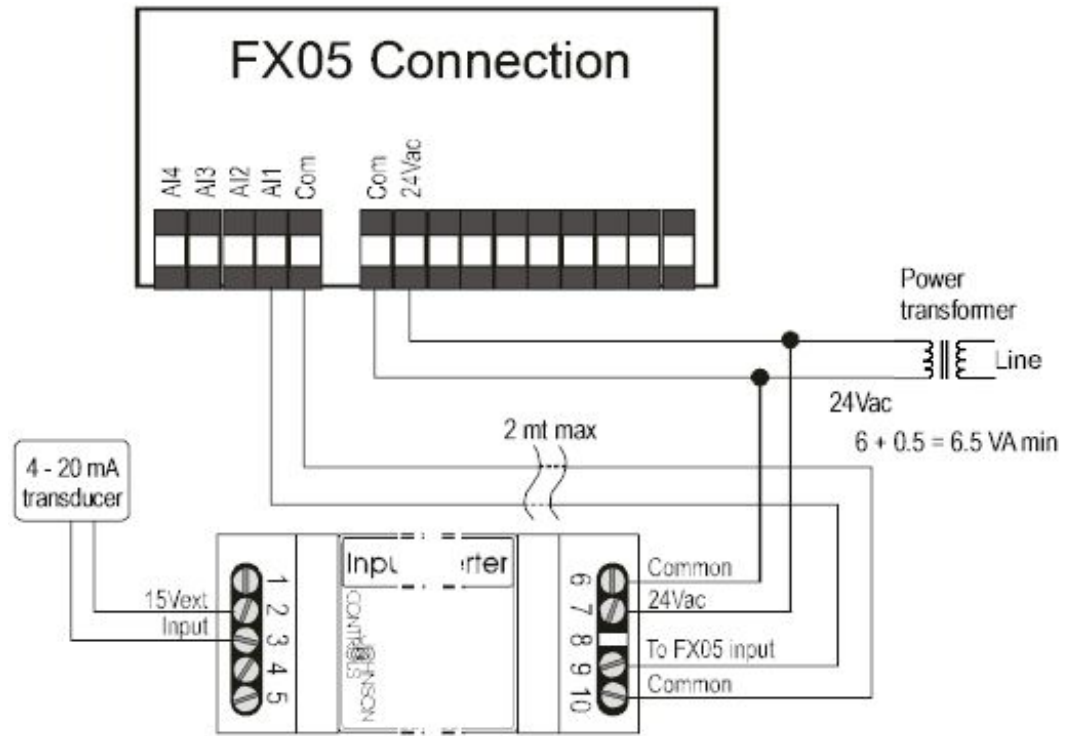
The Input Converter Module can be connected to any analog input of the FX05, providing that the software has been configured accordingly (see *Operation* for details on the configuration).

The same transformer should be used to power both controller and converter.

**IMPORTANT:** Make sure to respect polarities when connecting the 24 VAC power supply. The Input Converter Module can be connected to any analog input of the FX controllers, but the software has to be configured accordingly.

#### **4 - 20 mA Input Converter Module**

This Input Converter Module allows the connection of an active 4 - 20 mA signal to an FX05 analog input. The FX05 analog inputs must be configured in software as Linear.



**Figure 11: (4-20mA) Input Converter Wiring**

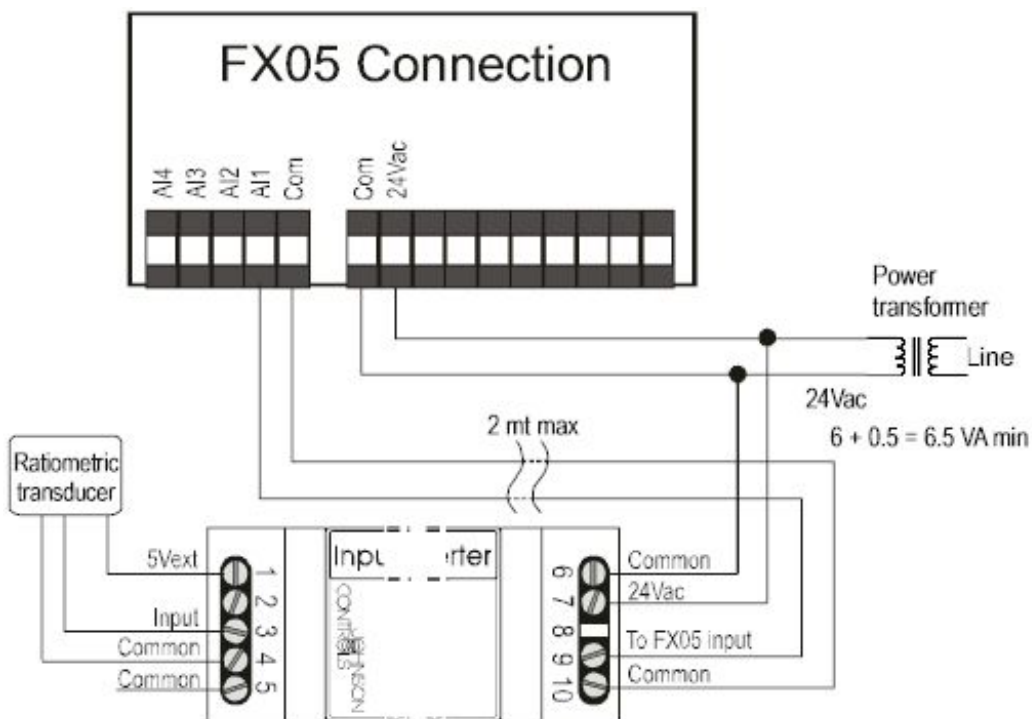
For the correct (4-20mA) Input Converter Wiring connections please see Table 3.

**Table 3: (4-20mA) Input Converter Wiring Connections**

PIN	Meaning
1	Not connected
2	+15 VDC ( $\pm 0.75V$ ) sensor power supply
3	Signal input (max allowed level 30 mA)
4	Not connected
5	Not connected
6	24 VAC Common
7	24 VAC power supply
9	To FX05 AI (max 2m (6.5ft))
10	To FX05 AI Common (max 2m (6.5ft))

### Ratiometric Input Converter Module

This Input Converter Module allows the connection of a ratiometric signal to an FX05 analog input. The FX05 analog input must be configured in software as Linear.



**Figure 12: (Ratiometric) Input Converter Wiring**

For the correct Ratiometric Input Converter connections, see Table 4.

**Table 4: Ratiometric Input Converter Connections**

PIN	Meaning
1	+5 VDC ( $\pm 0.5$ V; 25 mA max) sensor power supply
2	Not connected
3	Signal input
4	Signal Common
5	Signal Common
6	24 VAC Common
7	24 VAC power supply
9	To FX05 input (max 2m (6.5ft))
10	To FX05 Common (max 2m (6.5ft))

### 0 – 10 V Input Converter Module

This Input Converter Module allows the connection a 0-10V signal to an FX05 analog input. The analog input must be configured in software as Linear.

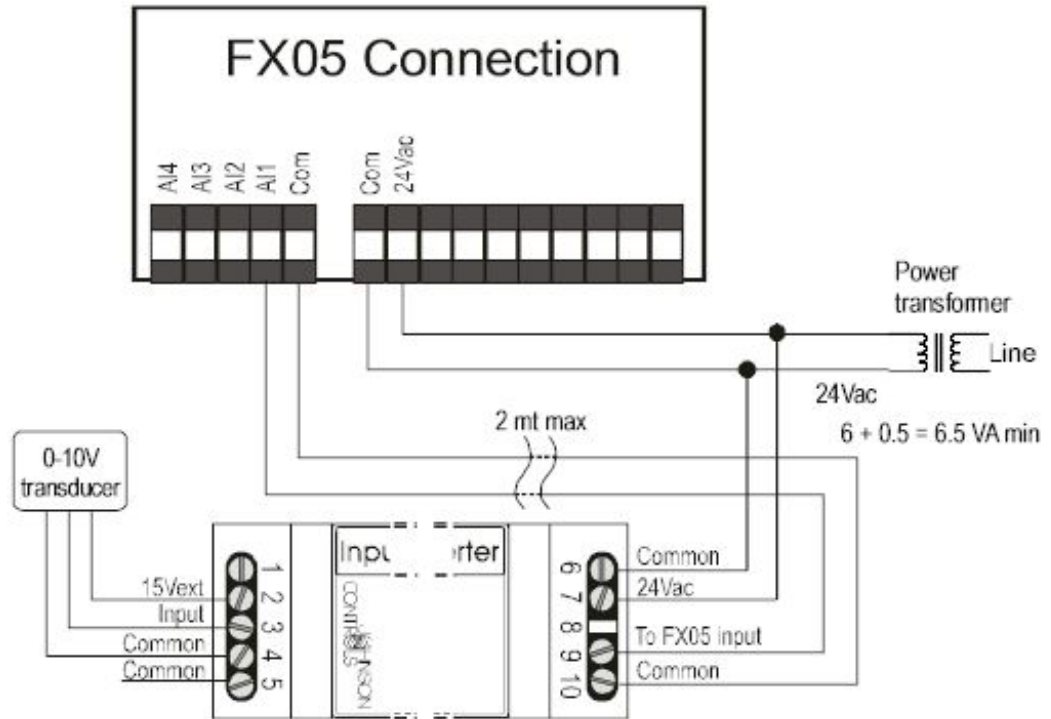
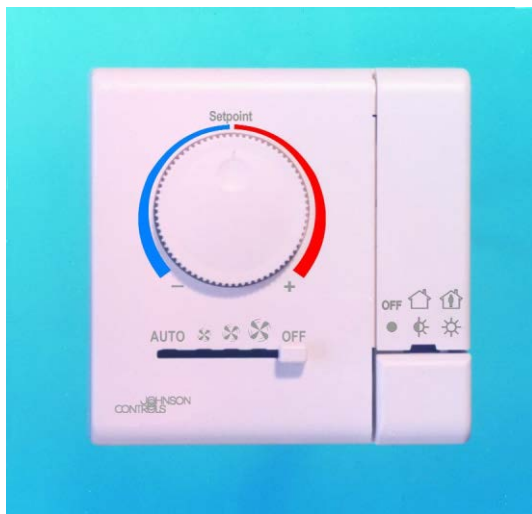


Figure 13: (0-10V) Input Converter Wiring

Table 5: (0-10V) Input Converter Connections

Pin	Meaning
1	Not connected
2	+15 VDC ( $\pm 0.75V$ , 25 mA max) sensor supply
3	Signal input
4	Signal Common
5	Signal Common
6	24 VAC Common
7	24 VAC power supply
8	To FX05 input (max 2m (6.5ft))
9	To FX05 Common (max 2m (6.5ft))
10	Not connected

## Connection Details for the Room Command Module



**Figure 14: Room Command Module KIT006**

The LP-KIT006-xxx series of Room Command Modules are designed for use with the FX05 controllers.



There are eight different models of KIT006 as described in Table 6.

**Table 6: Room Command Module Models**

<b>Model</b>	<b>Features</b>
<b>LP-KIT006-000C</b>	Fully featured model that includes: - Warm/cool adjustment +/- 3K - Fan speed control: auto, min, med, max and OFF - Room sensor (A99) - Occupancy button and LED - Connector for the communication interface.
<b>LP-KIT006-001C</b>	Setpoint setting from +12°C to +28°C - Room sensor (A99).
<b>LP-KIT006-002C</b>	Setpoint setting from +12°C to +28°C - Room sensor (A99) - Occupancy button and LED - Connector for the communication interface.
<b>LP-KIT006-003C</b>	Warm/cool adjustment +/- 3K - Room sensor (A99) - Occupancy button and LED - Connector for the communication interface.
<b>LP-KIT006-004C</b>	Fully featured model that includes: - Warm/cool adjustment +/- 3K - Fan speed control: auto, min, med, max and OFF - Room sensor (A99) - Occupancy button and LED - Connector for the communication interface - US Wall mounting kit
<b>LP-KIT006-005C</b>	Warm/cool adjustment +/- 3K - Room sensor (A99) - Occupancy button and LED - Connector for the communication interface - US Wall mounting kit
<b>LP-KIT006-006C</b>	Setpoint setting from 53.6 °F (12°C) to 82.4 °F (28°C) - Fan speed control auto, min, med, max, and OFF - Room sensor (A99) - Occupancy button and LED - Connector for the communication interface US Wall mounting kit
<b>LP-KIT006-007C</b>	Setpoint setting from +53.6 °F (+12°C) to +82.4 °F (+28°C) - Room sensor (A99) - Occupancy button and LED - Connector for the communication interface - US Wall mounting kit

***LP-KIT006-xxx - Room Command Module Connection***

The warm/cool or setpoint adjustment dial enables the room occupant to adjust the working setpoint of the controller. This functionality and the adjustment range must be programmed into the FX05 application software.

The pushbutton operation is completely customizable within the FX05 application software. A common use is to enable the occupant to change the mode of operation of the controller from Unoccupied to Bypass (or temporary occupied)

The LED indicator is completely customizable within the FX05 application software. A common use is to indicate the occupancy mode.

The fan speed selector switch enables the occupant to override the fan speed. This functionality must be programmed into the FX05 application software.

The serial connection through the service connector pins under the lateral cover (Figure 3) is available if the optional serial card (N2 Open or LON) is inserted in the FX05 and properly connected to the KIT006 Pins 10, 11, 12.

## Wiring

Before connecting or disconnecting any wires, ensure that all power supplies have been switched off and all wires are potential-free to prevent equipment damage and avoid electrical shock.



**WARNING: Risk of Electric Shock.** Disconnect power supply before making electrical connections. Contact with components carrying hazardous voltage can cause electric shock and may result in injury or death.

**AVERTISSEMENT: Risque de décharge électrique.** Débrancher l'alimentation avant de réaliser tout branchement électrique. Tout contact avec des composants conducteurs de tensions dangereuses risque d'entraîner une décharge électrique et de provoquer des blessures graves, voire mortelles.

Terminations are made on the terminal blocks in the base of the module, which accept up to 1.5mm<sup>2</sup> (AWG 16) wires. Follow the wiring diagrams shown in figures 4, 5 and 6. All wiring to the module is at extra low (safe) voltage and must be separated from power line voltage wiring. Do not run wiring close to transformers or high frequency generating equipment.

**IMPORTANT:** Complete and verify all wiring connections before applying power to the controller to which the module is connected.

The wiring connections to the FX05 must match the input and output assignments made in the FX05 application software.

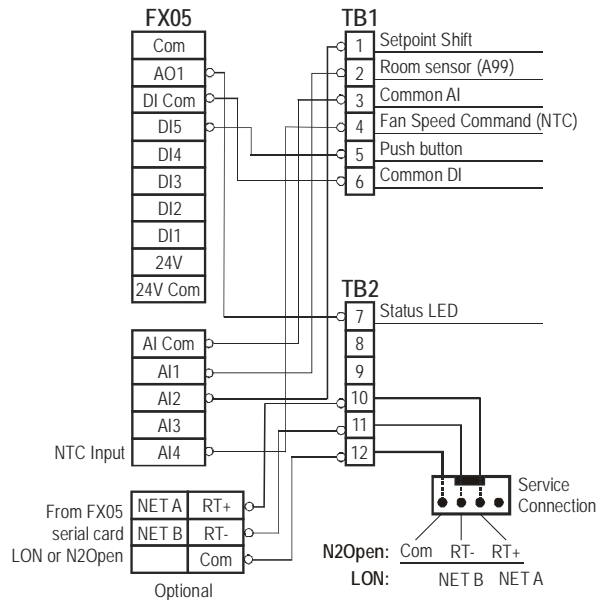
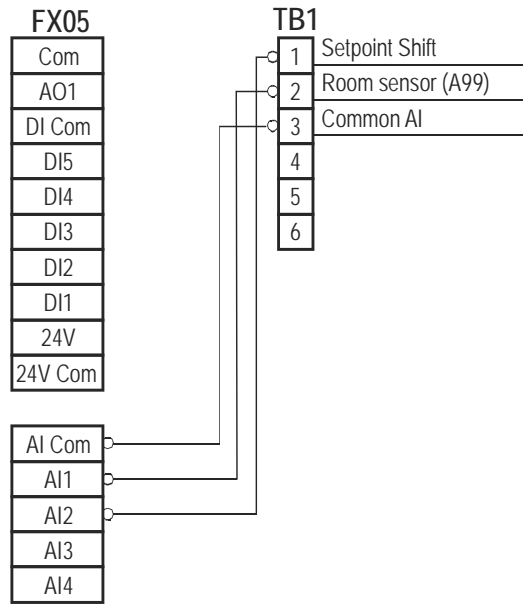
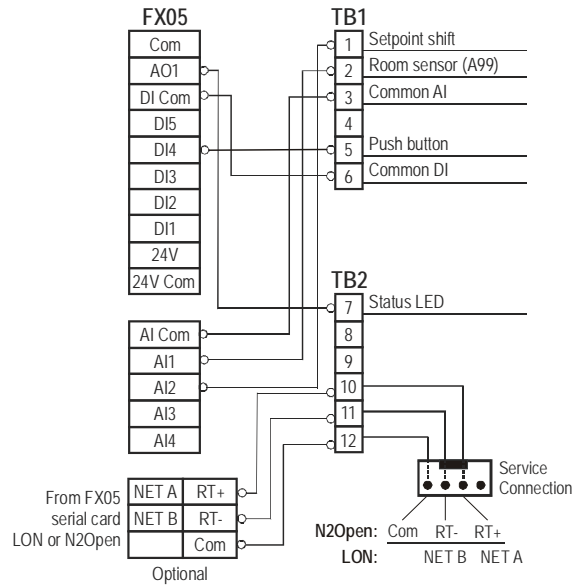


Figure 15: Wiring for LP-KIT006-000, -004, or -006



**Figure 16: Wiring for LP-KIT006-001**



**Figure 17: Wiring for LP-KIT006-002, -003, 005, or -007**

## Connection Details for the N2 Open Serial Card



**Figure 18: N2 Open Plug-in Communication Card**

The FX05 controller can be ordered with or without a communication card. If ordered without, the card can be assembled at a later time. See the *Ordering Codes* section.

The N2 Open communication card allows the FX05 controllers to be connected to an N2 Open compatible building management system.

If needed, assemble the communication card using the following instructions:

1. Power off the controller (hot plug-in not allowed).
2. Insert the card (see Figure 19).

Default N2 address is 255.

**IMPORTANT:** The Complementary Metal Oxide Semiconductor (CMOS) integrated circuit in the controller and on the communication card are sensitive to static current discharges. Take suitable precautions.

### Card Insertion

Remove the plastic sticker on the back of the controller. Insert the communication card into the back of the FX05 as shown below until fully secured.

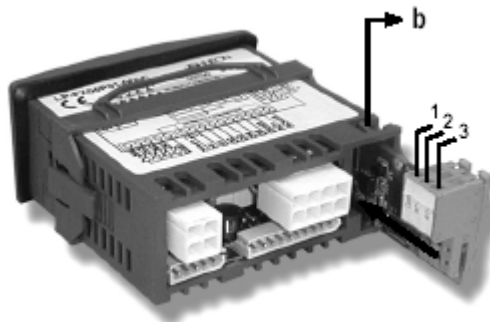


Figure 19: Card Insertion

### Wiring

The connection to the N2 network is made by means of the 3-pin plug-in connector as shown in the following Figure. Refer to the *N2 Communications Bus Technical Bulletin (LIT-636018)* for recommended wire sizes.

Insert thin flat blade screw driver into top slot to open clamp (bottom slot). Insert wire into bottom slot and remove screw driver.

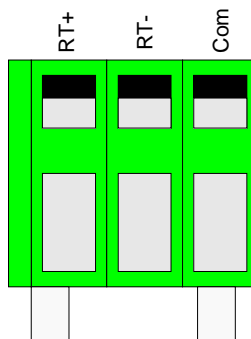


Figure 20: N2 Open Card Wiring

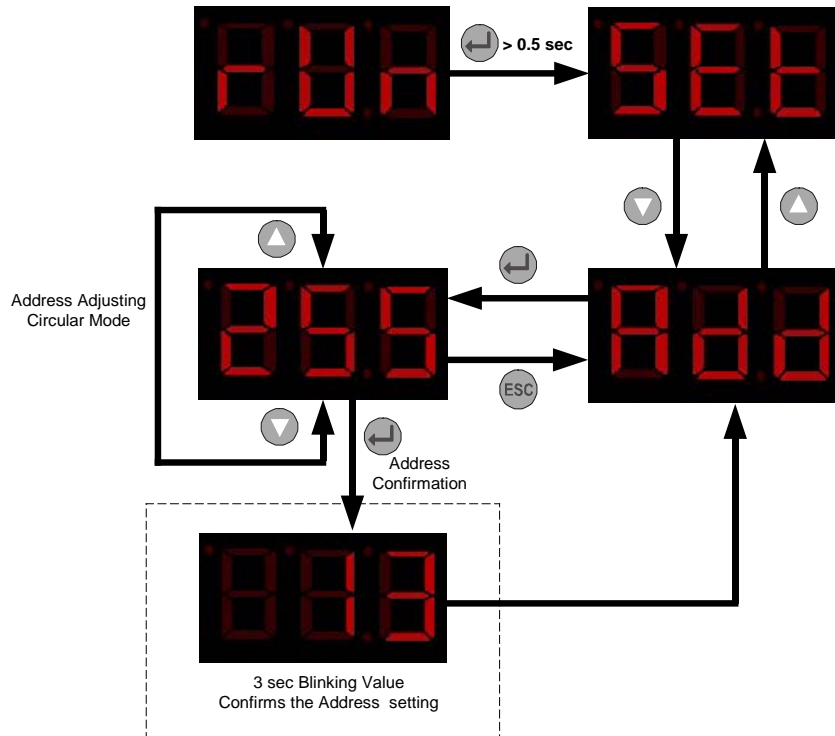
## N2 Address Selection

The N2 Address associated to an FX05 Controller can only be modified through the local user interface. The FX05 controllers are provided with a factory application pre-loaded. This application allows users to modify the default factory N2 Address setting of the FX05 Controller.

**IMPORTANT:** A power cycle is needed by the controller in order to activate the new address setting.

**NOTE:** Default N2 Address is 255.

The following procedures have to be executed to adjust the FX05 N2 address.



**Figure 21: N2 Address Factory Setting Adjustment**

### Network layout

Refer to the N2 Communications Bus Technical Bulletin (LIT-636018) for details on N2 wiring guidelines.

## Connection Details for the LON Card



**Figure 22: LON® Plug-in Communication Card**

The FX05 can be ordered with or without a communication card. If ordered without, a communication card can be inserted at a later time. See *Ordering Codes* for more information.

The LON communication card allows the FX05 to be connected to a LONWORKS network.

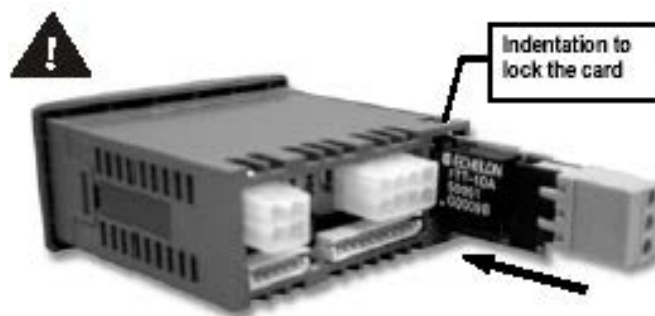
To assemble the LON communication card:

1. Power off the controller (hot plug-in not allowed)
2. Insert the card (see Figure 23 – Card Insertion)

**IMPORTANT:** The CMOS integrated circuit in the controller and on the communication card are sensitive to static current discharges. Take suitable precautions.

### Card Insertion

Remove the plastic sticker on the back of the controller and insert the communication card into the back of the FX05 as shown below until fully secured.



**Figure 23 – Card Insertion**



### Wiring

The connection to the LONWORKS network is made by means of the 2-pin plug-in connector as shown in the following figure.

See the following documents on the Echelon® web site ([www.echelon.com](http://www.echelon.com)): *LONWORKS FTT-10A Free Topology Transceiver User's Guide* (078-0156-01F) for technical guidelines associated with free topology restrictions. *Junction Box and Wiring Guidelines for Twisted Pair LONWORKS Networks* (005-0023-01) for more detailed information on wiring specifications.

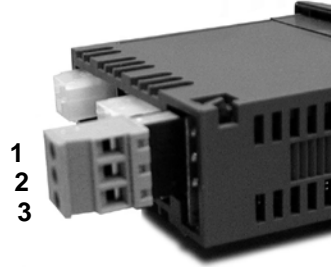


Figure 24: LON Card Wiring

### Getting the LON Neuron® ID

The FX05 Controller will send its Neuron Identifier over the LON network ONLY at power-up.

## Connection Details for the Real-Time Clock (RTC) Plug-In Card



Figure 25: Real-Time Clock Plug-In Card

The RTC plug-in card allows the FX05 to introduce functions based on a weekly time schedule.

In order to assemble the communication card, follow the instructions:

Power off the controller (hot plug-in not allowed);

Insert the card (see Figure 23 – Card Insertion);

**IMPORTANT:** The Complementary Metal Oxide Semiconductor (CMOS) integrated circuit in the controller and on the communication card are sensitive to static current discharges. Take suitable precautions.

**Card Insertion**

Remove the plastic sticker on the back of the controller and insert the RTC card into the back of the FX05 as shown below until fully secured.



Figure 26: RTC Card Insertion

# Inputs and Outputs

## Introduction

The FX05 Controller features the following I/O Channels:

- Four Analog Inputs (12 bit, A/D Converter);
- Five Digital Inputs from voltage free contacts, with internal pull-up resistors;
- Six opto-isolated Digital Outputs (6 Relays and 2 optional relays or triacs);
- One 0 to 10 VDC, Analog Output.

### LP-FX05P11-xxx Models

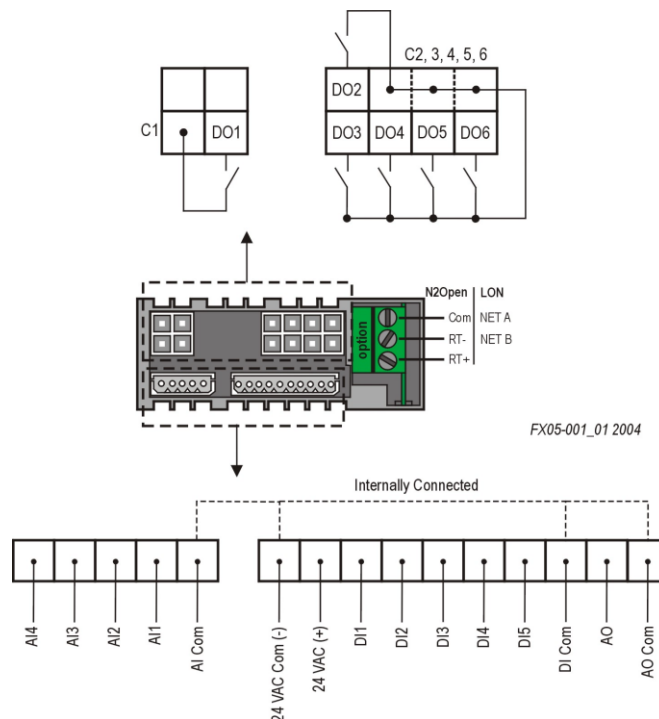


Figure 27: LP-FX05P11 Wiring Diagram

### LP-FX05P12-xxx Models

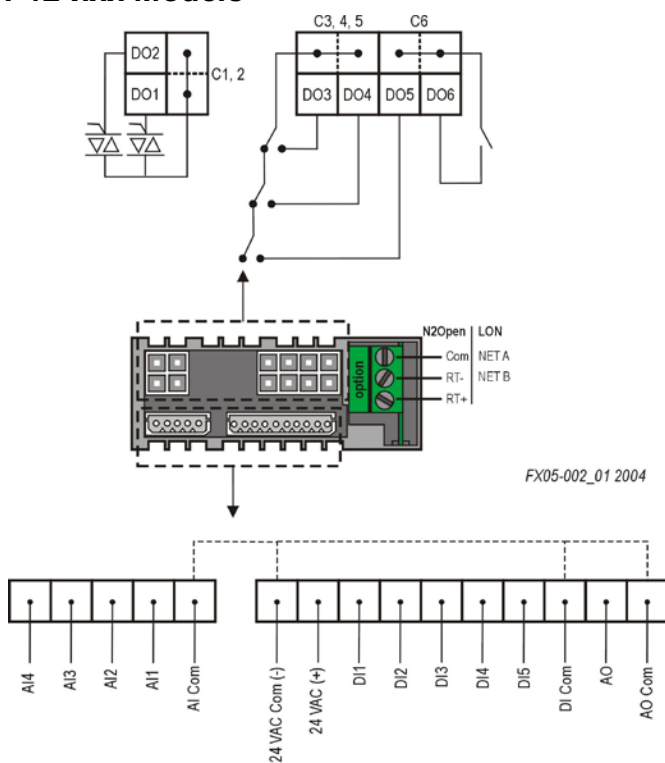


Figure 28: LP-FX05P12 Wiring Diagram

### LP-FX05P13-xxx Models

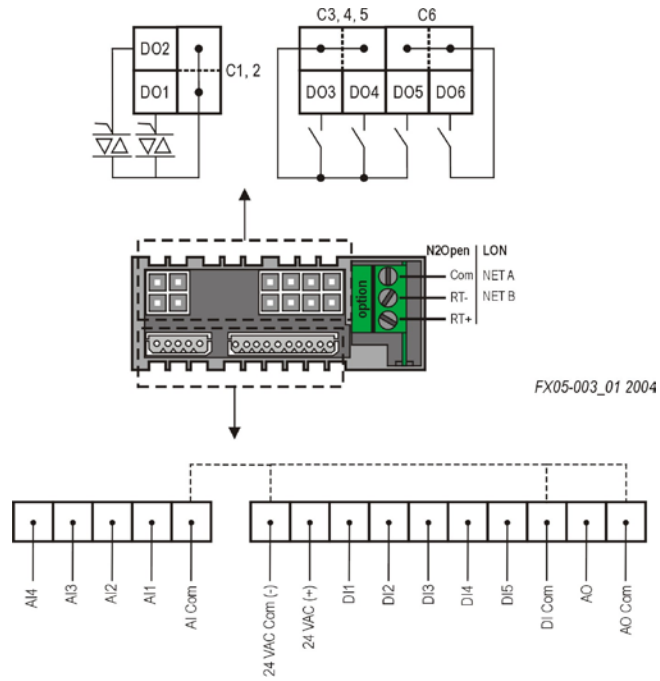


Figure 29: LP-FX05P13 Wiring Diagram

## **Key Concepts**

### ***Analog Inputs***

The FX05 Controller accepts up to four analog inputs; each of them can be configured to read A99, NTC 10K, PT1000 Standard Range, PT1000 Extended Range or Linear depending on their hardware model and application software.

### ***Digital Inputs***

The FX05 accepts up to five digital inputs with internal pull-up resistors (3k3  $\Omega$ ) from voltage free contacts, not isolated.

### ***Analog Outputs***

The FX05 provides one 0 to 10 VDC, 5 mA, analog output, not isolated.

### ***Digital Outputs***

The FX05 provides up to six digital outputs available in two different hardware configurations with 6 relays, or 4 relays and 2 triacs. The digital outputs are isolated from the other I/Os and they have been divided into different groups. The groups depend on the selected hardware model:

On the 6-relays models, group 1 is comprised of DO1 and group 2 is comprised of DO2 through DO6.

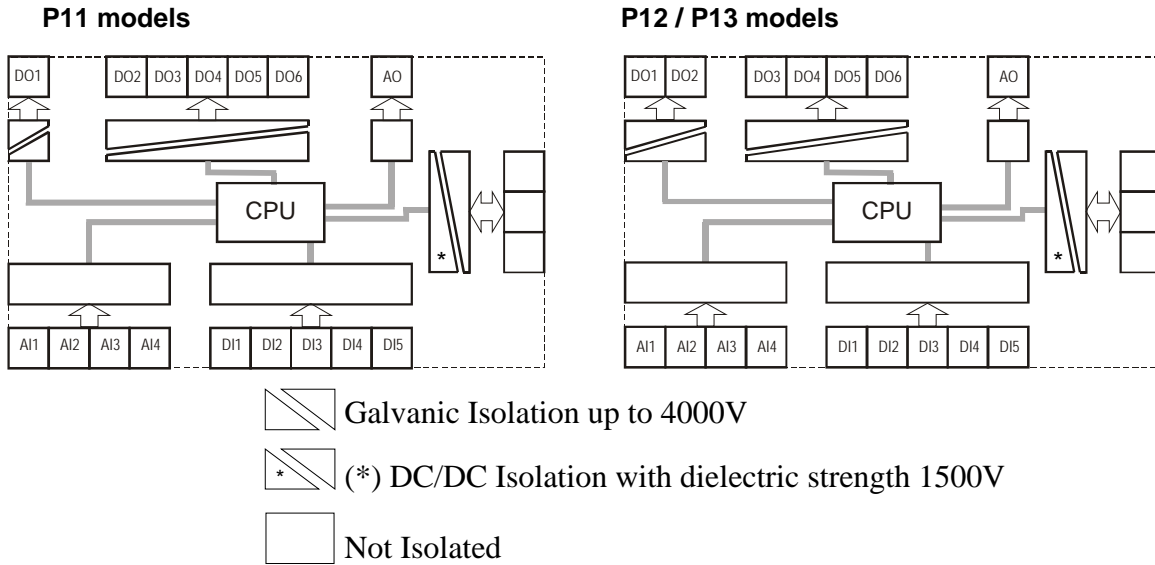
On the 4-free relays and 2-triacs models, group 1 is comprised of DO1 and DO2 (the 2 triacs), and group 2 is comprised of DO3 through DO6 (the 4 relays). DO6 is isolated from DO3,4,5.

On the 3-interlocked relays, 1-free relay and 2-triacs models, group 1 is comprised of DO1 and DO2 (the 2 triacs), group 2 is comprised of DO3 through DO5 (the 3 interlocked relays), and group 3 is DO6 (the 1 free relay).

# Detailed Procedures

## Isolation Diagram

In relation to the CPU the insulation of the several I/Os is represented in the diagrams below:



### Model Cross-Reference FX05 to FX05 (Advanced)

Model Description	FX05 (8-bit)	FX05 (16-bit)
PT1000 Standard, 6 Relays	LP-FX05P00	LP-FX05P11-012
A99 or PT1000 Ext, 6 Relays	LP-FX05P01	LP-FX05P11-022
A99 + NTC 10K, 2 Triacs, 3 Relays w/ Interlock, 1 free relay	LP-FX05P02	LP-FX05P12-002
A99 + NTC 10K, 2 Triacs, 4 Free Relays	LP-FX05P03	LP-FX05P13-002

## Analog Inputs

The four analog inputs can be configured to accept a wide range of input signals. In addition, they can be used together with optional Input Converter Modules to use Active sensors.

The Linear analog inputs are typically used when interoperating with Input Converter Modules and they are ranged using programmable Range parameters. These parameters, HighRange and LowRange, define the equivalent values for reading at High (10 V, 20 mA) and Low (0 V, 4 mA, 0 mA) signal input.

The Passive Sensors (resistance) have pre-programmed linearization curve. For these sensors the measurement range is fixed. The user can set via software the reliability range.

The read signal is converted by the FX05 according to the related Analog Input Object Setup, available Setup are:

- Linear
- A99
- NTC 10k Ohm
- Pt1000 Standard Range
- Pt1000 Extended Range

The measurement unit is also configurable to enable the controller to propagate via network the measured value according to the appropriate scale unit. Available configurable units are:

- Temperature
- Percentage
- Air Pressure
- Liquid Pressure
- Flow
- Concentration
- Ampere
- Voltage

A configurable filter constant in seconds is performed by the FX05 on its Analog Inputs for the reduction of signal instability.

An additional Anti-Spike filter can be configured to limit the rate of change of the input values to the value indicated by this attribute.



### Connecting Passive Resistive Sensors

The FX05 analog inputs accept resistive signals including, A99, Pt1000 Std., Pt1000 Ext., and NTC 10k. The inputs must be configured in the application software.

The following figure represents an A99 wiring diagram; however, all the resistive sensor types are connected in the same way.

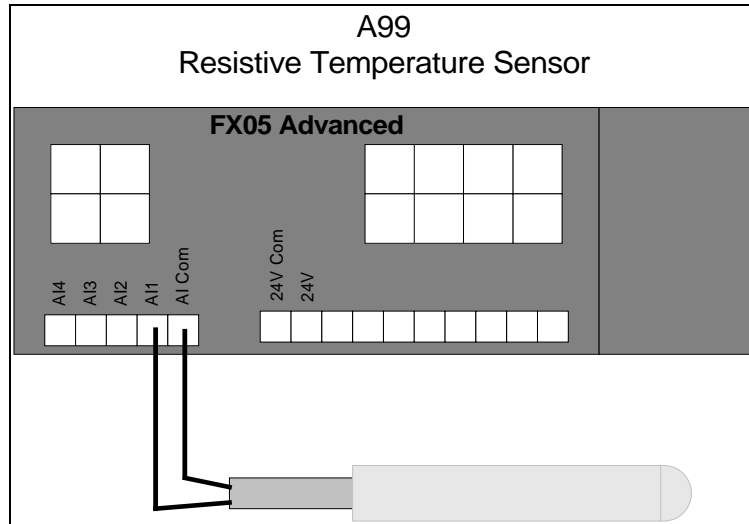


Figure 30: A99 Resistive Sensor, Connection Diagram

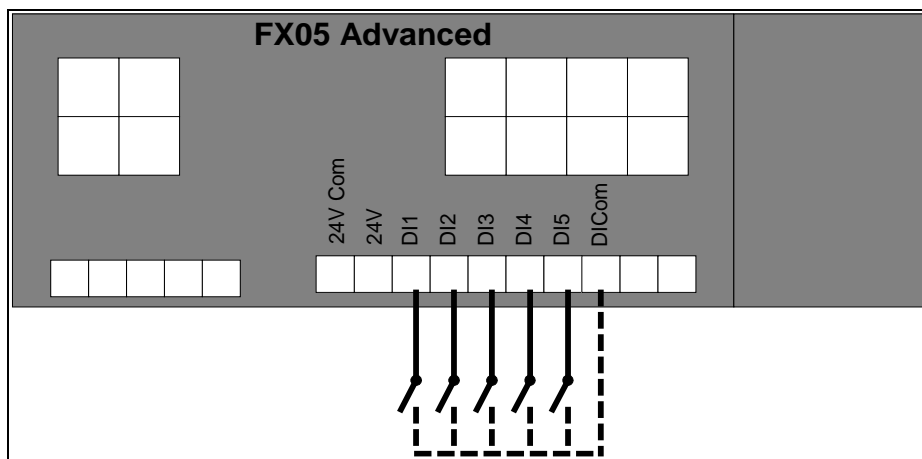
**IMPORTANT:** The two resistive probe leads are not polarity sensitive.

### Digital Inputs

The FX05 controller features five not isolated digital inputs. See the *Relay Specifications* table for FX05 I/O information.

The digital inputs can be configured for direct acting or reverse acting in the application software.

Voltage-free contacts can be connected directly to the controller as shown in the following figure:



**Figure 31 – Connecting voltage-free contacts**

FX05 Terminals	Description
DI 1	Digital Input 1, Voltage-Free contact
DI 2	Digital Input 2, Voltage-Free contact
DI 3	Digital Input 3, Voltage-Free contact
DI 4	Digital Input 4, Voltage-Free contact
DI 5	Digital Input 5, Voltage-Free contact
DI Com	Common Reference, Voltage-Free contact

## Analog Outputs

The FX05 Controller provides one 0 to 10 VDC - Max 5 mA, not isolated, analog output. See the *Ordering Codes* for the complete FX05 I/O table.

The analog output can be configured for direct acting or reverse acting in the application software. The output signal can also be limited by high limit (MaxOutput) and low limit (MinOutput) values.

### **Connecting the Analog Output**

The FX05 analog outputs are commonly used to drive proportional devices and can be connected to all the Johnson Controls series proportional valve actuators.

The connection diagram is represented in the following figure:



Any combination of loads on DO2 - DO6, DO3 - DO6 must not exceed 15 amperes and a maximum 5A on the common terminals.

### Connecting the Relays

The FX05 features up to six Digital Outputs with electromechanical relays. To simplify assembly the common terminals of some relays have been grouped together. The relays are divided into up to three groups, according to the controller model.

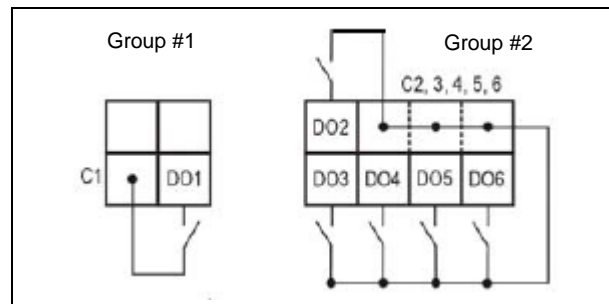


Figure 33: FX05P11 Relay Groups

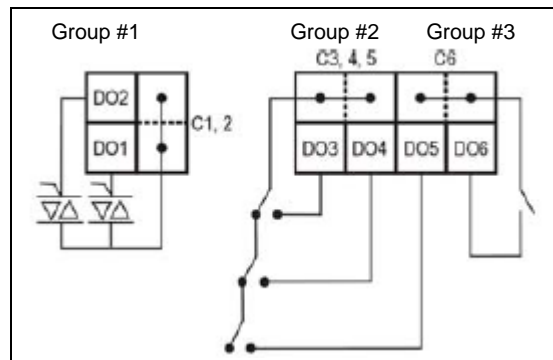


Figure 34: FX05P12 DO Groups

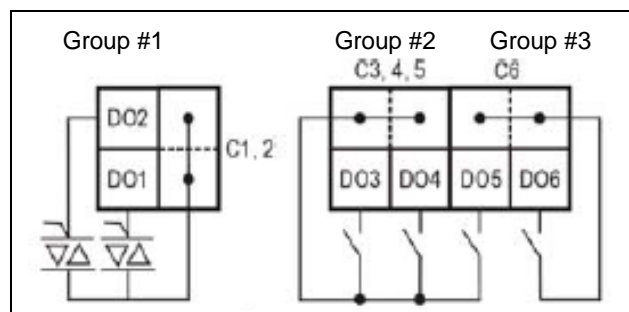
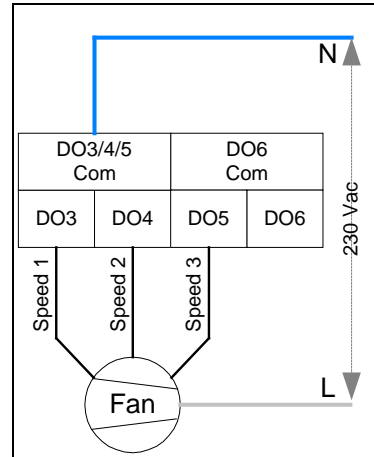


Figure 35: FX05P13 DO Groups

Inside each group, the relays have just single isolation and thus must be connected to the same voltage supply. Between the groups there is a double isolation and thus the groups can be connected to different voltage supplies.

Following is represented a typical application of the relay outputs as connection example:

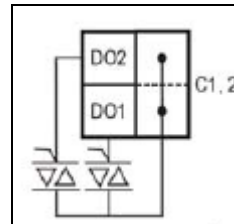


**Figure 36: Connecting a Three-Speed Fan Motor to Interlocked Relay Outputs**

**Note:** Please note that, for FX05P12 relays DO3 ÷ DO5 are hardware interlocked so they guarantee the safe management of the motor. Other FX05 relay outputs are **not** hardware interlocked and incidental energization of more than one relay at the same time might lead to fan motor damaging.

### **Connecting the Triacs**

The FX05P12/P13 triac (0.5A, 24 VAC) digital outputs are commonly used to operate in PAT and DAT modes.



**Figure 37: FX05P12/P13 Triac Outputs**

In particular the Digital Outputs PAT mode can be used through the Triac outputs to drive Incremental Valve Actuators.

Example of connection:

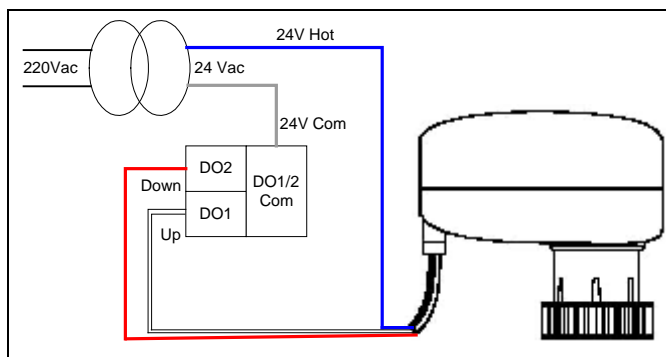


Figure 38: Connecting an Incremental Actuator

Table 8: Incremental Actuator Connections

FX05 Terminals	Description
DO2	24V ~ “Down” command
DO1	24V ~ “Up” command
24V ~ Hot	24V ~ Hot Reference
DO1/2 Com	24V ~ Common Reference

# Operation

## ***Introduction***

The FX05 has a powerful 16 bit microprocessor with enhanced software that supports the creation and management of larger applications. In addition, the FX05 controller can be interfaced as a slave device to the FX16 Master Controller or Master Display when designing a distributed control application.

Similar to the FX05 controller, the FX05 controller has been designed to respond to a wide range of applications.

The FX05 controller is fully programmable or configurable. The FX Builder tool is used to program the controller with the required application, using the 16 physical input/output points.

The application can be downloaded, tested and commissioned using FX Loader and FX CommPro software packages.

## Key Concepts

### Software Programming and Application Configuration

The FX05 provides configurable control algorithm, memory and connectivity services, real-time functions and I/O expansion through its customizable, objects and services oriented, architecture. The device configurations can be created and downloaded into the target controllers via the **FX Tools Pro** software package.

The tools available in the package are:

**FX Builder:** The programming and configuration of the Facility Explorer controllers is done using the menus, navigation trees and graphic screens of the FX Builder tool. The configuration includes the definition of the controllers to be connected, the physical inputs and outputs and data points to be monitored and the format of the display screen of the controller.

**FX Builder Express:** A simplified version of the FX Builder, called FX Builder Express, is also available to configure a library of standard applications specifically designed for Facility Explorer controllers. The configuration is done using the specific graphic user interfaces of the FX Builder Express.

**FX CommPro N2 and FX CommPro LON:** For commissioning and servicing of a connected device through the network profile. Parameter configuration, machine tuning, default parameters, saving for successive configurations are all things possible with the FX-CommPro tool, with the two protocols supported: N2 Open and LONWORKS.

### Alarm and Event Management

The FX05 manages and displays active events or alarms that are associated with data points or variables in the control application. Active events or alarms may be viewed on the FX05 3-Digit Display.

### Time Scheduling

This feature allows introducing functions based on a weekly time schedule. The Time Scheduling feature is enabled only when the Real-time Clock plug-in card is installed. The clock is battery backed up with an average duration time of 2 years.

### Integrated User Interface

The FX05 has an integrated user interface featuring a 3 Digit, 7-Segment display, providing the possibility to display and/or edit all the data points and information of the running application (see Figure 1). The display application is fully configurable at design time.



## Security

The FX Tools Pro and the FX controllers comes with an embedded security feature based on the use of two IDs: the family ID and the customer ID. This security feature prevents tampering with the applications and provides source code protection.

## Supervisory Option

The FX05 can be integrated into a supervisory building management system for continuous monitoring of the control system. The FX05 supports two methods of integration:

- N2 Open Integration
- LONWORKS Integration

## Application Upload/Download

The FX05 is a fully programmable controller and the application can be downloaded to the controller using FX Tools.

## Detailed Procedures

### Integrated User Interface

The FX05 has an integrated user interface featuring a 3 Digit 7-Segment display with the possibility to display/edit all the data points and information of the application.

The display application is fully configurable using the Display plug-in of the FX Builder.

### Security

The FX Tools Pro and the Facility Explorer controllers come with an embedded security feature based on the use of two IDs: the family ID and the customer ID.

#### Family ID

Family ID differentiates different hardware types and prevents downloading the wrong application to the wrong controller.

**Table 9: Family ID**

Facility Explorer Controller	FX Builder Code	Family IDs
<b>FX05 (Advanced)</b>	FX05P11-02	0218
	FX05P11-12	0210
	FX05P11-22	0211
	FX05P12-02	0212
	FX05P12-12	0214
	FX05P12-22	0215
	FX05P13-02	0213
	FX05P13-12	0216
	FX05P13-22	0217
<b>FX10 Standard</b>	FX10B1x	0301
<b>FX10 (Advanced)</b>	FX10B3x	0311
<b>FX15 Classic</b>	FX15D1x	0402
<b>FX15 Universal</b>	FX15D0x	0401

**Customer ID**

Customer ID protects a controller downloaded with a custom developed application and protects the application source code from editing by unauthorized users. Three Customer ID types are used:

**Public ID:** Applications that are saved with Public ID can be downloaded and commissioned by any user with the Public ID enabled in their FX-Tools.

**DEMO ID:** Applications that are saved with the DEMO ID can only be downloaded to demo controllers.

**Customer/Private Specific ID:** Applications that are saved with a specific customer/private ID will make those applications source files readable only by users who have the same ID enabled in FX-Tools. Once a controller has been downloaded with a specific Customer ID, the controller will become customer specific and only allow downloading of applications with the same customer specific ID.

## Specifications and Technical Data

### Ordering Codes

Tables 8 through 13 contain ordering information for the FX05 (Advanced), FX05 Accessories, and FX05 Software.

**Table 10: FX05 (Advanced) Field Controller Ordering Information**

Product Code Number	Description
LP-FX05P11-002C	FX05 Controller with 3 A99 AIs, 1 NTC AI, 5 DIs, 6 relay DOs, 1 AO, no comm. card, no cable
LP-FX05N11-002C	FX05 Controller with 3 A99 AIs, 1 NTC AI, 5 DIs, 6 relay DOs, 1 AO, N2 Open comm. card, 1 set Molex Cable
LP-FX05L11-002C	FX05 Controller with 3 A99 AIs, 1 NTC AI, 5 DIs, 6 relay DOs, 1 AO, LON comm. card, 1 set Molex Cable
LP-FX05P11-012C	FX05 Controller with 4 PT1000 std AIs, 5 DIs, 6 relay DOs, 1 AO, no comm. card, no cable
LP-FX05N11-012C	FX05 Controller with 4 PT1000 std AIs, 5 DIs, 6 relay DOs, 1 AO, N2 Open comm. card, 1 set Molex Cable
LP-FX05L11-012C	FX05 Controller with 4 PT1000 std AIs, 5 DIs, 6 relay DOs, 1 AO, LON comm. card, 1 set Molex Cable
LP-FX05P11-022C	FX05 Controller with 4 SW select AIs (A99, PT1000 ext., Linear), 5 DIs, 6 relay DOs, 1 AO, no comm. card, no cable
LP-FX05N11-022C	FX05 Controller with 4 SW select AIs (A99, PT1000 ext., Linear), 5 DIs, 6 relay DOs, 1 AO, N2 Open comm. card, 1 set Molex Cable
LP-FX05L11-022C	FX05 Controller with 4 SW select AIs (A99, PT1000 ext., Linear), 5 DIs, 6 relay DOs, 1 AO, LON comm. card, 1 set Molex Cable
LP-FX05P12-002C	FX05 Controller with 3 A99 AIs, 1 NTC AI, 5 DIs, 2 triac DOs, 3 interlocked relays DOs, 1 free relay DO, 1 AO, no comm. card, no cable
LP-FX05N12-002C	FX05 Controller with 3 A99 AIs, 1 NTC AI, 5 DIs, 2 triac DOs, 3 interlocked relays DOs, 1 free relay DO, 1 AO, N2 Open comm. card, 1 set Molex Cable
LP-FX05L12-002C	FX05 Controller with 3 A99 AIs, 1 NTC AI, 5 DIs, 2 triac DOs, 3 interlocked relays DOs, 1 free relay DO, 1 AO, LON comm. Card, 1 set Molex Cable
LP-FX05P12-012C	FX05 Controller with 4 PT1000 std AIs, 5 DIs, 2 triac DOs, 3 interlocked relays DOs, 1 free relay DO, 1 AO, no comm. card, no cable
LP-FX05N12-012C	FX05 Controller with 4 PT1000 std AIs, 5 DIs, 2 triac DOs, 3 interlocked relays DOs, 1 free relay DO, 1 AO, N2 Open comm. card, 1 set Molex Cable
LP-FX05L12-012C	FX05 Controller with 4 PT1000 std AIs, 5 DIs, 2 triac DOs, 3 interlocked relays DOs, 1 free relay DO, 1 AO, LON comm. card, 1 set Molex Cable
LP-FX05P12-022C	FX05 Controller with 4 SW select AIs (A99, PT1000 ext., Linear), 5 DIs, 2 triac DOs, 3 interlocked relays DOs, 1 free relay DO, 1 AO, no comm. card, no cable
Continued on next page. . .	

Product Code Number (Cont.)	Description
LP-FX05N12-022C	FX05 Controller with 4 SW select AIs (A99, PT1000 ext., Linear), 5 DIs, 2 triac DOs, 3 interlocked relays DOs, 1 free relay DO, 1 AO, N2 Open comm. card, 1 set Molex Cable
LP-FX05L12-022C	FX05 Controller with 4 SW select AIs (A99, PT1000 ext., Linear), 5 DIs, 2 triac DOs, 3 interlocked relays DOs, 1 free relay DO, 1 AO, LON comm. card, 1 set Molex Cable
LP-FX05P13-002C	FX05 Controller with 3 A99 AIs, 1 NTC AI, 5 DIs, 2 triac DOs, 4 free relay DOs, 1 AO, no comm. card, no cable
LP-FX05N13-002C	FX05 Controller with 3 A99 AIs, 1 NTC AI, 5 DIs, 2 triac DOs, 4 free relay DOs, 1 AO, N2 Open comm. card, 1 set Molex Cable
LP-FX05L13-002C	FX05 Controller with 3 A99 AIs, 1 NTC AI, 5 DIs, 2 triac DOs, 4 free relay DOs, 1 AO, LON comm. card, 1 set Molex Cable
LP-FX05P13-012C	FX05 Controller with 4 PT1000 std AIs, 5 DIs, 2 triac DOs, 4 free relay DOs, 1 AO, no comm. card, no cable
LP-FX05N13-012C	FX05 Controller with 4 PT1000 std AIs, 5 DIs, 2 triac DOs, 4 free relay DOs, 1 AO, N2 Open comm. card, 1 set Molex Cable
LP-FX05L13-012C	FX05 Controller with 4 PT1000 std AIs, 5 DIs, 2 triac DOs, 4 free relay DOs, 1 AO, LON comm. card, 1 set Molex Cable
LP-FX05P13-022C	FX05 Controller with 4 SW select AIs (A99, PT1000 ext., Linear), 5 DIs, 2 triac DOs, 4 free relay DOs, 1 AO, no comm. card, no cable
LP-FX05N13-022C	FX05 Controller with 4 SW select AIs (A99, PT1000 ext., Linear), 5 DIs, 2 triac DOs, 4 free relay DOs, 1 AO, N2 Open comm. card, 1 set Molex Cable
LP-FX05L13-022C	FX05 Controller with 4 SW select AIs (A99, PT1000 ext., Linear), 5 DIs, 2 triac DOs, 4 free relay DOs, 1 AO, LON comm. card, 1 set Molex Cable

Table 11: Communication Card Ordering Information

Product Code Number	Description
LP-NET051-000C	N2 Open communication card
LP-NET05A2-000C	LONWORKS communication card

Table 12: Accessories Available in Europe and North America Ordering Information

Product Code Number	Description
LP-RTC05-000C	Real-Time Clock Card
LP-KIT001-010C	Input Converter Module 4 - 20 mA to linear for FX05
LP-KIT002-010C	Input Converter Module Ratiometric to linear for FX05
LP-KIT004-010C	Input Converter Module 0 - 10 V to linear for FX05
LP-KIT005-010C	MOLEX cable - multi-color for LP-FX05Pxx

**Table 13: Accessories Only Available in Europe**

<b>Product Code Number</b>	<b>Description</b>
<b>LP-TR23024-10VA</b>	Transformer for FX05, 10 VA
<b>LP-KIT006-000C</b>	Room Sensor module for FX05 +/- dial, occupancy button, fan speed, service port
<b>LP-KIT006-001C</b>	Room Sensor module for FX05 12 - 28°C dial
<b>LP-KIT006-002C</b>	Room Sensor module for FX05 12 - 28°C dial, occupancy button, service port
<b>LP-KIT006-003C</b>	Room Sensor module for FX05 +/- dial, occupancy button, service port

**Table 14: Accessories Only Available in North America**

<b>Product Code Number</b>	<b>Description</b>
<b>LP-KIT006-004C</b>	Room Command module for FX05. Includes warm/cool adjustment dial, fan speed selector, occupancy button, and US mounting kit.
<b>LP-KIT006-005C</b>	Room Command module for FX05. Includes warm/cool adjustment dial, occupancy button, and US mounting kit.
<b>LP-KIT006-006C</b>	Room Command module for FX05. Includes setpoint (-54 - 82°F) adjustment dial, fan speed selector, occupancy button, and US mounting kit.
<b>LP-KIT006-007C</b>	Room Command module for FX05. Includes setpoint (-54 - 82°F) adjustment dial, occupancy button, and US mounting kit.

**Table 15: Software Ordering Information**

<b>Product Code Number</b>	<b>Description</b>
<b>LP-FXTPRO-0</b>	FX Tools Pro CD-Rom (FX Builder, FX Builder Express, FX CommPro N2, FX CommPro LON)
<b>LP-FXTEXP-0</b>	FX Tools Express CD-Rom (FX Builder Express, FX CommPro N2)

## Relay Specifications

### Relay Characteristics

Relays of the group DO2-DO6 or DO3-DO6 must be at the same voltage. Double Isolation between relay DO1 and the group DO2-DO6 or between triacs DO1, DO2 and group DO3-DO6.

Any combination of loads on DO2-DO6, DO3-DO6 must not exceed 15 amperes. Max 5A on the common terminals.

### Model: SCHRACK V23092-A1012-A302

DO2-DO6 on FX05P11

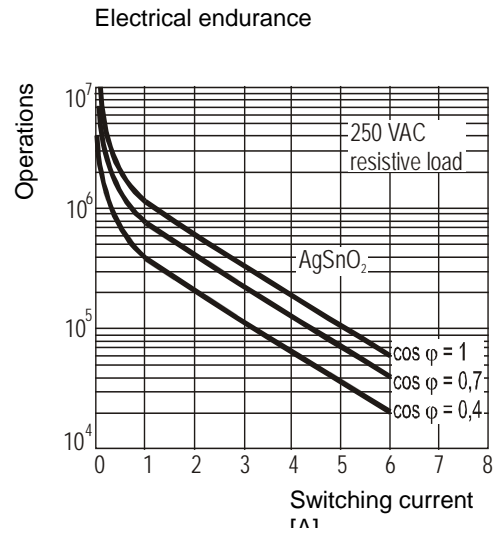
DO3-DO6 on FX05P12 / P13

**Table 16: Contact Data**

Rated current	6A
Rated voltage / max. breaking voltage AC	250 VAC / 440 VAC
Maximum breaking capacity AC	1500 VA

**Table 17: Contact Ratings**

Type	Load	Operations
A302	5 A, 250 VAC resistive	$1 \times 10^5$
A302	2 A, 250 VAC, $\cos \varphi 0.4$	$2 \times 10^5$
A302	1 A, 24 VDC, L / R=48 ms	$2 \times 10^5$



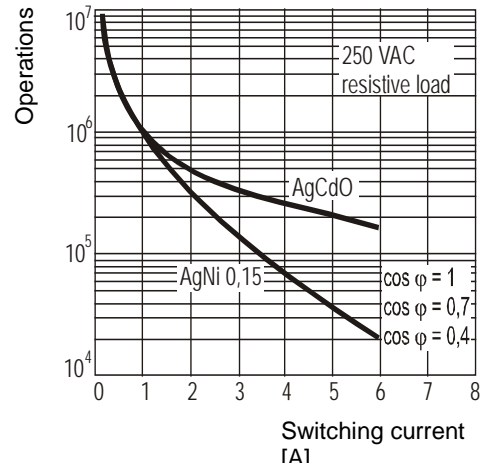
Model: SCHRACK RE030012 DO1 on FX05P11

**Table 18: Contact Data**

<b>Configuration</b>	1 N/O contact
<b>Rated current</b>	6A
<b>Rated voltage / max. breaking voltage AC</b>	250 VAC/440 VAC
<b>Maximum breaking capacity AC</b>	1500 VA
<b>Contact material</b>	AgCdO

**Table 19: Contact Ratings**

Type	Load	Operations
RE 030	2 A, 400 VAC, AC 11	$2 \times 10^5$ VDE 0660
RE 030	2 A, 250 VAC, AC 11	$4 \times 10^5$ VDE 0660
RE 030	0.33 A, 250 VAC, AC 11	$5 \times 10^6$ VDE 0660
RE 030	1/8hp, 120 VAC	$3 \times 10^4$ UL 508
RE 030	1/4hp, 240 VAC	$3 \times 10^4$ UL 508
RE 030	B 300	UL 508
RE 030	6 A, 30 VDC, resistive	$5 \times 10^5$
RE 030	0.3 A, 50 VDC, L/R=40 ms	$3 \times 10^6$
RE 030	6 (3) A, 250 VAC	$1 \times 10^5$ VDE 0631

**Electrical endurance****Table 20: N2 Open Communication Card Specifications**

<b>RS485 line</b>	maximum length without repeater: 1200m (4000ft), AWG26 twisted pair with shield.
<b>Devices</b>	maximum of 32 per 1200m (4000ft) bus segment.
<b>RS485/232 Converter</b>	IU-9100 if third party converter is used then make sure it supports automatic DSC (Data Send Control)
<b>Electrical Isolation</b>	1500 V

**Table 21: LON Communication Card (LCC) Specifications**

<b>LON network and Line Terminators</b>	Daisy-chained Bus Topology: two terminators of 100 Ohm required, one at each end of the bus. Free (star) topology: single terminator of 50 Ohm required.	
<b>Nodes</b>	64 (if repeaters are not used), FTT-10 nodes only.	
<b>Cable type:</b>	Length with FTT-10 devices	
	Bus topology	Free topology
<b>Belden 85102</b>	2700m (1.7 mi)	500 m (0.3 mi)
<b>Belden 8471</b>	2700m (1.7 mi)	500 m (0.3 mi)
<b>Level IV 22 AWG</b>	1400m (0.9 mi)	400 m (0.3 mi)



## Technical Specifications

### FX05 (Advanced) Controller (Part 1 of 2)

Product Codes	LP-FX05xxx-xxxC (see Table 10 for details)			
Power Requirements	24 VAC/VDC ±15%, 50/60 Hz			
Power Consumption	6 VA			
Protection Class	Front Plate IP54; Rear IP20			
Insulation	Class II			
Ambient Operating Conditions	-20°C (-4°F) to 65°C (149°F) 10 to 95 % RH (noncondensing)			
Ambient Storage Conditions	-30°C (-22°F) to +80°C (176°F) 10 to 95 % RH (noncondensing)			
Control Accuracy at 20°C (68°F) Ambient (sensor error not included)	Sensor Type	Range	Accuracy	
	A99	-40 to 70°C (-40 to158°F)	±0.5°C (±1°F)	
	NTC K10	-40 to 160°C (-40 to 320°F)	±0.5°C (±1°F)	
	PT1000 Extended	-40 to 100°C (-40°F to 212°F)	±1°C (±1.8°F)	
	PT1000 Standard	-10 to 70°C (14°F to 158°F)	±0.5°C (±1°F)	
	Linear	Software Configurable	±1% of the total range	
Display Resolution	± 0.1°C, between -9.9 to +99.9			
Digital Inputs:	Voltage free contacts, 3k3 pull-up resistors, not isolated			
Analog Inputs:	Not isolated. Spare inputs must be connected to the common.			
	Model	Channel	Type	Remark/Applicatio n
	FX05P1x-002	AI1 ÷ AI3	A99 Range: -40 to 100°C (-40 to 212°F) Accuracy: ±0.3°C (± 0.6°F) at 20°C (68°F) ambient	Application: temperature. Humidity, pressure, etc.
		AI4	NTC K10 Range: -10 to 70°C (14 to 158°F) Accuracy: ±0.5°C (± 1°F) at 20°C (68°F)	Also for the Fan Speed control signal coming from the Room Command Module
	FX05P1x-012	AI1 ÷ AI4	PT1000 Standard Range: -40 to 70°C (-40 to 158°F) Accuracy: ±0.5°C (± 1°F) at 20°C (68°F) ambient (sensor error not included)	Application: temperature
	FX05P1x-022	AI1 ÷ AI4	A99 or PT1000 Extended or Linear See Table Below.	Software configurable
Analog Outputs:	0...10 VDC, 5 mA, not isolated, 16-bit resolution, used for analog actuators, frequency drives.			
Continued on next page . . .				

**FX 05 (Advanced) Field Controller Technical Specifications (Part 2 of 2)**

<b>Digital Outputs General</b>	<p>Relays of the group DO2 to DO6 or DO3 to DO6 must be at the same voltage source. Double isolation between relay DO1 and the group DO2 to DO6 or between triacs DO1, DO2 and group DO3 to DO6.</p> <p>Dielectric test voltage at open relay contact: 1,000 VAC RMS. Maximum relay switching rate at nominal load: 6 operations/min</p>			
<b>Digital Outputs for Selected Models</b>	<b>Model</b>	<b>Channel</b>	<b>Type</b>	<b>Remark/Application</b>
	FX05P11	DO1	SPST 5 A res.; 1 FLA, 6 LRA ind.; 250 VAC power relay	Double insulated from the other relay group. Application: alarm output, etc
		<b>DO2 – DO6</b>	SPST 4 A res.; 1 FLA, 6 LRA; 250 VAC power relay	<p>Max. 4 A on C2/3 Max. 4 A on C4/5 Max. 4 A on C6</p> <p>In any case, any combination of loads must not exceed 12 A in total (the commons pins are internally connected)</p>
	FX05P12 /P13	DO1, DO2	0,5A / 24 VAC triacs	3-point incremental actuators, thermal actuators, etc
		<b>DO3 – DO6</b>	SPST 5 A res.; 1 FLA, 6 LRA ind. 250 VAC power relay	<p>On the <b>P12 model</b> the DO3 - DO5 relays are physically interlocked, i.e. only one output can be closed at one time. The total load connected to DO3 – DO5 cannot exceed 5 A. Application: 3-speed fan motors.</p> <p>The DO6 relay is free and is separately rated 5 A</p> <p>On the <b>P13 model</b>, all relays are freely usable. However, the total load connected to DO3 – DO5 cannot exceed 5 A. The DO6 relay is separately rated 5 A.</p>
<b>Connections</b>	<p>Molex connectors</p> <p>Relay outputs: Mini-Fit family: Series 5569 94V-2, mates with 5557 dual row receptacle, terminals Series 5556, cables AWG18</p> <p>Low voltage I/Os: Series 5268-NA, mates with 5264-N terminal housing, terminals Series 5263, cables AWG22</p>			
<b>Dimensions (H x W x D)</b>	35 mm (1.4 in.) x 75 mm (2.9 in.) x 90 mm (3.6 in.)			
<b>Compliance</b>	<b>Europe</b>	<ul style="list-style-type: none"> <li>– 89/336/EEC, EMC Directive: EN 61000-6-3, EN 61000-6-1</li> <li>– 72/23/EEC, Low Voltage Directive: EN 60730</li> </ul>		
	<b>Canada</b>	<ul style="list-style-type: none"> <li>– UL Listed (PAZX7), CAN/CSA C22.2 No. 205, Signal Equipment</li> <li>– UL Recognized (XAPX8), CAN/CSA C22.2 No. 24, Temperature Indicating and Regulating Equipment</li> <li>– Industry Canada, ICES-003</li> </ul>		
	<b>United States</b>	<ul style="list-style-type: none"> <li>– UL Listed (PAZX), UL 916, Energy Management Equipment</li> <li>– UL Recognized (XAPX2), UL 873, Temperature Indicating and Regulating Equipment</li> <li>– FCC compliant to CFR 47, Part 15, Subpart B, Class A</li> </ul>		

*The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.*



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