# FX16 Master Controller

# Introduction to FX16 Master Controller


**Figure 1: FX16 Master Controller with Display**

The FX16 Master Controller is a high performance field controller in the Facility Explorer system. The FX16 Master Controller is specifically designed for commercial Heating, Ventilating, Air Conditioning, and Refrigeration (HVACR) applications, such as chillers and rooftops, indoor packaged air conditioning units, air handling units, and close control units.

The controller has 27 physical inputs and outputs and supports a wide range of temperature sensors and actuating devices. Additional physical inputs and outputs may be achieved by adding the XT/XP expansion modules on the local Extension bus.

The FX16 Master Controller can manage a distributed control application with up to 16 FX slave controllers (FX05 Advanced, FX06, FX07, FX14 or FX15 controllers). You can display and modify parameters in the distributed control application from the optional integral or remote mounted user interface.

The FX16 also features communication services to transmit event notification messages via Short Messaging Service (SMS) or e-mail. With its embedded Web server, you can browse and make adjustments to parameters of the application from remote locations.

The FX16 Master Controller is fully configurable or programmable, using the FX Tools Pro software package, for a wide range of commercial HVACR applications.

The FX16 Master Controller is also available with a serial communication card for the integration into an N2 Open or LONWORKS® Building Automation network system.

Optional accessories make the FX16 Master Controller the ideal solution for the building controls market. These include:

- N2 Open, plug-in communication card
- LON, plug-in communication card
- RS-232C, plug-in serial communication card
- Global System for Mobile Communications (GSM) modem
- Medium User Interface (MUI): integral, remote panel or wall-mountable

# *FX16 Master Controller Key Concepts*

## FX16 Master Controller

The main features of the FX16 Master Controller include:

- fully programmable using FX Tools software package
- RS-485, N2 Open, or LON FTT10 plug-in communication card for supervisory system
- as an alternative, an RS-232C port for a modem (or null modem) connection
- DIN rail mounting
- removable screw connectors for servicing operations
- embedded Web server
- e-mail and SMS communications services manager
- Input/Output (I/O) expansion modules (up to 64 points)
- Distributed Application with up to 16 FX slave controllers
- optional Medium User Interface: integral, or remote panel or wall-mounted
- multiple language support
- trend logging (up to 4 MB flash memory)
- easy commissioning via FX CommPro commissioning tool
- Programming Key for easy application uploading and downloading

# Installation

This chapter takes you through the process of installing an FX16 Master 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 severe personal injury or death.

**IMPORTANT:** Use this FX16 controller only as an operating control. Where failure or malfunction of the FX16 could lead to personal injury or damage to the controlled equipment or other property, additional precautions must be designed into the control system. Incorporate and maintain other devices such as supervisory or alarm systems or safety or limit controls that are intended to warn of, or protect against, failure or malfunction of the FX16 controller.

**IMPORTANT:** In North America, the controller is intended for installation with Class 2 inputs and outputs only where no special electrical safety mounting precautions are generally necessary. These controllers are UL- recognized as Temperature Indicating and Regulating Equipment in accordance with UL 873 and UL Listed as Open Energy Management Equipment per UL 916.

**IMPORTANT:** Before specifying the FX16 for plenum applications, verify acceptance of exposed plastic materials in plenum areas with the local building authority. Building codes for plenum requirements vary by location. Some local building authorities accept compliance to UL 1995, Heating and Cooling Equipment, whereas others use different acceptance criteria.

**IMPORTANT**: Cables and wiring at Safety Extra-Low Voltage (SELV) and Class 2 wiring (North America) must be separated from power line voltage wiring. A minimum separation distance of 30 cm (12 in.) is recommended. Do not run extra low voltage cables parallel to power line voltage cables for long distances greater than 3 m (10 ft). Do not run extra low voltage wiring close to transformers or high frequency generating equipment.

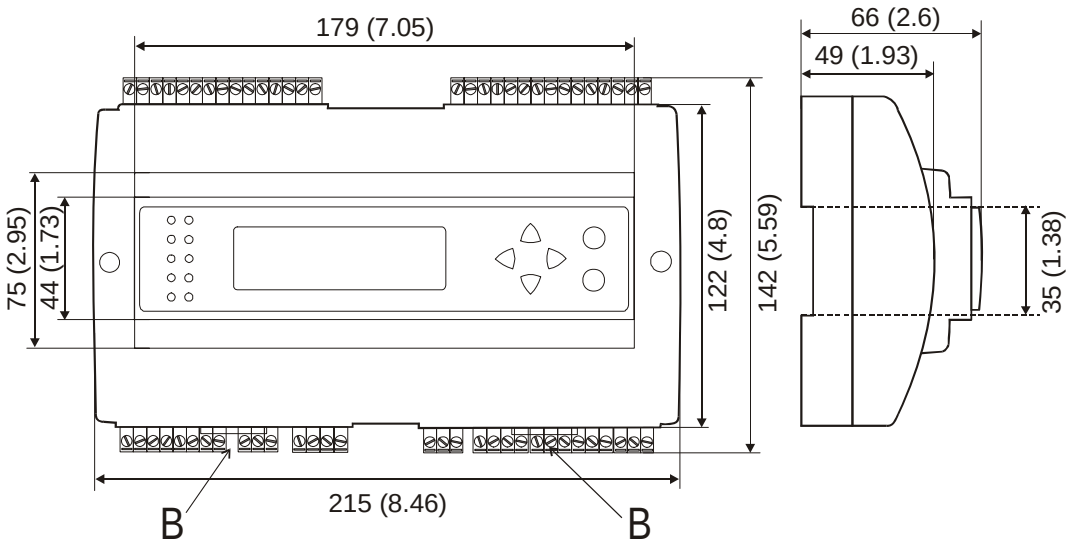



**Figure 2: Mounting Dimensions for FX16 (Shown with Integral User Display and Screw Connectors), mm (in.)**

Two different types of **terminal connectors** are available: spring clamp or screw connectors. The screw connectors are included, whereas you must order the spring clamp connectors separately. For details, see *Ordering Codes*.

## 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 is 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.

# Installation Procedures

Follow these instructions to properly install and connect the FX16.

**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 severe personal injury or death.

## Mounting the FX16 Controller

To mount the FX16 controller:

1. Snap the controller onto the 35 mm (1.38 in.) rail for DIN rail mounting.

   To release the controller, insert a screwdriver in Slot B and lift the retaining clip. Since the retaining clip is spring-loaded, you can also remove the controller without a screwdriver by carefully pushing the controller up against the clip and then tilting the top forward to release the top lugs from the DIN rail.

2. Make wiring terminations with detachable connectors.

   The detachable connectors accept 1 x 1.5 $mm^2$ (0.002 $in.^2$)/14 AWG cable. Two types of connector are available: screw connectors shipped with the controller and cage clamp connectors ordered separately.

   Terminations to the Supervisor Link, Local Link Bus, and Remote Display are made via the connectors provided with the controller.

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

4. Set the jumpers and address switches of the controller. For more information, see *Jumper Details*.

**IMPORTANT:** The Complementary Metal Oxide Semiconductor (CMOS) circuits in the controller are sensitive to static electricity. Take suitable precautions.

## Connection Details

### *Wiring Diagram*

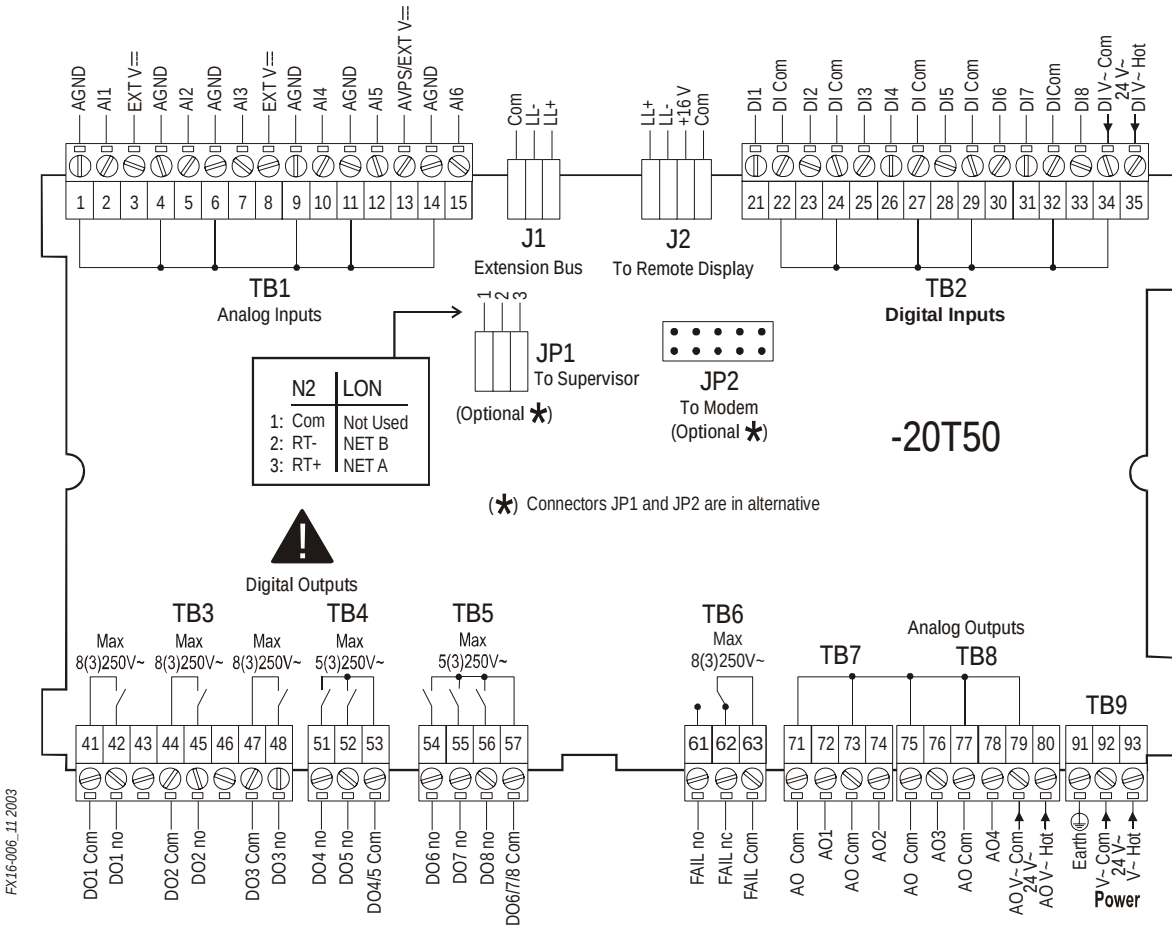



**Figure 3: Connection Details for the FX16 Master Controller LP-FX16D0x-000C, LP-FX16X0x-000C, and LP-FX16X5x-000C (with 9 Relays)**

In the FX16X Rev. A controllers, 24 VAC power is isolated at 500 V from the internal processor circuits. This isolation enables the use of the 24 VAC power supply to the controller for the Analog Outputs (AOs) and Digital (binary) Inputs (DIs), maintaining the isolation from the internal processor circuits. Therefore, in the FX16X Rev. A controllers, the external wiring of a 24 VAC power supply to the analog outputs (terminals 79 and 80) and to the digital inputs (terminals 34 and 35) is not required as the 24 VAC power supply is used internally for the analog outputs and digital inputs. The terminals 34, 35, 79 and 80 still exist on the FX16X Rev. A controllers to provide backward compatibility when replacing a controller. In the FX16X Rev. A controllers, terminals 35 and 80 are not connected to any internal circuit. You can use terminals 34 and 79 as extra Com connections, which are electrically connected to the 24 VAC Power Com.

### *Isolation Diagram*

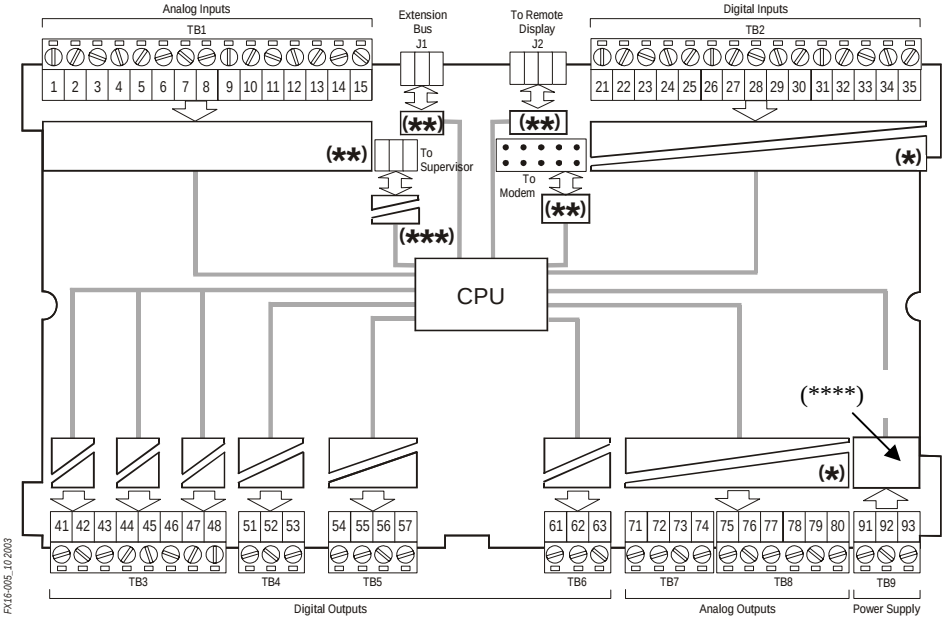



**Figure 4: FX16 Isolation Diagram**

Figure 4 displays the isolation diagram for the FX16 controller. Use the following list as a reference to understand the diagram:

- (*) Opto-isolated from the Central Processing Unit (CPU) circuits (max. 500 V):
  LP-FX16D and LP-FX16X (not Rev. A), when separate power supply is used
  LP-FX16X (Rev. A), with same power supply as controller
- (**) Not isolated from CPU (Analog Inputs, Local Link Extension Bus, and Modem connections)
- (***) DC/DC converter with dielectric strength up to 500 V
- (****) Isolation of power supply from CPU is hardware model dependent:
  - Models LP-FX16D and LP-FX16X (not Rev. A) are not isolated.
  - Model LP-FX16X (Rev. A) is isolated (maximum 500 V).

### *FX16D and FX16 Controllers (Not Rev. A)*

Consider the following information when you work with the connections details for FX16D and FX16X controllers (not Rev. A):

- Analog Inputs (AIs) are not isolated from the processor circuits (CPU) or the 24 VAC power supply.

- Analog Outputs (AOs) are opto-isolated and externally powered at 24 VAC. To maintain the opto-isolation, you must use a separate power supply (3 VA) only for the analog outputs.
- Digital Inputs (DIs) are opto-isolated and externally powered at 24 VAC. To maintain the opto-isolation, you must use a separate power supply (3 VA) only for the digital inputs.
- Digital Outputs (DOs) are isolated relays or opto-isolated triacs supporting 24 VAC.
- N2 and LON communication ports are electrically isolated from the digital inputs and analog/digital outputs and power supply.
- The RS-232C communication port is not isolated from the processor circuits (CPU) or 24 VAC power supply.

### *FX16X Controllers (Rev. A)*

Consider the following information when you work with the connections details for the FX16X controllers (Rev. A):

- Analog Inputs (AIs) are not isolated from the Central Processing Unit (CPU) but are isolated from the 24 VAC power supply.
- Analog Outputs (AOs) are opto-isolated from the CPU and internally powered at 24 VAC from the power supply. An external 24 VAC power supply for the AOs is not required.
- Digital Inputs (DIs) are opto-isolated from the CPU and internally powered at 24 VAC from the power supply. An external 24 VAC power supply for the DIs is not required.
- Digital Outputs (DOs) are isolated relays or opto-isolated triacs supporting 24 VAC
- N2 and LON communication ports are electrically isolated from the digital inputs and analog/digital outputs and power supply.
- The RS-232C communication port is not isolated from the CPU but is isolated from 24 VAC power supply.

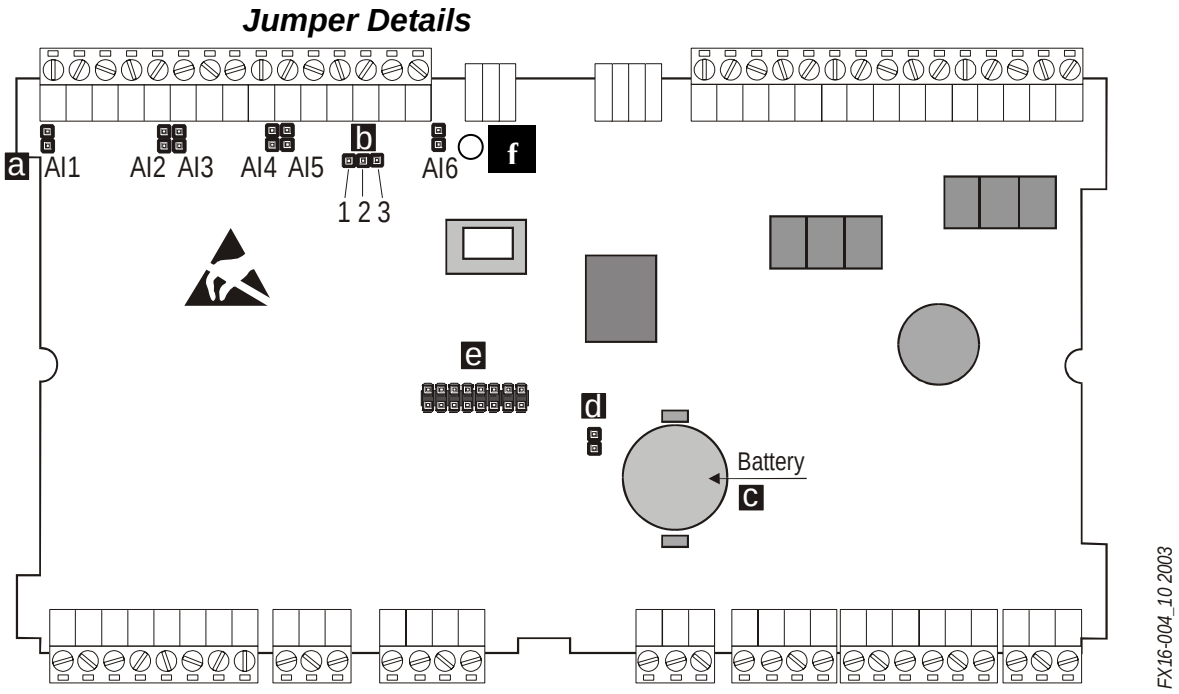



**Figure 5: Jumper Connections**

**Table 1: Jumper Connections**

| Diagram Location | Analog Input | 0-20/4-20 mA | Resistive, 0-10 V or Ratiometric |
|---|---|---|---|
| **a** | AI1-AI6 | Jumpers Closed | Jumpers Open<br>(Default configuration) |
| | **Sensors Power Supply** | **Audio Visual Presentation Series (AVPS) +5 V 20mA** | **EXT VDC+16 V 80mA (Total)** |
| **b** | Terminal Number 13 | Pins closed between 1 and 2 | Pins closed between 2 and 3<br>(Default configuration) |
| **c** | Battery Type CR2032, average life time: 3 years, dispose of correctly with due regard for the environment | | |
| **d** | Pin strip closed: battery backup enabled<br>Pin strip open: battery disconnected (to preserve charge)<br>Jumper **d** is set to ON at the factory and should only be set to OFF if the controllers are to be kept in storage without power for an extended period of time. The jumper must be set to ON before the controllers is installed and powered up, otherwise backup function for RAM and Real-Time Clock (RTC) is not enabled. | | |
| **e** | Plug-in connector for optional cards insertion | | |
| **f** | Hole for standoff for communication card | | |

## Connection Details for FX Slave Controllers - Distributed Application and Gateway Objects - on Local Link Extension Bus

Figure 6 displays the connection details for the FX slave controllers on the local extension bus.

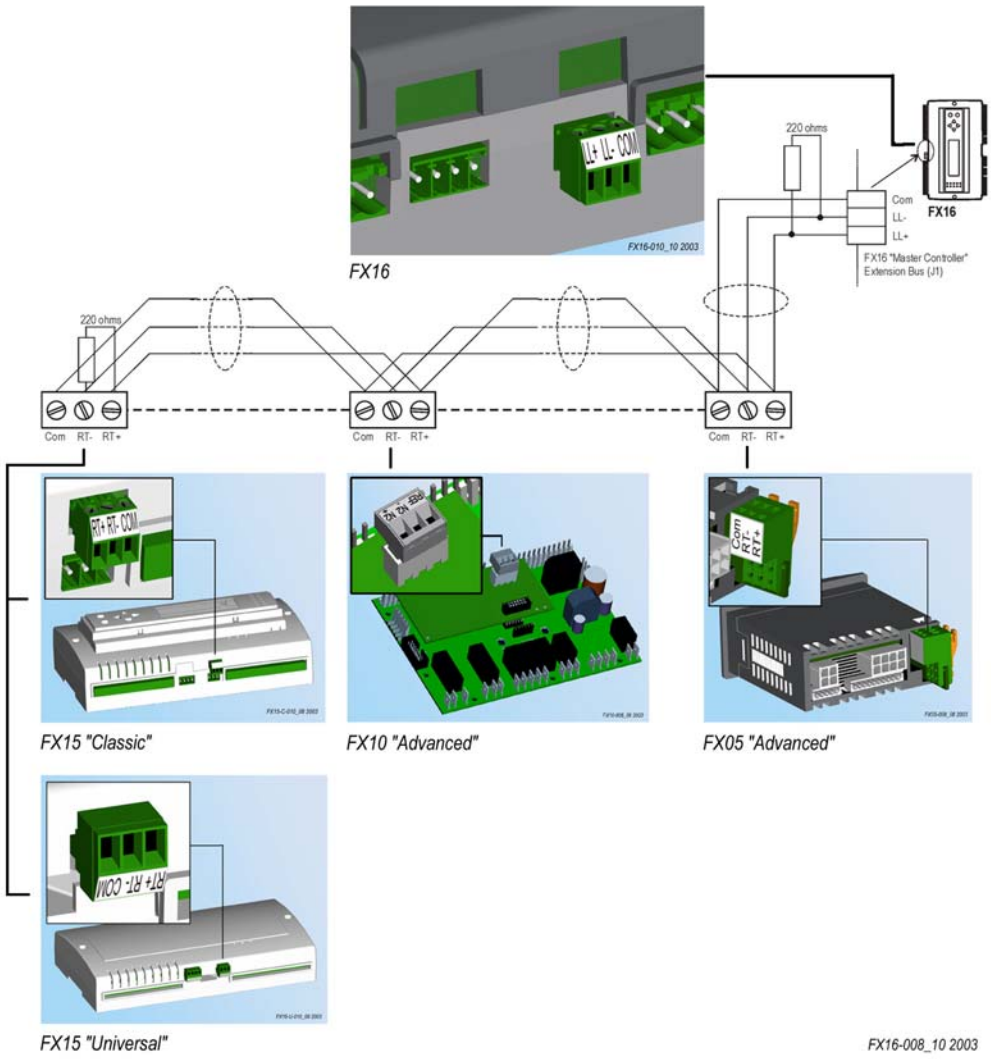



**Figure 6: Connection Details for the Slave Controllers**

Consider the following information when you work with the connections details for FX slave controllers:

- FX16 supports a maximum of 16 Facility Explorer slave controllers. All slave controllers may be in a Distributed Application or monitored by a Gateway Object, or you can use any combination that does not exceed 16 devices.
- Slave model types for a Distributed Application: FX05 Advanced, FX06, FX07, FX14, FX10 Advanced, FX15 Classic and FX15 Universal
- An FX controller used as a slave must have an RS-485 N2 Open plug-in communication card installed.
- Slave model types for a Gateway Object: FX controller with N2 communication card, N2 Open Vendor (VND) device, or System 91 N2 controller (DX-9100 or TC-910x).
- The appropriate N2 bus serial address must be set on each slave device.
- Maximum bus length is 1,200 m (4,000 ft).
- Install a repeater (for example, RP-9100-810x) to regenerate the RS-485 signal. You install the repeater in case more than 31 N2 devices are connected on the local link extension bus and/or the local link extension bus length is more than 1,200 m (4,000 ft).
- Install 220 ohm end-of-line resistors at each end of the bus line when the bus length is greater than 100 m (330 ft). When the bus length is fewer than 100 m (330 ft), insert only one 220 ohm resistor at the FX16 Master Controller end only.
- The distributed application is downloaded to the FX16 Master Controller. Then the FX16 Master Controller downloads the specific parts of the application to the corresponding FX slaves.
- Devices connected and monitored by the Gateway object must be programmed and/or configured independently.
- Slave devices can coexist with XT91/XP91 modules on the local link extension bus.

## Connection Details for I/O Expansion (XT91/XP91 Modules) on Local Extension Bus

Figure 7 displays the connection details for XT/XP modules on a local extension bus.

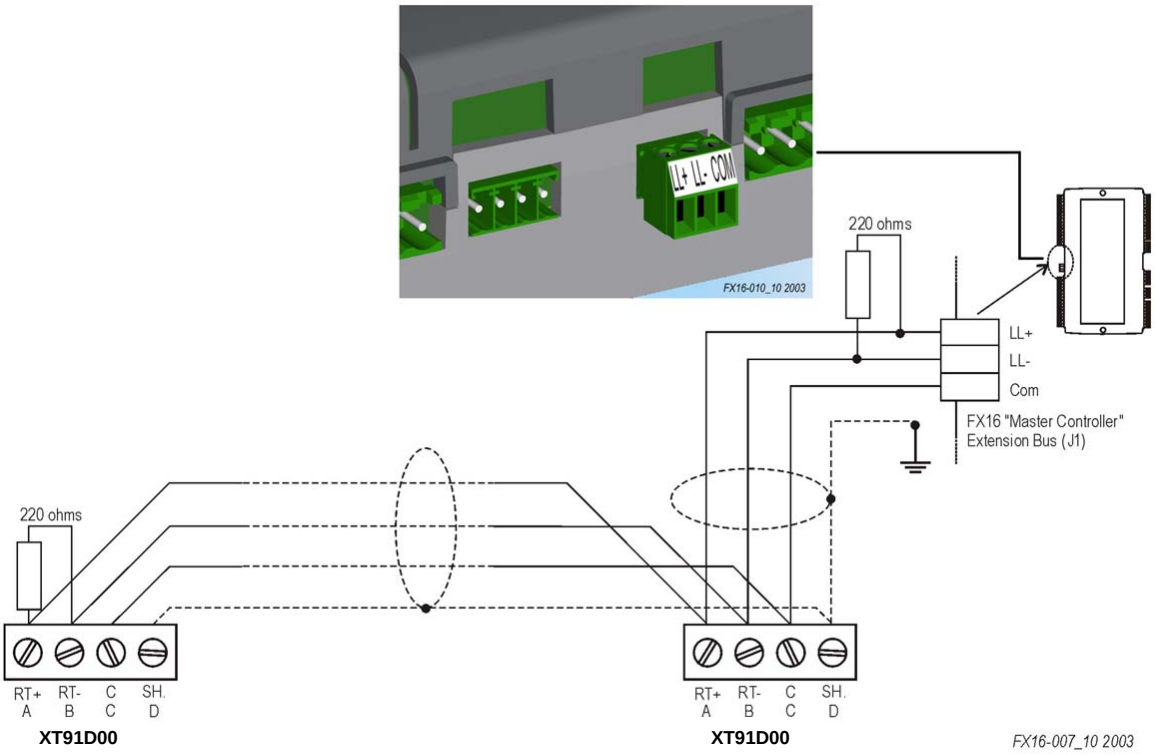



**Figure 7: Connection Details for the XT/XP Module**

Consider the following information when you work with the connections details for the XT91/XP91 Modules:

- Maximum XT modules are 4 x XT91D00 (or XT-9100).
- Maximum bus length is 1200 m (4000 ft).
- You must set appropriate N2 bus serial address on each XT module.
- Install a repeater (for example, RP-9100-810x) to regenerate the RS-485 signal. You install the repeater in case more than 31 N2 devices are connected on the local link extension bus and/or the local link extension bus length is more than 1,200 m (4,000 ft).
- Install 220-ohm end-of-line resistors at each end of the XT-Bus line when the bus length is greater than 100 m (330 ft). When the bus length is less than 100 m (330 ft), insert only one 220 ohm resistor at the FX16 Master Controller end only.

- You can download the control application to the FX16 Master Controller. Then the FX16 Master Controller downloads the specific parts of the application to the corresponding XT modules.
- You must program and/or configure devices connected and monitored by the Gateway object independently.
- XT91/XP91 modules can coexist with slave controllers on the local link extension bus.

## Connection Details for the RS-485 N2 Open Card

You can order the FX16 Master Controller with the RS-485 N2 Open communication card, or you can order the N2 Open communication card separately to insert the card at a later time. See *Ordering Codes*.

The RS-485 communication card allows the FX16 Master Controller to connect to an N2 Open network of a building automation system.

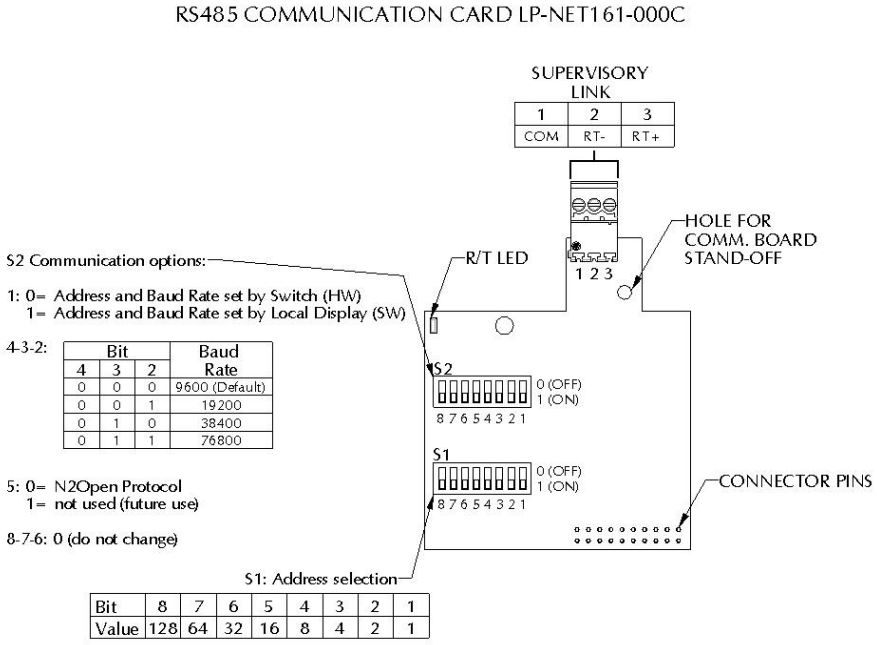



**Figure 8: N2 Open Plug-in Communication Card**

**Note:** The N2 Open communication card for the FX16D and FX16X (not Rev. A) controllers does not have S2 Communication Options switch.

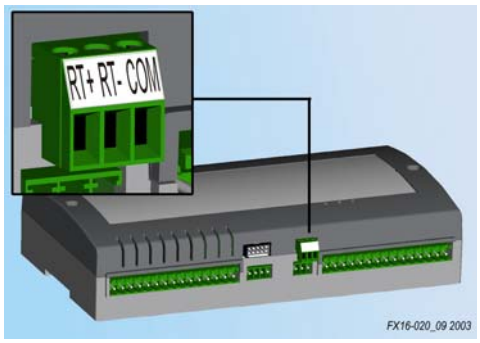



**Figure 9: N2 Open Card Terminals**

### *Installing the RS-485 N2 Communication Card*

To install the RS-485 N2 communication card:

1. Turn off the controller (hot plug-in not allowed) and isolate all high-voltage connections to the controller.
2. Open the controller by removing the two screws. See Figure 10.

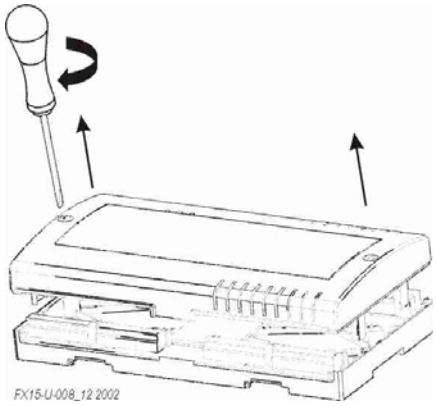



**Figure 10: Open the Controller**

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

3. Fit the standoff supplied with the card into the hole in the FX16 board (located close to the Local Link Bus terminals).
4. Press the connector pins into the communication board connector on the FX16 board and press the card over the standoff to fit the card firmly in position. See Figure 11.

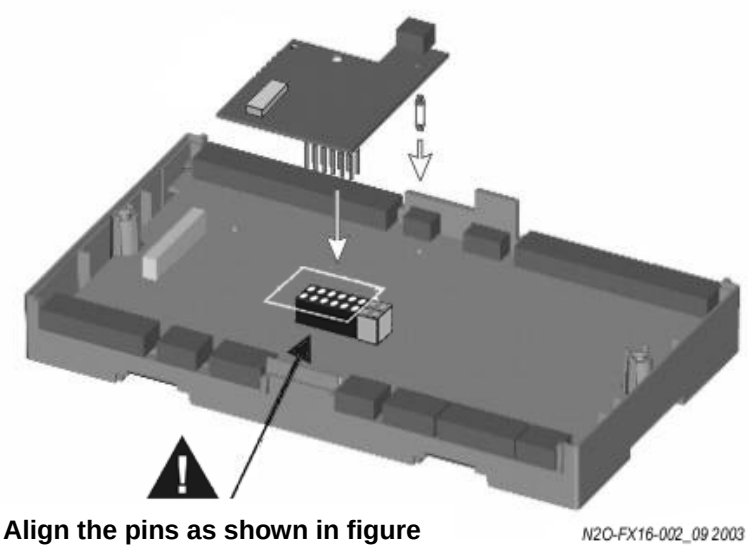



**Figure 11: Insertion of the N2 Open Card**

5. On the upper DIP switch block (S2), set Switch 1:

   **Models with an integral display**:

   0 = baud rate and N2 Address set on DIP switches

   1 (On) = baud rate and N2 Address set on controller display

   **Models without an integral display**:

   0 = baud rate and N2 Address set on DIP switches

6. If Switch 1 of S2 is set to 0, set the Baud Rate.

   **Note:** For N2 communication with Metasys® supervisory systems, you must select the baud rate of 9600 (factory default).

7. If Switch 1 of S2 is set to 0, set the N2 Address on the lower DIP switch block (S1) in binary format (1 = ON). Examples are:

   8 7 6 5 4 3 2 1
   0 0 0 0 0 0 0 1 = N2 Address 1
   0 0 0 0 0 0 1 1 = N2 Address 3
   1 0 0 0 0 0 0 1 = N2 Address 129
   1 1 1 1 1 1 1 1 = N2 Address 255

   **Note:** Address zero is not supported on the N2 Open network. The factory default address is 1.

8. Replace the control cover and secure the cover with the two screws.
9. Turn on the controller after you safely restore all connections.

**IMPORTANT:** If you change the N2 Address during a bench test with power applied to the controller, cycle the power for a new address to become active in the controller.

### *N2 Open Communication Card Connection*

The FX16 controller cover displays **1**, **2**, and **3** as the Supervisory Link terminals. For the N2 Open Communication Card, the connections to the RS-485 N2 Bus using the information in Table 2. The connections are polarity sensitive; therefore, you must make the connections correctly.

**Table 2: RS-485 N2 Bus Connections**

| Supervisory Link | N2 Bus |
|---|---|
| **1** | COM |
| **2** | RT - |
| **3** | RT + |

### *Network Layout*

For details about how to lay out the N2 network, refer to the *N2 Communication Bus Technical Bulletin (LIT-636018).*

## LONWORKS Communication Card

You can order the FX16 controller with the LONWORKS communication card installed, or you can order the LONWORKS communication card separately to insert at a later time. See *Ordering Codes*.

The LONWORKS communication card allows the FX16 to connect to a LONWORKS free topology (FTT) network.

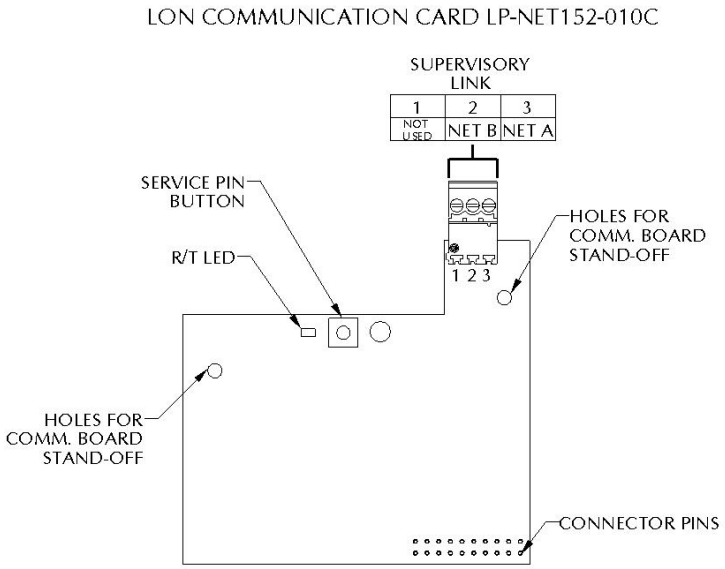



**Figure 12: LON Plug-in Communication Card**

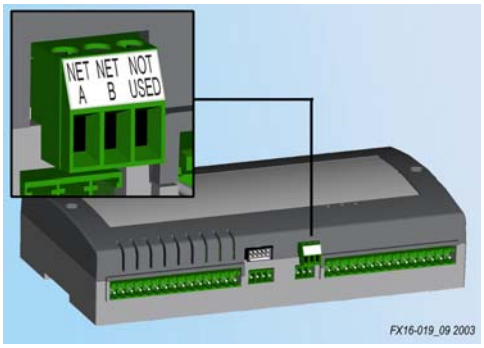



**Figure 13: LON Card Connection**

### *Installing the LON Communication Card*

To install the LON communication card:

1. Turn off the controller (hot plug-in not allowed) and isolate all high voltage connections to the controller.
2. Open the controller by removing the two screws. See Figure 14.

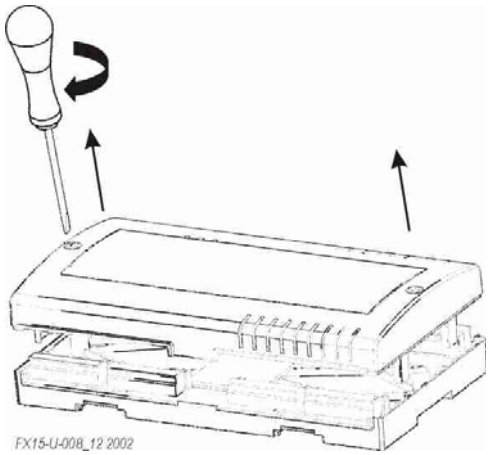



**Figure 14: Open the Controller**

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

3. Fit the standoff supplied with the card into the hole in the FX16 board (located close to the Local Link Bus terminals).
4. Press the connector pins into the communication board connector on the FX16 board and then press the card over the standoff to fit the card firmly in position. See Figure 15.

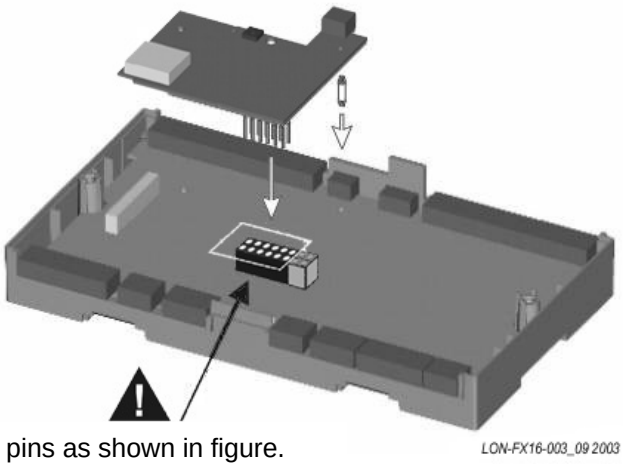



**Figure 15: Insertion of the LON Card**

5. Replace the control cover and secure it with the two screws.
6. Turn on the controller after you safely restore all connections.

### *LON Communication Card Connection*

The FX07 controller cover displays **1**, **2**, and **3** as the Supervisory Link terminals. For the LONWORKS Communication Card, the connections to the FTT LON network appear in Table 3. The connections are not polarity sensitive; however, we recommend that you make consistent connections for easier troubleshooting.

**Table 3: FTT LON Network Connections**

| Supervisory Link | LON Network |
|---|---|
| **1** | Not used |
| **2** | NET B |
| **3** | NET A |

### *LON Neuron® ID*

After you press the Service Pin located on the LON communications card (accessible through the controller cover), the FX16 controller sends a unique Neuron ID over the LON network. There is also a label on the LON communications card with the Neuron ID (number and barcode).

### *LONWORKS Network Layout*

Refer to the *LONWORKS FTT-10A Free Topology User's Guide (078-0156-01F)* for technical guidelines associated with free topology restrictions. Refer to the *Junction Box and Wiring Guidelines for Twisted Pair LONWORKS Networks (005-0023-01)* for more detailed information on wiring specification. You can locate these documents on the Echelon® Web site (www.echelon.com).

## RS-232C Communications Card

You can order the FX16 controller with the RS-232C communication card, or you can order the RS-232C communication card separately to insert the card at a later time. See *Ordering Codes*.

The RS-232C Plug-in card allows the FX16 Master Controller to connect to a Global System for Mobile (GSM) Communications modem or to a standard land-line modem.

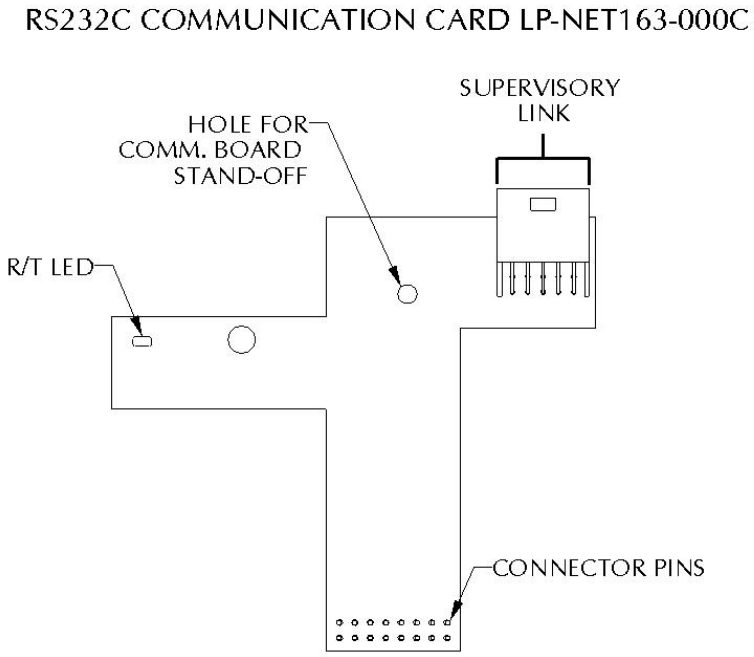



**Figure 16: RS-232C Plug-in Communication Card**

### *Installing the RS-232C Communications Card*

To install the RS-232C communications card:

1. Turn off the controller (hot plug-in not allowed) and isolate all high-voltage connections to the controller.
2. Open the controller by removing the two screws. See Figure 17.

**IMPORTANT:** The CMOS integrated circuits in the controller are sensitive to static current discharges. Take suitable precautions.

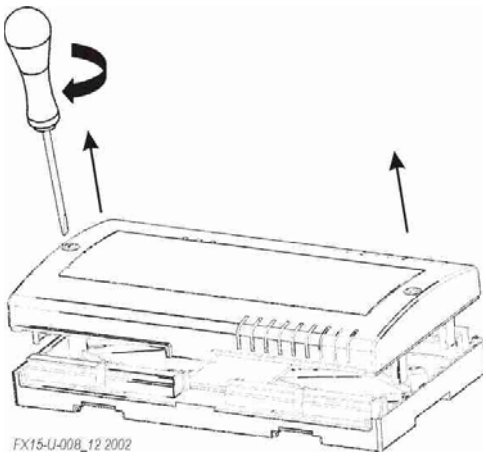



**Figure 17: Open the Controller**

3. Fit the standoff supplied with the card into the hole in the FX16 board (located close to the Local Link Bus terminals).

4. Press the connector pins into the communication board connector on the FX16 board, and press the card over the standoff to fit the card firmly in position. See Figure 18.

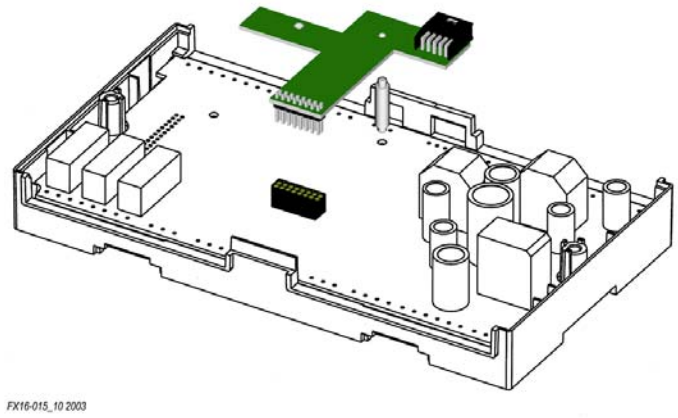



**Figure 18: Insertion of the RS-232C Card**

5. Replace the control cover and secure the cover with the two screws.
6. Turn on the controller after you safely restore all connections.

### *Connecting the Modem*

You can connect the FX16 Master Controller to V.92 standard landline modem (suggested brand-U.S. Robotics) or to a GSM modem. See *Ordering Codes*. The functions of the FX16, through the RS-232C serial card, are defined in the software configuration. These functions also include event notification via SMS or e-mail to one or more users or groups of users and access to the embedded Web pages.

For the connection between the FX16 Master Controller and a modem, two different cables are available:

- cable for a standard modem
- cable for a GSM modem

The cable length provided is 1.5 m (4.9 ft). See Figure 19.

The RS-232 standard allows for a maximum connection length of 15 m (50 ft). For connection pin-out, see Figure 20 and Figure 21. Spare female ampere connector and crimps are provided with the RS-232 card.

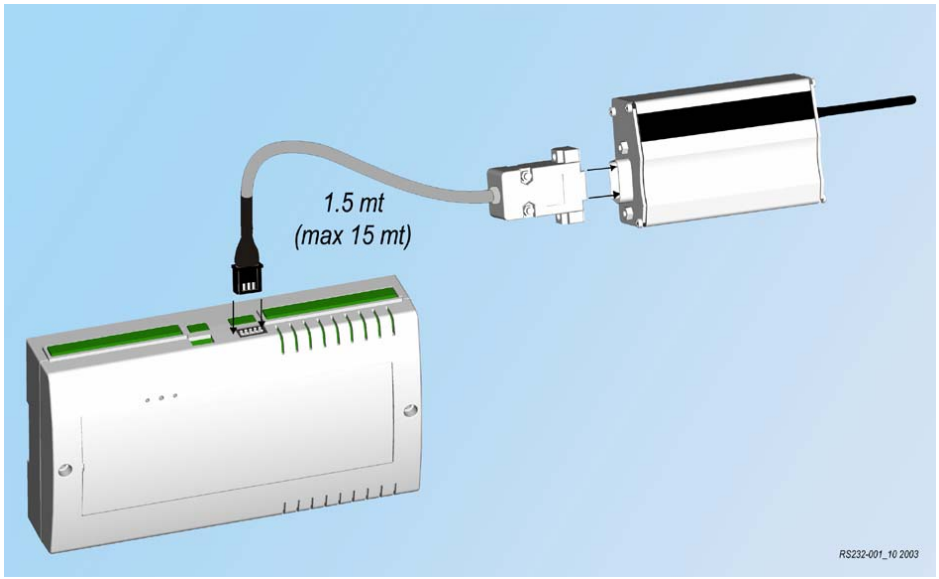



**Figure 19: Connecting the Modem**

**LP-KIT007-001C** is a 1.5 m (4.9 ft) long cable with DB9 male connector for the connection to a standard Land Line modem. See Figure 20.

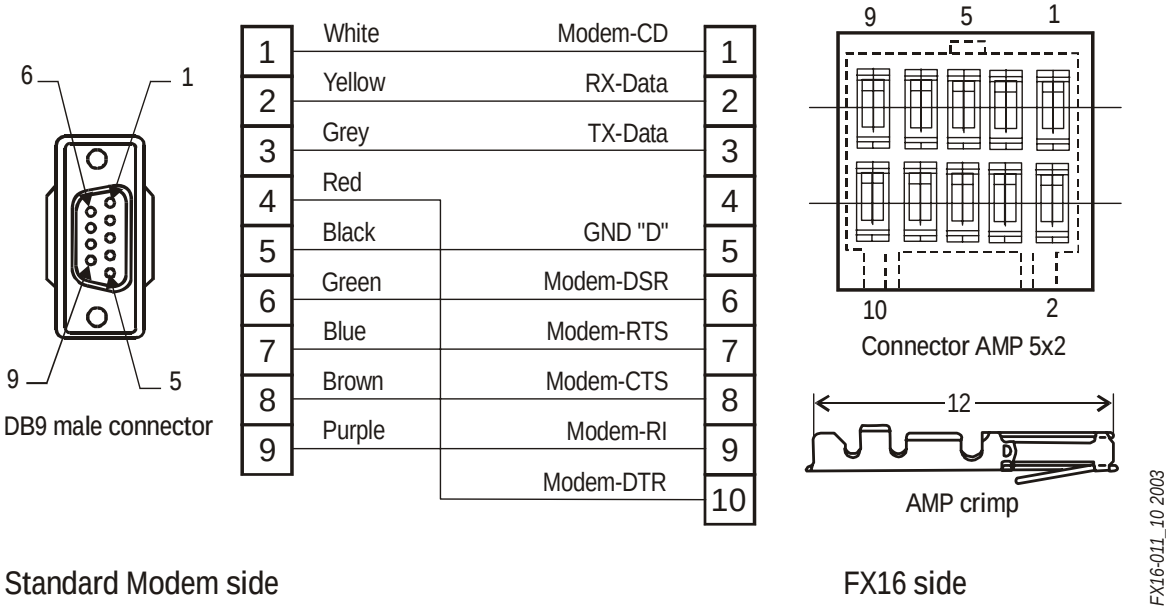



**Figure 20: Connection Details of Standard Modem Cable**

**LP-KIT007-002C** is a 1.5 m (4.9 ft) long cable with a DB15 male connector for the connection to the GSM modem. See Figure 21.

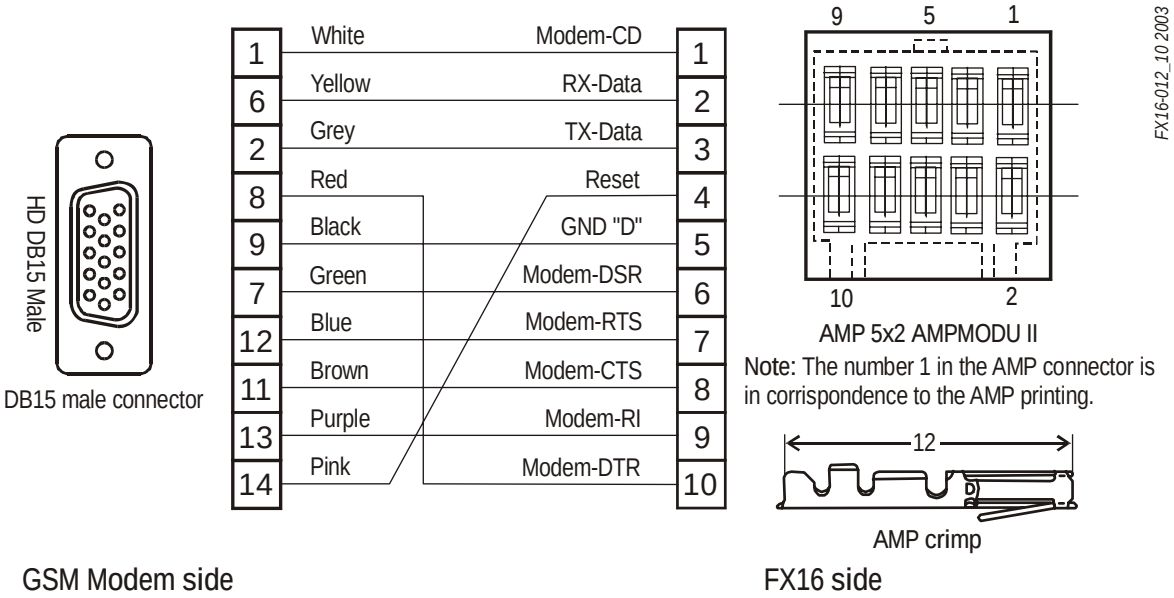



**Figure 21: Connection Details of GSM Modem Cable**

Consider the following information when you work with the connections details for the GSM modem cable:

- Run the modem cable separately from line voltage/power cables and use a minimum of 30 cm (12 in.) separation for 230 V/30 A circuits.
- Do not run modem cable parallel to power cables for long distances (> 3m [10 ft]).
- Do not run modem cable close to transformers or high frequency generating equipment.

### *GSM Modem Antenna*

Connect the GSM modem to a proper antenna with the characteristics in Table 4.

**Table 4: GSM Modem Characteristics**

| Characteristic | Description |
|---|---|
| **Frequency range** | Dual-band GSM 900/1800 MHz |
| **Impedance** | 50 ohms |
| **Gain (antenna + cable)** | 0 dB |
| **VSWR (antenna + cable)** | -10 dB |

You must install the antenna in a position where the GSM modem field is strong enough to ensure proper communication.

To verify the GSM signal strength, connect the modem using a null modem cable to a computer with a VT100 emulator program. Send the AT command **AT + CSQ** to the modem. Monitor the response. See Table 5.

**Table 5: GSM Signal Strength**

| AT+CSQ Response (RSSI) | Signal Quality |
|---|---|
| **11 to 31** | Sufficient |
| **0 to 10 and +99** | Insufficient |

### *Antenna Types*

The three available antenna types include:

- unit mount antenna
- remote mount antenna
- panel mount antenna

The **Unit Mount Antenna (LP-KIT90-001C)** plugs directly into the modem. You must mount the modem with antenna in a free space where both antenna and modem are always visible (not enclosed in a metal cabinet or electrical panel where the GSM field might not be strong enough).

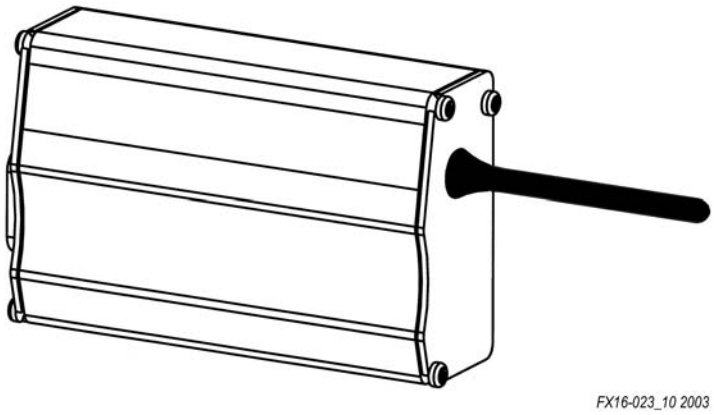



**Figure 22: Unit Mount Antenna**

The **Remote Mount Antenna (LP-KIT090-003C)** has a permanent magnet in its base and is designed for mounting on a metal surface. It is supplied with a 2.5 m (8.2 ft) long cable and an adapter to connect the cable to the modem.

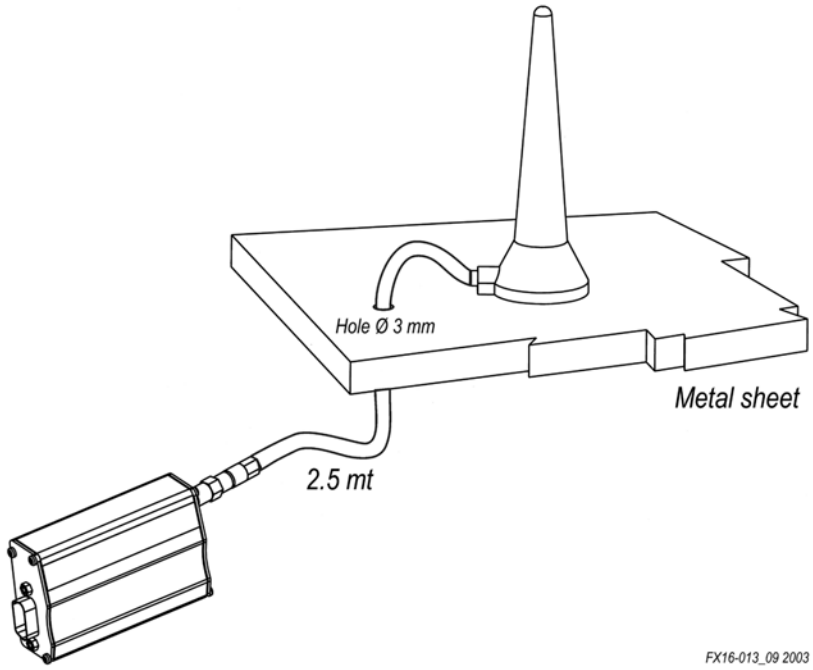



**Figure 23: Remote Mount Antenna (Magnetic)**

The **Panel Mount Antenna (LP-KIT090-004C)** is designed for mounting through an 11 mm (0.44 in.) hole in a panel. It is supplied with a 5 m (16.4 ft) long cable and adapters to connect the cable to the antenna and the modem.

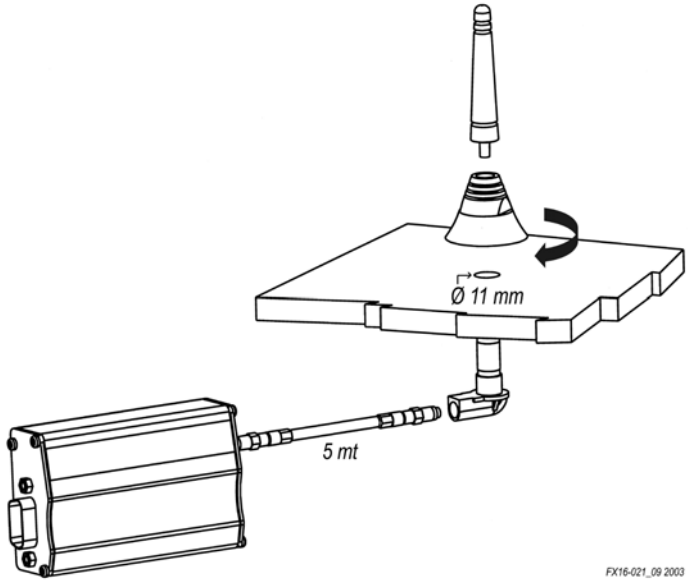



**Figure 24*:* Panel Mount Antenna**

### *GSM Modem Power*

The GSM modem requires 5 to 32 VDC power at 12 Watts (W) maximum to operate.

**The GSM Modem Power Adapter (LP-KIT090-005C)** is a nonregulated AC/DC adapter with a wall plug for a Central European socket. The input is 230 VAC and the output is 9 VDC at 1,300 mA maximum. You must purchase an equivalent adapter in areas with other supply voltages and plugs.


**Figure 25: GSM Modem Power Adapter**

### *GSM Modem Interface*

The modem contains a simple Light-Emitting Diode (LED) interface indicating the operating status. See Table 6 for LED descriptions.

**Table 6: LED Operating Statuses**

| LED | Description |
|---|---|
| **LED Off** | Device switched off - not ready |
| **LED On** | Device switched on - connecting to network |
| **LED Flashing Slowly** | Device switched on - idle mode (registered to network) |
| **LED Flashing Rapidly** | Device switched on - transmission mode |

### *Installing the SIM Card on the GSM Modem*

To install the SIM Card on the GSM modem:

1. Turn off the GSM modem.
2. Push the yellow button located in the front of the GSM modem to remove the SIM card housing. See Figure 26.


**Figure 26: SIM Card Installation**

3. Place the SIM card into the housing.
4. Insert the SIM card in the slot.
5. Insert the housing with the SIM card back into the modem slot.

### *SIM Card Configuration*

GSM mobile telephone service provider needs to preconfigure the SIM card. Use the following specifications:

- PIN request: DISABLE
- ENABLE for Data Transmission.
- ENABLE for SMS Transmission with valid Service Center number.

## Connecting a Computer with the Null Modem Cable

This section provides details for the Direct RS-232 connection and the RS-232/RS-485 connection.

### *Direct RS-232 Connection*

For local monitoring, you can directly connect a computer (instead of a modem) to the RS-232C port of the FX16 Master Controller using a null modem cable.

The null modem connection is an alternative to the modem connection. With a null modem connection, you can establish a Point-to-Point Protocol (PPP) connection between the personal computer and the

controller and use Internet Explorer to navigate the FX16 Master Controller Web pages. See Figure 27.

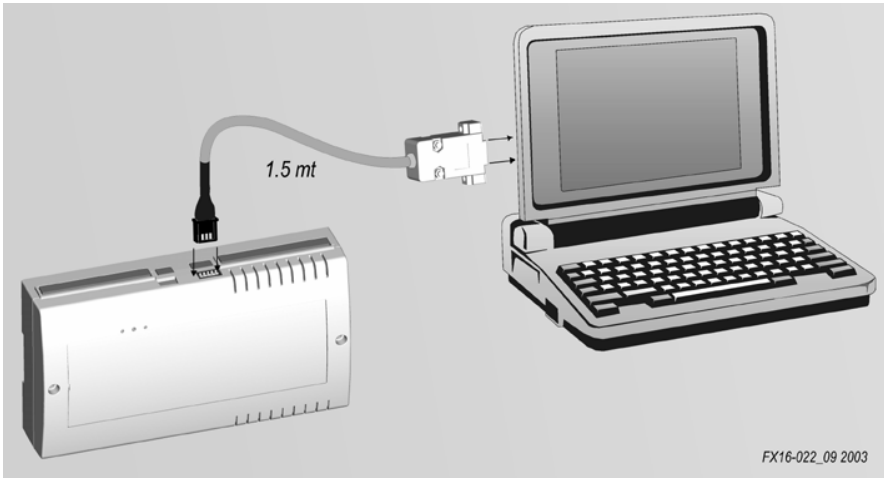



**Figure 27: Connection Details for the Null-Modem Cable**

There are two codes available for cables:

- **LP-KIT007-013C:** null modem cable 3 m (9.8 ft) long
- **LP-KIT007-014C:** null modem cable 15 m (49.2 ft) long

The maximum RS-232C connection length is 15 m (49.2 ft).

Figure 28 displays the connection details of the null modem cable.

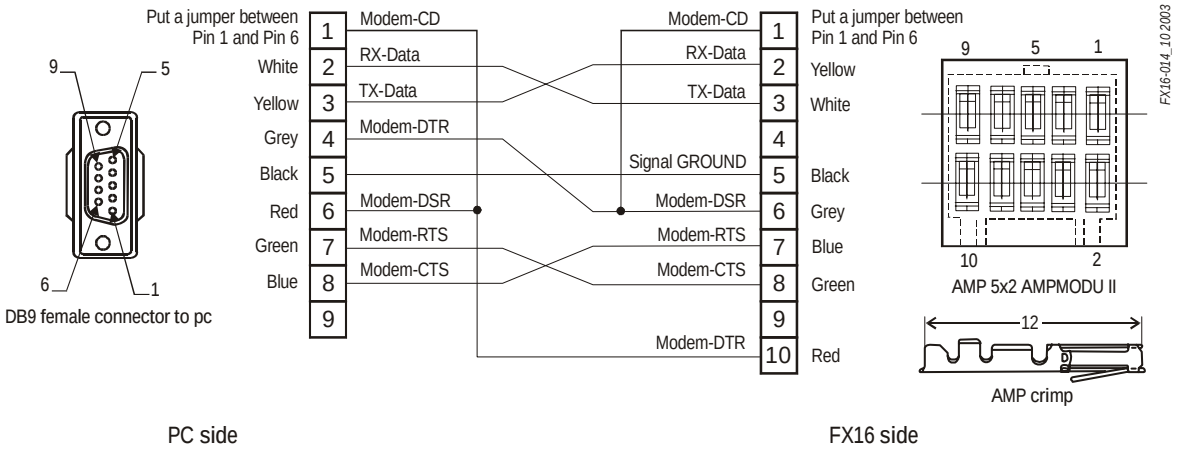



**Figure 28: Wiring Connection of the Null Modem Cable**

Consider the following information when you work with the wiring connection for the null modem cable:

- Run the null modem cable separately from line voltage/power cables. Use a minimum of 30 cm (12 in.) separation for 230 V/30 A circuits.
- Do not run the null modem cable parallel to power cables for long distances (> 3m [9.8 ft]).

- Do not run the null modem cable close to transformers or high frequency generating equipment.

### *RS-232C/RS-485 Connection*

In case the distance between the controller and the personal computer needs to be bigger than 15 m (49.2 ft) (up to 1,200 m [4,000 ft]), you need to insert an RS-485 trunk between the computer and the FX16. See Figure 29.

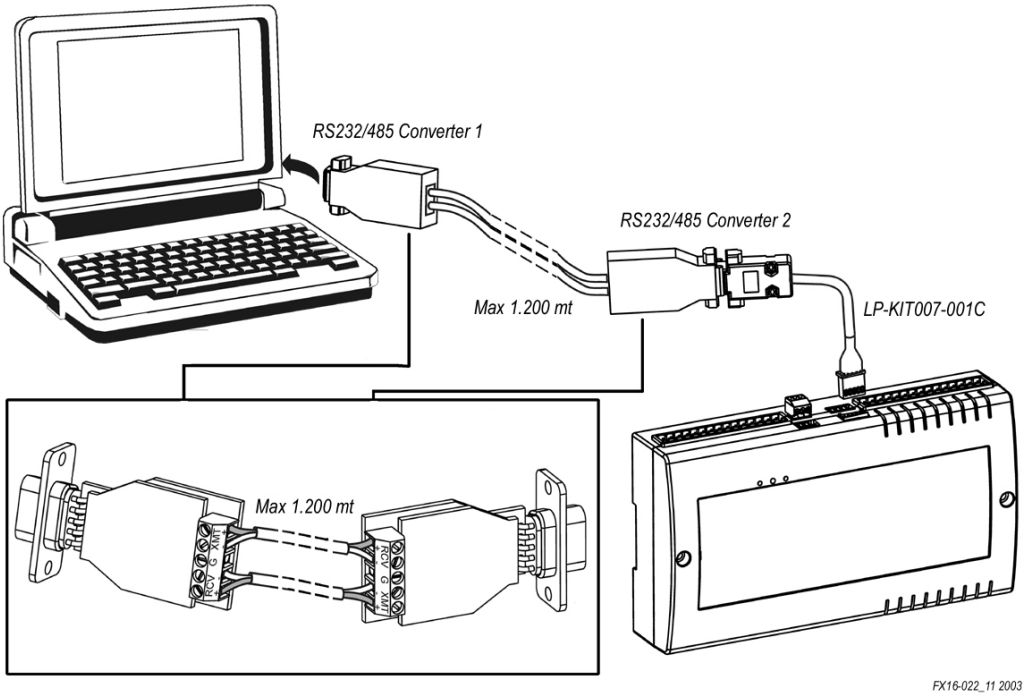



**Figure 29: RS-485 Connection in Null Modem Configuration**

Consider the following information when you work with an RS-485 in a null modem configuration:

- Use two RS-232/RS-485 converters and set to **full-duplex** mode. Cross connect the two converters as described in Table 7.

**Table 7: Cross Connect RS-232/RS-485 Converters**

| Converter 1 | | Converter 2 |
|---|---|---|
| XT+ | → | RC+ |
| XT- | → | RC- |
| RC+ | ← | XT+ |
| RC- | ← | XT- |

**IMPORTANT:** Do not use the Johnson Controls® IU-9100, as it can only work in half-duplex mode.

- Use the cable LP-KIT007-001C between the FX16 Master Controller and the first RS-232/RS-485 converter.
- The RS-232 port of the FX16 Master Controller has the possibility to power the converter (for those converters that offer the port-powered option).

**Table 8: RS-232/RS-485 Setup Options**

| Setup Option | Description |
|---|---|
| **Transmission Format** | Asynchronous |
| **Transmit Mode** | 4-wire, full-duplex |
| **Receive impedance** | 120 ohm |
| **Echo Mode** | Echo OFF |
| **Transmitter OFF Impedance** | High |

- Run the 485 trunk cable separately from low-voltage power cables and use a minimum of 30 cm (12 in.) separation per 230 V/30 A circuits.
- Do not run the RS-485 cable in parallel to power cables for long distances (>3 m [9.8 ft])
- Do not run the RS-485 cable close to transformers or high-frequency generating equipment.

## User Interfaces

The FX16 Master Controller can support up to two user interfaces at the same time. An FX16 with an integral Medium User Interface (MUI) can support one remote MUI. An FX16 without an integral MUI can support two remote MUIs.

The remote MUI is available in two models: a **panel mount** nonisolated version (up to 3 m [9.8 ft] from the controller) and a **wall mount** isolated version (up to 1 km [0.6 miles] from the controller). The FX16 Master Controller can supply power to one panel mount MUI. See Figure 30 and Figure 31 for installation details.

For the panel mount connection, use the cable connection kit (LP-KIT007-000C), 3 m (9.8 ft) long, with a phone jack on the MUI end and a screw connector on the FX16 Master Controller end.

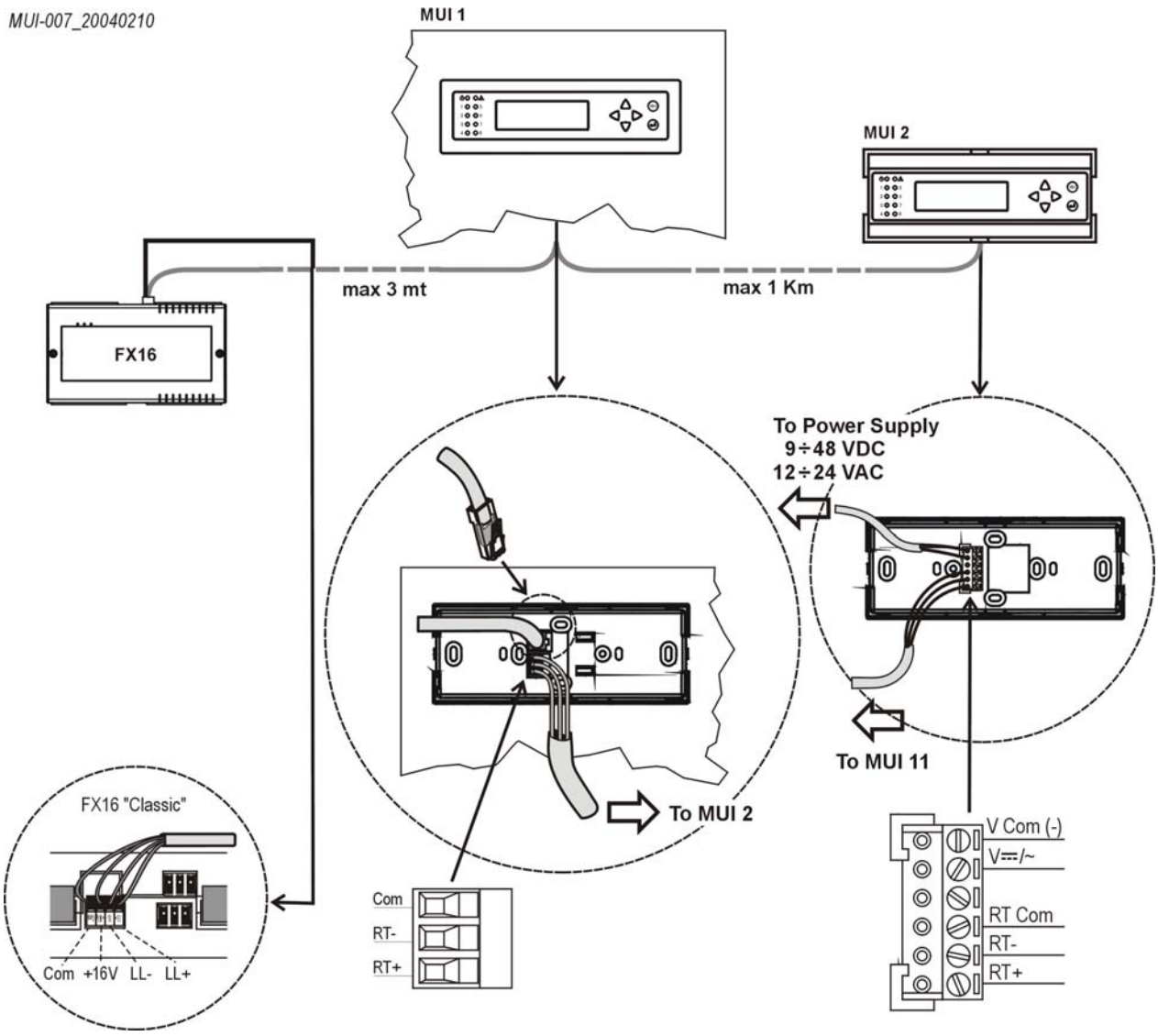



**Figure 30: Installation for One Panel and One Wall Mount MUI**

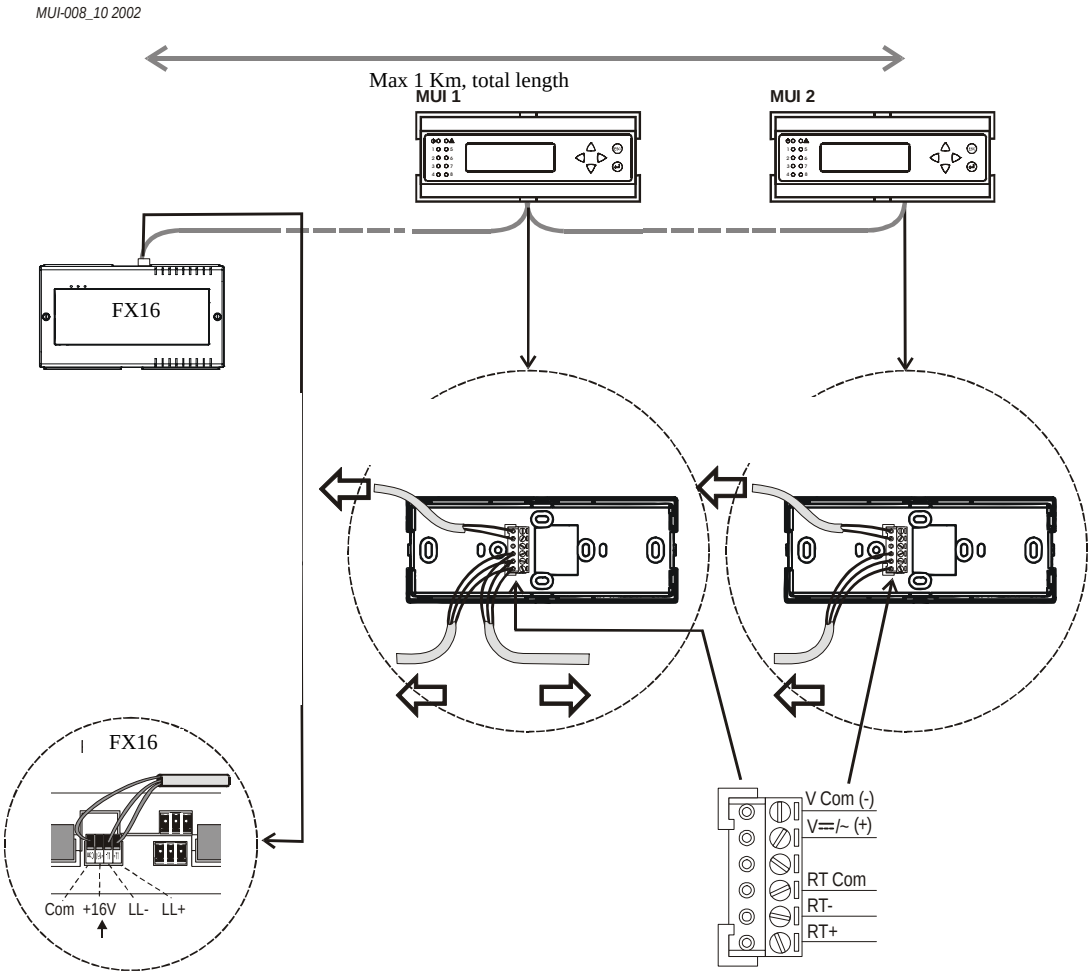



**Figure 31: Installation of Two Wall Mount MUIs**

### *Assigning the MUI Address for Multiple Connections*

At power up, a remote MUI automatically has a default N2 address of **1**.

If you connect two remote MUIs, then you must change the second MUI N2 address to avoid communication conflicts.

To assign the MUI address for multiple connections:

1. Wait for the second MUI to display Device Offline (as shown in Figure 32).

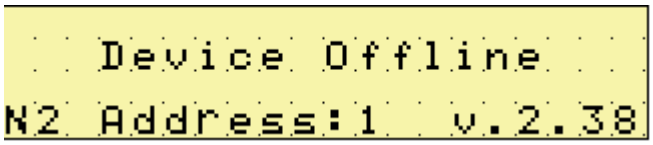



**Figure 32: MUI N2 Address Selection**

2. Press the ESC and ↵ keys simultaneously to switch the N2 address to **2**. See Figure 33.

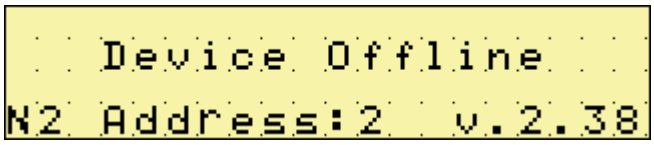



**Figure 33: MUI N2 Address Change**

## Integral MUI

Some models of the FX16 Master Controller have an integral display that you can also use to diagnose the FX16 Master Controller.

### *Integral MUI Entry Page Details*

At first power-up the integral display appears (Figure 34 and Figure 35).

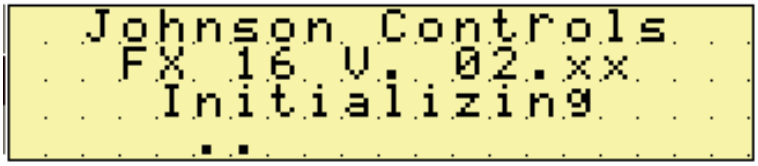



**Figure 34: FX16 Initializing Process**

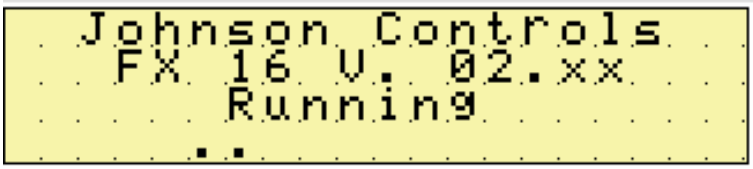



**Figure 35: FX16 in Running Mode**

In case a system event occurs, the integral display provides the information on the 3rd line, as shown in Figure 36.

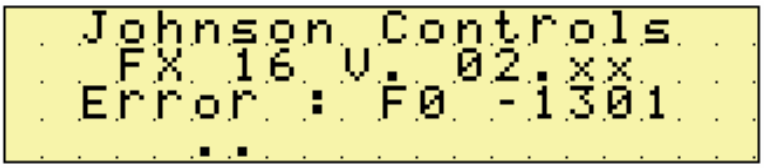



**Figure 36: Diagnostic Message F0 - 1301 Appears**

The integral display page reports on its rows:

- **first row**: Company name
- **second row**: Device name and Firmware version
- **third row**: Used to indicate the FX16 Status (for example, running mode or stopping mode) or error codes.
- **fourth row**: Displays scrolling dots (for example, **….**).

### *FX16 Master Controller Status*

During operation, the Integral MUI shows the status of the FX16 Master Controller on the 3rd row. See Table 9.

**Table 9: Controller Status**

| Controller Status | Description |
|---|---|
| **Without the application** | Waiting for a new application. No valid application was found. |
| **Initializing** | Initializing internal structures |
| **Stopping** | Executing operations that puts the FX16 Master Controller in idle state |
| **Downloading** | Receiving data (application or firmware) from the communication interface (LON, N2 Open) |
| **Polling Key** | Found the programming key on the local port and is waiting for key commands |
| **Key Read** | Uploading an application from the programming key |
| **Key Write** | Downloading its application to the programming key |
| **Polling** | Polling the local bus to detect FX Slave controllers or Expansion Modules |
| **Running** | Running properly |

On the third row of the integral display page, Error codes or diagnostic messages appear when the FX16 detects abnormal conditions within the system.

### *Common Error Codes or Diagnostic Messages*

Table 8 and Table 9 summarize the most common error codes (identified by **xx - xxxx**) and diagnostic messages (identified by **F0-xxxx**).

**Table 10: Error Codes**

| Error Code | Description |
|---|---|
| **01 - xxxx** | Unknown Object found in the Application |
| **02 - xxxx** | Too Many Objects found in the Application |
| **08 - xxxx** | Application size exceeds the limits |
| **09 - xxxx** | FX Slave Controllers Failure |
| **17 - xxxx** | Download Failed |
| **41 - xxxx** | Display Database Error |
| **42 - xxxx** | Display CFG Database Error |
| **44 - xxxx** | Application Missing (without the application status) |
| **50 - xxxx** | FX Programming Key Generic Error |
| **51 - xxxx** | FX Programming Key CustomerID Mismatch |
| **52 - xxxx** | FX Programming Key is not Empty. |
| **53 - xxxx** | FX Programming Key DeviceID Mismatch |
| **54 - xxxx** | FX Programming Key is Empty. |
| **60 - xxxx** | No Modem Found |

**Table 11: Diagnostic Codes**

| Diagnostic Code | Description |
|---|---|
| **F0 - 1006** | Failed to clear trend buffer |
| **F0 - 1202** | FX Slave controllers not responding or not connected |
| **F0 - 1301** | Notification (SMS and/or E-mail) executed successfully |
| **F0 - 1302** | General notification error (for example, cable unplugged during notification) |
| **F0 - 1303** | Notification skipped due to comm. failure (low GSM signal strength, wrong e-mail address, and SMS mobile number) |
| **F0 - 1401** | GSM/Standard modem failure (switch off, not working) |

## FX Programming Key

Use the Programming Key to upload an application from a computer or from a preprogrammed FX16 Master Controller. You can then download the application to other FX16 Master Controllers.

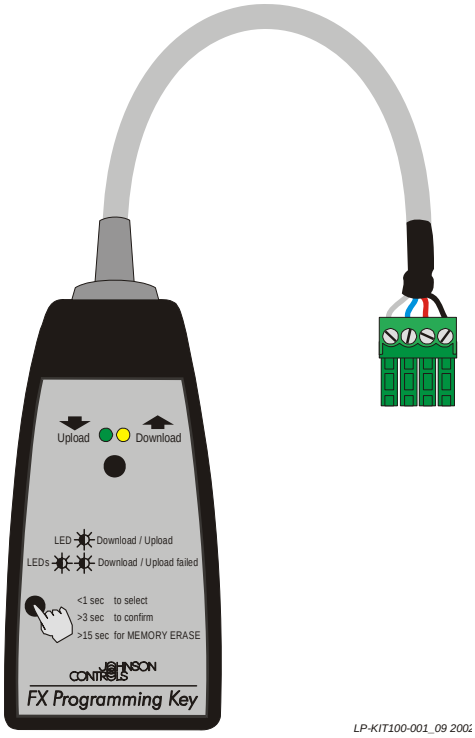



**Figure 37: Programming Key**

### *Connecting the Programming Key to an FX16*

To connect the Programming Key to an FX16 Master Controller:

1. Turn off the controller.
2. Detached any connected user interfaces from the Remote Display Port JP2.
3. Plug the Programming Key into the Remote Display Port (see Figure 38).

**Note:** Programming Keys with date code L0639 and later have a mating connector for the FX06/7/14 display port. An adapter is provided to plug the Programming Key into the Remote Display terminals.

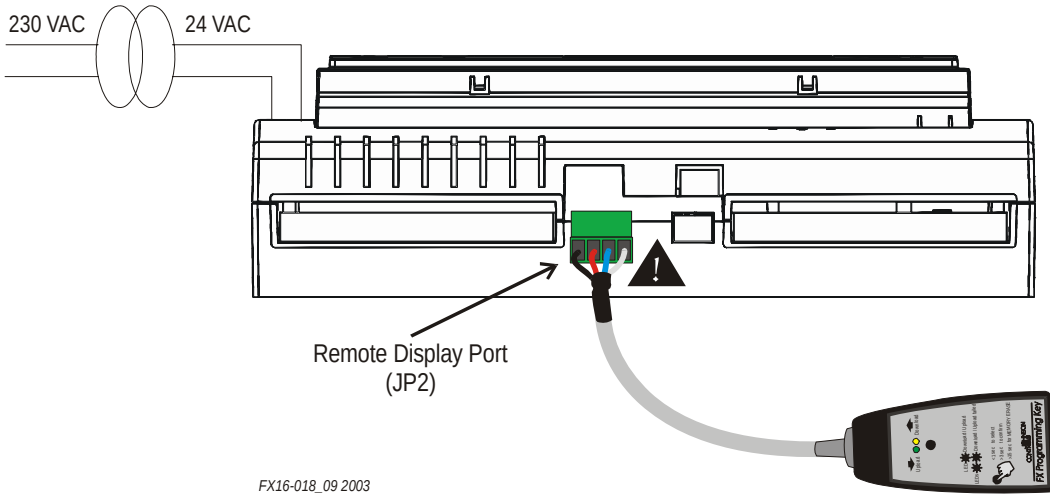



**Figure 38: Programming Key Connection to FX16 Master Controller**

4. Turn on the controller and download or upload the application.

### *Connecting the Programming Key to a Computer*

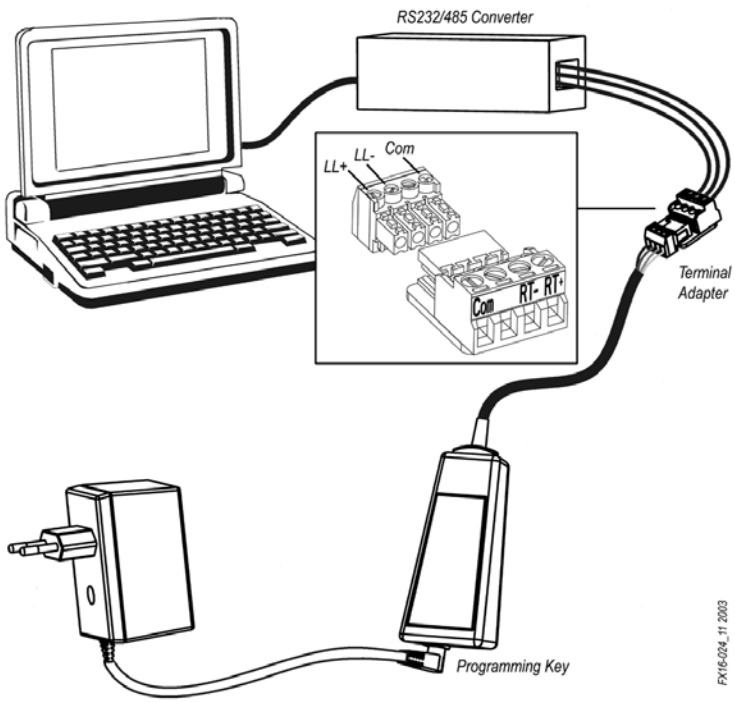



**Figure 39: Programming Key Connection to a Computer**

To connect the key to a computer:

1. Connect the Programming Key using the adapters (included with the Programming Key kit) to the RS-232C/485 converter connected to the computer.

**Table 12: Programming Key Adapter Kit**

| Adapter | RS-232C/485 Converter |
|---|---|
| **1** | Com |
| **2** | Not used |
| **3** | RT - |
| **4** | RT + |

2. Turn on the Programming Key using the AC/DC power adapter.
3. Start FX Loader from the computer.
4. Upload the application.

# Inputs and Outputs

## Introduction

The FX16 Master Controller features the following physical Input/Output I/O channels. You can directly connect up to 27 physical inputs and outputs to the FX16. The Input/Output I/O channels include:

- 6 Analog Inputs (AIs)
- 8 Digital (Binary) Inputs (DIs)
- 9 Digital (Binary) Outputs (DOs) (9 relays or 4 relays, and 5 triacs)
- 4 Analog Outputs (AOs)

# *Inputs and Outputs Concepts*

## Analog Inputs

The FX16 Master Controller accepts six high-resolution, universal analog inputs. You can configure each of them as Active or Passive by the application software and jumper configurations.

## Digital Inputs

The FX16 Master Controller accepts eight opto-isolated digital (binary) inputs from potential free contact. With the input filter set at 50 Hz, a transition counter (minimum 10 ms ON and minimum 10 ms OFF) is configured in the control application for any one or more of the digital inputs.

## Analog Outputs

The FX16 Master Controller provides four opto-isolated analog outputs, 0-10 V at 1.5 mA (5 mA for Rev. A controllers).

## Digital Outputs

The FX16 Master Controller provides nine digital (binary) outputs, available in two hardware configurations with either:

- 9 relays
- 4 relays and 5 triacs

# *Detailed Inputs and Outputs Procedures*

## FX16D and FX16X (Not Rev. A) Master Controller 24 VAC Power Connection

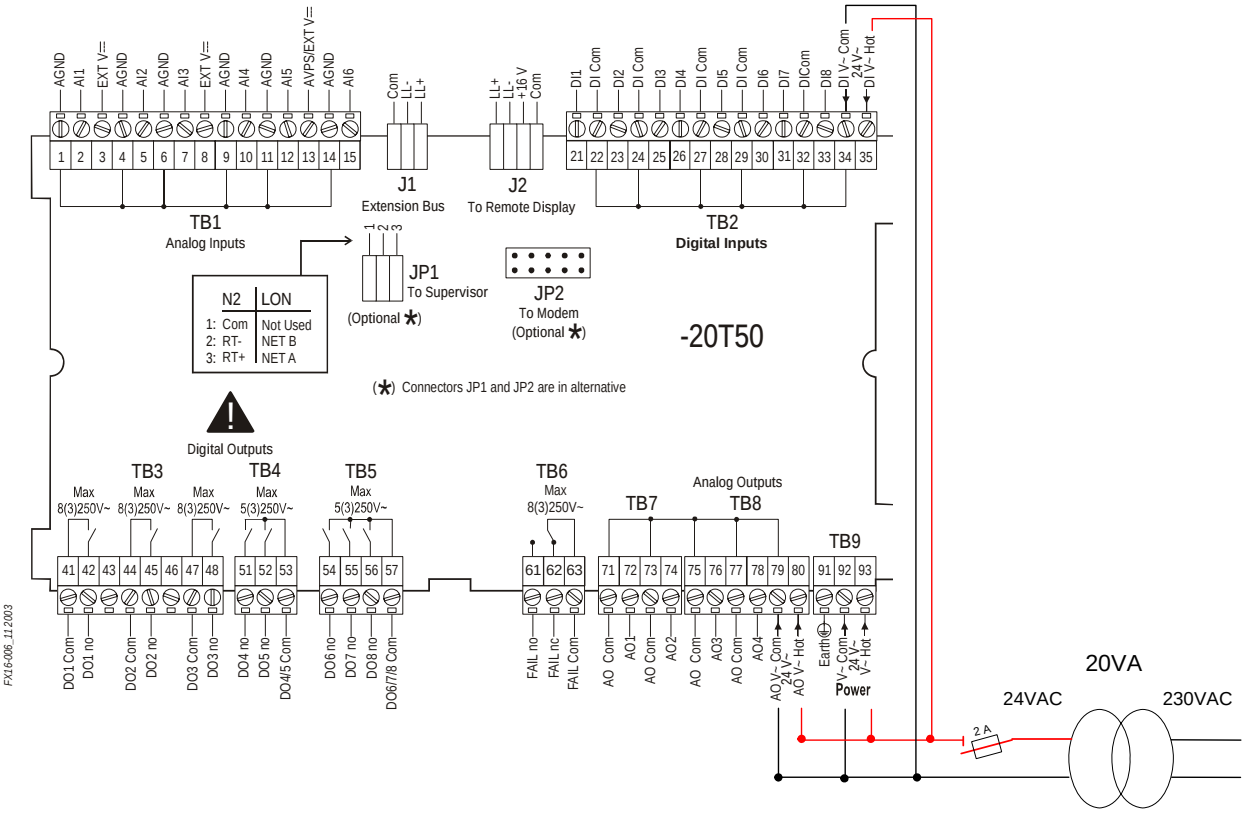



**Figure 40: Powering FX16D and FX16X Controllers (Not Rev. A) and I/Os**

If isolation between the FX16 Master Controller internal processor circuits and the AOs and DIs are **not** required, run the power supply cable as shown in Figure 40, adding an external fuse (2 ampere) to protect against incorrect wiring.

To maintain isolation, power the DIs and AOs with a separate transformer as shown in the *Digital Inputs* and *Analog Outputs* sections.

**IMPORTANT:** Respect the power supply polarity (Hot and Com) to avoid a short circuit that causes the external fuse to blow.

# FX16X Rev. A Master Controller 24 VAC Power Connection

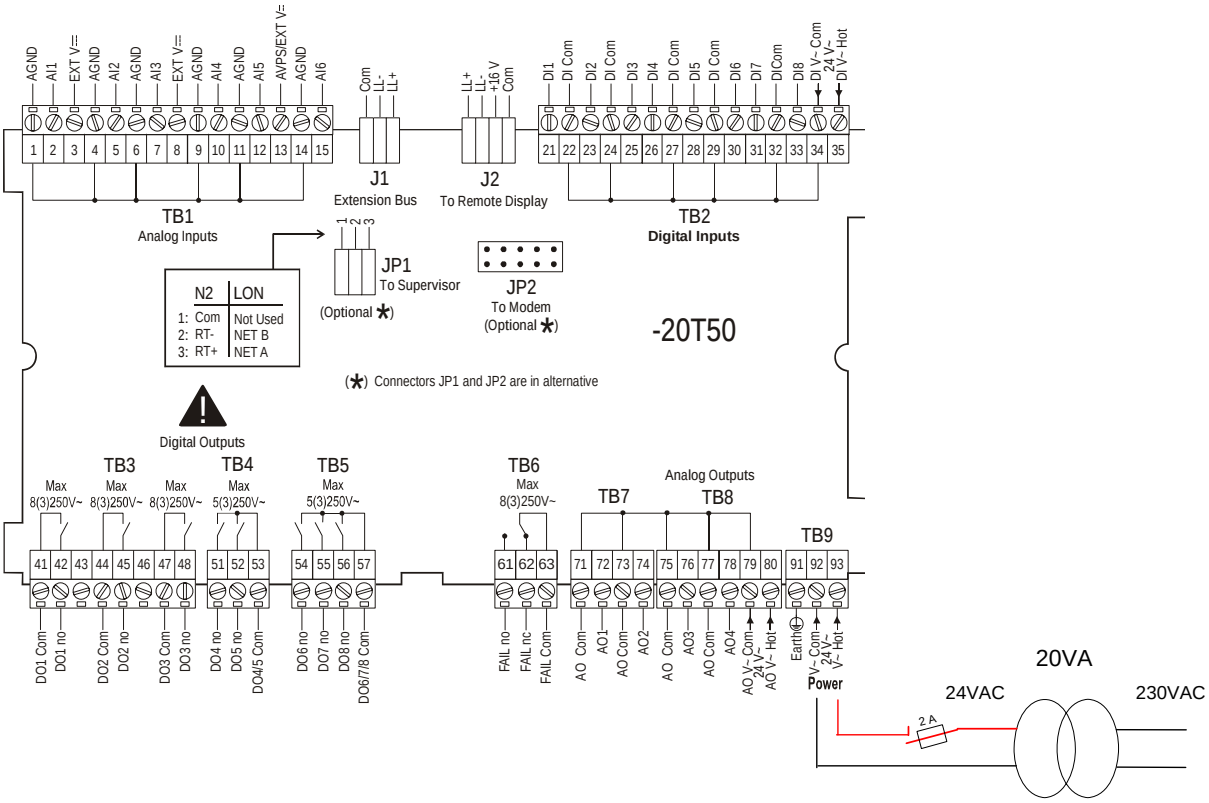



**Figure 41: Powering FX16X Rev. A Controller and I/Os**

In the FX16X Rev. A controller, the power supply is isolated from the Central Processing Unit (CPU) circuits and is connected internally to the Analog Output (AO) and Digital Input (DI) power supply. External power supply connections for the AO and Digital Output (DO) circuits are not required. Run the power supply cable to the controller (Figure 41), adding an external fuse (2 ampere) to protect against incorrect wiring.

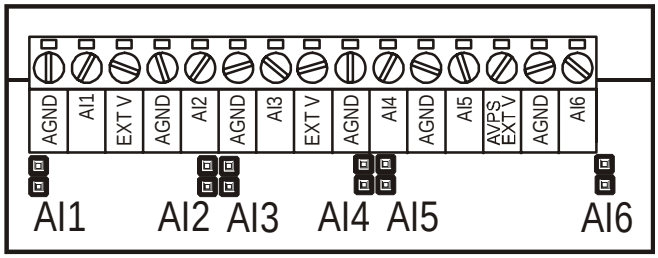
**IMPORTANT:** In the FX16X Rev. A controller, the Power Com, AO Com, and DI Com terminals are electrically connected.

## Analog Inputs

You can configure the six FX16 analog inputs to accept a wide range of voltage, current, and resistive input signals (in the related analog input object setup configuration using FX Builder).

See *I/O Technical Details* for the complete FX16 I/O table.

There is a jumper on the FX16 circuit board for each analog input. This jumper should be installed in its closed position if the connected sensor provides a current signal (0-20/4-20 mA). This jumper should be installed in its open position if the connected sensor provides a resistive, ratiometric, or voltage (0-2/0-10 V) input signal.




*FX16-025_10 2003*

**Figure 42: Analog Input Jumpers**

Using FX Builder, you can set the ranges of active sensor (voltage or current) inputs in the configuration parameters. These parameters, HighRange and LowRange, define the equivalent values for reading at high (10 V, 20 mA, 4.5 V) and low (0 V, 4 mA, 0 mA, 0.5 V) signal input. A square root function (SQRT) can linearize voltage and current inputs from differential pressure transducers, which operate over the complete range of the input.

The passive sensors (resistance) have a preconfigured linearization characteristic within the application software. For these sensors, the measurement range is fixed, but you can set the reliability range.

The setup possibilities are:

- linear 0-10 V
- SQRT 0-10 V
- linear 0-10 V, 20% suppression (0-2 V)
- linear 0-2 V
- SQRT 0-2 V
- linear 0-2 V, 20% suppression (0.4-2 V)
- linear 0-20 mA
- SQRT 0-20 mA
- linear 0-20 mA, 20% suppression (0.4-2 mA)

- Resistance 2 k ohm
- A99
- NTC 2.2 k ohm
- NTC 10 k ohm
- Ni1000 JC
- Ni1000 JC Extended
- Ni1000 Siemens® (Landis® and Gyr®)
- Ni1000 DIN
- Pt1000
- Ratiometric (0.5 to 4.5 V)

The measurement unit of the analog value also enables the controller to transmit the measured value via the network in the appropriate format. (This is particularly important for LONWORKS networks.) Available configurable units include:

- temperature
- percentage
- air pressure
- liquid pressure
- flow
- concentration Pulse Per Minute (PPM)
- ampere
- voltage

A configurable filter object is available in the FX16 application software. You can create the filter object for each analog input to reduce signal instability and to limit the rate of change of the input value.

The FX16 Master Controller provides a jumper configurable:

- +5 V Analog Voltage Power Supply (AVPS) or
- +16 V External VDC (EXT VDC)

supply on terminal 13 for active analog input sensors.

The EXT VDC (also on terminals 3 and 8) can supply up to 80 mA for a maximum of four 0/4-20 mA active sensors. The AVPS can supply up to 20 mA for ratiometric sensors.

### *Connecting Active 0-10 V Sensors*

The FX16 Master Controller can accept active temperature, pressure, flow and humidity sensors providing 0-10 V signals, including the Johnson Controls TS-9101, RS-1100, and HT-9000 series.

Figure 43 shows the connection between an FX16 Master Controller and an HT-9001 sensor.

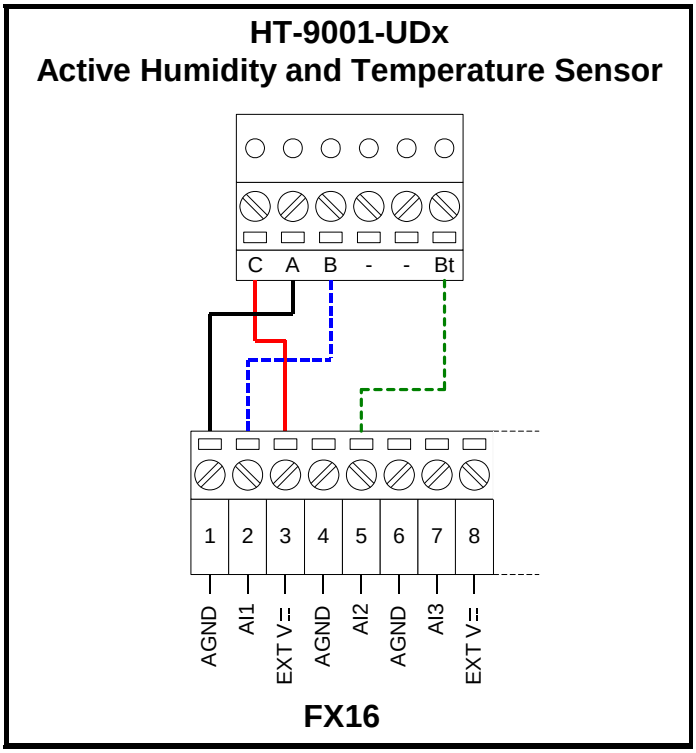



**Figure 43: Active 0-10 V Sensor Connection**

You must configure the inputs to accept 0-10 V signals by the application software resident in the FX16. You must also open the AI Jumpers (factory default setting) to accept voltage inputs. See Table 13.

**Table 13: Active 0-10 V Sensors**

| FX16 Terminals | HT-9001 Terminals | Description |
|---|---|---|
| **AI Com (1)** | A | Common Reference |
| **EXT V (3)** | C | Sensor Power Supply 16 V, 80 mA |
| **AI1 (2)** | B | Humidity Output 0-10 V |
| **AI2 (5)** | Bt | Temperature Output 0-10 V |

**Note:** The numbers between the brackets are the FX16 terminal numbers.

### *Connecting Passive Resistive Sensors*

The analog inputs in the FX16 Master Controller accept linear resistive signals as **Resistive 2k ohm** configuration. The Analog Input software can also linearize signals provided by the most common sensors such as Ni1000, Pt1000 (HT-9006), NTC 2k2 (RS-1143), NTC 10k (TM2141), and A99 (A99BB).

You must configure the inputs to accept the appropriate resistive sensor by the application software resident in the FX16 Master Controller. You must also open the AI Jumpers to accept resistance input (factory default setting). Figure 44 shows an A99 wiring diagram. You can connect any resistive sensor the same way.

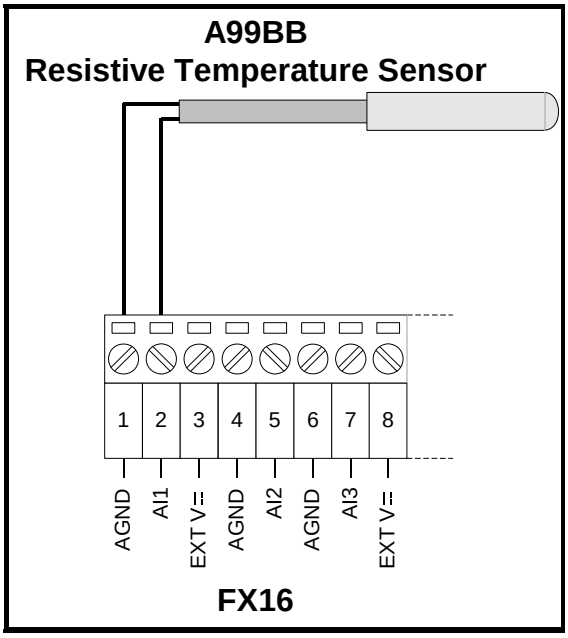



**Figure 44: A99 Resistive Sensor Connection Diagram**

**Table 14: Passive Resistive Sensors**

| FX16 Terminals | A99 Wires | Description |
|---|---|---|
| **AI Com (1)** | Any wire | Common Reference |
| **AI1 (2)** | Other wire | Temperature Signal |

**Note:** The numbers between the brackets are the FX16 terminal numbers.

**IMPORTANT:** The two resistive sensor leads are the same, in that they have no polarity; therefore it is not necessary to respect any specific order when connecting to the terminal block.

### *Connecting Active Current Sensors*

The FX16 Master Controller analog inputs accept a maximum of four active current sensors (powered by the FX16) in the range 0-20 mA or 4-20 mA. You need to configure the AIs via software (and hardware jumpers) to accept current signals. To connect a 4-20 mA sensor, you must close the specific hardware jumpers (see Figure 42) and configure the application through FX Builder (setting **0-20 mA, 20% suppression**).

You can connect the FX16 Master Controller to P299xAx series of Johnson Controls pressure sensors that generate a 4-20 mA signal.

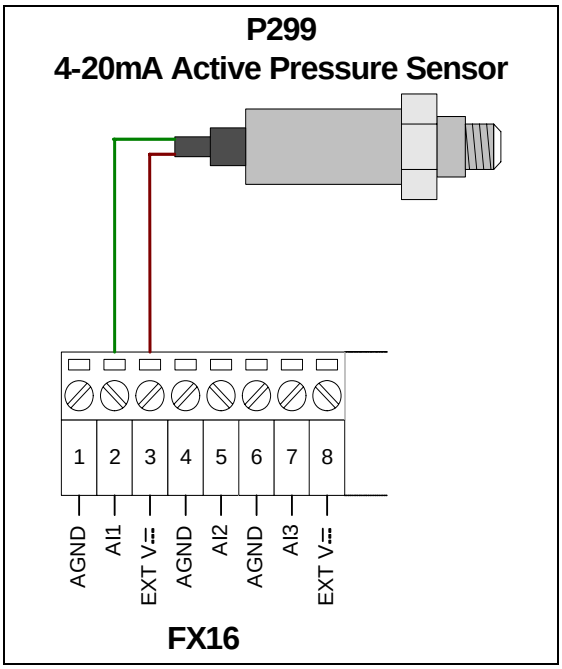



**Figure 45: Pressure Sensor Connection Diagram**

**Table 15: Active Current Sensors**

| FX16 Terminals | P299xAx Cable | Description |
|---|---|---|
| **EXT V (3)** | Brown | Sensor Power Supply 16 V, 80 mA |
| **AI1 (2)** | Green | Pressure Output 4-20 mA |

**Note:** The numbers between the brackets are the FX16 terminal numbers.

### *Connecting Active Sensors Powered by 24 VAC*

The FX16 Master Controller accepts active temperature, pressure, flow, and humidity sensors providing 0-10 V or current signals powered by 24 VAC.

A second transformer (24 VAC/24 VAC, 3 VA maximum) powering the analog input is required to maintain the insulation from the microprocessor.

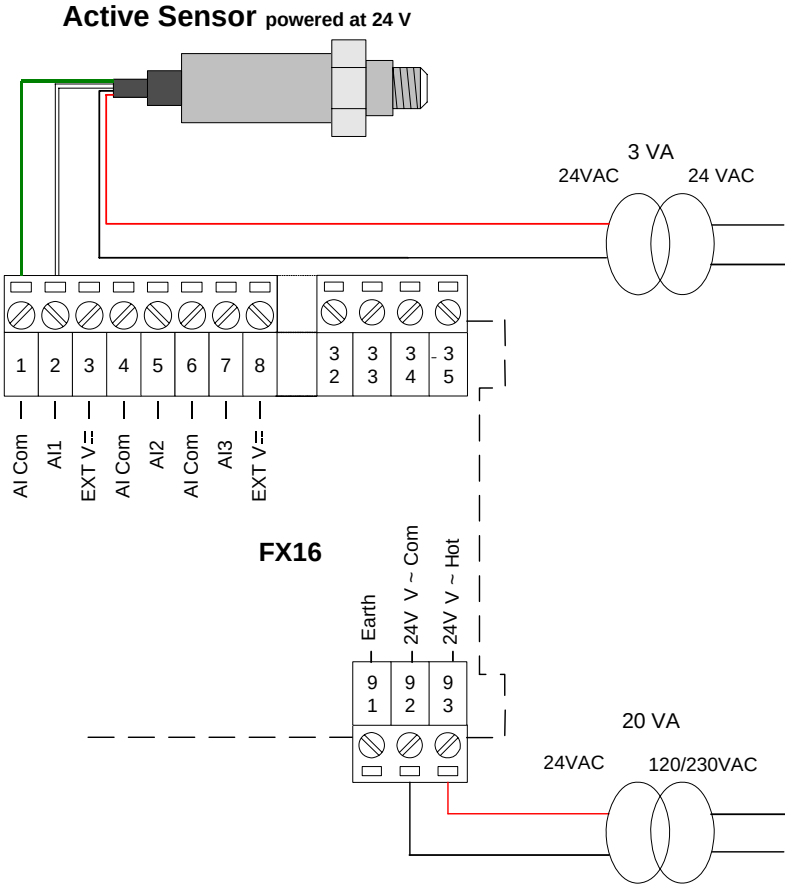



**Figure 46: Active Sensor Powered by 24 VAC Connection Diagram**

**Table 16: Active Sensors Powered by 24 VAC**

| FX16 Terminals | Sensor Cable | Description |
|---|---|---|
| **AI Com (1)** | Green | Common Reference |
| **AI1 (2)** | White (0-10 VDC) | Signal Output |

**Note:** The numbers between the brackets are the FX16 terminal numbers.

**IMPORTANT:** Power the Analog Input with a separate transformer. Using the power supply of the FX controller may result in a short circuit and therefore causing the FX16 Master controller to fail.

## Digital Inputs

The FX16 Master Controller features eight opto-isolated digital inputs from potential free contacts. A digital input is active depending on its Polarity setting (in the related Digital Input object setup configuration using FX Builder). The default setting is **Direct**, which means that it is active (true) when closed.

See *I/O Technical Details* for the complete FX16 I/O table.

### *Powering the Digital Inputs*

#### FX16D and FX16X (Not Rev. A) Master Controller

You must power the eight FX16 Master Controller digital inputs with 24 V (through terminals 34 and 35). You can use either AC or DC voltage to power the digital inputs. If you use DC voltage, make sure the power supply of the DIs stays independent from the controller power supply, as the FX16 (not Rev. A) Master Controller is only compatible with AC power. The digital inputs can use the same power supply as FX16 Master Controller or you can separately power them to maintain the isolation from the internal processor (CPU) circuits.

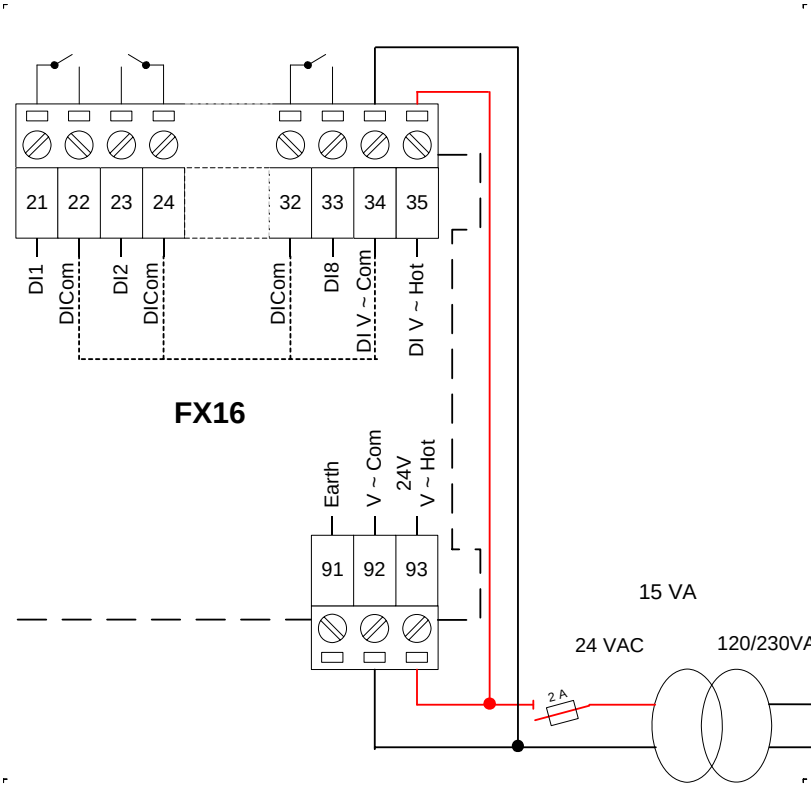



**Figure 47: Powering the Digital Inputs - FX16D and FX16X (Not Rev. A) Controller**

**Table 17: Digital Inputs Powered by 24 VAC**

| FX16 Terminals | Description |
|---|---|
| **DI V ~ Hot (35)** | 24 VAC, Digital Inputs Power Supply |
| **DI V ~ Com (34)** | Digital Inputs Power Supply Common |
| **DI8 (33)** | Digital Input 8, Voltage-Free contact |
| **DI Com (32)** | Common Reference, Voltage-Free contact |

**Note:** The numbers between the brackets are the FX16 terminal numbers.

**IMPORTANT:** Not respecting the power supply polarity may result in a short circuit causing the blowing of the external fuse.

To achieve isolation from the microprocessor circuits and better immunity against electrical disturbances, use a separate 24 VAC power supply to power the digital inputs (terminals 34, 35). See Figure 48.

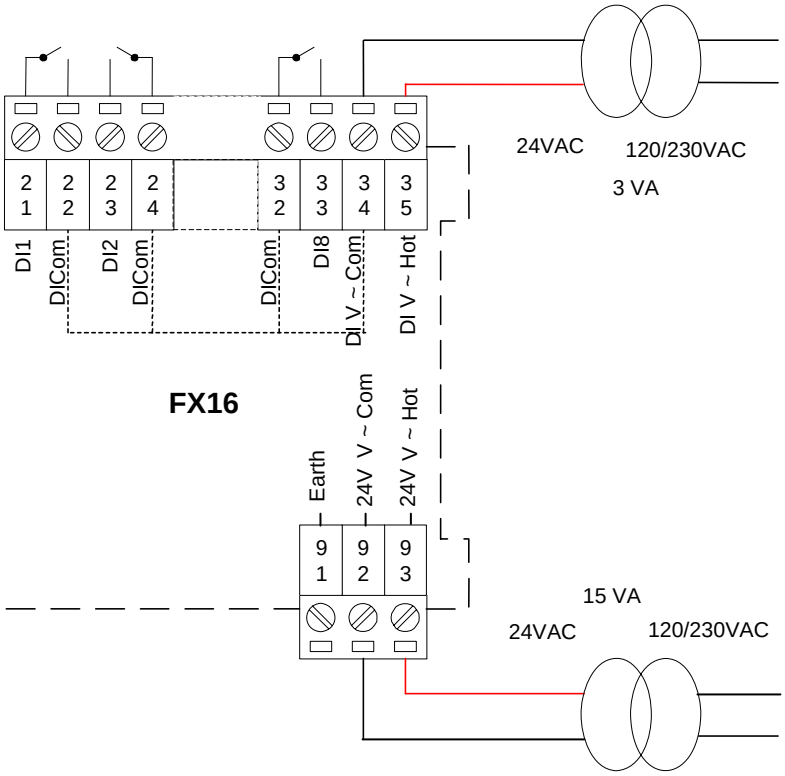



**Figure 48: Powering the Digital Inputs Separately - FX16D and FX16X (Not Rev. A)**

## FX16X Rev. A Master Controller

The eight digital inputs of the FX16 Master Controller (Rev. A) are powered internally by the 24 VAC voltage power supply of the controller. The power supply of the FX16 Master Controller (Rev. A) is isolated from the internal processor (CPU) circuits so that the isolation of the digital inputs is maintained. Terminal 35 is not connected internally and Terminal 34 can be used as an extra DI Com connection.

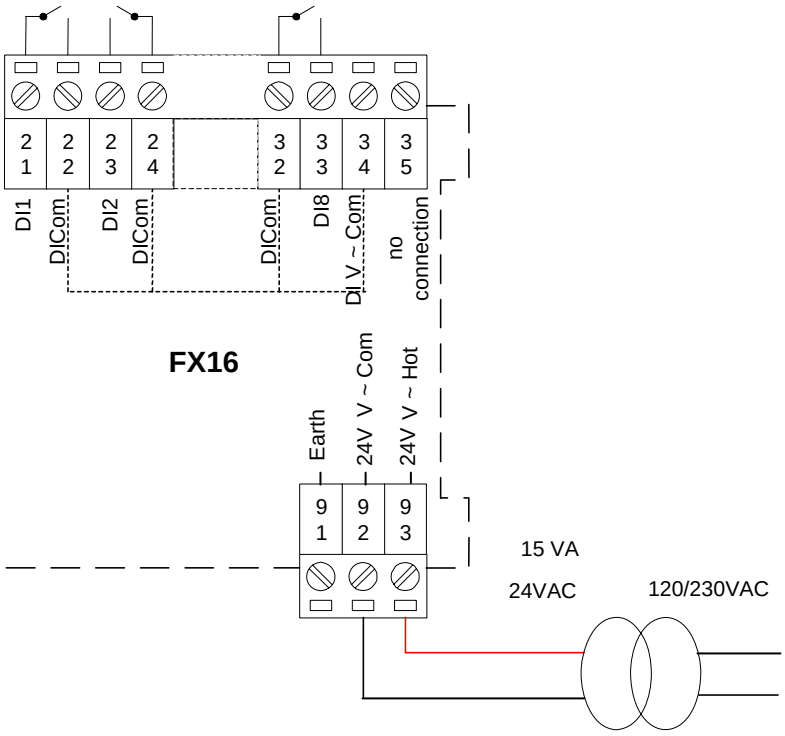



**Figure 49: Powering the Digital Inputs - FX16X Rev. A**

### *Digital Counters*

The FX16 Master Controller features a Digital Counter object configurable in FX Builder to the DI channels. When the signals are not filters, the Digital Counter counts up to 50 Hz transitions on digital input signal. For unfiltered signals, the signal must be closed for at least 10 ms and opened for at least 10 ms.

The maximum frequency is 10 Hz on filtered signals. For filtered signals, the signal must be closed for at least 50 ms and open for at least 50 ms. The Digital Counter object setup configures the filter.

### *Using Analog Inputs as Digital Inputs*

If you need more than eight available digital inputs, the FX16 Master Controller allows you to use an analog input as digital input.

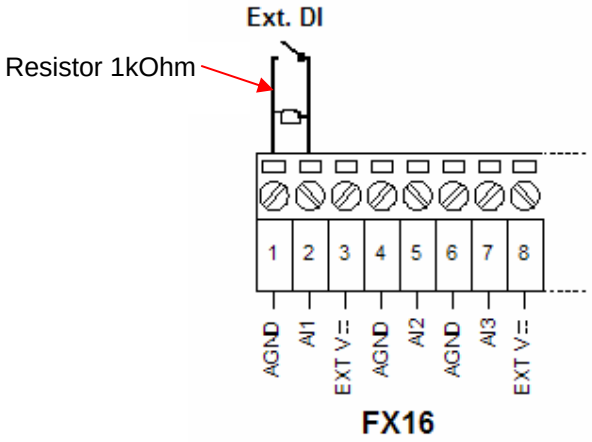



**Figure 50: Digital Input Connection**

A 1k ohm resistor must connect to the analog input terminals to prevent instability in the sensitive circuits from electrical disturbances on the wiring. You need to configure the analog input as an A99 input in FX Builder. The digital signal is derived from the Reliability attribute of the analog input object. An open contact gives a Normal status and a closed contact gives an Unreliable Low status.

## Analog Outputs

The FX16 Master Controller provides four 0-10 VDC, 1.5 mA (5 mA in a Rev. A controller), opto-isolated analog outputs. The Analog Output objects provide the interface between the four hardware analog output channels and the control application.

See *I/O Technical Details* for the complete FX16 Master Controller I/O table.

Each of the analog outputs is ranged to give zero output if the request is 0%. Each of the analog outputs is ranged to give 10 V when the request reaches 100%.

You can configure the analog outputs for direct or reverse acting in the analog output object setup in FX Builder. You can limit the output signal by high-limit (MaxOutput) and low-limit (MinOutput) values.

You can override the analog output object and its value modified via a supervisory system if both the object and value were configured in the control application.

### *Powering the Analog Outputs*

#### FX16D and FX16X (Not Rev. A) Master Controller

You must power the four FX16 Master Controller analog outputs with 24 VAC (through terminals 79 and 80). The analog outputs can use the same power supply as FX16 Master Controller. Analog outputs can also be separately powered to maintain the isolation from the internal processor (CPU) circuits.

The FX16 Master Controller analog outputs are commonly used to drive proportional devices; therefore, you can connect these analog outputs to all the Johnson Controls proportional actuators. See Figure 51.

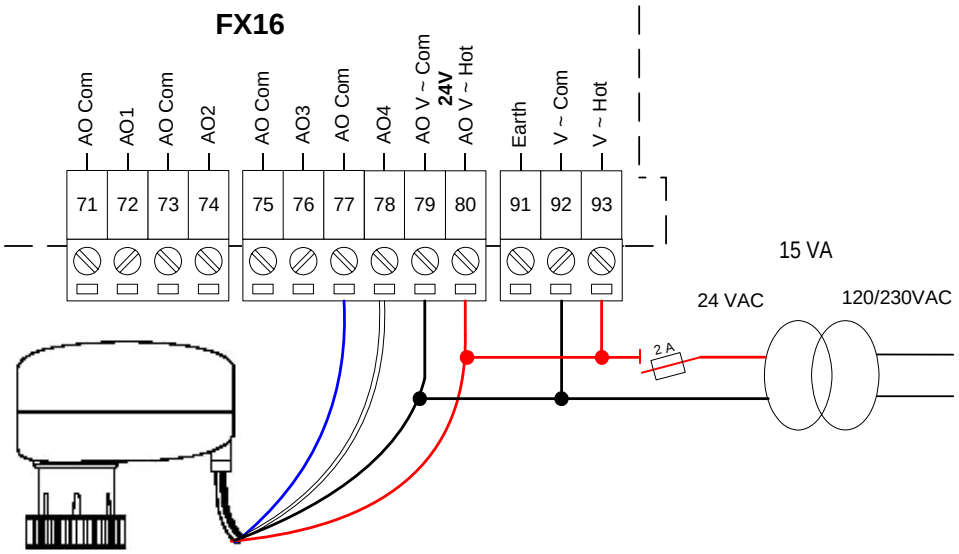



**Figure 51: Connecting an Analog Output - FX16D and FX16X (Not Rev. A) Controllers**

**Table 18: Analog Output Powered by 24 VAC**

| FX16 Terminals | Description |
|---|---|
| **AO Com (77)** | Common Reference |
| **AO4 (78)** | Analog Output 0-10 V |
| **AO V~ Com (79)** | Common Reference |
| **AO V~ Hot (80)** | Power Supply 24 VAC |

**Note:** The numbers between the brackets are the FX16 terminal numbers.

**IMPORTANT:** Not respecting the power supply polarity results in a short circuit causing the blowing of the external fuse.

To achieve isolation from the microprocessor circuits and better immunity against electrical disturbances, use a separate 24 VAC power supply to power the analog outputs (terminals 79, 80). See Figure 52.

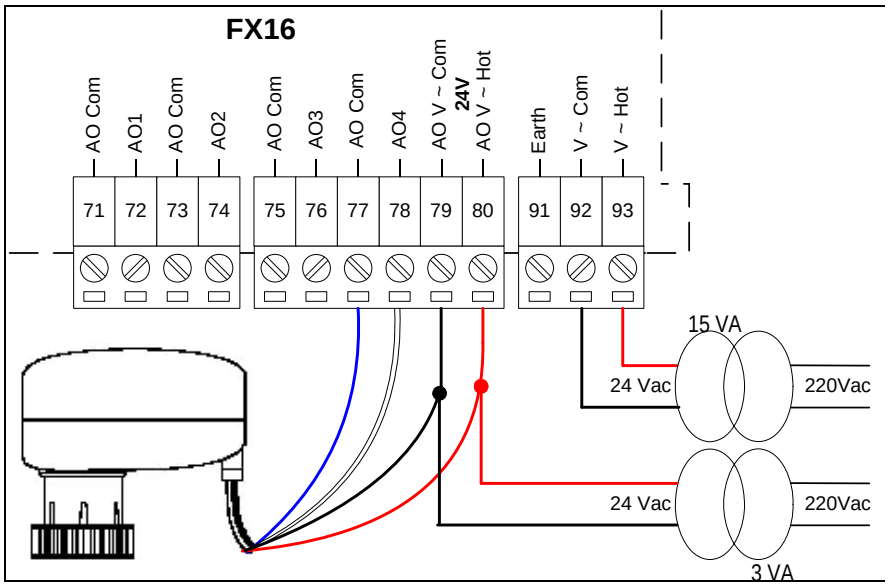



**Figure 52: Separately Powering Analog Outputs - FX16D and FX16X (Not Rev. A) Controllers**

## FX16X Rev. A Master Controller

The four analog outputs of the FX16 Master Controller (Rev. A) are powered internally by the 24 VAC voltage power supply of the controller. The power supply of the FX16 Master Controller (Rev. A) is isolated from the Central Processing Unit (CPU) circuits, so that the isolation of the analog outputs is maintained. Terminal 80 is not connected internally but can be used to connect power to the actuator.

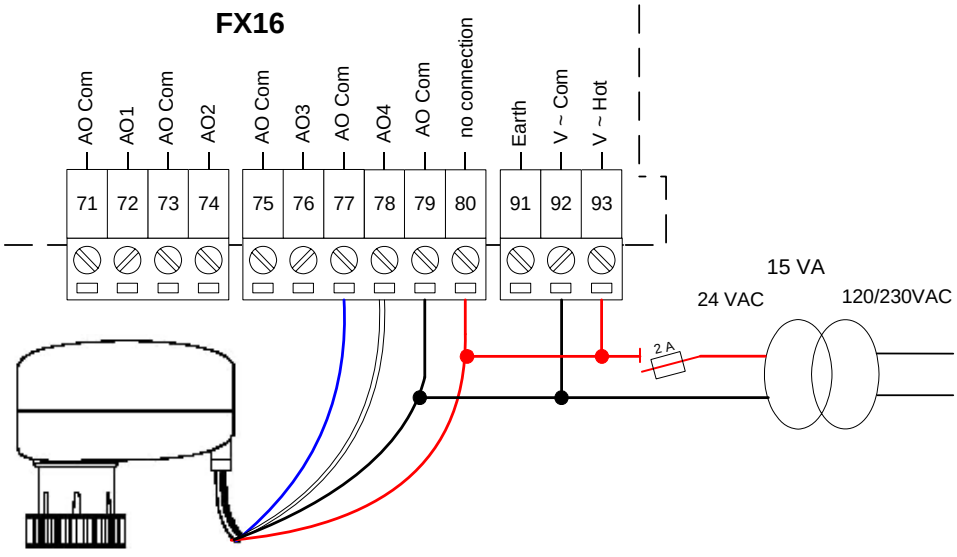



**Figure 53: Connecting an Analog Output - FX16X Rev. A Controller**

## Digital Outputs

The FX16 Master Controller features nine digital outputs. The digital outputs are available in two hardware configurations with 9 relays, or 4 relays and 5 triacs. See *I/O Technical Details* for the complete FX16 Master Controller I/O table.

The digital output objects provide the interface between the hardware digital output channels and the control application. You can set the parameters in FX Builder.

You can override a digital output and its value modified via a supervisory system if the digital output and its value were configured in the control application.

Using FX Builder, you can configure the Digital Output objects to provide the output types in Table 19.

**Table 19: Output Types**

| Output | Description |
|---|---|
| **On/Off Output** | Commands the triac or relay to switched on or off depending on the input request. |
| **Hermetic Compressor Output** | Features all the functions required to drive a hermetic compressor. This output type provides the logic, interlocking, and timing features required for such application. |
| **Duration Adjusting Type (DAT) Output** | Commands the DO (typically a triac) to drive on or off with a time based duty cycle proportional to the numeric input request. You may set a minimum On/Off time to avoid very short On pulses when the value is close to the low range value (Output at 0%) and very short Off pulses when the value is close to the high range value (Output at 100%). |
| **Position Adjusting Type (PAT), Incremental Control Output** | You can use a pair of triacs to drive a synchronous reversible electric actuator in one of the two directions in response to a change in the numeric input request.<br>A PAT output gives modulating control by using the configured actuator full-stroke (fully open to fully close) time to drive the actuator for a part of that time base in proportion to the change in the controlling numeric input. For example, for a 100-second actuator to achieve 40% open, the actuator runs 40 seconds from the fully closed position.<br>You may set a dead band, in percent of full-stroke time, to avoid driving the actuator for very small changes in the output signal. This reduces unnecessary wear on the drive mechanism.<br>The PAT object requires two digital output channels, typically triacs. One triac is switched on when the output must increase. The other triac is switched on when the output must decrease. The polarity of the PAT can change the increasing and decreasing physical channels without rewiring.<br>At 0 or 100% position, the duration of switching increases by a configurable value (ResyncAmount). This ensures the valve or other controlled device is completely at its end position. If the estimated position remains fixed at 0 or 100% for a time equal to a configurable period (typically 2 hours), a synchronization action occurs according to the ResyncAmount configurable parameter.<br>If the output remains in a fixed position for more than another configurable period, the PAT output applies the anti-sticking function (if enabled) to exercise the device and the drive mechanism. This is particularly useful for water valves that require regular activity of the inner parts to keep them free to move. |
| **Damper PAT Output** | Damper PAT Output type is identical to the PAT with the exception that it does not increase the duration of the switching when 0 or 100% is reached. This avoids the unstable control of air systems and implements the synchronization action as configured. This output does not implement the anti-sticking function as damper drives are not typically subject to this problem. |

### *Connecting the Relays*

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

The FX16 Master Controller features up to nine digital outputs with electromechanical relays. The relays are divided into six groups and the common terminals of relays have been grouped together.

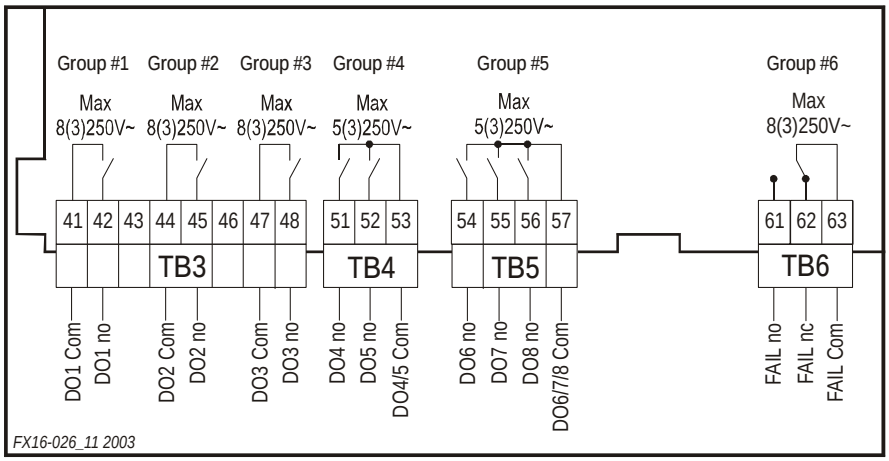



**Figure 54: Relay Groups**

Inside each group, you must connect the groups to the same voltage supply. A double isolation is between the groups; therefore, you can connect the groups to different voltage supplies.

### *Connecting the Triacs*

The FX16 Master Controller triac (0.5 A, 24 VAC) digital outputs are commonly used to operate in Position Adjust Type (PAT) and Duration Adjust Type (DAT) modes.

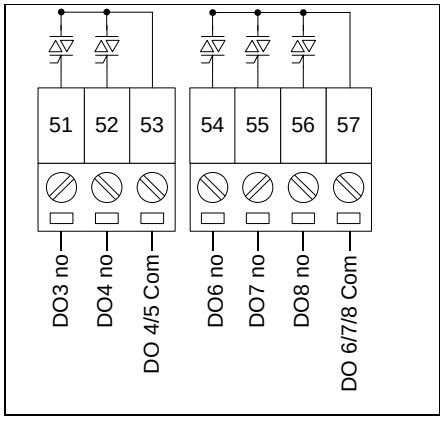



**Figure 55: Triac Groups**

In particular, you can use the Digital Outputs PAT mode through the triac outputs to drive Incremental Valve Actuators.

Figure 56 displays an example of a triac connection:

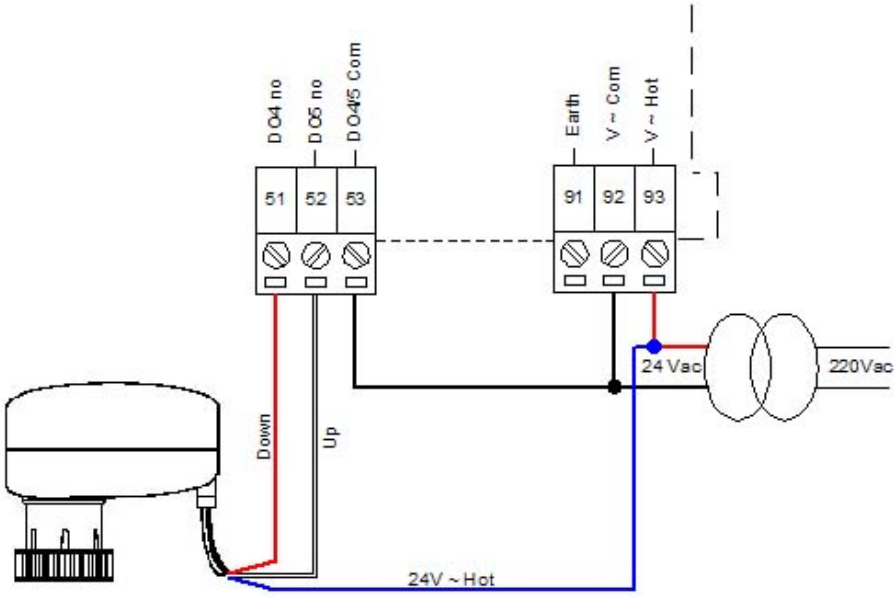



**Figure 56: Connecting an Incremental VA-7450 Actuator**

**Table 20: Connecting an Incremental VA-7450 Actuator**

| FX16 Terminals | Description |
|---|---|
| **DO4 (51)** | 24 V ~ Down command |
| **DO5 (52)** | 24 V ~ Up command |
| **V ~ Hot (93)** | 24 V ~ Hot Reference |
| **DO 4/5 Com (53)** | 24 V ~ Common Reference |

**Note:** The numbers between the brackets are the FX16 terminal numbers.

## Extension Modules

You can extend the input/output capacity of the FX16 Master Controller by connecting up to four extension modules via the Local Link Extension Bus.

An extension module is formed by an XT91D00 processor/communications module and one or more XP expansion modules. The expansion modules provide input/output capability for the extension modules. The following are available for the XT91D00 extension module:

- XP91D02: six analog inputs and two analog outputs
- XP91D03: eight digital outputs (triac)
- XP91D04: four digital inputs and four digital outputs (triac)
- XP91D05: eight digital inputs
- XP91D06: four digital outputs 230 VAC (relay) (EU only)
- XP91D07: four digital outputs 24 VAC (relay) (NA only)

**Analog inputs** to extension modules may be 0-10 V, 0-20 mA or passive RTD-Ni1000 (Johnson Controls characteristic only), Pt1000, or A99 sensors.

**Voltage and current inputs** from differential pressure transducers that can be linearized by a square root function.

**Digital inputs** to extension modules are potential-free contacts. The input is active (true) when the contact is closed.

**Digital counters** are available in extension modules, which do not have analog inputs or outputs. Digital counters are associated with digital inputs. The number of positive transitions of the physical digital input required to increment the counter can be programmed in the extension module.

**Note:** Counter values are saved in Electrically Erasable Programmable Read Only Memory (EEPROM) by the XT module only at power down. When you download an application to modules via the FX16 Master Controller, the increments recorded since the last power cycle is lost. A power cycle of the XT module immediately before proceeding with the program download can solve this problem.

**Analog outputs** in extension modules can be configured to provide 0-10 V, 0-20 mA or 4-20 mA signals. The output is ranged by low range and high range variables to provide a 0-100% signal to the extension module.

**Digital outputs** in extension modules can only be configured as on/off or pulse type, and the physical output may be a triac or a relay contact. Pulse type outputs switch on for a configurable period (1 to 1,275 ms) for each transition of the connected variable.

You can combine an XT91D00 with its expansion modules to provide one of the following configurations:

- 8 analog inputs/outputs
- 8 digital inputs/outputs, with digital counters associated with the digital inputs
- 8 analog inputs/outputs and 8 digital inputs/outputs
- 16 digital inputs/outputs, with digital counters associated with the digital inputs within the first 8 input and output points

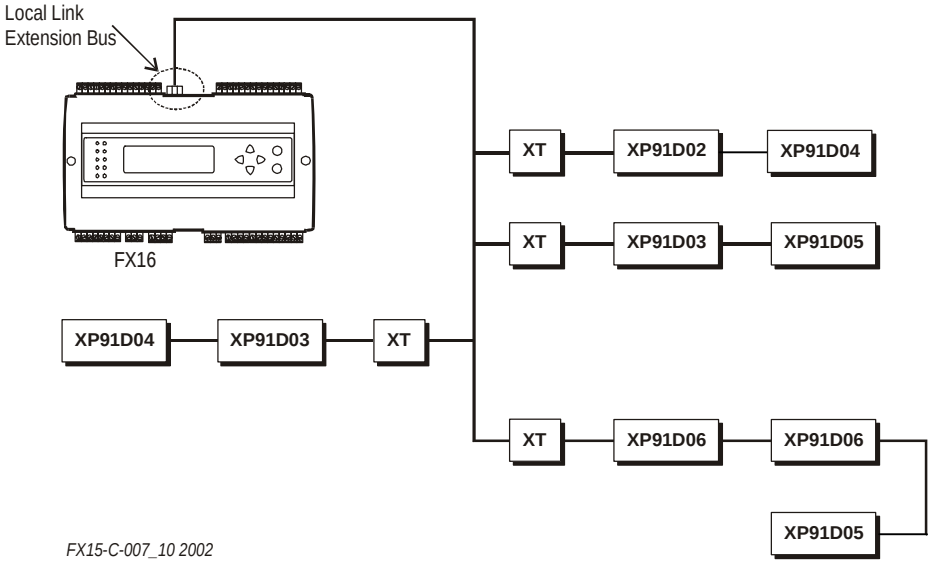



**Figure 57: Example of Maximum Configuration**

# *Troubleshooting*

## Reading 9999 or Invalid from the Analog Inputs

- **Error/Condition:** The Analog Input object retrieves an **Invalid** value through network variables or the User Interface Unit shows **9999** or Invalid customized tag.
- **Problem:** Happens in the case the signal applied to the Analog Input channel does not match with the one configured via software on the Analog Input Object. The read signal is outside the configured reliability range. The problem is due to the Jumper configuration of the Analog Input channel, which cannot be set according to the signal provided by the sensor.
- **Solution:** In case the signal does not match with the configured, change the Analog Input Object configuration via FX Builder. If the software is properly configured but the problem still happens, check the analog inputs jumpers are properly set to accept the sensor signal and verify the probe functioning and wirings.

## Cannot Properly Read Current Sensors

- **Error/Condition:** Connecting an active, current sensor to an Analog Input channel, the AI Object retrieves an Invalid value.
- **Problem:** In the case the AI Object is properly configured and the probe is correctly wired and functioning, the problems may be due to a wrong AI Jumper configuration.
- **Solution:** A dedicated Jumper is placed onboard for each Analog Input Channel. This Jumper is used in its close configuration in the case the connected sensor provides a current signal (0-20/4-20 mA). Its open configuration has to be used for Resistive, Ratio-Metric or Voltage (0-2/0-10 V) input signals.

# Operation

## *Introduction*

The FX16 is a high performance field controller designed to control a wide range of applications including dual compressor chillers and rooftops, close control units, packaged air handling units, unit vents, and water source heat pumps.

The FX16 Master Controller manages a distributed control application with up to 16-slave controllers (types FX05 Advanced, FX06, FX07, FX14, or FX15). The FX16 Master Controller has 27 physical input/output points onboard. You can further expand the FX16 by connecting the XT91D00/XP91D0x series expansion modules.

Other features include the communication services to transmit event notification messages via Short Messaging Service (SMS) or by e-mail. With its onboard Web server, the user can browse and make adjustments to parameters of the application from a remote location.

## *Operation Concepts*

### Local Link Extension Bus

The FX16 Master Controller features a Local Link Extension Bus that supports up to 16 slave devices. The FX16 can be in a Distributed Application (FX controllers only) or monitored by the Gateway function (FX controllers or N2 Open devices). The Local Link Extension Bus also supports expansion modules (XT/XP modules).

## Distributed Application

The FX16 Master Controller allows you to expand the I/O point and control capacity by using a distributed application strategy. You can connect up to 16 slave devices from the Facility Explorer field controller family to the FX16 Master Controller Local Link Extension Bus to be included in the Distributed Application. Each slave device works independently and provides its own information to the network through its application profile. The FX16 controller polls, refreshes, or commands the network variables within the controllers to synchronize the entire distributed application and to get it to work as a single application. The distributed application is directly downloaded into the FX16 controller and then the relevant parts are subsequently downloaded by the FX16 to the connected slaves.

## Gateway Function

The FX16 Master Controller (Rev. A) features the Gateway object. The Gateway object can monitor up to 16 devices on the Local Link Extension Bus that are not slaves to a Distributed Application. These slave devices can be FX controllers fitted with RS-485 N2 Open communication cards, N2 Open devices (UNT, VAV, and AHU), Metasys system compatible devices (VND), or System 91 devices (DX-9100 and TC-910x).

## Web Server

The FX16 Master Controller features an embedded Web server that allows a remote user, running Internet Explorer, to dial in and establish a point-to-point communication with the FX16 and to browse alarms, logged data, configuration parameters, and controller variables included in the Web pages. The Web pages contained in the FX16 are developed at design time through a dedicated plug-in of FX Builder. You can limit the access to the navigation of the FX16 Web pages with several levels of passwords to different users.

## Communication Services

The FX16's RS-232C communication card option allows the FX16 Master Controller connect to a modem (standard or GSM). The RS-232C communication card also allows you to use a null modem to connect with the standard communication port of a computer.

The communication services of the FX16 Master Controller are defined in the software configuration in FX Builder. Using a modem, the controller can send e-mails and SMS messages (only GSM modem) to report events and trend logs.

## Supervisory Option

You can integrate the FX16 Master Controller into a supervisory building automation system for continuous monitoring of the control system. The FX16 Master Controller supports two methods of integration:

- N2 Open integration
- LONWORKS network integration

Alternatively, you can use the RS-232 communication plug-in card to allow for a modem connection (either GSM or landline standard models can be connected) or a null modem connection. This allows a computer to directly connect to the FX16 for point-to-point communication via Transmission Control Protocol/Internet Protocol (TCP/IP) protocol.

## Alarm and Event Management

The FX16 Master Controller manages and records events generated by the operating system and events associated with data points or variables in the control application.

You can also configure the event to send a message via one or more of the communication services available (e-mail or SMS).

You can view the table of active events and the event history log on the integral or remote display (MUI) or on a Web browser.

## Data Trend Logging

The FX16 Master Controller can log analog and digital data in onboard flash memory. The original FX16 controllers have a limited amount of memory for trend logging (16 variables). The latest FX16X Rev. A controllers have 4 MB of flash memory dedicated to trend logging of up to 40 variables from within the control application. You can configure the FX16 Master Controller to record data samples at defined intervals from one minute to one day, each variable with its own sampling rate.

You can view the trend log buffer from a Web browser, and you can configure the FX16 to transmit trends at regular intervals via the modem connection to an e-mail server. A system event message appears if the trend buffer is not configured in the circular recording mode and the buffer becomes full.

## Time Scheduling

Time Scheduling allows the execution of functions based on a weekly time schedule and an exception day schedule in a calendar. The real-time clock operation is supported by an onboard battery with an average backup time of more than 3 years.

## User Interface

The FX16 Master Controller supports up to two user interfaces that are either integral or remote. The user interface allows you to display and edit data point and information from the running application. The user interface display screen format is fully configurable at design time in FX Builder. The FX16 can also store a display database with up to five languages (downloaded at design/commissioning time). You can then select at runtime the display language from the user interface screen.

## Application Configuration and Commissioning

The FX16 is based on an object and services oriented architecture that includes configurable input/output, control algorithm and real-time functions, and serial communication options. You can create control applications, download them into the FX16 controller, and commission the FX16 using the FX Tools software package.

FX Tools software package provides the following tools:

- **FX Builder:** You use FX Builder to program and configure Facility Explorer controllers (using menus, navigation trees, and graphic screens). With FX Builder, you use the application configuration to define the physical inputs and outputs, data point values to be monitored, and the user interface displays of the controller.
- **FX Builder Express:** You use this special version of FX Builder to select and configure a predefined application from a library of standard applications for Facility Explorer controllers (using selection menus and graphic screens). FX Builder Express is available in North America only.
- **FX CommPro N2/LON:** You use this commissioning tool for Facility Explorer controllers with parameter configuration to control sequence and loop tuning. With this tool, you can save parameters to download to other controllers with the same application. The FX CommPro tool supports controllers on N2 Open and LONWORKS protocol networks.

## Security

The FX Tools software package and the Facility Explorer controllers come with embedded security features based on the use of two Identifiers (IDs):

- Family ID (embedded in the controller hardware at the factory)
- Customer ID (embedded in the application file by the user)

The Family ID and the Customer ID provide protection against the downloading of applications to the wrong controller. The Family ID and the Customer ID also prevent the unauthorized access within the software tools to applications developed by other users.

## Application Upload/Download

You can download N2 and LON applications to the controller via a computer using the FX CommPro N2/LON software tool. You can also upload or download N2 applications using the FX Programming Key. You can download controller firmware using the FX Loader utility.

# *Detailed Operation Procedures*

## Local Link Extension Bus

The FX16 Master Controller is the highest level field controller in the Facility Explorer system and is very flexible in terms of expandability. The FX16 allows you to connect devices to the Local Link Extension Bus via expansion I/O modules, Distributed Application, or Gateway strategy.

The maximum recommended point expansion, using the FX16 Master Controller in a Distributed Application, is 300 monitored physical data points. See Figure 58.

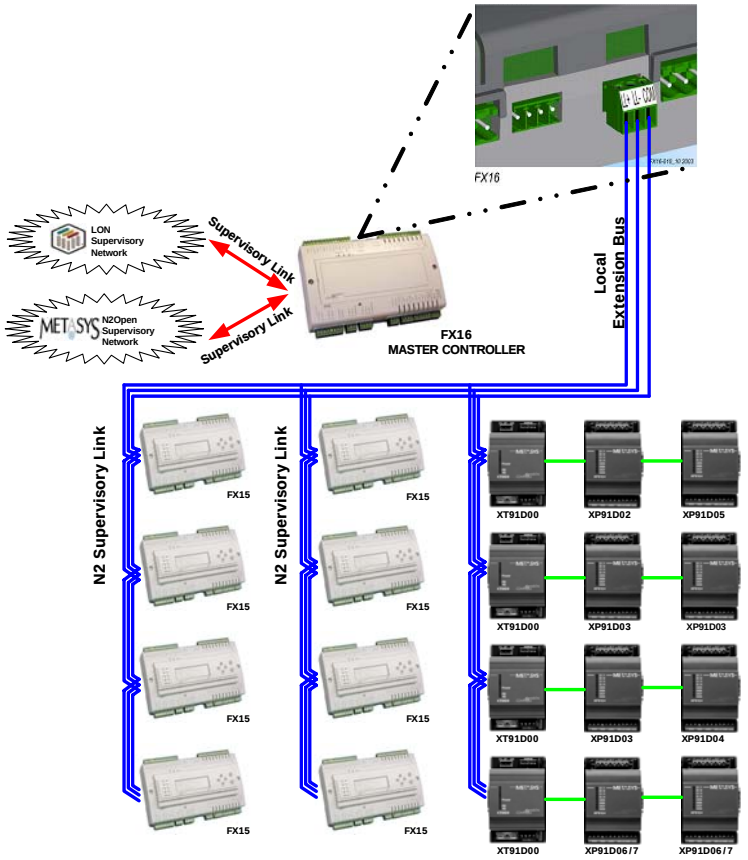



**Figure 58: FX16 Master Controller Expansion**

In this example:

- FX16 master controller → 27 points +
- 8 x FX15 Slave controllers → (8 x 27 points) 216 points +
- XT/XP modules connected to FX16 → 56 points =

**299** points

Although a fully loaded distributed application normally manages up to 300 physical data points, the performance of the whole application also depends on a number of important factors:

- Local Link Extension Bus performance. See *Local Link Extension Bus Performances*.
- network variables data flow rate and the number of variables in each slave device in a Distributed Application
- FX16 Master Controller memory availability.

  **Note:** The distributed application is stored in the FX16 controller and the entire memory is dynamically managed; therefore, the larger the distributed application, the smaller the memory left for the display configuration and other services (such as Web and trends).

I/O expansion points from XTs modules on the FX16 Master Controller do **not** count as shared network variables. You can only use the value of an expansion point in a slave device by mapping it to a shared variable in the FX16 Master Controller.

You can also connect XT modules to FX15 slave devices. The I/O expansion points then count toward the total number of physical points managed by the distributed application.

The best use of resources in the FX16 Master Controller is when you distribute control processes to the slave controllers. Do not use the FX16 as a supervisory controller for points **not** involved in a control process.

### *I/O Expansion*

The FX16 Master Controller has on-board inputs and outputs for monitoring and control of local equipment. The Local Link Extension Bus allows additional inputs and outputs to be connected to the FX16 Master Controller locally or remotely.

The FX16 Master Controller supports up to four XT extension modules with a variety of combinations of analog and binary, input, and output points. You can use data from these modules for display or as additional inputs and outputs for control routines in the FX16 Master Controller (or other connected controllers).

### *Extension Modules*

An extension module comprises an XT91D00 processor/communications module and one or two XP expansion modules. The expansion modules provide input/output capability for the extension modules. The following are available for the XT91D00 extension module:

- XP91D02: six analog inputs and two analog outputs
- XP91D03: eight digital outputs (triac)

- XP91D04: four digital inputs and four digital outputs (triac)
- XP91D05: eight digital inputs
- XP91D06: four digital outputs 230 VAC (relay) (Europe only)
- XP91D07: four digital outputs 24 VAC (relay) (North America only)

### *Local Link Extension Bus Performances*

We conducted a performance test with the following system configuration.

An FX16 Master Controller performing a distributed application strategy with:

- **8** slave controllers (FX05/10/15)
- **4** XT/XP modules (64 variables)
- **30** variables shared with each slave (**240** total)
- **255** network profile variables and parameters in FX16 controller
- **200** objects running in the application

Table 21shows the measured times in seconds for the transfer of a DI in the source device to a DO in the destination device.

**Table 21: Local Extension Bus Performances**

| Source | Destination | Min. | Max. | Average |
|---|---|---|---|---|
| **FX16** | FX10 | 1.7 | 6.3 | 3.5 |
| **FX16** | FX05 | 2.1 | 6.1 | 3.6 |
| **FX16** | XT/XP | 1.0 | 6.2 | 3.2 |
| **FX15** | FX16 | 0.7 | 5.2 | 2.3 |
| **XT/XP** | FX16 | 0.6 | 8.6 | 3.9 |

## Distributed Application

A distributed application is a control strategy managed by the FX16 Master Controller; however, a distributed application executes concurrently in the FX16 Master Controller and in up to 16 Facility Explorer controllers connected to the Local Link Bus. The network variables in the distributes application define the communication between the controllers. FX16 Master Controller also executes the communication in the most effective way to maintain the performance of the entire control system.

Distributed applications are used for the coordinated control of a central plant and the remote equipment that the central plant serves. For example, you can apply a distributed application to an FX15 controlling an air handling unit and a number of FX07 controllers controlling zone temperature controllers. With the distributed application, you can also select Facility Explorer controllers to provide the required inputs and outputs for the individual pieces of physical equipment. Then you can develop an application that is automatically distributed and executed in the individual controllers as a single combined control system.

Each slave device works independently and provides its own information to the network through the application profile. The FX16 controller polls, refreshes, or commands the network variables within the controllers to synchronize the entire distributed application and to get it to work as a single application.

The distributed application directly downloads into the FX16 controller and the relevant parts are subsequently downloaded by the FX16 to the connected slaves.

### *Slave Controllers in a Distributed Application Polling Mechanism*

The FX16 Master Controller continuously polls the connected devices as defined in the control application. As soon as the devices respond, the FX16 starts to download the relevant part of the distributed application.

The Facility Explorer controllers used as slave devices must have the N2 Open communication card properly installed.

The connectable slave controllers appear in Table 22.

**Table 22: Connectable Slave Controllers**

| Device | Order Code |
|---|---|
| **FX05 Advanced Controller (not for new installations)** | LP-FX05P1x-xxx |
| **FX06 Compact Controller** | LP-FX06Pxx-xxx |
| **FX07 Terminal Unit Controller** | LP-FX07Dxx-xxx<br>LP-FX07Axx-xxx |
| **FX14 OEM Controller** | LP-FX14Dxx-xxx |
| **FX10 Advanced OEM Controller (not for new installations)** | LP-FX10D2x-xxx<br>LP-FX10D3x-xxx |
| **FX15 Universal Controller** | LP-FX15D0x-xxx<br>LP-FX15D5x-xxx |
| **FX15 Classic Controller** | LP-FX15D1x-xxx<br>LP-FX15D2x-xxx<br>LP-FX15D6x-xxx<br>LP-FX15D7x-xxx<br>LP-FX15X1x-xxx<br>LP-FX15X2x-xxx |

You must set the N2 addresses defined in the distributed application in the slave controllers before connection to the Local Link Bus.

***Distributed Application Variable Data Flow and Limits***

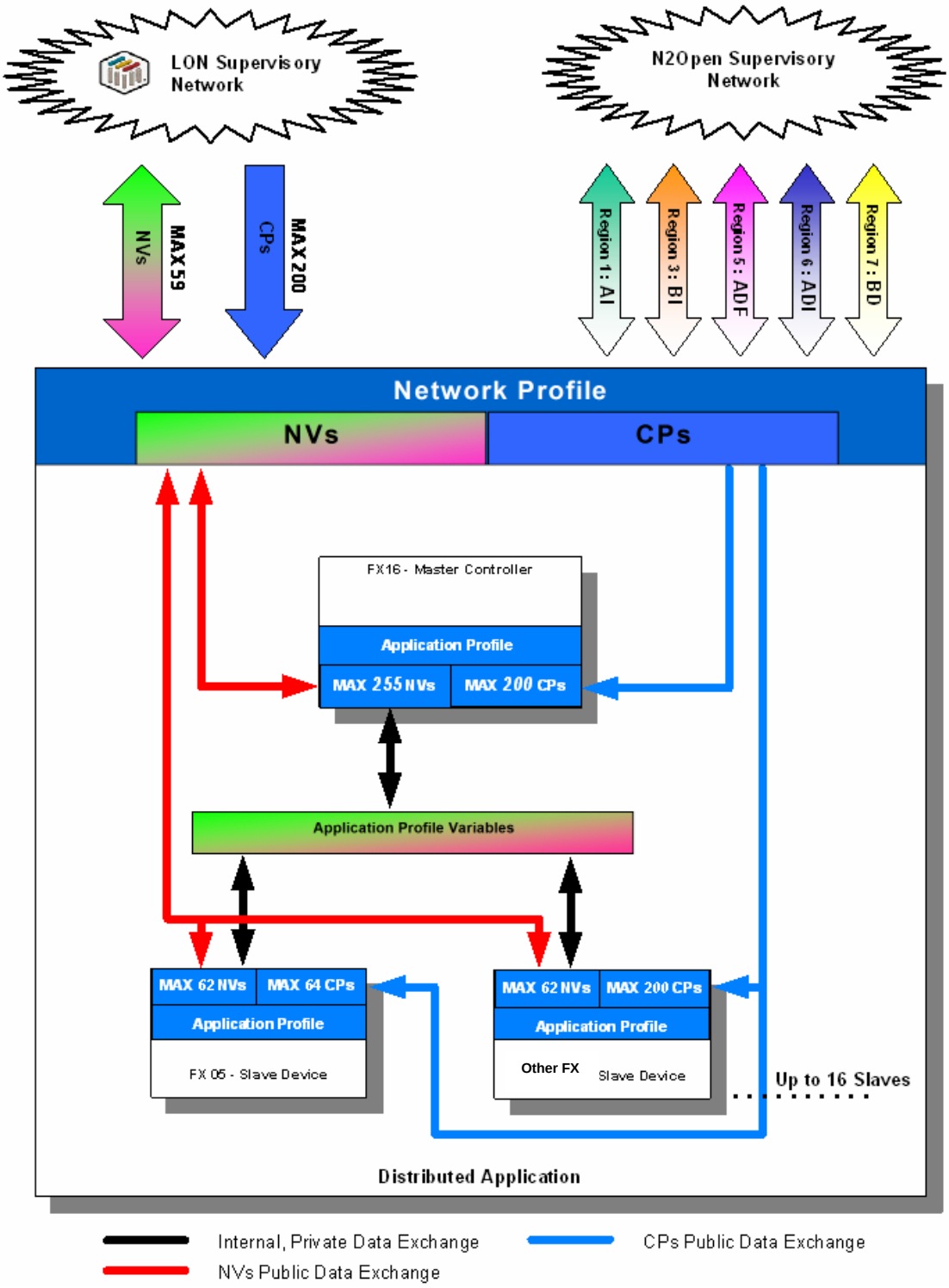



**Figure 59: Network Variable Data Flow with Maximum Values**

## Gateway Function (LP-FX16X Rev. A Only)

The FX16 Master Controller (Rev. A) features the Gateway object. The Gateway object can monitor up to 16 slave devices on the Local Link Extension Bus that are not part of a Distributed Application. These slave devices can be FX controllers with an RS-485 N2 Open communication card or N2 Open VND (Vendor) devices that are Metasys compatible. System 91 N2 devices (DX-9100 and TC-910x) are also supported.

When you evaluate the performance of the Local Link Extension Bus, you must include controllers connected as devices monitored by a Gateway object. You should connect no more than 16 devices and the number of physical input/output data points should not exceed 300 for a reasonable response (3 to 4 seconds on average) within a control sequence. If you require a faster response time, then you must reduce the number of devices and data points. You should also perform a physical test made with the configuration to measure the actual response times.

Use the Gateway function to connect the sensor and/or actuators devices with an N2 Open serial interface (such as a variable speed motor drive).

## Web Server

The FX16 Master Controller features an embedded Web server that allows a user, running Internet Explorer, to remotely dial in and establish point-to-point communication with the FX16. Users can browse alarms, logged data, configuration parameters, and controller variables if they are included in the Web pages developed at design time through the dedicated plug-in of FX Builder. You can limit the access to navigation of the site, which is stored in the controller configuration, with several levels of user passwords.

### *Web Configuration*

You can configure the Web access via the Application/Notification Services/Web menu.

When you configure the Web Service, you need to define the authentication couple data (user identification [UserID] and password) for each user who connects to the FX16. Multiple users can have the same authentication data; however, only one user can connect to the FX16 Master Controller at a time over the PPP connection.

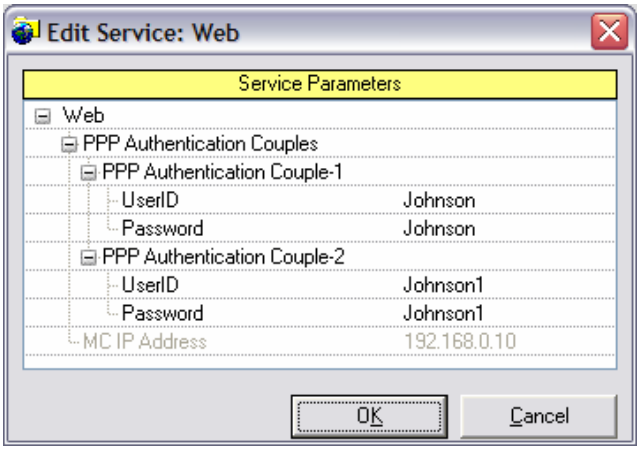



**Figure 60: Edit Service: Web Configuration Window**

### *Web Maker*

The Web Maker is the FX Builder plug-in dedicated to the design and development of the Web pages downloadable to the controller.

The World Icon  allows you to open the Web Maker plug-in.

### *Default Site Map*

The first page that appears is the Index page (Figure 61).

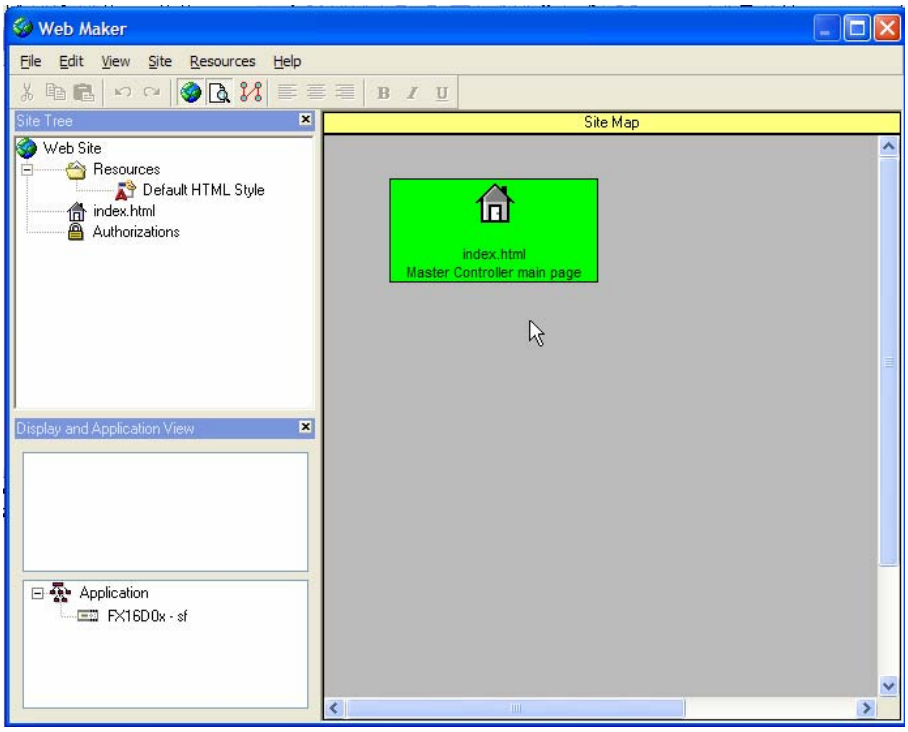



**Figure 61: Default Web Site**

### *Setting Up a Point-to-Point Connection on a Windows XP® Operating System*

The FX16 Master Controller provides an embedded Internet Information Server (IIS), which allows you to view and work with Web pages in the FX16 controller. You can use two different kinds of PPP connections to access the FX16 IIS, depending on the user and application needs:

- local **Direct Connection** through the RS-232C port and a null modem connection
- remote **Dial-in Internet Connection** through a modem from a normal Internet connection

To create software communications via PPP, you need to configure the computer to manage these kinds of connections.

To set up a point-to-point connection on a Windows XP operating system:

1. In the Network Connections manager on your computer, set up the PPP connection.
2. Create a new connection from the Network Connection manager.

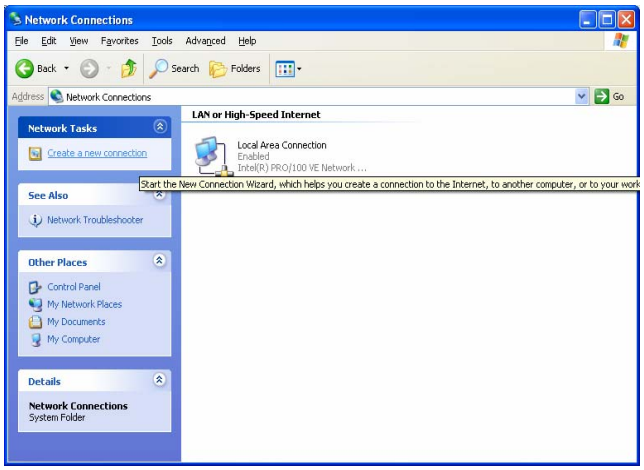



**Figure 62: Make New Connection**

3. If you want a direct, null modem connection, set the Network Connection Type to **Set up an advanced connection**.

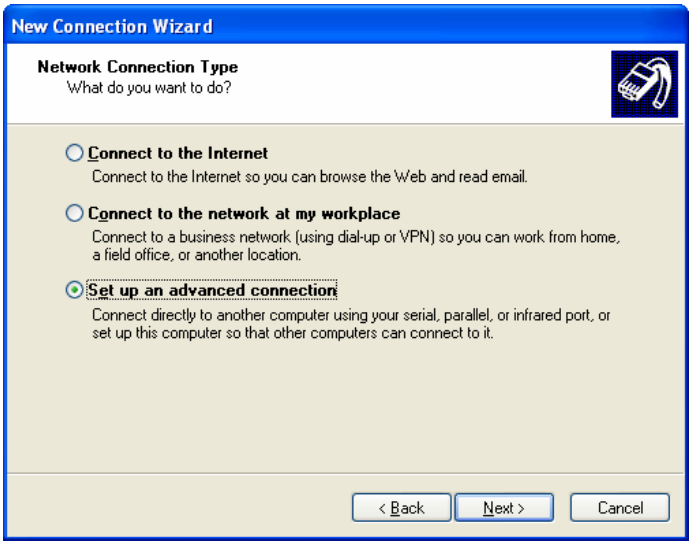



**Figure 63: Network Connection Type, Direct Null-Modem**

4. If you plan to dial in to the Internet, set the Network Connection type to **Connect to the Internet**.

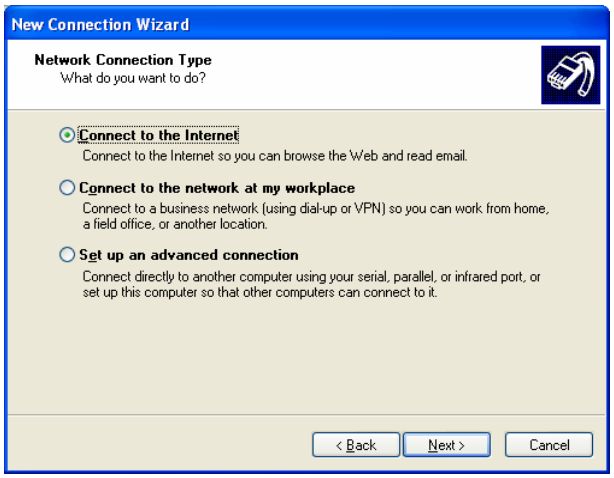



**Figure 64: Network Connection Type, Dial-In Internet**

Depending on the connection you selected, the configuration wizard prompts you to perform different actions.

### *Setting up a Direct, Null Modem Connection*

To set up a direct, null modem connection:

1. In the Control Panel, double-click **Phone and Modem Options**.

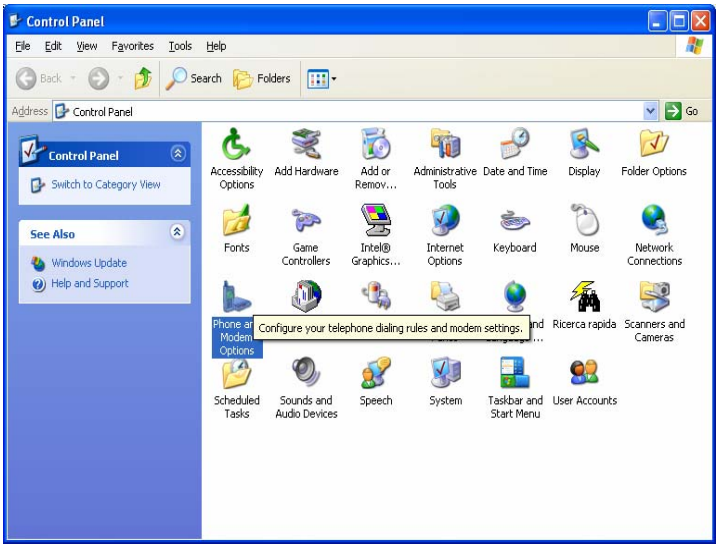



**Figure 65: Control Panel**

2. Select the Modems folder.

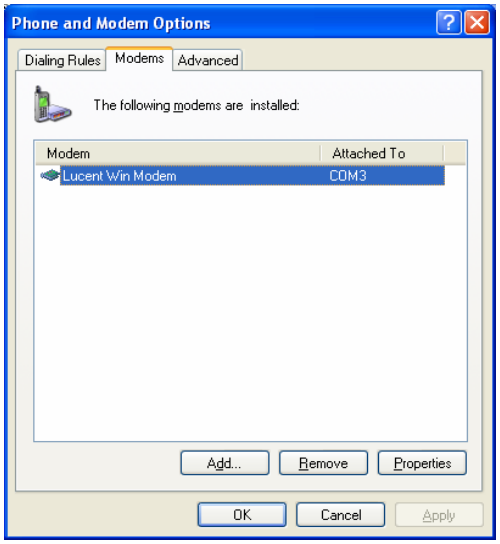



**Figure 66: Phone and Modem option**

3. Click Add.

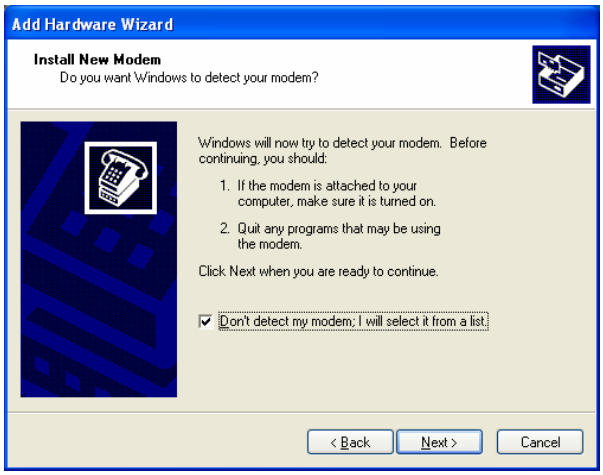



**Figure 67: Install New Modem**

4. Select the **Don't detect my modem; I will select it from a list** option to select all available modems from the entire proposed list.

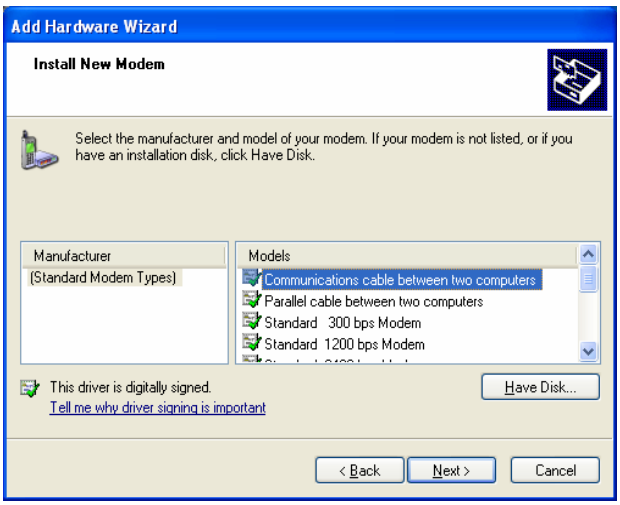



**Figure 68: Select Modem Types**

5. From the Models list, select **Communications cable between two computers**. This option sets up a new null modem device.

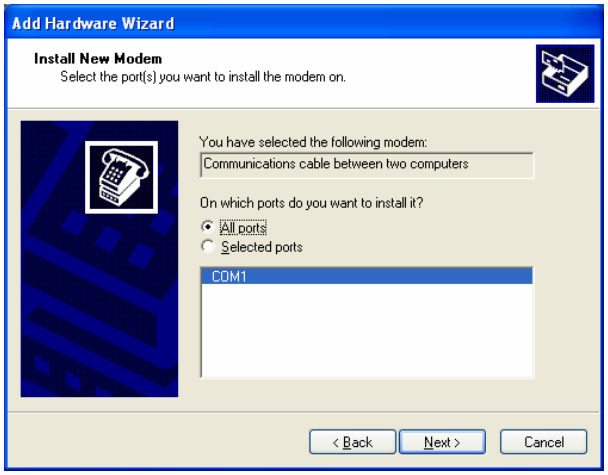



**Figure 69: Select the Installation Ports**

6. Select the **All ports** option to scan all the RS-232C ports available on the computer.
7. Locate the new added modem called **Communications cable between two computers**.

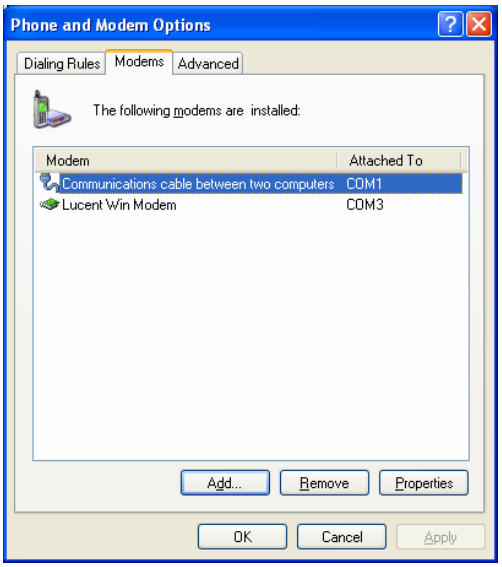



**Figure 70: Null Modem Created**

8. Go through the Network Connection creation (see Figure 63) and select **Set up an advanced connection** and click Next. The system prompts you to choose the role of the computer within the connection.
9. Select **Guest**.


**Figure 71: Host or Guest**

10. Select the Communication device to use for the direct connection (typically using COM port).

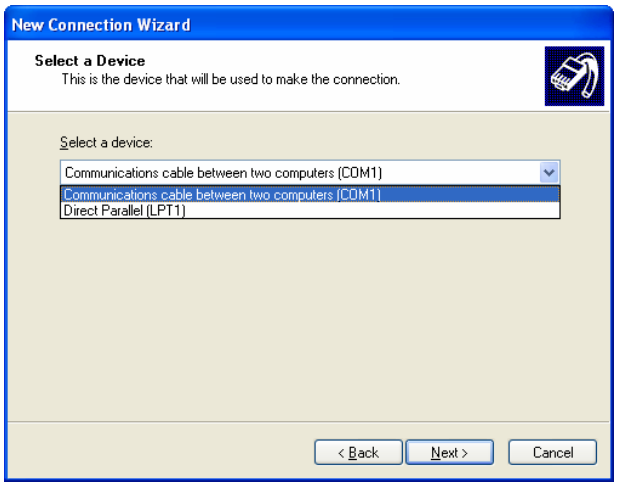



**Figure 72: Select a Device**

11. Set the connection availability to **Anyone's use** and define the name for the new connection.

    The network connection configuration is now complete. A Connection window appears.

12. Click Properties to configure the communication device selected during the Network Connection creation.

    **Note:** If you selected COM Port as communication device, then you can access the COM configuration page. Configure the Maximum Speed at **9600** bits per second (bps). You must clear all the other Hardware Features.

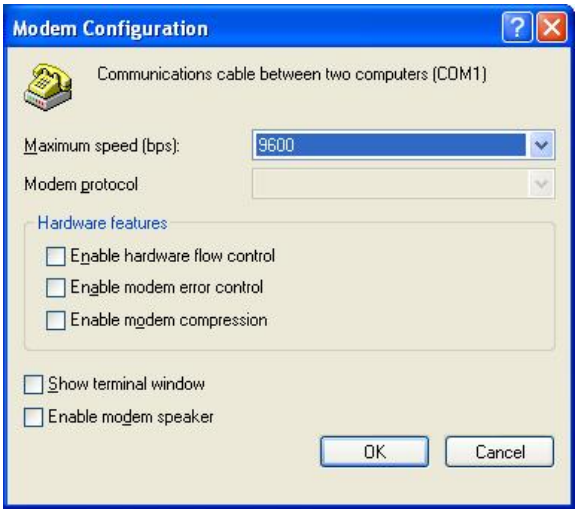



**Figure 73: COM Port Configuration**

You can now use the connection.

13. Enter the account data into the connection form and click Connect. Make sure the User Name and Password matches the ones configured in the FX16 Master Controller.

**Note:** The COM port configuration of the computer **must** match the configuration defined in the application.

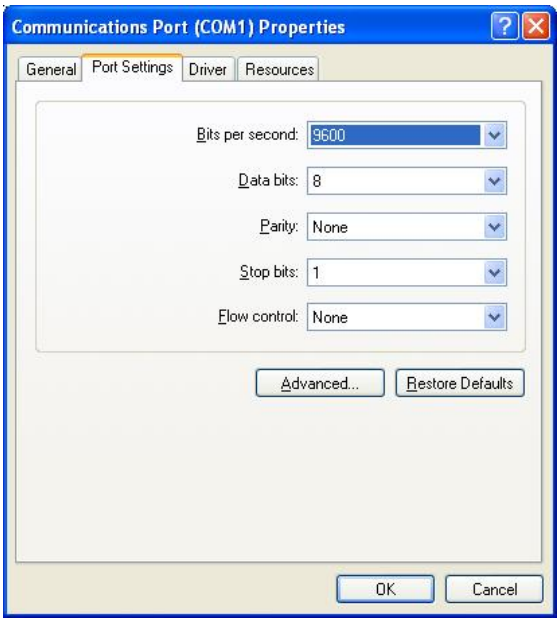



**Figure 74: COM Port Configuration (Computer Side)**

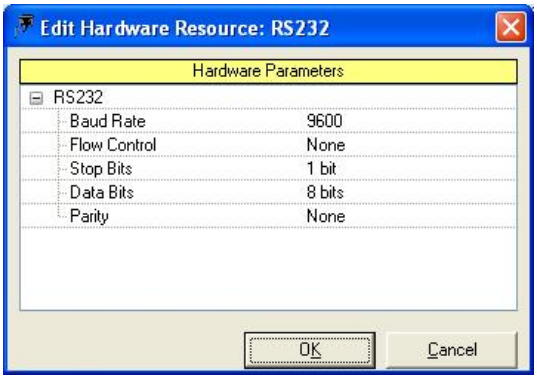



**Figure 75: COM Port Configuration (FX Builder Side)**

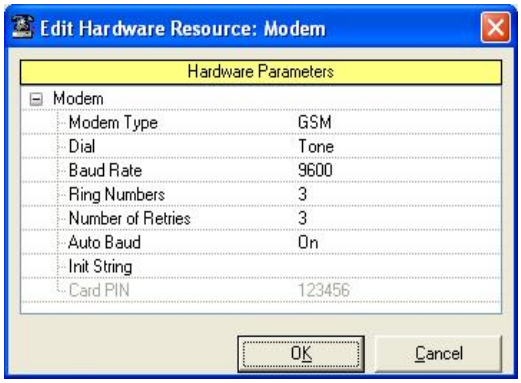



**Figure 76: Modem Type Configuration (FX Builder Side)**

### *Setting Up a Dial-in Internet Connection*

After you choose **Connect to Internet**, the system asks you for an Internet account or if you want to create a new one.

Because the Internet account is the same as the one from the FX16 Master Controller, you need to manually set up the connection.

To set up a dial-in Internet connection:

1. Select Set up my connection manually.

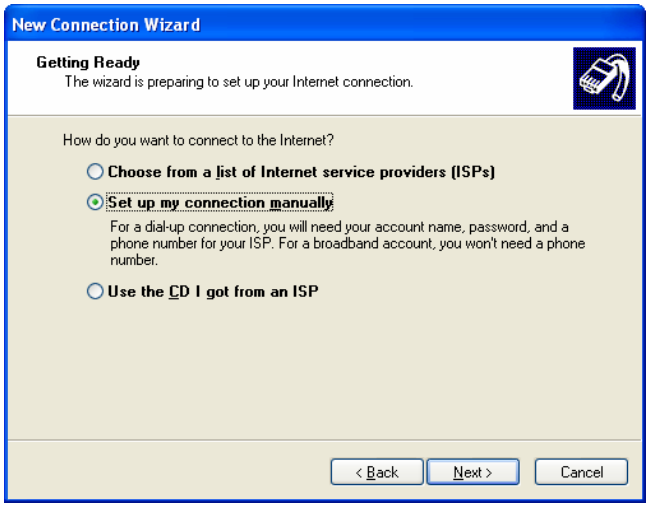



**Figure 77: Internet Account**

2. Select **Connect using a dial-up modem**. The manager automatically detects the modem installed on the computer.

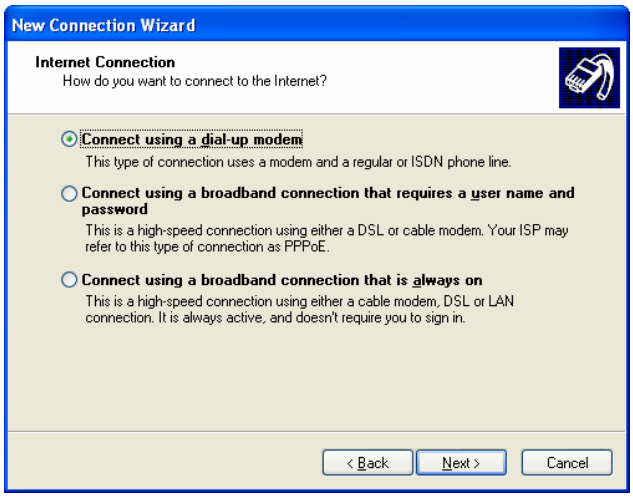



**Figure 78: Select a Device**

3. Enter the information related to the FX16 Master Controller Internet Service Provider (ISP) account. The information requested is the ISP name and the ISP telephone number.
4. Enter the phone number for the FX16 Master Controller. This phone number has the embedded Internet Information Server (IIS), which can manage Internet connections.

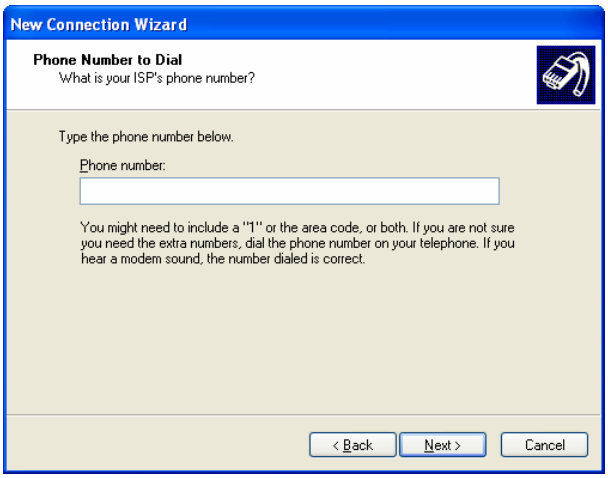



**Figure 79: Insert Telephone Number**

5. Choose the connection availability to **Anyone's use.** Additional account information such as User Name and Password is required to continue the Internet Connection Wizard.


**Figure 80: Account Logon Information**

The connection creation process is now finished. You must now enter the new connection name and create a new e-mail account, which is not necessary for an FX16 Master Controller connection.

6. Enter the account data into the connection form and click Connect. Make sure the User Name and Password matches the ones configured in the FX16 Master Controller.

### *Web Page Loading Time Performance*

A performance test was performed with the following system configuration.

An FX16 Master Controller performing a Distributed Application Strategy connected to:

- a PSTN modem (56k V.92 U.S. Robotics Modem)
- using Internet Explorer Version 5.5 as a browser.

Table 23 displays the average loading time, in seconds, of the Web page with 16 displayed parameters.

**Table 23: Web Page Loading Time Performance**

| Number Variables in Application | Number of Parameters in Web Page | Average Time |
|---|---|---|
| **62** | 16 | 27 |
| **100** | 16 | 28 |
| **150** | 16 | 30 |
| **255** | 16 | 33 |

## Communication Services

The RS-232C Serial Card is a plug-in card that allows the FX16 Master Controllers to connect to a modem (standard or GSM) or to a computer via the standard communication port of the computer (null modem connection). Using a connected modem, the FX16 Master Controller sends e-mails and SMS messages (GSM modem only) to report alarms, events, and trend logs.

You can program e-mails to send periodically. Sending e-mails off-loads the controller memory containing the logged trend data.

The communication services are configurable in FX Builder via the Application/Notification Services/E-mail or via the Application/Notification Services/SMS menus.

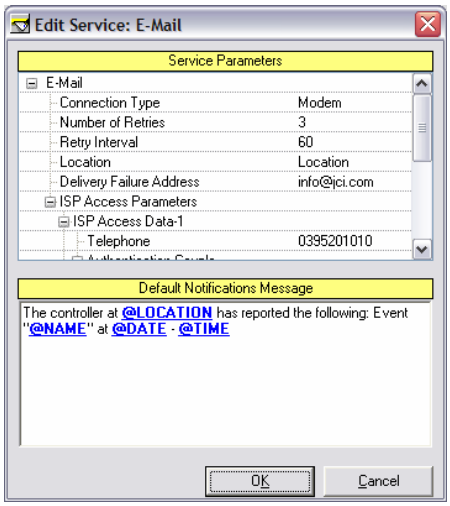



**Figure 81: E-Mail Configuration**

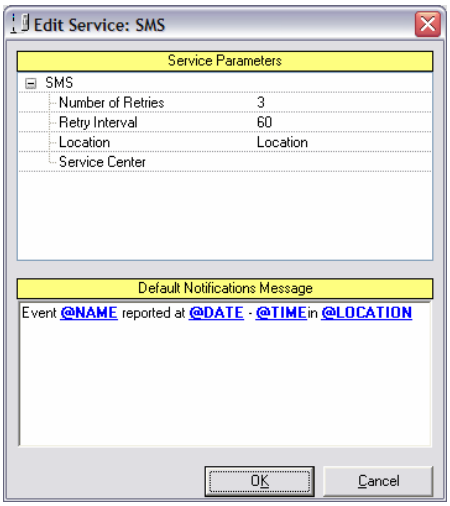



**Figure 82: SMS Configuration**

## Supervisory Option

You can integrate the FX16 Master Controller into a supervisory building automation system for continuous monitoring of the control systems. The FX16 supports two methods of integration: N2 Open Integration and LONWORKS Network.

### *N2 Open Integration*

You can connect the FX16 controller to the N2 Open network of a Building Automation System (BAS). The BAS then has access to all the control network variables and parameters available in the FX16's network profile.

The list of variables and parameters available to the network is defined in the network profile. The network profile is part of the application loaded to the controller. You can customize the network profile for each device.

The FX16, like the other controllers in the Facility Explorer family, can integrate into Johnson Controls Metasys systems as an N2 Open Compatible Vendor Device (**VND**). FX Builder generates a file (.prn) that contains the relevant information from a control application for the integration of the FX16 into a supervisory workstation or supervisory controller with an N2 Open interface. The .prn file contains columns labeled Point Type and Point Address. This information generates the Network Point Type and Network Point Address in the supervisory system or controller.

#### N2 Open Network Profile Limits

The FX16 N2 Open interface exposes up to 62 network variables (volatile points) and up to 100 parameters (permanent points) to the N2 Open network. The Device Application Network Profile imposes this limitation.

### *LONWORKS Network*

An FX16 controller fitted with a LON communication card enables the FX16 to send and receive data to and from LON controllers on a LONWORKS network. The FX16 controller can also send data on request to a supervisory system or a supervisory controller fitted with a LONWORKS network interface card.

The FX16's LON network profile is defined along with the control application using FX Builder. You can configure the Network Variable Input (NVI) and Network Variable Output (NVO) points in the network profile of the control application using a LONWORKS network management tool (binding tool). This allows the NVI and NVO to transmit and receive data over the LONWORKS network.

A network of FX controllers fitted with the LON communication card can share data on a peer-to-peer basis. The network supervisory controller is not required to pass data from one controller to another.

#### LONWORKS Network Profile Limits

The FX16 LONWORKS interface can expose up to **62** Network Variables (NVIs and NVOs) and up to **100** Configuration Parameters (CPs) to the LONWORKS network. This limitation is imposed by the LONWORKS Neuron processor on the communication card.

## Event Management

The FX16 Master Controller manages and records events or errors that the operating system generates. The FX16 also manages and records and events associated with data points or variables in the control application.

### *System Events*

System events indicate that the control system requires some attention and includes events, such as:

- system power up
- trend buffer full
- communication message failure (E-mail, SMS)
- device communication error
- application or display diagnostic error

### *Application Events*

Application events indicate that the controlled equipment requires attention or that the controlled conditions are not within the expected limits. For example:

- analog value is outside of a desired range
- status value represents a condition that is not normal

When an event goes into the active state, the FX16 enters the event into the table of active events and the event history log with the time and date of occurrence. A message then appears on the display screen of the FX16.

You can also configure the FX16 to send the event message to one or more of the following:

- e-mail Message Server
- mobile telephone with Short Message Service (SMS)

If you configure active events to require user acknowledgement, the FX16 only removes events from the active events table when the events are acknowledged and returned to the inactive or normal state. You can acknowledge events from the integral remote MUI.

You can view the table of active events and the event history log on the remote user interface or Web browser.

**Note:** The FX16 Master Controller manages two main processes working on the same RS-232C modem port: the Web server and the SMS server. The two processes share the RS-232C plug-in card applying a time-sharing philosophy. If an event goes into the active state and it requires an SMS transmission, the SMS server and E-mail have a higher priority over the Web server.

### *Events Plug-In*

FX Builder includes an Events Plug-In, which allows you to configure the events needed to treat and the type of treatment to use.

The **Events Menu Item**  opens the Event Plug-In (Figure 83).

The LP-FX16 (not Rev. A) Master Controller handles 20 events, whereas the latest LP-FX16X Rev. A Master Controller handles up to 250 events.

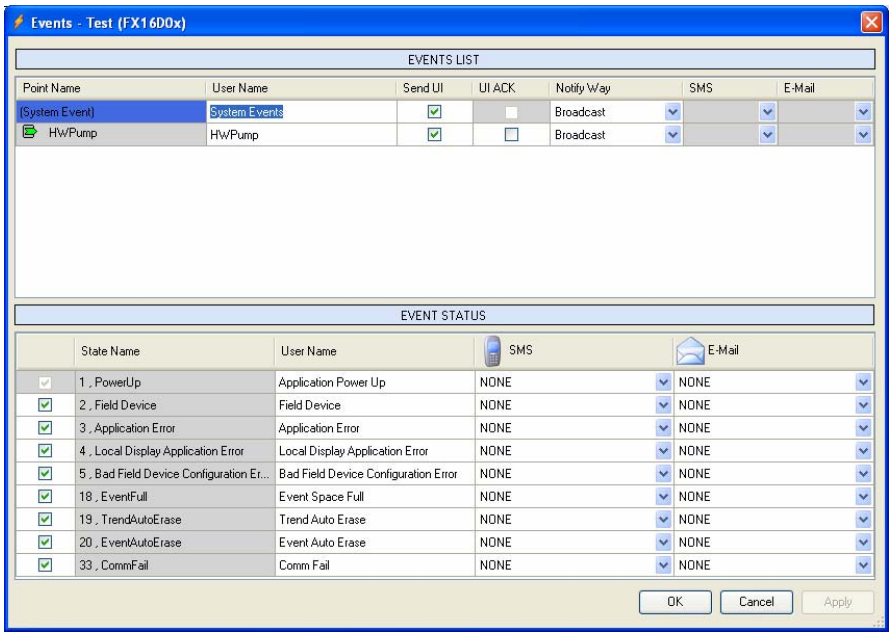



**Figure 83: Event Maker Screen**

You can define events on binary (two state) or enumerated (multistate) variables in the Network Profile or in the Application Profile. Another group of events are defined as the System Events Group and comprise predefined event conditions related to the proper execution of the application.

The message destinations are the available contacts and groups defined in the Address Book. The message destinations enable the user to select the required destination for the selected event. You must uniquely define each final destination in case the user wants to send notification to more than one contact. The final destination can also be a group definition within the Address Book. Groups contain all the contacts to receive a notification at the same time.

## Data Trend Logging

You can configure the FX16 Master Controller to record data samples from within the control application at defined intervals. The sample interval is defined for each variable. You can set the sample interval from every minute to once per day.

### LP-FX16D and LP-FX16X (Not Rev. A) Models

The LP-FX16D and LP-FX16X (not Rev. A) models can trend 16 variables with up to 2,000 samples each. Therefore, these models can trend 16 variables at 15 minute intervals for 20 days.

### LP-FX16X Rev. A Models

The LP-FX16X Rev. A models have an extended memory allocation of 4 MB for the trend log. These models can trend 40 variables with up to 10,000 samples each. Therefore, these models can trend 40 variables at 15 minute intervals for 100 days.

You can view the trend data for each variable in a text format on the integral or remote user interface within a specified time range.

You can also view the trend log buffer from a Web browser. You can then copy and paste the trend information into a spreadsheet application, such as Excel, for further processing and electronic storage. The trend logs can also be transmitted at regular intervals from one hour to every day via the telephone modem connection to an e-mail server. The FX16 generates a system event message if the trend buffer is not configured in the circular recording mode and the buffer becomes full.

You can control the trend logging of each variable by a logic variable so that trending only occurs during certain times of the day or week or when a particular equipment status or alarm exists.

## Time Scheduling

The FX16 Master Controller has a real-time clock with battery backup and clock, scheduler, and calendar objects. You can configure the FX16 (via FX Builder) to perform functions based on a weekly time schedule.

### *Real-Time Clock (LP-FX16D and LP-FX16X [Not Rev. A])*

Use this object to set the time of the hardware clock and make its parameters available to the application.

### *Clock and Date Set (LP-FX16X Rev. A)*

Use this object to set the time of the hardware clock and make its parameters available to the application. This object also manages the automatic summer and winter daylight saving time changeover.

### *On-Off Time Scheduler*

The On-Off Time Scheduler object controls a binary (On-Off) output according to a configurable event schedule, real time, day of the week and holidays (or exception days) in the calendar.

Use FX Builder to preconfigure the scheduler and FX CommPro to modify the scheduler in a graphic format. You can modify the scheduler from the integral/remote interface or Web page if configured in the application.

You can also define a logic command to force the Time Scheduler object output to On or Off for a simple override function from a user interface or the Web page for remote access.

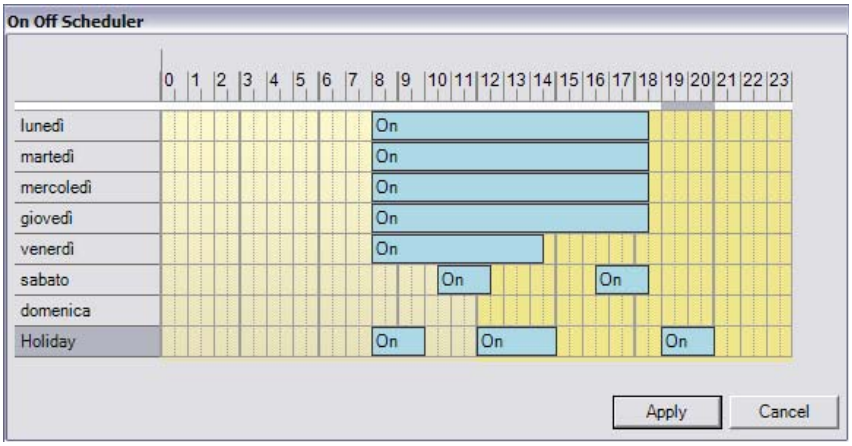



**Figure 84: On-Off Scheduler Definition**

### *Weekly Occupancy Scheduler*

The Weekly Occupancy Scheduler object controls a multistate output with the states of Occupied, Standby and Unoccupied. This is according to a configurable event schedule, real time, day of the week, and holidays (exception days) in the calendar.

Use FX Builder to preconfigure the scheduler and FX CommPro to modify the scheduler in a graphic format. You can modify the scheduler from the integral/remote interface or Web page if the scheduler was configured in the application.

You can also define a multistate command to force the Time Scheduler object output to Occupied, Standby, or Unoccupied. This is a simple override function from a user interface or Web page for remote access.

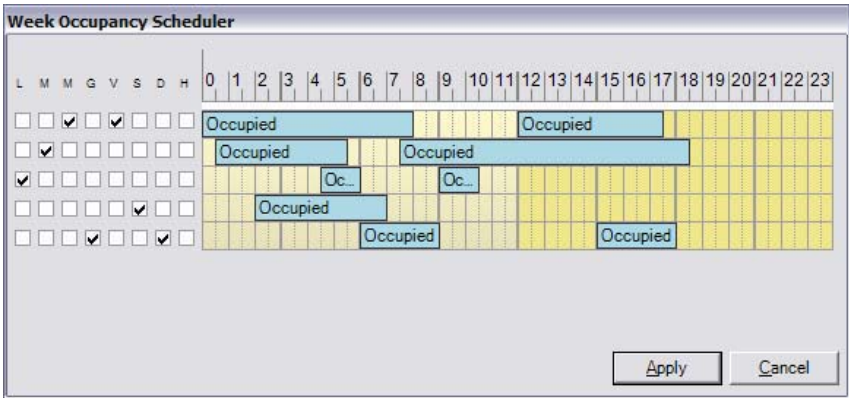



**Figure 85: Weekly Occupancy Scheduler Definition**

### *Exceptions Calendar*

Use the Exceptions Calendar in FX Builder to define holidays or exception days in a graphic format. Use FX CommPro to modify the holidays or the integral or remote user interface if configured in the application.

## User Interfaces

The FX16 Master Controller can support to up to two user interfaces allowing the capability to display and edit data point and information in the running application. The user interface application is fully configurable using FX Builder. The FX16 Master Controller can store a user interface database with up to five different languages (defined in the application). You can then select, through a configuration parameter on the screen, the displayed language.

A user interface is optional. This means that the controller can also work without a user interface.

One user interface can be integral. Depending on the controller model, one interface can be panel-mounted and one or two can be remotely wall-mounted. The total number of user interfaces cannot exceed two units.

The display models that connect to the FX16 are:

- LP-DIS60P20-0C: Panel mount, non-isolated version. Medium User Interface, 4x26 character backlit Liquid Crystal Display (LCD), IP54, extended temperature range: -20°C (68°F) to 50°C (122°F).
- LP-DIS60P21-0C: Wall mount isolated version. Medium User Interface, 4x26 character backlit LCD, IP54, extended temperature range: -20°C (68°F) to 50°C (122°F)

**Figure 86: Medium User Interface**

Mount the panel mount version up to 3 m (9.8 ft) from the controller. Mount the wall mount version up to 1 km (0.6 miles) from the controller.

To connect the panel mount, use the cable connection kit (LP-KIT007-000C), with a phone jack on the MUI side and a screw connector on the FX16 side.

### *Multi-language Database*

All the text on the user interface display is fully programmable. You can enter up to five different languages using the table provided in the programming tool that lists all the texts for translation. You can then select the preferred language from a screen menu after you log onto the system.

The display plug-in allows you to develop the main display application in the chosen primary language. An export feature then allows you to export all the different strings and names of variables to a file that can be translated. The translation must follow certain rules (for example, maximum string length).

An import feature of the display plug-in inserts the additional language databases into the display application (ready for the download).

This feature is well suited for those who export systems to many countries in the world or for systems in areas where more than one language is spoken.

## Application Configuration and Commissioning

The programming and configuration of the FX16 Master Controller is done using the navigation trees and graphic screens of FX Builder. FX Builder is part of the FX Tools Pro software package.

The applications are generated in a graphic screen environment with many features that help you build the application quickly and accurately. The applications are built from standard function blocks and control objects that you can nest in custom assemblies, which you can save for reuse in other applications. The tool offers complete flexibility in the generation of applications but has the features to save and reuse existing assemblies and standard applications where appropriate for an economic solution.

The configuration includes the definition of the devices to connect, the physical inputs and outputs and data points to monitor, and the format of the user interface. If a Web browser monitors the FX16 Master Controller, FX Builder provides the environment for the design of the Web pages and the data content for display on the browser screen.

You can define the communication parameters for supervisory functions and event messaging in FX Builder. You can define user profiles with passwords to protect the FX16 Master Controller from unauthorized access. In FX Builder, you also configure trend logs, generate time schedules, and define event messages.

FX Builder builds the control functions that the FX16 Master Controller executes. FX Builder builds these control functions using data from monitored controllers and commands from the integral or remote display, embedded Web server, SMS messages, or a supervisory system (if connected to the controller via a communications card).

In particular, FX Builder builds a distributed application or Gateway object application that encompasses the control functions of the FX16 Master Controller and up to 16 Facility Explorer controllers on its local link bus.

## FX Builder

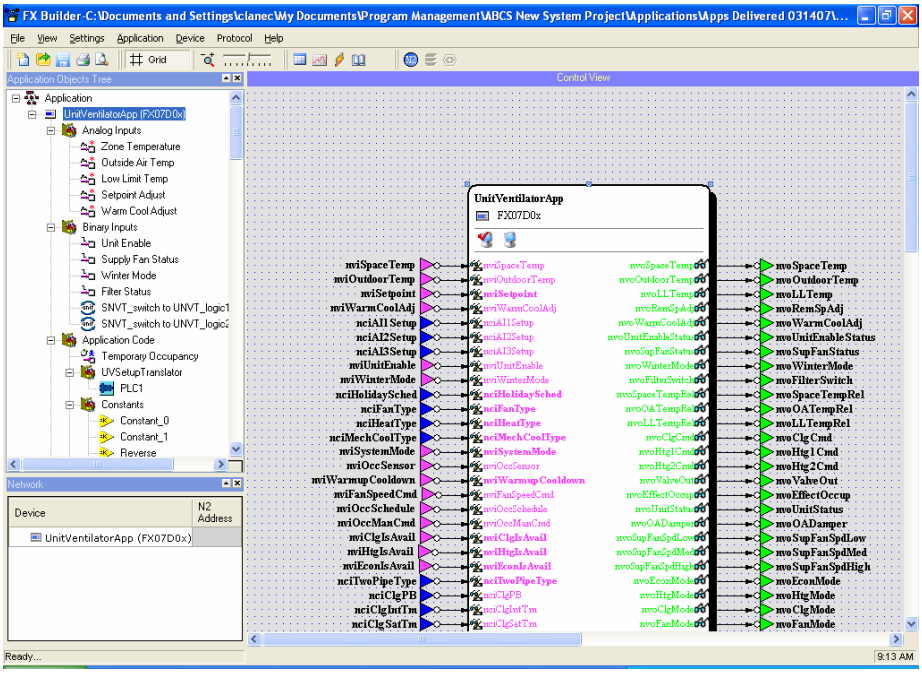



**Figure 87: FX Builder Tool**

Use FX Builder to build the control application that the FX16 controller executes when downloaded into the controller. You also use FX Builder to generate a network profile through which the controller communicates to other devices on a control system network. You can select the network profile for the N2 Open protocol or for the LON protocol.

For the FX16 Master Controller, you can develop two types of control application:

- **Stand-alone applications** where the application runs only in the FX16 Master Controller.
- **Distributed applications** where the FX16 Master Controller is the master of a small network of up to 16 Facility Explorer controllers acting as slaves. The relevant parts of the application is distributed and runs in the individual controllers, but the FX16 Master Controller coordinates the whole application, which is also the network interface for the entire distributed application.

The functions of the distributed application are defined in the FX16 Master Controller and are distributed to run as follows.

- structure of application with the definition and network addresses of the slave devices - master.
- network profile of distributed system (N2 Open or LON) - master
- control application and application profiles - master and slaves

- user interfaces - master and slaves as defined
- events and trends - master
- messaging services and address book - master
- Web page and services - master

### *Control Application*

The control application defines the functions of a controller. Each controller, whether master or slave, executes its own control application.

Use FX Builder to build control algorithms and logic on a graphical canvas by creating and connecting instances of the objects in the database of the controller. An object is a functional block with inputs, attributes, an internal processing method, and outputs.

By means of connections between inputs and outputs, values are passed between the objects or between the objects and the network profile. A connection has always the same direction, from the source to the destination. Sources can be the network variables inputs and configuration parameters in the network profile, and the object outputs. Destinations are the network variable outputs in the network profile and the object inputs.

The object inputs are used by the object to obtain values from other objects or from the control system network via the network profile.

The object outputs are used by the object to present its results. They can then be used by other objects or sent to other devices through the network profile and the control system network.

The objects also have some static values, set at design-time, known as attributes. These values are typically used to determine the behavior of an object or used as default values in case input values are missing or have invalid values.

When you develop an application, a maximum of 255 instances of the available objects can be included. The available objects in the FX16 controller are shown in the following table.

The control application and logic can also interact with the alarm and event management, user interfaces, and communication services to generate information and alarm messages for the user.

## *FX16 Master Controller Object List*

**Table 24: FX16 Master Controller Object List**

| Object List | Object |
|---|---|
| **Input** | Analog Input[1]<br>Digital Input[1]<br>Occupancy Input[1]<br>Temporary Occupancy<br>Fan Controller Command<br>Input Counter |
| **Output** | LED<br>Analog Output[1]<br>On/Off Output[1]<br>Damper PAT Output[1]<br>DAT Output[1]<br>PAT Output[1]<br>Hermetic Compressor (x3) |
| **Numeric Functions** | Extended Calculation<br>Timer with Reset<br>Timer<br>Compare<br>Constant<br>Event Counter<br>Butterworth Filter<br>Integrator<br>Average (8 input)<br>Average (2 input)<br>Maximum (8 input)<br>Maximum (2 input)<br>Minimum (8 input)<br>Minimum (2 input)<br>Selector (8 input)<br>Selector (2 input)<br>Psychrometric 1<br>Psychrometric 2<br>Ramp<br>Sample and Hold<br>Span[1]<br>Segment<br>Time Counter[1]<br>Storage Element |
| **Control Functions** | Automatic Economizer<br>Proportional plus Integral plus Derivative (PID) Controller<br>On/Off Controller<br>Fan Controller[1] |
| **Continued on next page …** | |

1. New enhanced version of object in FX Platform at Release 2.0.

| Object List (Cont.) | Object |
|---|---|
| **Logic Functions** | AND (8 input)<br>AND (2 input)<br>OR (8 input)<br>OR (2 input)<br>XOR (8 input)<br>XOR (2 input)<br>NOT<br>Enumeration Override<br>Enumeration Logic<br>Output Override Logic<br>PLC |
| **Alarm** | Analog Alarm (Auto Reset)<br>Manual Reset Binary Alarm<br>Out of Range<br>Compressor Envelope |
| **Special Functions** | Emergency/Application Mode<br>Binary Sequencer<br>General Setpoint<br>Occupancy Mode<br>Sensor Failure<br>Temperature Setpoint<br>Load Manager<br>Optimal Start Stop<br>Array Sequencer (eight outputs)<br>Sequencer (four outputs)<br>Source Mode<br>Summer-Winter Compensation |
| **Application Control** | End Application |
| **Schedulers** | Exceptions Calendar<br>On-Off Time Scheduler<br>Weekly Occupancy Scheduler |
| **Unit Conversion** | Convert Format<br>UNVT_logic to SNVT_state<br>SNVT_state to UNVT_logic<br>Enumeration to UNVT_logic<br>SNVT_switch to UNVT_logic<br>SNVT_hvac_status generator<br>SNVT_chlr_status generator<br>SNVT_lev_disc to SNVT_switch |
| **Refrigeration** | Accumulative Defrost<br>Refrigeration Defrost<br>Refrigeration Defrost Initiation<br>Refrigerant Saturation Properties |
| **Continued on next page …** | |

| Object List (Cont.) | Object |
|---|---|
| **Extension** | XT/XP Modules<br>Gateway Object |
| **System Functions** | Clock and Date Set[2]<br>System Resource<br>Real Time Clock[2] |

2. Real Time Clock object was replaced by Clock and Date Set object.

**Note:** The previous versions of these objects are listed for the FX16 as Obsolete and available only for compatibility with older applications.

You can use several objects of the same type within one control application. Each copy of an object type is called an **instance** of the object, and you can configure each instance differently according to the application requirements. For example, to read the physical inputs AI1 and AI2 on a controller, the control application should include two instances of the Analog Input object, which differ in their configuration. One instance is configured to read Channel 1. The other instance should read Channel 2.

## FX CommPro N2/LON

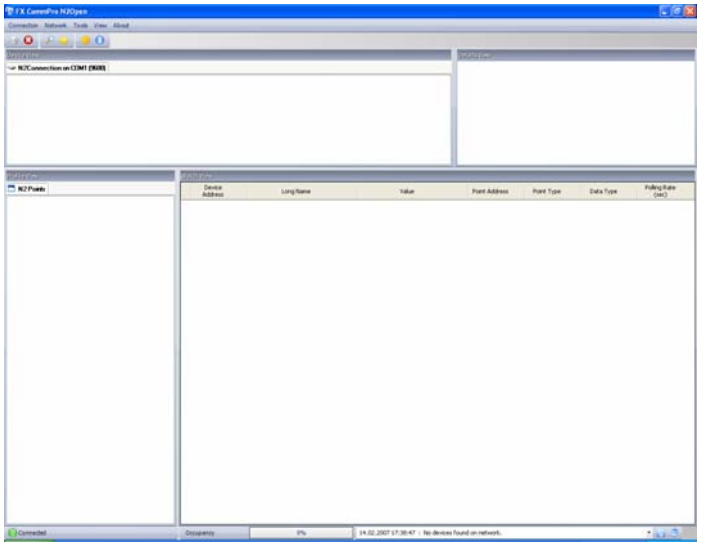


**Figure 88: FX CommPro N2 Main Screen**

The FX CommPro, available in the N2 Open and LON, commissions the FX controllers (specifically the FX16 Master Controller).

FX CommPro can display the network profile (input variables, output variables and parameters) of the connected controller.

Input variables and parameters are read and write parameters; output variables are for monitoring only.

### *FX Loader Utility*


**Figure 89: FX Loader Tool**

Use FX Loader to download the application to the target controller. You can choose either the N2 Open or LON protocol; this means that the controller needs to have the appropriate N2 Open or LON card assembled to communicate with the software.

Through FX Loader, you can download (N2 Open only) Firmware updates of the FX16 Master Controller.

## Security

The FX Tools Pro and Facility Explorer controllers have an embedded security feature based on two identifiers: the Family ID and the Customer ID.

### *Family ID*

The Family ID identifies the different controller hardware types and prevents the downloading of an application to the wrong controller.

**Table 25: Family IDs**

| Facility Explorer Controller | FX Builder Code | Family ID |
|---|---|---|
| **FX05 (Advanced) Controller** | 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 |
| **FX06 Compact Controller (Models FX06P0x, FX06P2x, and FX06P3x)** | FX06P0x | 0701 |
| **FX06 Compact Controller (Model FX06P1x)** | FX06P1x | 0700 |
| **FX07 Terminal Unit Controller (All Models FX07Dxx and FX07Axx)** | FX07D0x | 0900 |
| **FX14 Field Controller (All Models)** | FX14D1x | 0801 |
| **FX15 Field Controller (All Models)** | FX15D1x | 0402 |
| **FX15 Universal Controller (All Models)** | FX15D0x | 0401 |
| **FX16 Master Controller (All Models FX16Dxx and FX16Xxx)** | FX16D0x | 0501 |
| **Master Display** | MD20D00 | 0600 |
| | MD20D01 | 0601 |
| | MD20D02 | 0602 |
| | MD20D03 | 0603 |
| | MD20D04 | 0604 |
| | MD20D05 | 0605 |

### *Customer ID*

The Customer ID protects a custom developed application within a controller. It also prevents unauthorized users from editing the application source code in FX Builder. Three Customer ID types are used:

- **Public ID:** Applications configured and saved with the Public ID can be modified, downloaded, and commissioned by any user with the Public ID enabled in FX Builder (default).
- **Demo ID:** Applications configured and saved with the Demo ID can only be downloaded to Demo controllers (that only have the Demo ID in their database). Applications from controllers with the Demo ID can only be modified by users with the Demo ID in FX Builder (typically sales offices). The Demo ID prevents demonstration equipment from being used for installations.
- **Customer Specific/Private ID:** The source files for applications configured and saved with a Customer Specific ID are readable and modifiable only by users who have the same ID enabled in FX Builder. Once a controller is downloaded with a Customer Specific ID, the controller becomes customer specific and only allows the downloading of applications with the same Customer Specific ID.

## Application Upload/Download

You can download applications to the controller via personal computer with the FX Tools or upload and download applications via the Programming Key.

### *Direct Computer Connection*

To download an application with a direct computer connection, you need to install a communication card (N2 Open, RS-232C, or the LON) on the FX16 controller.

### *N2 Open or RS-232C Card*

Use an RS-232C to RS-485 converter (for example, IU-9100 or LP-KIT200-000C) to connect the computer to the N2 Open card of the FX16. Make sure the converter supports the Automatic Send Data Control and does not require Request To Send (RTS)/Clear To Send (CTS) control.

Use FX CommPro N2 to download the application. Select N2 Open or Direct for RS-232C. The N2 Open network profile or communication parameters are also downloaded for the FX16 controller.

### *LON Card*

Use an SLTA or a PCC10 LON interface converter to connect the computer to the LON card of the FX16.

Use the FX CommPro LON card to download the application. The LON network profile is also loaded into the LON card.

### *FX Programming Key (Not for LON Applications)*

The Programming Key allows you to download an application to the FX16 controller. This is convenient when loading multiple controllers on a construction site or in the factory at the end of the production line. You can load the FX16 at the press of a button with no need for a computer, communication card, or converter.

Before you use the Programming Key to load the FX16 controller, you need to load the FX16 with the appropriate application. You can download the application via FX Loader (Version 3.1.3 and later) or upload the application from an already programmed FX16 controller.

### *Uploading the Application from a Preprogrammed FX16 to the FX Programming Key*

To upload the application from a preprogrammed FX16 to the Programming Key:

1. Turn off the FX16 controller.
2. Connect the Programming Key to the Remote Display terminals of the FX16 controller
3. Turn on the FX16 controller. The two LEDs on the Programming Key blink alternately. This indicates that an operation has to be selected.
4. Press the Programming Key button to move from upload mode to download mode and vice-versa (the corresponding LED blinks quickly). Make sure the green upload LED continues to blink and then confirm the Uploading action by pressing the button for more than 3 seconds.

During the uploading process, the LED blinks. When the operation ends successfully, the blink stops and the green LED remains steady ON. If the operation fails, the two LEDs blink together.

**Note:** If parameter values of the source FX16 controller are changed by the user via display or via computer connection (using FX CommPro), these changes do not upload to the Programming Key. The application uploaded contains the parameter defaults saved by FX Builder at design time. If the same application is required with different parameter defaults, you must change the parameters and then save them again in FX Builder.

Use the Programming Key to download the application to other FX16 controllers.

### *Uploading the Application from FX Loader to the Programming Key*

To upload the application from FX Loader to the Programming Key:

1. Connect the Programming Key to the RS-485/232 converter via the plug-adapter and power the Programming Key with a dedicated AC/DC power adapter.
2. Open FX Loader.
3. Select N2 Open and then select FX-AppKey (Figure 90).

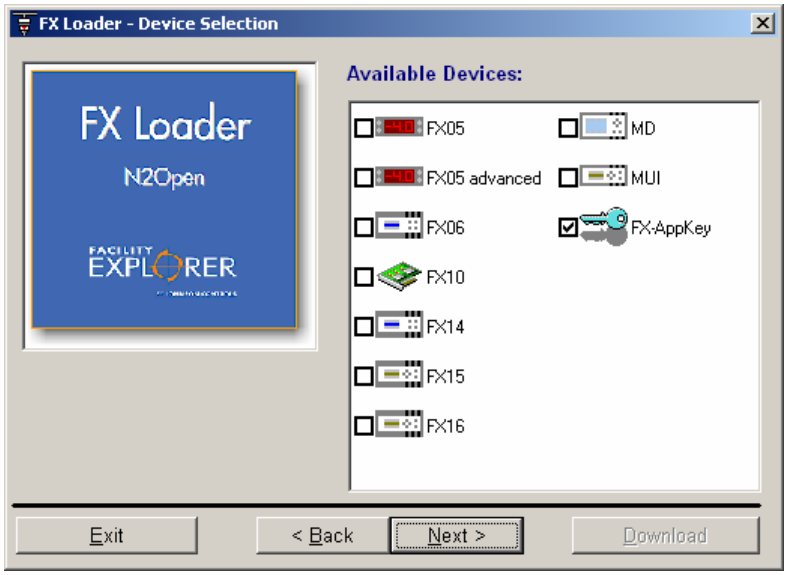



**Figure 90: Loader-Device Selection Page**

4. Turn on the Programming Key via the AC/DC adapter. The two LEDs blink alternately. This indicates that an operation has to be selected.
5. Select the application in FX Loader to upload (Figure 91).

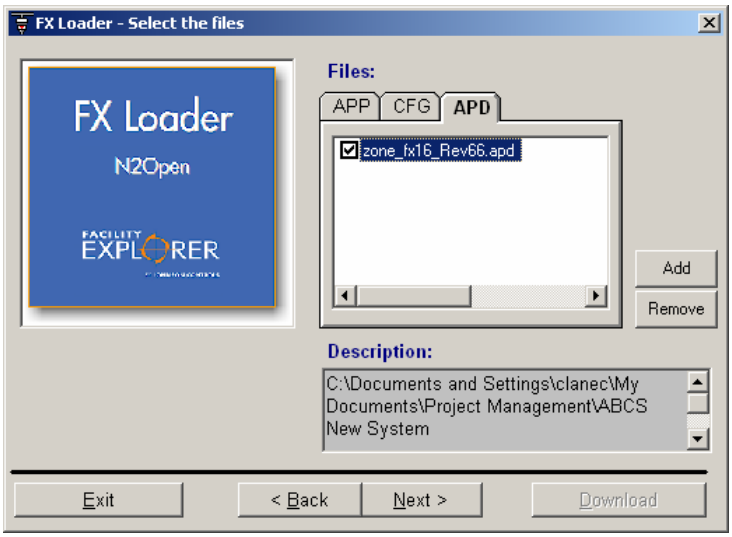



**Figure 91: Application Selection**

6. Press the Programming Key button until the green Upload LED blinks. Confirm the Upload action by pressing the button for 3 seconds.
7. Click Next and then click Download the FX Loader tool.

If the key already contains an application, FX Loader asks if you want to keep the application or erase it. If you answer no, the operation is aborted. If you answer yes, the application in the key is erased and the new application is uploaded.

During the upload, the LED blinks. When the operation ends successfully, the blinking stops and the green LED remains steady on. If the operation fails, the two LEDs blink together.

### *Downloading the Application from the Programming Key to the FX16*

To download the application from the Programming Key to the FX16:

1. Turn off the FX16 controller.
2. Connect the Programming Key to the Remote Display terminals.
3. Turn on the FX16 controller. The Programming Key turns on, and the two LEDs blink alternately. This indicates that an operation has to be selected.
4. Press the Programming Key button to move from upload mode to download mode and vice-versa (the corresponding LED also blinks). Make sure the yellow Download LED is blinking and then confirm the download action by pressing the button for more than 3 seconds.

During the download process, the yellow LED blinks. When the operation ends successfully, the two LEDs begin to blink alternatively and the controller starts running the new application. If the operation fails, the two LEDs blink together.

### *Security*

The uploading to the Programming Key is always performed with no restrictions (such as Customer ID or Family ID). The program uploaded is in a compiled format. You cannot download the program to a computer nor can you open and edit the program with FX Builder. Application privacy and security are not compromised.

The downloading process follows the security rules implemented via the customer ID. See Table 26.

**Table 26: Security Rules for Download**

| Customer ID of the Application in the Programming Key | Customer ID in the Controller | Download |
|---|---|---|
| **Public ID** | Public ID | Executed |
| **Public ID** | Private ID | Not Executed |
| **Private ID** | Private ID | Executed only if Customer IDs match. |
| **Private ID** | Public ID | Executed and controller is given the customer ID of the program in Programming Key. |

### *Performing a Programming Key Memory Erase*

If the key is already loaded with an application and you need to substitute it with a different application, you can perform a memory erase.

FX Loader automatically performs the memory erase when the application is loaded from a computer. When the application is uploaded from another FX16, you need to manually perform the memory erase.

To perform a Programming Key memory erase:

1. Turn on the key, either by hot-plugging it to an FX16 (already on) or with an AC/DC adapter.
2. Initiate the memory erase by pressing the key button down for 15 seconds.

   During the erase, the green Light-Emitting Diode (LED) slowly blinks. Then the green and the yellow LEDs blink twice alternately. Finally the green LED remains steady on. The flash memory erases.

If the two LEDs blink simultaneously, it means that the erase process has failed. Retry. When the memory completely erases, the LEDs stop blinking. The key is now ready for a new upload. The memory erase is also necessary if the previous upload from the FX16 did not finish successfully (for example, if the communication failed or was interrupted).

# *Troubleshooting*

## GSM Modem Not Able to Send SMS #1

- **Error/Condition:** The GSM modem is not able to send SMS.
- **Problem:** This happens when the GSM modem field is not powerful enough. The GSM field needs to be strong enough to ensure proper communication. The problem can be due to the positioning of the antenna.
- **Solution:** To verify the GSM signal strength, send the modem the AT command (**AT + CSQ**) via a connected computer. See Table 27.

**Table 27: AT Commands**

| AT+CSQ response (RSSI) | Signal Quality |
|---|---|
| **11 to 31** | Sufficient |
| **0 to 10 and +99** | Insufficient |

## GSM Modem Not Able to Send SMS #2

- **Error/Condition:** The GSM modem is not able to send SMS.
- **Problem:** This happens when the SIM card is inserted into a GSM modem is not enabled for SMS/DATA transmission.

  The problem can be due to the wrong SIM card configuration.
- **Solution:** To verify the SMS sending operation, you can send to the modem the AT command (**AT + CMGS**) via a connected computer.

### *Verifying the SMS Sending Operation*

To verify the SMS sending operation:

1. Send the **AT-CMGS=<SIM Phone Number>** (for example, 0039333922222) command.
2. Press  .
3. When the > symbol appears, enter the message text and terminate the string with a **CRTL-Z** command. For example:

   **> typeyourSMStext (CTRL-Z)**
4. If the SMS is sent, the following message appears on your computer.

   **+CMGS: 192**

   **OK**
5. If a **NO CARRIER** message appears instead of the OK message, contact your mobile phone provider.

## Null Modem Connection Problems

### *Dialer Retrieves Error 619*

- **Error/Condition:** While attempting to connect a computer via null modem cable to an FX16, the dialer retrieves Error 619.
- **Problem:** If an attempt is made to connect to an FX16, which does not have a Web site defined in its application, the FX16 does not handle the communication port on incoming connections.
- **Solution:** Define a Web site and load it into the FX16.

### *Dialer Retrieves Error 777*

- **Error/Condition:** While attempting to connect a computer via null modem cable to an FX16, the dialer retrieves Error 777.
- **Problem:** The RS-232 card is not recognized properly.
- **Solution:** There are two possible conditions triggering this problem:
  - The RS-232 communication card is still configured as N2 card. A power cycle may not have been performed following an application download. A power cycle is required to reconfigure the communication card. In this case, the solution is to power cycle the FX16.
  - The RS-232 communication card is performing an outgoing notification so that the line is busy. In this case, the solution is to retry at a later time.

## Multiple Null Modem Connections Error

- **Error/Condition:** The null modem connection retrieves Error 52.
- **Problem:** This problem occurs when the user tries to simultaneously connect to different controllers.

  The FX16 is equipped with a static IP address. The Windows® operating system recognizes another name duplicated in the network.
- **Solution:** Establish only one connection per device.

# Specifications and Technical Data

## *Ordering Codes*

**Table 28: FX16D Master Controller**

| Ordering Codes | Description |
|---|---|
| **LP-FX16D00-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (relays), no communications card |
| **LP-FX16D01-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (relays), N2 Open communications card |
| **LP-FX16D02-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (relays), LON communications card |
| **LP-FX16D03-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (relays), RS-232C communications card |
| **LP-FX16D10-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), no communications card |
| **LP-FX16D11-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), N2 Open communications card |
| **LP-FX16D12-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), LON communications card |
| **LP-FX16D13-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), RS-232C communications card |

**Table 29: FX16X Rev. A Master Controller Extended Temperature Range**

| Ordering Codes | Description |
|---|---|
| **LP-FX16X00-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (relays), no communications card |
| **LP-FX16X01-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (relays), N2 Open communications card |
| **LP-FX16X02-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (relays), LON communications card |
| **LP-FX16X03-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (relays), RS-232C communications card |
| **LP-FX16X10-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), no communications card |
| **LP-FX16X11-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), N2 Open communications card |
| **LP-FX16X12-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), LON communications card |
| **LP-FX16X13-000C** | FX16 Master Controller, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), RS-232C communications card |

**Table 30: FX16X Rev. A Master Controller Extended Temperature Range with Display**

| Ordering Codes | Description |
|---|---|
| **LP-FX16X50-000C** | FX16 Master Controller with display, 6 AI, 8 DI, 4 AO, 9 DO (relays), no communications card |
| **LP-FX16X51-000C** | FX16 Master Controller with display, 6 AI, 8 DI, 4 AO, 9 DO (relays), N2 Open communications card |
| **LP-FX16X52-000C** | FX16 Master Controller with display, 6 AI, 8 DI, 4 AO, 9 DO (relays), LON communications card |
| **LP-FX16X53-000C** | FX16 Master Controller with display, 6 AI, 8 DI, 4 AO, 9 DO (relays), RS-232C communications card |
| **LP-FX16X60-000C** | FX16 Master Controller with display, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), no communications card |
| **LP-FX16X61-000C** | FX16 Master Controller with display, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), N2 Open communications card |
| **LP-FX16X62-000C** | FX16 Master Controller with display, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), LON communications card |
| **LP-FX16X63-000C** | FX16 Master Controller with display, 6 AI, 8 DI, 4 AO, 9 DO (4 relays + 5 triacs), RS-232C communications card |

**Table 31: FX16 Communication Cards**

| Ordering Codes | Description |
|---|---|
| **LP-NET151-010C** | N2 Open communication card for FX16D and FX16X |
| **LP-NET152-010C** | LONWORKS communication card |
| **LP-NET161-000C** | N2 Open communication card for FX16X Rev. A |
| **LP-NET163-000C** | RS-232C communication card |

**Table 32: FX16 Accessories**

| Ordering Codes | Description |
|---|---|
| **LP-KIT007-000C** | Link cable: FX16 to the MUI display - 3 m (9.8 ft) |
| **LP-KIT007-001C** | Link cable: FX16 to standard modem - DB9, 1.5 m (5 ft) |
| **LP-KIT007-002C** | Link cable: FX16 to GSM modem - DB15, 1.5 m (5 ft) |
| **LP-KIT007-013C** | Null modem link cable - RS-232C, 3 m (10 ft) |
| **LP-KIT007-014C** | Null modem link cable - RS-232C, 15 m (49 ft) |
| **LP-KIT015-000C** | Kit of removable screw connectors |
| **LP-KIT015-001C** | Kit of removable cage clamp connectors |
| **LP-KIT090-000C** | Modem: GSM 900/1800 FastTrack |
| **LP-KIT090-001C** | GSM modem plug-in antenna |
| **LP-KIT090-003C** | GSM modem magnetic mount antenna - 2.5 m (8 ft) cable |
| **LP-KIT090-004C** | GSM modem panel mount antenna – 5 m (16 ft) |
| **LP-KIT090-005C** | GSM modem power adapter, 230 VAC/12 VDC, Central European wall plug |
| **LP-KIT100-000C** | FX Programming Key |
| **DT-9100-8901** | Power Supply for Programming Key: 230 VAC/12 VDC |
| **LP-KIT100-001C** | Power Supply for Programming Key: 120 VAC/12 VDC |

**Table 33: User Interface Displays**

| Ordering Codes | Description |
|---|---|
| **LP-DIS60P20-0C** | MUI Medium User Interface (V.3): 4x26 characters, backlit LCD, panel mount non-isolated version |
| **LP-DIS60P21-0C** | MUI Medium User Interface (V.3): 4x26 characters, backlit LCD, wall mount isolated version |

**Table 34: Demo Cases**

| Ordering Codes | Description |
|---|---|
| **DEMO-FX16-001** | Demo Case FX16 Master Controller with N2 Open communication, 230 V |
| **DEMO-FX16-002** | Demo Case FX16 Master Controller with LON communication, 230 V |
| **DEMO-FX16-003** | Demo Case FX16 Master Controller with RS-232C communication, 230 V |
| **DEMO-FX16-011** | Demo Case FX16 Master Controller with N2 Open communication, 120 V |
| **DEMO-FX16-012** | Demo Case FX16 Master Controller with LON communication, 120 V |
| **DEMO-FX16-013** | Demo Case FX16 Master Controller with RS-232C communication, 120 V |

**Table 35: Expansion Modules**

| Ordering Codes | Description |
|---|---|
| **LP-XT91D00-000C** | Extension module |
| **LP-XP91D02-000C** | Expansion board: 6 AI, 2 AO |
| **LP-XP91D03-000C** | Expansion board: 8 DO (triacs) |
| **LP-XP91D04-000C** | Expansion board: 4 DI, 4DO (triacs) |
| **LP-XP91D05-000C** | Expansion board: 8 DI |
| **LP-XP91D06-000C** | Expansion board: 4 DO (relays) 230 VAC (Europe only) |
| **LP-XP91D07-000C** | Expansion board: 4 DO (relays) 24 VAC (North America only) |

**Table 36: Software**

| Ordering Codes | Description |
|---|---|
| **LP-FXTPRO-0** | FX Tools Pro CD-Rom (FX Builder, FX Builder Express, FX CommPro N2, FX CommPro LON, MDLON Loader) – New user version |
| **LP-FXTPRO-6** | FX Tools Pro CD-Rom (FX Builder, FX Builder Express, FX CommPro N2, FX CommPro LON, MDLON Loader) – Upgrade version |
| **LP-FXTEXP-0 (North America only)** | FX Tools Express CD-Rom (FX Builder Express, FX CommPro N2) |

# *Technical Specifications*

## I/O Technical Details

**IMPORTANT:** For installation with Class 2 inputs and outputs only, no special mounting precautions are generally necessary. For use with one or more line voltage outputs (above 30 V), installation as part of a UL 508A industrial control panel may be required by the local building or electrical authority. These controllers are UL Recognized as Temperature Indicating and Regulating Equipment in accordance with UL 873 and UL Listed as Open Energy Management Equipment in accordance with UL 916.

**Table 37: Analog Input (AI)**

| Terminal | Channel | Type | Remark/Application |
|---|---|---|---|
| **TB1 (1-15)** | AI1, AI2, AI3, AI4, AI5, AI6 | See list of available sensor inputs. | Software configurable, Application: temperature, humidity, pressure |
| **3, 8** | EXT-VDC | 16 V, 80 mA | Power for AIs from the controller. Maximum four 0-20 mA/4-20 mA sensors |
| **13** | AVPS/EXT-VDC | AVPS = 5 V, 20 mA **or** EXT-VDC = 16 V, 80 mA | Directly power ratiometric sensors with AVPS **or** 0-10 V, 0/4-20 mA Sensors with EXT-VDC. AVPS or EXT-VDC selected by jumpers. |
| **List of Available Sensor Inputs** | | | |
| **Sensor Type** | | **Linearization Range** | **Accuracy @ 20°C (68°F) Controller Ambient** |
| **Ni1000 JCI** | | -45°C (-49°F) to 120°C (248°F) | ±0.5°C (1°F) |
| **Ni1000 JCI Extended** | | 20°C (68°F) to 287°C (548.6°F) | ±0.5°C (1°F) |
| **Ni1000 Siemens (L&G)** | | -50°C (-58°F) to 160°C (320°F) | ±0.5°C (1°F) |
| **Ni1000 DIN** | | -60°C (-76°F) to 180°C (356°F) | ±0.5°C (1°F) |
| **Pt1000** | | -50°C (-58°F) to 160°C (320°F) | ±0.5°C (1°F) |
| **A99** | | -50°C (-58°F) to 100°C (212°F) | ±0.5°C (1°F) |
| **NTC 2.2k** | | -40°C (-40°F) to 150°C (302°F) | ±0.5°C (1°F) |
| **NTC 10k** | | -40°C (-40°F) to 150°C (302°F) | ±0.5°C (1°F) |
| **0 to 5 VDC ratiometric** | | 10 to 90% of supply voltage (0.5 to 4.5 V nom) | ±0.05 VDC |
| **Active 0 to 20 mA** | | 0 to 20 mA linear | ±0.1 mA |

**Table 38: Digital Input (DI)**

| Terminals | Channel | Type | Remark/Application |
|---|---|---|---|
| **TB2 (21-33)** | DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8 | Potential free contacts | Transition counter at 50 Hz max.<br>Minimum time ON: 10 ms<br>Minimum time OFF: 10 ms<br>Prescaler function: max. division by 100 |
| **34, 35** | DI V~ Hot<br>DI V~ Com | 24 VAC | FX16 (not Rev. A): for isolation of DIs from the microprocessor a separate 24 VAC power supply is required. |

**Table 39: Digital Output (DO)**

| Terminals | Channel | Type | Remark/Application |
|---|---|---|---|
| **TB3** | DO1, DO2, DO3 | SPST 8(3)A power relays | Max. switching power:<br>Motor: 240 W, 0.5 hp, 250 VAC<br>Rating (resistive): 8 A 125 VAC<br>8 A 30 VDC<br>8 A 250 VAC<br>UL tested life (min. operations): 30,000 operations (at 360 ops x hour)<br>Dielectric strength coil-contacts: 4,000 V RMS for 1 minute |
| **TB4** | DO4, DO5 | SPST 5(3)A power relays<br>**or**<br>0,5A/24 VAC triacs | Max. switching power (relays):<br>Motor: 150 W, 0.25 HP, 250VAC<br>Rating (resistive): 5 A 125 VAC<br>5 A 30 VAC<br>5 A 250 VDC<br>UL tested life (min. operations): 30,000 operations (at 360 ops x hour)<br>Dielectric strength coil-contacts: 4,000 V RMS for 1 minute |
| **TB5** | DO6, DO7, DO8 | SPST 5(3)A power relays<br>**or**<br>0,5A/24 VAC triacs | |
| **TB6** | DO9 | SPDT NC 8(3)A 250 V relay | Same as TB3 relays<br>Fail relay for enhanced security. The relay returns to its Normally Closed (NC) position not only at power fail but also in case the microprocessor should fail: watch-dog, brown-out, and so on. |

**Table 40: Analog Outputs (AO)**

| Terminal | Channel | Type | Remark/Application |
|---|---|---|---|
| **TB7** | AO1, AO2 | 0 -10 VDC<br>FX16D/FX16X: 1.5 mA<br>FX16X Rev. A: 5 mA | Used to drive motor actuators, power triacs, frequency drives. 16 bit resolution. |
| **TB8** | AO3, AO4 | 0 -10 VDC<br>FX16D/FX16X: 1.5 mA<br>FX16X Rev. A: 5 mA | Used to drive motor actuators, power triacs, frequency drives. 16 bit resolution. |
| **79, 80** | AO V~ Hot<br>AO V~ Com | 24 VAC | FX16 (not Rev. A): for isolation of AOs from the microprocessor a separate 24 VAC power supply is required |

## FX16 Master Controller

**Table 41: FX16 Master Controller**

| | |
|---|---|
| **Product** | **FX16D** Master Controller<br>**FX16X** Master Controller Extended Temperature Range<br>**FX16X** Rev A Master Controller Extended Temp. Range |
| **Power Supply** | 24 VAC ±15%, 50/60 Hz - Class 2 Power Supply |
| **Power Consumption** | 15 VA at max. load |
| **Internal Fuse** | 2 A, 250 V |
| **Protection Class** | IP 20 IEC60529 |
| **Isolation** | See Isolation Diagram. |
| **Ambient Operating Conditions** | **FX16D and integral display**: -20°C (-4°F) to +50°C (122°F) ,10 to 95% RH (noncondensing)<br>**FX16X Extended Temperature Range: -40°C (-40°F) to 60°C (140°F)**, 10 to 95% RH (noncondensing) |
| **Ambient Storage Conditions** | -40°C (-40°F) to +70°C (158°F),10 to 95% rH (noncondensing) |
| **Dimensions (H x W x D)** | 142 mm (5.6 in.) x 215 mm (8.5 in.) x 49 mm (1.9 in.)<br>With display: 142 mm (5.6 in.) x 215 mm (8.5 in.) x 66 mm (2.6 in.) |
| **Weight (with package)** | 0.74 kg (1.6 lb) |
| **I/O ratings** | See *Ordering Codes.* |
| **Connection Terminals for Signals and Power Supply** | Screw terminals for max. 1 x 1.5 $mm^2$, 16 AWG wires. |
| **N2 Open Bus Connection terminals** | Screw terminals, cable size 0.5 mm to 1.5 $mm^2$, 24 AWG to 16 AWG. Belden® cable, 4-core twisted pair with shield |
| **LON Network Connection terminals** | Screw terminals, cable size 0.5 mm to 1.5 $mm^2$, 24 AWG to 16 AWG. Belden cable, 2-core twisted pair with shield |
| **Connection for Extension Bus and Remote Display** | Screw terminals, cable size 0.5 mm to 1.5 $mm^2$, 24 AWG to 16 AWG. Belden cable, 4-core, twisted pair with shield |
| **Continued on next page …** | |

| | | |
|---|---|---|
| **Single Cable Lengths (Cont.)** | | |
| **Digital Inputs DI1 - DI8** | | Max. 100 m (328 ft) with cables ≥ 0.6 mm, 22 AWG |
| **Analog Inputs AI1 - AI6** | | Max. 100 m (328 ft) with cables ≥ 0.6 mm, 22 AWG |
| **Triac Outputs** | | Max. 100 m (328 ft) with cables ≥ 1.5 $mm^2$, 16 AWG |
| **Analog Outputs AO1-AO4** | | Max. 100 m (328 ft) with cables ≥ 1.5 $mm^2$, 16 AWG |
| **Remote Display** | | Max. 3 m (10 ft) if display is powered by controller. Max. 1 km (0.6 miles) if display independently powered |
| **Extension Modules** | | Max. 1 km (0.6 miles) |
| **Compliance:** | **Europe** | – 89/336/EEC, EMC Directive: EN 61000-6-3, EN 61000-6-2<br>– 72/23/EEC, Low Voltage Directive: EN 60730 |
| | **Canada** | – UL Listed (PAZX7), CAN/CSA C22.2 No. 205, Signal Equipment<br>– UL Recognized (XAPX8), CAN/CSA C22.2 No. 24, Temperature Indicating and Regulating Equipment<br>– Industry Canada, ICES-003 |
| | **United States** | – UL Listed (PAZX), UL 916, Energy Management Equipment<br>– UL Recognized (XAPX2), UL 873, Temperature Indicating and Regulating Equipment<br>– FCC compliant to CFR 47, Part 15, Subpart B, Class A |

## N2 Open Card

**Table 42: N2 Open Card**

| | |
|---|---|
| **RS-485 Line** | Maximum length without repeater: 1,200 m (4,000 ft), AWG22 (minimum) twisted pair with shield. |
| **Devices** | Maximum of 32 per 1,200 m (4,000 ft) bus segment |
| **RS-485/232 Converter** | IU-9100 (Europe)<br>LP-KIT200-000C Commissioning Adapter (North America)<br>If third-party converter is used, then ensure it supports automatic DSC (Data Send Control). |
| **Electrical Isolation** | 500 V |

## LON Connection

**Table 43: LON Connection**

| | | |
|---|---|---|
| **LON Network and Line Terminators** | Daisy-chained Bus Topology: two terminators of 100 ohm required, one at each end of the bus.<br>Free (star) topology: single terminator of 50 ohm required. | |
| **Nodes** | 64 (if repeaters are not used), FTT-10 nodes only. | |
| **Cable Type:** | **Length with FTT-10 devices** | |
| | **Bus Topology** | **Free Topology** |
| **Belden 85102** | 2,700 m (8,900 ft) | 500 m (1,640 ft) |
| **Belden 8471** | 2,700 m (8,900 ft) | 500 m (1,640 ft) |
| **Level IV 22 AWG** | 1,400 m (4,600 ft) | 400 m (1,300 ft) |

Note: For full technical details of LONWORKS networks, refer to the LONMARK® Guidelines at www.lonmark.org.

# GSM Connection

**Table 44: GSM Modem**

| GSM Modem | | GSM 900 | | | GSM 1800/1900 | | |
|---|---|---|---|---|---|---|---|
| **Voltage Range** | | 5 to 32 VDC | | | | | |
| **Power Supply at 25°C** | | **Min.** | **Typ.** | **Max.** | **Min.** | **Typ.** | **Max.** |
| **Input Supply Voltage** | | 5 | 13.2 | 32 | 5 | 13.2 | 32 |
| **Input peak supply current (in communication)** | at 5 V | | | 1.8 A | | | 1.1 A |
| | at 13.2 V | | | 0.7 A | | | 0.4 A |
| | at 32 V | | | 0.4 A | | | 0.2 A |
| **Input average supply current (in communication)** | at 5 V | | | 330 mA | | | 220 mA |
| | at 13.2 V | | | 130 mA | | | 95 mA |
| | at 32 V | | | 65 mA | | | 50 mA |
| **Input average supply current (in idle mode)** | at 5 V | | | 31.4 mA | | | 31.4 mA |
| | at 13.2 V | | | 13.2 mA | | | 13.2 mA |
| | at 32 V | | | 5.6 mA | | | 5.6 mA |
| **Ambient Operating Conditions** | -20°C (-4°F) to 55°C (131°F) | | | | | | |
| **Ambient Storage Conditions** | -25°C (-13°F) to 70°C (158°F) | | | | | | |
| **Housing Material** | Aluminum profiled | | | | | | |
| **Volume** | 12.2 $cm^3$ (0.7 $in.^3$) | | | | | | |
| **Weight** | <130 g (0.3 lb) | | | | | | |
| **Dimensions** | 98 mm (3.9 in.) x 54 mm (2.1 in.) x 25 mm (1 in.) (excluding connectors) | | | | | | |
| **Overall Dimensions** | 110 mm (4.3 in.) x 54 mm (2.1 in.) x 25 mm (1 in.) | | | | | | |

## Programming Key

**Table 45: Programming Key**

| | |
|---|---|
| **Power Supply** | Directly powered from the Display Bus port of the FX16 Master Controller or from an AC/DC adapter providing 12 to15 VDC 2 VA minimum |
| **Memory Type and Size** | Flash memory 1 MB |
| **Connection to Controller** | Via RS-485, not isolated, 10 cm cable provided with the key |
| **Enclosure IP Class** | IP40 IEC60529 |
| **Ambient Limits** | Operating: 0°C (32°F) – 40°C (104°F), 10-95% RH (noncondensing)<br>Storage: -20°C (-4°F) – 70°C (158°F), 10-95% RH (noncondensing) |
| **CE Compliance** | Europe: EMC Directive: EN 61000-6-3, EN 61000-6-2 |

*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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