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Innovative Ideas in Motion

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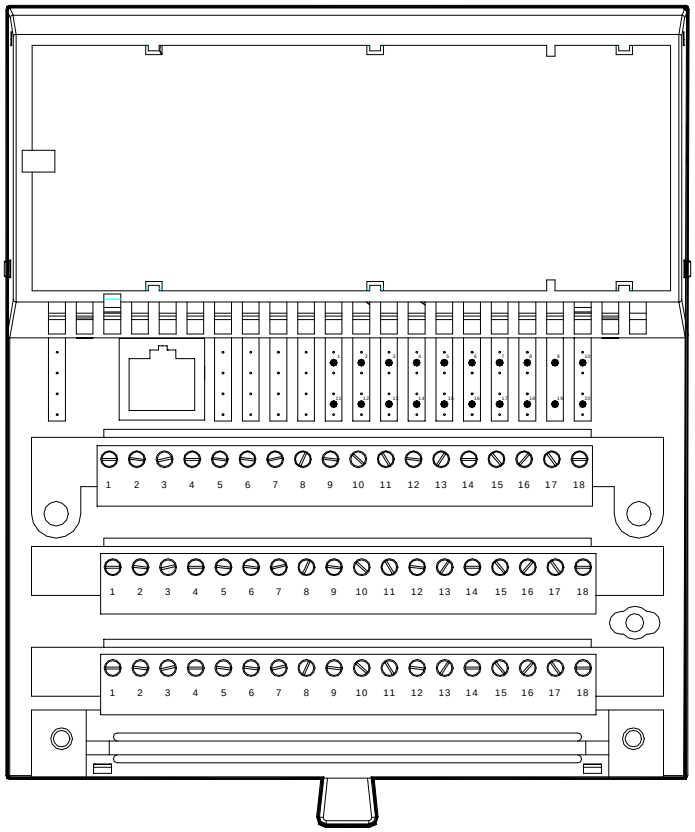
IFC 220E
Two Axes - Momentum I/O Base Servo Control Module

User's Guide
(P/N: 5000-04)



Revision 1.6
09/26/02

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In this Chapter you will learn about:

- Important User Information
- Product Warranty
- Return Policy
- Technical Support
- Assumptions
- Contents of This User's Guide
- IFC 220E Module Basics

1.1. Important User Information

To ensure safe and satisfactory operation of the equipment described in this user's guide, as well as the equipment connected to and used with your IFC 220E, all applicable local and national codes that apply to installing and operating the equipment must be followed.

WARNING ☞ Failure to comply with applicable local and national codes and standards can result in damage to equipment and/or serious injury to personnel.

Personnel responsible for the installation and/or operation of the equipment should study this user's guide and all referenced documentation prior to installation or operation of the equipment.

In no event is the provider of the equipment liable for any incidental, consequential or special damages of any kind or nature whatsoever, including but not limited to lost profits arising from or in any way connected with the use of this user's guide or the equipment.

The IFC 220E is designed to provide solutions for a wide variety encoder and servo applications. Therefore, it is the end user's responsibility to determine the acceptability of any products used in any application. The equipment provider assumes no responsibility for the User's misapplication of the IFC 220E.

Since I²T constantly strives to improve its products, we reserve the right to change this user's guide and any equipment mentioned herein at any time without notice.

1.2. Product Warranty

I²T warrants that all equipment they manufacture will be free from defects in materials and workman-ship for a period of one (1) year from the date of invoice. Within this warranty period, I²T shall, at its option, repair or replace – free of charge, any equipment covered by this warranty. This warranty does not cover any equipment damaged by improper installation, accident, alteration or misuse. In no event shall I²T be liable for incidental or consequential damages or for delay in performance of this warranty.

1.3. Return Policy

Any equipment returned as new must be in the original, unopened shipping carton and is subject to a 20% restocking fee. All equipment returned to I²T for repair or replacement, regardless of warranty status, must have return authorization. To receive return authorization, call the I²T technical assistance number with the following product information:

- Product Part Number
- Serial Number
- Description of Problem

I²T issues a Return Material Authorization (RMA) number. You must ship the product to I²T with shipping charges prepaid and the RMA clearly marked on the outside of the shipping container. Title and risk of loss or damage remains with the customer until shipment is received by I²T. All equipment returned for warranty repair must be in the original shipping container or additional handling charges apply. In special cases, I²T will provide emergency replacement of defective equipment. For special cases, the customer must provide a Purchase Order number in the amount of a product being shipped plus any applicable taxes and shipping charges. In the event that the defective equipment is not returned within seven (7) days, I²T bills the customer for the replacement equipment.

1.4. Technical Support

All I²T products are sold through authorized Schneider Electric high-tech distributors. The customer should attempt to resolve any problems through their local distributor before contacting I²T directly. Should your local distributor be unavailable or unable to solve a problem, contact I²T Technical Support at (412) 828-1200. Setup Software and Firmware updates are available via our WEB site at www.isquaredt.com

1.5. Assumptions

To effectively use the IFC 220E User's Guide to install, develop and maintain your system, you should have a fundamental understanding of the following:

- Electronic concepts such as voltage, current, switches, etc.
- Motion control concepts such as position, velocity, acceleration, etc.,
- Ladder Logic programming skills
- Contents of this IFC 220E User's Guide.

1.6. Contents of This User's Guide

Each chapter provides a different level of help to get your system set up and ready to go. Below is a summary of each chapter's purpose.

Chapter / Appendix	Purpose
1 – Overview	Provides an overview of the items to be covered in this IFC 220E User's Guide.
2 – Introduction	Describes the IFC 220E and provides a brief overview of its features and design.
3 – Installation	Provides instructions for configuring, mounting and wiring the IFC 220E Momentum I/O Base Servo Control Module.
4 – IFC 220E Windows Setup Software	Allows the user to configure and test the module in a Windows environment.
5 – PLC Programming	Describes the IFC 220E's user functions in detail and shows how to implement them in your application.
6 – Troubleshooting	Describes methods for isolating and resolving hardware and software problems. Describes the Diagnostics LEDs and the fault registers returned to the PLC.
A – Calculating User Units	Provides information on calculating user units.
B – Drawings	Provides drawings showing Module/Field interconnections and mechanical drawings of Motors and Drives.

1.7. IFC 220E Module Basics

This section provides the user with an understanding of the capabilities related to the IFC 220E. The IFC 220E is designed to be an easy-to-use PLC-based 2-axis I/O base servo control module. Some of the uses for the IFC 220E are described below.

1.7.1. 2-Axes Encoder Feedback Module

This application uses the IFC 220E to read the position or velocity of two encoder channels directly into the Schneider Momentum PLC. A user loadable function block maps registers from the module directly to the PLC. When using the function block, the position and velocity of the axes is written directly into PLC registers. For more complex applications, a command-response protocol (see Send Packet in *Section 4.3.1.3*) transfers commands to and from the module from the PLC. The following is a list of I²T encoders and cables that are compatible with the module when using encoder feedback.

Part No.	Description
3000-07	Flange Mount Heavy-Duty Encoder (1024 PPR), 90 deg Connector, IP65 Sealed
3000-08	Flange Mount Heavy-Duty Encoder (1024 PPR), Straight Connector, IP65 Sealed
4006-025	Encoder Cable, 25 foot
4006-050	Encoder Cable, 50 foot
4006-100	Encoder Cable, 100 foot

Table 1-1: Encoder Feedback – Encoders and Cables

1.7.2. 2-Axes Motion Control Module

The IFC 220E can control two servo motors with encoder feedback through a single phase torque or velocity command to the servo drives (±10Vdc). The IFC 220E can easily perform complex motion functions using the loadable function block (for Schneider ProWorx NXT or Concept) developed by I²T. All motion programming is done via PLC logic. The following is a list of some of the motion functions available in the IFC 220E.

- Blended Moves
- High-speed Registration
- Input Position Latching
- Programmable Limit Switch Function
- Move Table with 16 Move Profiles
- Electronic Gearing Master/Slave CAM Function
- Point-to-point Absolute or Index Moves

The following is a list of I²T motors and drives that are compatible with the module when using servo control mode.

Part No.	Description
BM75E	Servo Motor, NEMA 23, 75 oz-in, MS Conn, 1000 Line Encoder
BM130E	Servo Motor, NEMA 23, 130 oz-in, MS Conn, 1000 Line Encoder
BM200E	Servo Motor, NEMA 23, 200 oz-in, MS Conn, 1000 Line Encoder
BM250E	Servo Motor, NEMA 34, 260 oz-in, MS Conn, 1000 Line Encoder
BM500E	Servo Motor, NEMA 34, 510 oz-in, MS Conn, 1000 Line Encoder
BM800E	Servo Motor, NEMA 42, 780 oz-in, MS Conn, 1000 Line Encoder
BM1400E	Servo Motor, NEMA 42, 1365 oz-in, MS Conn, 1000 Line Encoder
BM2000E	Servo Motor, IEC, 130 in-lb, MS Conn, 1000 Line Encoder
BM3400E	Servo Motor, IEC, 210 in-lb, MS Conn, 1000 Line Encoder
BM4500E	Servo Motor, IEC, 280 oz-in, MS Conn, 1000 Line Encoder
BA10	Servo Drive, 5A Cont, 10A Peak, 120Vac
BA20	Servo Drive, 10A Cont, 20A Peak, 120Vac
BA30	Servo Drive, 15A Cont, 30A Peak, 120Vac
BA50	Servo Drive, 25A Cont, 50A Peak, 230Vac, 3-phase
BA75	Servo Drive, 37A Cont, 75A Peak, 230Vac, 3-phase
BA100	Servo Drive, 50A Cont, 100A Peak, 230Vac, 3-phase
PFC-15	Cable, Encoder to Drive
PMC-XX	Cable, Drive to Motor for BM75, BM130, BM200, BM250
PMC1-XX	Cable, Drive to Motor for BM500, BM800, BM1400
PMC2-XX	Cable, Drive to Motor for BM2000, BM3400, BM4500
4007-015	Cable, Controller to Drive, 3 Foot

Table 1-2: Servo Control Mode – Motors and Drives

In this Chapter you will learn about:

Product Description

Product Features

Hardware Block Diagram

2.1. Product Description

The IFC 220E is a Momentum PLC servo module that provides two channels of encoder feedback and control. I²T manufacturers this module using the latest hardware components and surface mount technology. The IFC 220E is certified by Schneider Electric (previously Modicon) to be a ModConnect/Schneider Alliance product.

The IFC 220E can operate in one of two modes described in *Table 2-1*.

Mode	Description
1	Velocity & Position Feedback with Software Limit Switch.
2	Positioning Mode to position DC, Flux Vector or Servo Drives with encoder feedback. A set of 16 position, speed, accel and decel registers are used to initiate moves from the PLC.

Table 2-1: Operational Modes of the IFC 220E

Users may configure the IFC 220E with the supplied Universal HMI Windows Setup Software (P/N 2000-03). This software package runs on an IBM compatible computer running Windows 9X or higher. The module configuration data is entered via a PC or downloaded to the IFC 220E via an RJ45 serial programming port on the front of the module (see *Figure 3-1* for location of this port). The configuration data is stored in the Flash Memory of the IFC 220E so that data is maintained during a power loss.

I²T developed a user loadable function block (FN43) for use with the IFC 220E to make programming the module easy (see *Chapter 5*). The FN43 User Loadable provides eight functions which are summarized in *Table 2-2*.

Function	Description
0	Get Loadable Version
1	Read Position, Speed, Status and Programmable Limit Switch Monitor
2	Axis Homing
3	Point-to-Point Move Profile
4	Download 16-Point Move Table
5	Execute 16-Point Move Table
6	Copy Setup Configuration from Module to PLC
7	Copy Setup Configuration from PLC to Module

Table 2-2: Functions of the FN43 User Loadable

2.1.1. Function 0 – Get Loadable Version

Returns the version of the loadable.

2.1.2. Function 1 – Position, Speed, Status and PLS Monitor

Allows the IFC 220E to write position, velocity and diagnostic information directly into user-defined PLC registers.

2.1.3. Function 2 – Axis Homing

Allows the axes to initiate a homing sequence. The user loads the appropriate PLC registers with the speed and direction of the homing move.

2.1.4. Function 3 – Point-to-Point Move Profile

Point-to-Point moves are accomplished by loading the appropriate registers of the function block with the desired position, speed, acceleration and deceleration of the move. An additional register in the function block identifies the move as Absolute, Incremental Negative or Incremental Positive.

2.1.5. Function 4 – Download 16-Point Move Table

Load up to sixteen Move Table entries to the IFC 220E. Each table entry contains a position, velocity, acceleration and deceleration. Once the **Move Table** is loaded to the IFC 220E, it is possible to initiate the move with Function 5.

2.1.6. Function 5 – Execute 16-Point Move Table

By setting bits in a register from the PLC, users can execute any of the 16 move positions. A corresponding bit in another PLC register is set when the move completes.

2.1.7. Function 6 – Copy Setup Configuration from Module to PLC

Copy the IFC 220E Setup Data to the PLC. The setup data can then be downloaded to a new module without using the HMI Software.

2.1.8. Function 7 – Copy Setup Configuration from PLC to Module

Copy setup data to the IFC 220E that was previously saved to the PLC using Function 6 described above.

2.1.9. Function 8 – Send Generic Low-level Commands

Allows the PLC to execute a low-level function.

2.2. Product Features

The IFC 220E incorporates many features. Each feature is described below.

2.2.1. Module Type

Momentum PLC compatible Two-axis I/O Base Servo Control Module.

2.2.2. Resolution

Encoder resolution ranges from 100 to 100,000 counts/rev. This feature converts encoder counts to user units for use in a PLC. Using Modulo 10,000 format (how position values are stored in PLC registers) the IFC 220E can count position up to 655,359,999 and send that information to the PLC. Encoder Counts/Revolution = 2^{31-1}. Encoder User Units/Revolution = 32,767 (counts/rev).

2.2.3. Information Throughput

Reads position and calculates velocity every 500 microseconds. Presents data to the PLC every scan.

2.2.4. Encoder Feedback

Quadrature type feedback ranging from 100 to 100,000 pulses/rev.

2.2.5. Encoder Channels

The IFC 220E has two differential encoder channels (A, B and Marker) that can be scaled in user units and read into PLC registers.

2.2.6. Discrete Inputs

The IFC 220E consists of four 10 to 30Vdc limit inputs per axis (FWD, REV, Home and Fault) and five user definable inputs.

2.2.7. Discrete Outputs

Sinking 10 to 24Vdc @ 250 mA: One dedicated drive enable per axis and five user.

Sourcing 24 Vdc @ 1A: Two user.

2.2.8. Analog Outputs

One per Axis, 16 Bit under servo control, 14 bit under user control (not PID). Capable of sourcing 200mA.

2.2.9. Function Blocks

Program motion via an FN43 User Loadable Function Block for Schneider Electric's ModSoft, ProWorx Plus, ProWorx NxT and Concept.

2.2.10. Move Profiles & Blended Moves

The module has sixteen positions, speeds, accels and decels stored in memory. This allows the PLC to execute individual move profiles or blended moves to create a complex move.

2.2.11. Registration Function

The module permits registration for labeling and packaging applications.

2.2.12. Electronic Gearing

The IFC 220E permits electronic gearing for process synchronization and gantry cranes.

2.2.13. CAM Tables

Downloadable CAM tables permit complex contouring applications.

2.2.14. Parameter Storage

Provides On-board Flash Memory for storage and retrieval.

2.2.15. Power Consumption

Maximum 1 Amp @ 24 Vdc. Minimum 0.3A. Typical 0.7A. Actual current is determined by top hat used and encoder power requirements.

Note: Readings do not include current necessary for 24 Vdc sourcing outputs.

2.2.16. Environmental Conditions

- Operating Temperature: 0 to 60°C
- Relative Humidity: 5 to 95% (Non-condensing)
- Storage Temperature: -40 to 85°C

In this Chapter you will learn about:

- Inspecting the Shipment
- Typical System Components
- List of Components
- Installation Precautions
- Panel Layout
- IFC 220E System Wiring

3.1. Shipment Inspection

Check your IFC 220E packages, upon receipt, for obvious damage that may have occurred during shipment. Report any damage to the shipping company immediately. I²T cannot be held responsible for damage incurred during shipment. Along with your IFC 220E Momentum I/O Base Servo Control Module (P/N 1003-01), the following should be included:

- HMI Windows Setup Software (P/N 2000-03)
- User's Guide (P/N 5000-04)

Retain the shipping container in case you need to return the IFC 220E for any reason. Any damage incurred due to improper packing is the responsibility of the shipper and will further delay the repair or replacement of your parts. Motors, encoders, drives and cables are each shipped in separate containers. It is necessary to also inspect these items for damage as they are received. Again, retain your shipping containers in the case that you may need to return your products for any reason.

Figure 3-1 shows a diagram of the parts necessary to setup and operate a typical IFC 220E control system.

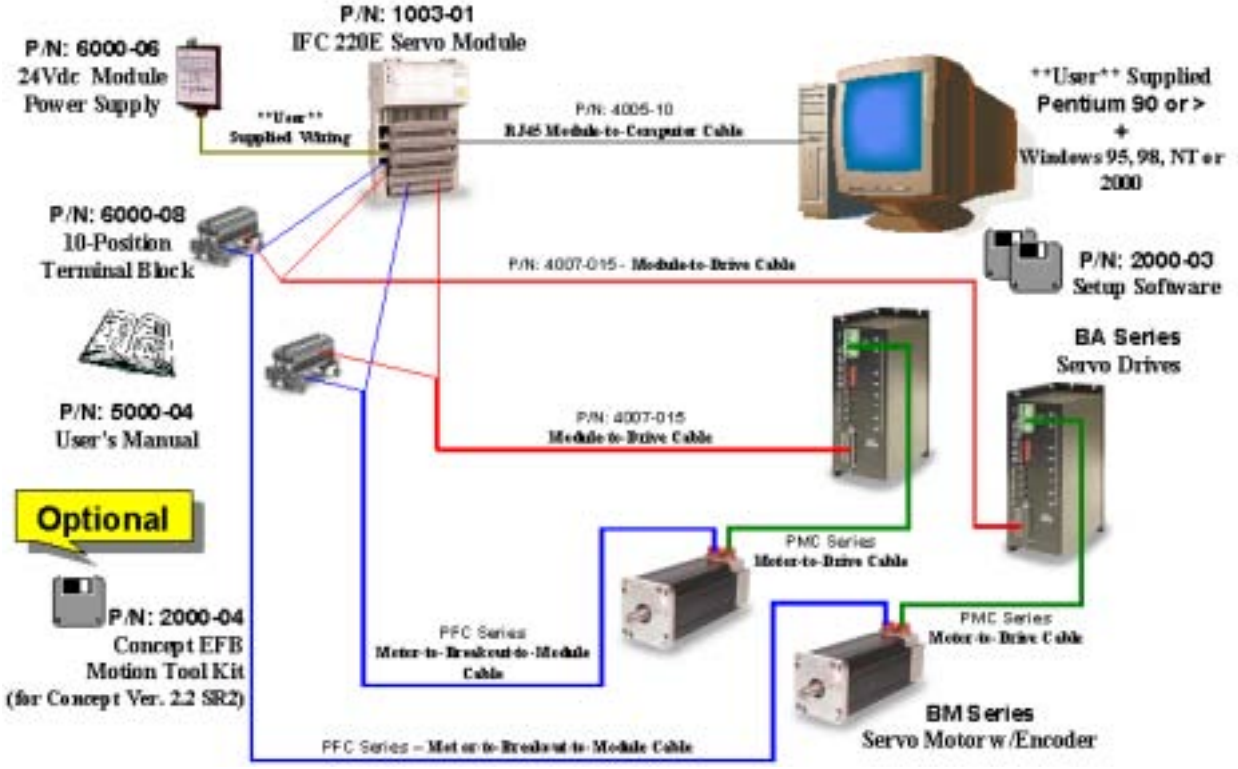


Figure 3-1: Typical Servo Control System

3.2. Typical System Components

Refer back to *Table 1-1* and *Table 1-2* for a complete list of components that I²T supplies. Our broad selection of components allows you to put together a complete IFC 220E servo control system with encoder feedback. If a component you are looking for is not listed, call the I²T technical support team (412-828-1200) for availability.

3.3. Installation Precautions

Before installing your IFC 220E, there are several precautions to take. If for any reason you are unsure about your system design, call your I²T distributor or the I²T technical support team before completing your design.

3.3.1. Electrical Noise

Before installing your IFC 220E, observe the following installation precautions to minimize the possibility of electrical noise.

CAUTION ☞ **Do not route high-voltage wires and low-level signals in the same conduit.**

Ensure all components are properly grounded.

Ensure all wiring is properly shielded. All shields should only be tied to the earth ground pin on the IFC 220E. This terminal must then be tied to a good earth ground.

Always use twisted-pair shielded cables when running signals.

Always use isolated circuits for remote signals. Use isolated analog and digital signals when possible.

Never cut the encoder cable to land on a terminal strip. Always run this cable from the encoder directly to the IFC 220E. This keeps the shielding scheme intact and minimizes the possibility of creating ground loops.

Put surge suppression components on all electrical coils: resistor/capacitor filters, MOVs, Zener and clamping diodes.

3.3.2. Heat & Humidity

All PLC equipment should be housed in an enclosure that prevents exposure to dirt, dust, liquids and harsh environments. To ensure personal safety and long life of your IFC 220E, pay special attention to the environmental conditions below.

NOTE ☝ **Always operate your IFC 220E at an ambient temperature between 0 and 60°C.**

Always store your IFC 220E at an ambient temperature between -40 and 85°C.

Maintain a relative humidity below 95% (Non-condensing).

3.4. Panel Layout

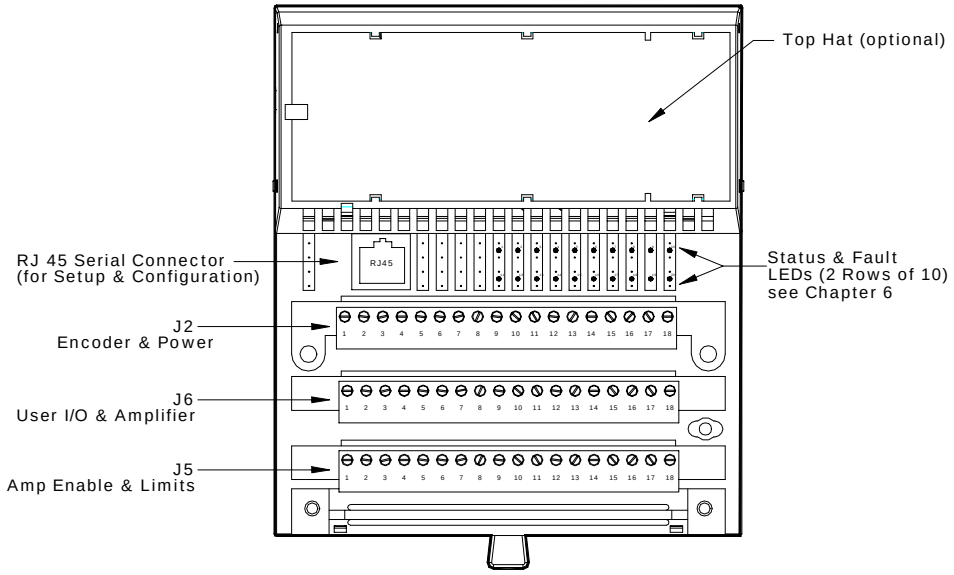
Install your IFC 220E in an enclosure that will protect it from atmospheric contaminants such as oil, metallic particles, moisture and dirt. The National Electrical Manufacturers Association (NEMA) established standards that define the degree of protection electrical enclosures provide. The enclosure that you use for PLC equipment should minimally conform to a NEMA 12 standard.

The IFC 220E mounts on a DIN rail in any Momentum PLC local or remote I/O. You will need a 24Vdc power supply capable of delivering 1.3 Amps (I²T P/N 6000-06) to drive the Digital I/O and Analog Outputs.

NOTE **Due to EMI generated by power switching devices, any device mounted in the same control panel as the IFC 220E should be located as far away as possible from PLC equipment and should have surge-suppressing devices installed on their terminals. This includes motor contactors, starters and relays.**

3.5. System Wiring Connections

The following sections explain how to wire your IFC 220E to an I²T BA Series Servo Drive and BM Series Servo Motor, an Over-travel and Home Limit Switch, a Power Supply, and an encoder feedback device. The following (in order of the terminal block pins seen on the front of the module) identifies the connections on the IFC 220E.



3.5.1. Encoder & Power (J2)

Table 3-2 identifies the IFC 220E encoder and power connections for Axis 1 and Axis 2. I²T encoders are flange mount (see *Appendix B*).

To minimize induced noise, run the encoder cable in its own conduit away from high power cables. Encoder cables are available from I²T in 25, 50 and 100 ft. lengths (P/N 4000-XXX).

To read accurate, jitter-free position values from the IFC 220E, you must keep the encoder signals clear of electrical noise. To do this, run the encoder wiring away from high-voltage signals and use shielded twisted-pair cable for the encoder signals. I²T designed the IFC 220E I/O Base Servo Control Module to be used with differential encoders.

To avoid potential noise problems, encoder shields must be tied to earth ground (Pin 7 or Pin 14) on the J2 connector. Do not tie shields to the power supply common.

Pin No.	Signal Name	Description	Pin No.	Signal Name	Description
1	Ax1 Encoder A+	Channel Encoder Input A	10	Ax2 Encoder B+	Channel Encoder Input B
2	Ax1 Encoder A-	Channel Encoder Input A not	11	Ax2 Encoder B-	Channel Encoder Input B not
3	Ax1 Encoder B+	Channel Encoder Input B	12	Ax2 Encoder Z+	Channel Encoder Input Z
4	Ax1 Encoder B-	Channel Encoder Input B not	13	Ax2 Encoder Z-	Channel Encoder Input Z not
5	Ax1 Encoder Z+	Channel Encoder Input Z	14	Shield	Shield
6	Ax1 Encoder Z-	Channel Encoder Input Z not	15	Encoder +5V	Encoder +5Vdc
7	Shield	Shield	16	Encoder GND	Encoder Ground
8	Ax2 Encoder A+	Channel Encoder Input A	17	+24V In	Isolation Voltage
9	Ax2 Encoder A-	Channel Encoder Input A not	18	24V GND In	

Table 3-2: Encoder Connections (J2 – Top Connector)

3.5.2. Limit Switch & Overtravel (J5)

Table 3-3 identifies the Home Limit Switch and Over-travel connections to the standard IFC 220E (I²T P/N 1003-01). A 24Vdc power supply (I²T P/N 6000-06) must be connected to the module for isolation voltage generation. This same power supply can be used to feed voltage to the Over-travel and Home Limit Switches. It is necessary to connect a normally closed (N.C.) type limit switch to the FWD (Pin 1 or 4) and REV (Pin 2 or 5) limit switch pins for the axis. This is a fail-safe connection that faults the axis in the event continuity is broken in this circuit. You may connect a normally closed (N.C.) or normally open (N.O.) limit switch to the Home Limit Switch pin (Pin 3 or 6).

Pin No.	Signal Name	Description
1	Ax 1 FWD EOT	Forward End of travel on Axis 1
2	Ax1 REV EOT	Reverse End of travel on Axis 1
3	Ax1 Home	Home Axis 1
4	Ax2 FWD EOT	Forward End of travel on Axis 2
5	Ax2 REV EOT	Reverse End of travel on Axis 2
6	Ax2 Home	Home Axis 2
7	Limit Common	EOT/Home Common for Axis 1 & Axis 2.
8	Ax1 Fault Input +	Positive Fault Input on Axis 1
9	Ax1 Fault Input –	Negative Fault Input on Axis 1
10	Ax2 Fault Input +	Positive Fault Input on Axis 2
11	Ax2 Fault Input –	Negative Fault Input on Axis 2
12	Ax1 Enable Sink	Enable Axis 1
13	Digital Output 6 (Source)	User Defined Digital Output 6
14	Ax2 Enable Sink	Enable Axis 2
15	Digital Output 7 (Source)	User Defined Digital Output 7
16	Enable/D.O. Common	Enable/Digital Output common
17	Enable/D.O. Common	Enable/Digital Output common
18	Shield	Shield

Table 3-3: Limit Switch Connections (J5 – Bottom Connector)

3.5.3. User I/O & BA Series Drive (J6)

The IFC 220E has an additional 5 user inputs and 5 user outputs that can be controlled directly from the PLC program. The user inputs can accept 10-30 Vdc (true high). The user outputs are 24 Vdc sinking at 0.25 Amps.

The IFC 220E has two dedicated axis outputs (Pins 14, 15, 16, 17) that can either be controlled from the PLC or the module. When controlled by the IFC 220E, the output can either control the enable of a drive by sinking the amp input or by controlling an enable relay (Motion Torque Mode or Motion Velocity Mode). The output can also be used to control a relay that controls the direction of a variable frequency drive. (See the **Output** dialog box under **Setup** in *Chapter 4*.)

Table 3-4 identifies the connections for the User I/O and I²T BA Series Servo Drive that uses an encoder for position feedback.

Pin No.	Signal Name	Description
1-5	User Input 1-5	User Defined Inputs 1 through 5
6	Input Common	Input Common
7	Signal Common	Signal Common
8-12	Digital Output 1-5 (Sink)	User Defined Digital Output1through 5
13	Digital Output Common	Digital Output Common

Table 3-4: User I/O and Drive Connections (J6 – Middle Connector)

3.5.4. Analog Output (J6)

The analog outputs, when controlled by the PLC, have a resolution of 12 bits. When the analog outputs are controlled by the IFC 220E (Motion Torque Mode or Motion Velocity Mode) the analog outputs have a resolution of 16 bits.

Through the HMI Windows Setup Software (*Chapter 4*) you can set the analog outputs to operate at ±10Vdc, 0 to 10Vdc or 0 to 5Vdc. (See the **Output** dialog box under **Setup** in Chapter 4.) *Table 3-5* describes each analog output.

Pin No.	Signal Name	Description
14	Ax 1 Analog Out +	Positive Analog Output Axis 1
15	Ax1 Analog Out -	Negative Analog Output Axis 1
16	Ax2 Analog Out +	Positive Analog Output Axis 2
17	Ax2 Analog Out -	Negative Analog Output Axis 2
18	Shield	Shield

Table 3-5: Analog Output Connections (J6 – Middle Connector)

In this Chapter you will learn about:

Software Installation

Running the Setup Software

Using the Setup Software

4.1. Software Installation

Before attempting to install the 32-bit universal HMI Setup Software on your computer, verify that your system meets the following requirements.

- Pentium 90 or higher
- Microsoft Windows 95, 98, NT, 2000 or XP
- 8 MB of RAM or higher
- 12 MB Hard Disk (free space) or higher
- CD-ROM drive
- VGA Monitor or higher

The Universal HMI Setup Software (P/N 2000-03) is used to configure the IFC 220E during installation. I²T includes this Setup Software with the IFC 220E Momentum I/O Base Servo Control Module on an *Install* CD.

This *Install* CD can install the following applications:

HMI Setup Software, MPL Development Environment, PLS Interface Software.

Also, Firmware and Loadables for all I²T Modules.

The following procedure explains how to install the Universal HMI Setup Software onto your hard disk:

1. Insert the *Install* CD into the CD-ROM drive.
2. If your system supports the auto-run feature, installation will start automatically.

   If your system does not support the auto-run feature, select **Start** on the task bar, select **Run**, then enter the letter of the CD-ROM drive and the word Install.exe (example: D:\Install.exe).
3. Follow the instructions as they appear.

4.2. Running the Setup Software

Before proceeding, you must have successfully completed the software installation described in *Section 4.1*.

Next, connect your PC to the IFC 220E Momentum I/O Base Servo Control Module using an I²T RJ45 Momentum Programming Cable (P/N 4005-10). For a detail drawing of this cable, see *Appendix B.*

4.2.1. Windows 95/98/NT/2000/XP Startup

To begin running your IFC 220E, start Windows 95, 98, NT, 2000 or XP and double click on the I²T "HMI Setup Software" icon that was previously installed on the Windows desktop during the installation.

The software automatically establishes the baud rates and serial port parameters to match your IFC 220E module.

To verify that your PC is communicating with the IFC 220E, check to see if the #2 Green LED (Top Row) is flashing on the front of the module and that the computer screen indicates "I²T Module Interface - Connected to IFC 220E Momentum I/O Base Servo Control Module".

Another way of verifying communications is that the icons on the software tool bar change from gray to color

4.3. Using the Setup Software

Help files were placed on your hard drive during the install procedure in section 4.1. Please refer to these files for details on using the Universal HMI Setup Software and for a listing of the command packets used to communicate with the IFC220E module.

To access the help files simply press the **F1** key or use the **Help** Pull-down Menu and select **Help Topics**.

NOTE ☝ **Once you finish setting up the IFC 220E parameters, Copy them to Flash (under the *Module* Pull-down Menu) Memory so they will not be lost during power-down.**

NOTE ☝ **Any Windows Setup Software function described in the *Help Topics* can also be done in real-time by issuing commands from the PLC. The IFC 220E uses a User Loadable Function Block (FN43) to make programming the module easy. If your PLC programming software requires that you have the loadable in a specific directory, you must copy the FN43.dat file to that directory.**

In this Chapter you will learn about:

PLC Configuration

Using User Loadable

5.1. PLC Configuration

The IFC 220E Momentum I/O Base Servo Control Module can be used with any Schneider Electric Momentum processor or communication adapter. This allows the IFC 220E to be I/O mapped into any Momentum, Quantum or "E" series slot mount PLC network. The IFC 220E controls the motion of two axes from the PLC logic. A user loadable function block (FN43) is provided with the IFC 220E to allow the user to program motion using the traditional 984 ladder logic programming language (ModSoft, Taylor ProWorx Plus, Taylor ProWorx NxT, and the 984 ladder logic language of Concept). I²T also provides DFBs used to program motion in the function block programming section of Concept. The use of the DFBs will be covered in a separate document. The FN43.DAT file is included with the Windows Setup Software on two 3-1/2" diskettes. The following are the eight modes of operation of the FN43 function block:

Mode 0. Get Loadable Version

Mode 1. Position, Speed, Status and Programmable Limit Switch Monitor

Mode 2. Axis Homing

Mode 3. Point-to-Point Move Profile

Mode 4. Download Sixteen-Point Move Table

Mode 5. Execute Sixteen-Point Move Table

Mode 6. Copy Setup Configuration from IFC 220E to PLC

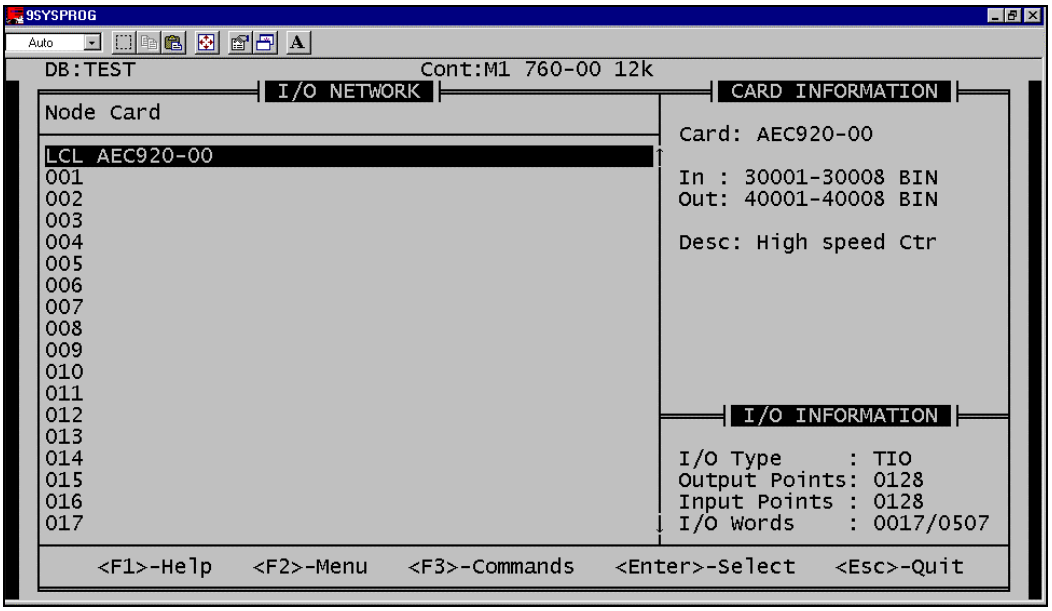
Mode 7. Copy Setup Configuration from PLC to IFC 220E

Each of the eight modes of operation is described in this chapter. You can program the IFC 220E with or without the FN43 User Loadable. This loadable is designed to make modes of operation easy to program from ladder logic. Install the FN43 loadable according to the instructions in the Configuration menu of your programming software (ModSoft, Taylor or Concept).

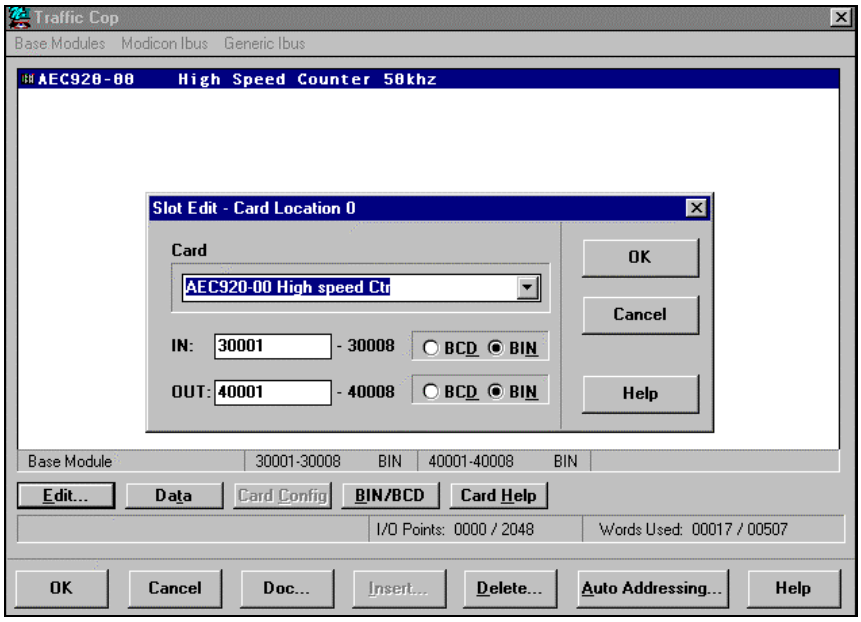
NOTE **The IFC 220E can also be used with the Schneider Electric Concept Programming package. The FN43 Function Block can be used in the 984 ladder logic programming section of Concept. A separate document will be supplied at a later date for programming the IFC 220E with I²T developed DFB's or EFB's for the Function Block programming section of Concept.**

5.1.1. I/O Mapping the Module

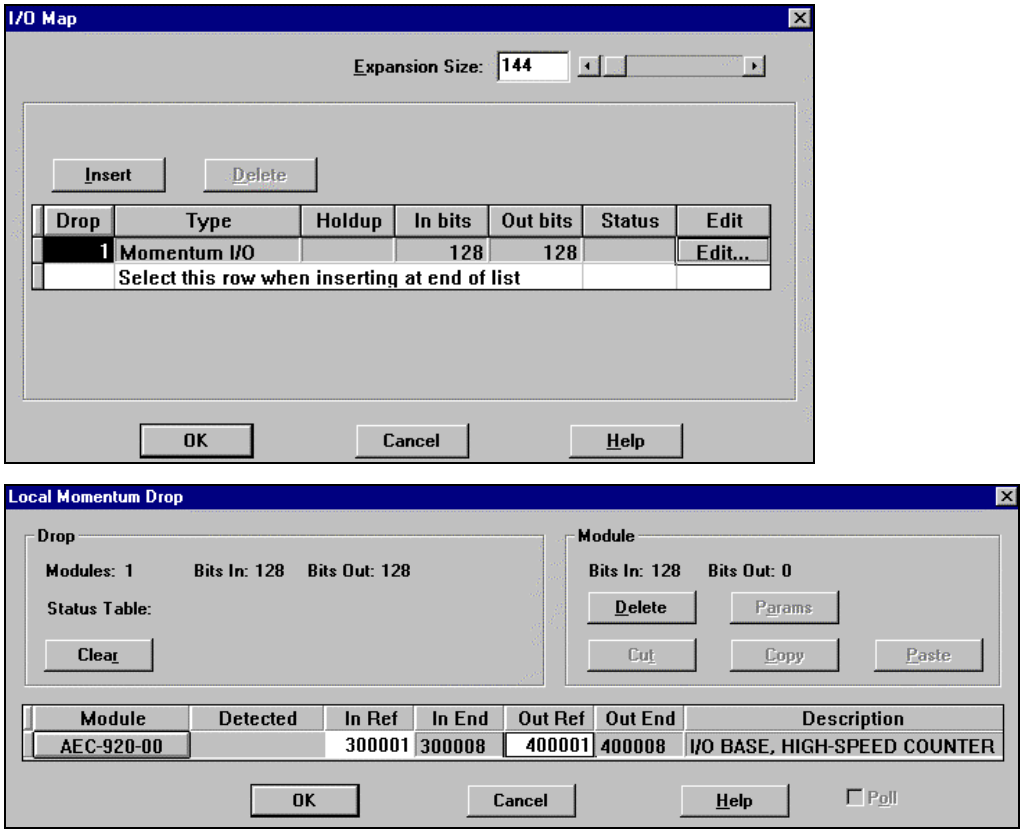
Knowledge of programming Momentum and the Schneider Electric line of PLCs is critical to properly install and program the IFC 220E. The procedures in the following sections may vary based on the type of programming software and PLC hardware used. The IFC 220E can be I/O mapped after the FN43 loadable is installed in the PLC configuration section of the PLC programming software. The IFC 220E is I/O mapped as an AEC920-00 High Speed Counter Module that uses eight binary (BIN) bi-directional registers (4XXXX and 3XXXX). The following screens are examples of how the IFC 220E is I/O mapped using the different PLC programming packages:



Screen 5-1: IFC 220E I/O Mapped using Taylor ProWorx Plus PLC Programming Software



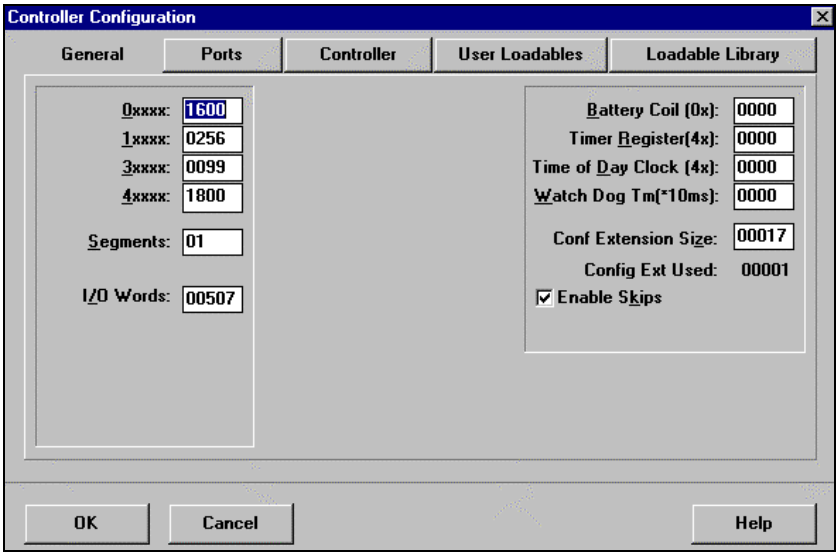
Screen 5-2: IFC 220E I/O Mapped using Taylor ProWorx NxT



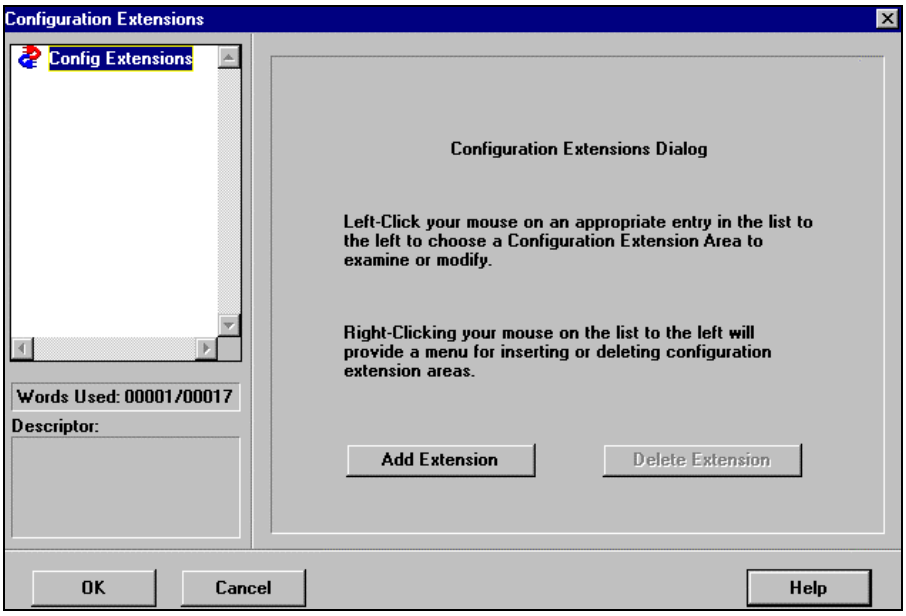
Screen 5-3: IFC 220E I/O Mapped using Schneider Electric Concept

5.1.2. Peer-Copping the Module

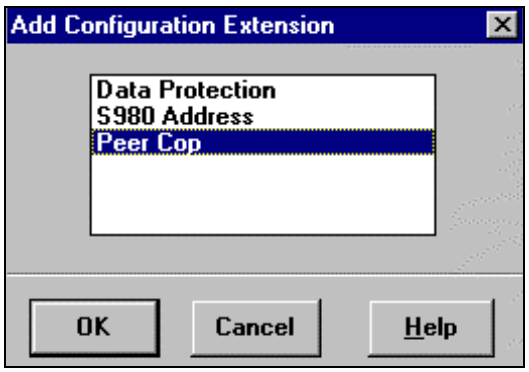
The following is an example of peer-copping the IFC 220E in a Modbus Plus network. The module can be used with a Modbus Plus communication adapter in a Quantum, an "E" series slot mount or a Momentum Modbus Plus network. This example uses Taylor ProWorx NxT software to peer-cop the module as specific I/O on address 2 on the MB+ network. After the module is peer-copped, the FN43 loadable sends commands to the IFC 220E via the 8 bi-directional registers setup in the specific I/O dialog box.



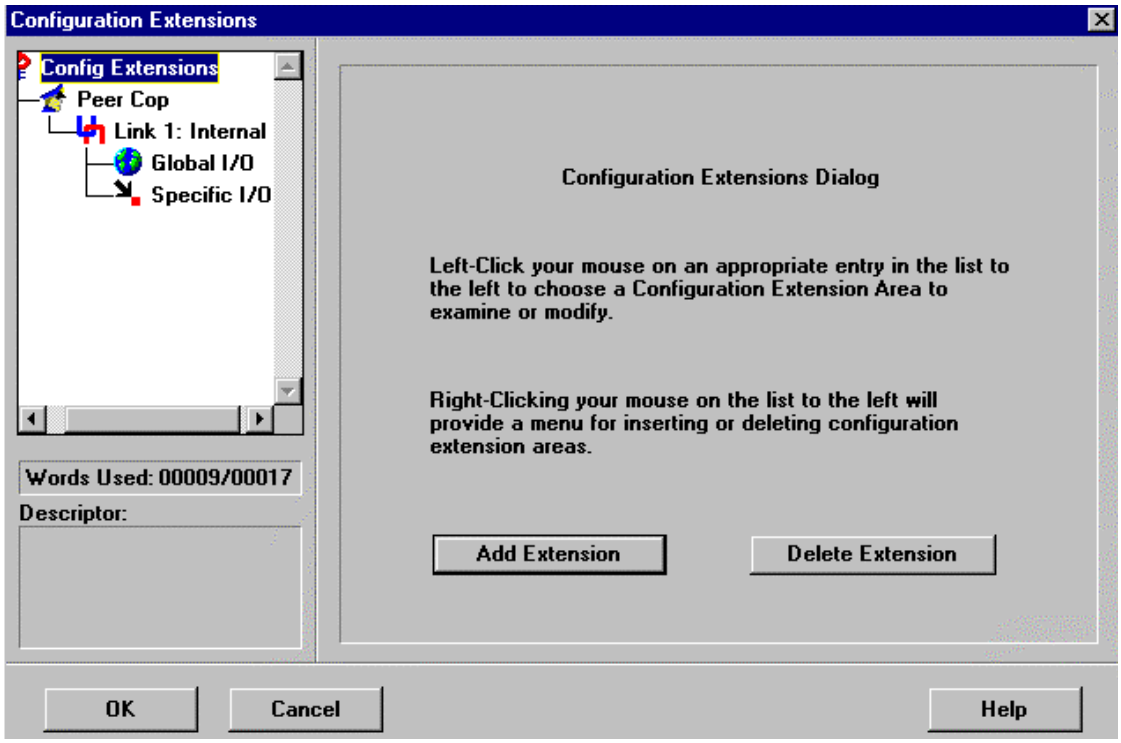
Screen 5-4: Set Configuration Extension Size to 00017 for one MB+ Node under the General Tab of the Controller Configuration Box. Extra Nodes require additional words.



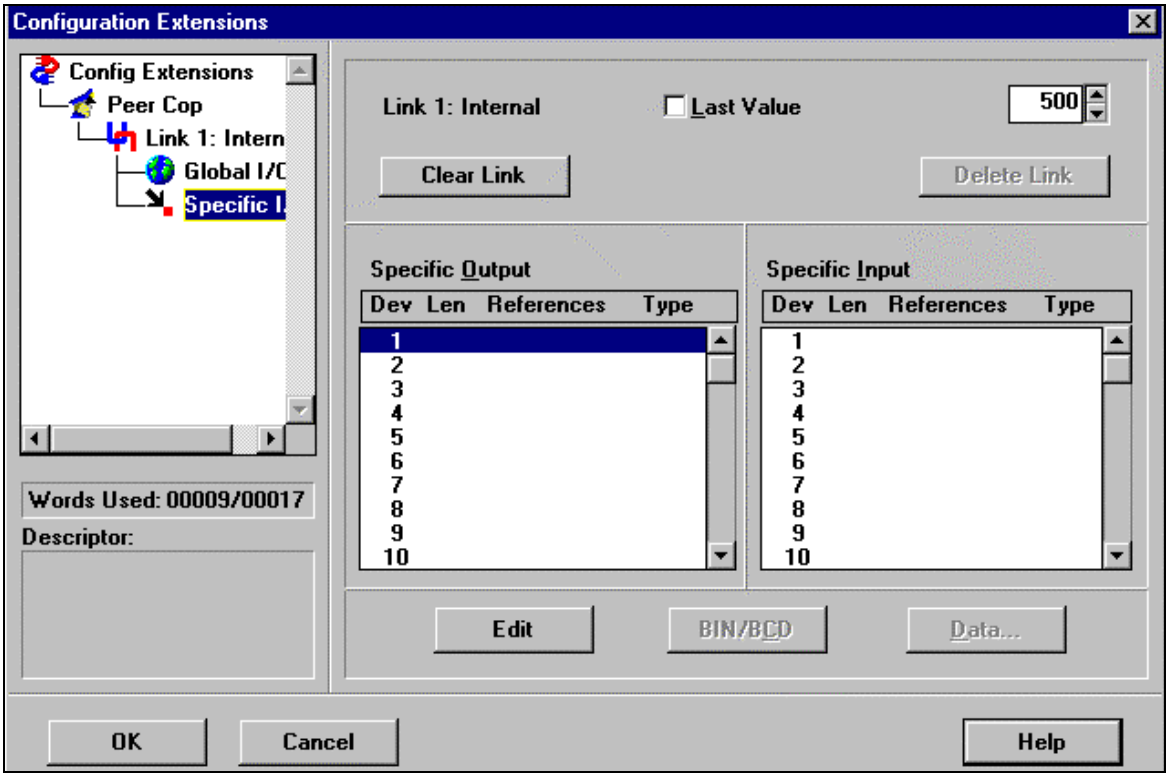
Screen 5-5: Select Add Extension Under Configuration dialog box



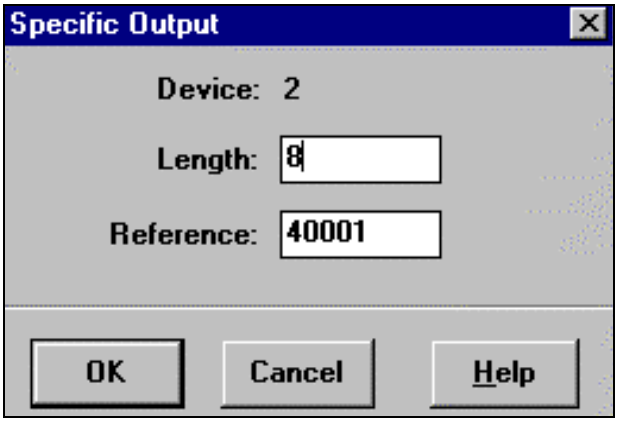
Screen 5-6: Select Peer Cop in the Add Configuration dialog box



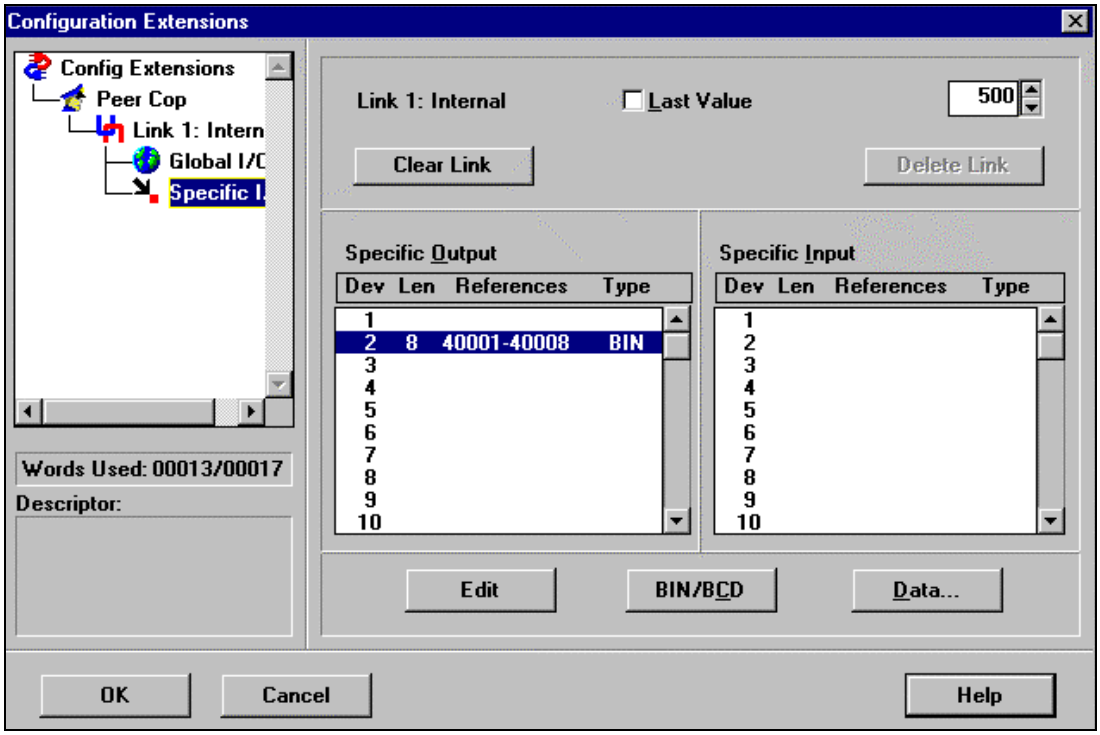
Screen 5-7: Configuration dialog box from selecting Peer Cop



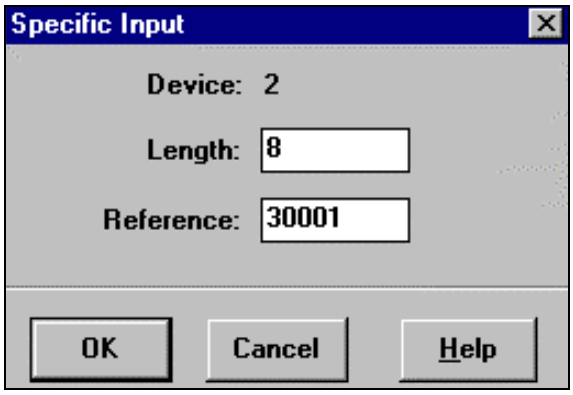
Screen 5-8: Select Specific I/O, Select 2 in the Specific Output Field, and then Select Edit



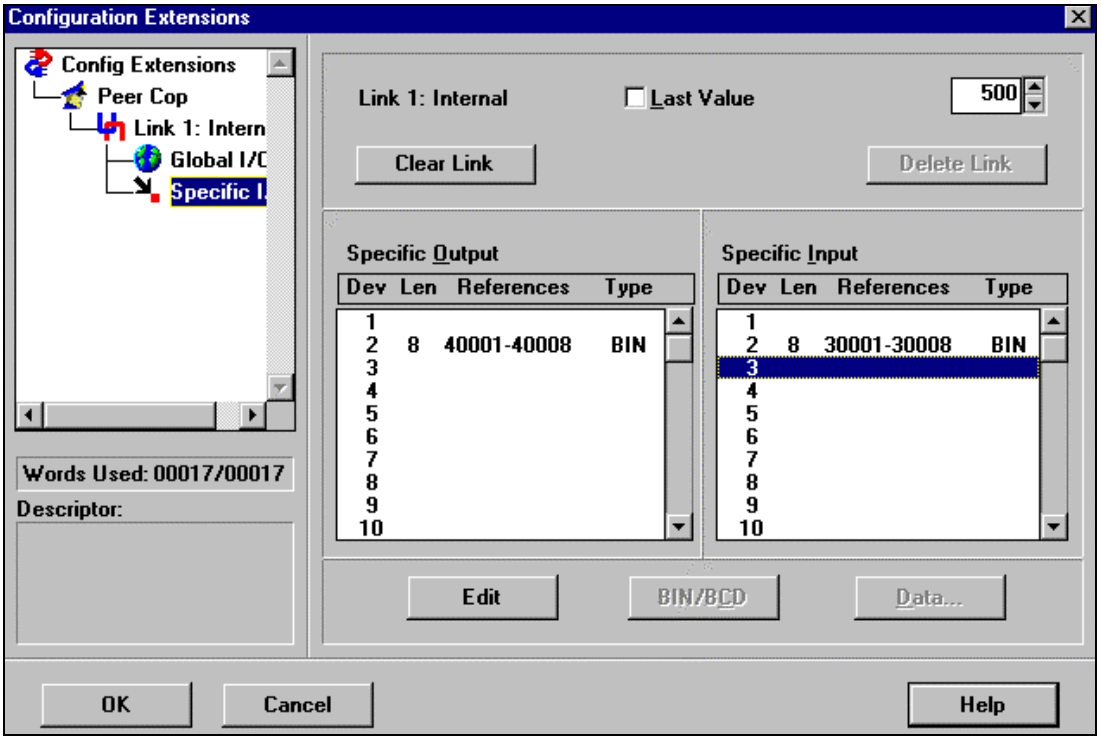
Screen 5-9: Enter 8 in Length Field. In Reference Field enter the starting 4XXXX Register for 8 consecutive registers that will peer-cop as specific I/O to the IFC 220E. Press OK after entering data.



Screen 5-10: Select Specific I/O, Select 2 in Specific Input Field, and then Select Edit



Screen 5-11: Enter 8 in Length Field. In Reference Field, Enter Starting 3XXXX Register for 8 Consecutive Registers that will Peer-cop as Specific I/O to the IFC 220E. Press OK after entering data.



Screen 5-12: Configuration Extension dialog Should Appear as Above. Press OK to Peer-cop the IFC 220E Module as Address 2, Specific I/O as Registers 40001-40008 and 30001-30008 in the Modbus Plus Network. Note that Seventeen Words were Used in Configuration Extension Area.

After I/O mapping the IFC 220E, put the PLC in the RUN state and verify that the IFC 220E LEDs (see Troubleshooting in *Chapter 6*) are in the following state:

1. Ensure the IFC 220E Module Heartbeat LED is blinking.
2. Ensure the IFC 220E PLC Communication Active LED is on.
3. Ensure the following Fault LEDs are NOT on.
    - Serial Communications Fault
    - PLC Communications Fault
4. Log onto the Momentum PLC processor or system PLC with ProWorx Plus, ProWorx NxT or Concept
5. Enter a command in the 1st I/O mapped write register to the IFC 220E. The same command should be echoed back in the first I/O mapped read register. If the read register does not have the same command as the write register, make sure that no other modules are I/O mapped to the same registers. Check that no PLC logic is overwriting these registers (i.e., 40001 = 10003, 30001 = 10003).

5.1.3. Configuring the Module

The IFC 220E contains factory-established default setup information. To use the module with your mechanical configuration, you must first configure the module using the provided HMI (*Chapter 4*). Once you configure the module, write the configuration data to Flash RAM for storage. The configuration data is read from Flash RAM on each subsequent power-up of the module. It is only necessary to change configuration data when a mechanical part of the system changes (i.e., Gear Ratio). To save the configuration to Flash, select **Copy Setup to Flash** under the **Comm** menu.

5.2. IFC 220E I/O Map Register Description

The IFC 220E is I/O mapped as an AEC920-00 High Speed Counter Module that uses eight binary (BIN) bi-directional registers (4XXXX and 3XXXX). The first 6 input and 6 output registers are used to send and receive data back-and-forth to the IFC 220E. The 7th and 8th input and output registers are used to send and control and status information to the module. The following describes the I/O mapped registers of the IFC 220E module.

5.2.1. I/O Map Registers

Register	Description	Register	Description
4XXXX+0	Command Register	3XXXX+0	Echo Register
4XXXX+1	Data to IFC 220E	3XXXX+1	Data from IFC 220E
4XXXX+2	Data to IFC 220E	3XXXX+2	Data from IFC 220E
4XXXX+3	Data to IFC 220E	3XXXX+3	Data from IFC 220E
4XXXX+4	Data to IFC 220E	3XXXX+4	Data from IFC 220E
4XXXX+5	Data to IFC 220E	3XXXX+5	Data from IFC 220E
4XXXX+6	Control Register	3XXXX+6	Status Register
4XXXX+7	User Outputs	3XXXX+7	Axis and User Inputs

5.2.2. Control & Status Register Bits

Control Register 4XXXX+6		Status Register 3XXXX+6	
Bit	**Description**	**Bit**	**Description**
Bit 1	Clear Faults	Bit 1	Axis 1 Faulted
Bit 2	Axis 1 Enable	Bit 2	Axis 1 Enabled
Bit 3	Axis 1 Disable	Bit 3	Axis 1 Homed
Bit 4	Axis 1 Home	Bit 4	Axis 1 Jogging +
Bit 5	Axis 1 Jog+	Bit 5	Axis 1 Jogging -
Bit 6	Axis 1 Jog -	Bit 6	Axis 1 In-Position
Bit 7	Axis 1 Zero Position	Bit 7	Axis 1 In-Deceleration
Bit 8	Reserved	Bit 8	Reserved
Bit 9	Reserved	Bit 9	Axis 2 Faulted
Bit 10	Axis 2 Enable	Bit 10	Axis 2 Enabled
Bit 11	Axis 2 Disable	Bit 11	Axis 2 Homed
Bit 12	Axis 2 Home	Bit 12	Axis 2 Jogging +
Bit 13	Axis 2 Jog +	Bit 13	Axis 2 Jogging -
Bit 14	Axis 2 Jog -	Bit 14	Axis 2 In-Position
Bit 15	Axis 2 Zero Position	Bit 15	Axis 2 In-Deceleration
Bit 16	Reserved	Bit 16	Reserved

5.2.3. User Output & Input Register Bits

User Output Register 4XXXX+7		User Input Register 3XXXX+7	
Bit	**Description**	**Bit**	**Description**
Bit 1	Reserved	Bit 1	Reserved
Bit 2	Reserved	Bit 2	Reserved
Bit 3	Reserved	Bit 3	Reserved
Bit 4	Reserved	Bit 4	User Input 5
Bit 5	Reserved	Bit 5	User Input 4
Bit 6	Reserved	Bit 6	User Input 3
Bit 7	Reserved	Bit 7	User Input 2
Bit 8	Reserved	Bit 8	User Input 1
Bit 9	User Source 2	Bit 9	Axis 2 Fault Input
Bit 10	User Source 1	Bit 10	Axis 2 Home Input
Bit 11	Allow PLC to Set User Outputs	Bit 11	Axis 2 REV Input
Bit 12	User Output 5	Bit 12	Axis 2 FWD Input
Bit 13	User Output 4	Bit 13	Axis 1 Fault Input
Bit 14	User Output 3	Bit 14	Axis 1 Home Input
Bit 15	User Output 2	Bit 15	Axis 1 REV Input
Bit 16	User Output 1	Bit 16	Axis 1 FWD Input

The FN43 User Loadable Function Block allows for easy motion programming of the IFC 220E. Do not set control register (4XXXX+6) bits when the FN43 or a Concept IFC function block is enabled. These bits will conflict with the commands being sent to the module by the function block. You can, however, send read commands to the IFC 220E via registers 4XXXX+0 thru 4XXXX+5, while the control bits are being set.

For Example: A 1020 command can be placed in register 4XXXX+0 and the positions of Axis 1 and Axis 2 can be read back into register 3XXXX+1 thru 3XXXX+4. The enable and disable bits (4XXXX+6, Bits 2, 3, 10, 11) should be pulsed until the enabled bits (3XXXX+6, Bits 2, 10) turn on or off. The axis home bits (4XXXX+6, Bits 4, 12) can also be pulsed. The axis homed bits (3XXXX+6, Bits 3, 11) will turn on after completion of the homing sequence. The axis homed bits will reset on power up or when the axis home bits are set. The homing sequence is setup on the HMI Windows Setup Software **Axis** dialog box. When the jog bits (4XXXX+6, Bits 5, 6, 13, 14) are on, the axis will jog in the direction indicated by the bit. ***Note:*** The jog+ and jog- cannot be on at the same time. There are two new commands to set the jog and homing speed. The format is as follows:

5.2.4. Set Homing & Jog Speeds

Set Homing Speed		Set Jog Speed	
Register	**Description**	**Register**	**Description**
4XXXX+0	2043 Command	4XXXX+0	2044 Command
4XXXX+1	Axis 1 or 2	4XXXX+1	Axis 1 or Axis 2
4XXXX+2	Home Speed High Word	4XXXX+2	Jog Speed High Word
4XXXX+3	Home Speed Low Word	4XXXX+3	Jog Speed Low Word
4XXXX+4	N/A	4XXXX+4	N/A
4XXXX+5	N/A	4XXXX+5	N/A

Examples of how to use the above registers and commands appear in *Appendix C.*

5.3. Using the FN43 User Loadable Function Block

As stated earlier, the FN43 loadable has eight modes of operation each selected by placing the Function # in the first node. Each mode is described in detail below.

5.3.1. Mode 0 – Get Loadable Version

Mode 0 returns the version of the loadable. *Figure 5-2* shows the Mode 0 operation of the FN43 loadable.

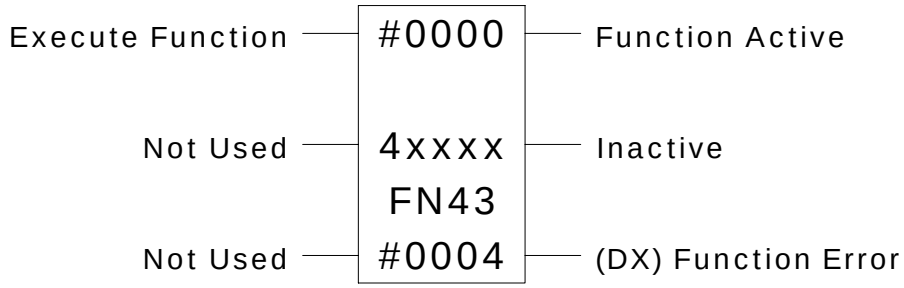


Figure 5-2: Get Loadable Version Operation of FN43

The top output indicates that the module is active. This output should always be on when input power is applied to the top input. The middle is not used.

The bottom output indicates a DX Function Fault. This fault condition indicates incorrect node information.

Mode 0 returns the loadable version in the first register specified in the FN43 loadable.

5.3.1.1. Mode 0 - PLC Read/Reserved Registers

Table 5-1 lists the read/reserved registers associated with Mode 0.

Register	Description
4XXXX+0	Loadable Version
4XXXX+1	Reserved for Internal Use
4XXXX+2	Reserved for Internal Use
4XXXX+3	Reserved for Internal Use

Table 5-1: Mode 0 - PLC Read/Reserved Registers

5.3.2. Mode 1 – Position/Speed Monitor

Mode 1 allows the PLC program to monitor the position and speed of the encoder in user units. This mode allows the PLC program to monitor the status of each encoder channel such as faults, discrete input status, and software programmable limit states. In Mode 1, the PLC program can turn On/Off discrete outputs of each channel as well as set the value of each analog output from 0 to 4095. This analog value sets the voltage of the analog output to the range (i.e., 0 to 10Vdc, ±10Vdc or 0 to 5Vdc) selected in the **Axis Setup** screen of the HMI Windows Setup Software (see *Chapter 4*). The FN43 loadable makes it easy for a PLC programmer to set up and interrogate the IFC 220E. The loadable writes the Traffic-Copped 4XXXX registers to the IFC 220E and reads the Traffic-Copped 3XXXX registers from the IFC 220E transparent to the User's Ladder Logic. The user must only read and write data to/from 4XXXX registers to designated registers. In Mode 1, the loadable uses a user-defined group of 19 registers for passing information to and from the module. These 19 registers are divided into groups of write and read registers. Write registers send analog output values to the module while read registers interrogate the module. *Figure 5-3* shows the Mode 1 operation of the FN43 loadable.

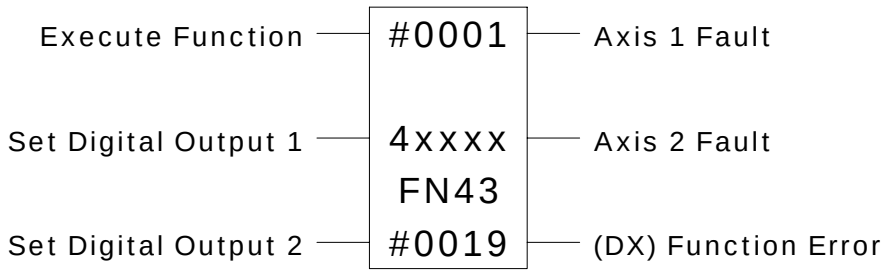


Figure 5-3: Mode 1 Position/Speed Monitor Operation of FN43

To place the IFC 220E in Mode 1, write a 1 in the top node of the FN43 function block. The middle node specifies the starting 4XXXX register for the 19 consecutive function block data registers. For Mode 1, place a 19 in the bottom node to designate the number of registers being used by the function block.

When power is applied to the top input, the function block executes. Power should remain on the top input at all times when the module is in use. If the IFC 220E outputs are under command control (i.e., not tied to the programmable limits switch, etc.), the outputs can be controlled by applying power to the middle and bottom nodes.

When power is applied to the middle input the discrete output of Axis 1 turns on. When power is removed from the middle input, the output of Axis 1 turns off. When power is applied to the bottom input, the discrete output of Axis 2 turns on. If you remove power from the bottom input, the output of Axis 2 turns off.

The top output indicates a fault on Axis 1. The middle output indicates a fault on Axis 2.

The bottom output indicates a DX Function Fault condition which usually implies incorrect node information, the IFC 220E is not present, or a module communication error.

The FN43 loadable constantly sends analog output values to the IFC 220E and updates the PLC read registers using the first 6 input and first 6 output registers defined in the PLC Traffic-Cop. Below is a list of FN43 Mode 1 User Loadable registers.

5.3.2.1. Mode 1 - PLC Write Registers

Below in *Table 5-2* is a list of the write registers associated with Mode 1. A detailed description of each register follows.

Register	Description
4XXXX	Starting Traffic-Copped Output Register (40001 - 49999)
4XXXX+1	Starting Traffic-Copped Input Register (30001 - 39999)
4XXXX+2	Analog Output 1
4XXXX+3	Analog Output 2

Table 5-2: Mode 1 - PLC Write Registers

4XXXX ***Starting Traffic-Copped Output Register***

Enter the number of the first 4XXXX Output Register Traffic-Copped to the module. This number must range between 0001 and 9999, and must match the register defined in the Traffic-Cop.

Example: 1234 is register 41234

4XXXX+1 ***Starting Traffic-Copped Input Register***

Enter the number of the first 3XXXX Input Register Traffic-Copped to the module. This number must range between 0001 and 9999, and must match the register defined in the Traffic-Cop.

Example: 0334 is register 30334

4XXXX+2 ***Analog Output 1***

Write the Analog Output 1 voltage to this register. Values can range between 0 and 4095, while values above 4095 are ignored.
If the analog output range is set to ±10Vdc, then:

When = 0: -10V out
When = 4095: 10V out

If the analog output range is set between 0 and 10Vdc, then:

When = 0: 0V
When = 4095: 10V

This register is constantly sent to the module by the FN43 loadable.

4XXXX+3 ***Analog Output 2***

Write the Analog Output 2 voltage to this register. Values can range between 0 and 4095, while values above 4095 are ignored.

If the analog output range is set to ±10Vdc, then:

When = 0: -10V out

When = 4095: 10V out

If the analog output range is set between 0 and 10Vdc, then:

When = 0: 0V

When = 4095: 10V

This register is constantly sent to the module by the FN43 loadable.

5.3.2.2. Mode 1 - PLC Read/Reserved Registers

Below in *Table 5-3* is a list of the read registers associated with Mode 1. A detailed description of each register follows.

Register	Description
Axis 1 and Axis 2 Read Registers (Read Only)	
4XXXX+4	Axis 1 Position High Word (user units)
4XXXX+5	Axis 1 Position Low Word (user units)
4XXXX+6	Axis 1 Speed (user units)
4XXXX+7	Axis 1 Status and Limits
4XXXX+8	Analog 1 Input 1 Value (0 - 4095)
4XXXX+9	Axis 2 Position High Word (user units)
4XXXX+10	Axis 2 Position Low Word (user units)
4XXXX+11	Axis 2 Speed (user units)
4XXXX+12	Axis 2 Status and Limits
4XXXX+13	Analog 2 Input 2 Value (0 - 4095)
Module Fault Registers (Read Only)	
4XXXX+14	Module Fault Status Word
4XXXX+15	Module Inputs Status Word
4XXXX+16	Axis 1 Latched Faults
4XXXX+17	Axis 2 Latched Faults
4XXXX+18	Reserved for Internal Use

Table 5-3: Mode 1 - PLC Read/Reserved Registers

4XXXX+4 ***Axis 1 Position High Word***

Contains the high word of the Channel 1 encoder position in user units. The IFC 220E calculates a new position value every 500 uSec. Use this register with Position Low Word to form a two-register position value. Position is represented in modulo 10000.

4XXXX+5 ***Axis 1 Position Low Word***

Contains the low word of the Channel 1 encoder position in user units. Use this register with the Position High Word to form a two-register position value. Position is represented in modulo 10000.

Example 1: If the module is setup for position in inches, has two decimal places, the high word is 50, and the low word is 8051, then the actual encoder position value in user units is 50.8051 inches.

Example 2: If the module is setup for position in millimeters, has one decimal place, the high word is 5, and the low word is 623, then the actual encoder position value in user units is 5.0623 millimeters.

4XXXX+6 ***Axis 1 Speed***

Current speed of the Channel 1 encoder (user units/sec or user units/min).

4XXXX+7 ***Axis 1 Status and Limits***

Channel 1 module status and limits data. Each status bit is described below:

Bit 1 ***Channel 1 Fault*** - Set high by the module anytime a fault exists on Channel 1. Read the fault status word to find the nature of the fault.

Bit 2 ***Digital Input 1 Status*** – Current state of Digital Input 1.

Bit 3 ***Not Used***

Bit 4 ***Digital Output 1 Status*** – Current state of Digital Output 1.

Bit 5 ***Homed*** – Indicates if the Channel 1 encoder was homed.

Bit 6 ***Overspeed/Underspeed*** **–** Encoder is rotating below the set under-speed value or above the set over-speed value.

Bit 7 ***+EOT Limit Reached*** – Current Channel 1 encoder position exceeded the set +EOT position.

Bit 8 ***-EOT Limit Reached*** – Current Channel 1 encoder position is below the set -EOT position.

Bit 9 ***Software Limit Switch 0*** – Shows the current status of the Channel 1 Software Limit Switch 0.

When = 0: Current encoder position is below On Position or above Off Position.

When = 1: Current encoder position is above On Position or below Off Position.

Bit 10 ***Software Limit Switch 1*** – Current status of the Channel 1 Software Limit Switch 1.

Bit 11 ***Software Limit Switch 2*** – Current status of the Channel 1 Software Limit Switch 2.

Bit 12 ***Software Limit Switch 3*** – Current status of the Channel 1 Software Limit Switch 3.

Bit 13 ***Software Limit Switch 4*** – Current status of the Channel 1 Limit Switch 4.

Bit 14 ***Software Limit Switch 5*** – Current status of the Channel 1 Limit Switch 5.

Bit 15 ***Software Limit Switch 6*** – Current status of the Channel 1 Software Limit Switch 6.

Bit 16 ***Software Limit Switch 7*** – Current status of the Channel 1 Software Limit Switch 7.

4XXXX+8 ***Not Used***

4XXXX+9 ***Axis 2 Position High Word***

Contains the low word of the Channel 2 encoder position in user units. Use this register with Position High Word to form a two-register position value. Position is represented in modulo 10000.

4XXXX+10 ***Axis 2 Position Low Word***

Contains the low word of the Channel 2 encoder position in user units. The IFC 220E calculates a new position every 500 uSec. Use this register with Position High Word to form a two-register position value. Position is represented in modulo 10000.

4XXXX+11 ***Axis 2 Speed***

Current speed of the Channel 2 encoder (user units/sec or user units/min).

4XXXX+12 ***Axis 2 Status and Limits***

Contains Channel 2 module status and limits data. Each status bit is described below:

Bit 1 ***Channel 2 Fault*** - Set high by the module anytime a fault exists on Channel 2. Read the fault status word to find the nature of the fault.

Bit 2 ***Digital Input 2 Status –*** Current state of Digital Input 2.

Bit 3 ***Not Used***

Bit 4 ***Digital Output 2 Status –*** Current state of Digital Output 2.

Bit 5 ***Homed –*** Indicates if the Channel 2 encoder was homed.

Bit 6 ***Overspeed/Underspeed –*** Encoder is rotating below the set under-speed value or above the set over-speed value.

Bit 7 ***+EOT Limit Reached*** – Current Channel 2 encoder position exceeded the set +EOT position.

Bit 8 ***-EOT Limit Reached*** – Current Channel 2 encoder position is below the set -EOT position.

Bit 9 ***Software Limit Switch 0*** – Current status of the Channel 2 Software Limit Switch 0.

- **When = 0:** Current encoder position is below On Position or above Off Position.
- **When = 1:** Current encoder position is above On Position or below Off Position.

Bit 10 ***Software Limit Switch 1*** – Current status of the Channel 2 Software Limit Switch 1.

Bit 11 ***Software Limit Switch 2*** – Current status of the Channel 2 Software Limit Switch 2.

Bit 12 ***Software Limit Switch 3*** – Current status of the Channel 2 Software Limit Switch 3.

Bit 13 ***Software Limit Switch 4*** – Current status of the Channel 2 Software Limit Switch 4.

Bit 14 ***Software Limit Switch 5*** – Current status of the Channel 2 Software Limit Switch 5.

Bit 15 ***Software Limit Switch 6*** – Current status of the Channel 2 Software Limit Switch 6.

Bit 16 ***Software Limit Switch 7*** – Current status of the Channel 2 Software Limit Switch 7.

4XXXX+13 ***Not Used***

4XXXX+14 ***Module Fault and Status Word***

Contains module fault and status information. This register is only updated when a fault occurs on the module. Fault information bits include:

Bits 1-7 ***Not Used***

Bit 8 ***Setup Data Changed –*** Active setup data doesn't match Flash data. Cleared when data is saved to Flash.

Bit 9 ***Module Code Checksum Failure –*** Module code checksum failed, reload the Firmware.

Bit 10 ***Serial Checksum or Time-out –*** Error! A bad checksum was received from the serial port or a message time-out occurred. May be caused by removing the serial cable during transmission.

Bit 11 ***Serial Command Error –*** PC sent a bad command to the IFC 220E. Check cable and verify you selected the right com port.

Bit 12 ***PLC Command Error –*** PLC sent a bad command to the IFC 220E. Check messages from the PLC.

Bit 13 ***Flash Default –*** Error! Module is using default parameters. This bit should be on when the unit is first powered-up.

Bit 14 ***Flash Memory Error –*** Should not occur. Consult factory.

Bit 15 ***Not Used***

Bit 16 ***PLC Error –*** Should not occur. Consult factory.

4XXXX+15 ***Module Input Status Word***

Contains axis specific fault and status information. This register is only updated when a fault occurs on the module. Fault information bits include:

Bit 1 ***Digital Input 1 State –*** State of Channel 1 digital input.

Bit 2 ***Digital Input 2 State –*** State of Channel 2 digital input.

Bit 3 ***Channel 1 Loss of Cosine Feedback –*** Cosine Input on Channel 1 is missing or corrupt.

Bit 4 ***Channel 1 Loss of Sine Feedback –*** Sine Input on Channel 1 is missing or corrupt.

Bit 5 ***Not Used***

Bit 6 ***Channel 2 Loss of Cosine Feedback –*** Cosine Input on Channel 2 is missing or corrupt.

Bit 7 ***Channel 2 Loss of Sine Feedback –*** Sine Input on Channel 2 is missing or corrupt.

Bits 8-16 ***Not Used***

4XXXX+16 ***Axis 1 Latched Faults***

These faults are latched once they are observed.

Bits 1-9 ***Not Used***

Bit 10 ***Module Fault –*** Communication with PLC failed.

Bit 11 ***Current Limit Fault*** – During PID motion control, the average current command exceeded the set limit.

Bit 12 ***-EOT Fault*** – Module detected a negative end-of-travel limit.

Bit 13 ***+EOT Fault*** – Module detected a positive end-of-travel limit.

Bit 14 ***Not Used***

Bit 15 ***Not Used***

Bit 16 ***Position Error Fault*** – During PID motion control, the position commanded minus observed position exceeded the set limit.

4XXXX+17 ***Axis 2 Latched Faults***

For descriptions of the bits in this register, refer to Axis 1 Latched Faults above.

4XXXX+18 ***Reserved for Internal Use***

Used by the loadable. Do not write to this register.

5.3.2.3. FN43 PID Mode Operations

Operating Modes 2 through 5 of the FN43 loadable control the position and velocity of a drive/motor combination. The IFC 220E uses an encoder to close the position or velocity loop on the drive and motor. By adjusting PID and Position Loop gains of Axis 1 and Axis 2, the IFC 220E can control the drive/motor in a servo-like manner. The types of drive/motor combinations that the IFC 220E can control are: AC Vector, AC Inverter, DC SCR, DC Servo and AC Servo type drives. These drives must accept either a ±10Vdc torque command or a 0 to 10Vdc velocity reference with a Discrete Direction Input.

NOTE ☝ **The IFC 220E must be set up from the Move Pull-down menu of the HMI to control the shaft position of the servo motor. The PID gains and Position Loop gains must be tuned properly to ensure the motor/load are stable (not oscillating) while the system is under PID control.**

WARNING ☞**Ensure the control system can be stopped from an Emergency Stop circuit. User's must follow all federal, state, local, and plant codes for protecting humans and machinery from automatic control equipment. If the system requires end of travel limits to protect the machinery, they must be wired into the end of travel limit terminals of the IFC 220E. Failure to do so may cause mechanical destruction to machinery, bodily harm, or death!!! See *Chapter 4* for more information on controlling a motor with the IFC 220E.**

5.3.3. Mode 2 – Homing

Mode 2 allows the PLC program to home both Axis 1 and Axis 2 under PID control from the IFC 220E. Use extreme caution when enabling any type of motion from the IFC 220E. *Figure 5-4* shows the Mode 2 operation of the FN43 loadable.

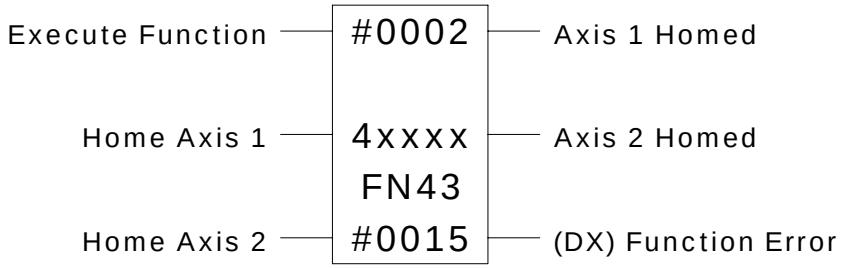


Figure 5-4: Mode 2 - Homing Operation of FN43

To place the IFC 220E in Mode 2 write a 2 in the top node of the FN43 function block. The middle node specifies the starting 4XXXX register for the 15 consecutive function block data registers. Place a 15 in the bottom node to designate the number of registers being used by the function block.

Before applying power to the inputs of the FN43 Mode 2, enter data into the PLC write registers of the function block. Mode 2 of the function block uses 15 consecutive registers to write and read data between the PLC and the IFC 220E.

When power is applied to the top input, the function block executes. Power should remain on the top input at all times when the module is in use.

When power is applied to the middle input, the servo motor connected to Channel 1 of the IFC 220E begins moving in the direction set in register 4XXXX+2 at the speed set in register 4XXXX+3 and 4XXXX+4. The motor continues to move until the home switch connected to the Discrete Input 1 is asserted to the state checked on the **Axis Setup** screen of the HMI Software. After the home switch is asserted, the axis continues to move in the home direction/speed until it reaches the Encoder Marker Pulse. After the axis stops, the top output of the FN43 loadable turns on and the position of the axis is set to 0 or to the home offset value set in the **Axis** dialog box.

When power is applied to the bottom input, the servo motor connected to Channel 2 of the IFC 220E begins moving in the direction set in register 4XXXX+5 at the speed set in register 4XXXX+6 and 4XXXX+7. The motor continues to move until the home switch connected to the Discrete Input 2 is asserted to the state checked on the **Axis Setup** screen of the HMI Software. After the home switch is asserted, the axis continues to move in the home direction/speed until it reaches the Encoder Marker Pulse. After the axis stops, the middle output of the FN43 loadable turns on and the position of the axis is set to 0 or to the home offset value in the **Axis** dialog box.

The bottom output is used to indicate a DX Function Fault. This fault condition usually implies incorrect node information, the IFC 220E is not present, or a module communication error.

NOTE **The Homing Input is recognized by the loadable on a transition from low-to-high and while power is applied to the top node. Homing will not occur if power is applied to top and Home Input simultaneously.**

If power is removed from the Home Input while homing, the axis will halt.

The axes will not enable and move if a fault is present on the axis.

5.3.3.1. Mode 2 - PLC Write Registers

There are eight PLC write registers associated with the FN43 Mode 2 function block, see *Table 5-4*. A detailed description of each register follows.

Register	Description
4XXXX	Starting Traffic-Copped Output Register (40001 - 49999)
4XXXX+1	Starting Traffic-Copped Input Register (30001 - 39999)
4XXXX+2	Axis 1 Homing Direction (0 = FWD, 1 = REV)
4XXXX+3	Axis 1 Homing Speed (High Register)
4XXXX+4	Axis 1 Homing Speed (Low Register)
4XXXX+5	Axis 2 Homing Direction (0 = FWD, 1 = REV)
4XXXX+6	Axis 2 Homing Speed (High Register)
4XXXX+7	Axis 2 Homing Speed (Low Register)

Table 5-4: Mode 2 - PLC Write Registers

4XXXX ***Starting Traffic-Copped Output Register***

Enter the number of the first 4XXXX Output Register Traffic-Copped to the module. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 1234 is register 41234

4XXXX+1 ***Starting Traffic-Copped Input Register***

Enter the number of the first 3XXXX Input Register Traffic-Copped to the module. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 0334 is register 30334

4XXXX+2 ***Axis 1 Homing Direction***

Enter a value of 0 or 1.

When = 0: Homes Axis 1 in FWD direction.
When = 1: Homes Axis 1 in REV direction.

4XXXX+3 ***Axis 1 Homing Speed (High Register)***

Enter a whole number value (user units) to set the homing speed of Axis 1.

4XXXX+4 ***Axis 1 Homing Speed (Low Register)***

Enter a fractional portion (user units) to set the homing speed of Axis 1.

Example: 5.1234 in/sec
4XXXX+3 = 00005
4XXXX+4 = 01234

4XXXX+5 ***Axis 2 Homing Direction***

Enter a value of 0 or 1.

When = 0: Homes Axis 2 in FWD direction.
When = 1: Homes Axis 2 in REV direction.

4XXXX+6 ***Axis 2 Homing Speed (High Register)***

Enter a whole number value (user units) to set the homing speed of Axis 2.

4XXXX+7 ***Axis 2 Homing Speed (Low Register)***

Enter a fractional portion (user units) to set the homing speed of Axis 2.

Example: 5.1234 in/sec
4XXXX+3 = 00005
4XXXX+4 = 01234

5.3.3.2. Mode 2 - PLC Read/Reserved Registers

There are seven PLC read/reserved registers associated with the FN43 Mode 2 function block, see *Table 5-5*. Do not write to these registers.

Register	Description
4XXXX+8	Reserved for Internal Use
4XXXX+9	Reserved for Internal Use
4XXXX+10	Reserved for Internal Use
4XXXX+11	Reserved for Internal Use
4XXXX+12	Reserved for Internal Use
4XXXX+13	Reserved for Internal Use
4XXXX+14	Reserved for Internal Use

Table 5-5: Mode 2 - PLC Read/Reserved Registers

5.3.3.3. Mode 2 - Homing Methods

Homing to Encoder Marker Pulse with a Normally Open Home Switch

Use this method when a normally open home switch is being used and you want the Encoder Marker Pulse to be the home position. Select this mode by setting the USE ENCODER MARKER PULSE FOR HOMING and selecting HOME USING LOW TO HIGH TRANSITION in the HMI Software. When homing begins, the IFC 220E looks for a transition from low-to-high of the Home Switch Input. When this transition is seen, the module looks for the first Encoder Marker Pulse to be the home position. If the home switch changes state back to low before an Encoder Marker Pulse is seen, homing aborts. The home switch state must be low when the Encoder Marker Pulse is seen in order for homing to complete. To ensure this occurs, your home switch should be on for at least one revolution of the encoder, but less than two revolutions. If you cannot ensure this, use a homing method that only uses the home switch to determine home position.

Homing to Encoder Marker Pulse with a Normally Closed Home Switch

Use this method when a normally closed home switch is being used and you want the Encoder Marker Pulse to be the home position. Select this mode by setting the USE ENCODER MARKER PULSE FOR HOMING and selecting HOME USING HIGH TO LOW TRANSITION in the HMI Software. When homing begins, the IFC 220E looks for a transition from high-to-low of the Home Switch Input. When this transition is seen, the module looks for the first Encoder Marker Pulse to be the home position. If the home switch changes state back to high before an Encoder Marker Pulse is seen, homing aborts. The home switch state must be high when the Encoder Marker Pulse is seen for homing to complete. To ensure this occurs, your home switch should be on for at least one revolution of the encoder, but less than two revolutions. If you cannot ensure this, use a homing method that only uses the home switch to determine home position.

Homing to the Low-to-High Transition of the Home Switch

Use this method when a normally open (N.O) home switch is used and you do not want to use the Encoder Marker Pulse. Select this mode by setting HOME USING LOW TO HIGH TRANSITION and not USE ENCODER MARKER PULSE FOR HOMING. In this mode, when homing begins, the IFC 220E looks for a transition from low-to-high of the Home Switch Input. When this transition is seen, the IFC 220E sets the axis position to the home offset value.

Homing to the High-to-Low Transition of the Home Switch

Use this method when a normally closed (N.C.) home switch is used and you do not want to use the Encoder Marker Pulse. Select this mode by setting HOME USING HIGH TO LOW TRANSITION and not USE ENCODER MARKER PULSE FOR HOMING. In this mode, when homing begins, the IFC 220E looks for a transition from high-to-low of the Home Switch Input. When this transition is seen, the IFC 220E sets the axis position to the home offset value.

Homing to Encoder Marker Pulse

Use this method when you have an absolute system and you want the Encoder Marker Pulse to be the home position. To choose this mode, select USE ENCODER MARKER PULSE FOR HOMING and do not select any transition level in the HMI Software. When homing begins, the IFC 220E looks for the first Encoder Marker Pulse to be the home position. No home switch is used.

5.3.4. Mode 3 – Single-Point Move

Mode 3 of the FN43 loadable allows the PLC to move the axis to a predefined position or an incremental distance. The PLC program sets up the move by writing the position, speed, acceleration and deceleration to predefined registers of the loadable. When the Execute Move Input receives power, the loadable sends the data to the IFC 220E to execute the move. When the move completes, the FN43 loadable turns on its In Position Output indicating that the move is finished and the axis in position. Use extreme caution when enabling any type of motion from the IFC 220E. *Figure 5-5* illustrates the use of the FN43 Mode 3 operation.

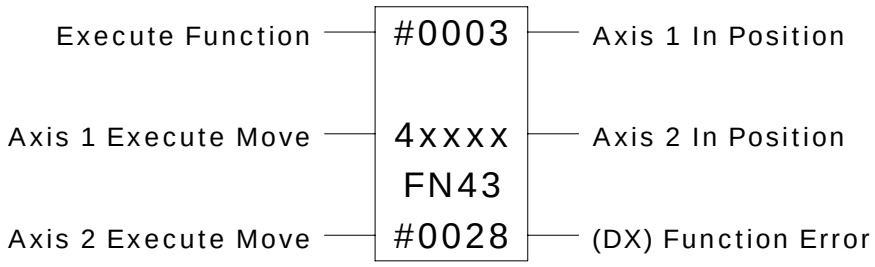


Figure 5-5: Mode 3 – Single-Point Move Operation of FN43

To place the IFC 220E in Mode 3 write a 3 in the top node of the FN43 function block. The middle node specifies the starting 4XXXX register for the 28 consecutive function block data registers. Place a 28 in the bottom node to designate the number of registers used by the loadable.

Before applying power to the inputs of the FN43 Mode 3, enter data into the PLC write registers of the function block. Mode 3 uses 28 consecutive registers to write and read data between the PLC and the IFC 220E.

The bottom output indicates a DX Function Fault. This fault condition usually implies incorrect node information, the IFC 220E is not present, or a module communication error.

NOTE **The Execute Move Input is seen by the loadable on a transition from low-to-high and while power is applied to the top node. Motion will not occur if power is applied to top and Execute Move Input simultaneously.**

If power is removed from the Execute Move Input while moving, the axis halts.

The axis will not enable and move if a fault exists on the axis.

5.3.4.1. Mode 3 - PLC Write Registers

There are eighteen PLC write registers associated with the FN43 Mode 3 function block, see *Table 5-6*. A detailed description of each register follows.

Register	Description
4XXXX	Starting Traffic-Copped Output Register (40001 - 49999)
4XXXX+1	Starting Traffic-Copped Input Register (30001 - 39999)
4XXXX+2	Axis 1 Move Type (0 = Abs, 1 = Inc Pos, 2 = Inc Neg)
4XXXX+3	Axis 1 High Register Position (user units)
4XXXX+4	Axis 1 Low Register Position (user units)
4XXXX+5	Axis 1 High Register Velocity (user units)
4XXXX+6	Axis 1 Low Register Velocity (user units)
4XXXX+7	Axis 1 Acceleration (1 – 32767 mSec)
4XXXX+8	Axis 1 Deceleration (1 – 32767 mSec)
4XXXX+9	Axis 1 Acc/Dec Mode (0 = constant, 1 = S-curve)
4XXXX+10	Axis 2 Move Type (0 = Abs, 1 = Inc Pos, 2 = Inc Neg)
4XXXX+11	Axis 2 High Register Position (user units)
4XXXX+12	Axis 2 Low Register Position (user units)
4XXXX+13	Axis 2 High Register Velocity (user units)
4XXXX+14	Axis 2 Low Register Velocity (user units)
4XXXX+15	Axis 2 Acceleration (1 – 32767 mSec)
4XXXX+16	Axis 2 Deceleration (1 – 32767 mSec)
4XXXX+17	Axis 2 Acc/Dec Mode (0 = constant, 1 = S-curve)

Table 5-6: Mode 3 - PLC Write Registers

4XXXX ***Starting Traffic-Copped Output Register***

Enter the number of the first 4XXXX Output Register Traffic-Copped to the module. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 1234 is register 41234

4XXXX+1 ***Starting Traffic-Copped Input Register***

Enter the number of the first 3XXXX Input Register Traffic-Copped to the module. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 0334 is register 30334

4XXXX+2 ***Axis 1 Move Type***

Enter the type of move to accomplish:

When = 0: Absolute Move
When = 1: Incremental Positive Move
When = 2: Incremental Negative Move

Note: Use additional bits to disable the axis or change the axis velocity.

Bits 15,16

When = 0: Absolute Move (mask 00 binary)

When = 1: Incremental Positive Move (mask 01 binary)

When = 2: Incremental Negative Move (mask 10 binary)

Bit 14 This bit (mask 100 binary) disables the axis at the end of a move.

Bit 13 When this bit (mask 1000 binary) is active and the axis in motion, the axis velocity will update using the velocity values below in register 4XXXX+5 and 4XXXX+6. The loadable resets this bit when the velocity update occurs.

Example: To issue an Absolute move and disable the axis after a move, the value should be 4 decimal.

4XXXX+3 ***Axis 1 Position High***

Enter a whole number value (user units) for the position. Range is 0 to 65535.

4XXXX+4 ***Axis 1 Position Low***

Enter a fractional value (user units) for the position. Range is 0 to 9999.

4XXXX+5 ***Axis 1 Velocity High***

Enter a whole number value (user units) for the velocity of the move.

4XXXX+6 ***Axis 1 Velocity Low***

Enter a fractional value (user units) for the velocity of the move.

4XXXX+7 ***Axis 1 Acceleration***

Enter the acceleration time of the move (mSec).

4XXXX+8 ***Axis 1 Deceleration***

Enter the deceleration time of the move (mSec).

4XXXX+9 ***Axis 1 Acc/Dec Mode***

Enter either a 0 or 1.

When = 0: Accel/Decel portions of the move are constant.

When = 1: Accel/Decel will use S-curve (1-cosine) acceleration, often referred to as anti-jerk due to its tendency to smooth out bottom and top portions of the move profile.

4XXXX+10 ***Axis 2 Move Type***

Enter the type of move to accomplish:

When = 0: Absolute Move
When = 1: Incremental Positive Move
When = 2: Incremental Negative Move

Note: Use additional bits to disable the axis or change its velocity.

Bits 15,16
When = 0: Absolute Move (mask 00 binary)
When = 1: Incremental Positive Move (mask 01 binary)
When = 2: Incremental Negative Move (mask 10 binary)

Bit 14 This bit (mask 100 binary) disables the axis at the end of a move.

Bit 13 When this bit (mask 1000 binary) is active and the axis in motion, the axis velocity will update using the velocity values below in register 4XXXX+13 and 4XXXX+14. The loadable resets this bit when the velocity update occurs.

Example: To issue an Absolute move and disable the axis after a move, the value should be 4 decimal.

4XXXX+11 ***Axis 2 Position High***

Enter a whole number value (user units) for the position. Range is 0 to 65535.

4XXXX+12 ***Axis 2 Position Low***

Enter a fractional value (user units) for the position. Range is 0 to 9999.

4XXXX+13 ***Axis 2 Velocity High***

Enter a whole number value (user units) for the velocity of the move.

4XXXX+14 ***Axis 2 Velocity Low***

Enter a fractional value (user units) for the velocity of the move.

4XXXX+15 ***Axis 2 Acceleration***

Enter the acceleration time of the move (mSec).

4XXXX+16 ***Axis 2 Deceleration***

Enter the deceleration time of the move (mSec).

4XXXX+17 ***Axis 2 Acc/Dec Mode***

Enter either a 0 or 1.

When = 0: Accel/Decel portions of the move are constant.

When = 1: Accel/Decel will use S-curve (1-cosine) acceleration, often referred to as anti-jerk due to its tendency to smooth out bottom and top portions of the move profile.

5.3.4.2. Mode 3 - PLC Read/Reserved Registers

There are ten PLC read/reserved registers associated with the FN43 Mode 3 function block, see *Table 5-7*.

Register	Description
4XXXX+18	Reserved for Internal Use
4XXXX+19	Reserved for Internal Use
4XXXX+20	Axis 1 PID Status Register
4XXXX+21	Reserved for Internal Use
4XXXX+22	Axis 1 Observed Position (High Register in user units)
4XXXX+23	Axis 1 Observed Position (Low Register in user units)
4XXXX+24	Axis 2 PID Status Register
4XXXX+25	Reserved for Internal Use
4XXXX+26	Axis 2 Observed Position (High Register in user units)
4XXXX+27	Axis 2 Observed Position (Low Register in user units)

Table 5-7: Mode 3 - PLC Read/Reserved Registers

4XXXX+18, +19 ***Reserved***

4XXXX+20 ***Axis 1 PID Status Register***

Bit 1 ***Homing Off Input –*** Axis is homing off the input switch. Once off, it reverses direction and continues homing.

Bit 2 ***Homing –*** Axis is currently homing.

Bit 3 ***Faulted –*** Axis is currently faulted.

Bit 4 ***Moving Continuously –*** Axis is moving continuously. A homing sequence or a start motion is in progress.

Bit 5 ***Reserved***

Bit 6 ***Decelerating –*** Axis is decelerating.

Bit 7 ***Reserved***

Bit 8 ***In-Position*** **–** Axis is In Position or Done.

Bit 9 - 14 ***Reserved***

Bit 15 ***Moving Negative*** **–** Axis is moving in a negative direction.

Bit 16 ***Moving*** **–** Axis is moving.

4XXXX+21 ***Reserved***

4XXXX+22 ***Axis 1 Position High Word***

Contains the observed high word of the encoder position (user units).

4XXXX+23 ***Axis 1 Position Low Word***

Contains the observed low word of the encoder position (user units).

4XXXX+24 ***Axis 2 PID Status Register***

Bit 1 ***Homing Off Input*** **–** Axis is homing off the input switch. Once off, it reverses direction and continues homing.

Bit 2 ***Homing*** **–** Axis is currently homing.

Bit 3 ***Faulted*** **–** Axis is currently faulted.

Bit 4 ***Moving Continuously*** **–** Axis is moving continuously. A homing sequence or a start motion is in progress.

Bit 5 ***Reserved***

Bit 6 ***Decelerating*** **–** Axis is decelerating.

Bit 7 ***Reserved***

Bit 8 ***In-Position*** **–** Axis is In Position or Done.

Bit 9 - 16 ***Reserved***

Bit 15 ***Moving Negative*** **–** Axis is moving in a negative direction.

Bit 16 ***Moving*** **–** Axis is moving.

4XXXX+25 ***Reserved***

4XXXX+26 ***Axis 2 Position High Word***

Contains the observed high word of the encoder position (user units).

4XXXX+27 ***Axis 2 Position Low Word***

Contains the observed low word of the encoder position (user units).

5.3.4.3. Entering Data in the Loadable for a Given Move

Example: Move axis from 10.5 to 26.75 inches at a rate of 15.34 in/sec.

The axis must accel up to speed in 1 inch and decel to a stop in 1.5 inches using S-curve acceleration. Calculate the following and enter the data into the registers of the FN43 Mode 3 User Loadable:

Accel time = dist/0.5 * rate => 1.00/0.5 * 15.34 = 0.13038 sec
Decel time = dist/0.5 * rate => 1.50/0.5 * 15.34 = 0.19557 sec

Assume the IFC 220E is Traffic-Copped at 40001 and 30001. Enter the data into the registers as shown below:

For Absolute Move		***For Incremental Move***	
4XXXX	= 00001	4XXXX	= 00001
4XXXX+1	= 00001	4XXXX+1	= 00001
4XXXX+2	= 00000	4XXXX+2	= 00001
4XXXX+3	= 00026	4XXXX+3	= 00016
4XXXX+4	= 07500	4XXXX+4	= 02500
4XXXX+5	= 00015	4XXXX+5	= 00015
4XXXX+6	= 03400	4XXXX+6	= 03400
4XXXX+7	= 00130	4XXXX+7	= 00130
4XXXX+8	= 00196	4XXXX+8	= 00196
4XXXX+9	= 00001	4XXXX+9	= 00001

Apply power for the axis Execute Move Input.

5.3.5. Mode 4 – Sixteen-Point Move Download

Mode 4 allows the PLC to write data to the 16-point **Move Table** of the IFC 220E. The PLC program keeps an Original Data Table that stores the position, speed, acceleration and deceleration for up to 16 different positions for each axis. The PLC also keeps a Mirror Data Table that is compared with the Original Data Table. Changes to the Original Data Table cause the loadable to write the new data to the IFC 220E and then update the Mirror Data Table stored in the PLC. *Figure 5-6* illustrates the use of the FN43 Mode 4 User Loadable.

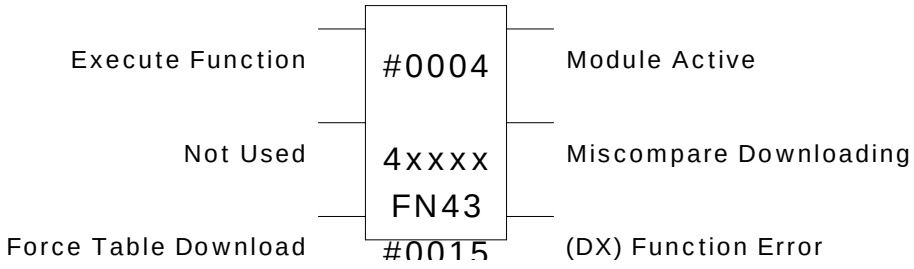


Figure 5-6: Mode 4 – Sixteen-Point Move Download Operation of FN43

To place the FN43 in Mode 4 write a 4 in the top node of the function block. The middle node specifies the starting 4XXXX register for the 15 consecutive function block data registers. In the bottom node write a 15 to represent the number of consecutive registers used by the loadable.

When the top input receives power, Mode 4 starts comparing the Original Data Table with the Mirror Data Table. If any data in the Original Data Table changes, the loadable sends the new data to the IFC 220E and updates the Mirror Data Table.

The middle input is not used.

When the bottom input receives power, the loadable forces a download of all data to the IFC 220E 16-point **Move Table**. The top output passes power when the top input is on. The middle output turns on when the loadable finds a miss-compare between the Original Data Table and the Mirror Data Table. The bottom output indicates a DX Function Fault. This fault condition usually implies incorrect node information, the IFC 220E is not present, or a module communication error.

The following describes the read/ write registers of the FN43 Mode 4 User Loadable:

5.3.5.1. Mode 4 - PLC Write Registers

There are five PLC write registers associated with the FN43 Mode 4 function block, see *Table 5-8*. A detailed description of each register follows.

Register	Description
4XXXX	Starting Traffic-Copped Output Register (40001 - 49999)
4XXXX+1	Starting Traffic-Copped Input Register (30001 - 39999)
4XXXX+2	Starting Register for Original Data Table of Registers
4XXXX+3	Starting Register for Mirror Data Table of Registers
4XXXX+4	Total Number of Registers in Original Data Table

Table 5-8: Mode 4 - PLC Write Registers

4XXXX ***Starting Traffic-Copped Output Register***

Enter the number of the first 4XXXX Output Register Traffic-Copped to the module. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 1234 is register 41234

4XXXX+1 ***Starting Traffic-Copped Input Register***

Enter the number of the first 3XXXX Input Register Traffic-Copped to the module. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 0334 is register 30334

4XXXX+2 ***Starting Register for Original Data Table of Registers***

Enter the number of the first 4XXXX Output Register of the original data.

4XXXX+3 ***Starting Register for Mirror Data Table of Registers***

Enter the number of the first 4XXXX Output Register of the mirrored data.

4XXXX+4 ***Total Number of Registers in Original Data Table***

Enter the number of registers in the original data.

5.3.5.2. Mode 4 - PLC Read/Reserved Registers

There are ten PLC read/reserved registers associated with the FN43 Mode 4 function block, see *Table 5-9*. Do not write to these registers.

Register	Description
4XXXX+5 to 14	Reserved for Internal Use

Table 5-9: Mode 4 - PLC Read/Reserved Registers

To find the number of registers used in the Original Data Table, use the following formula:

(# points) x [2(pos regs) + 2(velocity regs) + 1(accel reg) + 1(decel reg)]

Example:

16 positions * (2+2+1+1) = 192 Original Data Table registers and 192 Mirror Data Table registers. This value is placed in the loadable register 4XXXX+4.

Table 5-10 is an example memory map of the FN43 Mode 4 User Loadable.

Adder	Description	Value
40200	Starting Traffic-Copped Read Register	00001
40201	Starting Traffic-Copped Write Register	00001
40202	Starting Register of Original Data Table	06000
40203	Starting Register of Mirror Data Table	06200
40204	Total Number of Registers in Data Table	00192

Table 5-10: Mode 4 - FN43 Example Memory Map

Table 5-11 lists the registers of the Original Data Table and Mirror Data Table used by Mode 4 for sending positions, speeds, accelerations and decelerations for the 16 different axis moves.

Original Table Adder	Mirror Table Adder	Description	Value
46000	46200	Axis 1 Position 1 High Register	00010
46001	46201	Axis 1 Position 1 Low Register	05000
46002	46202	Axis 1 Position 2 High Register	00020
46003	46203	Axis 1 Position 2 Low Register	02500
46004	46204	Axis 1 Position 3 High Register	00030
46005	46205	Axis 1 Position 3 Low Register	07500
46030	46230	Axis 1 Position 16 High Register	00005
46031	46231	Axis 1 Position 16 Low Register	05000
46032	46232	Axis 2 Position 1 High Register	00010
46033	46233	Axis 2 Position 1 Low Register	05000
46034	46234	Axis 2 Position 2 High Register	00020
46035	46235	Axis 2 Position 2 Low Register	02500
46036	46236	Axis 2 Position 3 High Register	00030
46037	46237	Axis 2 Position 3 Low Register	07500
.	.	.	
.	.	.	
.	.	.	
46062	46262	Axis 2 Position 16 High Register	00005
46063	46263	Axis 2 Position 16 Low Register	05000
46064	46264	Axis 1 Velocity 1 High Register	00002
46065	46265	Axis 1 Velocity 1 Low Register	05000
46066	46266	Axis 1 Velocity 2 High Register	00004
46067	46267	Axis 1 Velocity 2 Low Register	05000
46068	46268	Axis 1 Velocity 3 High Register	00006
46069	46269	Axis 1 Velocity 3 Low Register	05000
46094	46294	Axis 1 Velocity 16 High Register	00008
46095	46295	Axis 1 Velocity 16 Low Register	05000
46096	46296	Axis 2 Velocity 1 High Register	00002
46097	46297	Axis 2 Velocity 1 Low Register	05000
46098	46298	Axis 2 Velocity 2 High Register	00004
46099	46299	Axis 2 Velocity 2 Low Register	05000
46100	46300	Axis 2 Velocity 3 High Register	00004
46101	46301	Axis 2 Velocity 3 Low Register	05000
.	.	.	
.	.	.	
.	.	.	
46126	46326	Axis 2 Velocity 16 High Register	00008
46127	46327	Axis 2 Velocity 16 Low Register	05000
46128	46328	Axis 1 Acceleration 1 Register	01000
46129	46329	Axis 1 Acceleration 2 Register	01500
46130	46330	Axis 1 Acceleration 3 Register	02000
.	.	.	
.	.	.	
.	.	.	

Table 5-11: Original & Mirror Data Table Registers

Original Table Adder	Mirror Table Adder	Description	Value
46143	46343	Axis 1 Acceleration 16 Register	01500
46144	46344	Axis 2 Acceleration 1 Register	01000
46145	46345	Axis 2 Acceleration 2 Register	01500
46146	46346	Axis 2 Acceleration 3 Register	02000
.	.	.	
.	.	.	
.	.	.	
46159	46359	Axis 2 Acceleration 16 Register	01500
46160	46360	Axis 1 Deceleration 1 Register	01000
46161	46361	Axis 1 Deceleration 2 Register	01500
46162	46362	Axis 1 Deceleration 3 Register	02000
.	.	.	
.	.	.	
.	.	.	
46175	46375	Axis 1 Deceleration 16 Register	01500
46176	46376	Axis 2 Deceleration 1 Register	01000
46177	46377	Axis 2 Deceleration 2 Register	01500
46178	46378	Axis 2 Deceleration 3 Register	02000
.	.	.	
.	.	.	
.	.	.	
46191	46391	Axis 2 Deceleration 16 Register	01500

Table 5-11: Original & Mirror Data Table Registers Cont'd

5.3.6. Mode 5 – Execute Move from Table

Mode 5 of the FN43 allows the PLC to execute one of the sixteen different moves stored in the IFC 220E 16-point **Move Table** for each axis. The PLC executes a move by setting one bit out of sixteen in a Move Mask register for the axis to be moved. If the axis is enabled, the IFC 220E commands the axis to move to the position corresponding to the bit selected in the Move Mask register. When the move completes, the IFC 220E sets a corresponding bit in the Move Complete Mask register to inform the PLC that the move is complete and the axis in-position. When the PLC initiates another move, the Move Complete bit is reset. *Figure 5-7* illustrates the use of the FN43 Mode 5 User Loadable.

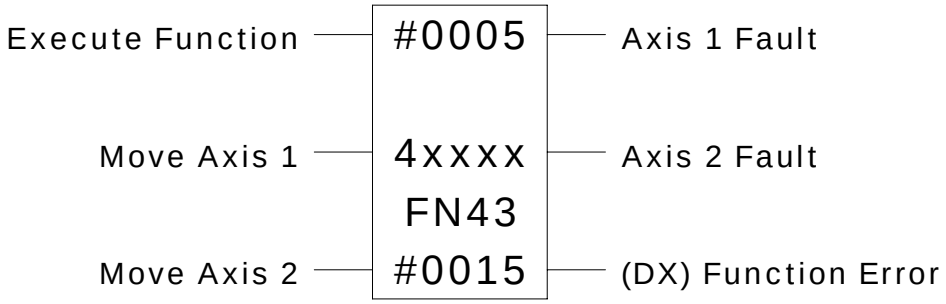


Figure 5-7: Mode 5 - Execute Move from Table Operation of FN43

To place the FN43 in Mode 5 write a 5 in the top node of the function block. The middle node specifies the starting 4XXXX register for the 15 consecutive function block data registers. Place a 15 in the bottom node to designate the number of registers used by the loadable. Before applying power to the inputs of the loadable, configure the FN43 by entering data into the PLC write registers (see Mode 5 register descriptions). Once you configure the loadable you may apply power to the inputs.

When power is applied to the top input, the function block executes. Power should remain on the top input at all times when this mode is in use.

When power is applied to the middle input, the axis enables (Bit 3 in 4XXXX+4 is set) and a bit is selected in the Move Mask register (4XXXX+2), the move stored in the IFC 220E corresponding to the bit selected in the Move Mask for the axis will execute. When the move completes, a corresponding bit in the Move Complete Mask register will be set for the axis (4XXXX+5). If a fault occurs on the axis, the top output turns on. When the fault is cleared, the output turns off.

The bottom output is used to indicate a DX Function Fault. This fault condition usually implies incorrect node information, the IFC 220E is not present, or a module communication error.

NOTE **The Move Input is recognized by the loadable on a transition from low-to-high and while power is applied to the top node. Motion will not occur if power is applied to top and Move Input simultaneously.**

5.3.6.1. Mode 5 - PLC Write Registers

The following *Table 5-12* provides a description of the 5 write registers used by the FN43 Mode 5 User Loadable:

Register	Description
4XXXX	Starting Traffic-Copped Output Register (40001 - 49999)
4XXXX+1	Starting Traffic-Copped Input Register (30001 - 39999)
4XXXX+2	Axis 1 Move Mask
4XXXX+3	Axis 2 Move Mask
4XXXX+4	Axis 1 & 2 Absolute/± Incremental Move, Enable Mask

Table 5-12: Mode 5 - PLC Write Registers

The following is a detailed description of the PLC write registers of the FN43 Mode 5 User Loadable:

4XXXX ***Starting Traffic-Copped Output Register***

Enter the number of the first 4XXXX Output Register Traffic-Copped to the module. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 1234 is register 41234

4XXXX+1 ***Starting Traffic-Copped Input Register***

Enter the number of the first 3XXXX Input Register Traffic-Copped to the module. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 0334 is register 30334

4XXXX+2 ***Axis 1 Move Mask***

PLC uses this register to select the corresponding move from the Axis 1 **Move Table**. You can only select one bit at a time.

Example: If Bit 9 is selected in this register, the IFC 220E moves Axis 1 to the position stored in the 9th field of the **Move Table**. The axis moves at the predefined speed, acceleration, and deceleration.

4XXXX+3 ***Axis 2 Move Mask***

PLC uses this register to select the corresponding move from the Axis 2 **Move Table**. Only one bit can be selected at a time.

Example: If Bit 9 is selected in this register, the IFC 220E moves Axis 2 to the position stored in the 9th field of the **Move Table**. The axis moves at the predefined speed, acceleration, and deceleration.

4XXXX+4 ***Axis 1 and Axis 2 Absolute / ± Incremental Move, Enable Mask***

PLC uses this register to enable Axis 1 or Axis 2 and to establish an Incremental or Absolute move. Absolute moves are indicated by the absence of Bits 1 and 2. The following describes the bits in this register:

Bit 1 ***Axis 1 Incremental Move Positive –*** If set, Axis 1 moves a relative distance in the positive direction from its present position. If Bits 1 and 2 are zero, the axis moves to the absolute position selected by the bit in the Move Mask Register referenced from the encoder's zero position.

Bit 2 ***Axis 1 Incremental Move Negative –*** If set, Axis 1 moves a relative distance in the negative direction from its present position. If Bits 2 and 1 are zero, the axis moves to the absolute position selected by the bit in the Move Mask Register referenced from the encoder's zero position.

Bit 3 ***Axis 1 Enable –*** If this bit is set, Axis 1 is configured correctly, and no faults exist on the axis, the axis enables its PID to control the motion of the servo drive and motor.

Bit 4-8 ***Not Used***

Bit 9 ***Axis 2 Incremental Move Positive –*** If set, Axis 2 moves a relative distance in the positive direction from its present position. If Bits 1 and 2 are zero, the axis moves to the absolute position selected by the bit in the Move Mask Register referenced from the encoder's zero position.

Bit 10 ***Axis 2 Incremental Move Negative –*** If set, Axis 2 moves a relative distance in the negative direction from its present position. If Bits 2 and 1 are zero, the axis moves to the absolute position selected by the bit in the Move Mask Register referenced from the encoder's zero position.

Bit 11 ***Axis 2 Enable*** – If this bit is set, Axis 2 is configured correctly, and no faults exist on the axis, the axis enables its PID to control the motion of the servo drive and motor.

Bit 12-16 ***Not Used***

5.3.6.2. Mode 5 - PLC Read/Reserved Registers

Register	Description
4XXXX+5	Axis 1 Move Complete Mask
4XXXX+6	Axis 2 Move Complete Mask
4XXXX+7	Axis 1 Status
4XXXX+8	Axis 2 Status
4XXXX+9	Axis 1 Position High
4XXXX+10	Axis 1 Position Low
4XXXX+11	Axis 2 Position High
4XXXX+12	Axis 2 Position Low
4XXXX+13	Reserved for Internal Use
4XXXX+14	Reserved for Internal Use

Table 5-13: Mode 5 - PLC Read/Reserved Registers

The following is a detailed description of the PLC read/reserved registers of the FN43 Mode 5 User Loadable:

4XXXX+5 ***Axis 1 Move Complete Mask***

PLC uses this register to monitor when the selected move in 4XXXX+2 Move Mask Register is complete.

Example: If Bit 9 in 4XXXX+2 is set, and the module moved Axis 1 to the position in the 9th field, Bit 9 in this register is set (or reset) once the move completes.

4XXXX+6 ***Axis 2 Move Complete Mask***

PLC uses this register to monitor when the selected move in 4XXXX+3 Move Mask Register is complete.

Example: If Bit 9 in 4XXXX+3 is set, and the module moved Axis 2 to the position in the 9th field, Bit 9 in this register is set once the move completes.

4XXXX+7 ***Axis 1 Status***

PLC uses this register to monitor the status of Axis 1 while the axis is moving or at rest. The following describes the bits in this register:

Bit 1 ***Homing Off*** – If set, the axis is moving off the Home Input during a homing sequence.

Bit 2 ***Homing*** – Set to 1 when the axis receives a Home command. Resets to 0 when homing completes.

Bit 3 ***Faulted*** – Set to 1 when the axis faults. Resets to 0 when faults are cleared.

Bit 4 ***Moving Continuously –*** Set to 1 when the axis receives a command to move indefinitely at a constant velocity. Resets to 0 when the axis stops.

Bit 5 ***Reserved***

Bit 6 ***In-Decel*** – If set, the axis is decelerating to a stop. Resets to 0 when the axis reaches the predefined In-position band.

Bit 7 ***Reserved***

Bit 8 ***In-Position*** – If set, the axis is within the predefined In-Position band.

Bit 9 ***Velocity Feed Forward*** – If set, the velocity feed forward gain for the axis is enabled. When enabled, the axis attempts to run with minimal or no following error. Following error is the difference between the commanded and actual position of the axis.

Bit 10 ***Reverse Output Mode*** – If set, the reverse output mode of the motion PID is enabled. When enabled, the axis applies torque in the opposite direction of the force exerted by the load.

Bit 11 ***Enabled*** – If set, the motion PID for the axis is enabled. This allows the IFC 220E to control the motion of the axis.

Bit 12 ***In Negative Current Clamp*** – If set, the Analog Output Register value equals the set value of the Negative Current Clamp on the PID tuning screen in the HMI Software.

Bit 13 ***In Positive Current Clamp*** – If set, the Analog Output Register value equals the set value of the Positive Current Clamp on the PID tuning screen in the HMI Software.

Bit 14 ***Reserved***

Bit 15 ***Moving Minus*** – If set, the axis is moving in a negative direction. When 0, the axis is moving in the positive direction.

Bit 16 ***Moving*** – If set, the axis is moving. When 0, the axis is at rest.

4XXXX+8 ***Axis 2 Status***

PLC uses this register to monitor the status of Axis 2 while the axis is moving or at rest. The bits in this register are updated independently from Axis 1, above.

4XXXX+9 ***Axis 1 Position High Word***

Contains the observed high word of the Axis 1 encoder position (user units).

4XXXX+10 ***Axis 1 Position Low Word***

Contains the observed low word of the Axis 1 encoder position (user units).

4XXXX+11 ***Axis 2 Position High Word***

Contains the observed high word of the Axis 2 encoder position (user units).

4XXXX+12 ***Axis 2 Position Low Word***

Contains the observed low word of the Axis 2 encoder position (user units).

4XXXX+13 - 14 Used by the loadable to store variables. Do not write to these resisters.

5.3.7. Mode 6 – Copy Setup Data from Module to PLC

Mode 6 of the FN43 User Loadable allows the PLC to copy axis setup data from the IFC 220E to the PLC. Using Mode 7, you can then load the data stored in the PLC to the same IFC 220E or to a new IFC 220E. This allows the PLC to initialize the IFC 220E instead of using the HMI Windows Setup Software. *Figure 5-8* illustrates the use of the FN43 Mode 6 User Loadable.

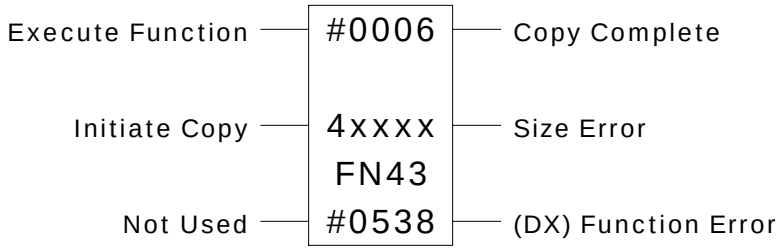


Figure 5-8: Mode 6 – Copy Setup Data Operation of FN43

To place the FN43 User Loadable in Mode 6 write a 6 in the top node of the function block. The middle node specifies the starting 4XXXX register for the 538 consecutive function block data registers. Place a 538 in the bottom node to designate the number of PLC registers used by the loadable. Before applying power to the inputs of the FN43 Mode 6 User Loadable, you must configure the loadable by entering data into the PLC Mode 6 Write Registers (description below). Once configured, you may power the inputs.

When power is applied to the top input, the function block executes. Power should remain on the top input at all times when Mode 6 is in use.

When power is applied to the middle input, the function block copies the setup data from the IFC 220E to the PLC Write Registers. Once this process completes, the top output becomes active.

The bottom node of 538 (number of registers necessary for this function) is valid for Firmware Version 1.00. If later versions of Firmware require additional registers, a Size Error may occur on the middle output. In this case, the user can determine the correct value for this node by reading the register at the base register plus 9.

The bottom output indicates a fault condition. This fault condition usually implies incorrect node information, the IFC 220E is not present, or a module communication error.

NOTE **The Copy Input is recognized by the loadable on a transition from low-to-high and while power is applied to the top node. Copying will not occur if power is applied to top and Copy Input simultaneously.**

5.3.7.1. Mode 6 - PLC Write Registers

The following *Table 5-14* provides a description of the registers used by the FN43 Mode 6 User Loadable:

Register	Description
4XXXX	Starting Traffic-Copped Output Register (40001 - 49999)
4XXXX+1	Starting Traffic-Copped Input Register (30001 - 39999)

Table 5-14: Mode 6 - PLC Write Registers

The following is a detailed description of the PLC write registers of the FN43 Mode 6 User Loadable:

4XXXX ***Starting Traffic-Copped Output Register***

Enter the number of the first 4XXXX Output Register Traffic-Copped to the IFC 220E. This number must range from 0001 to 9999 and must match the register defined in the Traffic-Cop.

Example: 1234 is register 41234

4XXXX+1 ***Starting Traffic-Copped Input Register***

Enter the number of the first 3XXXX Input Register Traffic-Copped to the IFC 220E. This number must range from 0001 to 9999 and must match the register defined in the Traffic-Cop.

Example: 0334 is register 30334

5.3.7.2. Mode 6 - PLC Read/Reserved Registers

The following *Table 5-15* provides a description of the read/reserved registers used by the FN43 Mode 7 User Loadable:

Register	Description
4XXXX+2	Reserved for Internal Use
4XXXX+3	Reserved for Internal Use
4XXXX+4	Reserved for Internal Use
4XXXX+5	Reserved for Internal Use
4XXXX+6	Reserved for Internal Use
4XXXX+7	Reserved for Internal Use
4XXXX+8	Reserved for Internal Use
4XXXX+9	Number Registers Required
4XXXX+10	Start of Setup Data
.	.
.	.
.	.
4XXXX+537	End of Setup Data

Table 5-15: Mode 6 - PLC Read/Reserved Registers

The following is a detailed description of the PLC read registers of the FN43 Mode 6 User Loadable:

4XXXX+2 - 8 ***Reserved for Internal Use***

4XXXX+9 ***Total Registers Required by Function 6***

The value will be 538 for Firmware Version 1.00. Later Firmware versions may require addition registers. Use this value to adjust the bottom node of the FN43 function block, if necessary. The bottom node should be equal to this value plus 10.

4XXXX+10 - 537 ***Contains the Setup Data***

5.3.8. Mode 7 – Copy Setup Data from the PLC to the Module

Mode 7 of the FN43 User Loadable allows the PLC to copy the axis setup data saved using Mode 6 of the loadable (from PLC to IFC 220E). This allows the PLC to initialize the IFC 220E without using the HMI Windows Setup Software. *Figure 5-9* illustrates the use of the FN43 Mode 7 User Loadable.

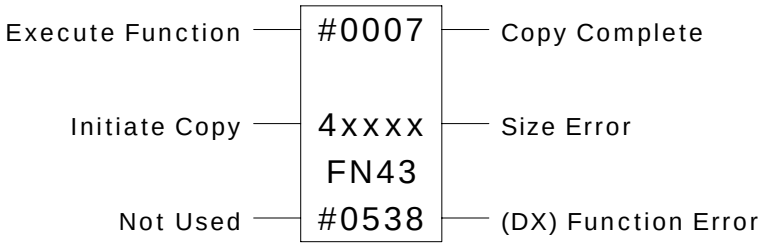


Figure 5-9: Mode 7 – Copy Setup Data Operation of FN43

To place the FN43 User Loadable in Mode 7 write a 7 in the top node of the function block. The middle node specifies the starting 4XXXX register for the 538 consecutive function block data registers. For most cases, this register is the same one used in the middle node of the Mode 6 FN43 Function Block used to save the data.

For Mode 7 place a 538 in the bottom node to designate the number of registers used by the loadable. Before applying any power to the inputs of Mode 7, configure the loadable by entering data into the PLC write registers. See the FN43 Mode 7 register descriptions. After you configure the loadable, you may apply power to its inputs.

When power is applied to the top input, the function block executes. Power should remain on the top input at all times when this mode is in use.

When power is applied to the middle input, the function proceeds to copy the setup data from the IFC 220E to the PLC registers. Once the process completes, the top output becomes active.

Note: The copy process starts when the middle input goes active after being inactive and it must stay active until the process completes.

The bottom node of 538 (number of registers necessary for this function) is valid for Firmware Version 1.00. If later versions of Firmware require additional registers, a Size Error may occur on the middle output. In this case, use Mode 6 to determine the correct value for this node.

Size Error may also occur if the data size saved in the PLC does not match the data size in the Firmware. This may be a result of incompatible Firmware Versions or corrupted data in the PLC.

The bottom output indicates a DX Function Fault. This fault condition usually implies incorrect node information, the IFC 220E is not present, or a module communication error.

NOTE **The Copy Input is recognized by the loadable on a transition from low-to-high and while power is applied to the top node. Copying will not occur if power is applied to top and Copy Input simultaneously.**

5.3.8.1. Mode 7 - PLC Write Registers

The following *Table 5-16* provides a description of the two write registers used by the FN43 Mode 7 User Loadable:

Register	Description
4XXXX	Starting Traffic-Copped Output Register (40001 - 49999)
4XXXX+1	Starting Traffic-Copped Input Register (30001 - 39999)

Table 5-16: Mode 7 - PLC Write Registers

4XXXX ***Starting Traffic-Copped Output Register***

Enter the number of the first 4XXXX Output Register Traffic-Copped to the IFC 220E. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 1234 is register 41234

4XXXX+1 ***Starting Traffic-Copped Input Register***

Enter the number of the first 3XXXX Input Register Traffic-Copped to the IFC 220E. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 0334 is register 30334

5.3.8.2. Mode 7 - PLC Read/Reserved Registers

The following *Table 5-17* provides a description of the read/reserved registers used by the FN43 Mode 7 User Loadable:

Register	Description
4XXXX+2	Reserved for Internal Use
4XXXX+3	Reserved for Internal Use
4XXXX+4	Reserved for Internal Use
4XXXX+5	Reserved for Internal Use
4XXXX+6	Reserved for Internal Use
4XXXX+7	Reserved for Internal Use
4XXXX+8	Reserved for Internal Use
4XXXX+9	Reserved for Internal Use
4XXXX+10	Start of Setup Data
.	.
.	.
.	.
4XXXX+537	End of Setup Data

Table 5-17: Mode 7 - PLC Read/Reserved Registers

5.3.9. Mode 8 – General Low-level Commands

Mode 8 of the FN43 User Loadable allows the PLC to execute a low level command on the IFC 2220E. The command is triggered on a rising edge on the execute input of the loadable. The Command Complete output node is activated upon completion of the command. *Figure 5-10* illustrates the use of the FN43 Mode 8 User Loadable.

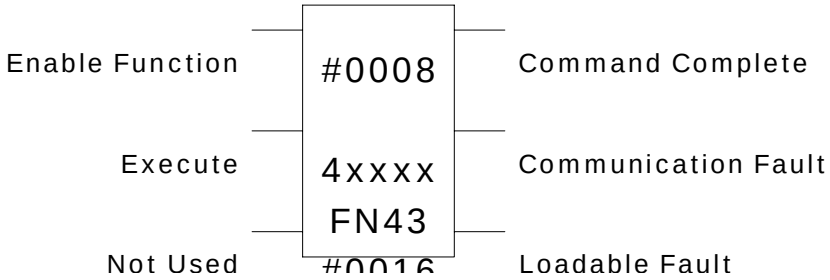


Figure 5-10: Mode 8 – Execute Low-level Command of FN43

To place the FN43 in Mode 8, do the following:

1. Write an 8 in the top node of the FN43.
2. The middle node specifies the starting 4XXXX register for the 15 consecutive FN43 data registers.
3. Place a 16 in the bottom node to set the number of registers used by the loadable.

Before applying power to the inputs of the FN43 Mode 5, they must be configured by entering data into the PLC write registers. See the FN43 Mode 8 register descriptions on the following page. After the loadable is configured, power can be applied to its inputs.

When power is applied to the top (**Enable Function**) input, the FN43 begins to execute. Power should remain on the top input at all times when this mode is in use.

When power is applied to the middle (**Execute**) input, the command with its data will be sent to the IFC 220E. Then, the loadable will either enable the Command Complete Output or the IFC 220E will process a Communication Fault Output.

The top (**Command Complete**) output indicated that the command has been successfully processed.

The middle (**Communication Fault**) output indicates a communication fault with the IFC 220E. Either the module is not present or the command is not properly formatted.

The bottom (**DX Function Error**) output is used to indicate a DX function fault. This fault condition usually indicates incorrect node information or incorrect register information.

NOTE **The Execute Command Inputs are recognized by the loadable on a transition from low-to-high and while power is applied to the top node.**

Register	Description
4XXXX	Starting Traffic-copped Output Register (40001-49999)
4XXXX+1	Starting Traffic-copped Input Register (30001-39999)
4XXXX+2	Command Word
4XXXX+3	Command Data Word 1
4XXXX+4	Command Data Word 2
4XXXX+5	Command Data Word 3
4XXXX+6	Command Data Word 4
4XXXX+7	Command Data Word 5

Table 5-18: Mode 8 - PLC Write Registers

4XXXX ***Starting Traffic-Copped Output Register***

Enter the number of the first 4XXXX Output Register Traffic-Copped to the IFC 220E. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 1234 is register 41234

4XXXX+1 ***Starting Traffic-Copped Input Register***

Enter the number of the first 3XXXX Input Register Traffic-Copped to the IFC 220E. This number must range from 0001 to 9999, and must match the register defined in the Traffic-Cop.

Example: 0334 is register 30334

4XXXX+2 ***Command Word***

Specifies the command.

Example: 1003 is the command to get the firmware revision level of the IFC 220E.

4XXXX+3 ***Optional Command Data Word 1***

4XXXX+4 ***Optional Command Data Word 2***

4XXXX+5 ***Optional Command Data Word 3***

4XXXX+6 ***Optional Command Data Word 4***

4XXXX+7 ***Optional Command Data Word 5***

Register	Description
4XXXX+8	Command Response
4XXXX+9	Response Data Word 1
4XXXX+10	Response Data Word 2
4XXXX+11	Response Data Word 3
4XXXX+12	Response Data Word 4
4XXXX+13	Response Data Word 5
4XXXX+14	Reserved for Internal Use
4XXXX+15	Reserved for Internal Use

Table 5-18: Mode 8 - PLC Read/Reserved Registers

4XXXX+8	***Command Response***
4XXXX+9	***Optional Response Data Word 1***
4XXXX+10	***Optional Response Data Word 2***
4XXXX+11	***Optional Response Data Word 3***
4XXXX+12	***Optional Response Data Word 4***
4XXXX+13	***Optional Response Data Word 5***
4XXXX+14 - 15	***Reserved for Internal Use***

In this Chapter you will learn about:

- Troubleshooting Procedures
- Diagnostic LEDs
- Setup Software Diagnostics
- PLC Diagnostics

6.1. Troubleshooting Procedures

The information in this chapter will help you isolate and resolve system hardware and software problems. When your system does not function properly (or as you expect it to operate), the first thing that you must do is identify and isolate the problem. When you have accomplished this, you can effectively begin to resolve the problem.

The first step to troubleshooting is to isolate each system component and ensure that each component functions properly when it runs independently. You may have to dismantle your system and rebuild it piece-by-piece in order to detect the problem. If you have additional components available, you may want to try replacing them with existing components or components that are working in another system. You should also try removing features until the component is running in its most basic mode.

Determine if the problem is mechanical, hardware or software-related. Try to recreate or repeat the problem. Do not attempt to make quick rationalizations about the problem. Random events may appear to be related, but they are not necessarily contributing factors to the problem. You must carefully investigate and decipher the events that occur leading up to the problem.

You could be experiencing more than one problem. Try to isolate and solve one problem at a time. Document all testing and problem isolation procedures for review with a technician at a later time. When you feel that you have exhausted all possibilities and the problem still exists, call your local distributor or I²T Technical Support at (412) 828-1200. Please have the following information available when you call:

- Product Part Numbers (P/N)
- Product Serial Number (SN)
- Detailed Description of the Problem
- Description of the Application
- Firmware Version
- HMI Windows Setup Software Version (see **Help Topics** Menu in *Chapter 4*)
- Loadable Version (see Mode 0 in *Chapter 5*)

6.2. Diagnostic LEDs

A diagnostic LED array is mounted on the circuit board directly above the terminal connections (see *Figure 6-1*) at the front of the IFC 220E. This array consists of 20 LEDs: ten in the top row and ten in the bottom row. When the IFC 220E Momentum I/O Base Servo Control Module is configured into the I/O Network and the Momentum PLC is in the RUN mode, the 3rd LED in the Top Row illuminates Green (active). The system is capable of displaying more than one fault at any time (multiple LEDs light). *Table 6-1* summarizes these LEDs as they appear on the module.

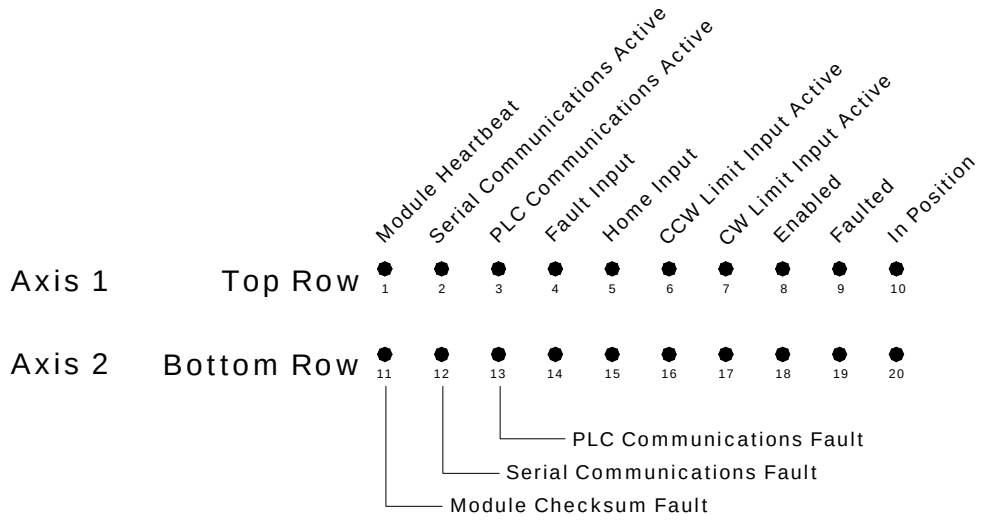


Figure 6-1: Diagnostic LED Array

LED	Description	LED	Description
Axis – Module Status/Fault LEDs (Top Row)		***Module Status/Fault LEDs (Bottom Row)***	
General Module Information			
1	Module Heartbeat	11	Module Checksum Fault
2	Serial Communications Active	12	Serial Communications Fault
3	PLC Communications Active	13	PLC Communications Fault
Axis Specific Information			
4	Fault Input – Axis 1	14	Fault Input – Axis 2
5	Home Input – Axis 1	15	Home Input – Axis 2
6	REV Limit Input Active – Axis 1	16	REV Limit Input Active – Axis 2
7	FWD Limit Input Active – Axis 1	17	FWD Limit Input Active – Axis 2
8	Enabled – Axis 1	18	Enabled – Axis 2
9	Faulted – Axis 1	19	Faulted – Axis 2
10	In-Position -- Axis 1	20	In-Position Axis 2

Table 6-1: Module Status and Fault LEDs

6.2.1. Module Status/Fault LEDs – Axis 1 (Top Row)

The following describes the Status and Fault LEDs as they appear on the module beginning with the Top Row from left to right (1-10).

6.2.1.1. Module Heartbeat (LED 1)

This status LED continuously blinks at a steady rate when the module is functioning properly.

6.2.1.2. Serial Communications Active (LED 2)

This status LED blinks when there is communication between the User's PC and the IFC 220E Serial Setup Port.

6.2.1.3. PLC Communications Active (LED 3)

This status LED is on while the Momentum PLC issues commands to the IFC 220E Momentum I/O Base Servo Control Module.

6.2.1.4. Fault Input (LED 4)

This status LED is on when the fault switch is active.

6.2.1.5. Home Input (LED 5)

This status LED signals on when the Axis Home Limit Switch is active.

6.2.1.6. REV Limit Input Active (LED 6)

This LED signals on when the Axis 1 REV Limit Switch is active. If the axis is moving in the REV direction and the REV Input trips, all motion stops, the axis disables, and the module faults. Re-enable the axis and jog off in the FWD direction to clear this fault. Issue a clear fault command (4XXXX = 1001 and 4XXXX+1 = 1) to clear the IFC 220E fault or pulse the clear faults bit.

6.2.1.7. FWD Limit Input Active (LED 7)

This LED is on when the Axis 1 FWD Limit Switch is active. If the axis is moving in the FWD direction and the FWD Input trips, all motion stops, the axis disables, and the module faults. Re-enable the axis and jog off in the REV direction to clear this fault. Issue a clear fault command (4XXXX = 1001 and 4XXXX+1 = 1) to clear the IFC 220E fault or pulse the clear faults bit.

6.2.1.8. Enabled (LED 8)

This status LED is on when Axis 1 enables the servo drive.

6.2.1.9. Faulted (LED 9)

This LED is on when any number of faults has occurred on Axis 1.

6.2.1.10. In-Position (LED 10)

Turns on when the position commanded minus observed position, while under PID motion control, exceeds the limit specified for the axis in the **Tune** dialog box.

6.2.2. Module Status/Fault LEDs – Axis 2 (Bottom Row)

With the exception of LEDs 11, 12 and 13 in this row (*Table 6-1*) refer to the descriptions given above (where 4=14, 5=15, etc.) for Axis 1 Status and Fault LEDs. ***Note:*** Only Axis 2 applies.

6.3. PLC Diagnostics

User's may perform module diagnostics in one of two ways. First, use the fault register information returned to the PLC from the IFC 220E. This information contains four separate fault registers with bits defined for specific faults. The second approach is to perform diagnostics using the Windows Setup Software to look at fault information. This section describes both methods.

6.3.1. Using PLC Fault/Status Registers for Diagnostics

With the **Get Fault & Status Codes** command (1001) you may use the PLC to perform fault diagnostics. To obtain the fault/status information, place a 1001 in the first register that is Traffic-Copped to the IFC 220E. To read the IFC 220E faults/status, place a 0 in the second register. To clear module faults, place a 1 in the second register. The module returns faults and status of the IFC 220E in four input registers.

Output Register	Description	Value	Input Register	Description
4XXXX	Command	1001	3XXXX	Echo
4XXXX+1	Reset Faults	1 or 0	3XXXX+1	Module Status/Faults
4XXXX+2	N/A		3XXXX+2	Module Digital Inputs – Axis 1 and Axis 2
4XXXX+3	N/A		3XXXX+3	Fault Mask – Axis 1
4XXXX+4	N/A		3XXXX+4	Fault Mask – Axis 2
4XXXX+5	N/A		3XXXX+5	N/A

Table 6-2: Fault and Status Registers

The following describes the fault and status registers along with details about the fault and status bits in each register:

3XXXX ***Echo***

3XXXX+1 ***Module Status/Faults (Axis 1 and Axis 2)***

The IFC 220E returns status and fault information by setting bits in this register. The following describes these bits:

Bits 1-7 ***Not Used***

Bit 8 ***Setup Not Saved to Flash*** – Changes to the IFC 220E Module Setup were not saved to Flash Memory.

Bit 9 ***Code Checksum Failure*** – Code in the IFC 220E Firmware is corrupt. Call I²T or download the latest Firmware to the module.

Bit 10 ***Serial Checksum or Timeout Error*** – CRC checksum or timeout occurred on the IFC 220E Serial Port. Verify the serial cable is connected properly or that there is no high voltage noise generating components near the serial cable.

Bit 11 ***Serial Command Error*** – PC, connected to IFC 220E Serial Port, sent an erroneous command or bad data within a command to the IFC 220E.

Bit 12 ***PLC Command Error*** – PLC sent an erroneous command or bad data within a command to the IFC 220E. Check PLC logic for bad module commands, and clear this fault.

Bit 13 ***Flash Memory Default*** – IFC 220E is operating with the power up default data.

Bit 14 ***Flash Memory Fault*** – IFC 220E has trouble reading or writing to Flash Memory. Consult I²T if you cannot clear this fault.

Bit 15 ***Not Used***

Bit 16 ***PLC Error*** – Communication failure between the PLC and IFC 220E.

3XXXX+2 ***Module Digital Inputs (Axis 1 and Axis 2)***

The IFC 220E returns the state of the module limits in this register. The following describes the bits in this register.

Bits 1-8 ***Not Used***

Bit 9 ***Axis 2 Fault Input*** – If set, the Axis 2 Fault Input is on.

Bit 10 ***Axis 2 Home Input*** – If this occurs, the Axis 2 Home Limit Switch activates.

Bit 11 ***Axis 2 REV Input*** – If this occurs, the Axis 2 REV Soft EOT Limit Switch activates, the axis disables and no motion is allowed in the REV direction. Re-enable the axis and jog off in the FWD direction.

Bit 12 ***Axis 2 FWD Input*** – If this occurs, the Axis 2 FWD Soft EOT Limit Switch activates, the axis disables and no motion is allowed in the FWD direction. Re-enable the axis and jog off in the REV direction.

Bit 13 ***Axis 1 Fault Input*** – If set, the Axis 1 Fault Input is on.

Bit 14 ***Axis 1 Home Input*** – If this occurs, the Axis 1 Home Limit Switch activates.

Bit 15 ***Axis 1 REV Input*** – If this occurs, the Axis 1 REV Soft EOT Limit Switch activates, the axis disables and no motion is allowed in the REV direction. Re-enable the axis and jog off in the FWD direction.

Bit 16 ***Axis 1 FWD Input*** – If this occurs, the Axis 1 FWD Soft EOT Limit Switch activates, the axis disables and no motion is allowed in the FWD direction. Re-enable the axis and jog off in the REV direction.

3XXXX+3 ***Fault Mask (Axis 1)***

The IFC 220E returns Axis 1 faults in this register. The following describes the bits in this register:

Bits 1-5 ***Not Used***

Bit 6 ***Fault Input*** – If set, the Fault Limit Switch activates.

Bit 7 ***REV Hardware EOT*** – REV Hardware EOT Limit Switch activates, the axis disables and no motion is allowed in the REV direction. Re-enable the axis and jog off in the FWD direction.

Bit 8 ***FWD Hardware EOT*** – FWD Hardware EOT Limit Switch activates, the axis disables and no motion is allowed in the FWD direction. Re-enable the axis and jog off in the REV direction.

Bit 9 ***Reserved***

Bit 10 ***Module Fault*** – IFC 220E is not I/O Mapped or the PLC is not in the RUN state. I/O Map the module as an AEC920-00 high-speed counter module.

Bit 11 ***Current Limit*** – Current limit exceeded. Set by the percentage and time setup in the **Tune** dialog box of the IFC 220E Windows Setup Software.

Bit 12 ***REV Software EOT*** – Encoder position exceeds the Soft EOT- value set in the **Axis** dialog box. When this occurs, the axis disables. Re-enable the axis and jog off the Soft EOT in the FWD direction.

Bit 13 ***FWD Software EOT*** – Encoder position exceeds the Soft EOT+ value set in the **Axis** dialog box. When this occurs, the axis disables. Re-enable the axis and jog off the Soft EOT+ in the REV direction.

Bit 14 ***Reserved***

Bit 15 ***Reserved***

Bit 16 ***Position Error*** – Actual position minus commanded position exceeds that set in the **Tune** dialog box of the HMI Software.

3XXXX+4 ***Fault Mask (Axis 2)***

The IFC 220E returns Axis 2 faults in this register. The following describes the bits in this register:

Bits 1-5 ***Not Used***

Bit 6 ***Fault Input*** – If set, the Fault Limit Switch activates.

Bit 7 ***REV Hardware EOT*** – REV Hardware EOT Limit Switch activates, the axis disables and no motion is allowed in the REV direction. Re-enable the axis and jog off in the FWD direction.

Bit 8 ***FWD Hardware EOT*** – FWD Hardware EOT Limit Switch activates, the axis disables and no motion is allowed in the FWD direction. Re-enable the axis and jog off in the REV direction.

Bit 9 ***Reserved***

Bit 10 ***Module Fault*** – IFC 220E is not I/O Mapped or the PLC is not in the RUN state. I/O Map the module as an AEC920-00 high-speed counter module.

Bit 11 ***Current Limit*** – Current limit exceeded. Set by the percentage and time setup in the **Tune** dialog box of the IFC 220E Windows Setup Software.

Bit 12 ***REV Software EOT*** – Encoder position exceeds the Soft EOT- value set in the **Axis** dialog box. When this occurs, the axis disables. Re-enable the axis and jog off the Soft EOT in the FWD direction.

Bit 13 ***FWD Software EOT*** – Encoder position exceeds the Soft EOT+ value set in the **Axis** dialog box. When this occurs, the axis disables. Re-enable the axis and jog off the Soft EOT+ in the REV direction.

Bit 14 ***Reserved***

Bit 15 ***Reserved***

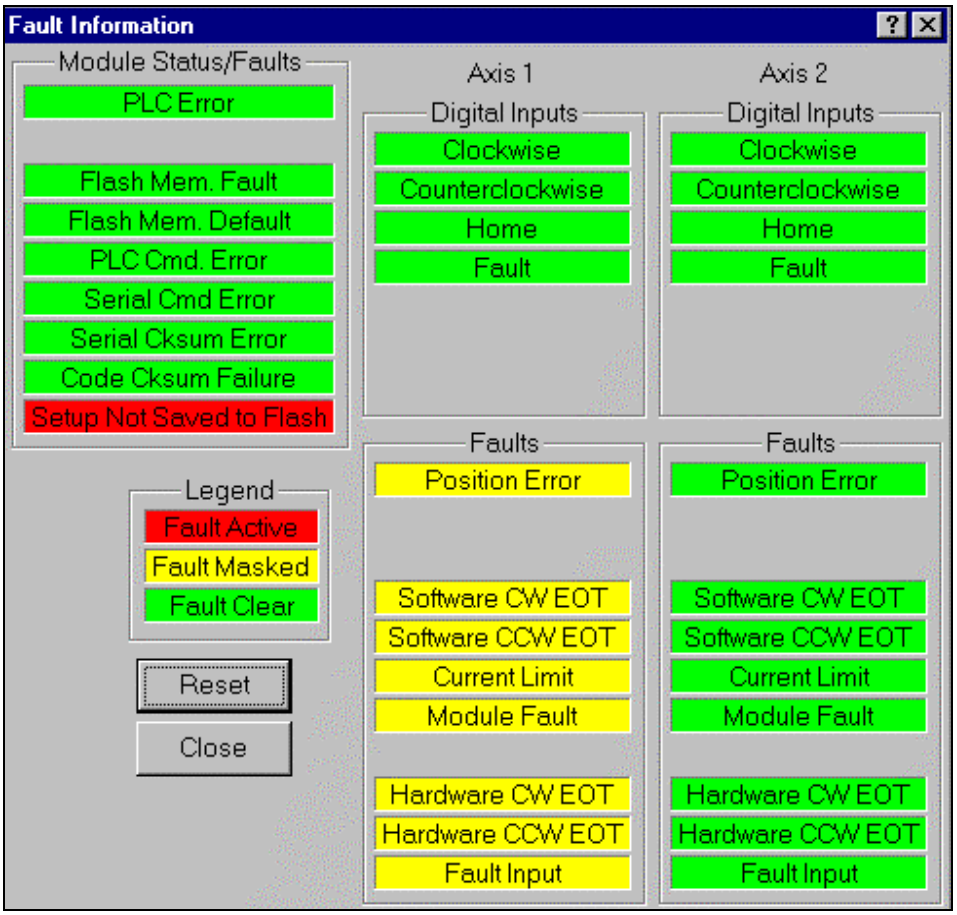
Bit 16 ***Position Error*** – Actual position minus commanded position exceeds that set in the **Tune** dialog box of the HMI Software.

3XXXX+5 ***Not Used***

4XXXX	***Command***
4XXXX+1	***Reset Faults*** To clear faults on the IFC 220E, pulse the specific Control & Status Register Bits described in *Section 5.2.2*. If the fault cannot be cleared, check physical setup (i.e., limit switches, etc.).
4XXXX+2 - 5	***Not Used***

6.4. Using Setup Software for Diagnostics

You may use the HMI Windows Setup Software to perform module diagnostics. Connect your PC to the serial setup port on the module and start the Windows Setup Software by clicking on the I²T HMI icon. Once the software loads, select **Tools** then **Faults** from the Main Menu.



This screen displays fault and input information for Axis 1 and Axis 2. When a fault occurs or a Limit Switch Input is true, the box associated with the condition appears in red. If able, the **Reset** button clears the fault. The **Close** button allows you to close the dialog box. The following is a description of the faults that appear in the dialog box above:

6.4.1. Module Fault Status Indicators (Axis 1 and Axis 2)

The following describes the faults that can occur on the IFC 220E.

6.4.1.1. PLC Error

PROBLEM/CAUSE	SOLUTION
Module is not configured in the Momentum I/O Network by the PLC or the PLC is not in a RUN state. Cause may be hardware failure.	Verify the module is configured in the Momentum I/O Network and ensure the PLC is in the RUN state.

6.4.1.2. Flash Memory Fault

PROBLEM/CAUSE	SOLUTION
Module failure on flash device.	Contact your I²T distributor.

6.4.1.3. Flash Memory Default

PROBLEM/CAUSE	SOLUTION
Module is in a default state. ***Note:*** Modules are shipped in this state.	User must configure the module to clear this status. ***Note:*** This is a good indication of an un-programmed module.

6.4.1.4. PLC Command Error

PROBLEM/CAUSE	SOLUTION
PLC issued an invalid or unknown command to the module. Registers designated for the module are being un-initialized or used for other purposes.	Ensure valid module command data is present in these registers and no other logic is writing to the I/O Mapped Registers. This fault remains latched until cleared by the 1001 command and will not prevent operation while active.

6.4.1.5. Serial Command Error

PROBLEM/CAUSE	SOLUTION
PC issued an invalid or unknown command to the module via the serial port. Cause may be communication failure due to faulty cables or from removing the serial connection while communicating.	Ensure serial cable is in good condition and well secured to the module and PC. ***Note:*** This fault remains latched until cleared by the 1001 command and will not prevent operation while active. ***Note:*** If communicating at higher baud rates and this error frequently occurs, try choosing a lower baud rate.

6.4.1.6. Serial Checksum Error

PROBLEM/CAUSE	SOLUTION
Module received corrupt data from the PC via the serial port. May be caused by communication failures due to faulty cables or by removing the serial connection while communicating.	Ensure serial cable is in good condition and well secured to the module and PC. ***Note:*** This fault remains latched until cleared by the 1001 command and will not prevent operation while active. ***Note:*** If communicating at higher baud rates and this error frequently occurs, try choosing a lower baud rate.

6.4.1.7. Code Checksum Failure

PROBLEM/CAUSE	SOLUTION
Failure on startup self check of Firmware code.	Re-download Firmware and Setup to the module. If this re-occurs, contact your I²T distributor.

6.4.1.8. Setup Not Saved to Flash

PROBLEM/CAUSE	SOLUTION
When active, the user has modified module settings that were not stored in Flash Memory.	Indicator may be cleared if user sends the **Copy Setup to Flash** command from the **Comm** Pull-down Menu. If this is active, any changes to the setup since the last power-up or save will be lost when the module is reset.

6.4.2. Digital Inputs (Axis 1 and Axis 2)

6.4.2.1. Forward

When this occurs, the FWD EOT Limit Switch activates, the axis disables, and no FWD motion is allowed. Re-enable the axis and jog off in REV direction.

6.4.2.2. Reverse

When this occurs, the REV EOT Limit Switch activates, the axis disables, and no REV motion is allowed. Re-enable the axis and jog off in the FWD direction.

6.4.2.3. Home

When this input occurs, the Home Limit Switch activates.

6.4.2.4. Fault

When this input occurs, the Fault Limit Switch activates.

6.4.3. Fault Status (Axis 1 and Axis 2)

6.4.3.1. Position Error

Occurs when the actual position minus the commanded position (position error) is exceeded by the axis. Users may increase the position error value (in the **Tune** dialog box) or use longer accel ramps and slower speeds. This could indicate that the servo motor and drive are not properly sized for the application.

6.4.3.2. Software FWD EOT

Occurs when the encoder position exceeds the FWD Soft EOT+ value set in the **Axis** dialog box. When this fault is true, the axis disables. Re-enable the axis and jog off in the REV direction. Verify your limit is a reasonable value and/or the commanded move was issued correctly.

For Example: Accidentally issuing an Incremental Forward move instead of an Absolute or Incremental Reverse move could send the commanded position past the limit.

6.4.3.3. Software REV EOT

Occurs when the encoder position exceeds the FWD Soft EOT- value set in the **Axis** dialog box. When this fault is true, the axis disables. Re-enable the axis and jog off in the FWD direction. Verify your limit is a reasonable value and/or the commanded move was issued correctly.

For Example: Accidentally issuing an Incremental Reverse move instead of an Absolute or Incremental Forward move could send the commanded position past the limit.

6.4.3.4. Current Limit

This fault occurs when the current limit value in the **Tune** dialog box (in the **Tools** Pull-down Menu) exceeds the current limit time also set in the **Tune** dialog box.

6.4.3.5. Module Fault

This fault occurs if the IFC 220E was not configured into the Momentum I/O Network or the PLC is not in the RUN state. To correct this fault, verify the module is configured correctly and ensure the PLC is in the RUN state. This module uses 8 input and 8 output registers.

6.4.3.6. Hardware FWD EOT

This fault occurs when positive motion is commanded and the Limit Switch Input is active. When this occurs, the FWD Hardware EOT Limit Switch activates, the axis disables, and no motion is allowed in the FWD direction. To clear this fault, verify the input is wired correctly and in the correct location. Verify your limit is a reasonable value and/or the commanded move was issued correctly.

For Example: Accidentally issuing an Incremental Forward move instead of an Absolute or Incremental Reverse move could send the commanded position past the limit.

6.4.3.7. Hardware REV EOT

This fault occurs when negative motion is commanded and the Limit Switch Input is active. When this occurs, the REV Hardware EOT Limit Switch activates, the axis disables, and no motion is allowed in the REV direction. To clear this fault, verify the input is wired correctly and in the correct location. Verify your limit is a reasonable value and/or the commanded move was issued correctly.

For Example: Accidentally issuing an Incremental Reverse move instead of an Absolute or Incremental Forward move could send the commanded position past the limit.

6.4.3.8. Fault Input

When this input occurs, the Fault Limit Switch activates. To clear this fault, determine the source of the fault and correct it. If the Fault Input is not being used, mask the fault or jumper the input wiring so that the signal is inactive.

In this Chapter you will learn about:

Application Calculations

A.1. Application Calculations

This section describes how to calculate user units for your application. There are some limitations to the user unit number because of the way the PLC stores numbers. This section will help you select a user unit value that gives you the resolution that you need and shows you how to calculate the maximum number of revolutions that the motor travels before a rollover occurs.

Position values are always stored in two PLC registers using Modulo 10,000 format. The following are some examples of how numbers are stored in the PLC using this format.

Number	PLC High Register	PLC Low Register
0583	00000	00583
10,020	00001	00020
125,933	00012	05933
17,592,015	01759	02015
107,921,882	10792	01882

The resultant number is obtained by using the following formula.

Position = (PLC High Register * 10000) + PLC Low Register

The low register is always 9999 or less and the high register any number from 0 to 65535. Using Modulo 10,000 format, the largest number that can be shown is 655,359,999. This number represents the largest number of position counts that can be sent to the PLC by the IFC 220E. Keep this in mind when setting user units to measure position over long distances.

User units are entered in counts/rev of the encoder via the HMI Software. Thus, entering a value of 0.0001 returns 1 count/encoder rev in the low register. A value of 0.0010 returns 10 counts/encoder rev in the low register. A set value of 1.0000 returns 10,000 counts/encoder rev in the low register or 1 count/encoder rev in the high register. The maximum encoder output is 4,096 counts/rev, limiting the resolution as you enter larger user unit values. The maximum number of revs that the encoder turns without rolling over is 65,535 user units, with a maximum number of 1,047,363 revs in all cases. Given the above example, if user units are set to 1.0000, the maximum number of encoder revs is 65,535/1.0000 or 65,535. If you set user units to 0.0010, a maximum number of encoder revs is 65,535/0.0010 or 65,535,000.

In most applications, the user configures the module to rollover at a specified number, eliminating concern for the maximum number of motor revs. The only application where rollover is a concern is on Totalizer applications, where the encoder measures position over a long distance. The maximum number of encoder revs is 1,047,363. This number may be reduced depending on the user units that you use.

The following table shows the maximum number of revs for different user unit values.

User Units	Counts/Rev	Encoder Position	PLC High Register	PLC Low Register	Max. No. (Revs.)	Max. Posn. Value
0.0010	10	2,000 (200 revs)	00000	02000	1,047,363	10,473,630
0.0200	200	2,000 (10 revs)	0000	02000	1,047,363	10,473,630
0.500	5000	2,000 (0.4 revs)	0000	02000	131,070	655,350,000
1.2500	1250	2,000 (0.16 revs)	0000	02000	52,428	655,350,000
360.0000	3600000	2,000 (0.00055 revs)	0000	02000	182	655,350,000

NOTE **As larger user units are entered, the counts/rev increase, but the actual resolution of the system remains limited to 4,096 counts/rev. For example, using user units of 1.2500, the position reported back to the PLC would increment 3 counts for every encoder count.**

The following are some real-world examples of setting user units.

A.1.1. Setting User Units – Example 1

A motor with an encoder is mounted on a drum with a 1 to 1 ratio and you want to report position back to the PLC in hundredths of a degree of drum rotation.

Your user units would be 3.6000, giving you 36,000 counts/drum rev. The rollover value would be set to 3.6000 to allow the position to rollover on each rev of the drum. The following values are returned in the PLC position registers.

Drum Position	PLC High Register	PLC Low Register
45 degrees	00000	04500
90 degrees	00000	09000
270 degrees	00002	07000
359 degrees	00003	05900

If you did not use a rollover value, the maximum number of drum revs before a rollover would occur is 65,535/3.6 or 18,204.

A.1.2. Setting User Units – Example 2

A motor with an encoder is mounted on a 12" circumference wheel that measures the length of a strip of steel and you want a resolution of 0.1 inches reported back to the PLC.

Your user units would be 0.0120, giving you 120 counts/wheel rev. It is unnecessary to use a rollover value, because you want to measure the maximum length of steel. The following values are returned in the PLC position registers.

Steel Position	PLC High Register	PLC Low Register
10.5 in (0.875 ft)	0000	00105
65.2 in (5.4 ft)	0000	00652
190.8 in (15.9 ft)	0000	01908
20054.3 in (1671.2 ft)	0000	00543

The maximum number of feet that can be measured using this resolution is 1,047,363 inches.

A.1.3. Setting User Units – Example 3

A motor with an encoder is mounted on a ball screw with a pitch of 8 revs/inch and you want a resolution of 0.0001 inches reported back to the PLC.

Your user units would be 0.1250, giving you 1,250 counts/rev or 10,000 counts/inch of travel. You would not use a rollover value because your ball screw has a limited length of travel. The following values are returned in the PLC position registers.

Ball Screw Position	PLC High Register	PLC Low Register
0.2250	00000	02250
1.1592	00001	01592
22.9923	00022	09923
100.5820	00100	05820

In this Chapter you will learn about:

Drawings

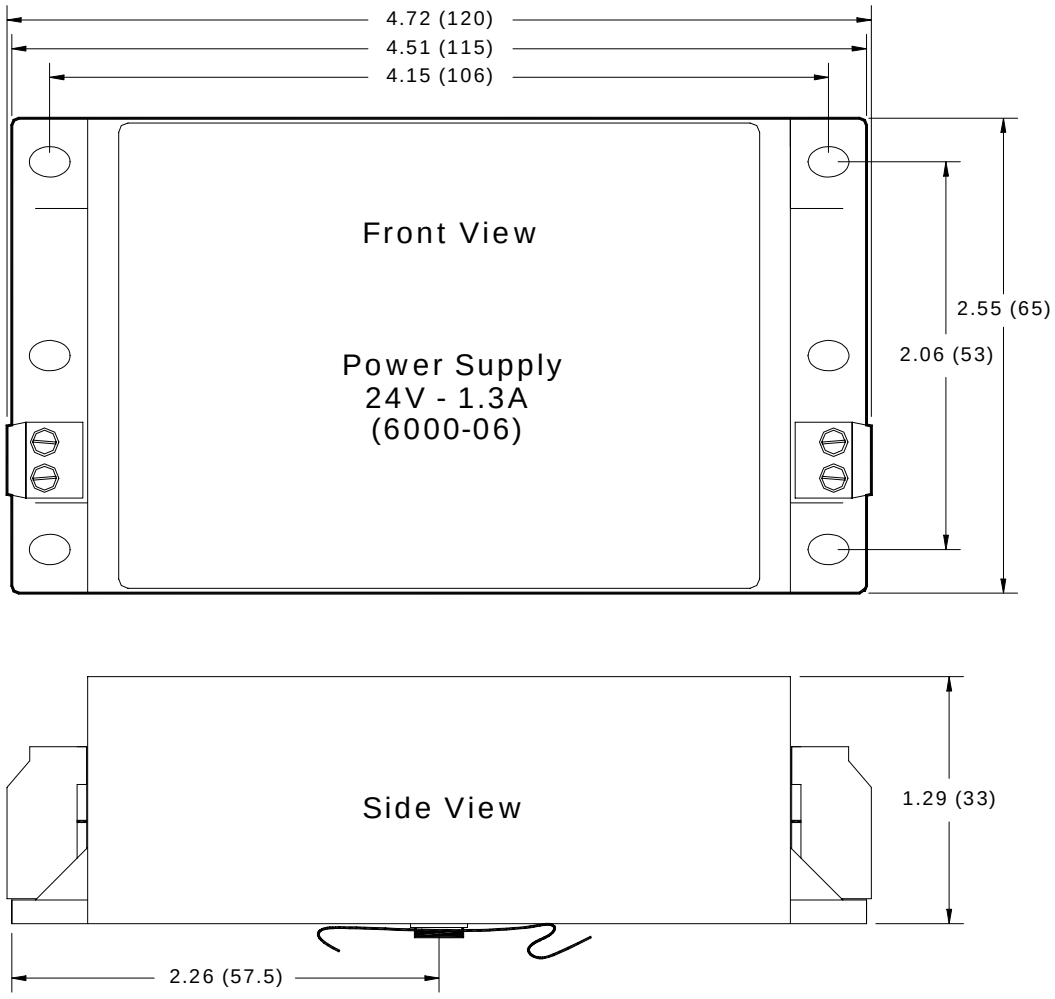


Figure B-1: ± 24Vdc Power Supply Dimensions (6000-06)

J2 (Top Connector)

Pin #	Description
1	Ax1 Encoder A+
2	Ax1 Encoder A-
3	Ax1 Encoder B+
4	Ax1 Encoder B-
5	Ax1 Encoder Z+
6	Ax1 Encoder Z-
7	Shield
8	Ax2 Encoder A+
9	Ax2 Encoder A-
10	Ax2 Encoder B+
11	Ax2 Encoder B-
12	Ax2 Encoder Z+
13	Ax2 Encoder Z-
14	Shield
15	Encoder +5V
16	Encoder GND
17	+24V In
18	24V GND In

J6 (Middle Connector)

Pin #	Description
1	User Input 1
2	User Input 2
3	User Input 3
4	User Input 4
5	User Input 5
6	Input Common
7	Signal Common
8	Digital Output 1 (Sink)
9	Digital Output 2 (Sink)
10	Digital Output 3 (Sink)
11	Digital Output 4 (Sink)
12	Digital Output 5 (Sink)
13	Output COM
14	Ax1 Analog Out+
15	Ax1 Analog Out-
16	Ax2 Analog Out+
17	Ax2 Analog Out-
18	Shield

J5 (Bottom Connector)

Pin #	Description
1	Ax1 FWD EOT
2	Ax1 REV EOT
3	Ax1 Home
4	Ax2 FWD EOT
5	Ax2 REV EOT
6	Ax2 Home
7	Limit Common
8	Ax1 Fault Input+
9	Ax1 Fault Input-
10	Ax2 Fault Input+
11	Ax2 Fault Input-
12	Ax1 Enable Sink
13	Digital Output 6 (Source)
14	Ax2 Enable Sink
15	Digital Output 7 (Source)
16	Ax1 Enable COM
17	Ax2 Enable COM
18	Shield

Figure B-2: Ifc 220E Connection Diagram

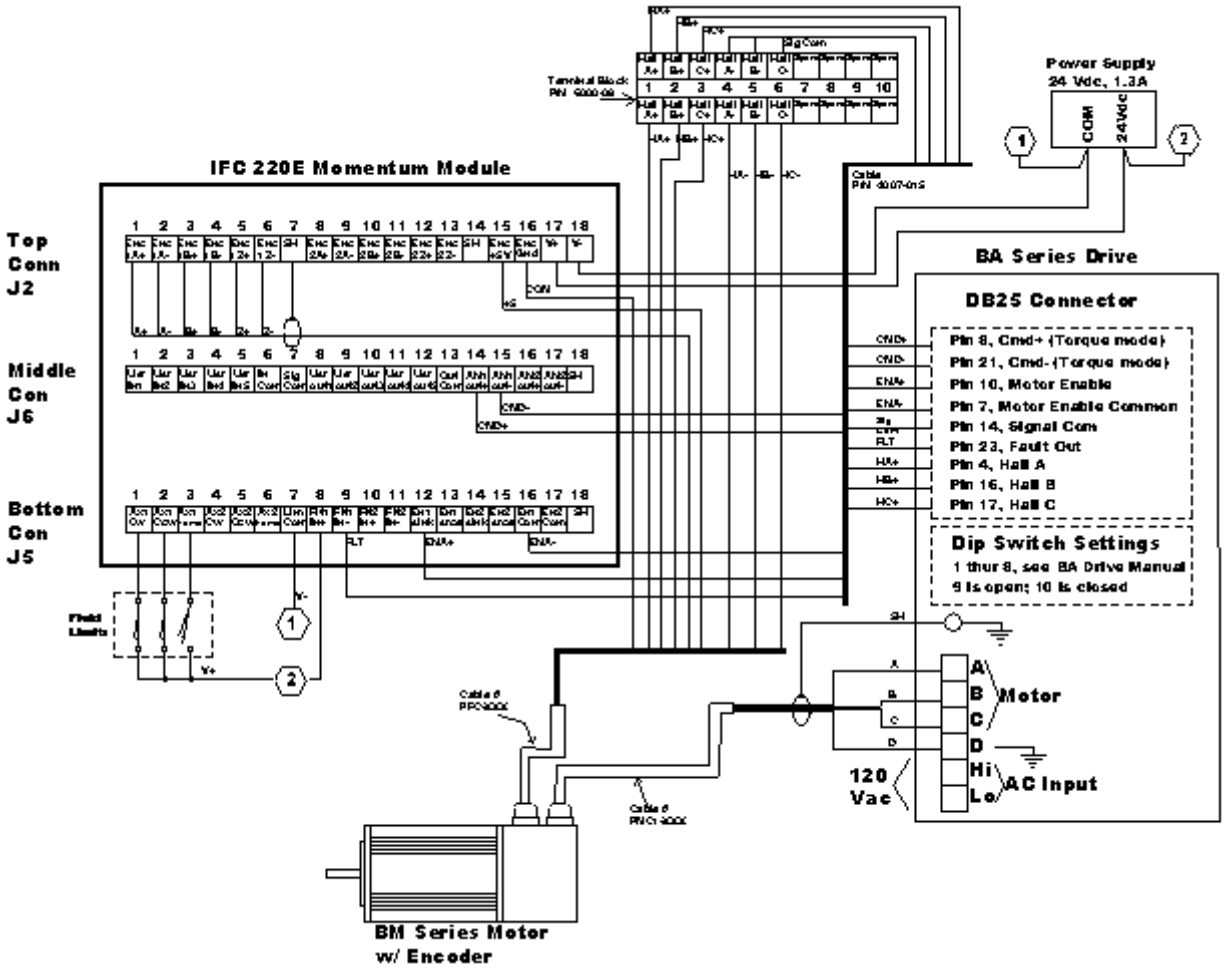


Figure B-3: IFC 220E Axis 1 Wiring Configuration

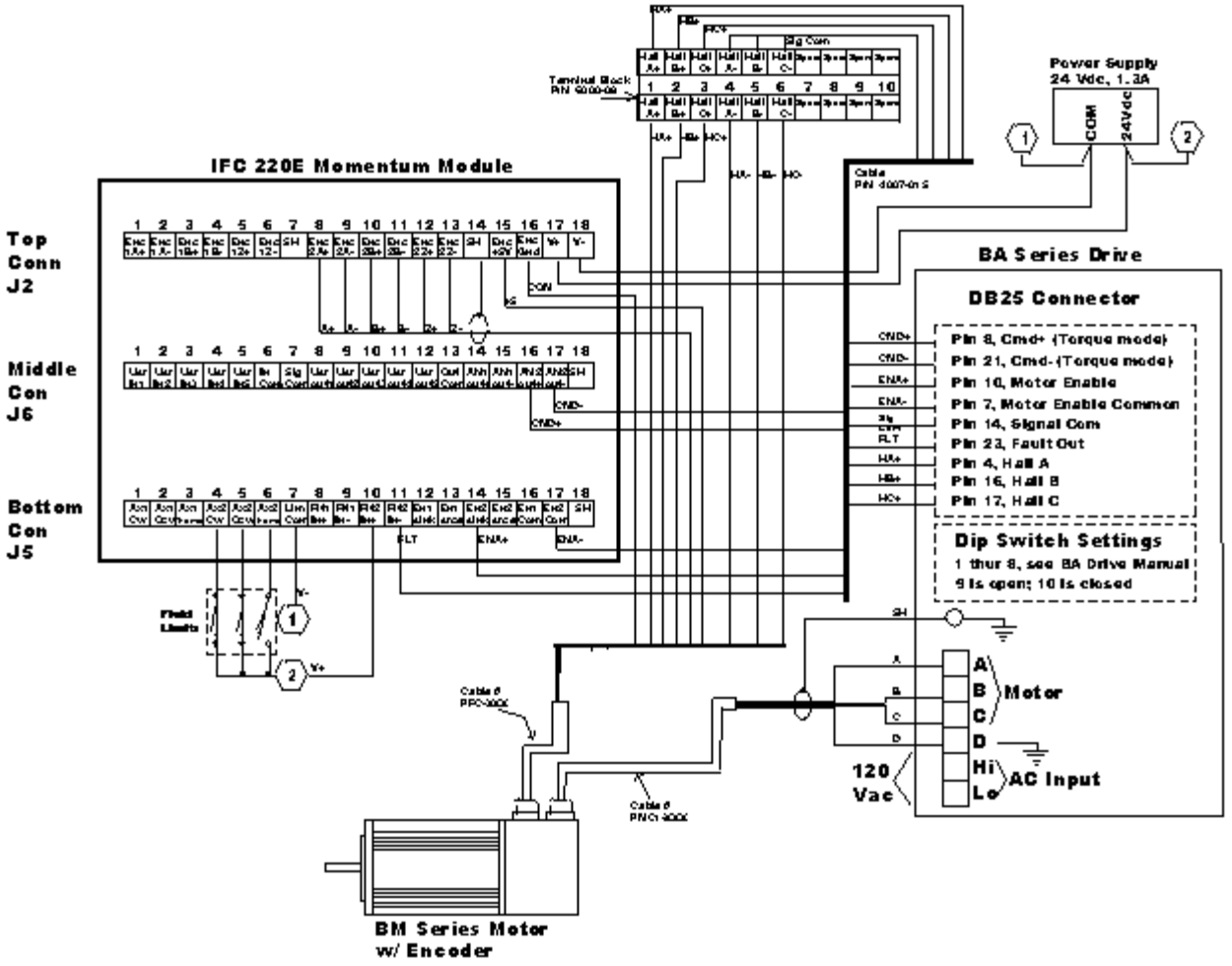
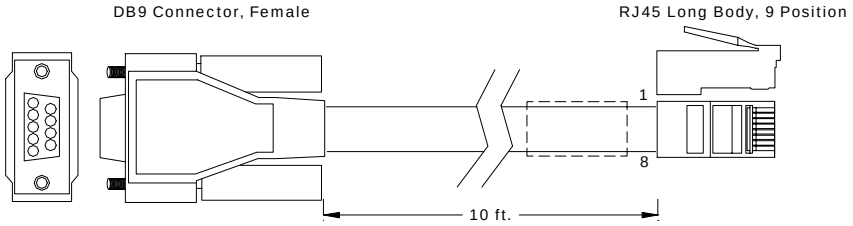


Figure B-4: IFC 220E Axis 2 Wiring Configuration



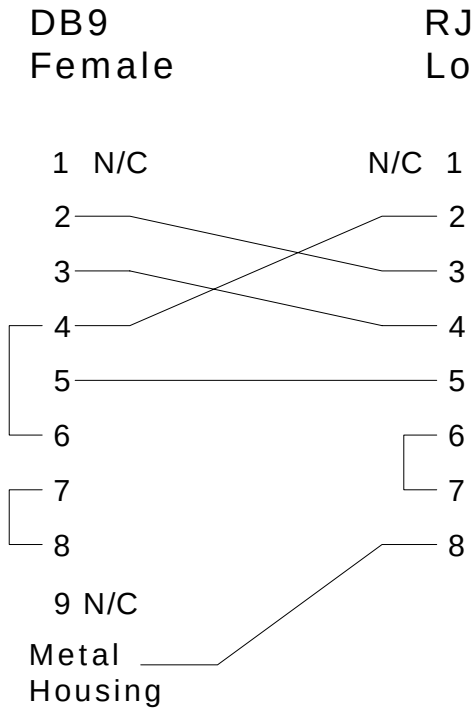


Figure B-5: RJ 45 Momentum Programming Cable (P/N 4005-10)