# Counter / Flow Meter Input Module

Cat. No. Quantum Automation Series
140 EHC 204 00sc - 4 Channel
140 EHC 208 00sc - 8 Channel

Installation Instructions

SPECTRUM
C O N T R O L S

Contents

Preface

Read this preface to familiarize yourself with the rest of the manual. This preface covers the following topics:

- What this guide covers
- Who should use this guide
- Contents of the guide
- Related publications
- Conventions used in this guide

What this Guide Covers

This guide describes the hardware and firmware included in the 4- and 8-channel Quantum™ Counter/Flow Meter modules for the Schneider Automation Series Quantum PLC. The document contains the information required to install and wire, configure, use, and troubleshoot the modules.

Who Should Use This Guide

Use this guide if you install, configure, or maintain a control system that uses the module with a PLC. You should have a basic understanding of Quantum products. Additionally, you should understand electronic process control and the ladder program instructions required to generate the electronic control signals for the PLC. If you do not have these prerequisites, contact your local Schneider Alliance representative for the proper training before using this product.

Manual Contents

The table below lists the contents of this guide.

Table 1   Contents of this Guide

Chapter	Description
Chapter 1	An overview of the module
Chapter 2	Installation and wiring guidelines
Chapter 3	Instructions for configuring the module
Chapter 4	Programming instructions
Chapter 5	Information on module diagnostics and troubleshooting
Appendix A	Specifications for the module

Related Documentation

The table below lists a number of reference documents that provide information to assist you when working with one of the Quantum counter modules.

Table 2   Related Documents

Document Title	Publication
Modicon Modsoft Programmer User Manual	Schneider Electronics, 890 USE 115 00
Modicon TSX Quantum Automation Series Hardware Reference Guide	Schneider Electronics, 840 USE 100 00
Guide for the Installation of Electrical Noise Inputs to Controllers from External Sources	IEEE Std. 518- 1977
Recommended Practice for Grounding of Industrial and Commercial Power Systems	IEEE Std. 142- 1982
Noise Reduction Techniques in Electronic Systems	Henry W. Ott; published by Wiley-Interscience of New York, 1976

Conventions Used in This Manual

The following conventions are used throughout this manual:

- Bulleted lists (like this one) provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- Text in `Courier` type face indicates words or phrases you should type.

1 Chapter

Overview

This chapter describes the 4- or 8-channel Quantum Counter/Flow Meter input module (called "Quantum counter" module in this document). It also explains how the Schneider Automation Series Quantum PLC reads input data from a Quantum counter module.

Shipped with your module is an MS-DOS formatted floppy disk titled "Quantum Runtime Files," Spectrum Controls, Inc. The disk contains runtime files that are required to use all versions of this module. Files include an ID file, parameter screen software, and multiplexing software examples for 4X and 3X register use.

NOTE   The module is used with a field wiring terminal block, Modicon 140 XTS 002 00 or 140 CFA040 00 40-pin cablefast. Either of these must be ordered separately.

Included in this chapter is information about:

- General description
- Hardware features
- Overview of module
- System operation

General Description

The Quantum counter module is designed for general-purpose counter and flow meter applications that require a large number of input channels and high accuracy. It supports both AC and DC input signals from counter and flow meter encoders (both normal and quadrature). The module conditions the inputs to standard digital levels. It stores the converted data in its image table for retrieval by any Quantum PLC.

The module communicates with the PLC and receives its power through the PLC backplane from the +5VDC rack power supplies. No external power supply is required.

Your Quantum counter module supports connections from any combination of counter and flow meter devices, with different input voltage ranges. Each channel is individually configurable via software for a specific input device and provides rate and limit detection. Count mode and input range are configured in two channel groups.

Meter Input Modes

The module's flow meter mode is compatible with a variable reluctance AC input, which counts AC zero crossing signals from 50 mV to 75V AC peak.

Count input modes include uni-directional, bi-directional and quadrature. Bi-directional and quadrature inputs require the use of two inputs, with up to four counters of this type being supported.

The module accepts +5 to +45 V gating (enable) pulses for standard meter proving applications. To accommodate these pulses, the module uses a pulse-to-enable converter circuit that can be enabled and disabled with software. Note that this module does not perform pulse interpolation for meter proving.

The module also has external inhibit/trigger lines using a 5V discrete pulse to regulate activity.

Module Features

The Quantum counter module features:

- Eight input channels
- Support for four quadrature encoders
- Eight external enable inputs
- Input voltage ranges: AC (50 mV to 75V peak), 5VDC, 12VDC, 24VDC
- Eight 24V gating (enable) pulses for meter proving
- Input filter frequency 50 kHz max., AC or DC
- Maximum count value 65 K or 16 M
- Programmable scaling, K, M, and R factors
- Channel update time 4 ms/channel
- Rate output
- Counter logic level state
- Programmable counter functions: start, stop, reset, preset, max limit
- Programmable counter alarm flags and zero flags in internal counter and rate operating modes
- Two software-selectable filters: 30 or 50 kHz digital, 15 kHz analog
- Channel-to-backplane isolation 1000VDC
- Channel-to-channel isolation 0 V

Hardware Features

The Quantum counter module contains a removable Modicon 40-pin terminal block providing connections for up to eight input devices. The illustration below shows the hardware features of the module.

For quadrature operation, the module configures channels into quadrature encoding pairs. Both channels in a pair must be configured for quadrature mode. Quadrature encoding reports the same quadrature count value on the output of each channel.

The module supports these input types:

- AC (50 mV to 75V peak)
- 5VDC
- 12VDC
- 24VDC

Both rate and count data are simultaneously available to the user. User selectable instantaneous or average rate modes are supported.

For improved noise reduction, the module has a digital filter that is selectable between 50 kHz and 30 kHz. A selectable analog 15 kHz single-pole filter is also available for low speed applications.

Module configuration is stored in the PLC memory. Normally configuration uses ModSoft, Concept, and ProWorks programming software. Details are provided in chapter 3, "Module Configuration."

Counter Mode

The counter functions of the module include programmable control of the counter, including start, stop, reset, and preset control and user-defined flags. The module makes the state of input counter levels available to the PLC, allowing any channel to be used as a discrete input.

Counter inputs can be configured in pairs for quadrature encoding. A total of four quadrature inputs can be supported to detect up and down count signals. The module has an onboard timer that converts counter inputs into a rate output. Both counter total and calculated input rate are made available to the PLC at the same time. The maximum filter frequency for an input signal is 50 kHz.

When a counter reaches its preset limit value or counts down to zero, it sets a limit or zero flag. The counter supports the following input K, M, R scale factors:

- "K" used for range scaling; programmable for each channel.   (Count = Raw count / K)
- "M" used for meter calibration. (Count = raw count * M / 10,000, Rate = raw rate * M/10,000)
- "R" used to scale the rate output. (Rate = Raw Rate / R * M/10,000)

In counter mode, the module updates normal encoder and quadrature outputs at <1.5 ms/channel. The counter accumulator output is available in two ranges. The maximum count total for the noraml range is 65 K. The extended range uses two data words per channel and counts up to 16 M.

Hardware	Description
Door (removable)	Covers the terminal block and includes an identification label for terminals.
Door label	Permits easy terminal identification.
LED indicators	Display operating and fault status of module.
	Details are provided in "**Diagnostic LEDs**".
Side label (nameplate)	Provides module identification.
Self-locking tabs	Secure module in rack slot.
Terminal block	Used for field wiring the module.

Diagnostic LEDs

The module supports the LEDs listed in table 1-1 . These LEDs help you identify the source of problems that can occur during power-up or during normal operation. Power-up and operation diagnostics are explained in chapter 5, "Maintenance and Diagnostics."

Table 1-1   Module LEDs

LED Name	Color	State	State Description
Ready (Module Status)	Green	On	Module powered up and functioning normally.
		Off	Module is not powered up.
Active	Green	On	Bus communication is established between module and PLC.
		Off	No bus communication.
Fault	Red	On	Module self-test error or fatal hardware error. LED blinks to indicate type of self-test error.
		Blinking	Type of self-test error. Count the number of blinks before a pause to determine the error code. Possible codes are listed in the table below.
Channel Status (8 LEDs)	Green	On	Channel is enabled and a valid input signal is present. The LED indicates the state of the counter enable bit. It does not indicate the state of an external hardware gate. See description of the counter enable bit in chapter 3, "Module Configuration."

Table 1-2   Channel LEDs

Code (Number of Blinks)	Error Type
On Solid	No Faults
1	Frequency Limit Out of Range.
2	Counter Limit Out of Range.
3	Counter Preset Out Of Range.
4	Channel Pair Gate Enable Configuration Mismatch.
5	Quadrature Pair Configuration Mismatch.
6	Both Stop on 0 and Stop on Limit selected (Mutually exclusive).
7	Both Roll Over to Preset and Roll Under to Preset (Mutually exclusive).
8	Unrecognized parameter type.

Table 1-3 Blink Codes for Fault LED

Code (Number of Blinks)	Error Type
Off	No Faults
1	Dual Port RAM fault.
2	FPGA init fault.
3	FPGA1 program fault.
4	FPGA2 program fault.
5	FPGA1 fault.
6	FPGA2 Fault.
7	Watchdog Fault.
8	ROM CRC fault.
9	EEPROM fault.
10	Both Speed mode and Autosequence mode selected (Mutually exclusive)

Recommended Cables

To minimize interference from radiated electrical noise, we recommend twisted-pair and shielded cables.

2Chapter

Installation and Wiring

This chapter includes information about:

- Module compliance with safety standards
- Power requirements
- Installation considerations, such as prevention of electrostatic discharge
- Installing the module
- Field wiring of the module and analog input devices

Compliance with Safety Standards

The module is compliant with the safety standards described in this section. It is intended for use in an industrial environment. The product has been approved for installation within the European Union and EEA regions.

UL and CUL Safety Standards

The module complies with UL and CSA safety requirements and is certified to the applicable standards, as described in appendix A.

EMC Directive

The module has been tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2
  EMC - Generic Emission Standard, Part 2 - Industrial Environment

- EN 50082-2
  EMC - Generic Immunity Standard, Part 2 - Industrial Environment

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, since it operates with inputs under 75 VDC and 50VAC rms. It applies the safety requirements of EN 61131-2 Programmable Controllers, Part 2 – Equipment Requirements and Tests. For specific information required by EN 61131-2, see the appropriate sections in this publication.

Power Requirements

The module receives power through the PLC backplane from the +5VDC power supply. The maximum current drawn for the 8 channel module is 670mA and the 4 channel module is 470mA.

Installation Considerations

This section describes several considerations to keep in mind when installing the module in a PLC system. The following documents contain information that might help you as you install and wire the module:

- *National Electrical Code*, published by the National Fire Protection Association, Boston, MA

- IEEE Standard 518-1977, *Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources*

- IEEE Standard 142-1982, *Recommended Practices for Grounding of Industrial and Commercial Power Systems*

- *Noise Reduction Techniques in Electronic Systems*, by Henry W. Ott; published by Wiley-Interscience, New York, 1976

Preventing Electrostatic Discharge

CAUTION: Electrostatic discharge can damage integrated circuits or semiconductors if you touch module bus connector pins. Substitution of components may impair suitability for Class 1, Division 2.

To prevent electrostatic discharge, follow these guidelines when you handle the module:

- Touch a grounded object to discharge static potential.
- Wear an approved wrist strap grounding device.
- Do not touch the backplane connector or connector pins.
- Do not touch circuit components inside the module.
- If available, use a static-safe work station.
- When it is not in use, keep the module in its static-shield box.

Reducing Noise

Most applications require installation in an industrial enclosure to reduce the effects of electrical interference. Electrical noise, to which analog inputs and outputs are highly susceptible, will reduce the performance (accuracy) of the module.

Selecting a Location

WARNING EXPLOSION HAZARD This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or nonhazardous locations only. Substitution of components may impair suitability for Class I, Division 2.   Do not replace, connect, or disconnect components unless power has been switched off or the area is known to be nonhazardous. This product must be installed in an enclosure. All wiring must comply with N.E.C. article 501-4(b).

Two factors determine where to install the module in the PLC rack: ambient temperature and electrical noise. Place the module:

- In any slot but slot 0 (reserved for the processor).
- Close to the bottom of the enclosure to take advantage of cooler air.
- Away from modules that generate significant heat, such as 32-point I/ O modules.
- In a slot away from AC or high-voltage DC modules, hard contact switches, relays, and AC motor drives.
- Away from the rack power supply (if installing a modular controller system).

Protecting Circuit Boards from Contamination

The printed circuit boards of the module must be protected from dirt, oil, moisture, and other airborne contaminants. Ensure that the module is kept in an enclosure at all times. The interior of the enclosure should be kept clean and the enclosure door should be kept closed whenever possible.

Wiring

- For UL and CUL compliance, power and input/output wiring must be in accordance with Class 1, Division 2 wiring methods (Article 501-4(b) of the National Electrical Code, NFPA 70) and in accordance with the authority having jurisdiction.

- Channels are isolated from one another.

- Route field wiring away from any other wiring and as far as possible from sources of electrical noise, such as motors, transformers, contactors, and ac devices. As a general rule, allow at least 15.2 cm (6 in.) of separation for every 120V of power.

- Routing field wiring in a grounded conduit can reduce electrical noise.

- If field wiring must cross AC or power cables, ensure that they cross at right angles.

- If multiple power supplies are used with analog inputs, the power supply commons must be connected.

- To ensure optimal accuracy, limit overall cable impedance by keeping a cable as short as possible. Locate the module as close to input devices as the application permits.

- Tighten terminal screws with care. Excessive tightening can strip a screw.

- The module is generally mounted to a well grounded mounting surface, such as a metal panel. Additional grounding connections from the module's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded. Keep shield connection to ground as short as possible.

- Under normal conditions, the drain wire and shield junction should be connected to earth ground, via a panel or mounting screw at the module end. Refer to IEEE Std. 518, Section 6.4.2.7 or contact the sensor manufacturer for additional details.

- For field wiring, use shielded, twisted-pair cable, and ground each cable's shield wire at one end only. At the opposite end of each cable, tape the exposed shield wire to insulate it from electrical contact. A good shield wire ground is a rack assembly mounting bolt or stud.

- In the process of wiring the modules, route all signal wires as far as possible from potential sources of electrical noise, such as motors, transformers, etc. (especially AC devices).

- If noise persists for a device, try grounding the opposite end of the cable. (You can only ground one end at a time.)

Module Installation

This section tells how to insert the module in the PLC rack and remove it as needed. The Quantum counter module is suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution Degree 2) and for circuits not exceeding Over Voltage Category II (IEC 60664-1).

Installing the Terminal Block

To install the terminal block:

1. Gently insert the terminal block into the module housing.

2. Install the upper and lower retaining screws, using 0.46 Nm (4.1 in-lb) torque.

3. Use the write-on label located on the door of the module to identify the module location and type.

Inserting the Module in the PLC Rack

Do the following to place the module in the PLC rack:

1. Ensure that the rack is properly grounded and installed in a NEMA-rated enclosure.

    2. Disconnect all power to the module, and disconnect it from any connected devices. See " **Removing Power."**
             WARNING Installation or removal of the module with power applied can cause an electrical arc. An arc can cause personal injury or property damage by sending an erroneous signal to your system's field devices. This signal can result in unintended machine motion, an explosion in a hazardous environment, or excessive wear to contacts on both the module and its mating connector (possibly leading to premature failure).

3. Align the module with the top of the rack. slot.

4. Slide the module into the slot until both top and bottom are secure.

5. Apply firm, even pressure to the module to attach its backplane connector to the PLC bus connector. Never force the module into the slot.

6. Tighten the module screws that hold the module to the rack..

7. Align the terminal block to the module in gently press until it is properly seated.

Removing the Module

To remove the module from the PLC rack:

    1. Disconnect all power to the module, and disconnect it from any connected devices. See "**Removing Power."**
2. Gently slide the module out of the rack slot.
             WARNING Installation or removal of the module with power applied can cause an electrical arc. An arc can cause personal injury or property damage by sending an erroneous signal to your system's field devices. This signal can result in unintended machine motion, an explosion in a hazardous environment, or excessive wear to contacts on both the module and its mating connector (possibly leading to premature failure).

Field Wiring

This section provides instructions for field wiring the installed module. You will need:

- A small flat-head screwdriver
- Belden 8761 (shielded, twisted pair) cable or equivalent

See " **Wiring**" for wiring guidelines to keep in mind during field wiring of the module.

Removing and Replacing the Terminal Block

When wiring the module, it is not necessary to remove the terminal block. However, if necessary, you can use this procedure for removal and replacement.

1. Loosen the upper and lower retaining screws, alternating between screws. The terminal block backs away from the module as you remove the screws.

2. Carefully pry the terminal block loose.

3. When ready to replace the terminal block, insert and tighten the retaining screws. Torque the retaining screws to 0.46 Nm (4.1 in-lb).

Wiring the Terminal Block

The module terminal block has eight shield terminals provided as frame ground connections for input wire shielding. It also provides eight external encoder disable pins used to externally gate each input. A low input allows each channel (or channel pair) to operate. There are also 8 counter enable lines that are compatible with 5, 12, and 24 VDC inputs. If pulled high with one of these inputs, a channel (or channel pair) is disabled.
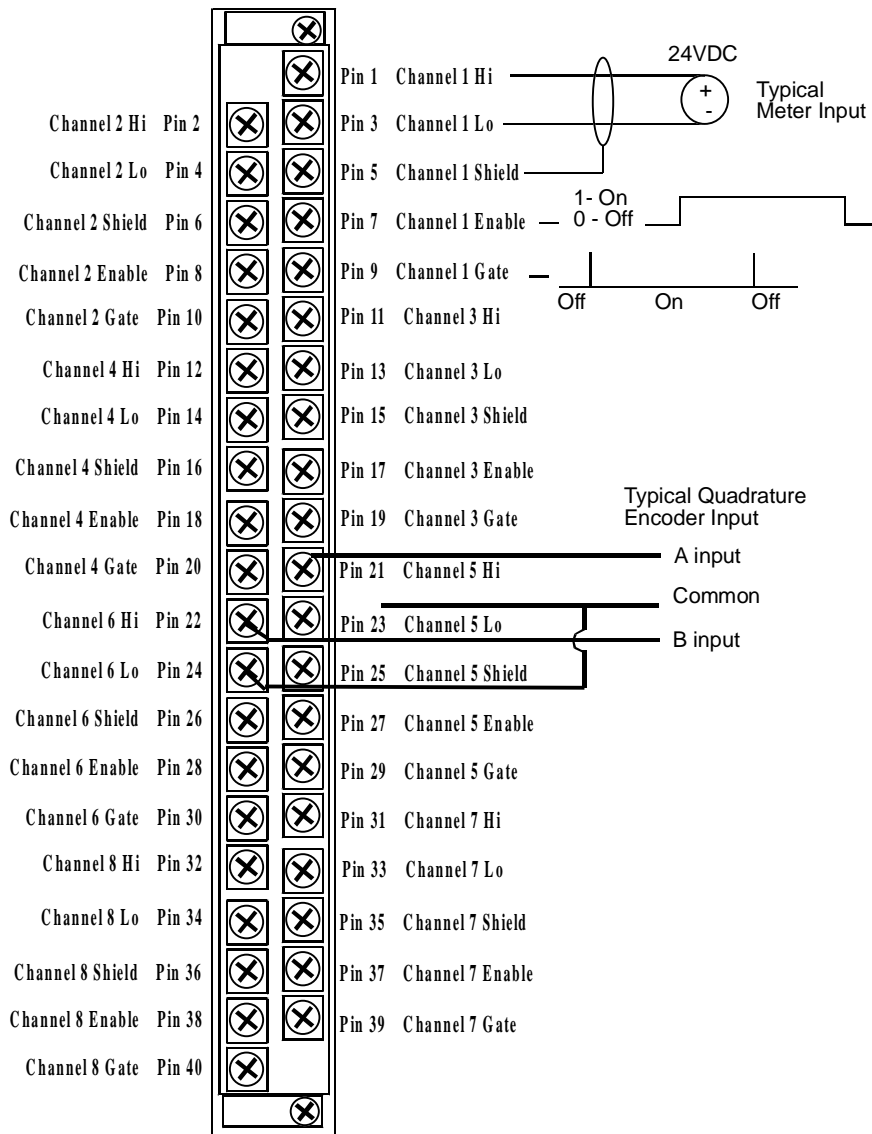
Each terminal accepts up to two wires, with the restrictions noted in the following table (for shielded, twisted-pair cable).

Specification	Value
Wire Type	Stranded, Cu-90°C (194°F)
Wire Size	16 to 22 AWG
Terminal Screw Torque	0.68 Nm (6 in-lb)
Retaining Screw Torque	0.46 Nm (4.1 in-lb)

To wire the terminal block:

1. Determine the length of cable you need to connect a channel to its field device. Remember to include additional cable to route the drain wire and foil shield to their ground points.

2. If you need to remove the terminal block cover, insert a screwdriver into one of the square wiring holes, and gently pry the cover off. Be sure to replace the cover before proceeding.

3. Loosen the terminal screw to be wired.

4. Route the wire under the terminal pressure plate.

5. Connect only one end of the shield to the module. You can use the bare wire or a spade lug. The terminals accept a 6.35 mm (0.25 in.) spade lug.

6. Tighten the terminal screw, making sure the pressure plate secures the wire.

7. A removable write-on label (ID tag) is provided with the terminal block. Remove the label from the door, mark the identification of each terminal with permanent ink, and slide the label back into the door. The ID tag is visible when the module door is closed.

Wiring the Module for Inputs

After the terminal block is wired, use the procedure in this section to connect the inputs to the terminal block. To ensure proper operation and high immunity to electrical noise, always use Belden 8761 shielded, twisted-pair wire, or equivalent.

CAUTION - To prevent shock hazard, take care when wiring the module to analog signal sources. Before wiring, disconnect power from the system power supply and from any other source.

 CAUTION - When wiring an analog input, take care to avoid connecting a voltage source to a channel configured for current input. Improper module operation or damage to the voltage source can occur.

1. At each end of the first cable, strip some casing to expose the individual wires.

2. On each end of the cable, separate the wires and trim the signal wires to 5.08 cm (2 in.) lengths. Strip about 4.76 mm (.18 in.) of insulation to expose the end of each wire. Be sure to not cut the wires too short.

CAUTION - Be careful when stripping wires. Wire fragments that fall into a module could cause damage at startup.

3. At the module end of the cable, cut the drain wire and foil shield.

4. Check the signal wires to ensure that they are the correct length to connect to the terminal block.

5. At the input device end of the cable, twist the drain wire and foil shield together. Under normal circumstances, you will connect the drain wire and shield to earth ground, via a panel or DIN rail mounting screw at the end of the module. Keep the length of the drain wire as short as possible.

6. Connect the cable to the input device as required.

7. Repeat steps 1 through 6 for the other cables.

8. Configure the module as described in chapter 3, "Module Configuration."

3Chapter

Module Configuration

This chapter includes information on the following:

- • Module addressing
- • Setting up the PLC configuration software (ModSoft, Concept, and SCIOCFG)
- • Making bit settings for zoom (parameter) registers
- • Making bit settings for 4X configuration (output) registers
- • Making bit settings for 3X data and status registers

Some configuration can be performed using the ModSoft, Concept, and SCIOCFG configuration programs. However, many configuration steps require ladder logic to be prepared for your PLC. For these cases, module addressing details and bit settings are provided in this chapter, while programming details are included in chapter 4, "Programming."

Module Addressing

The module uses sixteen zoom (parameter) registers, nine 4X (output) registers for configuration words, and eight 3X (input) registers for data and status words.

Table 3-1   Module Registers

Register	Function
Zoom+0..7	Basic Configuration data (4ch - 0..3 / 8ch - 0..7)
Zoom+8****	Bank Switch Period in Autosequence Mode
4X	Module Configuration Word
4X+1	Scale Factor / Count Limit Word
4X+2	Channel 1 Control Word
4X+3	Channel 2 Control Word
4X+4	Channel 3 Control Word
4X+5	Channel 4 Control Word
4X+6*	Channel 5 Control Word
4X+7*	Channel 6 Control Word
4X+8*	Channel 7 Control Word
4X+9*	Channel 8 Control Word
3X	Module Status
3X+1***	Count Data LSW Chan 2*N-1
3X+2***	Count Data MSW 2*N-1
3X+3***	Count Data LSW Chan 2*N
3X+4***	Count Data MSW 2*N
3X+5***	Rate Data 2*N-1
3X+6***	Rate Data 2*N
3X+7***	Status Data 2*N-1
3X+8***	Status Data 2*N

Note X=bank number

*These registers only apply to the 8 channel counter (140 EHC 208 00).

***Comprehensive Mode shown. Speed mode explained in Data retrieval and Module Configuration Word (4X+0 Register under the description for Multiplexing Mode and Bank Number.

****The default is that the module update as fast as possible. This register allows the user to set in milliseconds the update rate. For example, a 60 in this register will cause each bank to be updated in 60miliseconds. Since there are four banks (in the 8 channel module) the total update time will be 240ms. In the four channel module the update time would be 120ms.

Setting Up the Configuration Software

The module is compatible with several configuration software packages: ModSoft version 2.4 or later, Concept version 2.1 or later, and ProWorx NxT. Setup and configuration instructions for ModSoft and Concept are provided in this manual.

Included with the module is a 3.5-inch floppy disk. Install the disk files to update the configuration software so that you can properly configure your module. These files update the configuration software and include application programming examples.

Table 3-2   Module Files

File Name	Installation Disk Directory	Description
GCNFTCOP.SYS	\MODSOFT\	ModSoft I/O map module definitions
LMSFDT.SYS	\MODSOFT\	ModSoft zoom screens
QUANTUM.SYS	\MODSOFT\	Quantum help screens for ModSoft
SCIOCFG.EXE	\CONCEPT\	Spectrum utility that runs under Concept to provide help setting up configuration I/O files; this is a 32-bit Windows program requiring Windows 95/98/NT
SPECTRUM.HLP	\CONCEPT\	Spectrum I/O for Quantum module help file
SPECTRUM.MDC	\CONCEPT\	Spectrum I/O for Quantum module definition file

Setting Up ModSoft

For ModSoft (version 2.4) to recognize the Quantum counter module, you must update the software with the LMSFDT.SYS, GCNFTCOP.SYS, and QUANTUM.SYS files. You should also install the ModSoft example files at this time. See " **Setting Up the Configuration Software.**"

To install the runtime files for ModSoft:

1. Identify the path in which ModSoft is installed, for example, C:\MODSOFT\.

2. Insert the installation disk in the drive (probably A:).

3. From MS-DOS on the PC, enter the following command (assuming installation from the A: drive):

    C:\> COPY A:*.SYS   C:\MODSOFT\RUNTIME\

4. Verify that the files have been copied to the C:\MODSOFT\RUNTIME\ directory.
5. Verify that the example files have been copied to the C:\MODSOFT\PROGRAMS\ directory.

Setting Zoom Registers Using ModSoft

The procedure below tells how to enable the zoom registers and make configuration settings in ModSoft. Refer to " **Zoom Register Layout.**"

1. Ensure that the ModSoft configuration software has been updated from the module installation disk, as described in " **Setting Up ModSoft**" .

2. Open ModSoft, and access the I/O map screen.

3. Select the slot in which you have installed the module.

4. Now enter Shift+? to display a list of modules available for placement in the selected slot.

5. Choose your Quantum counter module from the list. For module-specific help, enter Alt+H.

6. Choose the first 3X and 4X registers to be used in the system for the module.

7. Now enter the zoom screens by highlighting the entry for your module and pressing Alt+Z. For zoom screen operation, see Modicon's *ModSoft Programmer User Manual*.

8. Select an input type for each group of two channels. The default is 5 volts.

9. For each group of two channels, select an input range that corresponds to the input type selected. See " **Input Range, Bits 15 and 16.**"

10. Select a count mode for each group of two channels. See " **Count Mode, Bit 13 and 14.**"

11. Select a filter frequency for each channel. See " **30 kHz Filter, Bit 12.**"

12. Select a filter frequency for each channel. See " **15 kHz Filter, Bit 11.**"

13. Select a count size for each channel. See " **Count Size, Bit 10.**"

Setting Up Concept

For Concept to recognize the Quantum counter module, you must update the software with the files SPECTRUM.MDC and SPECTRUM.HLP. See " **Setting Up the Configuration Software.**"

To install the runtime files for Concept:
1. Identify the path in which Concept is installed, for example, C:\CONCEPT\. You will probably use the A: drive for the installation disk.
2. Using your file manager copy the files SPECTRUM.MDC and SPECTRUM.HLP on the disk to the C:\CONCEPT directory.
3. Verify that the files have been copied to the C:\CONCEPT directory.

Setting Zoom Registers Using Concept

The next procedure describes how to enable the zoom registers and make configuration settings in Concept. Refer to " Zoom Register Layout."

1. Ensure that the Concept software has been updated from the installation disk as described in "**Setting Up Concept**."

2. Start the Concept Modconnect tool (Modconf.exe).

3. From Modconnect, open the file SPECTRUM.MDC.

4. Select the Quantum counter module, or click **Add All**.

5. Save your changes and exit Modconnect to update the Concept database. The changes are permanent unless you later undo the changes using Modconnect, or perform a new Concept software installation.

6. In Concept, create a new project.

7. Enter the starting 3X register address (InRef). Nine registers are automatically allocated.

8. Enter the starting 4X register address (OutRef). 6/10 registers are allocated. (4ch - 6 / 8ch - 10)

9. Select the Configurator tool from the project pulldown menu.

10. Choose **Configure**, then click **I/O Map** to open the I/O map editor.

11. In the I/O map screen, type the number for the correct "drop" and click **Edit**.

12. From the list presented, select the Spectrum Controls catalog number of the module.

13. Click the button in the module select column for the appropriate rack slot.

14. The next screen represents your module. Click the parameters button.

15. Insert hexadecimal values for registers 1-9 (1-5 for the 4-ch module) to fully configure the module if you are not using the SCIOCFG utility program.

Setting Up SCIOCFG Software

Version 2.1 of Concept introduced a tool for importing Modconnect module definition files into the Concept database. This allows you to configure Modconnect I/O. However, Concept 2.1 does not provide a means for you to design your own I/O configuration menus. Instead, Concept provides a generic interface in which you must enter configuration parameters in hexadecimal values. To save you the trouble of calculating the correct hexadecimal values for configuration parameters, Spectrum provides the SCIOCFG utility.

SCIOCFG presents user-friendly selection lists using standard Windows interfaces. The utility automatically constrains all parameters to legal values during the data entry process. You can run the utility in standalone mode or synchronous mode. In standalone mode, you will configure module data as desired. SCIOCFG then presents the parameters in hexadecimal values so that you can manually transfer this data to Concept at a later time.

In the synchronous mode, SCIOCFG runs in the background waiting for you to select the module in the Concept generic I/O parameter configuration menu. When this occurs, SCIOCFG reads the data from the Concept generic I/O parameter configuration menu, and activates the appropriate I/O parameter configuration menu. When you click the **SCIOCFG OK** button, the new data is sent to Concept.

Set up SCIOCFG as follows to run the utility from Concept:

1. Identify the path in which to install SCIOCFG, for example, C:\SCIOCFG\. You will probably use the A: drive for the installation disk.

2. Using Windows Explorer, copy the SCIOCFG.EXE file from the installation disk to the desired directory. Then add a shortcut to the Windows desktop or add the program to the Windows taskbar using standard Windows techniques.

NOTE   You may create a desktop shortcut to the program by locating the sciocfg.exe file on your drive, right click and select copy the file and then right click and paste a shortcut to your desktop.

3. Now SCIOCFG EXE is ready to run as a background task when Concept is used to change the configuration registers of the module. For more about its use, see "**Setting Zoom Registers Using Concept.**"

Making Bit Settings for Zoom Registers

One parameter (zoom) register is assigned to each input channel, for a total of eight registers. Note that some data needs to be the same for channel pairs. For example, quadrature mode must be selected on two adjacent channels, since quadrature inputs use two channels. Also, the input range is controlled with one multiplexer for an input pair. Thus each channel pair must have the same input range.

For zoom registers, you can make bit settings from either ModSoft or Concept software. This section first describes the layout of the register and then tells how to set the bits from both programs.

Zoom Register Layout

The following table shows the layout for each of the zoom registers. The 8 channel module uses this layout for the first eight registers. The four channel uses the first 4 zoom registers. (The nineth - 8 channel or 5th - channel zoom register specifies the Bank Switch Period in the Autosequence Mode.) , with bit 1 the MSB and bit 16 the LSB.

Table 3-3   Bit Settings for Zoom Registers

Function		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Input range*	5V **															0	0	
	12V															0	1	
	24V															1	0	
	AC															1	1	
Count mode*	Unidirectional **													0	0			
	Bidirectional													0	1			
	Quad. 1X													1	0			
	Quad. 4X													1	1			
30kHz filter	Disabled **												0					
	Enabled												1					
15 kHz filter	Disabled **											0						
	Enabled											1						
Count size	65K **										0							
	16M										1							
Rate Scale	1.0Hz									0								
	0.1Hz									1								
Unused		X	X	X	X	X	X	X	X									

* Channel Pairs (1-2, 3-4, 5-6, 7-8) must be configured the same to operate properly.
** Default Settings

Input Range, Bits 15 and 16

These bits select one of the four available input ranges: 5V, 12V, 24V and AC. Select the range that is closest to the maximum amplitude of your device signal. For example: If your flow meter has a peak signal amplitude of 20 volts, select the 24V input range. Each range selection determines the counter trip level. Matching the input range to your signal amplitude will miximize false counting.

NOTE: Allow at least one scan time for input range information to be updated at the PLC.
NOTE: Channel pairs (1-2, 3-4, 5-6, 7-8) must be configured with identical input ranges to function properly.

Count Mode, Bits 13 and 14

The count mode bits select the type of input operation. Possible types are:

- Unidirectional
- Bidirectional
- Quadrature 1X
- Quadrature 4X

Uni-Directional

With this configuration, the input increments in an upward direction. All 8 channels may be configured in the unidirectional mode. Every clock pulse will increment the counter on the rising edge.   Note: The direction of the counter may be inverted by setting the Count Direction bit described in the Configuration chapter.

Bi-Directional

The bidirectional counter requires 2 input channels. In this mode the first channel is used as the counter input and the 2nd channel is used to determine the count direction. The counter will increment when the Direction Channel value is 0, and will decrement when the Counter Direction Channel value is 1.

X1 Quadrature Encoder

The quadrature mode requires 2 input channels. When a quadrature encoder is attached to inputs 1 and 2, the count direction is determined by the phase angle between inputs 1 and 2. If 1 leads 2, the counter increments. If 2 leads 1, the counter decrements. (The counter changes value *only* on one edge of input 1.) The counter increments once per quadrature cycle.

X4 Quadrature Encoder

Like the X1 quadrature encoder, the count direction is determined by the phase angle between inputs 1 and 2. If 1 leads 2, the counter increments. If 2 leads 1, the counter decrements. However, the counter changes value on the rising and falling edges of inputs 1 *and* 2. The counter increments four times per quadrature cycle.

Note: If 2 is low, the count increments on the rising edge of input 1 and decrements on the falling edge of input 1. If 2 is high, all transitions on input 1 are ignored.
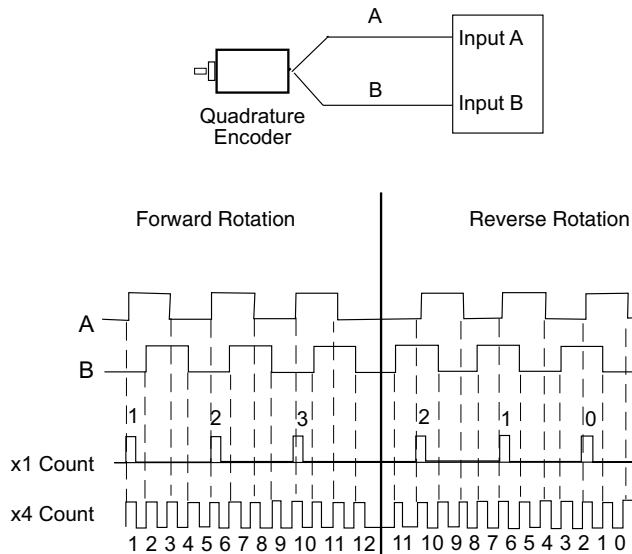
30 kHz Filter, Bit 12

The 30 kHz filter is recommended for counter or flow meter applications running at speeds less than 25 kHz. Set this bit to 0 when running to speeds of 50 kHz. Setting this bit to 1 filters input noise above 30 kHz.

15 kHz Filter, Bit 11

The 15 kHz filter is recommended for counter or flow meter applications running at speeds less than 15 kHz. Set this bit to 0 when running to speeds above 15 kHz. Setting this bit to 1 filters input noise above 15 kHz.

Count Size, Bit 10

This bit determines the maximum counter value. When set to 0 the channel counter will count up to 65,535 (1- 16bit word of data). When the maximum value of 65,535 is reached, the Maximum Count flag is set, and rollover will occur at this point. When the count size is extended to 16,777,216 by setting this bit to 1, the Counters Maximum flag is extended to 16M and data output is formed using two words. The counter Preset and Limit values are also extended to 16M. This means that the resolution of the Preset and Limit values are set in blocks of 256 counts (8bits) beacause only one word is available for each limit. This allows the preset and limit values to cover the whole 16M bit range.

Rate Scale, Bit 9

The Rate Scale bit allows the user to adjust the resolution of the Rate output word. The default resolution is 1Hz. Setting this bit to 1 changes the resolution to 0.1Hz. The Rate output word is a 16 bit integer. When set to 0.1Hz the decimal point is implied to be the first position in the integer word. For example, 1Hz rate = 32767, 0.1Hz rate = 3276.7 .

Note: This setting is only valid while operating in the Instantaneous Rate Mode.

Bits 8 through 1 - Not Used

Making Bit Settings for 4X Registers

You can only set 4X register bits using ladder logic. This section describes the layout for the registers and defines the bits. Ladder logic examples are provided in chapter 4, "Programming."

The first 4X register controls channel enabling and multiplexing. The following table shows the bit settings for this register.

Table 3-4   Bit Settings for First 4X Register

Function		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bank/Data	Bank 1/ LSW															0	0
Format Select	Bank 2/ MSW															0	1
	Bank 3/Rate*															1	0
	Bank 4/ Status*															1	1
Data Delivery	Comprehensive													0			
	Speed													1			
Multiplexing	Manual												0				
Control	Auto-sequence												1				
Parameter	Preset										0	0	0				
Definition	Count Limit										0	0	1				
(for scale/	Rate Limit										0	1	0				
limit word)	M factor										0	1	1				
	K Factor										1	0	0				
	R factor										1	0	1				
	Undefined										1	1	0				
	Undefined										1	1	1				
	Not Used									X							
Channel Number	Channel 1						0	0	0								
(for scale	Channel 2						0	0	1								
/limit word)	Channel 3						0	1	0								
	Channel 4						0	1	1								
	Channel 5*						1	0	0								
	Channel 6*						1	0	1								
	Channel 7*						1	1	0								
	Channel 8*						1	1	1								
	Not Used				X	X											
Scaling**	Enabled			0													
	Disabled			1													
Program	Do Not Program		0														
EEPROM	Program		1														
Limit Word	Disabled	0															
	Enabled	1															

* Applies only to the 8 channel module.
**When this bit is set it will disable K, M, and R scaling. It has no effect on limit words (preset, count limit, and rate limit).

Bank/Data Format Select: Bits 15-16

The function of these two bits is determined by the Data Delivery Mode, Bit 14.

If the Data Delivery Mode is comprehensive, Bit 14 = 0, the bank will be displayed as shown below:

00:	Bank 0 – channels 1 and 2
01:	Bank 1 – channels 3 and 4
10:	Bank 2 – channels 5 and 6
11:	Bank 3 – channels 7 and 8

If the Data Delivery Mode is Speed, Bit 14 = 1, the bank will be displayed as shown below:

00:	All channels Count LSW only.
01:	All channels Count MSW only.
10:	All channels Rate only
11:	All channels Status only.

Data Delivery Mode Select: Bit 14

This bit specifies which multiplexing mode is being used: 0 = Comprehensive or 1 = Speed

This bit directly effects the Bank/Data Format Select settings, Bits 15-16.

The Comprehensive mode reports counter LSW, MSW, Rate and Status in channel pairs (1-2, 3-4, 5-6, 7-8) This mode is slower than the speed mode but offers all available data to the end user.

The Speed mode reports a specific data or status value for all channels within one word. This is a faster method of retrieving data as one may, for example, retrieve Rate values for all channels by reading one data word.

Be aware of data synchronization problems when in the speed mode.
Note that when the Speed method is used there is no data synchronization between groups. I.e. if count LSW is read followed by Count MSW, Count MSW data will be more recent data and will not be synchronized with the previous Count LSW data.

Multiplexing Control: Bit 13

This bit allows the user to determine if multiplexed registers must be manually specified before retrieval or if these registers are automatically sequencially reported.

Setting this bit to 0 activates the Manual mode.
Setting this bit to 1 activates the Autosequence mode.

Parameter Definition: Bits 10- 12

These bits determine which Parameter Value (for scale/limit word) is being prepared for pro gramming into EEPROM. These bits are used in conjunction with the Channel Number selec tion, Bit 6-8, to determine the scale factors for a specific channel.

The actual parameter value is defined in register 4X+1.

Due to the limited register availability of the Quantum Platform, the scale and limit factors are multiplexed onto register 4X+1. Changing these values will generally occur either at power-up or line changeover. On power up, scale factors default to the values stored in EEPROM and the count limit values (preset, count limit, and rate limit) default to zero.

These values can be altered during operation, but if the new power up default values are desired, the values must be programmed into the EEPROM by using the Programm EEPROM setting, Bit 2.

Not Used - Bit 9

Channel Number for scale/limit word: Bits 6-8

These bits are used to specify the channel to which the scaling values will be applied. It is critical that these are set along with the Parameter Definition settings, Bits 11-13 in order to program the proper scale factors to a particular channel.

Not Used : Bits 4-5

Disable Scaling : Bit 3

Asserting this bit disables the K, M, and R scaling factors without effecting the limit words (preset, count limit, and rate limit).

Program EEPROM : Bit 2

Asserting this bit places the parameter that is currently in to 4x+1 register into EEPROM. After the value has been programmed the module will retain the value even if power is removed. It is recommended that you programm all scaling factors first and then write them to EERPROM. This is faster and will prolong the life of the EEPROM.

Enable Scale/Limit Word: Bit 1

Asserting this bit enables register 4X+1. The value in register 4X+1 is defined by the Channel Number bits and the Parameter Definition bits.

If the customer desires to update the K, M, R, Preset, count limit, or rate limit values the enable scale/limit word bit must be set. The default values for all of these scaling and limit words is initially 0. Programming these values in EEPROM so that the values will need to be stored only once. The module will retain these values even if power is removed.

Layout for 4X+1 Register

The 4X+1 register is used to set the Preset, count limit, Rate Limit, M scale factor, K scale factor, and R scale factor for each channel as explained in Table X Module Configuration Word (4X+0 Registers). These scale factors are explained as follows:

Counter Preset:

This output data word is used in conjunction with the Counter Preset enable bit. When this bit is set, the value in the counter preset word is loaded into the counter. The counter preset can be used to set the counter to an initial starting value. The bit should be set for at least one I/O scan. The bit can be held on until the data in the counter data is verified to be equal to the preset value. The counter will hold the preset value until the counter preset bit is turned off. At this time normal counter functions will resume. The preset value should always be set less than the Counter limit value.

When the count size is extended to 16M, the Counters Maximum flag is extended to 16M. The counter Preset and Limit values are also extended to 16M. This means that the resolution of the Preset and Limit values are set in blocks of 256 counts (8bits). This allows the preset and limit values to cover the whole 16M bit range.

Counter Limit:

Note: the User sets The Count Limit and Preset. When the module is in the extended count mode all limits and preset values are multiplied by 256. If the module has a K factor set the resulting value is then divided by the K factor.

Rate Limit

This input data register is used in conjunction with the Preset and Count Limit Mode bits. When the Rate limit value other than 0 is present the data value in this register can be used as an upper frequency limit and annunciated via the Rate Limit Status Flag. To write the value to EEPROM the Program EEPROM bit must be toggled from a zero to a one.

M Scale Factor:

In Program Mode the data value in this register is used for scaling. The Scale data can be stored in EEPROM. To store the scale data in EEPROM valid data must be place into this data register. When the Program EEPROM bit toggles from a zero to a one, data in the Scale Register will be written into the modules EEPROM. The M scale factor is used for meter calibration. When a non-zero Scale Factor value is set the scale calculation is always performed. A value of zero must be written to the Scale Factor to disable this feature.

The M factor value expressed as a 16 bit unsigned integer divided by 10,000. This value is multiplied by the counter actual count value, and gives the M factor a range of 0.0001 to 6.5535 Most M factors will be within +- 5% of 1.0000.

K Scale Factor:

The K scale factor is used for flow meter scaling. This allows users to scale the meter output into more useful units, like gallons. When a non-zero Scale Factor value is set the scale calculation is always performed. A value of zero must be written to the Scale Factor to disable this feature. This counter value is divided by the K factor. K factors are be positive numbers.

When a non-zero K factor is programmed into EEPROM, K divides the physical counter value. Counter Output Value = Actual Counter Value / K.

R Rate Factor:

The R scale factor can be used for scaling of the output frequency. The output frequency is divided by the R scale value.   Typically a factor of two will be used. The result is the rate data value being 1/2 of the actual value. R factors must be positive numbers.

Rate Output Value = Actual Rate Value / R Factor

Layout for 4X+2 through 4X+9 Registers

Registers 4X+2 through 4X+9 registers contain control word information for the each channel. The information includes runtime configuration and control options. The next table shows the bit settings for these control word registers.

Function		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Disable	Start								`								0
	Stop																1
Preset	Off															0	
	On															1	
Reset Counter	No Reset														0		
	Reset														1		
Gate Enable	Disable													0			
	Enable													1			
Count direction	Up												0				
	Down												1				
Reset flags	Normal											0					
	Reset											1					
Stop on zero	Off										0						
	On										1						
Stop on limit	Off									0							
	On									1							
Rate Mode	Average								0								
	Instantaneous								1								
Roll Over To	Zero							0									
	Preset							1									
Roll Under to	Max Count						0										
	Preset						1										
Unused			X	X	X	X									X		
Apply M Factor	Apply	0															
	Do Not Apply	1															

Counter Enable, Bit 16

Set bit 16 to 1 to enable the counter to continue to count up or down from its present value. Use a setting of 0 to stop the counter. Enabling the counter using bit 16 does not override the external counter enable input. Both bit 16 of the control word register and the input must be enabled for the counter to continue counting. If either is disabled, the counter will hold its last value and stop counting.

Preset, Bit 15

Set bit 15 to 1 to load the counter preset value into the counter. This value is used to set the counter to an initial starting value. Set bit 15 for at least one I/O scan, and hold it on until counter data is verified to be equal to the preset value. The counter holds the preset value until the bit 15 is turned off (set to 0). At this time normal counter functions resume.

NOTE A counter preset function begins when bit 15 is set to 0.

Reset Counter, Bit 14

This bit resets the counter. When this bit is set the count value will go to zero and all flags will be reset.

Gate Enable, Bit 13

Set bit 13 to 1 to enable the 5-24VDC pulse-to-enable circuit used during meter proving. This bit should be set to 0 at all other times.

Count Direction, Bit 12

Bit 12 determines the count direction for a counter. Normally you will set this bit to 0 to count up, and to 1 to count down. For a quadrature encoder, however, a setting of 0 uses the normal quadrature decode direction. A setting of 1 inverts the direction.

Reset Flags, Bit 11

Bit 11 is used to reset the internal flags that indicate the maximum, limit, and zero conditions for the counter and the input rate. The flags are defined in the following table.

Table 3-6   Reset Flags

Flag
Maximum

> **For the Counter**
> Indicates when the count passes the counter maximum. The maximum depends on the count size, described in "**Count Size, Bit 9**" on page S   Section header]1. The maximum is set at 65,536 for standard mode or 16,777,216 for extended mode. The status of the flag is reflected in the counter maximum bit in the 3X state register register for the channel. See " **Counter Limit State, Bit 10**".
> **For the Input Rate**
> Indicates when the input rate exceeds the maximum range for the rate mode, described in " **Rate Mode, Bit 12**" on page S   Section header]1. The status of the flag is reflected in the rate maximum bit in the 3X state register for the channel. See " **Rate Maximum State, Bit 7**".

Limit

> **For the Counter**
> Indicates when the count passes the counter limit. The limit depends on the count size, described in " **Count Size, Bit 9**" on page S   Section header]1 . The status of the flag is reflected in the counter limit bit in the 3X state register register for the channel. See " **Counter Limit State, Bit 10**".
> For the Input Rate
> Indicates when the input rate exceeds the non-zero limit set in the rate limit/R data register, and that the input rate is above it limit (see " **Contents of Registers 4X+4 and 4X+8**" on page S   Section header]1). The status of the flag is reflected in the rate limit bit in the 3X state register register for the channel. See " **Rate Limit**

State, Bit 6".

Zero

For the Counter

Indicates when the count is zero. The status of the flag is reflected in the counter zero bit in the 3X state register register for the channel. See "**Counter Zero State, Bit 8**".

For the Input Rate

Indicates when the input rate is zero or below. The status of the flag is reflected in the rate zero bit in the 3X state register register for the channel. See "**Rate Zero State, Bit 5**".

Setting bit 11 to 0 latches the normal state of the flags until they are reset. This allows the ladder logic program to monitor the state of the flags and reset them (to 1) as needed when parameter settings change. Setting bit 11 to 1 reports the counter flags to the PLC for one scan cycle, and then resets them automatically. If the maximum, limit, or zero condition still exists, the module sets the flags back to 1 on the next update cycle.

NOTE: You can use bit 11 to reset the reset flags as a counter value passes through a maximum range value. However, the two values cannot be equal at the time the counter value is read from the backplane. For example, if the counter limit is set to 10,000, the counter limit flag is set when the count exceeds 10,000. The next count value transferred to the rack might be 10,050. The status register will have the counter maximum range flag set for this transfer of counter data.

Stop on Zero, Bit 10

Set this bit to 1 to hold the counter output at zero. When the counter counts down to zero, it either rolls down through zero into full scale or holds its output at zero counts, until the counter zero flag is reset. When the flag is reset, the counter continues to count. See "**Reset Flags, Bit 11.**" for more about the counter zero flag.

Stop on Limit, Bit 9

Set this bit to 1 to hold the counter output at its limit value. When the counter counts up to the limit value, the counter either rolls over to zero or holds its output at the limit value, until the counter limit flag is cleared. When the flag is cleared, the counter continues to count. If the user-defined count limit is equal to zero, the limit is internally set to 65,536 (64 K count size) or 16,777,216 (16 M count size). See the count size parameter description in "**Making Bit Settings for Zoom Registers.**"

Rate Mode, Bit 8

When this bit is reset to "0" the frequency detection circuit operates in "Instant" mode. Instant mode times the period of a single input transition from one rising edge to the next rising edge of an input signal. Instant measurements are fast, in that they calculate a frequency based on one cycle. However the accuracy of the measurement degrades as the input clock frequency goes up to 50KHz, and any jitter within one cycle will be measured.

When the frequency mode bit is set to a "1" the frequency detection circuit is in "Average" mode. Average mode counts the number of input transitions over a 1 second interval and calculates the input frequency averaged over the 1-second interval. The average mode is slow, in that it reports updated frequency rates once per second. However this mode is accurate to +- 1 count over the full range of measurement.

Roll over to, Bit 7

When the counter exceeds the maximum count or limit value it will roll over the top. When the counter rolls over it can roll over to a starting value of zero, or it can start at the user-defined Preset value. When this bit is set to zero the counter will roll over to zero. When set to 1 the counter will roll over to the preset value. If the stop on limit flag is set the counter will not roll over until the flag is released. When released the counter will roll over to its zero or preset value on the next input clock.

Roll under to, Bit 6

When the counter, counts down to zero it will roll under. When the counter rolls under it can roll into positive full-scale numbers, or it can jump to the predefined Preset value. When this bit is set to zero the counter will roll into positive full scale numbers. When set to 1 the counter will roll over to the preset value. If the stop on zero flag is set the counter will not roll under until the flag is released. When released the counter will roll under to its maximum or preset value.

Unused, Bits 5-2

Apply M to Rate, Bit 1

If this bit is set to 0 the M factor will be applied to the Rate data value. When set to one, the M factor will be applied to the rate value.

Bit Settings for 3X+0 Registers

The 3X+0 registers contain data, scaling and status information for channels 1 through 8. You can only set 3X register bits using ladder logic. This section describes the layout for the registers and defines the bits. Ladder logic examples are provided in chapter 4, "Programming."

Table 3-7   3X+0 Register Bit Settings

Function		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bank/Data Format Select Echo	Bank 1/ LSW															0	0
	Bank 2/ MSW															0	1
	Bank 3/Rate															1	0
	Bank 4/ Status															1	1
Data Delivery Echo	Comprehensive														0		
	Speed														1		
Multiplexing Control Echo	Manual													0			
	Autosequence													1			
Parameter Definition Echo (for scale/limit word)	Preset										0	0	0				
	Count Limit										0	0	1				
	Rate Limit										0	1	0				
	M factor										0	1	1				
	K Factor										1	0	0				
	R factor										1	0	1				
Not Used										X							
Channel Number Echo (for scale/limit word)	Channel 1						0	0	0								
	Channel 2						0	0	1								
	Channel 3						0	1	0								
	Channel 4						0	1	1								
	Channel 5*						1	0	0								
	Channel 6*						1	0	1								
	Channel 7*						1	1	0								
	Channel 8*						1	1	1								
Not Used						X											
Configuration Error	No Error				0												
	Error				1												
System Error	No Error			0													
	Error			1													
Program EEPROM Echo	Do Not Program		0														
	Program		1														
Enable Scale /Limit Word Echo	Disable	0															
	Enable	1															

All fields in the above table are echoes of what is in the 4X+0 register except configuration error and system error. Refer to the section Configuration Word (4X+0 Register) for more details. Configuration error indicates an erroneous configuration has been input for at least one input channel. A system error indicates a problem with either the module or with a module input.

The process for updating the scale coefficients and the count limits is as follows:

1.   Set the Scale/Limit Word to its desired value (4x+1 register). This must be performed before updating the module control word.
2.   Set the following bits on the module control word (register 4X+0) to the appropriate state for the value to be written:
a.   Channel Number
b.   Parameter Definition
c.   Enable Scale/Limit Word (set to 1)
Note: This bit can be set at the same time as the channel number and parameter definition, but not earlier.
3.   Read Module Status word (Register 3X+8) and verify the Enable Scale/Limit Word bit is set.
       This verifies the module has received the control word update.
4.   Set the Enable Scale/Limit Word bit to 0.
5.   Update other Scale/Limit values by redoing steps 1 through 7.

To store K, M, and R values into the EEPROM perform the following:

1.   Set the Program EEPROM bit (bit 2) in the Control Word (Register 4X+0).
2.   Read Module Status word (Register 3X+0) and verify the Program EEPROM Echo(bit 2) is set. This verifies the module has received the control word update.
3.   Verify the Program EEPROM Echo bit has been set in the Module Status Word.
4.   Zero the Program EEPROM bit and the Enable Scale/Limit Word bits in the Module Control Word.

Please refer to our website, www.spectrumcontrols.com, for ladder logic samples and technical notes.

Bit Settings for 3X Registers

The 3X registers (3X+1 through 3X+8) contain data and status information for channels 1 through 8. You can only set 3X register bits using ladder logic. This section describes the layout for the status registers (3X+1 through 3X+8) and defines the bits. Ladder logic examples are provided in chapter 4, "Programming."

Table 3-7   3X+1 to 3x+8 Register Bit Settings

Function		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Counter Disable	Start																0
	Stop																1
Counter Preset Flag	Reset															0	
	Set															1	
Gate Enable Echo	Disabled														0		
	Enabled														1		
Counter Invert	Off													0			
	On													1			
Counter Input State	Low												0				
	High												1				
Quadrature Direction	Normal											0					
	Inverted											1					
Count Size	65K										0						
	16M										1						
Counter Max Flag	Reset									0							
	Set									1							
Counter Limit Flag	Reset								0								
	Set								1								
Counter Zero Flag	Reset							0									
	Set							1									
Rate Max Flag	Reset						0										
	Set						1										
Rate Limit Flag	Reset					0											
	Set					1											
Rate Zero Flag	Reset				0												
	Set				1												
K&M Factor Set	Reset			0													
	Set			1													
R Factor Set	Reset		0														
	Set		1														
Configuration Error	OK	0															
Flag	Error	1															

Enable Start/Stop Echo: Bit 16

This bit echoes the setting of the Counter Enable bit set in the channels control register. The counter enable bit allows the counter to continue to count up or down from its present value.   Starting or enabling the counter with this bit will not override the external counter input. Both the external input enable and the counter start bit must be enabled for the counter to continue counting.   If either the counter stop bit or the external input enable line are disabled the counter will hold its last value and stop counting.

Counter Preset Flag: Bit 15
  When the Counter Preset value is reached this flag bit is set. The bit is reset when the counter in incremented up or down from the Preset value.

Gate Enable Echo: Bit 14
  This bit echos the state of the gate enable line.   The gate enable line is an external logic line used to time counter events.

Counter Invert Echo: Bit 13
  This bit echos the state of the counter direction.   The invert flag indicates if the invert bit has been set. It is not an absolute indication of direction but instead an indication that the starting direction has been changed. For example: If the counter begins in a downward direction and the bit it set,

Counter Input State: Bit 12
  This bit shows the current value of the output state. The state of the output will be sampled at the end of the current update cycle. For rapidly changing counter inputs the state of this bit could be either high or low depending on the exact time of measurement. This purpose for this bit is to provide slow counter feedback and single count diagnosis. This bit can also be used as a general-purpose digital input line back to the PLC.it will invert direction to an upward mode.

Quadrature Direction State: Bit 11
  This bit shows the current direction of the quadrature encoder. The state of the encoder will be sampled at the end of the current update cycle. For rapidly changing counter inputs the state of this bit could be either high or low depending on the exact time of measurement. This purpose for this indicator is to provide quadrature detection feedback to aid in system diagnosis.

Count Size Selection Echo: Bit 10
  This bit echo's the state of the maximum counter value selected in the configuration register. When reset to zero the channel counter will count up to 65K (1 word of data).   When the counter at 65K the maximum count value is reached, the Maximum Count flag is set, and rollover will occur at this point. Channel update time should be faster if the counter values are set to 65K.   The level of speed improvement will need to be determined.   When the count size is extended to 16M, the Counters Maximum flag is extended to 16M. The counter Preset and Limit values are also extended to 16M. This means that the resolution of the Preset and Limit values are set in blocks of 256 counts (8bits). This allows the preset and limit values to cover the whole 16M bit range.

Counter Max Flag: Bit 9:
  This flag indicates that the counters accumulator has reached its maximum count value. When the counter value is greater then or equal to the Max value the Counter Limit flag bit will be set. The Max flag will stay set until the Reset Flags bit is toggled in the channels' configuration register.   The
  Max flag is set at 65,536 and 16,777,216 depending on the data output mode.
  Note that the internal counter H/W will set is Max flag when the counter is at –1 for both 65K and 16M modes.

Counter Limit Flag: Bit 8
    This flag indicates that the counters accumulator has reached its user-defined count limit. When the Counter Limit word is in use, i.e. it has a value other than zero, then the Counter Range flag indicates the counter is at the User defined limit. When the counter value is equal to the Limit value the Counter Limit flag bit will be set until the Reset Flags Bit is set.   If the Stop On Limit bit is set the counter will not exceed the counter limit.   If the Counter Limit function is not in use, i.e. its value is zero, and then the Limit flag will never be set.   This value is either 65,536 or 16,777,216 depending on the accumulator size selected.

Counter Zero Flag: Bit 7
    The Counter Zero flag is set when the counter is reset to zero or counts down to zero. If the Stop On Zero bit is set the counter will not roll until the Limit flag cleared.   The Limit flag will stay set until the Reset Flags bit is toggled in the channels' configuration register.

Over Rate Flag: Bit 6
    The over Rate flag is set when the input frequency exceeds its maximum range of 50KHz. This flag indicates that the input counter rate is over the valid range of the module and that the value indicated in the frequency data register may not be correct. This flag is normally set at 50kHz unless a rate scale factor is used

Rate Limit: Bit 5
    A user defined Rate Limit flag is active when the user has set the rate limit data register to a limit value other than zero.   When the rate value is greater then or equal to the limit value the Rate Limit flag bit will be set indicating that the input rate is above its limit.

Rate Zero Flag: Bit 4
    The Rate Zero flag is set when the input rate is zero. This flag can be used to flag an input fault condition. Any input signal less than .5Hz will set the Zero rate flag.

K & M Factor Set Flag: Bit 3
    This bit indicates that a non-zero K or M factor value has been written to the module EEPROM. This value will be use to scale the input counter data. When a K or M factor is set all rate data will be scaled by either one or both factors.

R Factor Set Flag: Bit 2
    This bit indicates that a non-zero R factor value has been written to the modules EEPROM. When a R factor is set all rate data will be divided by this factor.

Configuration Error Flag: Bit 1
    This flag is set when the channel configuration word is set to an illegal state. An example would be if one channel was configured for quadrature detection and its quadrature pair was not. In this case both channels would have their configuration flags set until the configuration word was corrected.   All counter and rate data will be set to zero when an illegal configuration occurs.

    Possible Configuration errors:
    1. Range data between channel pairs in quad mode
    2. Filter data between channel pairs in quad mode

4Chapter

Programming

With configuration complete, it is time to prepare ladder logic to reflect your configuration settings. Programming the module requires knowledge of counter configuration, PLC ladder logic, and data management.

This chapter includes information on the following:

- Register Description
- Demultiplexing the data
- General programming examples
- Ring Counters
- Use of Meter Proving Input

Registers Description

You can configure the 4X registers in ladder logic. The program needs to reflect all the bit settings discussed in chapter 3, "Module Configuration." The 3x registers communicate data and status information. Below is a listing of register utilization.

Address	Description		
400001	4x	Register	Configuration Word for Counter Card
400002	4x+1	Register	Limit word
400003	4x+2	Register	Channel 1 Configuration
400004	4x+3	Register	Channel 2 Configuration
400005	4x+4	Register	Channel 3 Configuration
400006	4x+5	Register	Channel 4 Configuration
400007	4x+6	Register	Channel 5 Configuration
400008	4x+7	Register	Channel 6 Configuration
400009	4x+8	Register	Channel 7 Configuration
400010	4x+9	Register	Channel 8 Configuration

Address		Description	
300001	3x	Register	Counter card Configuration Word echo
300002	3x+1	Register	Channel Data word 1
300003	3x+2	Register	Channel Data word 2
300004	3x+3	Register	Channel Data word 3
300005	3x+4	Register	Channel Data word 4
300006	3x+5	Register	Channel Data word 5
300007	3x+6	Register	Channel Data word 6
300008	3x+7	Register	Channel Data word 7
300009	3x+8	Register	Channel Data word 8
400200	N/A	Channel 1 Preset	
400201	N/A	Channel 1 Count limit	
400202	N/A	Channel 1 Rate limit	
400203	N/A	Channel 1 M factor	
400204	N/A	Channel 1 K factor	
400205	N/A	Channel 1 R factor	
400300	N/A	Channel 2 Preset	
400301	N/A	Channel 2 Count limit	
400302	N/A	Channel 2 Rate limit	
400303	N/A	Channel 2 M factor	
400304	N/A	Channel 2 K factor	
400305	N/A	Channel 2 R factor	
400400	N/A	Channel 3 Preset	
400401	N/A	Channel 3 Count limit	
400402	N/A	Channel 3 Rate limit	
400403	N/A	Channel 3 M factor	
400404	N/A	Channel 3 K factor	
400405	N/A	Channel 3 R factor	
400500	N/A	Channel 4 Preset	
400501	N/A	Channel 4 Count limit	
400502	N/A	Channel 4 Rate limit	
400503	N/A	Channel 4 M factor	
400504	N/A	Channel 4 K factor	
400505	N/A	Channel 4 R factor	
400600	N/A	Channel 5 Preset	
400601	N/A	Channel 5 Count limit	
400602	N/A	Channel 5 Rate limit	
400603	N/A	Channel 5 M factor	
400604	N/A	Channel 5 K factor	
400605	N/A	Channel 5 R factor	
400700	N/A	Channel 6 Preset	
400701	N/A	Channel 6 Count limit	
400702	N/A	Channel 6 Rate limit	
400703	N/A	Channel 6 M factor	
400704	N/A	Channel 6 K factor	
400705	N/A	Channel 6 R factor	

Address	Description		
400800	N/A	Channel 7	Preset
400801	N/A	Channel 7	Count limit
400802	N/A	Channel 7	Rate limit
400803	N/A	Channel 7	M factor
400804	N/A	Channel 7	K factor
400805	N/A	Channel 7	R factor
400900	N/A	Channel 8	Preset
400901	N/A	Channel 8	Count limit
400902	N/A	Channel 8	Rate limit
400903	N/A	Channel 8	M factor
400904	N/A	Channel 8	K factor
400905	N/A	Channel 8	R factor
401100	N/A	Channel 1	Count data Lsw
401101	N/A	Channel 1	Count data Msw
401102	N/A	Channel 2	Count data Lsw
401103	N/A	Channel 2	Count data Msw
401104	N/A	Channel 1	Rate data
401105	N/A	Channel 2	Rate data
401106	N/A	Channel 1	Status data
401107	N/A	Channel 2	Status data
401200	N/A	Channel 3	Count data Lsw
401201	N/A	Channel 3	Count data Msw
401202	N/A	Channel 4	Count data Lsw
401203	N/A	Channel 4	Count data Msw
401204	N/A	Channel 3	Rate data
401205	N/A	Channel 4	Rate data
401206	N/A	Channel 3	Status data
401207	N/A	Channel 4	Status data
401300	N/A	Channel 5	Count data Lsw
401301	N/A	Channel 5	Count data Msw
401302	N/A	Channel 6	Count data Lsw
401303	N/A	Channel 6	Count data Msw
401304	N/A	Channel 5	Rate data
401305	N/A	Channel 6	Rate data
401306	N/A	Channel 5	Status data
401307	N/A	Channel 6	Status data
401400	N/A	Channel 7	Count data Lsw
401401	N/A	Channel 7	Count data Msw
401402	N/A	Channel 8	Count data Lsw
401403	N/A	Channel 8	Count data Msw
401404	N/A	Channel 7	Rate data
401405	N/A	Channel 8	Rate data
401406	N/A	Channel 7	Status data
401407	N/A	Channel 8	Status data

Example : Demultiplexing Data

The following ladder logic shows how to move data from the 4 multiplexed input words to a block of 8 output words starting at location 400001 using the manual mode. This and other ladder logic samples may be found on our website, www.spectrumcontrols.com.

Rung 1 demultiplex data or channels 1 and 2 - Rung 2 demultiplexes data or channels 3 and 4
Rung 3 demultiplex data or channels 5 and 6 - Rung 4 demultiplexes data or channels 7 and 8
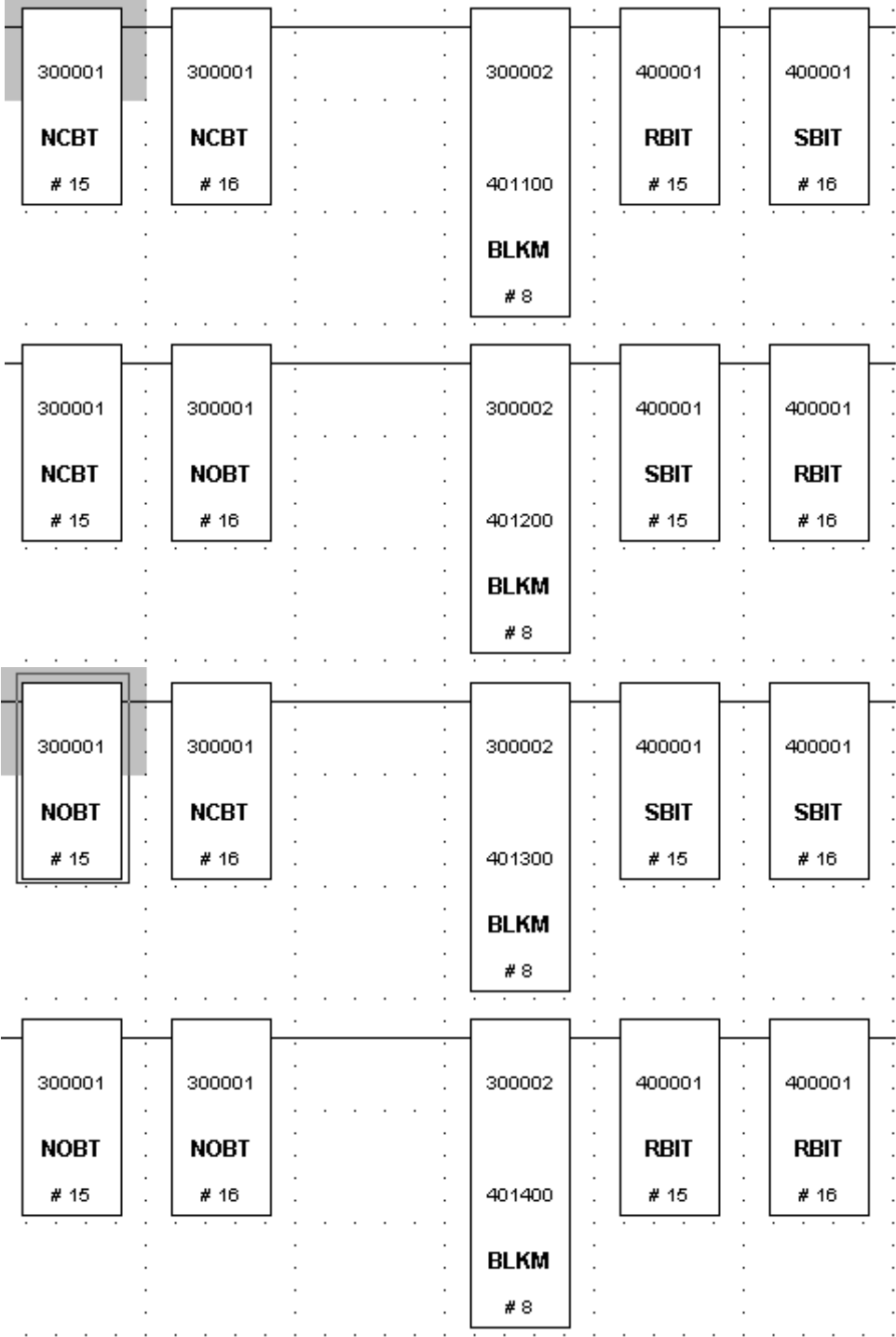
General Programming Examples

Example 1: Loading Scaling Factors

The following sample ladder logic shows how to load scale factors into the module. Refer to the configuration bit table for information regarding factor and channel bit settings

Initialization: First Pass Condition - Coil 1 is True for only one scan. Rung 3 starts and stops the ladder following this network.
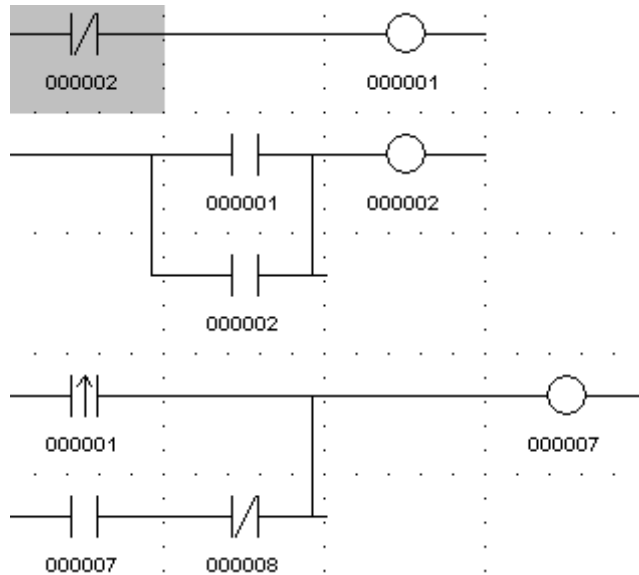
Handshake for the counter card: Rungs 1 and 2 are used as a handshake to verify that valid data is being passed to the card and that the counter card has received the data and is ready for the next packet.
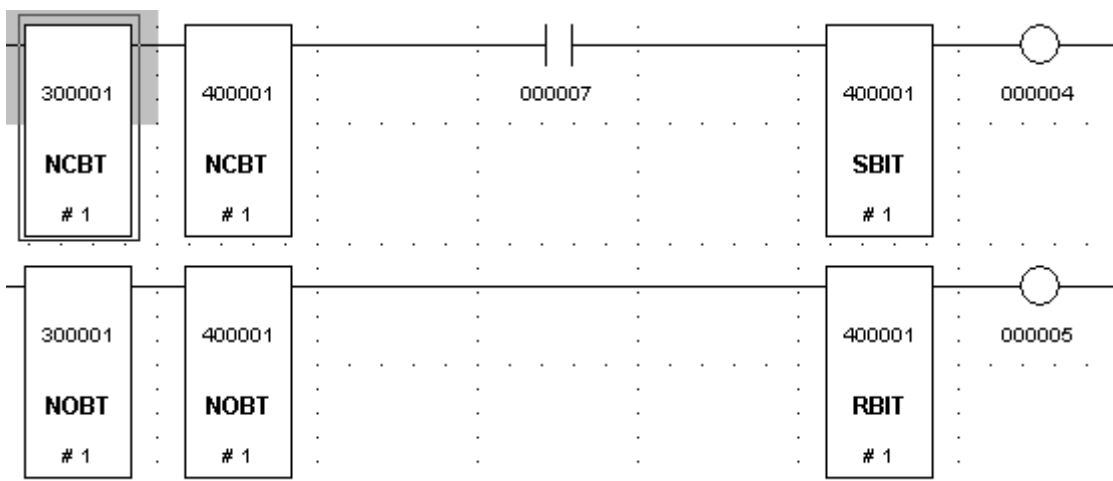
Select Channel - Rungs 1 and 2 select and load the data for channels 1 and 2 respectively.
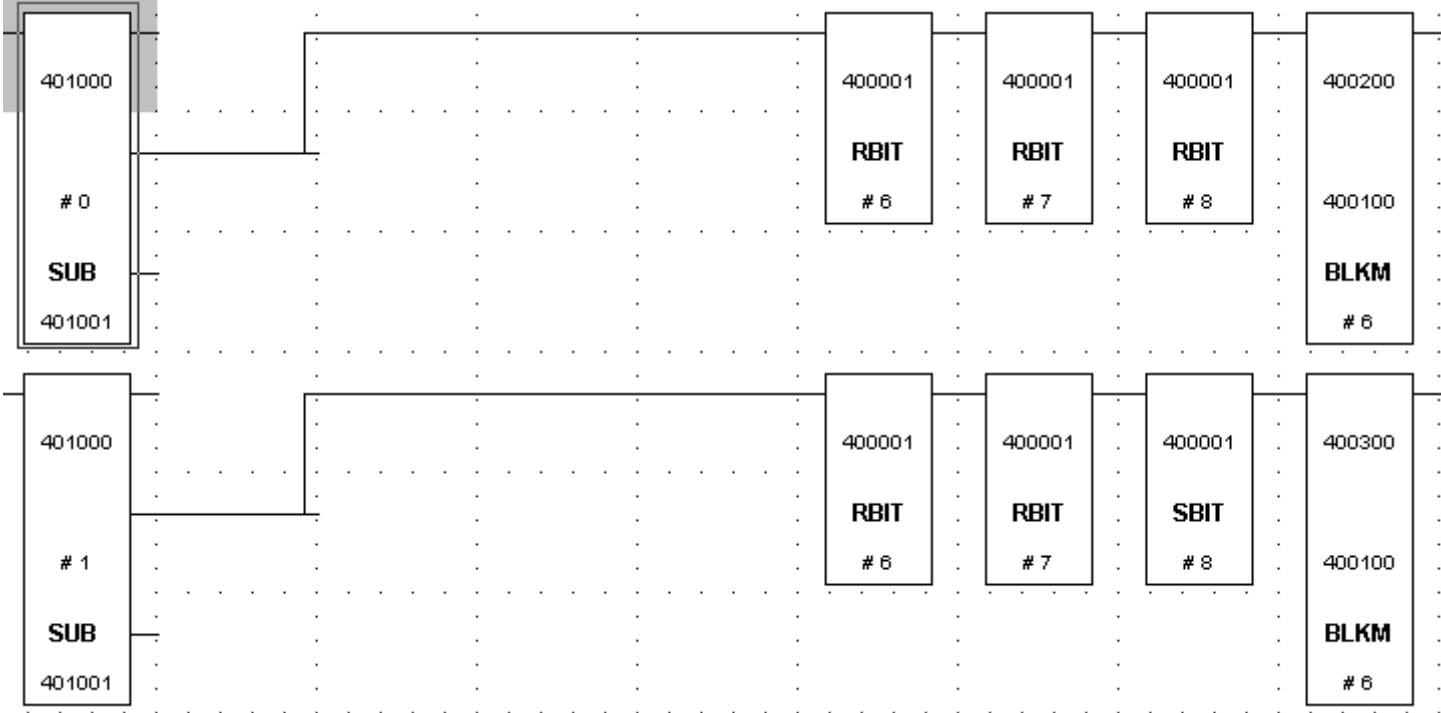
Select Channel - Rungs 1 and 2 select and load the data for channels 3 and 4 respectively.
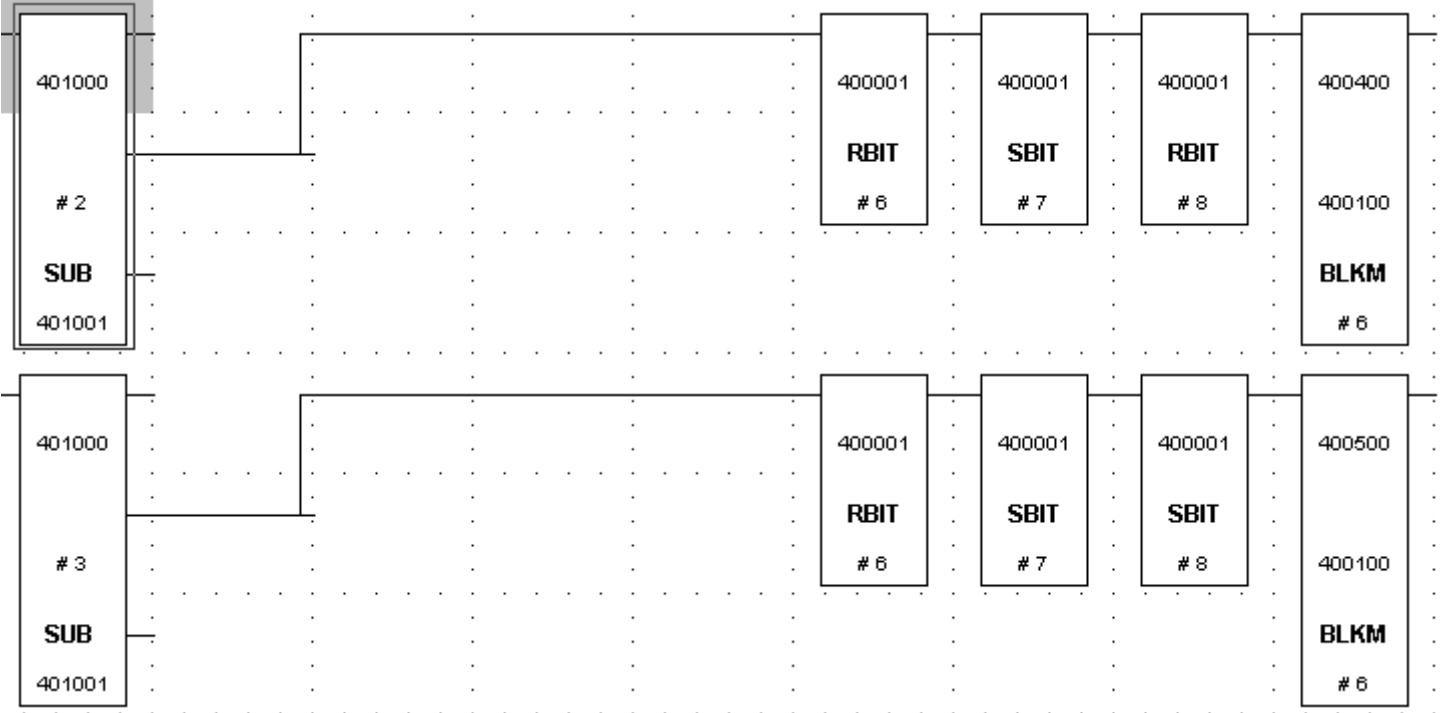
Select Channel: Rungs 1 and 2 select and load data for channels 5 and 6 respectively

401000		400001	400001	400001	400600
# 4		SBIT	RBIT	RBIT	400100
SUB		# 6	# 7	# 8	BLKM
401001					# 6

401000		400001	400001	400001	400700
# 5		SBIT	RBIT	SBIT	400100
SUB		# 6	# 7	# 8	BLKM
401001					# 6
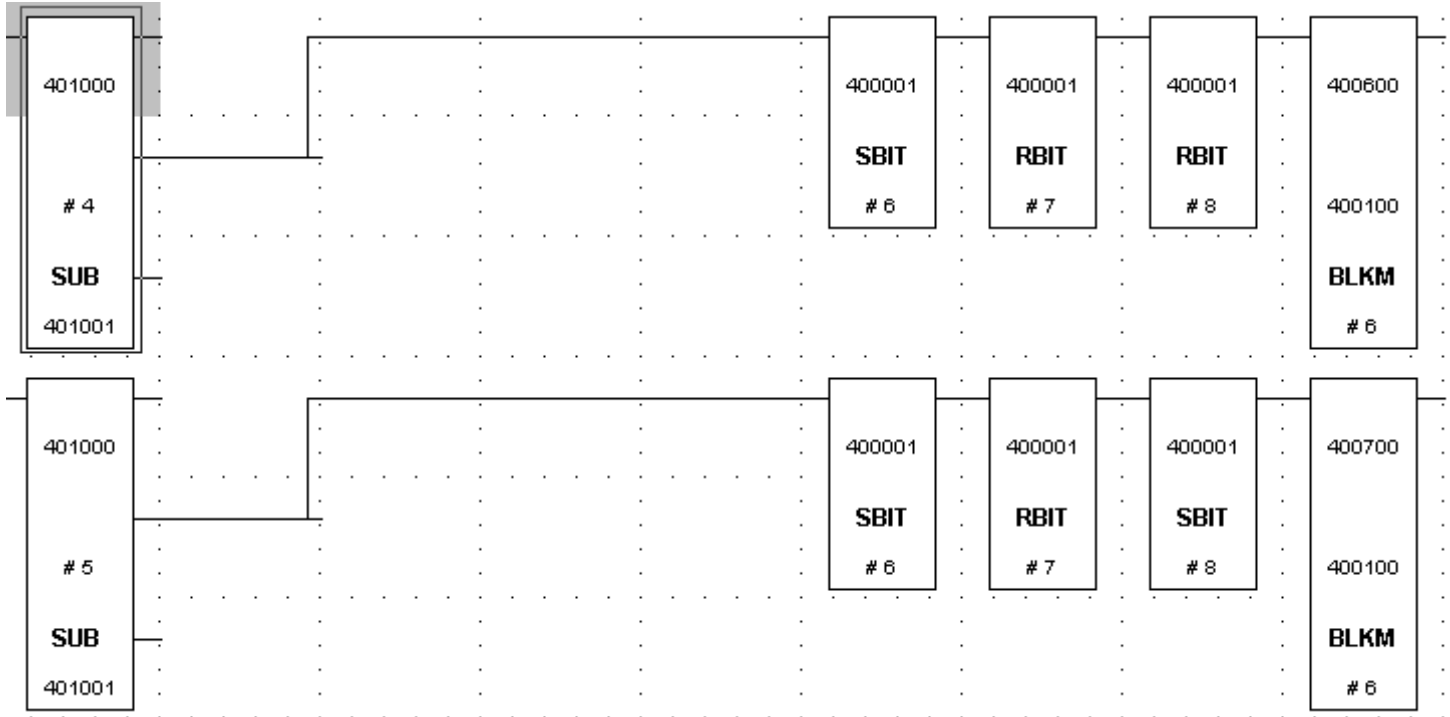
Select Channel: Rungs 1 and 2 select and load data for channels 7 and 8 respectively

401000		400001	400001	400001	400800
# 6		SBIT	SBIT	RBIT	400100
SUB		# 6	# 7	# 8	BLKM
401001					# 6

401000		400001	400001	400001	400900
# 7		SBIT	SBIT	SBIT	400100
SUB		# 6	# 7	# 8	BLKM
401001					# 6
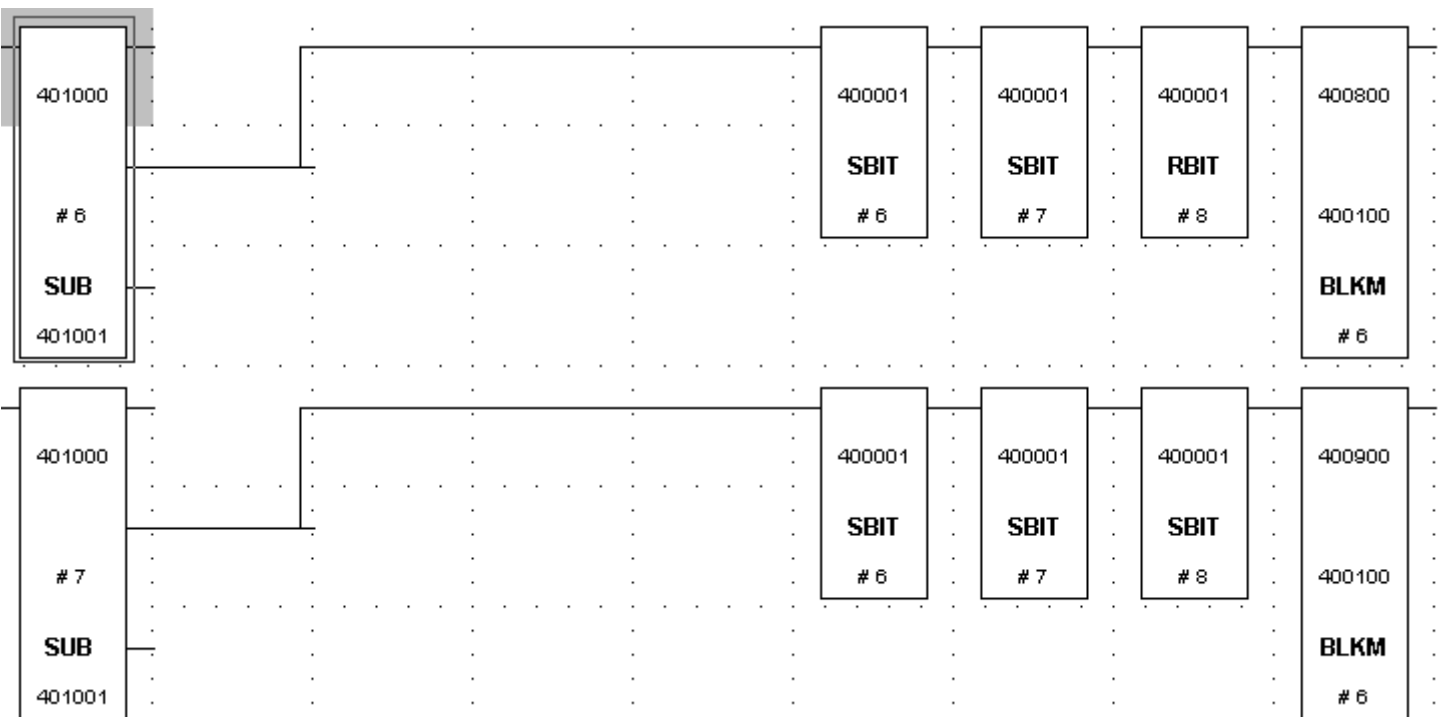
Stop Ladder: Rung 1 stops the ladder after all the data has been loaded for channels 1-8
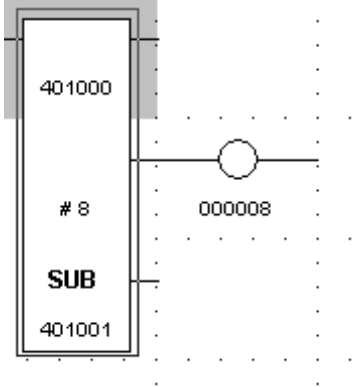
```
┌─────────┐
│ 401000  │
│         │      ◯
│  # 8    │   000008
│  SUB    │
│ 401001  │
└─────────┘
```

Select Variable: Rungs 1, 2 and 3 select one of the following variables: Preset, Count Limit, Rate Limit, M Factor, K Factor, and R Factor.

400050	400050	400050	400001	400001	400001
NCBT	NCBT	NOBT	RBIT	RBIT	RBIT
# 14	# 15	# 16	# 10	# 11	# 12

400050	400050	400050	400001	400001	400001
NCBT	NOBT	NCBT	RBIT	RBIT	SBIT
# 14	# 15	# 16	# 10	# 11	# 12

400050	400050	400050	400001	400001	400001
NCBT	NOBT	NOBT	RBIT	SBIT	RBIT
# 14	# 15	# 16	# 10	# 11	# 12

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Select Variable: Rungs 1, 2 and 3 select one of the following variables: Preset, Count Limit, Rate Limit, M Factor, K Factor, and R Factor.

400050	400050	400050	400001	400001	400001
NOBT	**NCBT**	**NCBT**	**RBIT**	**SBIT**	**SBIT**
# 14	# 15	# 16	# 10	# 11	# 12

400050	400050	400050	400001	400001	400001
NOBT	**NCBT**	**NOBT**	**SBIT**	**RBIT**	**RBIT**
# 14	# 15	# 16	# 10	# 11	# 12

400050	400050	400050	400001	400001	400001	000003
NOBT	**NOBT**	**NCBT**	**SBIT**	**RBIT**	**SBIT**	
# 14	# 15	# 16	# 10	# 11	# 12	
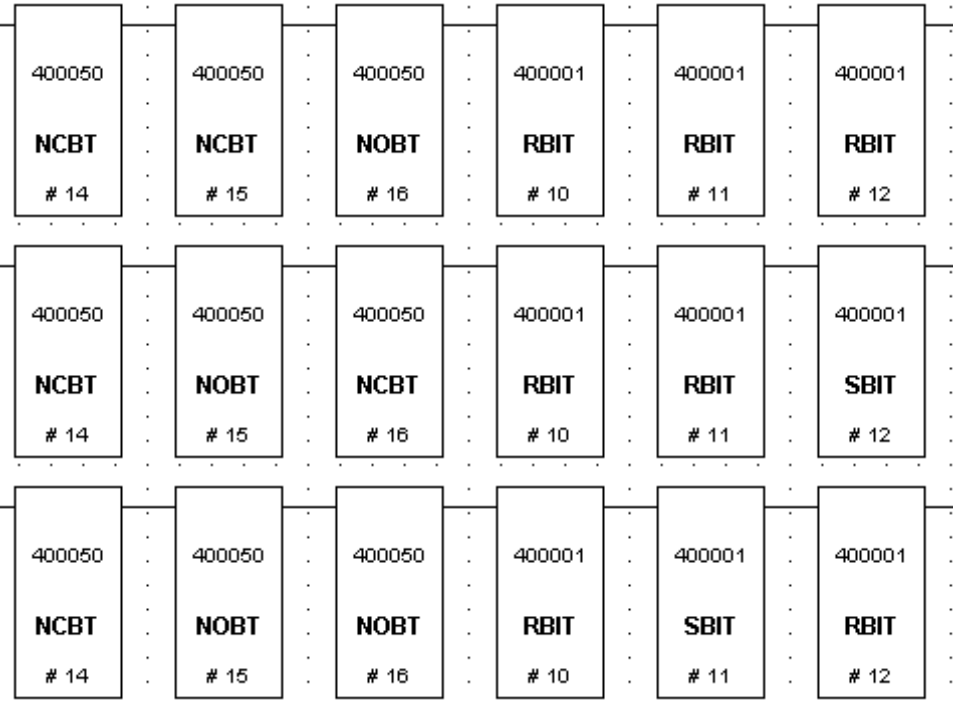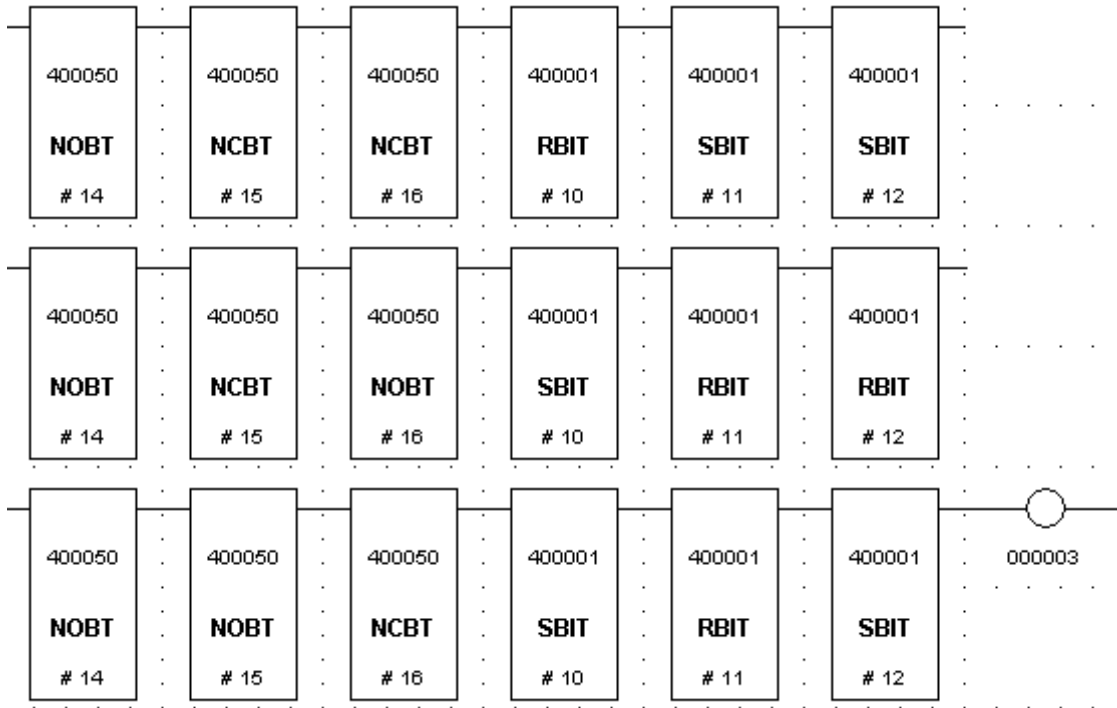
Select the channel: When coil 3 is energized the counter is incremented, selecting the next channel. When the accumulated value of the counter reaches 8 the ladder stops executing.

```
      000003          # 8

      000007         UCTR
                    401000
```

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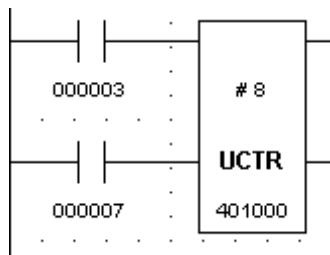
Pass the variable to the counter card: Rung 1 loads the current variable (Preset, Count, Limit, Etc.) in to a temporary holding register. Rung 3 passes the value stored in the temporary holding register to the counter card.

```
       | |                                              ┌─────────┐
      ─┤ ├──────────────────────────────────────────────┤ 400100  │
      000004                                            │         │
                                                        │ 400050  │
       | |       | |                                    │         │
      ─┤ ├──────┤ ├────┐                                │  T->R   │
      000003    000005 │                                │   # 6   │
                       │                                └─────────┘
       | |             │
      ─┤ ├─────────────┘
      000001
  ┌─────────┐
  │ 400051  │
  │         │
  │ 400002  │
  │         │
  │  BLKM   │
  │   # 1   │
  └─────────┘
```
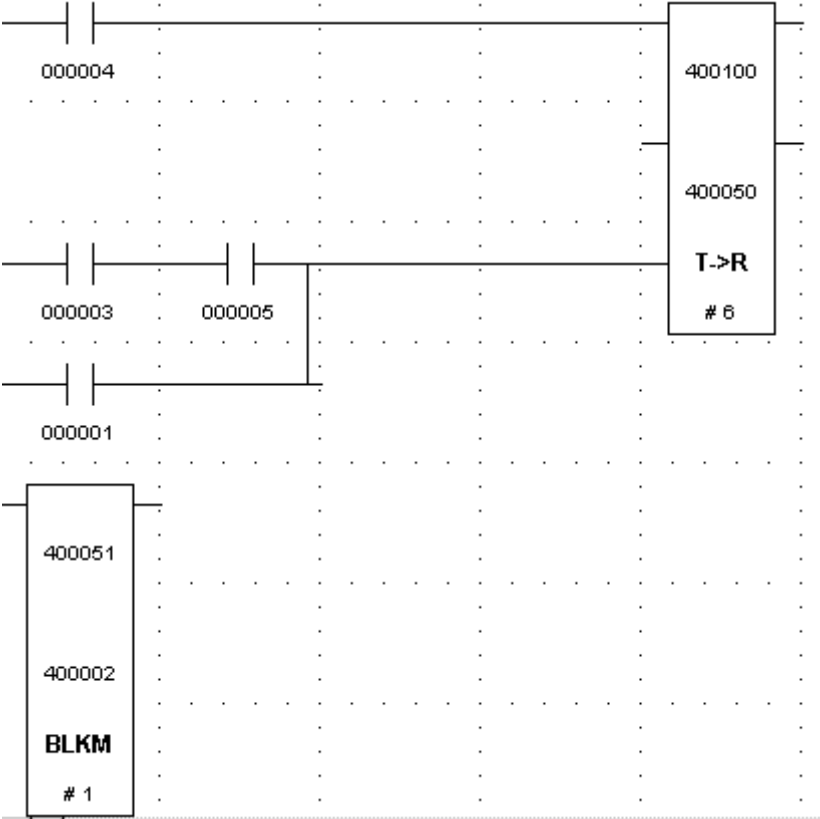
Sample Configuration
Simple Bi-Directional Ring Counter:

The figure below demonstrates ring counter operation. In a ring counter operation, the count value changes between zero and maximum. If, when counting up, the counter reaches the maximum value, it rolls over to zero. If, when counting down, the counter reaches zero, it rolls under to the maximum value.

Ring Counter

Maximum Value   Zero

Rollover

Count Down   Count Up
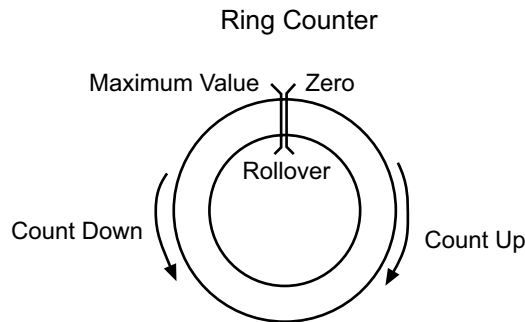
This configuration will allow the user to count from a minimum value of 0 to the counter maximum value. Each time a revolution has occurred the counter limit flag will be set. Your ladder program may use this flag to increment an accumulator, thus counting revolutions. The flag must be reset before another complete revolution occurs otherwise the accumulator can not be incremented.

A bi-directional ring counter is configured by setting the preset and limit to the same valueand setting the roll over to zero and roll under to preset bits. Zero must always be the starting point and the maximum value must always be positive.

Bi-Directional
Ring Counter

Maximum   0

Rollover
Flag Set
on Each
Revolution   Count Up
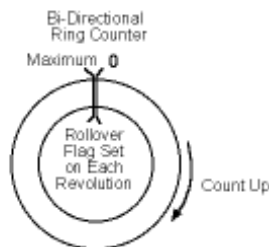
The above figure illustrates counting in a clockwise direction. The ring counter may also count in a counterclockwise direction by toggling the counter direction bit (bit 12 4x 2-9).

Sample Configuration
Using the Meter Proving Inputs

A ball proving system would use the meter proving input found on the module. The ball meaures the flow velocity over a fixed length of line. When the ball crosses the starting point a momentary high signal from a proximity switch starts the counter. When the ball crosses the prover exit another proximity switch triggers causing the counter to stop. During the movement of the displacer the meter count is monitored. Once complete the transit time is compared to the meter count. Any difference in these values may be used to adjust the calibration (M factor) of the flowmeter.
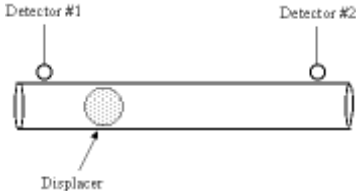
The Meter Proving Inputs are designed for use with typical meter proving applications. These inputs differ from the hardware inhibit/trigger inputs in the way the start and stop the counter.

Inhibit / Trigger Line

Meter Proving Input
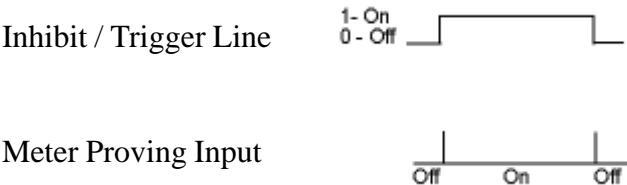
The inhibit trigger line turns the counter on and off by holding the logic signal high or low. The Meter Proving Input starts counter operation by applying a momentary high logic level signal (pulse). The counter is stopped by applying another momentary high logic level signal (pulse).

Utilizing the meter proving input to start and stop count functions enables the user to count pulses as fast as 20 microseconds to an accuracy of 1 count.

Here is an example wave form representing the start and stop transitions on the external gate enable, and the associated pulses that the module would accumulate:
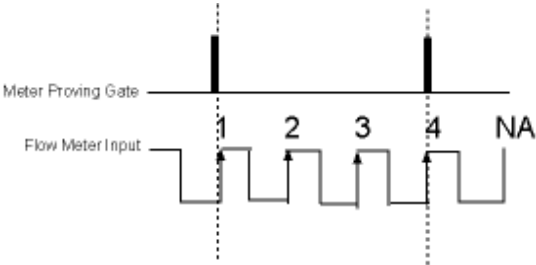
Given the above wave form, the module will begin counting the first positive going input pulse after the external enable input goes low. The module will accumulate 4 counts in the channel count register and stop when the external enable input goes high. The external enable line accommodates 5 Vdc, 12 Vdc and 24 Vdc signals and is pulled low internally.

5Chapter

Maintenance and Diagnostics

This chapter describes maintenance and diagnostics for the Quantum counter module. Provided information includes:

- Safety considerations during maintenance
- Preventive maintenance
- Internal diagnostics
- Startup testing
- Troubleshooting
- Module errors

Safety Considerations

Safety considerations are an important element of proper maintenance and diagnostic procedures. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance. The following sections describe several safety concerns you should be aware of when troubleshooting your control system.

ATTENTION Never reach into a machine to activate a switch, because unexpected motion can occur and cause injury. Remove all electrical power at the main power disconnect switches before checking electrical connections or inputs causing machine motion.

Indicator Lights

When the ready (module status) LED on the module is illuminated, it indicates that power is applied to the module.

Activating Devices

When servicing the module, never reach into the machine to activate a device. Unexpected machine motion can occur.

Standing Clear of the Equipment

When troubleshooting any system problem, have all personnel remain clear of the equipment. The problem can be intermittent, and sudden unexpected machine motion can occur. Have someone ready to operate an emergency stop switch in case it is necessary to shut off power.

Program Alteration

There are several possible causes of alteration to the user program, including extreme environmental conditions, electromagnetic interference (EMI), improper grounding, improper wiring connections, and unauthorized tampering. If you suspect that a program has been altered, check it against a previously saved program on an EEPROM or UVPROM memory module.

Safety Circuits

Circuits installed on the equipment for safety reasons, such as over-travel limit switches, stop pushbuttons, and interlocks, should always be hard-wired to the master control relay. These devices must be wired in series so that, when any one device opens, the master control relay is de-energized, thus removing power to the equipment. Never alter these circuits to defeat their function. Serious injury or machine damage can result. Refer to your system's installation and operation manuals for more information.

Preventive Maintenance

This section describes preventive maintenance procedures to help in maintaining your module.

> **ATTENTION** The National Fire Protection Association (NFPA) recommends maintenance procedures for electrical equipment. Refer to article 70B of the NFPA for general safety-related work practices.

Maintaining Printed Circuit Boards

The printed circuit boards of your module must be protected from dirt, oil, moisture, and other airborne contaminants. To protect these boards, install the PLC system in an enclosure suitable for its operating environment. Keep the interior of the enclosure clean, and whenever possible, keep the enclosure door closed.

Inspecting Terminal Connections

Regularly inspect the module terminal connections for tightness. Loose connections can cause the module or PLC system to malfunction, or damage module or system components.

> **WARNING** Before inspecting connections, always ensure that incoming power is off. Failure to observe this precaution can cause personal injury and equipment damage.

Internal Diagnostics

The module performs internal diagnostics at both the module and channel levels of operation. When detected, module error conditions are immediately indicated by the ready (module status) LED. Channel errors are reported at their respective LEDs.

The module reports error conditions to the PLC. Channel error conditions are reported in the module's input data table. Module hardware errors are typically reported in the PLC I/O status file. Refer to your controller manual for details.

When a fault condition is detected, the PLC sets analog outputs to zero. The data in the output data file is retained during the fault. Once the fault condition is corrected and the major fault bit in the controller is cleared, the retained data is sent.

Fault LED:

Number of Blinks:	Fault:
Off	No Faults
1	Dual Port RAM fault.
2	FPGA init fault.
3	FPGA1 program fault.
4	FPGA2 program fault.
5	FPGA1 fault.
6	FPGA2 Fault.
7	Watchdog Fault.
8	ROM CRC fault.
9	EEPROM fault.
10	Both Speed mode and Autosequence mode selected (Mutually exclusive

Power-Up Diagnostics

At module power-up, a series of internal diagnostic tests is performed. These diagnostic tests must be successfully completed for the ready (module status) LED to be illuminated. If the tests are not successful, the ready LED remains off and a module error results and is reported to the PLC.

Channel Diagnostics

When an input channel is enabled, the module performs a diagnostic check to see that the channel has been properly configured. In addition, the channel is tested on every scan for configuration errors, hardware errors, and roll-over/under conditions.

If a channel configuration word is improperly defined, the module disables the channel.Common reasons for configuration errors are:

On Solid	No Faults
1	Frequency Limit Out of Range
2	Counter Limit Out of Range.
3	Counter Preset Out of Range.
4	Channel Pair Gate Enable Configuration Mismatch.
5	Quadrature Pair Configuration Mismatch.
6	Both Stop on 0 and Stop on Limit selected (Mutually exclusive).
7	Both Roll Over to Preset and Roll Under to Preset (Mutually exclusive).
8	Unrecognized parameter type.

Startup Testing

This section presents testing procedures recommended for use at module startup to verify correct installation and configuration.

Physical Inspection

1. Inspect the module to ensure that all wire connections are correct and secure and that no wires are missing or broken.

2. Ensure that the shield for the cable used to wire your module is properly grounded. Refer to Chapter 2, "Installation and Wiring" for more information.

3. Ensure that the removable terminal block on your module is secure.

4. Before enabling a channel (through your ladder program), ensure that you have chosen a proper input range for the input signal. Failure to observe this precaution can cause improper module operation or equipment damage.

5. Verify that the rack power supply is properly connected to the PLC.

6. Turn on the PLC and ensure that it powers up properly. See the *Quantum Automation Series Hardware Reference Guide* for more information.

7. Verify that the module ready LED (green) turns on to indicate power to the module and completion of the self-test. If the LED does not turn on, note the blink code as this indicates the fault condition.

8. Ensure that the active LED is illuminated to indicate that the module is communicating with the rack. If not, bus communication has not been established. Be sure the module is properly installed.

9. Check the channel LEDs for any errors.

10. If the module fault LED is red, it indicates a self-test error or fatal hardware error. Refer to the blink code tables for specific fault conditions.

Health Status Test (ModSoft)

1. In ModSoft, access the I/O map screen and ensure that the module description, slot location, and register assignments are correct.

2. Use the I/O map screen to verify that the module is recognized and reported as healthy. If you find an asterisk in front of the module name, the rack does not recognize the module.

Health Status Test (Concept)

1. In Concept, access the I/O configurator and ensure that the module description, slot location, and register assignments are correct.

2. Use the controller status to verify that the module is recognized and reported as healthy. If you find an asterisk in front of the module name, the rack does not recognize the module. To correct the problem, see troubleshooting.

Register Operation Test

1. Check the count rate in the input register for a signal indication. If status bit 14 (counter input state) is set to 0 and status bit 4 (zero rate) is set to 1, no signal is indicated. See " **No Signal Indication**".

2. It is a good idea to ensure that the 4X register and the 3X+3 Status word are set up properly. As a quick check, disable all ladder programming and set the 4X register to 0000 hex.

Troubleshooting

Ready LED Does Not Illuminate

Possible Causes

The most probable reasons for the LED not illuminating are:

- The PLC system is not receiving power from its power supply.
- The module is located in a defective PLC rack slot.
- The module is defective.

Corrective Action

1. Make sure that the PLC is receiving power.

2. Reinstall the module in the rack according to instructions in chapter 2, "Installation and Wiring."

3. If the ready LED still does not illuminate, try it in another PLC rack slot.

4. If you are still unable to start the module, call your local distributor.

Active LED Does Not Illuminate

Possible Causes

The module is not communicating with the PLC rack.

Corrective Action

1. Deinstall the module. See chapter 2, "Installation and Wiring."

2. Place the rack in run mode.

3. Reinstall the module in the rack. See chapter 2, "Installation and Wiring."

Fault LED Does Not Illuminate

Possible Causes

- Module self-test error
- Fatal hardware error

Corrective Action

Contact your local distributor.

Fault LED Blinking Red

Possible Causes

Type of self-test error. Possible codes are indicated in the Diagnostic LEDs section of chapter 1, "Overview."

Corrective Action

Verify module configuration information.

No Signal Indication

There is no indication of a signal in the input register count rate word. If status bit $3x+1$ - $3x+8$ (Bit 14) (counter input state) is high and status bit 4 (rate zero) is high.

Possible Causes

If you have an open collector output or a relay or contact type output, you might require a 1 to10 kohm pull-up / pull-down resistor.

Corrective Action

If necessary, install a pull-down resistor between the channel input and channel common or a pull-up resistor to a positive voltage source.

Module Not Recognized by Rack (ModSoft)

Possible Causes

- Module not correctly installed.
- Module runtime files not correctly installed.

Corrective Action

1. Reinstall the module in the rack. See chapter 2, "Installation and Wiring."

2. Check the I/O map screen in ModSoft to see if the problem still exists.

3. If the module name is still marked with an asterisk (indicating a health status problem), select the module name using the Shift+? key.

4. If the module is not listed at all, reinstall the ModSoft runtime files. See software installation instructions in chapter 3, "Module Configuration."

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Glossary

The following terms and abbreviations are used throughout this manual.

A/D converter – The analog-to-digital converter used in the module. The converter produces a digital value with a magnitude that is proportional to the magnitude of an analog input signal.

attenuation – Reduction in the magnitude of a signal as it passes through a system.

bus connector – A 16-pin male and female connector that provides electrical interconnection among modules in a controller system.

channel – Analog input interface available on the terminal block of a module. Each channel is configured for connection to an input device, and has its own configuration and image input data words.

channel update time – The time required for the module to sample and convert the input signals of one enabled input channel and update the data word.

common mode voltage – Voltage difference between the negative terminal and analog common during normal differential operation.

common mode voltage range – For analog inputs, the largest voltage difference allowed between either the positive or negative terminal and analog common during normal differential operation.

configuration word – Word containing the channel configuration information needed by the module to set up and operate each channel.

cutoff frequency – The frequency at which the input signal is attenuated 3 dB by a digital filter. Frequency components of the input signal that are below the cutoff frequency are passed with under 3 dB of attenuation for low-pass filters.

data word – A 16-bit integer that represents the value of an input channel. The data word is valid only when the channel is enabled and there are no channel errors. When the channel is disabled, the channel data word is cleared (set to 0).

digital filter – A low-pass noise filter incorporated into an A/D converter. The filter provides high-rejection notches at frequencies that are integral multiples of the filter cutoff frequency. The notches are used for rejecting AC power line noise and higher frequency noise.

effective resolution – The number of bits in a channel configuration word that do not vary due to noise.

filter frequency – User-selectable frequency for a digital filter.

full scale – The magnitude of input over which normal operation is permitted.

gain drift – Change in full-scale transition voltage measured over the operating temperature range of the module.

input data scaling – Data scaling that depends on the data format selected for a channel configuration word.

LSW – Least significant word.

module update time – The time required for the module to sample and convert the input signals of all enabled input channels and make the resulting data values available to the processor.

MSW – Most significant word.

multiplexer – A switching system that allows several input signals to share a common A/D converter.

normal operating range – Configured range for input signals.

overall accuracy – The worst-case deviation of the digital representation of the input signal from the ideal over the full input range. Overall accuracy is expressed in percent of full scale.

sampling time – The time required by an A/D converter to sample an input channel.

Specifications

This appendix lists the specifications for the Quantum counter module.

Specification	Value
Data Registers	8 - 3X registers 10 - 4X registers 8 - zoom (parameter) registers
LED Indicators:	
1 Green LED, Module Status	The module status LED indicates the status of the power-up self-test. The LED is on when the module is ready. Any self-test error is indicated with a blink code.
	8 Green LEDs, Channel Status Each channel status LED indicates that the corresponding channel is active.
Terminal Block	40-pin removable connector
Wire Size	One 14 AWG wire or two 22 AWG wires
Backplane Interface	Standard ASIC and dual port memory interface
Compatibility:	
	Hardware All Quantum PLC racks
	SoftwareModSoft, Concept, and ProWorks
Dimensions	Standard slot configuration (using a standard single-slot plastic case, and existing shipping box)
Shipping Weight	300 g (.65 lb)

Environmental Specifications

Environmental testing is in accordance with the standards specified or in accordance with Schneider Alliance IPA2000/3000 or equivalent. For reference see SA IAP 2000, Mechanical Environmental Specifications #043 500021, revision 1.02.

Test Description	Standard	Class/Limit
Mechanical:		
Vibration of Unpackaged Products		IEC 68-2-6 5g at 10-500 Hz per product
Shock of Unpackaged Products Operating		15 g peak acceleration, 11±1 ms pulse width
Non-operating		50 g peak acceleration, 11±1 ms peak width
Temperature/Humidity:		
	Operating Temperature	0 to 60°C (32 to 131 °F), min.
	Storage Temperature	-40 to 85 °C (-40 to 185°F)
	Humidity-Temperature	IEC 68-2-3 0 to 95 percent RH noncondensing at 60 °C
Altitude		2000 meters fully operational
Electrical:		
	Electrostatic Discharge	IEC 801-2
	Surge Transient Susceptibility	
	Radiated EMI Susceptibility	IEC 801-3
	Dielectric Withstand	
	Conducted EMI Susceptibility	
	Conducted Emissions	CISPR 11 Class A

Electrical Fast Transient   IEC 801-4
Radiated Emissions   CISPR 11   Class A
Surge Impulse   IEC 801-5
Conducted Immunity   IEC 801-6
Fast Surge Immunity   EN61000-4-5
Voltage Dropouts (Variation and Dips) EN61000-4-11

Electrical Specifications

Specification	Value			
Configuration	8 channels of differential counter inputs 4 channels of quadrature encoding 8 input enable control lines			
Input Modes	DC counter, AC flow meter			
Voltage Range:	AC 0-75V	5VDC	12VDC	24VDC
VIL[1]	-50 mV	1V	3V	6
VIH	+50 mVpk	3.5V	9V	10.5
Vmax CE	±75Vrms	±75V	±75V	±75V
Current Range	6 mA max. at 75VDC			
Input Impedance	15 kohm			
Counter Speed:				
DC Inputs 5V, 12V, 24V, AC	0 to 50 kHz			
Input Frequency:				
DC Inputs	0 to 50 kHz (count mode)			
AC Inputs	0 to 50 kHz (count mode)			

Counter Enable Input:

VIL   1.0V min.
VIH   3.5V max.
Vmax   45V
Input Impedance   14 kohm

Meter Proving Input:

VIL   1V min.
VIH   3.5V max.
Vmax   45V
Input Impedance   14 kohm

Minimum Pulse Time:		
External Enable/Disable	Enable and disable setup time = 10 us	
Channel Update Time:		
No Scaling	<1 ms per channel, worst case	
Scaling	<1.5 ms per channel	
Accuracy:		
Frequency Mode	±0.8 percent at 50 kHz, +/- 1 Hz Avg. Mode / .01 percent Resolution	
Maximum Count Value	Low range 65 K High range 16 M	
Fault Detection	Over-range and under-range status bits, for all current and voltage modes	
Data Format:		
Counter mode	Maximum binary value 16,777,216	
Frequency mode	Maximum binary value 65,536	
Isolation:		
Channel to Rack	1000VDC continuous, optical and magnetic	
Channel to Channel	0 VDC	

Input Protection	Max. input voltage ±75VDC continuous, 106VAC peak
	Max. input current less than or equal to 6 mA at 75VDC
Power Requirements:	
Internal Rack +5V	Less than 650 mA - 8 channel
	Less than 470 mA - 4 channel

Standards Compliance

The following certifications will be obtained:

- UL 508.
- CUL and Class 1, Division II (CSA equivalent).
- CE compliance with EN 61010-1 and EN 61131-2, EN50081-2, EN50082-2. This allows for the application of the CE mark and will include the low-voltage directive (LVD).

Spectrum Controls Support

If you need technical assistance, please review the information in chapter 5, "Maintenance and Diagnostics." If you still have questions, call your local distributor of Spectrum Controls products.

Note that your module contains electronic components that are susceptible to damage from electrostatic discharge (ESD). An electrostatic charge can accumulate on the surface of ordinary plastic or cushioning material. In the unlikely event that the module should need to be returned to Spectrum Controls, please ensure that it is enclosed in approved ESD packaging (such as static shielding or metallic bag or a black conductive container). Spectrum Controls reserves the right to void the warranty on any unit that is improperly packaged for shipment.

For further assistance, please call the Spectrum Controls Customer Satisfaction department at (425) 746-9481, from 8:00 am to 5:00 pm Pacific Standard Time.

Declaration of Conformity

Declaration of Conformity

Application of Council Directive(s)	89/336/EEC Electromagnetic Compatibility
Standard(s) to which Conformity is Declared	EN50081-2:1993, EN61000-6-2:1999, EN61010-1:1993, EN61131-2:1995
Manfacturer's Name Manfacturer's Address	Spectrum Controls Inc. 2700 Richards Road Southeast Bellevue, Washington 98005 U.S.A.
Importer's Name Importer's Address	Spectrum Controls Inc. 2700 Richards Road Southeast Bellevue, Washington 98005 U.S.A.
Type Of Equipment	Schneider Automation TSX Quantum
Model No.	140 Series

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s)

Date Of Issue: 7/2/02

Place: Bellevue, Washington U.S.A.

(Signature)

Bruce M. Wanta
(Name)

Chairman
(Position)

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