



Absolute Encoder Module

Catalog Number 1771-DE

Introduction

Use this documentation update with the Absolute Encoder Module User Manual, publication 1771-6.5.32 - January 1986. This documentation update revises that user manual. Keep this update with your user manual.

What This Document Contains

For this Information	Refer to Page
Important User Information	2
Updated Information	4
New Write-data Throughput Time	4
Response to External Fault	5
Removing Power Before Installing or Removing the Module	6
Power Requirements	6
Offset Feature	6
Offset Words	9
Block-transfer Write Data with Offset	9
Block-transfer Read Data with Offset	10
Programming Considerations with Offset	12
Specifications	14

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at <http://www.ab.com/manuals/gi>) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc. is prohibited.

Throughout this manual, when necessary we use notes to make you aware of safety considerations.

WARNING

Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
 - avoid a hazard
 - recognize the consequence
-

SHOCK HAZARD

Labels may be located on or inside the equipment (e.g., drive or motor) to alert people that dangerous voltage may be present.

BURN HAZARD

Labels may be located on or inside the equipment (e.g., drive or motor) to alert people that surfaces may be dangerous temperatures.

Environment and Enclosure

ATTENTION

- This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 meters without derating.
- This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.
- This equipment is supplied as "open type" equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

NOTE: See NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure. Also, see the appropriate sections in this publication, as well as the Allen-Bradley publication 1770-4.1 ("Industrial Automation Wiring and Grounding Guidelines"), for additional installation requirements pertaining to this equipment.

Preventing Electronic Discharge

ATTENTION

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
 - Wear an approved grounding wrist strap.
 - Do not touch connectors or pins on component boards.
 - Do not touch circuit components inside the equipment.
 - If available, use a static-safe workstation.
 - When not in use, store the equipment in appropriate static-safe packaging.
-

Updated Information

Add the following information to Chapter 2 in the Compatible Encoders section on page 2-2:

Compatible Encoder Output Drivers

There are three types of compatible encoder output drivers:

- standard TTL or LSTTL gates (7400, 74LS04)
- open collector (7406, 74LS38)
- differential line driver (DM8830, 75ALS192)

These encoders do not cause overcurrent through the optocoupler. When an input is high, the photodiode receives current through the on-board pull-up resistor. When an input is low, the current flowing through the on-board pull-up resistor is shunted away from the photodiode and pulled to ground.

The following sections remain unchanged from the second Documentation Update 1.

New Write-data Throughput Time

Refer to the module specifications on page 2-6. The new write-data throughput time (worst case) is 4.7 ms.

The new write-data throughput time is the time between the end of a block-transfer-write operation and the module update of its outputs. The module's response time can vary, depending on the number of outputs it controls, the type of absolute encoder you use, and if you have an offset value. Use the following table to determine the module's response time in milliseconds for your application.

Type of Encoder (with or without offset)	Number of Outputs			
	2	4	6	8
BCD without offset	1.2	1.8	2.5	3.1
BCD with offset	2.0	2.9	3.8	4.7
Gray code or binary without offset	1.3	2.0	2.6	3.3
Gray code or binary with offset	1.9	2.6	3.4	4.1

Response to External Fault

Add the following paragraphs to Chapter 3, immediately before the section on Keying (page 3-4):

Except for downloading programs or commands and reporting status, the module operates independent of the host processor. In the event of a processor or I/O communications fault, the module either continues operation or its outputs turn off, depending on how you set the last state switch of the chassis in which you place the module.

If you set the last state switch to turn outputs off, the module's outputs are turned off.

If you set the last state switch to hold outputs in last state, the module continues operating.

IMPORTANT

The 1771-DE module is a component of the 1771 I/O system that requires a properly installed system chassis. Refer to publication 1771-IN075 for detailed information on acceptable chassis and proper installation and grounding requirements.

Removing Power Before Installing or Removing the Module

Replace the first warning on page 3-11 with the following:

ATTENTION

Remove power from the 1771 I/O chassis backplane and wiring arm before installing or removing the module.



-
- Failure to remove power from the backplane or wiring arm could cause module damage, degradation of performance or injury
 - Failure to remove power from the backplane could cause injury and/or equipment damage due to possible unexpected operation

Power Requirements

Add this information to page 3-5:

ATTENTION

If multiple power sources are used, do not exceed the specified isolation voltage.



Offset Feature

Offset is a new feature of the Absolute Encoder Module (cat no. 1771-DE, rev. B). Revision A modules do not have this feature.

Offset is the difference between the 0 position of the absolute encoder and the 0 position of the machine shaft to which the encoder is connected. You can program this value to compensate for such factors as machine wear or improper mechanical setup. You do not have to disconnect your equipment to realign the 0 position of the machine shaft with the 0 position of the absolute encoder.

Determining the Offset Value

You can find the offset value using either of two equations, depending on whether you use the 0 machine position or the 0 encoder position as your reference.

To calculate an offset value from a 0 encoder position, use this equation:

$$N - M = S$$

where N = number of encoder positions, M = machine position at encoder 0, and S = offset.

To calculate an offset value from a 0 machine position, use this equation:

$$E - N = S$$

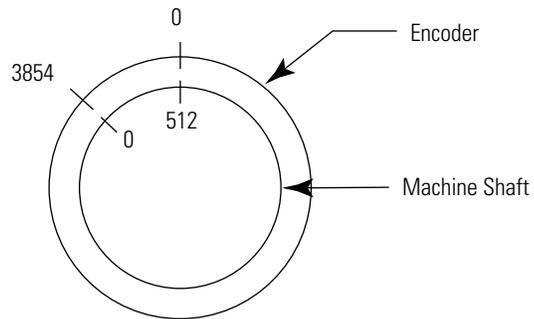
where E = encoder position at machine 0, N = number of encoder positions, and S = offset.

Here is an example of how to find the offset value with reference to 0 encoder position and 0 machine position. Assume the following:

- you have a 0 to 4095-position encoder (4096 positions)
- the machine shaft is at position 512 when the machine is at position 0
- the encoder is at position 3584 when the machine is at position 0

In this example, the 0 machine position is “ahead” of the 0 encoder position. Depending on which equation you use (your reference point), the offset value is either positive or negative.

Offset Value from 0 Encoder Position and from 0 Machine Position



At encoder position 0, machine shaft position is 512.
The offset is +3,584

At machine shaft position 0, encoder position is 3854.
The offset is -512.

13522-M

The equation (from 0 encoder position) is:

$$4096 - 512 = 3584$$

The offset is +3584

The equation (from 0 machine position) is:

$$3584 - 4096 = -512$$

The offset is -512

You get the same result from programming either +3584 or -512.

Offset Words

Once you determine the offset value, you need to program two write-block transfer words. These are the last two words of the write-data block that you send to the absolute encoder module.

Your program them in BCD, as you do the preset values.

Format of Offset Words

17	16	15	14	13	12	11	10	7	6	5	4	3	2	1	0	Bits
S	Offset Value															
No. of encoder positions																

The offset words are the last two words of the write-data block that you send to the absolute encoder module.

If you are controlling:	The offset words are:
2 outputs	words 6 and 7
4 outputs	words 11 and 12
6 outputs	words 16 and 17
8 outputs	words 21 and 22

S = sign bit. Set this bit if the offset has a negative value; reset the bit if the offset has a positive value.

13523-M

The first offset word contains the value of the offset. Bit 17 of this word is the sign bit. It indicates whether the offset is negative or positive. Set bit 17 if the offset is negative; reset it if the offset is positive.

The second offset word is the number of positions of the encoder. If you are using a 0 to 4095-position encoder, your second offset word is 4096.

Block-transfer Write Data with Offset

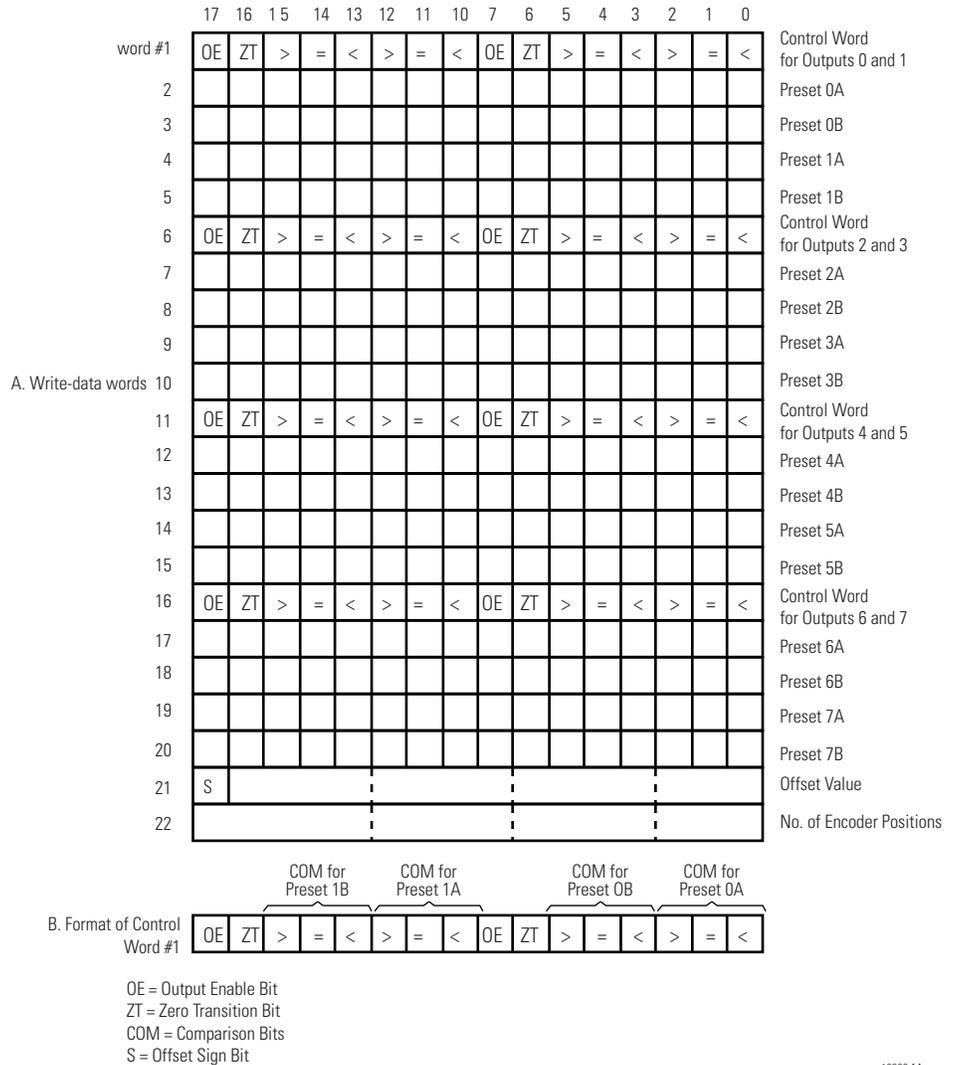
The number of words you send to the module depends on the number of outputs the module controls. The offset feature adds two words to the total number of words you send to the module:

If the module controls:	You send:
2 outputs	7 words
4 outputs	12 words
6 outputs	17 words
8 outputs	22 words

Allen-Bradley PLCs

If the module is controlling eight outputs, your block-transfer write data now looks like this:

Format of Block-transfer Write Data with Offset



12839-M

Block-transfer Read Data with Offset

The upper byte of word 1 indicates the status of the eight outputs controlled by the module. The module sets each bit when the corresponding output is turned on.

The lower byte of word 1 (by bit) is:

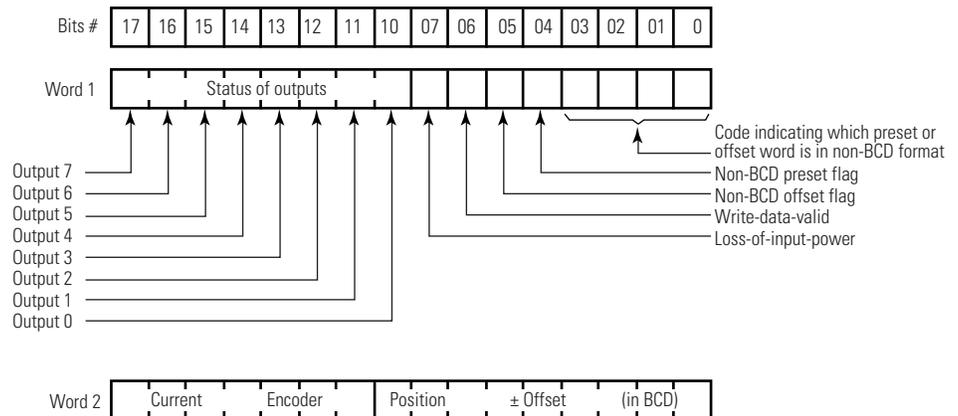
- bit 7 is the loss-of-input-power bit. It is set when input power is lost; it is reset when power is restored and bit 6 is reset

- bit 6 is the write-data-valid bit. It is set at power-up and when the processor changes from program mode to run mode; it is reset when the module receives valid data in a block-transfer write operation
- bit 5 is the non-BCD offset flag. See the description of bit 0 (below) to identify which offset word is in error
- bit 4 is the non-BCD preset flag. It is set when a preset word is in non-BCD format
- bits 3 thru 0 are a binary or hexadecimal code that indicates which preset word is not in BCD format. Refer to Appendix D of the User's Manual for the value of these bits.
- bit 0 identifies which offset word is in non-BCD format when bit 5 is also set
 - if bit 0 is set, the word containing the number of encoder positions is in error
 - if bit 0 is reset, the word containing the offset value is in error

The module identifies each non-BCD word in the order it finds them (one at a time). Once you correct the format of one word, the module continues to identify other non-BCD words.

Word 2 indicated the current position of the encoder, with the offset value in BCD.

Format of Block-transfer Read Data with Offset



13070-M

Programming Considerations with Offset

The default block lengths (00) for block-transfer instructions are 20 block-transfer write words and two block-transfer read words. These are the block lengths that transfer to and from the absolute encoder regardless of whether you use the offset feature.

For example, when you have an offset value and the module is controlling eight outputs, the number of words you send to the module is 22. You must enter the numbers 22 and 2 for the block lengths of write and read data. Do not enter the default block length in your instructions if you use the module's offset feature.

For PLC-2 family processors, do not enable the read-and-write block-transfers in the same scan when you use the offset feature.

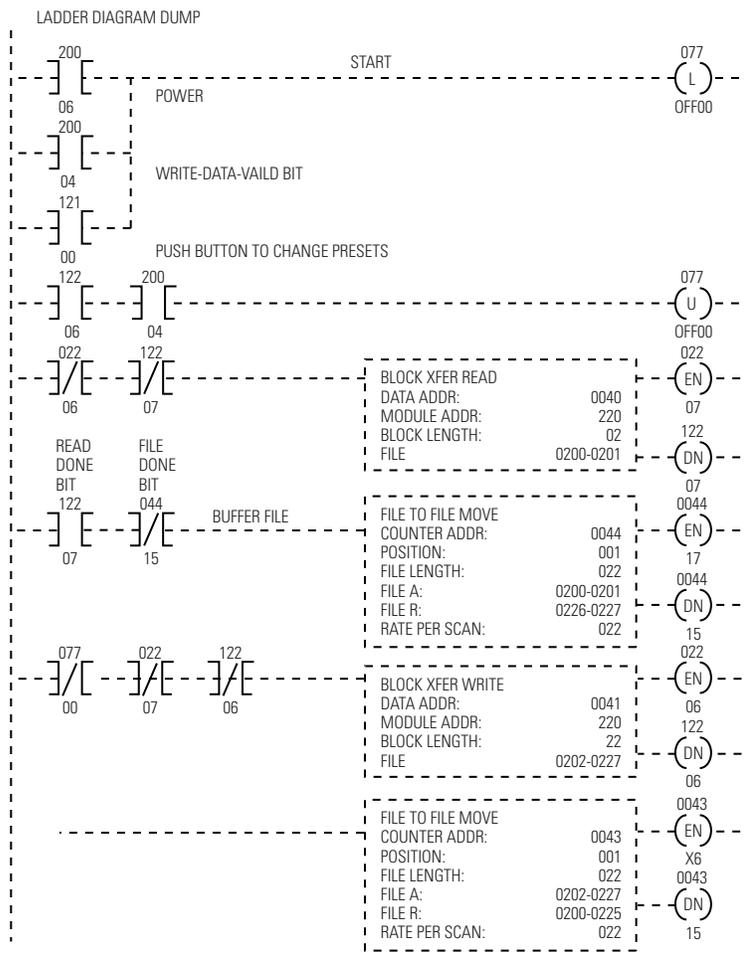
An example program enabling the instruction separate scans follows.

ATTENTION

When the block lengths of bidirectional block-transfer instructions are set to unequal value, do not enable the rung containing the alternate instruction until the done bit of the first transfer is set. If you enable them in the same scan:

- the number of words transferred may not be the number intended
- invalid data could be operated upon in subsequent scans
- output devices could be controlled by invalid data

Unexpected and/or hazardous machine operation could occur. Damage to equipment and/or injury could result.



31160-M

Rung 1	200/06 and 200/04 are returned in the read operation and latch 077/00. When 077/00 is latched, the module toggles between a read operation and a write operation. 121/00 is optional and lets the processor initiate a block-transfer write operation.
Rung 2	This rung examines the write-done bit (122/06) and the valid BCD data bit (200/04) to unlatch 077/00 and begin the read-only operation
Rung 3	This rung contains the block-transfer read instruction, conditioned by the read-done bit and the write-enable bit.
Rung 4	Use a file-to-file move to buffer the read data. Use addresses 0226 and 0227 when making any data comparisons.
Rung 5	This rung contains the block-transfer write instruction, conditioned by the write-done bit and the read-enable bit.
Rung 6	This rung is for display purposes only.

Specifications

Inputs	
Input Power Supply	+5V dc SELV @ 300 mA
Number of Inputs	Up to 12 encoder input bits per module
Input Voltage Range and Logic State	Logic 1: 2.4V to 5.0V dc Logic 0: 0.0V to 0.6V dc
Input Current per Channel (sunk by encoder device)	11 mA for single-ended drivers 18 mA for differential drivers
Backplane Power	5V dc @ 800 mA
Maximum Input Frequency	50 KHz
Encoder Data Settling Time	100 ns
New Position Throughput Time	200µs
New Write-data Throughput Time	3 ms
Encoder Formats	BCD Natural Binary Standard Gray
Digital Resolution	Up to one part in 4,095 with natural binary and standard Gray encoders. Up to one part in 999 with BCD encoders
High-true Logic	From totem pole, open collector, or differential line drivers. Can select direction of rotation of increasing position of Gray encoders
Outputs	
Output Power Supply	Selectable: +5 to +24V dc SELV @ 16A maximum
Number of Outputs	8
Output Ratings	2A sourced per output (no derating with all outputs on)
VA Rating	48W per output 384W per module
Surge Rating	4A for 10ms
Output Fuses	250V 3A rectifier fuses (Littelfuse 322003, Buss GBB003 or equivalent)
General Specifications	
Module Location	Any 1771 I/O chassis; any 2-slot I/O group
Input and Output Isolation	50V - Tested to 850V dc for one second
Keying (for slot 0 only)	Between 2 and 4 Between 26 and 28
Operational Temperature	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): 0-60°C (32–140°F)
Storage Temperature	IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold), IEC 60068-2-2 (Test Bc, Un-packaged Non-operating Dry Heat), IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock): –40 to 85°C (–40 to 185°F)
Relative Humidity	IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat): 5–95% non condensing
Enclosure Type Rating	None (open style)
Specifications continued on next page	

Power Consumption and Dissipation	Source	Nominal Voltage	Max. Current	Power
	Isolated Inputs	5V dc	300mA	1.5W
	Module Circuitry	5V dc	800mA	4W
	Isolated Outputs	0.14V dc	16A	2.24W
	Total on-module			7.74W
Backplane to User Isolation Voltage	50V - Tested to 850Vdc for one second			
Wire Size	22-14AWG			
Wiring Category ¹	2 - on signal ports			
Wire Type	Copper			
Certifications ² (when product is marked)	CE	European Union 89/336/EEC EMC Directive, compliant with: EN 50082-2; Industrial Immunity EN 61326; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions		
	C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions		
¹	Use this Conductor Category information for planning conductor routing. For more information, refer to publication 1770-4.1, Industrial Automation Wiring and Grounding Guidelines.			
²	See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details			

Allen-Bradley PLCs

Rockwell Automation Support

Rockwell Automation provides technical information on the web to assist you in using its products. At <http://support.rockwellautomation.com>, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration and troubleshooting, we offer TechConnect Support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit <http://support.rockwellautomation.com>.

Installation Assistance

If you experience a problem with a hardware module within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your module up and running:

United States	1.440.646.3223 Monday – Friday, 8am – 5pm EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

New Product Satisfaction Return

Rockwell tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned:

United States	Contact your distributor. You must provide a Customer Support case number (see phone number above to obtain one) to your distributor in order to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for return procedure.

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444

Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640

Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846