Installation Instructions

Allen-Bradley

FLEX I/O 2-Channel Incremental Encoder Module

Catalog Numbers 1794-ID2 Series B

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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.rockwellautomation.com/literature/) 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.

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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.
	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 and recognize the consequences.
	SHOCK HAZARD: Labels may be on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment (for example, drive or motor) to alert people that surfaces may reach dangerous temperatures.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

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 60664-1), at altitudes up to 2000 m (6562 ft) without derating.
This equipment is not intended for use in residential environments and may not provide adequate protection to radio communication services in such environments.
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 enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA or be approved for the application if nonmetallic. 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.
In addition to this publication, see:

- Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication 1770-4.1, for additional installation requirements.
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

Prevent Electrostatic 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 wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

European Hazardous Location Approval

The following module is European Zone 2 approved: 1794-ID2 Series B.

The following applies when the product bears the Ex Marking

European Zone 2 Certification (The following applies when the product bears the Ex Marking)
This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC. DEMKO certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in Zone 2 potentially explosive atmospheres, given in Annex II to this Directive.
Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15:2012 and EN 60079-0:2010.

WARNING: Observe the following additional Zone 2 certification requirements:

- This equipment is not resistant to sunlight or other sources of UV radiation.
- This equipment must be installed in an enclosure providing at least IP54 protection when applied in Zone 2 environments.
- This equipment shall be used within its specified ratings defined by Rockwell Automation.
- Provision shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 40% when applied in Zone 2 environments.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

North American Hazardous Location Approval

The following module is North American Hazardous Location approved:
1794-ID2 Series B

The following information applies when operating this equipment in hazardous locations:	**Informations sur l'utilisation de cet équipement en environnements dangereux:**
Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.	Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.
WARNING: EXPLOSION HAZARD • Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. • Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product. • Substitution of components may impair suitability for Class I, Division 2. • If this product contains batteries, they must only be changed in an area known to be nonhazardous.	**WARNING:** RISQUE D'EXPLOSION • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit. • La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2. • S'assurer que l'environnement est classé non dangereux avant de changer les piles.

ATTENTION: Personnel responsible for the application of safety-related programmable electronic systems (PES) shall be aware of the safety requirements in the application of the system and shall be trained in using the system.

ATTENTION: FLEX I/O systems are grounded through the DIN rail to chassis ground. Use zinc plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (for example, aluminum or plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding. Secure DIN rail to mounting surface approximately every 200 mm (7.8 in.) and use end-anchors appropriately.

ATTENTION: Do not remove or replace a Terminal Base unit while power is applied. Interruption of the backplane can result in unintentional operation or machine motion.

ATTENTION: For Class I Division 2 applications, use only Class I Division 2 listed or recognized accessories and modules approved for use within the 1794 platform.

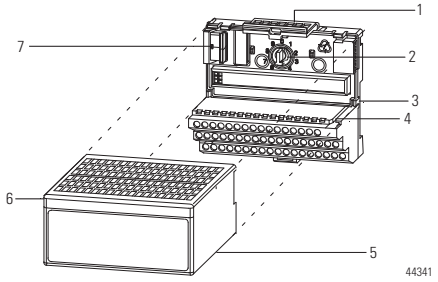
ATTENTION: If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

WARNING: When used in a Class I, Division 2, hazardous location, this equipment must be mounted in a suitable enclosure with proper wiring method that complies with the governing electrical codes.

WARNING: If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

Install the Module

Read this for information about how to install the module, which mounts on a 1794-TB3 or 1794-TB3S terminal base.



Module Description

	Description		Description
1	Latching mechanism	5	Alignment bar
2	Keyswitch	6	Module
3	Terminal base	7	FlexBus connector
4	Groove		

ATTENTION: During mounting of all devices, be sure that all debris (such as metal chips or wire strands) is kept from falling into the module. Debris that falls into the module could cause damage on powerup.

To install the module on a 1794 terminal base, refer to the figure and complete the following.

1. Rotate the keyswitch (2) on the terminal base (3) clockwise to position 1 as required for this type of module.
2. Make sure the flexbus connector (7) is pushed all the way to the left to connect with the neighboring terminal base or adapter.

ATTENTION: You cannot install the module unless the connector is fully extended.

3. Make sure the pins on the bottom of the module are straight so they align properly with the connector in the terminal base.

WARNING: If you remove or insert the module while the backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

4. Position the module (6) with its alignment bar (5) aligned with the groove (4) on the terminal base.
5. Press firmly and evenly to seat the module in the terminal base unit, noting that the module is seated when the latching mechanism (1) is locked into the module. Remove debris wrapper before applying power to the module.

Wire the Module

1794-TB3 and 1794-TB3S Terminal Base Wiring

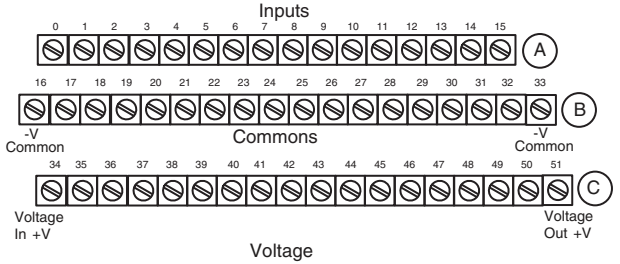
WARNING: If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

To connect wiring for 1794-TB3 and 1794-TB3S bases, refer to the tables and figure and complete the following.

1. Connect individual input wiring (A+, A-, B+, B-, Z+, Z-, G+, G-) for each channel to numbered terminals on the 0...15 row (A) as indicated in the table below.
2. If applicable, connect the encoder commons to any terminal on the 16...33 row (B) for each input as indicated.

ATTENTION: To reduce susceptibility to noise, power analog modules and digital modules from separate power supplies. Do not exceed a length of 3 m (9.8 ft) for DC power cabling.

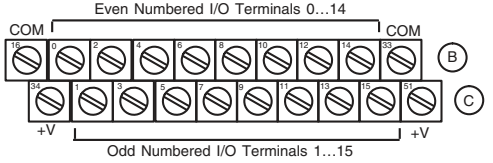
3. Connect any signal wiring shields to functional ground as near as possible to the module.
4. When powering the encoder from the 1794-ID2 module, connect the encoder power lead to any terminal on the 34...51 row (C).
5. Connect +V DC power to terminal 34 on the 34...51 row (C).
6. Connec DC return to terminal 16 on the 16...33 (B).
7. If daischaining power to the next terminal base, connect a jumper from terminal 51 (+V DC) on this base unit to terminal 34 on the next base unit.
8. If continuing DC common to the next base unit, connect a jumper from terminal 33 (common) on this base unit to terminal 16 on the next base unit.



-V (Supply Common) = Terminals B-16 and B-33
+V (Supply +Voltage) = Terminals C-34 and C-51
(Use B-33 and C-51 for daisy-chaining to next terminal base unit.)

(1794-TB3 shown)

1794-TBN Terminal Base Wiring



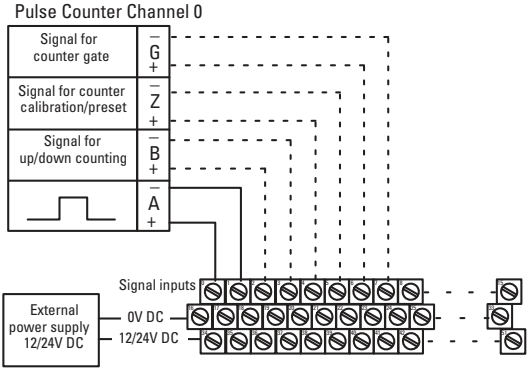
+V = Terminals C-34 and C-51
COM (-V) = Terminals B-16 and B-33

Wiring Connections for 1794-ID2

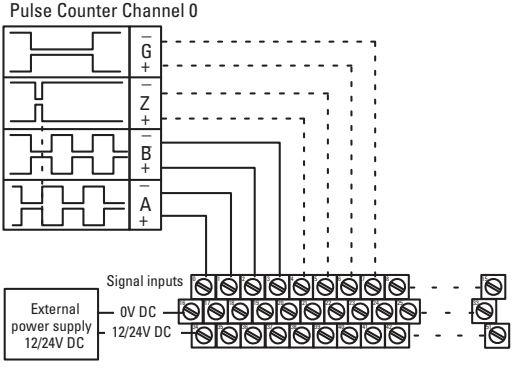
Signal Name	1794-TB3, 1794-TB3S			1794-TBN[1]
	Signal	0V DC COM	12/24V DC	Signal
Channel 0				
A+	A-0	B-17	C-35	B-0
A-	A-1	B-18	C-36	C-1
B+	A-2	B-19	C-37	B-2
B-	A-3	B-20	C-38	C-3
Z+	A-4	B-21	C-39	B-4
Z-	A-5	B-22	C-40	C-5
G+	A-6	B-23	C-41	B-6
G-	A-7	B-24	C-42	C-7
Channel 1				
A+	A-8	B-25	C-43	B-8
A-	A-9	B-26	C-44	C-9
B+	A-10	B-27	C-45	B-10
B-	A-11	B-28	C-46	C-11
Z+	A-12	B-29	C-47	B-12
Z-	A-13	B-30	C-48	C-13
G+	A-14	B-31	C-49	B-14
G-	A-15	B-32	C-50	C-15
0V DC COM	Terminals 16…33 (1794-TB3, 1794-TB3S)			Terminals 16 and 33
12/24V DC	Terminals 34…51 (1794-TB3, 1794-TB3S)			Terminals 34 and 51

1 Auxiliary terminal blocks are required when using these terminal base units.

Example of Incremental Encoder Wiring



Example of pulse transmitter with 1 pulse train. For connection of channel 1, refer to connection diagram. To reduce noise, connect negative input to 0V DC terminal.
Note: Dotted lines indicate signals not always used.



Example of incremental encoder with 2 pulse trains, with or without reference, and/or gate function. For connection of channel 1, refer to connection diagram.
Note: Dotted lines indicate signals not always used.

Input (read) Image for 1794-ID2

Dec.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Oct.	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	CT DIR 1	CT DIR 0	PR 1	PR 0	S1	S0	C1	C0	G 1	Z 1	B 1	A 1	G 0	Z 0	B 0	A 0
1	Channel 0 – Stored counter value of channel 0															
2	Channel 1 – Stored counter value of channel 1															
3	Channel 0 – Current counter value															
4	Channel 1 – Current counter value															
5	Channel 0 – Counter word readback															
6	Channel 1 – Counter word readback															
7	Revision read – software version code															

Where A0 = Status of input A, channel 0 - bit = 1 when input is on
B0 = Status of input B, channel 0 - bit = 1 when input is on
Z0 = Status of input Z, channel 0 - bit = 1 when input is on
G0 = Status of input G, channel 0 - bit = 1 when input is on
A1= Status of input A, channel 1 - bit = 1 when input is on
B1 = Status of input B, channel 1 - bit = 1 when input is on
Z1 = Status of input Z, channel 1 - bit = 1 when input is on
G1 = Status of input G, channel 1 - bit = 1 when input is on
C0 = Cal 0 - when bit is set, counter 0 has been calibrated (reset by CalReset)
C1 = Cal 1 - when bit is set, counter 1 has been calibrated (reset by CalReset)
S0 = Stored 0 - when bit is set, counter 0 value has been saved in Store 0 (reset by StoreReset)
S1 = Stored 1 - when bit is set, counter 1 value has been saved in Store 0 (reset by StoreReset)
Once a store has occurs, L0 and L1 are on until cleared by StoreReset (counter word bit 14)
PR0 = Preset 0 reached - when bit is set, counter 0 has reached value of preset (reset by PresetReset)
PR1 = Preset 1 reached - when bit is set, counter 1 has reached value of preset (reset by PresetReset)
CT DIR 0 = Increase/Decrease counter value for counter 0: set to 0 at startup. 0 = last pulse decreased
counter value; 1 = last pulse increased counter value
CT DIR 1 = Increase/Decrease counter value for counter 1: set to 0 at startup. 0 = last pulse decreased
counter value; 1 = last pulse increased counter value

Output/Configuration Image for 1794-ID2

Dec.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Oct.	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	**Control Word 0** – Channel 0 – Sets the function of counter 0															
1	**Control Word 1** – Channel 1 – Sets the function of counter 1															
2	Channel 0 Preset – Value to load or compare with counter 0															
3	Channel 1 Preset – Value to load or compare with counter 1															
4	**Control Word 2** - Filter Function Control Word – Enables filter, and sets filter constant															
5…6	Reserved															

Description of Control Words 0 and 1

Bit	Description			
00…02	02	01	00	Mode Selection Bits
	0	0	0	Counting on positive (rising) edge of input signal A. (Up/dwn counting determined by B.)
	0	0	1	Quadrature encoder X1
	0	1	0	Quadrature encoder X2
	0	1	1	Quadrature encoder X4
	1	0	0	Counting up on positive edge of input signal A, and counting down on positive edge of input signal B.
	1	0	1	No count function
	1	1	0	
	1	1	1	
03	**Preset (Reset) bit –** A positive edge on this bit moves the value in Preset X to Counter X, independent of Preset Enable. **Note:** To use Preset as a Reset, use a count value of 0000 in the Preset Value word.			
04	**Enable Z Preset (Reset) bit –** When this bit is set (1), a positive edge on Z preloads Counter X = Preset X, independent of Cal Enable. **Note:** If Z is configured to do Store and Preset (Reset), the Store will occur first.			
05	**Count Enable bit –** When this bit is set (1), the pulse counter is enabled.			
Calibration Control Bits 06-08				
06	**Enable bit –** When this bit is set (1), the pulse counter can be calibrated.			
07	**Direction bit –** When this bit is set (1), calibration is performed in a negative direction; when reset (0), calibration is performed in a positive direction.			
08	**Reset bit –** Calibration is acknowledged and a new calibration is enabled on a positive edge on this bit.			

Description of Control Words 0 and 1

Bit	Description		
09…10	10	09	Gate Control Bits
	0	0	No gate function on input G
	0	1	Counting only if G is high (active)
	1	0	Counting only if G is low (inactive)
	1	1	The counter can be calibrated when G is high (active)
11…12	12	11	**Store Control Bits** – These bits will trigger a Store only if the channel Store status bit (S0 or S1) are cleared (0).
	0	0	Save counter value on positive edge of Z (if S0 or S1 = 0)
	0	1	Save counter value on positive edge of G (if S0 or S1 = 0)
	1	0	Save counter value on negative edge of G (if S0 or S1 = 0)
	1	1	Save the counter value on the positive edge and negative edge of G (if S0 or S1 = 0)
13	Rollover bit – When set (1), the counter counts up to the preset and then restarts at 0. If this bit is reset (0) (not rollover), the rollover preset value is FFFF hex = 65535 decimal		
14	Store Reset bit – A positive edge on this bit resets the channel Store status bit (S0 or S1).		
15	Preset Reset bit – A positive edge on this bit resets the Preset Reached (PR0 or PR1).		

Decription of Control Word 2

Bit	Description		
00	**Filter A0 Enable bit** – When this bit is set (1), and counter 0 is in mode 000 (Pulse counting), signal A0 is filtered by a digital low pass filter with selectable constant.		
01	**Filter A1 Enable bit** – When this bit is set (1), and counter 1 is in mode 000 (Pulse counting), signal A1 is filtered by a digital low pass filter with selectable constant.		
02…07	Reserved – set to 0		
08…09	09	08	**Filter Constant Bits** – This constant is common to both counters
	0	0	73.5 kHz or min 0.007 ms pulsewidth
	0	1	37.8 kHz or min 0.013 ms pulsewidth
	1	0	12.8 kHz or min 0.04 ms pulsewidth
	1	1	1.2 kHz or min 0.4 ms pulsewidth
10…15	Reserved – set to 0		

Specifications

General Specification

Attribute	Value
Number of inputs	2
Number of inputs per counter	4 (A, B, Z, and G)
Recommended terminal base unit	1794-TB3, 1794-TB3S, 1794-TBN, 1794-TBKD, 1794-TB37DS
Input pulse width, min	Each signal condition must be stable for at least 2 µs to be recognized
Counting frequency, max	100 kHz
On-state voltage, min	6V DC
On-state voltage, max	26.4V DC (24V DC ±10%)
On-state current, min	3 mA @ 6V DC
On-state current, nom	9 mA @ 12V DC
On-state current, max	15 mA @ 24V DC
Off-state voltage, min	-26.4V DC
Off-state voltage, max	3V DC
Isolation voltage	Tested @ 500V AC for 60 s
FlexBus current	5 mA @ 5V DC
Power dissipation, max	5 W @ 26.4V DC
Thermal dissipation, max	17.1 BTU/hr @ 26.4V DC
Terminal base screw torque	Determined by installed terminal base
Dimensions, HxWxD (with module installed)	46 x 94 x 53 mm (1.8 x 3.7 x 2.1 in.)
Indicators (field side indication, customer device driven)	1 green/red power/status indicator 12 yellow status indicators
External power supply voltage	12…24V DC (±10%)
External power supply current	150 mA @ 12V DC 75 mA @ 24V DC
North American temperature code	T4

General Specification

Keyswitch position	1
Enclosure type rating	None (open-style)
Input conductors, wire	Belden 8761, 304.8 m (1000 ft.)
Wiring category[1]	2

(1) Use this conductor category information for planning conductor routing as described in Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications

Attribute	Value
Temperature, operating	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…55 °C (32…131 °F) **Note:** Do not connect maximum input voltage simultaneously to all inputs if the module ambient temperature is expected to exceed 40 °C.
Temperature, nonoperating	IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock): -40…85 °C (-40…185 °F)
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Damp Heat) 5…95% noncondensing
Vibration	IEC 60068-2-6 (Test Fc, Operating): 5 g @ 10…500 Hz
Shock, operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 30 g
Shock, nonoperating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 50 g
Emissions	CISPR 11 (IEC 61000-6-4): Class A (with appropriate enclosure)
ESD immunity	IEC 61000-4-2: 6 kV contact discharges 8 kV air discharges
Radiated RF immunity	IEC 61000-4-3: 10 V/m with 1 kHz sine-wave 80%AM from 30 MHz…1000 MHz

Environmental Specifications

Attribute	Value
EFT/B immunity	IEC 61000-4-4: ±2 kV @ 5 kHz on signal ports
Surge transient immunity	IEC 61000-4-5: ±2 kV line-earth(CM) on shielded ports
Conducted RF immunity	IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz

Certifications

Certification (when product is marked)[1]	Value
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E193170.
CE	European Union 2004/108/EC EMC Directive, compliant with: EN 61326-1; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
EAC	Russian Customs Union TR CU 020/2011 EMC Technical Regulation
RCM	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions

(1) See the product certifications link at http://www.rockwellautomation.com/products/certification/ for Declarations of Conformity, Certificates, and other certification details.

Notes:

Notes:

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support/, 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://www.rockwellautomation.com/support/.

Installation Assistance

If you experience a problem 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 product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation 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, follow these procedures.

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

Documentation Feedback

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