



# Installation Instructions

## FLEX I/O Digital Input and Output Modules w/Diagnostics

1794-IB16D and 1794-OB16D

### 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.

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Throughout this manual 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

#### ATTENTION



#### Environment and Enclosure

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.

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.

#### WARNING



When you insert or remove the module while 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.

#### ATTENTION



FLEX I/O is 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 (e.g. aluminum, plastic, etc.) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding.

### North American Hazardous Location Approval

The following modules are North American Hazardous Location approved: 1794-IB16D and 1794-OB16D.

#### The following information applies when operating this equipment in hazardous locations:

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.

#### Informations sur l'utilisation de cet équipement en environnements dangereux :

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.

#### AVERTISSEMENT



#### 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

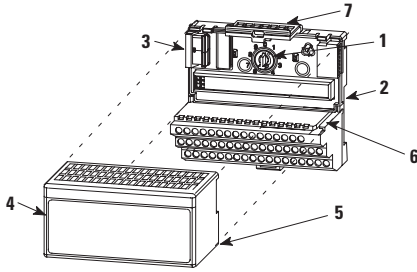


#### Preventing Electrostatic Discharge

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.
- If available, use a static-safe workstation.

## Installing Your Digital Input or Output Module



**ATTENTION**



During mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage on power up.

The input module mounts on a 1794-TB32 or -TB32S terminal base. The output module mounts on a 1794-TB2, -TB3 or -TB3S terminal base.

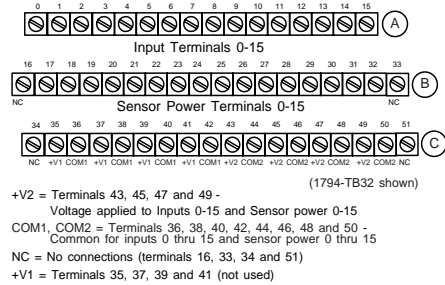
1. Rotate the keyswitch (1) on the terminal base (2) clockwise to position 2 as required for this type of module.
2. Make certain the flexbus connector (3) is pushed all the way to the left to connect with the neighboring termbase/adaptor. You cannot install the module unless the connector is fully extended.
3. Make sure the pins on the bottom of the module are straight so they will align properly with the connector in the terminal base.
4. Position the module (4) with its alignment bar (5) aligned with the groove (6) on the terminal base.
5. Press firmly and evenly to seat the module in the terminal base unit. The module is seated when the latching mechanism (7) is locked into the module.

### Connecting Wiring for the 1794-IB16D (using 1794-TB32 or -TB32S terminal base)

1. Connect individual input wiring (IN00-IN15) to terminals 0 thru 15 on the 0-15 row (A) as indicated in the table below.
2. Connect individual Sensor Power wiring (sensor power 0 thru 15) to terminals 17 thru 32 on the 16-33 row (B) as indicated in the table below. **Do not connect to terminals 16 or 33.**
3. Connect the associated +V2 dc power lead of the input device to the corresponding terminal on the 34-51 row (C) for each input as indicated in the table below. (The +V2 power terminals of row (C) are internally connected together.)
4. Connect the associated input common (3-wire devices only) to the corresponding terminal on the 34-51 row (C) for each input as indicated in the table below. (Commons are internally connected together.)
5. Connect +V dc power to pin 43 (+V) on the 34-51 row (C).
6. Connect -V dc common to pin 44 (COM2) on the 34-51 row (C).
7. If daisy chaining input wiring power to the next terminal base, connect a jumper from terminal 49 (+V dc) on this base unit to the power terminal on the next base unit (refer to the installation instructions for the next terminal base unit).

8. If continuing input wiring common to the next base unit, connect a jumper from terminal 50 (common) on this base unit to the common terminal on the next base unit (refer to the installation instructions for the next terminal base unit).

### 1794-TB32 and -TB32S Terminal Base Wiring for the 1794-IB16D



### Wiring for 1794-IB16D (use with 1794-TB32 or -TB32S terminal base units)

Input	Input Terminal	Sensor Power Terminal	Common	Supply <sup>1</sup>
IN 00	A-0	B-17	-V common connected to terminals 36, 38, 40, 42, 44, 46, 48 and 50	+V2 connected to terminals 43, 45, 47 and 49
IN 01	A-1	B-18		
IN 02	A-2	B-19		
IN 03	A-3	B-20		
IN 04	A-4	B-21		
IN 05	A-5	B-22		
IN 06	A-6	B-23		
IN 07	A-7	B-24		
IN 08	A-8	B-25		
IN 09	A-9	B-26		
IN 10	A-10	B-27		
IN 11	A-11	B-28		
IN 12	A-12	B-29		
IN 13	A-13	B-30		
IN 14	A-14	B-31		
IN 15	A-15	B-32		
+V2 dc power	Power terminals 43, 45, 47 and 49 (power terminals are internally connected together in the module)			
COM dc Return	Common terminals 36, 38, 40, 42, 44, 46, 48 and 50 (common terminals are internally connected together in the module)			

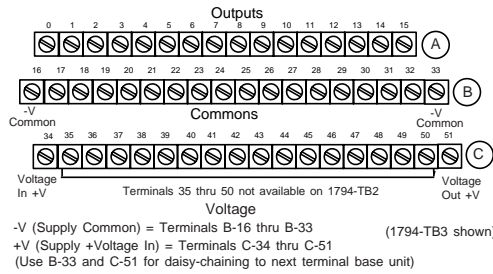
<sup>1</sup> 3-wire devices only. 2-wire devices use input and sensor power terminals; 3-wire devices use input, sensor power and common terminals.

### Connecting Wiring for the 1794-OB16D (using 1794-TB2, -TB3 or -TB3S terminal base)

1. Connect individual output wiring to numbered terminals on the 0-15 row (A) as indicated in the table below.
2. Connect the associated common for each output to the corresponding terminal on the 16-33 row (B) as indicated in the table below. (The common terminals of row (B) are internally connected together.)
3. Connect +V dc power to terminal 34 on the 34-51 row (C). (The power terminals of row (C) are internally connected together.)
4. Connect dc common (COM) to terminal 16 on the 16-33 row (B).
5. If daisy chaining 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.

- 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

**1794-TB2, -TB3, and -TB3S Terminal Base Wiring for the 1794-OB16D**



**Wiring Connections for the 1794-OB16D (use with 1794-TB2, -TB3 or -TB3S terminal base units).**

Outputs	Output Terminal	Common Terminal
Output 00	A-0	B-17
Output 01	A-1	B-18
Output 02	A-2	B-19
Output 03	A-3	B-20
Output 04	A-4	B-21
Output 05	A-5	B-22
Output 06	A-6	B-23
Output 07	A-7	B-24
Output 08	A-8	B-25
Output 09	A-9	B-26
Output 10	A-10	B-27
Output 11	A-11	B-28
Output 12	A-12	B-29
Output 13	A-13	B-30
Output 14	A-14	B-31
Output 15	A-15	B-32
+V dc	C-34 and C-51 (1794-TB2) (Power Terminals are internally connected in the terminal base unit. C-34 thru C-51 (1794-TB3, -TB3S) (Power terminals are internally connected in the terminal base unit.	
Common	B-16 thru B-33 (Common terminals are internally connected in the terminal base unit.	

**Diagnostics**

(See configuration information below for location of diagnostic bits.)  
**Note:** Each unused sensor port requires a dummy resistor to mask the channel diagnostic function.

**Diagnostic Functions for the 1794-IB16D)**

Ext. Power	Wiring	Input Status	Channel LED Status	Open Wire Error Bit	Short Error Bit	Rev. Error Bit	Module Error Bit/LED
OFF	Open	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
	Short	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
	Normal	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
ON	Open	Off	RED	1	0	0	1/RED
		On	RED/YEL	1	0	0	1/RED
	Short	Off	RED	0	1	0	1/RED
		On	RED/YEL	0	1	0	1/RED
	Normal	Off	Off	0	0	0	0/OFF
		On	YEL	0	0	0	0/OFF
REV	Open	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED
	Short	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED
	Normal	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED

The module monitors each sensor-power port for current and voltage. It turns on the channel red LED and sets (1) the error bit when 1) the module detects a short circuit (no voltage at the sensor-port), and 2) the module detects an open wire ( no current at the sensor-port).

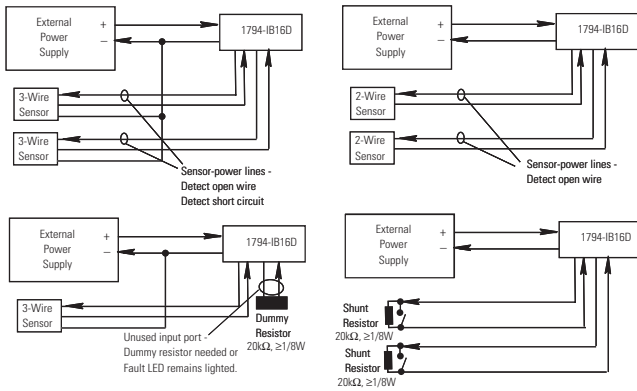
**Diagnostic Functions for the 1794-OB16D**

**Note:** Each unused output port requires a dummy resistor to mask the channel diagnostic function.

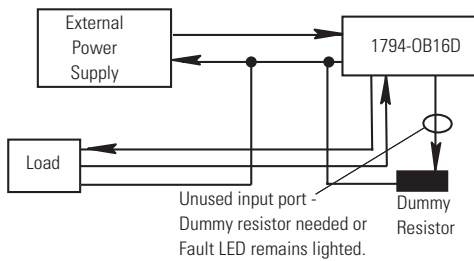
Ext. Power	Wiring	Output Status	Channel LED Status	Open Wire Error Bit	Short Error Bit	Rev. Error Bit	Module Error Bit/LED
OFF	Open	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
	Short	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
	Normal	Off	Off	0	0	0	0/OFF
		On	Off	0	0	0	0/OFF
ON	Open	Off	RED	1	0	0	1/RED
		On	YEL	0	0	0	0/OFF
	Short	Off	Off	0	0	0	0/OFF
		On	RED	0	1	0	1/RED
	Normal	Off	Off	0	0	0	0/OFF
		On	YEL	0	0	0	0/OFF
REV	Open	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED
	Short	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED
	Normal	Off	Off	0	0	1	1/RED
		On	Off	0	0	1	1/RED

The module monitors each output channel. It turns on the channel red LED and sets (1) the error bit when 1) the module detects a short circuit (the output signal is active at a channel and the corresponding output voltage is low), and 2) the module detects an open wire (the output signal is inactive at a channel and the corresponding output voltage is high).

### Sensor Diagram for the 1794-IB16D



### Sensor Diagram for the 1794-OB16D



## Configuration

### Configuring Your 1794-IB16D Input Module

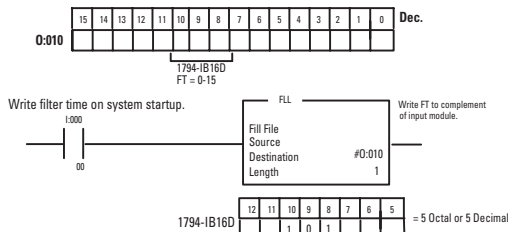
Configure your input module by setting bits in the configuration word (word 3). This module is compatible with the Remote I/O network (with 1794-ASB series E or later), DeviceNet network, and the ControlNet network. (**Note:** You must use the Module Connection when used in a ControlNet system.)

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
Read 1																
Read 2																
Write 3	Not used				Input Filter FT 0-15				Not used				Read Diagnostics Status			

Where I = Input  
 FT = Input filter time  
 Diagnostic status:  
 Bit 00 = module error;  
 Bit 01 = external power reverse polarity error;  
 Bit 02 = sensor power short error;  
 Bit 03 = sensor power open wire error

### Setting the Input Filter Time

To set the input filter time, set the associated bits in the output image (complementary word) for the module.



Bits			Description	Filter Time
10	09	08	Filter time for inputs 0 thru 15	Off to On/ On to Off
0	0	0	Filter time 0 (default)	0.25ms
0	0	1	Filter time 1	0.5ms
0	1	0	Filter time 2	1ms
0	1	1	Filter time 3	2ms
1	0	0	Filter time 4	4ms
1	0	1	Filter time 5	8ms
1	1	0	Filter time 6	16ms
1	1	1	Filter time 7	32ms

### Configuring Your 1794-OB16D Output Module

Configure your output module by setting bits in the configuration word (word 3). This module is compatibility with the Remote I/O network (with 1794-ASB series D or later), DeviceNet network, and the ControlNet network. (**Note:** You can use the Module Connection or Rack Connection when used in a ControlNet system.)

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
Read 1	Not used												Read Diagnostics Status			
Write 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Where 0 = Output  
 Diagnostic status:  
 Bit 00 = module error;  
 Bit 01 = external power reverse polarity error;  
 Bit 02 = output short error;  
 Bit 03 = output open wire error

## Specifications

### Specifications - 16 Input Module w/Diagnostics, 1794-IB16D

Meets IEC 3 24V dc input specifications

Number of Inputs	16 (1 group of 16), group isolation
Module Location	Cat. No. 1794-IB32, -TB32S
On-state Voltage	10V dc minimum 24V dc nominal 31.2V dc maximum
On-state Current	2.0mA minimum at 10V dc 8.2mA nominal at 24V dc 12.1mA maximum at 31.2V dc (See Derating Curve)
Off-state Voltage	5.0V dc maximum
Off-state Current	1.5mA minimum
Input Impedance	3.1K ohms
Indicators (field side indication, customer device driven)	16 yellow ON/OFF status indicators (field side) 16 red diagnostic status indicators (each channel, field side) 1 red module fault indicator (field side)
Input Filter Time Off to On On to Off	0.25ms, 0.5ms, 1ms, 2ms, 4ms, 8ms, 16ms, 32ms 0.25ms, 0.5ms, 1ms, 2ms, 4ms, 8ms, 16ms, 32ms 0.25ms default - Selectable using configuration word 3
Isolation Voltage	Tested at 2121V dc for 1s between user and system No isolation between individual channels
Power Dissipation	8.5W maximum @ 31.2V dc
Thermal Dissipation	Maximum 29 BTU/hr @ 31.2V dc
Sensor Power Voltage Drop Power Current Power Line Short Detect Circuit Open Wire Detect	2.2V dc maximum 50mA maximum 1.0A minimum (in 10s) 50µA maximum
Detect Reverse Polarity Voltage	Minimum 10V: Module must detect if the reverse polarity external power supply voltage is greater than the value.
Flexbus Current	30mA

### Specifications - 16 Output Module w/Diagnostics 1794-OB16D

Meets IEC 0.5A 24V dc Output Specifications

Number of Outputs	16 (1 group of 16), group isolation
Module Location	Cat. No. 1794-TB2, -TB3, -TB3S
Output Voltage	10V dc minimum 24V dc nominal 31.2V dc maximum
On-state Current	2.0mA minimum per output 0.5A per output, 8A per module maximum
Output Current Rating	8.0A (16 outputs @ 0.5A)
Surge Current	2A for 50ms, repeatable every 2s
Off-state Voltage	31.2V dc maximum
Off-state Leakage	0.5mA maximum
On-state Voltage Drop	0.5V dc at 0.5A
Isolation Voltage	Tested at 2121V dc for 1s between user and system No isolation between individual channels
Indicators (field side indication, customer device driven)	16 yellow on/off status indicators (field side) 16 red diagnostic status indicators (each channel, field side) 1 red module fault indicator (field side)
Flexbus Current	60mA
Power Dissipation	4.8W maximum @ 31.2V dc
Thermal Dissipation	Maximum 16.4 BTU/hr @ 31.2V dc
Short Circuit Protect and Detection	Thermal shutdown (auto reset) Detection condition: when external power active, output signal active, and output port voltage less than 2V.
Open Wire Detect off-state leakage current	0.1mA - When external power active and output signal inactive.
Detect Reverse Polarity Voltage	10V minimum: Module must detect if the reverse polarity external power supply voltage is greater than the value.

### General Specifications

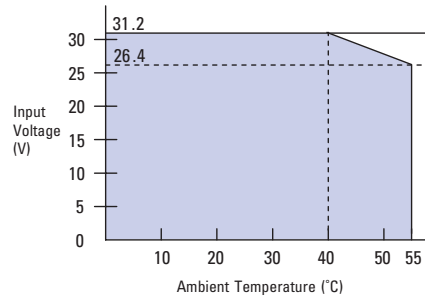
Module Keying	Position 2
Terminal Base Screw Torque	7 pound-inches (0.8Nm)
Dimensions (with module installed)	1.8H x 3.7W x 2.1D inches 45.7H x 94.0W x 53.3D mm
External dc power Supply voltage Voltage range	24V dc nominal 10.0 to 31.2V dc (includes 5% ac ripple)
Environmental Conditions	
Operating Temperature	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 to 55°C (32 to 131°F)
Storage Temperature	IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold), IEC 60068-2-2 (Test Bb, 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 to 95% non-condensing
Vibration	IEC60068-2-6 (Test Fc, Operating): 5g @ 10-500Hz
Shock	IEC60068-2-27 (Test Ea, Unpackaged shock) Operating 30g Non-operating 50g
Emissions	CISPR 11: Group 1, Class A (with appropriate enclosure)
ESD Immunity	IEC 61000-4-2: 6kV contact discharges 8kV air discharges
Radiated RF Immunity	IEC 61000-4-3: 10V/m with 1kHz sine-wave 80%AM from 80MHz to 2000MHz 10V/m with 200Hz 50% Pulse 100%AM at 900MHz 10V/m with 200Hz 50% Pulse 100%AM at 1890MHz

EFT/B Immunity	IEC 61000-4-4: ±2kV at 5kHz on signal ports ±2kV at 5kHz on power ports
Surge Transient Immunity	IEC 61000-4-5: ±1kV line-line(DM) and ±2kV line-earth(CM) on signal ports ±1kV line-line(DM) and ±2kV line-earth(CM) on power ports
Conducted RF Immunity	IEC 61000-4-6: 10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz
Enclosure Type Rating	None (open-style)
Conductors Wire Size Category <sup>1</sup>	12AWG (4mm <sup>2</sup> ) stranded copper wire rated at 75°C or higher 3/64 inch (1.2mm) insulation maximum 2
Certifications (when product is marked) <sup>2</sup>	<b>cULus</b> UL Listed Industrial Control Equipment, certified for US and Canada <b>cULus</b> UL Listed for Class I, Division 2, Groups A, B, C and D Hazardous locations certified for US and Canada <b>CSA</b> CSA certified for Class I, Division 2, Groups A, B, C and D Hazardous locations <b>CE<sup>2</sup></b> European Union 89/336/EEC EMC Directive, compliant with: EN 61000-6-4; Industrial Emissions EN 50082-2; Industrial Immunity EN 61326; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity <b>C-Tick<sup>2</sup></b> - Australian Radiocommunications Act compliant with AS/NZS CISPR 11, Industrial Emissions

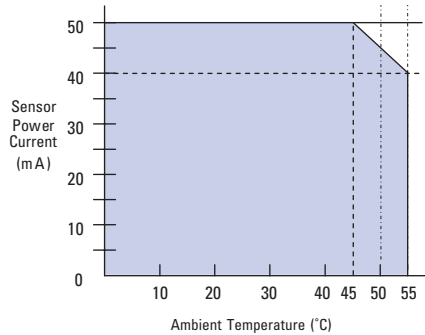
1 You use this category information for planning conductor routing as described in Allen-Bradley publication 1770-4.1, Industrial Automation Wiring and Grounding Guidelines.

2 For the latest up-to-date information, see the Product Certification link at [www.ab.com](http://www.ab.com) for Declarations of Conformity, Certificates and other certification details. For notification of any additional release notes, refer to [www.ab.com/manuals/](http://www.ab.com/manuals/).

### Derating Curves 1794-IB16D Input Voltage



### Sensor Power



[www.rockwellautomation.com](http://www.rockwellautomation.com)

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