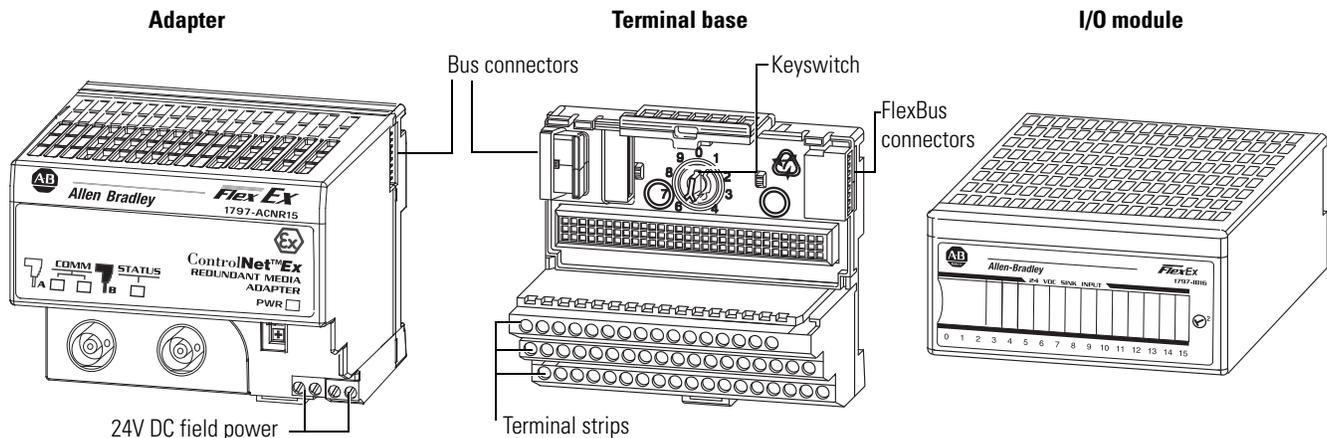


About the FLEX Ex I/O Systems

1797 FLEX Ex I/O Overview

FLEX Ex I/O offer:



FLEX Ex I/O leverages advanced technologies allowing the application to move to a distributed architecture in the hazardous area. We have taken our experience gained with the standard FLEX I/O system and used it to create an intrinsically safe system with the same look, feel, and ease of use.

Mounts without purged or explosion-proof enclosures in the hazardous area. FLEX Ex I/O is a modular I/O system that eliminates the need for Intrinsic Safety (IS) barriers/isolators or long wiring runs to the control cabinet.

One adapter communicates with up to eight I/O modules. Allows connection to:

- 128 digital inputs/outputs, or
- 64 analog inputs, or
- mix to meet your needs.

Redundant media ControlNet adapter communicates with up to eight I/O modules and can be mounted in the hazardous area.

Adjust the keyswitch to prevent incorrect module insertion into a preconfigured terminal base.

Exchange terminal bases without moving other bases in your system.

Connect FLEX Ex power supplies to the terminal base that provides power to the I/O modules and field devices. No additional power supplies are needed.

Plug the I/O module into the terminal base. Use the module to connect to the I/O bus and field devices.

Remove and insert modules under power. No direct wiring to the module enables you to change modules without disturbing field wiring or system power.

Mix and match I/O modules. Wide variety of digital, analog, temperature, frequency, and HART modules.

FlexBus Isolator allows connection to standard FLEX I/O adapters and I/O thus providing a choice of other networks.

Conformal coating on all modules meets the noxious gas requirement of ISAS71.04-1985 severity level G3 for hydrogen sulfide, sulfur dioxide, chlorine, nitrogen dioxide, hydrogen fluoride, ammonia, and ozone.

FLEX Ex combines a terminal strip and intrinsic-safety isolation with an I/O interface. Use the terminal strip on the terminal base to wire your field devices directly. The FLEX Ex design also offers these features:

- modularity for distributed IS systems
- all of the features of a larger, rack-based system
- installation near the field devices to reduce wiring costs and complexity
- terminations for field wiring eliminating the need for marshalling or extra terminal strips
- ControlNet-based networking solution in the hazardous area with ControlNet Ex products
- DIN-rail mounting

FLEX Ex provides additional value if system problems develop. The terminal base lets you remove and insert I/O modules under power without rewiring or disrupting your system. Combining your field-wiring terminations, IS isolation, and the I/O interface into the same location saves you time, money, and makes your system easier to maintain and troubleshoot. Additional benefits include:

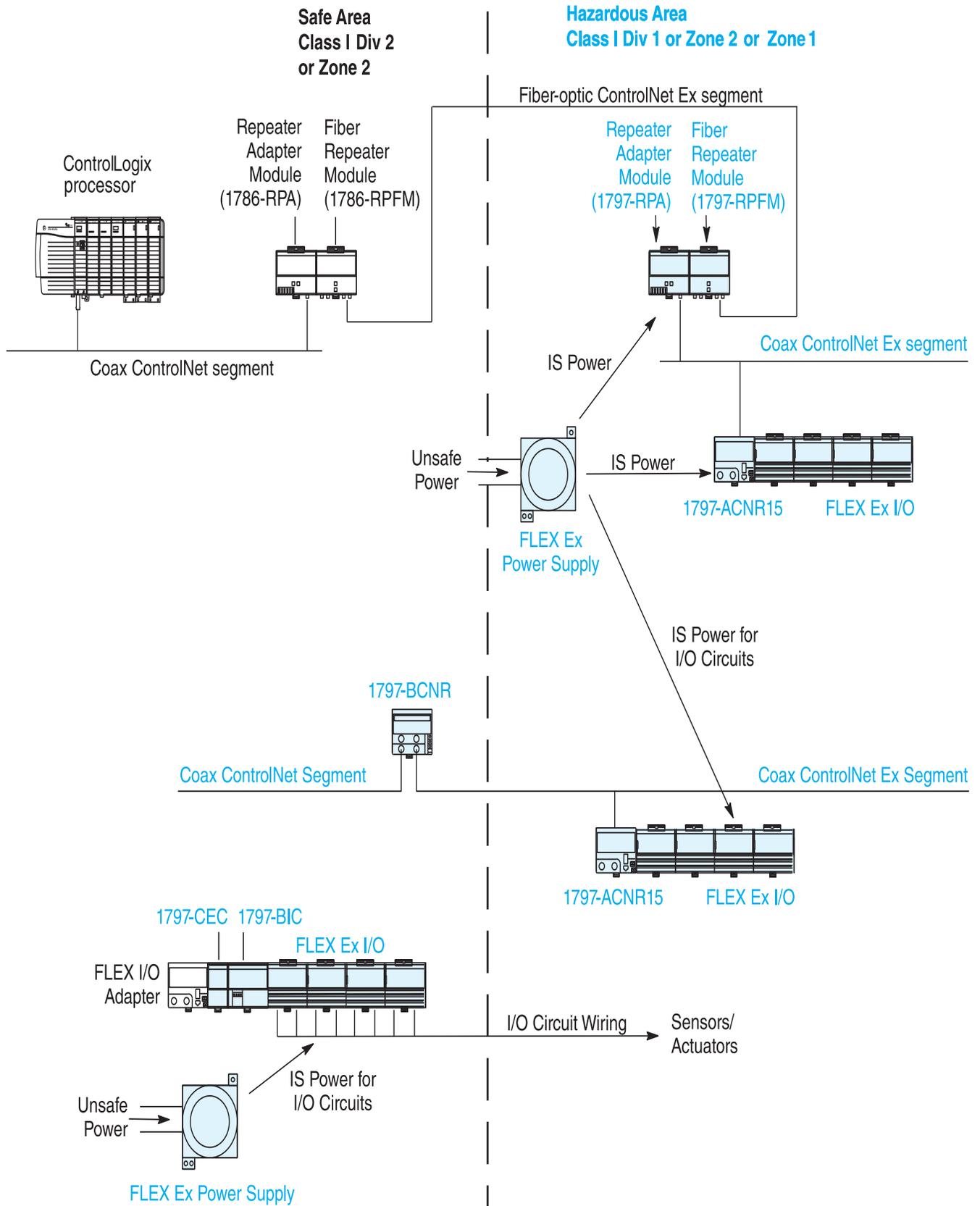
- galvanic isolation between the I/O backplane, input circuitry, and power supply
- dual-fault protection IS circuits provide the highest fault tolerance
- I/O circuitry provides full IS field-device protection
- the modules themselves are IS protected for installation in hazardous environments

FLEX Ex I/O modules may be removed and inserted while operating under power. Network module maintenance and cable connections can be made in the hazardous area while the system is in operation and the area is hazardous.

FLEX Ex Typical Configurations

The following are typical configurations of FLEX Ex I/O in an intrinsically safe system:

- FLEX Ex I/O modules are interfaced through a ControlNet Ex I/O adapter module to a coax ControlNet segment that is confined to the hazardous area. This coax ControlNet Ex segment is interfaced through a ControlNet Ex coax drop repeater module and ControlNet Ex fiber media port adapter to a fiber-optic ControlNet segment, which is fed through from the safe area. A FLEX Ex power supply powers the repeater module, fiber media port adapter, ControlNet Ex I/O adapter module, and I/O modules individually. This configuration is best for long distances and a large number of nodes.
- The FLEX Ex ControlNet barrier allows connection to a ControlNet Ex I/O adapter module in the hazardous area via coax directly from the safe area. The barrier is mounted in the safe area. This is more economical for intermediate distances and nodes.
- Sensors and actuators in a hazardous area can be connected to FLEX Ex I/O modules, which are connected through a bus isolator module and connector to a FLEX I/O adapter in a safe area thus allowing connectivity to DeviceNet, ControlNet, Universal Remote I/O, and EtherNet/IP. This configuration may be most economical for low-point applications or when networks other than ControlNet are required.
- FLEX Ex I/O modules in a hazardous area can be connected through an extender cable to a FlexBus feed-through connector in an explosion-proof enclosure. Inside the enclosure, the feed-through connector is connected through a FLEX Ex extender cable, and then a bus isolator module and connector, to a FLEX I/O adapter.



Entity-Based Architecture

Entity parameters provide a system of quantifying and matching safe levels for voltage, current, inductance, and capacitance when connecting intrinsically safe field devices and system devices together.

Configuration of the FLEX Ex system is based on the entity parameter method. Using entity parameters allows high system flexibility in matching field and system devices. This provides maximum utility to the IS system designer and installer. For more information, refer to the FLEX Ex System Certification Reference Manual, publication [1797-RM001](#).

Hazardous Area Designation

A hazardous area is designated as any location in which a combustible material is or may be present in the atmosphere in sufficient concentration to produce an ignitable mixture.

The North American method identifies these areas by Class, Division, and Group while the IEC (CENELEC) designates these areas by Zone and Gas Group.

Recently, North America has adopted the Zone method of identifying hazardous locations as an option to the Division method.

Class Designation

Class identifies the type of hazardous atmosphere.

Class I	Gas or vapor
Class II	Dust
Class III	Fiber or flying (no group designation)

Division/Zone Designations

Division/Zone identifies the likelihood of a hazardous atmosphere being present.

	Division Method (North America)	IEC Standard Zone Method
Ignitable mixture present continuously (long periods)	Division 1	Zone 0 (Zone 20 - Dust)
Ignitable mixture present intermittently		Zone 1 (Zone 21 - Dust)
Ignitable mixture is not normally present	Division 2	Zone 2 (Zone 22 - Dust)

Gas/Dust Groups

Hazardous locations are grouped according to their ignition properties.

Typical Gas	North American Gas Group	IEC Gas Group
Acetylene	A	IIC
Hydrogen	B	
Ethylene	C	IIB
Propane	D	IIA
Methane ⁽¹⁾	D	I
Metal dust	E	—
Coal dust	F	
Grain dust	G	

(1) Mining applications under jurisdiction of MSHA.

Use in North American Hazardous Locations

FLEX Ex modules are rated for installation in Class I Division 1 & 2, Groups A-D hazardous areas. They are also rated to connect to field devices that are located in Class I, II, or III, Groups A-G hazardous areas.

If FLEX Ex components are to be installed in a Class II or III location in your application, you must mount them in a suitable, dust-proof enclosure with the appropriate connectors, glands, and seals. For example, a NEMA 9 enclosure may be appropriate. The FLEX Ex modules are rated to connect to devices located in Class II or III locations.

FLEX Ex modules are rated for installation in North American Class I Zone 1 & 2, Groups IIC, IIB, & IIA hazardous areas. They are also rated to connect to field devices that are located in North American Class I Zone 0, 1, & 2, Groups IIC, IIB, & IIA hazardous areas.

As always, observe local code requirements when applying your FLEX Ex application. For more information, refer to the FLEX Ex System Certification Reference Manual, publication [1797-RM001](#).

Use in ATEX Hazardous Locations

FLEX Ex modules are rated for installation in European Zones 1, 2 and 22. They are also rated to connect to field devices that are located in European Zones 0, 1, 2, 21 and 22 hazardous areas. The FLEX Ex power supplies (1797-PS1E and -PS2E2) are rated for use in Zone 1 and 22.

If FLEX Ex components are to be installed in a European Zone method dust or fiber location in your application, you must mount them in an approved, dust-proof enclosure with the appropriate connectors, glands, and seals. Pepperl+Fuchs have three cabinets that are approved for use with FLEX Ex components in Zone 22 applications: IVK2-ISRPI-V8LC; IVK2-ISRPI-V8HYW; and IVK2-ISRPI-V16LC. P+F has offices in Twinsburg, Ohio, USA, and Mannheim, Germany. See their website at www.pepperl-fuchs.com.

As always, observe local code requirements when applying your FLEX Ex application. For more information and full certification, refer to the FLEX Ex System Certification Reference Manual, publication [1797-RM001](#).

Specify a FLEX Ex System

Follow these steps as you specify your FLEX Ex I/O system:

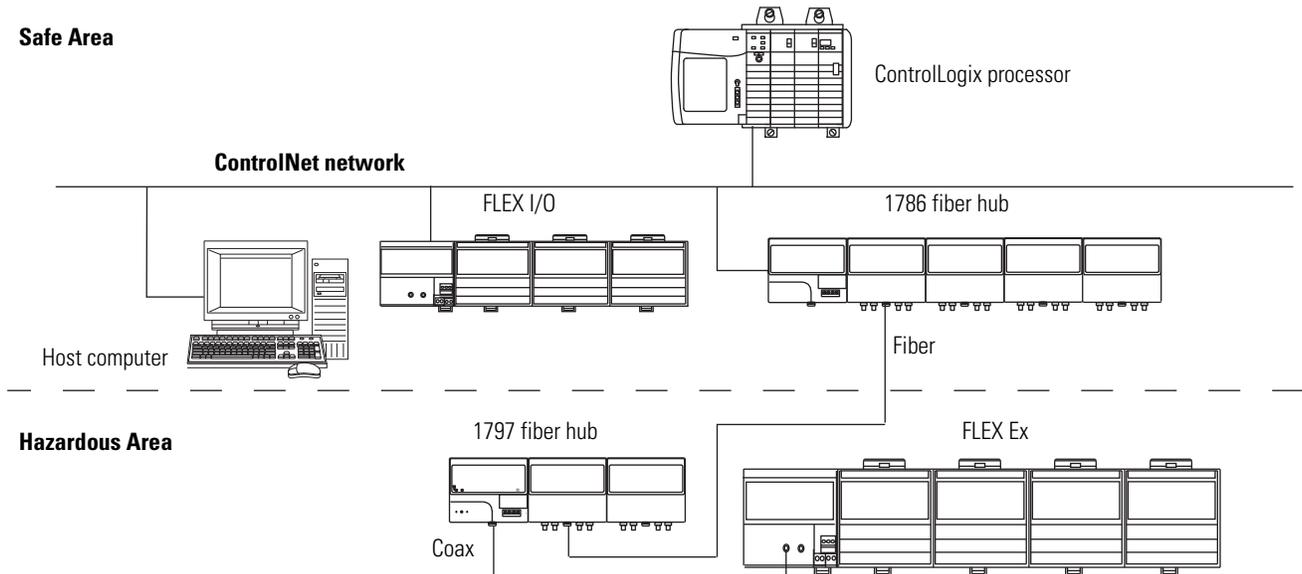
✓	Step	See	Page
	1 Select an adapter and distribution method Choose an adapter and fiber hub or coax barrier to distribute FLEX Ex into the hazardous area. Or, choose a bus isolator pair to connect to various networks.	Select FLEX Ex I/O Communication Adapters and Distribution Method 1797-RPFM ControlNet Ex 3 km Fiber Media Port Adapter 1797-BCNR Coax Barrier Module 1797-BIC Bus Isolator Module and 1797-CEC FlexBus Connector	79 82 82 84
	2 Determine the I/O devices <ul style="list-style-type: none"> • location of the device • number of points needed • appropriate catalog number • number of points available per module • number of modules 	Digital I/O Modules Analog Modules HART Interface Modules Counter I/O Module	87 91 95 98
	3 Select a terminal base Choose an appropriate terminal base for your modules.	Terminal Base Wiring Diagrams	103
	4 Select power supplies <ul style="list-style-type: none"> • Choose appropriate power supply • Ensure sufficient power for the communication adapter and modules 	Select a FLEX Ex I/O Power Supply Understanding System Planning Assigning Power Supplies Hazardous Area Installation General Specification Comparison	105 106 108 109 105
	5 Select optional accessories <ul style="list-style-type: none"> • Determine whether to panel mount or DIN rail mount the FLEX I/O system and at what orientation (horizontal or vertical) • Choose appropriate optional accessories to enhance your system 	Mount the FLEX System 1794-CE1 and 1794-CE3 Extender Cables 1797-BOOT ControlNet BNC Boot 1797-INS Trunk Insulator and 1797-EXMK Marking Kit ControlNet Ex Taps	113 115 117 117 118

Network Comparison by Application Requirement

Catalog Number.	Description	Agency Certification	Intrinsically Safe Output Characteristics	Intrinsically Safe Power Supply (V, -V)	See page:
1797-RPA	ControlNet Ex modular repeater adapter	Class I Division 1 Groups A...D T4 Class I Zone 1 AEx ib IIC T4 Class II Division 1 Groups E, F, G; Class III ⁽¹⁾	30 pin male TTL bus connector $U_o \leq 5.4V$ DC $I_o \leq 201mA$ $P_o \leq 1.09 W$ $L_o \leq 0.45 \mu H$ $C_o \leq 71\mu F$	$U_i \leq 9.5V$ DC $I_i \leq 1A$ $P_i \leq 9.5 W$ $L_i =$ Negligible $C_i \leq 120 nF$	81
1797-RPFM	ControlNet Ex fiber repeater module, medium distance	Class I Division 1 Groups A-D T4 Class I Zone 1 AEx ib [ia] IIC T4 Class II Division 1 Groups E, F, G; Class III ⁽¹⁾	30 pin male TTL bus connector $U_o \leq 5.4V$ $I_o \leq 201 mA$ $P_o \leq 1.1 W$ $L_o \leq 0.45 mH$ $C_o \leq 71 \mu F$	—	82
1797-BCNR	Redundant ControlNet galvanic isolation barrier module	II (2) G [Ex ib] IIC	Open circuit voltage $U_o = 7V$, max $I_o = 14 mA$ (at the resonant frequency of 66kHz)	—	82
1797-BIC	Bus isolator module	Nonincendive, use for Class I, Division 2 Groups A...D or Class I, Zone 2 Group IIC Provides intrinsically safe outputs to Class I, Division 1 Groups A...D or Class I, Zone 1 Group IIC	$V_t \leq 5.75V$ DC $I_t \leq 3.98.25 mA$ $C_a \leq 39.67 \mu F$ $L_a \leq 210 \mu H$	—	84
1797-CEC	FlexBus connector module	Nonincendive, use for Class I, Division 2 Groups A...D or Class I, Zone 2 Group IIC	—	—	84

(1) For Class II Division 1 Groups E, F, G and Class III, modules must be installed in a UL listed Type 4, 4X, 6, 6P, 9, 12, or 12K enclosure.

Figure 1 - Distribution Between Areas

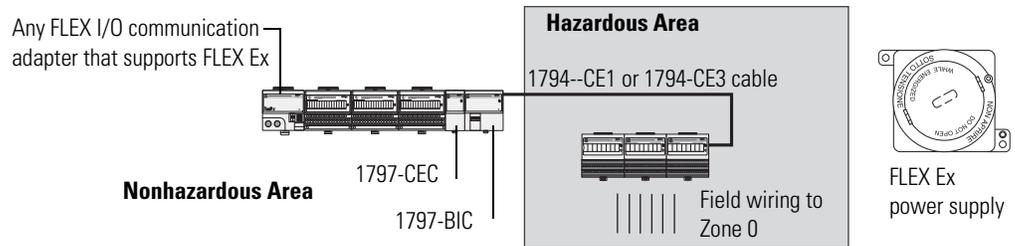
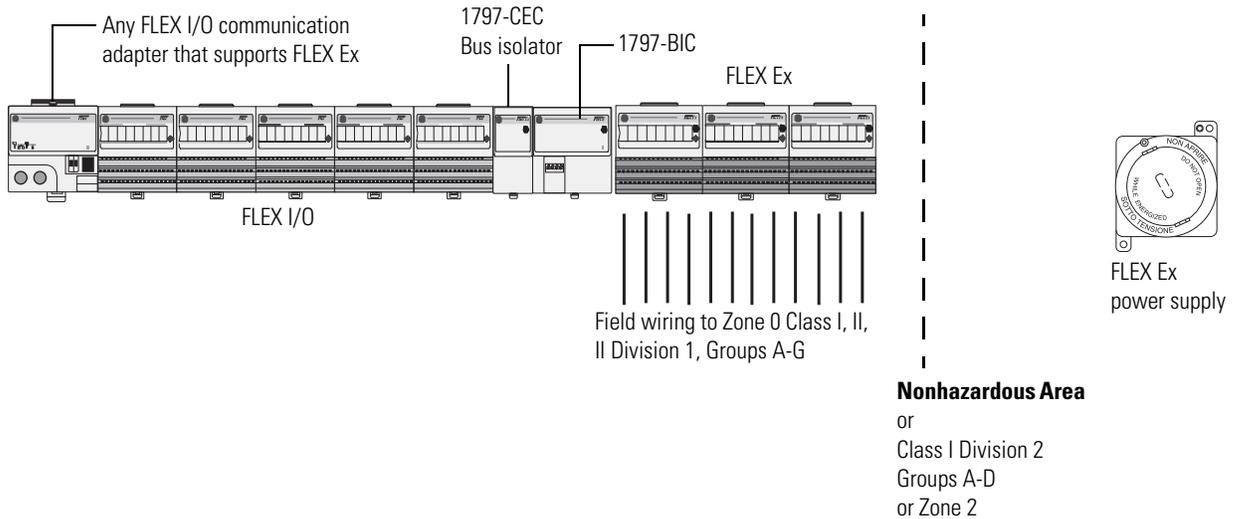


1797-BIC Bus Isolator Module and 1797-CEC FlexBus Connector

The bus isolator modules, 1797-BIC and -CEC, allow you to configure FLEX Ex modules and FLEX I/O modules on the DIN Rail when attached to the same adapter and grouped together on appropriate sides of the bus isolator module. This highly flexible, cost-effective solution combines intrinsically safe and non-intrinsically safe systems.

Intermixed system can be configured for use in the:

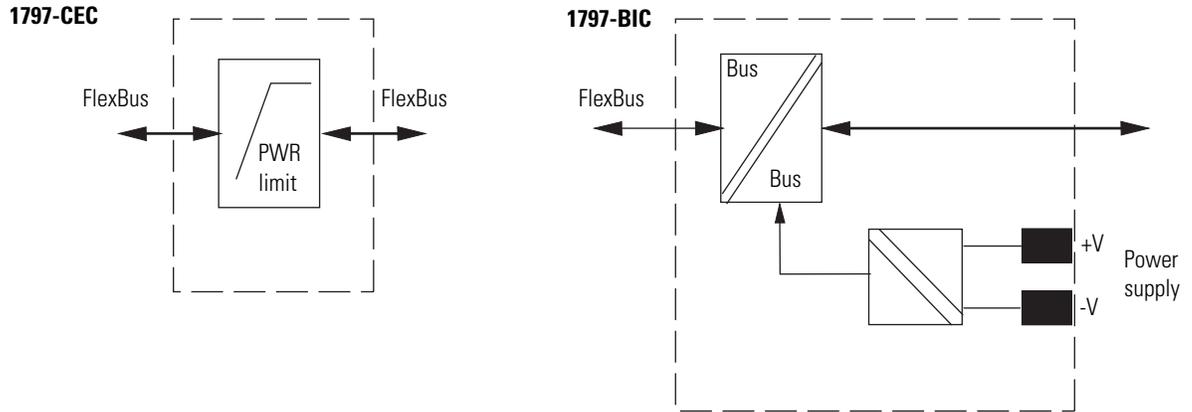
- safe area much like traditional IS and I/O systems
- hazardous and safe control equipment where the distance of physical separation is short
- FLEX Ex I/O with communication adapters that are not intrinsically safe



The 1797-BIC and -CEC modules provide an IS-compatible mechanism to separate two sections of the backplane, allowing IS and non-IS field-device wiring to the same I/O group. It converts hazardous power to IS-safe power to run one side of the bus receiver/transmitter circuitry and IS-safe power to slave side modules. A total of eight I/O modules (1794 FLEX I/O or 1797 FLEX Ex I/O) may be attached to the adapter.

When combining 1794 FLEX I/O and 1797 FLEX Ex I/O, the 1794 FLEX I/O modules are placed to the left of the 1797-BIC and -CEC modules while the 1797 FLEX Ex I/O modules are placed on the right.

IMPORTANT A FLEX Ex power supply (1797-PSxxx) must be used to power the 1797 FLEX Ex I/O regardless of where they are located.



Attribute	1797-BIC
I/O module capacity	8 ⁽¹⁾
Isolation voltage	System to System and System Slave Side to Power Supply: Galvanic to DIN EN 50020
Power consumption, max	0.15 A @ 18...32V DC
Power source failure, max input	$U_m = 253V$ AC
Noxious gas exposure	Tested to severity level G3, ISA-S71.04-1985
Power dissipation	2.1 W
Thermal dissipation	7.2 BTU/hr
Dimensions HxWxD	87 x 94 x 75 mm 3.4 x 3.7 x 2.95 in.
Weight, approx.	0.2 kg (0.44 lbs)

(1) 8 FLEX Ex modules. Note that a total of eight I/O modules can be attached to a 1794 FLEX I/O adapter. The 1797-BIC and 1797-CEC are not included in this number. In intermixed systems, the number of 1797 FLEX Ex I/O modules (attached onto the 1797-BIC) plus the number of 1794 FLEX I/O modules (connected between the adapter and the 1797-CEC) cannot exceed eight.

Select a FLEX Ex I/O Power Supply

Step 4 – Select:

if power consumption exceeds the maximum for a single power supply, install additional power supplies

The power supply is an essential component in the operation of an intrinsically safe system. It must isolate the unsafe incoming power from the control system and limit the available energy to IS-safe levels.

FLEX Ex I/O power supplies provide power for the FLEX Ex ControlNet network, communication adapter, I/O modules, fiber hub, and IS field devices. No other power sources are needed to operate any components attached to the FLEX Ex system in the hazardous area. Power for valves, actuators, or transmitters come from the FLEX Ex modules.

FLEX Ex I/O power supply modules must be used to supply power to FLEX Ex I/O modules. Other power supplies are not allowed in order to meet the certification of the system. Power for valves, actuators, and transmitters come from the FLEX Ex modules.

There are two types of enclosures: (N-Type) explosion-proof with 1 inch conduit pipe thread input/output terminations that are certified in North America and (E-Type) flame-proof with increased safety input/output terminations that are certified to European standards. Each type is available in 24V DC or 85...253V AC for supply sources.

The 24V DC power supply includes dual power feeds for sour input redundancy whereas the AC power supplies support daisy chaining.

Common features include:

- four channels, 8.5 W output each channel
- outputs are IS galvanically isolated from the source
- all channels are independently IS limited

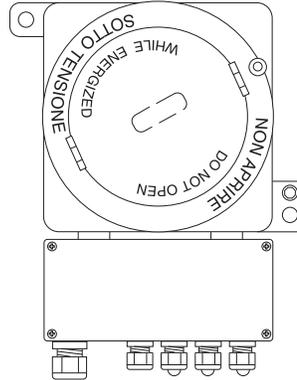
General Specification Comparison

Catalog	Description	Input Voltage, max	Output Power (W)	Dimensions (HxWxD), approx	Weight approx
1797-PS1N	FLEX Ex 85...250V AC Power Supply	250V AC	34 W ⁽¹⁾	174 x 174 x 140 mm (6.9 x 6.9 x 5.51 in.)	6 kg (13.2 lbs)
1797-PS1E	FLEX Ex 24V DC Power Supply	253V AC		260 x 174 x 140 mm (10.2 x 6.9 x 5.51 in.)	6.9 kg (15.2 lbs)
1797-PS2N2	FLEX Ex conduit pipe North American-certified Power Supply	32V DC max		174 x 174 x 140 mm (6.9 x 6.9 x 5.51 in.)	6.1 kg (13.4 lbs)
1797-PS2E2	FLEX Ex flame-proof European-certified Power Supply			260 x 174 x 140 mm (10.2 x 6.9 x 5.51 in.)	7 kg (15.4 lbs)

(1) 8.5 W at each of 4 outputs.

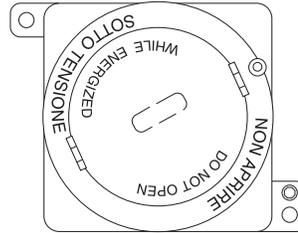
E Type Power Supply

1797-PS1E
or
1794-PS2E2



N Type Power Supply

1797-PS1N
or
1797-PS2N2



Understanding System Planning

Part of system planning is determining what modules are needed for the application, how many power supplies are needed, how to best partition the system, and where to locate the system cabinets.

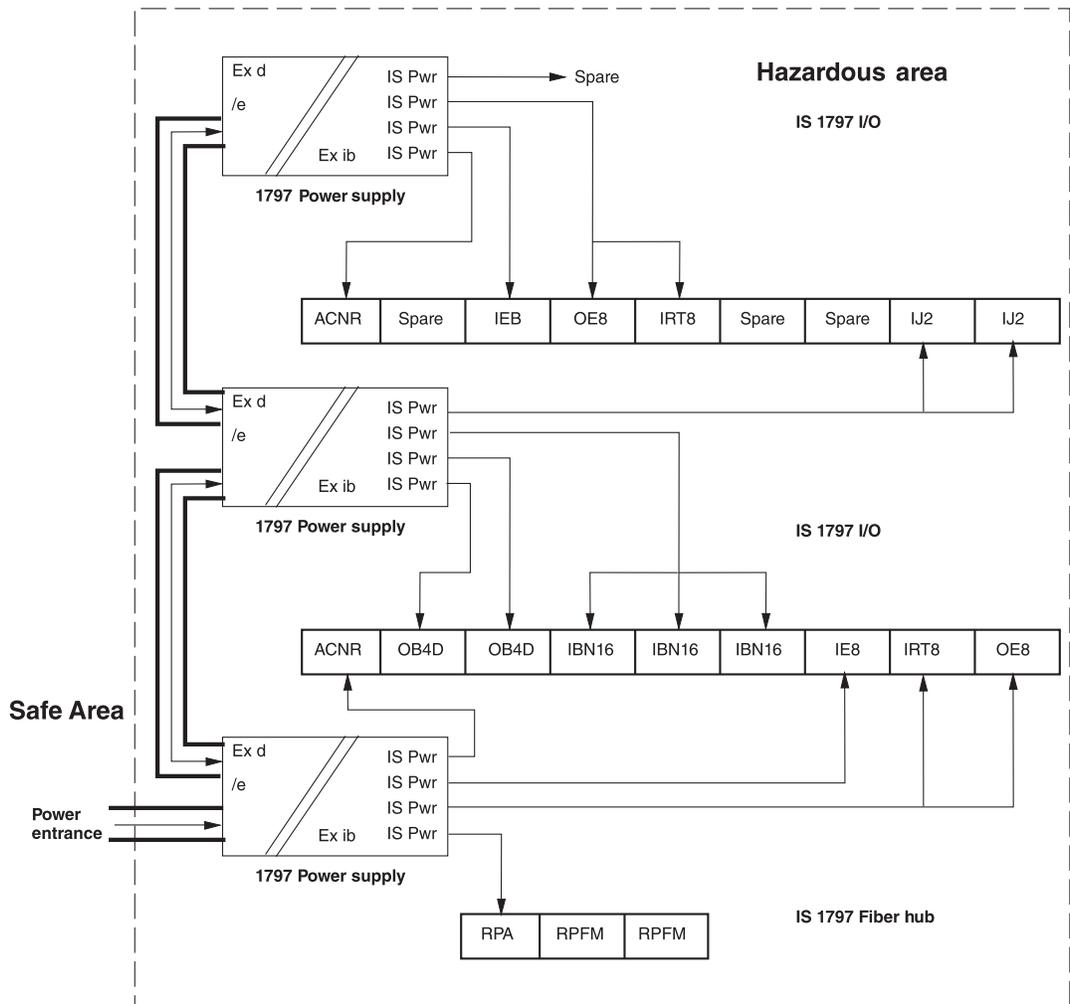
A key task in the development cycle is determining the number of power supply outputs (thus power supplies) you will need.

Each power supply has four independent IS power outputs capable of 8.5W each. In this example, we required eleven IS power outputs so three power supplies were sufficient.

Power Requirements

Modules	Requires
Fiber hub	8.5 W
Two ControlNet adapters	8.5 W each
Two analog inputs	7.5 W each
Two analog outputs	6.3 W each
Two thermocouple inputs	1.6 W each
Two digital outputs	7.5 W each
Three NAMUR digital inputs	2.8 W each
Two counter inputs	4.25 W each

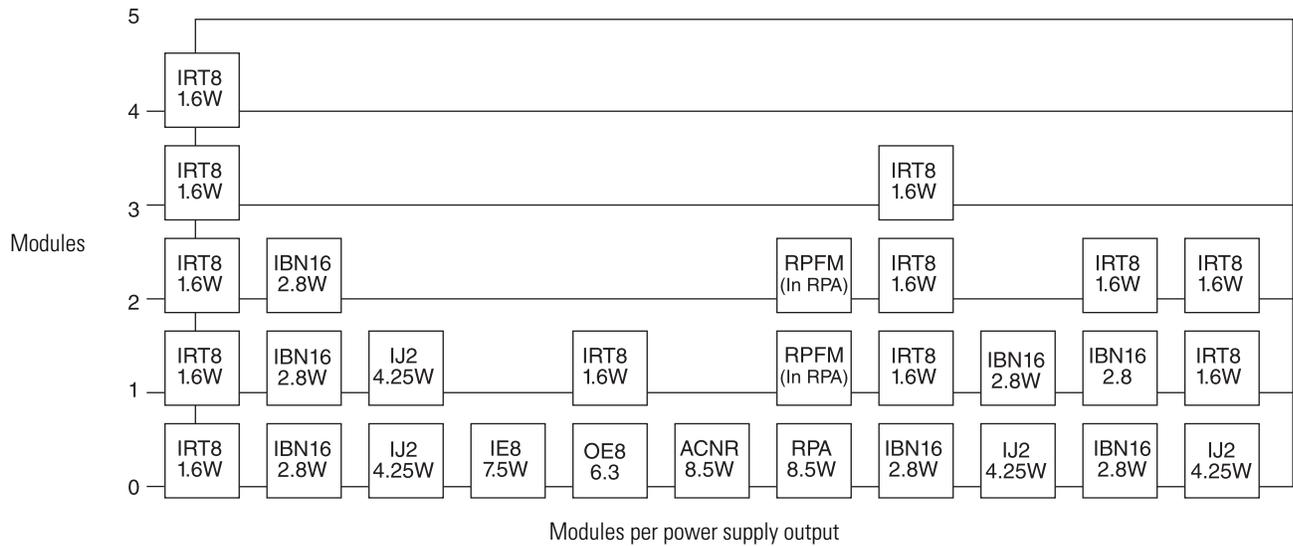
The total number of power supplies needed depends on the modules used and the total system configuration. The following illustration shows how this example may be configured.



Assigning Power Supplies

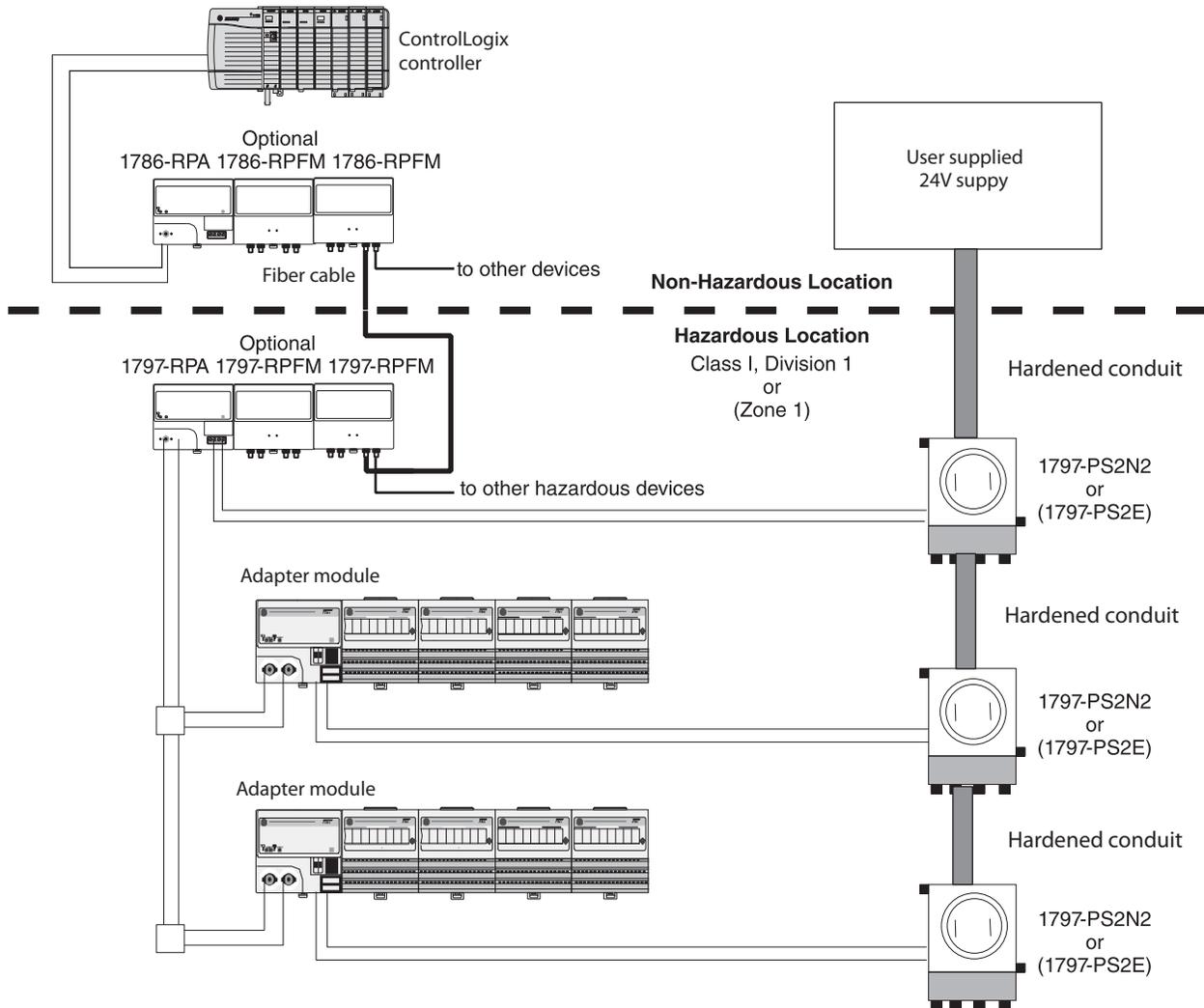
Note the amount of power each module requires and assign it to a power supply output. Continue to assign modules to the power supply output until the supply's output power rating is consumed.

Each power supply output in the FLEX Ex system is rated for 8.5 W. Modules can be attached to the output until their combined power equals that number. Do not exceed the power supply maximum of 8.5 W.



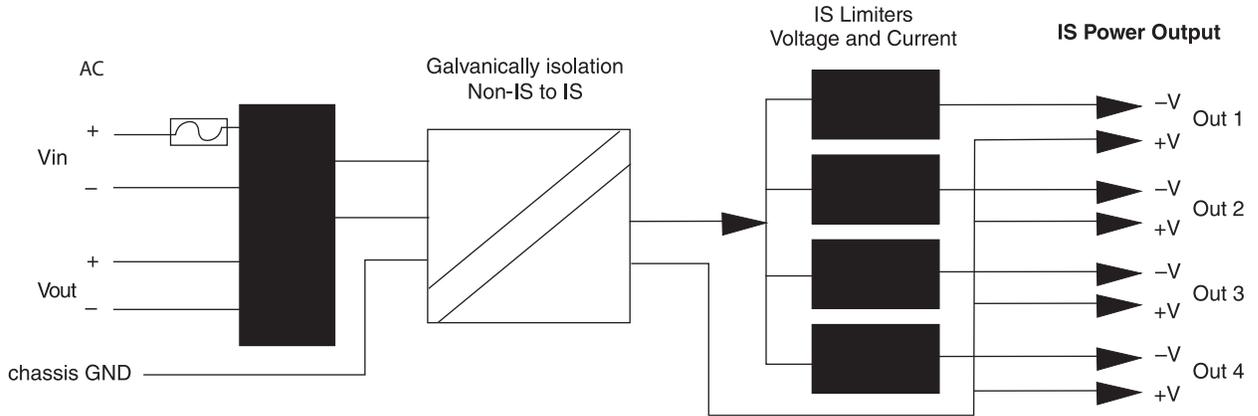
Hazardous Area Installation

The following illustration provides an example of how power supplies are arranged within the FLEX Ex system when using fiber hubs.



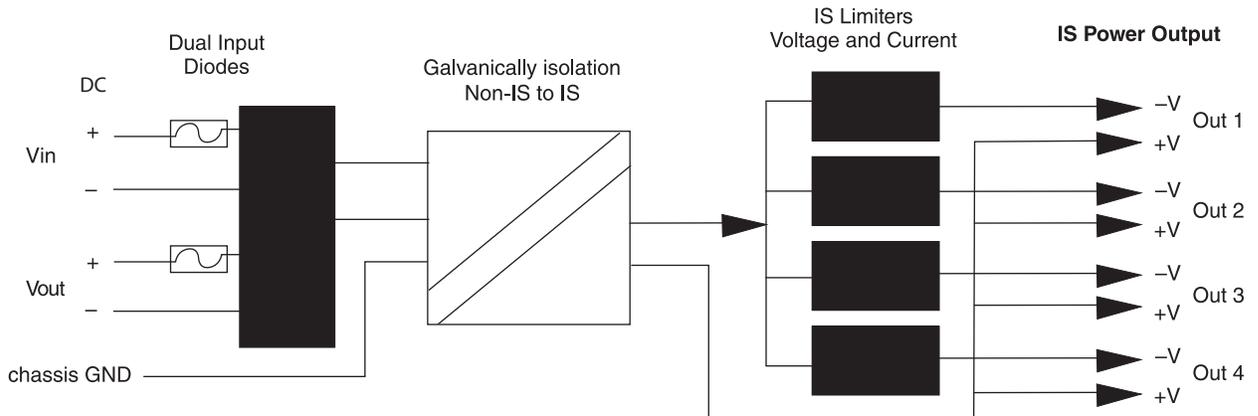
1797-PS1N and 1797-PS1E 85V...253V AC In/Quad-Ex DC Out

Type of Power Input



1797-PS2N2 and 1797-PS2E2 24V DC In/Quad-Ex DC Out

Type of Power Input



General Specifications Summary

Specification	1797-PS1N	1797-PS1E	1797-PS2N2	1797-PS2E2
Intrinsically safe module	Class I, Division 1, Groups A...D T4 (UL and C-UL) Class II, Division 1 Groups E...G (UL and C-UL) Class III (UL, FM and C-UL)	Zone1: II 2G Ex de [ib] IIC T4 Zone 22: II 3D Ex tD A22 IP54 T90°C X	Class I Division 1 Groups A...D T4 (UL, C-UL and FM) Class II Division 1 Groups E...G (UL, FM, CUL) Class III	Zone1: II 2G Ex de [ib] IIC T4 Zone 22: II 3D Ex tD A22 IP54 T90°C X
Input connector terminals	Terminals 1, 2, 4, 5	Terminals 1, 2, 4, 5	Terminals 1, 2, 4, 5	Terminals 1, 2, 4, 5
Operating voltage range	85...250V AC 120...250V DC	85...253V AC	18...32V DC	18...32V DC
Current consumption	0.9 A	0.9 A	3.1 A	3.1 A
Ripple	—	—	5% AC	—

General Specifications Summary

Specification	1797-PS1N	1797-PS1E	1797-PS2N2	1797-PS2E2
Input power entry	1 in NPT, ≤ 6 in conduit allowed between power supply and seal (UL, FM and C-UL)	Increased safety	1 in NPT, 6 in conduit allowed between power supply and seal (UL and C-UL) 1 in NPT, 0 in conduit allowed between power supply and seal (FM)	Increased safety
Output connector terminals	Terminals 10...17			
Power supply output power (W)	34 W ⁽¹⁾			
Safe voltage, max U_m	250V AC	253V AC	40V DC	
Voltage U_0	≤ 9.5V			
Current I_0	≤ 1 A			
C_0 (IIC)	≤ 500 nF			
L_0 (IIC)	≤ 8μH			
Output cable resistance, max	≤ 0.1 Ω (both directions)			
Power supply input power	55 W			
Power dissipation	21 W			
Thermal dissipation, max	71.67 BTU/hr			
Dimensions (HxWxD), approx ⁽²⁾	174 x 174 x 140 mm 6.9 x 6.9 x 5.51 in	260 x 174 x 140 mm 10.2 x 6.9 x 5.51 in	174 x 174 x 140 mm 6.9 x 6.9 x 5.51 in	260 x 174 x 140 mm 10.2 x 6.9 x 5.51 in
Weight, approx. (with packaging)	6 kg (13.2 lbs)	6.9 kg (15.2 lbs)	6.1 kg (13.4 lbs)	7 kg (15.4 lbs)
Protection class	IP 66/NEMA 7B	IP 65/NEMA 7B	IP 66/NEMA 7B	IP 65/NEMA 7B

(1) 8.5 W at each of 4 outputs.

(2) Refer to individual installation instructions for mounting dimensions.