FBM245, 0 to 20 mA I/O Interface Module with HART® Support (Redundant)

The FBM245 0 to 20 mA I/O Interface Redundant Module with HART® support provides four input and four output communication channels for analog field signals.

FEATURES

Key features of the FBM245 module are:

- Four 0 to 20 mA analog input channels, used for a HART analog sensor input such as a 4 to 20 mA transmitter or a self-powered 20 mA source
- Four analog output channels, used to drive an external load and produce a 0 to 20 mA output
- Support for the HART universal commands necessary to interface the field device with the I/A Series® system database
  Both inputs and outputs are galvanically isolated
- Compact, rugged design suitable for enclosure in Class G3 (harsh) environments
- Termination Assemblies (TAs) for locally or remotely connecting field wiring to the FBM245
- Termination Assemblies for per channel internally and/or externally loop powered transmitters.

OVERVIEW

A redundant pair of FBM245 modules combine to provide redundancy at the Fieldbus Module (FBM) level, with field I/O wired to one common termination assembly. They perform the signal conversion required to interface the electrical input/output

signals from the field sensors and actuators to the redundant Fieldbus. Each module contains four 0 to 20 mA galvanically isolated analog input and output channels (eight total). They support any mix of standard 4 to 20 mA devices and HART devices as shown in Figure 1.

Each input channel accepts an analog sensor input such as a 4 to 20 mA transmitter or a self-powered 20 mA source. Each output channel drives an external load and produces a 0 to 20 mA output.

A redundant analog input and redundant analog output block in the control software validates each input and output in conjunction with information to/from the module. When a failure is detected in one of the FBM245s, its output is driven to 0 mA, and the corresponding channel in the good module automatically continues supplying the proper current to the output current loop.

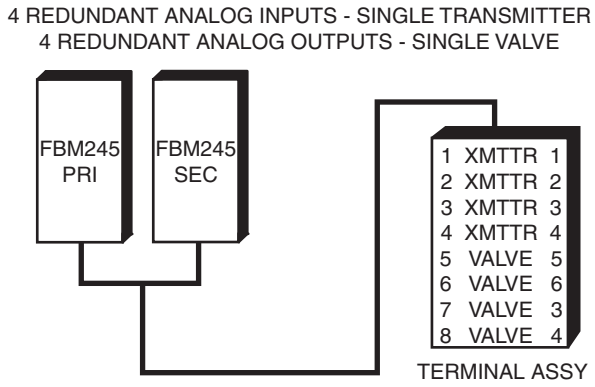


Figure 1. Redundant I/O Configurations

Each module executes the analog I/O application program. The configurable options for this program include Fail-Safe Action (Hold/Fallback), Analog Output Fail-Safe Fallback Data (on a per channel basis), Fieldbus Fail-Safe Enable, and Fieldbus Fail-Safe Delay Time.

When connected to the appropriate TAs, the FBM245 module provides functionality formerly provided by the 100 Series FBM I/O subsystem. TAs are available which support the functionality of the the 100 Series FBM05, when the FBM05 is used with HART devices.

COMPACT DESIGN

The FBM245 module has a compact design, with a rugged extruded aluminum exterior for physical protection of the circuits. Enclosures specially designed for mounting the FBMs provide various levels of environmental protection, up to harsh environments per ISA Standard S71.04.

EASY REMOVAL/REPLACEMENT

The modules can be removed/replaced without removing field device termination cabling, power or communications cabling.

VISUAL INDICATORS

Light-emitting diodes (LEDs) incorporated into the front of the modules provide visual status indications of Fieldbus Module (FBM) functions.

MODULAR BASEPLATE MOUNTING

The modules mount on a modular baseplate which accommodates up to four or eight FBMs. The modular baseplate is either DIN rail mounted or rack mounted, and includes signal connectors for redundant fieldbus, redundant independent dc power, and termination cables.

FIELDBUS COMMUNICATION

A Fieldbus Communication Module or a Control Processor interfaces the redundant 2 Mbps module Fieldbus used by the FBMs. The FBM245 module accepts communication from either path (A or B) of the redundant 2 Mbps fieldbus – should one path fail or be switched at the system level, the module continues communication over the active path.

TERMINATION ASSEMBLIES

Field I/O signals connect to the FBM subsystem via a DIN rail mounted termination assembly. The TA used with the FBM245 modules is described in "TERMINATION ASSEMBLIES AND CABLES" on page 6.

FUNCTIONAL SPECIFICATIONS

Supported Hart Instrument Types

HART instruments compliant to Version 5, 6, or 7 of the HART specifications may be used

Process I/O Communications

Communicates with its associated FCM or FCP via the redundant 2 Mbps module Fieldbus.

Input Channels

INPUT
4 isolated and independent redundant channels(1)

INPUT RANGE (EACH CHANNEL)
0 to 20.4 mA dc

ACCURACY
±0.075% of span

COMMUNICATION
Via a redundant Fieldbus

INPUT CONNECTIONS
Two configurations (see Figure 2)

Output Channels

OUTPUT
4 isolated and independent redundant channels(2)

OUTPUT RANGE (EACH CHANNEL)
0 to 20.4 mA dc

OUTPUT LOAD (MAXIMUM)
735 Ω

COMPLIANCE VOLTAGE
18.0 V nominal at 20 mA dc at I/O field terminals

ACCURACY
±0.05% of span (25°C) between 4-20 mA

OUTPUT TEMPERATURE COEFFICIENT
100 ppm/°C

COMMUNICATION
Via a redundant Fieldbus

SETTLING TIME
100 ms to settle within a 1% band of steady state for a 10 to 90% input step change.

LINEARITY ERROR
±0.05% of span

RESOLUTION
12 bits

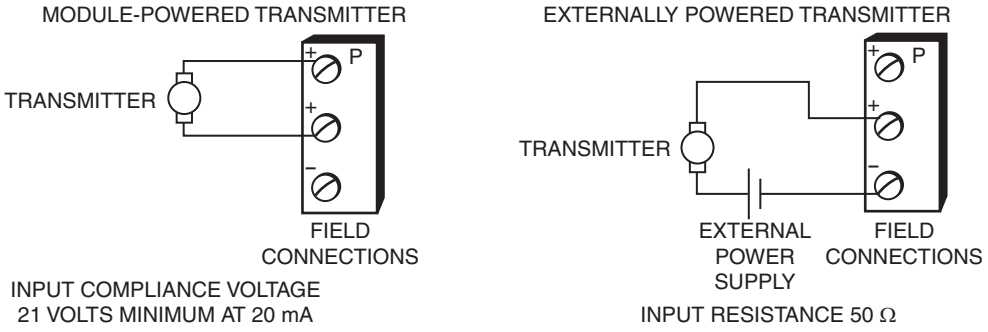


Figure 2. Input Connections

(1) Redundant inputs pairs are connected by a common field I/O connector and therefore, are not isolated from each other.
(2) Redundant output pairs are connected by a common field I/O connector and therefore, are not isolated from each other.

FUNCTIONAL SPECIFICATIONS (CONTINUED)

Input Channel Isolation

Each channel is galvanically isolated from all other channels and earth (ground). The module/TA withstands, without damage, a potential of 600 V ac applied for one minute between any channel and ground, or between a given channel and any other channel.

CAUTION

This does not imply that these channels are intended for permanent connection to voltages of these levels. Exceeding the limits for input voltages, as stated elsewhere in this specification, violates electrical safety codes and may expose users to electric shock.

Fastest Allowed ECB Block Period

100 msec - However, it is recommended that you refer to the *Sizing Guidelines and Excel Workbook* appropriate for your Control Processor to determine the optimal loading for a 100 msec Block Processing Cycle (BPC).

Power Requirements

INPUT VOLTAGE RANGE (REDUNDANT)
24 V dc +5%, -10%

CONSUMPTION
7 W (maximum)

HEAT DISSIPATION
3 W (maximum)

Calibration Requirements

Calibration of the module and termination assembly is not required.

Regulatory Compliance

ELECTROMAGNETIC COMPATIBILITY (EMC)

European EMC Directive 89/336/EEC
Meets: EN 50081-2 Emission standard
EN 50082-2 Immunity standard
EN 61326 Annex A (Industrial Levels)

CISPR 11, Industrial Scientific and Medical (ISM) Radio-frequency Equipment - Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement
Meets Class A Limits

IEC 61000-4-2 ESD Immunity
Contact 4 kV, air 8 kV

IEC 61000-4-3 Radiated Field Immunity
10 V/m at 80 to 1000 MHz

IEC 61000-4-4 Electrical Fast Transient/Burst Immunity
2 kV on I/O, dc power and communication lines

IEC 61000-4-5 Surge Immunity
2kV on ac and dc power lines; 1kV on I/O and communications lines

IEC 61000-4-6 Immunity to Conducted Disturbances Induced by Radio frequency Fields
10 V (rms) at 150 kHz to 80 MHz on I/O, dc power and communication lines

IEC 61000-4-8 Power Frequency Magnetic Field Immunity
30 A/m at 50 and 60 Hz

FUNCTIONAL SPECIFICATIONS (CONTINUED)

PRODUCT SAFETY

Underwriters Laboratories (UL) for U.S. and Canada

UL/UL-C listed as suitable for use in UL/UL-C listed Class I, Groups A-D; Division 2; temperature code T4 enclosure based systems. These modules are also UL and UL-C listed as associated apparatus for supplying non-incendive communication circuits for Class I, Groups A-D hazardous locations when connected to specified I/A Series® processor modules as described in the *I/A Series DIN Rail Mounted Subsystem User's Guide* (B0400FA). Communications circuits also meet the requirements for Class 2 as defined in Article 725 of the National Electrical Code (NFPA No.70) and Section 16 of the Canadian Electrical Code (CSA C22.1). Conditions for use are as specified in the *I/A Series DIN Rail Mounted Subsystem User's Guide* (B0400FA).

European Low Voltage Directive 73/23/EEC and Explosive Atmospheres (ATEX) directive 94/9/EC

CENELEC (DEMKO) certified as EEx nA [nL] IIC T4 for use in CENELEC certified Zone 2 enclosure certified as associated apparatus for supplying non-incendive field circuits for Zone 2, Group IIC, potentially explosive atmospheres when connected to specified I/A Series processor modules as described in the I/A Series DIN Rail Mounted Subsystem User's Guide (B0400FA). Also, see Table 1 on page 7.

ENVIRONMENTAL SPECIFICATIONS(3)

Operating

TEMPERATURE

FBM245

-20 to +70°C (-4 to +158°F)

Termination Assembly

-20 to +70°C (-4 to +158°F)

RELATIVE HUMIDITY

5 to 95% (noncondensing)

ALTITUDE

-300 to +3,000 m (-1,000 to +10,000 ft)

Storage

TEMPERATURE

-40 to +70°C (-40 to +158°F)

RELATIVE HUMIDITY

5 to 95% (noncondensing).

ALTITUDE

-300 to +12,000 m (-1,000 to +40,000 ft)

Contamination

Suitable for use in Class G3 (Harsh) environments as defined in ISA Standard S71.04, based on exposure testing according to EIA Standard 364-65, Class III.

Vibration

7.5 m/S^2 (0.75 g) from 5 to 500 Hz

(3) The environmental limits of this module may be enhanced by the type of enclosure containing the module. Refer to the applicable Product Specification Sheet (PSS) which describes the specific type of enclosure that is to be used.

PHYSICAL SPECIFICATIONS

Mounting

FBM245
The modules mount on a modular baseplate. The baseplate can be mounted on a DIN rail (horizontally or vertically), or horizontally on a 19-inch rack using a mounting kit. Refer to *DIN Rail Mounted Modular Baseplates* (PSS 21H-2W6 B4) for details.

TERMINATION ASSEMBLY
The TA mounts on a DIN rail and accommodates multiple DIN rail styles including 32 mm (1.26 in) and 35 mm 1.38 in).

Mass

FBM245
284 g (10 oz) approximate

TERMINATION ASSEMBLY
181 g (0.40 lb) approximate

Dimensions – FBM245

HEIGHT
102 mm (4 in),114 mm (4.5 in) including mounting lugs

WIDTH
45 mm (1.75 in)

DEPTH
104 mm (4.11 in)

Dimensions – Termination Assembly

See page 9

Part Numbers

FBM245
P0927AL

TERMINATION ASSEMBLIES
See “FUNCTIONAL SPECIFICATIONS – TERMINATION ASSEMBLIES” on page 7

REDUNDANT ADAPTER
P0924DU

Termination Cables

CABLE LENGTHS
Up to 30 m (98 ft)

CABLE MATERIALS
Polyurethane or Low Smoke Zero Halogen (LSZH)

TERMINATION CABLE TYPE
Type 1 – See Table 2 on page 8

CABLE CONNECTION
FBM Baseplate End
37-pin D-subminiature
Termination Assembly End
25-pin D-subminiature

Construction – Termination Assembly

MATERIAL
Polyamide (PA), compression

Field Termination Connections

COMPRESSION-TYPE ACCEPTED WIRING SIZES
Solid/Stranded/AWG
0.2 to 4 mm^2/0.2 to 2.5 mm^2/24 to 12 AWG
Stranded with Ferrules
0.2 to 2.5 mm^2 with or without plastic collar

TERMINATION ASSEMBLIES AND CABLES

Field input signals connect to the FBM subsystem via DIN rail mounted Termination Assemblies.

The redundant adapter connects the redundant FBMs baseplate input/output connectors together. The redundant adapter provides a single termination connection to a single TA.

The TA for the FBM245 module is available as a compression screw type using Polyamide (PA) material.

See “FUNCTIONAL SPECIFICATIONS – TERMINATION ASSEMBLIES” on page 7 for the TA used with the FBM245 modules.

The DIN rail mounted TAs connect to the redundant adapter by means of a removable termination cable. The cable is available in a variety of lengths, up to 30 meters (98 feet), allowing the TA to be mounted in either the enclosure or in an adjacent enclosure.

Termination cables are available in the following materials:

- Polyurethane
- Low Smoke Zero Halogen (LSZH).

See Table 2 for a list of termination cables used with the TA for the FBM245 modules.

FUNCTIONAL SPECIFICATIONS – TERMINATION ASSEMBLIES

FBM Type	Input Signal	TA Part Number[a]		Termination Type[b]	TA Cable Type[c]	TA Certification Type[d]
		PVC	PA			
FBM245	Four input and four output channels, 4 to 20 mA analog signal, from HART devices		P0924QU, P0924QZ[e]	C	1	1, 2

(a) PVC is polyvinyl chloride rated from -20 to +50°C (-4 to +122°F); PA is polyamide rated from -20 to +70°C (-4 to +158°F).
(b) C = TA with compression terminals; RL = TA with ring lug terminals.
(c) See Table 2 for cable part numbers and specifications.
(d) See Table 1 for Termination Assembly certification definitions.
(e) P0924QZ has four output bypass jacks. It is not suitable for use in any hazardous locations - ordinary locations only.

Table 1. Certification for Termination Assemblies

Type	Certification[a]
Type 1	TAs are UL/UL-C listed as suitable for use in Class I; Groups A-D; Division 2 temperature code T4 hazardous locations. They are CENELEC (DEMKO) certified EEx nA [nL] IIC T4 for use in Zone 2 potentially explosive atmospheres.
Type 2	TAs are UL/UL-C listed as associated apparatus for supplying non-incendive field circuits Class I; Groups A-D; Division 2 hazardous locations when connected to specified DIN rail mounted FBMs and field circuits meeting entity parameter constraints specified in *DIN Rail Mounted Subsystem User's Guide* (B0400FA). They are also CENELEC (DEMKO) certified as associated apparatus for supplying field circuits for Group IIC, Zone 2 potentially explosive atmospheres. Field circuits are also Class 2 limited energy (60 V dc, 30 V ac, 100 VA or less) if customer-supplied equipment meets Class 2 limits.

(a) All TAs are UL/UL-C listed to comply with applicable ordinary location safety standards for fire and shock hazards. Hazardous location types comply with ATEX directive for II 3 G use. They also comply with the requirements of the European Low Voltage Directive. All listings/certifications require installation and use within the constraints specified in DIN Rail Mounted Subsystem User's Guide (B0400FA) and the conditions stated in UL and DEMKO reports.

Table 2. Cable Types and Part Numbers

Cable Length m (ft)	Type 1 P/PVC [(a)]	Type 1 LSZH [(b)]	Type 1 H/XLPE[(c)]
0.5 (1.6)	P0916DA	P0928AA	P0916VA
1.0 (3.2)	P0916DB	P0928AB	P0916VB
2.0 (6.6)	P0931RM	P0928AC	P0931RR
3.0 (9.8)	P0916DC	P0928AD	P0916VC
5.0 (16.4)	P0916DD	P0928AE	P0916VD
10.0 (32.8)	P0916DE	P0928AF	P0916VE
15.0 (49.2)	P0916DF	P0928AG	P0916VF
20.0 (65.6)	P0916DG	P0928AH	P0916VG
25.0 (82.0)	P0916DH	P0928AJ	P0916VH
30.0 (98.4)	P0916DJ	P0928AK	P0916VJ

(a) P/PVC is polyurethane outer jacket and semi-rigid PVC primary conductor insulation. Temperature range: -20 to +80°C (-4 to +176°F)

(b) Low smoke zero halogen or low smoke free of halogen (LSZH) is a material classification used for cable jacketing. LSZH is composed of thermoplastic or thermoset compounds that emit limited smoke and no halogen when exposed to high sources of heat. Temperature range: -40 to +105°C (-40 to +221°F)

(c) H/XLPE is Hypalon outer jacket and XLPE (cross-linked polyethylene) primary conductor insulation. Temperature range; -40 to +90°C (-40 to +194°F). Hypalon cables are no longer available for purchase.

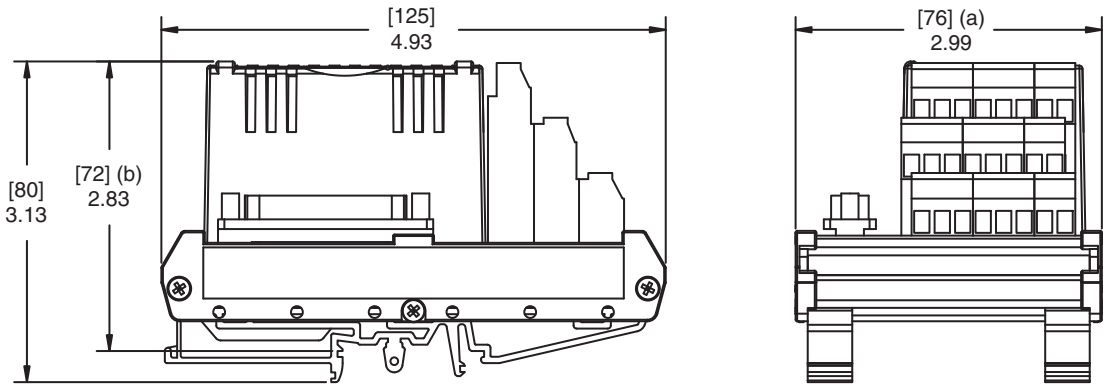
Use of Termination Assemblies in 100 Series Upgrade

When a redundant FBM245 is used to replace the 100 Series FBM05, it may use any of the appropriate termination assemblies listed above for the FBM245's field I/O wiring.

DIMENSIONS – NOMINAL

[mm]
in

TERMINATION ASSEMBLY - Compression - P0924QU, P0924QZ



(a) Overall width – for determining DIN rail loading.
(b) Height above DIN rail (add to DIN rail height for total).

RELATED PRODUCT SPECIFICATION SHEETS (PSS)

PSS Number	Description
PSS 21H-2W1 B3	DIN Rail Mounted FBM Subsystem Overview
PSS 21H-2W1 B4	100 Series Fieldbus Module Upgrade Subsystem Overview
PSS 21H-2W2 B3	DIN Rail Mounted FBM Equipment, Agency Certification
PSS 21H-2W6 B4	DIN Rail Mounted Modular Baseplates
PSS 21S-3B2 B3	Control Processor 270 (CP270) Integrated Control Software

Invensys
10900 Equity Drive
Houston, TX 77041
United States of America
http://www.invensys.com

Global Customer Support
Inside U.S.: 1-866-746-6477
Outside U.S.: 1-508-549-2424 or contact your local Invensys representative.
Website: http://support.ips.invensys.com