Foxboro™ DCS

FBM208/b, Redundant with Readback, 0 to 20 mA I/O Module

PSS 41H-2S208

Product Specification

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Legal Information

Overview

Single input/single output control schemes with high availability requirements can take advantage of the FBM208 arranged as a redundant pair. A readback feature is provided that detects failures of the output channel. In a repair situation, when a single module is replaced, the inputs and outputs are maintained by the redundant module. HART® signals are electrically compatible with the 4-20 mA signals, permitting the plant to upgrade field devices without the need to change the control system. The FBM208b provides the same functionality and is used to upgrade from the older FBM05.

A redundant pair of the modules combine to provide redundancy at the Fieldbus Module (FBM) level, with field I/O wired to one common termination assembly (see *Figure 1, page 4*). Each module independently attempts to hold the output(s) at its specified output value(s), and each independently reports its observed value of the inputs

A redundant analog input and redundant analog output block in the Foxboro™ DCS Control Software validates each input and output in conjunction with information to/from the module.

The FBM208 is electrically compatible with standard HART signals.

Features

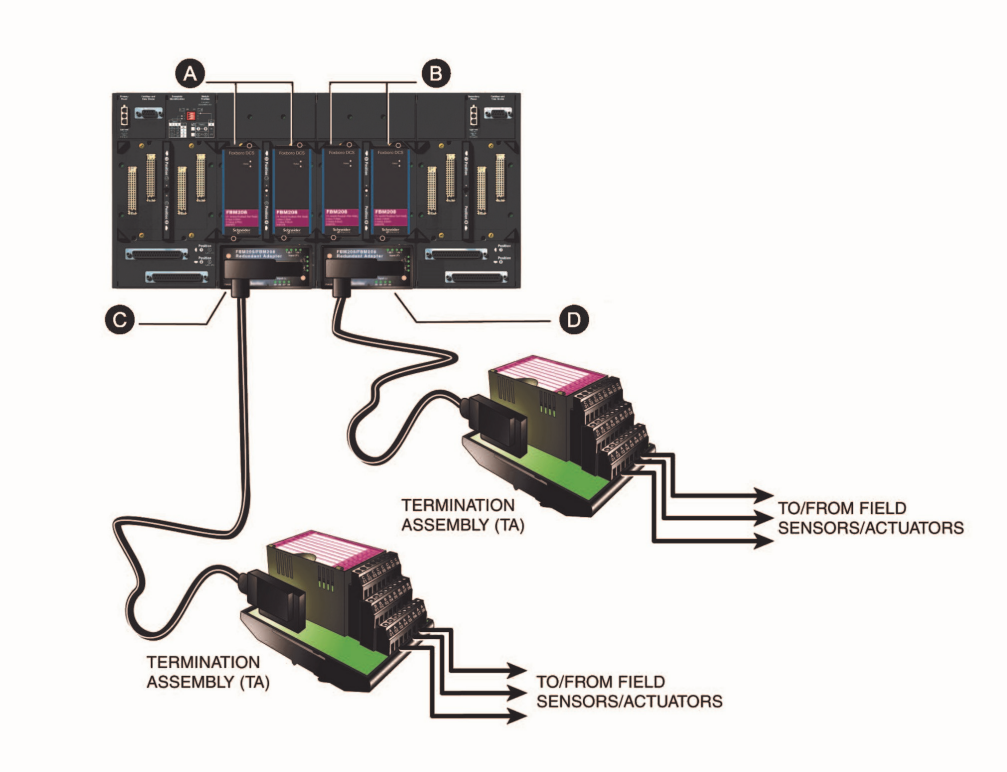
- Four 0 to 20 mA dc analog input channels
- Four 0 to 20 mA dc analog output channels with readback
- Compares FBM's output value with the current readback value. If the readback value differs from the desired output by more than ± 2%, the FBM marks its output channel BAD
- Monitors FBM's internal channel current loop power and marks the channel BAD if power is less than 16 V dc
- Marking a channel Bad causes the corresponding channel in the redundant module to continue to drive the outputs
- Redundant modules increase reliability
- Termination Assemblies (TAs) for locally or remotely connecting field wiring to the FBM208

Readback

The FBM compares its output value with the current readback value. If the readback value differs from the desired output by more than ±2%, the FBM marks its output channel BAD. In addition, if the output value is greater than the desired output by more than +2%, the power to that channel is shut off to help prevent the bad channel from interfering with the control of that channel by the redundant partner FBM. The power to a failed channel remains off until the FBM is replaced or rebooted by the user.

When the FBM's output channel is marked BAD, the CP presents that information to the Foxboro DCS for display as a System Management alarm message and as a control block alarm.

Figure 1 - Redundant FBM208/208b I/O Configuration (2 Pairs Shown)



Legend	
A	Fieldbus Modules (FBM208/b)
B	Fieldbus Modules (FBM208/b)
C	Redundant Adapter
D	Redundant Adapter

Redundant Analog Inputs

Each input channel accepts an analog sensor input such as a 4 to 20 mA transmitter or a self-powered 4 to 20 mA source.

Transmitter power from each module is diode OR'd together in the redundant adapter to help assure redundant power.

A redundant analog input function block, AINR, is used for each redundant pair of inputs. The AINR block handles input reads and initialization logic for the redundant channels. On each execution cycle of the AINR block, identical reads are sent to both modules, fully exercising the fieldbus and the logic circuitry of each module.

Input channel options include a configurable choice of integration time on a per module basis. Input channel availability is enhanced by redundantly powering the input current loop from per channel power supplies in each module of the pair.

Redundant Analog Outputs

Each output channel drives an external load and produces a 0 to 20 mA output.

A redundant analog output block, AOUTR, is used for each redundant pair of outputs. The AOUTR block handles output writes and initialization logic for the redundant channels. On each execution cycle of the AOUTR block, identical output writes are sent to both modules, fully exercising the fieldbus and the logic circuitry of each module. When a failure is detected in one of the modules, 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.

Configurable options in the modules for output failsafe and fallback options are always set to their default values (0 mA). This removes one of the pair of redundant output channels from service for detectable problems such as a module not properly receiving output writes or not passing diagnostic tests on FBM microprocessor writes to output registers. Using the default failsafe/fallback options of 0 mA output also minimizes the possibility of a “fail high” result.

High Accuracy

For high accuracy, the module incorporates sigma-delta converters for each channel. This provides new analog input readings every 25 ms and a configurable integration period to remove any process noise and power line frequencies. Each time period, the FBM converts each analog input to a digital value, averages these values over the time period and provides the averaged value to the controller.

High Reliability

The redundancy of the module pair, coupled with the high coverage of detected faults, provides a very high subsystem availability time.

The microprocessor of each module executes the analog I/O application program, plus diagnostic routines that validate the health of the FBM.

Either module may be replaced without upsetting field input or output signals to the good module. The module can be removed/replaced without removing field device termination cabling, power, or communications cabling.

Light-emitting diodes (LEDs) incorporated into the front of the module provide visual indications of the module’s operational status.

Standard Design

FBM208/208b has 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.

Fieldbus Communication

The Fieldbus Communications Module (FCM) or the Field Control Processor (FCP) interfaces to the redundant 2 Mbps module Fieldbus used by the FBMs. The FBM208/208b accepts communication from either path (A or B) of the 2 Mbps Fieldbus. If one path is unsuccessful or is switched at the system level, the module continues communication over the active path.

Modular Baseplate Mounting

The FBM208 module mounts on a DIN rail mounted modular baseplate, which accommodates up to four or eight FBMs. The FBM208b module also mounts on conversion mounting structures. See *100 Series Conversion Mounting Structures* (PSS 41H-2W8).

Redundant modules must be located in adjacent positions on the baseplate, with the first module located in an odd-numbered position (for example, the positions labelled "3" and "4"). To achieve redundancy, a redundant adapter module is placed on the two adjacent baseplate termination cable connectors to provide termination for a single cable (see *Figure 1, page 4*). A single termination cable connects from the redundant adapter to the associated termination assembly (TA).

Easy Removal/Replacement

When redundant, either module may be replaced without upsetting field input signals to the good module. Each module can be removed/replaced without removing field termination cabling, power, or communications cabling.

Redundant Modules in Foxboro DCS HMI

To system configurator applications and to other systems monitoring through SMON, Foxboro DCS System Manager, and SMDH, redundant FBM208/208bs appear to be separate, nonredundant modules. The functional redundancy for these modules is provided by their associated control blocks.

Termination Assemblies

Field I/O signals for the FBM208 connect to the FBM subsystem via DIN rail mounted termination assemblies (TAs). The TAs used with the FBM208 are described in *Termination Assemblies And Cables, page 13*.

For field I/O signals for the FBM208b, see *Use of Termination Assemblies in 100 Series Upgrade Subsystem, page 15*.

Functional Specifications

Process I/O Communications	Communicates with its associated FCM or FCP via the redundant 2 Mbps module Fieldbus
Input/Output Channels	Four 0 to 20 mA dc analog input channels and four 0 to 20 mA dc analog output channels. Each channel is isolated and independent. **NOTE:** Redundant pairs (input or output) are connected together by a common field I/O connector and therefore are not isolated from each other.
Input/Output Range (Each Channel)	0 to 20.4 mA dc
Input Channels (Four)	• Analog Accuracy (Includes Linearity): ◦ ±0.3% of span which Includes the tolerance of the sense resistor in the redundant adapter. ◦ Accuracy temperature coefficient: ±50 ppm/ºC. • Input Channel Impedance: 60 Ω nominal (resistor in redundant adapter). • Input Signal A/D Conversion: Each channel performs its own A/D signal conversion, using the sigma-delta conversion technique. • Integration Period: Software configurable • Common Mode Rejection: >100 db at 50 or 60 Hz • Normal Mode Rejection: >95 db at 50 or 60 Hz • Loop Power Supply Protection: Each channel is channel-to-channel galvanically isolated, current limited, and voltage regulated. All analog inputs are limited by their design to less than 30 mA. If the current limit circuit shorts out, the current is limited to about 100 mA. • Field Device Cabling Distance: Maximum distance of the field device from the FBM is a function of compliance voltage (22.8 V dc), wire resistance, and voltage drop at the field device.

Output Channels (Four)	• Analog Accuracy: ±0.05% of span • Output Load: 750 Ω maximum • Output Processing Delay: 30 ms maximum • Resolution: 13 bits • Loop Power Supply Protection: Each channel is channel-to-channel galvanically isolated, current limited, and voltage regulated. All analog outputs are limited by their design to about 25 mA. If the output FET shorts, the output current could increase up to 35 mA. In normal operation the FBM outputs a constant current into a 0 to 750 Ω load. • Field Device Cabling Distance: Maximum distance of the field device from the FBM is a function of compliance voltage (19.6 V dc at 20.4 mA), wire resistance, and voltage drop at the field device. • HART® Protocol Compatibility: The channels meet the impedance requirements for a HART High Impedance Device and can be used in a HART loop without interfering with the HART signals between the field device and a Hand-Held Communicator (HHC). If a FoxCom or HART transmitter is used with FBM208/208b, a 200 Ω in-line resistor (assembly part number RH902VY) must be added in series with the transmitter.
Input/Output Channel Isolation	Each channel is galvanically isolated from all other channels and earth (ground). The TA/module 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. **⚠⚠DANGER** **HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH** 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. **Failure to follow these instructions will result in death or serious injury.**
Calibration Requirements	Calibration of the module and termination assembly is not required.
Power Requirements	• Input Voltage Range (Redundant): 24 V dc +5%, -10% • Consumption: 10 W (maximum) total for redundant pair • Heat Dissipation: 7 W (maximum) total for redundant pair

Regulatory Compliance: Electromagnetic Compatibility (EMC)	• *European EMC Directive 2004/108/EC (Prior to April 20, 2016) and 2014/30/EU (Beginning April 20, 2016)*: Meets: EN61326-1:2013 Class A Emissions and Industrial Immunity Levels
Regulatory Compliance: Product Safety	• *Underwriters Laboratories (UL) for U.S. and Canada*: UL/UL-C listed as suitable for use in UL/ULC listed Class I, Groups A-D; Division 2; temperature code T4 enclosure based systems when connected to specified Foxboro DCS processor modules as described in the *Standard and Compact 200 Series 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). • *European Low Voltage Directive 2006/95/EC (Prior to April 20, 2016) and 2014/35/EU (Beginning April 20, 2016) and Explosive Atmospheres (ATEX) directive 94/9/EC (Prior to April 20, 2016) and 2014/34/EU (Beginning April 20, 2016)*: DEMKO certified as Ex nA IIC T4 for use in certified Zone 2 enclosure when connected to specified processor modules as described in the *Standard and Compact 200 Series Subsystem User's Guide* (B0400FA).
RoHS Compliance	Complies with European RoHS Directive 2011/65/EU, including amending Directives 2015/863 and 2017/2102.
Marine Certification	ABS Type Approved and Bureau Veritas Marine certified for Environmental Category EC31.

Environmental Specifications

	Operating	Storage
Temperature	• Module: -20 to +70°C (-4 to +158°F) • Termination Assembly — PA: -20 to +70°C (-4 to +158°F)	-40 to +70°C (-40 to +158°F)
Relative Humidity	5 to 95% (noncondensing)	
Altitude	-300 to +3,000 m (-1,000 to +10,000 ft)	-300 to +12,000 m (-1,000 to +40,000 ft)
Vibration	7.5 m/s^2 (0.75 g) from 5 to 500 Hz	
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.	

NOTE: 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) that describes the type of enclosure to be used.

Physical Specifications

Mounting	• Module: The FBM208 mounts on a Modular Baseplate. The Modular Baseplate can be mounted on a DIN rail (horizontally or vertically), or horizontally on a 19-inch rack using a mounting kit. Redundant modules must be located in odd and adjacent even positions on the baseplate (positions 1 and 2, 3 and 4, 5 and 6, or 7 and 8). See *Standard 200 Series Baseplates* (PSS 41H-2SBASPLT) for details. The FBM208b mounts on a 100 Series conversion mounting structure. See *100 Series Conversion Mounting Structures* (PSS 41H-2W8) for details. • Termination Assemblies: The TAs accommodate multiple DIN styles including 32 mm (1.26 in) and 35 mm (1.38 in).
Weight	• Module: 284 g (0.62 lb) approximate (each module) • Compression Screw TA: 363 g (0.8 lb) • Ring Lug TA: 464 g (1.0 lb)
Dimensions - Module	• 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 Assemblies	See *Dimensions - Nominal, page 16*
Part Numbers	• FBM208 Module: RH914TB • FBM208b Module: RH924EV • Termination Assemblies: See *Functional Specifications - Termination Assemblies, page 14* • Redundant Adapter: RH916NN

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, page 15* • Cable Connection: ◦ FBM Baseplate End: 37-pin D-subminiature ◦ Termination Assembly End: 25-pin D-subminiature
Construction - Termination Assembly	• Material: Polyamide (PA) Material, compression or ring lug
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 • Ring Lug Type Accepted Wiring Sizes: #6 size connectors (0.375 in (9.5 mm)) 0.5 to 4 mm^2 /22 AWG to 12 AWG

Termination Assemblies and Cables

The FBM208 field I/O signals connect to the FBM subsystem via DIN rail mounted TAs.

The redundant adapter connects the redundant FBMs baseplate input/output connectors together. The redundant adapter provides a single termination connection to a single TA (see *Figure 1, page 4*).

TAs are available in these materials:

- Polyamide (PA) material

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 these materials:

- Polyurethane
- Low Smoke Zero Halogen (LSZH)

Functional Specifications - Termination Assemblies

FBM Type	Input/Output Signal	TA Part No. PA (a)	Termination Type (b)	TA Cable Type (c)	TA Cert. Type (d)
FBM208	Four 0 to 20 mA input, four 0 to 20 mA output	RH916XL	C	1	1, 2
		P0917JP(e)	RL		
FBM208b	Four 0 to 20 mA input, four 0 to 20 mA output	n/a(f)			

(a) 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, page 15* for cable part numbers and specifications.

(d) See *Table 1, page 14* for termination assembly certification definitions.

(e) Polyamide RL supersedes the PVC RL. This is not a RoHS part.

(f) See *Use of Termination Assemblies in 100 Series Upgrade Subsystem, page 15*.

Table 1 - Certification for Termination Assemblies

Type	Certification
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 DEMKO certified EEx nA 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 200 Series FBMs and field circuits meeting entity parameter constraints specified in *Standard and Compact 200 Series Subsystem User's Guide* (B0400FA). They are also 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.

Table 2 - Termination Cable Types and Part Numbers

Cable Length m (ft)	Type 1 P/PVC[a]	Type 1 LSZH[b]
0.5 (1.6)	RH916DA	RH928AA
1.0 (3.2)	RH916DB	RH928AB
2.0 (6.6)	RH931RM	RH928AC
3.0 (9.8)	RH916DC	RH928AD
5.0 (16.4)	RH916DD	RH928AE
10.0 (32.8)	RH916DE	RH928AF
15.0 (49.2)	RH916DF	RH928AG
20.0 (65.6)	RH916DG	RH928AH
25.0 (82.0)	RH916DH	RH928AJ
30.0 (98.4)	RH916DJ	RH928AK

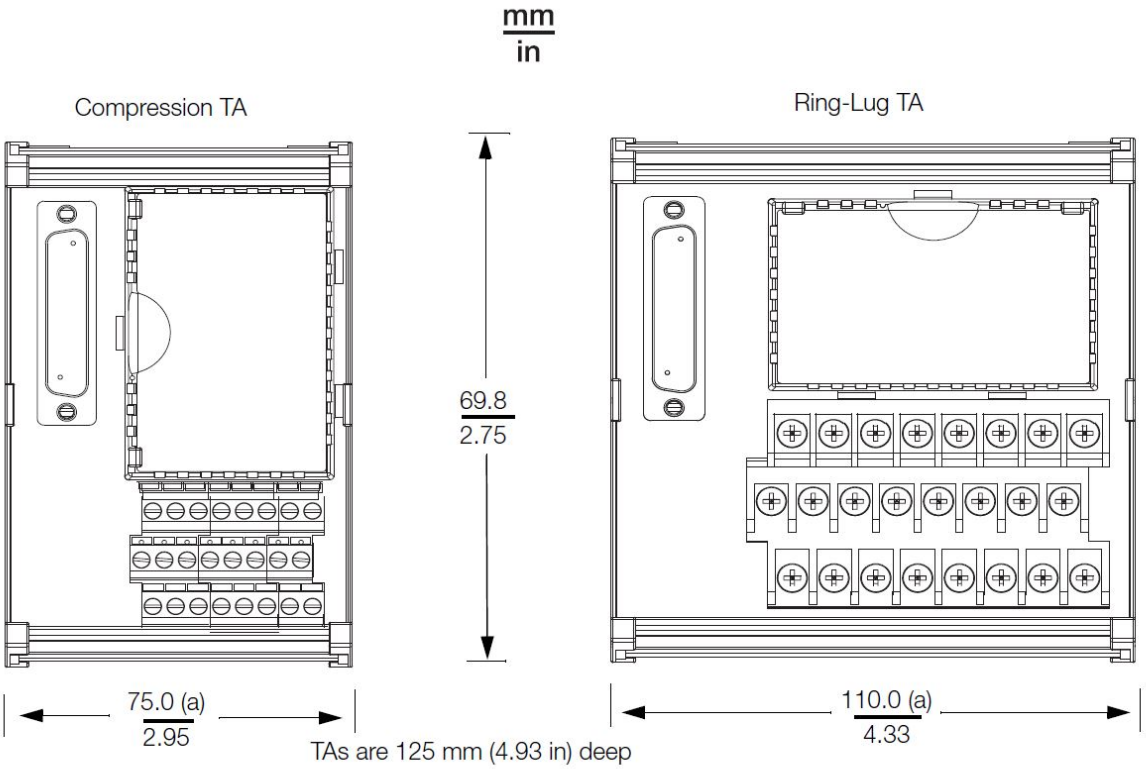
[a] P/PVC is polyurethane outer jacket and semi-rigid PVC primary conductor insulation. Temperature range: -20 to +80°C (-4 to +176°F).

[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).

Use of Termination Assemblies in 100 Series Upgrade Subsystem

When an FBM208b is used to replace the 100 Series FBM05, it must accept the FBM05's field I/O wiring through a Termination Assembly Adapter (TAA) instead of a termination assembly. See *Termination Assembly Adapter Modules for 100 Series Upgrade* (PSS 41H-2W4).

Dimensions - Nominal



(a) Overall width – for determining DIN rail loading.

Related Product Documents

Document Number	Description
PSS 41H-2SOV	*Standard 200 Series Subsystem Overview*
B0400FA	*Standard and Compact 200 Series Subsystem User's Guide*
PSS 41H-2W100	*100 Series Fieldbus Module Upgrade Subsystem Overview*
PSS 41H-2CERTS	*Standard and Compact 200 Series I/O, Agency Certifications*
PSS 41H-2W4	*Termination Assembly Adapter Modules for 100 Series Upgrade*
PSS 41H-2SBASPLT	*Standard 200 Series Baseplates*
PSS 41H-2W8	*100 Series Conversion Mounting Structures*
PSS 41S-3FCPICS	*Field Control Processor 280 (FCP280) Integrated Control Software*

⚠ **WARNING**: This product can expose you to chemicals including lead and lead compounds, which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information, go to www.p65warnings.ca.gov/.

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As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

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