

Compact FBM216b, HART® Communication Redundant Input Interface Module



The Compact FBM216b offers redundant modules for eight individually isolated HART® input channels. Each channel accepts a 4 to 20mA analog signal or a digital HART® signal superimposed on an analog signal.

FEATURES

Key features of the Compact FBM216b module are:

- ▶ Eight individually isolated analog input channels. Each channel accepts one of the following inputs:
 - Standard 4 to 20 mA analog sensor signal
 - Digital HART Frequency Shift Keying (FSK) signal superimposed on a 4 to 20 mA analog signal.
- ▶ Module pair offers redundancy at the FBM level
- ▶ FSK modem dedicated to each input channel for bi-directional digital communications with a HART field device
- ▶ Analog to digital conversion of each of the 4 to 20 mA input signal from the HART devices
- ▶ Support for the HART universal commands necessary to interface the field device with the Foxboro Evo™ Control Core Services system database
- ▶ Per channel galvanic isolation of each of the eight input channels from each other, ground and module logic

- ▶ Compact, rugged design suitable for enclosure in Class G3 (harsh) environments
- ▶ High accuracy achieved by sigma-delta analog-to-digital conversions for each channel
- ▶ Termination Assembly (TA) for locally or remotely connecting field wiring to the Compact FBM216b
- ▶ Termination Assembly provide for per channel internally and/or externally loop powered transmitters.

OVERVIEW

The Compact FBM216b HART Communication Redundant Input Interface Module contains eight individually isolated input channels. It supports any mix of standard 4 to 20 mA devices and HART devices, and is part of the Compact 200 Series I/O subsystem described in *Compact 200 Series I/O Subsystem Overview* (Reference 1). (See Table 3, "Reference Documents," on page 15 at the end of this document.)

A pair of modules combines to provide redundancy at the Fieldbus Module (FBM) level, with field inputs wired to one common termination assembly (see Figure 1). In this configuration, one Compact FBM216b is the Master, and the other is the Tracker.

The Compact FBM216b serves as a HART communications field device host, enabling the Foxboro Evo system to request and receive two digital messages per second from each field device. The message pass-through capability can be used to support HART universal, common practice, and device-specific commands, but not the burst communication mode. These commands are implemented using the Intelligent Field Device Configurator (IFDC — see *Intelligent Field Device Configurator FoxCom and HART Protocols* (Reference 2) for details).

The Compact FBM216b provides individually isolated power supplies to power each of the eight channels.

Optionally, the channels for this module can be powered by an external power supply. However, when a common external power supply is used with two or more channels, a Cable Balun module is required to prevent HART communication channel crosstalk.

HIGH ACCURACY

For high accuracy, the module incorporates a Sigma-Delta analog-to-digital converter which can provide new analog input values for each channel every 100 milliseconds.

COMPACT DESIGN

The Compact FBM216b's design is narrower than the standard 200 Series FBMs. It has a rugged acrylonitrile butadiene styrene (ABS) 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.

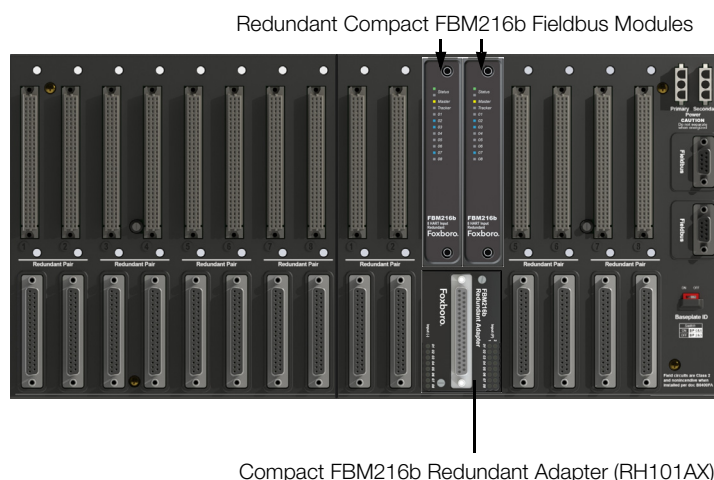


Figure 1. Compact FBM216b Redundant Module Configuration

HIGH RELIABILITY

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

Either module may be replaced without upsetting field input signals to the other module. A module can be removed or replaced without removing field device termination cabling, power, or communications cabling.

REDUNDANT ANALOG INPUTS

For each input operation, identical signals are sent to both redundant modules, fully exercising the Fieldbus and the logic circuitry of each module. Each input channel accepts an analog sensor input or a self-powered 4 to 20 mA source. Device power from each module is diode OR'd together in the redundant adapter to ensure redundant power.

The microprocessor of each module executes the analog I/O application program, plus security routines that validate the health of the FBM. Input channel availability is enhanced by redundantly powering the input current loop from per-channel power supplies in each module of the pair.

VISUAL INDICATORS

Light-emitting diodes (LEDs) incorporated into the front of the module provide visual indication of the module's operational and master or tracker status, and communication activity on the channels.

EASY REMOVAL/REPLACEMENT

The module mounts on a Compact 200 Series baseplate which is either DIN rail mounted or rack mounted horizontally, and includes signal connectors for redundant Fieldbus, redundant independent dc power, and termination cables. Two screws on the FBM secure the module to the Compact 200 Series baseplate.

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). A single termination cable connects from the redundant adapter to the associated termination assembly (TA).

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.

FIELD BUS COMMUNICATION

A Fieldbus Communication Module or a Control Processor interfaces the redundant 2 Mbps module Fieldbus used by the FBMs. The Compact FBM216b accepts communication from either path (A or B) of the redundant 2 Mbps fieldbus – should one path fail or be switched off at the system level, the module continues communication over the active path.

The use of an external power supply common to two or more loops requires a Cable Balun module to maintain communication signal line balance.

TERMINATION ASSEMBLIES

Field input signals connect to the FBM subsystem via DIN rail mounted TAs. The TA used with the Compact FBM216b is described in “TERMINATION ASSEMBLIES AND CABLES” on page 11.

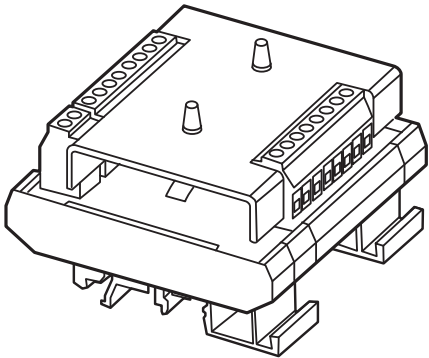
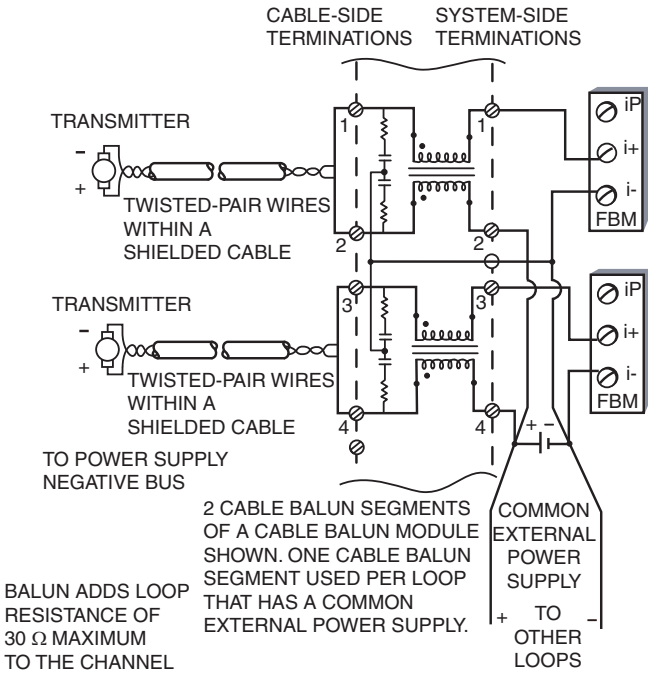
CABLE BALUN MODULE

The Cable Balun module is used to maintain digital communication line balance for HART Transmitter to FBM loops that are powered from a common external power supply. This powering effectively connects one line of each loop together. Without the Baluns, the common connection at the external power supply, would cause near end crosstalk at the system end of the loop. Loops using FBM internal power source do not require Cable Baluns.

The Cable Balun module contains multiple Baluns. One Balun segment is interconnected in each externally-powered loop (see Figure 2). There is one

Cable Balun module for four channels.

Cable Balun Module		
Module Model	Module Part No.	No. of Baluns in the Module
CBM-4	RH903SV (supersedes P0903SV)	4



CABLE BALUN MODULE

Figure 2. Cable Balun Module

FUNCTIONAL SPECIFICATIONS

Field Device Channels

SUPPORTED HART INSTRUMENT TYPES

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

INTERFACE

8 individually isolated channels

COMMUNICATION TO THE DEVICE

Point-to-point, master/slave, asynchronous, half-duplex, at 1200 baud

ERROR CHECKING

Parity on each byte, and one CRC check byte

SPEED

2 messages per second

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).

MAXIMUM DISTANCE (FBM216b TO FIELD DEVICE)

Meets HART FSK physical layer specification HCF_SPEC-54, Revision 8.1 [up to 3030 m (10000 ft)]⁽¹⁾

INTERNAL LOOP SUPPLY COMPLIANCE

VOLTAGE AT TERMINATION ASSEMBLY

18.5 V dc minimum at 20.5 mA

CURRENT INPUTS

Sense Resistor

280 Ω $\pm 0.02\%$

Total Input Resistance Including

Redundancy Adapter

280 Ω nominal

CURRENT INPUTS (CONT.)

Analog Accuracy (Includes Nonlinearity)

$\pm 0.075\%$ of full scale

Temperature Coefficient

50 PPM/ $^{\circ}\text{C}$

Resolution

15 bits

Update Rate

100 ms

Integration Time

500 ms

Common Mode Rejection

>100 db at 50 or 60 Hz

Normal Mode Rejection

>35 db at 50 or 60 Hz

LOOP POWER SUPPLY PROTECTION

Each channel is individually galvanically isolated, current limited and voltage regulated. All field connections are limited by their design to less than 37 mA with a single module installed (72 mA when redundant modules are installed).

SYSTEM SOFTWARE

Requires I/A Series software v8.8 or Foxboro Evo Control Core Services v9.0 or later.

(1) The maximum allowable distance decreases when the loop is operated through an intrinsic safety barrier. The maximum distance of the field device from the FBM is a function of compliance voltage, wire gauge and voltage drop at the device.

FUNCTIONAL SPECIFICATIONS (CONTINUED)

INPUT RESISTANCE INCLUDING TERMINATION ASSEMBLY AND REDUNDANCY ADAPTER

Externally Powered

282 Ω

Internally Powered

302 Ω

FBM INTERNAL POWER FOR FIELD DEVICE

Per channel isolated 24 V dc $\pm 10\%$ supply. Loop supply output impedance is 20 Ω including the termination assembly.

ISOLATION

The individual channel inputs and loop supplies are galvanically isolated from each other, ground and module logic.

The module's isolation is designed to withstand, without damage, a common mode potential of 600 V ac applied for one minute between the isolated input circuits and earth (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.

Fieldbus Communication

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

Power Requirements

INPUT VOLTAGE RANGE (REDUNDANT)

24 V dc $+5\%$ -10%

CONSUMPTION

7 W (maximum)

HEAT DISSIPATION

4 W (maximum)

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

SAFETY CERTIFICATION (FBM AND CABLE BALUN)

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

UL/UL-C listed as suitable for use in Class I, Groups A-D; Division 2; temperature code T4 enclosure based systems. Where power is supplied by the FBM, 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 *Standard and Compact 200 Series Subsystem User's Guide* (Reference 3).

European Low Voltage Directive 2014/35/EU and Explosive Atmospheres (ATEX) directive 2014/34/EU

ATEX (DEMKO) Ex nA IIC T4 Gc certified when connected as described in the *Standard and Compact 200 Series Subsystem User's Guide* (Reference 3). For use in an enclosure suited for an ATEX Zone 2 classified area. Also, see Table 1 on page 12

FUNCTIONAL SPECIFICATIONS (CONTINUED)

Regulatory Compliance (Cont.)

RoHS COMPLIANCE

Complies with European RoHS Directive 2011/65/EU

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 when connected to specified Foxboro Evo 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). Conditions for use are as specified in the *Standard and Compact 200 Series Subsystem User's Guide* (B0400FA).

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 I/A Series processor modules as described in the *Standard and Compact 200 Series Subsystem User's Guide* (B0400FA).

MARINE CERTIFICATION

(FBM216b only)

ABS Type Approved and Bureau Veritas Marine certified for Environmental Category EC31.

Calibration Requirements

Calibration of the module or termination assembly is not required.

ENVIRONMENTAL SPECIFICATIONS

Operating

TEMPERATURE

Module

-20 to +60°C (-4 to +140°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 +85°C (-40 to +185°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/S² (0.75 g) from 5 to 500 Hz

PHYSICAL SPECIFICATIONS

Mounting

MODULE

The Compact FBM216b mounts on a Compact 200 Series 16-slot horizontal baseplate. The baseplate can be mounted on a horizontal DIN rail or on a 19-inch rack using a mounting kit. Refer to *Compact 200 Series 16-Slot Horizontal Baseplate* (Reference 4) 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

MODULE

185 g (6.5 oz) approximate

TERMINATION ASSEMBLY

Compression

181 g (0.40 lb) approximate

Dimensions – Module

HEIGHT

130 mm (5.12 in)

WIDTH

25 mm (0.98 in)

DEPTH

150 mm (5.9 in) - Including baseplate connectors, 139 mm (5.46 in)

Dimensions – Termination Assembly

See page 14.

Part Numbers

COMPACT FBM216b MODULE

RH101AD

TERMINATION ASSEMBLIES

See “FUNCTIONAL SPECIFICATIONS – TERMINATION ASSEMBLIES” on page 11

REDUNDANT ADAPTER

RH101AX

Termination Cables

CABLE LENGTHS

Up to 30 m (98 ft)

CABLE MATERIALS

Polyurethane (PVC) or Low Smoke Zero Halogen (LSZH)

TERMINATION CABLE TYPE

Types 1 – See Table 2 on page 13.

CABLE CONNECTION – TA

FBM Baseplate End

37-pin D-subminiature

Termination Assembly End

25-pin D-subminiature

Field Termination Connections

COMPRESSION-TYPE ACCEPTED WIRING SIZES

Solid/Stranded/AWG

0.2 to 4 mm²/0.2 to 2.5 mm²/24 to 12 AWG

Stranded with Ferrules

0.2 to 2.5 mm² with or without plastic collar

TERMINATION ASSEMBLIES AND CABLES

Field input signals connect to the Compact 200 Series I/O subsystem via DIN rail mounted Termination Assemblies. The TA for the Compact FBM216b module is available in Polyamide (PA) material with compression screw terminations.

See the following “FUNCTIONAL SPECIFICATIONS – TERMINATION ASSEMBLIES” for the TA used with the Compact FBM216b.

The Compact FBM216b pair and redundant adapter combination provides sufficient loop resistance to allow use of the HART Hand-Held Terminal, or PC20 Intelligent Field Device Configurator (Reference 5). A

removable termination cable connects the DIN rail mounted TA to the FBM via a field connector on the baseplate in which the FBM is installed. Termination cables are available in the following materials:

- ▶ Polyurethane (PVC)
- ▶ Low Smoke Zero Halogen (LSZH).

Termination cables are available in a variety of lengths, up to 30 meters (98 feet), allowing the Termination Assembly to be mounted in either the enclosure or in an adjacent enclosure. See Table 2 for a list of termination cables used with the TAs for the Compact FBM216b.

FUNCTIONAL SPECIFICATIONS – TERMINATION ASSEMBLIES

FBM Type	Input Signal	TA Part Number	Termination	TA Cable	TA Certification
		PA(a)	Type(b)	Type(c)	Type(d)
Compact FBM216b Module	8 input channels, 4 to 20 mA analog signal, alone or with HART signal superimposed	RH924JH	C	1	1, 2

(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 for cable part numbers and specifications.
(d) See Table 1 for Termination Assembly certification definitions.

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 Ex 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 DIN rail mounted FBMs and field circuits meeting entity parameter constraints specified in <i>Standard and Compact 200 Series Subsystem User's Guide</i> (Reference 3). 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 *Standard and Compact 200 Series Subsystem User's Guide* (Reference 3) and the conditions stated in UL and DEMKO reports.

Table 2. Cables Types and Part Numbers

Cable Length m (ft)	Type 1 P/PVC^(a)	Type 1 LSZH ^(b)
0.5 (1.6)	RH100BY	RH100BC
1.0 (3.2)	RH100BZ	RH100BD
1.5 (4.9)	RH100EP	RH100EL
2.0 (6.6)	RH100CA	RH100BE
3.0 (9.8)	RH100CB	RH100BF
5.0 (16.4)	RH100CC	RH100BG
10.0 (32.8)	RH100CD	RH100BH
15.0 (49.2)	RH100CE	RH100BJ
20.0 (65.6)	RH100CF	RH100BK
25.0 (82.0)	RH100CG	RH100BL
30.0 (98.4)	RH100CH	RH100BM

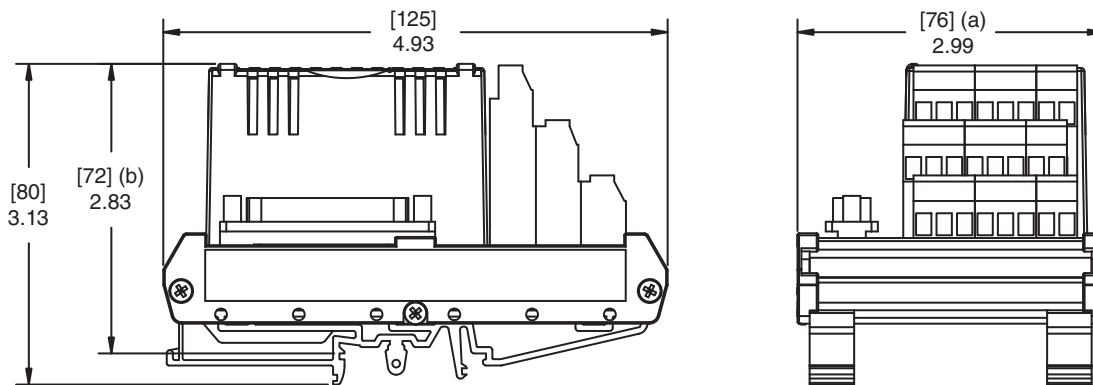
(a) P/PVC is polyurethane outer jacket and semi-rigid PVC primary conductor insulation. Temperature range: -20 to +80°C (-4 to +176°F).

(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)

DIMENSIONS – NOMINAL

[mm]
in

Compression Termination Assembly - RH924JH



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

RELATED PRODUCT DOCUMENTS

Table 3. Reference Documents

Reference	Document Number	Description
1	PSS 31H-2COV	Compact 200 Series I/O Subsystem Overview
2	PSS 21S-8A3 B3	Intelligent Field Device Configurator FoxCom and HART Protocols
3	B0400FA	Standard and Compact 200 Series Subsystem User's Guide
4	PSS 31H-2C200	Compact 200 Series 16-Slot Horizontal Baseplate
5	PSS 2A-1Z3E	Model PC20 Intelligent Field Device Configurator for Use with Transmitter with FoxCom or HART Communication Protocol

Table 4. Other Related Documents

Document Number	Description
PSS 31H-2CERTS	Standard and Compact 200 Series I/O, Agency Certifications
PSS 31H-2C480 B4	Compact Power Supply - FPS480-24
PSS 31S-3FCPICS	Field Control Processor 280 (FCP280) Integrated Control Software
PSS 21S-3CP270IC	Control Processor 270 (CP270) Integrated Control Software

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