

## **FBM216b Redundant HART® Communication Input Module**



*An FBM216 pair provides up to eight redundant HART® input channels. In a repair situation, when a single module is replaced the inputs are maintained by the redundant module. HART inputs are electrically compatible with 4-20 mA signals, permitting the plant to upgrade field devices without the need to change the control system.*

### **OVERVIEW**

The FBM216b Redundant HART Communication Input Module contains eight individually isolated input channels. It supports any mix of standard 4 to 20 mA devices and HART devices.

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 FBM216b is the Master, and the other is the Tracker.

The 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 Foxcom™ and HART™ Protocols* (IFDC — refer to PSS 21S-8A2 B3 for details).

The 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.

## FEATURES

Key features of the 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 system database
- ▶ Per channel galvanic isolation of each of the 8 input channels from each other, ground and module logic
- ▶ Rugged design suitable for enclosure in Class G3 (harsh) environments per ISA Standard S71.04
- ▶ High accuracy achieved by sigma-delta data conversions for each channel

- ▶ Termination Assembly (TA) for locally or remotely connecting field wiring to the FBM216b
- ▶ Termination Assembly provide for per channel internally and/or externally loop powered transmitters.

## HIGH ACCURACY

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

## STANDARD DESIGN

The FBM216b 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.

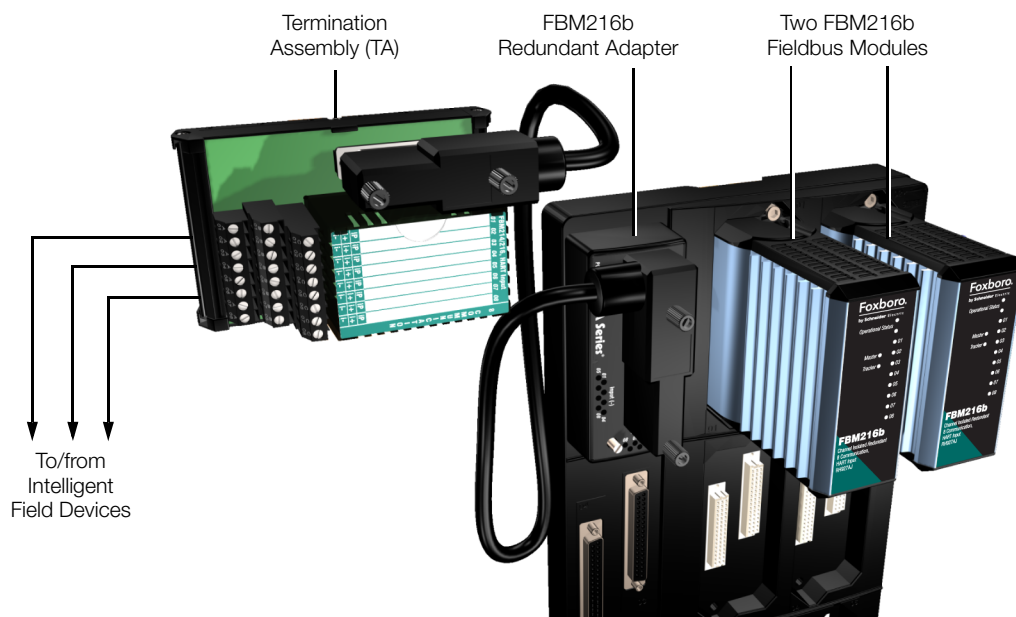


Figure 1. Redundant FBM216b Module Configuration

## 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 reads are sent to both 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 security 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 redundancy status, and communication activity on the channels. Two additional LEDs provide the master or tracker status of the modules.

**FIELDBUS COMMUNICATION**

A Fieldbus Communication Module or a Control Processor interfaces the redundant 2 Mbps module Fieldbus used by the FBMs. The FBM216b module 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.

**MODULAR BASEPLATE MOUNTING**

The module mounts on a modular baseplate. 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.

Redundant modules must be located in adjacent positions on the baseplate (positions 1 and 2, 3 and 4, 5 and 6, or 7 and 8). To achieve redundancy, a redundant adapter module is placed on the two adjacent baseplate termination cable connectors to provide a single termination cable connection (see Figure 1). A single termination cable connects from the redundant adapter to the associated termination assembly (TA).

**TERMINATION ASSEMBLIES**

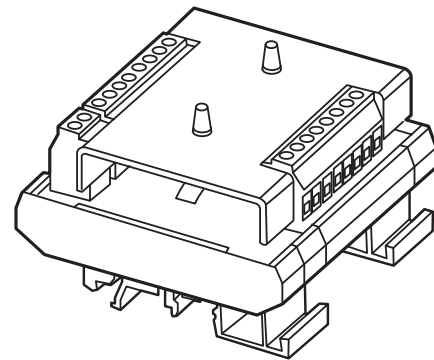
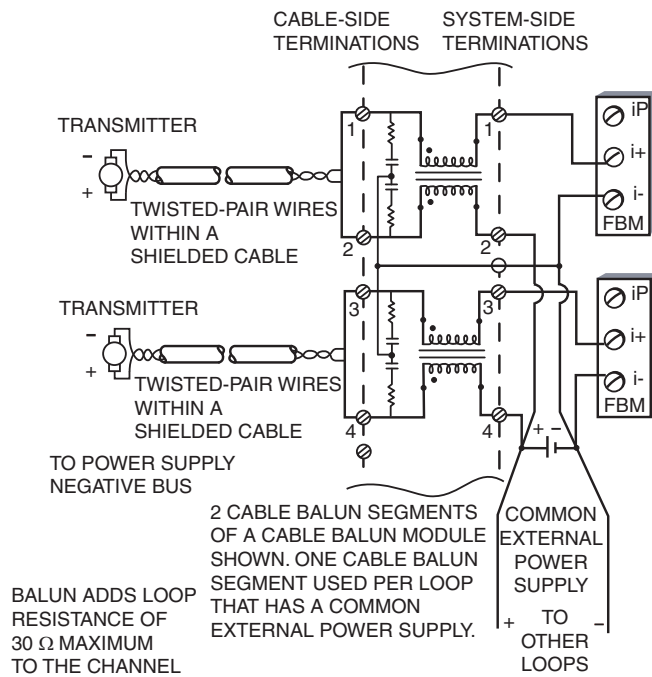
Field input signals connect to the FBM subsystem via DIN rail mounted TAs. The TA used with the FBM216b is described in “TERMINATION ASSEMBLIES AND CABLES” on page 10.

**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, in each loop so powered, the common connection at the external power supply, would cause near end crosstalk at the system end of the loop wiring cable. Loops using FBM internal power source do not require Baluns.

The Cable Balun module contains multiple Baluns. One Balun segment is interconnected in each loop powered from an external power supply per the diagram below. 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<br>(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)]<sup>(1)</sup>

#### INTERNAL LOOP SUPPLY COMPLIANCE

#### VOLTAGE AT TERMINATION ASSEMBLY

18.5 V DC minimum at 20.5 mA

#### CURRENT INPUTS

*Sense Resistor*

280  $\Omega$   $\pm 0.02\%$

*Total Input Resistance Including*

*Redundancy Adapter*

280  $\Omega$  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).

### I/A SERIES®/CONTROL CORE SERVICES

Requires I/A Series software v8.2 to v8.8 or Foxboro Evo Control Core Services software 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  $\Omega$

*Internally Powered*

302  $\Omega$

### FBM INTERNAL POWER FOR FIELD DEVICE

Per channel isolated 24 V DC  $\pm 10\%$  supply. Loop supply output impedance is 20  $\Omega$  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

#### 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).

## FUNCTIONAL SPECIFICATIONS (CONTINUED)

**MARINE CERTIFICATION**

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<sup>(2)</sup>**

**Operating**

**TEMPERATURE**

*Module*

-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<sup>2</sup> (0.75 g) from 5 to 500 Hz

(2) 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

#### MODULE

FBM216b mounts 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 *Standard 200 Series Baseplates* (PSS 31H-2SBASPLT) 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).

### Weight

#### MODULE

284 g (10 oz) approximate

#### TERMINATION ASSEMBLY

*Compression*

181 g (0.40 lb) approximate

### 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 Assembly

See page 13.

### Part Numbers

#### FBM216b

RH927AJ (supersedes P0927AJ)

#### TERMINATION ASSEMBLIES

See “FUNCTIONAL SPECIFICATIONS – TERMINATION ASSEMBLIES” on page 10

#### REDUNDANT ADAPTER

RH924DT (supersedes P0924DT)

### Termination Cables

#### CABLE LENGTHS

Up to 30 m (98 ft)

#### CABLE MATERIALS

Polyurethane or Low Smoke Zero Halogen (LSZH)

#### TERMINATION CABLE TYPE

Types 1 – See Table 2 on page 11.

#### 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 mm<sup>2</sup>/0.2 to 2.5 mm<sup>2</sup>/24 to 12 AWG

*Stranded with Ferrules*

0.2 to 2.5 mm<sup>2</sup> with or without plastic collar

## TERMINATION ASSEMBLIES AND CABLES

Field input signals connect to the FBM subsystem via DIN rail mounted Termination Assemblies. The TA for the FBM216b is available in Polyamide (PA) material with compression screw terminations.

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

The 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* (PSS 2A-1Z3 E).

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
- ▶ 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 FBM216b.

## FUNCTIONAL SPECIFICATIONS – TERMINATION ASSEMBLIES

| FBM Type | Input Signal   | TA Part Number                  | Termination         | TA Cable            | TA Certification    |
|----------|--|---------------------------------|---------------------|---------------------|---------------------|
|          |  | PA <sup>(a)</sup>               | Type <sup>(b)</sup> | Type <sup>(c)</sup> | Type <sup>(d)</sup> |
| FBM216b  | 8 input channels, 4 to 20 mA analog signal, alone or with HART signal superimposed | RH924JH<br>(supersedes P0924JH) | C                   | 1                   | 1, 2                |

(a) PA is Polyamide rated from -20 to +70°C (-4 to +158°F).

(b) C = TA with compression 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 <sup>(a)</sup>   |
|--------|--|
| 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 <i>Standard and Compact 200 Series Subsystem User's Guide</i> (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 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* (B0400FA) and the conditions stated in UL and DEMKO reports.

**Table 2. Cables Types and Part Numbers**

| Cable Length<br>m (ft) | Type 1<br>P/PVC <sup>(a)</sup>  | Type 1<br>LSZH <sup>(b)</sup>   |
|------------------------|---------------------------------|---------------------------------|
| 0.5 (1.6)              | RH916DA<br>(supersedes P0916DA) | RH928AA<br>(supersedes P0928AA) |
| 1.0 (3.2)              | RH916DB<br>(supersedes P0916DB) | RH928AB<br>(supersedes P0928AB) |
| 2.0 (6.6)              | RH931RM<br>(supersedes P0931RM) | RH928AC<br>(supersedes P0928AC) |
| 3.0 (9.8)              | RH916DC<br>(supersedes P0916DC) | RH928AD<br>(supersedes P0928AD) |
| 5.0 (16.4)             | RH916DD<br>(supersedes P0916DD) | RH928AE<br>(supersedes P0928AE) |
| 10.0 (32.8)            | RH916DE<br>(supersedes P0916DE) | RH928AF<br>(supersedes P0928AF) |
| 15.0 (49.2)            | RH916DF<br>(supersedes P0916DF) | RH928AG<br>(supersedes P0928AG) |

**Table 2. Cables Types and Part Numbers (Continued)**

| <b>Cable Length<br/>m (ft)</b> | <b>Type 1<br/>P/PVC<sup>(a)</sup></b> | <b>Type 1<br/>LSZH <sup>(b)</sup></b> |
|--------------------------------|---------------------------------------|---------------------------------------|
| 20.0 (65.6)                    | RH916DG<br>(supersedes P0916DG)       | RH928AH<br>(supersedes P0928AH)       |
| 25.0 (82.0)                    | RH916DH<br>(supersedes P0916DH)       | RH928AJ<br>(supersedes P0928AJ)       |
| 30.0 (98.4)                    | RH916DJ<br>(supersedes P0916DJ)       | RH928AK<br>(supersedes P0928AK)       |

- (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**

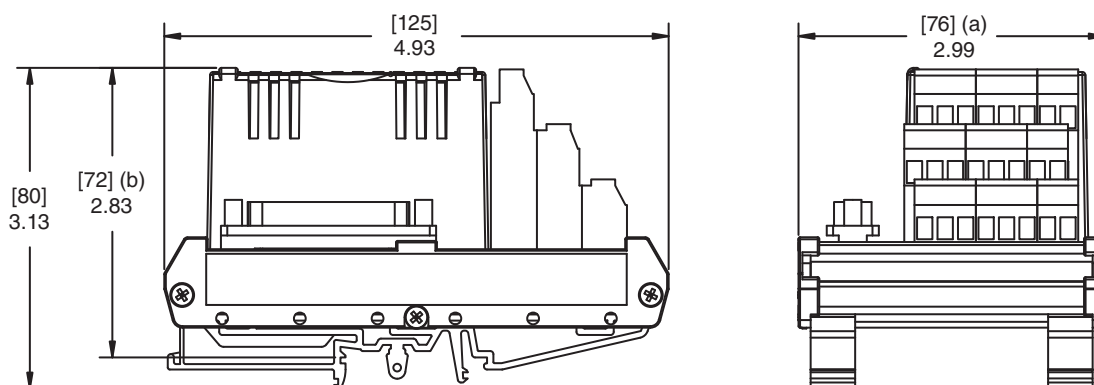
When an FBM216b is used for redundant field I/O

from HART devices, it may use the RH924JH (supersedes P0924JH) termination assembly in 100 Series Fieldbus Module Upgrade subsystems.

## DIMENSIONS – NOMINAL

[mm]  
in

Compression Termination Assembly - RH924JH (supersedes P0924JH)



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

**RELATED PRODUCT SPECIFICATION SHEETS**

| <b>PSS Number</b> | <b>Description</b>  |
|-------------------|---|
| PSS 31H-2SOV      | Standard 200 Series Subsystem Overview                          |
| PSS 31H-2W100     | 100 Series Fieldbus Module Upgrade Subsystem Overview           |
| PSS 31H-2W4       | Termination Assembly Adapter Modules for 100 Series Upgrade     |
| PSS 31H-2W8       | 100 Series Conversion Mounting Structures                       |
| PSS 31H-2CERTS    | Standard and Compact 200 Series I/O, Agency Certifications      |
| PSS 31H-2SBASPLT  | Standard 200 Series Baseplates                                  |
| PSS 21S-3CP270IC  | Control Processor 270 (CP270) Integrated Control Software       |
| PSS 31S-3FCPICS   | Field Control Processor 280 (CP280) Integrated Control Software |



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