

## Foxboro™ DCS

### FBM205, 0 to 20 mA I/O Interface Module (Redundant)

#### PSS 41H-2S205

#### Product Specification

August 2019



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# Overview

The FBM205, 0 to 20 mA I/O Interface (Redundant) contains four redundant 0 to 20 mA dc analog input channels and four redundant 0 to 20 mA dc analog output channels. The inputs/outputs are galvanically isolated from other channels and ground.

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*). 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.

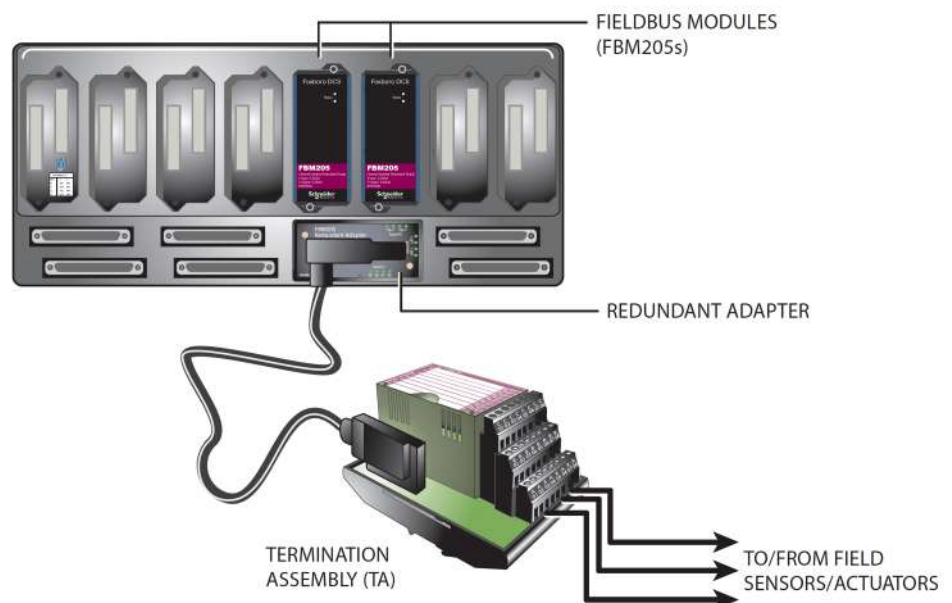
A redundant analog input and redundant analog output block in the control software validates each input and output in conjunction with information to/from the module.

The FBM205 is electrically compatible with standard HART signals.

## Features

- 4 redundant 20 mA dc analog input channels
- 4 redundant 20 mA dc analog output channels
- Each input and output channel is galvanically isolated
- Rugged design suitable for enclosure in Class G3 (harsh) environments
- Execution of an analog input application program that provides conversion time and configurable options for Rate of Change Limits
- Configurable options in the modules for output security include Fail-Safe Action
- High accuracy achieved by sigma-delta data conversions for each channel
- Termination Assemblies (TAs) for locally or remotely connecting field wiring to the FBM205
- Redundant loop power on FBM powered transmitters
- 3-tier termination assembly for per channel internally and/or externally loop powered transmitters

**Figure 1 - Redundant I/O Configuration**



## Redundant Analog Inputs/Outputs

A redundant analog output function 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.

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.

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. Each output channel drives an external load and produces a 0 to 20 mA output. Transmitter power from each module is diode OR'd together in the redundant adapter to help 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 options include a configurable choice of integration time on a per module basis. Input channel security is enhanced by redundantly powering the input current loop from per channel power supplies in each module of the pair.

Configurable options in the modules for output security 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. The Analog Output Fail-Safe Fallback Data option must be set for 0 mA output. 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 security tests on FBM microprocessor writes to output registers. Setting of the Analog Output Fail-Safe Fallback Data option for 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, which 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 faults, provides a very high subsystem availability time.

The Redundant Adapter provides test points that can be used for periodic test and measurement of the output voltage of each transmitter power supply. Such periodic testing can increase the statistical availability of the module.

## Standard Design

FBM205 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, per ISA Standard S71.04.

## Visual Indicators

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

## Easy Removal/Replacement

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.

## Fieldbus Communication

A Fieldbus Communications Module or a Control Processor interfaces to the redundant 2 Mbps module Fieldbus used by the FBMs. The FBM205 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 module mounts on a DIN rail mounted 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.

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 the 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).

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

## Functional Specifications

Input/Output Channels	<p>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.</p> <p><b>NOTE:</b> Redundant pairs (input or output) are connected together by a common field I/O connector and therefore are not isolated from each other.</p>
Input/Output Range (Each Channel)	0 to 20.4 mA dc
Input Channels (4)	<ul style="list-style-type: none"> <li>• Analog Accuracy (Includes Linearity):  <math>\pm 0.3\%</math> of span (Includes tolerance of sense resistor in redundant adapter)  Accuracy temperature coefficient: <math>\pm 50</math> ppm/<math>^{\circ}\text{C}</math> </li> <li>• Input Channel Impedance:  60 <math>\Omega</math> nominal (resistor in redundant adapter) </li> <li>• Input Signal A/D Conversion:  Each channel performs its own A/D signal conversion, using the sigma-delta conversion technique </li> <li>• Integration Period:  Software configurable </li> <li>• Common Mode Rejection:  <math>&gt;100</math> db at 50 or 60 Hz </li> <li>• Normal Mode Rejection:  <math>&gt;95</math> db at 50 or 60 Hz </li> <li>• 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 </li> <li>• 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 </li> </ul>

Output Channels (4)	<ul style="list-style-type: none"> <li>• Analog Accuracy: ±0.05% of span</li> <li>• Output Load: 750 Ω maximum</li> <li>• Output Processing Delay: 30 ms maximum</li> <li>• Resolution: 13 bits</li> <li>• 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.</li> <li>• 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.</li> <li>• 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 of HART transmitter is used with FBM205, a 200 ohm in-line resistor (assembly part number RH902VY) must be added in series with the transmitter.</li> </ul>
Input/Output Channel Isolation	<p>Each channel is galvanically isolated from all other channels and earth (ground). The 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.</p> <div style="background-color: black; color: white; text-align: center; padding: 5px;">  <b>⚠️ DANGER</b> </div> <div style="border: 1px solid black; padding: 5px;"> <p><b>HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH</b></p> <p>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.</p> <p><b>Failure to follow these instructions will result in death or serious injury.</b></p> </div>
Communication	Communicates with its associated FCM or FCP via the redundant 2Mbps module fieldbus.
Power Requirements	<ul style="list-style-type: none"> <li>• Input Voltage Range (Redundant): 24 V dc +5%, -10%</li> <li>• Consumption: 10 W (maximum) total for redundant pair</li> <li>• Heat Dissipation: 7 W (maximum) total for redundant pair</li> <li>• Loop Power Supply Protection: Each channel is channel-to-channel galvanically isolated, current limited, and voltage regulated.</li> </ul>
Calibration Requirements	Calibration of the module and termination assembly is not required.

Regulatory Compliance: Electromagnetic Compatibility (EMC)	<ul style="list-style-type: none"> <li><i>European EMC Directive 2004/108/EC (Prior to April 20, 2016) and 2014/30/EU (Beginning April 20, 2016):</i> Meets: EN61326-1:2013 Class A Emissions and Industrial Immunity Levels</li> </ul>
Regulatory Compliance: Product Safety	<ul style="list-style-type: none"> <li><i>Underwriters Laboratories (UL) for U.S. and Canada:</i> 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 DCS processor modules. 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). For more information, see <i>Standard and Compact 200 Series Subsystem User's Guide</i> (B0400FA).</li> <li><i>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):</i> DEMKO certified as Ex nA IIC T4 for use in certified Zone 2 enclosure when connected to specified processor modules as described in the <i>Standard and Compact 200 Series Subsystem User's Guide</i> (B0400FA). Also, see <i>Table 1, page 13</i>. <b>NOTE:</b> DEMKO Certification does not apply to Termination Assembly RH917QW (supersedes P0917QW). See Types 4 and 5 on Table 1.</li> </ul>
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
<b>Temperature</b>	<ul style="list-style-type: none"><li>Module: -20 to +70°C (-4 to +158°F)</li><li>Termination Assembly — PA: -20 to +70°C (-4 to +158°F)</li></ul>	-40 to +70°C (-40 to +158°F)
<b>Relative Humidity</b>	5 to 95% (noncondensing)	5 to 95% (noncondensing)
<b>Altitude</b>	-300 to +3,000 m (-1,000 to +10,000 ft)	-300 to +12,000 m (-1,000 to +40,000 ft)
<b>Vibration</b>	7.5 m/s <sup>2</sup> (5 to 500 Hz)	
<b>Contamination</b>	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 Specification Sheet (PSS) that describes the type of enclosure to be used.

## Physical Specifications

Mounting	<ul style="list-style-type: none"> <li>Module: FBM205 mounts on a baseplate. The 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 adjacent positions on the baseplate (positions 1 and 2, 3 and 4, 5 and 6, or 7 and 8). See <i>Standard 200 Series Modular Baseplates</i> (PSS 41H-2SBASPLT) for details regarding baseplate usage.</li> <li>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)</li> </ul>
Weight	<ul style="list-style-type: none"> <li>Module: 284 g (10 oz) approximate</li> <li>Termination Assemblies               <ul style="list-style-type: none"> <li>Compression: 159 g (0.35 lb, approximate)</li> <li>Ring Lug: 204 g (0.45 lb, approximate)</li> </ul> </li> </ul>
Dimensions - Module	<ul style="list-style-type: none"> <li>Height: 102 mm (4 in), 114 mm (4.5 in) including mounting lugs</li> <li>Width: 45 mm (1.75 in)</li> <li>Depth: 104 mm (4.11 in)</li> </ul>
Dimensions - Termination Assemblies	See <i>Dimensions - Nominal</i> , page 15
Part Numbers	<ul style="list-style-type: none"> <li>FBM205 Module: RH914XG</li> <li>Termination Assemblies: See <i>Functional Specifications - Termination Assemblies</i>, page 13</li> <li>Redundant Adapter: RH916NN</li> </ul>

Termination Cables	<ul style="list-style-type: none"><li>• Cable Lengths: Up to 30 m (98 ft)</li><li>• Cable Materials: Polyurethane or Low Smoke Zero Halogen (LSZH)</li><li>• Termination Cable Type: Type 1 — See <i>Table 2, page 14</i></li><li>• Cable Connection: 25-pin male D-subminiature</li></ul>
Termination Assembly Construction	<ul style="list-style-type: none"><li>• Material: Polyamide (PA), compression PA, ring lug</li><li>• Terminal Blocks:<ul style="list-style-type: none"><li>◦ Inputs - 3 tiers, 4 positions</li><li>◦ Outputs - 3 tiers, 4 positions</li><li>◦ Output Bypass Jacks - 4 (RH917QW)</li></ul></li></ul>
Field Termination Connections	<ul style="list-style-type: none"><li>• Compression-Type Accepted Wiring Sizes:<ul style="list-style-type: none"><li>◦ Solid/Stranded/AWG: 0.2 to 4 mm<sup>2</sup>/0.2 to 2.5 mm<sup>2</sup>/24 to 12 AWG</li><li>◦ Stranded with Ferrules: 0.2 to 2.5 mm<sup>2</sup> with or without plastic collar</li></ul></li><li>• Ring-Lug Type Accepted Wiring Sizes: #6 size connectors (0.375 in (9.5 mm)) 0.5 to 4 mm<sup>2</sup>/22 AWG to 12 AWG</li></ul>

## Termination Assemblies and Cables

Field I/O signals connect to the FBM subsystem via DIN rail mounted termination assemblies, which are electrically passive. TAs for the FBM205 module are available in the following forms:

- Compression screw type using Polyamide (PA) material
- Ring lug type using Polyamide (PA) material.

Each FBM205 Termination Assembly and its associated termination cable provide feedthrough connection between four 2-wire analog input signals and four 2-wire analog output signals, and the FBM205 Redundant 0 to 20 mA I/O Interface Module.

When used in a redundant FBM205 configuration, a redundant adapter (RH916NN) is required for connection between the FBM baseplate and the termination cable.

Termination Assembly (RH917QW) includes built-in bypass jacks for each output channel. Jacks accept a bypass plug from the Output Bypass Station (Foxboro P/N P0900HJ) or other external 20 mA sources. This option should be considered for applications where maintaining output during maintenance operations is desired.

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, page 14* for a list of termination cables used with the TAs for the FBM205 module.

## Functional Specifications - Termination Assemblies

FBM Type	Input		Output		TA Part No.	Term. Type <sup>(b)</sup>	TA Cable Type <sup>(c)</sup>	TA Cert. Type <sup>(d)</sup>
	Qty.	Signal	Qty.	Signal	PA <sup>(a)</sup>			
FB-M205	4	0 to 20 mA	4	0 to 20 mA	RH916XL P0917JP <sup>(e)</sup>	C RL	1	1, 2
FB-M205	4	0 to 20 mA	4	0 to 20 mA	RH917QW	C	1	4,5

(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. Knife has compression terminals.

(c) See *Table 2, page 14* for cable part numbers and specifications.

(d) See *Table 1, page 13* for Termination Assembly certification definitions.

(e) Polyamide RL supersedes the PVC RL, note this is not a RoHS part.

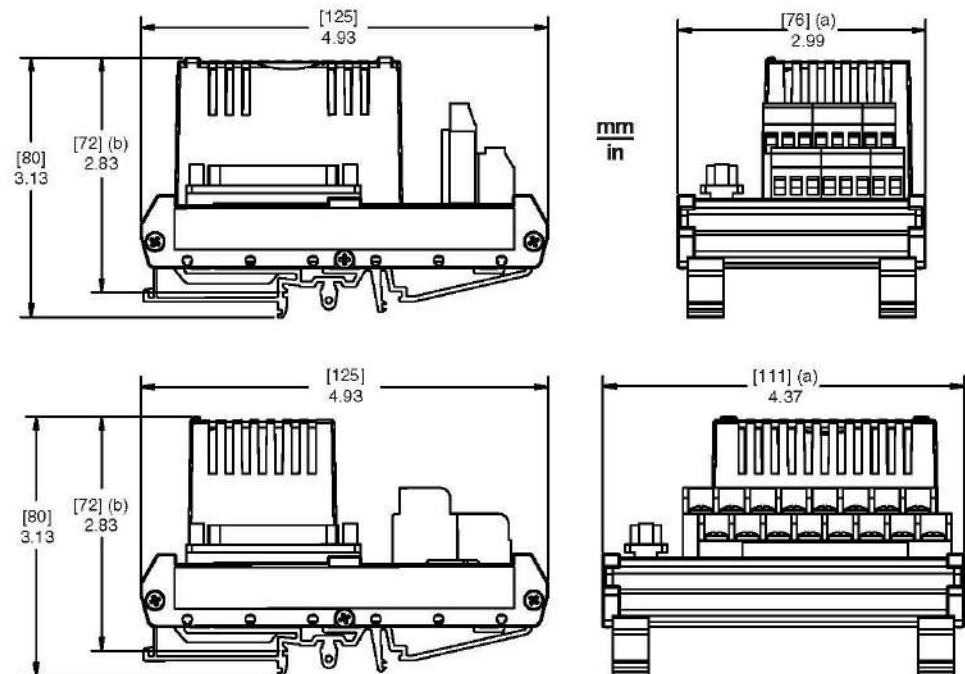
**Table 1 - Certifications for Termination Assemblies**

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 <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.
Type 4	All field circuits are Class 2 limited energy (60 V dc, 30 V ac, 100 VA or less) if customer-supplied equipment meets Class 2 limits.
Type 5	The TA and its field circuitry are for use in only ordinary (non-hazardous) locations.

**Table 2 - Cable Types and Part Numbers**

<b>Cable Length m (ft)</b>	<b>Type 1 P/PVC<sup>(a)</sup></b>	<b>Type 1 LSZH<sup>(b)</sup></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
<p><sup>(a)</sup> P/PVC is polyurethane outer jacket and semi-rigid PVC primary conductor insulation. Temperature range: -20 to +80°C (-4 to +176°F).</p> <p><sup>(b)</sup> 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).</p>		

## Dimensions - Nominal



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

(b) Height above DIN rail (add to DIN rail height for total).

## Related Product Documents

Document Number	Description
PSS 41H-2SOV	<i>Standard 200 Series Subsystem Overview</i>
PSS 41H-2CERTS	<i>Standard and Compact 200 Series I/O - Agency Certifications</i>
PSS 41H-2SBASPLT	<i>Standard 200 Series Baseplates</i>
PSS 21H-2S2 B4	<i>Output Bypass Station (4 to 20 mA)</i>
PSS 41S-3FCPICS	<i>Field Control Processor 280 (FCP280) Integrated Control Software</i>
B0400FA	<i>Standard and Compact 200 Series Subsystem User's Guide</i>





**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/](http://www.p65warnings.ca.gov/).