PHOENIX CONTACT Wireless | Interface

Wireless Interface Products

- One-way Wireless System

Module Grouping		Product Description	Type Description/ Order Number	Datasheet/ Manual	CAD Drawing
DIN mount Transmitter/Receiver set 	24 V dc	One-way wireless system for one 4-20mA and two discrete signals. DIN rail mount 17.5mm wide integrated radio with I/O.	 RAD-ISM-900-SET-UD-ANT 2867102	Datasheet Manual	
Conduit fit transmitter/DIN mount receiver 	110-240 V ac	One-way wireless system for one 4-20mA and two discrete signals. Weather proof (NEMA 4X) conduit mount transmitter with DIN rail mount receiver. Accepts ac (110-240 V ac) line voltage inputs.	RAD-ISM-900-SET-AC-UD 2867021	Manual	
Conduit fit transmitter/DIN mount receiver 	12-30 V dc	One-way wireless system for one 4-20mA and two discrete signals. Weather proof (NEMA 4X) conduit mount transmitter with DIN rail mount receiver. Accepts ac (12-30 V dc) voltage inputs.	RAD-ISM-900-SET-DC-UD 2867034	Manual	

DIN mount Receiver-Spare 	24 V dc	Spare receiver to be used as replacements or to duplicate the receiving signals in one-way point to multipoint applications	RAD-ISM-900-RX 2867047	Datasheet Manual	

- Two-way Wireless System (with expandable I/O options)

Module Grouping		Product Description	Type Description/ Order Number	Datasheet/ Manual	CAD Drawing
[No image]		ME BOS-KA (protective plugs for female side bus)	ME BOS-KA 2854173		
		ME B-SA/NS 35 (protective cover for male side bus)	ME B-SA/NS 35 2935959		
Integrated Radio with I/O 	9-30 V dc	Two-way radio transceiver set with 0ne 4-20mA in/out and two discrete signals in/out. 22.5mm wide with bus connection for power and communication. **Does not include antennas.**	RAD-ISM-900-SET-BD-BUS 2867089	Datasheet Manual	
		Two-way radio transceiver set with 0ne 4-20mA in/out and two discrete signals in/out. Includes 1/4 wave whip antenna with 6' cable. 22.5mm wide with bus connection for power and communication.	RAD-ISM-900-SET-BD-BUS-ANT 2867270	Datasheet Manual	

Repeater/Spare 	9-30 V dc	Device can be configured as a spare or as a repeater for long distance or heavily obstructed applications (requires HOPKEY for configuration)	RAD-ISM-900-BD-BUS 2867092	Manual	
Transceiver/Repeater HOPKEY 		Device used to configure spare, repeaters or duplicates (requires ID number for original transceiver when used as a spare or in repeater configuration)	RAD-ISM-900-HOP-US 2867539		

▸ Signal Duplication with Expandable I/O

Module Grouping		Product Description	Type Description/ Order Number	Datasheet/ Manual	CAD Drawing
One-way signal duplicating 	9-30 V dc	Configured as a one-way system with one transmitter and two receivers. Multiple receivers can be added to extend duplication using MCR-RT-I/O repeater. Expandable I/O modules can be added to the transmitter and corresponding receivers.	RAD-ISM-900-1TX-2RX-BUS 2867571		

▸ Expandable I/O

Module Grouping	Product Description	Type Description/ Order Number	Datasheet/ Manual	CAD Drawing

4-channel Analog Input 	Four channel analog input module (passive non-isolated 4-20mA input signals from 2-, 3-, 4-wire devices)	RAD-IN-4A-I 2867115	Manual	
4-channel Analog Output 	Four channel analog isolated output module	RAD-OUT-4A-I 2867128	Manual	
8-channel Digital Input 	Eight channel digital input module (input voltage range 5-36 V ac/dc)	RAD-IN-8D 2867144	Manual	

8-channel Digital Output 	Eight channel digital output module with relay outputs (120 V ac 5A rated contacts)	RAD-OUT-8D-REL 2867157	Manual	

Return to Wireless Section

Phone: (800) 888-7388

Email: info@phoenixcon.com

Wireless I/O Interface Transmitter/Receiver Set RAD-ISM-900-...-UD

Class I, Div. 2 approved

Data Sheet 1483B

August 2003

Features

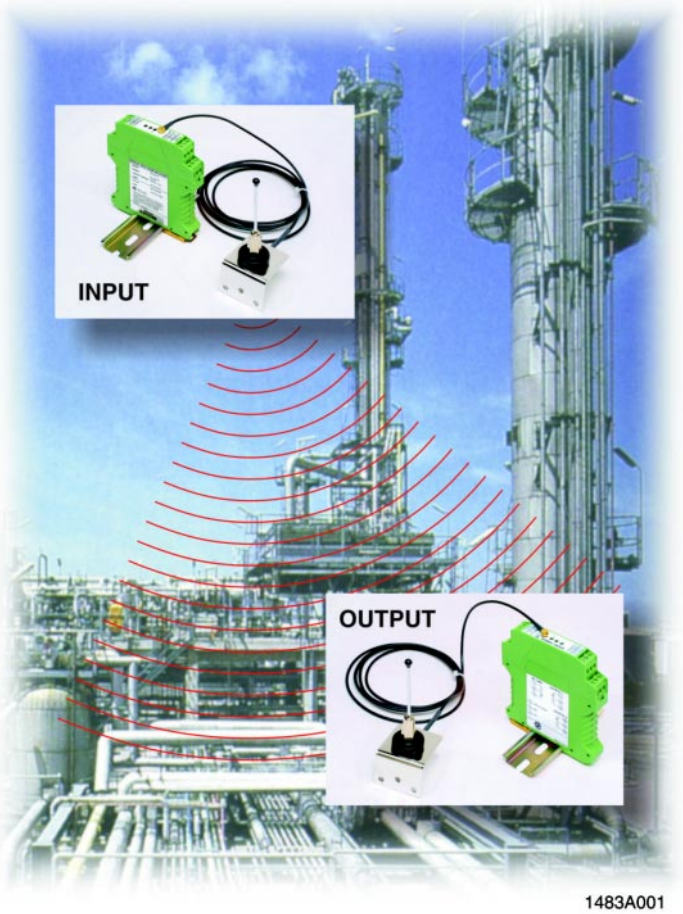
- 1 watt transmit power
- Wireless conduit for one 4-20 mA and two digital signals
- Interference free - Frequency Hopping Spread Spectrum technology
- License free 902-928 MHz Industrial, Scientific and Medical (ISM) band
- Easy to use, wire in – wire out, no setup or programming
- Range: 600 – 1000 feet in-plant, no line-of-sight
- Class I, Division 2 approved for hazardous area installation (UL, CUL and CSA approved)

Applications

- SCADA systems
- PLC/RTU extensions
- Pump control
- Water/wastewater
- Oil and gas
- Petro-chem
- Tank level
- Mills/quarries/factories
- Sensor monitoring
- Utilities
- Irrigation systems

Benefits

- Reduce cost of labor and installation
- Eliminate conduit and wiring
- Reliable and dependable operation



1483A001

Frequency Hopping Spread Spectrum Technology

The Phoenix Contact RAD-ISM-900-...-UD is an integrated radio & I/O module designed to eliminate cable and conduit for one 4-20 mA current loop and two digital signals in harsh industrial environments. This unique addition to the Phoenix Contact signal conditioning line utilizes 902-928 MHz ISM band spread spectrum frequency hopping technology to guarantee a license free, interference free link between remote devices and the control room. Costly cable and conduit runs on new projects, or retrofitting of existing systems, are eliminated and replaced with a maintenance free, reliable and versatile wireless solution.

Wireless I/O Interface Transmitter/Receiver Set RAD-ISM-900-...-UD

Table 1. Technical Specifications

RAD-ISM-900-...-UD

Transmit power ..... 1 watt

Range ..... 600-1000 feet, in-plant, no line of sight
4-5 miles, line-of-sight, flat terrain, raised antennas
20+ miles, line-of-sight, flat terrain, professional propagation study, installation and directional antennas

Frequency ..... 902-928 MHZ

Power source ..... 12 V to 30 Vdc (regulated)

Power consumption ..... 8.4 watt peak, 1.8 watt average (350 mA @ 24 Vdc peak, 75 mA @ 24 Vdc average)

Inputs ..... 1 x 4-20 mA analog (250 input impedance)
2 x 5 to 30 Vac/dc digital
(for 120 Vac discrete inputs use relays to convert to specified voltage levels. Consult factory for relay options)

RAD-ISM-900-...-UD

Frequency ..... 902-928 MHZ

Power Source ..... 12 V to 30 Vdc (regulated)

Power consumption ..... 3 watt (125 mA @ 24 Vdc)

Outputs ..... 1 x 4-20 mA analog (12-bit resolution)
3 x 120 Vac 0.5 A digital (dry contact)

Max. Loop Impedance ... 450 to 1350 for power supply voltages of 12-30 Vdc

$$\text{Maximum Loop Impedence} = \frac{(\text{Supply Voltage} - 3)\text{V}}{20\text{ mA}}$$

Repeatability 0.02%

Accuracy ..... 0.2% of full scale

General Specifications

Temperature range ..... -40° to +70°C (-40° to +158°F)

Dimensions ..... 102 x 114 x 17.5 (mm)
4 x 4.5 x 0.7 (inch)

Approvals ..... UL listed (Class 1, Division 2 Groups A, B, C and D) CSA approved

1483B004

Ordering Information

Part Description	Part Number
RAD-ISM-900-SET-UD System	**28 67 10 2**

Accessories Ordering Information

Part Description	Part Number
MINI-PS-100-240AC/24DC/1 (universal voltage input 1 A, 24 Vdc power supply)	**29 38 84 0**
Class I, Div. 2 Approved Power Supplies	
QUINT PS 120AC/24DC/1(1A,24VDC)	**56 02 77 1**
QUINT PS 120AC/24DC/2.5(2.5A,24VDC)	**56 02 76 9**
CM50-PS120/230/24DC/2.5IF	**29 39 42 5**
CM125-PS120/230/5IF	**29 39 52 2**
Class I, Div. 2 Approved Signal Converters	
MCR-T/UI-E (thermocouple or RTD to 4-20 mA converter)	**28 14 11 3**
MCR-C-UI/UI-DCI (converters for current to voltage or vice versa)	**28 10 91 3**
MCR-S1/5-UI-SW-DCI-NC (transducer for 0-11 A AC/DC)	**28 14 73 1**
MCR-S10/50-UI-SW-DCI-NC (current transducer for 0-55 A AC/DC)	**28 14 74 4**
MCR-F-UI-DC (frequency converter for 0-120 kHz)	**28 14 60 5**

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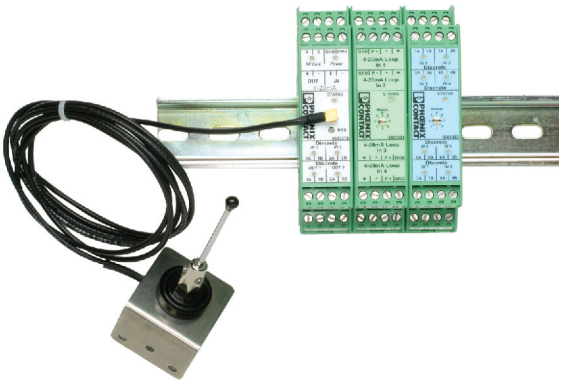
Wireless Interface MCR-RT-I/O-PLUS...

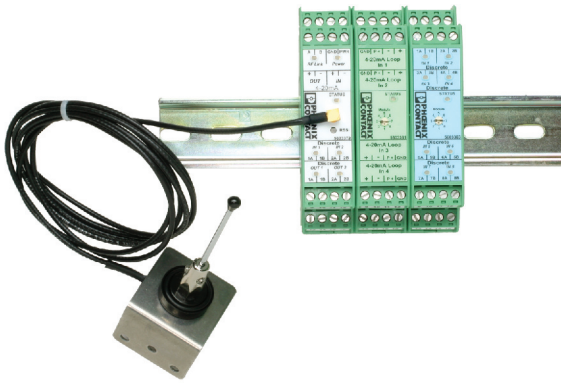
Two-way (Point-to-Point) Monitoring and Control with Expandable I/O Options

Data Sheet 1655B

February 2003



Expandable . . .



Features

- Modular DIN-rail mount transceiver and I/O
- No programming required
- Class I, Div. 2 approved
- Up to eight (8) expandable I/O modules per transceiver on common power and communications bus with multiple combinations
- Maximum thirty-three (33) analog or sixty-six (66) discrete signals in one direction
- Dry contact LINK diagnostic output

Typical Applications

- SCADA systems
- PLC/RTU extensions
- Pump controls
- Tank level/pressure/temperature monitoring
- Water/wastewater
- Petro-chem

Description

The Phoenix Contact MCR-RT-I/O-PLUS is an integrated radio & I/O module designed for bi-directional interfacing of a 4-20mA current loop and two digital signals in harsh industrial environments. This unique design also allows the user the flexibility to add on multiple channels of I/O to the paired transceivers in combinations. The Frequency Hopping Spread Spectrum (FHSS) utilizes 902-928MHz ISM band to guarantee a license free, interference free link between remote devices and the control room. The design is ideal for moving numerous signals within high interference environments without costly cable and conduit runs.

Wireless Interface MCR-RT-I/O-PLUS...
Two-way (Point-to-Point) Monitoring and Control with Expandable I/O Options

Engineering Specifications

Range	600 to 1000 feet (180 to 305 m) in-plant [obstructed]; 4 to 5 miles (6 to 8 km) line-of-sight with Omni antenna; 20+ miles (32+ km) line-of-sight with Yagi antenna
Inputs	One (1) 4-20 mA analog (16-bit resolution; 125 ohms impedance) Two (2) discrete (5 to 36 V dc)
Outputs	One (1) 4-20 mA analog (16-bit rsolution; short-circuit protected) Two (2) discrete (dry contact, Normally Open (NO), contact rating: 250 V ac/5 A)
I/O Expansion	Eight (8) analog and/or discrete I/O modules per transceiver station
Accuracy	Current loop: 0.2% of full-scale @ 77°F (25°C)
Repeatability	Current loop: 0.02%
Wiring Connections	12-24 AWG screw-type terminals; removable terminal blocks
Mounting	DIN-rail mount
Power (Input voltage)	9 to 30 V dc
Power Consumption	75 mA at 24 V (average) 200 mA at 24 V (peak)
Reverse Polarity Protection	Yes
Surge Protection	Yes
Temperature Rating	-40°F to 158°F (-40°C to 70°C)
Humidity	20% to 90% (non-condensing)
Dimensions	4.5" x 3.9" x 0.9" (114 mm x 99 mm x 22.5 mm)
LED Indicators	External (Power, RF Link, I/O Status)
Unit ID	Factory configured (unique); 16-bit coding of each transceiver pair allows multiple units to be used in the same area (easy configuration of spares with HopKey)
Frequency	902 to 928 MHz - license-free ISM band
Transmit Power	1 Watt (30dBm)
Antenna Connector	MCX (female)
Environmental Rating	NEMA 1 (equivalent to IP30)
Approvals	USA - FCC Part 15.247 Canada - ISC RSS 210
Certifications	CSA/C & US UL - Class I, Div. 2 (Groups A, B, C ,D - pending)

Specifications subject to change without notice

MCR-RT-I/O-PLUS Components

The MCR-RT-I/O-PLUS base system includes the following items:

- Two MCR-RT-I/O-PLUS transceiver modules
- Two 3" ¼ wave whip antennas, each with 6' of RG174 cable. The antennas can be mounted on an "L" bracket (also supplied) inside or outside a cabinet.

Ordering Information

Part Description		Part Number
MCR-RT-I/O-PLUS	Transceiver set	5603378
MCR-RT-I/O-REPEATER		5603379

spare transceiver (can be used as repeater or in simplex mode for expansion)

Expandable I/O options

Part Description	Part Number
MCR-RT-4AI-DC	5603381
MCR-RT-4AO-DC	5603382
MCR-RT-8DI	5603383
MCR-RT-8DO-REL	5603384

OMNEX Trusted Wireless

PHOENIX CONTACT

Wireless Analog/Digital Link Transmitter/Receiver Set RAD-ISM-...-UD

Class I, Div. 2 approved

Installation Instructions 1473B

August 2003

Features

- Wireless conduit for one 4-20 mA and two digital signals
- Range: 600 – 1000 feet in-plant, no line-of-sight
- Easy to use, wire in – wire out, no setup or programming
- Frequency Hopping Spread Spectrum technology (Interference free operation)
- License free 902-928 MHz ISM band
- 1 watt transmit power
- 17.5 mm wide DIN-rail mount transmitter and receiver (Optional 120 Vac version for direct conduit mounting)
- Class I, Division 2 approved for hazardous area installation (UL, CUL and CSA approved)

RAD-ISM-900-...-UD General Description

The Phoenix Contact RAD-ISM-900-...-UD is an integrated radio & I/O module designed to eliminate cable and conduit for one 4-20 mA current loop and two digital signals in harsh industrial environments. This unique addition to the Phoenix Contact signal conditioning line utilizes 902-928 MHz ISM band spread spectrum frequency hopping technology to guarantee a license free, interference free link between remote devices and the control room. Costly cable and conduit runs on new projects, or retrofitting of existing systems, are eliminated and replaced with a maintenance free, reliable and versatile wireless solution. Common applications include monitoring/ control of pressure, level, temperature, flow, switching and alarms in situations where cable and conduit are either impossible or too costly to install, for example, retrieving pressure readings from a device on the other side of a railway track.

Figure 1. Wireless Analog/Digital Link Transmitter/ Receiver Set RAD-ISM-900-...-UD

The modules are available as a transmitter/receiver pair and come factory programmed, calibrated and tested as a set. Further switch configuration and programming are not required. Each set is given a unique address at the factory enabling multiple RAD-ISM-900 systems to work independently in the same area without interference. The transmitter and receiver are powered separately by a 12-30 Vdc source (power supply, battery, solar etc). Quick and easy to install, the process signals are simply wired to the input terminals of the transmitter and output via wires connected to the receiver. No wiring is required in between. Typical in-plant range is 600 – 1,000 feet with no line-of-sight, much farther with outdoor applications.

Both the transmitter and receiver are DIN-rail mountable and with their dimensions of 102 mm (length) x 114.5 mm (height) x 17.5 mm (width) (4” x 4.5” x 0.7”) they offer a small wireless solution for every control cabinet. The RAD-ISM-900-...-UD provides LED indicators for digital input/output signal status at both radios and radio link status at receiver.

As an option, weatherproof transmitters mounting directly to ½ inch NPT conduit are also available for AC or DC power sources. The RAD-ISM-900-...-UD transmitter and receiver pair is UL/CUL listed and approved for Class I, Division 2 installation.

What is Frequency Hopping Spread Spectrum Technology?

Prior to its introduction to Industrial, Scientific and Medical (ISM) use in 1987, this technology was used by the military for battlefield communications and weapons control due to its extreme tolerance of interference, and the difficulties it presented to those wishing to jam or intercept it. The key elements for the success of these radios are: a) their ability to frequency hop, b) their use of powerful narrowband signals (highest transmit power available under FCC guidelines), and c) their reliance on the redundant nature of the data being sent. Broadcasting within the 902-928 MHz band, RAD-ISM-900 radios transmit the status of their inputs on one frequency, then hop to transmit again on a different frequency. Hopping approximately every 20 milliseconds, the status of their inputs is updated 50 times per second in an interference free environment. In an industrial application, where interference is encountered from a variety of sources, EMI, motors, arc welders, etc., some hops will be affected. Anticipating interference the RAD-ISM-900 receivers' error-check the data packet on every hop. When corrupted packets are received they discard the bad data and, hopping in synch with their transmitters, they look for the next clean update, which is then output. Since interference is encountered in most industrial applications it is assumed that all updates will not get through. Even so, if only 50 to 75% of the packets make it through unscathed this is more than adequate to update pressure, level, temperature, flow, ON/OFF and alarm.

RAD-ISM-900-...-UD System Components

The standard RAD-ISM-900-SET-UD system includes the following items (see Figure 1):

One RAD-ISM-900-TX – a 12-30 Vdc DIN-rail mount transmitter

One RAD-ISM-900-RX – a 12-30 Vdc DIN-rail mount receiver

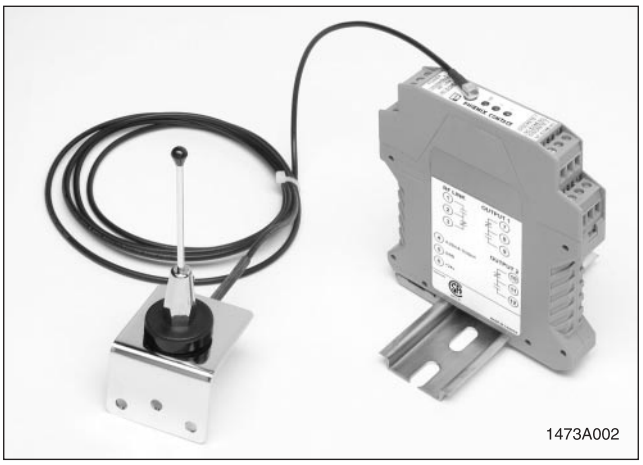


Figure 2. DIN-rail mounted units with antennas

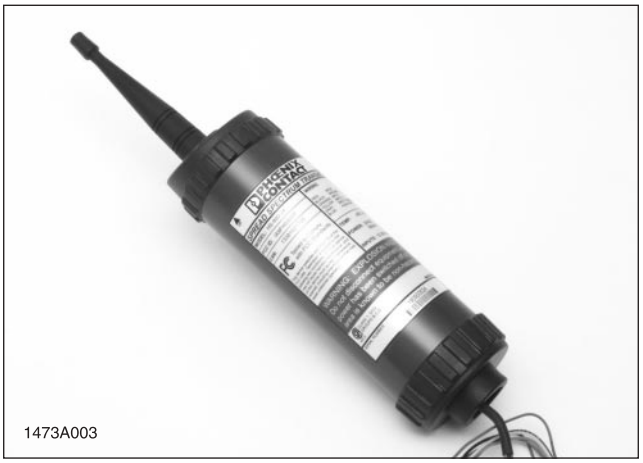


Figure 3. weather proof transmitter

Two 3 ¼" wave whip antennas, each with 6' of RG174 cable. The antennas can be mounted on an "L" bracket (also supplied) inside or outside a cabinet.

For applications where a weatherproof housing is required for a field mounted transmitter two options are available:

1) **The RAD-ISM-900-TX-DC –** a 12-30 Vdc NEMA 4X conduit mount (½" NPT) transmitter.

2) **The RAD-ISM-900-TX-AC –** a 110-240 Vac NEMA 4X conduit mount (½" NPT) transmitter that includes a 24 Vdc power supply for powering loop.

(information available upon request)

When either of these transmitters are chosen they are paired with an RAD-ISM-900-SET-UD 12-30 Vdc DIN-rail mount receiver. In this case, two different antennas are supplied, a 3" antenna mounting directly to the transmitter, and the standard 3 ¼" wave whip antenna with 6' of RG174 cable for the receiver.

RAD-ISM-900 Transmitter Diagnostics

RAD-ISM-900-TX:

- RF LED is solid green when unit is transmitting normally.
- LEDs 1 and 2 show status of digital inputs 1 and 2. Solid green = ON.

RAD-ISM-900-TX-DC: (optional weatherproof DC system)

- Green LED on top of unit is solid green when unit is transmitting normally.
- This unit does not have LEDs for digital inputs.

RAD-ISM-900-TX-AC: (optional weatherproof AC system)

- Green LED on top of unit is solid green when unit is transmitting normally.
- This unit does not have LEDs for digital inputs.

RAD-ISM-900-RX Receiver Diagnostics

- The receiver features an RF link relay (alarm) that closes when RF link is established and locked with the transmitter. This provides solid indication (to PLC or other monitoring equipment) of the wireless link.
- RF link LED blinks once every 2 seconds when receiver is ON but transmitter is either OFF, or out of range.
- RF link LED continually blinks very rapidly when marginal signal is being received. This is an indication that one or both radios should have their antennas moved to an area where they will get better reception.
- RF link LED blinks occasionally (random). This is an indication that interference is being encountered on some hops. This will not affect the performance of the radio and the installation should be considered successful.
- RF LED is solid when an extremely secure link is established.
- LEDs 1 and 2 show status of digital outputs 1 and 2. Solid green = ON.

Default Output Status

As default the 4-20 mA analog signal on the receiver is designed to maintain last state. The default status of the two digital outputs is to also maintain last state.

For diagnostics and alarm purposes the RF link output can be used to drop the 4-20 mA to 0 mA if the analog output is wired through the RF link contact (or with an external relay) - this gives you 0 mA when the link is lost. The RF link relay can be used to turn ON/OFF one or both of the digital outputs by wiring them through the RF link contact (or an external relay connected to it) - this gives you options for the digital outputs when link is lost.

Transmitter Wiring Diagrams

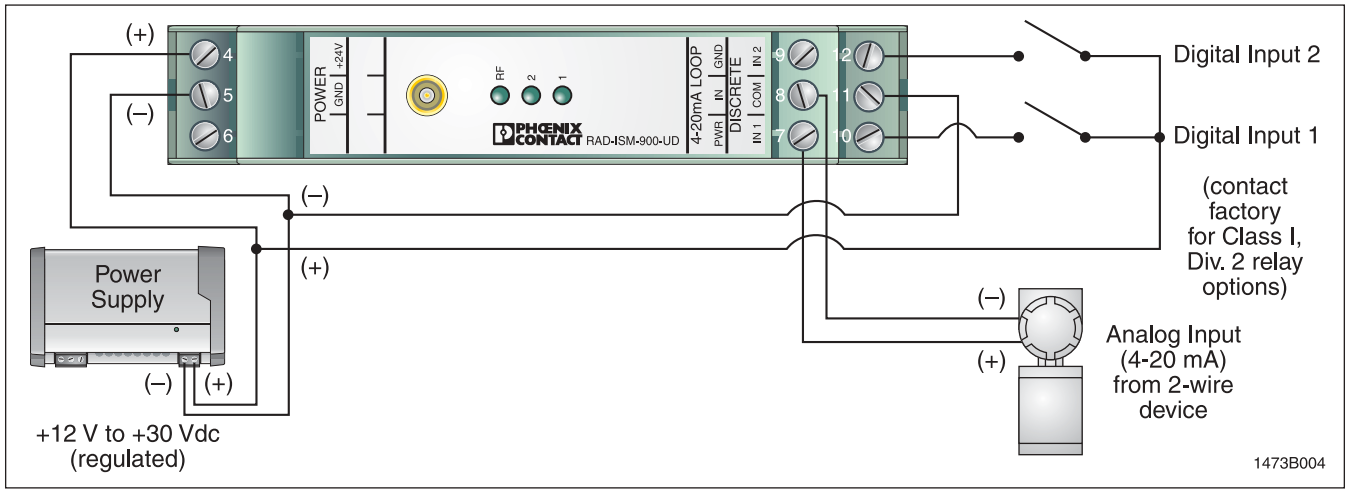


Figure 4. 2 Wire Field device (4-20 mA) and 2 digital signals

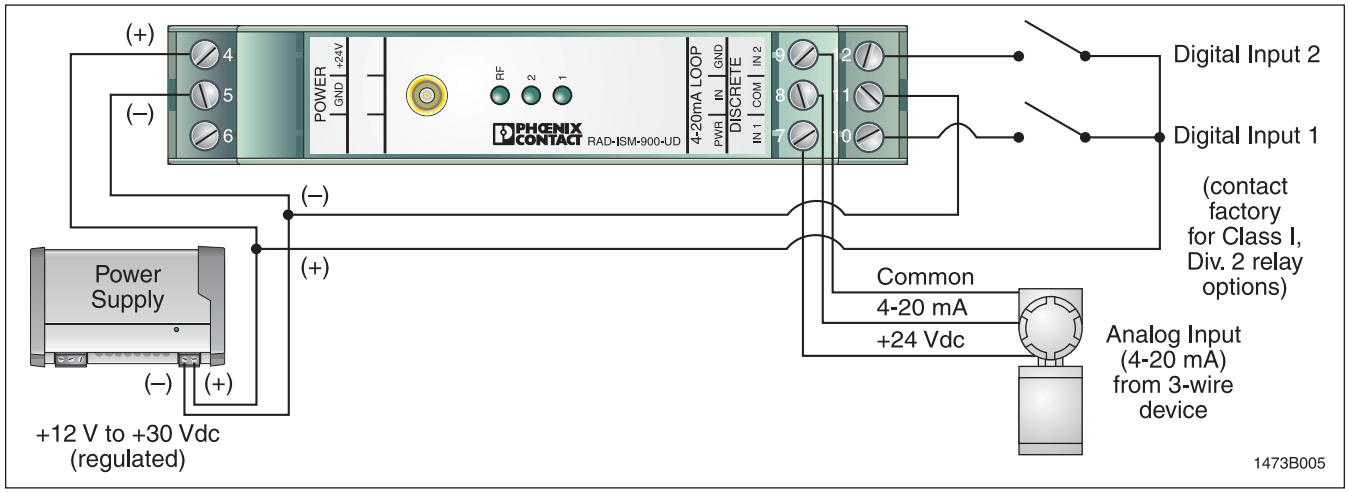


Figure 5. 3 Wire Field device (4-20 mA) and 2 digital signals

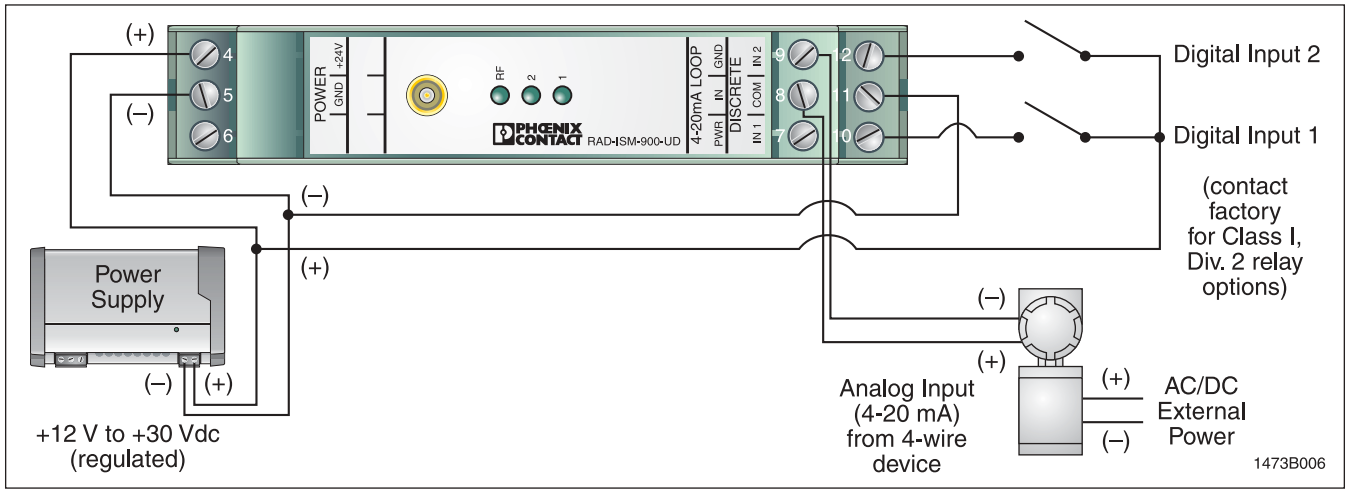


Figure 6. 4 Wire Field device (4-20 mA) and 2 digital signals

Receiver Wiring Diagram

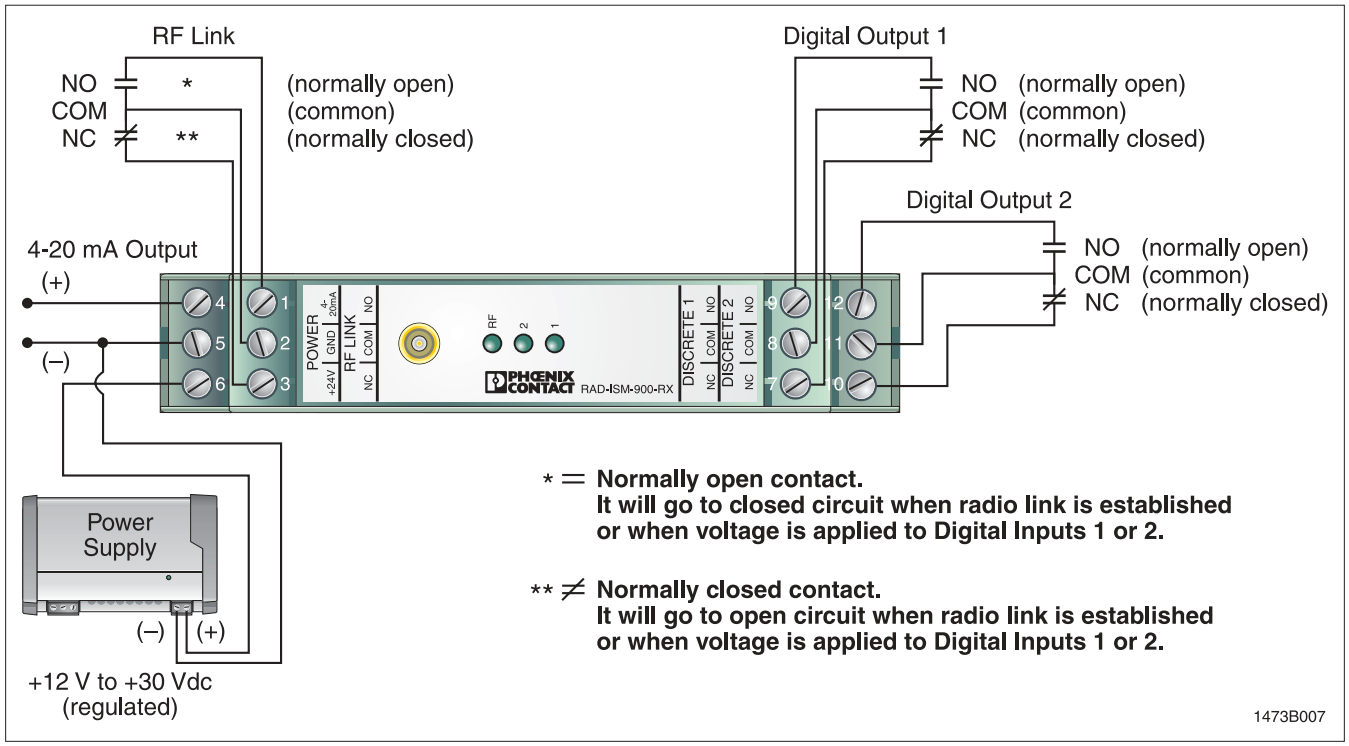


Figure 7. Receiver Wiring Diagram

If used in a Class I, Div. 2 area, do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Specifications

Table 1. Technical Specifications

RAD-ISM-900-...-UD

Transmit power ..... 1 watt

Range ..... 600-1000 feet, in-plant, no line of sight
4-5 miles, line-of-sight, flat terrain, raised antennas
20+ miles, line-of-sight, flat terrain, professional propagation study, installation and directional antennas

Frequency ..... 902-928 MHZ

Power source ..... 12 V to 30 Vdc (regulated)

Power consumption ..... 8.4 watt peak, 1.8 watt average (350 mA @ 24 Vdc peak, 75 mA @ 24 Vdc average)

Inputs ..... 1 x 4-20 mA analog (250 input impedance)
2 x 5 to 30 Vac/dc digital
(for 120 Vac discrete inputs use relays to convert to specified voltage levels. Consult factory for relay options)

RAD-ISM-900-...-UD Receiver

Frequency ..... 902-928 MHZ

Power Source ..... 12 V to 30 Vdc (regulated)

Power consumption ..... 3 watt (125 mA @ 24 Vdc)

Outputs ..... 1 x 4-20 mA analog (12-bit resolution)
3 x 120 Vac 0.5 A digital (dry contact)

Max. Loop Impedance ... 450 to 1350 for power supply voltages of 12-30 Vdc

$$\text{Maximum Loop Impedence} = \frac{(\text{Supply Voltage} - 3)\text{V}}{20\ \text{mA}}$$

Repeatability 0.02%

Accuracy ..... 0.2% of full scale

1473B008

Table 2. General Specifications

Temperature range ..... -40° to 70°C (-40° to 158°F)

Humidity ..... 0-95% non-condensing

Dimensions ..... 102 x 114 x 17.5 (mm)
4 x 4.5 x 0.7 (inch)

Mounting ..... DIN-rail

Environmental ..... NEMA 1

Approvals ..... UL listed (Class 1, Division 2 Groups A, B, C and D) CSA approved

1473A009

Ordering Information

Part Description	Part Number
RAD-ISM-900-SET-UD	**28 67 10 2**
RAD-ISM-900-RX (receiver only)	**28 67 04 7**
Optional AC and DC weather-proof transmitter systems	
RAD-ISM-900-SET-AC-UD	**28 67 02 1**
RAD-ISM-900-SET-DC-UD	**28 67 03 4**

Accessories Ordering Information

Part Description	Part Number
MINI-PS-100-240AC/24DC/1 (universal voltage input 1 A, 24 Vdc power supply)	**29 38 84 0**
Class I, Div. 2 Approved Power Supplies	
QUINT PS 120AC/24DC/1(1A,24VDC)	**56 02 77 1**
QUINT PS 120AC/24DC/ 2.5(2.5A,24VDC)	**56 02 76 9**
CM50-PS120/230/24DC/2.5IF	**29 39 42 5**
CM125-PS120/230/5IF	**29 39 52 2**
Class I, Div. 2 Approved Signal Converters	
MCR-T/UI-E (thermocouple or RTD to 4-20 mA converter)	**28 14 11 3**
MCR-C-UI/UI-DCI (converters for current to voltage or vice versa)	**28 10 91 3**
MCR-S1/5-UI-SW-DCI-NC (transducer for 0-11 A AC/DC)	**28 14 73 1**
MCR-S10/50-UI-SW-DCI-NC (current transducer for 0-55 A AC/DC)	**28 14 74 4**
MCR-F-UI-DC (frequency converter for 0-120 kHz)	**28 14 60 5**

The Phoenix Contact control system RAD-ISM-900-...-UD is a frequency hopping spread spectrum radio designed for professional installation and integration with other products. When installed with the provided antenna, the system integrator needs to make sure the RAD-ISM-900-...-UD's FCC label, or a copy of that FCC label, is clearly visible on the RAD-ISM-900-...-UD is approved to operate within the 900 MHz ISM Band under Part 15 of the FCC Rules & Regulations.

FCC: This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

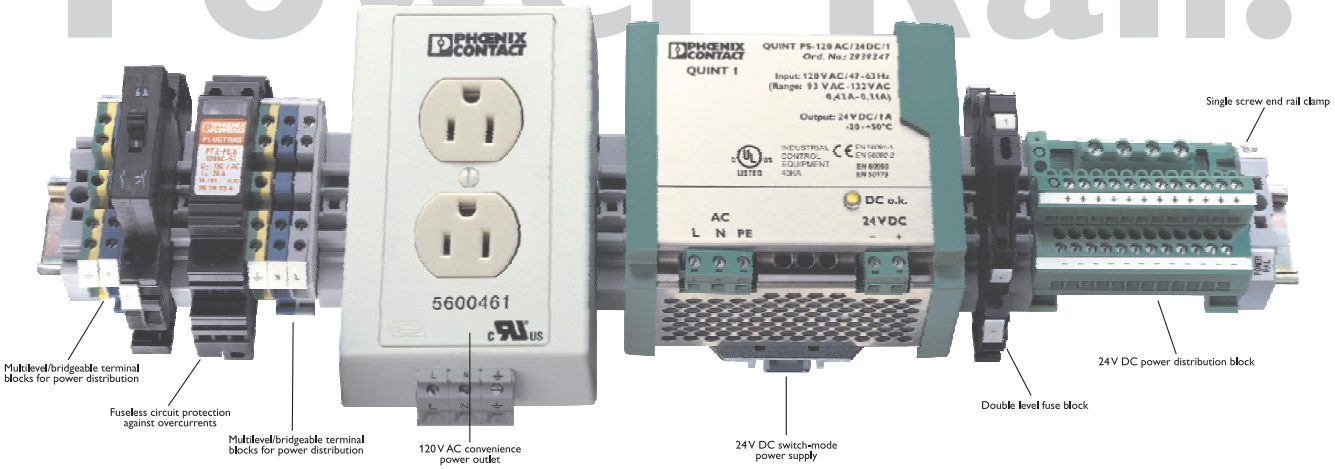
(1) This device may not cause harmful interference,

and

(2) This device must accept interference received, including interference that may cause undesired operation.

Changes or modifications not expressly authorized by Phoenix Contact could void the user's authority to operate the equipment. The system integrator may only use antennas that have been tested and approved with this radio to maintain the FCC approval. If a system integrator uses non-approved antenna they are responsible for obtaining their own FCC certification.

Wireless Analog/Digital Link Transmitter/Receiver Set MCR-RAD-...



For more information on Power Rail alternatives from Phoenix Contact, check out our website: **www.powerrail.com**

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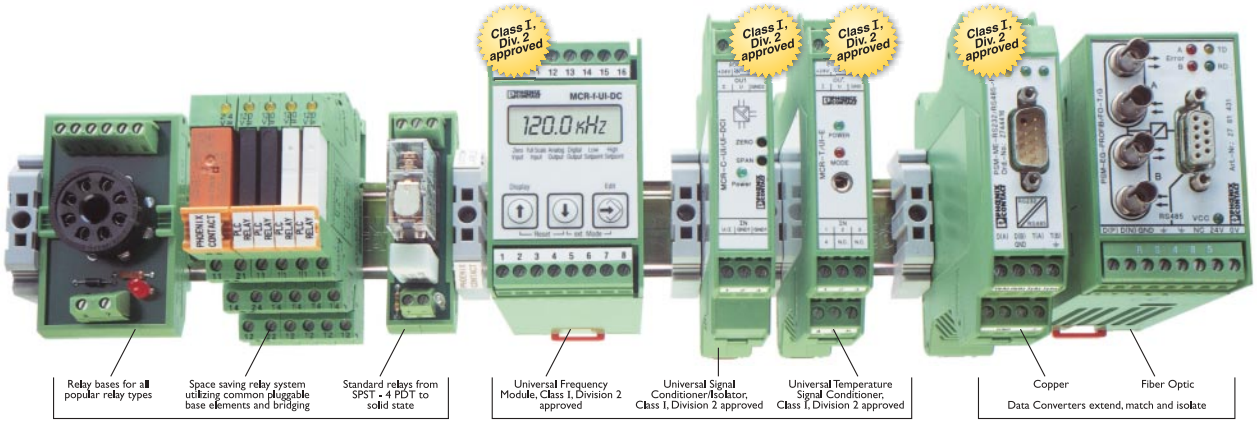

For more information on I/O enhancers from Phoenix Contact, check out our website: **www.iorail.com**

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Wireless Analog/Digital Link
NEMA 4x Transmitter/DIN-rail Receiver Set

Installation Instructions 1713B

August 2003

Features

- Wireless conduit for one 4-20 mA and two digital signals
- Weatherproof NEMA 4x (equivalent to IP65) housing
- Range: 4 to 5 miles line-of-sight with Omni antenna
- Easy-to-use, wire-in/wire-out, no set-up or programming
- Frequency Hopping Spread Spectrum technology
- License free 902 - 928MHz ISM band
- 1 watt transmit power
- Mounts on 1/2" NPT conduit

Figure 1. Wireless Analog/Digital Link Transmitter/ Receiver Set RAD-ISM-900-...-UD

RAD-ISM-900-...-UD General Description

The Phoenix Contact RAD-ISM-900-SET-AC/DC-UD is an integrated radio & I/O module designed to eliminate cable and conduit for one 4-20 mA current loop and two digital signals in harsh industrial environments. This unique addition to the Phoenix Contact signal conditioning line utilizes 902-928 MHz ISM band spread spectrum frequency hopping technology to guarantee a license free, interference free link between remote devices and the control room. Costly cable and conduit runs on new projects, or retrofitting of existing systems, are eliminated and replaced with a maintenance free, reliable and versatile wireless solution. Common applications include monitoring/control of pressure, level, temperature, flow, switching and alarms in situations where cable and conduit are either impossible or too costly to install, for example, retrieving pressure readings from a device on the other side of a railway track.

The modules are available as a transmitter/receiver pair and come factory programmed, calibrated and tested as a set. Further switch configuration and programming are not required. Each set is given a unique address at the factory enabling multiple RAD-ISM-900 systems to work independently in the same area without interference. The weatherproof transmitters are available in both ac and dc power versions, the receiver in dc only, suitable for DIN-rail mounting. Voltage requirement for the ac transmitter is 100 to 240 V ac. The dc powered modules require a 12 to 30 V dc power source (power supply, battery, solar, etc.). Quick and easy to install, the process signals are simply wired to the color-coded wires of the transmitter and output via wires connected to the receiver. No wiring is required in between. Typical outdoor range is 1 to 2 miles with no line-of-sight, 4 to 5 miles with line-of-sight, and 20+ miles with professional antenna propagation study and installation.

The transmitters mount directly to 1/2" NPT conduit and are rated NEMA 4x (IP65) and measure 279 mm x 57 mm or 11" x 2.3" including Omni antenna. The space-efficient DIN-rail mounted receiver taking up only 102 mm (length) x 114.5 mm (height) x 17.5 mm (width) or 4" x 4.5" x 0.7" in the control cabinet.

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What is Frequency Hopping Spread Spectrum Technology?

Prior to its introduction to Industrial, Scientific and Medical (ISM) use in 1987, this technology was used by the military for battlefield communications and weapons control due to its extreme tolerance of interference, and the difficulties it presented to those wishing to jam or intercept it. The key elements for the success of these radios are: a) their ability to frequency hop, b) their use of powerful narrowband signals (highest transmit power available under FCC guidelines), and c) their reliance on the redundant nature of the data being sent. Broadcasting within the 902-928 MHz band, RAD-ISM-900 radios transmit the status of their inputs on one frequency, then hop to transmit again on a different frequency. Hopping approximately every 20 milliseconds, the status of their inputs is updated 50 times per second in an interference free environment. In an industrial application, where interference is encountered from a variety of sources, EMI, motors, arc welders, etc., some hops will be affected. Anticipating interference the RAD-ISM-900 receivers' error-check the data packet on every hop. When corrupted packets are received they discard the bad data and, hopping in synch with their transmitters, they look for the next clean update, which is then output. Since interference is encountered in most industrial applications it is assumed that all updates will not get through. Even so, if only 50 to 75% of the packets make it through unscathed this is more than adequate to update pressure, level, temperature, flow, ON/OFF and alarm.

RAD-ISM-900-SET-AC/DC-UD System Components

For applications where a weatherproof housing is required for a field mounted transmitter two options are available:

1) **RAD-ISM-900-TX-DC –**
   a 12-30 Vdc NEMA 4X conduit mount (½" NPT) transmitter.

2) **RAD-ISM-900-TX-AC –**
   a 110-240 Vac NEMA 4X conduit mount (½" NPT) transmitter that includes a 24 Vdc power supply for powering loop.

When either of these transmitters are chosen they are paired with an RAD-ISM-900-RX12-30 Vdc DIN-rail mount receiver. In this case, two different antennas are supplied, a 3" antenna mounting directly to the transmitter, and the standard 3 ¼" wave whip antenna with 6' of RG174 cable for the receiver.

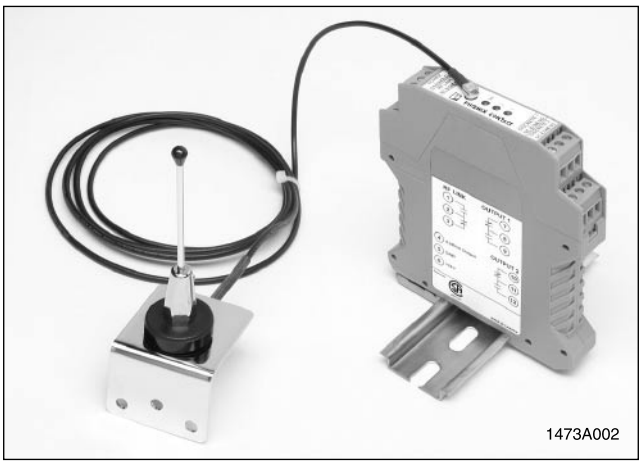


Figure 2. DIN-rail mounted receiver with antenna

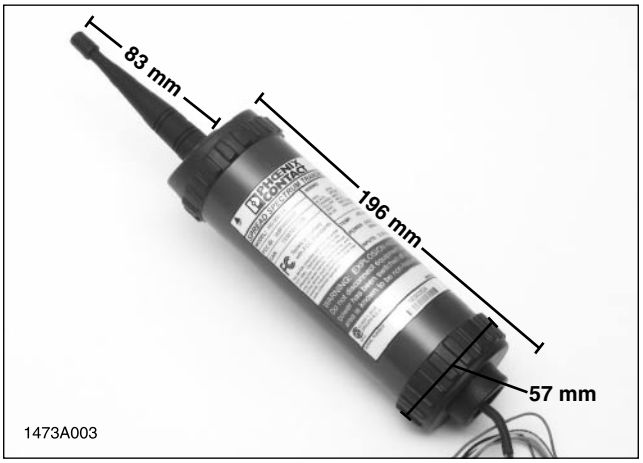


Figure 3. weather proof transmitter

RAD-ISM-900 Transmitter Diagnostics

RAD-ISM-900-TX-DC: (optional weatherproof DC system)

- Green LED on top of unit is solid green when unit is transmitting normally.
- This unit does not have LEDs for digital inputs.

RAD-ISM-900-TX-AC: (optional weatherproof AC system)

- Green LED on top of unit is solid green when unit is transmitting normally.
- This unit does not have LEDs for digital inputs.

RAD-ISM-900-RX Receiver Diagnostics

- The receiver features an RF link relay (alarm) that closes when RF link is established and locked with the transmitter. This provides solid indication (to PLC or other monitoring equipment) of the wireless link.
- RF link LED blinks once every 2 seconds when receiver is ON but transmitter is either OFF, or out of range.
- RF link LED continually blinks very rapidly when marginal signal is being received. This is an indication that one or both radios should have their antennas moved to an area where they will get better reception.
- RF link LED blinks occasionally (random). This is an indication that interference is being encountered on some hops. This will not affect the performance of the radio and the installation should be considered successful.
- RF LED is solid when an extremely secure link is established.
- LEDs 1 and 2 show status of digital outputs 1 and 2. Solid green = ON.

Default Output Status

As default the 4-20 mA analog signal on the receiver is designed to maintain last state. The default status of the two digital outputs is to also maintain last state.

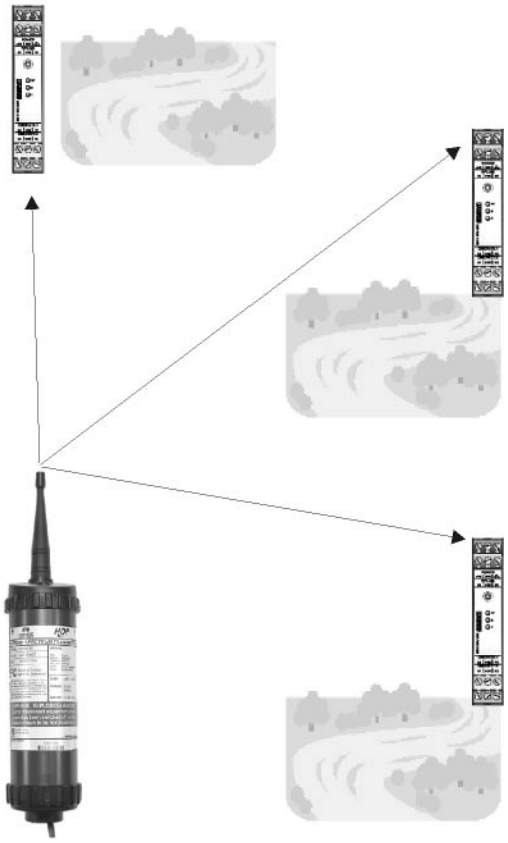
For diagnostics and alarm purposes the RF link output can be used to drop the 4-20 mA to 0 mA if the analog output is wired through the RF link contact (or with an external relay) - this gives you 0 mA when the link is lost. The RF link relay can be used to turn ON/OFF one or both of the digital outputs by wiring them through the RF link contact (or an external relay connected to it) - this gives you options for the digital outputs when link is lost.

If used in a Class I, Div. 2 area, do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

The Phoenix Contact control system RAD-ISM-900 is a frequency hopping spread spectrum radio designed for professional installation and integration with other products. When installed with the provided antenna, the system integrator needs to make sure the RAD-ISM-900's FCC label, or a copy of that FCC label, is clearly visible on the outside of the integrated product. The RAD-ISM-900 is approved to operate within the 900 MHz ISM Band under Part 15 of the FCC Rules & Regulations.

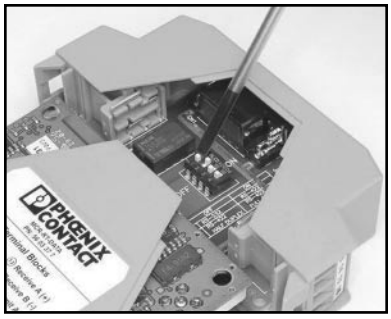
RAD-ISM-900-...-UD Point-to-Multipoint Applications

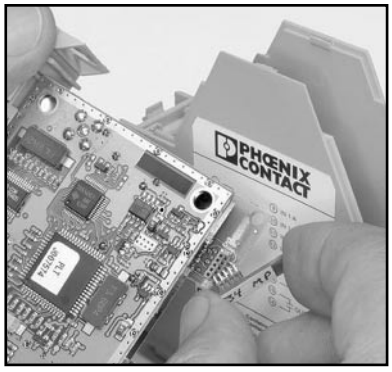
With the RAD-ISM-900-...-UD, multiple receiver applications are easily integrated by simple programming process that can be done by the customer in a few easy steps. Along with a RAD-ISM-900-...-UD pair (transmitter and receiver) the customer will have to order spare receivers. The spare receiver comes without a frequency hopping sequence programmed into the module. This gives the customer the flexibility of programming any spare to replace any radio or add a spare radio to any existing group of radios at their convenience. If spares are kept on hand for emergencies, it's not necessary to keep a preprogrammed spare on the shelf for every group of radios the customer has. Nor does the customer have to wait for the radio vendor to program a radio to match their existing radios.

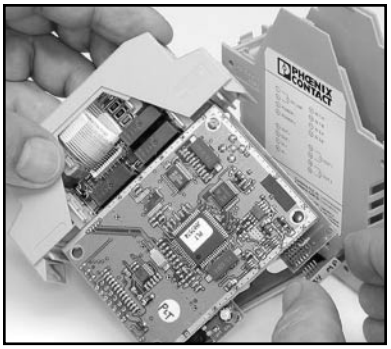


Easy as 1, 2, 3

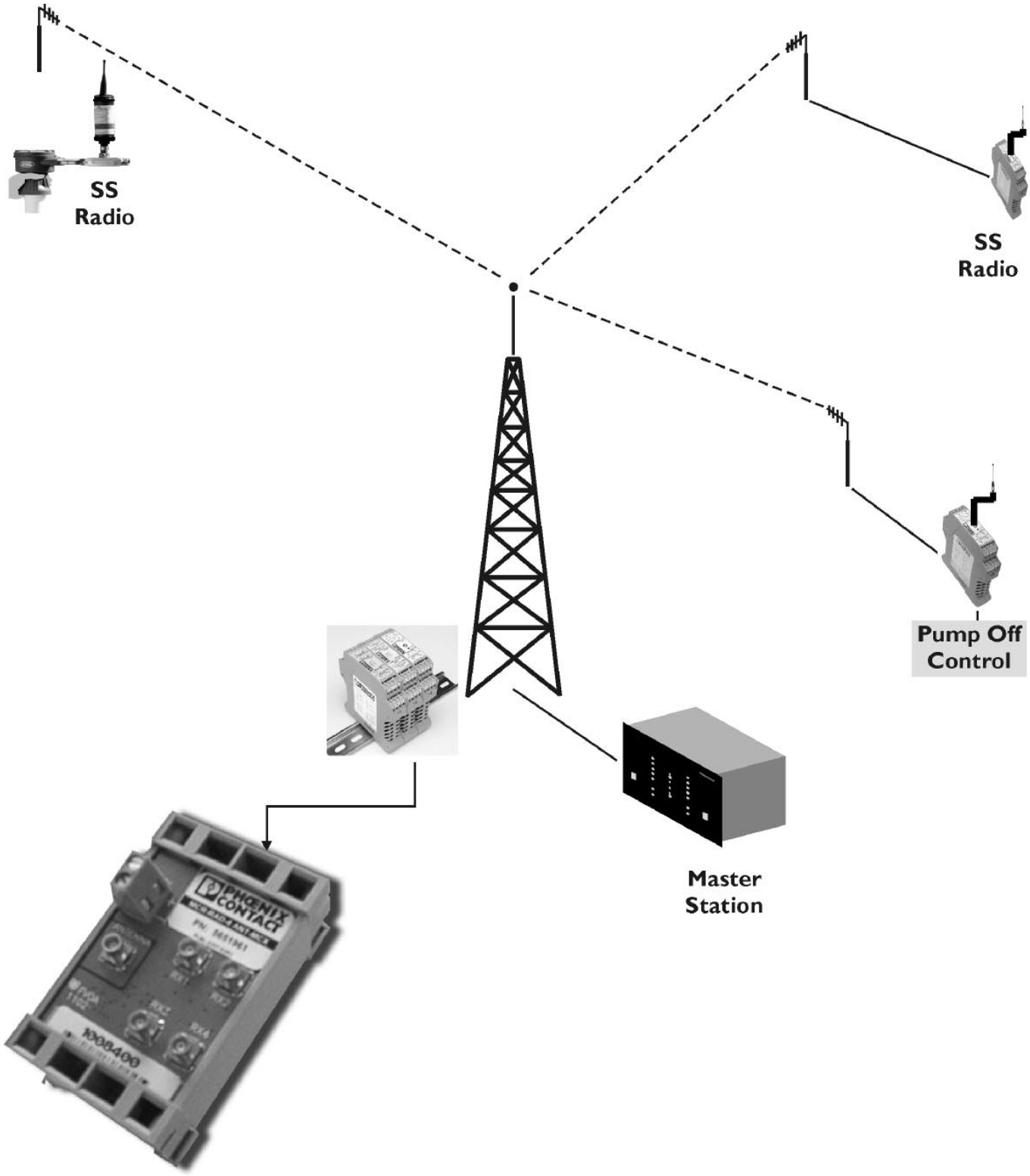
1. Open an existing Receiver containing a Hopkey. This is done by depressing the housing catch on each side of the module as shown in picture 1 (the sides do not have to be depressed at the same time), and take out the HopKey (as shown in picture 2).
2. Plug the Hopkey into the daughter board of the new Receiver, close up the module, then power-up the Receiver for three seconds.
3. Power down the new Receiver, take out the Hopkey, replace it back into the original receiver, close-up both modules and your done. The new receiver is now ready to be put into service with the rest of the group.







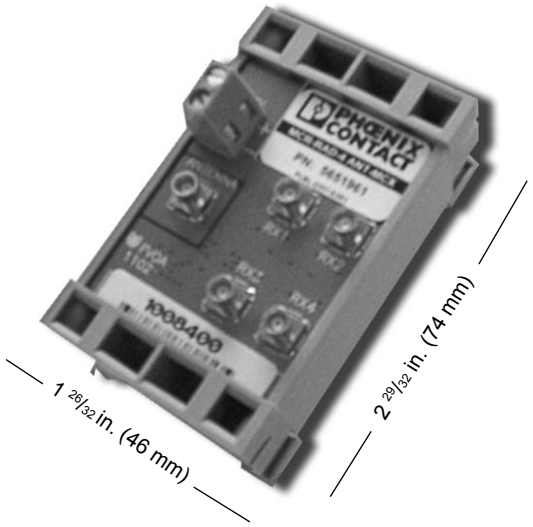
Antenna Splitters for Receivers



4-Way Antenna Splitter

Description

The 4-Way Antenna Splitter allows four RAD-ISM-900 receivers to share a single antenna. Designed for use with RAD-ISM-900 receivers, RAD-ISM-900-UD-1TX/2RX-BUS mode (2867571) receivers, which are pre-programmed to receive only. These splitters can also be cascaded together to connect a maximum of sixty-four receivers to one antenna. For best performance when cascading, the signal should not pass through more than three splitters before reaching a receiver. This DIN-rail mount product, with MCX(F) connectors for both the antenna and receivers, will perform amplification and impedance-matching functions, and operates across a broad power supply and temperature range.



RAD-ISM-900-ANT-4

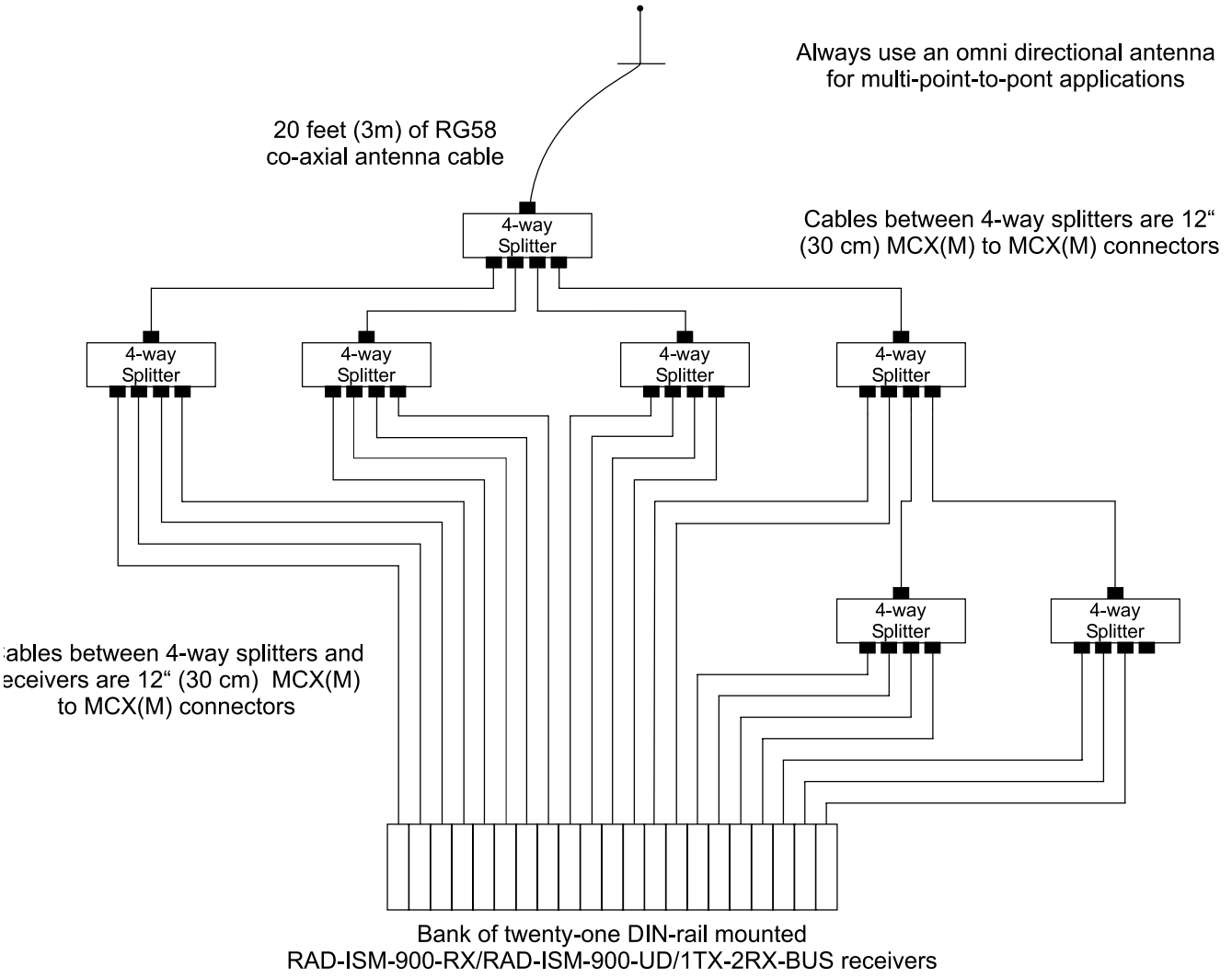
Specifications

Frequency range	902 to 928 MHz
Insertion loss in bandwidth	0dB (+/-1)
Input impedance	50 ohms
Output impedance	50 ohms
Output isolation	30 dB
Composite noise figure	4.2 dB
Input IP3	3 dB
Absolute maximum input	7 dB
Supply voltage	8 to 30 V DC
Supply current	25 mA
Operating temperature range	-40°F to 190°F (-40°C to 85°C)

Part Numbers

RAD-ISM-900-ANT-4 (**28 67 05 0**)	4-way Antenna Splitter
RAD-CON-MCX-MCX (**28 67 60 7**)	12” (30 cm) adapter cable to connect MCR-RAD receiver, MCR RT-I/O-SPLIT/SIMPLEX receiver, or another 4-way antenna splitter

Connection Example Showing Twenty-one RAD-ISM-900 Receivers Connected to One Antenna

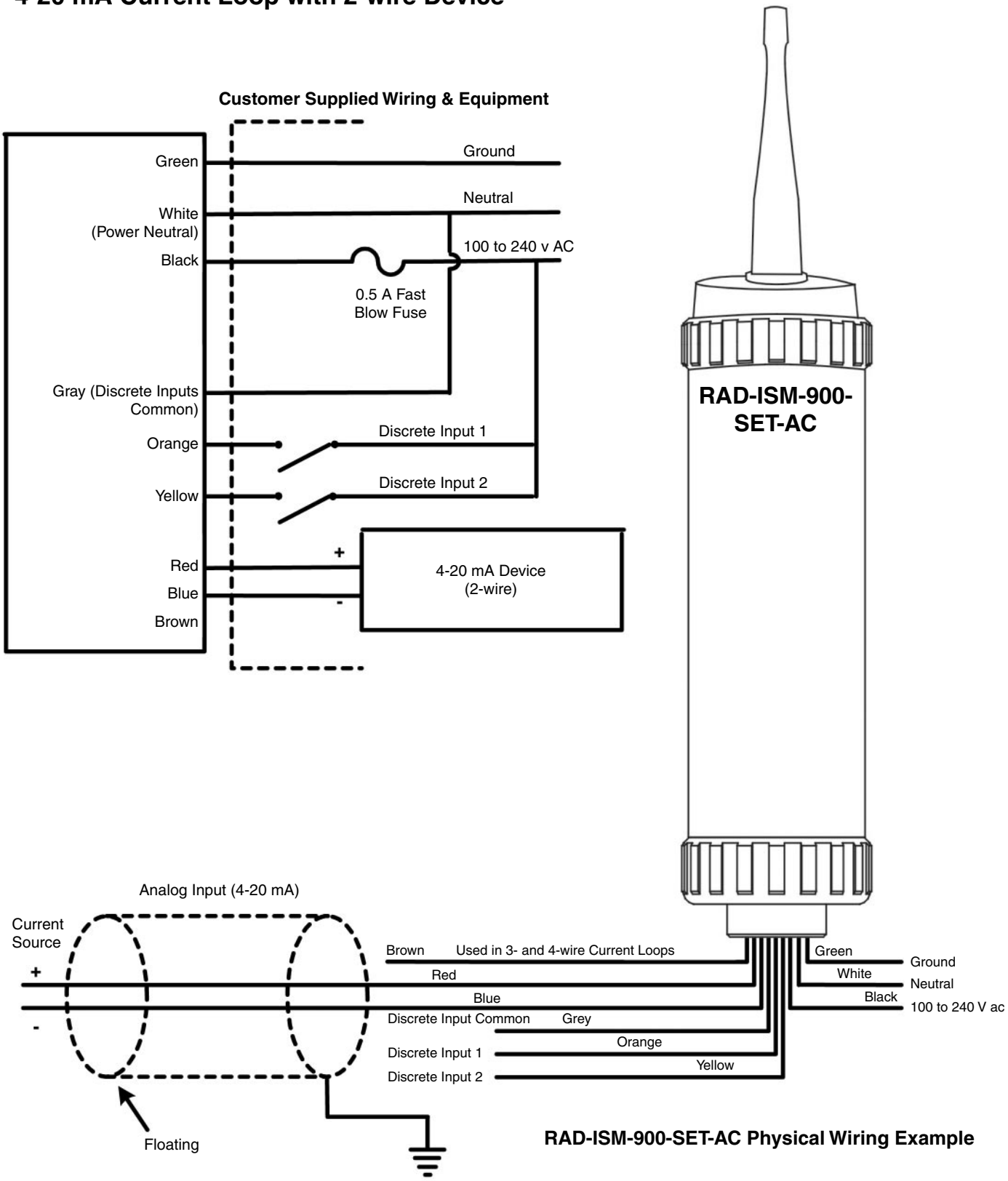


Notes:

1. The 4-way splitters require 12-30VDC power.
2. The 4-way splitters can only be cascaded through 3 levels.
3. The RAD-ISM-900 receivers and the 4-way splitters are all DIN-rail mounted and need weather protection.
4. A high gain omni antenna should be used to ensure the radio link with the farthest RAD-ISM-900 transmitter.
5. If longer antenna cable is needed, a higher grade of antenna cable should be used to minimize a cable losses.

RAD-ISM-900-SET-AC

4-20 mA Current Loop with 2-wire Device

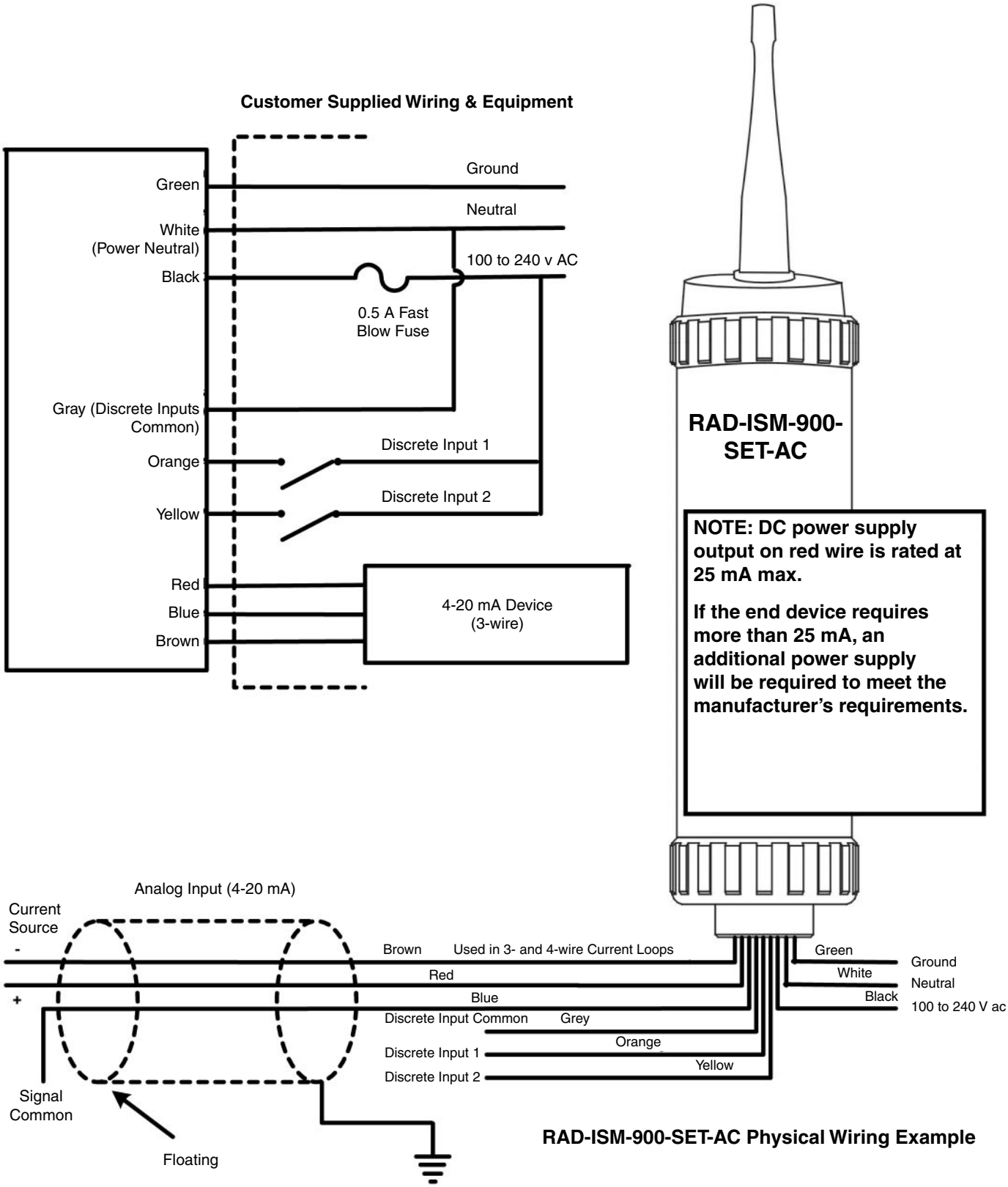


RAD-ISM-900-SET-AC Physical Wiring Example

Wireless Analog/Digital Link Transmitter/Receiver Set RAD-ISM-900-...-UD

RAD-ISM-900-SET-AC Transmitter

4-20 mA Current Loop with 3-wire Device

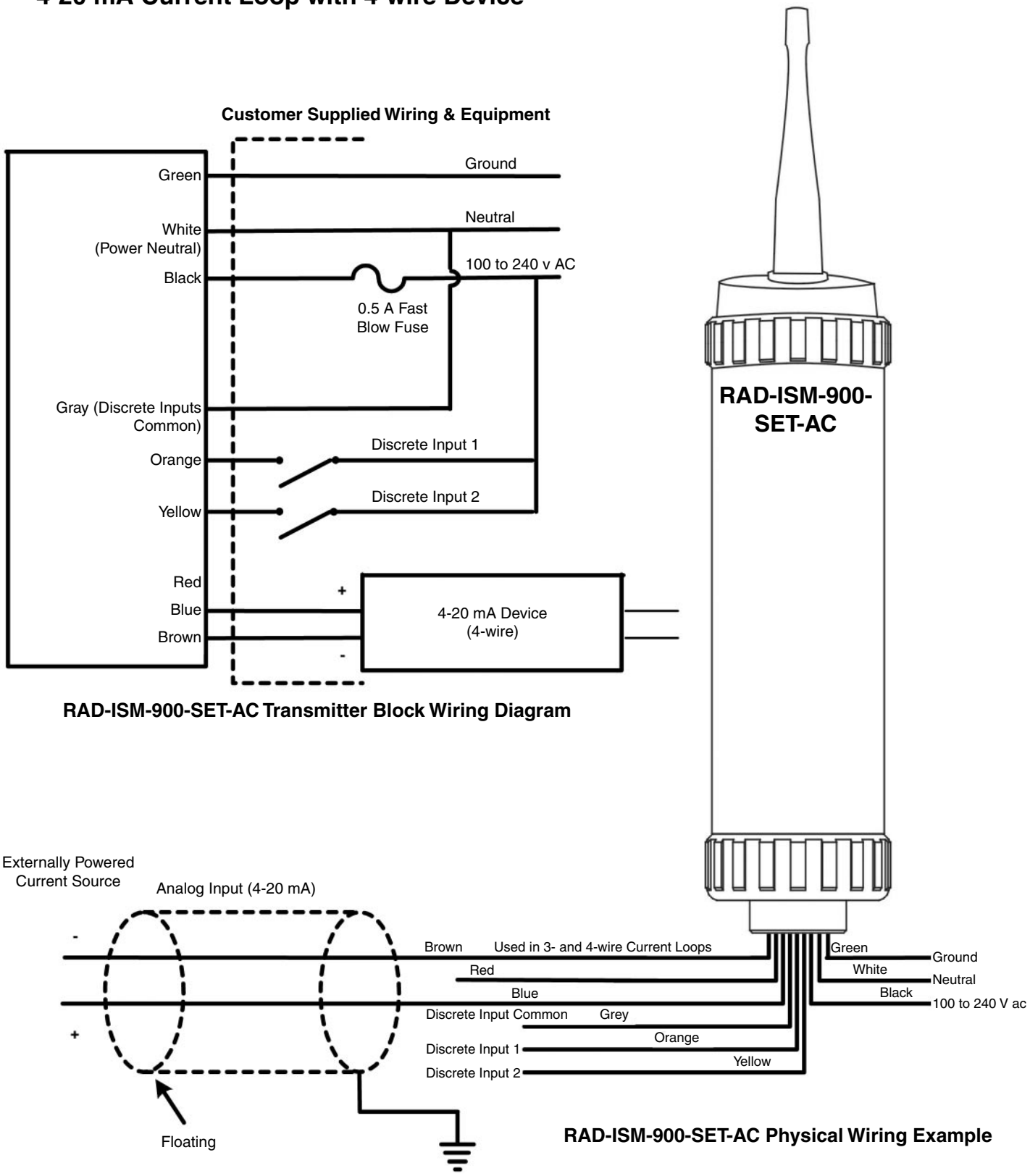


RAD-ISM-900-SET-AC Physical Wiring Example

Wireless Analog/Digital Link Transmitter/Receiver Set RAD-ISM-900-...-UD

RAD-ISM-900-SET-AC Transmitter

4-20 mA Current Loop with 4-wire Device

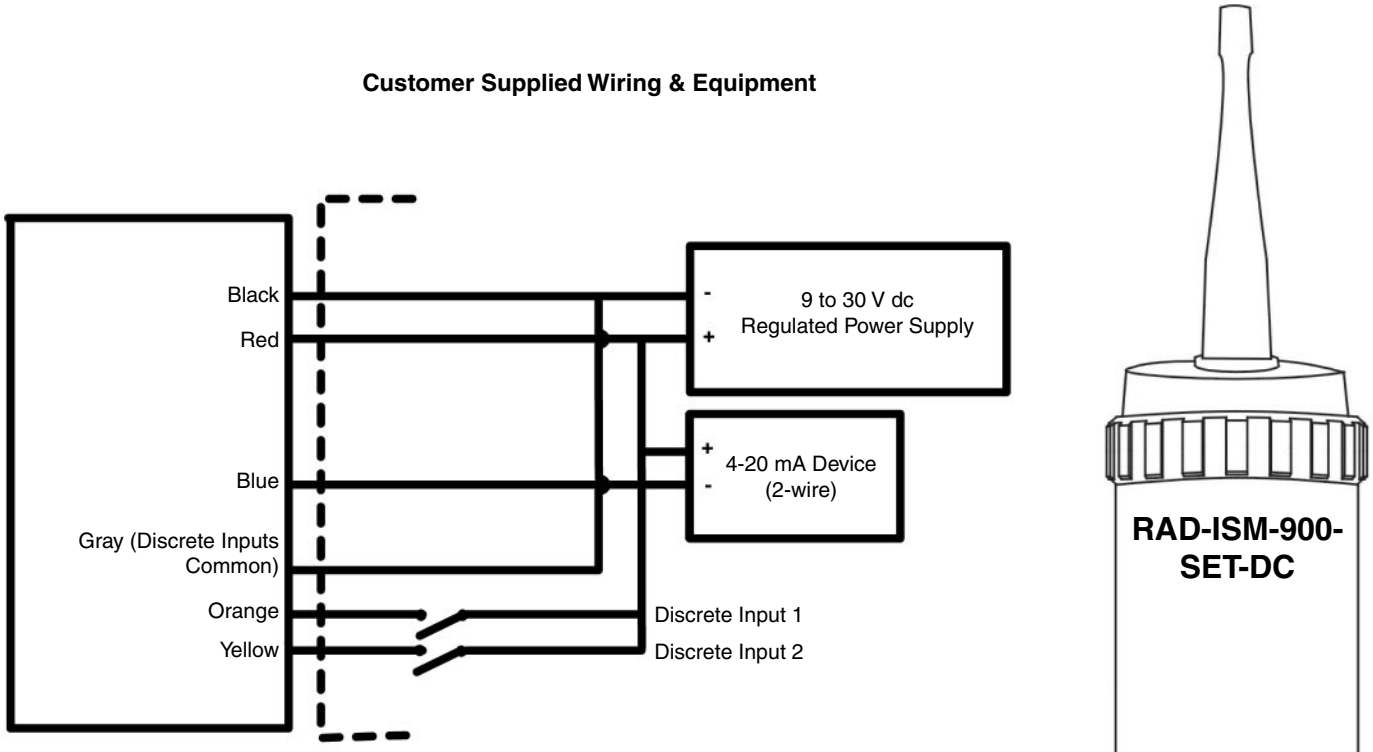


RAD-ISM-900-SET-AC Transmitter Block Wiring Diagram

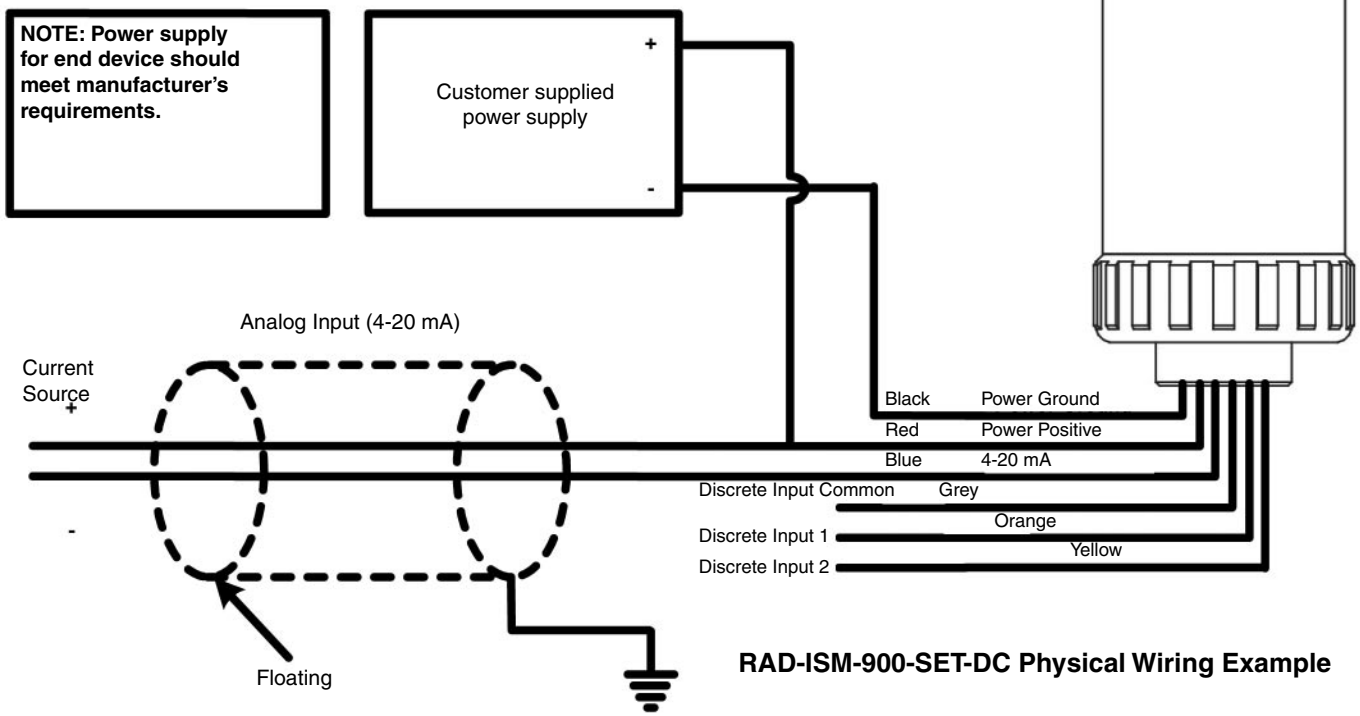
RAD-ISM-900-SET-AC Physical Wiring Example

RAD-ISM-900-SET-DC Transmitter

4-20 mA Current Loop with 2-wire Device



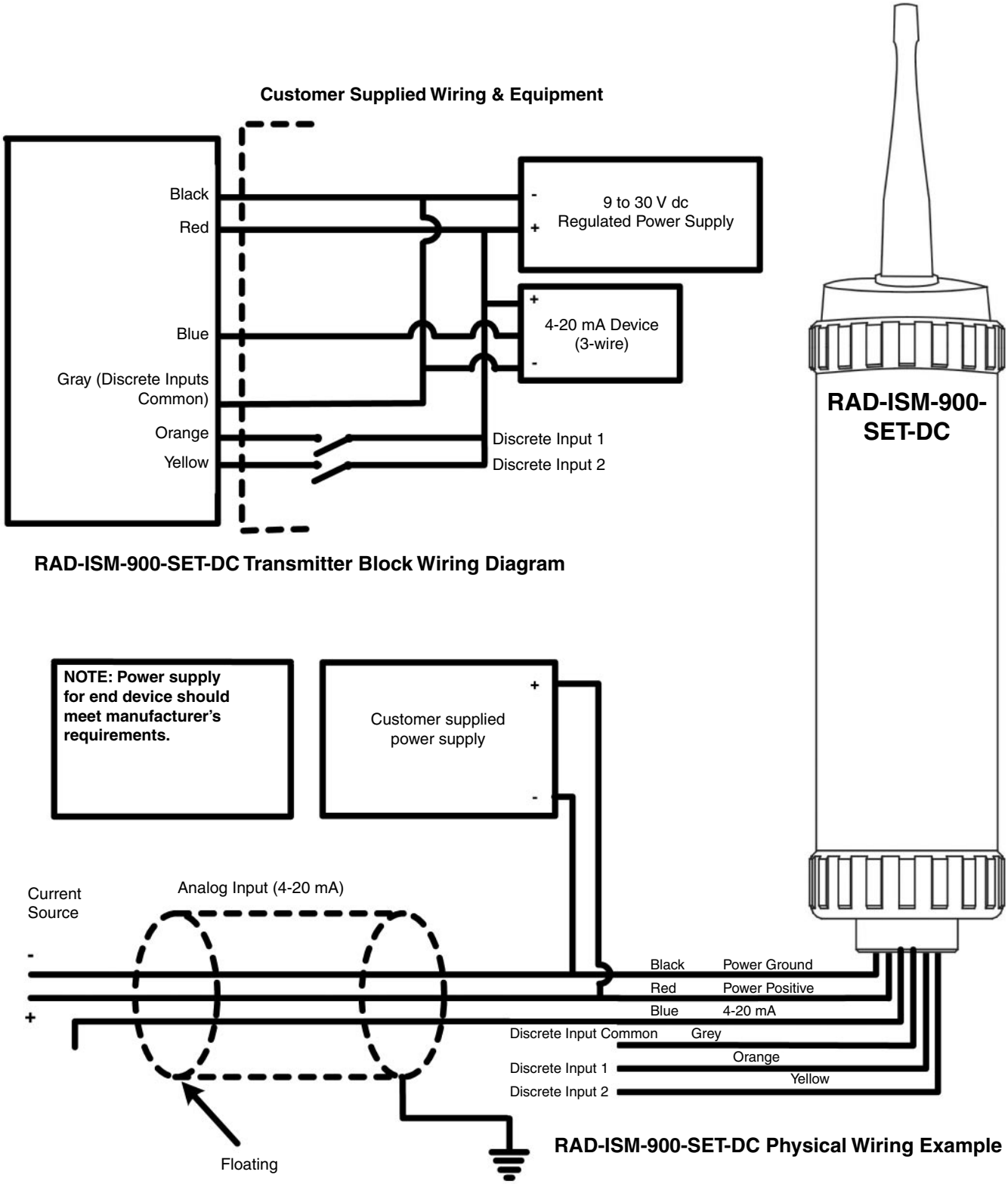
RAD-ISM-900-SET-DC Transmitter Block Wiring Diagram



RAD-ISM-900-SET-DC Physical Wiring Example

RAD-ISM-900-SET-DC Transmitter

4-20 mA Current Loop with 3-wire Device

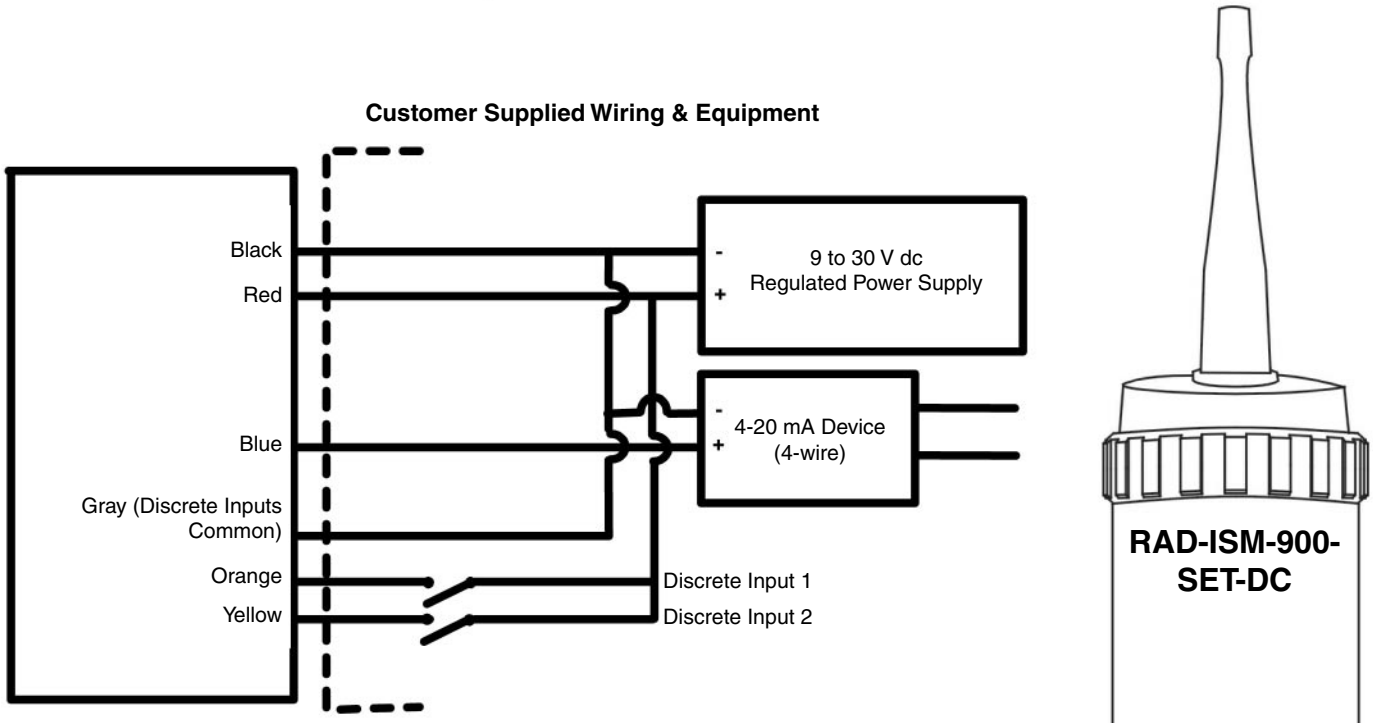


RAD-ISM-900-SET-DC Transmitter Block Wiring Diagram

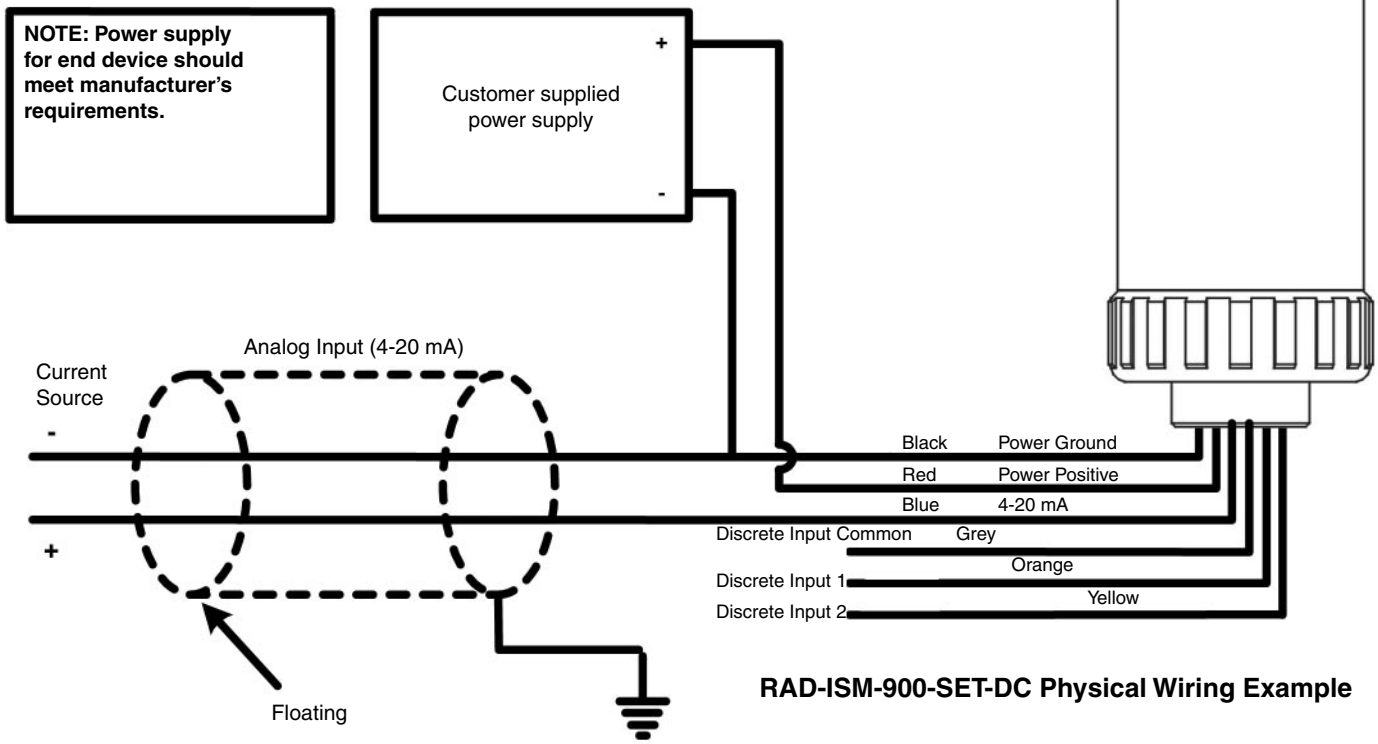
RAD-ISM-900-SET-DC Physical Wiring Example

RAD-ISM-900-SET-DC Transmitter

4-20 mA Current Loop with 4-wire Device



RAD-ISM-900-SET-DC Transmitter Block Wiring Diagram



RAD-ISM-900-SET-DC Physical Wiring Example

Receiver Wiring Diagram

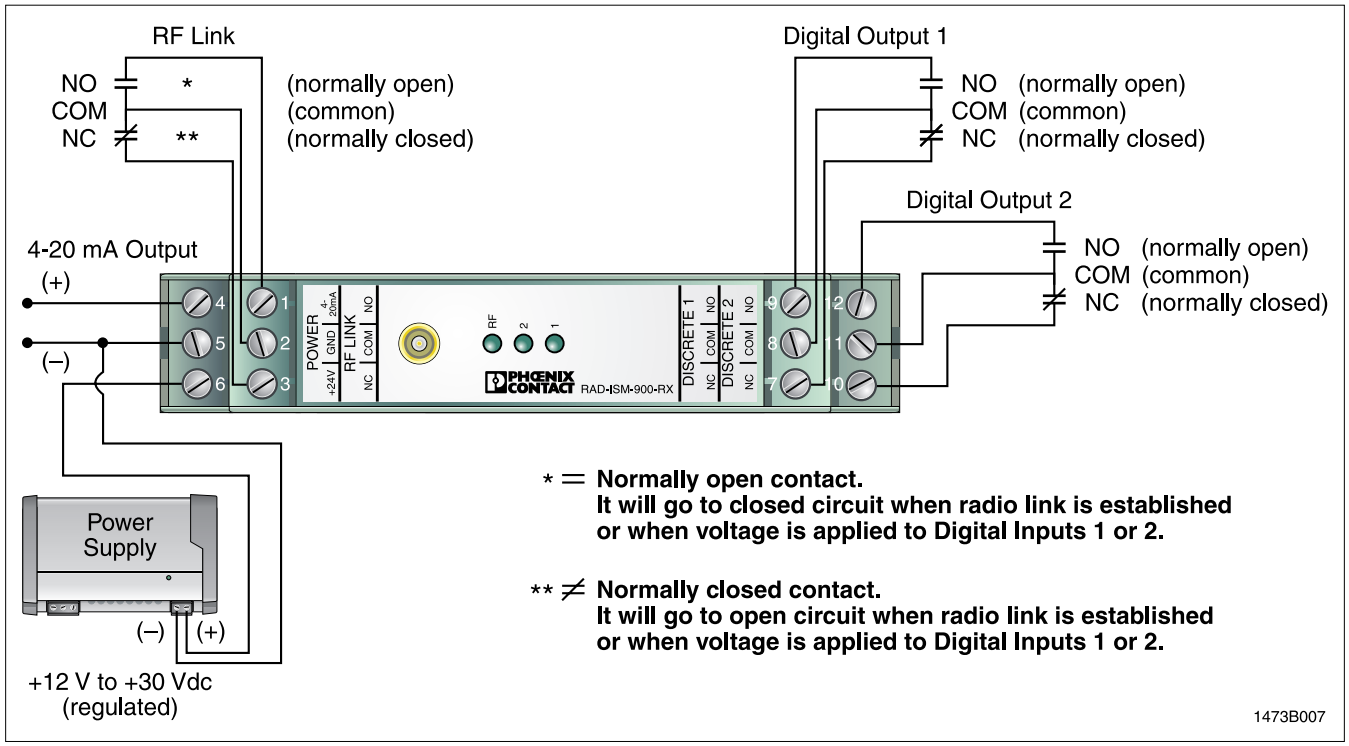


Figure 7. Receiver Wiring Diagram

FCC: This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference,

and

(2) This device must accept interference received, including interference that may cause undesired operation.

Specifications

Table 1. Technical Specifications

RAD-ISM-900-SET-AC Transmitter

Transmit power ..... 1 watt

Range ..... 600 to 1,000 feet, in-plant, no line-of-sight.
4-5 miles, line-of-sight, flat terrain, raised antennas.
20+ miles line-of-sight, flat terrain, professional antenna propogation study, and directional antennas.

Frequency ..... 902 to 928 MHz

Power source ..... 100 to 240 V ac, 50 to 60 Hz, 10 VA

Power consumption ... 13 watts

Inputs ..... 1 x 4 - 20 mA analog (250 ohm input impedance); 2 x 85 to 240 V ac discrete inputs

Temperature range .... -40° to 158°F (-40° to 70°C)

Humidity ..... NEMA 4x

Dimensions ..... 11" x 2.3" (279 mm x 57 mm) diameter, dimensions include Omni antenna

Mounting ..... 1/2" NPT (female) - vertical

Environmental ..... NEMA 4x (IP65)

Approvals ..... UL listed (Class I, Division 2 Groups A, B, C and D) pending, CSA approval

RAD-ISM-900-SET-DC Transmitter

Transmit power ..... 1 watt

Range ..... 600 to 1,000 feet, in-plant, no line-of-sight.
4-5 miles, line-of-sight, flat terrain, raised antennas.
20+ miles line-of-sight, flat terrain, professional antenna propogation study, and directional antennas.

Frequency ..... 902 to 928 MHz

Power source ..... 9 to 30 V dc

Power consumption ... 1.8 watts (average), 8.4 watts (peak)

Inputs ..... 1 x 4 - 20 mA analog (250 ohm input impedance); 2 x 5 to 30 V ac discrete inputs

Temperature range .... -40° to 158°F (-40° to 70°C)

Humidity ..... NEMA 4x

Dimensions ..... 11" x 2.3" (279 mm x 57 mm) diameter, dimensions include Omni antenna

Mounting ..... 1/2" NPT (female) - vertical

Environmental ..... NEMA 4x (IP65)

Approvals ..... UL listed (Class I, Division 2 Groups A, B, C and D) pending, CSA approval

RAD-ISM-900-...-UD Receiver

Frequency ..... 902 to 928 MHz

Power source ..... 12 to 30 V dc (regulated)

Power consumption ..... 3 watts (125 mA @ 24 V dc)

Outputs ..... 1 x 4-20 mA analog (12-bit resolution), 3 x 120 V ac 0.5 A digital (dry contact)

Max. Loop Impedance ... 450 to 1350 Ω for power supply voltages of 12-30 V dc

$$\text{Maximum Loop Impedence} = \frac{\text{(Supply Voltage-3)V}}{\text{20 mA}}$$

Repeatability 0.02%

Accuracy ..... 0.2% of full scale

Temperature range ..... -40° to 70°C (-40° to 158°F)

Humidity ..... 0 to 95% non-condensing

Dimensions ..... 102 x 114 x 17.5 (mm)
..... 4 x 4.5 x 0.7 (in.)

Mounting ..... DIN-rail

Environmental ..... NEMA 1

Approvals ..... UL listed (Class I, Division 2 Groups A, B, C and D) pending, CSA approval

Ordering Information

Part Description	Part Number
AC and DC weather- proof transmitter systems	
RAD-ISM-900-SET-AC-UD System	**28 67 02 1**
RAD-ISM-900-SET-DC-UD System	**28 67 03 4**
RAD-ISM-900-RX (receiver only, can be used as spare)	**28 67 04 7**

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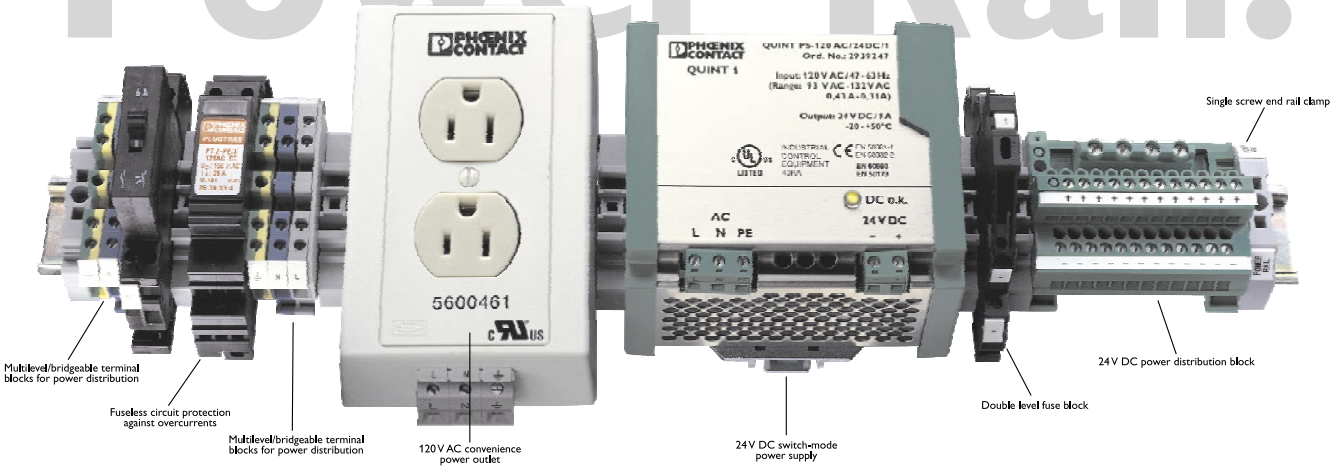
Accessories Ordering Information

Part Description	Part Number
MINI-PS-100-240AC/24DC/1 (universal voltage input 1 A, 24 Vdc power supply)	**29 38 84 0**
Class I, Div. 2 Approved Power Supplies	
QUINT PS 120AC/24DC/1(1A,24VDC)	**56 02 77 1**
QUINT PS 120AC/24DC/2.5(2.5A,24VDC)	**56 02 76 9**
CM50-PS120/230/24DC/2.5IF	**29 39 42 5**
CM125-PS120/230/5IF	**29 39 52 2**
Class I, Div. 2 Approved Signal Converters	
MCR-T/UI-E (thermocouple or RTD to 4-20 mA converter)	**28 14 11 3**
MCR-C-UI/UI-DCI (converters for current to voltage or vice versa)	**28 10 91 3**
MCR-S1/5-UI-SW-DCI-NC (transducer for 0-11 A AC/DC)	**28 14 73 1**
MCR-S10/50-UI-SW-DCI-NC (current transducer for 0-55 A AC/DC)	**28 14 74 4**
MCR-F-UI-DC (frequency converter for 0-120 kHz)	**28 14 60 5**

Wireless Analog/Digital Link Transmitter/Receiver Set RAD-ISM-900-...-UD

Power Rail.



For more information on Power Rail alternatives from Phoenix Contact, check out our website: **www.powerrail.com**

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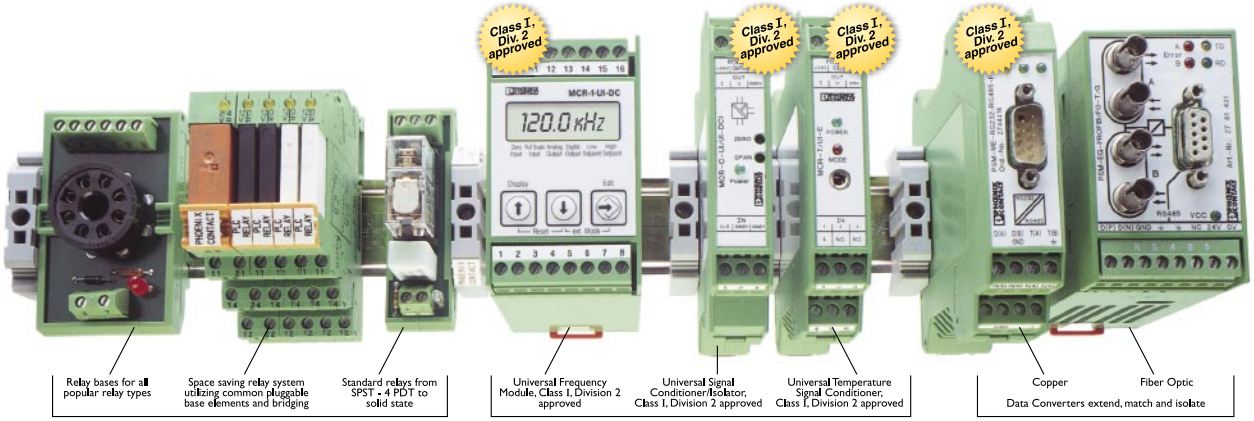
I/O Enhancers



Digital **Analog** **Data**

For more information on I/O enhancers from Phoenix Contact, check out our website: **www.iorail.com**

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Fax: (905) 890-0180

OMNEX Trusted Wireless

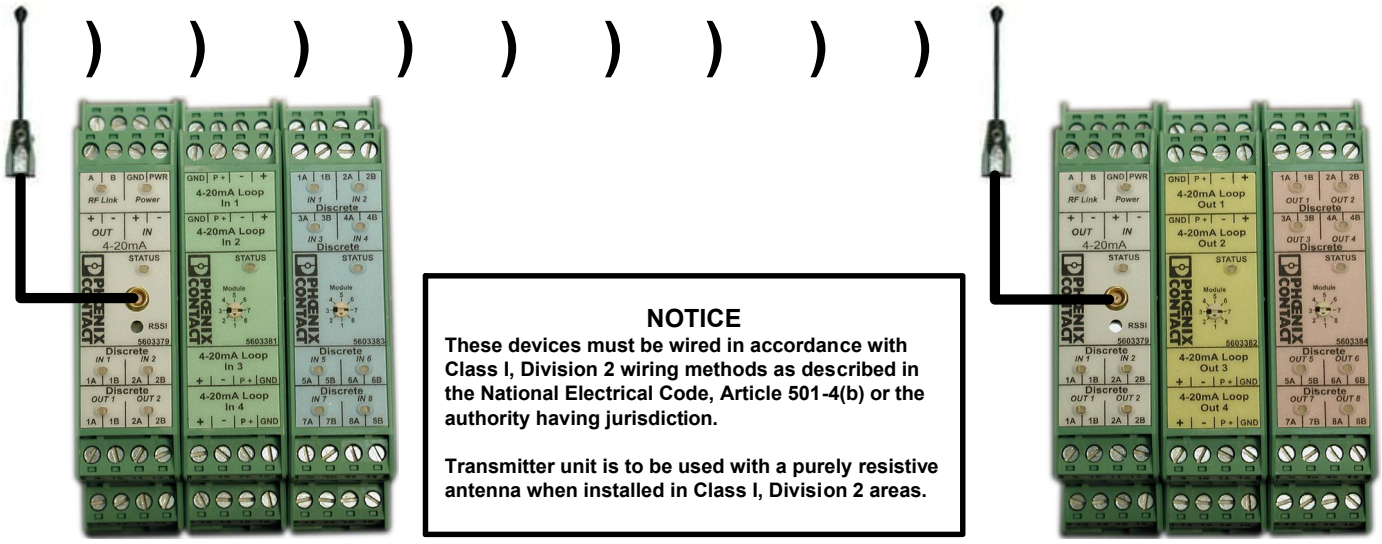
PHOENIX CONTACT

Wireless Interface RAD-ISM-900-SET-BD...

Two-way (Point-to-Point) Monitoring and Control with Expandable I/O Options

User Manual

L001662



NOTICE

These devices must be wired in accordance with Class I, Division 2 wiring methods as described in the National Electrical Code, Article 501-4(b) or the authority having jurisdiction.

Transmitter unit is to be used with a purely resistive antenna when installed in Class I, Division 2 areas.

- **Modular DIN-rail mount transceiver and I/O**
- **No programming required**
- **Maximum thirty-three (33) analog or sixty-six (66) discrete signals in one direction**
- **Class I, Div. 2 approved**
- **Dry contact RF LINK diagnostic output**
- **Up to eight (8) expandable I/O modules (passive inputs and outputs) per transceiver on common power and communications bus with multiple combinations**

The Phoenix Contact RAD-ISM-900-BD is an intergrated radio & I/O module designed for bidirectional interfacing of a 4-20 mA current loop and two digital signals in harsh industrial environments. This unique design also allows the user the flexibility to add on multiple channels of I/O to the paired transceivers in combinations. The Frequency Hopping Spread Spectrum (FHSS) utilizes 902-928MHz ISM band to guarantee a license free, interference free link between remote devices and the control room. The design is ideal for moving numerous signals within high interference environments without costly cable and conduit runs.

FCC Rules and Compliance

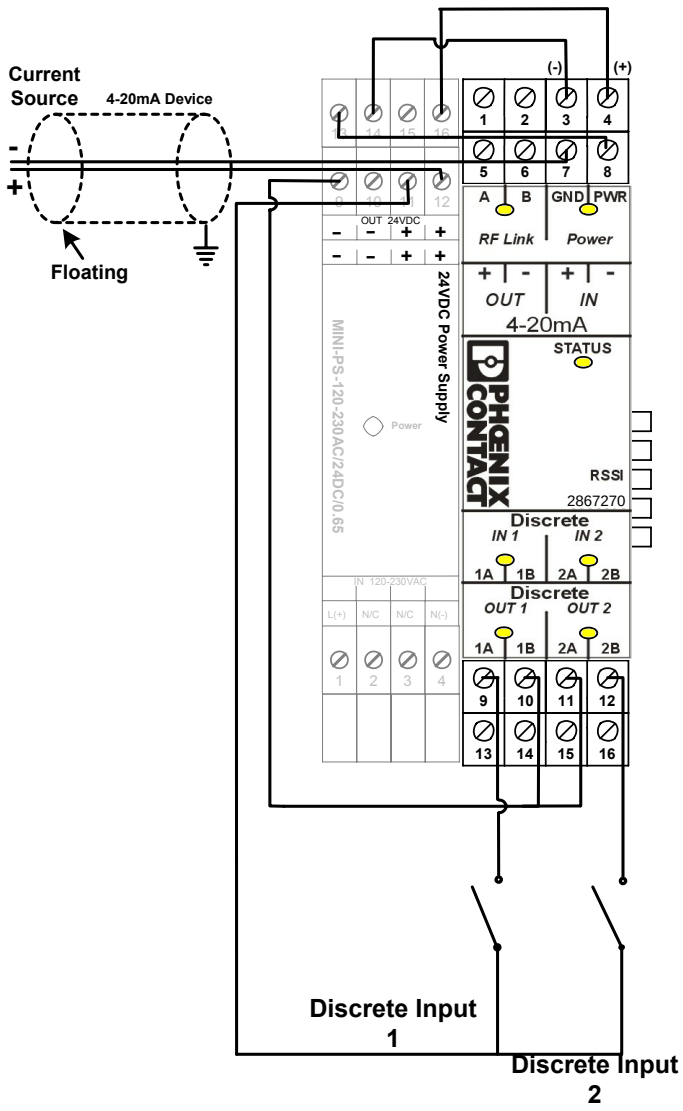
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This devic e may not cause harmful interference, and (2) this device must accept any interference received, including interference th at may cause undesired operation.
Changes or modifications not expressly approved by Phoenix Contact will void the user's authority to operate the equipment.
This product is intended for fixed installation applications. In order to comply with FCC/ISC adopted RF exposure requirements, installation of this transmitter system's antennas must be performed in a manner that will provide at least a 6 foot (2m) clearance from the front radiating aperture to any user or member of the public.

FCC	Part 15.247
ISC	RSS 210
CSA/C & US/UL	Class I, Div 2 (Groups A,B,C,D - *pending*)

RAD-ISM-900-BD Transceiver

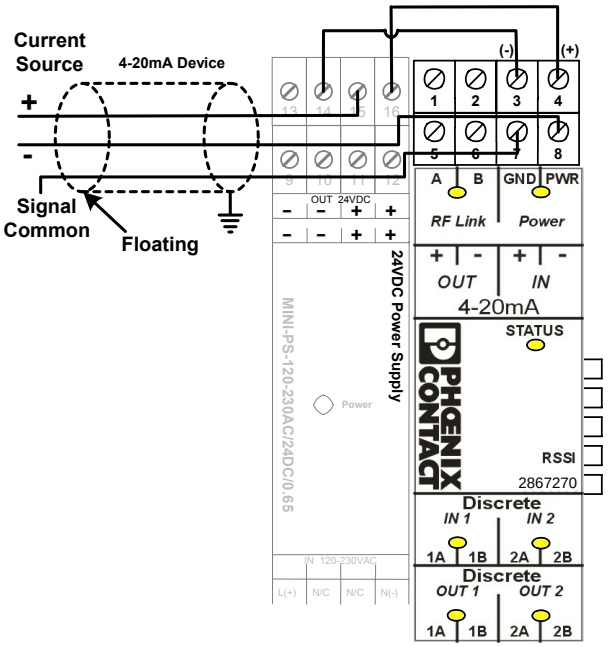
Analog and Discrete *INPUTS*

Input Example 1



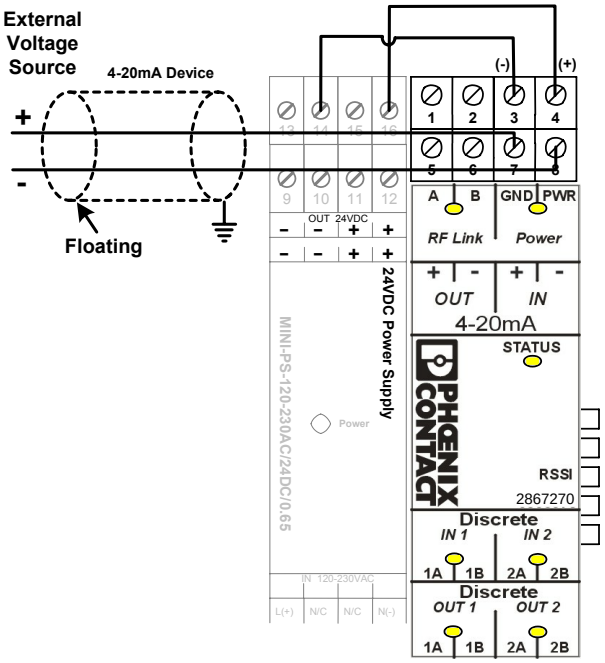
2-Wire Device 4-20mA Current Loop

Input Example 2



3-Wire Device 4-20mA Current Loop

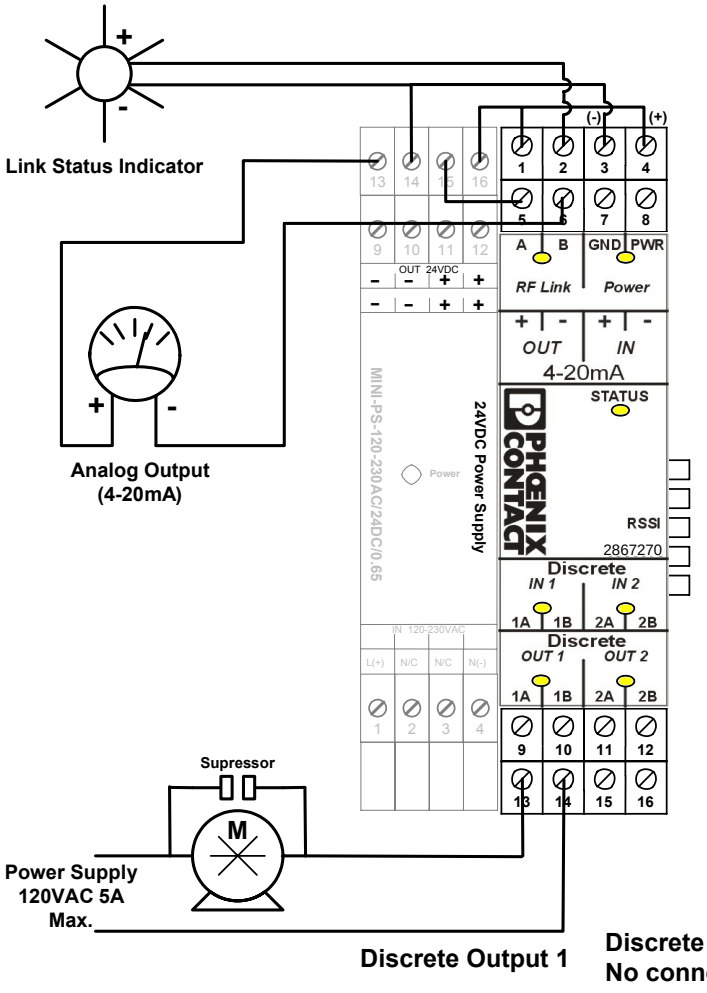
Input Example 3



4-Wire Device 4-20mA Current Loop

RAD-ISM-900-BD Transceiver
Analog and Discrete *OUTPUTS*

RAD-ISM-900-BD Transceiver
Output Examples



RF Link and Choosing Output States

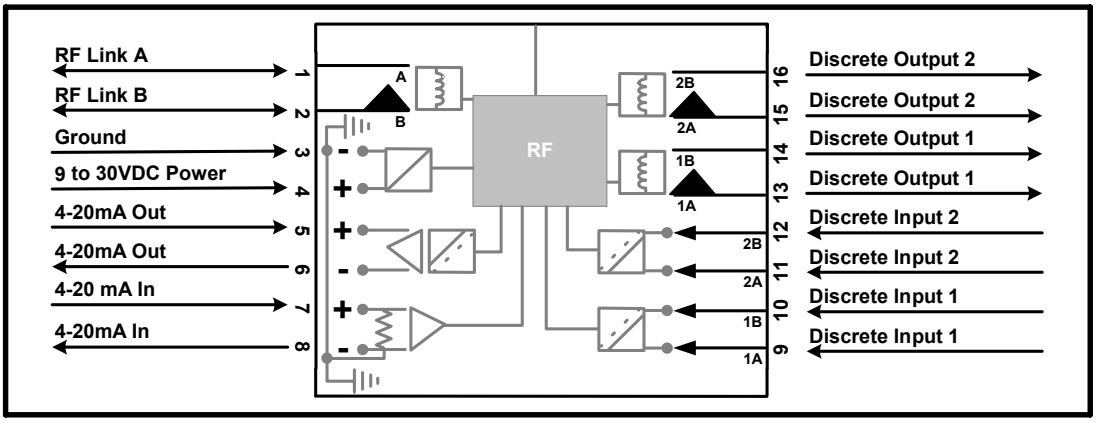
RF Link Output

The Link Status contact on the RAD-ISM-900-BD is Normally Open (NO) and closes when the radio establishes an RF Link. It can be used to switch either a STATUS light or a FAULT indicator.

Selecting State of Outputs upon Loss of RF Link

The default state upon loss of RF signal for the analog and discrete outputs is MAINTAIN LAST STATE. They may be wired in series with the RF Link contact to provide a FAULT OFF when RF Link is terminated.

RAD-ISM-900-BD Transceiver
Block Diagram



RAD-IN-4A-I

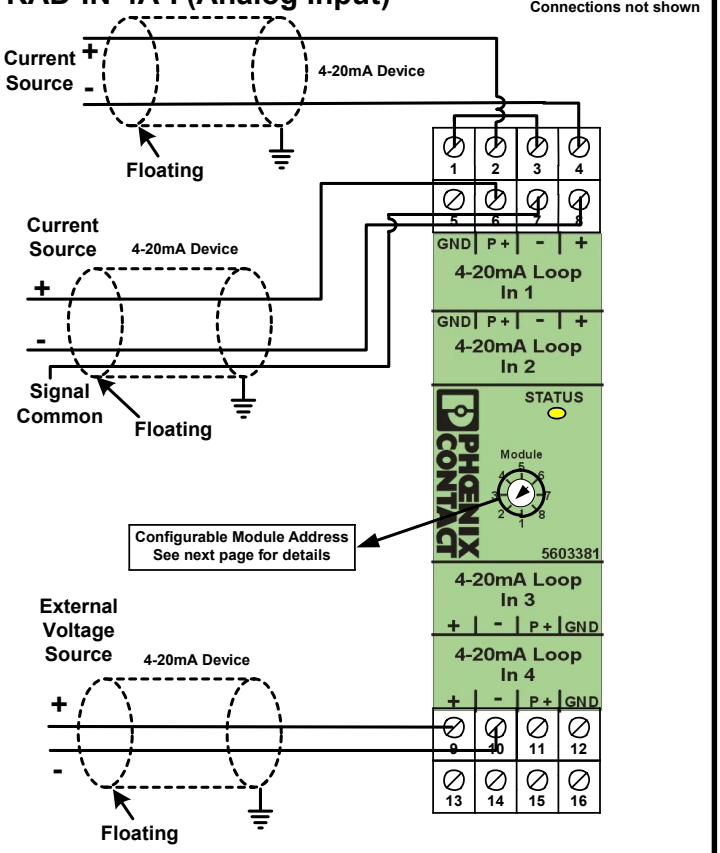
Analog Expansion Modules

Passive Inputs and Outputs

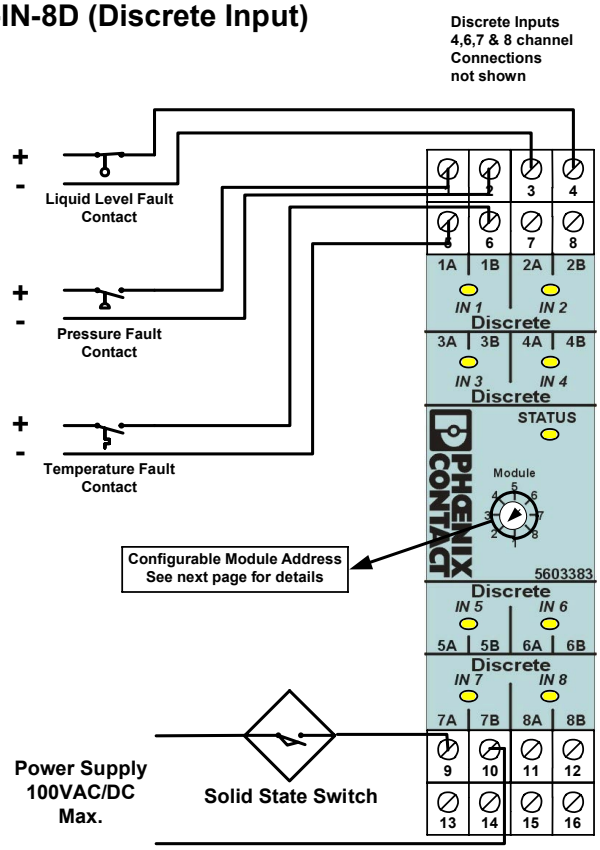
RAD-IN-8D

Discrete Expansion Modules

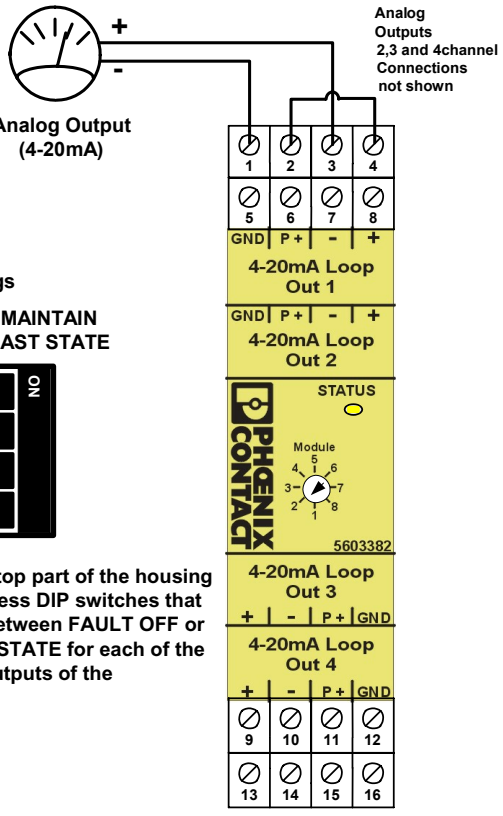
RAD-IN-4A-I (Analog Input)



RAD-IN-8D (Discrete Input)



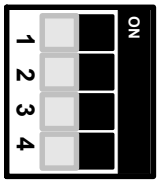
RAD-OUT-4A-I (Analog Output)



DIP Switch Settings

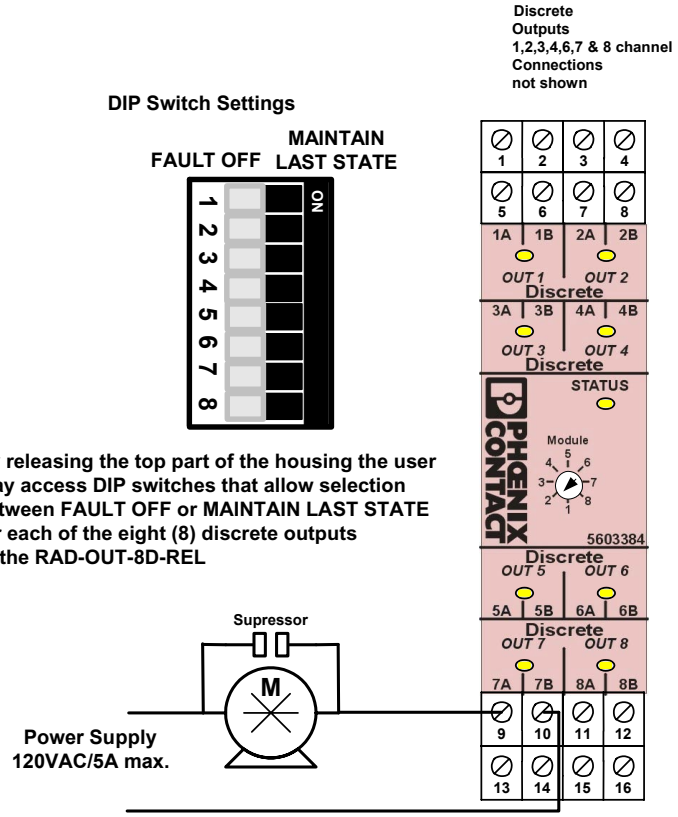
MAINTAIN LAST STATE

FAULT OFF

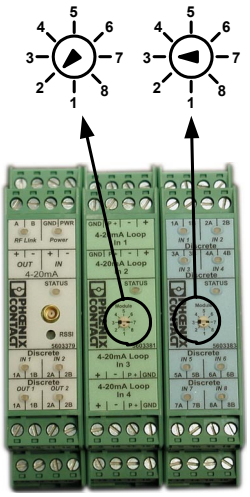


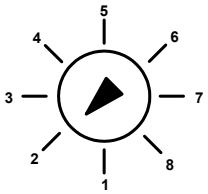
By releasing the top part of the housing the user may access DIP switches that allow selection between FAULT OFF or MAINTAIN LAST STATE for each of the four (4) analog outputs of the RAD-OUT-4A-I

RAD-OUT-8D-REL (Discrete Output)

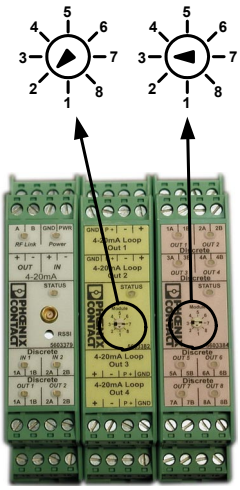


Configuring I/O Module Addresses





Module Address Selection Switch



Each pair of I/O modules, such as the RAD-IN-4A-I (2867115) and the RAD-OUT-4A-I (2867128), must share a unique module address. Once a module address has been assigned to a pair of I/O modules, that module address may not be used on any other pair of I/O modules on the same radio pair. Available addresses are numbers 1 through 8. If module addresses conflict, or are improperly set within a connected group, an indication will be given by the STATUS LED (see section below).

The RAD-ISM-900-BD transceivers are designed to operate as matched pairs and are factory programmed. Manual address configuration is not required for the transceiver units.

Power Budget Requirements (assuming internal bus power is used for analog I/O****)

The following table may be used as a reference when determining your power supply requirements. Total power requirements are shown per module, per side of the system. For example, the Transmitter side may have one (1) Transceiver, one (1) RAD-IN-4A-I (2867115) Expansion Module and one (1) RAD-IN-8D (2867144) Expansion Module. The total power requirement for this side of the system would be 213mA. [75 mA + 26 mA + 32 mA + (4*20 mA)]

The matching Receiver side would have one (1) Transceiver, one (1) RAD-OUT-4A-I (2867128) Expansion Module and one (1) RAD-OUT-8D-REL (2867157) Expansion Module. The total power requirement for this side of the system would be 287mA. [75 mA + 100 mA + 32 mA + (4*20 mA)]

MCR-RT-I/O-PLUS Rail Builder Power Budget Worksheet *			
	Quantity X	**Power Requirement (in mA) =**	**Total Power Consumption (in mA)**
5603379 Transceiver **	1	75 ***	75
5603383 Expansion Module digital input	8 max.	26	208
5603384 Expansion Module digital output	8 max.	100	800
5603381 Expansion Module analog input	8 max.	32	256
5603382 Expansion Module analog output	8 max.	32	256
Analog I/O using Internal Power ****	8 max.	20	660
Total Power Supply Requirement (Sum of all devices used)			

* These currents are @ 24VDC.

** Allow for 200mA peak on the Transceiver.

*** 75mA (average), 200mA (peak)

**** If you are using internal power for the analog 4-20mA current loops, then you will need to add 20mA for each input and output being used in this fashion.

Status LED's

Power LED Power LED indicates presence of power to the device. It is ON when power is present and OFF when there is no power.

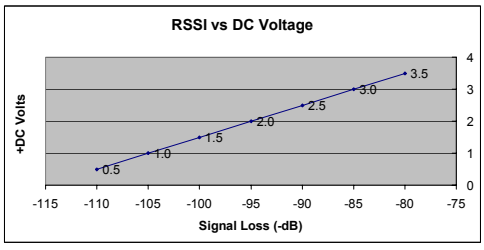
Status LED When flashing rapidly it indicates an "Internal Error" or a "Module Type Mismatch". A "Module Type Mismatch" occurs when the Module Address selection for two different modules (i.e. one (1) discrete module and one (1) analog module are set to the same address, or two (2) pairs of modules are sharing the same address).
When Status LED is ON steady, Module Address settings are OK.

RF LED
- Flashes once every two seconds when there is no RF Link
- Flashes rapidly when signal strength is marginal (see RSSI Table)
- ON steady indicates an exceptionally strong RF Link.
- Most systems will flash occasionally indicating the presence of intermittent interference in the area

Discrete Input / Output
- OFF means that the discrete input or output is Open
- ON means that the discrete input or output is Closed

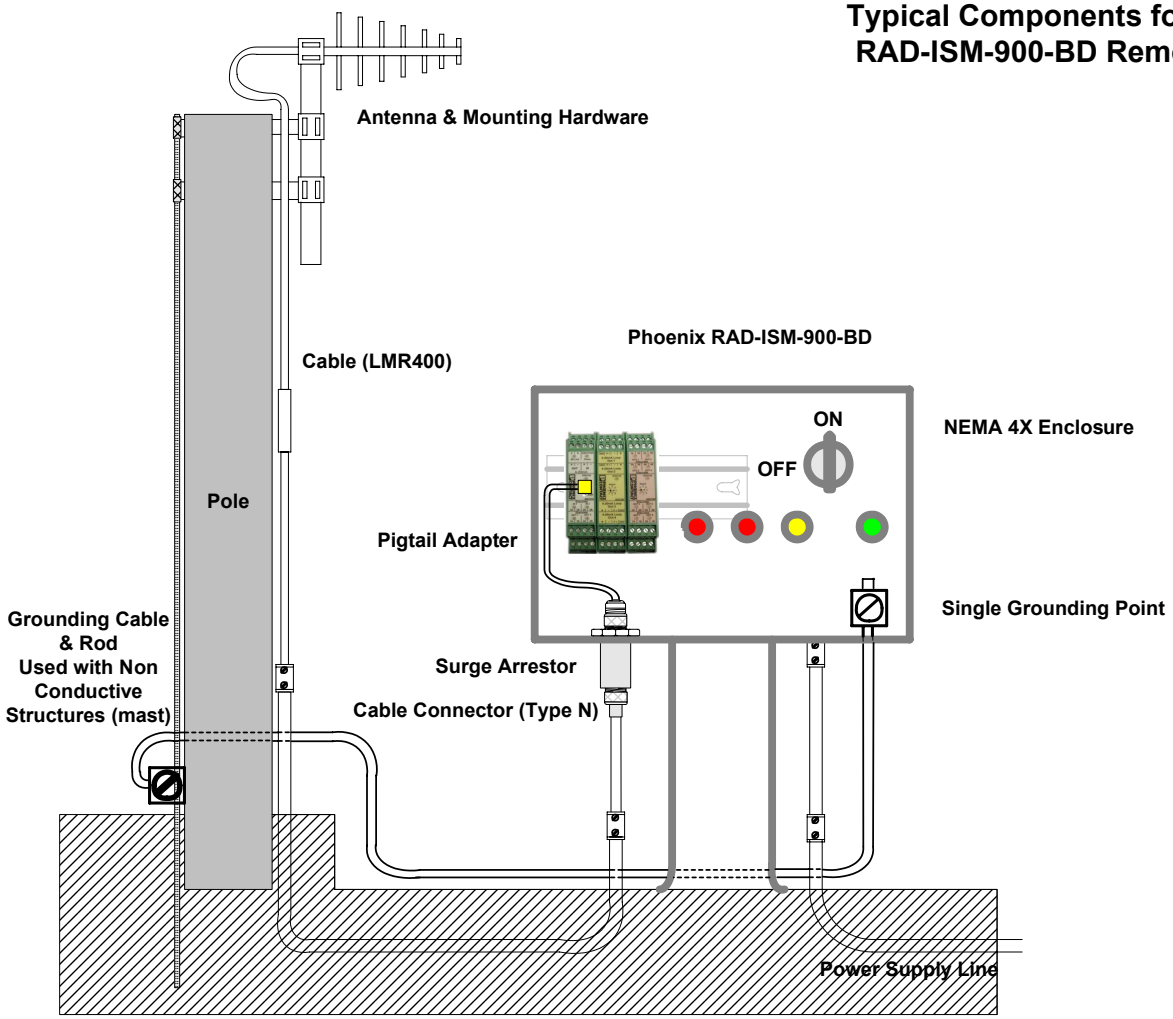
RSSI Troubleshooting

RSSI (Received Signal Strength Indicator) is measured using a DC Voltmeter between the test point and power supply ground. The test point is accessed by inserting a positive meter probe into the RSSI hole on the face of the RAD-ISM-900-SET-BD-BUS and the negative meter probe to the GROUND terminal.



The following RSSI table may be used to test the Receive Signal Strength of the RAD-ISM-900-BD. The ideal voltage that should be read from the RSSI test point is 2.5VDC. This represents a 90dB signal loss and typically indicates that the radio has 20dB fade margin left until loss of link. It is recommended that the radios be set up with no less than 20dB margin.

Typical Components for a RAD-ISM-900-BD Remote Site



Wireless I/O Interface Ordering Information	
Part Description	Part Number
RAD-ISM-900-SET-BD-AN (two-way transceiver set with quarter-wave whip antennas)	2867270
RAD-ISM-900-SET-BD (two-way transceiver set without antennas)	2867089
RAD-IN-4A-I (four-channel analog input module)	2867115
RAD-OUT-4A-I (four-channel isolated analog output module)	2867128
RAD-IN-8D (eight-channel digital input module)	2867144
RAD-OUT-8D-REL (eight-channel digital output with relays)	2867157
RAD-ISM-900-BD (can be used as a spare or a repeater - requires ID number of transceivers)	2867092
RAD-ISM-900-1TX-2RX-BUS (configured as one-way system w/one transmitter & two receivers-expandable)	2867571
RAD-ISM-900-HOP-US (used to configure repeaters or replacement transceivers)	2867539
RAD-ISM-900-ANT-4 (4-way antenna splitter to cascade receivers in simplex mode)/MCX(M) to MCX(M) patch cable	2867050/5603376

Wireless I/O Accessories		
Item	Part Description	Part Number
Antennas	1/4 Wave Omni Antenna & 10' cable (0dB gain antenna L mount with BNC (M) connection)	2867173
	5dB Omni Base Station Antenna (5dB gain antenna L mount with 24" mast and propeller type base Type N(F) connector. (Requires cable adapter)	2867199
	6dB Yagi Antenna (6dB gain 3-element antenna with Type N(F) connector. Requires cable adapter)	2867209
	9dB Yagi Antenna (9dB gain 7-element antenna with Type N(F) connector. Requires cable adapter)	2867351
Cables	RG58 Cable (Cable loss = 16dB/100' (16dB/30.5m) BNC(M) & Type N(M) For distances less than 20'	2867393
	RG213 Cable (Cable loss = 7.6dB/100' (7.6dB/30.5m) Type N(M) both ends. For distances to 50'	2867225
	LMR400 Cable (Cable loss = 3.9dB/100' (3.9dB/30.5m) Type N(M) both ends. For distances up to 100'	2867238
Surge Arrestor	Phoenix Contact COAXTRAB CN-UB-280DC-BB Type N(F) to Type N(F) Bulkhead Mount	5603859
Adapters	Type MCX(M) to N(M) adapter (4' RG316 cable)	2867254
	Type MCX(M) to BNC(F) / adapter for connection J0004	2867267/2867241

Antennas (a brief overview)

dBi

The FCC Part 15 regulations limit the antenna system gain for a 1 Watt unlicensed radio system to 6dBi.
This is based on an "isotropic" antenna model or "theoretical" antenna that radiates equally well in all directions. Such an antenna does not exist in the real world, but for purposes of determining the amount of antenna system gain permissible under Part 15 of this theoretical model is used.

The importance of understanding "theoretical" antennas versus "real" antennas has to do with the fact that the FCC views antenna gain in terms of dBi while the antenna manufacturers typically rate antenna gain in terms of dBd, which relates to a real world antenna known as a half-wave dipole. This difference in starting points influences "the math" a company like Phoenix uses when correctly determining the gain/loss of an antenna, cable and connector system it supplies.

How is "the math" influenced? Without going into a long technical discussion, simply stated, the difference between dBd and dBi is expressed by the value 2.15. An antenna with a gain of 3dBd is viewed by the FCC as having a gain of 3 + 2.15 = 5.15dBi.

Since most end-users seldom use or understand dBd, dBi, or dBm (not discussed here), but instead use the general "catch phrase" dB when referring to the gain/loss of antenna system components, we recommend that they are aware of the fact that Phoenix Contact uses the following standard formula when determining Gain/Loss of an antenna system connected to a 1 Watt Phoenix FHSS radio.

Antenna gain (dB) - cable/connector losses (dB) + 2.15 = System Gain/Loss in dBi (not to exceed 6dBi)

Gain

In simple terms, gain can be thought of as the yardstick for determining how far a radio/cable/antenna system will transmit a signal by "focusing" the radiated energy produced by that radio. The simplest antenna - a 0dBi Omni - can be visualized as radiating signals in a sphere. To add "gain" to such an antenna, the radiation pattern of the energy can be shaped/focused, and in the case of an Omni directional antenna one thing that can be done is to flatten, or squish, the sphere. By turning the sphere into a donut, less energy is allowed to radiate vertically and more energy is diverted horizontally. An Omni antenna with its energy focused in this fashion will radiate energy further on a horizontal plane. Nothing is added to the system - only the radiation pattern is changed.

Loss

Loss is the yardstick, often given in "dB," for measuring the resistance of all the things that reduce the strength of a signal as it travels to the antenna. Cables, connectors, surge protectors, etc. all absorb energy from the signal as it passes through them. LMR400 cable, for example, has a loss of 3.9dB per 100 feet. When calculating antenna gain and cable loss, be sure to add 2.15 to the final value in order to convert the total dB gain/loss to dBi.

Gain/Loss Example

An antenna with 6dB gain will be mounted on a mast and require 100 feet of LMR400 cable. Using the formula given above, this would be calculated as 6dB - 3.9dB + 2.15 = 4.25dBi. Since this is within the 6dBi limit, it would be acceptable under FCC Part 15 to implement this system.

Types of Antennas

Omni directional antennas radiate and receive signals in all directions. They usually resemble vertical rods but can come in other shapes as well. Some have horizontal rods at their base to form a ground plane for increased performance. Because Omni antennas focus their gain over a wide area, they are typically used at MASTER radios that need to send and receive information to and from many surrounding radios, and with radio systems separated by short distances or residing in obstructed locations where the signals are bouncing around structures and buildings.

Yagi antennas are uni-directional, meaning they have their energy focused tightly enough to only transmit and receive signals in the direction they are pointed. Yagi antennas are useful when you want to increase signal strength in one direction and send the signal farther than you could with an Omni antenna. They are typically used in outdoor installations to cover long distances from point to point.

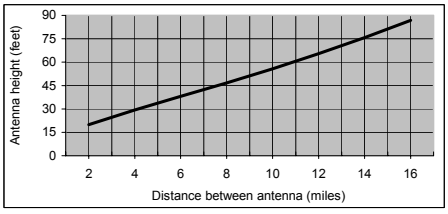
Antenna Height

For maximum transmission effectiveness, several factors must be taken into account. Obviously, distances between antennas are important, as radio signals dissipate as they travel. The Fresnel Zone, or the space occupied by the propagating radio signal, changes shape as it travels across the earth and must be relatively clear of obstacles. For distances greater than 7 miles (11km), the curvature of the earth can adversely affect the radio link because it enters into the Fresnel zone. As a result, the overall formula for calculating approximate total antenna heights is:

Where:
H = antenna height in feet
D = distance between radios in miles

$$H = 13.7\sqrt{D + \frac{D^2}{8}}$$

To simplify this, refer to the table at the right to find the suitable minimum height of the antennas at each end of the link.



Mounting

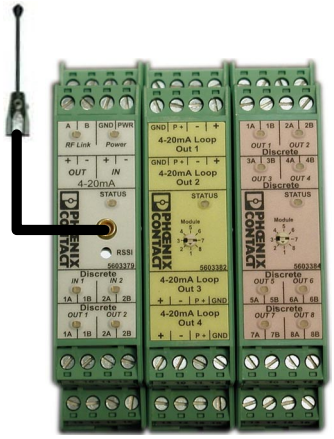
No matter what type of radio you are using, to maximize the signal strength getting to the receiver, mounting the radios with in Line-of-Sight of each other is the best option. That much said, 902 to 928MHz signals (used by Phoenix Contact) have characteristics that lend themselves well to bouncing and reflecting off of objects. This enables them to perform well in industrial environments where Line-of-Sight cannot be achieved. To take full advantage of bouncing and reflecting signals in an obstructed environment, Omni directional antennas should be used and mounted in areas where they can radiate and capture signals coming from the maximum number of reflective surfaces. For examle, in a refinery, mounting an Omni directional antenna outside the control room on a catwalk open to the superstructure of the facility, rather than burying it inside the control room, will greatly enhance the performance of the radio link.

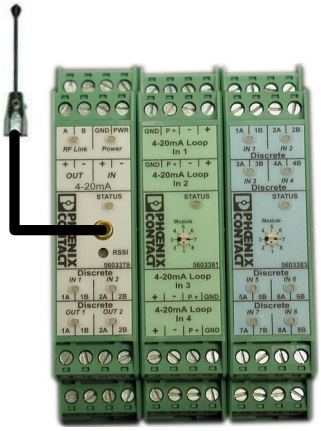
When using Yagi antennas at remote sites to communicate back to a central MASTER with an Omni antenna, be sure to aim the Yagi's directly at the Omni and mount the elements of the Yagi antennas vertically - like the Omni. This will ensure maximum signal strength within the system.

If two Yagi antennas are used in a point to point application, their elements need to be aligned the same, either vertically or horizontally. Some system designers prefer to mount the Yagi elements horizontally as they feel this helps reduce interference from other radio systems in the area (which are typically vertically polarized).

Specifications

2867270	RAD-ISM-900-BD
General	
Range	600 to 1000 feet (180 to 305m) in-plant [obstructed]; 4-5 miles (6-8km) LOS with Omni antenna; 20+ miles (32+km) LOS with Yagi antenna
Inputs	One (1) 4-20mA analog input (16-bit, 125 ohms impedance) Two (2) discrete inputs (5-36VDC)
Outputs	One (1) 4-20mA analog output (16-bit, short-circuit protected) Two (2) discrete outputs (dry contact, NO, contact rating: 120VAC/5A)
I/O Expansion Capability	Four (4) analog and eight (8) discrete I/O modules
Repeatability	Current loop: 0.02%
Accuracy	Current loop: 0.2% of full-scale @ 77°F (25°C)
Wiring Connections	12-24 AWG screw-type terminals; removable terminal blocks
Mounting	DIN rail mount
Primary Power	
Input Voltage	9 to 30VDC
Reverse Polarity Protection	Yes
Surge Protection	Yes
Power Consumption	75mA (average) / 200mA (peak) @ 24VDC during transmission (plus I/O modules)
Transceiver	
Frequency	902 to 928MHz - ISM band
Transmit Power	1 Watt (30dBm)
RX Sensitivity	-105dBm
Unit ID	Factory configured (unique); 16-bit coding of each transceiver pair allows multiple units to be used in the same area
Antenna Connector	MCX female
Antenna Impedance	50 ohms
Diagnostics	
Indicators	External LED's (Power, RF Link, I/O status)/RF link relay 120 VAC/5 A
Environmental	
Humidity	20% - 90% (non-condensing)
Temperature	Operating: -40°F to 158°F (-40°C to 70°C)
Size	4.5" x 3.9" x 0.9" (114mm x 99mm x 23mm)
Weight	5.3 oz (150 g)
Enclosure	NEMA 1 (equivalent to IP20)
Agency Approvals	
FCC	Part 15.247
ISC	RSS 210
CSA/C & US	Class I Div 2 (Groups A, B, C, D - *pending*)
I/O Expansion Modules	
2867144	RAD-IN-8D Discrete Input Module – Low Volt
Channels	Eight (8)
Input Voltage Range	5 to 36VAC/DC
Input Impedance	5K ohms
Optically Isolated	3kV (input/output and channel/channel)
Reverse Polarity Protected	Yes
Over-Voltage Rating	100VAC/DC max.
Power Consumption	26mA
2867157	RAD-OUT-8D-REL Discrete Output Module – 8 Ch, Relay
Channels	Eight (8)
Output Terminals	Dry contact (NO)
Contact Ratings	120VAC/5A
Power Consumption	10mA @ 24VDC (outputs OFF) 100mA @ 24VDC (outputs ON)
2867115	RAD-IN-4A-I 4-20mA Analog Input Module – 4 Ch
Channels	Four (4)
Resolution	16-bit
Input Impedance	125 ohms
Reverse Polarity Protected	Yes
Over-Voltage Rating	42VDC max.
Accuracy	0.2%
Power Consumption	32mA (inputs disconnected)
2867128	RAD-OUT-4A-I 4-20mA Analog Output Module – 4 Ch, ISOL
Channels/Load per Channel	Four (4)/9 V voltage drop per channel
Resolution	16-bit
Short-Circuit Protection	Yes
Optically Isolated	3kV (input/output and channel/channel)
Accuracy	0.12%
Power Consumption	32mA (outputs disconnected)





PHOENIX CONTACT