BW TECHNOLOGIES

RRJ Transmitter with Sensor

4-20 mA Combustible Gas Monitor

Instruction Sheet

Introduction

The Rig Rat Junior (RRJ) gas monitor ("the monitor") warns of hazardous gas at levels above a factory set alarm setpoint. The monitor is a 3-wire, 4-20 mA transmitter with sensor. The monitor is factory calibrated and tested.

Standard RRJ Transmitter with sensor kit includes:

- RRJ 0-100% LEL monitor
- Calibration plug
- Instruction sheet

Table 1. Order Numbers

Model	Description	Max Operating Life
RRJ-RW1	RRJ transmitter with LEL sensor	2 years
RRJ-RW1-K	RRJ transmitter with LEL sensor and pigtail assembly	2 years

Table 2. International Symbols

Symbol	Meaning
	Approved to both U.S. and Canadian Standards by the Canadian Standards Association
ATEX	Conforms to European ATEX Directives
IECEx	International Electrotechnical Commission Scheme for Certification to Standards for Electrical Equipment for Explosive Atmospheres
CE	Conforms to European Union Directives

Certified to CAN/CSA C22.2 No. 152 and ANSI.ISA S12.13 Part 1 when connected to a controller that has zero span adjustment and is certified to the combustible gas performance standards.

D1423/3
iERP: 117813

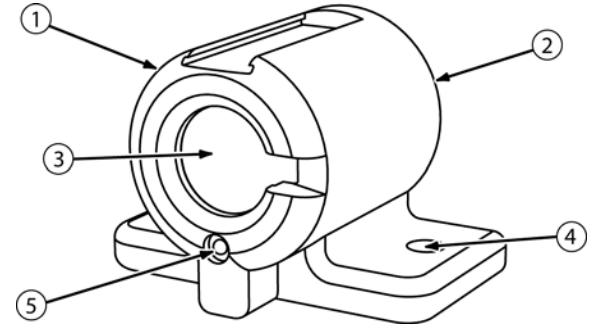
⚠ *Safety Information - Read First*

Users of the monitor require a full understanding of the installation, operating, and maintenance instructions; otherwise protection provided by the monitor may be impaired. Read and understand the instruction sheet completely before operating or servicing.

- ⇒ **Install according to local electrical regulations and codes.**
- ⇒ **Installation should be performed by qualified personnel.**
- ⇒ **Do not activate the monitor after the date on the package.**
- ⇒ **Make sure the sensor screen is free of dirt and debris.**
- ⇒ **Make sure the sensor screen is not covered.**
- ⇒ **Do not expose the monitor to electrical shock and/or continuous mechanical shock.**
- ⇒ **Do not expose the sensor to high-pressure water spray.**
- ⇒ **Do not install in atmospheres containing ketones, alcohols, or acids.**
- ⇒ **Calibrate the system before first-time use and then on a regular schedule, depending on use and sensor exposure to poisons and contaminants.**
- ⇒ **It is recommended that a "bump test" be performed before each day's use to verify proper instrument operation. Calibrate if the readings are not within the specified limits.**
- ⇒ **It is recommended that the combustible sensor be checked with a known concentration of calibration gas after any known exposure to catalyst contaminants/poisons (sulfur compounds, silicon vapors, halogenated compounds, etc.).**
- ⇒ **The combustible sensor is factory calibrated to 50% LEL methane. If monitoring a different combustible gas in the % LEL range, calibrate the sensor using the appropriate gas. High off-scale % LEL or % v/v methane readings may indicate an explosive concentration.**
- ⇒ **Protect the combustible sensor from exposure to lead compounds, silicones, and chlorinated hydrocarbons. Although certain organic vapors (such as leaded gasoline and halogenated hydrocarbons) may temporarily inhibit sensor performance, in most cases, the sensor will recover after calibration.**
- ⇒ **Any rapid up-scaling reading followed by a declining or erratic reading may indicate a gas concentration beyond upper scale limit, which may be hazardous.**
- ⇒ **Do not test the combustible sensor's response with a butane cigarette lighter; doing so will damage the sensor.**
- ⇒ **Do not use the monitor if it is damaged. Before use, inspect the monitor. Look for cracks, missing metals, or plastics. If the monitor is damaged, contact BW Technologies immediately.**
- ⇒ **The warranty will be voided if the customer or any unauthorized service personnel attempt to repair the unit.**

Parts of the RRJ

Table 3. Parts of the RRJ



1	Transmitter with sensor
2	Plug-in connector (not shown)
3	Sensor filter
4	Mounting flanges
5	Sensor LED

Installation

Read the information in the following sections to properly install the monitor.

Monitor Location

The following suggestions should be considered to assure detection of the target gas. Select the most suitable location for each monitor.

Air Currents: If there are fans, wind, or other sources of air movement, gases may tend to rise or collect in certain areas of a facility. The local air currents should be assessed to aid in selecting the sensor location. Air convection can often be more important in determining gas concentration areas than factors of vapor density.

Gas Emission Sources: As a rule, at least one monitor should be located in close proximity to each point where an emissions is likely to occur.

Mounting the Monitor

The monitor is equipped with two predrilled mounting flanges. Simply fix where desired.

⚠ Caution

The sensor should face sideways or down to prevent the accumulation of dirt, debris, water, or snow on the sensor filter, thereby preventing the flow of ambient air to the sensor.

Shielded Cable: Use shielded cable only to avoid radio frequency interference (RFI) or electromagnetic interference (EMI). The shield (including Mylar) must be grounded at the controller.

Note

BW Technologies' manufactured cables are shielded.

4-20 mA Loop

Cable Routing: Separate cables are required for each monitor.

Power Supply: Power is supplied by the controller.

Recommend: BW recommends regulating the power supply if using any other controller.

⚠ Caution

Supply voltage to be 24 V nominal. Fluctuations not to exceed 28 Vdc or go below 10 Vdc. Applicable for any 3-wire, 4-20 mA transmitter that can operate down to 10 volts.

Connect the Monitor to the Controller

There are three ways that you can connect the monitor to a controller.

1. Using BW's RRJ sensor cable;
2. Using your own sensor cable;
3. Using a pigtail connector (if cable is not needed).

Note

Do not turn on the controller power until all wiring is complete.

BW Plug-In Monitor Manufactured Cable Kits

- Part No. RRJ-SC###-K

The rugged artic black shielded cable kit comes complete with molded plug-in connectors and a controller compression fitting. The maximum cable length is 1,000 ft. (305 m). To install, complete the following steps and refer to the following two figures.

Wire to Controller

1. RRJ-4000 controllers: Install the compression fitting on the controller (supplied), if applicable. Remove the outer casing of the shield (including the wires within the shield) to expose the connected wires (minimum five inches of exposure).
2. Strip 5/16 inch of insulation on to pin A, C, and F.
3. Connect the pin F wire to the +V controller connection.
4. Connect the pin C wire to the 4-20 mA return signal connector.
5. Connect the pin A wire to the 4-20 mA return connector.

Plug into Monitor

1. Plug cable into monitor and secure outer weatherproof ring to prevent moisture invasion.

Note

If the monitor is always mated to the same channel on the controller, the controller LCD only requires calibration the first time the monitor head is installed.

Cable bend allowances should not exceed 65 degrees.

2. Calibrate the controller display and test with gas (refer to the Calibrate the Controller section).

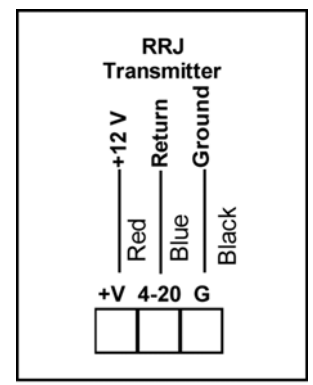


Figure 1. Controller Wiring

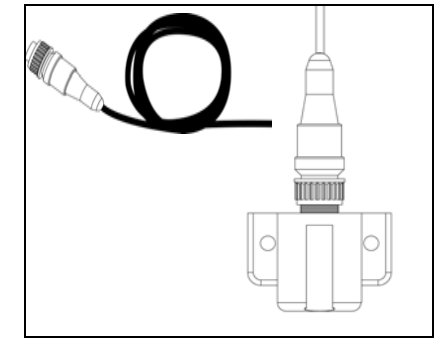


Figure 2. Transmitter Plug

Customer-Supplied Cable Installation

- Part No. RRJ-FW1-K

The distance the 4-20 mA signal can travel is dependent on several factors, including cable gauge. Maximum loop resistance is 650 ohms less the controller resistance.

Note

RRJ-4000 controller and CR-4000 controller resistance is 120 ohms.

⚠ Caution

Use 3-wire, 18-22 AWG shielded copper wire cable. Cable should be shielded to prevent RF line interference.

The following table assumes a constant 12 V power supply at 68°F (20°C) for RRJ-4000 and 24 V power supply at 68°F (20°C) for CR-4000.

Table 4. Maximum Transmission Distance

RRJ-4000 Controller				**CR-4000 Controller**			
Conductor Size		Max. Length		Conductor Size		Max. Length	
SQ mm	AWG	Feet	Meters	SQ mm	AWG	Feet	Meters
0.64	22	1,300	395	0.64	22	6,600	2,010
0.75	20	2,100	640	0.75	20	10,500	3,200
1.00	18	3,300	1,005	1.00	18	16,700	5,090

Wire to Controller

When the transmitter wiring connection is made to the applicable controller, connect the dc supply to the monitor (refer to Figure 1. Controller Wiring).

⚠ CAUTION

Polarity must be observed. If the return and supply voltage wires are reversed, the monitor will not work.

Follow the instructions in the controller manual and connect as shown in the diagram.

- RRJ-4000 Controller: Power (+12 V) to +V
  Ground to G
  Return signal line to 4-20 mA
- CR-4000 Controller: Power (+24 V) to +V
  Ground to G
  Return signal line to 4-20 mA
- Other controllers: Check the power range specifications in the controller manual.

Note

CR-4000 power supply is +24 volts.

Wire Field Connector and Connect to Monitor

Plug-in field wiring connectors (one supplied with each monitor)

1. Feed wire through hose as shown in the diagram.
2. Solder as follows: 4-20 mA return signal line to pin C
   GND to pin A
   +12 volt power line to pin F
3. Reassemble field connector. Ensure cable clamp is securely fastened to prevent moisture invasion.
4. Plug connector into the monitor and secure outer weatherproof ring to prevent moisture invasion.

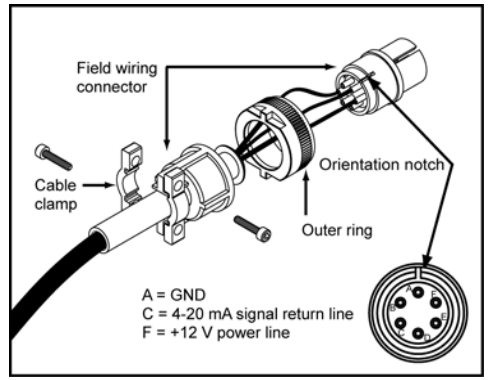


Figure 3. Field Transmitter Wiring with Customer Cable

Note

If the monitor is always mated to the same channel on the controller, the controller LCD only requires calibration the first time the transmitter head is installed.

Cable bend allowances should not exceed 65 degrees.

5. Calibrate the controller display and test with gas (refer to the **Calibrate the Controller** section).

The following table assumes a constant 24 volt power supply at 68°F (20°C) with copper wire and a controller resistance of 250 ohms. The signal range from the controller/PLC, etc, to the monitor takes into account the return loop. The distance shown is from the controller to the monitor.

Table 5. Cable Length

Conductor Size		Distance	
22 AWG	0.64 mm	6,709 ft.	2,045 m
20 AWG	0.75 mm	10,670 ft.	3,253 m
18 AWG	1.0 mm	22,810 ft.	5,167 m

Pigtail Assembly

Part No. RRJ-PT1-K2

1. If a cable is not needed for installation, use a pigtail connector and refer to Figure 3. Field Transmitter Wiring with Customer Cable.

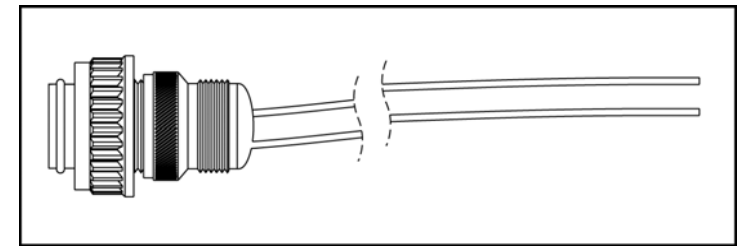


Figure 4. Pigtail Assembly

Note

If the monitor is always mated to the same channel on the controller, the controller LCD only requires calibration the first time the transmitter head is installed.

Cable bend allowances should not exceed 65 degrees.

2. Calibrate the controller display and test with gas.

I.S. Barriers

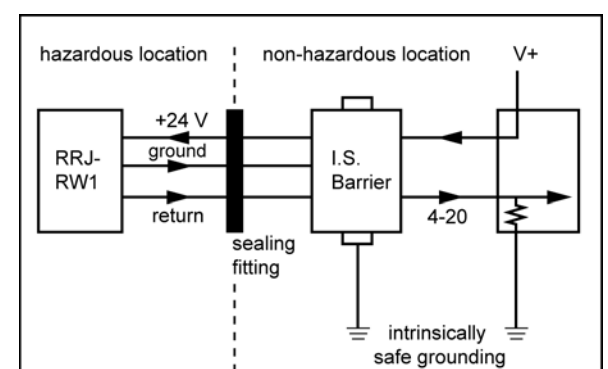


Figure 5. Installation of Barriers

Note

Installation must comply with the Canadian Electrical Code (CEC) and the National Electrical Code (NEC).
I.S. barrier is required for Class I, Div I and Zone I
I.S. barrier is not required for Class I, Div 2, or Zone 2
Requires a 10 V input minimum

Table 6. Entity Parameters

Group	A/B
Vmax (V)	30
Imax (mA)	113
Ci (µF)	0
Li (µH)	0

Use MTL 5042 Barrier

Table 7. Limiting Energy

I.S. Barrier		RRJ
Open circuit voltage, VOC	≤	Vmax, maximum current allowed
Short circuit current, Isc	≤	Imax, maximum current allowed
Allowed capacitances, Ca	≥	Ci, internal capacitance +Ccable, cable capacitance
Allowed inductances, La	≥	Li, internal inductance +Lcabel, cable inductance

Note

Ca and La include capacitance and inductance.

Connect the Controller (PLC etc.) and Power Supply

Ensure that all connections are made and the monitor is complete with cable connectors correctly in place before applying power. Follow the procedures and recommendations in the control systems manual to complete the installation.

Shields and any unused wires should be tied to the controller ground as outlined in the National Electrical Code (NEC) practices.

Attach wire to the controller and power as described in the controller manual.

Power Up

Apply power. The monitor sets the operational life clock and then performs the full function sensor integrity self-test.

If the monitor passes the self-test, the sensor will stabilize in less than 30 seconds. Upon a successful self-test, the red status LED lights and the transmitter sends a 4-20 mA current output to the controller equivalent to the %LEL level measured by the monitor. Instructions describing what to do in the event of a self-test failure appear in the section **Self-Test Fail**.

Table 8. Sensor LED Status

LED Status	Advise	Output to Controller
On	Power on	4-20 mA
	Over range alarm	24 mA
Fast flashes (once every 0.5 seconds)	Fault: Self-test fail	2 mA
Slow flashes (once every 2 seconds)	Life-ending warning	4-20 mA
Off	Life-ended	2 mA
	Power off	0 mA

Calibrate the Controller

Follow the procedures and recommendations in the controller manual.

4 mA = 0% LEL (zero); 20 mA = 100% LEL (full scale)

To ensure proper operation, test with gas. Apply a known concentration of quality test gas to the sensor for 2 minutes to allow the sensor response to stabilize. The control system should read the same as the %LEL of the gas being applied. If it does not, calibrate the controller.

⚠ Caution

Allow a ±3% tolerance in some cases due to sensor repeatability.

The monitor is now ready for use.

Self-Test

Automatic Self-Test

The sensor is tested automatically every 24 hours while in operation and every time power is applied.

Note

A high risk gas alarm will take precedence, therefore the self-test will not be performed in the event of a high or high/high gas alarm.

Self-Test Fail

If the sensor fails the test, the LED flashes quickly and the monitor sends a 2 mA signal to the controller. If the monitor fails the self-test, replace the monitor and return the unit to BW Technologies.

Operational Life

The operational life of the RRJ monitor is 2 years in normal operation. The life counter is activated when power is applied and runs continuously while the monitor is operating. If the power is interrupted or turned off, the counter stops and resumes counting once power is restored. The counter does not reset, and continues counting from the point where it stopped.

Life-Ended Warning

When only 1 month of the instrument life is remaining, the LED flashes slowly to advise the unit soon requires replacement.

Life-Ended Alarm

The life-ended alarm occurs when the monitor's useful life has ended. The monitor sends a 2 mA signal to the controller and the LED is shut off. The monitor is now disabled. Replace the monitor.

Operation

The RRJ monitor is factory calibrated. No further calibration is required.

Maintenance

Visually inspect the sensor and test with gas on a regular schedule to ensure that the sensor is not damaged or plugged. If the sensor screen is dirty, remove the screen to wash or replace it.

The inner sensor screen, if dirty, may be cleaned with a soft brush using warm, clean water.

In the event that the screen still appears plugged with dirt or particulate, expose the sensor to a combustible test gas. Verify the response to the gas to ensure that the sensor is functioning. Replace a plugged or damaged sensor screen.

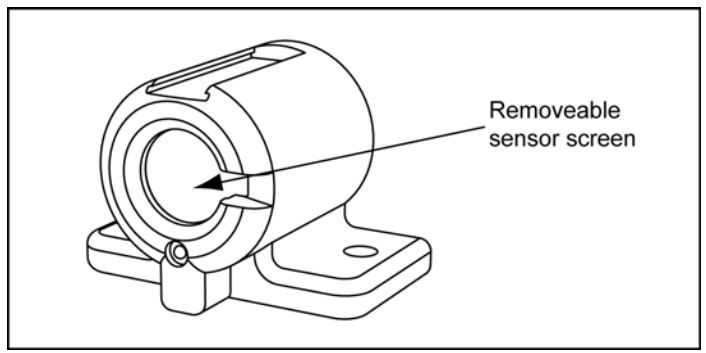


Figure 6. Replaceable Sensor Screen

Replacement Parts and Accessories

Table 9. Replacement Parts and Accessories

Model No.	Description	Qty
RRJ-FW1-K	Field wiring transmitter connector	1
RRJ-FW2-K	Military-style connector for RRJ transmitters	1
RRJ-PT1-K2	Pigtail connector for RRJ transmitter	1
RRJ-SC010-K	RRJ sensor cables with compression fitting	10 ft./3 m
RRJ-SC(###)-K	RRJ sensor cables 20 to 1,000 ft. (6.1 to 305 m) – order in 10 ft./3 m increments	per ft.
RRJ-FIL-K5	Sensor screen replacements	Kit of 5
M2493	Calibration plug	1
D1423	Instruction sheet	1

Specifications

Table 10. System Design

Supply voltage		10 to 28 Vdc supplied by controller
Power consumption	**RRJ-4000**	70 mA @ 12 Vdc maximum 50 mA @ 12 Vdc nominal
	CR-4000	55 mA @ 24 Vdc maximum 35 mA @ 24 Vdc nominal
Loop resistance		650 ohms maximum
Output current		Normal operation: 4-20 mA
		Fault: 2 mA signal
		Sensor expired: 2 mA signal
		Over range: 24 mA signal (max)
Cable		3-wire, 18 to 22 AWG

Table 11. General Specifications

Operating temperature	-40°C to +50°C (-40°F to +122°F)
Operating humidity	0 to 99% relative humidity (non-condensing)
Calibration	Not required
Monitor	4-20 mA combustible gas transmitter
Maximum operating life	2 years
Measuring range	0-100% LEL
Visual alarm	Red light emitting diode (LED)
Self-test	Daily full function sensor self-test
Monitor type	Zero-maintenance disposable
Sensor type	Catalytic sensor
Sensor screen	Field replaceable
Physical	Rugged polyurethane encapsulated sensor head
Size (dxwxh)	6.73 x 5.84 x 8.25 cm (2.65 x 2.3 x 3.25 in.)
Weight	175 g (6.2 oz)
Warranty	2 years
Approvals	Class 1, Div. 1, Gr. A, B, C, D T6 CAN/CSA C22.2 No. 152 ANSI/ISA S12.13 Part 1

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules and ICES-003 Canadian EMI requirements. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Contacting BW Technologies

To contact BW Technologies call:
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Warranty

LIMITED WARRANTY & LIMITATION OF LIABILITY

BW Technologies LP (BW) warrants this product to be free from defects in material and workmanship under normal use and service for a period of two years, beginning on the date of activation. This Warranty is valid only if the detector is activated by the date on the package. This warranty extends only to the sale of new and unused products to the original buyer. BW's warranty obligation is limited, at BW's option, to refund of the purchase price, repair, or replacement of a defective product that is returned to a BW authorized service center within the warranty period. In no event shall BW's liability hereunder exceed the purchase price actually paid by the buyer for the Product.

This warranty does not include:

a) fuses, disposable batteries or the routine replacement of parts due to the normal wear and tear of the product arising from use;
b) any product which in BW's opinion, has been misused, altered, neglected or damaged by accident or abnormal conditions of operation, handling or use;
c) any damage or defects attributable to repair of the product by any person other than an authorized dealer, or the installation of unapproved parts on the product; or

The obligations set forth in this warranty are conditional on:

a) proper storage, installation, calibration, use, maintenance and compliance with the product manual instructions and any other applicable recommendations of BW;
b) the buyer promptly notifying BW of any defect and, if required, promptly making the product available for correction. No goods shall be returned to BW until receipt by the buyer of shipping instructions from BW; and
c) the right of BW to require that the buyer provide proof of purchase such as the original invoice, bill of sale or packing slip to establish that the product is within the warranty period.

THE BUYER AGREES THAT THIS WARRANTY IS THE BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. BW SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, WHETHER ARISING FROM BREACH OF WARRANTY OR BASED ON CONTRACT, TORT OR RELIANCE OR ANY OTHER THEORY.

Since some countries or states do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any provision of this warranty is held invalid or unenforceable by a court of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.