

# rotork®

Keeping the World Flowing  
for Future Generations

## R series

RCx-B-xxxAx-8.09 user manual



 **HANBAY INC.**  
A rotork® Brand

**RCx-B-xxxAx-8.09**  
(24 VDC; Battery Backup; 4-20 mA Control)

**Hazardous Location** (Only models RCx-B-BxxxAx w/ ex-proof lid engraving)

**USER MANUAL**

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## INTENDED USE

Rotork R-Series actuators are intended to be used in combination with any valve to regulate the flow automatically. The output of the actuator is rotary or linear, and is paired with the valve stem to achieve the desired flow control.

## MANUFACTURER DETAILS

Rotork manufactures the R-Series actuator at the following facilities:

Hanbay Inc.  
135 Brunswick Blvd.  
Pointe-Claire, QC H9R5N2 Canada

Fairchild Industrial Products Company  
3920 West Point Blvd.  
Winston Salem, NC 27103 USA

## MEANING OF SYMBOLS



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product.



The Lightning Flash with arrowhead symbol within an equilateral triangle, is intended to alert the user to the presence of un-insulated "dangerous voltage" within the product enclosure that may be of sufficient magnitude to constitute a risk of shock to persons.

## INSTALLATION

The safety of any system incorporating the equipment is the responsibility of the assembler of the system.

### Environmental Conditions

The R-Series actuator has an IP68 rating and is recommended for outdoor use. The relative humidity of the environment has no effect on the R-Series.

The ambient temperature range for the standard R-Series is -20 to 40 °C (-4 to 104 °F).  
The internal heater option shifts the temperatures to a lower range of -40 to 40 °C (-40 to 104 °F).

The standard R-Series has been approved for use at altitudes of up to 2000 m.



**Mounting**

The holes indicated in the image are intended for a mounting bracket. They are threaded for 1/4-20 and are 0.4" deep.

**Grounding and Securing**

The other two visible holes are threaded 10-32, 0.50" deep, and are intended to be used to lock the lid in position (top) and as an external grounding connection (bottom) using user-supplied screws.

For detailed dimensions see p.17.

Additionally, there is a grounding connection supplied internally.



### Wiring

#### Wiring for Explosion Proof Actuators



The **RCx-B-BxxAx** Explosion-Proof actuator does **not** come with a pre-installed cable, nor cable gland. A cable gland that meets site specifications for the appropriate hazardous location rating is required for installation. The cable gland and the cable for hazardous location should be installed by qualified personnel in accordance with site and local requirements.

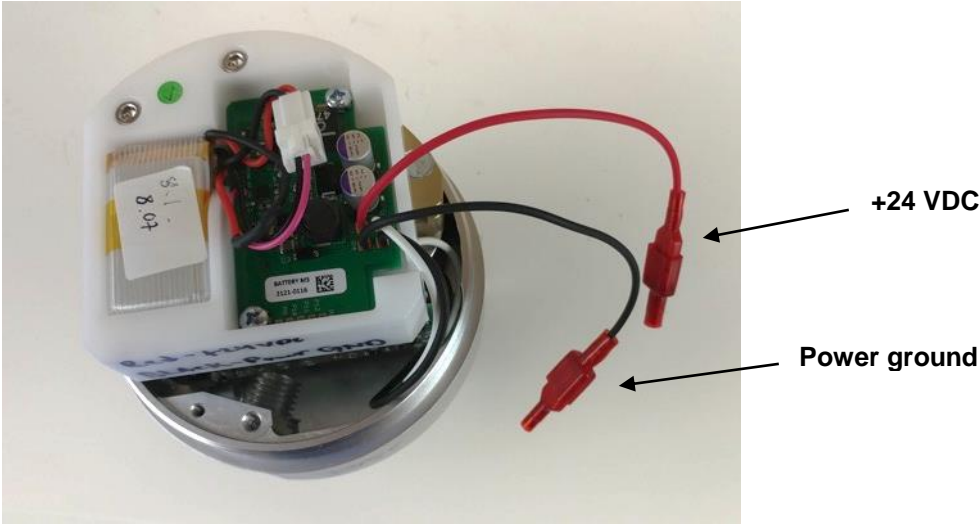
The actuator comes standard with a 1/2" FNPT thread cable entry. See p.17 for location of 1/2" FNPT housing access. A cable with 5 wires is required; it is recommended to use 16-24 AWG for all wires.



#### Standards for cable gland and cable in hazardous locations:

Compliance Standards Required to be Met	Cable Types Permitted in Class I Division 1 Hazardous Locations
ANSI / UL 514B, ANSI / UL 1203, ANSI / UL 2225, C22.2	Non-Armored Extra Hard Usage Cord & TC-ER-HL
ANSI / UL 514B, ANSI / UL 1203, ANSI / UL 2225	Armored IEEE 45 & IEEE 1580 Marine Shipboard Cable
ANSI / UL 514B, ANSI / UL 1203, ANSI / UL 2225	MC-HI, ITC-HL
ANSI / UL 514B, ANSI / UL 1203, C22.2	Teck 90 (Canada Only)

\* In explosion-proof models, the FNPT thread is not intended for conduit connection. Cable gland only.



**Note:** Power ground must be externally connected to earth ground, or one of the case grounding screws (see Grounding and Securing section) must be used to connect a grounding wire of minimum 22AWG.

The battery board holder (white plastic part, see image below) will have to be unscrewed to access the terminal block on the circuit board for wiring. When wiring is complete screw the battery board holder back into place.

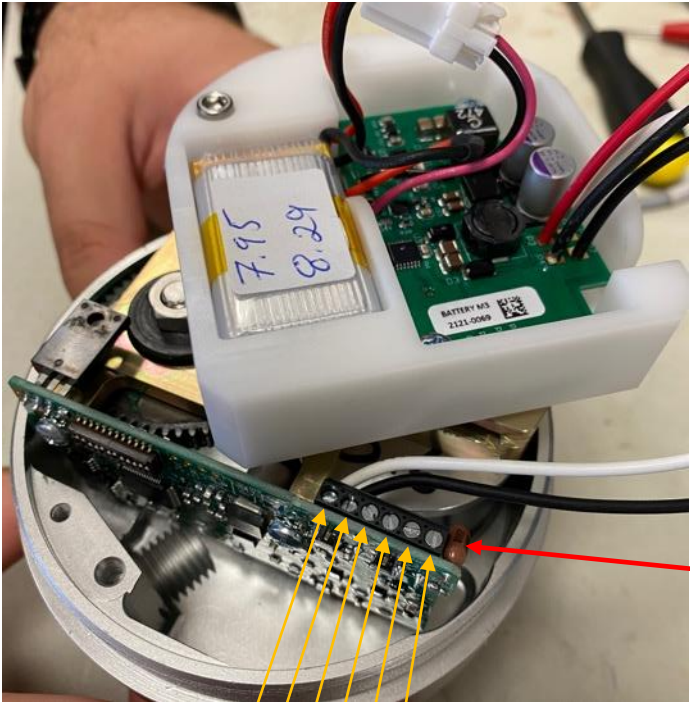


Do not remove or change the existing **BLACK** and **WHITE** wires that connect the battery board to the processor board.

Once the cable and cable gland are installed, connect the wires to the pins on the terminal block as indicated here:

Pin	Function
6	Already Connected to battery board Connect +24 VDC wire to loose red cable with crimp connector (see above)
5	Already Connected to battery board Connect power ground wire to loose black cable with crimp connector (see above)
4	Feedback signal (4-20 mA)*
3	Not connected
2	Isolated** input signal gnd.
1	Isolated** input signal (4-20 mA)

\* "feedback" available in RCx-B-xxxAF version only.  
\*\* "isolated" available in RCx-B-xxxAI and xxxAF versions only.



6 5 4 3 2 1  
Terminal

Remove sensing resistor R66 to convert from 4-20 mA to 1-5 V control signal

**Note:** if R66 is removed, we recommend placing a 10K resistor between signal and signal GND or simply using shielded cable (for noise reduction).

## Wiring for Non-Explosion Proof actuators

The actuator comes standard with a Turck 5 position connector and a 20' cable (5x 22 AWG) with plug. Cut the cable to the length required and then connect according to the following wire color schematic:

Pins indicate the connection of the cables to the terminal block on the PCB board within the actuator. These are pre-wired at the factory for non-explosion proof actuators.

### Wire color schematic for "Turck 5" cable:

Pin	Color	DC power supply only
6	White	+24 VDC
5	Black	Power gnd.
4	Grey	Output signal (4-20 mA) *
3		<i>Not connected</i>
2	Brown	Isolated** input signal gnd.
1	Blue	Isolated** input signal (4-20 mA)

\* "feedback" available in RCx-B-xxxAF version only.

\*\* "isolated" available in RCx-B-xxxAI and xxxAF versions only.



**Note:** Power ground must be externally connected to earth ground, or one of the case grounding screws (see Grounding and Securing section) must be used to connect a grounding wire of minimum 22AWG.

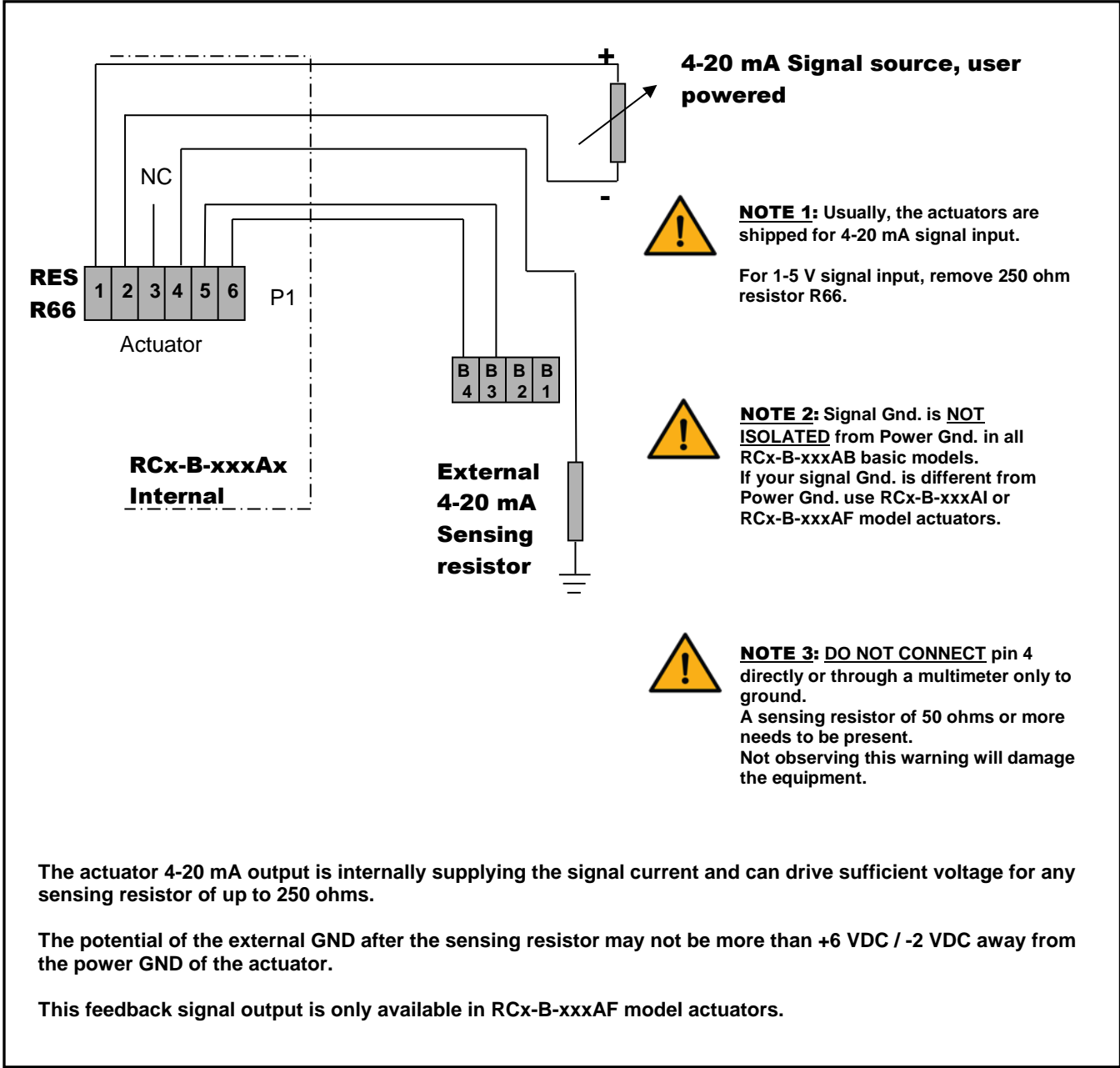
## Power Supply and Current Draw

The **RCx-B-xxxAx** can **ONLY** be connected to 24 VDC +/- 10%. The DC supply to the actuator must be limited by a 4 A fuse or circuit breaker; it is recommended to have this installed near the actuator.

The current draw will range from minimum 100 mA to maximum 3 A while the actuator is active. When not moving, the actuator draws approx. 50 mA.

### Control Signal and Feedback

Locate the correct connection terminals/wires as shown on the previous page, then connect your input signal on positions 1 and 2 (blue and brown wires) as shown below. Feedback, if applicable is connected to position 4 (grey wire).





## GENERAL SPECIFICATIONS

<b>Stall protection</b>	Electronic position and motion detection
<b>Gears &amp; Bearings</b>	Metal and bronze, oiled/greased for life
<b>External fasteners</b>	Stainless Steel
<b>Life Expectance</b>	250'000 cycles in specified conditions
<b>Motor</b>	Brushless DC motor, computer control
<b>Positioning precision</b>	$\pm 0.25^\circ$
<b>Positioning resolution</b>	$\pm 0.15^\circ$ max.
<b>End travel detection</b>	By motion detection
<b>Power setting</b>	Adjustable
<b>Mechanical Shock</b>	Repeated $\leq 130$ g-force, no effect Occasional $\leq 150$ g-force, no effect >150 g-force not tolerated
<b>Mechanical Vibration</b>	Random SAE J1211, Chassis, Exterior
<b>Thermal Shock</b>	-20 to +60 °C (-4 to 140 °F) in 10 min.
<b>Weight</b>	RxJ, RxL, RxM: 1200 g RxH, RxF: 1920 g
<b>Isolated Signals (AI &amp; AF models only)</b>	Optical isolation min. 1000 V

## Operation

### DIP switches

The DIP switches allow you to change the settings on your actuator. To flip a switch, gently use a small flat-head screwdriver.

See the table below for DIP switch functionality.



In this example DIPs 1, 2, 5 and 12 are on.

DIP	Function
1	<b>Speed:</b> Choose how quickly the actuator will turn the valve. See p.12.
2	
3	Defines fail-to position. ON = FAIL OPEN, OFF = FAIL CLOSED
4	<b>Turns:</b> The actuator usually ships from the factory with the recommended number of turns for the valve. However, this number can be changed. Turning on a switch will add a specific number of turns to the actuator's movement.
5	
6	
7	See p.12 for relation between positions of the DIP switches and number of turns.
8	Example: Turning on DIP 6 adds four turns, turning on DIP 8 adds one turn. If both DIP 6 and 8 are on, then the total turns of the actuator would be five.
9	<b>Signal loss:</b> See p.14.
10	<b>Seating Torque:</b> Set how much torque the actuator exerts on the valve lever during the calibration
11	(finding valve seat) procedure. See p.12.
12	<b>Direction/Calibration:</b> Toggle switch on and off while powered to re-calibrate actuator (find valve seat). Also sets direction in which the actuator will open and close. See p.14.

Example: The RCM model actuator turns clockwise when the signal is decreased with DIP 12 in the OFF position. Putting DIP 12 in the ON position will cause counterclockwise turning for a decrease in signal. For changes in DIP 12 position to take effect, the power to the actuator must be cycled.

## Controlling the Actuator

The 4-20 mA (or 1-5 V / 1-10 V) input signal represents a total span of a number of turns.

I.e.: If you set the number of turns to 2, then a signal of 12 mA will set the actuator to exactly 1 turn from the fully closed position. 15 mA will give:  $(15-4)/16=0.6875 \Rightarrow 68.75\%$  of 2 turns  $\Rightarrow 1.375$  turns from closed.

**Changing the number of turns**

With the DIP switch settings, you can adjust anything between 1 and 31 turns to represent the full signal range of 4-20 mA. Check in the table below. (1 = "On", 0 = "Off")

Total Turns Dip4=0	DIP 5	DIP 6	DIP 7	DIP 8
reserved	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

**For more turns, set DIP 4 to the ON position.** This will add 16 turns to the number set by DIPs 5 through 8, as shown in the table.

DIP 4=0	+0 turns
DIP 4=1	+16 turns



**WARNING:** Be sure that the number of turns the actuator is set for is **LESS** than the number of turns for the valve. The actuator should not stop itself on a fully opened valve. It can damage the valve, and the actuator will lose its position.

## Torque Settings

To accommodate different valves and other applications with different torque requirements, the actuator can be set to apply different torque on the valve stem when in the seating mode.

During normal operation, the actuator will try to reach the speed set by DIP 1 and DIP 2. It will use 100% torque to try and reach the selected speed, regardless of the positions of DIP 10 and DIP 11. Current draw is limited to 3 A regardless of settings.

Please see the box to the right and the tables below to select the power setting that is right for your application.

To deal with sticking valves, at the beginning of the first reversing movement after the seating (“zeroing”) of the valve, the actuator will apply double the power set by DIP 10 and DIP 11 (up to 100% power.) This “pull out” function is always enabled.

### Seating power settings:

DIP 10	DIP 11	Power
OFF	OFF	16%
OFF	ON	33%
ON	OFF	66%
ON	ON	100%



**WARNING:** High power settings can supply enough torque to damage your valve. Please be cautious, especially when using the 100% power setting.



**Note:** 66% setting and 100% setting require voltage supply minimum values as follows:

- Supply voltage needs to be min 14 VDC for 66% setting
- Supply voltage needs to be 16 VDC for 100% setting
- When operating above 20VDC and 66% power, Duty cycle is reduced to 50% - 25% maximum. At these levels, the electronics produce more heat which must be dissipated (depending on environmental temperature)

## Speed and Torque Details

The maximum speed of the actuator can be set by using the first two positions of the DIP switch selector. As a result of this setting, the actuator will limit the maximum speed. The tables below show the time required to complete one turn.

The seating torque depends on the voltage provided in the power connection and on the seating power settings on DIP 10, 11 as shown below.

### RCL-B-xxxAx Actuators

Speed:		
DIP 1	DIP 2	Time for 1 turn (sec)
OFF	OFF	7
OFF	ON	3
ON	OFF	2
ON	ON	1

Torque:			
DIP 10	DIP 11	Seating Torque (in-lbs)	Operating torque is 100%
OFF	OFF	12	
OFF	ON	20	
ON	OFF	38	
ON	ON	48	

**NOTE:** If actuator is RCJ-B-xxxAx, divide torque values by 3.  
**To convert in-lbs to Nm, divide by 9.**

RCM-B-xxxAx Actuators

Speed:		
DIP 1	DIP 2	Time for 1 turn (sec)
OFF	OFF	23
OFF	ON	11
ON	OFF	7
ON	ON	4

Torque:			
DIP 10	DIP 11	Seating Torque (in-lbs)	Operating torque is 100%
OFF	OFF	35	
OFF	ON	60	
ON	OFF	115	
ON	ON	145	

**NOTE:** If actuator is RCK-B-xxxAx, divide torque values by 3.  
**To convert in-lbs to Nm, divide by 9.**

RCH-B-xxxAx Actuators

Speed:		
DIP 1	DIP 2	Time for 1 turn (sec)
OFF	OFF	90
OFF	ON	45
ON	OFF	30
ON	ON	18

Torque:			
DIP 10	DIP 11	Seating Torque (in-lbs)	Operating torque is 100%
OFF	OFF	120	
OFF	ON	205	
ON	OFF	400	
ON	ON	497	

**To convert in-lbs to Nm, divide by 9.**

RCF-B-xxxAx Actuators

Speed:		
DIP 1	DIP 2	Time for 1 turn (sec)
OFF	OFF	186
OFF	ON	94
ON	OFF	56
ON	ON	38

Torque:			
DIP 10	DIP 11	Seating Torque (in-lbs)	Operating torque is 100%
OFF	OFF	230	
OFF	ON	380	
ON	OFF	720	
ON	ON	915	

**To convert in-lbs to Nm, divide by 9.**

## Signal Loss and Calibration

1. In the event of a power loss, the **battery fail-safe** model will move to its designated fail-position. This position is programmed at the factory (based on user request) and cannot be changed in the field.



**IF YOU HAVE TO** turn the actuator manually when its power is turned off, it will lose its position, and it will need to be re-zeroed (as described in sub-section 3).

2. The behavior on signal loss can be set as follows:

### Normal position of DIP 9: OFF

With DIP 9 in the off position, the actuator will ignore the signal if it is lost (i.e.: if the signal falls below 0.700 V or 2.80 mA) and simply remain in its current position.

### Predetermined signal loss position DIP 9: ON

With DIP 9 in the on position, the actuator will move to a predetermined position when the signal is lost (i.e.: if the signal falls below 2.80 mA or 0.700 V).

Setting of the predetermined signal loss position:

- a.- turn DIP 9 to the “off” position
  - b.- re-zero the actuator by sending and holding an input signal between 2.80 and 4.16 mA (0.700 and 1.04 V) wait until the device is re-zeroed, (i.e.: valve is closed)
  - c.- by varying the input signal, move the actuator to the position that is going to be the predetermined signal loss position.
  - d.- switch DIP 9 to the “on” position. The current actuator position will be saved as the default signal loss position. (The default signal position is an absolute actuator position. i.e.: not a signal value.)
3. **Re-zeroing the actuator and initiating calibration routine:**  
The actuator will re-zero when the input signal is between 2.80 and 4.16 mA (0.700 and 1.04 V). It will turn clockwise until the actuator has reached the fully closed position of the valve.

**If the valve is removed for any reason, the calibration routine must be initiated on the actuator manually.** This is done by toggling DIP 12 (switch position, then back to the original position) while the actuator is powered. This will prevent damage to the valve.

**If you need to re-zero in the opposite direction** (i.e.: for pressure regulators, which typically go to the “top” fully open position at 4 mA) change the setting of DIP 12 and cycle power. Remember to **wait 2 minutes before restoring the power**, to allow the battery board to shut down after moving to the fail-safe position.

4. **Feedback calibration: [RCx-B-xxxAF model actuators only]**

The current feedback will be calibrated from the factory.

### To re-calibrate the feedback:

- a.- Turn off the actuator and **wait 2 minutes** to allow the battery board to shut down after moving to the fail-safe position. Then disconnect the feedback and input signals. If possible, remove the actuator from the valve.
- b.- Connect the feedback signal to the signal input. Also connect the power and signal grounds.
- c.- Power up the actuator with this “signal loop-back” setup.
- d.- Short SP1. It will automatically run a special routine to calibrate the feedback signal to the signal input. The whole process takes about 1.5 seconds.
- e.- turn off the power and reconnect the actuator as normal.

## Manual Override

The RCx-B-xxxAx actuator with manual override can also be certified for hazardous locations. The additional manual override gear case and handle has no effective ignition sources and can therefore be used in all hazardous locations for which the actuator enclosure is certified for.

Operation of the manual override when the actuator is powered will be difficult as the actuator will try to maintain the valve in the position it has been commanded to.



**Power should be removed if the valve is to be moved manually. If the valve is moved with the manual override when its power is turned off, it will lose its position, and it will need to be re-zeroed (as described in the Signal Loss and Calibration section).**



## Troubleshooting

Upon noticing a problem, your first step should almost always be to recalibrate the actuator by toggling DIP 12 while the actuator is powered. This alone can solve basic problems. See sub-section 3 above for more details.

**If the actuator does not move, try following these steps:**

- 1) Re-calibrate the actuator. This will move the actuator regardless of what signal it is receiving.
- 2) A sticking valve may be the problem. Remove the valve from the actuator, and re-test the actuator.
- 3) Remove power. Re-check the wiring and the power/signal apparatus. Power actuator and re-calibrate. If the problem persists, please call Rotork for technical support.

**Any parts found to be defective should be examined and/or replaced by Rotork.**

## Battery Fail Safe Function

1. In the event of a loss of power or signal, the battery will maintain power to the P1 processor and trigger the actuator to move the valve to its designated fail-safe position, using power from the battery.
2. Once the valve has reached its fail-safe position, and after about one minute, the P1 processor will go into sleep mode to preserve the battery life.
3. The actuator will not respond to commands until the power supply is restored.

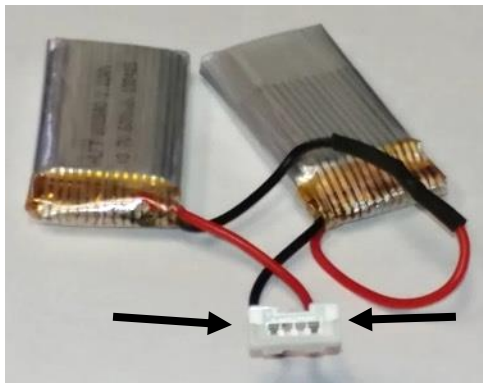
**Note:** The battery will maintain a charge for up to 2 months without power being applied. The fail-safe actuation can be performed for 30 cycles on the charge available in the battery. During normal operation, from totally discharged, the batteries will take 2 hours to re-charge.



If in a critical fail-safe application, the battery function should be tested monthly.

## Testing Battery Fail-Safe

- The batteries will be continuously on charge when power is available to the actuator.
- Regardless of application, the fail-safe function should be tested monthly by signaling the unit to the position opposite the fail position, removing the power to the actuator and observing whether the actuator reaches the desired fail position.
- The battery voltage can be measured with a multimeter set for DC volt measurement.



Measure battery voltage between the connector terminals. Value should be:  $7.9 \pm 0.4$  VDC





## CERTIFICATIONS

### Hazardous Location Rating (Ex)

Actuator model number: RCx-**B**xxAx

#### Canada:

Class I, Division 1, Groups B, C, D (T5)  
Class II, Division 1, Groups E, F, G (T5)

CSA C22.2 No. 30-M1986  
CSA C22.2 No. 25-17

Ambient temperature range: -50°C to +40°C

\* Serial number will be engraved on lid.  
**Lid engraving with Canadian hazardous location certification:**



#### USA:

Class I, Division 1, Groups B, C, D (T5)  
Class II, Division 1, Groups E, F, G (T5)

UL 1203 (Edition 5.0)

Ambient temperature range: -20°C to +40°C

\* Serial number will be engraved on lid.  
**Lid engraving with USA hazardous location certification:**



### International (IECEx) – available upon request:

Ex db IIB+H2 T3 Gb

IEC 60079-0:2017, 7th Edition  
IEC 60079-1:2014, 7th Edition

\*Serial number will be engraved on the lid.

## Electrical Compliance (EC)

### Canada & USA:

CSA.UL 61010-1

### Europe:

EC Declaration of Conformity (CE)

UK Declaration of Conformity (UKCA)

## Electromagnetic Compatibility (EMC)

### United States:

FCC 47 CFR Part 15, Subpart B (Unintentional radiators), Class A

Canada:

ICES-001 Issue 5, July 2020, Class A

Europe:

EN 61326-1:2013 (Group 1, Class A; Industrial electromagnetic environment)

IEC 61000-6-2:2016

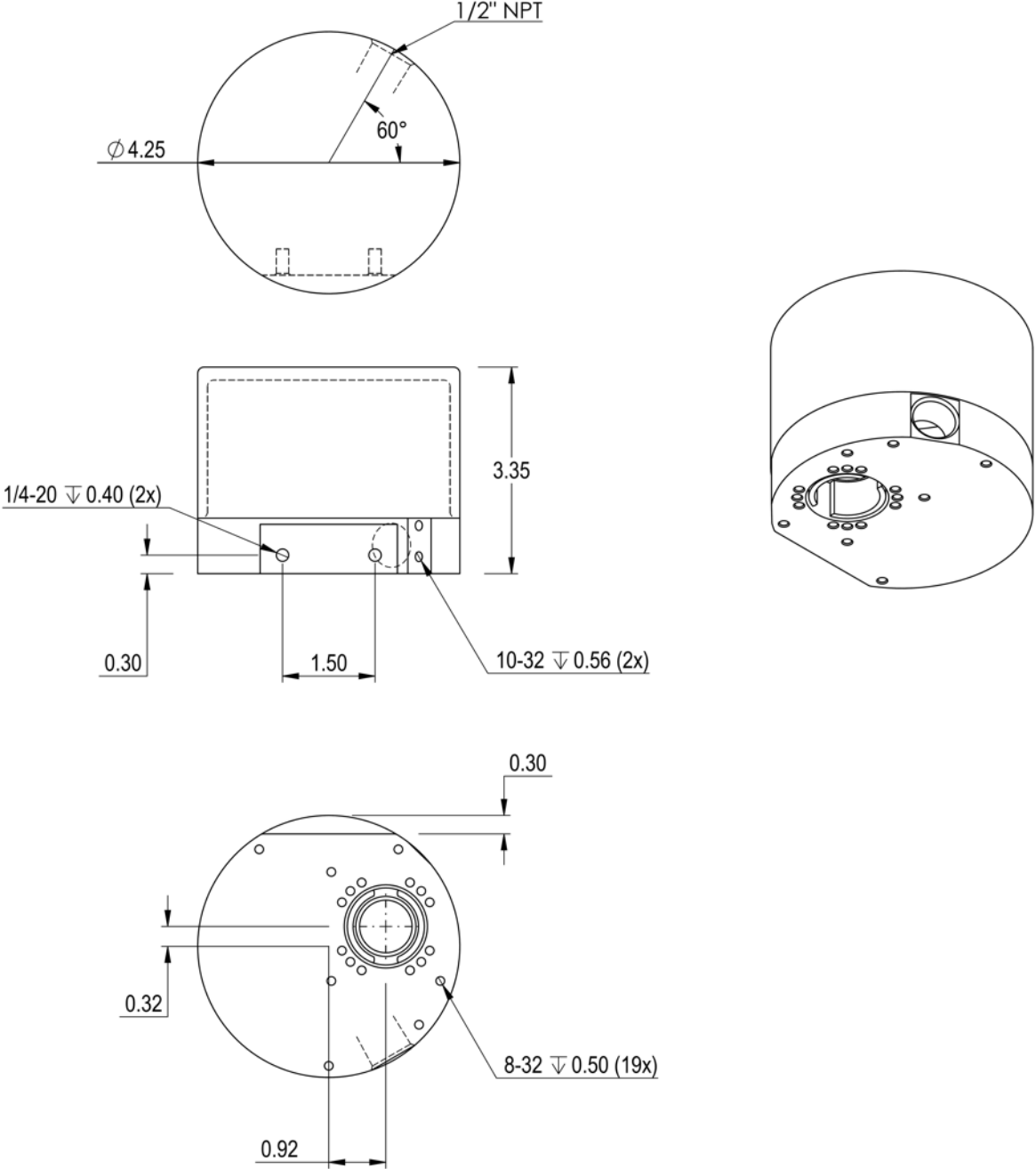
IEC 61000-6-4:2018

## Dust and Water Ingress Protection (IP)

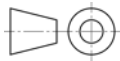
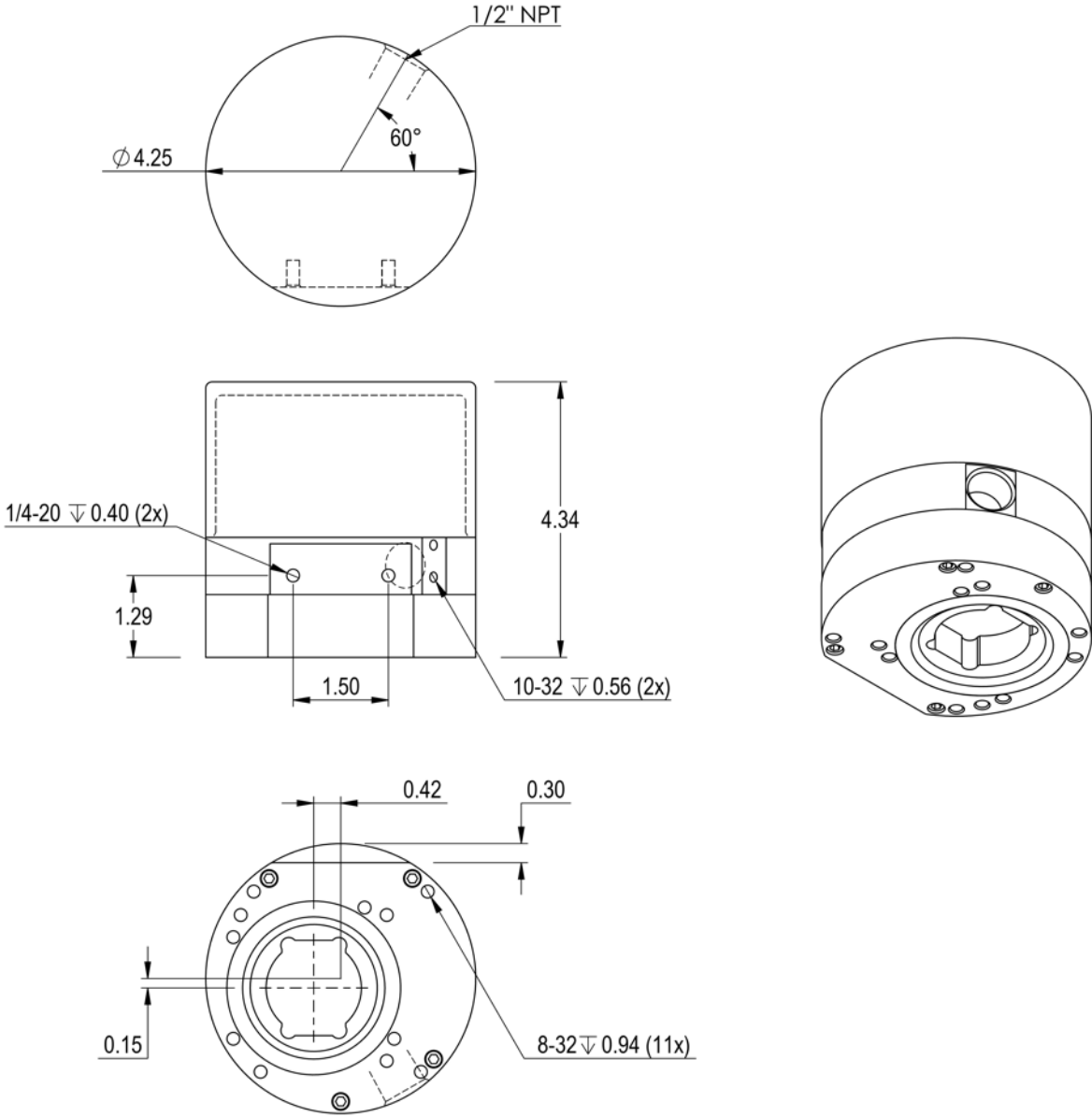
IP68, certified using standard IEC 60529:2013.

# ACTUATOR DIMENSIONS

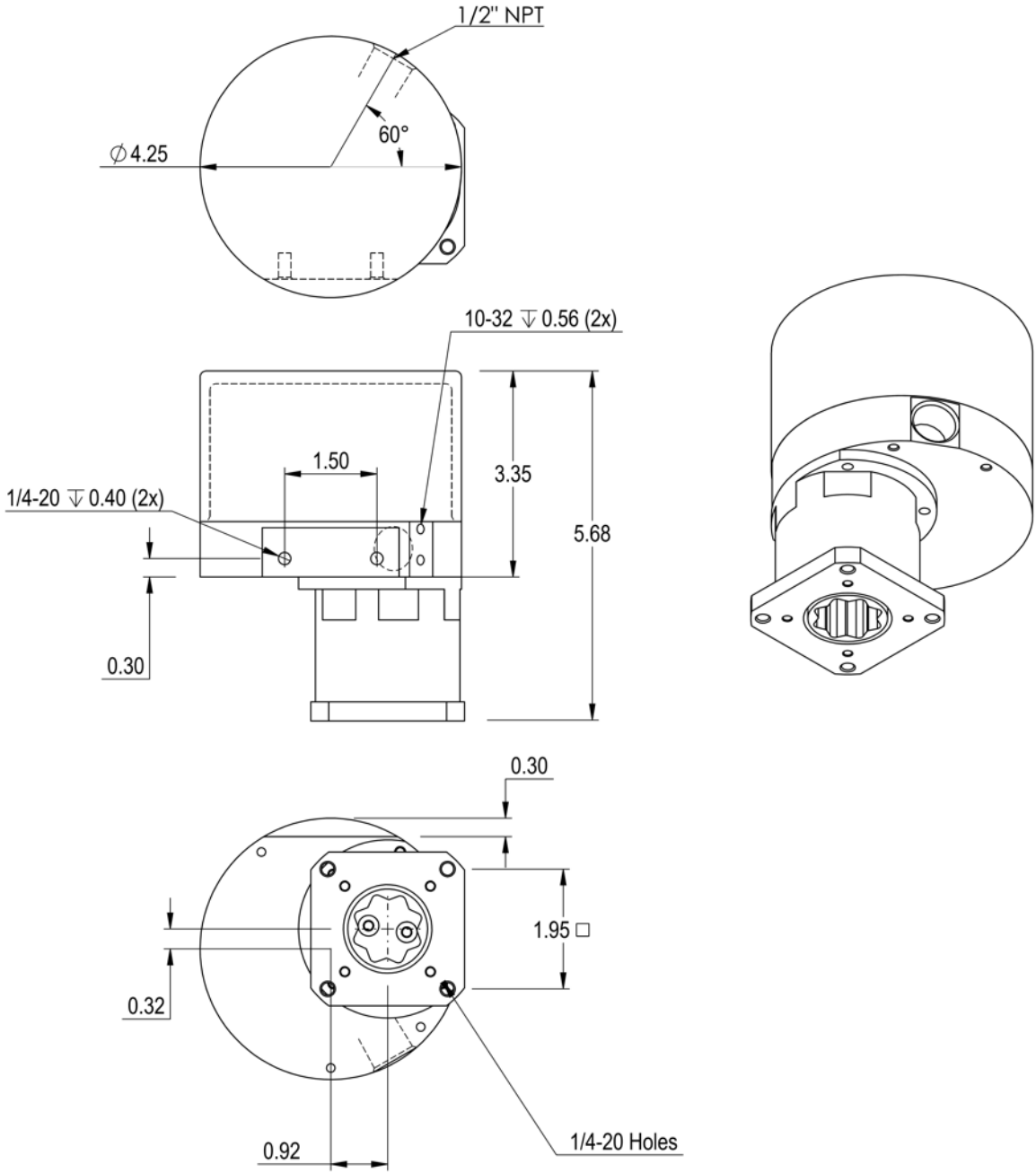
## RCJ/ RCL/ RCM -B-xxxAx models



**RCH-B-xxxAx models**



**RCF-B-xxxAx models**



# PART NUMBER BREAKDOWN

Full Part Number:

R	C	-	B	-		Ax	-		-	
---	---	---	---	---	--	----	---	--	---	--

Base Enclosure	Positioning	Gear Train	Special Options	Enclosure Options	Wiring	Thermal Management	PCB	Mounting Kit	Valve Part Number
R		-	-					-	Valve Manufacturers Part # / CU #
R	R-Series								0 No Valve or Mounting Kit 1 Mounting Kit, Customer Supplies Valve, does not send valve to Hanbay 2 Mounting Kit, Customer Supplies Valve, sends valve to Hanbay 3 Mounting Kit, Hanbay Provides Valve
C	Continuous								
D	Discrete								
J	Extra Low Torque								
L	Low Torque								
M	Medium Torque								
H	High Torque (Add. Gear Stage)								
F	F-Gear Stage (Add. Gear Stage)								
									AB Analog Signal Board AF Analog Signal Board Isolated with Feedback AI Analog Signal Board Isolated Input AS Modbus Control with Feedback DC24 Continuous TTL Board, 0V input / 24V feedback signal DC5 Continuous TTL Board, 0V Input / 5V feedback signal DT24 Discrete TTL Board, 0V Input / 24V feedback signal DT5 Discrete TTL Board, 0V Input / 5V feedback signal PT Propane Board, Limit Switches, Thermal Cut Off
									0 No Option H Internal Heater
									0 Cable Gland (Specify Cable & length at added cost) *If the actuator has an ex-proof enclosure, 0 indicates an NPT plug 4 Custom Dual Gauge Cable, 10ft. 5 TURCK 5 Position Connector w. 20' Cable and Plug 6 TURCK 6 Position Connector w. 20' Cable and Plug 7 TURCK 5 Position Connector Only 9 TURCK 6 Position Connector Only
									0 Standard Anodised Alloy Enclosure B Hazardous Locations-Rated S Stainless Steel Enclosure E Stainless Steel Hazardous Locations-Rated
									0 No Special Options AC 110-240 VAC Power Supply B Battery Backup BS Bottom Stop G G-Stage Gate Valve (with MCM or MCL) HT High Temperature Mounting Kit L1 Linear 16 TPI L2 Linear 8 TPI M Manual Override PM Position Indicator (Multi-turn) QR Quick Release Mounting Kit RS Reverse Spring Return S Spring Return

# LABEL BREAKDOWN

### Firmware Version

- AF-1.05
  - AB-1.05
  - AS-1.05
  - DT-2.01
  - DC-2.01
  - M-Dx V2.34
- MM = Multiturn  
MML = Multiturn Low Torque  
MMUL = Multiturn Extra Low Torque  
QM = Quarter turn  
QM97 = Quarter turn 97°

### Actuator Supply Voltage

12-24 VDC @ 3.0 A or  
110-240 VAC, 50/60 Hz @ 1.5 A

### Actuator Series

M-Series or R-Series

### Circuit Board Version

- Ax-8.09
- Dx-10.41
- Px-10.3



www.hanbayinc.com



(336) 659 3400  
NC, 27103

R-Series 12-24 VDC 3.0A

# RCM-050AB

POWER OFF UNIT BEFORE REMOVING COVER

Made in USA

S/N: 19103201-01

Ax-8.09  
AB-1.05MM

User Manual:



### Actuator Part Number

Refer to part number breakdown for available options.

### Actuator Serial Number

This serial number is unique for each individual unit and is directly tied to your order/invoice number.

### QR Code

Scan this QR code for a direct link to the user manual for your unit!

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