



**Coriolis**  
Mass Flow Meters

## Coriolis Flow Meters

RCT1000 Batch Control



**Badger Meter**

CRL-UM-02096-EN-02 (May 2018)

# User Manual

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## INTRODUCTION

The Badger Meter® Coriolis mass meter does batching control that can be linked to discrete and analog inputs and outputs.

### Badger Meter Software

The RCT Console software can be installed on a computer that connects to the transmitter through the USB programming port. Along with meter configuration, the RCT Console software provides logging, trending and diagnostic capabilities. The RCT Console software is included with the Coriolis mass meter.

### Batch Control Feature

The RCT transmitters are supplied with a variety of batching options which, for most applications, eliminate the need for a separate batch control device. These features are user-selected via the transmitter keyboard and include:

- Single-stage or two-stage batch shutdown.
- Batch control by mass, volume, percent solids or percent soluble.
- User defined pre-trigger to compensate for line drainage after batch valve is closed.
- Remote push-button and keyboard “stop/start” capability.

**NOTE:** Throughout this document, parameters are identified by *Parameter Description (Parameter Symbol, Parameter Number)*. For example, *Batch Setpoint (BSpt, 93)*.

## SAFETY

### Safety Symbol Explanations

#### DANGER

**INDICATES A HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED IS ESTIMATED TO BE CAPABLE OF CAUSING DEATH OR SERIOUS PERSONAL INJURY.**

#### WARNING

**INDICATES A HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED COULD RESULT IN SEVERE PERSONAL INJURY OR DEATH.**

#### CAUTION

**INDICATES A HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED IS ESTIMATED TO BE CAPABLE OF CAUSING MINOR OR MODERATE PERSONAL INJURY OR DAMAGE TO PROPERTY.**

### Safety Precautions

#### DANGER

**THE POWER SUPPLY BOARD CAN HAVE LINE VOLTAGES APPLIED TO IT. DISCONNECT ELECTRICAL POWER BEFORE OPENING THE INSTRUMENT ENCLOSURE. USE WIRING PRACTICES THAT CONFORM TO LOCAL AND NATIONAL CODES WITHIN THE REGION WHERE THE PRODUCT IS INSTALLED. [FOR EXAMPLE: THE NATIONAL ELECTRICAL CODE® HANDBOOK IN THE U.S.; CANADIAN ELECTRIC (CE) CODE IN CANADA].**

#### CAUTION

**IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.**

## OPERATION

Batching can be started, stopped (canceled) and suspended (paused) from a remote push-button wired to the inputs and outputs of the transmitter, or started and stopped through the display-keypad interface.

### RCTN Inputs and Outputs

Default Status Assignments	
Out_Status #1	Batch output relay
Out_Status #2	Batch dribble output to relay (two stage batching)
Out_Status #3	User alarm
Out_Status #4	System alarm
In_Status #1	Batch start
In_Status #2	Batch stop/cancel
In_Status #3	Batch suspend/resume
In_Status #4	Unused

### RCTX Inputs and Outputs

Default Status Assignments	
Out_Status #1	Batch output relay
Out_Status #2	Batch dribble output relay (two stage batching)
In_Status #1	Batch start
In_Status #2	Batch stop/cancel
In_Status #3	Batch suspend/resume

Batch outputs must be wired to an interposing solid-state relay to engage pump(s) or valve(s). Outputs are tied to ground when the output is ON. Batch inputs must be on momentarily to start, stop, suspend or resume a batch, whether wired to inputs or over a network.

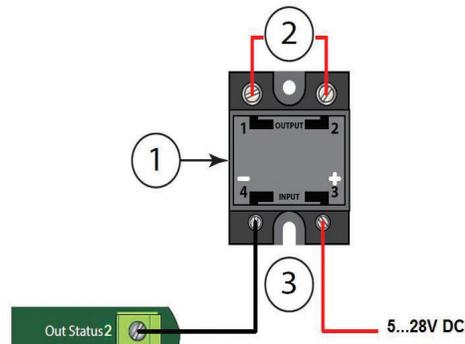


Figure 1: Batch outputs

1	Solid-state Relay
2	Solenoid Valve, pump or like device
3	Relay input (see user manual for max. current)

### **⚠ WARNING**

**FAST ACTING SOLENOID VALVES CAN CAUSE FLUID HAMMER IN THE FLOW LOOP WHICH CAN CAUSE READING ERRORS AND POSSIBLE DAMAGE TO THE CORIOLIS METER TUBES. INSTALL EQUIPMENT TO PREVENT THE PRESSURE WAVE FROM PROPAGATING THROUGH THE PIPES.**

## Operation from Remote Push-buttons

### IMPORTANT

**A password level of operator, technician or engineer is required to operate the batch or change the setpoint. See the "Coriolis Flow Meters User Manual" for password information.**

#### Starting a Batch Process

To start a batch process, momentarily turn on *In\_Status\_1* (see the user manual for digital input specifications). The batch continues to run until the end of the batch or the batch is suspended or the batch is stopped.

#### Suspending a Batch Process

Set *Suspend Batch (BatSus, 32)* to enable the batch to be suspended. To suspend a batch process, momentarily turn on *In\_Status\_3*. When a batch is suspended, the outputs are turned off. The operation of the batch totalizer depends on the batch type. To resume the batch process, turn off *In\_Status\_3*.

#### Stopping a Batch Process

To stop a batch, momentarily turn on *In\_Status\_2*. When a batch is stopped, it cannot be resumed. The accumulated value in the *Batch Total (BTot, 90)* remains until the next batch is started.

## Operation from Transmitter

### Enabling the Batch Menu

The *Batch* menu must be enabled to view and operate batching through the display/keypad interface on the transmitter. To configure the *Batch* menu to be visible:

1. Navigate to *Main Menu > Set Up > Menus*.
2. Select **MnuBatch** to show the menu, or select parameter **138 Batch Menu** in the RCT Console configuration software. The *BATCH* menu selection appears in the main menu.

### Starting a Batch Process

1. From the *Menus* screen, scroll until *BATCH* is the active line at the top of the list and press **Enter**.



```

BATCH
TOTAL
ALARMS
MEASUREMENT
  
```

Figure 2: Batch menu

2. From the *Batch* menu, scroll until *START BATCH* is the active line at the top of the list.
3. Press and hold **Enter** to start the batch.



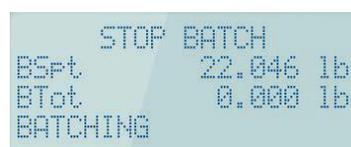
```

START BATCH
BSft      22.046 lb
BTot      0.000 lb
mTot     9031.954 lb
  
```

Figure 3: Start batch screen

### Stopping a Batch Process

1. From the *Batch* menu, scroll until *STOP BATCH* is the active line at the top of the list.
2. Press and hold **Enter** to stop the batch.



```

STOP BATCH
BSft      22.046 lb
BTot      0.000 lb
BATCHING
  
```

Figure 4: Stop batch screen

### **Changing the Batch Setpoint**

1. From the *Batch* menu, scroll until *BSpt* is the active line at the top of the list.
2. Press and hold **Enter** to start editing the value.

See "*Editing Parameter Units, Values and Resolution*" in the user manual for editing instructions.

### **Additional Control Options**

The *Batch Setpoint 93 (BSpt, 93)* and *Batch Total 90 (BTot, 90)* parameters can be set over Modbus RTU, EtherNet/IP and Modbus TCP/IP. Batching parameters are not available in HART. *Batch Total 90 (BTot, 90)* can be assigned to a current or frequency output and/or read over a network.

## **IMPORTANT**

***A password level of operator, technician or engineer is required to operate the batch or change the setpoint. See the "Coriolis Flow Meters User Manual" for password information.***

### **Operation Over a Network**

The batch process can be operated from a DCS or PLC over EtherNet/IP, Modbus RTU, Modbus TCP/IP and HART. Outputs from the DCS or PLC to the inputs of the meter must be short pulses to start, stop, suspend or resume the batch. See the RCT 1000 user manual or RCT 1000 HART user manual for the specific addresses or commands to operate the batch.

## BATCH MEASUREMENT

Most of the batch measurement and batch options can be set up from the display/keypad interface in the *Main Menu > Set Up > Program* menu. All of the parameters can be set through the RCT Console configuration software.

The Coriolis meter can be set up to measure *mass*, *volume* or *% mass* for the batch. The *Batch Mode (BMode, 94)* parameter controls the flow measurement used for batching.

### Batch Types

#### Simple Start/Stop Batching

For simple Start/Stop Batching, set the *Batch Type (BType, 99)* parameter to **Start/Stop Batching**.

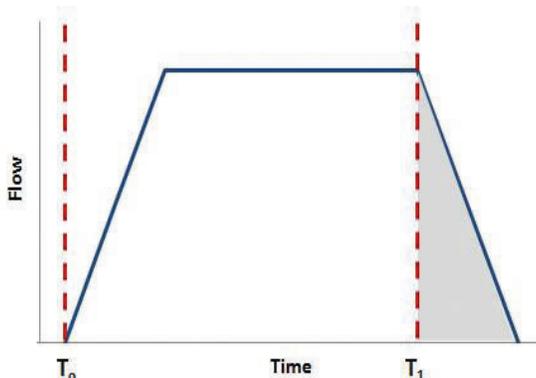


Figure 5: Simple start/stop batching

When the batch starts (at  $T_0$  in Figure 5), *Out\_Status\_1* turns on, engaging the pump or opening the valve. When the *Batch Total (BTot, 90)*  $\geq$  *Batch Setpoint (BSpt, 93)*, then *Out\_Status\_1* turns off (at  $T_1$  Figure 5), stopping the pump or closing the valve.

Typically, there is some lag in the process before the flow is fully stopped, as shown in the shaded area in Figure 5. This overrun quantity is NOT included in the *Batch Total (BTot, 90)*.

#### Flow End Batching

Flow End Batching operates the same as the simple start/stop batching except the overrun quantity is included in the *Batch Total (BTot, 90)* if the *Batch Type (BType, 99)* is set to **Flow End Batching**.

#### Diverter Batching

Diverter Batching requires a 3-way valve or flow diverter. When the batch is stopped, the fluid is diverted into a recirculating loop and the fluid continues to flow through the meter, but not into the container. Set *Batch Type (BType, 99)* to **Diverter Batching** to enable diverter batching.

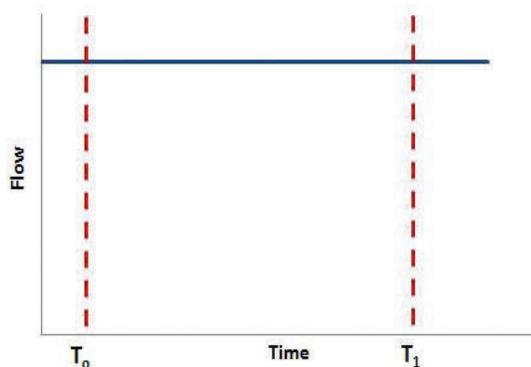


Figure 6: Diverter batching

When the batch starts (at  $T_0$  in Figure 6), *Out\_Status\_1* turns on to allow fluid to flow into the container. When the *Batch Total (BTot, 90)*  $\geq$  *Batch Setpoint (BSpt, 93)*, then *Out\_Status\_1* turns off (at  $T_1$  in Figure 6), diverting the flow to the recirculating loop. The *Batch Total (BTot, 90)* only accumulates while the output is ON, although fluid continues to flow through the meter.

## BATCHING OPTIONS

### Batching Pre-Triggers

If the overrun flow is significant, you can set a pre-trigger to turn off *Out\_Status\_1* early to reduce the amount of overrun. The pre-trigger can be time-based or quantity-based.

The time-based pre-trigger is most often used when the process system has a consistent response, such as the time for a valve to close, and the flow rate is constant during the batch but not necessarily the same between batches. Set the batch *Time-Based Pre-Trigger (BTPrt, 95)* to the length of time that the batch output should turn off early. The transmitter calculates the amount of mass or volume that will continue to accumulate by multiplying the flow rate and the time pre-trigger:

$$\text{batch total (BTot, 90)} + (\text{flow rate} * \text{time pre-trigger (BTPrt, 95)}) \geq \text{batch setpoint (BSpt, 93)}$$

If the flow rate is consistent across all batches, it may be easier to use the quantity based pre-trigger (*BQPr*). For quantity pre-trigger, the batch output turns off when:

$$\text{batch total (BTot, 90)} + \text{quantity pre-trigger (BQPr, 96)} \geq \text{batch setpoint (BSpt, 93)}$$

Use the RCT Console software to set up either pre-trigger.

For Start/Stop or Flow End Batching, the pre-trigger does not affect the *Batch Total (BTot, 90)*. For Diverter Batching, the quantity defined by the pre-trigger is added to the *Batch Total (BTot, 90)* when the batch output is turned OFF.

### Two-Stage Batching

In Two-Stage Batching, fluid flows through a valve that has three positions: fully open, low flow and closed. Two-Stage Batching minimizes batch overruns and water hammer, both of which may damage equipment (including the meter) over time.

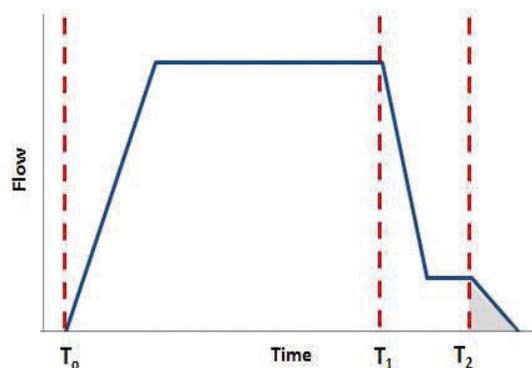


Figure 7: Two-stage batching

Initially, both *Output\_Status\_1* and *Output\_Status\_2* are on and fluid flows through the fully open valve. *Batch Preset (BPrst, 97)* is the remaining quantity at which the first stage will finish and *Output\_Status\_1* turns off as shown at T<sub>1</sub> in Figure 7:

$$\text{batch total (BTot, 90)} + \text{batch preset (BPrst, 97)} \geq \text{batch setpoint (BSpt, 93)}$$

*Output\_Status\_2* remains on until *Batch Total (BTot, 90)* ≥ *Batch Setpoint (BSpt, 93)*, closing the valve.

Use the RCT Console software to set up two-stage batching.

## BATCH PARAMETERS

### Basic Batch Setup

Parameter Symbol	Parameter Number	Description	RCT Console Software	Transmitter Display
BSpt	93	Batch setpoint	X	X
BType	99	Batch type (start/stop, flow end batching or diverter)	X	X
BMode	94	Flow parameter to batch (mass, volume, % mass)	X	X
BatSus	32	Enables batch to be suspended	X	

### Advanced Batch Setup

Parameter Symbol	Parameter Number	Description	RCT Console Software	Transmitter Display
BTPrt	95	Time based pre-trigger	X	X
BQPrt	96	Quantity based pre-trigger	X	X
BPrst	97	First stage trigger for two-stage batching	X	X

### Batch Setpoint and Measurements in Batch Menu

Parameter Symbol	Parameter Number	Description	Password Levels								
			Operator			Technician			Engineer		
			Read	Write		Read	Write		Read	Write	
				Value	Unit/Decimal		Value	Unit/Decimal		Value	Unit/Decimal
BSpt	93	Batch setpoint	X	X	X	X	X	X	X	X	X
BTot	90	Batch total	X		X	X		X	X		X
mTot	80	Mass total	X		X	X		X	X		X
mFlo	59	Mass flow rate	X		X	X		X	X		X
%mFlo	58	Percentage of mass flow rate	X		X	X		X	X		X
BFloAv	291	Average flow rate during batch	X		X	X		X	X		X
Temp1	65	RTD1 temperature	X		X	X		X	X		X

### Diverter Batching Example

In the production of many mixtures, the addition of a liquid ingredient is carefully dosed into a mixer to be combined with a dry ingredient. Sometimes, the liquid-based ingredient is kept in a recirculation piping loop to maintain optimum temperature and viscosity for uniform spray patterns into the mixing tank and to prevent liquid from solidifying. The RCT1000 transmitter accepts a digital input to initiate a batch sequence and also produce the output signals for solenoid valves, which divert the flow from recirculate to spray, accurately dosing the exact amount required for each production run.

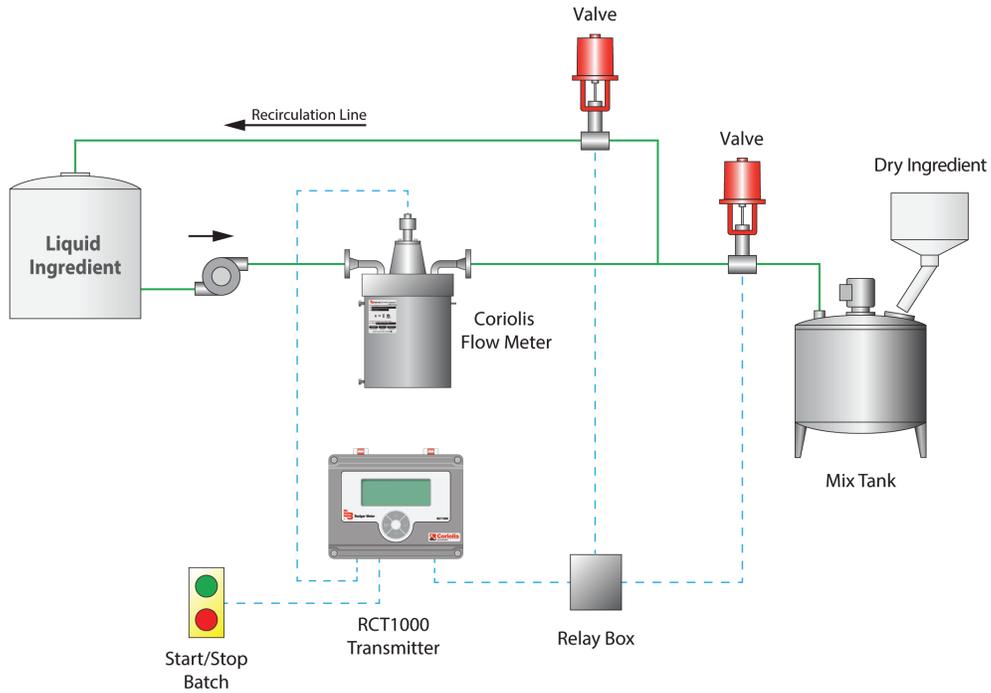


Figure 8: Diverter batching example

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