Nixon Flowmeters Ltd

99B Manual

Issue 2

September 1999

# Installation & Operation
# of the 99B Batch Controller

**Note**

Read this manual prior to installation

CONTENTS

# 1 INTRODUCTION

The 99B is a microprocessor based instrument designed for batch control applications that include flowmetering and industrial counting.
The input circuit has been designed to accept the wide range of pulsed signals generated by flow measurement equipment.
The Batch Controller will easily handle applications ranging from single relay switching to slow start-up and soft shut down. Additional features include no flow detection, remote switch operation and automatic over run compensation.

Either flow rate and batch count, or preset quantity and batch count can be simultaneously displayed on the two large LED displays. The batch quantity can be set via the front panel, and an accumulated non resettable total is available at the push of a button.
The rate can be displayed in engineering units, with a time base of seconds, minutes or hours.
The instrument can compensate for flowmeter non-linearity by adjusting the scaling factor over eight distinct frequency steps, with linear interpolation between points.
The instrument is fully programmable via the front panel and the information is stored in non volatile memory.
The instrument will operate directly from voltages between 12 and 28 VDC or from the AC mains. A DC output is provided from the rear of the instrument to power remote sensors.

## 2 QUICK SET-UP

Calibration

To enter the calibration mode disconnect any remote button inputs and short terminals 11 and 12. Pressing the “Prog” button will cycle through the entries, while the “right arrow” button (Run) will select the next digit to the right and the “up arrow” button (Reset) will increment the flashing digit. To store any changes remove the link while the instrument is powered up.

| Display | Options | Description | Section |
|---|---|---|---|
| Cal 1 | | Integer value of K factor | Sect. 5.1 |
| Cal 2 | | Decimal value of K factor | |
| Cal 3 | r | Rate on lower display | |
| | p | Preset quantity on lower display | |
| If rate is selected: | | | |
| Cal 3.1 | 0 to 4 | Decimal places for rate display | |
| Cal 3.2 | 0 | Units per second | |
| | 1 | Units per minute | |
| | 2 | Units per hour | |
| Cal 3.3 | 0 | No filtering | Sect. 5.2 |
| | to | | |
| | 99 | Heavy filtering | |
| Cal 3.4 | | Filter bandwidth | |
| Cal 4 | u | Count up | |
| | d | Count down | |
| Cal 5 | 0, 1, 2 | Batch resolution | |

| | | | |
|---|---|---|---|
| Cal 6 | 1, 2 | Relay control mode | Sect. 5.4 |

If mode 2 selected:

| | | |
|---|---|---|
| Cal 6.1 | 00.00 to 99.59 | Delay time for relay 2 in minutes and seconds |
| Cal 6.2 | 0 to 999999 | Prestop quantity for relay 2<br>To same resolution as set in Cal 5 |

| | | | |
|---|---|---|---|
| Cal 7 | d | Automatic over-run compensation disabled | Sect. 5.6 |
| | E | Automatic over-run compensation enabled | |
| Cal 8 | 0 to 99 | Signal Time Out, in seconds (No flow detection alarm delay) | Sect. 5.5 |
| Cal 9 | d | Linearisation disabled | Sect. 5.3 |
| | E | Linearisation enabled | |

If enabled

| | | |
|---|---|---|
| | F1 to 8 | Lowest to highest frequencies |
| | d | Deviation at each frequency |

Note: If a frequency of 0000 is entered, no further deviations need to be programmed and the sequence will cycle back to Cal 1 .

# 3 OPERATION

## 3.1 Front Panel

The upper display will show the batched volume, either counting up or down. The lower display can be programmed to display either the preset batch quantity or the flow rate, in engineering units. The units are determined by the K factor programmed during calibration.
LEDs will indicate if either of the relays are active.

## 3.2 Setting the Batch Quantity

| | |
|---|---|
| Press “Batch Set” - | The last preset quantity will show on the lower display, with the most significant digit flashing to show that it can be changed. |
| Press “ ” - (Reset) | The flashing digit will increment by 1. |
| Press “ ” - (Run) | The next digit will flash, and can now be changed. |
| Press “Batch Set” - | The new preset quantity will now be stored. Once set, the preset quantity will be stored in non-volatile memory until changed by the user. |

Note: The batch quantity cannot be changed during a batch run, however if flow rate is being displayed the preset quantity can be viewed by pressing the “Batch Set” button.

## 3.3 Starting a Batch

Pressing the “Run” button will start the instrument. The relays will operate, and the instrument will start to count. The relay control modes are described in section 5.

## 3.4 Stopping a Batch

The instrument will de-energise the relays at the end of the batch. The batch can be interrupted at any time by pressing the “Stop” button. During the pause state, where the process has been interrupted, the batch can be resumed by pressing the “Run” button or reset to zero by pressing the “Reset” button.

If the instrument has been configured for a slow start-up, and has been interrupted during a batch, the slow start-up procedure will be repeated when the batch is re-started

## 3.5 Resetting

The instrument cannot be reset until a batch is complete (i.e. flow has stopped and “Signal Time Out” period has elapsed), or the process has been interrupted with the “Stop” button.

## 3.6 Restarting without Resetting

The instrument can be configured to reset and start a batch by just pressing the “Run” button. This is done by linking terminals 12 and 14 prior to powering up the instrument.
This is particularly useful where the batch is started from a remote switch, PLC or “End of Batch” signal from another batch controller.
The instrument cannot be restarted by this method until after the “Signal Time Out” period is complete (Section 5.5).

## 3.7 Accumulated Total

While not counting, a non resettable total can be displayed by pressing and holding the “Stop” button followed by the “Batch Set” button. The total is displayed only while these two buttons are simultaneously held in.
Once the total has reached the maximum displayable it will roll over to zero, and the instrument will continue to totalise. If power to the instrument is lost all totals will be stored in the non volatile memory, and recalled when power is re-applied.

# 4 INSTALLATION

## 4.1 General

The standard Batch Controller is supplied as a panel mounting instrument, with side clips to secure it to the panel. The cut-out should be 92mm x 92mm.
The instrument will operate from either 12 - 28 VDC or from the AC mains. The mains voltage is factory set to either 115V or 230V nominal. An internal mains transformer provides isolation between the mains and the electronic circuits. The use of a mains filter (typically RS 210-443) will give added protection from mains borne transient interference.
An earthing point is provided via a stud on the back panel. This earthing point provides the earth for the case. For EMC purposes or where the instrument is connected to the mains this point must be connected to a clean earth via a suitable cable.
It is recommended that shielded cable is used for all signal connections to the instrument. Shields should be connected to earth at the instrument only. To comply with Directive 89/336/EEC of the Council of European Community, this wiring practice is mandatory. It is also good practice to separate power cables from those carrying signals.
There are no user serviceable parts within the instrument.
A regulated output voltage is provided to power external sensors. If the instrument is mains powered it is adjustable between 8 - 24 VDC via a potentiometer at the side of the instrument. If the instrument is DC powered the maximum voltage will be 3.5V less than the supply voltage. The maximum output current is 50 mA.

## 4.1a RC Networks For Relay Contact Protection & EMI Suppression

There are two relay outputs available from the 99B, each having a normally closed & normally open contact.
To limit the amount of electrical noise caused by arcing across the contacts, 0.01µF, 100 suppressors have been fitted internally.
When switching highly inductive loads it may be necessary to fit larger suppressors to the relay output terminals on the rear panel.
Noise generated from the contacts arcing, may, in extreme cases, cause the processor to act erratically.
Note : The use of a 0.01µF, 100 suppressor across the contacts means that the relay output is not an isolated output, i.e. when driving highly reactive A/C loads, a small voltage will be present even when the contact is open.

## 4.2 Signal Connections

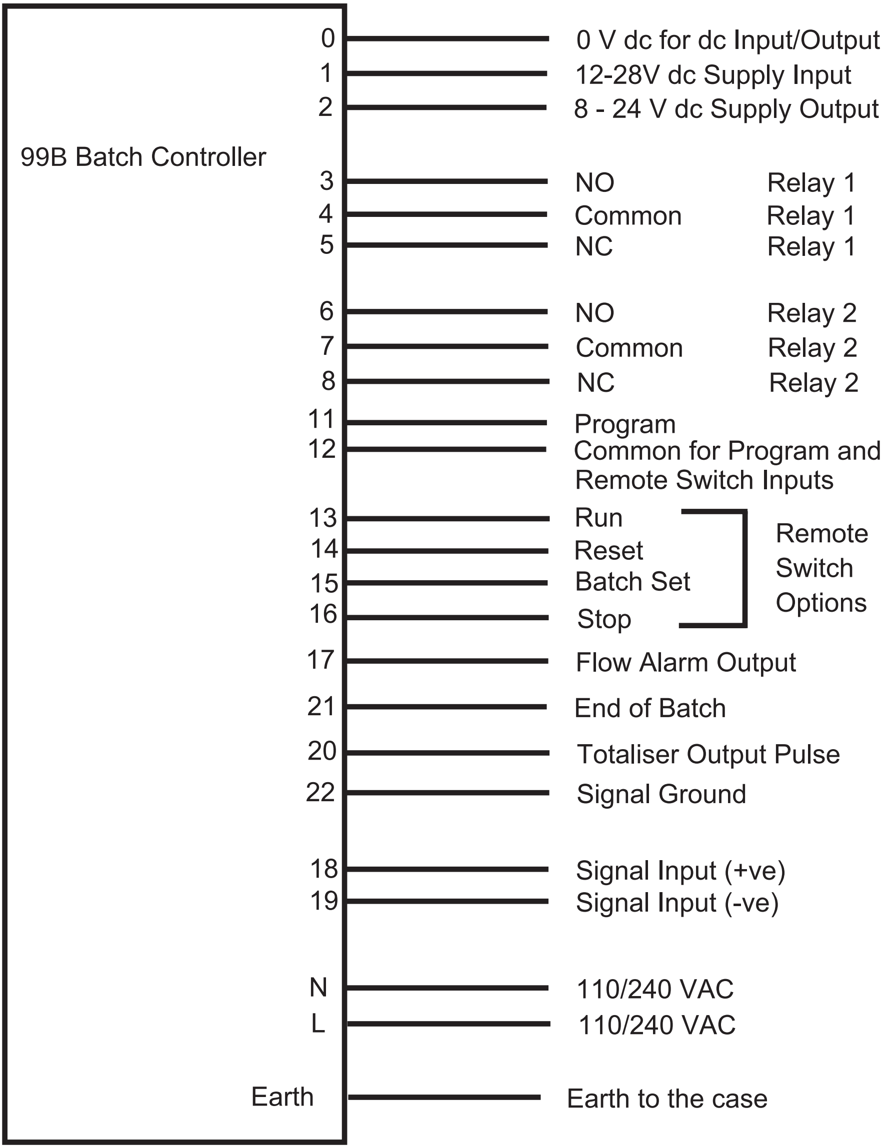
| Signal Type | Typically From | Connections | DIP Switches On |
|---|---|---|---|
| Voltage Pulse (Square Wave) | PPW Amplifier TTL | +ve to 18 -ve to 19 | 5 7 |
| Voltage Pulse (Sine Wave) | Turbine Meter RN & Hoverflo | 18 & 19 No Polarity | 1 4 |
| Switch (Contact Closure) | Reed Switch PT Meter | 18 & 19 No Polarity | 3 5 7 8 |
| Open Collector | Magnetic Meters | +ve to 18 -ve to 19 | 5 8 |
| Current Pulse | P/5 Amplifier | +ve to 2 -ve to 18 | 2 5 6 |

Also Put a 220 resistor between 18 & 19

| | | | |
|---|---|---|---|
| Current Pulse | Namur Sensor | +ve to 2 -ve to 18 | 2 5 6 |

Also Set the voltage output at 2 to 8.2 VDC by using the pot at the side of the case

## 4.3 Installation Diagram



## 5 PROGRAMMING OPTIONS

### 5.1 K Factor

This is the number of pulses per unit volume generated by a flowmeter. Changes to this number will allow different engineering units to be displayed.

> e.g.. Suppose a flowmeter gives out 100.00 pulses per litre:
> Setting a K factor to 100.00 pulses per unit would give a display in litres
> Setting the K factor to 454.6 pulses per unit would give a display in gallons, using a conversion of 4.546 litres = 1 gallon.

### 5.2.1 Filter Constant

Frequency fluctuations caused by pulsating flow through a flowmeter, vibration on a shaft or speed variations in a motor may make the rate display unstable. The 99B has a digital filter to average out these fluctuations and ease the reading of the instrument. The level of filtering can be adjusted to give stable readings without excessive lag. As a guide the following table gives the response time in seconds for the displayed value to reach 90% and 99% of a step change in input frequency

| Filter Constant | 90% | 99% |
|---|---|---|
| 2 | 1 | 2 |
| 4 | 3 | 6 |
| 6 | 4 | 8 |
| 10 | 7 | 14 |
| 20 | 14 | 28 |
| 40 | 28 | 56 |
| 60 | 42 | 84 |
| 80 | 56 | 112 |
| 99 | 70 | 140 |

### 5.2.2 Filter Bandwidth

While filtering has tremendous advantages in producing a steady and accurate reading of rate, it has the disadvantage of slowing the response to intended changes in frequency.

To overcome this problem a window can be programmed to define the frequency range over which the filtering operates. If the input frequency jumps by more than this window, the displayed value will immediately track the new rate.

The bandwidth is defined in relation to the input frequency in Hz and is symmetrical about the current input frequency.

e.g. If the input frequency is 500 Hz and the window is set to 100 Hz, the signal will be filtered between 450 and 550 Hz. If the signal jumps to 600 Hz, the display will immediately update to this rate and the filtering will be between 550 and 650 Hz.

In practice the following procedure will give the optimum balance between filtering and bandwidth:

1) Set the window to 5000 Hz, effectively disabling it.
2) Increase the filter constant until a steady reading is obtained.
3) Decrease the window bandwidth until the display becomes unsteady. (The fluctuation exceeds the displayed bandwidth)
4) Finally increase the window bandwidth slightly again to steady the display.

## 5.3 Non-Linearity Correction

### Description

Most flowmeters have some form of linearity error, where the K factor at a particular flow rate differs from the average. Many flowmeter manufacturers can provide a calibration certificate which list these errors. Provided the error is repeatable the accuracy of the display can be greatly improved.

The correction can be performed over the frequency range 0 to 5.0 kHz, with a deviation of up to 9.99%.

Example

A low cost flowmeter may have the characteristics as shown below:
Average Pulses/Lit (K Factor): 35.46

| Frequency (Pulses/Sec) | Pulses/Lit | Flow Error (%) |
|---|---|---|
| 104 | 33.69 | 4.99 |
| 216 | 34.42 | 2.93 |
| 398 | 35.05 | 1.16 |
| 611 | 35.95 | -1.38 |
| 805 | 37.23 | -4.99 |
| 1102 | 35.40 | 0.17 |

From this example the overall accuracy is +/- 4.99%, using the average K factor.
Programming the deviations into the BC/7 will result in the accuracy being improved by up to 10 times, provided the errors are repeatable.

Programming Correction Factors

In the calibration sequence, with linearisation enabled, up to 8 frequencies can be programmed with their respective deviations. The first frequency entered should be the lowest one required. At lower frequencies the microprocessor will use this first correction factor.
The deviation will show pxx.xx, with the first digit being P for positive deviations and - for negative. The remaining digits represent the percentage difference between the K factor entered in Cal 1 and 2, and the actual pulses per unit at the frequency in question.
If a frequency of 0000 is entered the instrument will move back to Cal 1, allowing the user to set fewer than 8 correction factors.

## 5.4 Relay Control Modes

The two control modes dictate the sequence of relay operations, to operate control valves or pumps, started by the “Run” button.

### Mode 1

This is the simplest of the two modes. On pressing the “Run” button relay 1 will energise, once the batch quantity is reached it will de-energise.
If the instrument is configured in the programming to count up from zero, the display will show the total volume passed, including any overrun, . If it is configured to count down from the preset value to zero, any overrun will be shown as a negative value.

### Mode 2

This is intended for use in batching operations where a slow start and/or stop is required. In such applications relay 1 is used to control the slow flow, while relay 2 is used to control the main flow.
The delay between the start and relay 2 energising is programmed in minutes and seconds, with a maximum of 99 minutes and 59 seconds.
Relay 2 is de-energised when the prestop quantity is reached (i.e. the quantity to the end of the batch). This can provide increased accuracy by slowing the flow rate over the final part of the batch, provided the lower rate is within the operating range of the flowmeter.
The prestop quantity is entered in the calibration sequence, to the same resolution as the main display.

## 5.5 Signal Time Out / Flow Alarm

The signal time out period is the time interval during which, if no pulses are received the flow is considered to have stopped. It has two functions:
1) To detect the loss of signal from the flowmeter during a batch, indicating a failure in the system. In this case the instrument will enter an alarm condition.
The relays will de-energise, the “Alarm” LED on the front display will light and a signal will be produced at terminal 17. This is an open collector, capable of sinking 100 mA, to drive external relays, alarms or lamps.
The alarm status must be cancelled by pressing the “Stop” button before any further batches can be started.
2) After the preset quantity has been reached and the relays have de-energised, some overrun may occur. The signal time out is used to provide an end point where the batch is considered complete, and the “End of Batch Signal” is given (Section 6.5).

Since a new batch cannot be started until after the “End of Batch” has been reached (i.e. flow has stopped and time out has elapsed) it is recommended that the period is kept as short as possible. It should however be significantly longer than the period between successive input pulses from the flowmeter. A time of 6 - 10 seconds is practical for most applications.
Setting the time out to 0 will disable the function, and the “End of Batch” signal will be given when relay 1 de-energises.

## 5.6 Automatic Overrun Compensation

In many applications the volume delivered will be greater than the preset quantity, due to delays in actuating valves or pumps after the relays have de-energised. The instrument can be programmed to automatically compensate for this overrun.
The quantity actually delivered will be subtracted from the preset quantity, and averaged with the previous two overruns. The instrument will then de-energise the relays before the preset quantity is reached to allow for the excess. Clearly only repeatable errors can be eliminated, as the instrument cannot predict erratic results.
In calibration it is important to set the “Signal Time Out” to a period that allows time for the flow to stop after the relays have de-energised, as only flows up to this point will be compensated for.

# 6 EXTERNAL WIRING OPTIONS

Note: All links must be installed while the instrument is powered down. On powering up, the microprocessor notes the existence of the links and configures the software accordingly.

## 6.1 Inhibiting the Batch Set Button

If it is required to prevent an operator from adjusting the batch quantity from the front panel, a link should be placed between terminals 12 and 15. A key switch will allow authorised operators access to the Batch Set Option. This switch should be a normally closed momentary switch. One operation of the switch would put the instrument into Batch Set Mode, and a second operation would return the instrument to normal operation.

## 6.2 Inhibiting the Run Button

If it is required to prevent unauthorised starting of the batch from the front panel, a link or key switch should be connected between terminals 12 and 16.(the Stop Button). The instrument will only start a batch when the key switch is open or the link disconnected.

## 6.3 Connecting Remote Buttons

It is possible to duplicate the functions of the front panel buttons using remote switches. This allows the instrument to be operated by PLCs or from a control room.

Run Button: Connect a momentary switch across terminals 12 and 13.

Reset Button: Connect a momentary switch across terminals 12 and 14.

Batch Set Button: Connect a momentary switch across terminals 12 and 15.

Stop Button: Connect a momentary switch across terminals 12 and 16.

6.4 Output Pulse

A scaled pulse output is available at terminal 20 of the instrument. One pulse is produced each time the accumulated total increments by one (whole units only).

An open collector produces the current sinking pulse of approximately 50 mSec, and is limited to 100 mA. In most cases the counters will provide the load for the open collector, but for those that require a voltage pulse an external pull-up resistor may be required.

The output is intended for totalisation as the uneven spacing of the pulses makes them unsuitable for rate indication.

6.5 End of Batch Signal

The end of batch is defined as the point when flow has stopped, and the signal time out has elapsed. An open collector capable of sinking 100 mA will operate. This will continue until the “Reset” button is pressed.

## 7 SPECIFICATION

| | |
|---|---|
| Display | 2 rows of 6 digit, 7 segment LEDs.<br>Upper row: 14mm Lower row: 10mm |
| Input Frequency | Rate 0.25 Hz to 5.0 kHz<br>Total 0 to 5.0 kHz |
| Input Circuit | Will accept most sine, logic or switch inputs |
| Scaling Factor Range | 0.0001 to 99999.9999 |
| Linearity Correction | Up to 8 correction factors, max. correction 9.99% |
| Accuracy | Better than 0.05% |
| Scaled Pulse Output | One 50 mSec pulse per unit<br>Open collector will sink 100 mA |
| Supply Output | Adjustable from 8 to 24 VDC if mains powered<br>Adjustable from 8 to (Input - 3.5 V) if DC powered. 50 mA maximum |
| Power Requirements | Factory set to 95-135 VAC or 190-260 VAC<br>12 - 28 VDC input as standard<br>300 mA Typical |
| Control Relays | Max switching voltage: 250 VAC, 30 VDC<br>Max switching current: 8 Amps for a resistive load.<br>Operate time: 15mSec approx.<br>Release time: 10mSec approx |
| Ingress Protection | IP65 on front panel |
| Operating Temp | 0 - 45 $^{o}$C |
| Dimensions | 96 x 96 x 175.4 mm |
| Panel Cut-out | 92 x 92 mm |

## 8 TROUBLESHOOTING

Instrument will not start counting

Check: that instrument is not in “Alarm” condition. If it is, press “Stop” to cancel.
fluid is flowing in the line
signal is coming from the flowmeter
DIP switches are on correct setting for flowmeter type
relays are operating

Instrument will not reset

Check: that the “Signal Time Out” has not been set to an excessively long period.

No display

Check: there is power to the instrument
the voltage is correct

Counting erratically or when no flow is present

This is probably due to interference. In electrically noisy areas it is essential that good quality screened cable is used, correctly earthed and routed away from power cables.
For voltage pulse inputs the logic zero threshold can be raised by switching off 7. This will reduce the effects of interference.