BA350BP & BA350BC intrinsically safe Batch Controllers

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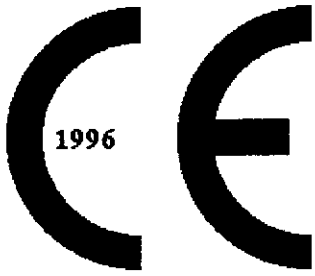


This product meets the essential protection requirements of Council Directive 89/336/EEC and has been tested to EN50 081-1:1992 pr EN50 082-2:1991

A Declaration of Conformity is available on request.

CONTENTS

BA350BP and BA350BC intrinsically safe batch controllers

ILLUSTRATIONS

1. HOW TO USE THIS MANUAL

This instruction manual has been written so that the reader can quickly obtain the information they require without having to read unnecessary sections. However, we recommend that whatever your interest you read sections 2 and 3, Description and Function followed by the sections covering your particular requirements.

2. DESCRIPTION

The BA350B is an intrinsically safe batch controller, primarily for use with flowmeters, which has been certified by BASEEFA and other national authorities for installation in hazardous areas. Although incorporating sophisticated features the instrument is very easy to use and can operate as a stand-alone controller, or form part of a more complex control system. Two independent outputs may be programmed for one or two stage control which, together with automatic overrun compensation, minimises batching errors caused by actuator delays.

Front panel push-buttons enable the operator to start and stop the batch, adjust the batch setpoint and to select one of four different operating displays: current batch total, input rate, batch setpoint or grand total. The display may be in any engineering units and the input rate can be shown per second, minute or hour. A light emitting diode (LED) above each front panel push-button indicates which display has been selected. For applications where large or remote push-buttons are required, control may be transferred to external switches with or without the front panel push-buttons inhibited.

Two alternative versions of the BA350B batch controller are available. For pulse signals the BA350BP accepts inputs from a wide range of transducers including certified 2-wire proximity detectors, switch contacts, open-collector transistors and voltage pulse signals. The BA350BC has a galvanically isolated analogue input which may be connected in series with most certified intrinsically safe 4/20mA linear or square law current loops.

Both versions of the BA350B may also be used as a simple totaliser and ratemeter, for these applications all the batch control functions may be inhibited by one programme command.

Adjustment of the batch setpoint and programming of all functions is performed via the five front panel push-buttons, or remote switches. To prevent accidental or unauthorised adjustments three levels of access are defined by the position of two security links connected between terminals at the rear of the instrument. These links may be hard-wired, or connected to a panel mounting key switch when frequent changes are required.

A light emitting diode (LED) on the front panel indicates when the batch controller is in the programme mode, and the display has helpful plain language menus which guide the user through the selection procedure.

An optional plug-in RS232 serial communication board enables the BA350B to be interrogated and controlled remotely, and thus to be integrated with supervisory computers.

For safe area applications the complementary BA550P and BA550C batch controllers are available.

3. FUNCTION

The BA350BP which is shown in Fig 1 incorporates programmable input scaling to convert the number of input pulses into a display of total flow in engineering units.

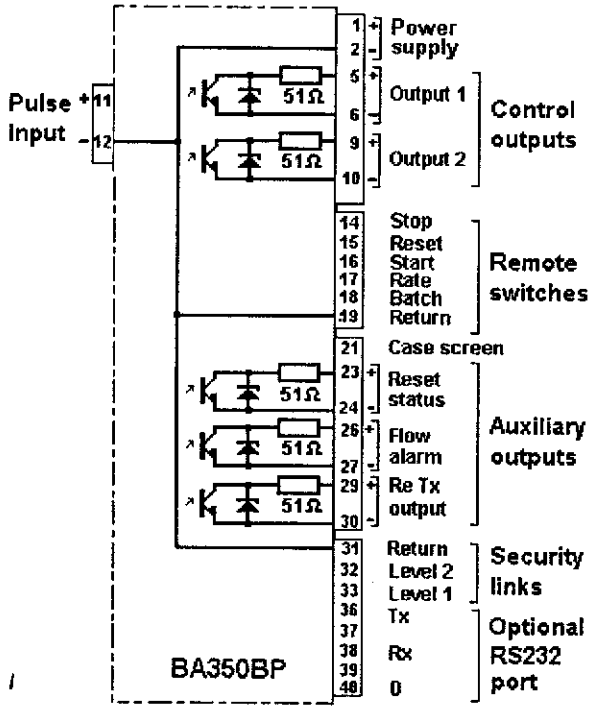


Fig 1 Block diagram of BA350BP

For example, a controller connected to a turbine flowmeter producing 107 pulses per litre may be programmed to display this signal in litres, gallons or any other units by selecting the appropriate scale factor. Similarly the rate parameters, which are totally independent, may be programmed so that the BA350BP displays the flowrate in litres, gallons or any other units per second, minute or hour.

The BA350BC which is shown in Fig 2 accepts a 4/20mA analogue input signal which is integrated and scaled to provide a display of total flow in engineering units. Again an independent flow rate display is available.

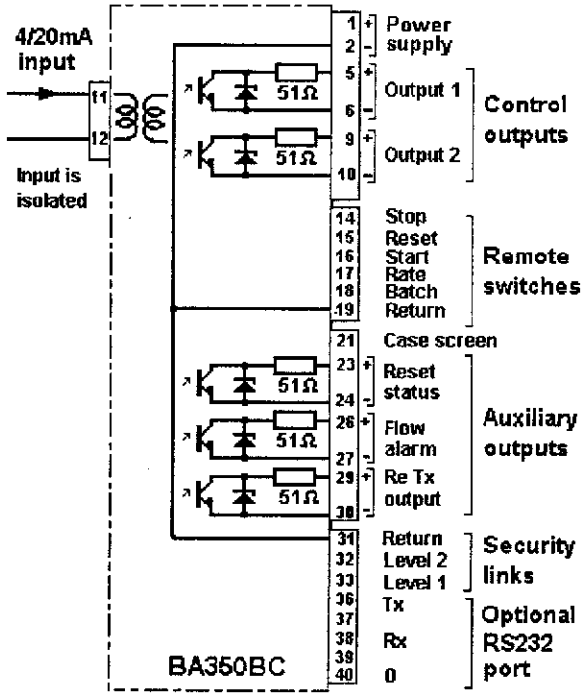


Fig 2 Block diagram of BA350BC

Both the BA350BP and the BA350BC have two adjustable setpoints which are compared with the total volume display in engineering units. The relative values of the setpoints and the displayed total volume determine the status of two solid state output switches. For batch control application these two outputs may be used to operate control valves.

Output 1 is energised immediately the *Start* push-button on the controller is operated, followed by Output 2 after a programmable time delay. Towards the end of the batch, Output 2 is de-energised a programmable number of counts before the batch setpoint is reached, when Output 1 is also de-energised. Fig 3 illustrates a typical application of two stage control. By operating a small bypass valve from Output 1, and the main control valve from Output 2 the flow can be started and stopped slowly, reducing batching errors and flow surges.

With the batch control functions disabled the BA350B becomes a very flexible totaliser and rate indicator which can be used in many applications, including the integration of a 4/20mA flow signal to calculate and display total flow.

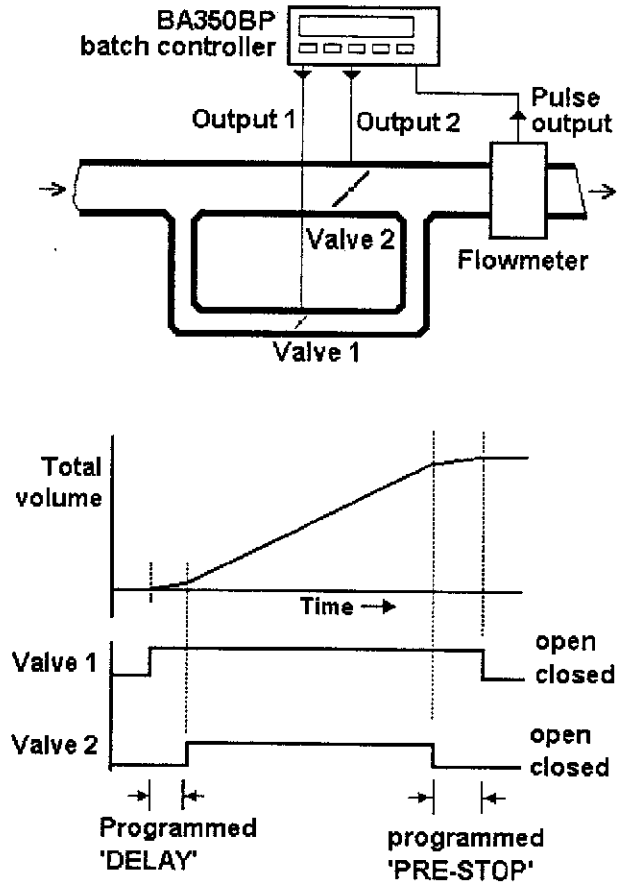


Fig 3 Application of two stage control

4. OPERATING a BA350BP or a BA350BC

This section is primarily intended for users who wish to operate a BA350BP (pulse input) or a BA350BC (4/20mA input) after it has already been installed, programmed and commissioned.

4.1 Initialisation

Each time a BA350B is connected to a power supply it goes though an initialisation sequence which briefly displays 8.8.8.8.8.8.8.8 and illuminates the eight front panel LED indicators. The instrument then enters the operating mode in the stop state.

4.2 Operation as a batch controller

The BA350B is operated via five front panel push-buttons, each of which has a single function in the operating mode shown in bold black letters on the front panel. Operation of any push-button is acknowledged by a red light emitting diode (LED) located immediately above the button. Three additional red LED's show the status of the two control outputs and indicate when the controller is in the programme mode.

Throughout this manual push-button and front panel LED functions are shown in italics e.g.. *Batch* push-button and *STOP* LED. Legends displayed by the BA350B are shown within inverted commas e.g.. 'CLEAR' and ' DELAY'.

The functions of the push-buttons are:

Start Causes one or both of the outputs to be energised which will start the batch. The *Start* LED will remain illuminated until the batch is finished, or the *STOP* push-button is operated. If a start delay has been programmed, Output 1 will be energised immediately the *Start* button is pushed, followed by Output 2 after the start delay time.

STOP Operating this button during a batch immediately de-energises both Output 1 and Output 2 causing the batch to pause. During a pause any input signal continues to be counted, the *Start* LED is extinguished and the *Stop* LED flashes to indicate that the batch is not complete.
The batch may be resumed at any time by pressing the *Start* button. If a start delay has been programmed, Output 1 will be energised immediately the *Start* button is pushed, followed by Output 2 after the start delay time. At the end of each batch Output 1 and Output 2 will be de-energised, the *Start* LED extinguished and the *STOP* LED continuously illuminated.

Special case: When overrun compensation is enabled, Output 1 may be de-energised before the batch setpoint is reached to compensate for measured delays in the process. If a pause is initiated by pressing the *STOP* button near to the end of the batch, and process delays cause the calculated setpoint to be exceeded, pressing the *Start* button will not resume the batch.

Reset After completion of a batch the display must be reset before the next batch can be started, unless automatic reset or restart have been selected - see automatic reset and restart notes at the end of this section. The display may also be reset whilst the controller is in the pause mode resulting from the *STOP* button being operated during a batch. After resetting the display the *Reset* and the *STOP* LED's are continuously illuminated. Whilst reset the batch controller ignores input signals until the *Start* button is pressed to initiate the next batch.

Batch This button has two functions: when pressed and held the display initially shows the programmed batch setpoint for three seconds, followed by the grand total.

Rate This button toggles the display between the current batch total and the current input rate. The LED above the button is illuminated when rate is being displayed.

NOTE: Two software selectable options modify the function of these push-buttons:

Automatic reset eliminates the need to manually reset the BA350B at the end of each batch. The *Stop* LED is illuminated at the end of the batch and it is only necessary to press the *Start* button to initiate the next batch - see section 9.3.9

Automatic restart on completion of a batch and following a programmable time delay, the display is reset and the next batch started automatically. This sequence continues until the *STOP* button is operated - see section 9.3.10

4.2.1 Adjusting the batch setpoint

The batch setpoint can only be adjusted when level 2 or 3 access has been selected - see section 9.1

To prevent accidental selection of a dangerously high setpoint, a programmable setpoint limit 'SP LIMIT' is included above which the batch setpoint can not be adjusted - see section 9.4.2 When the batch parameter menu is selected, 'SP LIMIT' will be displayed first if the batch setpoint limit is 'OFF'..

Note: Outputs 1 and 2 can not be energised if the batch setpoint limit is zero.

To select the batch parameter programme menu press the *Prog* and *Batch* push-buttons simultaneously until the display shows 'SETPOINT' and the *Prog* and *Batch* LED's are illuminated. If the setpoint limit is off, 'SP LIMIT' will be displayed first as a reminder that no limit has been programmed, either a limit may be entered or the programme scrolled to 'SETPOINT' by operating the *Up* button.

When 'SETPOINT' is displayed press *Ent* and the existing batch setpoint will be displayed with the most significant left hand digit flashing to show that this may be adjusted by pressing the *Up* or *Down* button. When set to the required figure, or if no adjustment of this digit is required, press *Ent* to move to the next digit. Adjust each digit in turn until all have been set to the required figures and then return to the operating mode by pressing *Prog* twice. Fig 19 shows this procedure diagrammatically.

The setpoint can not be adjusted above the setpoint limit. If the setpoint limit is reduced to a value below the programmed setpoint the setpoint will automatically be reduced.

4.3 Operation as a totaliser

Both versions of the BA350B may be used for totalising and rate indicating applications when the batch control functions are not required. To simplify operation for these applications, the batch control functions and the *Start* & *STOP* push-buttons may be inhibited by one programme command.

When programmed as a totaliser, operation of the *Reset*, *Rate* and *Batch* push-buttons is acknowledged by a red LED located immediately above each button. An additional red LED indicates when the instrument is in the programming mode. The LED's indicating the status of the two output relays are inhibited.

When programmed as a totaliser the function of the push-buttons are:

Start No function

STOP No function

Reset This push-button resets the display to zero. The reset LED will remain illuminated until the next input pulse is received when totalising will begin again. Operating the *Reset* button does not reset the grand total. Input pulses are ignored while the *Reset* push-button is pressed.

Batch When pushed the display will show 'NO LIMIT' for approximately three seconds followed by the grand total.

Rate This button toggles the display between the current total and the current input rate. The LED above the button is illuminated when the rate is being displayed.

5. INTRINSIC SAFETY CERTIFICATION

This section should be read before designing a system incorporating a BA350B.

There are two versions of the BA350B batch controller. The BA350BP accepts pulse signals from a wide range of transducers including certified 2-wire proximity detectors, magnetic pick-ups, switch contacts, open-collector transistors and voltage pulse signals. The BA350BC has a galvanically isolated analogue input which may be connected in series with most certified intrinsically safe 4/20mA linear or square law current loops. Apart from the safety description of the input terminals, all other functions and safety features are the same for both versions.

The BA350BP (pulse input) and the BA350BC (4/20mA input) have been certified intrinsically safe by BASEEFA to BS5501:Part 1:1977 EN50 014 and BS5501:Part 7:1977 EN50 020. The instruments bear the Community Mark and, subject to local Codes of Practice, may be installed in any of the CENELEC member countries, i.e.. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. This manual describes installations which conform with the UK Code of Practice BS5345:Part 5:1977. When designing systems for installations outside the UK the local code of practice should be consulted.

Copies of the BASEEFA apparatus certificate Ex94C2249 and the system certificates Ex94C2250 and Ex94C2251 are available from BEKA Associates.

5.1 Apparatus certificate

The BA350BP (pulse input) and the BA350BC (4/20mA input) have been certified EEx ia IIC T5 which allows them to be installed in:

Zone 0	Explosive gas-air mixture continuously present.
Zone 1	Explosive gas-air mixture likely to occur in normal operation.
Zone 2	Explosive gas-air mixture not likely to occur and if it does, will only exist for a short time.

To be used with gases or vapours in gas groups:

Group IIA	Propane
Group IIB	Ethylene
Group IIC	Hydrogen

Having a temperature classification of:

T1	450°C
T2	300°C
T3	200°C
T4	135°C
T5	100°C

This allows both versions of the BA350B to be installed in all Zones and to be used with most common industrial gases.

5.2 System Certificates

There are two BASEEFA system certificates. One defines how the BA350BP and the BA350BC may be used with Zener barriers and the other with galvanic isolators. Both are divided into two sections to cover input signal sources in the safe and in the hazardous area.

Certificate No		Input location	BEKA drawing
Zener barriers			
Ex94C2250	System A	safe	CI350-03
	System B	haz	CI350-02
Galvanic isolators			
Ex94C2251	System C	safe	CI350-05
	System D	haz	CI350-04

The following two sections of this manual interpret these system certificates and illustrate how to design systems for pulse and 4/20mA inputs using both Zener barriers and galvanic isolators.

The system certificates specify the safety description of Zener barriers and the manufacturers model number of galvanic isolators which may be used. These certificates are occasionally updated to include new devices, and the latest issue should be consulted before designing a system.

5.3 Use with Zener barriers

Zener barriers are the least expensive intrinsically safe interface between a safe and a hazardous area. However they do not provide isolation and require a high integrity earth connection which may be expensive to install.
For a single BA350B It is often less expensive and complicated to use galvanic isolators when a high integrity earth connection is not already available.

The BASEEFA system certificates specify the maximum safety description of the Zener barriers, so any certified device complying with these requirements may be used. Only 'special' barriers, such as those incorporating a diode return channel, are identified by a manufacturers type number.

Fig 4 shows the basic circuit which is used for all BA350B installations using Zener barriers. In this illustration the two control outputs and the three auxiliary outputs are used, but any may be omitted if not required. Similarly, the remote switches may be omitted if they are not required.

5.3.1 Power supply

The BA350B may be powered via any certified 28V 300Ω Zener barrier. Normally a positive polarity barrier is used so that the negative supply (terminal 2 of the BA350B) is connected to the barrier earth busbar.
The minimum operating voltage of the BA350B is 10V, and the maximum current consumption at 10V is 30mA. The end-to-end resistance of the Zener barrier must be considered when calculating the minimum permissible power supply voltage.

Min supply = (Barrier resistance x 0.030)+10

Most 28V 300Ω barriers have a maximum end-to-end resistance of approximately 340Ω which results in an absolute minimum permissible supply voltage of 20.2V. The maximum permissible supply voltage is determined by the maximum operating voltage of the Zener barrier. This will depend upon the type and manufacturer, but is usually about 26.5V. As the permissible supply voltage range is fairly narrow a regulated dc power supply is recommended.

5.3.2 Control & auxiliary outputs

The two control and the three auxiliary outputs are all identical optically isolated open collector transistors protected by 51Ω series resistors and 33V Zener diodes. Each is segregated and has been certified as a separate intrinsically safe circuit with a safety description complying with the requirements for 'simple apparatus'. Any 28V 300Ω Zener barrier or a specified 28V 300 Ω diode return barrier may be connect to each output, providing that all have the same polarity as the power supply barrier.

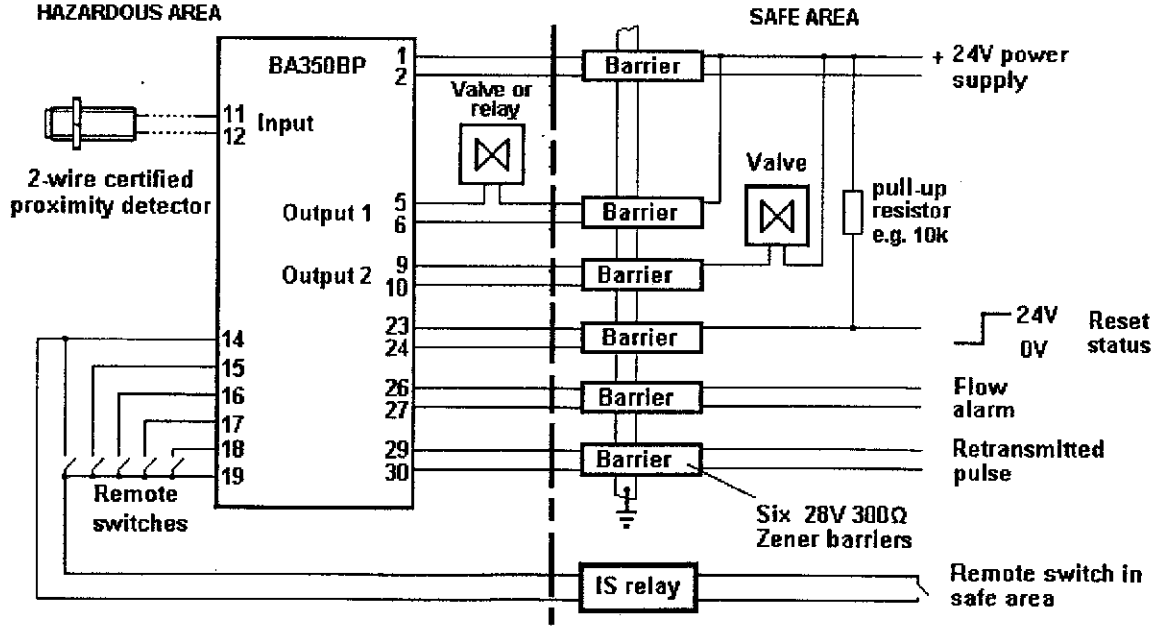


Fig 4 Proximity detector in hazardous area using Zener barriers

Because each output is isolated and complies with the requirements for simple apparatus, any device, such as an intrinsically safe solenoid valve, which has been certified for use with a 28V 300Ω Zener barrier may be connected directly to a BA350B output within the hazardous area. Fig 4 shows output 1 of a BA350B controlling a certified intrinsically safe solenoid valve mounted within the hazardous area.

Any load may be connected to the safe area terminals of the Zener barrier. For connection to equipment which requires a logic voltage signal, such as a PLC, a pull-up resistor will normally be required. Fig 4 shows a 10k pull-up resistor connected to the reset status output which converts the BA350B open collector output to a 24V digital signal.

5.3.3 Remote switches

The BA350B may be operated via the front panel push-buttons, remote switches, or the serial communications port. The six terminals for connection to the remote switches are not galvanically isolated and the switches must be located in the hazardous area or transferred from the safe area via one of the intrinsically safe relays specified on the system certificate. Zener barriers must not be connected to BA350B remote switch terminals.

When located in the hazardous area the remote switches must be mechanically activated and the contacts and associated cables must be able to withstand a 500V rms test voltage to earth for one minute.

Fig 4 also illustrates how the BA350B can be controlled from remote switches in the hazardous area, and/or from remote safe area switches via specified intrinsically safe relays.

5.3.4 2-wire proximity detector input

Any of the certified 2-wire proximity detectors specified on the system certificates may be connected directly to the BA350BP input terminals as shown in Fig 4.
When conditioned for use with a proximity detector, the output from photo-transistors can also be counted if the transistor complies with the requirements for 'simple apparatus' defined in clause 1.3 of EN 50 014.

If the proximity detector is located in the safe area, an additional 10V 50Ω Zener barrier must be connected between the detector and the BA350BP as shown in Fig 5. This barrier must have the same polarity as the power supply and output barriers. Any 2-wire certified or uncertified proximity detector which complies with the NAMUR standard may be used.

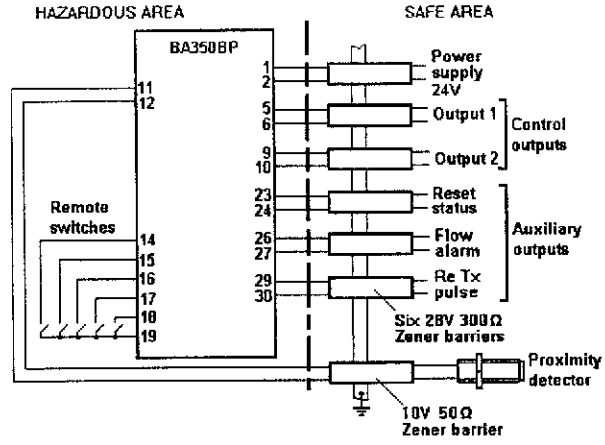


Fig 5 Proximity detector in safe area using Zener barriers

5.3.5 Voltage-free contact input

A voltage free contact located in the hazardous area may be connected directly to the input of the BA350BP. The contact and wiring must be able to withstand a 500V rms test voltage to earth for one minute, and must be mechanically activated. If the contact is located in the safe area, an additional 10V 50Ω Zener barrier with the same polarity as the power supply and output barriers is required. Both configurations are illustrated in Fig 6.

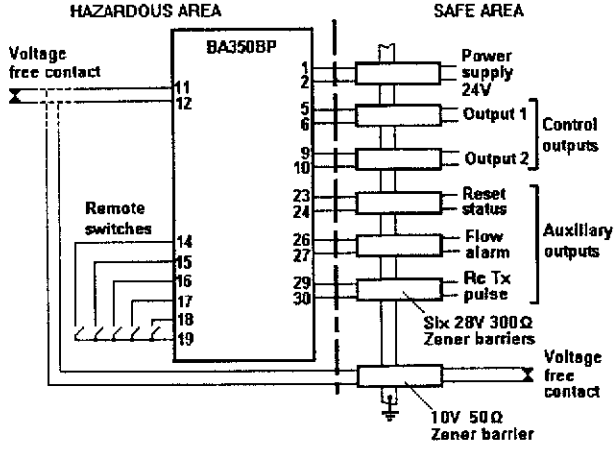


Fig 6 Voltage free-contact input using Zener barriers

5.3.6 Voltage pulse input

Any of the certified magnetic pick-ups specified on the system certificates and those complying with the requirements for 'Simple Apparatus' may be directly connected to the BA350BP input terminals.

The output from certified voltage producing devices which do not comply with these requirements must be returned to the safe area, and then retransmitted back into the hazardous area via a 28V 300Ω Zener barrier for connection to the BA350BP as shown in Fig 7. This circuit may also be used to connect voltage pulse signals generated in the safe area to the BA350BP.

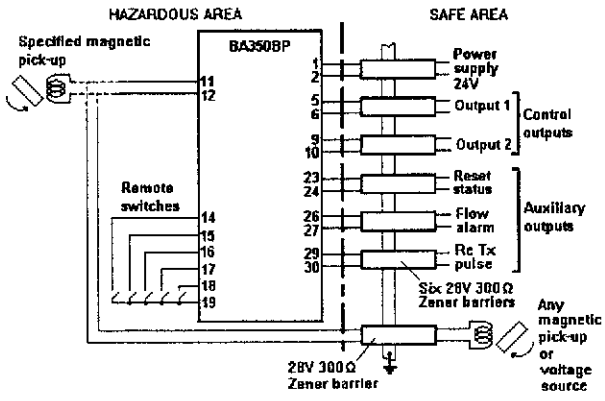


Fig 7 Voltage pulse input using Zener barriers

5.3.7 4/20mA input

The input terminals of the BA350BC are galvanically isolated and comply with the requirements for 'simple apparatus' defined in clause 1.3 of EN50 014. These input terminals may therefore be connected in series with any certified intrinsically safe 4/20mA current loop which is powered by a Zener barrier or galvanic isolator having a safety description equal to or less than 28V; 159mA; 0.8W. These requirements are not restrictive and allow the BA350BC input to be connected in series with most intrinsically safe 4/20mA current loops without the need for additional certification as shown in Fig 8.

Fig 9 shows how a 4/20mA signal generated in the safe area can be transferred to a BA350BC in the hazardous area. Any certified single channel 28V 300Ω Zener barrier or one of the diode return barriers specified on the system certificate may be used. This barrier must have the same polarity as the barrier used to power the BA350BC.

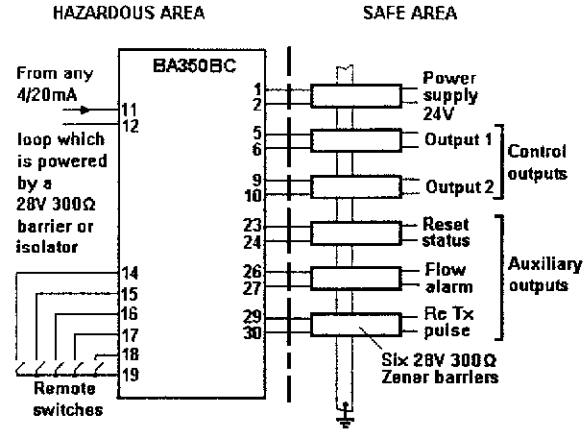


Fig 8 4/20mA input in hazardous area using Zener barriers

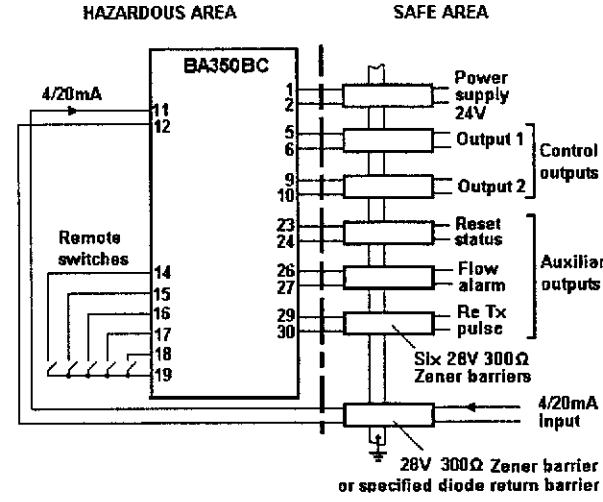


Fig 9 4/20mA input in safe area using Zener barriers

5.4 Use with galvanic isolators

Although intrinsically safe galvanic isolators are more expensive than Zener barriers, they do not require a high integrity earth connection, and are often easier to apply for small systems. Unlike Zener barriers, only the devices specified in the BASEEFA system certificates may be used .

Fig 10 shows the basic circuit which is used for all installations using galvanic isolators. In this illustration the two control outputs and the three auxiliary outputs are used, but any output may be omitted if not required. Similarly, the remote switches may be omitted if they are not required.

5.4.1 Power supply

The system certificates list a wide range of galvanic isolators which may be used to power the BA350B. These isolators were designed to power hazardous area loads such as a solenoid valve, and some incorporate additional terminals which must be joined to activate the output.
24V dc and mains powered devices are included.

5.4.2 Control & auxiliary outputs

The two control and the three auxiliary outputs are all identical optically isolated open collector transistors each protected by a 51Ω series resistor. Each output is a separate intrinsically safe circuit which can control a certified hazardous load such as a lamp, or any safe area load. Fig 10 illustrates both applications.

When a hazardous area load is to be controlled a solenoid driver galvanic isolator should be selected from the types specified on the BA350B system certificate. The system certificate for the hazardous area load should also specify the chosen isolator. Output 1 in Fig 10 is connected in this way.

If a safe area load is to be controlled, a switch transfer galvanic isolator should be selected from those specified on the BA350B system certificate. These isolators repeat the status of a hazardous area switch (a BA350B output) in the safe area, where it may be used to control any load. Output 2 in Fig 10 is connected in this way.

Again 24V dc and mains powered devices are specified on the system certificates.

5.4.3 Remote switches

The BA350B may be operated via the front panel push-buttons, remote switches, or the serial communications port. The remote switches must be located in the hazardous area or transferred from the safe area via one of the intrinsically safe relays specified in the system certificate.

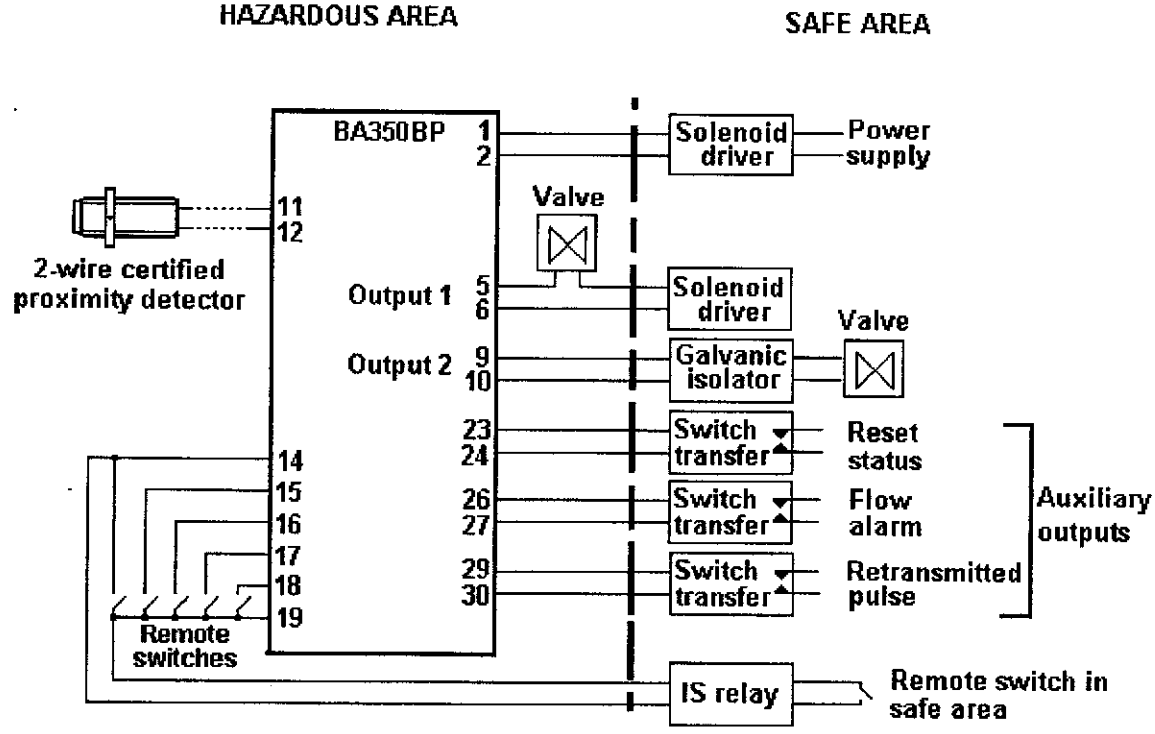


Fig 10 Proximity detector in hazardous area using galvanic isolators

When located in the hazardous area the remote switches must be mechanically activated and the contacts and associated cables must be able to withstand a 500V rms voltage to earth for one minute.

Fig 10 illustrates the use of remote switches in both the safe and hazardous area.

5.4.4 2-wire proximity detector input

Any of the certified 2-wire proximity detectors specified on the system certificates may be connected to the BA350BP input terminals. Fig 10 shows a typical installation.

When conditioned for use with a proximity detector, the output from photo-transistors can also be counted if the transistor complies with the requirements for 'simple apparatus' defined in clause 1.3 of EN 50 014.

5.4.5 Voltage-free contact input

A voltage free contact located in the hazardous area may be connected directly to the input of the BA350BP. The contact must be able to withstand a 500V rms voltage to earth for one minute, and must be mechanically activated.
If the contact is located in the safe area it may be connected to the BA350BP via one of the intrinsically safe relays specified in the system certificates. Fig 11 shows a typical application.

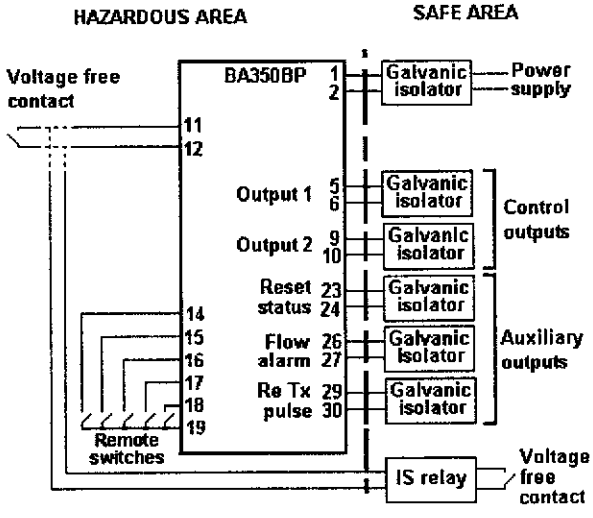


Fig 11 Voltage-free contact input using galvanic isolators

5.4.6 Voltage pulse input

Any of the certified magnetic pick-ups specified on the system certificates and those complying with the requirements of 'Simple Apparatus' may be directly connected to the BA350BP input terminals as shown in Fig 12.

The output from certified voltage producing devices which do not comply with these requirements must be returned to the safe area, and then retransmitted back into the hazardous area via a specified isolator.

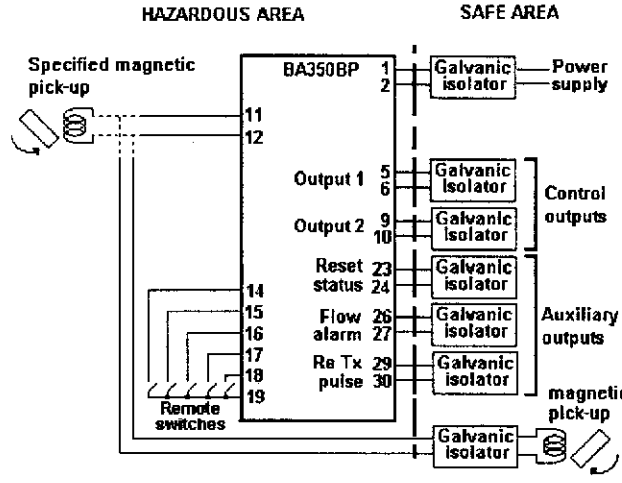


Fig 12 Voltage pulse input using galvanic isolators

5.4.7 4/20mA input

The input terminals of the BA350BC are galvanically isolated and comply with the requirements for 'simple apparatus' defined in clause 1.3 of EN50 014. These input terminals may therefore be connected in series with any certified intrinsically safe 4/20mA current loop which is powered by a galvanic isolator or a Zener barrier having a safety description equal to or less than 28V; 159mA; 0.8W. These requirements are not restrictive and allow the BA350BC input to be connected in series with most intrinsically safe 4/20mA current loops without the need for additional certification.

Fig 13 shows how a 4/20mA signal generated in the safe area can be transferred to a BA350BC located in a hazardous area using one of the current repeating galvanic isolators specified in the system certificates.

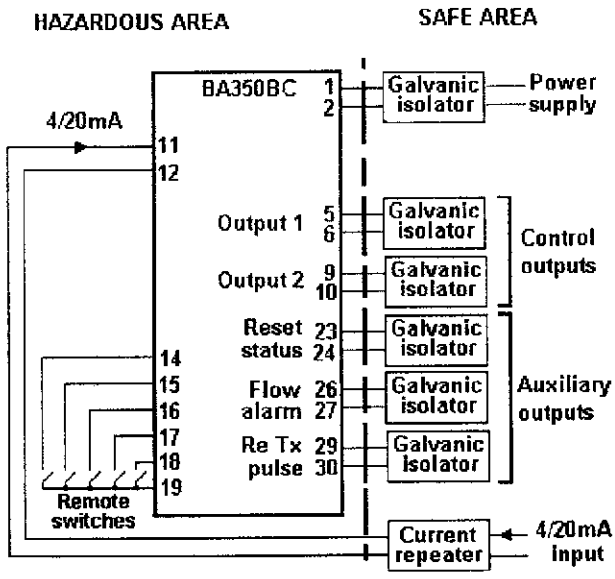


Fig 13 4/20mA input in safe area using galvanic isolators

5.5 Cables

The maximum permissible parameters for each cable are shown in the system certificates. For most installations they are not restrictive, but the permitted capacitance should be considered if cables longer than 150m are used in IIC gases.

Cables may be single twisted pairs, or multicore cables if they comply with the requirements for 'A' or 'B' cables defined in EN50 039. 'A' cables which do not have screens around each pair of wires must be secured and protected from mechanical damage.

See section 8.2 for recommendations regarding EMC susceptibility.

6. AUXILIARY OUTPUTS

In addition to the two control outputs both versions of the BA350B have three isolated auxiliary outputs. Each output is an open-collector NPN transistor protected by a 51Ω series resistor and a 33V Zener diode which can be connected to Zener barriers or galvanic isolators as described in section 5.

6.1 Retransmitted pulse

When enabled this output closes for 0.8ms each time the least significant digit of the grand total is incremented, allowing a remote instrument or counter to record the grand total in engineering units. The maximum output frequency is 500Hz. The retransmitted pulse output from a BA350BC (4/20mA input) may also be used to operate a remote counter.

Care should be taken to ensure that the capacitance and inductance of the line, and of the Zener barrier do not attenuate the retransmitted pulse. Similarly, galvanic isolators must be able to transmit a 0.8ms pulse.

6.2 Reset status

This output closes when the batch controller is reset, and opens when the *Start* button is operated. This output may be used to monitor the status of the batch controller or to count the number of batches completed.

When the batch controller is programmed as a totaliser the reset status output closes when the display is reset, and opens when the first input pulse is received.

6.3 Missing pulse detection (Flow alarm)

It should be noted that the missing pulse detection closes (energises) the solid state output in the alarm condition. i.e. it is not fail safe.

6.3.1 BA350BP (Pulse input)

The flow alarm output closes when the time between successive input pulses exceeds a programmed missing pulse time - see 9.3.5. A flow alarm also de-energises both Output 1 and Output 2 causing the batch to pause.

In the alarm condition the *Start* LED is extinguished, the *STOP* LED flashes and the BA350BP displays 'ALARM'. The alarm may be cleared by pushing any of the front panel buttons which will open the flow alarm output. The BA350BP will display 'CLEAR' until the button is released when the last batch total will be displayed.

After the flow alarm is cleared the batch may be resumed by operating the *Start* button, However, if input pulses are not received within the programmed missing pulse time the alarm will recur.

When programmed as a totaliser, the flow alarm output 'closes' if the time between successive input pulses exceeds the programmed missing pulse time. In the alarm condition the BA350BP display alternates between 'ALARM' and the selected display. The alarm is automatically cleared when the next input pulse arrives, but will recur if a second pulse is not received within the programmed missing pulse time.

When totalising continuous pulses with a period greater than the programmed missing pulse time, the flow alarm will be cleared for the missing pulse time after each input pulse is received.

6.3.2 BA350BC (4/20mA input)

The BA350BC converts a 4/20mA analogue input current into a 0 to 1kHz internal pulse signal. The flow alarm may be set to operate at any input current by calculating the equivalent missing pulse time in seconds from the formula shown below:

$$\text{Missing pulse time} = \frac{1}{62.5 \times (\text{Input current mA} - 4)}$$

Therefore:

$$\text{Input current mA} = \frac{1}{62.5 \times (\text{Missing pulse time})} + 4$$

7. REMOTE SWITCHES

For applications where large or remote push-buttons are required, control may be transferred to external push-buttons - see section 9.3.2. When remote switches are used, the front panel *Start*, *Reset* and *STOP* push-buttons may be inhibited or operated in parallel with the remote switches.

Any switch with a normally open contact that closes when pushed may be used. Although the remote switches are monitored with a 5V supply that will overcome most surface contaminating films, for industrial applications it is recommended that high quality switches with sealed contacts are used.

Providing that the remote switches are mechanically actuated and will withstand a 500V rms insulation test for one minute, they may be located within the hazardous area without any additional protection.

If remote switches are required in the safe area each switch status must be transferred to the BA350B via specified intrinsically safe relays - see sections 5.3.3 and 5.4.3.

Note: If the external switches are disconnected while the front panel push-buttons are inhibited, control can be re-established by briefly connecting terminals 31, 32 & 33 together. This connection automatically reprogrammes the BA350B to respond to the front panel push-buttons.

8. INSTALLATION

8.1 Location

The BA350B batch controller is housed in a 144 x 72mm panel mounting DIN enclosure which may be installed into any panel which does not cause the environmental limits shown in the specification, or the certification limits shown on the BASEEFA certificates to be exceeded.

The BA350B has an IP65 sealed front panel. If the installation requires that the joint between the instrument and the panel is also to be sealed, the panel cut-out must comply with the tighter tolerances shown in Fig 14, and the instrument should be secured with four panel mounting clips.

8.2 EMC Directive

The BA350B has been tested to prEN50 082-2:1992 (10V/m between 27 and 1,000MHz) and EN50 081-1:1992. A Declaration of Conformity with the European EMC Directive is available on request. To minimise susceptibility It is recommended that all input and output connections are made with screened twisted pairs, and that the cable screen is connected to the instrument enclosure terminal 21.

8.3 Input conditioning

8.3.1 BA350BP (pulse input)

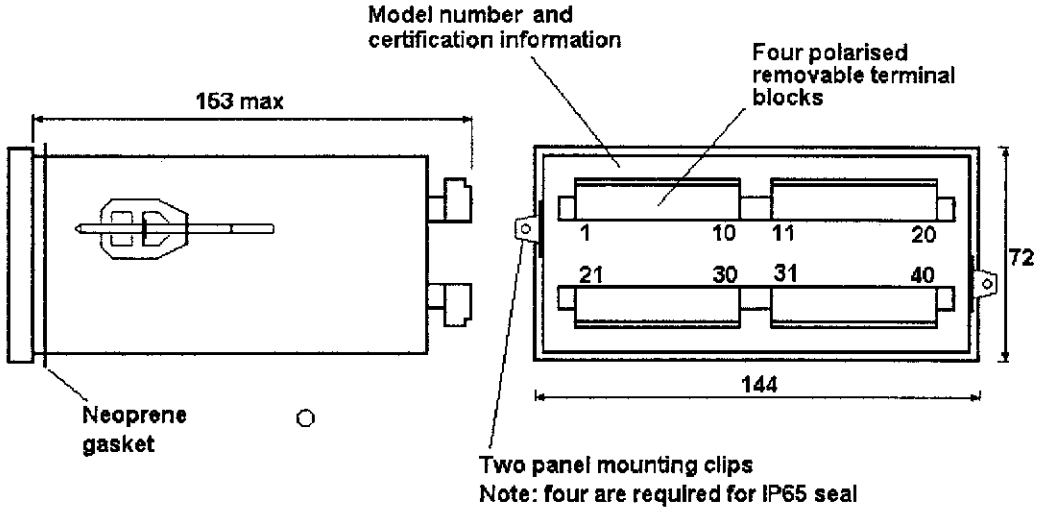
The BA350BP, which is fitted with a pulse input card, may be conditioned by an internal plug-in link to accept one of four types of input:

Input	Switching threshold
2-wire proximity detector	1.2 & 2.1mA
Voltage free contact	100 & 1,000Ω
High voltage pulse	1 & 3V
Low voltage pulse	10 & 30mV

Access to the conditioning link is gained by removing the rear panel of the BA350BP; the link positions are shown in Fig 15.

CAUTION

Before removing the BA350BP rear panel disconnect the 24V dc supply, and connections to the control and auxiliary outputs.



PANEL CUTOUT DIMENSIONS mm

For DIN 43 700					
138	+1.0 -0.0	X	68	+0.7 -0.0	
To achieve an IP65 seal between instrument and panel: four panel mounting clips required					
138	+0.5 -0.0	X	66.2	+0.5 -0.0	

Fig 14 Dimensions of BA350B and panel cutout

To remove the rear panel unscrew the four corner screws and gently pull the panel backwards taking care not to bend any of the connector pins. By using a pair of long nosed pliers the plug-in conditioning link can be repositioned without removing the instrument from the enclosure.
When refitting the rear panel care must be taken to align the connector pins before the panel is pushed into position.

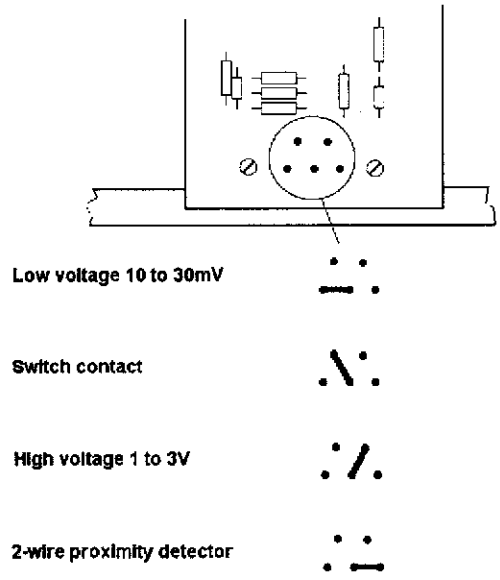


Fig 15 Location of BA350BP input conditioning links

8.3.2 BA350BC (4/20mA input)
The BA350BC, which is fitted with an analogue input card, only accepts a 4/20mA current so no input conditioning is required.

8.4 Installation procedure

a. Insert the BA350B into the panel aperture from the front ensuring that the sealing gasket is correctly positioned.

b. Clip two or four panel mounting clips to the enclosure and evenly tighten the screws until the instrument is held firmly in position.

Connections to the BA350B are made by four removable terminal blocks. Terminal numbers are shown in Figs 1, 2 and 16.

Note: Some of the terminals are interconnected within the instrument:

BA350BP (pulse input)
Terminals 2, 12, 19, and 31 interconnected

BA350BC (4/20mA input)
Terminals 2, 19 and 31 interconnected

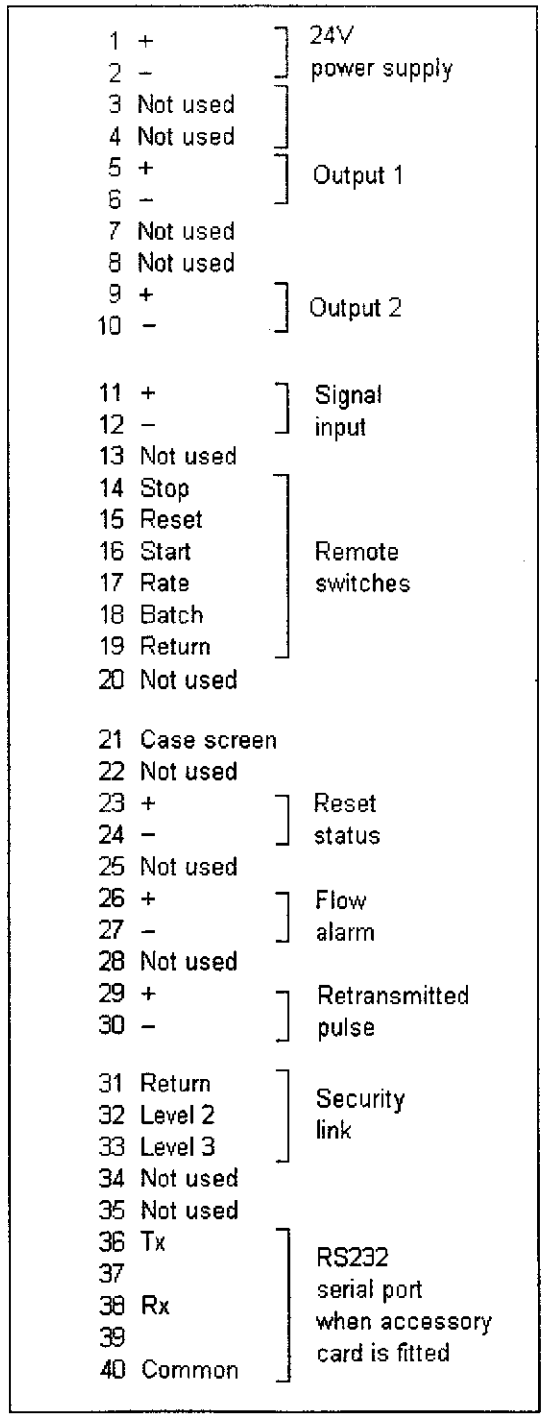


Fig 16 BA350BP & BA350BC terminal numbers

9. PROGRAMMING

9.1 Security

To prevent unauthorised or accidental access to the programme functions, three different levels of access may be selected by linking terminals on the rear panel.

Level	Link terminals	Access
1	None	No programme functions
2	31 & 32	Only batch setpoint
3	31 & 33	All programme functions

The selection can be made by fitting a wire link between the terminals, or where frequent changes are required, the terminals may be wired to a key operated switch located in the hazardous area.

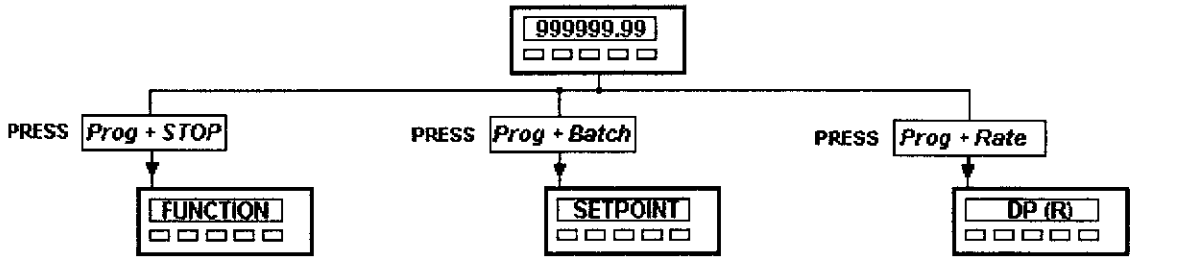
9.2 Programme structure

Conditioning and calibration of the BA350B is performed via the front panel push-buttons or remote switches when connected. For simplicity the adjustments are divided into three separate programme menus as shown in Fig 17.

Programme menu	Refer to
Mode parameters	section 9.3 & Fig 18
Batch parameters	section 9.4 & Fig 19
Rate parameters	section 9.5 & Fig 20

Access to each of the menus is gained by pressing *Prog* plus either the *STOP, Batch* or *Rate* push-buttons. Once within the selected menu the required parameter can be reached by scrolling the display using the *Up* or *Down* push-buttons.

The three programme menus are described in the following sections and are shown diagrammatically in Figs 18, 19 and 20. Each section of this manual starts with a brief summary of all the parameters within the menu cross referenced to full descriptions later in the section. This simple menu driven system enables most adjustments to be made without repeated reference to this manual.



Mode parameters - see Fig 18
FUNCTION Batcher or totaliser
CONTROL Local and/or remote control
RTX O/P Retransmitted output
ROOT EXT Square root extraction
TIMEOUT Missing pulse time
INHIBIT Flow alarm delay time *
S/COMMS Serial communication
UP/DOWN Direction of count *
AUTO RST Automatic reset *
AUTO-S Automatic restart *
OVERRUN Overrun compensation *
LANGUAGE Display language
TEST Display test

Batch parameters - see Fig 19
SETPOINT Setpoint *
SP LIMIT Setpoint limit *
DELAY Start delay time for Output 2 *
PRE-STOP Stop delay for Output 2 *
DP (T) Decimal point
SCALE (T) Batch scale factor
GRANDTOT **Grand total sub-menu**
VIEW HI 8 highest digits
VIEW LO 8 lowest digits
ZERO GT Zero grand total

Rate parameters - see Fig 20
DP (R) Decimal point
SCALE(R) Rate scale factor
TIMEBASE Display timebase
FILTER Rate display filter

Fig 17 Programme structure

9.3 Mode parameters see Fig 18

The mode parameters define the basic functions of the BA350B and should be programmed first. Each parameter is summarised below and cross referenced to a full description in a following section.

To access the mode parameter menu press the *Prog* and the *STOP* front panel push-buttons simultaneously. The display will show 'FUNCTION' which is the first parameter in the menu. Other parameters may be accessed by scrolling through the menu using the *Up* or *Down* push-buttons. After selecting the required parameter press *Ent* to reveal the current value or status.

The status of parameters can be changed by pressing the *Up* push-button which will toggle the display between the options. When the display shows the required option press *Prog* to return to the programme menu from which another parameter may be selected for adjustment, or the BA350B may be returned to the operating mode by pressing the *Prog* push-button a second time.

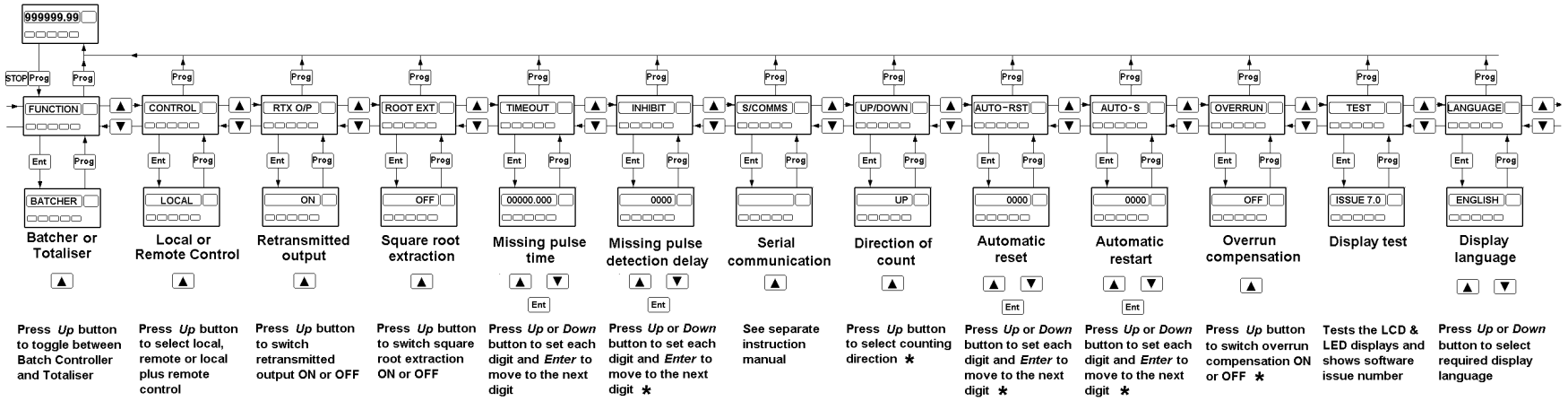
Parameters, such as the Missing Pulse Time, which require a number to be entered are initially displayed with one digit flashing indicating that this digit may be adjusted by pressing the *Up* or *Down* push-buttons. When this digit has been set to the required number, press *Ent* to adjust the next digit. When all the digits have been adjusted press *Prog* to return to the programme menu from which another parameter may be selected for adjustment, or the BA350B may be returned to the operating mode by pressing the *Prog* push-button a second time.

Fig 18 shows a diagrammatic representation of the mode parameter menu and the method of moving between the parameters.

SUMMARY OF MODE PARAMETERS

Parameter	Description
FUNCTION	**Function of BA350B** Conditions the BA350B as a batch controller and rate indicator or as a totaliser and rate indicator. When conditioned as a totaliser, parameters which only affect batch control are omitted from the mode and batch menus. See section 9.3.1
CONTROL	**Local or remote control** Determines whether the BA350B is controlled by the front panel push-buttons, by remote switches or by both the front panel push-buttons and the remote switches. See section 9.3.2
RTX O/P	**Retransmitted output** Turns the retransmitted pulse output 'ON' or 'OFF'. When 'ON' is selected, the auxiliary output closes for 0.8ms each time the least significant digit of the displayed total is incremented, or decremented when the batch controller is programmed to count down. See section 9.3.3
ROOT EXT	**Square root extraction** Turns the square root extraction for linearising the output from differential flowmeters 'ON' or 'OFF'. See section 9.3.4
TIMEOUT	**Missing pulse time (flow alarm)** When the time between successive input pulses exceeds the specified missing pulse time, the flow alarm 'closes'. See section 9.3.5
INHIBIT *	**Missing pulse time delay** Inhibits the missing pulse detection for a programmable time after the start of a batch. See section 9.3.6
S/COMMS	**Serial communication** Turns the serial communications port 'ON' or 'OFF'. Note: This function is only available when the optional serial communications board is fitted. See section 9.3.7
UP/DOWN *	**Direction of count** Determines whether the batch controller counts upwards from zero, or downwards from the batch setpoint. See section 9.3.8
AUTO RST *	**Automatic reset** Automatically resets the previous displayed batch count when the *Start* button is pushed to initiate another batch. See section 9.3.9
AUTO-S *	**Automatic restart** Automatically resets the displayed batch count and starts another batch a programmable time after completion of the previous batch. See section 9.3.10
OVERRUN *	**Overrun compensation** Measures and compensates for delays within the batching system. See section 9.3.11
LANGUAGE	**Display language** Selects English, French or German menu display. See section 9.3.12
TEST	**Display test routine** Checks that the display is functioning correctly and shows the software version number. See section 9.3.13

Note: Parameters marked with an * are only included in the menu when the FUNCTION parameter is set to 'BATCHER' which conditions the BA350B as a batch controller.



Parameters marked with an * are only included in the menu when FUNCTION is set to BATCHER

Fig 18 Mode parameter menu

9.3.1 Function of BA350B: FUNCTION

The BA350B may be conditioned as a batch controller and rate indicator or as a totaliser and rate indicator. When the totaliser function is selected, all the functions associated with batch control are disabled and the batch parameters are omitted from the mode and batch menus.
To define the function of the BA350B select 'FUNCTION' from the mode programming menu, and press *Ent* to reveal if the instrument is conditioned as a batch controller 'BATCHER' or as a totaliser 'TOTALISE'. If the function is correct press the *Prog* button to return to the menu, or press the *Up* button to change the function followed by the *Prog* button to return to the menu.

9.3.2 Local or remote control: CONTROL

The BA350B may be controlled by the five front panel push-buttons, by remote switches or by both the front panel push-buttons and the remote switches. Selection of remote control will inhibit the operation of the front panel *Start, Reset* and *STOP* push-buttons, but the *Batch* and *Rate* push-buttons will continue to function so that the batch setpoint, input rate and grand total display can be selected.

To choose the method of control select 'CONTROL' from the mode setting menu and press *Ent* to reveal the current setting.

Display	BA350B controlled by
'LOCAL'	Front panel push-buttons only
'REMOTE'	Remote switches only
'LOC+REM'	Front panel push-buttons and remote switches

To change the control setting press the *Up* button until the required display is obtained, followed by the *Prog* push-button to return to the mode parameter menu. The change will not be executed until the BA350B is returned to the operating mode.

When 'REMOTE' has been selected, local control may be re-established in the absence of remote switches by briefly linking terminals 31, 32 and 33 together which reprogrammes the instrument to 'LOC+REM'.

9.3.3 Retransmitted output: RTX O/P

The retransmitted output closes for 0.8ms each time the least significant digit of the displayed total is incremented when counting up, or decremented when counting down. The maximum output frequency is 625Hz.

To activate the retransmitted output select 'RTX O/P' from the mode parameter menu and press *Ent* to reveal if the option is 'ON' or 'OFF'. If the option is set as required press *Prog* to return to the menu, or press the *Up* button to change the option followed by the *Prog* button to return to the menu.

9.3.4 Square root extraction: ROOT EXT

This function is primarily intended for use with non-linear differential flowmeters which have a square law 4/20mA output. It may also be used with pulse inputs up to 1kHz. To prevent cumulative errors resulting from totalising the output of a flowmeter operating at very low flows, below 5% of full flow (4.04mA input) totalisation is inhibited and the rate display is zeroed.

To activate the square root extractor select 'ROOT EXT' from the mode parameter menu and press *Ent* to reveal if the option is 'ON' or 'OFF'. If the option is set as required press *Prog* to return to the main menu, or press the *Up* button to change the option followed by the *Prog* button to return to the menu.

9.3.5 Missing pulse detection: TIMEOUT (Flow alarm)

Missing pulse detection measures the time between successive input pulses and compares this with a pre-set time which is adjustable between 0.001 and 3600 seconds. When the time between input pulses exceeds the pre-set time, the flow alarm output will close, the BA350B will enter a pause condition and the display will show 'ALARM'.

To set the missing pulse time select 'TIMEOUT' from the mode parameter menu and press *Ent* to reveal the existing time which may be adjusted by pressing the *Up* or *Down* buttons. When set to the required time return to the main menu by pressing the *Prog* push-button.

Missing pulse detection may also be used with a BA350BC which has an analogue 4/20mA input. The flow alarm may be set to operate at any input current by calculating the equivalent missing pulse time in seconds from the formula shown below.

$$\text{Missing pulse time} = \frac{1}{62.5 \times (\text{Input current mA} - 4)}$$

If missing pulse detection is not required the missing pulse time should be set to 0.000. The display will oscillate between 'OFF' and '000.000' and missing pulse detection will be disabled.

See section 6.3 for additional information on missing pulse detection.

Note: *The solid state flow alarm output 'closes' in the alarm condition*

9.3.6 Missing pulse detection time delay: INHIBIT

(Batch controller only)

This function disables missing pulse detection for a programmable time after the start of a batch which prevents false alarms occurring while the system is accelerating.

The inhibit time during which the flow alarm is disabled may be adjusted between 1 and 3600 seconds in 1 second increments. If a delay is not required, the inhibit time should be set to 0.

To set the inhibit time select 'INHIBIT' from the mode parameter menu and press *Ent* to reveal the existing time which may be adjusted by pressing the *Up* or *Down* buttons. When set to the required time return to the main menu by pressing the *Prog* push-button.

9.3.7 Serial communication: S/COMMS

The serial communications port can only be activated when a serial communication board is installed within the BA350B.

To activate the serial communications port select 'S/COMMS' from the mode parameter menu and press *Ent* which will reveal if the option is 'ON' or 'OFF'. If the required option is selected press *Prog* to return to the main menu, or press the *Up* button to change the option followed by the *Prog* button to return to the menu.

Operation of the serial communications port is described in a separate manual.

9.3.8 Direction of count: UP/DOWN

(Batch controller only)

The direction of count determines whether the batch controller display counts upwards from zero to the batch setpoint, or downwards from the batch setpoint to zero.

To set the direction of count select 'UP/DOWN' from the mode parameter menu and press *Ent* to reveal the existing direction. If the direction is set as required press *Prog* to return to the main menu, or press the *Up* button to change the direction followed by the *Prog* button to return to the menu.

9.3.9 Automatic reset: AUTO RST

(Batch controller only)

The automatic reset option causes the displayed batch count from the previously completed batch to be automatically reset when the *Start* push-button is operated, reducing the number of push-button operations required to start a batch.

To activate automatic reset select 'AUTO RST' from the mode parameter menu and press *Ent* to reveal if the option is 'ON' or 'OFF'. If set as required press *Prog* to return to the main menu, or press the *Up* button to change the option followed by the *Prog* button to return to the menu.

9.3.10 Automatic restart: AUTO-S

(Batch controller only)

The automatic restart option causes the BA350B to start another batch without operator intervention, a programmable time after completion of the previous batch. The delay before the next batch starts may be adjusted between 1 and 3600 seconds in 1 second increments.

To set the automatic restart delay select 'AUTO-S' from the mode parameter menu and press *Ent* to reveal the existing time which may be adjusted by pressing the *Up* or *Down* buttons. When set to the required time return to the main menu by pressing the *Prog* push-button.

If automatic restart is not required set the delay time to 0. The display will oscillate between 'OFF' and '000' and automatic restart will be disabled.

9.3.11 Overrun compensation: OVERRUN
(Batch controller only)

Overrun compensation automatically corrects for time delays in the batching system which may cause product dispensing to continue after Output 1 has been de-energised.
When overrun compensation is selected, the average number of input pulses received after Output 1 is de-energised is calculated and automatically subtracted from the batch setpoint.
If missing pulse detection is 'ON', overrun pulses will be counted between the time Output 1 is de-energised and the time at which the input pulse interval exceeds the programmed missing pulse time. If missing pulse detection is 'OFF', overrun pulses will be counted from the time Output 1 is de-energised until the *Reset* push-button is operated.

To activate overrun compensation select 'OVERRUN' from the mode parameter menu and press *Ent* to reveal if the option is 'ON' or 'OFF'. If the option is set as required press *Prog* to return to the main menu, or press the *Up* button to change the option followed by the *Prog* button to return to the menu.

Note: *When root extraction is selected, up to 20 counts of overrun error may be caused by computation delays within the BA350B batch controller.*

9.3.12 Display language: LANGUAGE

The BA350B can display the programming menus and messages in English, French or German.

To change the display language, select 'LANGUAGE' from the mode parameter menu and press *Ent*. Pressing the *Up* push-button will scroll the display through the three options. When the required language has been selected press *Prog* twice to return to the operating mode, after which all menus will be displayed in the new language.

9.3.13 Display test: TEST

This function tests the eight digit alphanumeric display and the eight front panel LED indicators without changing any of the instrument outputs. During the test routine the issue number of the BA350B software is displayed.

To run the test routine select 'TEST' from the mode parameter menu and press *Ent*. To stop the routine press *Prog* which will return the display to the mode menu.

9.4 Batch parameters See Fig 19

The batch parameters define the operation of the batch control and totalising functions. When the BA350B is programmed as a totaliser batch control parameters are omitted from the menu.

To access the batch parameter menu the *Prog* and *Batch* front panel push-buttons should be pressed simultaneously.

When conditioned as a batch controller 'SETPOINT' will be the first parameter displayed unless the setpoint limit is off when 'SP LIMIT' will be displayed first. When programmed as a totaliser 'DP(T)' will always be displayed first. Other parameters may be accessed by scrolling through the menu using the *Up* or *Down* push-buttons.

After selecting the required parameter press *Ent* to reveal the current value or status. The status of parameters can be changed by pressing the *Up* push-button which will toggle the display between the options. When the display shows the required option press *Prog* to return to the programme menu from which another parameter may be selected for adjustment, or the BA350B may be returned to the operating mode by pressing the *Prog* push-button a second time.

Parameters which require a number to be entered are initially displayed with one digit flashing indicating that this digit may be adjusted by pressing the *Up* or *Down* push-buttons. When this digit has been set to the required value, press *Ent* to adjust the next digit. When all the digits have been adjusted press *Prog* to return to the programme menu from which another parameter may be selected for adjustment, or the BA350B may be returned to the operating mode by pressing the *Prog* push-button a second time.

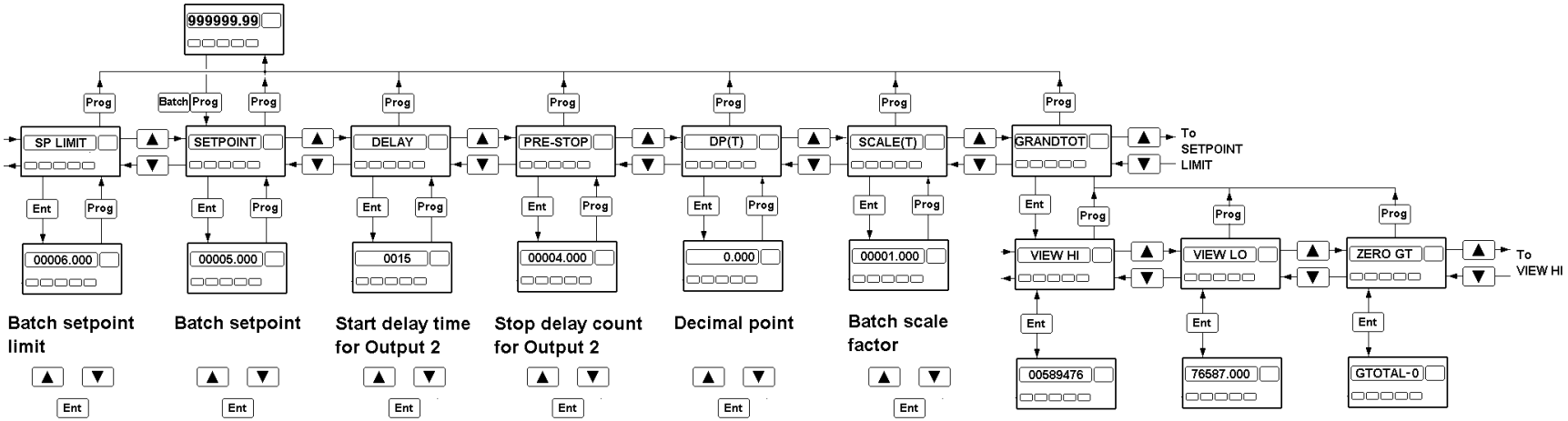
Fig 19 shows a diagrammatic representation of the batch parameter menu and the method of moving between the adjustments. Each parameter is summarised below and cross referenced to a full description in a following section.

SUMMARY OF BATCH PARAMETERS

Parameter	Description
SETPOINT	***Batch setpoint** The batch setpoint defines the size of the batch. When counting up, Output 1 is de-energised when the batch total equals the batch set-point. See section 9.4.1
SP LIMIT	***Setpoint limit** This parameter defines the maximum setpoint which may be entered. See section 9.4.2 **Note**: If setpoint limit is off it will be displayed before setpoint.
DELAY	***Start delay time for Output 2** Defines the time delay between Output 1 and Output 2 being energised at the start of a batch. See section 9.4.3
PRE-STOP	***Stop delay count for Output 2** Defines the number of counts before the end of the batch at which Output 2 is de-energised. See section 9.4.4
DP (T)	**Decimal point** This parameter defines the position of the dummy decimal point when the BA350B is displaying total. See section 9.4.5
SCALE(T)	**Batch scale factor** A dividing factor which defines the relationship between the number of input pulses received and the displayed total. Used to convert the input into engineering units. See section 9.4.6

Parameter	Description
GRANDTOT	**Grand total** Is the sum of all the batch totals and is not affected by the front panel *Reset* push-button. The grand total may be viewed as a sixteen digit number and may also be reset to zero. In the operating mode the grand total can be viewed in the form n.nnnnEnn by pressing and holding the *Batch* push-button. See section 9.4.7

Note: *Parameters marked with an * are only included in the menu when the BA350B is conditioned as a batch controller.*



Batch setpoint limit

Press *Up* or *Down* button to set each digit and *Enter* to move to the next digit *

Range
0 to 99999999

Batch setpoint

Press *Up* or *Down* button to set each digit and *Enter* to move to the next digit *

Range
0 to 99999999

Start delay time for Output 2

Press *Up* or *Down* button to set each digit and *Enter* to move to the next digit *

Range
0 to 3600

Stop delay count for Output 2

Press *Up* or *Down* button to set each digit and *Enter* to move to the next digit *

Range
0 to 99999999

Decimal point

Press *Up* or *Down* button to position the dummy decimal point

Batch scale factor

Press *Up* or *Down* button to set each digit and *Enter* to move to the next digit

Range
0.01 to 999999.99

View the upper 8 digits of the Grand Total

View the lower 8 digits of the Grand Total

Zero Grand Total

WARNING:
Figure can not be retrieved

Parameters marked with an * are only included in the menu when FUNCTION is set to BATCHER

Fig 19 Batch parameter menu

9.4.1 Batch setpoint: SETPOINT

(Batch controller only)

The batch setpoint is the batch total at which Output 1 is de-energised when counting up, and the display starting point when counting down. The batch setpoint may be adjusted between 0 and 99999999 or the setpoint limit 'SP LIMIT' if this has been programmed to a lower number.

To adjust the batch setpoint select 'SETPOINT' from the batch parameter menu and press *Ent* to reveal the existing number which may be adjusted by pressing the *Up* or *Down* buttons.

9.4.2 Batch setpoint limit: SP LIMIT

(Batch controller only)

To prevent accidental over-filling, the batch setpoint limit defines the maximum batch setpoint which may be entered.

To adjust the batch setpoint limit select 'SP LIMIT' from the batch parameter menu and press *Ent* to reveal the existing number which may be adjusted by pressing the *Up* or *Down* buttons.

If the batch setpoint limit is not required adjust the limit to 0. The display will oscillate between '0000000' and 'OFF' and the setpoint limit will be disabled.

9.4.3 Start delay time for Output 2: DELAY

(Batch controller only)

At the start of a batch, Output 1 is energised immediately the *Start* button is operated. Output 2 may be energised at the same time, or delayed by up to 3600 seconds.

To set the delay time select 'DELAY' from the batch parameter menu and press *Ent* to reveal the existing delay time in seconds which may be adjusted by pressing the *Up* or *Down* buttons.

When the delay time is set to zero both outputs are energised at the same time.

9.4.4 Stop delay count for Output 2 : PRE-STOP

(Batch controller only)

Output 1 is de-energised when the batch total equals the batch setpoint. Output 2 may be de-energised at the same time or a programmable number of display counts before the batch setpoint.

To set the number of display counts between de-energising of the two outputs select 'PRE-STOP' from the batch parameter menu and press *Ent* to reveal the existing number which may be adjusted by pressing the *Up* or *Down* buttons.

The pre-stop value remains fixed when the batch setpoint is adjusted, but can not be greater than the batch setpoint.

9.4.5 Decimal point: DP (T)

This parameter defines the position of the dummy decimal point when the BA350B is displaying the total. The dummy decimal point may be positioned between any of the eight digits or may be omitted.

To position the decimal point select 'DP (T)' from the batch parameter menu and press *Ent* to reveal the existing position which may be changed by pressing the *Up* or *Down* buttons.

Note: *If the Batch scale factor is changed the decimal point will not be automatically repositioned.*

9.4.6 Batch scale factor: SCALE(T)

The batch scale factor defines the relationship between the number of input pulses received and the total displayed by the BA350B. It is a dividing factor which is used to convert the number of input pulses into meaningful engineering units and may be adjusted between 0.01 and 999999.99

For a BA350BP (pulse input)

$$\text{SCALE(T)} = \frac{\text{Number of input pulses received}}{\text{Required total display}}$$

When calculating the batch scale factor the 'Required total display' must include all the digits on both sides of the displayed dummy decimal point, but the decimal point should not be included in the calculation. e.g. for a required total display of 500.0 enter 5000 in the formula.

The following table illustrates how the scale factor changes depending upon the display resolution required.

Required display after 1000 input pulses have been received	Scale factor
20	50.00
20.0	5.00
20.00	0.50

For a BA350BC (4/20mA input)
The BA350BC converts the 4/20mA analogue input current into an internal 0 to 1000Hz pulse signal which is counted and scaled to provide the total display. To calculate the scale factor it is therefore necessary to specify the required display after 1 second with a 20mA input.

When calculating the batch scale factor the 'Display after 1 second with a 20mA input' must include all the digits on both sides of the displayed dummy decimal point, but the decimal point should not be included in the calculation. e.g. for a required display of 500.0 after 1 second enter 5000 in the formula.

$$\text{SCALE(T)} = \frac{1000}{\text{Display after 1s with 20mA input}}$$

To adjust the batch scale factor select 'SCALE(T)' from the batch parameter menu and press *Ent* to reveal the existing dividing factor which may be changed by pressing the *Up* or *Down* buttons.

9.4.7 Grand total: GRANDTOT
The grand total is stored in a separate counter which is not zeroed by the front panel *Reset* push-button. This counter contains the total of all batches which have been dispensed, or when programmed as a totaliser, the absolute total ignoring resets.

In the operating mode the grand total can be viewed at any time by pressing and holding the *Batch* push-button. For figures up to 99999999 the grand total is displayed with a decimal point in the same position selected for the batch total display - see 9.4.5 & 9.4.6. Above 99999999 the display changes to an exponent form, n.nnnnEnn which is equivalent to n.nnnn x 10^{nn} and retains the significance of the decimal point.

The maximum capacity of the grand total register is 2.814 x 10^{14}. When a decimal point is specified for the batch total display the maximum grand total is reduced to 2.814 x $10^{(14-N)}$ where N is the number of digits on the right hand side of the decimal point.

In the programming mode the grand total can be read to sixteen significant figures and if required reset to zero. To access the grand total counter select 'GRANDTOT' from the batch parameter menu and press *Ent* which will reveal a sub-menu with three options.

The grand total counter is divided into two eight digit numbers. To view the most significant eight digits select 'VIEW HI' from the sub-menu and press and hold the *Ent* button to reveal the number. To view the least significant eight digits select 'VIEW LO' and again press and hold *Ent.* Viewing the grand total register does not change the contents.

To zero the Grand total register select 'ZERO GT' from the sub-menu, and press the *Ent* button to reset the grand total register to zero.

CAUTION
After zeroing, the old grand total can not be recovered

9.5 Rate parameters See Fig 20

To access the rate parameter programming menu the *Prog* and *Rate* front panel push-buttons should be pressed simultaneously. The display will show 'SCALE(R)' which is the rate scale factor, other parameters may be accessed by scrolling through the menu using the *Up* or *Down* push-buttons. After selecting the required parameter press *Ent* to reveal the current value or status.

The status of parameters can be changed by pressing the *Up* push-button which will toggle the display between the options. When the display shows the required option press *Prog* to return to the programme menu from which another parameter may be selected for adjustment, or the BA350B may be returned to the operating mode by pressing the *Prog* push-button a second time.

Parameters which require a number to be entered are initially displayed with one digit flashing indicating that this digit may be adjusted by pressing the *Up* or *Down* push-buttons. When this digit has been set to the required number, press *Ent* to adjust the next digit. When all the digits have been adjusted press *Prog* to return to the programme menu from which another parameter may be selected for adjustment, or the BA350B may be returned to the operating mode by pressing the *Prog* push-button a second time.

Fig 20 shows a diagrammatic representation of the rate parameter menu and the method of moving between the adjustments. Each parameter is summarised below and cross referenced to a full description in a following section.

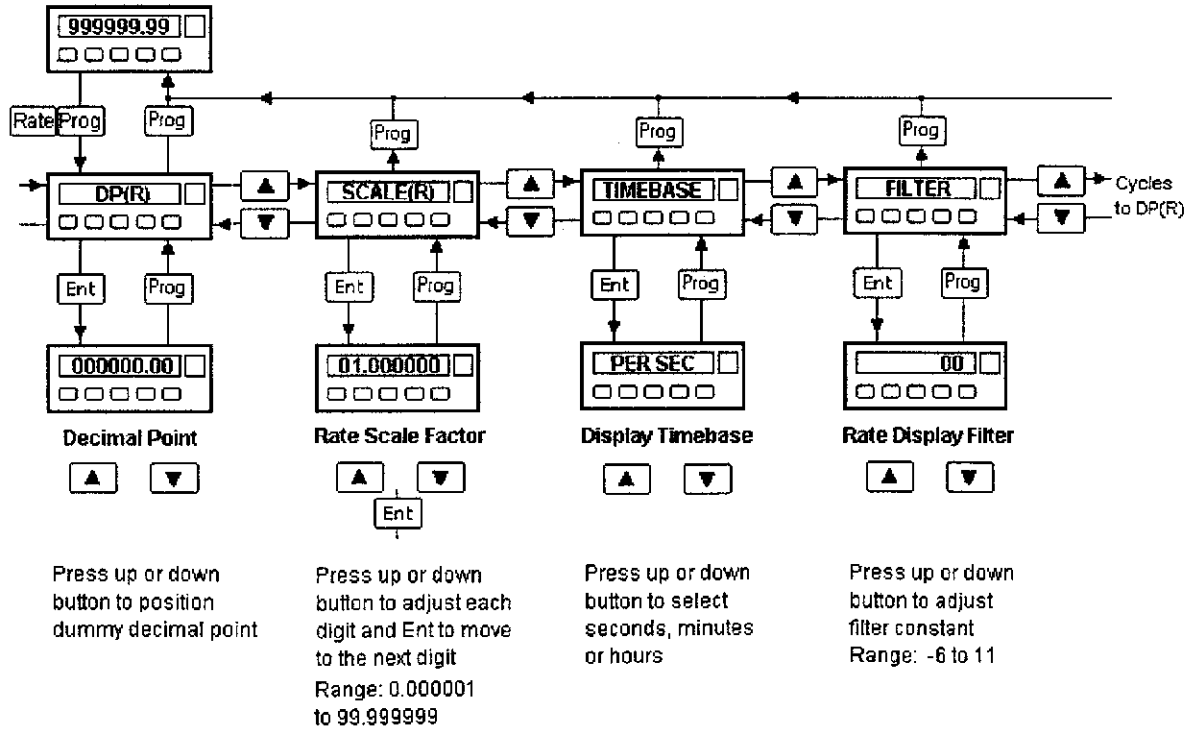


Fig 20 Rate parameter menu

SUMMARY OF RATE PARAMETERS

Parameter	Description
DP (R)	**Decimal point** This parameter defines the position of the dummy decimal point when the BA350B is displaying rate. See section 9.5.1
SCALE(R)	**Rate scale factor** A multiplying factor which defines the relationship between the input frequency and the displayed input rate per second. See section 9.5.2
TIMEBASE	**Display timebase** Additional multiplying factors which determine whether the rate is displayed in engineering units per second, minute or hour. See section 9.5.3
FILTER	**Rate display filter** This parameter adjusts the amount of filtering applied to the rate display. See section 9.5.4

9.5.1 Decimal point: DP (R)

This parameter defines the position of the dummy decimal point when the BA350B is displaying rate. The decimal point may be positioned between any of the eight digits or may be omitted. To position the decimal point select 'DP (R)' from the rate parameter menu and press *Ent* to reveal the existing position which may be changed by pressing the *Up* or *Down* button.

Note: *If the Rate scale factor or the Timebase are changed the decimal point will not be automatically repositioned.*

9.5.2 Rate scale factor: SCALE(R)

The rate scale factor defines the relationship between the input pulse frequency and the rate displayed by the BA350B. It is a multiplying factor used to convert the input frequency into a meaningful rate in engineering units per second and may be adjusted between 0.000001 and 99.999999

The rate may also be displayed per minute or per hour using the additional TIMEBASE multiplying factors which are described in section 9.5.3

BA350BP (Pulse input)

$$\text{SCALE(R)} = \frac{\text{Required rate display per sec}}{\text{Number of input pulses per sec}}$$

When calculating the rate scale factor the 'Required rate display per second' must include all the digits on both sides of the displayed decimal point, but the decimal point should not be included in the calculation. e.g.. if the required rate display per second is 60.00 enter 6000 in the formula. The following table illustrates how the scale factor changes depending upon the display resolution required.

Required rate display per second with an input of 120 pulses per second	Scale factor
3	00.025000
3.0	00.250000
3.00	02.500000

BA350BC (4/20mA input)
The BA350BC converts the analogue input current into an internal 0 to 1000Hz pulse signal which is scaled to provide the rate display. For a BA350BC the formula to calculate the rate scale factor becomes:

$$\text{SCALE(R)} = \frac{\text{Required rate display per second at 20mA}}{1000}$$

When calculating the rate scale factor the 'Required rate display per second at 20mA' must include all the digits on both sides of the displayed decimal point, but the decimal point must not be included in the calculation. e.g.. if the required rate display per second is 37.0 with a 20mA input , enter 370 in the formula.

Note: *To minimise the affects of temperature drift within the BA350B, it is recommended that the rate scale factor for a BA350BC (4/20mA input), is limited to about 5.*

To adjust the rate scale factor select 'SCALE(R)' from the rate parameter menu and press *Ent* to reveal the existing factor which may be adjusted by pressing the *Up* or *Down* push-buttons.

9.5.3 Display timebase: TIMEBASE
The rate scale factor described in the previous section defines the relationship between the input pulse frequency and the rate display in Hz (Cycles per second). The display timebase provides additional multiplying factors of 60 and 3600 so that the rate can be displayed in engineering units per minute or per hour.

To change the display timebase select 'TIMEBASE' from the rate parameter menu and press *Ent* to reveal the existing setting which may be changed by pressing the *Up* or *Down* buttons.

Note: *Changing the timebase does not automatically change the position of the displayed dummy decimal point which must be manually positioned to suit the timebase selected - see section 9.5.1*

9.5.4 Rate display filter: FILTER
The BA350B contains an adjustable rate display filter to reduce noise and provide a stable rate display. The amount of filtering required, which will depend upon the application, is controlled by a filter constant entered during programming. The filter constant is adjustable in integers between -6 and +11 with a default of 0. Minus 6 provides no filtering and plus 11 maximum filtering.

To adjust the filter constant, select 'FILTER' from the rate parameter menu and press *Ent* to reveal the existing number. If more filtering is required increment the number by pressing the *Up* button; if less filtering is required decrement the number by pressing the *Down* button.

10. APPLICATIONS

This section contains examples of how the BA350B may be used as both a batch controller and a totaliser.

10.1 Use as a totaliser & rate indicator

The BA350BP (pulse input) may be programmed to count the number of input pulses and display the total in engineering units, and to display the input pulse rate (frequency) in the same or different units.

EXAMPLE 1

For the application shown in Fig 21 the BA350BP is used as a totaliser to display the speed and total number of components printed by an inkjet printer using a flammable ink. Each completed component is detected by an intrinsically safe 2-wire proximity detector.

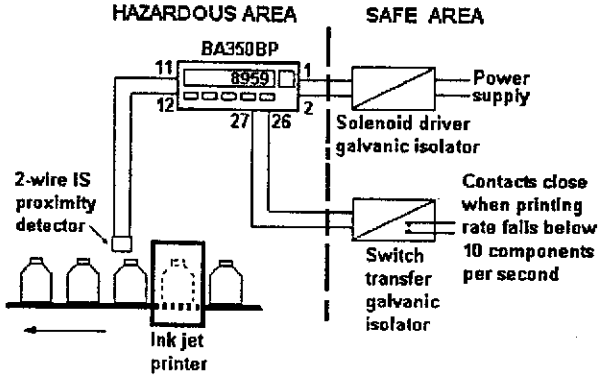


Fig 21 BA350BP counting number of components printed in hazardous area

Although more expensive than Zener barriers, galvanic isolators have been chosen for this application because they do not require a high integrity earth which can be prohibitively expensive for small installations.

The BA350BP is required to:

Be mounted in hazardous area

Count and display the total number of components printed.

Display the rate of printing per hour.

Initiate an alarm when output falls below ten components per second

Input conditioning see 8.2.1

Put internal plug-in link in 2-wire proximity detector position.

Programming

Mode Parameters

FUNCTION see 9.3.1 — select 'TOTALISE'

CONTROL see 9.3.2 — select 'LOCAL'

RTX O/P see 9.3.3 — select 'OFF'

ROOT EXT see 9.3.4 — select 'OFF'

TIMEOUT see 9.3.5 — set to 0000.100

Flow alarm is required to operate when printing rate falls below 10 components per second i.e. when time between components exceeds 0.1 seconds.

S/COMMS see 9.3.7 — Ignore, serial communications card not installed.

LANGUAGE see 9.3.12 — select 'ENGLISH'

Batch Parameters

DP (T) see 9.4.5 — select no point

SCALE(T) see 9.4.6 — set to 000001.00

SCALE(T)

$$= \frac{\text{Number of pulses received}}{\text{Required total display}}$$

$$= \frac{1}{1} = 1$$

Rate Parameters

DP (R) select no point
see 9.5.1

SCALE(R) set to 01.000000
see 9.5.2

SCALE(R)

$$= \frac{\text{Required rate display per s}}{\text{Number of input pulses per s}}$$

$$= \frac{1}{1} = 1$$

TIMEBASE select 'PER HOUR'
see 9.5.3

Selects additional multiplying factor of 3,600 so rate display is in components per hour.

FILTER select 00
see 9.5.4

Filter may need adjusting to obtain stable rate display, start at setting 00.

EXAMPLE 2

In this example which is shown in Fig 22, a BA350BP displays the total flow and rate of flow being measured by a turbine flowmeter and initiates an alarm if the flow falls below a pre-set rate.

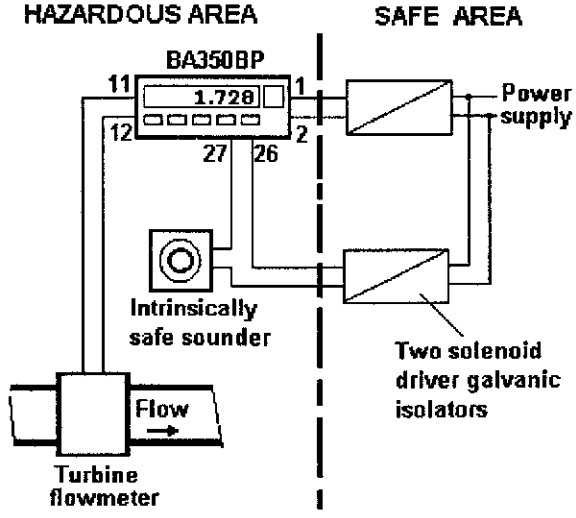


Fig 22 BA350BP displaying total and rate of flow in hazardous area

The BA350BP is required to:

Be mounted in hazardous area

Display the total flow in cubic metres with a resolution of 0.01 cubic metres.

Display the rate of flow in cubic metres per hour with a resolution of 0.001 cubic metres per hour.

Initiate an alarm when output falls below one cubic metre per hour.

The turbine meter produces 200,497.95 pulses per cubic metre.

Input conditioning see 8.2.1

Put internal plug-in link in the low voltage pulse position.

Programming

Mode Parameters

FUNCTION select ' TOTALISE'
see 9.3.1

CONTROL select 'LOCAL'
see 9.3.2

RTX O/P select 'OFF'
see 9.3.3

ROOT EXT select 'OFF'
see 9.3.4

TIMEOUT set 0000.018
see 9.3.5

Flow alarm to operate when flow rate falls below 1 cubic metre per hour. The turbine flowmeter produces 200,497.95 pulses per cubic metre so at a flow rate of 1 cubic metre per hour there will be:

$$\frac{200{,}497.95}{60 \times 60} = 55.694 \text{ pul/sec}$$

Maximum period between pulses

$$= \frac{1}{55.694} = 0.0179 \text{ seconds}$$

S/COMMS see 9.3.7 — Ignore, serial communications card not installed.

TIMEBASE see 9.5.3 — select 'PER HOUR'

FILTER see 9.5.3 — select 00

Filter may need adjusting to obtain stable rate display, start at setting 00

Batch Parameters

DP (T) see 9.4.5 — Select 0.00

Resolution of 0.01 cubic metres is required so dummy decimal point is positioned before the second least significant digit

SCALE(T) see 9.4.6 — set to 2004.98

SCALE(T)

$$= \frac{\text{Number of pulses received}}{\text{Required total display}}$$

$$= \frac{200497.95}{100} = 2004.9795$$

Note: *Required total display is 1.00 i.e. 100 ignoring the dummy decimal point.*

Rate Parameters

DP (R) see 9.5.1 — select 0.000

Resolution of 0.001 cubic metres is required so dummy decimal point is positioned before the third least significant digit

SCALE(R) see 9.5.2 — set to 00.004988

Scale(R)

$$= \frac{\text{Required rate display per s}}{\text{Number of input pulses per s}}$$

$$= \frac{0.2777777}{55.693875} = 0.0049875$$

Note: *Required rate display per hour is 1.000 i.e. 1000 ignoring the dummy decimal point, so rate display per second is 1000/3600 = 0.27777777*
Number of input pulses per second was calculated to define timeout.

EXAMPLE 3

The third totaliser example shown in Fig 23 illustrates how a BA350BC (4/20mA analogue input) may be used with a differential pressure flowmeter to display the total flow and flow rate of a flammable feedstock. Two single channel Zener barriers have been used for this example, but a two channel barrier or galvanic isolators would also be suitable.

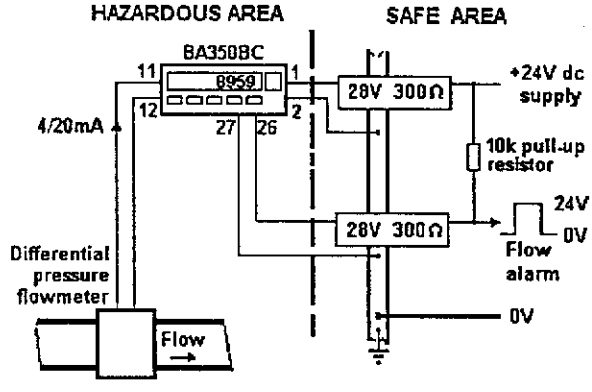


Fig 23 BA350BC displaying total and rate of flow

The BA350BC is required to:

Display total flow in litres with a resolution of 0.1litres

Transmit a pulse to a remote counter in the safe area

Display flow rate in litres per minute, with a resolution of 1 litre.

The differential pressure flowmeter produces a 20mA output at a flow of 20 litres per second.

Input conditioning see 8.2.2
None required BA350BC only accepts a 4/20mA input.

Programming

Mode Parameters

FUNCTION select 'TOTALISE'
see 9.3.1

CONTROL select 'LOCAL'
see 9.3.2

RTX O/P select 'ON'
see 9.3.3

ROOT EXT select 'OFF'
see 9.3.4

TIMEOUT set 000.000/OFF
see 9.3.5

S/COMMS Ignore, serial communications
see 9.3.7 card not installed.

LANGUAGE select 'ENGLISH'
see 9.3.12

Batch Parameters

DP (T) select 0.0
see 9.4.5

Resolution of 0.1 litres is required so dummy decimal point is positioned before the least significant digit

SCALE(T) set 0000005.00
see 9.4.6

The required total display after one second is 20.0 Ignoring the dummy decimal point, enter 200 as the required display in the formula:

SCALE(T)

$$= \frac{1000}{\text{Display after 1s with 20mA input}}$$

$$\text{SCALE(T)} = \frac{1000}{200} = 5$$

Note: *Display after 1 second with 20mA input is 20.0 i.e. 200 ignoring the dummy decimal point.*

Rate parameters

DP (R) no decimal point
see 9.5.1 required.

SCALE(R) set 00.020000
see 9.5.2

The flow meter has an output of 20mA at a flow rate of 20litres/second. Although the rate display is required in litres per minute, the rate scale factor is calculated as a rate per second and the TIMEBASE used to convert this to a rate per minute display.

SCALE(R)

$$= \frac{\text{Required rate display per s at 20mA}}{1000}$$

$$= \frac{20}{1000} = 0.02$$

TIMEBASE select 'PER MINUTE'
see 9.5.3

This multiplies the rate display by 60 to convert it from litres/second to litres/minute.

FILTER select 00
see 9.5.4

Filter may need adjusting to obtain stable rate display, start at setting 00.

10.2 Use as a batch controller & rate indicator
The BA350B may be used for most batch control applications where the input signal is a pulse or a 4/20mA analogue signal representing flow.

EXAMPLE 1

In the first batch control example a BA350BP is used with a turbine flowmeter to control the filling system shown in Fig 24.

The BA350BP (pulse input) is required to:

Dispense 1800 gallons of liquid into a tank having a maximum capacity of 1900 gallons.

Display the dispensed total with a resolution of 0.1 gallons.

Control two parallel valves (2 stage control).

At the start of each batch valve 2 is to open 15 seconds after valve 1, and close when only 50 gallons of liquid remain to be dispensed.

Compensate for errors resulting from actuator delays.

Initiate an alarm if flowrate falls below 0.5 gallons per second. Alarm to be inhibited for the first 30 seconds of each batch.

Display the rate of filling in gallons per second with a resolution of one gallon.

The turbine flowmeter incorporates a 2-wire proximity detector which produces 137 pulses per gallon.

Input Conditioning see 8.2.1
To accept a 2-wire proximity detector the internal plug-in link should be put in the proximity detector position

Programming

Mode Parameters
FUNCTION select 'BATCHER'
see 9.3.1

CONTROL select 'LOCAL'
see 9.3.2

RTX O/P select 'OFF'
see 9.3.3

ROOT EXT select 'OFF'
see 9.3.4

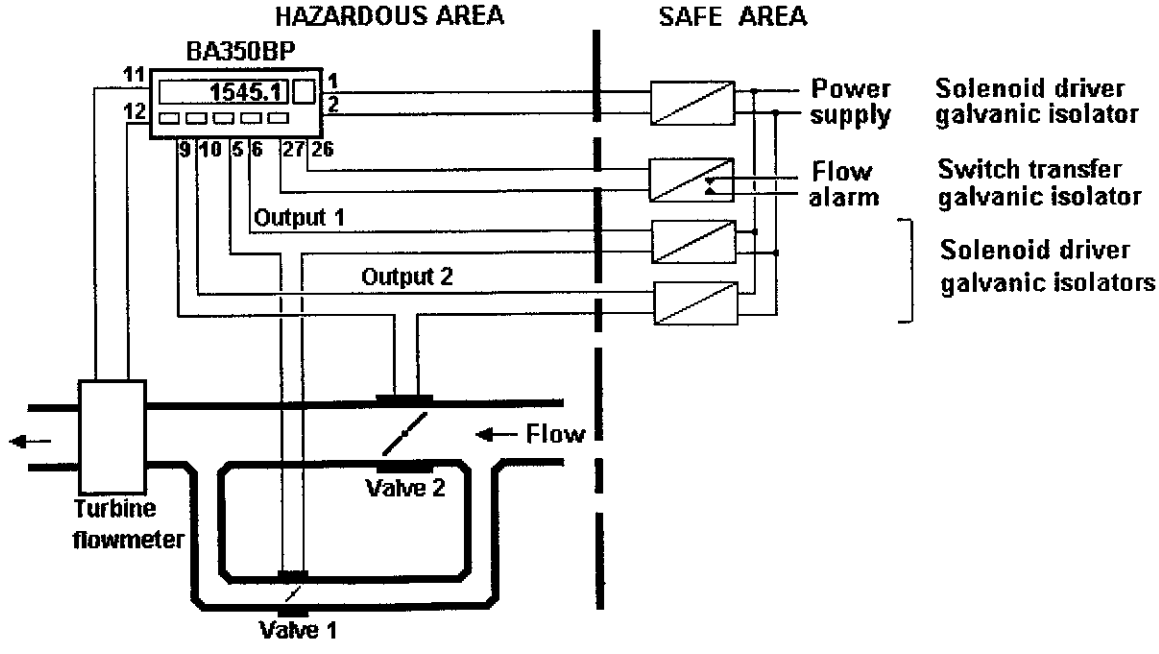


Fig 24 BA350BP batch filling system in a hazardous area

TIMEOUT set 0000.015
see 9.3.5

The alarm is to be activated when rate falls below 0.5 gallons per second. The flowmeter has an output of 137 pulses per gallon, so 0.5 gallons per second will produce 68.5 pulses per second

Maximum time between consecutive pulses

$$= \frac{1}{\text{frequency}} = \frac{1}{68.5}$$

= 0.015 seconds

INHIBIT set to 0030
see 9.3.6

S/COMMS Ignore, serial communications card not installed.
see 9.3.7

UP/DOWN select 'UP'
see 9.3.8

AUTO RST select 'OFF'
see 9.3.9

AUTO-S select '000/OFF'
see 9.3.10

OVERRUN select 'ON'
see 9.3.11

LANGUAGE select 'ENGLISH'
see 9.3.12

Batch Parameters

DP (T) 0.0
see 9.4.5

Resolution of 0.1 gallons is required so dummy decimal point is positioned before least significant digit.

SCALE(T) set to 000013.70
see 9.4.6

SCALE(T) =

$$= \frac{\text{Number of pulses received}}{\text{Required total display}}$$

$$= \frac{137 \times 1800}{18000} = 13.7$$

Note: *Required total display is 1800.0 i.e. 18000 ignoring the dummy decimal point.*
Number of pulses received is the product of number of pulses from flowmeter per gallon (137) and number of gallons dispensed (1800).

SETPOINT 1800.0
see 9.4.1

SP LIMIT 1850.0
see 9.4.2

Set slightly below maximum capacity of tank to prevent dangerously high setpoint being entered.

DELAY set to 0015
see 9.4.3

PRE-STOP set to 50.0
see 9.4.4

Rate Parameters

DP(R) select no point
see 9.5.1

SCALE(R) set to 00.007299
see 9.5.2

Scale(R)

$$= \frac{\text{Required rate display per s}}{\text{Number of input pulses per s}}$$

$$= \frac{1}{137}$$

$$= 0.007299$$

Note: *Required rate display per second is 1.*
Number of input pulses per second to produce a rate display of 1 is 137 i.e. the number of pulses from the flowmeter per gallon.

TIMEBASE select 'PER SECOND'
see 9.5.3

FILTER select 00
see 9.5.4

Filter may need adjusting to obtain stable rate display, start at setting 00.

EXAMPLE 2

Fig 25 shows a simple batch control system using one control output from the batch controller and a differential flowmeter with a 4/20mA analogue output.

The BA350BC (4/20mA input) is required to:

Dispense 10m^3 of liquid.

Display the dispensed total with a resolution of 0.01 m^3.

Control one valve.

Compensate for errors resulting from actuator delays.

Display the rate of flow in m^3/hour with a resolution of 0.1

The flowmeter has a linear 4/20mA output corresponding to 0 to 60m^3/hour.

Input conditioning see 8.2.2
None required BA350BC only accepts a 4/20mA input.

Programming

Mode Parameters

FUNCTION select 'BATCHER'
see 9.3.1

CONTROL select 'LOCAL'
see 9.3.2

RTX O/P select 'OFF'
see 9.3.3

ROOT EXT select 'OFF'
see 9.3.4

TIMEOUT set 000.000/OFF
see 9.3.5

INHIBIT set to 0000
see 9.3.6

S/COMMS Ignore, serial communications
see 9.3.7 card not installed.

UP/DOWN select 'UP'
see 9.3.8

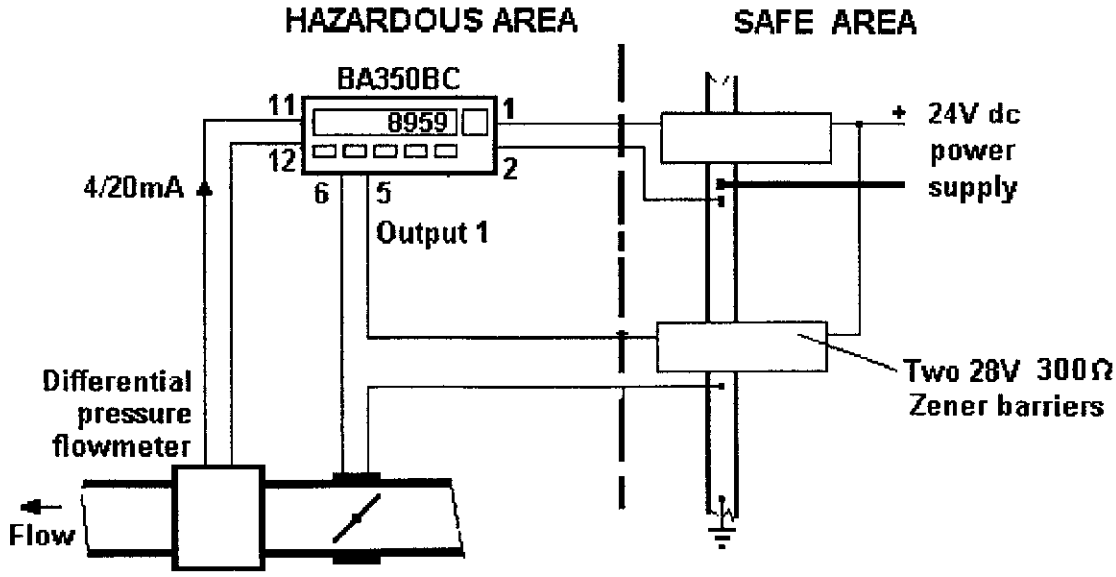


Fig 25 BA350BC batch control system in a hazardous area

AUTO RST select 'OFF'
see 9.3.9

AUTO-S
see 9.3.10 '000/OFF'

OVERRUN select 'ON'
see 9.3.11

LANGUAGE select 'ENGLISH'
see 9.3.12

SETPOINT set to 10.00
see 9.4.1

SP LIMIT set to '000000.00/OFF'
see 9.4.2

DELAY set to 0000
see 9.4.3

PRE-STOP set to 00000.00
see 9.4.4

Batch Parameters

DP (T) select 0.00
see 9.4.5

Resolution of 0.01m^3 is required so dummy decimal point is positioned before the second least significant digit.

SCALE(T) set to 00000600
see 9.4.6

Scale(T)

$$= \frac{1000}{\text{Display after 1s with 20mA input}}$$

The required display after one second with a 20mA input is:

$$\frac{\text{60 cubic metres}}{60 \times 60} = 0.016666\text{m}^3$$

The required total display resolution is 0.01m^3 so after one second the BA350BC will actually display 0.02

Ignoring the dummy decimal point, enter 1.66666 as the required display in the formula:

SCALE(T)

$$= \frac{1000}{\text{Display after 1s with 20mA input}}$$

$$= \frac{1000}{1.66666} = 600$$

Rate parameters

DP (R) select 0.0
see 9.5.1

Resolution of 0.1m^3 /hour is required so dummy decimal point is positioned before the least significant digit

SCALE(R) set to 00.000167
see 9.5.2

SCALE(R) =

$$\frac{\text{Required rate display per second at 20mA}}{1000}$$

The required rate display per second with 20mA input is:

$$\frac{\text{60 cubic metres per hour}}{60 \times 60}$$

= 0.01666666m^3 per sec

The require rate display resolution is 0.1m^3/hour ignoring the dummy decimal point enter 0.1666667 into the formula:

SCALE(R) =

$$\frac{\text{Required rate display per second at 20mA}}{1000}$$

$$\text{SCALE(R)} = \frac{0.1666667}{1000} = 0.0001666$$

Note; *Rounding up to 0.00167 results in a 0.2% error*

TIMEBASE select 'PER HOUR'
see 9.5.3

FILTER see 9.5.4	select 00 Filter may need adjusting to obtain stable rate display, start at setting 00.

11 MAINTENANCE

11.1 Fault finding during commissioning

Problems experienced during commissioning usually result from incorrect wiring, incorrect programming or a poor power supply. If when first switched on the instrument does not function, use the following table to help diagnose the cause of the problem

If a programming error is suspected it is often helpful to scroll through the menus and check that the instrument has been programmed as intended. To simplify this check, Appendix 1 contains blank programming sheets for the BA350BP (pulse input) and the BA350BC (4/20mA input) for both totaliser and batch control applications.

If you are unable to identify the cause of the difficulty, please contact the BEKA sales office or our agent in your area. If a programming problem is suspected a completed programme sheet from Appendix 1 may help us to resolve the problem.

Symptom	Solution
No LEDs illuminated and LCD display is blank	Check that supply voltage between terminals 1 & 2 is greater than 10V & has correct polarity
BA350B will not initialise; repeatedly initialises or all LEDs are illuminated at reduced brilliance	Check power supply ripple between terminals 1 & 2 is less than 0.25V peak to peak
Programme menus are not accessible	Security link incorrectly positioned See section 9.1
Batch controller programme functions not available	BA350B has been conditioned as a totaliser; batch parameters therefore omitted from menus. See section 9.3.1
Front panel push-buttons do not function.	Instrument programmed for control by remote switches. See section 9.3.2
When programmed as a batch controller setpoint can not be entered	Setpoint limit set to a lower value than the required setpoint. See section 9.4.2
When programmed as a batch controller output one is not energised when the *Start* push-button is operated	Setpoint set to zero. See section 9.4.2
When programmed as a batch controller the BA350B continues counting after batch setpoint is reached	The BA350B will only stop counting when the input pulses stop or the input current falls below 4mA. The control loop must be closed so that the BA350B outputs controls the input signal.
BA350BP will not count input pulses.	Incorrect input conditioning, or input polarity reversed. See section 8.2
BA350BC will not provide a rate or total display.	Input terminals reversed.
Accuracy of BA350BP total display is poor and/or overrun compensation does not function correctly.	Total represented by each input pulse is too large.

11.2 Servicing

It is not easy to service a BA350B on site, we therefore recommended that faulty instruments are returned to BEKA Associates or one of our agents for repair. The instrument has plug-in terminal blocks so a faulty unit can easily be replaced without disconnecting the field wiring.

11.3 Warranty

Instruments which fail within the warranty period should be returned to BEKA Associates or the local agent from whom the instrument was purchased. It is helpful if a brief description of the fault symptoms is provided.

12 ACCESSORIES

12.1 Scale card

1. The BA350B has a window on the right hand side of the eight digit display to hold a scale card showing the units of measurement. Instruments can be supplied fitted with a scale card printed with any unit(s) specified by the customer at the time of ordering. If a printed card is not requested when the instrument is ordered a blank card will be supplied.

Scale cards can easily be marked or changed on site as follows:

CAUTION

Before removing the BA350B rear panel disconnect the 24V dc supply, and connections to the control and auxiliary outputs.

1. Remove the rear panel by unscrewing the four corner screws and gently pull the panel backwards taking care not to bend any of the connector pins.

2 Slide the plastic scale card carrier out of the enclosure and remove the card which is secured by a self-adhesive pad.

3 Mark legend onto the card using a stencil or transfer, fix the card to the carrier and replace in the enclosure. Ensure that the legend is aligned with the front panel window.

4 Replace the rear panel taking care not to damage or bend the connector pins. Do not overtighten the four corner screws.

12.2 Tag strip

Instruments can be supplied with a thermally printed plastic tag strip secured by screws to the rear of the enclosure. This tag is not visible from the front of the instrument after installation.

13. CUSTOMER COMMENTS

BEKA Associates is always pleased to receive comments from customers about its products and services. All communications are acknowledged, and whenever possible suggestions are incorporated into revisions and new products.

APPENDIX 1

Programming sheets for:

BA350BP (pulse input) used as a totaliser

BA350BP (pulse input) used as a batch controller

BA350BC (4/20mA input) used as a totaliser

BA350BC (4/20mA input) used as a batch controller

BA350BP (pulse input) conditioned as a totaliser

Instrument serial number:

INPUT CONDITIONING	DESCRIPTION	OPTIONS	REQUIRED
INPUT CONDITIONING LINK see: 8.3	Selects input type	Proximity detector Voltage free contact Voltage pulse(1 to 3V) Voltage pulse(10 to 30mV)	

MODE PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
FUNCTION see: 9.3.1	Conditions BA350BP as a totaliser or as a batch controller	BATCHER or TOTALISE	'TOTALISE'
CONTROL see: 9.3.2	BA350BP can be controlled from front panel push-buttons (local); remote switches (remote), or both	LOCAL REMOTE LOC + REM	
RTX O/P see: 9.3.3	Turns retransmitted pulse output 'on' or 'off'	ON or OFF	
ROOT EXT see: 9.3.4	Turns square root extraction 'on' or 'off'	ON or OFF	
TIMEOUT see: 9.3.5	Sets missing pulse detection time (flow alarm)	0.001 to 3600 seconds or 0.000/OFF	
S/COMMS see: 9.3.7	Selects control via the RS232 serial port Note: internal serial communication board must be fitted.	ON or OFF See separate instruction manual.	
LANGUAGE see: 9.3.12	Selects menu language	ENGLISH, FRENCH or GERMAN	

BATCH PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
DP(T) see: 9.4.5	Selects position of dummy decimal point in total display	Between any of the eight digits, or omitted	
SCALE(T) see: 9.4.6	Dividing factor which defines relationship between number of input pulses and displayed total	0.01 and 999999.99	

RATE PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
DP(R) see: 9.5.1	Selects position of dummy decimal point in rate display	Between any of the eight digits or omitted	
SCALE(R) see: 9.5.2	Multiplying factor which defines relationship between input pulse frequency and rate display in Hz	0.000001 and 99.999999	
TIMEBASE see: 9.5.3	Selects additional multiplying factor so rate can be displayed per second, minute or hour	PER SECOND, PER MINUTE or PER HOUR	
FILTER see: 9.5.4	Selects amount of rate display filtering	Between -6 and +11	

BA350BP (pulse input) conditioned as a batch controller

Instrument serial number:

INPUT CONDITIONING	DESCRIPTION	OPTIONS	REQUIRED
INPUT CONDITIONING LINK see: 8.3	Selects input type	Proximity detector Voltage free contact Voltage pulse(1 to 3V) Voltage pulse(10 to 30mV)	

MODE PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
FUNCTION see: 9.3.1	Conditions BA350BP as a totaliser or as a batch controller	BATCHER or TOTALISE	BATCHER
CONTROL see: 9.3.2	BA350BP can be controlled from front panel push-buttons (local); remote switches (remote), or both	LOCAL REMOTE LOC + REM	
RTX O/P see: 9.3.3	Turns retransmitted pulse output 'on' or 'off'	ON or OFF	
ROOT EXT see: 9.3.4	Turns square root extraction 'on' or 'off'	ON or OFF	
TIMEOUT see: 9.3.5	Sets missing pulse detection time (flow alarm)	0.001 to 3600 seconds or 0.000/OFF	
INHIBIT see: 9.3.6	Sets time missing pulse detection is disabled at beginning of each batch	0 and 3600 seconds	
S/COMMS see: 9.3.7	Selects control via the RS232 serial port Note: internal serial communication board must be fitted	ON or OFF See separate instruction manual.	
UP/DOWN see: 9.3.8	Selects direction of count	UP or DOWN	
AUTO RST see: 9.3.9	Automatically resets displayed batch count from previous batch when *Start* push-button is operated	ON or OFF	
AUTO-S see: 9.3.10	Sets delay before batch is automatically repeated	1 to 3600 seconds or 000/OFF	
OVERRUN see: 9.3.11	Compensates for errors caused by actuator delays	ON or OFF	
LANGUAGE see: 9.3.12	Selects menu language	ENGLISH, FRENCH or GERMAN	

BATCH PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
SETPOINT see:9.4.1	Sets the batch setpoint	8 digits	
SP LIMIT see: 9.4.2	Defines maximum setpoint which may be entered	8 digits	
DELAY see: 9.4.3	Sets time delay before Output 2 is energised at the start of a batch	0 to 3600 seconds	
PRE-STOP see: 9.4.4	Sets number of display counts before end of batch at which Output 2 is de-energised	0 to setpoint	
DP(T) see: 9.4.5	Selects position of dummy decimal point in total display	Between any of the eight digits, or omitted	
SCALE(T) see: 9.4.6	Dividing factor which defines relationship between number of input pulses and displayed total	0.01 and 999999.99	

RATE PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
DP(R) see: 9.5.1	Selects position of dummy decimal point in rate display	Between any of the eight digits or omitted	
SCALE(R) see: 9.5.2	Multiplying factor which defines relationship between input pulse frequency and rate display in Hz	0.000001 and 99.999999	
TIMEBASE see: 9.5.3	Selects additional multiplying factor so rate can be displayed per second, minute or hour	PER SECOND, PER MINUTE or PER HOUR	
FILTER see: 9.5.4	Selects amount of rate display filtering	Between -6 and +10	

BA350BC (4/20mA input) conditioned as a totaliser

Instrument serial number:

MODE PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
FUNCTION see: 9.3.1	Conditions BA350BC as a totaliser or as a batch controller	BATCHER or TOTALISE	'TOTALISE'
CONTROL see: 9.3.2	BA350BC can be controlled from front panel push-buttons (local); remote switches (remote), or both	LOCAL REMOTE LOC + REM	
RTX O/P see: 9.3.3	Turns retransmitted pulse output 'on' or 'off'	ON or OFF	
ROOT EXT see: 9.3.4	Turns square root extraction 'on' or 'off'	ON or OFF	
TIMEOUT see: 9.3.5	Sets flow alarm setpoint	4 to 20mA (0.001 to 3600 seconds) or 0.000/OFF	
S/COMMS see: 9.3.7	Selects control via the RS232 serial port Note: internal serial communication board must be fitted	ON or OFF	
LANGUAGE see: 9.3.12	Selects menu language	ENGLISH, FRENCH or GERMAN	

BATCH PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
DP(T) see: 9.4.5	Selects position of dummy decimal point in total display	Between any of the eight digits, or omitted	
SCALE(T) see: 9.4.6	Dividing factor which defines relationship between input current and displayed total	0.01 and 999999.99	

RATE PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
DP(R) see: 9.5.1	Selects position of dummy decimal point in rate display	Between any of the eight digits or omitted	
SCALE(R) see: 9.5.2	Multiplying factor which defines relationship between input current and rate display in Hz	0.000001 and 99.999999	
TIMEBASE see: 9.5.3	Selects additional multiplying factor so rate can be displayed per second, minute or hour	PER SECOND, PER MINUTE or PER HOUR	
FILTER see: 9.5.4	Selects amount of rate display filtering	Between -6 and +11	

BA350BC (4/20mA input) conditioned as a batch controller

Instrument serial number:

MODE PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
FUNCTION see: 9.3.1	Conditions BA350BC as a totaliser or as a batch controller	BATCHER or TOTALISE	BATCHER
CONTROL see: 9.3.2	BA350BC can be controlled from front panel push-buttons (local); remote switches (remote), or both	LOCAL REMOTE LOC + REM	
RTX O/P see: 9.3.3	Turns retransmitted pulse output 'on' or 'off'	ON or OFF	
ROOT EXT see: 9.3.4	Turns square root extraction 'on' or 'off'	ON or OFF	
TIMEOUT see: 9.3.5	Sets flow alarm setpoint	4 to 20mA (0.001 to 3600 seconds) or 0.000/OFF	
INHIBIT see: 9.3.6	Sets time flow alarm is disabled at beginning of each batch	0 and 3600 seconds	
S/COMMS see: 9.3.7	Selects control via the RS232 serial port Note: internal serial communication board must be fitted	ON or OFF See separate instruction manual.	
UP/DOWN see: 9.3.8	Selects direction of count	UP or DOWN	
AUTO RST see: 9.3.9	Automatically resets displayed batch count from previous batch when *Start* push-button is operated	ON or OFF	
AUTO-S see: 9.3.10	Sets delay before batch is automatically repeated	1 to 3600 seconds or 000/OFF	
OVERRUN see: 9.3.11	Compensates for errors caused by actuator delays	ON or OFF	
LANGUAGE see: 9.3.12	Selects menu language	ENGLISH, FRENCH or GERMAN	

BATCH PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
SETPOINT see:9.4.1	Sets the batch setpoint	8 digits	
SP LIMIT see: 9.4.2	Defines maximum setpoint which may be entered	8 digits	
DELAY see: 9.4.3	Sets time delay before Output 2 is energised at the start of a batch	0 to 3600 seconds	
PRE-STOP see: 9.4.4	Sets number of display counts before end of batch at which Output 2 is de-energised	0 to setpoint	
DP(T) see: 9.4.5	Selects position of dummy decimal point in total display	Between any of the eight digits, or omitted	
SCALE(T) see: 9.4.6	Dividing factor which defines relationship between number of input pulses and displayed total	0.01 and 999999.99	

RATE PARAMETERS	DESCRIPTION	OPTIONS	REQUIRED
DP(R) see: 9.5.1	Selects position of dummy decimal point in rate display	Between any of the eight digits or omitted	
SCALE(R) see: 9.5.2	Multiplying factor which defines relationship between input pulse frequency and rate display in Hz	0.000001 and 99.999999	
TIMEBASE see: 9.5.3	Selects additional multiplying factor so rate can be displayed per second, minute or hour	PER SECOND, PER MINUTE or PER HOUR	
FILTER see: 9.5.4	Selects amount of rate display filtering	Between -6 and +11	

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