

## Author's Note

The Tracker 280 is a highly flexible instrument which provides 5 application modes. Configuration of the instrument is quite simple: once the required application mode has been selected, only the parameters for that application mode can be configured.

To assist the user in configuring the instrument for the required application mode, the Author recommends that the user:

1. Reads the **Introduction** on *pages 4 and 5*.
2. Follows the **Installation** instructions on *pages 6 to 16*.
3. Reads **Getting Started - Overview of Application Modes** on *pages 17 to 19*.
4. Reads **Getting Started - Choosing Your Application** on *pages 20 and 21* and then configures the example on *pages 22 to 24*.
5. Reads about the required application mode in **Getting Started - Choosing Your Application** on *pages 25 to 37*.
6. Reads **Getting Started - Setting Up the Instrument** on *pages 38 to 47* to familiarise yourself with the instrument.
7. Reads **Configuring the Input** on *pages 48 to 52* whilst setting up the required application mode.
8. Reads **Configuring the Channels** on *pages 53 to 73* whilst setting up the required application mode.
9. Configures the rest of the instrument's parameters whilst reading the relevant sections starting with **Configuring the Display** on *page 74*.

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## Introduction

This Setup Guide describes how to install and configure your instrument.



**This instrument is marked with the international hazard symbol. It is important to read this Setup Guide before installing or commissioning your panel meter as it contains important information relating to safety and Electromagnetic Compatibility EMC.**

The instrument provides the following features as standard:

- 6-digit bright LED display.
- 4 configurable alarms.
- Dual logic/status inputs.
- Programmable function keys.
- Scalable analogue retransmission output.
- Optional dual relay output or quad digital (TTL) outputs.
- 5/12V transducer supply.
- RS485 serial communications interface with 3 protocols including Modbus<sup>TM</sup>-RTU.

The instrument can be used in any one of the 5 application modes:

- Counter Mode (Dual Channel) (see *pages 17 and 25*).
- Encoder Mode (see *pages 17 and 28*).
- Frequency Mode (Dual Channel) (see *pages 18 and 31*).
- Timer Mode (Dual Channel) (see *pages 18 and 34*).
- Edge Timer Mode (see *pages 19 and 36*).

### NOTE

*In the default condition, the instrument is setup as a counter.*

### WARNING

It is important to select the appropriate measurement mode for your application as the menu structures and some default values depend on the application type selected and will change.

**Common Features and Functions**

All of the *above* measurement modes provide the following features and functions:

- 2 front panel function keys - *for displaying other values or initiating other functions.*
- 2 status (logic) inputs - *as above but from external switches.*
- 4 Alarms - *for both primary and derived measured values.*
- A separate 6 or 12-digit totaliser - *for maths derived input from Channels A and/or B with its own scaling and display format.*
- Batch control facility - *for models with relay or TTL outputs only.*
- Scalable analogue output - *for transmitting a primary or derived measured value.*
- Serial Communications - *for allowing access to all measurement values and configuration parameters.*

**Testing the Sensor Connections**

*In the default condition, the instrument is setup as a counter. The display shows the count value for Channel A. This is a good setup to use to test that the sensor on Channel A has been installed and wired correctly to the instrument. In most cases the instrument can also power the sensors using the 5 and 12V DC outputs provided. Installation instructions follow on pages 6 to 16.*

## Installation

To install your instrument, you will need to carry out the following steps:

- Install the instrument into a panel.
- Make connections to the instrument.

### WARNING

- Ensure that the power to the instrument is switched off before carrying out any installation or maintenance work.
- It is recommended that all connections to the terminals are made using ferrules to afford greater reliability and to prevent short circuits between adjacent terminals.
- Avoid installing the instrument close to switch gear, contactors or motor starters.
- Do not place signal and power supply wiring in the same loom.
- Use screened cables or wires for all signal/sensor leads with screen earthed at one point only.



**If this instrument is not installed in accordance with the instructions in this manual, protection against electrical hazards may be impaired resulting in injury or loss of life. Installation Category II as defined by BSEN61010-1 and Pollution Degree 2 environments apply.**



**This instrument should be disposed of correctly. Do not burn or throw into any fire as there is a risk of explosion. Please contact your supplier or local council for advice.**



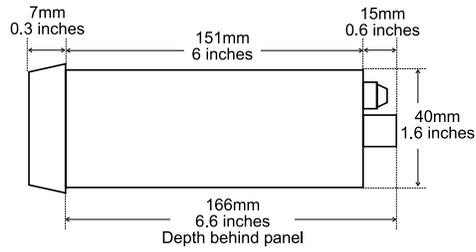
**For data retention purposes, this instrument contains a lithium battery type CR2032. In normal circumstances, the battery will provide a service life in excess of 5 years.**



**The battery contained in this instrument should be disposed of correctly. Please contact your supplier or local council.**

## Panel Mounting

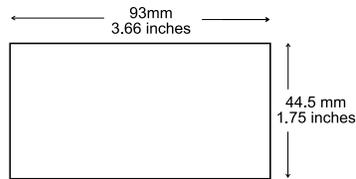
Ensure that there is sufficient space behind the instrument panel for the depth of the instrument to allow for safe routing of cables. The diagram *below* shows a side view of the instrument's dimensions.



The instrument is supplied with an installation kit consisting of 2 mounting clamps and a panel sealing gasket.

To install the instrument:

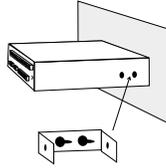
1. Make the panel cutout with the dimensions as shown *below*. Panel thickness from 1.5mm to 9.5mm can be accommodated.



2. Fit the rubber seal by slipping it over the unit from the rear of the box and pushing it forwards until it sits behind the front lip of the unit.
3. Insert the instrument into the panel from the front, pushing it through as far as the front lip to ensure correct seating of the rubber seal between the panel and the unit.

## Installation - Connecting the Terminals

- Working from behind the panel, take the 2 mounting brackets and locate onto the case as shown *below* (note orientation of keyhole slots relative to instrument case). With the brackets located, slide them backwards until they lock into place.
- Tighten the screws until they bite into the panel, securing the instrument in place. Take care not to overtighten the screws as this may damage the case of the instrument.



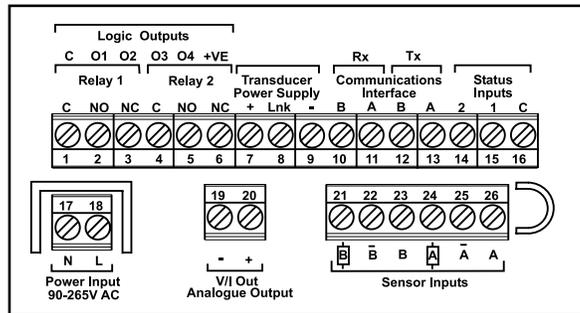
## Connecting the Terminals

The diagram *below* shows the rear panel terminal connection arrangement.

### NOTE

Terminals 1 to 6 are not used on some models (see the table on *page 9*).

### Rear Panel Terminal Connections



**Terminal Connections**

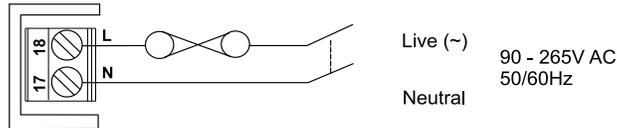
<b>Terminal</b>	<b>Outputs</b>	<b>Dual Relays</b>	<b>Quad TTL</b>
1	None	Relay 1 - Common	Common
2	None	Relay 1 - Normally Open	Output 1
3	None	Relay 1 - Normally Closed	Output 2
4	None	Relay 2 - Common	Output 3
5	None	Relay 2 - Normally Open	Output 4
6	None	Relay 2 - Normally Closed	Supply
7	Transducer Supply +ve		
8	Link for 5V		
9	Transducer Supply -ve		
10	Receive B		
11	Receive A		
12	Transmit B		
13	Transmit A		
14	Status (Logic) Input 2		
15	Status (Logic) Input 1		
16	Status Input Common (GND)		
17	Power Input Neutral (-)		
18	Power Input Live (+)		
19	Analogue Retransmission Output -ve		
20	Analogue Retransmission Output +ve		
21	Channel B Pull Up/Down Resistor		
22	Channel B Complementary Input		
23	Channel B Input		
24	Channel A Pull Up/Down Resistor		
25	Channel A Complementary Input		
26	Channel A Input		

## Powering the Instrument

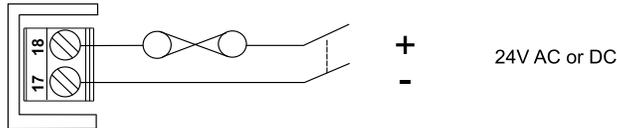
**THERE ARE 2 SUPPLY VARIANTS:** a mains supply variant and a low voltage supply variant. The instrument is designed to operate from either an AC supply with voltages in the range 90 to 265V AC 50/60Hz mains supply or from a DC supply with voltages in the range 24 to 32V DC (20V to 30V AC) 50/60Hz low voltage supply with a maximum power consumption of 20VA when all outputs are fully loaded and the display has all segments illuminated.

The diagrams *below* show how the instrument should be connected to the mains supply. Isolation should be provided by a double pole switch and a time delay 1A fuse.

### Recommended Mains Supply Connections



### Recommended Low Voltage Supply Connections



### WARNING

The instrument is designed for installation in an enclosure which provides adequate protection against electric shock. Access to power terminals should be restricted to authorised skilled personnel only. Application of supply voltages higher than those for which the instrument is intended may compromise safety and cause permanent damage.

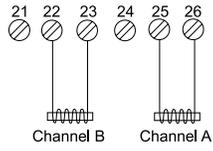


**BEFORE POWERING UP THE INSTRUMENT,** check the model label on the underside of the instrument for the version variant, eg. MAINS OR LOW VOLTAGE.

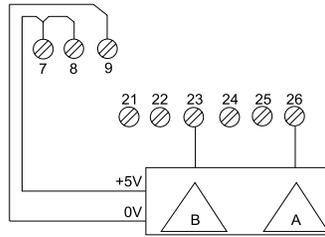
### Connecting the Sensors

If a channel is not going to be used, then pulling up this channel via linking the pull up/down terminal to excitation+, will prevent it picking up unwanted noise.

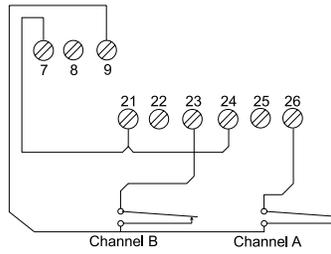
#### Magnetic Pickups



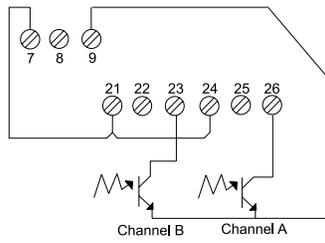
#### TTL Inputs



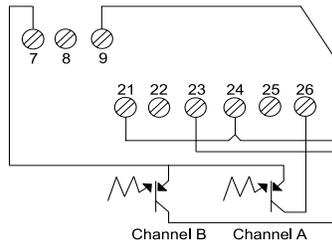
#### Relay Contacts



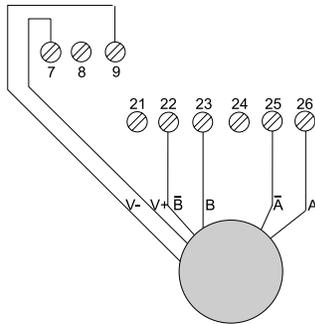
**NPN Sensors**



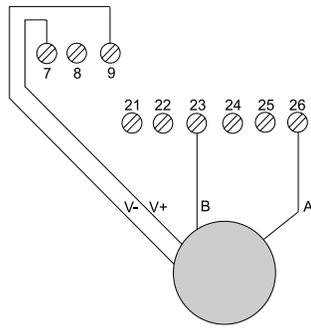
**PNP Sensors**



**Encoder with Complementary Outputs**



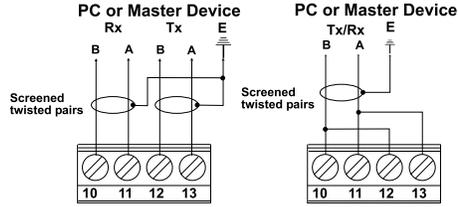
Encoder with Single Outputs



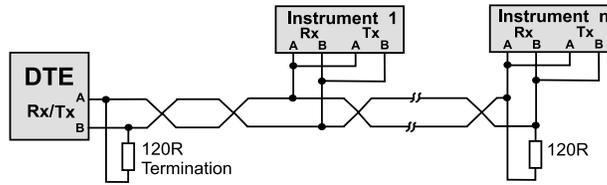
### Connecting the Communications Interface

The diagrams *below* show the connections necessary to interface your instrument to a PC RS485/422 port or to an RS485 to RS232 converter. It is recommended that a screened twisted pair cable be used for all applications requiring cable lengths greater than 3m. It is also recommended that a 120Ω termination resistor is added across each pair of wires at the furthest point from the master device. The screen of the cable should be connected to the frame ground or ground connection of the master device. The diagrams *below* show the wiring required for both 4-wire full duplex and 2-wire half duplex installations.

#### 4-Wire & 2-Wire Communications Interface Connections



#### Typical RS485 Multidrop Half Duplex Application



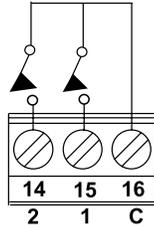
### Connecting the Status Inputs

There are 2 status (logic) inputs provided by your instrument. The inputs can be used with either voltage free contacts such as relay contacts, switches, open collector transistor outputs or voltage driven. The inputs are active low, ie. apply a short circuit between the status input and status common. The diagrams *below* show some typical applications.

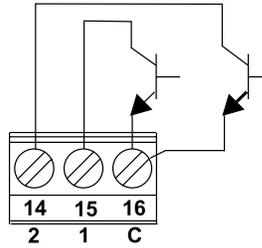
#### NOTE

These inputs are not isolated from the instrument's input circuit.

#### Voltage Free Contacts

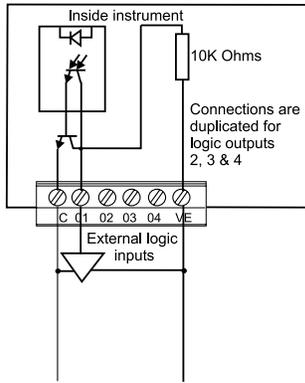


#### Open Collector TTL Outputs

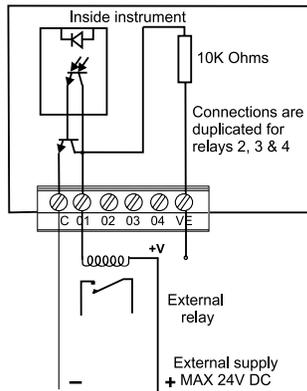


## Connecting the Logic Outputs

### Connecting to External Logic Inputs



### Connecting to External Relays



## Getting Started

### Overview of Application Modes

The Timer/Counter/Rate Meter is extremely flexible and as a consequence has a large number of user parameters within the configuration menus. However, having defined the application, **it is surprising how few parameters actually need to be altered and HOW FAST THE INSTRUMENT CAN BE COMMISSIONED.**

The first action is to decide the primary application for the unit. Alarm functions, display and an analogue output (retransmission) are available for all the primary, secondary and derived values. The communication interface also allows all values to be accessed.

### Primary Application - Counter Mode (Dual Channel)

#### Secondary Functions

- Scaling to engineering units (eg. 2400 pulses = 1litre) for each channel.
- 6/12-digit totalisation for Channel A, B, A+B or A-B.
- Retransmission of the total for Channel A, B, A+B or A-B.
- Retransmission of the rate (frequency) for Channel A, B, A+B or A-B.
- Retransmission of the ratio between Channel A and B.
- Display of the total for Channel A, B, A+B or A-B.
- Display of the rate for Channel A, B, A+B or A-B.
- Display of the ratio between Channel A and B.
- Output a pulse each time a preset count value is reached for each channel.

### Primary Application - Encoder Mode

#### Secondary Functions

- Channel A counts up or down, dependent on the state (or phase) of Channel B.
- OR
- Channel A counts, dependent on the state of Channel B (count inhibit) allowing the count range to be preset to user defined

values.

- Retransmission of the rate.
- Display of the rate.
- Quadrature measurement.

**Primary Application - Frequency Mode (Dual Channel)**

Secondary Functions

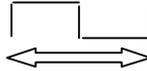
- Scaling to engineering units (eg. litres per minute) for each channel.
- Linearisation to compensate for nonlinear conversion of frequency to engineering units.
- 6/12-digit totalisation (integration of rate in engineering units).
- Retransmission of the total for Channel A, B, A+B or A-B.
- Retransmission of the rate for Channel A, B, A+B or A-B.
- Retransmission of the ratio between Channel A and B.
- Display of the total for Channel A, B, A+B or A-B.
- Display of the rate for Channel A, B, A+B or A-B.
- Display of the ratio between Channel A and B.

**Primary Application - Timer Mode (Dual Channel)**

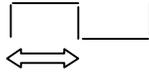
Secondary Functions

Period - Times a period.

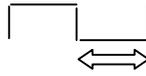
- Scaling to engineering units.
- Linearisation to compensate for nonlinear conversion of timing to engineering units.
- Retransmission of the ratio between Channel A and B.
- Display of the ratio between Channel A and B.



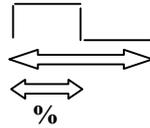
High - As Period *above*, but high time only.



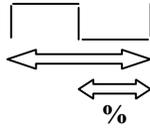
Low - As Period *above*, but low time only.



Duty (High) - As Period *above*, but measures the high condition of a period and calculates the percentage value.



Duty (Low) - As Period *above*, but measures the low condition of a period and calculates the percentage value



### Primary Application - Edge Timer Mode

#### Secondary Functions

- As Timer Mode measurement *above*.
- Scaling to engineering units.
- Time between pulse edges between Channel A and B.

## Choosing Your Application

You can select one of the following application types by altering the **tYPE** (Type) parameter within the **inPt** (Input) Menu.

- **Cnt** Counter Mode (Dual Channel) (see *pages 25 to 27*) (*the default application type*).
- **EnC** Encoder Mode (see *pages 28 to 30*).
- **FrEq** Frequency Mode (Dual Channel) (see *pages 31 to 33*).
- **tiME** Timing Mode (Dual Channel) (see *pages 34 to 35*).
- **EdgE** Edge Timing Mode (timing between pulse edges (see *pages 36 to 37*).

### NOTE

*In the default condition, the instrument is setup as a counter.*

### WARNING

This parameter must be selected **first** as the menu structures and some default values depend on the application type selected and will change.

Once you have decided on the application that best suits your process, only certain parameters need to be setup (see the **Setup Menu Structure** on *page 40*).

## The Source Parameters

Once you have selected your application mode within the **inPt** (Input) Menu and configured the channel(s) in the **CHA/CHb** (Channel) Menus, you should configure the **diSP** (Display) Menu. Within this menu, the **SorC** (Source) parameter determines which measurement value is normally displayed while the instrument is running. Other values can be displayed during normal operation by using the front panel buttons and status (logic) inputs.

The choices for the **SorC** parameter are:

- **EngA** Engineering units for Channel A.
- **EngB** Engineering units for Channel B.
- **rtEA** Rate on Channel A.



## Example Counting Application

Count 75cl size bottles of whisky on a conveyor, display the total number of bottles and total the amount of whisky produced. The instrument is required to normally display the number of bottles produced but will display the total amount of whisky, in litres, when a front panel button is pressed.

**Parameters to be Changed from the Default Condition**  
(see the Setup Menu Structure on *page 40*).

From within the **tot** (Totaliser) Menu set:

<b>EnAb</b> to <b>on</b>	Enables the total function.
<b>SorC</b> to <b>A</b>	The totaliser takes the bottle counts/source value from Channel A.
<b>PSCL, tyPE</b> to <b>MuLt</b>	Uses the multiplier prescale function.
<b>VAL</b> to <b>0.75</b>	The prescale will count each bottle as 0.75 litres.

From within the **KEY1** (Function Key 1) Menu set:

<b>diSP</b> to <b>Ltot</b>	Displays the <b>Ltot</b> value when Key 1 is pressed.
----------------------------	---

## AND THATS IT!!

If you are counting boxes of whisky and each box contains 6 bottles, you can scale each box count to equal 6 in the Channel A scaling. You will still be counting bottles and totalising the amount of whisky.

From within the **CHA1** (Channel A) Menu set:

<b>CHA, ENGA</b> to <b>6</b>	1 count = 6.
------------------------------	--------------

### Adding a Rate Measurement

Now let us add a requirement to measure the bottle rate per minute, which will be displayed by pressing **KEY2** (Function Key 2) on the front panel.

From within the **KEY2** (Function Key 2) Menu set:

**diSP** to **rtEA**      Displays the **rtEA** value when Key 2 is pressed.

From within the **rAtE** (Rate) Menu set:

**PSCL** to **MULT**      Uses the multiplier prescale function.

**VAL** to **60000**      Multiplies the input rate by 60000 (bottles/min) - **WHY?**

**VAL2** to **1**      (Set to 60 for bottles/hour, 1440 for bottles/day)

#### **WHY multiply the rate value by 60000?**

The rate value defaults to kHz. As it is unlikely that 1000s of bottles of whisky are made per second, the prescale function allows the multiplication from bottles per mS (which would be a fractional number) to bottles per second if a value of 1000 is entered, or bottles per minute if a value of 60,000 is entered. To display bottles per day, set 60000 in the **VAL** prescale multiplier parameter and 1440 in the **VAL2** parameter (60mins x 24hours).

#### **WARNING**

Using such large multiplier values will cause the rate display to appear noisy if the count rate is not constant (eg. the bottles are not evenly spaced together). If rate is the most important measurement, Frequency Mode should be used.

### Adding Pulsed Outputs

Quite often there is a need to give an output signal once a preset number of counts have occurred.

#### For example

Our whisky bottle counter may have to signal another machine that 24 bottles have been counted and signal again when the next 24 bottles are counted. This function requires an instrument that is fitted with relay or TTL alarm/control outputs (Channel A uses Output 1 and Channel B uses Output 2).

From within the **CHA** (Channel A) Menu set:

**oP-1 to 24** Turns on Output 1 each time 24 bottles are counted.

From within the **o/P** (Output) Menu set:

**PuLS, EnAb to on** Enables the output to pulse when Output 1 is turned on.

**dELY to 0.3** Sets the pulse on time to 0.3 seconds.

This setup will result in Output 1 on Channel A pulsing for 0.3 seconds for every 24 bottles counted on Channel A.

**SEE HOW EASY IT IS!**

### **Counter Mode (Dual Channel) - *Cnt***

For use with applications where counting or totalising is the primary requirement, eg. proximity sensors, turbine flow meters or any sensors that give a contact closure or pulsed output. Each pulse can be scaled so that the totalised values can be in engineering units.

When the input type is ***Cnt***, Channel A and Channel B are independent counters.

Both of the input channels can:

- Accept pulses at a rate of up to 150KHz (a low frequency cut off is available to stop counts that are below a user definable value).
- Scale each channel separately.
- Count pulses on each channel separately.
- Approximate a frequency for each channel separately.
- Obtain a derived total for Channel A, Channel B, Channel A - Channel B or Channel A + Channel B.

A **third** totaliser can be set up to give a 6 or 12-digit total for:

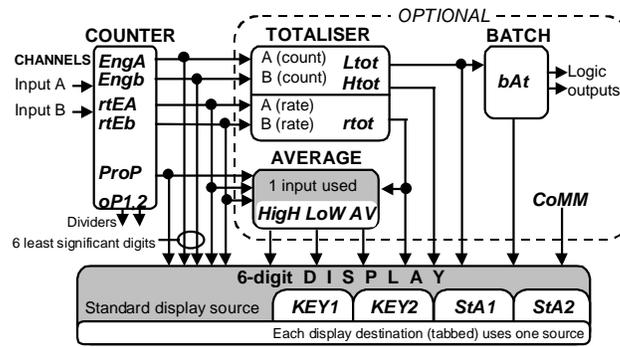
- Channel A or Channel B.
- Channel A + Channel B.
- Channel A - Channel B.

This **separate** totaliser can be scaled and ranged for any engineering units independently from the input totalisers.

The rate on Channel A and Channel B can be approximated, eg. litres per hour. From the rate calculation, a proportional value can also be approximated.

For models with relay or TTL outputs, each input channel also has a pulse divider feature. Each time a multiple of a preset value is counted, an output can be switched to indicate to an external device that a number of counts has been reached.

Displayable Counter Values



**EngA** and **Engb** Precise counts on Channels **A** and **b** in 12-digit scaled **Engineering** units. The 6 least significant digits are displayed.

Optional

**rtEA** and **rtEb** Scaled count **rate A** and **b** estimates with further independent rate scaling. The resolution is no better than 1 in 255. *By default, rate is measured in kHz.*

**ProP** Ratio of counts  $100\% \times \frac{EngA}{EngA+Engb}$ .

**Ltot** and **Htot** Scaled 6-digit **Low** and **High totals** (**EngA** and **Engb**). Total source can be **EngA**, **Engb**, **EngA+Engb** or **EngA-Engb**. The totaliser provides the only way of seeing the 6 high digits.

**rtot** 6-digit **total rate** approximation. Rate source can be **rtEA**, **rtEb**, **rtEA+rtEb** or **rtEA-rtEb**.

**bAt** Batch process output. This is a copy of **Ltot** which is zeroed each time the batch process is re-triggered.

**High, LoW, AV** Highest, lowest and average of **rtEA**, **rtEb**, **ProP** or **rtot**.

**CoMM** Value written to Analogue Location **3** via comms.

From the displayable values, the user can setup a normal realtime display and up to 4 alternate displays which are presented when **KEY1/2** (Function Key 1/2) or **StA 1/2** (Status Input 1/2) is activated in realtime.

Derived values

It is important to understand that in Counter Mode, the count measurements (**EngA** and **Engb**) are precise whilst the derived rate measurements (**rtEA** and **rtEb**) are estimates. If rate is the more important measurement in respect to accuracy and update speed (precise rates but approximated counts), change the input type to Frequency Mode (see *page 31*).

Derived rate values can be displayed, transmitted or have alarm actions assigned.

**For example**

You may wish to have an alarm for the rate of counts or occasionally display the current count rate.

### **Encoder Mode - EnC**

For use with applications where distance or angle measurement is the primary requirement, eg. rotary or linear incremental encoders that give a contact closure or pulsed output. Each pulse can be scaled so that the totalised values can be in engineering units.

When the input type is **EnC**, Channel A and Channel B are used together to give a single position count caled **EngA**.

Both input channels can:

- Accept pulses at a rate of up to 150KHz (a low frequency cut off is available to stop counts that are below a user definable value).
- Approximate a frequency.
- Obtain a derived total for Channel A, Channel B, Channel A - Channel B or Channel A + Channel B.

There are 4 Encoder Modes:

- **Quadrature Mode** counts the direction on Channel A controlled by the edges of Channel A and Channel B.
- **Phase Mode** counts the direction on Channel A controlled by the phase of Channel B.
- **Up/Down Mode** counts the direction of Channel A. Similar to Phase Mode but the state (on or off) of Channel B controls the direction of counts on Channel A.
- **Start/Stop Mode** controls Channel A by the state of Channel B. Similar to Phase Mode but Channel B can inhibit the counting on Channel A.

Whenever possible, use the Quadrature Mode as this gives the best resolution. Phase and Quadrature Modes are particularly useful for incremental encoders.

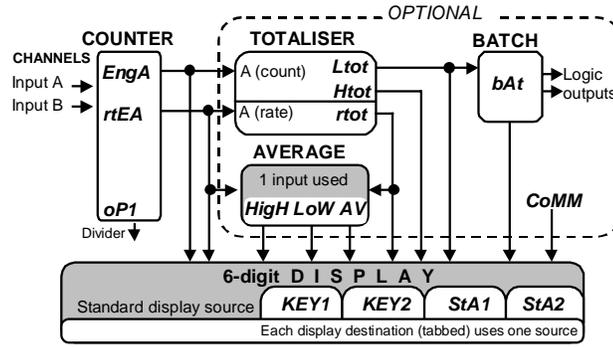
Particularly useful for rotary encoders, is the display range control, which limits the range of the display.

**For example**

If you are using a rotary encoder to display an angle, you can limit the range to 0.01 - 360.00 degrees. As the encoder passes **up** through 360.00 degrees, the display counts again from 0.01, or if the encoder passes **down** through 0.01 degrees, the display continues to count down from 360.00.

For models with relay or TTL outputs, Channel A also has a pulse divider feature. Each time a multiple of a preset value is counted, an output can be switched to indicate to an external device that a number of counts has been reached.

**Displayable Encoder Values**



**EngA** Precise encoder position in 12-digit scaled **Eng**ineering units. The 6 least significant digits are displayed.

*Optional*  
**rtEA** Scaled encoder speed estimate, with further independent rate scaling. The resolution is no better than 1 in 255. The sign indicates direction. *By default, rate is measured in kHz.*

## Getting Started - Choosing Your Application - Encoder Mode

---

<b>Ltot</b> and <b>Htot</b>	Scaled 6-digit <b>Low</b> and <b>High total</b> of encoder position ( <b>EngA</b> ). The totaliser provides the only way of seeing the 6 high digits.
<b>rtot</b>	Same as <b>rtEA</b> if totaliser enabled.
<b>bAt</b>	Zeroed <b>Ltot</b> , zeroed when the batch control process is re-triggered.
<b>High, LoW, AV</b>	Highest, lowest and average of <b>rtEA</b> or <b>rtot</b> .
<b>CoMM</b>	Value written to Analogue Location <b>3</b> via comms.

From the displayable values, the user can setup a normal realtime display and up to 4 alternate displays which are presented when **KEY1/2** (Function Key 1/2) or **StA1/2** (Status Input 1/2) is activated in realtime.

### Derived values

It is important to understand that in Encoder Mode, the position measurement (**EngA**) is precise whilst the derived rate measurement (**rtEA**) is an estimate. If rate is the more important measurement in respect to position, change the input type to Frequency Mode (see *page 31*).

Derived rate values can be displayed, transmitted or have alarm actions assigned.

### **For example**

You may wish to have an alarm for the rate of counts or occasionally display the current count rate.

### **Frequency Mode (Dual Channel) - FrEq**

For use with applications where speed or frequency measurement is the primary requirement, eg. turbine flow meters (eg. rate of litres/hour) or machinery (eg. speed RPM) that use a magnetic pickup or any sensors that give a contact closure, a pulsed output or a sine wave output. Each pulse can be scaled so that the totalised values can be in engineering units.

When the input type is **FrEq**, Channel A and Channel B measure frequencies independently.

Both of the input channels can:

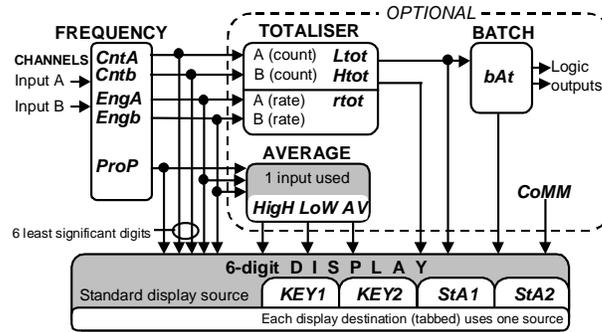
- Accept pulses at a rate of up to 150KHz (a low frequency cut off is available to stop counts that are below a user definable value).
- Scale each channel separately.
- Obtain a derived total for Channel A, Channel B, Channel A - Channel B or Channel A + Channel B.

The frequency input rates can be:

- Individually displayed.
- Displayed as a combined rate (if the engineering units are the same for both channels).

If the frequency measurement is nonlinear in respect to the required engineering units, an 8-point linearisation curve can be configured to compensate for the error.

Displayable Frequency Values



**EngA and Engb** Frequencies (or rates) on Channels **A** and **b** in 6-digit scaled **Eng**ineering units. The resolution is typically 1 in 10,000 or better but depends on the frequency. *By default, rate is measured in kHz.*

Optional

**CntA and b** 12-digit scaled **C**ount **A** and **b** estimates with further independent rate scaling. *By default, counts are measured in thousands of counts.*

**ProP** Ratio of frequencies  $100\% \times \text{EngA} / (\text{EngA} + \text{Engb})$ .

**Ltot and Htot** Scaled 6-digit **L**ow and **H**igh **t**otals (**CntA** and **Cntb**). Total source can be **CntA**, **Cntb**, **CntA+Cntb** or **CntA-Cntb**. The totaliser provides the only way of seeing the 6 high digits.

**rtot** 6-digit total rate approximations. Rate source can be **EngA**, **Engb**, **EngA+Engb** or **EngA-Engb**.

**bAt** Batch process output. This is a copy of **Ltot** which is zeroed each time the the batch process is re-triggered.

**High, Low, AV** Highest, lowest and average of **EngA**, **Engb**, **ProP** or **rtot**.

**CoMM** Value written to Analogue Location **3** via comms.

## **Getting Started - Choosing Your Application - Frequency Mode**

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From the displayable values, the user can setup a normal realtime display and up to 4 alternate displays which are presented when **KEY1/2** (Function Key 1/2) or **StA 1/2** (Status Input 1/2) is activated in realtime.

### Derived values

It is important to understand that in Frequency Mode, the frequency measurements (**EngA** and **Engb**) are precise whilst the derived count measurements (**CntA** and **Cntb**) are estimates. If count is the more important measurement in respect to accuracy and update speed (precise counts but approximated rates), change the input type to Counter Mode (see *page 25*).

Derived totalised scaled counts can be displayed, transmitted or have alarms assigned.

### **For example**

You may wish to have an alarm for the number of totalised counts or occasionally display the current count value.

### Timer Mode (Dual Channel) - *tiME*

For use with applications where timing is the primary requirement, eg. proximity sensors, external switches or any sensors that give a contact closure or a pulsed output. Each pulse can be scaled so that the totalised values can be in engineering units.

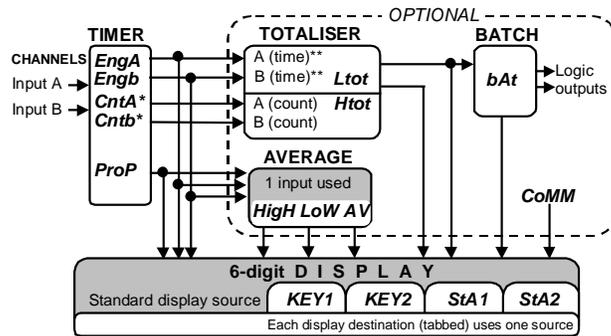
When the input type is *tiME*, Channel A and Channel B can measure time periods, pulse widths and duty cycles independently.

Both of the input channels can:

- Accept pulses at a rate of up to 150KHz (a low frequency cut off is available to stop counts that are below a user definable value).
- Scale each channel separately.
- Obtain a derived total for Channel A, Channel B, Channel A - Channel B or Channel A + Channel B.

If the frequency measurement is nonlinear in respect to the required engineering units, an 8-point linearisation curve can be configured to compensate for the error.

#### Displayable Timer Values



\* Period only. The measurement may be : period, pulse high time, pulse low time, duty high % or duty low %  
 \*\* Pulse time only.

**EngA** and **Engb** Precise times (or duty %) on Channel **A** and **b** in 6-digit scaled **Eng**ineering units. The resolution depends on the frequency and what is being timed. *By default, timings are measured in mS.*

*Optional!*

**CntA** and **b** 12-digit scaled **Count A** and **b** approximations with further independent rate scaling. If measuring period, *by default, the value is in thousands of periods.* If measuring pulse times or duty cycles, *by default, the value is in mS.*

**ProP** Ratio of timings 100%  $\text{EngA}/(\text{EngA}+\text{Engb})$ .

**Ltot** and **Htot** Scaled 6-digit **Low** and **High totals** ( $\text{EngA}+\text{Engb}$ ). Total source can be **EngA**, **Engb**,  $\text{EngA}+\text{Engb}$  or  $\text{EngA}-\text{Engb}$ . The totaliser provides the only way of seeing the 6 high digits. *By default, the total is in the same units as CntA + Cntb.*

**bAt** Batch process output. This is a copy of **Ltot** which is zeroed each time the the batch process is re-triggered.

**HigH, LoW, AV** Highest, lowest and average of **EngA**, **Engb**, **ProP** or **rtot**.

**CoMM** Value written to Analogue Location **3** via comms.

From the displayable values, the user can setup a normal realtime display and up to 4 alternate displays which are presented when **KEY1/2** (Function Key 1/2) or **StA 1/2** (Status Input 1/2) is activated in realtime.

Derived values

It is important to undersand that in Timer Mode, the timing measurements (**EngA** and **Engb**) are precise whilst the derived rate measurements (**CntA** and **Cntb**) are estimates. If rate is the more important measurement in respect to accuracy and update speed (precise rates but approximated timing), change the input type to Frequency Mode (see *page 31*).

Derived totalised scaled times can be displayed, transmitted or a have alarms assigned.

**For example**

You may wish to have an alarm for the number of scaled times or occasionally display the current time value.

## Edge Timer Mode - *Edge*

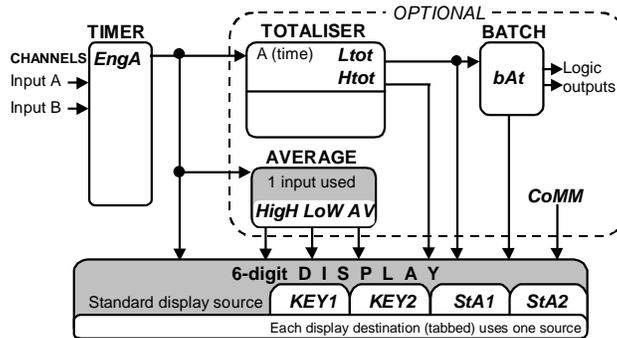
For use with applications where accurate timing between 2 sensors is the primary requirement, eg. proximity sensors, external switches or any sensors that give a contact closure or pulsed output. Each pulse can be scaled so that the totalised values can be in engineering units.

When the input type is *Edge*, Channel A and Channel B are used together to produce a single measurement from the time between a rising or falling edge on Channel A to a rising or falling edge on Channel B.

Both of the input channels can:

- Accept pulses at a rate of up to 150KHz (a low frequency cut off is available to stop counts that are below a user definable value).
- Produce accurate timing between pulse edges between Channel A and Channel B.
- Obtain a derived total for Channel A, Channel B, Channel A - Channel B or Channel A + Channel B.

### Displayable Edge Timer Values



**EngA** Precise time between edges (Channel A then Channel B) in 6-digit scaled *Eng*ineering units. The

resolution increases as the time measured increases.  
By default, time is measured in mS.

Optional

- Ltot** and **Htot** Scaled **Low** and **High** 6 digits of **total** of **EngA**. The totaliser provides the only way of seeing the 6 high digits.
- bAt** Batch process output. This is a copy of **Ltot** which is zeroed each time the the batch process is re-triggered.
- High, LoW, AV** Highest, lowest and average of successive **EngA** times.
- CoMM** Value written to Analogue Location **3** via comms.

From the displayable values, the user can setup a normal realtime display and up to 4 alternate displays which are presented when **KEY1/2** (Function Key 1/2) or **StA 1/2** (Status Input 1/2) is activated in realtime.

Derived values

It is important to understand that in Edge Timer Mode, the timing measurement (**EngA**) is precise.

Derived totalised scaled times can be displayed, transmitted or have alarms assigned.

**For example**

You may wish to have an alarm for the number of scaled times or occasionally display the current time value.

## Setting Up the Instrument

The choice of application mode is set in the first Setup Menu by the first setup option ***inPt, tYPE*** (see **Configuring the Input** on page 48). Setup the input type before anything else because:

- Setup Menus change to list only relevant setup options for the chosen input type.
- *Changing the input type causes some setup options to be defaulted to sensible values for that input type.*

### NOTE

- Most **primary input** setup is covered in the first 4 Setup Menus (see Setup Menu Structure on page 40):
  - ***InPt*** Input Menu (see page 48).
  - ***CHA*** Channel A Menu (see page 53).
  - ***CHb*** Channel B Menu (see page 53). (***CHb*** does not apply when the input type is ***EdgE***).
  - ***DiSP*** Display Menu (see page 74).
- *When the input type is changed, sensible defaults are applied to the primary input setup for immediate basic operation.*
- **Start up messages** are displayed when the instrument is turned on.
- These start up messages are followed by **displayed measurements**.
- The instrument is configured via **Setup Menus** which are accessed from the displayed measurements using the front panel keys.

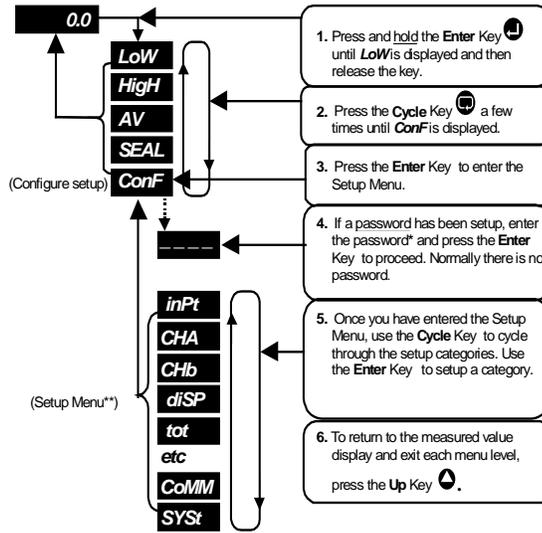
Whilst there are between 500 and 600 setup values in total, users do not need to consider each value in turn because most of these values configure optional features and much of the rest are set to sensible defaults. It is best to think of the setup as divided into groups that setup:

Inputs	4 items.
Channel A scaling	Several items.
Channel B scaling	Several items.
Display attributes	Several items.
System wide/miscellaneous setup	Several items.

Optional features

Alarms, function keys, status inputs, logic outputs, analogue output, totaliser, batch counter.

How to Enter & Exit the Setup Menus

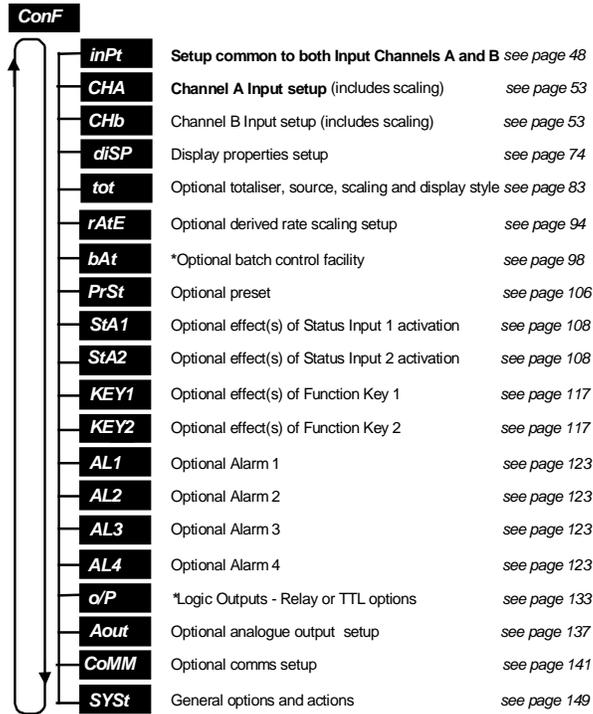


\* To enter the password, use the Up/Down Keys to edit the digit value and the Cycle Key to go to the next digit.  
 \*\* The full Setup Menu is shown on page 40.

## The Setup Menu Structure

The diagram *below* outlines the structure of the Setup Menu and the purpose of each category.

### Setup Menu Structure



\*If outputs fitted.

**NOTE**

- The instrument's basic application mode is set by the **tYPE** option in the **inPt** (Input) Menu (see **Configuring the Input** on page 48). This in turn will cause some setup categories to be omitted from the menu if they are not applicable, eg. **CHb** is absent when input type is **EdgE**.
- Most of the instrument's setup parameters are optional.
- The instrument's setup is retained even when it is switched off.
- The whole setup can be defaulted from the **SYSt** (System) Menu. Default setup ensures optional facilities are disabled and other settings are given safe settings.

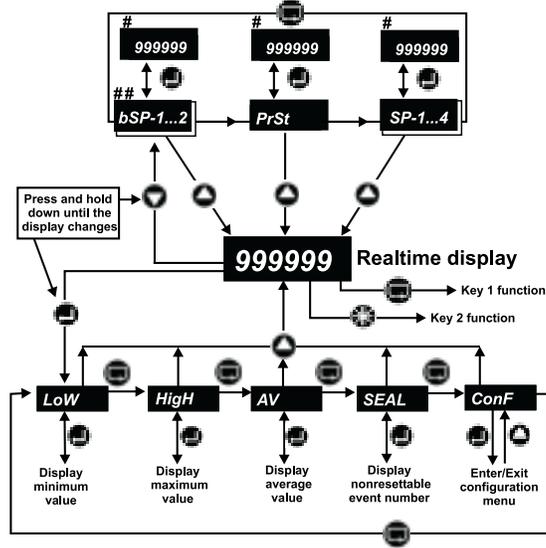
**Defaulting the Instrument**

If the instrument has been used before and you wish to return it to the factory default conditions at any time, turn the **SySt** (System) Menu **dFLt** (Default) parameter to **on** (which will automatically switch **oFF** again when the factory default parameters have been set). It is good practice to default the instrument before setting it up for a new application.

If you are using both channels and you wish to check that the sensor on Channel B is functioning correctly, set the **diSP** (Display) Menu **SorC** (Source) parameter from **EngA** to **Engb** (from engineering units on Channel A to engineering units on Channel B). This will display any counts recorded on Channel B. Once you have established that Channel B is working correctly, the **diSP**, **SorC** parameter can be returned to **EngA** if required.

## Operator Functions

All of the operator functions are described in the following section along with the key actions required. The diagram *below* shows the facilities available directly from the measured value/realtime display Operator Mode.



# Only editable if the alarm **Edit** option is **on** (see page 131). If editable, a flashing digit is displayed.

## Only displayed if the batch process has been enabled (see **Enable** on page 99).

Use the **Down Key**  to view.

Use the **Enter Key**  to edit.

**SP-1** **SP-2** **SP-3** **SP-4** Represent Alarm Setpoints 1 to 4 (see **Setpoints** on page 125).

**bSP-1** **bSP-2** Represent Batch Setpoints 1 and 2 (see **Setpoints** on page 102).

**LoW** Displays the lowest measured value/realtime display since last reset (see **Reset** on pages 114 and 122).

**High** Displays the highest measured value/realtime display since last reset (see **Reset** on pages 114 and 122).

**AV** Displays the average measured value/realtime display since last reset (see **Reset** on pages 114 and 122).

**SEAL** Refers to the calibration seal and displays a nonresettable value. Changes to any one of the setup items listed *below*, will cause the **SEAL** value to increment and thereby show that a calibration change has taken place.

**inPt** (Input) Menu

**tYPE** (Input type).

**CHA/CHb** (Channels A and B) Menus

Counter Mode

**EngA/b** (Engineering units).

**CntA/b** (Corresponding counts).

Encoder Mode

**EngA** (Engineering units).

**CntA** (Corresponding counts).

Frequency Mode

**EngA/b-1...8** (Engineering units).

**KHZA/b-1...8** (Corresponding frequencies).

Timer Mode

**EngA/b-1...8** (Engineering units).

**inPA/b-1...8** (Corresponding times).

Edge Timer Mode

**EngA** (Engineering units).

**tot** (Totaliser) Menu

**tiME** (Corresponding time).

**SorC** (Source of total value).

**P-Ld** (Preload) **EnAb** (Enable).

**dP** (Totaliser decimal point position).



## Key Functions - Menu Mode

The instrument may be configured from the measured value/realtime display using the front panel keys to enter and navigate through the multilevel menu structure.

### CAUTION

The keys have an "auto-repeat" facility whereby holding down a key for longer than necessary will have the same effect as multiple presses.

The **Enter** Key  allows access to the operator functions (**LoW**, **High** (peak) and **AV** (average) values) since last reset, **SEAL** and **ConF** (Configuration/Setup Mode). To access the operator functions, press and hold down for approximately 3 seconds until **LoW** is displayed.

When navigating through the menus, the keys perform the following functions:

The **Cycle** Key  scrolls through options at the current menu level.

The **Enter** Key  selects an option which may be a submenu or a final setting.

The **Up** Key  returns to the parent menu level. Multiple key presses will always return the instrument to the measured value/realtime display.

The menu system lists *categories* (eg. **inPt**, **CHA**, **CHb**, **diSP**). Selecting a category may lead to a subcategory, but eventually it leads to a list of configurable instrument *parameters* (eg. category **diSP** leads to parameters **SorC**, **dPCu** etc.).

When the **Enter** Key  is pressed to change a parameter, the existing *setting* is displayed. A letter or digit always flashes when a setting is on display.

Some settings are chosen from a list of settings (eg. parameter **dPCu** has 7 settings: **0**, **1**, **2**, **3**, **4**, **5**, **Auto**).

## Getting Started - Setting Up the Instrument

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Other settings are setup by editing a multidigit value (eg. **LOW** has a default numeric setting of [0000.0]).

### Selecting a Setting from a List

When the first letter or digit of a menu option flashes, it represents the setting for a parameter.

The **Cycle** Key  scrolls round the list of possible settings for the parameter.

The **Star** Key  aborts the setting selection without changing the setting.

The **Enter** Key  makes the currently displayed setting the new setting.

### Editing a Numeric Value

When the last digit of a numeric value flashes, it represents the setting for a parameter.

The flashing digit is the one that is edited by the **Up** and **Down** Keys   
.

The sign is changed by editing the most significant digit.

The **Up** Key  increments the flashing digit. If the decimal point is flashing, the decimal point moves left.

If negative values are allowed and the most significant digit is flashing, the digit rotates round the sequence: 0 1 2 3 4 5 6 7 8 9 -1 -.

The **Down** Key  decrements the flashing digit. If the decimal point is flashing, the decimal point moves right.

If negative values are allowed and the most significant digit is flashing, the digit rotates round the sequence: 9 8 7 6 5 4 3 2 1 0 - -1.

The **Cycle** Key  selects the next flashing digit to edit (the next digit left).

When the leftmost digit is reached and if the decimal point position can be changed, the decimal point flashes next.

The **Star** Key  clears the whole value to zero (if zero is a valid value).

The **Enter** Key  saves the selected parameter setting/value and exits to the parent menu.

### Key Functions - Operator Mode

Once the instrument has been configured, the operator has instant access from the measured value/realtime display to the following:

The 2 function keys: the **Cycle** Key/Function Key 1  and the **Star** Key/Function Key 2  can be configured to perform various functions. Details of the facilities available and how to configure both function keys are described later in this Guide (see **Configuring the Function Keys** on page 117).

The **Up** Key  exits from the Configuration Menus to the measured value/realtime display.

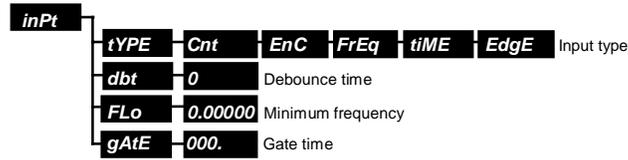
The **Down** Key  accesses the 4 alarm and 2 batch setpoints for viewing and editing if enabled (see **Edit** on page 131).

If a status input has been setup, the **Up** and **Down** Keys   when pressed together, will perform an alarm acknowledge for latched alarms and **ACK** will be displayed (see **Acknowledge Latched Alarms** and **Latching** on pages 113 and 128).

## Configuring the Input

**inPt** The Input Menu sets up the input options that are common to both Input Channels A and B and which are listed in the menu structure diagram below. All 4 parameters must be setup to avoid unwanted instrument behaviour (described where relevant).

### Input Menu Structure



**Type** *Default: Cnt (dual counters)*

**tYPE** Configures the instrument's basic mode of operation. The input type can be:

- **Cnt** Counter Mode (Dual Channel) (see page 54).
- **EnC** Encoder Mode (see page 57).
- **FrEq** Frequency Mode (Dual Channel) (see page 65).
- **tiME** Timer Mode (Dual Channel) (see page 68).
- **EdgE** Edge Timer Mode (see page 72).

A description of the displayable values for each of the 5 input types, is given in the **Getting Started** section (see pages 25 to 37).

Changing the **tYPE** setting, resets much of the instrument's other primary input setup so that the instrument is immediately ready to measure and display a relevant value for Channel A.

Analogue 62 Comms Location					Read/Write
Analogue value	0	1	2	3	4
Input type	<b>Cnt</b> Counter	<b>EnC</b> Encoder	<b>FrEq</b> Frequency	<b>tiME</b> Timer	<b>EdgE</b> Edge Timer

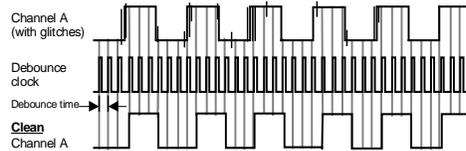
## Debounce Time

*Default: 0mS (disabled)*

**dbt** The purpose of the debounce facility is to prevent more than one count registering on Channel A or B when a mechanical switch contact opens or closes once.

Debounce works by latching the momentary states of Channels A and B every debounce time. The debounce time should be less than or equal to **half** the input signal period at least, in order to latch in both the high and low levels of an alternating signal. We recommend first trying shorter debounce times however, to guarantee all legitimate states are detected when the signal is high low.

### Debounce Operation



On each rising edge of the debounce clock, the instrument copies and latches the state of Channel A (and B) producing a **Clean** Channel A (and B). The resulting number of pulses is the same as the number input, but without the glitches caused by contact bounce. Without debounce, the glitches would be counted too.

**dbt** can be any whole number of mS (milliseconds, thousandths of a second) in the range **0** to **250**. A setting of **0** disables the debounce facility and values of **1** to **250** enable it. The setting affects both primary input Channels A and B in the same way at the same times. Small debounce times like 1 or 2mS, should be tried in favour of longer times because small debounce times reduce the chance of missing a genuine pulse, whilst often still effectively ignoring contact bounces.

The suggested relationship between maximum input frequency (count rate) and maximum debounce time is:

$$\text{Maximum debounce time in mS} = 1000 / (4 \times \text{maximum frequency in Hz})$$

### Example

If the maximum expected input frequency is 8Hz (8 counts per second), the debounce time must be under  $1000/(4 \times 8\text{Hz}) = 31\text{mS}$  (the absolute maximum). In practice, setting the debounce time to **1** or **2mS** might be tried first, progressing up to **31** only if necessary (if extra counts are being registered).

### Example

The maximum expected frequency is 800Hz (800 counts per second), the debounce time must be under  $1000/(4 \times 800\text{Hz}) = 0.3\text{mS}$ . Since this is less than 1mS, the debounce must be set to **0** (ie. disabled).

Generally, debounce should only be used (set to values above **0**) when:

- The primary input(s) are sourced from mechanical switches (including mechanical relays). Mechanical switches should not generally be switched at rates faster than about 10Hz (10 times a second).
- The instrument is attempting to measure frequencies (count rates) that are much slower than about 125Hz, eg. 10Hz (10 counts per second).

We recommend that debounce is used only when input type is **Cnt** or **EnC** as frequency and timing measurements are severely impaired by the debounce facility.

### COMMON MISTAKES:

A common mistake, is to have debounce active when attempting to measure frequencies of one or more kHz. In such a case, the primary input measurements will be completely wrong (frequencies and (up)counts will be lower than expected, and timings will be longer than expected). To reduce the chance of this mistake, the instrument disables debounce by clearing it to **0** (mS) when the input type setting is changed from **Cnt** or **EnC** to **FrEq**, **tiME** or **EdgE** (see **Type** on 48).

Another common mistake, is to estimate the debounce time based on the maximum count rate expected on just one channel. If a higher count rate is being measured on the other channel, the debounce time must be based on that other channel.

Analogue 63 Comms Location	Read/Write
Debounce time range (mS)	0 to 250

**Minimum Cut Off Frequency***Default: 0.00000Hz*

**FLo** This is the minimum frequency in Hz that the instrument will measure or count. If the instrument detects a frequency that is lower than this, no counts are accumulated, the frequency is reported as zero, and the period is reported as over range.

When **FLo** is **0**Hz, counts are never missed and the instrument attempts to measure all frequencies no matter how low. This means waiting 10 to 20 seconds for the unit to report a frequency of 0.1Hz (see **Appendix F - Mode Issues - Frequency & Period Measurement During Operation** on page 169).

Some benefits of using a cut off frequency are:

- The instrument can quickly conclude that the applied rate has stopped when it stops or is very slow.
- Extremely nonlinear frequency outputs from some transducers at low frequencies can be ignored.
- Flow totals are not affected by false residual flow measurements when the system is idle for long periods.

**FLo** affects all input **tYPE** settings except **tiME** and **EdgE**, unless period time is sought by setting the channel's **Find** parameter to **Per** (see **Type, Timing Sought** and **Edge Timing Sought** on pages 48, 68 and 72).

Analogue 65 Comms Location	Read/Write
Minimum frequency range (Hz)	0 to 9999

**Gate***Default:0 seconds*

**gAtE** Specifies the number of seconds over which pulses are counted to find their frequency and may range from **0** to **15** seconds. A setting of **0** implies a standard setting which is the same as a setting of **1** second.

The average frequency or flow rate is found over the gate time. It can be useful to specify a long gate time in order to ignore short regular periods of inactivity at the primary inputs. For example, an average flow rate over an extended time may be needed when monitoring the flow rate from a displacement pump. Increasing the gate time increases the interval

## Configuring the Input

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between meaningful display updates. If a frequency is recalculated every 10 second **gAtE** time, the display can update no faster.

Analogue 64 Comms Location	Read/Write
Gate time range (seconds)	0 to 15

## Configuring the Channels

**CHA** **CHb** The Channel Menus setup the Channel A and B options which are listed in the menu structure diagrams *below*. The Channel A and B Menus are different for each input type setting (see **Type** on *page 48*).

This section covers the whole setup for each **tYPE** setting:

- **Cnt** Counter Mode (Dual Channel) (see *page 54*).
- **EnC** Encoder Mode (see *page 57*).
- **FrEq** Frequency Mode (Dual Channel) (see *page 65*).
- **tiME** Timer Mode (Dual Channel) (see *page 68*).
- **EdgE** Edge Timer Mode (see *page 72*).

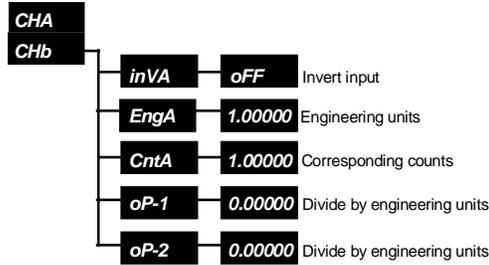
### NOTE

There is no **CHb** Menu when input type is **EdgE**.

## Counter Mode (Dual Channel) - *Cnt*

The instrument is setup for Counter Mode by setting the input type setting to **Cnt** (see **Type** on page 48). In Counter Mode, the Channel A and B Menus are the same. The Channel A Menu sets up Counter A and the Channel B Menu sets up Counter B. The suffix **A** or **B** appears in submenu texts to indicate which channel is being setup.

### Channels A & B Menu Structure In Counter Mode



#### NOTE

Assume Channel B is setup as Channel A as described *below*.

### Invert Input

*Default: Off*

**inVA on** inverts Input A so that the count increments on the falling edge of pulses instead of the rising edge.

Logic 56 Comms Location	Read/Write
On	Inverts Channel A
Off	Channel A not inverted

### Engineering Units

*Default: 1.00000*

**EngA Engb** Sets the number of engineering units corresponding to the number of counts specified by **CntA** and **Cntb** respectively. Any 6-digit value can be entered with the decimal point in any position (see **Corresponding Counts** on page 55).

**NOTE**

A negative value will make the counter count down.

Analogue 67 Comms Location		Read/Write
Integer value	Any value in the displayable range	

**Corresponding Counts**

*Default: 1.00000Counts*

**CntA** **Cntb** Defines the number of counts corresponding to the number of engineering units specified by **EngA** and **Engb** respectively. Any 6-digit value can be entered with the decimal point in any position (see **Engineering Units** on page 54).

Analogue 68 Comms Location		Read/Write
Integer value	Any value in the displayable range	

**Example**

If each pulse arriving at Channel A corresponds to 5 litres:

Set **EngA** to **5** (litres) and **CntA** to **1** (pulse)

**Divider Output**

*Default: 0.00000*

**oP-1** **oP-2** Applies to models fitted with relay or TTL outputs only. Activates the relay or TTL Output 1 or 2 every time the scaled count, in engineering units, is a multiple of this setting. Channel A uses Output 1 and Channel B uses Output 2. A value of **0.0** disables this facility.

**Important NOTE**

- The setting must correspond to a whole number of raw/unscaled counts. If it does not, the instrument will use a value that corresponds to the nearest smaller count.
- If the setting is too small or the count rate is too high, the output will stay activated all the time until the count rate slows down or stops.
- The output should not be used for another function at the same time (eg. any alarm or the batch facility).
- The relevant relay or TTL output must be setup to pulse, otherwise it will stay activated on the first multiple of this setting. This can be done with a simple high alarm (see **Configuring the Alarms** and **Pulse** on pages 123 and 135).

## Configuring the Channels - Counter Mode

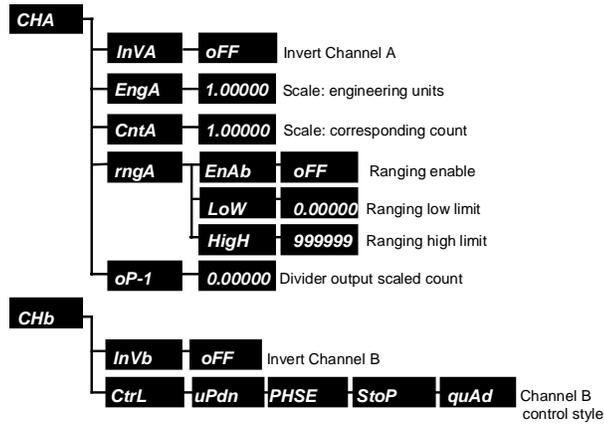
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Comms Locations		Read/Write
Analogue	Output	Scaled counts on
227	1	Channel A
228	2	Channel B

## Encoder Mode - EnC

The instrument is setup for Encoder Mode by setting the input type to **EnC** (see **Type** on page 48). In Encoder Mode, the Channel A and B Menus are different. The suffix **A** or **B** appears in some submenu texts to indicate which channel is being setup.

### Channels A & B Menu Structure in Encoder Mode



### Invert Input A

Default: Off

**inVA on** inverts Input A so that the count increments on the falling edge of pulses instead of the rising edge. Changing this parameter also changes the phase of Input A with Input B by 180°.

Logic 56 Comms Location	Read/Write
On	Inverts Channel A
Off	Channel A not inverted

### Engineering Units

Default: 1.00000

**EngA** Sets the number of engineering units corresponding to the number

of counts specified by **CntA**. Any 6-digit value can be entered with the decimal point in any position (see **Corresponding Counts** below).

### NOTE

A negative value will make the counter count down.

Analogue 67 Comms Location		Read/Write
Integer value	Any value in the displayable range	

## Corresponding Counts

*Default: 1.00000Counts*

**CntA** Defines the number of counts corresponding to the number of engineering units specified by **EngA**. Any 6-digit value can be entered with the decimal point in any position (see **Engineering Units** on page 57).

Analogue 68 Comms Location		Read/Write
Integer value	Any value in the displayable range	

### Example

If each pulse arriving at Channel A corresponds to 5 litres:

Set **EngA** to **5** (litres) and **CntA** to **1** (pulse).

## Ranging Submenu

**rngA** Ranging affects the way the encoder position measurement is displayed. The 6 least significant digits of this value are displayed.

Without ranging, the 12-digit encoder position measurement is **linear** and may increase or decrease forever until the instrument's internal 12-digit limit is reached and it restarts from zero.

With ranging, a 6-digit upper and lower limit are defined and the encoder position measurement behaves like an **angle**.

### NOTE

The user can setup the **1°** and **360°** positions to other values.

**Example**

If: Ranging is set to **1 (LoW)** and **360 (High)**  
 Moving backwards from **1** by 1  
 Changes the measurement to **360** and not **-1**

**Enable**

*Default: Off*

**EnAb on** makes the encoder position measurement behave like an angle as described *above*.

Logic 58 Comms Location	Read/Write
On	Enables ranging
Off	Disables ranging

**Range Low & High**

*Default: Low 0.00000, high 999999*

**LoW High** As described *above*, when ranging is enabled, the unscaled counts that come directly from the encoder, are limited to values between and including the **LoW** and **High** values. These limits affect the displayable range.

**Example**

If: **EngA** is set to **2**  
**CntA** is set to **1**  
**LoW** is set to **0**  
**High** is set to **99**  
 The displayable range will be **0 - 198**.

**LoW** and **High** must be integers.

During operation, zeroing a ranged value with the **A=0** or **b=0** status input/function key action sets it to the range **LoW** value (see **Zero EngA** and **Zero Engb** on *page 111*).

**Example**

On Channel A, a simple up-counter must be setup that can be stopped and started by the state of the Channel B input. The display must reset to the starting value (**20**) every 10<sup>th</sup> count, and count up as shown *below*:

Items counted: 0 1.. 9 10 11 .. 19 20 21..  
Displayed: 20 21 ..29 20 21 .. 29 20 21..

To do this:

1. Ensure:  
**inPt: tYPE** is **EnC**.  
**CHb: Ctrl** is **StoP**.  
**CHA: EngA** and **CntA** are both set to **1** (no scaling).
2. Enable ranging by setting:  
**CHA: rngA: EnAb** to **on**.
3. Set:  
**CHA: rngA: LoW** to **20**.
4. Set:  
**CHA: rngA: High** to **29**.

**Example**

This example changes this up-counter to a down-counter. The display must reset to the starting value of **29** every 10<sup>th</sup> count, and count down as shown *below*.

Items counted: 0 1.. 9 10 11 .. 19 20 21..  
Displayed: 29 28 ..20 29 28 .. 20 29 28..

To do this:

1. Ensure:  
**inPt: tYPE** is **EnC**.  
**CHb: Ctrl** is **StoP**.  
**CHA: EngA** is **-1** and **CntA** is **1** to count down.
2. Enable ranging by setting:  
**CHA: rngA: EnAb** to **on**.
3. Set:  
**CHA: rngA: LoW** to **-29**.
4. Set:  
**CHA: rngA: High** to **-20**.

Since the first example on *page 59*, the sign of **EngA** has been changed to minus, range **LoW** has been changed from **20** to **-29** and range **High** has been changed from **29** to **-20**.

Comms Locations		Read/Write
Analogue	Encoder ranging	Integer value range
244	<b>LoW</b>	-199999 to +999999
245	<b>High</b>	-199999 to +999999 (but must not be <b>LoW</b> +1)

**Important NOTE**

If the sign of the 2 scaling values are different, the sign of the **High** and **LoW** values actually used by the instrument, is always opposite the sign entered for them. Consequently, to avoid confusion, it is recommended that the sign of the 2 scaling values should always be the same. If it is necessary to change the normal count direction, try another way: eg. if the phase or state of Channel B controls count direction, invert Channel B to change the normal count direction.

**Divider Output**

*Default: 000000*

**oP-1** By setting this option to a nonzero value, the relay or TTL Output 1 is activated every time the scaled count, in engineering units, is a multiple of the setting. A value of **0.0** disables this facility.

**Important NOTE**

- The setting must correspond to a whole number of raw/unscaled counts. If it does not, the instrument will use a value that corresponds to the nearest smaller count.
- If the setting is too small or the count rate is too high, the output will stay activated all the time until the count rate slows down or stops.
- The output should not be used for another function at the same time (eg. any alarm or the batch facility).
- The relevant relay or TTL output must be setup to pulse, otherwise it will stay activated on the first multiple of this setting. This can be done with a simple high alarm (see **Configuring the Alarms** and **Pulse** on pages 123 and 135).

Comms Locations		Read/Write
Analogue	Output	Scaled counts on
227	1	Channel A
228	2	Channel B

### Invert Input B

Default: Off

**inVb** Changing **inVb** reverses the control action specified in the **Ctrl** option of the Channel B Menu (see **Control Style Channel B** below) as follows:

- **UPdn inVb** reverses the effect of Input B on the direction of the count.
- **PHSE inVb** reverses the effect of Input B on the direction of the count.
- **StoP inVb** reverses the effect of Input B on whether the counter stops or counts.
- **quAd inVb** reverses the effect of Input B on the direction of the count.

Use **inVb** if the encoder always counts in the wrong direction or stops when it should not and vica versa.

Logic 57 Comms Location	Read/Write
On	Inverts Channel B
Off	Channel B not inverted

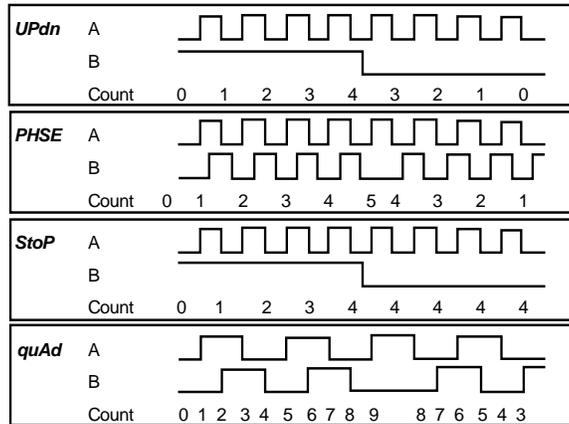
### Control Style Channel B

Default: Updown

**Ctrl** Defines how Channel B affects counting. The option chosen should depend of the type of encoder employed:

- **UPdn** The state of Channel B controls the direction of count.
- **PHSE** The phase of Channel B with Channel A controls the direction of count.
- **StoP** The state of Channel B controls whether counting stops or not.
- **quAd** The phase of Channel A with Channel B controls the direction of count. The resolution is 4 counts per pulse.

Summary of Encoder Control Styles



When the control style is **uPdn** and **inVb** is **oFF**, the counter counts up when Input B is high (Input B voltage higher than  $V_B$ ) and counts down when Input B is low.

When the control style is **PHSE** and **inVb** is **oFF**, the counter counts up if Input A rises when Input B is low (Input B voltage lower than  $V_B$ ) and counts down if Input A falls when Input B is low. In other words, **EngA** counts up when the **phase** of Input B lags Input A by  $90^\circ$  and counts down when the phase of Input B leads Input A by  $90^\circ$ . In this phase configuration, the number of pulses on Input A is accumulated. Negative increments are accumulated when the direction is reversed.

When the control style is **StoP** and **inVb** is **oFF**, the counter counts when Input B is high (Input B voltage higher than  $V_B$ ), and stops counting when Input B is low. The count **direction** is set by editing the sign of **CHA**, **EngA**. However, if ranging is also enabled, the sign of **rngA**, **LoW** and **HigH** must also be changed. Furthermore, it may be necessary to change **rngA**, **HigH** and/or **LoW** by 1 (see **Engineering Units** and **Enable** on pages 57 and 59).

## Configuring the Channels - Encoder Mode

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When the control style is **quAd** and **inVb** is **oFF**, the counter counts up in any of the following conditions:

1. Input B rises when Input A is high.
2. Input B falls when Input A is low.
3. Input A rises when Input B is low.
4. Input A falls when Input B is high.

The counter counts down in any of the following conditions:

1. Input B falls when Input A is high.
2. Input B rises when Input A is low.
3. Input A falls when Input B is low.
4. Input A rises when Input B is high.

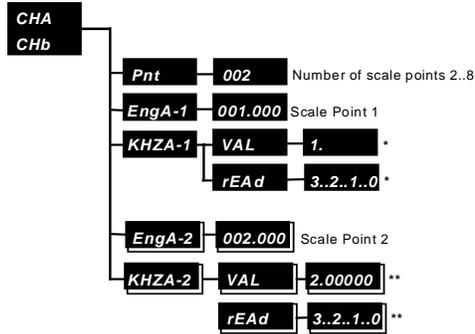
In other words, **EngA** counts the total number of edges on Input A and Input B and the sign (polarity) of this number is determined by the phase difference between the 2 inputs, ie. **EngA** counts up when the phase of Input B lags Input A by  $90^{\circ}$  and counts down when Input B leads Input A by  $90^{\circ}$ .

Analogue 246 Comms Location				Read/Write
Analogue value	0	1	2	3
Control style	<b>UPdn</b>	<b>PHSE</b>	<b>StoP</b>	<b>quAd</b>

### Frequency Mode (Dual Channel) - FrEq

The instrument is setup for Frequency Mode by setting the input type to **FrEq** (see **Type** on page 48). In Frequency Mode, the Channel A and B Menus are different. The suffix **A** or **B** appears in some submenu texts to indicate which channel is being setup.

#### Channels A & B Menu Structure in Frequency Mode

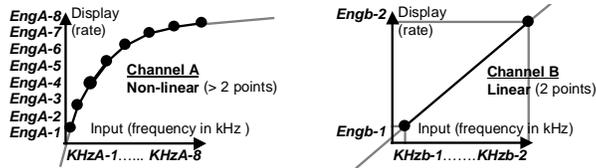


\* Scale Point 1 options  
 \*\* Scale Point 2 options

### Number of Scale Points Default: 2 (linear scale)

**Pnt** Sets the number of scale points which may range from 2 to 8. It is possible to specify up to 8 scale points for each channel as illustrated for Channel A, to allow linearisation of, eg. frequencies. For nonlinearisation measurement, as illustrated for Channel B, consider a scale point as a dot on a graph. The position of each point is identified by a **frequency** in kHz (**KHZb-1**) and a corresponding **display value** in engineering units (**Engb-1**). At least 2 points are needed to draw a straight line between them. For any position along the resulting line, there is an input frequency in kHz and a displayed value in engineering units. This is how we define the engineering units for any input frequency (see **Engineering Units and Corresponding Frequencies** on page 66).

Linearisation of Frequencies for Channels A & B



Comms Locations		Read/Write	
Analogue	66	83	
Channel	Channel A	Channel B	
Analogue value range	2 to 8		

Engineering Units

Default EngA-1 to 8: 1, 2, 3, 4, 5, 6, 7, 8 kHz

**EngA-1..8** Sets the number of engineering units corresponding to the frequencies specified by **KHZA-1...8** respectively. The resulting pairs of values identify the scale points. **EngA-1...8** may be any value in the displayable range set by the **dP** setting in the **diSP** (Display) Menu (see **Decimal Point Position** on page 76). The decimal point position is not normally editable. *By default, the engineering units and input units for each point are the same to ensure 1:1 scaling* (see **Number of Scale Points** and **Corresponding Frequencies** and on page 65 and below).

Analogue Comms Locations		Read/Write	
Analogue value	Channel A	Analogue value	Channel B
67	<b>EngA-1</b>	84	<b>Engb-1</b>
69	<b>EngA-2</b>	86	<b>Engb-2</b>
71	<b>EngA-3</b>	88	<b>Engb-3</b>
73	<b>EngA-4</b>	90	<b>Engb-4</b>
75	<b>EngA-5</b>	92	<b>Engb-5</b>
77	<b>EngA-6</b>	94	<b>Engb-6</b>
79	<b>EngA-7</b>	96	<b>Engb-7</b>
81	<b>EngA-8</b>	98	<b>Engb-8</b>

Corresponding Frequencies

Default: kHzA-1 to 8: 1, 2, 3, 4, 5, 6, 7, 8 kHz

**KHZA-1..8** Defines the frequencies corresponding to the number of

engineering units specified by **EngA-1...8** respectively. The resulting pairs of values identify the scale points. **KHZA-1...8** may be any value in kHz, that the instrument is capable of measuring, ie. any frequency below 500kHz. **KHZA-1...8** may be specified by editing a number from the **VAL** option or by sampling a frequency from the **rEAd** option (see **Number of Scale Points** and **Engineering Units** on pages 65 and 66).

**Value**

*Default: kHzA-1 to 8: 1,2,3,4,5,6,7,8kHz*

**VAL** Enables editing of a scale point's frequency in kHz.

**Read**

**rEAd** Reads the frequency in kHz, corresponding to the engineering units (**Eng**) specified for the point. It is necessary to ensure the correct frequency signal is applied to the relevant channel input when the **rEAd** prompt is on the display.

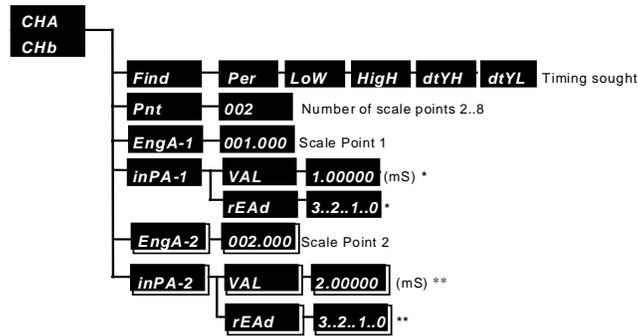
To begin sampling the frequency, press the instrument's **Enter** Key when **rEAd** is on display. The display will count down from **3, 2, 1, 0**. When the **3** to **0** sampling display stops counting, the measured frequency is displayed for the user to acknowledge. Check the value looks correct and press the **Enter** Key to return to the **KHZA-1...8** display. If no signal is applied or the frequency is below 0.3Hz, the count will continue to descend through negative numbers and if it does not stop, the applied frequency is either 0Hz or very slow indeed. If the value is wrong, adjust the signal source and resample it or supply the frequency by editing it from the **VAL** prompt, as shown *above*.

Analogue Comms Locations		Read/Write	
Analogue value	Channel A	Analogue value	Channel B
68	<b>KHZA-1</b>	85	<b>KHZb-1</b>
70	<b>KHZA-2</b>	87	<b>KHZb-2</b>
72	<b>KHZA-3</b>	89	<b>KHZb-3</b>
74	<b>KHZA-4</b>	91	<b>KHZb-4</b>
76	<b>KHZA-5</b>	93	<b>KHZb-5</b>
78	<b>KHZA-6</b>	95	<b>KHZb-6</b>
80	<b>KHZA-7</b>	97	<b>KHZb-7</b>
82	<b>KHZA-8</b>	99	<b>KHZb-8</b>

## Timer Mode (Dual Channel) - *tiME*

The instrument is setup for Timer Mode by setting the input type to ***tiME*** (see **Type** on page 48). In Timer Mode, the Channel A and B Menus are the same. The suffix **A** or **b** appears in some submenu texts to indicate which channel is being setup.

### Channels A & B Menu Structure in Timer Mode



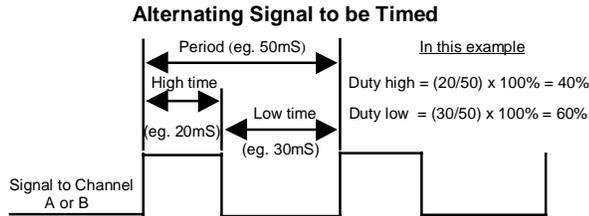
\* Scale Point 1 options  
\*\* Scale Point 2 options

### Timing Sought

*Default: Period*

**Find** Defines which attribute of an alternating signal should be timed.  
The choices are:

- **PER** Period (the time between rising edges of a waveform).
- **LoW** Low time (the duration of the low-going pulses).
- **High** High time (the duration of the high-going pulses).
- **DtYH** Duty high percent (the ratio: high time divided by period [x 100%]).
- **DtYL** Duty low percent (the ratio: low time divided by period [x 100%]).



**NOTE**

When the totaliser is enabled (see **Enable** on page 85):

- If timing **PER** (**period**), the number of thousands of periods is passed to the totaliser (assuming the period is timed in mS (milliseconds, thousandths of a second) as by default).
- If **LOW** or **HIGH** (**time**) is sought, the total low or high time is totalised.
- If **DtYH** or **DtYL** (**duty cycle**) is timed, nothing is totalised.
- The totaliser rate output **rtot** cannot be used when input **tYPE** is **tiME**.

Comms Locations			Read/Write		
Analogue	249		250		
Channel	Channel A		Channel B		
Analogue value	0	1	2	3	4
Timing sought	<b>PER</b>	<b>LOW</b>	<b>HIGH</b>	<b>DtYH</b>	<b>dtYL</b>

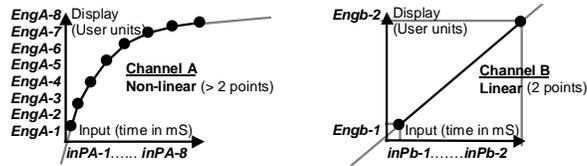
**Number of Scale Points**

*Default: 2 (linear scale)*

**Pnt** Sets the number of scale points which may range from 2 to 8. It is possible to specify up to 8 scale points for each channel, as illustrated for Channel A, to allow linearisation of, eg. times to engineering units. For nonlinearisation measurement, as illustrated for Channel B, consider a scale point as a dot on a graph. The position of each point is identified by a **time** in mS (**inPb-1**) and a corresponding **display value** in engineering units (**Engb-1**). At least 2 points are needed to draw a straight line between them. For any position along the resulting line, there is an input time in mS and a displayed value in engineering units. This is how we

define the engineering units for any input time (see **Engineering Units** and **Corresponding Input Times** below and on page 71).

**Linearisation of Times for Channels A & B**



Comms Locations		Read/Write
Analogue	66	83
Channel	Channel A	Channel B
Analogue value range	2 to 8	

**Engineering Units**

Default EngA-1 to 8: 1, 2, 3, 4, 5, 6, 7, 8 mS

**EngA-1..8** Sets the number of engineering units corresponding to the times specified by **inPA-1...8** respectively. The resulting pairs of values identify the scale points described above. **EngA-1...8** may be any value in the displayable range set by the **dp** setting in the **diSP** (Display) Menu (see **Decimal Point Position** on page 76). The decimal point position is not normally editable. *By default, the engineering units and input units for each point are the same to ensure 1:1 scaling* (see **Number of Scale Points** and **Corresponding Frequencies** on pages 69 and 71).

Analogue Comms Locations		Read/Write	
Analogue value	Channel A	Analogue value	Channel B
67	<b>EngA-1</b>	84	<b>Engb-1</b>
69	<b>EngA-2</b>	86	<b>Engb-2</b>
71	<b>EngA-3</b>	88	<b>Engb-3</b>
73	<b>EngA-4</b>	90	<b>Engb-4</b>
75	<b>EngA-5</b>	92	<b>Engb-5</b>
77	<b>EngA-6</b>	94	<b>Engb-6</b>
79	<b>EngA-7</b>	96	<b>Engb-7</b>
81	<b>EngA-8</b>	98	<b>Engb-8</b>

**Corresponding Input Times** *Default: inPA-1 to 8: 1, 2, 3, 4, 5, 6, 7, 8mS*

**inPA-1..8** Defines the times corresponding to the number of engineering units specified by **EngA-1..8** respectively. The resulting pairs of values identify the scale points. **inPA-1..8** may be any value in mS (thousandths of a second), that the instrument is capable of measuring, ie. any time greater than 2 uS (microseconds, millionths of a second). **inPA-1..8** may be specified by editing a number from the **VAL** option or by sampling a time from the **rEAd** option (see **Number of Scale Points** and **Engineering Units** on pages 69 and 70).

**Value** *Default inPA-1 to 8: 1,2,3,4,5,6,7,8mS*

**VAL** Enables editing of a scale point's time in mS.

**Read**

**rEAd** Reads the time in mS, corresponding to the engineering units (**Eng**) specified for the point. It is necessary to ensure the correct timing signal is applied to the relevant channel input when the **rEAd** prompt is on the display.

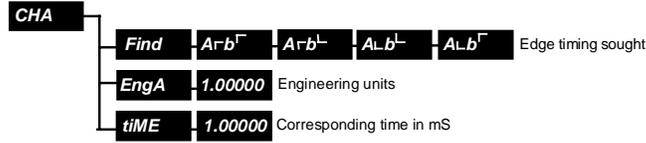
To begin sampling the time, press the instrument's **Enter** Key when **rEAd** is on display. The display will count down from **3** to **0** during which, the input is sampled. The measured time is displayed for the user to acknowledge. Check the value looks correct and press the **Enter** Key to return to the **inPA-1..8** display. If no signal is applied or the time is above 3 seconds, the count will continue to descend through negative numbers. If the value is wrong, adjust the signal source and resample it or supply the time by editing it from the **VAL** prompt, as shown above.

Analogue Comms Locations			Read/Write
Analogue value	Channel A	Analogue value	Channel B
68	<b>inPA-1</b>	85	<b>inPb-1</b>
70	<b>inPA-2</b>	87	<b>inPb-2</b>
72	<b>inPA-3</b>	89	<b>inPb-3</b>
74	<b>inPA-4</b>	91	<b>inPb-4</b>
76	<b>inPA-5</b>	93	<b>inPb-5</b>
78	<b>inPA-6</b>	95	<b>inPb-6</b>
80	<b>inPA-7</b>	97	<b>inPb-7</b>
82	<b>inPA-8</b>	99	<b>inPb-8</b>

### EdgeTimer Mode - *Edge*

The instrument is setup for Edge Timer Mode by setting the input type to **Edge**. In Edge Timer Mode, only the Channel A Menu is visible (see **Type** on page 48).

#### Channel A Menu Structure in Edge Timer Mode

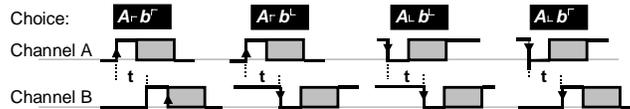


### Edge Timing Sought

*Default:  $A\uparrow b\uparrow$*

**Find** Defines which edges on Channel A-then-B are timed, as indicated by time **t**, in the diagram below.

#### Edges to be Timed



It does not matter if the Channel A pulse ends before or after the Channel B pulse begins or ends, but Channel B must be as shown when the sought edge on Channel A occurs or the display will not be updated. The sought edge is marked with an arrow on Channel A.

Analogue	252	Comms	Locations	Read/Write
Analogue value	0	1	2	3
Edges on A-then-B	$A\uparrow b\uparrow$	$A\uparrow b\downarrow$	$A\downarrow b\downarrow$	$A\downarrow b\uparrow$

### Engineering Units

*Default: 1.00000mS*

**EngA** Sets the number of engineering units corresponding to the time specified by **tiME**. Any 6-digit value can be entered with the decimal point in any position (see **Corresponding Time** below).

**NOTE**

A negative value will negate the measurement.

Analogue 67 Comms Location		Read/Write
Integer value	Any value in the displayable range	

**Corresponding Time**

*Default: 1.00000mS*

**tiME** Defines the time corresponding to the number of engineering units specified by **EngA**. Any 6-digit value can be entered with the decimal point in any position (see **Engineering Units** on page 72).

**NOTE**

A negative value should not be entered.

Analogue 68 Comms Location		Read/Write
Integer value	Any value in the displayable range	

**Example**

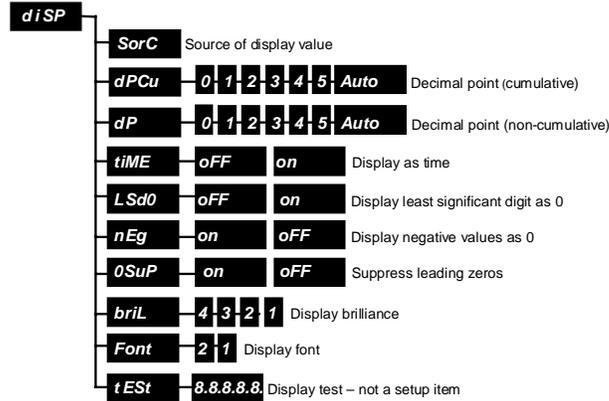
If each millisecond timed corresponds to 5 engineering units:

Set **EngA** to **5** (Engineering units) and **tiME** to **1** (mS)

## Configuring the Display

**diSP** The Display Menu sets up the display options which are listed in the menu structure diagram below.

Display Menu Structure



### Source Value

*Default: EngA (in Counter Mode)*

**SorC** Defines the value normally displayed during operation of the unit. The choices controlled by the **tYPE** option in the **inPt** Menu are different for each basic mode of operation. A description of the displayable values for each of the 5 basic modes of operation is given in the **Getting Started** section (see pages 25 to 37 and **Type** on page 48).

**EngA** is the Channel A measurement in scaled engineering units, ie.

- Count in **Counter** and **Encoder Modes**.
- Frequency in **Frequency Mode**.
- Time in **Time** and **Edge Timer Modes**.

Display Sources in Each Mode

<b>SorC</b>	<i>EngA</i>	<i>Engb</i>	<i>rtEA</i>	<i>rtEb</i>	<i>ProP</i>	<b>Cnt</b>
	<i>High</i>	<i>LoW</i>	<i>AV</i>	<i>Htot</i>	<i>Ltot</i>	Counter Mode
	<i>rtot</i>	<i>bAt</i>	<i>CoMM</i>			
	<i>EngA</i>	<i>rtEA</i>	<i>High</i>	<i>LoW</i>	<i>AV</i>	<b>EnC</b>
	<i>Htot</i>	<i>Ltot</i>	<i>rtot</i>	<i>bAt</i>	<i>CoMM</i>	Encoder Mode
<i>EngA</i>	<i>Engb</i>	<i>CntA</i>	<i>Cntb</i>	<i>Prop</i>	<b>FrEq</b>	
<i>High</i>	<i>LoW</i>	<i>AV</i>	<i>Htot</i>	<i>Ltot</i>	Frequency Mode	
<i>rtot</i>	<i>bAt</i>	<i>CoMM</i>				
<i>EngA</i>	<i>Engb</i>	<i>ProP</i>	<i>High</i>	<i>LoW</i>	<b>tiME</b>	
<i>AV</i>	<i>Htot</i>	<i>Ltot</i>	<i>bAt</i>	<i>CoMM</i>	Timer Mode	
<i>EngA</i>	<i>High</i>	<i>LoW</i>	<i>AV</i>	<i>Htot</i>	<b>EdgE</b>	
<i>Ltot</i>	<i>bAt</i>	<i>CoMM</i>			Edge Timer Mode	

When the display source is **High**, **LoW** or **AV**, the instrument displays the highest, lowest or average of the category selected by the **SYSt**, **AV** option (see **Average Source** on page 150).

**Important NOTE**

- The **SYSt**, **AVti** option also affects the **AV** value (see **Averaging Time** on page 150).
- The **rSEt** option in the **StA1/StA2** and **KEY1/KEY2** Menus also effects the **High**, **LoW**, and **AV** values (see **Reset High, Low & Average** on pages 114 and 122).

Display sources **Htot**, **Ltot** and **rtot** are outputs from the optional totaliser and should only be used if the totaliser is enabled (see **Enable Totaliser** on page 85).

**bAt** is a measurement produced by the optional batch facility. It derives its input from the optional totaliser output. The batch facility and the totaliser must be enabled for this display source to be valid (see **Enable** on pages 85 and 99).

When the display source is **CoMM**, the instrument displays a value

## Configuring the Display

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received via comms.

To change the displayed value to **50**, write to Analogue Location **3**.

### Example

Send ;001 SA 3 50<CR><LF>

Analogue 53 Comms Location					Read/Write	
Analogue value	0	1	2	3	4	
Display source	Input	High	Low	Average	Comm	

### Decimal Point Position

*Default: dPCu=0, dP=3*

**dPCu** Aligns the decimal point position for cumulative value displays, eg. scaled counts and encoder position.

**dP** Aligns the decimal point position for all noncumulative value displays, eg. rates, pulse-high-times and ratios.

The **dPCu** and **dP** settings are:

Setting	Display Format	Example 12.688 will be displayed as
<b>0</b>	<b>0</b>	<b>13</b>
<b>1</b>	<b>0.0</b>	<b>12.7</b>
<b>2</b>	<b>0.00</b>	<b>12.69</b>
<b>3</b>	<b>0.000</b>	<b>12.688</b>
<b>4</b>	<b>0.0000</b>	<b>12.6880</b>
<b>5</b>	<b>0.00000</b>	<b>oVEr</b> (see page 79)
<b>Auto</b>	<i>6 most significant digits</i>	<b>12.6880</b>

Leading **0s** are shown if **0SuP** is **oFF** (see **Leading Zero Suppression** on page 81).

Settings **0** to **5** fix the decimal point position. **Auto** lets the decimal point

move so that the 6 most significant digits are always displayed.

**Example**

Value	Auto Display Format	
123.45678	<b>123.457</b>	6 <sup>th</sup> digit is rounded up
0.0045678	<b>0.00457</b>	0s after the point are significant
-0.12345678	<b>-0.12345</b>	6 <sup>th</sup> digit is still rounded up
-123.45678	<b>-123.457</b>	-1 is a single character

**The Effect of *dPCu* and *dP* on the Display Range**

The highest and lowest displayable values for each *dPCu* and *dP* setting are:

Setting	Display Format	
	Highest	Lowest
<i>0, Auto</i>	<b>-199999</b> (-1 is a single character)	<b>999999</b>
<i>1</i>	<b>-19999.9</b>	<b>99999.9</b>
<i>2</i>	<b>-1999.99</b>	<b>9999.99</b>
<i>3</i>	<b>-199.999</b>	<b>999.999</b>
<i>4</i>	<b>-19.9999</b>	<b>99.9999</b>
<i>5</i>	<b>-1.99999</b>	<b>9.99999</b>

Cumulative values are treated differently to noncumulative values when they are outside the displayable range which has been defined by the appropriate decimal point settings.

***dPCu***

The displayable range of cumulative values is set by the *dPCu* parameter. When cumulative values are outside the displayable range, the instrument simply displays the 6 least significant digits to the set number of decimal places.

**Example****dPCu** setting = 0Largest displayable value = **999999**

Cumulative Value	Display Format	
999999	<b>999999</b>	(Largest displayable value)
1000000	<b>000000</b>	(Leading 0s indicate unseen 1)
1000001	<b>000001</b>	(Internal value is still 1000001)

**Example****dPCu** setting = 1Largest displayable value = **99999.9**

Cumulative Value	Display Format	
99999.9	<b>99999.9</b>	(Largest displayable value)
100000.0	<b>00000.0</b>	(Leading 0s indicate unseen 1)
100000.1	<b>00000.1</b>	(Internal value is still 1000001)

A cumulative value is stored internally as a 12-digit value but only the last 6 digits are displayed unless fed to the totaliser which can display both the most significant and the least significant digits (see **Configuring the Totaliser** on page 83).

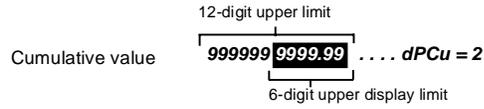
The totaliser output (**Htot** and **Ltot**) is displayed with its own decimal point value which is set from the **dP** option in the **tot** (Totaliser) Menu. The totaliser therefore uses its own **dP** setting when displaying the least significant half of totals (see **Totaliser Decimal Point Position** on page 92).

The 6-digit display and the internal 12-digit cumulative value have maximum limits both set by **dPCu**.

**Example**

**dPCu** setting = 2

The internal count rolls over from 9999999999.99 to 0000000000.01 when 0.02 is added, so the 12-digit internal maximum limit is 9999999999.99 whilst the top display limit is **9999.99** (the last 6 digits of the 12-digit maximum).



The totaliser can accept the whole 12 digits of a cumulative value and display it in 2 halves.

**dP**

The displayable range of noncumulative values is set by the **dP** parameter. When noncumulative values exceed the largest displayable value, **oVER** is displayed. When noncumulative values are below the smallest displayable value, **undEr** is displayed.

**NOTE**

- Setting the decimal point position to **Auto**, has the advantages of showing the widest range of values (**-199999** to **999999**) and the digits to the right of the decimal point whenever there is room, eg. **3.14159**.
- If the decimal point keeps changing position during operation, there is a danger of misreading the displayed value by a factor of 10 or even 100.

Analogue Comms Locations						Read/Write		
Analogue		54				55		
Decimal point option		<b>dP</b>				<b>dPCu</b>		
Analogue value		0	1	2	3	4	5	6
Digits to right of decimal point		0	1	2	3	4	5	Auto

**Display as Time**

*Default: Off*

**tiME** When **on**, the instrument takes the integer part of the

## Configuring the Display

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measurement, rounds it up if necessary, assumes it represents seconds, and converts the resulting seconds into hours, minutes and seconds.

### Example

150.0 seconds is displayed as **00.02.30** (0 hours, 2 minutes, 30 seconds).

It is essential to scale measurements so that the engineering units are seconds, especially since *by default, timings are in mS* (milliseconds, thousandths of a second).

The maximum time is **99.59.59** (99 hours, 59 minutes and 59 seconds or 359999 seconds). Greater values cause **oVER** to be displayed.

The minimum time is **-19.59.59** (minus 19 hours, 59 minutes and 59 seconds or -71999 seconds). Smaller values (nearer minus infinity) cause **undEr** to be displayed.

The time display format is not affected by either of the **dPCu** or **dP** decimal places setup.

### CAUTION

The underlying number of seconds will still rollover to zero when the internal 12-digit cumulative maximum is exceeded. For instance, if **dPCu** is **5** giving a maximum internal time of 999999 9.99999 seconds, the time display will not show **oVER** for the next 359999 seconds. If this is a problem, then assuming cumulative times only rise, a latching alarm can be setup to activate when the count first reaches 360000 (or 999999) seconds. An active alarm now indicates the time display is invalid (see **Latching** on *page 128*).

Logic 51 Comms Location	Read/Write
On	Seconds displayed as <b>hh.mm.ss</b>
Off	Seconds displayed as ssssss

### Least Significant Digit Zero

*Default: Off*

**LSd0** *on* enables the rightmost digit to be displayed as **0**.

**Example**

234.567 is displayed as **234.570**

**NOTE**

The next digit is rounded up if the digit replaced by zero was 5 or more.

Logic 49 Comms Location		Read/Write
On	Least significant digit displayed as <b>0</b>	
Off	Normal display	

**Negative Values**

*Default: On*

**nEg** **on** allows negative values to be displayed. When **oFF**, negative values are displayed as **0**.

Logic 50 Comms Location		Read/Write
On	Negative values displayed	
Off	Negative values displayed as <b>0</b>	

**Leading Zero Suppression**

*Default: On*

**oSuP** Leading zeros are not shown when **oSuP** is **on**. However, when a cumulative value exceeds 6 digits in length, the 6 least significant digits that are displayed are always visible, even if they start with zeros.

**Example**

1000002 is displayed as **000002** rather than **2**.

Logic 48 Comms Location		Read/Write
On	Leading zeros not displayed	
Off	Leading zeros displayed	

**Brilliance**

*Default: 4 (brightest)*

**bril** Adjusts the display brightness between **1** (dimmet) and **4** (brightest).

Analogue 57 Comms Location				Read/Write
Analogue value	0	1	2	3
Brilliance setting	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>

## Configuring the Display

---

### Font

Default: 2

**Font** Selects one of 2 fonts.

#### NOTE

- The appearance of the digits **6**, **7** and **9** are affected by the font selection.
- Font 1 displays **6** and **b** in the same format.

Logic 47 Comms Location		Read/Write
On	Font 2	976
Off	Font 1	97b

### Test

**tEst** Press the **Enter** Key to test that all display segments light. The correct test display is illustrated *below*. Press the **Enter** Key again to proceed.

**88888**

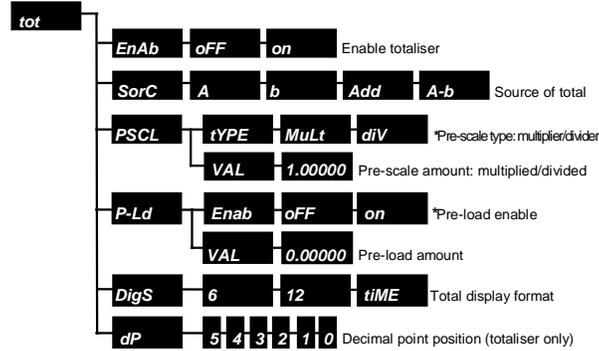
#### NOTE

This is not a setup item.

# Configuring the Totaliser

**tot** The Totaliser Menu sets up the totaliser options which are listed in the menu structure diagram *below*.

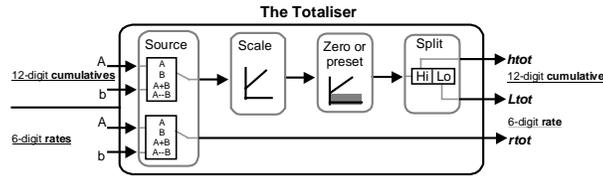
## Totaliser Menu Structure



Optional

The diagram *below* and the table *overleaf* illustrate how the totaliser produces a single 12-digit cumulative total value in 2 halves **Htot** (the 6 most significant digits) and **Ltot** (the 6 least significant digits). In some cases the totaliser also produces a single rate value **rtot** as shown *below*.

## The Totaliser



## Configuring the Totaliser

The values input to the totaliser depend on the basic *inPt, tyPE* setting. The **Accumulated** columns in the table *below* show which values are always fed to the totaliser for each particular input type setting (see **Type** on *page 48*).

Input Table

Input Type	Totaliser Inputs			
	Accumulated		Rate	
	A	B	A	B
<b>Cnt</b>	<b>EngA</b> <i>Counts</i>	<b>Engb</b> <i>Counts</i>	<b>rtEA</b> <i>KHz</i>	<b>rtEb</b> <i>KHz</i>
<b>EnC</b>	<b>EngA</b> <i>Counts</i>	-----	<b>rtEA</b> <i>KHz</i>	-----
<b>FrEq</b>	<b>CntA</b> <i>Thousands</i>	<b>Cntb</b> <i>Thousands</i>	<b>EngA</b> <i>KHz</i>	<b>Engb</b> <i>KHz</i>
<b>tiME</b> Period	<b>CntA</b> <i>Thousands</i>	<b>Cntb</b> <i>Thousands</i>	-----	-----
High Low	<b>EngA</b> <i>mS</i>	<b>Engb</b> <i>mS</i>	-----	-----
Duty high Duty low	-----	-----	-----	-----
<b>EdgE</b>	<b>EngA</b> <i>mS</i>	-----	-----	-----

### NOTE

- The table shows the default units in *italics* below each of the totaliser input types.
  - *Counts* are the cumulative number of periods or cycles.
  - *Thousands* are thousands of counts.
  - *mS* (milliseconds) are the most recent noncumulative timing.

- See the whole 12-digit total for **Htot** and **Ltot**, and not just the 6 least significant digits.
- Scale the total for display in other units (see **Prescale Submenu** and **Preload Submenu** on page 88).
- Show the total in **hh.mm.ss** format or to different decimal places (see **Digits Display Format** and **Totaliser Decimal Point Position** on pages 89 and 92).
- Add or subtract totalised Channel A and B values (see **Source of Total Value** on page 86).
- Independently zero or preset the total (see **Zero Grand Total: Htot & Ltot** on pages 85 and 119).

In addition to the capabilities described *above*, the totaliser accumulates the timings when the its input is a noncumulative timing in mS (milliseconds, thousandths of a second).

If rate measurements for Channels A and B are available, the totaliser will add or subtract the Channel A and B rates giving a net rate. Rate measurements are available only when the input is setup to count or measure rate, ie. when input **typE** is **Cnt**, **Enc** or **FrEq**.

#### **Important NOTE**

- The totaliser must be enabled to use the batch control facility (see **Enable Totaliser** and **Configuring the Batch Control Function** *below and* on page 98).

#### **Enable**

*Default: Off*

**EnAb** Enables the totaliser so that the output values **Htot**, **Ltot** and **rtot** described *above*, are valid for use. These totaliser outputs may be selected from the following menus:

- The **diSP**, **SorC** Menu (see **Source Value** on page 74).
- The **StA1/StA2**, **diSP** Menus (see **Display Alternative Value** on page 109).
- The **KEY1/KEY2**, **diSP** Menus (see **Display Alternative Value** on page 118).
- The **AL1/AL2/AL3/AL4**, **SorC** Menus (see **Source Value** on page 126).

- The **Aout, SorC** Menu (see **Source Value** on page 138).
- The **SYSt, AV** Menu (see **Average Source** on page 150).

### NOTE

The totaliser must be enabled to use the batch control facility (see **Enable Totaliser** on page 85).

Logic 196 Comms Location	Read/Write
On	Enables totaliser
Off	Disables totaliser

### Source of Total Value

*Default:A*

**SorC** Defines which channel or combination of channels the grand total (**Htot** and **Ltot**) and the grand total rate (**rtot**) are derived from. The choices are:

- **A** Channel A total.
- **b** Channel B total.
- **Add** Channel A total + Channel B total.
- **A-b** Channel A total - Channel B total.

In the following examples, it is useful to refer to the diagrams in the **Getting Started** section (see pages 25 to 37). They describe where the totals come from and what the names of the data values mean. A flow diagram of the totaliser can be found on page 83.

#### Counter Mode Example

If the totaliser source is set to **A-b**, the grand total (**Htot** and **Ltot**) is **EngA - Engb** but with further optional totaliser scaling. **EngA** and **Engb** are already cumulative outputs from the counters. The total rate **rtot** is **rtEA - rtEb** because these are the count rates.

#### Encoder Mode Example

The totaliser source must be set to **A** only. The grand total (**Htot** and **Ltot**) is **EngA** with further optional totaliser scaling. **EngA** is already the cumulative position of the encoder. The total rate **rtot** is equal to **rtEA**.

**Frequency Mode Example**

When the totaliser source is **Add**, the grand total (**Htot** and **Ltot**) is **CntA+Cntb** (in thousands of periods) but with further optional totaliser scaling. **CntA** and **Cntb** are already cumulative outputs in this mode. The total rate **rtot** is **EngA+Engb**.

**Timer Mode Examples**

If the total source is set to **b**, the grand total (**Htot** and **Ltot**) depends on what is being timed on Channel B.

- If the pulse high or low time is being measured on Channel B, the grand total (**Htot** and **Ltot**) is the cumulative sum of all these times. The grand total rate **rtot** is unusable.
- If period is being measured, the grand total (**Htot** and **Ltot**) is taken from **Cntb** which is found as follows:

$$\begin{aligned} \mathbf{Cntb} &= 1/\mathbf{period} \text{ time (in mS by default) } \times \text{elapsed seconds.} \\ &= \text{Thousands of } \mathbf{periods} \text{ counted (by default).} \end{aligned}$$

Thousands of cycles are counted because, by default, the period is timed in mS (milliseconds, thousandths of a second). If the period timing is scaled to time in seconds, **Cntb** would count periods rather than thousands of periods. The total rate **rtot** is unusable.

- If the duty cycle is being measured, no valid values are passed to the totaliser at all, so **Htot**, **Ltot** and **rtot** are all unusable.

**A to B Edge Timer Mode Example**

The totaliser source must be set to Channel A only. The grand total (**Htot** and **Ltot**) is accumulated from **EngA** timings and optionally rescaled by the totaliser. The grand total rate **rtot** is unusable in Edge Timer Mode.

Analogue 237 Comms Location			Read/Write	
Analogue value	0	1	2	3
Source setting	<b>A</b>	<b>B</b>	<b>Add</b>	<b>A-b</b>

### Prescale Submenu

**PSCL** The totaliser prescale is a value that the 12-digit cumulative total (**Htot** and **Ltot**) is multiplied or divided by before applying the preload offset.

Prescale can be used with preload. Together they offer further optional scaling of the cumulative total in order to display it in alternative engineering units (see **Preload Submenu** on page 88).

Prescale does not affect the total rate output **rtot**.

### Prescale Type

*Default: Mult*

**TYPE** May be set to:

- **MuLt** The cumulative total is multiplied by the prescale value.
- **diV** The cumulative total is divided by the prescale value.

Logic 198 Comms Location		Read/Write
On	Divides total by prescale value	
Off	Multiplies total by prescale value	

### Prescale Value

*Default: 1.00000*

**VAL** Specifies the amount the total is multiplied or divided by before applying the preload offset. Any 6-digit value may be entered but it should never be set to 0. A setting of **1** leaves the total unchanged. The position of the decimal point can be edited (see **Totaliser Decimal Point Position** on page 92).

Analogue 238 Comms Location		Read/Write
Integer value	Any value in the displayable range	

### Preload Submenu

**P-Ld** The totaliser preload is a positive or negative offset value that is added to the 12-digit total (**Htot** and **Ltot**) after applying the prescale value. The preload value offsets the total by a constant amount. Any 6-digit value may be entered. The position of the decimal point can be edited (see **Totaliser Decimal Point Position** on page 92).

Preload can be used with prescale. Together they offer further optional scaling of the cumulative total in order to display it in alternative engineering units (see **Prescale Submenu** on page 88).

### Preload Enable

Default: Off

**EnAb on** enables the preload offset (see **Preload Value** below) to be added to the grand total (**Htot** and **Ltot**). The grand total may still be multiplied or divided by the prescale value.

Logic 197 Comms Location		Read/Write
On	Adds preload value to total	
Off	Preload value not added to total	

### Preload Value

Default: 0.00000

**VAL** Specifies the amount the total is offset after applying the prescale value. Any 6-digit value may be entered. A setting of **0** leaves the total unchanged but it is more efficient to set preload **EnAb** to **OFF** if you wish to leave the total unchanged. The position of the decimal point can be edited (see **Totaliser Decimal Point Position** on page 92).

Analogue 239 Comms Location		Read/Write
Integer value	Any value in the displayable range	

### Digits Display Format

Default: 12

**digS** Determines which format is used to display the total via **Htot** and **Ltot**.

The choices are:

- **6** 6-digit display format: **Ltot** alone represents the total.
- **12** 12-digit display format: **Htot** and **Ltot** represent the grand total.
- **TIME** Time display format: **Ltot** represents the total in hours, minutes and seconds.

### 6-Digit Format

The 6 least significant digits of the 12-digit total (including its sign) are

## Configuring the Totaliser

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represented by the 6 digits of **Ltot** alone.

For positive values, the 6-digit display format simply sets **Ltot** to the 6 least significant digits of the 12-digit total. For example 4999999 would be displayed as **999999** (if the total **dP** is **0**).

All negative values below the lowest negative displayable value, are displayed as **undEr**. The lowest displayable negative value is **-199999** (if total **dP** is **0**) or, for example, **-1999.99** (if total **dP** is **2**) (see **Totaliser Decimal Point Position** on *page 92*).

### Example

Value	Ltot Display Format	
3,200000,100000	<b>100000</b>	(LSDs only, <b>ovEr</b> is <b>never</b> displayed)
4,002000	<b>002000</b>	(Notice leading zeros, rolled over)
300	<b>300</b>	(No leading zeros, not rolled over)
0	<b>0</b>	
-23	<b>-23</b>	(Value displayed because minus sign fits)
-199999	<b>-199999</b>	(Lowest displayable value)
-200000	<b>undEr</b>	( <b>Any</b> lower value displays <b>undEr</b> )

### 12-Digit Display Format

The 12 least significant digits of the total (including its sign) are represented by **Htot** (the 6 most significant digits) and **Ltot** (the 6 least significant digits).

## Example

Value	Display Format		
	<i>Htot</i>	<i>Ltot</i>	
2,000000,000001	<b>0</b>	<b>1</b>	(12-digit positive rollover occurred)
999999,999999	<b>999999</b>	<b>999999</b>	(Highest positive value)
4,002000	<b>4</b>	<b>002000</b>	(Rolled over <b>Ltot</b> has leading zeros)
300	<b>0</b>	<b>300</b>	(No leading zeros, not rolled over)
0	<b>0</b>	<b>0</b>	
-23	<b>-0</b>	<b>-23</b>	
-199999	<b>-0</b>	<b>-199999</b>	(Lowest displayable signed <b>Ltot</b> )
-200000	<b>-0</b>	<b>200000</b>	(Sign is in <b>Htot</b> only)
-2,000023	<b>-2</b>	<b>000023</b>	(Leading <b>0</b> s indicate unseen higher digits)
-199999,999999	<b>-199999</b>	<b>999999</b>	(Lowest negative value)
-200000,000001	<b>-0</b>	<b>-1</b>	(Negative rollover has occurred)

## Time Format

This format rounds the total to the nearest integer, treats the result as a number of seconds and displays it in hours, minutes and seconds. Each field is always 2 digits, separated by a decimal point. The **dp** setting is irrelevant to this format.

If the time display exceeds **99.59.59** (99 hours, 59 minutes and 59 seconds), **ovEr** is displayed. If the time display is less than **-19.59.59** (-19 hours, 59 minutes and 59 seconds), **undEr** is displayed. **-1** is one display character.

**Example**

Value	Ltot Display Format		
000000,360000	<b>oVEr</b>	(All greater times display <b>oVEr</b> )	
000000,359999	<b>99.59.59</b>	(Maximum time)	
000000,000150	<b>00.02.30</b>	(150 seconds is 2 minutes and 30 seconds)	
Analogue 241 Comms Location <span style="float:right">Read/Write</span>			
Analogue value	0	1	2
Display format	6 digits	12 digits	Time <b>hh.mm.ss</b>

**Totaliser Decimal Point Position**

*Default: 0*

**dP** Aligns the decimal point in the total to a display position. It also changes the highest and lowest total that may be displayed.

The **dP** settings are:

Setting	Display Format		Example 12.688 will be displayed as
	Htot	Ltot	
0	0	0	13
1	0	0.0	12.7
2	0	0.00	12.69
3	0	0.000	12.688
4	0	0.0000	12.6880
5	0	0.00000	<b>oVEr</b>

Leading **0s** are shown if **0SuP** is **oFF** or in the **Ltot** value only if the **Htot** value is not zero (see **Leading Zero Suppression** on page 81).

The highest and lowest displayable 12-digit -totals for each **dP** setting are:

Setting	Highest Display Format <i>Htot Ltot</i>	Lowest Display Format <i>Htot Ltot</i>
0	999999 999999	-199999 999999
1	999999 99999.9	-199999 99999.9
2	999999 9999.99	-199999 9999.99
3	999999 999.999	-199999 999.999
4	999999 99.9999	-199999 99.9999
5	999999 9.99999	-199999 9.99999

When **digs** is set to **12** for the 12-digit display format, the total rolls over and continues accumulating from 000000 000000 again when it reaches a limit (see **12-Digit Display Format** on page 90).

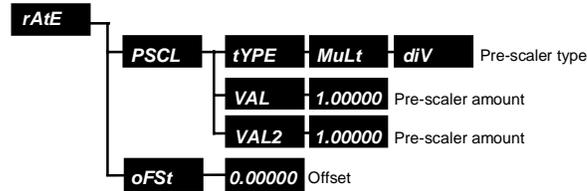
When **digs** is set to **6** for the 6-digit display format, **Htot** is always **0**. **Ltot** rolls over when rising upwards. However, when falling, **undEr** is displayed once **Ltot** falls below the 6-digit lowest limit shown above.

Analogue 240 Comms Location	Read/Write					
Analogue value	0	1	2	3	4	5
Digits to right of decimal point	0	1	2	3	4	5

## Configuring the Rate

**rAtE** The Rate Menu sets up the rate options which are listed in the menu structure diagram below (see **Type** on page 48). The Rate Menu is accessible when the instrument is setup as a counter or an encoder by setting the input type to **Cnt** or **Enc**.

Rate Menu Structure



The instrument finds the **count rate rAtE** from the count **EngA** as follows:

$$rtEA = \frac{\text{Change in EngA per second} \times (\text{or } \div) \text{ VAL} \times (\text{or } \div) \text{ VAL2} + \text{oFSt}}{1000}$$

**rtEb** is found from **Engb** in the same way:

$$rtEb = \frac{\text{Change in Engb per second} \times (\text{or } \div) \text{ VAL} \times (\text{or } \div) \text{ VAL2} + \text{oFSt}}{1000}$$

**VAL** and **VAL2** have no effect if both **1**. **oFSt** has no effect if **0**. With these default settings, **rtEA** and **rtEb** simply display the rate of change of the counts **EngA** and **Engb** in thousands of counts per second or kHz.

### Tips

- **rtEA** and **rtEb** are displayed by selecting them from the **diSP**, **SorC** Menu (see **Source Value** on page 74), or the **StA1/StA2**, **KEY1/KEY2**, **diSP** Menus (see **Display Alternative Value** on pages 109 and 118).

- By default, whatever the input type, the instrument always shows rates (**rtEA** and **rtEb**) in **kHz** to **3** decimal places. The best resolution is only 1 in 250 (see **Realtime Rate Measurements** on page 97).
- The decimal place setting for rates (**rtEA** and **rtEb**) is set by the **diSP**, **dP** option and is **3** by default. The decimal place setting for counts (**EngA** and **Engb**) is set by the **diSP**, **dPCu** Menu and is **0** by default (see **Decimal Point Position** on page 76).

### Prescale Submenu

**PSCL** The rate prescale is a value that the rate measurement is multiplied or divided by.

### Prescale Type

Default: Multiply

**tYPE** May be set to:

- **MuLt** The rate is multiplied by the prescale values.
- **diV** The rate is divided by the prescale values.

When **tYPE** is set to **diV**, **rtEA** is evaluated as follows:

$$rtEA = \left[ \frac{\text{Change in EngA per second} \div VAL}{1000} \right] \div VAL2 + oFSt$$

Logic 152 Comms Location	Read/Write
On	Divides total by prescale value
Off	Multiplies total by prescale value

### Prescale Values

Default: 1.00000

**VAL** **VAL2** Specify the amount rate estimates (derived values) are multiplied or divided by before applying the rate offset in order to represent them in alternative units. Any 6-digit value may be entered. The position of the decimal point can be edited. It may be necessary to adjust the decimal point position for all noncumulative value displays in order to prevent the rate going out of the displayable range. The prescale value may also be negative to change the displayed rate direction. During operation,

## Configuring the Rate

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rate measurements can change sign as the cumulative measurement rises or falls (see **Decimal Point Position** on page 76).

### Example

#### Question

The instrument is setup as an encoder. **EngA** is scaled to measure distance in mm (millimetres) and so by default **rtEA** measures speed in m/s (metres per second). However, the preferred speed measurement units are m/min (metres per minute). What should the Rate Menu settings be?

#### Answer

It is necessary to use a value that a speed in m/s can be multiplied or divided by to give m/min.

$$\text{Metres per minute} = \frac{\text{metres per second}}{1 \text{ metre}} \times \frac{60 \text{ sec}}{1 \text{ minute}}$$

The prescale **tyPE** should be set to **MuLt** and **VAL** set to **60**. (The **tyPE** could be set to **diV** and **VAL** to 0.01667 (1/60) but rounding errors would be more likely.)

Analogue Comms Locations			Read/Write
Analogue	254	255	Any integer value in the displayable range
Value setting	<b>VAL</b>	<b>VAL2</b>	

### Rate Offset

Default: 0.00000

**oFS:** The rate offset is a positive or negative offset value that is added to rate estimates (derived values) after applying the prescale values. It may be useful in compensating for known offset errors. Any 6-digit value may be entered. The position of the decimal point can be edited. It may be necessary to adjust the decimal point position for all noncumulative value displays in order to prevent the offset rate going out of displayable range (see **Decimal Point Position** on page 76).

Analogue 253 Comms Location	Read/Write
Integer value	Any value in the displayable range

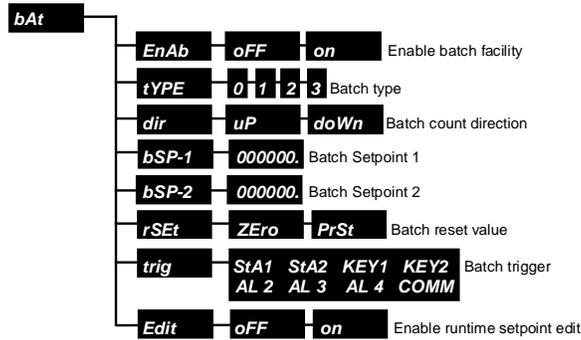
### Realtime Rate Measurements

- When the instrument is setup primarily for Counter or Encoder Modes, a count is never missed and rates **rtEA** and **rtEb** are only estimates (derived values).
- For all unscaled count rates above 250Hz, the resolution of rate estimates (derived values) is always only 1 in 250. For lower frequencies ranging from 1 to 250 Hz, the resolution is the same as the frequency, eg. at 10Hz, the resolution is 1 in 10.
- If high resolution rate measurements are more important than accurate cumulative measurements, setup the instrument primarily for frequency measurement by setting the input type to **FrEq**. In Frequency Mode, the frequencies are integrated to estimate the cumulative measurements (see **Type** on *page 48*).

## Configuring the Batch Control Function

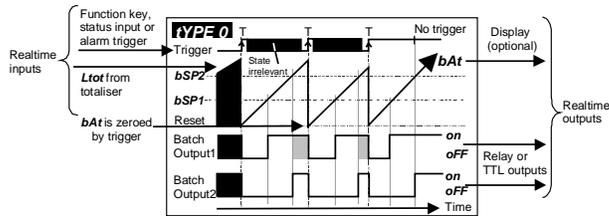
**bAt** The Batch Control Menu sets up the batch options which are listed in the menu structure diagram *below*. The batch control facility is only available on units fitted with relay or TTL outputs.

Batch Control Menu Structure



The batch control facility uses the total **Ltot** from the totaliser to deliver successive batch totals **bAt** over time. The totaliser must be setup and enabled because the batch process uses the totaliser output **Ltot** as an input.

Typical Batch Operation



The batch control process progresses from state-to-state. In each state, the process waits for something to happen before it makes a transition into the next state.

The input and output of the batch control process is also shown in the **Getting Started** section (see *pages 25 to 37*).

### Enable

*Default: Off*

**EnAb on** enables the batch control facility and makes the **bAt** display value valid. This value is listed amongst the possible display sources:

- The **diSP, SorC** Menu (see **Source Value** on *page 74*).
- The **StA1/StA2, diSP** Menus (see **Display Alternative Value** on *page 109*).
- The **KEY1/KEY2, diSP** Menus (see **Display Alternative Value** on *page 118*).

The totaliser must also be enabled (see **Enable** on *page 85*).

### NOTE

#### Relay & TTL Outputs

- If the instrument has no logic or relay outputs, the batch control facility cannot be used.
- When the batch control facility is enabled, it controls 2 relay/TTL outputs.
- Instruments with 2 relay outputs use Relay 1 as **b1** and Relay 2 as **b2**.
- Instruments with 4 TTL outputs, use Output 3 as **b1** and Output 4 as **b2**.
- Outputs **b1** and **b2** are associated with batch setpoints **bSP-1** and **bSP-2** respectively.

Logic 221 Comms Location	Read/Write
On	Enables batch control facility
Off	Disables batch control facility

### Type of Batch Control Process

*Default: 0*

**TYPE** There are 4 modes of batch control operation which can be

## Configuring the Batch Control Function

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determined by this setting.

The following sequence of events, outlines the stages of the batch control process with the effect of the **tYPE** setting on them shown:

1. The instrument waits for a trigger signal while the batch total **bAt** accumulates.

If batch **tYPE** is **0** or **1**, the trigger signal sought is a **change-of-state (edge triggered)**. If batch **tYPE** is **2** or **3**, the trigger signal sought is a **stable state (level triggered)** (see the table and the diagrams on *page 101*.)

2. Upon trigger, Batch Outputs 1 and 2 are turned off and the batch total **bAt** is reset (see **Reset Value** on *page 103*).
3. Batch total **bAt** accumulates. When it reaches Batch Setpoint 1, Batch Output 1 is turned on.
4. Batch total **bAt** continues to accumulate. When it reaches Batch Setpoint 2, Batch Output 2 is turned on.

If batch **tYPE** is **1** or **3**, Batch Output 1 is turned off, but if batch **tYPE** is **0** or **2**, Batch Output 1 remains on.

5. The batch control process now resumes.

The effect of the batch **tYPE** setting can be summarised as follows:

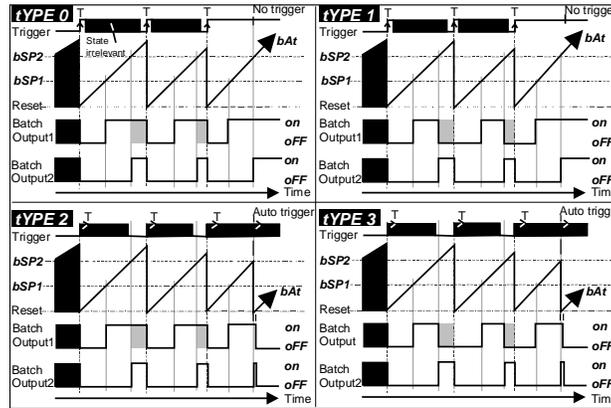
Type	Trigger	Batch Output 1 when Batch Setpoint 2 is reached
<b>0</b>	Edge	Kept on
<b>1</b>	Edge	Turned off
<b>2</b>	Level	Kept on
<b>3</b>	Level	Turned off

The advantage of **edge** trigger **tYPE 0** and **1**, is that the batch control process **cannot be automatically re-triggered**. In order to produce another trigger edge, the trigger must first be cleared before another can be

produced.

The advantage of level trigger **tTYPE 2** and **3**, is that the trigger can be held on to automatically re-trigger the batch control process when Batch Setpoint 2 is reached.

**Batch Control Process for Each Type with Count Direction Set to *uP***



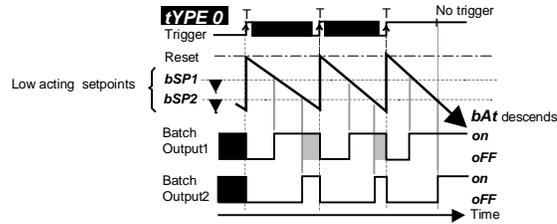
Analogue 230 Comms Location				Read/Write
Analogue value	0	1	2	3
Type setting	0	1	2	3

**Direction**

*Default: Up*

**dir** May be set to **uP** or **doWn**. If it is set to **uP**, the batch total **bAt** accumulates upwards (see the diagram *above* which shows 4 examples of the batch control process when **dir** is set to **uP**). If it is set to **doWn**, the batch total accumulates downwards (see the diagram *overleaf* which shows an example of the batch control process when **dir** is set to **doWn**).

Batch Control Process with Count Direction Set to *doWn*



When *dir* is set to *uP*, the relay/TTL outputs are changed by the batch total rising above high acting setpoints *bSP-1* and *bSP-2*. When *dir* is set to *doWn*, the relay/TTL outputs are changed by the batch total descending below low acting setpoints *bSP-1* and *bSP-2*.

Logic 223 Comms Location		Read/Write
On	Sets direction to <i>doWn</i>	
Off	Sets direction to <i>uP</i>	

Setpoints

Default: 000000.

***bSP-1*** ***bSP-2*** When the batch total *bAt* reaches *bSP-1*, Batch Output 1 (*b1*) is activated. When the batch total reaches *bSP-2*, Batch Output 2 (*b2*) is activated and *b1* is deactivated if batch type is 1 or 3 (see the diagrams above and on page 101).

NOTE

Relay & TTL Outputs

- If the instrument has no logic or relay outputs, the batch control facility cannot be used.
- When the batch control facility is enabled, it controls 2 relay/TTL outputs.
- Instruments with 2 relay outputs use Relay 1 as *b1* and Relay 2 as *b2*.
- Instruments with 4 TTL outputs, use Output 3 as *b1* and Output 4 as *b2*
- Outputs *b1* and *b2* are associated with batch setpoints *bSP-1* and *bSP-2* respectively.

Both **bSP-1** and **bSP-2** are **high acting** setpoints if the **tYPE** setting is **uP** and **low acting** setpoints if the **tYPE** setting is **doWn**. Relay/TTL outputs are changed by the batch total rising above high acting setpoints or descending below low acting setpoints (see **Setpoints** on page 102).

The batch total **bat** is set to the reset value when the batch control process is triggered. Whether the batch total accumulates upwards or downwards, it should reach the setpoint value **bSP-1** next before bSP-2. In other words, **bSP-1** should be closer to the reset value than **bSP-2** (see **Reset Value** below).

**bSP-1** and **bSP-2** are 6-digit totals expressed in the same engineering units as the totaliser output **Ltot**, which are fed to the batch control process input. Consequently, the setpoints share the same fixed decimal point setting and range limits as **Ltot** (see **Totaliser Decimal Point Position** on page 92).

It is possible to edit batch setpoints quickly, from the Setpoint Edit Menu when the instrument is displaying the measured value/realtime display (see **Edit** on page 105).

Analogue Comms Locations		Read/Write
231	232	Any integer value in the displayable range
<b>bSP-1</b>	<b>bSP-2</b>	

**Reset Value**

*Default: Zero*

**rSEt** Determines whether the batch total **bat** is zeroed or preset when the batch trigger occurs in order to begin counting a new batch total. If **PrSt** is chosen, it is necessary to setup the preset value from within the Preset Menu (see **Preset Value** on page 106).

Logic 224 Comms Location		Read/Write
Logic value		
0		On zeros <b>bAt</b> on trigger
1		On presets <b>bAt</b> on trigger

### Trigger

*Default: Status Input 1*

**trig** The batch trigger may be set to one of the following sources:

- **StA1** Status Input 1.
- **StA2** Status Input 2.
- **KEY1** Function Key 1.
- **KEY2** Function Key 2.
- **AL1** Alarm 1.
- **AL2** Alarm 2.
- **AL3** Alarm 3.
- **AL4** Alarm 4.

When a new batch is triggered during operation, the batch outputs are turned off and the batch total is reset (see **Reset Value** on page 103).

After reset, the batch total is expected to accumulate until Batch Setpoint 1 is reached, followed by Batch Setpoint 2. Once the batch total reaches Batch Setpoint 2, or passes beyond it, the batch control process expects to be re-triggered. Meanwhile the batch total continues accumulating.

It is possible to make the batch process automatically re-trigger when Batch Setpoint 2 is reached by:

- Setting the batch **tYPE** to **2** or **3 (level triggered)** (see **Type of Batch Process** on page 99).
- Holding the trigger on during operation (not possible when **trig** is **KEY1/KEY2**).

When a new batch is triggered automatically, the batch control process guarantees that Batch Output 2 will be activated for at least a tenth of a second after the batch total reaches Batch Setpoint 2 (see the diagrams on pages 101 and 102).

#### **Important NOTE**

It is important to check that the batch trigger does not also start a conflicting action. For example, if the trigger is **AL2**, check the setup for

## Configuring the Batch Control Function

Alarm 2, to ensure that it does not also activate Output 2 if one of the batch control outputs.

Logic 220 Comms Location		Read/Write
On	Triggers batch control process via comms (self clears to off)	

Analogue 235 Comms Location		Read/Write	
Analogue value	Trigger	Analogue value	Trigger
0	<b>StA1</b>	4	<b>AL1</b>
1	<b>StA2</b>	5	<b>AL2</b>
2	<b>KEY1</b>	6	<b>AL3</b>
3	<b>KEY2</b>	7	<b>AL4</b>
		8	<b>CoMM</b>

### Edit

*Default: Off*

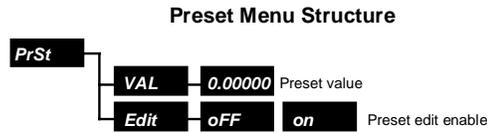
**Edit** During normal operation, **on** allows the operator to quickly edit Batch Setpoints 1 and 2 from the Setpoint Edit Menu, accessed by pressing the **Down** Key when the instrument is displaying a realtime measurement and it has no optional password protection (see Operator Functions on page 42).

When this option is **OFF**, the batch setpoints can only be **viewed** and **not edited** from the Setpoint Edit Menu.

Logic 222 Comms Location		Read/Write
On	Allows <b>bSP-1</b> and <b>bSP-2</b> to be <b>edited</b> from the Setpoint Edit Menu	
Off	Allows <b>bSP-1</b> and <b>bSP-2</b> to be <b>viewed</b> from the Setpoint Edit Menu	

## Configuring the Preset

**PrSt** The Preset Menu sets up the preset options which are listed in the menu structure diagram *below*.



This menu defines a preset value. The instrument can be setup to preset a displayable value when:

- The batch control process is re-triggered (see **Trigger** on *page 104*).
- A status input is changed (see **Zero Grand Total: Htot & Ltot**, **Preset EngA** and **Preset Engb** on *pages 111 and 112*).
- A function key is pressed (see **Zero Grand Total: Htot & Ltot**, **Preset EngA** and **Preset Engb** on *pages 119 and 120*).

It is most likely that cumulative values will be preset.

### Preset Value

*Default: 0.00000*

**VAL** Specifies the value that a displayable measurement becomes when it is preset. The value is preset by offsetting it. Presetting does not affect the ratio of engineering units to the raw/unscaled input quantity.

#### Example

The preset **VAL** has been set to **10.0**, and in the **KEY1** (Function Key 1) Menu, **b=P** has been set to **on**, so when Function Key 1 is pressed, **Engb** is preset to **10.0**. If **Engb** is **12.5** at the instant the preset key is pressed, the instrument finds the necessary  $\pm$  offset to add to **Engb** (ie. **-2.5**) to make it **10.0**. If **Engb** then changes by **+0.5**, **10.5** would be displayed because the same offset continues to be applied to **Engb**.

The preset value may be any 6-digit value. The position of the decimal point can be edited. Care should be taken to avoid a value outside the

displayable range of values to be preset. The displayable range of the totaliser output **Htot** and **Ltot** is controlled by the **dP** option in the **tot** (Totaliser) Menu. The displayable range of cumulative values **EngA** and **Engb** (in Counter and Encoder Modes) is controlled by the **dPCu** setting in the **diSP** (Display) Menu (see **Decimal Point Position** and **Totaliser Decimal Point Position** on pages 76 and 92).

It is possible to edit the preset value quickly from the Setpoint Edit Menu when the instrument is displaying the measured value/realtime display (see **Edit below**).

Analogue 60 Comms Location		Read/Write
Integer value	Any value in the displayable range	

**Edit**

*Default: Off*

**Edit** During normal operation, **on** allows the operator to quickly edit the preset value from the Setpoint Edit Menu, accessed by pressing the **Down** Key when the instrument is displaying a realtime measurement and it has no optional password protection (see **Operator Functions** on page 42).

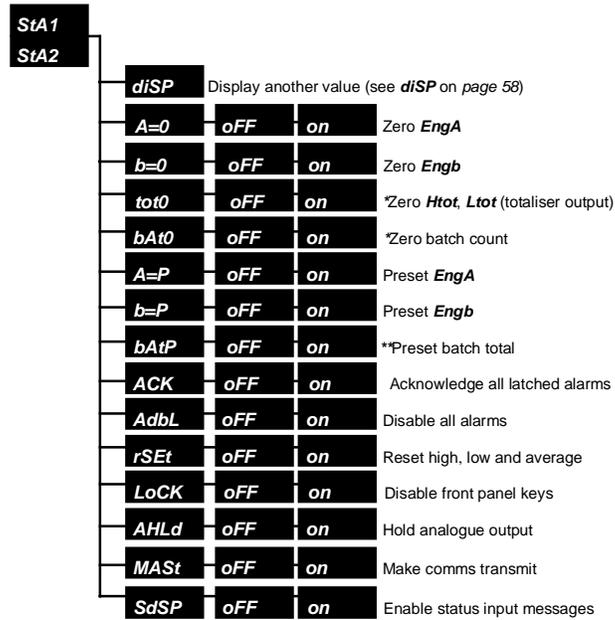
When this option is **off**, the preset value can only be **viewed** and **not edited** from the Setpoint Edit Menu.

Logic 151 Comms Location		Read/Write
On	Allows the preset value to be <b>edited</b> from the Setpoint Edit Menu	
Off	Allows the preset value to be <b>viewed</b> from the Setpoint Edit Menu	

## Configuring the Status Inputs

**StA1 StA2** The Status Inputs Menu setup the status input options which are listed in the menu structure diagram *below*.

Status Inputs 1 & 2 Menu Structure



\* Visible only if totaliser enabled.

\*\*Visible only if batch counter enabled.

This menu sets up the function(s) of activating a status input, eg. one or more than one function can be configured. It is recommended that only one function per input be configured. The function exists only while the

status input is activated (except for **MASt** which is a special case (see **Communications Master** on page 114). To activate a status input see the table on page 9 and **Connecting the Status Inputs** on page 15).

When the input type setting is changed, check that the functions of a status input remain relevant (see **Type** on page 48). If in doubt, turn the function off.

These **edge-triggered** functions include: **A=0**, **b=0**, **tot0**, **A=P**, **b=P**, **ACK**, **rSEt** and **MASt**.

**NOTE**

If a pulse is used, it must be at least 1 second long.

**Display Alternative Value** *Default: None (in Counter Mode)*

**diSP** Defines an alternative display value which is shown when the status input is activated. The choices for each input type setting are listed below.

**Displays Activated by Status Inputs in Each Mode**

<b>diSP</b>	<b>nonE</b>	<b>HoLd</b>	<b>EngA</b>	<b>Engb</b>	<b>rtEA</b>	<b>Cnt</b>	<b>Counter Mode</b>
	<b>rtEb</b>	<b>ProP</b>	<b>HigH</b>	<b>LoW</b>	<b>AV</b>		
	<b>LtSt</b>	<b>*Htot</b>	<b>*Ltot</b>	<b>*rtot</b>	<b>**bAt</b>		
<b>diSP</b>	<b>nonE</b>	<b>HoLd</b>	<b>EngA</b>	<b>rtEA</b>	<b>HigH</b>	<b>LoW</b>	<b>EnC</b>
	<b>AV</b>	<b>LtSt</b>	<b>*Htot</b>	<b>*Ltot</b>	<b>*rtot</b>	<b>**bAt</b>	<b>Encoder Mode</b>
<b>diSP</b>	<b>nonE</b>	<b>HoLd</b>	<b>EngA</b>	<b>Engb</b>	<b>CntA</b>	<b>FrEq</b>	<b>Frequency Mode</b>
	<b>Cntb</b>	<b>Prop</b>	<b>HigH</b>	<b>LoW</b>	<b>AV</b>		
	<b>LtSt</b>	<b>*Htot</b>	<b>*Ltot</b>	<b>*rtot</b>	<b>**bAt</b>		
<b>diSP</b>	<b>nonE</b>	<b>HoLd</b>	<b>EngA</b>	<b>Engb</b>	<b>CntA</b>	<b>tiME</b>	<b>Timer Mode</b>
	<b>Cntb</b>	<b>ProP</b>	<b>HigH</b>	<b>LoW</b>	<b>AV</b>		
	<b>LtSt</b>	<b>*Htot</b>	<b>*Ltot</b>	<b>**bAt</b>			
<b>diSP</b>	<b>nonE</b>	<b>HoLd</b>	<b>EngA</b>	<b>HigH</b>	<b>LoW</b>	<b>EdgE</b>	<b>Edge Timer Mode</b>
	<b>AV</b>	<b>LtSt</b>	<b>*Htot</b>	<b>*Ltot</b>	<b>**bAt</b>		

\* The totaliser must be setup and enabled for the value to be usable.  
 \*\* The batch counter AND the totaliser must be setup and enabled for the value to be usable.

A description of most of the **diSP** settings is given in the **Getting Started** section (see pages 25 to 37). Those settings which are not

included are described *below*.

- **nonE** Configures the status input to not show an alternative display value.
- **HoLd** Configures the status input to prevent updating the display for as long as the status input is activated.
- **LtSt** Configures the status input to light all the display segments for as long as the status input is activated. This is called a lamp-test.

If **SdSP** is also turned **on**, text describing the display function is displayed every 2 seconds (see **Enable Status Message** on *page 115*).

### Example

If the **diSP** setting is **EngA**, the word **EngA** is displayed every 2 seconds.

### Example

If the **diSP** setting is **nonE**, the word **nonE** will not be displayed as **nonE** programs the status input to not show an alternative display value.

If **diSP** is set to **High**, **LoW** or **AV**, the value displayed is governed by the **AV** and **AVti** values in the **SySt** (System) Menu **High**, **LoW** and **AV** are always displayed to the number of decimal places set by **dP** (not dPCu) in the **diSP** (Display) Menu as it is assumed that users normally want the highest, lowest and average of noncumulative values (see **Decimal Point Position**, **Averaging Time** and **Average Source** on *pages 76 and 150*).

### Important NOTE

Do not be tempted to enable the totaliser on the assumption that **Htot** and **EngA** represent the high and low halves of a 12-digit **EngA** count. They are not necessarily aligned to the same decimal point position. As a rule, if **Htot** can be displayed, then **Ltot** must be displayable too. ONLY Ltot represents the low half of **Htot:Ltot**.

## Configuring the Status Inputs

Analogue Comms Locations				Read/Write	
Analogue	197		201		
Status Input	1		2		
	Input type				
	<b>Cnt</b>	<b>EnC</b>	<b>FrEq</b>	<b>tiME</b>	<b>EdgE</b>
Analogue value	Value displayed when status input activated				
0	<b>nonE</b>	<b>nonE</b>	<b>nonE</b>	<b>nonE</b>	<b>nonE</b>
1	<b>hold</b>	<b>hold</b>	<b>hold</b>	<b>hold</b>	<b>hold</b>
2	<b>EngA</b>	<b>EngA</b>	<b>EngA</b>	<b>EngA</b>	<b>EngA</b>
3	<b>Engb</b>	<b>rtEA</b>	<b>Engb</b>	<b>Engb</b>	<b>HigH</b>
4	<b>rtEA</b>	<b>HigH</b>	<b>CntA</b>	<b>CntA</b>	<b>LoW</b>
5	<b>rtEb</b>	<b>LoW</b>	<b>Cntb</b>	<b>Cntb</b>	<b>AV</b>
6	<b>ProP</b>	<b>AV</b>	<b>ProP</b>	<b>ProP</b>	<b>LtSt</b>
7	<b>HigH</b>	<b>LtSt</b>	<b>HigH</b>	<b>HigH</b>	<b>Htot</b>
8	<b>LoW</b>	<b>Htot</b>	<b>LoW</b>	<b>LoW</b>	<b>Ltot</b>
9	<b>AV</b>	<b>Ltot</b>	<b>AV</b>	<b>AV</b>	<b>bAt</b>
10	<b>LtSt</b>	<b>rtot</b>	<b>LtSt</b>	<b>LtSt</b>	
11	<b>Htot</b>	<b>BAt</b>	<b>Htot</b>	<b>Htot</b>	
12	<b>Ltot</b>		<b>Ltot</b>	<b>Ltot</b>	
13	<b>rtot</b>			<b>rtot</b>	<b>bAt</b>
14	<b>bAt</b>		<b>bAt</b>		

### Zero EngA

*Default: Off*

**A=0** on zeros **EngA** when the status input is activated.

Logic Comms Locations			Read/Write
Logic	119	139	On enables zeroing of <b>EngA</b>
Status Input	1	2	Off disables zeroing of <b>EngA</b>

### Zero Engb

*Default: Off*

**b=0** on zeros **Engb** when the status input is activated.

Logic Comms Locations			Read/Write
Logic	120	140	On enables zeroing of <b>Engb</b>
Status Input	1	2	Off disables zeroing of <b>Engb</b>

### Zero Grand Total: Htot & Ltot

*Default: Off*

**tot0** on zeros **Htot** and **Ltot** when the status input is activated.

### NOTE

This option does not appear unless the totaliser is enabled (see **Enable** on page 85).

Logic Comms Locations			Read/Write
Logic	121	141	On enables zeroing of <b>Htot &amp; Ltot</b>
Status Input	1	2	Off disables zeroing of <b>Htot &amp; Ltot</b>

### Zero Batch Total: bAt

*Default: Off*

**bAt0** on zeros **bAt** when the status input is activated.

### NOTE

- This option does not appear unless the batch counter is enabled (see **Enable** on page 99).
- The totaliser must also be setup and enabled (see **Configuring the Totaliser** on page 83).

Logic Comms Locations			Read/Write
Logic	122	142	On enables zeroing of <b>bAt</b>
Status Input	1	2	Off disables zeroing of <b>bAt</b>

### Preset EngA

*Default: Off*

**A=P** on presets **EngA** when the status input is activated. The preset value is setup from the Preset Menu (see **Preset Value** on page 106).

Logic Comms Locations			Read/Write
Logic	123	143	On enables presetting of <b>EngA</b>
Status Input	1	2	Off disables presetting of <b>EngA</b>

### Preset Engb

*Default: Off*

**b=P** on presets **Engb** when the status input is activated. The preset value is setup from the Preset Menu (see **Preset Value** on page 106).

Logic Comms Locations			Read/Write
Logic	124	144	On enables presetting of <b>Engb</b>
Status Input	1	2	Off disables presetting of <b>Engb</b>

**Preset Batch Total: bAt**

*Default: Off*

**bAtP** *on* presets the batch count **bAt** when the status input is activated. The preset value is setup from the Preset Menu (see **Preset Value** on page 106).

**NOTE**

- This option does not appear unless the batch counter is enabled (see **Enable** on page 99).
- The totaliser must also be setup and enabled (see **Configuring the Totaliser** on page 83).

Logic Comms Locations			Read/Write
Logic	125	145	On enables presetting of <b>bAt</b>
Status Input	1	2	Off disables presetting of <b>bAt</b>

**Acknowledge Latched Alarms**

*Default: Off*

**ACK** A latched alarm is an alarm that stays on when the cause of the alarm no longer exists. An alarm can be made into a latched alarm (see **Alarms 1 - 4 Menu Structure** and **Latching** on pages 123 and 128).

*on* acknowledges all latched alarms when the status input is activated. Acknowledging a latched alarm, clears the alarm if the condition that triggered it no longer exists at the time of acknowledgement. When the realtime measurement is on display, latched alarms can also be cleared by pressing the **Up** and **Down** Keys together (the instrument momentarily displays **ACK**) and may be used instead of assignng a status input or function key to do this task.

Logic Comms Locations			Read/Write
Logic	114	134	On enables alarm acknowledge
Status Input	1	2	Off disables alarm acknowledge

**Disable All Alarms**

*Default: Off*

**AdbL** *on* disables and prevents all alarms for as long as the status input is activated.

## Configuring the Status Inputs

---

Logic Comms Locations			Read/Write
Logic	115	135	On enables alarm disable
Status Input	1	2	Off disables alarm disable

### Reset High, Low & Average

*Default: Off*

**rSEt** **on** resets the **High**, **LoW** and **AV** values to the current **High**, **LoW** and **AV** source when the status input is activated (see **Average Source** on page 150).

Logic Comms Locations			Read/Write
Logic	112	132	On enables reset function
Status Input	1	2	Off disables reset function

### Disable Front Panel Keys

*Default: Off*

**LoCK** **on** disables all the instrument's front panel keys while the status input is activated.

Logic Comms Locations			Read/Write
Logic	116	136	On enables key lock function
Status Input	1	2	Off disables key lock function

### Analogue Output Hold

*Default: Off*

**AHLd** **on** holds the analogue output at its current level while the status input is activated.

Logic Comms Locations			Read/Write
Logic	117	137	On enables analogue output hold
Status Input	1	2	Off disables analogue output hold

### Communications Master

*Default: Off*

**MASt** **on** enables Master Mode transmissions only when the status input is activated.

#### NOTE

- If both status inputs are setup to activate Master Mode transmissions, only one need be activated to enable transmissions.
- The **CoMM**, **MASt**, **EnAb** option must also be **on** (see the table

below and **Master Mode Enable** on page 146).

<b>CoMM MASt EnAb</b>	<b>StA1/StA2 MASt</b>	<b>StA1/StA2 State</b>	<b>Result Transmissions</b>
<b>oFF</b>	Irrelevant	Irrelevant	Disabled
<b>*on</b>	<b>*oFF</b>	Irrelevant	Enabled
<b>on</b>	<b>on</b>	<b>**oFF</b>	Enabled
<b>on</b>	<b>on</b>	<b>**on</b>	Enabled

- \* Master Mode transmissions are always enabled if the **CoMM, MASt, EnAb** option is **on** even if the **StA1/StA2, MASt** option is **oFF**.
- \*\* Master Mode transmissions are only enabled while the status input is **on**, if both **CoMM, MASt, EnAb** and **StA1/StA2, MASt, EnAb** are **on**. As soon as the status input is activated, a transmission occurs, and transmission timing is resynchronised to the event. Therefore, if the interval between automatic transmissions is long, momentary closures of the status input contacts can be used as single transmission triggers. Further timed transmissions occur only if the status input remains activated.

Logic Comms Locations			Read/Write
Logic	113	133	On triggers/enables Master Mode
Status Input	1	2	

**Enable Status Message**

*Default: On*

**SdSP on** displays a message indicating the action performed when the status input is activated. The message is flashed on the display every 2 seconds while the status input is active. The message is the same word used in these menus to describe the configured function of the status input.

- No message is displayed if the alternative display value is **nonE** or if all other possible functions of the status input are **oFF**.
- If a status input has been configured to have more than one function, a message for only one of the functions will be chosen arbitrarily and displayed. This message is interlaced with any alarm and out-of-range messages.

## Configuring the Status Inputs

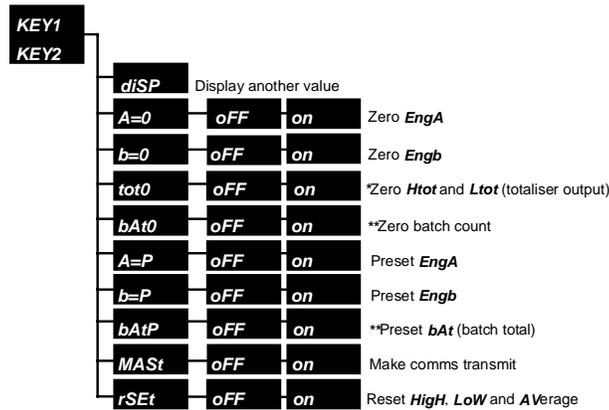
---

Logic Comms Locations			Read/Write
Logic	118	138	On enables status message display
Status Input	1	2	Off disables status message display

## Configuring the Function Keys

**KEY1** **KEY2** The Function Key Menu setup the function key options which are listed in the menu structure diagram *below*.

Function Keys 1 & 2 Menu Structure



\* Visible only if totaliser enabled.

\*\* Visible only if batch counter enabled.

This menu sets up the function(s) of pressing a function key, eg. one or more than one function can be configured. It is recommended that only one function per input be configured. The function exists only after it has been triggered by pressing the function key for at least half a second. (except for **MAsT** which is a special case (see **Communications Master** on page 121).

When the input type setting is changed, check that the functions of a function key remain relevant (see **Type** on page 48). If in doubt, turn the function off. If a pulse is used, it must be at least 1 second long.

## Configuring the Function Keys

These **triggered** irreversible one-way functions include: **A=0**, **b=0**, **tot0**, **bAt0**, **A=P**, **b=P**, **bAtP** and **rSEt**. **MASt** is different (see **Communications Master** on page 121).

### Display Alternative Value *Default: None (in Counter Mode)*

**diSP** Defines an alternative display value which is shown only while a function key is depressed. The choices for each input type setting are listed *below* (see also **Type** on page 48).

#### Displays Activated by Function Keys in Each Mode

<b>diSP</b>	<b>nonE</b>	<b>HoLd</b>	<b>EngA</b>	<b>Engb</b>	<b>rtEA</b>	<b>Cnt</b> Counter Mode	
	<b>rtEb</b>	<b>ProP</b>	<b>HigH</b>	<b>LoW</b>	<b>AV</b>		
	<b>LtSt</b>	<b>*Htot</b>	<b>*Ltot</b>	<b>*rtot</b>	<b>**bAt</b>		
	<b>nonE</b>	<b>HoLd</b>	<b>EngA</b>	<b>rtEA</b>	<b>HigH</b>	<b>LoW</b>	<b>EnC</b> Encoder Mode
	<b>AV</b>	<b>LtSt</b>	<b>*Htot</b>	<b>*Ltot</b>	<b>*rtot</b>	<b>**bAt</b>	
<b>nonE</b>	<b>HoLd</b>	<b>EngA</b>	<b>Engb</b>	<b>CntA</b>	<b>FrEq</b> Frequency Mode		
<b>Cntb</b>	<b>ProP</b>	<b>HigH</b>	<b>LoW</b>	<b>AV</b>			
<b>LtSt</b>	<b>*Htot</b>	<b>*Ltot</b>	<b>*rtot</b>	<b>**bAt</b>			
<b>nonE</b>	<b>HoLd</b>	<b>EngA</b>	<b>Engb</b>	<b>CntA</b>	<b>tiME</b> Timer Mode		
<b>Cntb</b>	<b>ProP</b>	<b>HigH</b>	<b>LoW</b>	<b>AV</b>			
<b>LtSt</b>	<b>*Htot</b>	<b>*Ltot</b>	<b>*rtot</b>	<b>**bAt</b>			
<b>nonE</b>	<b>HoLd</b>	<b>EngA</b>	<b>HigH</b>	<b>LoW</b>	<b>EdgE</b> Edge Timer Mode		
<b>AV</b>	<b>LtSt</b>	<b>*Htot</b>	<b>*Ltot</b>	<b>**bAt</b>			

\* The totaliser must be setup and enabled for the value to be usable.

\*\* The batch counter AND the totaliser must be setup and enabled for the value to be usable.

A description of most of the **diSP** settings is given in the **Getting Started** section (see pages 25 to 37). Those settings which are not included are described *below*.

- **nonE** Configures the function key to not show an alternative display value.
- **HoLd** Configures the function key to prevent updating the display for as long as it is pressed.
- **LtSt** Configures the function key to light all the display segments for as long as the function key is pressed. This is called a lamp-test.

Analogue Comms Locations				Read/Write	
Analogue	206		210		
Function key	1		2		
	Input type				
	<i>Cnt</i>	<i>EnC</i>	<i>FrEq</i>	<i>tiME</i>	<i>EdgE</i>
Analogue value	Value displayed when status input activated				
0	<i>nonE</i>	<i>nonE</i>	<i>nonE</i>	<i>nonE</i>	<i>nonE</i>
1	<i>hold</i>	<i>hold</i>	<i>hold</i>	<i>hold</i>	<i>hold</i>
2	<i>EngA</i>	<i>EngA</i>	<i>EngA</i>	<i>EngA</i>	<i>EngA</i>
3	<i>Engb</i>	<i>rtEA</i>	<i>Engb</i>	<i>Engb</i>	<i>HigH</i>
4	<i>rtEA</i>	<i>HigH</i>	<i>CntA</i>	<i>CntA</i>	<i>LoW</i>
5	<i>rtEb</i>	<i>LoW</i>	<i>Cntb</i>	<i>Cntb</i>	<i>AV</i>
6	<i>ProP</i>	<i>AV</i>	<i>ProP</i>	<i>ProP</i>	<i>LtSt</i>
7	<i>HigH</i>	<i>LtSt</i>	<i>HigH</i>	<i>HigH</i>	<i>Htot</i>
8	<i>LoW</i>	<i>Htot</i>	<i>LoW</i>	<i>LoW</i>	<i>Ltot</i>
9	<i>AV</i>	<i>Ltot</i>	<i>AV</i>	<i>AV</i>	<i>bAt</i>
10	<i>LtSt</i>	<i>rtot</i>	<i>LtSt</i>	<i>LtSt</i>	
11	<i>Htot</i>	<i>BAt</i>	<i>Htot</i>	<i>Htot</i>	
12	<i>Ltot</i>		<i>Ltot</i>	<i>Ltot</i>	
13	<i>rtot</i>			<i>rtot</i>	<i>bAt</i>
14	<i>bAt</i>		<i>bAt</i>		

### Zero EngA

Default: Off

**A=0** on zeros *EngA* when a function key is pressed.

Logic Comms Locations			Read/Write
Logic	164	184	On enables zeroing of <i>EngA</i>
Function Key	1	2	Off disables zeroing of <i>EngA</i>

### Zero Engb

Default: Off

**b=0** on zeros *Engb* when a function key is pressed.

Logic Comms Locations			Read/Write
Logic	165	185	On enables zeroing of <i>Engb</i>
Function Key	1	2	Off disables zeroing of <i>Engb</i>

### Zero Grand Total: Htot & Ltot

Default: Off

**tot0** on zeros *Htot* and *Ltot* when a function key is pressed.

### NOTE

This option does not appear unless the totaliser is enabled (see **Enable** on page 85).

Logic Comms Locations			Read/Write
Logic	166	186	On enables zeroing of <b>Htot</b> & <b>Ltot</b>
Function key	1	2	Off disables zeroing of <b>Htot</b> & <b>Ltot</b>

### Zero Batch Total: **bAt**

Default: *Off*

**bAt0** on zeros **bAt** when a function key is pressed.

### NOTE

- This option does not appear unless the batch counter is enabled (see **Enable** on page 99).
- The totaliser must also be setup and enabled (see **Configuring the Totaliser** on page 83).

Logic Comms Locations			Read/Write
Logic	167	187	On enables zeroing of <b>bAt</b>
Function key	1	2	Off disables zeroing of <b>bAt</b>

### Preset EngA

Default: *Off*

**A=P** on presets **EngA** when a function key is pressed. The preset value is setup from the Preset Menu (see **Preset Value** on page 106).

Logic Comms Locations			Read/Write
Logic	168	188	On enables presetting of <b>EngA</b>
Function key	1	2	Off disables presetting of <b>EngA</b>

### Preset Engb

Default: *Off*

**b=P** on presets **Engb** when a function key is pressed. The preset value is setup from the Preset Menu (see **Preset Value** on page 106).

Logic Comms Locations			Read/Write
Logic	169	189	On enables presetting of <b>Engb</b>
Function key	1	2	Off disables presetting of <b>Engb</b>

**Preset Batch Total: bAt**

*Default: Off*

**bAtP on** presets the batch count **bAt** when a function key is pressed. The preset value is setup from the Preset Menu (see **Preset Value** on page 106).

**NOTE**

- This option does not appear unless the batch counter is enabled (see **Enable** on page 99).
- The totaliser must also be setup and enabled (see **Configuring the Totaliser** on page 83).

Logic Comms Locations			Read/Write
Logic	170	190	On enables presetting of <b>bAt</b>
Function key	1	2	Off disables presetting of <b>bAt</b>

**Communications Master**

*Default: Off*

**MASt on** triggers a single Master Mode transmission only when a function key is pressed.

**NOTE**

- If both function keys are setup to activate Master Mode transmissions, only one need be pressed to trigger a transmission.
- The **CoMM, MASt, EnAb** option must also be **on** (see the table below and **Master Mode Enable** on page 146).

<b>CoMM MASt EnAb</b>	<b>KEY1/2 MASt</b>	<b>KEY/2 State</b>	<b>Result Transmissions</b>
<b>off</b>	Irrelevant	Irrelevant	Disabled
<b>*on</b>	<b>*off</b>	Irrelevant	Regular transmissions enabled
<b>on</b>	<b>on</b>	**Not pressed	Disabled
<b>on</b>	<b>on</b>	**Pressed	One transmission triggered

\* Master Mode transmissions are always enabled if the **CoMM, MASt**

**EnAb** option is **on** even if the **KEY1/KEY2, MAST** option is **off**.

- \*\* Only a single Master Mode transmission is triggered when a function key is pressed, if both **CoMM, MAST, EnAb** and **KEY1/KEY2, MAST, EnAb** are **on**.

Logic Comms Locations			Read/Write
Logic	163	183	On triggers/enables Master Mode
Function key	1	2	

### Reset High, Low & Average

*Default: Off*

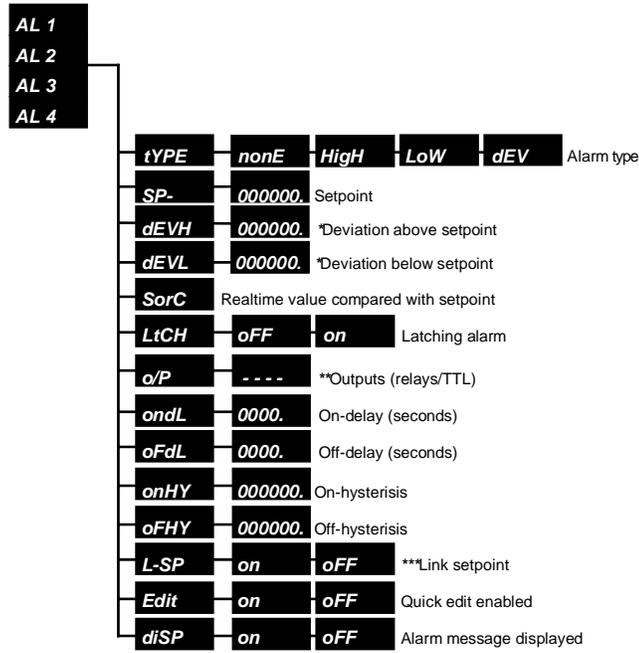
**rSEt on** resets the **High, LoW** and **AV** values to the current **High, LoW** and **AV** source when a function key is pressed (see **Average Source** on page 150).

Logic Comms Locations			Read/Write
Logic	162	182	On enables reset function
Function Key	1	2	Off disables reset function

# Configuring the Alarms

**AL 1 AL 2 AL 3 AL 4** The 4 Alarm Menus setup the alarm options which are listed in the menu structure diagram *below*.

Alarms 1 - 4 Menu Structure



\* **dEVH** and **dEVL** are only visible if alarm type is **dEV** (deviation).  
 \*\* **o/P** is only visible if the instrument has relay or TTL outputs fitted.  
 \*\*\* **L-SP** is only visible for Alarms 3 and 4.

## Configuring the Alarms

---

When an alarm occurs during operation, 2 things may happen:

1. An optional alarm message, which displays the alarm number and type, is flashed onto the display every 2 seconds, eg. **HiA4** (see **Message Display** on page 131).
2. Configured alarm outputs (relay or TTL) are optionally activated (see **Outputs** on page 128).

### Important NOTE

Avoid unintentionally setting up an output to be activated by another facility such as the batch counter at the same time as an alarm.

### Type

*Default: None*

**TYPE** Sets up the alarm type as one of the following:

- **nonE** Alarm disabled.
- **High** High acting alarm.
- **LoW** Low acting alarm.
- **dEV** Deviation alarm.

During operation, the instrument compares a changing realtime measurement with the fixed alarm setpoint (see **Setpoints** and **Source Value** on pages 125 and 126).

When the alarm type is set to:

- **nonE**, the alarm is turned off.
- **High**, the alarm is activated when the alarm source value is higher than the setpoint, eg. when **SorC** is **-8**.
- **LoW**, the alarm is activated when the alarm source value is less than the setpoint, eg. when **SorC** is **1**.
- **Dev**, the alarm is activated when the alarm source value is outside the deviation band. When a deviation alarm type is chosen, the options **dEVL** and **dEVH** appear between **SP-** and **SorC** in the Alarm Menu (see **Alarms 1 - 4 Menu Structure** and **Deviation Band** on pages 123 and 126).

**NOTE**

- An activated alarm can change the state of alarm outputs if fitted and display a message (see **Outputs** on page 128).
- The alarm behaviour of the instrument described *above* assumes the alarm latching, delay and hysteresis options are not in use. To see how they change the way alarms work, see **Latching, Delay** and **Hysteresis** on pages 128 and 129.

Analogue Comms Locations		Read/Write
Analogue	Alarm	Type setting
110	Alarm 1	0=High 1=Low 2=Deviation 3=None (disabled)
125	Alarm 2	0=High 1=Low 2=Deviation 3=None (disabled)
140	Alarm 3	0=High 1=Low 2=Deviation 3=None (disabled)
155	Alarm 4	0=High 1=Low 2=Deviation 3=None (disabled)

**Setpoints**

*Default: 000000*

**SP-1** **SP-2** **SP-3** **SP-4** Defines the alarm setpoint. This is the fixed value that is compared with the realtime source value (see **Source Value** on page 126).

**SP-** can be any value in the displayable range. The displayable range is determined by the decimal places setting. Take care when reducing the displayable range as this can leave a setpoint at an unreachable level (see **Decimal Point Position** on page 76).

It is possible to allow the setpoint to be changed quickly during operation (see **Edit** on page 131).

**NOTE**

If the **L-SP** option is **on** for an alarm, there is no point in changing the setpoint as it is a copy of another linked setpoint and any changes made to the copy are not saved. When setting up Alarm 3, the setpoint shown is for Alarm 1 and when setting up Alarm 4, the setpoint shown is for Alarm 2 (see **Setpoint Linking** on page 130).

The alarm type discussed *above*, determines which relationship between the setpoint and source, activates the alarm.

## Configuring the Alarms

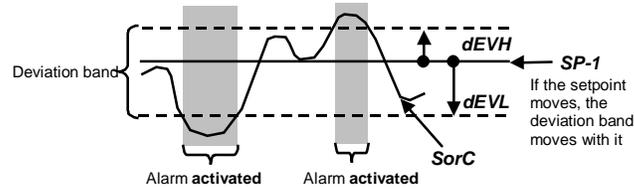
Analogue Comms Locations				Read/Write
Analogue	111	126	141	156
Setpoint for Alarm	1	2	3	4
Integer value	Any value in the displayable range			

### Deviation Band

Default: 000000.

**dEVH** **dEVL** These 2 values set the size of the deviation band as illustrated *below*.

#### The Deviation Band



**dEVH** and **dEVL** appear in the Alarms Menu only if the alarm type is setup as **dEV** for a deviation alarm. A deviation alarm is activated when the realtime **SorC** value falls outside the deviation band.

Analogue Comms Locations				Read/Write
<b>dEVH</b>	112	127	142	157
<b>dEVL</b>	113	128	143	158
Alarm	1	2	3	4

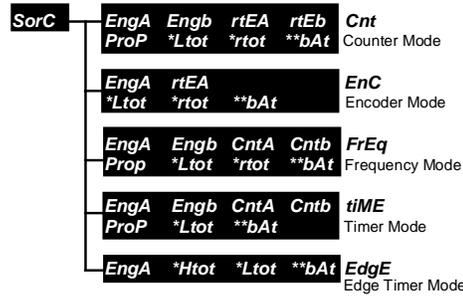
### Source Value

Default: EngA (in Counter Mode)

**SorC** Defines the realtime value that is compared with the setpoint to activate the alarm.

The choices for each input type setting are listed *overleaf* (see also **Type** on page 48).

Alarm Sources



- \* The totaliser must be setup and enabled for the value to be usable.
- \*\* The batch counter AND the totaliser must be setup and enabled for the value to be usable.

A description of each **SorC** setting is given in the **Getting Started** section (see pages 25 to 37).

Analogue Comms Locations			Read/Write		
Analogue	118	133	148	163	
Alarm	1	2	3	4	
	Input type				
	<b>Cnt</b>	<b>EnC</b>	<b>FrEq</b>	<b>tiME</b>	<b>EdgE</b>
Analogue value	Source value				
0	<b>EngA</b>	<b>EngA</b>	<b>EngA</b>	<b>EngA</b>	<b>EngA</b>
1	<b>Engb</b>	<b>rtEA</b>	<b>Engb</b>	<b>Engb</b>	<b>Ltot</b>
2	<b>rtEA</b>	<b>Ltot</b>	<b>ProP</b>	<b>ProP</b>	<b>bAt</b>
3	<b>rtEb</b>	<b>rtot</b>	<b>Ltot</b>	<b>Ltot</b>	
4	<b>ProP</b>	<b>bAt</b>	<b>rtot</b>	<b>bAt</b>	
5	<b>Ltot</b>		<b>bAt</b>		
6	<b>rtot</b>				
7	<b>bAt</b>				
	<b>Cnt</b>	<b>EnC</b>	<b>FrEq</b>	<b>tiME</b>	<b>EdgE</b>
<b>dPCu</b>	0,1,5,7	0,2,4	3,5	3,4	1,2
<b>dp</b>	Others	Others	Others	Others	Others

### Latching

*Default: Off*

**LtCH on** sets up the alarm to remain activated after the alarm condition has gone. Any output(s) and display message associated with the alarm also remain activated.

When the alarm condition has gone, all latched alarms can be cleared using the alarm acknowledge function, accessed by one of the following actions:

- Pressing the **Up** and **Down** Keys together to perform the **ACK** function on all latched alarms.
- Activating a status input which is setup to perform the **ACK** function (see **Acknowledge Latched Alarms** on page 113).

Logic Comms Locations	Read/Write			
Logic	65	75	85	95
On enables latching for Alarm	1	2	3	4

### Outputs

*Default: - -*

**O/P** Defines which outputs, if any, are activated when the alarm is activated.

#### Outputs Activated by the Alarm

<b>--</b>	No outputs
<b>1-</b>	Output 1 activated
<b>-2</b>	Output 2 activated
<b>12</b>	Outputs 1 and 2 activated

Each illuminated symbol is either a hyphen or a digit. The leftmost symbol corresponds to Output 1, the next symbol to Output 2, etc. A hyphen means the output is not activated by the alarm. A digit means the output is activated by the alarm.

- Use the **Up**, **Down** or **Cycle** Key to toggle between a flashing hyphen or digit.
- Use the **Cycle** Key to move to the next output.

**Important NOTE**

Avoid unintentionally setting up an output to be activated by another facility such as the batch counter at the same time as an alarm.

**NOTE**

- The diagram *above* applies to an instrument with 2 relay outputs fitted. On instruments with 4 TTL open collector outputs, 4 symbols are displayed.
- This option does not appear on instruments that do not have relay or TTL open collector outputs fitted.

Logic Comms Locations				Read/Write
On activates	Alarm 1	Alarm 2	Alarm 3	Alarm 4
Output 1	61	71	81	91
Output 2	62	72	82	92
Output 3	63	73	83	93
Output 4	64	74	84	94

**Delay**

*Default: 0000.*

**ondL** **oFdL** **ondL** specifies the number of seconds the alarm condition must persist before the alarm is activated. **oFdL** specifies the number of seconds the alarm condition must be absent before the alarm is deactivated.

**NOTE**

- Only a whole number of seconds may be specified.
- Both settings may range from **0** to **9999** seconds.

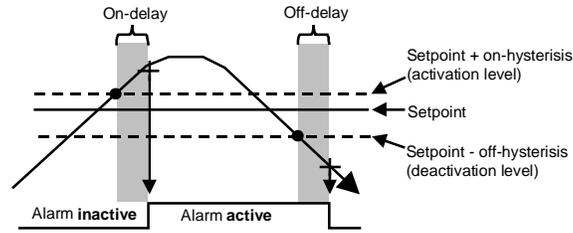
Analogue Comms Locations					Read/Write
On-delay	114	129	144	159	0 to 9999
Off-delay	115	130	145	160	0 to 9999
Alarm	1	2	3	4	Range (seconds)

**Hysteresis**

*Default: 000000.*

**onHY** **oFHY** **onHY** defines how far the measurement must go beyond the alarm activation level to activate the alarm. **oFHY** defines how far the measurement must go beyond the alarm deactivation level to deactivate the alarm.

Effect of Hysteresis and Delay on a High Alarm



The effect of hysteresis on a high alarm is to raise the activation level by the on-hysteresis amount and lower the deactivation level by the off-hysteresis.

The effect of hysteresis on a low alarm is to lower the activation level by the on-hysteresis amount and raise the deactivation level by the off-hysteresis.

The effect of hysteresis on a deviation alarm is to broaden the activation band by the on-hysteresis amount and narrow the deactivation band by the off-hysteresis amount.

Hysteresis might be used to prevent an alarm being activated and deactivated at a high frequency when a noisy measurement dithers around a setpoint.

Analogue Comms Locations					Read/Write
On-hysteresis	116	131	146	161	Any value in the displayable range
Off-hysteresis	117	132	147	162	
Alarm	1	2	3	4	Range

Setpoint Linking – Alarms 3 & 4

Default: Off

**L-SP** When invoked from the Alarm 3 Menu **AL3**, turning this option **on**, makes Alarm 3 use the setpoint for Alarm 1. Consequently, there is no point in editing the Alarm 3 Setpoint because it does not change the Alarm

1 Setpoint. Similarly, when invoked from the Alarm 4 Menu **AL4**, turning this option **on**, makes Alarm 4 use the setpoint for Alarm 2 and there is no point in editing the Alarm 4 Setpoint.

Linked setpoints are useful for associating 2 alarms with the same setpoint. For instance, when using this option, 2 deviation bands can be repositioned by changing one setpoint.

Logic Comms Locations		Read/Write	
Logic	88	98	
On enables setpoint linking for Alarm	3 (to 1)	4 (to 2)	

**Edit** *Default: On (Alarms 1 & 2), Off (Alarms 3 & 4)*

**Edit** During normal operation, **on** allows the operator to quickly edit Alarm Setpoints 1 to 4 from the Setpoint Edit Menu, accessed by pressing the **Down** Key when the instrument is displaying a realtime measurement and it has no optional password protection (see **Operator Functions** on page 42).

When this option is **OFF**, the alarm setpoints can only be **viewed** and **not edited** from the Setpoint Edit Menu.

Logic Comms Locations		Read/Write			
Logic	66	76	86	96	
On enables setpoint edit for Alarm	1	2	3	4	

**Message Display** *Default: On*

**diSP on** programs the instrument to display a message when an alarm occurs.

The 4-character message shows the alarm type and alarm number:

The first 3 letters of the message indicate the alarm type:

- **HiA** High alarm.
- **LoA** Low alarm.
- **Hid** High deviation alarm.
- **Lod** Low deviation alarm.

## Configuring the Alarms

---

The last digit of the message indicates the alarm number:

- **1 to 4** Alarm number.

When more than one alarm is activated, messages are prioritised so that the most severe alarm condition is reported.

### NOTE

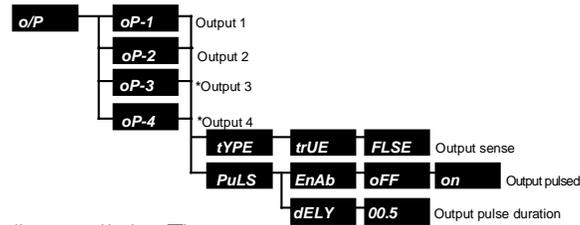
The most severe alarm is the one caused by the largest intrusion into the alarm's zone.

Logic Comms Locations	Read/Write			
Logic	67	77	87	97
On enables message display for Alarm	1	2	3	4

## Configuring the Logic Outputs

**o/P** The Logic Outputs Menu sets up the logic outputs options which are listed in the menu structure diagram *below*.

### Logic Outputs Menu Structure



\*Instruments with relay or TTL outputs.

This menu determines the way outputs work how ever they are activated, eg. by an alarm, the batch counter or the counter divider output.

The illustration *above* shows that it is possible to reverse the sense of the outputs or make them activate for a preset time period.

### NOTE

- The diagram *above* only applies to an instrument with 2 relay or 4 TTL open collector outputs fitted.
- The **PuLS** option must be enabled for the counter divider output (see **Divider Output** on *page 55*).
- See **Connecting the Logic Outputs** on *page 16* for information on connecting logic outputs to other devices.

### Output Selection

**oP-1** **oP-2** **oP-3** **oP-4** Selects the output to be setup.

### NOTE

**oP-3** and **oP-4** are not available for instruments that do not have 2 relay outputs.

**Sense**

Default: True

**TYPE** May be set to **trUE** or **FLSE** (false).

Output operation is affected by the output sense as shown in the table below and the diagram on page 135. Both show that during operation, when the output sense is **trUE**:

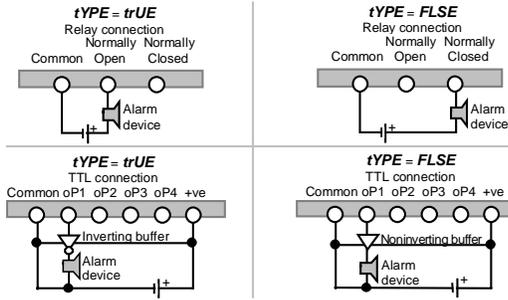
- A relay is energised when turned **on**.
- A TTL (open collector) output is Logic **0** when **on** by default.

During operation, when the output sense is **FLSE**:

- A relay is energised when turned **oFF**. This setting might be used in a failsafe application so that an alarm device connected to the output is also activated when the instrument loses power.
- A TTL (open collector) output is Logic **1** when **on**.

Output Sense				
Output	True		False	
Relay	<b>on</b>	The instrument connects Common to Normally Open.	<b>on</b>	The instrument connects Common to Normally Closed.
	<b>oFF</b>	The instrument connects Common to Normally Closed.	<b>oFF</b>	The instrument connects Common to Normally Open.
TTL	<b>on</b>	The instrument sets output to 0 Volts (ie. Logic 0).	<b>on</b>	The instrument sets output to +ve Volts (ie. Logic 1).
	<b>oFF</b>	The instrument sets output to +ve Volts (ie. Logic 1).	<b>oFF</b>	The instrument sets output to 0 Volts (ie. Logic 0).

Output Sense



Logic Comms Locations	Read/Write			
Logic	200	205	210	215
On sets type to <b>truE</b> for Output	1	2	3	4

Pulse

**PULS** Sets up a pulsed output that can be activated as normal, but is deactivated automatically after the programmed time interval.

During operation:

- Once a pulse starts, it continues, even if the original cause disappears.
- Maintaining the original cause of the pulse does not extend it.
- A second pulse occurs only if the cause of the first pulse disappears and a new stimulus occurs after the first pulse ends.

Pulse Enable

*Default: Off*

**EnAb** *on* enables a pulsed output (see **Pulse** above).

This option must be enabled if the input type is **Cnt** or **EnC** and the divider output option is used (see **Divider Output** on pages 55 and 61).

## Configuring the Logic Outputs

---

Logic Comms Locations			Read/Write	
Logic	201	206	211	216
On enables pulsed output for Output	1	2	3	4

## Pulse Duration

*Default: 00.5*

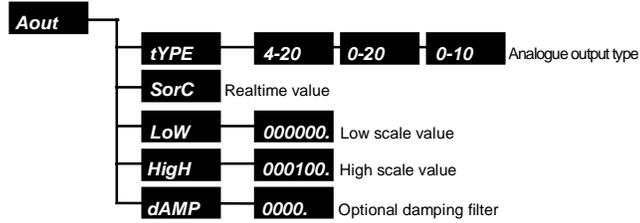
**dELY** This value sets the output's pulse duration and may range from from **00.1** to **99.0** seconds.

Analogue Comms Locations			Read/Write	
Analogue	219	221	223	225
Output	1	2	3	4
Integer range (seconds)	5 to 4950 (20mS ticks) (eg. 50=1 second)			

## Configuring the Analogue Output

**Aout** The Analogue Output Menu sets up the analogue output options which are listed in the menu structure diagram *below*. This menu sets up the scalable analogue output transmission level.

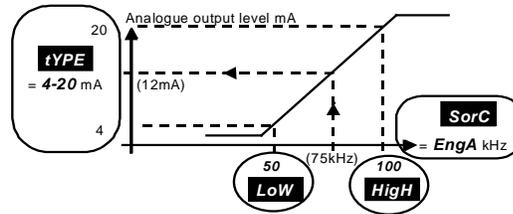
### Analogue Output Menu Structure



### Example

The diagram *below* shows how to setup **tYPE**, **SorC**, **LoW** and **HigH** so that an **EngA** value of 50kHz would output 4mA, and an **EngA** value of 100kHz would output 20mA.

### Analogue Output Scaling



### NOTE

For normal operation, the source value **EngA**, should lie between **LoW** and **High**.

### Type

*Default: 4 to 20*

**tYPE** Selects the output range from:

- **4 - 20** 4 to 20 mA (milliAmperes).
- **0 - 20** 0 to 20 mA.
- **0 - 10** 0 to 10 Volts.

Analogue 170 Comms Location			Read/Write
Analogue value	0	1	2
Sets output type	0 to 10V	0 to 20mA	4 to 20mA

### Source Value

*Default: EngA (in Counter Mode)*

**SorC** Defines the realtime value that is used to determine the retransmission output level.

The choices for each input type setting are listed on *page 139* (see also **Type** on *page 48*).

With the exception of the **CoMM** source setting, a description of each **SorC** setting is given in the **Getting Started** section (see *pages 25 to 37*).

If the **SorC** is set to **CoMM**, the analogue output is controlled by writing to Analogue Location **175** via comms.

**Example** (Refer to the diagram on *page 137*)

If: **SorC** is changed to **CoMM**

Sending **;001 SA 175 75 <CR><LF>** to the instrument via comms

Sets the analogue output to half way (12mA).

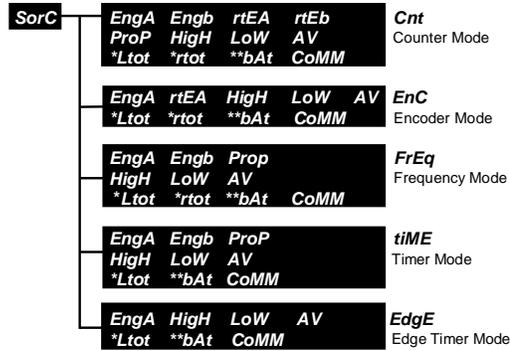
**EngA** is always the default analogue output source whatever the input type. However, if the instrument is setup:

- As a counter **EngA** is a scaled count.
- To measure frequency **EngA** is a rate.
- As a timer **EngA** is a time.

If the **SorC** value is **AV**, the **AV** and **AVti** options in the **SYSt** (System) Menu determine the source of the average value and the time over which this average is taken (see **Averaging Time** and **Average Source** on page 150).

The **AV**, **High** and **LoW** values are reset to the current **AV** source if the **rSEt** function is performed from a function key or status input (see **Reset High, Low & Average** on pages 114 and 122).

**Analogue Output Sources**



\* Always selectable, but the totaliser must be setup and enabled for the value to be usable.  
 \*\* The batch counter AND the totaliser must be setup and enabled for the value to be usable.

Remember, after setting the analogue output **SorC**, it is also necessary to specify the analogue source values **High** and **LoW** that correspond to the analogue output range limits **tYPE** (see **Type** on page 138).

## Configuring the Analogue Output

Analogue 175 Comms Location					Read/Write
<b>SorC=CoMM</b>					
Analogue 171 Comms Location					Read/Write
Input type					
	<b>Cnt</b>	<b>EnC</b>	<b>FrEq</b>	<b>tiME</b>	<b>EdgE</b>
Analogue value	Source value				
0	<b>EngA</b>	<b>EngA</b>	<b>EngA</b>	<b>EngA</b>	<b>EngA</b>
1	<b>Engb</b>	<b>rtEA</b>	<b>Engb</b>	<b>Engb</b>	<b>HigH</b>
2	<b>rtEA</b>	<b>LoW</b>	<b>ProP</b>	<b>ProP</b>	<b>LoW</b>
3	<b>rtEb</b>	<b>LoW</b>	<b>HigH</b>	<b>HigH</b>	<b>AV</b>
4	<b>ProP</b>	<b>AV</b>	<b>LoW</b>	<b>LoW</b>	<b>Ltot</b>
5	<b>HigH</b>	<b>Ltot</b>	<b>AV</b>	<b>AV</b>	<b>bAt</b>
6	<b>LoW</b>	<b>rtot</b>	<b>Ltot</b>	<b>Ltot</b>	<b>CoMM</b>
7	<b>AV</b>	<b>bAt</b>	<b>rtot</b>	<b>bAt</b>	
8	<b>Ltot</b>	<b>CoMM</b>	<b>bAt</b>	<b>CoMM</b>	
9	<b>rtot</b>		<b>CoMM</b>		
10	<b>bAt</b>				
11	<b>CoMM</b>				
	<b>Cnt</b>	<b>EnC</b>	<b>FrEq</b>	<b>tiME</b>	<b>EdgE</b>
<b>dPCu</b>	0,1,8,10	0,5,7	6,8	6,7	4,5
<b>dp</b>	Others	Others	Others	Others	Others

### Scaling

Default: Low: 000000., high: 000100

**LoW** **HigH** These values correspond to the analogue output limits set by the analogue output **tYPE** (see **Type** on page 138).

Analogue Comms Locations		Read/Write
172	173	Range 0 to 2
<b>LoW</b>	<b>HigH</b>	

### Damping

Default: 0000.

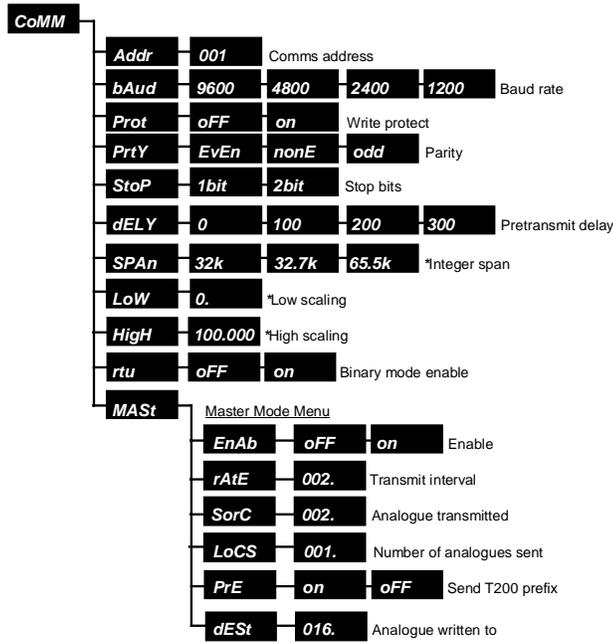
**dAMP** Defines a time constant in seconds over which a simulated rolling average is applied to the analogue output level. Longer times make the analogue output steadier but give it a slower step response. The time may range from **0 (oFF)** to **9999** seconds.

Analogue 174 Comms Location		Read/Write
Integer damping time (seconds)	0 to 9999	0=no damping

# Configuring the Serial Communications

**CoMM** The Communications Menu sets up the communications interface options which are listed in the menu structure diagram below.

## Communications Menu Structure



\* Scaling Modbus

## Configuring the Serial Communications

---

The communications setup can be divided into 3 categories:

- **General** Important settings that can affect all communications.
- **Modbus** Optional setup that applies only to Modbus™-ASCII or Modbus™-RTU (binary) protocols.
- **Master** Optional setup which is used only if the instrument transmissions are to be sent automatically at timed intervals or triggered by a status input or function key.

The instrument can be setup to use one of 3 protocols:

- ASCII Native .. .. Easy to use manually ASCII protocol (no checksums).
- ASCII Modbus Modbus™-ASCII.
- Binary-RTU Modbus Modbus™-RTU.

The *rtu* option (see **Remote Terminal Unit** on *page 145*) controls which protocols can be used.

### NOTE

By default the instrument responds in both ASCII protocols.

### Instrument Address

*Default: 001*

**Addr** Defines a unique communications address for the instrument which may range from **001** to **247**. Unique addresses mean commands can be directed to one instrument. They also stop all instruments replying at the same time. A command is sent to a particular address by ensuring the address field in the command equals the address of the instrument the command is intended for.

#### Example

The command **:001 SA 175 10<CR><LF>**  
Addresses instrument **001** because the address field is **001**  
Stores the value **10** to **Analogue Location 175**.  
The instrument responds with **OK<CR><LF>**

During normal operation, a master may send commands to address **000**. This is a broadcast address used only for store commands (see *page 159*) as is the example *above*. Instruments retrieve but never reply to broadcast commands.

**NOTE**

When more than one instrument is connected to a master via a multidrop bus, each instrument must have a different address.

Analogue 182 Comms Location		Read/Write	
Instruments communications address range		1 to 247	

**Baud Rate**

*Default: 9600bps*

**bAud** Sets the communications speed.

Analogue 183 Comms Location				Read/Write	
Integer value	0	1	2	3	
Communications baud rate	1200	2400	4800	9600	

**Protection**

*Default: Off*

**Prot on** protects the instrument's setup from any changes via comms. **oFF** allows any analogue or logic location to be changed unless it is a read only location. Attempts to write to a protected or read only location using the native protocol causes the instrument to reply with **#2** (see **Errors** on *page 161*).

Logic 102 Comms Location		Read/Write	
On	Enables protection		
Off	Disables protection		

**Parity**

*Default: Even*

**PrtY** Defines the parity setting for all communications.

Always set parity to **nonE** when **rtu** is **on** (see **Remote Terminal Unit** *page 145*).

Analogue 184 Comms Location				Read/Write	
Integer value	0	1	2		
Parity	Odd	Even	None		

**Stop Bits**

*Default: 1bit*

**StoP** Defines the number of stop bits for all communications. **Always** set stop bits to **1bit** when **rtu** is **on** (see **Remote Terminal Unit** on page 145).

Logic 103 Comms Location		Read/Write
On	2bits	
Off	1bit	

**Transmit Delay**

*Default: 0mS*

**dELY** Defines a delay in mS (milliseconds, thousandths of a second) before the instrument replies to commands received via comms. It is ignored if **rtu** is **on**.

The delay is useful if there is difficulty handling the instrument's fast response to commands using a 2-wire (half duplex) connection. For example, this is likely if a simple program is being written in Visual Basic under Windows, connected to the instrument via a 2-wire (half duplex) connection.

Analogue 188 Comms Location				Read/Write
Integer value	0	1	2	3
Delay before transmit (mS)	0	100	200	300

**Scaling** (Modbus™ only) *Default: span 32k, Low 0, High 100*

**SPAn** **LoW** **High** Allow transmission of values normally outside the range of Modbus™ integers.

**SPAn** defines the integer range used to transmit values ranging from low frequency to high frequency as follows:

**LoW** to **High** (kHz) is transmitted:

- As 0 to.32000 when **SPAn** is **32k**.
- Or 0 to 65536 when **SPAn** is **65.5k**.
- Or 0 to.32767 when **SPAn** is **32.7k**.

Analogue Comms Locations		Read/Write
185	<b>SPAN</b>	0=32k 1=32.7k 2=65.6k
186	<b>LoW</b>	Any value in the displayable range
187	<b>HigH</b>	Any value in the displayable range

**Example**

Option	Setting
<b>SpAn</b>	<b>32000</b>
<b>LoW</b> (frequency)	<b>0.00</b>
<b>HigH</b> (frequency)	<b>100.00</b>
<b>Display range</b>	<b>Modbus range</b>
<b>0.00...100.00</b>	<b>0...32000</b>

A display value of **50.00** will result in a Modbus value of 16000.

**Remote Terminal Unit**

*Default: Off*

**rtu** *on* makes the instrument use only Modbus™-RTU protocol. When the **rtu** is *on*:

- Parity must be set to **nonE**.
- Stop bits should be **1bit**.
- Delay before transmission is ignored (see **Transmit Delay** on page 144).

**NOTE**

Modbus™-RTU is a binary protocol requiring 8 data bits per byte.

Logic 104 Comms Location	Read/Write
On	Enables rtu
Off	Disables rtu

**Master Mode**

**MASt** Sets up the instrument as a master. Masters transmit without being asked for data.

## Configuring the Serial Communications

---

It is not recommended to send commands to an instrument whilst Master Mode is **on** as it may not respond.

A message is composed of:

- An optional prefix ("**;000SA016<space>**" by default).
- A programmable number of values (*1 value by default*), starting from a specified analogue location (*Analogue Location 2 by default*) and separated by commas.
- An end of line sequence **<CR><LF>**.

### Example

**;000SA016 +0.0000<CR><LF>**

In this example, a value of **+0.0000** is sent from Analogue Location **2** to be stored in Analogue Location **016**.

Enabling the default Master Mode setup allows another instrument connected via comms, to act as a remote display unit. The other instrument must be setup so the displayed value is sourced from comms (see **Source Value** on page 74).

### NOTE

Master Mode does not work when **rtu** (binary Modbus™-RTU) is enabled (see **Remote Terminal Unit** on page 145).

### Master Mode Enable

*Default: Off*

**EnAb** **on** enables Master Mode. Master Mode transmissions will not take place when enabled if the **MASt** option in a **StA1/StA2** (Status Input) Menu is **on** and the status input(s) concerned is not activated (see **Communications Master** on page 114).

Logic 105 Comms Location	Read/Write
On	Enables Master Mode
Off	Disables Master Mode

**Interval Between Transmissions** *Default: 2 seconds*

**rAtE** Defines the number of seconds between each transmission from the instrument. **0** to **999** may be entered. **0** causes transmissions at the display update rate.

Analogue 192 Comms Location		Read/Write
Integer range (seconds)	0 to 999	

**Source Analogue Location** *Default: 002(displayed value)*

**SorC** Defines the (first) analogue location transmitted.

Analogue 189 Comms Location		Read/Write
Source Analogue Location (integer)	0 to 255	

**Locations to Transmit** *Default: 1 location*

**LoCS** Specifies the number of consecutive analogue locations to transmit, starting from the source analogue location defined *above*. **1** to **19** can be entered.

Long messages at low baud rates cannot be sent as fast as the display is updated. In these circumstances the messages are sent as fast as possible and they are never truncated.

**NOTE**

Some instruments which support the native protocol may only receive one location per message and this location must not be read only.

Analogue 190 Comms Location		Read/Write
Analogue Locations to transmit (integer)	1 to 9	

**Prefix Enable** *Default: On*

**PrE** *on* enables a message prefix.

**Example**

Whole default message with prefix:  
**;000SA016 +0.1000 <CR><LF>**

**Example**

Whole default message with no prefix:  
**+0.1000<CR><LF>**

(See also **Destination Location** *below*.)

Logic 106 Comms Location		Read/Write
On	Enables prefix	
Off	Disables prefix	

**Destination Location**

*Default: 016 (display source)*

**dES:** Defines the analogue location where the first value sent should be stored by the receiving instrument. **0** to **255** can be entered, but the valid range depends on the instrument receiving the message. The destination location can only receive one location per message and this location must not be read only.

This analogue location number makes up the last 3 digits of the optional message prefix as underlined *below*.

**Example**

**;000SA016<space>**

**NOTE**

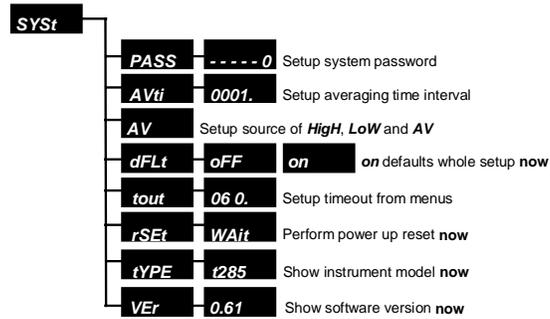
Only **0** may be written to an unused location.

Analogue 191 Comms Location		Read/Write
Destination Analogue Location in target (integer)		0 to 255

## Configuring the System Options

**SYSt** The System Menu sets up the system options which are listed in the menu structure diagram *below*.

System Menu Structure



The system menu can be used to:

- Setup miscellaneous system wide settings (**PASS**, **AVti**, **AV** and **tout**) .  
OR
- Immediately:
  - View information about the instrument **tYPE**, **VEr** etc.
  - Default **all** instrument settings to factory defaults .
  - Perform a power up reset without changing any of the setup.

### Password Setup

*Default: 0 (Disabled)*

**PASS** Defines an optional password. Its value may be any whole number from **000000** to **099999**. If the password is not **000000**, it is requested whenever the instrument enters the **ConF** (Configuration) Menu to change the instrument setup. In order to avoid unwanted observation of

the password, only the digit being edited can be seen. The other digits are shown as hyphens "-".

**Important NOTE**  
**IF YOU FORGET THE PASSWORD,**  
**THE INSTRUMENT SETUP**  
**CANNOT BE ACCESSED**  
**FROM THE FRONT PANEL**

### Averaging Time

*Default: 0001.*

**AVti** Defines a time in seconds, over which a simulated rolling average is taken. Its value may be any whole number from **0000** to **9999**.

During normal operation, the average can be viewed by:

- Activating a status input or function key that has been setup to display **AV** (see **Display Alternative Value** on pages 109 and 118).
- Selecting **AV** from the **High, LoW, AV, SEAL** and **Conf** Menu which is reached during normal operation by holding down the **Enter** Key for 2 seconds (see **Setting Up the Instrument** on page 38).

The rolling average may be taken from a selection of sources (see **Average Source** below).

Analogue 214 Comms Location	Read/Write
Averaging time range (seconds)	0 to 9999 0 performs no averaging at all

### Average Source

*Default: rtEA (In Counter Mode)*

**AV** Defines the source from where the simulated rolling average, the highest and lowest values, is taken.

For example, if **AV** is set to **rtEA**, **High**, **LoW** and **AV** are the highest, lowest and average **rtEA** values since the instrument was powered up, or since a **rSEt** was triggered from a status input or function key (see **Reset High, Low & Average** on pages 114 and 122).

The choices for each input type setting are listed below. The origin of each possible source value is summarised in the **Getting Started** section (see pages 25 to 37 and **Type** on page 48).

**High, Low & Average Sources**



\*The totaliser must be setup and enabled for the value to be usable.

No matter where the high, low and average values are sourced from, they are always displayed to the number of decimal places used for noncumulative values. This is true even if the high, low and average values are sourced from a cumulative value (see **Decimal Point Position** on page 76).

Analogue 216 Comms Location		Read/Write
Averaging time range (seconds)	0 to 9999	
	0 performs no averaging at all	

**Default**

*Default action: Off (no action)*

**dFLt** is not a setup item but an **action** that is performed. **on** defaults the **whole** instrument setup to sensible factory defaults. **oFF** has no effect on anything whatsoever.

**NOTE**

## Configuring the System Options

---

Throughout this manual, the factory default settings are shown in italics to the right of each setup item title.

Logic 154 Comms Location		Read/Write
On	Defaults the instrument's setup	

### Timeout

*Default 60 seconds*

**tout** Specifies the maximum number of seconds the instrument will wait for a key press before it returns to normal operation from a **CONF** (Configuration) Submenu.

Analogue 215 Comms Location		Read/Write
Timeout range (seconds)	15 to 255	

### Reset

**rSEt** Makes the instrument perform a power up reset. Press the **Enter** Key when **rSEt** is on display.

The instrument will display **WAit** for a moment before resetting. Resetting an instrument does not change any of the instrument's setup. If changes were made to the setup just before resetting the instrument, those changes will have been saved. It is not necessary to exit the setup menus completely for the most recent changes to be saved.

Logic 155 Comms Location		Read/Write
On	Resets the instrument	

### Model Number

**tYPE** Makes the the instrument display the instrument model number. Press the **Enter** Key when **tYPE** is on display. The model will be one of the following:

- Timer/counter with **no logic outputs**.
- Timer/counter with **2 relay outputs**.
- Timer/counter with **4 open collector (TTL) outputs**.

**Important NOTE**

Always quote the model number and software version when contacting your supplier with a technical query.

Analogue 0 Comms Location	Read Only
Value may be 243, 244 or 245	

**Software Version**

**VER** Makes the the instrument display the software version number. Press the **Enter** Key when **VER** is on display, eg. **0.61**.

**Important NOTE**

Always quote the model number and software version when contacting your supplier with a technical query.

Analogue 9 Comms Location	Read Only
Version eg. +0.5900	

## Product Specification

### Power Requirements

Mains supply	90V AC to 265V AC 50/60Hz, 20VA maximum.
Low voltage supply	20V AC to 30V AC 50/60Hz, 24V DC to 32V DC

### Operating Conditions

Ambient temperature	Storage -10°C to 70°C. Operating 10°C to 50°C.
Humidity	10% to 95% RH noncondensing.

### Display

Type	14.7mm high brightness 7 segment LED red (optionally green).
Range	-199999 to +999999.

### Input

2 inputs, each configurable for	AC magnetic pickup, contact closure, TTL Logic and NPN/PNP.
Time base/measurement accuracy	<100ppm.
Measurement	Up to 150 kHz.

### Transducer Supply

Range	5/12V DC.
Output current	100mA maximum (limited).

**Analogue Output**

Ranges	0 to 10V, 0 to 20mA or 4 to 20mA selectable.
Accuracy	0.2% of span.
Temperature drift	<100ppm/°C.
Output ripple	<10mV or 50µA @ 30Hz.
Response	63% within 32mS. 99% within 100mS.
Resolution	0.05% of span, 5mV or 0.01mA.
Maximum output	18V @ 22mA.
Isolation	500V.

**Alarm Relays (when fitted)**

Type	2 off changeover.
Rating	1A @ 250V.

**Logic Outputs (when fitted)**

Type	4 off optically isolated (common ground) open collector transistor outputs.
Rating	20mA, 24V.

**Communications Interface**

Type	EIA RS485 (RS422 compatible).
Isolation	500V DC/Peak AC.

## Appendix A - Display Messages

### Power Up Messages

**uCAL** The instrument has lost its factory calibration constants in nonvolatile memory. Could be nonvolatile memory failure. Return unit to factory.

### Out of Range Messages

**undEr** Indicates either:

- The displayed value is below the displayable range (see **Decimal Point Position** on *page 76*).
- The measured value/realtime display is below the measurable range.

**oVER** Indicates either:

- The displayed value is above the displayable range (see **Decimal Point Position** on *page 76*).
- The measured value/realtime display is above the measurable range.

### Alarm Messages

Alarm messages are 3 letters followed by the alarm number. The codes are:

<b>HiA1</b>	<b>HiA2</b>	<b>HiA3</b>	<b>HiA4</b>	High alarm, eg. <b>HiA4</b> indicates high Alarm 4 has been activated.
<b>LoA1</b>	<b>LoA2</b>	<b>LoA3</b>	<b>LoA4</b>	Low alarm.
<b>Hid1</b>	<b>Hi d2</b>	<b>Hid3</b>	<b>Hid4</b>	High deviation alarm.
<b>Lod1</b>	<b>Lod2</b>	<b>Lod3</b>	<b>Lod4</b>	Low deviation alarm.

When more than one alarm is activated, messages are prioritised so the highest high alarm or the lowest low alarm is reported.

## Appendix B - Connecting the Serial Interface

Four instrument Terminals: 10, 11, 12 and 13 are used for serial communications. These can be used to establish a 2-wire or 4-wire RS485 connection with a master device (usually a PC). The interconnecting wires are collectively known as a "BUS".

A strict rule governs how the bus is routed. Obviously it must be connected from the master to one instrument, but if there is a second instrument, the bus should continue only from the terminals of the first instrument to the second. Similarly, if there is a third instrument, the bus should continue only from the terminals of the second instrument to the third, and so on. This is called a "multidrop bus". There should be no T-junctions in the bus.

A 120Ω resistor should be connected between Terminals 10 and 11 on the last instrument furthest from the master.

### Half Duplex - 2-Wire Communications

One of the bus wires must be connected to Terminals 10 and 12 of each instrument, and the other wire must be connected to Terminals 11 and 13 of each instrument as described *above*.

A 2-wire bus can communicate in only one direction at a time. The direction of communication is controlled by the master. Masters must:

- a) Know how to switch from transmit to receive (RTS goes low).
- b) Avoid switching to receive before transmit is finished.
- c) Avoid switching to receive after some/all of the reply is missed.

For example, Windows Terminal transmits via a 2-wire bus okay, but the instrument's replies are not received because the Terminal does not know it should switch from transmit to receive, or how, or when.

### **Full Duplex - 4-Wire Communications**

One bus wire must be connected to Terminal 10 of each instrument, the second wire to Terminal 11, the third wire to Terminal 12, and the fourth wire to Terminal 13 of each instrument, as described *above*.

One pair of wires is used for transmitting and the other pair listens. This avoids the problems of how and when to switch from transmit to receive as described *above*.

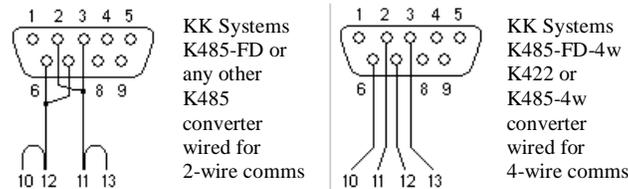
4-wire links are useful for experimenting with the Windows Terminal.

The instruments have an RS485/RS422 compatible interface with the additional ability to release the instrument-to-master communication channel when not transmitting. This allows other instruments wanting to transmit to do so.

### **PC Setup Program**

The program runs on a PC running Windows 3.1, 95 or NT4.0 or later. It transmits and receives whole setups between the PC and an instrument. The setups can also be saved and retrieved from disk. The program automatically adapts to a 2 or 4-wire bus. Only a KK Systems K485-FD, wired as shown *below*, is recommended with the program.

#### **Instrument Terminals**



KK Systems can be contacted by telephone on +44 (0) 1273 857 185.

## Appendix C - Using the Native Communications Protocol

Throughout this Guide, analogue and logic locations corresponding to setup parameters have been documented. These locations can be read and written to via the serial interface. All locations can be write-protected by setting **Prot** to **on** in the **CoMM** (Communications) Menu. Some read only locations, eg. the displayed value, can never be written to via comms (see **Protection** on page 143).

### Command Structure

Here is an example of a command sent to an instrument:

```
;001 SA 54 2<CR><LF>.
```

and here is the normal reply:

```
OK<CR><LF>.
```

This is what each piece of the command does (and each piece must be present):

;        Start of the command.

**01**        Instrument Address  
May range from **000** to **247**. There must always be 3 digits. These 3 digits must match the instrument's address as setup in the **CoMM, Addr** (Communications, Address) menu. **000** can only be used in write commands to broadcast to all instruments simultaneously.

**<space>** This space character after the address is optional.

**SA**        Action  
SA = Store Analogue    RA = Read Analogue  
SL = Store Logic        RL = Read Logic

**54**     Data Location  
May range **0** to **255**. Some locations are not used. Unused analogue locations only read/write as **0.0000**. Unused logic locations only read/write as off.

**<space>**

**2**     Data  
For read commands RA and RL, this is the number of consecutive parameters to read from the instrument.  
For write commands, it is the data to be written. If more values follow, separated by spaces, these are written to consecutive data locations following the Data Location. If an error occurs during a multiwrite, only writes up to the error are completed.  
For logic writes only, the data may only be on or off.

Eg. **;001 SL 154 ON<CR><LF>**

**<CR>**    End-of-line carriage return  
(ASCII 13 decimal).

**<LF>**    Linefeed  
(ASCII 10 decimal).

Here is an example of a read command which reads 4 analogues from Location **0**:

**;001RA0 4<CR><LF>**

and here is the reply:

**+284.00 -3723.5 -03723 ?99999<CR><LF>**

The **?99999** indicates the value was over range. **?19999** indicates a value is under range (see **Troubleshooting Comms** on *page 165*).

## Errors

- #1** Invalid command action. Only SA, SL, RA and RL allowed (see *page 159*). Check address field is 3 digits. Also check you have not used on or off as data for a Store Analogue command. Ensure numeric data, eg. **0**, or **1** has not been used in a Store Logic command.
- #2** Attempted a write to a read only or protected location. Some locations are permanently read only. However, this message also occurs for any location if the **Prot** option in the **CoMM** (Communications) Menu has been turned **on** (see **Protection** on *page 143*).
- #3** Data location specified does not exist. Start location or number of locations could be invalid.
- #4** Invalid data value, or no space before the data value, or syntax error.
- #5** Attempted to change a location while instrument is in the **ConF** (Configuration) Menu. *By default, the instrument will normally exit from menu after one minute.*
- #7** Attempted to write to a nonzero value to an unused location.

## Appendix D - Realtime Comms Locations

### Analogue Locations

(RO indicates location can be Read Only, RW indicates Read/Write)

0	RO	Instrument type ie: +283.00 or +284.00 or +285.00.
3	RW	Source of displayed value when from comms (ie. when Analogue Location <b>53</b> is <b>4</b> ) - see <b>Source Value</b> on <i>page 74</i> ).
5	RO	Number of logic outputs fitted: 0, 2 (relays) or 4 (TTLs).
6	RO	Calibration seal. Value changes if certain setup items changes (see <i>pages 43 to 44</i> ).
7	RO	First 4 digits of serial number.
8	RO	Last 4 digits of serial number.
9	RO	Instrument software version (eg. +99.9900)
16	RW	Comms to display value.
31	RO	Batch stage.
35	RO	Low display value (minimum peak since reset - see <b>Reset</b> on <i>pages 114 and 122</i> ).
36	RO	High display value (maximum peak since reset - see <b>Reset</b> on <i>pages 114 and 122</i> ).
37	RO	Average display value (over <b>AVti</b> - see <b>Averaging Time</b> on <i>page 150</i> ).
40	RO	Proportion value.
41	RO	Instantaneous Channel A rate or timing.
42	RO	Instantaneous Channel B rate or timing.
43	RO	Cumulative Channel A measurement.
44	RO	Cumulative Channel B measurement.
45	RO	High 6 digits of grand total <b>Htot</b> .
46	RO	Low 6 digits of grand total <b>Ltot</b> .

<b>47</b>	RO	Grand total rate.
<b>48</b>	RO	High 6 digits of count A.
<b>49</b>	RO	Low 6 digits of count A.
<b>50</b>	RO	High 6 digits of count B.
<b>51</b>	RO	Low 6 digits of count B.
<b>175</b>	RW	Realtime source of analogue output level when <b>SorC</b> is <b>CoMM</b> .
<b>217</b>	RW	User linearisation point to be sampled next.
<b>218</b>	RW	User linearisation channel to be sampled next.

### Logic Locations

#### Status

<b>6</b>	RO	State of Function Key 1	on = pressed (leftmost key).
<b>7</b>	RO	State of Function Key 2	on = pressed (rightmost key).
<b>8</b>	RO	State of Status Input 1	on = contacts closed.
<b>9</b>	RO	State of Status Input 2	on = contacts closed.
<b>10</b>	RO	State of Alarm 1	on = activated.
<b>11</b>	RO	State of Alarm 2	on = activated.
<b>12</b>	RO	State of Alarm 3	on = activated.
<b>13</b>	RO	State of Alarm 4	on = activated.
<b>14</b>	RO	on = abnormal state of Output 1* .	
<b>15</b>	RO	on = abnormal state of Output 2* .	
<b>16</b>	RO	on = abnormal state of Output 3* .	
<b>17</b>	RO	on = abnormal state of Output 4* .	
<b>24</b>	RO	on = calibration sampling in progress.	

\* Only instruments with relay or TTL/logic outputs fitted.

#### Commands

<b>25</b>	RW	on starts calibration sampling.
-----------	----	---------------------------------

## Appendix D - Realtime Comms Locations

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- 26 RW on acknowledges alarms.
- 27 RW on performs the reset function (see **Reset** on *pages 114 and 122*).
- 28 RW on resets the high value (maximum peak) to the current display value.
- 29 RW on resets the low value (minimum peak) to the current display value.
- 30 RW on resets the average value to the current display value.
- 43 RW on begins sampling user linerisation input value.
- 44 RW on - Channel A scaling setup and sampling finished.
- 45 RW on - Channel B scaling setup and sampling finished.

## Appendix E - Troubleshooting Comms

1. When using 2-wire comms with a KK Systems' converter on a PC serial port, it is necessary to:
  - a) Assert the RS232 RTS output in order to TRANSMIT.
  - b) Send the command and monitor its progress in order to:
    - i) Clear the RTS immediately after the <LF> has been sent, AND
    - ii) Only then, read the reply from the instrument.
2. When checking for an **OK** response, look for **K** anywhere in the response and not just in a set position. Garbage can precede it.
3. When a reply is out of range, the first character is a question mark.
4. If you are having difficulty with comms, try sending a command which resets the instrument, such as:

**;001 SL 155 ON<CR><LF>**

This way, it is possible to tell if the instrument is receiving okay even if it cannot transmit. This may narrow down the possible reasons for the problem. This test can be performed using Windows Terminal (not Hyperterminal). Terminal will never be able to show responses from the instrument if connected in 2-wire mode. In this case, if the test passes, it is likely comms between instrument and PC are okay. Terminal must be setup to match the instrument comms setting which *defaults to*:

*Communications:*

- *Baud*            9600.
- *Parity*           Even.
- *Stop bits*       1.
- *Parity check*   [Yes].
- *Comm port*      (As applicable).

- *Flow control* None.

*Terminal Preferences:*

- **CR →CR/LF outbound, enabled**

6. The most common comms problems are:
- a) Connected to the wrong comm port or not connected at all!
  - b) Setup mismatch. Baud, parity, stop bits different. Make sure the address in the command match the **COMM, Addr** of the instrument. If using Modbus™-RTU, ensure parity = none and stop bits = 1.
  - c) Incorrect wiring. Wires of a pair the wrong way round; whole set of 4 wires shifted along one terminal position; terminals not screwed up tightly, wire dropped off fragile home-made cable.
  - d) RTS (at master RS232 end) not asserted when master transmits, or cleared when master is to receive (2-wire comms).
  - e) Comms converter has inadequate supply. Self powered converters require DTR to be high. If a laptop is used, ensure POWER.EXE is DISABLED.
  - f) 120Ω resistor not fitted across Terminals 10 and 11 of last instrument in daisy chain.

**NOTE**

The instrument's use of the Modbus™ protocol differs from the norm in that there is no requirement to subtract one from a data location accessed.

Eg. If **x** is the data location to access, specify location **x** and not **x-1**.

## Appendix F - Mode Issues

### Counter Mode

Setting the input type to **Cnt** defaults the instrument's setup to display **EngA**, which is the pulses counted on Input Channel A (with optional scaling into engineering units).

Two independent **12-digit counts** called **EngA** and **Engb** (for Channels A and B respectively) are maintained by the instrument but it displays only the **6 least significant digits** of **EngA**.

**EngA** is displayed by default as the **SorC** option in the **diSP** (Display) Menu. To display **Engb**, change the **SorC** option to **Engb** (see **Source Value** on page 74).

If **EngA** or **Engb** is displayed, the position of the decimal point is fixed and controlled by the **dPCu** option in the **diSP** Menu which in turn changes the largest displayable 6-digit value. **dPCu** means decimal point for **Cumulative** values like counts or distances (see **Decimal Point Position** on page 76).

#### Examples

<b>dPCu</b>	<b>Count</b>	<b>12 Digits Stored</b>	<b>6 Digits Displayed</b>
<b>0</b>	123456789	000123456789	<b>456789</b>
<b>2</b>	123456789	0123456789.00	<b>6789.00</b>

When **dPCu** is **0**, counts **EngA** and **Engb** must exceed 999999 for display truncation to occur. If **dPCu** is **2**, counts need only exceed 9999 to be truncated on the display.

Although **EngA** is a 12-digit cumulative value, only the 6 least significant digits are displayed. For example, if **dPCu** is **0**, **EngA** can count from 0 to 999999999999 before rolling over back to 0. However, since only the last 6 digits of **EngA** can actually be displayed, it appears to rollover whenever the last 6 digits are 999999.

When **dPCu** is **0**, the largest possible 12-digit count in **EngA** and **Engb** is 999999999999 (twelve nines). Adding 1 to this value makes it rollover to 0. However, when **dPCu** is **2**, the largest whole 12-digit count is 9999999999.00. Adding 1 makes it rollover to 0.00.

The separate totaliser function can display all 12 digits of **EngA** or **Engb** and is just a way of seeing all 12 digits of an existing count. In its basic form, the totaliser accepts all 12 digits and splits them into 2 **displayable** 6-digit values called **Htot** and **Ltot**. In order to display both halves, you could setup the **diSP**, **SorC** option to show **Ltot** normally (**NOT EngA**) and then setup a function key to show **Htot** when the key is pressed. The totaliser does not perform a totalisation because **EngA** is already a cumulative total (see **Display Alternative Value** on *page 118*).

The totaliser provides the option to further scale **Htot** and **Ltot**, to set the decimal point position anywhere in **Ltot**, and to see both halves of **EngA+Engb** or **EngA-EngB** in this way.

Scaling for **EngA** is setup from the **CHA** (Channel A) Menu by editing the **EngA** and **CntA** values (see **Engineering Units** and **Corresponding Counts** on *pages 54 and 55*).

### Example

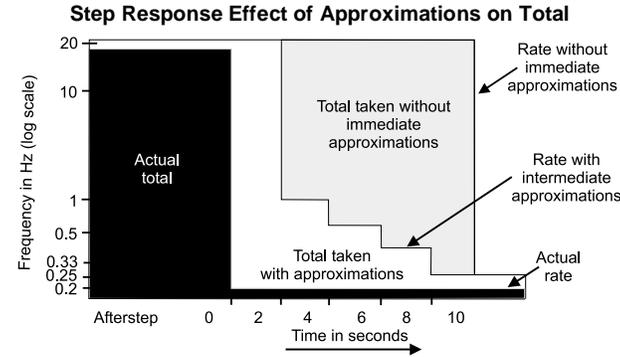
To display millimetres when the display source is **EngA**, if 3 pulses on Channel A correspond to 1 millimeter, **CntA** should be set to **3** and **EngA** to **1**.

The count rate **rtEA** or **rtEb** can be selected for display from the **diSP**, **SorC** option. They display estimates (derived values) the pulse rate in thousands of **EngA** or **Engb** units per second. When a rate is displayed, the position of the decimal point is controlled by the **diSP**, **dP** option (see **Decimal Point Position** on *page 76*).

### Frequency & Period Measurement During Operation

When an alternating signal stops and *FLO* is 0 (no minimum frequency), after 2 seconds of inactivity, the instrument knows the period of oscillation must be at least 1 second. After a further 2 seconds, it knows the period must be at least 2 seconds etc. In this way the instrument approximates the period and frequency while the input is static - waiting for the next edge.

After (seconds inactive)	2	4	6	8	...	N
Period approximation (seconds)	1	2	3	4	...	N/2
Frequency approximation (Hz)	1	0.5	0.33	0.25	...	2/N



For example, if frequency is being measured and it is changed suddenly from 20Hz to 0.22Hz, over time, the instrument may display 20, 1, 0.5, 0.33, 0.25, 0.22. This is better than displaying 20 all the time until 0.22 is measured.

The instrument will not display approximations for higher frequencies (shorter periods) than the last true reading (eg. 0.22).

Some benefits of approximations are:

- The operator has faster visual **feedback** when the signal stops or slows to a frequency below 0.5Hz.
- The instrument does not misleadingly continue to show the last true frequency/period reading after the signal stops.
- If the last true frequency or period were displayed after the signal stopped, it would continue to add that rate to the totaliser when a much lesser value, or nothing at all, should be added.
- There is no need for an arbitrary inactivity timeout.
- By setting **FLo** to 1Hz or more, the first approximation of 1Hz will cause **0** to be displayed within 2 seconds of the signal stopping.

A period approximation takes between 1 and 2 times the period to find. This is because the instrument measures periods between rising edges only. If the instrument starts looking for a rising edge just after one occurs, it must wait nearly a whole period before it finds the first of the 2 rising edges to be timed.

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## Appendix G - Glossary

**Default:** The initial safe or optimum value of a setup item. The factory settings for the instrument setup. The value assigned to a setting by the instrument in the absence of any attention from the user. The whole instrument setup can be defaulted from the Setup Menus. First enter the Setup Menus as described in **Setting Up the Instrument** on page 39. To default the instrument, from **ConF**, press the **Cycle** Key repeatedly until **SYSr** is displayed. Press the **Enter** Key. Press the **Cycle** Key repeatedly until **dfLt** is displayed. Press the **Enter** Key. Finally use the **Cycle** Key to select **on** and press the **Enter** Key.

**Hertz or Hz:** A unit of frequency measurement. Periods per second. For example, a frequency of 10Hz has a period of 1/10 seconds or 0.1 second. See also **KiloHertz** below and **Period** on page 172.

**Integrate:** To estimate a count from a rate, simply by multiplying the rate by the elapsed time. For example, after 2 seconds, at a rate of 5 counts per second, a count reaches 10. A count found by integrating a rate in this way is not exact especially if the rate is constantly changing. However, a count found using the instrument's Counter Mode, is exact unless the counter is setup to ignore counts arriving below a certain rate set by **FLo** in the **inPt** (Input) Menu. In Counter Mode, the rate measurements are not exact.

**KiloHertz or kHz:** A unit of frequency measurement. 1kHz = 1000Hz and has a period of 1mS. A frequency of 10kHz has a period of 0.1mS (or 100uS). *By default the instrument measures frequency in kHz* (see also **Period** on page 172 and **Hz** above).

**Microsecond or uS:** One millionth of a second.

**Millisecond or mS:** One thousandth of a second. *By default the instrument measures all timings in milliseconds* (see also **Period** on page 172).

**Nanosecond or nS:** One thousandth of a millionth of a second.

**Normal operation:** This is when the instrument is displaying a realtime measurement.

**Period:** A cycle. The wavelength or period of repetition of an oscillation in units of time. The reciprocal of the frequency, ie.  $\text{period} = 1/\text{frequency}$ . *By default, the instrument measures timings (including periods) in milliseconds (see **Microsecond** and **Millisecond** and **Nanosecond** on page 171).*

**Primary inputs:** The counter/timer/frequency measurement input Channels A and B. The setup for the primary inputs is covered by the first 4 Setup Menus: **inPt**, **CHA**, **CHb**, and **diSP**. When the input type is setup as **EnC** (encoder) or **EdgE** (Channel A edge to Channel B edge timing), 2 primary inputs are used but the instrument produces measurement(s) on Channel A only. In these 2 modes, the totaliser source should always be setup as **A** (Channel A).

**Quantization error:** The difference between 2 consecutive binary representations of an analogue measurement. In other words, the amount represented by the least significant binary bit of a digital value.

**Resolution:** The ratio of a digital value to its quantization error (see **Quantization error** above). For example, if the quantization error is 10 and the displayed value is **20**, then the resolution is 2. The maximum resolution of a 6-digit display is **999999** divided by 1 which is about one million. The T280 display has 6 digits but the values it displays are usually a lower resolution. A high resolution is usually preferable to a low resolution but its production can incur costs like taking more time and memory to handle.

When the instrument is setup as a counter or encoder, it derives a low resolution (coarse) frequency measurement from the change in the count every second. The coarse measurement has a top resolution of only 250 for all frequencies above 250Hz, and an even lower resolution

for frequencies below 250Hz (unless the gate time is lengthened - see **Gate** on page 51).

When the instrument is setup for dedicated frequency or time measurement, the resolution is much higher for all measurements but varies depending on the frequency or time being measured (see the diagram on page 169).

**Setup:** The instrument setup is a collection of analogue and logic(on/off) values that the user can change via menus or comms to customise the instrument's behaviour.

Changes to setup values are remembered even if the instrument is turned off and on again. The whole setup can be reset to factory defaults in a single action (see **Default** on page 171).

Whilst there are between 500 and 600 setup values in total, users do not need to consider each value in turn because most of these values configure optional features and much of the rest are set to sensible defaults. It is best to think of the setup as divided into groups that setup:

Inputs	4 items.
Channel A scaling	Several items.
Channel B scaling	Several items.
Display attributes	Several items.
System wide/miscellaneous setup	Several items.
Optional features	Alarms, function keys, status inputs, logic outputs, analogue output, totaliser, batch counter.

Normally, all but the optional features must be given careful consideration. When the basic input type setting is changed, many setup items are defaulted so that the instrument behaves sensibly with the new setup (see **Type** on page 48).