Contents

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.

Instrument Operation Modes

The instrument can be used in any one of the following operation modes:

Operation Mode	Input Type	See
Counter Mode (Dual Channel) This is the default mode.	***Cnt***	*Counter Mode (Dual Channel) - Cnt* on *page 8*.
Encoder Mode	***EnC***	*Encoder Mode - EnC* on *page 10*.
Frequency Mode (Dual Channel)	***FrEq***	*Frequency Mode* (Dual Channel) - *FrEq* on *page 12*.
Timer Mode (Dual Channel)	***tiME***	*Timer Mode (Dual* Channel) - *tiME* on *page 14*.
Edge Timer Mode	***EdgE***	*Edge Timer Mode* - EdgE on *page16*.

For a detailed product specification for each of the operation modes, see *Product Specification* on *page 149*.

As your first configuration task, you must decide which operation mode you want to use for the instrument. Selecting the operation mode determines which set up menus and parameters are displayed for further configuration. Suitable safe default values are set for the parameters required by the selected operation mode. The operation mode is configured as the setting for the ***tYPE*** parameter on the configuration ***inPt*** menu.

Standard Features

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™-RTU.

Measurement Mode: Features and Functions

All 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

By default the instrument is set up as a counter and 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.

Deciding on the Operation Mode

The instrument provides five possible operation modes. You must decide which operation mode you want to use the instrument in. You can only use the instrument in one mode.

Note

After installing the instrument and getting familiar with the operator functions, you must set the operation mode before doing any further configuration.

The following operation modes are provided:

- ***Cnt*** Counter (Dual Channel) (see *page 8*).
- ***EnC*** Encoder (see *page 10*).
- ***FrEq*** Frequency (Dual Channel) (see *page 12*).
- ***tiME*** Timing (Dual Channel) (see *page 14*).
- ***EdgE*** Edge Timer (times between pulse edges (see *page 16*).

When you set the instrument operation mode, the appropriate menus and parameters, required by that operation mode are displayed. Safe default parameters are also set for the selected operation mode.

By default, the instrument is configured as a dual channel counter (***Cnt***). Each of the operation modes are described in detail in rest of this section.

Your first configuration task is to decide which operation mode you want to use.

Note

In all modes, inputs of up to 650 kHz can be accepted from proximity sensors, turbine flow meters or sensors that give a pulsed output or contact closure. For contacts, the maximum safe frequency is usually 10Hz and you should use a non zero debounce, see the **Debounce Time** parameter on *page* 42 in *Configuring the Input Settings (All Modes)*.

Available Measurements

Depending on the operation mode that you configure, a different set of measurements is displayed. Measurements are displayed in menus such as the alarm or display source menu. See *Configuring the Display (All Modes)* on *page 68*.

The following list shows the available sets of measurements.

- ***EngA*** Engineering units for Channel A**. All modes**.
- ***EngB*** Engineering units for Channel B.
- ***rtEA*** Rate on Channel A.
- ***rtEb*** Rate on Channel B.
- ***ProP*** Proportion of Channel [A / (A+B)] x 100%.
- ***HigH*** Highest (maximum) value.
- ***LoW*** Lowest (minimum) value.
- ***AV*** Average value.
- ***Htot*** High total - the 6 most significant digits on the totaliser
- ***Ltot*** Low total - the 6 least significant digits on the totaliser
- ***rtot*** Rate total - on the totaliser.
- ***bAt*** The batch control output value (if enabled).
- ***CoMM*** A value sent via the serial communications interface.

Counter Mode (Dual Channel) - *Cnt*

Use this mode where precise 12-digit counting or totalising is more important than the approximate rate measurement available in this mode.

When you set the operation mode to ***Cnt***, Channels A & B maintain two independent, internal, 12 digit, one-way, scaled counts: ***EngA*** & ***Engb***.

By default the displayed value is ***EngA*** which is the least significant 6 digits of the total count arriving on Channel A with 1:1 scaling. All 12 digits can be displayed using the totaliser. See *Configuring the Channels: Counter Mode - Cnt* on *page 47*.

Each channel can independently:

- Scale the **counts** to engineering units: ***EngA , Engb***.
- Approximate count **rates** in engineering units: ***rtEA, rtEb***
- Pulse an output (if fitted) each multiple of any scaled count.

Other values like a proportional value ***ProP*** can also be calculated as 100% x ***EngA***/(***EngA+Engb***).

The totaliser can select channel A, B, A+B or A-B giving;-

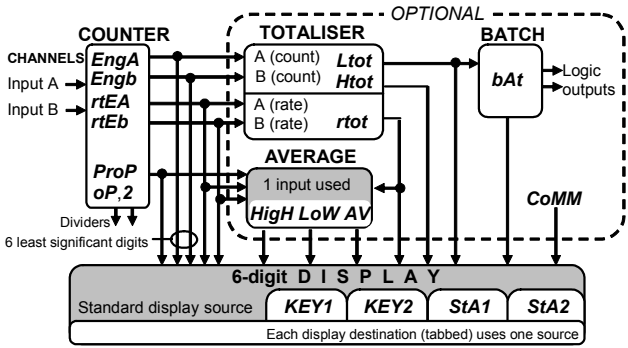
- A net precise cumulative total ***htot:Ltot*** from the selected **counts**
- A net approx. instantaneous rate ***rtot*** from the same selected **rates**

Any of the measurements are available for display, alarming and access via comms, see *Appendix D - Realtime Comms Locations* on *page 160*.

Up to 4 extra values may be displayed in real time when Function Key 1 or 2, or Status Input 1 or 2 are activated. For example the most significant 6 digits ***htot*** of the total may be displayed when function 1 is pressed.

A summary of the values that may be displayed in counter mode follows on the next page.

Summary of Displayable Counter Values



EngA and ***Engb***	Precise counts on Channels ***A*** and ***b*** in 12-digit scaled ***Eng***ineering units. The 6 least significant digits are displayed. Use the totaliser to see all 12 digits.
Optional	
rtEA and ***rtEb***	Scaled count ***r****a****tE 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% x ***EngA***/(***EngA+Engb***).
Ltot and ***Htot***	Scaled 6-digit ***L***ow and ***H***igh ***tot***als. Total source can be ***EngA***, ***Engb***, ***EngA+Engb*** or ***EngA-Engb***. The totaliser provides a way of seeing the 6 high digits.
rtot	6-digit ***tot***al ***r***ate 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.
HighH, ***LoW***, ***AV***	Highest, lowest and average of ***rtEA***, ***rtEb***, ***ProP*** or ***rtot***.
CoMM	Value written to Analogue Location **3** via comms.

Encoder Mode - *EnC*

Use this mode in applications where precise distance or angle measurement from an encoder is the primary requirement.

When you set the operation mode to ***EnC***, Channel A and B are used together to give a single signed encoder position count called ***EngA***. See *Configuring the Channels: Encoder Mode - EnC* on *page 50*.

Encoder mode can:

- Precisely measure a distance or angle from a scaled count.
- Approximate a rate or speed from a derived frequency.
- Support cyclic ranging for 360 degree angle measurement.
- Pulse an output (if fitted) each multiple of any scaled count.

There are 4 Encoder Modes, (see the diagram, *Summary of Encoder Control Styles* on *page* 56.):

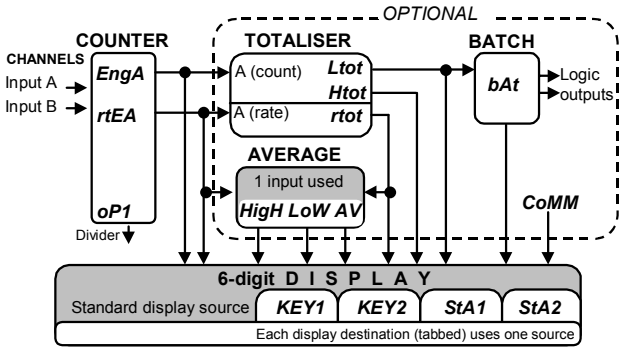
- **Quadrature Mode.** Best resolution. All *edges* on A & B change count. Direction set by phase of channel B with respect to A.
- **Phase Mode**. Good resolution. Counts pulses on Channel A. Phase of Channel B controls direction.
- **Up/Down Mode** Counts pulses on Channel A. State of Channel B controls the direction of count.
- **Start/Stop Mode** Counts pulses on channel A. State of channel B enables/disables counting.

Any of the displayable values are available for display, alarming and access via comms, see *Appendix D - Realtime Comms Locations* on *page 160*.

You can configure up to 4 extra values which can be displayed when Function Key 1 or 2, or Status Input 1 or 2 are activated.

A summary of the values that may be displayed in encoder mode are shown on the next page.

Summary of Displayable Encoder Values



EngA	Precise encoder position in 12-digit scaled ***Eng***ineering units. The 6 least significant digits are displayed. Use the totaliser to display all 12 digits.
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.*
Ltot and ***Htot***	Scaled 6-digit ***L***ow and ***H***igh ***tot***al of encoder position (***EngA***). The totaliser provides the only way of seeing the 6 high digits.
rtot	Same as ***rtEA*** if the totaliser is enabled.
bAt	Zeroed ***Ltot***, zeroed when the batch control process is re-triggered.
HigH, ***LoW***, ***AV***	Highest, lowest and average of ***rtEA*** or ***rtot***.
CoMM	Value written to Analogue Location **3** via comms.

Frequency Mode (Dual Channel) - *FrEq*

Use for applications where precise instantaneous frequency measurement, flow rate, or speed measurement is more important than the approximation of integrated totals also provided in this mode.

When the operation mode is set to ***FrEq***, Channels A and B measure independent frequencies.

By default the Channel A frequency is measured in kHz and displayed in kHz due to 1:1 scaling. See *Configuring the Channels: Frequency Mode - FrEq* on *page 58*.

Both input channels independently:

- Scale frequency in kHz to engineering units*: **rates**; ***EngA***, ***Engb***.
- Integrate approximate flow totals giving **counts**: ***CntA***, ***Cntb***.

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

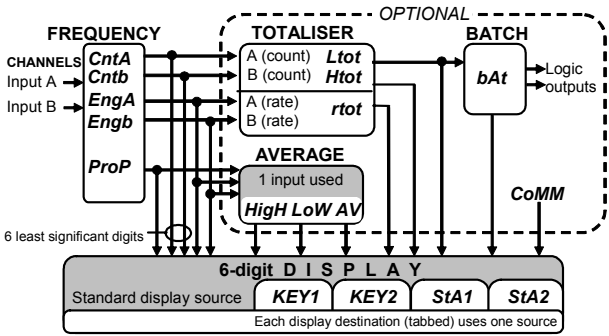
The totaliser (*page 77*) can *select* channel A, B, A+B or A-B giving;-

- A net approx. cumulative total ***htot:Ltot*** from the *selected* **count**
- A net precise instantaneous rate ***rtot*** from the same selected **rate**

Any of the displayable values are available for display, alarming and access via comms, see *Appendix D - Realtime Comms Locations* on *page 160*. Up to 4 extra values to be displayed in real time when Function Key 1 or 2, or Status Input 1 or 2 ***are*** activated. For example the most significant 6 digits ***htot*** of the total may be displayed this way.

The slowest frequency that can be measured is 1/429.5s or 0.0024Hz. At that frequency it takes at least the period of 429.5s to take a measurement. Meanwhile estimates would close-in on the correct value. *See Appendix F – Mode Issues* on *page 165*.
A summary of the values that may be displayed in frequency mode are shown on the following page.

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***ou***nt A*** and ***b*** estimates with further independent rate scaling. *By default, counts are measured in thousands of counts.*
ProP	Ratio of frequencies 100% x ***EngA***/(***EngA+Engb***).
Ltot and ***Htot***	High and low halves of 12 digit total. Total source can be ***CntA***, ***Cntb***, ***CntA+Cntb*** or ***CntA-Cntb***. The totaliser provides the only way of seeing the 6 high digits of a count.
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 batch process is re-triggered.
HighH, ***LoW***, ***AV***	Highest, lowest and average of ***EngA***, ***Engb***, ***ProP*** or ***rtot***.
CoMM	Value written to Analogue Location **3** via comms.

Timer Mode (Dual Channel) - *tiME*

Use timer mode for precise instantaneous timing of regular pulses, periods, or duties.

When the operation mode is set to ***tiME***, Channel A and B can independently measure time periods, pulse widths or duty cycles. Before scaling, times are measured in ms and duties in percent of period time.

By default channel A and B *period* times are measured and 1:1 scaling is applied so engineering units ***EngA***, ***Engb*** are displayed in ms. See *Configuring the Channels: Timer Mode - tiME* on *page 62*.

Both input channels independently:

- Scale time in ms (or duty in %) to engineering units*: ***EngA***, ***Engb***.
- When measuring period times; Integrate approximate number of periods giving: ***CntA***, ***Cntb*** in thousands of counts.

*If the time or duty measurement is nonlinear with respect to the required engineering units, an 8-point linearization curve can be configured to compensate for the error.

The totaliser (page 77) can *select* channel A, B, A+B or A-B values giving a 6+6digit total ***htot:Ltot*** from the *selected* channel(s). The values totalized depends on the timing found as follows;-

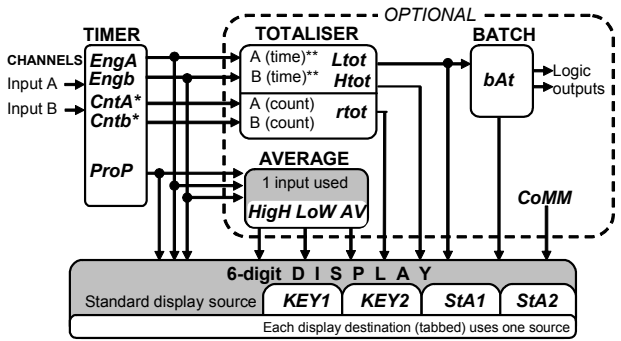
- When **period**; no. of 1000's of periods ***CntA***, ***Cntb*** are used directly.
- When **High** or **Low** time found; times ***EngA***, ***Engb*** are accumulated.
- When **duty** is found, nothing is totalized!

Any of the displayable values are available for display, alarming and access via comms, see *Appendix D - Realtime Comms Locations* on *page 160.*

Up to 4 extra values can be displayed in real time when Function Key 1 or 2, or Status Input 1 or 2 are activated. For example the most significant 6 digits ***htot*** of the total may be displayed this way.

The maximum period time that can be handled is 429.5 s. Obviously a time that long would take at least that time to measure. Meanwhile crude estimates close-in on the correct value. See *Appendix F – Mode Issues* on *page 165*.
A summary of the values that may be displayed in timer mode follows.

Summary of Displayable values in Timer mode



* 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 %s) for 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*** — Integrated 12-digit scaled ***C***ou***nt A*** and ***b*** approximations with further independent rate scaling. By default: with 1:1 scaling, periods, are *in thousands*. Pulse times or duty cycles, are *in mS.*

ProP — Ratio of timings 100% ***EngA***/(***EngA+Engb***).

Ltot and ***Htot*** — High and low halves of 12 digit total. The totaliser provides the only way of seeing the 6 high digits. *By default, the total is in the same units as* ***CntA***.

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

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

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

Edge Timer Mode - *EdgE*

Use with applications where accurate timing between edges on the signals from two different sensors is the primary requirement.

When the operation mode is set to ***EdgE***, Channel A and B pulse streams are combined to produce instantaneous scaled measurements of the time between rising or falling edges on Channel A to the next rising or falling edge on the Channel B.

By default 1:1 scaling applies giving measurements in milliseconds between *rizing* edges on channel A and B. See *Configuring the Channels: Edge Timer Mode - EdgE* on *page 66*.

The maximum measurable time is 1/10e6MHz x 2^{32} which is 429.5 s. Obviously a time that long would take at least that long to measure. Meanwhile estimates would close-in on the correct value. See *Appendix F – Mode Issues* on *page 165*.

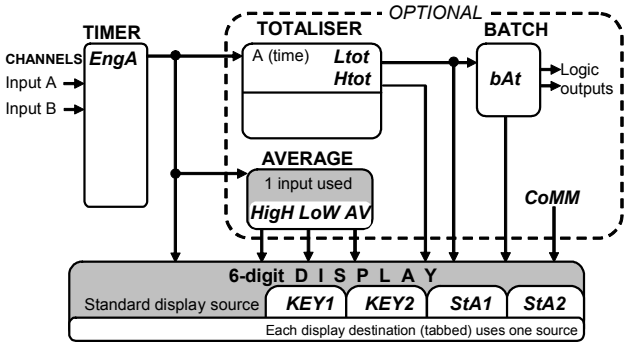
The totaliser can accumulate scaled ***EngA*** timings giving a 6+6digit total in ***htot*** and ***Ltot***. This total can be further scaled and offset. If scaled into seconds then ***Ltot*** can be presented in ***hh.mm.ss*** format.

Any of the displayable values are available for display, alarming and access via comms, see *Appendix D - Realtime Comms Locations* on *page 160*.

Up to 4 extra values to be displayed in real time when Function Key 1 or 2, or Status Input 1 or 2 are activated. For example the most significant 6 digits ***htot*** of the total may be displayed this way.

A summary of the values that may be displayed in edge timing mode follows on the next page.

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 ***L***ow and ***H***igh 6 digits of ***tot***al 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 batch process is re-triggered.
HighH, ***LoW***, ***AV***	Highest, lowest and average of successive ***EngA*** times.
CoMM	Value written to Analogue Location **3** via comms.

Installation

To install your instrument, you must do 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 BS EN 61010-1 and Pollution Degree 2 environments apply.

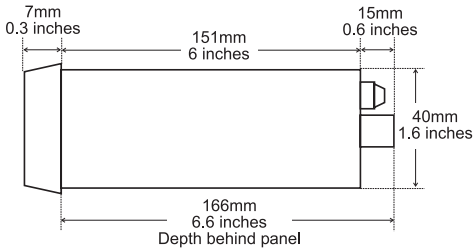
This instrument should be disposed of correctly. Do not burn or throw into any fire as there is a risk of explosion. Please contact your supplier or local authorities for advice.

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 authorities for advice.

Panel Mounting

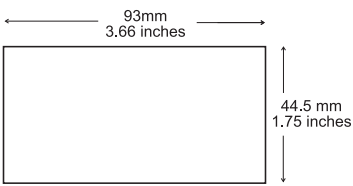
Ensure that there is sufficient space behind the instrument panel for the depth of the instrument to allow for safe routing of cables. The diagram below shows a side view of the instrument's dimensions.



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 cut out with the dimensions as shown below. Panel thickness from 1.5mm to 9.5mm can be accommodated.

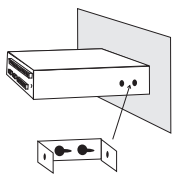


2. Fit the rubber seal by slipping it over the unit from the rear of the box and pushing it forwards until it sits behind the front lip of the unit.

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.

4. 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.

5. Tighten the screws until they bite into the panel, securing the instrument in place. Take care not to over tighten the screws as this may damage the case of the instrument.



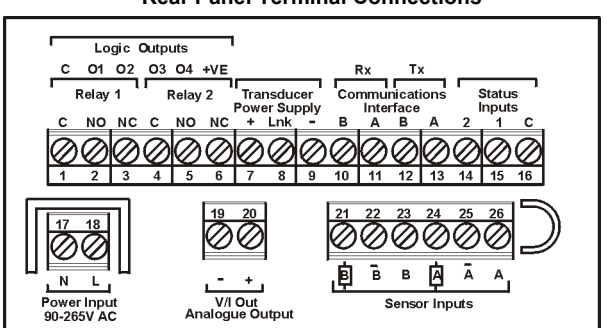
Connecting the Terminals

The diagram below shows the rear panel terminal connection arrangement.

NOTE

Terminals 1 to 6 are not used on some models (see the table, *Terminal Connections* on *page 21*).

Rear Panel Terminal Connections



Terminal Connections

Terminal	Outputs	Dual Relays	Quad TTL
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		

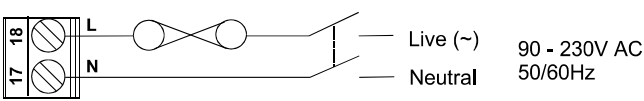
Powering the Instrument

The instrument is designed to operate from an AC supply with voltages in the range 90 - 265V AC 50/60Hz mains supply with a maximum power consumption of 20VA when all outputs are fully loaded and the display has all segments illuminated.

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.

The diagram below shows 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.

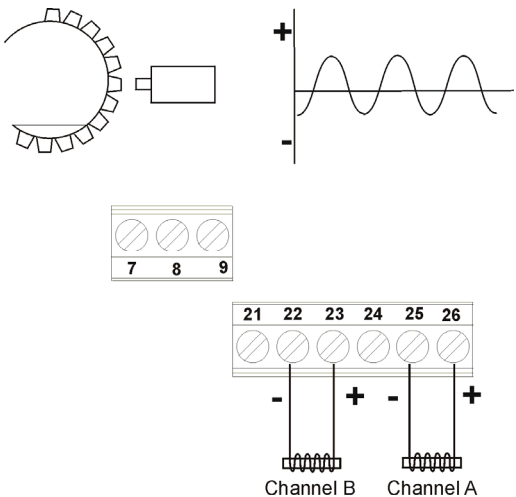
Recommended Mains Supply Connections



Connecting the Sensors

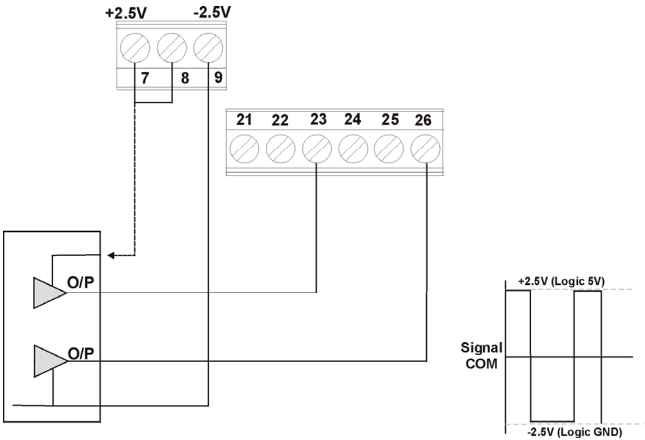
If a channel is not going to be used, then pulling up this channel via linking the pull up/down terminal to excitation+, will prevent it picking up unwanted noise.

Magnetic Pickups



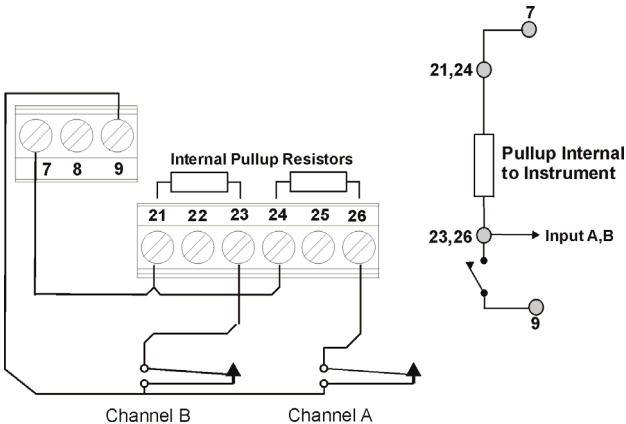
For additional information about connecting some types of magnetic pickups, see *Appendix I - Application Examples*.

TTL Outputs

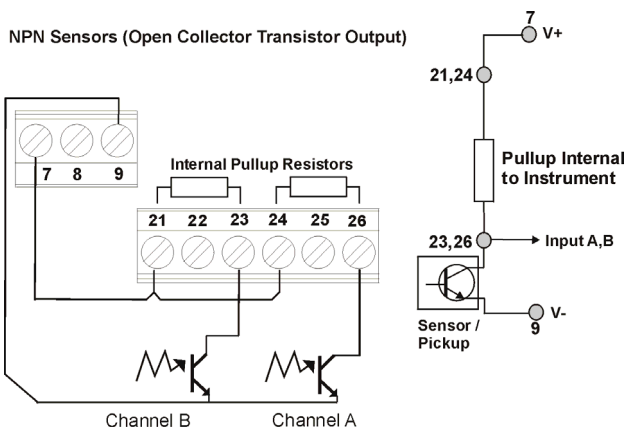


For PLC or other logic (TTL) output devices, the Transducer supply is configured to provide 5V (+/- 2.5V with respect to logic device signal common (GND /0V)). If the logic device provides its own supply then omit the connection to pin 7 of the instrument.

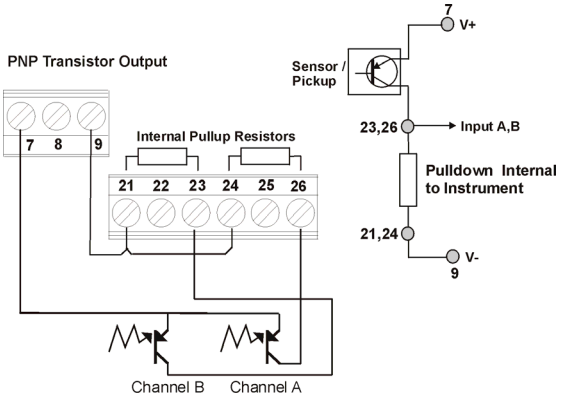
Volt Free Contacts



NPN Sensors

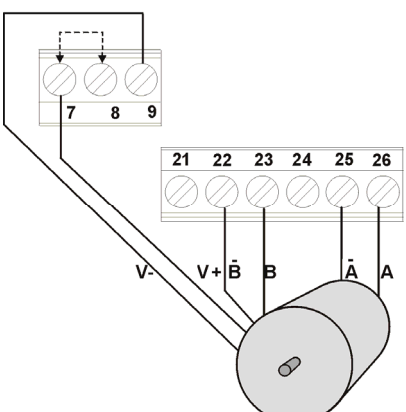


PNP Sensors



Encoder with Complementary Outputs

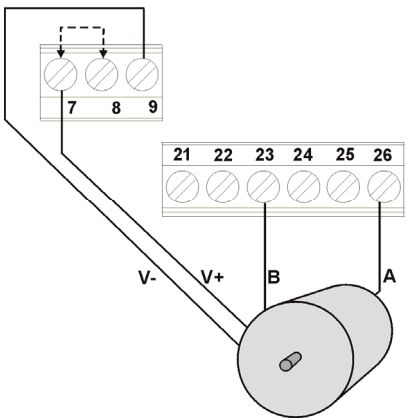
For 5VDC Encoder Link 7 to 8 or Encoders with TTL Outputs



Note: Encoders are available with a range of output voltages and output types, for example, NPN (open collector) transistor, TTL and so on. Refer to the previous connection diagrams for wiring details.

Encoder with Single Outputs

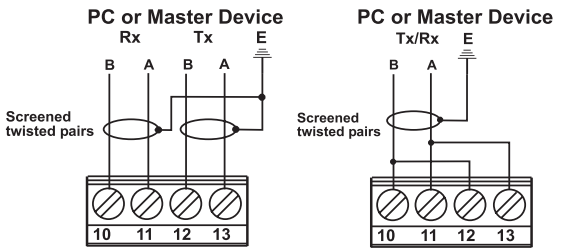
For 5VDC Encoder Link 7 to 8 or Encoders with TTL Outputs



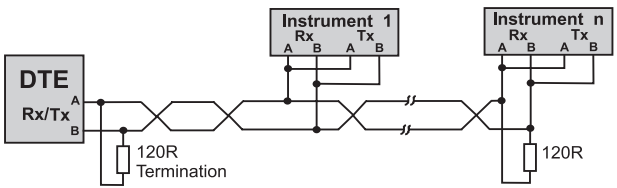
Connecting the Communications Interface

The following diagrams 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 following diagrams 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 Multi-drop Half Duplex Application



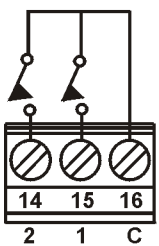
Connecting the Status Inputs

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 following diagram show some typical applications.

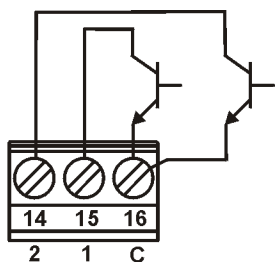
Note

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

Voltage Free Contacts

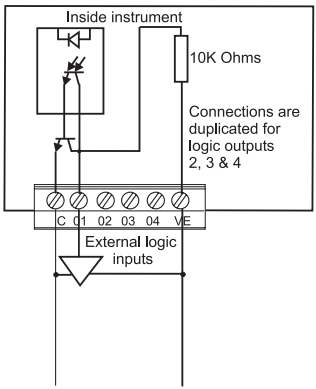


Open Collector TTL Outputs

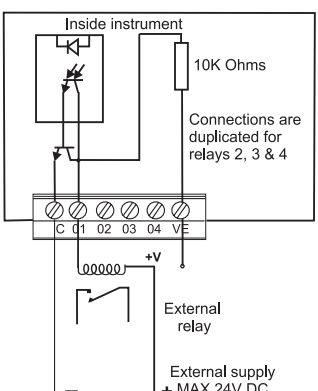


Connecting the Logic Outputs

Connecting to External Logic Inputs



Connecting to External Relays

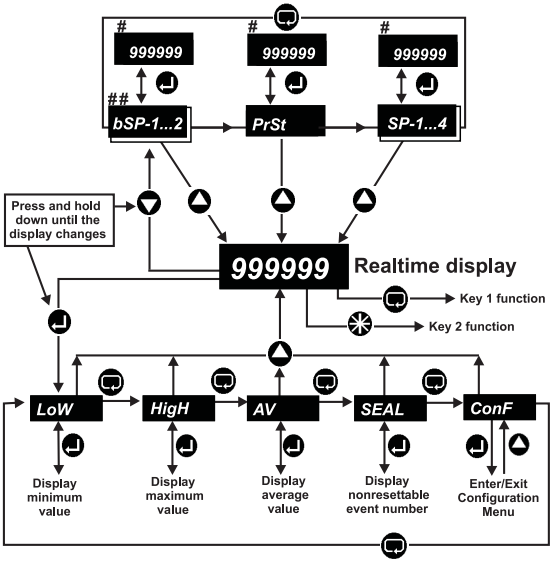


Getting Started with the Instrument

Read this section to find out how to use the instrument. It covers how to use the operator functions, keys and how to navigate through the configuration menus.

Operator Functions

Facilities available directly from the real time display in Operator mode:



Only editable if the alarm ***Edit*** option is ***on*** (see *page* 126 in *Configuring the Alarms*). If editable, a flashing digit is displayed.

Only displayed if the batch control function has been enabled (see **Enable** on *page 93* in *Configuring the Batch Control Function*).

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** in *Configuring the Alarms* on *page 120*).

bSP-1 ***bSP-2*** Represent Batch Setpoints 1 and 2 (see **Setpoints** in *Configuring the Batch Control Function* on *page 96*).

LoW ***HigH*** ***AV*** Displays the lowest, highest or Average measured value since the last reset (see **Reset High, Low & Average** in *Configuring the Status Inputs* on *page 109* and *Configuring the Function Keys* on *page 117*).

SEAL Displays the calibration seal. This is a number that is incremented each time a configuration change is made. This allows you to see that the configuration has changed. For details of the changes that cause the seal to be incremented, see *Appendix H – Calibration Seal* on *page 172*.

ConF Enters Configuration//Setup Mode and displays the configuration menus. The configuration menus and how to access them in covered in more detail in *Configuration Overview* on *page 37*.

Keys in Operator Mode

 Function keys 1 and 2 can be configured to perform various functions. (see *Configuring the Function Keys* on *page 112*).

 Down Key. Press and hold the down key until the display changes to the Setpoints Edit menu. This menu includes Preset, 4 alarm setpoints and 2 batch setpoints for viewing or editing, if editing has been enabled. For example, after ***PrSt*** is displayed, use the **cycle** key to select a setpoint, then press the **Down key** again to *view* the setpoint value. Finally press the **Up** key twice to exit to real time display.

 Up key. Press to exit from *any* **menu** to the real time display.

 Press simultaneously to acknowledge any latched alarms and display ***ACK*** (see the **Acknowledge Latched Alarms** parameter on *page 108 in Configuring the Status Inputs* and the **Latching** parameter on *page 123 in Configuring the Alarms*).

 Press and hold the enter key for about 3 seconds until ***LoW*** is displayed. This accesses the operator functions: ***LoW***, ***HigH***, ***AV SEAL*** and ***ConF*** described above. ***ConF*** accesses the instruments configuration menu as described in *How to Enter & Exit the Configuration Menus* on *page 40*.

Key Functions in Menus

All keys have an auto-repeat facility whereby holding down a key has the same effect as multiple presses.

Navigating Menus

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

The **Enter** key selects an option which may be a submenu or a parameter to edit.

When the selected option is a submenu, nothing flashes indicating these same navigation **keys** continue to apply.

When a parameter is selected, its existing *setting* is displayed and a letter or digit always flashes indicating the setting is waiting to be changed:

- Some parameters are chosen from a list of settings, for example,. parameter ***dPCu*** has 7 settings: ***0***, ***1***, ***2***, ***3***, ***4***, ***5***, ***Auto***.
- Other numeric parameters are edited directly (for example, ***PrSt→VAL*** has a default numeric setting of [***0.00000***]).

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

A timeout returns to the real time display after 60s by default. Any changes saved up to this time remain safely saved. The timeout period can be changed via the ***SYSt→tout*** parameter. See the **Timeout** parameter in *Configuring the System Options on page 144*.

Selecting a Setting from a List

When the *first* letter or digit of a menu option for a parameter *flashes*, it means the setting is waiting to be changed and the following keys apply;-


Cycle scrolls round the list of possible settings for the parameter. The up key does the same and the down key cycles in the opposite direction.


Enter saves the currently displayed setting as the new setting.


Star leaves the parameter setting unchanged.

A timeout leaves the parameter unchanged and by default, returns to the realtime display after 60s.

Editing a Numeric Setting

When the *least significant* digit of a numeric value *flashes*, it means the entire number is waiting to be edited, starting with the digit that is flashing. The sign is changed by editing the most significant digit.


Cycle selects the next (left) flashing digit to edit. If the decimal point position is editable then that flashes for editing after cycling through each digit position.


Up increments and **Down** decrements a flashing digit. 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 -. If a decimal point is flashing then **Up** moves it left **Down** moves it right one place.


Star clears the whole value to zero, if zero is a valid value.


Enter saves the displayed setting and exits to the parent menu, displaying the name of the parameter just viewed or edited.

A timeout leaves the parameter unchanged and returns to the real time display after 60s by default.

Configuration Overview

Before starting the configuration tasks, you should have decided which mode of operation you want to use. See *Deciding on the Operation Mode* on page 6.

Step 1: Configure the Operation Mode

Your first configuration task is to set the operation mode. When you set the operation mode, the appropriate menus are displayed for configuring that mode. Appropriate safe default values are also set for most of the required parameters. See *Configuring the Mode of Operation* on *page 41*.

Step 2: Configure Additional Input Settings for All Modes

After configuring the operation mode, you must configure the rest of the input settings as described in *Configuring the Input Settings (All Modes)*on *page 42*. Note that if you are using contact closures, you must configure a non-zero value for the **Debounce** input parameter.

Step 3: Configure Channels A and B for All Modes

Configure the channels as described in *Configuring the Channels* on *page 46*. The instructions are different for each operation mode. Only the parameters for your selected operation mode are displayed.

Step 4: Configure the Display for All Modes

The display attributes are different for each mode. Follow the instructions in *Configuring the Display (All Modes)* on *page 68*.

Optional Additional Tasks

After doing the configuration tasks in steps 1 to 4, you have completed the basic configuration of the instrument. Suitable default values are configured for your operation mode.

You can change the default parameters for other settings as required. A full list of the optional additional configuration tasks are described in detail in *Optional Additional Configuration* on *page 38*.

Optional Additional Configuration

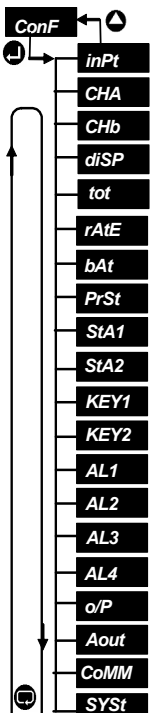
The following table lists the optional configuration menus and items and where to find further information..

Totaliser	***tot***	See *Configuring the Totaliser* on *page 77*. By default, the totaliser is not enabled. You must enable it if you want to use the batch control function.
Rate	***rAtE***	Only available for Counter - ***Cnt*** and Encoder – ***EnC*** operation modes. See *Configuring the Rate* on *page 88*.
Batch Control Function	***bAt***	Only available on units fitted with relay or TTL outputs. See *Configuring the Batch Control Function* on *page 92*. The totaliser must be enabled to use this function.
Preset	***PrSt***	See *Configuring the Preset* on *page 101*. You can set up the instrument to present a displayable value when: the batch control process is retriggered, a status input is changed or a function key is pressed.
Status Inputs	***StA1*** ***StA2***	See *Configuring the Status Inputs* on *page 103*.
Function Keys	***KEY1*** ***KEY2***	See *Configuring the Function Keys* on *page 112*.
Alarms	***AL1*** ***AL2*** ***AL3*** ***AL4***	See *Configuring the Alarms* on *page 118*.
Logic Outputs	***o/P***	If outputs are fitted, you can optionally configure Relay or TTL options, see *Configuring the Logic Outputs* on *page 128*.
Analogue Output	***Aout***	See *Configuring the Analogue Output* on *page 132*.
Serial Comms	***CoMM***	See *Configuring the Serial Communications* on *page 136*.
System Options	***SYSt***	Configure general system options and actions. See *Configuring the System Options* on *page 144*.

Full Configuration Menu Structure

The following diagram shows the full configuration menu structure.

Configuration Menu Structure



Setup for both Input Channels A & B

Channel A Input setup (includes scaling)

Channel B Input setup (includes scaling)

Display properties setup

Optional totaliser, source, scaling and display style

Optional derived rate scaling setup

*Optional batch control facility

Optional preset

Optional effect(s) of Status Input 1 activation

Optional effect(s) of Status Input 2 activation

Optional effect(s) of Function Key 1

Optional effect(s) of Function Key 2

Optional Alarm 1

Optional Alarm 2

Optional Alarm 3

Optional Alarm 4

*Logic Outputs - Relay or TTL options (if fitted)

Optional analogue output setup

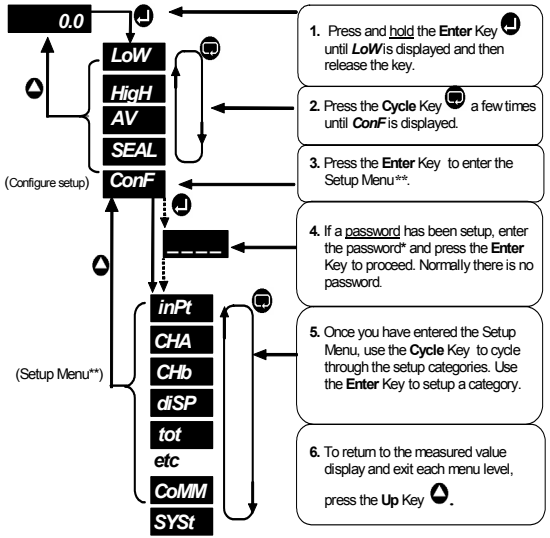
Optional comms setup

General options and actions

* If outputs fitted.

How to Enter & Exit the Configuration Menus

The following diagram show how to enter and exit the configuration menus that are used in the rest of this manual.



* To enter the password, use the **Up**/**Down** Keys to edit the digit value and the **Cycle** Key to go to the next digit.

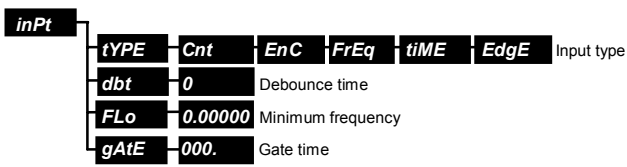
** The full list of configuration menus is shown on the previous page.

Configuring the Mode of Operation

You must do this task as your first configuration task as it affects all other displayed menu options, parameters and default settings. After configuring the mode of operation, you must configure the additional input parameters as described in the next section, *Configuring the Input Settings (All Modes)*.

inPt Use the Input Menu, ***inPt***,to configure the ***tYPE*** parameter which sets the mode of operation.

Input Menu Structure



Type

Default: Cnt (dual counters)

tYPE Configures the instrument's basic mode of operation. See *Deciding on the Operation Mode* on *page 6*. The input type can be one of the following:

- ***Cnt*** Counter Mode (Dual Channel) (see *page 8)*. This is the default setting.
- ***EnC*** Encoder Mode (see *page 10*).
- ***FrEq*** Frequency Mode (Dual Channel) (see *page12*).
- ***tiME*** Timer Mode (Dual Channel) (see *page14*).
- ***EdgE*** Edge Timer Mode (see *page16*).

Changing the ***tYPE*** parameter, 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	***Cnt*** Counter	***EnC*** Encoder	***FrEq*** Frequency	***tiME*** Timer	***EdgE*** Edge Timer

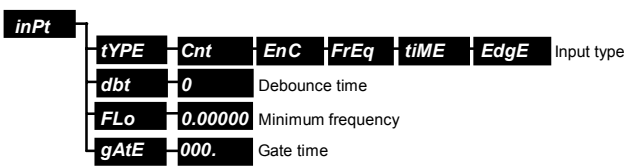
Configuring the Input Settings (All Modes)

Before configuring the input settings described in this section, you must set the mode of operation using the ***tYPE*** parameter as described in *Configuring the Mode of Operation* on *page 41*.

inPt Use the Input Menu, ***inPt***, to configure the additional input parameters, **Debounce Time**, **Minimum Frequency** and **Gate**, to avoid unwanted instrument behaviour which is described where appropriate. Input options are common to both Input channels A and B and are listed in the following menu structure.

The Input menu (***inPt***) is accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Input Menu Structure



Debounce Time

Default: 0mS (disabled)

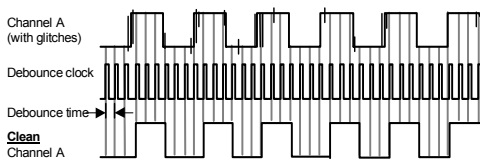
dbt The purpose of the debounce facility is to prevent more than one count registering on Channel A or B when a mechanical switch contact opens or closes once.

For all modes, inputs of up to 650 kHz can be accepted from proximity sensors, turbine flow meters or sensors that give a pulsed output or contact closure. For contacts, you must configure a non zero debounce.

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 also be counted.

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 ***2***mS, 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:

Maximum debounce time in mS = 1000/(4 x 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 x 8Hz) = 31mS (the absolute maximum). In practice, setting the debounce time to ***1*** or ***2***mS 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 x 800Hz) = 0.3mS. 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).

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

Common debounce setup errors
1. To have debounce active when attempting to measure frequencies of over 1 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***.

2. 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.

3. Not using debounce when input type is a contact relay. Frequency and count measurements will likely be higher than expected and more erratic.

Minimum Cut Off Frequency

Default: 0.00000Hz

FLo You can specify a minimum cut off frequency to stop counting below a user definable rate.
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 down to the minimum measurable of 0.0024Hz.

This means waiting 10 to 20 seconds for the unit to report a frequency of 0.1Hz (see *Appendix F – Mode Issues* on *page 165*).

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 by measuring 0Hz sooner.
- 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 modes of operation except ***tiME*** and ***EdgE***, unless period time is sought by setting the channel's ***Find*** parameter to ***Per*** (see **Timing Sought** and **Edge Timing Sought** on *pages 62 and 66* in *Configuring the Channels: Edge Timer Mode - EdgE*).

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 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 set up the options for Channel A and Channel B.

The Channel A and B menus depend on the mode of operation that you selected when you configured the mode of operation. See *Configuring the Mode of Operation* on *page 41*.

To find the Channel A and B menus for your configured operation mode, see:

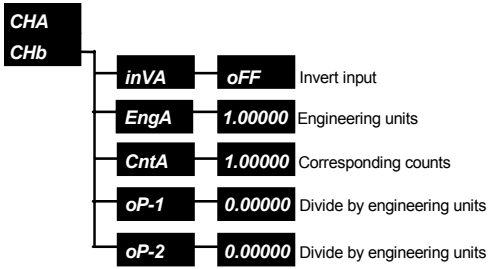
- Counter mode ***Cnt*** (see *page 47*)
- Encoder mode ***Enc*** (see *page 50*).
- Frequency mode ***FrEq*** (see *page 58*).
- Timer mode ***tIME*** (see *page 62*).
- Edge time mode ***EdgE*** (see *page 66*) Channel A menu only.

Configuring the Channels: Counter Mode - *Cnt*

Follow the instructions in this section if you have set the operation mode to type ***Cnt*** using the Input menu. 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 the submenu texts to indicate which channel is being setup.

The Channel menus (***CHA*** and ***CHb***) are accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Channels A & B Menu Structure In Counter Mode



Invert Input

Default:Off

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

Logic Comms Location		Read/Write
56	On inverts Channel A	
57	On inverts Channel B	

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 the **Corresponding Counts** parameter.

A negative value will make the counter count down.

Analogue	Comms Location	Read/Write
67	***EngA***	Any value in the displayable range
84	***Engb***	

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 the **Engineering Units** parameter.

Analogue	Comms Location	Read/Write
68	***CntA***	Any value in the displayable range
85	***Cntb***	

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 control function).
- 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* on *page 118* and the **Pulse** parameter in *Configuring the Logic Outputs* on *page 130*).
-

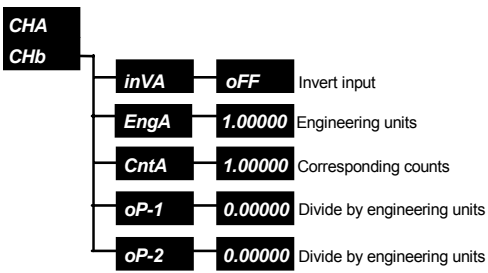
Comms Locations		Read/Write
Analogue	Output	Scales counts on
227	1	Channel A
228	2	Channel B

Configuring the Channels: Encoder Mode - *EnC*

Follow the instructions in this section if you have set the operation mode to Encoder Mode, ***EnC***.using the ***inPt*** menu. 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.

The Channel menus (***CHA*** and ***CHb***) are accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

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 the **Corresponding Counts** parameter on the next page.

NOTE
A negative value will make the counter count down.

Analogue 67 Comms Location		Read/Write
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 the **Engineering Units** parameter on the previous page.

Analogue 68 Comms Location		Read/Write
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 in the previous section.

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

Range Low & High

Default: Low 0.00000, high 999999

LoW ***HigH*** When ranging is enabled, as described earlier, 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 the **Zero EngA** and **Zero Engb** parameters in *Configuring the Status Inputs* on *page 106*).

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 10th count, and count up as shown overleaf:

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 10th 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 52*, 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	Value range
244	***LoW***	-199999 to +999999
245	***HigH***	-199999 to +999999 (but must not be ***LoW***+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 non-zero 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 control function).
- 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 118 and 130*).

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 vice versa.

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

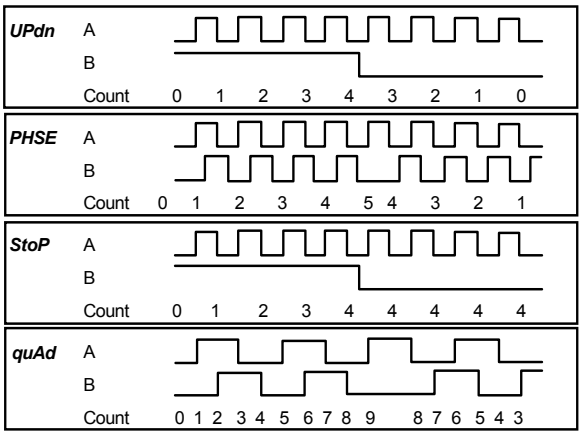
Control Style Channel B

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 /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 /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° and counts down when the phase of Input B leads Input A by 90°. 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 /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 the **Engineering Units** and **Enable** parameters on *pages 50 and 51*).
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 ^{o} and counts down when Input B leads Input A by 90 ^{o}.

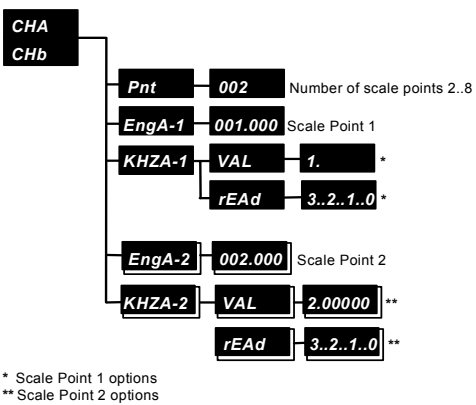
Analogue 246 Comms Location				Read/Write
Analogue value	0	1	2	3
Control style	***uPdn***	***PHSE***	***StoP***	***quAd***

Configuring the Channels: Frequency Mode - *FrEq*

Follow the instructions in this section if you have set the operation mode to ***FrEq***. 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.

The Channel menus (***CHA*** and ***CHb***) are accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Channels A & B Menu Structure in Frequency Mode



* Scale Point 1 options
** Scale Point 2 options

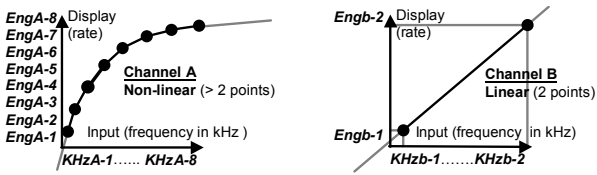
Number of Scale Points

Default: 2 (linear scale)

Pnt Sets the number of scale points between 2 and 8. Only specify more than 2 points for nonlinear scaling as illustrated ahead for Channel A. Consider a scale point as a point on a graph. The position of each point is identified on the X axis by a **frequency** in kHz (***KHZb-1***) and a corresponding **display value** in engineering units (***Engb-1***) on the Y axis.

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 the **Engineering Units** and **Corresponding Frequencies** parameters on *page 59 and 60)*.

Linearization 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 ***Engb-1..8*** Sets the number of engineering units corresponding to the frequencies specified by ***KhZA-1…8*** respectively.

Example: *EngA* display is required in litre/minute. Pulses arrive at 1 litre/s;-
EngA-1 = 60 (litre/min), when KhZA-1 = 0.001 (1Hz or 1litre/s),
EngA-2 = 120 (litre/min), when KhZA-2 = 0.002 (2Hz or 2 litre/s).

EngA-1…8 may be any value in the displayable range set by the decimal point parameter on the Display menu.). See the **Decimal Point Position** (***dP***) parameter on *page 70* in *Configuring the Display (All Modes)*. 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 the **Number of Scale Points** and **Corresponding Frequencies** parameters on *page 58* and *60*).

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

Corresponding Frequencies

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

KHZA-1..8 ***KHZb-1..8*** Defines the frequencies corresponding to the number of engineering units specified by ***EngA-1…8*** respectively.

khZA-1…8 may be any value in kHz, that the instrument is capable of measuring, ie. any frequency between 0.001kHz and 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 the **Number of Scale Points** and **Engineering Units** parameters on *pages 58* and *59*).

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. 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***.

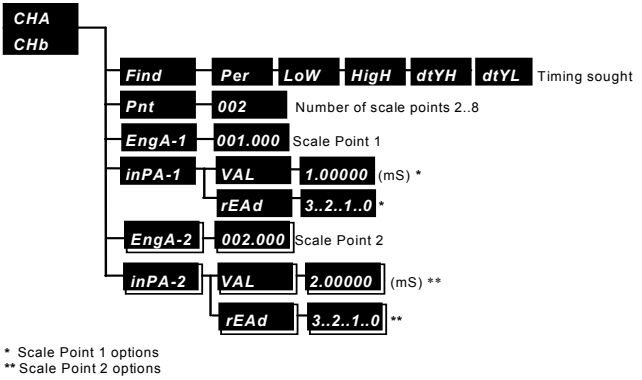
When the ***3*** to ***0*** sampling display stops counting, the measured frequency is displayed for you to acknowledge. Check the value looks correct and press the **Enter** key to return to the ***KhZA-1...8*** display. If no signal is applied or the frequency is below 0.3Hz, the count will continue 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	***KhZA-1***	85	***KhZb-1***
70	***KhZA-2***	87	***KhZb-2***
72	***KhZA-3***	89	***KhZb-3***
74	***KhZA-4***	91	***KhZb-4***
76	***KhZA-5***	93	***KhZb-5***
78	***KhZA-6***	95	***KhZb-6***
80	***KhZA-7***	97	***KhZb-7***
82	***KHZA-8***	99	***KHZb-8***

Configuring the Channels: Timer Mode - *tiME*

Follow the instructions in this section if you have configured the operation mode as ***tiME.*** In Timer Mode, the Channel A and B menus are the same because they set up independent channels. The suffix ***A*** or ***b*** appears in some submenu texts to indicate which channel is being setup. The ***CHA*** and ***CHb*** menus are accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Channels A & B Menu Structure in Timer Mode



* Scale Point 1 options
** Scale Point 2 options

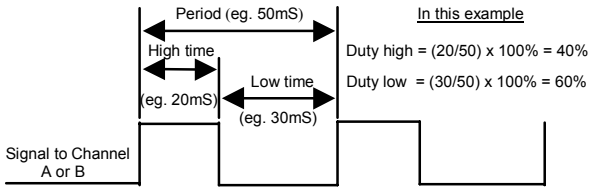
Timing Sought

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%]).

Alternating Signal to be Timed



When the totaliser is enabled (see *Configuring the Totaliser* on *page 77*):

- 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	***PEr***	***LoW***	***HigH***	***DtYH***	***dtYL***

Number of Scale Points

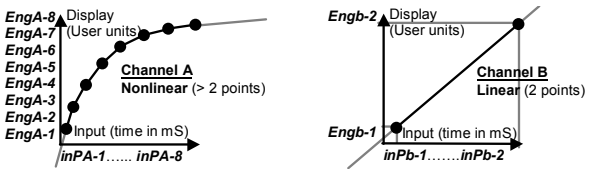
Default: 2 (linear scale)

Pnt Sets the number of scale points which may range from 2 to 8. Only specify more than 2 points for nonlinear scaling as illustrated on the next page for Channel A.

Consider a scale point as a point on a graph. The position of each point is identified on the X axis by a **time** in ms (***inPb-1***) and a corresponding **display value** in engineering units (***Engb-1***) on the Y axis. 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 the **Engineering Units** and **Corresponding Input Times** parameters.

Linearization 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 ***Engb-1..8*** Sets the number of engineering units corresponding to the times specified by ***inPA-1…8*** respectively. ***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** in *Configuring the Display (All Modes)* on *page 70*). 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 the **Number of Scale Points** and **Corresponding Input Times** parameters on *pages 63 and 65*.

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

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

inPA-1..8 ***inPb-1..8*** Defines the times corresponding to the number of engineering units specified by ***EngA-1…8*** respectively. ***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 2µS (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 the **Number of Scale Points** and **Engineering Units** parameters on *pages 63 and 64*).

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.

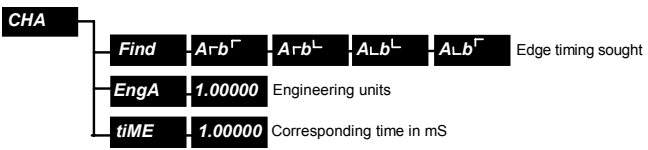
To begin sampling the time, press the instrument's **Enter** key when ***rEAd*** is on display. The display will count down from ***3*** to ***0*** during which, the input is sampled. The measured time is displayed for the user to acknowledge. Check the value looks correct and press the **Enter** key 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	***inPA-1***	85	***inPb-1***
70	***inPA-2***	87	***inPb-2***
72	***inPA-3***	89	***inPb-3***
74	***inPA-4***	91	***inPb-4***
76	***inPA-5***	93	***inPb-5***
78	***inPA-6***	95	***inPb-6***
80	***inPA-7***	97	***inPb-7***
82	***inPA-8***	99	***inPb-8***

Configuring the Channels: Edge Timer Mode - *EdgE*

Follow the instructions in this section if you have set the operation mode to ***EdgE***. In Edge Timer Mode, only the Channel A Menu (***CHA***) is visible. You access this menu from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Channel A Menu Structure in Edge Timer Mode

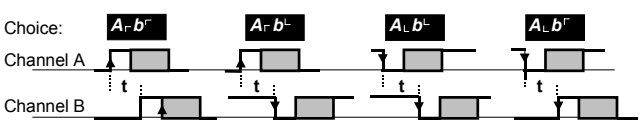


Edge Timing Sought

Default: A ⌜ b ⌜

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⌜b⌜	A⌜b⌞	A⌞b⌞	A⌞b⌜

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 the **Corresponding Time** parameter.

NOTE

A negative value will negate the measurement.

Analogue 67 Comms Location		Read/Write
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 the **Engineering Units** parameter.

NOTE

Do not enter a negative value.

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

Example

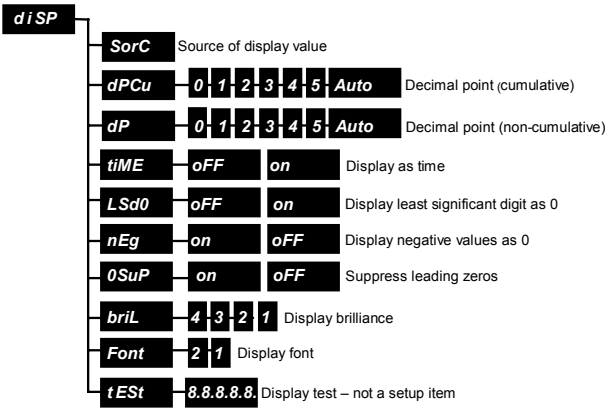
If each millisecond timed corresponds to 5 engineering units:

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

Configuring the Display (All Modes)

diSP The Display menu sets up the display options which are listed in the menu structure diagram below. The Display menu (***diSP***) is accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Display Menu Structure



Source Value

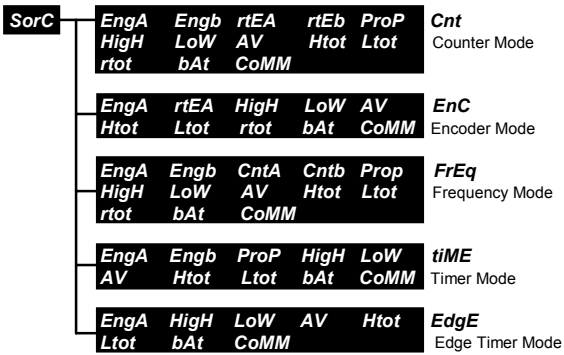
Default: EngA (in Counter Mode)

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 *Deciding on the Operation Mode* on *page 6*.

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 for Each Operation 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** in *Configuring the System Options* on *page 146*.

Important NOTE

- The ***SYSt***, ***AVti*** option also affects the ***AV*** value (see **Averaging Time** in *Configuring the System Options* on *page 146*).
- The ***rSEt*** option in the ***StA1***/***StA2*** and ***KEY1***/***KEY2*** Menus also effects the ***HigH***, ***LoW***, and ***AV*** values (see **Reset High, Low & Average** in *Configuring the Status Inputs* on *page 109* and *Configuring the Function Keys* on *page 117*).

Display sources ***Htot***, ***Ltot*** and ***rtot*** are outputs from the optional totaliser and should only be used if the totaliser is enabled. See *Configuring the Totaliser* on *page 77*.

bAt is a measurement produced by the optional batch control function. It derives its input from the optional totaliser output. The batch control function and the totaliser must be enabled for this display source to be

valid. See *Configuring the Totaliser* on *page 77* and *Configuring the Batch Control Function* on *page 92*.

When the display source is ***CoMM***, the instrument displays a value 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 non-cumulative 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
0	***0***	***13***
1	***0.0***	***12.7***
2	***0.00***	***12.69***
3	***0.000***	***12.688***
4	***0.0000***	***12.6880***
5	***0.00000***	***oVEr*** (see ***dP*** on *page 73*)
Auto	6 most significant digits	***12.6880***

Leading ***0***s are shown if ***0SuP*** is ***oFF*** (see the **Leading Zero Suppression** parameter on *page 75*).

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	***123.457***	6th digit is rounded up
0.0045678	***0.00457***	0s after the point are significant
-0.12345678	***-0.12345***	6th digit is still rounded up
-123.45678	***-123.457***	***-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
0, Auto	***-199999*** (***-1*** is a single character)	***999999***
1	***-19999.9***	***99999.9***
2	***-1999.99***	***9999.99***
3	***-199.999***	***999.999***
4	***-19.9999***	***99.9999***
5	***-1.99999***	***9.99999***

Cumulative values are treated differently to non-cumulative 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 = ***0***
Largest displayable value = ***999999***

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

Example

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

CumulativeValue	Display Format	
99999.9	***99999.9***	(Largest displayable value)
100000.0	***00000.0***	(Leading ***0***s indicate unseen **1**)
100000.1	***00000.1***	(Internal value is still **1**000001)

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 77*).

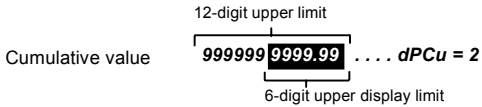
The totaliser output (***Htot*** and ***Ltot***) is displayed with its own decimal point value which is set from the ***dP*** option in the ***tot*** (Totaliser) menu. The totaliser therefore uses its own ***dP*** setting when displaying the least significant half of totals (see the **Totaliser Decimal Point Position** parameter on *page 86*).

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 non-cumulative values is set by the ***dP*** parameter. When non-cumulative values exceed the largest displayable value, ***oVEr*** is displayed. When non-cumulative 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	***dP***						***dPCu***
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 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).

NOTE: 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 roll over 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 the **Latching** parameter in *Configuring the Alarms* on *page 123)*.

Logic 51 Comms Location		Read/Write
On	Seconds displayed as ***hh.mm.ss***	
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 ***0***
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 ***0***

Leading Zero Suppression

Default:On

0SuP Leading zeros are not shown when ***0SuP*** 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*** (dimmest) and ***4*** (brightest).

Analogue 57 Comms Location				Read/Write
Analogue value	0	1	2	3
Brilliance setting	***1***	***2***	***3***	***4***

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 1displays ***6*** and ***b*** in the same format.

Logic 47 Comms Location		Read/Write
On	Font 2	9Ꮾ6
Off	Font 1	976

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.

8.8.8.8.8.8.

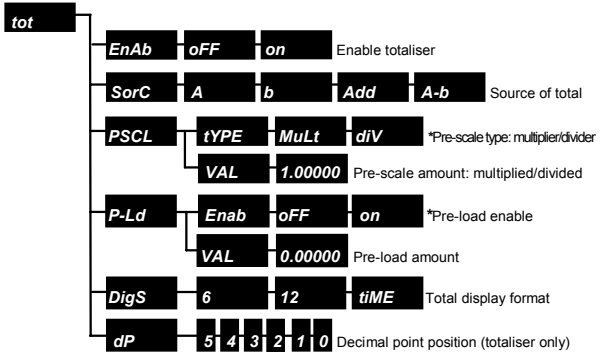
Note that this is not a setup item.

Configuring the Totaliser

By default, the Totaliser is not enabled. You must enable it if you want to use the batch control function.

tot The Totaliser menu sets up the totaliser options which are listed in the menu structure diagram below. To access the ***tot*** menu from the Configuration menu (***ConF***), see *How to Enter & Exit the Configuration Menus* on *page 40*.

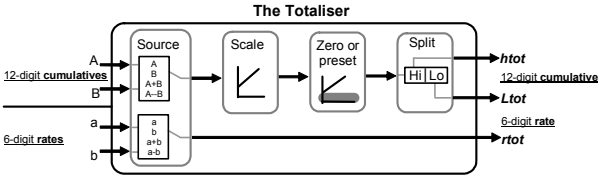
Totaliser Menu Structure



* Optional

The following diagram and the table illustrate how the totaliser produces a single 12-digit cumulative total value in two 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 in the diagram.

The Totaliser



The values input to the totaliser depend on the mode of operation (***inPt***, ***tyPE*** setting). The **Accumulated** columns in the following table show which values are always fed to the totaliser for each particular operation mode.

Input Table

Input Type	Totaliser Inputs Accumulated (***htot,Ltot***)		Rate(***rtot***)	
	A	**B**	**a**	**b**
Cnt	***EngA*** *Counts*	***Engb*** *Counts*	***rtEA*** *KHz*	***rtEb*** *KHz*
EnC	***EngA*** *Counts*	-------	***rtEA*** *KHz*	-------
FrEq	***CntA*** *Thousands*	***Cntb*** *Thousands*	***EngA*** *KHz*	***Engb*** *KHz*
tiME Period	***CntA*** *Thousands*	***Cntb*** *Thousands*	-------	-------
High Low	***EngA*** *mS*	***Engb*** *mS*	-------	-------
Duty high Duty low	-------	-------	-------	-------
EdgE	***EngA*** *mS*	-------	-------	-------

NOTE

- The table on the previous page 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 non-cumulative 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 the Totaliser's **Prescale Submenu** and **Preload Submenu** on *page 82*).
- Show the total in ***hh.mm.ss*** format or to different decimal places (see the Totaliser's **Digits Display Format** and **Totaliser Decimal Point Position** parameters on *pages 83 and 86*).
- Add or subtract totalised Channel A and B values (see the Totaliser's **Source of Total Value** parameter on *page 80*).
- Independently zero or preset the total (see **Zero Grand Total: Htot & Ltot** parameters in *Configuring the Status Inputs* on *page 107* and *Configuring the Function Keys* on *page 115*).

In addition to the capabilities described above, the totaliser accumulates the timings when the its input is a non-cumulative 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 using the ***EnAb*** parameter if you want to use the batch control function. See *Configuring the Batch Control Function* on *page 92*).

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 the **Source Value** parameter in *Configuring the Display (All Modes)* on *page 68*).
- The ***StA1***/***StA2***, ***diSP*** menus (see the **Display Alternative Value** parameter in *Configuring the Status Inputs* on *page 104*).
- The ***KEY1***/***KEY2***, ***diSP*** menus (see the **Display Alternative Value** parameter in *Configuring the Function Keys* on *page 113*).
- The ***AL1***/***AL2***/***AL3***/***AL4***, ***SorC*** Menus (see the **Source Value** parameter in *Configuring the Alarms* on *page 121*).
- The ***Aout***, ***SorC*** Menu (see the **Source Value** parameter in *Configuring the Analogue Output* on *page 133*).
- The ***SYSt***, ***AV*** menu (see the **Average Source** parameter in *Configuring the System Options* on *page 146*).

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 *Deciding on the Operation Mode* on page 6. 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 78*.

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:

  Cntb = 1/**period** time (*in mS by default*) x elapsed seconds.
  = *Thousands of* ***periods*** *counted* (*by default*).

  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	***A***	***B***	***Add***	***A-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** below).

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 the **Totaliser Decimal Point Position** parameter on *page 86*).

Analogue 238 Comms Location		Read/Write
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 the **Totaliser Decimal Point Position** parameter on *page 86*).

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 the **Prescale Submenu** on *page 82*).

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 the **Totaliser Decimal Point Position** parameter on *page 86*.

Analogue 239 Comms Location		Read/Write
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 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 the **Totaliser Decimal Point Position** parameteron *page 86*).

Example

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

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

Example

Value	*Ltot* Display Format	
000000,360000	***oVEr***	(All greater times display ***oVEr***)
000000,359999	***99.59.59***	(Maximum time)
000000,000150	***00.02.30***	(150 seconds is 2 minutes and 30 seconds)

Analogue 241 Comms Location			Read/Write
Analogue value	0	1	2
Display format	6 digits	12 digits	Time ***hh.mm.ss***

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 *Htot*	*Ltot*	Example 12.688 will be displayed as
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***	***oVEr***

Leading ***0***s are shown if ***0SuP*** is ***oFF*** or in the ***Ltot*** value only if the ***Htot*** value is not zero (see **Leading Zero Suppression** in *Configuring the Display (All Modes)* on *page 75*).

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

Setting	Highest Display Format *Htot Ltot*	Lowest Display Format *Htot Ltot*
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 84*).

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.

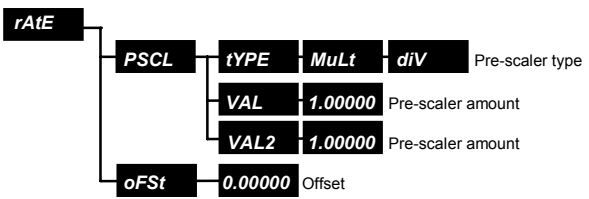
Analogue 240 Comms Location						Read/Write
Analogue value	0	1	2	3	4	5
Digits to right of decimal point	0	1	2	3	4	5

Configuring the Rate

The Rate menu is only available when you have set the operation mode as a counter, (***Cnt)*** or encoder (***EnC)***. The Rate menu (***rAtE***) is accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

rAtE The Rate menu sets up the rate options which are listed in the menu structure diagram below.

Rate Menu Structure



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

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

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

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

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** in *Configuring the Display (All Modes)* on *page 68*), or the ***StA1***/***StA2***, ***KEY1***/***KEY2***, ***diSP*** Menus (see the

Display Alternative Value parameter in *Configuring the Status Inputs* on *page 104* and *Configuring the Function Keys* on *page 113*).

- 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 91*).
- 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** in *Configuring the Display (All Modes)* on *page 70*).

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:

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

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 non-cumulative 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, rate measurements can change sign as the cumulative measurement rises or falls (see the **Decimal Point Position** parameter on *page 70*).

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.

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

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 value in the displayable
Value setting	***VAL***	***VAL2***	range

Rate Offset

Default: 0.00000

oFSt 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 non-cumulative value displays in order to prevent the offset rate going out of displayable range (see the **Decimal Point Position** parameter on *page 70* in *Configuring the Display (All Modes)*).

Analogue 253 Comms Location		Read/Write
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 operation mode to ***FrEq***. In Frequency Mode, the frequencies are integrated to estimate the cumulative measurements. See *Configuring the Mode of Operation* on *page 41*).

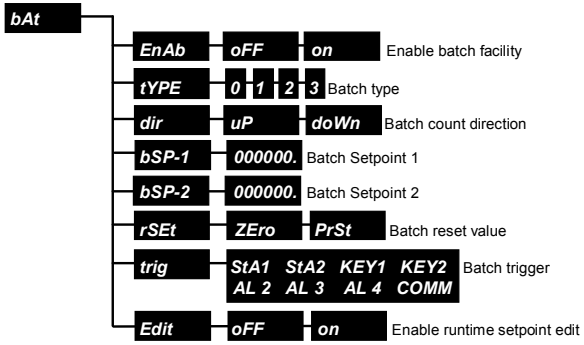
Configuring the Batch Control Function

The batch control function is only available on instruments fitted with relay or TTL outputs. By default, it is disabled. To use the batch control function, the totaliser must be enabled. See *Configuring the Totaliser* on *page 77*.

The Batch control menu (***bAt***) is accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

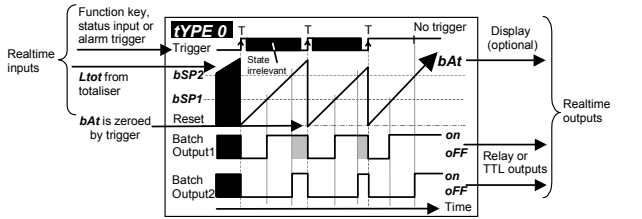
bAt The Batch Control Menu sets up the batch options which are listed in the menu structure diagram below..

Batch Control Menu Structure



The batch control function 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 mode descriptions in *Deciding on the Operation Mode* on *page 6*.

Enable

Default: Off

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

- The ***diSP***, ***SorC*** menu (see the **Source Value** parameter in *Configuring the Display (All Modes)* on *page 68*).
- The ***StA1***/***StA2***, ***diSP*** menus (see the **Display Alternative Value** parameter in *Configuring the Status Inputs* on *page 104*).
- The ***KEY1***/***KEY2***, ***diSP*** menus (see the **Display Alternative Value** parameter in *Configuring the Function Keys* on *page 113*).

NOTE: Relay & TTL Outputs

- If the instrument has no logic or relay outputs, the batch control function cannot be used.
- When the batch control function 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 function	
Off	Disables batch control function	

Type of Batch Control Process

Default: 0

tYPE There are four modes of batch control operation (***0***, ***1***, ***2*** and ***3***) that you can set. The following list shows the sequence of events, in each stage of the batch control process and the effect of the selected batch ***tYPE*** on them:

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 below and the diagrams on *page 95*.)
2. Upon trigger, Batch Outputs 1 and 2 are turned off and the batch total ***bAt*** is reset (see the **Reset Value** parameter on *page 98*).
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.
   - If batch ***tYPE*** is ***0*** or ***2***, Batch Output 1 remains on.
5. The batch control process now resumes.

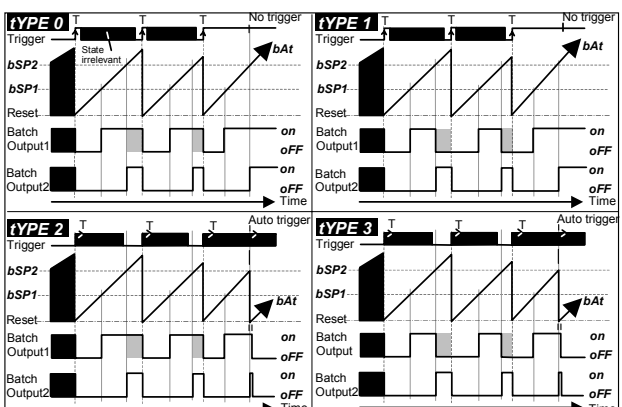
The effect of the batch ***tYPE*** setting can be summarised as follows:

Type	Trigger	Batch Output 1 when Batch Setpoint 2 is reached
0	Edge	Kept on
1	Edge	Turned off
2	Level	Kept on
3	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 ***tYPE 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*



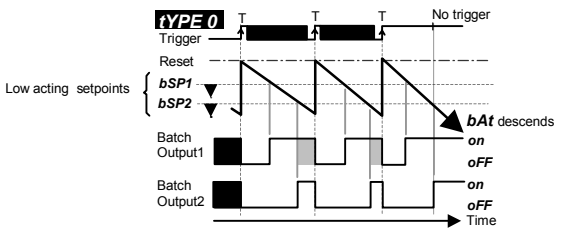
Analogue 230 Comms Location				Read/Write
Analogue value	0	1	2	3
Type setting	***0***	***1***	***2***	***3***

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 ***doWn***	
Off	Sets direction to ***uP***	

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 batch control diagrams in this section for more information.

NOTE: Relay & TTL Outputs

- If the instrument has no logic or relay outputs, the batch control function cannot be used.
- When the batch control function 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.

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 the **Reset Value** parameter on *page 98*).

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 the **Totaliser Decimal Point Position** parameter on *page 86*).

It is possible to edit batch setpoints quickly, from the Setpoint Edit Menu, see *page 34*, when the instrument is displaying the measured value/real time display. The batch setpoints must be editable, (see the **Edit** parameter on *page 99*).

Analogue Comms Locations		Read/Write
231	232	Any value in the displayable range
bSP-1	***bSP-2***	

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 the **Preset Value** parameter in *Configuring the Preset* on *page 101*).

Logic 224 Comms Location	Read/Write
Logic value	
0	On zeros ***bAt*** on trigger
1	On presets ***bAt*** 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**).

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 the **Type of Batch Control Process** parameter on *page 94*).
  AND
- 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 95 and 96*).

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 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	***StA1***	4	***AL1***
1	***StA2***	5	***AL2***
2	***KEY1***	6	***AL3***
3	***KEY2***	7	***AL4***
		8	***CoMM***

Edit

Default: Off

Edit During normal operation, setting this parameter to ***on*** allows the operator to quickly edit Batch Setpoints 1 and 2 from the Setpoint Edit Menu, which is accessed by pressing the **Down** key when the instrument is displaying a real time measurement and it has no optional password protection (see *page 34*).

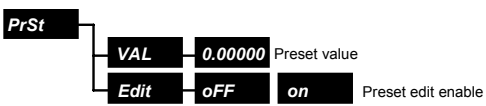
When this option is ***oFF***, the batch setpoints can only be **viewed** and **not edited** from the Setpoint Edit Menu

Logic 222 Comms Location	Read/Write
On	Allows ***bSP-1*** and ***bSP-2*** to be **edited** from the Setpoint Edit Menu
Off	Allows ***bSP-1*** and ***bSP-2*** to be **viewed** 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. The Preset menu (***PrSt***) is accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Preset Menu Structure



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 the **Trigger** parameter in *Configuring the Batch Control Function* on *page 98*).
- A status input is changed (see the **Zero Grand Total: Htot & Ltot**, **Preset EngA** and **Preset Engb** parameters in *Configuring the Status Inputs* on *pages 107 and 108*).
- A function key is pressed (see the **Zero Grand Total: Htot & Ltot**, **Preset EngA** and **Preset Engb** parameters in *Configuring the Function Keys* on *pages 115* and *116*).

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 ± 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 the **Decimal Point Position** parameter in *Configuring the Display (All Modes)* on *page 70* and the **Totaliser Decimal Point Position** parameter in *Configuring the Totaliser* on *page 86*).

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

Analogue 60 Comms Location		Read/Write
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 real time measurement and it has no optional password protection (see *page 34*).

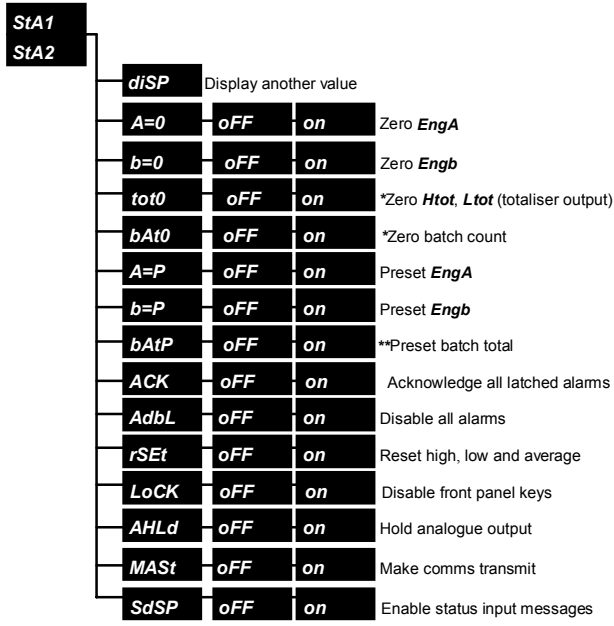
When this option is ***oFF***, the preset value can only be **viewed** and **not edited** from the Setpoint Edit Menu.

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

Configuring the Status Inputs

StA1 ***StA2*** The Status Inputs menus set up the status input options which are listed in the menu structure diagram below. The Status Inputs menus (***StA1*** and ***StA2***) are accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Status Inputs 1 & 2 Menu Structure



* Visible only if the totaliser enabled.
** Visible only if the batch counter enabled.

This menu sets up the function(s) of activating a status input. 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 the **Communications Master** parameter on *page 110*).
To activate a status input see the table on *page 21* and *Connecting the Status Inputs* on *page 29*).

Note

If you change the operation mode, you must, check that the functions of a status input remain relevant. 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

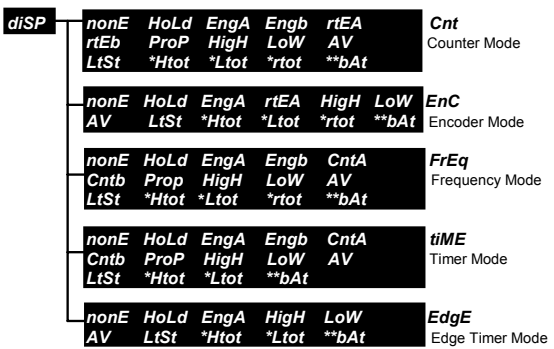
If a pulse is used, it must be at least 1 second long.

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



* 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.

Descriptions of most of the ***diSP*** settings are given in *Configuring the Display (All Modes) on page 68*. The settings that were not covered are as follows:

- ***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 the **Enable Status Message** parameter on *page 111*).

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 non-cumulative values.

See the **Decimal Point Position** parameter in *Configuring the Display (All Modes)* on *page 68*, and the **Averaging Time** and **Average Source** parameters in *Configuring the System Options* on *pages 145* and *146*).

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***.

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

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 ***EngA***
Status Inputs	1	2	Off disables zeroing of ***EngA***

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 ***Engb***
Status Input	1	2	Off disables zeroing of ***Engb***

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 *Configuring the Totaliser* on *page 79*).

Logic Comms Locations			Read/Write
Logic	121	141	On enables zeroing of ***Htot*** & ***Ltot***
Status Input	1	2	Off disables zeroing of ***Htot*** & ***Ltot***

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 the **Enable** parameter on *page 93* in *Configuring the Batch Control Function*).

The totaliser must also be setup and enabled (see *Configuring the Totaliser* on *page 79*).

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

Default: Off

A=P ***on*** presets ***EngA*** when the status input is activated. The preset value is setup from the Preset menu (see the **Preset Value** parameter on *page 101*).

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

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 the **Preset Value** parameter on *page 101*).

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

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 the **Preset Value** parameter on *page 101*).

NOTE

- This option does not appear unless the batch counter is enabled. See *Configuring the Batch Control Function* on page 92.
- The totaliser must also be setup and enabled (see *Configuring the Totaliser* on *page 77*).

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

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 *Configuring the Alarms* on page 118.

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 real time 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 assigning 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.

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 the **Average Source** parameter in *Configuring the System Options* on *page 146*).

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** in *Configuring the Serial Communications* on *page 141*).

CoMM MASt EnAb	***StA1/StA2 MASt***	***StA1/StA2* State**	**Result Transmissions**
oFF	Irrelevant	Irrelevant	Disabled
****on***	****oFF***	Irrelevant	Enabled
on	***on***	*****oFF***	Enabled
on	***on***	*****on***	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.

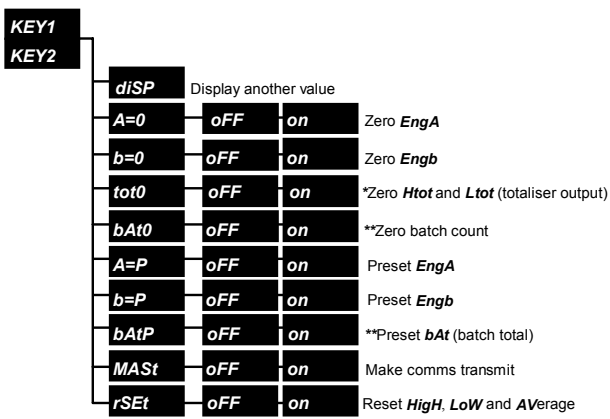
- No message is displayed if the alternative display value is ***nonE*** or if all other possible functions of the status input are ***oFF***.
- If a status input has been configured to have more than one function, a message for only one of the functions will be chosen arbitrarily and displayed. This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

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 menus set up the function key options which are listed in the menu structure diagram below. The Function Key menus (***KEY1*** and ***KEY2***) are accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Function Keys 1 & 2 Menu Structure



* Visible only if the totaliser enabled.
** Visible only if the 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. ***MASt*** is a special case (see **Communications Master** on *page 116*).

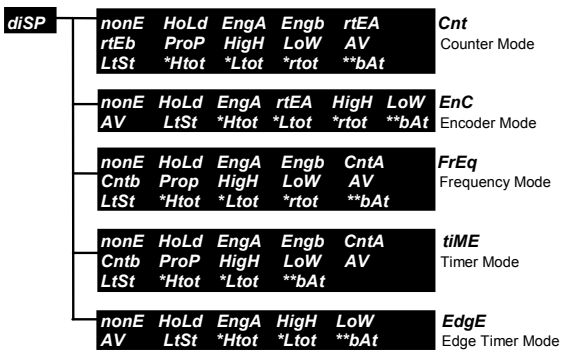
When the input type setting is changed, check that the functions of a function key remain relevant (see **Type** on *page 41*). If in doubt, turn the function off. If a pulse is used, it must be at least 1 second long.
These **triggered** irreversible one-way functions include: ***A=0***, ***b=0***, ***tot0***, ***bAt0***, ***A=P***, ***b=P***, ***bAtP*** and ***rSEt***. ***MASt*** is different (see

Communications Master on *page 116*).

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

diSP Defines an alternative display value which is shown <u>only</u> while a function key is depressed. The choices for each operation mode are listed.

Displays Activated by Function Keys in Each Mode



* 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 *Deciding on the Operation Mode* on *page* 6). Additional settings are described below.

- ***nonE*** Configures the function key to <u>not</u> 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				
	Cnt	***EnC***	***FrEq***	***tiME***	***EdgE***
Analogue value	Value displayed when status input activated				
0	***nonE***	***nonE***	***nonE***	***nonE***	***nonE***
1	***hold***	***hold***	***hold***	***hold***	***hold***
2	***EngA***	***EngA***	***EngA***	***EngA***	***EngA***
3	***Engb***	***rtEA***	***Engb***	***Engb***	***HigH***
4	***rtEA***	***HigH***	***CntA***	***CntA***	***LoW***
5	***rtEb***	***LoW***	***Cntb***	***Cntb***	***AV***
6	***ProP***	***AV***	***ProP***	***ProP***	***LtSt***
7	***HigH***	***LtSt***	***HigH***	***HigH***	***Htot***
8	***LoW***	***Htot***	***LoW***	***LoW***	***Ltot***
9	***AV***	***Ltot***	***AV***	***AV***	***bAt***
10	*LtSt*	***rtot***	***LtSt***	***LtSt***	
11	*Htot*	***BAt***	***Htot***	***Htot***	
12	*Ltot*		***Ltot***	***Ltot***	
13	*rtot*			***rtot***	***bAt***
14	*bAt*		***bAt***		

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 ***EngA***
Function Key	1	2	Off disables zeroing of ***EngA***

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 ***Engb***
Function Key	1	2	Off disables zeroing of ***Engb***

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 *Configuring the Totaliser* on *page 77*).

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

Zero Batch Total: bAt

Default: Off

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

NOTE

NOTE

- This option does not appear unless the batch counter is enabled (see **Enable** *Configuring the Batch Control Function* on *page 92*).
- The totaliser must also be setup and enabled (see *Configuring the Totaliser* on *page 77*).

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

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 the **Preset Value** parameter in *Configuring the Preset* on *page 101*).

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

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 the **Preset Value** parameter in *Configuring the Preset* on *page 101*).

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

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 the **Preset Value** parameter on *page 101*).

NOTE

- This option does not appear unless the batch counter is enabled (see *Configuring the Batch Control Function* on *page 93*).
- The totaliser must also be setup and enabled (see *Configuring the Totaliser* on *page 77*).

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

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** in *Configuring the Serial Communications* on *page 141*).

CoMM MASt EnAb	***KEY1/2 MASt***	***KEY/2* State**	**Result Transmissions**
oFF	Irrelevant	Irrelevant	Disabled
****on***	****oFF***	Irrelevant	Regular transmissions enabled
on	***on***	******Not pressed	Disabled
on	***on***	******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

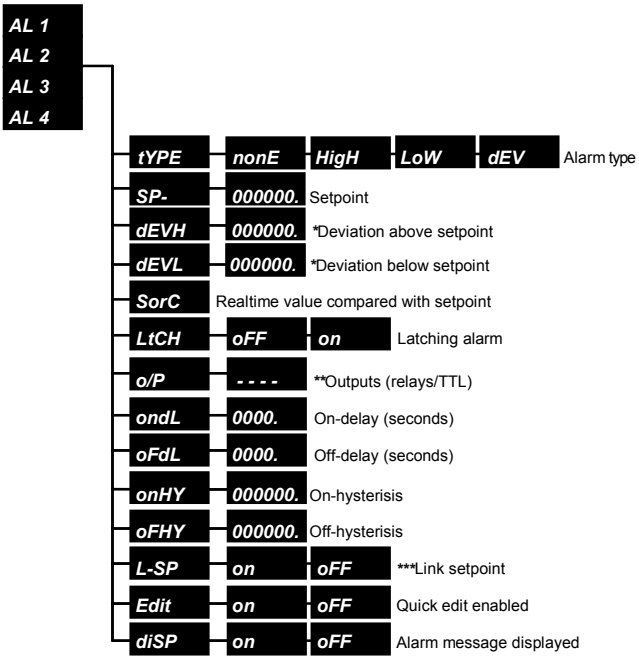
rSEt ***on*** resets the ***HigH***, ***LoW*** and ***AV*** values to the current ***HigH***, ***LoW*** and ***AV*** source when a function key is pressed (see the **Average Source** parameter in *Configuring the System Options* on *page 146*).

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 four Alarm menus set up the alarm options which are listed in the menu structure diagram below. The Alarm menus (***AL1*** to ***AL4***) are accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

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.

When an alarm occurs during operation, two 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 the **Message Display** parameter on *page 127*).

2. Configured alarm outputs (relay or TTL) are optionally activated (see the **Outputs** parameter on *page 123*).

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 real time measurement with the fixed alarm setpoint (see the **Setpoints** and **Source Value** parameters on *pages 120 and 121*).

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.

NOTE

- An activated alarm can change the state of alarm outputs if fitted and display a message (see the **Outputs** parameter on *page 123*).
- The alarm behaviour of the instrument described above assumes the alarm latching, delay and hysteresis options are not in use. To see how they the change the way alarms work, see the **Latching**, **Delay** and **Hysteresis** parameters on *pages 123 and 124*.

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*** Define the alarm setpoints. This is the fixed value that is compared with the real time source value (see the **Source Value** parameter on *page 121*).

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 the **Decimal Point Position** parameter in *Configuring the Display (All Modes)* on *page 70*).

It is possible to allow the setpoint to be changed quickly during operation (see the **Edit** parameter on *page 126*).

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 the **Setpoint Linking** parameter on *page 126*).

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

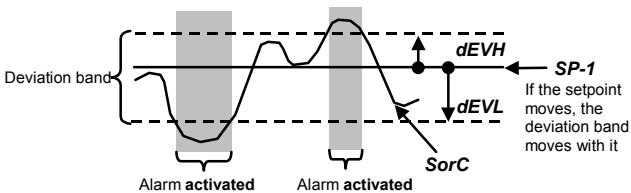
Analogue Comms Locations				Read/Write
Analogue	111	126	141	156
Setpoint for Alarm	1	2	3	4
Value	Any value in the displayable range			

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 real time ***SorC*** value falls outside the deviation band.

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

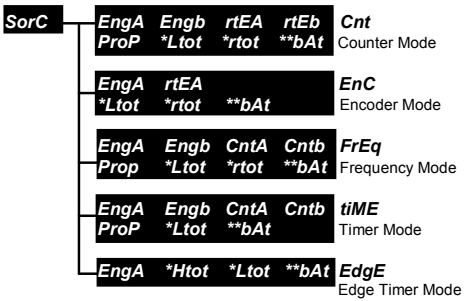
Source Value

Default: EngA (in Counter Mode)

SorC Defines the real time value that is compared with the setpoint to activate the alarm.

The choices for each operation mode are listed on the next page.

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 *Deciding on the Operation Mode* on *page 6*.

Analogue Comms Locations					Read/Write
Analogue	118	133	148		163
Alarm	1	2	3		4
	Input type				
	Cnt	***EnC***	***FrEq***	***tiME***	***EdgE***
Analogue value	Source value				
0	***EngA***	***EngA***	***EngA***	***EngA***	***EngA***
1	***Engb***	***rtEA***	***Engb***	***Engb***	***Ltot***
2	***rtEA***	***Ltot***	***ProP***	***ProP***	***bAt***
3	***rtEb***	***rtot***	***Ltot***	***Ltot***	
4	***ProP***	***bAt***	***rtot***	***bAt***	
5	***Ltot***		***bAt***		
6	***rtot***				
7	***bAt***				
	Cnt	***EnC***	***FrEq***	***tiME***	***EdgE***
dPCu	0,1,5,7	0,2,4	3,5	3,4	1,2
dp	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** in *Configuring the Status Inputs* on *page 108*).

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

– –	No outputs
1 –	Output 1 activated
– 2	Output 2 activated
1 2	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 on the previous page 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.

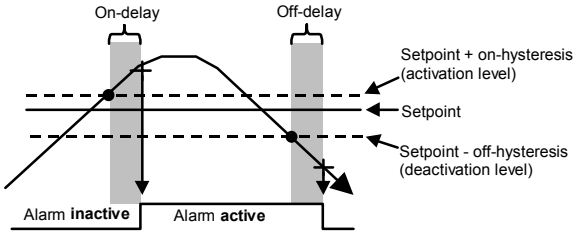
Analogue Comms Locations					Read/Write
On-delay	114	129	144	159	0 to 9999
Off-delay	115	130	145	160	0 to 9999
Alarm	1	2	3	4	Range (seconds)

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 real time measurement and it has no optional password protection (see *page 34*).

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.

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

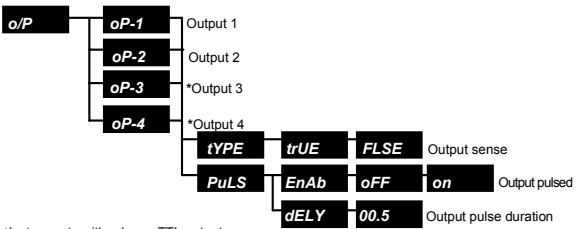
The most severe alarm is the one caused by the largest intrusion into the alarm's zone.

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. The Logic Outputs menu (**o/P**) is accessed from the Configuration menu (**ConF**). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Logic Outputs Menu Structure



*Instruments with relay or TTL outputs.

This menu determines the way outputs work however they are activated, for example, 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 the **Divider Output** parameter in *Configuring the Channels: Counter Mode - Cnt* on *page 48*).
- See *Connecting the Logic Outputs* on *page 30* for information on connecting logic outputs to other devices.

Output Selection

oP-1 **oP-2** **oP-3** **oP-4** Selects the output that you want to set up.

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 diagrams on *page 130*. They show that during operation, when the output sense is ***truE***:

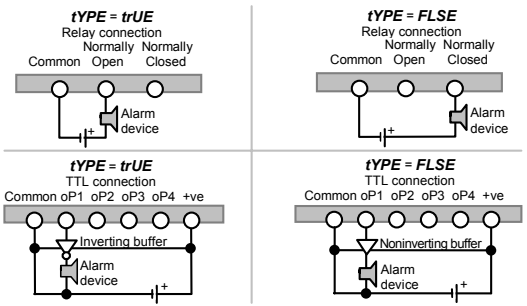
- A relay is energised when turned ***on***.
- *A TTL (open collector) output is Logic* **0** *when* ***on*** *by default.*

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	***on***	The instrument connects Common to Normally Open.	***on***	The instrument connects Common to Normally Closed.
	oFF	The instrument connects Common to Normally Closed.	***oFF***	The instrument connects Common to Normally Open.
TTL	***on***	The instrument sets output to 0 Volts (ie. Logic 0).	***on***	The instrument sets output to +ve Volts (ie. Logic 1).
	oFF	The instrument sets output to +ve Volts (ie. Logic 1).	***oFF***	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 ***truE*** 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 extent 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** in *Configuring the Channels: Counter Mode - Cnt* on *page 48* and *Configuring the Channels: Encoder Mode - EnC* on *page 53*).

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

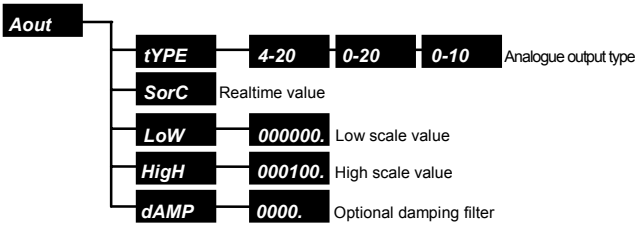
dELY This value sets the output's pulse duration and may range from ***00.1*** to ***99.0*** seconds.

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. The Analogue Output menu () is accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

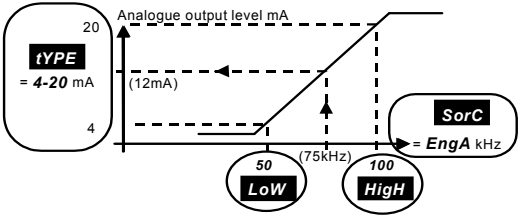
Analogue Output Menu Structure



Example

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

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 real time value that is used to determine the retransmission output level.

The choices for each input type setting are listed on *page 134* (see also **Type** on *page 41*) .

With the exception of the ***CoMM*** source setting, a description of each ***SorC*** setting is given in *Deciding on the Operation Mode* on *page 6*.

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 132*)

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).

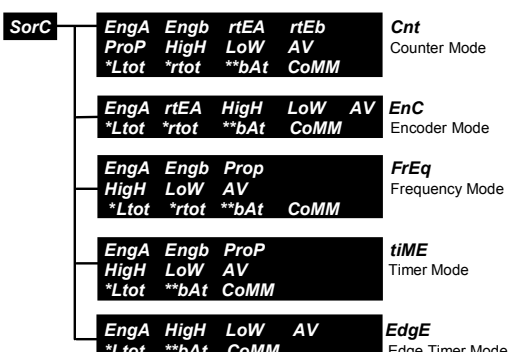
EngA is always the default analogue output source whatever the input type. However, if the instrument is setup:

- 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** in *Configuring the System Options* on *pages 145* and *146*).

The ***AV***, ***HighH*** and ***LowW*** 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** in *Configuring the Status Inputs* on *page 109* and *Configuring the Function Keys* on *page 117*).

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 ***HighH*** and ***LowW*** that correspond to the analogue output range limits ***tYPE*** (see the **Type** parameter on *page 133)*.

Analogue 175 Comms Location					Read/Write
SorC=CoMM					
Analogue 171 Comms Location					Read/Write
	Input type				
	Cnt	***EnC***	***FrEq***	***tiME***	***EdgE***
Analogue value	Source value				
0	***EngA***	***EngA***	***EngA***	***EngA***	***EngA***
1	***Engb***	***rtEA***	***Engb***	***Engb***	***HigH***
2	***rtEA***	***LoW***	***ProP***	***ProP***	***LoW***
3	***rtEb***	***LoW***	***HigH***	***HigH***	***AV***
4	***ProP***	***AV***	***LoW***	***LoW***	***Ltot***
5	***HigH***	***Ltot***	***AV***	***AV***	***bAt***
6	***LoW***	***rtot***	***Ltot***	***Ltot***	***CoMM***
7	***AV***	***bAt***	***rtot***	***bAt***	
8	***Ltot***	***CoMM***	***bAt***	***CoMM***	
9	***rtot***		***CoMM***		
10	***bAt***				
11	***CoMM***				
	Cnt	***EnC***	***FrEq***	***tiME***	***EdgE***
dPCu	0,1,8,10	0,5,7	6,8	6,7	4,5
dp	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*** parameter (see *page 133*).

Analogue Comms Locations		Read/Write
172	173	Range 0 to 2
LoW	***HigH***	

Damping

Default: 0000.

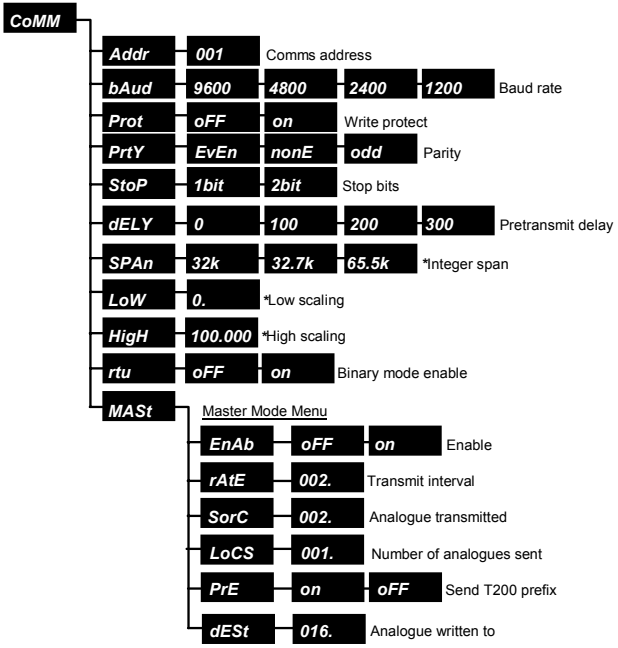
dAMP Defines a time constant in seconds over which a simulated rolling average is applied to the analogue output level. Longer times make the analogue output steadier but give it a slower step response. The time may range from ***0*** (***oFF***) to ***9999*** seconds.

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. The Serial Communications menu (***CoMM***) is accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

Serial Communications Menu Structure



* Scaling Modbus

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 140*) 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 **A**nalogue 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 157* in *Appendix C - Using the Native Communications Protocol*) as is the example above. Instruments retrieve but never reply to broadcasts commands.

NOTE
When more than one instrument is connected to a master via a multi-drop 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
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 159* in *Appendix C - Using the Native Communications Protocol*).

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 140*).

Analogue 184 Comms Location			Read/Write
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 140*).

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
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	***SPAn***	0=32k 1=32.7k 2=65.6k
186	***LoW***	Any value in the displayable range
187	***HigH***	Any value in the displayable range

Example

Option	Setting
SpAn	***32000***
LoW (frequency)	***0.00***
HigH (frequency)	***100.00***
Display range	**Modbus range**
0.00…100.00	***0…32000***

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 139*).

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.
It is recommended that you do not 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 68* in *Configuring the Display (All Modes)*).

NOTE

Master Mode does not work when *rtu* (binary Modbus™-RTU) is enabled (see *Remote Terminal Unit* on page 140).

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 110* in *Configuring the Status Inputs*).

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)

dESt 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

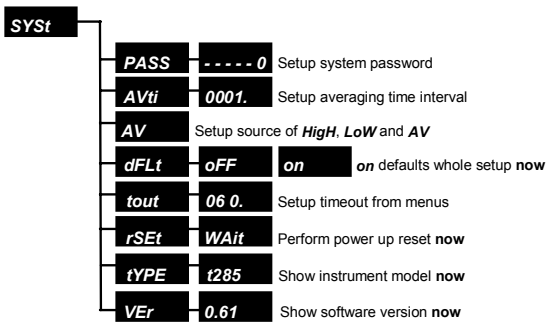
Only ***0*** may be written to an unused location.

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 diagram of the menu structure shown below. The System menu (***SYSt***) is accessed from the Configuration menu (***ConF***). See *How to Enter & Exit the Configuration Menus* on *page 40*.

System Menu Structure



The System Menu can be used:

- To setup miscellaneous system wide settings (***PASS***, ***AVti***, ***AV*** and ***tout***) .

OR

- To 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 "**-**".

DO NOT FORGET THE PASSWORD
OTHERWISE
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 104 and 113*).
- 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 *How to Enter & Exit the Configuration Menus* on *page 40*).

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

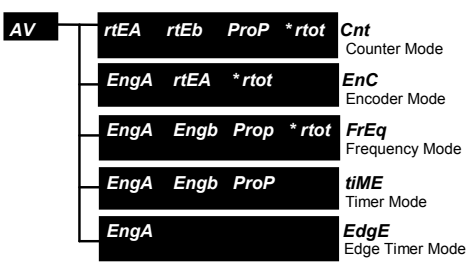
Default: rtEA (In Counter Mode)

AV Defines the source from where the simulated rolling average, the highest and lowest value, is taken.

For example, if ***AV*** is set to ***rtEA***, then ***HigH***, ***LoW*** and ***AV*** are the highest, lowest and average ***rtEA*** values since the instrument was powered up, or since a reset was triggered from a status input or function key (see the **Reset High, Low & Average** parameters on *page 109* in *Configuring the Status Inputs* and *page 117* in *Configuring the Function Keys*).

The choices for each input type setting are listed below. The origin of each possible source value is summarised in *Deciding on the Operation Mode* on *page 4*).

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 non-cumulative values.

This is true even if the high, low and average values are sourced from a cumulative value (see **Decimal Point Position** on *page 70* in *Configuring the Display (All Modes)*).

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

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 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 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 non-condensing.

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.

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.

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.

Frequency Mode (Dual Channel)

Secondary Functions

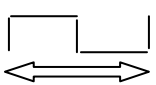
- Scaling to engineering units (eg. litres per minute) for each channel.
- Linearization to compensate for nonlinear conversion of frequency to engineering units.
- 6/12-digit totalisation (integration of rate in engineering units).
- Retransmission of the total for Channel A, B, A+B or A-B.
- Retransmission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

Timer Mode (Dual Channel)

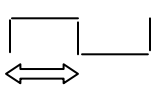
Secondary Functions

Period - Times a period.

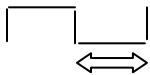
- Scaling to engineering units.
- Linearization to compensate for nonlinear conversion of timing to engineering units.
- Retransmission of the ratio between Channel A and B.
- Display of the ratio between Channel A and B.



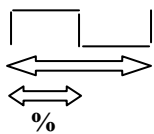
High - As Period above, but high time only.



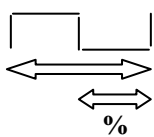
Low - As Period above, but low time only.



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



Edge Timer Mode

Secondary Functions

- Scaling to engineering units.
- Time between pulse edges between Channel A and B.

Appendix A - Display Messages

Power Up Messages

uCAL The instrument has lost its factory calibration constants in non-volatile memory. Could be non-volatile 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 70*).
- The measured value/real time display is below the measurable range.

oVEr Indicates either:

- The displayed value is above the displayable range (see **Decimal Point Position** on *page 70*).
- The measured value/real time display is above the measurable range.

Alarm Messages

Alarm messages are 3 letters followed by the alarm number. The codes are:

HiA1 ***HiA2*** ***HiA3*** ***HiA4***	High alarm, eg. ***HiA4*** indicates high Alarm 4 has been activated.
LoA1 ***LoA2*** ***LoA3*** ***LoA4***	Low alarm.
Hid1 ***Hi d2*** ***Hid3*** ***Hid4***	High deviation alarm.
Lod1 ***Lod2*** ***Lod3*** ***Lod4***	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".

The bus should be routed only from the terminals of the master-PC to the first instrument then from the first to the second, the second to the third and so on. This is called a "multi-drop bus".

A 120Ω resistor should be connected between Terminals 10 and 11 on the last instrument furthest from the master. A 0.1uF capacitor may be connected in series with the resistor to reduce DC current drain.

Half Duplex - 2-Wire Communications

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 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

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.

Automatic Device Enable ADE Converters USB-485 and K2-ADE

The KK-Systems USB-485 converter from www.kksystems.com is a USB to RS485 port adapter that allows a 2wire RS485 connection to behave like a 4 wire RS485 connection by taking on the responsibility of switching between transmitting and listening so the PC software does not have to do so by manipulating RTS.

PC Setup Program

A PC Setup program is available from the following location: www.dtrack.com/datatrackpi/downloads/downloads.htm. The program runs on a PC running Windows 3.1, 95 or NT4, 2000, XP, or later. It transmits and receives whole setups between the PC and an instrument. Setups can also be saved and retrieved from disk. The program automatically adapts to a 2 or 4-wire bus. The KK Systems USB-485 converter is recommended for use with this software. If the K2-ADE is used at 9600 baud, only switches 1 & 4 should be ON.

Converter Connection details

2-wire 9 way D-type Male

T280	**USB-485 &K2-ADE**	K485-FD	K48599-FD
10 & 12	3 & 7	6 & 7	3 & 7
11 & 13	8 & 2	2 & 3	2 & 8

4-wire

10 ←	3	6	3
11 ←	8	2	8
12 →	7	7	7
13 →	2	3	2

The K2-ADE converter shown in the table above has 9 way D-type female connectors (with holes) at both ends which are clearly marked; RS232 and RS485. The RS232 side fits directly into a PC's COM1 or other serial port. The K2-ADE maybe used on a USB-serial port adapter, but it may be necessary to install a driver for the USB converter. It may also be necessary to use Windows 'device manager' to identify the COM port assignment.

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*** (Serial Communications) Menu. Some read only locations, eg. the displayed value, can never be written to via comms (see **Protection** on *page 138* in *Configuring the Serial Communications*).

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.

001 Instrument Address
May range from **001** 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 multi-write, 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 *Appendix E - Troubleshooting Comms* on *page 163*) .

Errors

#1 Invalid command action. Only SA, SL, RA and RL allowed (see *page* 157). 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 138*).

#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 means the location is Read Only, RW means it is Read/Writable.

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 **53** is **4**). See the **Source Value** parameter on *page 68* in *Configuring the Display (All Modes)*).
5	RO	Number of logic outputs fitted: 0, 2 (relays) or 4 (TTLs).
6	RO	Calibration seal. Value increments if certain setup items change (see *Appendix H – Calibration Seal*).
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 the **Reset High, Low & Average** parameter on *page 109* in *Configuring the Status Inputs* and *page 117* in *Configuring the Function Keys*).
36	RO	High display value (maximum peak since reset – see the **Reset High, Low & Average** parameter on *page 109* in *Configuring the Status Inputs* and *page 117* in *Configuring the Function Keys*).
37	RO	Average display value, see the **Averaging Time** parameter on *page 144 in Configuring the System Options*.
40	RO	Proportion value. ***ProP***
41	RO	Instantaneous Channel A rate or timing. ***rtEA***
42	RO	Instantaneous Channel B rate or timing. ***rtEb***
43	RO	Cumulative channel A measurement ***EngA*** or ***CntA*** dependent on mode
44	RO	Cumulative channel B measurement ***Engb*** or ***Cntb*** dependant on mode

45	RO	High 6 digits of grand total ***Htot***.
46	RO	Low 6 digits of grand total ***Ltot***.
47	RO	Grand total rate. ***rtot***
48	RO	High 6 digits of count A. ***EngA*** or ***CntA*** dep on mode
49	RO	Low 6 digits of count A. ***EngA*** or ***CntA*** dep on mode
50	RO	High 6 digits of count B. ***Engb*** or ***Cntb*** dep on mode
51	RO	Low 6 digits of count B. ***Engb*** or ***Cntb*** dep on mode
175	RW	Realtime source of analogue output level when ***SorC*** is ***CoMM***.
217	RW	User linearization point to be sampled next.
218	RW	User linearization channel to be sampled next.

Logic Locations

Status

6	RO	State of Function Key 1. on = pressed (leftmost key).
7	RO	State of Function Key 2. on = pressed (rightmost key).
8	RO	State of Status Input 1. on = contacts closed.
9	RO	State of Status Input 2.on = contacts closed.
10	RO	State of Alarm 1. on = activated.
11	RO	State of Alarm 2. on = activated.
12	RO	State of Alarm 3. on = activated.
13	RO	State of Alarm 4. on = activated.
14	RO	on = abnormal state of Output 1*****
15	RO	on = abnormal state of Output 2*****
16	RO	on = abnormal state of Output 3*****
17	RO	on = abnormal state of Output 4*****
24	RO	on = calibration sampling in progress

***** Only instruments with relay or TTL/logic outputs fitted.

Commands

25	RW	on starts calibration sampling.
26	RW	on acknowledges alarms.
27	RW	on performs the reset function (see the **Reset High, Low & Average** parameter on *page 109* in *Configuring the Status Inputs* and *page 117* in *Configuring the Function Keys*).
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 linearization 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. Use the KK-Systems USB-485 converter as described on *page 156* in *Appendix B - Connecting the Serial Interface*)
2. If using 2-wire comms with a *non* ADE 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.

3. When checking for an **OK** response, look for **K** anywhere in the response and not just in a set position. Garbage can precede it.
4. When a reply is out of range, the first character is a question mark.
5. 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. In this case, if the test passes, it is likely comms between instrument and PC are okay. 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 unless an ADE converter is used (see *Appendix B - Connecting the Serial Interface*). The 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. For short runs this can be omitted and there of no known case of its omission causing problems. Indeed the presence of the resistor can cause draw too much current from serial ports with low current capability. A safe compromise is to connect a 120 Ohm resistor in series with a 0.1uF capacitor across the stated terminals. USB serial ports appear to be more likely to deliver enough current compared with standard mother board serial ports.
   g) Another program is already using the computers serial port.

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.

e.g. 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 68* in *Configuring the Display (All Modes)*.

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 ***Cu***mulative values like counts or distances (see **Decimal Point Position** on *page 70* in *Configuring the Display (All Modes)*.

Examples

dPCu	Count	12 Digits Stored	6 Digits Displayed
0	123456789	000123456789	***456789***
2	123456789	0123456789.00	***6789.00***

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 (see *Configuring the Totaliser* on *page 77*) 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 the **Display Alternative Value** parameter on *page 113 in Configuring the Function Keys*).

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 the **Engineering Units** and **Corresponding Counts** parameters on *page 48* in *Configuring the Channels: Counter Mode - Cnt*.

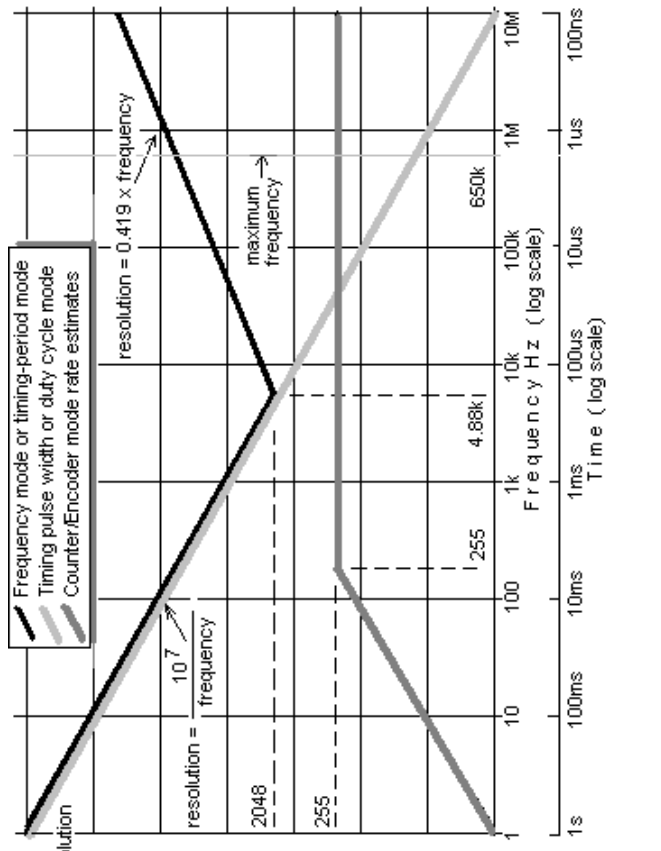
Example

To display millimetres when the display source is ***EngA***, if 3 pulses on Channel A correspond to 1 millimetre, ***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 the **Decimal Point Position** parameter on *page 70* in *Configuring the Display (All Modes)*.

Resolution of Frequency & Timing Measurements

The following graph shows the relationship between frequency and resolution.

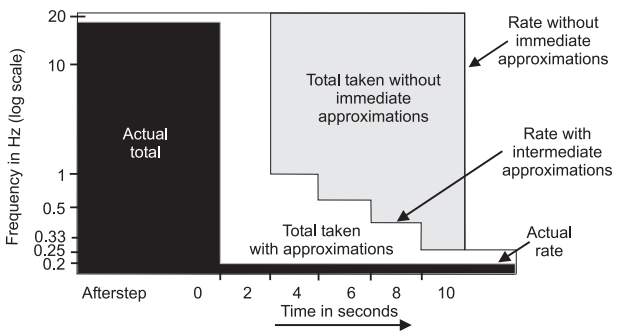

Frequency mode or timing-period mode
Timing pulse width or duty cycle mode
Counter/Encoder mode rate estimates
resolution = 0.419 x frequency
resolution = 10^7 / frequency
maximum frequency
2048
255
650k
4.88k
255
Resolution
Frequency Hz (log scale)
Time (log scale)
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1
10
100
1k
10k
100k
1M
10M
1s
100ms
10ms
1ms
100us
10us
1us
100ns

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

Step Response Effect of Approximations on Total



For example, if frequency is being measured and it is changed suddenly from ***20***Hz to ***0.22***Hz, 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 ***1***Hz 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 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.

Appendix G – Glossary

Default

The preconfigured factory settings for the instrument which include safe or optimum settings for parameters. You can default the whole instrument back to its default factory settings. See the **Default** action in *Configuring the System Options*.

Integrate

To estimate a count from a rate, 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 set up to ignore counts arriving below a certain rate set by the ***FLo*** parameter. See *Configuring the Input Settings (All Modes)* on *page 42*. In Counter Mode, the rate measurements are not exact. See *Configuring the Channels: Counter Mode - Cnt* on *page 8*.

Normal operation

This is when the instrument is displaying a real time measurement.

Period

A cycle. The wavelength or period of repetition of an oscillation in units of time. The reciprocal of the frequency, ie. period = 1/frequency. By default, the instrument measures timings (including periods) in milliseconds

Primary inputs

The counter/timer/frequency measurement input Channels A and B. To set up the primary inputs, see *Configuring the Mode of Operation* on *page 41* and *Configuring the Input Settings* on *page 42*. When the operation mode is set 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). See *Configuring the Totaliser* on *page 77*.

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 instrument 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 the **Gate** parameter on *page 45* in *Configuring the Input Settings*).

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 *Resolution of Frequency & Timing Measurements* on *page 166*).

Setup

The instrument setup is a collection of analogue and logic(on/off) values that you can change using 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. You can reset the whole instrument to its factory defaults in a single action See the **Default** action in *Configuring the System Options*.

There are between 500 and 600 setup values in total, but you do not need to configure each value as most parameters are set to sensible defaults and other parameters are for option features.. See *Configuration Overview* on *page 37*. If you change the operation mode, many configuration items are defaulted so that the instrument behaves sensibly with the new setup.

Appendix H – Calibration Seal

SEAL displays the calibration seal which is a number that is incremented when a change is made to one of the following setup items. This allows you to see that the calibration has changed. See *Operator Functions* on page 32.

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).
	tiME (Corresponding time).
tot (Totaliser) Menu	***SorC*** (Source of total value).
	P-Ld (Preload) ***EnAb*** (Enable).
	dP (Totaliser decimal point position).
Aout (Analogue Output) Menu	***tyPE*** (Type).
	SorC (Source value).
	LoW (Low scaling).
	HigH (High scaling).
	dAMP (Damping).
CoMM (Serial Comms) Menu	***SPAn*** (Integer span).
	LoW (Low scaling).
	HigH (High scaling).

*effect Modbus only

Appendix I - Application Examples

Example Counting Application

The following example counts 75cl size bottles of whisky on a conveyor, displays the total number of bottles and total the amount of whisky produced. The instrument will 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 Values

See *How to Enter & Exit the Configuration Menus* on *page 40*. From within the ***tot*** (Totaliser) menu set the following:

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

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

diSP to ***Ltot***	Displays the ***Ltot*** value when Key 1 is pressed.

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:

CHA, ***ENGA*** to ***6***	1 count = 6.

Adding a Rate Measurement

There is an additional requirement to measure the bottle rate per minute, which is displayed by pressing ***KEY2*** (Function Key 2) on the front panel.

From within the ***KEY2*** 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 60,000 (bottles/min). **See below for why.**
VAL2 to ***1***	Set to 60 for bottles/hour, 1,440 for bottles/day.

WHY multiply the rate value by 60000?
The rate value defaults to kHz. As it is unlikely that 1,000s 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 1,000 is entered, or bottles per minute if a value of 60,000 is entered. To display bottles per day, set 60,000 in the ***VAL*** prescale multiplier parameter and 1,440 in the ***VAL2*** parameter (60mins x 24hours).

Caution

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.

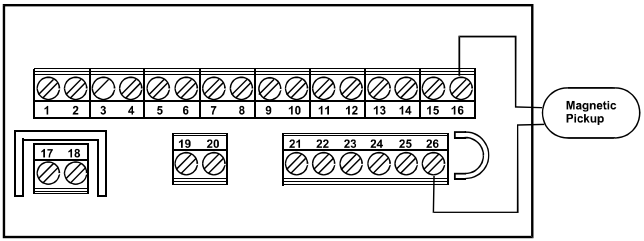
Tip: To check Channel B

If you are using both channels in counter mode and you wish to check that the sensor on Channel B is functioning correctly, temporarily change 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.

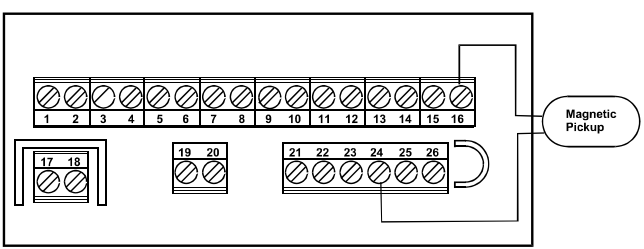
Connecting Some Types of Magnetic Pickup

Noise can interfere with the signal and create instability. Generally noise is prevented from interfering with the reading by adding hysteresis to the input circuitry. The Tracker 280 has 60mV hysteresis (30mV either side of null).

- If the amplitude of the pickup is too small (below 60mV) then, **if possible**, move the pickup nearer to the moving part being detected. This will increase its output.
- If noise is a problem, connect terminal (16) ‘status common’ to mains Earth. This will greatly reduce any noise pickup.
- For better noise immunity, ground one pole of the pick-up by connecting one side of the pickup to terminal (26) ‘A’ and the other side to terminal (16) ‘status common’ leaving terminal (25) ‘/A’ unconnected as shown in the following figure.



- If the sensor is in an extremely noisy environment and the output of the pickup is quite high, it is worth connecting the pickup as follows:make one connection to the 'A pull-up/down' terminal (24) and the other connection to the 'Status common' terminal (16); leaving 'A' and '/A' unconnected. This effectively adds a Lowpass Filter to the input, reducing the noise level below 60mV. As the speed of the moving part being detected increases, the amplitude of the pickup output should rise sufficiently and the noise level should stay the same (signal to noise ratio).



Index

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

R

S

T

U

V

Z