

CAL 30 IOM

Multipurpose Calibrator

Model CAL 30

User's Guide

July 2002

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|         |                                  |    |
|---------|----------------------------------|----|
| 1.      | Introduction                     | 1  |
| 2.      | Specifications                   | 2  |
| 3.      | The Keypad                       | 4  |
| 4.      | Normal Operation                 | 6  |
| 4.1     | Power ON                         | 6  |
| 4.2     | Measurement                      | 6  |
| 4.3     | Zeroing the input                | 6  |
| 4.4     | Selecting an output signal       | 7  |
| 4.5     | Changing the output value        | 7  |
| 4.6     | Zeroing the output               | 7  |
| 4.7     | LOW, MID and HIGH Preset Outputs | 8  |
| 5.      | Programmable Functions           | 9  |
| 5.1     | SETUP functions                  | 9  |
| 5.2     | Presets Setup                    | 9  |
| 5.2.1   | Set 10 Extra Presets             | 9  |
| 5.2.2   | Selecting the 10 Preset outputs  | 10 |
| 5.3     | AUTO functions                   | 10 |
| 5.3.1   | Auto Ramp                        | 11 |
| 5.3.1.1 | Set Ramp Size                    | 11 |
| 5.3.1.2 | Set Auto Ramp Time               | 12 |
| 5.3.1.3 | Set Auto Dwell Time              | 12 |
| 5.3.1.4 | Start Auto Ramp                  | 12 |
| 5.3.2   | Auto Low/High                    | 13 |
| 5.3.2.1 | Set Auto Step Time               | 13 |
| 5.3.2.2 | Start Auto Low/High              | 14 |
| 5.3.3   | Auto 3-Way Step                  | 15 |
| 5.3.3.1 | Set Auto Step Time               | 15 |
| 5.3.3.2 | Start Auto 3-Way Step            | 15 |
| 5.3.4   | Auto 10-Way Step                 | 16 |
| 5.3.4.1 | Set Auto Step Time               | 16 |
| 5.3.4.2 | Start Auto 10-Way Step           | 16 |
| 5.3.5   | Transduce                        | 17 |
| 5.3.5.1 | Set Transduce Input Range        | 18 |
| 5.3.5.2 | Set Transduce Output Range       | 18 |
| 5.3.5.3 | Start Transduce                  | 18 |
| 5.4     | Engineering Units Setup          | 19 |
| 5.4.1   | Input Engineering Units          | 20 |
| 5.4.2   | Output Engineering Units         | 22 |
| 5.5     | Square Root Units Setup          | 24 |
| 5.5.1   | Input Square Root Units          | 24 |
| 5.5.2   | Output Square Root Units         | 26 |
| 5.6     | Defaults Setup                   | 28 |
| 5.6.1   | Save Defaults                    | 28 |
| 5.6.2   | Set Auto Shutoff Time            | 29 |
| 5.6.3   | Enable / Disable Auto Shutoff    | 30 |
| 5.6.4   | Enable/Disable Auto Defaults     | 31 |
| 5.7     | Miscellaneous Status Displays    | 32 |

## **1. Introduction**

The CAL 30 Calibrator is a precision tool used to calibrate electronic process instruments such as controllers, transmitters, transducers, recorders etc. Designed by practical engineers, this dual test instrument allows simultaneous, independent measurement and simulation of Volts, millivolts and milliamps. The milliamps output mode can be used to simulate a 2-Wire or a 4-Wire Transducer. A multitude of programmable functions, such as indication in process engineering units, square root extraction for flow signals, isolated signal conversion or automatic changing of the output value, simplify many calibration tasks and increase maintenance efficiency.

A tactile feel membrane keypad allows the selection of any combination of input or output ranges for display.

The calibrator combines ultra low power electronics with replaceable alkaline batteries for superior operating time and very light weight.

## 2. Specifications

### INPUT RANGES:

-10.000 to 24.000 mV /-10.000 to 120.00 mVDC (Auto-ranging)  
0.000 to 12.000 VDC  
0.000 to 24.000 mADC

### INPUT IMPEDANCE:

Input impedance 1 megohm minimum plus 10 nanoAmps maximum for V and mV inputs. Input impedance is approximately 6 ohms for mA input.

### OUTPUT RANGES:

|                    |  |
|--------------------|--|
| -10 to 120.00 mVDC | 2 KOhm minimum load  |
| 0 to 12.000 VDC    | 2 KOhm minimum load  |
| 0 to 24.000 mADC   | 25 Volts (nominal excitation or external 'loop power' of 75 V maximum) |

### INPUT & OUTPUT ACCURACY (including linearity, repeatability from 15°C to 35°C):

|                     |                             |
|---------------------|-----------------------------|
| -10 to 120.00 mVDC: | ±0.025% of range ± 1 count* |
| 0 to 12.000 VDC:    | ±0.025% of range ± 1 count  |
| 0 to 24.000 mADC:   | ±0.025% of range ± 1 count* |

\*Zeroing is required.

TEMPERATURE DRIFT: ±0.0025%/°C outside the range of 15°C to 35°C

INPUT/OUTPUT ISQLATION: 500 VDC

WARM UP TIME: 60 seconds max. for all range to rated accuracy

OPERATING TEMPERATURE: -20 to 45°C

RELATIVE HUMIDITY: 0 to 90% Rh non-condensing

POWER SUPPLY: Replaceable alkaline batteries (3 x 9 VDC)

OPERATING TIME: 100 hours for measurement or voltage output.  
30 hours with 12mADC continuous output.

CIRCUIT PROTECTION: Input protected for connection to 24 VDC continuously or 120 VAC momentarily. Output protected for continuous connection to 24 VDC.

SIMULATOR OUTPUT: 75VDC max. external excitation voltage sinks current to 24.000mA as selected by keypad

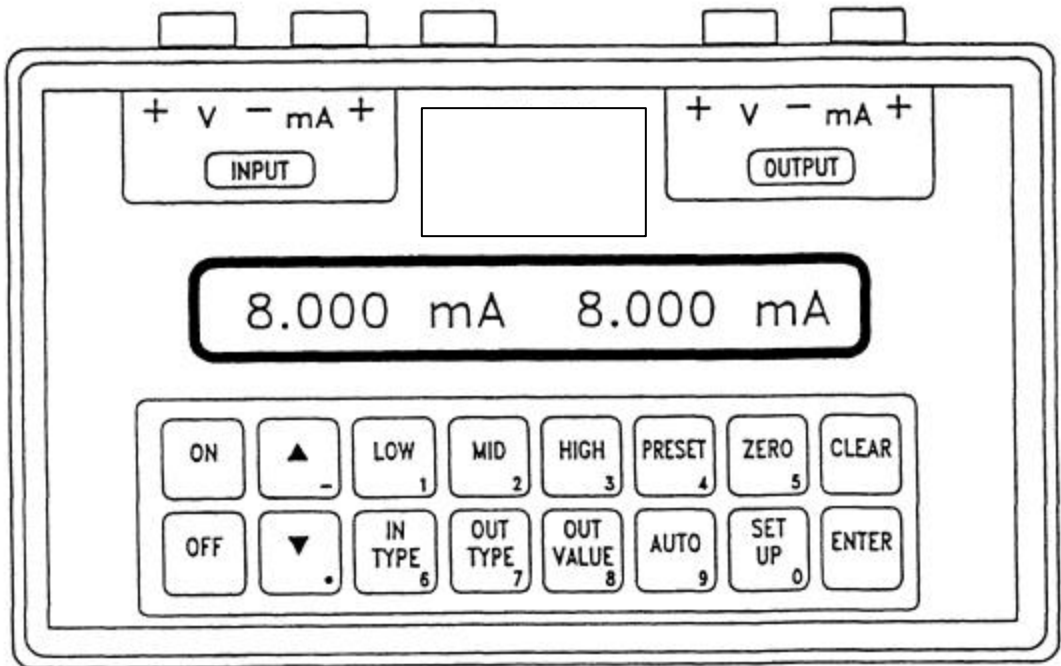
AUTO POWER OFF: Programmable turn off 60 to 6000 seconds after last keystroke. Can be disabled.

AUTO STEP TIME: Programmable 1 to 6000 seconds for 2-way, 3-way and 10-way steps.

DISPLAY: 24 Character dot matrix LCD, 5mm (0.2") character height

INPUT INDICATION: Up to 5 digits depending on range.

ELECTRICAL CONNECTIONS: Standard banana jacks on 3/4" centers.  
 WEIGHT: 520 gm. (1.15 lbs) including batteries.  
 SIZE: 155mm W x 100mm H x 50mm D (6.1" x 3.9" x 2.0")  
**3. The Keypad**



- ON                      Used to turn POWER on.
- OFF                     Used to turn POWER off.
- SET UP                Used to display menu selections for programming special functions such as square root conversion, display in engineering units etc.
- ▲ or ▼                Used to ramp the output to increase or decrease the output value. Also used to ramp through the menu selections that are made available by selecting 'IN TYPE', 'OUT TYPE', 'SET UP' or 'AUTO'.
- LOW                    Instantly recalls the output value that has been assigned to this key. Normally used for the zero input value to the instrument under test.
- MID                    Instantly recalls the output value that has been assigned to this key. Normally used for the mid-scale input value to the instrument under test.
- HIGH                   Instantly recalls the output value that has been assigned to this key. Normally used for the full-scale input value to the instrument under test.
- PRESET                Used to recall the output values that have been assigned to Presets 1 to 10.
- IN TYPE                Selects the 'input type' menu. Menu selections are scrolled using the ramp keys.

|              |   |
|--------------|---|
| OUT TYPE     | Selects the 'output type' menu. Menu selections are scrolled using the ramp keys.                                 |
| OUT VALUE    | Displays the present output value and allows a new output value to be entered from the numeric keypad.            |
| AUTO         | Selects the automatic functions menu. The ramp keys are used to scroll through the available automatic functions. |
| ZERO         | Sets the selected input or output circuit to read or generate a zero value signal.                                |
| CLEAR        | Used to erase digits during numeric entry and to abort selections.  |
| ENTER        | Used to terminate entry of numeric data or to choose a selection from a menu.                                     |
| NUMERIC KEYS | Used for entry of numeric data such as an output value.   |

## 4. Normal Operation

### 4.1 Power ON

Press the ON key to turn the calibrator on. The display will show:

#### **Dwyer Model CAL 30**

and, after a short delay, will show the input and output default ranges. Pressing the OFF key will turn power off.

### 4.2 Measurement

If the default input type shown in the display is not the required type, press the key IN TYPE. The display will show the measurement range of the selected input. To change the input type, use the ramp key(s) to scroll through the available ranges:

**Input 0 to 12V**  
**Input -10 to 120mV**  
**Input 0 to 24mA**  
**Battery Voltage**

To select voltage or current measurements, simply press the ENTER key when the correct range is displayed. Connect the signal to the input terminals as identified by the faceplate graphics. The present input value will be shown in the left side of the display window and the present output value will be shown in the right side of the display window.

Selection of **Battery Voltage** from the IN TYPE menu will show the battery voltage in the left side of the display window. Press IN TYPE to exit to menu.

### 4.3 Zeroing the input

For greatest accuracy the measurement circuits should be zeroed, if necessary, after the calibrator has been switched on and the temperature has been allowed to stabilize. If the displays do not indicate zero when a zero signal is being applied i.e.

for mA measurement, terminals should be open circuit.

for Volt or millivolt measurements, terminals should be short circuited.

Press the ZERO key, the display will show **Zero Input**. Press ENTER to set the measurement circuit and the display to zero.

#### 4.4 Selecting an output signal

If the default output type shown in the display is not the required type, press the key OUT TYPE. The display will show the measurement range of the selected output. To change the output type, use the ramp key(s) to scroll through the available ranges:-

**Output 0 to 12V**  
**Output -10 to 1 20mV**  
**Output 0 to 24mA**

To select **0 to 12 VDC** or **-10 to 120 mVDC** ranges, simply press the ENTER key when the correct range is displayed. An output value of 0.000 V or 0.000 mV will be shown in the right side of the display window and the present input value will be shown in the left side of the display window.

To select current output, display **Output 0 to 24mA** and press ENTER. The display will indicate the type of current output that is presently selected:

**Internal PWR (4wire)**  
**External PWR (2wire)**

**Internal PWR (4wire)** simulates a 4-wire transmitter which generates a current signal using its own internal power supply. **External PWR (2wire)** simulates a 2-wire transmitter which is 'loop powered' by an external power supply (up to 75VDC maximum). Use the ramp keys to display the required output type and press ENTER. An output value of 0.000 mA will be shown in the right side of the display window and the present input value will be shown in the left side of the display window.

#### 4.5 Changing the output value

To change the value, press the OUT VALUE key. The display will show:

**Output= XXXX\_**

Use the numeric keys 0 to 9 and the (-) key to enter the new output value and press ENTER. If the value entered is outside the range for the selected output, the display will indicate OVER or UNDER as appropriate when the ENTER key is pressed. Press CLEAR to exit OUT VALUE mode.

#### 4.6 Zeroing the output

For greatest accuracy the output circuit(s) should be zeroed, if necessary, after the calibrator has been switched on and the temperature has been allowed to stabilize. First zero the measurement circuit(s) as described in section 4.3, then select the measurement range to be the same as the required output range. Connect the output signal to the input terminals and enter a zero output value. Press the ZERO key, the display will show Zero Input. Press a ramp key to select Zero Output. Press ENTER to set the output value to zero. The microprocessor will adjust the output until the input measures zero.

#### 4.7 LOW, MID, HIGH Preset Outputs

The LOW, MID and HIGH keys are used to recall calibration values for simulating ZERO, MIDSCALE and FULL SCALE signals for the instrument under test. Each output type has a factory programmed 'default' set of values for the three keys. The default values for each type are:

| Type          | LOW    | MID    | HIGH      |
|---------------|--------|--------|-----------|
| DC millivolts | 0.000  | 50.000 | 100.00 mV |
| DC Voltage    | 1.0000 | 3.0000 | 5.0000 V  |
| DC Current    | 4.000  | 12.000 | 20.000 mA |

The keys can be programmed for other suitable values.

Select the required output range and press SET UP, the display will show

**Presets Setup**

Press ENTER, the display will show:

**Set Low Preset**

Use the ramp keys to scroll through other selections such as:

**Set Mid Preset**

**Set High Preset**

**Set 10 Extra Presets**

To display the value of the presently selected preset, press ENTER. The preset value can be changed by entering a new value using the numeric keys and pressing ENTER. If the LOW and HIGH presets are changed, the MID preset will automatically be set to a value which is the midpoint between these two values. However, the MID preset can be set to a different value if it is entered after the LOW and HIGH presets have been entered.

NOTE, when selecting the LOW or HIGH presets for display after setting the MID preset, use the CLEAR key to exit from the function. If the ENTER key is used to exit, the displayed value is re-entered and this will set the MID preset back to the midpoint value.

The new preset values can be saved in non-volatile memory by using the **Save Defaults** function as described in section 5.6.1. If the new values are not saved, the LOW, MID and HIGH presets will revert to the previous default values when power is turned off.

## **5. Programmable Functions**

### **5.1 SET UP functions**

The SET UP menu is entered by pressing the SET UP key. When first entered, the **Presets Setup** function appears in the display. To display other functions, use the ▲ and ▼ ramp keys to scroll through the list of functions. The menu wraps from end to beginning and vice versa.

A displayed function is executed by pressing the ENTER key. Most functions will prompt for numeric information to be entered by the user. The calibrator is expecting user input whenever an underline cursor\_ appears in the display. During numeric entry, the CLEAR key will erase the last digit entered. If no digits are shown in the display, the calibrator will return to the SET UP Command menu with no change to the selected parameter. Negative numbers may be entered by pressing . as the first key. A decimal point may be entered by using the (.) key. Numbers are terminated with the ENTER key and the unit returns to the SET UP Command mode. To revert to normal display mode from the SET UP Command mode, press the CLEAR key.

The selections that are available from the SET UP menu are:

**Presets Setup**

**Auto Functions Setup**

**Engineering Units Setup**

**Square Root Units Setup**

**Defaults Setup**

**Misc. Status Displays**

These selections can be scrolled through the display using the ramp key(s). To select a function, press ENTER when the function is displayed.

## 5.2 Presets Setup

This function is used to assign output values to the MID, LOW and HIGH keys as described in section 4.7 as well as assigning 10 extra preset values which can be recalled using the numbers 1 to 10.

### 5.2.1 Set 10 Extra Presets

In addition to the LOW, MID and HIGH presets, 10 extra preset values can be entered into memory and recalled using the identification numbers 1 to 10. To enter or examine the 10 extra presets, press the SET UP and ENTER keys. Select Set 10 Extra Presets using the ramp key(s) and press ENTER. The display will show:

**Preset# 1**

To examine or change a preset value other than #1, enter the number of the required preset using the numeric keys. Press ENTER when the correct preset number is displayed, the display will show:

**Pres X = nnnn u**

where X = preset number 1 to 10  
n = output numeric value  
u = output units

If the output value (nnnn) is correct, press CLEAR. A new preset can then be examined by entering the number 1 to 10 and pressing ENTER.

To enter a new output value, use the numeric keys and press ENTER. The display will show:

**Preset # X Enable**

press ENTER to enable it if this preset is to be used for the 10-Way Auto Step or press a ramp key to display **Preset # X Disable** and press ENTER. The display will show the next preset (X+1) and the procedure can then be repeated for other preset outputs.

To exit from this function press the CLEAR key repeatedly until the required display appears.

The new preset values can be saved in non-volatile memory by using the **Save Defaults** function as described in section 5.6.1. If the new values are not saved, the 10 presets will revert to the previous default values when power is turned off.

### 5.2.2 Selecting the 10 Preset outputs

With the normal display of input and output values being shown, press the PRESET key. The display will show:

**Preset # X**

Enter a number from 1 to 10 corresponding to the required preset output and press ENTER. The value assigned to this preset number will be driven at the output terminals and the display will step to the next preset number. To output the next consecutive preset output, simply press ENTER. To output a non-consecutive preset output, press the equivalent numeric key(s) and then press ENTER. To exit this mode, press CLEAR.

## 5.3 AUTO functions

The AUTO functions, when started, will cause automatic changes to occur in the output signal. The changes will depend upon parameters that are programmed into memory using the SET UP function. AUTO function parameters can be saved in non-volatile memory by using the Save Defaults function as described in section

5.6.1. If the new values are not saved, they will revert to the previous default values when power is turned off. The AUTO functions are:

- a) Auto Ramp. This function increases or decreases the output signal in programmable increments with a programmable time between increments. The output will ramp between the values that have been programmed as the LOW and HIGH presets continuously until Auto Ramp is disabled.
- b) Auto Low/High. This function switches the output between the two values that are programmed as the LOW and HIGH presets. The time between switches is programmable. The Auto Low/High function gives hands free operation when making calibration adjustments.
- c) Auto 3-Way Step. This function switches the output between the three values that are programmed as the LOW, MID and HIGH presets. The time between switches is programmable.
- d) Auto 10-Way Step. This function switches the output between the 10 values that are programmed as the 10 Extra Presets. The time between switches is programmable. Only the values that have been enabled (section 5.2.1) are used.
- e) Transduce. This function allows the calibrator to operate as a signal converter. A range of measurement and a range of output signals are programmed. The output will vary as a linear function of the input over the specified ranges. This function can be used to solve isolation problems since the input and output are isolated from each other.

NOTE: Use of the AUTO functions will override the Auto Shutoff feature.

### 5.3.1 Auto Ramp

To use the Auto Ramp function, the parameters that define the ramp must be entered using the SET UP and Auto Functions Setup menus. With the normal display of input and output values showing, press the SET UP key. Select Auto Functions Setup using the ramp key(s) and press ENTER. A second menu with the following choices (and others), becomes available:

**Set Ramp Size**  
**Set Auto Ramp Time**  
**Set Auto Dwell Time**

These selections can be scrolled through the display using the ramp key(s). To select a function, press ENTER when the function is displayed.

#### 5.3.1.1 Set Ramp Size

The size of the incremental step change in the output (e.g. 0.00 1 V or 1 .000V), which is controlled by the automatic ramp output (or the ramp keys), can be programmed. Select Set Ramp Size and press ENTER, the present ramp size will be displayed:

**R Size= nnnn u**

Where            n = output numeric value  
                    u = output units

To change this value, enter the new value using the numeric keys and press ENTER. To exit without changing the value, press CLEAR.

#### 5.3.1.2 Set Auto Ramp Time

This function is used to program the time per step change in the output and can be set to be 1 to 6000 seconds. Select Set Auto Ramp Time and press ENTER, the present ramp time will be displayed:

**R Time= nnnn s**

Where            n = 1 to 6000  
                      s = seconds

To change this value, enter the new value using the numeric keys and press ENTER. To exit without changing the time, press CLEAR.

### 5.3.1.3 Set Auto Dwell Time

This function is used to program the time that the output will dwell at the minimum and maximum ramp values (i.e. the LOW and HIGH preset values) and can be set to be 1 to 6000 seconds. Select Set Auto Dwell Time and press ENTER, the present ramp time will be displayed:

**D Time= nnnn s**

Where            n = 1 to 6000  
                      s = seconds

To change this value, enter the new value using the numeric keys and press ENTER. To exit without changing the time, press CLEAR.

### 5.3.1.4 Start Auto Ramp

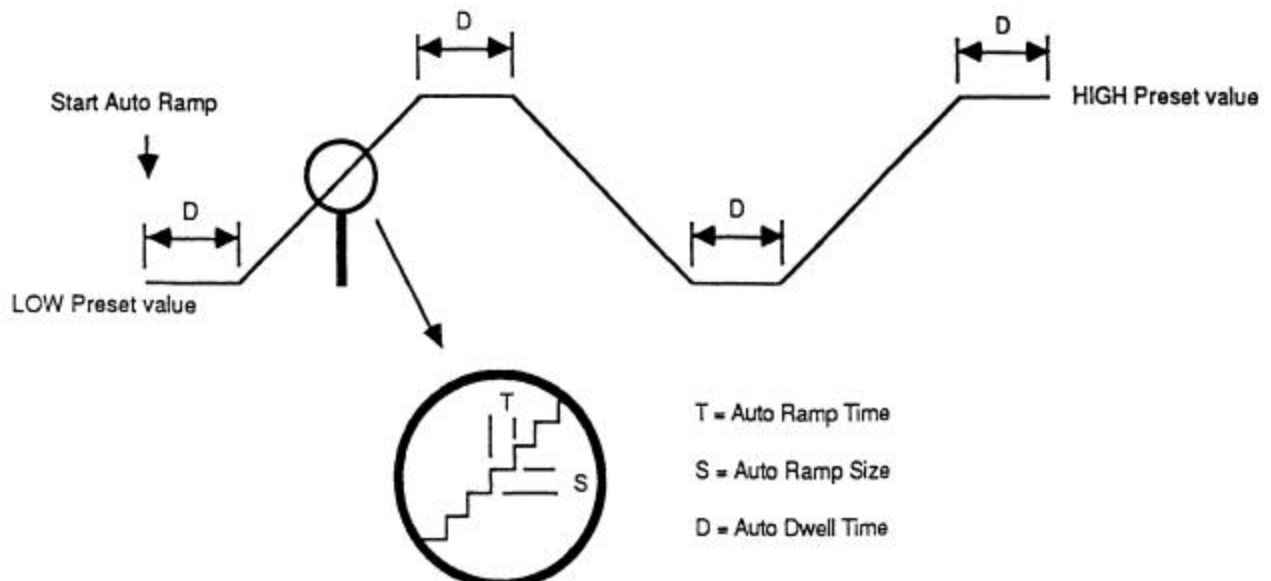
To start the Auto Ramp output, press CLEAR repeatedly until the normal input / output display appears. Press the AUTO key, the following display will appear:

**Start Auto Ramp**

Press ENTER, the display will show:

**Auto Ramp On**

The output will start ramping from the value stored as the LOW preset to the value stored as the HIGH preset, using the SET UP parameters, as illustrated below.



To see the output value, press ENTER to return to the normal input / output display.

To stop the Auto Ramp output, press the AUTO key, the following display will appear:

**Stop Auto Ramp**

Press ENTER, the display will show:

**Auto Function Off**

The output will stop ramping and remain at the value being generated when the Auto Ramp was stopped. Press ENTER to return to the normal input / output display.

### 5.3.2 Auto Low/High

To use the Auto Low/High function, the HIGH and LOW presets must be entered as described in section 4.7. The time required for switching between the two preset values must be entered using the SET UP / Auto Functions Setup menus. With the normal display of input and output values showing, press the SET UP key. Select Auto Functions Setup using the ramp key(s) and press ENTER. From the Auto Functions Setup menu, select Set Auto Step Time using the ramp key(s) and press ENTER.

#### 5.3.2.1 Set Auto Step Time

This function is used to program the time that the output will stay at the LOW and HIGH preset values and can be set to be 1 to 6000 seconds. Select Set Auto Step Time and press ENTER, the present step time will be displayed:

**STime= nnnns**

Where            n = 1 to 6000  
                    s = seconds

To change this value, enter the new value using the numeric keys and press ENTER. To exit without changing the time, press CLEAR.

#### 5.3.2.2 Start Auto Low/High

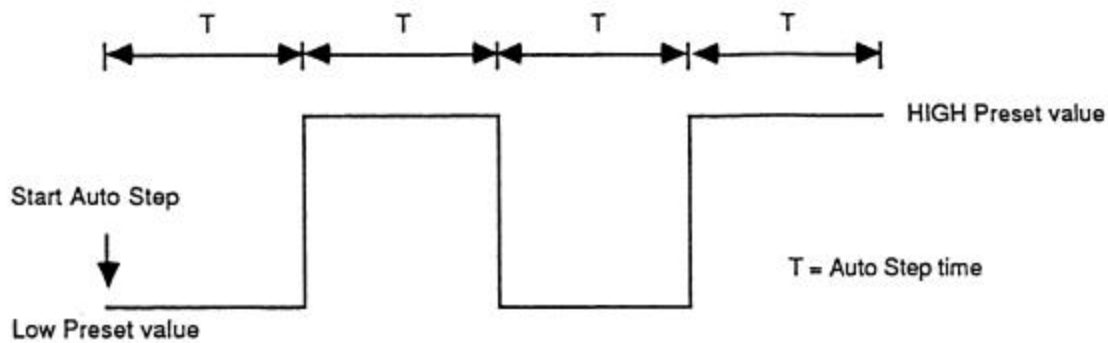
To start the Auto Low/High output, press CLEAR repeatedly until the normal input / output display appears. Press the AUTO key and scroll through the available choices using the ramp key(s) until the following appears:

**Start Auto Low/High**

Press ENTER, the display will show:

**Auto Low/High On**

The calibrator will generate the output value stored as the LOW preset and then switch to the value stored as the HIGH preset after the Auto Step Time, as illustrated below.



To see the output value, press ENTER to return to the normal input / output display.

To stop the Auto Step output, press the AUTO key, the following display will appear:

**Stop Auto Low/High**

Press ENTER, the display will show:

**Auto Function Off**

The output will stop switching and remain at the value being generated when the Auto Low/High function was stopped. Press ENTER to return to the normal input / output display.

NOTE: The programmed values can be stored in non-volatile memory for recall when power is turned on. See section 5.6.1.

### 5.3.3 Auto 3-Way Step

To use the Auto 3-Way Step function, the HIGH, MID and LOW presets must be entered as described in section 4.7. The time required for switching between the three preset values must be entered using the SET UP / Auto Functions Setup menus. With the normal display of input and output values showing, press the SET UP key. Select Auto Functions Setup using the ramp key(s) and press ENTER. From the Auto Functions Setup menu, select Set Auto Step Time using the ramp key(s) and press ENTER.

#### 5.3.3.1 Set Auto Step Time

This function is used to program the time that the output will stay at the LOW, MID and HIGH preset values and can be set to be 1 to 6000 seconds. Select Set Auto Step Time and press ENTER the present step time will be displayed:

**S Time= nnnn s**

Where            n = 1 to 6000  
                      s = seconds

To change this value, enter the new value using the numeric keys and press ENTER. To exit without changing the time, press CLEAR.

#### 5.3.3.2 Start Auto 3-Way Step

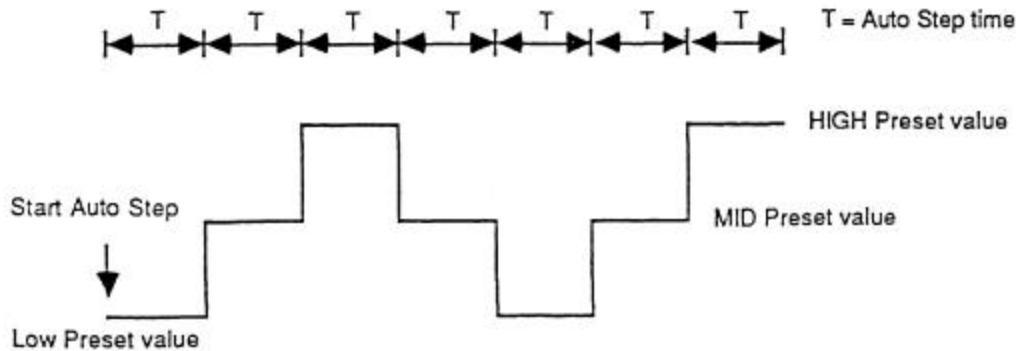
To start the Auto 3-Way Step output, press CLEAR repeatedly until the normal input / output display appears. Press the AUTO key and scroll through the available choices using the ramp key(s) until the following appears:

**Start Auto 3-Way Step**

Press ENTER, the display will show:

### **Auto 3-Way Step On**

The calibrator will generate the output value stored as the LOW preset, switch to the value stored as the MID preset after the Auto Step Time period, and then switch to the value stored as the HIGH preset after another Auto Step Time period as illustrated below.



To see the output value, press ENTER to return to the normal input / output display.

To stop the Auto 3-Way Step output, press the AUTO key, the following display will appear:

### **Stop Auto 3-Way Step**

Press ENTER, the display will show:

### **Auto Function Off**

The output will stop switching and remain at the value being generated when the Auto 3-Way Step function was stopped. Press ENTER to return to the normal input / output display.

NOTE: The programmed values can be stored in non-volatile memory for recall when power is turned on. See section 5.6.1.

## **5.3.4 Auto 10-Way Step**

To use the Auto 10-Way Step function, the required number of the 10 Extra Presets must be entered as described in section 5.2. The time required for switching between the ten preset values must be entered using the SET UP / Auto Functions Setup menus. With the normal display of input and output values showing, press the SET UP key. Select Auto Functions Setup using the ramp key(s) and press ENTER. From the Auto Functions Setup menu, select Set Auto Step Time using the ramp key(s) and press ENTER.

### **5.3.4.1 Set Auto Step Time**

This function is used to program the time that the output will stay at each of the enabled preset values and can be set to be 1 to 6000 seconds. Select Set Auto Step Time and press ENTER. The present step time will be displayed:

**S Time = nnnn s**

Where            n = 1 to 6000  
                    s = seconds

To change this value, enter the new value using the numeric keys and press ENTER. To exit without changing the time, press CLEAR.

### 5.3.4.2 Start Auto 10-Way Step

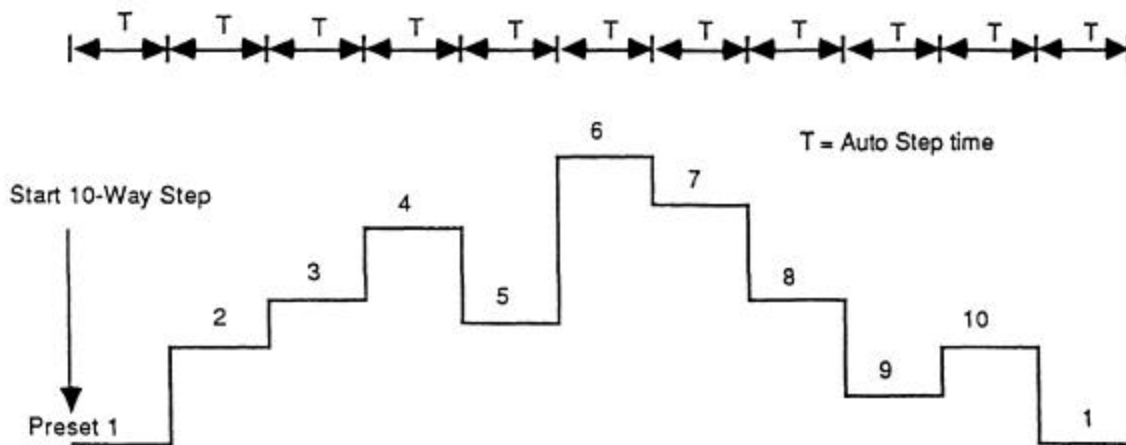
To start the Auto 10-Way Step output, press CLEAR repeatedly until the normal input / output display appears. Press the AUTO key and scroll through the available choices using the ramp key(s) until the following appears:

#### **Start Auto 10-Way Step**

Press ENTER, the display will show:

#### **Auto 10-Way Step On**

The calibrator will generate the output values stored as the 10 presets that are enabled, in the sequence 1 to 10, with the Auto Step Time between each preset value as illustrated below. In this example, all 10 preset values have been enabled.



To see the output value, press ENTER to return to the normal input/output display.

To stop the Auto 10-Way Step output, press the AUTO key, the following display will appear:

#### **Stop Auto 10-Way Step**

Press ENTER, the display will show:

#### **Auto Function Off**

The output will stop switching and remain at the value being generated when the Auto 10-Way Step function was stopped. Press ENTER to return to the normal input/output display.

NOTE: The programmed values can be stored in non-volatile memory for recall when power is turned on. See section 5.6.1.

### 5.3.5 Transduce

The Transduce function allows the calibrator to be configured as a signal converter. Selecting the appropriate input type and entering the zero and full-scale values using the Auto Functions Setup menu specify the range of measurement. The measurement range linearly generates an output signal, which is specified using the LOW and HIGH presets as the zero, and full-scale values for any of the available output ranges.

#### 5.3.5.1 Set Transduce Input Range

The input zero and full-scale values must be entered using the SET UP / Auto Functions Setup menus. With the normal display of input and output values showing, press the SET UP key.

Select Auto Functions Setup using the ramp key(s) and press ENTER. From the Auto Functions Setup menu, select Set XDucer Input Low using the ramp key(s) and press ENTER. The following will appear:

**I Low = nnnn u**

Where            n = output numeric value  
                    u = output units

This is the 'zero' input value. To change this value, enter the new value using the numeric keys and press ENTER. To exit without changing the value, press CLEAR.

Similarly, select Set XDucer Input High from the Auto Functions menu and enter the 'full-scale' input value.

### 5.3.5.2 Set Transduce Output Range

The output zero and full-scale values are entered as the LOW and HIGH preset output values as described in section 4.7.

### 5.3.5.3 Start Transduce

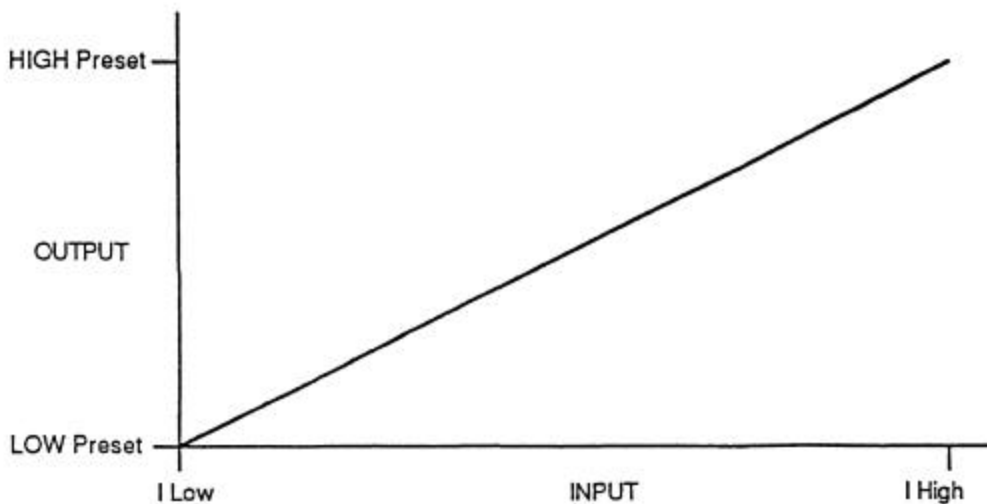
To start the Transduce(r) function, press CLEAR repeatedly until the normal input / output display appears. Press the AUTO key and scroll through the available choices using the ramp key(s) until the following appears:

**Start Transducer**

Press ENTER, the display will show:

**Transducer On**

The calibrator will generate the output value according to the measured input value as illustrated below.



To see the output value, press ENTER to return to the normal input! output display. To stop the Transduce function, press the AUTO key, the following display will appear:

**Stop Transducer**

Press ENTER, the display will show:

**Auto Function Off**

The output will remain at the value being generated when the Transduce function was stopped. Press ENTER to return to the normal input I output display.

NOTE: The programmed values can be stored in non-volatile memory for recall when power is turned on. See section 5.6.1.

## 5.4 Engineering Units Setup

Input signals can be displayed and output signals can be entered as process or other units of measurement that are linearly related to the calibrator's electrical units of measurement.

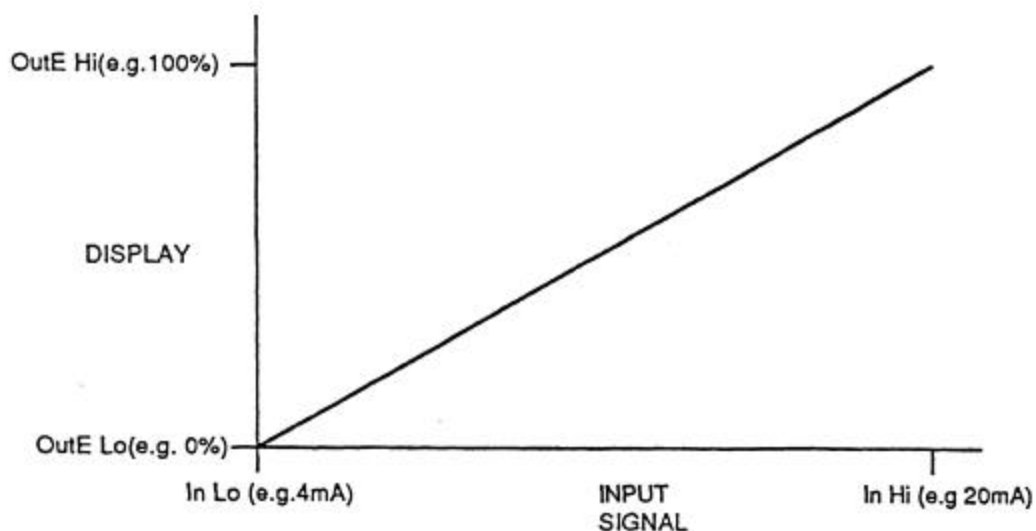
For example, an input of 4 to 20 mA DC can be displayed as 0 to 100% and an output, entered as 0 to 100%, can generate a signal of 4 to 20 mA DC.

To use the Engineering Units function, the parameters that define the conversion between electrical and engineering units must be entered using the SET UP I Engineering Units Setup menus. With the normal display of input and output values showing, press the SET UP key. Select Engineering Units Setup using the ramp key(s) and press ENTER. A second menu with the following choices become available:

- Enable Input Eng Mode**
- Enable Output Eng Mode**
- Input Eng Mode Setup**
- Output Eng Mode Setup**

### 5.4.1 Input Engineering Units

To read an input signal in other engineering units, such as process units, the relationship between the electrical measurement and the engineering units must be defined. This is done by setting a low and a high input value e.g. 4 and 20 mA DC followed by a low and a high engineering value e.g. 0 and 100%. The conversion from electrical to engineering units is linear as follows:



Path to follow:

Press Key

Menu Selection

Press Key

|        |                                 |  |
|--------|---------------------------------|--|
| SET UP | <b>Presets Setup</b>            | ▼  |
|        | <b>Auto Functions Setup</b>     | ▼  |
|        | <b>Engineering Units Setup</b>  | ENTER  |
|        | <b>Enable Input Eng. Mode</b>   | ▼  |
|        | <b>Enable Output Eng. Mode</b>  | ▼  |
|        | <b>Input Eng Mode Setup</b>     | ENTER  |
|        | <b>Set Input Low</b>            | ENTER  |
|        | <b>In Lo = nnnn u</b>           | Value, then ENTER or leave, CLEAR  |
|        | <b>Set Input Low</b>            | ▼  |
|        | <b>Set Input High</b>           | ENTER  |
|        | <b>In Hi = nnnn u</b>           | Value, then ENTER or leave, CLEAR  |
|        | <b>Set Input High</b>           | ▼  |
|        | <b>Set Input Eng Low</b>        | ENTER  |
|        | <b>InE Lo = nnnn u</b>          | Value, then ENTER or leave, CLEAR  |
|        | <b>Set Input Eng Low</b>        | ▼  |
|        | <b>Set Input Eng High</b>       | ENTER  |
|        | <b>InE HI = nnnn u</b>          | Value, then ENTER or leave, CLEAR  |
|        | <b>Set Input Eng High</b>       | ▼  |
|        | <b>Set Input Eng Unit</b>       | ENTER  |
|        | <b>Input Eng Unit = xx</b>      | ▼ or ▲ ramps through the character set. Press ENTER to select the displayed character and move the cursor. Repeat for the second character if desired. |
|        | <b>Set Input Eng Unit</b>       | CLEAR  |
|        | <b>Input Eng Mode Setup</b>     | ▼  |
|        | <b>Output Eng Mode Setup</b>    | ▼  |
|        | <b>Enable Input Eng Mode</b>    | ENTER (enables the display in engineering units).  |
|        | <b>Input Eng Mode Enabled</b>   | ENTER  |
|        | <b>Input Value Output Value</b> |  |

To disable Engineering mode and return to the normal display of the input signal:

Path to follow:

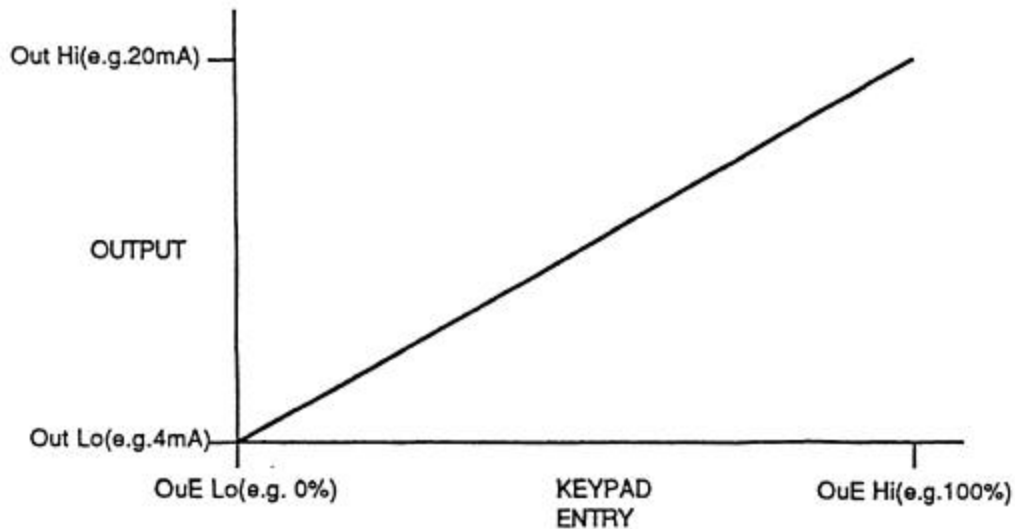
| <u>Press Key</u> | <u>Menu Selection</u>          | <u>Press Key</u> |
|------------------|--------------------------------|------------------|
| SET UP           | <b>Presets Setup</b>           | ▼                |
|                  | <b>Auto Functions Setup</b>    | ▼                |
|                  | <b>Engineering Units Setup</b> | ENTER            |
|                  | <b>Disable Input Eng Mode</b>  | ENTER            |
|                  | <b>Input Eng Mode Disabled</b> | ENTER            |

## Input Value Output Value

NOTE: The programmed values can be stored in non-volatile memory for recall when power is turned on. See section 5.6.1.

### 5.4.2 Output Engineering Units

The output signal can be requested via the numeric keys in other engineering or process units. The relationship between the electrical output signal and the engineering units must be defined. Setting a low and a high engineering value e.g. 0 and 100% followed by a low and a high output value e.g. 4 and 20 mA DC does this. The conversion from engineering to electrical units is linear as follows:



Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u>          | <u>Press Key</u>             |
|------------------|--------------------------------|------------------------------|
| SET UP           | <b>Presets Setup</b>           | ▼                            |
|                  | <b>Auto Functions Setup</b>    | ▼                            |
|                  | <b>Engineering Units Setup</b> | ENTER                        |
|                  | <b>Enable Input Eng Mode</b>   | ▼                            |
|                  | <b>Enable Output Eng Model</b> | ▼                            |
|                  | <b>Input Eng Mode Setup</b>    | ▼                            |
|                  | <b>Output Eng Mode Setup</b>   | ENTER                        |
|                  | <b>Set Output Eng Low</b>      | ENTER                        |
|                  | <b>OuE Lo = nnnn u</b>         | Value, ENTER or leave, CLEAR |
|                  | <b>Set Output Eng Low</b>      | ▼                            |
|                  | <b>Set Output Eng High</b>     | ENTER                        |
|                  | <b>OuE Hi = nnnn u</b>         | Value, ENTER or leave, CLEAR |
|                  | <b>Set Output Eng High</b>     | ▼                            |
|                  | <b>Set Output Low</b>          | ENTER                        |
|                  | <b>Out Lo = nnnn u</b>         | Value, ENTER or leave, CLEAR |

|                                 |  |
|---------------------------------|--|
| <b>Set Output Low</b>           | ▼  |
| <b>Set Output High</b>          | ENTER  |
| <b>Out Hi = nnnn u</b>          | Value, Enter or leave, CLEAR   |
| <b>Set Output High</b>          | ▼  |
| <b>Set Output Eng Unit</b>      | ENTER  |
| <b>Output Eng Unit = xx</b>     | ▼ or ▲ ramps through the character set. Press ENTER to select the displayed character and move the cursor. Repeat for the second character if desired. |
| <b>Set Output Eng Unit</b>      | CLEAR  |
| <b>Output Eng Mode Setup</b>    | ▼  |
| <b>Enable Input Eng Mode</b>    | ▼  |
| <b>Enable Output Eng Mode</b>   | ENTER (enables keypad entry and display in engineering units)  |
| <b>Output Eng Mode Enabled</b>  | ENTER  |
| <b>Input Value Output Value</b> | (normal display)   |

To disable Engineering mode and return to the normal display of the output signal:

Path to follow:

| <u>Press Key</u> | <u>Menu Display / Selection</u> | <u>Press Key</u> |
|------------------|---------------------------------|------------------|
| SET UP           | <b>Presets Setup</b>            | ▼                |
|                  | <b>Auto Functions Setup</b>     | ▼                |
|                  | <b>Engineering Units Setup</b>  | ENTER            |
|                  | <b>Enable Input Eng Mode</b>    | ▼                |
|                  | <b>Disable Output Eng Mode</b>  | ENTER            |
|                  | <b>Output Eng Mode Disabled</b> | ENTER            |
|                  | <b>Input Value Output Value</b> | (normal display) |

NOTE: The programmed values can be stored in non-volatile memory for recall when power is turned on. See section 5.6.1.

## 5.5 Square Root Units Setup

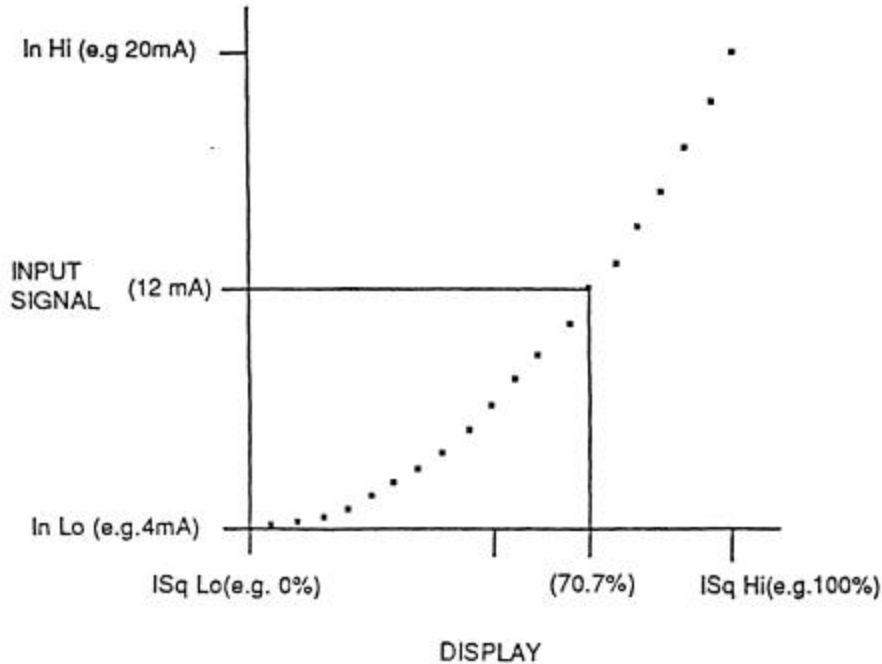
Input signals from differential pressure type flow meters, or other devices which follow a square law, can be linearized and displayed in process flow units to simplify calibration. The opposite function can be performed for the output, a process flow value entered from the keypad will be converted to the equivalent electrical signal which would be generated by a dp flow meter following a square law.

To use the Square Root Units function, the parameters that define the conversion between electrical and engineering units must be entered using the SET UP/Square Root Units Setup menus. With the normal display of input and output values showing, press the SET UP and ENTER keys. Select Square Root Units Setup using the ramp key(s) and press ENTER. A second menu with the following choices become available:-

**Enable Input Sqrt Mode**  
**Enable Output Sqrt Mode**  
**Input Sqrt Mode Setup**  
**Output Sqrt Mode Setup**

### 5.5.1 Input Square Root Units

To read an input signal which has a square law relationship to the process measurement, the relationship between the electrical measurement and the process units must be defined. This is done by setting a low and a high input value e.g. 4 and 20 mA DC followed by a low and a high process value e.g. 0 and 100%. The conversion from electrical to engineering units follows a square law as follows:



Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u>          | <u>Press Key</u>             |
|------------------|--------------------------------|------------------------------|
| SET UP           | <b>Presets Setup</b>           | ▼                            |
|                  | <b>Auto Functions Setup</b>    | ▼                            |
|                  | <b>Engineering Units Setup</b> | ▼                            |
|                  | <b>Square Root Units Setup</b> | ENTER                        |
|                  | <b>Enable Input Sqrt Mode</b>  | ▼                            |
|                  | <b>Enable Output Sqrt Mode</b> | ▼                            |
|                  | <b>Input Sqrt Mode Setup</b>   | ENTER                        |
|                  | <b>Set Input Low</b>           | ENTER                        |
|                  | <b>In Lo = nnnn u</b>          | Value, ENTER or leave, CLEAR |
|                  | <b>Set Input Low</b>           | ▼                            |
|                  | <b>Set Input High</b>          | ENTER                        |
|                  | <b>In Hi = nnnn u</b>          | Value, ENTER or leave, CLEAR |
|                  | <b>Set Input High</b>          | ▼                            |
|                  | <b>Set Input Sqrt Low</b>      | ENTER                        |

|                                 |   |
|---------------------------------|---|
| <b>ISq Lo = nnnn u</b>          | Value, ENTER or leave, CLEAR  |
| <b>Set Input Sqrt Low</b>       | ▼   |
| <b>Set Input Sqrt High</b>      | ENTER   |
| <b>ISq Hi = nnnn u</b>          | Value, ENTER or leave, CLEAR  |
| <b>Set Input Sqrt High</b>      | ▼   |
| <b>Set Input Sqrt Unit</b>      | ENTER   |
| <b>Input Sqrt Unit = xx</b>     | ▼ or ▲ ramps through the character set. Press ENTER to select the displayed character and move the cursor. Repeat for the second character if required. |
| <b>Set Input Sqrt Unit</b>      | CLEAR   |
| <b>Input Sqrt Mode Setup</b>    | ▼   |
| <b>Output Sqrt Mode Setup</b>   | ▼   |
| <b>Enable Input Sqrt Mode</b>   | ENTER (enables display in process units)  |
| <b>Input Sqrt Mode Enabled</b>  | ENTER   |
| <b>Input Value Output Value</b> | (normal display)  |

To disable Square Root mode and return to the normal display of the input signal:

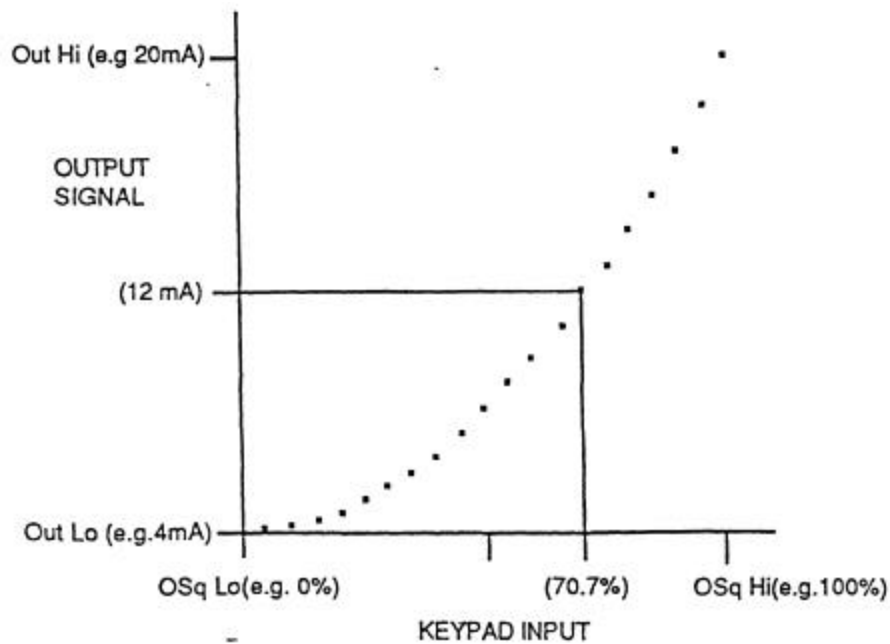
Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u>           | <u>Press Key</u> |
|------------------|---------------------------------|------------------|
| SETUP            | <b>Presets Setup</b>            | ▼                |
|                  | <b>Auto Functions Setup</b>     | ▼                |
|                  | <b>Engineering Units Setup</b>  | ▼                |
|                  | <b>Square Root Units Setup</b>  | ENTER            |
|                  | <b>Disable Input Sqrt Mode</b>  | ENTER            |
|                  | <b>Input Sqrt Mode Disabled</b> | ENTER            |
|                  | <b>Input Value Output Value</b> | (normal display) |

NOTE: The programmed values can be stored in non-volatile memory for recall when power is turned on. See section 5.6.1.

### 5.5.2 Output Square Root Units

To generate a signal which has a square law relationship to the process signal, the relationship between the process units and the electrical output must be defined. This is done by setting a low and a high process value e.g. 0 and 100% followed by a low and a high output value e.g. 4 and 20mA. The conversion from process to electrical units follows a square law as follows:



Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u>          | <u>Press Key</u>                              |
|------------------|--------------------------------|---|
| SETUP            | <b>Presets Setup</b>           | ▼   |
|                  | <b>Auto Functions Setup</b>    | ▼   |
|                  | <b>Engineering Units Setup</b> | ▼   |
|                  | <b>Square Root Units Setup</b> | ENTER   |
|                  | <b>Enable Input Sqrt Mode</b>  | ▼   |
|                  | <b>Enable Output Sqrt Mode</b> | ▼   |
|                  | <b>Input Sqrt Mode Setup</b>   | ▼   |
|                  | <b>Output Sqrt Mode Setup</b>  | ENTER   |
|                  | <b>Set Output Sqrt Low</b>     | ENTER   |
|                  | <b>OSq Lo = nnnn u</b>         | Value, ENTER or leave, CLEAR                  |
|                  | <b>Set Output Sqrt Low</b>     | ▼   |
|                  | <b>Set Output Sqrt High</b>    | ENTER   |
|                  | <b>OSq Hi = nnnn u</b>         | Value, ENTER or leave, CLEAR                  |
|                  | <b>Set Output Sqrt High</b>    | ▼   |
|                  | <b>Set Output Low</b>          | ENTER   |
|                  | <b>Out Lo = nnnn u</b>         | Value, ENTER or leave, CLEAR                  |
|                  | <b>Set Output Low</b>          | ▼   |
|                  | <b>Set Output High</b>         | ENTER   |
|                  | <b>Out Hi = nnnn u</b>         | Value, ENTER or leave, CLEAR                  |
|                  | <b>Set Output High</b>         | ▼   |
|                  | <b>Set Output Sqrt Unit</b>    | ENTER   |
|                  | <b>Output Sqrt Unit = xx</b>   | ▼ or ▲ ramps through the character set. Press |

|                                 |   |   |
|---------------------------------|---|---|
|                                 |   | ENTER to select the displayed character and move the cursor. Repeat for the second character if required. |
| <b>Set Output Sqrt Unit</b>     |   | CLEAR   |
| <b>Output Sqrt Mode Setup</b>   | ▼ |   |
| <b>Enable Input Sqrt Mode</b>   | ▼ |   |
| <b>Enable Output Sqrt Mode</b>  |   | ENTER (enables keypad entry and display in process units)   |
| <b>Output Sqrt Mode Enabled</b> |   | ENTER   |
| <b>Input Value Output Value</b> |   | (normal display)  |

To disable Square Root mode and return to the normal display of the output signal:

Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u>            | <u>Press Key</u> |
|------------------|----------------------------------|------------------|
| SETUP            | <b>Presets Setup</b>             | ▼                |
|                  | <b>Auto Functions Setup</b>      | ▼                |
|                  | <b>Engineering Units Setup</b>   | ▼                |
|                  | <b>Square Root Units Setup</b>   | ENTER            |
|                  | <b>Enable Input Sqrt Mode</b>    | ▼                |
|                  | <b>Disable Output Sqrt Mode</b>  | ENTER            |
|                  | <b>Output Sqrt Mode Disabled</b> | ENTER            |
|                  | <b>Input Value Output Value</b>  | (normal display) |

NOTE: The programmed values can be stored in non-volatile memory for recall when power is turned on. See section 5.6.1.

## 5.6 Defaults Setup

Defaults are the conditions of operation that are stored in non-volatile memory so that they will be recalled when the calibrator power is turned on. The default conditions can be set by the operator for his normal operations. The Defaults Setup menu is selected from the SET UP menu and allows the following selections:-

- Save Defaults**
- Set Auto Shutoff Time**
- Enable/Disable Auto Shutoff**
- Enable/Disable Auto Defaults**

### 5.6.1 Save Defaults

This function is used to save the values that have been programmed by the operator so that they will be automatically recalled when power is switched on. Values that are stored using this function are:

- Present input type**
- Present output type**
- LOW, MID and HIGH presets**
- 10 Extra presets**
- Auto Ramp Size, Auto Ramp Time, Auto Dwell Time**
- Auto Step Time**
- Transducer Input and Output parameters**

## Engineering Unit parameters - Input and Output Square Root parameters - Input and Output Auto Shutoff Time

To save default values before turning power off:

Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u>           | <u>Press Key</u> |
|------------------|---------------------------------|------------------|
| SETUP            | <b>Presets Setup</b>            | ▼                |
|                  | <b>Auto Functions Setup</b>     | ▼                |
|                  | <b>Engineering Units Setup</b>  | ▼                |
|                  | <b>Square Root Units Setup</b>  | ▼                |
|                  | <b>Defaults Setup</b>           | ENTER            |
|                  | <b>Save Defaults</b>            | ENTER            |
|                  | <b>Defaults Saved</b>           | ENTER            |
|                  | <b>Input Value Output Value</b> | (normal display) |

### 5.6.2 Set Auto Shutoff Time

This function is used to preserve the batteries and allows an elapsed time, in seconds, to be entered into memory. If there has been no keypad activity for this amount of time, the calibrator will switch off. The time can be set from 60 to 6000 seconds. Note that the calibrator will not shut off when an AUTO function is enabled.

Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u>          | <u>Press Key</u>             |
|------------------|--------------------------------|------------------------------|
| SET UP           | <b>Presets Setup</b>           | ▼                            |
|                  | <b>Auto Functions Setup</b>    | ▼                            |
|                  | <b>Engineering Units Setup</b> | ▼                            |
|                  | <b>Square Root Units Setup</b> | ▼                            |
|                  | <b>Defaults Setup</b>          | ENTER                        |
|                  | <b>Save Defaults</b>           | ▼                            |
|                  | <b>Set Auto Shutoff Time</b>   | ENTER                        |
|                  | <b>ASOTime nnnn s</b>          | Value, ENTER or leave, CLEAR |

If it is not required to save the auto shutoff time as a default, press CLEAR twice to return to the main display, otherwise:

|                                 |                  |
|---------------------------------|------------------|
| <b>Save Defaults</b>            | ENTER            |
| <b>Defaults Saved</b>           | ENTER            |
| <b>Input Value Output Value</b> | (normal display) |

### 5.6.3 Enable/Disable Auto Shutoff

The automatic shutoff can be enabled or disabled as required. The auto shutoff will be disabled when automatic functions such as ramp or step output have been selected. Assuming the auto shutoff is disabled, the procedure to enable it is as follows:

Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u>          | <u>Press Key</u> |
|------------------|--------------------------------|------------------|
| SET UP           | <b>Presets Setup</b>           | ▼                |
|                  | <b>Auto Functions Setup</b>    | ▼                |
|                  | <b>Engineering Units Setup</b> | ▼                |
|                  | <b>Square Root Units Setup</b> | ▼                |
|                  | <b>Defaults Setup</b>          | ENTER            |
|                  | Save Defaults                  | ▼                |
|                  | Set Auto Shutoff Time          | ▼                |
|                  | Enable Auto Shutoff            | ENTER            |
|                  | Auto Shutoff Enabled           | ENTER            |
|                  | Input Value Output Value       | (normal display) |

To save auto shutoff as a default, before switching off:

Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u>          | <u>Press Key</u> |
|------------------|--------------------------------|------------------|
| SET UP           | <b>Presets Setup</b>           | ▼                |
|                  | <b>Auto Functions Setup</b>    | ▼                |
|                  | <b>Engineering Units Setup</b> | ▼                |
|                  | <b>Square Root Units Setup</b> | ▼                |
|                  | <b>Defaults Setup</b>          | ENTER            |
|                  | Save Defaults                  | ENTER            |
|                  | Defaults Saved                 | ENTER            |
|                  | Input Value Output Value       | (normal display) |

To disable Auto Shutoff, follow a similar procedure.

#### 5.6.4 Enable/Disable Auto Defaults

If the Auto Defaults function is enabled, the values that have been entered as parameters for automatic functions or presets during normal operation will be automatically stored as defaults when power is switched off. If it is required to return to a standard set of default values e.g. LOW = 4mA, MID = 12mA and HIGH = 20 mA, this function should be disabled. The normal defaults can be saved using the Save Defaults function. To enable Auto Defaults:

Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u> | <u>Press Key</u> |
|------------------|-----------------------|------------------|
|------------------|-----------------------|------------------|

|        |                                |                  |
|--------|--------------------------------|------------------|
| SET UP | <b>Presets Setup</b>           | ▼                |
|        | <b>Auto Functions Setup</b>    | ▼                |
|        | <b>Engineering Units Setup</b> | ▼                |
|        | <b>Square Root Units Setup</b> | ▼                |
|        | <b>Defaults Setup</b>          | ENTER            |
|        | Save Defaults                  | ▼                |
|        | Set Auto Shutoff Time          | ▼                |
|        | En/Disable Auto Shutoff        | ▼                |
|        | Enable Auto Defaults           | ENTER            |
|        | Auto Defaults Enabled          | ENTER            |
|        | Input Value Output Value       | (normal display) |

To Disable Auto Defaults, Follow a similar procedure.

### 5.7 Miscellaneous Status Displays

This function displays the status of the following:

Calibration date - date that the BETA 560 was last calibrated.

Firmware version - which PROM version is installed.

Path to follow:

| <u>Press Key</u> | <u>Menu Selection</u>    | <u>Press Key</u> |
|------------------|--------------------------|------------------|
| SET UP           | Presets Setup            | ▲                |
|                  | Misc Status Displays     | ENTER            |
|                  | Calibrated: date         | ▼                |
|                  | Firmware Revision: vX    | CLEAR            |
|                  | Misc Status Displays     | CLEAR            |
|                  | Input Value Output Value | (normal display) |