Operating Manual

Programmable Frequency Transducer

Theta Hz



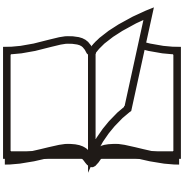
2-60-006-00-00563

Rev. A - 25/01/15

Read & understand this manual before using the Instrument



The proper and safe operation of the device assumes that the Operating Instructions are read and the safety warnings given in the various sections Mounting,Electrical Connections, Commissioning are observed.



All operations concerning installation, electrical connection & commissioning must be carried out by qualified, skilled personal & national regulations for the preventions of accidents must be observed.

If the equipment is used in used in a manner not specified by the manufacture, the protection provided by the equipment may be impaired.

Frequency Transducer

Programmable FrequencyTransducer Installation & Operating Instructions

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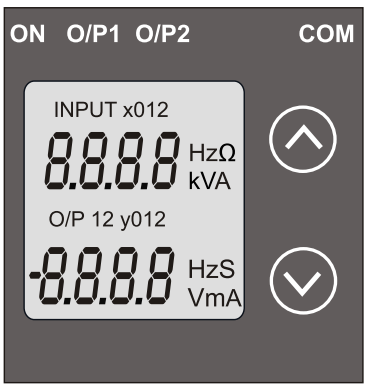
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1. Introduction

The Frequency Transducer is a DIN Rail / Wall mounted 43.5 X 65.5mm Transducer.

The Frequency Transducer is used to measure and convert Frequency input into proportional DC current or voltage output signal.

Input Frequency and Output Voltage/Current are displayed on LCD and indicated by LED's.



Frequency Transducer can be configured and programmed at site for the following : Input parameters (i.e start, end and elbow value of Input) and Output Parameters(i.e as Voltage or as Current and start, end and elbow value of outputs).

The front panel has two push buttons through which the user may scroll through the output screens and configure the product.

1.1 LED Indication

LED	LED OPERATING CONDITION	LED OPERATING STATUS
ON	Aux. Supply healthy condition	Green LED continuous ON
O/P 1	Output1 Voltage	Green LED continuous ON
	Output1 Current	Red LED continuous ON
O/P 2	Output2 Voltage	Green LED continuous ON
	Output2 Current	Red LED continuous ON

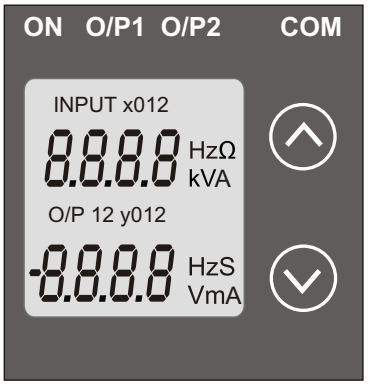
Table 1: Measured parameters

Measured parameters	Unit of Measurement
Frequency	Hz

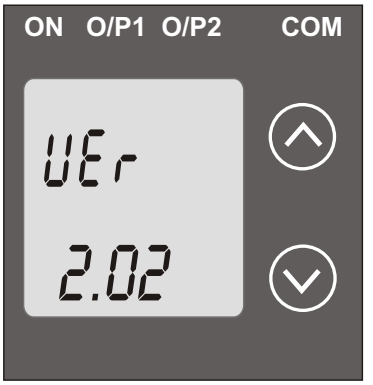
2. Input and Output screens

In normal operation the user is presented with display test screen followed by version screen to one of the output screen. These screens may be scrolled through one of the Output screen by pressing the“ ∧ Up key” or by pressing “ ∨ Down key”.

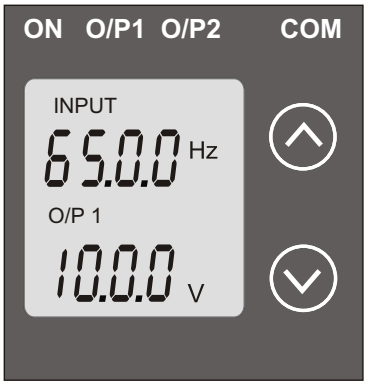
Screen 1 : Display Test



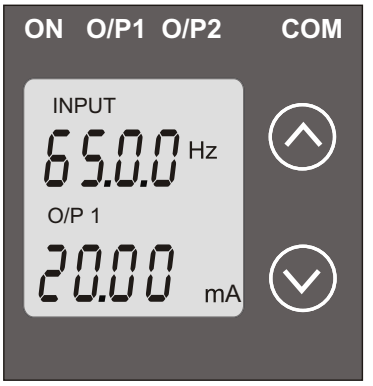
Screen 2 : Version Screen



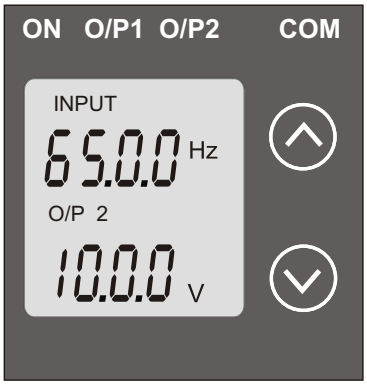
Screen 3 : Frequency Input and Output 1 as Voltage



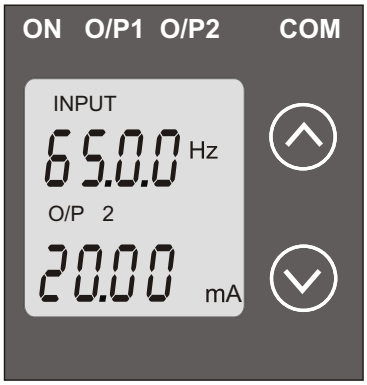
Screen 4 : Frequency Input and Output 1 as Current



Screen 5 : Frequency Input and Output 2 as Voltage



Screen 6 : Frequency Input and Output 2 as Current



3. Programming

Programming of transducer can be done in three ways

3.1. Programming Via Front LCD & two keys.

3.2. Programming Via Programming port available at front of Frequency transducer using optional PRKAB601 Adapter.

3.3. Programming Via optional RS485(MODBUS) communication port.

3.1 Programming via Front LCD & Two keys

The following sections comprise step by step procedures for configuring the Frequency Transducer for individual user requirements.

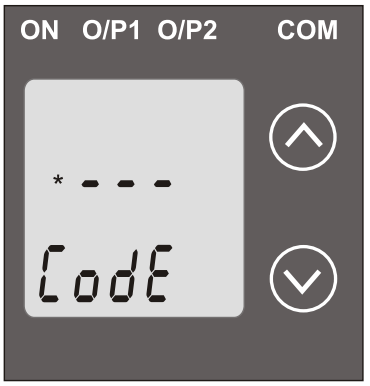
To access the set-up screens press and hold the " ∨ Down" and " ∧ Up" keys simultaneously for 5 seconds. This will take the User into the Password Protection Entry Stage .

3.1.1. Password Protection

3.1.1.1 Password Verification

Password protection can be enabled to prevent unauthorised access to set-up screens, by default password

protection is not enabled. Password protection is enabled by selecting a four digit number other than 0000, setting a password of 0000 disables the password protection.



Enter Password, prompt for first digit.(*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the first digit from 0 through to 9, the value will wrap from 9 round to 0.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the first digit in this case to "1".
In the special case where the Password is "0000" pressing the " v Up" key when prompted for the first digit will advance to the " Password Set / Confirmed" screen.

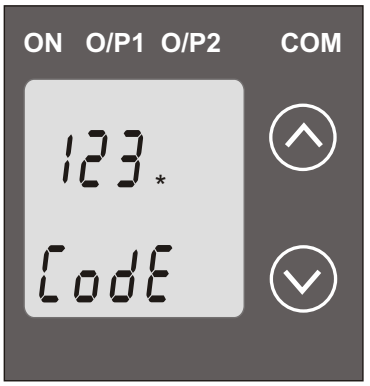


Enter Password, first digit entered, prompt for second digit. (*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the second digit from 0 through to 9, the value will wrap from 9 round to 0.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the second digit in this case to "2".



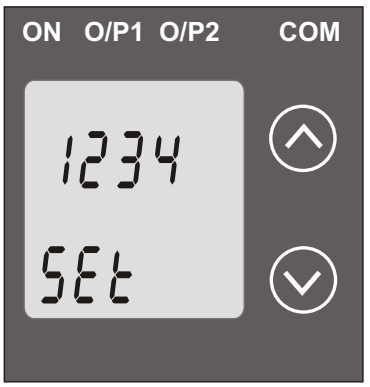
Enter Password, second digit entered, prompt for third digit. (*Denotes that digit will be flashing).

Pressing the " ∨ Down" key will scroll the value of the third digit from 0 through to 9, the value will wrap from 9 round to 0. Pressing the " ∧ Up" key will advance the operation to the next digit and set the third digit in this case to "3".



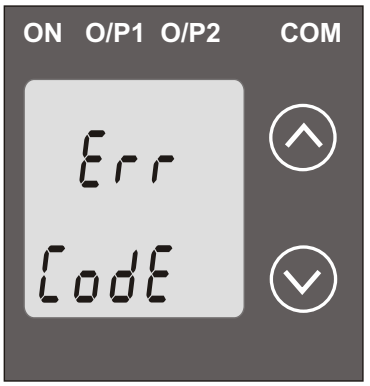
Enter Password, third digit entered, prompt for fourth digit. (*Denotes that digit will be flashing). Pressing the " ∨ Down" key will scroll the value of the fourth digit from 0 through to 9, the value will wrap from 9 round to 0. Pressing the " ∧ Up" key will advance the operation to the "Password Set/Confirmed" & set the fourth digit. In this case to "4".

Password Set / Confirmed.



Pressing " ∨ Down" key will enter to the "New / change Password" entry stage (section 3.1.1.2). Pressing the " ∧ Up" key will advance to the Communication parameter selection (section 3.1.2).

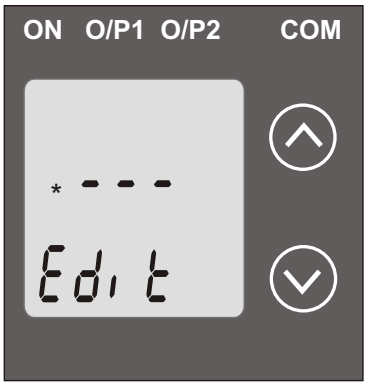
Password Incorrect.



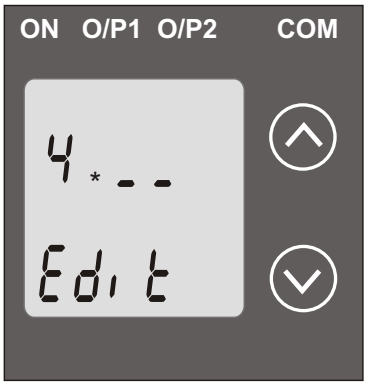
This screen is displayed ,when the unit has not accepted the Password entered. Pressing the " ∨ Down" key will return to the "Enter Password" entry stage. Pressing the " ∧ Up" key will exit the setup menu.

3.1.1.2 Editing Existing Password

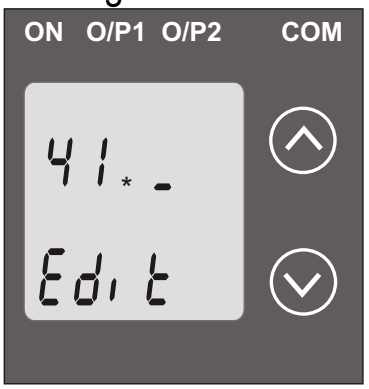
New / Change Password



(*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the first digit from 0 through to 9, the value will wrap from 9 round to 0.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the first digit, in this case to "4".

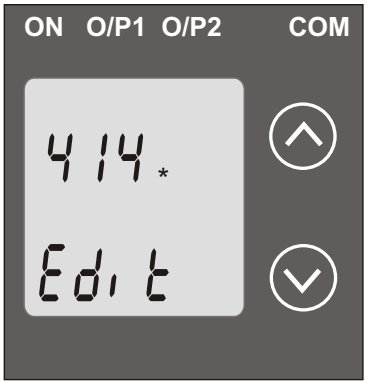


Enter New Password, first digit entered, prompting for second digit.
(*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the seconddigit from 0 through to 9, the value will wrap from 9 round to 0.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the second digit, in this case to "1".



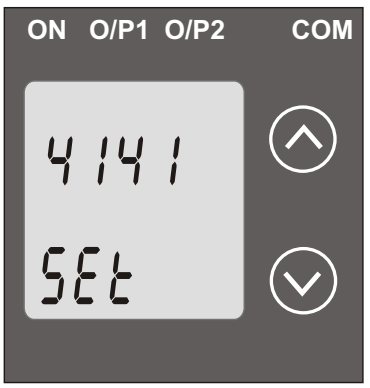
Enter New Password, second digit entered, prompting for third digit.
(*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the third digit from 0 through to 9, the value will

Pressing the " ∧ Up" key will advance the operation to the next digit and set the third digit, in this case to "4"



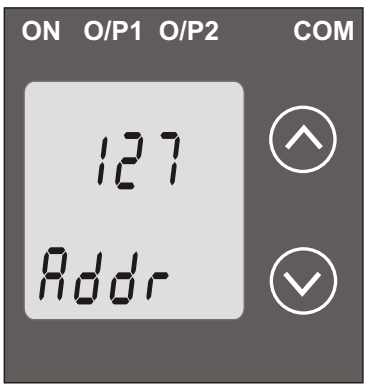
Enter New Password, third digit entered, prompting for fourth digit. (* denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the fourth digit from 0 through to 9, the value will wrap from 9 round to 0.Pressing the " ∧ Up" key will advance the operation to the "New Password Confirmed" and set the fourth digit, in this case to "1".

New/changed Password confirmed.



Pressing the " ∨ Down" key will re- enter to the "New Password" entry stage. Pressing the " ∧ Up" key will confirm New Password and advance to the Communication parameter setting (Section 3.1.2).

3.1.2. Communication Parameter Setting

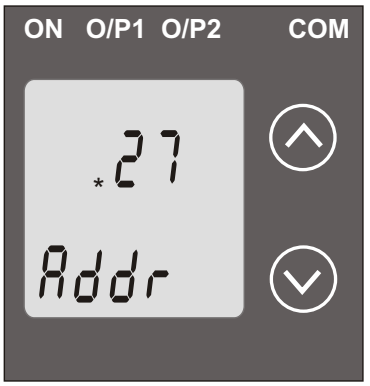


3.1.2.1 Address Setting

This screen applies to the RS 485 output only.
This screen allows the user to set RS485 parameter for instruments The range of allowable address is 1 to 247 .
Pressing " ∨ Down" key will advance to the "New/Change

Address value edit" mode.
Pressing the "∧ Up" key will confirm the present value as Address and advance to the Baud rate selection (section 3.1.2.2).

New / changed Address value

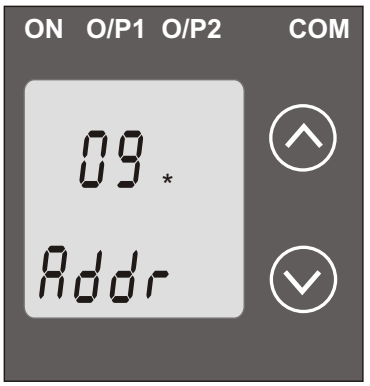


(*Denotes that digit will be flashing).
First digit is always blank.
Pressing the " ∨ Down" key will scroll the value of the second digit from 0 through to 2, the value will wrap from 2 round to 0.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the second digit, in this case to "0".



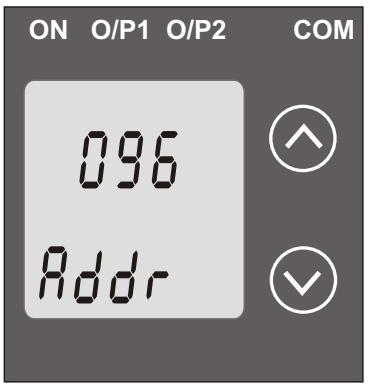
Enter New / Change Address value, second digit entered, prompting for third digit.
(*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the third digit from 0 through to 9, the value will wrap from 9 round to 0.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the third digit, in this case to "9".

Enter New / Change Address value, third digit entered, prompting for fourth digit.
(*denotes that digit will be flashing). Pressing the " ∨ Down" key will scroll the value of the fourth digit from 0 through to 9,



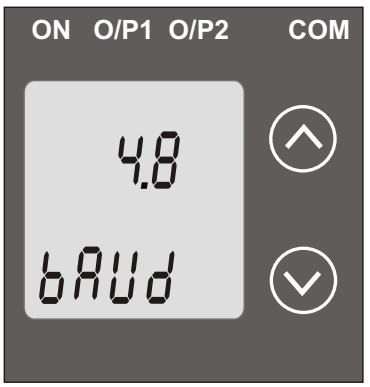
the value will wrap from 9 round to 0.
Pressing the " ∧ Up" key will advance the operation to the "New / Changed Address value confirmed" and set the fourth digit, in this case to "6".

New / changed Address value confirmed.



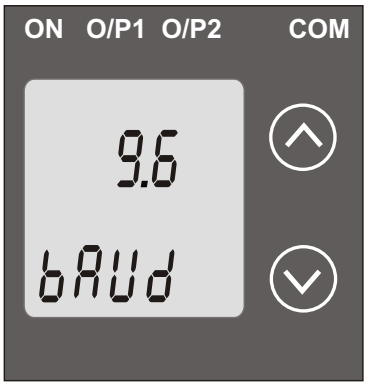
Pressing the " ∨ Down" key will re-enter to the "New / Change Address value".
Pressing the " ∧ Up" key will confirm New Address value and advance to the Baud rate selection (section 3.1.2.2).

3.1.2.2 RS 485 Baud Rate



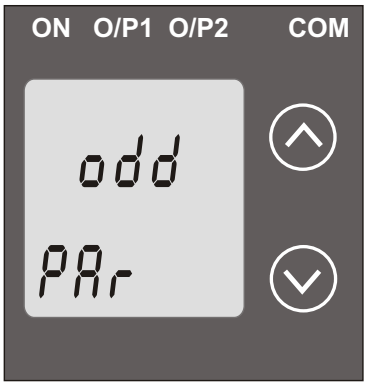
This screen allows the user to set Baud Rate of RS 485 port. The values displayed on screen are in kbaud .
Pressing the " ∨ Down" key will enter the "Baud Rate edit" mode and scroll the value through 2.4, 4.8, 9.6 , 19.2 and back to 2.4 (values are flashing). Pressing " ∧ Up" key will confirm the present value as Baud rate and advance to the Parity Selection (section 3.1.2.3).

RS 485 Baud Rate confirmation

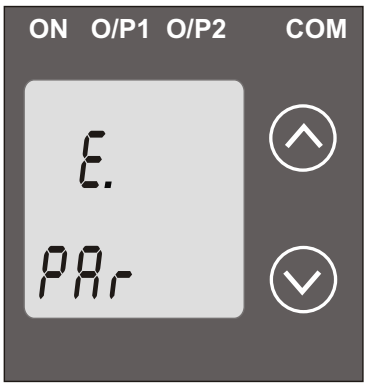


Pressing " ∨ Down" key will be re-enter into the. "Baud Rate Edit" mode
Pressing the " ∧ Up" key will confirm the Baud rate value and advance to the Parity Selection(section 3.1.2.3).

3.1.2.3 RS 485 Parity Selection



This screen allows the user to set Parity & number of stop bits of RS 485 port.
Pressing the " ∨ Down" key will enter the "Parity & stop bit edit" mode and scroll the value through
odd : odd parity with one stop bit
no. 1S : no parity with one stop bit
no. 2S : no parity with two stop bit
E : even parity with one stop bit
Pressing " ∧Up" key accepts the present condition and advance to the Output parameter selection (section 3.1.3).

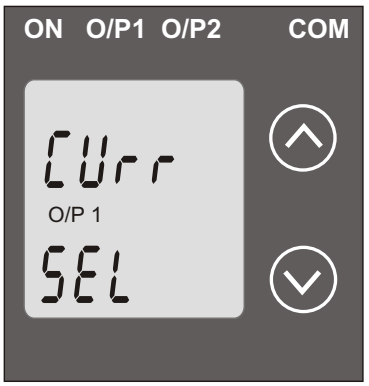


RS 485 Parity confirmation

Pressing " ∨ Down" key will be re-enter into Parity Edit mode.
Pressing the " ∧ Up" key will set the present condition as parity and advance to the Output type selection (section 3.1.3) .

3.1.3. Output Type Selection

3.1.3.1 Output 1 Type selection



This screen allows the user to set the output 1 type as Voltage or Current.
Pressing the " ∨ Down" key will enter the "output 1 type edit" mode and scroll between voltage and current.
Pressing " ∧ Up" key will confirm the present type for Output 1 and advance to Output 2 type selection (section 3.1.3.2).

Output 1 confirmation



Pressing " ∨ Down" key will re-enter into Output 1 Type Edit mode.
Pressing "∧ Up" key will confirm the present type for Output 1 and advance to Output 2 type selection (section 3.1.3.2).

3.1.3.2 Output 2 Type Selection



This screen allows the user to set the output 2 type as Voltage or Current for dual output transducers
Pressing the "∨ Down" key will enter the "output 2 type edit" mode and scroll between voltage and current.

Pressing " ∧ Up" key accepts the present type for Output 2 and advance to the Input Characteristics setting(section 3.1.4).

Output 2 confirmation



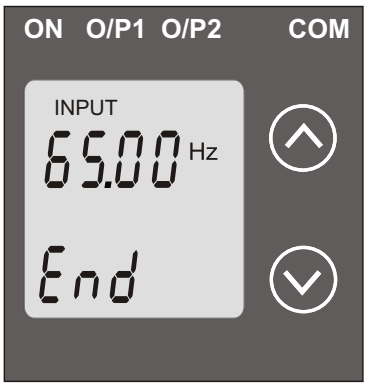
Pressing " ∨ Down" key will re-enterinto Output 2 Edit mode.
Pressing " ∧ Up" key accepts the present type for Output 2 and advance to the Input parameter setting (section 3.1.4).

Note: After Changing Output Type please ensure to change DIP Switch setting (Refer Section 3.3.1). If DIP Switches are already changed then switch ON/OFF Transducer.

3.1.4. Input Characteristics Setting

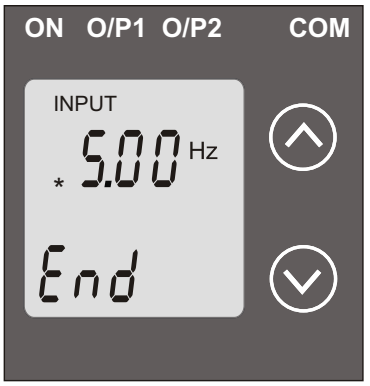
3.1.4.1 End value of Input

This screen allows the user to set the End value of Input.
End value of the Input can be selected in between 49 to 65 Hz.

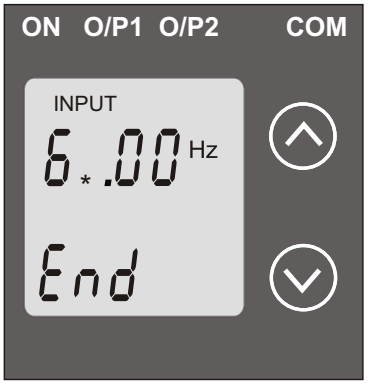


Pressing the " ∨ Down" key will enter the "New/Change End value of Input edit" mode.
Pressing " ∧ Up" key will confirm the present value as End value of Input and advance to the Start value of Input setting (section 3.1.4.2).

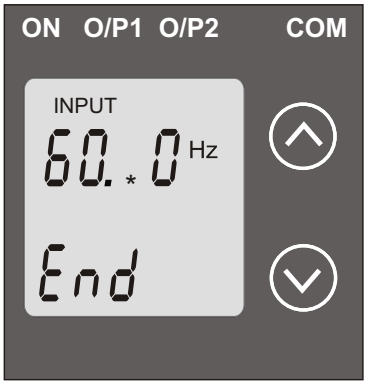
New / Change End value of Input



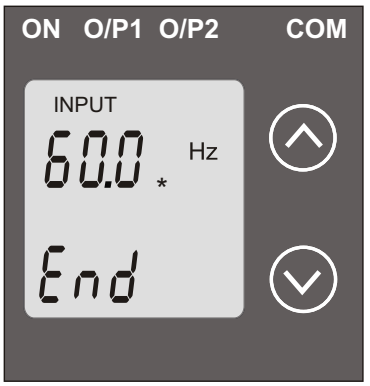
(*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the first digit from 4 through to 6, the value will wrap from 6 round to 4.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the first digit, in this case to "6".



Enter New / Change End value of Input, first digit entered, prompting for second digit. (*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the second digit from 0 through to 9, the value will wrap from 9 round to 0, if first digit is 5.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the second digit, in this case to "0".



Enter New /Change End value of Input, second digit entered, prompting for third digit. (*Denotes that digit will be flashing). Pressing the "∨ Down" key will scroll the value of the third digit from 0 through to 9, the value will wrap from 9 round to 0. Pressing the " ∧ Up" key will advance the operation to the next digit & set the third digit, in this case to "0".

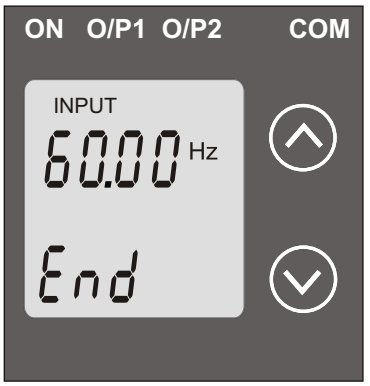


Enter New / Change End value of Input, third digit entered, prompting for fourth digit. (*denotes that digit will be flashing).

Pressing the " ∨ Down" key will scroll the value of fourth digit from 0 through to 9, the value will wrap from 9 round to 0.

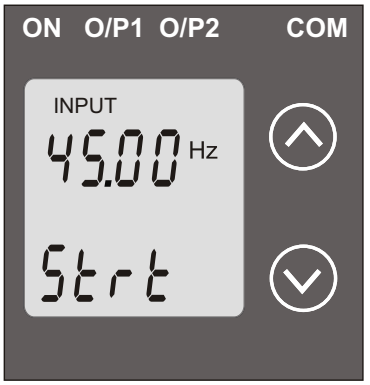
Pressing the " ∧ Up" key will advance the operation to the "New / Changed End value of Input" and set the fourth digit, in this case to "0".

New / changed End value of Input confirmed.



Pressing the " ∨ Down" key will re- enter to the "New / Change End value of Input".

Pressing the " ∧ Up" key will confirm New End value of Input and advance to the Start value of Input setting (section 3.1.4.2).



3.1.4.2 Start value of Input

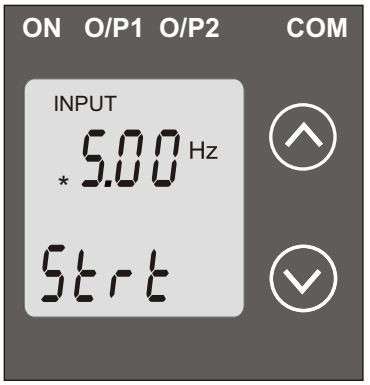
This screen allows the user to set the Start value of Input.

The start value of the Input can be set from 45 to End value - 4.

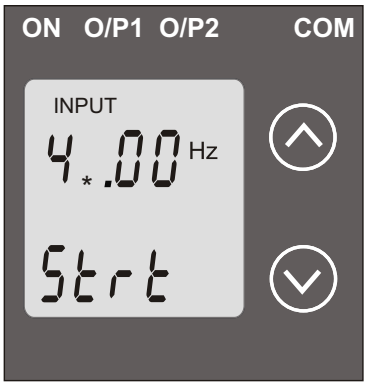
Pressing the " ∨ Down" key will enter the "New/Change Start value of Input edit" mode.

Pressing " ∧Up" key will confirm the present value as Start value of Input and advance to the Elbow function selection (section 3.1.4.3).

New / Change Start value of Input

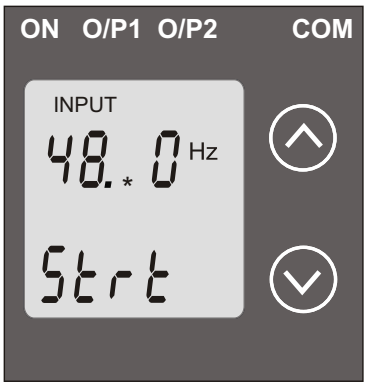


(*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the first digit from 4 through to 6, the value will wrap from 6 round to 4 depending on the set End value of Input.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the first digit, in this case to "4".

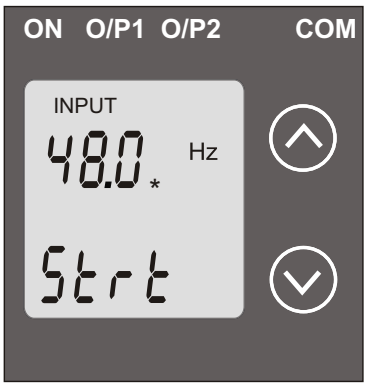


Enter New / Change Start value of Input, first digit entered, prompting for second digit. (*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the second digit from 0 through to 9, the value will wrap from 9 round to 0 depending on the set End value of Input.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the second digit, in this case to "8".

Enter New / Change Start value of Input, second digit entered, prompting for third digit.
(*Denotes that digit will be flashing).

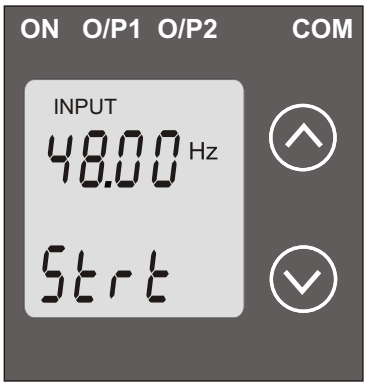


Pressing the " ∨ Down" key will scroll the value of the third digit from 0 through to 9, the value will wrap from 9 round to 0 depending on the set End value of Input.
Pressing the " ∧Up" key will advance the operation to the next digit and set the third digit, in this case to "0".



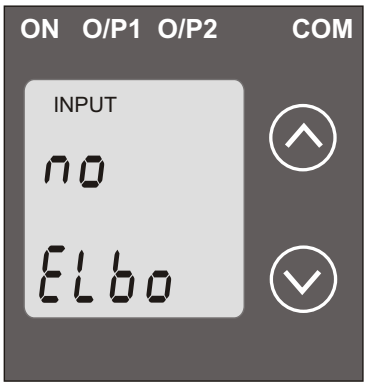
Enter New / Change Start value of Input, third digit entered, prompting for fourth digit. (*denotes that digit will be flashing).
Pressing the "∨ Down" key will scroll the value of the fourth digit from 0 through to 9, the value will wrap from 9 round to 0 depending on the set End value of Input.
Pressing the " ∧ Up" key will advance the operation to the "New / Changed Start value of Input" and set the fourth digit, in this case to "0".

New/changed Start value of Input confirmed.



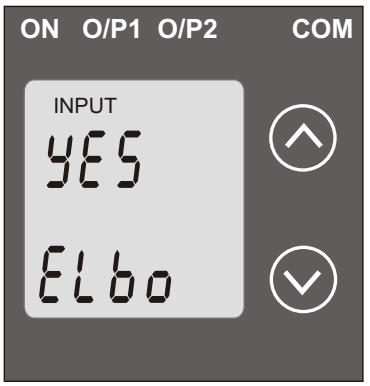
Pressing the " ∨ Down" key will re-enter to the "New / Change Start value of Input".
Pressing the " ∧ Up" key will confirm New Start value of Input and advance to the Elbow function selection (section 3.1.4.3).

3.1.4.3 Elbow Function Selection



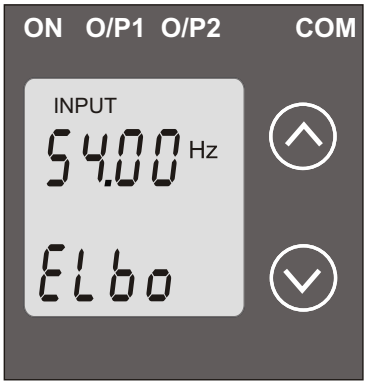
This screen allows the user to select Elbow function of input.
Pressing the "∨ Down" key will enter the "Selection of Elbow function of Input edit" mode and scroll the value between yes & no.
YES : Elbow function is enabled.
no : Elbow function is disabled.
Pressing " ∧ Up" key accepts the present condition and advance to output1 characteristics setting (section 3.1.5.1).

Elbow Function of Input confirmation



Pressing "∨ Down" key will re-enter into Elbow function of Input Edit mode.
Pressing the "∧ Up" key will set the value and advance to the Elbow value of Input selection (section 3.1.4.4).

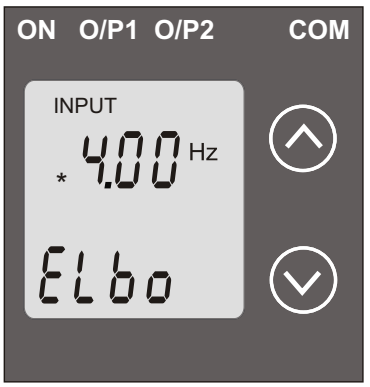
3.1.4.4 Elbow value of Input



This screen appears only when the Elbow function is enabled & allows the user to set the Elbow value of the Input. Allowable range of Elbow value of input is between (start value + 0.015* End value) to 0.985* end value
Pressing the "∨ Down" key will enter the "New/Change Elbow value of the Input edit" mode.

Pressing " ∧ Up" key will confirm the present value as Elbow value of the Input and advance to the Output Characteristics setting (section 3.1.5).

New / Change Elbow value of the Input

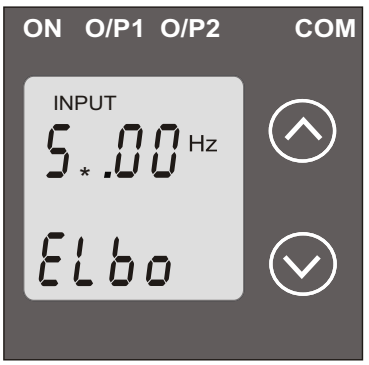


(*Denotes that digit will be flashing).

Pressing the " ∨ Down" key will scroll the value of the first digit from 4 through to 6, the value will wrap from 6 round to 4 depending on the set End value of Input.

Pressing the " ∧ Up" key will advance the operation to the next digit and set the first digit, in this case to "5".

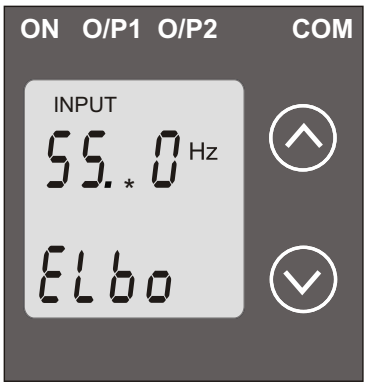
Enter New / Change Elbow value of the Input, first digit entered, prompting for second digit. (*Denotes that digit will be flashing).



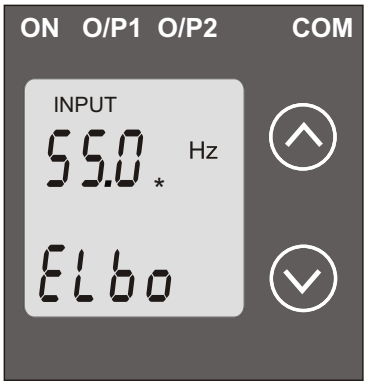
Pressing the " ∨ Down" key will scroll the value of the second digit from 0 through to 9, the value will wrap from 9 round to 0 depending on the set End value of Input.

Pressing the " ∧ Up" key will advance the operation to the next digit and set the second digit, in this case to "5".

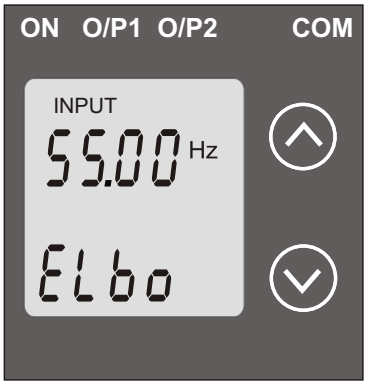
Enter New / Change Elbow value of the Input, second digit entered, prompting for third digit. (*Denotes that digit will be flashing).



Pressing the " ∨ Down" key will scroll the value of the third digit from 0 through to 9, the value will wrap from 9 round to 0 depending on the set End value of Input.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the third digit, in this case to "0".



Enter New / Change Elbow value of the Input, third digit entered, prompting for fourth digit. (* denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the fourth digit from 0 through to 9, the value will wrap from 9 round to 0 depending on the set End value of Input.
Pressing the " ∧ Up" key will advance the operation to the "New / Changed Elbow value of the Input" and set the fourth digit, in this case to "0".



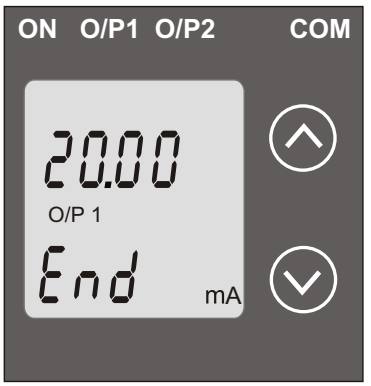
New/changed Elbow value of the Input confirmed.

Pressing the " ∨ Down" key will re-enter to the "New / Change Elbow value of the Input".
Pressing the "∧ Up" key will confirm New Elbow value of the Input and advance to the Output Characteristics setting (section 3.1.5).

3.1.5 Output Characteristics Setting

3.1.5.1 Output 1 characteristics setting

3.1.5.1.1 End value of output 1

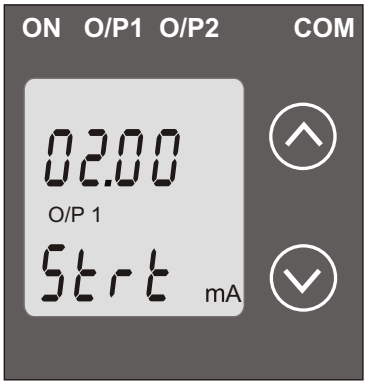


This screen allows the user to set the End value of Output 1, (considered as DC Current). The End value of Current Output fixed at 20mA.

Pressing the " ∨ Down" key value remains constant because end value is fixed.Pressing " ∧ Up" key will confirm the present value as End value of the Output 1 and advance to the Start value of Output1 setting (section 3.1.5.1.2).

3.1.5.1.2 Start value of output 1

This screen allows the user to set the Start value of Output 1, (considered as DC Current). Start value of Output can be set up to 20% of End value of Output.



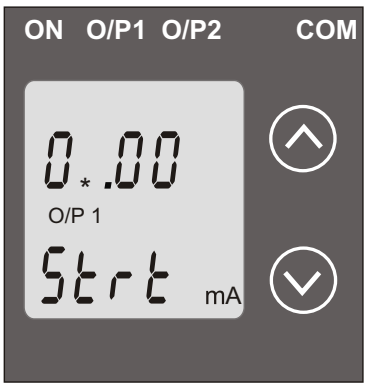
Pressing the "∨ Down" key will enter the "New / Change Start value of the Output 1 edit" mode.

Pressing " ∧ Up" key will confirm the present value as Start value of the Output 1 and advance to the selection of Elbow value of Output1 (section 3.1.5.1.3) or Output 2 parameter setting (section 3.1.5.2)

New/Change Start value of the Output 1

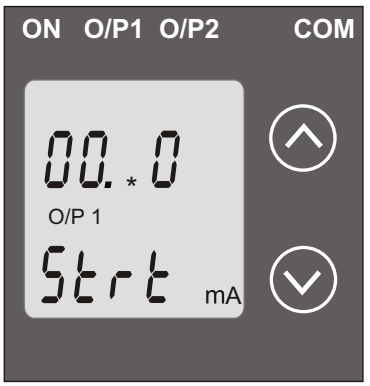


(*Denotes that digit will be flashing).Pressing the " ∨ Down" key will not affect the first digit It always remains 0. Pressing the " ∧ Up" key will advance the operation to the next digit and set the first digit, in this case to "0".



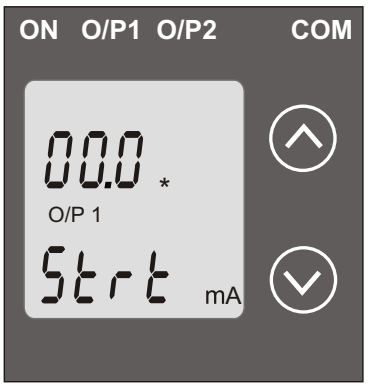
Enter New / Change Start value of the Output 1, first digit entered, prompting for second digit. (*Denotes that digit will be flashing). Pressing the "∨ Down" key will scroll the value of the second digit from 0 through to 4, the value will wrap from 4round to 0 depending on the set End value of Output.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the second digit, in this case to "0".

Enter New / Change Start value of the Output 1, second digit entered, prompting for third digit.



(*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the third digit from 0 through to 9, the value will wrap from 9 round to 0 depending on the set End value of Output.

Pressing the " ∧ Up" key will advance the operation to the next digit and set the third digit, in this case to "0"

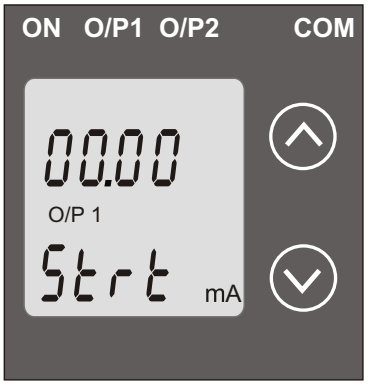


Enter New / Change Start value of the Output 1, third digit entered, prompting for fourth digit. (*denotes that digit will be flashing).

Pressing the " ∨ Down" key will scroll the value of the fourth digit from 0 through to 9, the value will wrap from 9 round to 0 depending on the set End value of Output.

Pressing the " ∧ Up" key will advance the operation to the "New / Changed Start value of the Output 1" and set the fourth digit, in this case to "0"..

New / changed Start value of the Output 1 confirmed.



Pressing the " ∨ Down" key will re- enter to the "New / Change Start value of the Output 1".

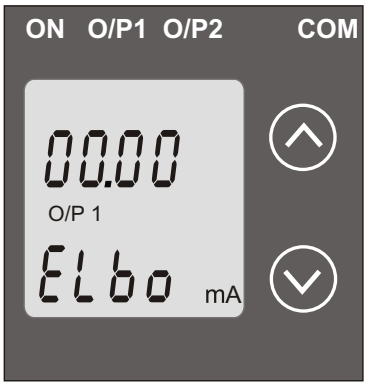
Pressing the " ∧ Up" key will confirm

New Start value of the Output 1 and advance to the selection of Elbow value of Output1 (section 3.1.5.1.3) or Output2 characteristics setting(section 3.1.5.2)

3.1.5.1.3 Elbow value of output 1

This screen appears only when Elbow function is enabled. This screen allows the user to set the Elbow value of Output

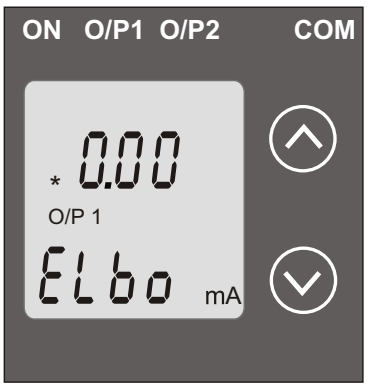
1, (considerd as DC Current). The Elbow value can be set any value between set Start and End value of Output1.



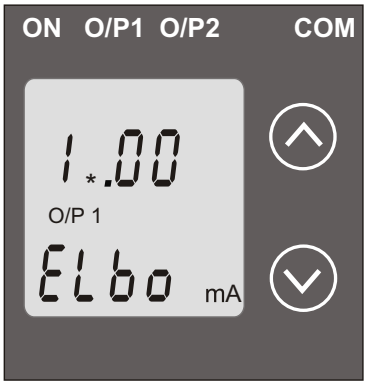
Pressing the " ∨ Down" key will enter the " New/Change Elbow value of the Output 1 edit" mode.
Pressing " ∧ Up" key will set the present value as Elbow value of the Output 1 and advance to the Output 2 characteristics setting(section 3.1.5.2).

New/Change Elbow value of the Output 1

(*Denotes that digit will be flashing).



Pressing the " ∨ Down" key will scroll the value of the first digit from 0 through to 1, the value will wrap from 1 round to 0 depending on the set End value of Output.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the first digit, in this case to "1".

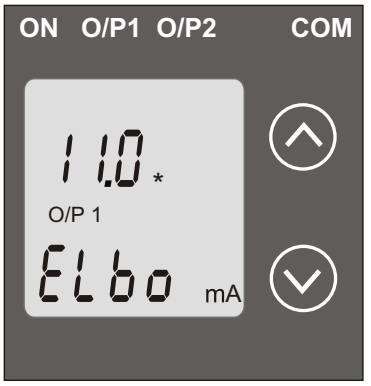


Enter New / Change Elbow value of the Output 1, first digit entered, prompting for second digit. (*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the second digit from 0 through to 9, the

value will wrap from 9 round to 0 depending on the set End value of Output.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the second digit, in this case to "1".

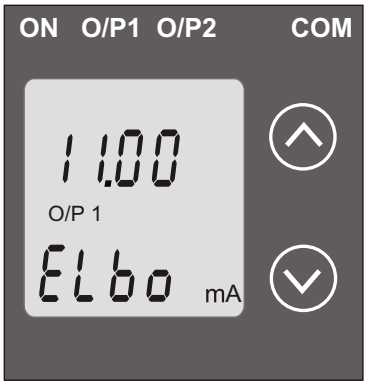


Enter New / Change Elbow value of the Output 1, second digit entered, prompting for third digit. (*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the third digit from 0 through to 9, the value will wrap from 9 round to 0 depending on the set End value of Output.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the third digit, in this case to "0".



Enter New / Change Elbow value of the Output 1, third digit entered, prompting for fourth digit. (* denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the fourth digit from 0 through to 9, the value will wrap from 9 round to 0 depending on the set End value of Output.
Pressing the " ∧ Up" key will advance the operation to the "New/Changed Elbow value of the Output 1" and set the fourth digit, in this case to "0".

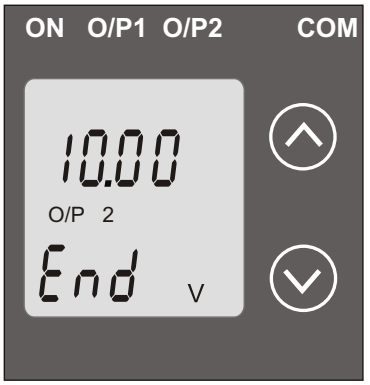
New/changed Elbow value of the Output 1 confirmed.



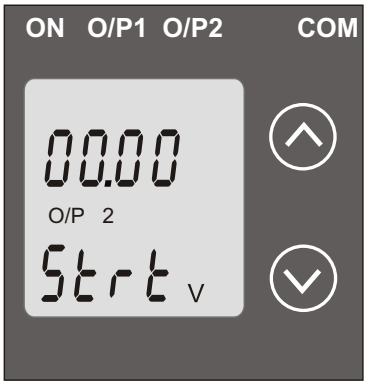
Pressing the " ∨ Down" key will re-enter to the "New / Change Elbow value of the Output 1".
Pressing the " ∧ Up" key will confirm New Elbow value of the Output 1 and advance to the Output 2 Characteristics setting (section 3.1.5.2).

3.1.5.2 Output 2 Characteristics selection

3.1.5.2.1 End value of output 2



This screen allows the user to set the End value of Output 2, (considered as DC Voltage) for dual output. The End value of Voltage Output fixed at 10V.
Pressing the "∨ Down" key value remains constant because end value is fixed.
Pressing "∧ Up" key will set the present value as End value of the Output 2 and advance to the Start value of Output settiing (section 3.1.5.2.2).



3.1.5.2.2 Start value of output 2

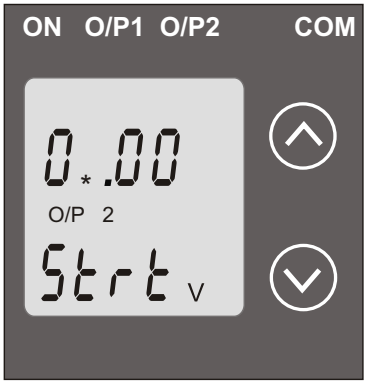
This screen allows the user to set the Start value of Output 2, (considerd as DC Voltage). Start value of Output can be set up to 20% of End value of

Pressing the " ∨ Down" key will enter the "New/Change Start value of the Output 2 edit" mode.
Pressing " ∧ Up" key will confirm the present value as Start value of the Output2 and advance to the Elbow value of Output2 setting(section 3.1.5.2.3) or exit setup menu.

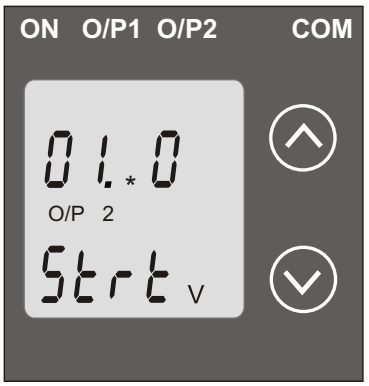
New/Change Start value of the Output 2



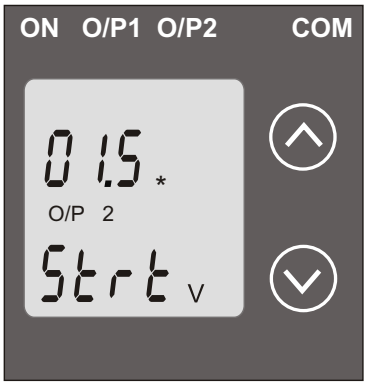
(*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will not affect the value of first digit, it is always 0.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the first digit, in every case to "0".



Enter New / Change Start value of the Output 2, first digit entered, prompting for second digit. (*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the second digit from 0 through to 2, the value will wrap from 2 round to 0.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the second digit, in this case to "1".?
Enter New / Change Start value of the Output 2, second digit entered, prompting for third digit. (*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the



third digit from 0 through to 9, the value will wrap from 9 round to 0.Pressing the " ∧ Up" key will advance the operation to the next digit and set the third digit, in this case to "5".



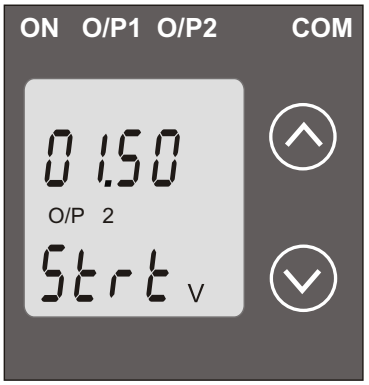
Enter New / Change Start value of the Output 2, third digit entered, prompting for fourth digit. (*denotes that digit will be flashing).

Pressing the " ∨ Down" key will scroll the value of the fourth digit from 0 through to 9, the value will wrap from 9 round to 0.

Pressing the " ∧ Up" key will advance the operation to the "New/Changed Elbow value of the Output 2" confirmation and set the fourth digit, in this case to "0".

New/changed Start value of the Output 2 confirmed.

Pressing the " ∨ Down" key will re-enter to the "New / Change Start valueof the Output 2".Pressing the "∧ Up" key will confirm New Start value of the Output 2 and advance to the Elbow value of Output2 setting (section 3.1.5.2.3) or exit setup menu, If elbow not enabled.



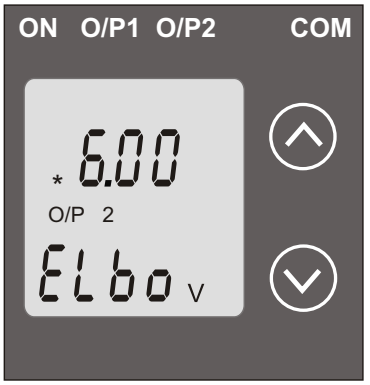
3.1.5.2.3 Elbow value of output 2

This screen appears only when Elbow function is enabled. This screen allows the user to set the Elbow value of Output 2 (considered as DC Voltage).
The Elbow value can be set any value between set Start and End value of Output.



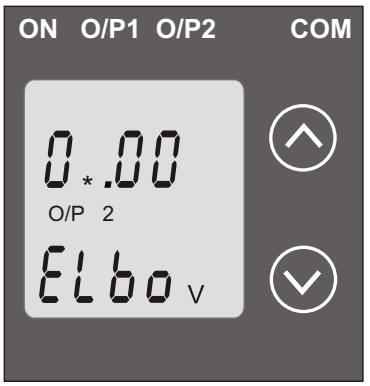
Pressing the " ∨ Down" key will enter the "New / Change Elbow value of the Output 2 edit" mode.
Pressing " ∧ Up" key will confirm the present value as Elbow value of the Output 2 and exit setup menu.

New/Change Elbow value of the Output 2

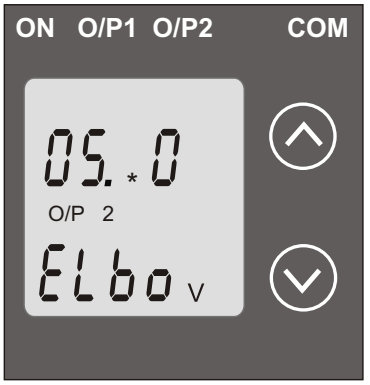


(*Denotes that digit will be flashing).
Pressing the " ∨ Down" key will scroll the value of the first digit from 0 through to 1, the value will wrap from 1 round to 0 depending the set End value of Output2.
Pressing the "∧Up" key will advance the operation to the next digit and set the first digit, in this case to "0".?

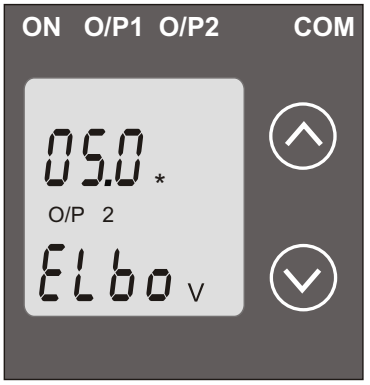
Enter New / Change Elbow value of the Output 2, first digit entered, prompting for second digit. (*Denotes that digit will be flashing).



Pressing the " ∨ Down" key will scroll
Pressing the "∧Up" key will advance the operation to the next digit and set the second digit, in this case to "5".



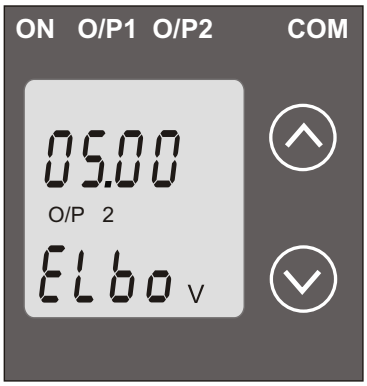
Enter New / Change Elbow value of the Output 2, second digit entered, \ prompting for third digit. (*Denotes that digit will be flashing).
Pressing the " ∨Down" key will scroll the value of the third digit from 0 through to 9, the value will wrap from 9 round to 0 depending the set End value of Output.
Pressing the " ∧ Up" key will advance the operation to the next digit and set the third digit, in this case to "0".



Enter New / Change Elbow value of the Output 2, third digit entered, prompting for fourth digit. (* denotes that digit will be flashing).
Pressing the " ∨Down" key will scroll the value of the fourth digit from 0 through to 9, the value will wrap from 9 round to 0 depending the set End value of Output.
Pressing the " ∧ Up" key will advance the operation to the

"New / Changed Elbow value of the Output 2 confirmation" and set the fourth digit, in this case to "0".

New/changed Elbow value of the Output 2 confirmed.



Pressing the " ∨ Down" key will re-enter to the "New / ChangeElbow value of the Output 2".
Pressing the " ∧ Up" key will confirm New Elbow value of the Output 2 and exit setup menu.

3.2 Programming Via Programming port available at front of Transducers using optional PRKAB601 Adapter

For programming of transducer, steps to be followed are

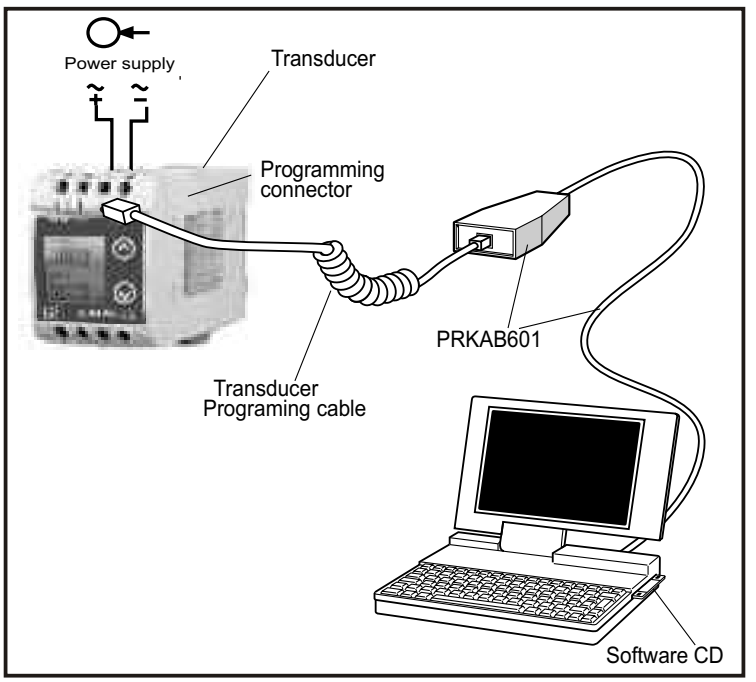
Step 1 : DIP Switch setting:

DIP Switches should configure for desired Output type as per given in section 3.3.1.

Step 2 : programming

A PC with RS 232 C interface along with the programming cable PRKAB601 and the configuration software are required to program the transducer.
(Details of the programming cable and the software are to be found in the separate Data sheet: PRKAB 601 Le.)
The connections between "PC PRKAB 601 Transducer.
The power supply must be applied to before it can be programmed.
The Configuration software is supplied on a CD.

The programming cable PRKAB601 adjusts the signal level and provides the electrical insulation between the PC and Transducers.



3.3 Programming Via optional RS485 (MODBUS) communication port.

(Refer section 4 for programming through MODBUS)

3.3.1: DIP Switch Setting for Changing Output type

The Transducer output type can be changed from DC current to DC voltage depending upon user requirement on site. To change output type user has to set the transducer output type parameter either to voltage or current along with DIP switch setting.

The transducer output type parameters can be configured using one of the three below given methods.

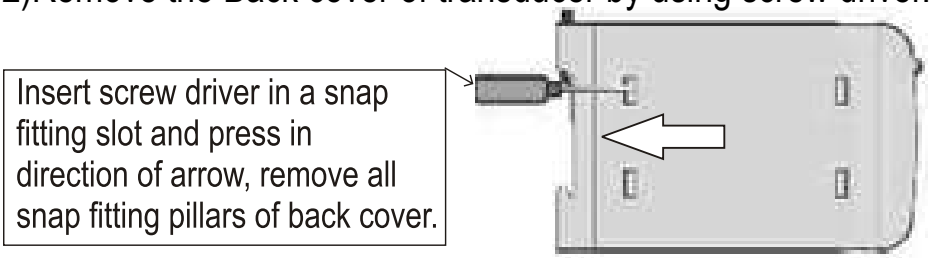
A) PRKAB 601(optional) : Using PRKAB601 through Transducer programming port (COM) and using PC based configuration software.

B) Front display (optional): Using front display user can enter into programming mode and can change the output type.
C) Modbus Rs485(optional): Using Modbus interface user can configure the output type refer Modbus Rs485 section.

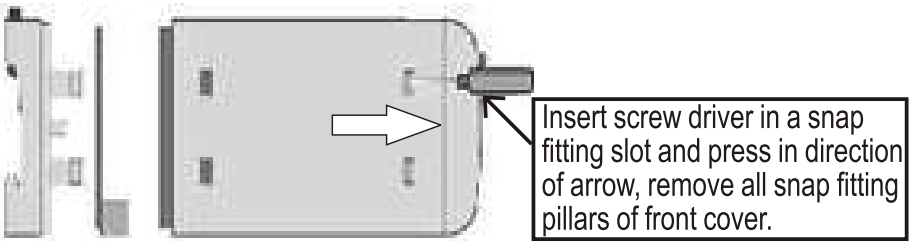
Note: If DIP switch setting is done first and then output type parameter is configured using either of the above three methods then switch OFF - ON the Transducer.
For changing DIP switches follow these steps

1) To change O/P switches from Current to Voltage or vice versa, ensure that transducer should be Electrically dead and all connection wires should be disconnected.

2)Remove the Back cover of transducer by using screw driver.



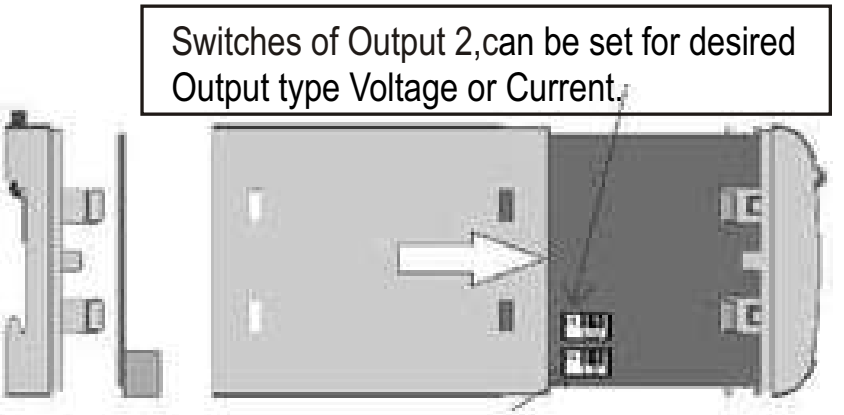
3) Remove the front cover and take the Output card out.



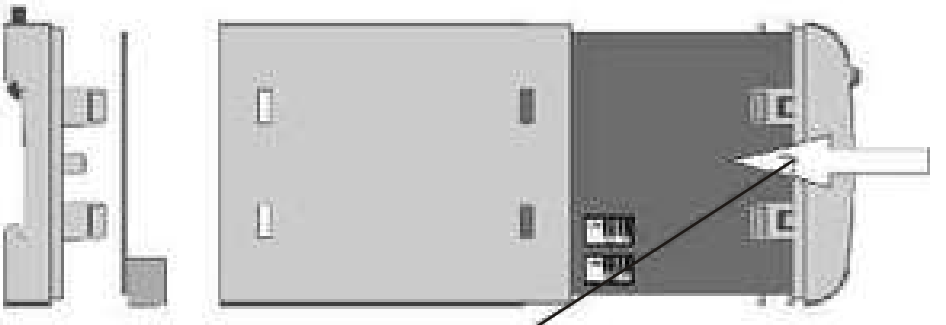
4) Configure the switches for Voltage or Current as shown below.

DIP Switch Setting	Type of Output Signal
	load-independent current
	load-independent voltage

Note: Black portion in this diagram indicates switch position

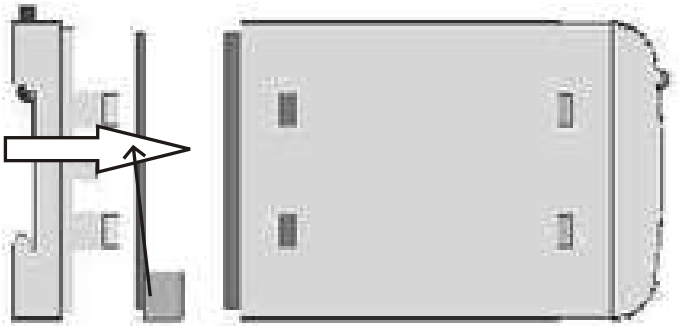


5) After changing the switches for desired Output, Insert the front cover.



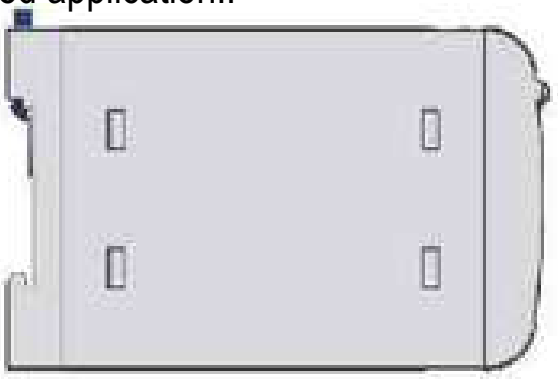
Insert the front cover,
press in direction of arrow.

6) After inserting the front cover insert the Interface card PCB and back cover..



Insert the Interface card PCB and Back cover,
press in direction of arrow.

7) After inserting the Back cover transducer, can be used for required application..



4. RS 485 (ModBus)

Frequency Transducer supports MODBUS (RS485) RTU protocol(2-wire). Connection should be made using twisted pair shielded cable. All "A" and "B" connections are daisy chained together. The screens should also be connected to the “Gnd” terminal. To avoid the possibility of loop currents, an Earth connection should be made at one point on the network.Loop (ring) topology does not require any termination load. Line topology may or may not require terminating loads depending on the type and length of cable used. The impedance of the termination load should match the impedance of the cable and be at both ends of the line. The cable should be terminated at each end with a 120 ohm (1/4 Watt min.) resistor.

RS 485 network supports maximum length of 1.2km. Including the Master, a maximum of 32 instruments can be connected in RS485 network. The permissible address range between 1 and 247 for 32 instruments. Broadcast Mode (address 0) is not allowed.

The maximum latency time of Frequency Transducer is 200ms i.e. this is the amount of time that can pass before the first response character is output.

After sending any query through software (of the Master), it must allow 200 ms of time to elapse before assuming that the frequency transducer is not going to respond. If slave does not respond within 200 ms, Master can ignore the previous query and can issue fresh query to the slave.
The each byte in RTU mode has following format:

	8-bit binary, hexadecimal 0-9, A-F 2 hexadecimal characters contained in each 8-bit field of the message
Format of Data Bytes	4 bytes (32 bits) per parameter. Floating point format (to IEEE 754) Most significant byte first (Alternative least significant byte first)
Error Checking Bytes	2 byte Cyclical Redundancy Check (CRC)
Byte format	1 start bit, 8 data bits, least significant bit sent first 1 bit for even/odd parity 1 stop bit if parity is used; 1 or 2 bits if no parity

Communication Baud Rate is user selectable from the front panel between 2400, 4800, 9600, 19200 bps.

Function code

03	Read Holding Registers	Read content of read /write location (4X)
04	Read input Registers	Read content of read only location (3X)
16	Presets Multiple Registers	Set the content of read / write locations (4X)

Exception Cases : An exception code will be generated when frequency transducer receives ModBus query with valid parity & error check but which contains some other error (e.g. Attempt to

set floating point variable to an invalid value) The response generated will be “Function code” ORed with HEX (80H). The exception codes are listed below

01	Illegal function	The function code is not supported by frequency transducer.
02	Illegal Data Address	Attempt to access an invalid address or an attempt to read or write part of a floating point value
03	Illegal Data Value	Attempt to set a floating point variable to an invalid value

4.1 Accessing 3 X register for reading measured values

Two consecutive 16 bit registers represent one parameter. Refer table 2 for the addresses of 3X registers (Parameters measured by the instruments).
Each parameter is held in the 3X registers. Modbus Code 04 is used to access all parameters.

Example

To read parameter ,
frequency : Start address = 46 (Hex) Number of registers

Note : Number of registers = Number of parameters x 2

Each Query for reading the data must be restricted to 20 parameters or less. Exceeding the 20 parameter limit will cause a ModBus exception code to be returned.

Query

01 (Hex)	04 (Hex)	00 (Hex)	46 (Hex)	00 (Hex)	02 (Hex)	90 (Hex)	1E (Hex)
Device Address	Function Code	Start Address High	Start Address Low	Number of Registers Hi	Number of Registers Lo	CRC Low	CRC High

Start Address High : Most significant 8 bits of starting address of the parameter requested.

Start Address low : Least significant 8 bits of starting address of the parameter requested.

Number of register Hi : Most significant 8 bits of Number of registers requested.

Number of register Lo : Least significant 8 bits of Number of registers requested.

(Note : Two consecutive 16 bit register represent one parameter.)

Response: frequency (50.0Hz)

01 (Hex)	04 (Hex)	04 (Hex)	42 (Hex)	48 (Hex)	00 (Hex)	00 (Hex)	6F (Hex)	EA (Hex)
Device Address	Function Code	Byte Count	Data Register1 High Byte	Data Register1 Low Byte	Data Register2 High Byte	Data Register2 Low Byte	CRC Low	CRC High

Byte Count : Total number of data bytes received.

Data register 1 High Byte : Most significant 8 bits of Data register 1 of the parameter requested.

Data register 1 Low Byte : Least significant 8 bits of Data register 1 of the parameter requested.

Data register 2 High Byte : Most significant 8 bits of Data register 2 of the parameter requested.

Data register 2 Low Byte : Least significant 8 bits of Data register 2 of the parameter requested.

(Note : Two consecutive 16 bit register represent one parameter.)

Table 2 : 3 X register addresses (measured parameters)

Address (Register)	Parameter No.	Parameter	Modbus Start Address Hex	
			High Byte	Low Byte
30071	1	Frequency	00	46

4.2 Accessing 4 X register for Reading & Writing

Each setting is held in the 4X registers. ModBus code 03 is used to read the current setting and code 16 is used to write/change the setting. Refer **Table 3** for 4 X Register addresses.

Example : Reading Device address

Device address : Start address = 0E (Hex)
Number of registers = 02
Note : Number of registers = Number of Parameters x 2

Query :

Device Address	01 (Hex)
Function Code	03 (Hex)
Start Address High	00 (Hex)
Start Address Low	0E(Hex)
Number of Registers Hi	00 (Hex)
Number of Registers Lo	02 (Hex)
CRC Low	A5 (Hex)
CRC High	C8 (Hex)

Start Address High : Most significant 8 bits of starting address of the parameter requested.
Start Address low : Least significant 8 bits of starting address of the parameter requested.
Number of register Hi : Most significant 8 bits of Number of registers requested.
Number of register Lo : Least significant 8 bits of Number of registers requested.

(Note : Two consecutive 16 bit register represent one parameter.)

Response: Device address (1)

Device Address	01 (Hex)
Function Code	03 (Hex)
Byte Count	04 (Hex)
Data Register1 High Byte	3F (Hex)
Data Register1Low Byte	80 (Hex)
Data Register2 High Byte	00 (Hex)
Data Register2 Low Byte	00(Hex)
CRC Low	F7 (Hex)
CRC High	CF (Hex)

Byte Count : Total number of data bytes received.
Data register 1 High Byte : Most significant 8 bits of Data register 1 of the parameter requested.
Data register 1 Low Byte : Least significant 8 bits of Data register 1 of the parameter requested.
Data register 2 High Byte : Most significant 8 bits of Data register 2 of the parameter requested.
Data register 2 Low Byte : Least significant 8 bits of Data register 2 of the parameter requested.
(Note : Two consecutive 16 bit register represent one parameter.)

Example : Writing Device address

Device address : Start address = 0E (Hex)
Number of registers = 02

Query:(Change Device address to 2)

Device Address	01 (Hex)
Function Code	10 (Hex)
Starting Address Hi	00 (Hex)
Starting Address Lo	0E (Hex)
Number of Registers Hi	00 (Hex)
Number of Registers Lo	02(Hex)
Byte Count	04 (Hex)
Data Register-1 High Byte	40 (Hex)
Data Register-1 Low Byte	00(Hex)
Data Register-2 High Byte	00(Hex)
Data Register-2 Low Byte	00(Hex)
CRC Low	67 (Hex)
CRC High	E3 (Hex)

Byte Count : Total number of data bytes received.
Data register 1 High Byte : Most significant 8 bits of Data register 1of the parameter requested.
Data register 1 Low Byte : Least significant 8 bits of Data register 1 of the parameter requested.
Data register 2 High Byte : Most significant 8 bits of Data register 2 of the parameter requested.
Data register 2 Low Byte : Least significant 8 bits of Data register 2 of the parameter requested.

Note: Two consecutive 16 bit register represent one parameter.)

Response

Device Address	01 (Hex)
Function Code	10 (Hex)
Start Address High	00 (Hex)
Start Address Low	0E(Hex)

Response

Number of Registers Hi	00 (Hex)
Number of Registers Lo	02(Hex)
CRC Low	20 (Hex)
CRC High	0B (Hex)

Start Address High : Most significant 8 bits of starting address of the parameter requested.
Start Address low : Least significant 8 bits of starting address of the parameter requested.
Number of register Hi : Most significant 8 bits of Number of registers requested.
Number of register Lo : Least significant 8 bits of Number of registers requested.

(Note : Two consecutive 16 bit register represent one parameter.)

Table 3 : 4 X register addresses

Address (Register)	Par-meter No.	Parameter	Read / Write	Modbus Start Address Hex	
				High Byte	Low Byte
40001	1	-	-	-	-
40003	2	Mode selection	R/Wp	00	02
40005	3	-	-	-	-
40007	4	-	-	-	-
40009	5	-	-	-	-
40011	6	-	-	-	-
40013	7	-	-	-	-
40015	8	Device address	R/Wp	00	0E
40017	9	RS 485 Setup	R/Wp	00	10
40019	10	Password	R/Wp	00	12

Address (Register)	Para-meter No.	Parameter	Read / Write	Modbus Start Address Hex	
				High Byte	Low Byte
40021	11	-	-	-	-
40023	12	-	-	-	-
40025	13	-	-	-	-
40027	14	Sim_Output A	Wp	00	1A
40029	15	Sim_Output B	Wp	00	1C
40031	16	Analog O/P Type 1	R/Wp	00	1E
40033	17	-	-	-	-
40035	18	Analog O/P Type 2	R/Wp	00	22
40037	19	-	-	-	-
40039	20	-	-	-	-

Explanation for 4 X register :

40003	Mode Selection	This is used to select the Mode of operation.Normal mode = 1. Simulation mode = 2.
40015	Device Adress	This address is used to set the Device Address between 1 to 247.
40017	RS 485 Setup	This address is used to set the Baud rate, Parity, No of Stop bits.
40019	Password	This address is used to set & reset the password. Valid Range of Password can be set is 0000 - 9999
40027	Sim_ Output A	This address is used to set the simulation Output A to 10% of Output by writing 1000 and 100% of Output by writing 10000 .

40029	Sim_ Output B	This address is used to set the simulation Output B to 10% of Output by writing 1000 and 100% of Output by writing 10000 .
40031	Analog O/P Type 1	This address is used to set the Analog O/P Type 1 as Voltage/Current. Voltage = 1 ,Current = 2.
40035	Analog O/P Type 2	This address is used to set the Analog O/P Type 2 as Voltage/Current. Voltage = 1 , Current = 2.

Note: After Changing Analog Output Type1/Type 2 please insure to change DIP Switch setting (Refer Section 3.3). If DIP Switches are already change then switch ON/OFF Transducer.

Table 4 : RS 485 Set-up Code

Baud Rate	Parity	Stop Bit	Decimal value
19200	NONE	01	12
19200	NONE	02	13
19200	EVEN	01	14
19200	ODD	01	15
9600	NONE	01	08
9600	NONE	02	09
9600	EVEN	01	10
9600	ODD	01	11
4800	NONE	01	04
4800	NONE	02	05
4800	EVEN	01	06
4800	ODD	01	07
2400	NONE	01	00
2400	NONE	02	01

Baud Rate	Parity	Stop Bit	Decimal value
2400	EVEN	01	02
2400	ODD	01	03

Note :
Codes not listed in the table above may give rise to unpredictable results including loss of communication. Exercise caution when attempting to change mode via direct Modbus writes.

5. Installation

The Frequency Transducer can be mounted either on a top-hat rail or directly on to a wall or a mounting plate.



The front of the enclosure conforms to IP 40. The terminals of the product should be protected from liquids.
The Frequency Transducer should be mounted in a reasonably stable ambient temperature and where the operating temperature is within the range 0 to 45^0 C . Vibration should be kept to a minimum and the product should not be mounted where it will be subjected to excessive direct sunlight.

⚠ Caution:

1. In the interest of safety and functionality this product must be installed by a qualified engineer, abiding by any local regulations.
2. Voltages dangerous to human life are present at some of the terminal connections of this unit. Ensure that all supplies are de-energised before attempting any connection or disconnection.
3. These products do not have internal fuses therefore external fuses must be used to ensure safety under fault conditions.

5.1 EMC Installation Requirements

This product has been designed to meet the certification of the EU directives when installed to a good code of practice for EMC in industrial environments,e.g.

1. Screened output and low signal input leads or have provision for fitting RF suppression components, such as ferrite absorbers, line filters etc., in the event that RF fields cause problems.

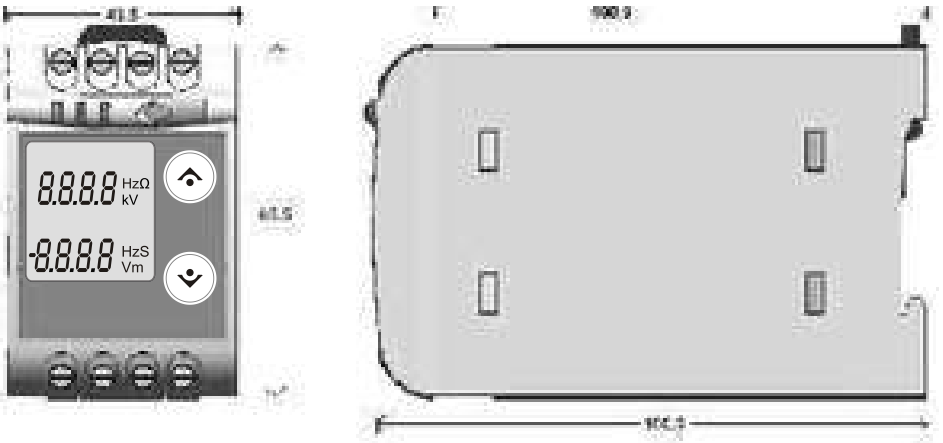
Note : It is good practice to install sensitive electronic instruments that are performing critical functions, in EMC enclosures that protect against electrical interference which could cause a disturbance in function.

2. Avoid routing leads alongside cables and products that are, or could be, a source of interference
3. To protect the product against permanent damage, surge transients must be limited to 2kV pk. It is good EMC practice to suppress differential surges to 2kV at the source. The unit has been designed to automatically recover in the event of a high level of

transients. In extreme circumstances it may be necessary to temporarily disconnect the auxiliary supply for a period of greater than 5 seconds to restore correct operation.

4. ESD precautions must be taken at all times when handling this product.

5.2 Case Dimensions



5.3 Wiring

Input connections are made directly to screw-type terminals with indirect wire pressure. Choice of cable should meet local regulations. Terminal for both Current and Voltage inputs will accept up to 2x 2.5mm² or 1x4mm² cables.

5.4 Auxiliary Supply

Transducer should ideally be powered from a dedicated supply, however it may be powered from the signal source, provided the source remains within the limits of the chosen auxiliary voltage. A switch or circuit, may be used in close proximity to the equipment & within easy reach of the OPERATOR & It shall be marked as the disconnecting device for the equipment.

5.5 Fusing

It is recommended that all voltage lines are fitted with 1 amp HRC fuses.

5.6 Earth/Ground Connections

For safety reasons, CT secondary connections should be grounded in accordance with local regulations.

5.7: Maintenance

No maintenance is required.

6: Specifications

Input:

Measuring Ranges	45Hz to 55Hz, 48Hz to 52Hz, 55Hz to 65Hz, 45Hz to 65Hz (min span 4Hz)
Nominal input Voltage(U_N)	$57V \leq U_N \leq 500$ V
Nominal input Voltage burden	< 0.6 VA max
Overload Capacity :	1.2 *U_N continuously, 2 *U_N for 1 second, repeated 10 times at 10 minute intervals

Auxiliary:

AC/DC Auxiliary Supply	60V.....300 VAC-DC ± 5% 24V.....60 VAC-DC ± 10%
Aux.Supply frequency range	45 to 65 Hz
Auxiliary Supply consumption	

60V.....300 VAC-DC	≤ 8VA for one output
	≤ 10VA for two outputs
24V.....60 VAC-DC	≤ 5VA for one output
	≤ 6VA for two outputs

Measuring Output Y (Single or Optional Dual)

Output type	Load independent DC Voltage or DC Current (Onsite selectable through DIP switches & Programming.)

Load independent DC output	0…20mA / 4…20mA / 0...1mA OR 0…10V
Output burden with DC current output Signal	$0 \leq R \leq 15V/Y2$
Output burden with DC voltage output Signal	$Y2/(2\ mA) \leq R \leq \infty$
Current limit under R=0	$\leq 1.25 * Y2$ with current overload output $\leq$ 100 mA with Voltage output
Voltage limit under $R \leq \infty$	$\leq 1.25 * Y2$ with voltage output $\leq$ 30 V with current output
Residual Ripple in Output signal	$\leq$ 1% pk-pk
Response Time	<400 ms

Accuracy: (Acc. to IEC 60688)

Reference Value	Output end Value Y2 (Voltage or Current)
Basic Accuracy	0.2*C

Factor C (The Highest value applies)

Linear characteristics:

$$C = \frac{1 - \frac{Y0}{Y2}}{1 - \frac{X0}{X2}} \text{ or } C=1 \qquad \text{For } X0 \leq X \leq X1$$

$$\text{For } X1 \leq X < X2$$

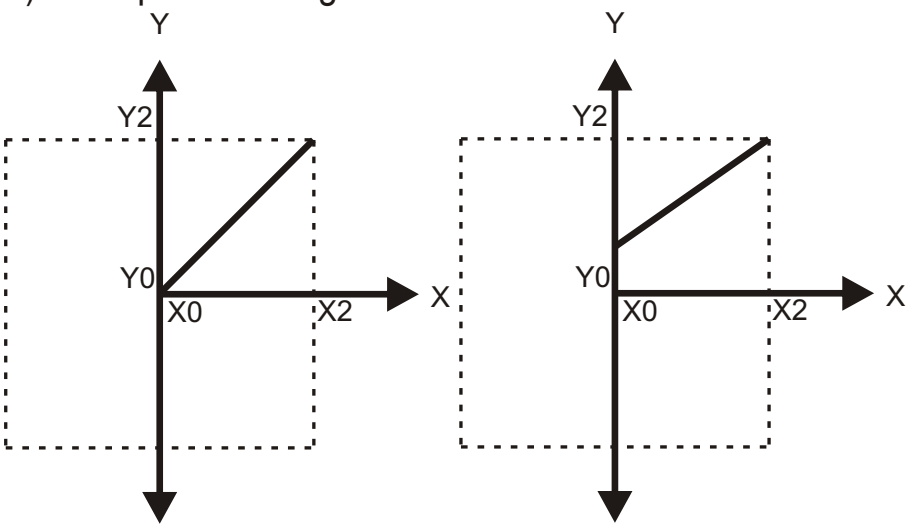
Bent characteristics:

$$C = \frac{Y1 - Y0}{X1 - X0} \bullet \frac{X2}{Y2} \text{ or } C=1$$

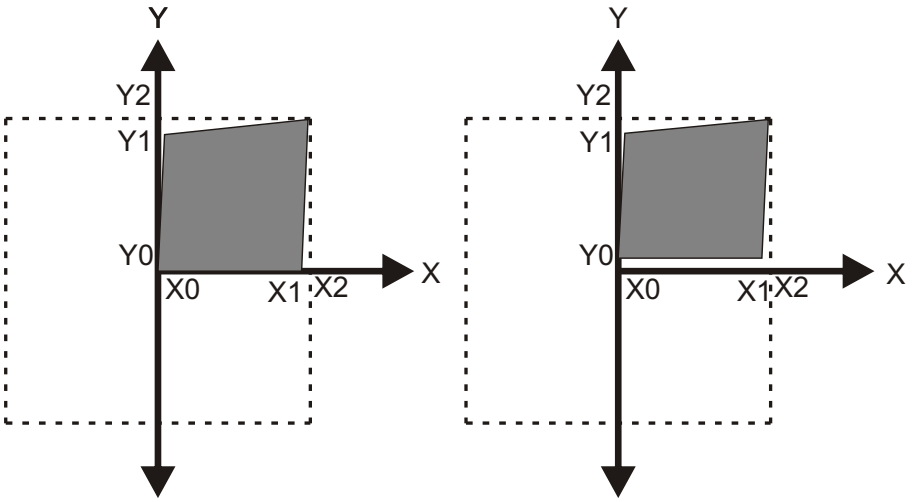
$$C = \frac{1 - \frac{Y1}{Y2}}{1 - \frac{X1}{X2}} \text{ or } C=1$$

Output characteristics

1) Example of setting with Linear characteristics



2) Example of setting with Bent characteristics



X0 = Start value of input
X1 = Elbow value of input
X2 = End value of input
R_N = Rated value of output burden

Y0 = Start value of output
Y1 = Elbow value of output
Y2 = End value of output
U_N = Nominal input voltage

Safety

Protection	IP 40, housing acording to EN 60 529 IP 20,terminal according toEN 60 529
Pollution degree	2
Installation Category	III
Insulation Voltage	50Hz,1min. (EN 61 010-1) 5500V, Input versus outer surface 3700V, Input versus all other circuits 3700V, Auxiliary supply versus outer surface and output 490V, Output versus output Rs485 each other versus outer surface.

Installation Data

Mechanical Housing	Lexan 940 (polycarbonate) Flammability Class V-0 acc. To UL 94,self extinguishing, non dripping, free of halogen
Mounting position	Rail mounting / wall mounting
Weight	Approx. 0.4kg

Connection Terminal

Connection Element	Conventional Screw type terminal with indirect wire pressure
Permissible cross section of the connection lead	$\leq$ 4.0 mm^2 single wire or 2 x 2.5 mm^2 Fine wire

Environmental

Nominal range of use	0 °C...23 °C... 45 °C (usage Group II)
Storage temperature	-40 °C to 70 °C
Relative humidity	$\leq$ 75%

of annual mean	
Altitude	2000m max
Location	Indoor use

Ambient tests

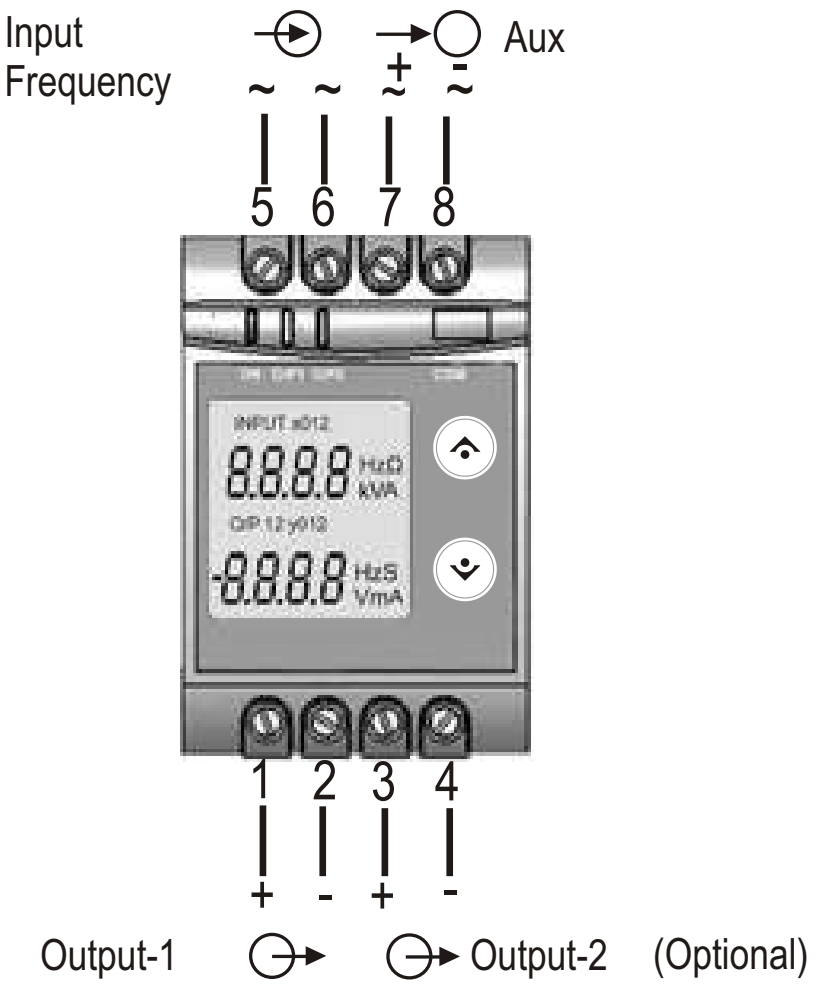
EN 60 068-2-6	Vibration
Acceleration	± 2 g
Frequency range	10....150...10Hz,
Rate of frequency sweep	1 octave/minute
Number of cycles	10, in each of the three axes
EN 60 068-2-7	Shock
Acceleration	3 x 50g 3 shocks in each direction
EN 60 068-2-1/-2/-3	Cold, Dry, Damp heat
IEC 61000-4-2/-3/-4/-5/-6	
IEC61326	Electromagnetic compatibility.

Reference conditions for Accuracy:

Ambient temperature	23°C +/- 1°C
Pre-conditioning	30 min acc. to IEC EN - 60688
Input Voltage	57V≤ UN≤ 500V
Input waveform	Sinusoidal, Form Factor 1.1107
Auxiliary supply voltage	Rated Value
Auxiliary supply frequency	Rated Value
Output Load	Rn = 7.5 V / Y2 ± 1%With DC current output signal. Rn = Y2 / 1 mA ± 1% With DC Voltage output signal.
Miscellaneous	Acc. to IEC - 60688
Additional Error	
Temperature influence	± 0.2% /10°C
Influence of Variations:	As per IEC -60688 standard.
Output stability	< 30min

7. Connection Diagram

Connection	Terminal details	
Measuring input	~ ~	5 6
Auxilliary Power supply	~ , + ~ , -	7 8
Measuring output - 1	+ -	1 2
Measuring output - 2	+ -	3 4



Rs 485 Connections:

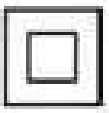
B	A	G

Rs 485

Meaning of symbols on the instrument



Warning concerning a point of danger
(Attention:observe documentation)



Equipment protected throught by
Double insulation or reinforced
insulation



DC voltage /Current



AC/DC voltage



Isolation between input versus all
other circuit is 3.7 KV.

- Notes -

- Notes -

- Notes -

WARRANTY

Dear Customer,

You are now the privileged owner of Transducer product that ranks the first of its kind in the world.

Company provides 12 months warranty from the original date of Purchase against defective material and workmanship.

In the unlikely event of failure of this meter / accessories within the warranty period, Company will repair meter / accessories free of charge, Please hand over the meter / accessories to the dealer / stockist from whom you have purchased along with this card and relevant Cash memo / Invoice. This warranty entitles you to bring the meter / accessories at your cost to the nearest stockist / dealer and collect it after repairs.

NO TRANSPORTATION CHARGES WILL BE REIMBURSED.

The warranty is not valid in following cases:

1) Warranty card not duly signed and stamped, and original Cash memo / Invoice are not sent along with Transducer .
2) Complete warranty card is not presented to authorised person at the time of repairs.
3) Meter / accessories is not used as per the instructions in the instruction manual.

4) Defect caused by misuse, negligence, accidents, tampering and Acts of God.

5) Improper repairing by any person not authorised by the company.

6) Any sort of Modification, Alteration is made in electrical circuitry.

7) Seal provided inside is broken.

In case of dispute to the validity of the warranty, the decision of Company service center will be final.

If you bought this product directly from the company, and if you notice transit damage, then you must obtain the insurance surveyors report and forward it to Company.

Thank you.

(To be filled by authorised dealer)

Model No. :_____

Serial Number :_____

Date of Purchase :_____

Cash Memo / Invoice No. :_____

Dealer's / Stockist's Signature :_____

Dealer's / Stockist's Stamp :_____

Scope of supply :

1) Transducer
2) Instruction Manual
3) Test Certificate
4) Warranty Card
5) RS-232 Interface Cable
*6) Software

* Only with Programmable Transducer

- Notes -

The Information contained in these installation instructions is for use only by installers trained to make electrical power installations and is intended to describe the correct method of installation for this product. However, Manufacturer has no control over the field condition which influence product installation.

It is the user's responsibility to determine the suitability of the installation method in the user's field conditions. Manufacturer only obligation are those in manufacturer condition of sale for this product or in no case will manufacturer be liable for any other incidental, indirect or consequential damages arising from the use or misuse of the products.

Sifam tinsley
PRECISION INSTRUMENTATION

Sifam Tinsley Instrumentation
3105, Creekside Village Drive,
Suite No 801,Kennesaw,
Georgia 30144
Contact Number: +1.404.736.4903
Web: www.sifamtinsley.com

Sifam Tinsley Instrumentation Ltd.
Central Buildings, Woodland Close,
Old Woods Trading Estate,
Torquey, Devan, England, TQ27BB
Website: www.sifamtinsley.com/uk
Contact Number: +44(O) 1803 615139
E-mail: infotinsley.co.uk