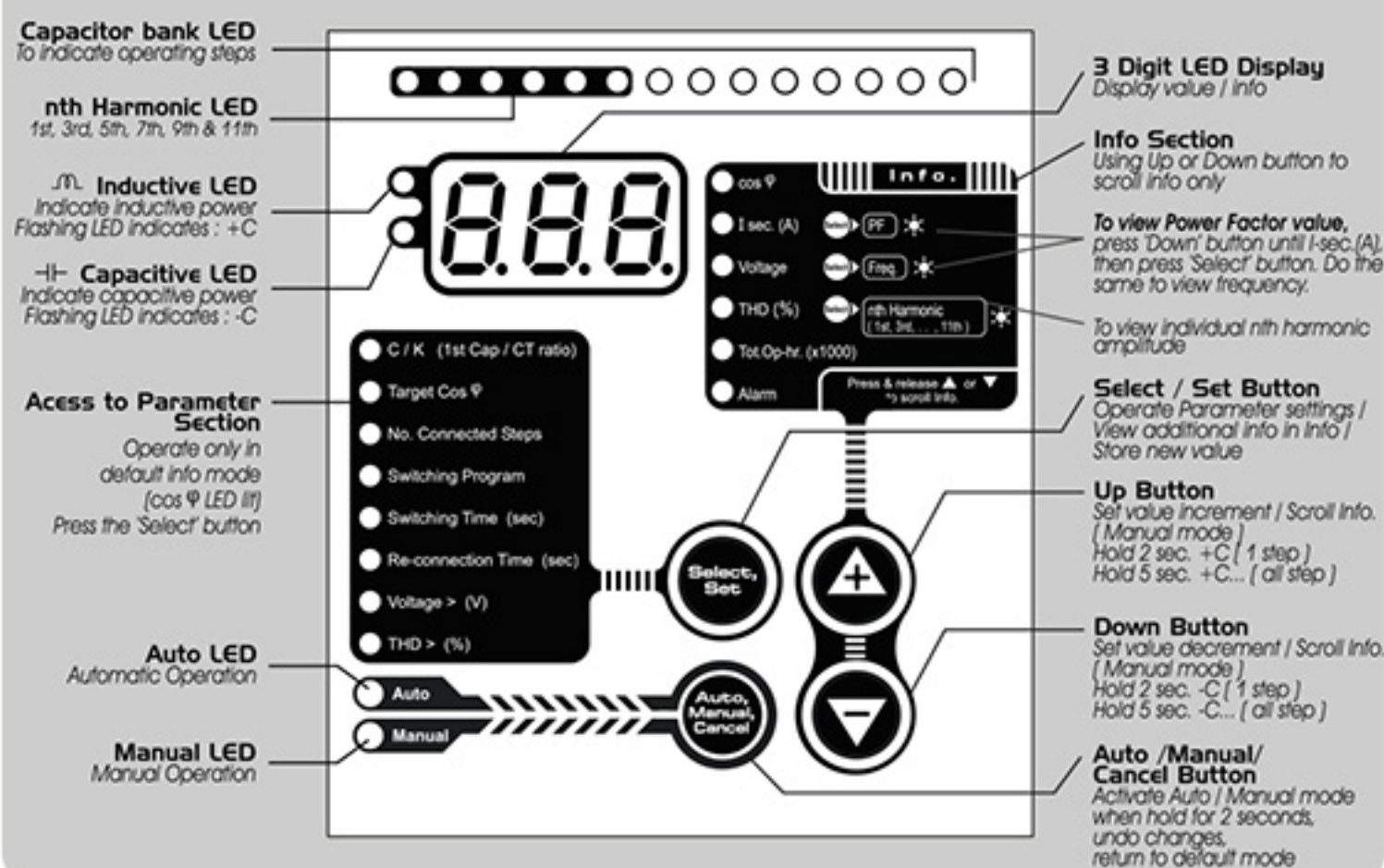


features

- Micro-processor based
- Digital power factor display
- Programmable / Auto switching sequence
- LED indication for individual step
- Auto / Manual operation
- Automatic detection of C.T. polarity
- Automatic C/K detection
- Secondary current / THD info
- Voltage / Frequency info display
- THD monitoring for current and voltage
- Programmable over-voltage alarm
- Programmable software lock
- Alarm output (Under/Over compensate/Over voltage)
- Individual nth odd harmonic amplitude info for current and voltage
- Flush mount

Panel Description



Specifications / Exhaust fan control

Exhaust Fan control / Technical data and setting range

Exhaust fan control

Automatic timer operation of exhaust fan when steps in use.

Maximum ON time : 30 minutes

Minimum OFF time : 5 minutes

The timer operation will help to keep the fan from over-heating from continuous operation.

Technical Data

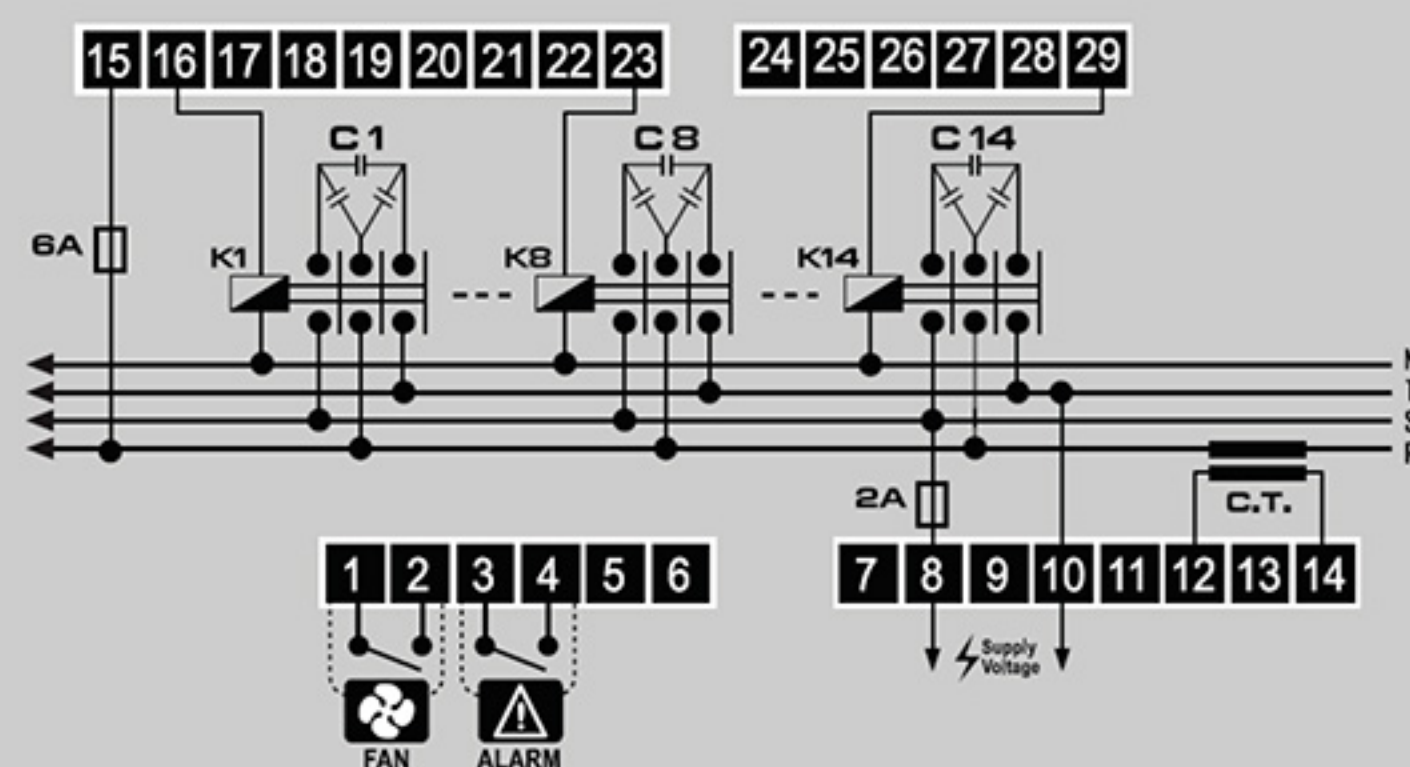
Power Supply	240 VAC \pm 10%
Rated Current (In)	.. / 5A
Working Current	0.02 ~ 10A
Operating Frequency	47 ~ 63 Hz
Output Relay / Alarm / Fan	5 A / 250 VAC
No voltage release	< 40 ms
Weight	~ 750g
Operating Temperature	0°C to +55°C

Specifications subject to change without prior notice.

Setting Range

C / K value	: 0.02 - 1.00
COS ϕ (target power factor)	: 0.85 (ind) - 0.95 (cap)
Switching Program	: P-0 - P-6 or custom
Switching Interval	: 2 - 200 sec.
Re-connection time	: Off / 1-250 sec.
Voltage (V)	: Off / 240 - 270 V
THD (%) (I) current	: Off / 20 - 100 %
THD (%) (V) voltage	: Off / 2.0 - 20.0 %

Wiring Diagram



Start-up / Default mode

Informations when powering-up the unit

Start-up

During start-up, the steps LED may flash, indicating that the steps will not be turn on until the re-connection time delay is over. The unit automatically enters default mode upon power-up or when left in any other mode for more that 20 secs.

Parameter setting section

A few of the parameters may require the user to set appropriately in order to achieve optimum compensation.)

Default mode

In default mode, the cos ϕ LED is lit. The unit will either show the power factor of existing load (cos ϕ) or $\cos \phi$ if secondary current < 0.02A

Info section

Press [Up] or [Down] to access to the info section.

Parameter setting section

To access to parameter setting section, make sure that 'cos ϕ ' LED is lit (default mode) then press [Select].

Auto / Manual Operation mode

To set Auto or Manual mode

User can activate Auto or Manual mode only when the unit is in default mode.

In Auto mode, the unit will automatically operate the steps based on load condition and setting parameters. In Manual mode, user will need to operate the steps by pressing [Up] or [Down].

(Default modes = info mode @ cos ϕ)

* If keypad lock in ON, manual mode cannot be activated. (Refer to pg. 12 for Keypad lock)

To activate Auto / Manual mode :



Manually selecting which cap bank to step in or out :

In Manual mode, user can select any available cap bank to step in or out by following the steps below:

- Step 1 : Enter manual mode by pressing 'Auto / Manual' button for 2 seconds
 - Step 2 : Press 'Select' button until the No. of Connected Steps LED is lit
 - Step 3 : Press & hold the 'Up / Down' button for 2 seconds
 - Step 4 : Select the desired cap bank to be step in using the 'Up / Down' button (Inductive LED will lit)
 - Step 5 : Press Select / Set button once to step IN (Inductive LED will blink) or OUT (Capacitive LED will blink)
- (User can step IN or OUT any cap banks by selecting with the Up / Down button and press the Set button.)
- To exit, press the Cancel button twice.

Parameter Setting

To adjust parameters for optimum compensation

Press 'Select' button while in default mode to access to Parameter Setting mode (Default modes = info mode @ cos ϕ)

C / K	Auto / Manual Sensitivity setting = 1st cap.Bank(Kvar) + CT ratio
Target Cos ϕ	Power factor to be achieved
No. Connected Steps	The number of capacitor bank connected to network
Switching Program	Custom program / Auto / 7 selectable switching programs.
Switching Time	Capacitor bank switching delay time (sec)
Re-connection Time	Re-connection delay time (sec)
Voltage > (V)	Over-voltage limit
THD > (%) current & voltage	Total harmonic distortion limit

Select, Set

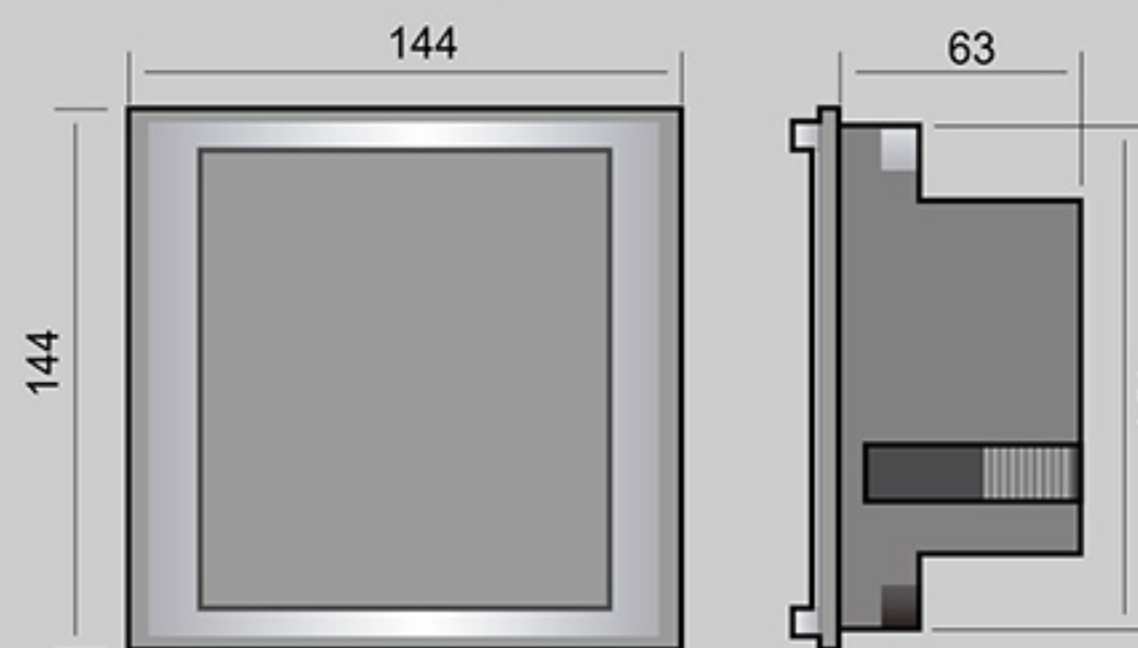
Press Up or Down button to adjust

(For fast increment or decrement, hold the UP or Down button while pressing it)

Press Set button to store new value and proceed to the next mode or Cancel to exit

Casing Dimension

All measurement in millimeters



Panel cut-out 136 x 136 mm

C/K setting

To set C/K value for optimum compensation

In default mode, press [Select] once to enter parameter section. C/K LED is lit. Set the correct C/K value using the [Up] or [Down] button. Newly selected C/K value will flash. Press [Select] to store / confirm new value, or press [Cancel] to undo changes while flashing. Set value to 'AUT' for automatic C/K detection. However, if load is fast-varying, auto detection may not be possible. It is recommended to manually set the C/K if possible. Follow the example below.

The C/K value is defined as the ratio of the 1st capacitor to the C.T. ratio.

Calculation of C/K

E.g. 1st cap bank= 25KVAR (true kvar)
(CT) ratio = 800/5 = 160

ratio C/K value = KVAR (1st cap) ÷ CT
= 25 ÷ 160
= 0.15

It is recommended to set C/K to a slightly lower than calculated value, so in the above example, set C/K value to 0.13 (approx. 80% of calculated)

Actual kvar versus rated kvar of Capacitor

The rated kvar of capacitor is true only if the rated voltage is supplied. In case when rated supply is very much different from the voltage supply, follow the example below to calculate the true kvar.

True kvar = $\frac{(\text{actual voltage})^2}{(\text{rated voltage})^2} \times \text{rated kvar}$

e.g. 30 kvar rated 525 V
actual voltage supply = 415 V

Then true kvar = $\frac{415^2}{525^2} \times 30$
= 19 kvar

Target cosφ setting

To set target cosφ for optimum compensation

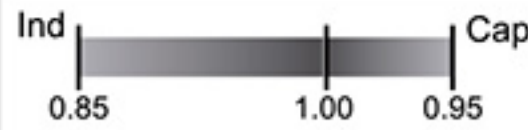
Press [Select] once when in C/K setting mode.

Target cosφ LED is lit.

The set value is displayed.

To change, press [Up] or [Down] then press [Set] to confirm.

It is recommended not to set target value to < 0.90 ind.



No. of connected steps

To set the number of capacitor bank to be utilized in the network

Press [Select] once when in Target cosφ setting mode.

The existing value is displayed.

Set correctly the number of available capacitor bank that would be utilized in the network using [Up] or [Down].

Press [Set] to confirm / store.

Switching Program

To select preset or auto or customize program sequence

Press [Select] once when in no. of connected step setting mode. Switching Program LED is lit. The current selection is displayed.

User can select one of the 7 preset sequence 'P-0' to 'P-6' or select 'Aut' (Auto) and let the unit detects the ratio of the individual cap banks. Alternatively, user can select 'CUS' to customize the ratio of individual cap banks if auto detection fails. Press [Up] or [Down] to modify the switching program. The new selection will be flashing on the display. Press [Set] to confirm the new selection.

To view selected preset description

Press [Up] and [Down] simultaneously and hold for 2 secs. If selection is flashing press [Set] to confirm selection first. Scrolling description will be displayed.

Program Sequence	
P-0	Linear
P-1	1 1 1 1 1
P-2	1 2 2 2 2
P-3	1 1 2 2 2
P-4	1 1 1 2 2
P-5	1 2 4 4 4
P-6	1 1 2 2 4

Auto / Custom Selection

Select 'Aut' only if load is not fast varying such that detection of the capacitor is possible. In case of fast varying load, chose preset or customize individual step ratio.

When 'CUS' is selected, unit will prompt user to enter the ratio of the current capacitor step starting from step 2 (1st step is always a ratio of 1.0). Press [Up] or [Down] to select a ratio between 1.0 to 10.0, then press [Set] to confirm and go on to next step as indicated by the step LEDs located at the top.

When all ratios are set (determined by the no. of connected steps), pressing [Select / Set] will move on to next setting mode.

Ratio setting range:

1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 4.0 | 5.0 | 6.0 | 8.0 | 10.0

Example:

Steps	1	2	3	4
kvar	5	10	15	15
ratio	1.0 (fixed)	2.0	3.0	3.0

To skip setting or viewing of customized ratio, press [Select] and hold for 2 secs.

Switching time

To set switching time

Set the appropriate switching time in seconds. This interval allows load condition to settle such that frequent switching can be avoided.

In default mode, press [Select] until re-connection LED is lit. Press [Up] or [Down] to set value. The new value will be flashing on the display.

Press [Set] to confirm the new value.

Re-connection time

To set delay time for reconnection

To prolong the life of the capacitor bank, it is recommended to set a delay time for re-connection to prevent steps which have just step out from connecting again immediately as the capacitor bank needs to discharge. User will have the option to turn off the re-connection time or set from 1second to maximum 250 seconds.

In default mode, press [Select] until re-connection LED is lit. Press [Up] or [Down] to set value. The new value will be flashing on the display.

Press [Set] to confirm the new value.

Voltage > (V)

To set over-voltage monitoring

Press 'Select' while in default mode until the Voltage > (V) LED is lit. The display will show 'OFF' which means that over-voltage is not monitored. To change, press 'Up / Down' to adjust the desired value for over-voltage monitoring then press 'Set' to confirm setting. Alarm LED will lit and alarm contact will be energized to indicate over-voltage condition.

Over-voltage protection for capacitor

If 'OFF' is set to 'ALL' or 'OV', all steps will turn off one at a time until no more steps are connected when over-voltage alarm is active. Alarms automatically clears when voltage drops below set limit and the unit resumes normal operation.

THD > (%) for current & voltage

To set total harmonic distortion monitoring for current & voltage

Press 'Select' while in default mode until the THD > (%) LED is lit. I sec LED is also lit to indicate existing THD setting is for current. Use the 'Up / Down' button to change value. Press 'Set' to store new value or proceed to THD setting for voltage. Voltage LED will be lit to indicate THD setting for voltage harmonic limit. Use the 'Up / Down' button to modify and press 'Set' button to store new value or exit. User can set to 'OFF' (for current & voltage harmonic limit) if no THD alarm is required.

THD protection for capacitor

If 'OFF' is set to 'ALL' or 'EHD', all steps will turn off one at a time until no more steps are connected. Alarms automatically clears when THD (%) drops below set limit and the unit resumes normal operation.

Info Section

To view info only



Additional info can be view by pressing the 'Select' Button as indicated on the info panel
(Flashing LED indicates additional info being selected)

Press & release 'Up' or 'Down' button when in default mode to scroll information

Cos φ	Displacement power factor (Default Mode)
I secondary (A)	Real-time secondary CT current (Ampere) Press [Select] to view Actual Power Factor
Voltage info	Real-time line voltage value Press [Select] to view Frequency(Hz) value
THD (%) (Current & Voltage)	Total Harmonic Distortion (Current : Load > 0.30 A) Press [Select] to view individual nth odd harmonic amplitude up to 11th order
Operation hr	Operation hour x 1000 hours e.g. (0.01 x 1000 = 10 hours in operation)
Alarm info.	Alarm warnings :- 0.0 - Under Compensate 0.0 - Over Voltage Err - Out of Freq. Range : 47Hz - 63Hz 0.0 - Under Voltage : power supply less than 200 VAC 0.0 - Over Compensate Err - Total Harmonic Distortion --- - No active alarm

Flashing alarm LED indicates alarm is active.
If multiple alarms are active, press [Select] to scroll through all active alarms.

I-sec. (A) / Power Factor

To view I-sec (A) and Power Factor

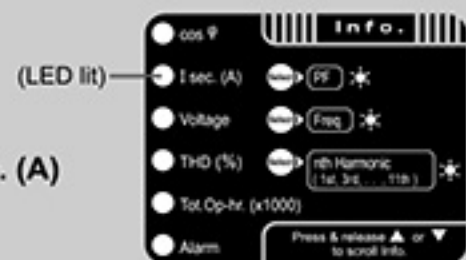
I-Sec (A)

In default mode, press the 'Down' button until THD (%) and the I-sec. (A) LED are lit.

Press the 'Select' button once to view the Power Factor value.

(I sec.(A) LED will flash).

To exit, press 'Cancel' button.



Voltage / Frequency

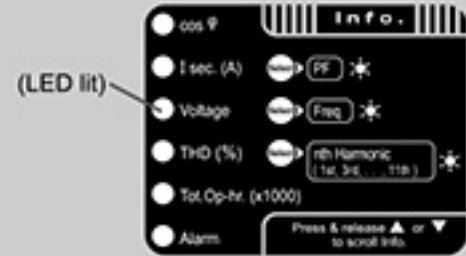
To view Voltage and Frequency

Voltage

In default mode, press the 'Down' button until Voltage LED are lit to view Voltage value.

Press the 'Select' button once to view the the Frequency value.
(Voltage LED will flash).

To exit, press 'Cancel' button.



THD (%)

To view THD I-sec. and THD Voltage value

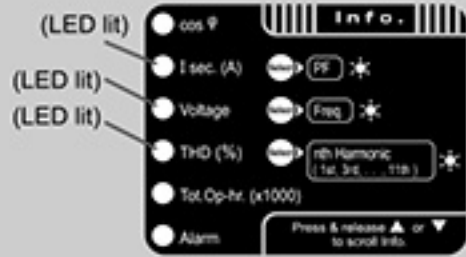
THD (%)

In default mode, press the 'Down' button until THD (%) & I-sec. LED are lit to view THD (I-sec.) value.

Press the 'Down' button once more to view the THD (Voltage) value.

Both THD (%) & Voltage LED are lit.

To exit, press 'Cancel' button.



Individual I-sec Harmonics

To view individual nth odd harmonic amplitude for I-sec (A)

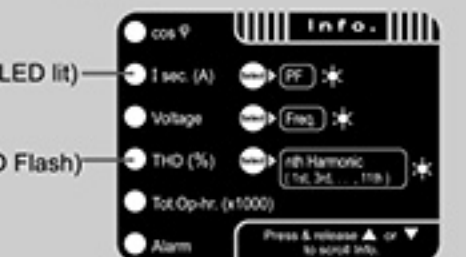
I-Sec (A)

In default mode, press the 'Down' button until THD (%) and the I-sec. (A) LED are lit.

Press the 'Select' button once to view the 1st harmonic amplitude for I-sec (A). (THD LED will flash).

Continue pressing the 'Select' button to scroll thru' the odd harmonic order up to 11th order.

To exit, press 'Cancel' button.



Individual Voltage Harmonics

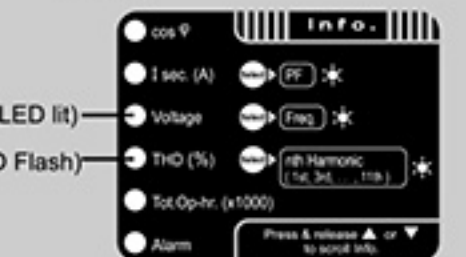
To view individual nth odd harmonic amplitude for Voltage

Voltage

In default mode, press the 'Down' button until THD (%) and the Voltage LED are lit.

Press the 'Select' button once to view the frequency for Voltage
(THD LED will flash).

To exit, press 'Cancel' button.



Total Operation Hour

To view the total hours of operation

e.g. 0.05 x 1000 = 50 hours

Tot.Op-hr (x1000)

In default mode, press the 'Down' button until Tot.Op-hr (x1000) are lit.

To exit, press 'Cancel' button.

Keypad Lock / Alarm protection mode

To prevent unauthorized or unintentional adjustment of parameters

Select, Set

Auto, Manual, Cancel

While in default mode, press [Select] and [Cancel] button simultaneously and hold for 5 seconds.

Loc Press [Up / Down] to select 'ON' or 'OFF'. Press [Set] button to confirm.

Ptc Press [Up / Down] to select one of the options:

OFF - No protection.	OV - Over Voltage When (Voltage) greater than setting, steps will turn off one at a time.
Ehd - Total Harmonic Distortion When (THD) is greater than setting, steps will turn off one at a time.	ALL - Ehd and OV protection ON.

Pol **Polarity Setting** : Press [Up / Down] to select 'Aut' or 'OFF'
Set to 'Aut' for automatic C.T. polarity detection.
Set to 'OFF' in case automatic polarity detection is not possible and user will need to configure C.T. wiring manually at terminal 12 & 14.

Fre **Frequency Setting** : Press [Up / Down] to select 'Aut' or '50' or '60'
Set to 'Aut' for operation of device based on network frequency. The allowance network frequency is 47Hz ~ 63Hz. In case network is too noisy and frequency detection is giving an alarm 'FrE', user may fix this option to 50Hz or 60Hz depending on the network frequency.

Alt **Alternate Setting** : Press [Up / Down] to select '30', '60', '120' or 'OFF'
This option allows the device to alternate the capacitors in commission. It functions by switching on one extra capacitor step in the same grouping such that the network will over achieve the target cosφ and then allowing the device to switch off the capacitor step which has been in commission for the longest period in the same capacitor grouping. User may set this alternating function every 30 mins, 60 mins, 120 mins or off if not desirable. This option functions only if there are available steps in the same grouping. Priority is given to capacitor steps with higher grouping.

When Loc mode is set to 'ON', user can only view setting parameters but will not be allowed to change any settings. Manual mode cannot be activated.