

# Contents

<b>Start-up</b> Informations on power-up the unit	2	<b>Switching Program</b> Auto, custom or preset operation	9
<b>Panel description</b> Overview / Buttons function	3	<b>Switching / re-connection time</b> To set switching / delay time	10
<b>Auto / manual operation</b> To set Auto or Manual mode	4	<b>Voltage / THD</b> Over-voltage / THD protection	11
<b>Info section</b> Viewing additional info	5	<b>Keypad lock / Cap protection</b> Prevent unauthorized adjustment / Cap protection mode	12
<b>Setting parameters section</b> Adjustment for optimum compensation	6	<b>Exhaust fan / Specifications</b> Fan control / Technical data, setting range	13
<b>C/K setting</b> To set C/K value for optimum compensation	7	<b>Casing dimension</b> Panel cut-out	14
<b>Target cos<math>\phi</math> setting</b> To set target cos $\phi$ for optimum compensation	8	<b>Wiring diagrams</b>	15
<b>No. connected steps</b> To set no. of cap bank to be utilized in the network	8	<b>I-Sec / Voltage Harmonics</b> To view individual nth odd harmonic amplitude	16

## 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.

**Default mode**

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

**Parameter setting section**

A few of the parameters may require the user to set appropriately in order to achieve optimum compensation. (Refer to pg. 7-11 on setting of parameters.)

**Info section**

Press [Up] or [Down] to access to the info section. (Refer to pg.5 on info section)

**Parameter setting section**

To access to parameter setting section, make sure that 'cos $\phi$ ' LED is lit (default mode) then press [Select]. (Refer to pg.6 on Parameter setting)

## Panel Description

**Capacitor bank LED**  
To indicate operating steps

**nth Harmonic LED**  
1st, 3rd, 5th, 7th, 9th & 11th

**Inductive LED**  
Indicate inductive power  
Flashing LED indicates +C

**Capacitive LED**  
Indicate capacitive power  
Flashing LED indicates -C

**Access to Parameter Section**  
Operate only in default info mode (cos $\phi$  LED lit)  
Press the 'Select' button

**Auto LED**  
Automatic Operation

**Manual LED**  
Manual Operation

**3 Digit LED Display**  
Display value / info

**Info Section**  
Using Up or Down button to scroll info only

To view Power Factor value, press 'Down' button until f=cos(A), then press 'Select' button. Do the same to view frequency.

To view individual nth harmonic amplitude, please refer to pg. 16

**Select / Set Button**  
Operate Parameter settings section / View additional info in info section / Store new value

**Up Button**  
Set value increment / Scroll Info. (Manual mode)  
Hold 2 sec. +C (1 step)  
Hold 5 sec. +C... (all step)

**Down Button**  
Set value decrement / Scroll Info. (Manual mode)  
Hold 2 sec. -C (1 step)  
Hold 5 sec. -C... (all step)

**Auto / Manual / Cancel Button**  
Activate Auto / Manual mode when hold for 2 seconds, undo changes, return to default mode

## 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 $\phi$ )

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

### To activate Auto / Manual mode :

Auto

Manual

Hold for 2 seconds to step in once (+C)  
Hold for 5 seconds to step in all (+C...) continuous step in

Hold for 2 seconds to step out once (-C)  
Hold for 5 seconds to step out all (-C...) continuous step out

Press and hold the 'Auto/Manual' button for 2 seconds to switch between Auto or Manual mode.

Press [Cancel] once to stop continuous manual step in / out.

### 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:

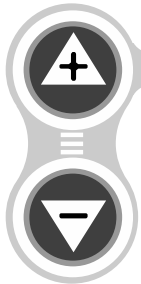
- Step 1 : Enter manual mode by pressing 'Auto / Manual' button for 2 seconds
- Step 2 : Press 'Select' button until the No. of Connected Steps LED is lit
- Step 3 : Press & hold the 'Up / Down' button for 2 seconds
- Step 4 : Select the desired cap bank to be step in using the 'Up / Down' button (Inductive 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.

## Info Section

To view info only

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



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

<b>Cos φ</b>	Displacement power factor (Default Mode)
<b>I secondary (A)</b>	Real-time secondary CT current (Ampere) Press [ Select ] to view Actual Power Factor
<b>Voltage info</b>	Real-time line voltage value Press [ Select ] to view Frequency(Hz) value
<b>THD (%)</b> (Current & Voltage)	Total Harmonic Distortion (Current : Load > 0,30 A ) Press [ Select ] to view individual nth odd harmonic amplitude up to 11th order
<b>Operation hr</b>	Operation hour x 1000 hours e.g. ( 0.01 x 1000 = 10 hours in operation )
<b>Alarm info.</b>	Alarm warnings :-

- Under Compensate	- Over Compensate
- Over Voltage	- Total Harmonic Distortion
- Out of Freq. Range : 45Hz - 67Hz	
- No active alarm	
- Under Voltage : power supply less than 200 VAC	

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

5

## 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 )

<b>C / K</b>	Auto / Manual Sensitivity setting = 1st cap.Bank(Kvar) ÷ CT ratio
<b>Target Cos φ</b>	Power factor to be achieved
<b>No. Connected Steps</b>	The number of capacitor bank connected to network
<b>Switching Program</b>	Custom program / Auto / 7 selectable switching programs. (Refer to pg.9)
<b>Switching Time</b>	Capacitor bank switching delay time (sec)
<b>Re-connection Time</b>	Re-connection delay time (sec)
<b>Voltage &gt; (V)</b>	Over-voltage limit
<b>THD &gt; (%) current &amp; voltage</b>	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

6

## 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. 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.

### Calculation of C/K

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

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

C/K value = KVAR (1st cap) ÷ CT ratio  
= 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.

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

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

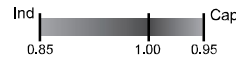
$$\begin{aligned} \text{Then true kvar} &= \frac{415^2}{525^2} \times 30 \\ &= 19 \text{ kvar} \end{aligned}$$

7

## 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.

8

## 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 8.0, 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.

9

## Switching time

To view info only

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.

10

## 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 [OV] is set to [ON] or [OFF], 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. 1 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 [THD] is set to [ON] or [OFF], 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.

11

## Keypad Lock / Alarm protection mode

To prevent unauthorized or unintentional adjustment of parameters

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

Select, Set

[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.

[Thd] - Total Harmonic Distortion  
When (THD) is greater than setting, steps will turn off one at a time.

[ALL] - [Thd] and [OV] protection ON.

Auto, Manual, Cancel

[POL] 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] 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] 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 cos $\phi$  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.

12

## 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 $\pm 10\%$ or other on request	
Rated Current (In)	.. / 5A (same phase with power supply)	
Working Current	0.02 ~ 10A	
Rated Frequency	45 ~ 65 Hz	
Output Relay / Alarm / Fan	5 A / 250 VAC	
No voltage release	< 20 ms	
Weight	~ 700g (NV-8s)	~ 750g (NV-14s)
Operating Temperature	0° to +55° C	

#### Setting Range

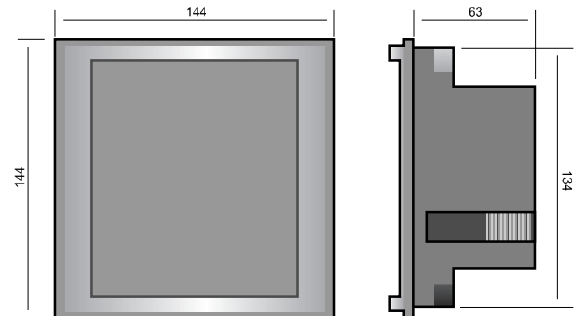
C / K value	: 0.02 - 1.00
COS $\Psi$ (target power factor)	: 0.85 (ind) - 0.95 (cap)
Switching Program	: P-0 - P-6
Switching Interval	: 2 - 60 sec.
Re-connection time	: Off / 1-250 sec.
Voltage (V)	: Off / 240 - 270 V
THD (%) (I) current	: Off / 20 - 100 %
THD (%) (V) voltage	: Off / 2.0 - 20.0 %

Specifications subject to change without prior notice.

13

## Casing Dimension

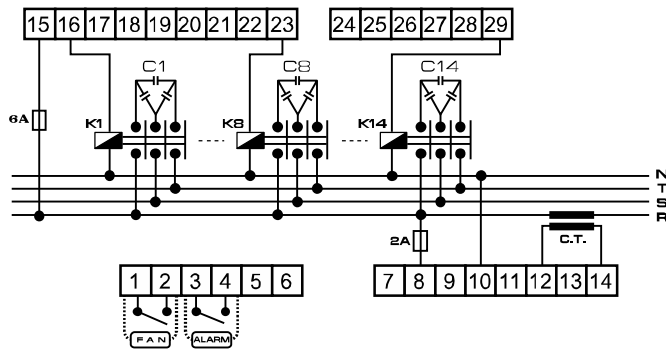
All measurement in millimeters



**Panel cut-out 136 x 136 mm**

14

## Wiring Diagram



15

## Individual I-sec / Voltage Harmonics

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

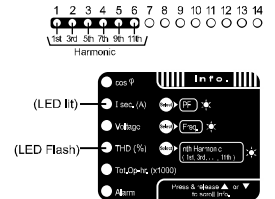
### I-Sec (A)

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.



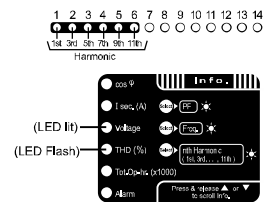
### Voltage

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

Press the 'Select' button once to view the 1st harmonic amplitude for Voltage. (**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.



16