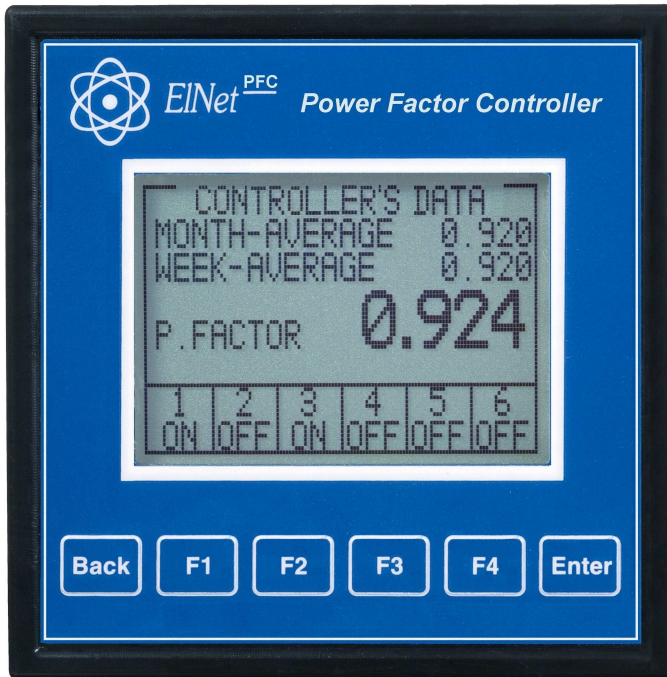


Supervision & control system

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Elnet PFC

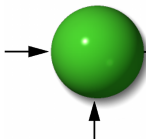
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Power Factor Controller

Rev. 1.4

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CHAPTER 1 – Electrical Wiring

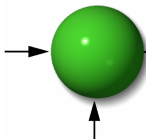
1.1. Electrical connections

All Connections, except those to the CT core of the *EI*Net PFC Power Factor Controller are made via terminal connector plugs. Recommended max tightening torque for the connector screws is 0.5 Nm.

The CT cores of the *EI*Net PFC Power Factor Controller are located externally on the rear of the instrument and the lead from the leg of the external Current Transformer must pass through in the correct direction.

NOTE!

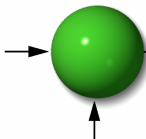
Ensure all the connections to the leads of the current transformer wiring are secure and there is no mechanical strain on the wire. The cross section of the leads to the Current transformer must be compatible with the power of the current transformer. We recommend a power transformer with at least 3VA and the length of the wiring of the transformer should not exceed 5m.



1. Insert the lead from side "K" of the Current Transformers of Line 1 through the hole marked "I1" – "K" of the *ElNet* PFC Power Factor Controller.
2. Repeat the procedure for Line 2 and Line 3 ("I2"/"I3"/"K").
3. Connect the rest of the connections to the *ElNet* PFC Power Factor Controller by means of terminal connector plugs.
All Rear Panel connections are according to the wiring diagram (See Figures 1.1, 1.2) and are easy to follow.

WARNING!

Never allow an open circuit between "K" & "L" of the Current Transformers.



1.2. Electrical Wiring Diagrams

Notice!

The distance between the external current transformer and the Elnet will not exceed 5m

Attention! Maximum current for contactors **R1** up to **R6** is up to **3A**

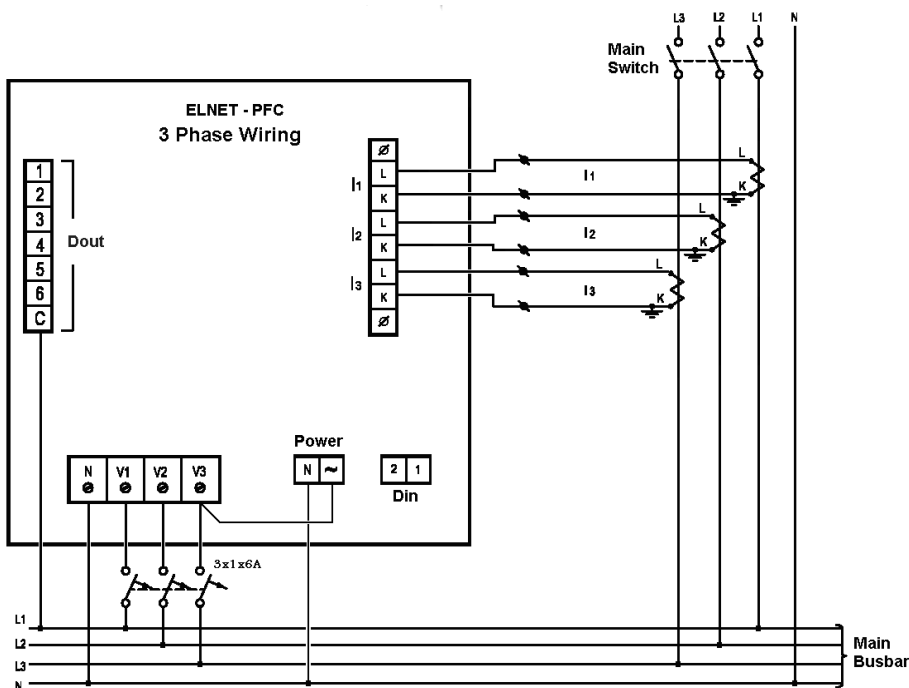


Figure 1.1 – Three Phase Electrical wiring diagram

Notice!

The distance between the external current transformer and the Elnet will not exceed 5m

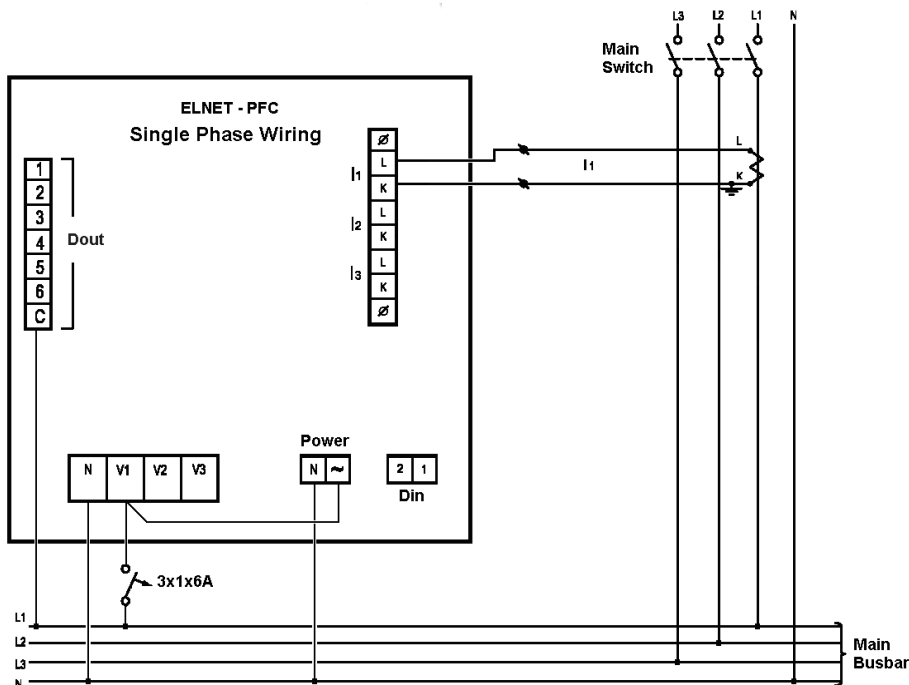
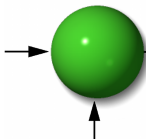


Figure 1.2 – Single Phase Electrical wiring diagram



Pin Designation	Description	Remarks
V1	Line 1 - Voltage Supply	Use 6Amp fuse to protect the line
V2	Line 2 - Voltage Supply	Use 6Amp fuse to protect the line
V3	Line 3 - Voltage Supply	Use 6Amp fuse to protect the line
I1	From external Current Transformer on Line1	Note the correct direction to insert the lead
I2	From external Current Transformer on Line2	Note the correct direction to insert the lead
I3	From external Current Transformer on Line3	Note the correct direction to insert the lead
~	Power 110 - 280 VAC	OR 90-250 VDC
N	Neutral	Neutral Line
Digital Out 1 2 3 4 5 6	Relay outputs for switching the capacitor's contactors.	Recommended operational load up to 5 Amp
C	Common connector for feeding voltage\neutral to all the contact relay outputs.	

Figure 1.3 – Connections on the back of the device

1.3. Test Relays Screen

1. From the Main Menu scroll to Settings and press "Enter".

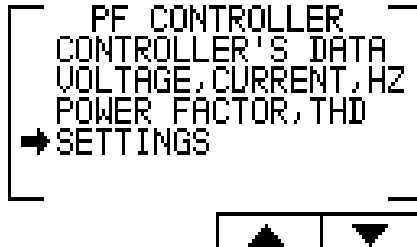


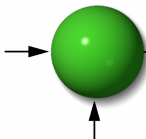
Figure 1.4 – Access the Settings screen

2. The ENTER CODE screen appears.



Figure 1.5 – Enter Code screen

3. The password to activate the Test Relay screen is **789**.
4. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".

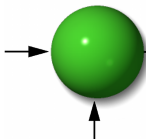


5. The TEST RELAY screen will appear.

TEST RELAY					
1	2	3	4	5	6
OFF	OFF	OFF	ON	OFF	ON

Figure 1.6 – Test Relay screen

6. Use the navigation buttons to force and release the relevant output.
7. When finished hold the "Back" pushbutton until the main menu appears.



CHAPTER 2 – Power Factor Controller

2.1 General Information.

ElNet PFC Power Factor Controller enables measurement and display of voltage, current, frequency, power factor, THD current and THD voltage.

Based on the above mentioned measurements *ElNet* PFC corrects the power factor by switching the capacitors.

Elnet PFC enables automatic identification of capacitors' size and its connection in various methods.

ElNet PFC Main Menu includes the following functions:

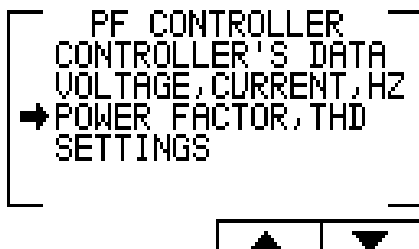


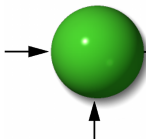
Figure 2.1 – Main Menu

Controller's data screen - enables displaying the readings of power factor and the capacitor status.

Voltage, Current, Hz screen - enables displaying the readings of voltage, current and frequency measurements.

Power Factor, THD screen - enables displaying the readings of power factor, THD voltage and current per phase.

Settings screen - enables setting all values requested for proper operation of the power factor controller.



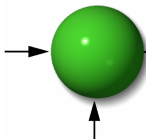
2.2 Controller's Data Screen.

Selection of "CONTROLLER'S DATA" from the main menu displays monthly and weekly average power factor (from the last power startup) and also real time power factor. In addition, at the bottom line you can see which capacitors are connected and which ones are disconnected. In case of fault one of the following messages appears:

- **"Low Current"** – Appears in case of measured current is lower than in the allowed "Working range" definitions.
- **"High THD"** - Appears in cases of measured current\ voltage THD is higher than in the allowed "Working range" definitions.
- **"Volt Range Error"** - Appears in cases of measured voltage is lower\ higher than in the allowed "Working range" definitions.
- **"Capacity Load"** - Appears in cases of the system is turned to capacitive.
- **"Need More Capacitors"** – Appears in cases of all the capacitors are ON, however the desirable Set Point is unreachable.

DATA SCREEN					
MONTH-AVARAGE		0.920			
WEEK-AVARAGE		0.920			
PF		0.927			
1	2	3	4	5	6
OFF	OFF	OFF	ON	OFF	ON

Figure 2.2 – Data Screen



2.3 Voltage, Current, Hz.

Selection of "Voltage, Current, Hz" menu from the main menu will grant access to all the basic measuring of the device.

1. From the Main Menu scroll to the Voltage, Current, Hz menu and press "Enter", the Voltage screen appears.

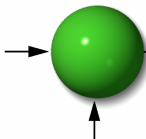
L1	220.5 v	
L2	220.1 v	
L3	220.2 v	
V-P	I	F

Figure 2.3 – Voltage, Current, Hz.

2. Use the F1, F2, F3 pushbuttons to choose the monitored on screen data (Voltage, Current, Frequency).

2.4 Power Factor, THD.

Selection of "Power Factor, THD" menu from the main menu will grant access to the readings of Power Factor per line, and to the THD of voltage and current per line.



1. From the Main Menu scroll to the Power Factor, THD menu, and press "Enter", the Power Factor screen appears.

L1	0.91 PF
L2	0.92 PF
L3	0.92 PF
THD-V	THD-I

Figure 2.4 – **Power Factor** screen.

2. Pressing on "F1" (THD-V), "F2" (THD-I) buttons allow to access the THD data screens.

THD-V	
L1	THD-V 0.00 %
L2	THD-V 0.00 %
L3	THD-V 0.00 %
MAX. THD-V -----	
THD-V	THD-I

Figure 2.5 – **THD** screen.

CHAPTER 3 – Power Factor Controller Settings

In order to set all values requested for proper operation of the Power factor controller, the following settings must be defined: Transformer Ratio, Vital Setting, Non Vital Setting & Working Range.

3.1 Single \ Three Phase modes.

1. Setting the PFC to operate in single phase or three phase mode will effect only on the screen appearance the rest of the features and settings will remain to be the same as described in the other chapters of this manual.
2. From Main Menu scroll to SETTING and press "Enter", The Enter Code screen appears.

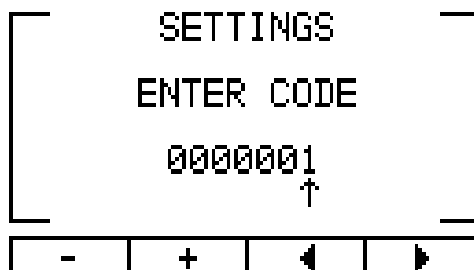
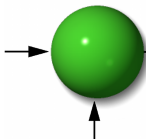


Figure 3.1 - Enter Password

The password is 1.



3. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".
4. The **Setting** screen appears.

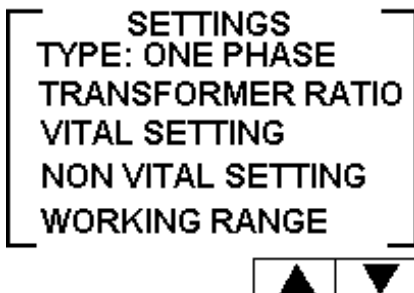


Figure 3.2 – **Settings**.

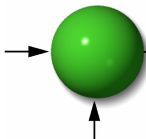
5. Scroll to TYPE and click Enter in order to change the mode between single phase and three phases.

3.2 Transformers Ratio.

1. From Main Menu scroll to SETTING and press "Enter", The Enter Code screen appears.

NOTE!

If the incorrect password is inserted into the Password field, an Error message appears and the password should be reentered



2. The **Setting** screen appears. (Please see figure 3.2).
3. Scroll to "Transformer Ratio" and press "Enter". The Transformer Ratio screen appears.
4. In order to set the **Current Transformers** ratio, scroll to Current Trans and press "Enter".

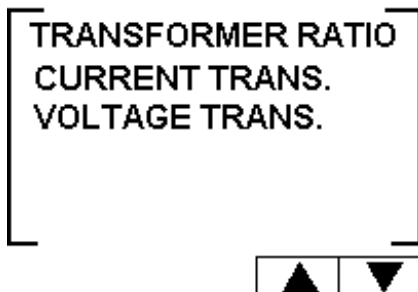


Figure 3.3 – Transformer Ratio.

5. The Current Transformer screen appears.

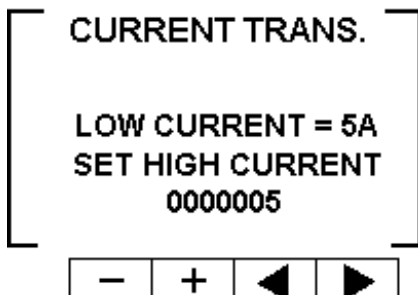


Figure 3.4 – Changing Transformer Ratio.

6. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".
7. In order to set the **Voltage Transformers** ratio, scroll to Voltage Trans and press "Enter".
8. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".

3.3 Vital Setting.

In order to define the Vital Setting, you must access the Setting screen by repeating steps from chapter 3.1, paragraphs 1,2,3.

1. Once the Setting screen appears, scroll to Vital Setting and press "Enter". The Vital Setting screen appears.

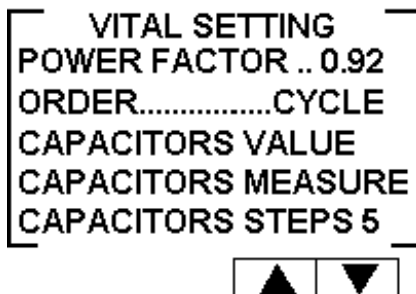
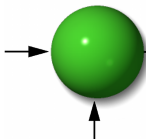


Figure 3.5 – Vital Setting screen.



3.3.1 Setting the Power Factor Set Point:

1. Scroll down to Power Factor and press "Enter".
2. The Power Factor setting screen appears.

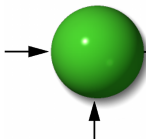


Figure 3.6 – **Power Factor change.**

3. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 &F2, when finished click "ENTER".

3.3.2 Changing the Capacitors Connection Order:

1. At the Vital Setting screen scroll down to "ORDER".
2. Each time you press Enter at the line indicating "ORDER", the connection order options will be changed from the following possibilities: "RANDOM", "FIRST", "CYCLE".
3. The capacitors chosen for power factor correction are chosen according to their size, meaning that it chose the minimal number of the capacitors for achieving the requested value of the power factor.



4. There are a number of methods as following:

"RANDOM" - this method enables random selection of equally-sized capacitors. In this method after a certain period, the number of the working hours, of all equally-sized capacitors will be equal.

"FIRST" - this method enables fixed selection, meaning a certain capacitor will always be first and the other will always be second and third and so on – this method is recommended in places preferring unequal working hours of the capacitors.

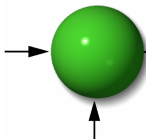
"CYCLE" - whenever there are a few capacitors of equal size there is a possibility to use the "cycle" method so that the number of working hours will be equally divided between these capacitors.

3.3.3 Capacitor's Value setting:

1. In order to define manually the values of the capacitors which are used in the system, at the Vital Setting screen scroll down to Capacitors Value, and press "Enter".
2. The Capacitor Value screen appears.

KVA	CAPACITOR
1.000	1
----	2
----	3
----	4
----	5
----	6

Figure 3.7 – Capacitor Value screen.



3. In order to manually define the value of the capacitor step, use F3 & F4 buttons to scroll between steps, and press "Enter" in order to access the value setup.
4. The Capacitors Value screen appears, Use the buttons F3 & F4 to move the cursor, to set the value use the buttons F1 & F2, when finished click "ENTER".

3.3.4 Capacitor's Value measure:

1. The Elnet PFC enables true capacitors value measure for capacitors 1 up to 6.
2. In order to measure and automatically define the values of the capacitors which are used in the system, at the Vital Setting screen scroll down to Capacitors Measure, and press "Enter".
3. The Value Measure screen appears.

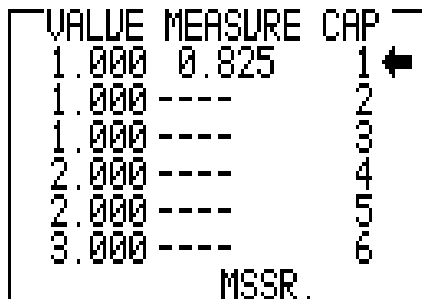
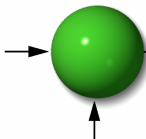


Figure 3.8 – Value measure of the capacitors.

4. Once the Value Measure screen appeared, the PFC will automatically begin measuring process. It will scan and measure each capacitor step, one by one, the whole process may take a few minutes.



5. Once the measuring process is finished, the measured values appear on screen.
6. The column "MEASURE" indicates the measured values.
7. The column "VALUE" indicates the capacitor's value as defined by the user.
8. The "RND" button enables correction of the measured values to the closest rounded value under the condition that the difference between the capacitors doesn't exceed 10%.
9. The "SAVE" button enables saving the measured (and/or rounded) values instead of the values entered by the user at the previous screen "capacitors value".

3.3.5 Capacitor's steps:

1. In order to set the number of the capacitors steps in the system, at the Vital Setting screen scroll down to Capacitors Steps, and press "Enter".
2. The Capacitors Steps screen appears. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".

3.4 Non-vital setting

In order to define the Non-Vital Setting, you must access the Setting screen by repeating steps from chapter 3.1, paragraphs 1,2,3.

1. Once the Setting screen appears, scroll to Non Vital Setting and press "Enter".
2. The Non Vital Setting screen appears.

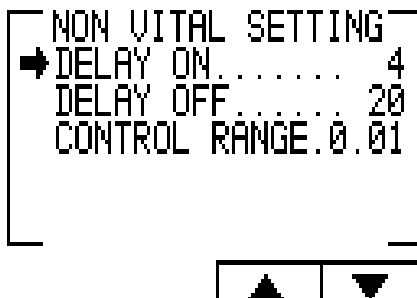


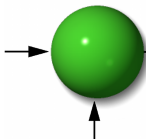
Figure 3.9 – Non vital setting.

3.4.1 "DELAY ON":

1. Delay On enables setting the delay (seconds) between the decision of connecting the capacitor and its actual connection. This delay is meant to minimize the number of connections/disconnections of the capacitors during control of the desired power factor value.
2. In order to change the delay on, scroll to DELAY ON and press "Enter". The Delay On screen appears.
3. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".

3.4.2 "DELAY OFF":

1. Delay Off enables setting the delay (seconds) between the decision of disconnecting the capacitor and its actual disconnection. This delay is meant to minimize the number of connections/disconnections of the capacitors during control of the desired power factor value.
2. In order to change delay off, scroll to DELAY OFF and press "Enter". The Delay OFF screen appears.



3. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".

3.4.3 "CONTROL RANGE":

1. Control Range enables the user to define the working range of the capacitors in performing power factor correction. When the "control range" = 0.01 the system is looking for the minimal capacitors number for performing power factor correction from the desired value (for example, 0.92) to the value $0.93 = 0.92 + 0.01$ (control range). From this point, the system is looking for the minimal capacitors' combination required, for reaching the power factor of 0.93 and its disconnecting capacitors accordingly.
2. In order to change Control Range scroll to Control Range line and press "Enter". The Delay Control Range screen appears.
3. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".

3.5 Working range settings

Working range settings enable defining limits for current, voltage, THD V and THD I values.

In order to define the Working Range Setting, you must access the Setting screen by repeating steps from chapter 3.1, paragraphs 1,2,3.

1. Once the Setting screen appears, scroll to Working Range and press "Enter". The Working Range screen appears.

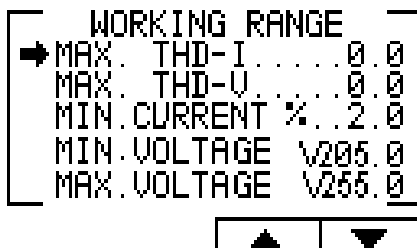
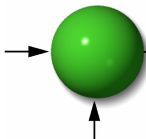


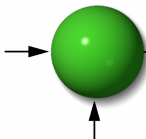
Figure 3.10 – Working range settings.

3.5.1 "MAX. THD I" setting:

1. Enables disconnection of all the capacitors whenever the actual THD I value exceeds the value which was defined by the user. When THD I = 0 this option is disabled.
2. In order to change the Max. THD-I, scroll to Max. THD-I line and press "Enter". The Max. THD-I screen appears.
3. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".

3.5.2 "MAX. THD V" setting:

1. Enables disconnection of all the capacitors whenever the actual THD V value exceeds the value which was defined by the user. When THD V = 0 this option is disabled.
2. In order to change the Max. THD-V, scroll to Max. THD-V line and press "Enter". The Max. THD-V screen appears.
3. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".



3.5.3 "MIN. CURRENT %" setting:

1. Enables defining value for minimal current under which power factor correction is not required, the value entered as % of the maximum current at the secondary current transformer.
2. In order to change the Min. Current %, scroll to Min. Current % line and press "Enter". Min. Current % screen appears.
3. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".

3.5.4 "MIN. VOLTAGE" setting:

1. Enables defining voltage low limit value, under this value all the capacitors will be disconnected.
2. In order to change the Min. Voltage, scroll to Min. Voltage line and press "Enter". The Min Voltage screen appears.
3. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".

3.5.5 "MAX. VOLTAGE" setting:

1. Enables defining voltage high limit value, above this value all the capacitors will be disconnected.
2. In order to change the Max. Voltage, scroll to Max. Voltage line and press "Enter". The Max Voltage screen appears.
3. Use the buttons F3 & F4 to move the cursor, to set the value use buttons F1 & F2, when finished click "ENTER".