



User manual Technical parameters

multicomp

4-quadrant Controller

**F144-NC-1V1C6RO-2
F144-NC-1V1C12RO-2**



15205-EDEBDA0144-1816-1_EN

System | English

**Your partner for
network analysis**

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1 Introduction

Thank you for choosing this **KBR quality product**.

In order to familiarize yourself with the operation and configuration of the device, we recommend that you read this manual thoroughly, so that you are able to make use of the entire range of functions of this high-quality product.

The individual chapters serve to explain the technical details of the device and show how to avoid damage by means of proper installation and commissioning.

1.1 User manual

This user manual describes the device version multicom 5D6. This user manual must be accessible for the user at all times (e.g. in the switchgear cabinet). Even when the device is resold to third parties, the manual remains part of the device.

Although we used the utmost care in assembling this user manual, we would like to thank you in advance for notifying us about any errors or ambiguous descriptions you might notice.

1.2 Explanation of safety relevant symbols

This user manual contains notes that must be observed for your personal safety and to avoid damage to equipment. These notes are identified by a warning sign or information symbol, depending on the degree of hazard they represent.



Warning

„Warning“ means that death, major injuries or damage may occur in case the appropriate safety measures are not taken.



Caution

„Caution“ means that minor injuries or damage may occur in case the appropriate safety measures are not taken.



Note

„Note“ is an important information on the product, its operation or the respective part of the user manual to which special reference is made.

Disclaimer

The content of this user manual has been carefully reviewed in terms of the hardware and software described. Certain deviations, however, cannot be excluded, and the manufacturer is not liable for complete conformity. The specifications made in this user manual are checked on a regular basis, necessary corrections will be included in the next revision.

1.3 Safety notes

In order to prevent operating errors, operation of this device is kept as simple as possible. This way, you will be able to quickly start working with the device.

In your own interest, however, you should read the following safety notes carefully. During assembly, the applicable DIN / VDE regulations must be observed!

Power supply connection, setup and operation of the device must only be performed by qualified personnel. Qualified personnel in accordance with the safety notes in this user manual are persons authorized to set up, ground and mark devices, systems and circuits in accordance with applicable standards and regulations.

To avoid fire and electrical shock, the device must not be exposed to rain or humidity!

Before connecting the device to the power supply, check whether the local power supply conditions comply with the specifications on the nameplate.



Caution

A faulty connection can lead to the destruction of the device!

When connecting the device, observe the connection chart (see chapter "Connection chart") and make sure that no voltage is applied to the connection lines. Only use proper wiring material and observe the correct polarity when wiring!

In order to ensure proper and safe operation of the product, it must be transported, stored, installed and assembled in accordance with the specifications and operated and maintained carefully.

A visibly damaged device must generally be considered unfit for use and disconnected from the power supply!

Error detection, repair and maintenance work may only be carried out in our facilities or after contacting the service team. Unauthorized opening of the device voids any warranty. Correct operation can no longer be guaranteed!

Opening the device may expose live parts. Capacitors in the device may still be loaded, even if the device has been disconnected from all voltage sources. It is generally not allowed to operate an open device!

In systems subject to hazard of lightning, lightning protection must be provided for all input and output lines!

Systems that are at risk from lightning strikes must feature lightning protection for all input and output lines!

1.4 Product liability

You have acquired a high-quality product. In its production, KBR only uses components of the highest reliability and quality.

Each device is subject to long-term testing before it is delivered.

Regarding product liability, we refer you to our general terms and conditions for electronic equipment, which you can find at www.kbr.de.

The warranted characteristics of the

1.5 Disposal

Defective, outdated or no longer used devices must be properly disposed of.

At your request, we will dispose of the devices for you.

1.6 Overvoltage and lightning protection

It is recommended to install overvoltage protection measures to protect our high-quality devices from damage. We also recommend to protect control voltage inputs and pulse lines, if required..

2 Controller functional principle

The controller's micro processor acquires the supply voltage and the current consumption of the downstream facility via measuring transformer inputs (A/D transformer) and calculates the active and reactive power ratios of the network. The controller operates based on a 4 quadrant operation.

- **Energy recovery in generator operation is recognized and displayed (the LCD shows a flashing „☐”). During this time, compensation to CosPhi 1.00 (recovery CosPhi) will be performed. To avoid alternating switching operations when switching between recovery and consumption, compensation to the recovery CosPhi is performed for 15 minutes when recovery is detected. During this period of time, the set target-CosPhi is disabled.**

The compensation power required for the target CosPhi is calculated continuously. If the power difference corresponds to the set hysteresis (switch on and off hysteresis), the staged switching is performed in accordance with the compensation power required. Manually switched stages, however, are not included in the optimization. In case of identical stages with identical power, the stage disconnected for the longest time is connected.

With only a few switching operations an optimal adjustment is obtained. Even for large facilities, sensitive controls may be set up with only a few modules. No stage ratios need to be considered. After compensation, switching operations are interrupted for a programmable time. In order to avoid alternating switching operations, the stage switch off hysteresis can be increased to up to 150% of the lowest stage power. For light load operation (secondary measurement current under the limit (< 20mA), the stages are switched off after 1 hour.

The programmed values are saved on an EEPROM and will thus not be lost after a network failure.

The measuring cycle of the controller for recording the necessary network parameters takes approx. 20 ms.



Note

Limiting value for overvoltage switch-off = nominal voltage + 10% (taking into account the measurement voltage transformer ratio). The value of 10% is unchangeable and serves the safety of the compensation facility. The reset hysteresis is 1% of the rated voltage.

In case of failure, the compensation stages are switched off and „overvoltage“ is displayed.

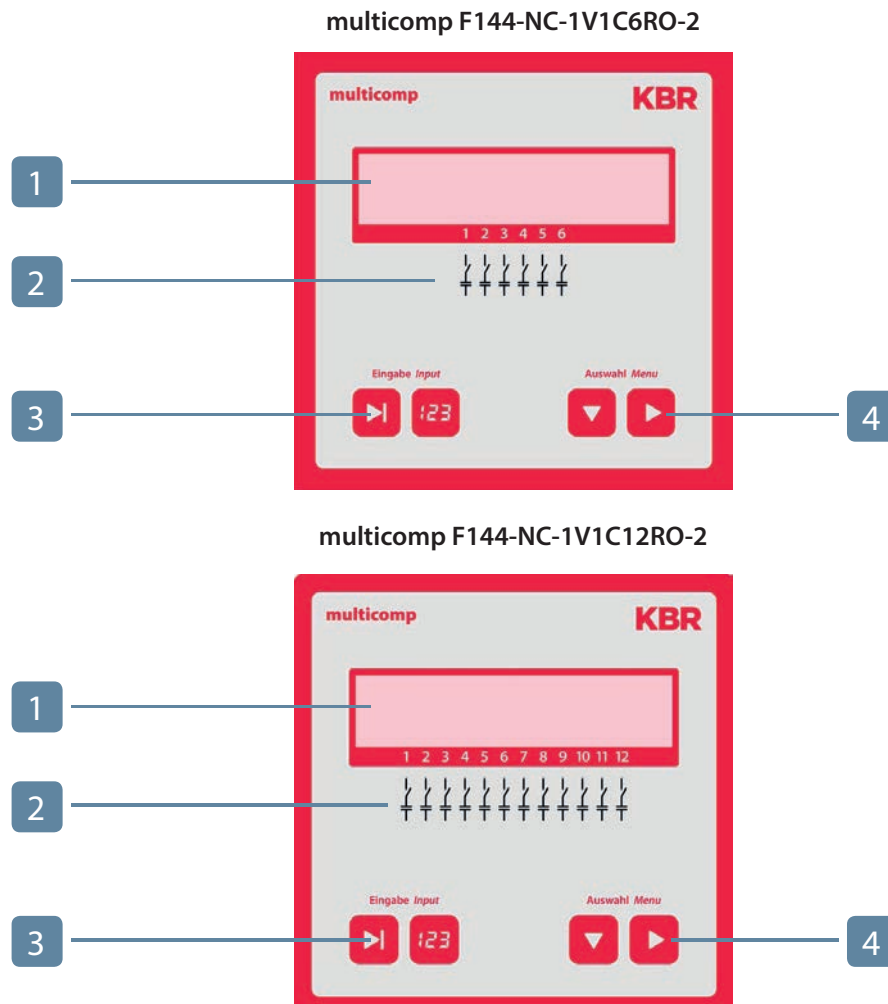
Important Safety Information



Caution

For the following programmes stage power the discharge times are determined automatically. These are, however, to review and revise by different capacitor specifications.





capacitor power	discharging resistor	discharge time
2,5 kvar - 7,5 kvar	300 kOhm	60 seconds
10 kvar - 17,5 kvar	300 kOhm	120 seconds
20 kvar and more	300 kOhm	180 seconds




Operating elements:

- 1 LCD displaying current status and user prompts
- 2 Number of controller output lines possible
- 3 Two sensor buttons for parameter programming
- 4 Two sensor buttons for menu selection

General notes on operating the sensor buttons:

- Button  Start input for configuration and reset.
- Button  Value change during configuration
- Button  Navigation through submenus
- Button  Navigation through main menus and save button during configuration

Key combinations:

- Button  and  Deletion of cumulated values Perform reset

Basic controller settings (default settings):

- Consumption target CosPhi: 0.95 inductive
- Recovery target CosPhi: 1.00
- Alarm CosPhi: 0.92 inductive
- Main transformer current: Primary current 1000 A
- Secondary current: 5 A
- Measurement voltage: Primary voltage 400 V Ph-Ph
(equivalent 230V Ph-N)
Secondary voltage 400 V Ph-Ph
(equivalent 230V Ph-N)
- Rot.field U: L1-N
- Rot.field I: L1
- Attenuation coefficient for current: 2
- Attenuation coefficient for voltage: 2
- Attenuation coefficient Qmiss: 2
- Alarm delay: 20 minutes (1200 seconds)
- Idle time: 30 seconds
- Switching interval: 8 seconds
- Hysteresis connection: 100% of smallest stage power
- Hysteresis disconnection: 100% of smallest stage power
- Limit switching cycles: 80000
- Switching cycle count: Activated by programmed limit
- Stage switching mode: Automatic
- Scanning frequency: Automatic
- Harmonics monitoring: Activated by programmed limit
- THD limit: 8%
- Stage power: not programmed
- Stage power monitoring: disabled
- Discharge time: 180 seconds
- Password: No password (9999, meaning all functions are accessible)
- Contrast setting: 4
- Low load limit: 15 mA
- Low load delay: 60 Minutes

The controls in the assembled compensation units are preset. The following needs to be checked or set:

- Target CosPhi according to energy supplier regulations
- (for kVA tariff CosPhi = 1)
- Primary current and secondary current in accordance with input current transformer.
- If required voltage transformer ratio

3 Mounting and electrical connection of the device

3.1 General, very important!

- Tighten all screws and connections as otherwise warranty will be void!
- The device needs to be installed and operated in accordance with valid VDE regulations (in particular VDE 0100) and energy supplier regulations.

Connection cross-sections and fuse protection table: see attachment

3.2 Current transformer connection and measurement voltage

If possible, mount the transformer in the phase that corresponds to L1 of the compensation facility (determine by means of voltage measurement). All capacitor and consumer currents need to be determined. In case of unbalanced phase load (small facilities), install the transformer in the phase with the highest load.

- P1 (K) to energy supply (indicated on the transformer).
- P2 (L) to load
- S1 (k) with terminal k (controller terminal 20) and
- S2 (l) with terminal l (controller terminal 21) needs to be connected in the compensation facility (use two-color cable!).

Line cross-section: up to 3 m = 1.5 mm², up to 6 m = 2.5 mm². For greater distances, we recommend using a 1 A transformer. The controller is designed for the connection of 5 A and 1 A transformers, switching is set in the configuration.

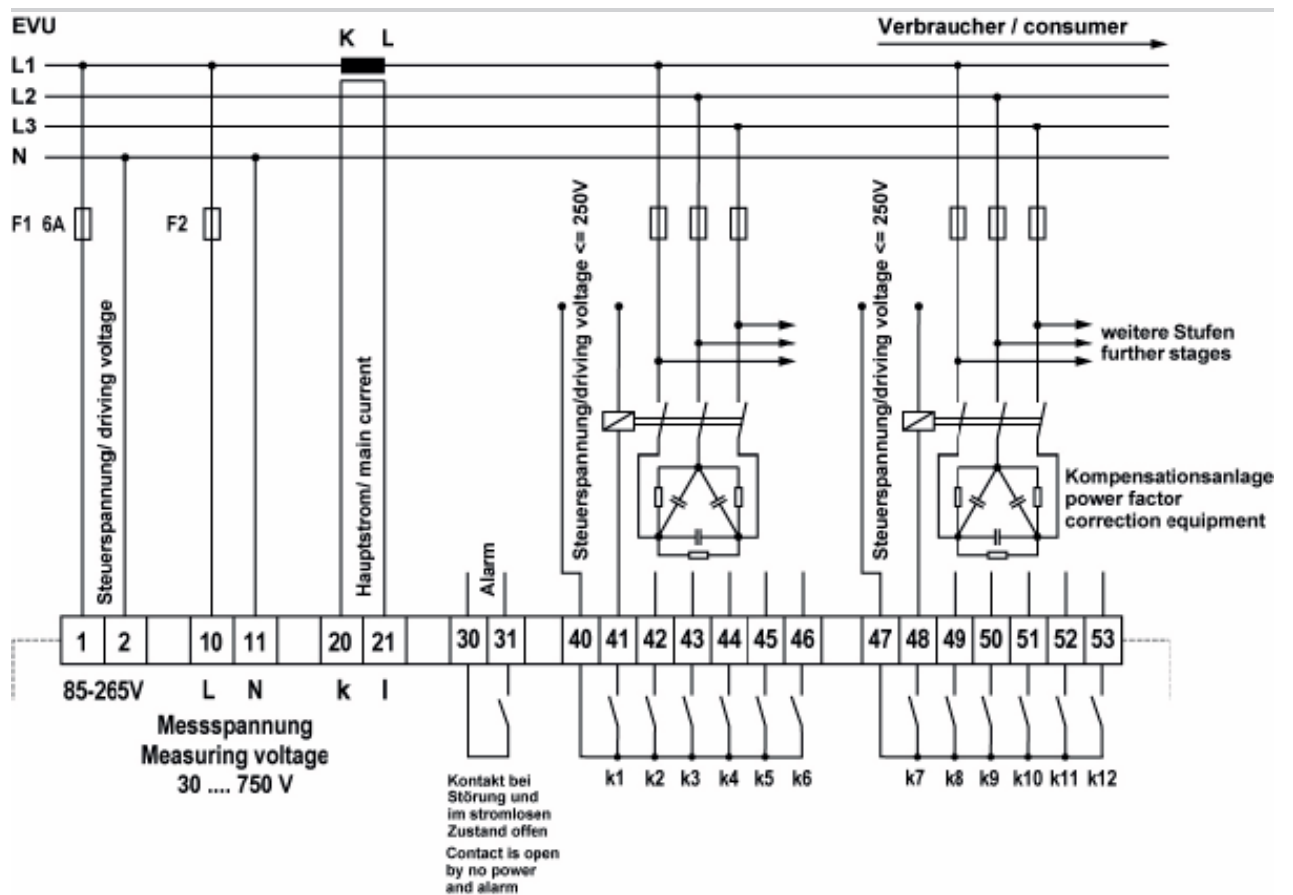
If using existing transformers, the current paths always need to be connected in series. The secondary transformer current needs to be at least 12 mA. For smaller currents, no capacitors will be connected (display shows "missing current").

Measurement voltage connection according to connection chart.

3.3 Current transformer dimensions

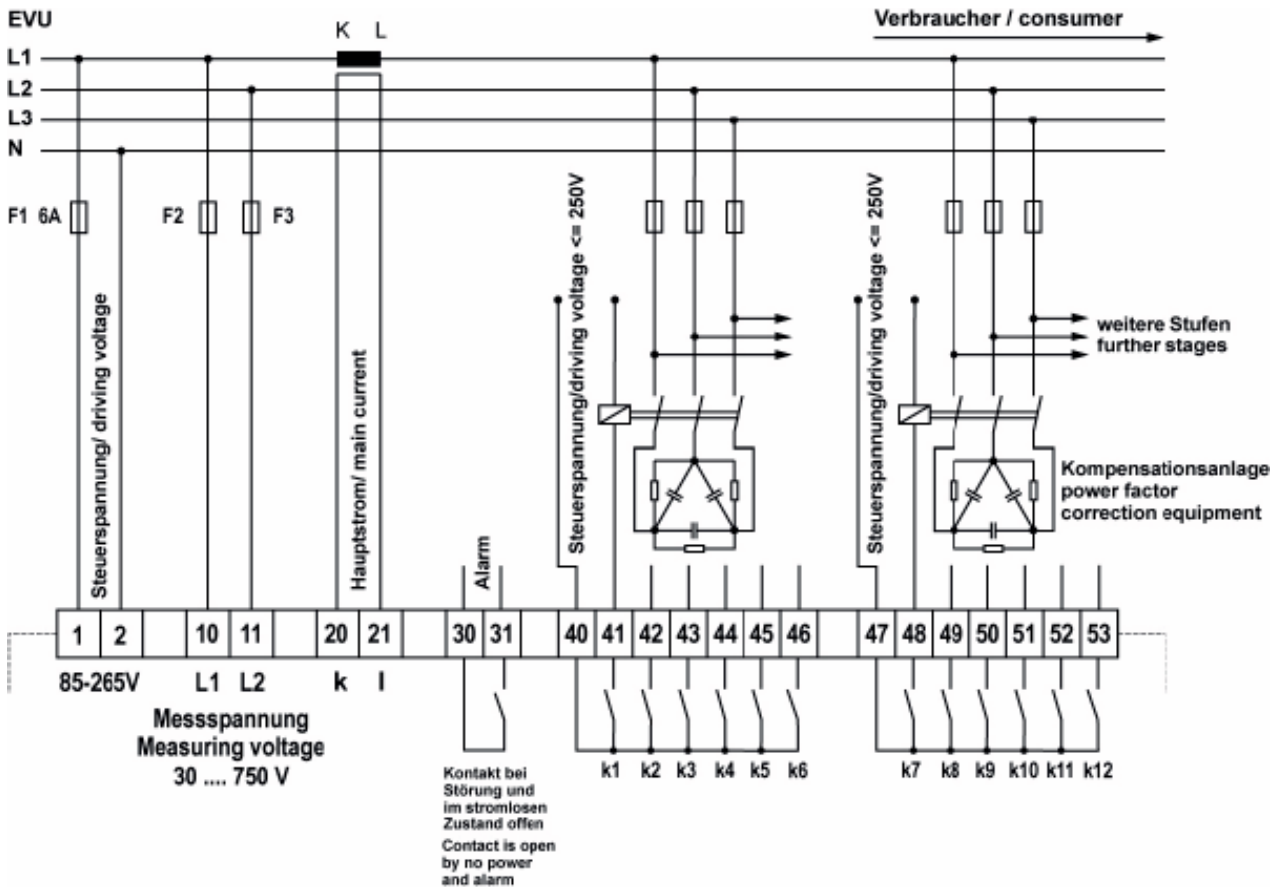
The current transformer is dimensioned based on the current consumption of the consumers and not the capacitor current. If other measuring devices are connected to a transformer in addition to the reactive power controller, the transformer power needs to be dimensioned accordingly. Also, losses occur in the current transformer line that need to be considered in case of large distances between the transformer and the controller.

3.4 Standard connection chart measurement voltage Ph-N



For voltage supply, see nameplate.

3.5 Standard connection chart measurement voltage Ph-Ph



For voltage supply, see nameplate.

4 Commissioning the facility

4.1 General commissioning notes

- VSwitch on a sufficient number of inductive consumers (e.g. motors) prior to switching on the compensation facility. A transformer current of at least 15 mA needs to flow in the secondary circuit for the controller to be activated. Below this limit the display will show “missing transformer current”.
- The transformer connection needs to be checked (transformer ratio too high?).
- Before switching on the controller, measurement voltage must be available. No error message is displayed, but the learning mode cannot be started.
- If stage power has been programmed, the power factor CosPhi should be displayed after initialization. Normally, when no capacitors are connected, CosPhi is in the range of 0.6 to 0.9 inductive, (e.g. CosPhi 0.80 ind).
- If a capacitive value is displayed, or if there is a flashing G symbol, the phase allocation of current and voltage measurement is incorrect. In the Commissioning programming menu, the phase allocation can be changed using the function Rot.field U and Rot.field I (provided that there is no generator operation at the time).
- The first switching operation may take up to 60 seconds. The stages are switched in a set 1 second interval until compensation. The CosPhi displayed has to converge target CosPhi.



Note

The learning process is started in the Commissioning menu, in the Activate learning mode submenu.

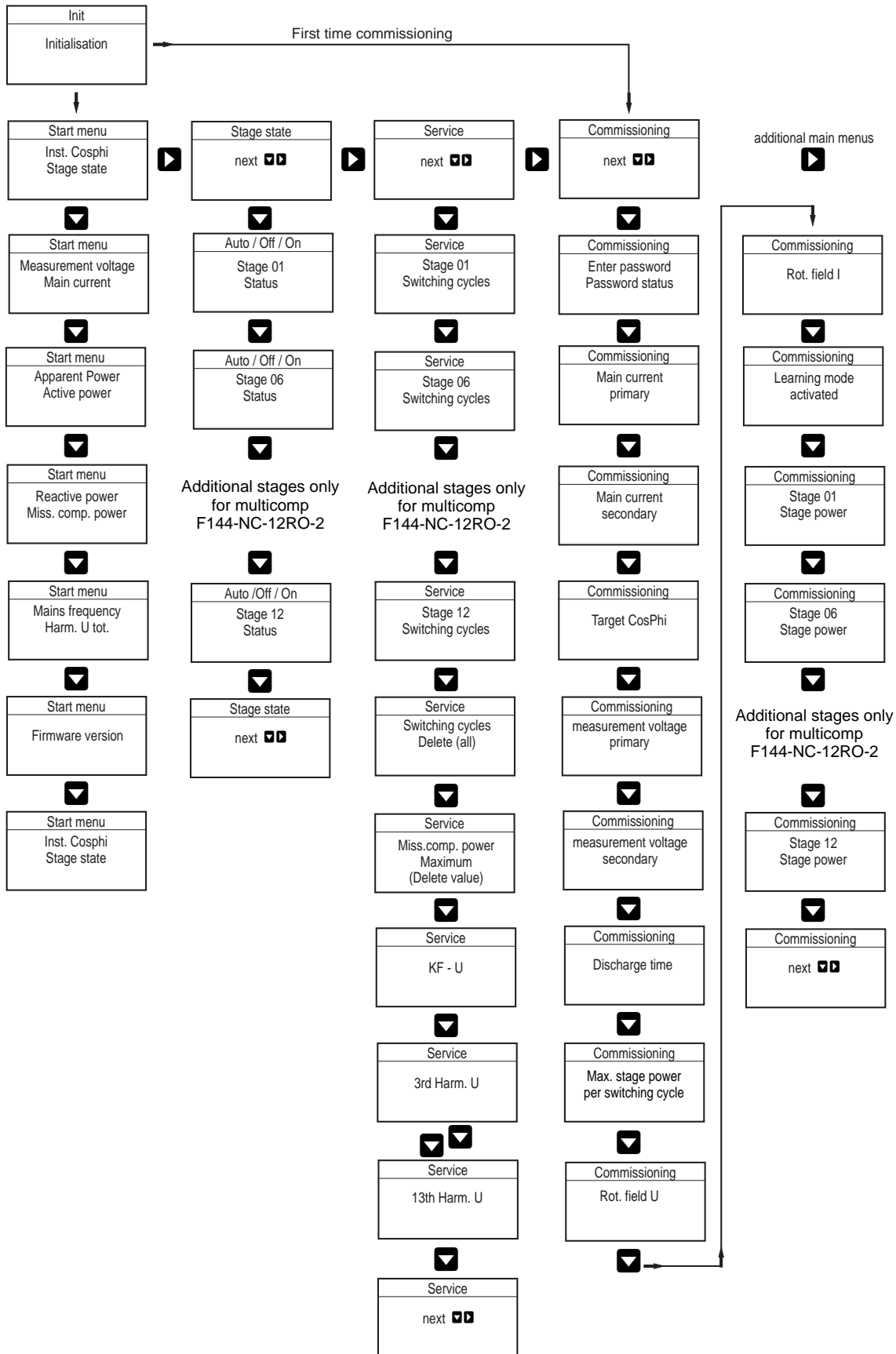
4.2 Compensation facility with controller

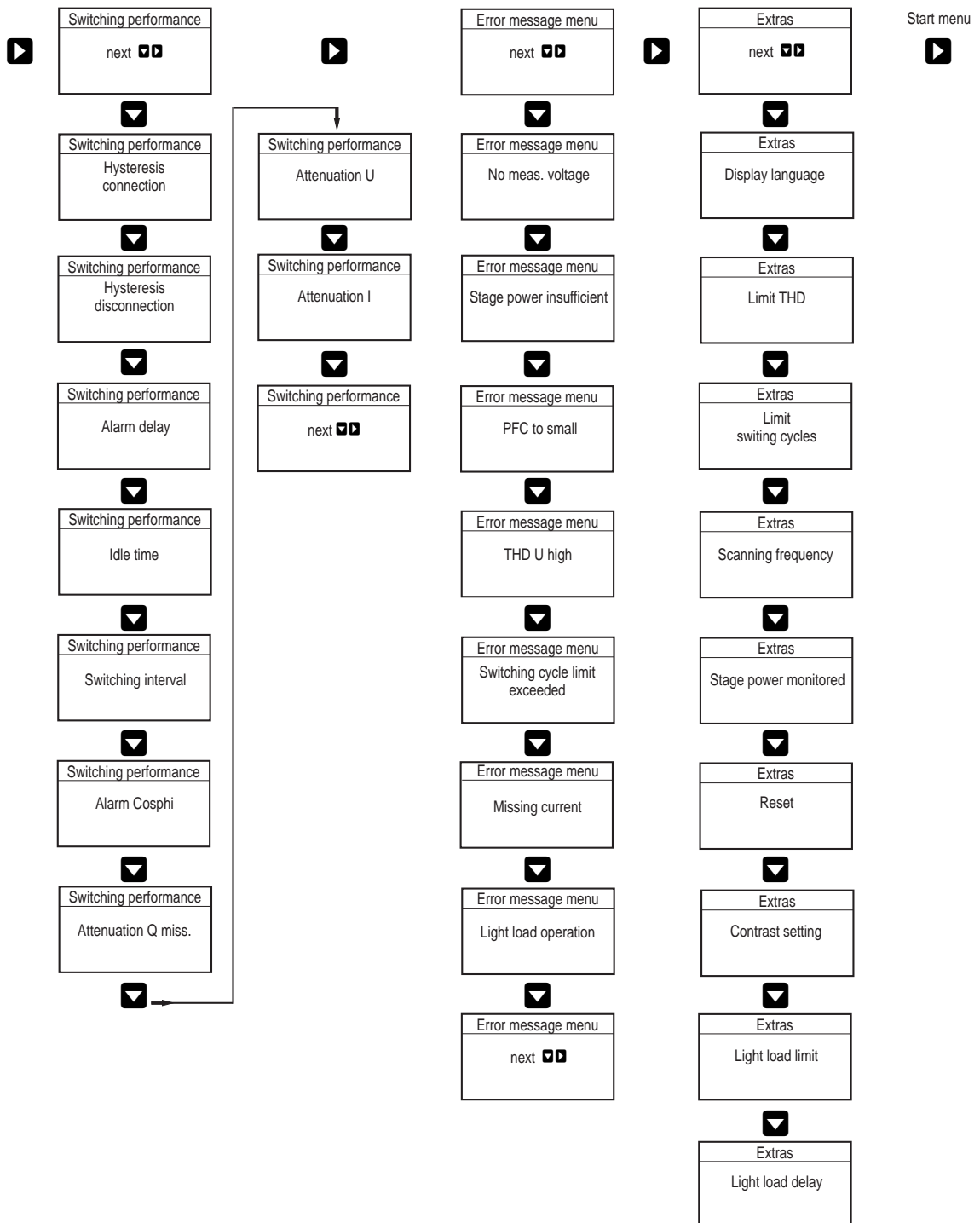
The controller is preset as a component of a compensation facility (refer to connection diagram of compensation facility). The following need to be programmed or checked:

- ZTarget CosPhi according to energy supplier regulations.
- Primary and secondary current in the main circuit according to the mounted transformer.
- If required, set measurement voltage transformer data.
- If no stage power has been programmed, the controller will switch into the Commissioning menu. Subsequently, stage power programming can be performed in the settings menu, or using the learning process.

The programmed values are saved on an EEPROM and will thus not be lost after a network failure.

5 Navigation and device displays





6 Main menu displays

For the current displays and the controller configuration, the following main menus with their submenus can be used: see item 5 Navigation and device displays:



Note

In the next chapter, the main menus and their submenus are described in detail.

Initialization menu – no input possible

```
multicomP 06 eco
Initialisation
```

multicomP 2F144-NC-1V1C12RO only

```
multicomP 12 eco
Initialisation
```

Start menu window - display of current values

```
cosψ 0.71 IND
↑      AAAA
```

multicomP 2F144-NC-1V1C12RO only

```
cosψ 0.71 IND
↑      AAAA
```

Stage state window – stage state can be changed

```
Stage state
next ↔
```


Service window – display and deletion options

```
Service  
next ↔
```

Commissioning window – entry of operating parameters

```
Commissioning  
next ↔
```

Switching behavior window – influencing switching behavior

```
Switch. perform.  
next ↔
```

Error message menu – editing the error message dialog

```
Message menu  
next ↔
```

Extras window – setting special parameters

```
Extras  
next ↔
```

7 Description of the individual display windows

7.1 Initialization window

```
multicomP 06 eco
Initialisation
```

multicomP 2F144-NC-1V1C12RO only

```
multicomP 12 eco
Initialisation
```

This is displayed after connecting the supply voltage to the controller.



Caution

During the initialization period, please do not press any sensor buttons; they are adjusted automatically to ensure correct operation.

7.2 Commissioning window if no stage power is programmed:

```
Commissioning
next ↔
```

If the multicomP **F144-NC-1V1C6/12RO-2** is being commissioned for the first time, after connecting the supply voltage, the initializing window is displayed, followed by the Commissioning window.

This menu is used for the **initial commissioning** of the controller, where all the necessary settings can be made.




If a controller already integrated into a KBR compensation facility by default should be used, only the parameters of the current transformer have to be configured.

Selection of submenus with button .

Password protection:

To protect a facility against unauthorized access of the configured parameters, a password can be entered (4-digit number code, e.g. 4321).

In case the password gets lost somehow, the controller can be unlocked with the master password 1976. When unlocking a password protected controller, it is possible to press a button within 300 seconds. If no button is pressed during this period, the controller is locked again.

The password can be configured by pressing the button  to start entering and changing the entry position,  to change or set the value and  to save the entry.

Configuring current transformer values:

For the compensation controller to function properly, all parameters concerning the current transformer have to be set correctly. Primary and secondary current of the transformer have to be set (submenu Iprim. / Isec.). These parameters can be read on the nameplate of the current transformer. In addition, the phase allocation of the transformer has to be set correctly. In the controller, the phase (L1, L2, L3) in which the current transformer is integrated has to be set (submenu Rot.field I). If the transformer connections are mixed up (k and l interchanged), this can be corrected with the setting -L1, -L2 and -L3.

Setting target CosPhi:

You can ask your energy supply company for the target CosPhi, which should be set up at this point. The target CosPhi is by default set to 0.95 inductive (see chapter Default settings).

Setting the voltage transformer parameters:

Specify the primary voltage in the U primary submenu, the secondary voltage under U secondary and the phase allocation of the measurement voltage under Rot.field U. These settings apply to a standard network (voltage Ph-Ph: 400V primary, 400V secondary). With measurement voltages of over 500V, the parameters specified on the voltage transformer have to be configured, e.g. 690V / 100V, as well as the measuring mode, e.g. L12 for the measurement voltage connection between the phases L1 and L2.

Setting the discharge time:

Checking or, if required, changing the discharge time of the capacitor stages is a very important menu item. Please make sure that the correct value is set, otherwise the capacitors could be damaged.

Configuring the capacitor stages:

There are two ways of configuring the capacitor stages: The stages can be configured manually or using the learning mode.



Caution

If there is no measurement voltage, the learning mode menu does not appear.

It is important to set the stage power correctly. The stage power can be looked up on the nameplate of the stage or the circuit diagram and then programmed manually. In this case, skip the menu item Activate learning mode and individually enter the power value for each stage.

If you want to Activate the learning mode, you have to make sure that all previous submenu parameters have been set correctly.

The learning mode is activated by pressing the button . Change to Yes with the button  and confirm with button .

The learning mode automatically sets the stage power. However, this value has to be checked after each time the learning process is performed.

Function test:

After all values have been programmed, a function test should be performed. To do so, the controller has to be taken off the voltage supply for a few seconds.

After connecting it to the voltage supply, the controller has to start automatically. When reading out the CosPhi voltage in the start menu immediately after switching on, CosPhi should be inductive. After approx. 60 seconds, the controller starts to switch on the individual capacitor stages, until the facility is compensated. The CosPhi, which can be read out in the start menu, should have risen in comparison with former values, or it should rise when switching on additional stages. If the compensation facility is set up correctly, the controller should compensate the set target CosPhi after a certain period of time.

7.3 Start menu window

Example: F144-NC-1V1C12RO-2

```
cosφ 0.71 IND  
+ AAAAA
```

This is displayed after the initialization window when the stage power has already been programmed. Here, the current total controller state and the currently measured CosPhi are measured.

Example:

Line 1: Currently measured CosPhi 0.71 inductive

Line 2: Controller connects stages, stage 1 to 4 are already connected in automatic operation, whereby for example the following applies:

+ stages are connected when compensation power is required.

+ stages are disconnected due to overcompensation.

A the stage has been connected in automatic operation.

H the stage has been connected manually.

Ø the stage has been disconnected manually.

X the stage has been recognized as being defect (stage monitoring activated, cf. main menu Extras, submenu Stage monitoring).

Selection of submenus with button .

The currently measured values are displayed in the submenus:

measurement voltage in Volt, depending on type of connection chosen (menu Commissioning, submenu Rot.field U) in Ph-N (⚡) or Ph-Ph (⚡).

Apparent current series transformer in Ampere (1-phase value measured).

Apparent power in kVA, extrapolated as 3-phase value (provided that the network load is symmetric).

Active power in kW, extrapolated as 3-phase value (provided that the network load is symmetric).

Apparent power in kvar, extrapolated as 3-phase value (provided that the network load is symmetric).

Missing compensation power to achieve the set target CosPhi.

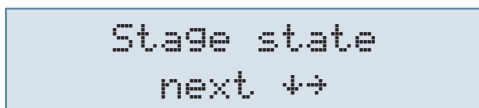
The missing compensation power is displayed up to a maximum value of 9999.9 kVar.

If the value exceeds this limit, ----.- kvar is displayed


Power frequency in Hertz




THD (Harm. U total) in %, decisive for setting the THD limit (menu Extras, submenu THD limit)

The firmware version of the controller, e.g. V 1.00R001, is important for support cases, as it can be used to deduce possible changes made to the device firmware.

7.4 Stage state window

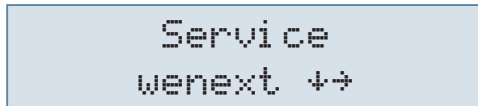
Selection of submenus with button .

In the submenus of this window, it is displayed whether or not the capacitor stages connected are working in automatic operation, or if they are switched on or off permanently. The individual capacitor stages can be selected by pressing button .

By pressing the buttons  to start entering values,  to change and  to save them, you can change the stage state from **Auto** (Automatic) to **Off** (switched off permanently) or **On** (switched on permanently)

**Note**

Capacitor stages permanently switched on or off are not available to calculate the optimizing automatic operation.

7.5 Service window:

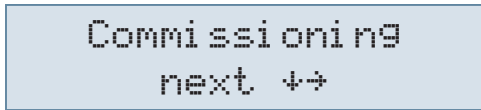
Selection of submenus with button .


In the submenus of this window, the number of connections of each individual capacitor stage is displayed. In the Delete switching cycles menu item, the cumulated switching cycles can be deleted for all stages. This is done by simultaneously pressing the buttons and .

If the number of switches equals or exceeds the value set in the menu item Extras / Switching cycle limit, a message is displayed, depending on the settings in the Error message menu / Switching cycle limit exceeded.

In addition, the value in the menu item Missing Comp. power maximum can be deleted by simultaneously pressing the buttons and , resetting the message Facility too small. In case the set target CosPhi is not reached despite all available stages switched on, this message is displayed after the set alarm delay time has elapsed. The alarm delay can be set in the menu Switching performance / Alarm delay.

7.6 Commissioning window




Selection of submenus with button .

In the submenus of this window, a step-by-step description of the commissioning process is given. For facilities already in operation, the parameters set during commissioning can be read out here.

Password protection:

To protect a facility against unauthorized access of the configured parameters, a password can be entered (4-digit number code, e.g. 4321).

In case the password gets lost somehow, the controller can be unlocked with the master password 1976. When unlocking a password-protected controller, it is possible to press a button within 300 seconds. If no button

is pressed during this period, the controller is locked again  to start entering and changing the entry position,  to change or set the value and  to save the entry.

Configuring current transformer values:

For the compensation controller to function properly, all parameters concerning the current transformer have to be set correctly. Primary and secondary current of the transformer have to be set (submenu Iprim. / Isec.).

These parameters can be read on the nameplate of the current transformer. In addition, the phase allocation of the transformer has to be set correctly. In the controller, the phase (L1, L2, L3) in which the current transformer is integrated has to be set (submenu Rot.field I). If the transformer connections are mixed up (k and l interchanged), this can be corrected with the setting -L1, -L2 and -L3.



Caution

Subsequently changing the main transformer parameters can directly influence the capacitor stages, for which the stage power was determined using the learning mode. This way it is ensured that the stage power is adequately adjusted in case of a subsequent correction of the transformer parameters. Manually configured stages are not taken into account here.

Setting target CosPhi:

You can ask your energy supply company for the target CosPhi, which should be set up at this point. The target CosPhi is by default set to 0.95 inductive (see chapter Default settings).

Setting the voltage transformer parameters:

Specify the primary voltage in the U primary submenu, the secondary voltage under U secondary and the phase allocation of the measurement voltage under Rot.field U. These settings apply to a standard network (voltage Ph-Ph: 400V primary, 400V secondary). With measurement voltages of over 500V, the parameters specified on the voltage transformer have to be configured, e.g. 690V / 100V, as well as the measuring mode, e.g. L12 for the measurement voltage connection between the phases L1 and L2.

Setting the discharge time:

Checking or, if required, changing the discharge time of the capacitor stages is a very important menu item. Please make sure that the correct value is set, otherwise the capacitors could be damaged.

Configuring the capacitor stages:

There are two ways of configuring the capacitor stages: The stages can be configured manually or using the learning mode.




It is important to set the stage power correctly. The stage power can be looked up on the nameplate of the stage or the circuit diagram and then programmed manually. In this case, skip the menu item Activate learning mode and individually enter the power value for each stage.



Note

If the menu item Activate learning mode cannot be selected, you have to verify that there is measurement voltage available at the controller. If this is not the case, the menu item is automatically disabled..

If you want to Activate the learning mode, you have to make sure that all previous submenu parameters have been set correctly.

The learning mode is activated by pressing the button , Change to Yes with the button  and confirm with the button .

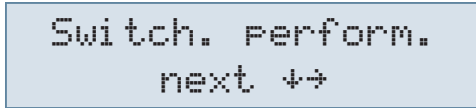
After starting the learning mode, „aktive“ is flashing, and the remaining time until the end of the learning mode is displayed..



Note

The learning mode then automatically sets the stage power. However, this value has to be checked after each time the learning process is performed..

7.7 Switching performance window



Selection of submenus with button .

In the submenus of this window, the settings made for the switching performance by default are displayed (default settings). These settings apply to most of the compensation facilities.



Caution

However, you have to check all parameters to make sure that there are no deviations from the requirements the facility has to fulfill.

The following submenus are available to influence the switching performance.

Hysteresis connection (default setting 100%, setting range 70 to 150 %): This value defines the switch-on criterion of the controller. This means the controller would switch on at 100% missing compensation power in relation to the smallest automatic capacitor stage of the facility.

Hysteresis disconnection (default setting 100%, setting range 70 to 150 %): This value defines the switch-off criterion of the controller. This means the controller would switch off at 100% overcompensation power in relation to the smallest automatic capacitor stage of the facility.

Alarm delay (default setting 1200 seconds, setting range 0 to 3000 seconds): This value defines the time until the message Facility too small is displayed. In case the set alarm CosPhi is not reached despite all available stages switched on, this message is displayed after the set alarm delay time has elapsed.

Idle time (default setting 30 seconds, setting range 0 to 300 seconds) This value defines the time the controller is idle after compensation before another switching operation is performed (connection or disconnection).

Switching interval (default setting 8 seconds, setting range 0 to 10 seconds): This value defines the time the controller is always idle between two switching operations.

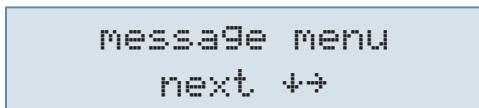
Alarm CosPhi (default setting ind. 0.92, setting range ind. 0.70 to 1.0): This value is connected to the message Facility too small. If this value is not reached after the alarm delay has elapsed despite all stages switched on, the message Facility too small is displayed

Attenuation Qmiss (default settings 2, setting range 0 to 9): This value defines how much the display is attenuated to prevent fast parameter changes of the missing compensation power.

Attenuation U (default settings 2, setting range 0 to 9): This value defines how much the display is attenuated to prevent fast parameter changes of the measurement voltage.

Attenuation I (default settings 2, setting range 0 to 9): This value defines how much the display is attenuated to prevent fast parameter changes of the measurement current.

7.8 Error message menu



Selection of submenus with button .

In the submenus of this window, the possible messages are displayed, as well as the display configuration.


The following error messages can be configured:

Alarm submenu	Possible actions			
	Off	Message	Alarm relay	Message and relay
Missing measurement voltage	✓	✓	✓	✓
Missing stage power	✓	✓	✓	✓
Facility too small	✓	✓	✓	✓
THD (voltage harmonics) too high	✓	✓	✓	✓
Switching cycle limit exceeded	✓	✓	✓	
Missing current	✓	✓	✓	✓
Light load operation	✓	✓	✓	✓

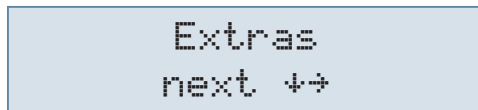
If a submenu is selected (using the button ) , the error message dialog can be changed by pressing the buttons  to start entering values,  to change the settings and  to save them.



Caution





If there is a Stage monitoring error (cf. menu Extras (7.9), submenu Monitoring stage power), no message is displayed, and only the stages in the start menu window are marked with an .

7.9 Window Extras



Selection of submenus with button .

In the submenus of this window, the additional settings possible are displayed.

If a submenu is selected (using the button ) , the settings can be changed by pressing the button  to start entering values,  to change the setting and  to save it.

The following submenus are available:

Language: In this submenu, you can choose the language of the LCD.

THD limit: The limiting value of the harmonic switch-off refers on one hand to the total of all measurement voltage harmonics. The programming range lies between 0 and 10%. The setting is done in steps of 1%. In addition, harmonics monitoring can be disabled here (for configuration limit = 0).

For voltage harmonics exceeding the limit, error messages are displayed and a stage disconnect is performed.

Limit switching cycles: The limiting value of the capacitor contactor switching cycles is used as an indication for customers that due to the number of switching actions accumulated, the capacitor contactor could be worn out. This message in no way influences the function of the compensation facility. It is used merely as a „maintenance note“.

Manual switching operations are not counted.

Scanning frequency: In this submenu, the power frequency tracing settings are displayed. The setting Auto causes the scanning frequency to be traced automatically, within a range of 40 to 70 Hertz. Alternatively, a fixed scanning frequency of 50 Hz or 60 Hz can be set.

Monitoring stage power:

In this submenu, the monitoring of the stage power can be enabled or disabled. However, only stages in automatic operation can be monitored.

The stage power configured manually is not taken into account, as it is assumed that the stage power has been configured in accordance with the nameplate of the compensation stage. Operating mode: Each time a capacitor stage is switched on, it is checked whether or not a change of current takes place in the series transformer. If this is not the case, the stage is marked with an ✘ in the start menu window. The following reasons are possible and have to be checked:

- Capacitor defective
- Contactor defective
- Fuse defective

Reset: With the item Reset, it is possible to reset the programmed parameters of the controller. Here, the programmable parameters are reset to default settings. A listing of the settings can be found in the appendix Technical Data. This has the advantage of all configured parameters to be deleted at once and the controller restarting with the default settings stored.

Perform reset: Menu Extras, menu item Reset


Press button  = Reset flashes

Press buttons  and  simultaneously = done is displayed

After about 2 seconds, the display switches back to Reset



Note

The resetting process can be interrupted by pressing the button .

Contrast setting: The contrast settings of the LCD can be changed in this submenu. Setting range: 0 to 10.

Low load measuring current limit: For the operating status low load operation, you can set the measuring threshold to 15 mA or 50 mA (the default setting is 165 mA).

Low load stage switch-off delay time: The delay time for switching off the compensation stages can be set to between 1 minute and 60 minutes (the default setting is 60 minutes).

**Note**

The operating status low load operation is activated if the measuring current flowing through the main current transformer is too low because of inactive consumers. If the measuring current falls below the measuring threshold, the compensation stages switched on in automatic mode are gradually switched off after the set delay time has elapsed. This does not apply to stages that were switched manually.

8 Notes on detecting errors

Undercompensation, not enough stages are connected:

Check controller for error displays (refer to section 7.8). If the target CosPhi is set to 0.8 capacitive, the capacitors need to be connected one after another. If the facility is not over-dimensioned, almost all stages need to be connected.

Undercompensation, all stages are connected:

The existing facility is not sufficient (e.g. due to new inductive consumers). Please contact your local representative (extend your facility). See the cover sheet of these operating instructions for the service telephone number.

Check the main fuse and group fuses of the facility. Check the controller parameters. The group fuses must display at least 1.7 times the value of the capacitor power. If the fuses do not hold, despite their being correctly selected, the groups must be checked individually for excessive current input and for defective contactors.

Overcompensation, too many stages are connected:

Check controller settings (target CosPhi capacitive?).
Transformer connected in the wrong position?

Controller switches a lot, in particular during low load (at the weekend, during the night):

Check programming of the transformer ratio.
Switch on a small stage permanently (manually), if required.

**Note**

If no cause of error is found, please call your local representative.
Please see the cover sheet of this manual for the phone number.

9 Facility and safety devices maintenance

In order to ensure proper function and a long service life of your facility, the following checks have to be performed after commissioning and then once a year!!

- Check and retighten all connections. Screwed connections may become loose at the beginning due to thermal stress.
- Check fuses, safety devices and switching equipment. Contactors are wearing parts. If the contactor is intact, switching must take place without excessive formation of sparks.
- Check the controller performance in automatic mode.
- Examine the cool air proportions (ventilators, temperature monitoring function).
- Clean filter mats, depending on how dirty they are.
- Visual inspection of capacitors.
- Examine the current input and capacitor terminal voltage.



Note

The input current and the temperature of these facilities must be checked regularly so that an overload on the capacitors can be detected at an early stage. A higher input current can be caused by an increasing proportion of harmonics or by defective capacitors

10 Setting range of the parameters configurable

Primary voltage	1 V to 39999 V Ph-Ph
Secondary voltage	1 V to 999 V Ph-Ph
Primary current	1 A to 39999 A
Secondary current	1 and 5 A
Rot.field U	L1N, L2N, L3N, L12, L23, L31
Rot.field I	L1, L2, L3, -L1, -L2, -L3
Consumption target CosPhi	ind. 0.80 to cap. 0.80
Recovery target CosPhi	ind. 1.0 (cannot be set)
PFC - System to small Alarm CosPhi	ind. 0.70 to 1.0
Attenuation coefficient current	0 to 9
Attenuation coefficient voltage	0 to 9
Attenuation coefficient Qmiss	0 to 9
Idle time	0 to 300 sec.
Alarm relay time	0 to 3000 sec.
Hysteresis connection	70 to 150 %
Hysteresis disconnection	70 to 150 %
Switching interval	0 to 10 sec.
Limit switching cycles	0 to 999999
Stage power	0 to 999.9 kvar
Discharge time	0 to 900 sec.
Stage switching mode	= Automatic, manual off, manual on
Stage power monitoring	Deactivatable
Harmonics monitoring	Deactivatable (0%)
THD limit	0 to 10%
Scanning frequency Automatic, fixed	50 Hz, fixed 60 Hz
Password	No password (9999, meaning all functions are accessible)
Display language	German, English, French or Spanish
Contrast settings	0 to 10
Low load limit	15 mA or 50 mA
Low load delay	1 Minute to 60 Minutes

Error message dialog:

Missing measurement voltage
 Missing measurement current
 Missing stage power
 Facility too small
 THD too high
 Switching cycle limit exceeded
 Light load operation

The settings Message or alarm relay /
 Message and error relay / Off
 is identical for all errors!

Error message dialog after reset:

Missing measurement voltage
 Missing current
 Missing stage power
 PFC (System to Small)
 THD too high
 Switching cycle limit exceeded
 Light load operation

Alarm relay
 Message
 Alarm relay
 Message and alarm relay
 Alarm relay
 Alarm relay
 Off

11 Technical Data

11.1 Measuring and display values

Voltage	Actual value of a measuring interval	Phase - 0 or phase - phase, depending on programming
	Units	[V, kV;] display is switched automatically
	Display range	0.00 kV to 99.9 kV
	Measuring range	30 ... 690 ... 790 V
Current (apparent)	Actual value of a measuring interval	Instantaneous value per phase
	Units	[A;kA] display is switched automatically
	Display range	0.00 A to 999 kA
	Measuring range	0,015 ... 5 ... 6 A
Frequency	Power frequency measurement	f_{Network}
	Units	[Hz]
	Measuring range	40.....70Hz
Apparent power	Calculation	S_{ges} , three-phase
	Units	kVA
	Measuring range	0.0 VA to 9999.9 kVA
Active power	Calculation	P_{total} ; three-phase
	Units	kW
	Measuring range	0.0 W to 9999.9 kW
Reactive power	Calculation —> ind. & cap.	Q_{total} ; Q_{miss} ; distinction between ind./cap.
	Units	kvar
	Display range	0.0 var to 9999.9 kvar
Power factor	Calculation —> ind. & cap.	CosPhi; distinction between ind./cap. CosPhi in display
	Anzeigebereich	CosPhi 0.10 ind. <—1 —> 0.10 cap.
Harmonics	Distortion factor (THD) of voltage	Voltage: KF-U
	Partial distortion factors	3rd; 5th; 7th; 9th; 11th; 13th; Voltage harmonics
	Units	[%]
	Measuring range	0.00% to 100%

11.2 Measuring accuracy

Current	$\pm 0,5\%$ / ± 1 Digit (at 0,1 to 5A)
Voltage	$\pm 0,5\%$ / ± 1 Digit (at 0,1 to 5A)
Power	$\pm 1\%$ / ± 1 Digit
Power factor	$\pm 2\%$ / ± 1 Digit
Frequency	$\pm 0,1\%$ / ± 1 Digit

11.3 Measuring principle

Reading	128 values per period
A/D converter	12 Bit
Measuring U and I	Acquiring measuring values for U and I simultaneously;
Measuring cycle	20 ms
Calculation of harmonics	DFT with 128 points over one period
Frequency measurement	Mode: Voltage measurement between phase Lx - N / Ly);

11.4 Device memory

Data storage	16 kB RAM volatile
Program and parameter memory	128 kB flash
Extreme values (Max.)	Missing compensation power Q_{\max}

11.5 Other limits

Limit violations: harmonics acquisition time	approx 100 ms
Overvoltage disconnect: acquisition time	approx 40 ms
No voltage disconnect: acquisition time	approx 40 ms (for measurement voltage)

11.6 Power supply

Power supply	85 to 265V AC/DC; max. 12 VA, 6 W
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11.7 Hardware inputs and outputs

11.7.1 Hardware inputs

Measuring input for voltage	U_{PH-N} or U_{PH-PH}	30V ... 690V ... 790V AC
	Direct impedance	750 kOhm
	Measuring range	1 measuring range, measurement voltage transformer programmable
Measuring input for current	I_{L1} or I_{L2} or I_{L3}	0,015A ... 5A ... 6A AC
	Power consumption	$\leq 2VA$ at 6A
	Measuring range	1 measuring range, current transformer programmable

11.7.2 Hardware outputs

Alarm relay	Switching capacity	250 V (AC) / 2 A potential-free
KCapacitor stage relay	Switching capacity	250 V (AC) / 2 A potential-free

11.8 Electrical connection

Connection elements		Plug-in terminals
Permissible cross section of the connection lines		2,5 mm ²
Measurement current voltage inputs	Fuse protection	max. 6 A
measurement current input	Fuse protection	NONE!!! Always short-circuit current transformer terminals k and l prior to opening the circuit!
Input Control voltage	Fuse protection	max. 6 A
Relay output	Fuse protection	max 2 A medium time-lag
Transformer connection	Connections	See connection chart

11.9 Mechanical data

Flush-mounted device	Housing measures	144 x 144 x 60 mm (H x W x D)
	Mounting cutout	138 x 138 mm
	Mode of protection	Front IP51 (with optionally available front door max. IP54), terminals IP20
	Weight	approx. 650g

11.10 Standards and Miscellaneous

Environmental conditions	Standards	DIN EN 60721-3-3/A2: 1997-07; 3K5+3Z11; (IEC721-3-3; 3K5+3Z11)
	Operating temperature	- 5°C ...+55°C
	Humidity	5%95%
	Storage temperature	-25°C ...+70°C
Electrical safety	Standards	DIN EN 61010-1/A2: Aug. 2002; (IEC1010-1/A2)
	Protection class	II, in accordance with DIN EN 61010-/A2: Aug. 2002
	Overtoltage category	CAT III: U_{PH-PH} up to 400V
	Mode of protection	IP20 in accordance with DIN EN 40050 Part 9: 1993-05
	Electromagnetic compatibility	DIN EN 61000-6-3: 2005-6; (IEC 61000-6-3) DIN EN 61000-6-2: 2005; (IEC 61000-6-2)
Password protection	4-stellig	Das Löschen und Programmieren am Gerät ist nicht möglich, wenn der Passwortschutz aktiviert is

11.11 Overtoltage category

Measuring input for voltage	Input control voltage
Relay outputs	Overtoltage category CAT II: Switching voltage up to 250V (AC)
Input control voltage	Overtoltage category CAT III: 85 - 265V AC/DC

12 Selection of lines and fuses

C power (400 V) Q (kvar)	Current input per Phase I (A)	Supply line Cu (mm ²)	Fuse protection slow-blowing 3 x I (A)
0,5	0,72	4 x 1,5	10
1	1,44	4 x 1,5	10
1,5	2,16	4 x 1,5	10
2	2,88	4 x 1,5	10
2,5	3,60	4 x 1,5	10
3	4,32	4 x 1,5	10
4	5,76	4 x 1,5	10
5	7,20	4 x 2,5	16
6	8,64	4 x 2,5	16
7,5	10,80	4 x 2,5	16
10	14,40	4 x 2,5	25
12,5	18,00	4 x 6	35
15	21,60	4 x 10	35
16,7	24,00	4 x 10	35
20	28,80	4 x 10	50
25	36,00	4 x 16	63
30	43,20	4 x 16	80
33,3	48,00	4 x 16	80
35	50,40	4 x 25	80
40	57,60	4 x 25	100
45	64,80	3 x 35/ 16	100
50	72,00	3 x 50/ 25	125
60	86,40	3 x 50/ 25	125
70	100,80	3 x 70/ 35	160
75	108,00	3 x 70/ 35	160
80	115,10	3 x 95/ 50	200
90	129,60	3 x 95/ 50	200
100	144,00	3 x 95/ 50	250
120	172,80	3 x 120/ 70	250
125	180,00	3 x 120/ 70	250
150	216,00	3 x 150/ 70	315
180	259,20	3 x 240/120	400
200	288,00	3 x 240/120	400
250	360,00	2 x 3 x 150/ 70	500
300	432,00	2 x 3 x 185/ 95	630
350	504,00	2 x 3 x 240/120	2 x 400
400	576,00	2 x 3 x 240/120	2 x 400
450	648,00	4 x 3 x 120/ 70	2 x 500
500	720,00	4 x 3 x 150/ 70	2 x 500

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