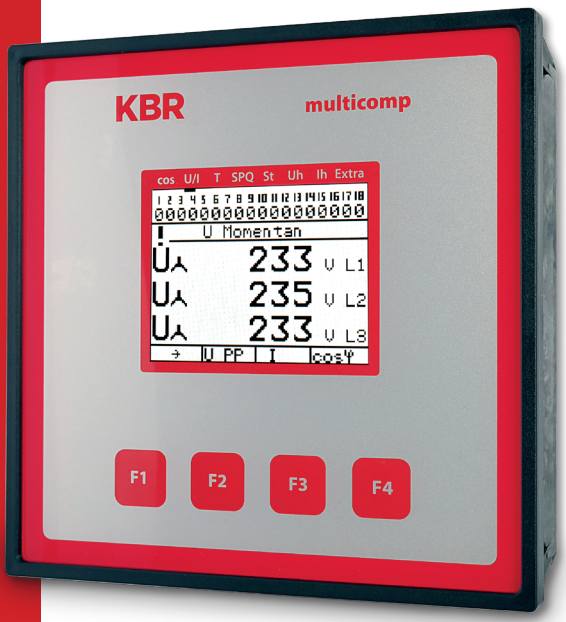
KBR Energy Management

User Manual
Technical Parameters



multicomp F144-3PH

System | English

19837_EDEBDA0227-3723-1_EN

Table of contents

19837_EDEBDA0227-3723-1_EN

19837_EDEBDA0227-3723-1_EN

1 Introduction

Thank you for choosing this KBR quality product.

To become familiar with the operation and programming of the device and to use the full range of functions of this high-quality product at all times, you should read this user manual carefully.

The individual chapters explain the technical details of the device and show how damage can be avoided through proper installation and commissioning.

1.1 User manual

This user manual describes the device version multicomp F144-3PH. This user manual must be accessible to the user at all times (e.g. in the switchgear cabinet). Even if the device is resold to third parties, the manual remains an inherent part of the device.

Although the utmost care has been taken in writing this user manual, errors may still occur. We would be very grateful if you would notify us of any errors or unclear descriptions you may notice.

19837_EDEBDA0227-3723-1_EN

1.2 Safety keys

This manual contains instructions that you must follow for your personal safety and to avoid material damage. These instructions are identified by a warning sign or information symbol, depending on the degree of hazard they warn about.

DANGEROUS VOLTAGE

"Warning" means that death, major injuries or damage may occur if suitable safety precautions are not taken.

CAUTION

"Caution" means that minor injuries or damage may occur if the appropriate safety precautions are not taken.

NOTE

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

Disclaimer

The contents of these ouser manual have been carefully reviewed in terms of the hardware and software described. However, deviations cannot be excluded and therefore complete conformity cannot be guaranteed. The specifications made in this user manual are reviewed on a regular basis; any corrections required will be included in the next revision.

19837_EDEBDA0227-3723-1_EN

1.3 Safety notes

In order to prevent operating errors, device operation is kept as simple as possible. This will enable you to start your device up quickly.

It is in your own interest to read the following safety instructions carefully. The applicable DIN/VDE regulations must be observed during installation!

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

To prevent fire and electric shock, do not expose the device to rain or moisture!

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

CAUTION

Incorrectly connecting the device can damage it.

For device connection, the data given in the connection diagram must be complied with (see chapter "Connection diagram") and the connection lines must be voltage-free. When wiring, always ensure that all wiring material used is neither damaged nor defective and that the polarity is correct!

Proper and safe operation of the product requires correct transport, storage, installation and assembly as well as careful operation and maintenance.

If the device has any visible damage it is considered unfit for use and must be disconnected from the mains!

Troubleshooting, repairs and maintenance work may only be carried out at our plant or after contacting our customer service team. If the device is opened without authorization, any warranty or guarantee claim is forfeited. Correct functioning can no longer be guaranteed!

Opening the device may expose live parts. Capacitors in the device may still be charged, even if the device has been disconnected from all power sources. Do not operate open devices under any circumstances!

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

1.4 Product liability

You have purchased a high-quality product. Only top-quality components with exceptional reliability are used.

19837_EDEBDA0227-3723-1_EN

Each device undergoes a long-term test before delivery.

With regard to product liability, please see our general terms and conditions for electronic devices, which you can read at www.kbr.de.

The warranty on device characteristics only applies if the device is operated in accordance with its intended use!

1.5 Disposal

Please dispose of defective, out-of-date or no longer used devices properly.

If required, we will dispose of the device for you.

1.6 Overvoltage and lightning protection

To protect your purchased high-quality devices from damage, we strongly recommend that you take overvoltage protection measures. Protect control voltage inputs, pulse and bus lines.

19837_EDEBDA0227-3723-1_EN

2 Description of functions of the multicomp F144-3PH

The multicomp F144-3PH reactive power controller works automatically in 4-quadrant operation (generator operation), i.e. even with energy recovery to the utility company network, missing compensation power is detected without a problem and compensated.

The control type of the device is optimizing, i.e. the controller selects the switching stage with the suitable compensation capacity according to the missing compensation power.

By using the "maximum switching power per switching operation" parameter (menu Extra / Commissioning / max. switching power), you can define how many kvar the controller can switch (on and off) at the same time. This enables faster compensation. If the set value is smaller than the largest switching stage available, the value of the largest stage is automatically used as the switching criterion.

Through the integrated temperature measurement input, the ambient temperature in the reactive power compensation system is also monitored and if a predefined limit temperature is exceeded, the fan is switched on. Furthermore, you can protect the system by setting an alarm / switch-off temperature which switches it off if there is a risk of damage due to overtemperature.

The controller is additionally equipped with a limit monitoring function for protection of capacitors from overvoltage and excessive harmonic load of voltage and current.

The 3-phase voltage and current recording makes it possible to not only realize 3-phase compensation as before, but also real single-phase compensation (balancing) or a mixture of single-phase and 3-phase compensation.

In this context, it is possible to separately configure 3-phase, phase-phase and single-phase stages for each of the 18 existing compensation stages.

Furthermore, it is also possible to operate a compensation system with capacitive stages only, inductive stages only or in mixed mode.

For 3-phase measurement, the measuring values are displayed separately per phase, making it possible to evaluate the actual power supply conditions in detail. For single-phase measurement, the measuring values of the phase measured are displayed but the power values are additionally projected as total power.

By using an additional digital input, it is possible to activate a second deviating target CosPhi.

Furthermore, the device is equipped with a RS485 bus interface for operation at the KBR eBus with the visual energy computer software. This enables comfortable visualization of the measuring values and the controller's operating state as well as convenient configuration of the device via the primary control unit.

19837_EDEBDA0227-3723-1_EN

Alternatively, this serial interface can also be accessed via Modbus (RTU). A detailed description can be found in the "Modbus data point description," available separately.

Please also observe the following notes on start-up and operation:

In case of operation in a 3-wire network, a zero-point creator is required (e.g. 700/100 V AC, primary 3-phase connection, available from KBR), as the controller needs a neutral conductor for trouble-free operation.

For operation as a single-phase measuring controller, the measuring current must always be connected at the terminals 20 und 21 (k1 and l1). After changing to single-phase operation, you can configure the phase shift between the measuring current and measuring voltage (menu Commissioning / Transformer / Main current transformer).

In this case, the measuring voltage must be connected to terminals 10 (L1) and 13 (N).

For this operating mode, the compensation system only may have 3-phase stages, as single-phase measurement is projected to 3-phase operation.

If the measuring current is taken from a phase other than the measuring voltage, this shift can be adjusted under the menu item Extra / Commissioning / Transformer / Main current transformer / Phase I (0°, 120°,240°)

The following settings are possible:

U L1, I L1	=	0°	U L2, I L2	=	0°	U L3, I L3	=	0°
U L1, I L2	=	120°	U L2, I L3	=	120°	U L3, I L1	=	120°
U L1, I L3	=	240°	U L2, I L1	=	240°	U L3, I L2	=	240°

19837_EDEBDA0227-3723-1_EN

NOTE

A phase-phase measurement (2 measuring phases without neutral conductor) is not possible with this device.

NOTE

For mixed operation of contactor stages and thyristor stages of the same size, the thyristor stages should be assigned to the stages in the back, as the front stages are switched first. The thyristor stages are detected if the discharge time set is under 1 second.

After 60 seconds, an active thyristor stage is replaced by a comparable contactor stage (if available) for continuous operation. This way, quick compensation is guaranteed even in case of fast load changes.

For mixed operation of phase-phase and phase-N stages, the largest phase-N stage must not be larger than the largest phase-phase stage. The smallest single-phase stage should only be half the size of the smallest phase-phase stage.

For mixed operation of phase-N stages and 3-phase stages, the largest 3-phase stage must be larger than the combination stage consisting of phase-N stages.

For mixed operation of phase-phase-phase stages and 3-phase stages, the largest 3-phase stage must be larger than the combination stage consisting of phase-phase stages.

For single-phase compensation (only phase-N stages or only phase-phase stages), 3-phase measurement needs to be programmed

19837_EDEBDA0227-3723-1_EN

3 Connecting the multicomp

3.1 Installation and assembly

- The applicable VDE regulations must be observed during installation!
- Before the device is connected to the power supply, check whether the local power supply conditions comply with the specifications on the nameplate. Incorrect connection may result in the destruction of the device. A different power frequency influences the measurement accordingly.
- The device must be connected in accordance with the connection diagram.
- The power supply input of systems that are at risk from lightning strikes must be equipped with suitable lightning protection.

CAUTION

The control voltage as well as the applied measuring voltage of the device must be protected by means of a back-up fuse.

When connecting the current transformers, the energy flow direction and the correct assignment to the voltage path must be observed!

NOTE

When connecting the phase (L1) to terminal 1 and the neutral conductor (N) to terminal 2 (Ph-N 100V – 240V+/-10 % 50Hz/ 60 Hz/DC) the safety device and the disconnector in the supply line to terminal 2 (N) are required.

The safety device and the disconnector to terminal 2 (N) are required for the following connection variants:

Alternating voltage:

Terminal 1 (L1) and terminal 2 (L2):
US1 Phase-Phase 100V - 240V +/-10% 50Hz/60 Hz

Direct voltage:

Terminal 1 (+) and terminal 2 (-):
US1 100V - 240V +/-10% DC

Connection variants of the power supply

19837_EDEBDA0227-3723-1_EN

Terminal 1	Terminal 2	Voltage	Safety device and disconnector to Terminal 2 required
		Power supply unit US1	
Phase L	Neutral conductor N	100V - 240V +/-10% AC 50/60 Hz	Yes
Phase L1	Phase L2	100V - 240V +/-10% AC 50/60 Hz	Yes
+	-	100V - 240V +/-10% DC	Yes

19837_EDEBDA0227-3723-1_EN

3.2 Current transformer connection:

When mounting the transformer, observe the direction of the current or energy flow. If the current transformer is mounted the wrong way, the measured current value will be negative.

A prerequisite for this is that energy is supplied to the device.

The following points must be observed when connecting the device:

- Direction of the energy flow
- Assignment of measuring voltage input / current transformer input

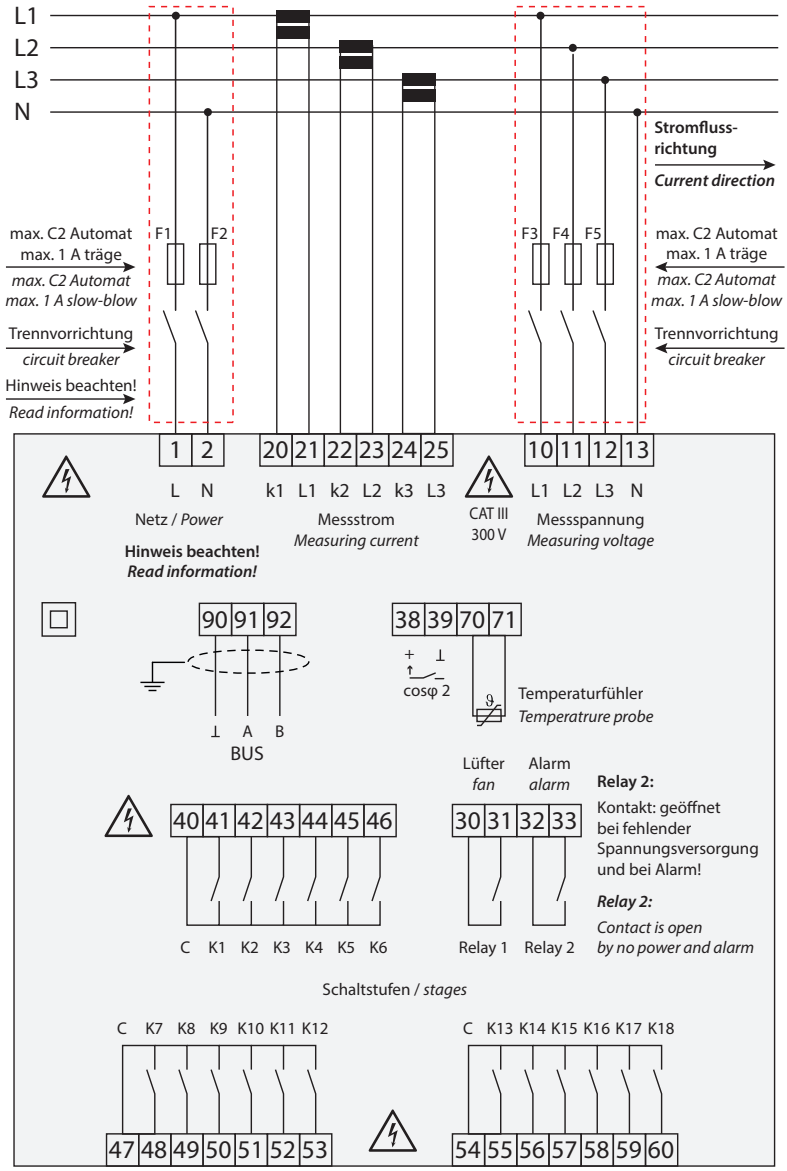
The current transformer on terminal 20/21 (k1/l1) must be installed in the phase in which the measuring voltage for terminal 10 (L1) is measured.

The device will display positive current when connection and energy flow direction are correct.

If connected incorrectly, the current displayed is negative. Interchange the connections until the display shows correct values.

19837_EDEBDA0227-3723-1_EN

3.3 Connection diagram



19837_EDEBDA0227-3723-1_EN

3.4 Terminal assignment

Terminal: **1 (L) and 2 (N):** **PE does not have to beconnected (Device is protection class II)**	**Power supply connection** A control voltage is required to supply the device with power. The unit is equipped with a multi-range power supply and may be supplied by voltages 100V – 240V+/ -10% 50Hz/60 Hz (see nameplate for device voltage).
Terminal: **10 (L1)** **11 (L2)** **12 (L3)** **13 (N):**	**Voltage measuring input** Input voltage both as PH-N and PH-PH measurement. 3-phase or single-phase measurement for 25... 230...280V AC PH-N, 50/60 Hz. The measuring range is configurable. For higher voltages, connection via voltage transformers is necessary (medium voltage measurement x/100 V), measuring range from 500V to 30.0 KV Ph-Ph.
20 (k1) and 21 (I1) **22 (k2) and 23 (I2)** **24 (k3) and 25 (I3):**	**Current measurement inputs** The measuring input for current must be connected via a current transformer x/1A AC or x/5A AC. When connecting the transformer, pay attention to the energy flow direction and the correct assignment of measuring voltage inputs to the current transformers.
30 and 31:	**Floating relay contact** The contact serves as switching output for the fan control. Maximum switching capacity 2A at 250V AC.
32 and 33:	**Floating relay contact** This contact serves as a message or alarm output. During operation, an acoustic or visual message can be activated or a consumer switched off using this relay. The contact is open as long as the device is dead as well as when there is an active message. Maximum switching capacity 2A at 250V AC.

19837_EDEBDA0227-3723-1_EN

40 (C): **47 (C):** **54 (C):**	**Connection for voltage supply to the relay output terminals 41 to 46** **Connection for voltage supply to the relay output terminals 48 to 53** **Connection for voltage supply to the relay output terminals 55 to 60** **The relays for the load contactor control outputs share the same connection to the supply voltage.**
41 (K1) to 46 (K6) **48 (K7) to 53 (K12)** **55 (K13) to 60 (K18):**	**Non-floating relay contacts** These contacts serve as control outputs for the load contactors of the compensation stages. The contacts are open as long as the device is dead and in stages that are not connected. Maximum switching capacity 2 A at 250 V AC.
38 (+) and 39 (-):	**Input for floating relay.** This input serves as switching input for the target cos phi. During operation, you can switch from target cos phi 1 to target cos phi 2. When connecting an electronic switch, please make sure to observe polarity.
70 (+) and 71 (-):	**Temperature sensor input** A temperature sensor, e.g. PT1000, can be connected to this input to measure the switchgear cabinet temperature. Temperature measuring range from -10 °C to +60 °C.
90 (ground) **91 (A)** **92 (B):**	**Interface connection** For KBR-eBus or Modbus communication.

19837_EDEBDA0227-3723-1_EN

3.5 Default controller settings (default setting):

Methods of measurement	3-phase

Commissioning:	
Measuring voltage transformer	Primary voltage 400 V Ph-Ph
Secondary voltage	400 V Ph-Ph
Zero-point creator	off
Main current transformer	Primary current 1000 A Secondary current 5 A
Rot.field I	0 ° (for single-phase measurement)
Consumption target CosPhi 1	0.95 inductive
Consumption target CosPhi 2	0.95 inductive
Recovery target CosPhi	1.00
Alarm CosPhi	0.92 inductive
Stage power	not set
Discharge time	60 seconds
Type of connection	3-phase
Type of stage	Capacitor stage
Max. switching capacity per switching operation	1 kvar or largest programmed stage power

Display (unaffected by reset):	
Display brightness	60 %
Dimming time	15 minutes
Dimming brightness	0 %

19837_EDEBDA0227-3723-1_EN

Basic system parameters switching performance:	
Hysteresis connection	70 % of lowest stage power
Hysteresis switch-off	100 % of lowest stage power
Alarm delay	1200 seconds (20 minutes)
Idle time:	10 seconds
Switching interval:	8 seconds
Current attenuation coefficient:	2
Voltage attenuation coefficient:	2
Attenuation coefficient Qmiss:	2

Basic system temperature parameters:	
Measurement	active
Switching thresholds	
Fan switched on	28 °C
Fan switched off	23 °C
Stages switched on	43 °C
Stages switched off	48 °C

Basic system limit parameters:	
Operating cycle limit	80000 connections
Operating cycle count	Activated by set limit
Overvoltage limit	440 VAC PhPh (corresponds to 10 %)
Current low load limit	10 A
Average current limit:	6-Fold current transformer ratio
Limit THD	8 %
	Activated by set limit
Limit Id	20 %
Harmonics monitoring	Activated by set limit

19837_EDEBDA0227-3723-1_EN

Miscellaneous:	
Sampling rate	Automatic
Error message dialog	In case of any errors, message and alarm relay

Service:	
Password	No password (9999, meaning all functions are accessible)

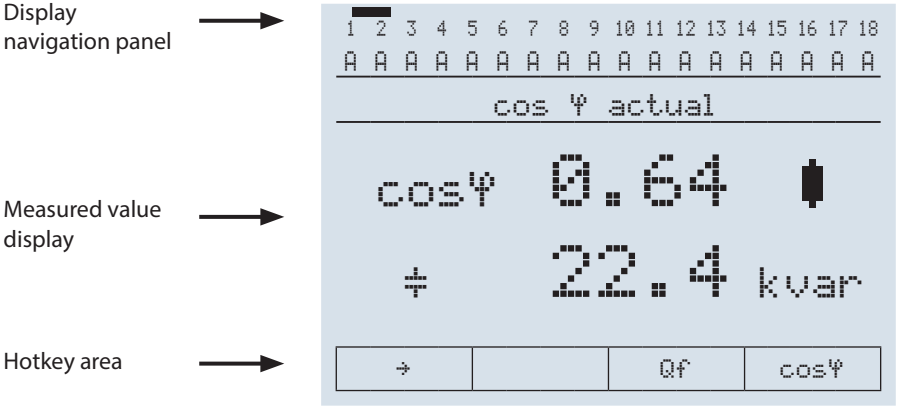
NOTE

Display parameters, sampling rate, password, bus parameters and language settings are unaffected by reset.

Error message dialog:	
No stage power:	Message and alarm relay
Power failure:	Message and alarm relay
Reset performed:	Message and alarm relay
Temperature switch-off of stages	Message and alarm relay
No measuring current:	Message and alarm relay
No measuring voltage:	Message and alarm relay
Low load operation:	Message and alarm relay
Harm. limit U exceeded:	Message and alarm relay
Harm. limit I exceeded:	Message and alarm relay
Operating cycle limit exceeded:	Message and alarm relay
Overvoltage limit exceeded	Message and alarm relay
Average current limit exceeded	Message and alarm relay
Facility too small:	Message and alarm relay

19837_EDEBDA0227-3723-1_EN

4 Control and display panel



4.1 Description of buttons and displays

1 Display navigation panel
The navigation panel shows the main menu selected, considerably simplifying operation of the device. The operator can immediately see what menu he is in.

2 Measuring value display
The DOT matrix display is normally used to show measured values. In some submenus, this display area is used to show additional information to assist operation.

3 Hot key area
The text line corresponds to the function keys below it and is used to issue messages and text. The interaction between key and corresponding display ensures user-friendly and self-explanatory operation.

Operating messages for individual switching stages:
1 = switching stage number
A = switched on in automatic operation

1 = switching stage number
= switched off in automatic operation

1 = switching stage number
H = switched on in manual operation

1 = switching stage number
0 = switched off in manual operation or no stage power is programmed

19837_EDEBDA0227-3723-1_EN

4.2 Description of general settings:

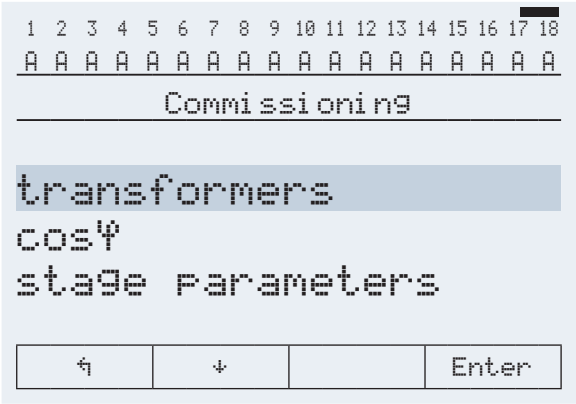
Attenuation (DC)	=	Reduction of the display fluctuations, the measuring cycle of the controller is not influenced.
Idle time (t idle)	=	Starts at compensation. After the idle time has expired, the next switching operation follows.
Alarm delay (t alarm)	=	Concerns the FTS message (Facility too small) i.e. all stages are hooked up and the set alarm CosPhi is not reached. After the set time has expired an error message is issued
Hysteresis (hyst.)	=	Refers to the smallest available stage power and the overcompensation or undercompensation, i.e. the hooking up or switching off starts at the percentage set
Switching interval	=	The time set defines the interval between two switching operations
Operating cycle limit	=	When the set value is reached, a message is issued. The value is based on the details from the contactor manufacturer.
Switch-off threshold Lim U	=	Overvoltage switch-off to protect the system, i.e. switching off the stages starts when the set limit is exceeded (hysteresis = 1 % of the limit)

19837_EDEBDA0227-3723-1_EN

5 Commissioning guideline for the multicomp F144-3PH

Start menu Commissioning:

If the multicomp is being commissioned for the first time, the menu Extra / Commissioning is displayed as the start screen (after the initialization phase) after setting up the supply voltage:



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

Controller preconfigured:

If you wish to use a controller that is already integrated into a KBR compensation system by default, only the parameters of the current transformer need to be configured.

1. Configuring current transformer values

All current transformer parameters need to be configured correctly for the compensation controller to function properly. Primary and secondary current of the transformer have to be set. These parameters can be found on the nameplate of the current transformer. In addition, the phase allocation of the transformer needs to be configured correctly. In the controller, the phase (L1, L2, L3) in which the current transformer is integrated has to be set. This setting does not have to be made for 3-phase measurement.

19837_EDEBDA0227-3723-1_EN

2. Function test

A function test should be performed after all values have been programmed step by step, by disconnecting the controller from the power supply for a few seconds.

The controller should start automatically after it is reconnected to the power supply. When reading out the CosPhi voltage in the cosPhi instantaneous menu immediately after switching on, CosPhi should be low and inductive. After approx. 60 seconds, the controller starts to switch on the individual capacitor stages.

The CosPhi, which can be read in the cosPhi instantaneous menu, should have risen in comparison with former values, or it should rise when switching on additional stages. If the compensation system is designed correctly, the controller should compensate to the set target cos phi after a while.

Controller not configured:

If a controller which has not been configured is to be started up, the following procedure has to be performed step by step.

1. Configuring current transformer values

All current transformer parameters need to be configured correctly for the compensation controller to function properly. Primary and secondary current of the transformer have to be set. These parameters can be found on the nameplate of the current transformer. In addition, the phase allocation of the transformer needs to be configured correctly. In the controller, the phase (L1, L2, L3) in which the current transformer is integrated has to be set. This setting does not have to be made for 3-phase measurement.

2. Setting target cosine

You can ask your electricity supplier for the target cos, which should be set up at this point. The target cosine is by default set to 0.95 inductive.

3. Configuring the capacitor stages

The stages can be configured manually.
The most important setting to pay attention to is the stage power. You can find the stage power on the nameplate of the stage or the circuit diagram and then program it manually.

19837_EDEBDA0227-3723-1_EN

4. Function test

A function test should be performed after all values have been programmed step by step, by disconnecting the controller from the power supply for a few seconds.

The controller should start automatically after it is reconnected to the power supply. When reading out the CosPhi voltage in the cosPhi instantaneous menu immediately after switching on, CosPhi should be low and inductive. After approx. 60 seconds, the controller starts to switch on the individual capacitor stages.

The CosPhi, which can be read in the cosPhi instantaneous menu, should have risen in comparison with former values, or it should rise when switching on additional stages. If the compensation system is designed correctly, the controller should compensate to the set target cos phi after a while.

5.1 Basic device configuration:

The menu guidance of the multicomp is self-explanatory.

The operator is guided and supported by the device through operating instructions displayed for the respective situation. The following terms are available for programming:

Enter	Return for configuration
EDIT	Perform configuration
↓	Submenu or parameter selection
+	Value input
?	Selection
YES	Confirmation to save configuration
NO	Discard configuration
↰	Return

As an example of the basic configuration procedure, the functions in the Extra / Commissioning menu will be looked at more closely.

Menu item: Transformer

<table>
<tr><td colspan="4">Transformer</td><td>Menu description</td></tr>
<tr><td>F1</td><td>F2</td><td>F3</td><td>F4</td><td></td></tr>
<tr><td>↰</td><td>↓</td><td>↑</td><td>ENTER</td><td>Display hot-key area</td></tr>
<tr><td>|</td><td>|</td><td>|</td><td>|</td><td></td></tr>
<tr><td>|</td><td>|</td><td>|</td><td colspan="2">Return for configuration</td></tr>
<tr><td>|</td><td>|</td><td colspan="3">Menu selection</td></tr>
<tr><td>|</td><td colspan="4">Menu selection</td></tr>
<tr><td colspan="5">Return</td></tr>
</table>

19837_EDEBDA0227-3723-1_EN

5.2 Setting transformer ratio

After pressing the F2 and F4 buttons, the following is displayed in the hot key area:

curr. transformer				Menu description
F1	F2	F3	F4	
↰	↓	↑	ENTER	Display hot-key area
|	|	|	|	
|	|	|	Return for configuration	
|	|	Menu selection		
|	Menu selection			
Return				

After pressing the F4 button, the following appears in the hot-key area of the display:

F1	F2	F3	F4	
↰			EDIT	Display hot-key area
|			|	
|			Configuration of primary current transformer	
|				
|				
Return				

After pressing the F4 (EDIT) button, the following appears in the hot-key area of the display:

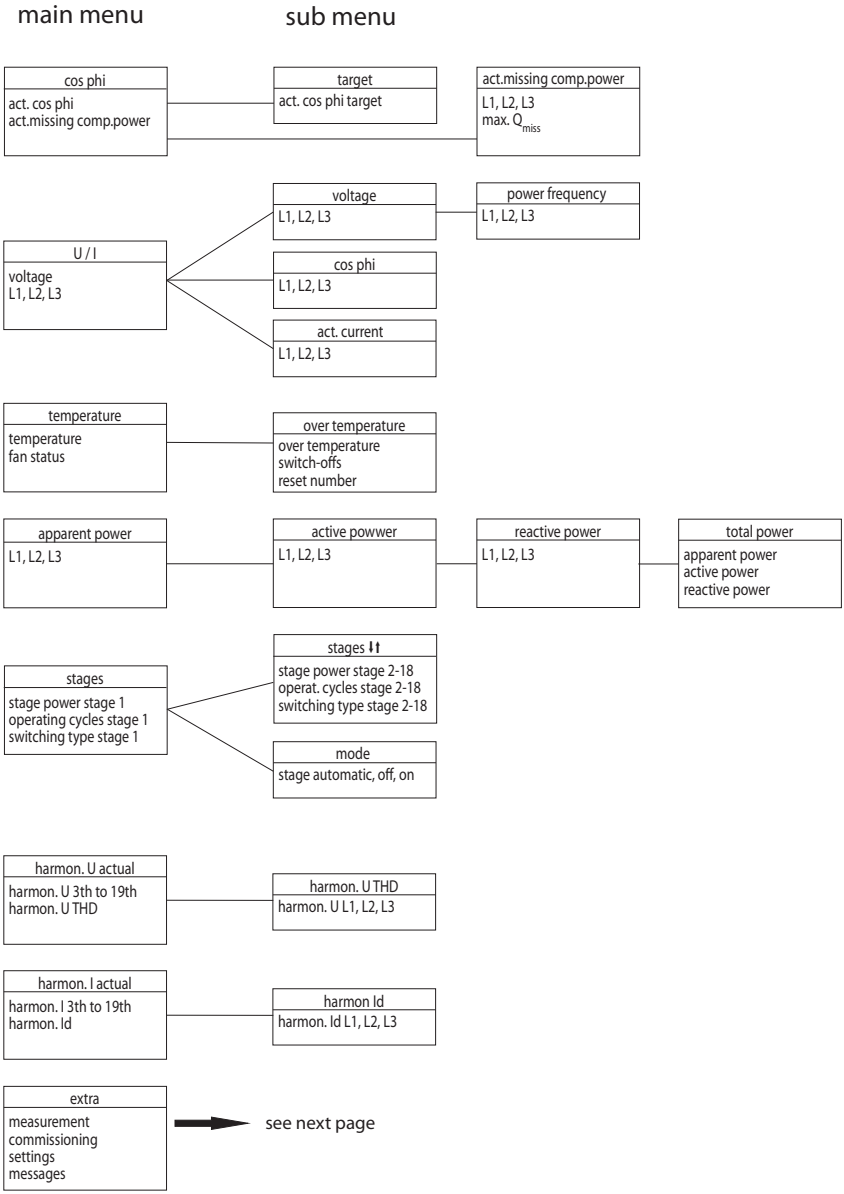
F1	F2	F3	F4	
↰		→	+	Display hot-key area
|		|	|	
|		|	Enter value	
|		Continue to next digit		
|				
Return				

19837_EDEBDA0227-3723-1_EN

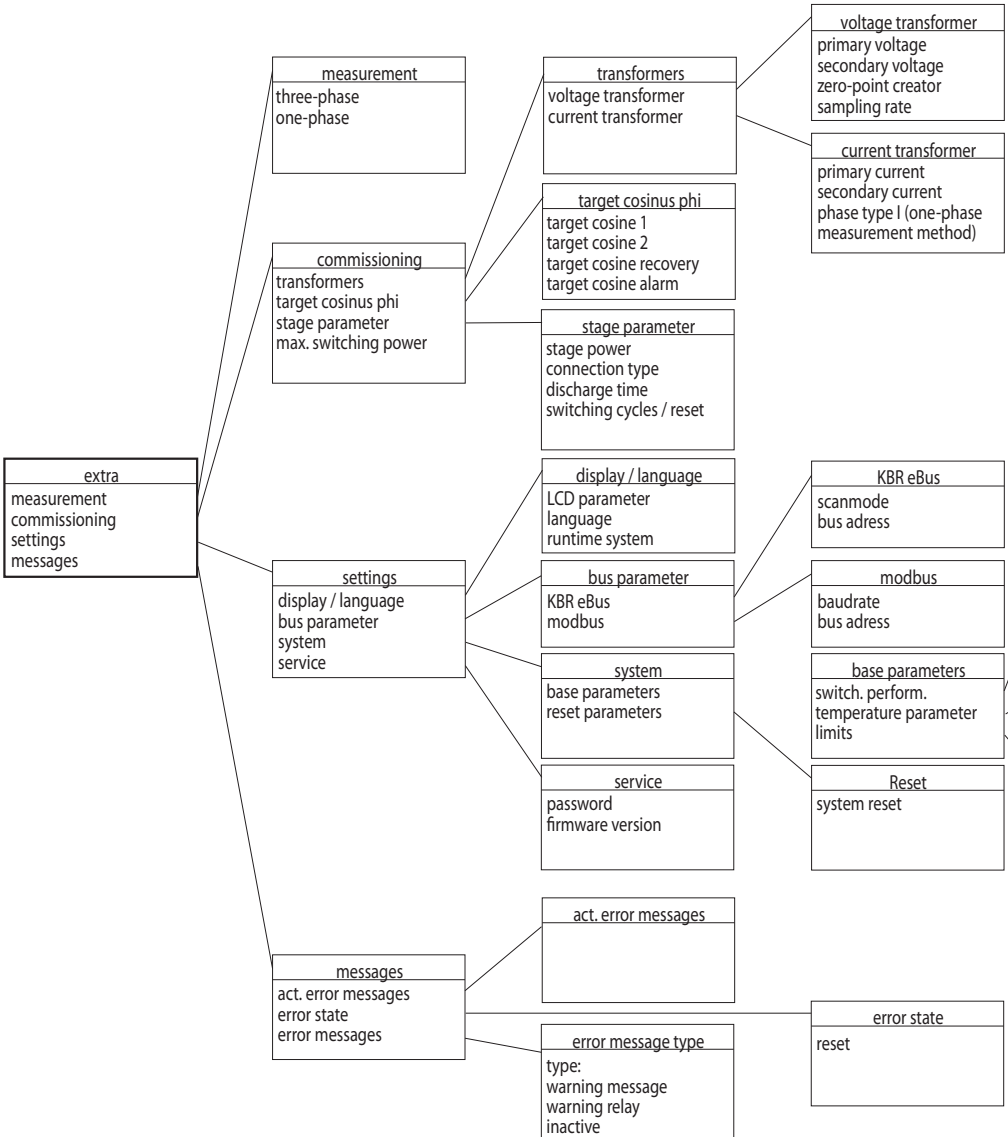
If the **setting was changed**, the following appears in the hot-key area of the display:

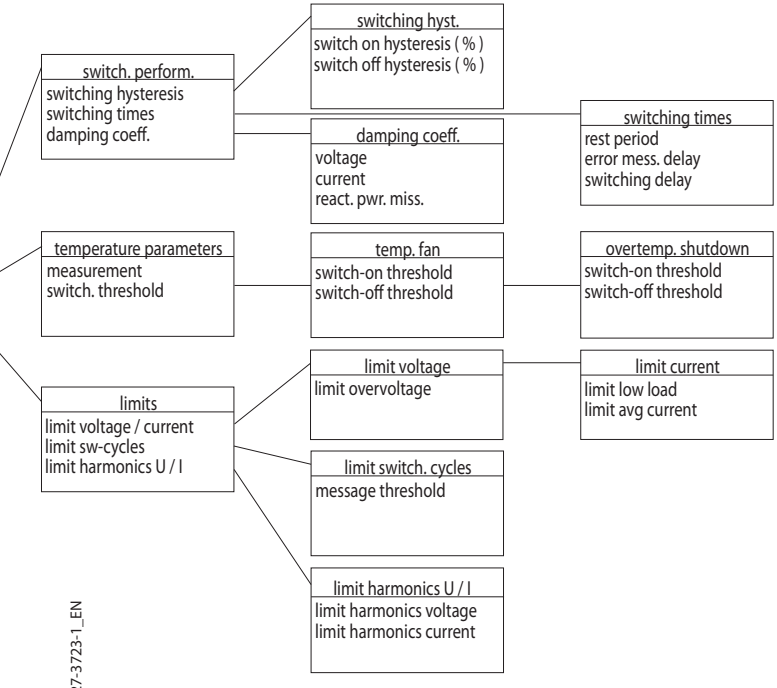
F1	F2	F3	F4	
NO	YES	→	+	Display hot-key area
|		|	|	
|		|	Enter value	
|		Continue to next digit		
|	Saving the last changes			
Leave setting menu without saving				

5.3 Operating Diagram



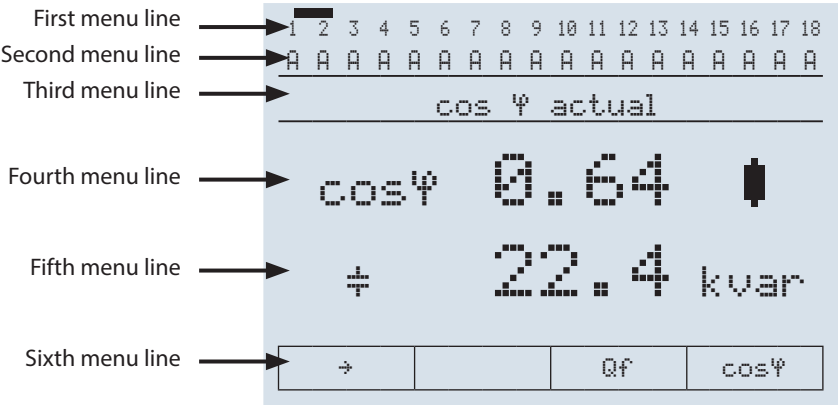
5.4 Menu structure





19837_EDEBDA0227-3723-1_EN

5.5 Main menu cos φ



The display is divided into various menu lines. The number of lines depends on which main or submenu item is selected:

First menu line:	Shows which of the eight main menus is being displayed
Second menu line:	Status display of the output lines
Third menu line:	Description of the menu and messages currently displayed
Fourth and fifth menu line:	Display of values of the current menu
Sixth menu line:	Navigation in the menu displayed

cos φ actual				Menu description
F1	F2	F3	F4	
→		Qf	cosφ	Display hot-key area
|		|	|	
|		|	Displaying the current target cosphi	
|		Display of the missing compensation power or maximum value		
|				
Scroll through main menu				

19837_EDEBDA0227-3723-1_EN

Display as example:

Main menu:	= cosφ actual (instantaneous)
Stage mode:	= all stages automatic on
Menu description:	= cosφ actual (instantaneous)
Measured cosφ:	= 0.64 inductive
Missing compensation power:	= 22.4 kvar

By pressing the button F3 twice, you can display the **maximum value of the missing compensation power**. The value is displayed in kvar. The value is only displayed if all available stages are switched on and the configured alarm CosPhi is not reached when the set alarm delay time has elapsed.

As soon as the value has been entered, the status **Facility too small** is displayed in the Messages sub menu.

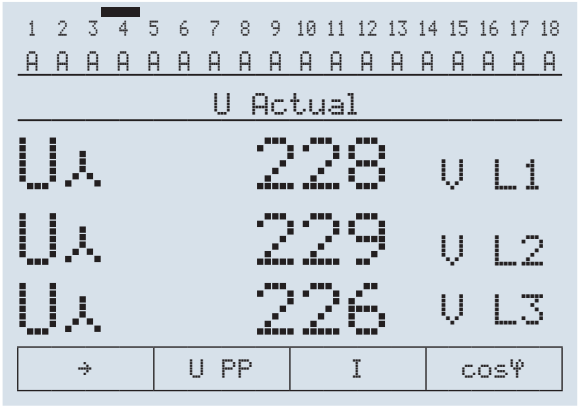
NOTE

In case of a 3-phase measurement, the values in the measurement display areas are displayed separately per individual phase.

In case of single-phase measurement, only the value of the phase measured is displayed.

19837_EDEBDA0227-3723-1_EN

5.6 Main menu Voltage / Current

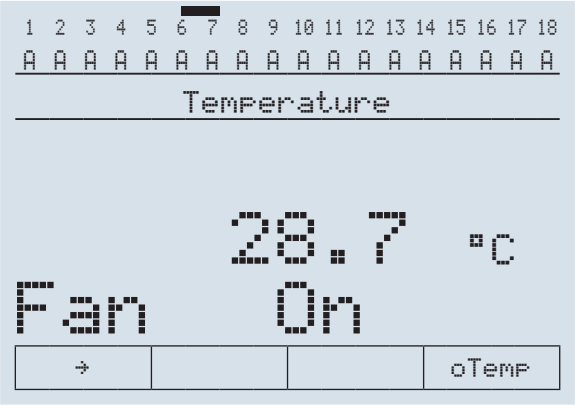


U Actual				Menu description
F1	F2	F3	F4	
→	U PP	I	cosφ	Display hot-key area
|	|	|	|	
|	|	|	Display of Cosine Phi	
|	|	Display of the apparent current		
|	Display of voltage phase-phase and the power frequency			
Scroll through main menu				

Display as example:
measured voltage per phase (phase-N)

19837_EDEBDA0227-3723-1_EN

5.7 Main menu Temperature



Temperature				Menu description
F1	F2	F3	F4	
→			oTemp	Display hot-key area
|			|	
|			Display of overtemperature switch-offs	
|				
|				
Scroll through main menu				

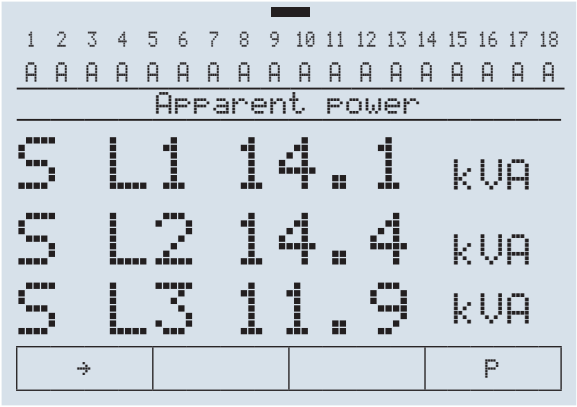
Display as example:
measured temperature: is 28,7°
Fan status = switched on

NOTE

For the error message **temperature sensor short circuit or broken wire**, the following message is displayed in the **Temperature** main menu:
sc = Short circuit
br = Broken wire
The following message is displayed if temperature measurement is deactivated:
na = Temperature measurement not activated

19837_EDEBDA0227-3723-1_EN

5.8 Main menu power



Apparent power				Menu description
F1	F2	F3	F4	
→			P	Display hot-key area
|			|	
|			Display of active power, reactive power and total power	
|				
|				
Scroll through main menu				

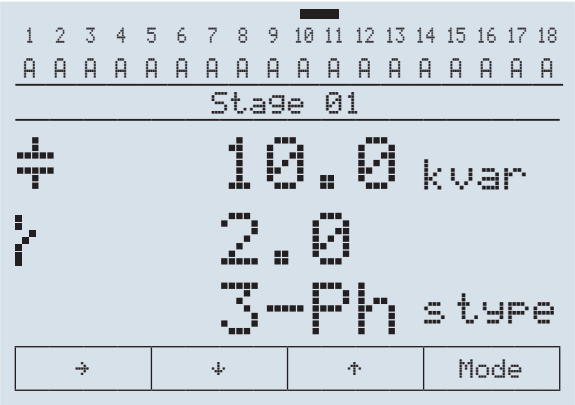
Display as example:

Apparent power L1:	14,1 kVA
Apparent power L2:	14.4 kVA
Apparent power L3:	11.9 kVA

By pressing the F4 button, the active power,
the fundamental reactive power and the total values of apparent power, active power and fundamental reactive power are displayed.

19837_EDEBDA0227-3723-1_EN

5.9 Main menu stages



Stage parameters				Menu description
F1	F2	F3	F4	
→	↓	↑	Mode	Display hot-key area
|	|	|	|	
|	|	|	Set switch mode of stages (On, Off, Automatic mode)	
|	|	Additional stages descending		
|	Additional stage display ascending			
Scroll through main menu				

Display as example:

Stage No.:	= Stage 01
Stage type:	= Capacitor stage
Stage power:	= 10kvar
Operating cycles:	= 2
Type of connection:	= 3-phase

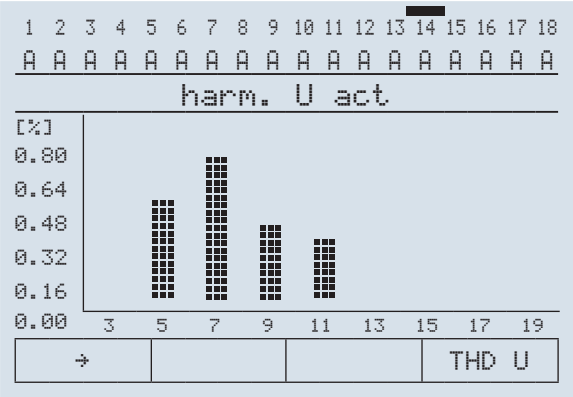
By pressing the F4 button, the Mode sub menu can be selected, in which you can individually configure the switching mode **per stage**.

The following options are available:

On	= the stage is switched on permanently
Off	= the stage is switched off permanently
Auto	= the stage is operated automatically, i.e. the stage can be switched on or off depending on the required compensation power.

19837_EDEBDA0227-3723-1_EN

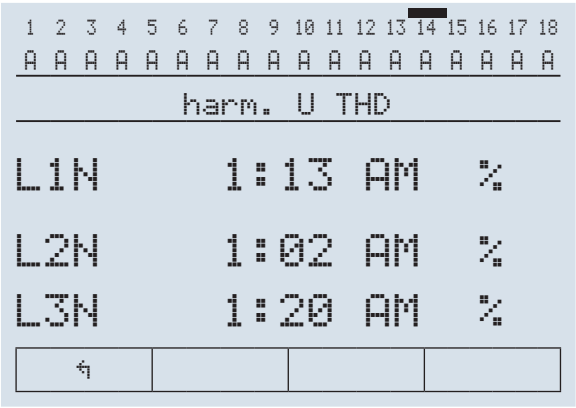
5.10 Main menu Uh voltage harmonics



harm. U act				Menu description
F1	F2	F3	F4	
→			THD U	Display hot-key area
|			|	
|			continue with THD U (in %)	
|				
|				
Scroll through main menu				

Display as example:= 3-phase bar chart

5.11 Sub menu THD voltage



harm. U THD				Menu description
F1	F2	F3	F4	
↰				Display hot-key area
|				
|				
|				
|				
Back to main menu				

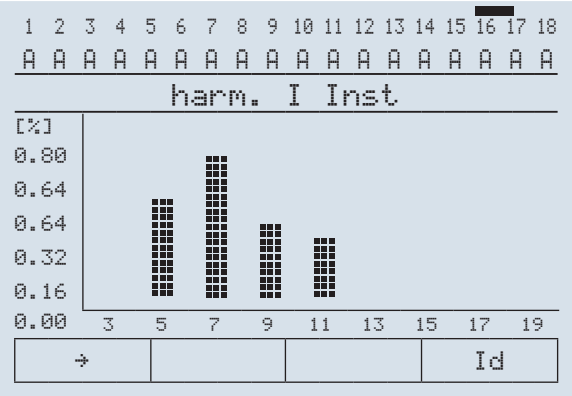
Display as example:

harm. U THD L1N: = 1.13 %
Harm. U THD L2N: = 1.02 %
Harm. U THD L3N: = 1.20 %

NOTE

The percentage value displayed refers to the measured voltage value of the fundamental!

5.12 Main menu Ih current harmonics

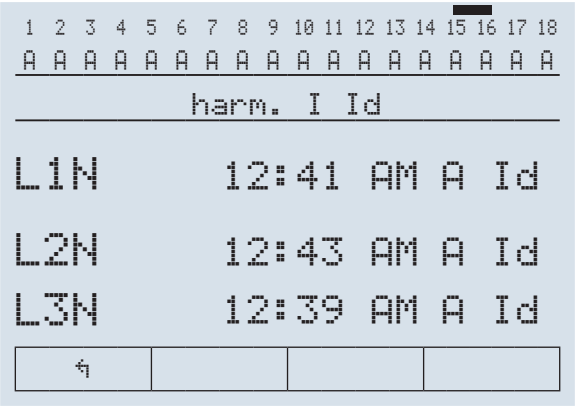


harm. I Inst				Menu description
F1	F2	F3	F4	
→			Id	Display hot-key area
|			|	
|			continue with Id (in Ampere)	
|				
|				
Scroll through main menu				

Display as example: = 3-phase bar chart

19837_EDEBDA0227-3723-1_EN

5.13 Sub menu ID current

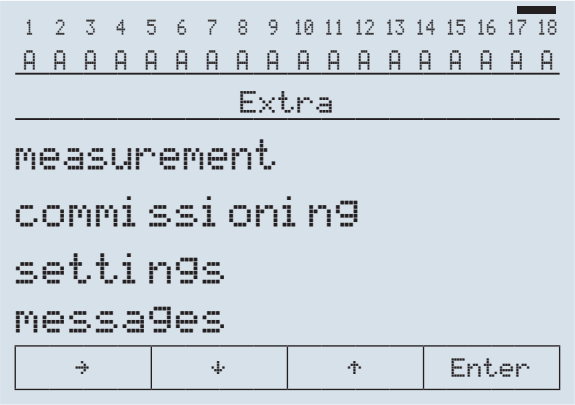


harm. I Id				Menu description
F1	F2	F3	F4	
↰				Display hot-key area
|				
|				
|				
|				
Back to main menu				

Display as example:

harm. Id L1N: = 0.41 A
Harm. Id L2N: = 0.43 A
Harm. Id L3N: = 0.39 A

5.14 Main menu Extras



Extra				Menu description
F1	F2	F3	F4	
→	↓	↑	Enter	Display hot-key area
|	|	|	|	
|	|	|	Call up menu	
|	|	Menu selection		
|	Menu selection			
Scroll through main menu				

19837_EDEBDA0227-3723-1_EN

5.15 Description of submenus

The Methods of measurement submenu contains the following items:
1. Single-phase measurement
2. 3-phase measurement

5.15.1 The Commissioning submenu contains the following items:

Transformer settings (voltage, current):

Voltage transformer	primary voltage
	Secondary voltage
	Zero-point creator
	Sampling rate

Main current transformer	Primary current
	Secondary current
	Phase allocation (for single-phase measurement)

Setting ranges:	
primary voltage	1 V to 999999 V Ph-Ph
Secondary voltage	1 V to 999999 V Ph-Ph
Zero-point creator	ON, OFF
Sampling rate	Auto, 50 Hz, 60 Hz
Primary current	1 to 999999 A
Secondary current	1 or 5 A
Phase I	0°, 120°, 240°

For the items primary voltage and secondary voltage, the respective parameter for the voltage transformer must be given, e.g. transformer 10,000/100V means a primary voltage of 10,000V and a secondary voltage of 100V.

The input field ranges from 1V to 999kV for the primary and secondary voltage.

Using the item **Zero-point creator**, the controller can be activated via a zero-point creator. For energy supply networks with outer conductor connected to the earth potential, suitable control gear with electrical isolation (e.g. voltage transformer) must be used.

19837_EDEBDA0227-3723-1_EN

These transducer adaptors (zero-point creator) are suitable for creating a virtual low-impedance neutral point for the device in a three-phase network without neutral conductor.

NOTE

In the 700 V variant, this also serves to adapt the measuring voltage to the device. Make sure that the device is configured for the operation with a zero-point creator.

Transformers are available in the following variants:

Type 400/100	Primary:	400 V phase-phase voltage
	secondary	100 V phase-phase voltage
Type 700/100	Primary:	700 V phase-phase voltage
	secondary	100 V phase-phase voltage

2. Target cosine - settings

a. Target cosφ 1 for power consumption	b. Target cosφ 2 for power consumption
c. Target cosφ for power recovery	d. Alarm cosφ for FTS message (facility too small)

Setting ranges:

Consumption target Cosφ 1.2	ind. 0.50 to cap. 0.50
Recovery target cosφ	ind. 0.50 to cap. 0.50
FTS alarm cosφ	ind. 0.50 to cap. 0.50

If active **power - recovery** is detected, this is signaled by the symbol in the display. In order to avoid alternating switching operations, the target cosφ for power output stays active until 15 minutes after the end of the power output.

3. Stage parameters

a. Stage selection, stage power	b. Type of connection
c. Discharge time	d. Operating cycles

Setting ranges:

Stage power	0 to 9999.9 kvar, inductive or capacitive
Type of connection	3-phase, phase-phase, single-phase
Discharge time	10 ms to 999.99 sec (thyro < 1 second)

19837_EDEBDA0227-3723-1_EN

4. Max. switching capacity

Setting ranges:

max. switching capacity per switching operation	0 to 999999 kvar

NOTE

The setting capacitive or inductive stage is indicated by the  or  symbol. alarm cosphi is not used for compensation systems with inductive switching stages.

5.15.2 The Settings submenu contains the following items:

1. Display / Language	
Display parameters	Display brightness
	Dimming time
	Dimming brightness
Language	
Runtime	
Setting ranges	
Contrast setting	00% to 99%
Brightness setting	00% to 99%
Dimming time	1 to 15 minutes
Dimming brightness	00% to 50%
Language selection (text display)	German, English

2. Bus parameters	
Setting ranges	
Bus parameters	Bus address, scan mode

19837_EDEBDA0227-3723-1_EN

3. System		
Basic parameters switching performance	Switching hysteresis:	Connection
		Disconnection
		Switch mode
	Switching times:	Idle time
		Alarm delay
		Switching interval
	Attenuation coefficients:	Voltage
		Current
		Qmiss
Temperature parameters	Activate measurement Switching thresholds:	Switching on fan
		Switching off fan
		Switching on system
		Switching off system
Limits	Voltage current:	Light load
		Average current value
	Operating cycles Harmonics:	Voltage
		Current
Reset of parameters:	Reset to default settings (delivery state)	

4. Service	
Password	
Firmware version	
Setting ranges	
Password	4-digit numerical default (9999, meaning all functions are accessible)

Under the item Password, changes to the controller parameters can be password-protected. The password can be any 4-digit number code.

The controller **is delivered** with the release code 9999, i.e. all functions of the device are available.

19837_EDEBDA0227-3723-1_EN

NOTE

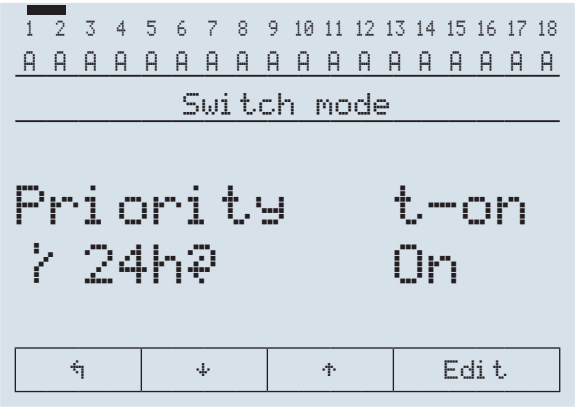
Stage selection mode (switching mode):

The priority of switching criteria for compensation stages can be changed in the menu Extra ==> Settings => System => Basic Parameters => Switching Performance => Switching Hysteresis => Switching Mode.

The aim of the switching criteria is to use the compensation stages as evenly as possible. The following modes are available:

- Priority 1: fewest operating hours (turn-on duration) of the compensation stage
- Priority 2: fewest switching cycles of the compensation stage

Display example for Priority 1:



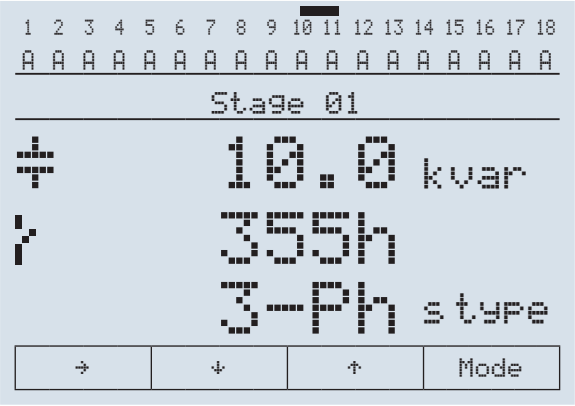
An exchange of the connected compensation stages with equivalent stages can be activated/deactivated after 24 hours of run-time in the Switching mode menu with the parameter ›24h‹¶ (though only with priority 1 – operating hours optimization).

The exchange takes place every 24 hours.

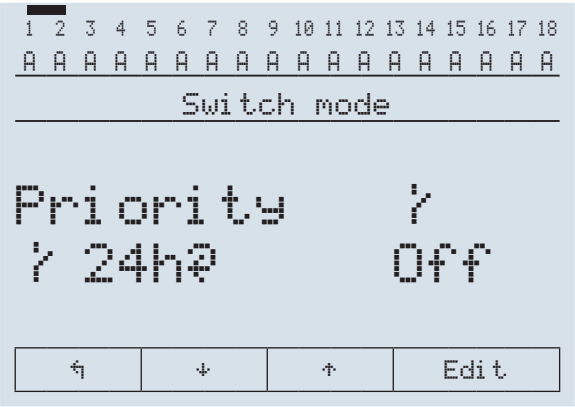
19837_EDEBDA0227-3723-1_EN

NOTE

In **Priority 1** under menu item **stages (St)**, instead of the operating cycle, the operating hours (turn-on duration) of the compensation stage are displayed.



Display example for **Priority 2**(fewest switching cycles of the compensation stage):



19837_EDEBDA0227-3723-1_EN

5.15.3 Reset of parameters: Reset to default settings (delivery state)

Setting ranges:	
Hysteresis connection	70 to 150 %
Hysteresis switch-off	70 to 150 %
Idle time	0 to 999.99 sec.
Alarm delay for FTS	1 to 9999 sec.
Switching interval	10 ms to 999.99 sec.
Attenuation coefficient for current	0 to 9
Attenuation coefficient for voltage	0 to 9
Attenuation coefficient Q_{miss}	0 to 9
Temperature measurement	active, inactive
Switching threshold for switching on fan	0 to 70 °C
Switching threshold for switching off fan	0 to 70 °C
Switching threshold for switching on stages	0 to 70 °C
Switching threshold for switching off stages	0 to 70 °C
Limit overvoltage switch-off	up to 150 %, dependent on primary voltage
Low load limit	0 to primary current transformer (in A)
Average current limit	0 to primary current transformer +20 % (in A)
Operating cycle limit	0 to 999999
Limit THD	0 to 100 %, deactivatable (0 %)
Limit I d	0 to 100 %, deactivatable (0 %)

The **temperature parameters** contain the general activation and deactivation of the temperature measurement and the switching behavior resulting from this.

In addition, the switching threshold and hysteresis for the fan control, the switching threshold and hysteresis for the overtemperature alarm and the switching threshold and hysteresis for the overtemperature switch-off can be set here. The following parameters are available for switching thresholds and hystereses:

Switching threshold fan	= 0 to 70 °C / hysteresis = 0 °C to 25 °C
Switching threshold alarm	= 0 to 70 °C / hysteresis = 0 °C to 25 °C
Switching threshold overtemperature	= 0 to 70 °C / hysteresis = 0 °C to 25 °C

19837_EDEBDA0227-3723-1_EN

The default settings are:	
Switching threshold fan	= 28 °C / hysteresis = 5 °C
Switching threshold alarm	= 45 °C / hysteresis = 5 °C
Switching threshold overtemperature	= 48 °C / hysteresis = 5 °C

This means that the fan switches on when 28 °C is exceeded and switches off again when the temperature drops below 23 °C.

The overtemperature alarm is triggered when 45 °C are exceeded and is reset when the temperature drops below 40 °C.

The overtemperature stage switch-off is activated when 48 °C are exceeded.

After the temperature has dropped below 43°C, the stages are hooked up again if required, after the discharge time has elapsed.

The setting range of the overvoltage switch-off goes up to 150 % of the measuring voltage, i.e. for a programmed measuring voltage of primarily 400 V Ph/Ph, the setting range is 400 V to 600 V Ph/N. The setting range is dependent on the programmed primary measuring voltage.

When the limit for the overvoltage switch-off is exceeded, the hooked up compensation stages are immediately switched off. After the temperature has dropped below the limit by 1% of the limit, the compensation stages are hooked up again after the discharge time has elapsed.

NOTE

The default setting for the overvoltage limit is, for a measuring voltage of 400 V PH-Ph 10 % more, i.e. 440 V PH-PH. In case of operation via voltage transformer, the limit is set respectively higher!

Example: For a voltage transformer of 700 V PH-PH
primary and 100 V PH-PH secondary, the limit is set to 770V PH-PH
(770 V PH-PH + 10 % (= 70 V) equals 770 V PH-PH).

That means: The limit value is converted internally into a percentage value (without decimal places) in relation to the set primary voltage. With a primary voltage of 400 V, for example, the limit value can be set in 4 V increments.

If the limit value corresponds to the set primary voltage, overvoltage monitoring is deactivated

The limit value dependends on the primary voltage!

19837_EDEBDA0227-3723-1_EN

5.15.4 The Messages submenu contains the following items:

Active error messages	
Error state	
Error messages	No stage power
	Power failure
	Reset performed
	Temperature switch-off
	No measuring current
	No measuring voltage
	Light load operation
	LIM Harmon U
	LIM Harmon I
	LIM Operating cycle
	LIM Operating cycle
	LIM Average current value
	PFC too small
Error message setting range	Display message
	Display message + alarm relay switches
	No output

19837_EDEBDA0227-3723-1_EN

6 Notes on Troubleshooting:

Undercompensation, not enough stages are switched on.

Check controller for error messages If the target cos phi is set to 0.8 capacitive, the capacitors need to start to be switched on. If the system is not over-dimensioned, almost all stages need to be switched on.

Check the system's main fuse and group fuses. All values can be found in the enclosed documents. The group fuses must display at least 1.7 times the value of the capacitor power.

If the fuses blow despite being correctly selected, the groups must be checked individually for excessive current input and defective contactors.

Undercompensation, all stages are switched on.

The existing system is not sufficient (e.g. due to new inductive consumers).

Undercompensation, too many stages are switched on.

Check controller settings (target cos phi capacitive?). Is the transformer installed in the wrong position?

Controller switches too often, in particular during low load times (at the weekend, at night).

Check the transformer ratio configuration. If necessary, (manually) switch a small stage on permanently.

19837_EDEBDA0227-3723-1_EN

7 System and Safety Device Maintenance

In order to ensure that your system functions properly and has a long service life, perform the following checks after commissioning and then on an annual basis.

- Check and re-tighten 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 sparking.
- Check the control performance in automatic mode.
- Check the cooling air setting (fans, temperature monitoring function):
- Check that the controller temperature relay switches the fans on at 28 °C.
- Check that the temperature monitoring switches the system off via controller at 48 °C.
- Clean the filter mats if necessary, depending on how dirty they are.
- Visual inspection of capacitors for leaks (a reliable encapsulation of the dielectric is a prerequisite for the long life of the capacitor).
- Examine the current input and capacitor terminal voltage once every three months.
- Check the reactive energy consumption on the basis of the electricity bill.

Limit temperatures:

Valid for systems in cabinets	+ 35° C on a 24-hour average
	+ 20° C on an annual average
	+ 40° C short-term highest value
	– 10° C lowest value

The above information applies particularly to reactor-connected systems. The current consumption and the temperature of these systems must be checked regularly so that overloading of the capacitors can be detected at an early stage. A higher input current can be caused by an increasing proportion of harmonics or by a change in capacitance of capacitors.

19837_EDEBDA0227-3723-1_EN

8 Technical data multicomp F144-3PH

8.1 Measuring and display values

Voltage	Units	[V, kV;] display switches automatically
	Display range	0 V to 999 kV
	Measuring range	3-phase 25 … 230 … 280 VAC, 50 / 60 Hz
Current (apparent current)	Units	[A;kA] display is switched automatically
	Display range	0 A to 999 kA
	Measuring range	3-phase 0,03 … 5 … 6 A
Frequency	Power frequency measurement	fnetwork ; measured with power supply correction
	Units	[Hz]
	Measuring range	40 - 62 Hz
Apparent power	Calculation	Stot , single-phase / 3-phase
	Units	kVA
	Display range	0 VA to 999 MVA
Active power	Calculation	Ptotal , single-phase / 3-phase
	Units	kW
	Display range	0.00W to 999 MW
Reactive power	Calculation ÷ ind. and cap.	Qtotal; Qmiss; distinction between ind./cap.
	Units	kvar
	Display range	0.00Var to 999 MVar
Power factor	Calculation ÷ ind. and cap.	cosφ; distinction between ind./cap. cosφ in the display
	Display range	CosPhi 0.1ind. ÷ 1 ÷ 0.1cap.
Harmonics	Distortion factor (THD) for voltag, Id for current	Voltage: KF- U current : Id
	Partial distortion factors	3rd; 5th; 7th; 9th; 11th; 13th; 15th; 17th; 19th; voltage and current harmonics
	Units	[%] for voltage, [A] for current
	Measuring range	0% to 100% for voltage, 0 to 999 kA for current

19837_EDEBDA0227-3723-1_EN

8.2 Measuring accuracy

Current	± 1 % / ± 1 digit
Voltage	± 1 % / ± 1 digit
Power	± 2 % / ± 1 digit
Power factor	± 2 % / ± 1 digit
Frequency	± 0.1 Hz / ± 1 digit

8.3 Measuring principle

Sampling	128 readings per period
A/D converter	12 bit
Measurement of U and I	simultaneous recording of measured values for U and I
Update speed (complete measuring cycle)	20 ms
Harmonics calculation	FFT with 128 points over one period
Frequency measurement	Consumption: Voltage measurement between phase Lx - N

8.4 Device memory

Memory		30 KB RAM (volatile)
Program and parameter memory		256 kB flash
Extreme value (max.)		Missing compensation power Qmax
Harmonic limit violation	Recording time	approx. 100 ms
Overvoltage switch-off	Recording time	approx. 40 ms
Zero-voltage switch-off	Recording time	approx. 40 ms (for measuring voltage)

8.5 Power supply

Power supply	100V - 240V +/-10% 50Hz/60 Hz/DC, max. 15 VA, 9W

19837_EDEBDA0227-3723-1_EN

8.6 Hardware inputs and outputs

8.6.1 Inputs

Voltage measuring input	UPH-N	25V... 230 ... 280V AC, 50/60 Hz
	Input impedance	750 kOhm
	Measuring range	1 measuring range, measuring voltage transformer
Current measuring input	IL1 and IL2 and IL3	0.03A...5A...6A AC
	Power consumption	≤ 0.3VA at 6A per measuring inputs
	Measuring range	1 measuring range, current transformer can be configured
Analog input	PT 1000 measurement sensor	Temperature measuring -10°C to 60°C, +/- 2°C
		Max. length of connecting cables < 3 meters
Digital input	S0 compatible	< 2 mA = off, > 10 mA = on
	Output voltage	Approx. 15 VDC, observe polarity
	Output current	<= 15 mA

8.6.2 Outputs

Alarm relay, fan relay	Switching capacity	250V (AC) / 2A floating
Compensation stage relay	Switching capacity	250V (AC) / 2A floating
Bus connection	Serial interface	RS 485 for connection to the KBR eBus; a maximum of 32 devices per bus segment, up to 1000 m without bus repeater if placed accordingly. For additional information see installation guide KBR eBus.
	Transmission speed	38,400 baud
	Bus protocol	KBR eBus
	KBR eBus address assignment	Can be addressed up to address number 9999, scan mode can be activated on the device
	Bus protocol	Modbus RTU
	Baud rate	e,4800; o,4800; n,4800; e,9600; o,9600; n,9600 e,19200; o,19200; n,19200; e, 38400; o,38400; n,38400
	Modbus address assignment	Address 1 to 247

19837_EDEBDA0227-3723-1_EN

8.7 Electrical connection

Connection elements		Plug-in terminals
Permissible cross-section of the connecting cables		Max. 2.5 mm² at 5 mm steps, 1,5 mm² at 3.5 mm steps
Measurement voltage inputs	Fuse	max. 1 A slow blow or max. C2 - automatic in addition isolating switch UL/IEC-approved
Measurement current inputs	Fuse	NONE!!! Always short-circuit current transformer terminals k and l before opening the circuit!
Input control voltage	Fuse	max. 1 A slow blow or max. C2 - automatic in addition isolating switch UL/IEC-approved
Relay output	Fuse	max 2 A medium time-lag
Connection of KBR eBus	Connection material	For proper operation, use shielded twisted-pair cables only, e.g. I-Y(St)Y 2x2x0.8
Transformer connection	Connections	See connection diagram

8.8 Mechanical data

Switchboard installation	Housing dimensions	144 x 144 x 60 mm (H x B x D), without plug terminals 144 x 144 x 70 mm (H x B x D), with plug terminals
	Installation cut-out	138 x 138 mm
	Protection type	Front IP51 (with optionally available front door max. IP54), terminals IP20
	Weight	approx. 800 g
Operation and display	Operation	4x sensor buttons
	Display	128 x 96 pixel graphic Display

19837_EDEBDA0227-3723-1_EN

8.9 Standards and miscellaneous

Environ-mental conditions	Standards	DIN EN 60721-3-3:1995-09 + DIN EN 60721-3-3/A2:1997-07; 3K5+3Z11; (IEC721-3-3;3K5+3Z11)
	Operating temperature	-5°C … +55°C
	Air humidity	5% … 95%, non-condensing
	Storage temperature	-25°C … +70°C
	Operating height	up to max. 2000 m above sea level
Electrical safety	Standards	DIN EN 61010-1:2011-07; DIN EN 61010-2-030:2011-07
	Protection class	II in accordance with DIN EN 61010-1: 2001; (IEC 61010-1:2001)
	Overvoltage category, measurement category	voltage measurement CAT III: 400V
		current measurement CAT III: 300V
		voltage supply CAT III: 300V
Protection type	Standards	DIN EN 60529:2014-09
	Front	IP 51 (with optional front door max. IP 54)
	Terminals	IP 20
EMC	Standards	DIN EN 61000-6-2:2006-03 +amendment 1:2011-06 DIN EN 61000-6-3:2011-09 +amendment 1:2012-11
	Rated surge voltage	4 kV
Password protection	4-digits, numerical	Deleting and programming parameters on the device is not enabled if password protection is active.

19837_EDEBDA0227-3723-1_EN

19837_EDEBDA0227-3723-1_EN

19837_EDEBDA0227-3723-1_EN

KBR Kompensationsanlagenbau GmbH

Am Kiefernschlag 7
D-91126 Schwabach
Germany

T +49 (0) 9122 6373 - 0
F +49 (0) 9122 6373 - 83
E info @ kbr.de

www.kbr.de

19837_EDEBDA0227-3723-1_EN