

Power Quality

Troubleshooting and Solutions

POWER QUALITY SERVICE

We do it for you!

MAX



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KBR. Because energy is precious.



KBR
Energy Management



Monitoring



Optimizing



Analysis

POWER QUALITY



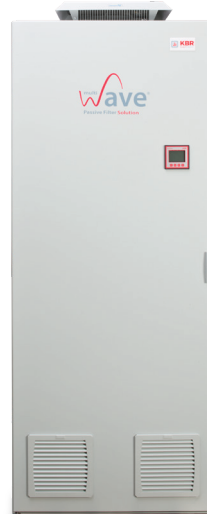
MADE IN GERMANY

High voltage quality ensures operational safety. Modern production processes with power electronic drives and controls are particularly dependent on a high quality of power supply. They enable significant energy savings, optimize processes, and increase productivity. Unfortunately, these also degrade the voltage quality due to their load characteristics.



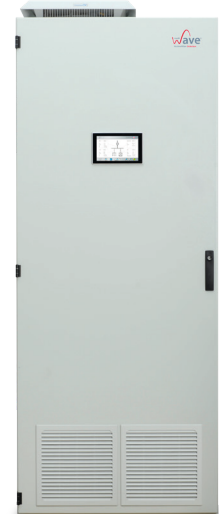
Power Quality Service

KBR's Power Quality Service is your contact for all questions concerning network quality. The trained power quality experts take measurements, analyze these measured values and prepare an expert opinion on the measured current grid. If a line filter is required to increase your operational safety, this will be designed by our specialist department.



multiwave passive

Passive filters are the perfect solution when it comes to filtering out a specific harmonic from the mains. These line filters are cost effective and very robust. Their design consists of precisely matched standard components.



multiwave active

Unlike passive filters, active filters can filter out an entire spectrum of harmonics from the mains. In addition, control parameters can be specified for these filters. Current-controlled, these filters can filter the entire mains, or voltage-controlled a specific part of the power network.



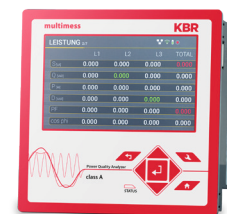
multilog 3

The measuring device is a powerful, portable and very easy-to-use network analyzer for mobile use in industry and energy providers. Due to the integrated power supply unit and the compact design, the network analyzer is suitable for mobile measurement operation in harsh industrial environments, as well as for measurement in the public mains.



multimes D9-PQ

„Stand-alone“ or integrated into visual energy, the network analyzers **multimes D9-PQ** and **multimes F144-PQ** permanently and seamlessly monitor the voltage quality at the measuring point. By permanently monitoring and controlling the network quality according to power quality standards, such as IEC 61000-2-2 / EN 50160, possible faults can be detected at an early stage before they lead to a production

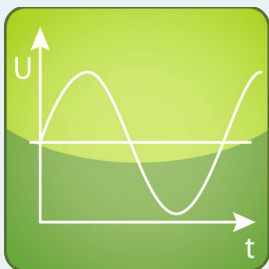


multimes F144-PQ

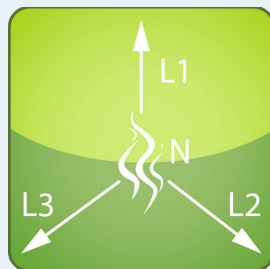
stoppage or defective plant components. In the case of faults in electrical systems or on machines, the causes of the fault can be analyzed by the measured values. The network analyzers register violations of the standard limit values already during operation and store them as events and disturbance records. In connection with visual energy, EN 50160 standard reports are automatically generated.



DISTURBANCES AND POTENTIAL SOLUTIONS



Harmonics



**Neutral conductor
overload**



**Voltage Dips
and Flickers**



Cause:

- Converters and rectifiers
- Single-phase power supply units
- Resonance points in the mains



Potential Solutions:

- Passive filters
- Active filters



KBR Products:

- multiwave passive
- multiwave active



Cause:

- Single-phase power supply units
- LED lights



Potential solutions:

- Active filters in 4-wire technology



KBR products:

- multiwave active



Cause:

- Starting currents
- Welding machines
- Cranes



Potential solutions:

- Dynamic Reactive power compensation

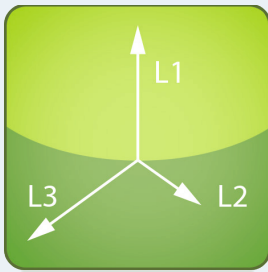


KBR products:

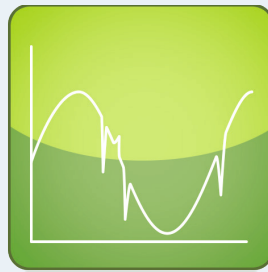
- multicap-R-Thyristor
- multiwave active



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Asymmetries



Commutation dips



Cycle frequency



Cause:

- 1- and 2-phase loads
- Asymmetrical network impedance



Potential solutions:

- Active filters



KBR products:

- multiwave active



Cause:

- Converters in thyristor technology



Potential solutions:

- High-frequency filter
- Active filters



KBR products:

- multiwave passive-HF
- multiwave active



Cause:

- Low-harmonic converter
- Power supply unit with active PFC



Potential solutions:

- High-frequency filter



KBR products:

- multiwave passive-HF

PRACTICAL EXAMPLES: NETWORK QUALITY THROUGH FAULT AND ERROR CORRECTION.

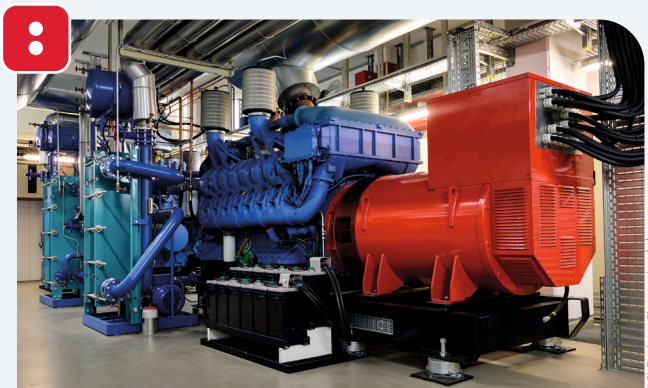


The best formula when values are critical

Strict standards and limits in the area of network disturbances are in force in many countries. Energy-consuming companies and institutions have to check their internal mains and ensure that limits are maintained. In the worst case scenario, the energy provider can cut them off! With **multiwave**, variations can, once identified, be reduced so that the value lies within tolerance again. The following standards and regulations define limits for harmonics in networks/devices:

EN 61000-2-2, EN 61000-2-4, EN 61000-3-2,
EN 61000-3-12, EN 61000-3-3, EN 50160, TOR D2,
IEEE 519 and D.A.CH.CZ.

multiwave is the easiest way to comply with these standards and limits.



UPS system malfunction

A clinic operates a backup power generator to provide emergency power. Switching from the public grid to the standby grid reduces the short-circuit power, which in turn leads to an increase in grid feedback. Various UPS units distributed in the system detect unstable grid conditions and supply their consumers via the integrated batteries instead of the grid. As soon as the batteries are drained, the devices are switched off.



The KBR Solution: The mains feedback from the devices was reduced by installing a **multiwave active** in the main distribution system to such an extent that the standard limits could again be complied with. The UPS systems now remain in mains operation.



The KBR Recommendation

multiwave active

→ p. 12

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Safety and cost-effectiveness are viewed as fundamentally important in companies. This means having machinery, production systems and office equipment function without fault. This is frequently not the case: Errors mostly occur for no apparent reason and despite UPS backup and emergency generators.



Mains Load in Paint Line

An automotive manufacturer operates a paint line for sealing the body shells. In the highly automated plant, a large number of converters of different power classes are used. The 5th harmonic, which is generated by the converters, then rises far above the normative limit and causes malfunctions in equipment and control systems.



The KBR solution: A **multiwave passive** was installed at each of the meshed low-voltage transformers, tuned to the 5th harmonic. These harmonics were thus removed from the mains and the overall voltage distortion was considerably reduced. Thanks to the broadband filter effect, it was also possible to attenuate a resonance point at 1100 Hz.



The KBR recommendation

multiwave passive
multiwave active

→ p. 16

→ p. 12



LED Lights Flickering

A manufacturer of plastic granules is building a new warehouse with a separate transformer station. The light bands in LED technology flicker intermittently in any sequence. The network analysis documents commutation dips originating from two machines in the neighboring hall. The machines were moved to the new station to relieve the old transformer station and now interfere with the lighting system.



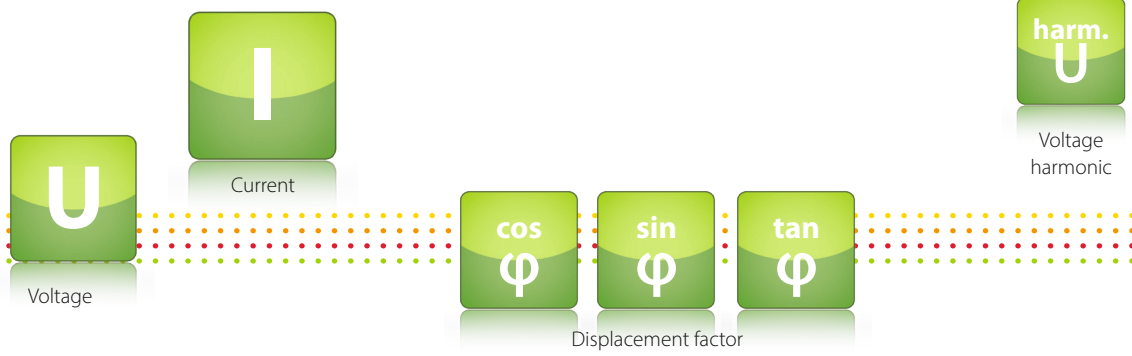
The KBR solution: The high-frequency spurious emission of the machines could be lowered by a high-frequency filter in the main distribution system.



The KBR recommendation

multiwave passive HF

→ p. 20



Proof of Delivery Quality

The printing center of a national newspaper is struggling with frequent failures in the controls of its printing presses. It is to be examined whether the failures are related to voltage dips and whether these were entered by the energy provider or caused by the company itself.

The KBR solution: A **multimes D9-PQ** was installed at the transfer point to the energy provider. The Class A network analyzer (according to IEC 61004 30) can be used to assess the energy provider's delivery quality. Using the data, it was now possible to document the frequency, depth of break-ins, and duration of break-ins. This was the basis for a notice of deficiency to the energy provider.

The KBR recommendation

- multimes F144-PQ** → p. 28
- multimes D9-PQ** → p. 26
- multilog** → p. 22



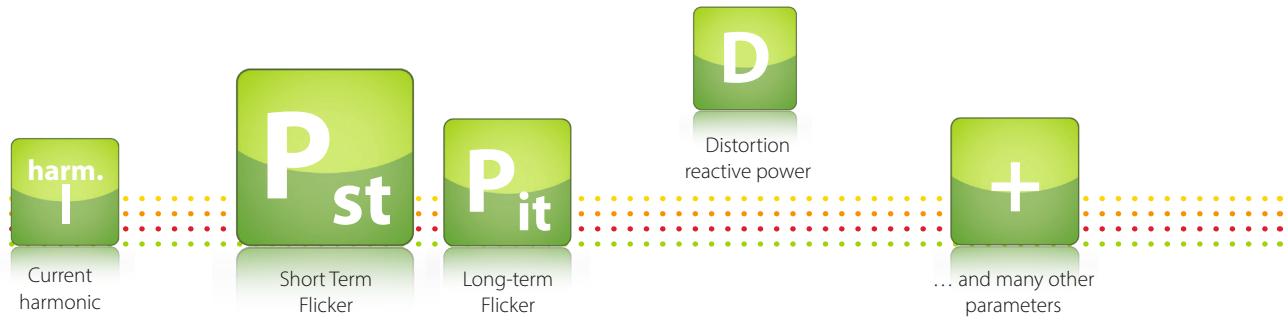
Poor Power Factor

The maintenance manager of a municipal waste management company noticed a poor power factor on its low-voltage main distribution boards. There was an expectation that this should be much better due to the compensation systems installed.

The KBR solution: Measurements were taken simultaneously at three transformer stations over a period of one week using mobile measuring devices. The evaluation of the measured values by KBR's Power Quality Service was written up in a measurement report. The cause of the poor power factor could be attributed to increased harmonic loading from the connected devices.

The KBR recommendation

- multilog** → p. 22
- Power Quality Service** → p. 10



Production Modernization

The plant engineering department of a plastic injection molding company would like to continuously document whether and how the stress quality changes due to the use of new production equipment. Since measurements are to be taken at the transfer point between the machine and the supply network, the network analyzer must be mobile. With the measurement results, in each case before and after the conversion, improvement measures can now be taken at an early stage.



The KBR solution: The customer decided to use the mobile network analyzer **multilog**. The device can be installed at all nodes in the mains and record all mains data there without gaps for up to one year. Similarly, multiple measurements can be taken in succession without having to read out the memory in between.



The KBR recommendation

multilog

→ p. 22

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Do you have any questions concerning a product or a special requirement? We will be happy to advise you personally.

Power Quality Services:

YOUR PARTNER FOR ENERGY MEASUREMENT IN ACCORDANCE WITH EN 50160 and IEC 61000-2-2/2-4.

Current and Voltage: Average,
minimum and maximum value

Energy: P, Q, P+, P-, Q+, Q-

Power: Active power, reactive power
and apparent power

Distortion reactive power: D

Flicker: P_{st} , P_{It}

Asymmetry: Current and Voltage

Voltage and current harmonics: 2 ... 50

THD: Current and Voltage

Interharmonics: 0 ... 49

Ripple-control signals

Frequency

cos Phi

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Power Quality Problems in the In-House Energy Network? - Act now.

Through measurements and network analyses, we determine the cause of the problem for you. The measured data are evaluated by our experienced Power Quality experts (VDE-certified).



Evaluation and Recommendation for action

The diagrams are commented on individually and the most important points are discussed in detail in a summary. Necessary or reasonable optimizations of the electrical distribution network are specified and dimensioned independently of KBR's own product portfolio.

multiwave active:

THE MULTITALENT FOR ALL DISTURBANCE PATTERNS.

Whether harmonics, load unbalance or reactive power – one device for all requirements.

Easy expansion due to modular design

Control current or voltage controlled

Minimal maintenance effort

Filtering up to 51. harmonic

Simple and fast commissioning



...and much more

multiwave active operates completely digitally and intelligently

The flexibility of the **multiwave active** is shown by the fact that the filter can be coupled to the power grid on the load or grid side and can be controlled by current or voltage. Once configured with a few clicks, the instantaneous mains current is measured permanently and occurring harmonics, load unbalance, reactive power as well as phase shifts are actively compensated. In microseconds, the **multiwave active** calculates the compensation currents for this and feeds them into the grid. Via the display, commissioning, selection and setting of individual parameters is very user-friendly.

With the right partner to an individual system

To find the best network quality solution for your business and facility, KBR's expert **Power Quality Service** is available to help: From consulting to network analysis and planning, to implementation and after-sales support. To say **multiwave active** has clearly improved your power quality efficiency.





Control both current and voltage controlled or both at the same time

Due to its individual control, the **multiwave active** adapts to any network and any requirement. All three control modes have their advantages.

Current-guided:

- Only one device is to be compensated
- Design via current spectrum
- Network symmetries
- Optimum utilization of transformer and cable
- Reactive power factor correction 50 Hz

Voltage guided:

- Control to the standard limits
- Adheres to the standard limits at the connection point of the filter
- High voltage distortion from medium voltage
- Compensation of small or high-frequency harmonic levels
- No installation of current transformers necessary

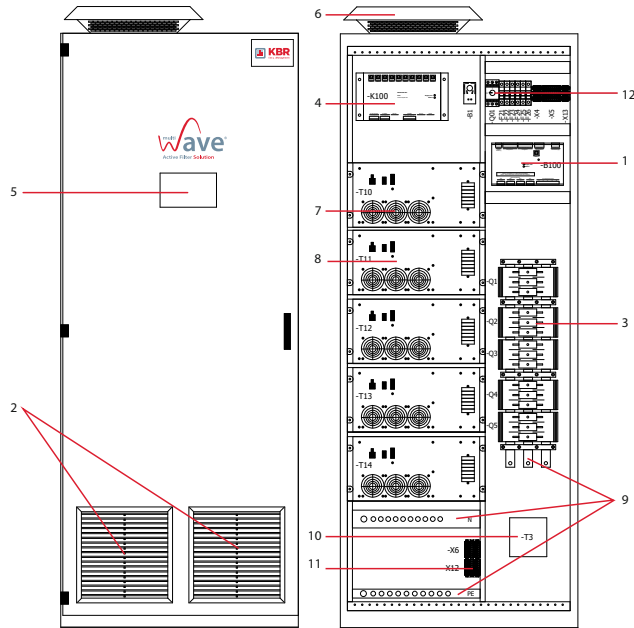
Combination:

- Compensation of low-frequency harmonics via current control, higher-frequency harmonics via voltage control. Thus, optimal utilization of the filter.

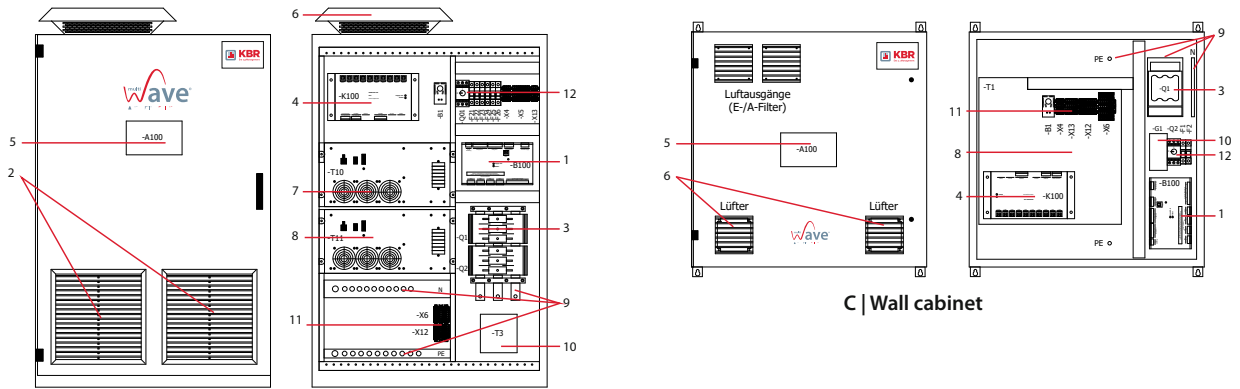
multiwave active **Technical data**

Rated voltage AC	400 V (max. 415 V) ±10 %				
Network frequency	50 / 60 Hz				
Peak current	2x rated current				
Cable connection	3-phase + PE + N/PEN, neutral conductor connection is required (Network configuration: TN)				
Operating mode	3-wire operation: External conductor, symmetrical and asymmetrical (positive and negative sequence network) 4-wire operation: also has neutral conductor (positive, negative, and zero sequence network)				
Compensation	1. – 51. Harmonic (50 Hz) // 1 – 41. Harmonic (60 Hz) All harmonics can be filtered at the same time				
Additional functions	<ul style="list-style-type: none"> - Dynamic reactive power compensation - Active and reactive power balancing (negative sequence network up to 60 %, zero sequence network up to 30 % rated current) - Voltage stabilization through Q(U) control - Flicker compensation - Neutral conductor load reduction 				
Number of filter modules	1	2	3	4	5
Rated current	60 A	120 A	180 A	240 A	300 A
Neutral conductor current	180 A	360 A	540 A	720 A	900 A
compensation power	42 kvar	84 kvar	126 kvar	168 kvar	210 kvar
Cabinet type	A B C	A B	A	A	A
Power dissipation	< 2.6% of compensation power maximum < 2.3% in typ. operation, < 0.7 % in idle, < 100 W in standby				
Switching frequency	20 kHz (low-loss version)				
Controls	Internal control computer with two digital signal processors				
Device setup and display	Via internal web servers (TCP/IP) and PC, SD card, or Anybus interface (field bus interface)				
Response time	<< 1ms				
Interfaces	<ul style="list-style-type: none"> - Ethernet (TCP/IP) - Various field bus systems via optional Anybus plug-in module (e.g. Profinet, Modbus TCP) - 4 digital outputs: 250 VAC (3 A) / 110 VDC (0.7 A) / 24 VDC (1 A), potential and parameterizable - 4 digital inputs: 24 VDC (10 mA), configurable for remote control and easy additional parameter adjustment 				
Current transformers	3-phase current measurement, xx/5 A or xx/1 A (parameterizable) The required current transformers are not included, class 1 or better recommended				
Inverters	3-level IGBT with intermediate voltage circuit (electrolytic capacitors)				
Coloring	Standard RAL 7035 light gray (other colors and designs on request)				
Dimensions	Standard: H/W/D 2000/800/600 mm Optional: other housing shapes and dimensions on request				
Cooling	Air cooling with speed-controlled fans				
IP Protection type	Standard IP20, optional IP21				
Ambient conditions	<ul style="list-style-type: none"> - Maximum ambient temperature without reduced performance: 40 °C - Recommended ambient temperature for continuous operation: < 25 °C - Minimum operating temperature: 0 °C - Relative humidity: maximum 95 % - Transport/storage: -20 °C ... 70 °C 				
Overvoltage category	CAT III, 300 V				
EMC class	Standard: EN 55011, Class A1 (industrial environment), optional: Class B (residential area)				
Standards	EN 50178, EN 61439-1, EN 61439-2, EN 61-6-2, EN 61000-6-4, EN 55011				

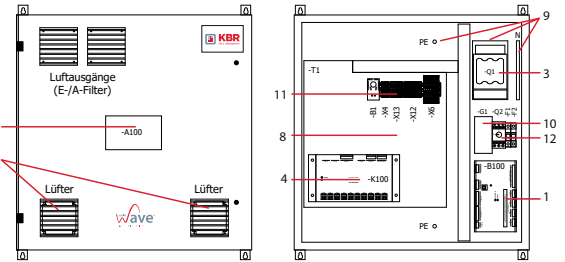
1. Measurement and I/O module (MIO)
2. Air inlet
3. NH 000 fused circuit breaker
4. Control computer (CCU)
5. Touch panel
6. Roof/door ventilator
7. Fan for Filter module
8. Filter module
9. Power connection/busbar
10. 24 V DC power supply
11. Terminal strip
12. Overcurrent protection equipment (circuit breaker)



A | Free standing cabinet



B | floor standing wall cabinet



C | Wall cabinet

Types	Dimensions (H x W x D)	Extensibility
A Free standing cabinet	2000 x 800 x 600 mm(excluding fan)	up to a maximum of 5 modules (210 kvar, 300 A)
B floor standing wall cabinet	1200 x 800 x 600 mm(excluding fan)	up to maximum 2 modules (84 kvar, 120 A)
C Wall cabinet	800 x 800 x 400 mm	1 module (42 kvar, 60 A)

Description of standards	Standards
Electromagnetic compatibility	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11, EN 61000-6-2, EN 61000-6-2, EN 61000-6-4 and EN 55011
Safety requirements	EN 62477-1, EN 60664-1, IEC 60364-6
Low voltage switchgear combination	EN 61439-1, EN 61439-2
Equipment of power installations with electronic equipment	EN 50178
Protection class	IP20 according to EN 60529 (air cooled)
Approval mark: CE Mark	2006/95/EC

multiwave passive: PASSIVE FILTER AGAINST HARMONICS.

The robust filter for simple tasks with the proven highly linear components from the KBR portfolio.

Improves the cos phi

For networks with a high proportion of frequency converters

Improves the total harmonic distortion of the voltage (THD-U)

Cost effective filter

Filters a harmonic from the mains

Robust construction

+ ...and much more



The loads in industrial networks are increasingly dominated by a large number of small and large converters. These are introduced with the new acquisition of machines or the retrofitting of existing machines to increase the energy efficiency.

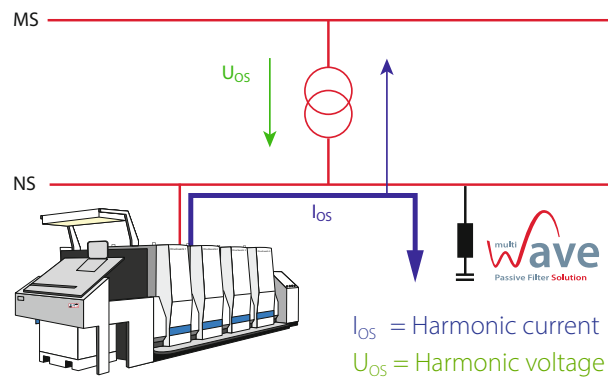
In this context, two effects can be observed. The decrease in motors operated directly from the grid reduces the need for inductive fundamental reactive power from the grid. At the same time, however, there is more and more reactive power caused by the harmonic currents of the converters.

The impedance of the network transformer plays a decisive role. A large part of the harmonic voltage is created here, leading to faults in the consumers. Frequently, the standard limit values for harmonics are already violated in the main distribution. This results in unreliable operation of the machines with an increased number of malfunctions in the control system. As a solution, KBR offers the harmonic filters of the **multiwave passive** product group as a matched filter circuit system.



The control and monitoring of the multiwave passive

Mode of operation passive harmonic filter



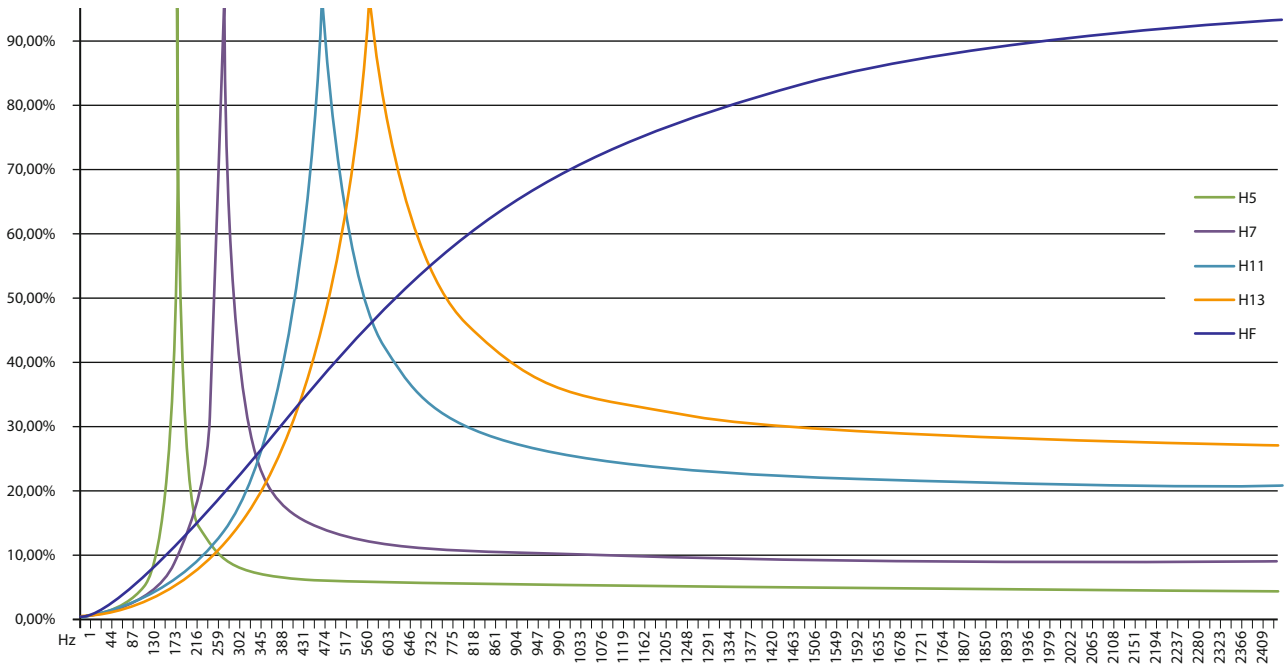
The **multiwave passive** has been developed specifically for networks with a high ratio of 5th and 7th harmonics, which are typical for industrial networks. The system is placed centrally in the low-voltage main distribution and takes over a large part of the harmonic current (see picture above). The degree of network cleaning depends on the design of the passive filter. The result is a significant improvement of the total harmonic distortion of the voltage (THD-U) and a lesser thermal load on the transformer.

The **multiwave passive** is controlled and monitored with the **multicomp D6** compensation controller equipped with a special filter circuit system program. The **multicomp D6** controls contactors and fans and monitors the system for overcurrent and overtemperature. Various network measuring functions are implemented as well as an error memory that can be displayed in the plain text display. You can also operate several systems in one mains in server/client operation.

Continued on the next page

multiwave passive

Frequency ranges of different filter stages



Example configuration with H5 stages

Number of filter modules	Type multiwave passive ... with H5 stages	Number of cabinets	Transformer with u_k 6 %						Max. Harmonic current
			630 kVA	1000 kVA	1250 kVA	1600 kVA	2000 kVA	2500 kVA	
			Suction effect in %						
2	...073/02-1100-4,25-SSEB	1 cabinet	73	63	57	51	46	40	190
3	...109/03-1110-4,25-SSEB	1 cabinet	80	72	67	61	56	50	285
4	...146/04-1111-4,25-SSEB	1 cabinet	84	77	73	68	63	57	380
5	...182/05-1111-4,25-SSEB	2 cabinets	87	81	77	72	68	63	475
6	...218/06-1111-4,25-SSEB	2 cabinets	90	84	80	76	72	67	570
7	...255/07-1111-4,25-SSEB	2 cabinets	91	85	82	79	75	70	665
8	...291/08-1111-4,25-SSEB	2 cabinets	—	87	84	81	77	73	760

Continuation multiwave passive

The compensation power of the **multiwave passive** is considerable. For example, a filter with 250 kvar fundamental reactive power can draw a harmonic current of up to 665 A from the mains. The broad-band filter effect yields the following typical degrees of compensation:

- 5th harmonic 85 %
- 7th harmonic 43 %
- 11th harmonic 32 %
- 13th harmonic 30 %

In order to guarantee this filter capacity in the long term, it is necessary to use components with a high load capacity. Once more, the components from our own production are the most convinc-

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ing. KBR developed the high-power inductor used specifically for this system type. The UHPC premium capacitors with an overload capability of up to twice the rated current can reliably absorb the harmonic currents.

Overall, we offer you a coherent concept for the significant improvement of your voltage quality at an unbeatable price/performance ratio.

Example configuration multiwave passive 146/04

Technology	LC series resonant circuit
Fundamental current	210 A
Max. permissible operating current	435 A continuous
Power dissipation	1500 W full load, 500 W idle
Control	Controller multicomp D6...-MW-5
Switch element	Capacitor contactors
Housing design	Sheet steel cabinet, HxWxD in mm: 2000 x 800 x 600, base 200 mm, interior and exterior paint RAL 7035 (other paint on request), Door hinge left (optionally right), Feed from bottom (on request from top), protection class I
Weight	400 kg
Ventilation	Integrated ceiling ventilation, temperature-controlled
Fuse	Back-up fuse 500 A

Technical Data

Connection	3-phase 3-wire	
Rated voltage	400 V ± 10 %	
Technology	LC series resonant circuit	
Response time	Real-time	
Harmonic compensation	according to design	
Reactive power compensation	36 kvar per stage	
Capacitors	low-loss UHPC power capacitors	$U_{\text{bem}} = 525 \text{ V}$
Filter circuit inductors	Linear filter circuit inductors with built-in temperature monitoring	Detuning factor according to design (e.g. 4.25 %)
Grounding system	TT, TN-C, TN-S-, TN-C-S, IT	
Housing	Sheet steel cabinet	Interior and exterior paint RAL 735 (other paint finishes on request), module plates galvanized, door hinge left (optionally right), power supply at bottom (from top on request), protection class 1
	Protection type	IP 20 (IP 54 on request), the components used correspond to BGV-A2
	Ambient temperatures	+40 °C maximum, short-term +35 °C 24-hour average +20 °C annual average -10 °C low
	Ventilation	Built-in roof ventilators
	Fuse	Group fusing with NH fuses and fuse bases (NH isolator on request)

multiwave passive High-frequency filter

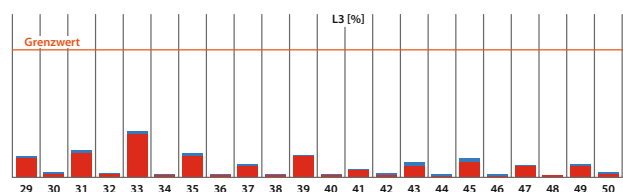
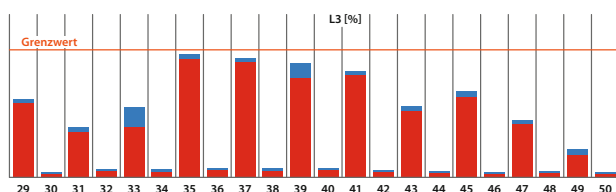
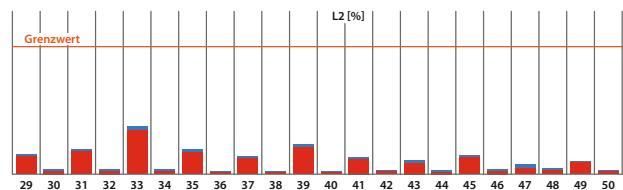
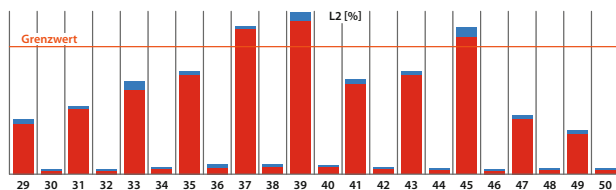
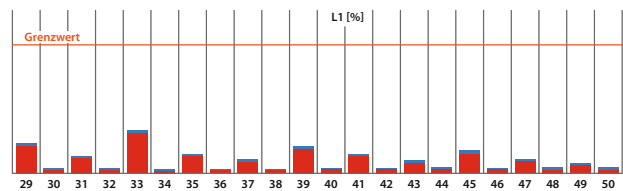
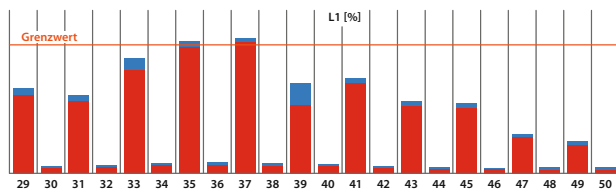


multiwave passive High-frequency filter

A high-frequency filter can significantly reduce interference in the high-frequency range above 1.5 kHz, such as resonances, commutation dips, clock frequencies and transients. The stage can be integrated individually in the wall cabinet or as a module in the free-standing cabinet of the **multiwave passive**. Several high frequency filters can also be connected simultaneously. The size of the filter depends on the level to be compensated. After the filter is switched on, it operates without being controlled and in real time. If required, this can be switched on and off via a signal.

Example configuration multiwave passive HF





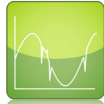


Technology	RC link
Fundamental current	18 A
Max. permissible operating current	2.1 I _n permanently
Power dissipation	800 W full load, 200 W idle
Control	Key switch 1-0 with delay for discharge time of the capacitors, optional apparent current relay for automatic mode
Switch element	Capacitor contactors
Housing design	Sheet steel cabinet, HxWxD in mm: 600 x 600 x 350, interior and exterior paint RAL 7035 (other paint on request), Module plates galvanized, door hinge left (optionally right), feed from bottom (on request from top), protection class I
Weight	50 kg
Ventilation	Integrated ceiling ventilation, temperature-controlled
Fuse	NH isolator 35 A



Harmonics without filter

Harmonics with high pass filter

Overview Disturbances and troubleshooting

	 Upper vibrations	 Asymmetries	 Voltage dips	 Voltage-range-deviation	 Commutation dips	 Flicker	 Neutral conductor overload
Automotive industry	■	■	■	■	■	■	■
Railroad applications	■	■	■	■	■	■	■
Mining	■	■	■	■	■	■	■
Office and commercial building	■	■	■	■	■	■	■
Basic industry	■	■	■	■	■	■	■
Cranes and conveyors	■	■	■	■	■	■	■
Public networks	■	■	■	■	■	■	■
Oil and gas industry	■	■	■	■	■	■	■
Metal processing	■	■	■	■	■	■	■
Water purification	■	■	■	■	■	■	■
Wind and PV parks	■	■	■	■	■	■	■

■ Rarely
 ■ Occasionally
 ■ Multiple times
 ■ Frequently


			High frequency filter	Active filter Current controlled	Active filter Voltage-controlled	Passive filter
Mains-fault	Disturbance on plant parts	Disturbance due to high-frequency harmonics	✓	✓		
		Disturbance due to commutation dips	✓	✓		
		Neutral conductor overload		✓		
		Disturbance due to low-frequency harmonics		✓	✓	✓
	Compliance with DIN EN 50160	Disturbance due to multiple harmonics		✓	✓	
		Disturbance due to high-frequency harmonics		✓		
		Disturbance due to commutation dips		✓	✓	
		Neutral conductor overload		✓	✓	
		Disturbance due to low-frequency harmonics		✓	✓	


multilog 3: ANALYZE NETWORKS WITH EASE USING MOBILE DEVICES.





multilog 3 light/expert with many accessories and convenient transport case

CLASS A IEC 61000-4-30 Class A


 Voltage quality in accordance with EN 50160/IEC 61000-2-2/2-4

 Oscilloscope and RMS recorder

 Analysis software for the PC


 Online readings on the smartphone

IEC 61850 Load analysis, energy measurements

 Ripple-control signal analysis

+ ... and many other advantages



 **IP65 OUTDOOR**
Installation and operation also possible outdoors.
Temperature range from -20 °C to +60 °C



multilog 3 is available in two versions:

multilog 3 light
The powerful base device for comprehensive network analysis and storage of measured data. Upgradeable to the expert version with a license

Comprehensive measurement options

- Complete recording of more than 2000 measured data
- Simultaneous long-term and online measurements
- Storage capacity of 1 GB allows for long-term storage for up to one year
- All relevant interfaces available, for example RS232 for time synchronization or USB port for fast data transfer

multilog 3 expert
With more trigger functions than the light version. Fast oscilloscope images are recorded automatically

The multilog 3 Class A mobile network analyzer stands out with a strong performance range: Recording of more than 2000 measured values, numerous trigger functions as well as comprehensive analysis and archiving options. The device is easy to operate and mobile, which makes it perfect for measurements in public and industrial networks.



POWER QUALITY
MADE IN GERMANY



Clear design and standard compliance: Assessment of the voltage quality in accordance with EN 50160 and IEC 61000-2-2

Easy evaluation

- Output as EN 50160/IEC 61000-2-2 report for a fast and precise overview of voltage quality
- Online analysis software displays graphically and in real time current and voltage signals, as well as harmonics and interharmonics up to 10 kHz (software included)
- Analysis of ripple control signals (optional)
- Time synchronization for the correlation of measured data of different devices
- Fault recording as oscilloscope images and as 10 ms RMS reports to detect the causes of network interference
- Continuous recording of more than 2000 different measured values per measurement interval


multilog mobil
App

Für Android und iOS

multilog mobile App

A variety of online measurement values can be displayed on a smartphone or tablet via the free app for Android and iOS operating systems.

multilog 3 Mobile network analyzer and fault recorder



multilog 3 mobile app for Android & iOS apps

Online measurement data & configuration multilog 3

Network analyzers via WLAN/Wifi interface

Via a free app for Android and iOS operating systems, the **multilog 3** can be operated wirelessly with the integrated WLAN/Wifi interface. A variety of online screens are available. All measuring devices can also be parameterized very easily via a smartphone, for example.

Technical details

	multilog 3 light and multilog 3 expert
4 voltage inputs	L1, L2, L3, N, E
Maximum input voltage value	DC 848V ~ AC 1039V/600V ~ 1.2 MΩ Impedance
4 current inputs	1000 mV for mini current clamps
	330 mV for Rogowski current clamps
	10 kΩ Impedance
	Max. 30 V to PE
Sampling rate	20.48 kHz at 50 Hz
Automatic synchronization to fundamental component	45 Hz to 65 Hz
Measurement interval	Settings between 1 and 30 minutes are possible
Memory	1 GB
Interfaces	WLAN/Wifi and USB
Time synchronization	NTP via WLAN
Dimensions	220 x 110 x 40 mm
Weight	1000 g
Protection type	IP65
IEC 61000-4-30 Ed. 3	Class A
Accuracy	< 0.1 %
Insulation category voltage inputs	CAT IV / 600V
High voltage test	Pulse voltage = 12.8 kV 5 sec = 7.4 kV RMS
A/D transformer	16 bit
Weathering resistance / temperature	Function: -20 ° – 45 °C
	Storage: -30 ° – 70 °C
Power supply	AC 100 V – 440 V ~ OVC IV 50/60Hz; 180 – 80mA or DC 100 V – 250 V ~; 105 – 35 mA; CAT IV



Measured values and functions

	multilog 3 light	multilog 3 expert
Statistic values acc. to EN50160/IEC61000-2-2; -2-4	✓	✓
PQ events	✓	✓
Recording free interval (1 second to 30 minutes)		
Voltage: Average, minimum, maximum value	✓	✓
Current: Average, maximum value	✓	✓
Power: P, Q, S, PF, cos (phi), sin (phi)	✓	✓
Distortion reactive power D	✓	✓
Flicker (Pst, Plt, output 5)	✓	✓
Asymmetry	✓	✓
Voltage harmonics	up to 50th	up to 50th
Voltage harmonic extreme values 200 ms	–	✓
Current harmonics	up to 50th	up to 50th
Current harmonic extreme values 200 ms	–	✓
Phase angle of current and voltage harmonics	–	✓
Active, reactive, apparent power Harmonics	–	✓
THD U and I; PWHD U and I; PHC	✓	✓
Interharmonic groups voltage, current	–	DC to 10 kHz
Ripple-control signal	✓	✓
Frequency	✓	✓
Power / Energy interval		
10/15/30 minimum power values P, Q, S, D, cos (phi), sin (phi)	✓	✓
Online mode		
Oscilloscope image	✓	✓
10 ms RMS value recorder	✓	✓
Voltage, current, interharmonics	✓	✓
FFT analysis (U, I)	–	10 kHz
Direction of harmonics	–	✓
Trigger functions (Rec A/Rec B)		
RMS value trigger underflow and overflow (U, I)	–	✓
RMS value trigger jump (U, I)	–	✓
Frequency undercut and overcut, frequency jump	–	✓
Phase jump trigger, envelope trigger	–	✓
Automatic trigger	–	✓

multimes D9-PQ: POWER QUALITY NETWORK ANALYZER FOR ALL NETWORK LEVELS.

Class A measuring device, Edition 3

Automatic reporting according to EN 50160

Free-of-charge analysis software included

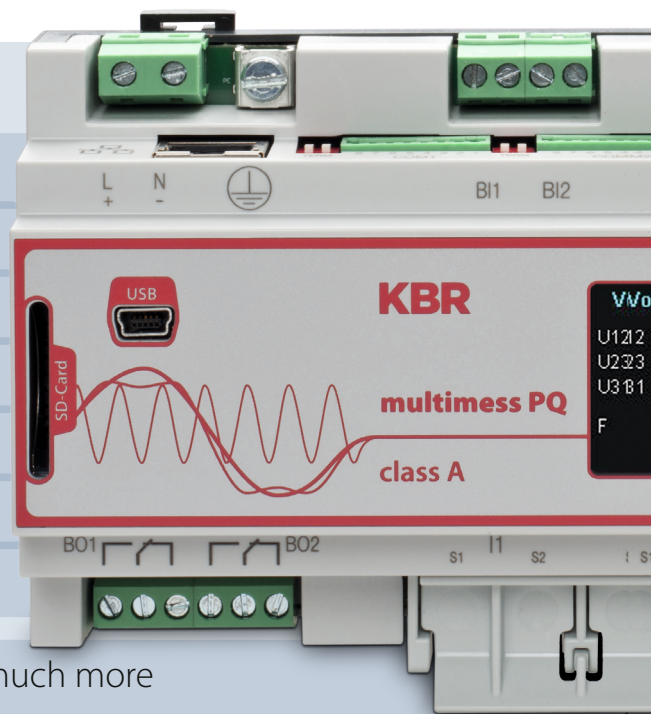
4 voltage and current measurement inputs each

Oscilloscope and 10 ms report on trigger thresholds

Large internal 1 GB memory, expandable to up to 32 GB

Harmonic measurement up to 20 kHz optional

+ ...and much more



Power Quality Analyzer and Fault Recorder

The **multimes D9-PQ** power quality analyzer and fault recorder is suitable for any measurement task required in electrical networks. You can use it as a power quality interface in accordance with network quality standard EN 50160 and as a measuring device for all physically defined measured values in alternating current networks. Additionally, it provides all consumption values required for energy data management.

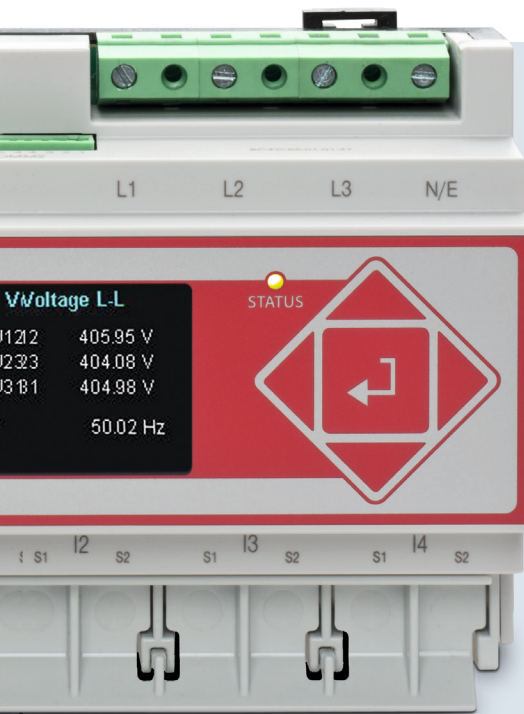
In addition to standard evaluations, the **multimes D9-PQ** also features a high-speed fault recorder with a recording rate of 40.96 kHz/10.24 kHz as well as a 10 ms rms value recorder. This makes a detailed evaluation of network interferences possible.

The network analyzer is primarily suitable for monitoring and recording quality agreements between energy providers and customers and making them available for evaluation or storage.

Voltage quality measuring devices operate according to the IEC 61000-4-30 standard. This standard defines measurement methods to create a comparable basis for the user. Devices of different manufacturers operating according to this standard necessarily have to obtain the same measuring results.

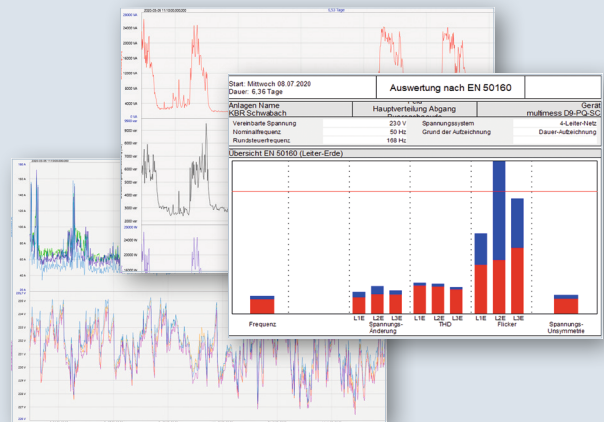
The **multimes D9-PQ** helps you to analyze the causes of malfunctions in electrical systems and machines. By permanently monitoring and controlling network quality, you can detect possible malfunctions early on.

POWER QUALITY
MADE IN GERMANY



Integrated into the energy data management system **visual energy** it provides a weekly EN 50160 network quality report for the required consumption values fully automatically.

When used as a power quality interface, the **multimes D9-PQ** provides comprehensive evaluations in accordance with the network quality standard DIN EN 50160, IEC 61000-2-2/-2-4



Technical Data

- 1.7 inch color display
- Class A measured data processing
- IEC 61000-4-30
- Recording of power quality events according to EN 50160; IEC 61000 -2-2; -2-12;-2-4
- Automatic EN 50160 network quality report
- 1 GB internal memory
- Input channel bandwidth 20 kHz
- 4 voltage inputs, measuring range end value: 480 V L-N, accuracy < 0.1 %
- 4 current inputs
- Simultaneous processing of scanned and calculated voltages and currents
- Voltage and current oscillograph sampling rate: 40.96 kHz / 10.24 kHz
- Half-cycle recorder: network frequency, RMS voltage and current, voltage and current pointer, power recording rate: 10 ms (50 Hz)/8.33 ms (60 Hz)
- Powerful triggering

multimes F144-PQ: STATIONARY NETWORK POWER QUALITY ANALYZER AND FAULT RECORDER.



Voltage quality in accordance with EN 50160 / IEC 61000-2-2/2-4



IEC 61000-4-30 Class A, Edition 3



Fault recorder (oscilloscope, RMS value, event)



Convenient visualization software WinPQ/PQ



Control system connection (TCP/IP, IEC 61850)



Residual current measurement



Harmonic measurement up to 20 kHz optional



... and many other advantages

multimes

LEISTUNG 2/7

L1 L2

S [VA] 0.000 0.000

Q [VAR] 0.000 0.000

P [W] 0.000 0.000

D [VAR] 0.000 0.000

PF 0.000 0.000

cos phi 0.000 0.000



Power Quality Analyzer and Fault Recorder multimes F144-PQ

Detect possible malfunctions before they lead to a loss of production or defects in plant components. The **multimes F144-PQ** measures and monitors the network quality. It can be used as a power quality interface according to network quality standards, such as IEC 61000-2-2 / EN 50160 or to check technical connection guidelines, such as DIN VDE AR 4110 and DIN VDE 4120.

The network analyzer is designed primarily for measurements in industrial environments with up to 690 V (L-L) measurement voltage as well as for measurements in public networks.

The 5th current transformer input for measuring the residual current (RCM) as well as the frequency measurement of voltage and current harmonics in accor-

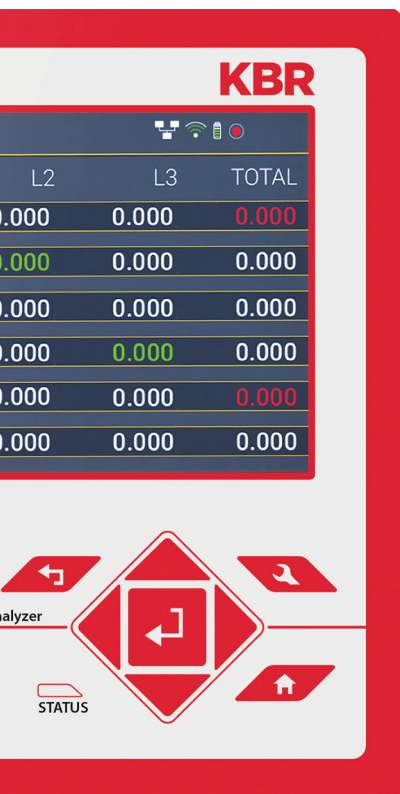
dance with IEC 61000-4-7 from 2 kHz to 20 kHz are available as options. Especially this measurement from 2 kHz to 20 kHz is important, since many pulse frequencies of converters and inverters, as well charging stations exist in this range.

Besides the possibility of standard evaluations, the **multimes F144-PQ** also has a high-speed disturbance recorder with a recording rate of 40.96 kHz/10.24 kHz as well as a 10ms RMS rms recorder. This makes an even more detailed evaluation of network interferences possible.

In addition, it is possible to freely program response thresholds for alarm messages or warnings. A device for increasing your operational safety.

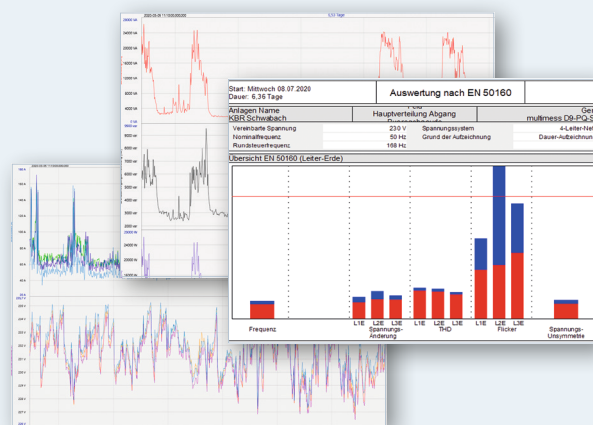
The power quality analyzer and fault recorder **multimes F144-PQ** for low, medium and high voltage networks is the central component of a system that can be used to solve all measurement tasks in electrical networks.

POWER QUALITY
MADE IN GERMANY



Integrated into the energy data management **visual energy**, it provides a weekly EN 50160 network quality report fully automatically for the required consumption values.

When used as a power quality interface, the **multimes F144-PQ** provides comprehensive evaluations in accordance with the network quality standard DIN EN 50160, IEC 61000-2-2/2-4.

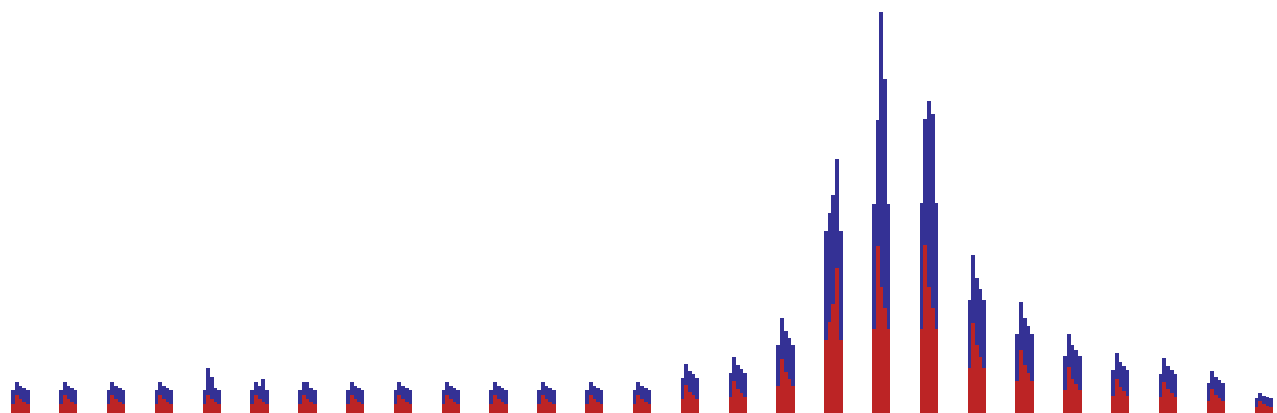


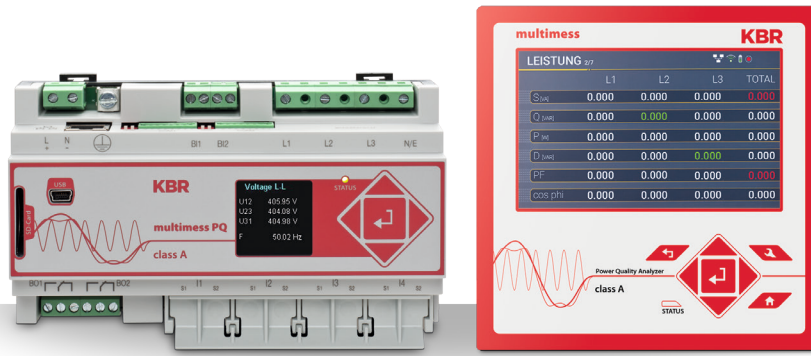
Technical Data

- 5 inch color display
- IEC 61000-4-30, Class A measurement data processing
- Acquisition of power quality events according to EN 50160; IEC 61000-2-2; -2-12;-2-4
- 1 GB internal memory (expandable to 32 GB)
- Bandwidth 20 kHz
- Residual current measurement RCM
- 4 voltage inputs, accuracy < 0.1 %
- 5 Current inputs
- Simultaneous processing of sampled and calculated voltages and currents
- Voltage and current oscillograph
Sampling rate: 40.96 kHz / 10.24 kHz
- Half-cycle recorder:
Network frequency, rms voltages and currents (RMS), pointer for voltage and current, power recording rate: ~10 ms (50 Hz) / ~8.33 ms (60 Hz)
- Powerful triggering

Detailed Overview Stationary Network Analyzers

Technical details multimes D9-PQ and F144-PQ	multimes D9-PQ	multimes F144-PQ
Color display	1.7 inch	5 inch
Keypad for basic configuration on the device	✓	✓
Memory 1GB internal, up to 32GB SD card	✓	✓
Protection type	IP 20	IP 54 (when installed)
4 voltage inputs, accuracy < 0.1 %	✓	✓
4 current inputs 1/5 A rated current	✓	✓
Measuring channel bandwidth 20 kHz (voltage and current)	✓	✓
ICE61000-4-30 Edition 3 Class A	✓	✓
Residual current input RCM	✓	optional
Temperature input PT100/PT1000	–	✓
Digital inputs	2	8
Digital outputs	2	4
Voltage and current oscillograph 10.24 kHz (40.96 kHz option)	✓	✓
Online streaming of voltages and currents	✓	✓
Voltage and current harmonics 2. – 50. Harmonic	✓	✓
Voltage and current harmonics 51. – 400. Harmonic	optional	optional
Interfaces Ethernet / RS 485	✓	✓
Communication protocol Modbus RTU TCP	✓ ✓	✓ ✓
Assembly	DIN rail, 9 horizontal pitch	Switchboard installation, 144 x 144 mm
Dimensions H x W x D (without terminals)	–	144 x 144 x 90 mm
Dimensions H x W x D (with terminals)	160 x 90 x 58 mm	144 x 180 x 110 mm
Dimensions breakout dimension (+0.8 mm)	–	138 x 138 mm
Weight	502 g	1220 g
Free evaluation software WinPQ Lite	✓	✓





Measurements and functions of multimes D9-PQ and multimes F144-PQ


multimes D9-PQ and multimes F144-PQ - automatic event detection and measurement standards:

EN 50160 (2013) / IEC 61000-2-2 / IEC 61000-2-12 / IEC 61000-2-4 (class 1; 2; 3) / NRS048 / IEEE519 / IEC 61000-4-30 Class A / IEC 61000-4-7 / IEC 61000-4-15

Permanent recording:

Five fixed and two variable measuring time intervals are available for permanent recording:
10/12 T (200 ms), 1 sec, n*sec, 150/180 T (3 sec), n*min, 10 min, 2 h

Time interval voltage	10/12 T	150/180 T	10 min	2 h	1 s	n* s	n* min
Network frequency, 10-s value (IEC61000-4-30)	✓	✓	✓	✓	✓	✓	✓
Extreme, standard deviation of the network frequency (10 s)	–	–	✓	–	–	–	–
RMS values (IEC61000-4-30)	✓	✓	✓	✓	✓	✓	✓
Extremes, standard deviation of T/2 values	–	–	✓	–	–	–	–
Breakdown [%], Overvoltage [%] (IEC61000-4-30)	✓	✓	✓	✓	–	–	–
Harmonic subgroups n = 0..50 (IEC61000-4-7)	✓	✓	✓	✓	–	–	–
Maximum values of 10/12 T harmonic subgroups n = 2..50	–	–	✓	–	–	–	–
Interharmonics subgroups n = 0..49 (IEC61000-4-7)	✓	✓	✓	✓	–	–	–
Total distortion factor (THDS) (IEC61000-4-7)	✓	✓	✓	✓	✓	✓	✓
Partially weighted distortion factor (PWHF)	✓	✓	✓	✓	✓	✓	✓
Asymmetry, negative/positive sequence, sequence characters	✓	✓	✓	✓	✓	✓	✓
Asymmetry, zero/positive sequence	✓	✓	✓	✓	✓	✓	✓
Positive/Negative/Null Sequence Pointer	✓	✓	✓	✓	✓	✓	✓
Phase angle (fundamental wave)	✓	✓	✓	✓	✓	✓	✓
Flicker (IEC61000-4-15)	–	–	✓	✓	–	–	–
Instantaneous value flicker (IEC61000-4-15)	✓	–	✓	–	–	–	–
Ripple-control voltage [%] (IEC61000-4-30)	✓	✓	–	–	–	–	–
Phase angle (zero crossings) of the phase voltage harmonic n=2. - 50. to the fundamental of the reference voltage	✓	✓	✓	✓	–	–	–
Frequency bands 1. - 35.2 kHz - 9 kHz, RMS (IEC61000-4-7)	–	–	✓	✓	✓	✓	✓



KBR is your reliable energy management partner.
With precision technology, efficient solutions and a comprehensive range of services, the KBR system helps companies in the plant engineering, industry or craft sectors maintain their technical edge. For a sustainable and future-proof energy supply.

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- Energy measuring devices
- Analysis software
- System integration
- Seminars & workshops
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