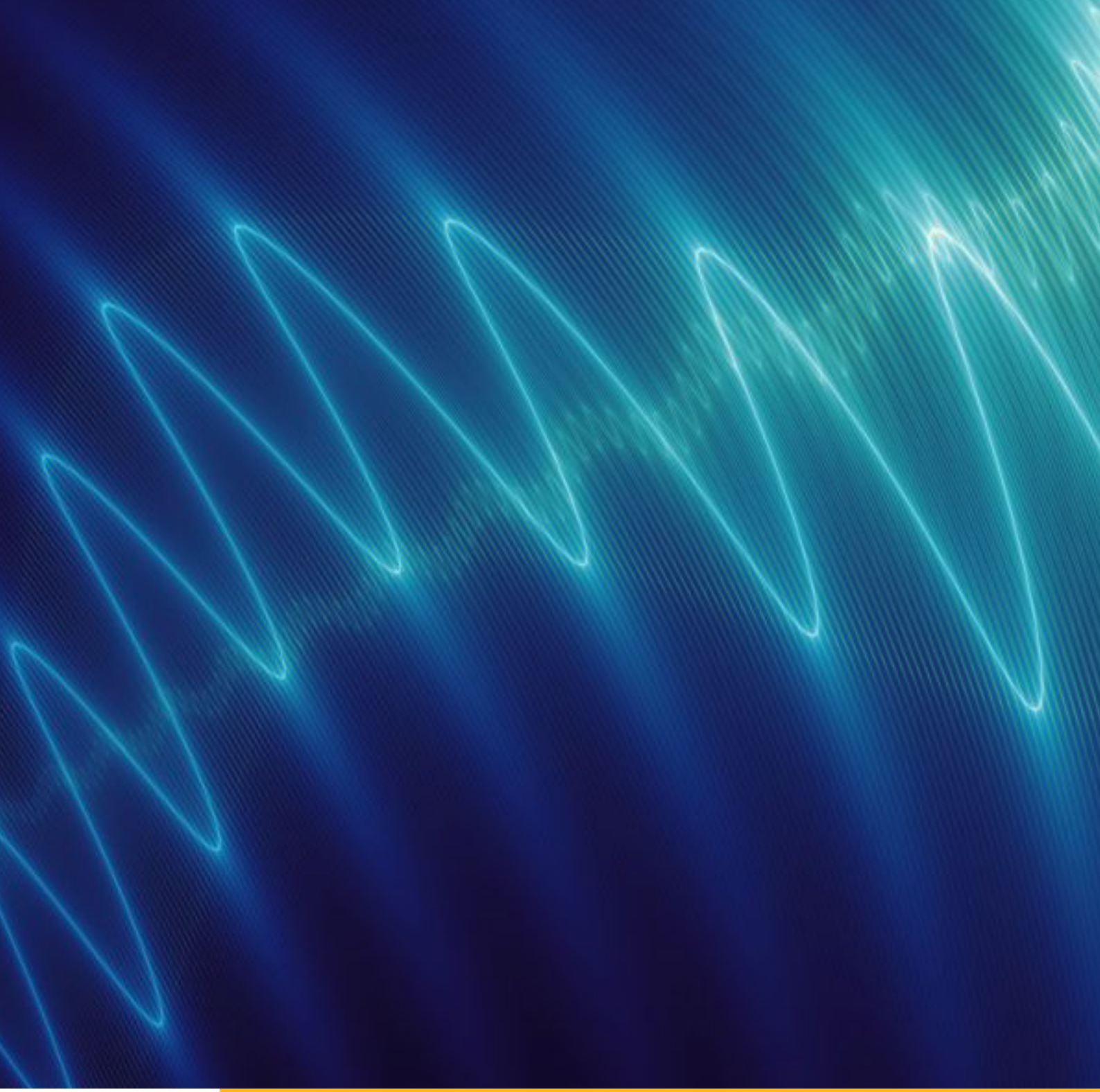


Technical catalogue
ACTIVE HARMONIC FILTER

BTB ELECTRIC

Technical catalogue
ACTIVE HARMONIC FILTER







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Introduction

We, **NEXUS BTB ELEKTRİK ÜRETİM TİCARET ANONİM ŞİRKETİ** (hereinafter referred to as BTB Electric), are a Turkey-based manufacturer of electrical equipment, specializing in advanced power quality solutions.

Our product portfolio includes capacitors, reactors, power factor controllers, Active Harmonic Filters (AHF), and smart low-voltage capacitors, serving the needs of industrial and commercial electrical systems.

BTB Electric solutions help improve power quality, enhance operational reliability, reduce power losses, and minimize costs associated with equipment failures. Our products are manufactured under an **ISO 9001**-certified Quality Management System, ensuring consistent quality and high reliability.

Product features

Active Harmonic Filters (AHF) help improve power quality while enhancing the safety and operational reliability of electrical systems:

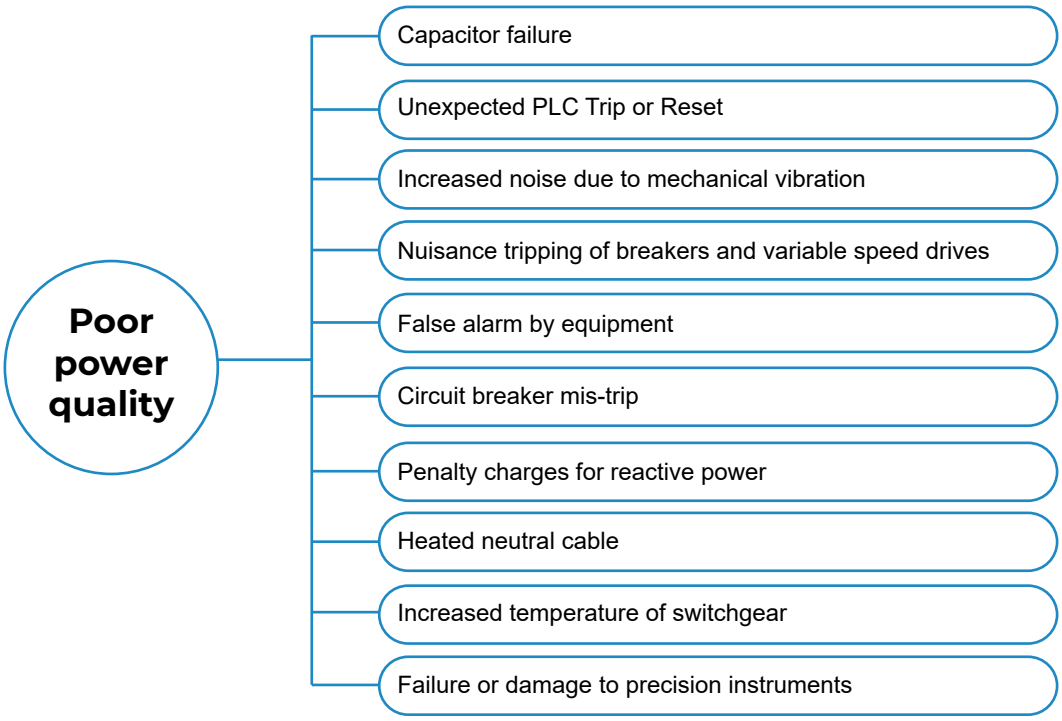
- Reducing Harmonic Effects: Minimizes overheating, reduces insulation aging, extends equipment service life, and lowers maintenance costs.
- Enhancing Safety: Reduces the risk of resonance in capacitor bank systems, minimizes electromagnetic interference (EMI), and reduces disturbances to control and communication signals.
- Reducing Power Losses: Minimizes overheating in motors, transformers, and other electrical equipment, helping maintain stable system operation.
- Protecting Sensitive Equipment: Reduces the impact of harmonics on computer systems, electronic equipment, and control systems.

Flexible Harmonic Filtering Capability

The AHF can simultaneously filter harmonic components from the 2nd to the 50th order. Users can select the specific harmonic orders to be filtered and allocate filtering capacity according to the load characteristics and actual requirements of the electrical system.

Common symptoms due to poor power quality

Below are typical harmful effects due to poor power quality.

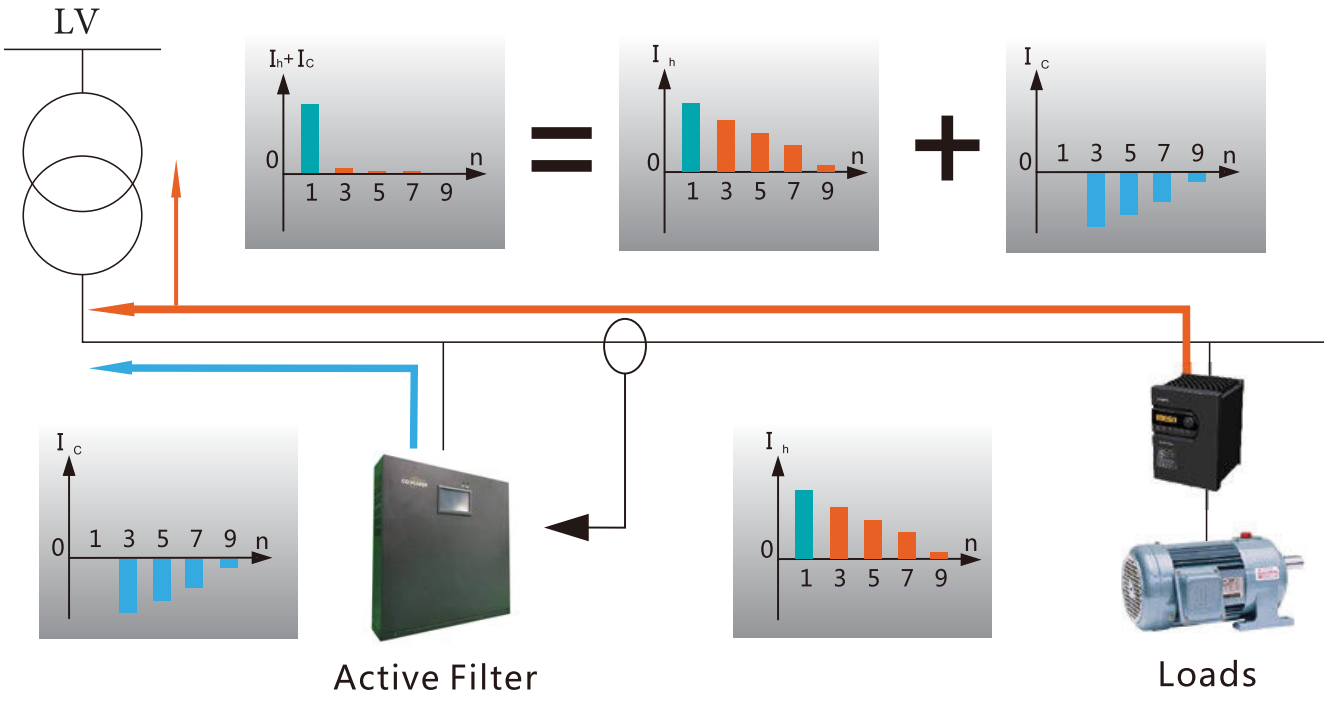


Causes of electrical harmonics

In an industrial environment, the causes of harmonic distortion are most often the electrical equipment in an operation. Modern industrial plants contain many pieces of equipment that may contribute to the overall distortion. A few obvious examples include variable frequency drives and electrical motors driven by inverters. These drives take in the regular AC voltage and current to convert that into DC and then create a variable frequency output so that the motors can be controlled more precisely. When the current is drawn into the inverter it is not taken as a pure sinewave but takes current irregularly to charge the components that are on the front end of the inverter. This irregular current draw distorts the current and, consequently, the voltage. These inverters may be used to drive motors that are part of the industrial process such as pumping, cooling or heating water, liquid materials, moving conveyors, or cooling fans. Other types of electronic controls will also be part of the process, and each one will create some distortion. When all this equipment is connected on the same network, the distortion will increase overall.

Benefits of using an Active Harmonic Filter (AHF)

AHFs are connected in parallel with the loads on the low-voltage busbar to improve power quality. Featuring smart control, high efficiency, rapid dynamic response, and stable and reliable operation, they address the complicated power quality problems and make it possible to significantly improve power quality.



- Improve power supply quality and enhance the reliability of enterprise equipment, reducing economic losses due to equipment malfunctions.
- Decrease the heating of power equipment and aging of insulation, thereby extending equipment service life and reducing maintenance costs.
- Lower the probability of harmonic resonance in compensation capacitors, enhancing power consumption security. Additionally, mitigate the impact of harmonics on system signals, thereby improving system reliability.
- Reduce heating of equipment such as motors, and decrease data error rates in computer systems. Minimize electromagnetic interference generated by harmonics, ensuring the normal operation of weak-current systems.
- Meet international and local standards for electrical equipment and power quality.

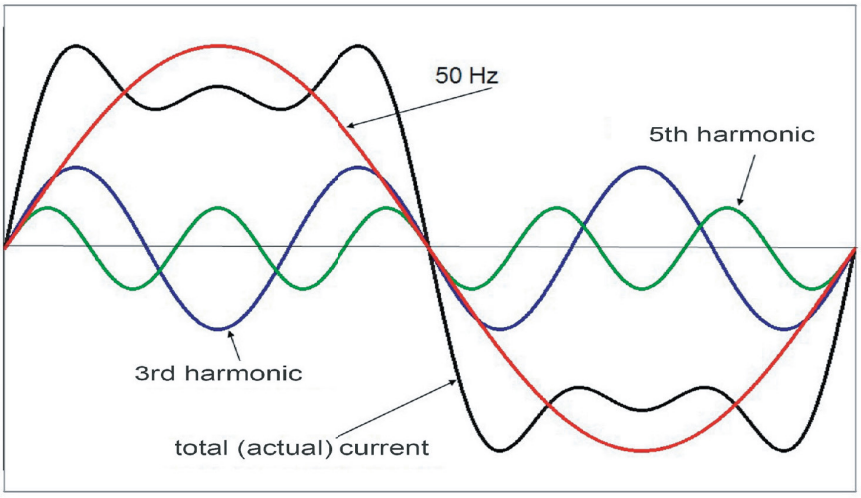
AHF operating principle - Three-level topology

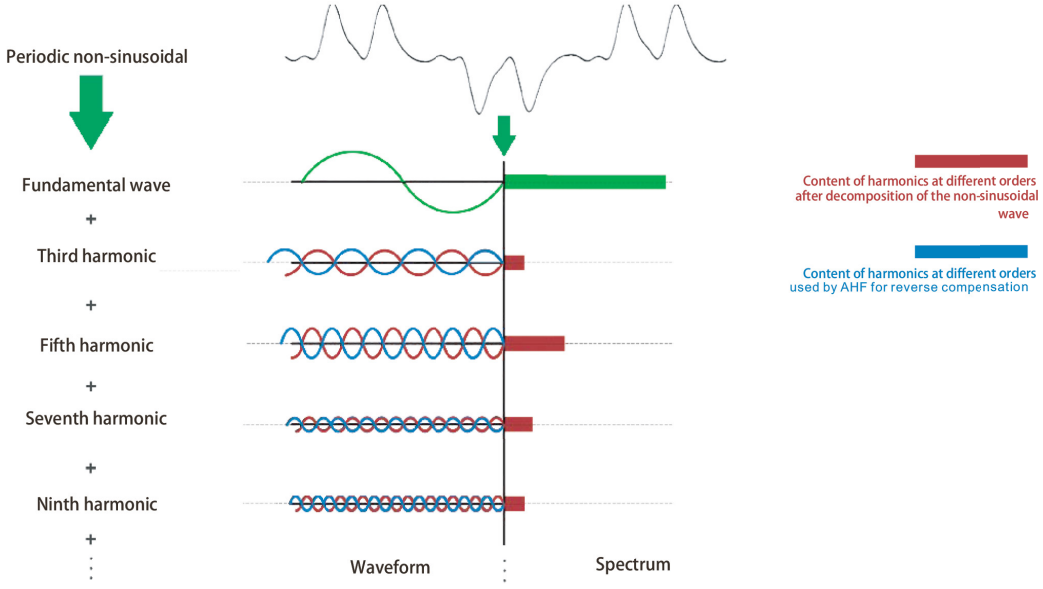
Active Harmonic Filters (AHF) featuring a three-level Neutral Point Clamped (NPC) topology are designed to minimize harmonic components generated by nonlinear loads and injected into the power grid. AHF units are typically installed in floor-standing cabinets or configured as wall-mounted modules, offering the following key features:

- Fast Response Time: High IGBT switching frequency of up to 20 kHz.
- Enhanced Voltage Withstand Capability: Improves the system's ability to withstand voltage stresses.
- Real-Time Dynamic Compensation: Provides instantaneous automatic compensation and is not affected by power system unbalance.

To mitigate harmonics, the control circuit measures the load current and calculates its harmonic spectrum using advanced control algorithms programmed in a Digital Signal Processor (DSP).

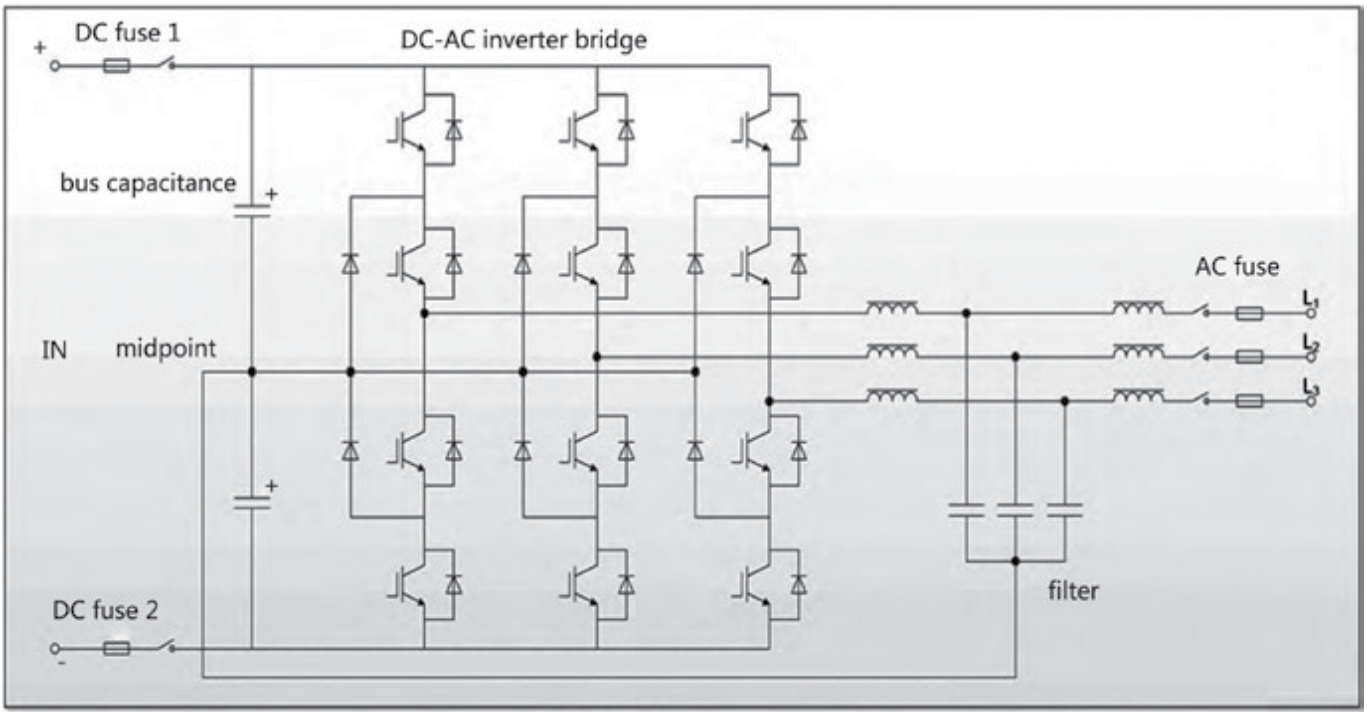
BTB Electric's AHF product series uses the Fast Fourier Transform (FFT) method to analyze the load current harmonic spectrum from the 2nd to the 50th order. Based on the analysis results, the control algorithm determines the required compensation current amplitude and generates compensation signals with opposite phase angles to the selected harmonic components, effectively canceling them out.





Next, the compensation current generation circuit sends control signals to the IGBTs (power semiconductor switches) using Pulse Width Modulation (PWM). This enables compensation currents with precisely opposite phase angles to the corresponding harmonic components to be injected into the electrical system.

As a result, harmonic currents on the source side are significantly reduced, thereby improving power quality and enhancing the operational reliability of the electrical system.

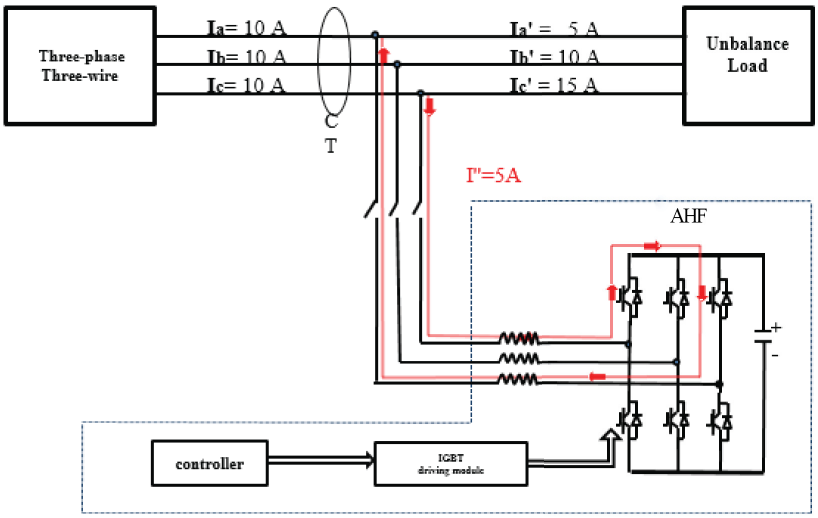


Three-level topology circuit diagram

Thanks to its three-level topology, based on zero-voltage-level switching (using lower-voltage-rated IGBTs to achieve higher switching frequencies), BTB Electric's Active Harmonic Filter (AHF) effectively suppresses unwanted current ripple while improving compensation accuracy and ensuring an output current waveform that closely approaches an ideal sinusoidal waveform.

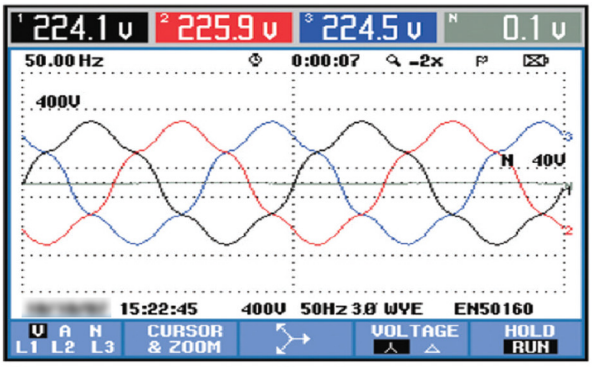
In addition to its primary function of harmonic current mitigation, the AHF can measure the current in each phase and redistribute load currents to balance the current across all three phases. It can also flexibly utilize its remaining compensation capacity to provide reactive power compensation, thereby improving the power factor (cos φ).

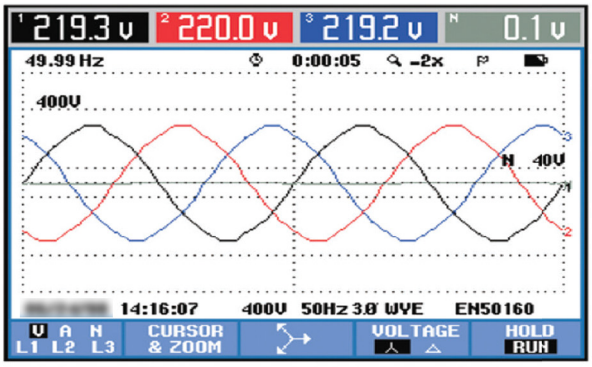
Users can configure the device's operating priority according to actual application requirements, choosing between Load Balancing and Reactive Power Compensation modes.



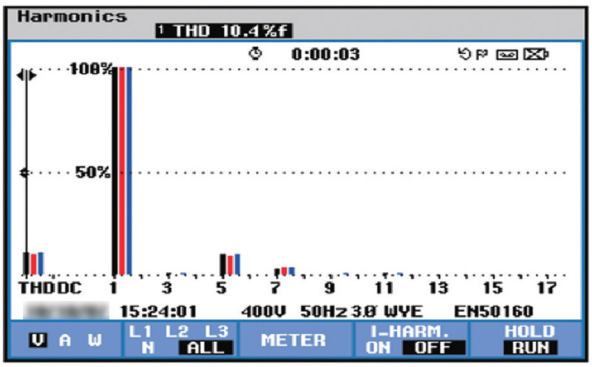
Load balancing example

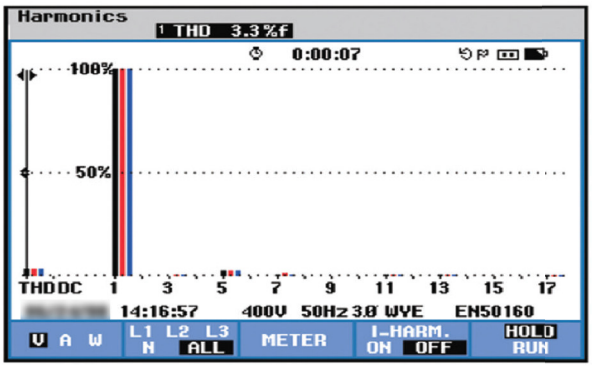
Examples:



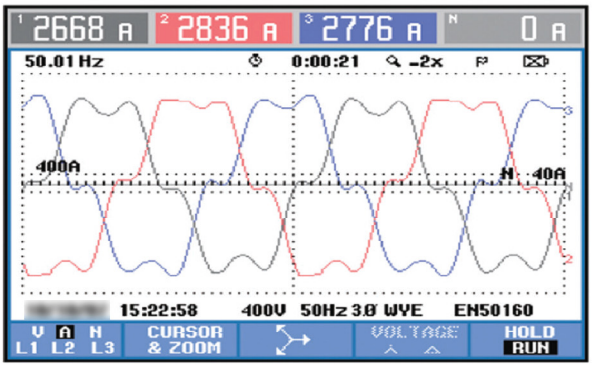


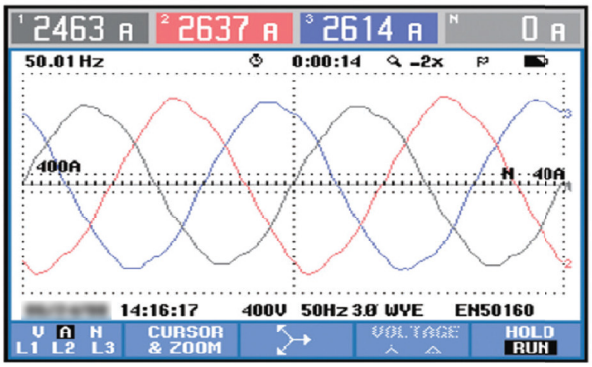
Waveforms and RMS values of phase voltages before and after AHF operation



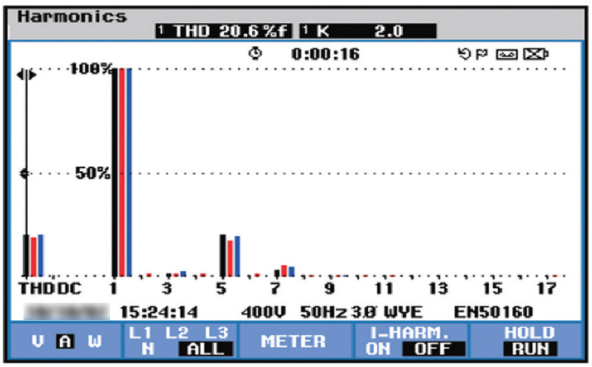


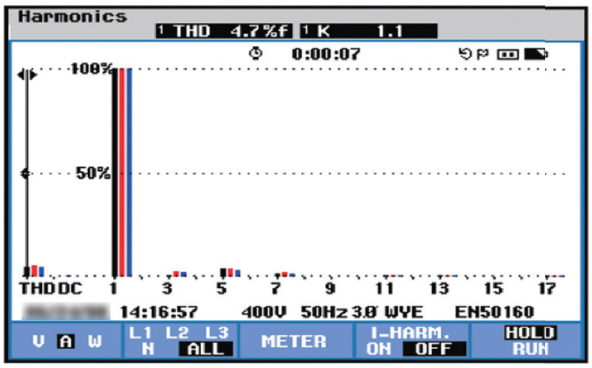
Harmonic spectrum of phase voltages before and after AHF operation





Waveforms and RMS values of phase currents before and after AHF operation





Harmonic spectrum of phase currents before and after AHF operation

Application


Automotive manufacturing

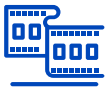

IDC industry


Hospital


Modern architecture


Sewage treatment


Power generation


Theater


Photovoltaic


Oil exploitation


Semiconductor


Distribution network transformer


EV charging station


Theme parks and hotels


Smelting steel


Papermaking


Subway


Rubber

Model description

BF3-07544LD

B	F3	XXX	4	4L	D
1	2	3	4	5	6

No.	Name	Meaning
1	Enterprise code	B: BTB Electric
2	Product type	F3: 3rd generation active harmonic filter
3	Compensation current (A)	50/75/100/150/200~600A
4	Voltage level	4: (400V), 6: (690V)
5	Wiring type	4L: (3P4W), 3L: (3P3W)
6	Mounting type	D: Drawer type, W: Wall-mounted type, C: Cabinet type

Product code	Product Description
BF3-05044LD / BF3-05044LW	AHF 50A, 3P4W, 400V, drawer/wall mounted
BF3-07544LD / BF3-07544LW	AHF 75A, 3P4W, 400V, drawer/wall mounted
BF3-10044LD / BF3-10044LW	AHF 100A, 3P4W, 400V, drawer/wall mounted
BF3-15044LD / BF3-15044LW	AHF 150A, 3P4W, 400V, drawer/wall mounted
BF3-20044LC	AHF 200A, 3P4W, 400V, cabinet type
BF3-25044LC	AHF 250A, 3P4W, 400V, cabinet type
BF3-30044LC	AHF 300A, 3P4W, 400V, cabinet type
BF3-35044LC	AHF 350A, 3P4W, 400V, cabinet type
BF3-40044LC	AHF 400A, 3P4W, 400V, cabinet type
BF3-45044LC	AHF 450A, 3P4W, 400V, cabinet type
BF3-50044LC	AHF 500A, 3P4W, 400V, cabinet type
BF3-60044LC	AHF 600A, 3P4W, 400V, cabinet type

690V / 3P3W: available on request

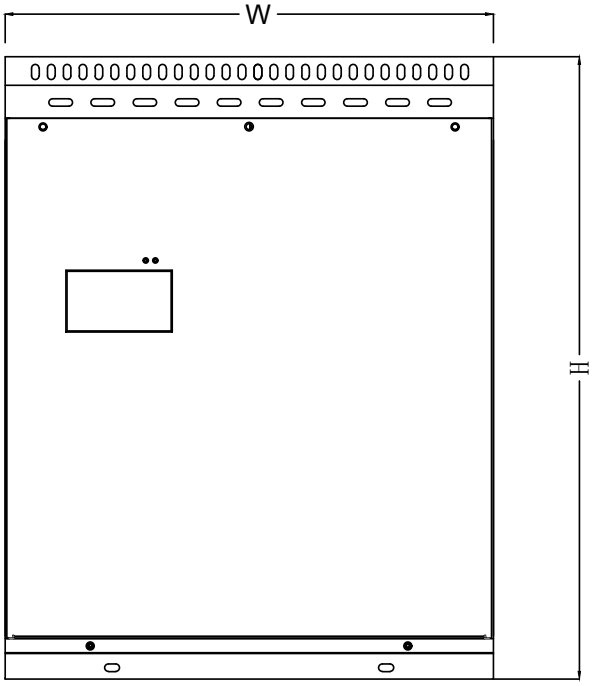
Technical specifications

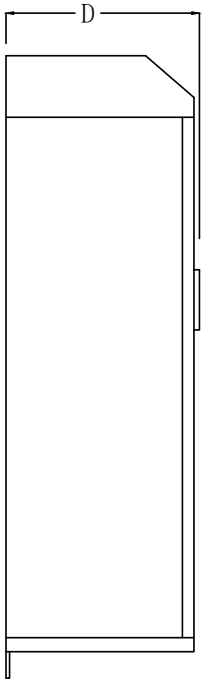
General characteristics	
Standards	JB/T 11067-2011, DL/T 1216-2013 IEC/EN 61439-1, 2014/30/EU, EN 61000-6
Rated input line voltage	400V (380V ±20%)
Frequency (fn)	50Hz ±10%
Compensation current	50A, 75A, 100A, 150A per module 200A, 250A, 300A, 350A, 400A, 450A, 500A, 600A per cabinet
Power grid structure	3P3W / 3P4W
Performance specifications	
Operating mode	Active harmonic filtering / Power factor correction / Load balancing
System efficiency	≥ 97%
Harmonic spectrum	2nd to 50th harmonics
Harmonic compensation selection	Individual selection from 2nd to 50th harmonics
Response time	Full response time < 10ms
Control algorithms	FFT, Intelligent algorithm and instantaneous reactive power theory
Power factor correction	Programmable from 1 (inductive) to -1 (capacitive)
Load balancing	Programmable load balancing between phases
Protections	Over-voltage protection, under-voltage protection, short-circuit protection, inverter bridge inverse protection, over-compensation protection etc.
Operation configuration	
Parallel operation	Unlimited
CT requirements	3 CTs required (50/5A ~ 5000/5A, class 0.5)
Circuit topology	Three-level
Power loss	Less than 3% of rated power
Communication monitoring capability	
Communication interface	RS485 and Modbus-RTU protocol / optional Ethernet
Module display interface	4.3-inch touch screen
Fault alarm	Up to 500 alarm records
Monitoring	Independent monitoring and centralized monitoring
Environmental conditions	
Operation temperature	-10 ~ 45°C
Humidity	≤ 95% non-condensing
Altitude	≤ 1500m, 1500~3000m (derating 1% per 100m)
Installation environment	No harmful gas and steam, no conductive or explosive dust, no severe mechanical vibration
Cooling	Intelligent forced air cooling
Protection class	IP20 (higher protection class available on request)
Noise level	Below 60 dB

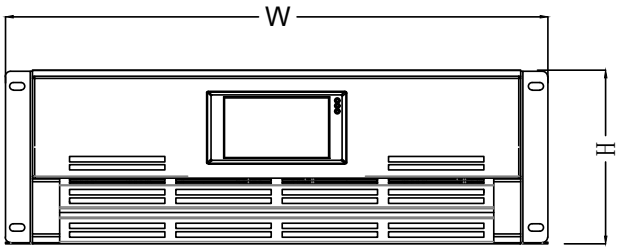
Dimension and structure

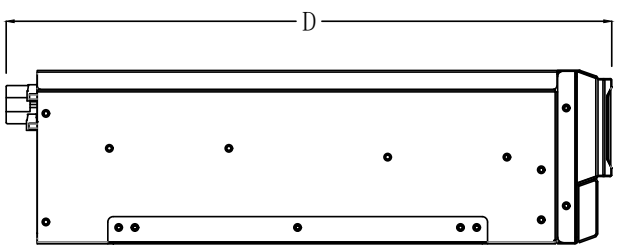
1. Drawer type and wall-mounted type

Code	Dimension (W×H×D) mm		Weight (kg)	
	Drawer type	Wall-mounted type	Drawer type	Wall-mounted type
BF3-05044LD BF3-05044LW	452×86×450	423×550×88	14	15
BF3-07544LD BF3-07544LW	550×190×540	503×597×190	35	36
BF3-10044LD BF3-10044LW	550×190×540	503×597×190	35	36
BF3-15044LD BF3-15044LW	558×220×540	503×608×220	44	45



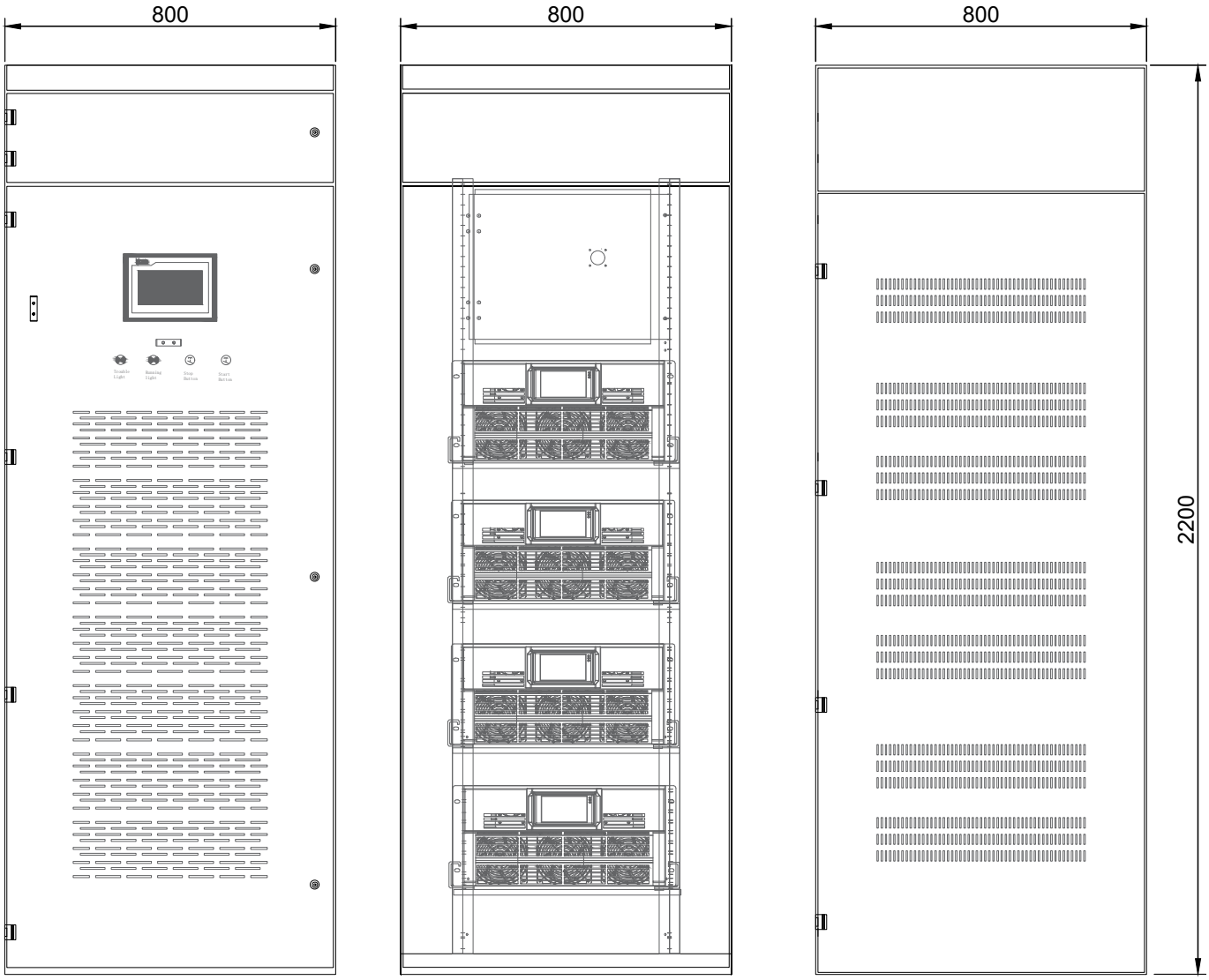






2. Cabinet type

Code	Installation	Dimension (W×H×D) mm
BF3-20044LC	2 modules	800x2200x800
BF3-25044LC	2 modules	
BF3-30044LC	2 modules or 3 modules	
BF3-35044LC	3 modules	
BF3-40044LC	3 modules or 4 modules	
BF3-45044LC	3 modules or 4 modules	
BF3-50044LC	4 modules	
BF3-60044LC	4 modules	



Product Advantages

- Harmonic compensation: AHF can filter 2nd to 50th order harmonics simultaneously.
- Reactive power compensation: Capacitive & Inductive (-1 ~ 1) stepless compensation.
- Fast response time.
- Design life is more than 100,000 hours (more than ten years).



Extremely high reliability

Three-level technology platform, excellent air duct design, flexible grid-connected technology, early warning monitoring function, maximum system reliability



Dynamic compensation mode

Flexible setting for harmonic compensation, harmonic & reactive compensation, harmonic & three-phase unbalanced hybrid compensation modes according to application conditions



High efficiency, high power density

Achieving 97% system efficiency with high power density, helping reduce investment and operating costs



Easy to expand and maintain

Featuring modular expansion and maintenance capabilities, with maintenance taking less than 15 minutes, ensuring maximum continuity of operation



Smart communication is easy to use

Supports RS485/Modbus-RTU and optional Ethernet for convenient data collection and monitoring

Select capacity according to transformer capacity and harmonic contamination level

Transformer capacity (kVA)	THDi					
	15%	20%	25%	30%	35%	40%
200	50A	50A	100A	100A	100A	100A
250	50A	100A	100A	100A	150A	150A
315	100A	100A	150A	150A	150A	200A
400	100A	150A	150A	200A	200A	250A
500	100A	150A	200A	200A	250A	300A
630	150A	200A	250A	300A	350A	400A
800	200A	250A	300A	350A	450A	500A
1000	200A	300A	400A	450A	550A	600A
1250	300A	350A	450A	550A	650A	750A
1600	350A	500A	600A	700A	850A	950A
2000	450A	600A	750A	900A	1050A	1200A
2500	550A	750A	900A	1150A	1300A	1500A

Note: For quick reference only. AHF capacity is calculated at 80% transformer loading.

Note

BTB ELECTRIC

ĐIỆN CÔNG NGHIỆP
CHUẨN CHÂU ÂU

Designed by NEXUS BTB ELEKTRİK ÜRETİM TİCARET ANONİM ŞİRKETİ
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Web: btb-electric.com

09 I 2026