01 Ultra AHF Product Introduction

1.1 Ultra AHF Completes the Last Puzzle Piece of AHF

iKonMac breaks through the barrier of the lack of a complete solution to power quality issues in weak grid environments. The independently developed Ultra AHF series stable active harmonic filters perfectly achieve the goal of jointly controlling current harmonics and voltage harmonics.

The Ultra AHF series stable active harmonic filters feature faster response times and can more accurately avoid resonance. The most prominent advantage is the ability to simultaneously control various unstable harmonics and stabilize the power grid.

Applicable Load Types

Heating Furnace Equipment

Medium Frequency Furnace Equipment

High Frequency Power Supply Equipment

1.2 Ultra AHF Advantag-

Advantages of Stable AHF

- Simultaneously compensates for current distortion rate (THDi) and voltage distortion rate (THDv)
- Capable of mitigating interharmonics, even-order harmonics, transient harmonics, and other unstable harmonics
- Switching frequency can reach up to 80kHz
- Response time ≤ 1ms

VS

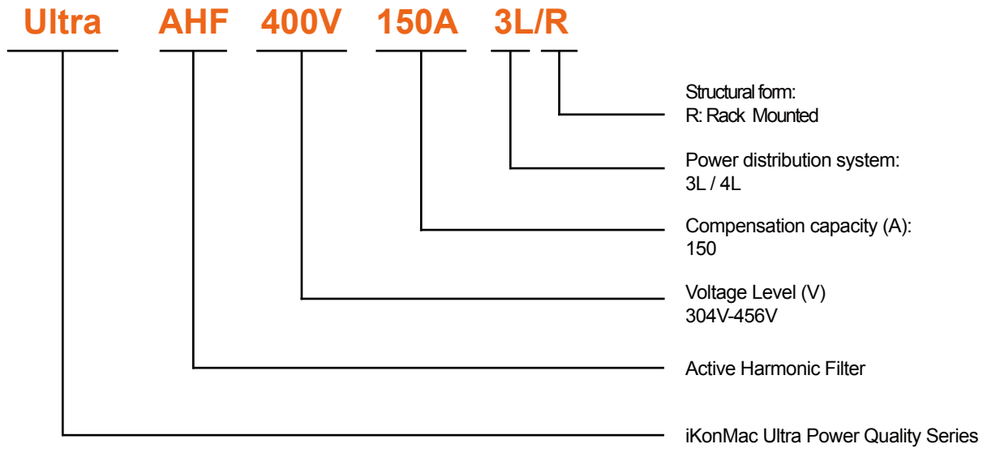
Challenges with Traditional AHF

- Can only mitigate current harmonics, not voltage harmonics. In weak grid conditions, where the voltage distortion rate is generally high, traditional AHF may fail to operate
- Cannot address complex harmonics such as interharmonics, even-order harmonics, or transient harmonics
- Susceptible to resonance issues

1.3 Ultra AHF Technical Specifications

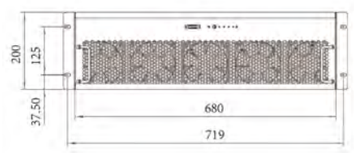
Category	Product	Indicators
Name	Product Series	Ultra Power Quality Series
Dimensions	Module Specifications	100A/150A
	Module Dimensions(W*H*D)	680*200*545
	Number of Parallels	12
	800*800*2200 Max Capacity Per Cabinet	750A
Input	Operating Voltage	(304V-456V)
	Operating Frequency	50Hz(±10%)
	Current Transformer	100 : 5 ~ 10000 : 5
Functions	Controller	100% Full FPGA, 16 CPUs parallel computation
	Harmonic Compensation	Harmonic Current: 2nd to 50th Order, Harmonic Voltage
	Efficiency	>98% & THDi < 5%
	Switching Frequency	80kHz (7th Generation Infineon IGBT)
Communi-cation Protocol	Communication Method	RS485, Modbus RTU, Wifi (Remote control debugging)
	Upper-Level Software	All parameters can be set via the upper-level software
	Fault Alarm	Up to 500 alarm messages can be recorded
	Monitoring	Supports independent monitoring of each module / centralized monitoring of the entire system
Technical Indicators	Response Time	≤1ms , instant response < 50us
	Active Power Loss	≤2%
	Cooling Method	Intelligent air cooling
	Noise	≤60dB
	Protection Functions	There are more than 20kinds of protection such as overvoltage, undervoltage, overheating, overcurrent, short circuit, etc
	CT Installation Location	Load Side
Mechanical Properties	Module Weight	38.5kg
	Color	7035 Fine orange texture spray painted
Environ-mental Require-ments	Operating Temperature	-20°C~+55°C
	Altitude	<5000meters (More than 1000 meters, For every 100 meters of additional elevation, the power is reduced by 1%.)
	Relative Humidity	<95%, No condensation
	Protection Level	Module IP20 + Electronic Layer IP42 (Customizable IP54 or IP65)
	Pollution Resistance Level	Level 2 (Customizable level 3)

1.4 Ultra AHF Model Description



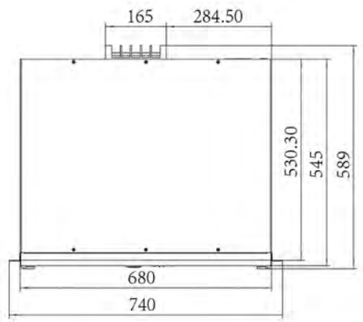
1.5 Ultra AHF Product Dimensions

Front view

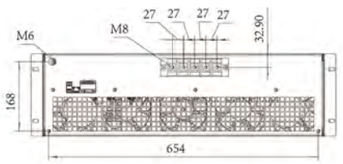


Side view

Top view



Rear view



1.6 Application in the Semiconductor Industry

Project Challenge

Dongni Electronics belongs to the semiconductor materials manufacturing industry, with its main load being crystal growth furnaces. During operation, a large amount of harmonics is generated. Multiple crystal growth furnaces cannot be used in parallel, resulting in serious voltage distortion. The load current increases, causing damage to components. Traditional AHF cannot effectively solve the resonance issues and voltage harmonic problems in this project.

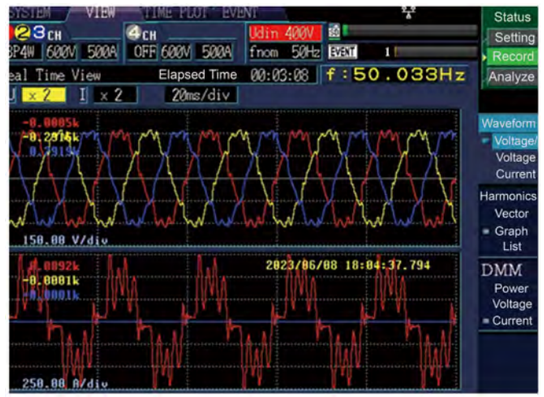
Solution

The crystal growth furnace is a high-frequency rectifier power source, which is unstable during operation and easily generates a large amount of voltage and current harmonics. iKonMac Technology solved the persistent voltage harmonic problem and also compensated for current harmonics by using the Ultra AHF stable active harmonic filter. The voltage distortion rate remained stable at less than 4%, and the current distortion rate stabilized at around 8%, effectively solving the complex harmonic issues on Dongni's site.

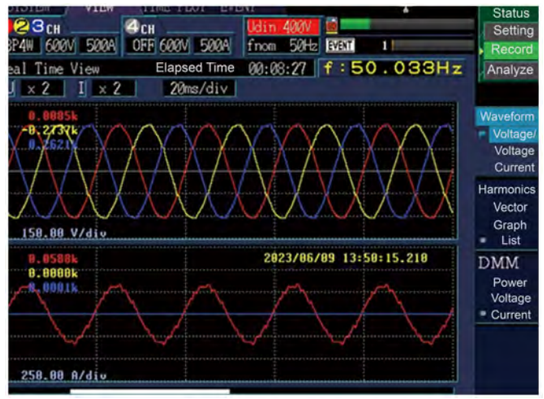
Before and After Treatment Comparison

Voltage Harmonic Distortion Rate

Decreased From 10.7% to 2.3%



Voltage waveform before treatment



Voltage waveform after treatment

1.7 Application in Supressing Odd Harmonics

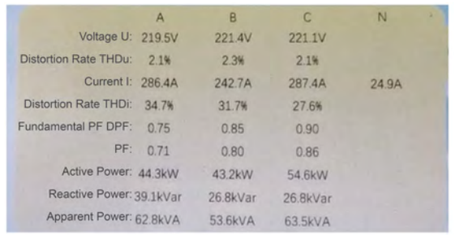
Project Challenge

In a rectifier power supply project in Qinghai, the power system had significant even-order harmonic current issues, particularly 2nd and 4th harmonic currents as high as 40A. Notably, the system's front-end power supply was an UPS (uninterruptible power supply). In this environment, using traditional Active Harmonic Filters (AHF) not only failed to effectively address the even-order harmonic issues, but also caused resonance between the AHF and the UPS, further destabilizing the system. Therefore, a more suitable harmonic mitigation solution was needed to ensure the stable operation of the power system.

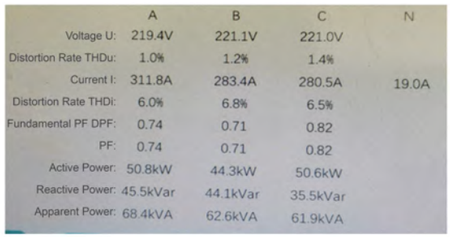
Project Solution

Unlike odd-order harmonics, even-order harmonics primarily arise from specific devices in the power system. These devices are typically non-linear loads, such as rectifiers, thyristors, and electric arc furnaces. When such non-linear loads are widely used in the power system, the even-order harmonic content significantly increases, posing a serious threat to the stability of the power system and the safe operation of equipment.

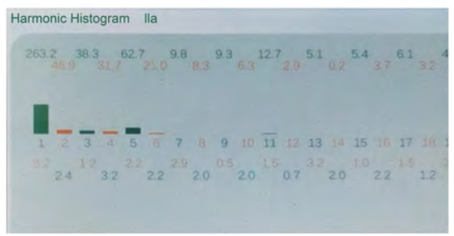
After installing the Ultra AHF stable active harmonic filter on the load side, the even-order harmonics were eliminated. The voltage distortion rate remained stable at around 1%, and the harmonic current distortion rate was significantly reduced from 34% to approximately 6%.



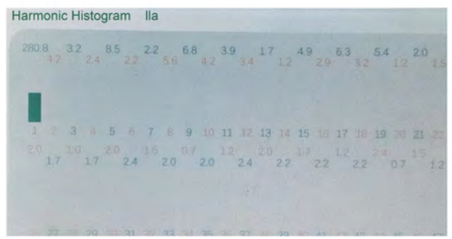
Before mitigation, the grid-side current harmonic distortion rate reached 34%.



After mitigation, the grid-side current harmonic distortion rate was reduced to 6%.



Before mitigation, there were even-order harmonics such as the 2nd and 4th harmonics.



After mitigation, even-order harmonics were successfully eliminated.

1.8 Application in Rectifier Power Supply Loads

Project Challenge

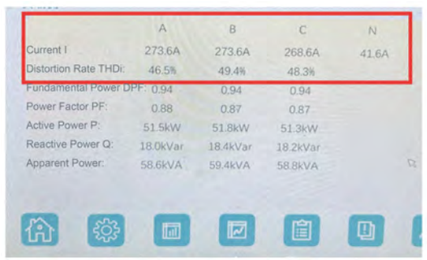
At the Tianma Power Supply project site, the load used is a rectifier power supply. When traditional AHF is used for compensation, the harmonics compensated for create resonance with high order harmonics, resulting in poor compensation and a discrepancy with the customer's target requirements.

Project Application Site

Project Solution

Rectifier power supply loads generate a series of harmonic components during the rectification process due to their non-linear nature. These harmonic components not only affect the efficiency of the rectifier power supply itself but also pollute the power grid, interfering with the normal operation of other electrical equipment.

By installing the Ultra AHF stable-type active harmonic filter on the load side and simultaneously compensating for both current and voltage harmonics, the harmonic current distortion rate was reduced from 46.5% to 1.9% after compensation.



Before mitigation, the current harmonic distortion rate was 46%.

After mitigation, the current harmonic distortion rate was 1.9%.

02 iKonMac Tech Core Advantages

2.1 Research and Development Strength

1 Master the Core Technology of AHF/SVG

- iKonMac specializes in R&D, with all products independently developed using core AHF and SVG technologies, including 7th-generation IGBT and full FPGA control chips.
- The Product Features a unique layered design, with industry-leading technical parameters and over 30 patents, including 5 inventions and 8 software copyrights.
- iKonMac continuously innovates to advance power quality products and drive industry progress.

Quality Comes From Professionalism

2 R&D Team Composition

- The R&D team of iKonMac is composed of high-tech professionals such as postdoctoral, doctoral, and master's degrees, with a R&D workforce accounting for 35%.
- The R&D team consists of positions such as Chief Engineer, Software, Control, Electronics, Electrical, Layout, Structure, Heat Flow, Testing, Process, etc. The R&D team is fully equipped.
- The R&D personnel mainly come from well-known universities such as Shanghai Jiaotong University, Zhejiang University, Xi'an Jiaotong University, Huazhong University of Science and Technology, and China University of Mining and Technology.

Focus On Creating Excellence

3 Experienced R&D Team

- Core R&D personnel with 30 years of experience in power electronics development and over 15 years of experience in AHF/SVG development.
- The R&D team previously developed the medium voltage SVG in 2007 and put it into use in 2008. In 2009, a full cabinet AHF was developed and put into use the same year. Modular AHF was developed from 2010 to 2011 and put into use in 2011. In 2015, AHF/SVG was developed based on the core technology of the 7th generation IGBT and full FPGA, and was put into use in 2016. Industrial specific models were developed in 2019 and officially put into use in 2020.

5 Proprtion of R&D Investment

- The proportion of R&D investment is greater than 12% of annual sales revenue and continues to increase year by year.

4 R&D Management and Development Equipment

- iKonMac follows the IPD product development process and has partnered with Shanghai JiaoTong University to establish a joint laboratory. This collaboration enhances R&D management, accelerates the transformation of high-tech achievements, and boosts product innovation.
- We have advanced development and testing equipment, including vibration tables, programmable power supplies, IGBT testers, power quality analyzers, temperature change test boxes, and performance testing platforms for active filters and static reactive power generators.
- A dedicated project customization team provides R&D support for product adjustments in special projects.

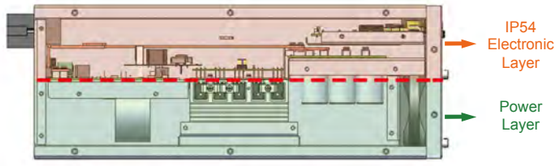
2.2 Product Core Advantages

1 Extremely High Anti Pollution Ability

The design adopts a layered structure, with the electronic layer and power components separated. The electronic layer provides effective insulation, moisture-proofing, and dust-proofing, while the power layer is cooled by fans. The electronic layer has an IP54 protection rating, and the module has a pollution resistance level of Class 3, making it suitable for harsh environments such as saline, humid, dusty, and corrosive gas conditions.

Germany's TÜV Rheinland Pollution Degree 3 certification

Shanghai Bureau of Technical Supervision IP54 certification for the electronic layer



Shematic diagram of the layered design

2 Adopting the 7th Generation IGBT from German Infineon

iKonMac's AHF/SVG uses the seventh generation IGBT, while most domestic AHF/SVG manufacturers still use the third generation. At the same time reducing switching loss by one-third and increasing the switching frequency by 2x40kHz, with parallel interleaving technology achieving an effective switching frequency of 80kHz. This challenges the control algorithm, as the main control chip needs to complete a PWM calculation within 1/80k=12.5us. iKonMac uses FPGA as the main control chip with parallel processing and multi-core CPU computing, allowing faster completion of control algorithms.

IGBT Driver Board

Seventh Generation IGBT

3 Adopting a Full FPGA Main Control Chip

Using the seventh-generation IGBT, doubling the switching frequency halves the control calculation time. Most manufacturers use DSP combined with CPLD or FPGA, but DSP's single-core serial processing can't meet the high switching frequency of the seventh generation IGBT. iKonMac's AHF/SVG uses an all FPGA control chip, with 8 million logic gates in the calculation program, equivalent to 16 parallel-running hardware CPU units.

FPGA Main Control Chip

4 Extremely Low Noise 60dB

Noise is crucial for user experience and comes from two main sources: first, heat dissipation, including airflow and fan noise. With the seventh generation IGBT, iKonMac reduces losses, adds temperature monitoring, and adjusts fan speed based on temperature, significantly lowering fan noise. Second, noise from the reactor is caused by high-frequency switching currents, with higher switching frequencies resulting in lower noise. iKonMac's seventh-generation IGBT achieves an effective switching frequency of 80kHz, compared to the common 20kHz, reducing module noise to under 60dB, while the industry standard is below 70dB.

Extremely Low Noise 60dB

5 Extremely Low Power Consumption 2.5%

The higher the active power loss, the more severe the heat generated by the device, and many failures in power electronics are due to internal heat damaging electronic components. Reducing active power loss is crucial, especially for large-scale applications like state grid industries. For AHF/SVG, power loss is a critical technical parameter. For instance, a 100A AHF module has a loss of 2.5%, which affects touch screen power, reactor heating, IGBT heating, etc., and reducing loss by even 0.1% is challenging.

iKonMac uses the seventh-generation IGBT, which reduces loss by 1/3 compared to the previous generation. By increasing the switching frequency to 40kHz, the inductance is halved, and with interleaved parallel technology, it is reduced even further. This results in an inductance value only 1/4 of similar products, leading to proportionally lower losses. As a result, iKonMac's AHF/SVG has a loss of less than 2.5%, while domestic products typically measure 3.5%.

Power Consumption ≤ 2.5%

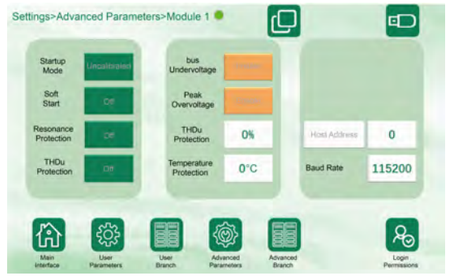
6 Extremely High Temperature Resistance of 55°C

For AHF/SVG, reliability comes from voltage and temperature resistance. iKonMac's AHF/SVG can run at full load in 55°C environments, thanks to the seventh-generation IGBT, which reduces loss and temperature rise, and the layered design that ensures effective heat dissipation and protection for the electronic layer.

Full-load operation at an ambient temperature of 55°C.

7 Intelligent Compensation Efficient Prevention of Resonance

iKonMac's AHF/SVG adds a smart startup mode in the software to effectively avoid resonance points and protect the device's normal operation, enhancing product reliability. This allows the product to be used in more challenging electrical environments.



Smart Startup Mode

8 Extremely High Power Density 800A/675kvar

iKonMac's AHF/SVG adopts a standard modular design with an efficient layout and high power density. For a 800x800 standard cabinet, its capacity can reach 800A or 675kvar.

Specification	Max Power
Single Module/ Wall Mounted	200A/150kvar
600(W) * 600(D) Cabinet	300A/200kvar
800(W) * 600(D) Cabinet	400A/300kvar
600(W) * 800(D) Cabinet	600A/300kvar
800(W) * 800(D) Cabinet (Recommend Dimensions: 800(W) * 1000(D) Cabinet	800A/675kvar

Maximum 800A/675kvar per cabinet

2.3 Quality Control

Incoming Inspection:

- All components are sourced from well-known international and domestic manufacturers.
- All materials undergo incoming inspection, with random checks for standard materials and full checks for critical ones.
- Key inspection equipment includes:
  Bridge —— for measuring inductance
  Heat sink jig —— for measuring hole positions on heat sinks
  Inductor jig —— for measuring inductor dimensions
  Oven —— for testing FPC terminal temperature resistance
  Microscope —— for inspecting PCBA soldering quality
  High-precision multimeter —— for measuring precision resistors (0.001)
- After all components are inspected, they are sent to the SMT factory for assembly.

ICT Testing

- The SMT factory conducts ICT testing on all completed PCBs to prevent soldering defects such as cold or missed solder joints.

FCT Testing

- Once the PCBs arrive at the company, full inspection is carried out with dedicated testing fixtures for each board

Assembly

- All assembly is done in an ESD-protected environment (ESD clothing, shoes, flooring, constant temperature and humidity chamber, ESD wristbands, ESD transit boxes, and all equipment grounded). Process inspections are conducted according to SOP.

Low-voltage Testing

- After assembly, products undergo 30V low-voltage communication testing on a custom automated test platform.

High-voltage Testing

- Next, products undergo 400V high-voltage on/off testing on a custom automated test platform.

Aging Test

- Full-load aging test of all modules for 24 hours.

Final Inspection

- Before shipment, the product undergoes a final inspection to check its operational status.



2.4 Service Competitiveness

Product Customization

- Custom brand silk printing
- Customized design for human-machine interface startup screen
- Customized shipping documentation
- Special projects with dedicated R&D technical support.

Power Quality Testing Services and Professional Solutions

- Provide power quality testing services
- Develop professional power quality management solutions
- Create reasonable corrective action plans
- Full-line technical support for solution implementation
- Provide project effectiveness reports and equipment operation reports.

Power Quality Issues:

Technical Consultation, Installation Guidance, Debugging, and Training Services

After-Sales Service Commitment

- **Supporting Documentation**

  We ensure product traceability with full documentation, including user manuals, product drawings, and technical info for each project.

- **Online-Remote Service**

  We offer remote technical support with a response time under 2 hours, and resolve issues within 24 hours. For unresolved issues, on-site technicians will be dispatched.

- **Post-Warranty Service**

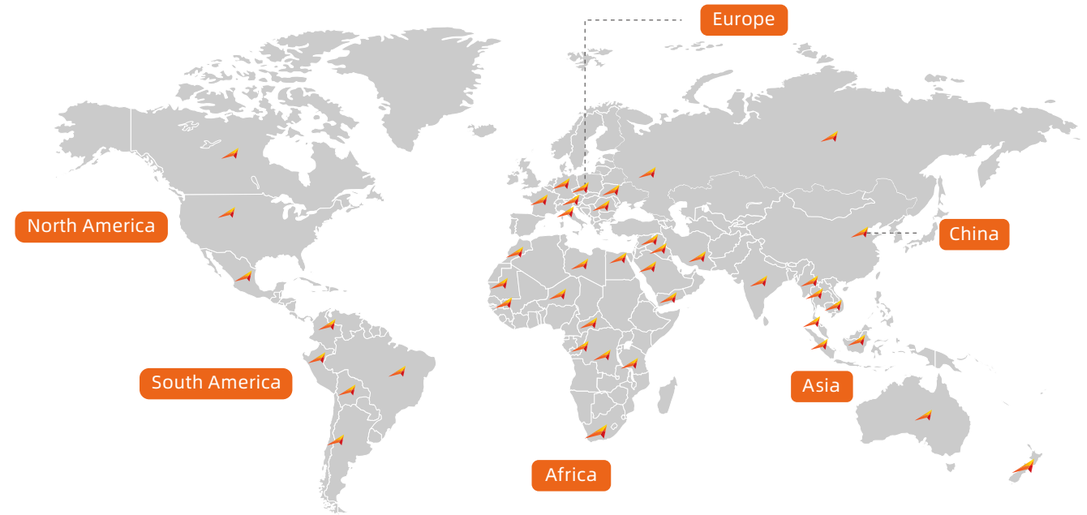
  Lifetime maintenance after warranty, charging only for costs. A full maintenance plan is provided beyond warranty.

- **Service Records**

  We keep detailed records of every customer interaction, service, and feedback for quality analysis.

- **Preventive Inspections**

  Regular follow-ups and site inspections to ensure customer satisfaction.



iKonMac *Reliability at Our Core*