Sinexcel®
Power Quality

Active Harmonic Filter (AHF)

AHF Wallmount
AHF Cabinet Mount

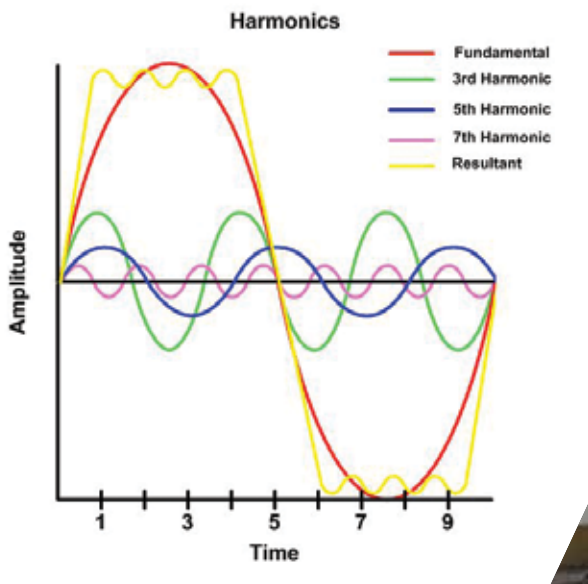
POWER ELECTRONICS®

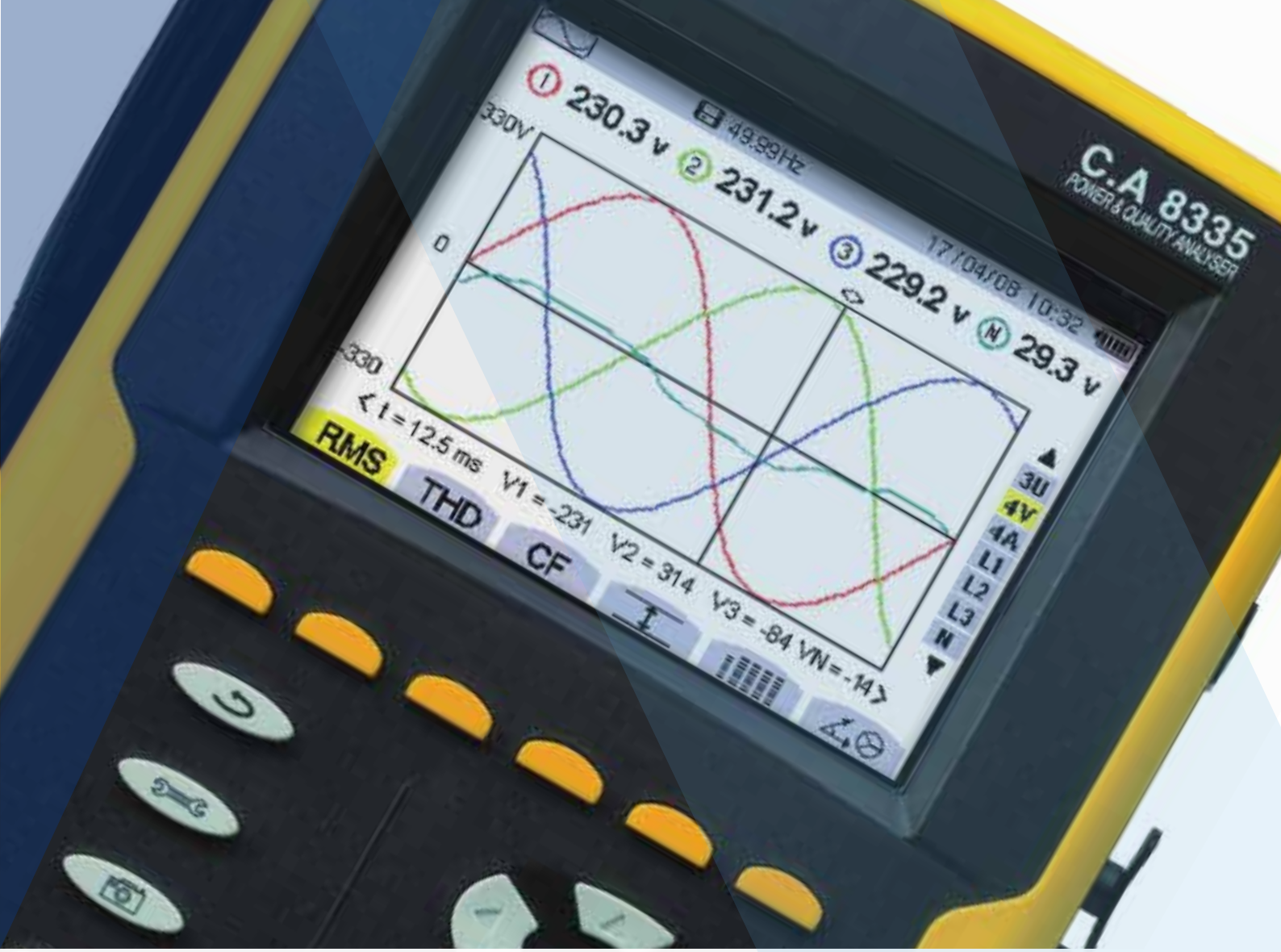
INTRODUCTION TO HARMONICS

Harmonics are an increasing problem in today's modern electrical system. The rapid uptake of sophisticated power electronics devices and non-linear loads has resulted in electrical networks rich in harmonic currents and voltage distortion.
Non-linear loads draw current from the electrical supply that is non-sinusoidal. These currents contain additional components at frequencies that are at multiples of the fundamental frequency (50Hz). These additional components are referred to as harmonic currents. If a high enough level of harmonic current is being drawn from the supply then this results in distortion of the voltage waveform.
The measurement of the distorted voltage wave form is described as the Total Harmonic Distortion Voltage or THDv. The measurement of the current waveform, including the fundamental and harmonics, is described as the Total Harmonic Distortion Current or THDi.

Typical Non-Linear Loads:

- Uninterruptable Power Supplies (UPS)
- Induction Furnaces & Welding Machines
- AC and DC Variable Speed Drives
- Battery Chargers and other DC Supplies
- LED and Fluorescent Lighting Circuits
- Computers and other devices containing Uncontrolled Rectifiers



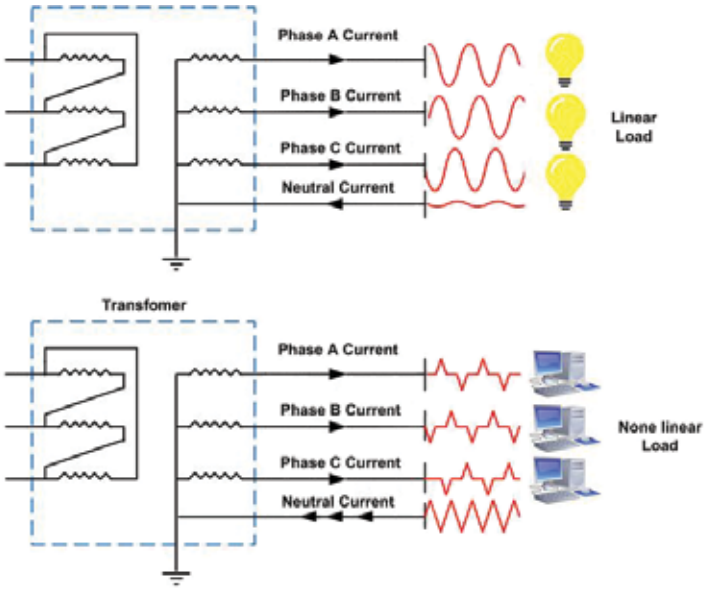


WHY IMPROVE MY HARMONICS?

Harmonic currents increase the level of current being drawn from the supply and negatively impact on the quality of the supply voltage. Most electrical networks have been designed to operate at the fundamental frequency only and the presence of currents outside of this frequency often stress distribution equipment and can disrupt normal power supply operation. Some typical effects of harmonics are:

- Overheating of transformers, switchboards, cables, motors due to increased current requirements
- Nuisance tripping of thermal protection devices such as overloads and circuit breakers
- Overloading of neutral conductors
- Poor Power Factor & premature failure of PFC capacitors
- Failure of PLC, DCS, computer, and other sensitive low voltage power supplies
- Premature failure of motors and poor motor performance

Harmonic currents can be improved by installing Active Harmonic Filtering (AHF) equipment. AHF equipment simply adds currents 180^0 out of phase with the existing harmonic currents, but that are equal in magnitude and frequency.



Example of how single phase harmonics compound in the neutral conductor

WHY DO THIRD HARMONICS OVERLOAD THE NEUTRAL CONDUCTOR?

Single phase harmonic loads can also create additional issues by introducing harmonic currents into the neutral conductor.

In a balanced three phase, four wire MEN electrical system with linear loads (no harmonics) the vector sum of each of the three phases is the neutral current. The system is typically engineered so that the vector sum or neutral current is very low as a ratio of the phase current.

Single phase non-linear loads, such as UPSs, LED lighting, computer and other switchmode power supplies; and light dimmers, draw current in pulses that combine in the neutral. This can result in neutral currents up to 3 times that of the phase currents.

The Sinexcel AHF is available in models to operate on balanced three phase non-linear loads (e.g. variable speed drives) or unbalanced three phase non-linear loads (e.g. commercial building supply)

THE BENEFITS OF ADDRESSING HARMONICS

- Lower operating costs by using power efficiently, lowering distribution costs, and avoiding network penalties.
- Reduces the threat of operational downtime from nuisance tripping, overloading, and premature plant failure.
- Eliminates the risk of electrical system resonance caused by harmonic currents.
- Reduces the risk of overloaded neutrals, transformer windings, and premature power factor correction capacitor failures, and other sensitive electronic equipment.
- Reduced failure rate of electronic hardware.
- Compliance with electrical network standards.

HARMONIC STANDARDS THAT APPLY TO NEW ZEALAND

The New Zealand Electrical Code of Practice for Harmonic Levels (NZECP36:1993) establishes the levels of voltage distortion that are acceptable to the NZ distribution system and has been widely applied in establishing required harmonic correction throughout the electrical industry.

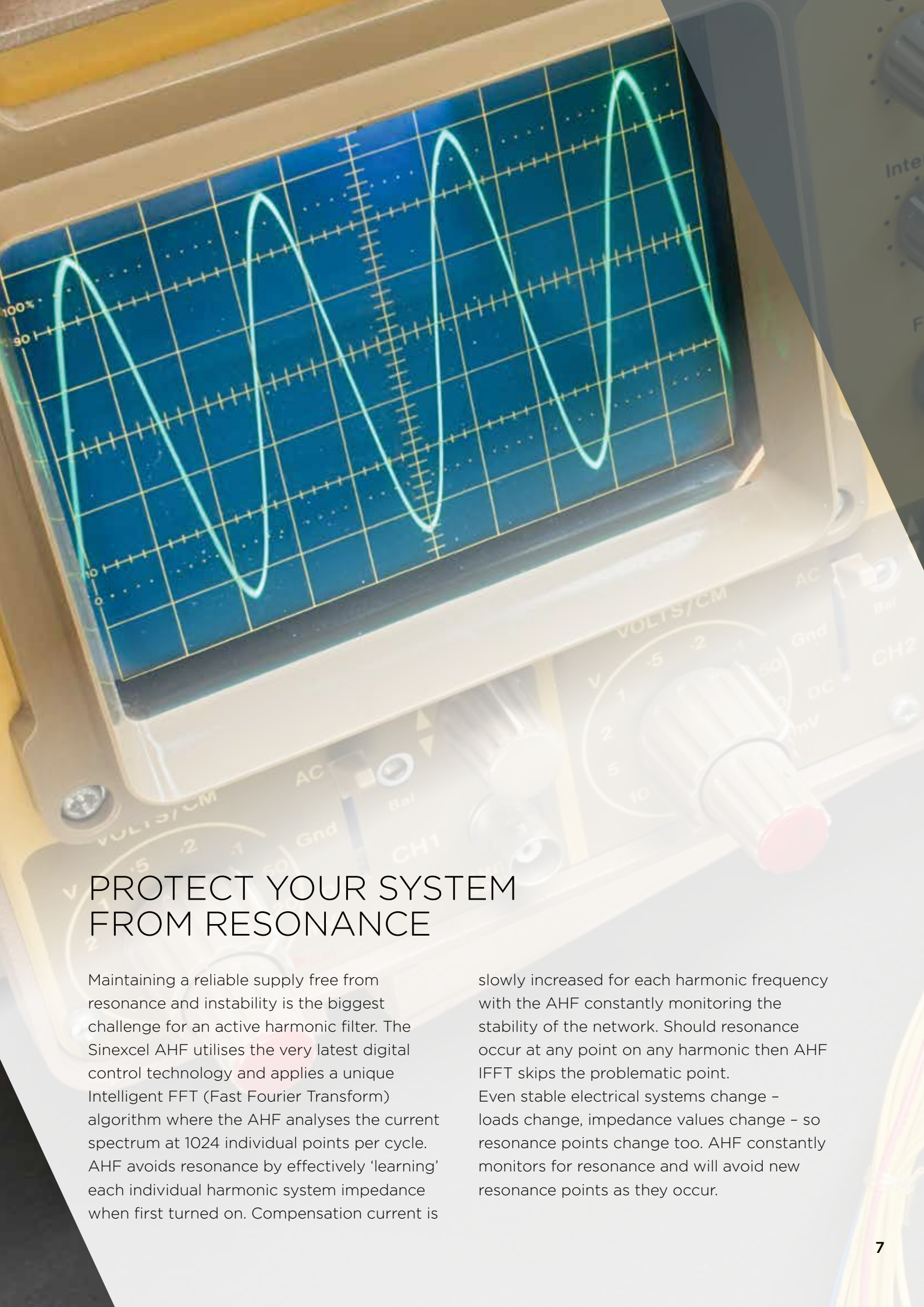
However with the increase in usage of variable speed drives, particularly in rural areas, many local network companies have introduced regional regulations to manage harmonic currents. These regional regulations are often considerably stricter than NZECP36, with many adopting levels of <8% TDD measured on the secondary side of the transformer. This has placed a much higher onus on harmonic generating consumers to be more active in harmonic mitigation.

The foundation of many of these local network companies regulations are based on international standard IEEE 519 which has been recognised as the international benchmark for acceptable harmonic current levels . IEEE 519 takes supply impedance or prospective short circuit current of the supply into consideration, as well as harmonic current levels.

Table 10.3: Current Distortion Limits for General Distribution Systems (120V through 69,000V)

Maximum Harmonic Current Distortion in Percent of I_L						
Individual Harmonic Order (Odd Harmonics)						
I_{SC}/ I_L	<11	11<=h <17	17<=h <23	23<=h <35	35<=h	TDD
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1,000	12.0	5.5	5.0	2.0	1.0	15.0
>1,000	15.0	7.0	6.0	2.5	1.4	20.0
Even harmonics are limited to 25% of the odd harmonic limits above.						
Current distortions that result in a DC offset (e.g. half-wave converters) are not allowed.						
*All power generation equip' is limited to these values of current distortion, regardless of actual I_{sc} / I_L						
Where, I_{SC}= maximum short circuit current at PCC I_L = maximum demand load current (fundamental frequency component) at PCC						

Table from IEEE 519 showing the maximum permitted harmonic levels for installations with various prospective short circuit (supply impedance) levels.



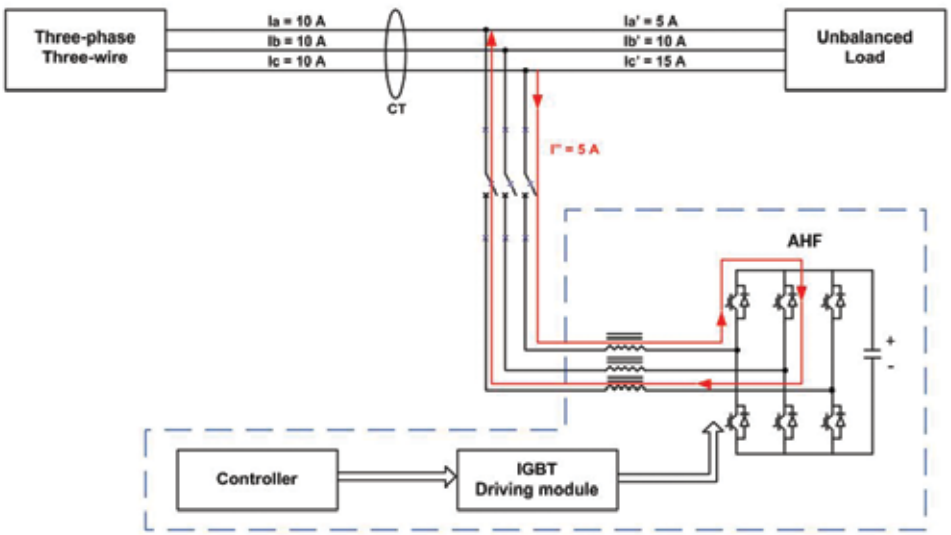
PROTECT YOUR SYSTEM FROM RESONANCE

Maintaining a reliable supply free from resonance and instability is the biggest challenge for an active harmonic filter. The Sinexcel AHF utilises the very latest digital control technology and applies a unique Intelligent FFT (Fast Fourier Transform) algorithm where the AHF analyses the current spectrum at 1024 individual points per cycle. AHF avoids resonance by effectively 'learning' each individual harmonic system impedance when first turned on. Compensation current is slowly increased for each harmonic frequency with the AHF constantly monitoring the stability of the network. Should resonance occur at any point on any harmonic then AHF IFFT skips the problematic point.

Even stable electrical systems change – loads change, impedance values change – so resonance points change too. AHF constantly monitors for resonance and will avoid new resonance points as they occur.

BALANCE YOUR LOAD AND CORRECT YOUR POWER FACTOR TOO

The Sinexcel AHF contains an algorithm that is able to measure the current load on each phase and redirect the existing load current to other phases to ensure a balanced load on the supply. Any additional capacity can be used to dynamically inject reactive power to improve the power factor. The user can configure the unit to prioritise whether additional capacity is used for load balancing or power factor correction.

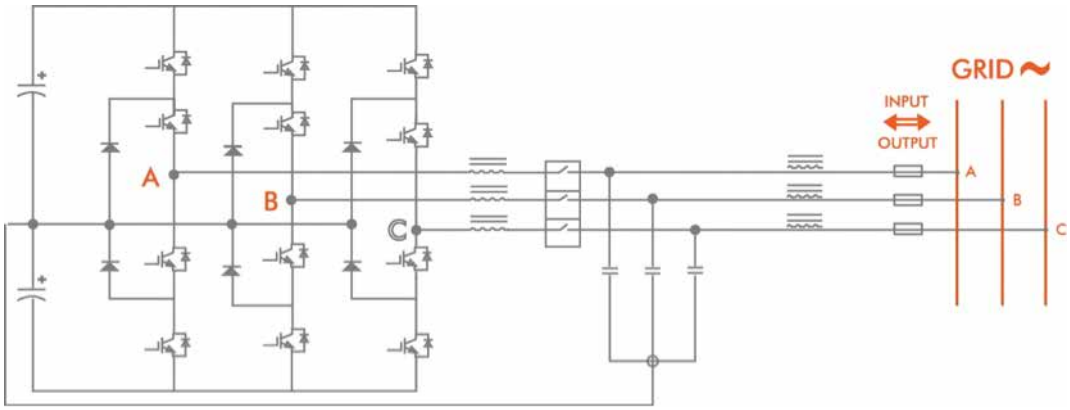


The Sinexcel AHF can transfer load between phases to balance three phase currents.

VERSATILE POWER QUALITY SOLUTION

SINEXCEL AHF OPERATING PRINCIPLES

Load current, including harmonics, are detected through external CTs and are fed to the internal DSP and CPU where an intelligent FFT algorithm separates the harmonic currents from the fundamental current. A compensating harmonic current, of equal magnitude but 180° out of phase, is dynamically and accurately calculated and sent to the IGBT control where a PWM signal is generated at a switching frequency of up to 35kHz. At the same time, the internal CT's detect the output current and provide negative feedback to the DSP which then makes adjustments to achieve a more accurate and stable system.



Innovative three level inverter technology

Sinexcel's innovative three level inverter is the foundation of every AHF unit. The modular three level inverter uses 12 IGBTs so reduces the switching loses and permits higher switching speeds. The need for small filter components provides for an ultra-compact, modular design with an improved waveform resulting in very low harmonic distortion and low levels of electromagnetic interference. Multiple Sinexcel AHFs can be configured to operate together simply by connecting the external CTs in series through all the units.

ULTRA-COMPACT FOOTPRINT

AUTOMATICALLY TUNABLE TO ANY SYSTEM

Sinexcel AHF provides real time response with constant correction to plant harmonics. The virtually instantaneous response ensures your plant power quality is at the highest possible level even with varying harmonic loads.

- THDi < 5%
- Selection of odd and even harmonics up to the 50th order
- Intelligent Fast Fourier Transform (FFT) for automatic correction of all 50 harmonic orders
- High efficiency >97%
- Reaction time <50us. Response time of <5ms
- FFT, Intelligent FFT and Instantaneous Reactive control modes.
- System impedance at each harmonic is “learnt” by the AHF
- On initial system connection compensation current is slowly increased with system stability closely monitored
- Should resonance be detected at any point the intelligent FFT can skip the problematic area
- Simple wall mount for 25/35/50/60/100/150/200/300amp sizes
- Pluggable rack mount option available in 75 amp
- Cabinet mount options for 25/35/50/60/100/150/200/300amp sizes
- One cabinet can accommodate up to 900amps utilising a combination of sizes
- Increase your capacity as your plant grows. Simply add as many units in parallel as required

DYNAMIC RESPONSE

FLEXIBLE CONTROL AND MONITORING

Easy to use, with displays on every unit providing all system information including grid voltage, compensating current, grid current, load current, grid PF, load PF, alarm code and operating status.

- Cabinet based systems come complete with 7” colour TFT touch screen so you can see exactly what is happening with your complete system. In addition to the information available on the standard unit display you can view individual module temperatures, THDv, THDi, voltage waveforms, harmonic spectrum.
- Optional alarm monitoring card allows AHF to be integrated into any plant control system
- RS485, RJ45 network port
- Modbus RTU, Modbus TCP/IP protocols supported

HMI ACTS AS A FULL POWER QUALITY METER

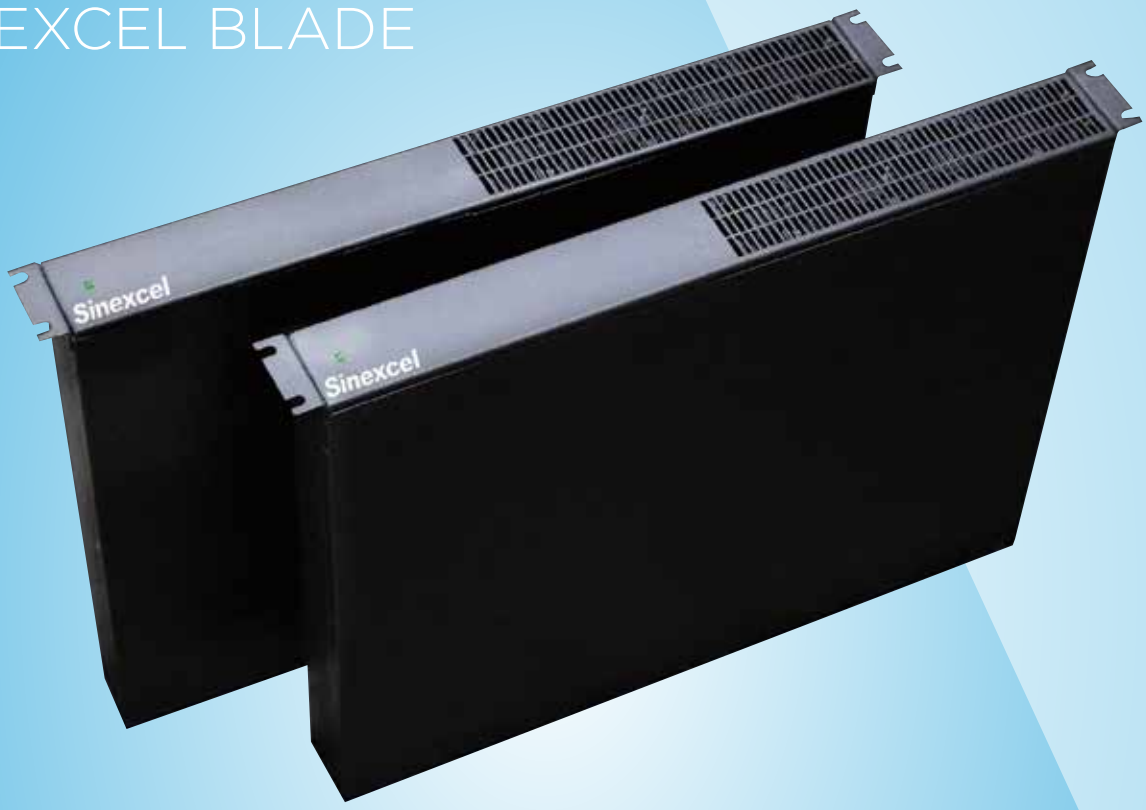
TECHNICAL SPECIFICATIONS

ITEM	400V					
	AHF Blade 005/010/015	AHF 025/035	AHF 050/060	AHF075/100	AHF 150	AHF 200/300
System parameters						
Rated input	400V (240V - 480V)	380 (228V - 456V)				
Power grid frequency	50/60Hz(range: 45Hz-62.5Hz)	50/60Hz(range: 45Hz-62Hz)				
Parallel operation	unlimited					
Overall efficiency	≥97%					
Power grid structure	3phase, 3wire/3phase, 4wire					
CT	50/5 - 10000/5	150/5 - 10,000/5				
Circuit topology	3-level					
Performance						
Rated capacity (phase)	5A/10A/15A	25A/35A	50A/60A	75A/100A	150A	200A/300A
Rated capacity (neutral)	15A/30A/45A	75A/105A	150A/180A	225A/300A	450A	600A/900A
Reactive power compensation	Supported					
Unbalance compensation	Supported					
Filtering range	2nd to 61st orders	2nd to 50th orders				
Filter performance	>95%					
Reaction time	<15μs	<50μs				
Overall response time	<5ms	<5ms				
Target power factor	Adjustable from -1 to +1					
Control algorithm	FFT,Intelligent FFT, and instantaneous reactive algorithm					
Switching frequency	90KHz	35kHz				
Cooling mode	44L/Sec	Smart air cooling 75L/Sec	Smart air cooling 151L/Sec	Smart air cooling 300L/Sec	Smart air cooling 405L/Sec	Smart air cooling 500L/Sec
Noise level	<55dB	<56dB			<65dB	<75dB
Communications and monitoring capabilities						
Communications ports	RS485	RS485, RJ45 (with optional PCB)				
Communications protocols	Modbus 2	Modbus RTU, Modbus TCP/IP (with optional PCB)				
Module display interface	WIFI display, 7-inch LCD touch screen (optional)	4.3-inch LCD colour touch screen				
Cabinet display	7" colour touch screen					
Protection functions	Over-voltage protection, under-voltage protection, short-circuit protection, inverter bridge inverse protection, over-compensation protection					
Alarm relay output	With optional PCB. Also connection to 7" HMI					
Fault alarm	Available, maximum of 500 alarm records					
Monitoring	Centralised monitoring and WIFI communication	Independent monitoring and centralised monitoring				
Mechanical properties						
Mounting type	Wall-mount or Rack-mount	Wall-mount or Rack-mount or Cabinet				
Net weight	5kg	18kg	35kg	40kg	62kg	110kg
Color	Black/grey/blue/orange/red (sand blast)	RAL7035, Black				
Environmental conditions						
Altitude	1500m. >1500m, 1% derating per 100m. 4000m max.					
Operating temperature	-10°C ~ +40°C					
Relative humidity	5% to 95%, non-condensing					
Protection class	IP20					
Qualifications and standards						
Qualifications	CE, ETL(UL508), BV, RCM (NZ)					
Standards compliance	IEEE519, AS/NZS 3820, EN 50178, IEC 61439-2 (cabinet), IEC 61000-6-4, IEC 61000-6-2					

POWER QUALITY SITE AUDIT AND SVG ENGINEERING SERVICES

For new installations our application team can assist with engineering an appropriate power quality solution to meet your system requirements. Alternatively, using our specialised measuring equipment, our technical support team can carry out an onsite audit to engineer a solution for your power factor needs. A report will be presented with recommendations on solutions. Please call Power Electronics to discuss your requirements with our technical support team.

A BREAK THROUGH IN COMPACT AHF TECHNOLOGY – THE SINEXCEL BLADE



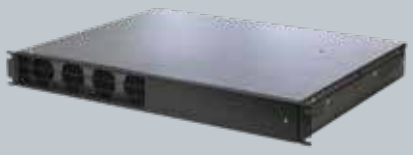
Finally a compact Active Harmonic Filter suitable for low power applications or distributed correction.
High power AHFs are used to correct harmonics at a centralised point – often the main switchboard. The Sinexcel Blade AHF is designed to allow for harmonic correction at the harmonic source – removing harmonic currents from all sub-circuits and associated switching devices, further protecting the installation from overloading and nuisance tripping.

To achieve this performance in such a compact frame the Sinexcel Blade utilises the latest power semi-conductor switching technology.

- Silicon Carbide semi-conductors allows switching frequencies of up to 90kHz – 4.5 times faster than traditional IGBT technology
- Harmonic filtering from the 2nd to 61st harmonic
- Ultra-compact size allows for easy installation
- Fast switching technology results in an almost pure sine wave output with minimal filtering required
- Configuration over WiFi
- Available in 5A, 10A, and 15A module

DIMENSIONS

5A, 10A and 15A Solutions



5A, 10A and 15A Rack-Mounted or Wall-Mounted
45W x 325D x 400H (mm)
Weight: 5kg

25A and 35A Solutions

25A and 35A Rack-Mounted AHF
440W x 470D x 150H (mm)
Weight: 18kg

25A and 35A Wall-Mounted AHF
440W x 150D x 470H (mm)
Weight: 18kg

NOTE: Wall mount units are supplied with a top cover. Allow a further 130mm in height

50A and 60A Solutions

50A and 60A Rack-Mounted AHF
440W x 585D x 190H (mm)
Weight: 35kg

50A and 60A Wall-Mounted AHF
440W x 190D x 585H (mm)
Weight: 35kg

NOTE: Wall mount units are supplied with a top cover. Allow a further 130mm in height

75A Solutions

75A Rack-Mounted AHF (available in both hardwired and pluggable)
500W x 560D x 195H (mm)
Weight: 43kg

75A Wall-Mounted AHF
500W x 195D x 560H (mm)
Weight: 43kg

NOTE: Wall mount units are supplied with a top cover. Allow a further 140mm in height

100A Solutions

100A Rack-Mounted AHF
440W x 555D x 230H (mm)
Weight: 43kg

100A Wall-Mounted AHF
440W x 230D x 555H (mm)
Weight: 43kg

NOTE: Wall mount units are supplied with a top cover. Allow a further 140mm in height

150A Solutions

150A Rack-Mounted AHF
500W x 560D x 270H (mm)
Weight: 62kg

150A Wall-Mounted AHF
500W x 287D x 555H (mm)
Weight: 62kg

NOTE: Wall mount models are supplied with a top cover. Allow a further 130mm in height

200A and 300A Solutions

200A and 300A Rack-Mount AHF
590W x 690D x 370H (mm)
Weight: 110kg

200A and 300A Wall-Mount AHF
590W x 370D x 692H (mm)
Weight: 110kg

NOTE: Wall mount models are supplied with a top cover. Allow a further 300mm in height

Cabinets

We have a wide variety of cabinets to house the rack-mount AHF modules. These cabinets can house a combination of modules up to a capacity of 900amps with options for top or bottom entry, rear or top airflow exhaust, inclusion of main switch or MCCB, bus coupling between cabinets and IP20 or IP54 design.

Please refer to our separate cabinet brochure for details.

Power Electronics NZ's power quality division represents the innovative Active Harmonic Filters and Static VAR Generators from international market leader Sinexcel. Sinexcel is the world's largest supplier of Active Harmonic Filters and Static Var Generators and leads the field in performance and design.

With an R&D centre of more than 180 people, and a manufacturing centre of more than 35,000 square meters, Sinexcel is a high-tech enterprise. It specializes in intelligent power quality technologies and concentrates on delivery of high quality products. Focused on customer support and service, Sinexcel is a great fit with Power Electronics New Zealand.

POWER ELECTRONICS®

www.power-electronics.co.nz

Power Electronics NZ Ltd

Christchurch Head Office
14B Opawa Road
PO Box 1269
Phone 03 379 9826
Fax 03 379 9827

Central Branch
Unit 1, 105 Ford Rd
Ford Road Business Park
Onekawa, Napier
Phone 06 845 9067

Northern Branch
16 Aranui Road
Mt Wellington, Auckland
Phone 09 527 8523

NZ Enquiries 0800 873 435 **sales@power-electronics.co.nz**