

GENERIS

TECHNICAL DOCUMENT



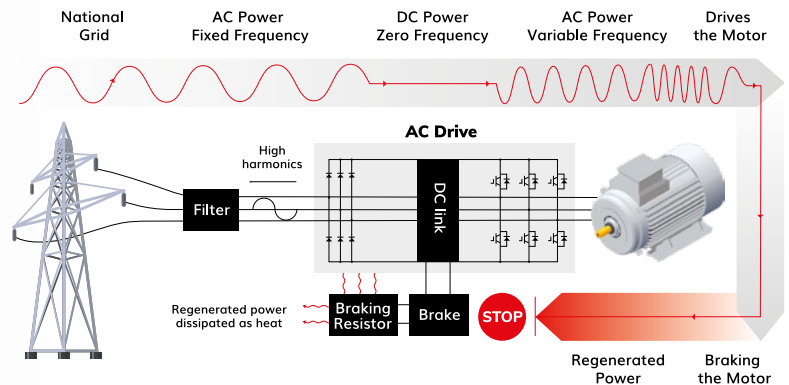
ADVANCED AC TECHNOLOGY

The Generis AC drive includes advanced technology that increases system efficiency, reduces supply current harmonics and allows continuous bi-directional power flow.

What is a traditional AC drive?

A traditional AC drive, or inverter, takes the three-phase AC mains and converts it into a DC voltage with a combination of a rectifier and smoothing capacitors. This 'DC link' voltage is then chopped at high frequency to synthesise a variable voltage, variable frequency supply to the motor.

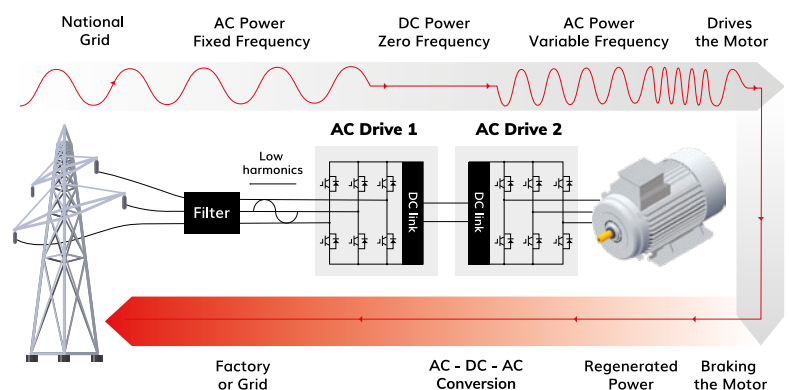
This circuit (pictured right) is fundamental to conventional inverters but it has a serious limitation: the drive cannot export power to the grid; it is prevented by the input rectifier diodes. If the motor is braked or overhauled, the current returned to the drive has nowhere to go and it pumps up the DC link voltage. Left unchecked this would destroy the DC link capacitors and so the usual solution is to dissipate the energy in a brake resistor. This is wasteful and reduces system efficiency.



Regenerating energy with TWO AC drives

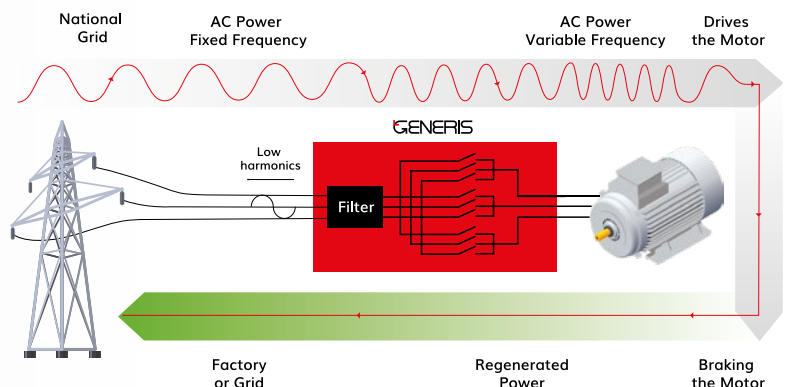
One way to recover the wasted energy is to add an 'Active Front End' (AFE) in front of the drive creating what is effectively two inverters back-to-back. However, there is still an intermediate DC link stage, making the solution both bulky and costly.

Moreover, to control the input current harmonics a large choke (typically around 5%) is required on the input side. This adds more cost and complexity to the system.



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The Generis AC drive doesn't have a DC link. It uses nine bidirectional power semiconductor switches and high-speed Digital Signal Processing (DSP) techniques to synthesize the AC output waveforms. With no DC link, power can be transferred in both directions through the converter with no need for braking resistors or the addition of a second inverter to return energy to the supply. Torque and speed can be continuously controlled in all four quadrants of operation.



UNITY POWER FACTOR

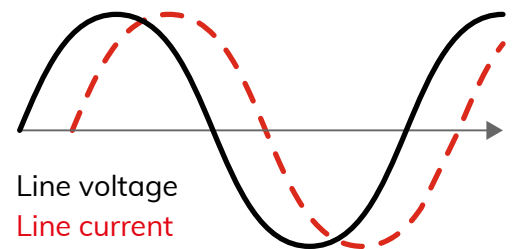
What is power factor?

Power factor is the ratio of volt-amperes (VA) to watts (W): $PF = \frac{VA}{W}$

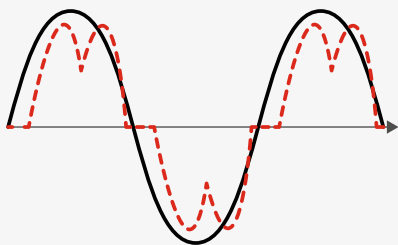
Ideally $PF = 1$ (unity) but in conventional inverters the power factor is reduced for two reasons:

1. The current lags the voltage
2. Harmonics in the current

A power factor less than unity means that load has to consume more current to deliver the power required. This creates loss in the system, making it less efficient.



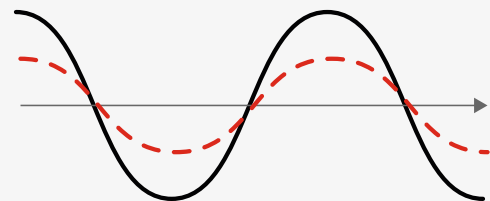
Traditional AC drive



The wave form of a traditional AC drive, it is not only out of phase but also heavily distorted, resulting in significant losses.

VS

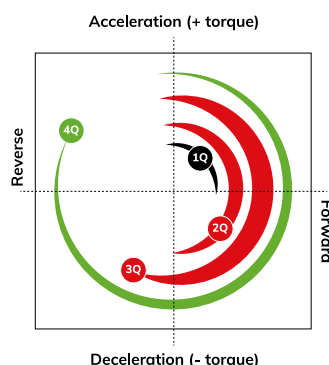
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In a Generis AC drive, the input current is controlled to be both sinusoidal and in-phase with the voltage – it operates at unity power factor. This is true in motoring and regenerating modes of operation.

4Q (4 QUADRANT)

4 Quadrant (4Q) control means that the drive can control motor torque in both directions of rotation – a vital characteristic in industrial applications. This is commonly available with DC drives but Generis brings true 4Q operation to the AC drive domain.

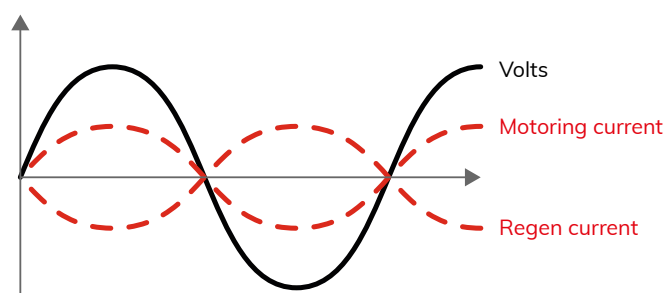


TECHNOLOGY FEATURES

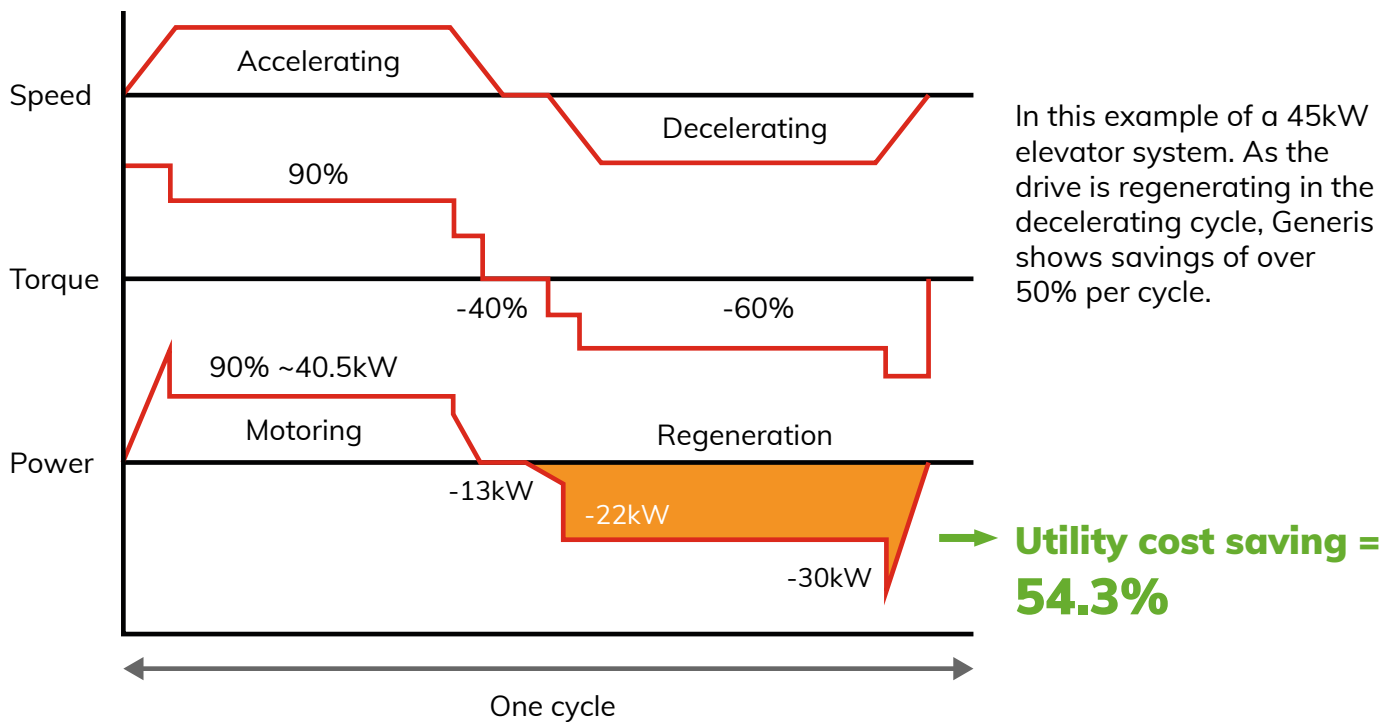
- Continuous bi-directional power control
- No DC link capacitor
- Single-stage converter
- Low input current harmonics

FULL CONTROL OF POWER IN BOTH DIRECTIONS

Generis controls the input current to be either in-phase with the supply voltage (motoring) or in anti-phase with the supply voltage (regenerating).

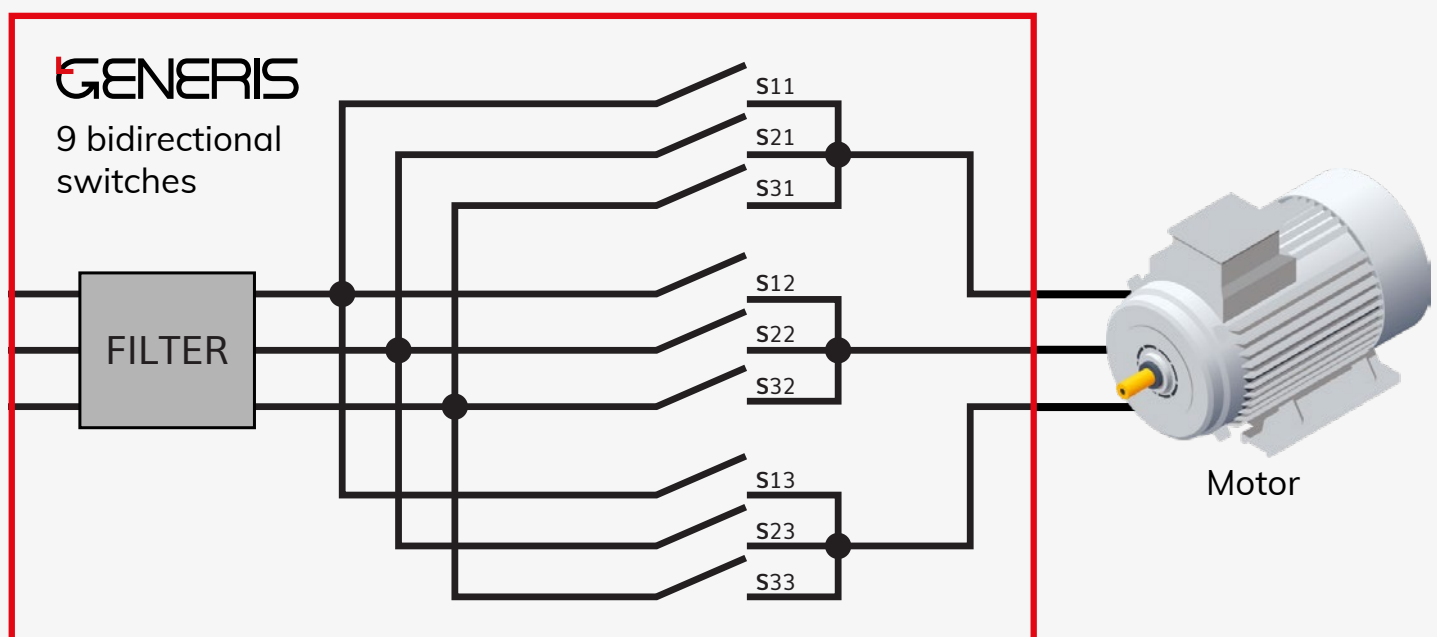


CASE STUDY: 45kW ELEVATOR SYSTEM WITH REGENERATIVE POWER



PERFECT LOAD SHARING

The configuration of the 9 bidirectional switches means that the load is shared over all 9 switches regardless of the output voltage generated.



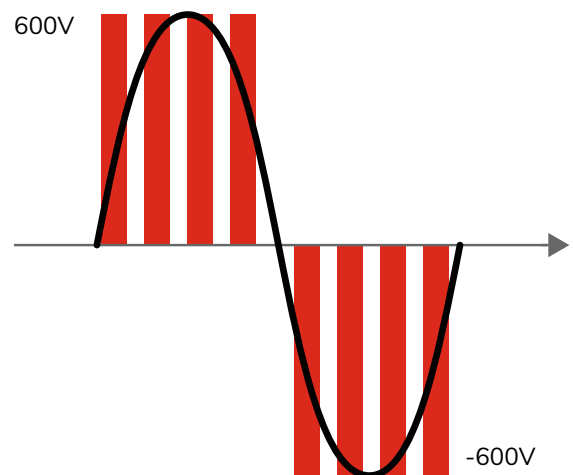
PERFECT LOAD SHARING FOR LOW SPEED CONTROL

- Any input phase can connect to any output phase
- Current cycles around the devices at mains frequency
- No derating at low or zero speeds
- Full motor torque available at zero speed indefinitely

DRIVE OUTPUT COMPARISON

Traditional ac drive output - 3, 6, 9 kHz

An inverter generates its output voltage by modulating the DC link voltage at high frequency. This voltage is typically around 600V and every switching event occurs at this voltage.



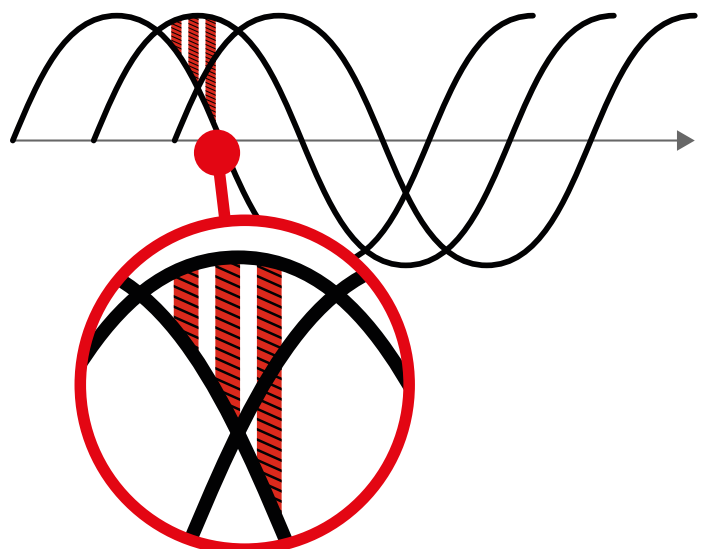
VS

GENERIS Output - 10 kHz fixed

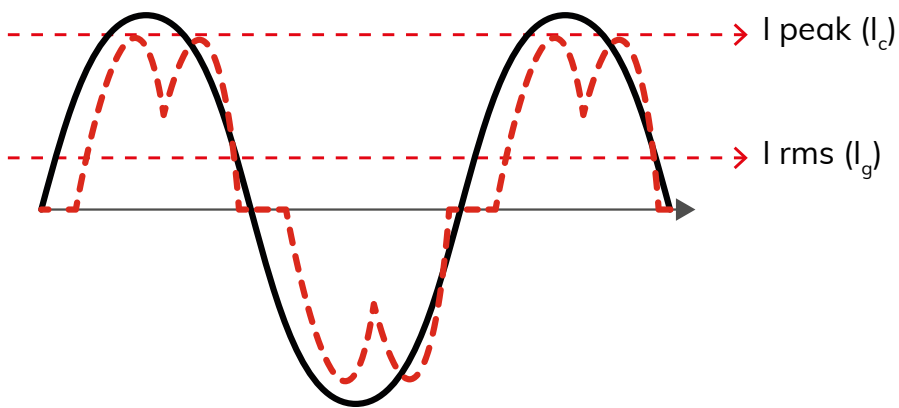
The Generis AC drive generates its AC output by switching between input phases.

This has the following advantages:

- Reduced switching stress
- Lower dv/dt leading to lower EMI
- Longer cable runs
- Lower audible noise



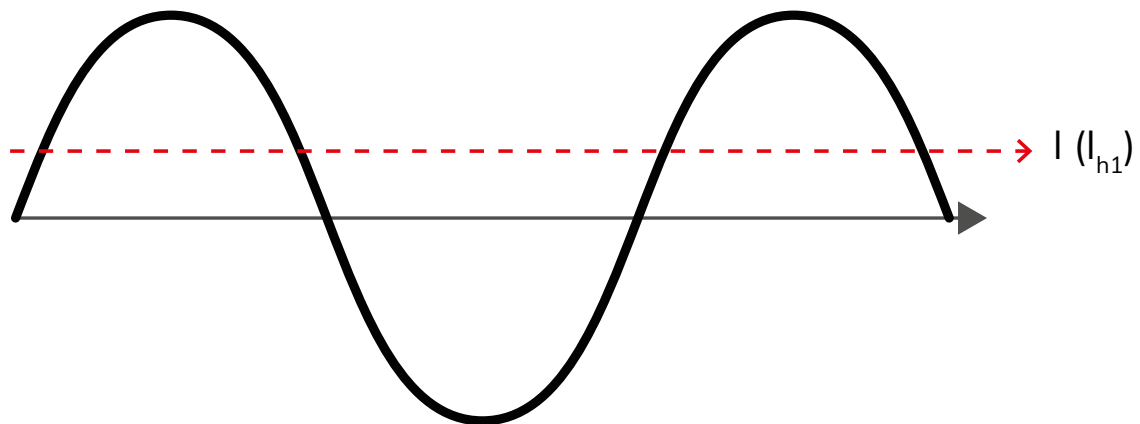
HARMONIC DISTORTION OF A TRADITIONAL THREE PHASE AC DRIVE



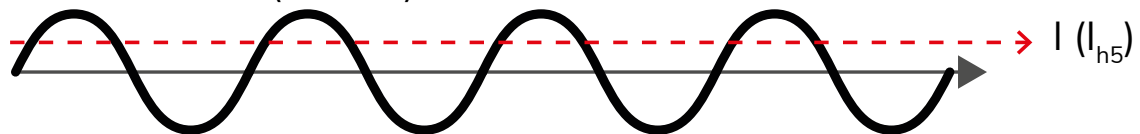
The diode rectifier in an inverter distorts the input current resulting in harmonic currents that contribute no power to the load, just I^2R loss in the cabling and switchgear.

The largest harmonic distortions are the 5th, 7th, 9th, 11th and 13th harmonic. The Generis AC Drive produces significantly reduced levels of these harmonics

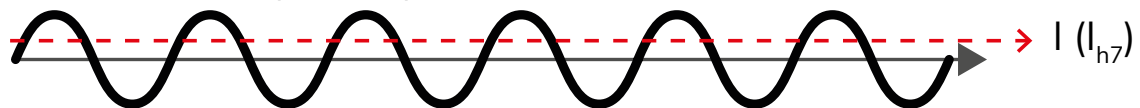
Fundamental 50Hz



5th Harmonic (250Hz)



7th Harmonic (350Hz)



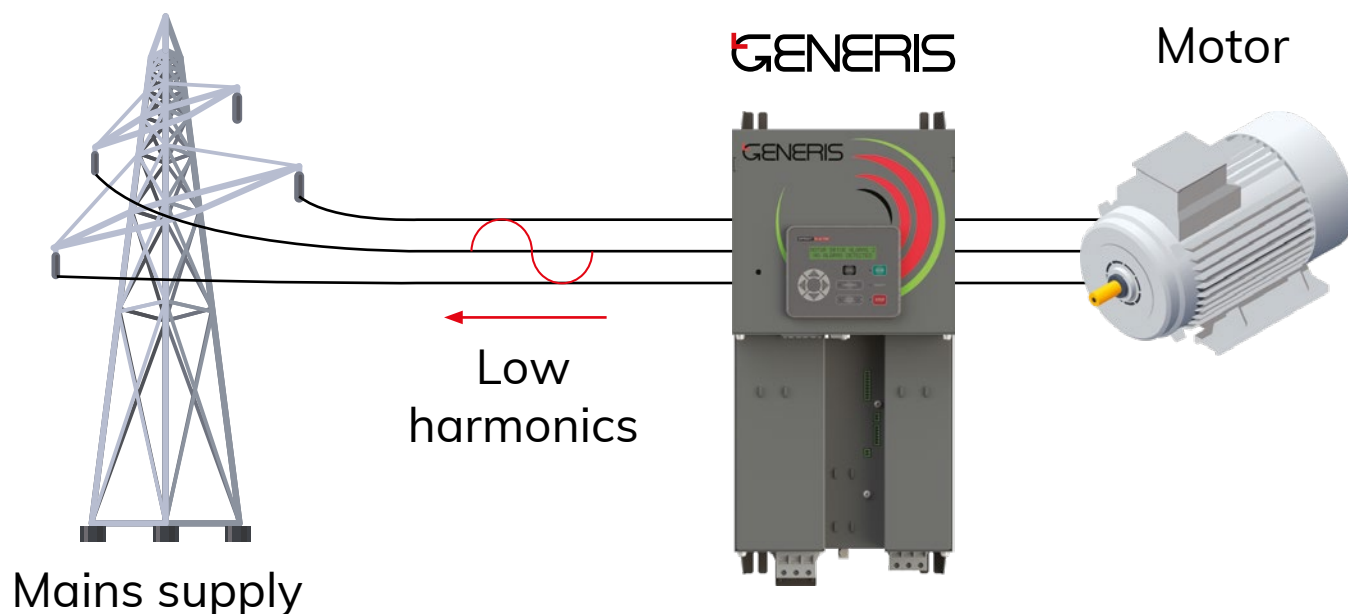
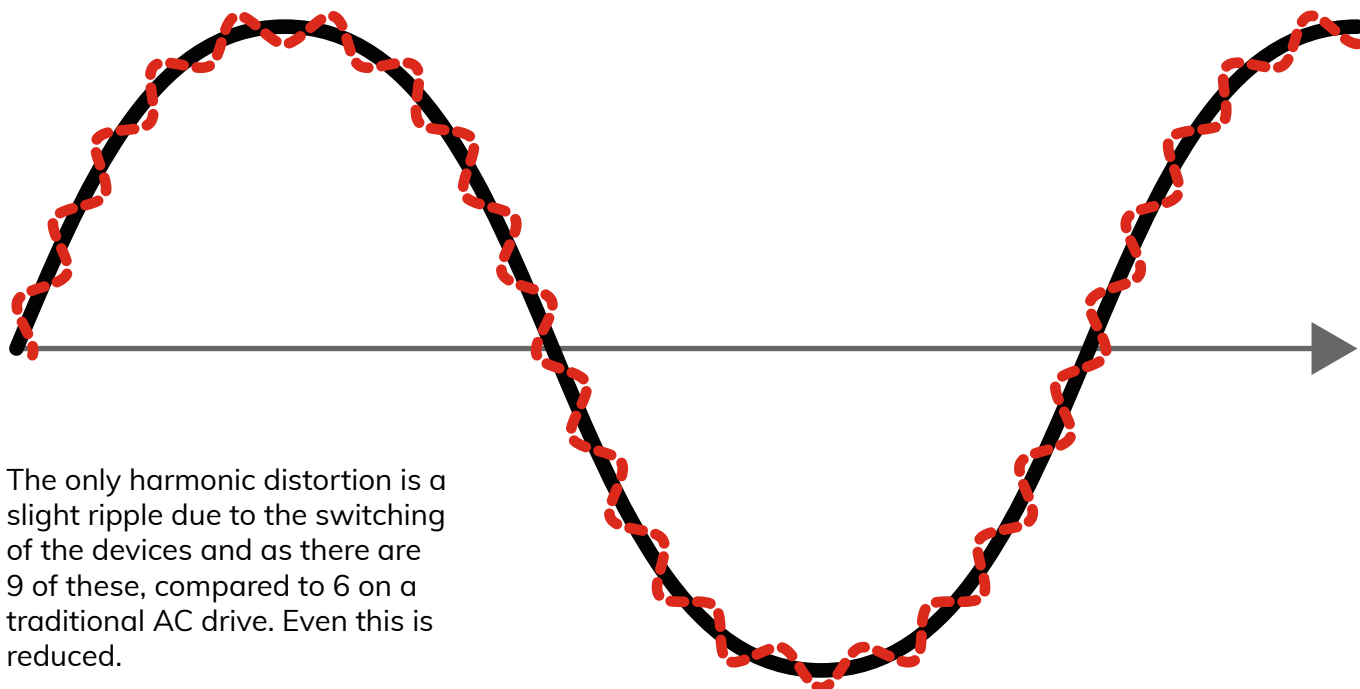
11th Harmonic (550Hz)



13th Harmonic (650Hz)



GENERIS - 9 SWITCHES LOWERS HARMONIC DISTORTION



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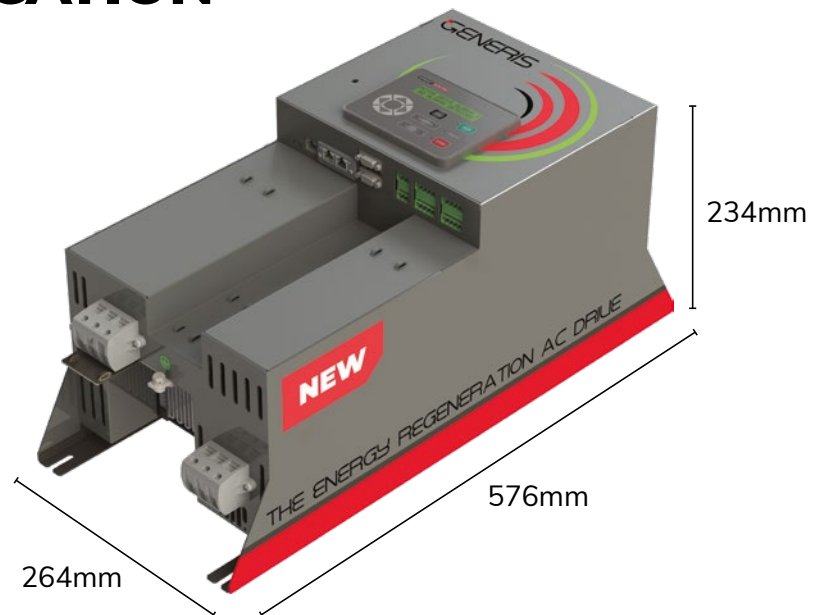
PRODUCT SPECIFICATION

22kW Frame 1

Weight 22kg

Features include:

- Single or dual encoder
- Supports all major fieldbus types
- Removable operator station
- Safe torque off
- Auxiliary power input
- Multiple motor types supported
- Configurable application blocks
- Comprehensive set of user I/O
- 40 character two line text display

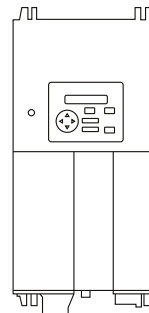


Frame 1

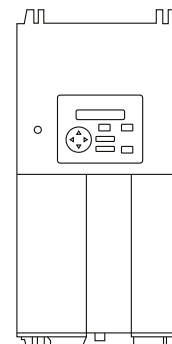
This is the build for frame 1 which takes us up to 22kW, shortly followed by three other frames and take us to 200kW.



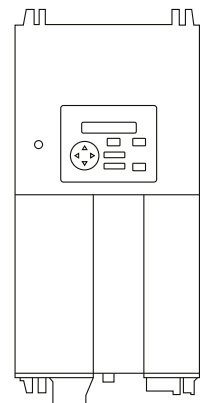
Size 1 - 22kW



Size 2 - 55kW

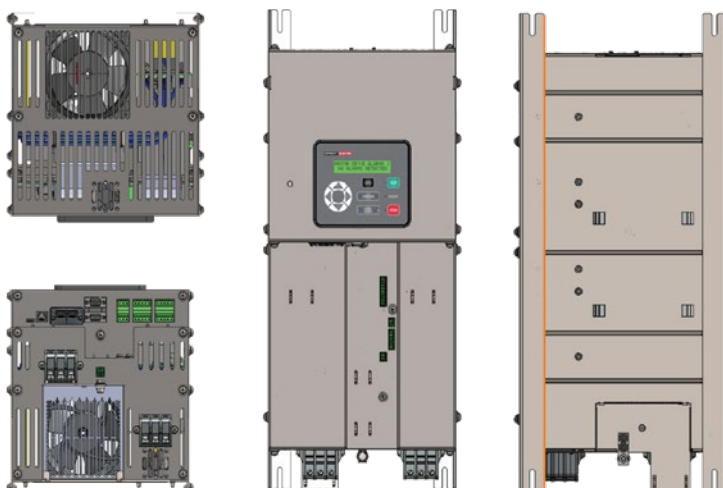


Size 3 - 90kW



Size 4 - 200kW

Frame 1 Views



Generis is packed with additional functionality. It is a fully intelligent AC drive. It has multiple analogue and digital inputs and outputs and these are all programmable. It has an IP55 rated remote operator station as well as single or dual encoder inputs and full comms capability. It is a fully programmable drive and includes a number of specific function blocks to allow it to be matched to most applications.

CONNECTIVITY

On-board webserver facilitates easy set up with no internet connection or software downloads required. Industry 4.0 connectivity is provided for remote commissioning, fault finding and firmware updates. The optional data streaming service to Generis Analytics facilitates cloud based monitoring, process optimisation and preventative maintenance.



GENERIS ANALYTICS



Generis Configuration

Only requires a web browser for web pages served up by the on-board Generis webserver.

No software download required and no internet connection necessary.

Data Collection

- Drive/motor temperature
- Supply frequency
- Motor speed
- Supply voltage
- Feedback optics

Ratings

Power configuration

- Four quadrant regenerative
- 380 – 500Vac, three-phase, 50/60Hz
- Auxiliary 24VDC input (optional)
- Internal EMC filter

Environment

- Ambient 0–50°C (derate above 40°C)
- Storage -25 to +55°C

Power rating

- 7.5, 11, 15, 18.5, 22kW

Current rating

- Normal duty: 16, 23, 32, 38, 45A; 110% overload for 30 seconds
- Heavy duty: 12, 16, 23, 32, 38A; 150% overload for 30 seconds

Output voltage/frequency

- $V_{out} = \leq 0.86 V_{in}$
- $f_{max} = 200\text{Hz}$

Speed / Accuracy

- 2% in Open-loop V/f
- 0.02% in closed-loop vector

Enclosure

- IP20
- Air-cooled with temperature controlled fans
- Keyhole slot mounting
- Two-part control connections

Operator station

- IP55
- Chassis or panel-mounting
- 2 x 20-character backlit LCD
- Four key menu navigation
- Local/remote modes
- Dedicated Run/Jog/Stop keys
- Direction and health indications

Standards

- EN 61800-5-1:2007 (CE - Low Voltage Directive)
- EN 61800-3:2017 (CE- EMC)
- EN61800-5-2:2017 (STO)
- UL 61800-5-1 (UL)

Protection

- Thermal fold-back
- Instantaneous over-current
- Motor over-temperature
- Heatsink over-temperature
- Mains supply loss
- Mains synchronisation loss
- Stall protection
- Standstill logic
- Fan fail
- Digital/analogue output short-circuit
- Digital/analogue input over-voltage (to 30VDC)

Analogue inputs

- 3 x $\pm 10\text{V}$ configurable reference supplies (10mA maximum)
- 1 x 4/20mA or $\pm 10\text{V}$ configurable reference

Analogue outputs

- $\pm 10\text{V}$ range
- Two configurable

Digital inputs

- 24V logic
- Current sinking
- Four dedicated: Run, Stop, Jog, Coast Stop
- Four configurable
- Seven configurable
- One configurable Coast Stop
- Dedicated coast stop

Digital outputs

- 24V logic
- Current sourcing (400mA maximum)
- Five configurable

Relay outputs

- 240VAC volt-free contacts
- Two configurable

Encoder inputs

- Single or dual incremental encoder inputs
- A, B and Marker
- Differential or single-ended
- 5, 12 or 24V (software selectable)
- Single / dual incremental encoder inputs

Motor temperature

- 1x PT100 input
- External sensor required

Safe torque off (STO)

- 2 x 24V input channels
- 1 x status output
- SIL3/PLe compatible

Software functions

Motor control

- Open-loop V/f and closed-loop vector modes
- Controls induction and permanent magnet motors
- Torque and speed control
- Constant torque and constant power modes
- Current loop autotune

Application functions

- Linear or S-ramp
- Brake control
- Jog/Crawl/Slack
- 2 x PIDs
- 4 x summer blocks
- 4 x filter blocks
- 10 x comparators
- 10 x changeover switches
- Latch
- 4 x Batch counters
- 10 x Interval timer
- 40 x Maths function blocks
- 40 x Logic function blocks

Diagnostics

- Motor current/voltage/speed/power
- AC supply voltage/frequency
- Heatsink temperature
- Motor temperature (external sensor required)
- User input voltages
- Run and powered hours

Interfaces

Communications

- USB-C
- Ethernet
- Modbus (through operator station port)
- CompactCom M40 Fieldbus options including PROFIBUS, PROFINET, EtherNet/IP, DeviceNet, EtherCAT, Modbus, CAN/CANopen & all major industrial networks

Programming

- Embedded webserver
- Configuration with standard web browser (Chrome, Firefox, Edge)
- Graphical programming
- drive.web option for distributed control
- Remote connection over the internet

Notes

Date: ____ | ____ | ____ | Time: ____

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SUMMARY

The Generis AC drive:

- Has no intermediate DC link or DC Rectifier
- Is highly efficient
- Gives full four quadrant performance
- Provides full torque and balanced load at low and zero speed
- Produces ultra-low harmonics
- Generates minimal mains distortion
- Fully programmable intelligent drive with analytics capability
- Is a brand-new product incrementing AC drive technology
- Smallest and lightest in class
- Easy to install
- 3ph in 3ph out

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