

4/8/2015

52nd Annual OTCO WW Workshop

W/WW Product Overview

ACQ550

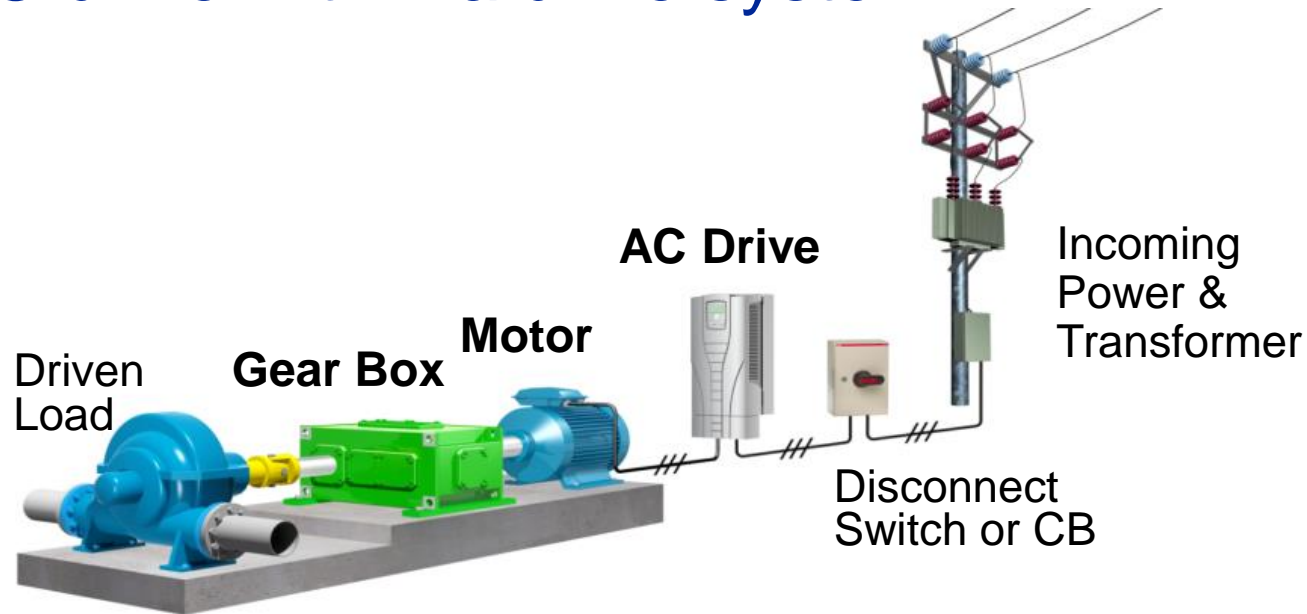
Drive Basics

- Why Use Adjustable Speed Drives?

- Reduced Energy Consumption
- Improved Process Control / Efficiency
- Increased Product Quality
- Expanded Automation / Integration
- Broader Equipment Flexibility / Versatility
- Increased Reliability / Availability
- Reduced Maintenance



AC drive within a drive system



AC Drive

- **Drive, Elec. Controller** – also known as VFD, ASD, Frequency
- Used control the **speed, torque** or **position** of an AC motor.
- The AC Drive regulates the motor frequency, current and voltage according to the requirements of the application.

AC Drive Systems include the drive, motor and transmission system

Applications, Applies to Centrifugal Type Loads

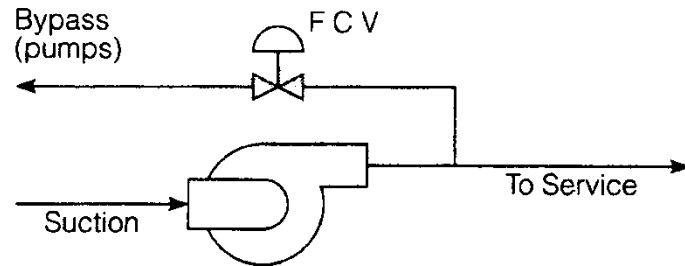
- Affinity Laws

- $Q \propto N$ flow rate proportional to rotary speed
- $H \propto N^2$ head (pressure) proportional to rotary speed squared
- $P \propto N^3$ power proportional to rotary speed cubed

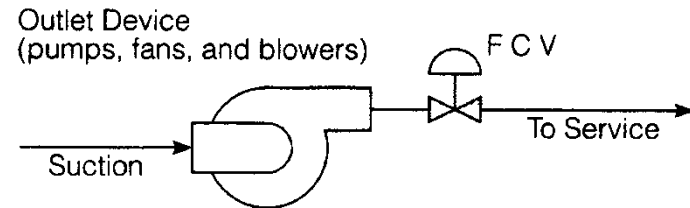
Applications, Types

Conventional Flow Control

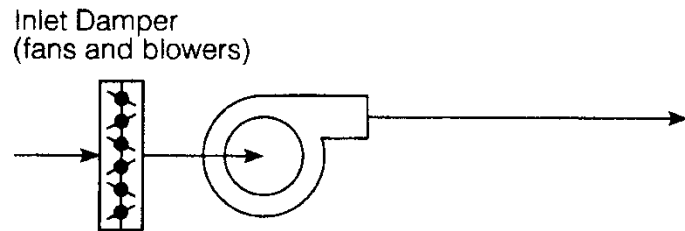
Bypass



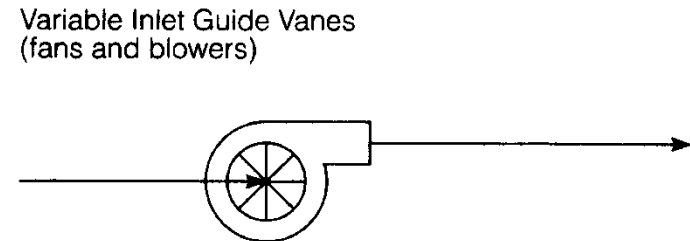
Outlet



Inlet



Inlet Vane



ACQ550

Product Information



- Motor control – scalar (V/Hz) and sensorless vector
- Unique pump control features
 - Default macro PID control
- Keypad unique to ACQ550
 - Special Start-Up Menu
 - Select pump type and required control
- Output frequency range 0 to 500Hz
- Switching frequency choices of 4/8/12 kHz
- 15 language choices
- EMC filter for CE compliance, 1st environment
 - Restricted through 200HP (wall-mount)

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ACQ550 Applications



- ACQ550 is specifically designed for water & wastewater applications:
 - Aerators
 - Belt presses
 - Conveyors
 - Mixers
 - Pumps of all types including:
 - Centrifugal pumps
 - Positive displacement
 - Submersible pumps

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ACQ550

Product Introduction



- Configurations:
 - ACQ550-U1 NEMA 1 Wall Mount
 - ACQ550-U1 NEMA 12 Wall Mount
 - ACQ550-PC Packaged with Circuit Breaker
 - ACQ550-PD Packaged with Disconnect
 - ACQ550-CC Packaged Two Contactor Bypass
 - ACQ550 Custom Drive Packages



ACQ550

Product Information



- Power range, wall mount
 - 1.0 to 100HP @ 240Vac
 - 1.5 to 200HP @ 480Vac
 - 2.0 to 150HP @ 600Vac
- Power range, packaged in enclosure
 - 1.0 to 100HP @ 240Vac
 - 1.5 to 550HP @ 480Vac
 - 2.0 to 150HP @ 600Vac
- Enclosure
 - UL Type 1 (NEMA 1) standard
 - UL Type 12 (NEMA 12) optional
 - NEMA, UL Type 3R optional

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ACQ550-U1

Product Information



- ACQ550-U1
 - 1 Through 200hp
 - Frames R1 through R6
 - 230/480 & 600 Volts available
 - NEMA 1 or NEMA 12 enclosures
 - Wall mount



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ACQ550-U1

Family Frame Sizes



- ACQ550-U1
 - Available options
 - Communication (Field Bus)
 - Extended I/O
 - Submersible pumps
 - Flange mounting kits



Enclosure Options



- Allows protection of equipment based in the installed environment
- NEMA 3R
 - Indoor / Outdoor Operation
 - Protection against the elements (rain & snow)



NEMA 3R
Wall Mount

PC – Packaged Enclosures

- NEMA 1 or 12 Construction
- Wall or Floor Mounting



NEMA 1
Wall Mount



NEMA 12
Floor Mount



NEMA 1
Floor Mount

ACQ550

Product Information



- ACQ550-CC = Two contactor bypass with optional service disconnect
 - 1 through 200hp wall mount
 - 250-550 HP floor standing
 - Enclosure types 1,12, and 3R
 - Pre-defined configurations
 - Communication options
 - Submersible pumps
 - 3R stainless steel
 - Common start or auto-bypass



Bypass – Standard Features



- Classic 3-Contactor Bypass
 - 1.0 to 100HP @ 240Vac
 - 1.5 to 400HP @ 480Vac
 - 2.0 to 150HP @ 600Vac
- Enclosure
 - UL Type 1 (NEMA 1)
 - UL Type 12 (NEMA 12)
 - NEMA, UL Type 3R
- Standard Features
 - Advanced Control Panel
 - Embedded Fieldbus (Modbus RTU)
 - Circuit Breaker Disconnect, Service & Drive-Off-Bypass Switches
- Optional Features
 - Hand-Off-Auto Switch
 - Drive, Bypass, External/MOL Fault Pilot lights



ACQ550 Product Features



- I/O structure
 - 2 AIs, 6 DIs, 2 AOs, 3 ROs
 - All ACQ550 units have the same customer interface regardless of power rating, voltage or enclosure (UL, NEMA or IP-class)
- Harmonics
 - 5% equivalent impedance with internal reactor(s)
 - Patented swinging choke design for superior harmonic mitigation (R1-R6)
 - 3% equivalent Impedance (R8)

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ACQ550 Standard Embedded Communications



- ACQ550 has an embedded industrial fieldbus protocol as standard:
 - Modbus RTU
- EIA-485 (RS-485) baud rate up to 115.2k
- Provides compatibility
 - Fieldbus technology makes more cost-effective installation possible
 - Feedback and local I/O advantages to industrial automation systems

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“R” Series Module

- Protocols available as internal options
 - Modules can plug into the fieldbus connector
 - Module power is provided by the drive – no external power supply needed
 - Multitude of protocols:
 - DeviceNet, Profibus-DP, ControlNet, Ethernet-IP, CANopen, PROFINET I/O
- Provide compatibility
 - Fieldbus technology makes a more cost-effective installation possible

Options - Hardware



- Option slot 1 for:
 - Relay option module
- Option slot 2 for:
 - Fieldbus modules
 - 115/230V digital input interface card

- Panel mounting kit

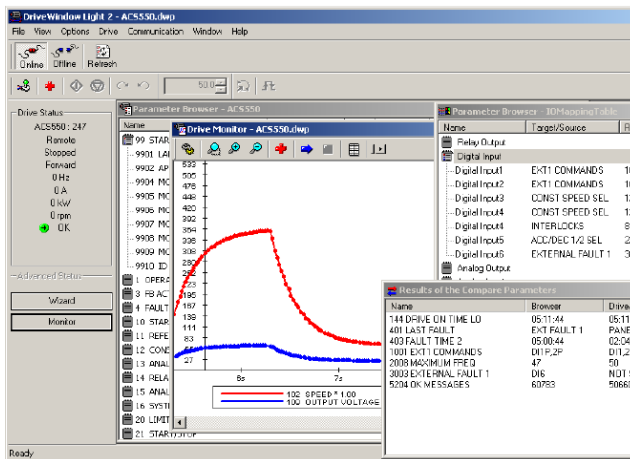
- NEMA 4X (IP66) cabinet panel mounting kit



ACQ550 Operator Interface



- Full-featured Control Panel:
 - Hand/Off/Auto Control
 - Compatible only with ACQ550



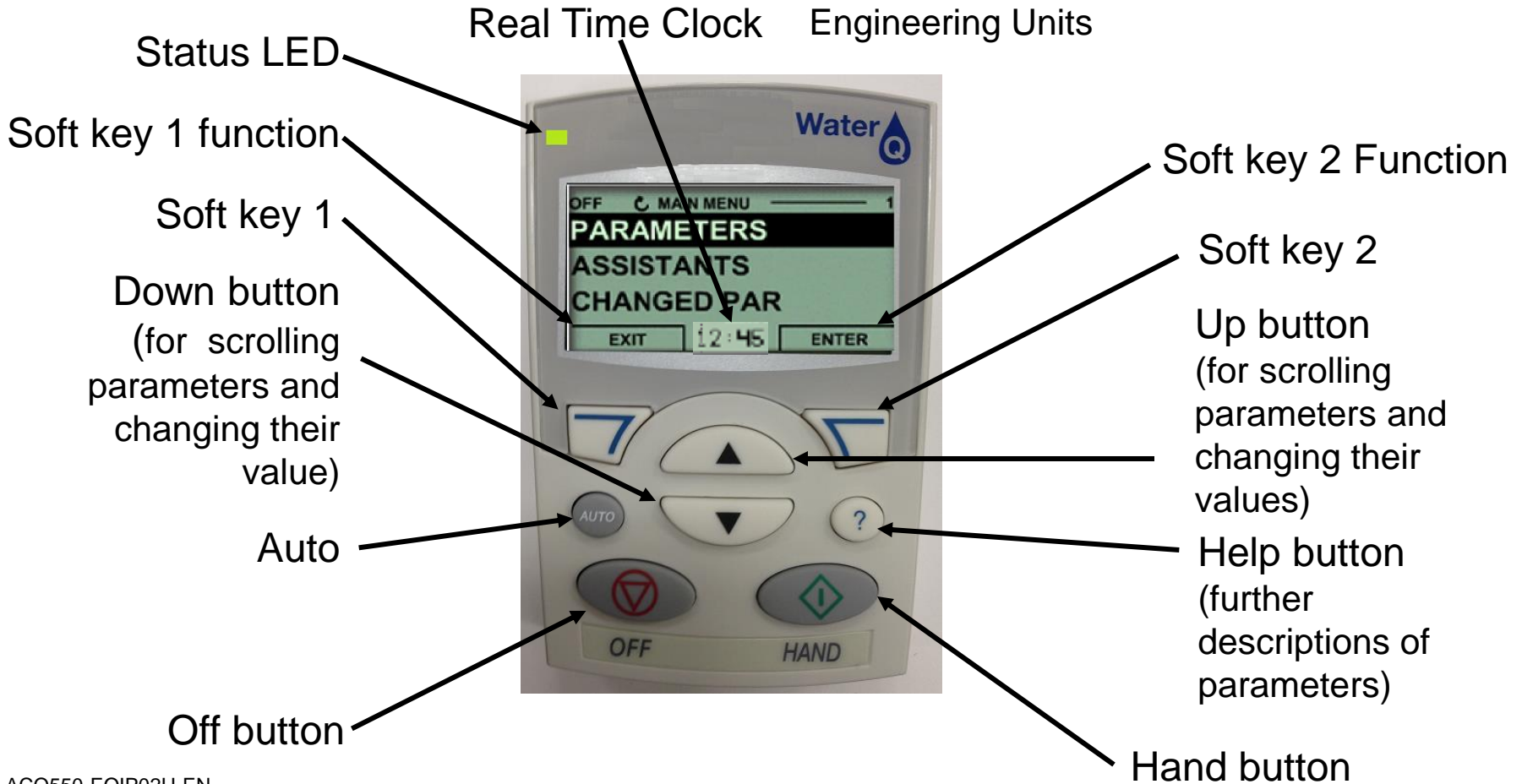
- Drive Window Light (option)
 - Commissioning & maintenance
 - Clear, graphical presentation, with direct & offline modes
 - Back-up values, trending

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ACQ550 Control Panel Use



Full Graphic Display
Back-lit LCD
Up to 3 actual values
Engineering Units



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ACQ550 Control Panel – Additional Features



- Hand control controls the drive using the keypad
 - Up and down arrows control speed.
 - Hand key starts the drive.
 - Off key stops the drive.
 - Auto key runs the process remotely.
- Auto control means externally programmed functions, such as analog and digital inputs, have control
 - Keypad can be used in Remote mode with external signals
- Drive will fault if keypad is defined as a controlling signal in either Hand or Auto and keypad is removed (panel loss)
- Local lock can be used to disable keypad control buttons

ACQ550

Overview of Control Panel Features



- Alphanumeric control panel with backlit LCD display
 - Easy monitoring – four-line display
 - Three selectable actual values displayed simultaneously
- Supports
 - Start-up Assistant
 - Fault indications with time stamp
 - Hand / OFF/ Auto control
- Removable: connection with CAT5 cable
- Parameter upload/download (copy)

ACQ550

Drive Control Panel Assistants



LOC MAIN MENU — 1
PARAMETERS
ASSISTANTS
CHANGED PAR
EXIT 00:00 ENTER

LOC ASSISTANTS — 1
Start-up assistant
Motor Set-up
Application
Speed control EXT1
Speed control EXT2
EXIT 00:00 SEL

LOC PAR EDIT —
9905 MOTOR NOM VOLT
220 v
EXIT 00:00 SAVE

LOC CHOICE —
Do you want to
continue with
application setup?
Continue
Skip
EXIT 00:00 OK

LOC PAR EDIT —
9905 MOTOR NOM VOLT
240 v
EXIT 00:00 SAVE

LOC HELP —
Set as given on the
motor nameplate.
Voltage value must
correspond to motor
D/Y connection.
EXIT 00:00

- Assistants Menu allows choice of 13 user-friendly startup assistants to guide the user through the setup procedure, such as:
 - Motor setup
 - Pump setup
 - Submersible
 - Centrifugal
 - Positive displacement
 - Drive application macros
 - Output signals
 - Time functions
 - Serial communication

ACQ550

Product Features



- Seven application macros
 - ABB 2-Wire
 - 3-Wire
 - PID
 - PFC
 - Hand / Auto
 - Motor Potentiometer
 - Alternate

ACQ550

Performance Features



- Two independent PIDs
 - Closed loop process control can be done within the drive (no external PID controller required)
 - Sleep and boost functionality are a part of the PID algorithm
- PFC macro with the ability to control five pumps
- Startup assistant for easy programming
- Maintenance assistant
 - Activated based on time or event triggers to display preventative maintenance recommendations
- Automatic noise reduction
- Motor thermistor input (both PT100 and PTC)
- On/Off controlled cooling fan

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ACQ550

Performance Features



Group 81: PFC CONTROL

This group defines a Pump-Fan Control (PFC) mode of operation. The major features of PFC control are:

The ACQ550 controls the motor of pump no. 1, varying the motor speed to control the pump capacity. This motor is the speed regulated motor.

Direct line connections power the motor of pump no. 2 and pump no.3, etc. The ACQ550 switches pump no. 2 (and then pump no. 3, etc.) on and off as needed. These motors are auxiliary motors.

The ACQ550 PID control uses two signals: a process reference and an actual value feedback. The PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference.

When demand (defined by the process reference) exceeds the first motor's capacity (user defined as a frequency limit), the PFC control automatically starts an auxiliary pump. The PFC also reduces the speed of the first pump to account for the auxiliary pump's addition to total output. Then, as before, the PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference. If demand continues to increase, PFC adds additional auxiliary pumps, using the same process.

When demand drops, such that the first pump speed falls below a minimum limit (user defined by a frequency limit), the PFC control automatically stops an auxiliary pump. The PFC also increases the speed of the first pump to account for the auxiliary pump's missing output.

An Interlock function (when enabled) identifies off-line (out of service) motors, and the PFC control skips to the next available motor in the sequence.

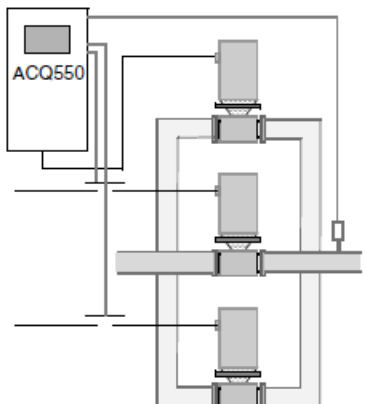
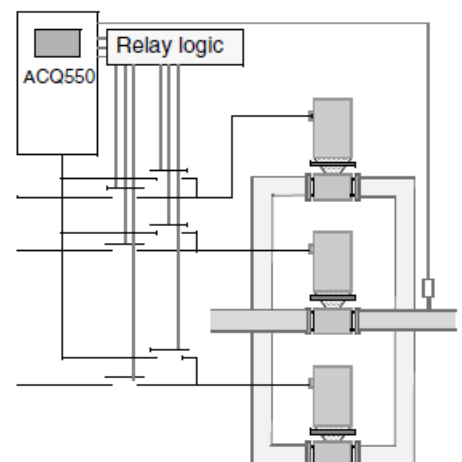
An Autochange function (when enabled and with the appropriate switchgear) equalizes duty time between the pump motors. Autochange periodically increments the position of each motor in the rotation – the speed regulated motor becomes the last auxiliary motor, the first auxiliary motor becomes the speed regulated motor, etc.

ACQ550

Performance Features



Group 81: PFC CONTROL

Code	Description
8117	<p>NR OF AUX MOT</p> <p>Sets the number of auxiliary motors.</p> <ul style="list-style-type: none"> Each auxiliary motor requires a relay output, which the drive uses to send start/stop signals. The Autochange function, if used, requires an additional relay output for the speed regulated motor. The following describes the set-up of the required relay outputs. <p>Relay outputs</p> <p>As noted above, each auxiliary motor requires a relay output, which the drive uses to send start/stop signals. The following describes how the drive keeps track of motors and relays.</p> <ul style="list-style-type: none"> The ACQ550 provides relay outputs RO1...RO3. An external digital output module (OREL-01) can be added to provide relay outputs RO4...RO6. Parameters 1401...1403 and 1410...1412 define, respectively, how relays RO1...RO6 are used – the parameter value 31 PFC defines the relay as used for PFC. The ACQ550 assigns auxiliary motors to relays in ascending order. If the Autochange function is disabled, the first auxiliary motor is the one connected to the first relay with a parameter setting = 31 PFC, and so on. If the Autochange function is used, the assignments rotate. Initially, the speed regulated motor is the one connected to the first relay with a parameter setting = 31 PFC, the first auxiliary motor is the one connected to the second relay with a parameter setting = 31 PFC, and so on. <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>Standard PFC mode</p> </div> <div style="text-align: center;">  <p>PFC with Autochange mode</p> </div> </div> <ul style="list-style-type: none"> The fourth auxiliary motor uses the same reference step, low frequency and start frequency values as the third auxiliary motor.



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ACQ550-U1 User's Manual
Parameters

Group 45: ENERGY SAVING

This group defines the setup of calculation and optimization of energy savings.

Note: The values of saved energy parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 and 0178 SAVED CO2 are derived from

subtracting the drive's energy consumed from the direct-on-line (DOL) consumption calculated on the basis of parameter 4508 PUMP POWER. As such, the accuracy of the values is dependent on the accuracy of the power estimate entered in that parameter.

Protection Functions



- Over-current
- DC over-voltage
- DC under-voltage
- Heat sink over-temperature
- Motor over-temperature
- Short circuit
- AI loss
- Panel loss
- Motor stalls
- Underload
- Overspeed
- Supply phase loss
- Motor phase loss
- Ground faults

In Addition:

Numerous diagnostic functions relating to configuration, communication and to the system
Internal limits and triggers to activate a fault message



ACQ550 Product Compliance



- ACQ550 complies with IEC/EN 61800-3 EMC products standard requirements in:
 - Category C2 (1st environment) with 75-3000m cable length
 - Category C3 (2nd environment) with 100-3000m cable length
- Approvals CE, UL, cUL, C-tick
 - Compliance with:

Low Voltage Directive 73/23/EEC with supplements
EMC Directive 89/336/EEC with supplements
RoHS directive 2002/95/EC with amendments

Quality assurance system ISO 9001
Environmental system ISO 14001
Machinery Directive 98/37/EC

- Applicable Standards:

IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency AC power drives
IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements
EN 60529 (1991 + corrigendum May 1993 + amendment A1:2000) Degrees of protection provided by enclosures (IP code)
IEC/EN 61800-3 (2004) - EMC product standard including specific test methods
UL 508C UL - Standard for Safety, Power Conversion Equipment, second edition

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