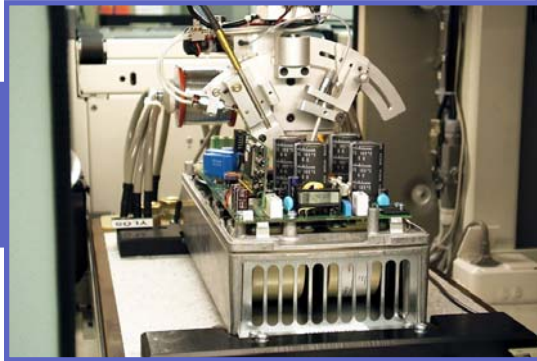ACH550 Launch

Jan 17-19 2005

ACH 550 Adjustable Frequency Drives for Commercial Applications

ABB

- **High Energy Savings**
  - High power factor
  - More efficient than other methods of speed or flow control

- **Reduced Capital Costs**
  - High displacement power factor frees up transformer capacity
  - Soft start frees up capacity

- **Operating Benefits**
  - More stable, finer flow, less violent
  - Less noise
  - More comforts

Benefits of using VFDs

- Lower Maintenance Costs

  - Less wear and tear on pump , motor , piping, throttling valve, ducting

  - No discharge valve slamming or wear

  - Less vibration damage

  - Soft start reduces wear and tear, no six times rated inrush current

  - Increased life expectancy of hardware

- Automatic Control

  - Auto Restart after power outage

  - Power loss ride through

  - Continuous fine variable speed control

VFD Applications

- Fans
- Pumps
- Cooling Towers
- Chillers
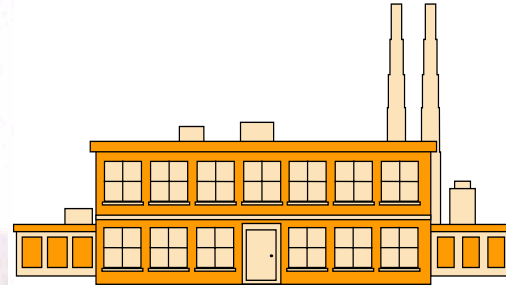
VFD Applications - Fans
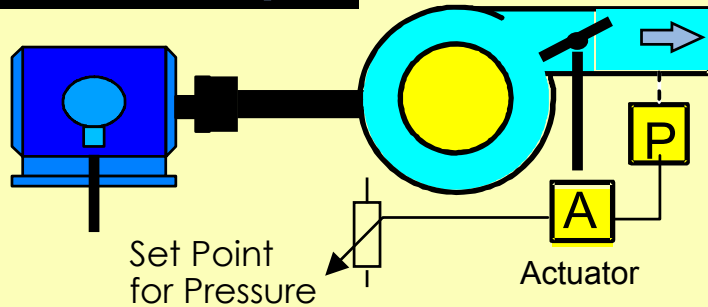
- **Supply & Return Fans**
  - Variable Air Volume
    - Inlet Guide Vanes
    - Outlet Dampers
    - Variable Pitch Vaneaxial
  - Exhaust fans
  - Condenser fans
  - Recirculation Fans
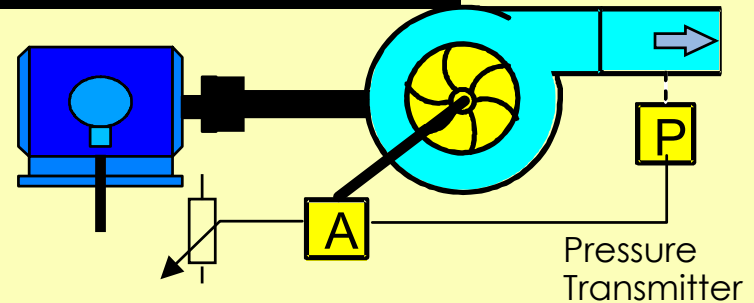 - Make-up Air fans
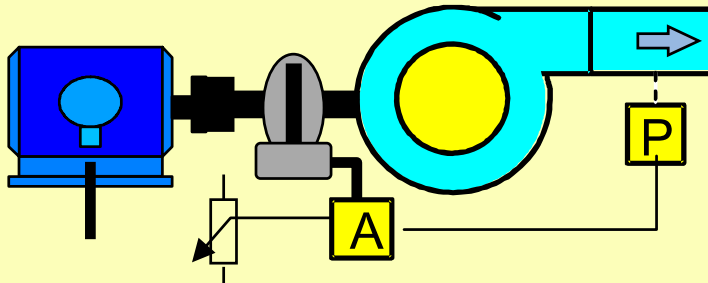 - Combustion fans

Air Volume Control of the Centrifugal Fan

Outlet Damper

Set Point for Pressure

Actuator

Inlet Guide Vane

Pressure Transmitter

Hydraulic coupling

AC Drive with PI Controller

ABB
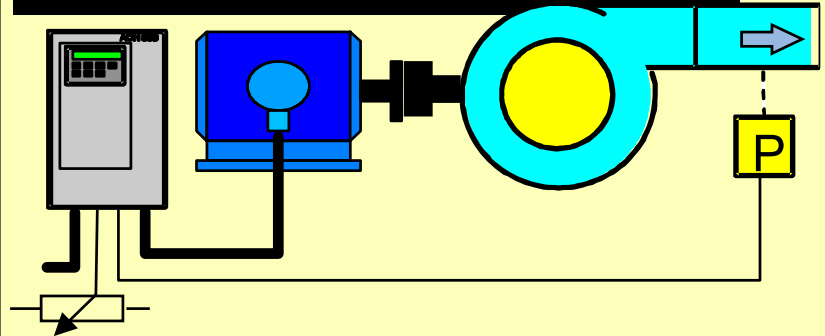
VAV Variable Speed Fans - Control

Exhaust air

Recirculation

Outside air

Return fan

ROOM 1   ROOM 2   ROOM 3   ROOM 4

P   P

T   T   T   T

ΔP

4 - 20 mA

Damper

Cooling

Filter   Heating

Supply fan

P

4 - 20 mA

Line

ABB
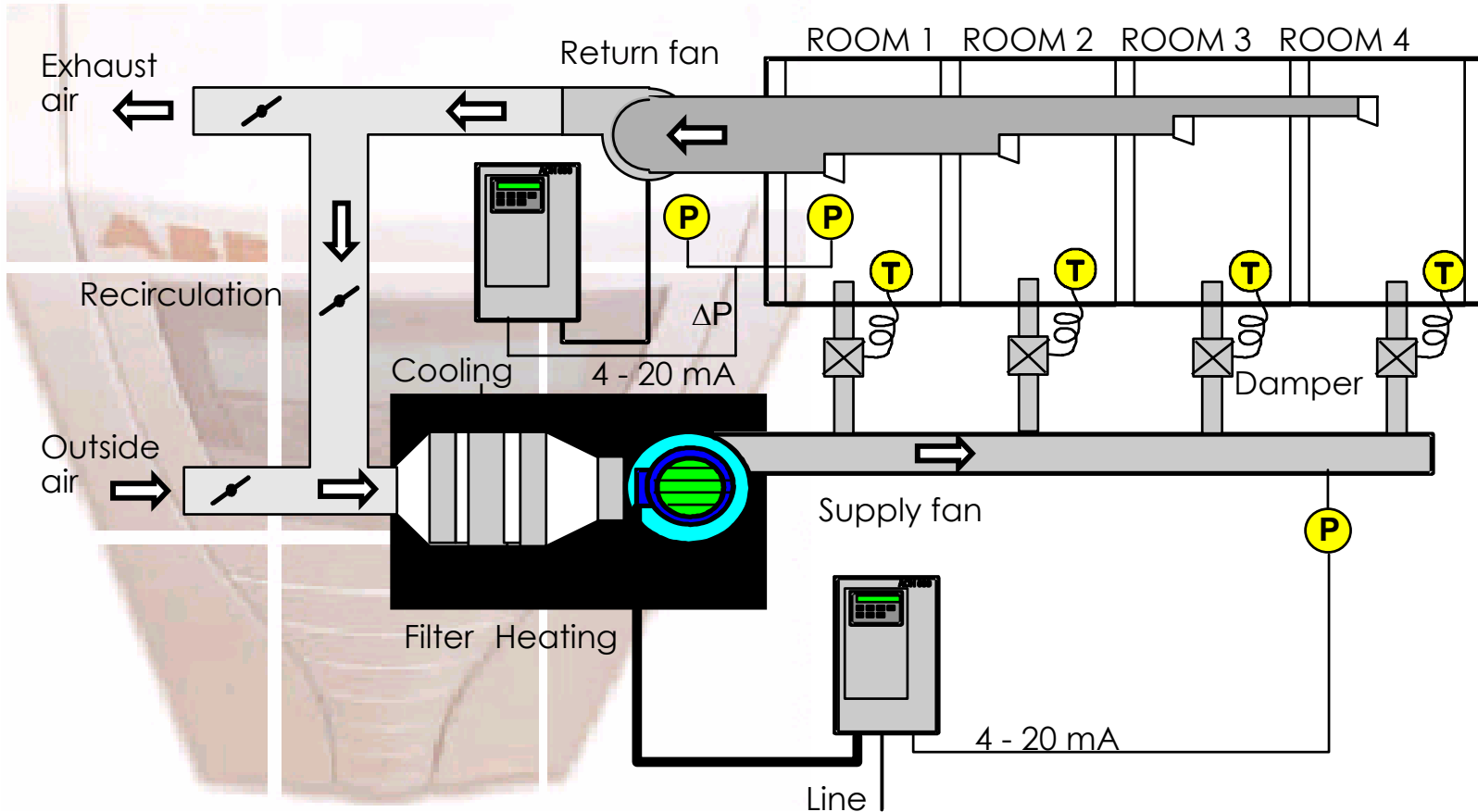
Fan Power with Different Air Volume Control Methods

Power consumption in % of the rated fan shaft power

Air Flow in % of the Rated Flow

Legend:
- Outlet Damper
- Inlet Vanes
- Hydraulic Coupl.
- Blade Pitch
- AC Drive
- Fan shaft power

ABB
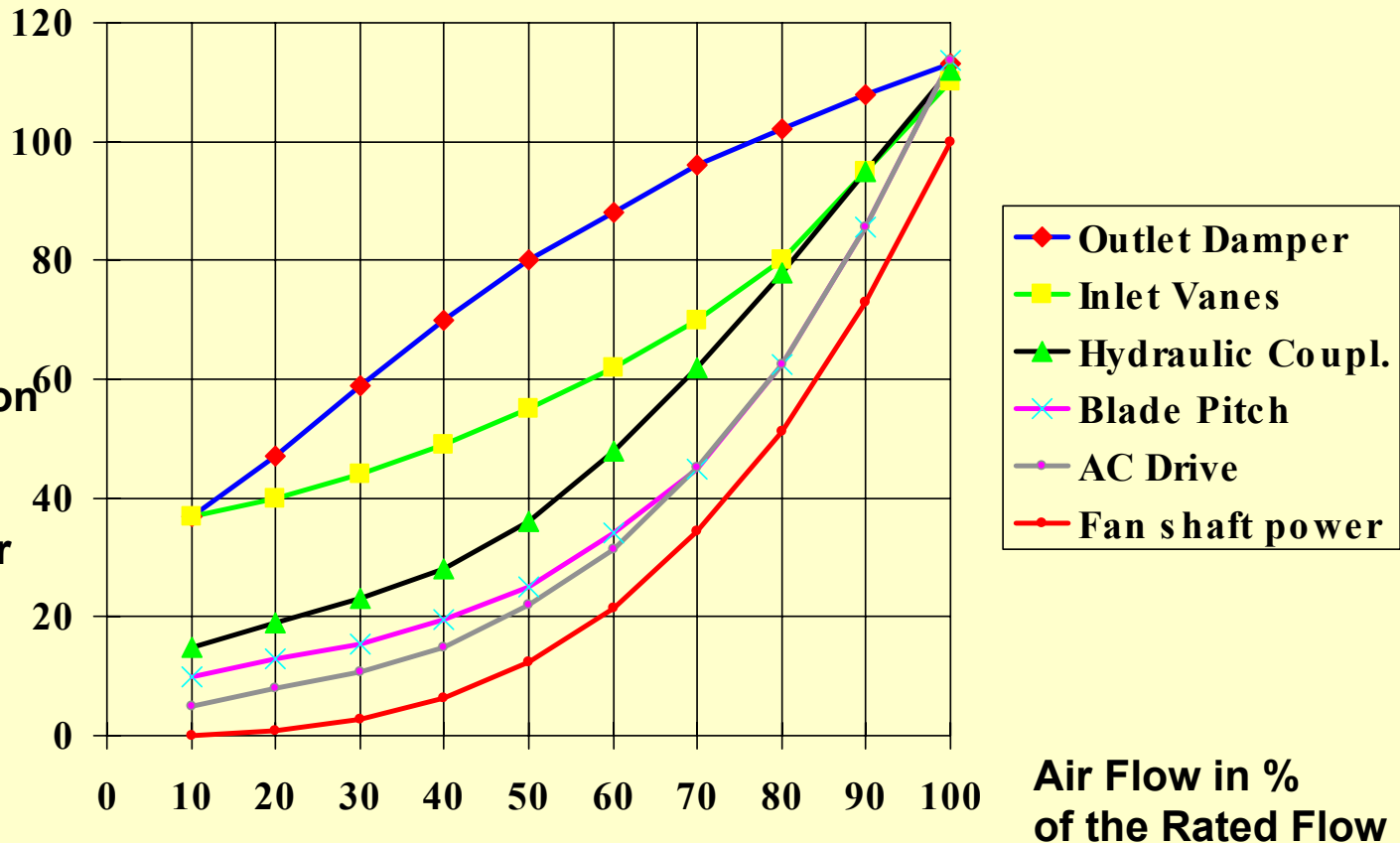
VFD Applications - Pumps

VFD Applications - Pumps

Valve Throttling

AC Motor
Centrifugal Pump
Actuator
A
P
Valve
Trans-ducer

Valve By-Passing

AC Motor
A
P

On-Off Control

AC Motor
Control Logic
P
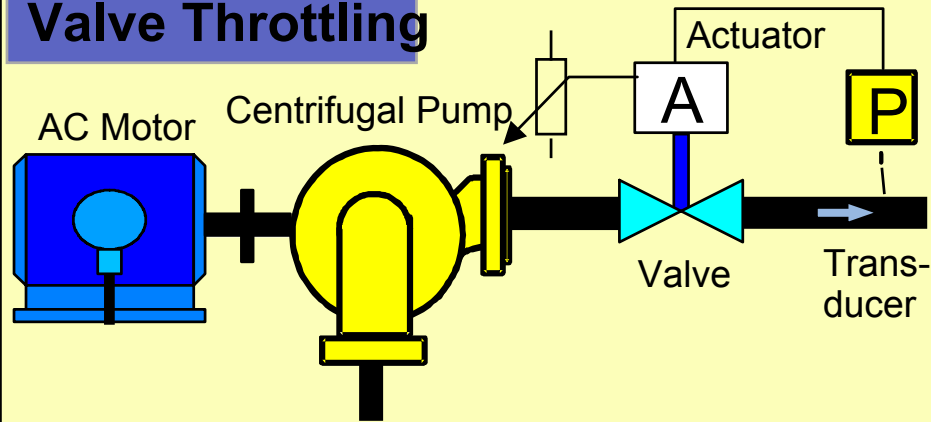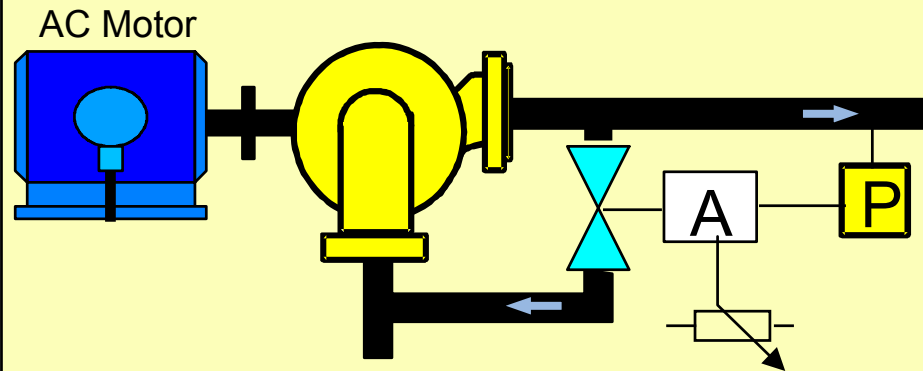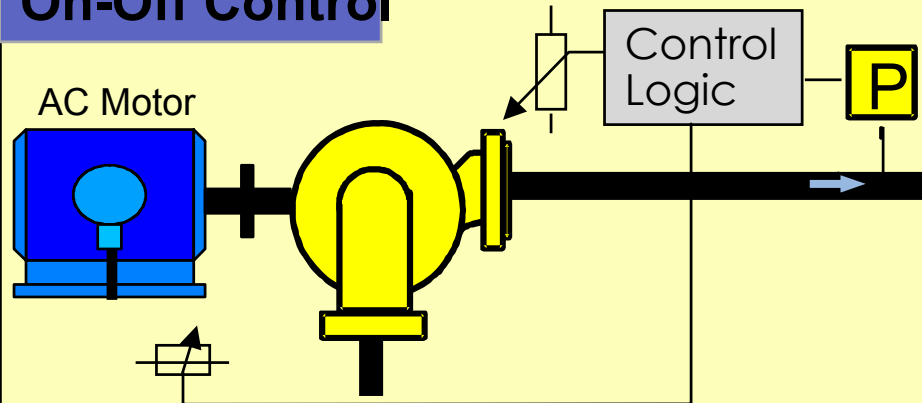
AC Drive with PI Controller

P

ABB
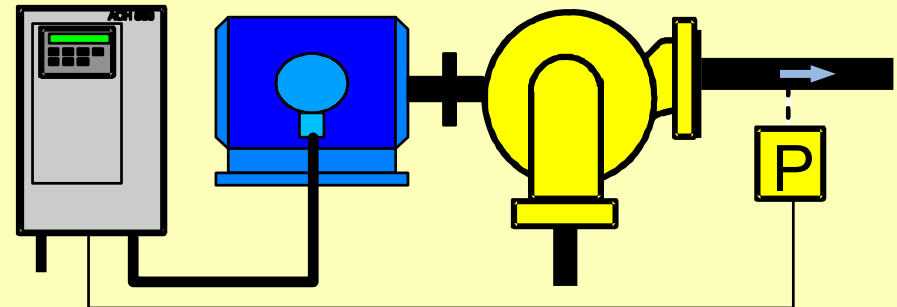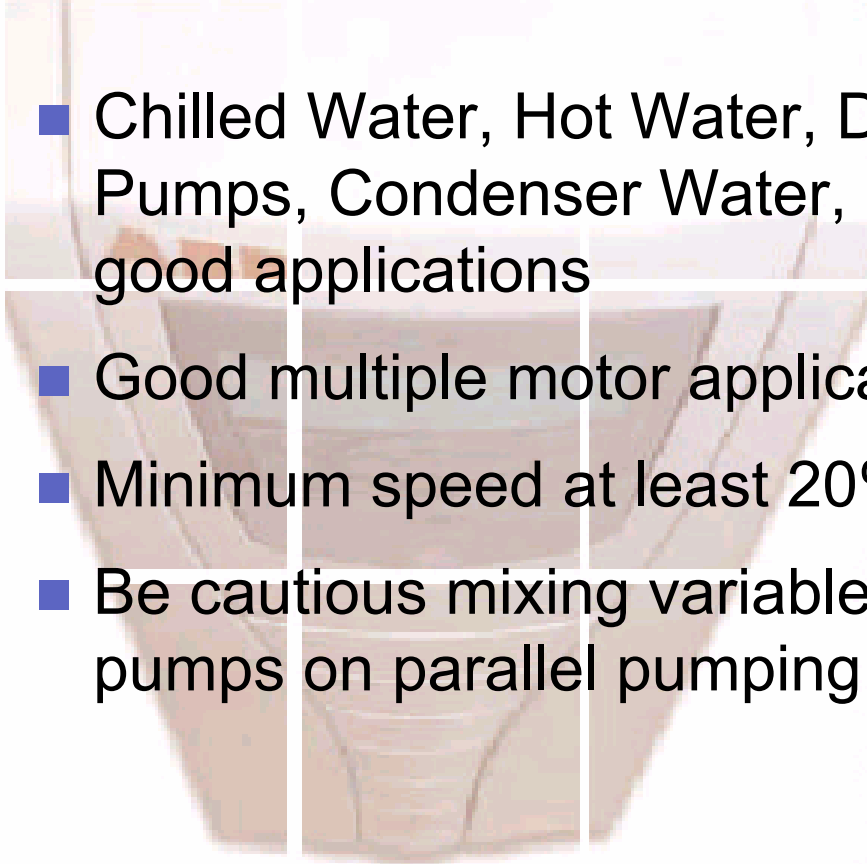
Power Consumption with Different Flow Controls
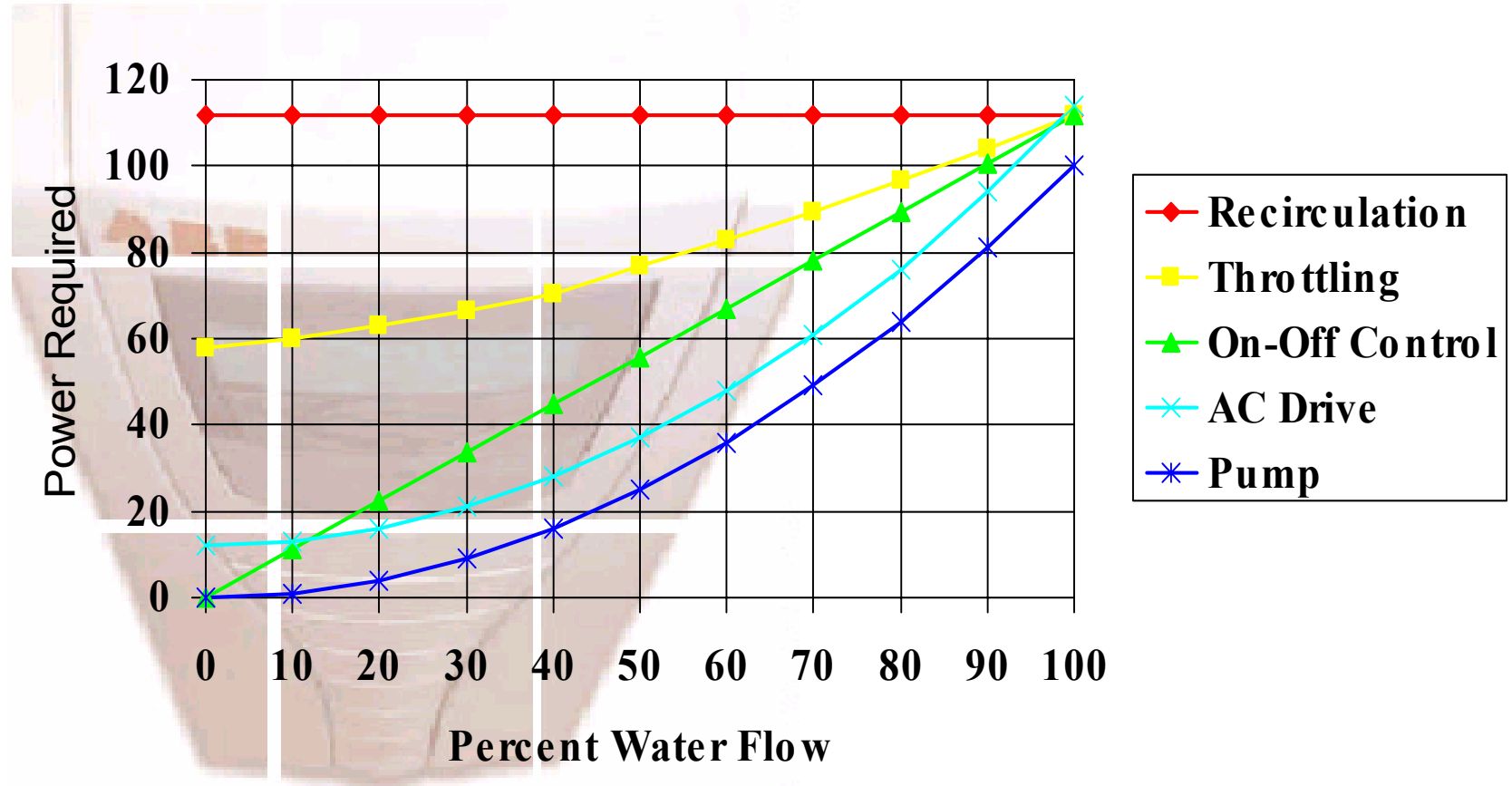
Variable Flow Chilled Water System

Evaporator

ROOM 1   ROOM 2   ROOM 3   ROOM 4

Cooling
Coils

Circulation Pump

4 - 20 mA
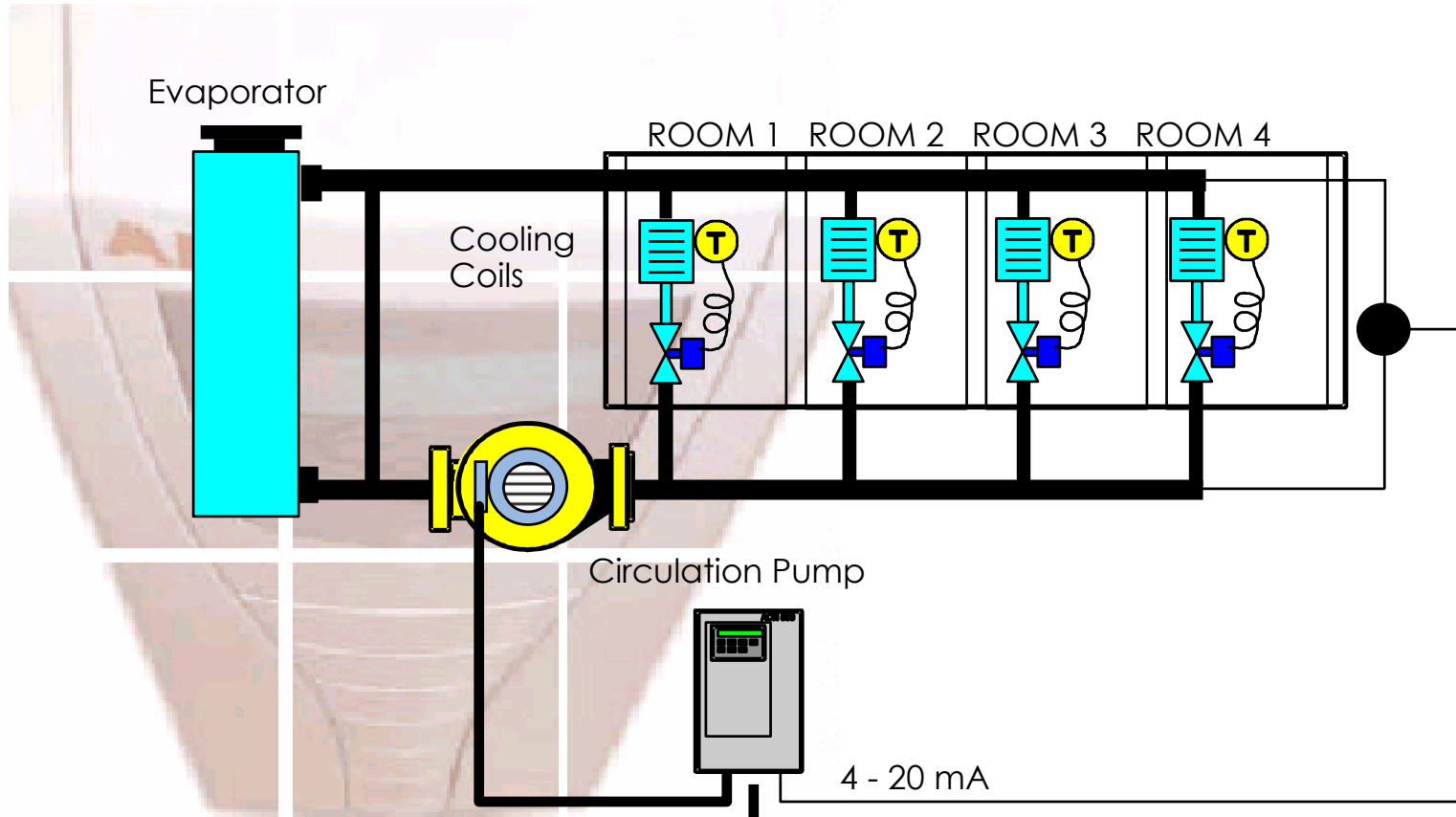
VFD Applications - Pumps

- Chilled Water, Hot Water, Domestic Water Booster Pumps, Condenser Water, Boiler Feed Pumps are all good applications

- Good multiple motor application (parallel pumps)

- Minimum speed at least 20% to open check-valves

- Be cautious mixing variable speed and constant speed pumps on parallel pumping systems

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VFD Application Considerations

- Minimum Speed setting of 10-30% for proper motor cooling

- VFD environment (0-40ºC), clean and non-condensing

- Enclosure rating (NEMA 1, NEMA 12, NEMA 3R)

- Specify AC or DC reactors for harmonic distortion control and enhanced protection from AC line transients

- Size VFD on the Name plate amp rating (6-pole motors and up)

ABB

VFD Motor and Motor Cable Considerations

- Use MG1 Part 31 Inverter duty motor

- With non inverter duty motor, supply load reactor or filter

- Set output switching Frequency low , 4 kz

- Keep motor lead lengths as short as possible

  - 10 to 200 meters

- Motor cables require shielding using conduit, armored cable or power symmetrically shielded cable.

- Ensure 3 metallic conduits are used (motor,power,and controls). Be careful with underground runs!

- Dedicated ground wires from motor to VFD and from power source to VFD

ABB

ACH550 Launch

Jan 17-19 2005
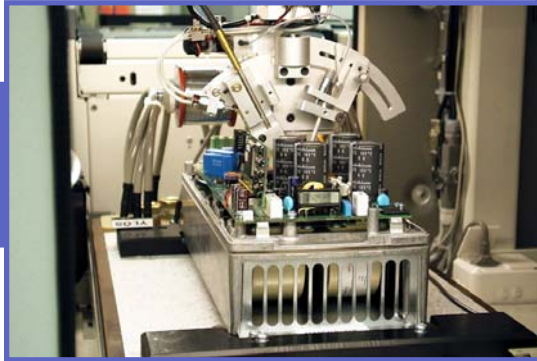
ACH 550 Product

ACH 550 Product Overview

- What is the ACH 550?

- It's a totally new design for HVAC with:

  - Wider power range 1-600 hp

  - NEMA 1 and 12

  - Easier to use

  - Patent Pending Harmonic reduction scheme

  - Extended Serial Communications Suite

  - Fieldbus Modules that fit "under the hood"

  - Removable Cell phone type Operator Panel

  - PWM Sensorless Vector (V/Hz programmable)

  - And more………….

Hardware Features

ABB

ACH 550 Hardware

- **Manufacturing Facilities in:**
  - New Berlin (Primary for North America)
  - Helsinki
  - Beijing
  - 600V only produced in New Berlin,

ACH 550 Hardware

- **ACH550-U1 Wall Mount**
  - R1 through R6 Frame Size
  - 2 through 150HP (600V)
  - 1 through 150 HP (480V)
  - 1 through 100 HP (208V)
    - Single phase to 40 hp
  - Flange mountable (with kit hardware)
  - Universal conduit box

ACH 550 Hardware

- *New* **5 %** **"**Swinging" DC Link Choke (Reactor)

  - Designed to reduce harmonics at **full and partial loads**

  - Perfect for Variable Torque Centrifugal Loads

  - Equivalent to a **5%** line reactor
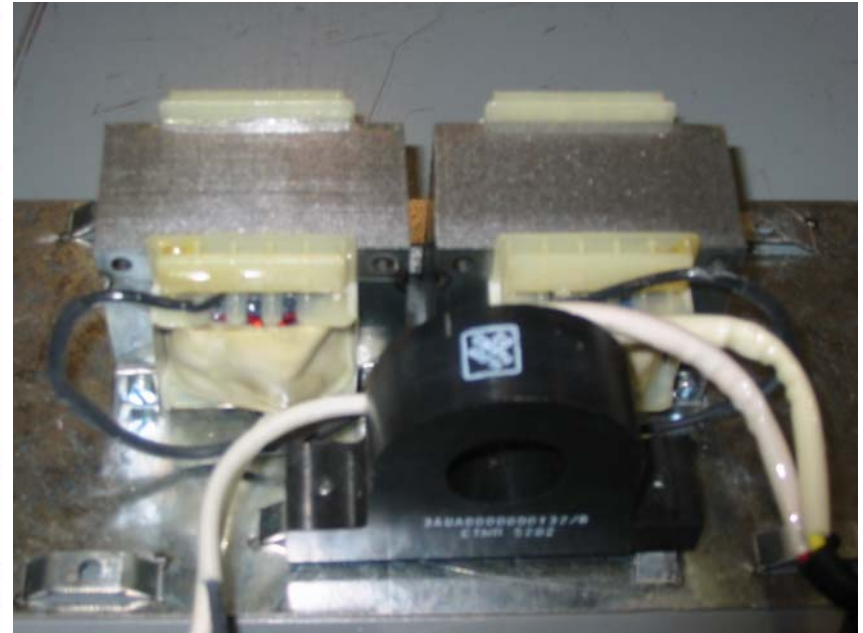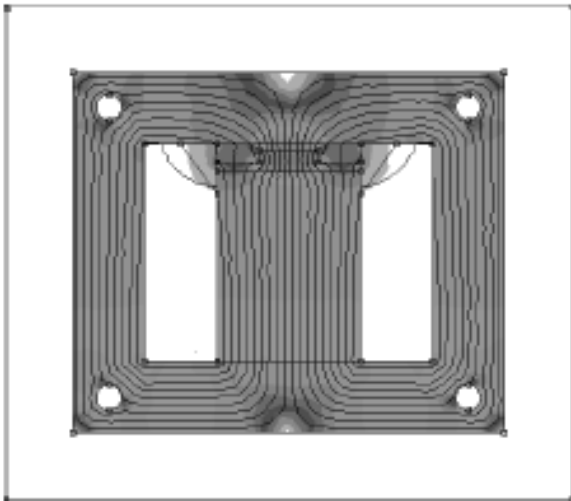
- More inductance per volume/weight

Swinging Choke Vs. Fixed Choke

% THD vs % Speed for Variable Torque Load

% TDD - Current

% Speed	ACH 550 vs ACH 400	PWM Drive w/o Choke
100%	8.6%	54.9%
95%	11.1%	57.3%
89%	15.1%	59.8%
84%	19.2%	61.9%
77%	23.0%	62.8%
71%	27.2%	64.1%
63%	28.5%	62.7%
55%	23.1%	63.6%
45%	12.7%	62.3%

ACH550 — ACH400 — PWM Drive w/o choke

% Speed

ABB
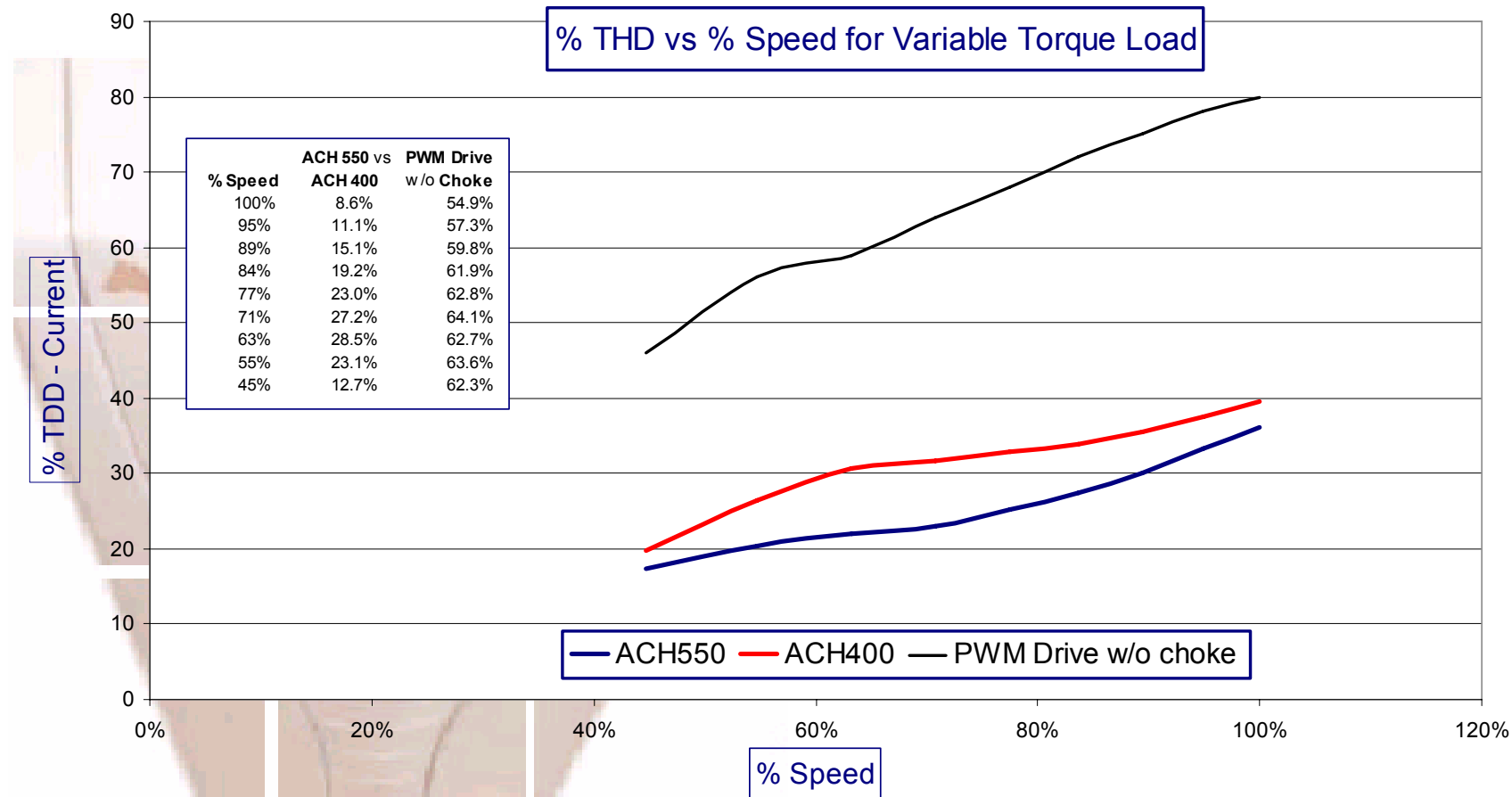
ACH 550 Hardware

- *New* Ratings (@ 600 volt)
  - 500 volt -10% to 600 volt + 10 %
  - Overvoltage trip 780 v (+30%)
  - Undervoltage trip 325 v (-35%)
  - Huge window of tolerated voltage deviation
  - 100 % output current at **40 degree C**.
  - Derated 1 % per 1 deg. C. up to **50 Deg. C**
  - Overload rating is 110% for 1 min. every 10 min.
  - **Actual Heat sink temperature controls output**
  - Results in Trip-free VFD
  - Fewer nuisance trips
  - **More reliability**

ACH 550 Hardware

- ***New* Surge Withstand Capability**
  - 4 MOV's ahead of bridge
  - 120 Joule rating
  - Bridge rated **1800V PIV**
  - UL listed and CSA approved for 100 KAIC (interrupting capacity) without the need for fuses.
  - Results in Trip-free VFD
  - **More reliable**
- ***Improved* Built in RFI/EMI Filter**
  - First Environment, restricted distribution, 30 meter cable length
- ***New* Current Measurement technique**
  - **All 3 phase currents measured**

ACH 550 Main Circuit Board

Power Terminals

Line Side MOV Snubbers

Gate driver Section

DC-capacitors

Power Supply
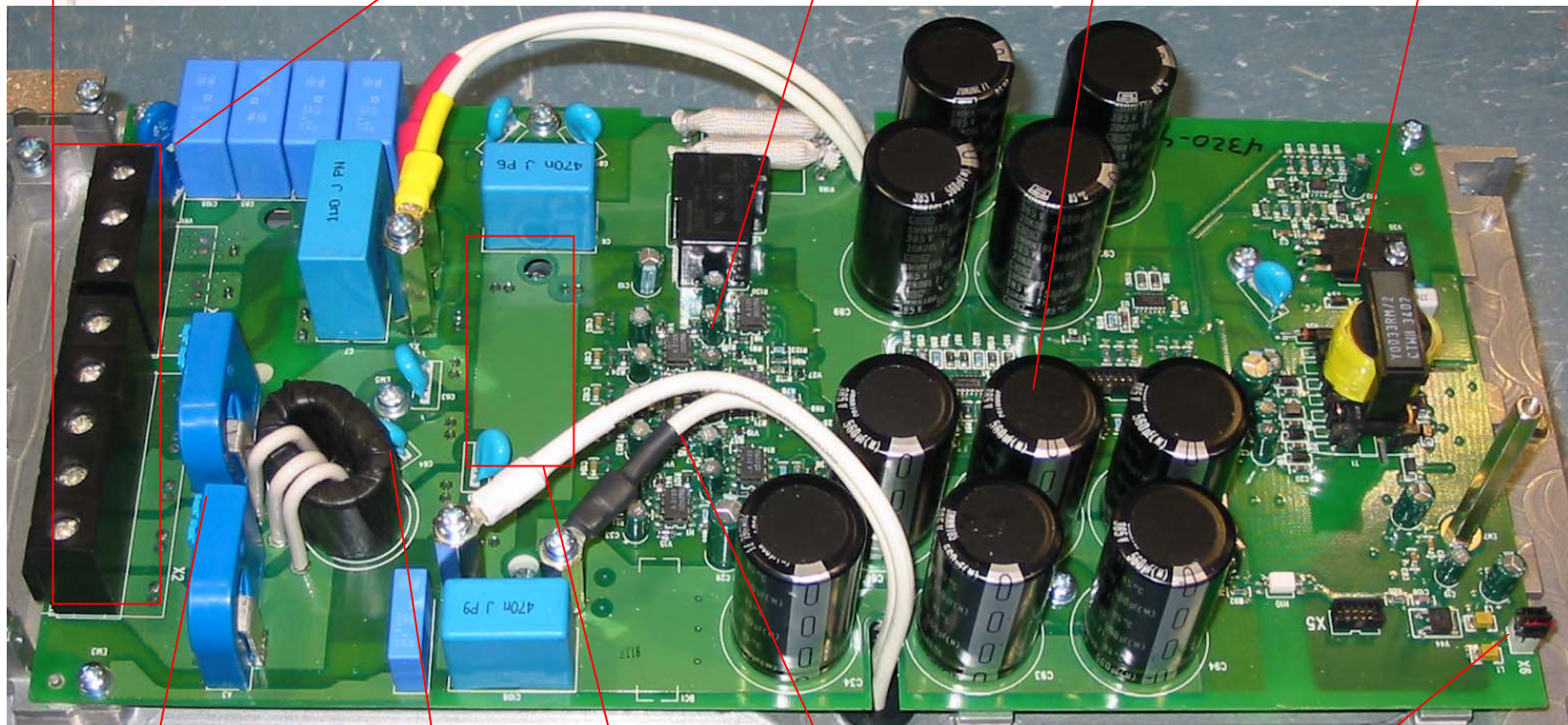
Current transducers

EMI/RFI Filter

Input Diode 1800V PIV

Bus Choke Leads

Cooling Fan +24VDC

Control Features

ABB

ACH 550 Control

- Advanced Control Panel Buttons:

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

Soft key 1 function

Soft key 2 Function

Soft key 1

Soft key 2

Down button
(for scrolling
parameters and
changing their
value)

Up button
(for scrolling
parameters and
changing their
values)

Auto button

Help button

Off button

Hand button
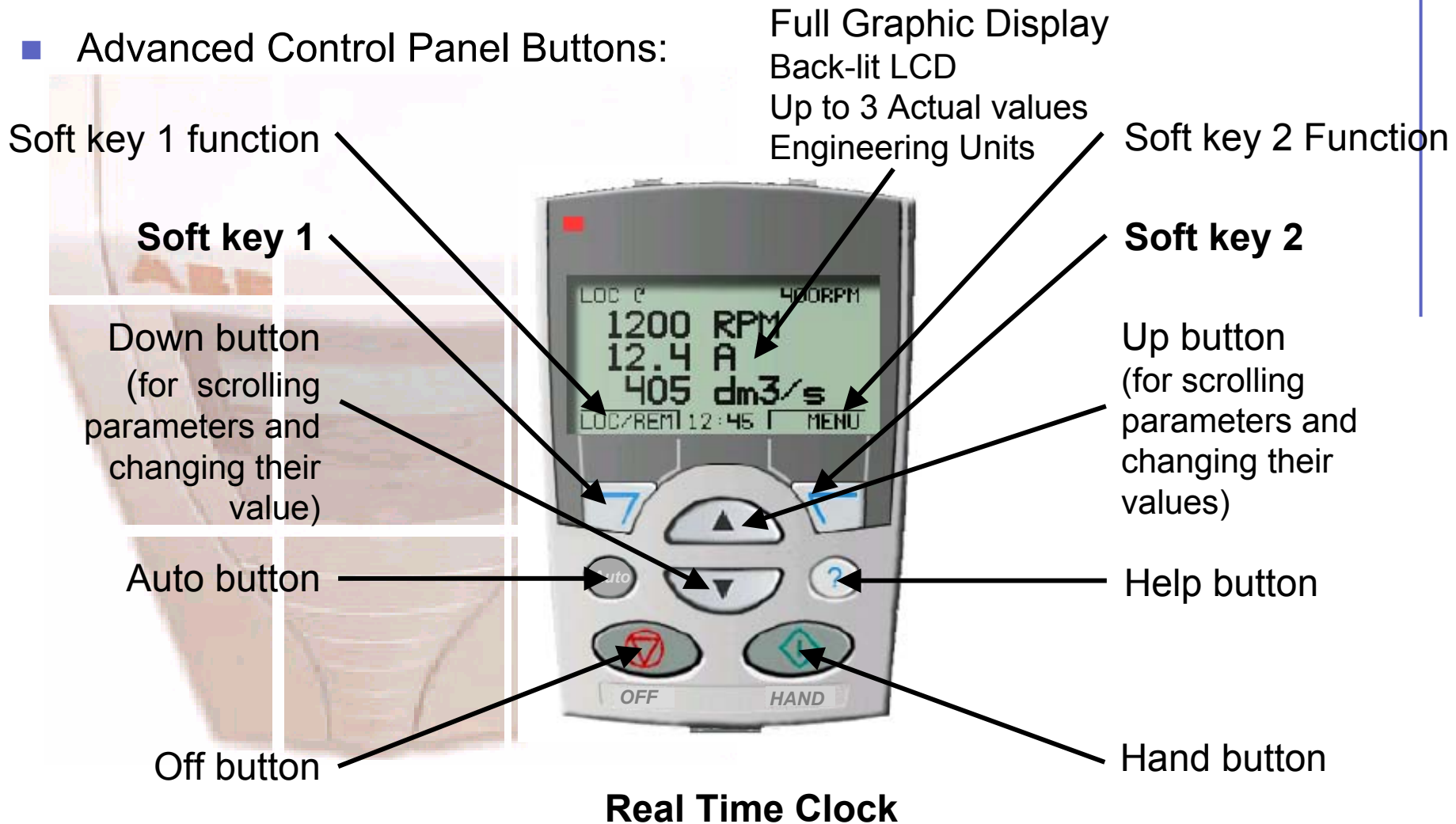
Real Time Clock

ACH 550 Control

- **New Advanced Control Panel** USF

    - **Intuitive to operate ,** designed like cell phone

    - **Real Time Clock**

    - **Start up, Maintenance, diagnostic assistants**

    - **Dedicated Help key (built-in manual)**

    - **Back-up and Restore Display**
        - Parameters and/or motor data

    - **Changed Parameter Display**
        - Creates unique short menu
        - shows parameters that differ from default

Firmware Features

ABB

ACH 550 Firmware Features

- ***Two New*** Macros (pre-programmed parameters)
    - User Macros 1 & 2
        - Example: Summer / Winter mode
    - Other Macros:
        - 'Suite' of HVAC Application Macros:
            - HVAC default, HOA, Supply fan, booster pump, PID, chilled water pump, cooling tower, electronic bypass, etc

ACH 550 Firmware Features

- *New* Motor RPM Counter
    - Tool to Schedule Preventative Maintenance

- *New* Monitor Group 3: Actual Signals

    - **Allows for monitoring of Field Bus Communication**

    - **Command word, eg. Stop/Start, Status word, eg. ready, enabled Fault word, eg. overcurrent Alarm word, eg. motor overtemp, etc**

    - Excellent Set-Up and troubleshooting tool

ACH 550 Firmware Features

- *New* System Controls – Group 16
  - *New* **Password protection with hidden pass code**
    Parameters can not be changed from the key pad
  - *New* **User Macro Change via Digital input**
    - **Summer / Winter setpoints, etc**

- *New* Fault Function – Group 30
  - *New* External Fault 1 & 2
    Example: **Fire-stat on fault input 1**
    Freeze-stat on fault input 2

- *New* Relay Output Parameters - Group 14
  - **Fully selectable - can be used for "Pass Thru"**
  - **Fieldbus can energize a relay to close a valve or damper**
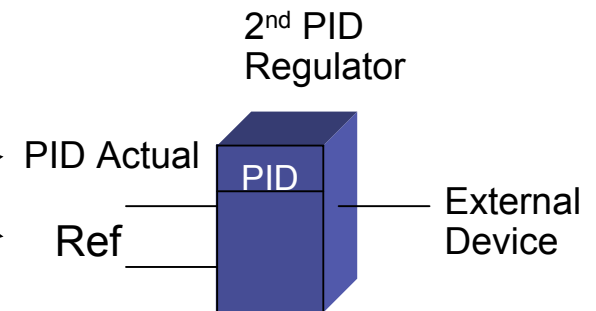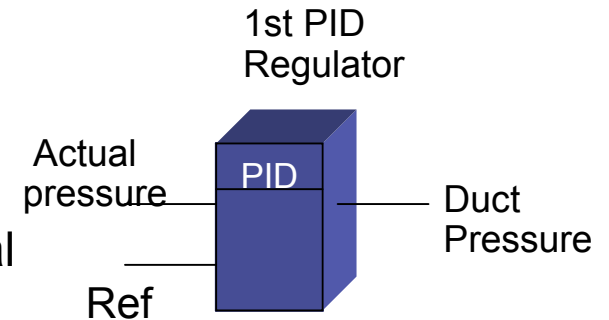 - **Saves need for additional hardware**

ACH 550 Firmware Features

- **_New_ PID Control Loop**
    - 2 Separate PID Loops

- **_New_ External/Trimming PID ⁃ Group 42**
    - External PID

    PID control can be set for control of an external device - **Example:**

    - **One PID is used with pressure transducer to control duct pressure**

    - **The external PID can be used to control the chilled water valve (uses AI2 & AO2)**

    - **All can be monitored and controlled w/ serial comm.**

1st PID Regulator

Actual pressure — PID — Duct Pressure

Ref

2nd PID Regulator

PID Actual — PID — External Device

Ref

ABB

ACH 550 Firmware Features

- **Embedded Field Bus** (EFB)– Group 53

- Sets up variables for the EFB serial communication protcol

- Embedded protocols as standard!

  ModBus RTU
  N2 – Johnson Control
  FLN – Siemens Building Control
  BacNet (Flash option)

  - ACH550 only drive BLT listed for **BacNet compatibility without 3rd party gate**

ACH 550 Firmware Features

- **_New_ Comm Options - Group 98**

  - Selects the Communication Protocol :
    - ModBus RTU via RS485 link
    - Johnson Controls N2
    - Siemens FLN
    - BacNet
    - External Field Bus

  - External Field Bus Modules:
    - LonWorks
    - EtherNet (dial up via PC)
    - DeviceNet
    - ControlNet
    - ProfiBus

ACH 550 Firmware Features

- *New* **Real Time Clock** Functions
   - Set 2 events per day: M-F(5 day week)
    - Set 2 events per weekend (2 days WE)
    - Set Start / Stop commands internally
    - Set relay outputs for user functions
    - Change reference selection based on time
    - Time Clock Over-Ride function (via soft key) to provide a "timed" run command (night and weekends)

- *New* **Fireman's Over-Ride**
    - Contact closure from fire panel starts drive and **ramps to preset speed (adjustable**)
    - **Ignores all other inputs** from safeties, speed reference and start/stop. (run to destruction)
    - Disables ALL keypad inputs – "OVERRIDE MODE" is displayed

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ACH550 Launch

Jan 17-19 2005
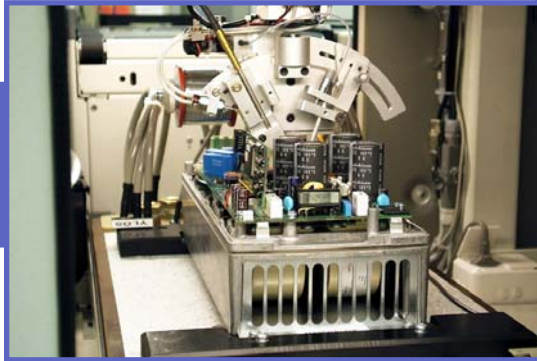
**ACH550
Product Packaging**

ACH550 Product Packaging
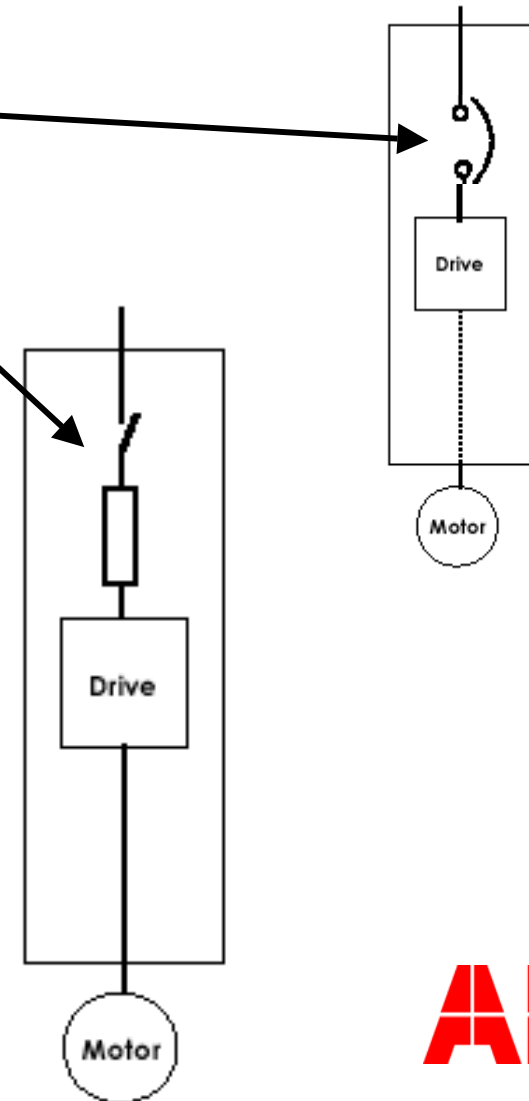
- What is the ACH550 offering?

  - Base Drives

  - Packaged Drives

  - Vertical E-Bypass

  - Standard E-Bypass

ACH550 Drive Packs

- Drive Packs Include as Standard
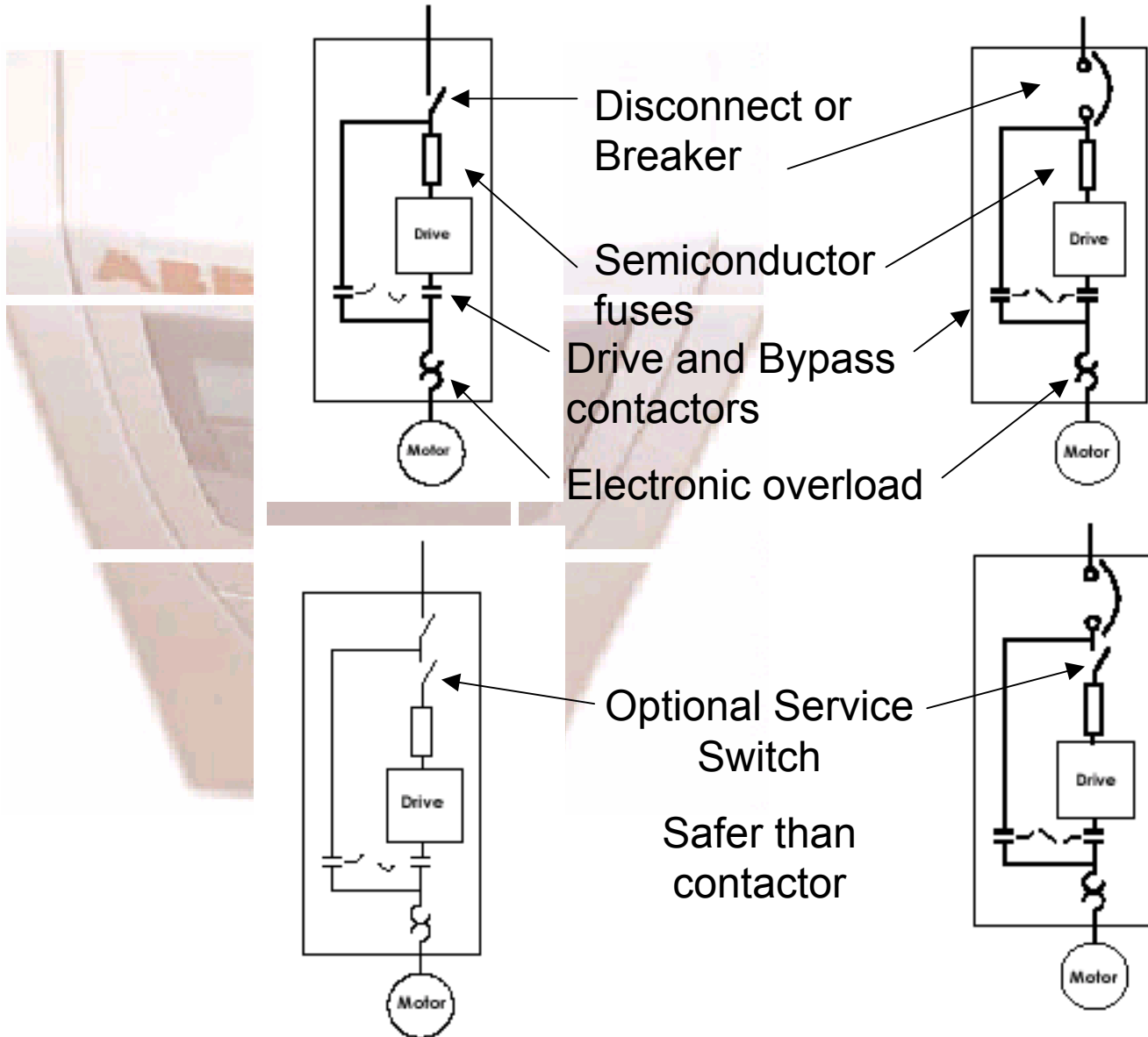 - **Circuit Breaker** or
  - **Input Disconnect and Fuses**
  - Operator Panel (HVAC Keypad)
  - ACH550 User's Manual
  - Embedded Serial Communications (Modbus, JCI N2, SBT FLN)
  - UL type 1 or UL type 12

Drive Pack Packaging

ACH550 Vertical E-Bypass Drives

Disconnect or Breaker

Semiconductor fuses

Drive and Bypass contactors

Electronic overload

Optional Service Switch

Safer than contactor

ACH550 Two vs. Three Contactor Bypass

- **Two-Contactor E-Bypass Safer**
    - Open Disconnect sw. only safe way of replacing VFD while running in Bypass mode
        - No welded contacts
        - No jammed contactor
        - No inadvertent contactor operation
        - Supply Line disturbance could cause contactor to close
        - Contactor can not be locked out
    - Voltage "brownouts" can cause contact chatter and loss of ride through
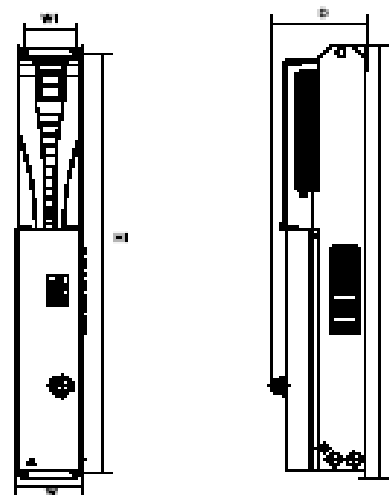   - Contactor coils can fail, resulting in down time

Vertical E-Bypass Packaging

Dimensions: ACH550-Vx UL Type 1 / NEMA 1 R1 through R4 Frame Size

Wall Mount (R1 - R4)

Frame Size	NEMA 1 Mounting Dimensions mm [Inches]		NEMA 1 Dimensions and Weights mm [Inches] kg [lbs]				
	H1	W1	Height (H)	Width (W)	Depth (D)	Weight	Dimension Drawing
R1	1078 [42.4]	98 [3.9]	1095 [43.1]	136 [5.4]	219 [8.6]	18 [40]	3AUA000005580 Sheet 1
R2	1179 [46.4]	98 [3.9]	1195 [47]	136 [5.4]	230 [9]	23 [50]	3AUA000005581 Sheet 1
R3	1332 [52.4]	160 [6.3]	1361 [53.6]	220 [8.7]	269 [10.6]	50.8 [112]	3AUA000005582 Sheet 1
R4	1437 [56.6]	160 [6.3]	1465 [57.7]	220 [8.7]	269 [10.6]	59.4 [131]	3AUA000005583 Sheet 1

Drawing is not for engineering purposes.

ACH550 Standard E-Bypass Drives

- Standard E-Bypass Drives Include as Standard
    - **UL Type 1 Enclosure or UL Type 12**
    - **Sheet Metal Enclosed Drive/Bypass Arrangement**
    - **Two Contactor E-Bypass**
    - **Drive Input Fuses**
    - **Circuit Breaker or**
    - **Input Disconnect**
    - Operator Panel (HVAC Keypad)
    - **E-Bypass** & ACH550 User's Manuals
    - Embedded Serial Communications (Modbus, JCI N2, SBT FLN)

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ACH550 Launch

Jan 17-19 2005
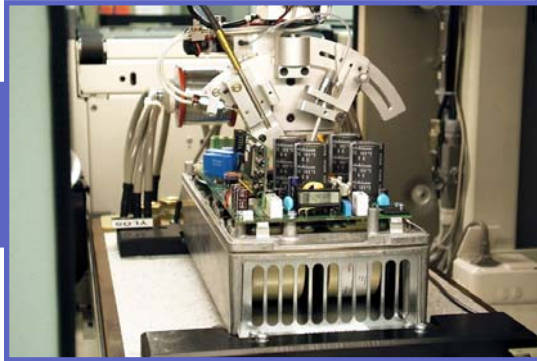
E-Bypass functionalities

ACH550 with E-Bypass

- E Bypass is a microprocessor-controlled HVAC enhanced system

- Separate E Bypass keypad with multi status indication and relay contacts

- 2 contactors with VFD Service Switch (option)

- Electronic overload protection

- Single phase protection

- Selectable class 20 or 30 overload curves

- Underload trip

- Fireman's override

- Bypass Override

- Serial communication capability to monitor and control Bypass
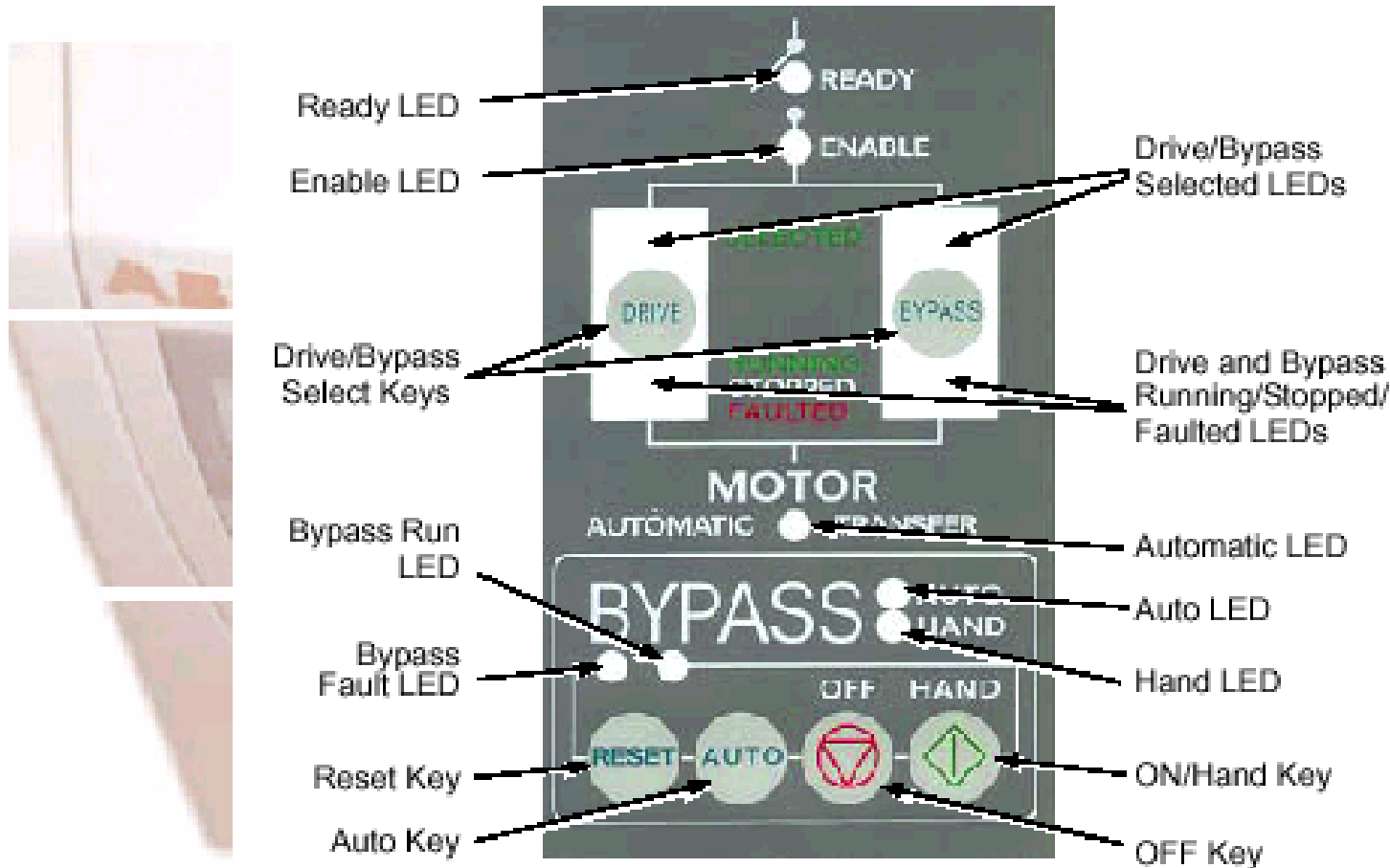
- NEMA1 and 12 availability

NEMA 1 or 12

NEMA1

ACH550 E-Bypass Operation Mode

ACH550 E-Bypass Operation Mode

- *Drive Mode :* Motor controlled by the drive, start/stop determined by the Hand/Off/Auto buttons <u>on the drive keypad</u>

- *Bypass Mode :* Motor is across the line, start/stop determined by the Hand/Off/Auto keys <u>on the Bypass keypad</u>

- *Fireman's Override Mode :* when the Fireman's Override input is activated (X2-4), the motor control is forced to bypass and no command or fault can stop it. <u>Runs until destruction</u>. When the Fireman's override is removed, the system resume operation in the mode prior to the override.

- *Bypass override Mode* : Similar to Fireman's override except it responds to the faults and interlock.

- *Automatic Transfer : Drive* automatically switches to bypass mode if the drive goes in fault condition.

- *Output Contactor Control* : If the Bypass fails, the drive's output contactor can be forced and the motor can be operated from the drive.

- Serial Communications link can monitor VFD/Bypass mode, status of HOA sw., Bypass fault, and override status and also force motor into Bypass

ACH550 Summary of Benefits

- **ACH550 is a World product**
- **Technically superior product**
- **Huge tolerance to supply line disturbances**
- **Built –in EMI/RFI filters**
- **Reliable product**
- **Patented Swinging Choke for lower harmonics at partial loads**
- **Real time clock**
- **N2, FLN and Modbus embedded**
- **Finally BACnet embedded without external 3rd party gateway**
- **Full output at 40 deg. C**
- **User friendly keypad**
- **Application Pre-configured HVAC Macros**
- **Commissioning, maintenance, and diagnostic assistants**
- **Microprocessor controlled Enhanced Bypass**
- **Fireman's override smoke controls**
- **Competitive pricing**

ABB

ABB the company

- Worldwide organization

- Hi brand name recognition

- Builds Quality products

- Builds Reliable products

- Five generations of VFD design experience at 600 volt

- Largest VFD supplier to the HVAC market in USA

- 24 Hr phone support line

- Experienced Service organization

- Experienced Channel Partner

    -ADM Engineering in Ontario

ABB