Critical Backup

Dedicated to engineering quality industrial electronics since 1962!

Overview
VFDs in Data Centers

- Advantages of VFDs
- VFD / UPS Relationship
- Energy Savings vs. Backup
- Bonitron Solution
- Question and Answer

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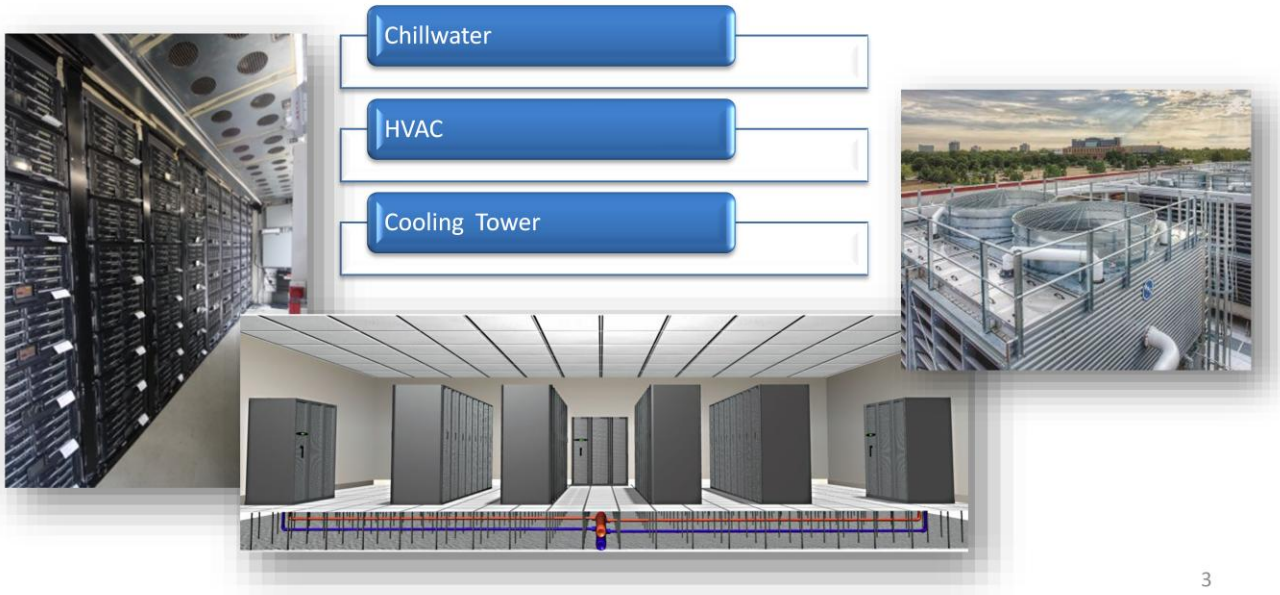
Topics we're going to cover in the presentation

VFDs in Data Center Applications



Variable frequency drives allow traditional single speed AC motors to run at different speeds on demand.
This can have several applications in Data Centers.
These three all have good applications for varying the speed in the motor rather than the traditional methods for flow and control.

Advantages

Advantages of VFDs in Data Center Applications

- Power Savings
- Lower Maintenance Costs

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How are you going to save power?
Why are maintenance costs lower?

System Maintenance

Eliminates Water Hammer

- Reduces stress during starting and stopping

Preventative Maintenance

- Allows remote monitoring through SCADA systems for preventative maintenance

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Water hammer occurs when pump starts and stops due to hard acceleration and deceleration. Can also occur during check valve closing and opening. This stresses the piping, which can cause premature failure. The smooth ramping of the VFD's virtually eliminates water hammer.

Power Savings

Flow

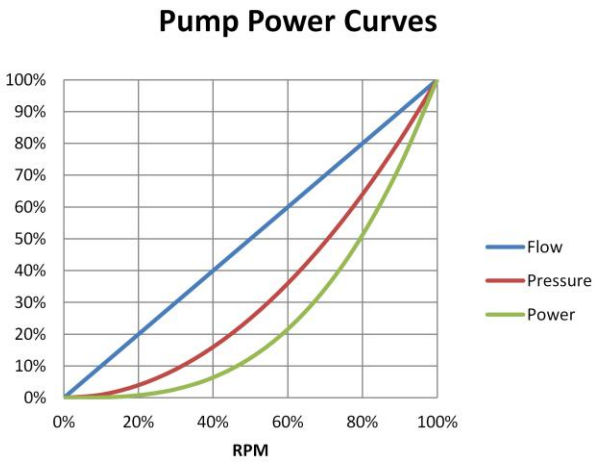
$$\frac{N_1}{N_2} = \frac{Q_1}{Q_2}$$

Pressure

$$\left(\frac{N_1}{N_2}\right)^2 = \frac{P_1}{P_2}$$

Power

$$\left(\frac{N_1}{N_2}\right)^3 = \frac{W_1}{W_2}$$



$$\frac{N_1}{N_2} = 80\%\ RPM$$

$$\left(\frac{N_1}{N_2}\right)^3 = (80\%)^3 = 51\%\ kW$$

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The affinity laws of pump dynamics show that the relationship between pump speed and power requirements is a cube. In other words, a 20% reduction in pump speed gives a 50% reduction in power required.
This translates to real power reductions in kWh consumed.

For instance, a 100h.p. motor = 75kW. When run at 80% shaft speed, the flow goes down 36%, but the power required goes to 38kW.

These savings are not possible with soft starts, because they can not run continuously at different speeds

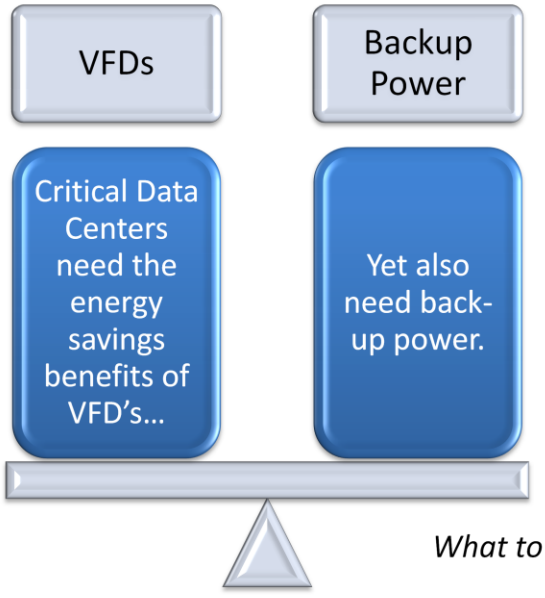
VFD Backup Applications

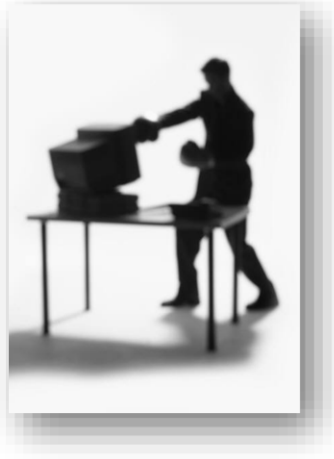
VFD backup needed in:

- Compressors
- Chillwater pumps
- Other areas to avoid chiller restart delays

Other areas…

Energy Savings vs. Backup





What to do…?

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One of the issues in critical processes is the need for backup through power dips, sags and outages. This can present special challenges.

VFD / UPS Relationship

- Advantages
- **VFD / UPS Relationship**
- Energy Savings vs. Backup
- Bonitron Solution
- Question and Answer

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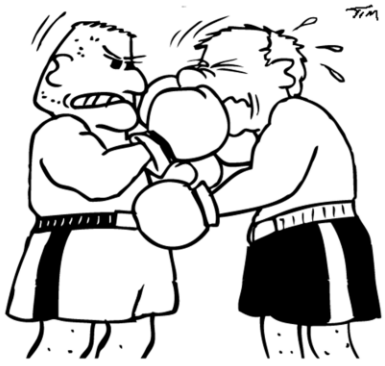
Let’s look at the challenges of putting VFD’s in critical applications with traditional UPS backup

VFD and UPS Systems

VFD's not recommended with Data Center UPS Systems

- VFD input reactance interacts with UPS inverters
- Reduced efficiency due to extra conversions
- Extra point of failure



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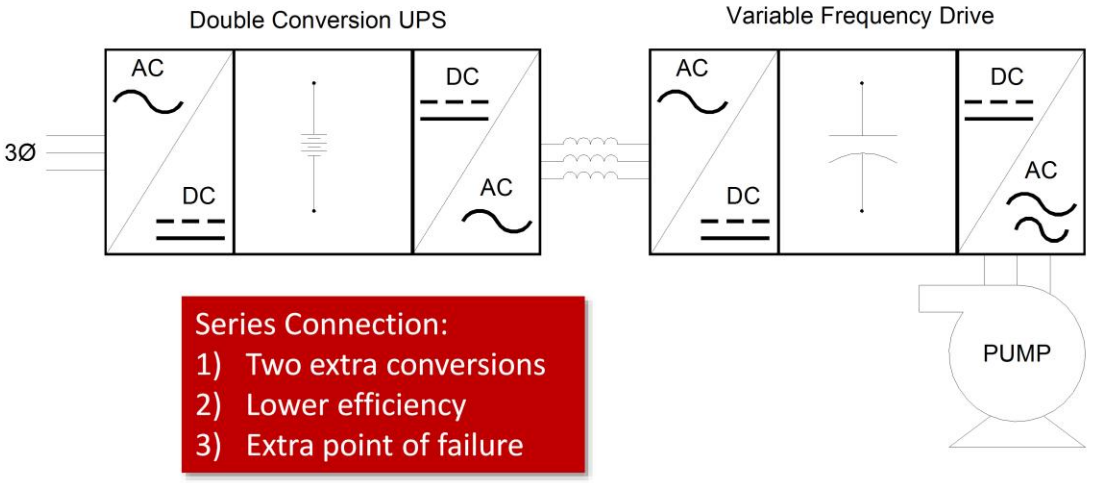
VFD's have inductors and capacitors on their AC-DC converter stage
Reactive loads interact unfavorably with UPS systems
Double conversion UPS systems have extra conversions that reduce efficiency
Series connection adds point of failure to normal operation

Note that squirrel cage motors used without VFD's require an oversized UPS due to poor power factor and high starting currents.

Double Conversion UPS



Series Connection:
1) Two extra conversions
2) Lower efficiency
3) Extra point of failure

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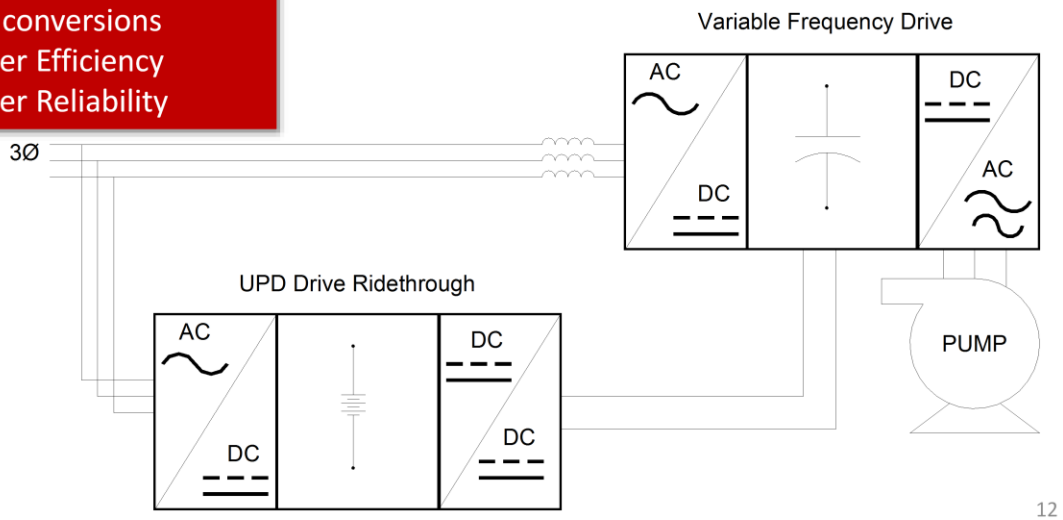
AC inverter section of UPS systems must be oversized to accommodate highly reactive loads.
Bypass options are not bumpless.
Each conversion adds 2-5% losses in system
Adds points of failure to the reliability diagram

Uninterruptible Power For Drives

Parallel Connection:
1) Less conversions
2) Higher Efficiency
3) Higher Reliability



The parallel solution offers:

Single conversion during backup -

Higher efficiency – system is off line until needed

Higher reliability – Adds no continuous point of failure – Ridethru can be taken off line with zero impact to process

Diode coupling allows for bumpless transfer of power flow

No inverter stage to VFD input, simpler topography

Bonitron Solution

What's the Solution?

Uninterruptable Power for Drives

- DC-DC converter with or without energy storage

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*Self-contained solution
*Usable with all AC drive brands
*Multiple types of protection from sags to complete outages
*Can use bulk energy storage or can be self-contained in Bonitron unit
*One Ride-Thru can support multiple VFDs

Bonitron UPD Systems

1 second full outage 150kW

1 second full outage 200kW

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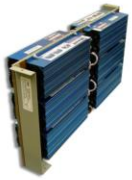
Typical system layouts shown.
Standard systems have simple connection to new or existing systems.
Footprint typically less than equivalent UPS systems.
These are ultracap solutions, which are largely maintenance free for over 10 years.

Energy Storage Optons

Electrolytic Capacitors

700v assembly

Ultracapacitors



180v module

48v module

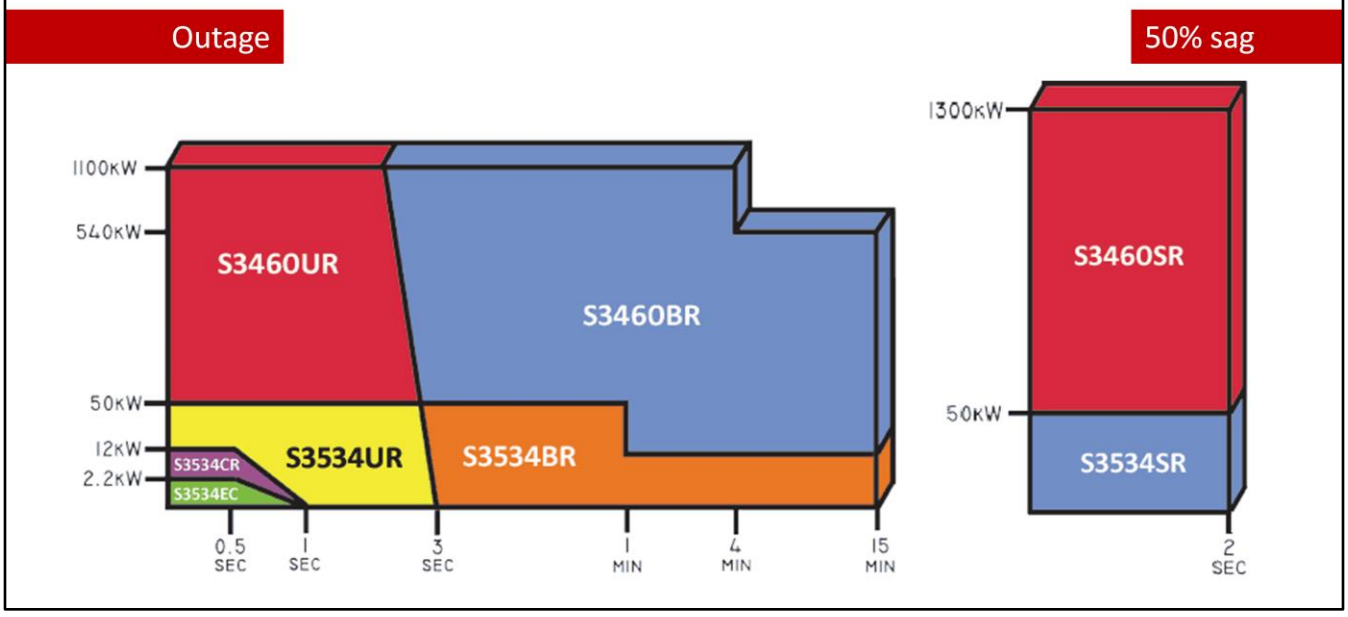
Batteries

12v battery

Up to ½ second full outage	Up to 3 seconds full outage	Up to 15 minute full outage
• Cost effective for short outages • Low HP drives	• Cost effective for short outages • High HP drives	• Cost effective for long outages • All drives

Electrolytic and Ultracapacitors are 10+ years with no maintenance. Batteries would be serviced the same as UPS applications, great support from local service providers.

Bonitron UPD System Ranges



Bonitron DC Backup systems are scalable to any size system, and any outage duration.
Sag solutions only need boost modules, therefore have no maintenance.

Uninterruptable Applications

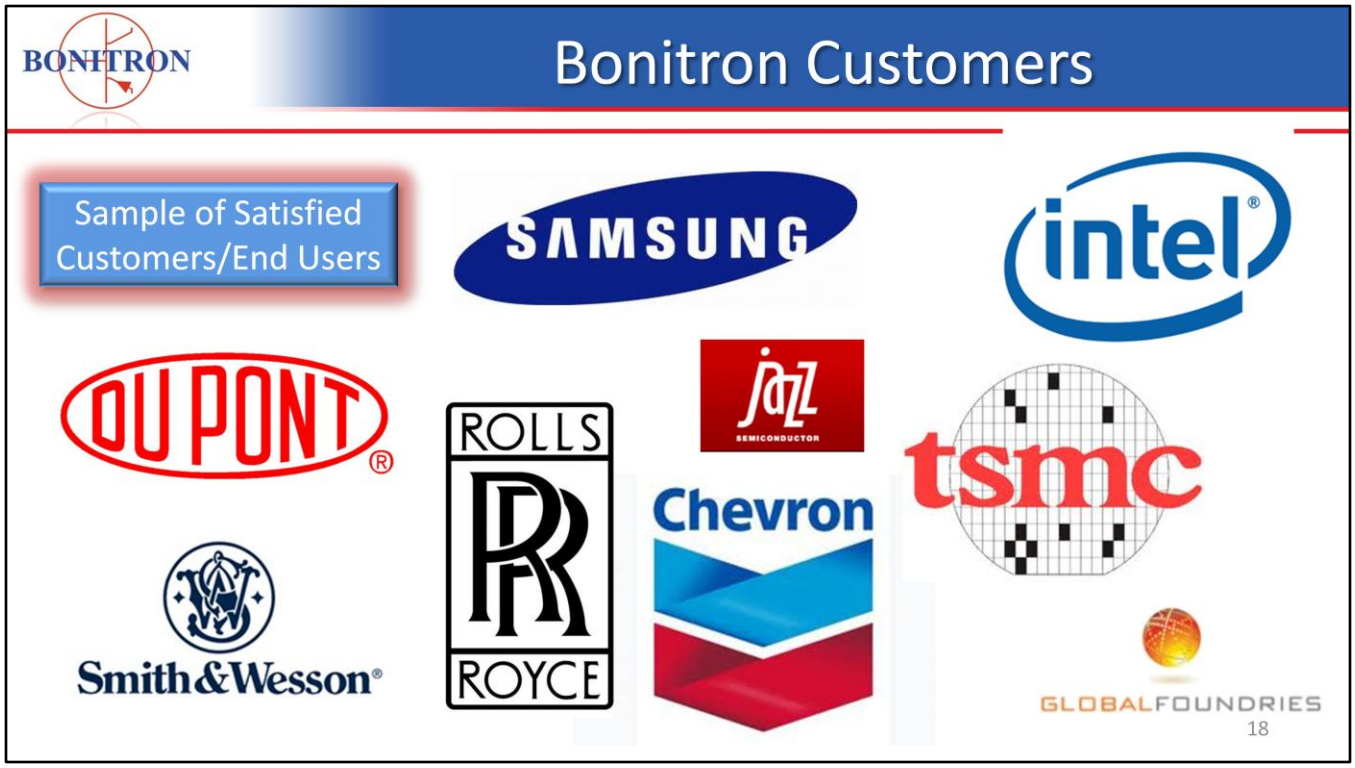
Applications

- Clean room air handling systems
- Cooling water systems
- Synthetic fibers spinning
- Semiconductor fabrication
- Turbine Lubrication pumps
- Oilfield extraction pumps

Reasons for Ride-Thru

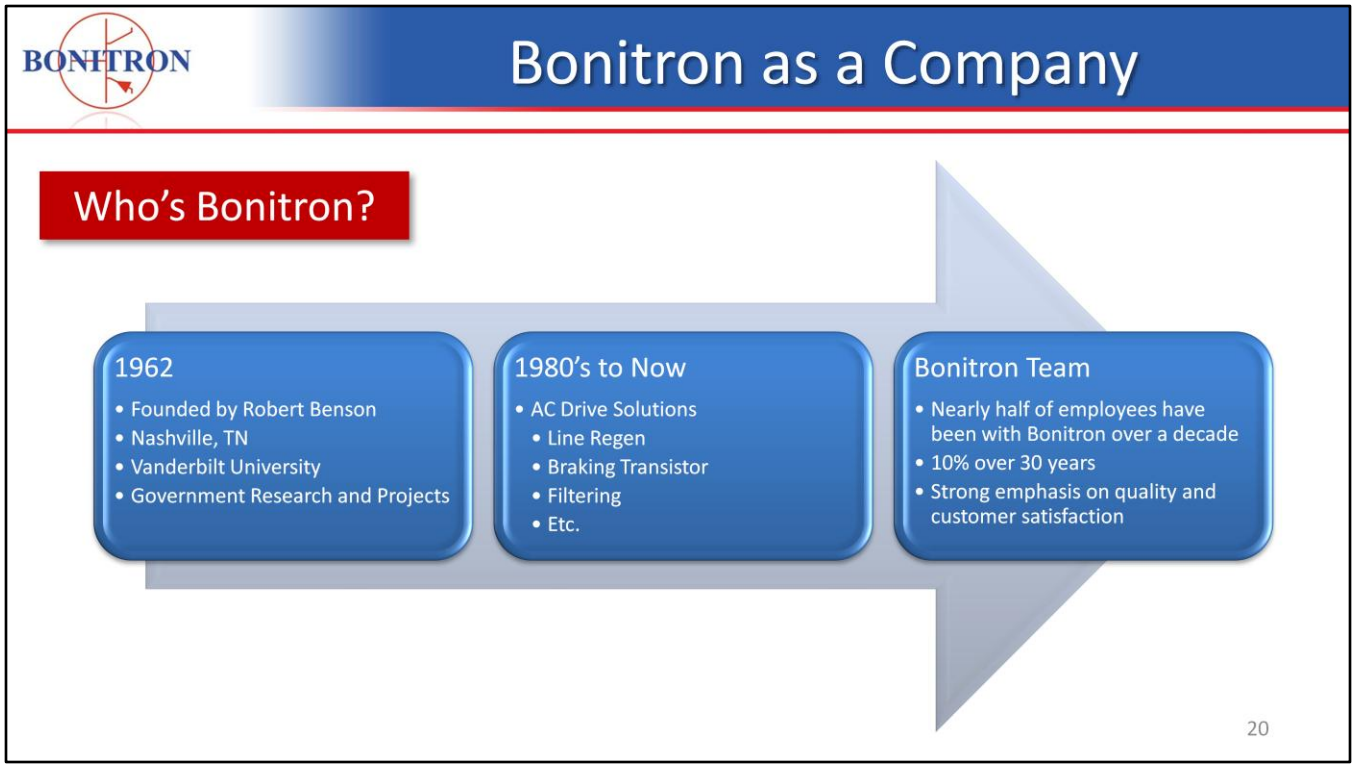
- Must maintain constant power to prevent costly production losses or equipment damage

These are some existing applications where the Bonitron UPD is currently installed.
Over 20 years of installed base in multiple critical areas.
The one thing they all have in common is the requirement for reliability and process availability.



All these industries represent backup needs due to extreme cost of production loss or equipment failure
Dupont – Continuous process/non woven fiber production
Samsung, Jazz, Intel, TSMC – Semiconductor wafer fabrication
Chevron – Oil pumps – Progressive Cavity Pumping
Rolls Royce – Gas turbine lubrication and fuel supply backup
First installation occurring in a major data center happening now.

Bonitron is compatible with any drive system that has a connection to the DC bus. This is the vast majority of drives above 10 h.p.



Bonitron has a long history of innovation and support. We've been providing equipment into major markets for well almost 50 years.

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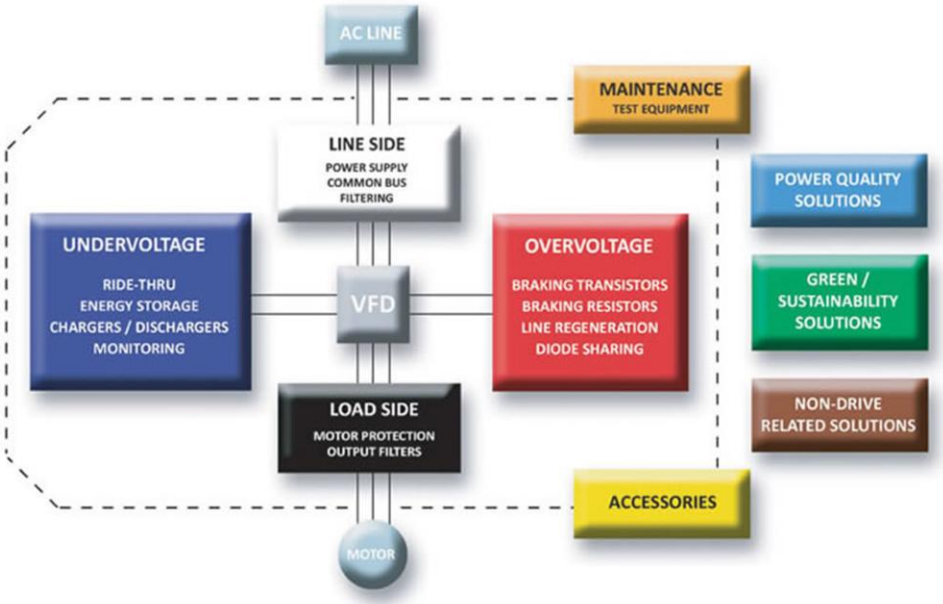
Bonitron Solutions



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Bonitron is also not a “one trick pony”
We have products in all areas of VFD operation, backup, and management.

Question and Answer

Questions?

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