



Body Shop:  
Building  
Strategies

**CATERPILLAR®**

**UPS Topologies**

# Agenda

- 9 Power Problems
- UPS Topologies
- Caterpillar's Focus
- UPS Evaluation
- Caterpillar's Direction
- Caterpillar's Solution

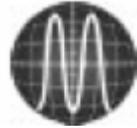
## 9 Power Problems



Power Failure - Total Loss of Utility Power



Power Sag - Short Term Low Voltage



Power Surge/Spike – Short Term High Voltage Above 110% of Nominal

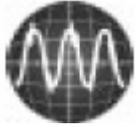


Undervoltage/Brownout – Reduced Line Voltage for an Extended Period of Time



Overvoltage - Increased Line Voltage for Extended Periods of Time

## 9 Power Problems



Line Noise - High Frequency Wave Form Caused by RFI or EMI Interference



Frequency Variation - Change in Frequency Stability



Instantaneous Undervoltage – Short Term

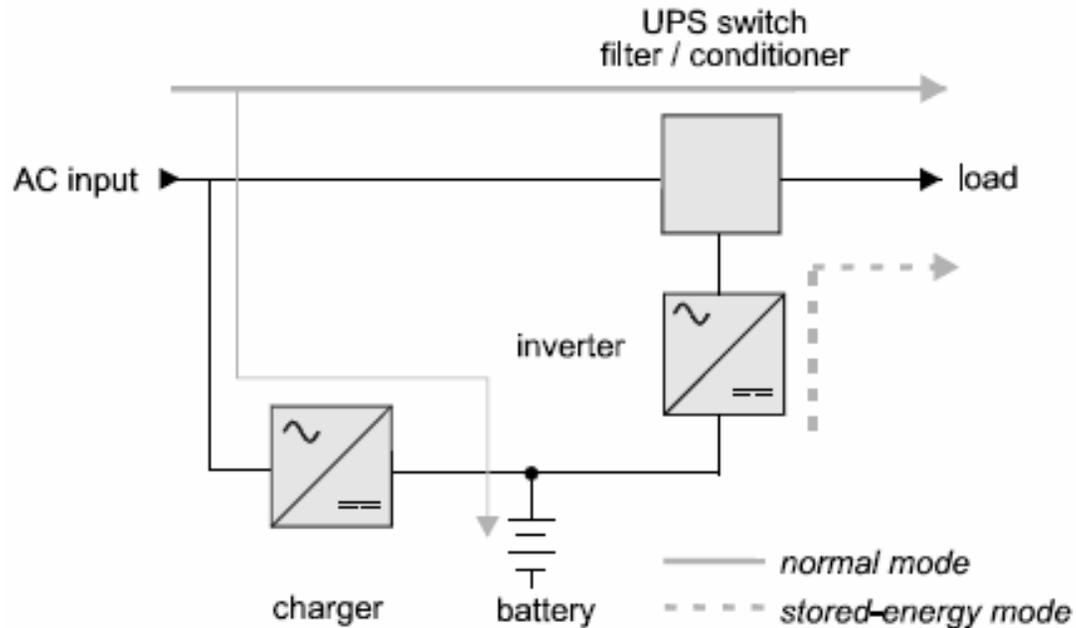


Harmonic Distortion - Distortion of the Normal Waveform Generally Transmitted by Nonlinear Loads

# UPS Topologies

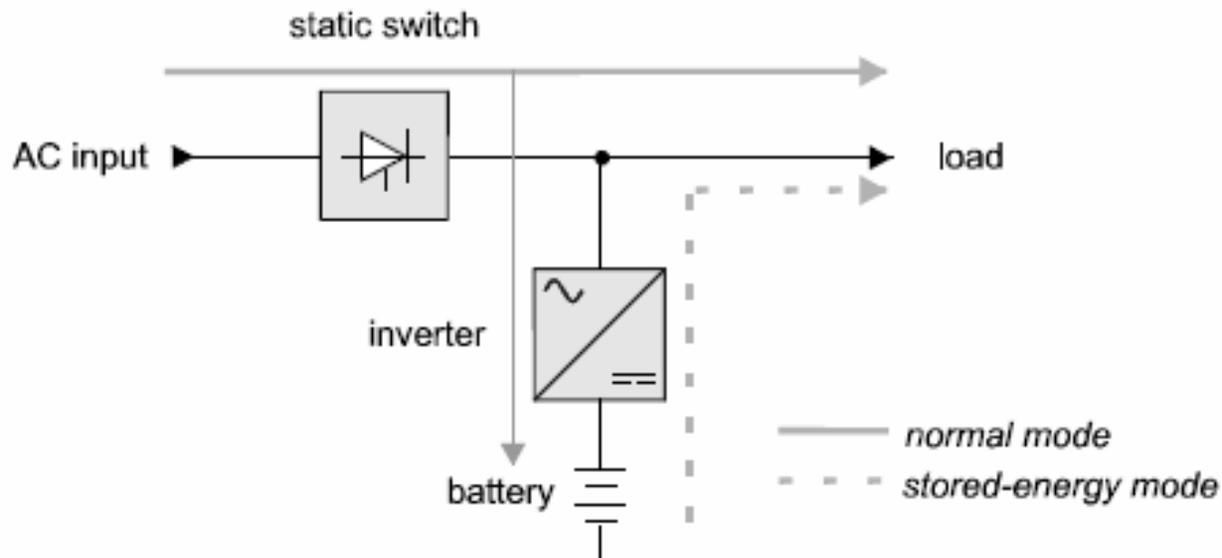
- Standby
- Line Interactive
- Double Conversion

# Standby UPS



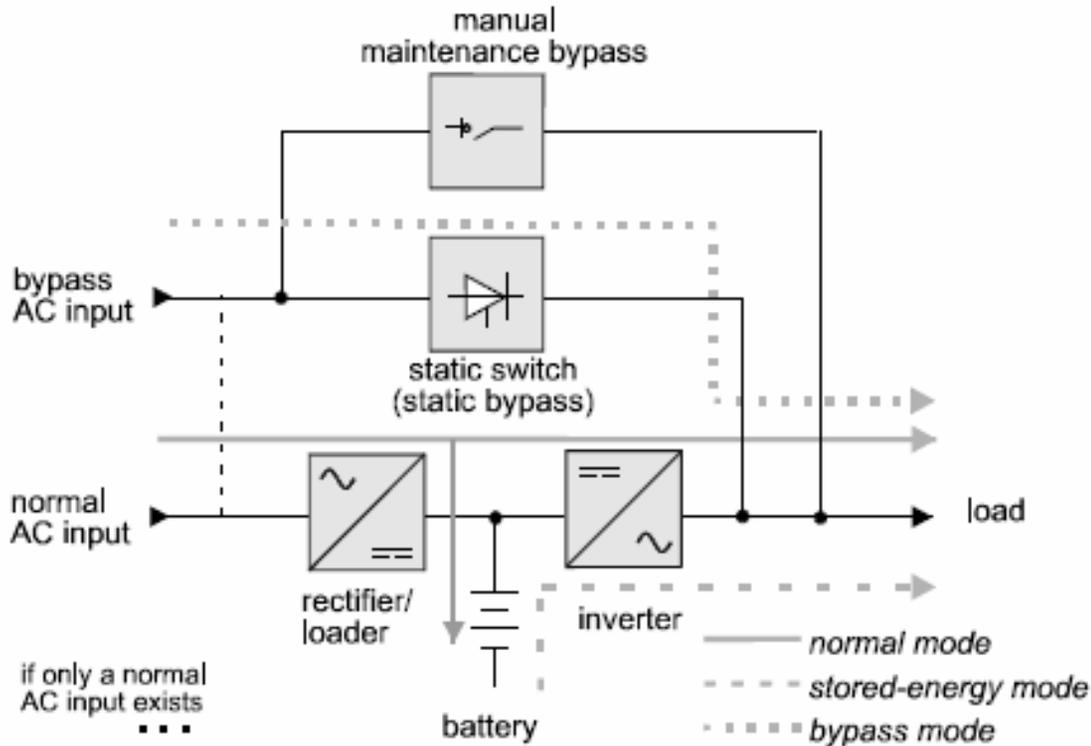
- Most Efficient
- Least Amount of Protection From Power Problems
- Least Expensive to Own

# Line Interactive UPS



- Highly Efficient (97% Typically)
- More Protection From Power Problems (8 of 9)
- Capital Investment Is More Than the Standby UPS
- Operating Costs Are About the Same As the Standby UPS

# Double Conversion UPS



- Efficiency of About 93%
- Most Complete Power Protection Available
- Capital Investment Is the Highest of the Three Topologies Shown
- Operating Costs Are About the Same As the Standby UPS

# Caterpillar's Focus

- Increase the Systems Integration Focus
- Identify Products That Are Engine Generator Set Friendly
- Broaden the Systems Product Offering
- Develop a Value Proposition That Allows the Caterpillar Dealer to Offer a Complete Caterpillar Branded Solution

# Caterpillar's Focus

- Deliver a UPS offering capturing these features
  - Generator Set Friendly
  - High Efficiency (95%+)
  - Small Foot Print
  - Reduce Maintenance
  - Reduce Owning and Operating Costs

# Caterpillar's UPS Evaluation

## Standby

- Adequate for Home Office Applications, but Falls Short of Customer Expectations in Larger, Mission Critical Installations.
- Very Engine Generator Set Friendly

## Line Interactive

- Very Engine Generator Set Friendly.
- Handles Most of the 9 Power Problems.
- Increased Operating Costs Due to Load Interaction With the Batteries

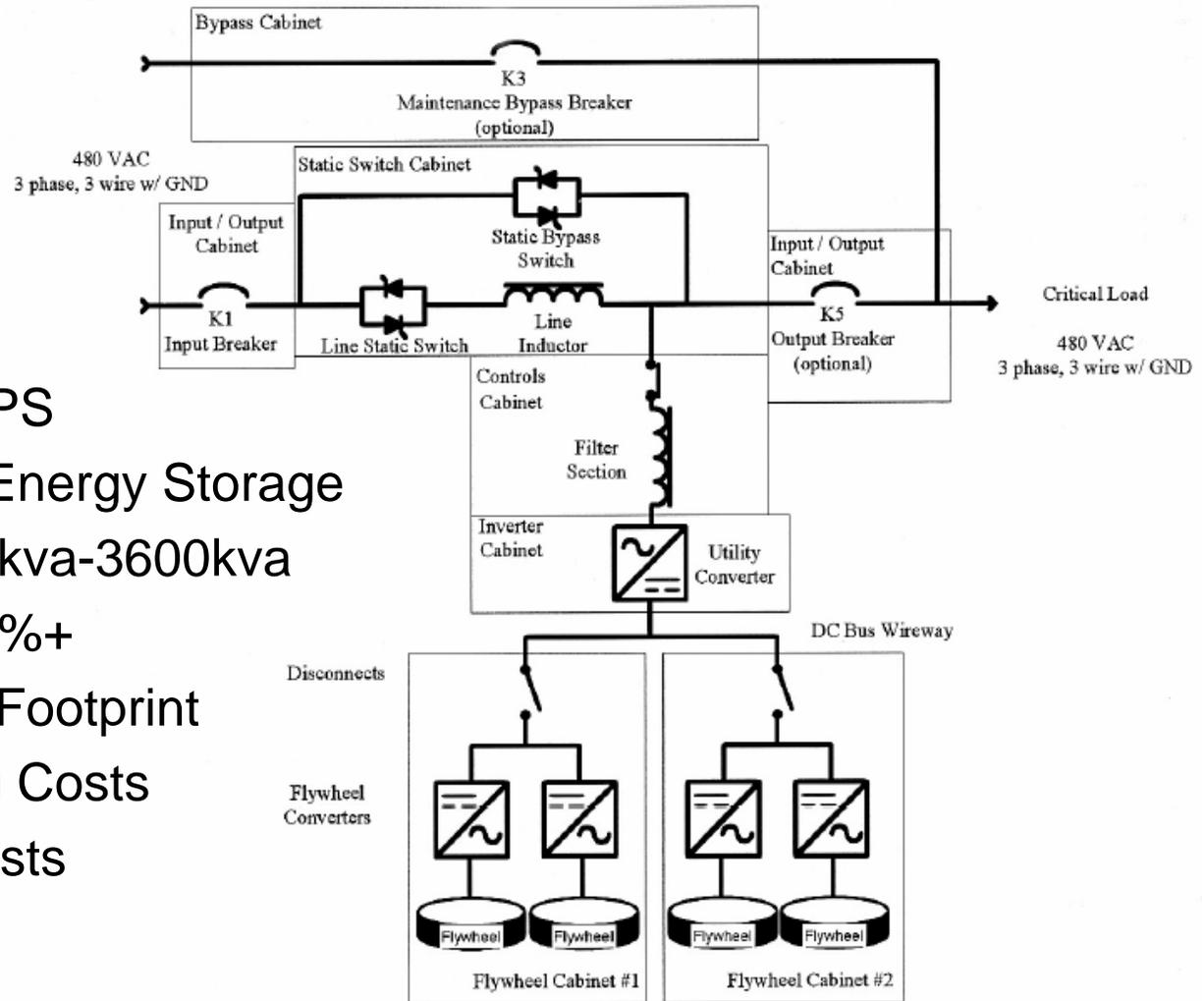
## Double Conversion

- Most Accepted by the Mission Critical Market
- Least Engine Generator Set Friendly Due to Switching Noise
- Increased Operating Costs Due to the Constant Load Interaction With the Batteries

# Caterpillar's Direction

- Identify a State-of-The-Art, Line-interactive UPS With Which to Enter the Market
- Utilizes an Alternative Form of Stored Energy (Not Battery Based)
- Integrate the Alternative Energy Storage Device Into the UPS
- Develop a UPS to Engine Generator Set Starter Power Path to Assure a Redundant Source of Starting Power to the Engine

# Caterpillar's Solution



- Line Interactive UPS
- Utilizes Flywheel Energy Storage
- Ranges From 120kva-3600kva
- Highly Efficient 97%+
- Smallest in Class Footprint
- Minimal Operating Costs
- Low Life Cycle Costs

# Caterpillar Solution

## Generator Set Start Module

- Redundant Starting Power Source
- Converts 480VAC to 24VDC
- Utilizes Existing UPS Power Source
- Typical Power Draw from UPS is 32 kVA.
- Provides 1725 Cold Cranking Amps at 24 VDC output to Genset Starter(s).

