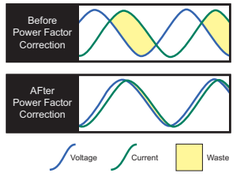
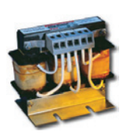
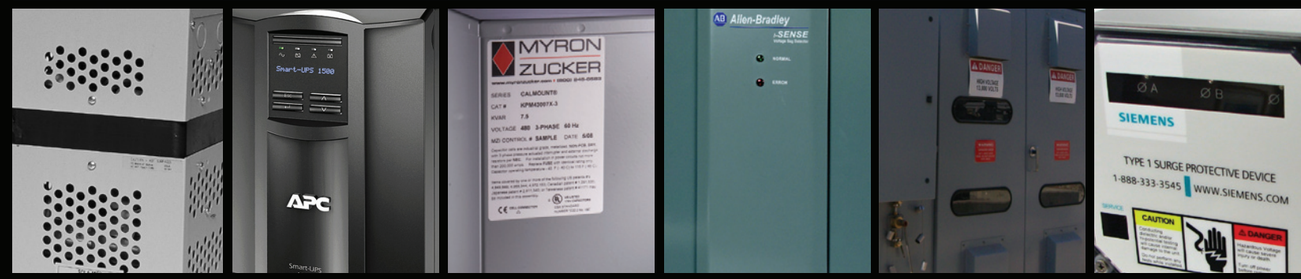
Power Quality Solutions Matrix

Electrical Disturbance	Causes / Effects	Solutions / Manufacturers
Power Factor Correction Power factor correction brings the power factor of an AC power circuit closer to 1 or unity by supplying reactive power. This is accomplished by adding the right capacitors or inductors to the power distribution system or end device. 	**Causes** • Increase of nonlinear loads like AC motors, solenoid valves, lighting ballast, arc welders, furnaces, rectifiers, variable frequency drives, power supplies, computer equipment or TVs **Effects** • Improve service or load power factor • Reduce line losses • Eliminate utility penalties and surcharges	***Solutions:*** Power Factor Correction Capacitor ***Manufacturers:*** Power Survey Myron Zucker 
Electrical Noise Electrical noise is a low amplitude, low current, high-frequency disturbance. 	**Causes** • High frequency generator • Static electricity • Electromechanical interface • Poor grounding or bonding • Poor wiring practices • Lightning strikes • Poor brush contacts **Effects** • Computer or process control glitches • Downtime	***Solutions:*** Active Tracking® Filters EMI/RFI Filters Isolation Transformers  ***Manufacturers:*** Acme MTE Sola HD TCI  
Harmonic Distortion This disturbance is a sine wave distortion of the voltage and current waveforms. Usually generated from internal nonlinear devices like power supplies, variable frequency drives (VFDs) and solid state electronics. 	**Causes** • Computers • Office equipment • Electronic ballast • Variable Frequency Drives (VFDs) • Electric furnaces and welders • Any device with a power supply **Effects** • Electrical terminations • Overheating neutral conductors • High neutral currents • Overheating transformers • Inadvertent tripping of breakers	***Solutions:*** Harmonic Filters Harmonic Mitigation Transformers ***Manufacturers:*** Acme Myron Zucker Power Survey TCI  
Frequency Variations While rare in utility power, frequency variations are most common with back-up power systems such as standby generators. 	**Causes** • Usually internally generated by onsite generation equipment • Out of frequency sequence • Disconnection of large loads and source generation • Computers • Office equipment **Effects** • Equipment failure, crashes or lockups • Loss of data	***Solutions:*** Power Conditioners UPS ***Manufacturers:*** APC by Schneider Electric Sola HD  

Schaedler yesco

Power Quality Solutions



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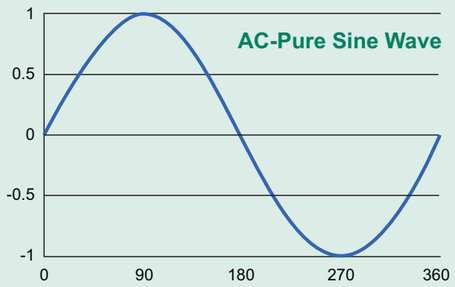
Power Quality Solutions

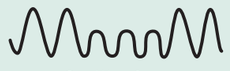
At Schaedler Yesco we recognized the importance of using our technical expertise and resources to develop awareness around power quality and disturbances. This subject is continuing to change with technology advancements in the smart utility grid and the further use of electronic equipment or smart devices in power distribution systems. Some of the key factors of implementing a good platform and sound power quality plan include:

- Understanding of the symptoms
- Field measurements and surveys to pin point the problem
- Corrective action plan with the right solution
- End goal in mind; develop and maintain a " Pure Sine Wave"

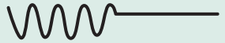


Power quality, simply stated, determines the health and stability of electrical distribution systems in residential, commercial and industrial facilities. These electrical variables are found both inside and outside the facility and comprise of anything that affects the pure sine waveforms components—variation in voltage, current and frequency. Even though utilities cause many power quality problems, such as voltage sags, recent studies by research organizations, like the Electric Power Research Institute (EPRI), have found that utility users cause 70 to 90 percent of their own power quality problems. Users are faced with numerous challenges to prevent these various electrical or power disturbances.

- Voltage Sags
- Voltage Swells
- Power Loss and Interruption
- Surge or Transients
- Poor Power Factor
- Electrical Noise
- Harmonics
- Frequency Variations


Sag Waveform

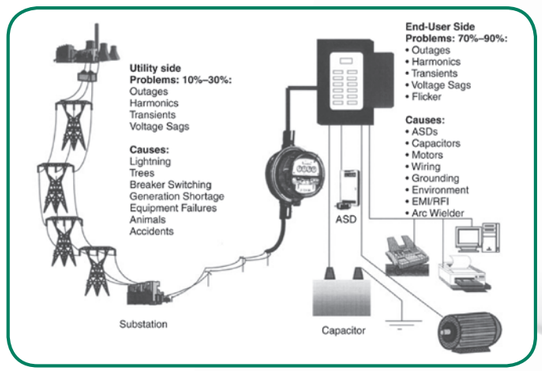

Swell Waveform


Power Loss Waveform


Surge or Transients Waveform

From an economic and operational standpoint, we realize end users are faced with multiple challenges in trying to mitigate these unwanted power disturbances. For these main reasons, the Schaedler Yesco team is in position to show the value of various power quality solutions.

Overview of Power Quality Issues (Utility and End User Side)



Impact of Power Disturbances

Poor power quality can negatively impact both the performance and the life expectancy of power distribution systems and electrical equipment. One of the challenges is trying to identify the cost impact of these disturbances and ensuring you have consistent and stable power for your operation. Part of the power assessment or return on investment is to evaluate the economics of the various power quality solutions.

Some of these impact areas and potential cost saving measures include:

- Loss of Power – Critical Loads
- Equipment Deterioration and Failures
- Equipment and Production Downtime – Cost Implications
- Equipment Overheating
- Penalty Charges from Electric Utilities
- Limit Electrical Distribution System Capacity
- Data Loss
- Inadvertent Tripping of Protection Equipment
- Additional Maintenance

Power Quality Measurement

One of the first step in solving any power quality issue or disturbance is to determine the cause of the problem. Other than a visual inspection, making the proper power measurements is the key in coming up with the next action steps and possible solution. Schaedler Yesco has a wide range of power loggers, portable and fixed power quality meters.

- Power Loggers / Portable Meters: Amprobe, Dent Instruments, Fluke and Rockwell Automation
- Fixed Meters: Eaton, E-Mon D-Mon, Leviton, National Meter and Siemens

Power Quality Solutions Matrix

Electrical Disturbance	Causes / Effects	Solutions / Manufacturers
Voltage Sags Reduction in voltage for a short period of time, or a voltage variation below nominal RMS voltage with a duration of half cycle up to a minute or more. Also called undervoltage conditions, voltage dips or voltage flicker. 	**Causes** • Loads with large inrush currents • Large motor starting • Arc furnaces and welders • Utility switching equipment **Effects** • Reduce equipment efficiency and lifespan • Nuisance undervoltage limit trips	***Solutions:*** Ferroresonant transformers Power Conditioners Sag Controllers UPS Voltage Regulators ***Manufacturers:*** Acme APC by Schneider Electric Rockwell Automation/Softswitch technologies Sola HD 
Voltage Swells Opposite of the voltage sag, a swell is a voltage variation above nominal RMS voltage with a duration of half cycle up to a minute or more. Swells can also have a longer duration. Also called overvoltage or voltage surges. 	**Causes** • Increased energy surge • Large load shutdowns • Cycling of large motors and HVAC systems • Loads with large inrush currents • Utility load shedding • Line to ground faults with lightning or tree making contact with a live conductor **Effects** • Equipment overheating • Nuisance overvoltage limit trips	***Solutions:*** Isolation transformers Line Filters Power Conditioners ***Manufacturers:*** Acme MTE Sola HD TCI 
Power Interruptions Complete loss in power or voltage for an extended period of time. ***Brownouts*** are a drop in voltage for an extended period of time. This can be intentional or unintentional. Also called brownouts and blackouts. 	**Causes** • Utility grid or network issues • Utility equipment failure (accident or storm) **Effects** • Excessive circuit overloading • Overcapacity or high demand • Reduce equipment efficiency and lifespan • Computer or process equipment crashes and failures • Data Loss	***Solutions:*** UPS Generators Energy Storage Systems ***Manufacturers:*** APC by Schneider Electric Siemens Rockwell Automation 
Surges or Transients Transients are a sudden decrease or increase of voltage or current. Lightning strokes are a good example of impulsive transients. Surges or transients can also be called spikes. 	**Causes** • Lightning strokes • Tripped breakers • Startup of large equipment **Effects** Sensitive equipment is at risk • Equipment failure, crashes or lockups • Data Loss	***Solutions:*** Surge Protective Devices (TVSS - old term) ***Manufacturers:*** APC by Schneider Dehn Mersen Siemens Sola HD Total Protection Solutions