

# Handheld Products



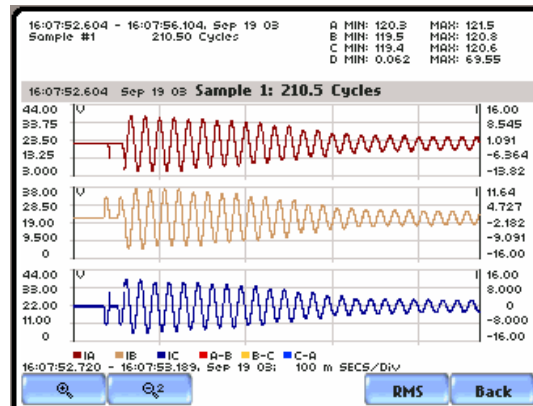
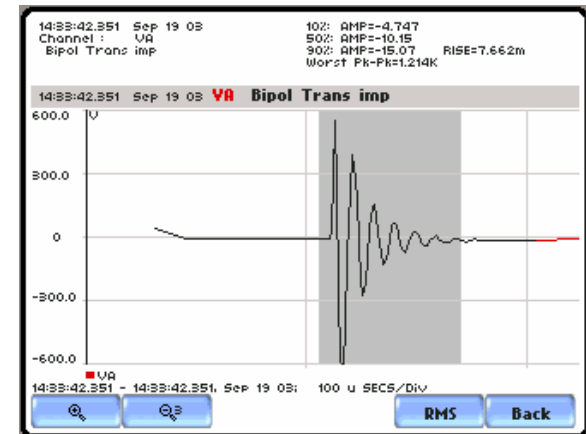
# Handheld Products

- Next generation of handheld products...
  - PowerVisa
  - PowerGuide 4400
  - PowerXplorer PX5
  - PowerXplorer PX5-400
- **Most advanced, most colorful feature set on the market**
- **Simplest user interface**



# Handheld Products

- Application Oriented Products
  - Price & Features targeted towards users budget & capabilities
  - New product mix repositions Dranetz-BMI in the market.
  - Today: Open doors closed previously by price & product obsolescence
  - Tomorrow: Open new doors by identifying new applications
    - “Outside the box”



# Common Features

- Display
  - 1/4 VGA Color Touch-Screen Display
    - Use finger, stylus, etc.
  - Color Graphical User Interface
    - Icon based
    - PDA Like
    - Very appealing look & feel!
- Ethernet, USB, Serial Communications
- New Design
  - Designed for compliance with present (and future) PQ & power measurement standards
    - IEEE 1159 – US PQ
    - IEEE 519 – US Harmonics
    - IEEE1453 – US Flicker
    - IEC 61000-4-30 Class A – Int. PQ
    - IEC61000-4-7 Int. Harmonics
    - EN50160 - Europe



# Common Features

- Data Acquisition

- 8 Channels
  - 4 Differential Voltage, AC/DC
  - 4 Current, AC/DC
- 256 Samples Per Cycle
- Harmonics to the 63<sup>rd</sup>
- Low Freq Transients (up to 5KHZ)
- Medium Freq Transients (5-10KHZ)



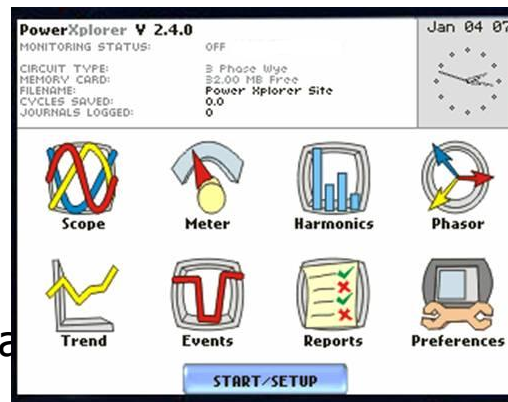
- Accessories

- All 4300 & 658 (with adapter) compatible CT's
  - Re-use existing inventory
  - TRxxx, LEMFlex, DC, etc.
- Weather resistant enclosures
- Communications adapters
  - Ethernet, USB, Serial
- Software
  - DranView 6.x
  - NodeLink



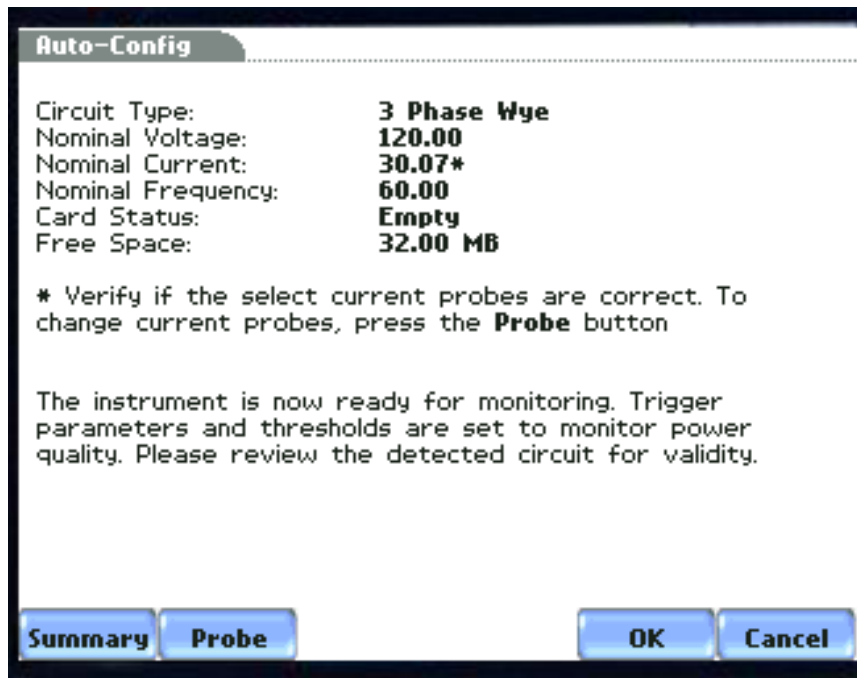
# Common Features

- Triggers
  - Voltage & Current RMS
  - Voltage & Current Transients
    - PK RMS, (2) Waveshape triggers
- Power parameters
  - W, VA, PF, etc
- Harmonics, Interharmonics
- Flicker
- Languages
  - English
  - French
  - Italian
  - German
  - Spanish
  - Swedish
  - Chinese (Simplified, tra
  - Korean
  - Japanese
  - Finnish



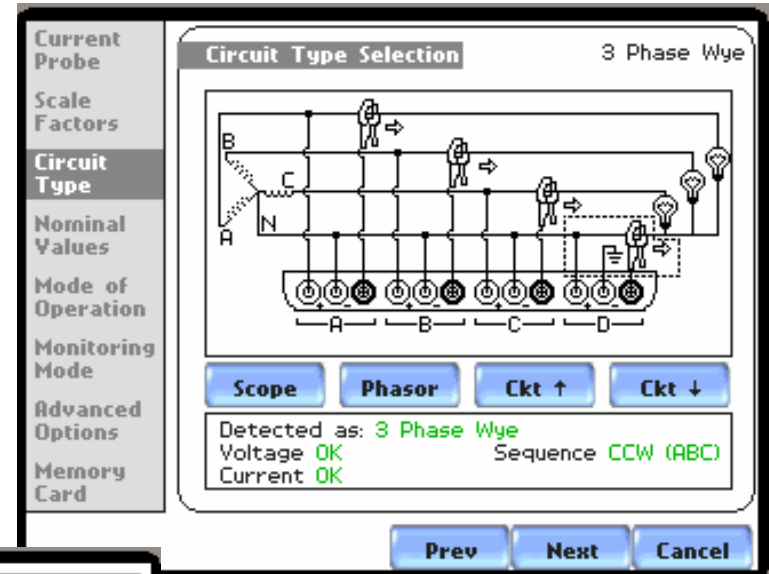
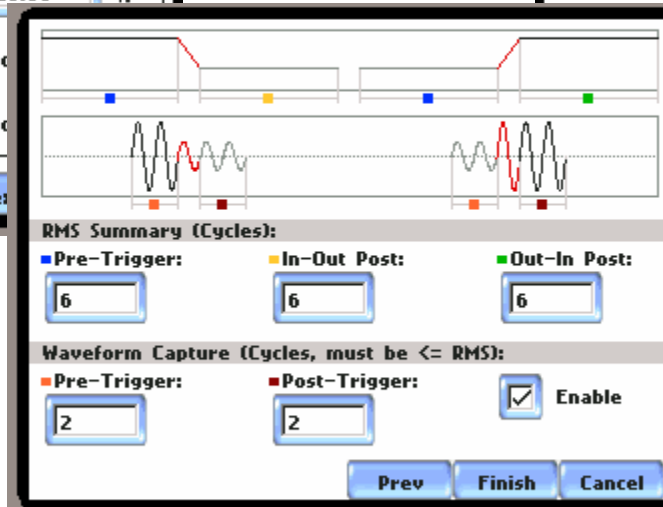
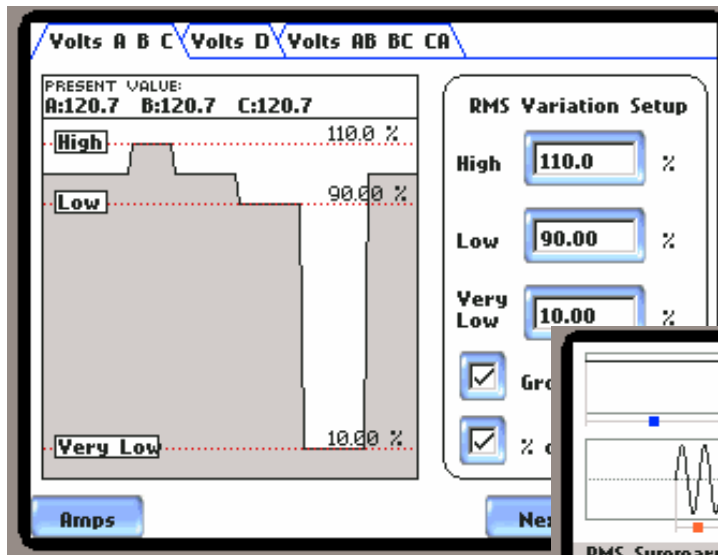
# Ease of Use

- Automated setups!
  - Automatically detects wiring configuration
  - Automatically detects nominal voltages
  - Automatically configures appropriately
  - Provides feedback of wiring mistakes
  - Just press OK to GO!



# Ease of Use

- Intuitive Manual Setups
  - Powerful yet easy to use
  - Color, graphical user feedback
  - Shows what will be captured!





# New Answer Modules!

- Available for 4400, PX5, PX5-400
  - Sag Directivity
  - Power Factor Capacitor Switching
  - Motor Panel
  - Not available on PowerVisa

Motor Panel			Since: 11:51:10, Oct 07 04
<b>Voltage (Vrms)</b> 120.88 120.26 120.88	<b>Current (Irms)</b> 30.07 32.06 30.16	<b>V Imbalance (%)</b> 0.05 2.50 0.05	
<b>True PF</b> -0.88 -0.86 -0.86	<b>Horsepower</b> 4.27 4.16 4.16	<b>I THD (%)</b> 0.75 4.05 0.75	
<b>Neg Seq Current</b> 0.29	<b>Derating Factor</b> 1.08 1.26 1.00	<b>Monitoring</b> ON	
<b>Clear</b>			<b>Exit</b>

10:18:36.599 Mar 04 04 Channel AV			
Trigger	Threshold	Min	Max
RMS High, Low, Very Low	264.0 216.0 24.00	15.15	174.0
Absolute Instantaneous Peak	400.0	18.52	328.1
RMS Distortion Waveshape	16.80	163.0	254.6
Cycle-to-cycle Waveshape	24.0, 10.0%	Triggered	
Integrated High Frequency Trigger	240.0	Not Triggered	

10:18:36.599 - 10:18:36.619, Mar 04 04  
 CHANNEL:: AV,  
 CATEGORY: Short Duration  
 CLASSIFICATION: Instantaneous Sag  
 DURATION: 1.50 Cycles (30.00mSECS)  
 DIRECTION: Upstream

Chan    +    -    Back



# Sag Directivity

- Sag Directivity
  - Based upon Encore Series System technology
  - Determines if a voltage Sag/Dip originated upstream or downstream from the monitoring location.

Trigger	Threshold	Min	Max
RMS High, Low, Very Low	264.0 216.0 24.00	15.15	174.0
Absolute Instantaneous Peak	400.0	18.52	328.1
RMS Distortion Waveshape	16.80	163.0	254.6
Cycle-to-cycle Waveshape	24.0, 10.0%	Triggered	
Integrated High Frequency Trigger	240.0	Not Triggered	

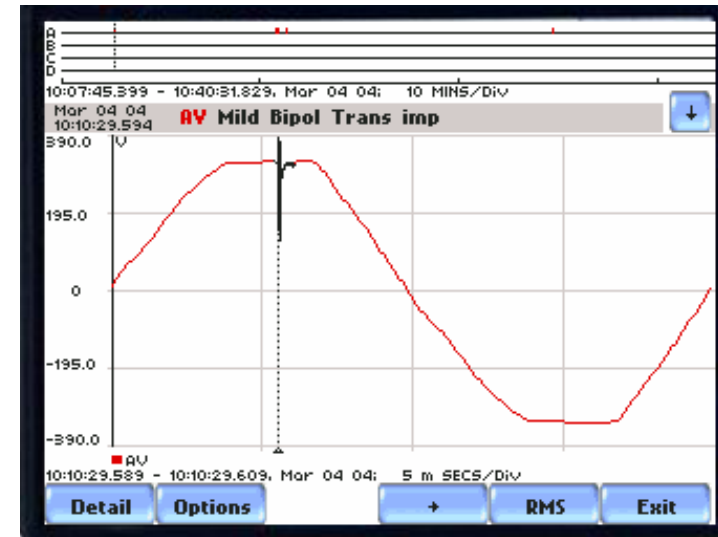
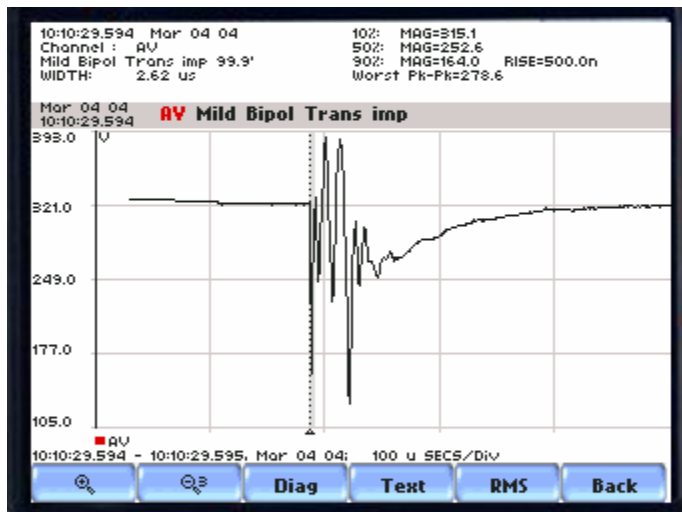
10:18:36.599 - 10:18:36.619, Mar 04 04  
CHANNEL: AV  
CATEGORY: Short Duration  
CLASSIFICATION: Instantaneous Sag  
DURATION: 1.50 Cycles (30.00mSECS)  
DIRECTION: Upstream

Chan    +    +    Back



# Power Factor Correction Switching

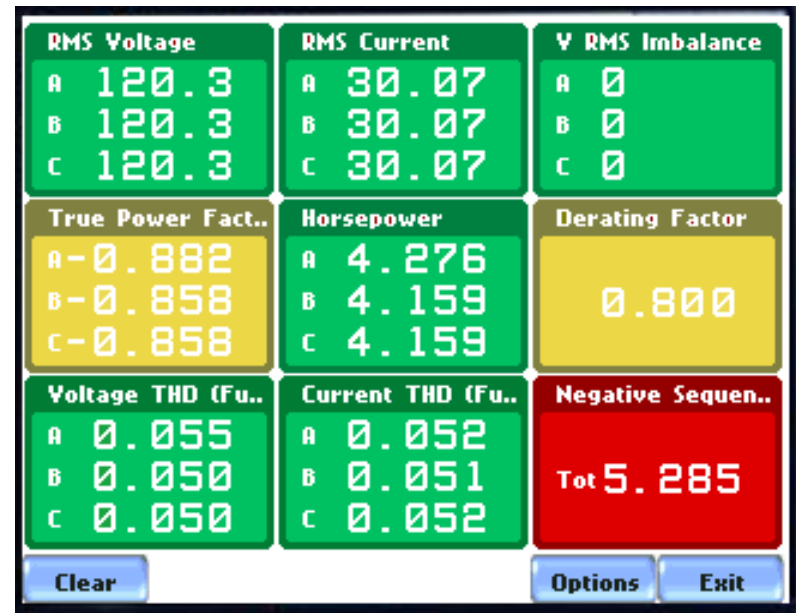
- Identifies the signature of a PF capacitor transient.
- Determines directivity of the capacitor as upstream or downstream from the monitoring location



# Motor Quality

- Motor Annunciator

- Motor health and diagnostics
- Derating Factor – Dranetz-BMI exclusive indicator of motor health and degradation.
  - Based on  $V_{rms}$ ,  $I_{rms}$ , Unbalance, THD, Sequence Components, Hp
- Color coded alarm panel indication
  - New parameters plus  $V$ ,  $I$ ,  $W$ , PF, Sequence components, Unbalance, THD, and more!



# Accessories

- Optional Accessories
  - Most 4300 accessories
  - CT's
    - TRxxx
    - LEMFlex
    - AC/DC
    - ISO658
  - Communications
    - Ethernet, USB, RS232
  - Enclosures
    - LPC
    - NEMA
  - CF Memory
    - 64MB, 128MB, 256MB
  - XBC-PX5 External Batter Charge
    - UPS to power LEM probes



# Feature & Applications Guide



	<b>PowerVisa 440</b>	<b>PowerGuide 4400</b>	<b>PowerXplorer PX5</b>
<b>Power Quality Testing (IEC61000-4-30 Class A, IEEE1159)</b>	X	X	X
<b>Energy/Load Surveys &amp; Studies</b>	X	X	X
<b>Advanced Load Distortion and Imbalance</b>			X
<b>400 HZ Measurements</b>			<b>PX5-400</b>
<b>Fault Recording / In-Rush</b>		X	X
<b>Motor Testing</b>	X	X	X
<b>Data Logging</b>	X	X	X
<b>Harmonic Analysis to 63<sup>rd</sup> (IEC61000-4-7, IEEE519)</b>	X	X	X
<b>Flicker per IEC61000-4-15, IEEE1453</b>	X	X	X
<b>High Speed Transient Capture</b>			X
<b>AnswerModules (motor health, cap switch, sag)</b>		X	X
<b>Monitoring Modes</b>	<b>4</b>	<b>7</b>	<b>7</b>
<b>Pre/Fault/Post Cycles</b>	<b>100</b>	<b>10,000</b>	<b>10,000</b>
<b>12 Languages</b>	X	X	X

# PowerVisa

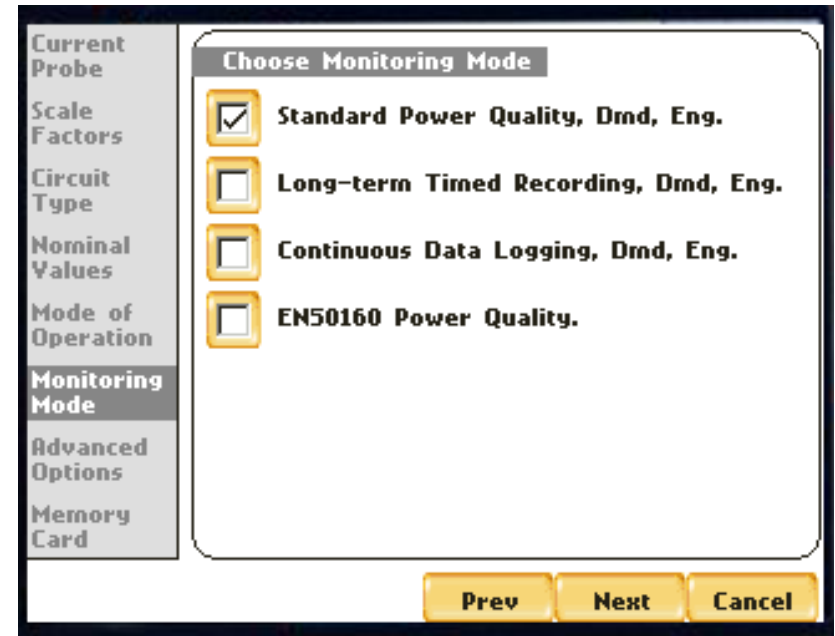


Specific  
Features & Benefits



# PowerVisa

- Powerful, yet cost effective PQ, Demand & Energy
- Easy to Use
- 4 Monitoring Modes
- 100 cycles per event capacity
- 11 Languages

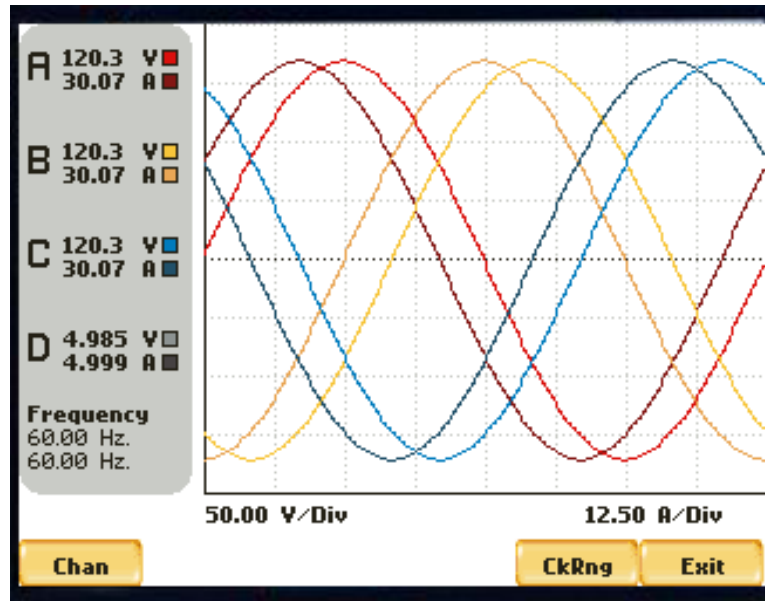




# PowerVisa

## Applications

- Compliance testing
- General PQ
- Energy Surveys
- Motor Testing
- More...



Standard		Distortion	
Basic	Volts	Amps	
Comp Basic	A	120.3	30.07
Power	B	120.3	30.07
Demand	C	120.3	30.07
Energy	D	4.985	4.999
Harmonics	A-B	209.3	*
Flicker	B-C	209.3	*
	C-A	206.3	*

\* Derived values

Exit

# PowerGuide 4400

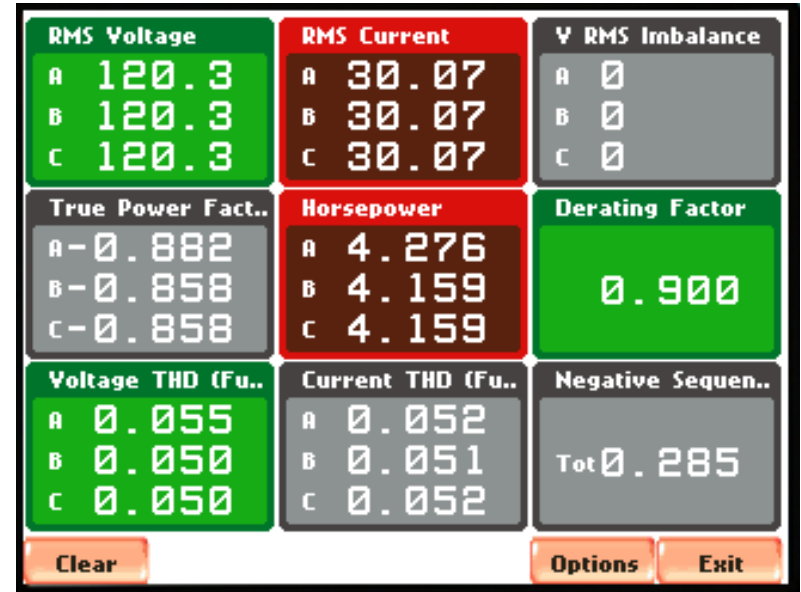


Specific  
Features & Benefits



# PowerGuide 4400

- Full Featured
- Easy to Use
- All PowerVisa Features
- Answer Modules
- 7 Monitoring Modes
- 10,000 cycle per event capacity



**Choose Monitoring Mode**

- Standard Power Quality, Dmd, Eng.
- Current Inrush.
- Fault Recorder.
- Long-term Timed Recording, Dmd, Eng.
- Continuous Data Logging, Dmd, Eng.
- EN50160 Power Quality.
- Motor Quality.

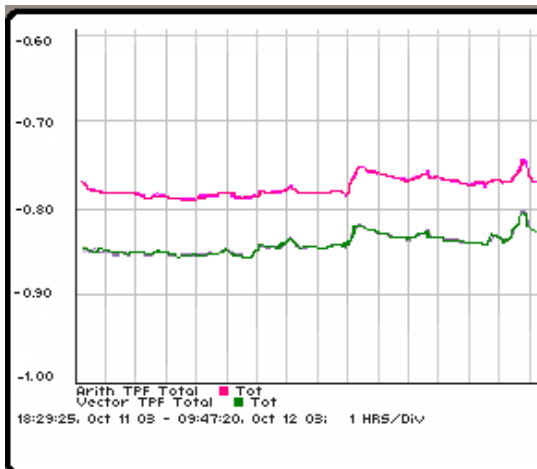
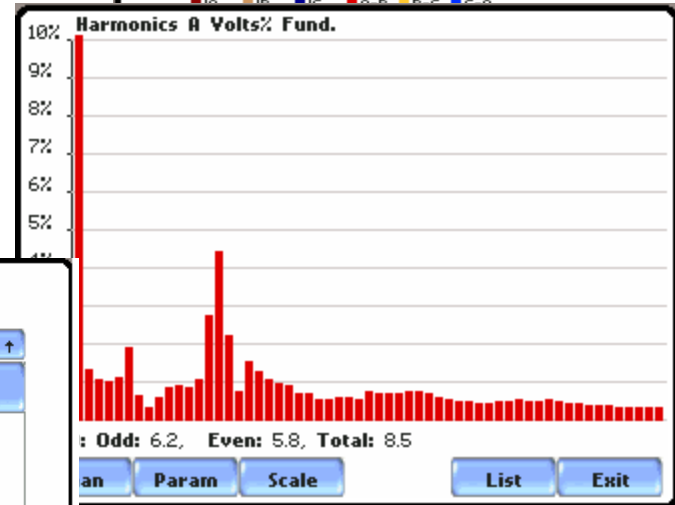
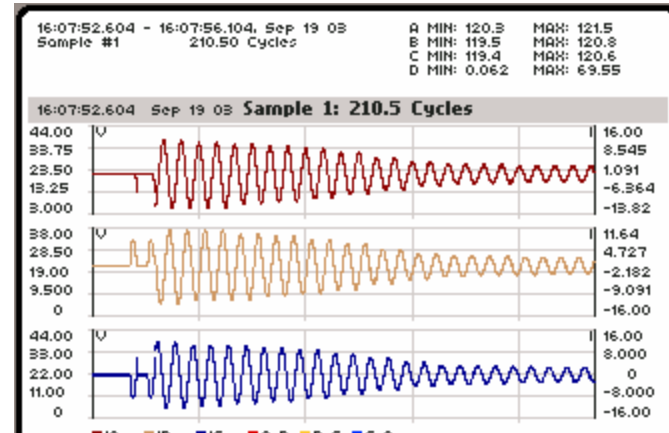
**Prev** **Next** **Cancel**



# PowerGuide 4400

## Applications

- Inrush
- Fault Recorder
- Motor Testing
- Power Studies
- System Commissioning/compatibility
- Telecommunications
- General Troubleshooting



16:09:58.590	Sep 19 03	VA Instantaneous Swell.
16:10:09.136	Sep 19 03	VA Instantaneous Sag.
16:10:18.870	Sep 19 03	VA Instantaneous Swell.
16:10:26.773	Sep 19 03	VA Instantaneous Sag.
16:10:32.056	Sep 19 03	VA Instantaneous Swell.
16:10:34.890	Sep 19 03	VA Instantaneous Sag.
16:09:42.425	Sep 19 03	VA Dropout 1/16 Cyc
16:09:42.423	Sep 19 03	VA Severe Bipol Trans 1/2 Cyc
16:09:42.431	Sep 19 03	VA Severe Bipol Trans 1/2 Cyc

OK Cancel



DRANETZ  
BMI

# PowerXplorer PX5, PX5-400

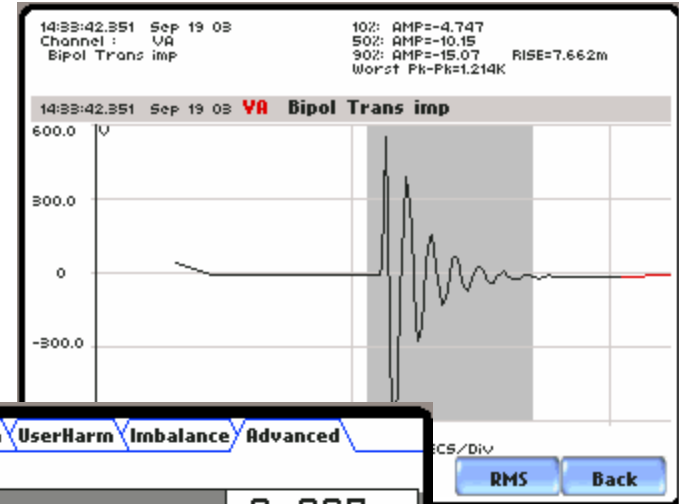


Specific  
Features & Benefits



# PowerXplorer PX5, PX5-400

- Advanced Power Quality Analysis
- Includes all PowerGuide 4400 Features
- High Speed Digitized Transients
- Advanced Power Analysis
  - IEEE1459
- PX5-400 – 400HZ



Standard Distortion UserHarm Imbalance Advanced

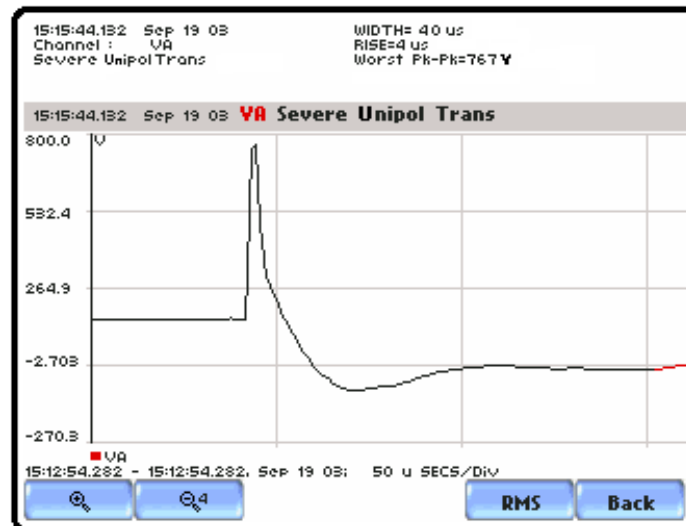
Arith Sum	Vector Sum PF	0.967
Vect Sum	Vector Sum DPF	0.967
Peak Power	Vector Sum VA	1.720K
Pred. Power	Fund Vector Sum VA	1.719K
Coin. Power		
Coin. PF		
Adv Energy		
Adv Pinst		

Exit

# PowerXplorer PX5, PX5-400

## Data Acquisition

- All PowerGuide 4400 Plus...
- High Speed Digitized transients
  - 1MHz Scope Like Sampling
    - 4V @1MHZ, 4I @0.5MHZ
- PX5-400
  - Hardware "Tuned" for 400HZ
- 50/60HZ, 16/20HZ (PX5)
- 400HZ, 50/60HZ (PX5-400)



# Data Acquisition Techniques





# *PV/4400/PX5 Data Acquisition*

## **RMS Cycle by Cycle measurements**

- 256 samples per cycle
- Sampling is gapless -- Continuous measurement with no gaps between AC cycles
- Phase Locked Loop (PLL) control for synchronous sampling
- 16 Bit Analog to Digital (A/D) converter for low and medium frequency signals.



# *PV/4400/PX5 Data Acquisition*

- **Journals** are measurements and computations recorded to memory based upon a timer. Min/Max/Average for 1000s of parameters
- **Transients** can be triggered and captured by magnitude & duration windows, rms deviation, integrated high freq energy; voltage and current
- **RMS Variations** per IEEE 1159 or IEC 61000-4-30 Class A; voltage and current
- **Flicker** – Pst, Plt, and sliding Plt per 61000-4-30 Class A
- **Harmonics and Interharmonics** – per 61000-4-7, voltage and current
- Other 61000-4-30 Class A Parameters
  - Frequency
  - Magnitude of Supply
  - Under/Over Deviation Voltage
  - Unbalance; voltage and current, sequence components and deviation from average



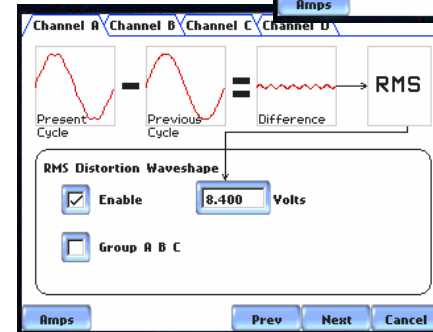
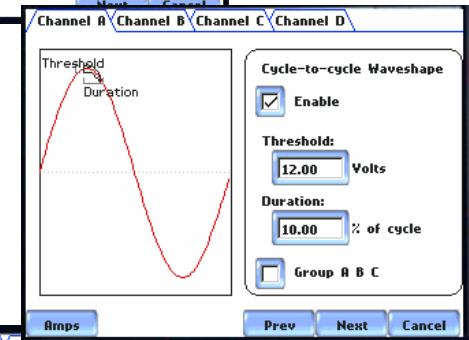
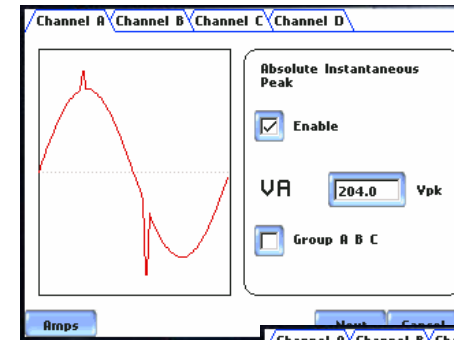
# PV/440/PX5 Data Acquisition

## Transients

RMS (256 s/c) samples are used to detect low and medium (as defined by IEEE) frequency transients. No high speed transients.

- PV/4400 Trigger methods

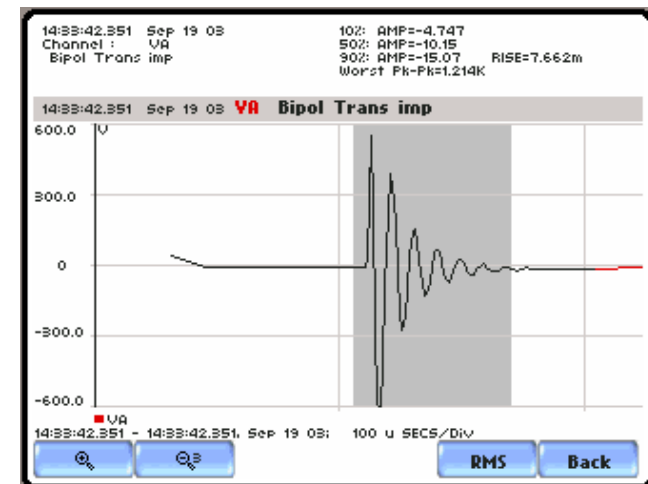
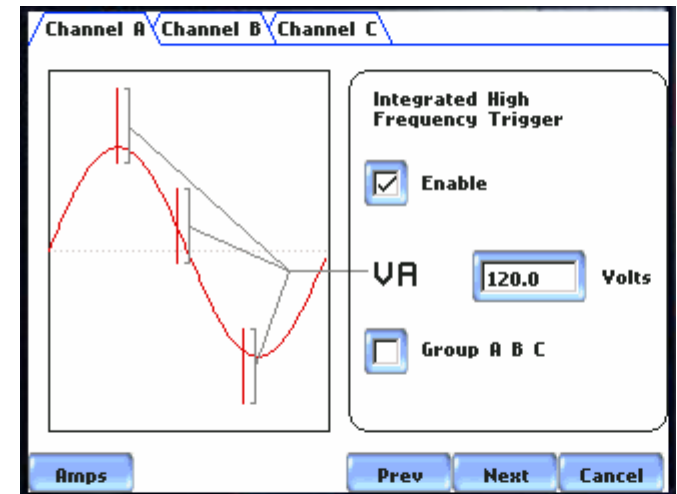
- Waveshape triggers
  - Cycle-to-cycle and difference methods
  - Compares present cycle to previous cycle
- Absolute instantaneous peak
  - Maximum peak (RMS) sample



# PX5 Data Acquisition

## Transients

- PV/4400 methods PLUS high speed digitized transients
- PX5 Digitizes high speed transients like a digital oscilloscope. Provides the user magnitude, point on wave and picture of transient
- 14 bit Analog to Digital (A/D) converter
- Sampling rate:
  - Voltage: 1Mhz
  - Current: 0.5Mhz



# *PV/4400/PX5 Data Acquisition*

## **RMS Voltage and Current Triggers**

- In accordance with IEC61000-4-30 Class A
- Voltage **and** Current measured in the same way
  - Goes beyond PQ standards and triggers on current
- User selectable pre and post trigger **waveforms** recorded
  - AC Waveforms recorded during PQ events
    - PowerVisa: Up to 100 cycles
    - 4400, PX5: Up to 10,000 cycles
- User selectable pre, post RMS **trend** data recorded
  - Records RMS computed for each cycle in addition to waveforms



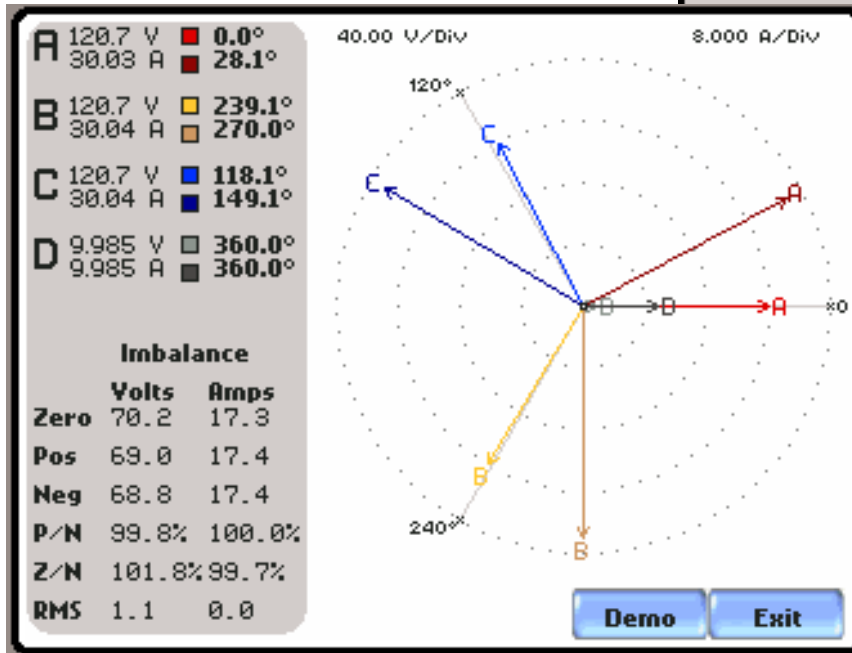
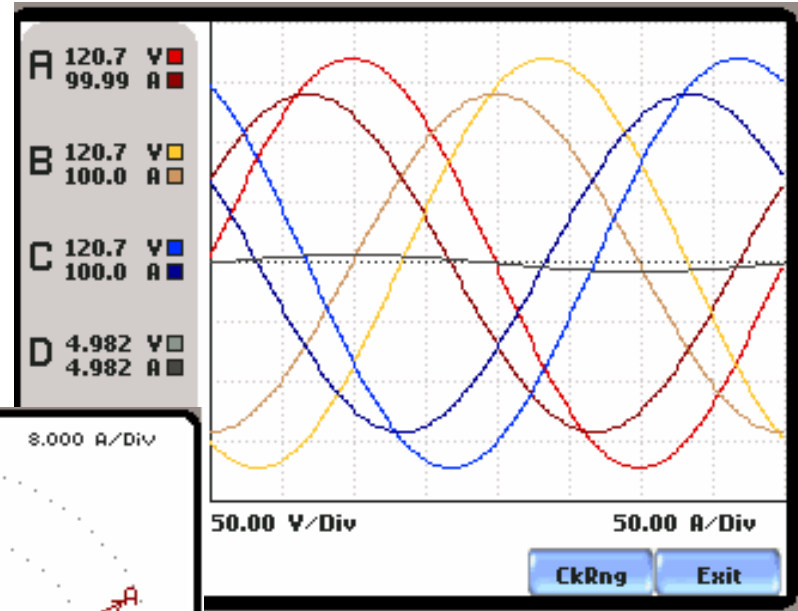
# Getting Around

- Real Time
- Settings
- Preferences
- Data review
- Reports



# Scope and Phasor Modes

- Colors matched to input connectors
- CheckRange
  - Feedback on voltage & current measured compared to range



# Meter Mode

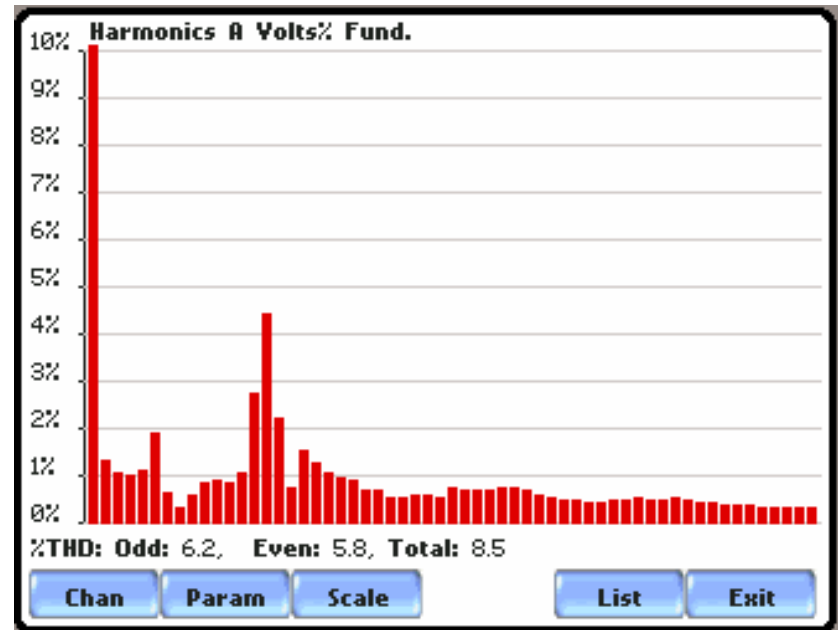
- Tab delineated
- Large numbers
- Easy to navigate
- PowerVisa, 4400
  - Simple to use
  - Reduced parameter set
  - Standard Tab
  - Distortion Tab
- PowerXplorer PX5, PX5-400
  - Advance parameter set
  - All tabs available

Standard				Distortion		UserHarm		Imbalance		Advanced	
Basic		Volts				Amps					
Comp Basic	A	120.7				99.99					
Power	B	120.7				100.0					
Demand	C	120.7				100.0					
Energy	D	4.982				4.982					
Harmonics	A-B		210.1								
Flicker	B-C		210.1								
	C-A		207.1								
<input type="button" value="Exit"/>											



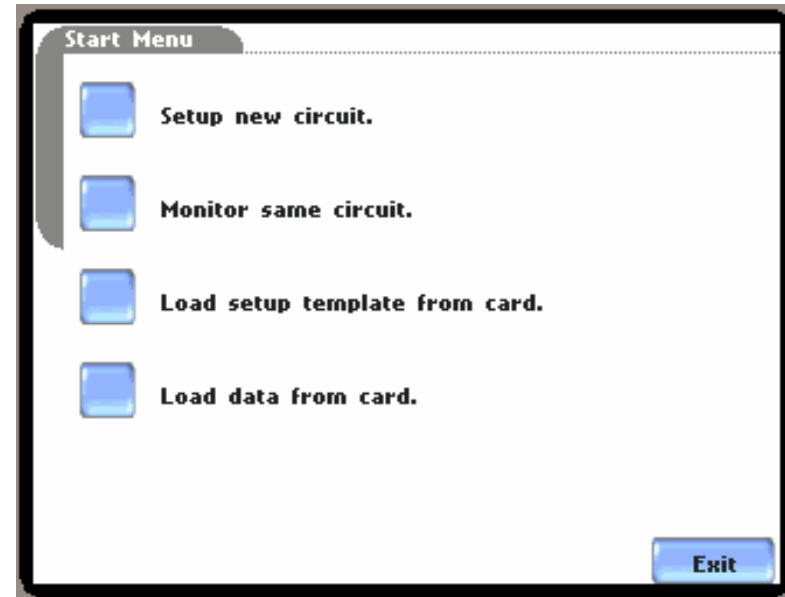
# Harmonics

- To the 63<sup>rd</sup>
- Per 61000-4-7
- Interharmonics
- Color coded to match input channels
- Harmonic Watts
  - Directivity based on Phase angle of watts



# Start/Setups

- Begin or Continue Monitoring
  - Wizard-like approach
  - Automatic or manual setups
  - Only change or enable desired parameters
- Load previously recorded data
- Load setups



# Auto-Config

- Automatically Detects
  - Circuit type
  - Nominal V & I
  - Nominal Frequency
- Summary of resultant settings
- Yes
  - Use auto-config
  - One more click and your off!
- No
  - Manual setup
- Best of both worlds:
  - No setups
  - Full control (setups)
  - User comfort level driven

The screenshot shows a software window titled "Auto-Config". It displays the following information:

Circuit Type:	<b>3 Phase Wye</b>
Nominal Voltage:	<b>120.00</b>
Nominal Current:	<b>30.07*</b>
Nominal Frequency:	<b>60.00</b>
Card Status:	<b>Empty</b>
Free Space:	<b>32.00 MB</b>

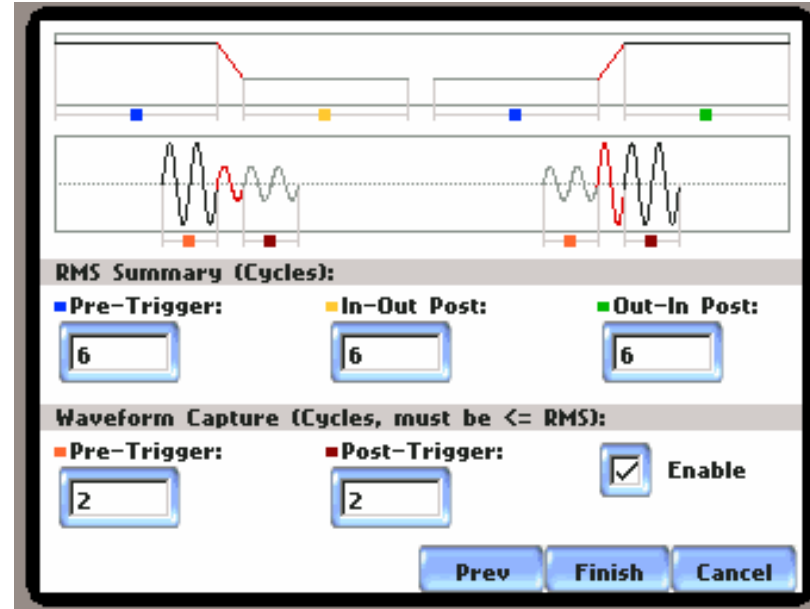
\* Verify if the select current probes are correct. To change current probes, press the **Probe** button

The instrument is now ready for monitoring. Trigger parameters and thresholds are set to monitor power quality. Please review the detected circuit for validity.

At the bottom, there are four buttons: "Summary", "Probe", "OK", and "Cancel".

# Manual Setups

- Complete control over monitoring
- Colorful User Feedback
  - Pictures show effects on recording
  - Parameter entry color matched to resultant picture
  - Simplifies complicated setups
- Group A, B, C the same if desired
- Signature System-like settings
  - RMS Triggers
    - RMS trend recorded with waveforms
  - Waveshape Triggers
    - Window (8800-like)
    - Difference (DAQ-like) also available (not in SigSys).
  - Journalled parameters
    - Log by time and limits
    - Low-low, low, high, high-high



# Transients

Window



Channel A Channel B Channel C Channel D

Threshold

Duration

Cycle-to-cycle Waveshape

Enable

Threshold: 12.00 Volts

Duration: 20.00 % of cycle

Group A B C

Amps Prev Next Cancel

Channel A Channel B Channel C Channel D

Present Cycle - Previous Cycle = Difference → RMS

RMS Distortion Waveshape

Enable 8.400 Volts

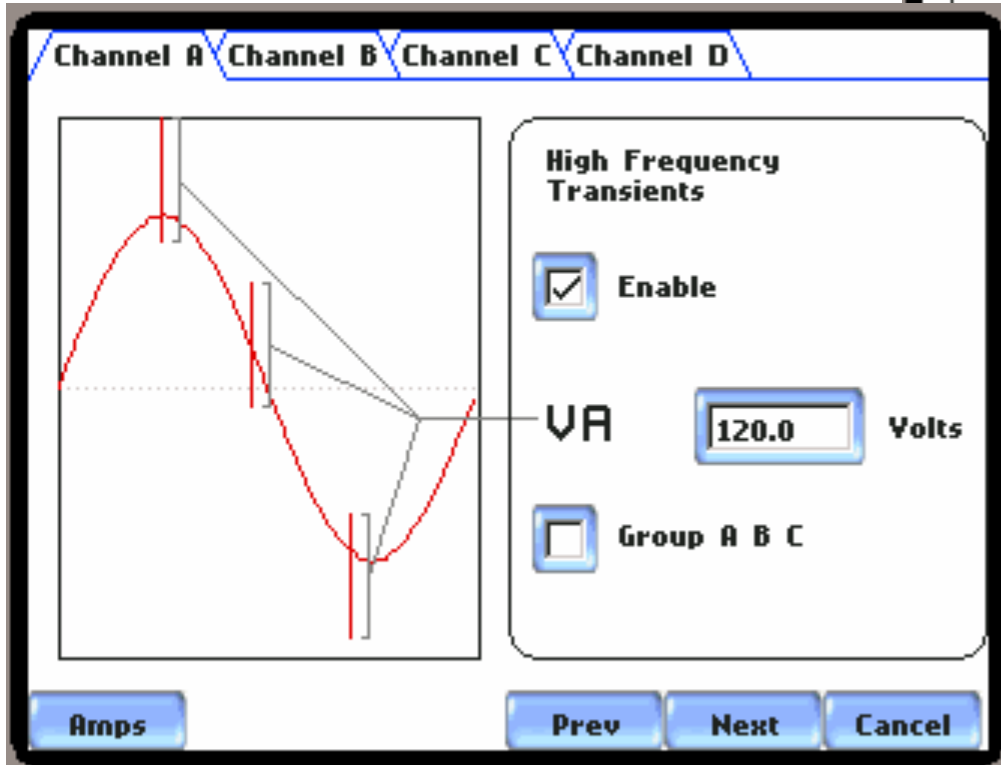
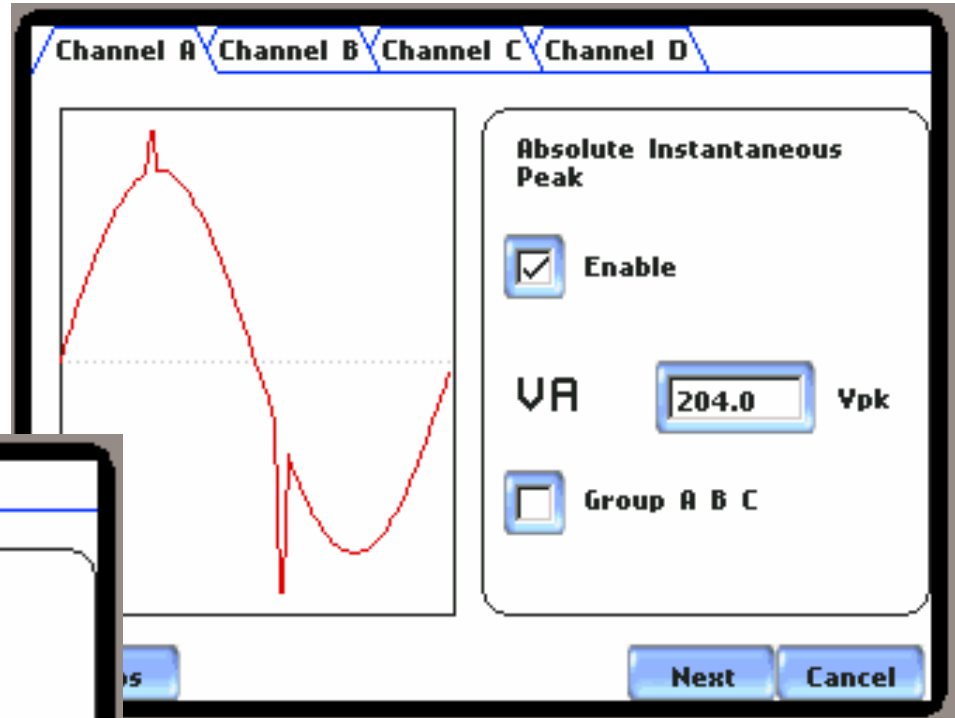
Group A B C

Amps Prev Next Cancel

← RMS Difference

# Transients

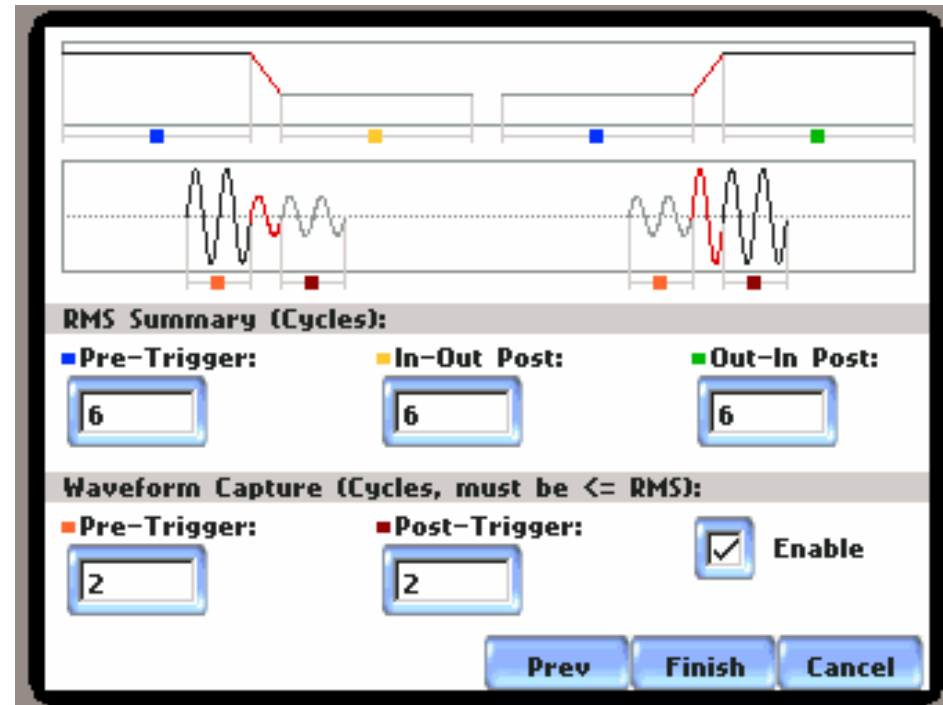
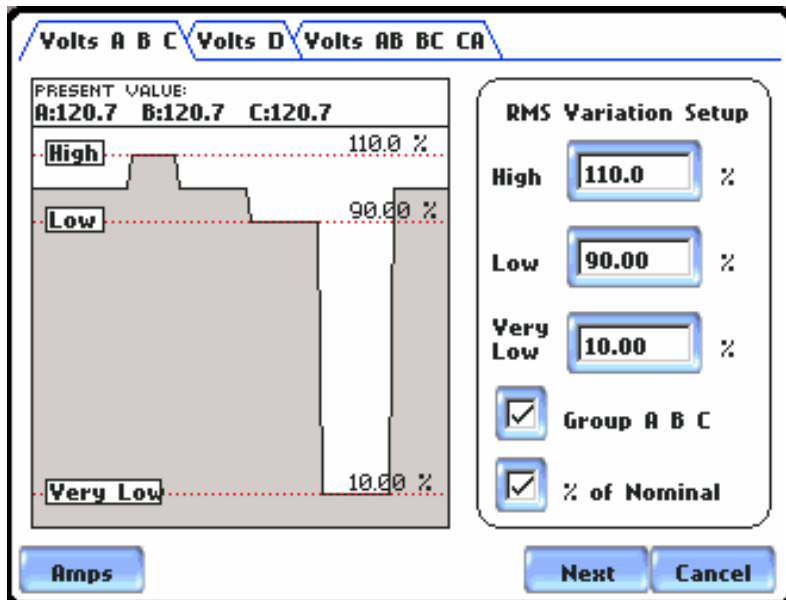
Absolute Instantaneous Peak



High Frequency

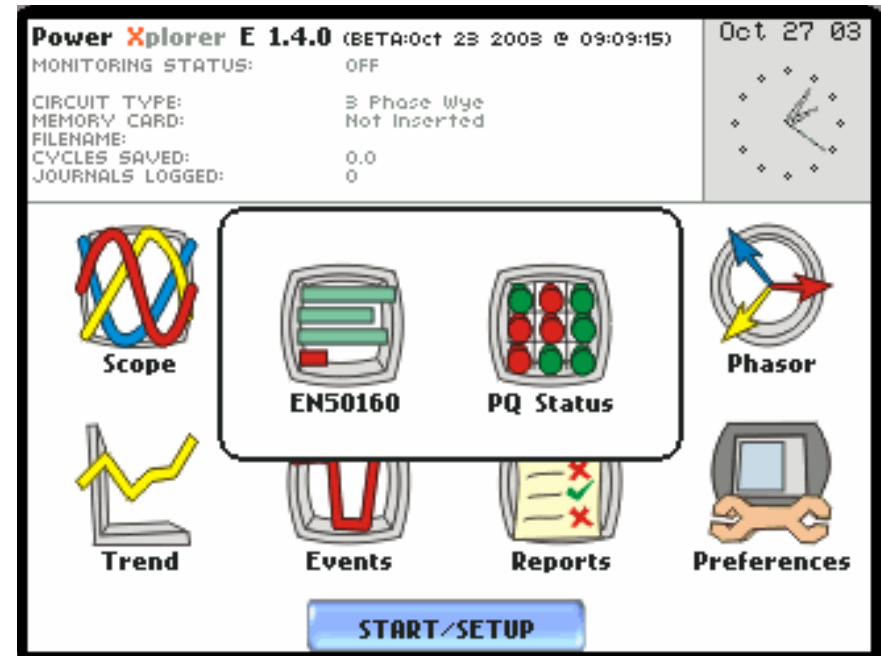
# RMS Triggers

- Colorful Visual Feedback
  - See effects of settings
- Waveforms and RMS Trend
- Variable Pre/Post Waveforms
- Variable Pre, Fault, Post Trend



# Reports

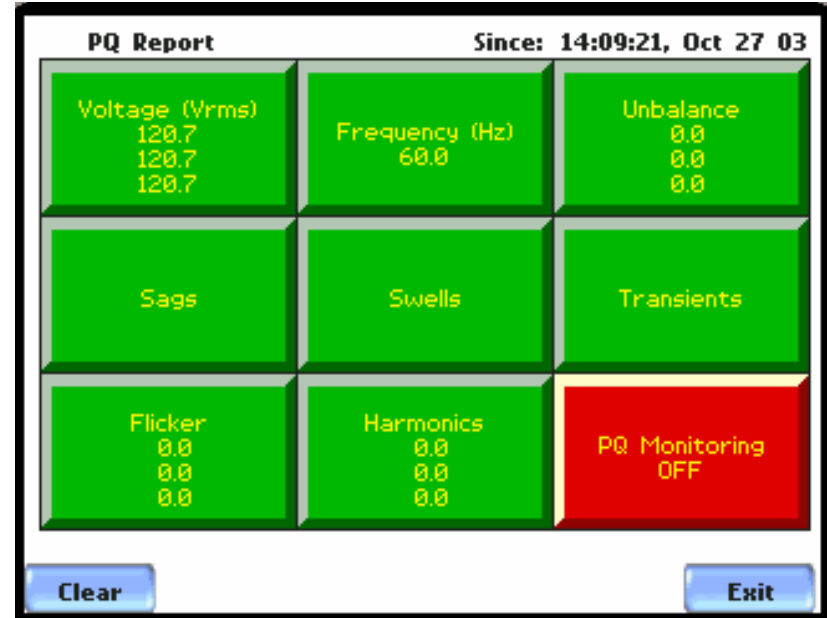
- PQ Status
  - Survey report card
- EN50160
  - Quality of Supply for Europe
- Monitoring Results At A Glance
- Interactive
  - Easily view underlying data





# PQ Status Report

- **Color Coded Monitoring Feedback**
  - Alarm panel
  - Green – No events of that type recorded
  - Red – Events of that type have been recorded.
- **Summarizes 9 Key Areas**
  - Voltage meter. Press to see trend
  - Frequency. Press to see trend
  - Unbalance, Press to see trend
  - Sags, Press to see Sag events
  - Swells, Press to see Swell events
  - Transients, Press to see transient events
  - Flicker, Press to see trend
  - Harmonics, Press to see trend Visual Feedback
- **Clear**
  - Acknowledgement. Reset to green



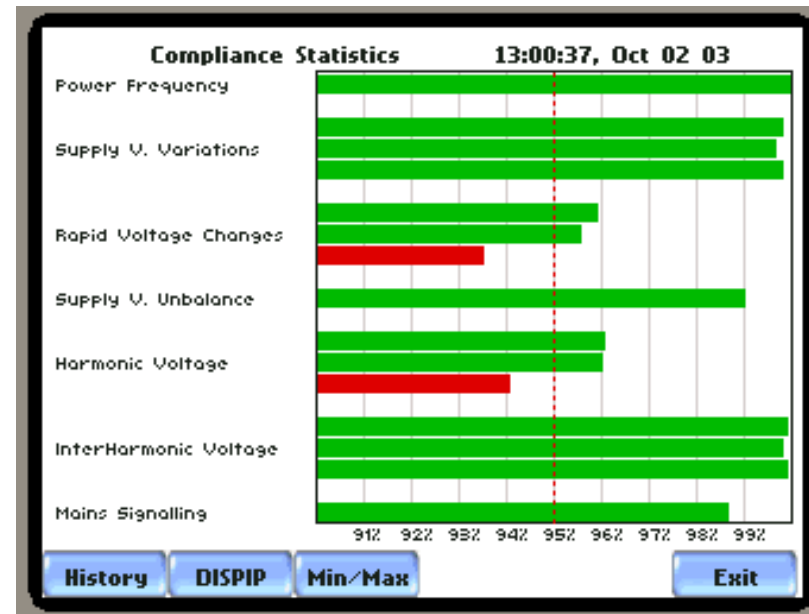
# Motor Quality

- Motor Annunciator
  - Available in PQ Report
  - Motor health and diagnostics
  - Derating Factor – Dranetz-BMI exclusive indicator of motor health and degradation.
    - Based on  $V_{rms}$ ,  $I_{rms}$ , Unbalance, THD, Sequence Components, Hp
  - Color coded alarm panel indication
    - New parameters plus V, I, W, PF, Sequence components, Unbalance, THD, and more!

<b>RMS Voltage</b> A 120.3 B 120.3 C 120.3	<b>RMS Current</b> A 30.07 B 30.07 C 30.07	<b>V RMS Imbalance</b> A 0 B 0 C 0
<b>True Power Fact..</b> A-0.882 B-0.858 C-0.858	<b>Horsepower</b> A 4.276 B 4.159 C 4.159	<b>Derating Factor</b> 0.900
<b>Voltage THD (Fu..</b> A 0.055 B 0.050 C 0.050	<b>Current THD (Fu..</b> A 0.052 B 0.051 C 0.052	<b>Negative Sequen..</b> Tot 0.285
<b>Clear</b>	<b>Options</b>	<b>Exit</b>

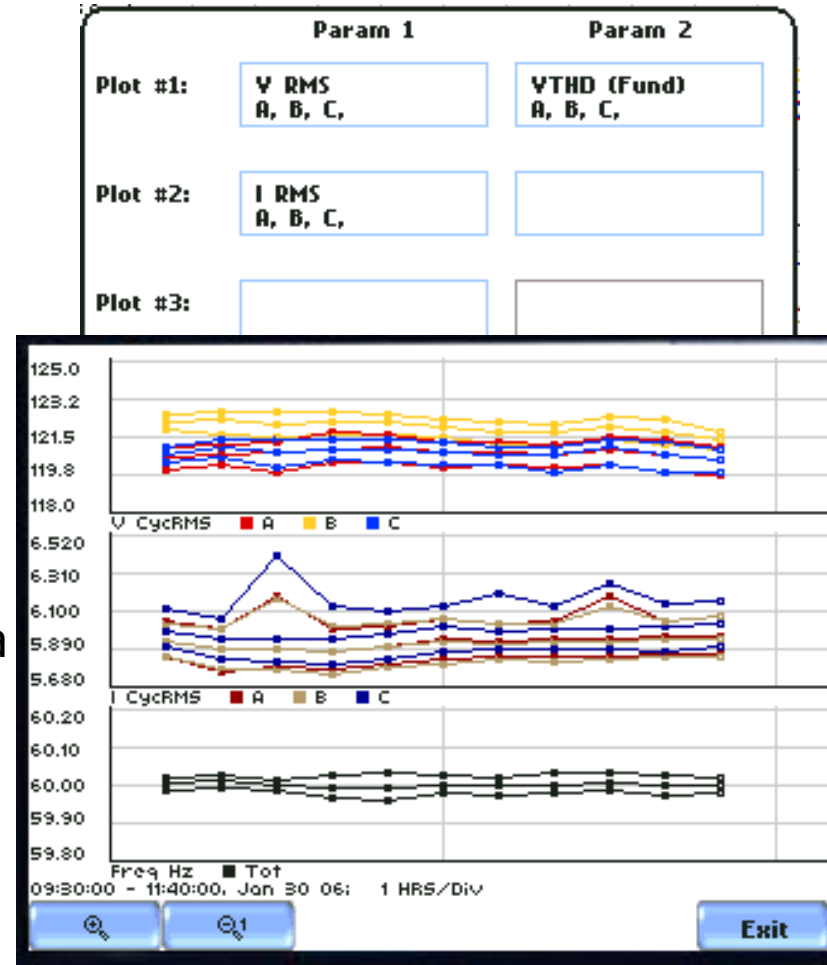
# EN50160 Report

- EN50160 Compliance Report
- Color Coded based on 7 day, 95% criteria
  - Green – Parameter is in compliance
  - Red – Parameter is not in compliance
  - Click to see details
- History
  - Shows previous monitoring periods and compliance
- DISDIP
  - UNIPEDE DISDIP Statistics
- Min/Max
  - Min/Max for each parameter



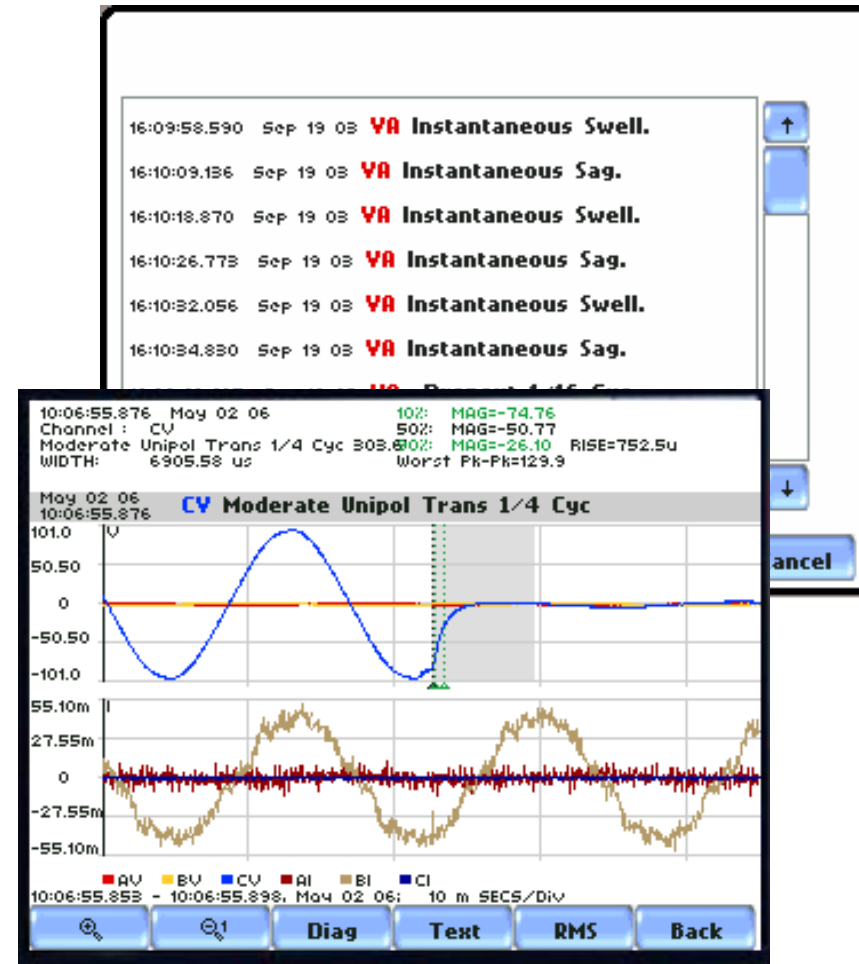
# Trends

- Trend any parameter vs. time
- Up to 4 plots stacked
- Up to 2 parameters overlaid per plot
- Zoom
  - DAQ-like zoom box
  - Move zoom window borders with fingers or stylus
  - Multiple zoom levels, down to the data points
  - Zoom out one level at a time



# Events

- Chronological Event List (pull down)
- Display Trend or Waveforms
- Display up to 4 channels overlaid
- Detail summary
  - Min/Max, Duration, etc
- Zoom
  - Move zoom window borders with fingers or stylus
  - Multiple zoom levels, down to the data points
  - Zoom out one level at a time



# PowerXplorer/PowerGuide Customers

## Electric Utilities

Alabama Power  
Centerpoint Electric  
Consolidated Edison  
Dominion Virginia Power  
Florida Power & Light  
Great River Energy  
Idaho Power  
Memphis Light, Gas & Water  
Northeast Utilities  
Public Service Gas & Electric  
Rochester Gas & Electric  
San Diego Gas & Electric  
South Carolina Electric & Gas  
Southern California Edison  
SE Illinois Electric  
Western Area Power Administration  
Wisconsin Power & Light  
Salt River Project (SRP)  
Arizona Public Service  
Xcel Energy  
Hawaii Electric (HECO)

Dayton Power & Light  
Commonwealth Edison  
Midwest Energy  
Vectren Energy Delivery  
Nebraska Public Power District  
People's Electric Coop  
WE Energies Electric  
Exelon Company  
Kentucky Power Company  
Entergy Louisiana  
Kerrville Public Utility Board  
Appalachian Power Co  
Grand River Dam Authority  
TXU  
Kansas City Power and Light  
Sauk Centre Public Utilities  
Commission  
Southern Minnesota Municipal  
Power Energy

## Rental Companies

TRS- Rentelco  
Electrorent  
Continental Resources  
Telogy

## Municipal/Rural Utility

Central New Mexico Co-Op  
Big Bend Co-Op  
Platte River  
Walla Walla Electric  
Sulphur Springs  
Moon Lake  
Southern California Water  
City of Aspen  
Public Service of Colorado  
East Bay Municipal Utility  
District  
Franklin Public Utility District  
Cleco Utility  
City of Farmington  
Fairfax County Utility  
Gwinnett County  
Lakehaven Utility District  
Nashville Electric Services  
Savannah E&P  
Union Rural Electric Coop

## Consultant/OEM

AES Design  
Brandon & Clark  
Energy Logic  
Franklin Electric  
Fuel Cell Energy  
DYNAMX SERVICE  
US BANK

Harris Corp  
Intelligent Energy  
Intelligent Switchgear  
McBride Electric  
Utility Services  
PowerKure  
Sean Finneson Inc.  
EPC Services  
Electric Services  
Electricians Inc

# PowerXplorer/PowerGuide Customers

## Government

FAA  
Lockheed Martin  
NASA  
NOAA  
Privatization Comm.  
Sandia National Labs  
US Air Force  
US Army  
US Navy  
Naval Surface Warfare Center  
Metropolitan Council  
The Boeing Company  
City of Chicago Water Treatment Facility  
City of Orange (Sheriff)  
Bechtel Nevada  
San Francisco Waste Water  
California Water Resources  
Sacramento Waste Water  
NASA Ames  
Fort Greely  
Hill AFB  
Port of Oakland  
SPAWAR  
High Desert Prison  
Shriver AFB  
Vandenberg AFB  
US Coast Guard

## Chem/Petro/Pharma

Air Liquid  
Baytown Refinery  
Bristol Myers Squibb  
Chevron  
Exxon Mobil  
Marathon Ashland  
Wyeth  
Abbot Laboratories  
Marathon Petroleum  
LLC  
Indspec Chemical Corp  
Champion Laboratories  
Suncor  
Monsanto

## Education

Clark College  
Museum of Natural History  
Texas A&M  
UCLA  
University of Mass  
Wake Forest University  
**University of Missouri**  
**Dallas Northside School District**  
**University of Iowa**  
**University of Minnesota**  
UCLA

## Hospital

Center for Disease Control  
Great River Medical  
Lexington Medical Center  
Mayo Clinic  
Providence Health  
St Jude Children's Research  
Sierra Vista Health  
Toledo Children's Hospital  
Mayo Foundation  
ST. Anthony's Medical Center  
MetroHealth Medical Center  
ST Johns Hospital & Med Ctr  
Faith Regional Health Services  
Charleston Area Medical Center  
Queens Medical Hospital  
Fred Hutch Cancer  
Eisenhower Medical  
Kaiser Permanente  
Rouge Valley Medical  
Providence Alaska Medical  
Veterans Administration Hospital  
Memorial Hospital

# International Customers

## Electric Utilities

Electricité de France  
Enea –Poland  
KW Belchatow - Poland  
Energa – Poland  
PSE - Poland  
Electrabel – Belgium  
Fecsa Endesa  
Gesa Endesa  
Unión Fenosa Distribución  
EDF Energy  
United Utilities  
Northern Electric  
Western Power Distribution  
Companhia de Electricidade, Macau  
JiangSu EPRI, China  
Sunnfjord Energi A/S/ Norway

ELES - Elektrogospodarstvo Slovenije Slovenia  
Elektro Primorska Slovenia  
HEP Transmission Company Croatia  
HEP Distribution Company Croatia  
Guangdong EPRI - China  
Shanghai Municipal Electric Power Company  
Shanxi EPRI - China  
Companhia de Electricidade, Macau  
JiangSu EPRI, China  
Sunnfjord Energi A/S/ Norway  
Shanghai Municipal Electric Power Company  
Shanghai Metro Traffic Co  
China EPRI  
HEFEI EPRI

## Finance/Banking

Banco de Peru  
Banco Popular  
Bloomberg, UK  
Credit Suisse, UK

## Commercial/Industrial

Olmex- Poland  
Cuprum –Poland  
Hewlett Packard – Netherlands  
Kemira GrowHow  
Netherlans  
Opel Belgium  
Antwerp  
Volvo Ghent  
Corus – Nthlds  
AluminumSolvay  
Daikin Europe  
Ibm jAPAN  
Belgian Navy

AIB Vinçotte  
Port of Antwerp  
European Research  
Inst. Power Quality  
Control – Spain  
Fundación Labein  
Ayuntamiento  
Zaragoza  
Instituto de  
Tecnología Eléctrica  
Revoz/Renault  
Slovenia  
Shanghai Metro  
Traffic Co

## Consultant/OEM

Gamesa Eólica-Spain  
Molinos del –Spain  
EbroCiemat-Spain  
Chloride Power Protection  
Halcyon Drives  
MGE



# International Customers

## Railways

Metro de Madrid, S.A.  
Dimetronic-Spain

## Computer/Information/Telco

Vodafone España, S.A.  
TVE  
Informatica del Ayuntamiento de Madrid  
SDC Ltd

## Education

Universidad de Zaragoza  
Universidad de Málaga  
Universidad Politécnica de Cartagena  
Universidad de Oviedo  
CITCEA - Universidad Politécnica de Cataluña  
Universidad de Sevilla  
Universidad de Córdoba  
Universidad de Vigo  
Universidad de Vigo

## Government

A.E.N.A. - Aeropuerto de Barajas  
A.E.N.A. - Aeropuerto de Barcelona  
A.E.N.A. - Aeropuerto de Gerona  
A.E.N.A. - Navegación Aérea  
Retes 22  
Arsenal Militar del Ferrol  
London Air Traffic Control  
MI-5

## Consultant/OEM

Gamesa Eólica-Spain  
Molinos del –Spain  
EbroCiemat-Spain  
NAVANTIA - Astillero del Ferrol  
STM de Alta Tension  
Construcciones y Montajes Industriales  
Sistemas Electrónicos de Potencia  
Mimaven Electrica  
Tempe, S.A  
Fullink UPS  
Socomec

## Commercial/Industrial

Olmex- Poland  
Cuprum –Poland  
Hewlett Packard – Netherlands  
Kemira GrowHow Netherlands  
Opel Belgium Antwerp  
Volvo Ghent  
Corus – Netherlands  
AluminumSolvay  
Daikin Europe  
Zardoya Otis Shanghai  
ZhengHua Harbour Machinery Corp.  
Siemen China  
Factory Automation Co. Ltd/GDEPRI  
AIB Vinçotte  
Port of Antwerp  
European Research Inst.  
Power Quality Control – Spain  
Fundación Labein Ayuntamiento Zaragoza  
Instituto de Tecnología Eléctrica  
CEPSA, S.A.  
Peugeot España  
Acerinox Pfizer, UK  
Renault, Slovenia  
Sintef  
Statoil  
SKYGUIDE  
Pfizer, UK  
Renault, Slovenia  
Elgar Sorenson

*Questions ??*