Multilin™ P30
Phasor Data Concentrator

Secure high performance Phasor Data Concentrator (PDC) for wide area monitoring and dynamic disturbance analysis

KEY BENEFITS

- Reduce deployment and operation cost of wide area monitoring systems integrating more Phasor Measurement Units (PMUs) per PDC
- Simplify analysis of power system events through fast and easy access to time synchronized phasor data archives
- Implement NERC-PRC-002-2 (draft) compliant dynamic disturbance recording (DDR) systems
- Integrate P30 PDC into NERC-CIP compliant systems using the built-in security features
- Enable control system wide area monitoring applications to reveal dynamics of the power grid though low latency time aligned synchrophasor signals
- Customize wide area monitoring systems with the optional Multilin P30 applications module without the costs associated with additional hardware

APPLICATIONS

- Collection, aggregation, archiving of synchrophasor time aligned data within the Substation for enhanced post event analysis
- Continuous recording and reporting of synchrophasor data through up to eight C37.118 clients for wide area monitoring applications
- Deployment of NERC-PRC-002-2 compliant Dynamic Disturbance Recording systems
- Visualization of live or recorded synchronized phasor data at substation, multiple substations and regional control centers

FEATURES

Connectivity

- Support for up to 40 PMU inputs
- Up to 8 individually configurable C37.118 output channels
- Up to 4 internal pseudo PMUs to notify Multilin P30 diagnostics
- Configurable reporting (1 to 120 frames per second accuracy)

Recording and Archiving

- Integrated 2500 tags historian module capable of recording up to 100,000 values/second with microsecond time stamps
- Direct access to the archived database from up to seven locations simultaneously using EnerVista Synchrophasor Viewer
- Support for up to 16 simultaneous connections to Multilin P30 historians from EnerVista Synchrophasor Viewer

Security

- Designed for integration into NERC-CIP compliant systems
- Centralized user profiles (customer furnished RADIUS server)
- Encrypted local passwords
- Secure firmware upgrades that prevents installation of unauthorized firmware
- Encrypted data transmission between EnerVista P30 Setup software and the Multilin P30 Phasor Data Concentrator to prevent unauthorized configuration

Software

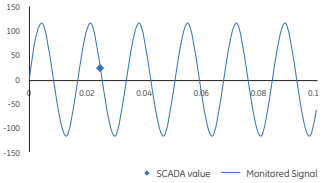
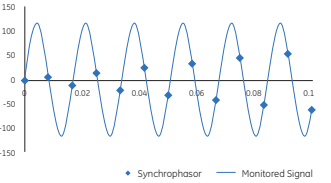
- Device setup and maintenance through the EnerVista suite of industry-leading software programs that simplify configuration, test, commissioning and operation of the Multilin P30 Phasor Data Concentrator
- Built in synchrophasor data analysis and reporting tools
- "Work Sheet" based visualization interface for phasor displays, trend charts, historian statistics and PMU status
- Easy export of Multilin P30 historian data to Microsoft® Excel®

Overview

Monitoring of electrical grid infrastructure is a critical task carried out continuously by system operators to ensure safe and reliable operations. Traditional SCADA systems give operators a view of the system's operating conditions with a typical latency in the range of seconds and minutes.

The relative low measurement frequency and low speed communications combined with the time required to execute analysis programs do not allow SCADA systems to handle system emergency operations in real time. Decisions are made based on static power system models where a trade-off with accuracy is generally needed.

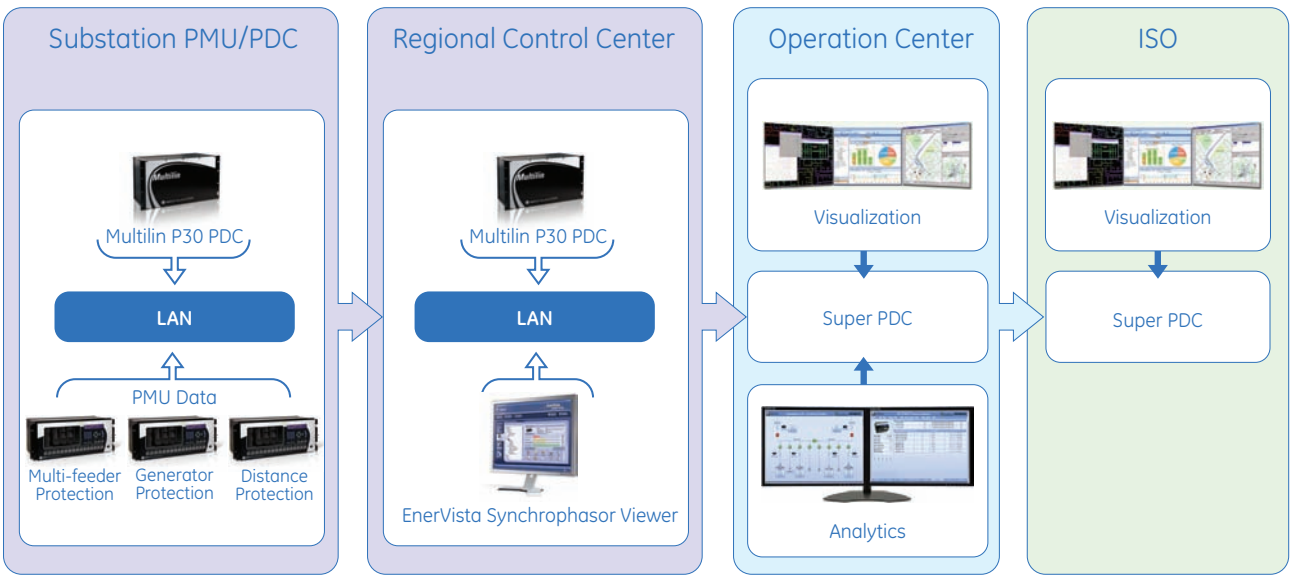
Communication and computing technologies available today allow monitoring functions with sub cycle resolution for power systems over large geographical areas. The faster and higher resolution measurements introduced with synchrophasor technologies, also known as dynamic monitoring capabilities, enable wide area monitoring at the system level based on accurate and precise data at high-speed data rates with extremely low latency, less than 200ms.

	TRADITIONAL SCADA	SYNCHROPHASORS MONITORING
	 Example: 100ms data for 115kV line voltage monitored with traditional SCADA. 1 poll every 2 seconds	 Example: 100ms data for 115kV line voltage monitored with PDC at 120 frames per second
Monitoring	**Static:** Steady and non-synchronous measurements	**Dynamic:** Synchronous measurements
Resolution	1 – 10 second scan rates	Sub cycle scan rate capabilities
Latency	Seconds, minutes	<200miliseconds

When applied to wide area applications, typically executed at the operation center level, synchrophasors enable operators to optimize system availability, reliability and stability analysis and operations. Phasor Data Concentrators (PDCs) and the Phasor Measurement Units (PMUs), that supply control centers with phasor data, are key components of synchrophasor based wide area monitoring systems.

GE's series of Multilin P30 PDCs and PMU devices leverage the latest advances in synchrophasor and computing technologies available for the power industry to enable synchrophasor based wide area monitoring applications.

The above table highlights key differences between traditional SCADA and synchrophasor monitoring technologies.



Typical synchrophasor based wide area monitoring system architecture

Connectivity

The Multilin P30 Phasor Data Concentrator is a modular, substation rated, high performance device capable of collecting, processing, recording and archiving C37.118 compliant synchrophasor data. The Multilin P30 supports up to forty PMU or PDC inputs and up to eight user configurable channels for transmission of synchrophasor data to clients such as other PDCs, Super PDCs and/or EnerVista Synchrophasor Viewer.

High Performance PDC

The primary function of the Multilin P30 PDC is to provide enhanced visibility of the electrical power grid. The Multilin P30 PDC data collector module communicates with up to forty PMUs or other PDCs to acquire and time-align synchrophasor data.

The Multilin P30 processor module structures output datasets from available data, interpolates, filters and decimates data as required.

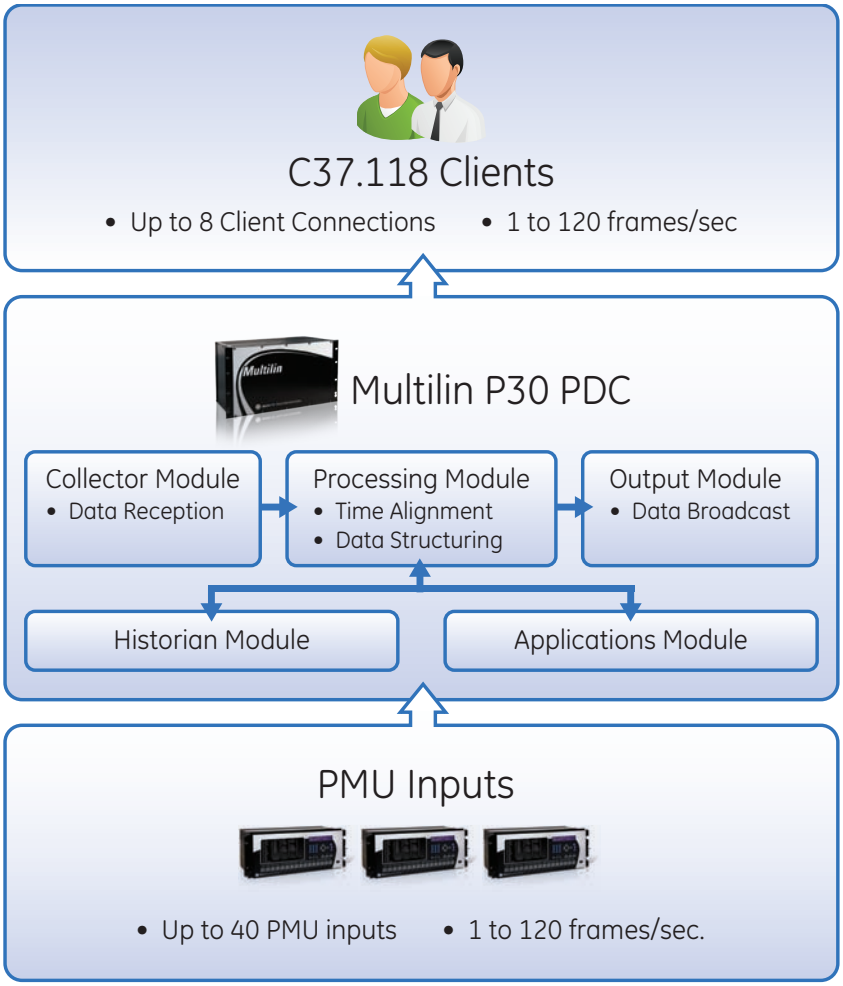
The Multilin P30 PDC can connect to up to eight output streams which can be individually configured to ensure clients such as other PDCs, Super PDCs, visualization devices, external historians and other external applications receive accurate and precise data at rates previously impossible to obtain from traditional SCADA systems.

Easy Expansion and Customization of Multilin P30 PDC

The Multilin P30 Applications Processor option is available to users that need to integrate custom applications into their synchrophasor monitoring systems.

The Multilin P30 Applications Processor is equipped with a Windows® operating system that allows installation of user's preferred applications including development tool kits.

The Multilin P30 Applications Processor can reduce DDR systems deployment cost leveraging the infrastructure built in to the Multilin P30 PDC to expand and customize the PDC platform while maintaining the system reliability associated with the Multilin P30 substation rated platform.



Multilin P30 Phasor Data Concentrator product architecture

Multilin P30 Supported Rates

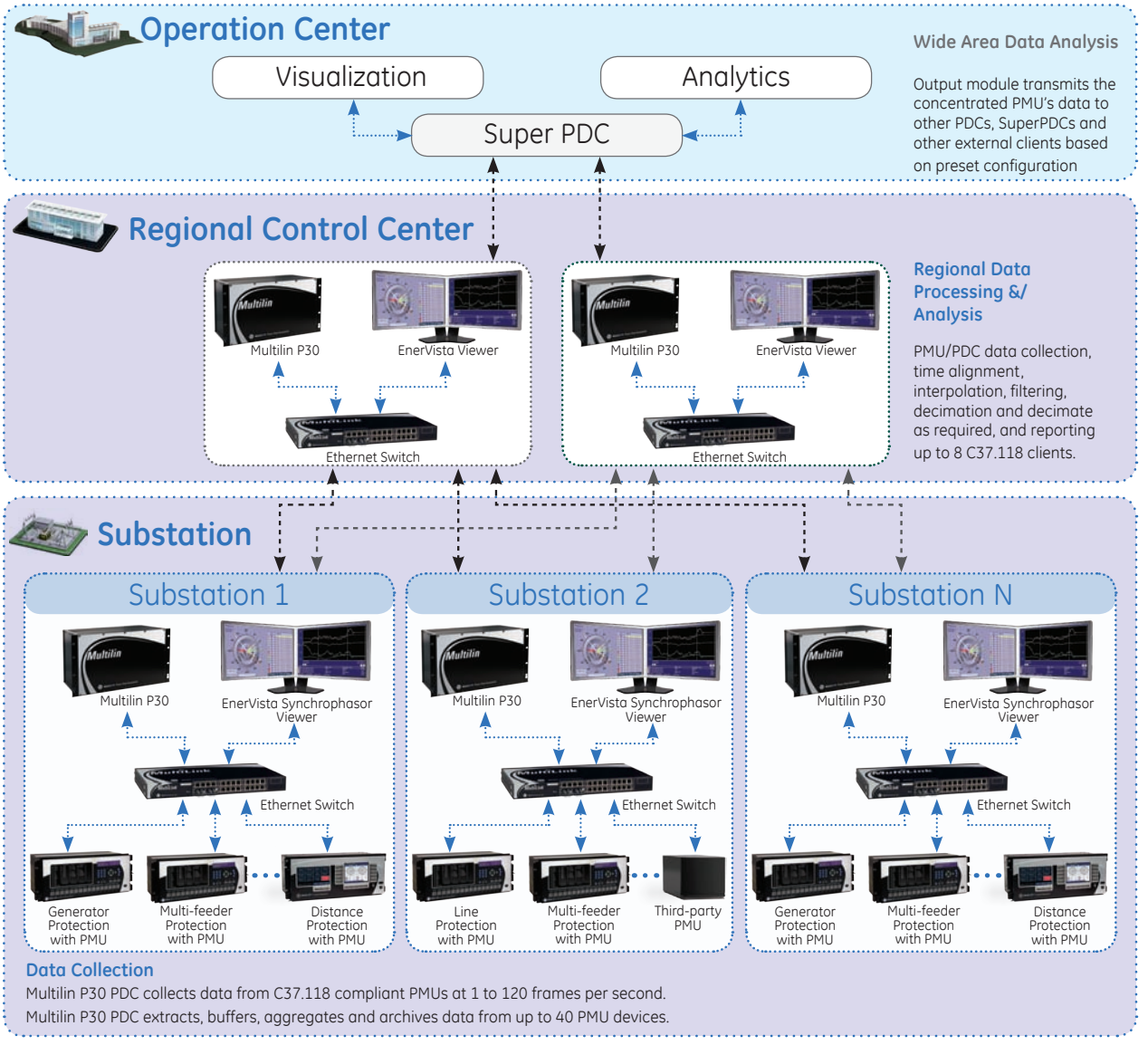
SYSTEM FREQUENCY	INPUT AND OUTPUT SUPPORTED RATES, FRAMES PER SECOND (FS)									
50Hz†	1	2	5*	10*	25	50	100			
60Hz	1	2	5	10*	12*	15*	20*	30*	60	120

** Required per C37.118-2005 standard*

† Available Q1-2012

Enabling Synchrophasor Based Wide Area Monitoring

Reduce synchrophasor based wide area monitoring deployment and maintenance cost by integrating more PMUs per PDC, while being compliant to NERC-PRC-002-2 dynamic disturbance recording requirements.



Integration of Phasor Measurement Units (PMUs)

PMUs connect to the instrument transformers on the power grid and serve current and voltage data to the wide area monitoring system. PMU function is becoming a standard function in most GE Protection & Control Relays. GE's Multilin UR family of protection and control devices (D60, F60, G60, L30, L90, T60 and N60) support PMU capabilities. GE's Multilin PMUs meet or exceed the requirements of the C37.118 synchrophasors for power systems standard for virtually all practical applications. The Multilin N60 Network Stability and Synchrophasor Measurement System for example supports up to four PMUs and can stream synchrophasors over its Ethernet ports at discrete rates from 1 to 120 frames per second. These high data rates allow GE's synchrophasor systems to measure and visualize the power system at twice the Nyquist rate for a 60Hz power system and therefore capture all essential waveform data.

Seamless Interface to Super PDCs

The Multilin P30 PDC is designed to stream data to a Super PDC using the C37.118 protocol. Super PDC devices typically collect and archive synchrophasor data at the control and system level. Super PDCs are designed to run on non-substation rated powerful computing platforms with large processing and storage capacity in order to support the large volumes of synchrophasor data reported from PMUs, PDCs and / or Regional PDCs.

Communications Infrastructure Requirements

The bandwidth required for PMU communications for a typical PMU including one Phasor, two analog channels, and sixteen digital channels reported at sixty frames per second is in the range of 70 to 75 kbps (kilobits per second). While it is possible to communicate synchrophasor information over serial communication channels, utilities taking advantage of synchrophasor technologies typically implement synchrophasor based wide area monitoring systems based on communication systems with that support Mega bit communications bandwidth.

Recording & Archiving

PRC-002-2 Dynamic Disturbance Recording (DDR)

PRC-002 is a standard under development that will define the requirements for recording and reporting Sequence Of Events (SOE) data, Fault Recording (FR) data, and Dynamic Disturbance Recording (DDR). The purpose of the standard is to facilitate analysis of disturbances.

FR and SOE are features commonly available today in protection relays and SCADA equipment.

The third type of recording defined in the PRC-002-2 standard is DDR. Large interconnected systems can have inter-area responses to each other resulting in slow oscillating load swings. These disturbances are characterized by oscillating power swings that can have frequencies in the neighborhood of 0.1 to 4Hz, and duration in the range of a few seconds to minutes or hours.

A dynamic disturbance recorder is a device cable of recording incidents that portray power system behavior during dynamic events such as low frequency (0.1Hz - 4Hz) oscillations and abnormal frequency or voltage excursions.

The advanced high capacity disturbance and event recording features available in the Multilin P30 Substation Phasor Data Concentrator support the requirements of the PRC-002-2 standard and can significantly reduce the time needed for analysis and reporting of disturbance analysis and regulatory reports.

NERC PRC-002-2 Highlights *

Applicability	• Transmission: substations having facilities rated 200kV or above • Generation: single generating unit of 500MVA or higher nameplate rating • Generation: generating plants with an aggregate plant total nameplate capacity of 1500MVA or higher
Dynamic Disturbance Recording (DDR) Data, Transmission & Generation Owners (Sections 7 & 8)	• At least one phase to neutral voltage • Frequency (at least one at the required substation) • At least one phase current • Power and reactive power
Specifications for DDR Data	• Use same phase for voltage and current recordings • Collect at least 960 samples per second to calculate RMS electrical quantities • Store calculated RMS values of electrical quantities at a rate of at least 6 times per second • SOE, FR and DDR functions to within +/- 2 ms of Universal Coordinated Time (UTC) • Have all recorded SOE, FR, DDR data available (locally or remotely) for 10 calendar days after a disturbance.

** Check NERC standard for latest available information.*

Multilin P30 Built-in Historian Capabilities

A typical GE substation DDR system comprises of several PMUs reporting synchrophasor data at various different rates from 1 to 120 frames per second to a Multilin P30 PDC. Each of GE's Multilin PMUs may include 1 to 14 sets of phasor values (Multilin N60). Below are some typical examples of different types of PMUs with various combinations of phasor, analog and digital parameters. Large volumes of data generated by a DDR system requires a fast and reliable archiving method to guarantee data integrity for future analysis.

Multilin P30 PMU Input Type Examples

PMU TYPE	PHASORS	ANALOG CHANNELS	DIGITAL CHANNELS	FRAMES PER SECOND	KILOBIT PER SECOND	PMUS (QTY)	STORAGE CAPACITY (DAYS)
Type 1	1	0	0	60	20.7	1	1098
Type 2	1	0	0	60	414.8	20	55
Type 3	8	2	1	60	2193	28	10
Type 4	4	2	16	60	94.6	1	240
Type 5	12	8	16	60	171.5	1	132
Type 6	12	2	16	60	1188	8	19
Type 7	12	2	16	120	2370	7	11
Type 8	12	8	16	120	5135	15	4.4

The Multilin P30 PDC historian processor is a high capacity platform capable of recording up to 100,000 values per second.

Local Archiving

Distributed synchrophasor data storage through local archiving is recommended under the following two scenarios:

1. Upstream communication channels don't support the bandwidth to report all data monitored by the PDC.
2. Communication channels supports transmission of all data monitored by the Multilin P30 PDC. Archiving at the Substation level is introduced to increase system reliability and preserve monitored data in case of upstream channel communications failure.

Software

EnerVista™ P30 Setup Software

The EnerVista P30 Setup software follows the user friendly structure characteristic of the industry leading EnerVista suite of software applications.

The EnerVista P30 Setup application provides easy access to the Multilin P30 PDC feature set through an intuitive tree view of the Multilin P30 parameters for a clear and simple configuration process. A series of convenient trouble-shooting and diagnostic tools such as trending, Multilin P30 sequence of events recorder live view of actual values is available in EnerVista P30 Setup to optimize the testing, commissioning and monitoring activities.

The Multilin P30 Setup software can operate without a Multilin P30 device physically connected to the computer allowing users to work on configuration projects and save settings in a configuration file for future use.

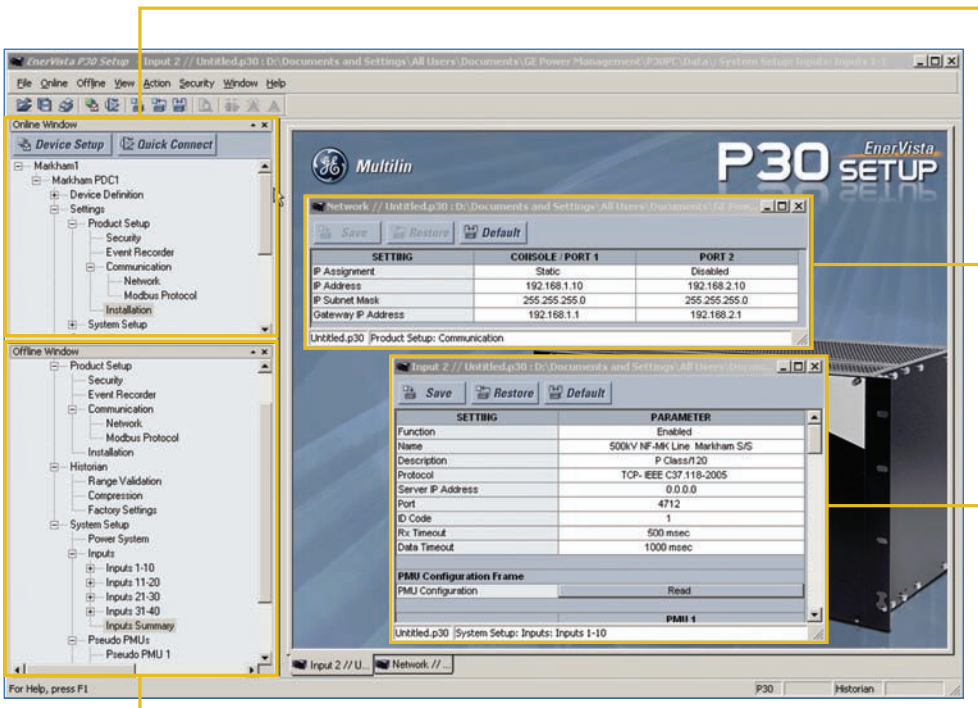
EnerVista Synchrophasor Viewer Software

EnerVista Synchrophasor Viewer is a powerful yet simple to use synchrophasor data management and visualization tool. EnerVista Synchrophasor Viewer can be customized to provide different views of the power system in a time aligned, live view or time aligned replay of historical events over user defined time span.

The visualization interface is based on an easy to use "worksheet" work environment. Users can create multiple worksheets on which multiple user configurable objects such as Phasor Displays, Trend Charts, Historian Statistics and PMU Status tables are displayed.

EnerVista Synchrophasor Viewer supports up to 16 Multilin P30 historians simultaneously. Each historian can be accessed by up to seven concurrent users.

The EnerVista P30 Setup software user friendly structure



Online Device Window
- Online communication to device
- Copy online settings to files offline

Active Settings Windows
- Consolidated views of device settings
- Simple access to configurable parameters

Offline File Window
- Direct access to device parameters from tree structured view
- Input settings summary for optimized validation and configuration

EnerVista Synchrophasor Viewer

Trend chart object:
- User configurable X and Y scales
- Sliding bars for quick indication of values at specific points in time or difference in values between two points

Worksheet work environment:
- Customizable worksheet layouts
- Flexible grouping of objects for visualization of synchrophasor data from up to 16 P30 PDC historians
- Live view or replay of synchrophasor data from P30 PDC historian

Phasor display object:
- Display up to 16 synchrophasor values with magnitude (length) and absolute or relative angles
- One click "Best Scaling" feature for automatic optimized display adjustment

PMU and Historian Status objects:
- Visual Indication of triggered events
- PMU and historian Status and system health indication to facilitate Synchrophasor system operation

Hardware Overview

Back Panel

Historian Module
100,000 Values per second Recording
2500 tags
2 x 10/100/1000 BaseT Ports for Configuration and Historian Access

C37.118 Synchrophasor Processor Module

Applications Module
Windows XP Embedded System

External Power Source
Dual SCADA Alarmed power supplies:
1. 36-72 VDC
2. 85-264VAC/88-280VDC

Electrical Connections Module
1. Power Input
2. Power Supply Fail Alarm Contacts
3. IRIG-B (DC Shift) Input

IEEE 1586.1 Single Width PCI Mezzanine Card (PMC) Expansion Slot

10/100/1000 BaseTX or 100 Base FX Ethernet Ports

Maintenance Port DB9 / RS 232

USB Port (Disabled)

Technical Specifications

PHASOR DATA PROCESSING SPECIFICATIONS	
Number of supported PMUs	Up to 40 PMUs
Synchrophasor data format	C37.118 2005
Number of c37.118 client connections supported	Seven concurrent C37.118 clients
Supported data scan rate	1 to 120 frames per second

MEMORY AND STORAGE	
Historian recording capacity	100,000 values/second
Historian number of tags	2500

HARDWARE SPECIFICATIONS		
POWER SUPPLY		
High Range	Nominal:	100-240VAC (50/60hz) 125 to 250VDC
	Range:	85 to 264VAC (48/62hz) 88 to 280VDC
	Ride though time:	35ms
Low Range	Nominal:	48VDC
	Range:	36 to 72 VDC
DIMENSIONS		
Form Factor:	19" Euro Chassis	
WxDxH:	19x11.29x10.48"	
COMMUNICATIONS		
Ethernet LAN	2 x 100 Base FX or 2 x 10/100/1000 Base TX	
IRIGB	IRIG-B DC Shift (BNC or two wire connections)	
Historian Module	2 x 10/100/1000 Base T Ports for Configuration and Historian Access	

TYPE TESTS	
SAFETY	
IEC60255-5	Dielectric Voltage Withstand
IEC61010-1	Impulse Voltage Withstand
ENVIRONMENTAL	
IEC-60068-2-1	Environmental Testing Cold (0C)
IEC-60068-2-2	Environmental Testing Dry Heat (70C)
IEC-60255-21-1	Environmental Testing Vibration, Vibration Tests (sinusoidal)
IEC-60255-21-2	Shock and Bump Tests
IEC-60255-21-3	Seismic Tests
IMMUNITY	
IEC61000-4-18/IEC60255-22-1	Damped Oscillatory
EN61000-4-2/IEC60255-22-2	Electrostatic Discharge
EN61000-4-3/IEC60255-22-3	Radiated RF Immunity
EN61000-4-4/IEC60255-22-4	Fast Transient Disturbance
EN61000-4-5/IEC60255-22-5	Surge Immunity
EN61000-4-6/IEC60255-22-6	Conducted RF Immunity
IEC61000-4-8	Power Frequency Magnetic Field Immunity

Ordering

	P30	*	**	**	XX	**	XX	***	
Base Unit	P30								Base Unit
Ethernet Interface Type		T							P30 Synchrophasor Processor Module, 10/100/1000 Base TX Ethernet Ports, 8 PMUs
		F							P30 Synchrophasor Processor Module, 100 Base FX Ethernet Ports, 8 PMUs
Power Supply			HI	HI					125/250VDC (88-280VDC); 120/240VAC (85-264 VAC, 50/60hz) input.
			LO	LO					48 VDC (36-72 VDC) Input
				XX					No Secondary Power Supply Option
Historian						XX			No Historian
						02			2,500 Tag Historian Option*
PMU inputs								040	Up to 40 PMU inputs
								XXX	Base Model: Up to 8 PMU Inputs

**Includes EnerVista Synchrophasor Viewer license.*

Digital Energy

Visit GEDigitalEnergy.com/P30 to:

- Download the instruction manual
- Buy the Multilin P30 Phasor Data Concentrator online
- View/download the Multilin P30 brochure