Elegant e^3 Efficient
Easy to Use

ERL

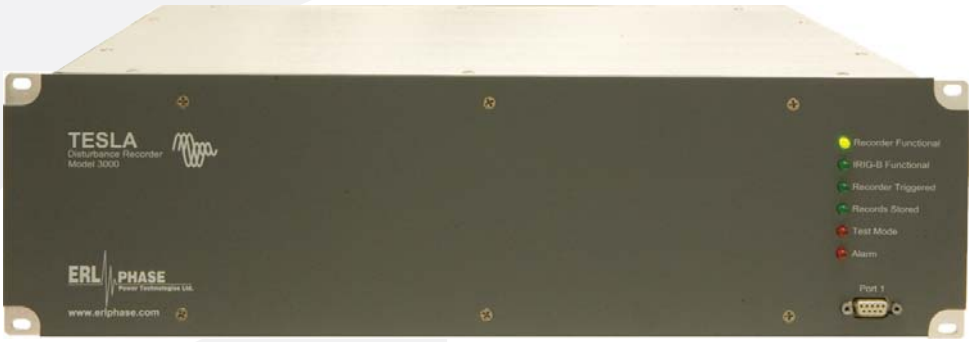
Power System Monitoring Recorder

TESLA 3000

Product Overview

TESLA 3000 is an easy-to-use and cost-effective, state-of-the-art, multi-time frame (simultaneous) power system recording monitor.
The optional Phasor Measurement Unit (PMU) functionality streams synchrophasor data which, together with the fault (fast), swing (slow) and trend records, gives the desired visibility of system health and performance.

- PMU per IEEE C37.118-2005 synchrophasor standard
- Easy-to-use settings and analysis software
- SCADA support with DNP3 and Modbus
- CDR meets NERC PRC-002 DME standards
- Non-volatile on board flash memory
- Remote input modules save on costly wiring runs
- Easy one time software calibration



TESLA 3000 Power System Monitoring Recorder

DFR	DSR	SER	PQR	LTR	CDR	PMU
Digital Fault Recorder	Dynamic Swing Recorder	Sequence of Event Recorder	Power Quality Recorder	Long Term Trend Recorder	Continuous Disturbance Recorder	Real Time Monitoring
0 - 30 sec	0 - 30 min	1 msec resolution	32 - 384 samples/ cycle	1 - 90 days	4 - 140 days	Continually Streaming Phasor Data

dnp Distributed Network Protocol

10 Year WARRANTY

Applications

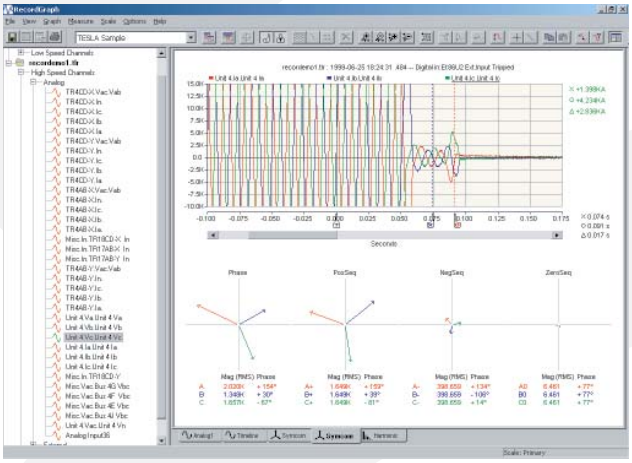
As a Multi-Timeframe Power System Recorder and Monitor

Use transient fault (fast) records to:

- Verify operation of relays and breakers
- Improve relay and breaker settings
- Confirm system and device models and improve coordination

Use up to 60 user-defined trends to:

- Monitor seasonal variations of load
- Analyze and model system component



Use dynamic swing (slow) records to:

- Review loading and stability criteria
- Monitor generator performance
- Verify power swing damping to improve stability
- Study SVC and PSS performance
- Detect sub-harmonic oscillations
- Understand out-of-step tripping

As a PQR:

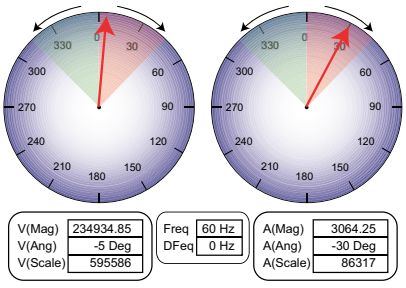
- Monitor single harmonic and THD
- Understand voltage sag/swell conditions
- Analyze and tune filter performance

As a CDR (continuous records 1 sample/cycle):

- Meet NERC PRC-002 DME requirements
- Create redundant storage of PMU data
- Understand long term power system behavior

As a PMU for Wide Area Monitoring

- Streams up to 12 user-selectable single-phase, 3-phase, +/-, zero sequence, and summated phasors
- Additionally streams up to 12 analog quantities of Watts, VARS, and VA and 64 digital (status) quantities
- Monitor voltage stability with real time phasor magnitude and phase angle supervision
- Improve transmission reliability planning



RecordBase Central Station for Wide Area Monitoring

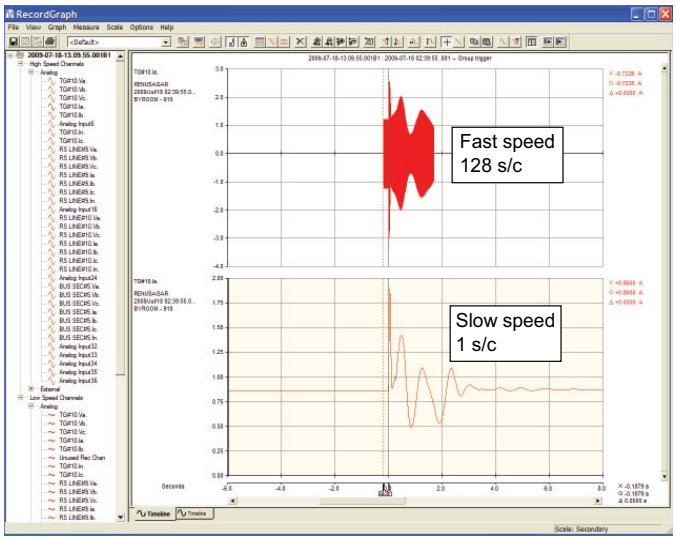
Central cross-triggering of TESLA recorders provides system-wide dynamic swing recordings for stability analysis

- Automated record transfer from on a scheduled call-out or by recorder initiation
- Supports COMTRADE, PTI and Excel output formats
- Company-wide access on existing Windows® computers through the corporate LAN

Features and Benefits

Simultaneous Multi-Functional Recording and Event Logging

- High-speed transient fault recording:
  96, 128, 256 and 384 samples/cycle
  0.2 to 30 second auto extend records
- Dynamic swing (disturbance) recording:
  1 samples/cycle (60 Hz)
  10 seconds to 30 minute records
- Trend logging:
  10 to 3600 seconds for 60 channels
  90 day storage
- Flash drive stores 1000 fault/swing records
- Co-operative mode: view records from multiple TESLA's as single record



PMU and CDR Functionality

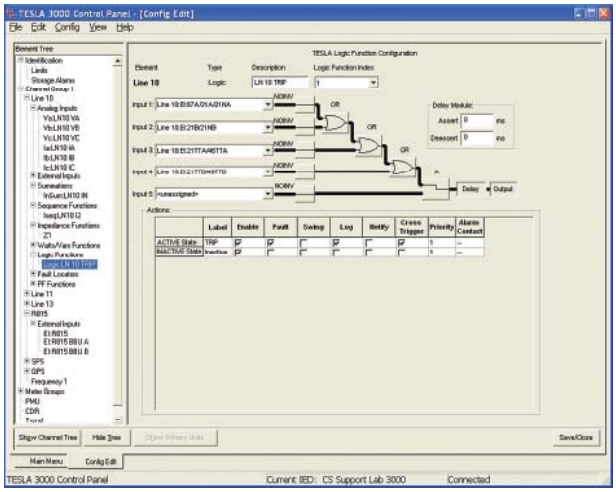
- Meets and exceeds IEEE C37.118-2005 standards
- Streams up to 12 user-selectable-single-phase, 3-phase, +/-, zero sequence, and summated phasors
- Additionally streams up to 12 analog quantities of Watts, VARS, and VA and 64 digital (status) quantities
- GPS time synchronized to 0.75 µs accuracy
- PMU reporting rates: up to 60 frames/second

CDR creates continuous RMS records at 1 sample/cycle without setting triggers

- 6 to 60 records per second per channel for up to 36 channels
- 10 to 140 days of continuous records storage
- Acts as a mini PDC with redundant storage of PMU data

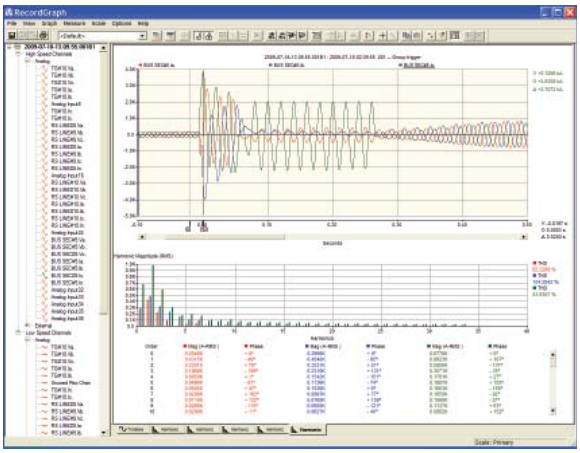
Easy-to-Use, Intuitive Windows-Based Setting and Analysis Software

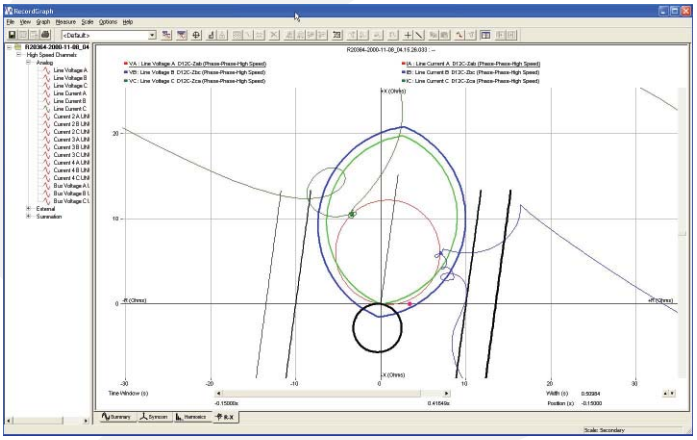
- Lossless data compression for fast file transfer
- Offline mode to view records and set configurations
- Over 1000 user-definable triggers
- User-assigned trigger priorities
- Centralized cross-triggering of dynamic swing data
- User-programmable control logic
- User-configurable report templates



RecordGraph™ and RecordBase View™ Waveform Analysis Software

- Display multiple channels simultaneously and combine records
- Display multiple component voltage, current or summed channels
- Display THD, harmonic magnitude
- Zoom, alignment, scaling, unit functions
- Record summaries including event lists
- COMTRADE, PTI and MS Excel export



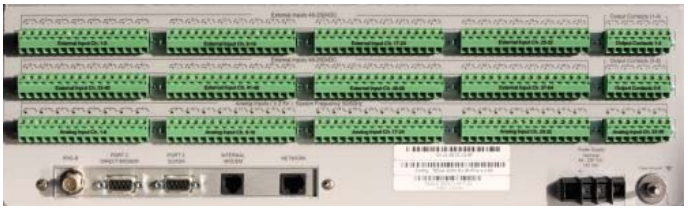


Over 120 Calculated Channels

- Summation: 30 channels, Sequence: 12 channels,
- Watts/Vars: 18 channels, Impedance: 18 channels
- Logic: 30 channels, Power Factor: 18 channels
- Fault Locator: 10 channels, Frequency: 2 channels

Advanced Communications

- SCADA support with DNP3 and Modbus
- User-configurable DNP3 point list mapping
- IRIG-B time sync, modulated or un-modulated



Flexible, Cost Saving Architecture

- 36 analog and 64 digital inputs (144 analog/256 digital with 4 units in cooperative mode)
- Remote input modules provide isolation and save costly PT and CT wiring runs
- On-board non volatile flash memory stores up to 1000 records — no mechanical moving parts
- Easy one time calibration
- Smallest footprint among recorders allows easy retrofit and installation
- Settings and adjustments done outside the box after installation avoids outages
- Configurable inputs — mix and match AC and DC signals with simple module changes
- AC/DC isolation module allows for inputs from any standard instrument or transducer
- Split core CT's allow easy installation while in CT in service, avoiding power outages

Detailed Specifications

TESLA 3000 Power System Monitoring Recorder

Item	Quantity/Specs	Notes
General		
Nominal Frequency	50 or 60 Hz	
Sampling Rate	User-adjustable @ 32, 64, 96, 128, 256 or 384 samples/cycle	256 & 384 samples/cycle limited to 18 & 9 channels respectively
Power Supply	Supply Range: 48 – 250 Vdc, 120 Vac	
Recording Rate:		
Transient Fault	User-configurable 32 – 384 samples/cycle	Up to 30 seconds per record
Dynamic Swing	1 sample/cycle	Up to 30 minutes per record
Trend	User-configurable, up to 60 trending channels 5 mode - Damped, Undamped, Avg, Min, Max	10 to 3600 seconds sample rate
Long Term Event		
Log Recording	Daily event log recording	Daily logging limit of 1000 events
Analog Input Accuracy	+/- 0.1% of FS amplitude +/- 0.5 degree phase	
Record Storage	1000 fault, swing or combined records	
A/D Resolution	16 bits, 65536 counts full scale	
Channels and Triggers		
Analog Inputs	High and low threshold, positive and negative rate of change, harmonic level, THD level and sag/swell.	All triggers have independent controls for delay, logging, transient or swing record initiation, alarm contact activation and cross triggering
Summations	High/low threshold, +/- rate of change	
Positive Sequence	High/low threshold, +/- rate of change	
Negative Sequence	High level	
Zero Sequence	High level	
Watts/VARs	High/low threshold, +/- rate of change	
Frequency	High/low threshold, +/- rate of change	
Impedance	Positive sequence circle combined with absolute rate of change	
Power Factor	Low capacitive, low inductive	
External Inputs	Rising edge, falling edge or both	
Logic	Rising edge, falling edge or both	
Fault Locator	Triggered by internal or external events	
Physical		
Weight	5.5 kg	
Dimensions	13.2 cm height x 48.26 cm width x 32.8 cm depth	
Input Modules	4 input current module, 3 input voltage module or 4 input dc isolation module, split-core & clamp-on CTs. Modules mount on DIN rail, up to 1200 meters (4000 feet) away from recorder chassis using twisted/shielded communication wiring.	

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Item	Quantity/Specs	Notes
Input & Output		
Analog Input Channels	Rating: In = 5 A or 1 A, Vn = 69 V Continuous: 3x In, 2x Vn One Second: 20x In without distortion	36 per unit, 144 maximum using 4 units in "Cooperative Mode". See Input Module data sheet for more information.
External Inputs (digital)	Will turn on: >= 38 Vdc Will not turn on: <= 25 Vdc Maximum input: <300 Vdc Burden: > 10 kilo ohm	32 or 64 per unit, 256 maximum using 4 units in "Cooperative Mode"
Alarm Output Relays (contacts)	300 Vdc max, externally wetted Make: 8 A Carry: 8 A Break: 0.15 A at 125 Vdc 0.10 A at 250 Vdc	4 or 8 per unit Contact #1: "Recorder Functional" Contact #4: High Speed "Cross Trigger" Pick-up, 10 ms, latch 100 ms Contact #2, 3, 5, 6, 7, 8 - User-definable Pick-up, Latch, 1.0 sec
Interface & Communication		
Front Panel Indicators	6 Leds	Recorder Functional, IRIG-B Functional, Recorder Triggered, Records Stored, Test Mode, Alarm
Serial User Interfaces	Port 1&2 RS-232 to 115 kbd	Port 2 can support an external modem
Network	10/100 BASE-T/Tx Ethernet	RJ-45 connector
Internal Modem	38.4 Kbps, V.32 bis	Optional feature
SCADA Interface	DNP3 or Modbus	Ethernet: DNP3 RS: 232: DNP3 or Modbus
Configurable Alarms	6 contacts per unit	Normally open
Cross-Trigger	1 contact per unit	Normally open
Phasor Measurement Unit (PMU) *optional software	12 user selectable phasors	Single-phase quantities or 3-phase positive, negative or Modulated or un-modulated auto-detect zero sequence phasors/summated phasors
Time Sync	IRIG-B, BNC connector/unit	Modulated or un-modulated auto-detect
Self Checking/Recorder Inoperative	1 contact	Normally closed
Phasor Measurement Unit (PMU)		
Phasor Measurement Unit (PMU) optional software module	12 user-selectable phasors	Single-phase quantities or 3-phase positive, negative or zero sequence phasors/ summated phasors
	1 Frequency channel	DFREQ will be reported based on frequency channel configured by user
	12 Analog values	MWatts, MVars and MVA
	64 Digital Status data	Contact status data reported (4 x 16 bits)

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Item	Quantity/Specs	Notes
Environmental		
Ambient Temperature Range	-10°C to 55°C	IEC 60068-2-1, IEC 60068-2-2
Humidity	Up to 95% without condensation.	IEC 60068-2-30
Insulation Test (Hi-Pot)	Power supply, analog inputs (through external isolation modules), external inputs, output contacts at 1.5 kV, 50/60 Hz, 1 minute	IEC 60255-5
Voltage dips, Interruptions, Variations	200 ms interrupt	IEC 61000-4-11, IEC 60255-11
Conducted RF Immunity		IEC 61000-4-6 Level 3, IEC 60255-22-6 Level 3
Radiated RF Susceptibility		IEC 61000-4-6 Level 3, IEC 60255-22-3 Level 3
Electrical Fast Track/Burst		IEC 61000-4-4 Level 3, IEC 60255-22-4 Class III
Oscillatory Transient		ANSI/IEEE C37.90.1-1989, IEC 61000-4-12 Level 3, IEC 60255-22-1 Level 3
Oscillatory Vibration		IEC 60068-2-6, IEC 60255-21-1 Class 1
Seismic		IEC 60068-3-3, IEC 60255-21-3 Class 1
Shock and Bump		IEC 60255-21-2 Class 1

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