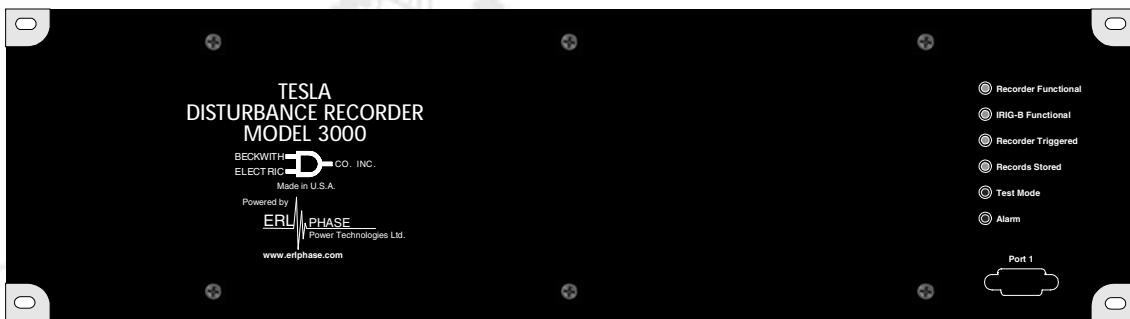




# TESLA 3000 POWER SYSTEM RECORDER

**The New TESLA 3000 is an intelligent, state of the art, user-friendly multi-timeframe dynamic power system recorder with advanced PMU and Continuous Disturbance Recording capabilities.**



- **Phasor Measurement Unit (PMU) per IEEE Standard C37.118-2005 Synchrophasors for Power Systems**
- **Meets NERC Continuous Disturbance Recording (CDR) standards with on-board memory. No external drive required.**
- **Powerful and intuitive setting and analysis software**
- **CDR permits use as a mini Phasor Data Concentrator (PDC)**
- **Multiple units can be configured to work cooperatively via Ethernet port**
- **Dynamic swing recording of disturbances with ability to cross-trigger for wide area recording of entire power system**
- **Input isolation modules eliminate costly CT and PT wiring runs**

## **Features**

### **Phasor Measurement Unit (PMU)**

- Up to 12 individual and/or derived phasors can be transmitted as per IEEE C37.118-2005 Synchro Phasor Standard.

### **Continuous Disturbance Recording (CDR) Capabilities**

- CDR data stored on the recorder on a 4GB flash disk memory (Other size disks available).
- Serves as a mini Phasor Data Concentrator (PDC).
- User definable range of data can be retrieved any time from the recorder
- Meets the NERC CDR Standards storing all the data on the TESLA itself. No separate memory storage is required.

### **Simultaneous multi-functional recording and event logging**

- High-speed transient fault recording
- 36 analog/64 digital inputs (optional 18 A/32 D channel model also available).
- Hundreds of additional user-defined derived channels are also available from those channels.
- Combined record storage maintains 1000 records, including fault, swing or combined records in on board memory.
- Multiple units can be configured to work cooperatively (via Ethernet port) providing up to 144 analog/256 external inputs and single fault record
- Multiple user selectable sample rates at 32, 64, 96, 128, 256 and 384 samples/cycle - captures up to the 100th harmonic.
- Dynamic swing recording of disturbances and ability to cross-trigger for wide area recording
- User configurable Trend recording of up to 60 channels with a 90 day storage facility.
- Monitors the substation and entire power system
- Fault location derived from single and calculated currents
- Real-time metering of all input and calculated quantities

### **Powerful and intuitive setting and analysis Windows based software (Control Panel)**

- Comprehensive Windows® based software for both local and remote setting and analysis.
- Creates over 1100 recording triggers to analyze every possible type of power system disturbance
- User-programmable control logic statements with ProLogic to create user defineable triggers
- Independent triggering and priority record setting
- User-configurable report templates
- Over 120 calculated channels per recorder

### **Designed to save time and cost with user friendly software and architecture**

- Ease of use and learning allows users to access more information for monitoring.
- All settings, calibration and adjustments done out side the box after initial installation.
- Split core CT's and Clamp-on devices allow easy installation while leaving main CT in service, avoiding power outages
- Analog ac or dc input isolation modules are external and DIN-rail mountable
- Input isolation modules may be mounted up to 4000 feet (1219 meters) away saving on costly cabling to recorder.
- The smallest footprint among recorders allows easy retrofit option and installation into panels.

## Advanced Communications

- Data compression for faster file transfer, COMTRADE import/export
- SCADA support with direct-connect DNP3 and Modbus protocols allow using TESLA as a RTU metering system eliminating transducers.
- IRIG-B clock synchronization (modulated and unmodulated)
- 10/100 BaseT Standard/Standard “Fast Ethernet”, optional high speed modem

## Options

- RecordBase Control Station Software for database management.

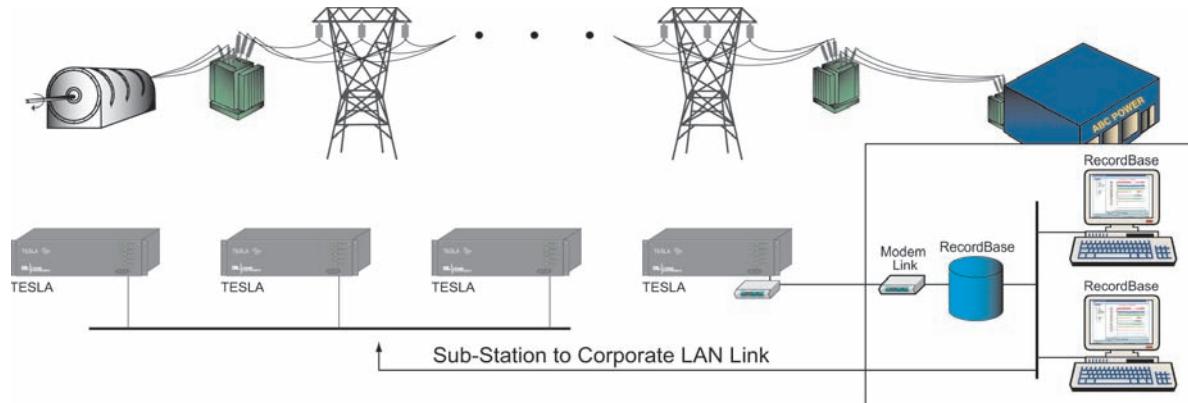


Figure 1 Typical recording installation connects to substation via corporate LAN

**SPECIFICATIONS**

Item	Quantity/Specs	Notes
<b>General</b>		
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 V dc, 120 V ac	
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	Solid State Flash Drive
A/D Resolution	16 bits, 65536 counts full scale	
<b>Channels and Triggers</b>		
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	

**SPECIFICATIONS (Cont'd)**

Item	Quantity/Specs	Notes
<b>Input &amp; Output</b>		
Analog Input Channels	Rating: In = 5 A or 1 A, Vn = 69 V Continuous: 3x In, 2x Vn One Second: 20x In without distortion.	18 or 36 per unit, 144 maximum using 4 units in "Cooperative Mode"
External Inputs (digital)	DC programmable gain 1000 V dc maximum, externally powered (48-250 V dc).	See Input Module data sheet for more information 32 or 64 per unit, 256 maximum using 4 units in "Cooperative Mode"
Alarm Output Relays (contacts)	40-150 V dc, externally wetted Make: 8 A Carry: 8 A Break: 0.15 A at 125 V dc	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 , 1.0 sec., Latch , 1.0 sec.
<b>Interface &amp; Communication</b>		
Front Panel Indicators	Recorder Functional, IRIG-B Functional, Recorder Triggered, Records Stored, Test Mode, Alarm	6 Leds
Serial User Interface	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
<b>Interface &amp; Communication (cont)</b>		
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 zero sequence phasors/summed phasors
Time Sync	IRIG-B, BNC connector/unit	Modulated or un-modulated auto-detect
Self Checking/Recorder Inoperative	1 contact	Normally closed

## **Software Overview**

Easy to use, simplified recorder setting and record analysis software uses Windows® based software to communicate, configure, download, display and analyze records.

TESLA recorder's inputs include 36 analog channels and 64 digital channels (optional 18 A/32 D channel model available). In "Co-operative mode" using 4 Tesla units, inputs can be a maximum of 144 analog and 256 digital channels. Hundreds of additional user-defined derived channels are also available.

Combined record storage maintains 1000 records, including fault, swing or combined records.

The recorder includes easy to use TESLA Control Panel recorder configuration and record analysis software (optional RecordBase Central Station).

TESLA Channel Summary:

- Analog and digital (measured) channel “types, scaling and names”
- Derived (calculated) channels
- Trigger conditions
- Trigger actions

## **Recording Capabilities**

36 analog and 64 digital inputs sample at multiple sample rates and create up to 3 records simultaneously. The TESLA recorder employs sophisticated trigger combination algorithms to combine data from multiple events into a single record and to reduce the amount of redundant data in the records. In addition, the TESLA combines data captured using multiple time-frames into a single record.

**Transient Fault Recording** – Transient fault (high speed sampled data) recording provides multiple sample rates for a duration of up to 30 seconds/record. The recorder produces THD calculations and selected single harmonic magnitudes up to the 100th harmonic. Triggers are available for:

The waveforms and auxiliary protection are recorded before, during and after a fault clearance. Use the recorder for post analysis to verify protection and breaker operations. Use this feature to verify short circuit models and correct relay co-ordination.

**Swing Recording** – Dynamic swing (low speed) recording samples at 1 sample/cycle (60 samples/ second) for a duration of up to 3 minutes/record to capture slower system dynamic swings. The waveforms and auxiliary protection are recorded before, during and after a fault clearance. Use this feature to review loading and stability criteria.

**Trend Recording** – Trend records are user-configurable for up to 60 measured or derived channels with a 90 day storage facility. Use this feature to monitor issues like long timeline power factor.

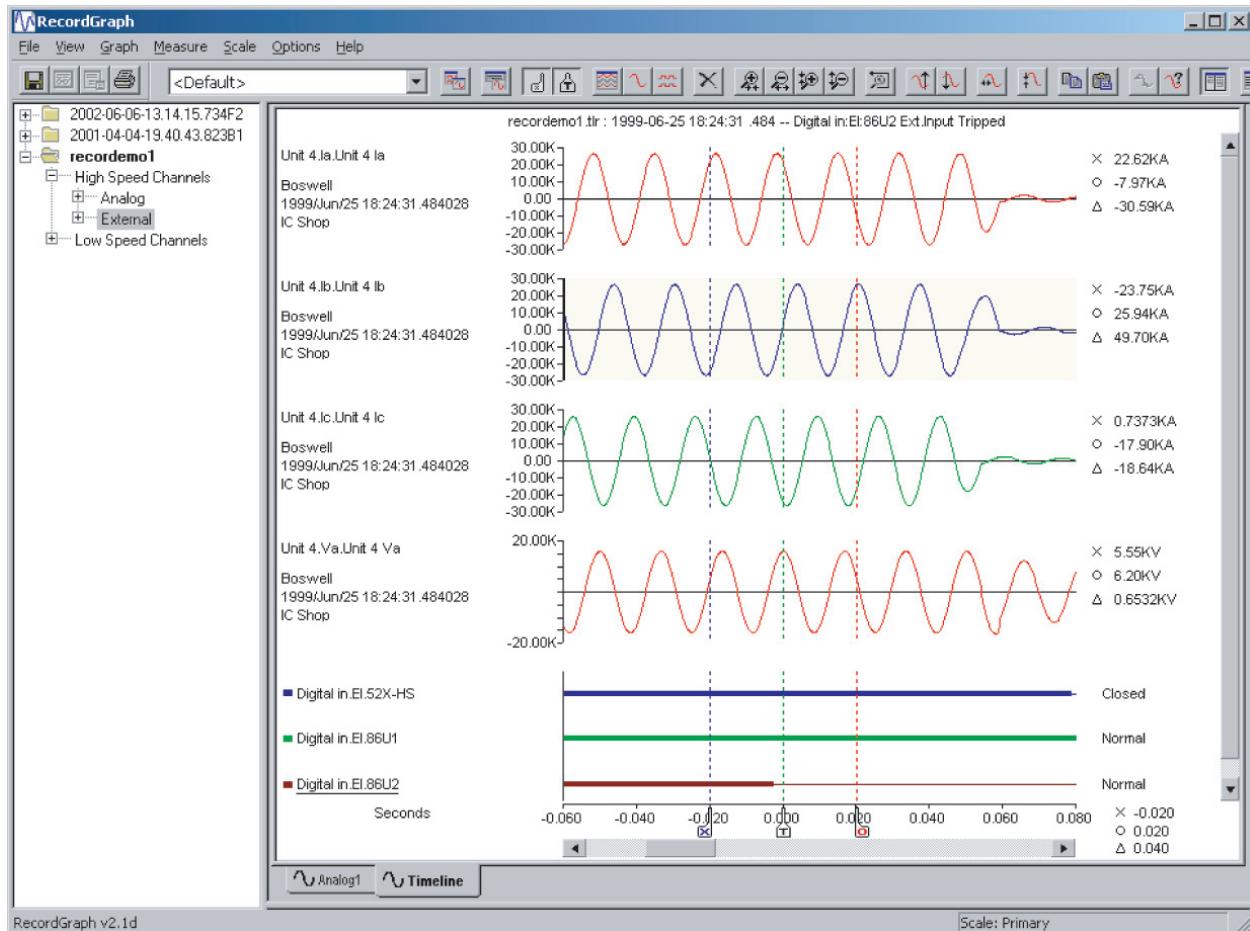
**Power Quality Recording** – Power quality captures and records information such as:

- Voltage and frequency profiles
- Voltage dips and surges (sag and swell)
- Loss of supply
- Harmonic contents
- Voltage imbalance
- Watts

### Real Time Monitor – View analog and digital inputs in real time.

- Panel meters
- Digital input states

Use a laptop to display these values locally or send the values to SCADA.



*Figure 2 Measured Channels*

## TESLA 3000

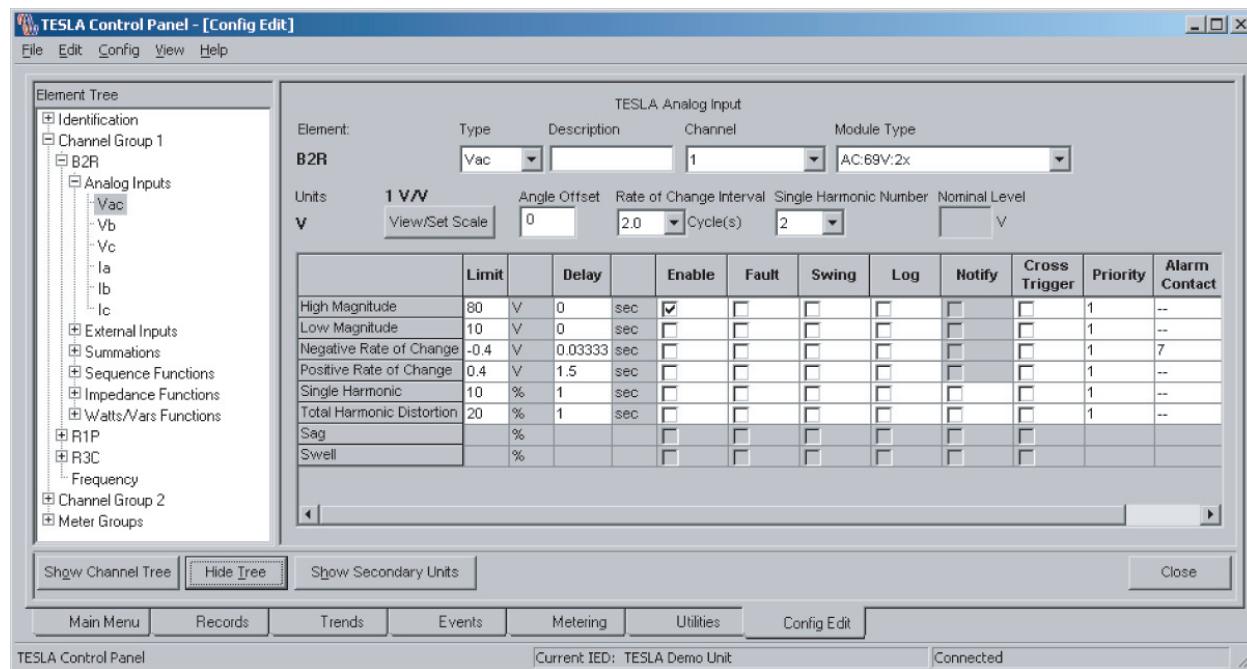


Figure 3 Calculated Channels

## Channel Configuration

### Analog Inputs

- 36 analog channels
- 32, 64, 96, 128, 256 and 384 samples/cycle, converted into phasor quantities
- Transient fault records sample individual points and phasors for transient conditions

Triggers:

- High/Low magnitude
- Positive/Negative rate of change
- THD magnitude
- Single harmonic magnitude
- Sag/Swell
- External input and logic
- Impedance

### External Inputs (digital)

- 64 digital channels
- 32, 64, 96, 128, 256 and 384 samples/cycle
- Transient fault condition records

Triggers:

- Positive/Negative edge transition (auxiliary inverting relays unnecessary)

## **Summation**

- 30 summation channels
- Evaluates the phasor quantities associated with its analog inputs
- Allows a combination of phasor quantities similar to an operational amplifier
- Individual scaling and angle offset “Triggers.”
- High/Low magnitude
- Positive/Negative rate of change

## **Sequence**

- 12 sequence channels
- Calculates positive, negative and zero sequence components in one step
- Input to a Watts/Vars or Impedance function

Triggers:

- Positive Sequence: High/Low magnitude, Positive/Negative rate of change
- Negative Sequence: High magnitude
- Zero Sequence: High magnitude

## **Watts/Vars**

- 18 Watts/Vars channels
- Calculates Apparent Power (volt-amps), Real Power (watts) and Reactive Power (vars) for one voltage input and one current input
- Calculates Watts and Vars on a three-phase basis when a Positive Sequence voltage and a Positive Sequence current are specified as the function inputs
- Watts (each with 2 detector settings)
  - High Level
  - Low Level
  - Positive rate of change
  - Negative rate of change
- Vars
  - High Level
  - Low Level
  - Positive/Negative rate of change

## **Impedance**

- 18 impedance channels
- Calculates phase to phase or phase to neutral impedance
- Triggering based on the rate of change of impedance within a defined impedance circle around the origin

## TESLA 3000

### Logic

- 30 logic channels
- Creates user programmable intuitive logical operations (AND, OR, etc.) from individual external inputs and internal detectors
- User-defined triggers and statement names

Triggers:

- Transition to ON state
- Transition to OFF state

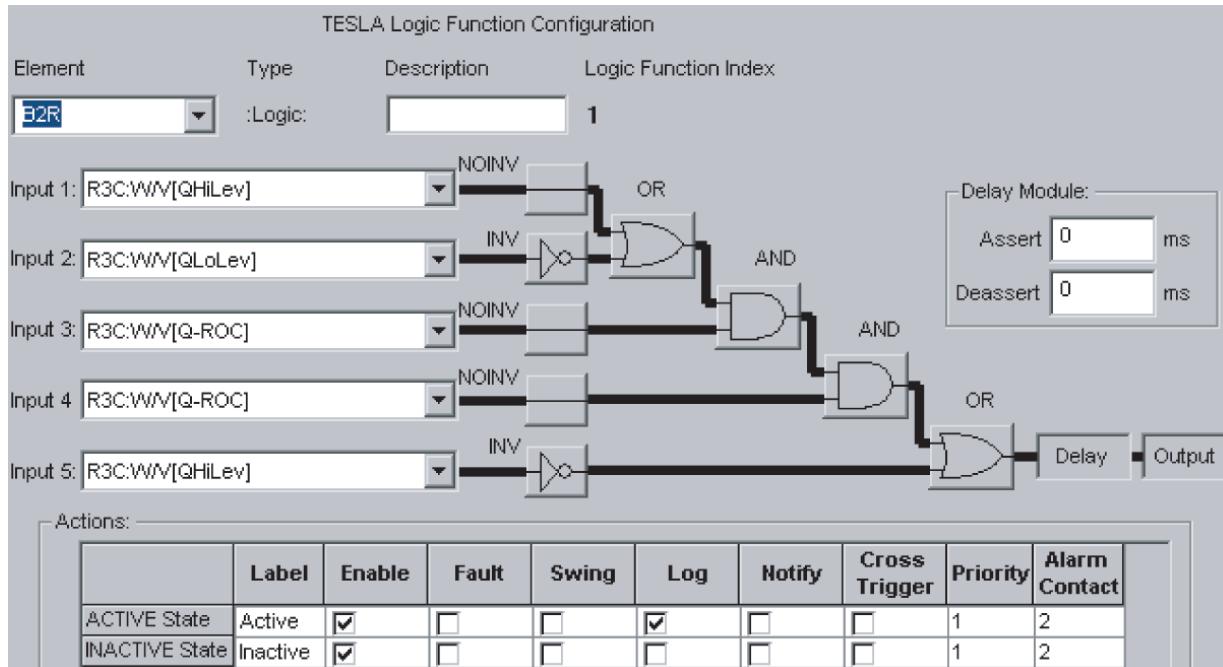


Figure 4 Logic Channels

### Frequency

- 2 frequency channels
- Measures the frequency of selected analog input

Triggers:

- High/Low magnitude
- Positive/Negative rate of change

**Power Factor** – The power factor detector monitors the watts, vars, and volt-amps values and operates when the power factor is less than a user-specified threshold. Separate detectors allow separate thresholds for lagging (inductive) and leading (capacitive) power factors. Use this feature to reduce the incidence of nuisance operations.

- 18 power factor channels
- Monitors power ratio of real power to total power (MVA) and reactive power values calculated by a Watts/Vars channel.
- Qualify triggers by total power level

Triggers:

- Inductive power factor separate low magnitude triggers for capacitive and inductive
- Capacitive power factor – low magnitude

**Fault Locator** – Calculates the distance to the fault using recording information. The fault locator channel monitors 3 line voltage inputs and 3 line current inputs. When an “assert” transition occurs, the phase information collected determines the location of the fault from the line conditions monitored prior to the transition. The line parameters refer to the total line length indicated in miles or kilometers.

- 5 fault locators/channel group
- Monitors 3 voltage phases and 3 current phases continuously
- Assesses the distance to fault with user-supplied line parameters
- Creates an event message if one or more of the impedances is consistent with a fault on the line
- Information made available on the SCADA channel

## TESLA Configuration

Use TESLA Control Panel software to create, display, modify, copy, save, rename, delete or load configuration files. TESLA Configuration menu manages recorder configurations for quick adjustments.

The Element Tree and the Channel Tree views display configuration information.

Each view provides four main branches:

- **Identification** – provides information “about the selected recorder and setting“ file.
- **Meter Groups** – branch for Meter Groups.
- **Trend** – 60 channels trending capacity.

## Views

**Element Tree View** – Identifies and organizes channels by power system element names. Use element names to group and identify associated analog, digital and calculated channels.

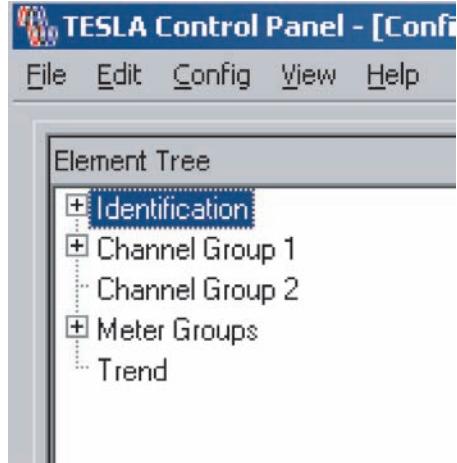


Figure 5 Element Tree View

## TESLA 3000

**Channel Tree View** – Organizes channels by channel type and provides an overview of channel usage.

Channel types:

- Analog Input
- Digital Input
- Summation
- Sequence Components
- Impedance
- Watt and Var
- Frequency
- Logic Function
- Fault Locator
- Power Factor

## Triggers

Apply trigger conditions to each measured or calculated channel.

The screenshot shows the 'TESLA Analog Input' configuration interface. At the top, there are dropdown menus for 'Element' (Line #1), 'Type' (Va), 'Description' (A Ph Voltage), 'Channel' (1), and 'Module Type' (401003 69Vac Common Neutral). Below these are input fields for 'Units' (2 kV/V), 'Angle Offset' (0), 'Rate of Change Interval' (1.0 Cycle(s)), 'Single Harmonic Number' (3), and 'Nominal Level' (69 V). The main area is a table with columns: Limit, Delay, Enable, Fault, Swing, Log, Notify, Cross Trigger, Priority, and Alarm Contact. The table lists various trigger types with their settings:

	Limit	Delay	Enable	Fault	Swing	Log	Notify	Cross Trigger	Priority	Alarm Contact
High Magnitude	75	V	0 sec	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1	2
Low Magnitude	10	V	0 sec	<input type="checkbox"/>	1	--				
Negative Rate of Change	0	V	0 sec	<input type="checkbox"/>	1	--				
Positive Rate of Change	0	V	0 sec	<input type="checkbox"/>	1	--				
Single Harmonic	1	%	1 sec	<input type="checkbox"/>	1	--				
Total Harmonic Distortion	1	%	1 sec	<input type="checkbox"/>	1	--				
Sag	75	%		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1	3
Swell	110	%		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	2

Figure 6 Triggers

**High and Low Magnitude** – Detects conditions where the channel's signal is outside of the defined threshold.

**Positive/Negative Rate of Change** – Detects conditions where the channel's signal is changing at a rate outside the defined boundary.

**Single Harmonic** – Sets target harmonic, specifies percentage of fundamental and minimum duration to initiate a trigger.

**Total Harmonic Distortion (THD)** – Specifies the percentage of total harmonic distortion (THD), the minimum duration the condition required to initiate a trigger.

**External Input and Logic** – Specifies the minimum condition duration required to trigger.

**Impedance** – Calculates the rate of change of impedance.

**Sag and Swell** – Available for ac voltage channels, calculates magnitude thresholds.

**Trigger Response** – Initiates an independent action.

**Record Fault** – Creates a transient fault recording.

**Record Swing** – Creates a dynamic swing recording.

**Log** – Enters an Event Log message.

**Notify** – Calls through modem (attached or internal) to RecordBase Central Station for wide area monitoring.

**Cross-Trigger** – Enables other local TESLA recorders to activate on the same event.

**Priority** – Assigns each individual trigger detector a priority level from 0 to 3, based on the highest priority event contained in the record.

**Alarm Contact** – Activates an external contact.

## External Connections

### Analog Input

TESLA's analog inputs are generic, low level (5 V peak to peak) signal inputs from external isolation modules. Connect any analog input to any isolation module. Channel definitions handle the configuration of a channel as a voltage or current.

### Analog Input Isolation Modules

TESLA uses external isolation modules for voltage and current inputs. Mount the modules (up to 4000 feet away from the recorder) on DIN rails to simplify wiring and minimize rack space requirements. Optional clamp-on or split core current CTs available.

The isolation modules provide scaling isolation and surge protection. Module outputs are low level voltage signals which feed directly into the recorder's rear panel analog inputs.

The following external devices allow for inputs to the recorder. For the individual specifications consult each device's data sheets.

### AC Current Input Module

The ac input current module provides isolation and scaling for four independent ac current channels. This module is available in two models with nominal current 5 Arms (Model 401014) and 1 Arms (model 401020) with a 20x over-range capability, for 1 second. The module has input and output terminal pairs for I1 through I4.

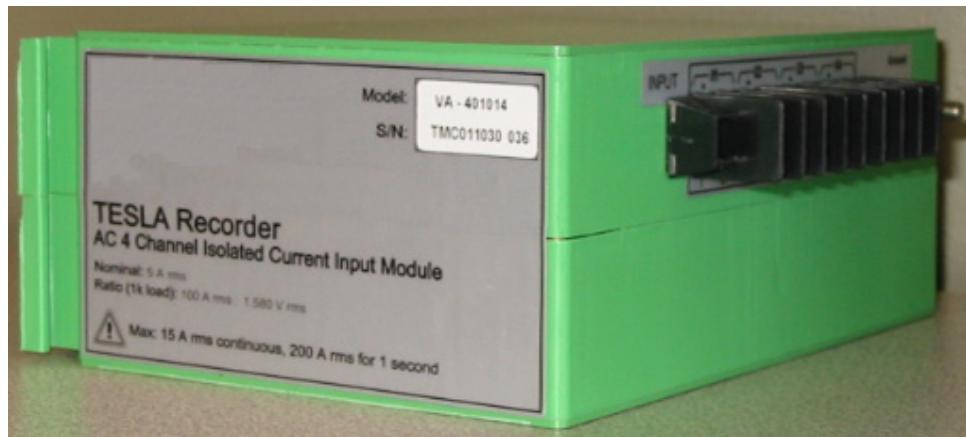


Figure 7 AC Current Input Module

## TESLA 3000

### AC Voltage Input Module

The ac voltage input module provides isolation and scaling for three ac voltage channels. Nominal voltage is 69 Vrms with a 2x over range capacity. This module provides three inputs, VA-N, VB-N and VC-N. The voltage input module has two output terminals for each of the three phases.

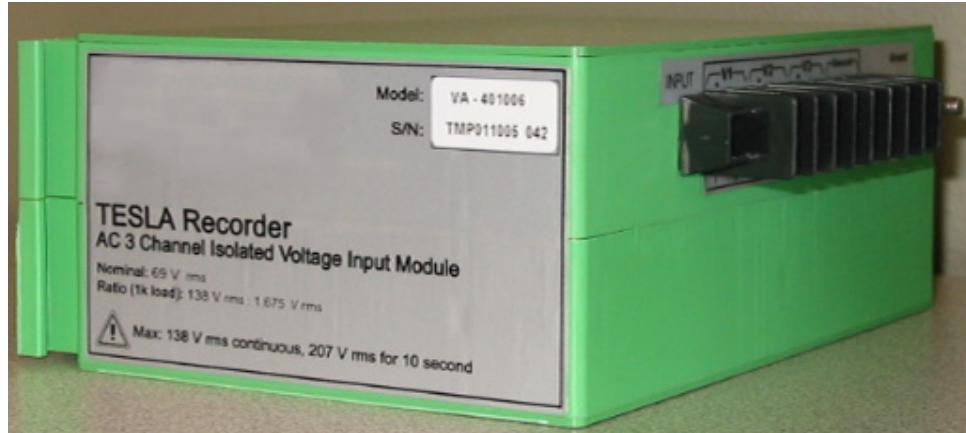


Figure 8 AC Voltage Input Module

### DC Input Module

The dc input module provides dc-coupled isolation and scaling for four independent dc or ac voltage or current channels. These channels have a dc to 2 kHz bandwidth but are limited to 1.5 kHz by antialiasing filters inside the recorder. Externally mounted resistors set the input type and full scale range.



Figure 9 DC Input Module (Optional)

### Split Core Current Transformer

The split core current transformer is an indoor device for measuring current in a 5 A or 1 A secondary CT circuit. The device's removable leg contains a polished and lapped spring-loaded core that mates with the precision core in the main housing. CT phase displacement is within 30 minutes or 0.5 degrees.



Figure 10 Split Core Current Transformer (Optional)

### Clamp-on Current Transformer

The clamp-on current transformer is an indoor device for measuring current in 5 A secondary CT circuits. The clamp-on has a 20 mm (0.78") jaw opening and accommodates conductors up to 250 MCM. Signals are output via two standard safety banana jacks.



Figure 11 Clamp-on Current Transformer (Optional)

## **TESLA 3000**

### **Digital Input Channels**

The digital inputs on the TESLA recorder are dry inputs intended for use with signals from a 48 V dc or a 125 V dc station battery. The inputs are isolated and protected against transient surges.

### **Alarm Contacts**

The TESLA recorder alarm contacts are dry contacts. They are isolated and protected against transient surges.

1	Recorder inoperative
2, 3	User-configurable
4	Cross-trigger
5, 6, 7, 8	User-configurable

Alarm contacts 1–4 are available for 18 analog/ 32 digital models only. Use the cross-trigger contact to initiate a recording on another recorder.

When activated, the cross-trigger contacts close for 0.10 seconds, regardless of the duration of the triggering condition. This ensures that the cross-trigger function does not become blocked by a continuous trigger condition.

### **IRIG-B Time Signal**

The TESLA recorder accepts and auto-detects modulated or unmodulated IRIG-B time signals.

### **Communication Ports**

The TESLA recorder has three communication ports configured via software:

- Port 1 (front): Used for direct connection to a computer running TESLA Control Panel.
- Port 2 (rear): Used for either an external modem or a direct cable connection to a computer running TESLA Control Panel.
- Port 3 (rear): SCADA supports Modbus ASCII, Modbus RTU and DNP3 Level 2.
- Network Port: RJ45 for 10/100 Base-T Ethernet

### **Power**

Nominal Range: 48 V dc – 250 V dc, 120 V ac, 50/60 Hz

Full Operating Range: 40 V dc – 300 V dc

### **Analog Input Calibration**

The TESLA Control Panel's Calibration Utility provides a means of calibrating the recorder's analog input channels.

### **Options**

An internal modem option can be supported.

## Metering

The TESLA recorder has a full set of real-time metering displays that provide the present readings from the analog and digital input channels, calculated channels and output alarms.

**Standard Metering Screens** – Select from multiple display screens: analogs, digitals and outputs present the readings from the analog inputs, external inputs and output alarms.

**User-Defined Metering Screens** – An additional eight user-defined metering screens provide a total of ten screens. Set up these additional screens is part of the TESLA Recorder's configuration.

**Display Zoom** – Use the Zoom Level (%) button to adjust the magnification of metering screens.

**Freeze/Thaw** – Provides a means to temporarily halt the metering display to ensure a synchronized set of readings for documentation purposes.

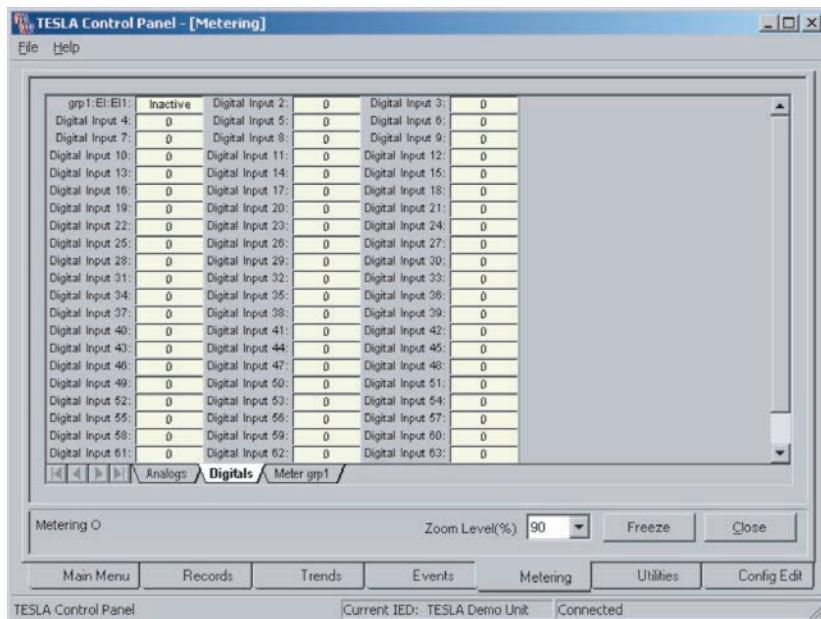


Figure 12 TESLA Control Panel Metering - Digitals

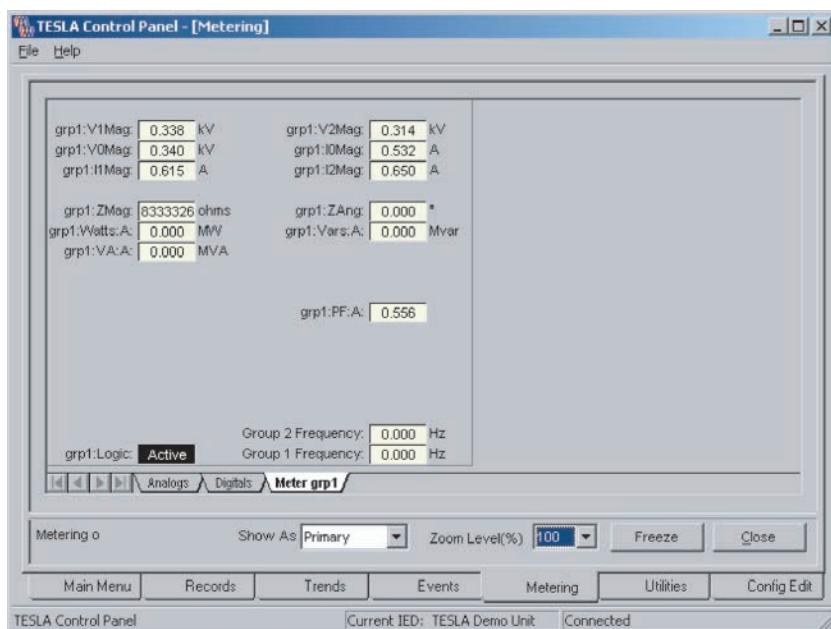


Figure 13 TESLA Control Panel Metering - Meter Group

## Record Management

TESLA Control Panel software includes record management functions.

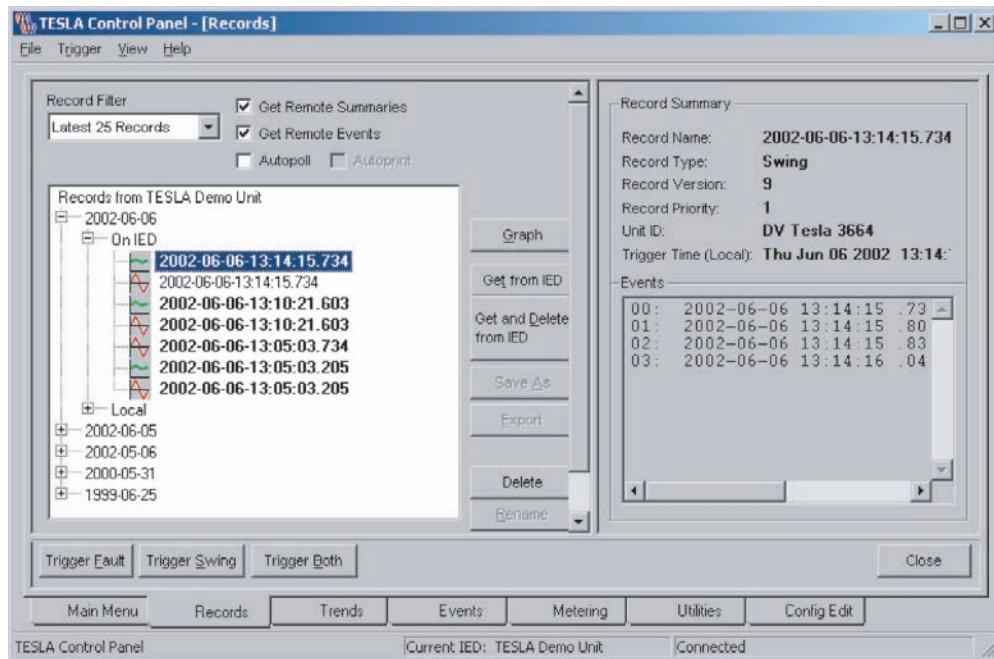


Figure 14 Record Management

**Record Lists** – Shows lists of records for the current TESLA recorder organized by date.

**Record Filter** – Controls the number of files resident on the recorder as well as local records displayed.

**Trigger Fault** – Creates a transient record:

- 15 second records
- Up to 30 second auto-extended records

**Trigger Swing** – Creates a swing record:

- Creates 30 minute records

**Trigger Both** – Creates a combined transient and swing record.

### Graphing Functions

RecordGraph is a tool used to display and analyze records from ERLPhase relays and recorders. This can be used to graphically view data recorded during fault, swing and trend modes.

**Record Export Utility** – The record export utility lets you convert records into different formats for use with other software tools. Export selected channels or all channels, based on different sampling rates.

**Comtrade** – Common Format for Transient Data Exchange (COMTRADE) is an industry standard record format used to share data between tools and to replay faults through a test set. The export utility supports viewing both ASCII and binary COMTRADE formats (1991 and 1999).

**PTI** – TESLA records can be exported in a PTI-compliant format for import into PTI tools. The export utility supports ASCII format and create output that complies with PTI version 1 and 2 formats.

**Excel (CSV)** – TESLA records can be exported in basic comma separated ASCII format suitable for importing into standard tools such as Microsoft Excel.

**Record Import** – The import utility supports viewing of both ASCII and binary COMTRADE formats (1991, 1999 and 2000). When the COMTRADE file is imported into the RecorderGraph, all its functionality can be seamlessly used to analyze the record.

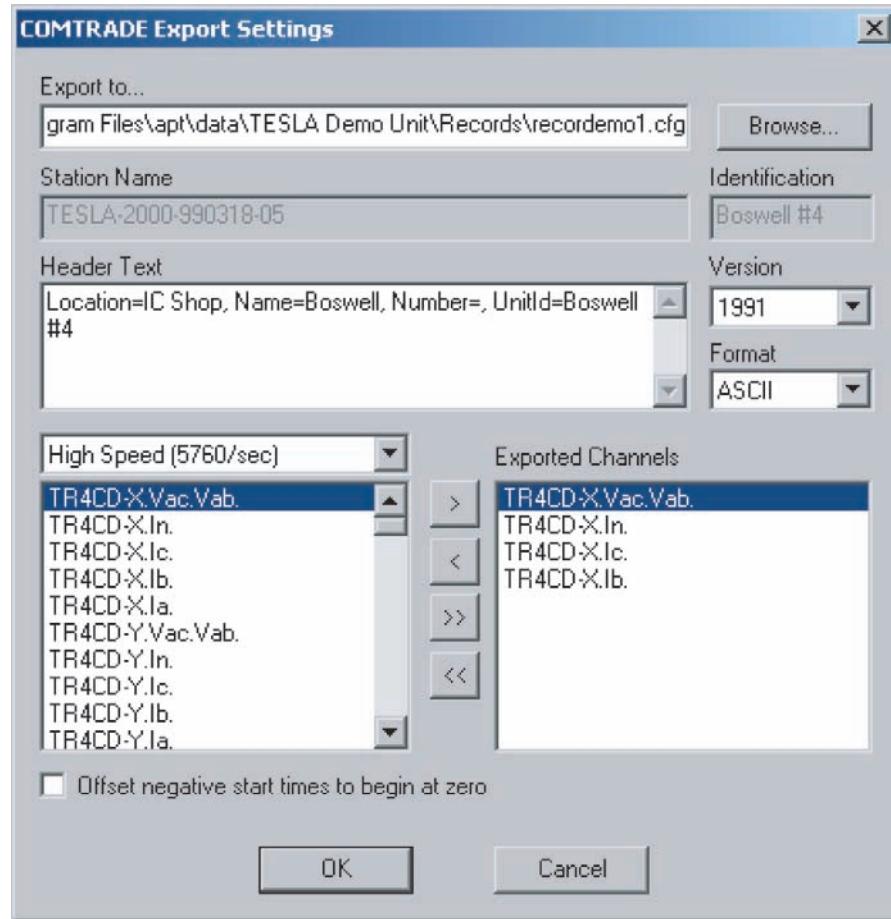


Figure 15 Export to COMTRADE

## Record Analysis

**Record Graphing** – TESLA Control Panel directly displays and analyzes fault and dynamic swing records.

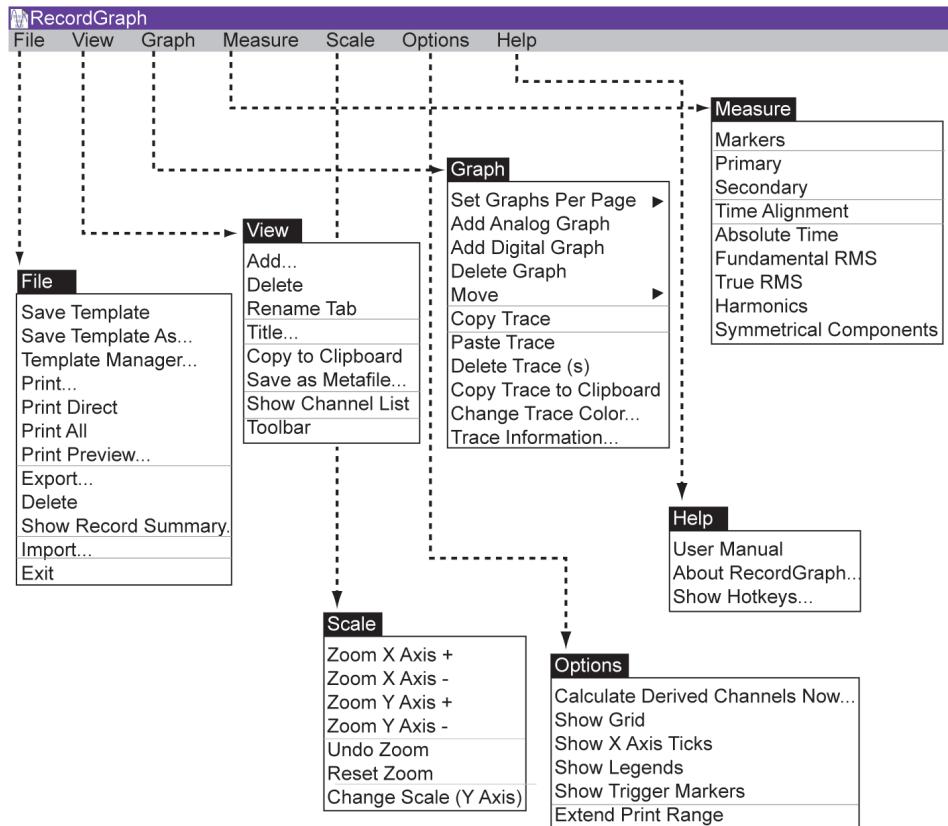


Figure 16 Graphing Menus

**Analysis Templates** – Template is a user-defined graphical layout file containing information about fixed views, graphs, traces, marker positions, readouts, scaling and zoom range. Quickly format and analyze disturbances recorded at different times and from different locations by applying templates.

**Readouts and Measurements** – The Measure menu consists of the following readouts and measurements: markers, primary/secondary, time alignment, absolute time, fundamental RMS, true RMS, harmonics and symmetrical components.

**Manipulating the Graphs** – Graph functions: clear/set markers, undo/reset zoom, delete view, change view title, set graphs per page, add/delete graph, change scale, copy/paste/delete a trace, show trace data, properties, copy to clipboard, save as meta file, print graphs.

### Views

- Timeline View
- Overlay View
- Symmetrical Component View
- Harmonic View
- Trend View

**Timeline View** – Displays the transient, dynamic swing and event data.

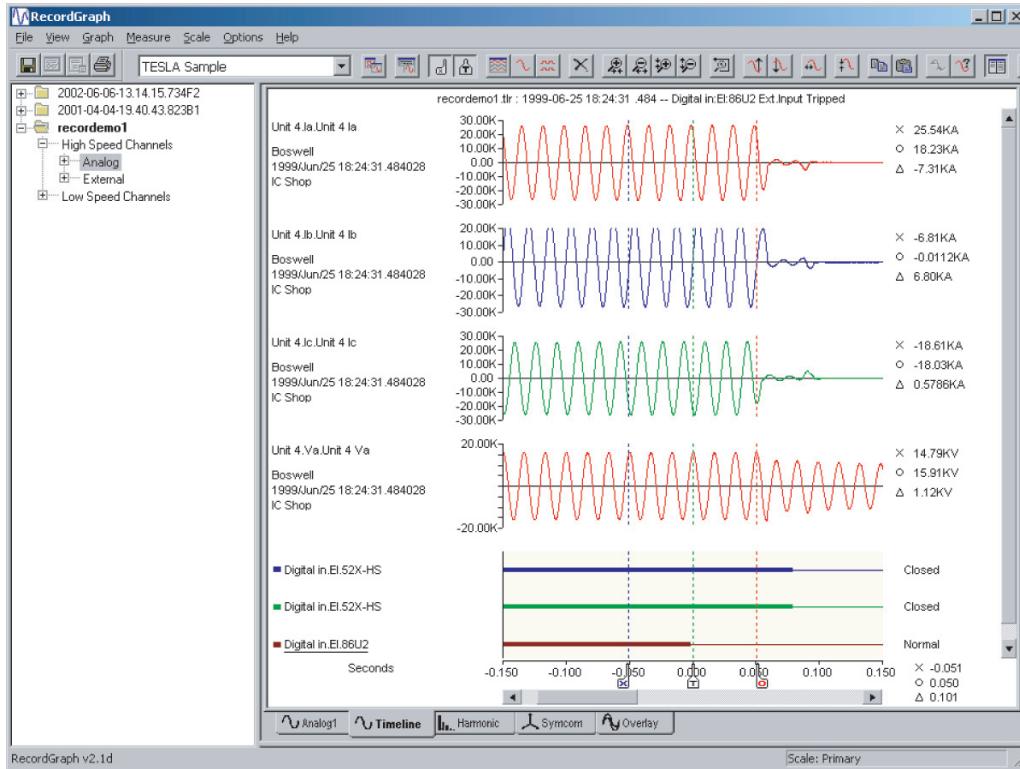


Figure 17 Timeline View

**Overlay View** – Displays multiple channels in a single timeline common to all graphs.

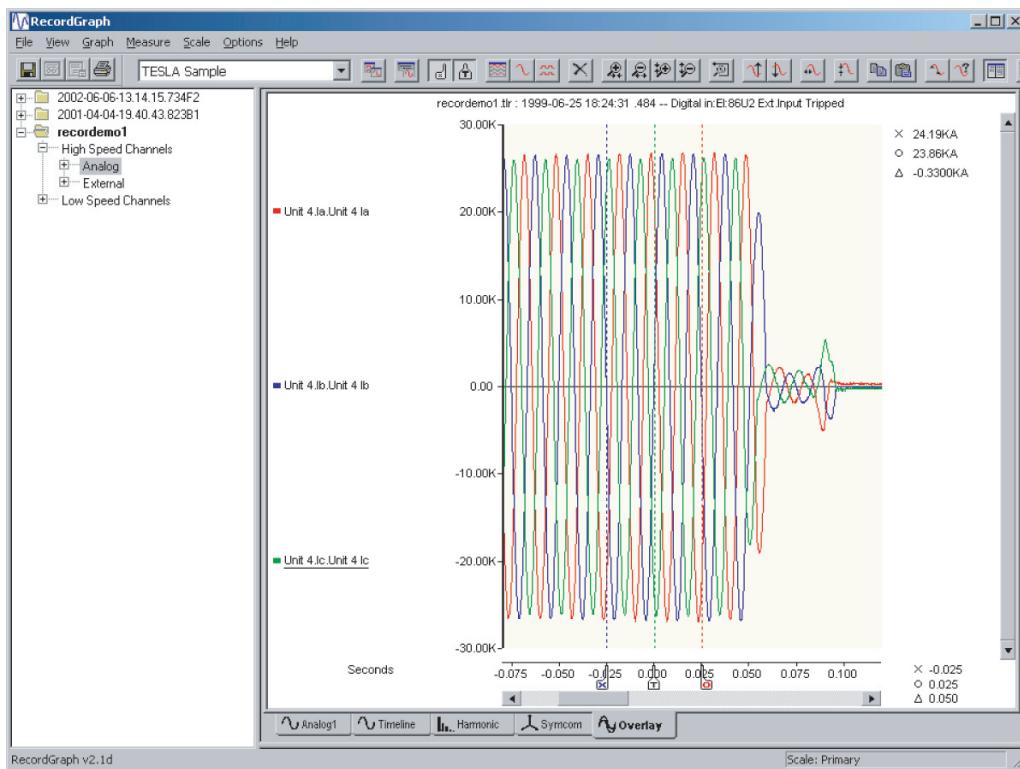


Figure 18 Overlay View

### Symmetrical Component View

Reviews positive, negative and zero sequence components of three phase voltages or currents. The symmetrical analysis shows:

- Analog channels
- RMS magnitude of the phase diagram of sequence components “and phase voltages or currents“
- Table of phase magnitude (RMS) and phase angle (degrees)

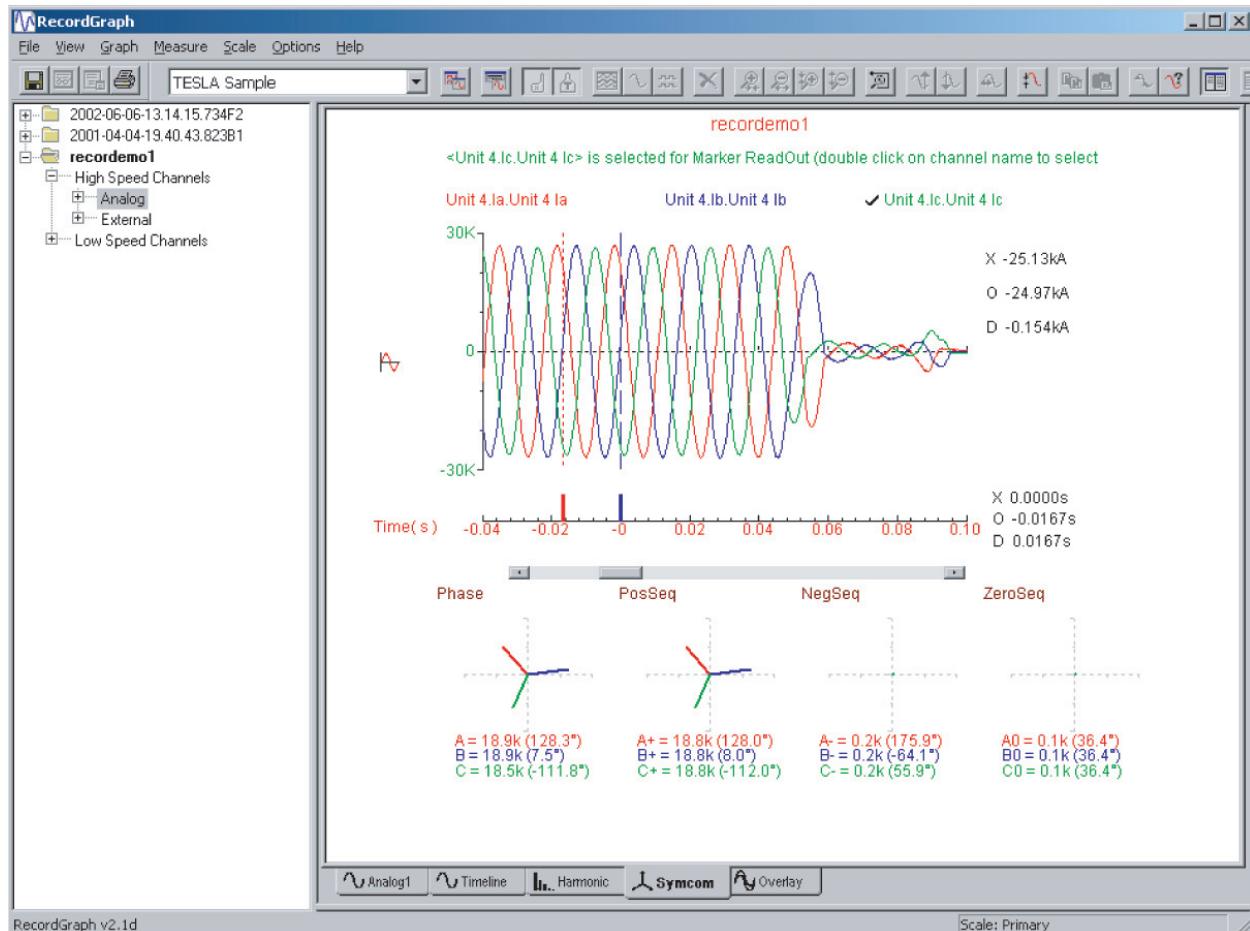


Figure 19 Symmetrical Components

## Harmonic View

Uses analog high speed channels for harmonic analysis. A bar graph depicts the magnitude of harmonics (to a maximum of the 100th harmonic) and a displays a corresponding table. The harmonic analysis shows:

- Analog channels
- RMS magnitude of harmonics up to 100th harmonic including dc “component”
- Total Harmonic Distortion (THD) in percent of the fundamental on the bar graph

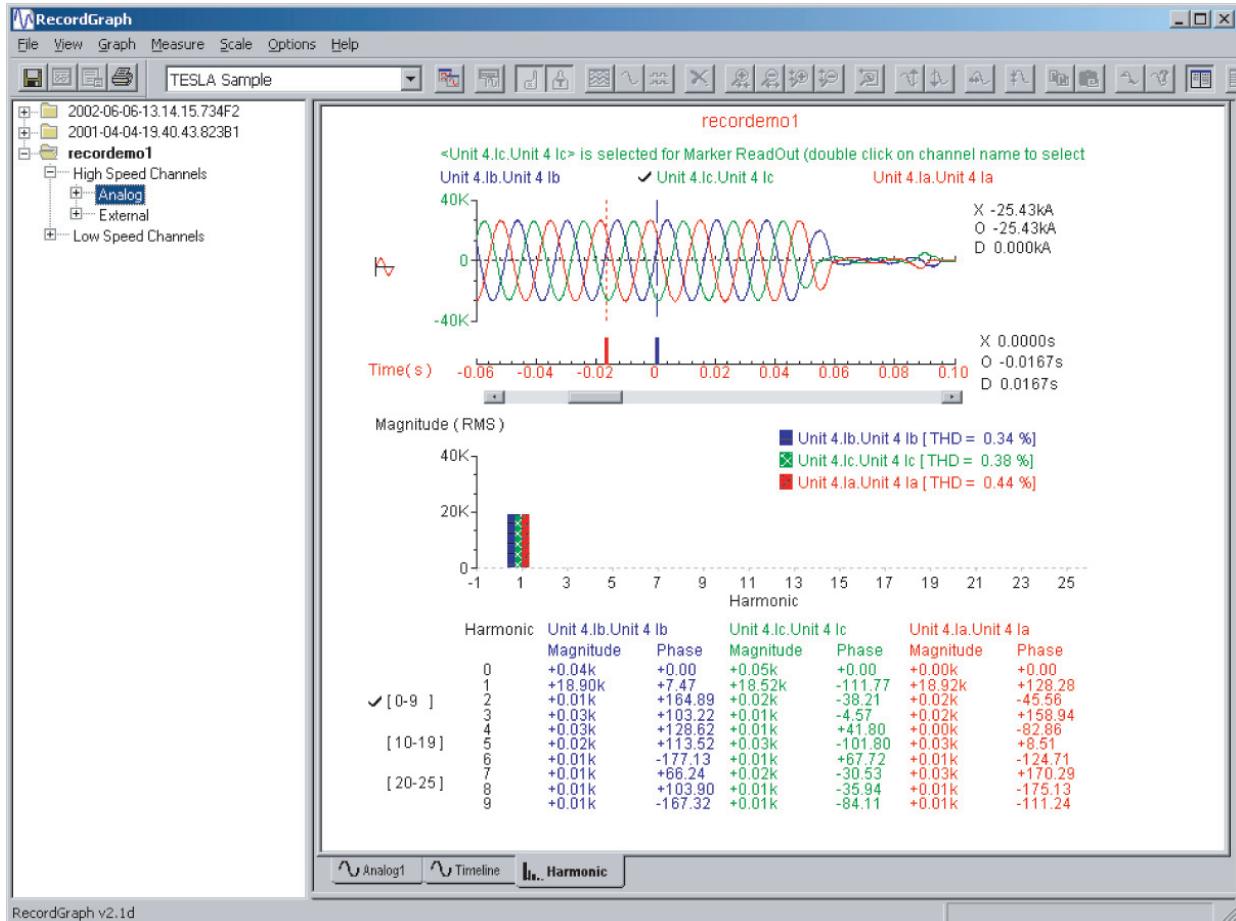


Figure 20 Harmonic View

## Trend View

Displays trend data.

## Environmental

**Ambient Temperature Range** -10°C to 55°C

IEC 60068-2-1/IEC 60068-2-2

### Humidity

IEC 60068-2-30

Up to 95% without condensation.

### Insulation Test (Hi-Pot)

IEC 60255-5

Power supply, analog inputs (through external isolation modules), external inputs, output contacts at 1.5 kV, 50/60 Hz, 1 minute

### Electrical Fast Transient

ANSI/IEEE C37.90.1-2002

## **TESLA 3000**

### **Oscillatory Transient**

ANSI/IEEE C37.90.1-2002

### **RFI Withstand**

ANSI/IEEE C37.90.2

IEC 255-22-3

### **Shock and Bump**

IEC 60255-21-2 Class 1

## **Physical**

**Weight:** 12 lbs (5.5 kg)

**Dimensions:** 5.25" (3U) high x 19.00" wide x 12.00" deep (19" rack mount)

**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 4000' away from recorder chassis using twisted/shielded communication wiring.

### **RecordBase Central Station (Option)**

To support multiple recording units RecordBase Central Station software provides automated collection, storage and network-wide access to fault and dynamic swing data produced by ERLPhase recorders and relays. RecordBase ensures the data is automatically brought to a secure location and made readily available to engineers and technicians for display and analysis.

### **Benefits**

- Improved system-wide monitoring with coordinated recordings via automatic cross-triggering
- Accelerated post-disturbance analysis, NERC-compliant
- Consistent recording data available in an easy to transfer data file format

### **RecordBase Features**

- Automated record transfer from recorders and relays on an ordered call-out schedule or by initiation
- Central cross-triggering of recorders for system-wide dynamic swing recording with cross-triggering zones
- Integrated record database with search, sort and filter functions by date/time, IED, fault class data, swing class data and record sets
- Graphical, interactive record display with timebase, phasor and harmonics analysis tools
- Record summaries with classification, priority assignment and event lists
- Supports COMTRADE, PTI and Excel formats
- Status reporting and self-monitoring
- Graphical and numeric export to support report writing and special analysis

### **System Description (minimum requirements)**

- RecordBase consists of two main software components:
- RecordBase Server and RecordBase Tools. Both components run on your corporate network with compatible PCs.
- RecordBase Server (Windows® NT) – Pentium II 350 MHz, 32 MB and 100 MB of disk space recommended.
- RecordBase Tools (Windows® 9x/ME/NT/2000) – Pentium, 32 MB recommended.

## Mechanical Drawings

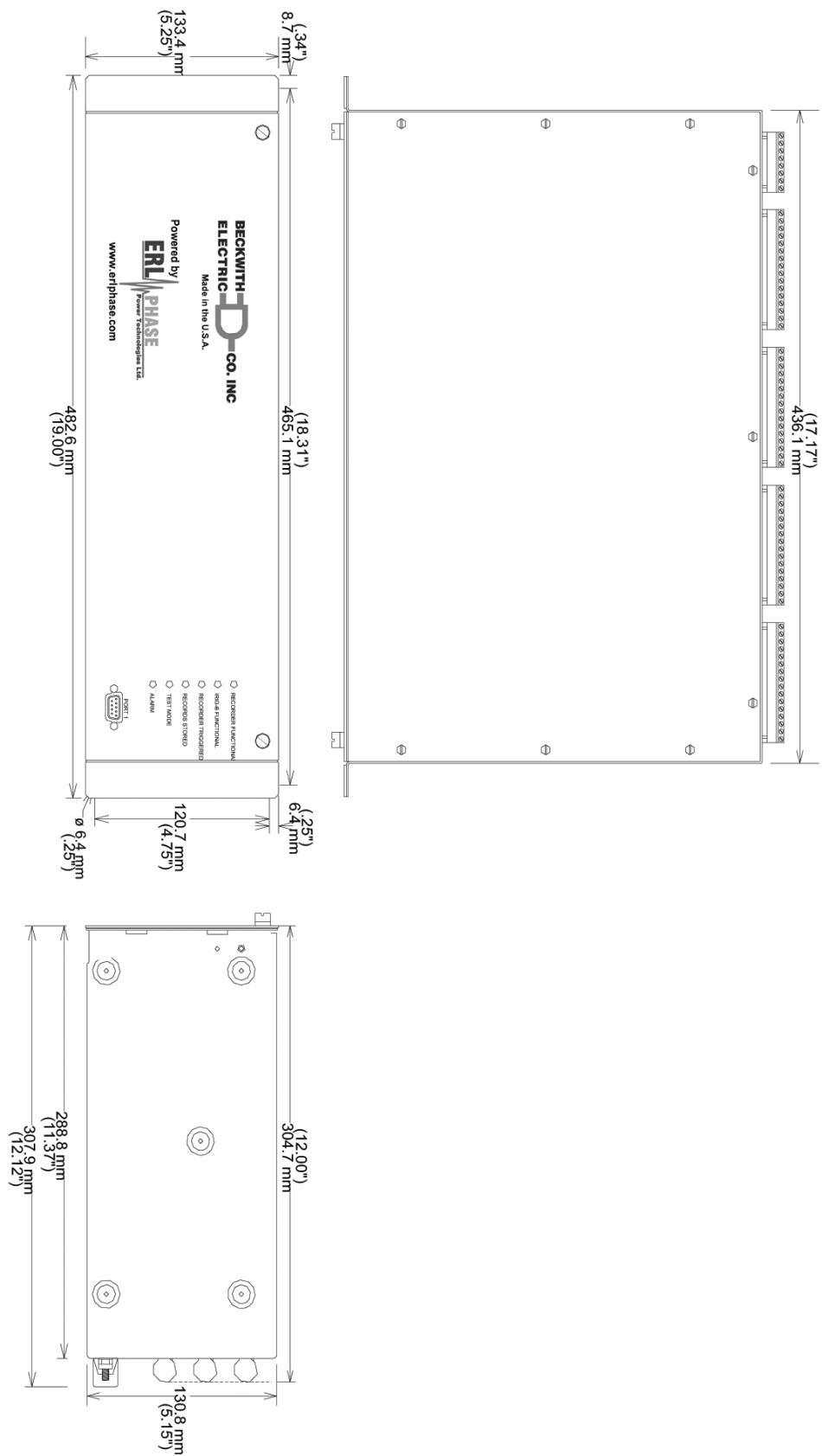


Figure 21 Mechanical Drawing

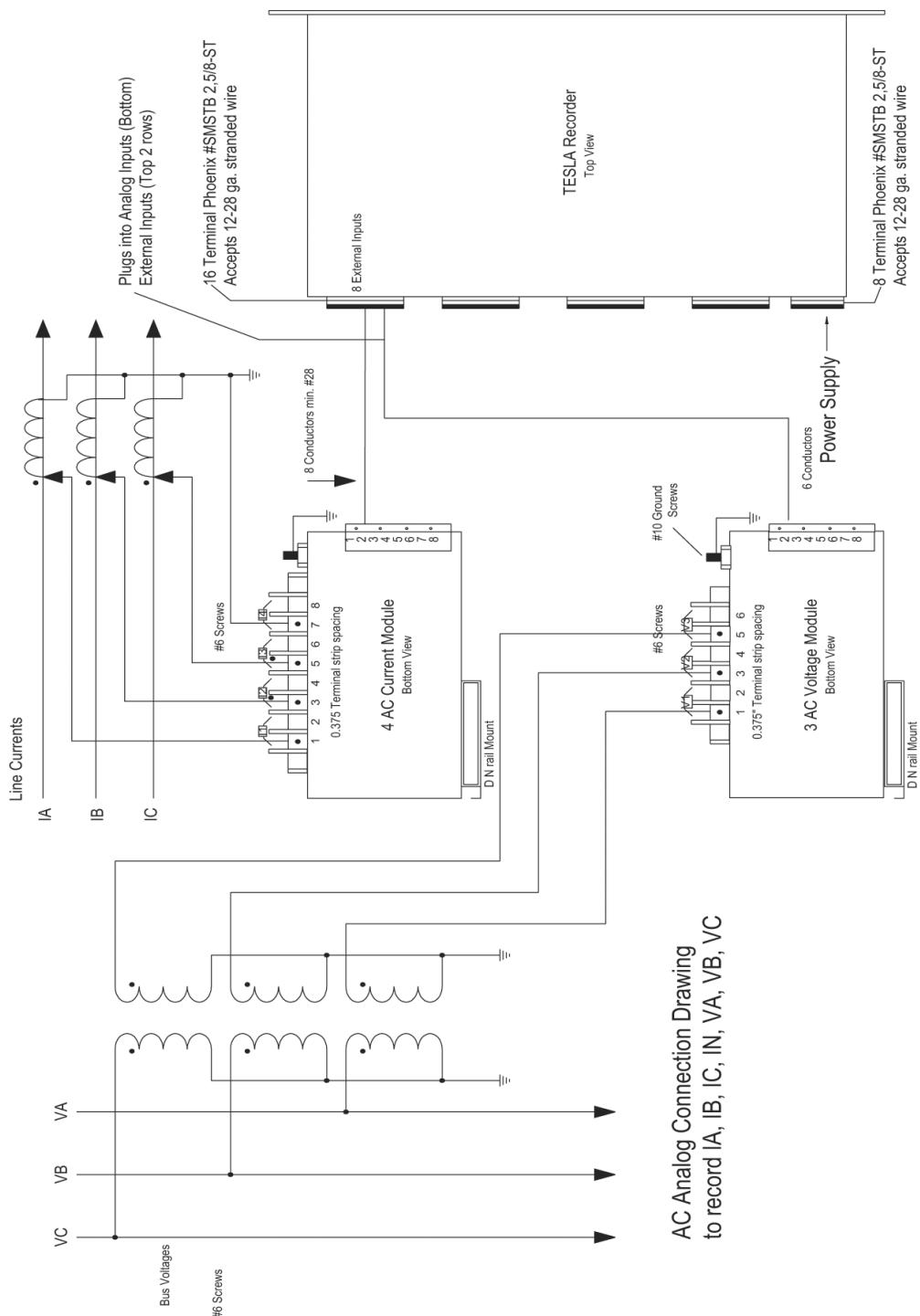
**AC Installation Drawing**

Figure 22 AC Installation Drawing



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