SYNCHROTEQ® PLUS

(19" Rack mount configuration shown here)

SYNCHROTEQ PLUS - DATASHEET

STP030000

2024-03-27

Reference: 21744: STP030000-SP-en

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PRODUCT OVERVIEW

SynchroTeq Plus is a component of the SynchroTeq System Family aimed at high voltage (HV, EHV and UHV) circuit breakers and switchgears.
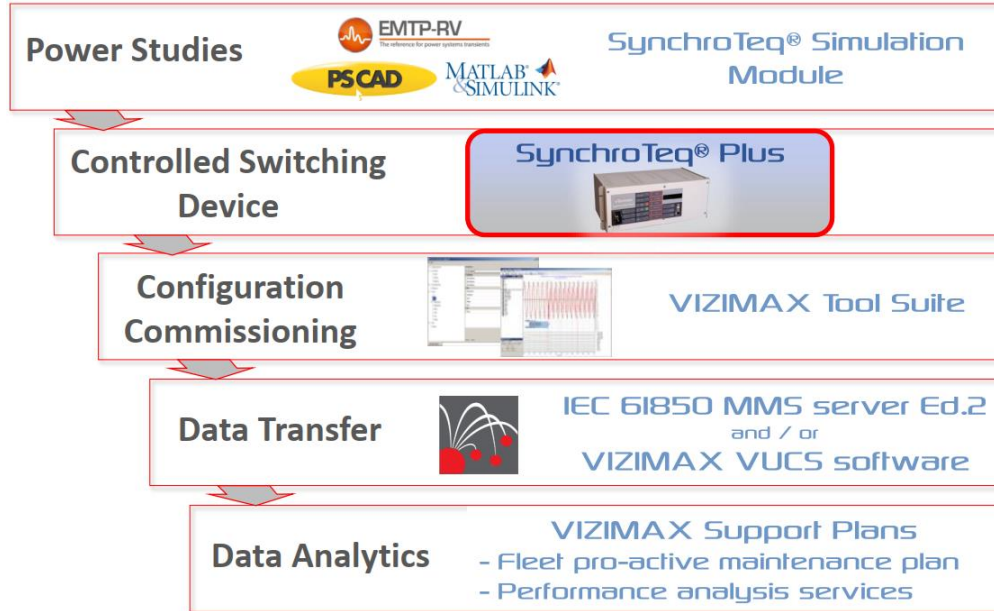
The SynchroTeq Plus is a powerful CSD (Control Switching Device) specifically designed for all types of load switching projects, for 1, 2 or 3 phase circuit breakers, as shown in Table 1 below:

TABLE 1   SYNCHROTEQ UNIT VS LOAD SWITCHING APPLICATION

Load Switching Application	SynchroTeq MV		SynchroTeq Plus	
	SynchroTeq MVR	SynchroTeq MVX	SynchroTeq Plus	SynchroTeq Plus + VL measurement
Discharged Capacitor Banks - MSC / MSCDN	☑		☑	
Shunt Reactors – MSR	☑		☑	
Power Transformers (Peak Voltage)	☑		☑	
Power Transformers (Residual Flux)		☑		☑
Power Transformers in Parallel (Residual Flux)*		☑		☑
Uncompensated Transmission lines (any kV level)			☑	
Compensated Transmission lines (any kV level)				☑
Cables (MV, HV, submarine)		☑	☑	
Partially Charged Capacitor Banks – MSC/FLT		☑	☑	
CB and a half (any kV level)			☑	☑
Voltage range	Up to 69kV		Up to UHV	

SynchroTeq Plus is also a manufacturer agnostic solution suitable for 'DC controlled' switchgears and circuit breakers (C/Bs) regardless of the make.

The appropriate circuit breaker / switchgear type and configuration must be carefully selected according to the considered load and application, as outlined in the following Table 2.

TABLE 2   CIRCUIT BREAKER / SWITCHGEAR TYPE VS LOAD SWITCHING APPLICATION

Load Switching Application	Circuit Breaker / Switchgear		
	Single Pole Operation (Independent poles)	**Three Pole Operation w/ Pole Staggering**	**Three Pole Operation** (Simultaneous poles)
Capacitor Banks - MSC / MSCDN Filter – SVC and STATCOM	☑	☑	
Shunt Reactors – MSR	☑	☑	
Power Transformers (Peak Voltage)	☑	☑	
Power Transformers (Residual Flux)	☑		☑
Power Transformers in Parallel with Residual Flux (requires TRAS system)	☑		☑
Transmission lines	☑		
Cables	☑		

NOTE: A set of two or three unipolar switches or circuit breakers is eligible as a 1-p operated, two or three-phase switchgear configuration.

APPLICATIONS OF SYNCHROTEQ PLUS

The outstanding performance of SynchroTeq Plus devices apply to a variety of circuit breakers – regardless of the make – and can be leveraged for optimized switching of shunt reactors, discharged and partially charged capacitor banks, harmonic filters, power transformers, cables and transmission lines.

Among other applications, SynchroTeq Plus is a powerful, communication-enabled IED suitable for:

- **Power Grids**:
  - Transmission lines energization
  - High voltage power transformers in substations.
  - Enhanced penetration of Renewable Energy.
  - Grid connection of DERs: waste-to-energy, CHP…etc
  - Capacitor banks switching.
- **HV Equipment / FACTS**:
  - Fast-switching of capacitor banks (MSC), shunt reactors switching (MSR), harmonic filters (FLT) combined with power electronics (ie: hybrid STATCOMs).
  - Energizing step-up transformers in Energy Storage systems.
  - Capacitor banks switches for PF Correction/VAR Compensation.
  - Advanced circuit breakers for power transformers energization.
- **Renewable Power Generation**:
  - Wind: energizing power transformers, for inrush current/voltage drop mitigation, improved power delivery, connection to the grid, grid code compliancy, energizing step-up transformers in STATCOMs.
  - Switching reactive loads, in standalone or in SVC/hybrid-STATCOM systems.
  - Energizing power cables.
- **Conventional Power Generation**:
  - Energizing power transformers in grid-scale waste-to-energy or CHP or genset or gas turbine projects.
  - Energizing power transformers in off-grid power generation: gensets, gas turbines and more.
  - Switching reactive loads.
  - Energizing power cables.
- **Industry**:
  - Electrical Arc Furnaces: transformers switching, MSC/MSR/FLT in SVC or STATCOM systems, reduction of switchgear wear, preservation and lifespan improvement of HV switchgears and transformers.
  - Transportation & Railways: energizing power transformers for rectifiers and inverters in traction substations, capacitor banks for VAR Compensation.
  - Oil&Gas: energizing power transformers with limited impacts of voltage disturbances/inrush currents on gensets, drives, power distribution.
- **C/B and a half**:
  - Energizing 2 load circuits from double bus bars.

SYNCHROTEQ PLUS HIGHLIGHT

- For new or existing Circuit breakers

- CPU-demanding Apps and complex models
    - Transmission lines
    - Numerous compensation channels
    - Fast-switching of reactive loads

- Strong Engine, Web-based operation
    - Stores up to 2000 events and waveforms

- Best-in-class HV transformer energization
    - Residual flux calculation modules
    - Bushing sensors for transformer voltage measurements

- Additional Modules and Tools:
    - Bypass / Redundancy module
    - Floating SPSBO-F: Isolated coil outputs
    - Re-energization Advisory System (TRAS)
    - RWS055000 for data transfer in substation or in central sites.

- Data transfer for SCADA / DCS:
    - Native IEC 61850 MMS Server Ed.2 including XCBR control model.

CONTROLLED SWITCHING

SynchroTeq Plus units perform the controlled closing and/or opening of circuit breaker poles. They are applicable to multiple switchgear/circuit breaker types and operation modes:

- Three-pole switchgear with Single-pole operation / independent pole operation.
- Three-pole operation / simultaneous pole operation (ie: metal enclosed switchgears as per IEC62271-1, 100, 200)
- Three-pole operation with pole staggering,
- Unipolar switchgears in 1, 2 or 3 phase configurations (resulting in single-pole operation).

Closing/Opening switchgear poles at optimal angles (simultaneously or individually when feasible) results in a drastic reduction of inrush currents, voltage transients and stresses, thus improving the quality of power delivery and preserving the health/lifespan of all HV assets such as switchgears, switched loads (power transformers, reactive loads, cables), and sensitive equipment (generators, power electronics incl. inverters, drives and more).

When receiving a command (OPEN or CLOSE) SynchroTeq Plus intercepts either a zero-crossing of the source voltage or a zero-crossing of the current, whichever is appropriate, for accurate switching synchronization. SynchroTeq Plus then computes and executes a delay/timer consisting of:

- A predicted switchgear operation time taking into account variations due to operating conditions, idle time, as well as timing measurements observed during previous operations (adaptive control for mechanical wear) and pole pre-arcing & arcing times (to avoid re-ignition while opening). When applicable, operation times are calculated for each individual pole.
- A synchronization delay.

Circuit breaker coil control output signals are then generated at very precise instants within the wave. The targeted electrical switching instants are determined according to the controlled switching strategy applicable to the considered load.

Contrary to conventional CSDs, the SynchroTeq Plus not only achieves "fixed switching strategies" (targeting predetermined switching angles – or fixed settings) but also performs advanced switching strategies with on-the-fly computation of optimal target angles according to relevant information retrieved in real time from the load status/environment.

In example, SynchroTeq Plus performs dynamic target angle calculations in the following contexts:

- **Power transformers:** switching angles are derived from voltage acquisition and Residual Flux Calculation, making it a highly effective inrush current limiter for energizing HV power transformers through 1-p as well as through 3-p operated switchgears/circuit breakers.
- **Partially charged capacitor banks or filters:** switching angles are derived from voltage acquisition and computation of trapped charges, making it possible to fast-switch capacitor banks and filters (ie: enabling an instantaneous restoration of reactive capacity, or the execution of fast O-C-O-C cycles in bursts without capacitor discharge).

CIRCUIT BREAKER WEAR MONITORING

SynchroTeq PLUS is not only a CSD, but also a circuit breaker monitoring tool that drastically reduces the C/B maintenance costs by allowing for scheduling maintenance only when required due to excessive wear.

SynchroTeq PLUS offers 2 C/B monitoring functions:

- **Electrical wear monitoring**

  For each phase, SynchroTeq PLUS measures the electrical wear of the circuit breaker at each operation (i²t), including protection and local switching operations. The i²t value for each phase is reported in the switching operation event. The accumulated electrical wear for each phase is also computed and stored in the unit and displayed by the web interface or the configurator tool in remote mode.

  An electrical wear alarm function can be enabled, including a warning threshold.

- **Mechanical wear monitoring**

  SynchroTeq PLUS computed and stored all the switching operations (closing + opening, controlled + random + external). The accumulated values are displayed by the web interface or the configurator tool in remote mode.

  A mechanical wear alarm function can be enabled, including a warning threshold.

OPERATING ENVIRONMENT

SynchroTeq Plus can be installed in the low voltage/control compartments of switchgears, as well as in control & relay rooms, or in independent enclosures. It is therefore offered in three housing versions for easy integration in various applications (see MOUNTING CONFIGURATIONS for details). SynchroTeq Plus is typically connected to the following subsystems:

- DC power supply: uninterruptible power source for the substation / switchgear control and protection equipment.
- Controlled high voltage switchgear or circuit breaker: control outputs, statuses/pole positions.
- Protection relays.
- AC measurements: system/source voltage, load current, as well as load voltage when applicable.
- Condition measurements: temperature or pressure transducer when applicable.
- Local control panels, networked SCADA/DCS systems, network infrastructure: switchgear or C/B control in substations or in equipment.

DISCHARGED CAPACITOR BANKS, SHUNT INDUCTANCES, FILTERS AND CABLES

SynchroTeq Plus is intended for the controlled switching of shunt reactors, discharged capacitor banks, harmonic filters, power cables, power transformers, all based on fixed switching angle strategies.
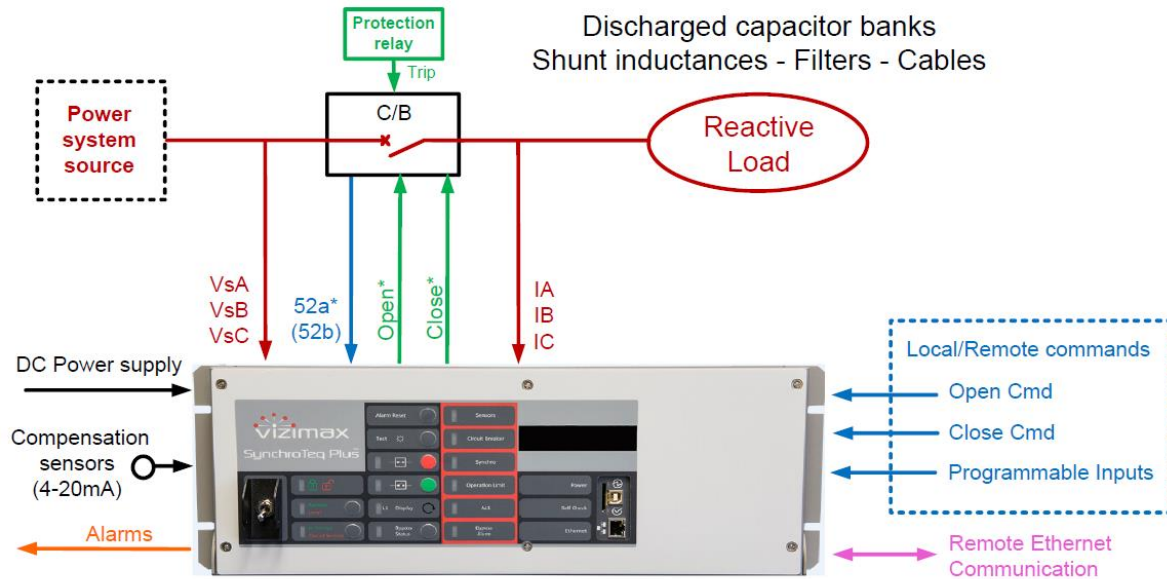
* The number of inputs and outputs depends on the C/B configuration:
- CB with independant pole operation (IPO) = 3x 52a (+3x 52b), 3x Open and 3x close commands
- 2 CBs connected in series for 2 / 1 sequential pole operation = 2x52a (+2x 52b), 2x open and 2x close commands

FIGURE 1   DISCHARGED REACTIVE LOAD

PARTIALLY CHARGED OR FAST SWITCHING OF CAPACITOR BANKS AND FILTERS

SynchroTeq Plus also features AC voltage measurement channels suitable for the acquisition of residual charges trapped in capacitive loads such as partially charged capacitor banks or harmonic filters.

Each time the C/B is opened, the capacitive load is 'initially charged' at the magnitude of source voltage corresponding to the moment of current interruption.

- If the opening is controlled by the SynchroTeq unit (controlled opening), this assessment of residual voltage is done automatically during the opening event, for any type of load connection (WYE-grounded, WYE-floating or delta).
- If the opening is external (protection trip or uncontrolled), a dedicated signal should be wired to a digital input (by default DI2), configured as "External Trip'' as shown below. The assessment of residual voltage in case of external trip is only accurate for WYE-grounded load. In case of WYE-floating or delta load, it is recommended NOT to perform closing operation until the load is fully discharged.

Re-closing angles are dynamically computed to match the residual charge, thus avoiding voltage disturbances/inrush currents and allowing for fast-switched MSC applications.
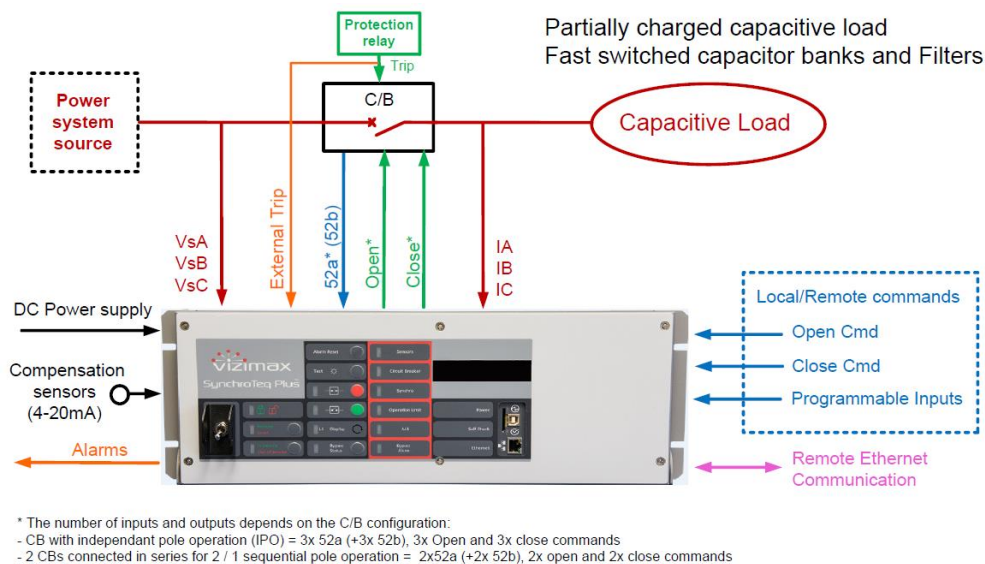
FIGURE 2   PARTIALLY CHARGED OR FAST SWITCHING OF CAPACITIVE LOAD

The SynchroTeq Plus offers the following performances with extremely short intervals between controlled open and controlled close commands:

- Close-160ms*-Open-15 seconds. Can be repeated any number of times (no limit)
- Open-160ms*-Close-15 seconds. Can be repeated any number of times (no limit)
- Open-160ms*-Close-160ms*-Open-160ms*-Close-30 seconds. Can be repeated 20 times (After 20 times, it's recommended waiting for at least 1 minute before the cycle repeats).
- Close-160ms*-Open-160ms*-Close-160ms*-Open-30 seconds. Can be repeated 20 times (After 20 times, it's recommended waiting for at least 1 minute before the cycle repeats).

NOTE: * the 160ms takes into account command duration of 25ms, coil output pulse duration of 50ms, C/B close time of 30ms and open time of 20ms.

ENERGIZING POWER TRANSFORMERS WITH RESIDUAL FLUX MANAGEMENT

SynchroTeq Plus features AC voltage measurement channels for the acquisition of power transformer voltage (from primary or secondary winding) and residual flux calculation for each phase. When re-energizing, the optimal closing angle is derived from the residual flux in transformer's core for the mitigation or elimination of the inrush currents.
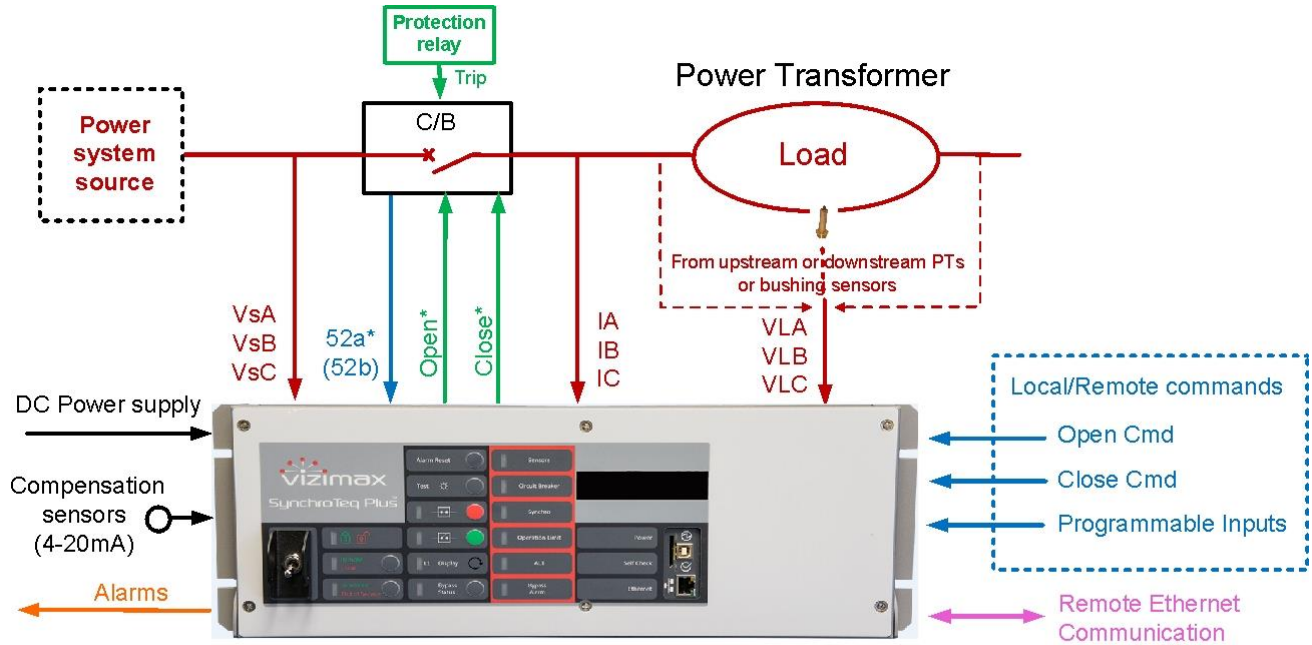
* The number of inputs and outputs depends on the C/B configuration:
- CB with independant pole operation (IPO) = 3x 52a (+3x 52b), 3x Open and 3x close commands
- CB with staggered pole operation = = 1x52a (+1x 52b), 1x open and 1x close commands
- CB with simultaneous pole operation = 1x52a (+1x 52b), 1x open and 1x close commands
- 2 CBs connected in series for 2 / 1 sequential pole operation = 2x52a (+2x 52b), 2x open and 2x close commands

FIGURE 3   EXAMPLE OF SYNCHROTEQ PLUS FOR ENERGIZING A POWER TRANSFORMER

ENERGIZING UNCOMPENSATED AND COMPENSATED TRANSMISSION LINE

SynchroTeq Plus controls the energization of uncompensated and compensated transmission line to minimize the switching overvoltage both during line energization and re-closing. Mitigating the switching overvoltage during line energization is particularly desirable in high voltage systems where the switching surge voltage is the determining factor for insulation coordination of the lines. Furthermore, SynchroTeq Plus reduces the possibilities of CB re-strikes during voluntary line de-energization. During line energization, it also decreases the line inrush current to almost the steady-state current value. It allows a fast and secure reclosing of compensated transmission lines.
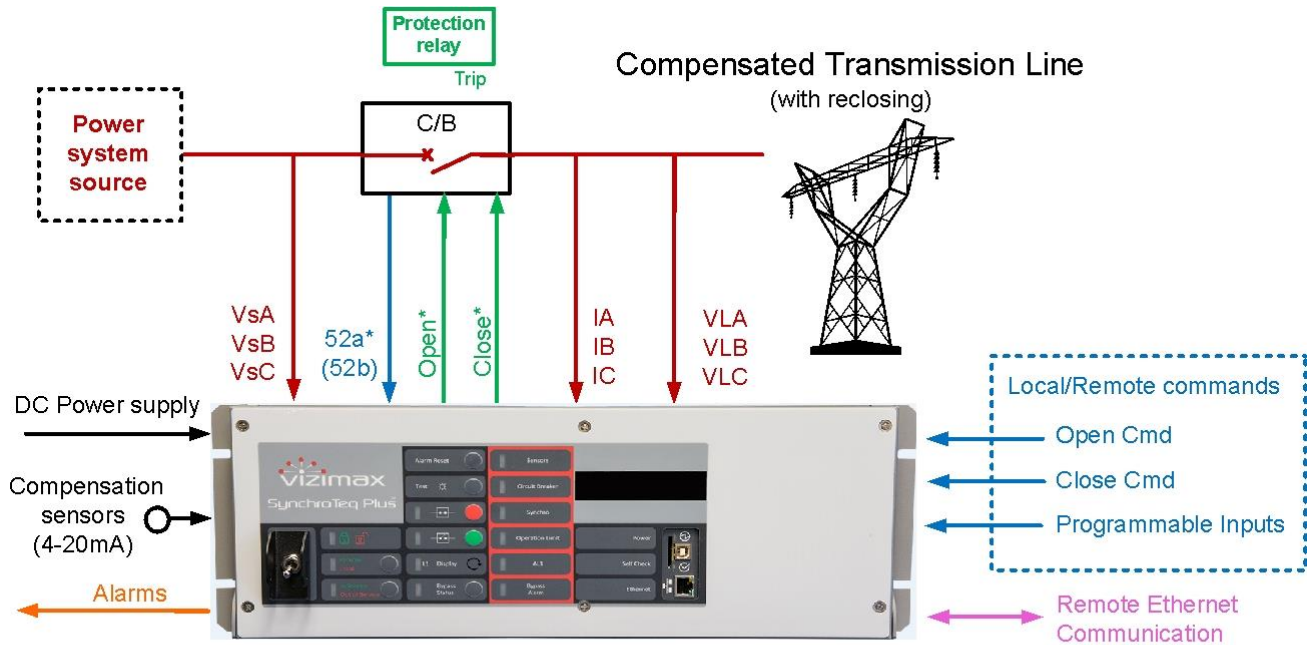
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- CB with staggered pole operation = = 1x52a (+1x 52b), 1x open and 1x close commands
- CB with simultaneous pole operation = 1x52a (+1x 52b), 1x open and 1x close commands
- 2 CBs connected in series for 2 / 1 sequential pole operation = 2x52a (+2x 52b), 2x open and 2x close commands

FIGURE 4   EXAMPLE OF SYNCHROTEQ PLUS FOR ENERGIZING A COMPENSATED TRANSMISSION LINE

ENERGIZING SINGLE LOAD CIRCUIT FROM DOUBLE BUS BARS

In this double buses configuration, the single load circuit (transformer, reactor, capacitor or line), can be fed from 2 different buses (Bus I or Bus II) by closing one of the 2 disconnect switches DS1 or DS2.

Inductive load, capacitive load,
transmission line, power transformer
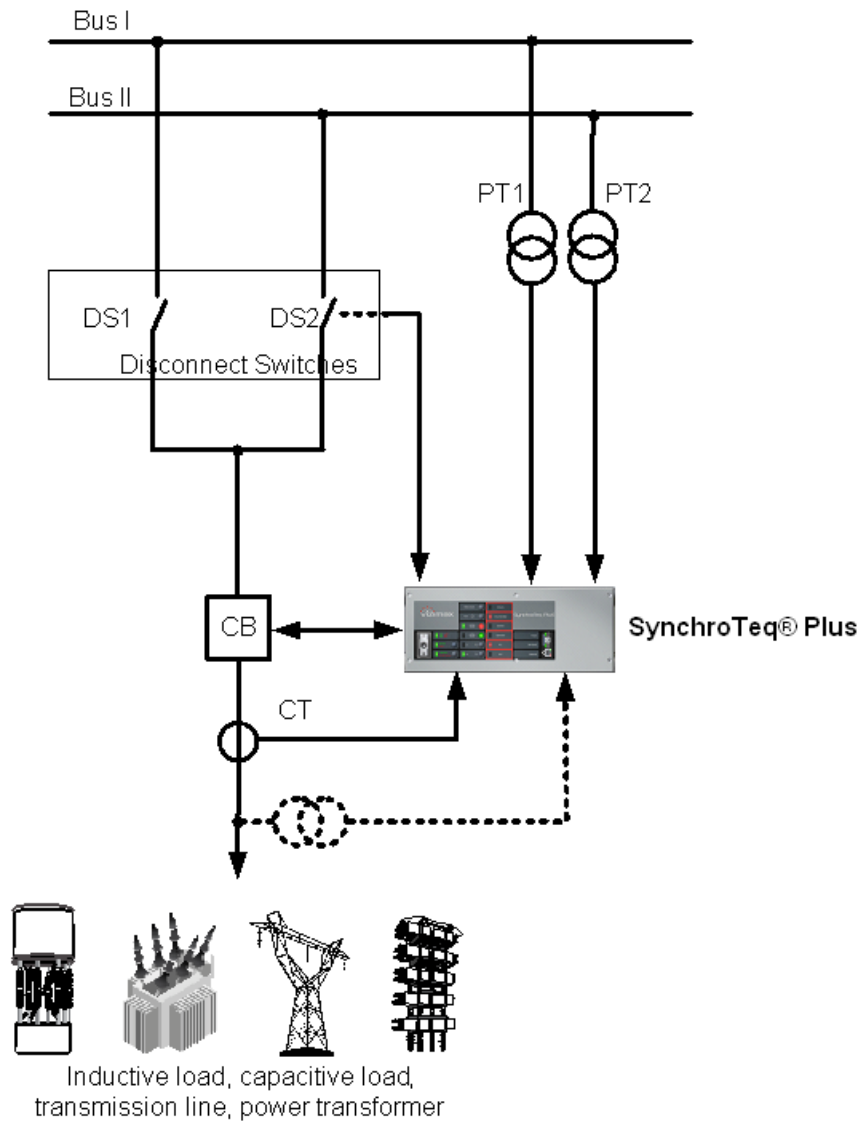
The SynchroTeq unit controlling the CB requires 2 application configuration files as the synchronization source signal depends on the selected bus.

The application file selection can be managed with 2 different modes:

- **'Forced application select'**: An external component 'forces' the state of a dedicated digital input.
- '**Automatic application select**': An automatic selection based on the result of a logical equation.

'CB AND A HALF' APPLICATIONS

In this double buses configuration, 2 load circuits can be fed from 1 or 2 different buses (Bus I or Bus II). Three circuit-breakers are connected between the buses to energize 2 load circuits. The middle CB is shared by both circuits.
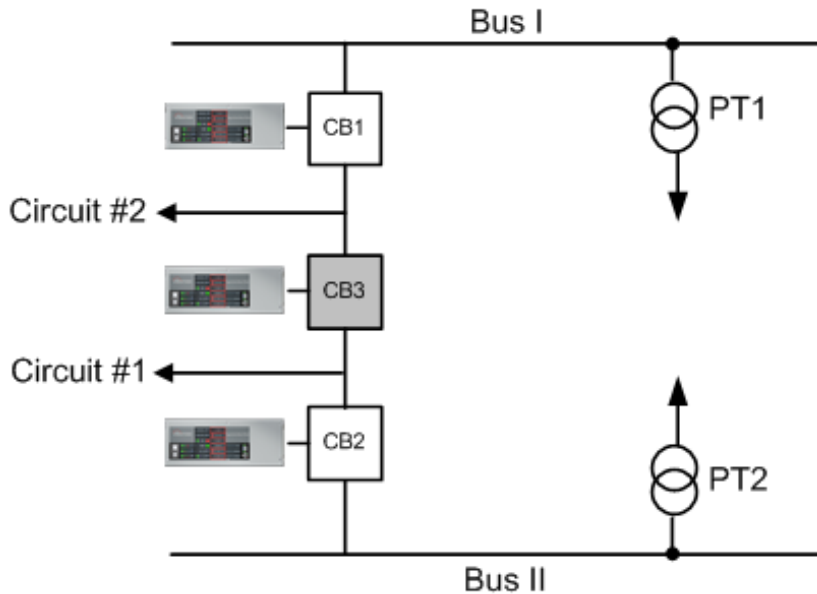
During normal operation, both buses are energized and the top and bottoms CBs are closed.

The status of the middle CB depends on the operating practices applicable to each installation. This CB allows energizing each of the load circuit from one of the buses, in the event of the other bus should be de-energized for maintenance or power failure.

In these 'CB and a half' applications, the SynchroTeq unit controlling the center CB requires 2 application configuration files as the synchronization sources and the type of load are different on both sides of the CB:

The application file selection can be managed with 2 different modes:

- **'Forced application select'**: An external component 'forces' the state of a dedicated digital input.
- '**Automatic application select**': An automatic selection based on the result of a logical equation.

Most of the time, the file selection is automatic and depends on the substation configuration and constraints.

The following figures show some of 'CB and a half' configuration examples, with various load circuits.

Two load circuits with static configurations and compensated lines

Inductive load, discharged capacitive load, transmission line, power transformer without residual flux
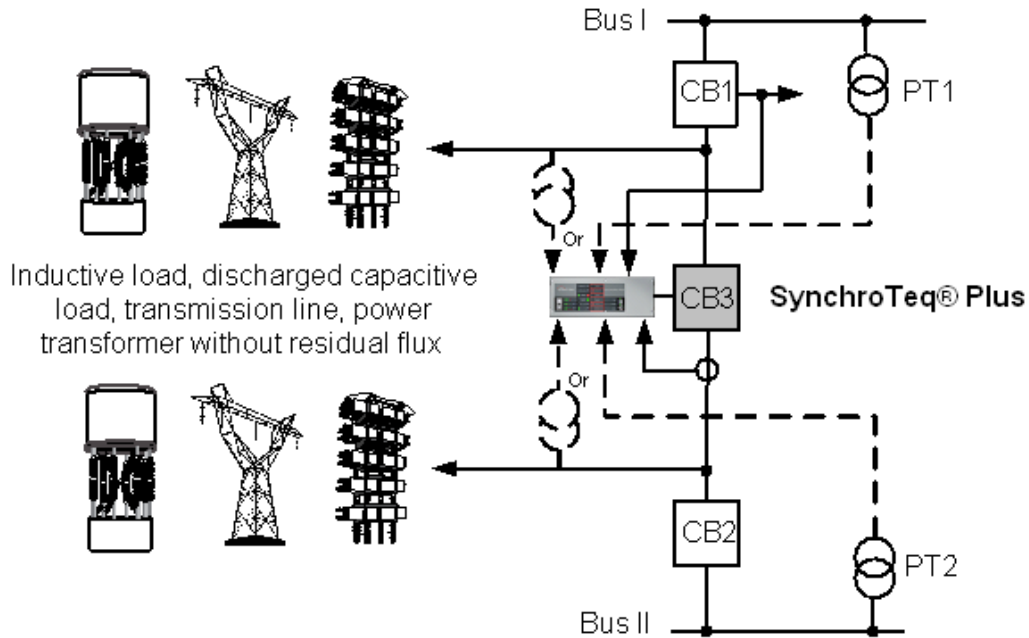
Two load circuits with static configurations and power transformer
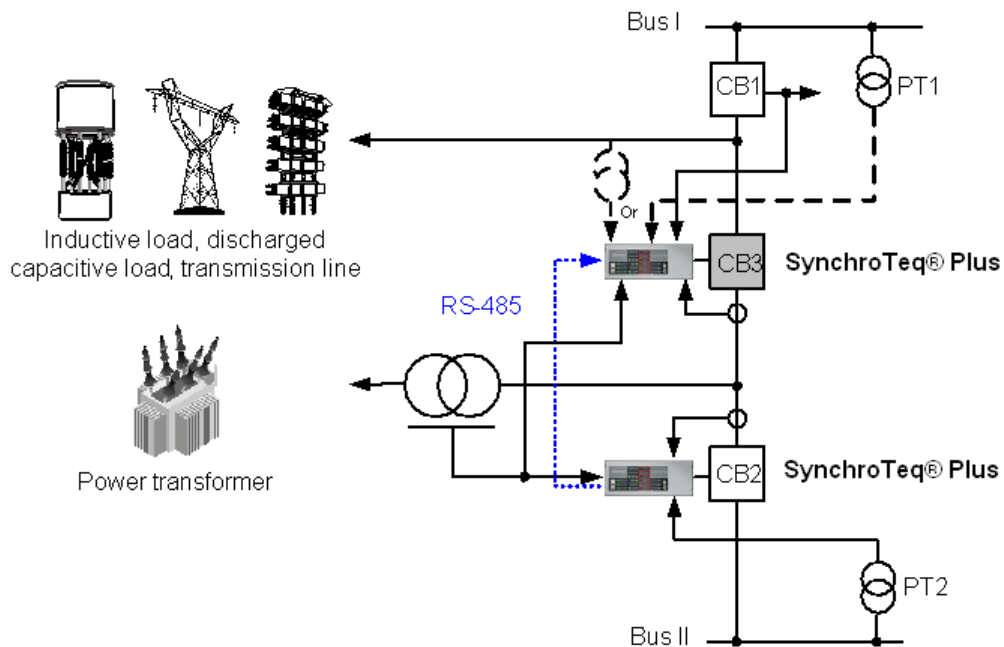
Inductive load, discharged capacitive load, transmission line

Power transformer

IMPORTANT: When the RS485 link is used for data transfer in 'CB and an half' applications, the serial port W is exclusively used for that purpose, and cannot be connected to the optional SynchroTeq Communication module (RWK000016).

Two load circuits with two power transformers
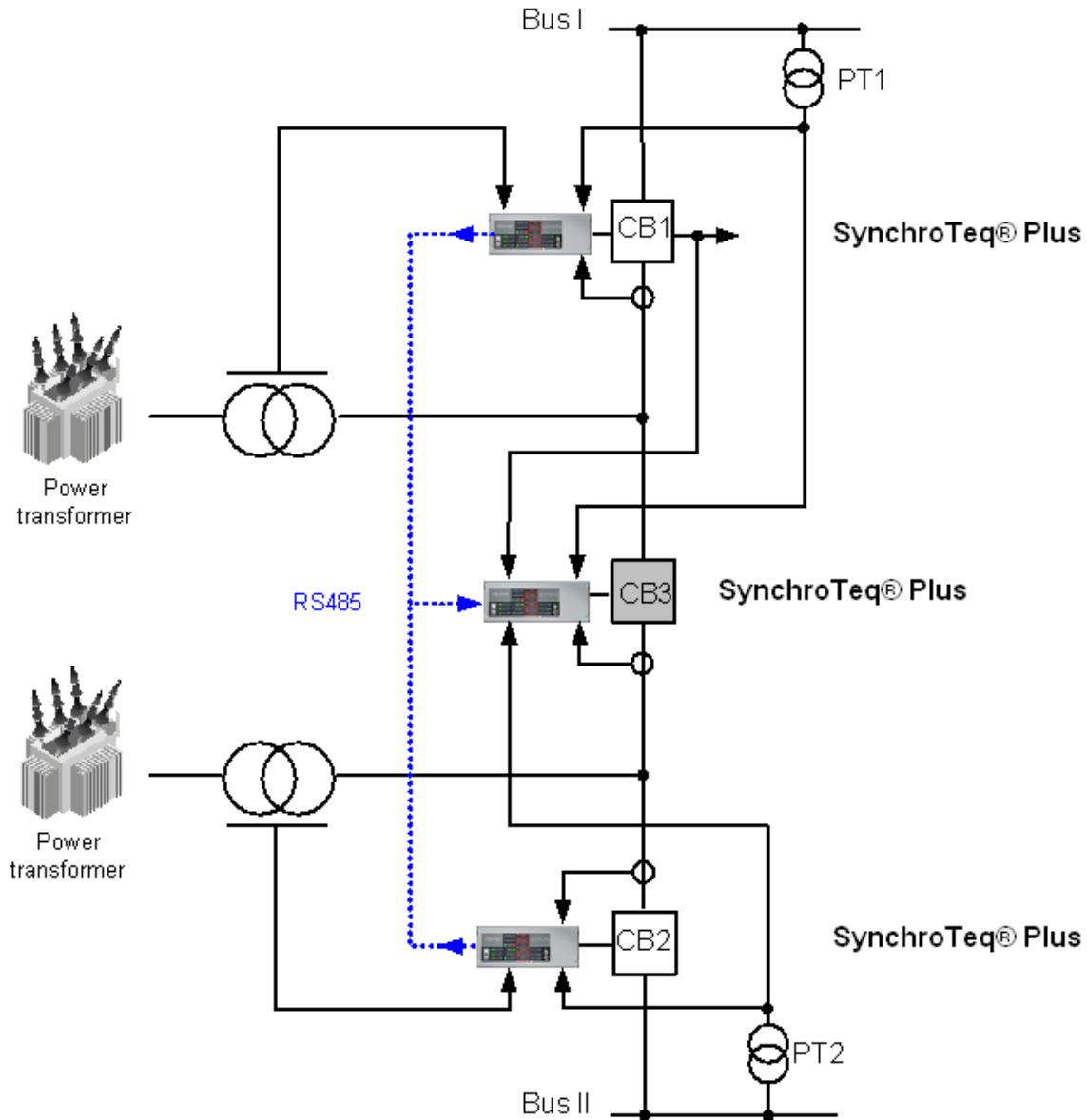
IMPORTANT: When the RS485 link is used for data transfer in 'CB and an half' applications, the serial port W is exclusively used for that purpose, and cannot be connected to the optional SynchroTeq Communication module (RWK000016).

COMMUNICATION LINKS – TIME SYNCHRONIZATION - SOFTWARE

All SynchroTeq Plus units feature built-in communication ports for network integration with external devices:

Ethernet links:

- 2x 100Base-T Ethernet ports
    - One in front panel for maintenance
    - One in rear panel for general use
- 2x optional Ethernet ports 100BASE-FX, 100BASE-LX10 or 100BASE-T on rear panel

Serial links:

- 1x RS-485 serial for local service operation on rear panel
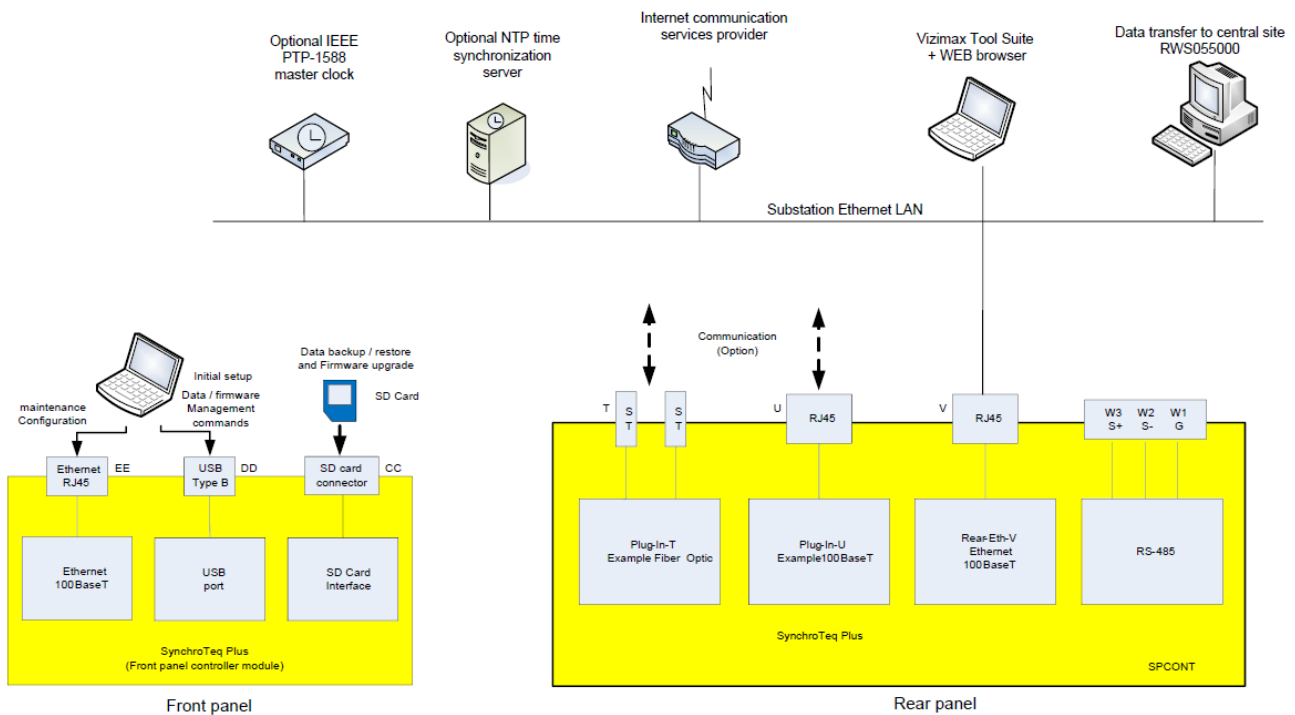
TIME SYNCHRONIZATION

The SynchroTeq Plus time synchronization can be achieved with either:

- PTP-1588 (IEEE Standard Precision Time Protocol) service over the Ethernet network. Supported profile is: ''PTP/IEEE-1588v2 UDP/IPv4, Multicast, End-to-End, Slave Only''.

- IRIG-B time synchronization protocol using the optional RWC0Y0000 module over either:
  - BNC connector with a compliant IEC 60044-8 TTL signal
  - Fiber optic ST type connector with a compliant IEC 61869-9 signal

  The IRIG-B supported formats are:

  - IRIG-B000/B004 IEEE C37.118
  - IRIG-B000/B004 IEEE-1344
  - IRIG-B003

- NTP/SNTP (Network Time Protocol) service over the Ethernet network

- By protocol using the optional SynchroTeq Communication module RWK000016.

Any one of these approaches allows to time stamp recorded operational events for remote data analysis.

FRONT PANEL / LOCAL HMI - REMOTE CONTROL

SynchroTeq Plus can be managed locally (front panel and built-in HMI) and/or remotely through either:

- The Vizimax Tool Suite (VCT) in remote mode
- Native IEC 61850 MMS Server Ed.2 substation automation protocol
- Substation automation: DNP3.0 or MODBUS via the optional SynchroTeq Communication Module (RWK000016)
- Dry contacts (commands) and relay outputs (statuses).

The SynchroTeq web-based interface (requires a web-browser) offers several system operation, event and alarm monitoring panels.

The SynchroTeq Plus front panel HMI and display allows to signal status and alarm message if any.

COMMUNICATIONS AND DATA ANALYTICS SOLUTIONS

SynchroTeq Plus supports native IEC 61850 MMS Server Ed.2 protocol (including the XCBR control model), for substation automation and SCADA system interfacing.

Vizimax also offers a full set of software tools to address client requirements for communication, data transfer to central site and Data Science (Big Data Analysis).

Vizimax Unified Communication Services: CSD fleet management interface + background communication service for PC computer or server with MS-Windows operating system.

- Automatic event and data collection, transfer and storage

Please contact your Vizimax representative for more details on the Vizimax Communication and Data Analytics solutions.

SYNCHROTEQ COMMUNICATION MODULE (OPTION RWK000016)

SynchroTeq Plus natively supports IEC 61850 MMS Server Ed.2 protocol. For application requiring other substation protocols like DNP3.0 or MODBUS, Vizimax offers an optional SynchroTeq Communication Module (RWK000016).

(This option is not available when SynchroTeq RS-485 serial port is assigned to another function).

Please contact your Vizimax representative for more details on the SynchroTeq Communication Module (RWK000016).

VIZIMAX TOOL SUITE AND WEB INTERFACE

The Vizimax Tool Suite is a user interface for configuring and operating the SynchroTeq product family. This multi-language software is composed of the following components:

- PC based configuration tool software for operation parameters (VCT);
- Vizimax Event Analyzer waveform viewer, which displays the waveform captured by SynchroTeq (COMTRADE format) for operation and functional analysis;
- USB port driver for the SynchroTeq product family;
- Web based local and online help site including documentation in PDF format

The Vizimax Commissioning Tool (VCT) is used to customize the operation of the SynchroTeq Plus and its Web interface using system and application configuration files. It supports both offline and online modes of operation and provides features to exchange these configuration files with the SynchroTeq unit. Typically, the configuration files are designed and managed offline on a maintenance PC and are uploaded to the SynchroTeq Plus as part of the system commissioning.

The Vizimax Event Analyzer is a COMTRADE compatible enhanced waveform viewer that displays the waveforms and the C/B operation simultaneously.

SYNCHROTEQ WEB INTERFACE

The unit status, alarms, readings values and event list can be displayed on any PC using a Web browser such as Internet Explorer or Firefox. The SynchroTeq Plus Web interface is secured (https://) and access is granted only to authenticated users.

The SynchroTeq Web interface is dedicated for remote operation, control and analysis of the SynchroTeq units. The Web interface offers several dedicated panels:

- **Dashboard**: This page displays real time status of the SynchroTeq unit, the circuit breaker and the load.
- **Details**: This page provides access to detailed statuses, including the SynchroTeq and C/B alarms and the C/B operating time predictions.
- **Events**: List of the most recent 2000 events recorded and stored in the SynchroTeq Plus.
- **Snapshot**: List of the most recent waveform captures manually triggered by the user.
- **System**: System page used to manage the SynchroTeq configuration files and provides hardware information.

EVENTS AND WAVEFORM RECORDING

At each switching operation, SynchroTeq Plus records current and voltage waveforms including the C/B interface signals (52a/52b/Trip/Close/inputs/commands) over a period length of 1250 ms including 250 ms pre-trigger (default configured values).

The recording period length can be configured up to 3000 ms including 1000 ms pre-trigger in some specific applications such as power transformer with RFC and transmission lines.

Waveform sampling rate is 167 samples / cycle (at nominal frequency).

These waveforms are part of the events list which includes alarms and operations performed on the unit (for example, alarm reset, in/out of service). Each event includes the SynchroTeq Plus's complete status and operating environment to allow for detailed further analysis. The SynchroTeq Plus has a memory capacity of 2000 events, including waveforms.
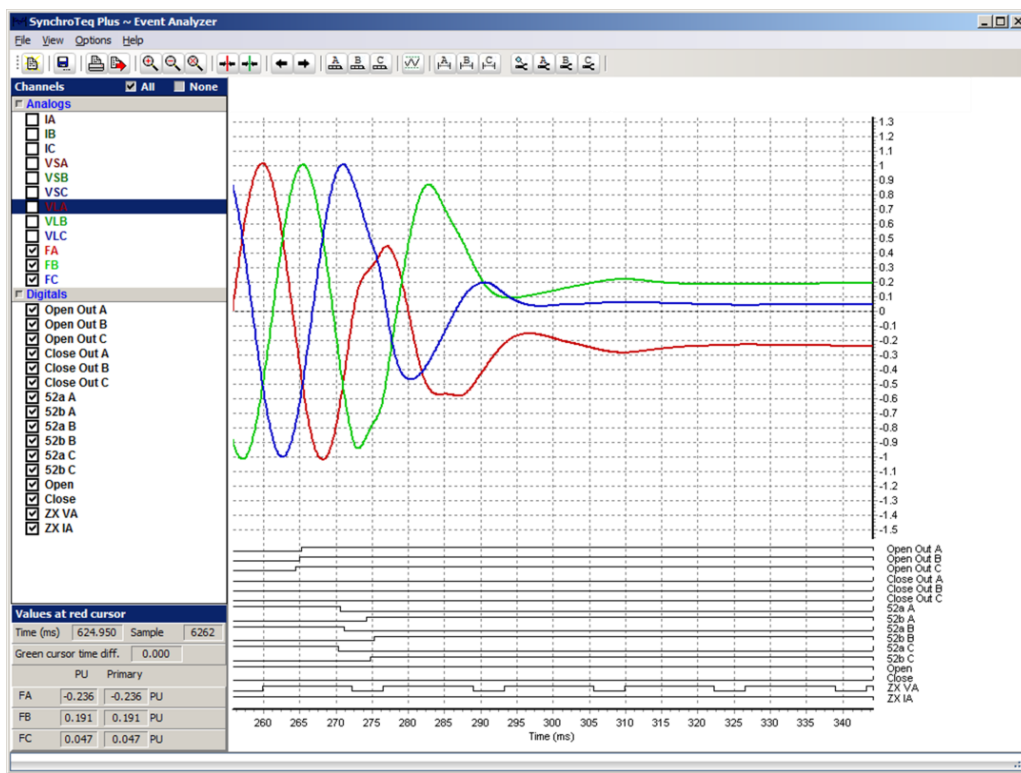
FIGURE 5   VIZIMAX EVENT ANALYZER

SYNCHROTEQ PLUS CONNECTORS AND HMI IDENTIFICATION

BACK PANEL CONNECTORS IDENTIFICATION

SPSBO standard
CB Coil Control Outputs,
Connectors: AA, BB
or
Floating SPSBO-F (Option)
Connectors: AA, BB
(See note 2)

Two Slots for optional Communication Plug-Ins
Connectors: T, U
(See note 3)

Ethernet Port
Connector: Q
(reserved for Vizimax use)

SPFLUX – Optional Residual Flux Calculation
(option 030103 or 030101)
Connectors: J, K, L

SPSUPPLY – Power supply
&
Relay outputs
Connectors: A, B, C

Notes:
1- For SPBYP, Optional Bypass Module (STP030302), please refer to the STP030302-UG manual and datasheet.
2- For floating SPSBO (option STP030304), please refer to the STP030304-UG manual.
3- For optional Communication Plug-Ins, please refer to the SynchroTeq Plus Product Catalog, and relevant product manuals or datasheets.

SPSEQ – Digital Inputs
Connectors: X, Y, Z

SPCONT - Communication Ports
Ethernet / RS-485
Connectors: V, W

SPACQ – Analog Sensor Inputs
Connectors: R, S

SPCTPT – AC Measurement Inputs
Connectors: M, N, O, P

SPBYP – Optional Bypass Module
Connectors: G, H, I
(See note 1)

FRONT PANEL USER INTERFACE AND DISPLAY

TECHNICAL SPECIFICATIONS

COMPLIANCE AND CERTIFICATIONS

ENVIRONMENTAL AND MECHANICAL

Test type	Standard	Value
Operating Temperature	IEC 60068-2-1 and IEC 60068-2-2	-50 °C to +70 °C (see note*)
Maximum Relative humidity (R.H.)	IEC 60068-2-30	95% without condensation
IP Rating	IEC 60529	IP30
Maximum Altitude	MEAS CAT III	2000 m
Storage temperature		-50 to +85 °C
Sinusoidal Vibration	IEC 60068-2-6 IEC60255-21-1	Class2 Tests Fc: 10 to 150 Hz at 1.0G Response 1 sweep/axis Class1 Withstand 20 sweep / axis
Shocks	IEC 60068-2-27 IEC 60255-21-2	Class1 Withstand 5G/11ms (3) Repetitive bump 10G/16ms (1000) Response 15G/11ms (3)
Seismic	IEC 60255-21-3	Method A , class 1
Drop & Topple	IEC 60068-2-31	Drop 100mm Edge/Corner/Face

NOTE: *See Temperature Test Performances table below.

TEMPERATURE TEST PERFORMANCES

Test type		Standard	Value
Temperature range	Operating temperature	IEC 60068-2-1 IEC 60068-2-2	Tests Ad: -50 °C 16hr. Tests B: +70 °C 16hr.
		IEC 61010-1	-40°C to +55°C for UL applications
Humidity	Damp Heat cyclic	IEC 60068-2-30	+55°C at 95% R.H. (144 hours)

ELECTROMAGNETIC COMPATIBILITY (EMC)

Test type	Standard	Value
Radiated Emissions	EN55011,22 CISPR 11, 22 60255-26 FCC	Class A 30MHz-1GHz (FCC part15: 2010 B, up to 2GHz)
Conducted Emissions	EN55011 CISPR 11	Class A 150kHz - 30MHz

Test type	Standard	Value
Radiated Immunity	IEC 61000-4-3 IEC 61000-6-5 IEC 60255-26	Level 3 20V/m (80MHz - 1GHz) 80%modulated (1 kHz)
Radiated Immunity	IEC 61000-4-3 IEC 61000-6-5 IEC 60255-22-3 IEC 60255-26	Level 3 10V/m (1.4 – 2.7GHz) 3V/m (5.15 - 5.75GHz)
Conducted Disturbance, HF	IEC 61000-4-6 IEC 61000-6-5 IEC 60255-22-6 IEC 60255-26	Level 3 10 Vrms (150kHz - 80 MHz) 80% modulated (1 kHz)
Conducted Disturbance, LF	IEC 61000-4-16 IEC 61000-6-5 IEC 60255-26	Level 4 15 – 150kHz 30V & 300V - 50Hz & 60Hz
Surge Immunity	IEC 61000-4-5 IEC 60255-22-5 IEC 61000-6-5 IEC 60255-26	Level 4 LN-PE 4KV , L-N 2Kv I/O: 40 Ohm-0.5uF
D.C. Power Ripple	IEC 61000-4-17 IEC 61000-6-5 IEC 60255-11 IEC 60255-26	Level 3 10% UT – 10min.
D.C. Power Voltage Dip & Interrupts	IEC 61000-4-29 IEC 61000-6-5 IEC 60255-11 IEC 60255-26	Level 3 Dips. 0, 40, 70% UT Slow variations 60 sec.
Electrostatic Discharge	IEC 61000-4-2 IEC 60255-22-2 IEC 61000-6-5 IEC 60255-26	Level 4 8KV Contact / 15kV Air Discharge.
Fast Transient	IEC 61000-4-4 IEC 60255-22-4 IEC 61000-6-5 IEC 60255-26	Level 4 4 kV 2.5kHz (Power Supply) 2 kV 5.0kHz (Other) 2kV 100kHz
Power Magnetic Field	IEC 61000-4-8 IEC 61000-6-5 IEC 60255-26	Level 4 30A-m continuous 300A-m short term

SURGE WITHSTAND CAPABILITY (SWC)

Test type	Standard	Value
Impulse Voltage	IEC 60255-5 IEC61180-1	OVC CAT IV 5KV 1.2/50 µs – 500 Ohm
Insulation Dielectric Insulation Resistance	IEC 60255-5 IEC61180-1	2000V$_{RMS}$ – 1 minute 100MΩ @ 500Vdc
Oscillatory Wave, High Frequency Disturbance	IEC 61000-4-18 IEC 60255-22-1 IEC 61000-6-5 IEC 60255-22-6	Level 3 2.5 kV CM/1kV DM (1 MHz/400 Hz) 200 Ω 1min. duration +/- polarity

SAFETY

Test type	Standard	Value
Safety (Phase1)	IEC 61010-1 (Test & measurement)	Complete evaluation performed by Regulatory Agency: Nemko CB Report TR230362, IEC 61010 2nd edition
Safety (Phase 2) w/ Bypass card and Active Junction Box options	IEC 61010-1 (Test & measurement)	Complete evaluation performed by Regulatory Agency: UL IEC Report E362524-A2-IT-1, IEC 61010 2nd edition Equipment marked CE, c-UL-us

MEAN TIME BEFORE FAILURE (MTBF)

Specifications	Value
MTBF	13 years estimated

POWER SUPPLY

The SynchroTeq Plus power supply (**SPALIM**) module is set according to the ordering option.

Parameter	Value
Power supply rating (48 V)	36 V dc to 72 V dc
Power supply rating (110 V)	88 V dc to 140 V dc
Power supply rating (125 V)	104 V dc to 140 V dc
Power supply rating (220 V)	180 V dc to 280 V dc
Rated power	45 W max (including 2 options STP030302* and STP030103*) 40 W typical (including 2 options STP030302* and STP030103*) 33 W typical (including 1 option STP030302*) 27 W typical (without optional module) - The external power supply must be able to sustain a cold start current up to 30A for 10ms at unit start up (See note 2 below).
Overvoltage category	OVC CAT III
Polarity inversion	No damage
Voltage interrupt (max) **IEC 61000-4-29**	100 ms @ 100%

* note:

- STP030302 :   Optional BYPASS module

- STP030103 :   Optional SPFLUX module

Note 2:

- The SynchroTeq Plus main DC power supply includes a power reserve capable of sustaining a 100ms power interruption. The energy storage components may induce a cold start current up to 30A for 10ms (typical value at 125Vdc) at unit start up. Please refer to the SynchroTeq Plus Installation guide for more details on power supply requirement and protections.

CONTROL – TIME SYNCHRONIZATION - COMMUNICATION

CONTROLLER AND TIME SYNCHRONIZATION

Parameter	Value
Main processor	3x independent CPU boards features : 32-bit, 384 MHz
OS	Linux
Memory	1024 MB Flash memory / 128 MB RAM
Real time clock	±3 ppm typical accuracy. Stability is ± 5 ppm across the complete operating temperature range. Autonomy is 300 hours without power (no battery required)
Time synchronization	IRIG-B clock source Using the optional IRIG-B RWC0Y0000 module: - IRIG-B000/B004 IEEE C37.118 - IRIG-B000/B004 IEEE-1344 - IRIG-B003 NTP/SNTP time server on Ethernet IEEE PTP 1588 clock source on Ethernet (see note) Manual synchronization from PC computer
Field upgrade	Field upgradable firmware available from VIZIMAX web site, support section

NOTE: Several different configurations (profiles) are defined with the PTP-1588 protocol. SynchroTeq Plus supports version 2 using UDP (layer 3) as defined by: ''PTP/IEEE-1588v2 UDP/IPv4, Multicast, End-to-End, Slave Only''.

LOCAL USER INTERFACE (FRONT PANEL)

Parameter	Value
Eight push buttons (Front panel)	- Remote / Local - In service / Out of service - Alarm Reset - Test - Circuit breaker control (Open / Close) - Display refresh - Bypass status
Fifteen DEL (Front panel)	- Lock / Unlock - Remote / Local - In service / Out of service - Open circuit breaker - Close circuit breaker - Alarms (x2) - Sensor alarm - Circuit breaker alarm - Synchronization alarm - Operation limit alarm - Bypass module alarm - Alarms - Power - Self Check
Display	- 2 lines display to signal SynchroTeq Plus status and alarm conditions if any.

COMMUNICATION PORTS

Port	Characteristics	Value
USB **Front panel**	Interface compatibility	2.0
	Maximum speed	480 Mbit/sec
	Connector type	Type B
	Voltage isolation level	N/A
SD card **Front panel**	Interface	2.0 high speed
	Connector Type	SD/SDHC board
	Voltage isolation level	N/A
100Base-T Ethernet **Front panel**	Interface	10/100 Mbps
	Connector name	Front-Eth
	Connector type	RJ-45
100Base-T Ethernet **Rear Panel**	Interface	10/100 Mbps
	Connector type	RJ-45
RS-485 serial **Rear Panel**	Connector family	Phoenix MC 1.5/..-STF 3.81 mm
	Connector type	Pluggable terminal block with screw flange, cage clamp

The SynchroTeq Plus supports up to two (2) additional optional communication ports on rear panel:

- 🔴 **RWC0D0000** : 100BASE-FX Ethernet on Multimode Fiber Optic with ST Connector
- 🔴 **RWC0P0000** : 100BASE-LX10 Ethernet on Single mode Fiber Optic with LC connector
- 🔴 **RWC0C0000** : Isolated 100BASE-Ethernet with RJ45 connector

NATIVE PROTOCOL

Protocol	Characteristics
IEC 61850 MMS Server Ed.2	• XCBR control • Full dataset refreshed every second • 4 predefined unbuffered reports • 120 COMTRADE waveform retrieval.

AC MEASUREMENTS INPUTS

The SynchroTeq Plus **SPCTPT** module is used to measure the C/B current using current transformers (CTs), and the source (line or bus) voltage using potential transformers (Magnetic type PTs).

CT INPUTS

Characteristics		Value
Number of inputs		3
Connector type		Auto-shorting pluggable connector, screw clamp
Current	Rated current	1 A or 5 A
	Saturation current	2 x In
	Maximum current for 1 second	20 x In
Measurement category		MEAS CAT III
Max Burden	At rated current In	0.1VA at 1A 1 VA at 5A
Asymmetrical current	During 100 ms	100 %
	Reading after 100 ms	80 %
Nominal frequency		50 Hz or 60 Hz
Bandwidth (-3 dB)		3.5 Hz to 4 KHz
Sampling frequency		167 samples / cycle at nominal frequency
Conversion resolution		16 bit
Full scale	Accuracy at 23 °C	0.3 %
	Rated noise level	0.15 %
Zero crossing detection	Range (frequency)	10 to 70 Hz
	Range (current)	5 % to 200 % In
	Accuracy	10 µs
Insensitivity to harmonic contents		Up to 7 % In (for 2nd to 10th harmonics)
Crosstalk isolation between channels		≥76 dB

PT INPUTS

Characteristics	Value	
Number of inputs	3	
Rated voltage	100 Vac, 110 Vac, 120 Vac, 100/√3 Vac, 110/√3 Vac, 120/√3 Vac	
Typical clipping level	For 120 Vac: typical clipping level = 147 VRMS (1.26PU) For 120/√3 Vac: typical clipping level = 88 VRMS (1.27PU)	
Thermal capacity (1 minute)	167 Vac	
Measurement category	MEAS CAT III	
Maximum Burden	1 VA	
Nominal frequency	50 Hz or 60 Hz	
Bandwidth (-3 dB)	3.5 Hz to 4 KHz	
Sampling frequency	167 samples / cycle at nominal frequency	
Conversion resolution	16 bit	
Full scale	Accuracy at 23 °C	0.3 %
	Rated noise level	0.05 %
Zero crossing detection	Range (frequency)	10 to 70 Hz
	Range (voltage)	37.5 % to 150 % Vn
	Accuracy	10 µs
Insensitivity to harmonic contents	Up to 50 % Vn (for 2nd to 10th harmonics)	
Crosstalk isolation between channels	≥ 84 dB	

ADDITIONAL THREE PHASE VOLTAGE MEASUREMENT REQUIRED FOR POWER TRANSFORMER AND TRANSMISSION LINE SWITCHING APPLICATIONS

The function boards (**SPFLUX** module) are used to calculate optimum C/B closing time based on the residual flux in the transformer core after the transformer is de-energized or to measure the transmission line voltage. The residual flux measurement option reduces the inrush current to a magnitude comparable to the magnetization current. SynchroTeq Plus calculates the residual flux from the voltage measurement on the transformer winding or measure the transmission line voltage using either magnetic type PTs or from high voltage bushing sensors installed on the test tap of the power transformer's bushing or on the test tap of the shunt reactor.

There are two function boards' versions:

● **Auxiliary measurement & Residual Flux Calculation Module for PT (STP030103)**:
   Including three (3) PT measurement inputs, plus three (3) additional 4 to 20 mA inputs. The 4 to 20 mA inputs can be used for two-wire sensor monitoring.

● **Auxiliary measurement & Residual Flux Calculation Module** for **High Voltage Bushing Sensors (STP030101):**
   Including three (3) high voltage bushing sensors measurement inputs for Vizimax bushing sensors, plus three (3) additional 4 to 20 mA inputs. The 4 to 20 mA inputs can be used for two-wire sensor monitoring. For power transformer application, the residual flux calculation is made using measurements from the bushing sensors.

This auxiliary measurement module is also required for the reclosing sequence in the compensated transmission line applications, where the line side voltage is necessary for the Prony algorithm analysis.

AUXILIARY MEASUREMENT & RESIDUAL FLUX CALCULATION MODULE FOR PT (STP030103)

PT inputs

Characteristics	Value
Number of inputs	3
Input operating range	57 Vac (or 100/√3 Vac) to 120 Vac
Measurement category	MEAS CAT III
Thermal capacity (1 minute)	167 Vac
Maximum Burden	0.4 VA
Rated frequency	50 Hz or 60 Hz
Bandwidth (dc component included)	0 to 3.6 KHz
Sampling frequency	167 samples / cycle at nominal frequency
Conversion resolution	16 bit
Full scale accuracy at 23°C	0.5 %
Full scale rated noise level	0.1 %

Additional 4 to 20 mA inputs

Characteristics	Value
Number of inputs	3
Input operating range (4 to 20 mA nominal)	0 to 25 mA
Temperature measurement range	-50ºC to +80 ºC
Sensor supply	24 Vdc / 60 mA provided by the SPFLUX card
Measurement category	MEAS CAT III
Temporary overvoltage for 2 seconds	50 Vac
Input impedance	220 Ω
Independent power supply loop numbers	3
Bandwidth (dc component included)	0 to 3.6 KHz
Sampling frequency	167 samples / cycle at nominal frequency
Conversion resolution	16 bit
Full scale accuracy at 23°C	0.5 %
Full scale rated noise level	0.2 %

AUXILIARY MEASUREMENT & RESIDUAL FLUX CALCULATION MODULE FOR VIZIMAX BUSHING SENSORS (STP030101)

Bushing sensor inputs

Characteristics	Value
Number of inputs	3
Voltage operating sensor range	4 to 20 mA
Transformer bushing sensor supply	24 Vdc provided by the SPFLUX card
Measurement category	MEAS CAT III
Temporary overvoltage for 2 seconds	50 Vac
Input impedance	220 Ω
Independent power supply loop numbers	3
Bandwidth (dc component included)	0 to 3.6 KHz
Sampling frequency	167 samples / cycle at nominal frequency
Conversion resolution	16 bit
Full scale accuracy at 23°C	0.5 %
Full scale rated noise level	0.2 %

Additional 4 to 20 mA inputs

Characteristics	Value
Number of inputs	3
Input operating range (4 to 20 mA nominal)	0 to 25 mA
Temperature measurement range	-50ºC to +80 ºC
Sensor supply	24 Vdc / 60 mA provided by the SPLUX card
Measurement category	MEAS CAT III
Temporary overvoltage for 2 seconds	50 Vac
Input impedance	220 Ω
Independent power supply loop numbers	3
Bandwidth (dc component included)	0 to 3.6 KHz
Sampling frequency	167 samples / cycle at nominal frequency
Conversion resolution	16 bit
Full scale accuracy at 23°C	0.5 %
Full scale rated noise level	0.2 %

DC MEASUREMENT INPUTS

The SynchroTeq Plus acquisition (**SPACQ**) module performs the following functions:

- Monitor C/Bs using analog measurements (SF6 pressure, hydraulic pressure, temperature) from 4 to 20 mA sensors connected to the apparatus. Each analog input provides features to calibrate and define the operating range for alarming (sensor alarm).
- Predict the C/B operating time influenced by external conditions such as the ambient temperature, isolation gas or drive mechanism pressures. The compensation is done from the analog inputs and can be activated or deactivated through the system configuration

4 TO 20 MA ANALOG MEASUREMENT INPUTS WITH COMPENSATION FUNCTION

Characteristics	Value
Number of inputs	4 AGC (GlobalComp), AP_A/B/C (PhsComp_A/B/C)
Operating range (4 to 20 mA nominal)	0 to 25 mA
Input impedance (resistive)	220 Ω
Temporary overvoltage for 2 seconds	50 Vac
Measurement category	MEAS CAT III
Frequency response (-3 dB)	0 to 3 Hz
Full scale accuracy at 23 °C	2 %
Full scale rated noise level	1 %
Sensor supply	24 Vdc/60 mA (internally provided by the SPACQ card)

C/B COIL VOLTAGE MEASUREMENT INPUT WITH COMPENSATION FUNCTION

Characteristics	Value
Number of inputs	1 V_CB (CBVol)
Rated voltage	0 Vdc to 300 Vdc
Input impedance (resistive)	166 KΩ
Overvoltage category	OVC CAT III
Frequency response (-3 dB)	0 to 3 Hz
Full scale accuracy at 23°C	0.5 %
Full scale rated noise level	0.05 %
Polarity inversion	no damage

AUXILIARY INPUT AU1 (USER1)

The SPACQ module also offers an auxiliary measurement input AU1 (User1). This input can be configured (by hardware) as an AC voltage measurement input (default configuration) or as a 4-20mA courant loop input.

AU1: AC VOLTAGE INPUT (DEFAULT CONFIGURATION)

Characteristics	Value
Rated voltage	+-300 V dc or 270 V ac
Input impedance (resistive)	200 KΩ
Overvoltage category	OVC CAT III
Frequency response (-3 dB)	0 to 3000 Hz
Full scale accuracy at 23°C	0.5 %
Full scale rated noise level	0.05 %

AU1: DC 4-20mA INPUT

Characteristics	Value
Operating range (4 to 20 mA nominal)	0 to 25 mA
Input impedance (resistive)	220 Ω
Temporary overvoltage for 2 seconds	50 V ac
Measurement category	MEAS CAT III
Frequency response (-3 dB)	0 to 3 Hz
Full scale accuracy at 23 °C	2 %
Full scale rated noise level	1 %
Sensor supply	24 V dc/60 mA (internally provided by the SPACQ card)

NOTE:.*: AC Voltage input configuration is only available for SPACQ 14508-1 model, delivered after August, 14th 2017. Previous SPACQ 14508 model only offers DC 4-20mA configuration on AU1 input.

SYNCHROTEQ PLUS INTERNAL TEMPERATURE MONITORING

Characteristics	Value
Number of sensors	1 internal sensor
Operating range	-55 °C to +85 °C
Accuracy	+/-1 °C

DIGITAL INPUTS AND OUTPUTS

DIGITAL INPUTS

The **SPSEQ** module is a processor circuit board with 12 opto-isolated digital inputs as follows:

- Six inputs for the C/B position (52a/52b contacts)
- Two inputs for the control of the C/B (OPEN/CLOSE commands)
- One input to force the SynchroTeq Plus Out of Service
- Three isolated general purpose contact inputs for C/B monitoring (for example, SF6 lock-out contact, heater contact and low pressure alarm)

Characteristics		Value			
Number of inputs		12			
Number of supervised inputs with opto-coupler tests		9			
Rated voltage		48 Vdc	110 Vdc	125 Vdc	220 Vdc
Input voltage range	For idle state	24 Vdc	69 Vdc	69 Vdc	150 Vdc
	For active state	31 Vdc	87 Vdc	87 Vdc	173 Vdc
Maximum input Voltage		72 Vdc	150 Vdc	150 Vdc	280 Vdc
Overvoltage category		OVC CAT III			
Maximum Burden		1 W			
Typical Input Impedance	48 Vdc, 110 Vdc, 125 Vdc	Min : 24 KΩ, Max : 49 KΩ			
	220 Vdc	Min : 70 KΩ, Max : 170 KΩ			
Capacitive coupling rejection		Cx up to 0.5 µF			
Protection against grounding		Yes			
Polarity reversal		no damage			
Activation delay	For OPEN and CLOSE inputs	2 ms			
	Of other inputs (max)	0.15 ms			

NOTE: For 3-phase circuit-breaker with simultaneous pole operation or staggered pole operation with single 52a auxiliary contact, this contact must be wired on Y2 (52a_A input) and chained in parallel on Y5 (52a_B input) and Y8 (52a_C input) for proper operation of SynchroTeq unit.

CIRCUIT BREAKER COILS COMMAND OUTPUTS

The SynchroTeq Plus **SPSBO** module drives the circuit breaker (C/B) coils.

SynchroTeq Plus unit only supports 'DC controlled' circuit-breaker.

Characteristics	Value
Number of outputs	6
Output driver technology	Solid State (SSR) Outputs
Rated voltage	48 Vdc, 110 Vdc, 125 Vdc, 220-250 Vdc
Overvoltage category	OVC CAT III
DC rated continuous current (tmax = 300 s)	5 A
Maximum making current (tmax = 200 ms)	30 A
Maximum breaking current (L/R = 40 ms)	20 A
Maximum output leakage current	0.1 mA
Voltage Burden	3.5 Vdc
Output pulse width (activation time)	10 ms to 1000 ms (by programmable increments of 10 ms or 100ms)
Coil Output command accuracy	10 µs (see note *)
C/B coil supervision function	3mA DC current injected in each coil circuit. Alarm signaled when 3mA current disappears. No current injected if function is disabled or when issuing a controlled command
C/B coil sequence supervision function	Read back coil output voltages after coil command. Alarm signaled if output voltages do not correspond to the expected level.

Specifications above apply to standard SPSBO module and dual batteries SPSBO (option STP030305). When using floating SPSBO-F module (option STP030304) please refer to the specifications provided in the 'Floating SPSBO-F module User guide: STP030304-UG-en' document.

(*) Important note on the C/B operating time accuracy:

In the SynchroTeq Plus, the coil output control command precision is +/- 10µs. However, it is important to understand that the overall operation precision of the breaker depends on many parameters:

- C/B mechanical scatter: Each C/B has a natural mechanical deviation on his main chamber operating times. This deviation is due to the overall imprecision in the mechanical moving parts of the breaker (shafts, gears…). It is important to mention that the mechanical deviation we are talking about (generally from 0.1ms up to several ms) refers to the "intrinsic" deviation of the mechanical operating times of the breaker main chamber under constant operation circumstances (temperature, coil voltage, pressure, humidity…).

- Availability of compensation data and their accuracy: Most of C/Bs are affected by the environmental operating parameters. If these effects are not taken into consideration, the overall C/B operation precision would be seriously degraded compared to the absolute mechanical scatter. The SynchroTeq Plus is able to

accurately compensate for all the operational parameters as long as the provided compensation data (generally from the C/B manufacturer) is also accurate. The SynchroTeq Plus can compensate for the ambient temperature variation, the DC coil voltage variation, the drive mechanism pressure variation (if any). Also, the SynchroTeq Plus is embedded with powerful idle-time compensation algorithm that predicts the effect of the idle-time on the main chamber operating mechanism. In general, this idle-time compensation data is a field-built information as most of C/B manufacturers cannot provide it.

<u>For example</u>, let us assume the following situation:

- Circuit-breaker with a natural mechanical scatter of +/- 0.3ms under +15°C
- The only parameter that affects the mechanical operating time is the ambient temperature
- Ambient temperature operating range : from -20°C to +55°C
- No compensation curve for the ambient temperature is provided, but the C/B manufacturer stated that the effect of the ambient temperature on the main chamber operating time is +/- 2ms

In this case, since no compensation data is provided, we can expect **an overall C/B operation precision of +/- 2.31ms :**

+/- 2ms for the ambient temperature variation
+/- 0.3ms for the mechanical scatter
+/- 0.01ms for the SynchroTeq Plus

CIRCUIT BREAKER COILS COMMAND OPTIONS

The standard SPSBO module (default factory setting) provides coil current from the positive power supply to the 6 C/B coils (3x Close and 3x open) that are connected to the negative power supply (source configuration).

<u>The optional floating SPSBO-F module</u> (STP030304) provides 6 potential free isolated solid state outputs. These outputs are designed to ''push'' the current or to "pull" the current from the C/B coils connected to the positive bus or to drive a C/B electronic controller that has floating inputs.

Please refer to the STP030304-UG manual for more information on this option.

<u>The optional Dual Batteries SPSBO module</u> (STP030305) provides 2 separate Open and Close power supply inputs providing 2 distinct 'source' configurations, one for the 3 Close outputs (with a common Close power supply) and another one for the 3 Open outputs (with a common Open power supply)

Please refer to the STP030305-UG manual for more information on this option.

NOTICE WHEN USING AN EXTERNAL COIL SUPERVISION SYSTEM

SynchroTeq Plus has a built-in, always active, C/B coil <u>sequence</u> supervision circuit drawing between 2.0 to 3.0mA at nominal voltage. When your SynchroTeq Plus is installed concurrently to an external CB coil supervision solution, such as an external Trip Coil Supervision system or 'TCS', additional power diodes (STA030302 Diode trio) may be required in series with the SynchroTeq coil command outputs to prevent unexpected interferences between both supervision systems. Similarly, SynchroTeq Plus offers a coil <u>continuity</u> supervision that should be deactivated when an external coil supervision is in effect, to not risk any interference between the two coil continuity monitoring options.

For more details, please contact the Vizimax technical support team at <u>support@vizimax.com</u> and inquire for the 'SynchroTeq Plus Guidelines: 000023-DS-01-01-en' document.

SIGNALING OUTPUTS

Up to 11 electromechanical relays are provided to signal statuses and alarm conditions to external devices such as RTUs and annunciators. They can also drive the external bypass logic when the SynchroTeq Plus is defective or out of service.

The signaling outputs have the following functions:

- **R1**: For bypass unit
- **R2**: C/B opening alarm
- **R3**: C/B closing alarm
- **R4**: Reserved
- **R5**: Controlled opening problem
- **R6**: Controlled closing problem
- **R7**: Local mode
- **R8**: Circuit breaker interface alarms
- **R9**: Sensor alarms
- **R10**: Out of Service
- **R11**: SynchroTeq Plus Failure

Parameter		Value
Number of outputs		11
Rated voltage		24 Vdc to 300 Vdc
Minimum operation voltage		24 Vdc
Overvoltage category		OVC CAT III
Rated current	At 125 Vdc	0.3 A
	At 300 Vdc	0.2 A
Current	Maximum making (tmax. = 200 ms)	1 A
	Maximum breaking (L/R = 40 ms) at 125 Vdc	0.3 A
	Maximum leakage	0.02 mA

OPTIONAL BYPASS MODULE (SPBYP)

In most of the applications, SynchroTeq Plus should be equipped with a bypass circuit that allows the processing of the C/B switching commands even in the case SynchroTeq Plus is out of service or failed.

The bypass logic to be implemented mainly depends on the application constraints and the C/B coil configuration.

Vizimax offers an optional Bypass module (STP030302) integrated in the SynchroTeq unit chassis (connectors G-H-I). The bypass module has 3 operating modes to fit specific application requirements and supports manual/external bypass commands.

Please refer to the STP030302-UG manual for more information on the configuration and the wiring of the optional bypass module (STP030202).

FUNCTIONAL ANALYSIS TOOLS

WAVEFORM CAPTURE

Parameter	Value
Memory capacity	Up to 2000 events (waveforms are stored in events)
Capture trigger	C/B commands from SynchroTeq Plus (OPEN and CLOSE) Voltage changes on switched side of C/B (for residual flux calculation on power transformer applications) Manual trigger using snapshot capture
Sampling rate	167 samples/cycle at nominal frequency
Recording time	1250 ms including 250 ms pre-trigger (default values) Configurable up to 3000 ms including 1000 ms pre-trigger for specific applications such as Power transformer with RFC and Transmission lines.
Recorded signals	Voltages from PTs on unswitched side of C/B (3) Load current (3) Option: Voltages on switched side of C/B (3) Option: Residual flux calculation (3) C/B control commands (3 x Open, 3 x close) C/B position contacts (3 x 52a, 3 x 52b) SynchroTeq Plus command inputs (OPEN and CLOSE) Phase A synchronization (1 x I, 1 x V) AU1 (User1) when configured in AC voltage and selected as synchronization source.

EVENT MEMORY

Parameter	Value
Memory capacity	2000 events, including waveforms when applicable
Recording trigger sources	C/B commands from SynchroTeq Plus Voltage changes on switched side of C/B (for residual flux calculation on power transformer applications) Status change (local/remote, in/out of service, cold start, reset, etc.) Alarms (self-check, sensors, C/B timing problems, C/B interface problem, loss of synchronization signal, etc.) Configuration changes (new parameters) Operation failure (rejected commands) Manual waveform capture Operation commands to SynchroTeq Plus (alarm reset, operation counters reset, set residual flux, etc.)
Search and display filtering capabilities	The event display can be filtered using one or the combination the following criteria: By event sequential number By date By type (open command, close command, residual flux calculation, sensor problem, etc.) By alarm type (sensor out of range, excessive inrush current, synchronization loss, etc.)
Time tagging display resolution	1 millisecond with time zone management

MOUNTING CONFIGURATIONS

SynchroTeq Plus is available in two mechanical configurations:

- 'Rackmount' (RM) for mounting in a 19'' rack.

- 'Standalone' (SA) for panel mount.

PHYSICAL DIMENSIONS

Specifications	Value
Width	444 mm/17.5 inch for standard (SA) 483 mm/19 inch for Rackmount installation (RM)
Height	4 UM (modular units: 177 mm/7 inch)
Depth	299 mm (12 inch)
Weight	7.5 kg (16.5 lbs.) with optional Residual flux and Bypass options

RACKMOUNT CONFIGURATION

The SynchroTeq Plus rackmount (RM) model is installed on an EIA 482.6 mm (19 in) rack in the substation control building.
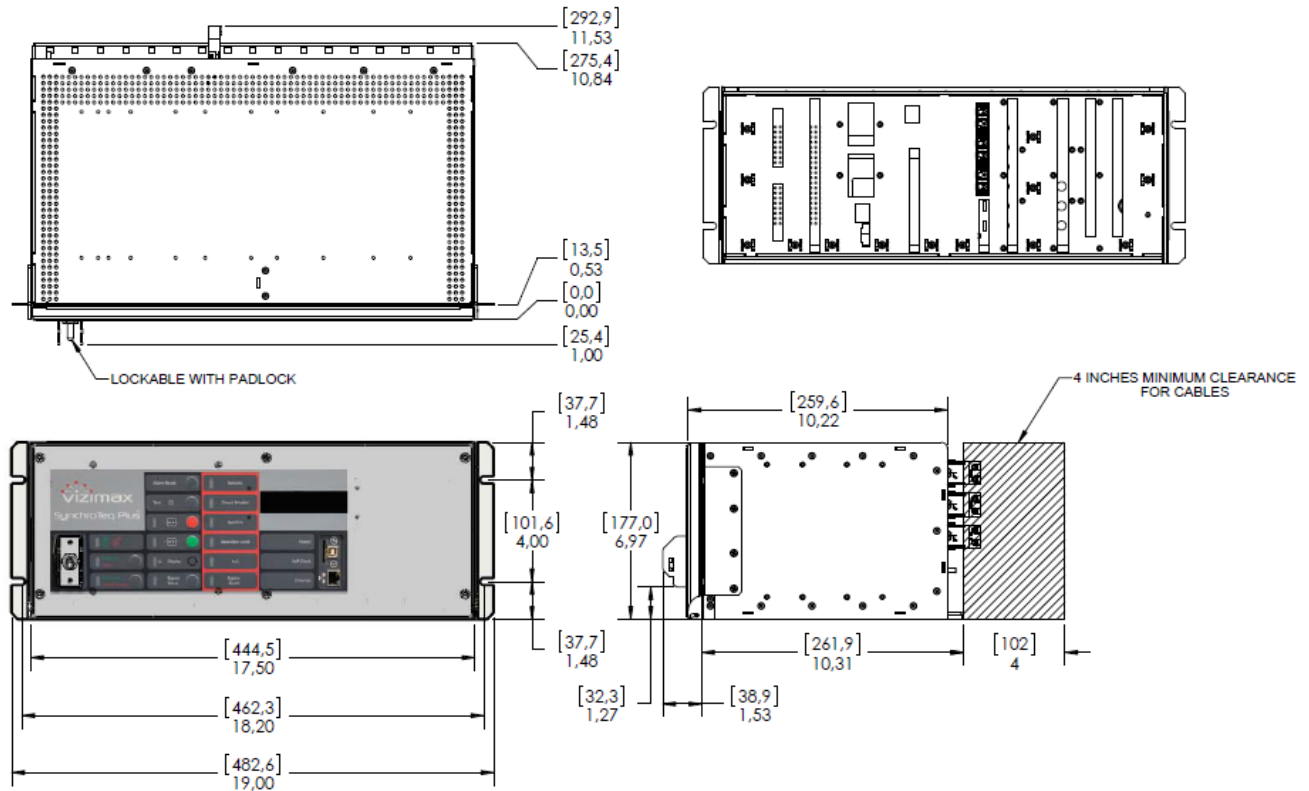

FIGURE 6   SYNCHROTEQ PLUS RACKMOUNT DIMENSIONS

NOTE: For RM installation, the mounting ears can be installed in the front of the unit, but they can be moved to the back or bottom of the unit for panel mount installations.

STANDALONE CONFIGURATION

The SynchroTeq Plus standalone (SA) unit is installed in the C/B switchyard, typically within the high voltage C/B control cabinet. Vertical mounting to a fixed panel or swing door is possible. A splash guard (protection cover) is provided with the unit.
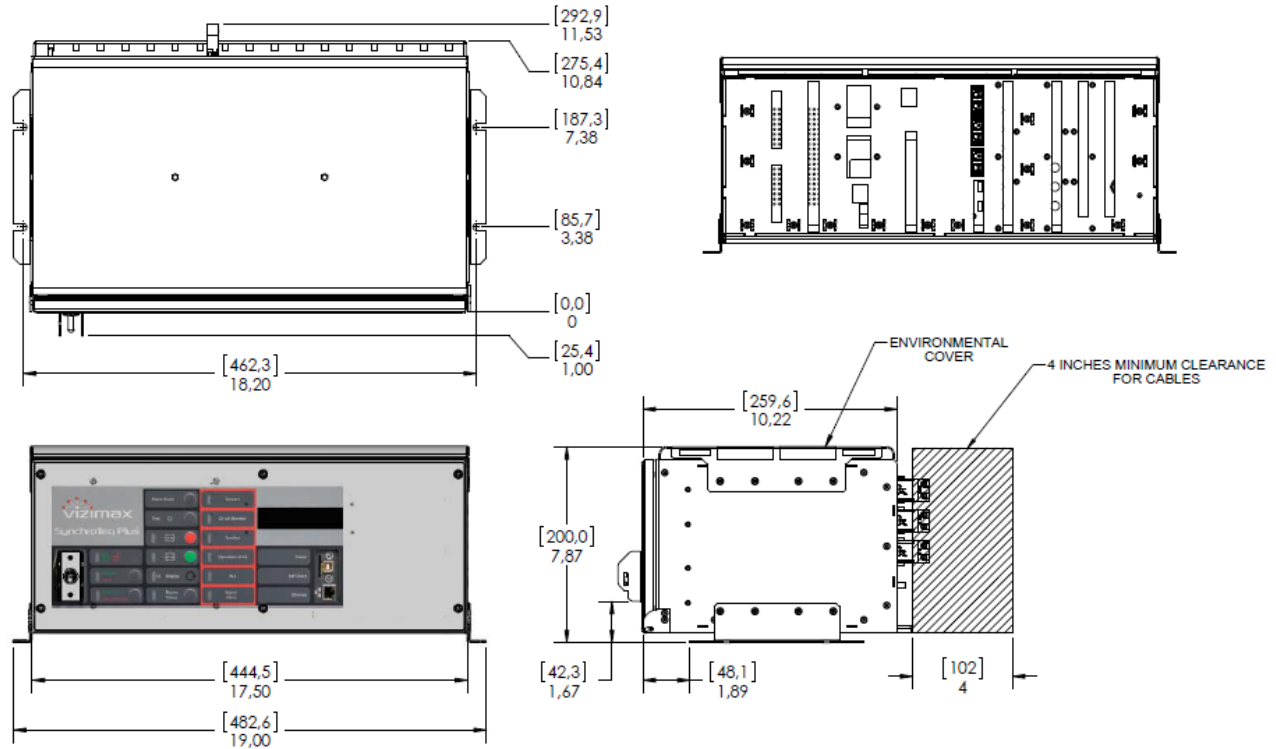

FIGURE 7   SYNCHROTEQ PLUS STANDALONE DIMENSIONS

NOTE: SA version should be installed in a water protected shelter together with the C/B. The SA option comes with an additional environmental protective cover.

ORDERING INFORMATION

STP030000: SynchroTeq Plus base unit (smart coding to be confirmed at order) - Compatible w/ either Rackmount or standalone mounting.

To select ordering options, please refer to the 'smart coding' document 'STP030000-SC' available in the Vizimax web site.

SynchroTeq Plus Options (non exhaustive list):

STP030101 Auxiliary measurement & Residual Flux Calculation Module for Vizimax Bushing Sensors
STP030103 Auxiliary measurement & Residual Flux Calculation Module for PT Analog Inputs
STP030302 Optional Bypass module (SPBYP)
STP030304 C/B coils Floating commands: SPSBO-F option
STP030305 Dual Open / Close Batteries SPSBO option
STP030200 Active Junction Box
STP030400 Bushing Sensors for HV Power Transformer
STA030302 Diode trio with transient suppressors : May be required when using an external coil monitoring system and/or when using a bypass module wired to an IPO C/B not having a GO command input.
RWC0Y0000 IRIG-B time synchronization optional module
RWK000016 SynchroTeq Communication Module, including (2x) Ethernet 100BASE-T + (1x) Ethernet 100BASE-FX multimode + (2x) serial ports and usual SCADA Protocols. (This option is not available when SynchroTeq RS-485 serial port is assigned to another function)
RWS055000 SynchroTeq Unified Communication Services: For automatic data transfer of events and waveforms.

Vizimax also offers commissioning and training services: for more details, please contact us.

NOTE: Specifications are subject to change without notice

Contact Vizimax: support@Vizimax.com
                                              www.Vizimax.com/contact