Vizimax
A PGC Company

SynchroTeq® Plus
Datasheet

19" Rack mount configuration shown

STP03000-SP-en
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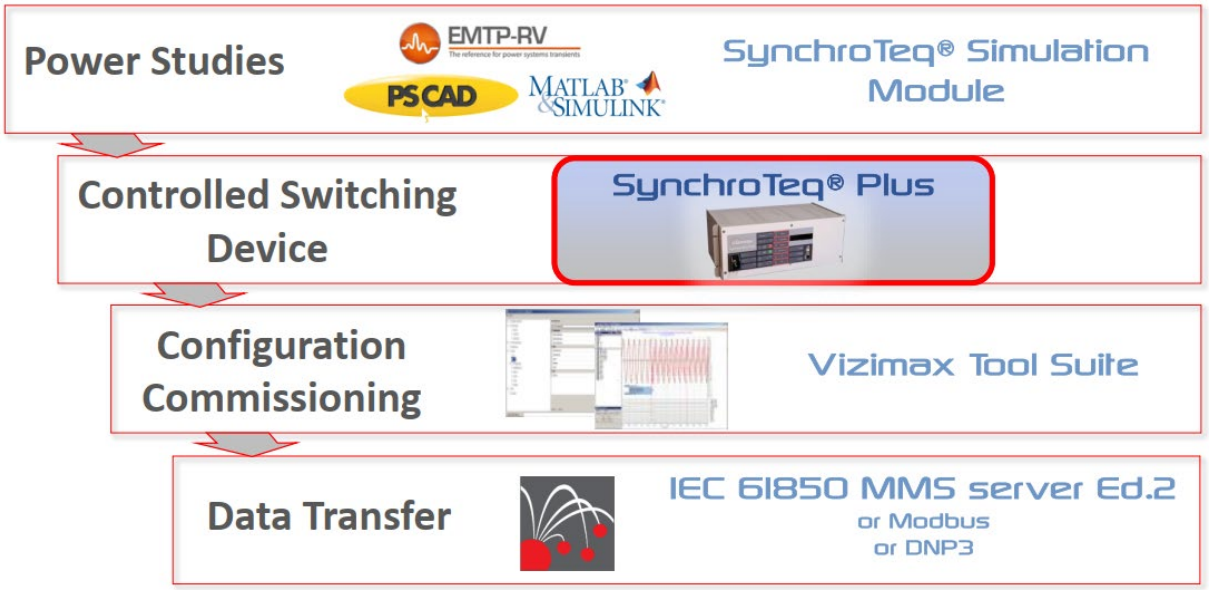
1 Product overview

SynchroTeq Plus is a component of the SynchroTeq System Family aimed at high voltage (HV, EHV and UHV) circuit breakers (CB) 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 CBs, as shown in Table 1 below:

Table 1 Comparison between SynchroTeq models by load switching application

Load Switching Application	SynchroTeq MV		SynchroTeq Plus	
	SynchroTeq MVR	SynchroTeq MVX	SynchroTeq Plus	SynchroTeq Plus+ VL measurement
Discharged capacitor banks and harmonic filters – MSC/MSCDN	☑		☑	
Shunt reactors – MSR	☑		☑	
Power transformers (Peak voltage)	☑		☑	
Power transformers (Residual flux)		☑		☑
Power transformers in parallel (Residual flux) (require TRAS)				☑
Uncompensated transmission lines (any kV level) with trapped charges (reclosing)			☑	
Compensated transmission lines (any kV level) with trapped charges (reclosing)				☑
Discharged transmission lines and cables			☑	
Partially charged capacitor banks – MSC/FLT		☑	☑	
CB and a half (any kV level)			☑	☑
Voltage range	Up to 69 kV		Up to UHV	

SynchroTeq Plus is a manufacturer agnostic solution suitable for “DC controlled” switchgears and CBs regardless of the make.

The appropriate CB/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 with trapped charges	☑		
Transmission lines and cables without trapped charges	☑	☑	

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

1.1 Applications of SynchroTeq Plus

The outstanding performance of SynchroTeq Plus devices apply to a variety of CBs – 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 others, SynchroTeq Plus is a powerful, communication-enabled intelligent electronic device (IED) suitable for:

Power Grids:

- Transmission lines energization and reclosing
- High voltage power transformers.
- Enhanced penetration of Renewable Energy.
- Grid connection of DERs
- Volt-Var regulation through the engagement of switchable reactive resources.

HV Equipment / FACTS:

- Fast-switching of capacitor banks (MSC), shunt reactors switching (MSR), harmonic filters (FLT) combined or not with power electronics (i.e. hybrid STATCOMs).
- Energizing step-up transformers in Energy Storage Systems.
- Capacitor banks switching for PF Correction/VAR Compensation.
- Advanced CBs 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, etc.
- Switching reactive loads.
- Energizing power cables.

Industry:

- Electrical Arc Furnaces: transformers switching, MSC/MSR/FLT 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. Flexible engagement of motor-starting capacitors.

CB and a half and ring configurations:

- Energizing 2 load circuits from double bus bars.

1.2 SynchroTeq Plus highlights

For new or existing CBs

CPU-demanding apps and complex models

- Transmission lines
- Numerous compensation channels
- Fast-switching of reactive loads

Strong engine, web-based operation

- 2000 events and waveforms storage

Best-in-class HV transformer energization

- Residual flux calculation modules
- Bushing sensors for transformer voltage measurements

Additional modules and tools

- Embedded Bypass module
- Floating SPSBO-F: Isolated coil outputs
- Transformer Re-energization Advisory System (TRAS)

Data transfer for SCADA / DCS (native protocols)

- IEC 61850 MMS Server Ed.2 incl. XCBR control model
- DNP3
- Modbus-TCP (Slave)

1.3 Controlled switching

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

- Three-pole switchgear with Single-pole operation / independent pole operation.
- Three-pole operation / simultaneous pole operation (i.e. metal enclosed switchgears as per IEC 62271-1, 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.

CB 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.

For 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/CBs.

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 (i.e. enabling an instantaneous restoration of reactive capacity, or the execution of fast O-C-O-C cycles in bursts without capacitor discharge).

1.4 Circuit breakers wear monitoring

SynchroTeq Plus is not only a CSD, but also a CB monitoring tool that drastically reduces the CB maintenance costs by allowing for scheduling maintenance only when required due to excessive wear.

SynchroTeq Plus offers numerous CB monitoring functions, including:

- Operating drifts
- Alarming of pole discrepancies
- Command coil supervision
- Electrical wear monitoring
- Mechanical wear monitoring

1.4.1 Electrical wear monitoring

For each phase, SynchroTeq Plus measures the electrical wear of the CB at each controlled operation (i^2t). The i^2t 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.

1.4.2 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.

1.5 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 CB: 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 CB control in substations or in equipment.

1.5.1 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.

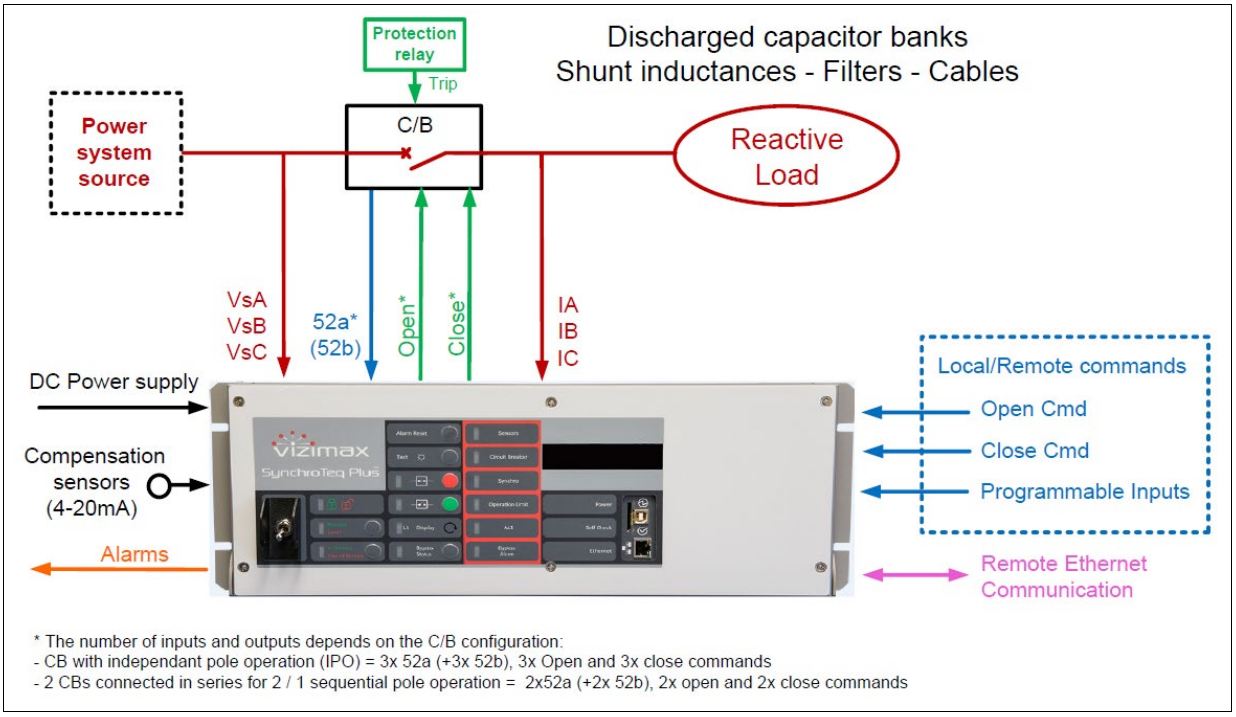


Figure 1 Example of energizing a discharged reactive load

1.5.2 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, allowing for the flexible switching of the asset (mitigating the need for a minimum down time).

Each time the CB 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.

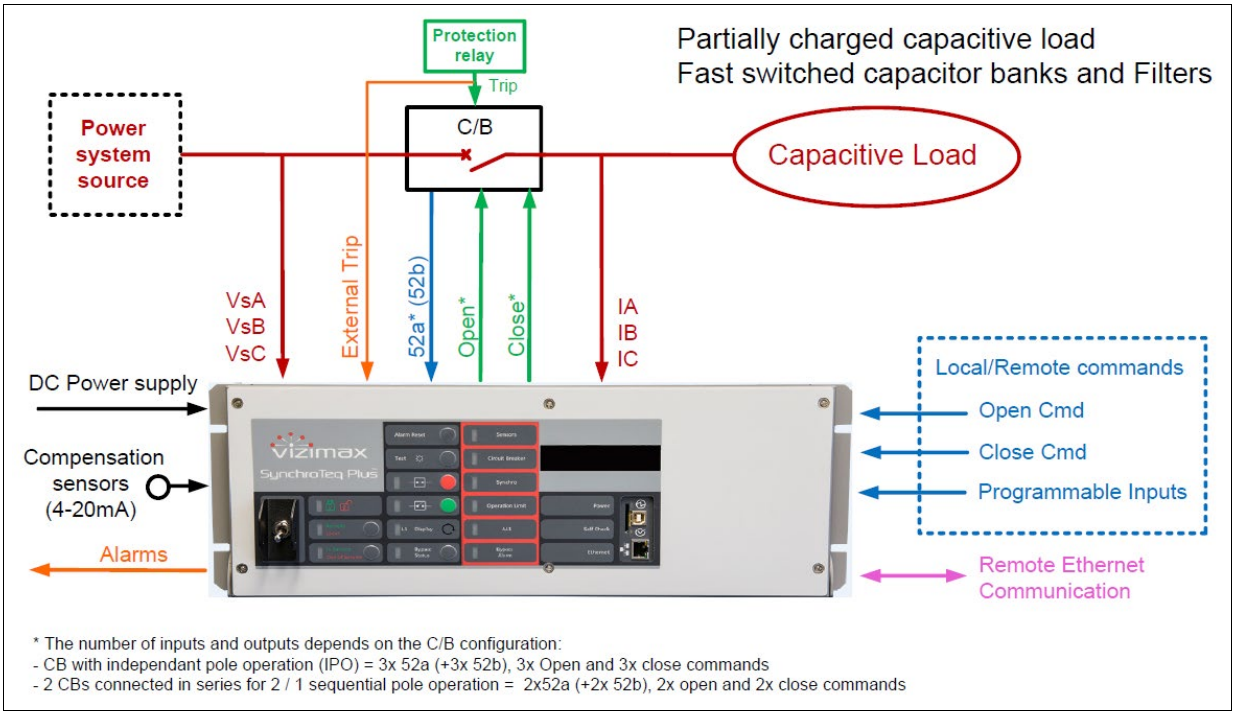


Figure 2 Example of energizing partially charged or fast switching capacitive loads

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

- Close-160 ms[1]-Open-15 seconds. Can be repeated any number of times (no limit)
- Open-160 ms[1]-Close-15 seconds. Can be repeated any number of times (no limit)
- Open-160 ms[1]-Close-160 ms[1]-Open-160 ms[1]-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-160 ms[1]-Open-160 ms[1]-Close-160 ms[1]-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 [1] The 160 ms takes into account command duration of 25 ms, coil output pulse duration of 50 ms, CB close time of 30 ms and open time of 20 ms.

1.5.3 Energizing power transformers with residual flux management

SynchroTeq Plus features AC voltage measurement channels for the acquisition of power transformer voltage (from primary, secondary or tertiary 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 and associated rapid voltage changes.

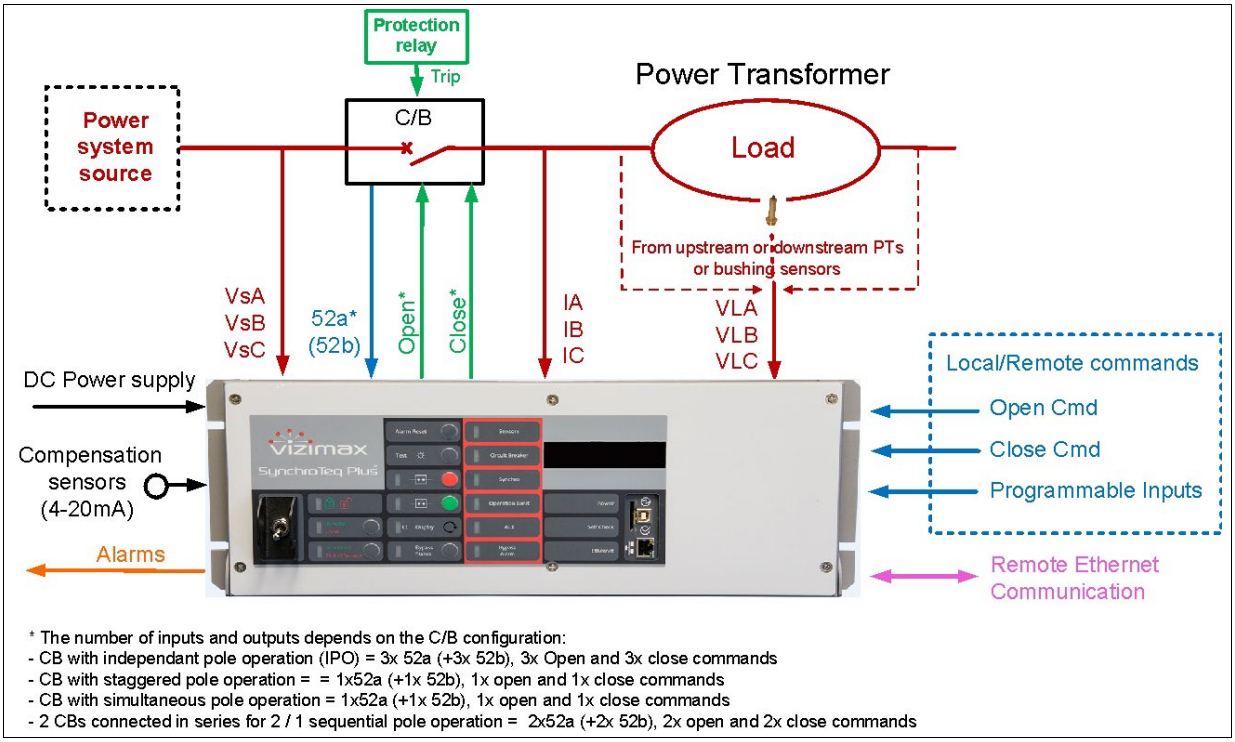


Figure 3 Example of energizing a power transformer

1.5.4 Energizing uncompensated and compensated transmission lines

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, without any need to uncommit its switchable line reactors.

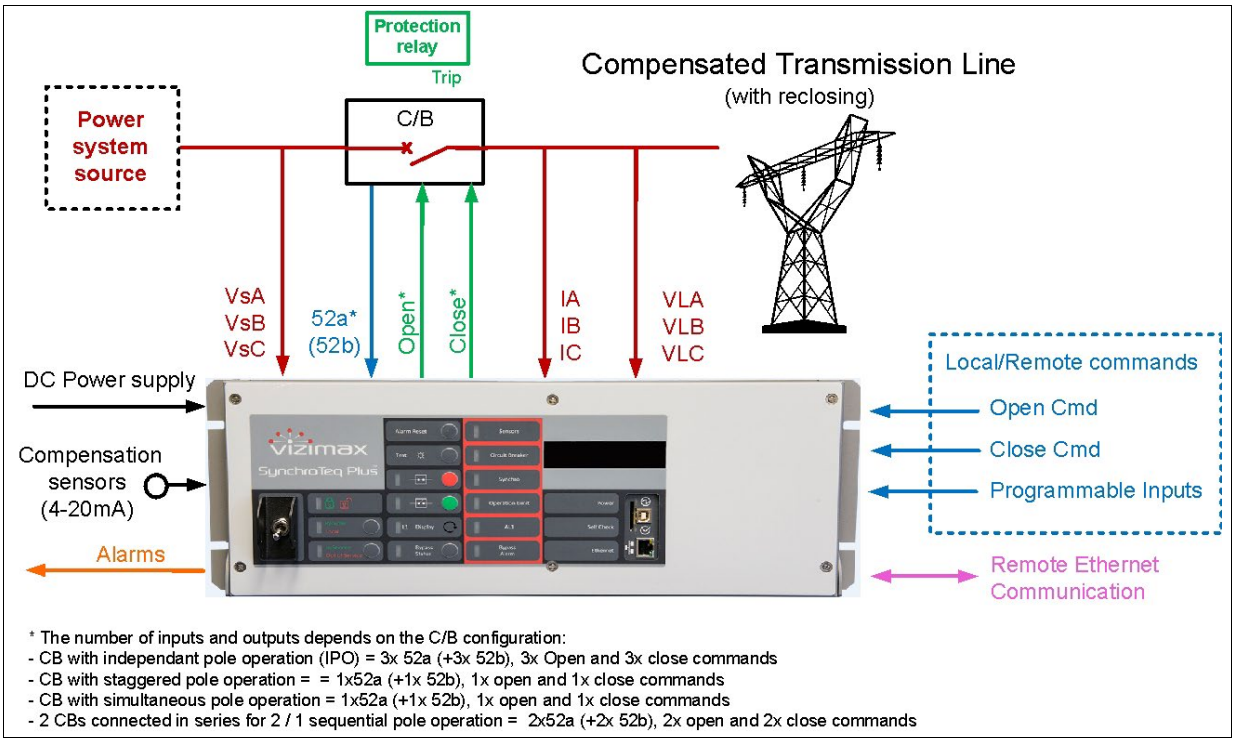


Figure 4 Example of energizing a compensated transmission line

1.5.5 Energizing single load circuits from double bus bars

In this double bus 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.

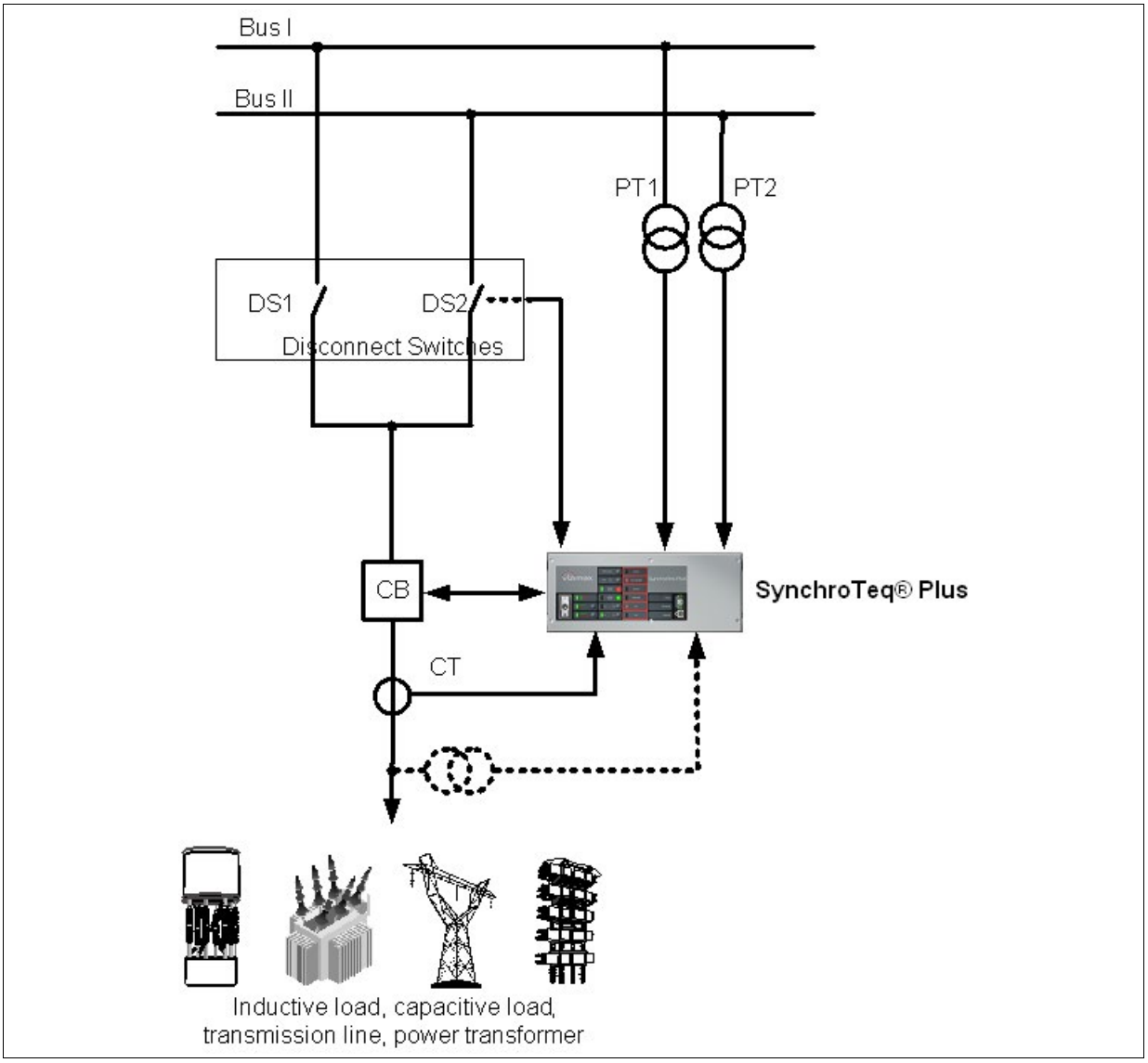


Figure 5 Example of energizing a single load circuit from double bus bars

The SynchroTeq unit controlling the CB requires 2 application configurations 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.

1.5.6 Circuit breaker and a half (or ring) applications

In this double bus 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.

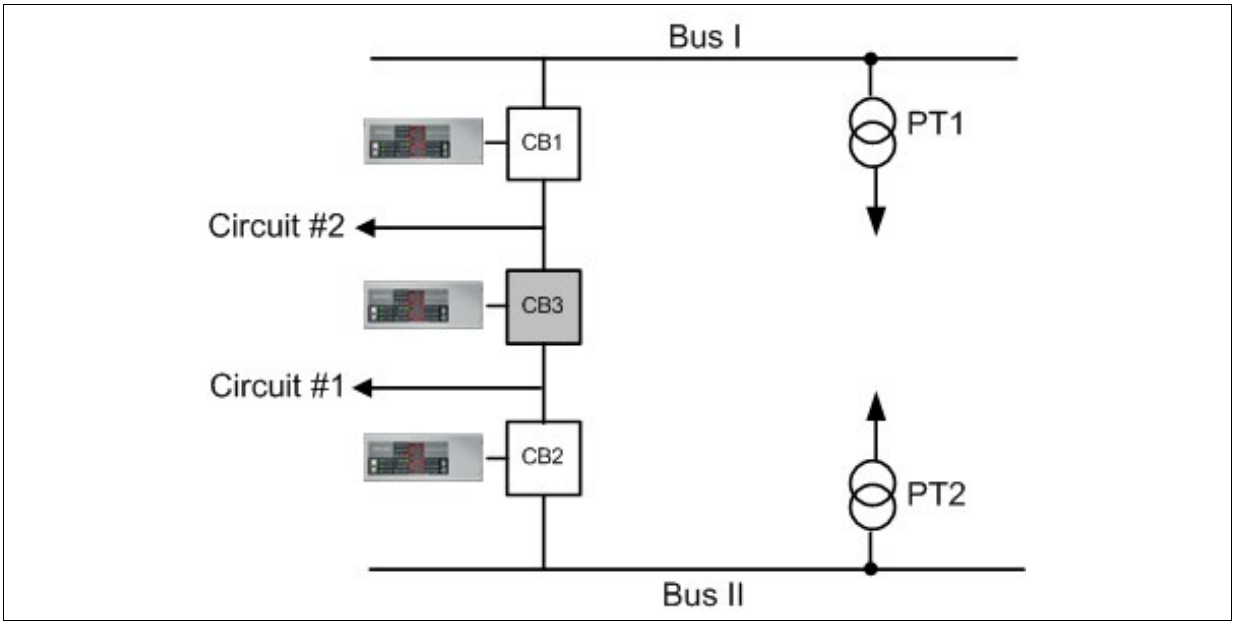


Figure 6 Example of energizing 'CB and a half' (or Ring) applications

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 examples of CB and a half configuration, with various load circuits.

Two load circuits with static configurations and compensated lines

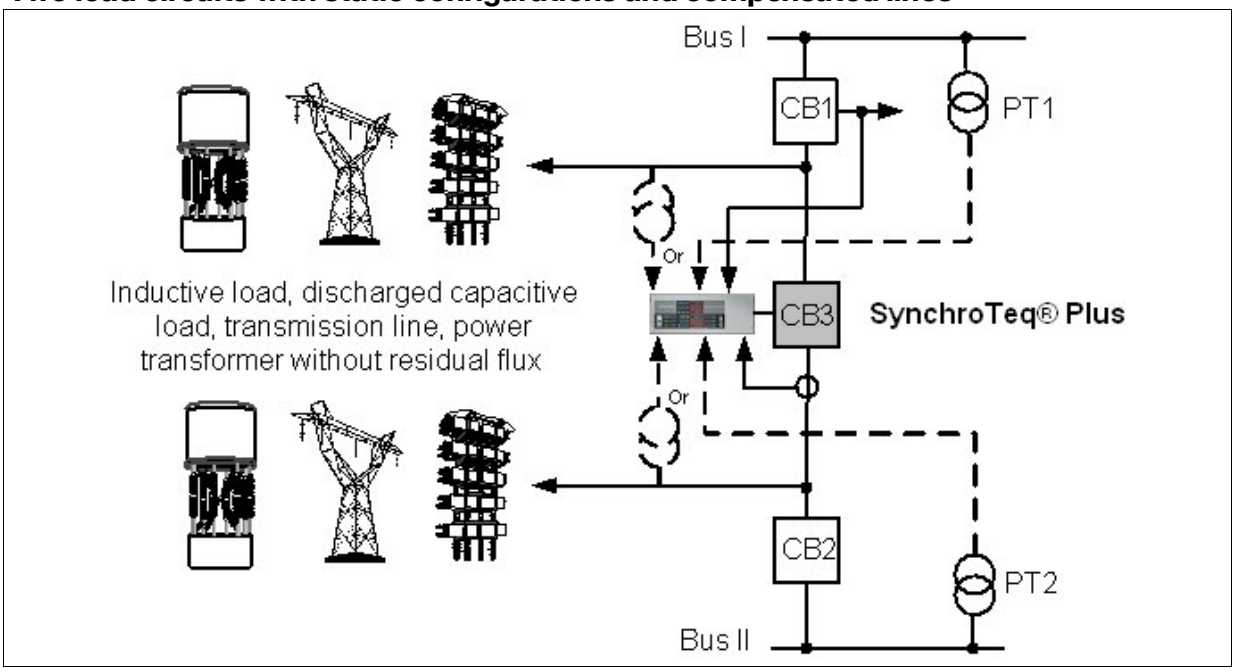


Figure 7 Example of controlling compensated lines in a CB and a half configuration

Two load circuits with static configurations and power transformers

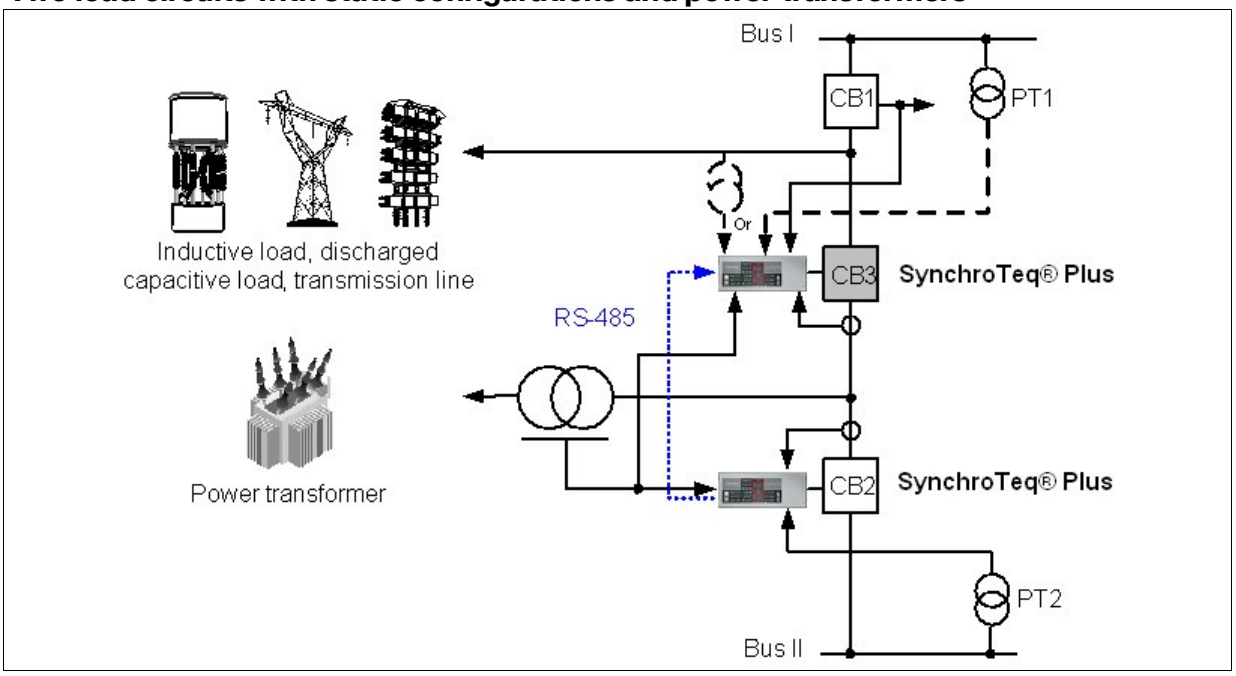


Figure 8 Example of controlling a power transformer in a CB and a half configuration

NOTE When the RS485 link is used for data transfer in CB and a half applications, the serial port W is exclusively used for that purpose and cannot be connected to the legacy optional SynchroTeq Communication module (RWK000016) or Transformer Re-energization Advisory System (BDL040000).

Two load circuits with two power transformers

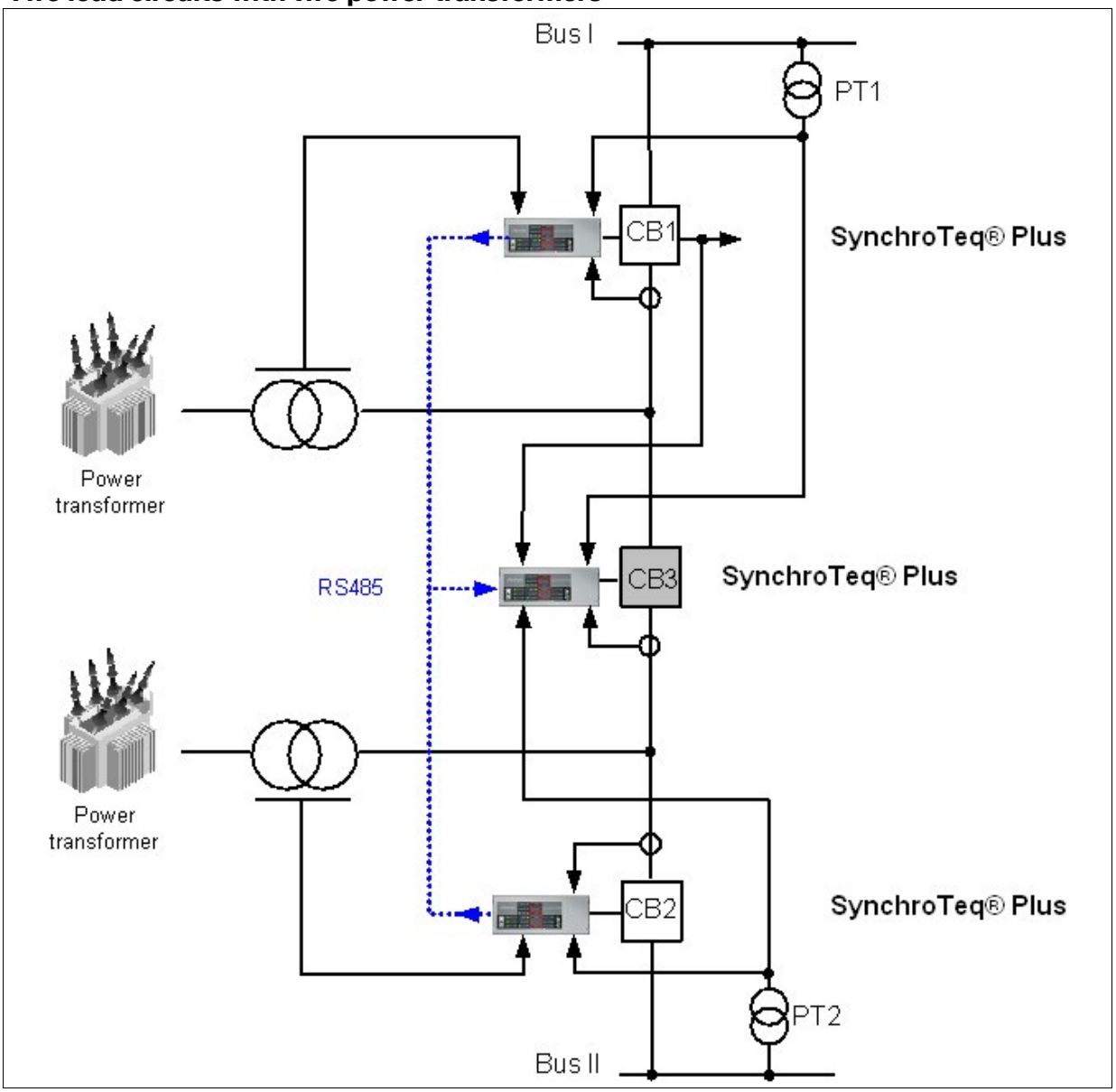


Figure 9 Example of controlling two power transformer loads in a CB and a half configuration

NOTE When the RS485 link is used for data transfer in CB and a half applications, the serial port W is exclusively used for that purpose and cannot be connected to the legacy optional SynchroTeq Communication module (RWK000016) or Transformer Re-energization Advisory System (BDL040000).

1.6 Communication protocols for unit management, time synchronization and data transfer

1.6.1 Communication ports

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
- Optional PRP (Parallel Redundancy Protocol) module with either:
  - 100BASE-FX on dual LC or copper connectors (multimode optical fiber)
  - 100BASE-T, on dual RJ45 connectors (copper).

Serial links

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

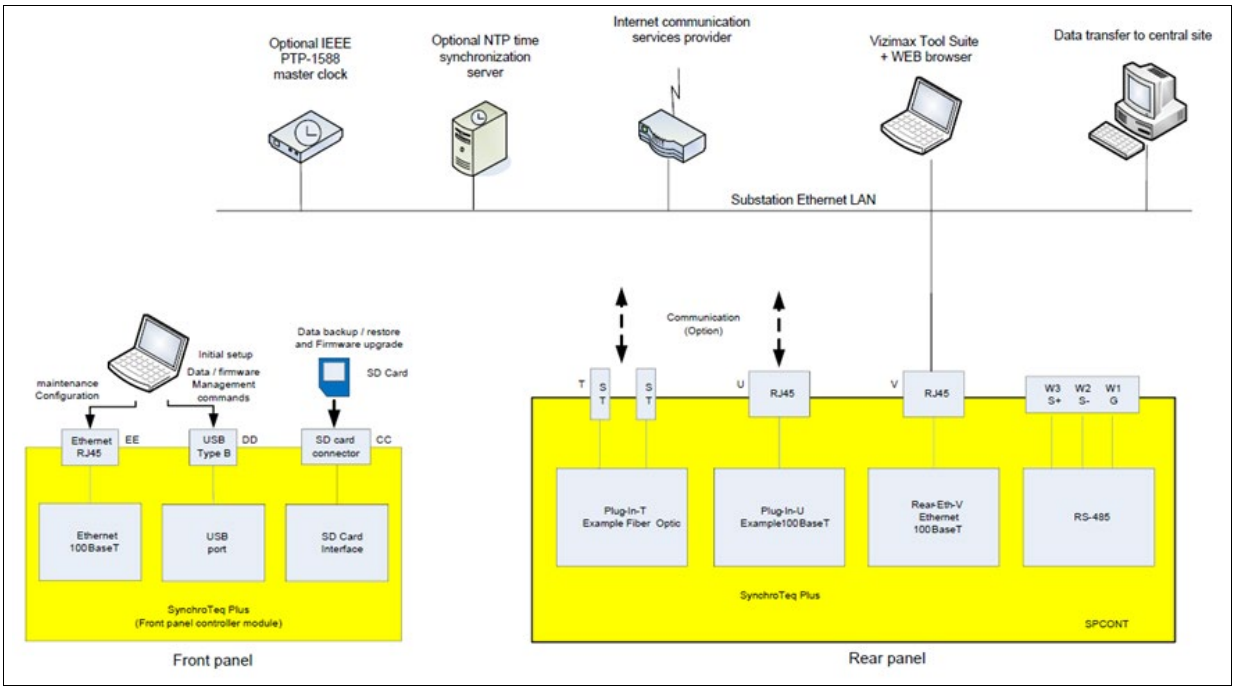


Figure 10 SynchroTeq Plus network environment

1.6.2 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 profiles are:
  - IEC 61850-9-3
  - IEEE C37-238 Profile (2011 and 2017)
  - L3_UDP_E2E
- NTP/SNTP (Network Time Protocol) service over the Ethernet network

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

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

1.6.3 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 substation automation protocols: IEC 61850 MMS Server Ed.2 or DNP3.0 or Modbus,
- 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.

1.6.4 Communications and Data transfer solutions

SynchroTeq Plus natively supports the following protocols:

- IEC 61850 MMS Server Ed.2 protocol (including the XCBR control model), for substation automation and SCADA system interfacing. IEC 61850 enables COMTRADE file transfer.
- DNP3
- Modbus-TCP (Slave)

1.7 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 CB operation simultaneously.

1.7.1 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 CB and the load.

Details
This page provides access to detailed statuses, including the SynchroTeq and CB alarms and the CB 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.

1.7.2 Events and waveform recording

At each switching operation, SynchroTeq Plus records current and voltage waveforms including the CB 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.

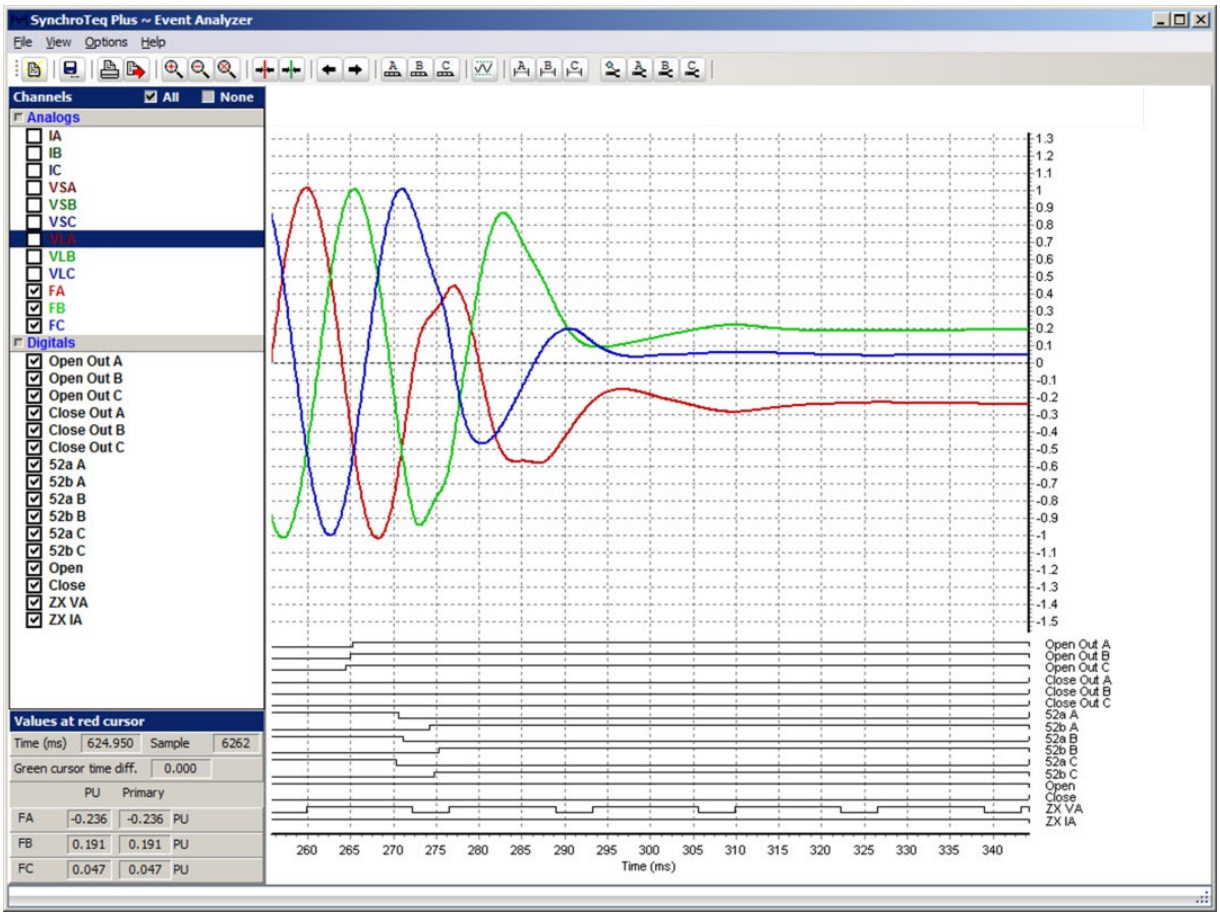


Figure 11 SynchroTeq Plus – Vizimax Event analyzer

1.8 SynchroTeq Plus connectors and HMI identification

1.8.1 Back panel connectors identification

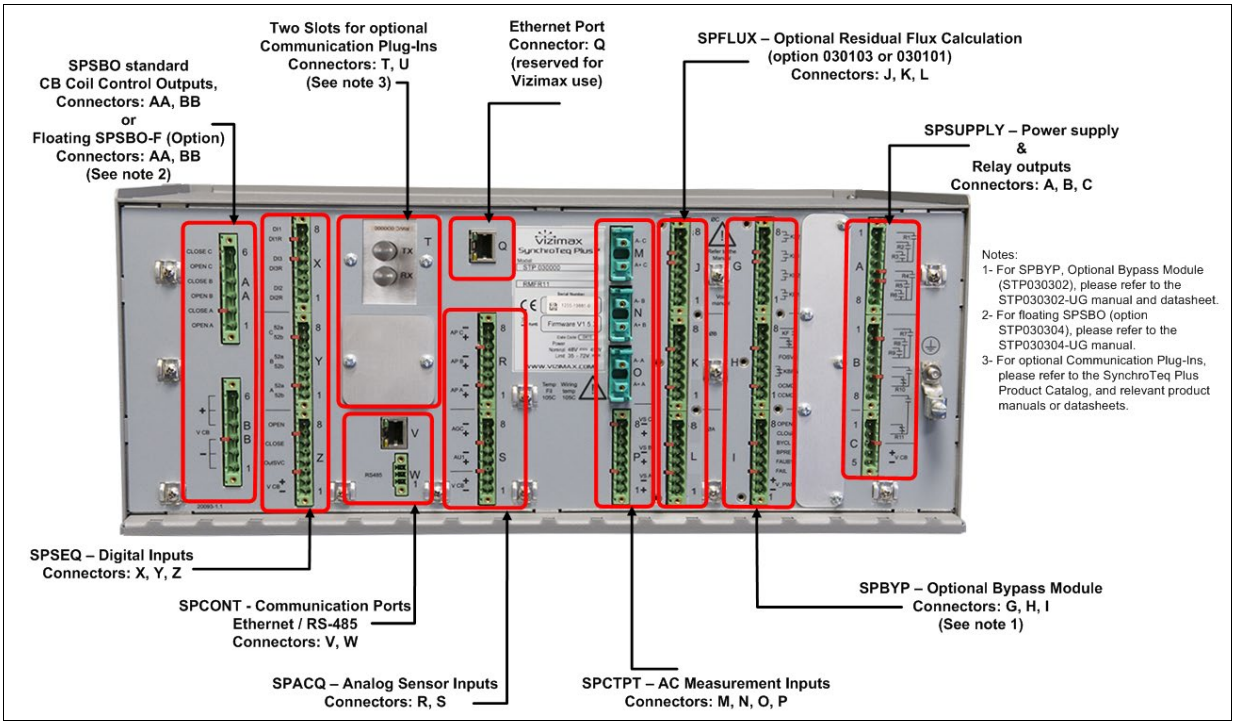


Figure 12 SynchroTeq Plus back panel connectors identification

1.8.2 Front panel user interface and display

Figure 13 SynchroTeq Plus front panel user interface and display

2 Technical specifications

2.1 Compliance and certifications

2.1.1 Environmental and mechanical

Table 3 SynchroTeq Plus environmental and mechanical specifications

Test type	Standard	Value
Operating temperature	IEC 60068-2-1 IEC 60068-2-2	-50°C to +70°C[1]
Maximum relative humidity (R.H.)	IEC 60068-2-30	95% without condensation
IP Rating	IEC 60529	IP30
Normal environmental conditions	IEC 60255-1 IEC 60947-1	• No significant air pollution • Pollution degree 2
Maximum altitude	MEAS CAT III	2 km
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/11 ms (3) Repetitive bump 10G/16 ms (1000) Response 15G/11 ms (3)
Seismic	IEC 60255-21-3	Method A, class 1
Drop & Topple	IEC 60068-2-31	Drop 100 mm Edge/Corner/Face
[1] See Table 4 SynchroTeq Plus temperature test performance specifications		

2.1.2 Temperature test performances

Table 4 SynchroTeq Plus temperature test performance specifications

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

2.1.3 Electromagnetic compatibility (EMC)

Table 5 SynchroTeq Plus electromagnetic compatibility (EMC) – EN, CISPR, FCC Standards

Test type	Standard	Value
Radiated emissions	EN55011,22 CISPR 11, 22 60255-26 FCC	Class A 30 MHz-1 GHz (FCC part 15: 2010 B, up to 2 GHz)
Conducted emissions	EN55011 CISPR 11	Class A 150 kHz – 30 MHz

Table 6 SynchroTeq Plus electromagnetic compatibility (EMC) – IEC Standards

Test type	Standard	Value
Radiated immunity	IEC 61000-4-3 IEC 61000-6-5 IEC 60255-26	Level 3 20 V/m (80 MHz – 1 GHz) 80% modulated (1 kHz)
Radiated immunity	IEC 61000-4-3 IEC 61000-6-5 IEC 60255-22-3 IEC 60255-26	Level 3 10 V/m (1.4 – 2.7 GHz) 3 V/m (5.15 – 5.75 GHz)
Conducted disturbance, HF	IEC 61000-4-6 IEC 61000-6-5 IEC 60255-22-6 IEC 60255-26	Level 3 10 V_{RMS} (150 kHz – 80 MHz) 80% modulated (1 kHz)
Conducted disturbance, LF	IEC 61000-4-16 IEC 61000-6-5 IEC 60255-26	Level 4 15 – 150 kHz 30 V & 300 V – 50 Hz & 60 Hz
Surge immunity	IEC 61000-4-5 IEC 60255-22-5 IEC 61000-6-5 IEC 60255-26	Level 4 LN-PE 4 kV, L-N 2 kV I/O: 40 ohm-0.5 µF
D.C. Power Ripple	IEC 61000-4-17 IEC 61000-6-5 IEC 60255-11 IEC 60255-26	Level 3 10% U_T – 10 min.
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% U_T Slow variations 60 s
Electrostatic discharge	IEC 61000-4-2 IEC 60255-22-2 IEC 61000-6-5 IEC 60255-26	Level 4 8 kV Contact / 15 kV Air Discharge.
Fast transient	IEC 61000-4-4 IEC 60255-22-4 IEC 61000-6-5 IEC 60255-26	Level 4 4 kV 2.5 kHz (Power Supply) 2 kV 5.0 kHz (Other) 2 kV 100 kHz
Power magnetic field	IEC 61000-4-8 IEC 61000-6-5 IEC 60255-26	Level 4 30 A/m continuous 300 A/m short term

2.1.4 Surge withstand capability (SWC)

Table 7 SynchroTeq Plus surge withstand capability (SWC) specifications

Test type	Standard	Value
Impulse voltage	IEC 60255-5 IEC61180-1	OVC CAT IV 5 KV 1.2/50 µs – 500 Ω
Insulation dielectric insulation resistance	IEC 60255-5 IEC61180-1	2 kV_{rms} – 1 minute 100 MΩ @ 500 V_{DC}
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/1 kV DM (1 MHz/400 Hz) 200 Ω 1 min. duration ± polarity

2.1.5 Safety

Table 8 SynchroTeq Plus safety standards

Test type	Standard	Value
Safety (Phase 1)	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

2.1.6 Mean time before failure (MTBF)

Table 9 SynchroTeq Plus mean time before failure (MTBF)

Specifications	Value
MTBF	13 years estimated

2.2 Power supply

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

Table 10 SynchroTeq Plus power supply specifications

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[1] and STP030103[2]) 40 W typical (including 2 options STP030302[1] and STP030103[2]) 33 W typical (including 1 option STP030302[1]) 27 W typical (without optional module) • The external power supply must be able to sustain a cold start current up to 30 A for 10 ms at unit start-up.[3]
Overvoltage category	OVC CAT III
Polarity inversion	No damage
Voltage interrupt (max) IEC 61000-4-29	100 ms @ 100%

[1] STP030302: Optional BYPASS module
[2] STP030103: Optional SPFLUX module
[3] The SynchroTeq Plus main DC power supply includes a power reserve capable of sustaining a 100 ms power interruption. The energy storage components may induce a cold start current up to 30 A for 10 ms (typical value at 125 VDC) at unit start up. Please refer to the SynchroTeq Plus Installation guide for more details on power supply requirement and protections

2.3 Control – Time synchronization – Communication

2.3.1 Controller and time synchronization

Table 11 SynchroTeq Plus controller and time synchronization specifications

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[1] Manual synchronization from PC computer
Field upgrade	Field upgradable firmware available from Vizimax web site, support section

[1] 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"

2.3.2 Local user interface (front panel)

Table 12 SynchroTeq Plus local user interface features (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 CB • Close CB • 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.

2.3.3 Communication ports

Table 13 SynchroTeq Plus communication ports specifications

Port	Characteristics	Value
USB Front panel	Interface compatibility	2.0
	Maximum speed	480 Mbit/s
	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 the rear panel:

RWC0D0000: 100BASE-FX Ethernet on Multimode Fiber Optic with ST Connector

RWC0C0000: Isolated 100BASE-Ethernet with RJ45 connector

RWDPRPLC0: Optional PRP (Parallel Redundancy Protocol) module with multimode optical fiber, 100BASE-FX, LC connectors ("2 slots" form factor (Slot T and U)).

RWDPRPRJ0: Optional PRP (Parallel Redundancy Protocol) module with copper, 100BASE-T, RJ45 connectors ("2 slots" form factor (Slot T and U)).

2.3.4 Native protocols

Table 14 SynchroTeq Plus native protocols features

Protocol	Characteristics
IEC 61850 MMS Server Ed.2	XCBR control Full dataset refreshed every second 4 predefined unbuffered reports 120 COMTRADE waveform retrieval.
DNP3	CB control SynchroTeq status[1] Alarms[1] Measurements[1]
Modbus-TCP (Slave)	CB control SynchroTeq status[1] Alarms[1] Measurements[1]
[1] Compared to MMS, partial list is available with DNP3 and Modbus. Refer to online help for details	

2.4 AC measurements inputs

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

2.4.1 CT inputs

Table 15 SynchroTeq Plus CT inputs specifications

Characteristics		Value	
Number of inputs		3	
Connector type		Auto-shorting pluggable connector, screw clamp	
Current	Rated current	1 A	5 A
	Saturation (clipping) current	2 A	10 A
	Maximum continuous current	4 A	10 A
	Maximum current for 1 second	30 A	200 A
Measurement category		MEAS CAT III	
Max burden	At rated current I_n	0.1 VA at 1 A 1 VA at 5 A	
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% I_n	
	Accuracy	10 µs	
Insensitivity to harmonic contents		Up to 7% I_n (for 2^{nd} to 10^{th} harmonics)	
Crosstalk isolation between channels		≥76 dB	

2.4.2 PT inputs

Table 16 SynchroTeq Plus PT inputs specifications

Characteristics	Value	
Number of inputs	3	
Rated voltage	100 V_{AC}, 110 V_{AC}, 120 $V_{AC.}$ 100/√3 V_{AC}, 110/√3 V_{AC}, 120/√3 V_{AC}	
Typical clipping level	For 120 V_{AC}: typical clipping Level = 147 V_{rms} (1.26 PU) For 120/√3 V_{AC}: typical clipping Level = 88 V_{rms} (1.27 PU)	
Thermal capacity (1 minute)	167 V_{AC}	
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% V_n
	Accuracy	10 µs
Insensitivity to harmonic contents	Up to 50% V_n (for 2^{nd} to 10^{th} harmonics)	
Crosstalk isolation between channels	≥84 dB	

2.4.3 Additional three phase voltage measurement module with residual flux calculation

Certain applications require an additional module to measure the load side voltages (SPFLUX).

For **transformer applications**, the SPFLUX module is used to measure the load side voltages (three phase) and – when this module is present – allows SynchroTeq to calculate the optimum CB closing time based on the residual flux in the transformer core after the transformer is de-energized. This reduces the inrush current to a magnitude comparable to the magnetization current.

In **compensated transmission line applications**, the SPFLUX module is required for the reclosing sequence, as the line side voltage is necessary for algorithmic analysis (Prony algorithm analysis).

NOTE For compensated transmission lines, the acronym SPFLUX is ambiguous, since it does not calculate the residual flux but rather serves to measure the load side voltage only.

Two versions of the SPFLUX module exist: one for magnetic PTs and one for high voltage bushing sensors. Bushing sensors are installed in the test tap of the power transformer's or shunt reactor's bushing.

- **SPFLUX module for magnetic PT measurement (STP030103)**
  - Includes three (3) PT measurement inputs and three (3) additional 4 to 20 mA inputs. The 4 to 20 mA inputs can be used for two-wire sensor monitoring.
- **SPFLUX module for bushing sensors (STP030101)**[1]
  - Includes three (3) high voltage bushing sensors measurement inputs for Vizimax bushing sensors, and three (3) additional 4 to 20 mA inputs. The 4 to 20 mA inputs can be used for two-wire sensor monitoring.

NOTE [1] Requires an active junction box and dedicated bushing sensors. See SynchroTeq Plus Smart Coding document STP030000-SC-en for details.

2.4.4 SPFLUX module for magnetic PT measurements (STP030103)

2.4.4.1 PT inputs

Table 17 SynchroTeq Plus PT inputs specifications

Characteristics	Value
Number of inputs	3
Input operating range	57 V_{AC} (or 100/√3 V_{AC}) to 120 V_{AC}
Measurement category	MEAS CAT III
Thermal capacity (1 minute)	167 V_{AC}
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%

2.4.4.2 Additional 4 to 20 mA inputs

Table 18 SynchroTeq Plus additional 4 to 20 mA inputs specifications for PT

Characteristics	Value
Number of inputs	3
Input operating range (4 to 20 mA nominal)	0 to 25 mA
Temperature measurement range	-50 °C to +80 °C
Sensor supply	24 V_{DC} / 60 mA provided by the SPFLUX card
Measurement category	MEAS CAT III
Temporary overvoltage for 2 seconds	50 V_{AC}
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%

2.4.5 SPFLUX module for bushing sensors (STP030101)

2.4.5.1 Bushing sensor inputs

Table 19 SynchroTeq Plus bushing sensor inputs specifications

Characteristics	Value
Number of inputs	3
Voltage operating sensor range	4 to 20 mA
Transformer bushing sensor supply	24 V_{DC} provided by the SPFLUX card
Measurement category	MEAS CAT III
Temporary overvoltage for 2 seconds	50 V_{AC}
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%

2.4.5.2 Additional 4 to 20 mA inputs

Table 20 SynchroTeq Plus additional 4 to 20 mA inputs specifications for bushing sensors

Characteristics	Value
Number of inputs	3
Input operating range (4 to 20 mA nominal)	0 to 25 mA
Temperature measurement range	-50 °C to +80 °C
Sensor supply	24 V_{DC} / 60 mA provided by the SPLUX card
Measurement category	MEAS CAT III
Temporary overvoltage for 2 seconds	50 V_{AC}
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%

2.5 DC measurement inputs

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

- Monitor CBs 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 CB 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

2.5.1 4 to 20 mA analog measurement inputs with compensation function

Table 21 SynchroTeq Plus 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 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)

2.5.2 CB coil voltage measurement input with compensation function

Table 22 SynchroTeq Plus CB coil voltage measurement input with compensation function

Characteristics	Value
Number of inputs	1 V_CB (CBVol)
Rated voltage	0 V_{DC} to 300 V_{DC}
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

2.5.3 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.

Table 23 SynchroTeq Plus – AU1: AC voltage input specification (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 3 kHz
Full scale accuracy at 23 °C	0.5%
Full scale rated noise level	0.05%

Table 24 SynchroTeq Plus – AU1: DC 4-20mA input specifications

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 4-20 mA configuration on AU1 input.

2.5.4 SynchroTeq Plus internal temperature monitoring

Table 25 SynchroTeq Plus internal temperature monitoring specifications

Characteristics	Value
Number of sensors	1 internal sensor
Operating range	-40 °C to +85 °C
Accuracy	±1 °C

2.6 Digital inputs and outputs

2.6.1 Digital inputs

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

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

Table 26 SynchroTeq Plus digital inputs specifications

Characteristics		Value			
Number of inputs		12			
Number of supervised inputs with opto-coupler tests		9			
Rated voltage		48 V_{DC}	110 V_{DC}	125 V_{DC}	220 V_{DC}
Input voltage range	For idle state	24 V_{DC}	69 V_{DC}	69 V_{DC}	150 V_{DC}
	For active state	31 V_{DC}	87 V_{DC}	87 V_{DC}	173 V_{DC}
Maximum input Voltage		72 V_{DC}	150 V_{DC}	150 V_{DC}	280 V_{DC}
Overvoltage category		OVC CAT III			
Maximum burden		1 W			
Typical input impedance	48 V_{DC}, 110 V_{DC}, 125 V_{DC}	Min: 24 kΩ, Max: 49 kΩ			
	220 V_{DC}	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 CBs 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.

2.6.2 Circuit breaker coils command outputs

The SynchroTeq Plus SPSBO module drives the CB coils.

NOTE SynchroTeq Plus unit only supports “DC controlled” circuit-breakers.

Table 27 SynchroTeq Plus CB coils command outputs specifications

Characteristics	Value
Number of outputs	6
Output driver technology	Solid State (SSR) Outputs
Rated voltage	48 V_{DC}, 110 V_{DC}, 125 V_{DC}, 220-250 V_{DC}
Overvoltage category	OVC CAT III
DC rated continuous current (t_{max} = 300 s)	5 A
Maximum making current (t_{max} = 200 ms)	30 A
Maximum breaking current (L/R = 40 ms)	20 A
Maximum output leakage current	0.1 mA
Voltage burden	3.5 V_{DC}
Output pulse width (activation time)	10 ms to 1000 ms (by programmable increments of 10 ms or 100 ms)
Coil output command accuracy	10 µs[1]
CB coil supervision function	3 mA dc current injected in each coil circuit. Alarm signaled when 3 mA current disappears. No current injected if function is disabled or when issuing a controlled command
CB coil sequence supervision function	Read back coil output voltages after coil command. Alarm signaled if output voltages do not correspond to the expected level.

[1] 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

NOTE Specifications above apply to standard SPSBO module and dual batteries SPSBO (option STP030305).

2.6.3 Important note on the CB operating time accuracy:

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

- **CB mechanical scatter**: each CB has a natural mechanical deviation on its main chamber operating times. This deviation is due to the overall imprecision in the mechanical moving parts of the breaker (shafts, gears, etc.). It is important to mention that the mechanical deviation we are talking about (generally from 0.1 ms 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, etc.).
- **Availability of compensation data and their accuracy**: most CBs are affected by the environmental operating parameters. If these effects are not taken into consideration, the overall CB 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 CB 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 a 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 CB manufacturers cannot provide it.

For example, let us assume the following situation:

- Circuit-breaker with a natural mechanical scatter of ±0.3 ms 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 CB manufacturer stated that the effect of the ambient temperature on the main chamber operating time is ±2 ms

In this case, since no compensation data is provided, we can expect **an overall CB operation precision of ±2.31 ms:**

- ±2ms for the ambient temperature variation
- ±0.3 ms for the mechanical scatter
- ±0.0 1ms for the SynchroTeq Plus

2.6.4 Circuit breaker coil command options

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

- **Optional floating SPSBO-F module (STP030304)**: provides 6 potential free isolated solid state outputs. These outputs are designed to ”push” the current or to “pull” the current from the CB coils connected to the positive bus or to drive a CB electronic controller that has floating inputs.

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

- **Optional Dual Batteries SPSBO module (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)

NOTE 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, CB coil sequence supervision circuit drawing between 2.0 to 3.0 mA 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 continuity 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.

NOTE For more details, please contact the Vizimax technical support team at support@vizimax.com and inquire for the “SynchroTeq Plus Guidelines: 000023-DS-01-01-en” document.

2.6.5 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**: Grouped alarms in remote mode
- **R2**: CB opening alarm
- **R3**: CB 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

Table 28 SynchroTeq Plus signaling outputs specifications

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

2.7 Optional bypass module (SPBYP)

In most of the applications, SynchroTeq Plus should be equipped with a bypass circuit that allows the processing of the CB 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 CB 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).

2.8 Functional analysis tools

2.8.1 Waveform capture

Table 29 SynchroTeq Plus waveform capture features

Parameter	Value
Memory capacity	Up to 2000 events (waveforms are stored in events)
Capture trigger	CB commands from SynchroTeq Plus (OPEN and CLOSE) Voltage changes on switched side of CB (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 CB (3) Load current (3) Option: Voltages on switched side of CB (3) Option: Residual flux calculation (3) CB control commands (3 x Open, 3 x close) CB 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.

2.8.2 Event memory

Table 30 SynchroTeq Plus event memory features

Parameter	Value
Memory capacity	2000 events, including waveforms when applicable
Recording trigger sources	CB commands from SynchroTeq Plus Voltage changes on switched side of CB (for residual flux calculation on power transformer applications) Status change (local/remote, in/out of service, cold start, reset, etc.) Alarms (self-check, sensors, CB timing problems, CB 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

3 Mounting configurations

SynchroTeq Plus is available in rackmount (RM model for mounting in a 19″ rack) and standalone (SA model for panel mount).

SynchroTeq Plus should be installed away from any heat producing equipment.
The SynchroTeq Lite is cooled by convection; it does not have a built in fan.

3.1 Physical dimensions

Table 31 SynchroTeq Plus physical dimensions

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

3.2 Rackmount configuration

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

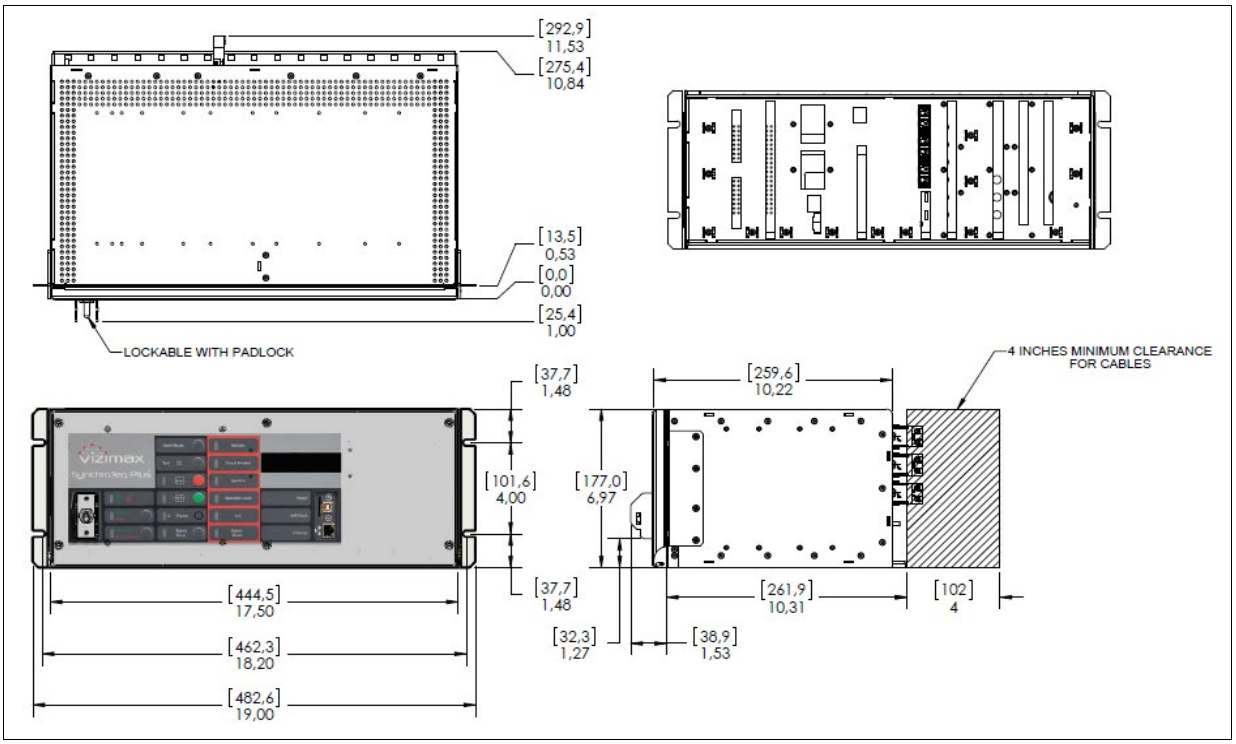


Figure 14 SynchroTeq Plus rackmount dimensions

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.

3.3 Standalone configuration

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

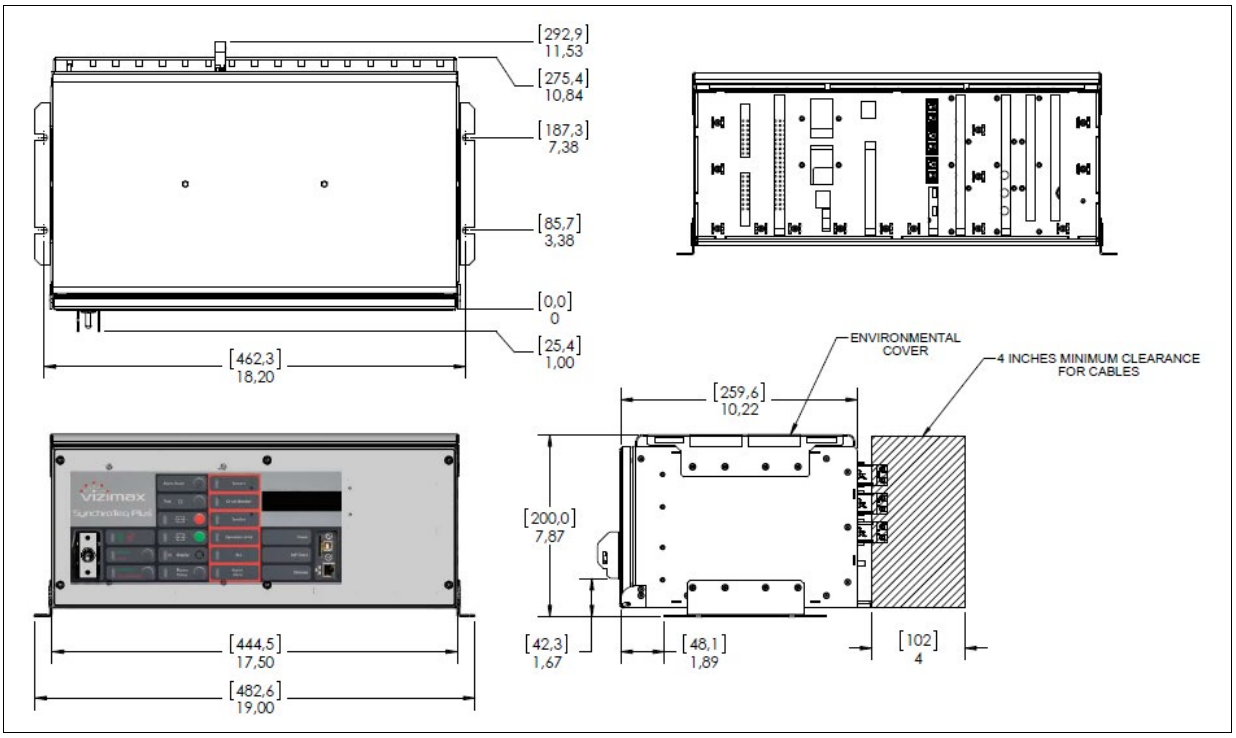


Figure 15 SynchroTeq Plus standalone dimensions

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

4 Ordering information

NOTE These specifications are subject to change without notice

4.1 Base models

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

4.2 Frequently ordered options

NOTE For a complete list of ordering options, refer to the 'smart coding' document 'STP030000-SC' available at vizimax.com.

STP030101 Auxiliary Measurement & Residual Flux Calculation Module for Bushing Sensors.

STP030103 Auxiliary Measurement & Residual Flux Calculation Module for PT Analog Inputs.

STP030302 Optional Bypass module (SPBYP)

STP030304 CB coils Floating commands (SPSBO-F)

STP030305 Dual Open / Close Batteries (SPSBO)

STP030200 Active Junction Box (for voltage acquisition through Vizimax bushing sensors)

STP030400 Bushing Sensors for HV Power Transformer

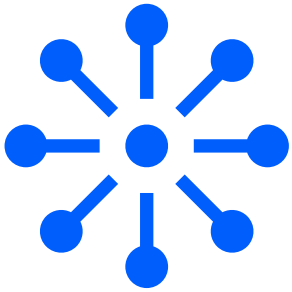
STA030302 Diode trio with transient suppressors (May be required when using an external coil monitoring system and/or when using a bypass module wired to an IPO CB not having a GO command input)

RWC0Y0000 IRIG-B time synchronization optional module

RWDPRPLC0 Optional PRP (Parallel Redundancy Protocol) module with multimode optical fiber, 100BASE-FX, on dual LC connectors (Dual rear Plug-In-T&U).

RWDPRPRJ0 Optional PRP (Parallel Redundancy Protocol) module with copper, 100BASE-T, on dual RJ45 connectors (Dual rear Plug-In-T&U).

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



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