Vizimax
A PGC Company

SynchroTeq® MV
Datasheet

Panel mount configuration shown here

STM0x0000-SP-en
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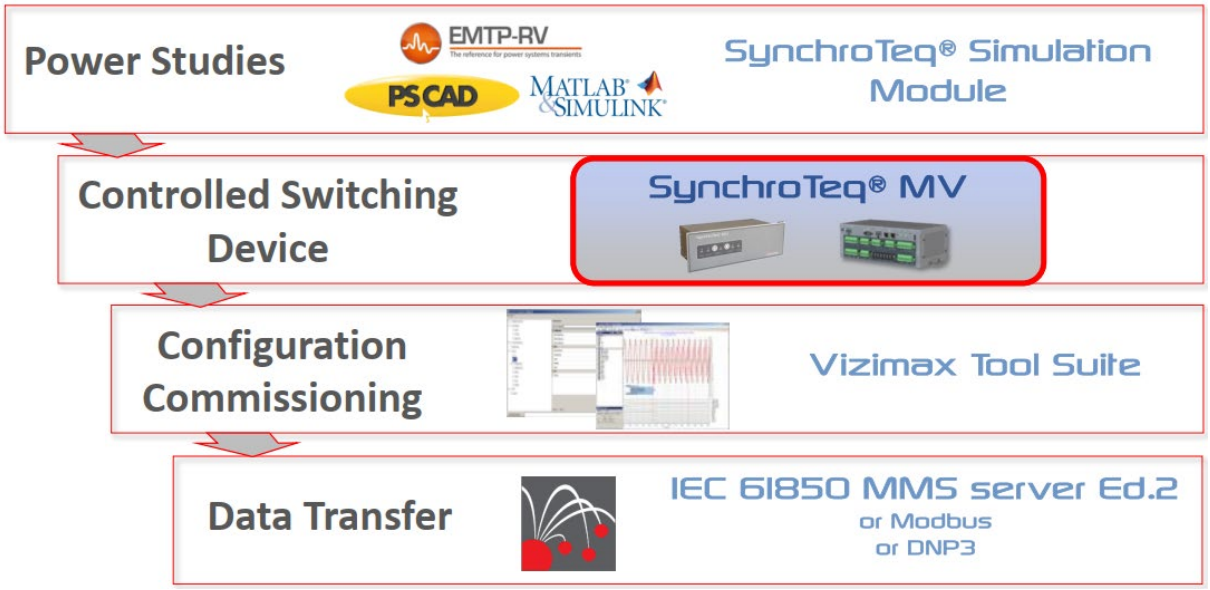
1 Product overview

SynchroTeq MV is a component of the SynchroTeq System family aimed at MV switchgears and circuit breakers (CB) up to 69 kV.



A compact Control Switching Device (CSD) for 1, 2 or 3 phase medium voltage switchgears, the SynchroTeq MV is specifically designed for load switching projects up to 69 kV. It is proposed in two versions: SynchroTeq MVR and SynchroTeq MVX respectively.

The SynchroTeq MV features a comprehensive set of Controlled Switching modes and performs significantly well in a variety of MV applications as shown in Table 1.

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 MV is a manufacturer agnostic solution suitable for 'DC controlled' switchgears and CBs or load break switches 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 Table 2.

Table 2 Circuit Breaker / Switchgear type vs load switching application

Load Switching Application	CB / 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. Likewise dual-single or triple-single recloser mechanisms may also be considered.

For example:

- SynchroTeq MVX is suitable for energizing a MV power transformer and features a dedicated control mode for a 3-p operated (or gang operated) switchgear or CB.
- In general, SynchroTeq MVR or SynchroTeq MVX in capacitor bank switching projects must be matched with 1-p operated switchgears, as well as with 3-p operated switchgears with pole-staggering, or with a relevant combination of unipolar switches or CBs.
- Both SynchroTeq MVR and SynchroTeq MVX are suitable for unipolar switchgears and loads in MV switching projects

1.1 Applications of SynchroTeq MV

The outstanding performance of SynchroTeq MV devices apply to a variety of MV switchgears – regardless of the make – and can be leveraged for optimized switching of shunt reactors, discharged and partially charged capacitors bank, harmonic filters and power transformers.

Among other applications, SynchroTeq MV is a powerful, communication-enabled intelligent electronic device (IED) suitable for:

Renewable Power Generation:

- Solar farms: energizing inverters' transformers for inrush current/voltage drop mitigation, improved power delivery, connection to the grid, grid code compliance.
- Wind: energizing power transformers in WTGs, advanced switching of feeders, 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.

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.

Industry:

- Electrical Arc Furnaces: transformer switching, MSC/MSR/FLT in SVC or STATCOM systems, reduction of switchgear wear, preservation and lifespan improvement of MV switchgears and transformers.
- Transportation & Railways: energizing power transformers for rectifiers and inverters in DC traction substations, MV capacitor banks for VAR Compensation.
- Oil&Gas: energizing power transformers with limited impacts of voltage disturbances/inrush currents on gensets, MV drives, power distribution. Capacitor bank switching.

MV Equipment / FACTS:

- Fast-switching of capacitor banks (MSC), shunt reactor switching (MSR), harmonic filters (FLT) combined with power electronics (i.e. hybrid STATCOMs).
- Energizing step-up transformers in Energy Storage Systems.
- Capacitors bank switches for PF Correction/VAR Compensation.
- Advanced MV switchgears for power transformer energization.

Power Grids:

- MV power transformers in substations
- Enhanced penetration of Renewable Energy
- Grid connection of DERs: waste-to-energy, CHP, etc.
- Capacitor bank switching

1.2 SynchroTeq MV highlights

For All MV Switchgears up to 69 kV[1]

- 3-p operated, w/ and w/o pole staggering
- 1-p operated (IPO)

Various Apps and Loads

- Discharged reactive loads
- Single or Three phase Transformers
- Advanced Switching of partially charged capacitor banks and filters w/ residual charge measurement
- Supports nominal grid frequency at 50 Hz or 60 Hz or $16^{2/3}$ Hz

Strong Engine, Web-based operation

- 500 events and waveforms storage
- Secured Web-Based interface

Best-in-class MV transformer energization

- MVX version w/ residual flux calculation
- For 1-p and 3-p operated Switchgears

Data transfer for SCADA / DCS (native protocols):

- IEC 61850 MMS server Ed.2 including XCBR control model
- DNP3.0
- Modbus-TCP (Slave)

NOTE [1] SynchroTeq MV functions with circuit breakers of any brand.

1.3 SynchroTeq MV units – Major features

Table 3 SynchroTeq MV major features

Features	SynchroTeq MVR	SynchroTeq MVX
CB coils control outputs	6x Coil control outputs (3x Open + 3x Close coils)	
AC current inputs	3x AC current measurement inputs (magnetic CT: 1 or 5 A) Optionally: 3x LPCT type, Rogowski coil, current sensor inputs (substituted to the 3 CT inputs)	
AC voltage input	1x AC voltage input for source voltage measurement	
Additional AC voltage inputs	N/A	3x AC voltage inputs for the measurement of the power transformer voltage or bus bar voltage for partially charged capacitors
Digital Inputs	10x digital inputs: • Three inputs for CB contact position (52a contacts) • Two inputs for CB or switchgear control (OPEN/CLOSE commands) • One input to set SynchroTeq MV Out of Service • One input to set SynchroTeq MV in Local / Remote mode • Three programmable inputs for CB monitoring and commands (with separate returns)	
DC measurement inputs with compensation function	2x DC measurement inputs with CB timing compensation function: • Temperature input (RTD or 4-20 mA from external sensor) • CB coil voltage input	
Signalization outputs	4x dry contact relay outputs: Alarms	
Power supply	24 V_{DC} or 48 V_{DC} or 110 V_{DC} or 125 V_{DC} or 220 V_{DC}	
Local user interface	• Two push buttons (rear and front panel) • Five LEDs (front panel) – Seven LEDs (rear panel)	
Communications ports	• 1x USB port • 2x 100Base-TX Ethernet • 1x RS-232 Serial port • 1x RS-485 Isolated Serial port	
Time synchronization	• NTP/SNTP time server on Ethernet • IEEE PTP 1588 clock source on Ethernet • IRIG-B clock source using the optional IRIG-B RWC0Y0001 module: ○ IRIG-B format selectable by software • Manual synchronization from PC computer	

Native protocols	• IEC 61850 M MS server Ed.2
	  ○ XCBR control
	  ○ Full dataset refreshed every second
	  ○ 4 predefined unbuffered reports
	  ○ 120 COMTRADE waveform retrieval.
	• DNP3.0
	• Modbus-TCP (Slave)	

Functional tools	• Event capture (up to 500 events including COMTRADE compatible waveform files) • SynchroTeq Event Analyzer • Secured web interface	
CB wear monitoring	• Electrical wear monitoring (i^2t) including warning and alarm function. • Mechanical wear monitoring including warning and alarm function	

1.4 Low energy analog sensor – Feature overview

1.4.1 Low energy analog voltage measurement

This feature, available on all SynchroTeq units delivered after March 31st, 2021, allows acquisition of both synchronization and load voltages (VS, VA, VB and VC) from very low voltage measurement levels.

This allows deploying SynchroTeq MV in applications using Low Energy Analog (LEA) voltage sensor such as capacitive or resistive voltage divider, commonly used in medium voltage switchgear applications.

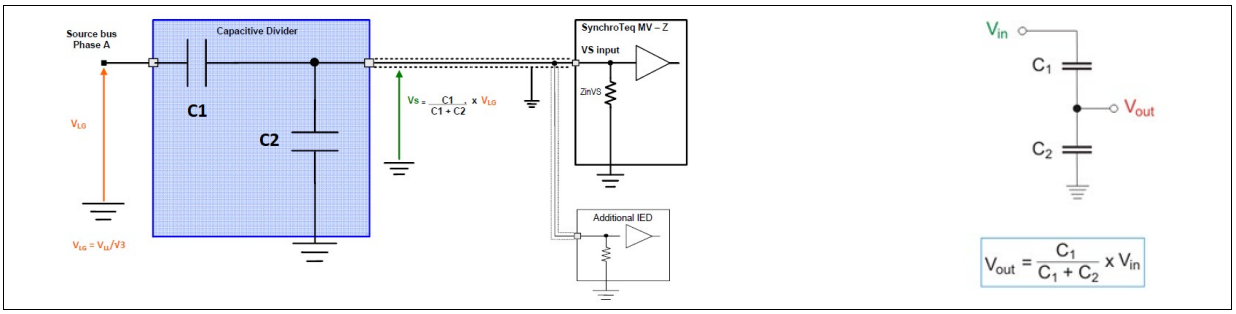


Figure 1 SynchroTeq MV – Example of capacitive voltage divider on VS input

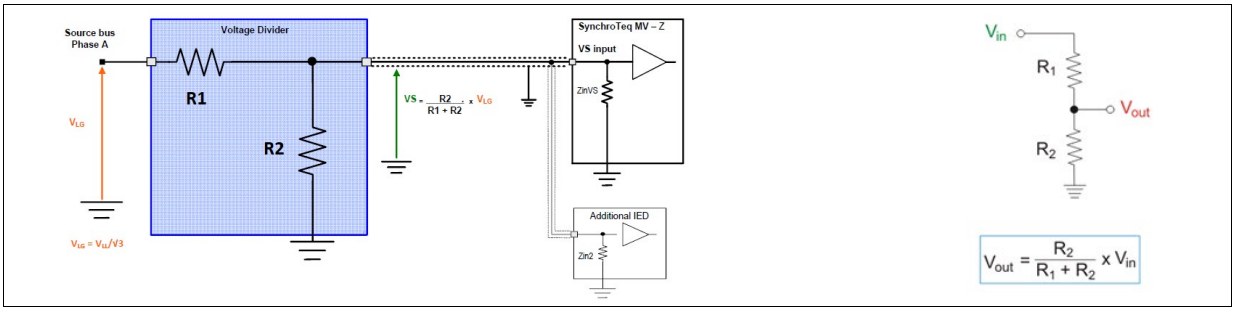


Figure 2 SynchroTeq MV – Example of resistive voltage divider on VS input

The LEA voltage feature offers 2 measurement input voltage ranges, and the associated gain is selectable by software:

- Low Gain used for up to 200 V_{AC} input measurement range (usually voltage transformer).
- High Gain used for low input voltage range, up to 20 V_{AC} maximum (capacitive or resistive voltage divider).

Input range configuration of source voltage (VS) and load voltage (VA, VB, VC) are independent.

1.4.2 Rogowski coil current measurement

NOTE This input type applies with special orders only. Please contact your Vizimax representative for more details.

This input type allows acquiring load currents (IA, IB and IC) from low power current transformer (LPCT) Rogowski type, instrument transformers.

This allows deploying SynchroTeq MV in applications using Low Energy Analog (LEA) sensors, commonly used in medium voltage switchgear applications.

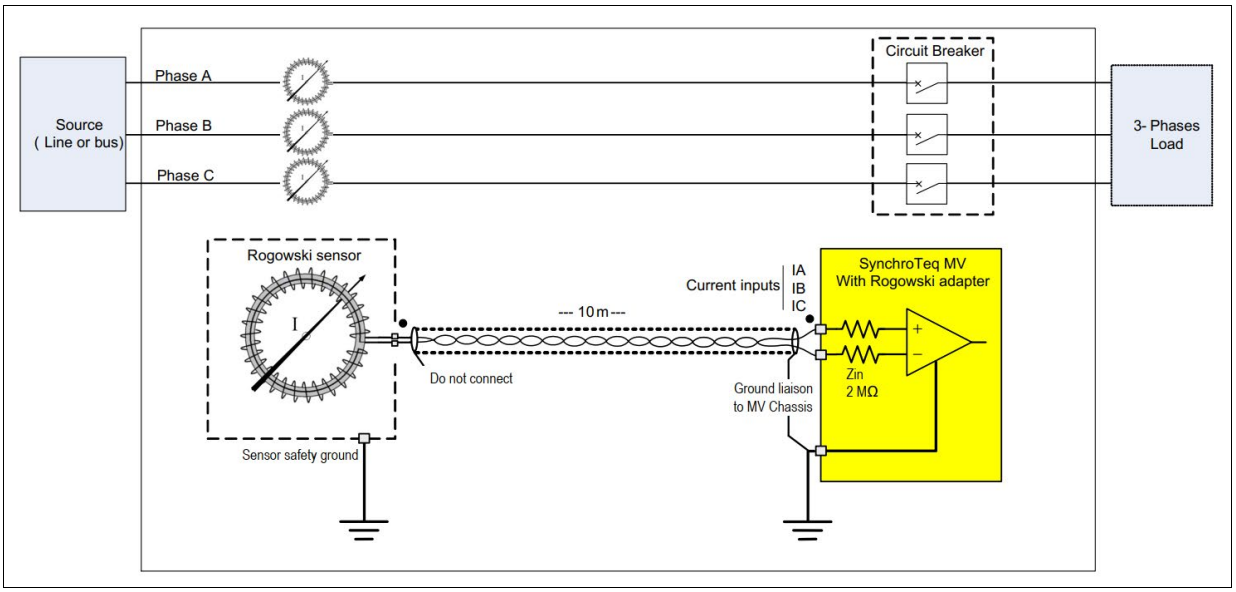


Figure 3 SynchroTeq MV – Example of Rogowski coil CT input (Special order)

SynchroTeq MV offers several measurement input ranges for each nominal frequency, allowing to support a wide range of Rogowski sensors commonly used in medium voltage switchgear. The input range (and the nominal system frequency) must be defined at SynchroTeq MV order and cannot be modified in the field.

The best appropriate range is calculated from the Rogowski sensor sensitivity (in mV/A), the nominal load current and the maximum clipping current (in PU).

Please refer to the smart coding document to calculate your appropriate input range.

NOTE Please note that Rogowski input type substitutes the standard magnetic CT inputs (connector L).

Vizimax offers several optional LEA adapters for current and voltage sensors (per phase cable with unterminated (open wire end) or with RJ45 female connector compatible with commonly used current and voltage sensors). Please refer to the smart coding document to select the STALxxx adapters fitting your current and voltage sensors.

1.5 Controlled switching

SynchroTeq MV units perform the controlled closing and/or opening of switchgear/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 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 dramatic reduction of inrush currents, voltage transients and stresses, improving the quality of power delivery and preserving the health/lifespan of all MV assets such as switchgears, switched loads (power transformers, reactive loads, cables), and sensitive equipment (generators, power electronics like inverters and drives).

When receiving a command (OPEN or CLOSE) SynchroTeq MV intercepts either a zero-crossing of the source voltage or a zero-crossing of the current, whichever is appropriate, for accurate switching synchronization. SynchroTeq MV 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 MV 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 MVX 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 MV power transformers through 1-p as well as through 3-p operated switchgears/CBs.
- **Partially charged Capacitors 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 C-O-C-O cycles in bursts without capacitor discharge).

1.6 Circuit breaker wear monitoring

SynchroTeq MV 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 MV offers two CB monitoring functions.

1.6.1 Electrical wear monitoring

For each phase, SynchroTeq MV measures the electrical wear of the CB at each operation (i^2t), including protection and local switching operations. 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.

1.6.2 Mechanical wear monitoring

SynchroTeq MV counts 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.

1.7 Operating environment

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

- DC power supply: uninterruptible power source for the substation / switchgear control and protection equipment.
- Controlled MV 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.

1.7.1 Switching a discharged capacitor bank or shunt reactor

SynchroTeq MVR 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.

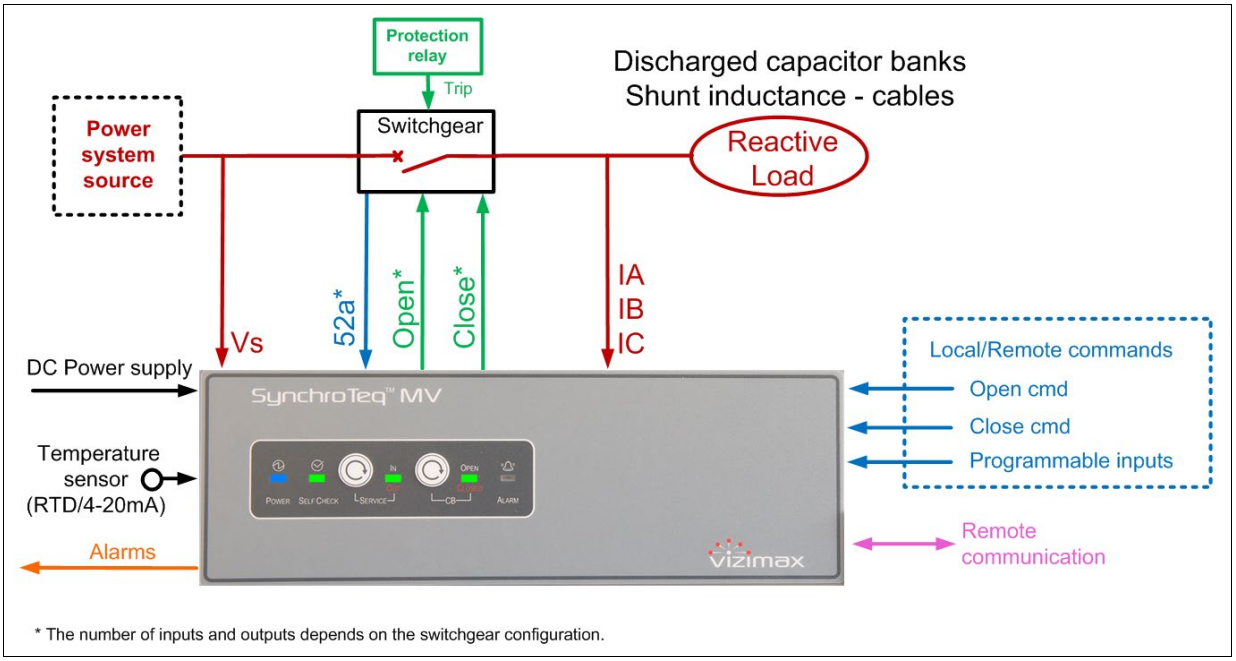


Figure 4 SynchroTeq MVR – Example of unit in discharged capacitor bank or shunt reactor

1.7.2 Energizing power transformers with residual flux management

SynchroTeq MVX 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 (Figure 5).

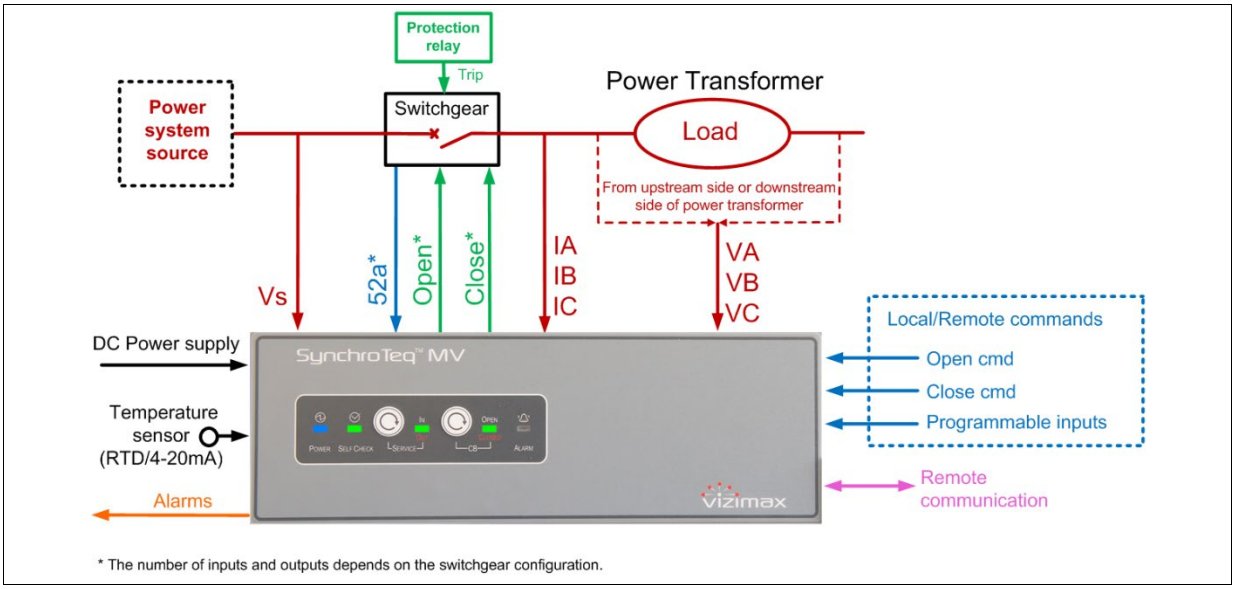


Figure 5 SynchroTeq MVX – Example of unit for energizing a power transformer

1.7.3 Switching a partially charged capacitor bank or filter

SynchroTeq MVX 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 (Figure 6).

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 MV (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 DI8), 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.

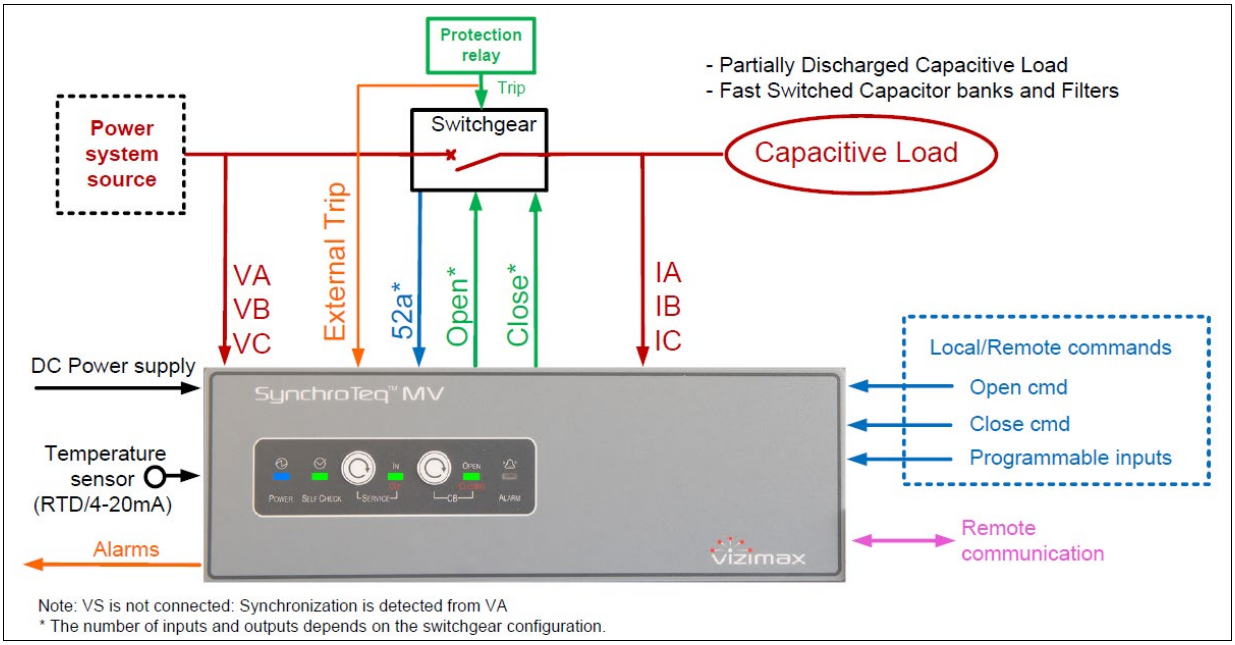


Figure 6 SynchroTeq MVX – Example of unit in fast switching of a capacitive load

The SynchroTeq MV 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, MVX output pulse duration of 50 ms, CB close time of 30 ms and open time of 20 ms.

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

1.8.1 Communication ports

All SynchroTeq MV units feature built-in communication ports for network integration and external devices:

- Two 100BASE-T Ethernet ports:
  - Ethernet-based Service Port
  - Ethernet-based general purpose network interface and IEC 61850 MMS
- Two serial communication ports:
  - One isolated RS-232/RS-485 port
  - RS-232 port for service operations

The communication ports are located on the rear panel, except for the Ethernet service port which is relocated to the front panel in the rack mount version.

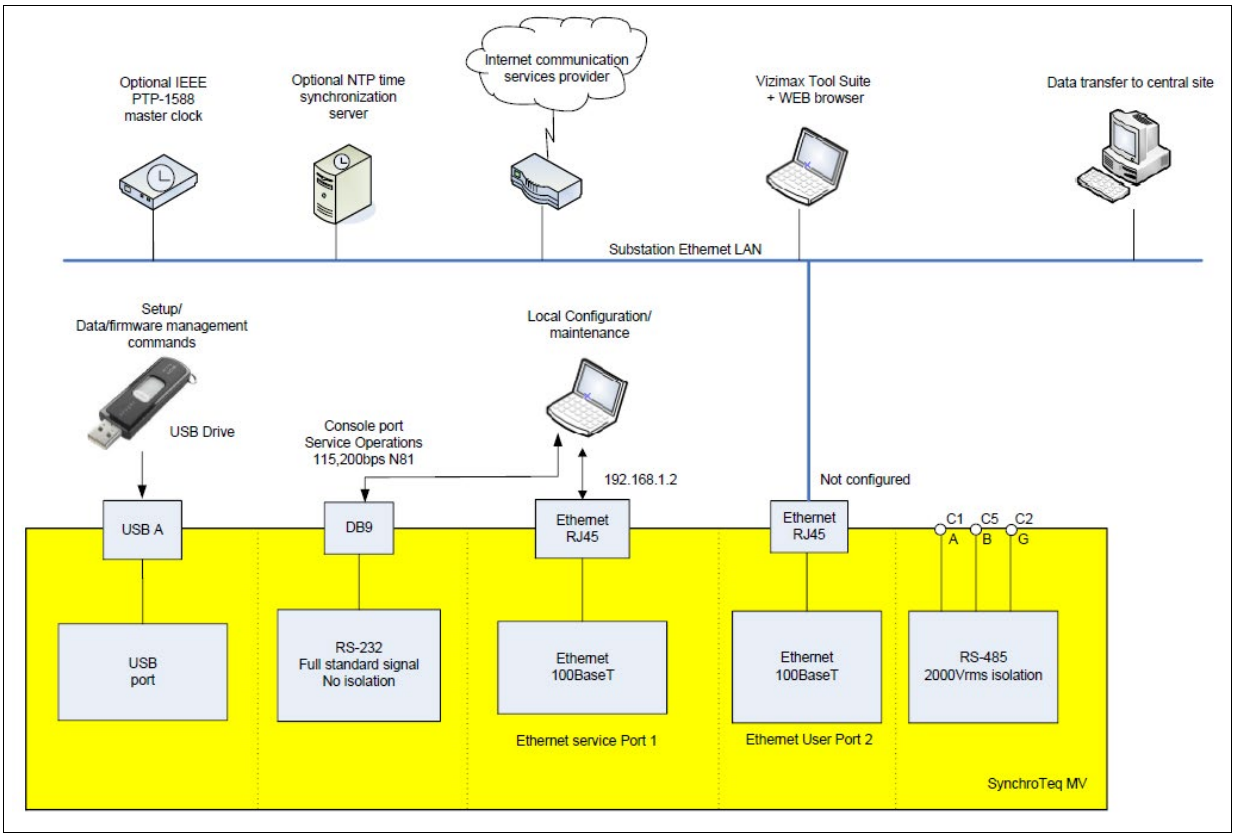


Figure 7 SynchroTeq MV communication ports

1.8.2 Time synchronization

SynchroTeq MV 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
- IRIG-B time synchronization protocol using the optional RWC0Y0001 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

Any one of these approaches allows the time stamping of recorded operational events for remote data analysis.

1.8.3 Front panel / Local HMI – Remote control

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

- The Vizimax Commissioning Tool (VCT) in remote mode
- Native substation automation protocols: IEC 61850 M MS 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.

1.8.4 Communications and data transfer solutions

SynchroTeq MV natively supports the following protocols:

- IEC 61850 MMS Server Ed.2 protocol (including the XCBR control model), for substation automation and SCADA system interfacing
- DNP3.0[1]
- Modbus-TCP (Slave)[1]

IEC 61850 protocol allows COMTRADE file transfer.

NOTE [1] Available with SynchroTeq firmware 2.3 and up.

1.9 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 firmware update or system backup.
- Local web based contextual help site including documentation in PDF format.

The Vizimax Commissioning Tool (VCT) is used to customize the operation of the SynchroTeq MV 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 MV unit. Typically, the configuration files are designed and managed offline on a maintenance PC and are uploaded to the SynchroTeq MV 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.

1.9.1 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 MV Web interface is secured (https://) and access is granted only to authenticated users.

The SynchroTeq Web interface is dedicated to system operation and alarm monitoring, event details 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 and electrical wear information.
- **Events**
  List of the most recent 500 events recorded and stored in the SynchroTeq MV.
- **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.

1.9.2 Events and waveform recording

At each switching operation, SynchroTeq MV records current and voltage waveforms including the CB interface signals (52a/Trip/Close/inputs/commands) over a period 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 transformers with RFC.

Waveform sampling rate is 80 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 MV's complete status and operating environment to allow for further detailed analysis. The SynchroTeq MV has a memory capacity of 500 events, including waveforms.

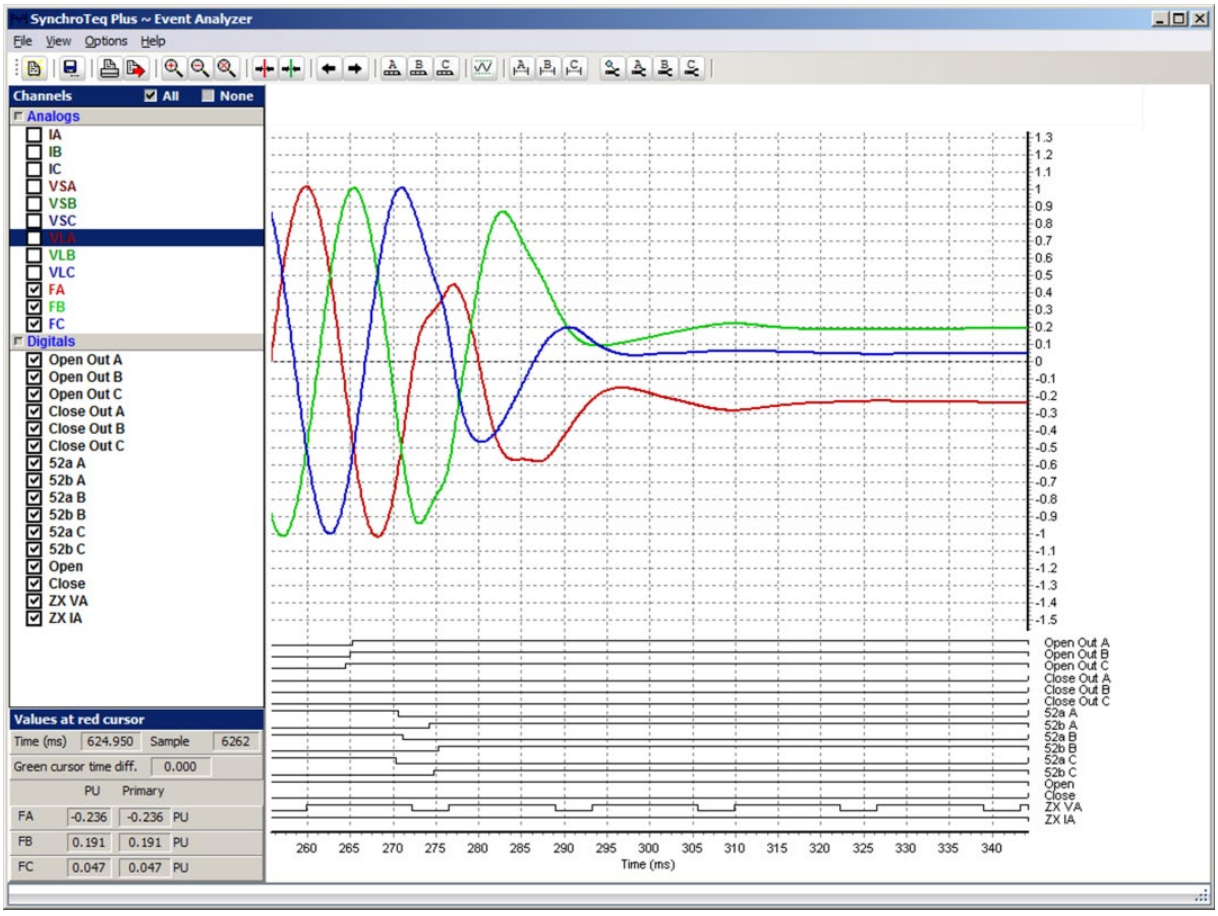


Figure 8 SynchroTeq MV – Vizimax event analyzer

1.10 SynchroTeq MV connectors and HMI identification

1.10.1 Back panel connectors identification

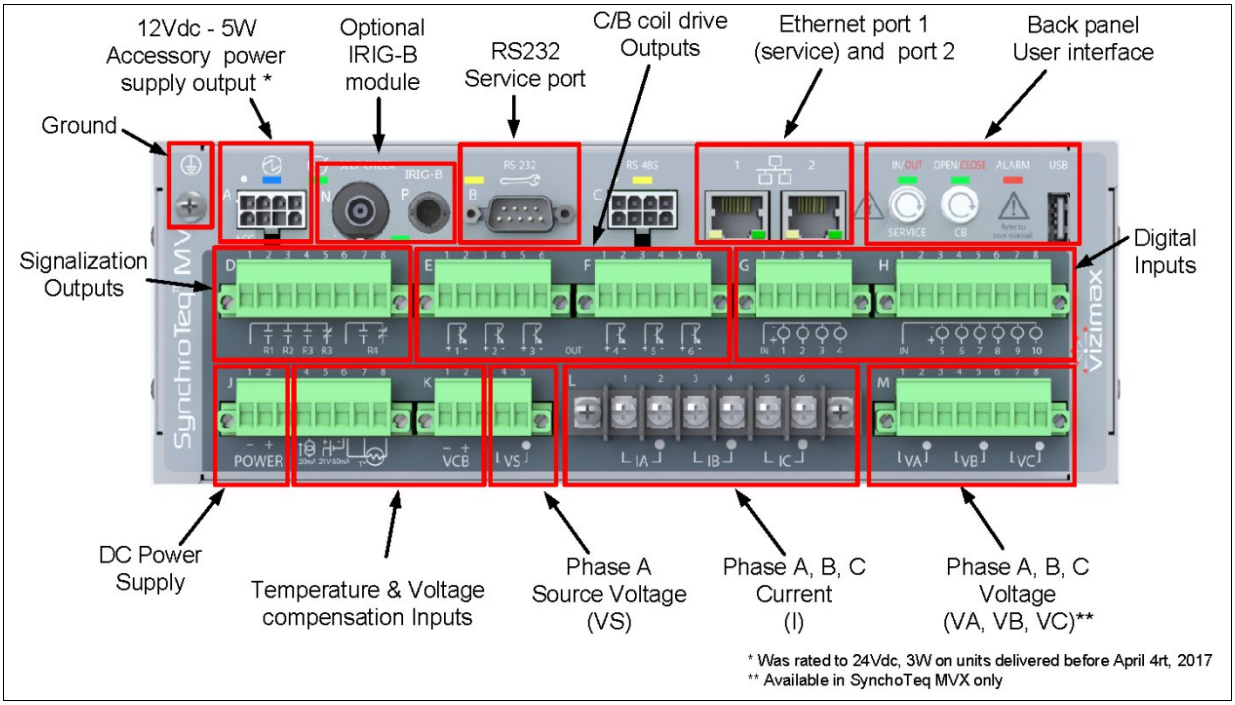


Figure 9 SynchroTeq MV back panel connectors identification

1.10.2 Front panel user interface

Figure 10 SynchroTeq MV front panel user interface

2 Technical specifications

2.1 Compliance and certifications

2.1.1 Test type

Table 4 SynchroTeq MV test type

Test type		Standard	Value
Temperature range		Operating temperature	-40 °C to +85 °C[1]
		Storage temperature	-50 °C to +85 °C
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		IEC 61010-1	2 km
Mechanical resistance to vibrations	Performance	IEC 60255-21-1	Class 2
	Endurance	IEC 60255-21-1	Class 1
Dielectric withstand	AC Inputs and I/Os	IEC 60255-5	2.2 kV_{AC}, 1 s
	Communication	IEC 60255-5	1.65 kV_{AC}, 1 s
Impulse voltage withstand		IEC 60255-5	5 kV
Electrostatic discharge (ESD)	Air discharge	IEC 61000-4-2	15 kV
	Direct contact discharge	IEC 61000-4-2	8 kV
Damped oscillatory wave (1MHz burst)	Common mode	IEC 60255-22-1	2.5 kV
	Differential mode	IEC 60255-22-1	1.0 kV
Fast transients (bursts)		IEC 60255-22-4	Level 4
RF Immunity		IEC 61000-4-3	20 V/m, from 80 MHz to 1 GHz
		IEC 60255-26	Spot Frequencies: 80 MHz to 2.15 GHz
		ANSI/IEEE 1613	10 V/m, from 1.4 GHz to 2.7 GHz
		SN62. 1008-1	3 V/m, from 5.15 GHz to 5.75 GHz
Conducted disturbance immunity		IEC 61000-4-6	150 kHz to 80 MHz
RF emissions		CISPR 11, CISPR 22, FCC	Class A
Safety		IEC 61010-1, 3rd ed. ISO 14971: 2012	Safety for measurement, control, and laboratory use

[1] Internal operating temperature; please refer to Table 5 SynchroTeq MV temperature test performance for more details.

2.1.2 Temperature test performances

Table 5 SynchroTeq MV temperature test performance

Test type		Standard	Value
Temperature type testing	Cold	IEC 60068-2-1	-40 °C (16 hours) after cold start at -50 °C
	Dry heat	IEC 60068-2-2	+75 °C (16 hours)
	Damp heat cyclic	IEC 60068-2-30	+55 °C at 95% RH (144 hours)
	UL Safety	IEC 61010-1	-40 °C to +70 °C

2.1.3 Mean time before failure (MTBF)

Table 6 SynchroTeq MV mean time before failure (MTBF)

Specification	Value
MTBF	28 years estimated

2.2 Power supply

The power supply is set in factory according to the ordering option.

Table 7 SynchroTeq MV power supply specifications

Parameter	Value
Power supply rating (24 V)	20 V_{DC} – 35 V_{DC}
Power supply rating (48 V)	36 V_{DC} – 72 V_{DC}
Power supply rating (110 V)	70 V_{DC} – 140 V_{DC}
Power supply rating (125 V)	70 V_{DC} – 140 V_{DC}
Power supply rating (220 V)	180 V_{DC} – 280 V_{DC}
Rated power	15 W max. (typical 9 W, 0.07 A @ 125 V_{DC}) – Idle 6 W • The external power supply must be able to sustain a 6 A cold start current for 50 ms at unit start up.[1]
Connector	Phoenix MSTB 5.08 mm
Isolation	3 kV during 1 second
Fuse	Time delay, 2 x 2 A (not user serviceable)
Voltage interrupt (max)	100 ms @ 100%
[1] The DC power supply includes a power reserve capable of sustaining a 100 ms power interruption. The energy storage components may induce a 6 A cold start current for 50 ms at unit start up. The external power supply must be able to sustain this inrush current when energizing.	

2.2.1 Accessory power supply output

SynchroTeq MV offers an accessory power supply output rated at 12 V_{DC}, 5 W maximum and internally referred to the chassis (protective earth).

Table 8 SynchroTeq MV accessory power supply output specifications

Parameter	Value
Power supply rating (12 V)	5 Watts maximum recommended load

NOTE The auxiliary power supply was rated at 24 V_{DC}, 3 W for units manufactured before April 4th, 2017.

2.3 Control – Time synchronization – Communication

2.3.1 Controller

Table 9 SynchroTeq MV controller and time synchronization specifications

Parameter	Value
Main processor	32-bit, 400 MHz high performance ARM processor
OS	Linux
Memory	512 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 36 hours without power (no battery required)
RTC synchronization	IRIG-B protocol using the optional RWC0Y0001 module LAN synchronization: NTP/SNTP or IEEE 1588
I/O board controller	32-bit, 168 MHz ARM processor with RTOS. 16-bit ADC.
Field upgrade	Field upgradable firmware available from Vizimax web site, support section

2.3.2 Local user interface

Table 10 SynchroTeq MV local user interface features

Parameter	Value
Two push buttons (back and front panel)	Open/Close In/Out of Service
Seven LEDs (back panel)	Service, CB position, Communication activity (2x), System status, Alarms and Power.
Five LEDs (front panel)	Service, CB position, System status, Alarms and Power.

2.3.3 Optional IRIG-B time synchronization module (RWC0Y0001)

Table 11 SynchroTeq MV optional IRIG-B time synchronization module specifications

Specification	Value
Typical base inaccuracy	≤10 µs
IRIG-B DCLS (Un-modulated) over fiber optic ST type (connector N)	Frequency range: 820 – 850 nanometers Base inaccuracy ≤1.0 µs + source inaccuracy
IRIG-B DCLS (Un-modulated) on BNC BNC type (connector P)	Input impedance: Zin = 500 Ω Input level: 2.5 V to 5.0 V_{DC} Base inaccuracy ≤10.0 µs + source inaccuracy
Voltage isolation level	500 V_{DC}
IRIG-B formats (selectable by software)	• IRIG-B000/B004 IEEE-C37.118 (default setting) • IRIG-B000/B004 IEEE-1344 • IRIG-B003

2.3.4 Communication ports

Table 12 SynchroTeq MV communication ports specifications

Port	Characteristics	Value
USB port (back panel)	Interface compatibility	2.0
	Maximum speed	480 Mbit/s
	Connector type	Type A
	Voltage isolation level	N/A
100BASE-T Ethernet 1 (Service port)	Interface	10/100 Mbps
	Connector	RJ-45
	Isolation	1.5 kV_{rms}
	Name	Port 1
	Function	Initial unit configuration and setup
100BASE-T Ethernet 2 (User communication link)	Interface	10/100 Mbps
	Connector	RJ-45
	Isolation	1.5 kV_{rms}
	Name	Port 2
RS-232 Serial	Function	Console port, service Operations
	Connector	DB-9 (connector B)
	Bit rate	115 kbps
RS-485 Isolated serial	Function	General purpose
	Connector	Molex Mini-Fit junior (connector C)
	Bit rate	38.4 kbps
	Mode	Two wire interface (A-B) with jumper selectable 120 Ω terminations. Reference wire (0 V) provided for high common mode voltage capability
	Isolation	2 kV_{rms}

2.3.5 Native protocols

Table 13 SynchroTeq MV native protocols specifications

Protocol	Characteristics
IEC 61850 MMS server Ed.2	• XCBR control • Full dataset refreshed every second • 4 predefined unbuffered reports • 120 COMTRADE waveform retrieval.
DNP3.0	• CB control • SynchroTeq status[1] • Alarms1 • 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 measurement inputs

SynchroTeq MV measures the following AC signals from current and voltage sensors:

Source voltage (VS) Phase A

This measurement is taken from a voltage sensor located on phase A of the source side. This signal is used for the CB operation synchronization and frequency measurement. Example of supported measurement devices (VS):

- Voltage measurement transformer (Output usually rated from 69 to 120 V_{AC})
- Resistive voltage divider (direct connection) Low Energy Analog sensor usually rated from 2.0 to 10 V_{AC}
- Capacitive voltage divider (direct connection) from VDS/VPI device and usually rated around 7.0 $V_{AC.}$

Phase A, B and C load current (IA, IB and IC)

These measurements are taken from current sensor located on either side of the switchgear to measure the load current for excessive inrush current detection, switchgear electrical closing time calculation and switchgear opening synchronization (Phase A). These inputs can be connected to either protection or measurement CTs.

Alternately, (special order applies) magnetic CT inputs can be substituted by low power current measurement inputs for Rogowski type coil instrument transformers (LPCT, *low power current transformer*). Several input measuring ranges are offered to cover a wide range of nominal current / LPCT combinations.

Phase A, B and C voltage (VA, VB and VC) (SynchroTeq MVX only)

These measurements are taken from voltage sensors located on the power transformer's primary or secondary winding to measure the power transformer voltage in order to calculate the residual flux resulting from transformer de-energization. When energizing the transformer, the residual flux calculation is used to reduce the inrush current to a magnitude comparable to the magnetization current by automatically adjusting the closing angle.

For capacitive load switching applications (partially discharge capacitor bank or harmonic filters, cables) with fast switching capability, these measurements are used to measure phase A, B and C of the source side. Example of supported measurement devices (VA, VB and VC):

- Voltage measurement transformer (Output usually rated from 69 to 120 V_{AC})
- Resistive voltage divider (Direct connection) Low Energy Analog sensor usually rated from 2.0 to 10 V_{AC}.
- Capacitive voltage divider (Direct connection) from VDS/VPI device and usually rated around 7.0 V_{AC}.

NOTE Low energy voltage divider measurement device can be used for fast switching of capacitor banks applications (SynchroTeq MVX) only through Firmware 1.15.2 and up.

2.4.1 AC current measurement inputs: Magnetic CT

Table 14 SynchroTeq MV AC current measurement inputs: magnetic CT specifications

Parameter		Value
Name		IA, IB and IC (connector L)
Number of inputs		3
Connector type		Barrier strip, screw type 14 AWG – 2.5 mm²
Rated current (In)		50 mA to 12.5 A (usual measurement CT are rated to 1 A, 5 A)
Thermal capacity (1 minute)		30 A
Measurement category		MEAS CAT IV
Maximum burden @ rated current		0.50 VA
Isolation		3 kV_{rms}
Asymmetrical current		80% after 100 ms
Nominal frequency		50 Hz or 60 Hz or $16^{2/3}$ Hz
Measurement bandwidth (-3 dB)		4 Hz to 4 kHz
Sampling frequency		80 samples/cycle (at nominal frequency)
Conversion resolution		16-bit
Accuracy		±0.4% (±60 ppm/°C)
Zero crossing detection	Range (frequency)	10 to 70 Hz
	Minimum current	50 mA
	Accuracy	10 µs
Insensitivity to harmonic contents		Up to 25% of 'In' for 2nd to 10th harmonics

2.4.2 AC current measurement inputs: Rogowski option (special order applies)

Table 15 SynchroTeq MV AC current measurement input: Rogowski option specifications

Parameter	Value
Name	IA, IB and IC (connector L)
Number of inputs	3
Connector type	Barrier strip, screw type (RJ45 adapter available) 14 AWG / 2.5 mm²
Maximum measuring range at clipping (to be specified at order)	Please refer to the smart coding document to calculate your appropriate input range.
Measurement category	MEAS CAT IV
Rated burden	2 MΩ // 50 pF (IEC61869-1:2023)
Isolation	1 kV_{rms}
CMRR	90 dB
Accuracy	±0.4% (±60 ppm/°C)
Zero crossing detection. Min. level	1.0% of clipping value (ex: 12 mV for a clipping range of 1200 mV)

2.4.3 AC source voltage measurement input (VS)

Table 16 SynchroTeq MV AC source voltage measurement input (VS) specifications

Parameter		Value	
Name		VS (connector K)	
Number of inputs		1	
Connector type		Phoenix MSTB 5.08 mm, pluggable screw type AWG 13-24 (2.5 mm^2 – 0.2 mm^2)	
Rated voltage (Vn)		2 measurement ranges selectable by software: • 0-200 V_{AC} with 'low gain' setting. (usual measurement PT are rated to 69 V_{AC}, 110 V_{AC}, 120 V_{AC}) • 0-20 V_{AC} with 'High gain' setting. (Low Energy Analog sensors typically rated between 2.0 and 10 V_{AC})	
Thermal capacity		300 V_{AC} (No time limit)	
Measurement category		MEAS CAT IV	
Maximum burden		0.005 VA[1]	
Isolation		2 kV_{rms} – 1 min	
Nominal frequency		50 Hz or 60 Hz or $16^{2/3}$ Hz	
Measurement bandwidth (-3 dB)		DC to 4 kHz	
Sampling frequency		80 samples/cycle (at nominal frequency)	
Conversion resolution		16-bit	
Accuracy		±0.3% (±50 ppm/°C)	
Zero crossing detection	Range (frequency)	10 to 70 Hz	
	Minimum voltage	Default (static)	40 V_{AC}
		'DynamicZX' = ON	4 V_{AC} @ Low gain
			0.4 V_{AC} @ High gain
	Accuracy	10 µs	
Insensitivity to harmonic contents		Up to 50% of Vn for 2nd to 10th harmonics	
Input impedance and rated burden		10.58 MΩ (common mode) / 21.2 MΩ (differential mode) Caution: units manufactured before April 4th, 2017, have input impedance of 1 MΩ only and cannot be used with capacitive voltage divider.[2]	
Common mode voltage range		700 V_{AC}	
Common mode rejection ratio		65 dB in 'low gain' setting (0-200 V_{AC} measuring range) 55 dB in 'high gain' setting (0-20 V_{AC} measuring range)	

[1] Please take note the burden of this input is very low. In case of lightly loaded PT or a non-standard PT, a parallel resistance of 5 KΩ (10 watts or more) must be added on this input

[2] When used in the high gain (0-20 V_{AC}) mode, the voltage input is fully compliant with burden of 2 MΩ // 50 pF (IEC61869-1:2023)

2.4.4 Additional AC voltage measurement inputs (SynchroTeq MVX only)

Table 17 SynchroTeq MV additional AC voltage measurement inputs specifications

Specifications			Value
Name			VA, VB and VC (connector M)
Number of inputs			3
Connector type			Phoenix MSTB 5.08 mm, pluggable screw type AWG 13-24 (2.5 mm^2 – 0.2 mm^2)
Rated voltage (Vn)			2 measurement ranges selectable by software: • 0-200 V_{AC} with “low gain” setting. (usual measurement PT are rated to 69 V_{AC}, 110 V_{AC}, 120 V_{AC}) • 0-20 V_{AC} with “High gain” setting. (Low Energy Analog sensors typically rated between 2.0 and 10 V_{AC})
Thermal capacity			300 V_{AC} (No time limit)
Measurement category			MEAS CAT IV
Maximum burden			0.005 VA[1]
Isolation			2 kV_{rms}
Nominal frequency			50 Hz or 60 Hz or $16^{2/3}$ Hz
Measurement bandwidth (-3 dB)			DC to 4 kHz
Sampling frequency			80 samples/cycle (at nominal frequency)
Conversion resolution			16-bit
Accuracy			±0.3% (±50 ppm/°C)
Zero crossing detection (Applicable only when signal is used as synchronization signal)	Range (frequency)		10 to 70 Hz
	Minimum voltage	Default (static)	40 V_{AC}
		‘DynamicZX’ = ON	4 V_{AC} @ Low gain
			0.4 V_{AC} @ High gain
	Accuracy		10 µs
Insensitivity to harmonic contents			Up to 50% of Vn for 2nd to 10th harmonics
Input impedance and rated burden			10.58 MΩ (common mode) / 21.2 MΩ (differential mode) Caution: units manufactured before April 4th, 2017, have input impedance of 1 MΩ only and cannot be used with capacitive voltage divider.[1]
Common mode Voltage range			700 V_{AC}
Common mode rejection ratio			65 dB in “low gain” setting (0-200 V_{AC} measuring range) 55 dB in “high gain” setting (0-20 V_{AC} measuring range)

[1] When used in the high gain (0–20 V_{AC}) mode, the voltage input is fully compliant with burden of 2 MΩ/50 pF (IEC61869-1:2023).

NOTE Please take note the burden of this input is very low. In case of lightly loaded PT or a non-standard PT, a parallel resistance of 5 kΩ (10 watts or more) must be added on this input.

2.5 DC measurement inputs with compensation function

SynchroTeq MV performs the following functions:

- Monitor CB operating temperature using a 4-20 mA loop powered sensor or a 100 Ohm Platinum RTD sensor installed in the CB mechanical housing. SynchroTeq MV provides an isolated 24 V_{DC} power supply for an external 4-20 mA conditioner when a remote sensor is used. The sensor has programmable limits to define out of range alarms.
- Monitor the CB DC control voltage using a 0-300 V isolated analog input.

The CB operating time prediction can be influenced by both the ambient temperature and the CB DC control voltage. With compensation functions enabled, SynchroTeq MV automatically adjusts the OPEN/CLOSE coil commands according to the predicted time to operate the CB at the optimal point on the wave. CB timing compensation curves are defined in the SynchroTeq MV configuration file.

2.5.1 Temp. monitoring input with compensation (user selectable, Pt100 RTD or 4-20 mA)

Table 18 SynchroTeq MV temperature monitoring input with compensation specifications

Parameter		Value
Name		RTD/4-20 mA (connector J)
Number of inputs		1
RTD	Range	-50 °C to +100 °C
	Accuracy	±0.8 °C (±200 ppm/°C)
4-20mA	Range	4-20 mA
	Accuracy	±0.4% (±40 ppm/°C)
Sensor supply		21 V – 50 mA output for current loop supply
Connector		Phoenix MSTB 5.08 mm, pluggable screw type
Measuring category		MEAS CAT IV
Input impedance		Current (4-20 mA): 15 Ω
Resolution		16-bit
Update rate		1 update/s

2.5.2 CB coil DC voltage monitoring input with compensation function

Table 19 SynchroTeq MV CB coil DC voltage monitoring input with compensation

Parameter	Value
Name	VCB (connector K)
Number of inputs	1
Rated voltage	0-300 V_{DC}
Connector	Phoenix MSTB 5.08 mm, pluggable screw type
Input impedance	21.2 MΩ differential, 10.58 MΩ common
Measuring category	MEAS CAT IV
Accuracy	±0.3% (±50 ppm/°C)
Resolution	16-bit
Update rate	1 update/s
Common mode voltage range	700 V_{AC}
Dielectric test	2 kV_{rms} – 1 min

2.6 Digital inputs/outputs

2.6.1 Digital inputs

SynchroTeq MV provides 10 opto-isolated digital inputs distributed in two isolated groups:

- Three inputs for CB position (52a contacts)
- Two inputs for the control of the CB (OPEN/CLOSE commands)
- Five programmable inputs for CB monitoring and commands with separate returns

Table 20 SynchroTeq MV digital inputs specifications

Parameter	Value
Name	DI 1 to 10 (connectors G-H)
Number of inputs	10 (6+4)
Maximum input voltage (24 V power supply)	30 V_{DC}, (detection threshold 16 V_{DC})
Maximum input voltage (48 V power supply)	72 V_{DC}, (detection threshold 28 V_{DC})
Maximum input voltage (110 V power supply)	Max: 140 V_{DC} Threshold: 52a inputs: 56 V_{DC} Threshold: all other inputs: 69 V_{DC} (±10%)
Maximum input voltage (125 V power supply)	Max: 140 V_{DC} Threshold: 52a inputs: 66 V_{DC} Threshold: all other inputs: 74 V_{DC} (±10%)
Maximum input voltage (220 V power supply)	Max: 280 V_{DC} Threshold: 52a inputs: 113 V_{DC} Threshold: all other inputs: 137 V_{DC} (±10%)
Isolation	Opto-coupler, 2 kV_{rms}
Measuring category	MEAS CAT IV
Burden	2 mA to 5 mA
Maximum hardware response time	0.10 ms at nominal voltage[1] 1.00 ms at 80% of nominal voltage
Software filter	Programmable, 5 ms increments up to 250 ms
Connector	Phoenix MSTB 5.08 mm, pluggable screw type.
[1] For 3-phase switchgear with simultaneous pole operation or staggered pole operation with single 52a auxiliary contact, this contact must be wired on DI1 and chained in parallel on DI2 and DI3 for proper operation of several major SynchroTeq features.	

NOTE Digital inputs operating range is set according to the ordered power supply operating range.

2.6.2 CB coils control outputs

SynchroTeq MV has potential free and isolated solid state coil driver outputs to control the opening and closing of the switchgear or CB.

SynchroTeq MV unit has 3 CLOSE and 3 OPEN outputs allowing the control of three phase independent pole operated switchgear.

Since the outputs are floating type, they can either source coil current (coil common to 0 V supply) or sink coil current (coil common to +DC supply).

NOTE SynchroTeq MV unit only supports 'DC controlled' switchgear / circuit-breakers.

Table 21 SynchroTeq MV digital output specifications

Specifications	Value
Name	Out 1 to 6 (connectors E-F)
Number of outputs	6 (3+3)
Output driver technology	Solid State, Select Before Operate (SBO)
Rated voltage	20 V_{DC} – 280 V_{DC}
DC rated output current	5 A DC continuous 22 A for 1 s 35 A for 200 ms 70 A pulsed 10 ms
Maximum breaking current	7 A @ L/R=40 ms
Type	Independent, sourcing or sinking outputs
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]
Isolation	2 kV_{rms}
Over voltage category	OVC CAT III
Connector	Phoenix MSTB 5.08 mm, pluggable screw type.

[1] For 3-phase switchgear with simultaneous pole operation or staggered pole operation with single mechanism, wire the control outputs from phase A only.

2.6.3 Important note on the CB operating time accuracy

In the SynchroTeq unit, 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 his 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 of 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 unit 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 MV can compensate for the ambient temperature variation, and the DC coil voltage variation. Also, the SynchroTeq MV 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 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:**

- ±2 ms for the ambient temperature variation
- ±0.3 ms for the mechanical scatter
- ±0.01 ms for the SynchroTeq unit

2.6.4 Signalization relay outputs

SynchroTeq MV offers 4 dry contacts digital outputs for alarming and status signalization. The outputs are arranged in two isolated groups with the following functions:

- **R1**: Out of service/Fatal alarm, form A
- **R2**: CB Temperature or CB DC control voltage monitoring alarm, form A
- **R3**: CB Operation limits and inrush current alarm, form C
- **R4**: System OK (watchdog), form C. The NC contact is used to indicate that the system is failed.

Table 22 SynchroTeq MV signalization relay outputs specifications

Specifications	Value
Number of outputs	R1 to R4 2x form A and 2x form C dry contact outputs (connector D)
Type	Electromechanical relays
Maximum steady AC current	3 A maximum at 250 V_{AC}
Maximum steady DC current	0.3 A maximum at 250 V_{DC}
Contact ratings	250 V_{AC}, 300 V_{DC}
Contact breaking capacity	10 A at 250 V_{AC} 8 A @ 30 V, 0.5 A @125 V, 0.3 A at 250 V_{DC}
Isolation	5 kV_{rms} (coil to contacts)
Over voltage category	OVC CAT III
Connector	Phoenix MSTB 5.08 mm, pluggable screw type.

2.7 Functional analysis tools

2.7.1 Waveform capture

Table 23 SynchroTeq MV waveform capture specifications

Parameter	Value
Memory capacity	Up to 500 events (waveforms are stored in events)
Capture trigger	CB commands from SynchroTeq MV (OPEN and CLOSE) Voltage changes on switched side of CB (for power transformer applications) Manual trigger using snapshot capture
Sampling rate	80 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.
Recorded signals	Voltage on unswitched side of CB (1) Load current (3) Option: power transformer application (3) CB control commands (3 x Open, 3 x close) CB position contacts (3 x 52a) SynchroTeq MV command inputs (OPEN and CLOSE) User programmable digital inputs (5) Phase A synchronization (1 x I, 1 x V)

2.7.2 Event memory

Table 24 SynchroTeq MV event memory features

Parameter	Value
Memory capacity	500 events, including waveforms when applicable
Recording trigger sources	CB commands from SynchroTeq MV Voltage changes on switched side of CB (for 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 MV (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 of 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
Time tagging synchronization	NTP/SNTP time server on Ethernet IEEE PTP 1588 clock source on Ethernet IRIG-B protocol using the optional RWC0Y0001 module Manual synchronization from PC computer

3 Mounting configurations

SynchroTeq MV is available with three mounting configurations:

- 19″ Rack mount (RM model, with a 19″ face plate)
- Panel mount (PM model, with a 12″ front panel)
- Standard mount (SM model, without face plate)

The SynchroTeq MV shoud 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 25 SynchroTeq MV physical dimensions

Specifications	Value
Width	257 mm/10.125 in for standard mount 305 mm/12 in for panel mount 483 mm/19 in for Rack mount
Height	92 mm/3.6 in for standard mount 105 mm/4.1 in for panel mount 3U: 132.5 mm/5.22 in for Rack mount installation
Depth	134 mm/5.25 in
Weight	Standard mount 3.0 kg (6.6 lb) Panel mount 3.3 kg (7.3 lb) Rack mount 3.6 kg (8 lb)

3.2 Standard mount (no face plate)

The SynchroTeq MV standard mount (SM model) is dedicated for a direct mounting inside a MV switchgear housing. It includes movable mounting brackets for multiple mounting positions (horizontal or vertical).

NOTE SynchroTeq MV ‘SM model’ does not include front panel interface. All connectors, ports, LEDs and command push buttons are located on the rear panel.

Figure 11 SynchroTeq MV standard mount configuration (SM model)

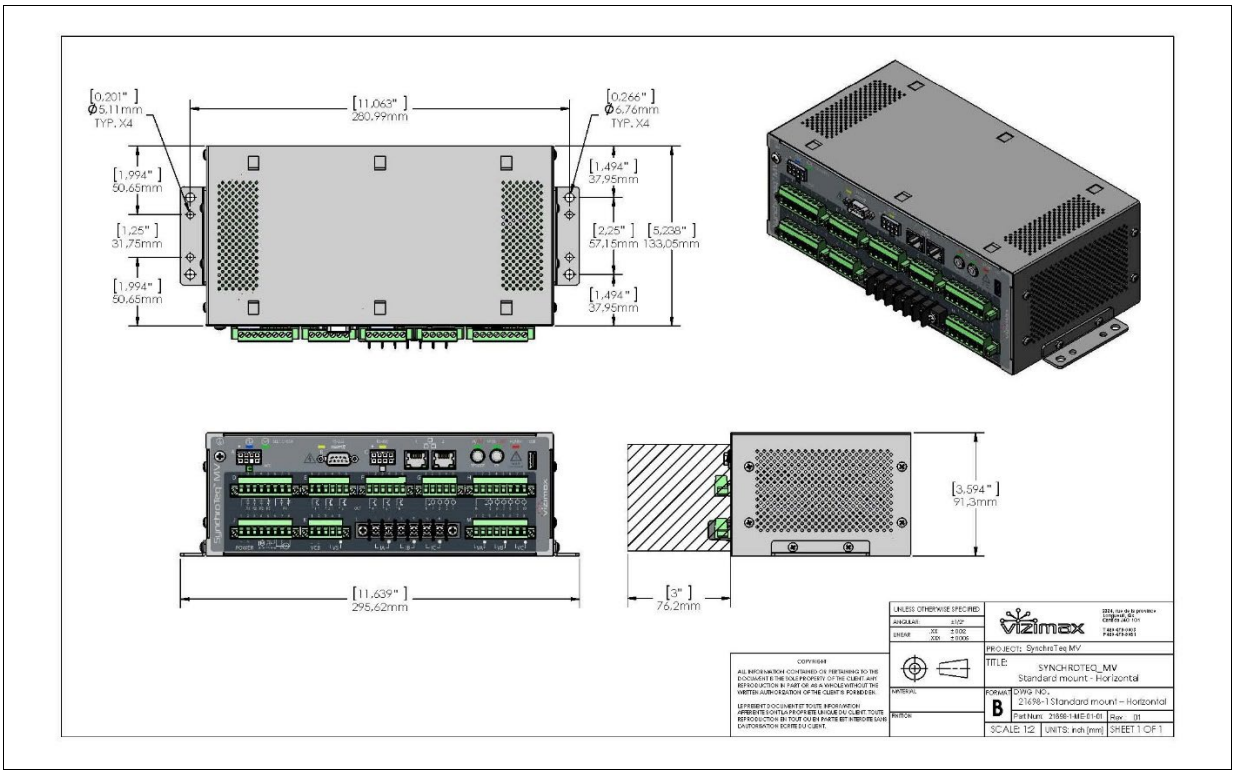


Figure 12 SynchroTeq MV standard mount – horizontal

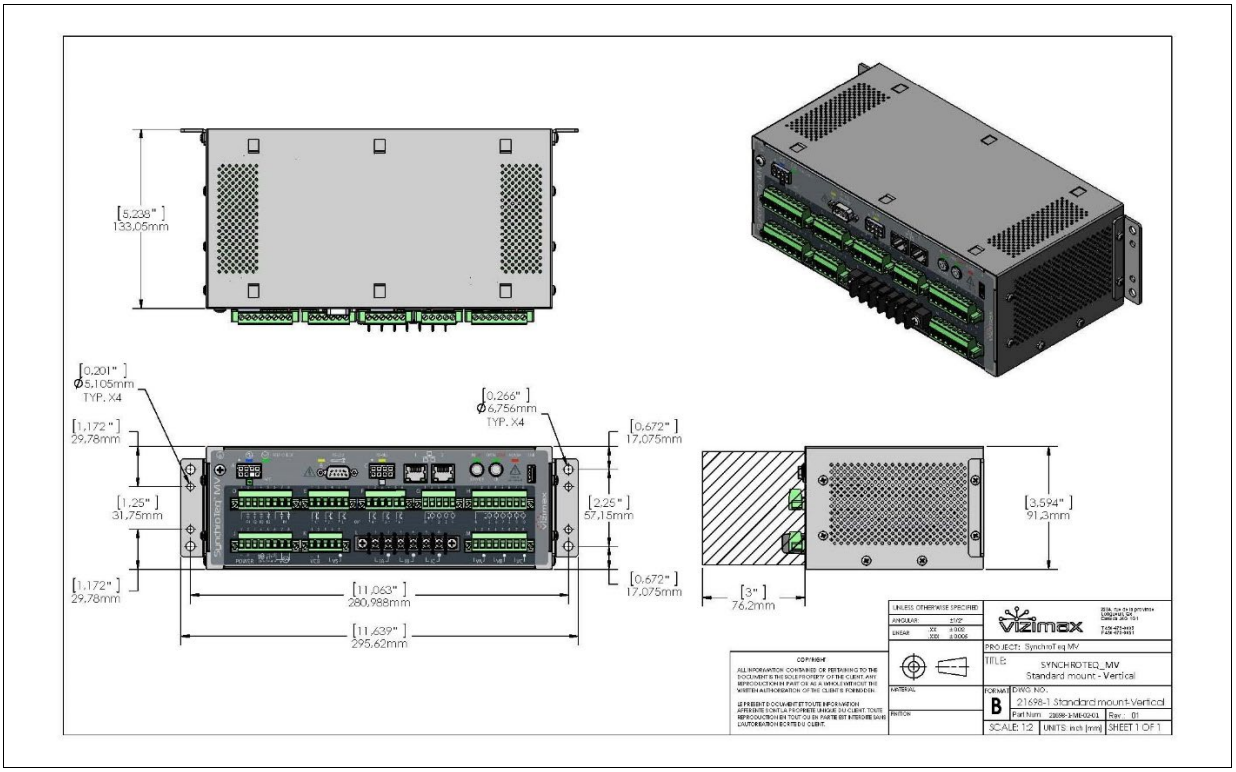


Figure 13 SynchroTeq MV standard mount – vertical

3.3 Panel mount (12" face plate)

The SynchroTeq MV Panel Mount (PM model) is for mounting to a metallic panel or swing door inside a breaker control or a switchgear housing. The mounting brackets are supplied with the unit. The front panel face plate is 104.14 x 304.8 mm (4.1 x 12.0 in).

Figure 14 SynchroTeq MV panel mount (PM model)

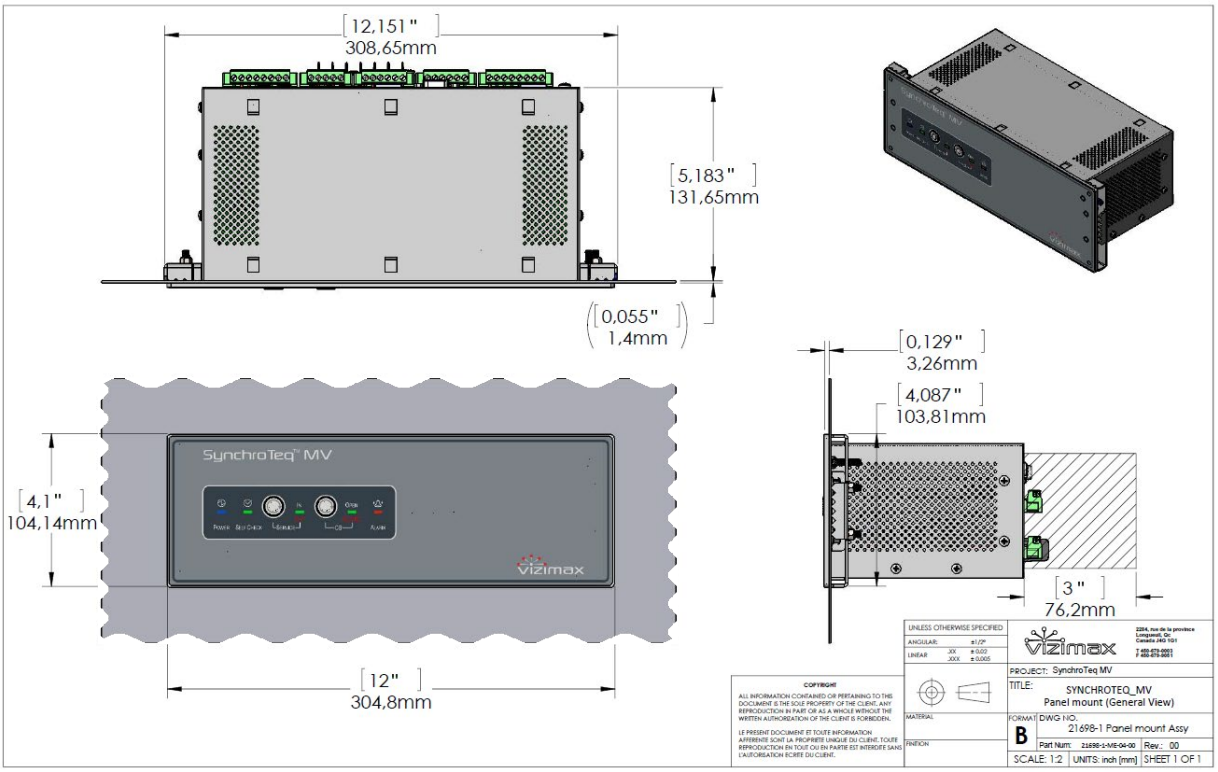


Figure 15 SynchroTeq MV panel mount dimensions

3.4 Rack mount (19" face plate)

The SynchroTeq MV rack mount (RM model) is for mounting on an EIA 482.6 mm (19 in) rack in the MV switchgear. Panel size: 3U standard panel (5.219 x 19 in).

In this configuration, the Ethernet service port is relocated on the front panel.

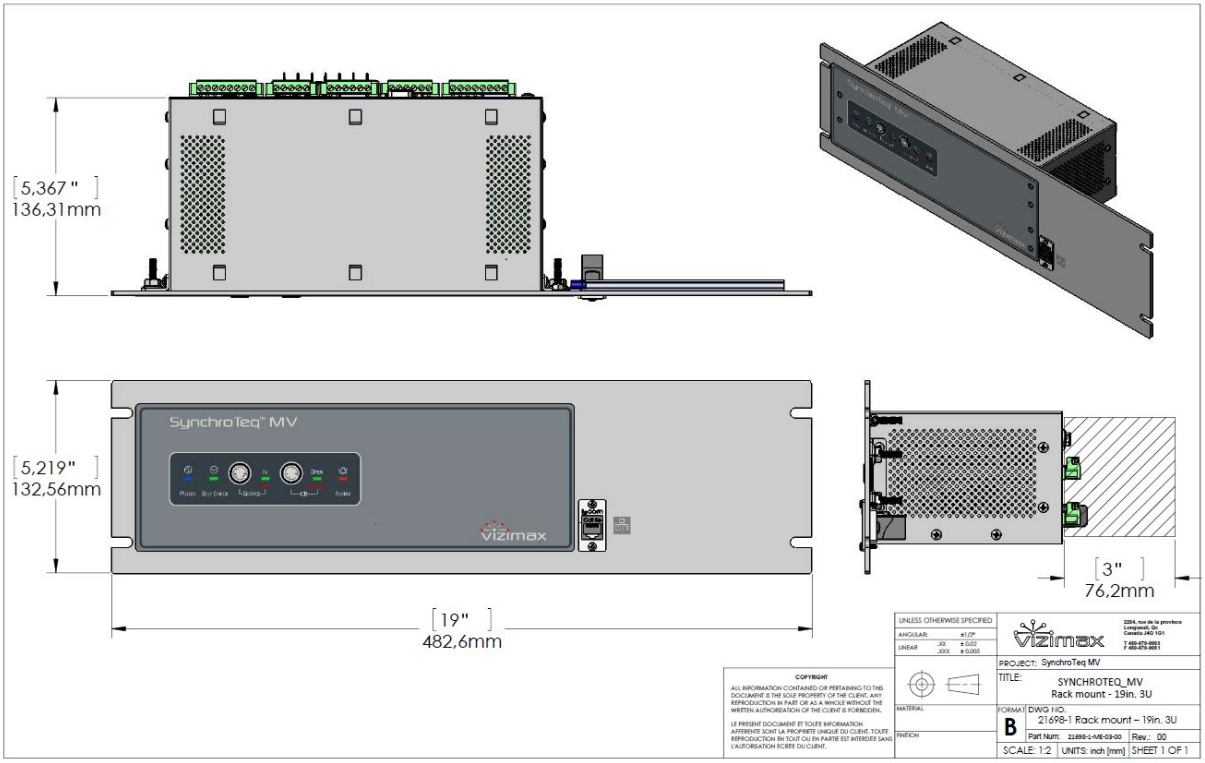


Figure 16 SynchroTeq MV 19" rack mount configuration (RM model)

A DIN rail (120 mm [4.8 in]) is provided on the rear panel to mount terminal blocks or IED accessories.

Figure 17 SynchroTeq MV DIN rail terminal block mount

4 Ordering information

NOTE These specifications are subject to change without prior notice.

4.1 Base models

STM010000 **SynchroTeq MVR**
(Smart Coding to be confirmed at order) for the controlled switching of shunt reactors, discharged capacitor banks, harmonic filters or power transformers, all based on fixed switching angle strategies.

STM030000 **SynchroTeq MVX**
(Smart Coding to be confirmed at order) for three-phase MV power transformer switching applications with residual flux calculation and partially discharged capacitor banks and filters with the acquisition of residual charges.

4.2 Frequently ordered options

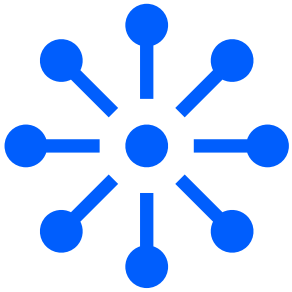
NOTE To select ordering options such as, housing configuration, or power supply voltage, or IRIG-B synchronization option or LPCT Rogowski coil current measurement input type, please refer to the 'smart coding' document 'STM0x0000-SC' available in the Vizimax web site www.vizimax.com.

STALxxx **Optional LEA adapters for current and voltage sensors**
Per phase cable with unterminated (open wire end) or with RJ45 female connector compatible with commonly used current and voltage sensors.

STA030302 **Diode trio with transient suppressors**
May be required in some situations such as when a bypass logic is installed with an IPO CB not having a GO command input.

RWC0Y0001 **IRIG-B time synchronization**
Optional module over either:
a BNC connector with a compliant IEC 60044-8 TTL signal, or
a fiber optic ST type connector with a compliant IEC 61869-9 signal.

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



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