Measure - Control - Switch
Solutions for HV-MV Power
Switch : SynchroTeq Product Line
Utility Grade Solutions for HV-MV Power

Measure
- High performance measurement of Frequency, ROCOF, Phasors
- Standalone Analog Merging Units

Control
- Substation automation, remote operation, asset monitoring
- Switchgear Control Units

Switch
- Inrush current limiters for power transformers and reactive loads
- New approaches for improved PFC and Voltage/VAR Control
Utility Grade Solutions for HV-MV Power

PMU / AMU
- IEEE C37.118 / IEC 61850-9-2LE compliant, IEC 61850, IEC 60870-5-10x and ModBus TCP/UDP with RightWON companion product
- Resilient to harmonics, high-performance in stressed power systems
- Fast & stable ROCOF calculation: 1.2 to 2 cycles typical, 3 cycles max.
- For local control, single phase, Micro-Grid, islanding, PMS, power quality

RightWON Satellite/Plus/Engine: Smart Substation Controller
- Automation + Monitoring + Alarm/Event management + Data gateway
- Full support of industrial, energy, power gen and utility protocols
- Integrated web HMI + local SCADA functionality

SynchroTeq System
- Controlled switching and monitoring IEDs
- For new and existing HV & MV switchgears, regardless of the makes
- Inrush Current Limiters for power transformers & reactive loads
- Advanced switching of reactive loads in VAR compensation, Volt/VAR control, PFC, FACTS, in SVC, STATCOM and standalone applications
Applications and Markets

Power Generation

Grid Connection of RES
Wind, Solar & more

Energy & Battery Storage

Power Generation: Hydro, CCGT, Coal, Genset

Power Electronics
SVC/Statcom, Rectifiers, Inverters, Drives

TSO & DSO: Grid Stability, Efficiency, Power Quality, Clean Connection of Consumers/Generators

HV/MV Transfo & FACTS
HVDC Substations

Power Grids

HV/MV Switchgears

Power Transformers

Oil & Gas
On-shore/Off-shore

Metal, Mining, Cements, Furnaces
AC-DC Railways, HST

HV- MV Equipment

Industry
Highlights

- Over 25 years in CSDs, applications and systems
- Support by dedicated CSD experts: st.support@vizimax.com
- Worldwide support thru a network of qualified & trained VARs
- Remote support via internet (https:// secured connection)
- CSDs used at 735kV (Hydro-Quebec, Canada), 765kV & 1200 kV (PGCIL India), HVDC (Manitoba-Hydro, Canada) among others
- Rugged solutions for HV & MV switchgears, compliance with international standards, worldwide certifications
- For new and existing switchgears, regardless of the makes

![Certifications Logos]
SynchroTeq® System Components 2017

Power Studies

Implementation

Controllers

Networking
SynchroTeq® Controlled Switching Devices

- Upgrade, control & monitor standard HV & MV switchgears
- OPEN and/or CLOSE at any precise electrical instants
- Operation times: accurate prediction & compensation

Target switching angles are dynamically determined for optimal results with a variety of load types and applications.

CLOSE command
Interception until 3ms before next zero-crossing

Zero-crossing Sync/Start

Control Delay
Control Output
Switchgear Operation time

(1) Screenshot: SynchroTeq Waveform/Digital Analyzer (Freeware)
SynchroTeq Plus – UHV, EHV, HV Switchgears

- For new & existing switchgears of all types and voltages...
  ... regardless of the makes
- Ultimate Inrush Current Limiter
- For control, monitoring and asset management
- Transformers, FACTS, Lines, Cables
SynchroTeq Plus – UHV, EHV, HV Switchgears

- For New and Existing Circuit Breakers
- CPU-demanding Apps and Complex Models
  - Transmission lines
  - Numerous compensation channels
  - Fast-switching of reactive loads

- Strong Engine, Web-based Operation
  - Stores 2,000-events and waveforms

- Best-in-Class HV Transformer Energization:
  - Residual Flux Calculation Modules
  - Bushing Sensors for transformer voltage measurements

- Additional Modules and Tools:
  - Bypass / Redundancy Module
  - Dual SPSBO : dual supply DC outputs
  - Re-energization Advisory System (TRAS)
  - OPC UA Server for SCADA and DCS in Substations or in Central Sites
SynchroTeq Plus – Scalable Platform

SynchroTeq™ Plus

- Advanced CSD
- Web-based Monitoring
- LAN Plug-Ins
- Bypass & Dual Outputs
- Load side AC voltage measurement

Fits in Substation’s Control House, or in Power Transformer’s Cabinet or in Circuit Breaker’s Cabinet
SynchroTeq MV – MV Switchgears

- For All MV Switchgears up to 69kV:
  - 3-p operated, w/ and w/o pole staggering
  - 1-p operated

- Various Apps and Loads:
  - Reactive Loads, Single-Phase Transformers, Three-Phase Transformers and Advanced Switching of Reactive Loads

- Strong Engine, Web-Based Operation:
  - 500-events and waveform storage
  - Supports partially charged reactive loads
  - Fast-Switching of capacitor banks and filters

- Best-in-Class **MV Transformer Energization**:
  - MVX version w/ Residual Flux Calculation
  - For 1-p and **3-p operated Switchgears**

- OPC Server, Data Transfer for SCADA/DCS in Substations and Central Sites
SynchroTeq MV – Compact & Flexible

SynchroTeq™ MV

1, 2, 3 Phase Applications
Switchgears - C/Bs - Reclosers
up to 69 kV

Advanced CSD
Web-based Monitoring

2 Compact Units for
FACTS & Transformers
Unified Communication Services - OPC UA Servers

SynchroTeq™ RWS 065000
- for server in central site:
  - transfer and storage of events/alarms
  - transfer and storage of waveforms
  - COMTRADE files
  - OPC UA Server to main SCADA
  - unlimited storage/unlimited number of devices

SynchroTeq™ RWS 055000
- for SCADA / DCS in substation:
  - transfer and storage of events/alarms
  - transfer and storage of waveforms
  - COMTRADE files
  - SynchroTeq™ OPC UA Server
  - access to SynchroTeq™ data models
  - Mirrors contents in SynchroTeq™ database
    - SynchroTeq™ Plus: 2,000 operations
    - SynchroTeq™ MV: 500 operations

For Control, File Transfer, Monitoring

(1) All data exchanges are tunnelled and secure
SynchroTeq Platforms – Side by Side

<table>
<thead>
<tr>
<th>Applications</th>
<th>SynchroTeq MV</th>
<th>SynchroTeq Plus</th>
<th>SynchroTeq Plus + VL mea.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharged Capacitor Banks - MSC / MSCDN</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Shunt Reactors – MSR</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Transformers (Peak Voltage)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Transformers (Residual Flux)</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Transformers in Parallel (Residual Flux)</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Transmission Lines</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Partially Charged Capacitor Banks - MSC/FLT</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CB and a half (any kV level)</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

| Load Voltage                                     | Up to 69kV    | Up to EHV and UHV |
## SynchroTeq vs Switchgear Types

<table>
<thead>
<tr>
<th>Applications</th>
<th>Circuit Breaker/Switchgear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Pole Operation</td>
</tr>
<tr>
<td>Capacitor Banks - MSC / MSCDN</td>
<td>✓</td>
</tr>
<tr>
<td>Shunt Reactors – MSR</td>
<td>✓</td>
</tr>
<tr>
<td>Transformers (Peak Voltage)</td>
<td>✓</td>
</tr>
<tr>
<td>Transformers (Residual Flux)</td>
<td>✓</td>
</tr>
<tr>
<td>Transformers in Parallel (Residual Flux, note 1)</td>
<td>✓</td>
</tr>
<tr>
<td>Transmission Lines</td>
<td>✓</td>
</tr>
</tbody>
</table>

(1) : Requires RWS 055000 or TRAS
# SynchroTeq – Key Factors in Switching Strategies

<table>
<thead>
<tr>
<th>Applications</th>
<th>Fixed Strategy</th>
<th>Dynamically Calculated Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharged Capacitor Banks - MSC / MSCDN</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Shunt Reactors – MSR</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Transformers (Peak Voltage)</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Transformers (Residual Flux) - Note 1</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Transformers in Parallel (Residual Flux) - Note 2</td>
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<td>✔️</td>
</tr>
<tr>
<td>Transmission Lines - Note 3</td>
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<td>✔️</td>
</tr>
<tr>
<td>Partially Charged Capacitor Banks - MSC/FLT</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>CB and a half (whichever is the switched load)</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

(1) Based on continuous voltage measurement (magnetic VT/PT) at transformer’s primary or secondary side, or using optional bushing sensors and junction box

(2) Requires RWS 055000 or TRAS

(3) SynchroTeq Plus is suitable for Uncompensated and Compensated Transmission Lines – Differences may apply according to the Line type
SynchroTeq in Action – Examples

(*) I/O channels and signals: see SynchroTeq Plus & SynchroTeq MV datasheets
SynchroTeq in Action – Examples
SynchroTeq in Action – Examples
SynchroTeq – Web-based operation – Dashboard

(1) Internet link and Login: [https://spdemo.vizimax.com/SynchroTalk.html#login](https://spdemo.vizimax.com/SynchroTalk.html#login)
SynchroTeq – Web-based operation – Status
SynchroTeq – Web-based operation – Journal

Filters
Open Waveforms
Check Configuration
Alarm Tag
SynchroTeq – Waveform & Digital Analyzer

(1) MV Switchgear, Power transformer & Inverter – Residual flux calculation
SynchroTeq – Waveform & Digital Analyzer

Cursors
Time interval between Cursors
Controlled switching & switchgear data

Exportable data table

(1) MV Switchgear, Power transformer & Inverter – Switchgear Closing & Inrush current limitation
## SynchroTeq – I/O Channels & Functions

<table>
<thead>
<tr>
<th>Feature</th>
<th>SynchroTeq Plus</th>
<th>SynchroTeq MVR</th>
<th>SynchroTeq MVX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source AC voltage measurement</td>
<td>3</td>
<td>N/A</td>
<td>1</td>
</tr>
<tr>
<td>Load AC current measurement</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Load AC voltage measurement (Opt.)</td>
<td>3 (Opt.)</td>
<td>N/A</td>
<td>3</td>
</tr>
<tr>
<td>DC control voltage compensation</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>4-20mA</td>
<td>-- RTD/4-20mA</td>
<td></td>
</tr>
<tr>
<td>Pressure compensation</td>
<td>3x4-20mA</td>
<td>-- N/A</td>
<td></td>
</tr>
<tr>
<td>Coil driver supervision</td>
<td>√</td>
<td>-- N/A</td>
<td></td>
</tr>
<tr>
<td>Integrated bypass unit</td>
<td>√ (Opt.)</td>
<td>-- N/A</td>
<td></td>
</tr>
<tr>
<td>Web interface</td>
<td>√</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Event/Waveform storage capacity</td>
<td>2000</td>
<td>--</td>
<td>500</td>
</tr>
</tbody>
</table>
SynchroTeq – Compensation Channels – Example

1- Factory compensation data of a test unit

Example: Opening time vs Temperature

\[ y = 21 - 10x^2 + 2E-09x^4 - 2E-07x^6 - 2E-06x^8 + 2E-05x^{10} + 0.0047x + 26.752 \]

2- Switchgear timing at commissioning

Configuration data – Compensation polynomials

3- Measurement of operating conditions (Temp, Pressures...)

4 → Predicted operation time calculations

Real time calculation
SynchroTeq Special Features

Power transformers
- Energizing any vector group switched from MV or HV side
- For Single-pole (1-p) operated and Three-pole (3-p) operated CBs/switchgears
- HV bushing sensors for Residual Flux Calculation in alternative to PT/VT
- TRAS or RWS 055000: energizing power transformers in parallel
- Active transformer monitoring, independent from CB/switchgear operation

Capacitor banks, Harmonic filters
- Fast switching of capacitor banks and filters, taking into account the residual charge trapped in capacitors

Circuit breakers in CB and a half configurations
- Transmission Line/Power Transformer, Transmission Line/Shunt Reactor...
- RWS 055000 for SCADA/DCS: system parameterization and control
SynchroTeq Advanced Features

CB monitoring
- $I^2t$ electrical wear computing on close/open/trip operations

CSD – Engineering tools
- EMTP-RV SynchroTeq simulation libraries: power studies, power flow analysis
- PSCAD SynchroTeq simulation libraries
- SynchroTeq LV units for HIL (Hardware In the Loop) testing

Enhanced output module
- CB control output modules with source/sink/floating capabilities & CB coil supervision
- Support of Dual voltage configuration (different voltages for closing and tripping coils)

Networking
- Measurement data sharing across multiple networked SynchroTeq Plus units
SynchroTeq Plus – Residual Flux & Voltage

1) VT/PT at the primary or secondary side of the transformer

The residual flux is calculated from the transformer voltage

2) HV Bushing sensor

With additional Voltage Measurement Module
SynchroTeq Plus – Bushing Sensors

Alternative to HV/MV Voltage Measurement Transformers