Protection and Control REX640
Product application examples and features
2NGA000306 A
Relion® Protection and Control REX640
All-in-one protection for any power distribution application

Protection and control relay – REX640

- A powerful all-in-one protection and control relay for advanced power distribution and generation applications
- Offering unmatched flexibility available during the complete life cycle of the device
- Modular design of both hardware and software elements
- Easy modification and upgrading
- Pushing the limits of what can be achieved with a single device
- Newest member of the Relion® protection and control family
Innovative, flexible and easy to use

The REX640 offers:
- Complete application coverage
- Ready-made application packages
- Customization freedom
- Fully modular hardware and software
- Easy adaption to changing requirements
- Continuous access to support
- Ready-made application-based LHMI pages
- Increased situational awareness
- Support for digitalization of substations
# Relion® Protection and Control REX640

New application package concept for maximum convenience and flexibility

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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| Feeder protection             | - Line differential protection  
                              - Line distance protection  
                              - Interconnection protection  
                              - Fault locator |
| Power transformer protection  | - Two and three-winding differential protection  
                              - On-load tap-changer control |
| Machine protection            | - Asynchronous machines  
                              - Synchronous machines |
| Shunt capacitor protection    | - Protection of single Y, double Y and H-bridge connected capacitor banks  
                              - Protection of harmonic filter circuits |
| Automatic synchronization     | - Generator circuit breaker  
                              - Non-generator circuit breaker |
| Arc protection                | - Four lens or loop sensors supported in any combination  
                              - Both sensor types are supervised |
| Busbar protection             | - High impedance based busbar protection  
                              - Double busbar protection |
| Petersen coil control         | - Automatic control of Petersen coil  
                              - Control of additional fixed parallel coil  
                              - Control of parallel resistor |
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Application packages

Overview

Functionality is divided into:

- **Comprehensive base functionality** – included as standard (always included)
- **13 application packages** (optional) – can be freely selected as required by the intended application – none, some or all
- **2 additional protection add-ons** (for selected application packages) – the add-on packages offer even more functionality on top of the selected application package

Note! The software options can also be added later on, even at site.
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Suggested example applications

**Retrofit applications**
- Modular design of hardware and software makes retrofitting of installed based easy
  - Flexibility in matching needed hardware
  - Flexibility in configuring modular software to match installed base functionality
  - Possibility to add upgrades and non-relay functionality to existing system

**Double busbar applications**
- Hardware flexibility and scope makes more complex and demanding applications possible
- Support for busbar voltage selection
- Upgraded arc-protection module to support both loop and lens type sensors for wider scope of protection in these complex configurations

**Digital switchgear**
- Designed with digitalization of switchgear and substations in mind
- Supports
  - sensor technology
  - IEC 61850-9-2 LE and IEC 61850-8-1
  - PTP, IEEE 1588 and IRIG-B
  - PRP and HSR

**Non-relay applications**
- Auto synchronization
  - Generator circuit breaker
  - Non-generator circuit breaker
- Petersen Coil controller
- Arc protection
  - Supervised loop and lens
  - Also optional shielded loop sensor (blind) extensions available
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Application example: One relay with many uses – One-for-all

Customer need

Need for:
- One single product that can be used in many different applications.
- Need for simple ordering, installation and ease of use.
- Standardized solution for complete installation.

Solution

- REX640 has door to new and the flexibility to be used for many different applications - only one type of relay is needed to cover many different applications due to the license-based protection and control packages.
- Wide range of hardware modules are available.
- With optimally relevant hardware modules installed, matching software licenses enable the flexible platform to satisfy most needs.
- The relay can handle various applications simultaneously. For example...
  - Line-distance, line–differential and fault locator applications
  - Generator protection and synchronization applications
- This flexibility enables the innovative protection and control applications

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Earlier it was quite common practice to employ local back-up by having overlapping protection schemes using several protection relays, each of them with dedicated functionality. This approach led to a situation where a number of relays were installed, increasing the life cycle costs of the system.

The REX640 can offer an approach where, instead of overlapping schemes, a single relay can handle all the different schemes. The protection availability can be increased by duplicating the relays, as main 1 and main 2.

Thus, for instance, making complex protection schemes for machines much simpler by combining several relays’ functionality into two REX640 relays that function in parallel as Main 1 and Main 2.

**Customer need**

Need for:
- Redundant protection and control scheme that effectively utilizes overlapping functionality in installed devices to maximize ROI and minimize system downtime and maintenance.
- Having the freedom and ability to build a protection scheme that was limited by the availability of technology in the past.
- Optimized spare management

**Solution**

- Earlier it was quite common practice to employ local back-up by having overlapping protection schemes using several protection relays, each of them with dedicated functionality. This approach led to a situation where a number of relays were installed, increasing the life cycle costs of the system.
- The REX640 can offer an approach where, instead of overlapping schemes, a single relay can handle all the different schemes. The protection availability can be increased by duplicating the relays, as main 1 and main 2.
- Thus, for instance, making complex protection schemes for machines much simpler by combining several relays’ functionality into two REX640 relays that function in parallel as Main 1 and Main 2.
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Application example: Complex switchgear requirements

Customer need

Need for:
- Maximum availability of power at key points in the network that drive the need for more complex switchgear arrangements.
- Avoidance of down-time during maintenance work.
- Protection selectivity and sensitivity during network fault situations in order to minimize power supply disturbances.

Solution

REX640 offers:
- The ability to be utilized in complex switchgear arrangements (for example DBB, 1,5 breaker, duplex, )
- Features:
  - Bus voltage switching within the relay based on bus-disconnector position
  - Current summation within the relay
  - Free allocation of measurements to protection functions
  - Possibility to control a variety of objects in the network (3 CB, 14 DC, 3 ES)
  - Maximum of 20 analogue input channels
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Application example: Arc protection

Customer need

Need for:
- Safety and selectivity with added arc protection
- Dependable arc protection
- Arc protection system incorporated in to overall protection scheme

Solution

REX640 offers arc protection for:
- Increased safety
- Increased selectivity because of 4 inputs – either loops or lenses
- Peace of mind by providing supervised sensors – increased dependability
- Minimized damage in case of arc fault due to ultra fast operation of the static power outputs
- Minimized down time
- Added security – not to operate when not needed – current levels are monitored and incorporated into protective actions
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Application example: Transformer protection and voltage control

**Customer need**

Need for:
- Transformer protection with fault current contribution from different directions (voltage levels)
- Supervision of transformer loading level
- Control of on-load tap-changer to keep secondary and tertiary voltages on the desired level
  - Need to run a number of transformers in parallel
- Differential protection for 3-winding power transformer

**Solution**

REX640 offers:
- Differential transformer protection with either two or three restraints to guarantee protection stability over all possible fault locations
- Thermal overload protection, hotspot monitoring and RTD-based measurements provide complete supervision of transformer loading level
- Onload tap changer controlled by automatic voltage regulator (AVR)
  - Possible to control up to six parallel-running transformers using either master-follower or minimizing circulating current principle.
  - LHMI provides complete visibility and control of parallel-running transformer control process.
- Support for various specialized connection-groups possible, even for marine applications

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Application example: Distance protection

Customer need

Need for:
- Protection of a feeder with varying fault current levels due to network switching and reconfiguration.
- Protection of a feeder where minimum fault current level is close to maximum load current level, including earth-fault protection.
- Back-up protection for the downstream network through a number of protection zones.
- Unit protection of interconnection feeder (between two separate substations) with back-up protection.

Solution

REX640 offers:
- Full-scheme line distance protection with 5 protection zones.
- Scheme communication enables unit-type protection for the feeder, improving protection selectivity and speed of operation.
- Scheme communication enables unit-type protection for the feeder to improve protection functionality and speed.
- Dedicated optical protection-communication channel (up to 50 km) for unit-type protection.
- Distance protection in combination with line differential protection.

Distance protection against phase and earth faults (EF)

Additional sensitive blocking based directional EF protection

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Application example: Line differential protection

Customer need

Need for:
- Protection of a cable feeder having a power transformer within the protection zone.
- Protection of a feeder where minimum fault current level is close to maximum load current level, including earth-fault protection.
- Protection of a closed ring-type network.
- Unit protection of interconnection feeder (between two separate substations) with back-up protection.

Solution

REX640 offers:
- Two-stage phase dedicated line differential protection.
- Functionality that enables compensation of power transformer connection group to facilitate the power transformer within the protection zone.
- Communication channel supervision provides security against maloperation.
- Directional over-current protection as back-up.
- Unit-type earth-fault protection that is enabled by the dedicated optical protection-communication channel (up to 50 km).
- Line differential protection in combination with distance protection.
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Application example: Motor protection

**Customer need**

Need for:
- Safeguarding that the thermal-overload threshold is not exceeded.
- Visualization of real-time situation regarding thermal load.
- Variability of motor differential protection principles used.
- RTD-based thermal supervision and protection.

**Solution**

REX640 offers:
- ABB’s tried and tested motor protection functionality developed over years of testing and installations globally.
- Visualization of the thermal load level via the LHMI.
- A time-to-restart countdown after thermal overload trip (visible on LHMI) – also incorporating one emergency start-up.
- Motor differential protection according to the following principles:
  - Biased low impedance based
  - High impedance based
  - Flux-balanced based
- Support for up to two RTD sensor input modules (10 RTD-inputs and 2 mA-channels per module)
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Application example: Generator protection

Customer need

Need for:
- Protection of synchronous generators of varying sizes.
- Main protection to be operational as early as possible during generator start-up.
- Synchronization of generators to the power grid or other external power sources.

Solution

REX640 offers:
- ABB’s tried and tested generator protection functionality developed over years of testing and installations globally.
- Frequency adaptiveness to be able to protect generator already at start-up
  - From 0.2x to 1.5x nominal frequency
  - Voltage-based frequency tracking available with current-based tracking as back-up
  - Current-based frequency tracking in case of no available voltage inputs
- Generator synchronization in the form of an application package
- Visualization and local control of the synchronization process via the LHMI
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Application example: Generator breaker synchronization

Customer need

Need for:
- Simpler solutions to efficiently integrate various generators of different sizes and characteristics into a system with high operational reliability and power supply continuity.
- An IEC 61850-based solution.

Solution

REX640 offers:
- Generator breaker synchronization as an additional application package to the machine protection application package
- Auto synchronization functionality for synchronizing each generator breaker closing individually. The auto synchronization operates according to given conditions and with minimal additional stress for generator and prime mover.
- Visualization and local control of the synchronization process via the LHMI
- IEC 61850 MMS and Modbus communication channels for upper level visibility and control
**Relion® Protection and Control REX640**

Application example: Non-generator breaker synchronization (Network Auto-synchronizer)

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**Customer need**

Need for:
- In addition to synchronization of number of generators, other non-generator breakers need to be closed in a synchronized manner.
- A solution to an evolving system with numerous generator and non-generator breakers that need synchronizing.
- Simple system that is continuously monitored with notification of possible defects already before the need for operation arises.

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**Solution**

REX640 offers:
- Non-generator breaker synchronization as an additional application package to the appropriate protection application of the relevant REX640 relay.
- Auto synchronization functionality for synchronizing each non-generator breaker closing individually. The auto synchronization operates according to given conditions and with minimal additional stress for generator and prime mover.
- Visualization and local control of the synchronization process via the LHMI.
- IEC 61850 MMS and Modbus communication channels for upper level visibility and control.
- Solution with a maximum number of 8 generator breakers and 17 non-generator breakers.
- IEC 61850-GOOSE communication between installed REX640 relays that removes the need for a dedicated synchronizing panel – reducing the installation space, engineering, testing time and cost.
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Application example: Earth fault and Arc suppression coil (ASC – Petersen coil) management in compensated networks

**Customer need**

Need for:
- Sensitive and selective earth fault protection in the compensated network
- Protection against restricking cable faults.
- Earth fault protection capable of coping with situation where the ASC is disconnected for maintenance
- Petersen coil (Arc suppression coil - ASC) controller that can manage both fixed and adjustable coil types
- Petersen coil controller that is capable of controlling the loading resistor as per a preset logic.

**Solution**

REX640 offers:
- The coil controller function for the automatic adjustment of the arc suppression coil compensation current based on the measured coil voltage and the desired compensation degree.
- Additionally, the multi-frequency admittance-based earth fault protection (MFA)
- MFA that can handle all earth fault types, various switching conditions, including conditions where ASC is connected or not.
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Application example: Super substitute – “Super-Sub”

Customer need

Need for:
- Need for easy and cost effective way to manage spares. Minimising the need for spare relays on site.
- Spares management not needing engineering tools or specialist services.
- Quick turnaround times for replacing or exchanging complete relays or relay modules.

Solution

REX640 offers:
- The ability to cover several applications (even at the same time) and thus one spare relay can be used in various situations and applications as a substitute.
- An improved view of relay status, pinpointing areas of concern visually on the LHMI with the “Self-supervision Status” page.
- LHMI- and relay-units that save back-ups of the configuration in cases where either relay or LHMI need replacing. This can be done without any software tool involvement (instructions given on LHMI screen).
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Application example: Modification after delivery

Customer need

Need for:
- A wide range of relays or relay functionality in an environment where, for instance import restrictions or project uncertainties cause delays.
- Specification changes force fast adjustments to relay functionality before commissioning.
- Upgrading or adjusting existing protection functionality.
- Exchanging relays between application areas.

Solution

REX640 offers:
- The freedom to add and modify hardware and software in a similar way as when ordering a new device.
- The ability to:
  • Add/upgrade functionality to the installed software.
  • Add/change type of hardware modules in the relay unit, if needed.
- An easy-to-use interface for these modifications after delivery. PCM600 is utilized in this process and no special certification needed to perform these tasks.

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Application example: LHMI – a whole new experience

Customer need

Need for:
- Enhanced protection and control process visibility.
- Customization of information presented by device locally.
- Easy-to-use, intuitive interface to the device.
- An improved system testing user interface.
- To visualize information flow within the digital substation.

Solution

REX640 offers:
- Ready-made application-based pages to support various activities, like testing and commissioning.
- User definable symbols and pages – allows customer specific tailoring according to detailed process requirements.
- The LHMI application can be easily adopted to the project’s needs using PCM600 tool.
- A rugged 7 inch industrial-grade color touch screen that enables use in demanding (IP54) environments with
  • USB 2.0 connection for reading of data from relay.
  • Two RJ45 for connection to relay and for PCM600 engineering/monitoring.
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Application example: Complex ATS solutions based on extensive analog inputs for LV/MV applications

Customer need

Need for:
- Automatic voltage recovery after primary source fails in a multisource system.
- Automatic voltage recovery without damaging rotating machines when primary source fails.
- Manual source change in a multisource system (under controlled circumstances).

Solution

REX640 offers:
- The capability to handle a 2 out of 3 ATS application with a single device (also 1 out of 2).
- The possibility of 9-2 communication to remote voltage measurements from source.
- Improved customizable user interface to:
  • Visualize current scheme status
  • Offer multiple control options
  • ATS based on remanent voltage and open transition principles.
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Application example: High-impedance busbar application

Customer need

Need for:

- Retrofitting existing high-impedence busbar protection with numerical relay.
- Local measuring of Bus A and Bus B voltages and voltage protection.

Solution

REX640 offers:

- The needed functionality in a single modern device to easily replace existing relays and maintain the current protection philosophy.
- The needed voltage and frequency protection functionality and thus reducing the need for retrofitting of additional devices.
Customer values
Relion® Protection and Control REX640
Innovative application and design

REX640 offers:

- Ability to cover full range of utility and industrial applications in one device
- Ability to manage multiple applications simultaneously
- Freedom to create unique relay for specific protection requirements because of the modularity and scalability of the software and hardware design
- Ability to customize, adapt and modify protection scheme throughout the relay life-cycle
- Entirely new applications enabled by the unique application-driven approach to the local human-machine interface (LHMI)
Customer value
Relion® Protection and Control REX640

Unmatched flexibility

REX640 offers:

– Flexibility to cover full range of utility and industrial applications with one device
– Freedom to adapt and modify the available protection functionality to suit evolving protection requirements at any point during the product life-cycle
– Availability to the latest software and hardware developments on a continuous basis as updates and upgrades
– Freedom to completely customize pages in the LHMI for user-specific visibility of process data

Unmatched flexibility help customers stay ahead of evolving power network requirements.
Customer value
Relion® Protection and Control REX640

Long awaited ease of use

REX640 offers:

- Easy ordering with ready-made application packages
- Efficient engineering of the complete protection scheme by only utilizing the needed functionality
- Increased situational awareness and maximum usability via the unique LHMI with clear and understandable user interface of relay and previously non-relay related functionality
- Ready-made application-based pages in the LHMI that minimize the need for graphical engineering – saving time and effort.
- Fully modular design that makes adapting to changing protection requirements easy

Long awaited ease of use supporting customers to make sense of complexities in distribution networks.
Protection and control application packages
Relion® Protection and Control REX640
Application packages
Relion® Protection and Control REX640

Overview
Functionality is divided into:

- **Comprehensive base functionality** – included as standard (always included)
- **13 application packages** (optional) – can be freely selected as required by the intended application – none, some or all
- **2 additional protection add-ons** (for selected application packages) – the add-on packages offer even more functionality on top of the selected application package

**Note!** The software options can also be added later on, even at site
Application packages
Relion® Protection and Control REX640

Base functionality*

The base functionality is always included and contains

- **All basic protection functionality**
  - Directional and non-directional overcurrent protection
  - Directional and non-directional earth-fault protection
  - Restricted earth-fault protection
  - Voltage protection
  - Frequency protection
  - Load shedding and restoration
  - Arc flash protection (requires sensor interface card in the relay unit)

- **All supervision and measurement functions**
- **Control functions for circuit breakers and disconnectors**

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* Always included as standard
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**Feeder EF protection extension package**

Functionality included
- Admittance based earth-fault protection
- Multi-frequency admittance-based earth-fault protection
- Wattmetric based earth-fault protection
- Transient / intermittent earth-fault protection
- Harmonics based earth-fault protection
Application packages
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Feeder fault locator package

Functionality included
- Fault location for both grounded and ungrounded networks
- Fault location also in compensated networks
Application packages
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**Line distance protection package**

- Functionality included
  - Five zone full scheme distance protection
  - Scheme communication logic
  - Weak infeed and current reversal logic
  - Local acceleration logic
  - Scheme communication logic for residual overcurrent
  - Weak infeed and current reversal logic for residual overcurrent

Relay includes dedicated optical protection communication channel for distances up to 50km. This channel enables the possibility to transfer up to 16 pcs of binary signals between line ends.
Application packages
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Line differential protection package

Functionality included
- Phase segregated line differential protection
- Biased low set-stage and unbiased high-set stage
- Transformer-in-the-zone supported
- Protection communication via inbuilt dedicated optical link or via twisted pair galvanic link supported by RPW600 modems
- Maximum distance with optical link is 50km and with galvanic link 8km

The protection communication channel enables the possibility to transfer up to 16 additional pcs of binary signals between line ends.
Application packages
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Shunt capacitor protection package

Functionality included
- Thermal overload protection
- Unbalance protection
- Switching resonance protection
- Wye, double wye and H-bridge banks
- Filter circuits
- Grounded and ungrounded installations
Application packages
Relion® Protection and Control REX640

Interconnection protection package

Functionality included
- Directional power protection
- Over-voltage variation protection
- Low voltage ride through protection
- Vector shift protection
- Directional reactive power under voltage protection
- Directional over power protection
**Application packages**

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**Machine protection package**

Functionality included
- Thermal over load protection
- Reverse power protection
- Low impedance differential protection
- High impedance differential protection
- Flux-balance differential protection
- Negative sequence over-current protection
- Loss of load protection
- Load jam protection
- Start-up supervision
- Phase reversal protection

**Note:** Additional functionality available in Add-on package
Application package add-ons
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Synchronous machine add-on

Functionality included

- Over excitation (V/Hz) protection
- Directional under power protection
- Under impedance protection
- Under excitation protection
- Stator earth-fault protection, third harmonic based
- Rotor earth-fault protection, injection based
- Pole slip protection
Application packages
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Power transformer protection package

Functionality included
– Low impedance differential protection for two windings transformers
– High impedance differential protection
– Restricted earthfault protection
– Over excitation (V/Hz) protection
– Thermal over load protection
– Directional over power protection
– Directional under power protection
– Under impedance protection

Note: Additional functionality available in Add-on package
Application package add-ons
Relion® Protection and Control REX640

3-winding transformer add-on

Functionality included
- Low impedance differential protection for three winding transformers
**Application packages**

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**Busbar protection package**

Functionality included

- High impedance differential protection
- Zone A + Zone B + Check zone
- Current circuit supervision for all zones

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+ Feeder EF protection extension package
+ Feeder fault locator package
+ Line distance protection package
+ Line differential protection package
+ Shunt capacitor protection package
+ Interconnection protection package
+ Machine protection package
+ Power transformer protection package
+ Busbar protection package
+ OLTC control package
+ Generator auto synch. package
+ Network auto synch. package
+ Petersen coil control package
+ Synchronous machine add-on
+ 3-winding transformer add-on
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Application packages
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**OLTC control package**

Functionality included
- Automatic voltage regulator
- Up to six parallel power transformers with the following schemes
  - Master/Follower
  - Minimizing circulating current
Application packages
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Generator auto synchronizer package

Functionality included
– Synchronized closing of a generator circuit breaker
– In-built synchrocheck functionality
– Auto / Semi-auto / Manual operation modes
– Remote controllable from DCS/SCADA
– Local HMI works as local interface enabling following features:
  • Start of synchronizing process
  • Selection of operation mode
  • Synchroscope
  • Double voltage and frequency meters
  • Control points for generator voltage and frequency
  • Manual “Close”-command for manual and semi-auto modes
Application packages
Relion® Protection and Control REX640

Network auto synchronizer package

Functionality included
– Synchronized closing of a non-generator circuit breaker
– Covers a maximum of 8 generator circuit breakers and 17 non-generator circuit breakers
– The synchronizer solution models the network switching status
– The local HMI of the circuit breaker related REX640 relay offers the local interface to the synchronizing process with necessary controls and measurements
Application packages
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Petersen coil control package

Functionality included
- Used in compensated networks
- Control based on the measured network healthy stage residual voltage
- Control enhanced by the measured coil current
- User-defined parameters utilized for connecting and disconnecting coil's parallel resistance
- Control for an additional fixed type parallel coil
- The local HMI offers the manual control point and visualization of related measurements, such as the V-curve