



ABB OY, DISTRIBUTION SOLUTIONS

Protection and control REX640

Product application examples

2NGA000306 C



Protection and control REX640

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Introduction

Introduction

All-in-one protection for any power distribution application

Protection and control REX640

Powerful all-in-one protection and control relay for advanced power distribution and generation applications

Fully modular hardware and software for maximum flexibility and easy adaption to changing network protection requirements

Continuous access to the latest software and hardware developments

Application-driven human-machine interface (HMI) for increased situational awareness and optimal usability

Designed to support the increasing digitalization of substations with support for a variety of digital switchgear solutions

Member of the Relion® protection and control family of relays



Introduction

Application coverage

Supported applications

Base functionality* <ul style="list-style-type: none">- Overcurrent protection- Earth-fault protection- Voltage protection- Frequency protection- Load-shedding	Power transformer protection and control <ul style="list-style-type: none">- Protection for two and three-winding power transformers- On-load tap-changer control- Automatic voltage regulation	Machine protection <ul style="list-style-type: none">- Protection of synchronous and asynchronous machines- Monitoring of diesel generator sets running in parallel	Interconnection protection <ul style="list-style-type: none">- Protection of interconnection points of distributed generation units	Shunt capacitor protection <ul style="list-style-type: none">- Protection of single Y, double Y and H-bridge-connected capacitor banks- Protection of harmonic filter circuits	Busbar protection <ul style="list-style-type: none">- High impedance-based busbar protection
Feeder / line protection <ul style="list-style-type: none">- Extensive earth-fault protection- Fault locator- Line distance protection- Line differential protection	High-speed transfer <ul style="list-style-type: none">- Automatic high-speed transfer between main and alternative feeder(s)- 4 transfer modes: fast, first coincidence, residual voltage-based and time delay-based	Generator auto-synchronizer <ul style="list-style-type: none">- Automatic, semi-automatic and manual generator synchronization- Fully visualized process with LHMI/SHMI	Network auto-synchronizer <ul style="list-style-type: none">- Synchronized closing of non-generator CB by actively adjusting selected generators- Fully visualized process with LHMI/SHMI	Petersen coil control <ul style="list-style-type: none">- Automatic control of Petersen coil- Control of additional fixed parallel coil- Control of parallel resistor	Arc protection <ul style="list-style-type: none">- Four lens or loop-type sensors supported in any combination- Both sensor types supervised

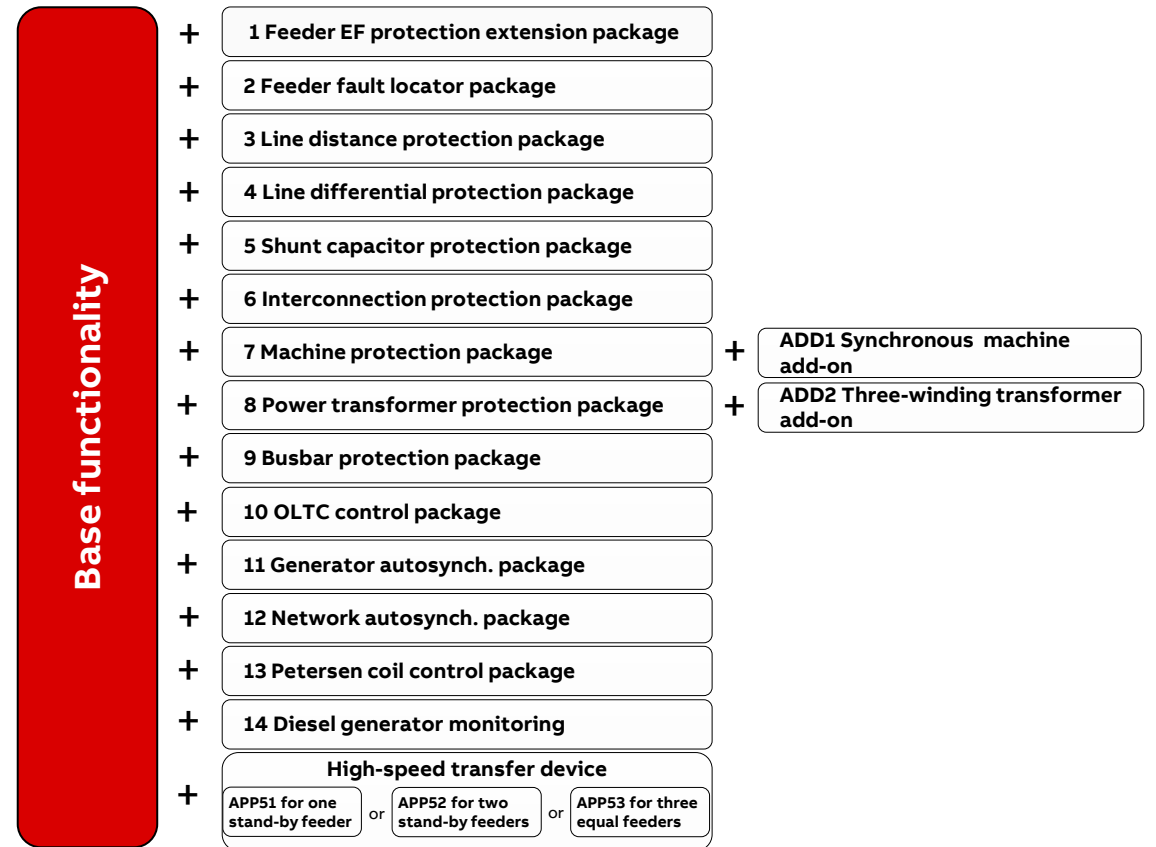
Introduction

Application packages

The functionality is divided into:

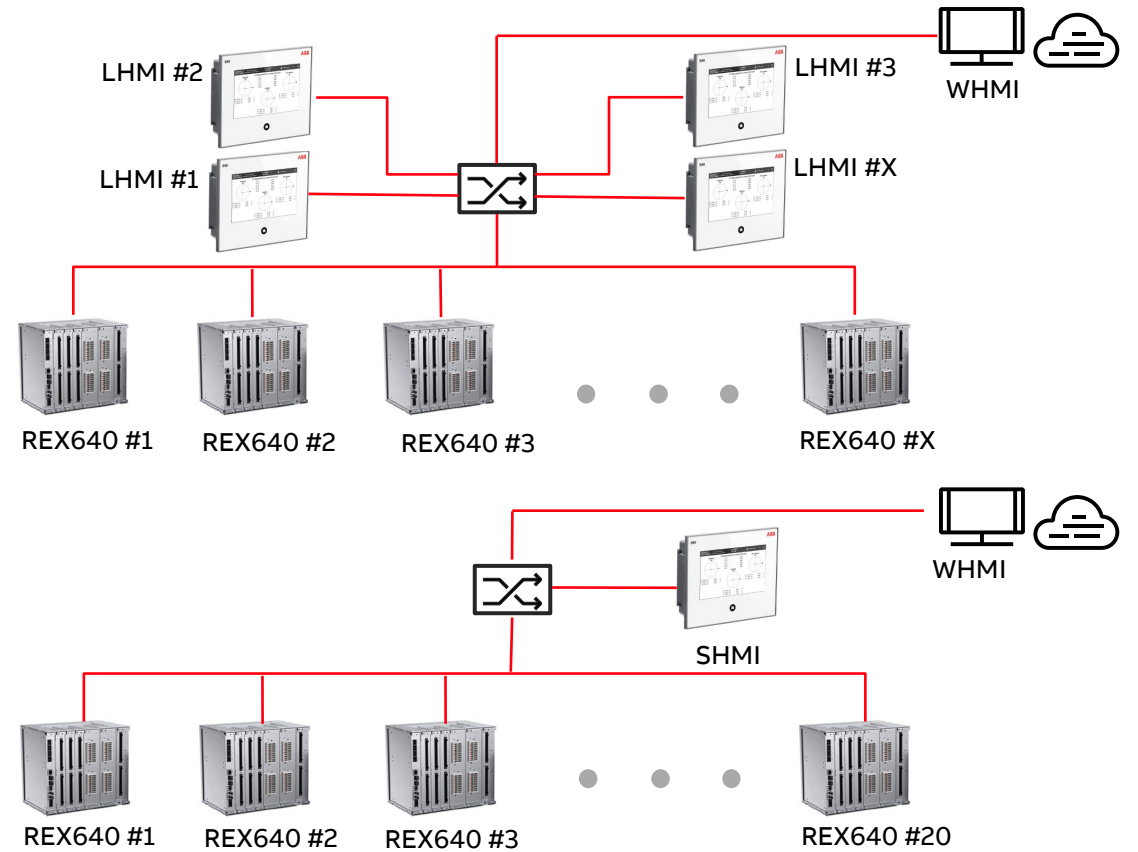
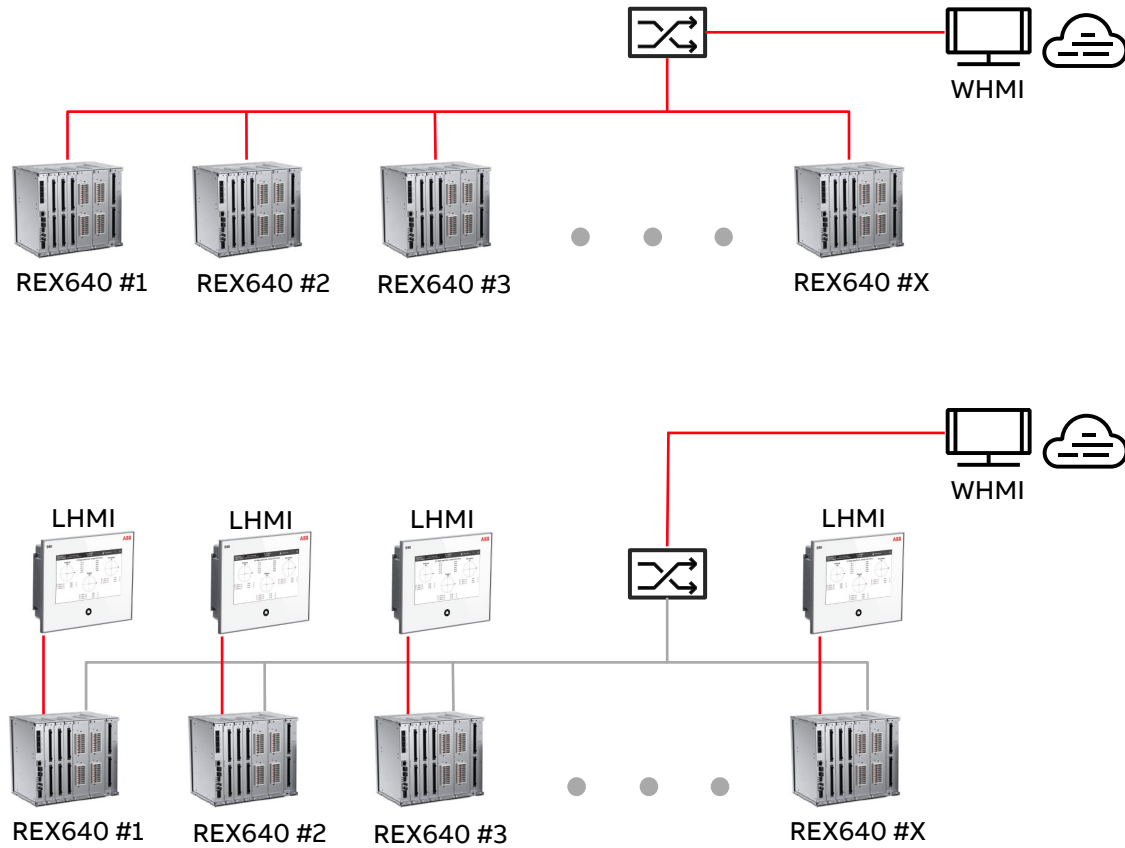
- **Comprehensive base functionality** – always included
- **17 application packages** (optional) – freely selected as required by the intended application (none, some or all)
- **2 additional protection add-ons** (for selected application packages) – the add-on packages offer even more functionality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

Note! The software options can be customized, modified and added at a later stage, even on site after installation.



Introduction

Human-machine interface (HMI) options



Introduction

Switchgear HMI (SHMI)

Switchgear level

Switchgear primary object position statuses
Alarm status indications
Internal status indications
Backups of relay configurations and settings



SHMI



Single panel/bay level

Bay primary object control
Bay primary object position status
Measurements
Alarm indication
Alarm listing
Relay status indication
Event listing
Fault records
Disturbance records
Settings
Commissioning and testing support
Backup of relay configuration and settings



SHMI



The complete switchgear lineup status is visible via the SHMI – in addition to all LHMI functionality.



Customer values

Customer values

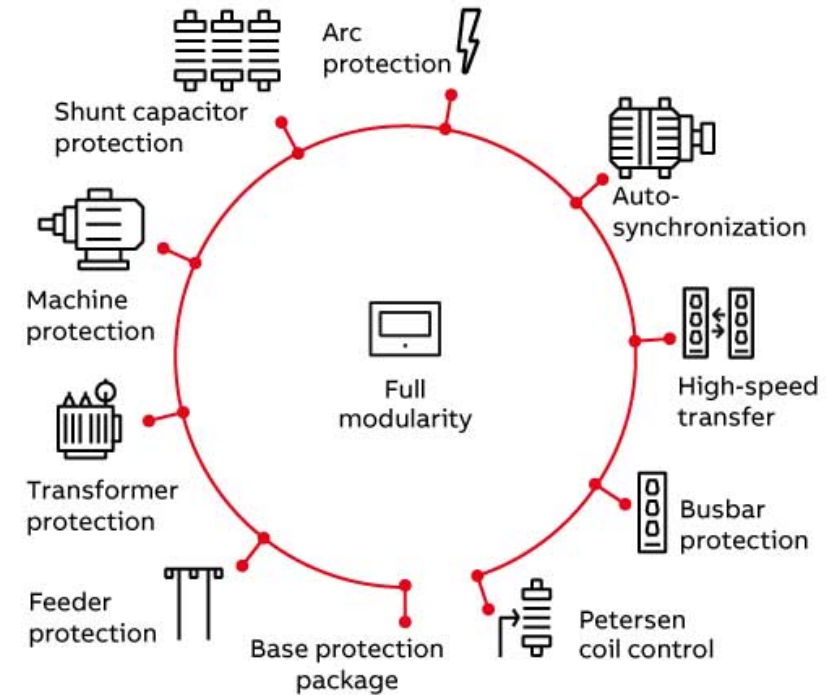
Complete coverage with innovative design

Complete application coverage with one device for optimal flexibility and cost-effectiveness

Application package concept for maximum convenience and flexibility

Designed to support the increasing digitalization of substations

- Supports a variety of digital switchgear solutions
- Suitable for both single and double-busbar applications



Innovative design – setting a new standard for what is possible with a single protection and control device

Customer values

Unmatched flexibility with fully modular hardware and software

Fully modular and scalable hardware and software for maximum flexibility throughout the entire relay life cycle

- Freedom of customization to meet specific protection requirements
- Easy adaptation to changing protection requirements
- Continuous access to the latest software and hardware developments

Smooth and easy ordering with ready-made application packages



Unmatched flexibility – helping customers stay ahead of the evolving power network requirements

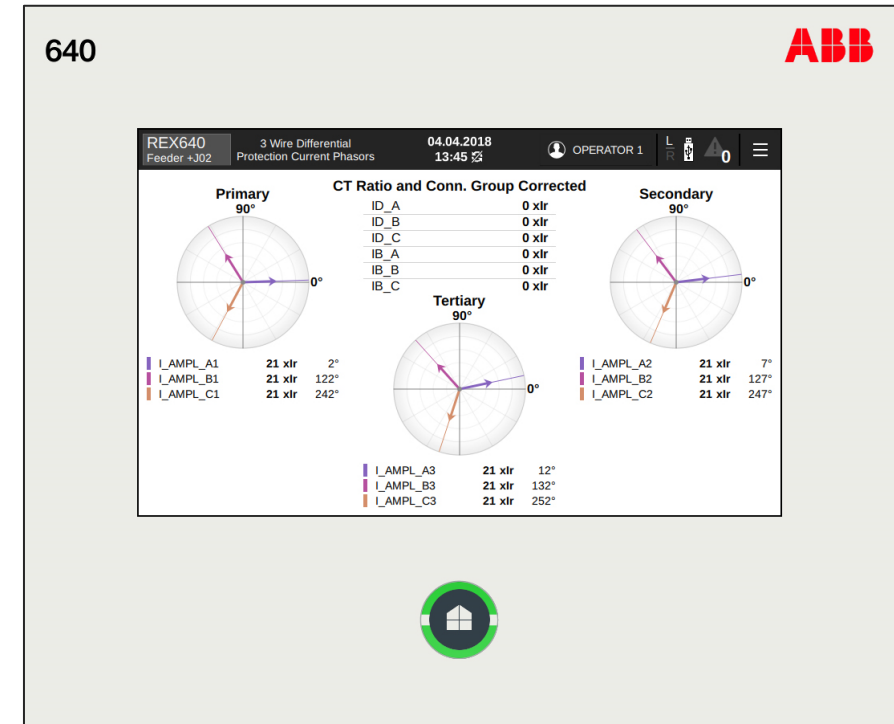
Customer values

Long-awaited ease of use with intuitive HMI

Increased situational awareness and optimal usability with application-driven local HMI (LHMI)/switchgear HMI (SHMI)

Novel 7-inch color touch screen for visualization of power distribution process information in an entirely new way

Ready-made application-based LHMI pages – saving both time and efforts



Long-awaited ease of use – supporting customers to make sense of complexities in evolving distribution networks

Application examples

Application examples

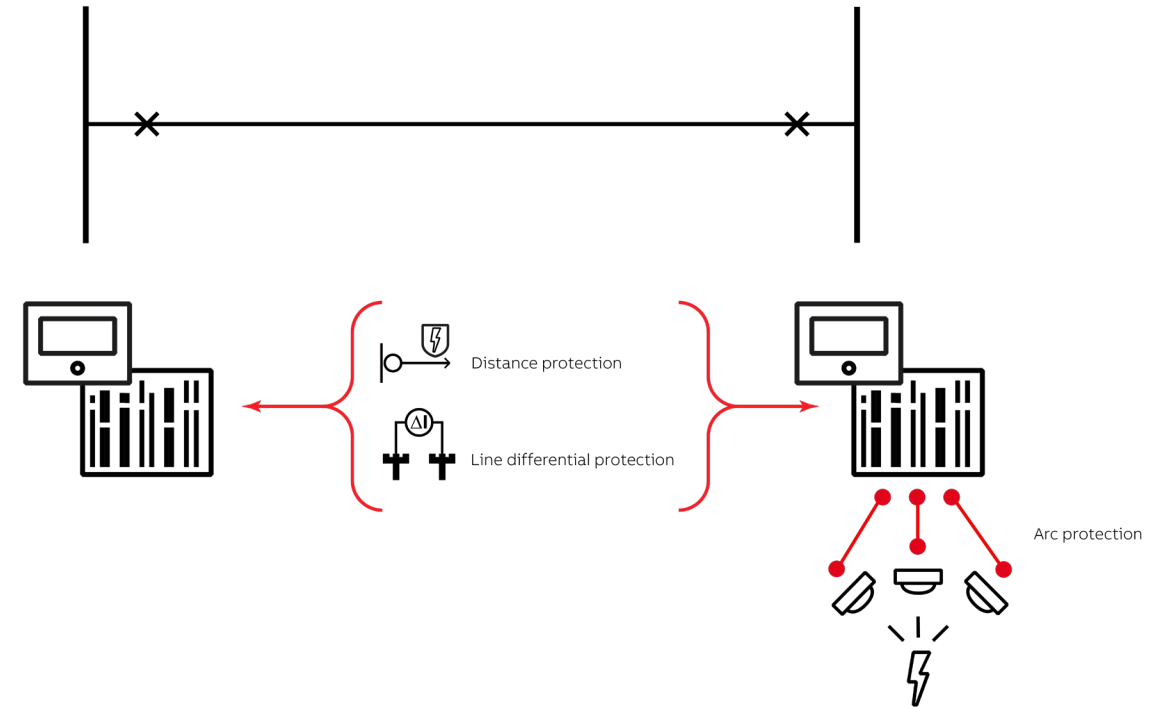
Complete application coverage with one device

Customer need

- One device for many different applications
- Easy to order, install and use
- Standardized solution for the complete installation

Solution

- Complete application coverage with one device for flexible, versatile and cost-efficient protection solutions
- Wide range of hardware modules available with up to 20 measurement channels for currents and voltages
- Ability to manage multiple applications simultaneously, such as:
 - Line distance, line differential and fault locator applications
 - Generator protection and synchronization applications



Application examples

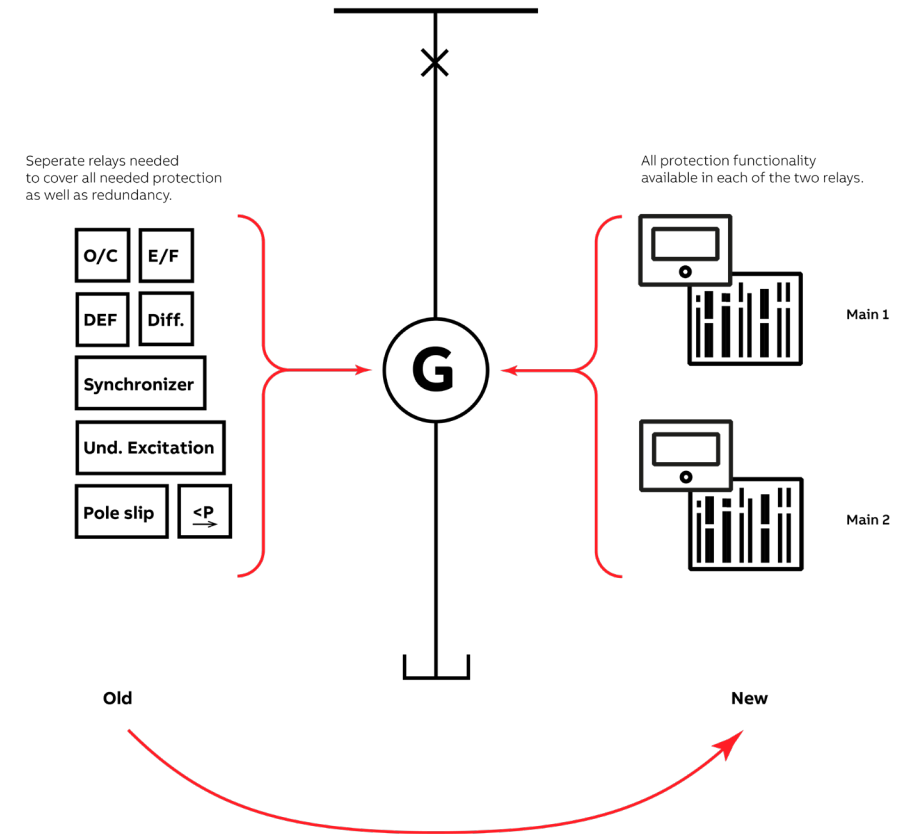
New philosophy for redundant protection functions

Customer need

- Redundant protection and control scheme that effectively utilizes overlapping functionality in installed devices to maximize return on investment (ROI) and minimize system downtime and maintenance
- Freedom and ability to build a protection scheme offering complete redundancy instead of partially overlapping protection functions
- Optimize spare unit management

Solution

- One relay capable of managing all necessary protection schemes
- Increased protection availability with two REX640 relays in parallel as Main 1 and Main 2



Application examples

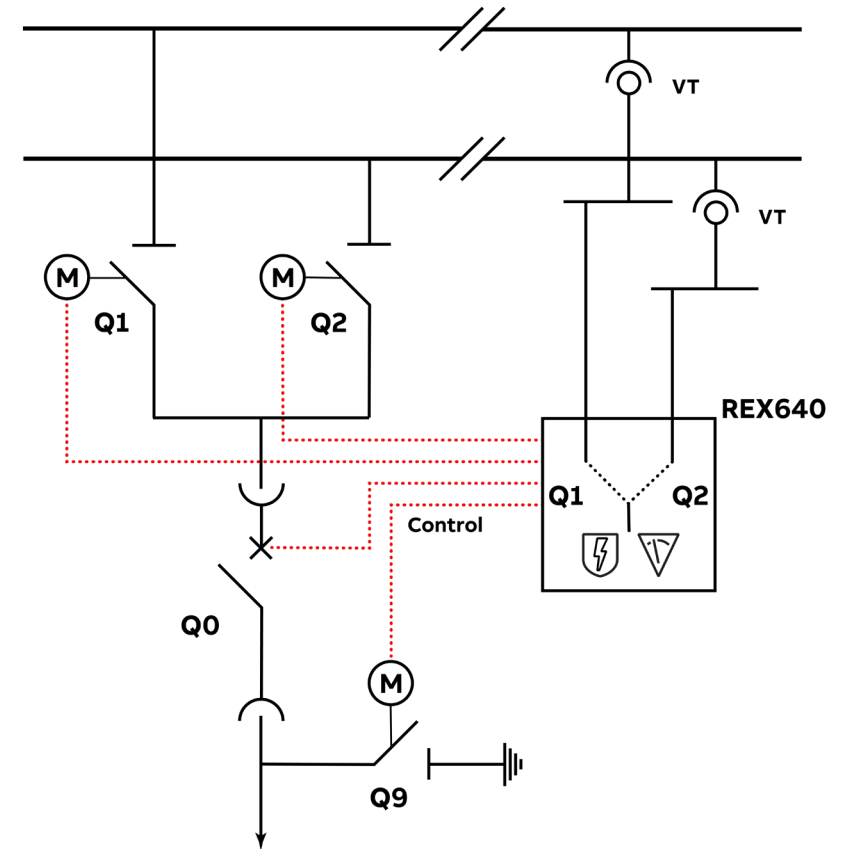
Complex switchgear requirements

Customer need

- Maximum availability of power at key points in the network – driving the need for more complex switchgear arrangements
- Avoid downtime during maintenance work
- Protection selectivity and sensitivity during network fault situations to minimize disturbances in power supply

Solution

- Suitability for both single and double-busbar applications
 - 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 circuit breakers, 14 disconnectors and 3 earthing switches)
 - A maximum of 20 analogue input channels



Application examples

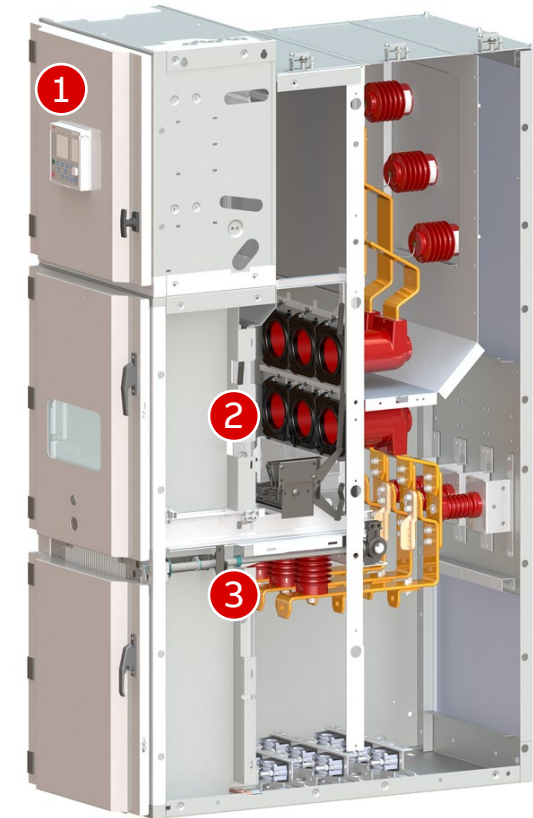
Digital switchgear

Customer need

- Increase switchgear supervision
- Reduce inter-panel wiring
- Increase flexibility to allow changes during the switchgear life cycle
- Minimize the need for inductive voltage transformers due to their increased failure rate over time

Solution

- Current measurement using standardized sensors (Rogowski coil) instead of customized current transformers
- Voltage measurement using standardized sensors (voltage dividers) instead of inductive voltage transformers
- Voltage measurement sharing across the switchgear using IEC61850-9-2 LE sampled measured values
- Transfer of binary information and commands using IEC61850-8-1 GOOSE messaging
- Supervised redundant IEC61850 communication between the relays
- Possibility to modify the functionality using ABB's relay setting and configuration tool – PCM600



- 1 Protection relay with IEC 61850
- 2 Current sensor
- 3 Voltage sensor

Application examples

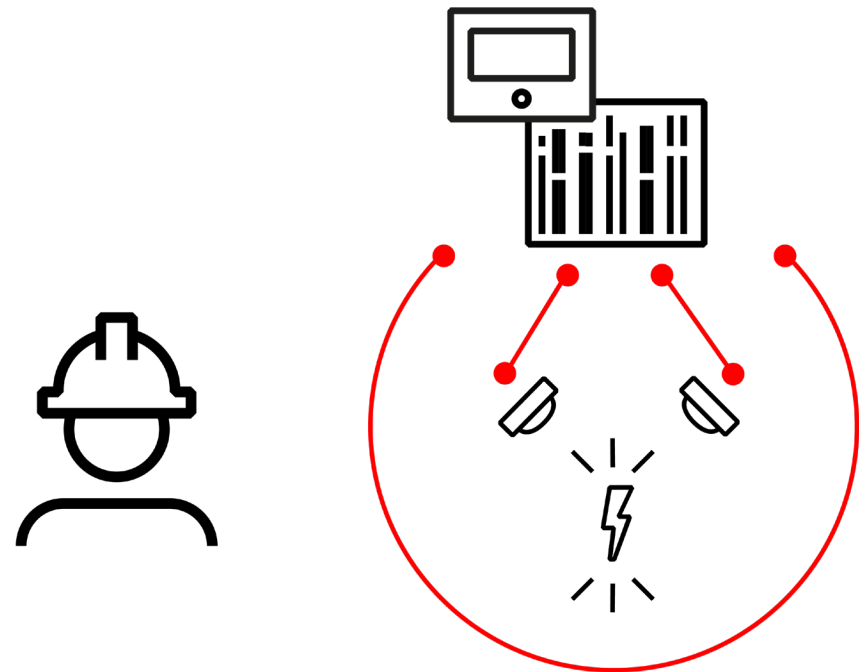
Arc protection

Customer need

- Added safety with flexible arc protection
- Selective tripping to minimize disturbances in primary processes
- Dependable arc protection with indication in case of failure
- Arc protection system incorporated into the overall protection scheme

Solution

- Increased selectivity with four sensor inputs – either loops or lenses
- Arc protection function integrated into the relay's self supervision
- Peace of mind with supervised sensors for increased dependability
- Minimized damage in case of an arc fault due to ultrafast operation of the static power outputs – with minimized downtime as a result
- Arc protection based on light, safeguarded by current measurement



Application examples

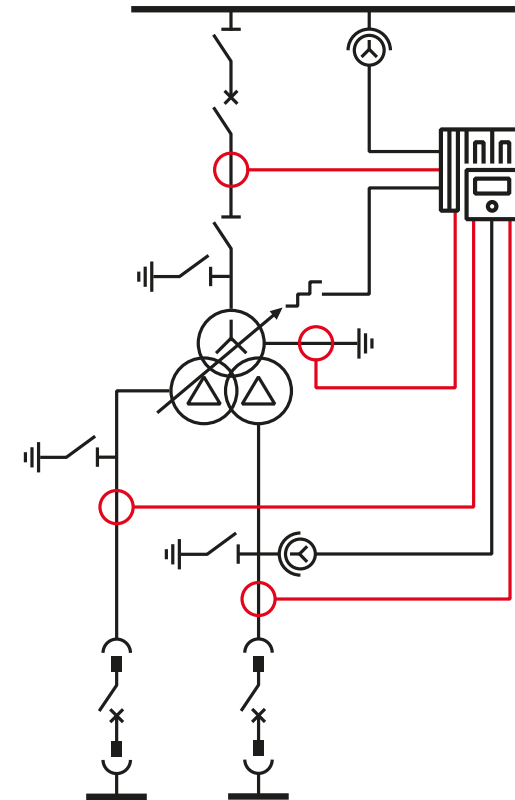
Transformer protection and voltage control

Customer need

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

Solution

- Differential transformer protection with either two or three restraints to guarantee protection stability in all possible fault locations
- Thermal overload protection, hotspot monitoring and RTD-based measurements for complete supervision of transformer load level
- On-load tap-changer controlled by an automatic voltage regulator (AVR)
 - Possible to control up to six parallel-running transformers using either the master-follower or minimizing circulating current principle
 - Complete visibility and control of the parallel-running transformer control process via the LHMI/SHMI
- Support for various specialized connection groups possible



Application examples

Distance protection

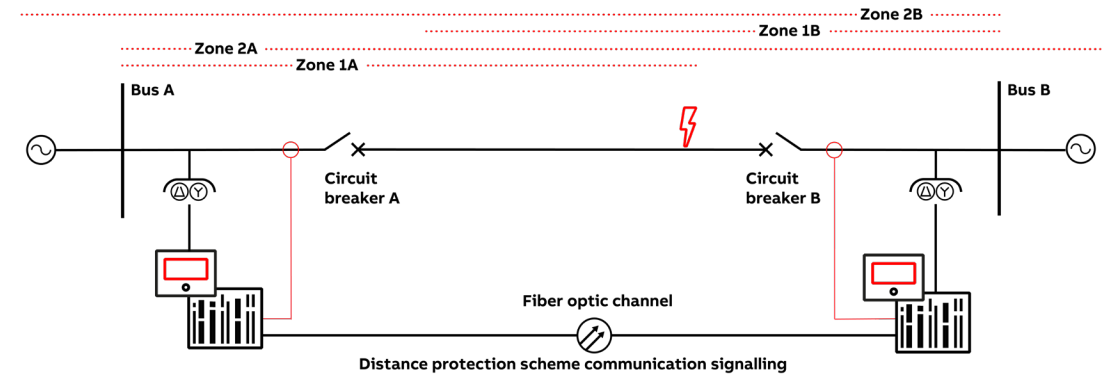
Customer need

- Protection of a feeder with varying fault current levels due to network switching and reconfiguration
- Protection of a feeder where the minimum fault current level is close to the maximum load current level
- Backup protection for the downstream network through multiple protection zones
- Prevention of operation during power system oscillations (power swings)

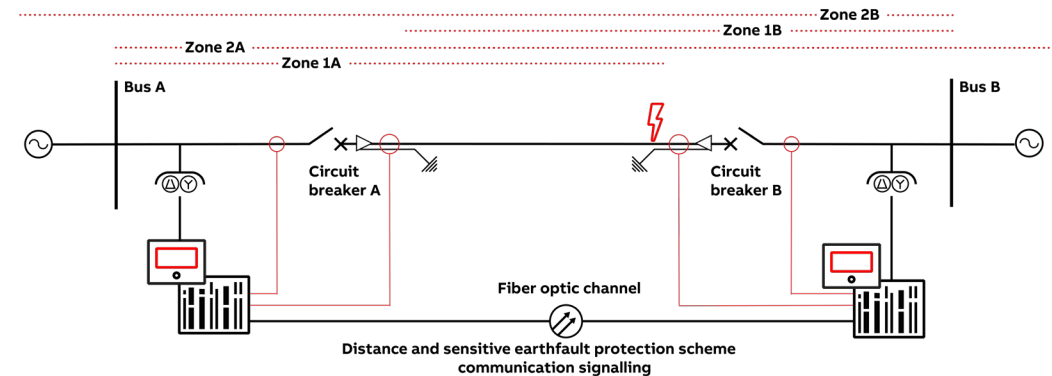
Solution

- Full-scheme line distance protection with five protection zones
- Unit-type protection possible for the feeder with scheme communication for improved protection selectivity and speed of operation
- Dedicated optical protection communication channel for distances up to 50 km for unit-type protection
- Distance protection in combination with line differential protection
- Possibility to block selected distance protection zones using power swing blocking functionality

Distance protection against phase and earth faults (EF)



Additional sensitive blocking based directional EF protection



Application examples

Line differential protection

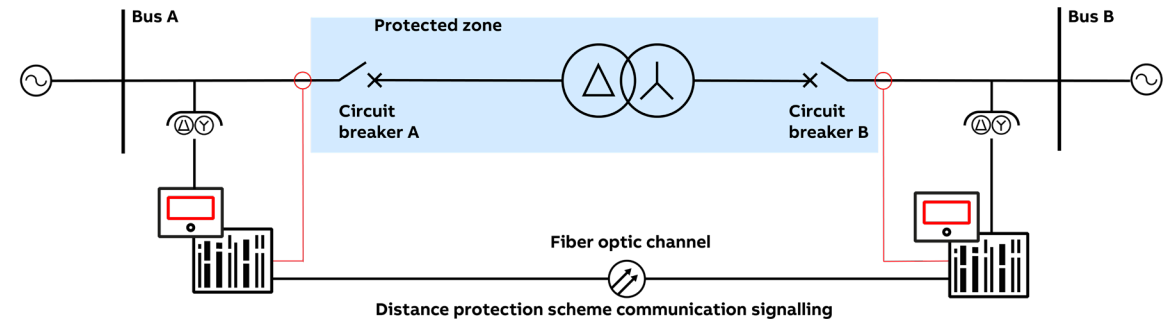
Customer need

- Protection of a feeder with a power transformer within the protection zone
- Protection of a feeder where the minimum fault current level is close to the maximum load current level
- Protection of a closed ring-type network
- Unit protection of an interconnection feeder between two substations with backup protection

Solution

- Two-stage phase-dedicated line differential protection
- Support for compensation of the transformer connection group
- Dedicated optical protection communication channel for distances up to 50 km
- Supervision of the protection communication channel to prevent protection malfunction
- Directional overcurrent protection as backup
- Unit-type earth-fault protection utilizing either blocking or unblocking schemes
- Line differential protection in combination with distance protection

In-Zone transformer



Application examples

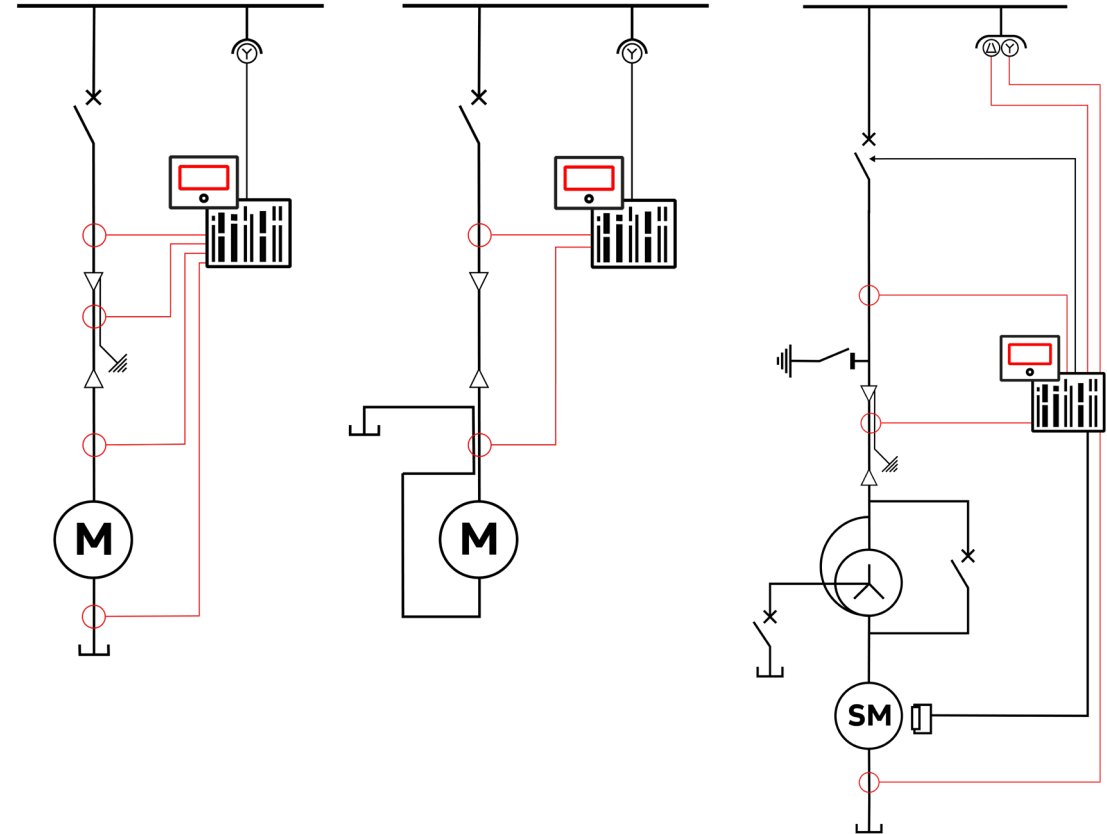
Motor protection

Customer need

- Ensure the thermal-overload threshold is not exceeded
- Visualize the thermal load in real time
- Different types of motor differential protection functions depending on the motor
- RTD-based thermal supervision and protection
- Ensure motors responsible for critical processes keep running or can be restarted irrespective of the thermal load level

Solution

- Visualization of the thermal load level via the LHMI/SHMI
- Time-to-restart countdown after a thermal overload trip (visible on the LHMI/SHMI) – including 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)



Application examples

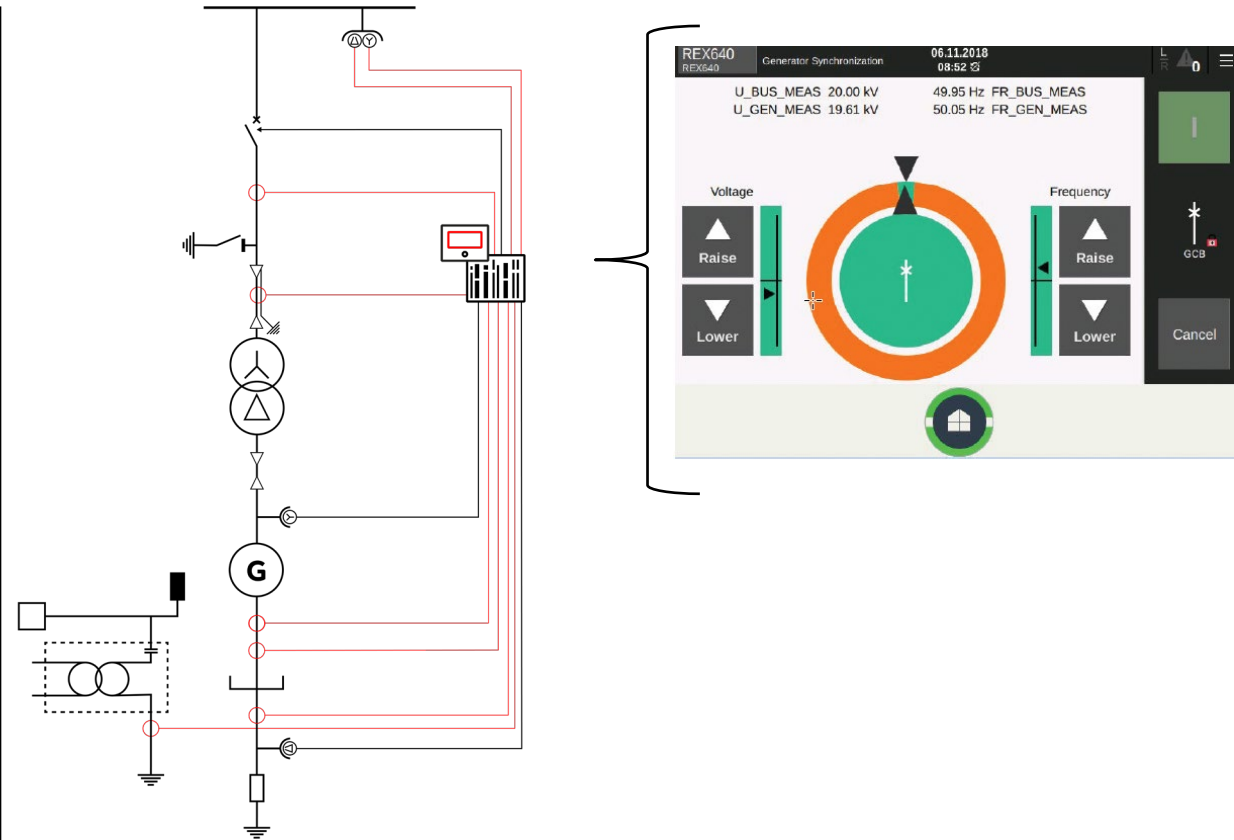
Generator protection

Customer need

- Protection of synchronous generators of varying sizes
- Main protection to be available as early as possible during the generator start-up sequence
- Synchronization of generators to the power grid or other external power sources

Solution

- Frequency adaptiveness for protecting generators already at start-up
 - From 0.2x to 1.5x nominal frequency
 - Voltage-based frequency tracking with current-based tracking as backup
 - Current-based frequency tracking in case of no available voltage inputs
- Generator synchronization available as an application package
- Visualization and local control of the synchronization process via the LHMI/SHMI



Application examples

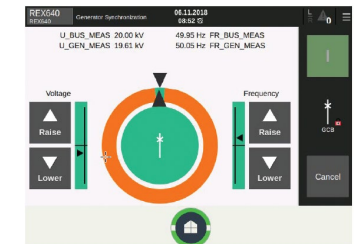
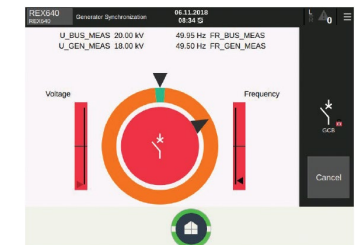
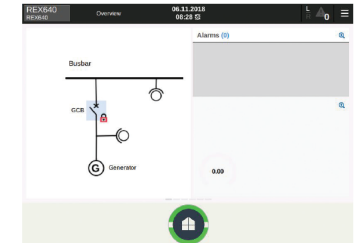
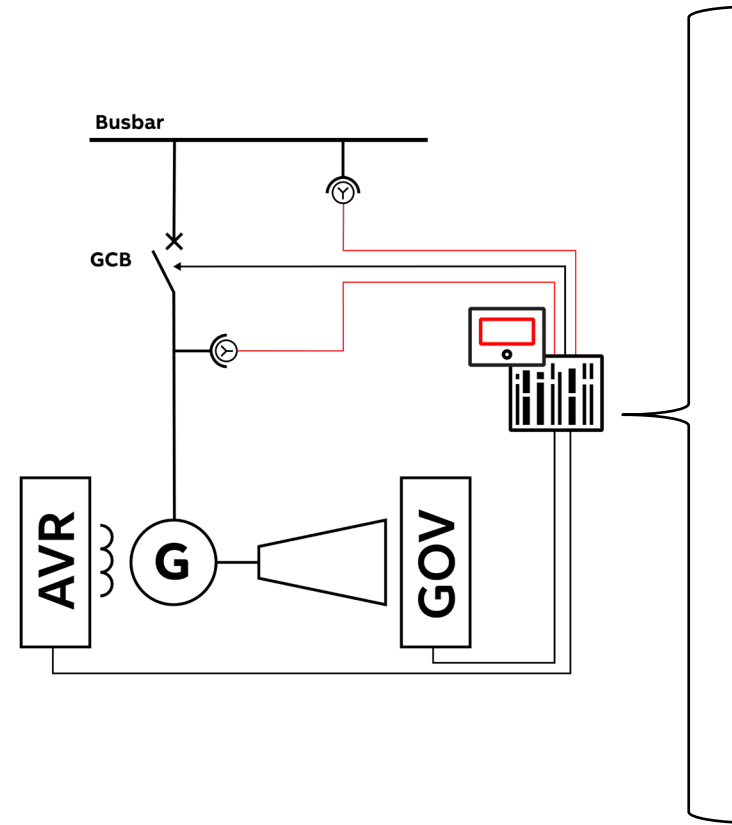
Generator breaker synchronization

Customer need

- 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

- Generator breaker synchronization as an additional application package to the machine protection application package
- Autosynchronization functionality for synchronizing each generator breaker closing individually
 - Operation according to given conditions and with minimal additional stress for the generator and prime mover
- Visualization and local control of the synchronization process via the LHMI/SHMI
- IEC 61850 MMS and Modbus communication channels for upper-level visibility and control



Application examples

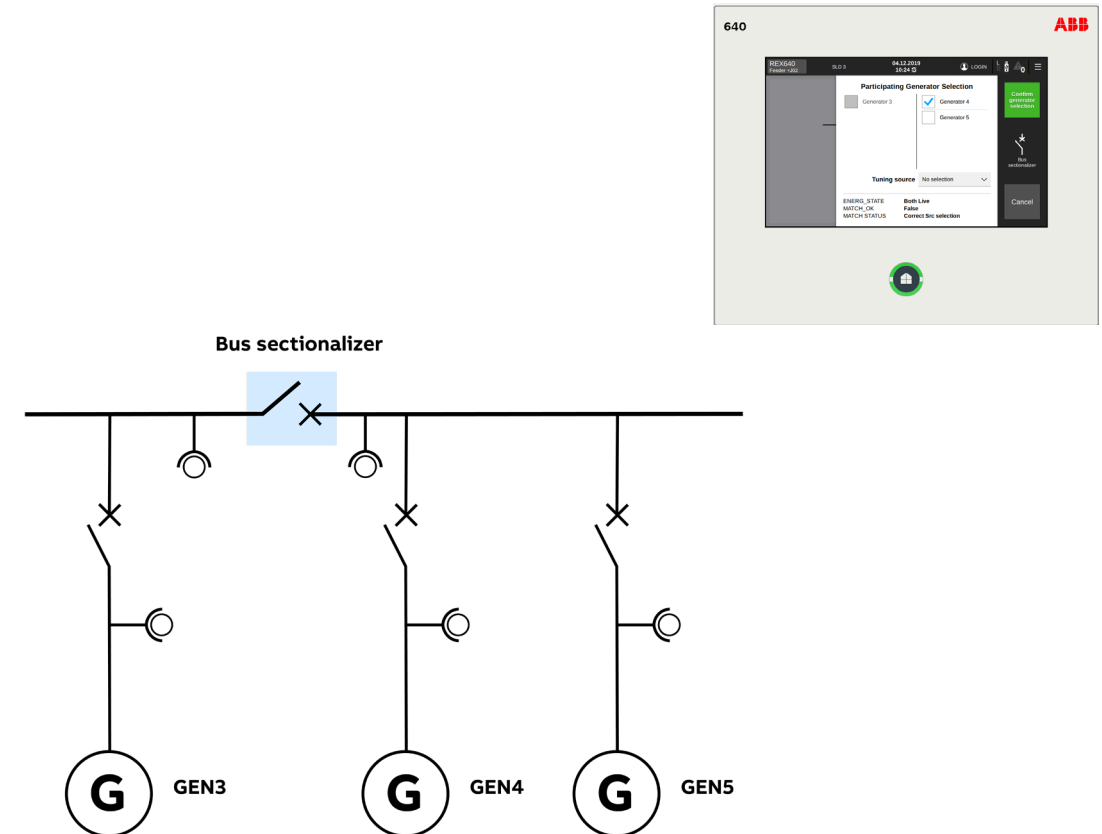
Non-generator breaker synchronization

Customer need

- Possibility to synchronize both generator breakers and non-generator breakers
- A synchronization system that engages the right generators of the available ones
- Simple system that is continuously monitored with notification of possible defects already before the need for operation arises

Solution

- Non-generator breaker synchronization as an additional application package (Network autosynchronizer)
- Modeling of the network switching status to ensure engaging the right generators of the available ones
- Visualization and local control of the synchronization process via the LHMI/SHMI
- IEC 61850 MMS and Modbus communication channels for upper-level visibility and control
- A maximum number of 8 generator breakers and 17 non-generator breakers
- IEC 61850 GOOSE communication between the REX640 relays – no need for a dedicated synchronization panel, reducing overall system costs



Application examples

Diesel generator monitoring

Customer need

- Identify and disconnect an oddly behaving diesel generator set before the fault cascades into the neighboring units and causes a complete shutdown

Solution

- Monitoring of up to 8 diesel generator sets running in parallel
- Identification and reporting of an abnormally behaving diesel generator set and ultimately disconnecting it from the network
- Detection of under or over fueling of the engine
- Detection of under or over excitation of the generator



Application examples

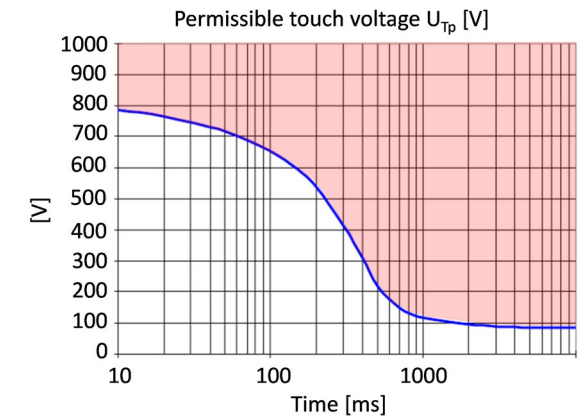
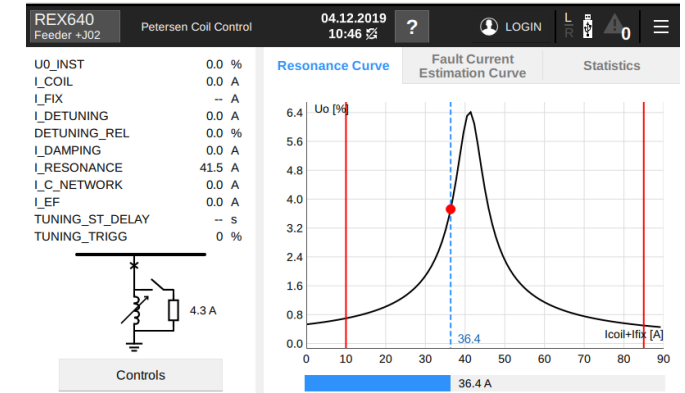
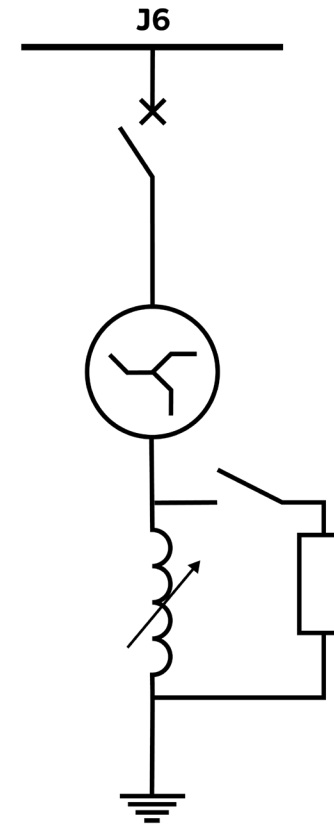
Earth-fault protection and Petersen coil control in compensated networks

Customer need

- Sensitive and selective earth-fault protection in compensated networks, including protection against intermittent earth faults
- Capability to manage earth faults when the Petersen coil is disconnected for maintenance
- Disconnect earth faults fast enough to ensure the permitted touch voltage levels are not exceeded
- Avoid unnecessary supply breaks in case of self-clearing earth faults
- Petersen coil controller that can also manage control of a fixed coil connected in parallel
- Petersen coil controller capable of controlling the loading resistor according to a preset logic

Solution

- Application package for automatic control of the Petersen coil – enhanced by the measured coil current and driven by the desired compensation degree
- Multi-frequency admittance-based earth-fault protection (MFA) for all types of earth fault and switching condition, both when the Petersen coil is connected and disconnected
- Touch voltage-based earth-fault protection for calculating the fault current at the fault location and estimating the resulting hazardous touch voltage
 - Varying operation delay, dependent on the estimated hazardous touch voltage, for ensuring the touch voltage remains within permitted limits



Application examples

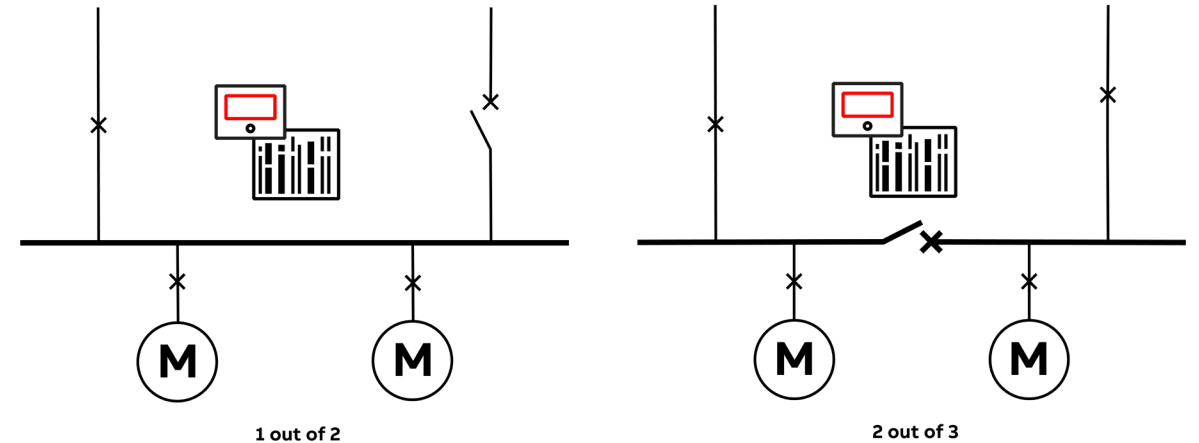
Time delay-based transfer schemes for LV/MV applications

Customer need

- Cost-efficient, time delay-based transfer solution for non-critical parts of the manufacturing process
- Automatic voltage recovery after a main feeder fails in a multifeeder system
- Automatic voltage recovery without damaging motors when the failing main feeder is disconnected and the alternative feeder is switched on
- Support for both automatic and manual transfer schemes

Solution

- Capability to handle a 2-out-of-3 automatic transfer scheme application with a single device (also 1-out-of-2)
- Enhanced customizable user interface for visualization of current scheme status and multiple control options
- Supported transfer modes*:
 - Residual voltage-based transfer
 - Time delay-based transfer



Application examples

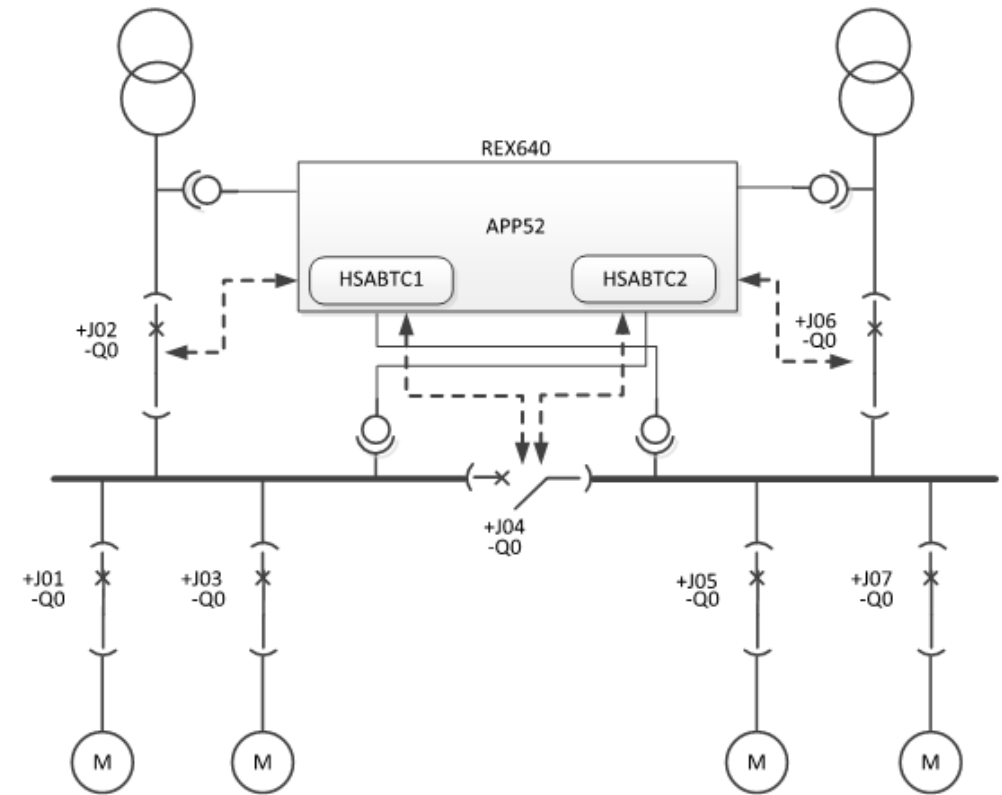
High-speed transfer device (HSTD)

Customer need

- Secure electrical supply for motors that operate critical parts of a manufacturing process by disconnecting a failing incoming feeder and closing the bus sectionalizer
- Ensure as fast a transfer as possible to minimize the impact on the manufacturing process
- Possibility to initiate manual transfer

Solution

- Continuous supervision of the main feeders and bus sections to ensure an optimal transfer and minimize the impact on the manufacturing process
- Supported transfer modes:
 - Fast transfer (simultaneous or sequential circuit breaker control schemes)
 - Transfer at first phase coincidence
 - Residual voltage or time delay-based transfer
- Transfer triggering options:
 - Internal voltage or frequency-based triggering
 - External protection-based triggering
 - Manual triggering



Application examples

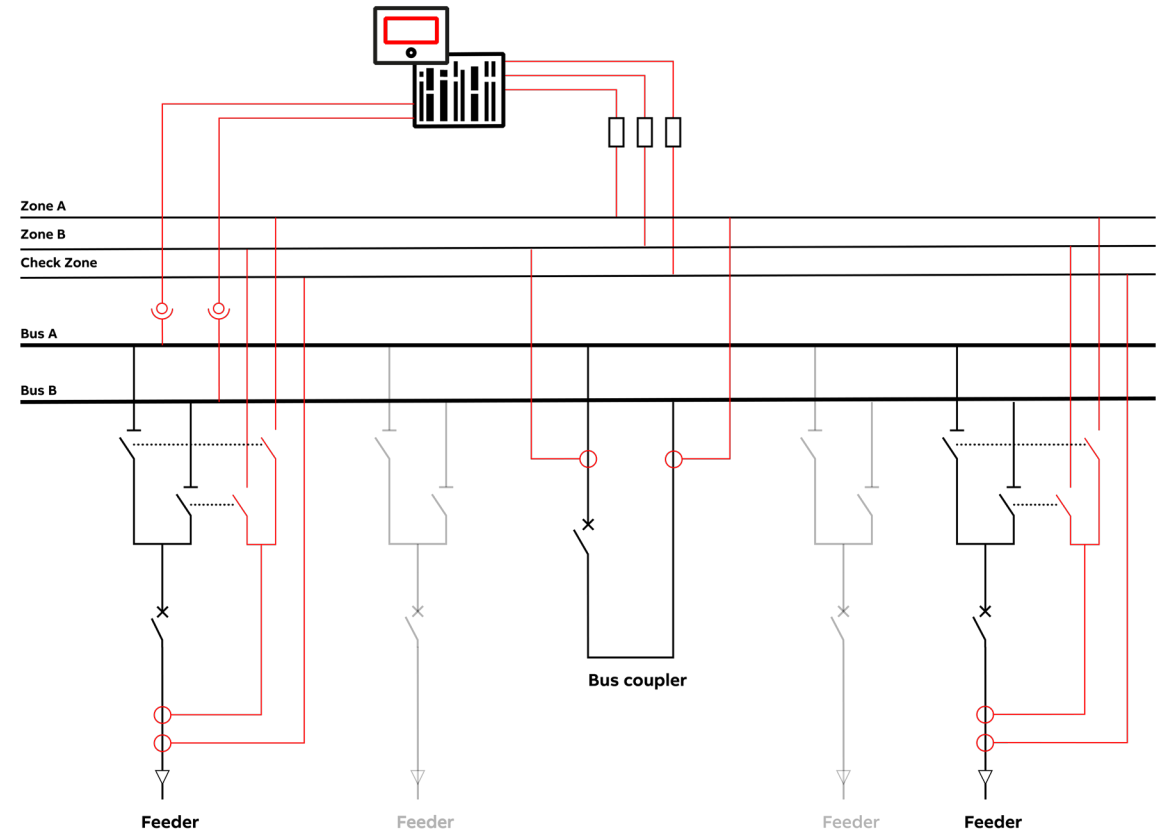
High-impedance busbar protection

Customer need

- Retrofit existing high-impedance busbar protection with a numerical relay
- Possibility to use the same relay for busbar voltage and frequency protection

Solution

- All required functionality in one device for easy replacement of existing relays - without having to make any changes to the protection philosophy
- Voltage and frequency protection functionality already included – minimizing the number of replacement relays



Application examples

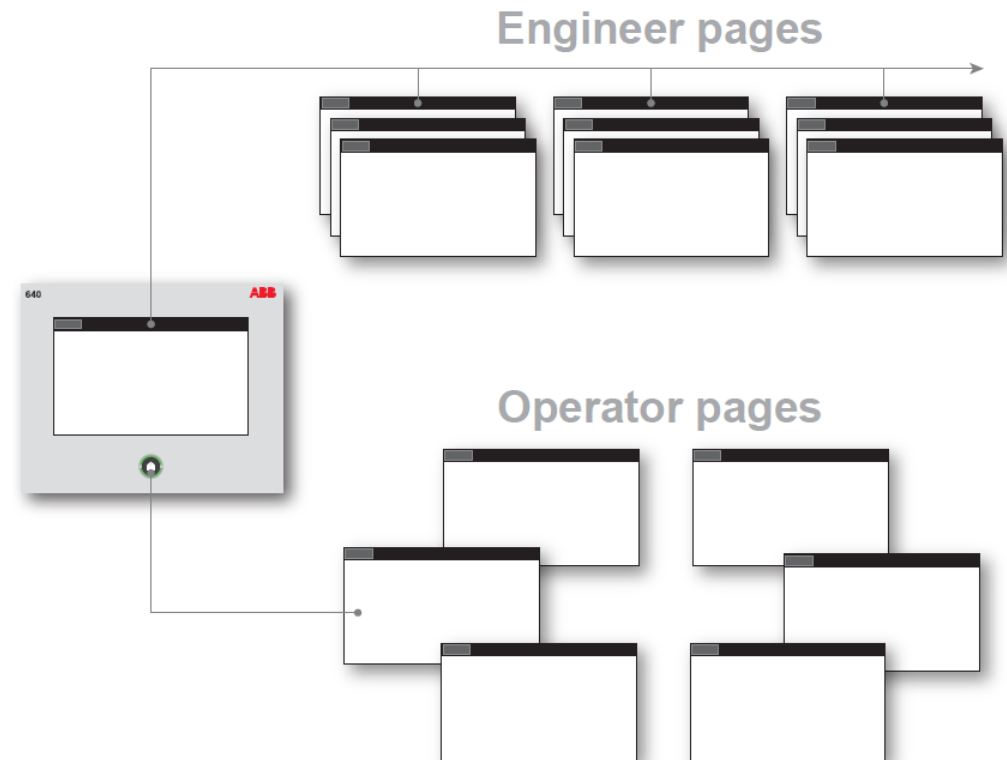
LHMI/SHMI – a whole new experience

Customer need

- Increase the situational awareness
- Possibility to customize the information displayed via the HMI
- Easy-to-use and intuitive interface
- Improve the user interface for system testing
- Visualize the power distribution process information

Solution

- Increased situational awareness and optimal usability with application-driven local LHMI/SHMI
- Complete switchgear lineup status visible via the optional SHMI – capable of covering up to 20 REX640 relays – with full LHMI functionality available on bay/panel level
- Ready-made application-based pages to minimize the need for graphical engineering – saving both time and efforts
- Possibility to customize symbols and pages, if necessary, using PCM600



Application examples

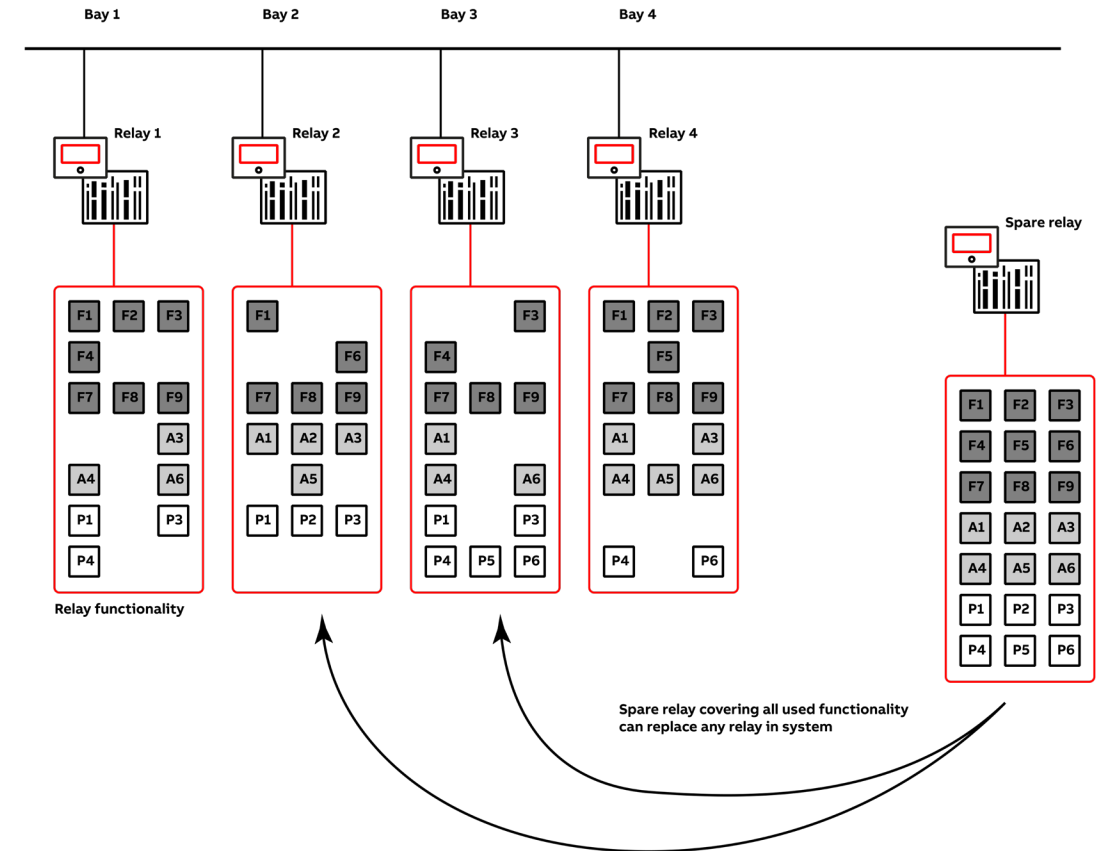
Super substitute

Customer need

- Easy and cost-effective way to manage spares and minimize the need for spare units on-site
- Possibility to manage spares without engineering tools or specialist services
- Quick turnaround times for replacing or exchanging complete relays or modules

Solution

- Same spare unit suitable as substitute for any REX640 relay as one relay covers all applications
- Visualization of both the problem and the fault location via the LHMI/SHMI
- LHMI/SHMIs and relays saving backups of each other's configurations for fast and easy replacements if necessary
 - No need for additional software tools with instructions via the LHMI/SHMI



Application examples

Modification after delivery

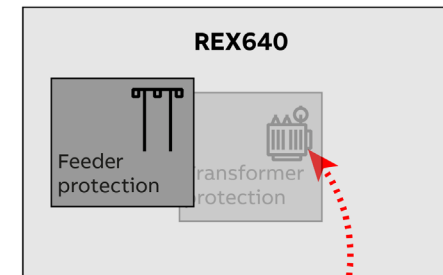
Customer need

- A wide range of relay functionality to allow keeping relays in store for fast and easy adaptation to new project deliveries – avoiding the impact of delays related to customs and delivery processes
- Ability to make fast adjustments to the relay functionality before commissioning in the event of late changes to the project specification
- Possibility to upgrade or adjust existing protection functionality throughout the relay life cycle
- Possibility to relocate the existing relay to serve a different application

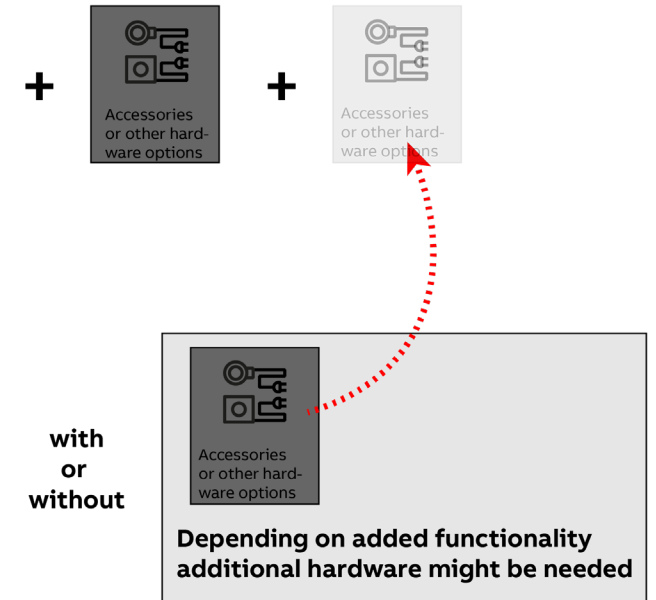
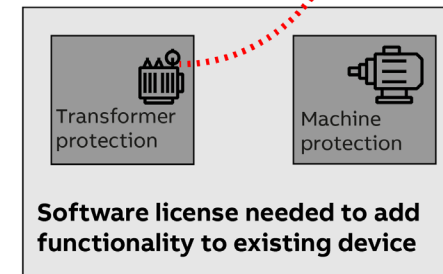
Solution

- Freedom to add and modify hardware and software for the lifetime of the relay
 - Add/upgrade functionality to the installed software
 - Add/change type of hardware modules in the relay
- Easy-to-use interface for modifications after delivery – PCM600 is utilized in this process and no special certification needed to perform these tasks

Existing device variant



Requested modification



ABB