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# Digital medium voltage switchgear

UniGear Digital- Innovative solution for medium-voltage switchgear





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## **Nontiwat Charoenbunyarit**

นนทิวัฒน์ เจริญบุญญาฤทธิ

Product Marketing Specialist

Distribution Automation

Electrification business

### **ABB ELECTRIFICATION (THAILAND) CO., LTD.**

297 Moo 4, Bangpoo Industrial Estate, Soi 6

Sukhumvit Road, Praeksa, Samutprakarn 10280, Thailand

Phone: +66 (0) 2665 1000

Mobile: +66 (0) 84 875 8515

Email: [nontiwat.charoenbunyarit@th.abb.com](mailto:nontiwat.charoenbunyarit@th.abb.com)

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# Type of medium voltage switchgear

# Medium Voltage Switchgear

Air-insulated primary switchgear, IEC type



## Air-insulated primary switchgear - UniGear

- Types and Ratings
  - Type ZS1, up to 4000 A / 50 kA at 12 kV and 2500 A / 31.5 kA at 24 kV
  - Type ZVC, compact motor control panel for ZS1 up to 50 kA and 7,2 kV
  - Type ZS2, 36 kV panel for 2500 A and 25 kA
  - Type ZS3.2,36/40,5 kV up to 3150A and 31.5 kA
- Features
  - Cassette type, fixed or floor rolling breakers
  - SF6 or vacuum interruption
  - Standard or compact panels
  - Double level (2 high CB panels)
  - Double busbar panels
  - Integrated sensors and controls as required
  - Fully arc tested

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# Medium Voltage Switchgear

Gas-insulated primary switchgear



## Gas-insulated primary switchgear – ZX

- Types and Ratings
  - Single busbar
    - ZX0 (...24kV,...1250A , ...25 kA)
    - ZX1.2 (...40.5kV, ...2500A , ...31.5 kA)
    - ZX1.5 (as ZX1.2 , 95 kV –1 min)
  - Single or Double busbar
    - ZX2 (...40.5kV, ...4000A , ...40 kA,)
    - ZX2.2 (as ZX2 , ANSI )
- Features
  - Medium voltage area shielded from surrounding
  - Independent of environmental conditions
  - Increased lifetime & safety
  - Reduced dimensions
  - Busbar -Plug technology for quick and safe installation

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# Medium Voltage Switchgear

Air-insulated secondary switchgear



## Air-insulated secondary switchgear - Unisec

- Ratings
  - up to 24kV, 1250A , 20kA (24kV), 25kA (12kV)
- Types
  - Unisec
- Features
  - Broad product portfolio, both functionally & accessories-wise
  - Broad application range, industrial, utility & infrastructure applications
  - Easy installation & maintenance
  - Flexible protection

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# Medium Voltage Switchgear

Gas-insulated secondary switchgear



## Gas-insulated secondary switchgear - Safering and Safeplus

- Ratings
  - up to 36kV, 630A, 20kA (\*25kA)
- Types
  - Safering and Safeplus
- Features
  - Flexible connections for quick installation
  - Completely insulated design
  - Compact
  - “Maintenance free”



# Digital medium-voltage switchgear

Definition



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# Digital medium-voltage switchgear

What is it?

## Definition

As a part of the ABB Ability™ portfolio of connected solutions, digital switchgear enables smart electrical networks that deliver power reliably and efficiently.

Digital switchgear combines the latest digital technologies within ABB's well-known and established medium-voltage switchgear and brings increased flexibility, reliability and safety, and additionally reduces switchgear weight, footprint and delivery time.

ABB's digital switchgear solutions integrate innovative protection, control and sensing devices, where all measures, statuses and commands are reliably transferred on a real-time Ethernet communication bus over the IEC 61850 protocol.

Digital switchgear enables pro-active management of the medium-voltage equipment throughout their entire life cycle. It enables easy integration to increase smart functionality, such as power management, real-time diagnostics and remote monitoring.



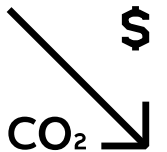
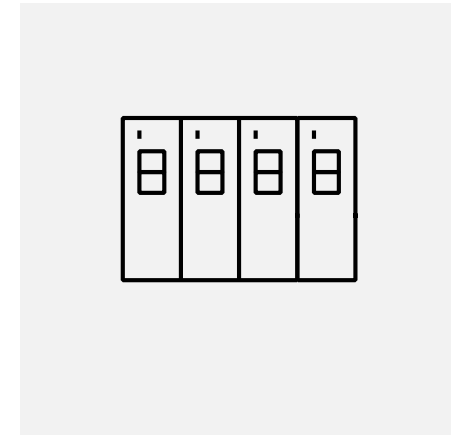
# Benefits of UniGear Digital

# Benefits of UniGear Digital

## Overview

### Main benefits

- Increased safety
- Energy-efficient and climate-friendly
- Increased flexibility
- Reduced footprint: 10% less space needed
- Optimized weight: up to 15% weight reduction
- Faster delivery time: up to 30% faster delivery
- Faster installation and commissioning: 25% reduction
- Increased switchgear reliability
- Increased system reliability



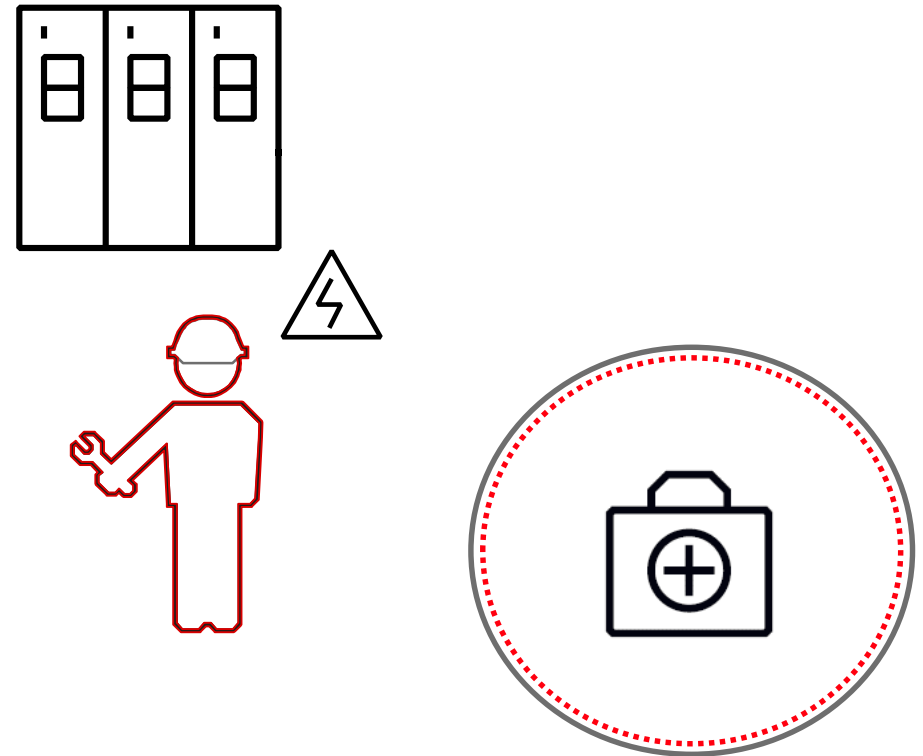
# Benefits of UniGear Digital

## Increased safety

### Safer switchgear operation

Sensor technology for current and voltage measurement ensures a safer working environment for personnel

- When testing current and voltage signal secondary circuits, personnel is not exposed to high-voltage
- Sensors are easier to work with compared to conventional metering transformers, minimizing risk of human errors
- Less material exposed to high-voltage electrical stress, decreasing risk of failure



# Benefits of UniGear Digital

## Energy-efficient and climate-friendly

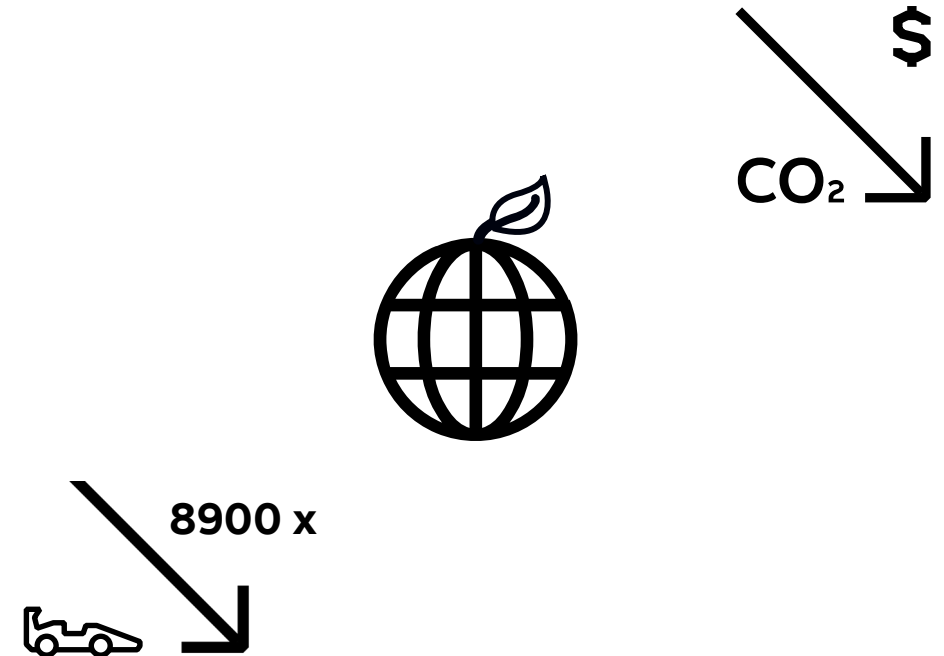
### Reduced environmental impact

Energy loss is minimized with the use of sensors

Reduced resource consumption in manufacturing

During 30 years of operation, 14 panels of digital switchgear (incl. 42 sensors)

- Lowers energy consumption up to 250 MWh
- 1 MW is equivalent to the power produced by 10 car engines, so the energy saved can power 8,900 Formula-E race cars from start to finish in one race
- Saves up to 150 tons of CO<sub>2</sub>
  - the same amount as the emissions from a mid-size car driven for 1 250 000 km
  - It takes 8200 trees one whole year to absorb that amount of CO<sub>2</sub>
- Cost savings: 51 380 EUR (with price of energy 20 cent EUR/kWh)



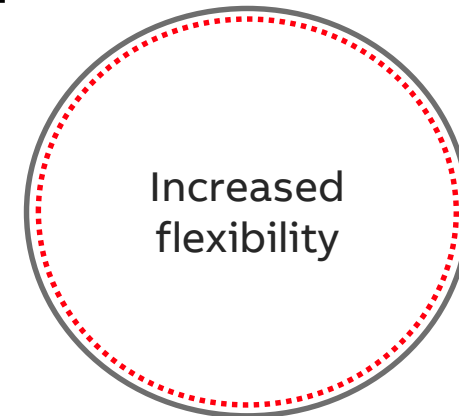
# Benefits of UniGear Digital

## Increased flexibility

### Adapt easily when requirements change

You can adapt the switchgear as the requirements in your network change, e.g. feeder current

- Digital switchgear can be adapted even at the final stage of the manufacturing process
- Changes can be applied via updating parameters or logics in a protection relay, no need to replace components
- IEC 61850 is future-proof standard, which ensures efficient future updates



# Benefits of UniGear Digital

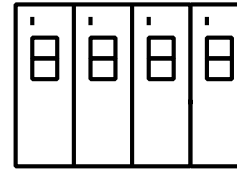
## Reduced footprint

### Reduced space requirement

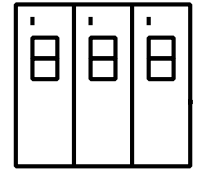
Up to 10% reduced switchgear footprint

- Minimized switchgear footprint as generally the busbar metering cubicle(s) can be omitted, because voltage sensors are more compact and fit to be placed in another panel
- New generation of sensors are a perfect fit in switchgear, requiring less space and they weigh less

Conventional switchgear



Digital switchgear



10%  
less space  
needed

# Benefits of UniGear Digital

## Optimized weight

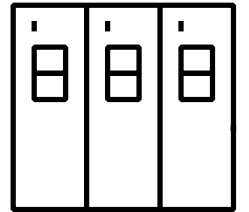
### Reduced switchgear weight

Lowered impact on site

- Metering cubicle is not needed
- Sensors are small and weigh less than current instrument transformers (CT) and voltage transformers (VT)
- CTs and VTs weigh 18-27 kg and sensors only 0.5-2 kg
- Weight reduction is up to 130 kg per panel
- Support structures and room layout can be adapted to lower weight

Up to  
**15%**  
weight  
reduction

Digital switchgear





# Benefits of UniGear Digital

## Faster delivery time

### 30% faster delivery

Shorter time from ordering to operation

- Digital switchgear can be delivered faster thanks to
  - One size fits all with sensor technology and is faster than engineering of CT/VTs
  - Range is wider and the same sensor can work for many different needs
  - Sensors available on stock
  - Need for configuration in hardware wiring is minimized, as changes can be made using the software logic in the protection relays



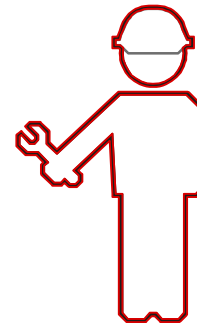
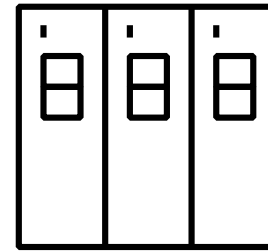
# Benefits of UniGear Digital

## Faster installation and commissioning

### Reduced time spent on installation and commissioning

Reduced time spent on installation and commissioning activities on site, thanks to:

- Fewer panels to be installed
- Less inter-panel cabling
- Fewer components to test in the low-voltage compartment
  - The switchgear can be delivered pre-tested, which minimizes amount of time needed for commissioning
  - For example, with a 30 panel switchgear line-up, the time saved on installation is up to two working days
- If the customer requires modifications in the commissioning phase, they can be done quickly in the protection relays, generally not requiring hardware changes



# Benefits of UniGear Digital

## Increased switchgear reliability

### Increased reliability

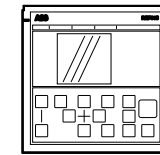
Digital switchgear is based on ABB's well-known and established switchgear hardware platforms, but uses sensors

- With sensors less human interaction is required, which leads to decreased risk of malfunction
- Sensors are smaller, reduce risk of isolation degradation in the switchgear
- Sensors are immune against grid disturbances, such as ferro-resonance phenomena

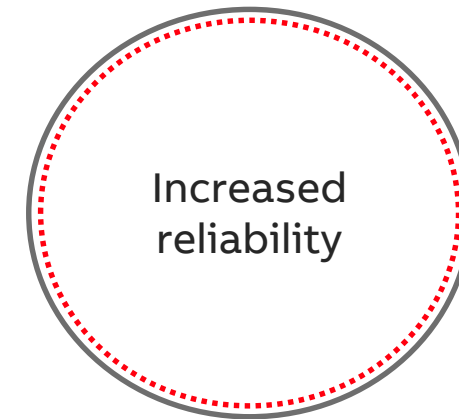
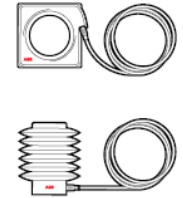
#### Digital communication

- Permanent active supervision of wiring and signal transfer with IEC 61850 digital communication to enable fast and precise actions in case of failures

#### Digital switchgear



IEC 61850



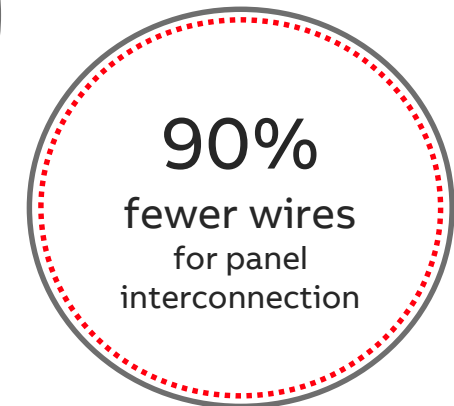
# Benefits of UniGear Digital

## Increased system reliability

### Benefits of IEC 61850 communication

Fast and reliable communication with IEC 61850, the global standard for communication in substations

- In conventional switchgear, a complex scheme requires large amounts of wires to be connected between the cubicles; with digital switchgear a self-supervised communication cable passes that information from cubicle to cubicle
- Flexibility to adapt and change the switchgear, without costly and time-consuming physical re-wiring and changing panel hardware
- Using the programmable logic in the protection relays changes are done easily and faster
- GOOSE (Generic Object Oriented Substation Event) communication between the station equipment for improved speed and reduced switchgear cabling
- Fewer wires reduces risk of failures





# UniGear Digital

Overview

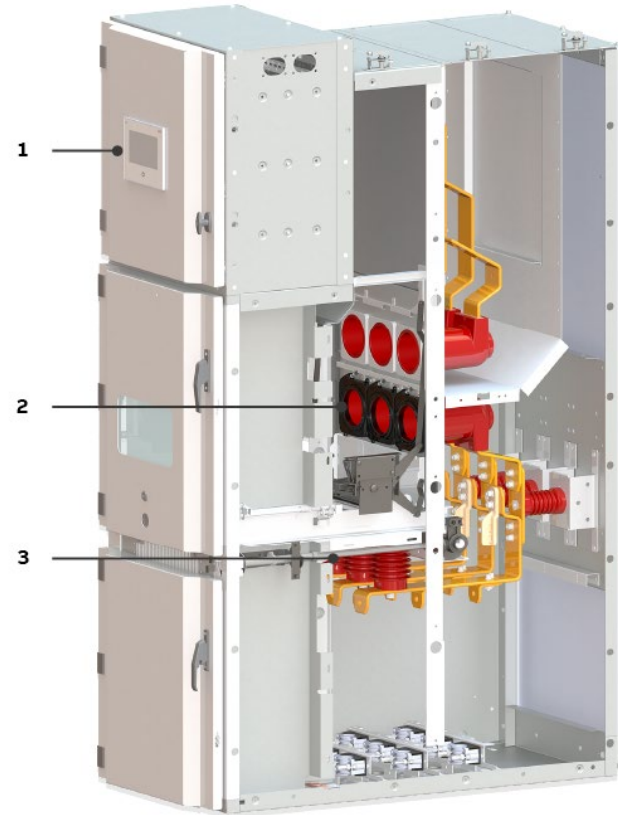
# UniGear Digital

## Features

### UniGear Digital

Same design platform as conventional UniGear panels

- Same robustness, safety and level of experience as conventional UniGear
- Simplified arrangement for current and voltage measurement, using sensors instead of conventional instrument transformers
- Conventional current and voltage transformers can be added for specific metering and protection requirements
- UniGear Digital features Relion 615 and 620 series and REX640 protection and control relays
- Horizontal exchange of GOOSE and IEC 61850-9-2 sampled analog values reduces wiring and accelerates testing and commissioning time
- Easy integration to increase smart functionality, such as remote condition monitoring and asset health for electrical systems as part of ABB Ability offering



1. Relion protection relay with IEC 61850
2. Current sensor
3. Voltage sensor

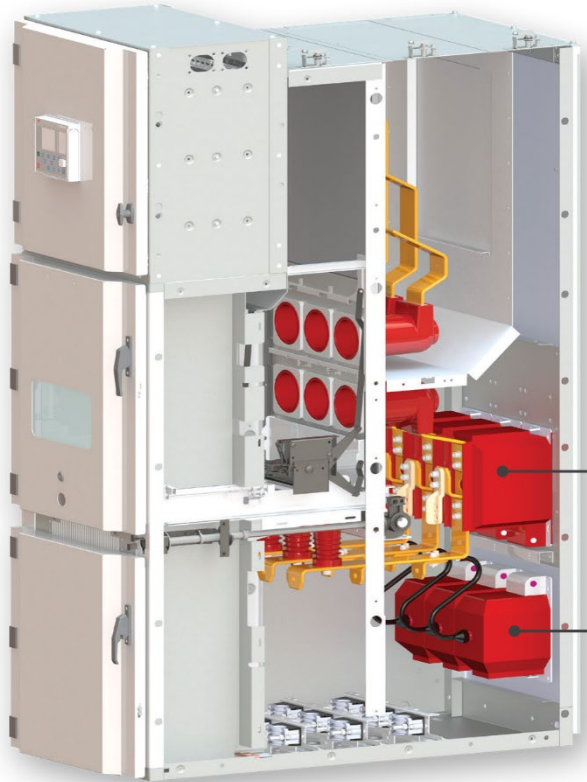
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# UniGear Digital

Instrument transformers versus sensor technology

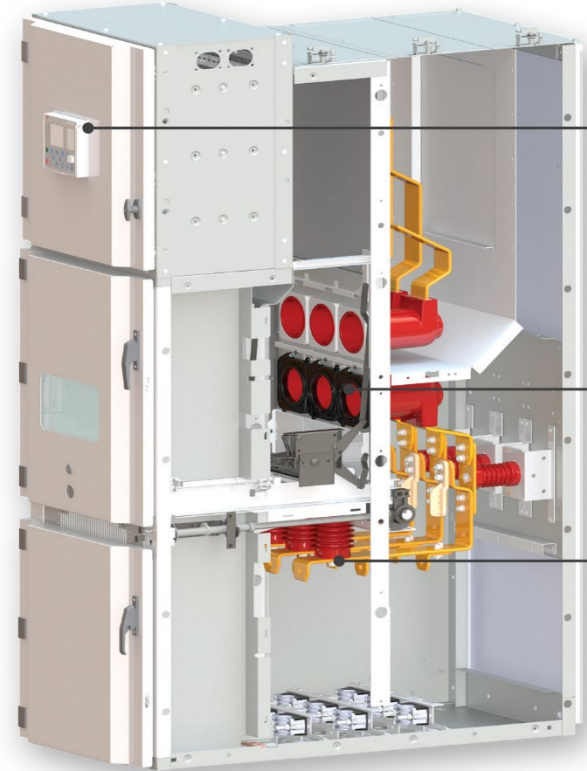
# Conventional versus digital switchgear

Sensors require less space



Conventional UniGear with instrument transformers

1. Current transformer
2. Voltage transformer



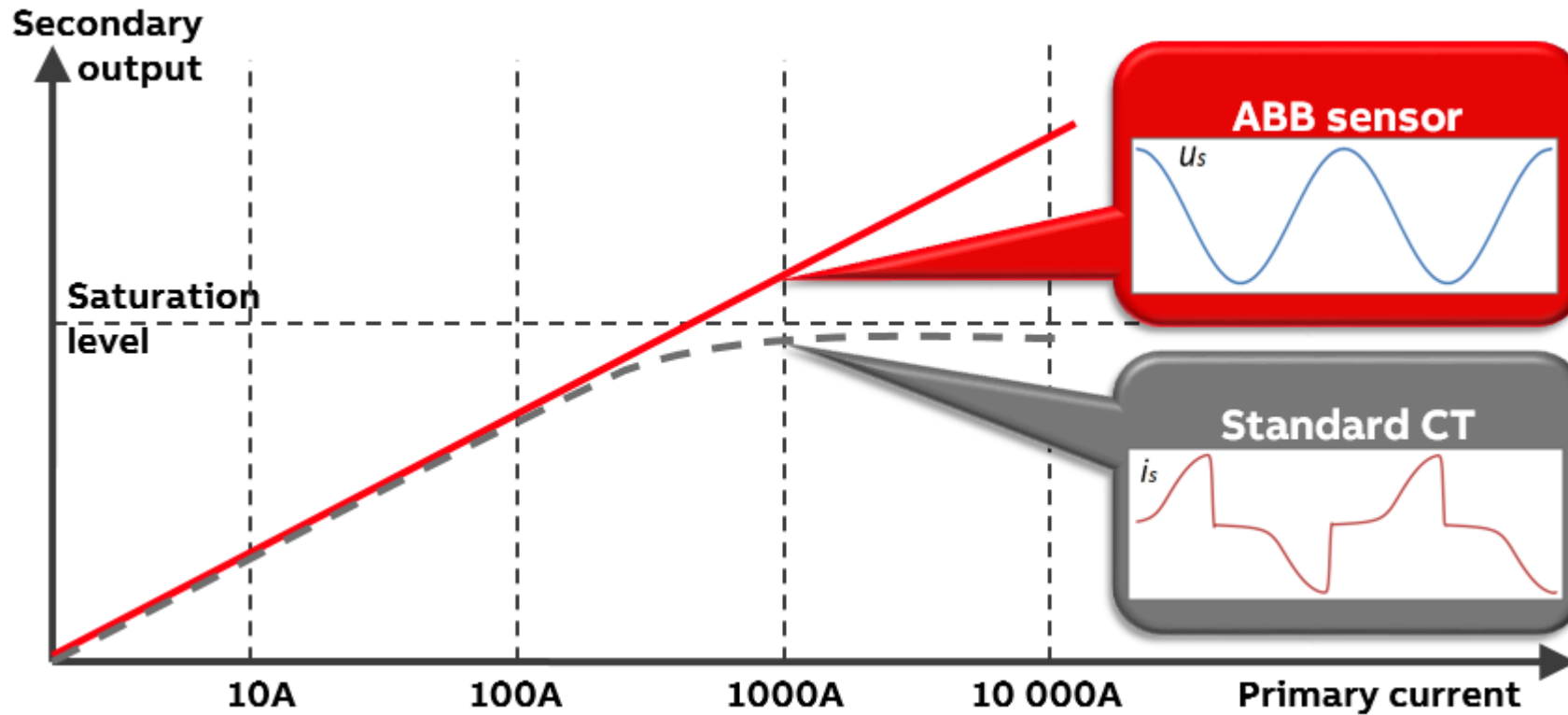
UniGear Digital with sensors

1. Relion® protection relay with IEC 61850
2. Current sensor
3. Voltage sensor



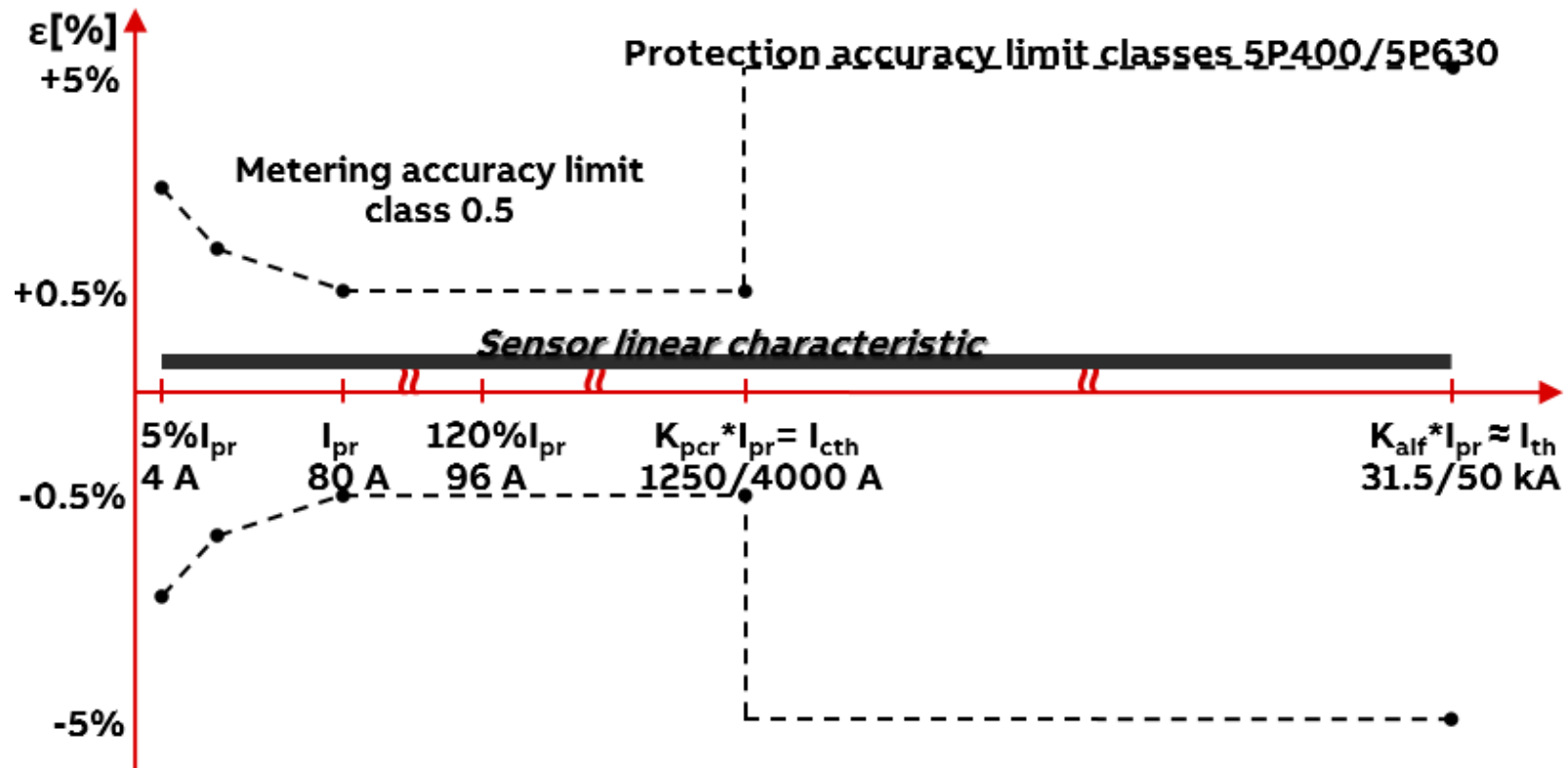
# Sensors have linear characteristic

Offer wider functionality range with higher rating standardization



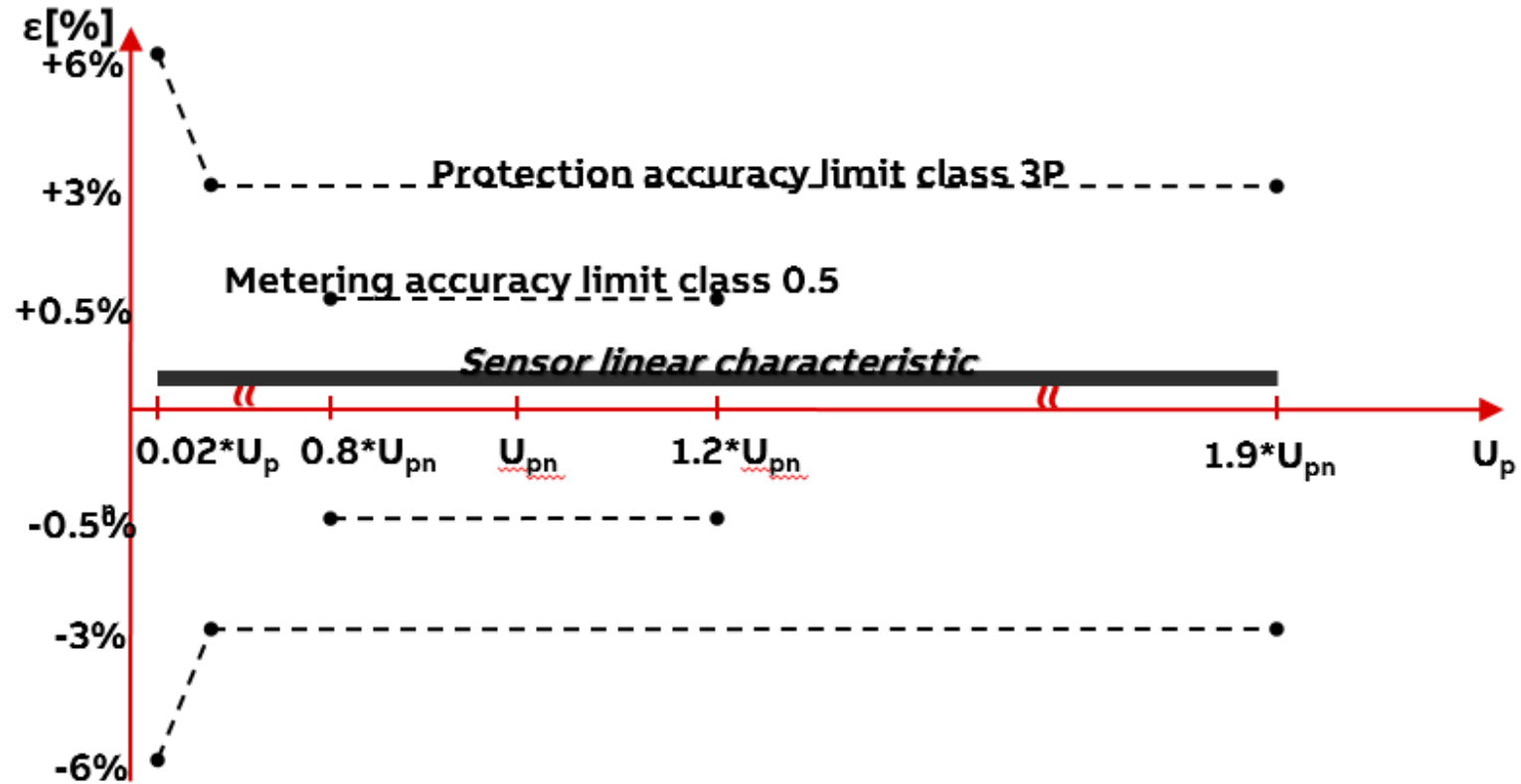
# MV Sensors are accurate in the whole operating range

Combined current accuracy class 0.5/5P



# MV Sensors are accurate in the whole operating range

Combined voltage accuracy class 0.5/3P



# Current sensors

## KECA 80 C104 / KECA 80 C165



### KECA 80 C104

- UniGear ZS1 Digital  
up to 17.5 kV, 650 mm panel

### KECA 80 C165

- UniGear ZS1 Digital  
up to 17.5 kV, 800 / 1 000 mm panel

## KECA 80 C184 / KECA 80 C216



### KECA 80 C184

- UniGear ZS1 Digital  
24 kV, 800 mm panel

### KECA 80 C216

- UniGear ZS1 Digital  
24 kV, 1 000 mm panel

## KECA 250 B1



### KECA 250 B1

- UniGear 550 Digital
- UniGear 500R Digital
- UniGear MCC Digital

# Voltage sensors

## KEVA 17.5 B20



### KEVA 17.5 B20

- UniGear ZS1 Digital up to 17.5 kV
- UniGear 550 Digital
- UniGear 500R Digital
- UniGear MCC Digital

## KEVA 24 B20



### KEVA 24 B20

- UniGear ZS1 Digital 24 kV

# Relion® protection and control relays for UniGear Digital

## Relion 615 series



The Relion 615 series protection relays can be defined as a compact and versatile solution for power distribution in utility and industrial applications. The 615 series provides standard configurations, which allows you to easily adapt and set-up your applications, still allowing you to adapt the configuration according to application-specific needs.

## Relion 620 series



They are delivered with example configurations to ease adaptation into your specific applications. The series offers customization possibilities, which supports higher levels of standardization in the applications. The 620 series extends the hardware possibilities further compared to the 615 series.

## Relion 640



REX640 makes protecting all your assets in advanced power generation and distribution applications easy. The fully modular design allows unequalled customization and modification flexibility, and easy adaptation to changing protection requirements throughout the relay life cycle.

# Sensor's standard accessory: a connector adapter

Combines Current and Voltage signals into one RJ-45

Current sensor



Voltage sensor



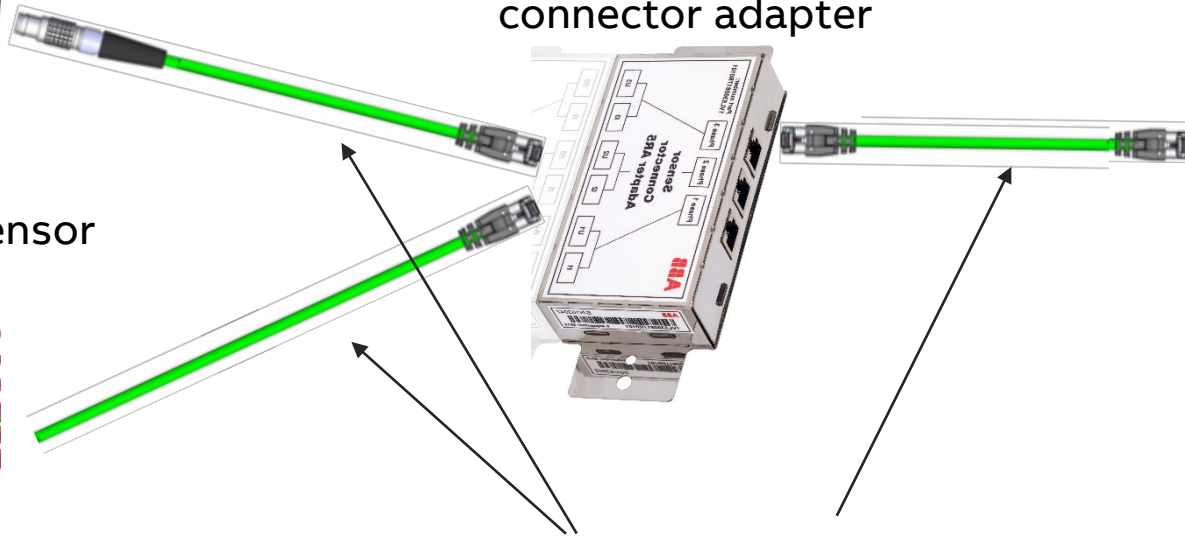
3-phase sensor connector adapter



Protection relay



Shielded cable with RJ45



# Essailec® RJ45

## Test blocks for Digital Switchgear

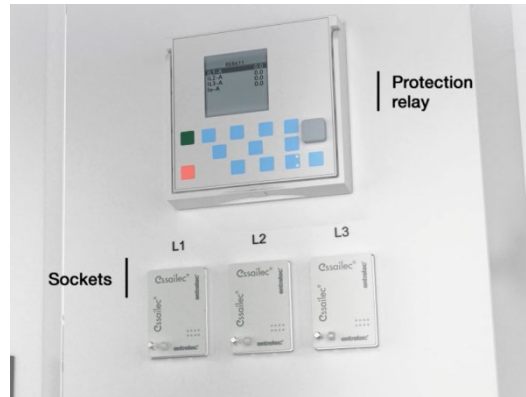
### Test block parts

- Socket
- Plug
- Lid



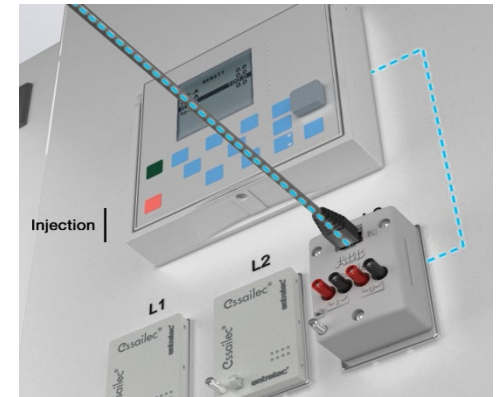
### Benefits

- Easy to install
- Safety and protection
- Continues operation



### Testing operation

- Current sensor measurement
- Voltage sensor measurement
- Injection





# UniGear Digital

## Statistical energy multimeter

### ESM-ET

Statistical energy multimeter compatible with ABB current and voltage sensors of UniGear Digital

Energy class 0.5S active energy, class 1 reactive energy (IEC 62052-11:2003, IEC 62053-22, 23:2003)

Power quality monitoring with Class S (IEC 61000-4-30:2008)

Ethernet ports: 2 (or 4) x RJ45 for IEC 61850-8-1, IEC 60870-5-104 or Modbus TCP with built-in switch with PRP and RSTP

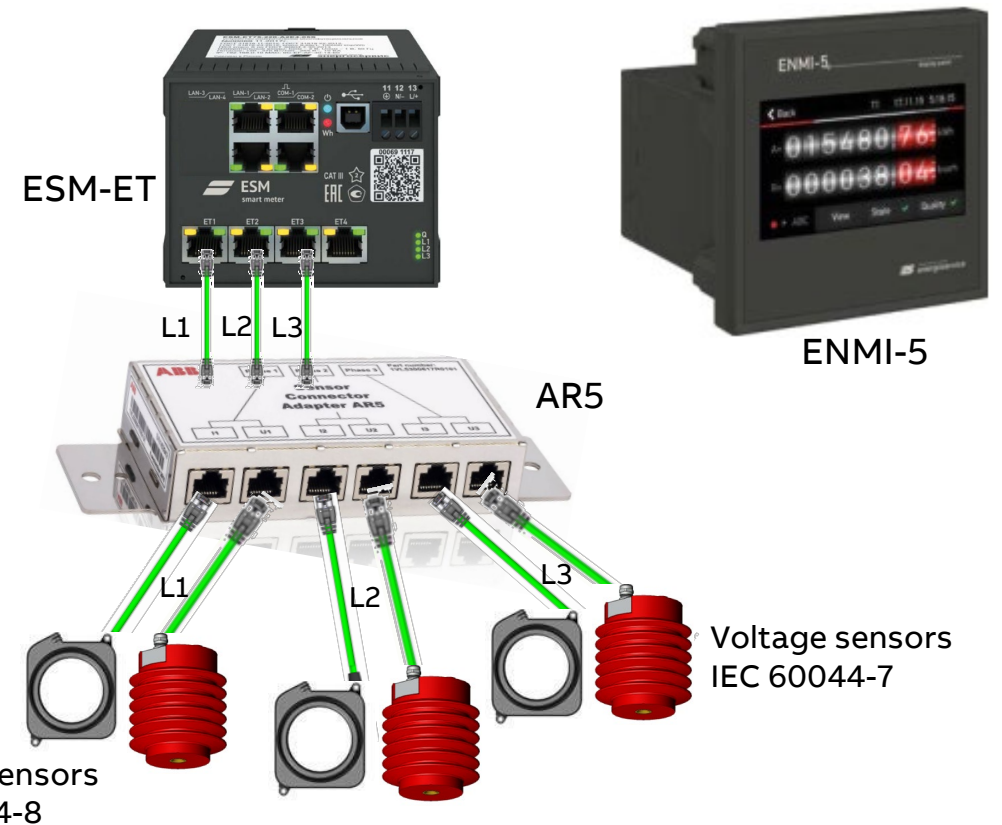
Serial ports: 2 x RS485 for IEC 60870-5-101 or Modbus RTU

Note: Dedicated set of sensors in UniGear Digital panel required

### ENMI-5

Optional display: 4.3" TFT color touch screen

Operating temperature range: -20 to 55 °C



# Monitoring & Diagnose unit SWICOM

ABB Ability™ Condition Monitoring for Switchgears based on IEC 61850

– One device for lineup - one Swicom can be connected to up to 24 Relion® 615/620 relays as primary sensing infrastructure to monitor the circuit breakers:

- Opening and closing times estimation and analytics
- Operation, trip counting etc.
- Contact wearing etc.

– Ready for additional sensors like:

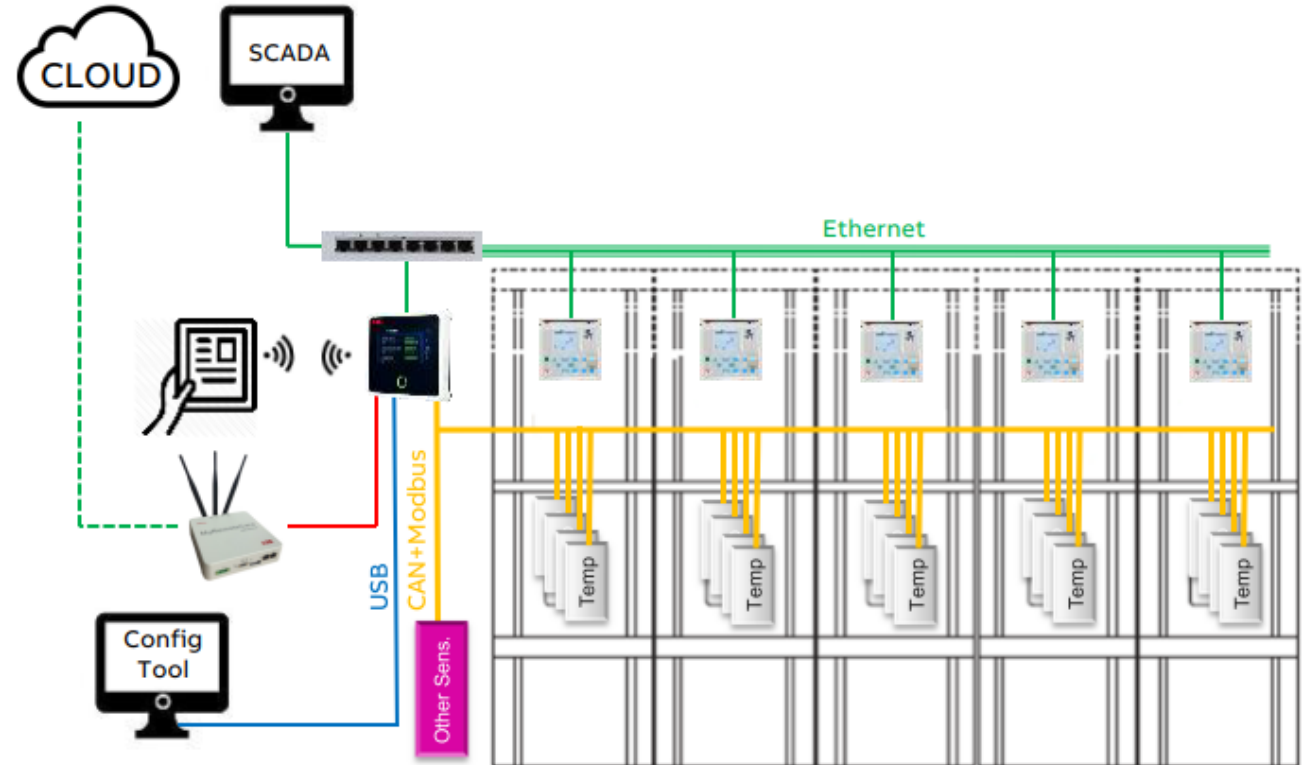
- Temperature (Senseor, Exertherm)
- Partial discharge (PDCOM)
- Ambient temperature/humidity



# Monitoring & Diagnose unit SWICOM

## ABB Ability™ Condition Monitoring for Switchgears based on IEC 61850

- Additional temperature sensing systems cover failure modes in busbar, circuit breaker and cable compartments:
  - SENSEOR – based on SAW\* sensors (wireless, battery-less)
  - EXERTHERM – based on IR sensors
  - Both of them are 24/7 systems, data collected by SWICOM via CAN or Modbus
- Additional partial discharge system PDCOM (ABB):
  - Measurement based on capacitive coupling principle
  - Monitoring of surface and internal partial discharges
  - One sensor for each Switchgear section up to 10 panels
  - No intervention to HV part needed in existing Switchgear



# Monitoring & Diagnose unit SWICOM

ABB Ability™ Condition Monitoring for Switchgears based on IEC 61850

– SWICOM features:

- Health indication and diagnosis on the touch HMI and mobile App via smart devices
- Configuration via RJ45, USB or wirelessly
- Extension to ABB cloud possible via MRC\* Gateway
- Connection also to SCADA through Ethernet TCP/IP
- HMI provides Lineup overview and panel detailed statuses, supported with traffic lights
- Documents can be downloaded and read from integrated SDCard





# References

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# Digital medium-voltage switchgear

## Worldwide references



By November 2019 ABB Brno, CZ, received orders for 2874 digital primary air insulated medium voltage (MV) switchgear panels

# UniGear Digital to Helsinki's smart city district

## Case: Helen Electricity Network, Finland

### Customer challenge

In city networks it is crucial that faults are located quickly and accurately to avoid costly power outages. In a smart city, the importance of electricity is further amplified and constantly increasing, and even short power cuts are more damaging. For Helen, the new smart city district, Kalasatama, brings about the need to introduce smart and reliability-improving solutions.

### ABB solution

UniGear Digital solution with more complex protection schemes, achieved with Relion® protection relays with IEC 61850 digital communication and GOOSE (Generic Object Oriented Substation Events) messaging; and with the use of sensor technology, the continuity of service is maximized.

### Customer benefits

- Fast and precise actions in case of network failures possible with the permanent active supervision feature of IEC 61850
- Minimized inventory with sensor technology-based solutions, all application needs covered with only a few current/combi sensors
- Accurate measurements and easy data management
- Considerable energy savings and higher safety level for operators
- Reduced cost and minimized switchgear footprint
- Switchgear is easily adapted when network requirements change



**End customer:** Helen Electricity Network Ltd.

**Country:** Finland

**Segment:** Utility

**Products delivered:** UniGear ZS1 digital switchgear, Relion 615 series protection relays, indoor current sensor KECA, indoor voltage sensor KEVA, vacuum circuit breaker VD4, Remote Terminal Unit RTU560

**Key result:** Secure, efficient power supply. Power failures can be completely avoided or the duration massively reduced.

# UniGear Digital to Siberian Coal Energy Company

## Case: Vanino bulk terminal, Russia

### Customer challenge

A secure and reliable power distribution solution to ensure minimized maintenance needs and downtime. A flexible and compact switchgear installation, which would allow them to make fast load changes and also allow remote operation. A compact and robust eHouse construction that would withstand harsh weather conditions.

### ABB solution

Energy-efficient and compact eHouse with UniGear Digital. To ensure fast and reliable communication, the solution uses IEC 61850 and GOOSE communication between the equipment. IEC 61850 communication is also used for remote monitoring and control of the substation from the main control room.

### Customer benefits

- Minimized switchgear footprint, as the metering cubicle(s) can be omitted and spare panels can easily be configured for future applications
- A compact and robust switchgear design, and reduced time needed for commissioning and installation with sensor technology
- Supply of a completely integrated and pre-tested eHouse that reduced energization and commissioning time on site



**End customer:** Siberian Coal Energy Company (SUEK)

**Country:** Russia

**Segment:** Mining and minerals

**Products delivered:** UniGear ZS1 digital switchgear, Relion® 615 series protection relays, Vacuum circuit breaker VD4, Indoor current sensors KECA, Indoor voltage sensors KEVA, all mounted in an eHouse

**Key result:** Reliable power supply and power outage prevention



# UniGear Digital to a petrochemical plant

## Case: Sasol, South Africa

### Customer challenge

Ensured plant and process continuity when complete substations needed to be replaced within a limited time frame. An alternative substation solution to ensure personnel safety and avoid damage to equipment.

### ABB solution

Flexible power supply solution: a mobile substation, built on UniGear switchgear with Relion relays and ABB's advanced sensor technology. To allow for easy relocation, this equipment was placed in an E-house and installed on a mobile truck trailer

### Customer benefits

A robust and flexible solution to meet customer's need.  
Reduced engineering time for cost-efficiency.



**End customer:** Sasol

**Country:** South Africa

**Segment:** Oil, gas and chemicals

**Products delivered:** UniGear ZS1 , Relion 615 series protection relays, Remote I/O unit RIO600, Vacuum circuit breaker VD4, Indoor current sensors KECA C, Indoor voltage sensors KEVA B, Arc fault detection system REA, truck trailer mounted E-house

**Key result:** Reliable power supply and power outage prevention

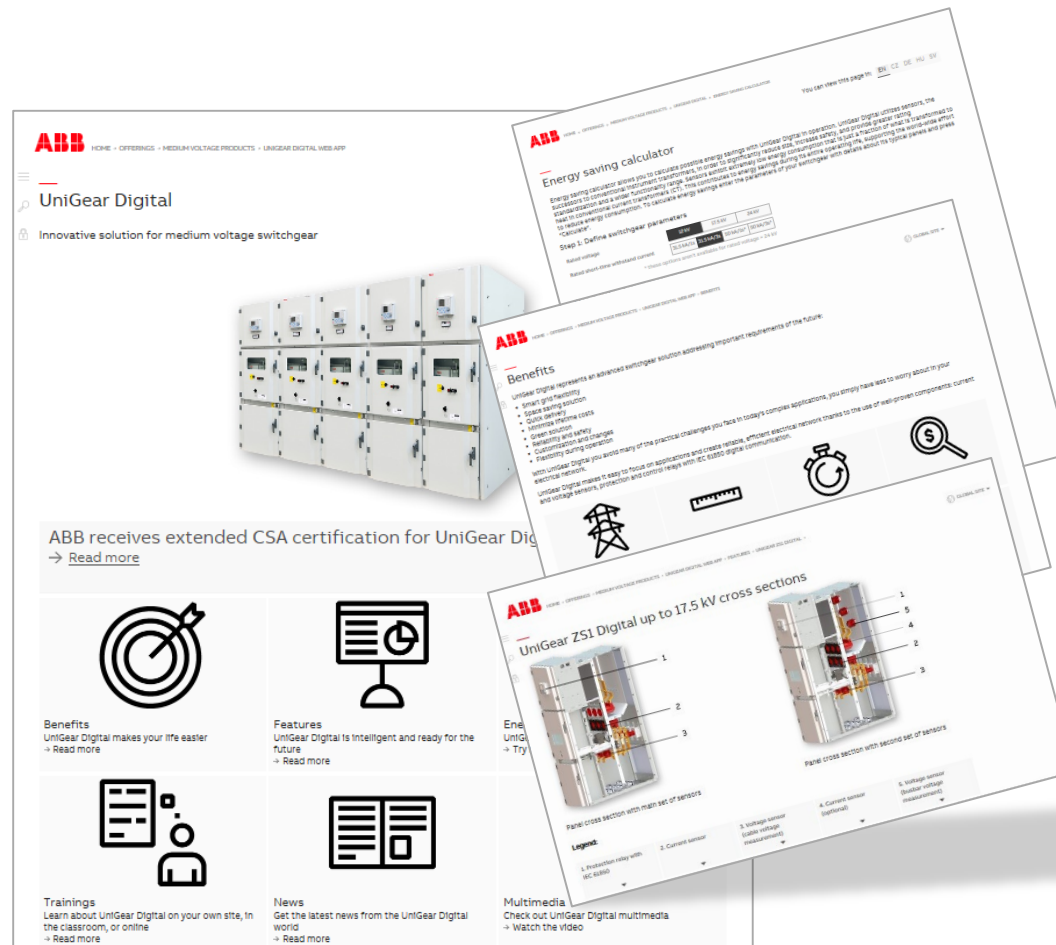


# UniGear Digital

Web application

# Find more about UniGear Digital on its web application

<https://new.abb.com/medium-voltage/unigear-digital>



The screenshot displays the ABB UniGear Digital web application interface. At the top, the ABB logo is visible, followed by navigation links: HOME, OFFERS, MEDIUM VOLTAGE PRODUCTS, and UNIGEAR DIGITAL WEB APP. The main heading is "UniGear Digital" with the subtext "Innovative solution for medium voltage switchgear". Below this is a large image of the UniGear Digital switchgear units. To the right, there is a "Energy saving calculator" section with a form for "Step 1: Define switchgear parameters" and a "Calculate" button. Below the calculator is a "Benefits" section with a list of advantages: Smart grid readiness, Space saving, Cost saving, Green and safe, Automation and changes, and Reducing outage. Further down, there is a section titled "ABB receives extended CSA certification for UniGear Digital" with a "Read more" link. The bottom of the page features a grid of icons and links for "Benefits", "Features", "Trainings", "News", and "Multimedia". On the right side of the screenshot, there is a detailed technical diagram of a "UniGear ZS1 Digital up to 17.5 kV cross sections" showing internal components like the Protection relay, Current sensor, Voltage sensor, and Current sensor (Bifurcated).

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# Question

ABB limited Gift

1. Current transformer แบบไหนที่ไม่ต้องกังวลในเรื่องการอิ่มตัวของขดลวด
  - CT Block type (Conventional)
  - CT Sensor



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# Question

ABB limited Gift

2. การสื่อสารที่เหมาะสมเพื่อตอบโจทย์สำหรับ Digital medium voltage switchgear คือ การสื่อสารด้วย protocol แบบไหน
- IEC61850
  - Serial communication



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# Q&A

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# ABB on social media

Website: [www.abb.co.th](http://www.abb.co.th)



Facebook: ABB Thailand



Line official: @askabb



**ABB**