



ABB AG

Power Technology Products for all applications – Make your choice

Agenda

- Vacuum Interrupters and Embedded Poles
- Circuit-breakers, contactors and cassettes
- Fuses, Indoor Switches and VisiVolt™
 - Medium voltage fuses
 - Medium voltage switches
 - Passive voltage indicator VisiVolt™
- Instrument Transformers and Sensors
- Outdoor breakers & railway products
- Ring Main Units
- Capacitive switches and surge arresters
- UFES™
Ultra-Fast Earthing Switch
- I_S-limiter
The world's fastest limiting switching device

Vacuum Interrupters and Embedded Poles

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Vacuum Interrupters and Embedded Poles

Core component in multiple indoor and outdoor applications



- Indoor and outdoor vacuum circuit-breakers
- Vacuum contactors
- Switch-disconnectors
- Railway switches
- Reclosers
- Capacitive switches
- Ring main units
- On-load tap changers



Vacuum Interrupters

Continuous improvement for our common success

Rated voltage:

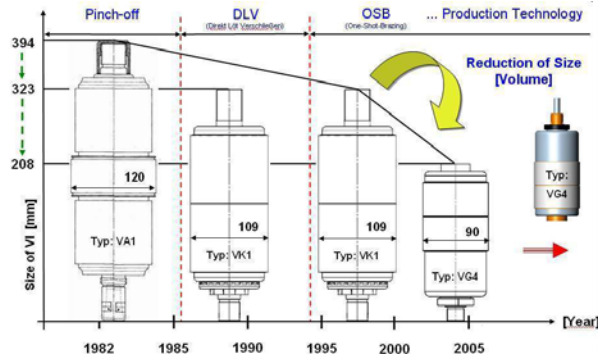
... 36 / 40.5 kV

Rated current:

... 4,000 A

Rated short-circuit
breaking current:

... 63 kA



- Over 30 years of experience in vacuum technology
- Worldwide more than 3 million ABB vacuum interrupters in service
- Latest technologies for high quality mass-production
- Compact and robust design
- High reliability and electrical life time
- Small number of VIs cover the full MV range
 - High reliability of supply & short delivery times
- Focussed OEM approach for VIs & EPs
 - Technical & commercial on site support including certified test laboratories

Embedded Poles

Continuous improvement for our common success

Rated voltage:

... 36 / 40.5 kV

Rated current:

... 3,150 A

Rated short-circuit
breaking current:

... 50 kA

Rated lightning impulse
withstand voltage:

... 200 kV



- World wide more than 1 million of ABB's Embedded Poles in service
- High dielectric strength without any further external measures
- Optimum protection of the vacuum interrupter from moisture, dust and external damage
- Suitable for different climatic conditions and altitudes of site
- High reliability and long life
- Easy adaption on the circuit-breaker
- Maintenance-free
- High quality standard
- Shop Floor Control (SFC) – System enabled
- Efficient increase of the dielectric strength without usage of green-house gas

Embedded Poles PT

Continuous improvement for our common success

Rated voltage:

... 17.5 kV

Rated current:

... 2,500 A

Rated short-circuit
breaking current:

... 40 kA



- New technology as invention for the future
- Environmental friendly in production, operation and disposal
- Requirements of IEC standards exceeded
- Improved low-temperature characteristics and enhanced mechanical strength
- High end production process
- High control of the production process

Circuit-breakers, contactors and cassettes

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Circuit-breakers

eVD4: The Smart eVolution

Vacuum circuit-breaker eVD4

Rated voltage:
... 17.5 kV

Rated current:
... 2,500 A

Rated short-circuit
breaking current:
... 40 kA



- Measures current and voltage of phases
- Integrates protection and control units
- Communicates measurements and status of protections to control system
- Controls electrical accessories through protection unit

Since 1987, over 550,000 VD4 circuit-breakers have been successfully installed in a wide range of applications, worldwide.

Circuit-breakers

eVD4: Complete integration in a single device



Current and voltage sensor in each pole



- Measuring
- Protection and control
- Communication



HMI (panel interface)

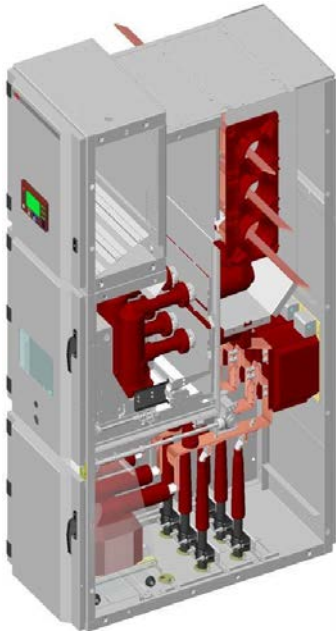


Equipped with Relion® technology: protection and control unit RBX615 with IEC61850 and Goose

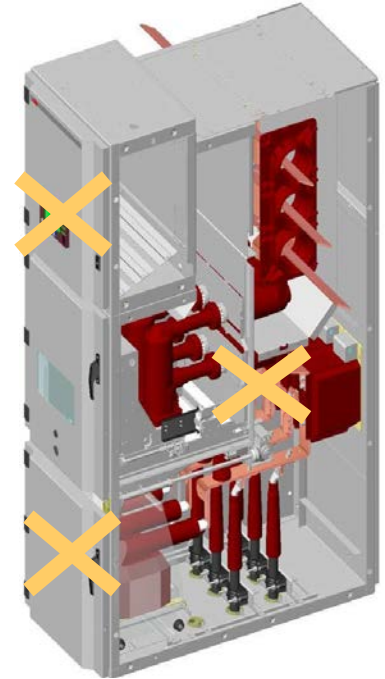
Circuit-breakers

eVD4: Reduce time from purchase to commissioning

Standard panel



Version with eVD4



Circuit-breakers

For any application

Vacuum
circuit-breaker
VD4-VM1

Rated voltage:
... 36 / 40.5 kV

Rated current:
... 4,000 A

Rated short-circuit
breaking current:
... 63 kA



SF₆
circuit-breaker HD4

Rated voltage:
... 36 / 40.5 kV

Rated current:
... 4,000 A

Rated short-circuit
breaking current:
... 50 kA



- Complete product range:
 - Vacuum and SF₆ breaking technology, fully interchangeable
 - Vacuum CB with magnetic or mechanical actuator
 - VD4-VM1 CB with embedded poles technology
- Complete range of accessories and interlocks
- Competitive product portfolio well positioned in the market

Circuit-breakers

VD4: the most utilized breaker in the world

Rated voltage:

... 36 / 40.5 kV

Rated current:

... 4,000 A

Rated short-circuit
breaking current:

... 63 kA



- Use of established and innovative embedded pole solutions
- Reliable actuation for 30,000 CO operations
- Low inspection efforts in service and shortened maintenance time
- Maximum safety guaranteed through built-in range of interlocks to prevent dangerous operations
- Complete range of accessories and interlocks

Circuit-breakers

Vmax: The low end solution

Vacuum circuit-breaker Vmax

Rated voltage:
... 17.5 kV

Rated current:
... 1,250 A

Rated short-circuit
breaking current:
... 31.5 kA



- Vacuum interrupter technology
- Small, lightweight and compact
- Developed for applications where space saving is a premium
- Based on freestanding vacuum interrupters and on moulded case design
- Applied in places where saving space is a must such as buildings and construction (e.g. Burj Khalifa)



Circuit-breakers

The circuit-breaker family for secondary distribution

Vacuum circuit-breaker

VD4/R-S

Rated voltage:

... 24 kV

Rated current:

... 1,250 A

Rated short-circuit
breaking current:

... 25 kA



SF₆ circuit-breaker

HD4/R-S

Rated voltage:

... 36 kV

Rated current:

... 1,250 A

Rated short-circuit
breaking current:

... 25 kA



- Vacuum or SF₆ breaking technology, fully inter-changeable
- Relays & current sensors on board, suitable also for installation in unmanned substations and without auxiliary power supply.
- Complete range of accessories and interlocks
- High reliability
- Used in secondary distribution applications such as the new Moscow race circuit

Contactors

VSC 7 / VSC 12

Rated voltage:
... 7.2 / ... 12 kV

Rated current:
... 400 A

... 100,000 CO AC3



Top class ABB technology

- VSC 7 / VSC 12:
 - OEM oriented contactor
 - Available in fixed and withdrawable version
 - Suitable for slimline & traditional type of panel
 - Magnetic actuator & extremely low power consumption
 - Contactor dedicated vacuum interrupters with high performance especially for switching of motors
 - Up to 1,000,000 mechanical operations
 - Maintenance-free
 - Electronic multi-voltage feeder

Cassettes / Enclosures

PowerCube family:

PowerCube

Rated voltage:

... 36 kV

Rated current:

... 4,000 A

Rated short-time current:

... 50 kA



PowerCube family:

PowerBloc

Rated voltage:

...40.5 kV

Rated current:

...5,000 A

Rated short-time current:

...50 kA



The efficient interface to OEMs installation

- Suitable for withdrawable circuit-breakers and contactors
- OEMs can add individually adapted components
- Making capacity earthing switch
- Maximum safety and high flexibility
- Type tested solution, ideal for retrofitting and revamping

Fuses, Indoor Switches and VisiVolt™

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Medium voltage fuses

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Medium voltage fuses

Introduction

Rated voltage:

... 36 kV

Rated current:

... 315 A

Rated short-circuit
breaking current:

... 63 kA



- ABB is a global manufacturer of both fuses and surge arresters.
- Surge arresters protect against overvoltages
- Fuses protect against overloads and/or overcurrents
- Sometimes combined fuse/surge arrester protection is used



Medium voltage fuses

Summary ABB current limiting fuses

Application of fuses in:

- Switches
- I_g -limiters
- Ring Main Units
- Contactors
- Air-insulated switchgear



Safety

- Unique design of ABB CEF/CMF family featuring: overload spots; a temperature released striker pin (TCU); and a secure and safe interruption process even in case of small overload currents
- Type tested (in scope of temperature rise and breaking performance) for application in SF₆ RMU and air insulated panels
- Compliance to IEC 62271-105 fuse-switch (LBS) combination standard for full voltage ratings
- Lowest temperature during breaking and overload conditions



Medium voltage fuses

Summary ABB current limiting fuses

Application of fuses in:

- Switches
- I_s -limiters
- Ring Main Units
- Contactors
- Air-insulated switchgear



Performance

- High breaking capability up to 63 kA in minimum physical dimensions
- The fastest overload protection devices for high short-circuit currents, capable of limit prospective short circuit current thus protecting surrounding equipment from electrodynamics and heat stresses during short-circuit



Medium voltage fuses

Summary ABB current limiting fuses

Application of fuses in:

- Switches
- I_s -limiters
- Ring Main Units
- Contactors
- Air-insulated switchgear



Quality

- Recently modernized and automated production line
- Superior accuracy of TCC tolerance (+/- 10% vs. standard +/- 20%)
- Maintenance-free long service life and the most effective costs / results ratio



Medium voltage switches

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ABB Indoor Switches

SFG/SHS2 Main Product Features

Rated voltage:

...24 kV

Rated current:

... 800 A

Rated short-circuit
breaking current:

... 20 kA



- Switch-disconnector (Line-Open-Earth)
- Can be used in combination with fuses

SHS2

- Metallic separation between busbar and line areas
- Integrated front panel

SFG

- Epoxy cast resin enclosure
- Inspection window to see knife position, three-position switch



ABB Indoor Switches

AM/NAL Main Product Features

AM:

Rated voltage:

...24 kV

Rated current:

... 630 A

Rated short-circuit
breaking current:

... 16 kA



NAL:

Rated voltage:

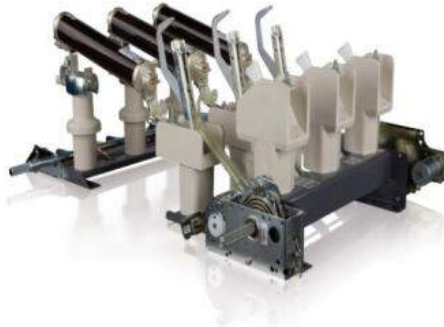
...36 kV

Rated current:

... 1250 A

Rated short-circuit
breaking current:

... 31,5 kA



AirSwitch

- Metallic separation between busbar and line areas
- Available as rotary isolator
- Integrated front panel

NAL/VR

- Class E3 for selected voltages
- ANSI/CSA/IEC tested
- 100 breaking operations tested at 630 A
- Arc quenching by means of air blast

ABB Indoor Switches

Main Product Advantages



Safety

- Earthed metallic separation between busbar and line areas (rotary type)
- Compliance to IEC 62271-105 fuse-switch combination standard
- Visible isolation with inspection windows to see the switch position (SFG)
- Integrated and free standing earthing switches with and without making capacity
- Interlocking devices



ABB Indoor Switches

Main Product Advantages



Performance

- Superior arc quenching technology by means of air pressure and gas blast combination
- Compact three positions (Line-Open-Earth) design (SFG / SHS2)
- Smart integration: Modular construction, compact size, easy installation, one switch – many applications
- High electrical and mechanical endurance



Quality

- Extremely durable and reliable actuator
- A life span of minimum 30 years, sealed for life, low maintenance costs
- Stringent testing of each unit, multi-standard worldwide use

Passive voltage indicator

VisiVolt™

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VisiVolt™ – Passive Voltage Indicator

Main functions



- Warning function – increased safety
 - Higher level of safety of operating and servicing the system.
- Check of voltage status
 - Without using any additional equipment, the personnel can check the status of voltage presence.
- Confirming of equipment operation
 - At equipment with no visible gap (e.g. Sectos switch- disconnecter) VisiVolt confirms the correct operation of the switch and disconnecter.

VisiVolt™ – Passive Voltage Indicator

Advantages of VisiVolt™



Differentiating features of the product:

- Both indoor and outdoor application possible
- Reflective display of good visibility at all lighting conditions (from dim indoor to bright outdoor)
- Large display size – visibility from long distance (e.g. on a pole mounted equipment)
- No electronic circuit – display element is the sensitive element
- All polymer components – no steel parts – no risk of corrosion
- Wide application range, easy installation, maintenance free
- Resistant to extreme operating conditions (salt fog, moisture, wind, solar radiation, high temperature)

Instrument Transformers and Sensors

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LV Instrument Transformers

Ratings

Rated voltage:

... 0.6 kV

Rated current:

... 50 000 A

Frequency

... 50 or 60 Hz



LV Instrument Transformers
for various application:

- Medium / low voltage systems
- Cast resin / non casted / plastic housing / thermoplastic rubber
- Openable (split core) / multi-ratio
- All electrical standards IEC, GOST, BS, AS, ANSI, CSA
- Electrical ratings provided as per individual client's needs
- For primary and secondary distribution
- For AIS or GIS application
- High Voltage Dead Tank CBs, Power Transformers and Generators

MV Instrument Transformers Indoor

Ratings

Rated voltage:
... 40.5 kV

Rated current:
... 8,000 A

Rated short-circuit
breaking current:
... 100 kA



MV Instrument Transformers
used by leaders in Switchgear:

- Wide range of types fits to many various applications
- Electrical ratings provided as per individual client's needs
- Electrical standards IEC, ANSI, DIN, BS, GOST, CSA
- Many metrology certificates & approvals available
- Leading in branch delivery performance
- Engineering and Customers Service hotline

MV Electronic Instrument Transformers Sensors

Ratings

Rated voltage:
... 24 kV

Rated current:
... 3 200 A

Rated short-circuit
breaking current:
... 40 kA / 3s



Advanced Sensor Technology
for Integrated Solution:

- Flexibility and design process simplification
 - Wide performance range
 - Smaller size
 - Reduced weight
- High safety by default
 - Safe output signals
 - Reduced risk of accident (open secondaries, ferroresonance and saturation free)
- Freedom of Design
 - Integrated solutions
 - Plug and play connections
 - Mistake prove design

MV Instrument Transformers Outdoor

Ratings

Rated voltage:

... 52 kV

Rated current:

... 2500 A

Rated short-circuit
breaking current:

... 100 kA



MV Instrument Transformers
for outdoor conditions:

- Wide range of types fits to many various applications
- Electrical ratings provided as per individual client's needs
- Many metrology certificates & approvals available
- Basic Impulse Level (BIL): up to 250 kV
- Typically used in large industrial plants with substation for primary revenue metering & relaying
- Products accepted by all end customers

Voltage Transformers

VT Guard

Rated voltage:

... 100 – 200 V

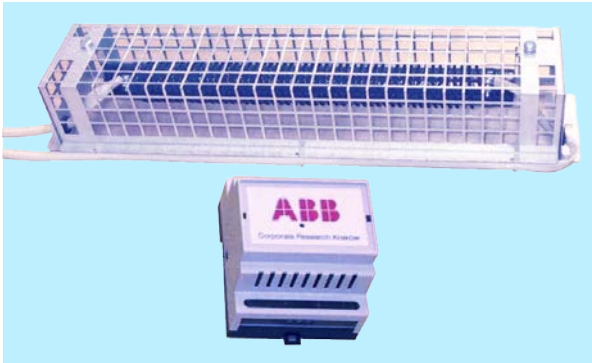
Insensitivity zone:

... 0 – 20 V

Damping time

at 100 V:

... 1 s



VT Guard:

smart solution for everyone

- Effective ferroresonance damping due to low resistance
- No thermal hazard to VT (real thermal protection)
- Non-sensitive to natural network asymmetry
- Small size (DIN – rail mounted)

Outdoor breakers & railway products

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Outdoor apparatus



- Complete range of MV outdoor products, e.g.:
 - Circuit-breakers and reclosers
 - Sectionalizers and switches
 - Air switch disconnectors
 - SF₆ switch disconnectors
 - Fuses and cutouts
- Innovative combination of vacuum technology and magnetic actuation in circuit-breakers and reclosers
- Excellent materials for outdoor applications

Railway breaker

Solution for maintenance-free railway applications



- Complete range of railway products, e.g.:
 - Outdoor single or two phase circuit-breaker
 - Outdoor single or two phase load break switch
 - AC circuit-breaker for rolling stock
- Especially suited for low space requirements
- Vacuum interrupter technology combined with electronically controlled operation and magnetic actuator
- Used in outdoor modules or any other OEM equipment
- Easy and fast installation

Ring Main Units

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Ring Main Units



- From basic RMU applications to advanced switchgears in one standardized range
- SafeRing / SafePlus / SafeLink
 - ... 40.5 kV / ... 630 A / ... 21 kA
 - Standardized configurations available
 - Available with load break switch, fuse combination or ABB vacuum interrupter
 - Completely sealed system
- Arc suppressor available
- Highest degree of personal safety
- Compact & robust solution
- Minimal maintenance
- Extensible on request
 - Standardized tools available for easy documentation access

Capacitive switches and surge arresters

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Capacitive switch – PS Range

Switching capacitors in distribution systems

Ratings

Up to 36 kV

PS15, 200 A

PS15, 400 A

PS17, 400 A

PS25, 200 A

PS36, 300 A



- 15 kV → 36 kV
- ABB vacuum interrupter technology
- Lightweight
- Storage and transportation made easier
- Magnetic actuator –
50,000+ close-open operations
- Mechanical or electrical latching
- Maintenance-free

Capacitive switch – PS Range

Switching capacitors in distribution systems



- Control circuit
 - Nominal voltage: 120 V AC/DC and 240 V AC
 - Nominal open/close times: < 100 ms
 - Nominal current: 10 A
- Switch status option
 - Voltage free contact
- Type tested to ANSI C37.66

Surge arresters

Lovos

280 - 1000 V @ 62 Hz

5 or 10 kA

25/40 kA @ 8/20 μ s



Polim-family

Rated voltage:

... 44 kV

10 kA @ 8/20 μ s

100 kA @ 4/10 μ s



Overvoltage protection for high availability and safety

- Protection of installations to increase reliability and safety
- Wide range of surge protection for nearly every application
- Focus on technical customer support
- For indoor and outdoor installation

UFES™

Ultra-Fast Earthing Switch

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Ultra-Fast Earthing Switch type UFES

The new active internal arc protection by ABB



UFES with electronic tripping unit type QRU100

- The new Ultra-Fast Earthing Switch type UFES
- Active internal arc protection in addition to available passive protection applicable for nearly all short-circuit proof, air-insulated switchgear
- Highest possible protection for switchgear in regard to the hazardous impacts caused by an internal arc

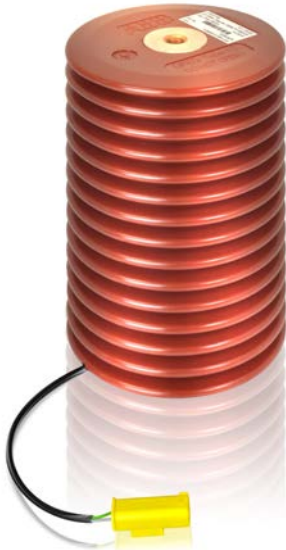
Ultra-Fast Earthing Switch type UFES

S³ – Speed, Safety, Savings

- Speed – A question of (Operation-) time
Nearly immediate extinction of an internal arc by fastest intervention of the Ultra-Fast Earthing Switch.
- Safety – Greatly enhanced protection for personnel, switchgear and the environment
A drastically reduced internal arc duration ensures minimized pressure and temperature rise. This leads, as a consequence, to minimal impacts at the fault location.
- Savings – The “insurance” for your switchgear
Greatly increased system and process availability in combination with drastically reduced repair costs.

Ultra-Fast Earthing Switch type UFES

Applicable for highest requirements



Maximum rated voltage:

$$U_r = 40.5 \text{ kV} \rightarrow I_k = 40 \text{ kA (3s)}$$

Maximum rated short-time withstand
current for medium voltage:

$$I_k = 50 \text{ kA (3s)}, 63 \text{ kA (1s)} \rightarrow U_r = 17.5 \text{ kV}$$

Maximum rated short-time withstand
current for low voltage:

$$I_k = 100 \text{ kA (0.5s)} \rightarrow U_r = 1.4 \text{ kV}$$

Ultra-Fast Earthing Switch type UFES



ABB offers the Ultra-Fast Earthing Switch via different sales channels and for several applications:

- ABB Switchgear
 - The UFES is offered as option in Unigear ZS1 in two versions:
 - Top box
 - Cable compartment
- Service / Retrofit
 - A service box or service truck can be used to increase the protection level of an existing switchgear
- Sales of loose components to OEM partners



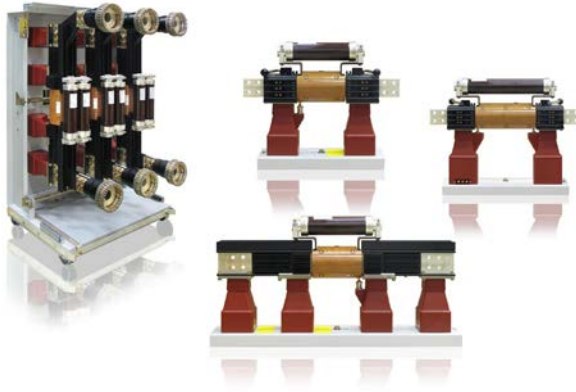
I_s -limiter

The world's fastest limiting switching device

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I_s -limiter

The world's fastest limiting switching device



I_s -limiter
The world's fastest switching device

- Reduces substation cost
- Solves short-circuit problems in new substations and substation extensions
- Optimum solution for interconnection of switchgears and substations
- In most cases the only technical solution
- Reliability and function proofed in thousands of installations
- Worldwide in service
- The peak short-circuit current will never be reached
- The short-circuit current is limited at the very first current rise

I_S-limiter – Product Overview

Applications

Generation

- Coal Powerplants
- Gas Powerplants
- Wind Parks
- Hydro Powerplants
- IPP's
- Biomass

Distribution

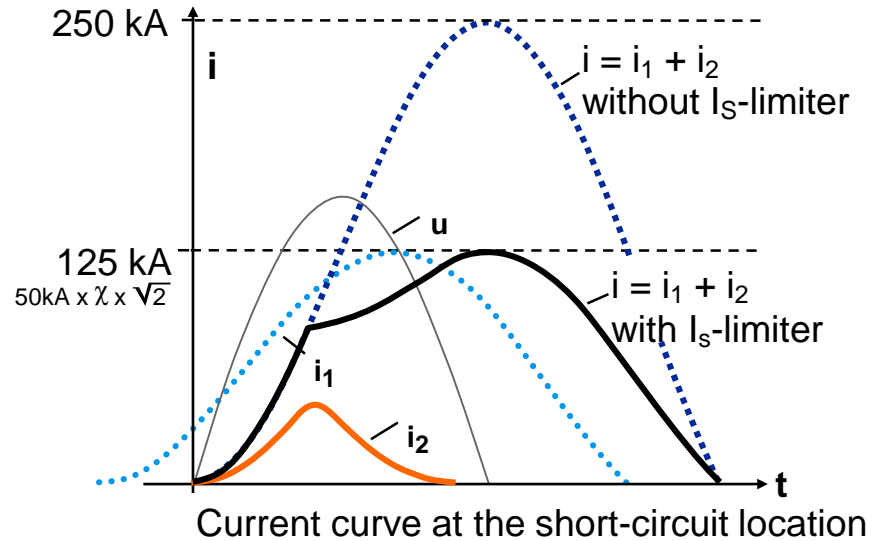
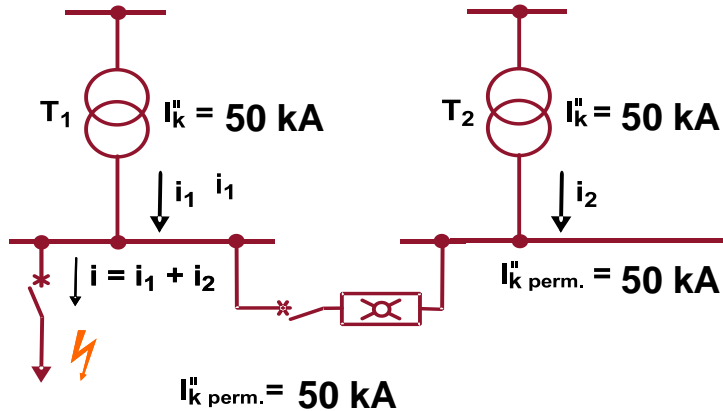
- Utilities

Consumer

- Pulp & Paper
- Refineries
- Sugar / Ethanol
- Mining Extraction
- Oil Extraction
- Cement Industry
- Steel & Aluminum Mills
- Test Labs
- Ships

I_S -limiter

Breaking of a short-circuit current with I_S -limiter



I_s -limiter Conclusions



- Reduces costs of switchgear installations
- Solves short-circuit problems in new and extended systems
- Optimum solution for interconnection of switchgears
- Tried and tested in thousands of installations
- In service worldwide
- The short-circuit is limited at the first current rise
- The peak short-circuit current cannot be reached

Substation Automation and Protection

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Relion®

REJ603 – self powered feeder protection



- Self powered IED
 - Overcurrent protection
 - Earth fault protection
 - Inrush detector
- Suitable for all usual sensitive trip coils (100 mJ)
- Operation area 8 – 448 A by use of 5 special set of CTs
- Touch-Display as an option

Relion®

610 series – simple distribution grid applications



- Simple protection IED
 - Feeder protection REF610
 - Motor protection REM610
 - Voltage protection REU610
- Two line text display
- Programming via switching groups
- Plug-in design

Relion®



- Combined protection and control units
 - Feeder protection REF615
 - Line differential protection RED615
 - Motor protection REM615
 - Transformer differential protection RET615
 - Voltage protection REU615
- Control of up to four switches
- Single line diagram
- Arc protection
- Easy programming via ACT tool
- Full GOOSE performance (IEC 61850)
- Plug-in design
- RTD/mA Module
- Sensor inputs in REF615

Relion®

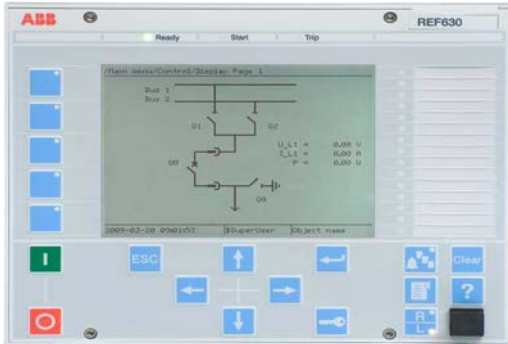
620 series – enhanced distribution grid applications



- Combined protection and switchbay control units
 - Feeder protection REF620
 - Motor protection REM620
 - Transformer differential protection RET620
- Enhanced binary inputs and outputs
- RTD/mA module
- Single line diagram
- Arc protection
- Free programmable applications allow maximum flexibility
- Full GOOSE performance (IEC 61850)
- Plug-in design

Relion®

630 series – complex distribution grid applications



- Combined protection and control units
 - Feeder protection REF630
 - Motor protection REM630
 - Transformer differential protection RET630
 - Generator protection REG630
- Control of up to eight switches
- Single line diagram
- Five free programmable push buttons
- Ereignisgesteuerte Anzeigefunktionen
- Full GOOSE performance (IEC 61850)
- RTD/mA Module
- Distance protection and transient/intermittent earth fault protection in REF630
- Voltage regulation of two winding transformers in RET630
- Motor differential protection in REM630

New devices and applications

Arc protection UFES meets REA101



„UFES meets REA“

- Different internal arc monitoring and supervision functions
 - Optical loop or lens sensors
 - Over current detection
 - Selectivity
- Ultra fast internal arc extinguishing with UFES
- Short trip time
< 4 ms (after detection)

combined arc protection UFES + REA

High Voltage Products for OEMs

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High voltage capacitors and filters



Capacitor and harmonic filtering solutions up to 800 kV to improve the efficiency and reliability of utility and Industrial networks.

HV and MV capacitors:

- Shunt capacitors
- Surge Capacitors
- Filter capacitors
- Single-, three- and split phase capacitor units

Applications:

- Reactive power compensation
- Improvement of asset utilization
- Reduction of network losses
- Compliance with grid regulations

High voltage capacitors and filters



Special features:

- Quality and technology leadership
- Products supported by application know-how
- Extensive portfolio coverage

Low voltage capacitors and filters



Capacitor units, banks and harmonic filters up to 1000 V to improve the efficiency and reliability of industrial and commercial networks

Applications:

- Automatic Power factor correction
- Harmonic filtering
- Load balancing
- Reactive power compensation
- Dynamic voltage support

Special features:

- 'Best in class' functionality
- High level of reliability and safety
- Compliance with Power Quality regulations

Capacitor Accessories



Capacitor controllers

- User friendly interface
- Extensive range of control modes (power factor etc.)
- Measurement & monitoring
- Data logging
- Protection
- Communication
- Easy programming & commissioning
- Durable IP54 power coated, stainless steel enclosure
- Touch screen color display further easing access to setup and monitoring functions

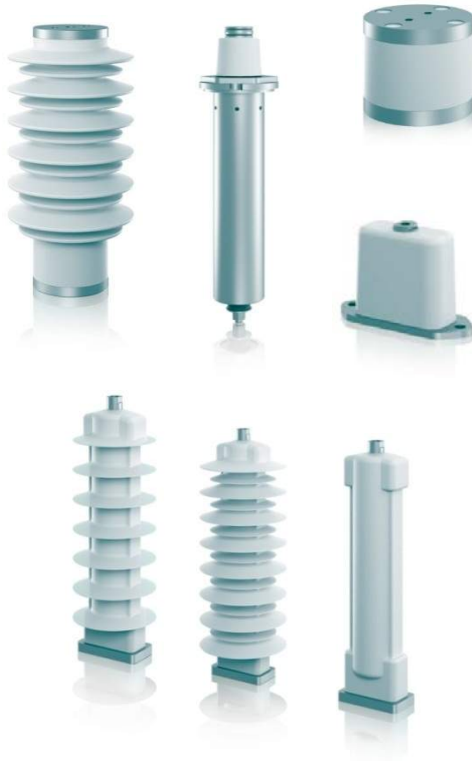
Capacitor Accessories



PS Switch

- ABB vacuum interrupter technology
- Lightweight
- Magnetic actuator – 50,000+ close-open operations
- Mechanical or electrical latching
- Maintenance free
- Rated voltage: up to 36 kV, 200 - 400 A

Medium Voltage Surge Arresters



Applications

- High current systems
- Wind Power
- Traction and Railway systems
- Railway applications
- Transformers protection
- Cable Installations
- Cable & cable sheath protection (including Linkboxes)
- MV AIS and GIS cubicles and switchgear
- Industries (capacitor banks, motors etc.)

Cable accessories



- Outdoor cable terminations – Porcelain and Composite
- Dry flexible cable terminations
- Cable connectors for GIS and transformer
- Premoulded cable joints
- Tools and accessories
- 12 kV - 420 kV

Extensive training courses – world renowned

Transformer Products and Components

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Transformer Products and Insulating Components

Product offering



- Distribution Transformers
- Dry Transformers
- Transformer components



Power and productivity
for a better world™

