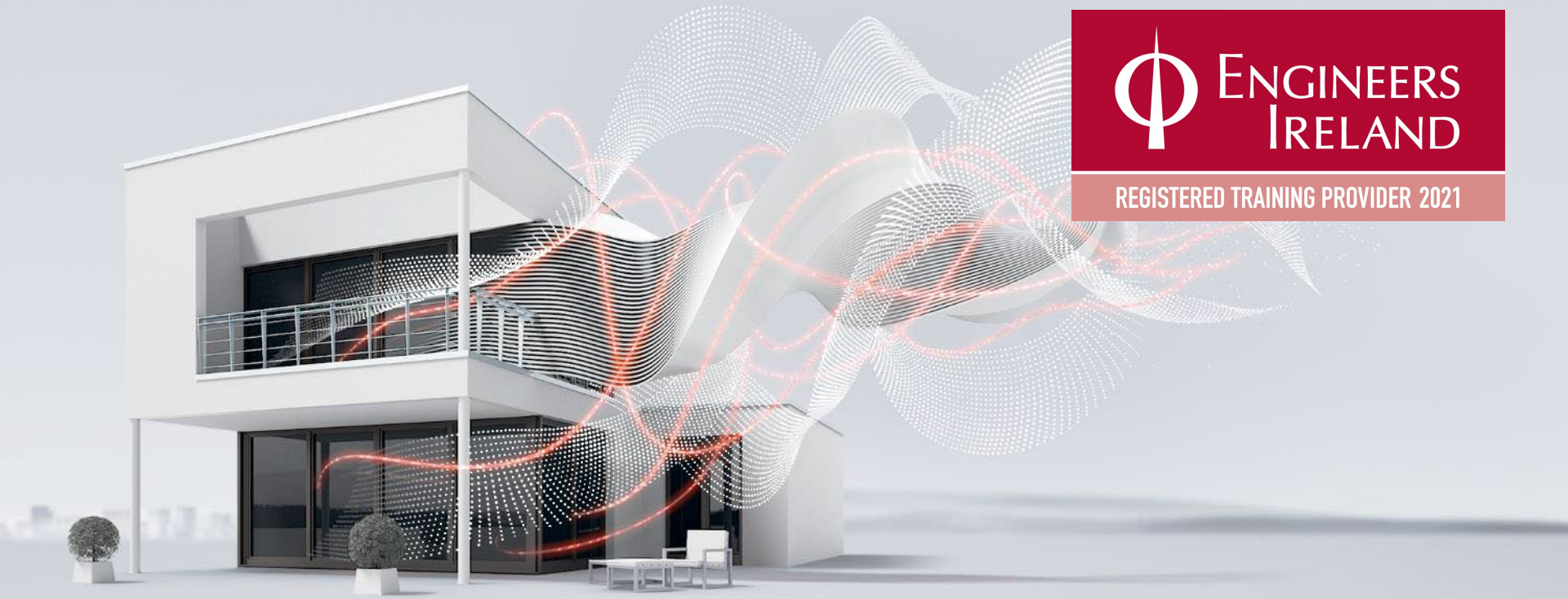


ENGINEERS IRELAND
REGISTERED TRAINING PROVIDER 2021

26TH APRIL 2022

Technical Overview:

L.V. Switchgear and Panel Selection

paul.hyland@ie.abb.com

Technical Overview CPD series:

- L.V switchgear and panel selection
- L.V selectivity and discrimination
- IEC61439 part 1 and 2 L.V switchgear & Control assemblies.

Technical support and training

Technical & Design Promotion Manager

Paul Hyland Electrical Engineer (Electrician)

29 +1 years LV switchgear and Control Assemblies

6 years ABB technical Support and product design

Degree in Electrical Service Design BEng

Honours Degree Electrical Service and Energy Management BSc

SACE Level 3 service engineer

Participating member of the ETC TC4 NSAI group for LV SWG

Member of Engineers Ireland

Participating member of the SC 121B IEC International Electrotechnical Commission, MT2 Maintenance team for the IEC 61439 part 0, part 1 and part 2. for LV switchgear

ABB provide all Technical support as one ABB team.

CPD Presentations – timetable

April/ May 2022

Monday	Tuesday	Wednesday	Thursday	Friday
	26th April Technical overview of LV Switchgear and Panel Selection. **Paul Hyland**	27th April Building Automation- KNX universal protocol & DALI **Pierre Badenhorst**	28th April The Fundamentals & Principles of Building Energy Management Systems **Seamus MacLughadha**	
	3rd May	4th May IIoTfor Electrical installations **Paul Mimnagh**	5th May Building Services Integration BACnet and other options **Seamus MacLughadha**	
	10th May LV Selectivity / Discrimination **Paul Hyland**	11th May Introduction to MV Switchgear **David Supple**	12th May IE5 Synchronous Reluctance Drive and Motor Package **Tero Helpio**	
	17th May IEC61439 overview of Standard for Low Voltage Switchgear & Assemblies **Paul Hyland**	18th May Electric Vehicle Charging Infrastructure **James Kelly**	19th May	
	24th May Arc Fault Detection Devices (New MCBs & RCBOs) **Paul Hyland**	25th May Harmonics, VSDs and mitigation technologies **Liam Blackshaw**		

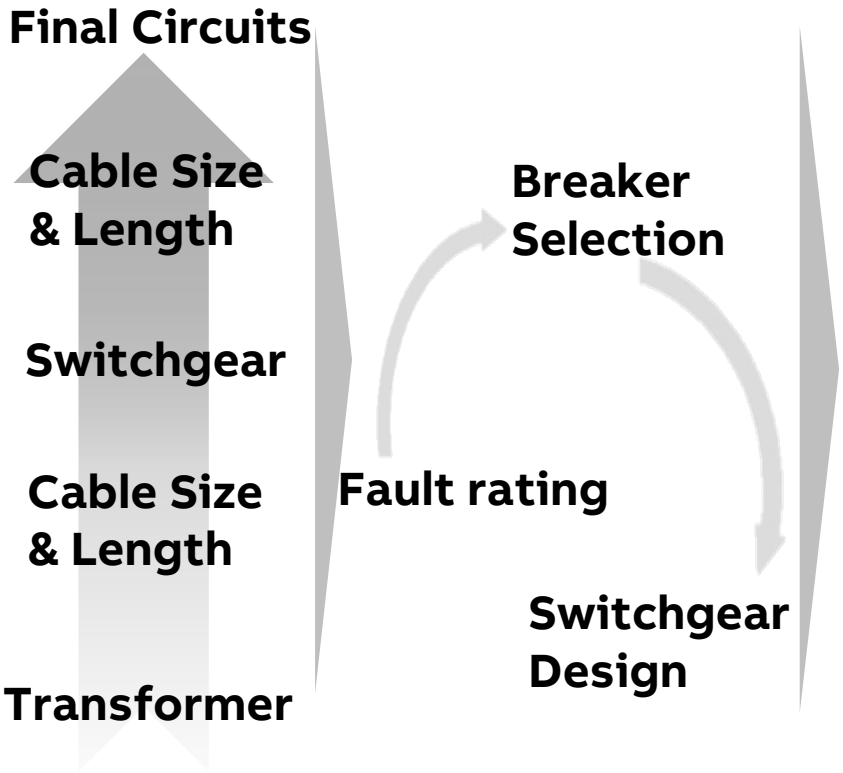
The main agenda for this presentation is to give an overview and introduction into the information required for a good balanced selection of Switchgear for the installation.

- Fault Rating
- Protective Device Selection & ATS Change-over
- Safety, Switching, Racking, RELT (new)
- Traditional & Intelligent Motor Protection
- Type of Switchgear Panels
- Busbar Sizing (FLC/SCC)
- Hot Swappable Plug-in Devices
- ~~Forms of Separation~~
- ~~Cable Entry~~
- Design tools

Panel Fault Ratings (PSC)

One of the first questions you will be asked if you are ordering a new breaker is:

"Do you know the fault rating"



In simplified terms –

Depending on were the fault occurs on the installation and how close it is to the transformer will depend on the level of the fault,

i.e. the distance the fault has to travel to find it's way home.

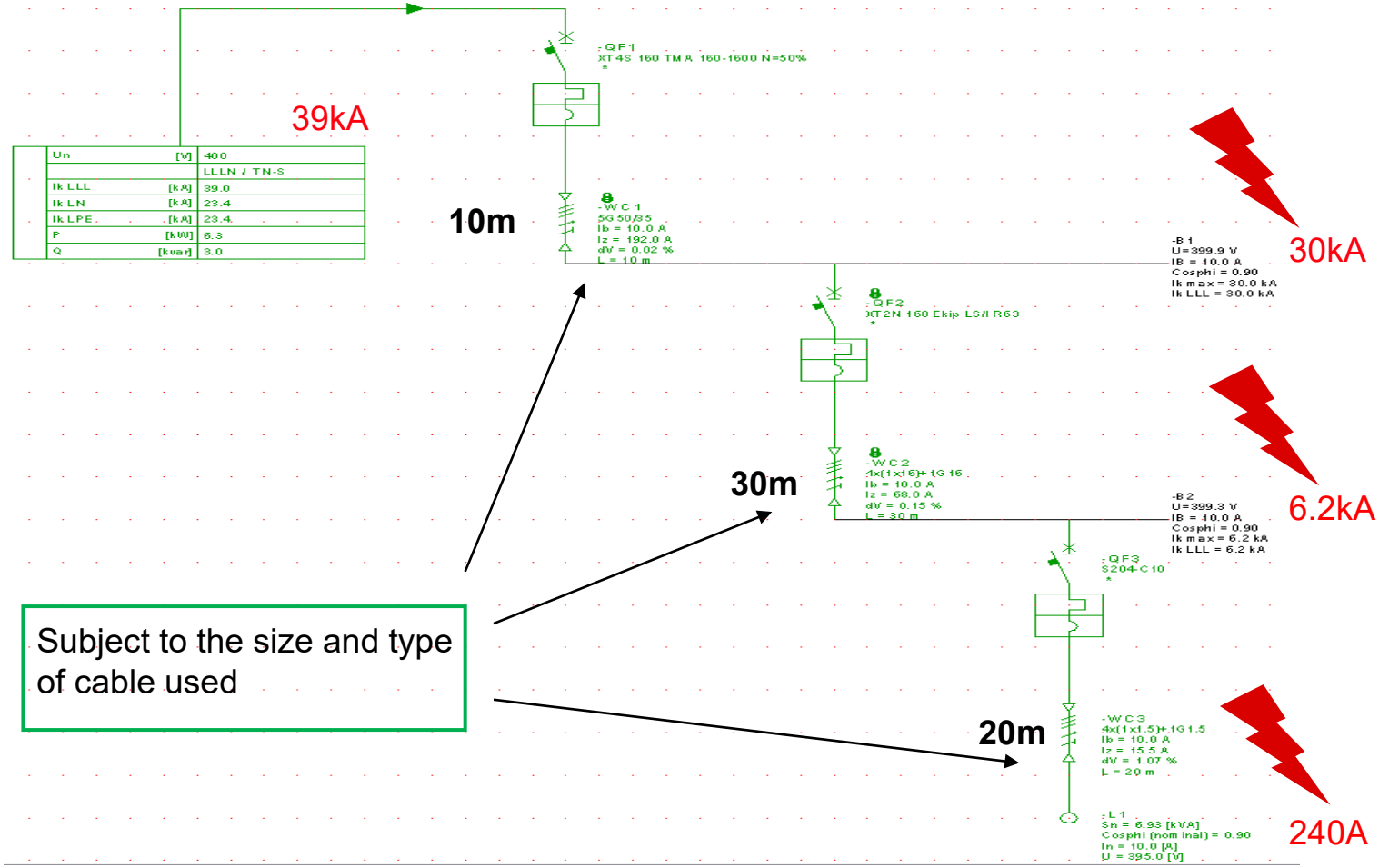
Formula
Phase Voltage (Vph 0°) / Impedance (Z)
Where Z=R+XL
R is resistance
XL is inductance

230/.0063 =

39kA

Example

Panel Fault Ratings (PSC)



Protective Device Selection

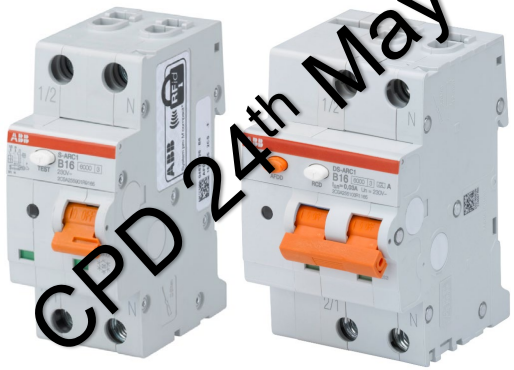
Circuits are generally protected for short circuit currents and overload currents

Air Circuit Breakers

Moulded Case Circuit Breakers

Miniature Circuit Breakers

Arc Fault Detection Device



Overload relays used
In motor protection

UMC universal motor controller

CPD 24th May

Protective Device Selection

Circuits are generally protected for short circuit currents and overload currents

IEC 60947-2:

Air Circuit Breakers
1600A

Moulded Case Circuit Breakers
1600A

Protective Device Selection

Fuses are widely used for protection installations

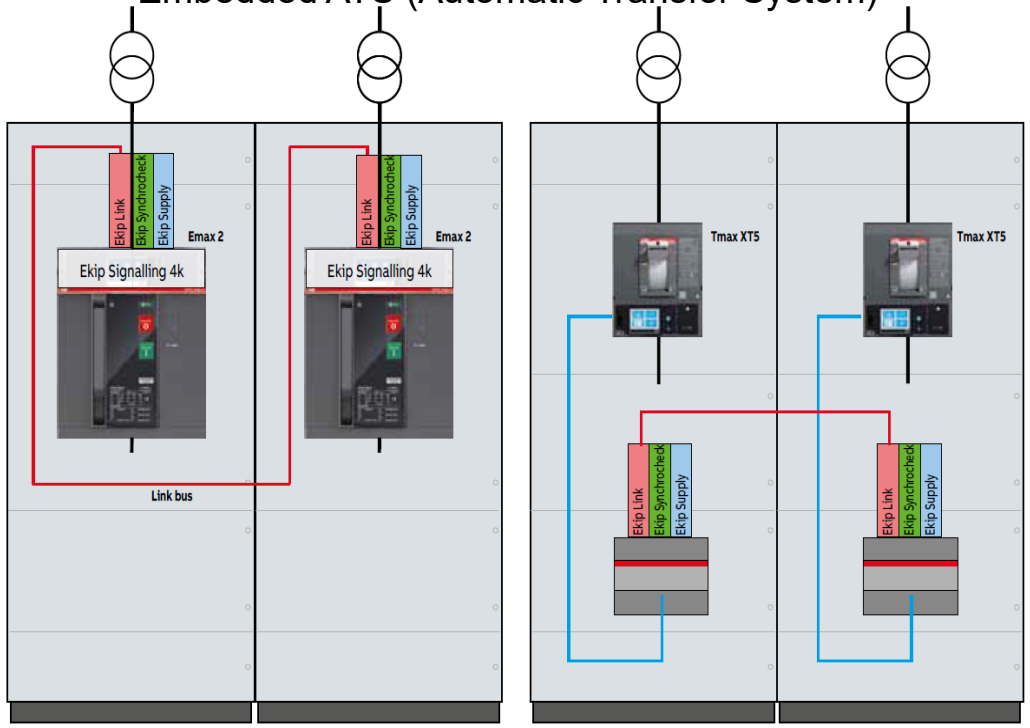
- High rupturing capacity
- Standard Characteristic
- High current limitation effects

Automatic Transfer Switche

Power Quality and Reliability

Hospitals
- Sports arenas
- Retail environments
- High-rise buildings
- Commercial buildings
- Financial environments
- Data Centers
- And more

Embedded ATS (Automatic Transfer System)



Compact ATS

Tru-One ATS (intelligent transfer switch)

Missed out on 2
0.07sec at worl

Automatic Transfer Switches

Tru-One ATS (intelligent transfer switch)

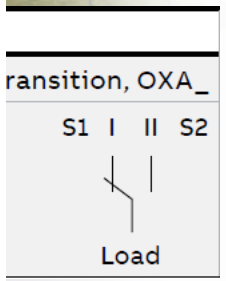
Power Quality and Reliability

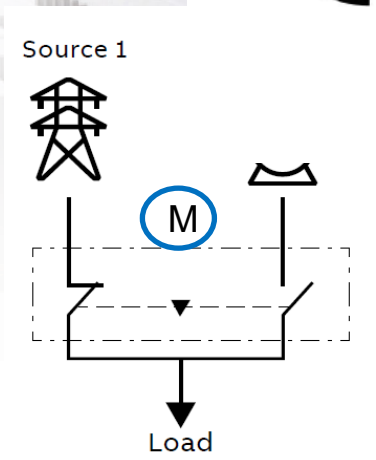
Hospitals
- Sports arenas
- Retail en
- High-rise
- Commer
- Financial
- Data Cen
- And mor

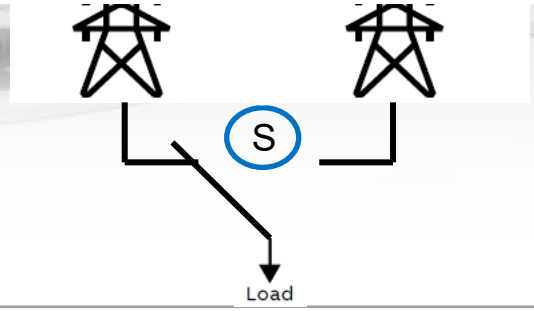
KEEP BUSINESS RUNNING.

Ensures fast in-phase open transition of power—under 50ms.
- Eliminates blinking lights and stopping motors
- Goes unnoticed

Reduces downtime and maintenance costs.
- Predictive maintenance and self-diagnostics
- Customer-replaceable critical modules





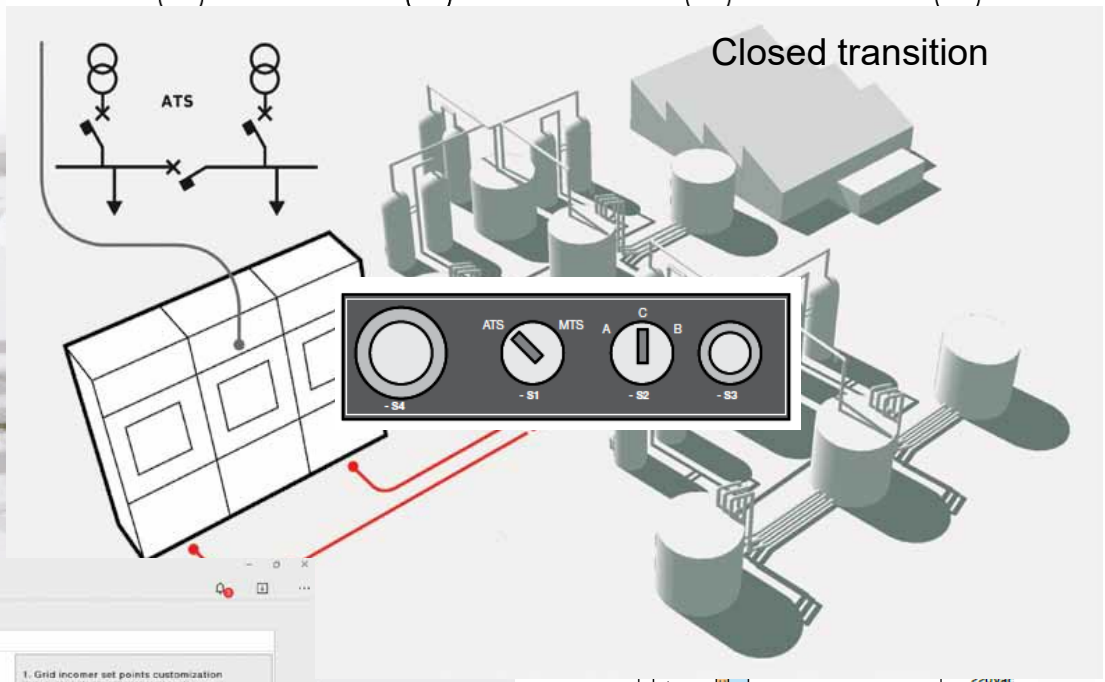


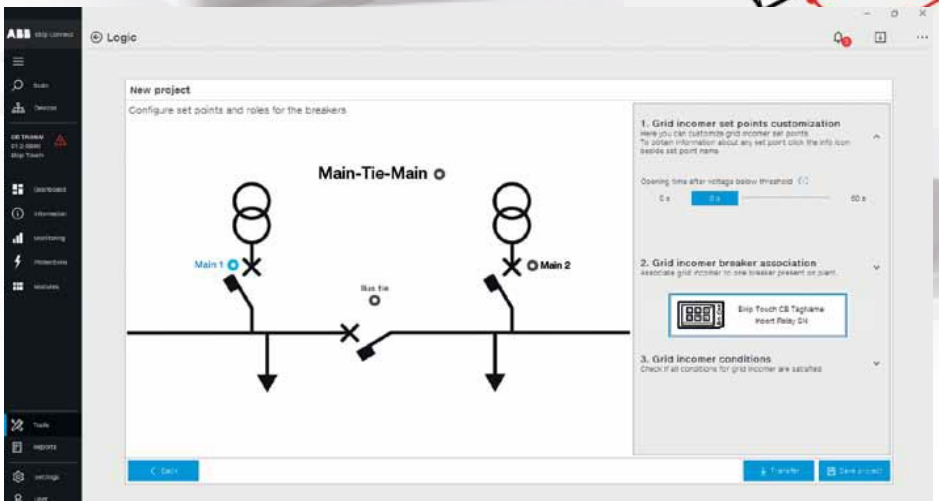
Automatic Transfer Switches

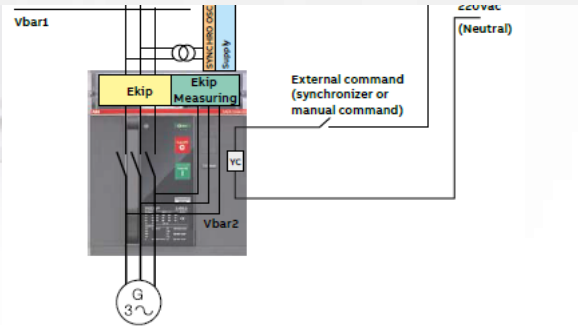
Power Quality and Reliability

Hospitals
- Sports arenas
- Retail environments
- High-rise buildings
- Commercial buildings
- Financial environments
- Data Centres
- And more

Embedded ATS (Automatic Transfer System)







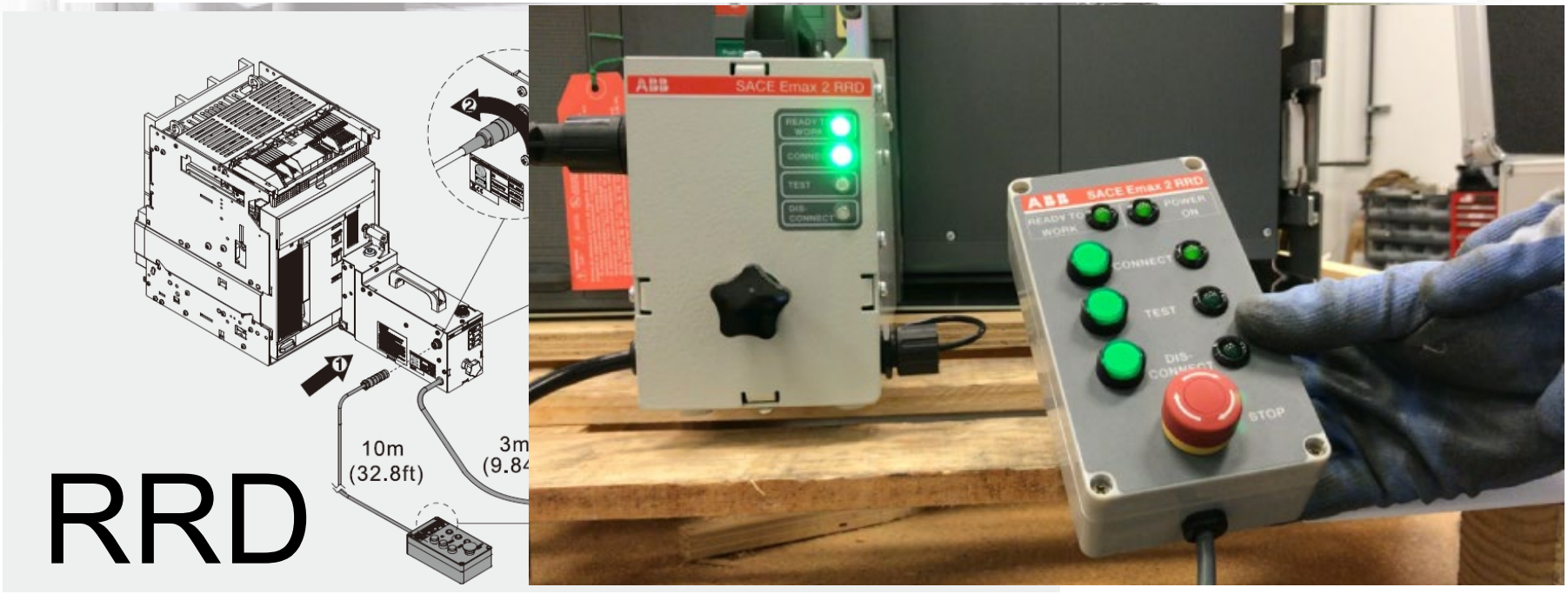
Safety, Switching, Racking, RELT

NEW TOPIC

Power Quality and Reliability

Preventive arc flash protection solutions
Safer operations at a distance

The RRD (Remote Racking Device)
Allows safe racking of an ACB from “Connected” position to “Test” and to “Disconnected”



Safety, Switching, Racking, RELT

Power Quality and Reliability

Preventive arc flash protection solutions
Safer operations at a distance

Arcswitch®

Safety, Switching, Racking, RELT

Power Quality and Reliability

Preventive arc flash protection solutions
Safer operations at a distance
Arcswitch®

Safety, Switching, Racking, RELT

Power Quality and Reliability

Preventive arc flash protection solutions
Safer operations at a distance
Arcswitch®

Distance. Electric maintenance, trouble-shooting personnel and operators are always exposed to risks when working in the switchgear room. Maintaining a safe distance between personnel and equipment during switching operations provides the most effective means of avoiding injury.

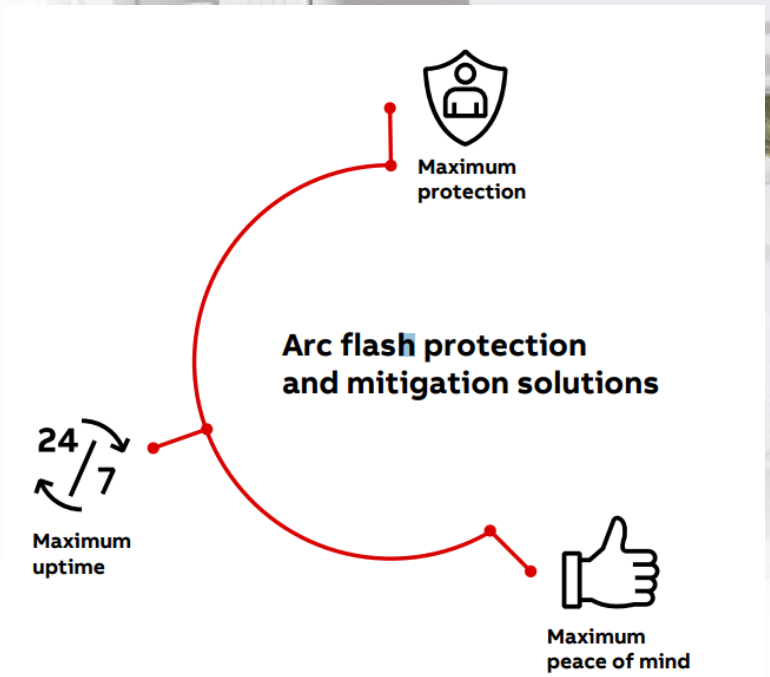
Putting the protection of your people first is a smart choice. Because safety is not a cost, it is an investment.

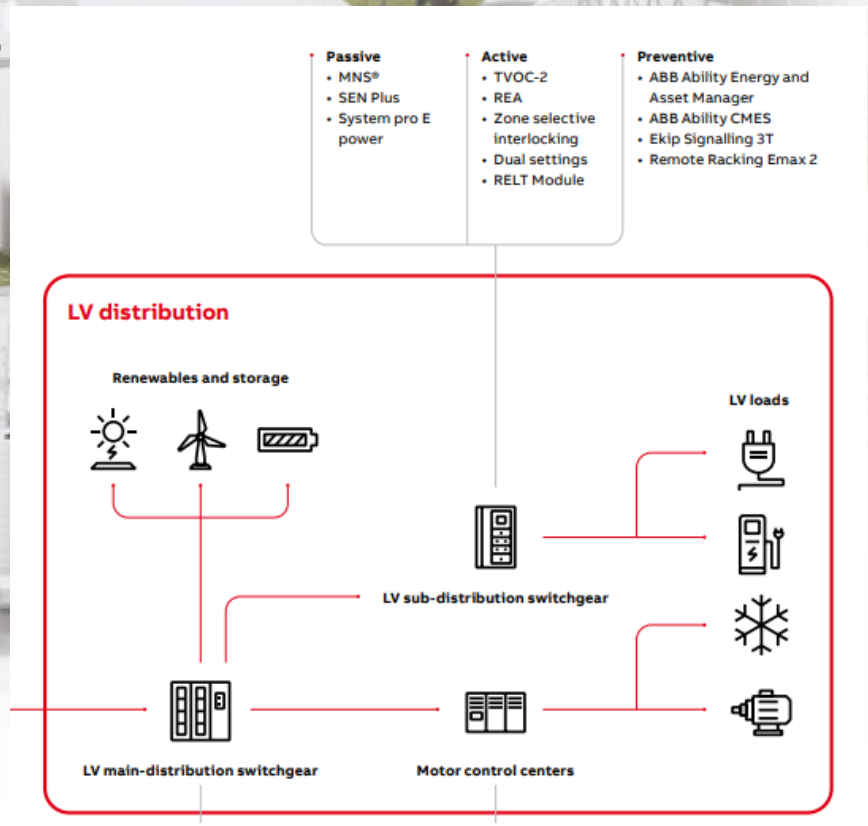
Safety, Switching, Racking, RELT

Power Quality and Reliability

Preventive arc flash protection solutions
Safer operations at a distance

Reduced Energy Let-Through RELT





Safety, Switching, Racking, RELT

Power Quality and Reliability

Preventive arc flash protection solutions
Safer operations at a distance

Reduced Energy Let-Through RELT

Emax 2 and Tmax XT - RELT module

Benefits and features

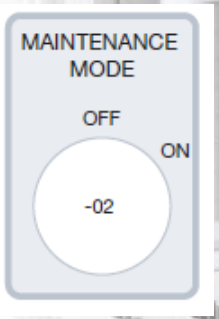
- Increased personnel safety. Dramatically reducing the impact of an arc flash event.
- The 2I is a temporary protection that is faster than the normal instantaneous protections.
- Depending on the fault current, this function can provide a total clearing time as low as 1.5 cycles at 60 Hz.
  - Cannot be deactivated remotely
  - Positive feedback provides a clear indication that the safety function is working properly
  - Easy to use wizard is automatically engaged during initial installation
  - Commissioning can be executed through the circuit breaker touch screen.

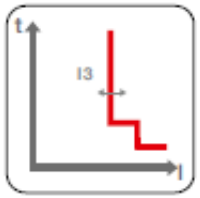
Safety, Switching, Racking, RELT

Power Quality and Reliability

Preventive arc flash protection solutions
Safer operations at a distance

Reduced Energy Let-Through RELT





Programmable instantaneous overcurrent (2I - ANSI 50): Second instantaneous tripping curve designed to mitigate against arc flashes (also referred to as RELT - Reduced Energy Let-Through). This protection can be adjusted from 1.5 to 15 x In, with a maximum setting of 18kA. The clearing time of the 2I protection is between 25 and 42ms at 60Hz (+5ms for 50Hz). Note: Easy activation and I/O assignment, including positive feedback, can be implemented using the RELT Ekip Signalling 2K-3 module.

Second I	Arcing Current (kA)	Clearing Time (ms)	Incident Energy (cal/cm²)	Hazard Risk Category	PPE Required
Without 2I	30	190	13.1	3	Cotton underclothing plus FR shirt, pants, overalls or equivalent
With 2I	30	30	2.2	1	Flame Retardant (FR) shirt and pants

Register for CPD on 10th May for Active Solution "Zone Selectivity"

Universal Motor Controller

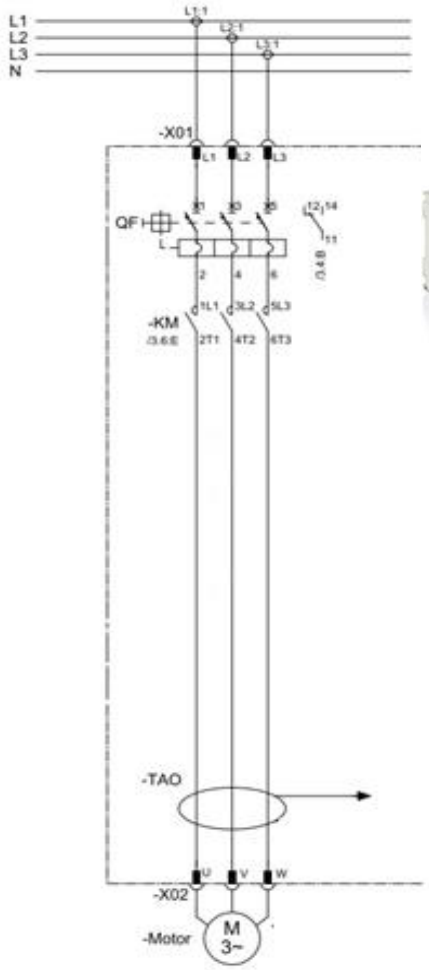
Motor management systems

(Traditional and Intelligent motor starters)

- Pharmaceutical process
- Water Treatment systems
- Oil and Gas industry
- Mining
- Food and Beverages
- Pulp and Paper Plants
- Atex approved

Solutions for Motor Feeders

Traditional



Protection Functions

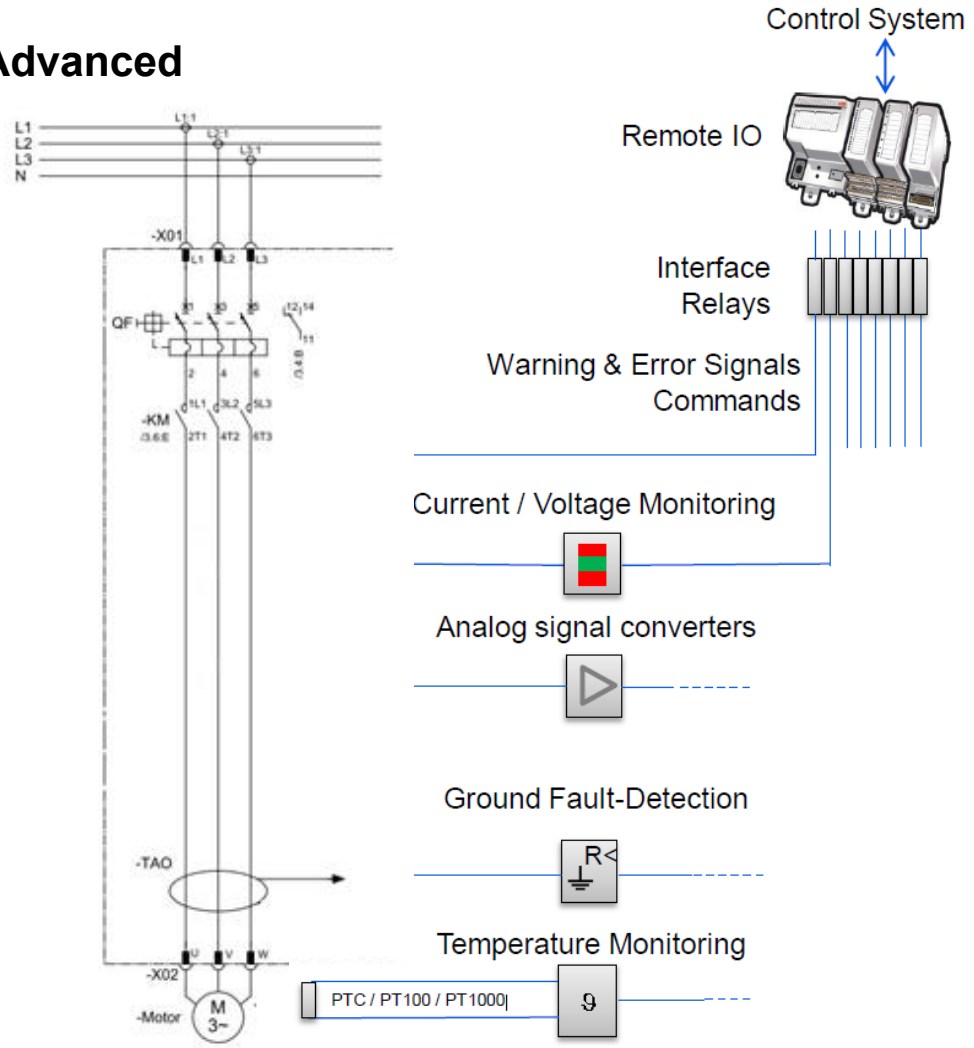
- Overloads
- Short Circuit

Devices

- Manual Motor Starters
- Thermal & Electronic Overload Relays
- Contactors
- Fuses

Solutions for Motor Feeders

Advanced



Adv. Protection Functions

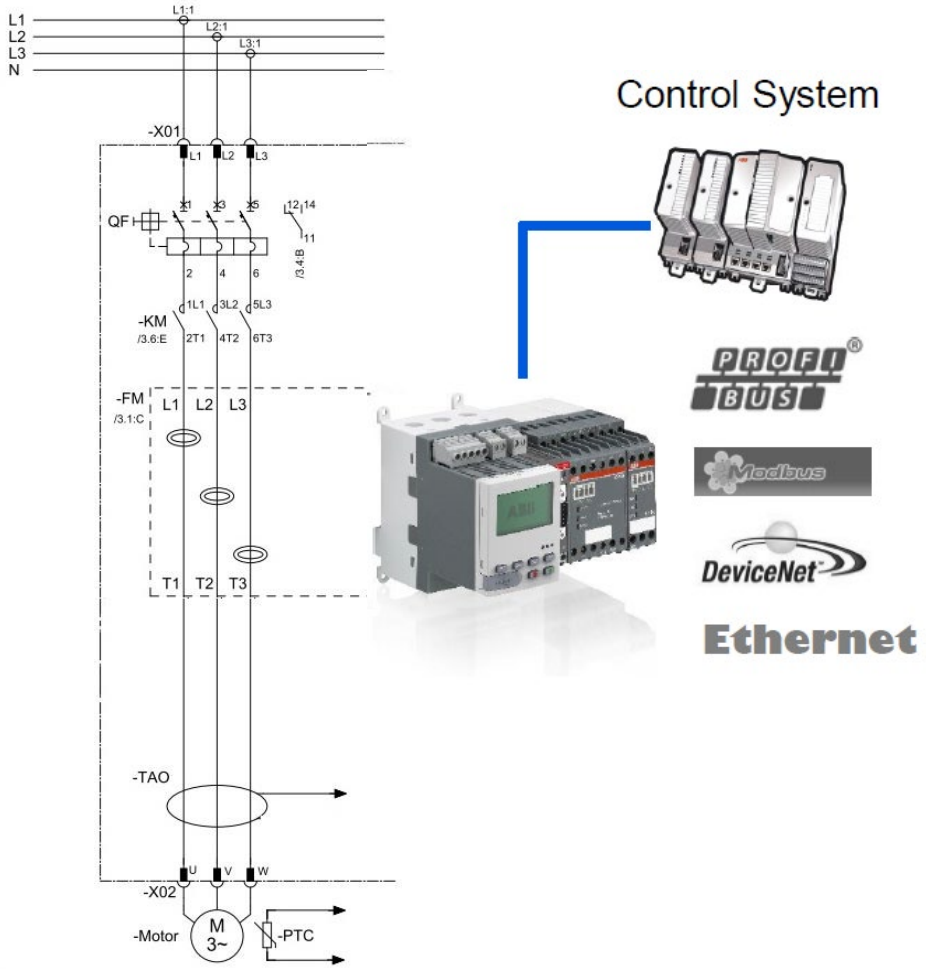
- Motor / Bearing Temperature Level Supervision
- Voltage / Current Level Supervision
- Ground Fault Detection
- Imbalance
- Phase Rotation

Supportive Devices

- Power Supplies
- Current Transformers
- Voltage Transformers
- Timers
- ……

Solutions for Motor Feeders

High Performance



Integrated Solution

- Motor Control
- Motor Protection
- Motor Diagnosis
- Communication

Benefits

- Reduces wiring and complexity
- One variant for all motor currents,
  trip classes and control functions >> reduce stock
- Compact.. Save space
- Increased flexibility during
  engineering & commissioning
- Pre-warnings;
  diagnosis and measured values

AFDD

Arc Fault Detection Device

- Rooms with sleeping accommodation
- Locations with risks of fire due to combustible constructional materials
- Locations that contain irreplaceable goods

SACE Tmax XT

Low Voltage Moulded-Case Circuit Breaker

MCCB

- Power Distribution
- Motor Protection
- Generator Protection
- Oversized Neutral Protection 160%
- Switch Disconnectors
- Special Applications (400Hz)
- XT1-XT4 < 200A
- XT5-XT7 < 1600A

Circuit Breakers

SACE Tmax XT range

XT1 160A

XT2 160A

XT5 320/630A

XT7 800/1600A

XT3 250A

XT4 160/250A

XT6 800/1000A

XT1 to XT4

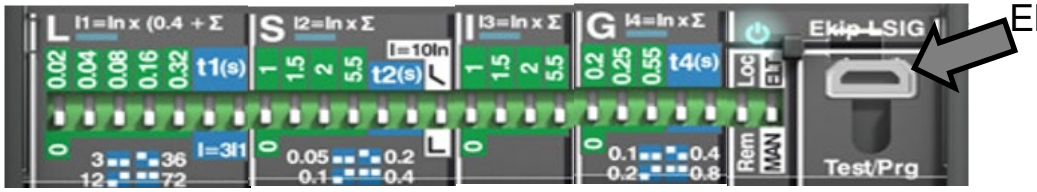
- Rated up to 250A in 4 frames
- 3 & 4 Pole
- ICU up to 150kA@415v AC, 90kA @690v
- Versions F/P/W

XT5 to XT7

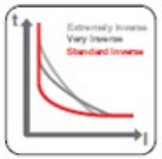
- Rated up to 1600A in 3 frames
- ICU up to 200kA @415vAC, 100kA @690v
- Versions F/P/W
- Touch screen electronic trip units
- Advanced electronics & communications

Circuit Breakers

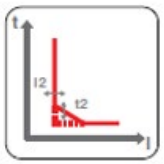
Electronic Trip Unit Descriptions and Settings



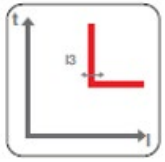
Electronic settings & reports



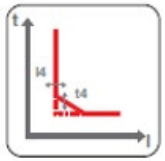
L – Overload (L - ANSI 49)
This function is used for protection against overloads. It allows the setting of the trip Trip time and pre-alarm threshold.



S – Time-delayed overcurrent (S - ANSI 51 & 50TD)
This function is used to protect against selective short-circuits. If necessary, it can be disabled, or if needed, only the trip can be excluded keeping the alarm indication, to be used in installations where continuity of service is required.



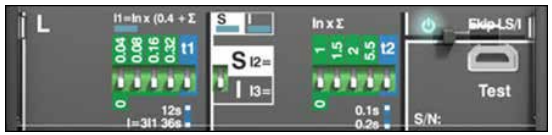
I – Short-circuit
This function is used for instantaneous protection against short-circuits. The trip threshold is
adjustable and, if needed, the protection can be disabled.



G - Ground fault
This function protects against earth faults. The trip threshold and trip time are adjustable. When
needed, the protection can be disabled.

Circuit Breakers

SACE XTmax range of new intelligence



Thanks to the maximum flexibility guaranteed by these packages, the new Ekip trip units are now completely customizable. Depending on the specific trip unit version, different packages are available by default, but all of them can be added to the trip unit.

Default functionalities and upgradability of the trip units:

	Standard Protection	Standard Measures	Measuring Package	Voltage Protections	Frequency Protections	Power Protections	Adaptive Protections	Adaptive Protections	Network Analyzer	Advanced Voltage Protections	ROCOF Protections	Power Controller
Ekip Touch	●	●	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Ekip Touch Measuring	●	●	●	↑	↑	↑	↑	↑	↑	↑	↑	↑
Ekip G Touch	●	●	●	↑	↑	↑	↑	●	↑	↑	↑	↑
Ekip M Touch	●	●	●	●	●	↑	●	↑	↑	↑	↑	↑
Ekip Hi-Touch	●	●	●	●	●	↑	●	●	●	↑	↑	↑
Ekip G Hi-Touch	●	●	●	●	●	●	●	●	●	●	●	↑

● Available by default
↑ Upgradable
↑ Some functions available. Upgradable with the full package.

The flexibility offered by the packages allows also the selection of the proper functions that can be required by the different segments and applications, purchasing only the needed functionalities.

Suggested packages by segment:

Packages	Wind	Solar	Data Center	Building Infrastructure	GenSet	Mining	Marine	Industries	Utilities
Voltage Protections	●	●		●	●		●		
Advanced Voltage Protections	●	●			●				
Frequency Protections	●	●			●	●		●	●
Power Protections			●	●		●		●	●
ROCOF Protections	●	●			●				
Adaptive Protections	●	●		●		●			
Measuring Package	●	●	●	●	●	●	●	●	●
Data Logger	●	●	●	●	●		●	●	
Network Analyzer	●	●	●	●	●	●	●		●
Power Controller			●	●		●			●

SACE Emax 2 range

Low Voltage Air Circuit Breaker

ACB

- Power Distribution
- Motor Protection
- Generator Protection
- Oversized Neutral Protection 200%
- Switch Disconnectors
- Special Applications
- 40A to 6300A
- Advanced Technology
- Carbon Footprint & EDCS

https://www.youtube.com/watch?v=Cas0U-DG_-0&feature=youtu.be

Air Circuit Breakers

Icu (440 Vac)	Versione	630	800	1000	1250	1600	2000	2500	3200	4000	5000	6300
200	X											
150	V											
100	H											
85	S											
66	N											
50	C											
42	B											

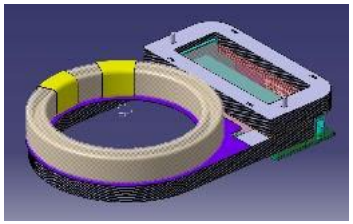
ACB 630amp up to 6300amp Fault Rating 42kA-200kA

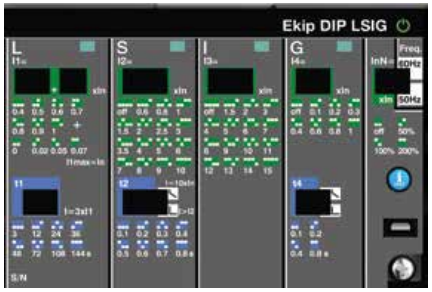
Air Circuit Breakers

Protective Device Selection

New Ekip Trip Units

- More precise currents measurements thanks to the new sensors
- Embedded Power Quality Monitoring Function
- Dedicated versions for Generator Protection





EKIP DIP:
Protection
Ekip Dip LI
Ekip Dip LSI
Ekip Dip LSIG

EKIP TOUCH:
Protection,
Measurements,
Communication

EKIP HI-TOUCH:
Ekip Touch + advanced protections,
Power Quality Monitoring

- Complete set of protections and measurements
- Dual settings of protection
- Network Analyzer function

Energy Measurements

Class 1 accuracy (IEC61557-12)
(.5 for Current and voltage)

SACE Emax 2

By functions

Protection

Interface protection ●

Generator protection ●

Distribution protection ●

Adaptive protection ●

Logic

● Fast load shedding

● Peak shaving

● Slow load shedding

● Transfer switch & logic

● Synchro-reclosing

● MV-LV interlocking

Emax 2 embeds

Measurement

Currents metering ●

Power & Energy metering ●

Voltages metering ●

Power quality ●

Connectivity

● Remote monitoring

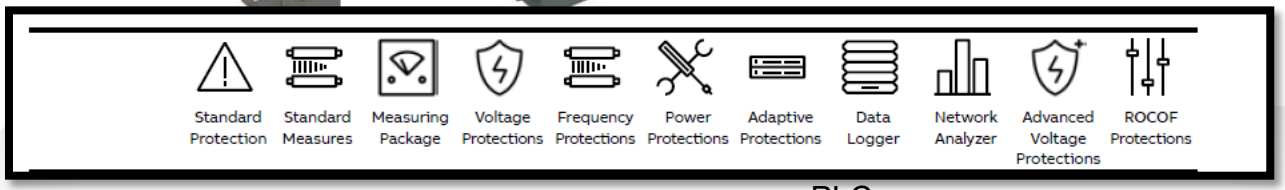
● Field monitoring

● Cloud-based monitoring

SACE Emax 2

By products

The Market Place



Protection

Interface relays ●

Multifunctional relays ●

Single protection relays ●

Logic

● PLC

● Control unit

● ATS

● Synchronizer

● Synchro check

● Cloud gateway

● Field gateway

● Energy management platform

Emax 2 embeds

Measurement

Current Sensors ●

Multimeters ●

Voltage sensors ●

Network analyzer ●

Connectivity

ABB Ability™ Electrical Distribution Control System

How it works

Embedded solution

Plug-in the **Ekip Com Hub** module on Emax 2, Ekip UP and TruONE and start Ekip Connect wizard.

In **less than 10 minutes** the panel is connected to the cloud.

Plug & play:

- LV Circuit breakers, Ekip E-Hub, Ekip UP
- Fusegear
- Arc-guard, grid-feeding relays
- Energy and Power meters, Branch monitoring
- Signalling units, analog inputs
- MV relays

CPD 4th May IIoT

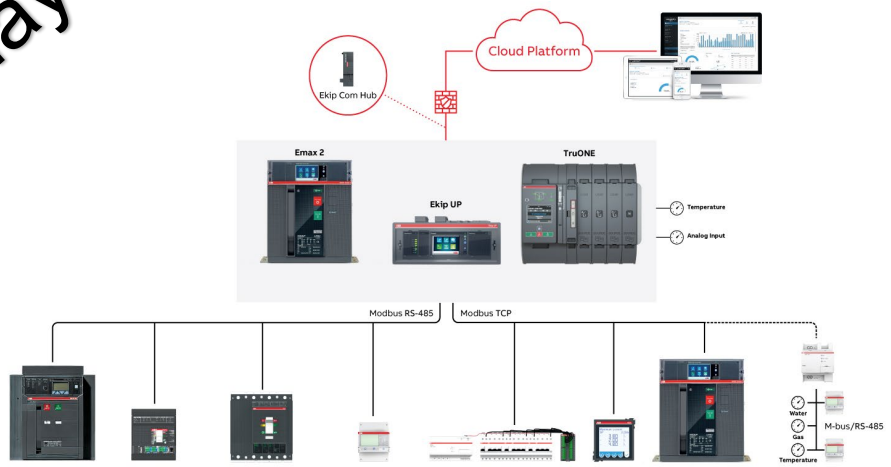


ABB Ability™ Electrical Distribution Control System

Features

Cloud-based Energy and Asset Management

Monitor

Discover plant performance, supervise the electrical system and allocate costs

Predict

Supervise the system health conditions and predict next maintenance actions

Optimize

Analyze the relevant information, improve the use of your assets and take the right business decision

Control

Remotely implement an effective power management strategy to simply achieve energy savings

Types of Switchgear

So what have they all got in common?

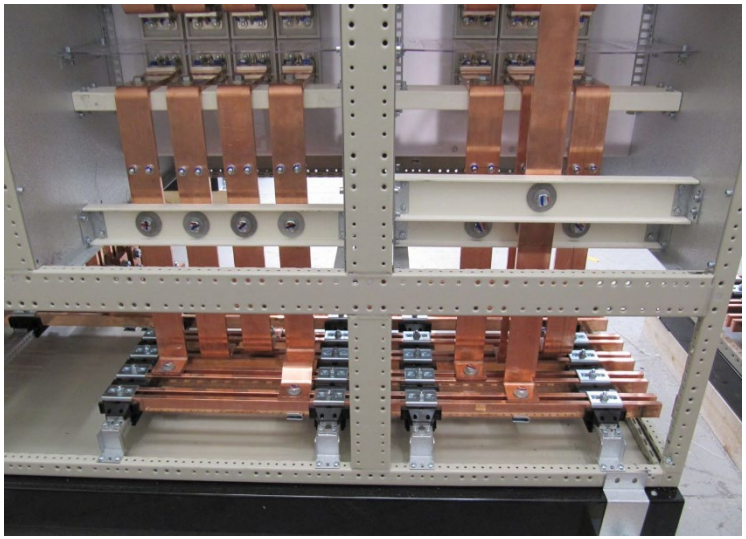
Types of Switchgear

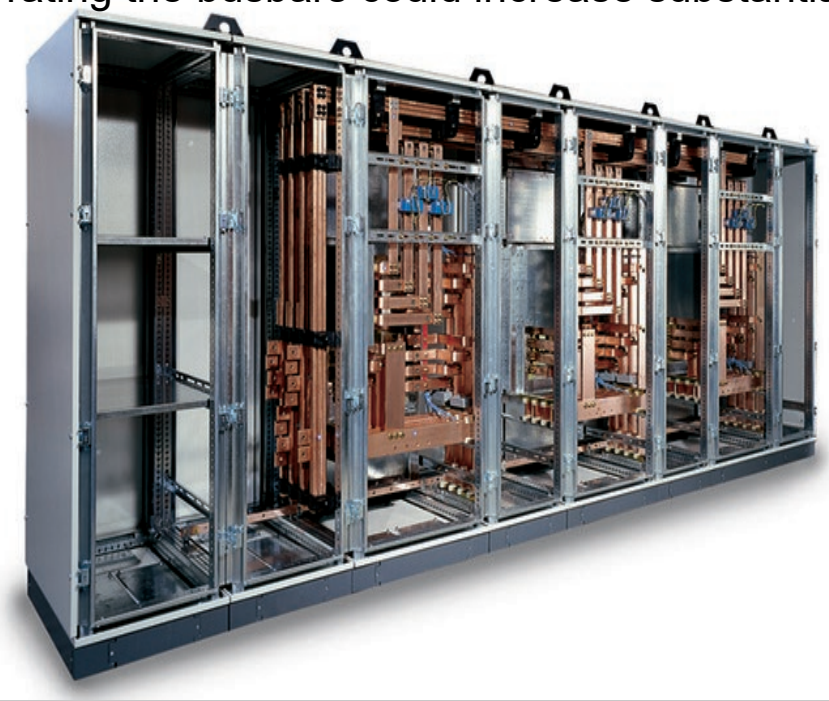
Busbar sizing (FLC/kA fault rating)

- When sizing busbars for Main Boards or Sub Main Board it must be noted that

The full load current rating of the busbar must take into account the fault rating on the board.

- Standard 800a main board at 16kA fault may be sized at 2 # 30x5 copper
- The same 800a main board at 80kA fault rating the busbars could increase substantially, 4 # 40x10 copper

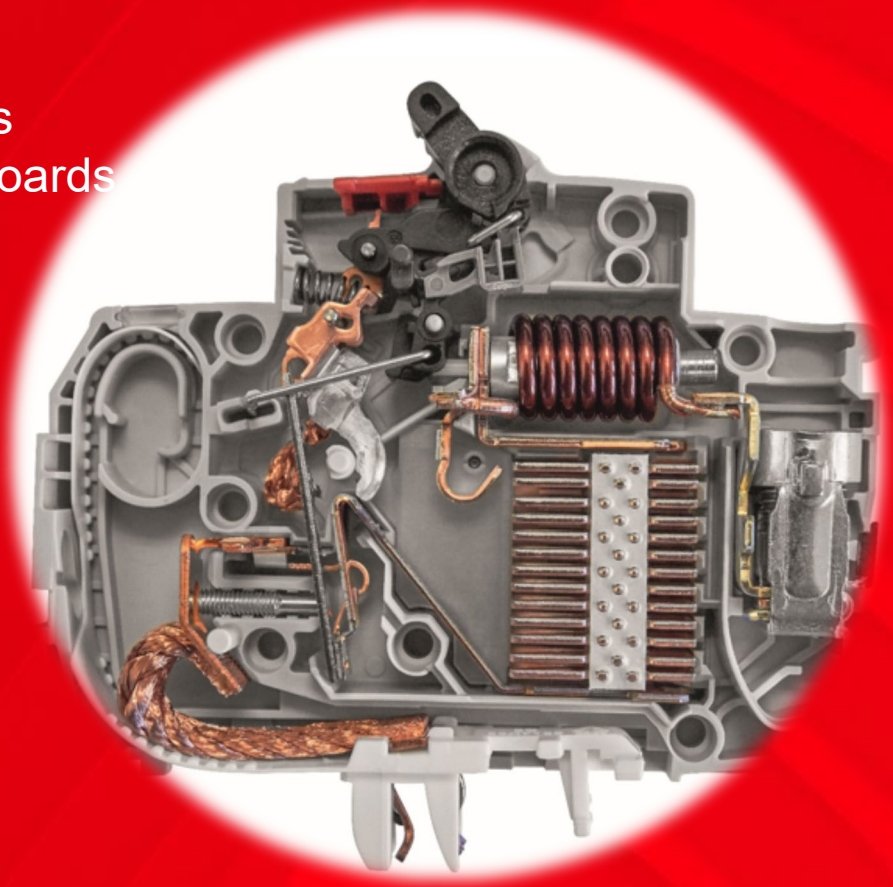




Distribution Panel Boards

Twinline and Smissline Overview

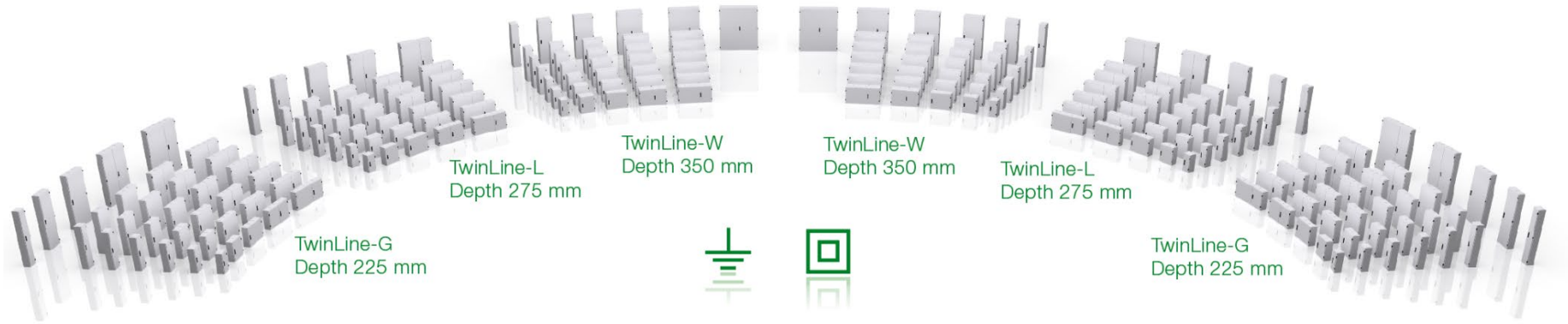
- Traditional Distribution Boards
- Hot Swappable Distribution Boards
- Branch Monitoring Systems



Distribution Panel Boards

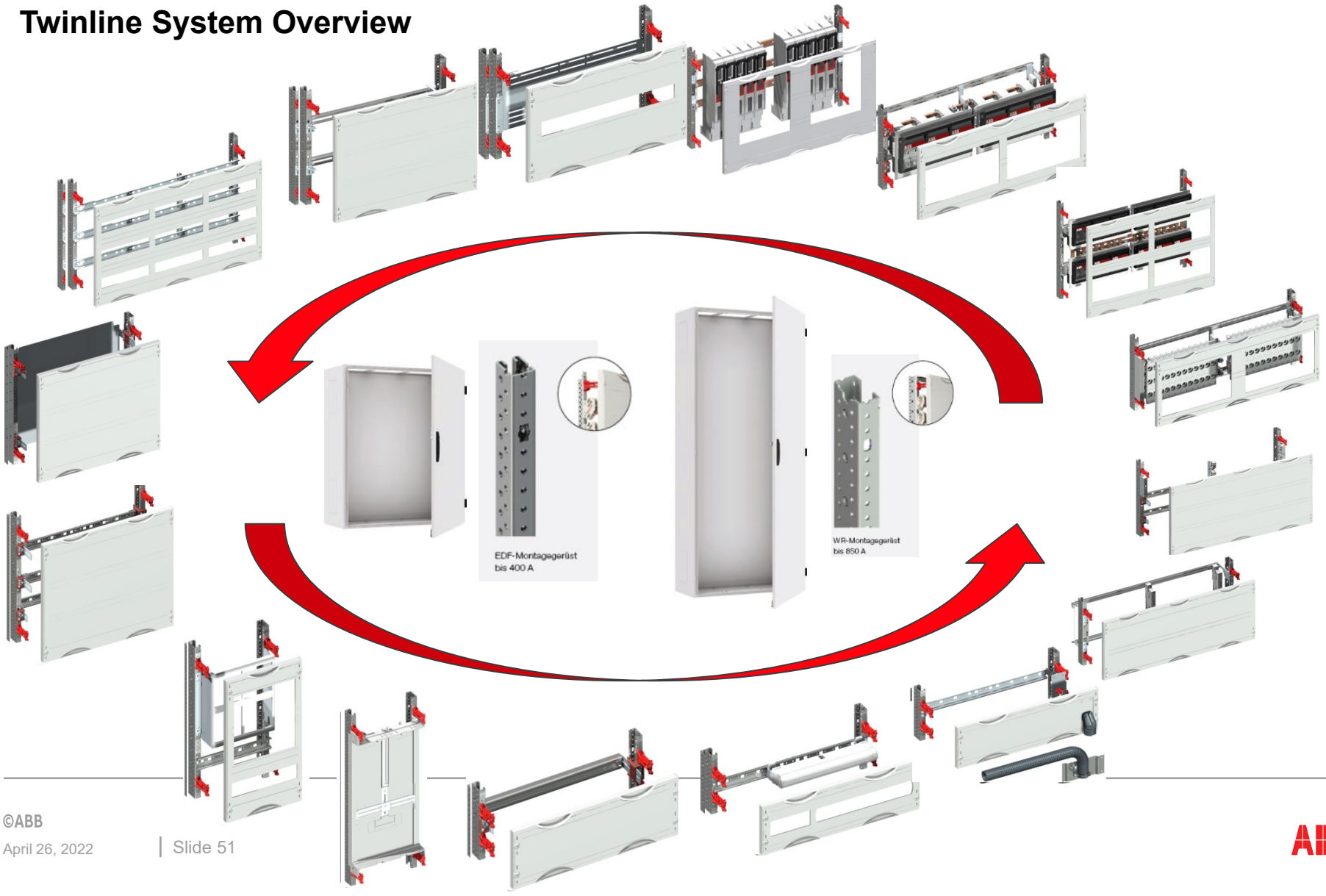
Twinline System Overview

One complete cabinet system, uniform design and uniform interior fittings
Two protection classes, all cabinets available as earthed or double insulated versions
Three cabinet depths, 225 mm, 275 mm and 350 mm
Endless possibilities, cabinet with door IP55, cabinet without door IP30 (optional sheet-steel door), earthed or double insulated versions available, 424 enclosure variants



Distribution Panel Boards

Twinline System Overview



Distribution Panel Boards

SMISSLINE TP – Touch Proof System Overview

Safety

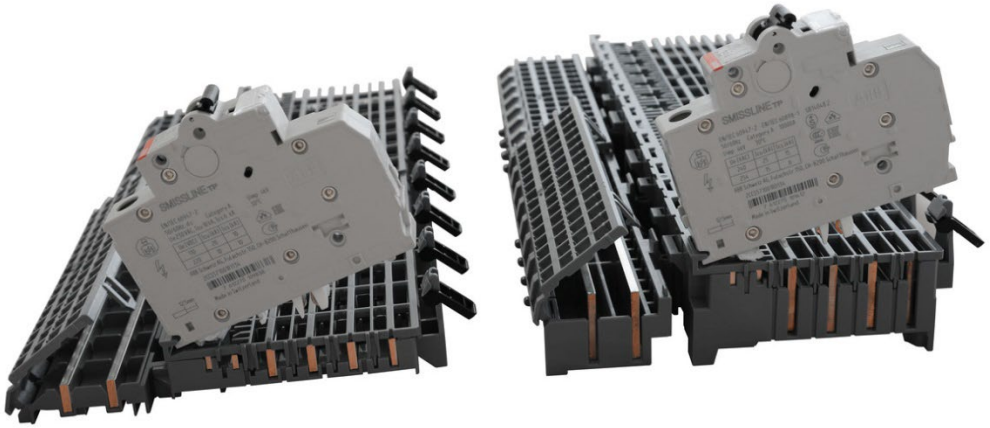
- **The SMISSLINE TP plug-in socket system allows for load-free plugging in and unplugging of live devices and components without additional personal safety equipment for protection against electrical hazards.**
- **Protection against electrical hazards:**
  - There is no risk of electrical shock during load-free plugging in and unplugging of devices on the SMISSLINE TP. The SMISSLINE TP plug-in socket system is fully protected against direct contact (IP2XB). The system remains fully touch-proof during plugging in and unplugging of devices. SMISSLINE TP prevents any risk to persons through switch arcs or fault arcs.

SMISSLINE TP

Safer, faster and even more flexible

SMISSLINE TP at a glance:

- Safe: load-free plugging in and unplugging possible live
- Flexible: rapid replacement, easy expansion, mixed-pole layout possible
- Economical: saves time and space thanks to the plug-in technology
- Flexible bus bar 125A and 250A
- Five different types of protection devices in one system



Unique Selling Proposition (USP)

Live- working:

Conventional

SMISSLINE TP

System pro M compact® InSite

System at a glance

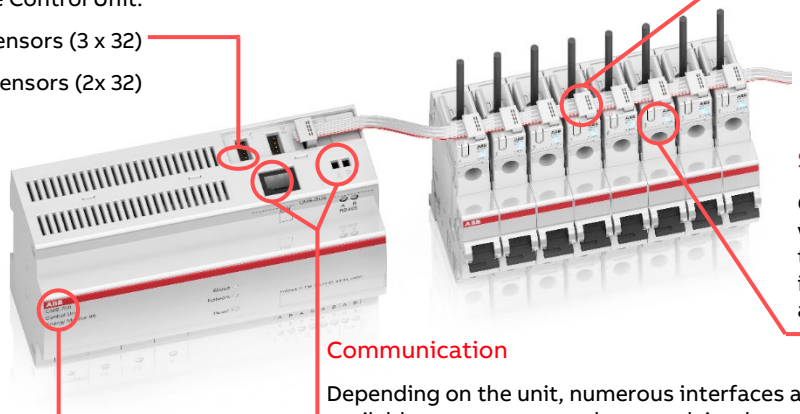
CMS bus interface

Each bus interface allows up to 32 sensors connected to the Control Unit:

- CMS-700: up to 96 sensors (3 x 32)
- CMS-600: up to 64 sensors (2x 32)

Connection technology

Connecting the sensors to the control unit is extremely easy and requires no special tools. All sensors are connected to the Control Unit by means of a flexible flat cable. Fully customizable positioning of sensors where measurement is required



Sensors

CMS sensors can be placed anywhere in the system, without any limitation. Easy initializing is guaranteed by the unique ID assigned to each sensors via Control Unit in just a few simple steps. All measurement functions are available right after commissioning.

Control Units

The Control Unit evaluates the measurement data picked up by the sensors and makes it available via the built-in interfaces

Communication

Depending on the unit, numerous interfaces and protocols are available to ensure smooth network implementation: RS485 (Modbus RTU), LAN (TCP/IP and Modbus TCP), SNMP v1/v2 and encrypted v3.

Thanks to the built-in web server, any internet browser can be used to visualize the values measured. Moreover, the measured values can also be exported to CSV files.

System pro M compact® InSite

What is measured is managed,

The Energy management can now be monitored at branch level in the facility.

Up-to-date system status

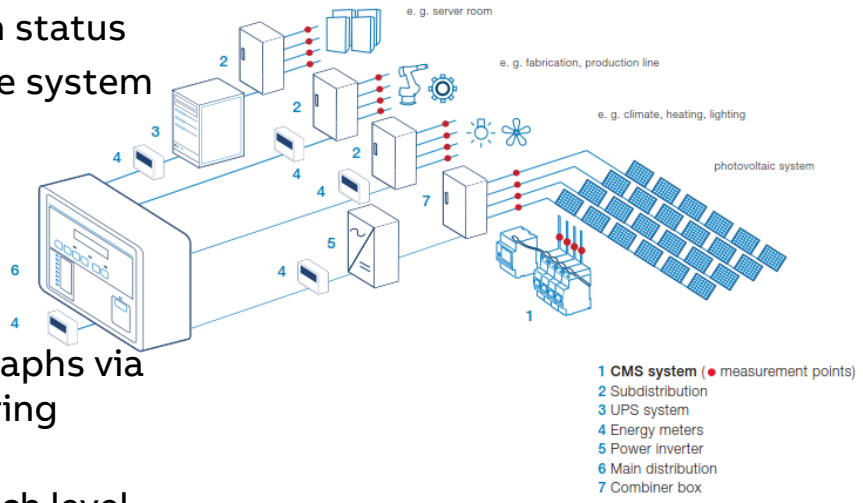
Early warnings to avoid downtimes, with quick notification of unusual system status

Predictive maintenance to guarantee system reliability and continuous operation

Granular energy management

Intuitive visualization of data and graphs via Web UI allows quick system monitoring

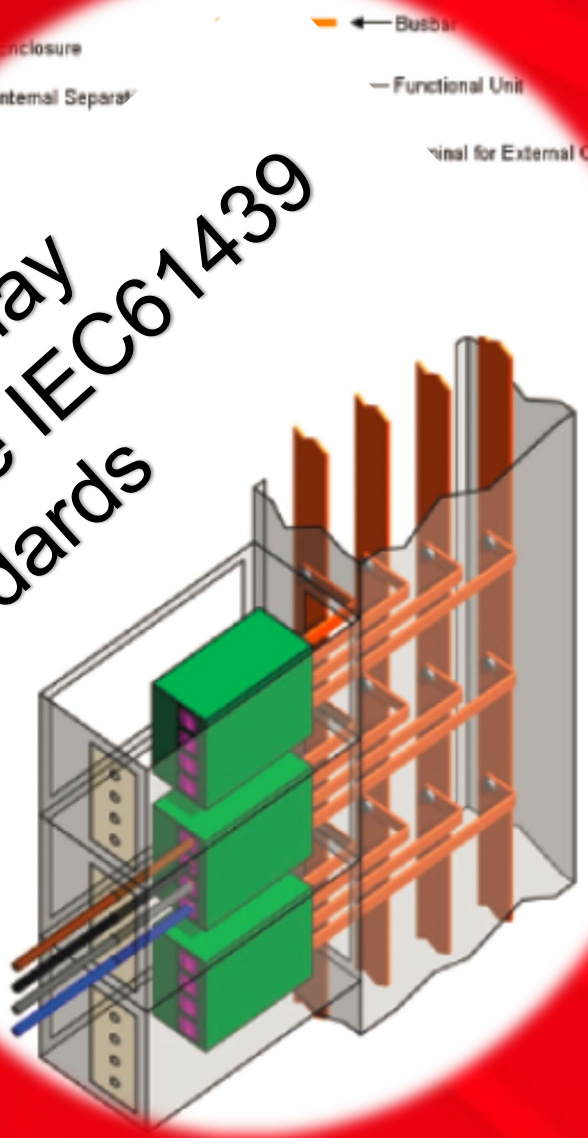
Immediate transparency of energy consumption made possible at branch level



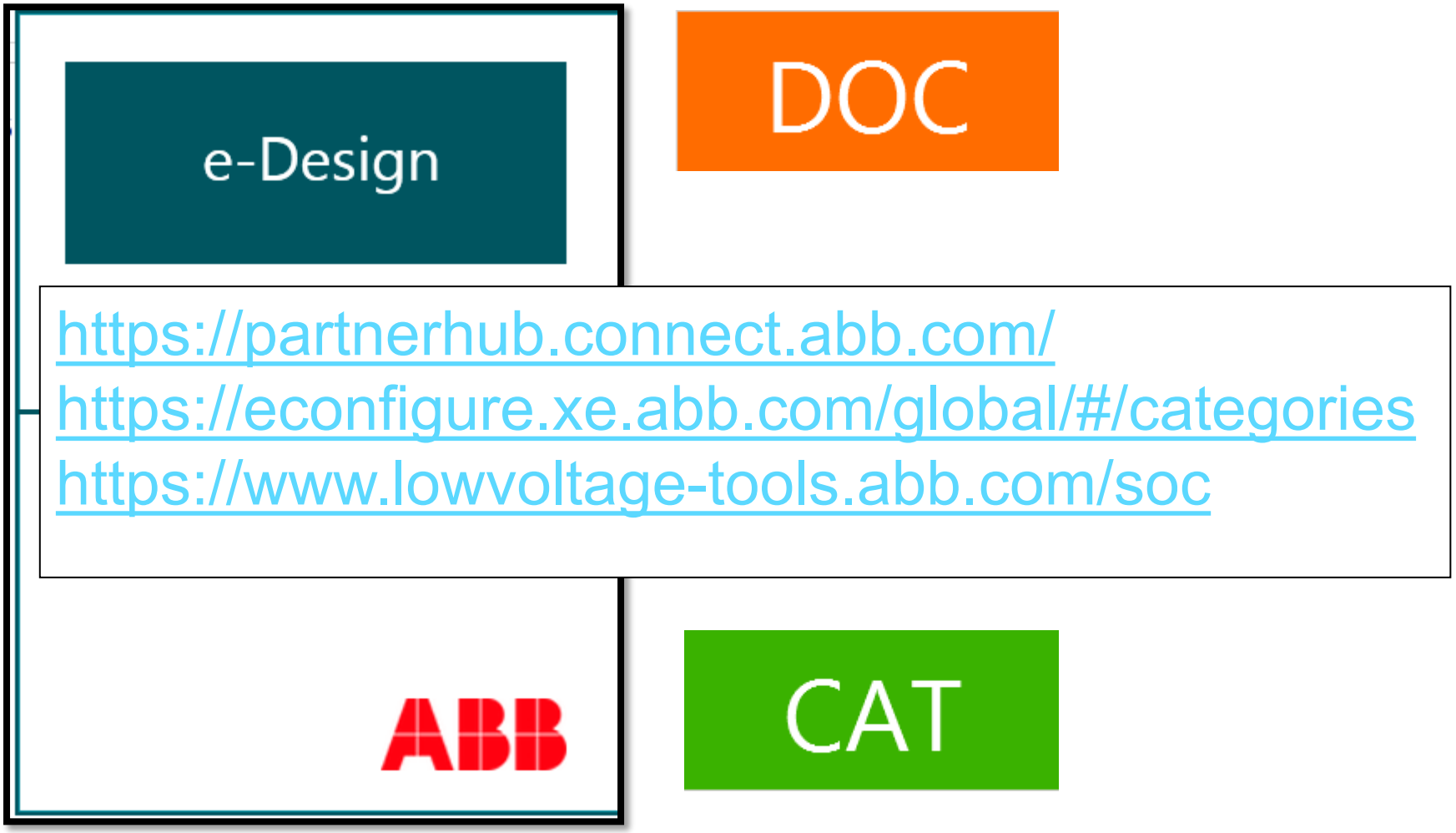
Types of Switchgear

Forms of Separations

CPD 17th May
Overview of the IEC61439 standards



Design Tool



Design Tools

PDC

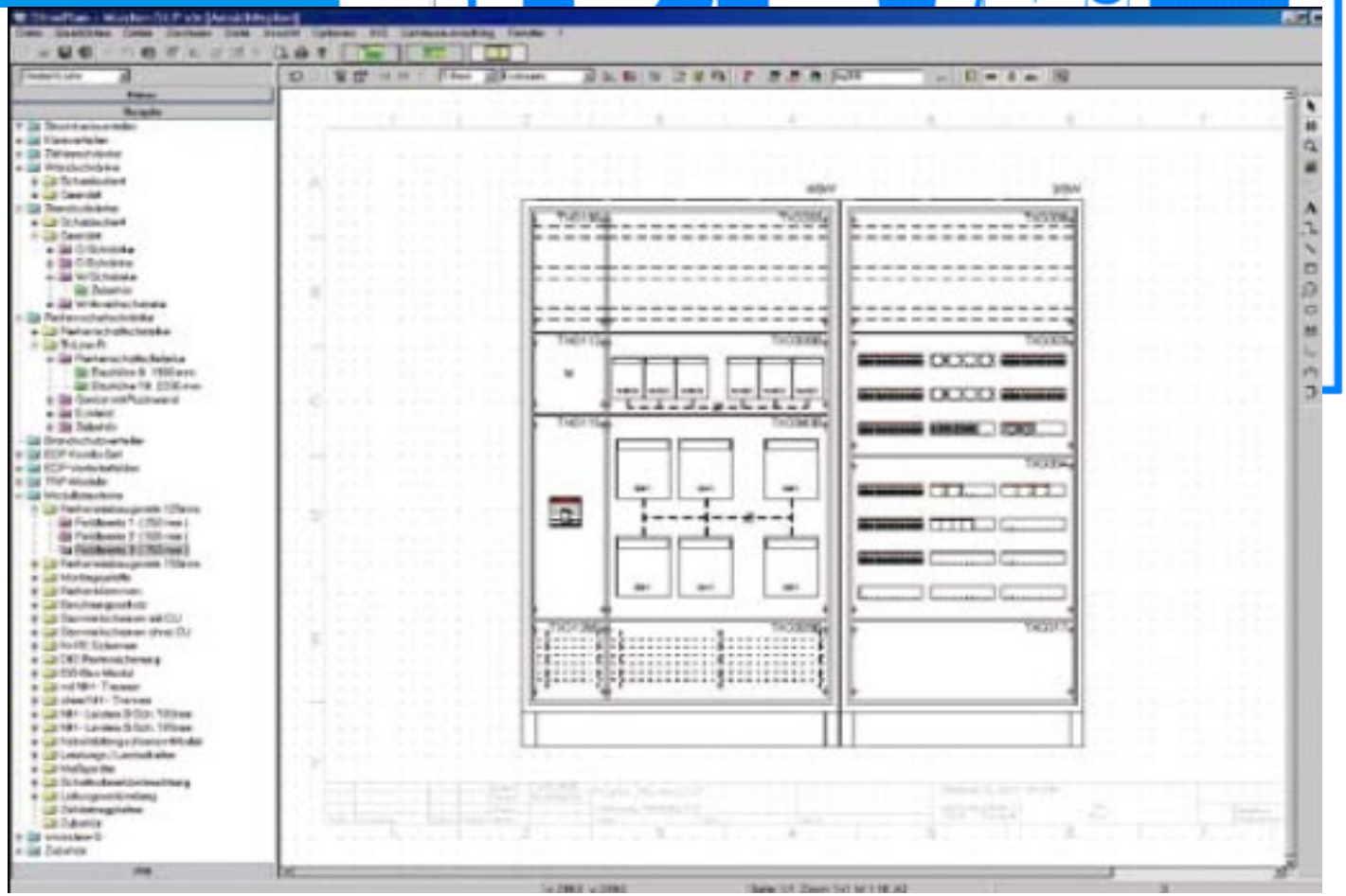


ABB in Ireland

At a glance

180

People work for ABB in Ireland

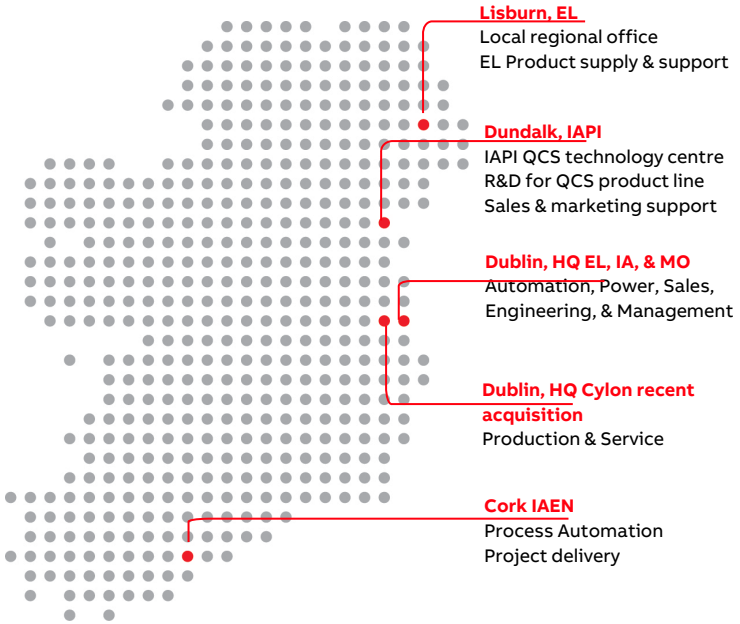
5

Sites where products are sold, serviced or engineered

Want to know more?

marketing@ie.abb.com

www.abb.ie



Skilled and experienced Irish team, backed by global networks