ABB Electrification Railway Products and Solutions
Presentation to STV and IEEE
Oleg Goureev, Eric Denis and Martin Bussiere
Agenda

- Introduction of ABB representatives and LTK representatives in needed
- Technical hands-on presentation of the ABB high speed circuit breaker
- Application of the ABB HSCB in a propulsion system.
- ABB Molded Case circuit breakers migration to the XT for the various onboard systems distribution and protection
- Push in technology connection on DC and AC Train Line relays and DC and AC Contactors versus Ring terminal
- ABB 1000Vdc Miniatures Circuits distribution and protection on Buses and Railcars
- ABB integrated engineered Solutions systems integration at our North American Center of excellence.
Smart Power Rail
Transportation Rail

Innovative solutions for Sustainable and Smart Mobility
More than 70 years experience in the railway Industry.
Rail is part of our DNA.

More than 50.000.000 products or systems installed on more than 40.000 vehicles.

Worldwide presence in more than 100 countries to support our customers.
ABB in the rail industry

Since 1996 a growing independent components and systems supplier
Rolling Stock Team NAM - History in North America

Components providers

- More than 30 years experience in the North American Rail industries
- More than 10,000,000 products or systems installed
- More than 25,000 cars (High Speed Trains, Regional Trains, Locomotives, LRV, Metro, Trams,...)
- More than $400MUSD installed base (ELSP/ELS/ELP)

A major supplier to the NAM Rail Industry
Rolling stock NAM - New vehicles and overhaul

High-speed rail

Commuter Electrical Multiple unit trains

Locomotive, dual, electric, diesel-electric

Metro

Light Rail Vehicles, People mover

E-Bus
DCBreak overview

Installation

1. Line contactor
2. Pre-charging contactor
3. LC filter contactor
4. Discharging contactor
5. Motor protection contactor
6. APS Input
7. APS Output
8. Battery supply contactor
# DC Break Product Family

## Key Features

### Application
- 750 V and 1500 V DC Rolling Stock
  - Metros
  - Light Rail
  - Tramways

Bi-directional protection of the vehicle against internal (traction chain) or external (OLE/Third Rail) electrical failure

New-builds and existing fleets

### Versions
- Operating DC voltages
  - 900 V (750 V)
  - 1800 V (1500 V)

- Installation
  - Free standing
  - In metallic enclosure

- Control voltage
  - 24 / 36 / 48 / 72 / 110 V

- Number of auxiliary contacts
  - 2 NO/ 2 NC up to 8 NO/8 NC

### Design Highlights
- Cadmium Free contacts
- Mechanical and electrical interfaces enabling replacement/substitution of similar products from other brands
- Light and compact free-standing version
- Easy access to wear parts, and replacement kit strategy to reduce service time
## DCBreak overview

### Available versions

<table>
<thead>
<tr>
<th></th>
<th>Rated voltage</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>900 V</td>
<td>1800 V</td>
<td></td>
</tr>
<tr>
<td>Free standing</td>
<td>DCBreak 915</td>
<td>DCBreak 1815</td>
<td></td>
</tr>
<tr>
<td>In metallic enclosure</td>
<td>DCBreak 915 B</td>
<td>DCBreak 1815 B</td>
<td></td>
</tr>
</tbody>
</table>
DCBreak overview

Applications

Types of installations:
- Tramways
- Trolley buses
- Monorails/ APM (Automated People Movers)
- Light rail/ commuters
- Subways/ metros
- Main lines

Focus on traction chain builders, OEM’s, operators.
**Dimensional features**
Small footprint and lighter design

40% less footprint

**Customer benefit & savings:**
- Reduced flashover distance
- Minimal weight
- Improved portability and facilitated installation
- Reduced handling time and cost
- Simplified systems integration
# Dimensional features

External overall dimensions

<table>
<thead>
<tr>
<th>Version</th>
<th>Weight [kg]</th>
<th>Height (A) [mm]</th>
<th>Width (B) [mm]</th>
<th>Depth (C) [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>915</td>
<td>28</td>
<td>340</td>
<td>168</td>
<td>468</td>
</tr>
<tr>
<td>915 B</td>
<td>68</td>
<td>370</td>
<td>364</td>
<td>712</td>
</tr>
<tr>
<td>1815</td>
<td>38</td>
<td>448</td>
<td>168</td>
<td>468</td>
</tr>
<tr>
<td>1815 B</td>
<td>78</td>
<td>470</td>
<td>364</td>
<td>712</td>
</tr>
</tbody>
</table>
# Applications

## Commercial applications versus DC Voltage Range

<table>
<thead>
<tr>
<th>Application</th>
<th>750 V (DCBreak 915/ 915 B)</th>
<th>1500 V (DCBreak 1815/ 1815 B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trolley buses</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Tramways</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Monorails/ APM</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Light rail/ commuters</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Subways/ metros</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Main lines</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
## DCBreak current positioning

### Applications

<table>
<thead>
<tr>
<th></th>
<th>750 V DC</th>
<th>1,5 kV DC</th>
<th>3 kV DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,0 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6,0 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4,6 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4,2 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,6 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,0 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,6 kA</td>
<td>Light rails / metro</td>
<td>Light rails / metro</td>
<td>Main lines</td>
</tr>
<tr>
<td>2,1 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,5 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,0 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Applications

DCBreak current positioning

<table>
<thead>
<tr>
<th>Current (kA)</th>
<th>750 V DC</th>
<th>1,5 kV DC</th>
<th>3 kV DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,0 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6,0 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4,6 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4,2 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,6 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,0 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,6 kA</td>
<td>Light rails / metro</td>
<td>Light rails / metro</td>
<td>Main lines</td>
</tr>
<tr>
<td>2,1 kA</td>
<td>Light rails / metro</td>
<td>Light rails / metro</td>
<td></td>
</tr>
<tr>
<td>1,5 kA</td>
<td></td>
<td>DCBreak Current positioning</td>
<td></td>
</tr>
<tr>
<td>1,0 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**DCBreak functioning**
Main components of free-standing circuit breaker

- **Main circuit**
- **Arc chute**
- **Mono-stable linear actuator** (closing and opening in normal service)
- **Tripping system** (opening during short-circuits and overloads)
- **Auxiliary switches**
- **Insulating housing**
DCBreak functioning

Section of lower part

- Mono-stable linear actuator (closing and opening in normal service)
- Main contacts
- Tripping system (opening during short-circuits and overloads)
DCBreak functioning
Closed position
DCBreak functioning
Closed position

When the actuator is energized, it pushes the main contacts and the main circuit closes.
DCBreak functioning

Open position
DCBreak functioning

Open position

When the actuator is de-energized, the main circuits opens thanks to the contact return spring
DCBreak functioning
Closed position
DCBreak functioning
Released position (tripping)

When the current in the main circuit overcomes the tripping value, the magnetic field activates the tripping system which unlatches the main contacts, forcing the main circuits to open.

The tripping current value can be set according to customer’s requirement.

The actuator is still energized
DCBreak functioning

 Interruption of short-circuit, current limiting (ref. IEC 60077-3)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>Current setting</td>
</tr>
<tr>
<td>A1</td>
<td>Breaking current</td>
</tr>
<tr>
<td>A2</td>
<td>Prospective peak current</td>
</tr>
<tr>
<td>A3</td>
<td>Prospective breaking current</td>
</tr>
<tr>
<td>A4</td>
<td>Cut off current</td>
</tr>
<tr>
<td>T</td>
<td>Time constant (IEC 60077-3 Table 1)</td>
</tr>
<tr>
<td>V0</td>
<td>Rated operational voltage</td>
</tr>
<tr>
<td>V1</td>
<td>Recovery voltage</td>
</tr>
<tr>
<td>V2</td>
<td>Peak arc voltage</td>
</tr>
<tr>
<td>t1</td>
<td>Opening time</td>
</tr>
<tr>
<td>t2</td>
<td>Arcing time</td>
</tr>
<tr>
<td>t3</td>
<td>Break time</td>
</tr>
<tr>
<td>i0</td>
<td>Tripping current (prosp. break. curr.)</td>
</tr>
<tr>
<td>i1</td>
<td>Cut-off current</td>
</tr>
</tbody>
</table>

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DCBreak functioning
Working principle of interrupting chamber
DCBreak functioning
Working principle of interrupting chamber
DCBreak functioning
Tripping current ranges

The tripping current must be within one of the following ranges (customer must select one of them):

- 0.9 kA to 1.1 kA
- 1.1 kA to 1.3 kA
- 1.3 kA to 1.8 kA
- 1.8 kA to 2.5 kA
- 2.5 kA to 3.6 kA

Once the tripping range is selected it is not possible to change it (different tripping system).

The precise tripping value within the selected range can be chosen by the customer.

If it’s not selected, the value is regulated equal to the lower threshold of the corresponding range (e.g. 0.9 kA to 1.3 kA \(\rightarrow\) 0.9 kA).

This regulation is done by ABB (manufacturer).

The regulation is done with a fine tuning on the regulating screw (in red circle):
DCBreak functioning

Control circuit

**Closing:**
1. K1 Control Relay - contact closes.
2. K2 Holding Relay - contact opens in 0.3-1s delay.

**Opening:**
1. K1 Control Relay - contact opens.
2. K2 Holding Relay - contact closes.

HSCB Control Circuit: Main Contact Closure

R – External Holding Resistor
DCBreak functioning
Operating sequences and durations

A: Coil current
B: Main contact
C: Auxiliary contact a (NO)
D: Auxiliary contact b (NC)
* duration: min. 0.3 s, max. 1 s
DCBreak functioning

Control circuit

Hold:

1. After appr. 500 ms the delayed contact -KFA3 closes and feeds the contactor -KFA2.
2. The contacts -KFA2 open by inserting the -RAR resistor.
3. The current decreases to a proper value to maintain the circuit breaker in closed position.

Low holding current allows to:

- reduce power consumption
- prevent damages to the actuator

NB: everything but –MBC (actuator) is not under DCBreak scope of supply
DCBreak functioning
Control circuit

Opening:

1. Opening of the pushbutton -SFO interrupts the current in the electromagnet -MBC.

2. The main contacts of the high speed circuit breaker -QAB open.

NB: everything but -MBC (actuator) is not under DCBreak scope of supply
DCBreak functioning
Main components of enclosure

Auxiliary circuits connections (Harting type, VEAM type on request)

Upper box (connected to arc chute)

Lower box (connected to lower part of Circuit Breaker)

Easy access for maintenance activities

IP65 tested degree of protection
Standard references
Applicable standards for DCBreak and type tests

DCBreak is designed and tested according to the following standards:

- **IEC 60077-3**: Railway applications – Electric equipment for rolling stock – Part 3: Electrotechnical components – Rules for d.c. circuit-breakers (STANDARD REPORTED ON NAMEPLATE)
- **IEC 61373**: Railway applications – Rolling stock equipment – Shock and vibration tests.
- **RoHS**: Restriction of Hazardous Substances Directive (cadmium free)
- **REACH**: Registration, Evaluation, Authorization and restriction of Chemicals
Standard references

Type tests

DCBreak has successfully passed the following type tests:

- Sequence I: general performance characteristics
- Sequence II: rated short-circuit making and breaking capacities
- Sequence III: capability to withstand vibration and shock
- Sequence IV: searching for critical currents
- Investigatory test: temperature Rise for temporary overload conditions
- IP degree test on metallic enclosure
## DCBreak characteristics

### Characteristics of main circuit

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
<th>DCBreak 915 / 915 B</th>
<th>DCBreak 1815 / 1815 B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated service voltage</td>
<td>Ue</td>
<td>900 V</td>
<td>1800 V</td>
</tr>
<tr>
<td>Rated insulations voltage</td>
<td>Ui</td>
<td>2300 V</td>
<td>2300 V</td>
</tr>
<tr>
<td>Rated impulse withstand voltage</td>
<td>U $BIL$</td>
<td>18 kV</td>
<td>18 kV</td>
</tr>
<tr>
<td>Rated service current</td>
<td>Ie</td>
<td>1500 A (1400 A in box)</td>
<td>1500 A (1400 A in box)</td>
</tr>
<tr>
<td>Conventional thermal current in free air (T.amb -5 °C to +40 °C)</td>
<td>Ith</td>
<td>1500 A (1400 A in box)</td>
<td>1500 A (1400 A in box)</td>
</tr>
<tr>
<td>Tripping time</td>
<td>topen</td>
<td>3..7mS</td>
<td>3..7mS</td>
</tr>
</tbody>
</table>
## DCBreak characteristics

### Characteristics of main circuit

<table>
<thead>
<tr>
<th></th>
<th>Symbol</th>
<th>DCBreak 915 / 915 B</th>
<th>DCBreak 1815 / 1815 B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated duty short-circuit making and breaking capacity</strong> (Nominal operating cycle): O - 20sec - CO - 60sec CO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time constant T1</td>
<td>Iss/ T</td>
<td>30 kA @ 0 ms</td>
<td>17 kA @ 0 ms</td>
</tr>
<tr>
<td>Time constant T2</td>
<td>Iss/ T</td>
<td>30 kA @ 15 ms</td>
<td>30 kA @ 15 ms</td>
</tr>
<tr>
<td>Time constant T3</td>
<td>Iss/ T</td>
<td>30 kA @ 50 ms</td>
<td>30 kA @ 40 ms</td>
</tr>
<tr>
<td>Time constant T4</td>
<td>Iss/ T</td>
<td>30 kA @ 150 ms</td>
<td>30 kA @ 100 ms</td>
</tr>
<tr>
<td><strong>Direct overcurrent release:</strong> possible setting ranges on request</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.9 to 1.1 kA</td>
<td>0.9 to 1.1 kA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.1 to 1.3 kA</td>
<td>1.1 to 1.3 kA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.3 to 1.8 kA</td>
<td>1.3 to 1.8 kA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.8 to 2.5 kA</td>
<td>1.8 to 2.5 kA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5 to 3.6 kA</td>
<td>2.5 to 3.6 kA</td>
</tr>
<tr>
<td><strong>Maximum arc voltage</strong></td>
<td>Ûarc</td>
<td>2.5 x Ue</td>
<td>2.5 x Ue</td>
</tr>
<tr>
<td><strong>Class of functional operations</strong></td>
<td></td>
<td>C3</td>
<td>C3</td>
</tr>
</tbody>
</table>
DCBreak characteristics
Normal service conditions

<table>
<thead>
<tr>
<th>Ambient temperature</th>
<th>T. amb</th>
<th>-25 °C ÷ +70 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative humidity</td>
<td></td>
<td>95% at 40 °C</td>
</tr>
<tr>
<td>Altitude</td>
<td>h</td>
<td>≤ 1400 m</td>
</tr>
</tbody>
</table>
## DCBreak characteristics

Characteristics of auxiliary and control circuits and actuator

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Un</th>
<th>24, 36, 48, 72, 110 V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage limits (-25 °C &lt; T.amb &lt; +70 °C)</td>
<td>0.7 x Un - 1.25 x Un</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actuator characteristics</th>
<th>Closing</th>
<th>Holding</th>
<th>Pmax R1</th>
<th>Microswitch to protect closing/opening control system of DCBreak circuit-breaker (recommended)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unom</td>
<td>Umin</td>
<td>Umax</td>
<td>Rnom</td>
</tr>
<tr>
<td>[V]</td>
<td>[V]</td>
<td>[V]</td>
<td>[Ω]</td>
<td>[A]</td>
</tr>
<tr>
<td>24</td>
<td>16.8</td>
<td>30</td>
<td>0.55</td>
<td>43.6</td>
</tr>
<tr>
<td>36</td>
<td>25.2</td>
<td>45</td>
<td>1.39</td>
<td>25.9</td>
</tr>
<tr>
<td>48</td>
<td>33.6</td>
<td>60</td>
<td>1.8</td>
<td>26.7</td>
</tr>
<tr>
<td>72</td>
<td>50.4</td>
<td>90</td>
<td>4.9</td>
<td>14.7</td>
</tr>
<tr>
<td>110</td>
<td>77</td>
<td>137.5</td>
<td>12.25</td>
<td>9.0</td>
</tr>
</tbody>
</table>

- (1) Coil temperature 20 °C
- (2) Coil temperature 70 °C and Umin
- (3) Coil temperature -25 °C and Umax
- (4) R1= holding resistor (should be 200 W)
### DCBreak characteristics

**Characteristics of auxiliary contacts**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Name</th>
<th>Unit</th>
<th>Value</th>
<th>Remarks / conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated insulation voltage</td>
<td>U\text{i}</td>
<td>V</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>Rated impulse withstand voltage</td>
<td>U\text{imp}</td>
<td>kV</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Thermal current</td>
<td>I\text{th}</td>
<td>A</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Minimum current</td>
<td>I\text{min}</td>
<td>mA</td>
<td>5</td>
<td>If ( &lt; 5 ) mA, gold alloy (on request)</td>
</tr>
<tr>
<td>Contact material</td>
<td></td>
<td></td>
<td></td>
<td>Hard silver (AgCu3)</td>
</tr>
<tr>
<td>Contact resistance</td>
<td></td>
<td>m\Omega</td>
<td>10</td>
<td>Normal</td>
</tr>
<tr>
<td>Mechanical life</td>
<td></td>
<td></td>
<td>(10 \times 10^6)</td>
<td></td>
</tr>
</tbody>
</table>

**Switching voltage (U):**

<table>
<thead>
<tr>
<th>Time constant U\text{R}</th>
<th>24 V DC</th>
<th>110 V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 ms</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>10 ms</td>
<td>&gt;16 A</td>
<td>&gt;16 A</td>
</tr>
<tr>
<td>20 ms</td>
<td>&gt;16 A</td>
<td>&gt;16 A</td>
</tr>
<tr>
<td>30 ms</td>
<td>&gt;16 A</td>
<td>&gt;16 A</td>
</tr>
<tr>
<td>40 ms</td>
<td>15 A</td>
<td>&gt;16 A</td>
</tr>
<tr>
<td>50 ms</td>
<td>12 A</td>
<td>&gt;16 A</td>
</tr>
<tr>
<td>60 ms</td>
<td>10 A</td>
<td>&gt;16 A</td>
</tr>
</tbody>
</table>

**Max. breaking capacity:**

- Time constant U\text{R}:
  - 5 ms: >16 A
  - 10 ms: >16 A
  - 20 ms: >16 A
  - 30 ms: >16 A
  - 40 ms: >16 A
  - 50 ms: >16 A

**Direct current electric power:**

- \( U = 24 \text{ V DC} \)
- \( U = 80 \text{ V DC} \)
- \( U = 110 \text{ V DC} \)
Spare parts
Available spare part kits

- DCBreak 915 arc chute kit
- Ceramic guides kit
- DCBreak 1815 arc chute kit
- Auxiliary contacts kit
- Main contacts kit
- Flexible connection kit
Spare parts
Available spare part kits

- Set of bolts, screws and nuts
- Cable gland kit
- Closing cap kit
- Handle kit
- Plug kit (24pins - 28pins - 36pins) for auxiliary circuits (Harting, VEAM on request)
Spare parts

Available spare part kits

Socket kit (24pins - 28pins - 36pins) for auxiliary circuits (Harting and VEAM)

Set of insulating parts
DCBreak Range
Service History

Uttar Pradesh Metro Rail Corporation (UPMRC).
67 Movia three-car trainsets built by Bombardier (Alstom) for the Agra-Kanpur metro projects.
# DCBreak Range

Delivered products

<table>
<thead>
<tr>
<th>Year</th>
<th>Country</th>
<th>QTY</th>
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<tr>
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<tr>
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<td>CH</td>
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<tr>
<td>2018</td>
<td>IT</td>
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<td>CH</td>
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<tr>
<td>2019</td>
<td>IT</td>
<td>17</td>
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<tr>
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<td>KR</td>
<td>2</td>
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<tr>
<td>2020</td>
<td>IT</td>
<td>49</td>
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<tr>
<td>2020</td>
<td>CH</td>
<td>3</td>
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<tr>
<td>2020</td>
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<td>1</td>
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<tr>
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<td>IT</td>
<td>168</td>
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<td>27</td>
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<tr>
<td>2022</td>
<td>NL</td>
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</table>

**TOTAL** 355
Motor Starting solutions  Push-in Technology
Electrification Transport & Infrastructure
Just push it
Push-in Spring motor starting solution
Connection types - The complete offering

- **Push-in Spring terminals for connection with standard ferrules**
  - With new Push-in Spring terminals, one push is all you need for a faster than ever installation, an easier than ever wiring and a reliable as ever connection.
  - From 9 to 38 A

- **Screw terminals for connection with standard ferrules**
  - For a safe insertion and wiring of cables.
  - From 9 to 370 A

- **Screw terminals for connection with ring tongue ferrules**
  - Non-detachable screw with conic washer on main and auxiliary terminals for a fast and secure tightening of cables with ring tongue ferrules.
  - From 9 to 370 A
One push is all you need
- extremely fast wiring
- no tool is required
- save up to 50% wiring time

and the connections are just as reliable.

For speed, ease and reliability, just push it!
Push-in Spring solution benefits

- Faster than ever installation
- Easier than ever wiring
- Reliable as ever connections
Faster than ever installation

Speed up your projects

**Push-in mode**

Connect rigid cables or ferruled cables simply by pushing them into the cable holes

- no need to use any tools
- intuitive wiring
- self-tightening terminals
- save up to 50% wiring time
Faster than ever installation

Speed up your projects

Smart accessories

Use ABB’s smart connection accessories
- 100% tool-free mounting
- significantly reduced installation time
- busbars, connecting kits and electrical interlock
- Direct on-line, Reversing or Star-Delta starters possible without using any wires
Reliable as ever connections

No need to re-tighten

With self-tightening terminals,
- there is no need to re-tighten after transportation
- there is no need to re-tighten during the product life
- high connection strength is guaranteed throughout the whole lifetime of the device.
Push-in Spring motor starting solution

Complete range, complete efficiency

- 2-in-1 connection
- Tool-free connecting links
- Accessories compatible with screw range
- Time-saving, easy & fault-free assembly with less cabling
- Just one screwdriver
- High connecting capacity
Push-in busbars

Complete range, complete efficiency

**Push-in busbars for manual motor starters**

The special design ensures a
- time-saving installation
- maintenance-free life cycle
- fault-free assembly with less cabling

All this for
- 2, 3, 4 or 5 manual motor starters
- with no or one lateral auxiliary contact,
- integrated feeder block and
- UL Type E / F approval.
Push-in Spring motor starting solution

Complete motor starting solution

- Manual motor starters
  Up to 32 A, 15kW 400 V AC-3/AC-3e
  Ics up to 100 kA

- Contactors
  Up to 38 A, 18.5 kW 400 V AC-3/AC-3e (and 25 hp 480 V)
  Up to 50 A, at 40°C AC-1 (and 45 A 600 V general use)

Possible combinations

- Direct on-line starters
  Up to 15kW

- Reversing contactors
  Up to 15kW

- Star-delta starter
  Up to 25kW

- Manual motor starter accessories
  Auxiliary contacts, signaling contacts and terminal spacer for UL Type E/F

- Contactor accessories
  Auxiliary contacts for front mounting and for side mounting

Accessories for starter combinations / group starters

- Connecting links
  Busbars

- Plug and connect mechanical and electrical interlock set

- Connecting sets for
  Reversing starters
  Star-delta starters
M Mini Contactors
Electrification Transport & Infrastructure
M Mini Contactors

Portfolio overview - Contactors and Contactor Relays

- 2 Contactor sizes: **MC1** and **MC2**
- **MCR** contactor relays
- 2 Connection types: **Screw** and **Ring tongue**
- **11 AC** coils voltages
- **7 DC** coil voltages

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Electrification Products Division - TRANSPORTATION

Acquisition of GEIS

- Small Footprint – Ideal for Electrical Cabinets with limited space
- NFPA-130 Compliant
GF contactors for DC switching
The new compact and efficient way to switch 1500 V DC

- 2-pole 1500 V DC contactor
- 750 V DC per pole
- Bidirectional switching
- 1500 V DC Thermal current up to 1325 A
- 1500 V DC-1 and UL DC general use
Molded Case Circuit Breakers
Electrification Transport & Infrastructure
Evolution of SACE Molded Case Circuit Breakers

SACE Tmax XT Molded Case Circuit Breakers
Evolution of circuit breaker technology

Three phases of trip units in the industry

**Thermal Magnetic Trip units**
- Uses bi-metal to detect overloads, and magnetism to detect Short circuits

**Electronic Trip Units**
- Uses Current sensors and a microprocessor to trip based on current measurements

**Advanced Electronic Trip units**
- Additional computing power allows advanced protections and embedded logic functions

The new trip units found in Tmax XT promise to open a new era of MCCB technology
## Trip units

### Trip units Performances levels

<table>
<thead>
<tr>
<th></th>
<th>XT1</th>
<th>XT2</th>
<th>XT3</th>
<th>XT4</th>
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<tr>
<td>Ekip Dip</td>
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<td>●</td>
<td>●</td>
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<td>Ekip Touch</td>
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Remote Communication

<table>
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<td>Tmax series</td>
<td>XT series</td>
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<tr>
<td>Modbus RTU</td>
<td>Modbus RTU</td>
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<tr>
<td>IEC61850</td>
<td>Modbus TCP/IP</td>
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<tr>
<td>DeviceNet</td>
<td>Ekip Link</td>
</tr>
<tr>
<td>Profinet</td>
<td>Profibus-DP</td>
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</table>

Different System Interface among the family

One system interface for the whole circuit breaker family - with less need for communication bridges!
Miniature Circuit Breakers
Electrification - Transport & Infrastructure
ST200 MTR Miniature Circuit Breaker
Endurance and safety for rolling stock applications
ST200 MTR Miniature Circuit Breaker

High short circuit capacity according to IEC/EN 60947-2
≤25 A: 25 kA (AC); 10 kA (DC)
>25 A: 15 kA (AC); 10 kA (DC)

Up to 1000 VDC in 4 poles
Configuration

Designed for North American market

Electrical endurance
20,000 cycles up to 32A

Short circuit tested
IEC/EN 60898 10kA

High technical performance with ring tongue connection

non-losable and directly accessible screw
ST200 MTR

Accessories Overview → for each application the fitting accessory
**ST200 MTR Miniature Circuit Breaker**

- **High technical performance**
  - With ring tongue connection
- **Full range compatibility**
  - With existing accessories
- **Compact dimensions**
  - (88 x 69 x 17.5 mm)

**COMPLIANCE TO TRACTION STANDARDS**

- Fire and Smoke (NFPA-130 & EN45545-2)
- Compliant to product standards (IEC/EN 60947-2)
- Vibration and Shock approved (IEC/EN 61373)

**ROBUSTNESS & HIGH ELECTRICAL ENDURANCE**

- Electrical endurance with 20,000 cycles up to 32 A
- Wide temperature span from -40°C to 75°C
- Strong resistance to extreme humidity and dryness

**SPACE & WEIGHT SAVINGS**

- Compact dimensions: 88 x 69 x 17.5 mm
- Ensure high protection with a smaller cable cross-section diameter than conventional solutions, saving cable costs, space and weight

**FLEXIBILITY & EASY REPLACEMENT**

- Flexible range compatible with System pro M compact® standard and ring lugs accessories
- Fast and intuitive ordering thanks to self-speaking codes
Benefits of mechanical circuit breakers
Technology comparison with hydraulic magnetic circuit breakers

- **TECHNOLOGY & SAFETY BENEFITS**
  - Less heating of the cables
  - Lower risk of fire emergence
  - Load & Conductor Protection
  - Current Limiting (Class 3)
  - Rated current is independent from the installation position
  - 6 kA AC / 10 kA DC short circuit
Benefits of mechanical circuit breakers
Technology comparison with hydraulic magnetic circuit breakers

<table>
<thead>
<tr>
<th></th>
<th>Mechanical MCB</th>
<th>Hydraulic Magnetic MCB</th>
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<tr>
<td>25 °C 14 AWG</td>
<td>14 AWG</td>
<td>14 AWG</td>
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<tr>
<td>70 °C 14 AWG</td>
<td>10 AWG</td>
<td>more than double size required</td>
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</tbody>
</table>

**ENSURED CABLE PROTECTION 24 A**

**ECONOMIC BENEFITS**
- Space and weight savings
- Ensuring higher protection with smaller cable section diameter to save space and costs for large cables

**DESIGN BENEFITS**
- Standard connection
- Non-losable parts
- Standardized component
Custom and Engineered products - OEM and Aftermarket

Electrification Products
Research, Development & Assembly (RDA)

- RDA area is 12,100 square meters (130,000 sf) with a total of 100 employees (EP represent 70 employees)

- NAM mandate for Traction systems/panels, Capacitor Banks, Fuel cell inverters, Power Excitation, Safety guards, EV Charging station, SoftStarter,…

- Full warehouse support and capabilities

- High safety procedure to maintain security for all workers
Electrification Products Division - Transport & Infrastructure

Documents and tools

**Outline drawing**

**Manufacturing drawings**

**Electrical drawings**

**Qualification test reports**

**Routing test procedures**

**Bench test equipment**

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March 27, 2022

©ABB
Fast delivery for a demanding market

Customer requirement
- 5 days delivery on custom & regular product
  - Capacitor, enclosed starter, enclosed switch, cam switch, etc.
- 10 days delivery
  - Custom fencing, enclosed soft starter, etc.
- Less than 8 weeks
  - Capacitor Bank, special panels, panels board, switch board, etc.
Center of Excellence, NAM

**Distribution**

**Protection**

**Controls**
Quality Management

**Quality process**

- Actual certification
  - ISO-9001 : 2015
  - ISO-14001:2015
  - OSHA H 18001

- APQP Process for automotive industry include
  - Quality Plan
  - DFMEA / PFMEA
  - Control Plan
  - PPAP / FAI

- Regular audit by supplier and authority
  - More than 10 audits per year (CSA, UL, Bombardier, Alstom, Volvo, etc.)
Replacement of Electrical panels and lockers

Existing 480V Distribution Panel

Improved 480V Distribution Panel
Replacement of Electrical panels and lockers

3 Distribution Bus bars to interconnect all circuit breakers
Disconnect switch to isolate Power Converter (1000VDC) Mounted in NEMA box

Widely used on Hybrid and Electric Buses.

Up to 350A DC-20
Electrification Products Division - TRANSPORTATION

ABB working with OEM to design Cabinets and Electrical panels

Electrical locker mounted inside an ABB designed Fire box
Electrification Products Division - TRANSPORTATION

ABB Designs on new Passenger vehicles

Electrical locker made by ABB for new Passenger vehicle
Replacement of obsolete Asea contactor with AF style contactor mounted on an adapter plate (2015T1004)
All 3 MCCBs were replaced with newer generation and fiberglass cover replaced by Lexan cover.
Product Obsolescence replacement

Complete panel replacement