Circuit Breaker LTB D with Motor Drive

Motor Drive™
Traditional technology

Traditional spring operating mechanism:

Closing mechanism

Tripping mechanism
Motor Drive technology

Motor for opening and closing

Control unit
Motor Drive technology

- The next step of drive development
- Electronics are used to operate and control the circuit breaker
- Mechanical systems and springs are replaced by a motor and drive electronics.

- The mechanical system is reduced to a minimum.
- Only one moving part in the operating mechanism.
Motor Drive technology

Motor for opening and closing

Simple torsion tubes between the phases. (No adjustments needed)

Drive unit with energy storage

Control cubicle
A digitally controlled motor directly moving the circuit breaker contacts
Motor Drive system demonstration

- Converter Unit
- Capacitor Unit
- Charging Unit
- Motor Resolver
- Control Unit
- I/O Unit

- AC
- DC

- LOW POWER FLOW
- HIGH POWER FLOW
- CONTROL SIGNALS
- MEASUREMENT SIGNALS
- STATUS SIGNALS

Breaker Contact Travel

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## Spring drive vs. Motor Drive, Main differences

<table>
<thead>
<tr>
<th></th>
<th>Spring drive, BLK</th>
<th>Motor Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy storage</strong></td>
<td>Trip and close springs</td>
<td>Capacitors</td>
</tr>
<tr>
<td><strong>Latching</strong></td>
<td>Latches and coils</td>
<td>Not needed due to construction</td>
</tr>
<tr>
<td><strong>Contact travel</strong></td>
<td>Pre adjusted</td>
<td>Active control</td>
</tr>
<tr>
<td><strong>Damping system</strong></td>
<td>Mechanical oil dampers</td>
<td>Motor *</td>
</tr>
<tr>
<td><strong>Mechanical system</strong></td>
<td>Arms and links transmits the force between the poles</td>
<td>Torsion tube system with few parts</td>
</tr>
<tr>
<td><strong>Single-pole operated</strong></td>
<td>3 BLK with cubicles</td>
<td>3 Motors</td>
</tr>
<tr>
<td><strong>configuration</strong></td>
<td>1 Central cubicle</td>
<td>1 Control cubicle</td>
</tr>
<tr>
<td><strong>Interlocking</strong></td>
<td>Electro mechanical</td>
<td>Logical functions, programmable</td>
</tr>
<tr>
<td><strong>Self supervision</strong></td>
<td>No</td>
<td>Yes, all parts of the drive are continuously checked</td>
</tr>
<tr>
<td><strong>Auxiliary contacts</strong></td>
<td>Mechanical</td>
<td>Relays (solid state)</td>
</tr>
</tbody>
</table>

* Energy is fed back to the capacitors during retardation
LTB D with Motor Drive

Available for:
- LTB D 72.5-170 kV
- Single and three pole operated
- WCB applications
- DCB under development

MD150: Single-pole operation
MD300: Three-pole operation

WCB = Withdrawable Circuit Breaker
DCB = Disconnecting Circuit Breaker
Three-pole operated LTB D with MD300

Configuration:
- Pole beam
- Phase distance: 1050-2500 mm

Design:
- Torsion tubes between phases
- Motor capable of 750 Nm
  (Standard car app. 200 Nm)

- Gas monitor and position of CB easily read from the same side of the breaker
Single pole operated LTB D with MD150

Configuration:
- Pole beam or single stands

Design:
- One motor at each phase
- Position indicator at each phase
- Motors capable of 250 Nm

- Only one cubicle
- Easy connection to the motors
Technical advantages

The aim of reduction of mechanical problems and service requirements during the development has resulted in:

- Optimized active controlled contact movement
- Continuous supervision of the system

Benefits:
- Easy installation
- Minimized maintenance
- No lubrication needed
- Eventual faults can be detected before the breaker needs to be operated
- Integrated Condition Monitoring
Drive diagnostics, Micro motion

- Diagnostic function that performs status checks of the complete breaker while in service.
- Minimal contact movement are performed at preset time intervals and checks the status of:
  - Electronic modules
  - Internal cabling
  - Motor
  - Mechanical system

- Unique in-service status check of breaker and drive
- Improves reliability significantly

![Diagram showing contact position over time with contact separation at approx. 0.5 mm.](image-url)
Drive diagnostics

On-line diagnostics of the drive improves the availability.

Makes sure that the circuit breaker is ready for operation when its needed.

Status check is performed continuously when the drive is energized.

Availability of the breaker increased by self supervision.
MD Service software makes it possible to connect to the drive and get support during installation and service.

- Download of data enables distance diagnostics
- Easy customization of breaker function
MD Service, connection kit

MD Service requires a connection kit between the drive and the computer

- Converter RS232 optical / electrical
- Optical fiber
Commercial Installations

- Fyns Net, Denmark
  Substation Kingstrup
- LTB 170D1/B with Motor Drive for 1-pole operation
- Installed July, 2002
- Application: 150 kV line

- Sydkraft Sweden
  Vaple, Granlo, Korsta, and Söderåsen transformer substations
- LTB 145D1/B with Motor Drive for 1-pole operation
- Installed 2001, 2002 and 2003
- Application: 130 kV capacitor bank
Commercial Installations

- VB Elnät, Sweden Substation Flatenberg
- LTB 145D1/B with Motor Drive for 3-pole op.
- Installed July, 2004
- Application: 130 kV line
- Flexible position for Control Cubicle

- Pan American Energy, Patagonia, Argentina
- LTB 145D1/B WCB, indoor version
- Installed 2005
Motor Drive™ summary

- Digitally controlled motor, directly moving the circuit breaker contacts
- Only one moving part
- Low mechanical stresses
- Integrated condition monitoring
- At present available for:
  - LTB D 72.5 – 170 kV
  - WCB LTB 72.5 – 145 kV
  - Single- or three-pole operation

Benefits:

- Highest reliability
- Long mechanical life
- Ideally suited for high operating frequency
- Very low audible noise
Control cubicle

Terminal blocks for connections of the control cables.

Local control panel.

Drive unit (MD electronics cubicle)
Link gear

The lower end of the breaker poles contain a link gear that transforms rotating movement into linear movement of the moving contact.

- 160 degree movement, (-5 to 155)
- Two gas valves per housing.
- Integrated housing for position indicator
- Integrated fastening flange for the motor
- Two X-rings at each side of the shaft provide a good dynamical sealing system.

- Simple self latching design
- Few parts
- No adjustments needed
## Motor, technical data

<table>
<thead>
<tr>
<th>Data:</th>
<th>Single-pole operated</th>
<th>Three-pole operated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer:</td>
<td>ABB</td>
<td></td>
</tr>
<tr>
<td>Degree of protection, IP:</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>-50° to +85°C</td>
<td></td>
</tr>
<tr>
<td>Rated voltage:</td>
<td>565 $V_{\text{rms}}$</td>
<td></td>
</tr>
<tr>
<td>Rated speed:</td>
<td>1000 rpm</td>
<td></td>
</tr>
<tr>
<td>Peak torque:</td>
<td>250 Nm</td>
<td>750 Nm</td>
</tr>
<tr>
<td>Weight:</td>
<td>28 kg</td>
<td>67 kg</td>
</tr>
</tbody>
</table>
Control cubicle: Drive unit, overview

The drive unit contains all electronics that controls the motion of the Circuit Breaker contact.

- EMC housing
- Charger unit
- Control unit
  (I/O boards and control board)
- Converters
- Capacitor unit
- Connections to the motors
Drive unit: Capacitor unit, overview

The capacitor unit is the storage facility of the energy needed to operate the circuit breaker.

- Insulated busbar
- 12 electrolytic capacitors
- Two groups connected in series – each consisting of 6 capacitors connected in parallel
- Well proven design of capacitors
- At service discharge of the energy can be made through the motor(s) or built in discharge resistors.
Verification of technology

Extensive testing has been performed to verify the technology and design. Some of the performed tests are:

- Alternative drive for BLK 222 according to IEC 62271-100
- T100s Single- and three-pole operated
- Mechanical endurance three-pole operated, 10,000
- Mechanical endurance single-pole operated, 10,000
- EMC tests, emission and radiation
- High / Low temp, -50 / +70°C
- Modular tests of electronics:
  - Vibration
  - Humidity and dry heat
- Extended mechanical endurance test:
  - **50,000 operations** without maintenance of the drive