APPLICATION NOTE

Motor Starting and Protection solutions for HVAC systems in rolling stock (IEC)

Rail

Heating and cooling are more than a luxury in today's world. They are a necessity wherever we live and work. Our Motor Starting and Protection solutions ensure that the HVAC systems installed in rolling stock vehicles are always up and running.

What are HVAC systems?
Heating, ventilation and air conditioning (HVAC) systems are used to control the temperature in Rolling stock vehicles to ensure passengers are comfortable at any time of the year.

Why you need Motor Starting and Protection solutions
HVAC systems must function no matter what! Our Motor Starting and Protection solutions ensure that combinations of core power devices work in coordination with each other, while providing continuous operation and guaranteeing ease of installation.
In addition, our solutions guarantee additional protection by providing control and monitoring functions for the whole system.

Main benefits

Continuous Operation
Less chance of failure in the HVAC system, which ensures higher availability thanks to reliable connections and coordinated products.

Energy efficiency
Reduced energy consumption in the control circuit system thanks to our solutions - which can run on less power - and to use of AF technology ensuring less heat dissipation and reduced temperature rise.

Compact control panels
Our solutions take up less space in the control panel and external unit of your HVAC system thanks to their extremely compact design, enabling them to easily fit into your application and allowing you to cut down on the size and cost of your system.

Easy Installation
Our wide range of easy-to-use accessories and connection sets enables our solutions to be rapidly assembled. This saves on labor costs, cuts the total cost of the installation and reduces time to market.

HVAC systems

The Global rail industry is continuously developing worldwide by renovating every year to provide the best possible transportation experience for the passengers. To ensure comfortable traveling, one of the most important variables to control onboard rolling stock vehicles is temperature.

Heating, ventilation and air conditioning (HVAC) systems are used to control the temperature in Rolling stock. HVAC systems must guarantee temperature control, from the hottest to the coolest days of the year. Air temperature and humidity conditions, heat transfer through door opening and noise levels are key paramenters. Thermal comfort assessment is based on interior air temperature, air velocity, relative humidity (RH), surface temperatures (radiant temperature asymmetry), vertical and horizontal temperature gradients, as specified in the International Standards for air conditioning in main line rolling-stock e.g.: EN 13129 Parts 1&2.
In modern passenger rolling stock vehicles, ventilation is usually achieved through balanced mechanical ventilation systems, where theoretically an equal amount of air is supplied and extracted from the passenger compartment. The ventilation system comprises an air-handling unit (roof mounted) and distribution ductwork.

Rolling Stock Vehicle typologies

Locomotives

High Speed Trains

Regional trains

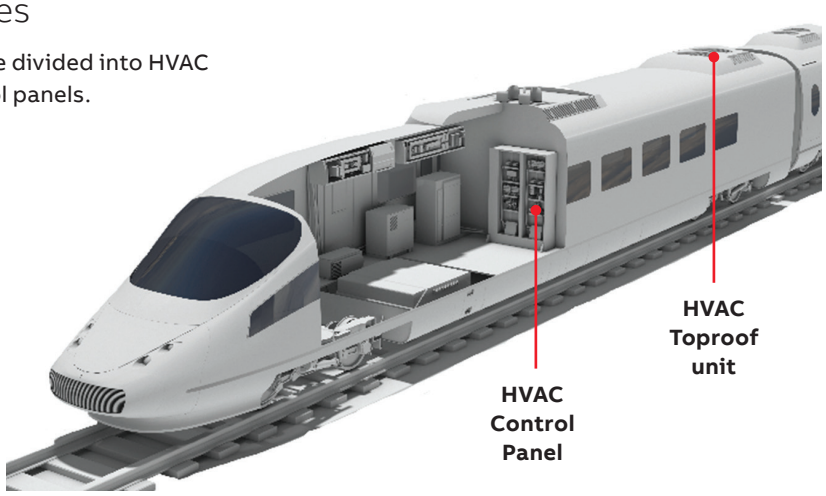
Metros / Light trains (LRV)

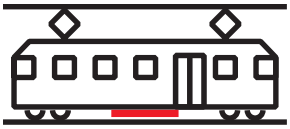
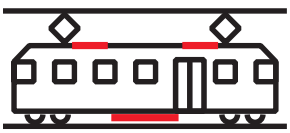
Passenger Coaches

Electric Buses

HVAC System typologies

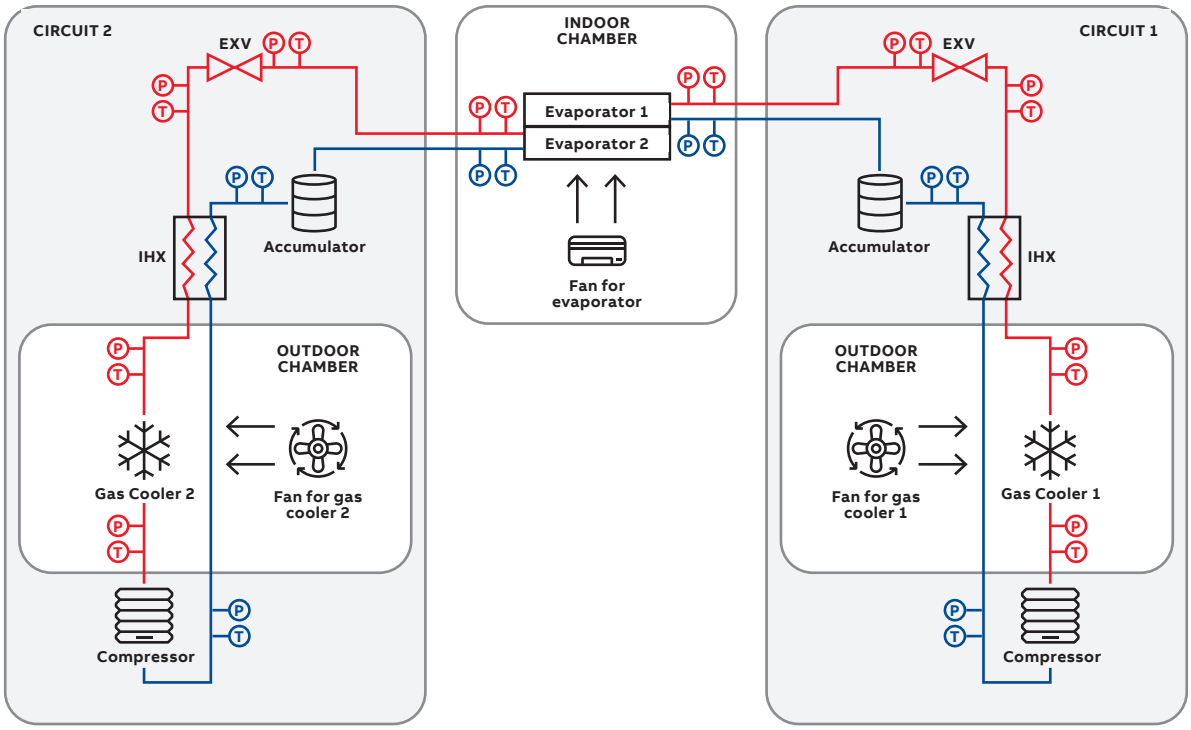
HVAC systems in Rolling stock are divided into HVAC external units and Internal control panels.



HVAC unit types:	
Toproof mounted: Regional, high speed, Metro, Light trains (LRV)	
Under floor mounted: High Speed trains	
Split top/underfloor mounted: Metro and Light trains (LRV)	

Main Components of the HVAC unit

- Compressors:
  - Scroll compressors
  - Screw compressors
  - Reciprocating/ piston compressors
- Heat exchangers
- Evaporators
- Condensers
- Gas coolers
- Accumulators



Applicable Standards

HVAC Rolling stock:

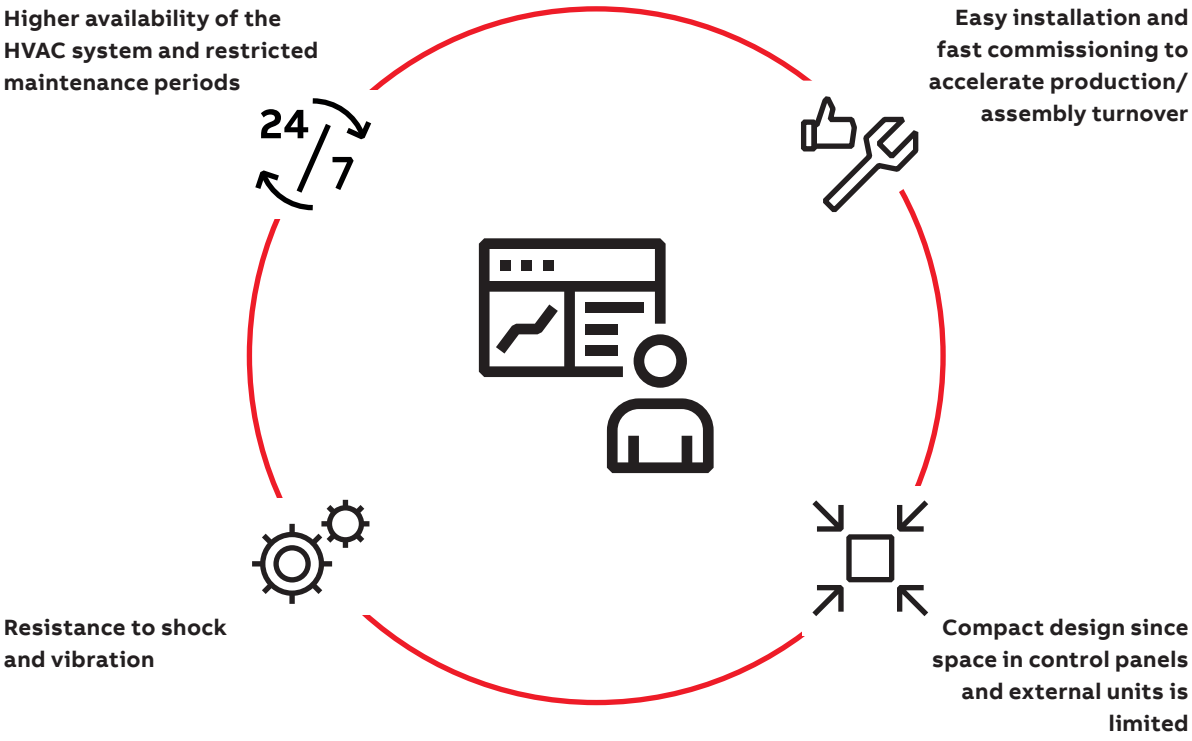
- EN 13129 Parts 1 & 2 -Air conditioning for main line rolling stock
- EN 14750 Parts 1 & 2 - Air conditioning for urban and suburban rolling stock
- EN 14813 Parts 1 & 2 - Air conditioning for driving cabs
- ISO 19659-2:2020 - Railway applications - Heating, ventilation and air conditioning systems for rolling stock - Part 2: Thermal comfort
- TB/T 1957-1991 - Heat Engineering Calculation Method for Air Conditioning Passenger Trains (China)
- AS 7513.3:2014 - Interior Environment, Part 3: Passenger Rolling Stock (Australia)
- JSA - JIS E 6602 - Air Conditioning Units for Rolling Stock (Japan)
- ANSI/ASHRAE 55-2013 Thermal Environment Conditions for Human Occupancy

ABB products for Rolling stock:

- IEC 60571 electronic equipment used on rail vehicles is the standard used for electronic equipment development and testing.
- IEC 61373 railway applications rolling stock equipment – shock and vibration tests.
  - Required by IEC 60077 / EN 50155
- ABB products for rolling stock comply with category 1 (body mounted) class B.
- EN 45545-2 railway applications fire protection on railway vehicles – Requirements for fire behavior of materials and components.
- ABB railway products plastic materials are rated HL3 R22 (the highest hazard level).
- NFPA 130 (North America) standard fixed guideway transit and passenger rail systems.
- Most plastic materials in ABB products comply with NFPA130 for tests to ASTM E 162 and ASTM E662 standards. Also complies with FRA238.103 and BSS 7239/SMP800-C standards.

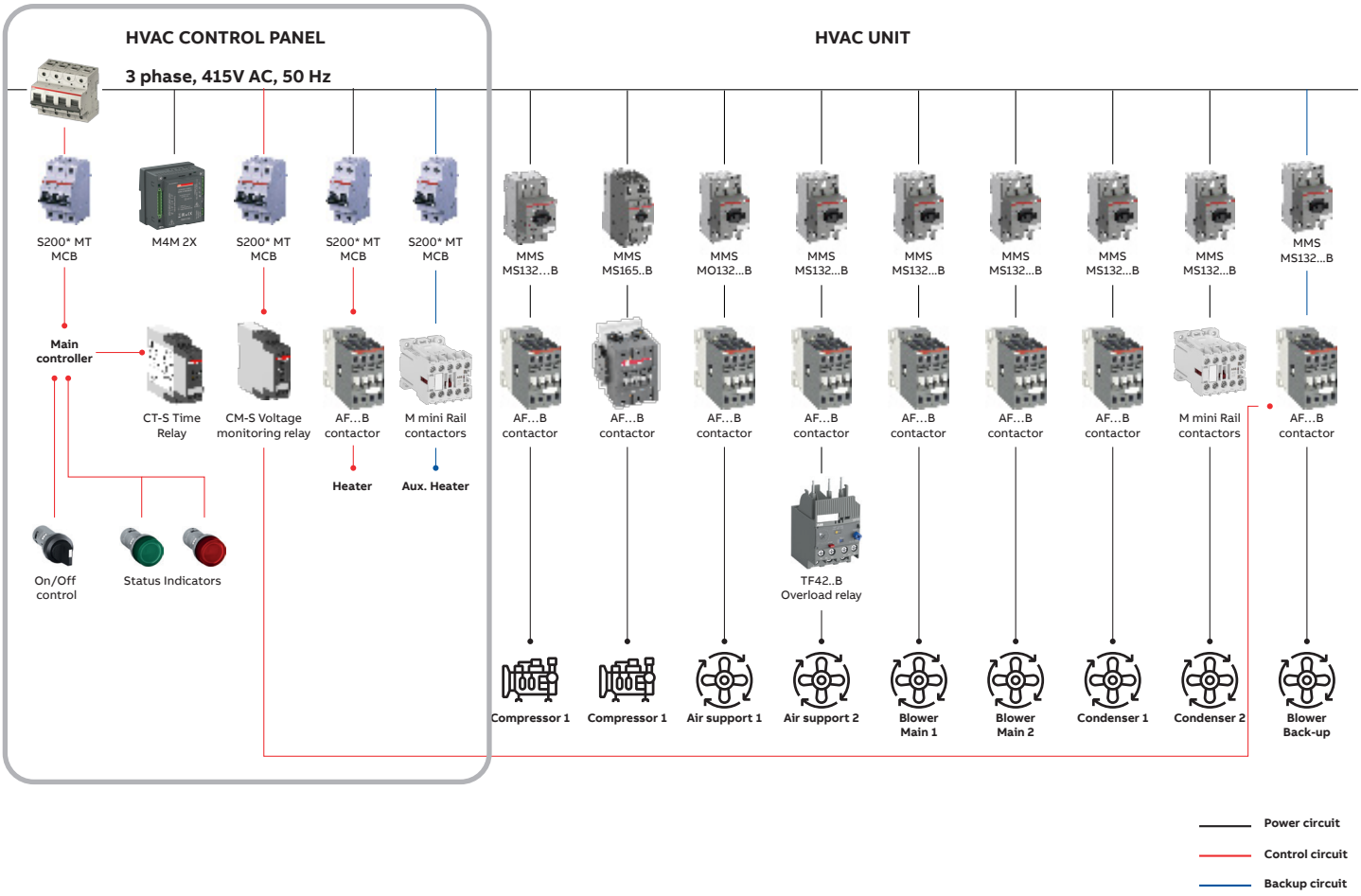
Motor Starting and Protection solutions for HVAC systems in rolling stock

Everyone involved in designing and managing HVAC installations faces new challenges every day: from ensuring higher availability of the HVAC system to improving its resistance to shock and vibration, while delivering the most compact design.



Our Motor Starting and Protection solutions for HVAC systems in rolling stock provide sturdy protection with enhanced control and monitoring functions. By ensuring that combinations of core power devices work in coordination with each other, we provide continuous operation and guarantee easy installation.

ABB offering (IEC)



APPLICATION FINDER

We've made it simpler for you to set up your project!
Click here to find the reference architecture that best fits your needs and download the Bill of Materials.

Bill of material

HVAC system for passenger coach with 2-compressor top roof unit (42k BTU/h each), Backup blower and control panel

List of parameters considered for development of the bill of materials	
Standard	IEC
System Voltage	Main 415V AC 50Hz 3-Phase Control 110V DC
System Power	2x Compressors 12.34kW 2x Axial Fan 0.75kW 2x Radial Fan 1.1 kW 2x Condenser Fan 0.75kW 1x Blower and 1x Emergency Blower 1.1 kW 2x Heater 6kW
Starter Type	Direct on line
Coordination Type	Motor Starters Coordination Type 2 with standard screw terminal

Product Notes	Part Number	Description	Quantity
Products for Power Circuit (Compressors)			
MMS for compressor	1SAM350200R1015	MS132-32B Manual Motor Starter	2
MMS Aux Block	1SAM201901R1001	HKF1-11 Aux. contact for front mounting	2
Contactor Compressor	1SBL276061R2200	AF30ZB-30-00-22 48-130V50/60HZ-DC Contactor	2
Contactor Auxiliary block	1SBN010120T1011	CAL4-11-T Auxiliary Contact Block	2
Connection kit	1SBN081306T1000	BEA16-4 Connecting Link with Manual Motor Starter	2
Products for power circuit (Axial fan & condenser fan)			
MMS for Axial & Condenser Fan	1SAM350200R1007	MS132-2.5B Manual Motor Starter	4
MMS Aux Block	1SAM201901R1001	HKF1-11 Aux.-contact for front mounting	4
Contactor for Axial & Condenser Fan	1SBL136061R2210	AF09ZB-30-10-22 48-130V50/60HZ-DC Contactor	4
Contactor Auxiliary block	1SBN010120T1011	CAL4-11-T Auxiliary Contact Block	4
Connection kit	1SBN081306T1000	BEA16-4 Connecting Link with Manual Motor Starter	4
Products for power circuit (Radial fan & Blower fan)			
MMS for Radial & Blower Fan	1SAM350200R1008	MS132-4.0B Manual Motor Starter	4
MMS Aux Block	1SAM201901R1001	HKF1-11 Aux.-contact for front mounting	4
Contactor for Radial & Blower Fan	1SBL136061R2210	AF09ZB-30-10-22 48-130V50/60HZ-DC Contactor	4
Contactor Auxiliary block	1SBN010120T1011	CAL4-11-T Auxiliary Contact Block	4
Connection kit	1SBN081306T1000	BEA16-4 Connecting Link with Manual Motor Starter	4
Products for Power circuit Control Panel			
MCB Mains	2CCS863001R0804	S803S-C80 High Performance MCB	1
MCB for Compressor	2CDS273006R0204	S203MT-C20 Miniature Circuit Breaker - 3P - C - 20 A	2
MCB for Blower Fan	2CDS273006R0104	S203MT-C10 Miniature Circuit Breaker - 3P - C - 10 A	1
MCB for Condenser Fan	2CDS273006R0104	S203MT-C10 Miniature Circuit Breaker - 3P - C - 10 A	2
MCB for Radial Fan	2CDS273006R0104	S203MT-C10 Miniature Circuit Breaker - 3P - C - 10 A	2
MCB for Axial Fan	2CDS273006R0104	S203MT-C10 Miniature Circuit Breaker - 3P - C - 10 A	2
MCB for Backup Blower Fan	2CDS273006R0104	S203MT-C10 Miniature Circuit Breaker - 3P - C - 10 A	1
MCB for Heater	2CDS272006R0165	S202MT-B16 Miniature Circuit Breaker - 2P - B - 16 A	2
Contactor for Heater	1SBL136061R2210	AF09ZB-30-10-22 48-130V50/60HZ-DC Contactor	2
Contactor Auxiliary block	1SBN010120T1011	CAL4-11-T Auxiliary Contact Block	2
MCB Crank Heater	2CDS272006R0104	S202MT-C10 Miniature Circuit Breaker - 2P - C - 10 A	2
Products for Control circuit Control Panel			
MCB for Controller	2CDS272065R0064	S202MT-C6UC Miniature Circuit Breaker - 2P - C - 6 A	1
Contactor for Controller	1SBL136061R2210	AF09ZB-30-10-22 48-130V50/60HZ-DC Contactor	1
Contactor Relay Fresh Air	1SBH136061R2140	NFZB40E-21 24-60V50/60HZ 20-60VDC Contactor Relay	1
Contactor Relay Return Air	1SBH136061R2140	NFZB40E-21 24-60V50/60HZ 20-60VDC Contactor Relay	1
Voltage monitoring relay (connected to main blower supply)	1SVR730794R3300	CM-PVS.41S Three-phase monitoring relay 2c/o, 0,0.1-30s, L1-L2-L3=3x300-500VAC	1
Contactor Relay Contactor Control	1SBH136061R2140	NFZB40E-21 24-60V50/60HZ 20-60VDC Contactor Relay	2
Contactor Relay Compressor Control	1SBH136061R2122	NFZB22E-21 24-60V50/60HZ 20-60VDC Contactor Relay	2

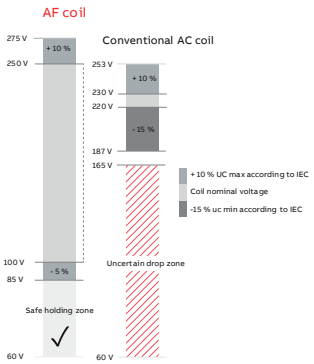
Key benefits of offered products

Reliable in all networks

The electronic system within the AF contactor continuously monitors the current and voltage applied to the coil. The contatctor is safely operated in an always-optimized, hum-free condition.

Wide control voltage range

The AF contactor ensures steady operation in unstable networks and signifies a major advancement in motor control and power switching, with no threat of voltages sags, dips, or surges. Prevents stoppages caused by voltage fluctualtions.

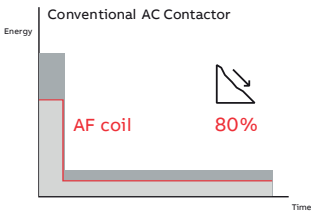


AC & DC control voltage

Thanks to AF technology, the same contactor can be used for both AC and DC control. This makes it easier to choose the type of contactor and reduces the number of parts to keep in stock.

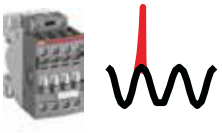
Reduced coil consumption

Thanks to AF technology contactor coil consumption is reduced by 80%, thus less heat dissipation and reduced temperature rise. This allows increased installation density in the panel, reduced control transformer rating, reduced control panel footprint and cost savings.



Built-in Surge suppressor

Conventional contactor technology normally requires an external surge suppressor. With AF contactor technology, surges are handled by a built-in contactor and never reach the control circuit. One less product required and no need to worry about complications causing electronics near contactors to fail.

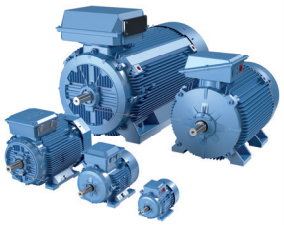


Troubleshooting made easy

Separate thermal and magnetic trip indication makes troubleshooting a lot easier and faster and reduces downtime. This allows you to easily take action based on thermal or magnetic tripping.

Ready for IE3 / IE4 motors

The ABB portfolio matches the latest requirements for IE3 and IE4 motor applications, including the most recent AC-3 upgrade and AC-3e utilization categories created for contactors and motor starters. ABB has validated coordination solutions for AC-3 and AC-3e applications. The results of these tests can be found in the ABB motor co-ordination tables.



Easy to connect

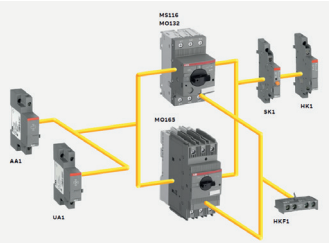
Save wiring time and avoid mistakes by using a connecting link between ABB manual motor starters and soft starters or contactors. This creates harmonious and compact starter combinations that are easy to mount.

AF with ring tongue ferrules

Non-detachable screw with conic washer on main and auxiliary terminals for fast and secure tightening of cables with ring tongue ferrules.

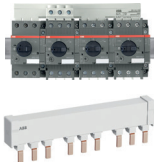
Harmonized range of accessories

MMS up to 80 A share the same main accessories like auxiliary contacts, signaling contacts, shunt trips and undervoltage releases.
This significantly reduces the part list and makes selection of the right accessories easy.



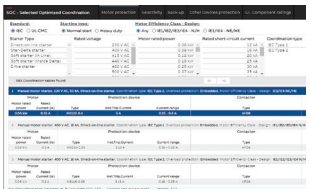
Busbar connectors for group assembly

Three-phase busbars ensure rapid, safe connection and are therefore a cost-effective solution. In addition, up to 5 manual motor starters can be fitted next to each other with optional spacing for auxiliary contacts.



Tested Co-ordination tables

ABB offers coordinated products to ensure the highest availability and protection for the installation. More than 1,800 tested and validated coordination tables are available in the SOC tool, so you can quickly and easily choose the right ABB solution.



Reduced coil consumption

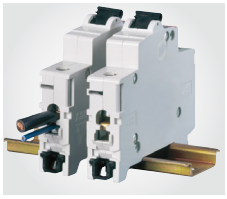
All System pro M compact® MCBs have contact position indications (CPI) on the toggle. You can easily see if the MCB is ON or OFF, thus maintenance work becomes simple and safe.

Installable in all positions

All devices can be supplied by cables or busbars from either the top or bottom.
Flexible installation in all positions.

High-quality terminal system

The integrated captive terminals and cable connection screws facilitate installation.
The integrated and failsafe cable connecting terminals ensure high safety standards.



Fast installation and wiring

All terminals on the M4M are removable, including the current transformer (CTs) inputs for current measurement. This means that you can speed up the process by wiring directly on the terminals. In addition, wiring inside the switchboard is much more convenient since the terminals are positioned vertically.

Smart commissioning

Being equipped with the Bluetooth BLE module ensures smart configuration and quick viewing via the unique EPIC commissioning tool, both available as mobile App and desktop software. Availability of regular remote firmware updates at any time guarantees you always have the latest and most secure version of the device with no impact on operations.

Product offering

Contactors:

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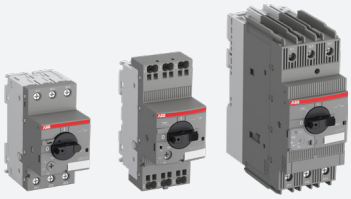
Manual motor starters:



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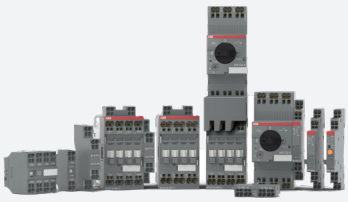
Push-In Spring Motor Starting solution:



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Time relays:

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Three phase monitoring relays:

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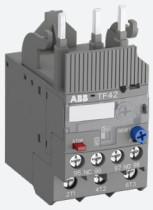
Thermal overload relays:



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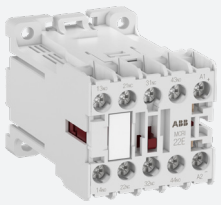
M mini contactors:



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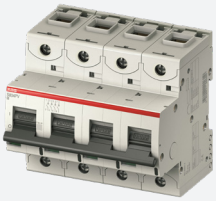
Modular DIN-Rail S800:



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Modular DIN-Rail S200:

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M4M 2X - Network analyzers:

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APPLICATION FINDER

Find the reference architecture tailored to your needs and speed up your project thanks to our new Application Finder Tool!

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