

APPLICATION NOTE

Motor Starting & Protection solutions for Ventilation Systems

Poultry and Livestock farming (IEC)



Enhance the economic performance of your farm and ensure animal welfare with our Motor Starting & Protection solutions. A complete offering of coordinated products from a reliable supplier for safely starting and protecting ventilation systems in Poultry & Livestock farms.

What is a Ventilation System?

Poultry & Livestock farming needs dedicated ventilation control to ensure economic performance of the farm and animal welfare. By controlling the quality and temperature of the air, Ventilation Systems are now able to remove excess heat, moisture, dust, harmful gases, and odors from indoor farms, while diluting airborne disease organisms which could otherwise compromise animal welfare.

Why you need a Motor Starting & Protection solution for your Ventilation System

By safely starting, protecting and running the ventilation system, ABB Motor Starting and Protection solutions guarantee that the animals in Poultry & Livestock farms are provided with optimal air and hygiene conditions.

Main benefits



Continuous Operation

Even in simple electromechanical starter combinations, ABB solutions and coordinated products guarantee continuous operation of your ventilation system in any condition, while being reliable in all networks.



Energy-efficient system

Make your ventilation starter panel energy-efficient thanks to AF technology, which ensures 80% reduction in contactor coil consumption, less heat dissipation, a reduction in temperature rise and allows installation density in the panel to be increased.



Compact control panels

Save space in the control panel with our AF contactors and reduced-width electronic compact starters. Discover our ready-made starter connection kits ensuring compact design and safe connections.



Ease of Installation

Cut control panel assembly time by up to 50% and achieve savings in labor costs, thereby reducing the total cost of the installation and time to market.

Poultry & Livestock farming

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To ensure animal well-being in Livestock & Poultry farms you need to monitor and control many variables: Weight & Behaviour, Feed consumption, Water availability and consumption, Sound level, Body Temperature and Climate conditions.

It is essential to monitor and control the climate conditions in Poultry & Livestock farms if you want to ensure animal welfare and the economic performance of your farm. The ventilation system ensures that good aeration and the right temperature are always provided. It removes excess heat, moisture, dust, harmful gases and odors from the farms while diluting airborne disease organisms. The most important controllable variables in Poultry & Livestock farms are:



Water availability and consumption



Climate conditions



Feed consumption



Sound level



Weight & Behaviour



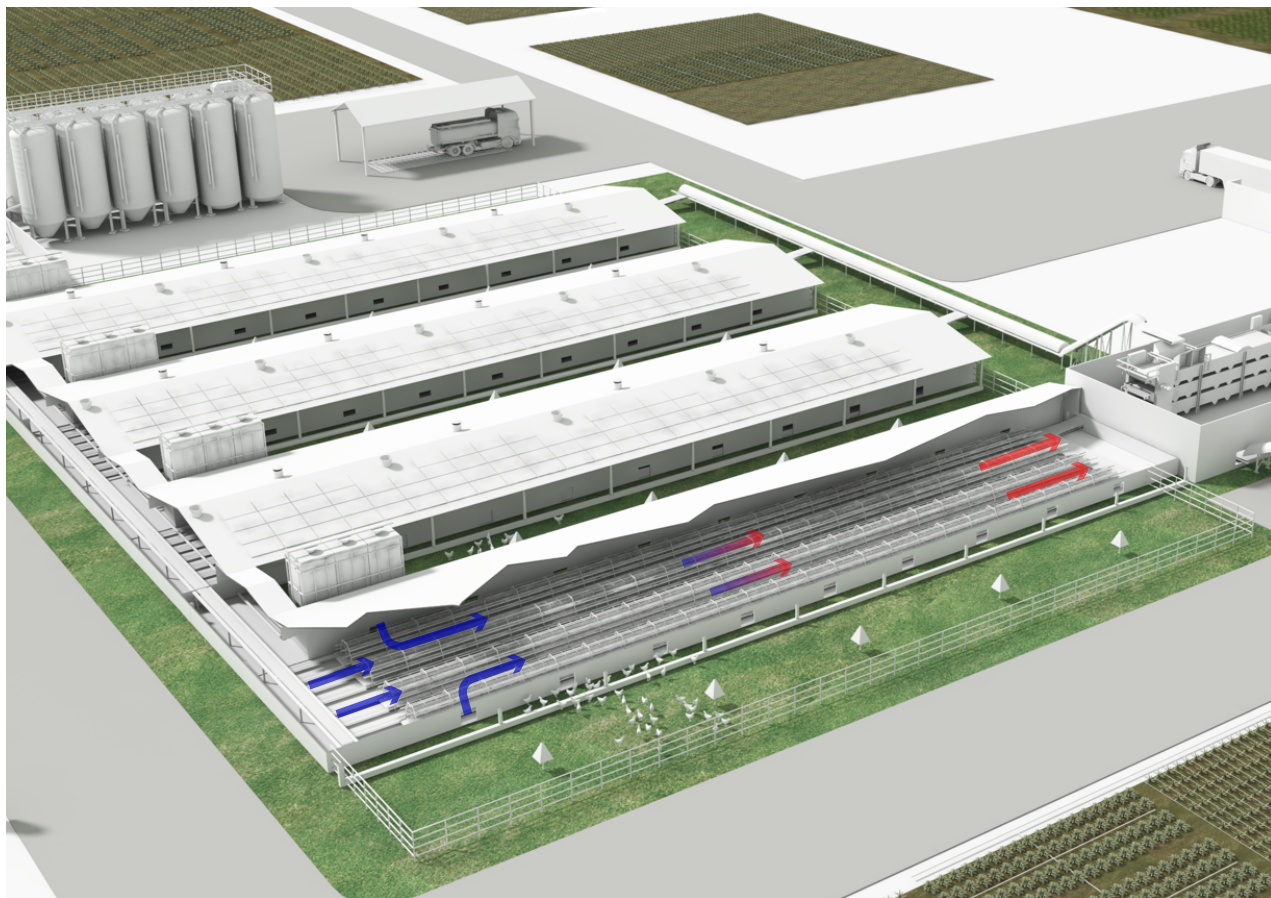
Ventilation systems in Poultry & Livestock farming

A mechanical ventilation system consists of fans, openings, heaters, and controls. Fans and openings (inlet or outlet) control the amount of air exchanged in a mechanical ventilation system.

A typical mechanical ventilation system leverages on either an air supply system or an exhaust system. The most commonly used ventilation system in Poultry & Livestock farms is the negative pressure system, which is exhaust-based.

The exhaust fan(s) create(s) a slight negative pressure or vacuum in the poultry house, which causes air to enter the structure through specifically designed inlets.

In this type of ventilation system, indoor air is continuously exhausted outside the building by fans installed on the walls.



There are two commonly used negative pressure systems, depending on how the farms are designed:

1. Tunnel ventilation system
2. Roof inlet/ outlet ventilation system

The **tunnel ventilation system** is the most widely used ventilation system in large-scale poultry and livestock farms. The tunnel system varies depending on its layout, orientation, capacity, how the shed is built and various other things. Tunnel ventilation systems are rarely speed controlled since the on-off switching method using contactors is preferred. While this method is simple to understand and deploy, it is energy-intensive and minimum ventilation levels are difficult to control.

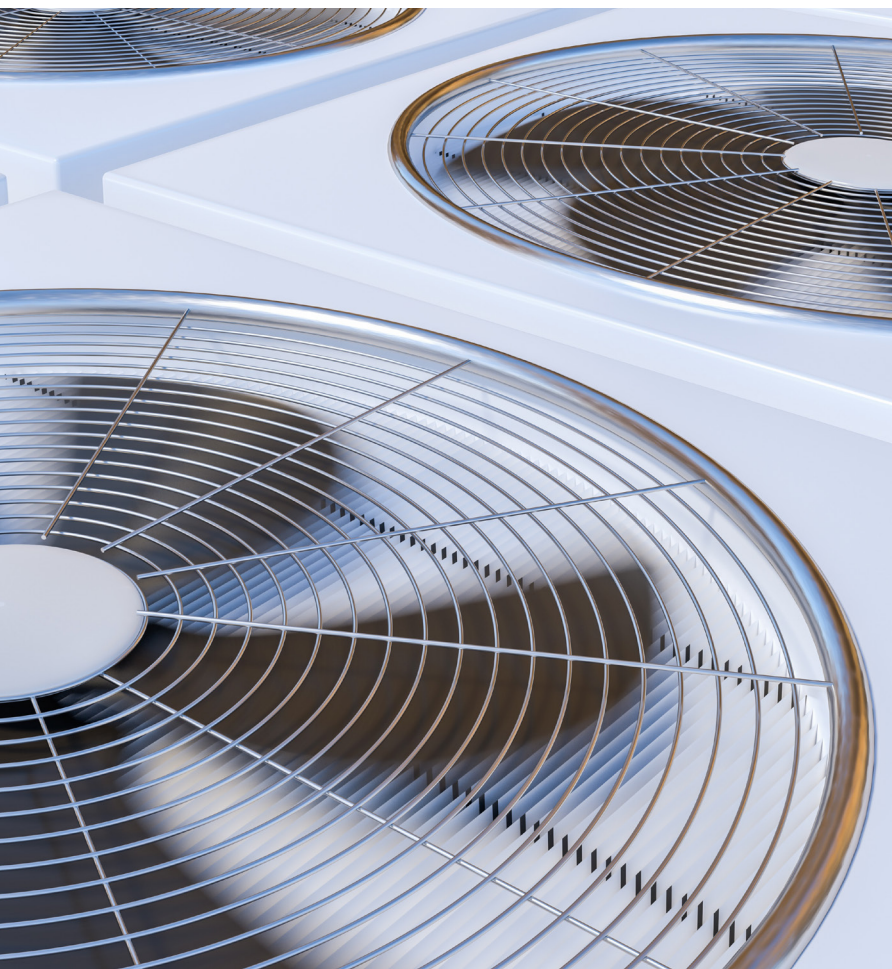
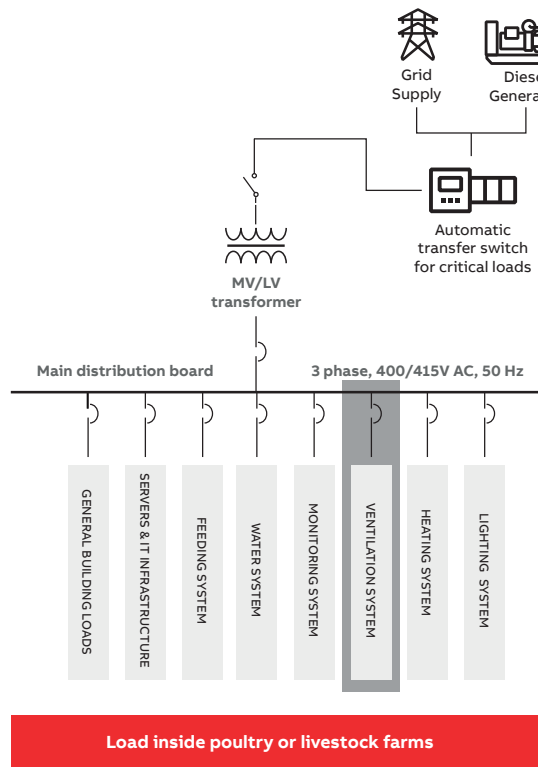
In **roof inlet/outlet systems (VSDs)** are used to control the fan speed in the inlet and outlet stacks employed for standard climate control. VSDs are the preferred choice for controlling ventilation in this equal pressure system since they enable the chickens to move freely between the house and the outside world.

In emergency situations, VSDs can enter the override mode, running fans to a chosen strategy and ignoring warnings and faults. This allows extended fan runtime in adverse conditions, enabling the layer houses to be safely evacuated.

Typical electrical distribution in Poultry & Livestock farms

The main distribution board supplies different sub-systems inside poultry and livestock farms. The figure below illustrates a typical electrical distribution system for Poultry & Livestock farms, from grid/

generator power sources (renewable energy sources can also be connected) to the main distribution board.



Fans

The most important components in a ventilation system are fans.

A fan is a powered machine that creates a flow of air. It consists of a rotating assembly of vanes or blades, generally made of wood, plastic or metal, which act on the air.

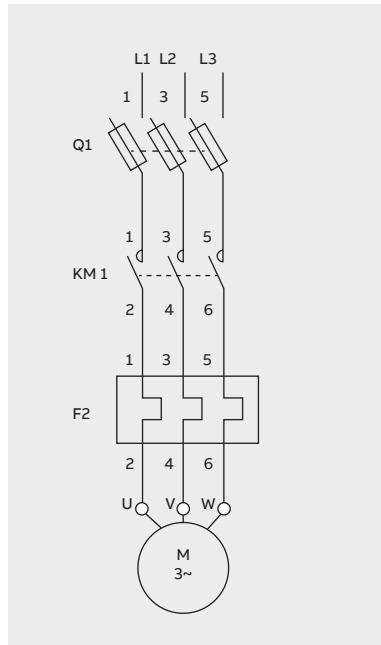
This rotating assembly of blades and hubs is known as an impeller, rotor, or runner. It is usually housed in some form of enclosure, or case, and is driven by an electric motor.

There are three main types of fans used for moving air: axial, centrifugal (radial), and cross-flow (tangential), but axial types are the most commonly used in Poultry & Livestock farms.

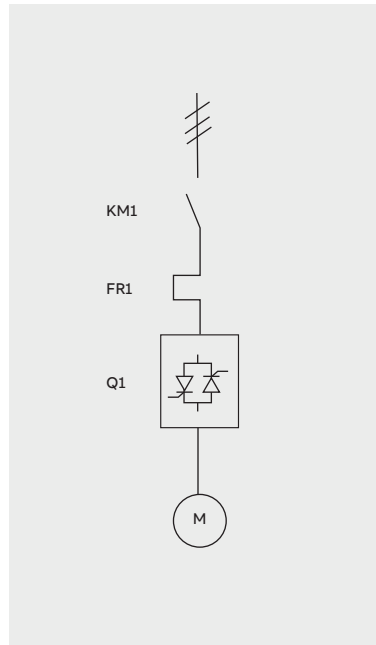
The typical **fan rating in a ventilation system is below 40A**. The starter type we recommend is a Direct-on-line starter & Softstarter if the fan rating is below 40A, if the fans are designed for full-speed running and considering a constant airflow pressure in the Poultry & Livestock farms.

If an adjustable airflow pressure in the farm is required, then a variable frequency drive is recommended to accurately control the speed of the inlet and outlet fans.

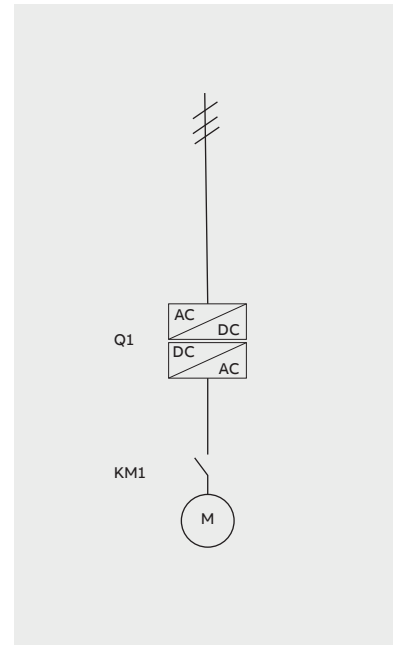
Recommended starter for ventilation fan control



**Direct-on-line
starter**



**Softstarter
starter**



**VFD
starter**

Design data requirements for fans

Main functions

- Short-circuit protection
- Overload protection (with adjustable current setting)
- Voltage level monitoring
- Phase loss & phase sequence – for correct management of fan operation
- Ground fault protection

Other functions

- Temperature monitoring in house
- Thermistor protection relay for monitoring winding temperature (based on fan design)
- Locked Rotor Protection - in the case of a jammed fan
- Digital connectivity (control, energy measurements, etc...)
- Safety relays (if required, based on design)

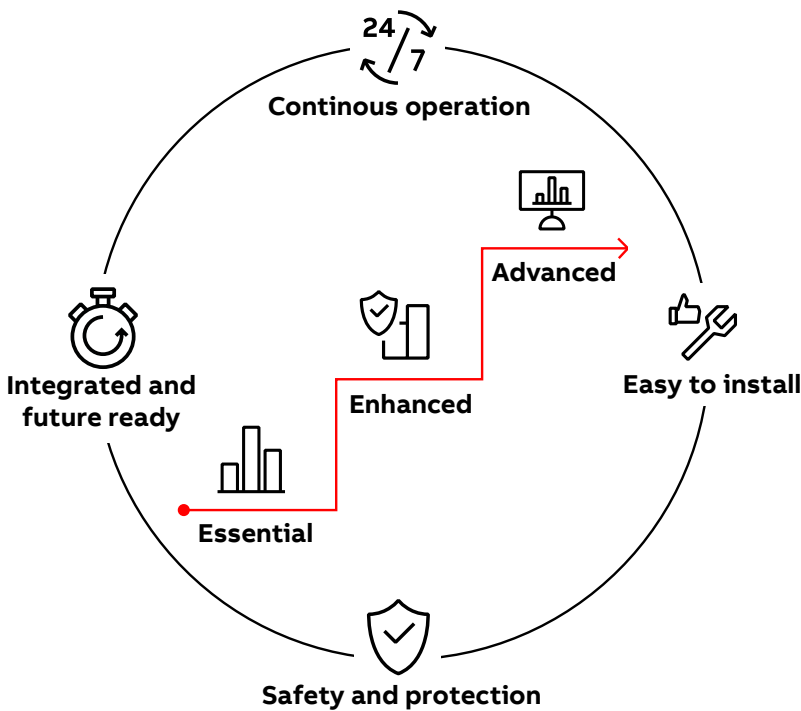
Fan starter panel design parameters

- Motor rated voltage
- Motor rated current
- Utilization category (AC-3/3e)
- Maximum operating current
- Number of switching cycles (ON/OFF)
- Starting torque depending on fan type.
- Acceleration time (starting time)
- Control voltage
- Ambient temperature
- Altitude
- Enclosure type
- Starter type
- Operations - Auto/Manual & Local/Remote
- Digital connectivity (control/monitor)



Motor Starting and Protection solutions for Ventilation Systems in Poultry & Livestock farms

Discover our Motor Starting and Protection solutions for Ventilation Systems. They always ensure the right amount of air is provided for animal welfare.



Essential Solution | Get the essentials right with fast and reliable installations
The Essential Solution ensures that combinations of core power devices function in a coordinated way, thereby guaranteeing continuous operation and ease of installation. In addition, the Essential Solution typically covers the requirements of stand-alone machinery like pumps, compressors, fans, etc.

Enhanced Solution | Get going with our robust protection offering featuring enhanced safety, control and monitoring functions
The Enhanced Solution provides enhanced control, safety, and monitoring functions for applications in the discrete automation field. The Enhanced Solution for Ventilation Systems in Poultry & Livestock farms includes additional protection functions like temperature monitoring, the thermistor motor protection relay, under- or over-voltage monitoring relay, safety relays and more besides. We can address any other requirements to suit end-user requests.

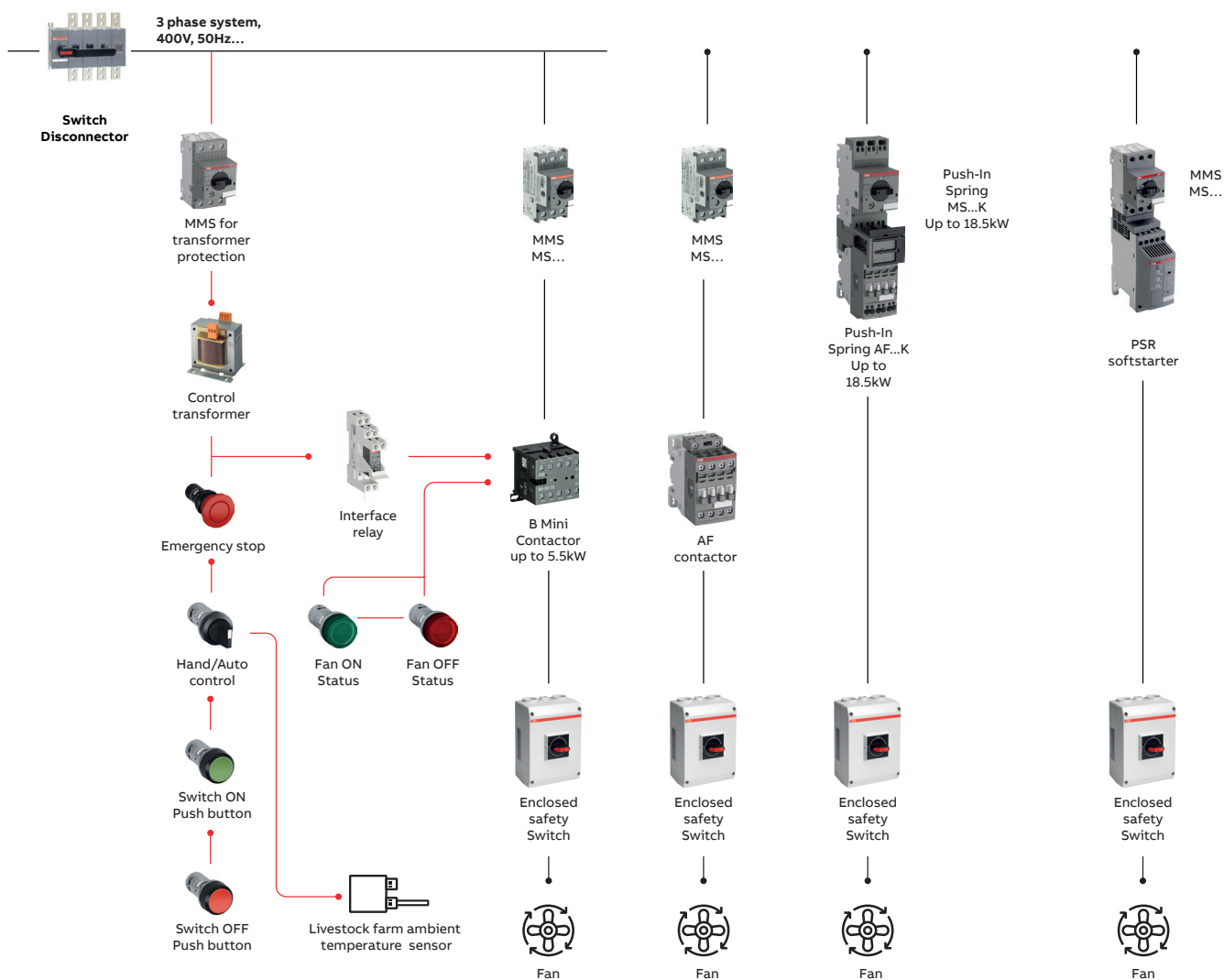
The table below provides an overview of the possible functions in different solution offerings for ventilation systems in Poultry & Livestock farms.

Solution level	Basic protection functions	Monitoring of additional protection functions	Digital connectivity and cloud monitoring
Essential	●		
Enhanced	●	●	
Advanced	●	●	●

Advanced Solution | Get ahead with smart data and predictive applications to keep your system running
The Advanced solution for Ventilation systems includes integrated and future-ready motor protection, flexible motor control, fault diagnostics, maintenance schedules and supports all major communication protocols.

Fuseless protection with MMS
for motor rating 0.06 kW up to 45 kW

Softstarter with MMS
for motor rating
1.5 kW up to 45 kW



*The enclosed safety switch will be close to the motor in case the fan needs maintenance to isolate the power supply and to ensure safety for a person working close to that pump.

— Power circuit
— Control circuit

The table below provides an overview of the difference between the combination products offered in the Essential Solution for Ventilation systems in Poultry & Livestock farms.

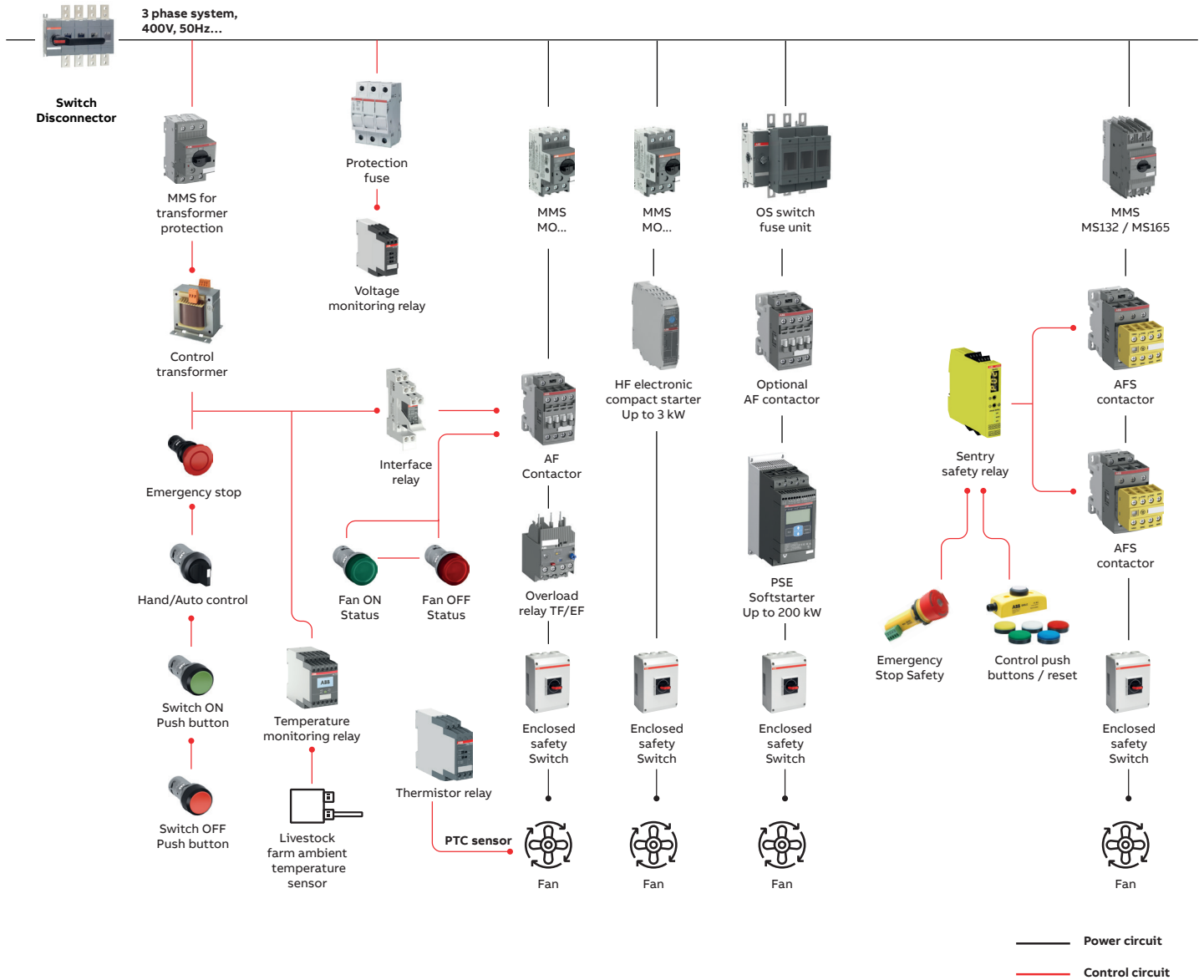
Product combination	Supported motor ratings	Key Differentiator
B Mini contactor	up to 5.5 kW	For efficiency and space saving
Contactor + MMS (Push-In Spring)	up to 18.5 kW	For reliable connection, faster and easier wiring. Vibration proof
Contactor + MMS (Screw version)	up to 45 kW	For standard offerings
PSR + MMS (Softstarter)	up to 45 kW	For Smooth starts and stops

Notes:
MMS - Manual Motor starter



ENHANCED

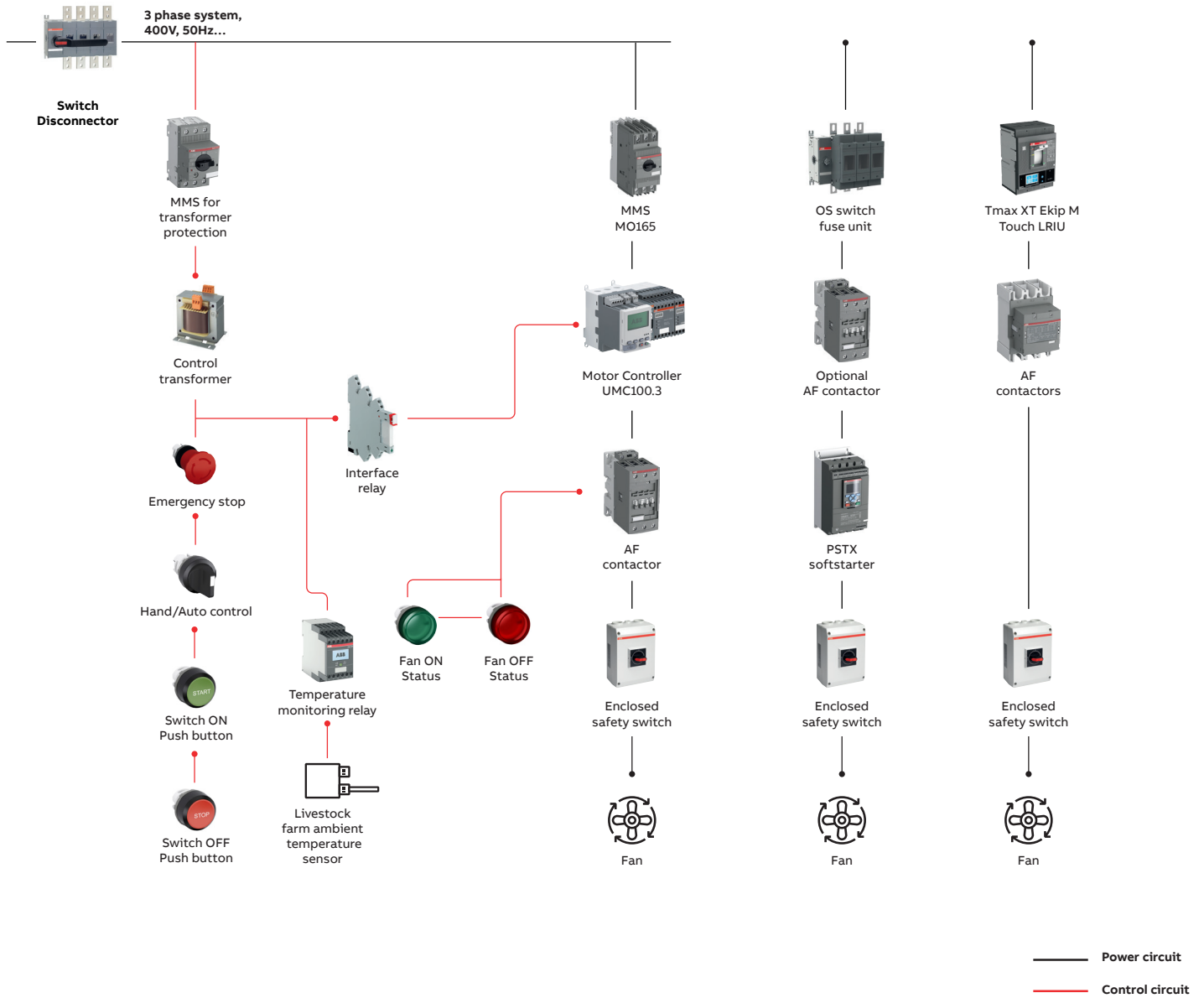
The ABB Enhanced Solution for starting fans





ADVANCED

The ABB Advanced Solution for controlling and monitoring fans (for 0.06 kW to 1200* kW motor ratings at 400V AC)

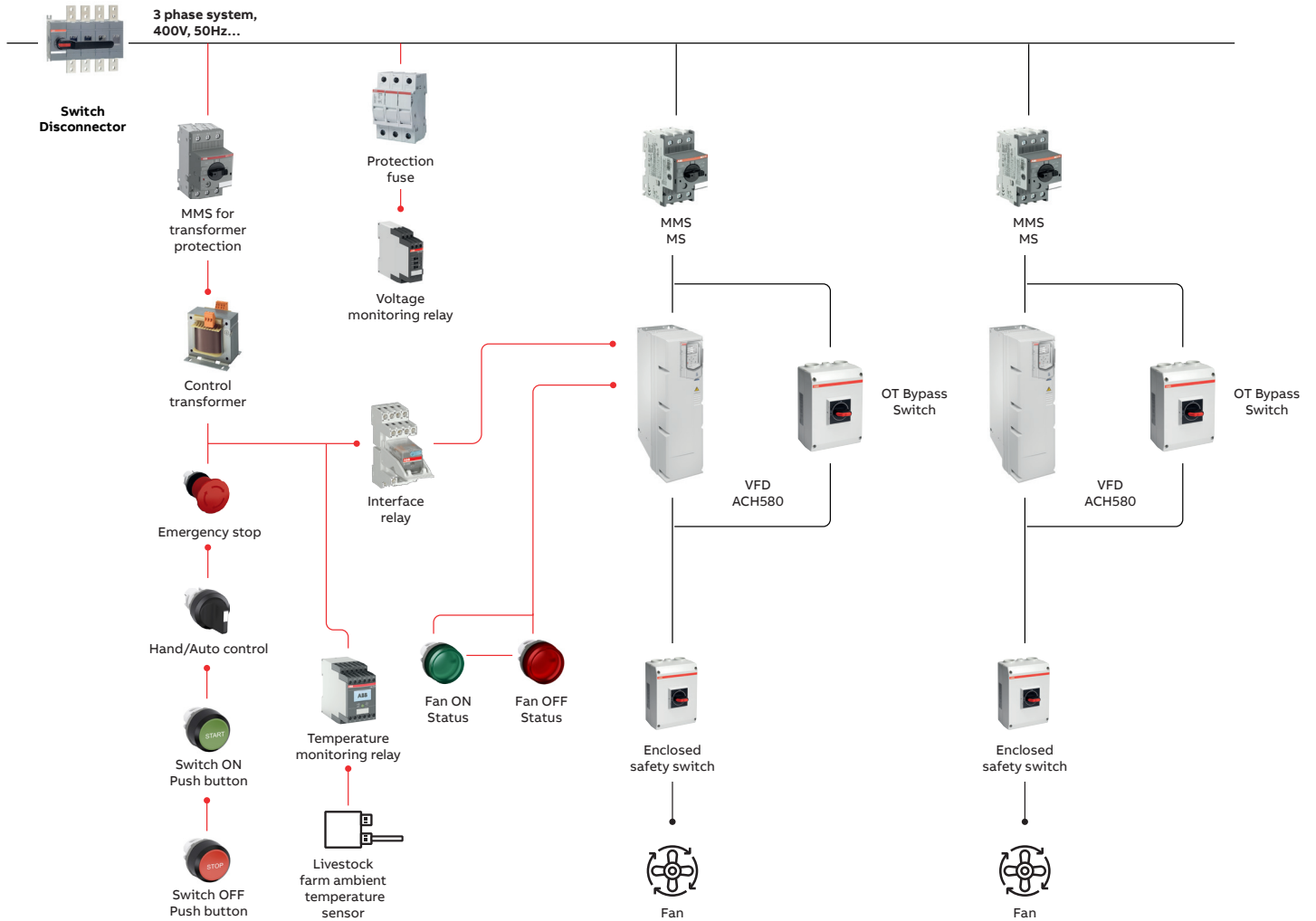


Notes:
*1200kW for Softstarter connected in inside delta



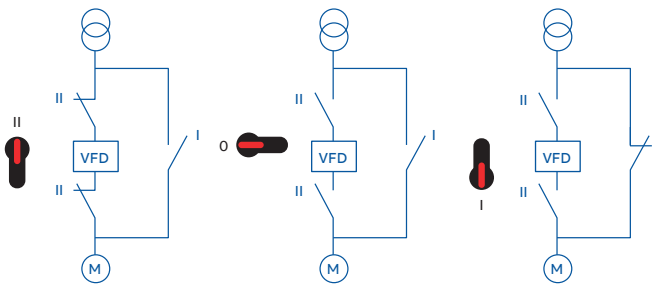
ADVANCED

The ABB VFD solution for starting fans with bypass enclosed switch for the DOL mode (for 1A to 500A motor ratings for VFD and bypass switch up to 40A at 400V AC)



Bypass switch for the frequency converter in order to maintain the power to the fans in case of maintenance on the variable frequency drive.

— Power circuit
— Control circuit



3 position bypass: "II - Frequency drive", "0 - OFF" and "I - Bypass position"

Digital offering

A smart ventilation system in Poultry & Livestock farms guarantees fresh air quality inside the farms themselves and removes harmful gases without requiring manual supervision. The ABB Advanced starter solution provides complete control and monitoring functions for all the important parameters ensuring optimized animal welfare and healthy poultry and livestock farms.



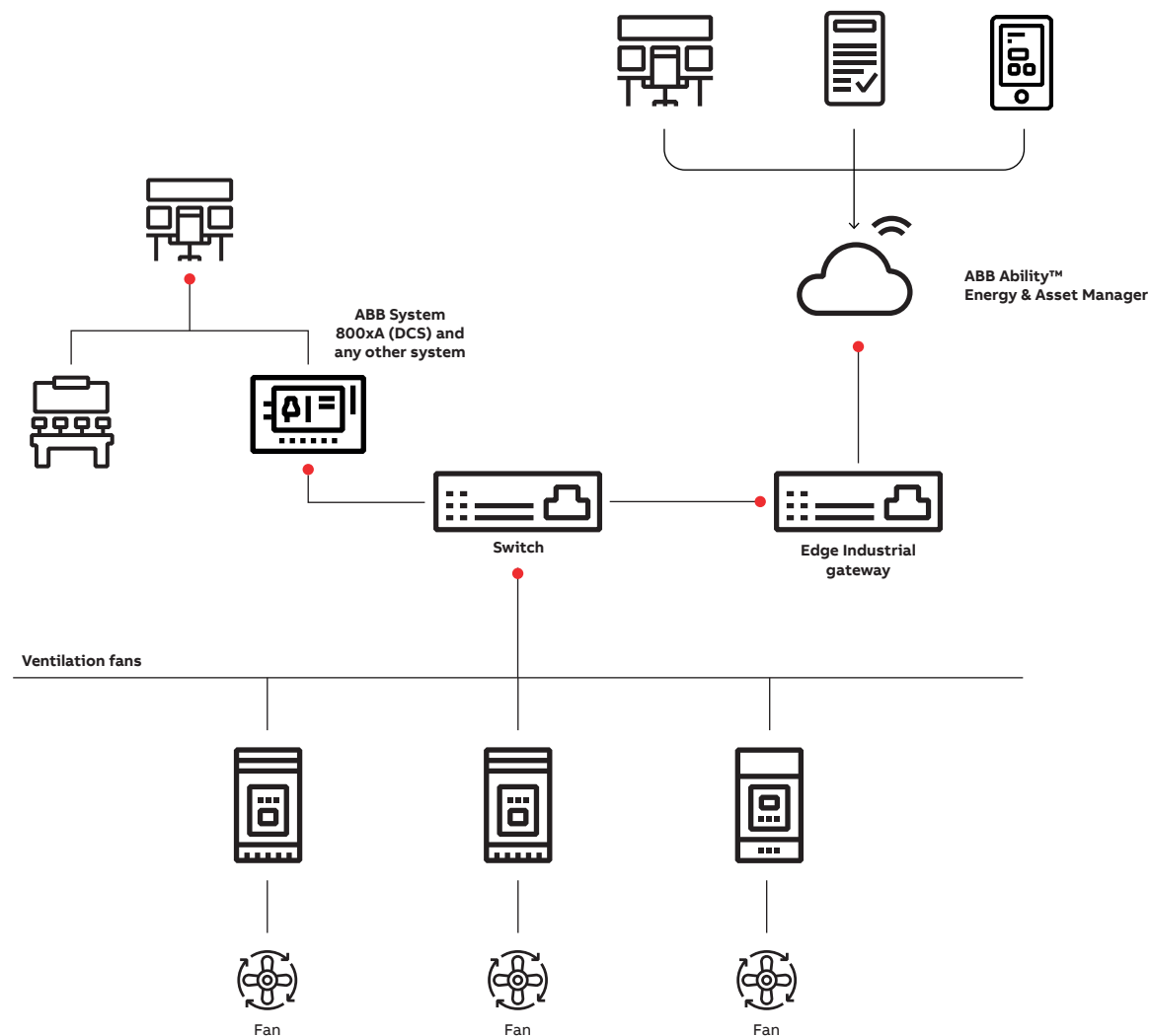
Digitalization enables flexible remote control of ventilation fans



100% availability of ventilation fan measurement data for early fault detection and as an aid to predictive maintenance



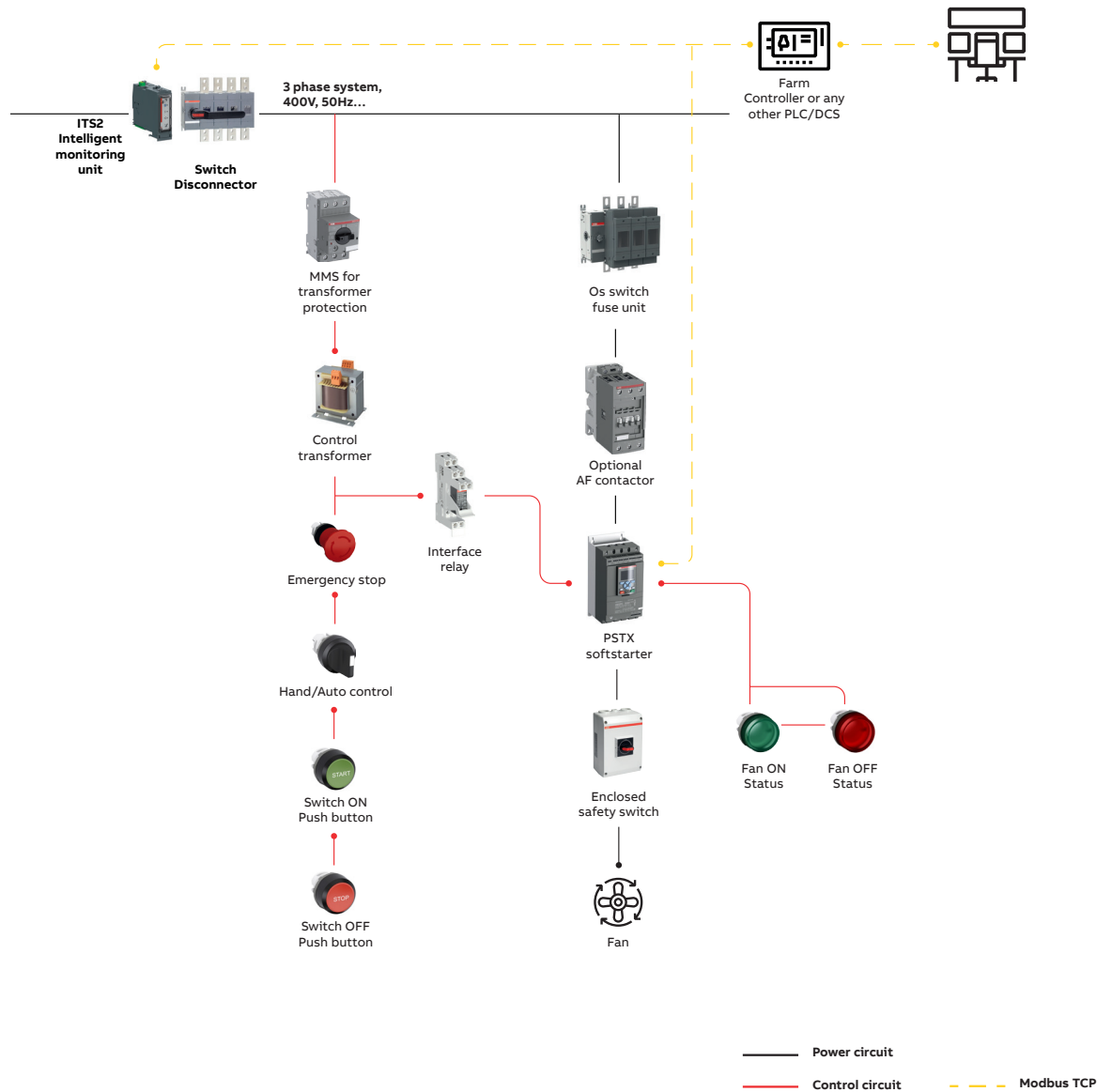
Cloud connectivity through ABB Ability™ Energy and Asset Manager ensuring that data are always quickly available via the web applications



1st scenario:

Digital offering with softstarter for controlling and monitoring fans

For 11 kW to 1200* kW motor ratings at 400V AC



Supporting communication protocols

Industrial Ethernet

- Ethernet/IP™ (2-port)
- Modbus TCP (2-port) Profinet (2-port)
- EtherCAT
- BACnet MS/TP

Fieldbus

- Modbus RTU
- DeviceNet™
- Profibus DP

Features

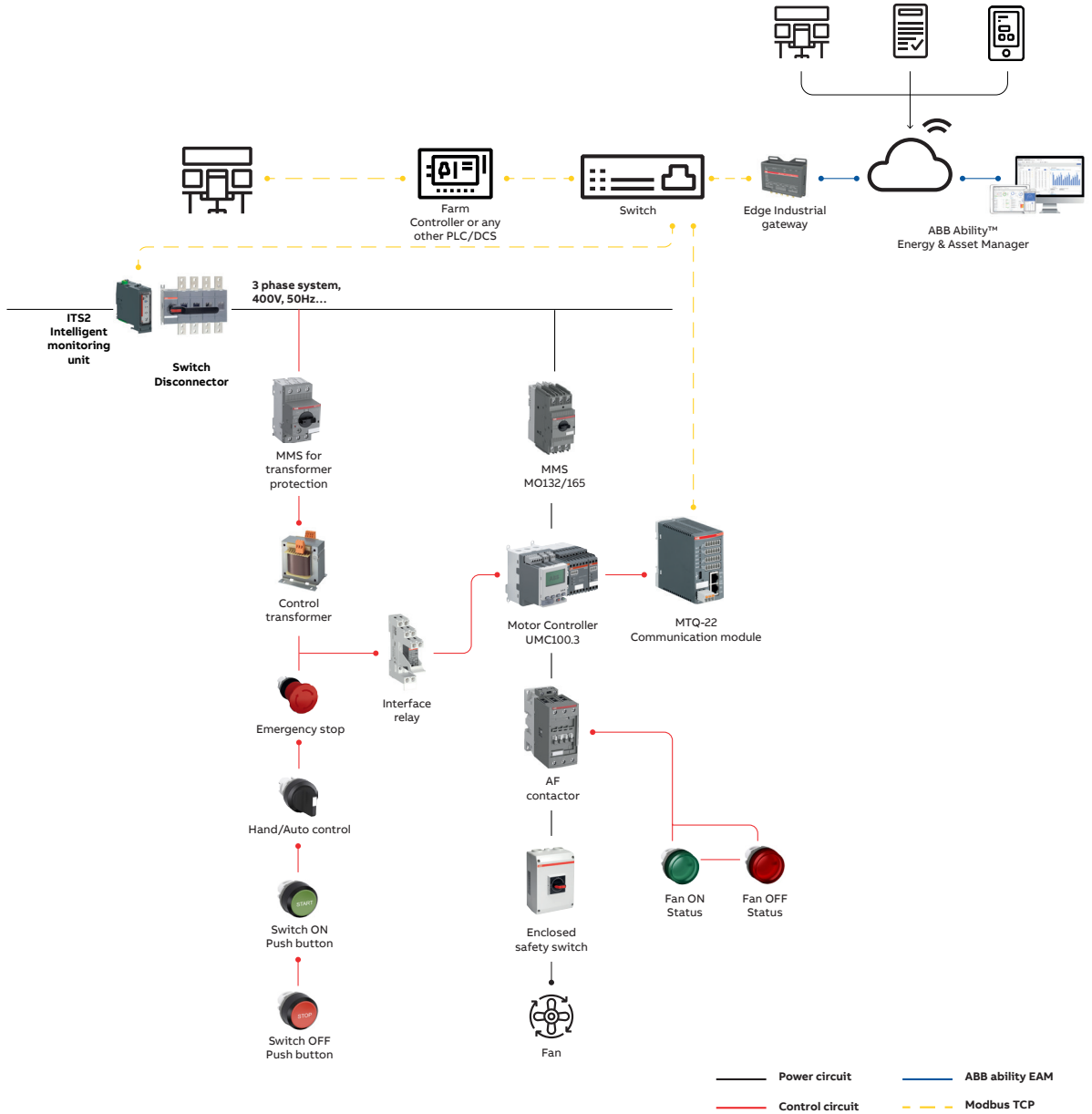
- Flexible ventilation fan control (remote or local)
- Advanced protection functions
- Status and fault diagnosis
- Monitoring of all electrical parameters
 - Voltage (V)
 - Current (A)
 - Power factor (Cos phi)
 - Active power (kW)
 - Reactive power (KVAR)
 - Apparent power (kVArh)
 - Main frequency (Hz)
 - Total harmonic distortion (THD)
 - Energy consumption in kWh
 - Motor temperature

Notes:

*1200kW for Softstarter connected in inside delta

Digital offering with UMC100.3 for controlling and monitoring fans with cloud connectivity

For 0.06 kW to 500 kW motor ratings at 400V AC



Industrial Ethernet

- Ethernet/IP™
- Profinet IO
- Profinet (S2)
- Modbus TCP

Fieldbus

- Modbus RTU
- DeviceNet™
- Profibus DP

- Flexible ventilation fan control (remote or local)
- Advanced protection functions
- Status and fault diagnosis
- Monitoring of all electrical parameters
 - Voltage (V)
 - Current (A)
 - Power factor (Cos phi)
 - Active power (kW)
 - Reactive power (KVAR)
 - Total harmonic distortion (THD)
 - Active energy (kWh)
 - Temperature
- Cloud connectivity - ABB Ability Energy & Asset Manager

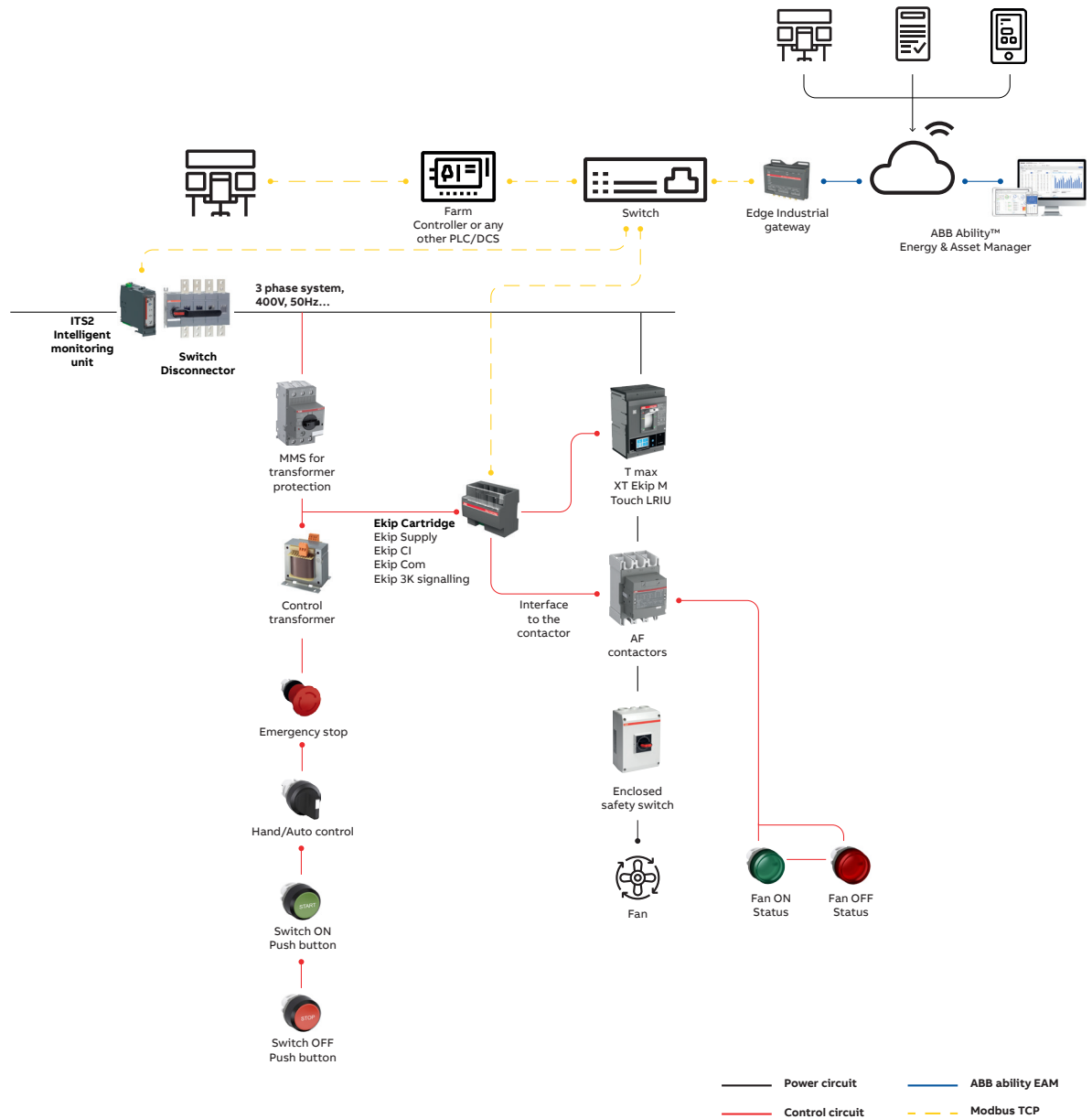
Note:

*UMC100.3 supports ABB ability through MTQ22 (Modbus TCP)

3rd scenario:

Digital offering with Tmax XT MCCB for controlling and monitoring fans with cloud connectivity

For 5.5 kW to 630 kW motor ratings at 400V AC



Supporting communication protocols

Fieldbus networks

- Modbus RTU
- Profibus DP
- DeviceNet™

Ethernet networks

- Modbus TCP
- Profinet
- Ethernet/IP™
- IEC 61850

Features

- Flexible ventilation fan control (remote or local)
- Advanced protection functions
- Status and fault diagnosis
- Monitoring of all electrical parameters
 - Voltage (V)
 - Current (A)
 - Power factor (Cos phi)
 - Active power (kW)
 - Apparent power (kVA)
 - Reactive power (KVAR)
 - Total harmonic distortion (THD)
 - Active energy (kWh)
 - Reactive energy (kVARh)
 - Temperature (with Ekip 3T)
- Cloud connectivity - ABB Ability Energy & Asset Manager

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 contactor is safely operated in an always-optimized, hum-free condition



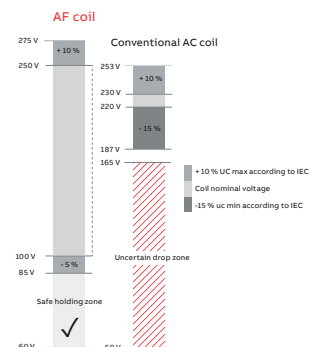
Troubleshooting made easy

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



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 voltage sags, dips, or surges. Prevents stoppages caused by voltage fluctuations.



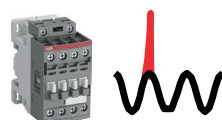
AC & DC control voltage

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.



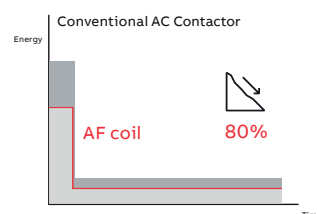
Built-in Surge suppressor

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.



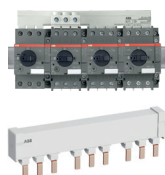
Reduced coil consumption

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.



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.



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.



Ready for IE3 / IE4 motors

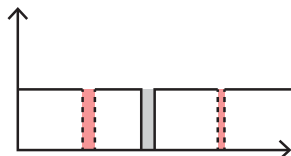
The ABB portfolio matches the latest requirements for IE3 and IE4 motor applications, including the most recent AC-3 upgrade and AC-3e utilization categories created for contactors and motor starters. ABB has validated coordination solutions for AC-3 and AC-3e applications. The results of these tests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



Limp mode

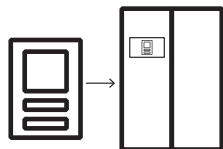
Plan stops for increased productivity.

- Keep running even when one thyristor has shorted.
- Service your plant when you have the time.
- Protections and main features continue to function.



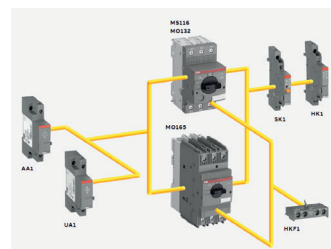
Detachable keypad

Control your process and softstarter safely. The detachable keypad makes safe installation possible and there is no need to buy accessories, thus cost savings for the customer.



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.



Motor heating option for softstarters

Keep your motor running reliably even in cold and damp environments.

- Removes condensation from idle motors.
- Prevents the motor from freezing."
- Perfect for damp installations and cold environments.



PT100 input for motor protection

The Softstarter has a 3-wire PT100 input. The trip temperature is set by the user. The highest trip temperature is 250° while the lowest is -25°. PT100 measurement accuracy must be +/- 3° with 3 wires measuring if the 3 connecting cables have the same resistance.



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.

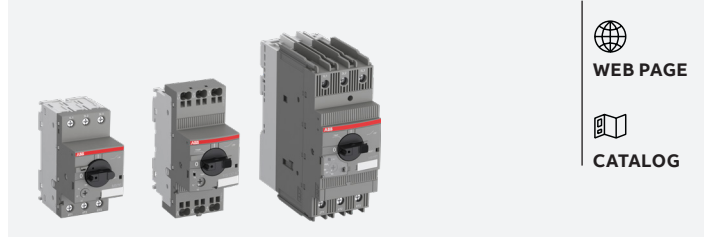
Selected Optimized Coordination				Motor protection	Overcurrent	Backup	Other devices protection	Coordination settings
Standards				Standards				
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
IEC, IEC, IEC, IEC				IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC	IEC, IEC, IEC, IEC
Short-circuit current				Rated voltage	Rated current	Rated short-circuit current	Coordination type	Coordination type
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Product offering

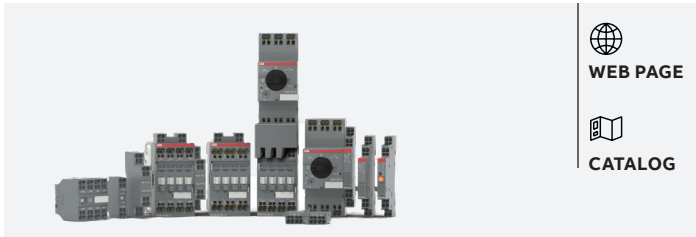
Contactors:



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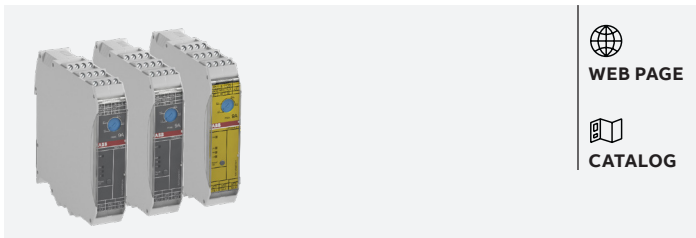
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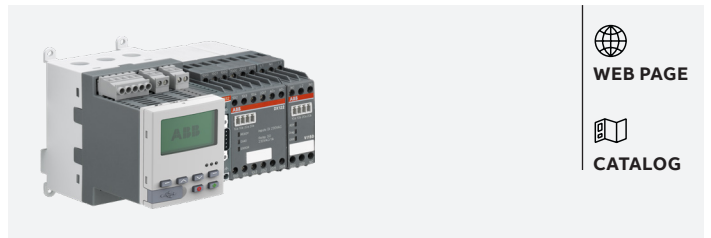
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Electronic compact starter:



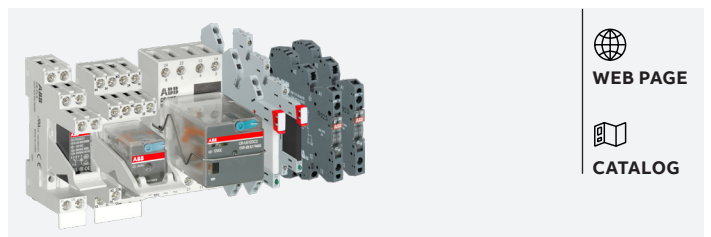
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Pluggable Interface Relays:



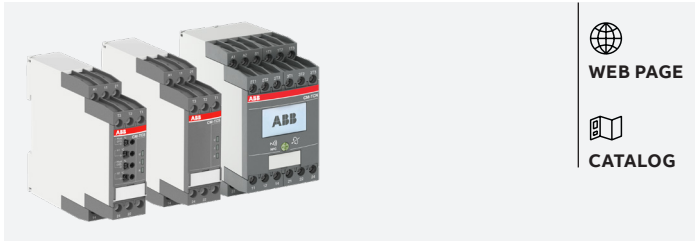
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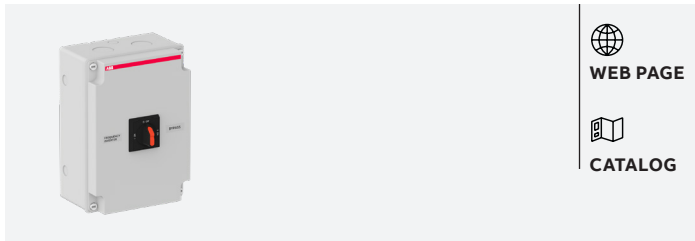
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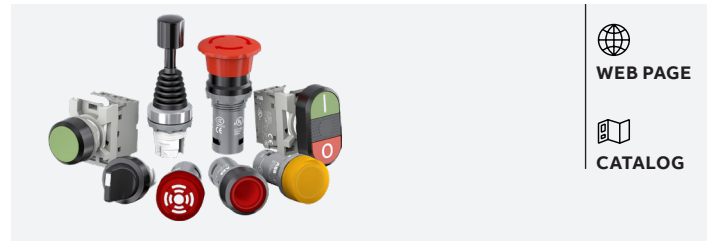
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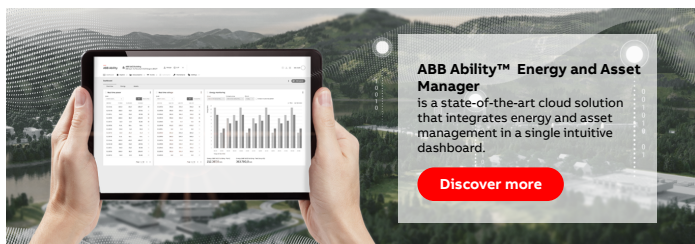


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