



Medium voltage products

DS1

Diode-based transient-free capacitor switch

Power and productivity
for a better world™



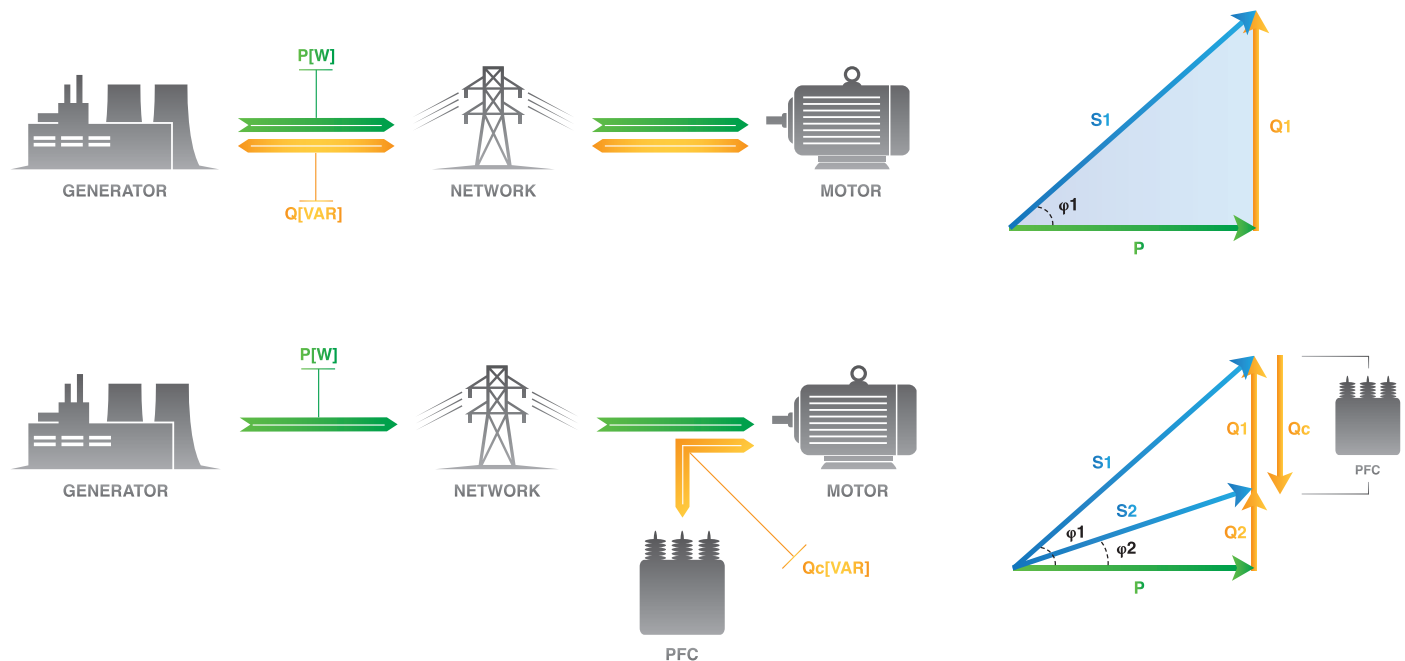
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1. Product description

Areas of use

Medium voltage capacitor banks are useful both in distribution substations to provide stability and reliability of service, and in industrial installations to provide reactive power locally for inductive loads, thereby increasing the power factor and thus the efficiency of the system.



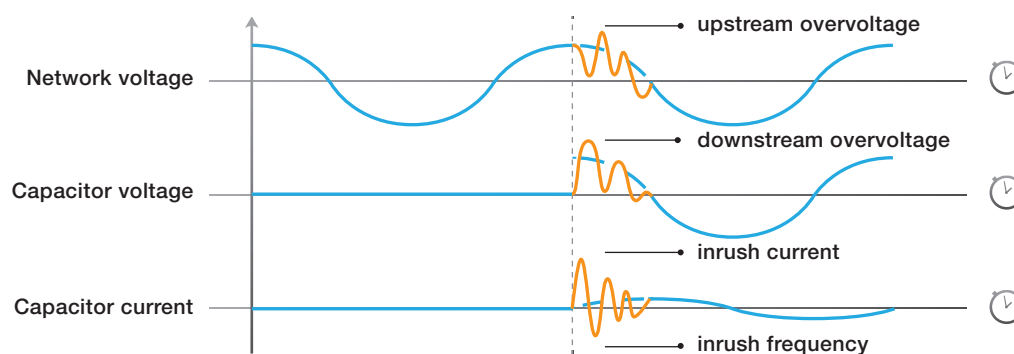
However, the operation of capacitive loads involves some technical difficulties.

Most of the problems concern operations for connection to the network, in which prestrike, high inrush currents and inrush frequencies drastically reduce the service life of the capacitors, of the actuating element and of all connected devices. In addition, voltage transients are propagated across the entire distribution network, disturbing the stability and

reliability of the network and of industrial installations.

In addition, the risk of restrike – a risk that is unpredictable but always present – can lead to serious damage and general malfunctions of the system.

In short, the connection and disconnection of capacitor banks has negative effects not only on the capacitors themselves, but also on connected equipment and across the entire network.



The DS1 is the first synchronous capacitor switch based on diode technology and isolated in dry air specifically devised and designed for capacitor banks.

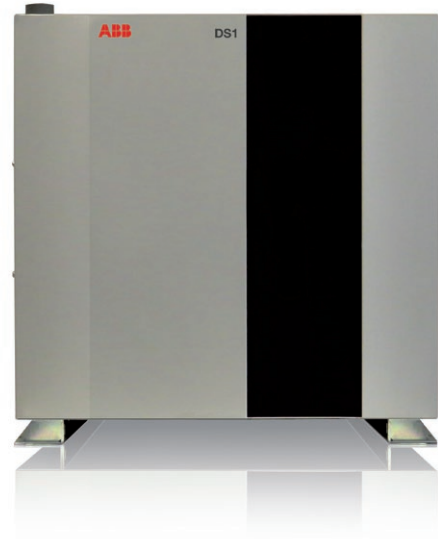
The perfect coupling regulated by the electronic control unit between the semiconductors and the synchronization with the network allows to increase reliability and efficiency and extend the life of the components thanks to operations without any transients.

Benefits on the network

- Increased stability thanks to prestrike and restrike-free switching
- Increased reliability thanks to embedded switch diagnostics
- Increased power quality thanks to transient-free switching
- Absolute protection of the components of the circuit to overvoltage switching

Benefits of the solution

- Safe operations thanks to the DS1 integrated advanced interlocking system
- Space saving thanks to switch compactness
- Easy coordination thanks to embedded control unit
- Long lasting life (50,000 maintenance-free operations)
- Reduced power losses thanks to elimination of inrush reactors



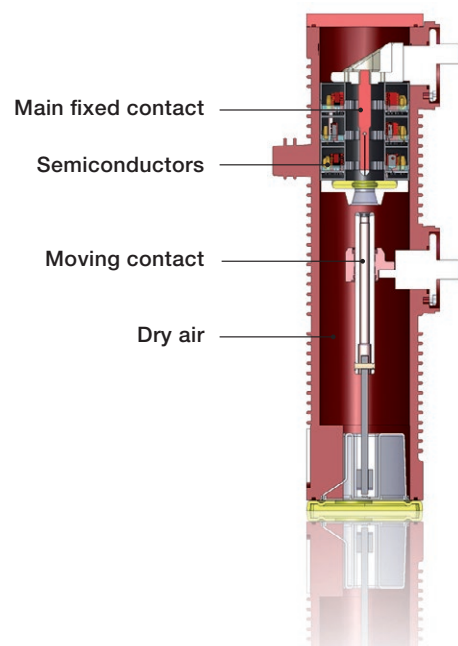
Diode pole

The DS1 is based on a completely innovative actuation concept that uses semiconductors, in other words power diodes, to energize and de-energize the capacitor bank without causing any voltage or current transients and without any physical possibility of prestrike or restrike.

Several diodes are connected in series on a printed circuit board (PCB) and subsequently inserted inside a container, called a diode box, insulated with resin.

The diode box is then housed inside epoxy resin pole. The main contact is also inserted inside the pole and consists of a fixed part and a movable part, and the rod-crank mechanism for moving the contact itself.

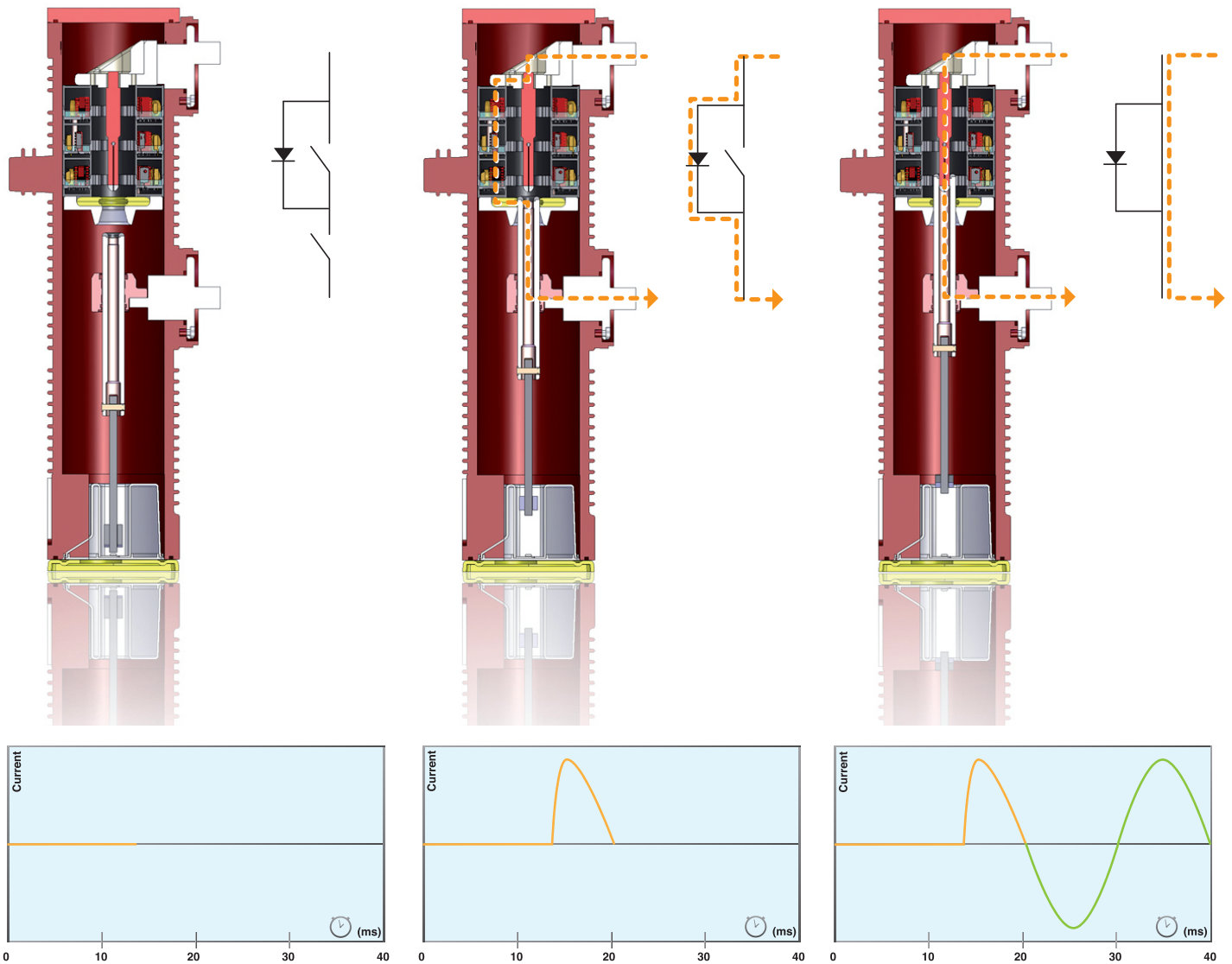
All the poles are insulated in dry air (air devoid of water vapour) making the DS1 a solution with a very low environmental impact, whether from an application or a construction perspective.



1. Product description

Closing without events

The DS1 can perform capacitor bank closing operations without any transient current, voltage or frequency and the possibility of prestrike.



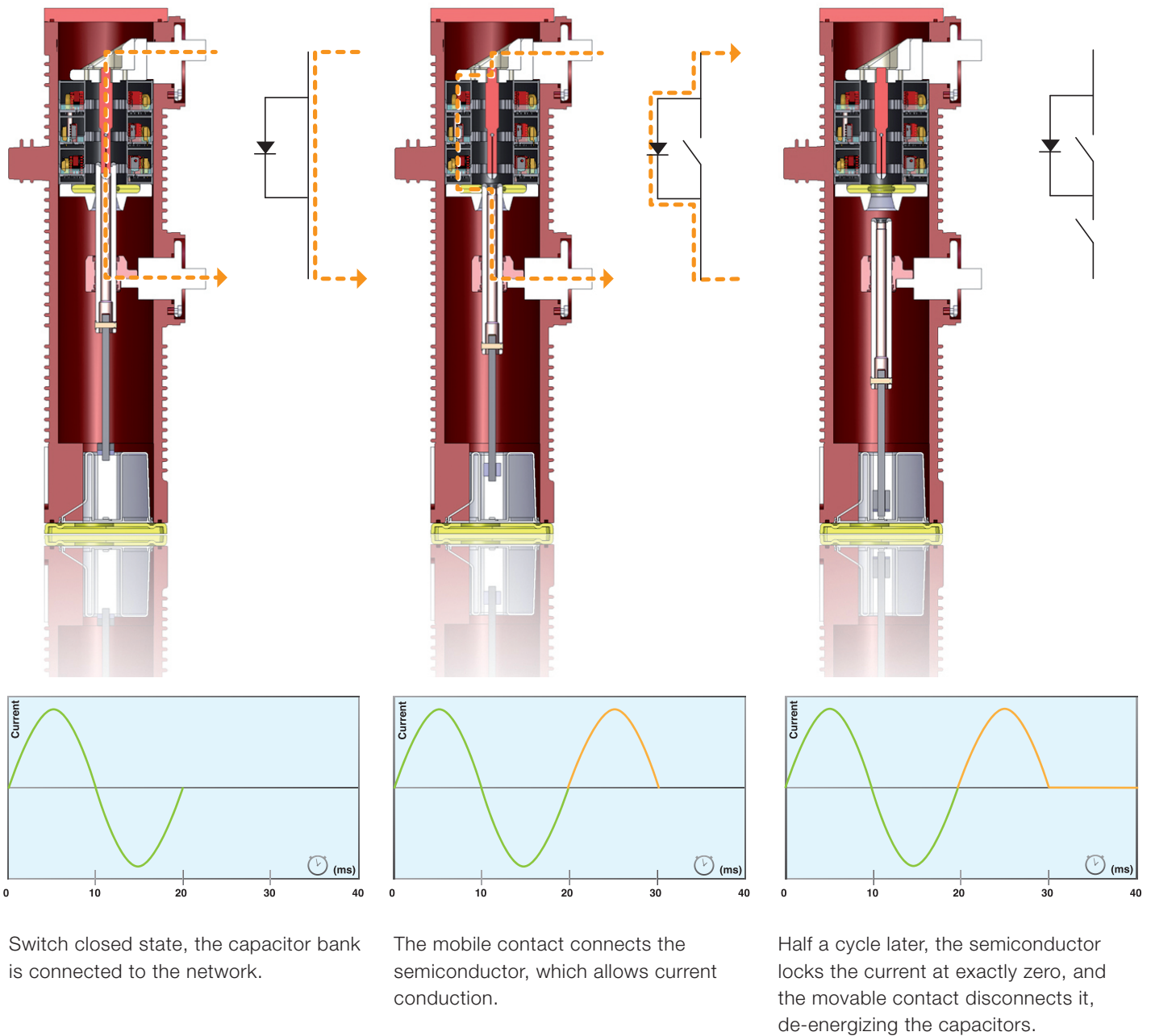
Switch open state, the capacitor bank is disconnected from the network.

The mobile contact connects the semiconductor, which naturally energizes the capacitor bank to zero voltage.

A quarter of a cycle later, the movable contact closes the switch allowing conduction without any power losses.

Opening without events

The DS1 can perform capacitor banks opening operations without disturbing the network and without the possibility of restrike.



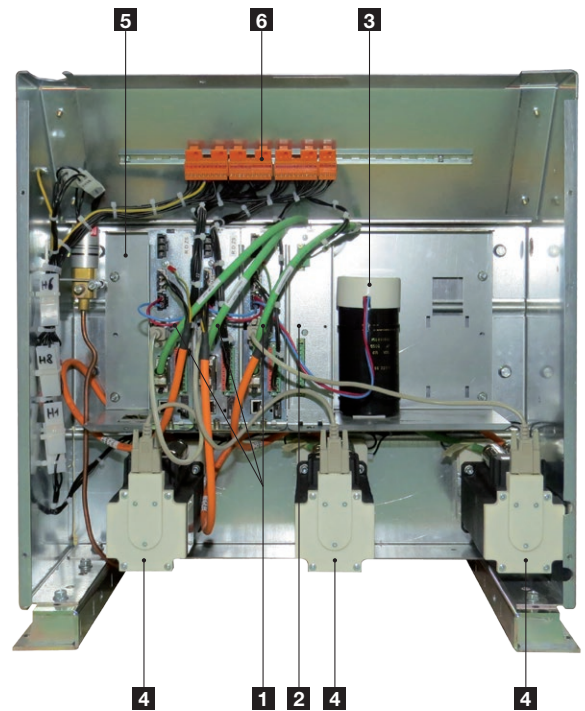
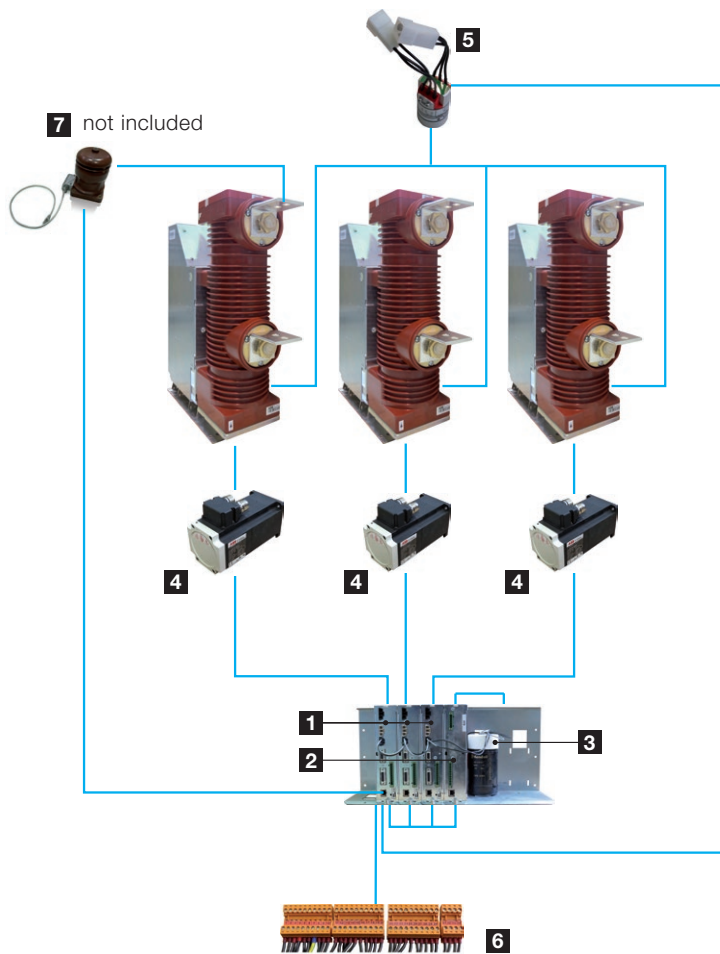
Both the opening and the closing operations take place independently for the three poles, so as to ensure synchronization with the three phases.

The operations are managed by the integrated control unit that receives the signal from a voltage sensor.

1. Product description

System architecture

The DS1 was created by combining power electronics and high precision mechanics and represents a completely innovative concept in switches able to guarantee network reliability, stability and efficiency that has never been achieved before.



1. Control unit

The electronic control unit manages the operations of the DS1 and their synchronization for each phase. It is integrated into the device and pre-calibrated in the factory.

It consists of three modules, each of which controls its own servomotor, thus creating a sub-system able to perform operations independently.

All three of sub-systems are coordinated by the module that controls the first phase, thus creating a system based on “Master”-“Slave 1”-“Slave 2” logic (from the left in the figure).

The control unit also performs diagnostic checks on the entire switch by monitoring:

- The state of the kinematic chain (periodic in closed state)
- The precision of the last actuation (post-actuation)
- The state of the servomotors (continuous)
- The synchronization signal (continuous)
- The dry air pressure of the poles (continuous)
- The state of the actuation capacitor (periodic)
- The state of the control unit (continuous)

See the “Diagnostics” section for further details.

2. Power supply unit

The power supply unit supplies power to the three control units and charges the actuation capacitor.

3. Actuation capacitor

The actuation capacitor supplies energy for the actuation of the servomotors. Thanks to this capacitor, the accumulated energy is always sufficient to complete the commanded operation, even in the event of sudden loss of power during the operation.

4. Servomotors

The mobile contacts of the DS1 are actuated independently for each phase through brushless servomotors equipped with high resolution encoders. The robustness of this solution guarantees extremely high precision and control of each operation.

5. Pressure switch

The pressure switch controls the dry air pressure inside the poles with three levels of warning:

- Pressure OK: the pressure is at an adequate level to perform operations safely.
- Warning Pressure: the pressure is sufficient to perform operations safely, but is less than the specification value.
- Low Pressure: the pressure is not sufficient to perform operations safely. The control unit inhibits all opening or closing commands.

See the “Diagnostics” section for further details.

6. Terminal box

The terminal box is used to interface the DS1 with the power factor correction system, in order to coordinate the switch with control equipment through input, output and interlock signals.

Refer to the “Interface” section for further details.

7. Voltage sensor

The DS1 control unit receives the waveform signal from a single voltage sensor placed on the first phase (R or A).

Structure

The overall dimensions of the DS1 are similar to those of ABB indoor circuit breakers with the same phase distance.

This allows simple and quick installation or replacement of the device without having to redesign existing switchboard panels or cassettes that host ABB products.

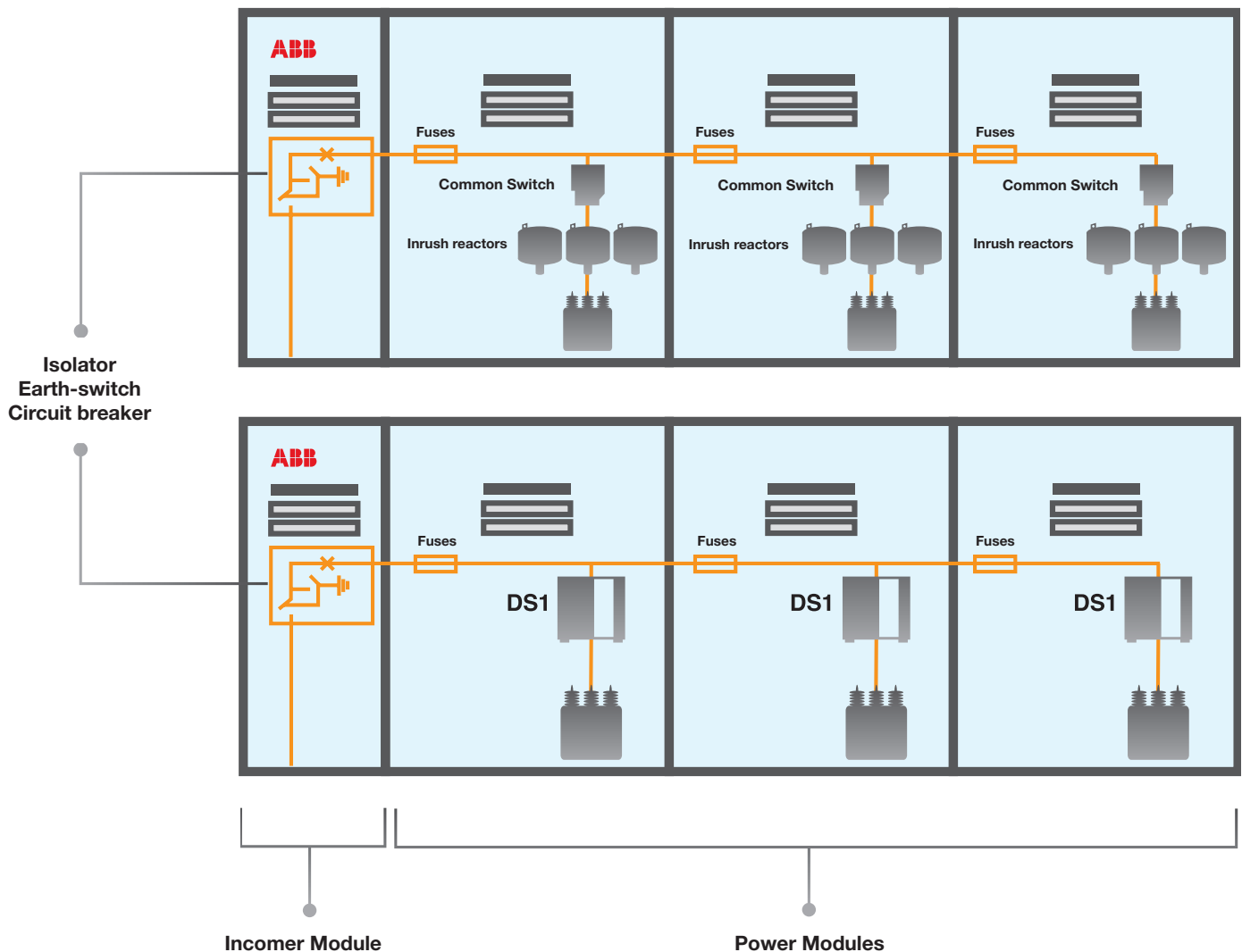


1. Product description

Application

Thanks to its compact design, DS1 reduces the space required inside the panel. In addition, its ability to perform operations without transients avoids additional components such as inrush reactors.

DS1 is the perfect solution for switching single-step or back-to-back capacitor banks for reactive power compensation, network stability and power factor correction, both for utilities and industries.



Diagnostics

The control unit integrated in the DS1 is able to monitor the whole device through the various diagnostic functions of the entire switch. In this way, the DS1 can inform the user of its state, so as to prevent failed operations and schedule preventive maintenance.

Communication takes place via binary outputs provided in the terminal.

The parameters monitored by the control unit are:

- **Micro motion control (periodic in closed state)**

The control unit commands the servo motors to perform

micro-movements every 24 hours when the switch is in the closed state in order to monitor position, speed and torque of actuation. This control has the important task of checking the status of the actuation chain before commanding an open operation, thus ensuring the highest reliability.

– **Full motion control (post-actuation)**

During each opening and closing operation the control unit monitors the position, speed and torque of the servomotors, in order to inform the user of the outcome of the operation that has just been performed.

– **State of the servomotors (continuous)**

The status of the wiring and windings of the servomotors is constantly monitored by the control unit so as to ensure that the primary actuation elements are in good condition.

– **Synchronization signal (continuous)**

The accuracy of the synchronization signal is constantly monitored in terms of presence of busbar voltage, frequency and harmonic distortion. The control unit automatically adjusts actuation according to the variation in these last two parameters (within a certain threshold, see Chapter 2. “Installation Requirements”) so as to always ensure a high level of synchronization.

– **Dry air pressure (continuous)**

Thanks to the integrated pressure switch, the control unit can recognize three levels of dry air pressure inside the poles (OK, Warning, Low) so as to ensure the dielectric isolation during an operation or in open state.

– **Actuation capacitor (periodic)**

The voltage of the actuation capacitor is periodically checked to ensure that the energy for a complete actuation is always available before it is commanded.

– **State of the control unit (continuous)**

The control unit constantly processes self-diagnostics in terms of temperature of the unit and the voltage and current circulating within it, so as to always guarantee proper operation.

For further details on how to interpret and manage output for diagnostic operations, refer to the DS1 Installation and Maintenance Manual.

Interface

The DS1 control and power supply unit interfaces with the external system in a simple manner by means of contacts in the terminal block to provide power and binary inputs and outputs.

Power supply

The power supply unit requires a constant source of energy according to the characteristics listed in the table:

Control unit power supply	
Rated voltage (Vsupply)	110 - 220 V DC
Continuous power	< 100 W
Peak power for capacitor load	< 200 W
Capacitor full charging time	10 s
Time to run full diagnostics at switch-on	1 min

Input

Three inputs are available with binary logic:

– **Open (command):** opening command when the DS1 is in the closed state.

– **Close (command):** closing command when the DS1 is in the open state.

– **Interlock:** actuation interlock.

This input allows the DS1 to be integrated with the control logic of any system, so as to prevent operation of the switch by opening the loop, when the logic of the system requires it.

The loop of the actuation interlock is automatically opened by the internal wiring if the pressure inside the poles drops to the “Low” level.

It is recommended to coordinate the hierarchy of the system interlocks with this input in wired logic, so as to open its loop when actuation of the DS1 must be avoided. In particular, since the DS1 cannot perform operations on a short circuit, the following interlocks are recommended:

– interlock with upstream circuit breaker.

In this way actuation of the DS1 can be avoided when the upstream circuit breaker is in operation.

– interlock with downstream earthing switch.

In this way actuation of the DS1 can be avoided when the downstream earthing switch is in the closed position.

The electrical characteristics of the contacts for inputs are listed in the following table:

Binary inputs	Open (command)	Close (command)	Interlock
Rated voltage	110 - 220 V DC		
Activation voltage	80 V DC		
Activation power	< 7 W	< 7 W	–
Time of supply for activation	20 ms	20 ms	–
Rated current	–	–	< 0.05 A
Type of contact	–	–	Supplied by +Vsupply

1. Product description

Output

Eight outputs are available with binary logic.

Status output

- **Open (state):** when active, the DS1 is in the open state.
- **Close (state):** when active, the DS1 is in the closed state.

The technical characteristics of the status outputs are shown in the following table:

Status output	Open (state)	Close (state)
Rated voltage	250 V AC / DC	
Rated current at 250 V	16 A AC / 0.3 A DC	
Type of contact	Dry contact	

Switch diagnostic outputs

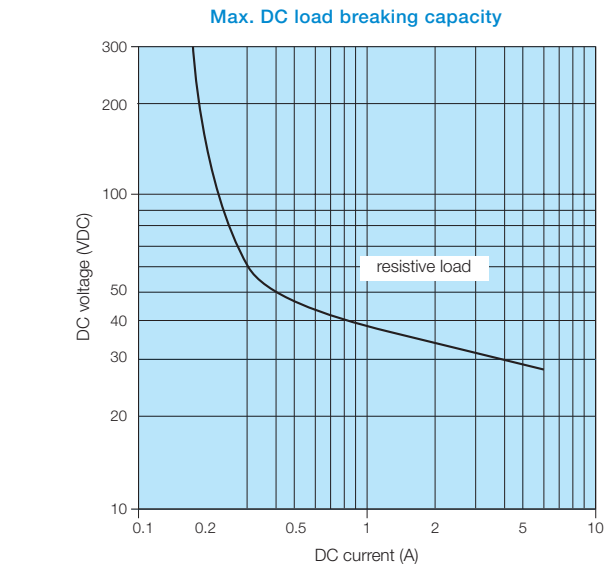
- **Ready:** when active, the DS1 is ready to perform a closing or opening operation.
- **Alarm:** when active, the DS1 presents a fault following an operation carried out.

The DS1 cannot operate.

The technical characteristics of the switch diagnostics outputs are shown in the following table:

Switch diagnostic output	Ready	Alarm
Rated voltage	240 V AC / DC	
Maximum rated current at 30 V	6 A	
Type of contact	Dry contact	

The technical characteristics of the switch diagnostic outputs in direct current are shown in the following table:



Control unit self-diagnostics output

- **Watchdog:** when flashing, the DS1 control system is active.

The technical characteristics of the control unit self-diagnostics output are shown in the following table:

Control unit self-diagnostics outputs	Watchdog
Rated voltage	250 V AC / DC
Rated current	< 100 mA
Type of contact	Solid state

Pressure diagnostics outputs

- **Pressure OK:** when active, the dry air pressure in the poles is above the normal operating threshold. From 4.7 bar (rated value) to 4.0 bar absolute.
- **Pressure Warning:** when active, the dry air pressure in the poles is below the normal operating threshold, but sufficient to operate. From 4.0 bar to 3.7 bar absolute.
- **Pressure Low:** when active, the dry air pressure in the poles is not sufficient to operate. Less than 3.7 bar absolute. The DS1 cannot operate.

The technical characteristics of the pressure diagnostics outputs are shown in the following table:

Pressure diagnostics output	Pressure		
	OK	Warning	Low
Rated voltage (Vsupply*)	110 - 220 V DC		
Rated current	0.05 A		
Type of contact	Supplied by +Vsupply*		

* Vsupply is the voltage at which the control unit is powered

The outputs can be controlled as desired by wired logic. For further details on how to interpret and manage the outputs, refer to the DS1 Installation and Maintenance Manual.

Inputs for maintenance and initialization



These inputs must be used only and exclusively by authorized personnel for maintenance and initialization operations in conditions of complete isolation and absence of busbar voltage. Refer to the installation and maintenance manual before using them. ABB declines all liability in the case of improper use of the following inputs.

- **Upstream CB interlock:** upstream circuit breaker interlock.

Allows the DS1 to operate without synchronization so as to perform opening and closing sequences in the absence of primary busbar voltage. In this condition, the delay of 5 minutes between an opening and the subsequent closing is eliminated.

The implementation of this interlock is also recommended in order to coordinate the activation of this input with the open and isolated state of the upstream circuit breaker.

The activation of this input in presence of primary busbar voltage is absolutely prohibited.

- **Homing:** initialization.

Allows the DS1 to enter open state to initialize its position. This command is part of the installation and maintenance procedures and can be processed by the DS1 only when the Upstream CB Interlock input is active and the primary busbar voltage is absent.

The activation of this input in presence of primary busbar voltage is absolutely prohibited.

- **Reset**

Allows you to reset the DS1 alarm state.

The activation of this input in presence of primary busbar voltage is absolutely prohibited.

Putting the DS1 back into service after a reset is absolutely prohibited.

The DS1 is equipped with an internal memory that keeps track of every event and operation requested from the switch. ABB technicians have full access to this memory. ABB declines all responsibility and liability if improper use of the inputs described above is detected.

Inputs for maintenance and commissioning	Upstream CB Interlock	Reset	Homing
Rated voltage	110 - 220 V DC		
Activation voltage	80 V DC		
Input power for activation	< 2 W	< 7 W	< 7 W
Holding time for activation	1000 ms	20 ms	20 ms

2. Installation requirements

Indoor

The design of the DS1 makes the synchronous switch suitable for indoor applications.

Harmonic distortion on voltage

The DS1 can perform synchronous operations even with high values of total harmonic distortion on voltage (THDV). However, this value must not be such that it will cause multiple zero-crossing of the voltage waveform.

Rated frequency

The DS1 can perform synchronous operations even when the power frequency is subject to variations compared to the rated value, by automatically adjusting its actuation time. Such variations must not, however, exceed ± 1.4 Hz.

Ungrounded capacitor banks

The synchronization signal acquisition logic of the DS1 is suitable for operating only on capacitor banks. These capacitors must have an ungrounded centre of the star. In case of retrofit on an existing capacitor bank with inrush reactors, such reactors must be eliminated or the DS1 must be electrically located downstream with respect to them.

Capacitor discharge

When a capacitor bank is disconnected from the network, the capacitor units remain charged to the voltage at which they are disconnected. These must therefore be discharged to a voltage value less than or equal to 50 V within 5 minutes, before being connected again, according to the standard IEEE C37.99.

To prevent reclosing before the capacitors are discharged, once the opening operation has been performed, the DS1 closing command is inhibited for 5 minutes by the control unit, thus ensuring that it is impossible to perform closing operations on the charged capacitor banks.

The DS1 can perform the following operational sequence:

C – 300 ms – O – 5 min – C

Contact ABB if the inhibition time needs to be changed. In any case, the closing of a non-discharged bank must never be carried out with DS1.

Voltage sensor

The DS1 requires the measurement of busbar voltage on phase R (A) by means of a voltage sensor. Only one sensor is needed, since the load is symmetrical (floating star centre) and purely capacitive.

DS1 has been tested and certified with the ABB KEVA 24 A3 sensor. ABB recommends the use of an ABB KEVA 24 A3 sensor or equivalent.

Direct phase rotation

The logic on which the opening and closing operations are based requires the sequence of the primary three-phase power supply network to follow the direct phase rotation R, S, T (A, B, C).

Fault-making

The DS1 cannot perform a fault-making operation. For this reason, the DS1 must be properly integrated into the system so as to minimize the likelihood and impact of this event.

If necessary, contact ABB to get technical support to assess these requirements.

3. General characteristics

Standards

DS1 synchronous switches meet the specifications of the following standards:

- **IEC 62271-1**
High-voltage switchgear and controlgear – Part 1:
Common specifications
- **IEC 62271-103**
High-voltage switchgear and controlgear – Part 103:
Switches for rated voltages above 1 kV up to and including 52 kV): special purpose switch for switching capacitor banks
- **IEC 62271-100**
High-voltage switchgear and controlgear – Part 100:
Alternating-current circuit-breakers:
6.111.9.1.4 - Three-phase capacitor bank (single or back-to-back) current switching tests
- **IEC 61000-4-2, /-3, /-4, /-5, /-6, /-8, /-9, /-12, /-16, /-17, /-18, /-29**
Electromagnetic compatibility (EMC)
- **IEEE C37.90-1/-2/-3**
IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

Electromagnetic compatibility

The DS1 switch guarantees operation even in the presence of interference caused by electronic equipment, atmospheric disturbances or electrical discharges.

It is also unable to create interference with any existing electronic equipment near the installation.

The above is in accordance with the Standards IEC–TS 61000-6-5, IEC 61000-4 and IEEE C37.90.

Vibration resistance

DS1 synchronous switches are not affected by mechanically or electromagnetically generated vibrations.

Tropicalization

DS1 switches are manufactured in compliance with the most stringent specifications concerning their use in hot-humid-saline climates.

All the more important metal parts are treated against corrosive substances corresponding to class C, in accordance with UNI 12500 Standards.

The galvanizing treatment is applied in compliance with Standard UNI ISO 2081, classification code Fe/Zn 12, thickness 12x10⁻⁶ m, protected by a conversion layer formed mainly by chromates, in accordance with Standard UNI ISO 4520.

These construction characteristics mean that all DS1 switches comply with standards IEC 60068-2-30 (Test Db: Damp Heat, cyclic) and IEC 60068-2-78 (Test Cab: Damp heat, steady state).

Altitude

The insulating properties of the air diminish as the altitude increases. This must be taken into account with regard to the external insulation of the equipment. This phenomenon must always be considered when designing the insulating components of equipment to be installed at more than 1000 m above sea level.

In this case, one must consider a correction coefficient that can be taken from the graph on the following page, created in accordance with the indications provided by Standards IEC 62271-1.

The example below gives a clear interpretation of the indications above.

3. General characteristics

Graph for establishing correction factor Ka depending on the altitude

H = altitude in meters;
m = value referring to industrial frequency and impulse withstand and phase to phase voltages.

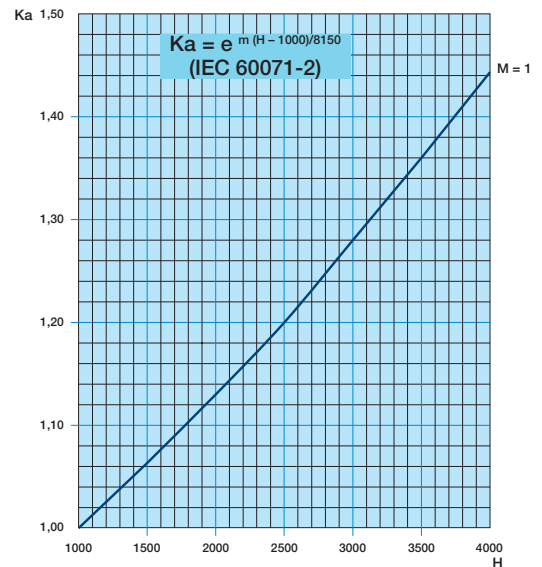
Example

- Installation altitude 2000 m
- Use at 12 kV rated voltage
- Withstand voltage 28 kV rms
- Impulse withstand voltage 75 kVp
- Ka factor read from the graph = 1.13.

In view of the aforementioned parameters, the equipment must withstand (during tests at zero altitude, i.e. at sea level):

- Withstand voltage equal to: $28 \times 1,13 = 31,6$ kVrms
- Impulse withstand voltage equal to: $75 \times 1,13 = 84,7$ kVp.

In this case, equipment with 17.5 kV rated voltage characterized by 38 kVrms insulation levels at power-frequency with 95 kVp impulse withstand voltage is required for installations at an altitude of 2000 m above sea level with 12 kV operating voltage.



Environmental protection program

DS1 synchronous switches are manufactured in accordance with the ISO 14000 Standards (Guidelines for environmental management).

The production processes are carried out in compliance with the Standards for environmental protection in terms of reduction in energy consumption as well as in raw materials and production of waste materials.

All this is thanks to the medium voltage apparatus manufacturing facility environmental management system. Assessment of environmental impact during the life cycle of the product obtained by reducing the overall energy consumption and use of raw materials for the product to the minimum, is put into effect during the design engineering phase through an accurate choice of materials, processes and packaging. This to allow the products and components to be recycled to the utmost degree at the end of their life cycle.

Quality Assurance System

Conforms to ISO 9001 Standards, certified by an independent third party.

The test laboratory

Conforms to UNI CEI EN ISO/IEC 17025 Standards, certified by an independent third party.

Environmental Management System

Conforms to ISO 14001 Standards, certified by an independent third party.

Health and Safety Management System

Conforms to OHSAS 18001 Standards, certified by an independent third party.

Technical literature

Order the following publications for more details about the technical aspects and applications of DS1 synchronous switches:

Technical Application Papers No.8 Power factor correction and harmonic filtering in electrical plants	code 1SDC007107G0202
ABBACUS Metal enclosed capacitor bank	code DPD 2572 ABB
EMPAC Metal enclosed capacitor bank	code 2GPC400100A002
KEVA 24 A Indoor voltage sensor	code 1VLC000583
DS1 Installation and Maintenance Manual	code 2RDA026079
PowerCare Service	code 1VCP000486-1410

4. Service

Spare parts

- Complete pole ^(*)
- Control and power supply unit ^(*)
- Gas distributor and pressure switch ^(*)
- Servomotor and external encoder ^(*)
- Actuation capacitor
- Servomotor power wiring
- Servomotor encoder wiring
- Servomotor external encoder wiring

For availability and ordering of spare parts, please contact our Service and specify the serial number of the DS1.

^(*) May be replaced only by trained personnel and/or in our workshops.

ABB Power Care

ABB Power Care allows you to better manage the electrification system, ensuring operational continuity and optimizing the financial resources available. Depending on the profile of each company, ABB can offer a wide range of assistance services, allowing customers to choose those best suited to the needs of the installation. The ABB Power Care platform is based on an array of services that the customers can select, according to their needs, when the service contract is activated. The services offered range from the possibility of dedicated access to a full range of support services for each type of equipment. All services are provided by qualified and certified ABB personnel.

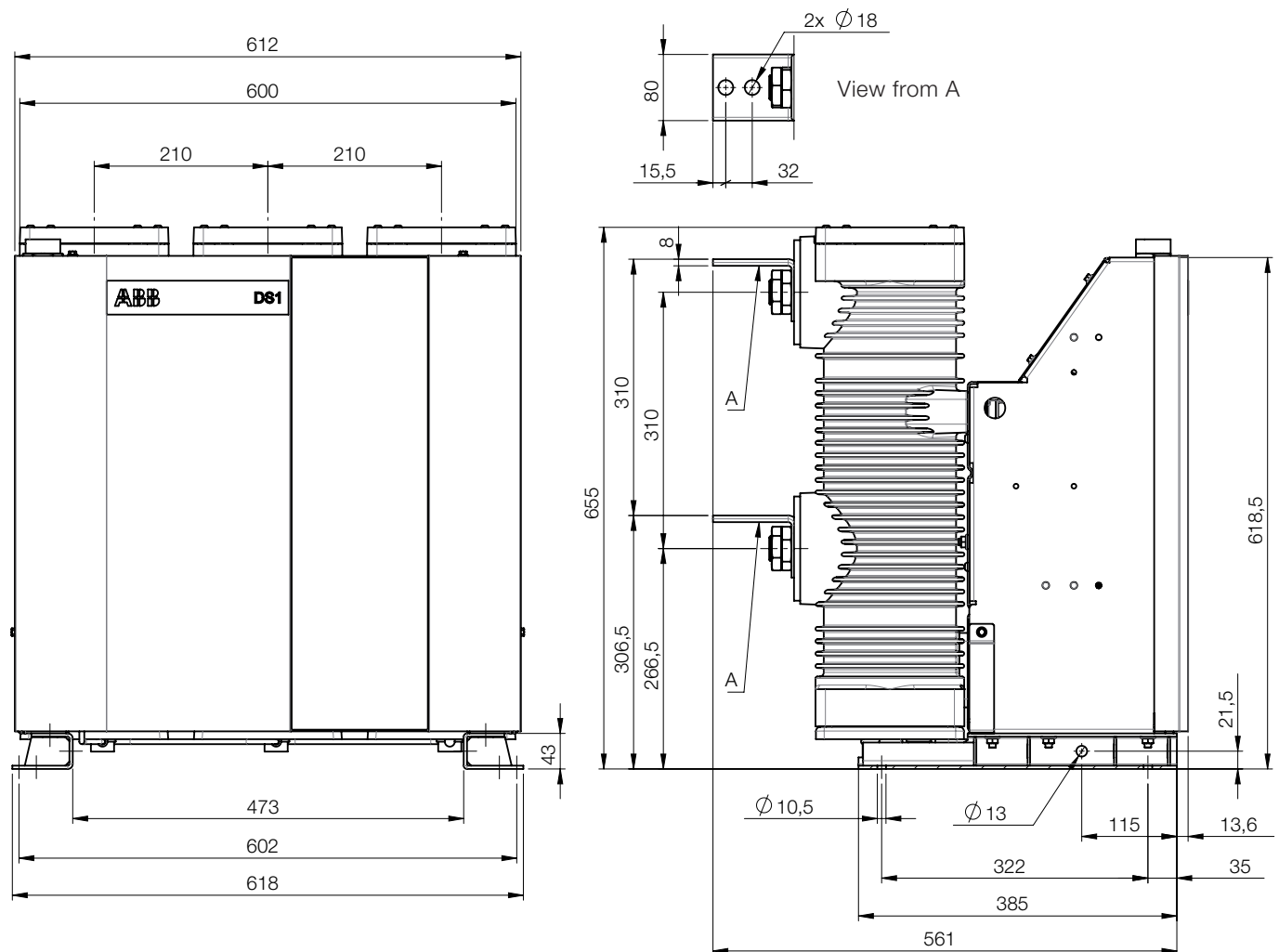
		The array of ABB Power Care package consists of five areas and four levels of service, in which each area is geared to different customer needs and the degree of ABB support offered increases in step with the levels.			
	ABB Power Care	Base level	Level 1	Level 2	Level 3
Includes training and retraining of personnel. The purpose of the courses on products and applications is to provide all participants with the necessary knowledge and skills on ABB equipment, while the ongoing training services help maintenance managers to develop a strategy for the ongoing training of staff tailored to their duties.	Services for skills development	List of training courses on products	Training courses on products	Training courses on applications	Ongoing training
Provides rapid assistance in emergency situations. Dedicated access provides a direct line in the case of request for "call based" service, while technical support and emergency services ensure that the customer receives adequate support within defined times. The contract may also include the management of strategic spare parts in the installation.	Emergency maintenance services	Dedicated access	Technical support within defined times	Emergency response within defined times	Assessment and management of spare parts
Allows the condition of the equipment to be ascertained and safety aspects to be monitored, as well as the definition of the measures necessary to contain risks. In this area, the ABB package includes periodic inspections or the installation of a monitoring system for the evaluation of the conditions of the equipment.	Services for diagnosis and assessment of conditions	Initial evaluation and documentation of the installed base	Assessment of the conditions and risk probability of the equipment ^(*)	Equipment monitoring	Remote monitoring of equipment
Includes support services for the personnel of the installation so that they are able to carry out extraordinary operations without any problems by being able to browse the online product documentation, to chat with ABB experts or to have dedicated online access to the ABB platform that hosts the files/documentation for the equipment of the installation.	Support for personnel of the installation	Report on the state of the life cycle of the installed base	Online manuals and instructions	Online support for personnel of the installation	File storage
ABB offers technical advice and preventive maintenance operations to keep the equipment in good condition, while minimizing the risk of outage and serious failures of the electrical equipment.	Maintenance services in the installation	MV	Annual measurement of partial discharges	Maintenance of protection and control units	Maintenance of circuit breakers
		LV	Periodic technical evaluation	Services for products	Advanced services for products
					Maintenance of switchgear
					Advanced services for switchgear ^(*)

^(*) These services are available for the installation/switchgear system.

5. Overall dimensions

DS1

The DS1 50 and DS1 60 versions differ only in the configuration of the control unit. Their size characteristics are identical.



6. Circuit wiring diagram

Application diagram

1VCD400238

Symbols for wiring diagrams

	Thermal effect		Terminal or clamp		Rectifier with two half-waves		Control coil (general symbol)
	Electromagnetic effect		Socket and plug (female and male)		Make contact		Overcurrent relay with adjustable long-time delay feature
	Pushbutton control		Isolated digital binary input		Break contact		Overcurrent relay with adjustable inverse long-time delay feature
	Earth (general symbol)		Capacitor (general symbol)		Make contact with retained position and reset with manual actuator		Overcurrent relay with adjustable short-time delay feature
	Earth, frame		Motor (general symbol)		Make position contact (limit)		Instantaneous overcurrent relay
	Conductor in shielded cable (e.g. two conductors)		Current sensor		Break position contact (limit)		Earth fault overcurrent relay with adjustable long-time delay feature
	Conductor connections		Current sensor with wound secondary and primary formed by three feed-throughs		Power isolator with automatic opening action		Lamp (general symbol)

6. Circuit wiring diagram

Diagram 1VCD400238

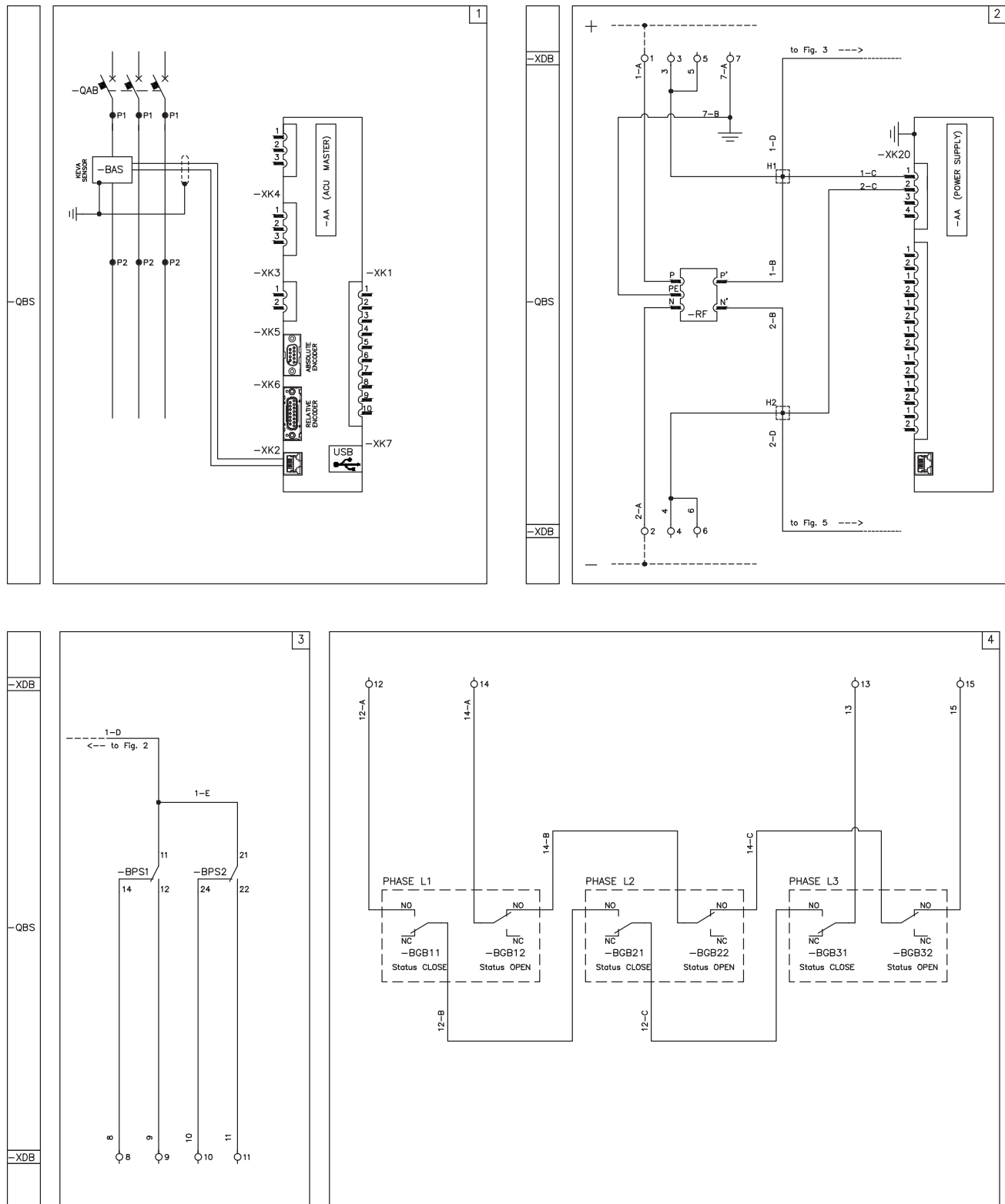
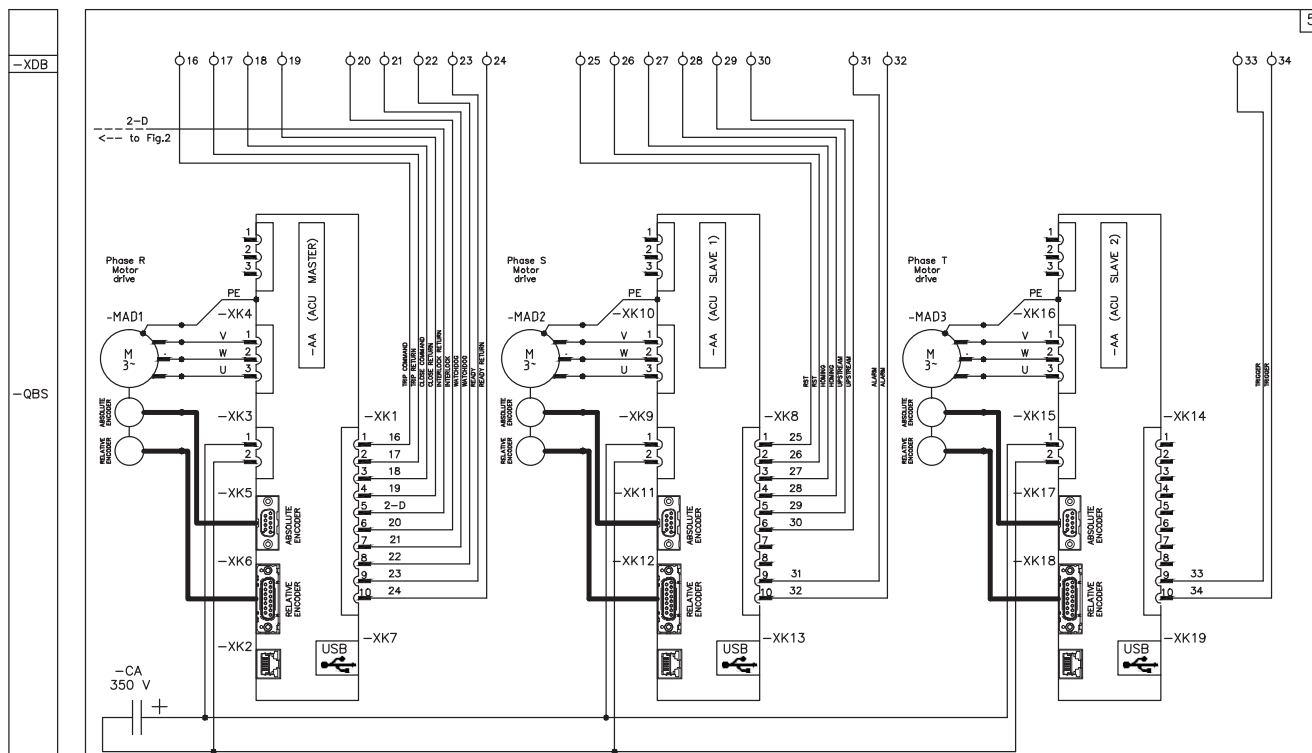


Diagram 1VCD400238



DESCRIPTION	STATUS / COMMAND	IN / OUT
Trigger	Normally Open. Closes for ~50ms at starting of every operation.	Dry contact Output
Alarm	Normally Open. Close if DS1 is in alarm mode.	Dry contact Output
Upstream CB interlock	Supply power to give command	+/- V Input
Homing	Supply power to give command	+/- V Input
Reset of alarms	Supply power to give command	+/- V Input
Ready	Close if DS1 is ready to operate	Dry contact Output
Watchdog	Open/close (flashing) if Control Unit is active	Solid state Output
Interlock (*)	To connect with terminal 10 to enable the functionality	Input
Close command (to close the DS1)	Supply power to give command	+/- V Input
Trip command (to open the DS1)	Supply power to give command	+/- V Input
Capacitor-switch status open	Close if DS1 is Open	Dry contact Output
Capacitor-switch status close	Close if DS1 is Closed	Dry contact Output
Low value of pressure	High (+V) if P=low	+ V supply Output
Interlock (*)	To connect with terminal 20 to enable the functionality	Output
Warning value of pressure	High (+V) if P=warning	+ V supply Output
Nominal value of pressure	High (+V) if P=nominal	+ V supply Output
GND		
Supply output	Power supply output	+/- V supply Output
Supply input	Power supply input	+/- V supply Input

(*) Interlock loop 10-20 has to be closed with a wire.
This wire loop can be used for additional interlocking hierarchy.
The loop has to be opened when DS1 operations must be prevented.
The loop is automatically opened (from pin 10) when pressure is low.

-XDB
Terminal
board
inside
the
DS1

6. Circuit wiring diagram

Diagram 1VCD400238

Operating state shown

The diagram illustrates the components in the following conditions:

- DS1 switch open
- circuits de-energized
- dry air gas pressure at nominal duty value (0.47 MPa absolute).

Key

- = Figure number of the diagram
- BAS = Voltage sensor on phase L1
- RF = Input power filter
- AA = Electric monitoring and actuator unit
- BPS = pressure switch with two tripping thresholds:
 - Tripping due to low gas pressure (-BPS1).
The contact 11-12-14 switches from the position indicated in the diagram when the gas pressure drops from 0.47 MPa absolute to a value less than 0.40 MPa absolute. If the rated pressure value returns, this same contact switches again when it rises from an initial value lower than 0.40 MPa absolute to a value of 0.42 MPa absolute
 - Tripping due to insufficient gas pressure (-BPS2).
The contact 21-22 switches when the gas pressure drops from 0.40 MPa absolute to a value less than 0.37 MPa absolute. If the rated pressure value returns, this same contact switches again when the pressure rises from 0.37 MPa absolute to approximately 0.40 MPa absolute
- BGB11 = Phase L1 position micro switch CLOSED state
- BGB12 = Phase L1 position micro switch OPEN state
- BGB21 = Phase L2 position micro switch CLOSED state
- BGB22 = Phase L2 position micro switch OPEN state
- BGB31 = Phase L3 position micro switch CLOSED state
- BGB32 = Phase L3 position micro switch OPEN state
- MAD1 = Phase L1 pole actuation motor
- MAD2 = Phase L2 pole actuation motor
- MAD3 = Phase L3 pole actuation motor
- CA = Actuation capacitor 350V
- QBS = DS1 switch
- XDB = Switch circuits delivery terminal box

Connectors for the "Master" module of the control unit -AA

- XK1 = Connector for digital inputs/outputs
- XK2 = Analog input connector
- XK3 = Connector for 350V DC line
- XK4 = Three-phase connector for motor -MAD1
- XK5 = Connector for the absolute encoder of the motor -MAD1
- XK6 = Connector for the relative encoder of the motor -MAD1
- XK7 = USB connector for data transfer

Connectors for the "Slave 1" module of the control unit -AA

- XK8 = Connector for digital inputs/outputs
- XK9 = Connector for 350V DC line
- XK10 = Three-phase connector for motor -MAD1
- XK11 = Connector for the absolute encoder of the motor -MAD2
- XK12 = Connector for the relative encoder of the motor -MAD2
- XK13 = USB connector for data transfer

Connectors for the "Slave 2" module of the control unit -AA

- XK14 = Connector for digital inputs/outputs
- XK15 = Connector for 350V DC line
- XK16 = Three-phase connector for motor -MAD1
- XK17 = Connector for the absolute encoder of the motor -MAD3
- XK18 = Connector for the relative encoder of the motor -MAD3
- XK19 = USB connector for data transfer

Connectors for the control unit power supply module -AA

- XK20 = Power supply connector

Description of the figures

- Fig. 1 = Connection of the voltage sensor.
- Fig. 2 = Connection of the power supply unit.
- Fig. 3 = Gas pressure monitoring circuit. This includes the contacts for remote signalling of normal, low and insufficient gas pressure.
See the key for the tripping values of the pressure switch -BPS.
- Fig. 4 = Position contacts for the open/closed state of the individual phases.
- Fig. 5 = Control circuit for the drive motors of the individual phases.
- Fig. 6 = List of signals on the connection terminal block.


Incompatibility

No incompatibility.

Notes

- A) The circuit-breaker comes equipped only with the applications specified in the order confirmation. Consult the catalogue of the device for instructions about how to make out the order.
- B) Caution!
Before operating on the auxiliary circuits, disconnect the line voltage and wait for at least 5 minutes in order for the capacitor -CA to discharge completely.

7. Technical specifications

Electrical characteristics		DS1 50	DS1 60
Rated frequency	Hz	50	60
Rated voltage	kV	17.5	15
Rated current	A	630	600
Withstand voltage			
– phase to phase and phase to earth	kV	38 ⁽¹⁾	36 ⁽¹⁾
– across the insulating distance	kV	45	45
Impulse withstand (BIL)			
– phase to phase and phase to earth	kV	95	95
– across the insulating distance	kV	110	110
Short-time current (time)	kA (s)	20 (0.5)	20 (0.5)
Short-time peak current	kAp	52	52
Other characteristics			
Mechanical operations	CO	50.000	
Maximum overall dimensions		H [mm]	655
		W [mm]	618
		D [mm]	575
		P [mm]	210
Weight	kg	130	
Working temperature range	°C	-15 ... +55	
Maximum installation altitude	mslm	4.000	
Rated dry air absolute pressure	MPa	0.470	

⁽¹⁾ Contact ABB for 42 kV version

Contacts

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