Medium voltage products

VD4
Vacuum circuit-breaker on withdrawable part – high duty

Contents

Power and productivity
for a better world™

Your safety first – always!

That's why our instruction manual begins with these recommendations:

- Only install switchgear and/or switchboards in enclosed rooms suitable for electrical equipment.
- Ensure that installation, operation and maintenance are carried out by specialist electricians only.
- Comply in full with the legally recognized standards (DIN VDE/IEC), the connection conditions of the local electrical utility and the applicable safety at work regulations.
- Observe the relevant information in the instruction manual for all actions involving switchgear and switchboards.
-  Danger!

  Pay special attention to the hazard notes in the instruction manual marked with this warning symbol.
- Make sure that under operation condition of the switchgear or switchboard the specified data are not exceeded.
- Keep the instruction manual accessible to all persons concerned with installation, operation and maintenance.
- The user's personnel are to act responsibly in all matters affecting safety at work and the correct handling of the switchgear.
- Always observe the five safety rules set out in EN 50110 on establishing and securing the off-circuit condition at the place of work for the duration of work on the switchgear.

  - Isolate

  - Secure to prevent reconnection

  - Check the off-circuit condition

  - Earth and short-circuit

  - Cover the guard off adjacent live parts

If you have any further questions on this instruction manual, the members of our field organization will be pleased to provide the required information.

1 Summary

1.1 General

The vacuum circuit-breaker of type VD4 on withdrawable part are intended for indoor installation in air-insulated switchgear of withdrawable design. Their switching capacity is sufficient to handle any conditions arising from switching of equipment and systems components under normal operating conditions, particulary short-circuits, within the parameters of their technical data.

Vacuum circuit-breaker have particular advantages for use in networks where there is a high switching frequency in the working current range and/or where a certain number of short-circuit breaking operations are expected. The vacuum circuit-breakers of the type VD4, designed in column form, are suitable for autoreclosing, and have exceptionally high operating reliability and long life.

Together with this instruction manual, it is essential to consult manual BA 359, Vacuum circuit-breaker type VD4, high current.

1.2 Standards and specifications

1.2.1 Switchgear manufacture

The switchgear complies with the following specifications in accordance with DIN VDE/the relevant IEC publications:

- VDE 0670, part 1000/IEC 60694.
- DIN VDE 0670, part 104, and IEC 62271-100
- DIN VDE 0847, part 4, and IEC 61000-4.

1.2.2 Installation and operation

The relevant specifications are to be taken into account during installation and operation, particularly:

- DIN VDE 0101, Power installations exceeding AC 1 kV
- VDE 0105, Operation of electrical installations
- DIN VDE 0141, Earthing systems for special power installations with rated voltages above 1 kV
- Accident prevention regulations issued by the appropriate professional bodies or comparable organisations.

  In Germany, these comprise the following safety regulations:

  – Health and Safety at Work Standards BGV A1 and BGV A2
- Safety guidelines for auxiliary and operating materials
- Order related details provided by ABB Calor Emag.

1.3 Operating conditions

1.3.1 Normal operating conditions

Design to VDE 0670, part 1000, “Common specifications for high-voltage switchgear and controlgear standards” and IEC publication 60694, with the following limit values:

- Ambient temperature:
  - Maximum +40°C
  - Maximum 24 hour average +35°C
  - Minimum (according to “minus 5 indoor class”) -5°C
- Humidity:
  - the average value of the relative humidity, measured over a period of 24 h, does not exceed 95%
  - the average value of the water vapour pressure, over a period of 24 h, does not exceed 2.2 kPa
  - the average value of the relative humidity, over a period of one month, does not exceed 90%
  - the average value of the water vapour pressure, over a period of one month, does not exceed 1.8 kPa
- Maximum site altitude: ≤ 1000 m above sea level.

1.3.2 Special operating conditions

Special operating conditions are to be agreed on by the manufacturer and user. The manufacturer must be consulted in advance about each special operating condition:

- Site altitude over 1000 m:
  - Allow for the reduction in the dielectric strength of the air.
- Increased ambient temperature:
  - Current carrying capacity is reduced.
  - Provide additional ventilation for heat dissipation.
- Climate:
  - Avoid the risk of corrosion or other damage in areas:
    - with high humidity and/or
    - with major rapid temperature fluctuations.
  - Implement preventive measures (e.g. electric heaters) to preclude condensation phenomena.

2 Technical data

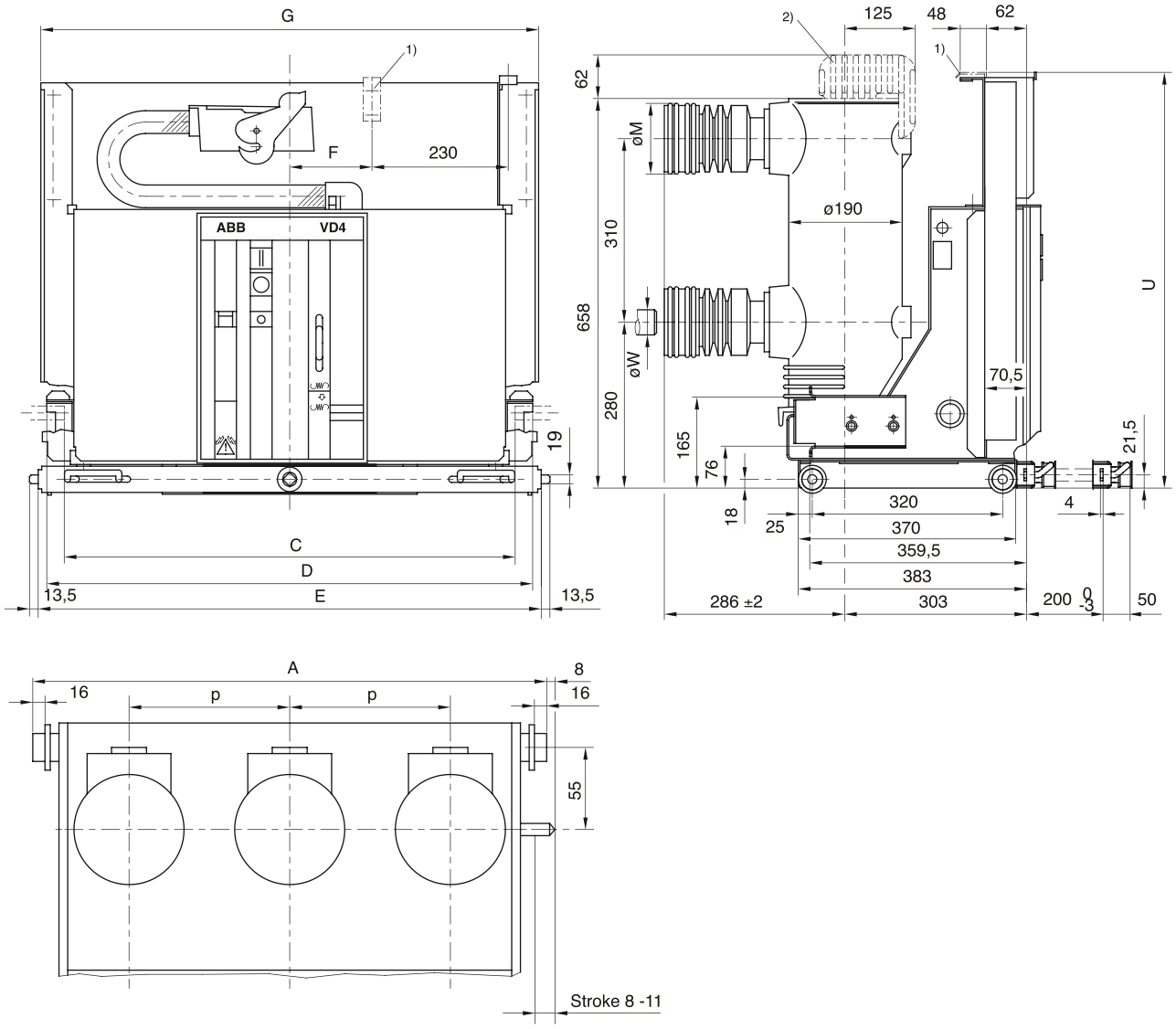
Dimensions and weights

Rated voltage 12 kV					
Panel type	Breakertype	Parameters	Pole centres p [mm]	Weight for hand-operated mechanism [1) 2)] [kg]	Dimension drawings: Number of Figure
UniGear-type ZS1	VD4	1250 A, 50 kA	210	190	2/1
		1600 A, 50 kA	210/275	190/195	2/1
		2000 A, 50 kA	275	195	2/1
		2500 A, 50 kA	275	205	2/1
		3150 A, ...50 kA	275	280	2/1
		4000 A, [3)] ...50 kA	275	280	2/1

Rated voltage 17.5 kV					
Panel type	Breakertype	Parameters	Pole centres p [mm]	Weight for hand-operated mechanism [1)2)] [kg]	Dimension drawings: Number of Figure
UniGear-type ZS1	VD4	1250 A, 40 kA	210	190	2/1
		1600 A, 40 kA	210/275	190/195	2/1
		2000 A, 40 kA	275	195	2/1
		2500 A, 40 kA	275	205	2/1
		3150 A, ...40 kA	275	280	2/1
		4000 A, [3)] ...40 kA	275	280	2/1

[1)] The weight raises about 5 kg for breakers with motor-operated mechanisms
[2)] The weight raises about 2 kg for motor-driven withdrawable parts
[3)] With fan cooling

Together with this instruction manual, it is essential to consult manual BA 359, Vacuum circuit-breaker type VD4, high current.



Dimensions in mm

Panel type	Parameter				p	A	C	D	E	F	G	M	W	U
	12 kV		17.5 kV											
UniGear-	1250 A,	50 kA	1250 A,	40 kA	210	650	618	640	653	44	636	115	79	694
type ZS1	1600 A,	50 kA	1600A,	40 kA	210	650	618	640	653	44	636	115	79	694
					275	850	812	836	853	144	844	115	79	694
	2000 A,	50 kA	2000 A,	40 kA	275	850	812	836	853	144	844	115	79	694
	2500 A,	50 kA	2500 A,	40 kA	275	850	812	836	853	144	844	149	109	694
	3150 A,	…50 kA	3150 A,	…40 kA	275	850	812	836	853	144	844	158	109	735
	4000 A [3],	…50 kA	4000 A [3],	…40 kA	275	850	812	836	853	144	844	158	109	735

[1] *Exists only for withdrawable parts of type A (see section 5.5)*
[2] *Exists only for rated currents above 2500 A*
[3] *with fan cooling*

Figure 2/1: Vacuum circuit-breaker on withdrawable part, type VD4

- *Use in UniGear type ZS1*
- *12 kV, ...2500 A, 50 kA, 12 kV, 3150/4000 A, ...50 kA*
- *17.5 kV, ...2500 A, 40 kA, 17.5 kV, 3150/4000 A, ...40 kA*

3 Circuit-breaker on withdrawable part

3.1 Basic structure

(Figures 3/1 to 3/3 and 4/1 to 4/4)

The withdrawable part, which can be moved manually or by a motor if fitted, consists of a steel sheet structure on which the circuit-breaker with its ancillary components is mounted.

Insulated contact arms (4.2) with the spring-loaded contact systems (4.3) are fitted to the circuit-breaker poles. These create the electrical connection to the panel when the withdrawable part is inserted into the service position.

A multi-pole control wiring plug connector (10) connects the signalling, protection and control wiring between the panel and the withdrawable part.

The withdrawable assembly and the circuit-breaker are connected via a multi-pole control wiring plug connector (10.3).

As soon as the withdrawable part (13) has been slid into the panel and its base frame has engaged in the test/disconnected position, it is positively connected to the panel. At the same time, it is earthed by its travel rollers in their rails. The stored-energy spring mechanism of the circuit-breaker, including its controls and indicators, is accessible at the front of the withdrawable part.

Withdrawable parts of the same version are interchangable. With the same dimensions but different circuit-breaker equipment, coding of the control wiring plug prevents impermissible combinations of withdrawable parts and panels.

Besides the design with mounted circuit-breaker, withdrawable parts can also be supplied with other fittings, e.g. for measurement purposes.

3.2 Interlocks/protection against maloperation

A series of interlocks are provided to prevent dangerous situations and any maloperation. The interlocks of the panel system ZS and/or the mounting frame, which are normally effective, are as follows (concerning the circuit-breaker):

- The withdrawable part can only be moved from the test/disconnected position into the service position (and back) with the circuit-breaker open and the earthing switch open (that means that the breaker must opened before)
- The circuit-breaker can only be closed when the withdrawable part is precisely in the defined test position or service position (mechanical interlock, with additional electrical interlock for circuit-breakers with electrical releases).
- The circuit-breaker can only be opened manually in the service or test position when no control voltage is applied, and cannot be closed (electromechanical interlock).
- Connection and disconnection of the control wiring plug connector (10.2) is only in the test/disconnected position possible.
- The earthing switch can only be closed when the withdrawable part is in the test/disconnected position or the removed position (mechanical interlock).
- The withdrawable part cannot be moved from the test/disconnected position into the service position when the earthing switch is closed (mechanical interlock).
- Details of any additional interlocks, e.g. in connection with a blocking magnet on the withdrawable part and/or earthing switch operating mechanism, can be found in the order documents for each individual case (see also section 5.5.6).
- Details of typical interlocks for the panels can be found in the panel documentation.

3.2.1 VD4 circuit-breaker run-on block

In case of any irregularity in the area of the inner control mechanism and of the charging function of the stored-energy spring mechanism, the run-on block disables the immediately subsequent switching operation.

This is a protective measure to prevent damage to the circuit-breaker

Release of run-on block may only be performed by servicing personnel from ABB or adequately trained specialist stuff.

3.2.2 Basic equipment

Hand-operated breaker		Motor-operated breaker	
1st shunt release OFF	-Y2	Shunt releases ON, OFF	-Y3, -Y2
5 pole auxiliary switches	-S3, -S4	5 pole auxiliary switches	-S1, -S3, -S4
Auxiliary switch for fault annunciation	-S7	Charging motor	-M0
Blocking magnet	-Y1	Anti-pump relais	-K0
Auxiliary switches	-S2, -S6	Auxiliary switch for fault annunciation	-S7
		Blocking magnet	-Y1
		Auxiliary switches	-S2, -S6

3.2.3 Mounting of the VD4 on trucks from other manufacturers

VD4 circuit-breakers which are not installed on ABB Calor Emag withdrawable parts must be fitted with one or two additional auxiliary switches which are dependent on the mechanical lock and release device. These must interrupt the circuit of shunt release ON -Y3.

Similarly to auxiliary switches -S8 and -S9 in ABB Calor Emag withdrawable parts, no electrical pulse may arrive during and before mechanical blocking of the spindle mechanism, and may only be applied again after the end of mechanical blocking.

This ensures that the shunt release ON cannot be loaded with an electrical ON pulse when the withdrawable part is in an intermediate position, which could burn out the coil.

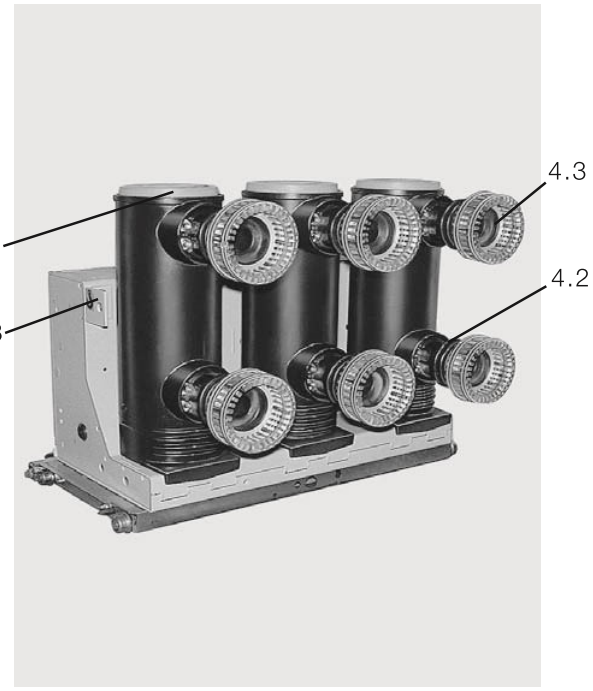


Figure 3/1: Pole side of a withdrawable part with high-voltage circuit-breaker, type VD4

13.9 Protective transport cover (remove before commissioning)
13.13 Lifting lug (remove before commissioning
4.2 Contact arm
4.3 Contact system

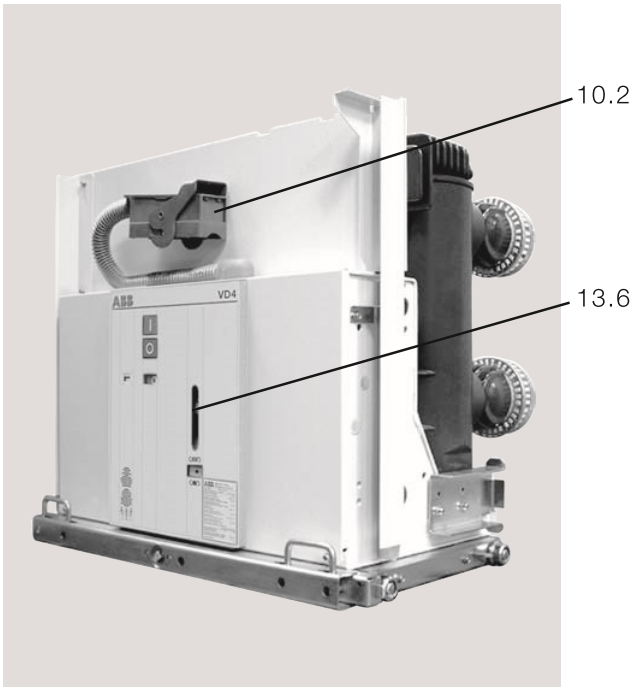


Figure 3/2: Withdrawable part with circuit-breaker, type VD4, mechanism side

10.2 Control wiring plug
13.6 Socket for charging lever (9)

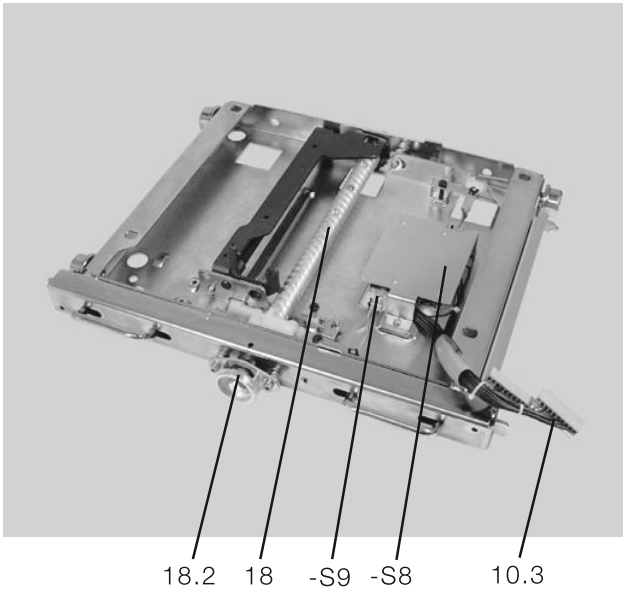


Figure 3/3: Withdrawable assembly with built-in auxiliary switch (type B, see section 5.5)

-S8 Test position indicator
-S9 Service position indicator
18 Spindle
18.2 Scene head on spindle
10.3 Control wiring connector plug for withdrawable assembly

4 Operation of the switchgear

Note on safety at work

- The switchgear may only be operated by specially trained personnel who are familiar with the characteristics of the particular device.
- Observe the relevant instructions in section 1.2.
- Due to safety reasons, the circuit-breaker has to be treated as “switched on” if the switching position can not be clearly determinated.
  In this case all high voltage connections to the breaker have to be de-energized and zero potential on the primary side of the breaker has to be confirmed prior to commissioning, operation, maintenance or repair work.

4.1 **Commissioning**

4.1.1 Preparatory work

(Figures 3/1 and 3/3)

In preparation for commissioning, the following work should be carried out prior to connection with the high-voltage power supply:

- Check the general condition of the switchgear for detrimental circumstances of all kinds.
- Perform a visual examination of the switching devices, withdrawable parts, isolating contacts, insulating parts, etc.
- Check the connection of the main earthing bar with the station earthing conductor (DIN VDE 0141).
- Check the paintwork for damage and touch up as described in section 5.4 where necessary.
- Remove all material residues, foreign bodies and tools from the switchgear.
- Clean the switchgear, rubbing down insulating parts with a clean, soft, non-fraying and dry cloth. Remove greasy or adhesive dirt as described in section 5.3.
- Properly refit all covers, etc., removed during assembly and testing processes.
- Transport caps (13.9) on the poles of vacuum circuit-breakers, where fitted, must be removed.
- Lifting lugs (13.13) for high current circuit-breakers, if still fitted, must be removed.
- Perform AC voltage testing on the main circuits to VDE 0670, Part 6 (IEC 60298) as far as necessary. Pay special attention during this procedure to voltage transformers and cables etc.
- Turn the auxiliary and control voltage on.
- Carry out test operations of switching devices manually or by electrical control, and simultaneously observe the relevant position indicators.
- Check mechanical and electrical interlocks for effectiveness, without using force.
- Set the protective devices in the panel to the required values, and check their functioning with test equipment.
- On motor-driven withdrawable parts, check the direction of rotation of the travel motors as described in section 5.5.5.
- For any further questions on the functions of the withdrawable circuit-breaker part and its testing, see section 5.5.
- Instruct the local operators in the fundamental details of regular handling of the switchgear.
- Check on the operational readiness and switching status of upstream and downstream electrical installations.

From areas bordering on the switchgear, in accordance with responsibilities, check on the following where applicable:

- Power cables
- Auxiliary cables
- Supply voltage source
- Remote control
- Entire earthing installation, according to DIN VDE 0141
- Switchroom equipment
- Switchroom condition

4.1.2 Start-up

- Comply with all relevant safety regulations.
- Ensure that the circuit-breakers and switch disconnectors in the switchgear are in the OFF position.
- Remove any existing earthing and short-circuiting connections in the critical switching area.
- Energize the feed cables.
- Connect the switchgear, step-by-step, observing the signals and indicators.
- Check that the relevant conductors are in phase, as far as necessary when several incoming feeder cables and switchgear sections are concerned.
- Carry out all measurements and check all functions dependent on the high voltage power supply being connected.
- Watch out for irregularities of any kind.

4.2 **Switching operations**

Perform switching operations with the front doors shut.

4.2.1 Withdrawable circuit-breaker part

(Figures 3/1, 3/4, 4/1 to 4/4)

Manual insertion from the test/disconnected position to the service position:

- Connect control wiring plug (10.2).
- Close the front door.
- Ensure that the circuit-breaker is in the OFF position.
- Fit the crank (121) on square spigot (18.1) of the spindle mechanism (18).

Note:

In order to avoid damage to the operating mechanism, use the original hand crank only.

- Standard version without slip clutch
- Optional version with slip clutch
- Move the withdrawable breaker part (13) into the service position with 20 clockwise turns of the crank (for Unigear type ZS1 panels).

  Note:

  Do not force to move the withdrawable breaker part (max. torque 25 Nm)!

  Comply with the conditions for movement of the withdrawable part as set out in section 5.5.6!
- Observe the position indicator.
- Remove hand crank (121) by pressing first against the hand crank and then remove.

  When removing the crank, it is essential to ensure that the spring-loaded scene head 18.2 slides into the untensioned front position. Spindle 18 is thus locked in place, preventing inadvertent turning of the spindle. Turning of the spindle opens auxiliary switches -S8/-S9 and thus prevents the circuit-breaker from being operated.

Note:

The withdrawable part must not be stopped at any position in the travel range between the service position and test/disconnected position!

Manual withdrawal from the service position into the test/disconnected position:

- Ensure that the circuit-breaker is in the OFF position.
- Reverse the procedure described above for insertion into the service position.

Note:

Withdrawable parts with blocking magnet -Y0 may not be forcibly moved during power failures. In such a case they are blocked in the service and test positions. For deblocking, see section 5.5.5.

Motor-driven movement of the withdrawable part:

- Briefly operate the electrical control for insertion or withdrawal (the withdrawable part then automatically moves into the opposite position).
- Observe the position indicator.

Note:

When the motor fails, the withdrawable part can be moved in emergency manual operation. If the drive motor fails during movement of the withdrawable part, the withdrawable part must be moved into a limit position in emergency manual operation.

Emergency manual operation is carried out with the hand crank (121) on the spindle mechanism (18), in a similar manner to operation of a withdrawable breaker part with manual systems:

- Turn off the supply voltage (m.c.b.), since the motor would otherwise be braked electrically.
- Turn hand crank (121) in the required direction.

When the withdrawable part moves, the motor turns. The motor functions in such a case like a generator, i.e. it can lead to reverse voltages in the terminals.

The motor protection device must not be changed from the specified type and rated value, or the behaviour of the permanent magnet motor could be irreversibly impaired

Caution:

On emergency manual operation of a motor-operated withdrawable breaker part:

- When a motor-operated earthing switch is fitted, the mechanical interlock with the earthing switch may not be available unless specially ordered.
- When a manual earthing switch is fitted, the mechanical interlock is always effective.

Withdrawal from the test/disconnected position onto the service truck:

- Open the door of the circuit-breaker compartment.
- Release control wiring plug (10.2) and engage it in the storage position on the withdrawable part.
- Position service truck (124) with the guide pins (124.2) of the adjustable bench top at the correct height facing the panel front, and allow catch (124.3) to engage.
- Move sliding handles (13.11) inwards against the springs to release withdrawable part (13), withdraw onto the service truck and secure it in the catches on the truck.
- Press the release lever (at the front underneath the bench top) and release the service truck from the panel.

Insertion from the service truck into the test/disconnected position:

- Carry out the procedure as described above for withdrawal, changing the order accordingly.

4.2.2 Circuit-breaker

(Figures 3/2 and 4/1)

Charging the stored-energy spring system

- On breakers with charging motors, charging is carried out automatically. If the charging motor should fail, the charging procedure can be carried out or completed by hand.
- On breakers with manual charging systems, door opened and withdrawable part in disconnected position, insert the charging lever (128) into the socket (13.6) and pump for approx. 25 strokes until the charged condition is indicated. When the charging condition is reached, the charging mechanism is automatically disengaged, and any further strokes of the lever have no effect.

Meaning of the charging condition symbols:

Discharged

Charged

Opening and closing the circuit-breaker:

- With the withdrawable part in the service position, on and off switching operations should only be carried out with the doors closed.
- Operate the local or remote electrical control.
- Observe the switch position indicator. The switching operation counter (13.5) for the circuit-breaker is automatically incremented by one unit with each operating cycle.

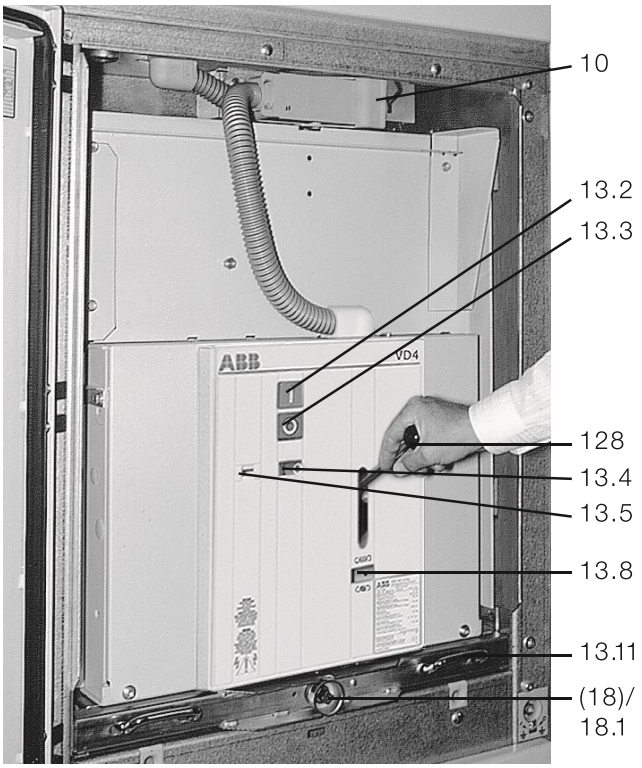


Figure 4/1: Manual operation and mechanical indicators of a withdrawable breaker part, withdrawable circuit-breaker part in test/disconnected position

10	*Control wiring plug connection*
13.2	*Mechanical ON push-button*
13.3	*Mechanical OFF push-button*
13.4	*Mechanical switch position indicator*
13.5	*Mechanical operating cycle counter*
13.8	*Charging condition indicator*
13.11	*Sliding handle, connected to the catch in the withdrawable part base frame*
(18)	*Spindle mechanism*
121	*Square spigot*
128	*Charging lever*

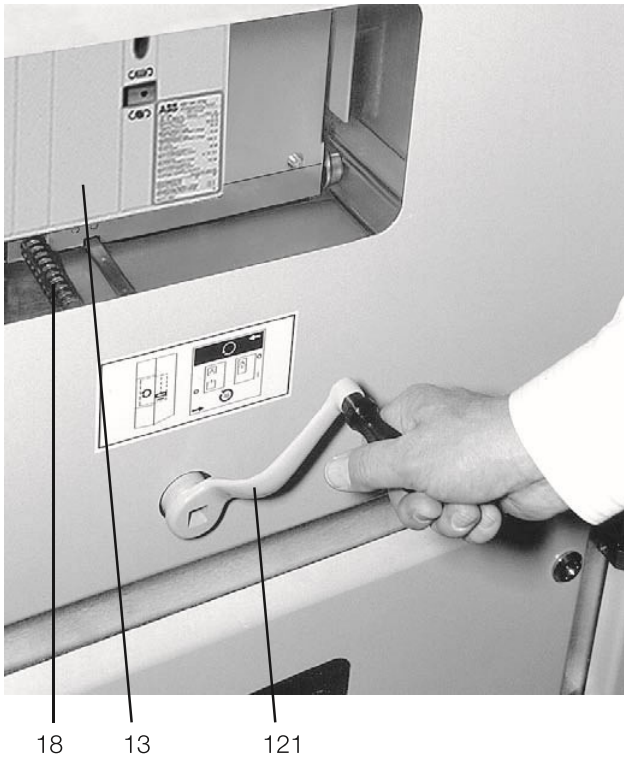


Figure 4/2: Movement of the withdrawable breaker part between the test/disconnected position and the service position, clockwise up to the stop for the service position and anti-clockwise for the test/disconnected position

13 Withdrawable circuit-breaker part
18 Spindle mechanism
121 Hand crank

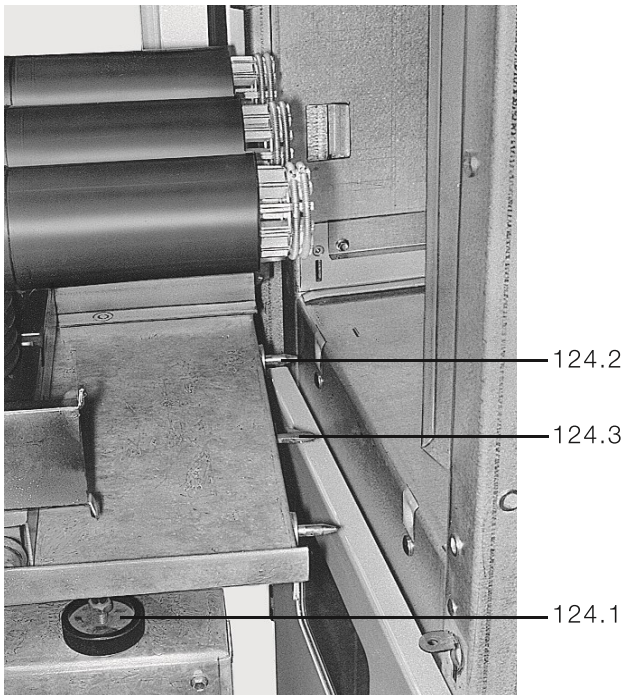


Figure 4/3: Approaching the panel and positioning the service truck with the guide pins of the adjustable height bench top at the correct height for the catch to engage

124.1 Height adjuster
124.2 Guide pin
124.3 Catch

Figure 4/4: Service truck engaged with the panel. Withdrawable circuit-breaker part released for removal by moving the sliding handles inwards

13 Withdrawable circuit-breaker part
13.11 Sliding handle
124 Service truck (not included in supply)

5 Maintenance

5.1 General

Maintenance serves to preserve trouble-free operation and achieve the longest possible working life of the switchgear. In accordance with DIN 31051 and/or IEC 61208, it comprises the following closely related activities:

Inspection: Determination of the actual condition.

Servicing: Measures to preserve the specified condition.

Repairs: Measures to restore the specified condition.

Vacuum circuit-breakers are characterized by their simple and robust construction. They have a long life expectancy. Their operating mechanisms have a low maintenance requirement, and the interrupters are maintenance-free during their working life. There is no adverse effect on the vacuum, even from frequent switching of operating and short-circuit currents.

The servicing intervals and scope are determined by environmental influences, the switching sequences and number of short-circuit breaking operations.

Note:

The following must be observed for all maintenance work:

- The relevant specifications in section 1.2.2
- Notes on safety at work in section 4.1
- Standards and specifications in the country of installation.

Maintenance work may only be performed by fully trained personnel, observing all the relevant safety regulations. It is recommended that ABB after-sales service personnel should be called in, at least during the performance of servicing and repair work.

While the work is in progress, all supply voltage sources must also be disconnected and secured to prevent reconnection.

Note:

In order to prevent accidents (particularly injury to hands!) extreme care should be taken during all repair work on the operating mechanism, especially with front plate removed.

The spiral spring in the spring energy storage mechanism, for instance, retains a basic tension which is independent of the charging and discharging processes during switching, so as to ensure correct function. This spring energy can be inadvertently released if work is performed incorrectly on the spring mechanism!

Together with this instruction manual, it is essential to consult manual BA 359, Vacuum circuit-breaker type VD4, high current.

The service life data fundamentally apply to all components which are not directly influenced by the operator.

Components operated manually (movement of the withdrawable part, etc.) may deviate, depending on how they are handled.

If necessary, further details can be taken from the technical documentation for the switchgear (including, for example, any agreed special operating conditions).

5.2 Inspection and functional testing

5.2.1 General

- The proper condition of the switching device is to be verified by regular inspection.
- The checks are to be performed in accordance with BGV A2 standards.
- Inspection at fixed intervals may be waived if the switchgear is permanently monitored by a qualified personnel.
- The checks first and foremost comprise visual examination for contamination, corrosion, moisture and discharge phenomena.
- In unusual operating conditions (including adverse climatic conditions) and/or special environmental pollutions (e.g. heavy contamination and aggressive atmosphere), inspection may also be necessary at shorter intervals.
- Visual checking of the isolating contact system. We recommend to turn alternately the contact system in order to clean the inner contact points of the contact system.

  The contact points should be cleaned if signs of unperminable overheating (discoloured surface) are visible (see section Repairs)
- If irregular conditions are detected, then corresponding repair measures should be initiated.

For details of inspection and functional testing, see the relevant sections of manual BA 359.

5.2.2 Withdrawable assembly

- The inspection should always include a visual examination of the withdrawable part assembly. Special attention is to be paid to those parts which may possibly be damaged by improper handling. (See section “Inspection/Circuit-breaker in general“.)
- Visual checking of the isolating contact system. We recommend turning the contact system alternately in order to clean the inner contact points.

  The contact points should be cleaned if signs of impermissible overheating (discoloured surface) are visible (see section “Repairs“).
- The interlock conditions and the ease of movement of the lock and release device are to be checked as described under “Repairs“.

  When checking the interlock conditions, it is essential to ensure that no force is used.

  Maximum torque 25 Nm!

5.3 Servicing

Cleaning surfaces:

If, on the occasion of an inspection in accordance with (5.2), the necessity of cleaning measures has been established, proceed as follows:

- Before cleaning, where required, the working area must be switched off and secured against reconnection in accordance with the „Safety Regulations“ specified by DIN VDE/IEC.
- Cleaning the surfaces in general:
  - Poorly adhering dry dust residues with a soft dry cloth.
  - More strongly adhering grime with mildly alkaline household cleaner or with Rivolta BWR 210.
- Cleaning insulating surfaces and conductive components:
  - Minor grime with Rivolta BWR 210.
  - Strongly adhering grime with cold cleanser 716.
- Observe the manufacturers’ directions and in particular ABB operating instructions BA 1002/E and BA 1006/E on safety at work.
- After cleaning, rinse with clean water and dry carefully.
- Should external discharges occur as a result of condensation, application of a thin silicone film on the surface concerned is often effective as a temporary remedy. It is advisable to request advice from the ABB after-sales service department on permanent solutions to such unusual problems.

For details of servicing, see also the relevant sections of manual BA 359.

5.4 Repairs

5.4.1 Switchgear in general

Repair of surface damage:

- Sheet steel parts, painted:
  - Remove rust, e.g. with a wire brush.
  - Grind off paint coat and degrease.
  - Apply anti-rust primer and top coat.
  - Use top coat paint in the standard colour RAL 7035.
- Sheet steel parts, with zinc surface and passivated functional parts:
  - Remove white rust with a wire brush or cleaning pad (e.g. Scotch-Brite white).
  - Remove loosely adhering particles with a dry cloth.
  - Apply zinc spray or zinc dust primer.
- Functional parts, phosphated:
  - Remove rust with a wire brush or cleaning pad (e.g. Scotch-Brite white).
  - Clean with a dry cloth.
  - Grease with Isoflex Topas NB 52.

Switchgear in general:

- Observe the maintenance instructions in the manuals for the individual equipment components.
- Check that the bolt connections at the contact points in the busbar system and the earth connections are tight, and that the isolating contact system functions correctly.
- Regrease the contact points and mechanism of the withdrawable part insertion system as necessary, or, when lubrication is inadequate or missing, thoroughly clean the areas concerned and regrease with Isoflex Topas NB 52 lubricant.
- Where required, regrease or thoroughly clean slide plates and bearings in the panel and regrease them with Isoflex NB 52 lubricant.

  Remove the contact system for thoroughly cleaning as described below (Figure 5/1):
  - Slide the two inner annular tension springs (4.4) facing the breaker pole to a position beside the other two outer annual tension springs, thus releasing contact system (4.3), and remove the contact system from contact arm.
  - Fit a new contact system back to front on the thin end of arbor (127), and slide it forwards onto the thicker part of the shank.
  - Fit arbor (127) onto the relevant contact arm, slide the contact system (4.3) over onto the contact arm, and withdraw the arbor.
  - Check all contact fingers and annular tension springs for perfect fit.

  Note:

  The set installation position of contact arms must not be changed by the improper use of force.

5.4.2 Replacement of components

1. Withdrawable assembly:

(Figures 5/2 to 5/6)

- Disconnect plug connector (10.3) (only for withdrawable assembly of type B)
- Remove interlock rod (13.91) with pin (13.27) from the withdrawable assembly
- For motorized withdrawable assemblies, remove the two socket head bolts which are accessible from below the assembly
- Unbolt the circuit-breaker from the withdrawable assembly (4 x M12 bolts)
- Mount the circuit-breaker on a new withdrawable assembly in the reverse order, using new circlip and special pliers for pin (13.27)
- Check the setting of interlocking rod (13.91):
  - Turn spindlel (18) anti-clockwise to the stop for the disconnected position:

    The distance between lever (13.26) and cam (13.25) must be 2^{+1} mm.

    The distance between roller (13.24) and blokking bracket (13.92) must be 0.2-0.5 mm.
  - Turn spindle (18) clockwise to the stop for the service position:

    The distance between lever (13.26) and cam (13.25) must be 2^{+1} mm.

    The distance between roller (13.24) and blocking bracket (13.92) must be 0.2-0.5 mm.
  - Loosen bolts (13.91.2 or 13.92.1) for any necessary adjustment.

For further details on repairs, see also the relevant sections of manual BA 359.

5.5 Testing withdrawable parts with a VD4 type circuit-breaker

When functional tests are carried out on withdrawable parts, compliance with the conditions listed below should also be checked. In this context, a distinction should be made between two types of the devices for the VD4 withdrawable part:

- Type A: Withdrawable assembly without integrated auxiliary switches (manual operation only).
- Type B: Withdrawable assembly with integrated auxiliary switches (manual or motorized operation).

5.5.1 Motor-driven withdrawable parts

(non-standard)

Carry out testing of motor-driven withdrawable parts in the same way as for manually operated withdrawable part:

- Turn off the supply voltage (m.c.b.), since the motor could otherwise be braked electrically.
- Turn hand crank (121) in the required direction.

Note:

When the withdrawable part moves, the motor turns. The motor functions in such a case like a generator, i.e. it can lead to reverse voltages in the terminals.

5.5.2 Checking the correctness of dimensional settings

(Figures 5/2 to 5/6)

1. The distance between lever (13.26) operated by link rod (13.91) and plastic cam (13.25) should be 2^{+1} mm. If adjustment is required, release the two bolts (13.91.1) and (13.91.2). Deviations from the specified value can have the following effects:
   - Dimensions too large, blocking system for the drive spindle deactivated.
   - Dimensions too small, proper action of the electrical interlock no longer guaranteed.
2. The distance between roller (13.24) and angle lever (13.92) should be 0.2-0.5 mm when the circuit-breaker is closed.

   If adjustment is required, release the two bolts (13.91.2) and (13.92.1)

5.5.3 Checking auxiliary switch settings on type A withdrawable parts

(Figure 5/2)

Compliance with the interlock conditions in the areas of the test/disconnected position and the service position is ensured by auxiliary switch -S6, located in the breaker housing and factory-set.

In test operations, the withdrawable part must be moved by hand with the crank fitted.

1. Settings in the area of the test/disconnected position
   - Move the withdrawable part out of the test/disconnected position towards the service position with a few turns of the crank.
   - Slowly move the withdrawable part back to the stop.

     Auxiliary switch -S6 must then operate when the hand crank has a remaining angle of $\geq 60^{o}$ of turn to reach the stop.
   - Slowly insert the withdrawable part from the test/disconnected position towards the service position until auxiliary switch -S6 just operates.

     In this position, it must still just be possible to move closing push rod (13.2.1). For this test, the function of the blocking magnet -Y0 must be deactivated manually.

     This condition ensures that the electrical interlock takes effect before the mechanical interlock in the motion sequence involved.

2. Settings in the area of the service position

   - Move the withdrawable part out of the limit position towards the test/disconnected position with a few turns of the crank.
   - Slowly move the withdrawable part forwards again to the stop:

     Auxiliary switch -S6 must then operate when the hand crank has a remaining angle of ≥ 60° of turn to reach the stop.

5.5.4 Checking auxiliary switch settings on type B withdrawable parts

(Figures 3/3 and 5/2)

Compliance with the interlock conditions in the test/disconnected and service position areas is ensured by position signalling switches -S8 and -S9 located in the withdrawable assembly and factory-set.

In test operations, the withdrawable part must be moved by hand with the crank fitted with the motor power switched off.

1. Settings in the area of the test/disconnected position

   - Move the withdrawable part out of the test/disconnected position towards the service position with a few turns of the crank.
   - Slowly move the withdrawable part back to the stop.

     Auxiliary switch -S8 must then switch over just before the stop is reached.
   - Slowly insert the withdrawable part from the test/disconnected position towards the service position until auxiliary switch -S8 just operates.

     In this position, it must still just be possible to move closing push rod (13.2.1). For this test, the function of the blocking magnet -Y0 must be deactivated manually.

     This condition ensures that the electrical interlock takes effect before the mechanical interlock in the motion sequence involved.

2. Settings in the area of the service position

   - Move the withdrawable part out of the limit position towards the test/disconnected position with a few turns of the crank.
   - Slowly move the withdrawable part forwards again to the stop:

     Auxiliary switch -S9 must then switch over just before the stop is reached.

5.5.5 Checking the direction of rotation of the travel motors on motor-driven withdrawable parts

- Move the withdrawable part by hand into a central position between the test/disconnected position and the service position.
- Remove the hand crank.
- Switch the supply voltage for the travel motor on.
- Use the local electrical controls to check that the withdrawable part moves in the correct direction.

Caution:

Do not allow the withdrawable part to run up against a block when the travel direction is incorrect! Switch the motor power off immediately (the travel process functions electrically by a seal-in system with limit position switch-off).

There may be a danger of injury when the door is open!

5.5.6 Testing of interlock conditions

(Figures 4/1 and 4/2)

The testing procedures for type A and type B withdrawable parts are identical.

1. The withdrawable part must only be movable from the test/disconnected position into the service position when the circuit-breaker is open and the earthing switch is open.

   Check the following conditions individually:

   - With the circuit-breaker closed, insertion of the withdrawable part towards the service position must be blocked after only half a turn of the crank in the clockwise direction, and the travel motor on motor-operated withdrawable parts must not be capable of being switched on.
   - With the earthing switch closed, insertion of the withdrawable part towards the service position must be blocked after only two clockwise turns of the crank, and the travel motor on motor-operated parts must not be capable of being switched on.

     Do not use force
     (max. torque 25 Nm)!

2. The withdrawable part must only be movable from the service position into the test/disconnected position with the circuit-breaker open.

   Check this condition as follows:

   - With the circuit-breaker closed, withdrawal movement of the withdrawable part must be blocked after only half a turn of the crank in the anti-clockwise direction, and the travel motor on motor-operated withdrawable parts must not be capable of being switched on.

3. Closing of the circuit-breaker must only be possible when the withdrawable part is in the defined test/disconnected position or service position.

   The control wiring plug (10.2) must previously have been inserted.

   Check this condition as follows:

   - It must not be possible to close the circuit-breaker with the withdrawable part in any position between the test/disconnected position and the service position.

- Enabling of switching when the withdrawable part moves into the service position is effected electrically by operation of auxiliary switch -S6 in the breaker housing (for type A), or of auxiliary switch -S9 in the withdrawable assembly (for type B), and mechanically slightly earlier; the latter corresponds to a position approximately half a turn of the crank before stop.
- For motion into the test/disconnected position, the same enabling conditions apply analogously, in this case by means of auxiliary switch -S6 in the breaker housing(for type A) or the auxiliary switch -S8 in the withdrawable assembly (for type B).

4. It must only be possible to open the circuit-breaker (manually) when the withdrawable part is in the service position or test/disconnected position and the control voltage has failed.

   Check this condition.

5. Withdrawable parts with order-related blocking magnet -Y0 may not be moved in case of control power failure, or when there is no control power. Do not forcibly move blocked withdrawable parts! The blocking magnet -Y0 is only present on manually operated withdrawable parts.

   Releasing the blocking magnet -Y0.

   - Remove front plate (1.1),
   - Disengage blocking magnet -Y0 by pulling the magnet armature,
   - While doing so, turn crank (121) about one half turn (either direction of rotation is permissible).

     The blocking magnet is only active in the test position and service position. In intermediate positions it has no effect.

6. Disconnection of the control wiring plug (10.2) as well as later insertion must be blocked in the withdrawable part's service position.

   Check this condition.

5.6 Spare parts, auxiliary materials, lubricants

5.6.1 Spare parts

When parts are required, the serial number of the relevant withdrawable breaker part or circuit-breaker should always be quoted. Setting instructions are to be requested separately.

Circuit-breaker VD4

- Shunt release, auxiliary switch:
  For notes on settings see drawing
  GCE 717 96 11
- Charging motor with gearbox:
  No special notes required
  (table 1)

Withdrawable assembly of VD4

- Manually moveable withdrawable assembly :
  - type A:
    For notes on settings see drawing
    GCE 7003570, sheet 1 and 2
  - type B:
    For notes on settings see drawing
    GCE 7003570, sheet 1 and 2.
- Motor-driven withdrawable parts:
  For notes on settings see drawing
  GCE 7003571
- Blocking magnet -Y0:
  For notes on settings see drawing
  GCE 7003820, sheet 1.
  (table 2)

Table 1: VD4 circuit-breaker

Designation	Item no.	Rated supply voltage	Part-no. (order code)
• Auxiliary switches	-S1		GCE7002397R0122
(with clamp type terminals)	-S3		GCE7002397R0121
	-S4		GCE7002397R0122
	-S5		GCE7002397R01..[1]
• Auxiliary switch on blocking magnet	-S2		GCE7003022P0101
• Auxiliary switch for fault annunciation	-S7		GCE0905121P0100
• 1st schunt release OFF	-Y2		GCE7004590P01..[2]
• 2nd shunt release OFF	-Y9		GCE7004590R01..[2]
• Shunt release ON	-Y3		GCE7004590P01..[2]
• Blocking magnet	-Y1		GCE9478103P01..[2]
• Undervoltage release with spring mechanism	-Y4		GCE9371466R01..[2]
• Delayed undervoltage release with spring mechanism	-Y4		GCE9371466R01..[2]
• Indirect overcurrent release with intermediate current transformer and spring mechanism	-Y7		GCE9371466R0112
• Intermediate current transformer for indirect overcurrent release			GCE9476148R0100
• Magnet holder, complete (with integrated rectifiers -V1, -V2, -V3, -V9)			GCE7000880R0111
• Series rectifier	-V4/-V7		GCE7004046R0101
Charging motor	-M0	DC 24 V	GCE0940084P0101
(with gearbox)		DC 48 V	GCE0940084P0103
		DC 60 V	GCE0940084P0104
		DC/AC 110 V	GCE0940084P0105
		DC 125 V	GCE0940084P0105
		DC/AC 220 and 240 V	GCE0940084P0106
• Push-on sleeve 4.8-2.5 for push-on blade 0.8 thick (for additional connections)			DIN 46247 Page 2

[1] Quote contact arrangement
[2] State the type of release and voltage

Table 2: VD4 withdrawable assembly

Designation	Item no.	Rated supply voltage	Part-no. (order code)
Auxiliary switch for manually operated mechanism (type A)	-S6		GCE7004023R0101
Auxiliary switch for manually operated mechanism (type B)	-S8/-S9		
• contacts silver plated			GCE7004024R0101
• contacts gold plated			GCE7004024R0103
Auxiliary switches for motor-operated driving mechanism	-S8/-S9		
• contacts silver plated			GCE7004024R0102
• contacts gold plated			GCE7004024R0104
Blocking magnet	-Y0	24 V	GCE7003820R0101
		30 V	R0102
		48 V	R0103
		60 V	R0104
		110 V	R0105
		125 V	R0107
		220 V	R0106
Motor with gearbox	-M1	24 V	GCE0940150P0111
		30 V	P0112
		48 V	P0113
		60 V	P0114
		110 V	P0115
		220 V	P0116

5.6.2 Auxiliary materials and lubricants

	Part-no. (order ref.)
Lubricant:	
• Isoflex Topas NB 52	GCE0007249P0100
Halogen-free cleansers:	
• Rivolta BWR210	GCE0007707P0100
(for general cleaning)	
Corresponding ABB operating instructions BA 1002 E	GCEA901002P0101
• Cold cleanser 716	GCE0007706P0100
(for use with conductive components, components of insulating materials and in case of serious grime!)	
Corresponding ABB operating instructions BA 1006 E	GCEA901006P0101
Touch-up paint:	
STandard colour RAL 7035	
• 1 kg-box	GCE9014060R0103
• Spray tin	GCE0007895P0100

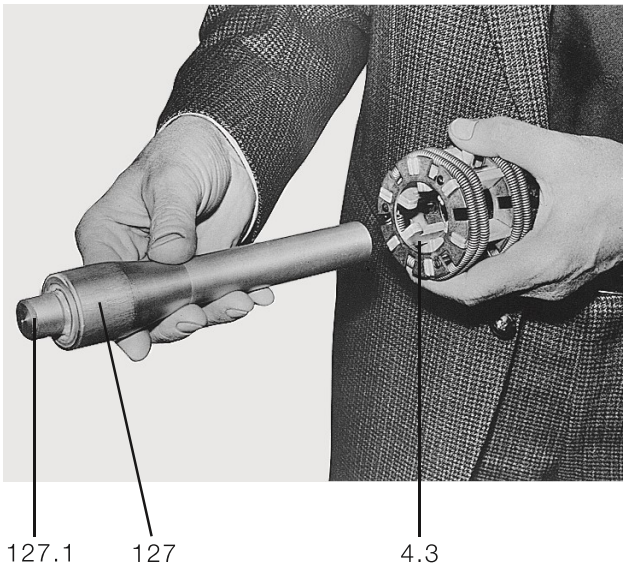


Figure 5/1: Fit the contact system back-to-front on the thin end of the arbor and slide it onto the thicker shank area

4.3 Contact system
127 Arbor
127.1 Journal

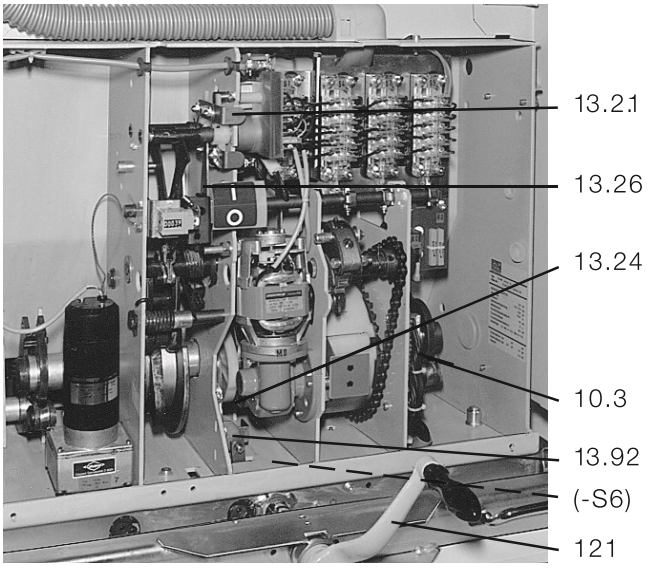


Figure 5/2: Motor-driven withdrawable part in an intermediate position close to the test/disconnected position, with fitted crank for manual operation and breaker front plate removed

10.3 Control wiring plug connector for withdrawable assembly
13.2.1 ON push rod
13.24 Roller
13.26 Lever
13.92 Angle lever
(-S6) Auxiliary switch (only with type A withdrawable part)
121 Hand crank

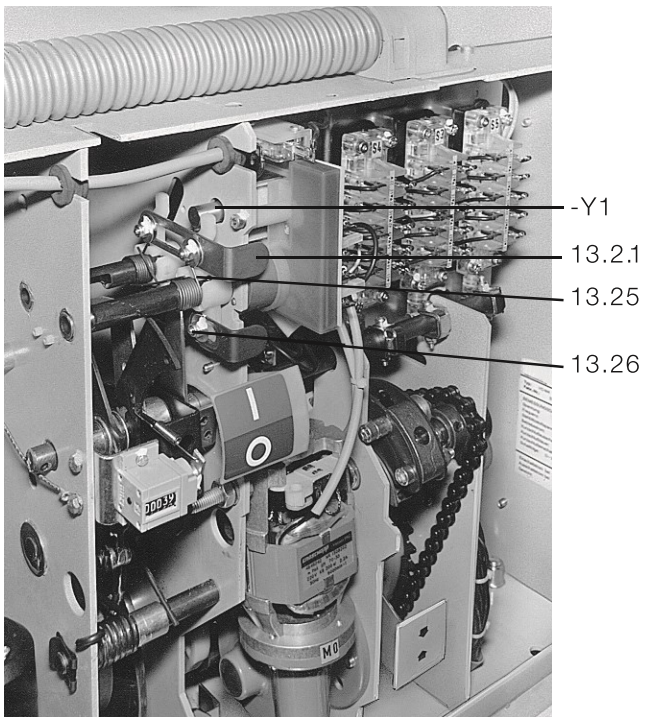


Figure 5/3: Detailed view of the opening and closing mechanism

13.2.1 ON push rod
13.25 Plastic cam
13.26 Lever
-Y1 Blocking magnet

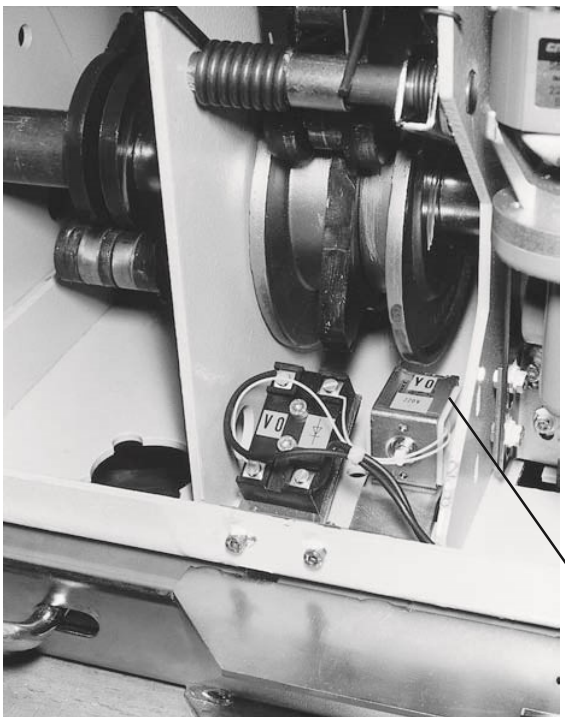


Figure 5/4: Manually moveable withdrawable part, front plate removed

-Y0 Blocking magnet for withdrawable part

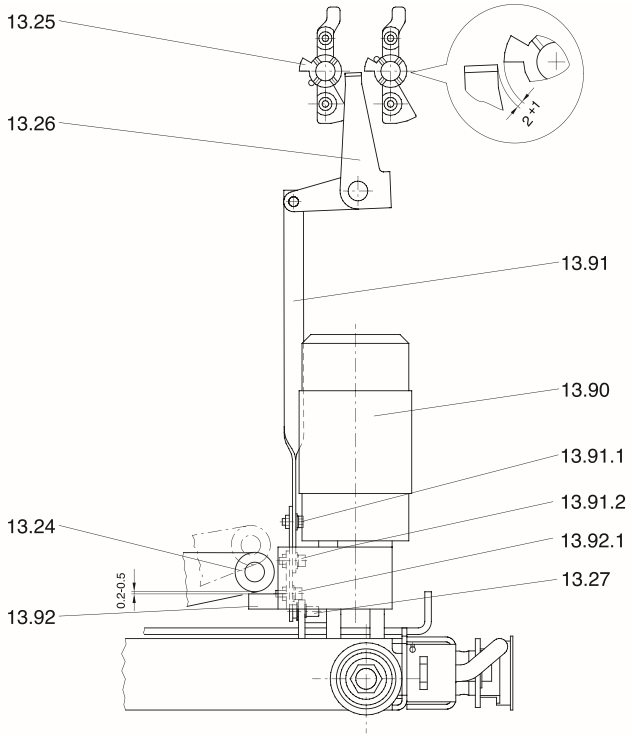


Figure 5/5: Detail in the area of a withdrawable part with travel motor, viewed from the left-hand side

13.24 Roller
13.25 Cam
13.26 Lever
13.27 Pin
13.90 Travel motor
13.91 Link rod
13.91.1 Bolt
13.91.2 Bolt
13.92 Angle lever
13.92.1 Bolt

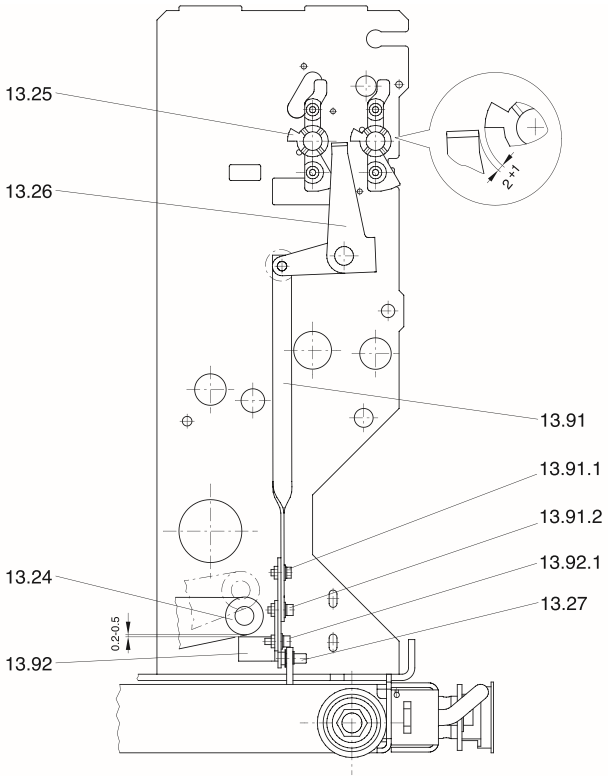
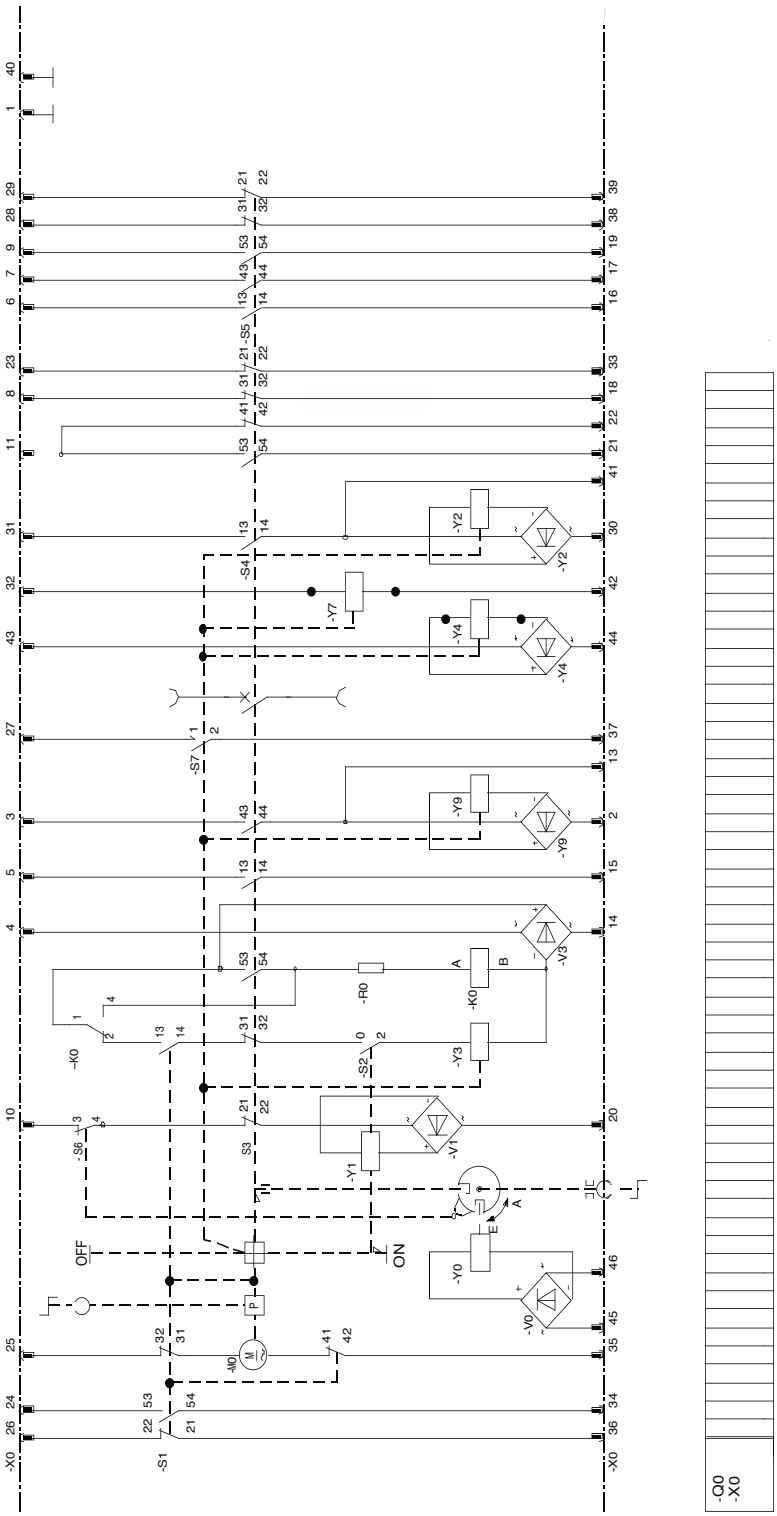


Figure 5/6: Mechanical interlock, withdrawable assembly/circuit-breaker with manually operated withdrawable parts

13.24 Roller
13.25 Cam
13.26 Lever
13.27 Pin
13.91 Link rod
13.91.1 Bolt
13.91.2 Bolt
13.92 Angle lever
13.92.1 Bolt

5.7 **Wiring diagrams for C.B. on withdrawable part**

Note:
The wiring diagrams comprise the basic components and all further equipment options for the various VD4 types. The scope of equipment possible within an individual type series is listed in the relevant switchgear list, and the euquipment fitted in each individual case can be found in the order documentation.



-Y0 Block Magnet on truck with rectifier -V0
-Y1 Closing block magnet with rectifier -V1
-Y2 1. Shunt release OFF with rectifier -V2
-Y3 Closing release with rectifier -V3
-Y4 Undervoltage release U< with rectifier -V4
-Y7 Indirect overcurrent release
-Y9 2. Shunt release OFF with rectifier -V9
-M0 Charging motor
-K0 Antipumping relay

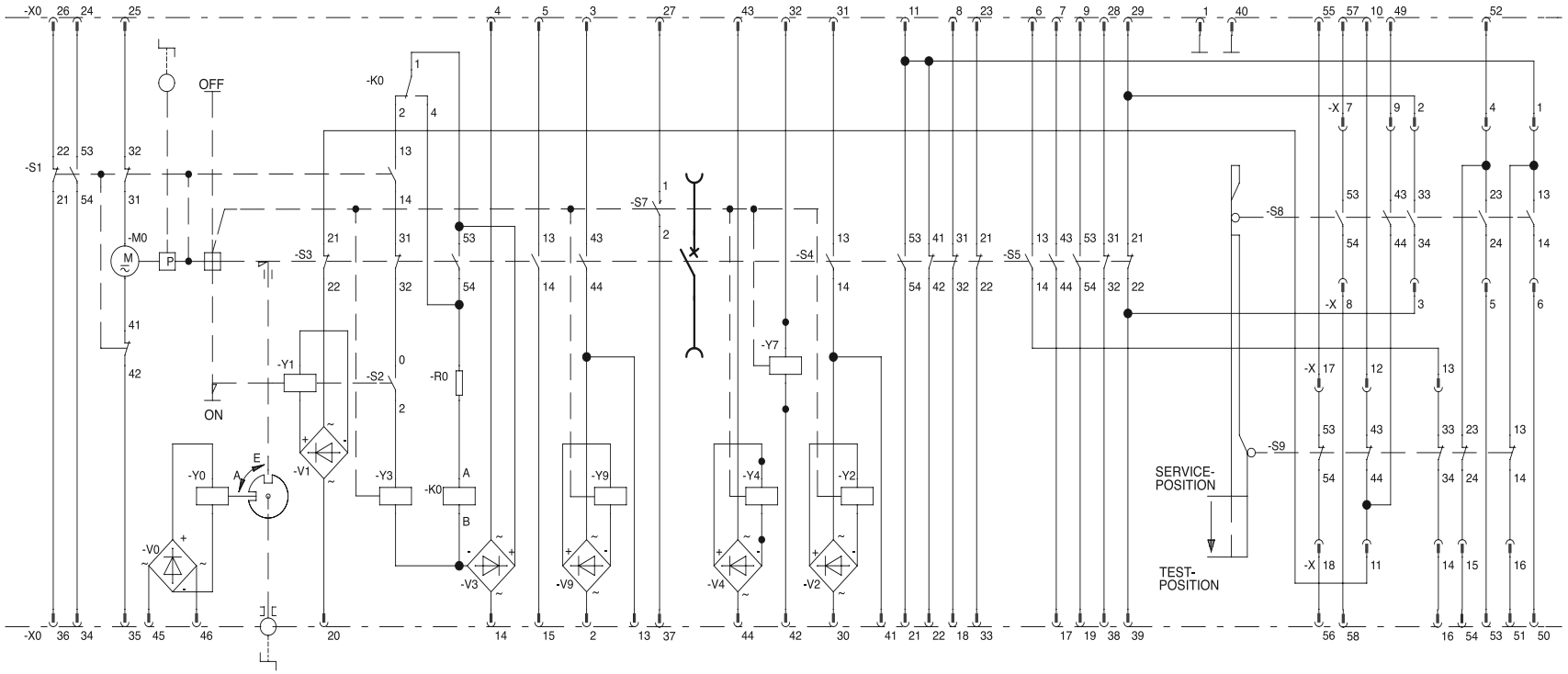
-S1 Auxiliary switch on mechanism
-S2 Auxiliary switch on block magnet -Y1
-S3 Auxiliary switch on switch shaft
-S4 Auxiliary switch on switch shaft
-S5 Auxiliary switch on switch shaft
-S6 Auxiliary switch at c.b.-unit
-S7 Fleeting contact 35 ms for c.b. tripped indication

Mode of presentation:

- Aux. switch -S1 shown for c.b.-mechanism discharged
- C.b.-unit in service position
- Control wiring plug 58-pole
- Earthing switch mechanical interlock with c.b.-unit:
  a) C.b.-unit in test position:
  Earth. switch can be operated
  b) Earth. switch open position:
  C.b.-unit can be moved in the service position

Figure 5/7: Wiring diagram for VD4 vacuum circuit-breaker on manually moveable withdrawable assembly.

- *Type A of withdrawable part*
- *Maximum of equipment*
- *Control wiring plug 58-pole*
- *Use in panel system UniGear-Typ ZS1*
- *Drawing no. GCE2032404*



-Y0 Block Magnet on truck with rectifier -V0
-Y1 Closing block magnet with rectifier -V1
-Y2 1. Shunt release OFF with rectifier -V2
-Y3 Closing release with rectifier -V3
-Y4 Undervoltage release U< with rectifier -V4
-Y7 Indirect overcurrent release
-Y9 2. Shunt release OFF with rectifier -V9
-M0 Charging motor
-K0 Antipumping relay

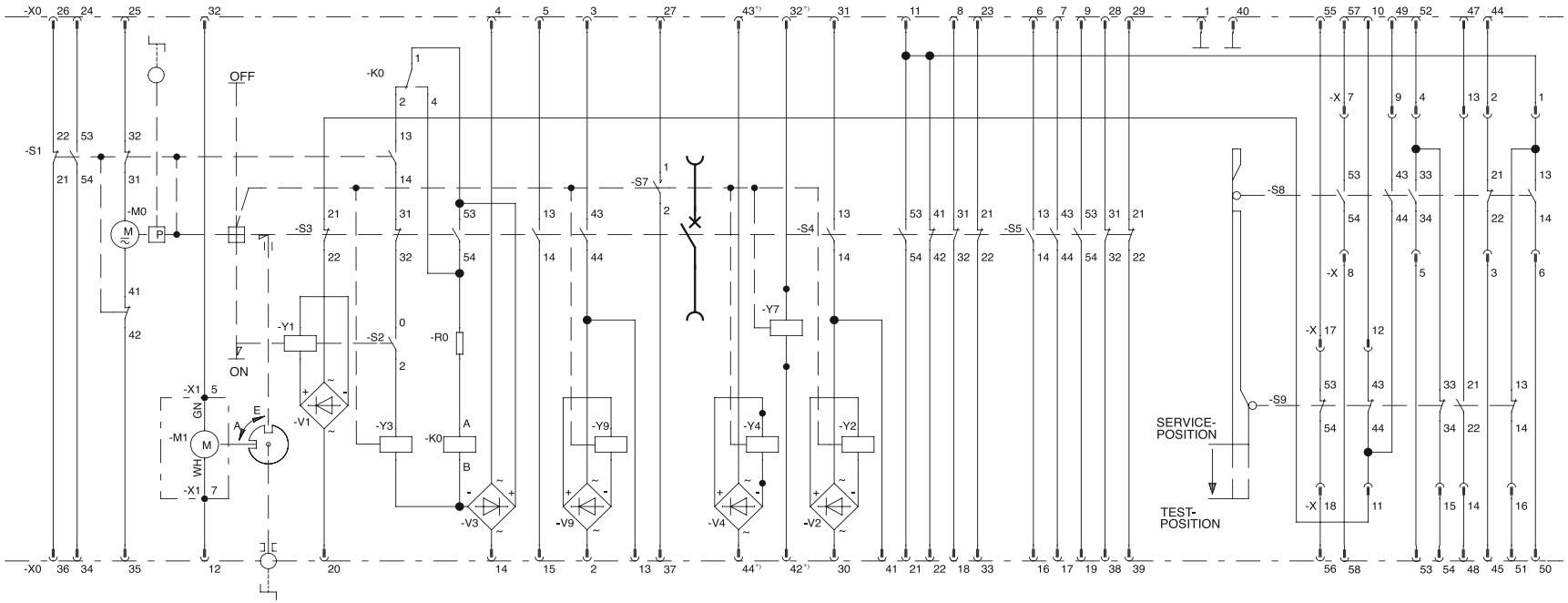
-S1 Auxiliary switch on mechanism
-S2 Auxiliary switch on block magnet -Y1
-S3 Auxiliary switch on switch shaft
-S4 Auxiliary switch on switch shaft
-S5 Auxiliary switch on switch shaft
-S7 Fleeting contact 35 ms for c.b. tripped indication
-S8 Limit switch test position
-S9 Limit switch service position

Mode of presentation:

- Aux. switch -S1 shown for c.b.-mechanism discharged
- C.b.-unit in service position
- Control wiring plug 58-pole
- Earthing switch mechanical interlock with c.b.-unit:
  a) C.b.-unit in test position:
  Earth. switch can be operated
  b) Earth. switch open position:
  C.b.-unit can be moved in the service position

Figure 5/8: Wiring diagram for VD4 vacuum circuit-breaker on manually moveable withdrawable assembly.

- *Type B of withdrawable part*
- *Maximum of equipment*
- *Auxiliary switch -S5 wired*
- *Control wiring plug 58-pole*
- *Use in panel system UniGear-Typ ZS1*
- *Drawing no. GCE2132701P0101*



-Y1 Closing block magnet with rectifier -V1
-Y2 1. Shunt release OFF with rectifier -V2
-Y3 Closing release with rectifier -V3
-Y4 Undervoltage release U< with rectifier -V4
-Y7 Indirect overcurrent release
-Y9 2. Shunt release OFF with rectifier -V9
-M0 Charging motor
-K0 Antipumping relay

-S1 Auxiliary switch on mechanism
-S2 Auxiliary switch on block magnet -Y1
-S3 Auxiliary switch on switch shaft
-S4 Auxiliary switch on switch shaft
-S5 Auxiliary switch on switch shaft
-S7 Fleeting contact 35 ms for c.b. tripped indication
-S8 Limit switch test position
-S9 Limit switch service position
-M1 Motor drive for draw out

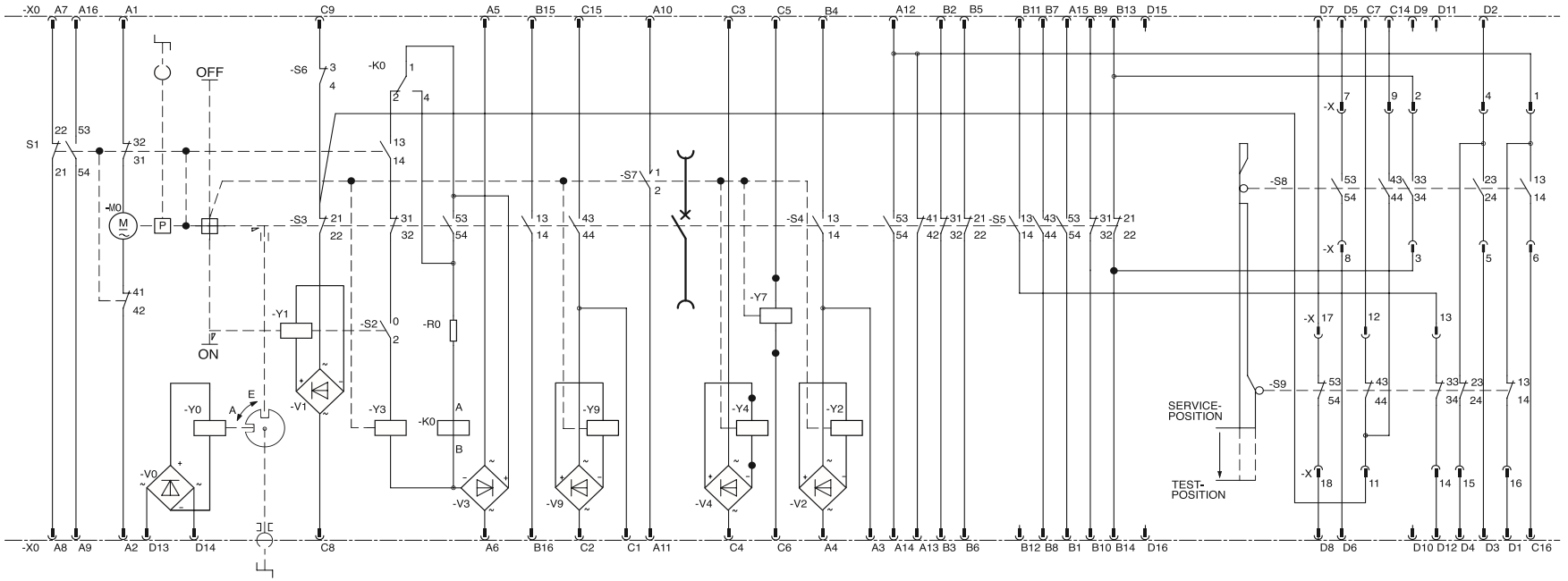
Mode of presentation:

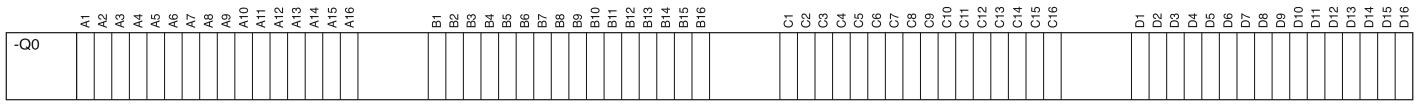
- Aux. switch -S1 shown for c.b.-mechanism discharged
- C.b.-unit in service position
- Control wiring plug 58-pole
- Earthing switch mechanical interlock with c.b.-unit:
  a) C.b.-unit in test position:
  Earth. switch can be operated
  b) Earth. switch open position:
  C.b.-unit can be moved in the service position

*) Connection points when undervoltage release -Y4 or indirect overcurrent release -Y7 are fittet:
-Y4: 42-43
-Y7: 42-43

Figure 5/9: Wiring diagram for VD4 vacuum circuit-breaker on motordriven withdrawable assembly.

- *Type B of withdrawable part*
- *Maximum of equipment*
- *Auxiliary switch -S5 free used*
- *Control wiring plug 58-pole*
- *Use in panel system UniGear-Typ ZS1*
- *Drawing no. GCE2132702P0101*





-Y0 Block Magnet on truck with rectifier -V0
-Y1 Closing block magnet with rectifier -V1
-Y2 1. Shunt release OFF with rectifier -V2
-Y3 Closing release with rectifier -V3
-Y4 Undervoltage release U< with rectifier -V4
-Y7 Indirect overcurrent release
-Y9 2. Shunt release OFF with rectifier -V9
-M0 Charging motor
-K0 Antipumping relay

-S1 Auxiliary switch on mechanism
-S2 Auxiliary switch on block magnet -Y1
-S3 Auxiliary switch on switch shaft
-S4 Auxiliary switch on switch shaft
-S5 Auxiliary switch on switch shaft
-S6 Auxiliary switch at c.b.-unit
-S7 Fleeting contact 35 ms for c.b. tripped indication
-S8 Limit switch test position
-S9 Limit switch service position

Mode of presentation:

- Aux. switch -S1 shown for c.b.-mechanism discharged
- C.b.-unit in service position
- Control wiring plug 64-pole
- Earthing switch mechanical interlock with c.b.-unit:
  a) C.b.-unit in test position:
  Earth. switch can be operated
  b) Earth. switch open position:
  C.b.-unit can be moved in the service position

Figure 5/10: Wiring diagram for VD4 vacuum circuit-breaker on manually moveable withdrawable assembly.

- *Type B of withdraw part or/and with auxiliary switch -S6 at withdrawable part*
- *Maximum of equipment*
- *Control wiring plug 64-pole*
- *Use in panel systemZS, UniGear-Typ ZS1*
- *Drawing no. GCE2009153*

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