VD4

Vacuum circuit-breaker 36 kV

Instruction manual BA 434/03 E

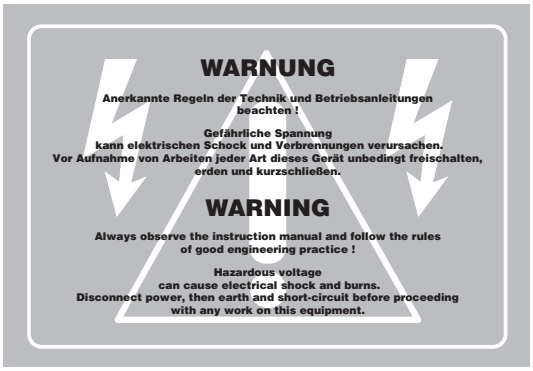
ABB Power Distribution

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.



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-breakers of type VD4 for 36 kV rated voltage are intended for indoor installation in air-insulated switchgear systems. Their switching capacity is sufficient to handle any conditions arising from switching of equipment and system components under normal operating and fault conditions, particularly short-circuits, within the parameters of their technical data.

Vacuum circuit-breakers 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. Type VD4 vacuum circuit-breakers are suitable for auto-reclosing, and have exceptionally high operating reliability and long life.

The vacuum circuit-breakers in column design are intended for permanent mounting. These devices also have trucks. Their basic structure is shown in figures 3/1 to 3/3.

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.

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 VBG 1 and VBG 4

- 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:
    - Rated current 1250 A + 55 °C
    - Rated current 1600 A + 40 °C
    - Rated current 2000 A + 55 °C
    - Rated current 2500 A + 40 °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 aperiod 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

2.1 Technical data circuit-breakers

Rated voltage	kV	36
Rated frequency	Hz	50/60
Rated lightning impulse withstand voltage	kV	170
Rated power frequency withstand voltage	kV	70
Rate of rise of transient recovery voltage	kV/µs	0.57
Peak of transient recovery voltage	kV	62
Rated operating sequence		O-3min-CO-3min-CO
Rated operating sequence with autoreclosing		O-0.3s-CO-3min-CO

Breaker type	Rated voltage	Rated current	Rated short-circuit breaking current symmetrical[1]	Short-circuit breaking current asymmetrical[1]	Rated short-circuit making current (peak)[1]	Rated short-circuit duration	Pole centres	Weight
VD4..	kV	A	kA	kA	kA	s	mm	c. kg
3612-25	36	1250[4]	25	27.3	63	3	360	320
3616-25		1600[6]					360	320
3620-25		2000[4] [5]					360	355
3625-25		2500[5] [6]					360	355
3612-31		1250[4]	31.5	34.3	80	3	360	320
3616-31		1600[6]					360	320
3620-31		2000[4] [5]					360	355
3625-31		2500[5] [6]					360	355

Guideline values for function times:

Closing time	approx.	65 ms	
Opening time	≤	45 ms	
Arcing time (at 50 Hz)	≤	15 ms	
Total opening time	≤	60 ms	
Minimum command time on closing		20 ms [2]	(120 ms [3])
Minimum command time on opening		20 ms [2]	(80 ms [3])

[1] When the operating voltage is lower than the rated voltage, the same values apply as for rated voltage. Higher values on request.
[2] At the rated auxiliary voltage.
[3] If the activating relay contact cannot itself interrupt the release coil current.
[4] Ambient temperature ≤ 55 °C.
[5] With natural ventilation of the switchgear panel.
[6] Ambient temperature ≤ 40 °C.

2.2 Technical data releases and blocking magnet

Equipment		Power consumption[1] AC VA	DC W
Shunt release OFF	Y2 [3], Y9 [3]	250	250
	Y2 [5], Y9 [5]	310	310
Shunt release ON	Y3 [3]	250	250
	Y3 [5]	310	310
Blocking magnet	Y1 [3] [5]	10	10
Undervoltage release	Y4		
• undelayed [3] [5]		11	10
• delayed [4]		10	-
Indirect overcurrent release with intermediate current transformer	Y7		
• two-phase		3.5 [2] /15	-
• three-phase		2.0 [2] /15	-

[1] Approximate values
[2] With short-circuited intermediate current transformer
[3] Rated voltages AC: 110 and 220 V, DC: 24, 48, 60, 110 and 220 V.
[4] See RN3U for supply voltage
[5] Rated voltage AC: 240 V, DC: 125 and 240 V.

2.3 Technical data Motor-operated mechanisms

Rated voltage V	Power consumption [1] VA/W	Motor protection (ABB-Stotz m.c.b.) A		Charging time (maximum) [2] s
AC				
110	150	1.6	S 281 UC-K	15
220	150	0.75		15
240	170	0.75		15
DC				
24	130	4.0	S 282 UC-K	15
48	130	3.0		15
60	130	2.0		15
110	140	1.0		15
125	160	1.0		15
220	140	0.75		15
240	150	0.75		15

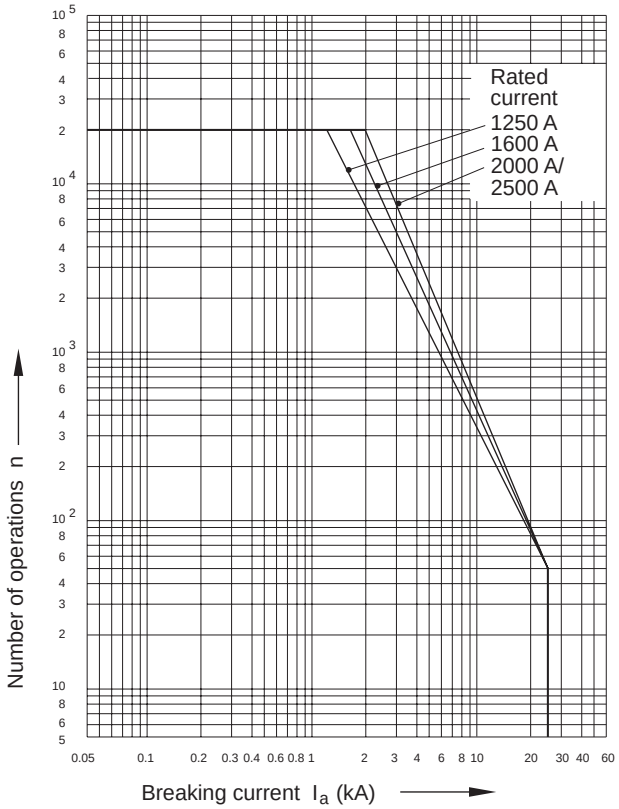
[1] Approximate values
[2] At the rated auxiliary voltage

2.4 Permissible number of vacuum interrupter switching operations in relation to breaking current

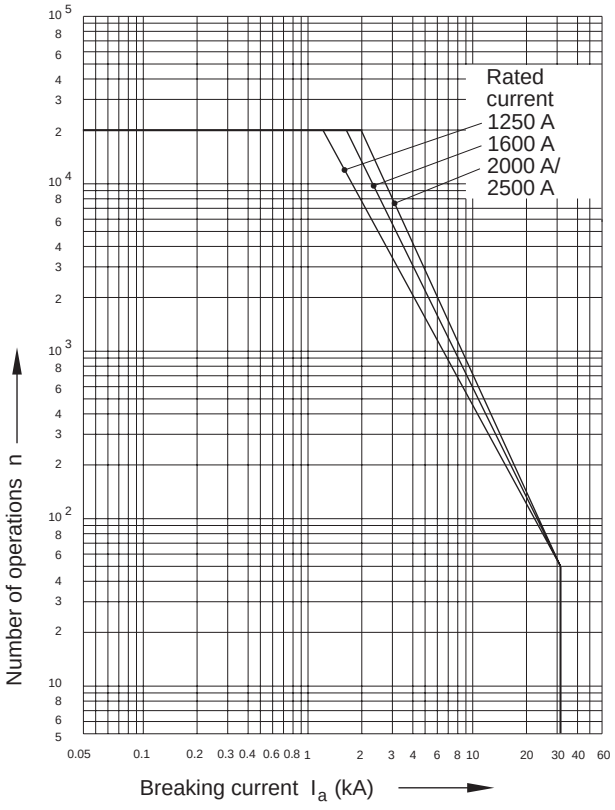
See figure 2/1.

2.5 Dimensions

See figure 2/2.

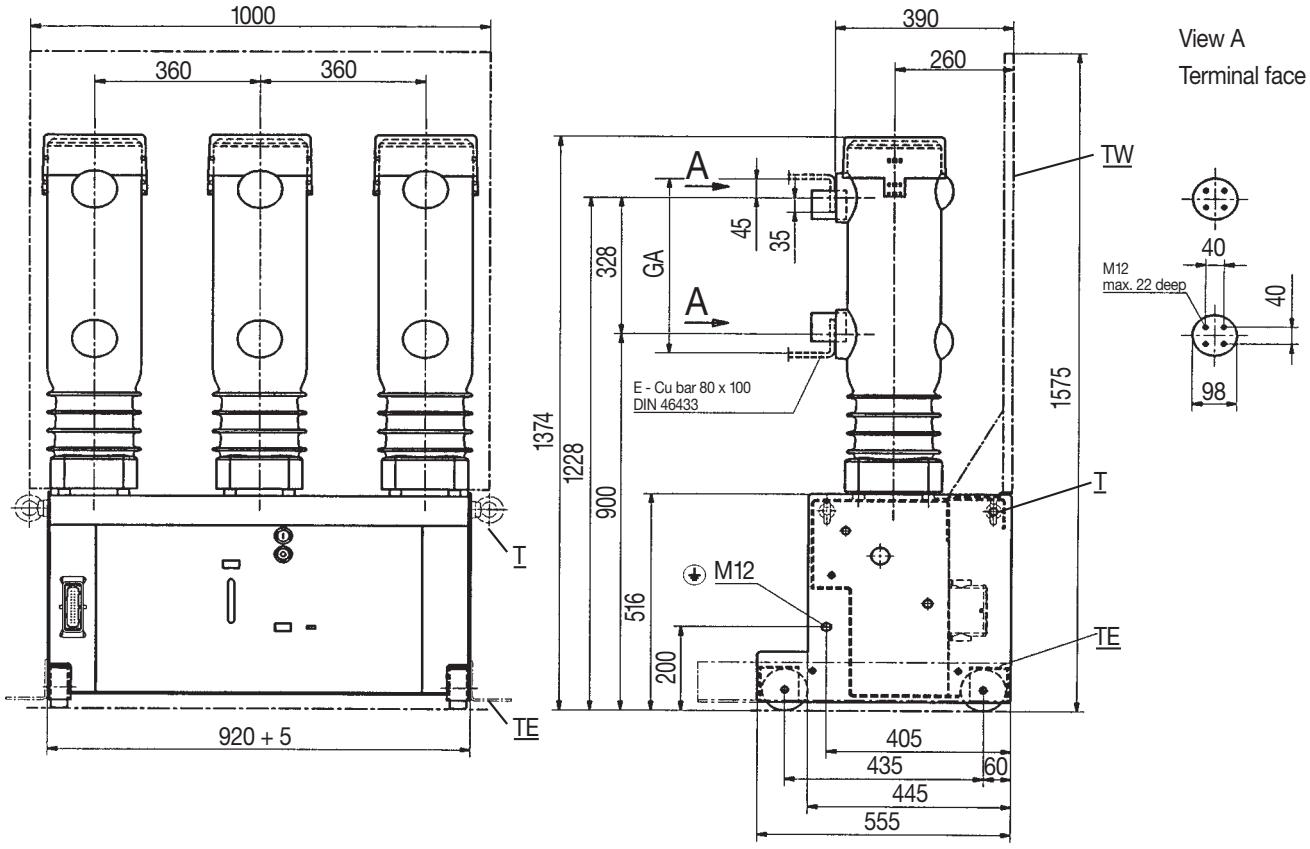


a) Circuit-breaker type VD4, 36 kV,
Rated short-circuit breaking current 25 kA



b) Circuit-breaker type VD4, 36 kV,
Rated short-circuit breaking current 31.5 kA

*Figure 2/1: Permissible number of **vacuum interrupter** operating cycles n as a function of the breaking current I_a*



Note:
Lifting lug T and handling unit TE only fitted for handling. Remove and store prior to commissioning.

GA = Tested terminal zone
T = Lifting lug
TE = Handling unit (required for movement on rollers 50.8)
TW = Partition, if specifically ordered
⏚ = Earthing conductor connection – use contact washer

Figure 2/2: Main Dimensions

3 Structure and function

3.1 Structure of the breaker poles

(Figures 3/1, 3/2 und 3/5)

The 36 kV circuit-breakers of type VD4 are intended for permanent installation.

The poles, which are constructed in column form, are mounted on a torsionally rigid enclosure sub-structure with rollers. The live parts of the breaker poles are located in the insulating material pole tubes 57.8 and protected from impacts and other external influences.

With the breaker closed, the current path leads from the upper terminal 57.1 and a chamber holder fixed in the pole tube to the fixed contact 58.2 in the vacuum interrupter 58, then via the moving contact 58.3 and roller contact to the lower terminal 57.2. The switching motion is effected by means of the insulated coupling rod with internal contact force springs.

The basic structure of a vacuum interrupter is explained in figure 3/5.

3.2 Structure of the breaker operating mechanism

(Figures 3/4, 7/2 und 7/3)

The operating mechanism located in the housing substructure is of the stored-energy spring type and acts on the three breaker poles. The necessary operating energy is stored ready for activation by charging the spring energy storage mechanism.

The stored-energy spring mechanism essentially consists of drum 55.33 containing the spiral spring, the charging system, the latching and operating mechanism and the linkages which transmit the force to the breaker poles. In addition, there are supplementary components such as the charging motor, releases, auxiliary switches and the controls and instruments.

The operating mechanism is fundamentally suitable for autoreclosing and, due to the short charging times, also for multi-shot autoreclosing.

The operating mechanism is normally fitted with a charging motor. There is also a facility for charging the stored energy spring manually.

There is one rating plate 55.7 with the main data of the switch equipment on front plate 50.7, and another on breaker mechanism housing.

The basic version of the stored-energy spring mechnism is fitted with the following auxiliary equipment:

- Shunt release OFF Y2
- Five-pole auxiliary switch S4 for annunciation purposes
- Auxiliary switch S7 for fault annunciation
- Mechanical ON push-button 54.2
- Mechanical OFF push-button 54.3
- Mechanical switch position indicator 55.4
- Charging condition indicator 55.8 for the spring energy store
- Mechanical operating cycle counter 55.5.

The following additional equipment can be installed:

- Blocking magnet Y1 with auxiliary switch S2
- Shunt release ON Y3
- Second shunt release OFF Y9
- Indirect overcurrent release Y7
- Undervoltage release Y4
- Five-pole auxiliary switches S3 and S5
- Charging motor M0
- Five-pole auxiliary switch S1 to switch the charging motor
- Anti-pumping relay K0.

3.2.1 Releases, blocking magnet and auxiliary switches

(Figure 7/3)

The releases and the blocking magnet are mounted at the bottom of the stored-energy spring mechanism.

The allocation of the auxiliary switches can be seen in the wiring diagram of figure 7/3.

The five-pole auxiliary switch S1 is operated by the charging condition indicator 55.8. It controls the charging motor M0, serves as an electrical interlock for shunt release ON Y3 when the spring energy storage mechanism is not sufficiently charged, and also provides an electrical switching readiness signal.

Operation of the five-pole auxiliary switches S3, S4 and S5 is dependent on the switching position of the circuit-breaker.

Auxiliary switch S3 interrupts the circuit of the optional additional shunt release OFF Y9 with the circuit-breaker in the open position, and the circuits of shunt release ON Y3 and the optional blocking magnet Y1 with the circuit-breaker in the closed position. There is one further NOC for other purposes.

Auxiliary switch S4 interrupts the circuit of shunt release OFF Y2 with the circuit-breaker in the open position. One further NOC and three NCCs are available for annunciation, control and interlock purposes.

Auxiliary switch S5 can be optionally designed with any possible combination of contacts from five NOCs to five NCCs. Its contacts are available for any required control, annunciation or interlock functions. The auxiliary switch is normally configured as shown in figure 7/3.

The single pole auxiliary switch S7 (fleeting contact time ≥ 30 ms) serves to provide a fault signal ("breaker released"). With remote control, the auxiliary switch is necessarily operated via:

- Shunt release OFF Y2 or
- Shunt release OFF Y9 or
- Undervoltage release Y4 or
- Indirect overcurrent release Y7.

Note:

1. Shunt releases OFF (Y2) and ON (Y3) are exclusively provided for opening and closing in normal operation. For safety breaking operations, the second shunt release OFF (Y9) must be used, in most cases with a separate control voltage supply.

   These three releases are of the solenoid type and suitable for a large number of operating cycles.

2. The undervoltage release (Y4) and/or indirect overcurrent release (Y7) are pure safety and protection releases and must not be used for switching in normal operation.

3.3 **Function**

3.3.1 Charging of the spring energy store

(Figures 6/1, 7/1 and 7/2)

To provide the necessary motive energy, the spring energy storage mechanism is charged via chain 55.34 fitted with ratchet wheel 55.35, either automatically by a charging motor or by hand in a vertical pumping action with charging lever 128. The current charging condition is shown at charging condition indicator 55.8

As a precondition for an autoreclosing sequence, the operating mechanism is either (re-)charged after a closing operation automatically by the charging motor, or it requires (re-)charging by hand if the operating mechanism is of the manual type.

3.3.2 Closing procedure

(Figures 3/4 and 3/5)

The closing process is initiated manually by the mechanical ON push-button 54.2, or electrically by activation of shunt release Y3. The release mechanism then permits drive shaft to be rotated by the (previously) charged spiral spring. The moving contact 58.3 in vacuum interrupter 58 is moved until the contacts touch by cam disk and further kinematic links. In the further sequence of motion, spring arrangement is tensioned and the appropriate amount of contact force thus applied. The available overtravel is higher than the maximum value of contact erosion during lifetime of the interrupter. During the closing process, opening springs are simultaneously tensioned.

3.3.3 Opening procedure

(Figures 3/4 and 3/5)

The opening procedure is initiated manually by the mechanical OFF push-button 54.3, or electrically by activation of one of the releases Y2, Y4, Y7 or Y9. Observe the notes in section 3.2.1 on control of the releases. Release mechanism then permits drive shaft 55.30 to be turned further by the spring energy storage mechanism, which is still sufficiently charged. The opening spring, which is thus released, moves the contact 58.3 into the open position at a defined speed.

3.3.4 Autoreclosing sequence

An OFF-ON or OFF-ON-OFF autoreclosing sequence is activated and checked by the protection system. It is necessary for the spiral spring in the operating mechanism to be in the (re-)charged condition, with the circuit-breaker in the closed position. The (re-)charging process is carried out automatically after closing of the breaker on breakers with motor charging mechanisms, but must be carried out manually on breakers without charging motors (or when the charging motor has broken down). Opening of the breaker is also possible during the (re-)charging process, but subsequent closing of the breaker is however blocked until the charging process has been completed.

3.3.5 Quenching principle of the vacuum interrupter

Due to the extremely low static interrupter chamber pressure of 10^{-4} to 10^{-8} mbar, only a relatively small contact gap is required to achieve a high dielectric strength. The arc is extinguished on one of the first natural current zeros.

Due to the small contact gap and the high conductivity of the metal vapour plasma, the arc drop voltage, and additionally, due to the short arcing time, the associated arc energy, are extremely low, which has advantageous effects on the life of the contacts and thus on that of the vacuum interrupters.

Figure 3/1: Circuit-breaker, operator's side

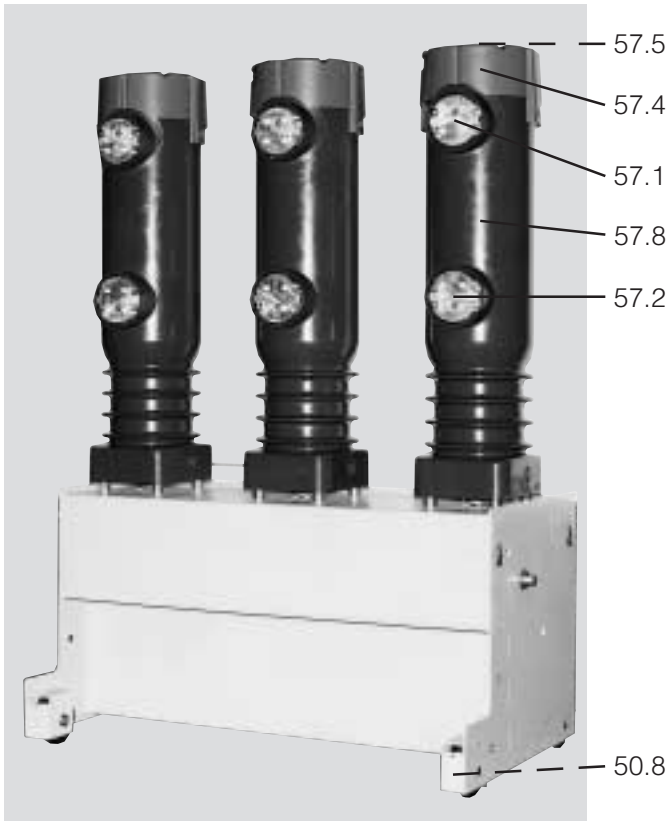


Figure 3/2: Circuit-breaker, terminal side

50.8 Wheel
57.1 Upper terminal
57.2 Lower terminal
57.4 Pole tube caps
57.5 Transport plugs
57.8 Insulating material pole tube

Figure 3/3: Circuit-breaker, version with partition, terminal side

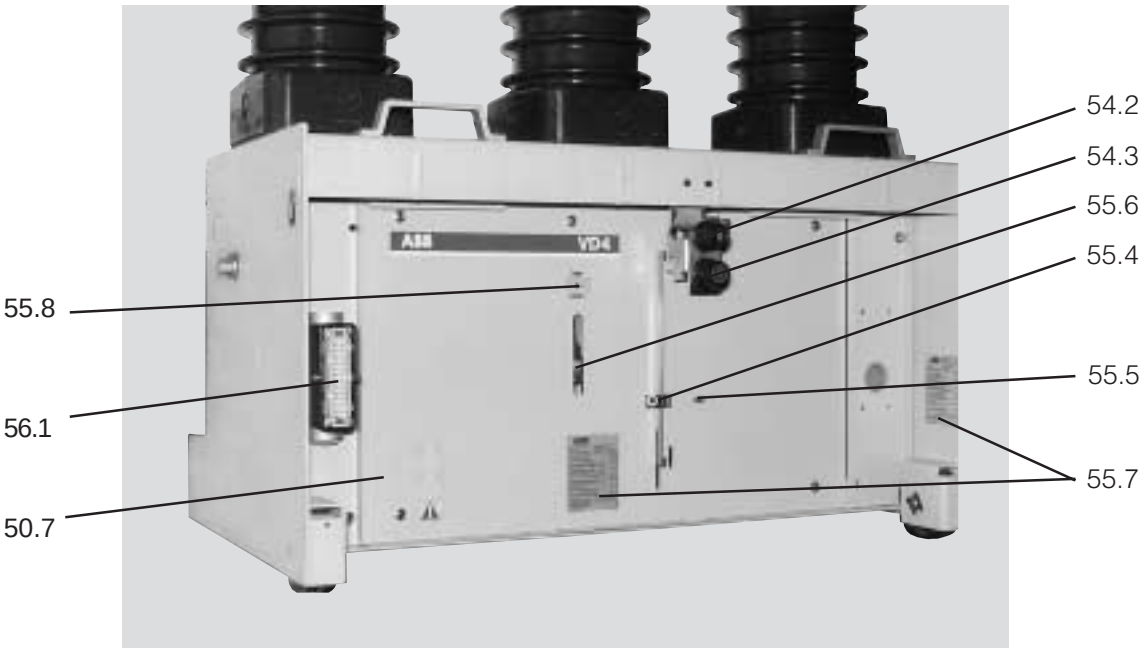


Figure 3/4: Controls for the circuit-breaker

50.7 Front plate
54.2 Mechanical ON push-button
54.3 Mechanical OFF push-button
55.4 Switch position indicator
55.5 Operating cycle counter
55.6 Socket (for charging level)
55.7 Rating plate
55.8 Charging condition indicator
56.1 Control wiring socket, 24-pole version (64-pole version on request)

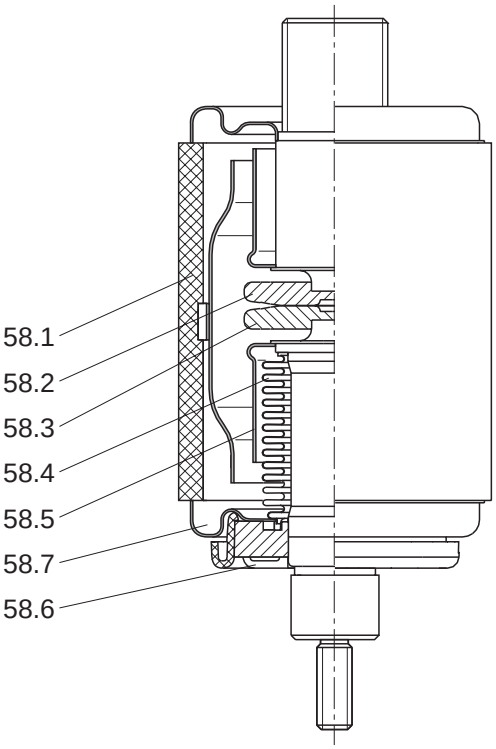


Figure 3/5: Partial section of a vacuum interrupter 58, simplified schematic diagram
Details vary according to the specified switching duties.

58.1 Insulator
58.2 Fixed contact
58.3 Movable contact
58.4 Metal bellows
58.5 Screen
58.6 Guide
58.7 Interrupter lid

4 Despatch and storage

4.1 Condition on delivery

- The factory-assembled switching devices are checked at the works for completeness of the equipment installed and simultaneously subjected to a routine test in accordance with VDE 0670, part 1000 or IEC publication 60694, thus verifying their correct structure and function.

4.2 Packaging

The switching devices are mounted individually on a wooden pallet and sealed in film and/or packed in cardboard for delivery.

Packaging for overseas shipment:

- Drying agent bags inserted in the film-sealed packaging.
- See instructions for use of the drying agent bags in accordance with DIN 55 473:
  - If colour indicator is blue: contents dry,
  - If colour indicator is pink: contents moist (e.g. relative humidity above 40 %).

4.3 Transport

(Figures 2/2, 3/2 and 6/2)

Loading of the package units must only be carried out with a

- crane,
- fork-lift truck and/or
- trolley jack.

Notes:

- Avoid impact during handling.
- Do not subject to other damaging mechanical stresses.
- Lifting gear must not be attached to the breaker poles or parts of the operating mechanism. Use the lifting lugs T in the Figures 2/2 and 6/2.
- Handling unit TE must be screwed on to move the breaker on rollers 50.8.

4.4 Delivery

The duties of the consignee on receipt of the switching devices at site include the following:

- Checking the delivery for completeness and freedom from damage (e.g. moisture and its adverse effects).
- Any short quantities, defects or damage in transit:
  - Must be precisely documented on the consignment note.
  - The shipper/carrier is to be notified immediately in accordance with the liability provisions of the German general conditions for forwarders (ADSp/KVO)

Note:

Always take photographs to document any major damage.

4.5 Intermediate storage

Intermediate storage of the switchgear in the switch position OFF and the stored-energy spring mechanisms discharged

(Indicator DISCHARGED: ).

Conditions for optimum intermediate storage:

1. Devices with basic packaging or unpacked:
   - A dry and well ventilated storeroom with climate in accordance with VDE 0670, part 1000/IEC 60694.
   - Room temperature which does not fall below –5 °C.
   - Do not remove or damage the packaging.
   - Unpackaged devices:
     - Are to be loosely covered with protective sheeting.
     - Sufficient air circulation must be maintained.
   - Check regularly for any condensation.
2. Devices with seaworthy or similar packaging with internal protective sheeting:
   - Store the transport units:
     - protected from the weather,
     - dry,
     - safe from damage.
   - Check the packaging for damage.
   - Check the drying agent (see also section 4.2):
     - on arrival of the consignment,
     - subsequently at appropriate intervals.
   - If the maximum storage period starting from the date of packaging has been exceeded:
     - The protective function of the packaging is no longer guaranteed.
     - Suitable action must be taken if intermediate storage is to continue.

5 Installation

Careful and professional installation of the switchgear is one of the fundamental conditions of trouble-free circuit-breaker operation.

- Remove handling unit TE and lifting lugs T if fitted (Figure 2/2).
- Install the breaker housing in the panel without tension or distorsion. The brackets of handling unit TE can also be used to fasten the breaker to the switchroom floor.
- Connect the main terminals without any permanent tension or pressure forces, exerted for example by the conductor bars.
- When connecting the conductor bars, the bolts must be inserted to the depth shown on the dimensional drawing.
- Take account of any tested terminal zone.
- Use DIN bolts of tensile class 8.8, fastening conductor bars together with dished washers.
- Make a short-circuit proof connection between the PE conductor and the main earthing bar in the switchgear, using contact washers.
- Remove any dirt. See also section 7.3.1.

	Recommended rated tightening torque[1)2)] Nm	
	Lubricant [3)]	
Thread size	without	Oil or grease
M 6	10.5	4.5
M 8	26	10
M 10	50	20
M 12	86	40
M 16	200	80

1) Rated tightening torques for fasteners without lubrication are based on the thread friction coefficient 0.14 (the actual values of which are subject to unavoidable, in some cases not insignificant, spread)

2) Rated tightening torques for fastener with lubrication in accordance with DIN 43 673.

3) Thread and contact face of head lubricated

Take account of any tightening torques which deviate from the general table (e.g. for contact systems or device terminals) as stated in the detailed technical documentation.

It is recommended that the threads or head contact surfaces of the bolts be lightly oiled or greased, so as to achieve a precisely defined rated tightening torque

6 Commissioning/Operation

6.1 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.

6.2 Preparatory activities

(Prior to application of primary voltage)

- Check the circuit-breaker for damage and restore to the proper conditions where necessary.
- Remove any contamination (particularly on the insulating materials) which has occurred during transit, storage or installation.
- Check the primary and secondary connections and the protectiv conductor terminal.
- Check the charging motor on circuit-breakers with motor-operated mechnisms by applying auxiliary voltage. The stored energy spring is charged.
- On breakers with manual charging mechanisms, charge the stored energy spring by hand (see Section 6.3.1).
- Perform a trial opening or closing operation of the circuit-breaker using push-button 54.2 or 54.3 (taking into account any required auxiliary voltage and any relevant interlocks). Observe switch position indicator 55.4 and charging condition indicator 55.8.
- Remove transport plugs 57.5 from the poles.
- Check that pole tube caps 57.4 are properly fitted.
- Ensure that the Instruction Manual is available to the operators at all times.

6.3 Operation of the circuit-breaker

(Figures 3/3 and 6/1)

6.3.1 Charging the spring energy storage mechanism

Circuit-breakers with charging motors:

- Charging takes place automatically.
- If the charging motor breaks down, the charging process can be carried out or completed manually.

Circuit-breakers with manual charging mechanisms:

- Insert charging lever 128 into locating socket 55.6 and pump up and down for approx. 25 strokes until the charged condition is displayed.
- When the charged condition is reached, the charging mechanism automatically disengages, and further strokes of the charging lever have no effect.

Key to the charging condition indications:


Discharged


Charged

As a precondition for an autoreclosing sequence, the operating mechanism is either (re-)charged after a closing operation automatically by the charging motor, or it requires (re-)charging by hand if the operating mechanism is of the manual type.

6.3.2 Closing and opening

Closing:

- Press mechanical ON push-button 54.2, or operate the electrical control unit.

Opening:

- Press mechanical OFF push-button 54.3, or operate the electrical control unit.

See also note in section 3.2.1

The operating cycle counter 55.5 is automatically incremented by one complete figure with each switching cycle. On completion of a switching operation the switch position indicator 55.4 in the window of front plate 50.7. shows the appropriate position of the circuit-breaker.

The anti-pumping relay K0 (wiring diagram in firgure 7/3) prevents repeated ON-OFF switching operations if, for example, the breaker is tripped by a protection relay in response to a primary side fault while a permanent electrical closing command is simultaneously applied. The circuit-breaker can then only be closed after the closing command has been interrupted.

6.3.3 Operating sequence

Cicuit-breaker with motorized charging of the stored-energy spring mechanism

Operating sequence	Result of operation Breaker Position	 Charging Condition	Posible subsequent switching operation
Switch on charging motor Automatic charging	 0	 	- On-Off
Close breaker... and automatically (re-)charge	I I	 	Off Off-On-Off or auto-reclosing sequence
Open breaker	0		On-Off
Close breaker... and automatically (re-)charge	I I	 	Off Off-On-Off or auto-reclosing sequence
Autoreclosing sequence Off (Activation via protection system On Off Automatic charging completed	0 I 0 0	   	 (automatic charging starts) On-Off
Close breaker... and automatically (re-)charge	I I	 	Off Off-On-Off or auto-reclosing sequence

6.3.4 Run-on block

When any irregularities occur in the internal control mechanism or with the charging function of the spring energy storage mechanism, the run-on stop blocks the next closing operation.

This is a protective function to prevent damage to the circuit-breaker.
Release of the run-on block is described in Instruction Manual BA 383/E.

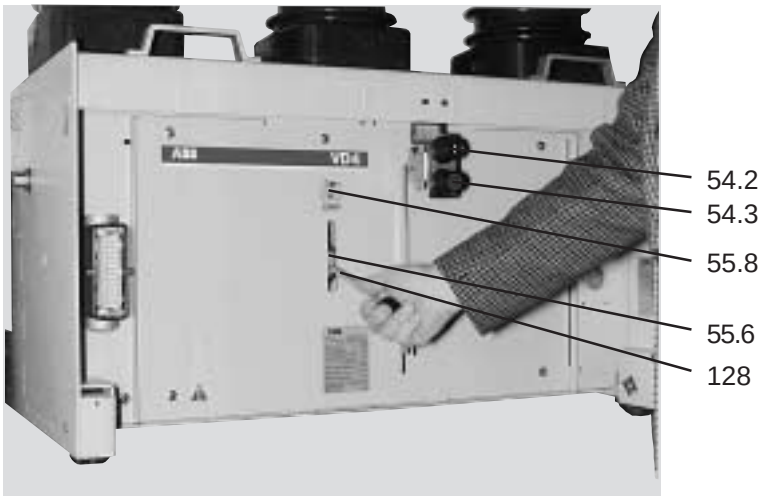


Figure 6/1: Charging the stored-energy spring mechanism manually by moving the inserted charging lever up and down

54.2 Mechanical ON push-button
54.3 Mechanical OFF push-button
55.6 Socket
55.8 Charging condition indicator
128 Charging lever

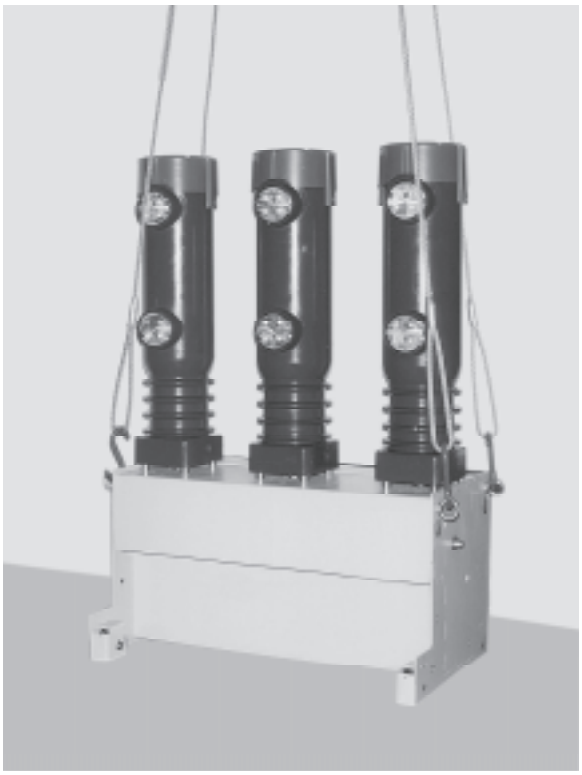


Figure 6/2: ⚠ *Only handle by crane when the lifting lugs are fitted. Always bear in mind that the high situated centre of gravity may induce the breaker to tip over!*

7 Maintenance

Maintenance serves to ensure trouble-free operation and achive the longest possible working life of the switchgear. In accordance with DIN 31 051 / IEC 61208 it comprises the following closely related activities:

Inspection: Determination of the actual condition

Servicing: Measures to maintain the specified condition

Repair: Measures to restore the specified condition.

7.1 General

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.

With carefully performed inspections and servicing work, and under normal operating conditions, the circuit-breakers, depending on the type, have a service life of up to 20,000 operating cycles and more.

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 6.1
- 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 Calor Emag 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 auxiliary 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 50.7 removed.

The spiral spring in the spring energy strage 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!

7.2 Inspection and functional testing

7.2.1 Switching devices in general

The proper condition of the switching device is to be verified by regular inspection.

Under normal operating conditions, testing by a qualified personnel is to be performed at least every 4 years (in accordance with VBG 4 standard).

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.

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.

If an incorrect condition is found, appropriate servicing measures are to initiated.

7.2.2 Stored-energy spring mechanism

(Figures 7/1 and 7/2)

Functional testing of the operating mechanism is to be performed:

- after 5000 operating cycles or
- during servicing work as set out in 7.2.1.

Prior to functional testing, switch the breaker off and isolate the outgoing feeder.

Note:

Isolate and secure the working area in accordance with the safety regulations specified by DIN VDE/ IEC.

Scope of functional testing:

- Perform several switching operations under no load, above all with circuit-breakers seldom operated in normal service.
- Switch off the charging motor (if fitted) and discharge the spring mechanism by ON/OFF switching operations.
- Examine visual the condition of the lubrication on rotary bearings, sliding surfaces, etc.
- Check the proper mechanical/electrical sequence of the individual functions.

7.2.3 Breaker pole

No inspection of the breaker pole above and beyond the stipulations of section 7.2.1 is necessary.

7.3 Servicing

7.3.1 Switching devices in general

If cleaning is found to be necessary during inspections as set out in 7.2.1, the following procedure is to be adopted:

- Prior to cleaning, the working area is to be isolated and secured against reclosing where necessary in accordance with the safety regulations of DIN VDE/IEC.
- Cleaning of surfaces in general:
  - Dry, lightly adhering dust deposits with a soft, dry cloth.
  - More strongly adhering contamination with slightly alkaline household cleanser or Rivolta BWR 210.
- Cleaning of the insulating material surfaces and conductive components:
  - Light contamination: with Rivolta BWR 210.
  - Strongly adhering contamination: with cold cleanser 716.

  Wipe down after cleaning, using clean water, and dry properly.
- Observe the manufacturer's instructions and the special ABB instruction manuals Ba 1002/E or BA 1006/E on safety at work.

  Note:

  Use only halogen free cleansers, and in no case 1.1.1-trichlorethane, trichlorethylene or carbon tetrachloride!

7.3.2 Stored-energy spring mechanism

Servicing or the spring mechanism is to be performed after 10,000 operating cycles.

Prior to servicing, switch the breaker off, and isolate the outgoing feeder.

Observe the safety regulations!

Details of the servicing:

- Swich off the charging motor (if fitted), and discharge the spring energy storage mechanism by closing and opening the breaker once.
- Replace parts subject to high climatic and mechanical stresses after 10,000 operating cycles as a precaution (for details see ABB Calor Emag after-sales service).

- For replacing highly stressed parts neutralize bysic tension of the spiral spring, state the rate. Be careful when carrying out!
- Relubricate pawls, support shafts, sliding and rotating bearing surfaces. Lubricant: Isoflex Topas NB 52.
- Check the fit of fasteners (e.g. locking pins) in cranks, pins, bolts etc. Check the tightness of fastening bolts.
- Always replace any spring lock washers, split pins and other fasteners removed during the work with new parts when reassembling the equipment.
- Check the general condition of the operating mechanism and recharge the spring energy store.
- Perform comprehensive mechanical and electrical functional tests.
- Ensure that the bolted joints at the contact locations of the conductor bar system and the earthing connections are tight.

Note:

This work may only be performed by the after-sales service personnel of ABB Calor Emag Mittelspannung GmbH or adequately qualified personnel.

7.3.3 Breaker pole

The breaker pole with the vacuum interrupter is maintenance-free up to reaching the permissible number of vacuum interrupter operating cycles in accordance with section 2.4.

Checking of the vacuum is only necessary when there is good cause to suspect that force applied externally to a pole tube has caused damage to the vacuum interrupter inside.

If the pole tube is damaged or destroyed, it may be necessary to replace the complete breaker pole.

The working life of the vacuum interrupter is defined by the sum current limit corresponding to the equipment data in individual cases in accordance with section 2.4:

- When the sum current limit is reached, the complete breaker poles are to be replaced.
- When the permissible number of mechanical operating cycles (i.e. the number corresponding to I_a=0 on the characteristic curve) of the vacuum interrupters has been reached, the breaker poles must be replaced. However, it should be investigated beforehand as to whether the installation of a new breaker would be more advantageous.

For testing the vacuum without dismantling the circuit-breaker you may use:

- Vacuum tester VIDAR, from Programma Electric GmbH, Bad Homburg v.d.H.

A test DC voltage of 60 kV is to be set for testing of the pressure inside the interrupter chamber with vacuum tester VIDAR.

Testing is to be performed at the rated contact distance in the OFF condition.

Note:

Dismantling and Replacement of the complete breaker poles should only be carried out by ABB Calor Emag after-sales service personnel or by specially trained personnel, particularly as proper adjustment is necessary.

7.4 **Repair**

7.4.1 Replacement of circuit-breaker parts and accessories

Only remove and reassemble circuit-breaker parts and accessories when the breaker has been switched off and the working area is to be isolated and secured against reclosing. The spring energy storage mechanism must be discharged.

All auxiliary voltage sources must be disconnected and secured against reclosing during the removal and installation work.

7.4.2 Touch up of surfaces

- Sheet steel parts, painted
  - Remove rust, e.g. with a wire brush.
  - Grind off paint coat and grease.
  - Apply anti-rust primer and top coat.
- Sheet steel parts, with zink 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.

7.5 **Spare parts and auxiliary materials**

7.5.1 Spare parts

Designation	Breaker type VD4..	Rated voltage kV	Rated current A	Rated short-circuit breaking current symm. kA	Part no.[1)] (order code)
Breaker pole, complete	3612-25	36	1250	25	GCE7002270R0111
	3616-25		1600		GCE7002270R0111
	3620-25		2000		GCE7002270R0107
	3625-25		2500		GCE7002270R0107
	3612-31		1250	31.5	GCE7002270R0111
	3616-31		1600		GCE7002270R0111
	3620-31		2000		GCE7002270R0107
	3625-31		2500		GCE7002270R0107

[1)] Always quote the serial number of the switch equipment when ordering parts.

Designation	Item no.	Auxiliary voltage	Ident no. (order code)
Auxiliary switch	S1		GCE7002397R0122
(with clamp-type terminal)	S3		GCE7002397R0121
	S4		GCE7002397R0122
	S5		GCE7002397R01..[1]
Auxiliary switch on blocking magnet	S2		GCE7003022P0101
Auxiliary switch for fault annunciation	S7		GCE0905121P0100
1st shunt release OFF	Y2		GCE7004590P01..[2]
2nd shunt release OFF	Y9		GCE7004590P01..[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 (with gearing)	M0	DC 24 V	GCE0940084P0101
		DC 48 V	GCE0940084P0103
		DC 60 V	GCE0940084P0104
		DC/AC 110 V	GCE0940084P0105
		DC 125 V	GCE0940084P0105
		DC/AC 220/240 V	GCE0940084P0106
Push-on sleeve 4.8-2.5 for push-on blade 0.8 thick (for additional external connections)			DIN 46247 Page 2

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

7.5.2 Auxiliary materials

	Ident no. (order code)
Lubricant:	
• Isoflex Topas NB 52	GCE0007249P0100
Halogen-free cleanser:	
• Rivolta BWR 210 (for general cleaning)	GCE0007707P0100
Observe the relevant ABB instruction manual BA 1002/E	GCEA901002P0102
• Cold cleanser (Kaltreiniger) 716 (use for conductive components, insulating-material components and for heavy contamination)	GCE0007706P0100
Observe the relevant ABB instruction manual BA 1006/E	GCEA901006P0102

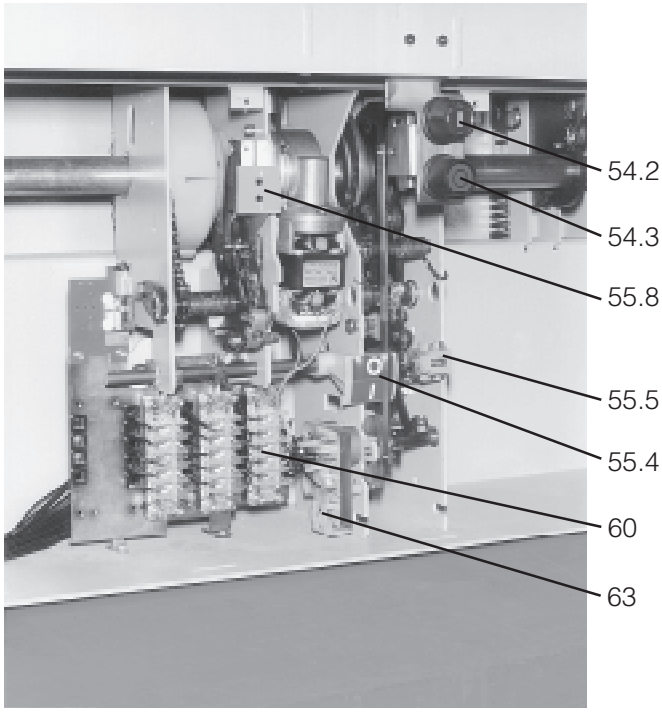


Figure 7/1: Stored-energy spring mechanism, front plate removed

54.2 Mechanical ON push-button
54.3 Mechanical OFF push-button
55.4 Mechanical switch position indicator
55.5 Mechanical operating cycle counter
55.8 Charging condition indicator
60 Auxiliary switch block
63 Magnet holder, complete

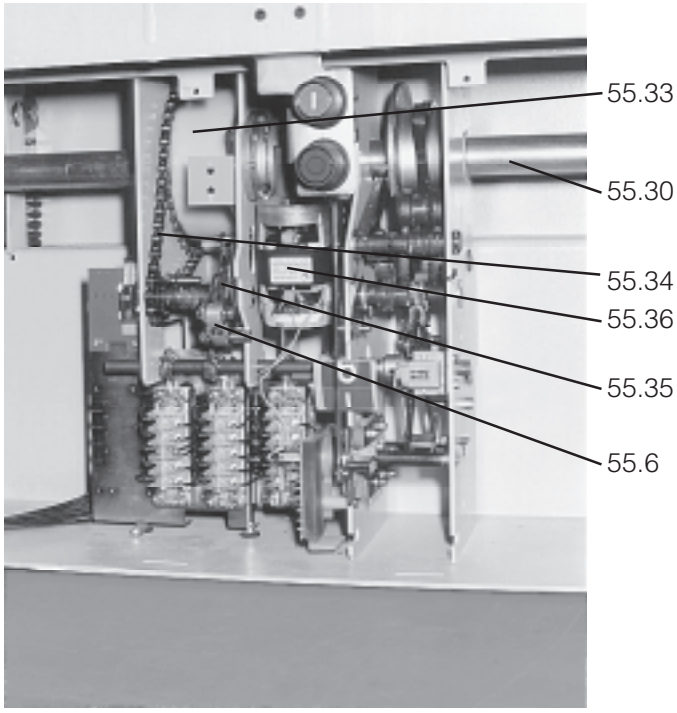
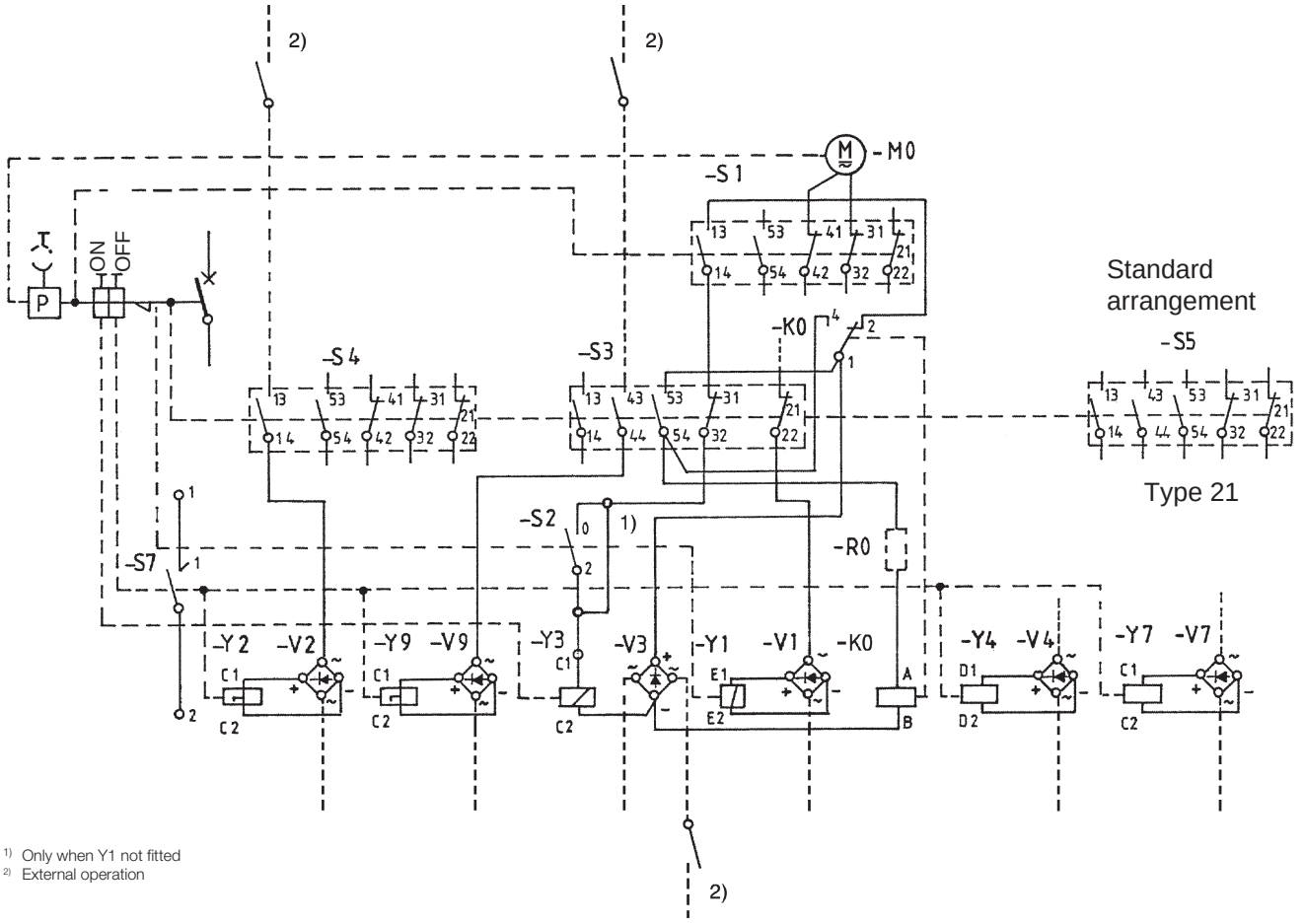


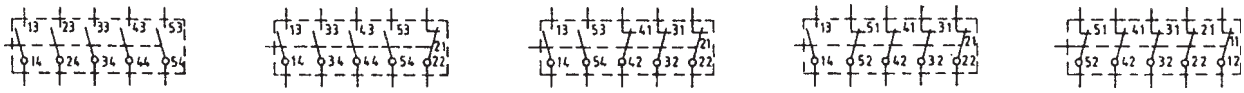
Figure 7/2: Stored-energy spring mechanism, front plate removed

55.6 Socket (for charging lever)
55.30 Drive shaft
55.33 Drum with spiral spring
55.34 Chain
55.35 Ratchet wheel
55.36 Charging motor



1) Only when Y1 not fitted
2) External operation

Special arrangement for – S5



Type19 Type 20 Type 22 Type 23 Type 24

– S1 Auxiliary switch on operating mechanism
– S2 Auxiliary switch on blocking magnet
– S3 Auxiliary switch on the breaker shaft
– S4 Auxiliary switch on the breaker shaft
– S5 Auxiliary switch on the breaker shaft
– S7 Auxiliary switch for fault annunciation (fleeting contact, time ≥ 30 ms)

– Y1 Blocking magnet
– Y2 Shunt release OFF
– Y3 Shunt release ON
– Y4 Undervoltage release
– Y7 Indirect overcurrent release
– Y9 Second shunt release OFF
– V1 Series rectifier for – Y1
– V2 Series rectifier for – Y2

– V3 Series rectifier for – Y3 and – K0
– V4 Series rectifier for – Y4
– V7 Series rectifier for – Y7
– V9 Series rectifier for – Y9
– M0 Charging motor for spring energy storage mechanism
– K0 Anti-pumping relay
– R0 Series resistor

Figure 7/3: Wiring diagram

Arrangement for DC 24, 48, 60, 110, 125, 220, 240 V; AC 110, 220, 240 V

Shown with the spring operating mechanism in the discharged state. The wiring diagram comprises 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 equipment fitted in each individual case can be found in the order documentation.

Note:
Shunt releases and blocking magnets are fundamentally wired with rectifiers (e.g. magnet holder 63 with integrated rectifiers V1, V2, V3 and V9).
Rectifiers function as free-wheeling diodes is d.c.-supply.

8 Application of the X-ray regulations

One of the physical properties of vacuum insulations is the possibility of X-ray emissions when the contact gap is open. The specified type test performed by the Physikalisch-Technische Bundesanstalt (PTB) in Brunswick demonstrates that the local dosage output of 1 µSv/h at a distance of 10 cm from the touchable surface is not exceeded.

The results are as follows:

- The use of the vacuum interrupters at rated voltage is completely safe.
- The application of the rated power frequency withstand voltage specified for the switching devices by DIN VDE 0670 and IEC 60056 is also safe.
- Higher voltages than the rated power frequency withstand voltage or DC test voltage specified in DIN VDE or IEC standards must not be applied!
- Fulfilment of the above requirement with the vacuum interrupter in the open position is dependent on maintenance of the specified distance between the contacts (which is automatically ensured with correct mechanism function and force transmission).

Instruction manual **no. GCEA 67 0434 P0102** Printed in Germany (07.00-1000-PPI) We reserve the right to make changes in the course of technical development.

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