INSTRUCTIONS

DC Control Circuit Monitoring Relays

CIRCUIT SHIELD

TYPE 27S  DC UNDervoltage relay
TYPE 27B  BATTERY GROUND DETECTOR RELAY
TYPE 74   TRIP CIRCUIT SUPERVISION RELAY

Type 27S
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INTRODUCTION

These instructions contain the information required to properly install, operate, and test the ABB Circuit-Shield™ Type 27S DC Undervoltage Relay, the Type 27B Battery Ground Detector Relay, and the Type 74 Trip Circuit Supervision Relay.

Each relay is housed in a case suitable for conventional semiflush panel mounting. All connections to the relay are made at terminals on the rear of the case that are clearly numbered.

Relays of the 439 catalog series are similar to relays of the 239 series. Both series provide the same basic functions and are of totally drawout construction; however, the 439 series relays provide integral test facilities.

Settings are made on the front panel of the relay, behind a removable clear plastic cover. The target indicator is reset by means of a pushbutton extending through the relay cover.

PRECAUTIONS

The following precautions should be taken when applying these relays:

1. Incorrect wiring may result in damage. Be sure wiring agrees with the connection diagram for the particular relay before energizing. Wiring for the 439 series units is different than for the 239 series.

2. Apply only the rated control voltage marked on the relay front panel. The proper polarity must be observed when the dc control power connections are made.

3. High voltage insulation tests are not recommended. See the section on testing for additional information.

4. The entire circuit assembly of the relay is removable. The unit should insert smoothly. Do not use excessive force.

5. Follow test instructions to verify that the relay is in proper working order.

CAUTION: since troubleshooting entails working with energized equipment, care should be taken to avoid personal shock. Only competent technicians familiar with good safety practices should service these devices.

PLACING THE RELAY INTO SERVICE

1. RECEIVING, HANDLING, STORAGE

Upon receipt of the relay (when not included as part of a switchboard) examine for shipping damage. If damage or loss is evident, file a claim at once and promptly notify Asea Brown Boveri. Use normal care in handling to avoid mechanical damage. Keep clean and dry.

2. INSTALLATION

Mounting:
The outline dimensions and panel drilling and cutout information is given in Fig. 1.
Connections:

Internal connections for each relay are shown in Figure 2. 439 series units are preferred for new applications due to the improved test features of the relays.

Connections for a typical dc control bus monitoring scheme using the Types 27B and 27S (439 series units) are shown in Figure 3.

Connections for typical trip circuit supervising schemes using the Type 74 are shown in Figures 4a and 4b.

DC must be connected in the proper polarity as shown in the diagrams.

These relays have metal front panels which are connected through printed circuit board runs and connector wiring to a terminal at the rear of the relay case. The terminal is marked "G". In all applications this terminal should be wired to ground.

3. SETTINGS

Type 74 Trip Circuit Supervision Relay:

No settings are required for this relay.

Type 27B Battery Ground Relay:

The 27B relay is provided with a continuously adjustable dial for selecting the sensitivity of the detection of grounds. The dial is labelled SENSITIVITY. In the MAX position (fully clockwise) the relay has its highest sensitivity to grounds on the dc bus. The MIN position (fully CCW) provides the least sensitivity. See Fig. 5 for the characteristic. In general the MAX position should be used; however, if nuisance alarms are experienced, the sensitivity can be backed off as needed for the particular system.

Type 27S DC Undervoltage Relay:

The DROPOUT dial is used to select the dc voltage level at which the relay will operate. The dial is continuously adjustable over the range of approximately 0.7 to 1.15 times the rated voltage. An internal adjustment (see acceptance testing) allows setting the differential between the operate and reset voltages, and has a range of approximately 0.5-4 percent of the setting.

An uncalibrated TIME DELAY adjustment is provided. This screwdriver adjustment has a range of approximately 0.1 to 2 seconds. This delay on dropout is provided to allow the relay to ignore any momentary drop in voltage level.

4. INDICATORS

Indicators are provided to assist in testing and to give operating personnel information on the status of the relay:

Type 74 Trip Circuit Supervision Relay:

Three light emitting diodes and a target are provided. When trip circuit conditions are normal, one of the yellow led's and the green led will be lit. The target can be reset by depressing the TARGET RESET button. The yellow led labelled "A" will be on when the circuit breaker is closed. The yellow led labelled "B" will be on when the circuit breaker is open. Should a problem occur with the trip coil circuit, or with the dc supply, the led's will go off, and the target will be set simultaneously with the operation of the relay's output contacts. The target can not be reset until normal system conditions are restored.

Type 27B Battery Ground Relay:

Two red led's are provided. The led labelled Ground-on-Positive will light when there is a ground on the positive dc bus which is sufficient to cause the 27B relay to operate. The led indication is simultaneous with the transfer of the output contacts (terminals 10-11-12 on 439 series units). For grounds on the negative bus the led labelled Ground-on-Negative will light, and the other set of output contacts will transfer (terminals 13-14-15 on 439 series units). Upon removal of the ground condition the relay contacts will be self-resetting and the led will go out.
INDICATORS (cont.)

Type 27S DC Undervoltage Relay:

One led and a target are provided. The green led will be on when a dc voltage above the reset voltage is applied to the relay. The target can be reset by pushing the TARGET RESET pushbutton. Should the dc voltage level fall below the dropout setting of the relay, the led will go off. If the voltage does not return above the reset setting by the end of the time delay period, the output contacts will transfer and the target will be set. The target can not be reset until the voltage returns to normal.

APPLICATION DATA

Type 74 Trip Circuit Supervision Relay:

The ABB Circuit-Shield™ Type 74 is used to monitor the integrity of a circuit breaker's trip coil and associated wiring. The relay may be connected to monitor the trip circuit with the breaker in both the open and closed positions (Figure 4a), or just for the closed position (Figure 4b).

The relay will alarm for an open trip circuit and for a loss of dc control voltage. It will also alarm if a trip signal is received but the breaker fails to operate.

Trip circuit continuity is measured by passing a small current through the trip coil circuit. Breaker auxiliary contacts are used to indicate to the relay whether the breaker is in the open or closed position.

The operating time of the relay is approximately 400 milliseconds to prevent nuisance alarms on breaker operation or dc control power transfer.

Type 27B Battery Ground Relay:

The ABB Type 27B relay is used to detect grounds on the normally ungrounded dc control power bus, and to indicate whether the ground is on the positive or negative conductor. This is accomplished by measuring the difference in potential between ground and the midpoint voltage. A midpoint is established within the relay by two 30 kilohm resistors connected between positive and negative and grounded at the centerpoint between them.

A sensitivity adjustment is provided on the front panel of the relay. For a 125vdc system, a fault resistance from the positive or negative conductor to ground of 70 kilohms or less can be detected with the relay set for maximum sensitivity. Refer to Figure 5 for the typical range of sensitivity provided.

When a ground is alarmed, action should be taken to locate and remove the ground in order to preserve the reliability of the control power system.

The Type 27B has been qualified for class 1E nuclear service.

Type 27S DC Undervoltage Relay:

The ABB Circuit-Shield Type 27S, catalog series 439U/239U is an accurate, self-powered relay for monitoring dc control power busses. It may be used to alarm an undervoltage condition, or to initiate transfer to an alternate supply. The dropout voltage of the relay is continuously adjustable from 70 to 115 percent of its nominal dc rating. Reset is adjustable from approximately 0.5 to 4 percent higher than the dropout voltage.

A time delay on dropout is provided to override momentary conditions, and standard units have an adjustment range of approximately 0.1-2 seconds.

The Type 27S employs a latching relay in its output stage to provide a long-life, as compared to relays where the coil is continuously energized. The Type 27S relay has been qualified for a 40 year life per IEEE-323 for class 1E nuclear service.
Figure 1: Relay Outline and Panel Drilling

NOTE: DIMENSIONS ARE INCH/MM

16D439C Type 27B Battery Ground Relay Drawout Test Case

16D439A Type 74 Trip Circuit Supervision Relay Drawout Test Case

16D439B Type 27S DC Undervoltage Relay Drawout Test Case

Figure 2: Internal Connections 439 Series Units

Notes:
1. For 239 Series Units refer to page 15.
2. Type 27B contacts shown in the "normal" (non-alarm) state.
   Type 27S contacts shown in the undervoltage state.
   Type 74 contacts shown in the trip-coil-open state (alarm).
SPECIFICATIONS:

Type 27B Battery Ground Relay:

Input Circuit Rating: 100-140 Vdc (125vdc nominal unit)
88-125 Vdc (110vdc nominal unit)
30-50 Vdc (48vdc nominal unit)

Input Circuit Burden: 50 ma. maximum.

Output Contact Ratings: see page 7.

Operating Temperature Range: -30 to +70 degrees C.

Dielectric: 2000 Vac rms, 1 minute, all circuits to ground, with ground connection removed from terminal 9.

Type 27S DC Undervoltage Relay:

Input Circuit Rating: 150 Vdc max. continuous (125vdc nominal unit)
135 Vdc max. continuous (110vdc nominal unit)
60 Vdc max. continuous (48vdc nominal unit)

Input Circuit Burden: 50 ma. max. (125vdc or 110vdc rated units)
80 ma. max. (48vdc rated unit)

Dropout Voltage: adjustable 0.7 - 1.15 times nominal rating.

Pickup/Dropout Ratio: adjustable 0.5 - 4% of dropout setting.

Operating Time: standard units adjustable approximately 0.1 - 2 seconds.

Output Contact Ratings: see page 7

Operating Temperature Range: -30 to +70 degrees C.

Tolerances: accuracy with respect to printed dial markings: +/-10%.

repeatability after calibration to a particular operating setting: better than +/-0.25%.

variation of dropout setting with temperature variation -20 to +70° C with respect to 25° C value: +/-2%.

variation of time delay setting with temperature variation -20 to +70° C with respect to 25° C value: +/-7%.

Dielectric: 2000 Vac rms, 1 minute, all circuits to ground, with ground connection removed from terminal 9.
Type 74 Trip Circuit Supervision Relay:

Input Circuit Rating: 140 Vdc max. continuous (125vdc nominal unit) 125 Vdc max. continuous (110vdc nominal unit)

Input Circuit Burden: 25 ma. maximum (supervising current through the trip circuit).

Control Power Drain: 20 ma. maximum (current into terminals 7 & 8).

Operating Time: approximately 400 milliseconds.

Dropout Voltage: approximately 30 Vdc on loss of dc control voltage.

Output Contact Ratings: see below.

Operating Temperature Range: -30 to +70 degrees C.

Dielectric: 2000 Vac rms, 1 minute, all circuits to ground.

Contact Ratings - Types 27B, 27S, 74:

<table>
<thead>
<tr>
<th>Each contact:</th>
<th>at 125 Vdc</th>
<th>at 120 Vac</th>
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</thead>
<tbody>
<tr>
<td>Tripping</td>
<td>30 A</td>
<td>30 A</td>
</tr>
<tr>
<td>Continuous</td>
<td>5 A</td>
<td>5 A</td>
</tr>
<tr>
<td>Break</td>
<td>0.3 A</td>
<td>2 A</td>
</tr>
</tbody>
</table>

SUMMARY OF COMMON UNITS - 439 Series

<table>
<thead>
<tr>
<th>Type</th>
<th>Control Voltage Rating²</th>
<th>Internal Connections</th>
<th>Catalog Numbers¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>27B</td>
<td>125 Vdc</td>
<td>16D439C</td>
<td>439G0045</td>
</tr>
<tr>
<td></td>
<td>110 Vdc</td>
<td></td>
<td>439G0005</td>
</tr>
<tr>
<td></td>
<td>48 Vdc</td>
<td></td>
<td>439G0035</td>
</tr>
<tr>
<td>27S</td>
<td>125 Vdc</td>
<td>16D439B</td>
<td>439U6345</td>
</tr>
<tr>
<td></td>
<td>110 Vdc</td>
<td></td>
<td>439U6305</td>
</tr>
<tr>
<td></td>
<td>48 Vdc</td>
<td></td>
<td>439U6335</td>
</tr>
<tr>
<td>74</td>
<td>125 Vdc</td>
<td>16D439A</td>
<td>439S0045</td>
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<tr>
<td></td>
<td>110 Vdc</td>
<td></td>
<td>439S0005</td>
</tr>
<tr>
<td></td>
<td>48 Vdc</td>
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<td>439S0035</td>
</tr>
</tbody>
</table>

Notes:

1. See page 15 for units of catalog series 239 which are obsolete. 439 series units have improved testing features and should be specified for new applications.

2. Consult factory for availability of control voltage ratings not listed.
27X - Annunciator, alarm for low dc voltage.
64X2 - Annunciator, alarm for ground on negative.
Legend: 64X1 - Annunciator, alarm for ground on positive.

Figure 3: Typical connections for Type 27B Battery Ground Relay and Type 27S DC UnderVoltage Relay
Figure 4a: Typical Connections for Type 74 Supervising Trip Circuit for Circuit Breaker in both the Open and Closed Positions.

Figure 4b: Typical Connections for Type 74 Supervising Trip Circuit for Circuit Breaker in the Closed Position only.
Figure 5: Sensitivity Characteristic
Type 27B Battery Ground Relay

Figure 6a: Type 27S

Figure 6b: Type 27B

Figure 6c: Type 74
TESTING

1. MAINTENANCE AND RENEWAL PARTS

No routine maintenance is required on these relays. Follow test instructions to verify that the relay is in proper working order. We recommend that an inoperative relay be returned to the factory for repair; however, a schematic diagram can be provided on request. Renewal parts will be quoted by the factory on request.

The earlier versions of these relays, catalog series 239 are now obsolete and have been superseded by catalog series 439 units which have improved testing features. See page 15 for information on the 239 series.

439 Series Units:

Metal handles provide leverage to withdraw the relay assembly from the case. Removing the unit in an application that uses a normally closed contact will cause an operation. The drawout assembly is identified by the catalog number stamped on the front panel and the serial number stamped on the bottom of the circuit board.

Test connections are readily made to the drawout relay unit by using standard banana plug leads at the rear vertical circuit board. This rear board is marked for easier identification of the connection points.

A test plug assembly, catalog 400X0002 is available for use with the 439 series units. This device plugs into the relay case on the switchboard and allows access to all external circuits wired to the case. See Instruction Book IB 7.7.1.7-8 for details on the use of this device.

2. HIGH POTENTIAL TESTS

High potential tests are not recommended. A hi-pot test was performed at the factory before shipping. If a control wiring insulation test is required, partially withdraw the relay unit from its case sufficient to break the rear connections before applying the test voltage.

3. BUILT-IN TEST FUNCTION

Be sure to take all necessary precautions if tests are run with the main circuit energized.

The built-in test feature is provided as a convenient functional test of the relay and its associated trip or alarm circuit. Pushing the TEST button will cause the relay to pick up, time-out, and operate. The button must be held down long enough for the relay's timing circuit to time-out.

Type 27B: Two test buttons are provided, one to simulate a ground on the positive conductor, and the other for a ground on the negative. When the button is pressed, the associated red led should light and the associated output contacts transfer. If both test buttons are depressed simultaneously no operation will occur.

Type 27G: The built-in test simulates an undervoltage condition. When the test button is pressed, the green led should go out, and after the time delay, the target should show and the output contacts transfer.

Type 74: The built-in test simulates a trip circuit failure. When the test button is pressed, the led's should go out, the target should show, and the output contacts should transfer.
4. ACCEPTANCE TESTS

**Type 27B Battery Ground Relay:**
A typical acceptance test circuit is shown in Figure 7. A resistor substitution box or potentiometer can be used to simulate the fault resistance to ground - R1 in the figure.

With rated dc voltage applied, test resistor R1 at maximum resistance, and the SENSITIVITY dial set to minimum, actuate the built-in test button for the positive side. Observe that the positive side led lights and contacts 11-12 transfer. Repeat for the negative side test button, and observe that the negative side led lights, and contacts 14-15 close.

With rated dc voltage applied, S1a closed, S1b open, and the SENSITIVITY dial set to MAX, reduce resistance R1 until the relay operates. The red led that indicates a ground on positive should light and contacts 11-12 should close. R1 should be between 70 and 120 kilohms.

Return R1 to its maximum value. Open S1a and close S1b. Reduce the resistance of R1 until the relay operates. The red led that indicates a ground on negative should light and contacts 14-15 should close. Again, R1 should be between 70 and 120 kilohm.

The internal balance adjustment, R12, can be used to equalize the Pos. side and Neg. side sensitivities if desired. See circuit board layout on page 11.

**Type 27S DC Undervoltage Relay:**
A typical acceptance and calibration test circuit is shown in Figure 8. A stable, adjustable, filtered dc power supply is needed as the test source.

Observing the green led pickup indicator on the front panel, raise and lower the dc source voltage slowly to determine the dropout and pickup voltages. The tolerance on the front panel DROPOUT voltage dial is +/-10%. Should the dial calibration be out of tolerance, internal calibration potentiometer R4 can be readjusted as necessary to improve its accuracy for the particular setting to be used in the application.

The voltage difference between the pickup and dropout points can be adjusted using internal calibration potentiometer R8. (See page 11 for the circuit board layout.)

To adjust the operating time of the relay, set the dc source voltage to a value above pickup. Then actuate switch S1. The relay will time out and operate. Read the operating time on the timer. The time delay potentiometer (screwdriver adjustment) on the front panel can be used to obtain the desired time delay (adjustment range 0.1-2.0 seconds +/-20%).

With the dc source voltage above pickup, actuate the TRIP TEST button and observe that the relay times out and transfers its contacts.

Proper operation of the green led pickup indicator and the operation target should be observed during the above tests.

**Type 74 Trip Circuit Supervision Relay:**
A typical acceptance test circuit is shown in Figure 9. Switch S1 is single-pole double-throw. Contact S1a is used to simulate the breaker 52/a contact, and S1b the breaker 52/b contact. Switch S2 simulates an open trip circuit or loss of dc control voltage.

Apply rated dc control voltage and close S2. With S1a closed, S1b open, the led indicators labelled "A" and "C" should be on. Contacts 11-12 and 14-15 should be open. Actuate the TARGET RESET.

Open S1a, close S1b. Led's "B" and "C" should be on and contacts 11-12 and 14-15 should have remained open with no momentary closure.

Open switch S2. All led's should go out and contacts 11-12 and 14-15 should close. The target should set to orange.
Figure 7: Typical Test Circuit
Type 27B

Figure 8: Typical Test Circuit – Type 27S

Figure 9: Typical Test Circuit
Type 74
5. CATALOG SERIES 239 UNITS (obsolete)

Catalog Numbers 239Gxxxx, 239Sxxxx, 239Uxxxx:

Catalog series 239 has been superseded by units of the 439 series due to the improved test features provided. Units with a catalog number 239xxxxxx which is identical (except for the first digit) to those listed on page 7 have the same electrical characteristics as the 439 series described in this instruction book; but the connections are different: the internal connection diagrams are given below in Figure 10.

The test procedures given for the 439 series units may be used for these relays if the test circuit connections are revised as required for the internal connections shown below.

![Diagram of Battery Ground Relay](image1)

![Diagram of Trip Circuit Supervision Relay](image2)

![Diagram of D.C. Undervoltage Relay](image3)

**Figure 10: Internal Connections 239 Series Units**

See page 5 for 439 Series Units

Type 27S Catalog Numbers 239Kxxx5, 239Lxxx5:

Relays with catalog numbers of this form are early versions of the Type 27S DC Undervoltage Relay, and were designed primarily for go/no-go monitoring of control voltage conditions. Type 27S relays of catalog series 439U and 239U are significantly more accurate than these relays and the 439U series is recommended as a replacement (wiring changes will be required). Internal connection diagram 12D239A shown above applies to the 239K and 239L series relays.

Type 27B Catalog Numbers 239D0505:

A Type 27B relay with catalog number 239D0505 is an early version of the Type 27B. The 439G0045 is recommended as a replacement (wiring changes will be required). Internal connection diagram 12D239C shown above applies to the 239D0505 relay.
These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in conjunction with installation, operation, or maintenance. Should particular problems arise which are not covered sufficiently for the purchaser’s purposes, the matter should be referred to Asea Brown Boveri.