HIGH POWER RECTIFIERS

Reverse current relay US B025 AE

Datasheet

Revision

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Abbreviation index

Abbreviation	Description
gnd	Ground
Vcc	Voltage at the common collector

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1 Purpose of document

This document will provide technical information about the ABB reverse current protection relay US B025 AE.

2 Application

The reverse current relay is designed to protect high-power DC rectifiers and their related circuitry. Typically, one relay is used on each rectifier bus that feeds a common load. The reverse current relay provides protection against both forward current and reverse-current overloads. The relay provides two outputs, one for forward current (out +) and the other for reverse current (out -) which are in high output state (~21V) when current is below the setting. In case the reverse current exceeds the set value, the output “out -“ changes to low state instantaneously. The same applies for forward current setting with “out +“ changing to low state on forward overcurrent.

3 Operating principle

The reverse current relay monitors the magnetic field with the aid of a hall sensor and generates two short circuit proof signals for controlling external relays when the field strength rises above or falls below a set limit. The first channel can be calibrated for a negative field and the second for a positive one. If the measured field strength is between the two limits, both outputs will be high. When the field strength is outside the set limits the corresponding output is low.

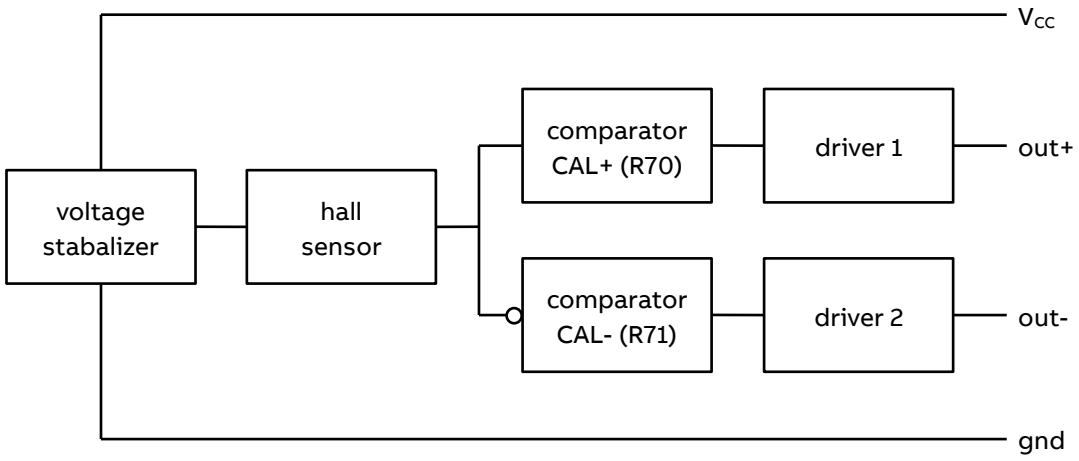

Figure 1: Block diagram

4 Technical data

4.1 Auxiliary supply

Supply voltage	15…32 V_{DC}
Supply current	250 mA

4.2 Input

Field strength	-35…0…+35 mT Perpendicular to the surface of the sensor field direction as marked on the casing

4.3 Output

Output signal high	OUT+ in high stage	15…32 V_{DC}, 50mA short-circuit proof
Output signal low	OUT+ in low stage	high impedance Connect external relay between OUT+ and GND without a free-wheeling diode
Output signal high	OUT- in high stage	15…32 V_{DC}, 50mA short-circuit proof
	OUT- in low stage	high impedance Connect external relay between OUT+ and GND without a free-wheeling diode

4.4 Settings

Forward current	R70	0…32 mT
Reverse current	R71	-32…0 mT

4.5 Protection class

According to IEC 60529.

Casing (IP65) and cable glands IP 65 [1) 2)].

[1)] After the cables have been terminated, the tops of the pressure screws must be sealed with a suitable compound and seals placed over the threads of the glands.

[2)] Dust and splash waterproof.

4.6 Ambient conditions

Ambient temperature	Operating	-40...85 °C
	Storage	-40...85 °C

4.7 Electrical connection diagram

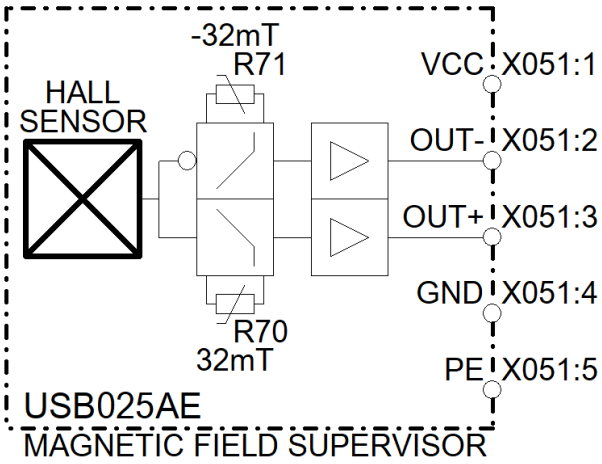

Figure 2: Electrical connection diagram

5 Mechanical Data

5.1 Mechanical design

Dimensions	150x300x166 (with case)
Case material	PA66
Terminals	0.2…4 mm^2

5.2 Mechanical drawing

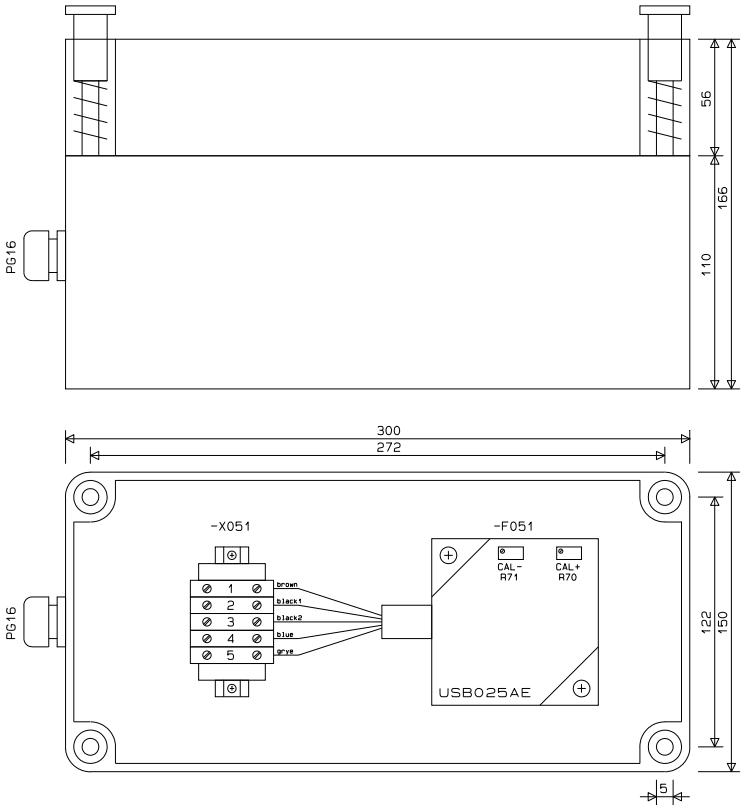

Figure 3: Mechanical drawing

5.3 Installation position

The box containing the reverse current relay must be mounted on the busbar. Current flow direction as indicated on relay must be respected.

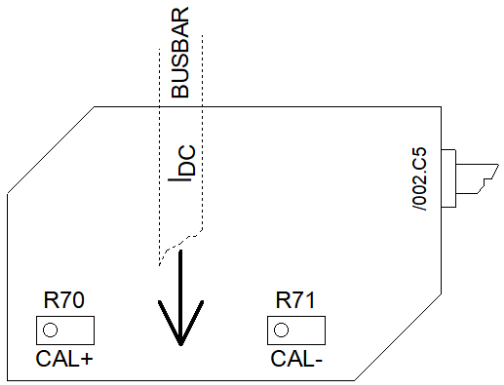

Figure 4: Current flow direction

Cable length must be long enough to rotate the box by 180° during adjustment of current settings.

6 Adjustment Procedure

The magnetic field at the sensor's location depends on the mechanical layout of the rectifier unit and the potline. Hence the relay can be adjusted at site only.

Caution

While the trip signal must be blocked for this procedure, the reverse current trip is out of operation. Operator's attention will be absolutely necessary should anything happen during this time.

6.1 Potentiometers for adjustment

Two potentiometers are located on the reverse current relay. These potentiometers can be adjusted with a small flat screwdriver. Direction of rotation from potentiometers are as shown below.

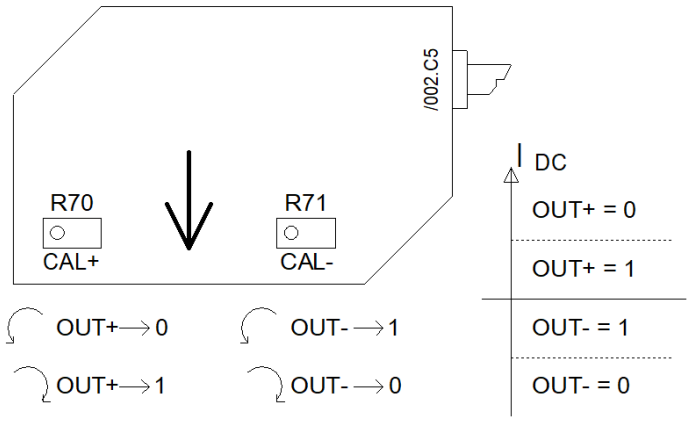

Figure 5: Potentiometer directions

6.2 Remark

Since this magnetic field monitoring detects current in both directions and usually only the reverse function is used, both output signals shall be set to the same limit (e.g. 15 kA). In case the reverse current output is malfunctioning, the relay can be turned by 180° and forward output can be used instead.

6.3 Procedure for reverse current setting

There are two different procedures how to calibrate the relay. While calibrating on a life busbar gives more accurate results, the calibration on a work bench allows working under no load.

6.3.1 Calibration procedure on life busbar

1. Ensure work can be done safely at the DC-busbar where the sensor is installed. Use a fiber glass step ladder to be completely isolated from the ground and make sure not to touch any metal part of the rectifier cubicle. Additionally to the standard PPE, wear electrical isolating boots and electrical isolating gloves while working at the sensor. In this setup the potline does not need to be stopped.
2. Block the trip signal of the to be adjusted reverse current relay from activating a potline trip (key-switch or jumper). The 24 VDC monitoring relay must still function normal for testing.
3. Turn the box with the sensor by 180° and run the unit at the desired setting for the reverse current (e.g. 15 kA, lower settings can cause nuisance trips).
4. Use the potentiometer R71 to calibrate the reverse current threshold level. Adjusting one potentiometer will always have slight impact on the setting of other direction. Turn at CAL- counterclockwise until the output terminal -X051:2 in the sensor box changes to high state (logical 1 ≈ 21 V_{DC}). One full turn of the potentiometer is related to approx. 1.6 kA.
5. Turn the sensor 180° back to the original position.
6. Use the potentiometer R70 to calibrate the forward current threshold level. Turn at CAL+ counterclockwise until the output terminal -X051:3 in the sensor box changes to high state (logical 1 ≈ 21 V_{DC}).
7. Turn the sensor again by 180° and verify the output signal is still high (logical 1 ≈ 21VDC). You need to reset the reverse current trip on the front door of the CTP for the 24 VDC monitoring relay to energize. You need a second person Infront of the CTP confirming that the 24 VDC monitoring relay is energized. Turn at CAL- in counterclockwise direction, until the output signal drop to about 17 VDC. The 24 VDC monitoring relay will drop off or be about to drop off (start chattering). If the output signal is already low, turn back CAL- clockwise until the output signal becomes high, reset the reverse current trip on the CTP and then turn CAL- in counterclockwise direction, until the output signal reach about 17 VDC.
8. Run the rectifier at a higher current (perhaps 20 kA) and reset the reverse current trip in the CTP. Ramp the rectifier down to 10 kA and observe at what current level the reverse current trip appears.
9. If it is in the region of 14 to 16 kA, the sensor is properly adjusted. Repeat the test above one more time.
10. Install the reverse current relay at its original rotational position. Reset the reverse current trip on the CTP and ramp the rectifier up to maximum current and down to zero current checking that the newly adjusted reverse current relay is not activating a trip. Do it two times, and then run the rectifier for two hours to see if the relay is stable.
11. Make sure that there is no trip signal activated on the CTP and then remove the block from this adjusted reverse current relay trip.
12. Clean the site and give the rectifier back to operations.

6.3.2 Calibration procedure on workbench

1. Ensure work can be done safely, wear your PPE.
2. Energize the relay with 24 V_{DC}.
3. Use the potentiometer R71 to calibrate the reverse current threshold level. Adjusting one potentiometer will always have slight impact on the setting of other direction. Turn at CAL- clockwise until the output terminal -X051:2 in the sensor box changes to low state (logical 1 ≈ 17 V_{DC}). One full turn of the potentiometer is related to approx. 1.6 kA. At this point, the relay is set up for detecting 0 kA_{DC}. Turn the CAL- counterclockwise back, to the desired value > calculation of turns:

   $$number\ of\ turns = \frac{desired\ \ DC\ current\ setting\ of\ relay\ in\ kA}{1.6\ kA}$$

   The relay is now set up on approx. the desired DC current in kA.
4. Repeat the same procedure for forward direction.
   Use the potentiometer R70 to calibrate the forward current threshold level. Turn at CAL+ counterclockwise until the output terminal -X051:2 in the sensor box changes to low state (logical 1 ≈ 17 V_{DC}). Turn from this point on backwards the desired amount of turns (same calculation as above).
5. Installation and test.
   Ensure work can be done safely at the DC-busbar where the sensor is installed. Use a fiber glass step ladder to be completely isolated from the ground and make sure not to touch any metal part of the rectifier cubicle. Additionally to the standard PPE, wear electrical isolating boots and electrical isolating gloves while working at the sensor. If the mounting place is behind the DC isolators use this chance and do the mounting while rectifier is switched off. Pay attention, collector DC busbar part inside rectifier cabin is always alive! If relay is mounted at the live busbar part (inside or outside of the rectifier container), take all necessary measures to work safely.
6. Block the trip signal of the to be adjusted reverse current relay from activating a potline trip by key-switch. The 24 VDC monitoring relay must still function normal for testing.
7. Place the box with the sensor turned by 180° towards final position and run the unit at the desired setting. Reverse current direction will detect forward current in this position.
8. Increase the DC current set point slowly above the set-up limit of relay. Check where exactly the trip active alarm is triggered (no trip signal since disabled, but a trip active alarm is appearing).
9. If the trip limit value is satisfying, switch the rectifier unit off again and turn the relay back in its final position (reverse current detects reverse direction). Otherwise, if trip limit value is not matching with desired limit, switch off the rectifier unit and adjust again with one turn per 1.6 kA.
10. Retest once again the trip limit as shown in step 8. In most cases, a trip limit difference of up to 4 kA is acceptable.
11. Install the relay box in its operation position.
12. Make sure that there is no trip signal activated on the CTP and then remove the block from this adjusted reverse current relay trip.
13. Clean the site and give the rectifier back to operations.

7 Ordering data

Reverse current relay US B025 AE	HIEE401196R0001
Reverse current relay with box and terminals	3BHE002061R0001