Application Note

A Guide for Performing the Anti-Pump relay check with the CIBANO 500

Author
Ryan Manning | ryan.manning@omicronenergy.com

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CIBANO 500

Application Area
Circuit Breaker testing

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Abstract

This document provides guidance on performing the anti-pump relay check on a circuit breaker using the CIBANO 500 test instrument. The anti-pump relay is critical in preventing pumping of a circuit breaker. Pumping causes the breaker contacts to repeatedly open and close. The anti-pump relay prevents this by cutting off the supply to the breaker close coil.

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1 Safety instructions

This Application Note may only be used in conjunction with the relevant product manuals which contain all safety instructions. The user is fully responsible for any application that makes use of OMICRON products.

Instructions are always characterized by a ▶ symbol, even if they are included in a safety instruction.

DANGER

Death or severe injury caused by high voltage or current if the respective protective measures are not complied with.

- ▶ Carefully read and understand the content of this Application Note as well as the manuals of the systems involved before taking them into operation.
- ▶ Please contact OMICRON support if you have any questions or doubts regarding the safety or operating instructions.
- ▶ Follow each instruction listed in the manuals, especially the safety instructions, since this is the only way to avoid the danger that can occur when working on high voltage or high current systems.
- ▶ Only use the equipment involved according to its intended purpose to guarantee safe operation.
- ▶ Existing national safety standards for accident prevention and environmental protection may supplement the equipment's manual.

Only experienced and competent professionals that are trained for working in high voltage or high current environments may implement this Application Note. Additionally, the following qualifications are required:

- Authorized to work in environments of energy generation, transmission, or distribution, and familiar with the approved operating practices in such environments.
- Familiar with the five safety rules.
- Good knowledge/proficient in working with the CIBANO 500 and testing of MV/HV circuit breakers

2 Introduction

The purpose of the anti-pump relay is to prevent an unintentional close operation on a circuit breaker. The anti-pump relay is in the close circuit. This unintentional close operation defines a scenario in which the circuit breaker repeatedly opens and closes its contacts without any control from the breaker operator. When energized, the anti-pump relay prevents this by cutting off the supply to the close coil.

Figure 1 shows the anti-pump relay within the breaker close circuit schematic.

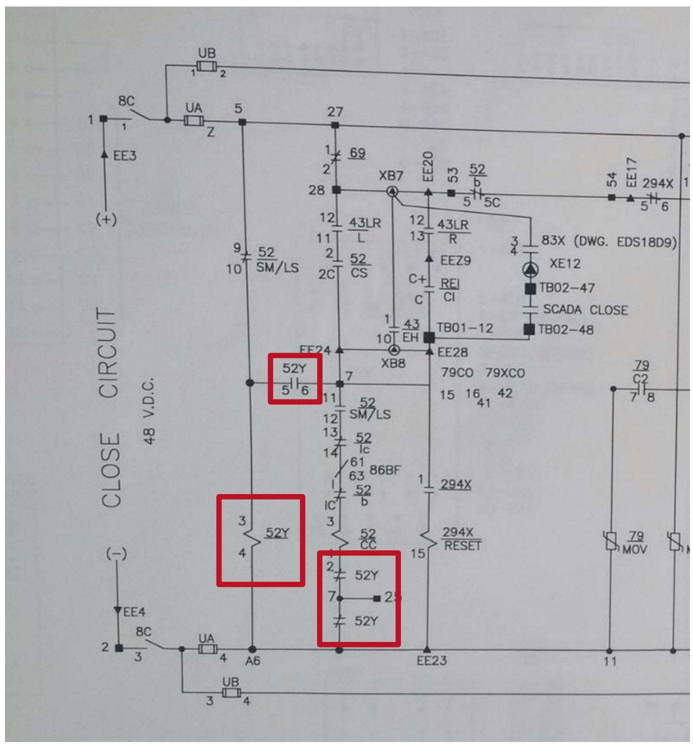

Figure 1: Anti-pump relay in the close circuit scheme.

Figure 2 shows a breaker control panel with a closer view of where the anti-pump relay is located.

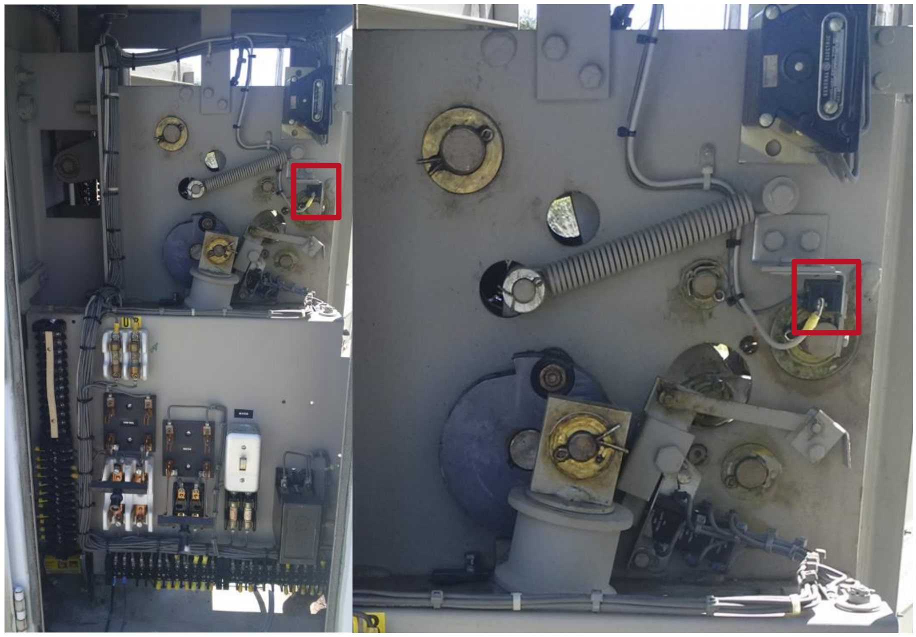

Figure 2: Anti-pump relay on a breaker control panel.

If an unintentional close operation occurs during a fault event, the breaker will trip open and immediately close because the unintentional close signal energizes the close coil. Because the fault persists, the breaker will again trip. If the close signal continues to be applied, this begins a cycle of uncontrollable tripping and closing known as pumping. This sequence can damage the breaker mechanism and contacts.

3 Measurement Theory

The anti-pump relay check is not a typical CIBANO 500 circuit breaker measurement. Instead, a contact timing test is used to verify the functionality of the relay, while also assessing the timing of the breaker main and auxiliary contacts. Because the test does not measure the relay specifically, it is more of a functional check than a measurement.

The timing measurement considers a variety of breaker operation types. These include the Open (O) timing, Close (C) timing, Close-Open (CO) timing, and Open-Close (O-C) timing. CO is also known as a trip-free operation, and O-C is also known as a reclose operation.

Figure 3 shows how these measurements are put into a test plan using the Primary Test Manager (PTM) software.

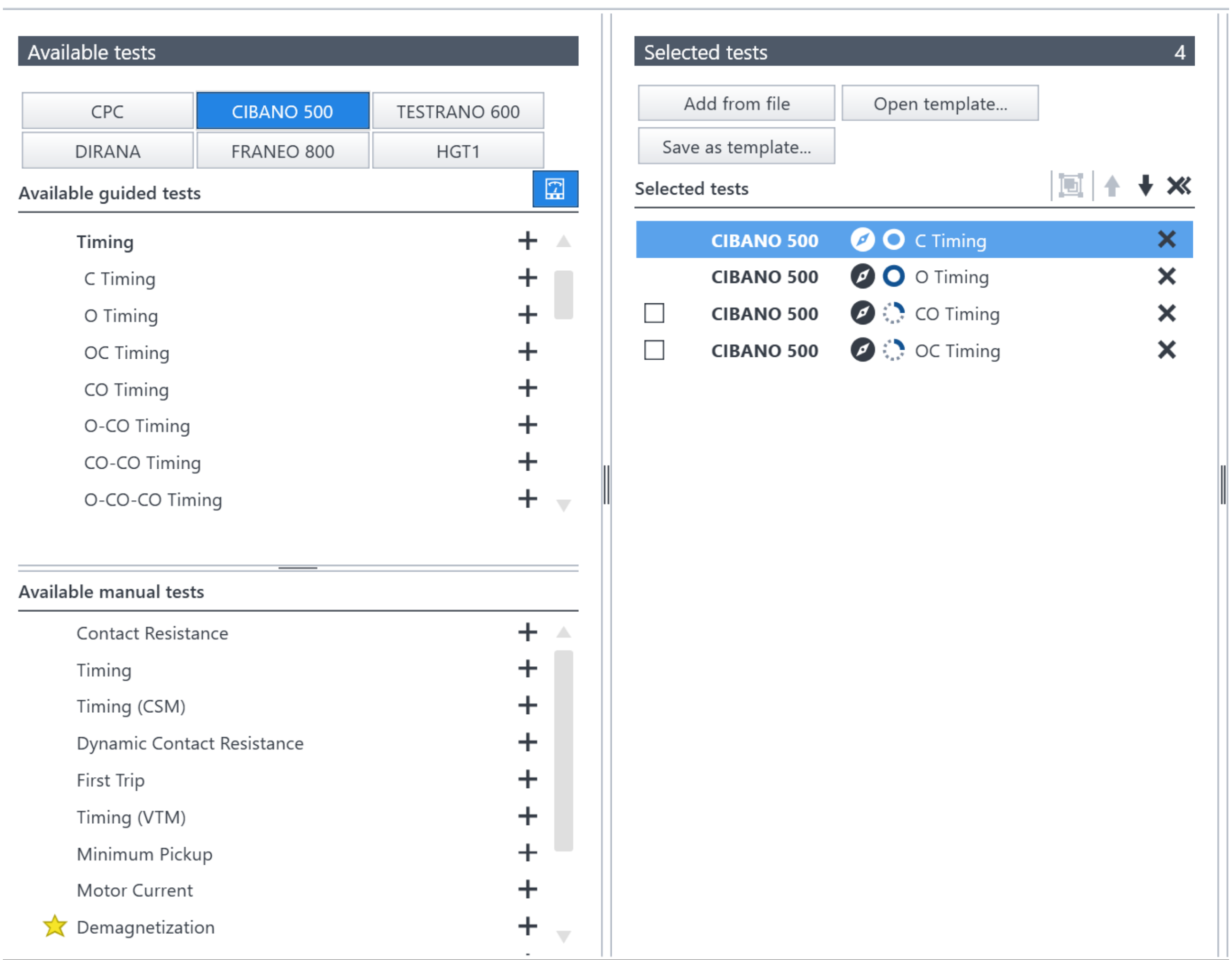

Figure 3: Contact timing test plan in PTM.

Performing the trip-free (CO) measurement emulates the circumstances in which the hunting effect occurs in the event of a TNC switch failure. There is a standing close signal applied followed by a trip signal. The trip signal represents the fault event occurring on the line. The standing close signal represents an unintentional close command on the breaker.

Figure 4 shows an example of a CO (Close-Open) timing measurement performed in PTM.

Figure 4: CO Timing measurement performed in PTM.

In a typical CO timing measurement, the close signal is applied for 133ms and the open signal is applied for 66ms. In the anti-pump relay check, the close signal time is significantly extended to emulate the overlapping of the applied open and close signals.

During the anti-pump relay check, the following sequence will occur:

1. The applied close signal energizes the close coil, the breaker contacts close.
2. The applied open signal energizes the open coil, the breaker contacts open.
3. The anti-pump relay recognizes the continued supply to the close coil.
4. The relay audibly clicks, cutting off supply to the close coil. The breaker contacts remain open.

It is critical to the anti-pump relay check that the circuit breaker charging motor is isolated. After the breaker close operation, the charging motor will immediately attempt to re-energize the close spring in preparation for the next close. This generates noise which will drown out the clicking sound of the relay.

This is avoided by opening the knife switch that connects the motor to its power supply. It is important that this knife switch is opened after the motor has already charged the close spring for this test.

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4 Measurement Execution

The procedure begins by setting up a CO timing measurement in a PTM test plan as shown in Figure 3. Continue by populating the CO timing measurement settings and physically wiring the CIBANO to the circuit breaker. It is important to verify the correct sources for the open/close coils and the charging motor.

Figure 5 shows an example of the completed settings and conditions for a CO timing measurement.

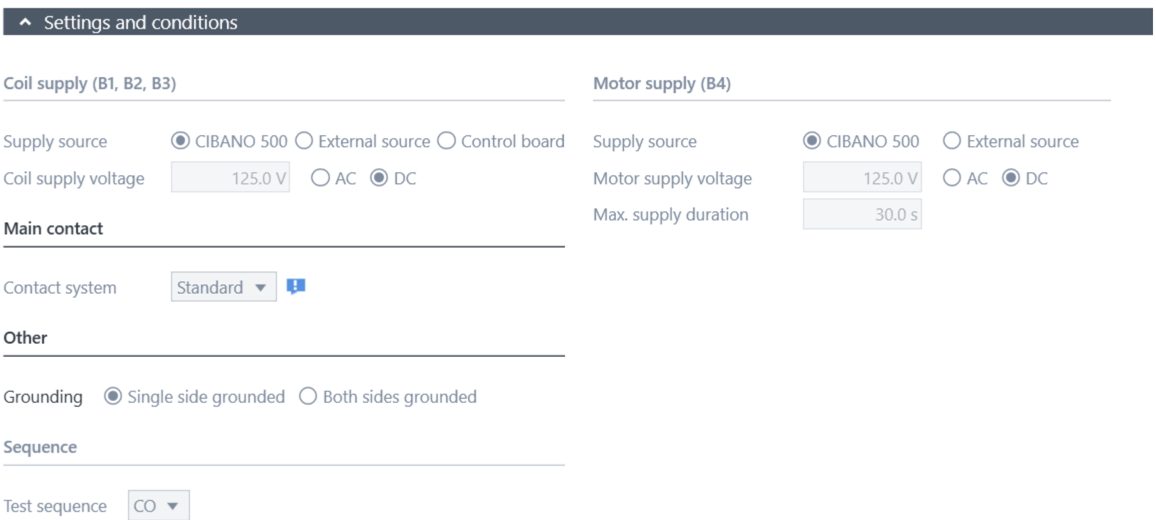

Figure 5: Settings and conditions for a CO timing measurement.

Figure 6 shows the wiring diagram for a CO timing measurement.

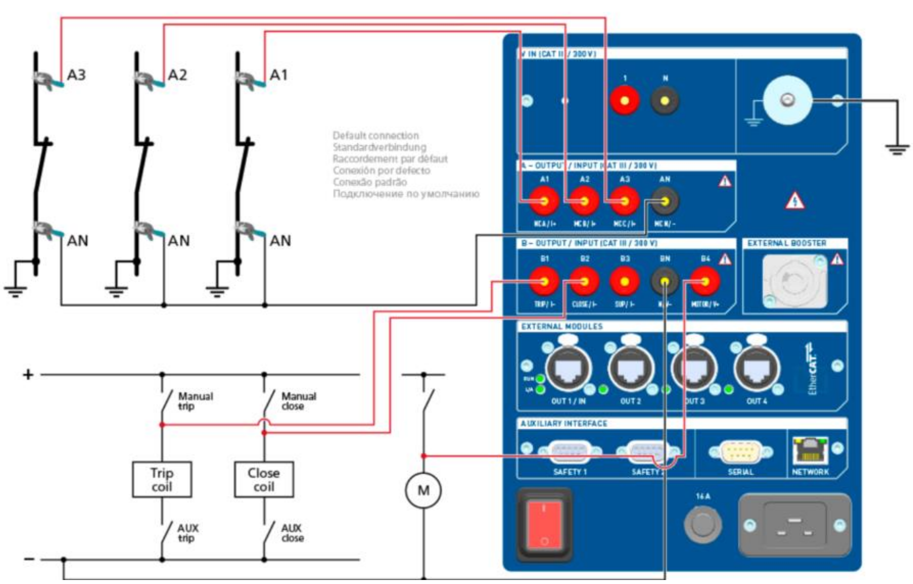

Figure 6: Wiring diagram for a CO timing measurement.

For the next step, the testing sequence of the breaker must be set up appropriately in PTM. The recommended sequence is as follows:

1. Set the close signal timing to 4950ms
2. Set the first delay to 500ms
3. Set the open signal timing to 200ms
4. Leave the final delay at the default 50ms

Figure 7 shows the completed CO timing sequence for the anti-pump relay check in PTM.

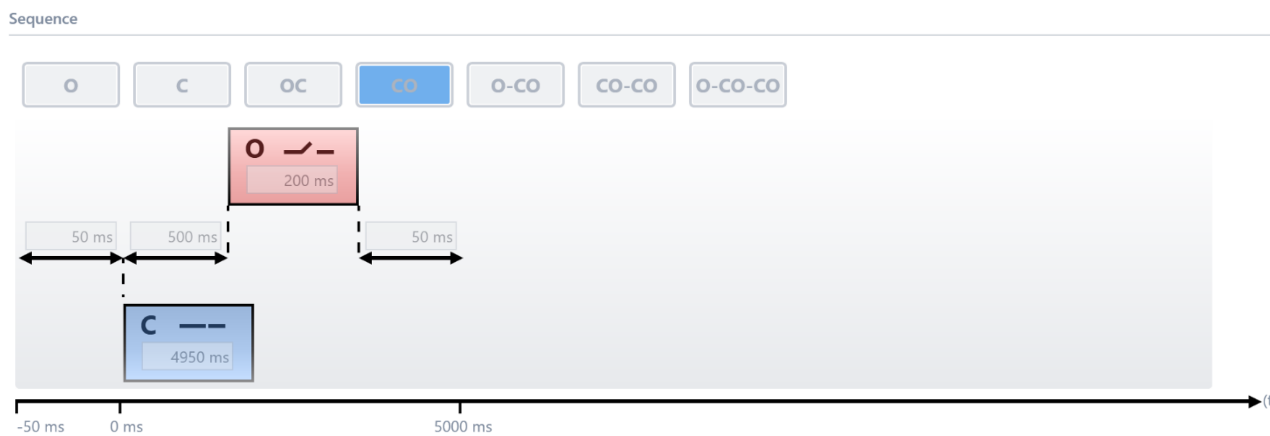

Figure 7: Anti-pump relay check timing sequence.

Notice that the total time of the sequence comes out to 5000ms or 5 seconds. This setup will create consistency throughout future timing tests and make their measurement plots easier to analyze.

Figure 8 shows the plotted results of a completed anti-pump check.

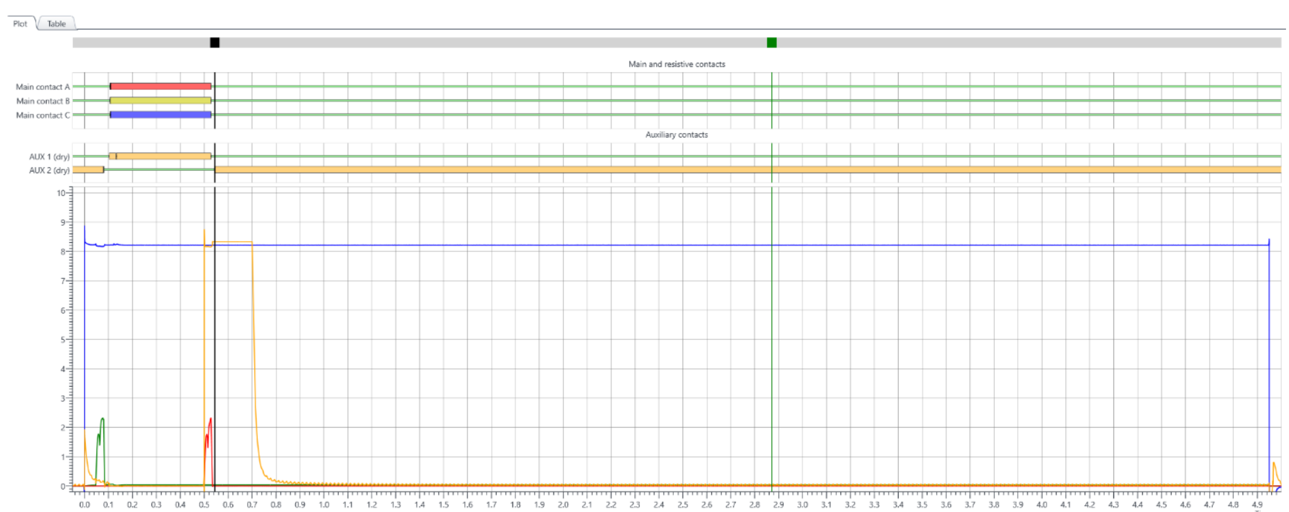

Figure 8: Anti-pump relay check timing results.

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The timing of the breaker main contacts and auxiliary (dry) contacts is shown just about the plot. Note that any wet (auxiliary) contacts of the breaker can also be measured. The main plot shows the coil current traces for the close (green) and open (red) coils. Also included are the voltage levels applied to both coils. The blue trace represents the voltage applied on the close coil. The yellow trace represents the voltage applied on the open coil.

The sequence of the breaker can be summarized using the plot:

1. The close signal is first applied (blue). The coil energizes (green) and the breaker closes.
2. After a 500ms delay, the open signal is applied (yellow). The open coil energizes (red) and the breaker opens.
3. The open signal ceases after 200ms while the close signal continues.
4. The close coil is not re-energized. The breaker contacts remain open.
5. 4,950ms after the start of the measurement, the close signal ceases.

Because the close coil is not re-energized, and because the breaker remains open, it is verified that the anti-pump relay has shut off the supply to the close coil as designed.

Figure 9 shows the measured values of each cursor on the plot.

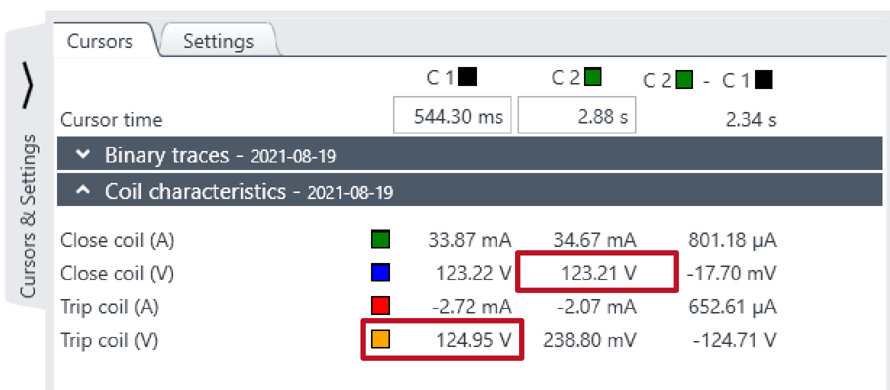

Figure 9: Plot cursor values from anti-pump check.

It is shown that the close signal applies roughly 123V throughout the duration of the signal. The open signal applies roughly 125V throughout its duration. These values coordinate to the control voltage that was determined in the coil supply settings in Figure 5.

This method shown by this note is an effective functional check of the anti-pump relay. Because the contact timing measurement is used, the anti-pump relay check can be incorporated into a standard circuit breaker test plan with minimal additional effort.

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