

## Testing Current transformers with ODEN or INGVAR

### Testing of current transformer

This application note informs about testing of current transformer with ODEN/INGVAR (hereafter only ODEN is mentioned, though the text is valid for both products), and the challenges that could arise for various current transformer installations.

#### Current transformers

Regarding current transformers, the impedance in the secondary circuit has a direct impact on the impedance. Shunting of unused circuits not included in tests of the CT should be considered. For outdoors current transformers, current cable impedance is usually the problem. Not the impedance of the current transformer.

#### ODEN current transformer tests

Usual tests on a current transformer

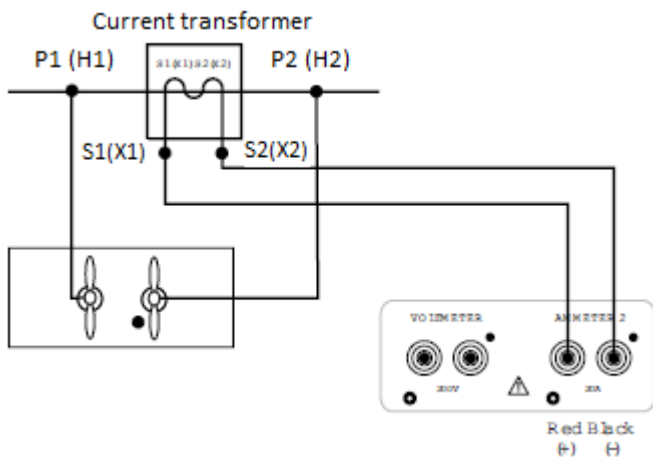
- Testing the ratio of a current transformer

When testing CT ratio on site, normally 10 % of the nominal current should be injected on the primary side.

Current is injected into the primary side of the current transformer. The current on the secondary winding is measured using the ODEN second ammeter (ammeter 2)

- Measure the polarity of a current transformer

In this test it is to be verified that the terminal S1 (X1) on the secondary side is positive relative to terminal S2(X2), when terminal P1 (H1) on the primary side is positive relative to terminal P2 (H2). If the phase angle is close to 0° the polarity is correct.



For detailed information on ODEN setup for these tests, refer to the ODEN user manual

Using the CT Switchbox to make measurements on several secondary windings

(Art no. BH-90130)



The CT Switchbox connected to ODEN AT is a tool that is used to facilitate CT testing with ODEN AT. The secondary windings on the CTs are connected to the CT Switchbox inputs, and the CT switchbox output is connected to ODEN AT Ammeter 2. The switch on the CT Switchbox is used to select which secondary winding on the CT that should be measured. The windings that aren't measured are shunted (or short circuited). The CT Switchbox can handle up to 5 secondary windings.

For detailed instruction on how to operate the CT Switchbox, refer to the CT Switchbox User manual

### Testing with high current

ODEN's current output capabilities are one of the features most frequently asked about. It's not enough to just to review the data sheet and get the current capability as the data sheet gives the output limits of different configurations and there is more to it than that.

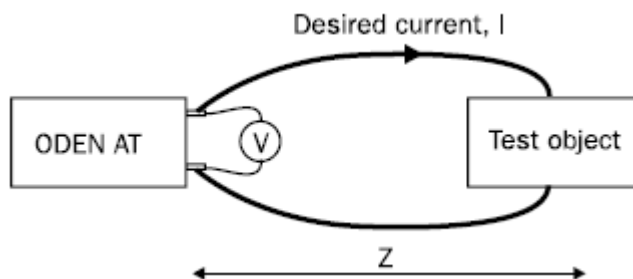
- Distance to current transformer
- Duration of test time
- Impedance of transformer
- Mains power supply on outlet

The typical load (impedance) of the current transformer itself can vary, approx. between  $0.1\text{m}\Omega$  to  $0.5\text{m}\Omega$ . Depending on type of transformer.

### Total impedance of the test object

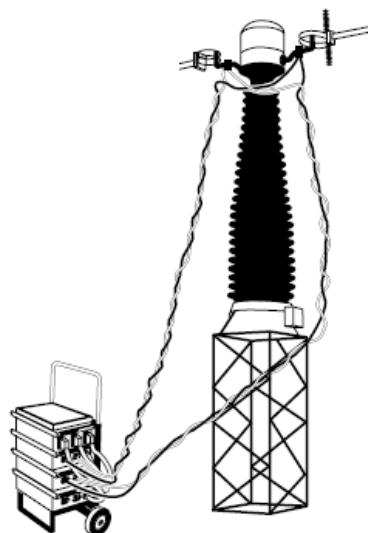
Since the specification describes the capability of the output, it is the total impedance of the circuit that must be considered. This means the current transformer resistance and current cable impedance between the ODEN and the current transformer.

Reducing the impedance for the output current cable arrangement is vital to reach currents close to the maximum specification of ODEN.



How does one minimise the impedance of high current cables?

Below is 2 examples of how to twist the current cables to minimise the impedance influence:



Refer to the ODEN user manual for further information on how to twist the cables in the best possible way.

#### Example: Test of a current transformer with ODEN

Test current 5kA.

Available mains voltage is 400V.

The transformer impedance is acc. to the breaker manufacturer 0.4m $\Omega$ .

Distance between the breaker and the ODEN is 5m.

Selecting a standard 5m cable with area 360 mm<sup>2</sup>(3 x 120mm<sup>2</sup>)

The impedance for this cable is 0.8m $\Omega$ (cable twisted) according to the ODEN user manual.

The weight for this cable is 42kg.

Select an ODEN system. In this case, the ODEN AT 1/S.

It gives at 3kA, a compliance voltage of 3.9V

Maximum allowed test circuit impedance:  $3.9V / 3kA = 1.3m\Omega$

Maximum allowed cable set impedance:  $1.3m\Omega - 0.4m\Omega = 0.9m\Omega$

The cable selected as above is 0.8m $\Omega$ , and therefore in this case the cable selected would due.

References: IEEE Std. C57.13 - 2016