CT demagnetization by means of C300B power calibrator

**Smart Calibration Devices**

1. Testing current transformer (CT) using a current source

The C300B calibrator has the capability to test a current transformer's accuracy (ratio and phase shift error). The Test consists of passing a current of known value through the wire (or hole) on the primary side of the transformer, and measuring the output signal from the secondary side of the transformer being tested. In practice, the C300B calibrator current output can force a primary current up to 120A from one phase or up to 360A of current in a three-phase connection (see the reference diagram pictures below for both connections).
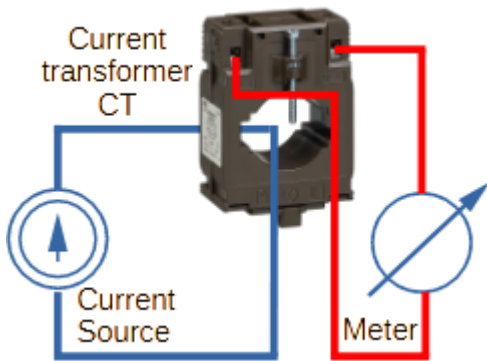
Typical connection diagram

360A three-phase connection to C300B

The Test is performed by the Calpro 300 PC Software with the function "*Test System / Current transformer*". As an example, the test is made for a CT with the nominal parameters of: ratio 100A/5A (20), accuracy class 0.2, and nominal power 2.5VA. First of all, the "*Type*" of the transformer needs to be set and saved in the PC Soft, as all of the main parameters of the CT are set In the "*Type*".
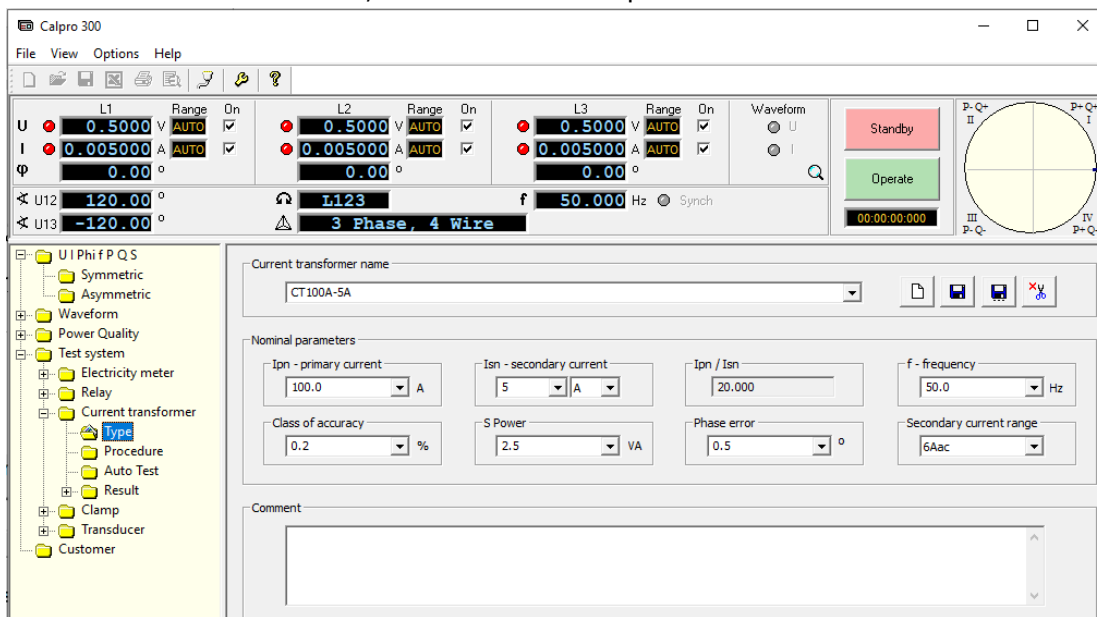
As the next step, the testing "Procedure" of the CT has to be set. It can test a transformer in the whole range of the primary current to get the full CT characteristic. The CT is tested for the primary currents: 1A, 5A, 10A, 20A, 30A, 40A, 50A, 60A, 70A, 80A, 90A, 100A and for each of the primary currents the error limit is defined in [%]. The "*Procedure*" can be saved under its name in the data base for later use.

The test is performed in the "*Auto test*" menu by entering "*Procedure name*" and "*Current transformer name*" after which the test can be executed. The results of testing are shown in the PC Soft screen, and can be saved in a file exported to an Excel sheet. For a visualization of the end results of that testing, please refer to the final diagram on the last page, where they're presented as the green line of that diagram.

No	Date	Time	Ip [A]	f [Hz]	Is [A]	Is(Ip) [A]	Ip/Is	Coil	Limit [%]	Epsilon [%]
1	17.10.2022	11:50:36	1	50	0,050	0,05	20,101	No	5	-0,504
2	17.10.2022	11:50:55	5	50	0,250	0,25	20,027	No	2	-0,134
3	17.10.2022	11:51:14	10	50	0,500	0,5	20,02	No	1	-0,098
4	17.10.2022	11:51:33	20	50	0,999	1	20,011	No	0,5	-0,055
5	17.10.2022	11:51:52	30	50	1,500	1,5	20,006	No	0,2	-0,031
6	17.10.2022	11:52:10	40	50	1,999	2	20,007	No	0,2	-0,034
7	17.10.2022	11:52:29	50	50	2,499	2,5	20,007	No	0,2	-0,035
8	17.10.2022	11:52:48	60	50	2,999	3	20,006	No	0,1	-0,028
9	17.10.2022	11:53:07	70	50	3,499	3,5	20,006	No	0,1	-0,031
10	17.10.2022	11:53:26	80	50	3,999	4	20,007	No	0,1	-0,036
11	17.10.2022	11:53:44	90	50	4,497	4,5	20,012	No	0,1	-0,060
12	17.10.2022	11:54:03	100	50	4,995	5	20,019	No	0,1	-0,094

2. CT magnetization

The magnetization of the current transformer is made only for testing purposes – normally there is no need to do it. Magnetization is an undesirable effect resulting from transformer damage (short-circuit in the winding), direct current flow, transient processes in the power grid, and even measuring the winding resistance with a typical ohmmeter. The magnetization of an example CT was made by the means of a DC 10A current flow in the primary winding in the span of 1 min. Then the accuracy was checked in the same way as in point 1. Please refer to the final diagram on the last page, where this is visualized as the red line of that diagram.

3. Demagnetization of current transformer

The demagnetization is performed by connecting a current source - the I1 output of the C300 Calibrator to the secondary winding of the CT (5A or 2A or 1A) – see diagram below. The primary winding should be opened. Demagnetization is made by changing the secondary current flowing through the CT from 0 to 6A in the span of 5 minutes, and then decreasing the current from 6A to 0 in the next 5 minutes.

Current transformer CT

Current Source
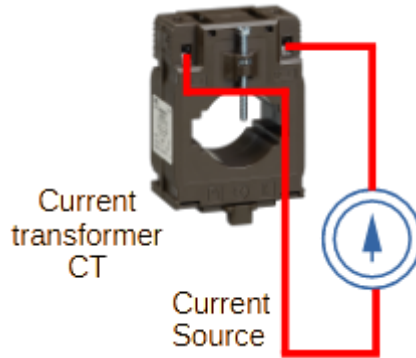
The demagnetization is made by the means of "*Slow Ramp*" function in the Power Quality tab of Calpro300 PC Soft. The settings of "*Device*" and "*Procedure*" are shown in the pictures below:

"*Device*" – the definition of a current transformer for the Ramp function;

"*Procedure*" – the definition of the current ramp-up;

N...	Point Name	U1 [V]	U2 [V]	U3 [V]	I1 [A]	I2 [A]	I3 [A]	φ1	φ2	φ3	∡12 [°]	∡12 [°]	f [Hz]
1	Start	STB	STB	STB	6.0	STB	STB	0.0 °	0.0 °	0.0 °	120.0	-120.0	50.0
2	Stop	STB	STB	STB	0.05	STB	STB	0.0 °	0.0 °	0.0 °	120.0	-120.0	50.0
3	off	STB	STB	STB	STB	STB	STB	0.0 °	0.0 °	0.0 °	120.0	-120.0	50.0

"*Procedure*" – the definition of the current ramp-down;

N...	Point Name	U1 [V]	U2 [V]	U3 [V]	I1 [A]	I2 [A]	I3 [A]	φ1	φ2	φ3	∡12 [°]	∡12 [°]	f [Hz]
1	Start	STB	STB	STB	6.0	STB	STB	0.0 °	0.0 °	0.0 °	120.0	-120.0	50.0
2	Stop	STB	STB	STB	0.05	STB	STB	0.0 °	0.0 °	0.0 °	120.0	-120.0	50.0
3	off	STB	STB	STB	STB	STB	STB	0.0 °	0.0 °	0.0 °	120.0	-120.0	50.0

4. Results of the CT test and demagnetization

The results of CT testing before magnetization, after magnetization, and demagnetization are presented in the diagram below. The C300B three-phase calibrator is an effective device for performing demagnetization of current transformers.

	1	5	10	20	30	40	50	60	70	80	90	100
before magn	-0,504	-0,134	-0,098	-0,055	-0,031	-0,034	-0,035	-0,028	-0,031	-0,036	-0,06	-0,094
after magn	-0,752	-0,465	-0,315	-0,224	-0,145	-0,114	-0,094	-0,072	-0,063	-0,065	-0,081	-0,106
after long 5min demag	-0,482	-0,123	-0,099	-0,049	-0,023	-0,025	-0,024	-0,019	-0,034	-0,046	-0,068	-0,102