Fast load current variations test according to IEC62052-11 ed.2020

CALMET
Smart Calibration Devices

Application Note No21

1. New requirement in IEC62052-11

The new edition (2020) of IEC62052-11 standard: *Electricity metering equipment – General requirement, tests and test conditions Part 11: Metering equipment* introduced a **new test** of fast load current variations (chapter 9.14.12). The main target of this test to check if the meter is not susceptible to sudden current changes caused by loads, such as welding machines, air conditioners, heaters with temperature control, arc furnaces, rolling mills, etc.

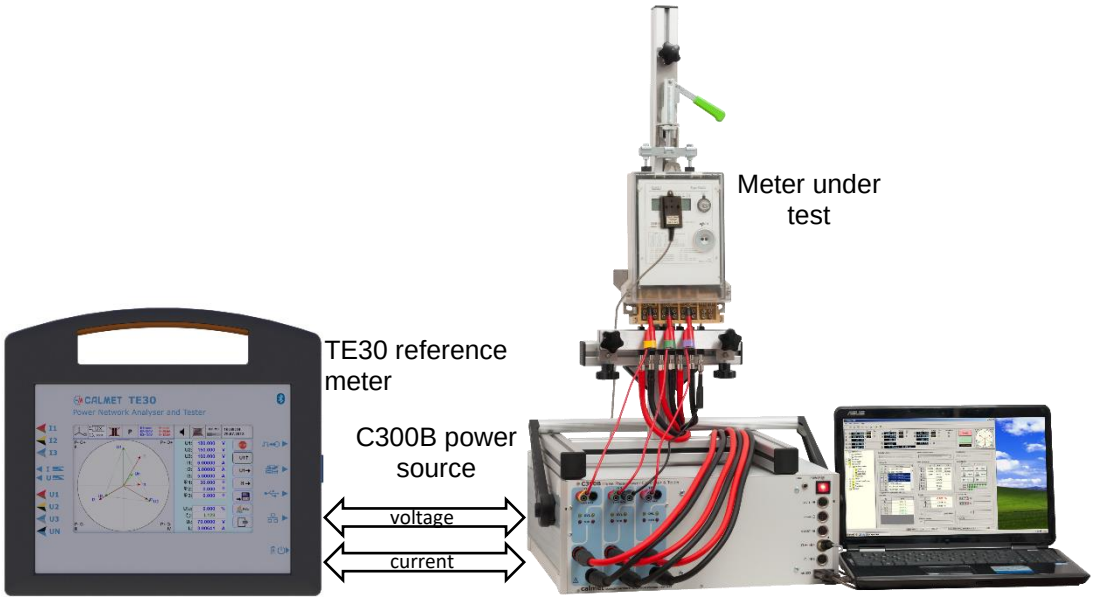
The meter under test should be powered up by the highest specified nominal voltage. The current shall be repeatedly switched ON and OFF between the nominal or maximum current and zero current. There are three types of test profiles with different current ON and OFF times:

1) t_{ON}=10s, t_{OFF}=10s and total test duration 4h;
2) t_{ON}=5s, t_{OFF}=5s and total test duration 4h;
3) t_{ON}=10s, t_{OFF}=0.5s and total test duration 4h;

The turn ON and OFF times do not need to be synchronized with the zero crossings of the mains, and the transient process between states should be no longer than one cycle of power frequency. The accuracy of the meter under test is tested under fast load current variations. The acceptance criterion is that the accuracy of the meter under test shall not exceed the limits specified for the accuracy class.

2. Recommended equipment for performing the test

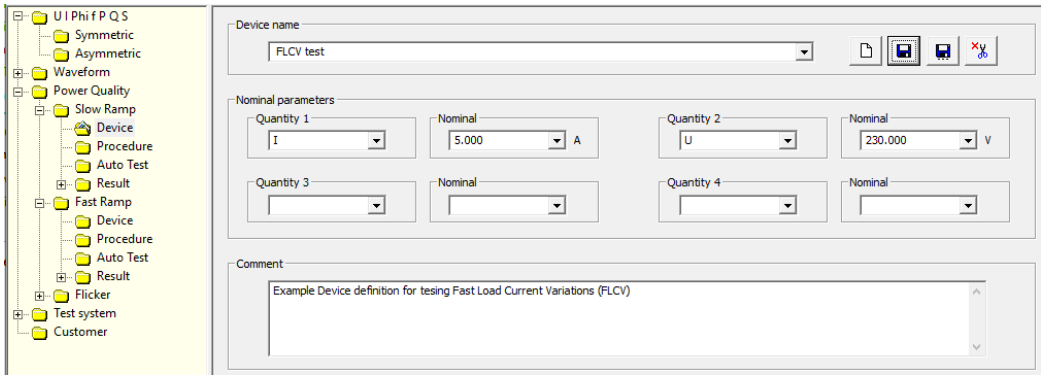
To perform the test, a programmable current and voltage source is required. The C300B Three-Phase Power Calibrator with the Power Quality Option can generate programmable current waveforms for any value of current versus time. To test accuracy, an external reference meter with an accuracy class at least five times better than the meter under test is required. The recommended reference meter is a TE30 (class 0.05) or a TS23 (class 0.02). The source, reference meter, and meter under test are connected as shown in the diagram below. The current wires are connected in series and the voltage wires are connected in parallel. The scanning head on the meter under test is connected to the reference meter.



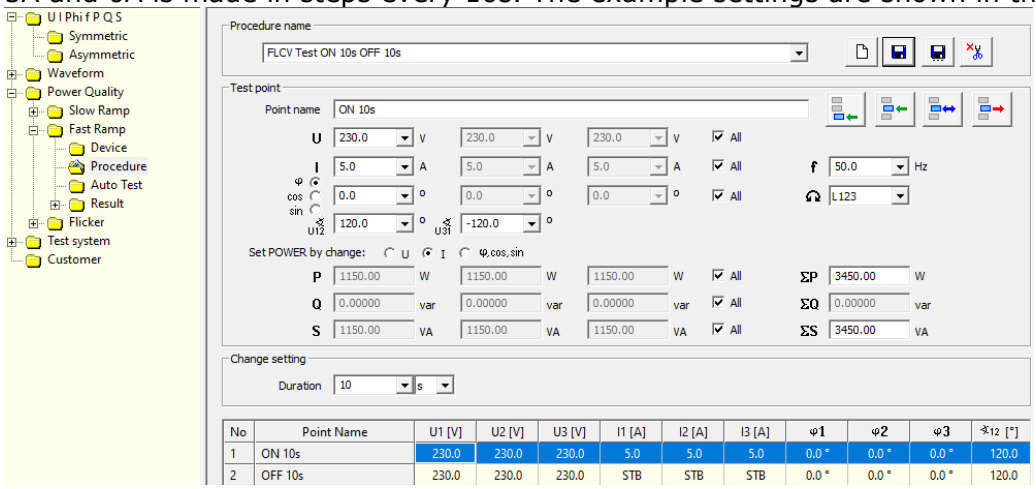
3. Setting the current pulse generation procedures

First of all, the programmable current and voltage source C300B should be programmed to generate proper testing signals. The three-phase power C300B PC Soft with the Power Quality option enables us to program Slow Ramp and Fast Ramp – changing current in the defined values of range and time. For rapid current changes, the Fast Ramp Function is recommended.

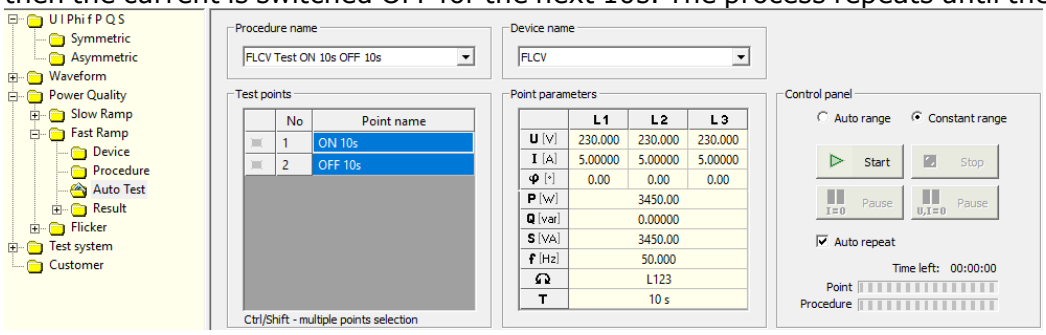
Programming can start by defining the device under test (electricity meter under test), including Quantity 1 (current I) and Quantity 2 (voltage U) – see example figure below.



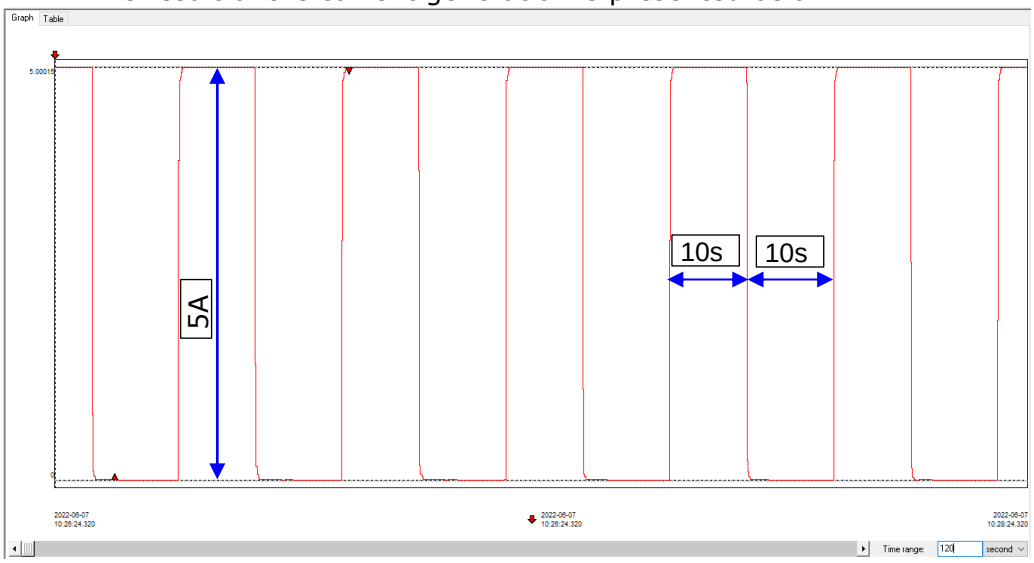
The next step is to define the values of the current and time of the change. The settings are found in the Procedure function. In the example below, the nominal current is set to 5A and the lack of current 0A is set as STB – the standby state of the calibrator current output. The change between 5A and 0A is made in steps every 10s. The example settings are shown in the figure below.



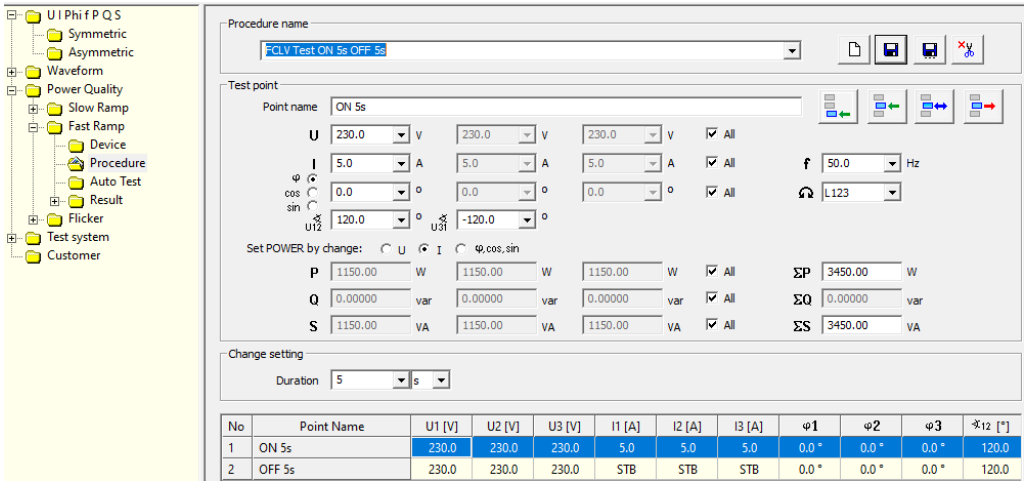
Then we can execute the Procedure in the Auto Test function (see figure below). It is important to mark step 1 and 2, select the constant range during generation and set the Auto repeat method of generation. When the Start button is pressed, the C300B calibrator generates pulses of 5A for 10s, then the current is switched OFF for the next 10s. The process repeats until the Stop button is pressed.



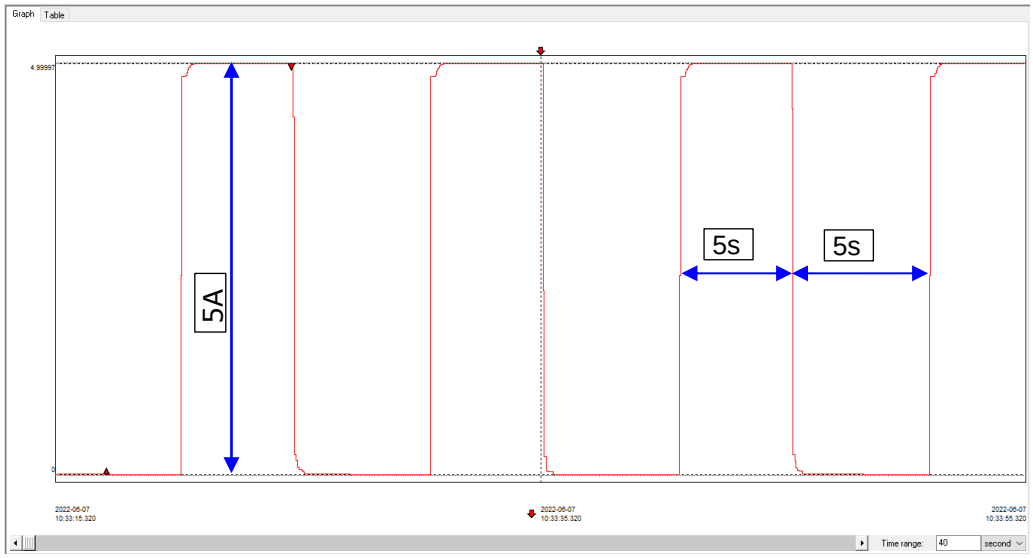
The result of the current generation is presented below.



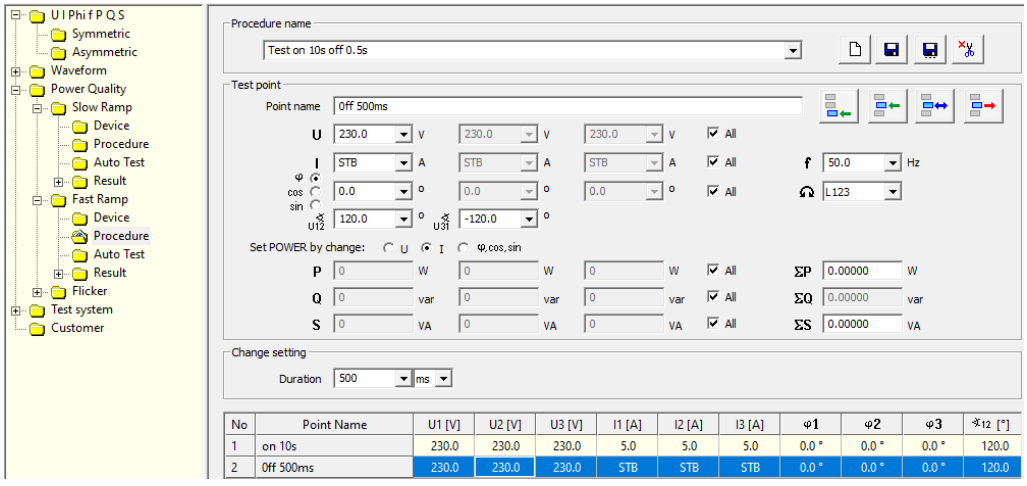
The same process can be repeated for the remaining pulse shapes. Below is the 5s ON and 5s OFF current generation Procedure and waveform result.



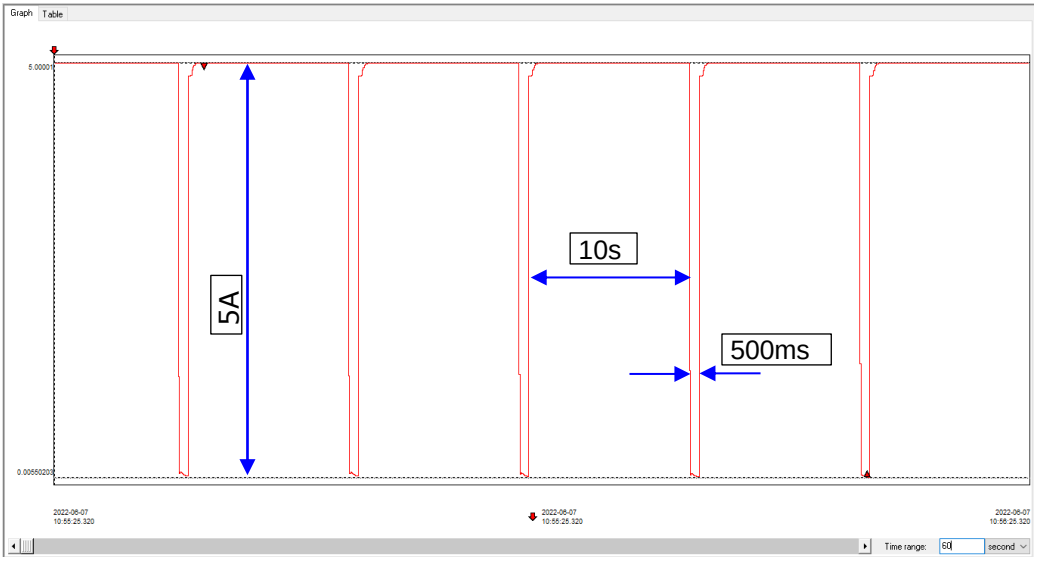
The result of the current generation is presented below.



For the last current pulse sequence of 10s ON and 0.5s OFF, the Fast Ramp functionality of the C300B calibrator is used. The Device is defined as before. The procedure is defined as in the figure below. The ON time is set to 10s, the OFF time is set to 500ms.



After the Auto test is performed, the waveform will look like the figure below.



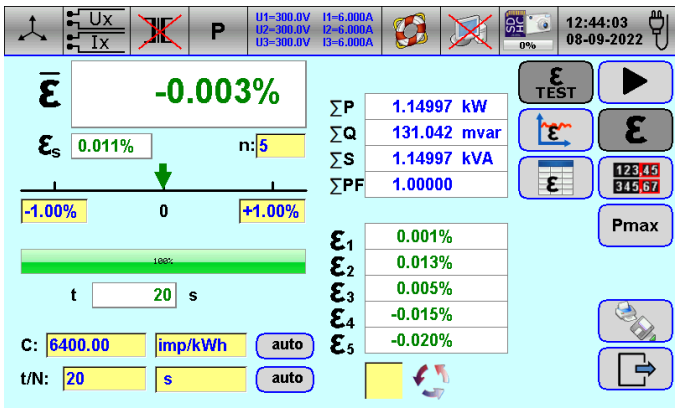
4. Setting the meter error testing procedures

Electricity meter testing can be performed in two ways: as error testing by counting pulses or a rotor speed or register (counter or dial test) test. The IEC62052-11 standard recommends that the register test be carried out for 4 hours. The meter under test is connected to the source of signal – the C300B power calibrator, which generates a pulse current as described above. The Reference Meter is connected to the source and the meter under test: the current wires are connected in series and the voltage wires are connected in parallel.

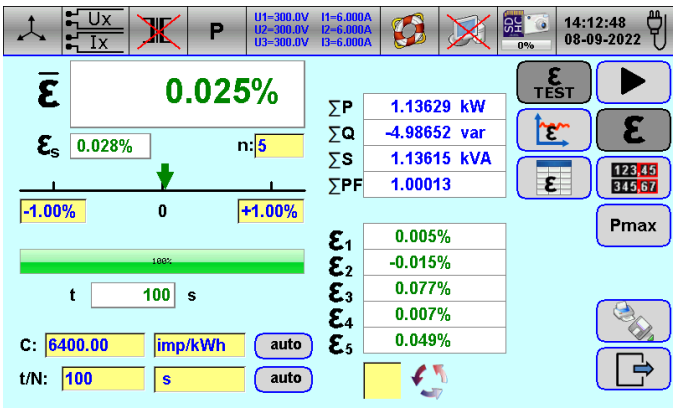
4.1. Testing by counting pulses

Care should be taken when setting the test parameters. The test time must be significantly longer than a period of load changes to avoid problems with the dynamic properties of the meter under test. Usually, it is enough to set the time 5 – 10 times longer than testing under stable load conditions. Similarly, if the test is performed by using the counting pulses method, the number of pulses for averaging should be 5 – 10 greater than under stable conditions. Additionally, the reference meter should operate in constant range mode (if possible) set to the highest expected current value. This is to avoid problems with the automatic range selection delay of the reference meter when testing with rapid load changes.

It is recommended to start testing the meter under test under stable conditions to get reference error results. Below are the results of testing a single-phase meter 230V / 5A(60A) with meter constant 6400imp/kWh and class 1 in stable and then dynamically changing load conditions (10s ON / 10s OFF).



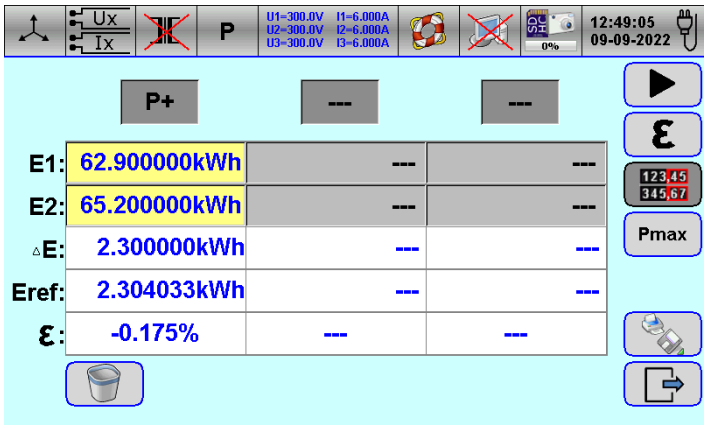
Reference results of meter test (t=20s)



Results with dynamic load current change (t=100s)

4.2. Testing by register test

In the register test, the value of the register should be read from the meter under test and then entered as a start value to the reference meter. The reference meter should operate in constant range mode (if possible) set to the highest expected current value. This is to avoid problems with the automatic range selection delay in the reference meter during tests with rapid load changes. Then the test procedure should be started both in the reference meter and in the signal generation by the source. The small time error in the moment of starting (e.g. a few seconds) is negligibly small compared to the total test time (4h=14400s). After four hours, the test should be stopped and the source should be switched off. The final value of the register in the meter under test should be written to the reference meter, which calculates the error. The sample result of the test (for the meter described above) is shown in the figure below.



The result of the register test with dynamic load 10s ON / 10s OFF

5. Conclusions

The C300B Three-Phase Power Calibrator is a suitable device for testing energy meters against the new IEC62052-11 requirements for fast load current variations. Together with the reference meter, it allows all tests to be performed. Care should be taken when setting the test conditions. The time or number of pulses should be set higher than the usual stable conditions test. The reference meter should operate in constant range mode (if possible) set to the highest expected current value. This is to avoid problems with the automatic range selection delay in the reference meter during tests with rapid load changes.