

1. New requirement in IEC62052-11

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

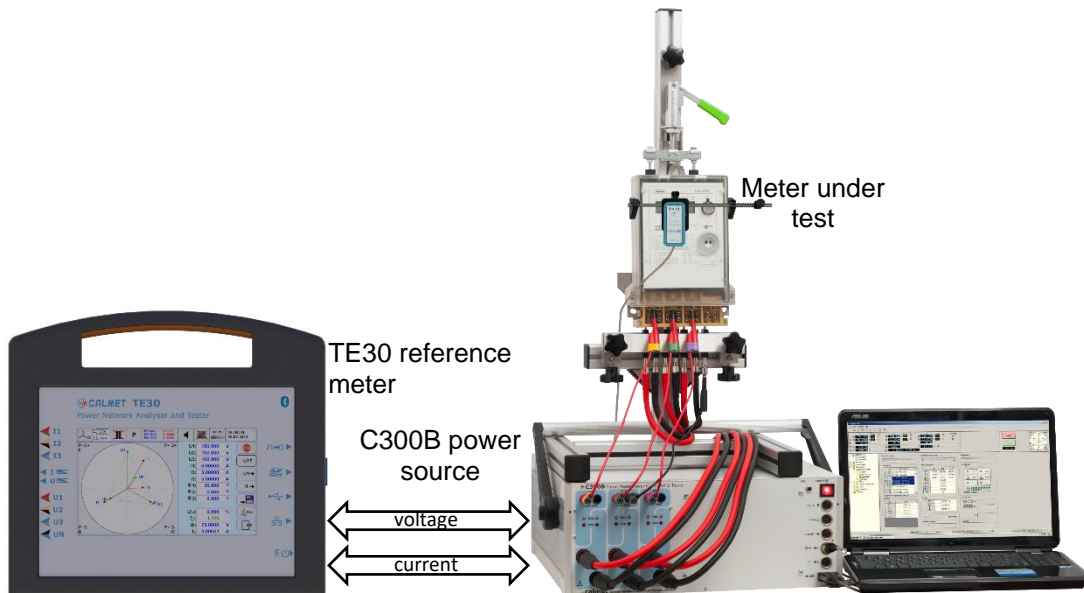
The meter under test should be powered up at the highest specified nominal voltage. The current shall be repeatedly switch ON and OFF between the nominal or maximum current and current equal to zero. There are three kinds of test profiles with different times of current ON and OFF:

- 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;

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

2. Recommended equipment to perform test

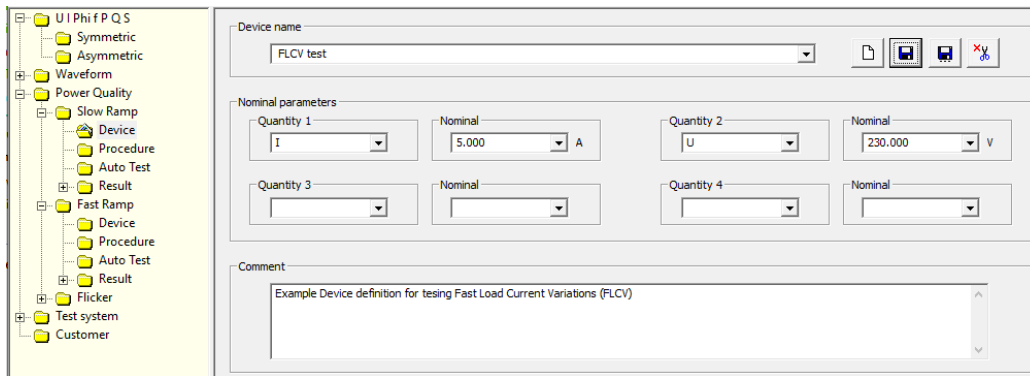
To perform test required is programmable current and voltage source. Three phase power calibrator type C300B with option Power Quality can generate programmable current waveforms for any value of current versus time. For testing accuracy required is external reference meter with accuracy class at least five times better than meter under test. The recommended reference meter is TE30 class 0.05 or TS23 class 0.02. The source, reference meter and meter under test are connected as in diagram below. The current are connected in series, the voltages in parallel. The scanning head on meter under test is connected to the reference meter.



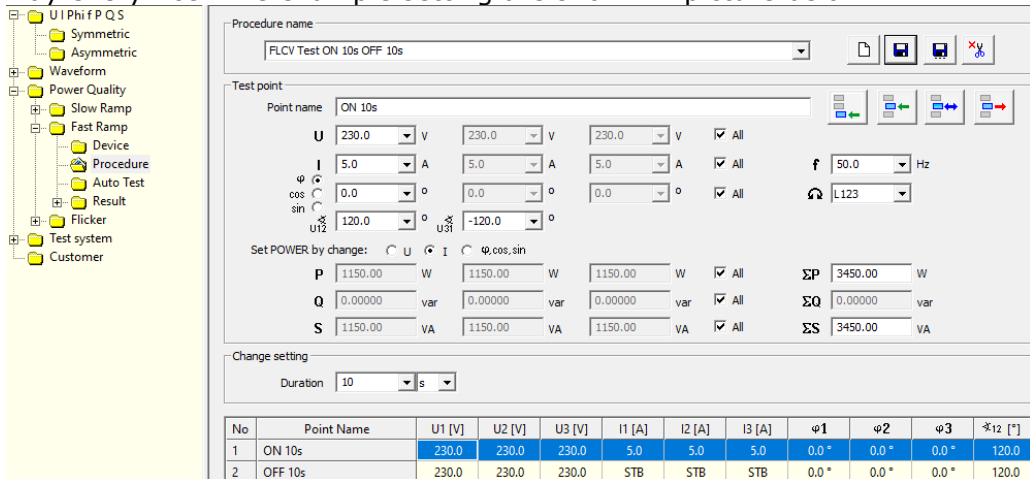
3. Setting current pulse generation procedures

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

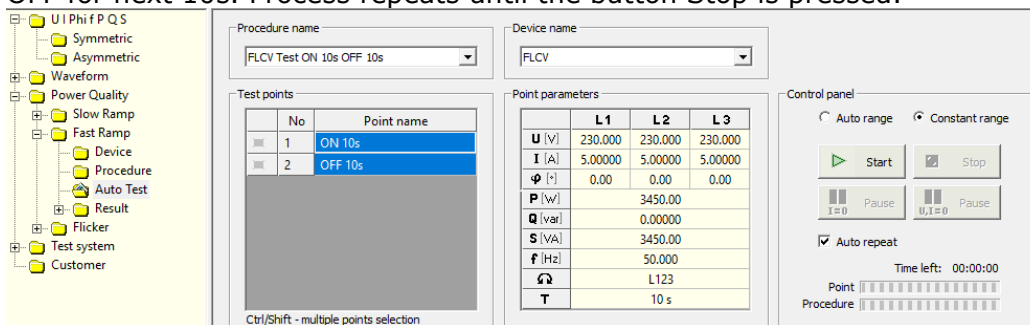
Programming can start from device under test definition (electricity meter under test) including Quantity 1 (current I) and Quantity 2 (voltage U) – see example picture below.



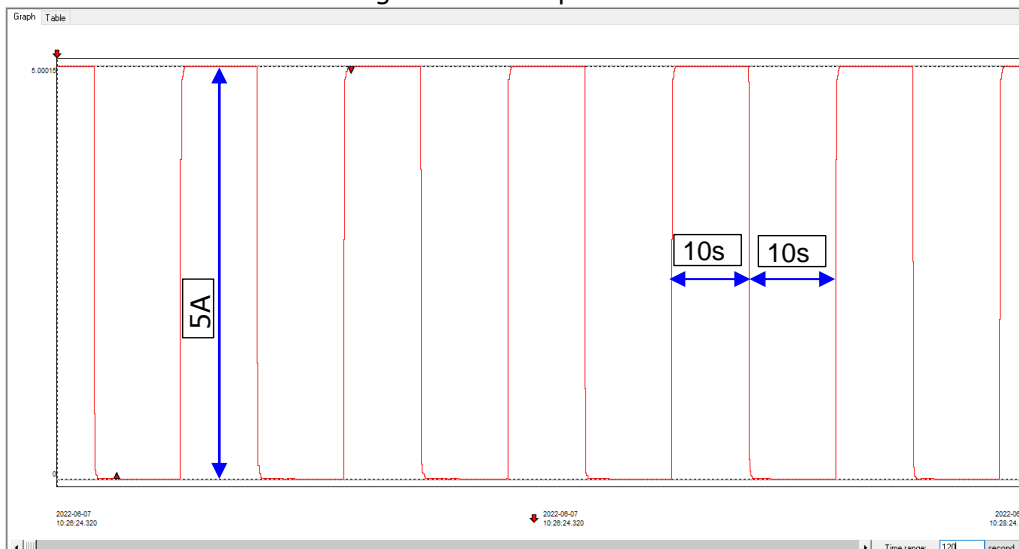
In the next step must be defined values of current and time of changing. The setting are made in Procedure function. In the example below the nominal current is set to 5A and lack of current 0A as STB – standby state of calibrator current output. The change between 5A and 0A is made in step way every 10s. The example setting are shown in picture below.



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



The result of current generation is presented below.



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

Procedure name: ECLV Test ON 5s OFF 5s

Test point: ON 5s

U: 230.0 V, 230.0 V, 230.0 V ✓ All
 I: 5.0 A, 5.0 A, 5.0 A ✓ All f: 50.0 Hz
 ϕ : 0.0 °, 0.0 °, 0.0 ° ✓ All
 cos: 120.0 °, sin: -120.0 °

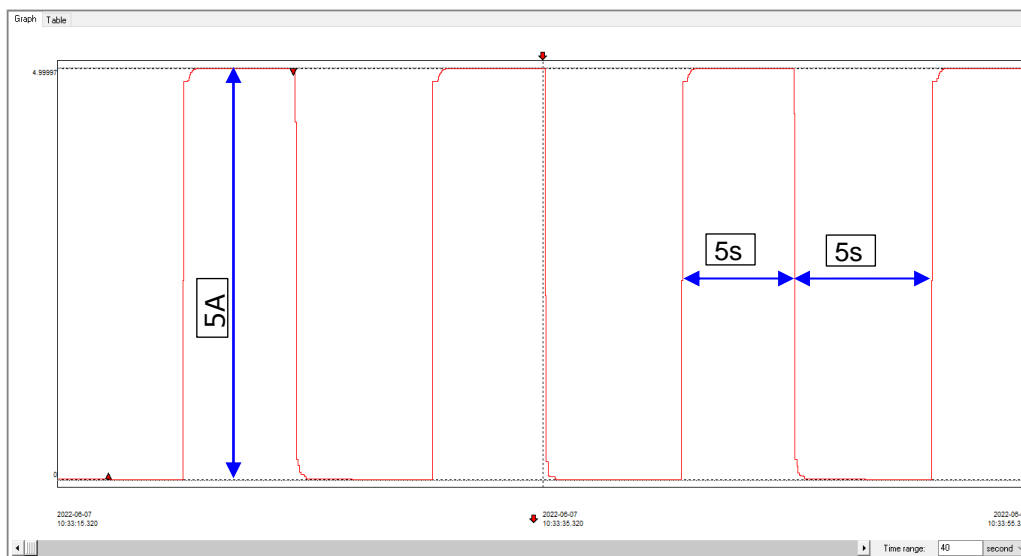
Set POWER by change: U I ϕ .cos.sin

P: 1150.00 W, 1150.00 W, 1150.00 W ✓ All ΣP : 3450.00 W
 Q: 0.00000 var, 0.00000 var, 0.00000 var ✓ All ΣQ : 0.00000 var
 S: 1150.00 VA, 1150.00 VA, 1150.00 VA ✓ All ΣS : 3450.00 VA

Change setting: Duration 5 s

| No | Point Name | U1 [V] | U2 [V] | U3 [V] | I1 [A] | I2 [A] | I3 [A] | ϕ 1 | ϕ 2 | ϕ 3 | $\ast 12$ [°] |
|----|------------|--------|--------|--------|--------|--------|--------|----------|----------|----------|---------------|
| 1 | ON 5s | 230.0 | 230.0 | 230.0 | 5.0 | 5.0 | 5.0 | 0.0 ° | 0.0 ° | 0.0 ° | 120.0 |
| 2 | OFF 5s | 230.0 | 230.0 | 230.0 | STB | STB | STB | 0.0 ° | 0.0 ° | 0.0 ° | 120.0 |

The result of current generation is presented below.



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

Procedure name: Test on 10s off 0.5s

Test point: Off 500ms

U: 230.0 V, 230.0 V, 230.0 V ✓ All
 I: STB A, STB A, STB A ✓ All f: 50.0 Hz
 ϕ : 0.0 °, 0.0 °, 0.0 ° ✓ All
 cos: 120.0 °, sin: -120.0 °

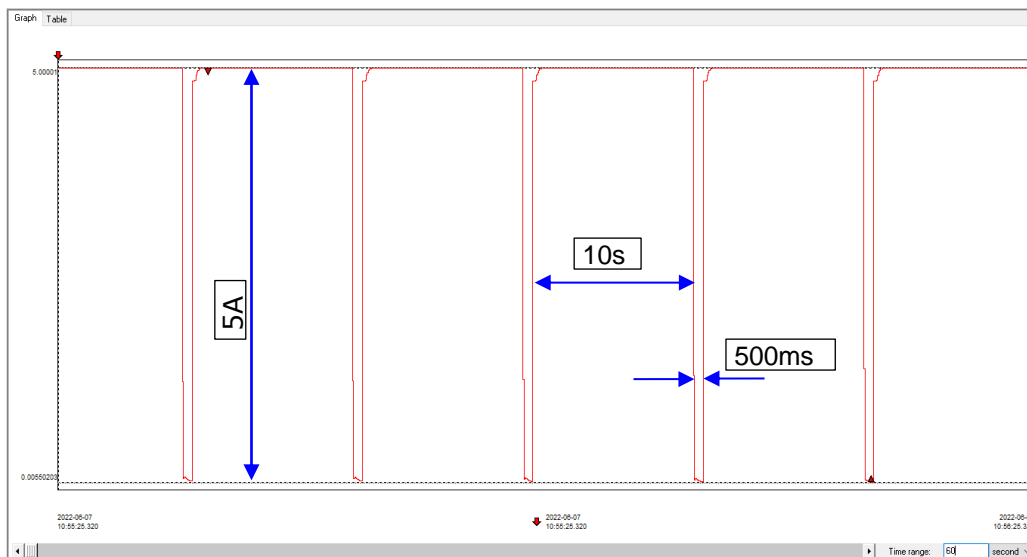
Set POWER by change: U I ϕ .cos.sin

P: 0 W, 0 W, 0 W ✓ All ΣP : 0.00000 W
 Q: 0 var, 0 var, 0 var ✓ All ΣQ : 0.00000 var
 S: 0 VA, 0 VA, 0 VA ✓ All ΣS : 0.00000 VA

Change setting: Duration 500 ms

| No | Point Name | U1 [V] | U2 [V] | U3 [V] | I1 [A] | I2 [A] | I3 [A] | ϕ 1 | ϕ 2 | ϕ 3 | $\ast 12$ [°] |
|----|------------|--------|--------|--------|--------|--------|--------|----------|----------|----------|---------------|
| 1 | on 10s | 230.0 | 230.0 | 230.0 | 5.0 | 5.0 | 5.0 | 0.0 ° | 0.0 ° | 0.0 ° | 120.0 |
| 2 | Off 500ms | 230.0 | 230.0 | 230.0 | STB | STB | STB | 0.0 ° | 0.0 ° | 0.0 ° | 120.0 |

After Auto test execution the waveform looks as in picture below.



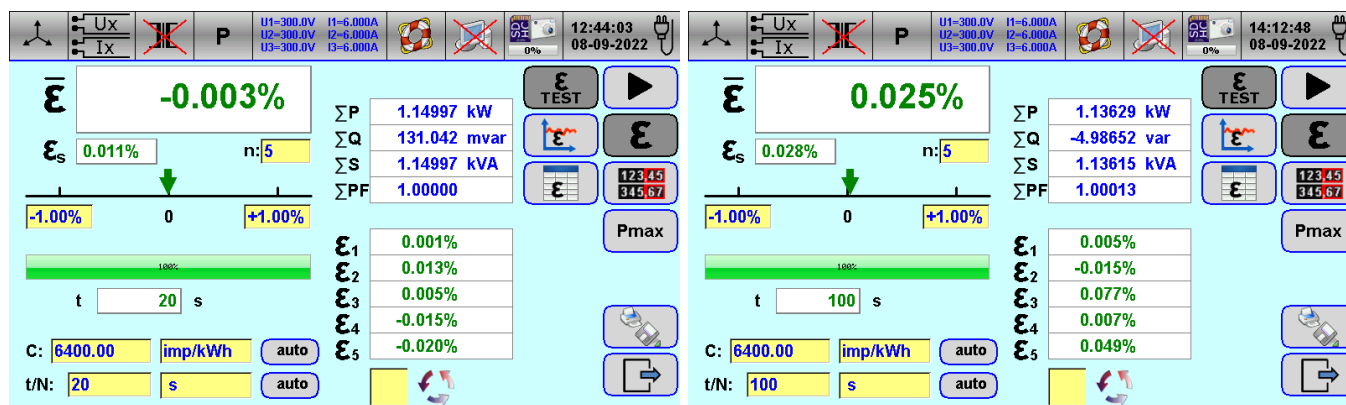
4. Setting meter error testing procedures

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

4.1. Testing by counting pulses

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

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

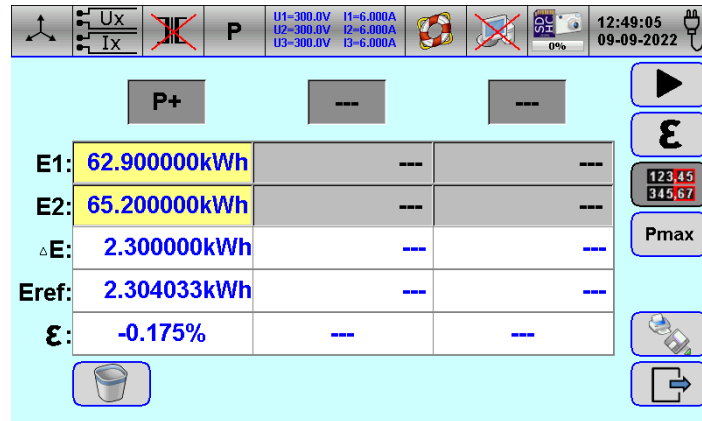


Reference results of meter test (t=20s)

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

4.2. Testing by register test

In register test the value of 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 automatic range selection delay in reference meter during test with rapid load changes. Then the procedure of testing should be started both in reference meter and signal generation by source. The small time error in moment of starting (eg. a few seconds) is negligibly small compared to the entire test time (4h=14400s). After four hours test should be stopped and source switched off. The final value of register in meter under test should be written to the reference meter which calculates the error. The example result of test (for meter described above) is shown in picture below.



Result of register test with dynamic load 10s ON / 10s OFF

5. Conclusions

Three phase power calibrator type C300B is very suitable device to test energy meter against new requirement in standard IEC62052-11 for fast load current variations. Together with reference meter it allows to perform all tests. Care should be taken during setting the test conditions. The time or number of pulses should be set greater than 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 automatic range selection delay in reference meter during test with rapid load changes.