Extremely Compact Design of Multi-position Meter Test Benches

CALMET Smart Calibration Devices

Application Note No29

What is Meter Test Bench?

According to IEC 62057-1 “Test equipment, techniques and procedures for electrical energy meters. Part 1: Stationary Meter Test Units (MTU)”, the MTU permanently installed in laboratory is used for testing and calibration of electricity meters on 50 Hz or 60 Hz networks with an AC voltage up to 600 V (phase to neutral) and is commonly called as Meter Test Bench (MTB).

The automatic MTB normally includes the following components:

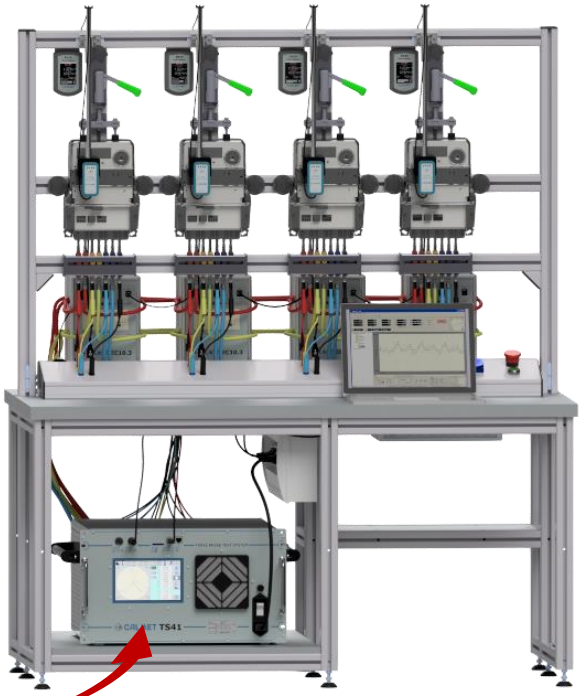
- Voltage Source and Current Source for generating voltage- and current signals with the appropriate frequency, magnitude, and with the appropriate phase angles between currents and voltages,
- Reference Standard (or Working Standard) also called as Reference Meter,
- N positions Suspension Rack for meter hanging, scanning heads, error calculation and indication system,
- Software,
- Isolating Current Transformers (ICT). Each phase and each meter test position will require an ICT to provide the isolation for testing direct connected polyphase meters with closed U-I links.

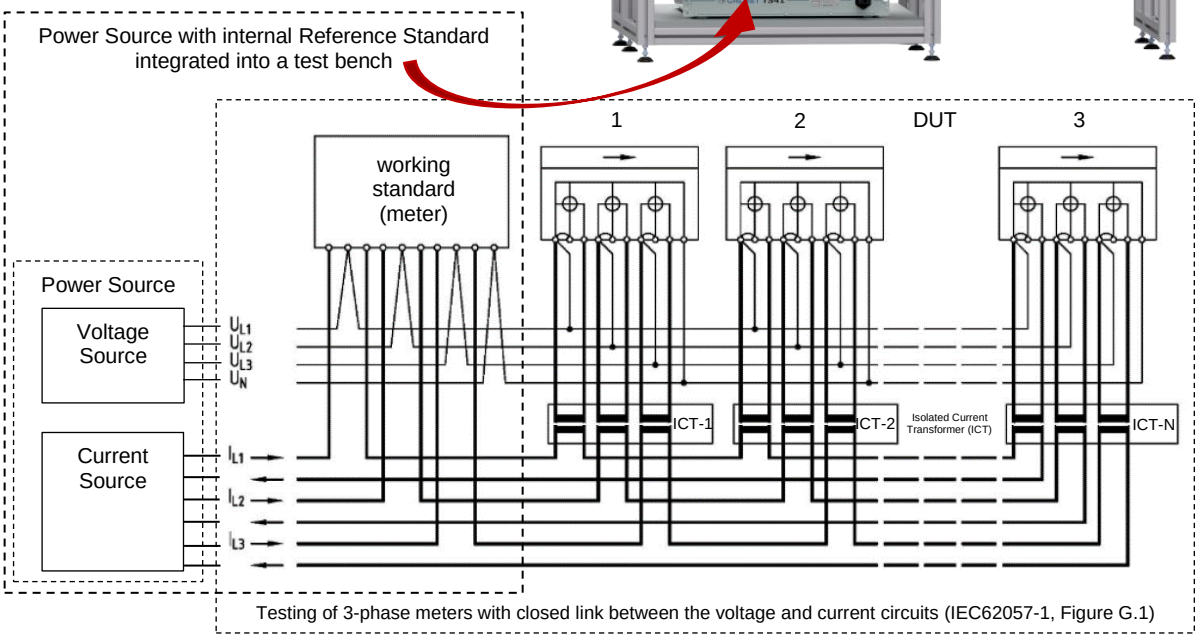
How to build an extremely compact MTB?

Three steps to an extremely compact MTB acc. to IEC62057-1:

1) A Power Source should be used instead of separate Voltage and Current Sources,
2) A Power Source with internal Reference Standard should be used instead of separate Power Source and Reference Standard,
3) A Power Source with internal Reference Standard should be integrated into a test bench.

This design allows
to reduce the number and length of connections
and consequently, to reduce the powering, weight and size,
and to obtain a free space at the table for the operator to work.





Testing of 3-phase meters with closed link between the voltage and current circuits (IEC62057-1, Figure G.1)

Measurement uncertainty of the MTB for testing three phase-meters with closed U-I links

Expanded measurement uncertainty according to type B considering the manufacturer specification for the reference/working standard and ICT is calculated from formula:

$$U = k \cdot \sqrt{u_{Cst}^2 + u_{ICT}^2}$$

where: k Coverage factor: 2,0 at coverage probability of 95%
u_{Cst} Standard measurement uncertainty associated with accuracy of the reference standard
u_{ICT} Standard measurement uncertainty associated with accuracy of the ICT

Note:
The standard measurement uncertainty associated with accuracy, expressed as the limit error *a*, is calculated from formula:

$$u = a/\sqrt{3}$$

The standard measurement uncertainty associated with accuracy, expressed as the expanded measurement uncertainty *U* with *k*=2, is calculated from formula:

$$u = U/2$$

Table 1. Different kind of the MTB for testing meters with closed U-I links

Parameter	Kind of the MTB				Note
	acc. to IEC62057-1 std			other std	
	classic	compact	extremely compact	compact	
components used	PS+RS+NxICT	PS+RS+NxICT	(PS+RS)+NxICT	VS+Nx(CS+ICT+RS)	1)
number of RS per one MTB	1	1	1	N	
example type of MTB	MTE's modular system components	MTS310 ZERA	TB41 Calmet	TST 3/5 Universal EMSYST	
example type of VS	-	-	-	EE-500V	
example type of CS	-	-	-	-	
example type of PS	SPE120.3	MTS310	-	-	
example type of RS	SRS400.3	EPZ303	-	-	
example type of PS+RS	-	-	TS41	-	
example type of ICT	ICT2.3	ICT127	EC10.3	-	
example type of CS+ICT+RS	-	-	-	EE-120A	
u_{Cst} [ppm]	$200/\sqrt{3} = 115$	$200/\sqrt{3} = 115$	$200/2 = 100$	$200/\sqrt{3} = 115$	2)
u_{ICT} [ppm]	$200/\sqrt{3} = 115$	$100/\sqrt{3} = 58$	$100/\sqrt{3} = 58$	-	2)
U [ppm]	327	258	231	231	2)

1) VS – Voltage Source, CS - Current Source, PS – Power Source, RS – Reference Standard, N – number of meter test positions
2) In the basic range of voltages and currents and at PF=1.0

Is it possible to build an MTB for testing of single- and three- phase meters with and without closed I-P links and accuracy class including up to 0.2/0.2S, without need to disconnecting ICT?

The IEC62057-1 recommends using reference/working standard with 0.02 accuracy class for testing DUT's with 0.2/0.2S accuracy class. Expanded measurement uncertainty according to type B considering the manufacturer specification for the reference/working standard with 0.02 accuracy class, expressed as the limit error *a*, is calculated from formula:

$$U_{Cst} = k \cdot \sqrt{u_{Cst}^2} = k \cdot \frac{a}{\sqrt{3}} = 2 \cdot \frac{0.02\%}{\sqrt{3}} = 0.0231\% = 231[ppm]$$

Therefore those MTB's for testing meters with closed U-I links, which have an extended measurement uncertainty of not more than 231 ppm, do not require ICT disconnection for testing meters of 0.2/0.2S accuracy class.