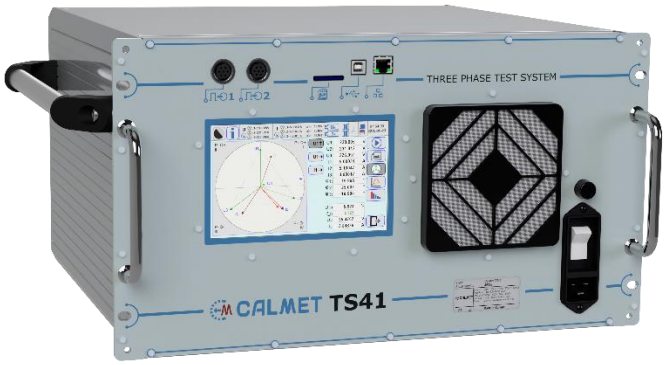
# High Power Three-phase Fully Automatic Test System with Reference Standard and Integrated 3-phase Current and Voltage Source

**Calmet TS41**

- Easy verification of meters under precise load conditions, using integrated current and voltage source
- Automatic operation with predefined load points without need of an external PC
- High output power per channel: up to 300VA for current and up to 150VA for voltage
- Modern SD flash memory card up to 32GB for storage of customer data and measurement results
- Display of vector diagram, phase sequence, wave form oscilloscope, harmonics spectrum bar and trend charts for analysis of the mains conditions
- User-friendly system for data input and operation of combined source and reference meter
- The system may be used either as a stand-alone reference standard meter class 0.04 or 0.1, or together with the integrated power source, or power source with reference meter for new or modernized test bench station
- Data readout and test system control via USB & Ethernet
- 4-wire voltage output and sense connection




Front view

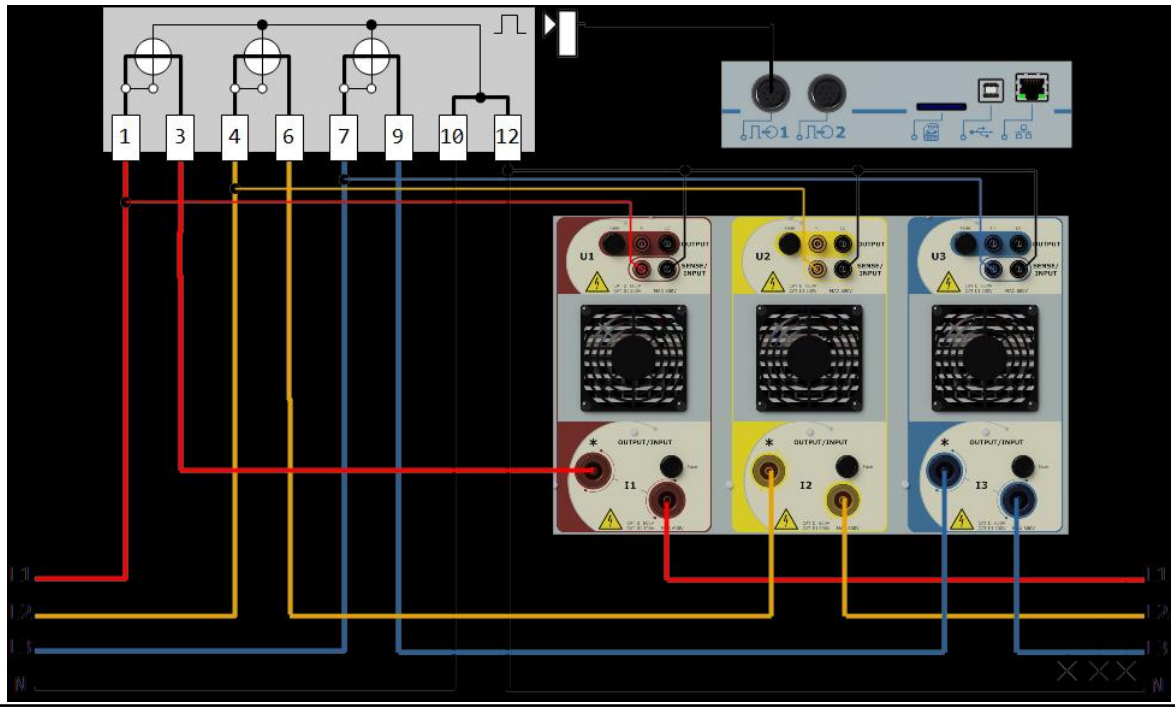
Calmet TS41 automatic test system consists of a three-phase reference meter of accuracy class 0.04% (or 0.1%) and integrated high power three-phase current and voltage source up to 3x120A/600V. The TS41 is designed for testing energy meters in meter test station eg TB41.

Calmet TS41 Automatic Test System is used for:

- testing electricity meters according to EN 50470, IEC 62052, IEC 62053 and ANSI C12 in laboratory including measure of meter error, register error, start up current, no load (creepage) test, repeatability and influence of different quantities,
- verification of power network wiring with measure and recording of basic power network parameters,
- powering test bench station up to 4 meter positions including isolation transformers ICT,
- metering power network parameters due built in high accuracy reference standard.

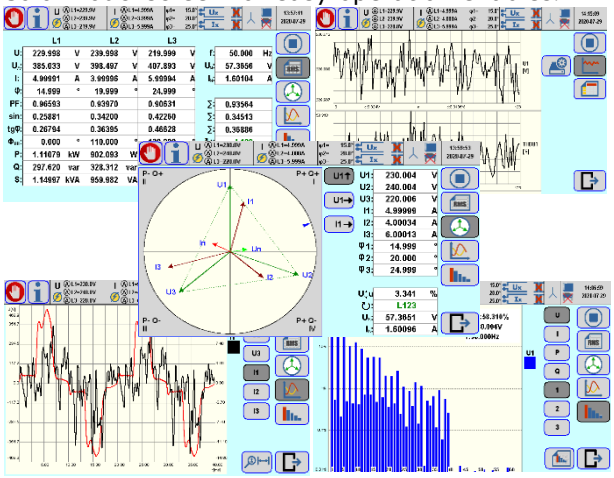
## Examples of application

The use of TS41 as a stand-alone reference meter for electricity meter testing



## The TS41 as a reference meter and power network parameters analyser

Color Touchscreen for easy operation enables:



- measurement of power network parameters:
  voltages U1, U2, U3, U12, U23, U13, UN,
  currents I1, I2, I3, IN,
  frequency f,
  phase angles φ1, φ2, φ3,
  power factors PF1, PF2, PF3, ΣPF,
  factors sinφ1, sinφ2, sinφ3, Σsinφ, tgφ1, tgφ2, tgφ3, Σtgφ,
  angles between voltages ∠U12, ∠U13,
  powers P, P+, P-, PH1, PH1+, PH1-, Q, Q+, Q-, QH1, QH1+, QH1-, S, S+, S-, SH1, SH1+, SH1,
- visualization of measurement results in form of:
  table,
  vectors,
  trend chart,
  oscilloscope (waveform) or
  bar chart (harmonics of U, I, P, Q).

**Specifications for the power network parameters**

| Parameter | Range | Accuracy 1)2)3)4) | |
|---|---|---|---|
| | | class 0.04 | class 0.1 |
| Voltage | 0.05…600V | ±0.04%5) | ±0.1% 5) |
| Current | 0.01…120A<br>0.001…0.01A | ±0.04%<br>±0.04%* | ±0.1%<br>±0.1%* |
| Power and energy | 0.01…120A / 10…600V<br>0.001…0.01A / 10…600V | ±0.04%<br>±0.04%* | ±0.1%<br>±0.1%* |
| Frequency | 40…70Hz | ±0.01Hz | |
| Phase shift | -180…+180° | ±0.02° 5)6) | ±0.04° 5)6) |
| Power factor cosφ and sinφ | 0…±1 | ±0.001 5)6) | |
| Temperature coefficient | 0.001% per 1°C in range -10…+50°C | | |
| Time stability | Short term [1h] = 0.01%, long term [1 year] = 0.03% | | |
| Power short term [1h] stability | | ±0.010% | ±0.020% |
| Power long term [1 year] stability | | ±0.025% | ±0.050% |
| Power temperature coefficient per 1°C | | ±0.002% | ±0.005% |

1) % - related to the measuring value, %* - related to the measuring range final value (is underlined)
2) absolute extended uncertainty under confidence level of 95% covers reference uncertainty of standards, stability in 12 months, influence quantities (ambient temperature +20…+26°C, humidity and power supply voltage 85…265V, frequency 47…63Hz)
4) power and energy errors related to apparent power
5) in voltage range 10…600V
6) in current range 0.01…120A

**Specifications for the power quality parameters**

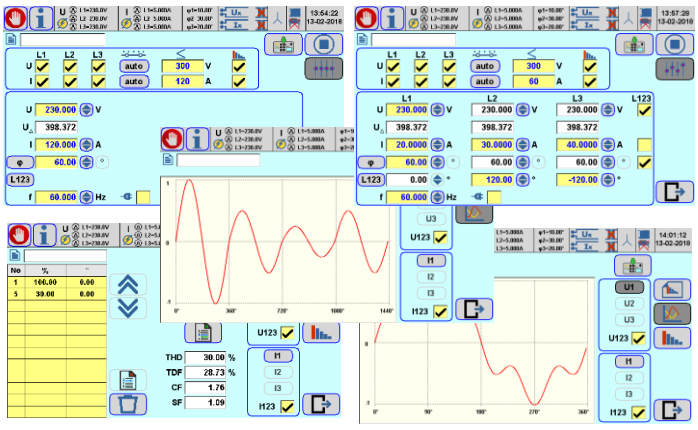
| Parameter | | Range | | Accuracy 1) |
|---|---|---|---|---|
| Harmonics in voltages, currents, P and Q powers | amplitude | 0…100% of input | 1st…63rd | ±0.1% 2) |
| | phase | -180…+180° | | ±0.5° 3) |
| Total harmonic distortion THD in voltages and currents | | 0…100% of input | 1st…63rd | ±0.1% 2) |
| Total interharmonic distortion TID in voltages and currents | | 0…15% of input | 40…3200Hz | ±0.2% 4) |

1) absolute extended uncertainty under confidence level of 95% covers reference uncertainty of standards, stability in 12 months, influence quantities (ambient temperature +20…+26°C, humidity and power supply voltage 85…265V, frequency 47…63Hz)
2) of input for 80-140Hz frequency range of harmonics with linear rise to 0.4% of input for 3200Hz
3) for 80-140Hz frequency range of harmonics with linear rise to 8° for 3200Hz
4) of input for 80-140Hz frequency range of interharmonics with linear rise to 5% of input for 3200Hz

## The TS41 as a power calibrator – current and voltage source

TS41 power calibrator can work as voltage and current source with programmable phase shift between current and voltage and between voltages.
TS41 power calibrator operates in symmetric and asymmetric circuit of connection and enables setting of:

- voltages U1, U2, U3, U12, U32, U13,
- currents I1, I2, I3,
- frequency f
- phase angles φ1, φ2, φ3,
- power factors PF1, PF2, PF3,
- factors sinφ1, sinφ2, sinφ3,
- angles between voltages ∠U12, ∠U13
- maximum allowed values of voltages and currents,
- wave shape of output signals with using harmonics and predefined shape functions.



| Specification for the sinusoidal signals | | | | | |
|---|---|---|---|---|---|
| **Parameter** | **Range** | **Settings span** | **Resolution** | **Accuracy** [1)2)] | **Maximum load** |
| Voltage U | 150V | 20...150V | 0.001V | ±0.1% | 1A@150V |
| | 300V | 150...300V | 0.01V | | 500mA@300V |
| | 600V | 300...600V | 0.01V | | 250mA@600V |
| Voltage short term [10min] stability | | | | ±0.01% | |
| Voltage short term [1h] stability | | | | ±0.03% | |
| Voltage distortion factor | | | | < 0.5% | |
| Current I | 0.12A | 0.02...0.12A<br>0.001...0.02 | 0.00001A | ±0.1%<br>±0.1%* | 5V@0.12A |
| | 1A | 0.12A...1A | 0.00001A | ±0.1% | 30V@1A |
| | 12A | 1...12A | 0.0001A | | 14V@12A |
| | 120A | 12...120A | 0.001A | | 3V@60A<br>2.5V@120A |
| Current short term [10min] stability | | | | ±0.01% | |
| Current short term [1h] stability | | | | ±0.03% | |
| Current distortion factor | | | | < 0.5% [3)] | |
| Frequency f | | 45...65Hz | 0.001Hz | ±0.005Hz | |
| Phase shift φ | | -180...+180° | 0.001° | ±0.10° | |
| Phase shift short term [10min] stability | | | | ±0.05° | |

1) absolute extended uncertainty under confidence level of 95% covers reference uncertainty of standards, stability in 12 months, influence quantities (ambient temperature +20...+26°C, humidity and power supply voltage 85...265V, frequency 47...63Hz)
2) % - related to the setting value, %* - related to the setting span final value (is underlined)
3) in current range 0.02...120A

| Specification for the non-sinusoidal signals | | | | |
|---|---|---|---|---|
| **Parameter** | | **Settings span** | **Resolution** | **Conditions** |
| Harmonics | amplitude | 0...50% output value [1)] | 0.1% | up to 40th or 2000Hz |
| | phase | -180...+180° | 0.1° | |

1) 50% of output value for frequency range of harmonics to 500Hz with linear decrease to 10% of output value for 2000Hz

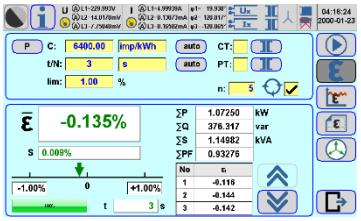
## The TS41 as a tester of electricity meters

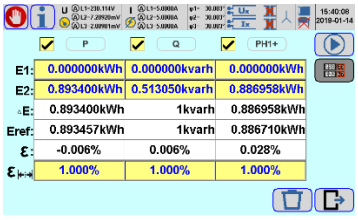
**Testing of electricity meters** (EM) may be realized in different situations:

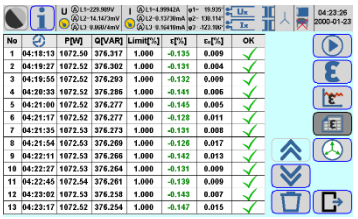
- voltage and current circuits of the EM are powered from power net – in this case the TS41 is used as a reference meter in manual operation mode or controlled via PC software,
- voltage and current circuits of the EM are powered from the TS41 – in this case the TS41 is used as a test system with reference meter and integrated voltage and current source in manual or automatic operation mode with predefined (voltage and current) load points,

with using following functions:

- calculating meter error (partial errors, average error, standard deviation) directly in [%] with method of settings time of measurement or number of pulses,
- measuring energy for verification of meter counters directly in [%],
- maximum power measuring for testing of maximum power meters,





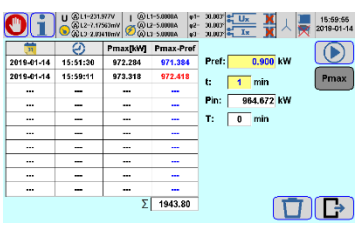


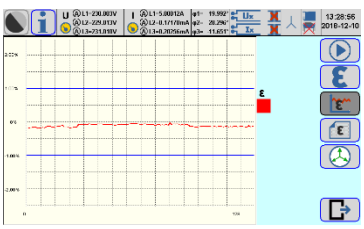
- ✓ for different kind of measuring powers P, P+, P-, PH1, PH1+, PH1-, Q, Q+, Q-, QH1, QH1+, QH1-, S, S+, S-, SH1, SH1+, SH1, as well as for the first harmonic of these powers,
- ✓ with visualization in form of table or trend chart.

In manual operation mode additionally may be used innovation functions:

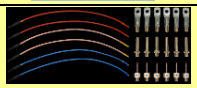
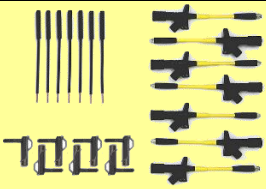
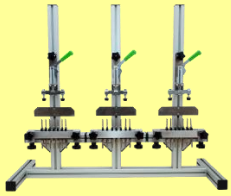
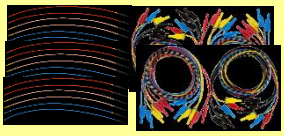
- ✓ automatic identification of meter constant,
- ✓ automatic determining time of measurement or number of pulses.

In automatic operation mode accuracy may be referenced to an internal reference of the TS41 or to an external reference meter.



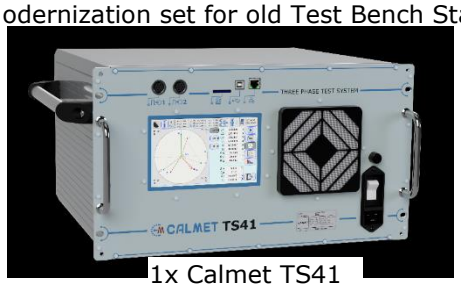


| Specifications for impulse input/output | | | |
|---|---|---|---|
| **Parameter** | **Voltage range** | **Frequency range** | **Uncertainty** |
| Impulse Input for counting pulses (two inputs) | 0...2V/4...30V | 0.0001Hz...210kHz | 0.001%@t≥1s |
| Impulse Output for Calmet TS41 testing | 28V/100mA open collector | 0.0001Hz...210kHz | |

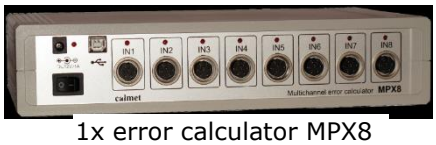
| Calmet TS41 Test System's equipment *) | | | |
|---|---|---|---|
| **All completed Calmet TS41 Test System's set consists of:** | | | |
| • Calmet TS41 test system class 0.04 or 0.1,<br>• power cord,<br>• fuse: 3xFF2.5A/600V, 3xFF16A/500V, 1xT12.5A/500V (2pcs),<br>• memory card SD 8GB,<br>• EA36 set of safety measurement cables (12pcs),<br>• EA25 set of shunts OUTPUT / SENSE (6pcs)<br>• C091A T3475-001 plug Amphenol for Reference pulse output,<br>• operation manual,<br>• warranty card,<br>• manufacturer calibration certificate. | | | |
| **Optionally for Calmet TS41 Test System are available:** | | | |
| • Calmet TS41 PC Soft with operation manual and USB B / USB A interface cable, |  | • MPX8 – 8 channel error calculator with control software, |  |
| • AKD300 120A test leads (6pcs) with terminals set (18pcs), |  | • ED10 – individual error display with USB output |  |
| • EA20 additional accessories for safety cables, |  | • ER30.3 3-position rack for hanging of meter with quick connection device 3-phase, |  |
| • CF106H photo head with holder for inductive meter and meter with LED, |  | • EA27.3, EA27.4 – set of cables for 3/4 postions test bench station with isolators ICT:<br>- 24/28 voltage cables<br>- 3 current cables 120A – long<br>• 9/12 current cables ICT 120A |  |
| • EA26 additional accessories for safety cables 12x banana plugs,12x fork plugs, |  | • EC10.3 – 3 phase current isolation transformer ICT, |  |
| • ER10H.3 1-position rack for hanging of meter with quick connection device 3-phase, |  | • ET32 transportation case for additional accessories. |  |

*) All pictures are for demonstration only and can be changed without notice

Example modernization set for old Test Bench Station to modern 4-positions station



1x Calmet TS41

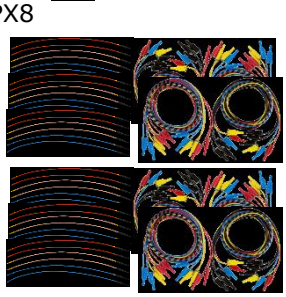


1x error calculator MPX8


4x photo head CF106


4x isolation transformers ICT

4x error display ED10


1x EA27.4 cables set

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