The Calmet TB40 Four Position Meter Test Bench is used for calibration and simultaneously testing up to four single and three phase electromechanical and electronic active and reactive electricity meters and portable test equipment with accuracy referenced to an internal reference meter.

The Calmet TB40 Test Bench employs modern precision power source with the internal reference (without need to use an additional external reference energy meter with additional cables). By this conception may be achieved simultaneously flexible customer orientated solution characterised by extremely compact size, light weight, high metrological properties at reasonable price. In case the high-accuracy application requirement, it is possible to upgrade the existing Calmet TB40 Test Bench by adding an external reference meter.

The Calmet TB40 Test Bench comprises:
- three phase power source with accuracy class of internal reference 0.02 or 0.05. Three phase power source generates voltage up to 560V and current up to 120A with programmable shapes, frequency in 40...500Hz range and phase shifts in 0...±360° range,
- four position testing stand with photo scanning heads and cables,
- MPX8 Eight Inputs Meter Error Calculator,
- PC laptop with installed MPX8 PC Soft and Calpro300 for controlling of testing process.

The Calmet TB40 Test Bench performs the following automatic tests of electricity meters:
- measure the basic error characteristics and repeatability,
- checking the counter error,
- checking the starting current and no-load run,
- measure the influence of frequency, voltage, self-heating, reversed phase sequence, distortion and special shapes of currents and voltages,
- checking the impulse output and energy meter counter,
- checking the maximum power indicator.

**Configuration of the Calmet TB40 with using external Reference meter**

- Eight Inputs Multiplexer MPX8
- Scanning Heads CF106H
- Device Under Test DUT and external Reference Meter
  
  It is possible to extend the test bench to eight DUTs with current range to 6A and small dimensions (necessary to use additional Scanning Heads and measuring Cables)

- Voltage and current source with internal reference C300B
  
  $I_{L1}$-$I_{L2}$-$I_{L3}$

- USB / RS232
The accuracy of the basic parameters of the Calmet TB40 - voltage, current, power and energy in a wide voltage 21...560V and current 0.05...120A ranges, is expressed as a percentage of the setting value, without the component as a percentage of the range value. This form of errors specification is very useful when checking instruments, such as electricity meters.

Energy errors diagrams of the Calmet TB40 class 0.02 as a function of current settings for balanced and unbalanced loads at 230V/50Hz and power factor cosφ=1 and 0.5L, achieved in automatic test procedure using Calpro300 TS software and reference meter Radian RD33.

### Power source with internal reference

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>Settings span</th>
<th>Resolution</th>
<th>Uncertainty 1)</th>
<th>Maximum load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage U</td>
<td>70V</td>
<td>0.5000...70.0000V</td>
<td>0.001V</td>
<td>±0.02% 2(4)</td>
<td>560mA@70V (I_{phase}=800mA)</td>
</tr>
<tr>
<td></td>
<td>140V</td>
<td>1.000...140.000V</td>
<td>0.001V</td>
<td>±0.05% 2(4)</td>
<td>280mA@140V (I_{phase}=400mA)</td>
</tr>
<tr>
<td></td>
<td>280V</td>
<td>2.000...280.000V</td>
<td>0.001V</td>
<td>±0.05% 2(4)</td>
<td>140mA@280V (I_{phase}=200mA)</td>
</tr>
<tr>
<td></td>
<td>560V</td>
<td>5.000...560.000V</td>
<td>0.001V</td>
<td>±0.02% 2(4)</td>
<td>70mA@560V (I_{phase}=100mA)</td>
</tr>
<tr>
<td>Voltage short term [1h] stability</td>
<td>±0.005% 2)</td>
<td>±0.010% 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage long term [1year] stability</td>
<td>±0.01% 3)</td>
<td>±0.02% 3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage temperature drift per 1°C</td>
<td>±0.0005% 2)</td>
<td>±0.0010% 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual current</td>
<td>6A</td>
<td>0.05000...6.00000A</td>
<td>0.00010A</td>
<td>±0.02% 2(5)</td>
<td><a href="mailto:17V@0.5A">17V@0.5A</a></td>
</tr>
<tr>
<td></td>
<td>20A</td>
<td>0.20000...20.0000A</td>
<td>0.0001A</td>
<td>±0.05% 2(5)</td>
<td>8.5V@6A</td>
</tr>
<tr>
<td></td>
<td>120A</td>
<td>1.000...120.000A</td>
<td>0.001A</td>
<td>±0.02% 2(5)</td>
<td>3.3V@20A</td>
</tr>
<tr>
<td>Current I</td>
<td>0.5A</td>
<td>0.0001000...50.00000A</td>
<td>0.000001A</td>
<td>±0.005% 2)</td>
<td>0.95V@60A</td>
</tr>
<tr>
<td></td>
<td>20A</td>
<td>0.20000...20.0000A</td>
<td>0.0001A</td>
<td>±0.05% 2)</td>
<td>0.70V@120A</td>
</tr>
<tr>
<td>Current short term [1h] stability</td>
<td>±0.005% 2)</td>
<td>±0.010% 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current long term [1year] stability</td>
<td>±0.01% 3)</td>
<td>±0.02% 3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current temperature drift per 1°C</td>
<td>±0.0005% 2)</td>
<td>±0.0010% 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current distortion factor</td>
<td>&lt; 0.1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency f</td>
<td>40.000...500.000Hz</td>
<td>0.001Hz</td>
<td>±0.005%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase shift ψ</td>
<td>0.00...360.00°</td>
<td>0.01°</td>
<td>±0.05° 2)</td>
<td>±0.10° 2)</td>
<td></td>
</tr>
<tr>
<td>Active power P</td>
<td>0...3x6720.0W</td>
<td>0.00001-0.1W</td>
<td>±0.02% 2(3)</td>
<td>±0.05% 2(3)</td>
<td></td>
</tr>
<tr>
<td>Reactive power Q</td>
<td>0...3x6720.0var</td>
<td>0.00001-0.1var</td>
<td>±0.02% 2(3)</td>
<td>±0.05% 2(3)</td>
<td></td>
</tr>
<tr>
<td>Apparent power S</td>
<td>0...3x6720.0V</td>
<td>0.00001-0.1V</td>
<td>±0.02% 2)</td>
<td>±0.05% 2(3)</td>
<td></td>
</tr>
<tr>
<td>Power short term [1h] stability</td>
<td>±0.005% 2(18)</td>
<td>±0.010% 2(18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power long term [1year] stability</td>
<td>±0.01% 2(18)</td>
<td>±0.02% 2(18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power temperature drift per 1°C</td>
<td>±0.0005% 2)</td>
<td>±0.0010% 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonics magnitude</td>
<td>up to 64th phase</td>
<td>0.01%</td>
<td>±0.02% 9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>or 3200Hz</td>
<td>0...360°</td>
<td>0.1°</td>
<td>±0.5° 9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1...3600s</td>
<td>15s</td>
<td>±0.01% 2)</td>
<td>±0.001s</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>calculated from settings of power and time</td>
<td>±0.02% 2(3)</td>
<td>±0.05% 2(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impulse output</td>
<td>programmable impulse output: open collector 28V/100mA up to 210kHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special shapes</td>
<td>Phase Fired and Burst acc. To EN50470</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>Single phase 90V...26V4 / 47...63Hz</td>
<td>900VA acc. to IEC 60359 for group I</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dimensions and weight**

- (width 480 x height 200 x depth 560)mm and 28kg
- Four position test rack is made of light aluminium profiles
- Set of cables (16 units), set of safety current cables up to 20A (15 units)

### Test setup

- **Test rack**
- **Photo scanning head**
  
  - Photo scanning head type CF106H (4units) which detect the disc movement or the LED flash of the meter

### Multiplexer

- **Impulse input**
  
  Eight impulse inputs INL 0...2V, INH 4...27V up to 200kHz
  
  - 0.001% @ t>4ms
  
  - Power supply
    
    9...12V and 1A@12V

**Dimensions and weight**

- (width 290 x height 70 x depth 200)mm and 1.3kg with cables

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1) absolute extended uncertainty under confidence level of 95% covers reference uncertainty of standards, stability in 12 months, influence quantities (ambient temperature in range +20...+26°C, humidity and power supply voltage, load, frequency in range 45...65Hz) and nonlinearity. For frequency band below 45Hz and above 65Hz – linear rise up typically to double value for frequency 40Hz and 500Hz

2) of setting value, for settings from 10% of current range and 30% of voltage range

3) uncertainty of power P(Q) under cosφ=1, for cosφ=0.95=1 linear rise up to 0.15% (class 0.02) or 0.30% (class 0.05) for cosφ=0.9

4) for voltage below 30% of range uncertainty 0.006% of range (class 0.02) or 0.015% of range (class 0.05)

5) for current below 10% of range uncertainty 0.002% of range (class 0.02) or 0.005% of range (class 0.05)

6) for energy dosage

7) 0.85V@60A and 0.50V@120A using the AKD300 current cables length 1m; limited to 80A with Quick Connectors

8) stability of power S and P(Q) under cosφ=1, for cosφ=0.95=1 linear rise up to 0.04% for cosφ=0.9

9) 0.02% of output value and 0.5° for frequency range of harmonics 80-120Hz with linear rise up to 0.2% of output value and 4° for 320Hz

*) Simultaneously can be tested up to 4 "opened link" electricity meters or 1 "closed link" meter in full range of settings and with specified accuracy.

For more than 1 meter with "closed link", each next meter influences on decreasing of measurement accuracy for low current
The Calmet TB40 Test Bench is controlled by means of personal computer with installed MPX8 PC software in MS Windows operating system.

**MPX8 PC Soft** features:
- using a modern concept, which allows the operator to create own test procedures - this is very important because new requirements for new meter generations can be realized easily without changing the complete software,
- the automated mode - direct execution of the complete test procedure automatically and requires no more additional handling by operator unless it will not be defined in the test procedure,
- the manual mode - direct execution of single test step. It offers an ideal solution for tests and evaluation of entire specifications for devices under test without generating the complete test procedure,
- computer database of customers, devices, measurement procedures as well as edition of results, diagrams, tables of results and reports,
- export of results to MS Excel.

**Meter type window** for entering data to tested devices database, contains the electrical and functional definitions of the device under test – DUT (base voltage and current values, maximal current value, accuracy class of the DUT, meter constant, meter connection,...).

**Procedure window** for entering data to measuring procedures database, describes the order and content of the various test steps in a sequence. For each test step are specified following data:
- parameters of test point (point name, percentage value of the base voltage and current, phase angle or power factor, frequency, waveform of the voltages and currents,...),
- test type (error test, counting test, counter test),
- test method (impulses counting or time counting for error test) and percentage error limit of the DUT,
- test duration for calculating of the standard deviation of error (number of cycles, time of the test point, energy dosage to counting).

**Configuration window** describes configuration of the MPX8 Multiplexer inputs (active / not active) and description of connected DUT (name, serial number and other necessary information).
Additionally the configuration window allows to set the external reference meter (option) connected to the 8th of the MPX8 input.

**Autotest window** for performing test of the DUT (tests of accuracy at reference conditions, repeatability, meter constant, starting and no-load condition, effect of influence quantities and tests of effect of disturbances of long duration as reversed phase sequence, voltage unbalance, self-heating, odd harmonics, even harmonics, subharmonics,...) according to measuring procedure in the manual mode or in the automated mode. The autotest function allows to allocate to a measurement procedure a meter type and select a test sequence.
During the test, the operator will be informed about:
- point status (passed / not passed, active point),
- progress indicator (cycle, point and procedure),
- error values for all DUTs in consecutive cycles,
- values of average error, standard deviation and error limit for all DUTs.
Additionally, in any time, the operator can pause or stop a procedure and repeat selected point.

**Advantages of MPX8 PC Soft:**
- user-friendly operation,
- demonstration software allows training to be given before delivery of the test system,
- database for meters and test procedures,
- fully-automatic test procedures,
- continuous monitoring of the test,
- generation of harmonics,
- generation of special test signals and waveforms acc. to the IEC 62052-11 and EN 50470-1,2,3,
- tables and graphics for presentation of results,
- operator interface available in several languages,
- customers database for automatic measurements report generation.
**Table result window** makes possible visualization and edition measured results in form of table and consists of measured results of DUTs in two kinds of table: table of individual DUTs results and table of all DUTs results.

During an automatic test sequence it is possible to view test results and after executing an automatic test sequence all saved results are available for further data processing (printing and exporting data to MS Excel).

**Graphic result window** makes possible visualization of measured results in form of diagram of error function with error limits.

The graphic result is fully customizable. The operator can change:
- add or hide graph of selected DUT to diagram,
- color of any graph,
- quantity of X axis (no, time, current, voltage,...),
- zoom in and out of diagram.

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**Calmet TB40**

All completed Calmet TB40 Test Bench’s set consists of:

- C300B calibrator class 0.02 or 0.05 with Calpro 300 Basic + TS software (for automatic test of electric equipment) + PQ software (for Power Quality measurement devices testing),
- MPX8 Eight Inputs Meter Error Calculator with MPX8 PC Soft (for controlling the process of simultaneously testing up to 4 energy meters),
- ER40H.3 four position testing stand including:
  - ER40 4-positions test rack,
  - EH10.3 quick connection device (4units),
  - set of safety voltage cables (16 units),
  - set of safety current cables up to 20A (15 units),
  - set of safety current cables up to 120A (15 units),
  - set of accessories for safety cables (68 units),
  - set of accessories for current cables up to 120A (24 units)
- Computer Laptop PC with PC software,
- CF106H photo head with holder for inductive meter and meter with LED (4units),
- AD300 sockets adapter,
- power cord (2units),
- USB / RS232 adapter,
- fuse T4A, 250V, 5x20 (2units),
- C091A T3475-001 plug Amphenol for Calibrator inputs,
- operation manuals (6units) and assembly manual,
- warranty card and calibration certificate.

Optionally for Calmet TB40 Test Bench are available:

- External reference meter Radian Research,
- C091A T3475-001 plug Amphenol for Calibrator inputs,