



CALMET

www.calmet.com.pl

Calmet – manufacturer of precision meter test equipment

1





Innovative-Developing Enterprise Calmet Ltd.

- ❑ Calmet = **CAL**ibrators + **MET**rology
- ❑ founded in **1989**, roots come from LUMEL, big factory of measurement equipment in Poland, Zielona Gora
- ❑ designing, production, selling and servicing new kind of calibrators and electric equipment testers
- ❑ employs over 15 engineers, including 3 with Ph.D.
- ❑ cooperates with University of Zielona Gora; common projects and lectures
- ❑ since 1996 – electricity meters testing and power network parameters analysing
- ❑ since 2002 – generating and measuring network quality parameters
- ❑ since 2006 – automation of electro-utility automatic protective equipment testing
- ❑ since 2011 – automatic Test Benches for energy meter testing

Measurement Equipment since 1989

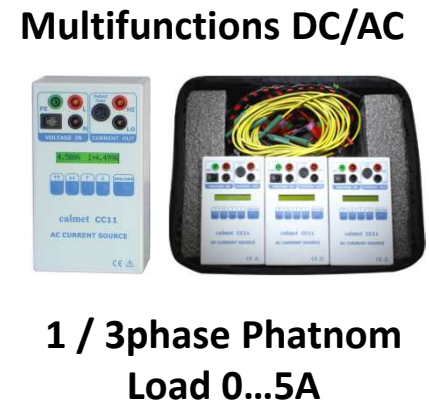
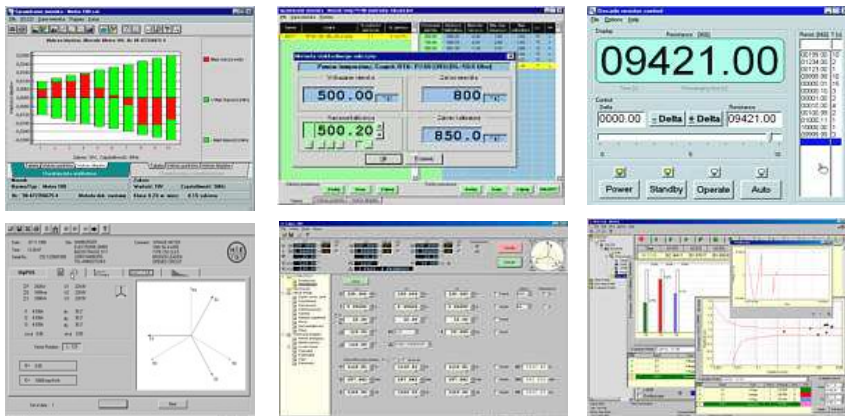
Customer Support in problems solving

Energy meter testers, Current Transformers testers, Power quality analysers

AC/DC Voltage, Current, Power & Resistance Calibrators, Test Benches



Control Software for measurement equipment



Presentation target:

1. Meter Test on site equipment presentation

- single phase energy meter testing;
- three phase directly connected energy meter testing;
- three phase, CT / VT connected, energy meter testing;
- Current transformer (CT) & Potential transformer (PT) testing;
- Power Quality Parameters influence for testing;
- basic technical parameters;
- standard (included in price) and optional accessories;

2. Calibrators of current, voltage, power & energy

- simple AC current source (1 / 3 phase);
- single phase power calibrator;
- three phase power calibrator;
- automatic testing of energy meters in full range of loads

3. Typical sets of equipment

4. Equipment presentation

New standards (in development) for test equipment and portable equipment

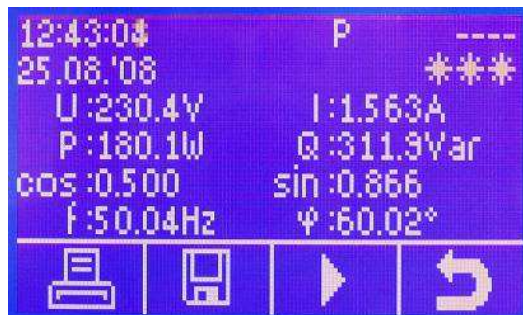
IEC 62057-1 Test equipment, techniques and procedures for electrical energy meters

IEC 62057-2 Portable Test Equipment and Test Procedure for Electricity Meter and Electricity Meter Installation

Energy Meter Tester and Power Network Analyser
type Caltest 10

Caltest 10 single phase energy meter tester

- accuracy 0,5% or 0,2%
- current range 0,01...100A (10A)(1000A)(3000A) with current clamp input enables connection without break in circuit
- power up from measurement circuit
- dummy load function
- graphic LCD display
- internal memory for results
- local results printing
- PC Software for data analysis



Included in price:

- tester Caltest 10 accuracy class 0.2 or 0.5;
- voltage cables (2) with set of replaceable tips (6);
- CT100A small current clamps up to 100A;
- interface RS232 cable & USB-RS232 adapter;
- Calsoft 10 PC software;
- CF100 Photo scanning head for LED energy meters with UCF100 assembly device;
- AD10 adapter for current source or printer power supply;
- transportation case, user manual;
- warranty card,
- manufacturer Calibration Certificate.



Optional:



- CT10A small current clamps up to 10A;
- CT1000A current clamps up to 1000A;
- FCT3000A flexible clamps up to 30/300/3000A;
- DR100 or DR200 small thermic printer,
- CF101 photo head for inductive energy meters with UCF100 assembly device;
- CC11 current source.

- ▶ Measure of power network parameters and Meters testing in accuracy class **0,05** or **0,1**
- ▶ Voltage range **0,05...300V**
- ▶ Current range **0,001...12(100)(1000)(30/300/3000)A**
- ▶ Testing of energy meters, potential and current transformers (**CT / PT**)
- ▶ Recording and analyse of **Power Quality**
- ▶ **Vector, oscilloscope**, bar and trend charts of three phase network
- ▶ Automatic Meter Constant recognition
- ▶ Automatic setting of measurement conditions
- ▶ Powering from measurement network 50...450V AC and from internal battery with its own charger
- ▶ Big 7-inch full colour touch screen and computer software Calmet TE30 PC soft
- ▶ Reading data and remote controlled via **USB, Ethernet, Bluetooth**
- ▶ Recording data on flash memory SD card up to **32GB**
- ▶ Calibration Certificate

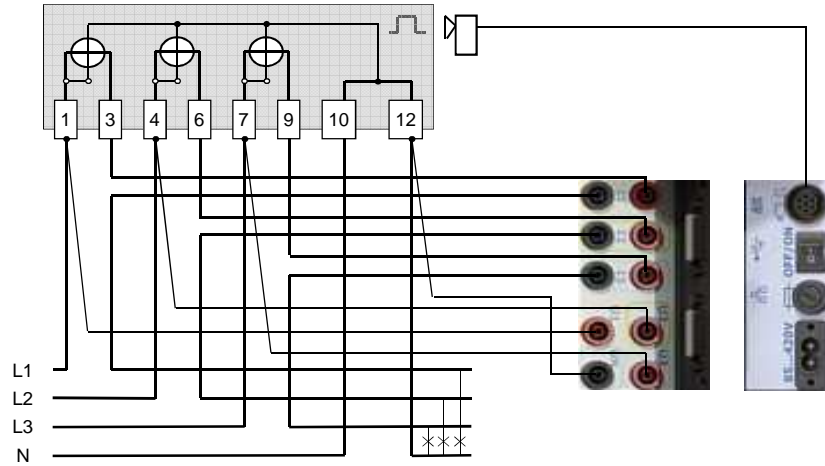


	L1	L2	L3		
U:	230.032 V	230.146 V	229.987 V	f:	50.001 Hz
U _Δ :	398.526 V	398.487 V	398.388 V	U _N :	0.14200 V
I:	12.0344 A	12.0032 A	11.9998 A	I _N :	4.99150 A
φ:	0.000 °	15.000 °	30.000 °	Σ:	0.94399
PF:	1.00000	0.96593	0.86603	Σ:	0.25293
sin:	0.00000	0.25880	0.49999	Σ:	0.28177
tgφ:	0.00000	0.26795	0.57735	Σ:	L123
Φ _{uφ} :	120.000 °	-120.000 °	120.000 °	Σ:	8870.23 W
P:	2768.30 W	3711.86 W	2390.07 W	Σ:	2374.38 var
Q:	0.00000 var	994.511 var	1379.87 var	Σ:	9370.88 VA
S:	2768.30 VA	3842.78 VA	2759.80 VA		

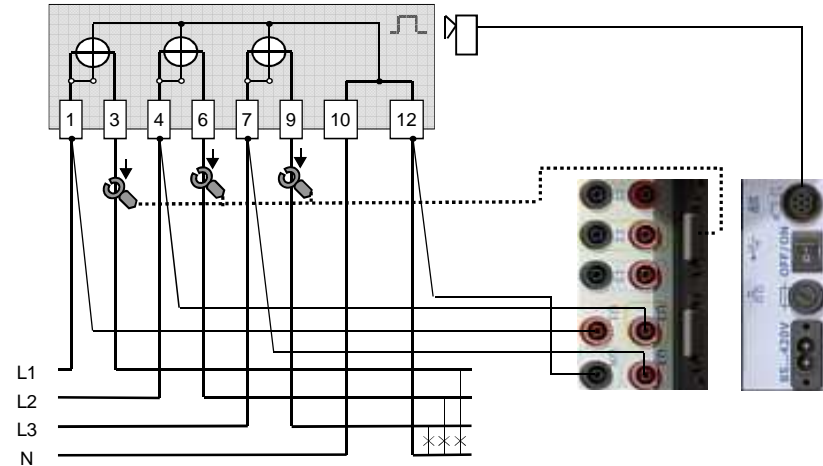


All possible types of connection: 1P2W, 3P4W, 3P3W, ... , direct or with clamps

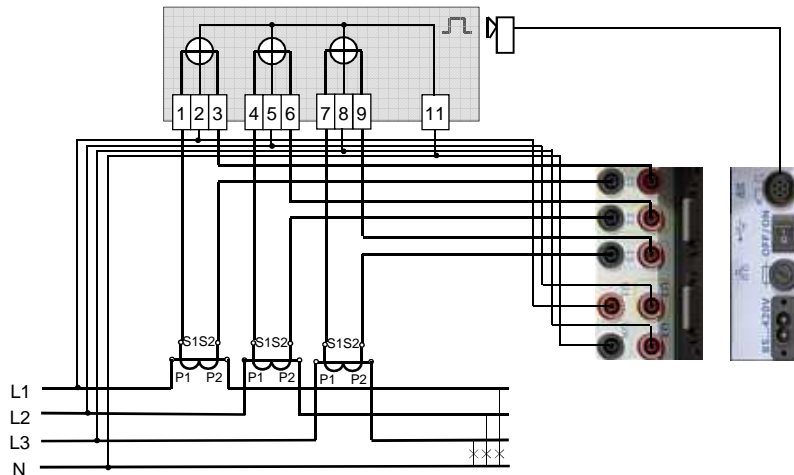
Electricity meter testing – direct connection



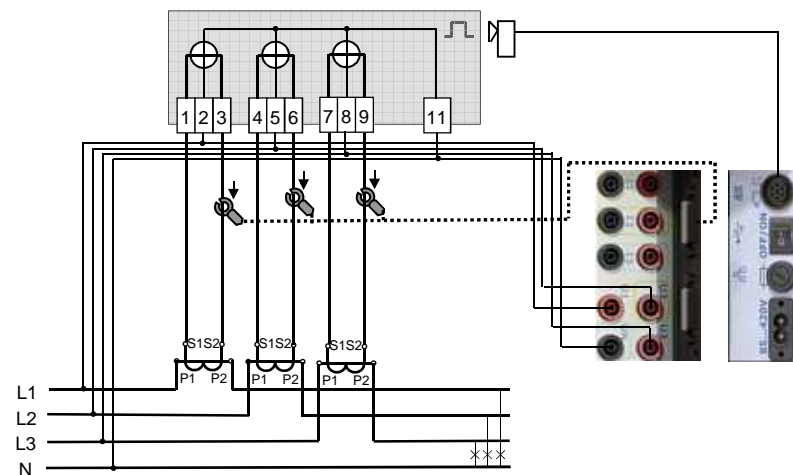
Electricity meter testing – connection with clamps



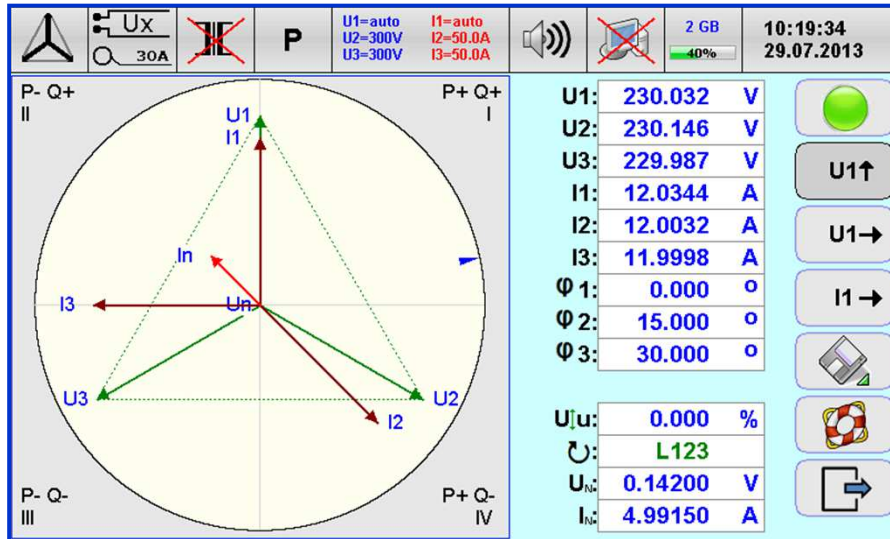
Electricity meter (CT) testing – direct connection



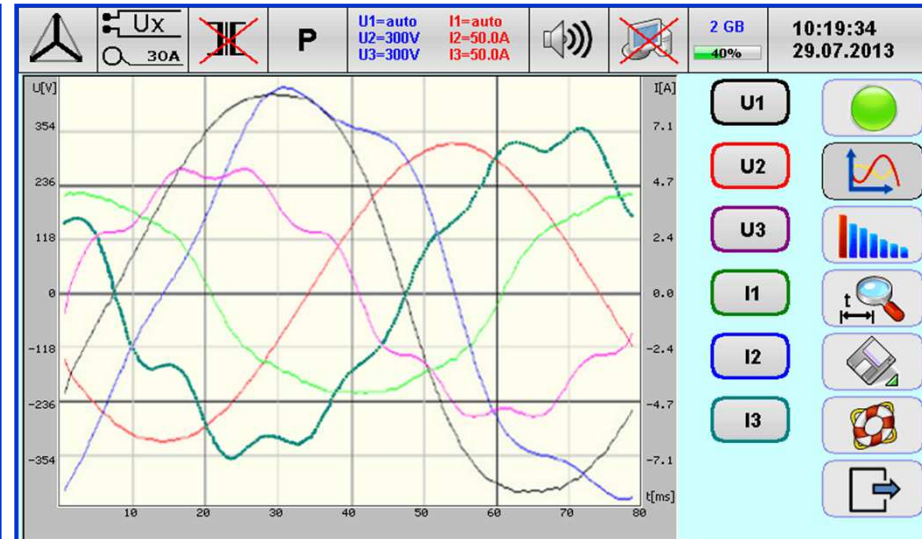
Electricity meter testing (CT) – connection with clamps



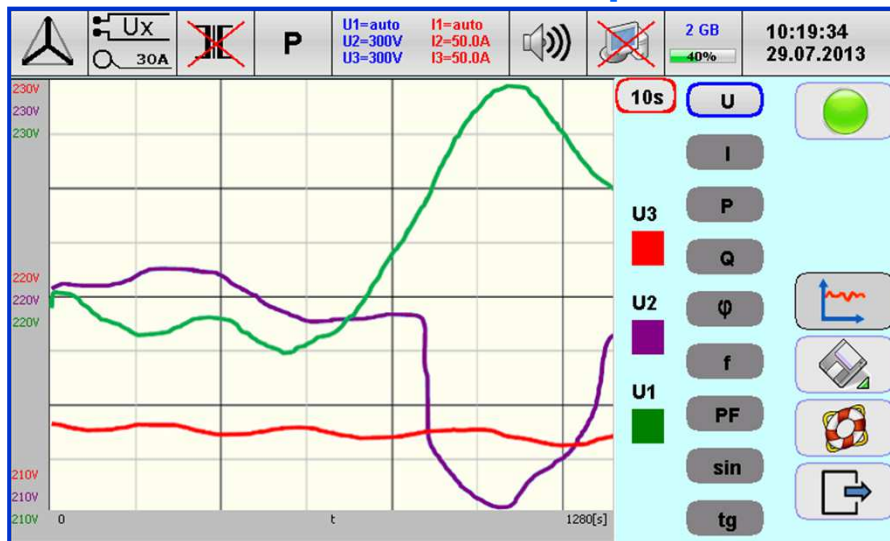
Vector diagram with calculated U_n & I_n



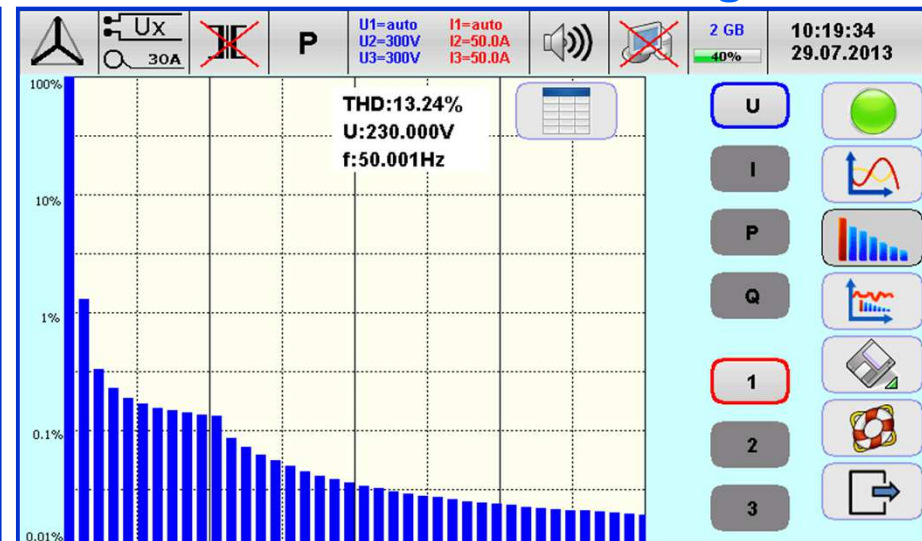
Oscilloscope of U1, U2, U3, I1, I2, I3



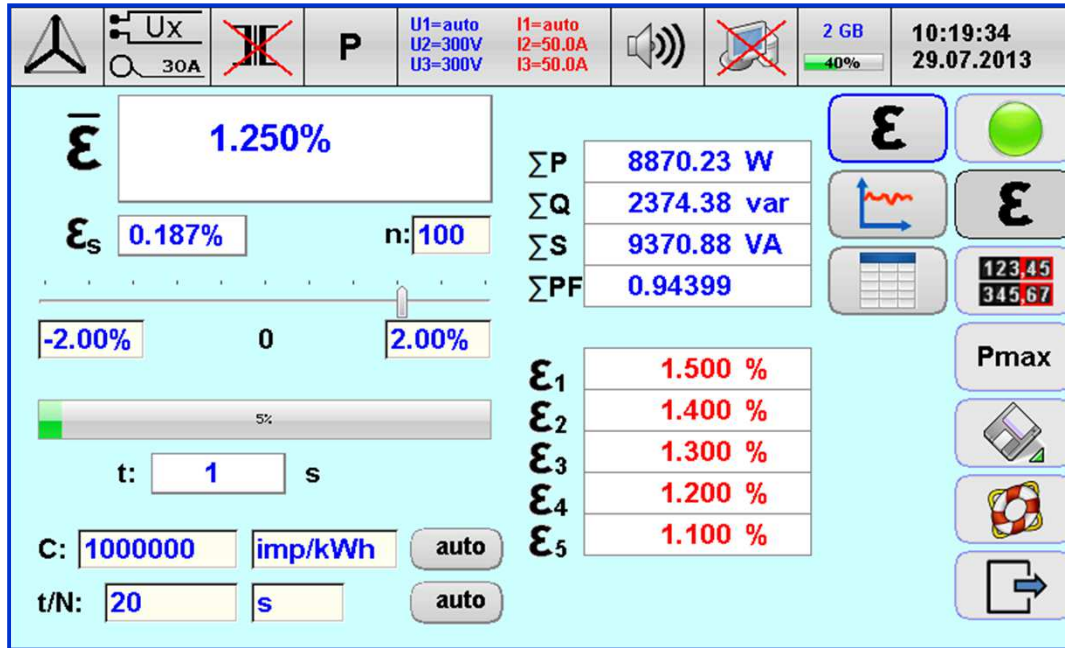
Time trend of U, I, P, Q, ϕ , f, PF,



Harmonics table & bar diagram



Energy meter testing on site and laboratory



- ▶ function of computing meter error (partial errors, average error, standard deviation) directly in percentages [%] with method of setting time of measurement or number of impulses,
- ▶ function of automatic identification energy meter constant,
- ▶ function of automatic determining measurement time or number of pulses.

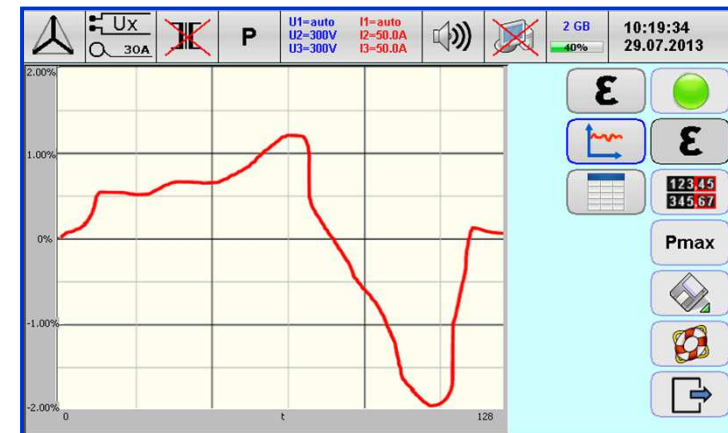
Results of testing are presented as:



No	Time	P[W]	Q[VAR]	Limit[%]	E[%]	Es[%]	OK
1	10:57:03	69000.0	0.00000	1.000	-0.485	0.000	✓
2	10:58:14	6900.00	0.00000	1.000	-0.343	0.011	✓
3	10:58:44	3450.00	5975.58	1.000	-0.165	0.000	✓
4	10:59:15	345.000	597.557	1.000	-0.222	0.025	✓
5	11:00:27	2300.00	0.00000	1.000	-0.389	0.009	✓
6	11:01:03	2300.00	0.00000	1.000	-0.326	0.009	✓
7	11:01:38	2300.00	0.00000	1.000	-0.320	0.000	✓
8	11:02:14	1150.00	1991.86	1.000	-0.225	0.055	✓
9	11:02:52	1150.00	1991.86	1.000	-0.103	0.009	✓
10	11:03:30	1150.00	1991.86	1.000	-0.135	0.040	✓

← TABLE

CHART →



Energy meter Register testing on site and laboratory

	P	P+	PH1
E1:	0.00kWh	0.01kWh	1234.00kWh
E2:	15.12kWh	16.18kWh	1249.89kWh
ΔE:	15.12kWh	16.17kWh	15.89kWh
Eref:	15.15kWh	15.15kWh	15.15kWh
ε:	-0.198%	6.733%	4.885%

▶ function of energy measurement with method of setting time periods for verification of energy meter Register directly in percent [%],

- P
- P+
- P-
- Q
- Q+
- Q-
- S
- PH1
- QH1

▶ function of energy measurement for power P, P+, P-, Q, Q+, Q-, S,

▶ function of energy measurement for the first (fundamental) harmonic of active power PH1 and reactive power QH1

IEC 62053-24/Ed.1 Static meters for reactive energy at fundamental frequency (classes 0,5 S, 1 S and 1)

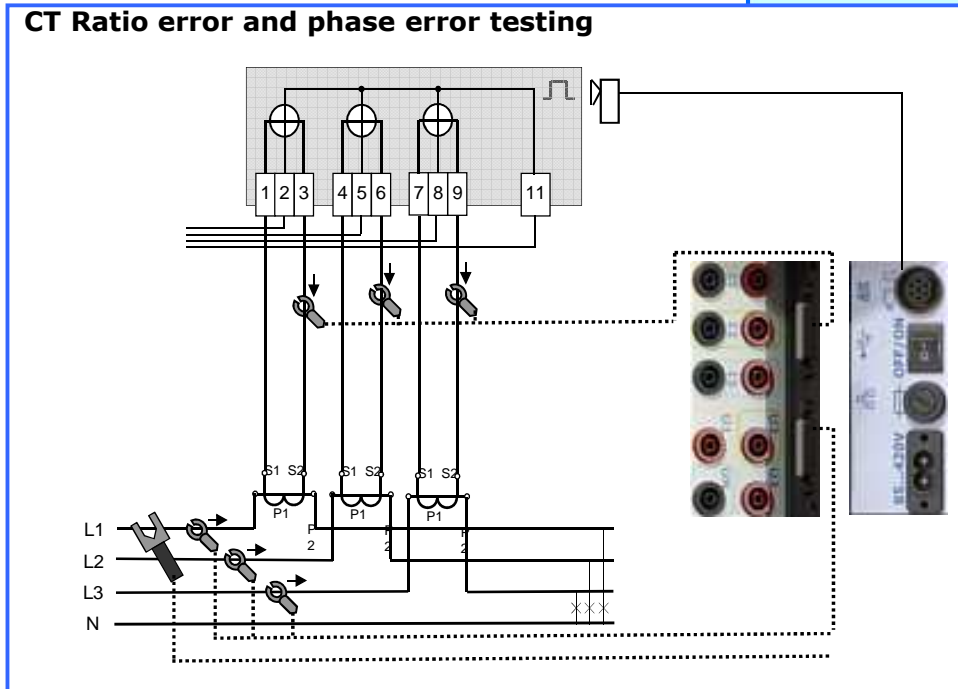
Maximum Demand Energy meter testing


	Date	Time	Pmax[kW]	Pmax-Pref
Pin:	03.12.2013	12:34	80.032	0.032
t:	03.12.2013	13:34	83.343	3.343
Pref:	03.12.2013	14:34	60.002	-19.998
T:	03.12.2013	15:34	92.989	12.989
	03.12.2013	17:34	101.132	21.132
	03.12.2013	18:34	80.111	0.111
	03.12.2013	19:34	156.309	76.309
	03.12.2013	21:34	80.898	0.898
	03.12.2013	22:34	89.325	9.325
	04.12.2013	01:34	80.786	0.786
	Σ			104.929


▶ function of maximum power measuring for testing of maximum demand energy meters,

CT, PT Transformers testing (LV & MV, voltage and current, simultaneously in three phases) directly on site: ratio error and phase shift error testing


Connection diagram









30A



U1=auto I1=auto
U2=300V I2=50.0A
U3=300V I3=50.0A





2 GB
40%

10:19:34
29.07.2013

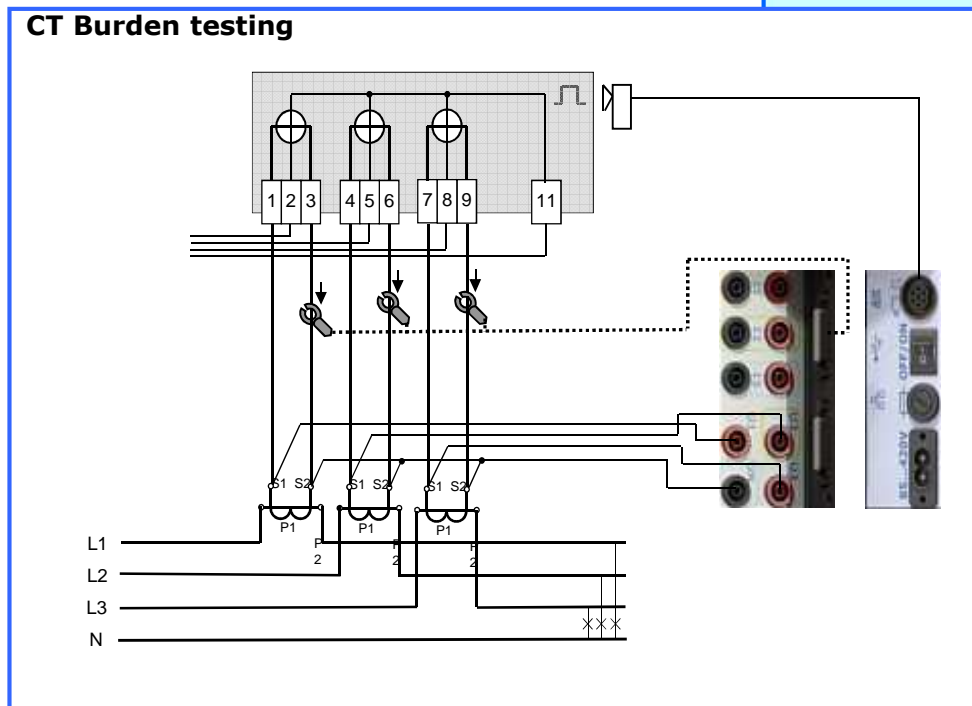
n:

	L1	L2	L3
Ip:	80.0320 A	79.0320 A	80.5320 A
Is:	4.00234 A	3.99234 A	4.10234 A
φ:	0.00100 °	0.00200 °	-0.00100 °
Ip/Is:	19.9963	19.7959	19.6307
δ:	0.01849 %	1.03097 %	1.88099 %
δs:	0.00232 %	0.00893 %	0.01864 %
δlim:	1.00 %	1.00 %	1.00 %
l _{pn} :	100.000 A	100.000 A	100.000 A
l _{pn} :	5.00000 A	5.00000 A	5.00000 A

- ▶ function of computing transformer ratio error directly in percent [%]
- ▶ function of computing phase shift error [°]

CT, PT Transformers testing (LV i MV, voltage and current, simultaneously in three phases) directly on site: CT / PT burden testing

Test can be done by taking into account the length (L) and cross-section of connection wires and serial fuse (Rf) resistance



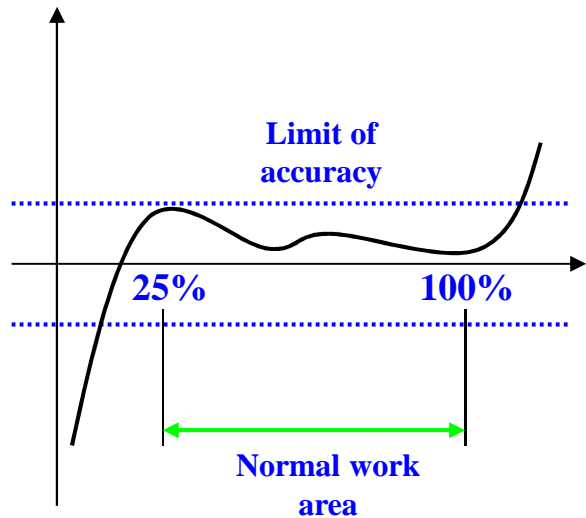
				U1=auto U2=300V U3=300V	I1=auto I2=50.0A I3=50.0A			2 GB 40%	10:19:34 29.07.2013	
PT <input type="radio"/>				2.64332 V 2.64332 V 2.64332 V						<input type="button" value="U I"/> <input type="button" value="I O N:M"/> <input type="button" value="U O N:M"/> <input type="button" value="Save"/> <input type="button" value="Help"/> <input type="button" value="Exit"/>
CT <input checked="" type="radio"/>				5.00021 A 5.00001 A 4.99983 A						
				0.001 ° 0.002 ° -0.001 °						
				1.00000 1.00000 1.00000						
				13.2167VA 13.2167VA 13.2167VA						
				15VA 15VA 15VA						
				88.0991 % 88.0991 % 88.0991 %						
				88.0991 % 88.0991 % 88.0991 %						
				88.1113 % 88.1113 % 88.1113 %						
				88.0991 % 88.0554 % 88.1163 %						
				L: 0.000 m						
				Ø: 0.0 mm ²						
				Rf: 0.000 Ω						

Why the tranformer burden (load) is so important?!



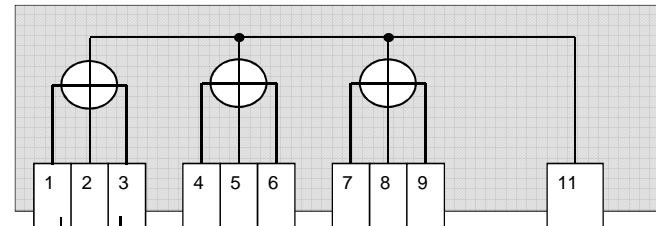
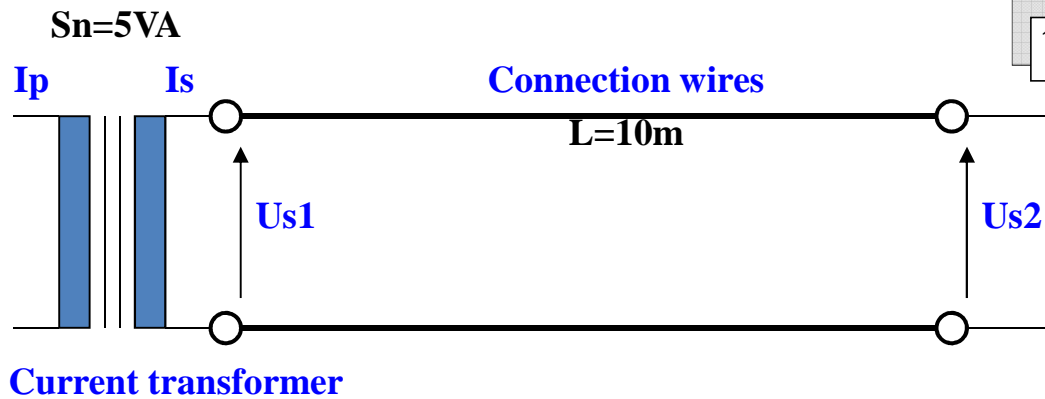
CT Transformer testing: burden testing

ϵ – ratio error [%]



CT – current transformer can operate with stated accuracy only between 25% - 100% of burden (load). In case of **too long**, or **too thin** wire dimension or **too small load**, the result, secondary current can be **out of accuracy limits**

[%] transformer power rating S_n

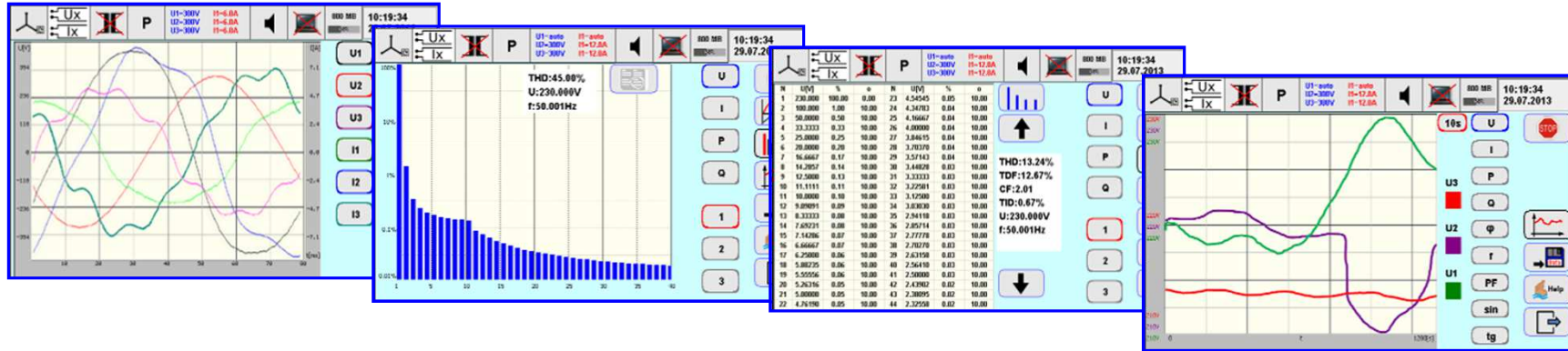


Example:

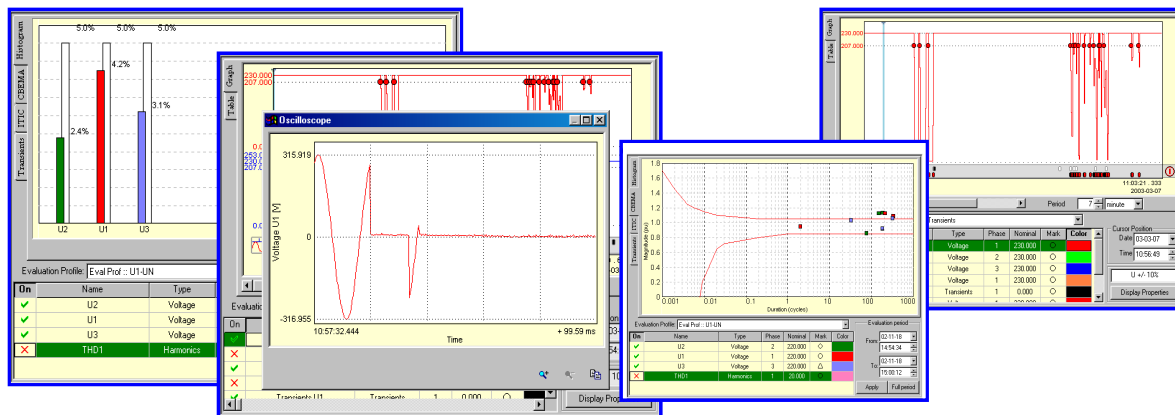
$$R_p = \frac{\rho_{Cu} \cdot l}{S} = \frac{0,0175\Omega \frac{mm^2}{m} \cdot 2 \cdot 10m}{1mm^2} = 0,35\Omega$$

$$P_p = I_2^2 \cdot R_p = 5^2 A \cdot 0,35\Omega = 8,75VA$$

Function of power quality analyser + recording



▶ measuring of power quality parameters according to IEC 61000-4-30 class A with visualization of measurement results in the real time mode



▶ analyzing of measurement results for EN 50160 compatibility or individual requirements of user

▶ recording of power network parameters in the SD Flash 4-32GB memory, which gives $(8÷64) \times 10^6$ sets of network parameters or long-term registration of power quality

Function of power quality analyser + recording

selecting recording method: average value, max / min value, outside limits, every Energy Meter error

selecting recorded parametrs and averaging times

selecting time length of recording and start date & time

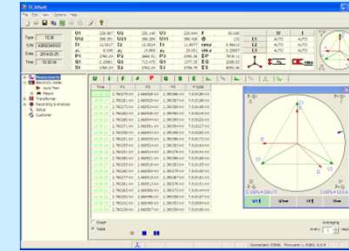
TE30 Analyzer's equipment delivered in price:

- TE30 Analyzer class 0.05 or 0.1;
- Power supply cord;
- Fuse T250mA@230V or T500mA@110V (2 units);
- Memory SD card (8GB);
- Operation manual of analyzer;
- Warranty card;
- Manufacturer calibration certificate;



TE30 Analyzer's optional equipment:

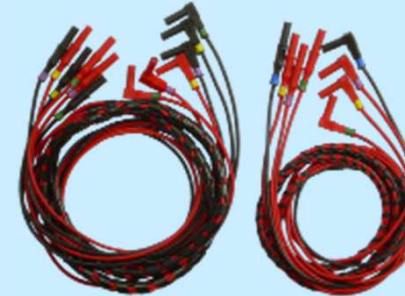
- Calmet TE30 PC Soft with operation manual (for Windows XP and higher versions) and USB mini / USB A interface cable,



- AD100EXT extension for powering TE30 from measurement network,



- EA30 set of safety measurement cables (10pcs) for voltage and current,



- AKD100 additional accessories (handlers, terminals, aligator clips, fork, banana plugs - 42pcs) for safety cables,





TE30 Analyzer's optional equipment:

- CF102 photo head with holder for inductive meter and meter with LED,



- DR200B miniature thermal printer with Bluetooth,



- ET30 transportation case,



- ET32 transportation case for additional accessories,



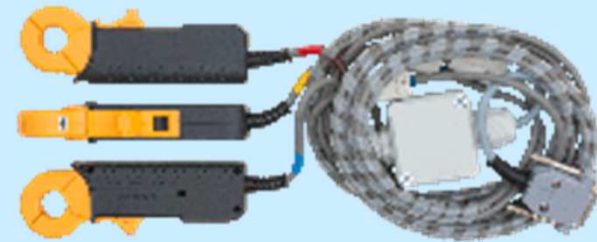


TE30 Analyzer's optional equipment:

- CT10AC electronic compensated clamps up to 10A (1compl),



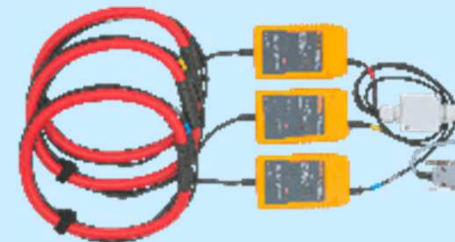
- CT100AC electronic compensated clamps up to 100A (1compl),



- CT1000AC electronic compensated clamps up to 1000A (1compl),



- FCT3000AC electronic compensated flexible clamps in ranges 30/300/3000A (1compl),





TE30 Analyzer's optional equipment:

- AmpLiteWire 2000A primary current sensors up to 2000A for LV and MV nets (1pc),



- VoltLiteWire 40kV primary sensors up to 40kV (1pc),



- rechargeable battery NiMH AA R6 1.2V 2700mAh (5pcs),



- TE30 option set 01 (TE30+ET30+CT100AC+CF102+EA30+AKD100).

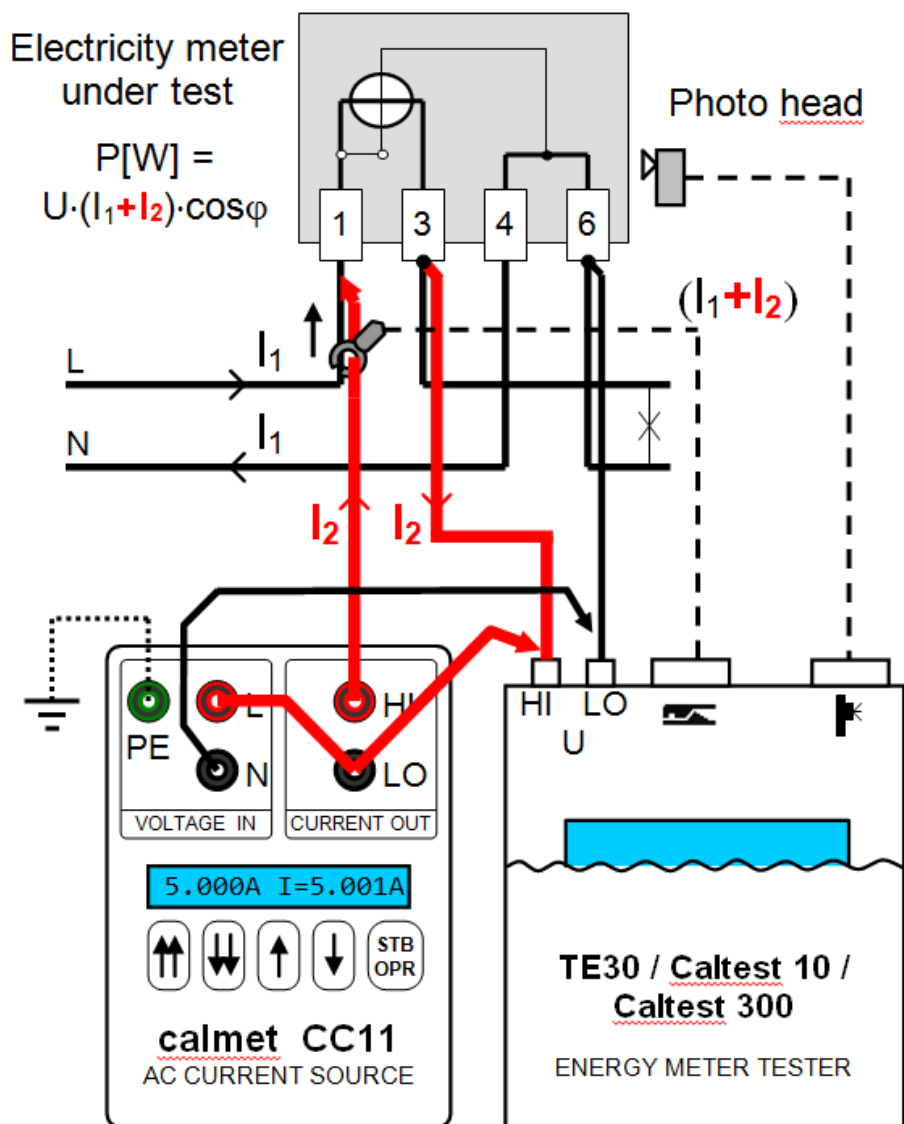


CC11 single phase AC source

- can work as a programmable load for single and 3-phase energy meters
- Range of current from 0,005 to 5,000A
- Digital measurement of input current
- Silent work and no warm up
- Operation without need of energy meter disconnection
- Powering from measurement circuit
- Insulated current output
- Accuracy class 0.2 for testing all kind of devices with current input

CC11





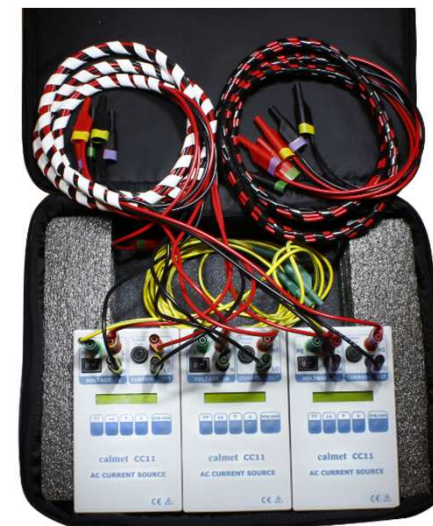
Measurement system for electricity meter testing on site with CC11 source and tester

Calmet CC11 CURRENT SOURCE'S EQUIPMENT
CC11 source's set consists of:

- CC11 AC current source,
- set of safety stackable measurement cables (5),
- AKD11 accessories for safety cables (6) (safety test clip Kleps (3), adapter with flexible Cu wire (2), safety crocodile test clip (1)),
- fuse FF6,3A 250V, 5x20 (5),
- operation manual,
- guarantee certificate,
- manufacturer calibration certificate.

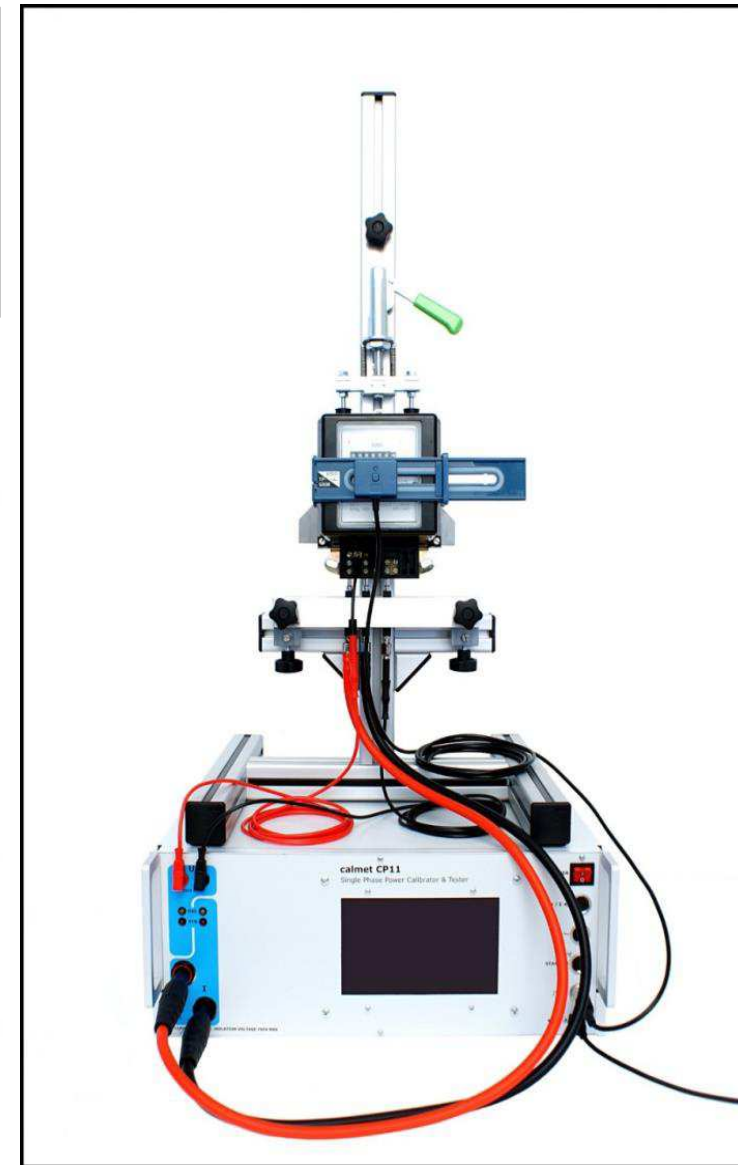
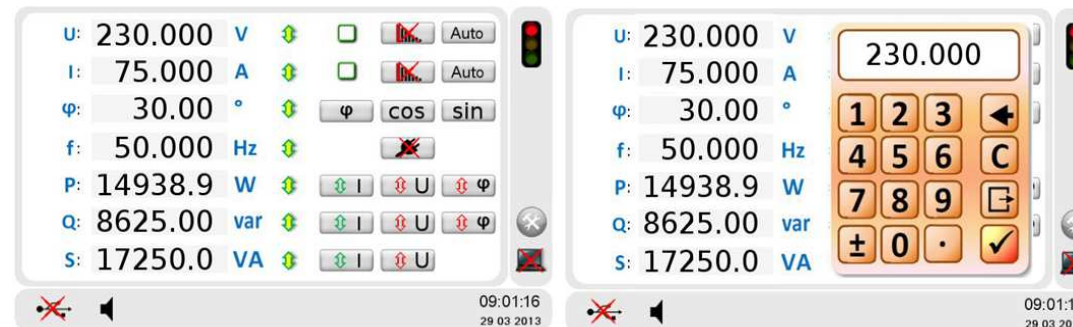
Optionally for CC11 source are available:

- ZW100/10A coil,
- ZW10/20A coil.

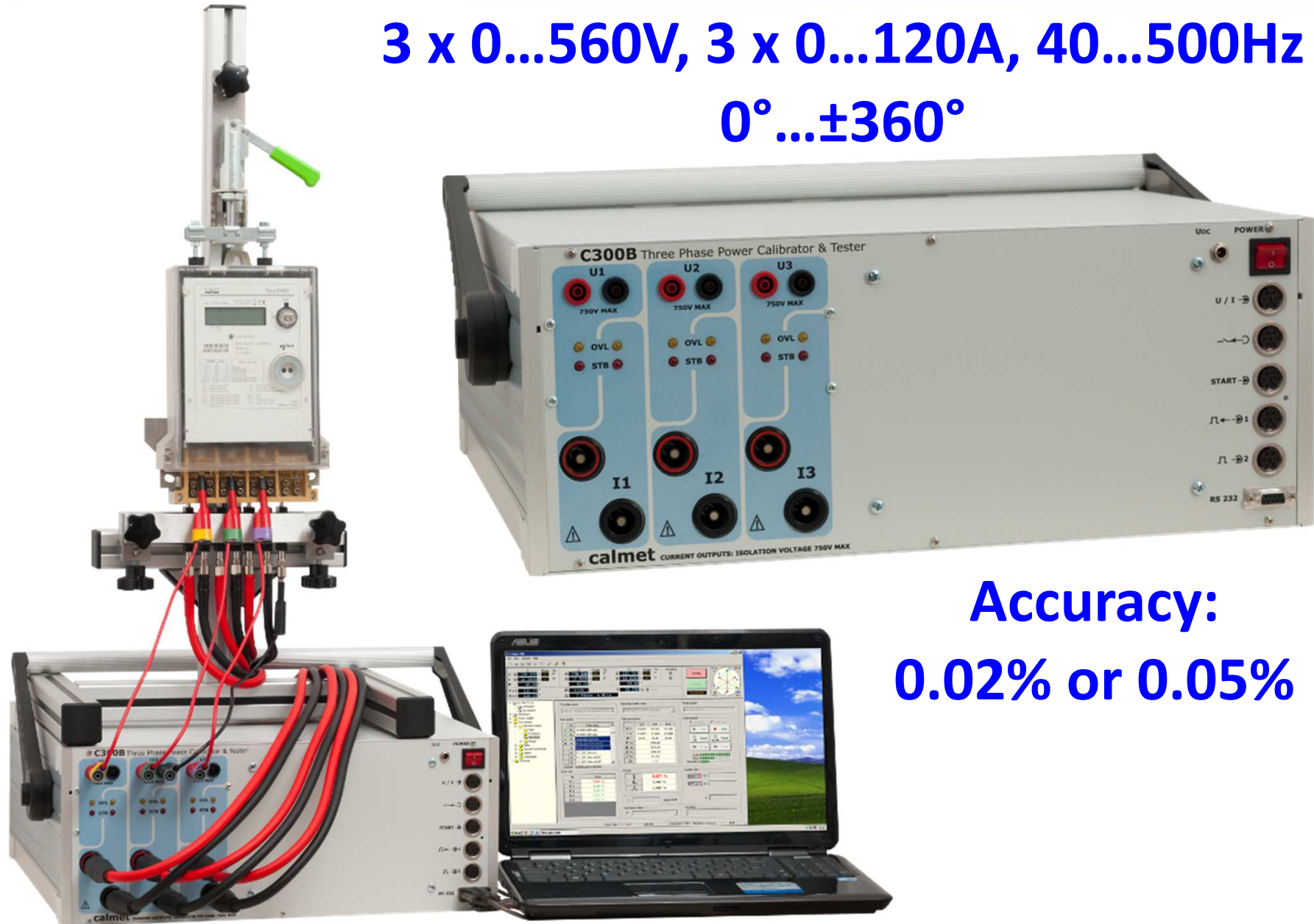


CP11 Power Calibrator and Tester

- Voltage source up to 560V
- Current source up to 120A with a single pair of current sockets
- Accuracy class 0.02% or 0.05% to calibrate digital instruments
- Single product in a single case without auxiliary amplifiers
- High burden of outputs to drive older analogue instruments
- Large color Touchscreen and Calpro 300 PCsoft
- Manual mode and automatic test procedures



**3 x 0...560V, 3 x 0...120A, 40...500Hz
0°...±360°**



**Accuracy:
0.02% or 0.05%**

Calibrator / tester C300 is used for adjusting, checking and verification of measuring instruments used in power engineering:

AC Voltmeter



AC Ammeter



Clamp Meter



Phase Meter



Power Factor Meter



AC Current Clamp



Transducer



Current Transformer



Power Meter P, Q, S



Protective Relay

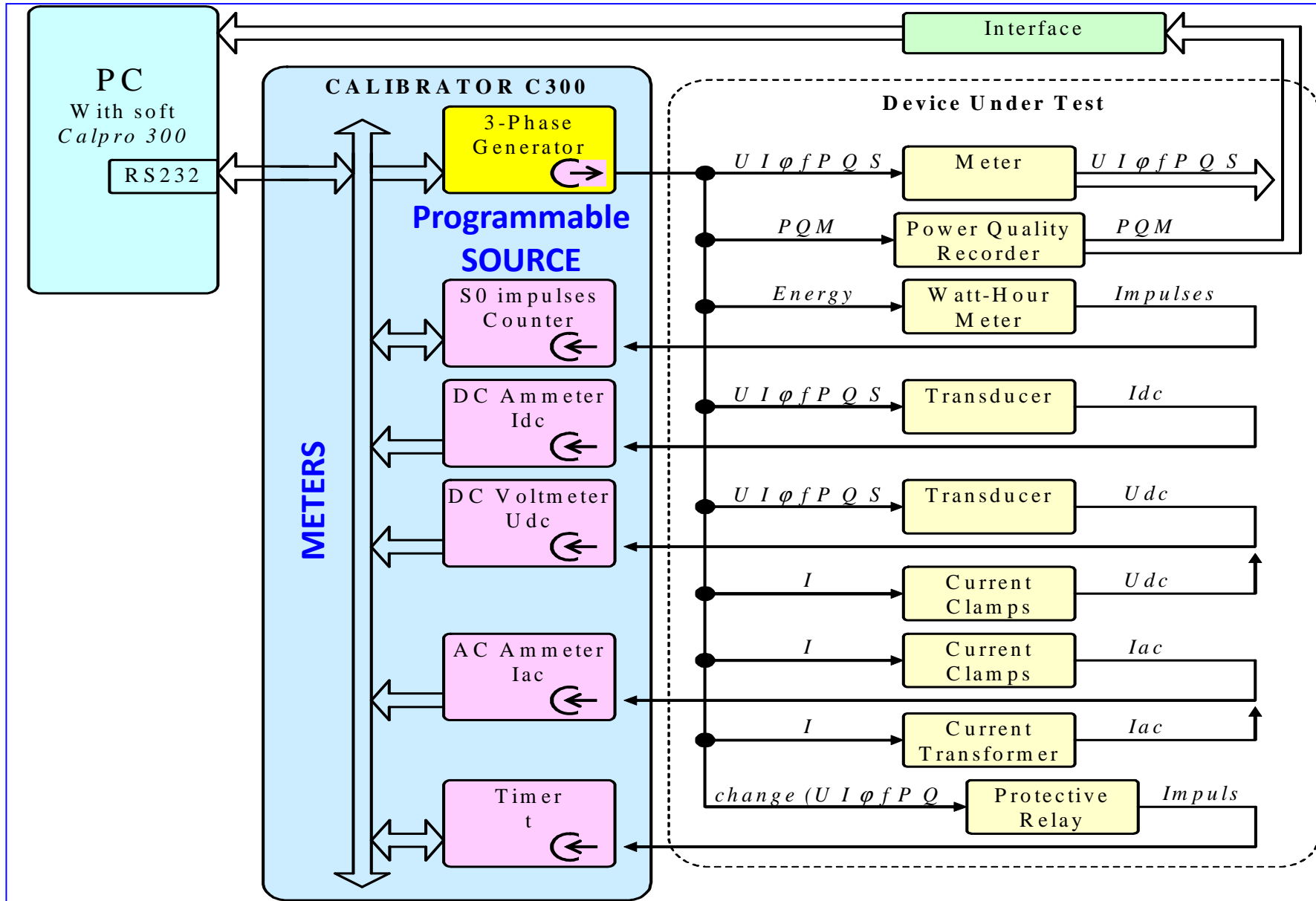


Power Quality Analyzer



Electricity Meter





Voltage:

- range: 0.5000V ... 560.000V
- uncertainty: $\pm 0.02\%$
- short term stability: $\pm 0.005\%$
- long term stability: $\pm 0.01\%$
- temp. drift: $\pm 0.0005\%/1^\circ\text{C}$



Current:

- range: 0.001000A ... 120.000A
- uncertainty: $\pm 0.02\%$
- short term stability: $\pm 0.005\%$
- long term stability: $\pm 0.01\%$
- temp. drift: $\pm 0.0005\%/1^\circ\text{C}$

Maximum load:

- 560mA@70V
- 280mA@140V
- 140mA@280V
- 70mA@560V
- sin distortion: 0.05%

Frequency:

- range: 40.000Hz... 500.000Hz
- uncertainty: $\pm 0.005\%$

Phase shift:

- range: 0.00° ... $\pm 360.00^\circ$
- uncertainty: $\pm 0.05^\circ$

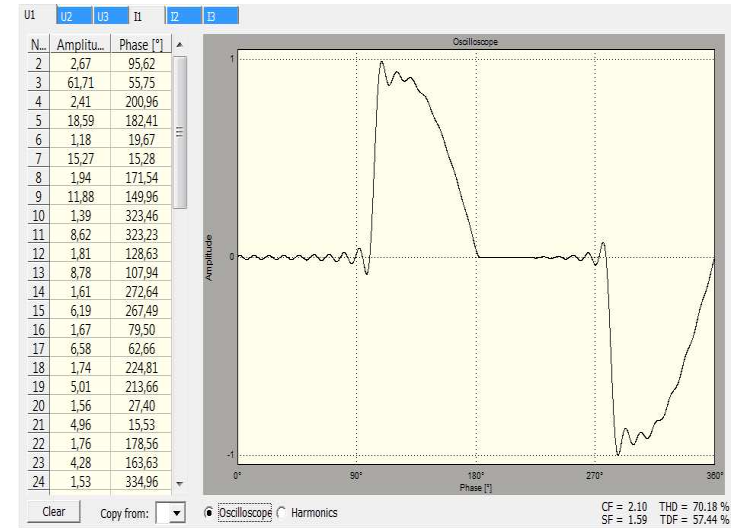
Power:

- range: 0...3 x 67200 W,var,VA
- resolution: 0.00001-1W,var,VA

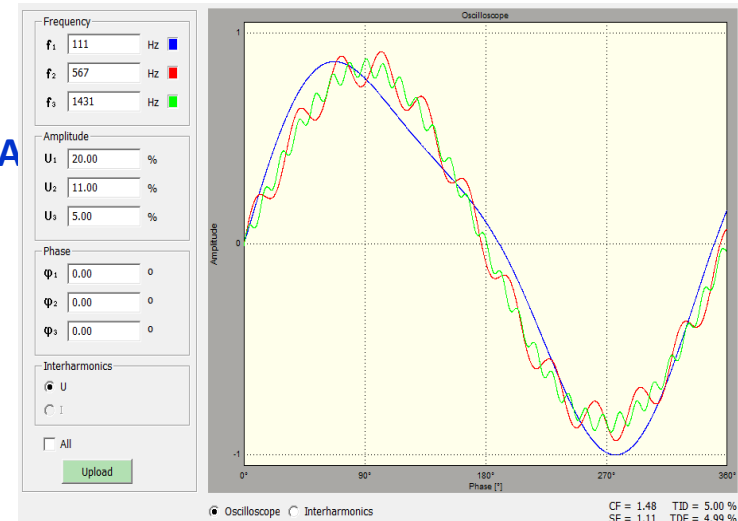
Maximum load:

- 17V@0.5A
- 8.5V@6A
- 3.3V@20A
- 0.70V@120A
- sin distortion: 0.1%

Waveform: harmonics (up to 3200Hz)

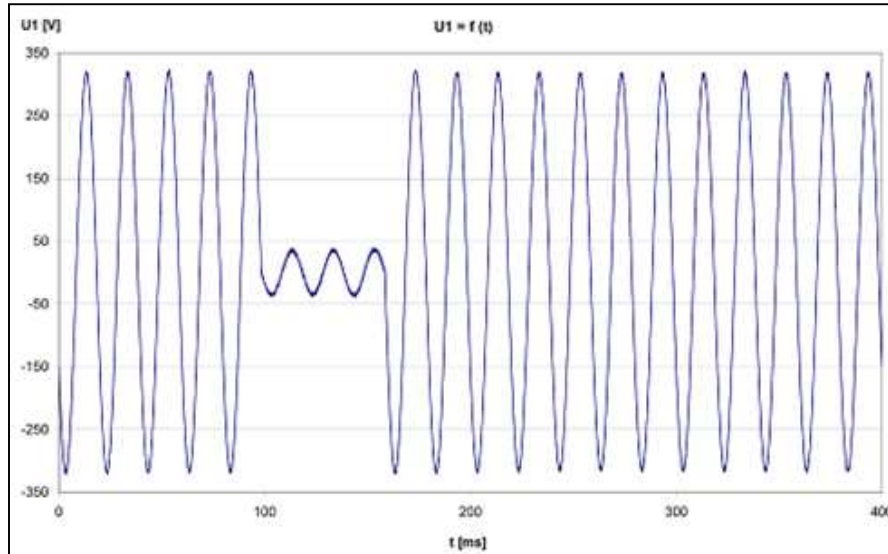


Waveform: interharmonics (up to 9kHz)

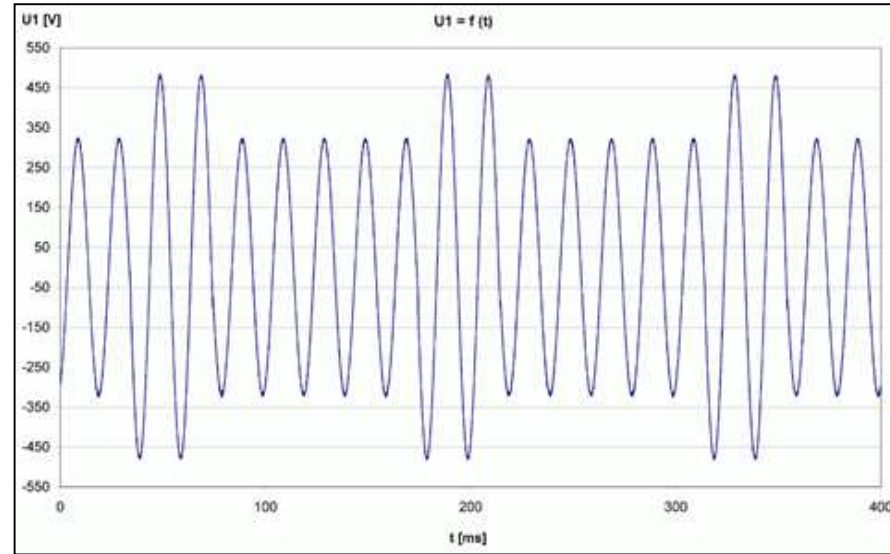


Calibrator output signal change versus time

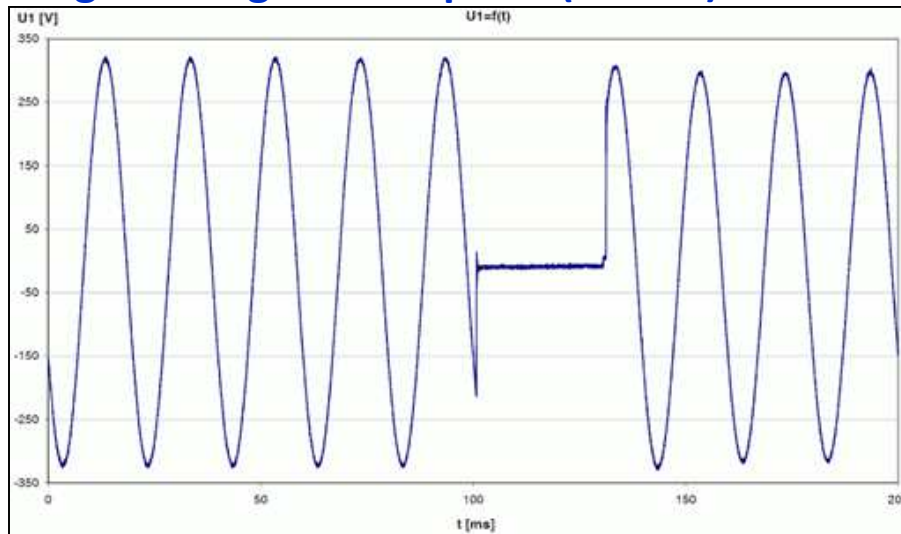
Single Voltage Dip (100ms)



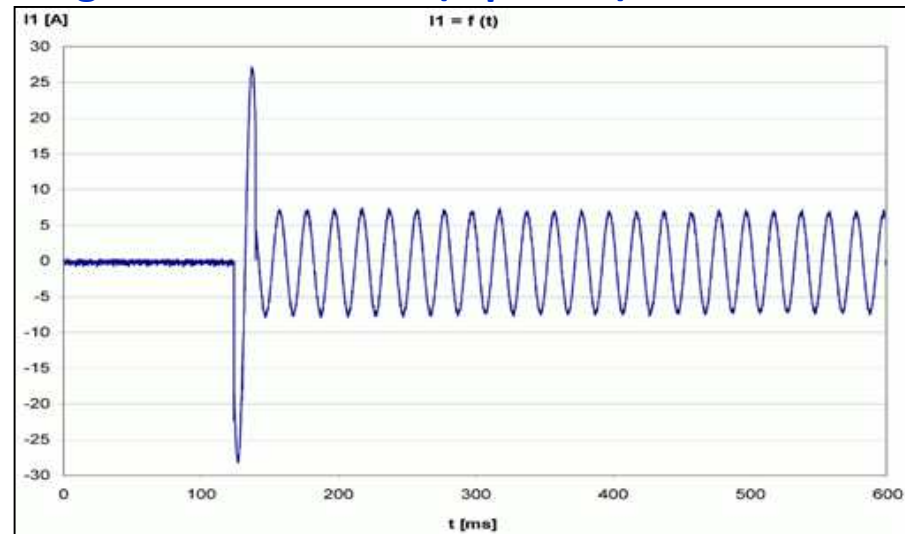
Periodic Voltage Swells (2 periods)



Single Voltage Interruption (100ms)



Single Current Shock (1 period)



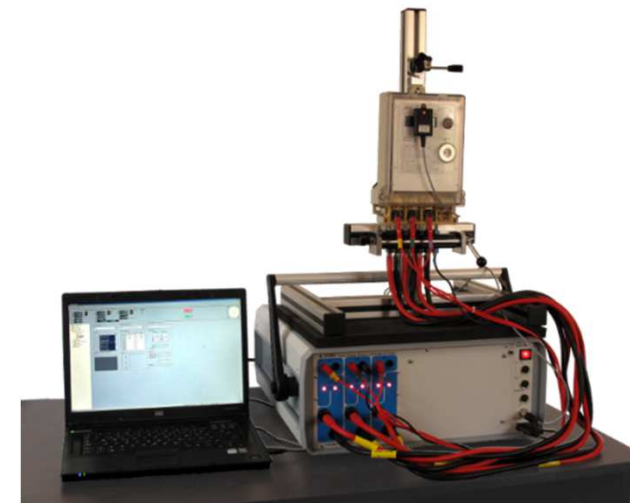
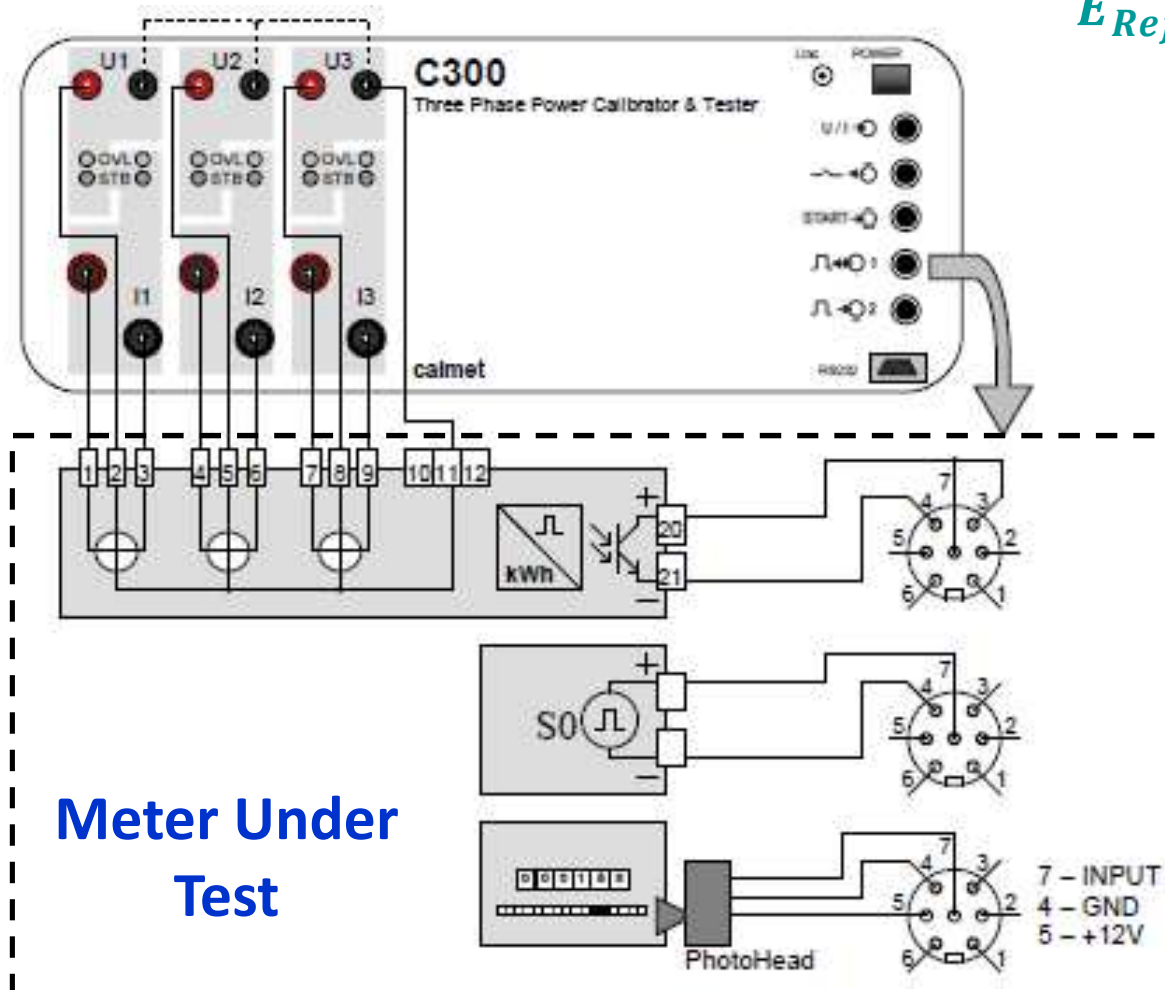
Testing Energy meter with C300 as a Source and Reference

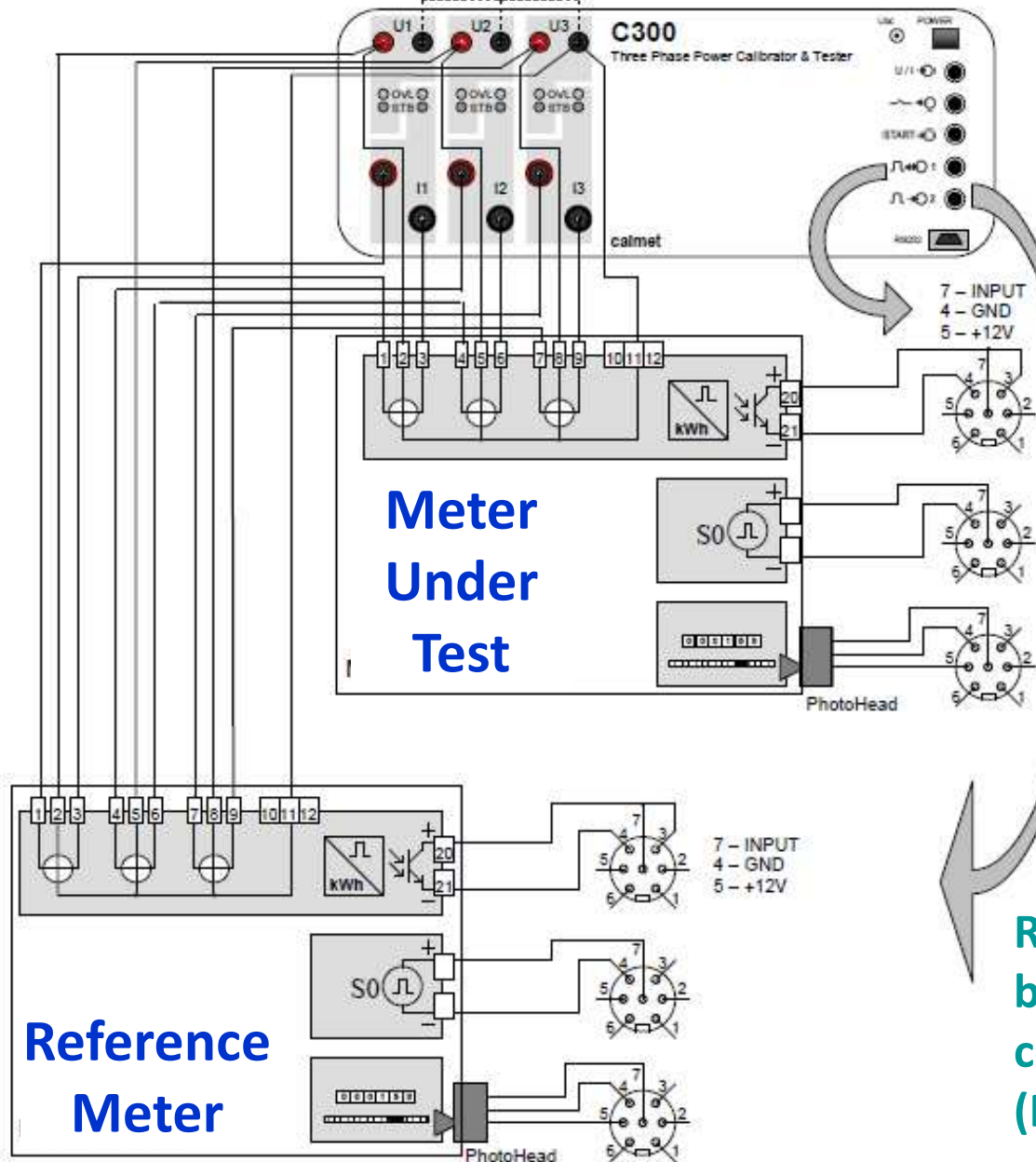
Reference Energy is calculated on base of equation:

$$E_{Ref} = U \times I \times \cos\varphi(\sin\varphi) \times t$$

Where:

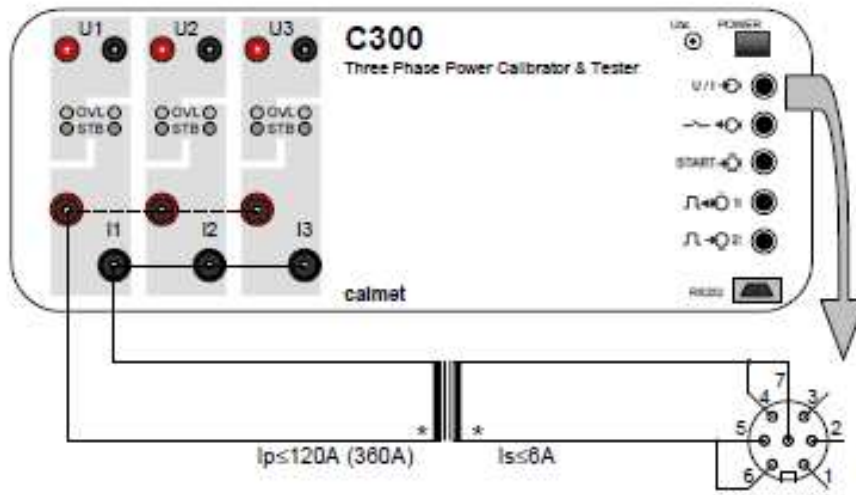
E_{ref} – reference energy
 U – set value of voltage
 I – set value of current
 $\cos/\sin\varphi$ – power factor
 t – time of impulses counting





Testing Energy meter with C300 as a Source and Error Calculator with external Reference Meter

Reference Energy is calculated on base of number of impulses and constant of any Reference Meter (Radian, ZERA, MTE....)



$I_{pmax} = 120A$
when using current I1 only

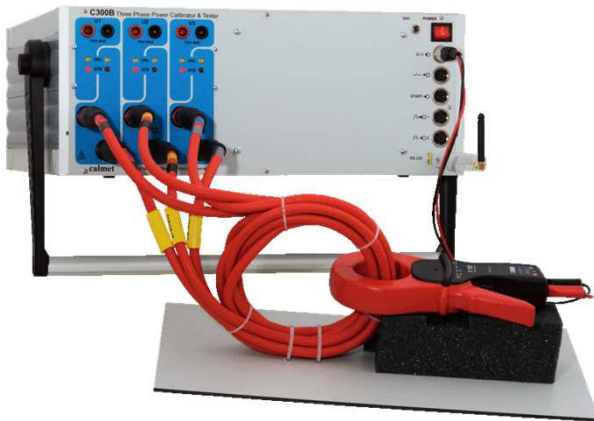
$I_{pmax} = 360A$
when shorted I1, I2 and I3
HI terminals and I1, I2, I3
LO terminals



Up to 360A in parallel



CT 100A / 5A



1000A clamp and sum of currents



1000A clamp with 100 turns coil



100A clamp and 100A cable

Standard set of C300 Power Calibrator delivery



Power Cord



Calpro 300 Soft



RS232 Cable



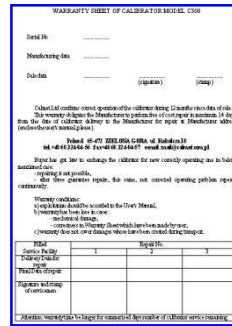
USB/RS232 Conv.



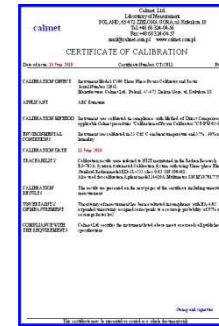
2 x Fuse



C300 Calibrator



Warranty



Calibration Certificate



Set of Manuals



4 x voltage cables



6 x 20A current cables



12 x 2 sets of plugs

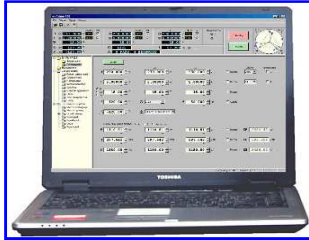


C091A plug for C300 inputs



AD300 Adapter

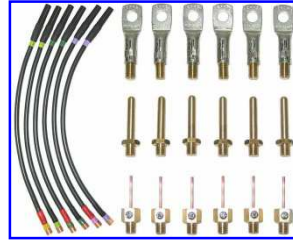
Optional Accessories for C300 Power Calibrator



Laptop PC with Software



10" small Laptop attached to front



6 x Current Cable up to 120A



C091A plug for C300 inputs



RS232 - Bluetooth converter



CF101 Photo Head (Electromechanical)



CF100 Photo Head (LED)



UCF100 Photo Head Holder



ZW Coils for Clamp Meter Testing

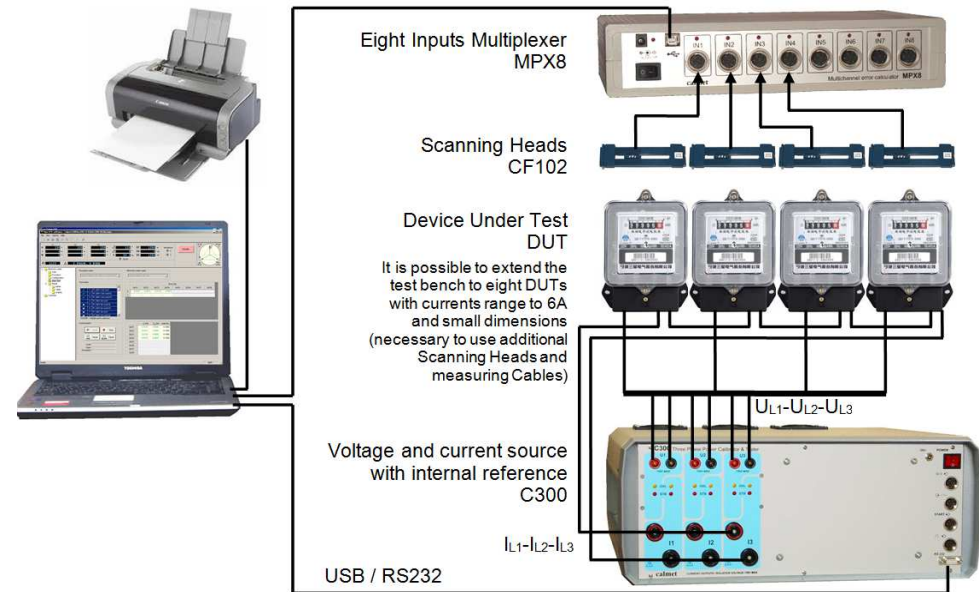


KAS300 Transportation Case



**Now also
0.02% version
available!**

Configuration of the TB40 Test Bench



TB40 Four Position Meter Test Bench

- New generation of the Meter Test Bench
- 0.05 accuracy class up to 3x120A and 3x560V
- Programmed form and special shapes of currents and voltages
- Automatic test procedures
- Extremely compact design size and light weight
- AC single phase power supply operation only



TE30
Caltest10

Site / Customer

The idea is based on using different Reference Meters and Sources depends on measurement on Site or in Laboratory

Energy Meter testing:

- many portable, light working standards;
- accuracy class 0.2 in single phase;
- accuracy class 0.05 in three phase;
- current clamps for easy connection;
- measurement at the load on site;
- connection test, CT test, burden test;
- harmonics & power quality check;

In some special cases, for the high load customers, the Power Calibrator can be taken for measurements on Site

C300
CP11



Laboratory / Utility

Energy Meter testing:

- high accuracy testing 0.02%, 0.05%;
- voltage & current source for full range load testing ;
- automatic testing procedures;
- portable working standards testing to avoid „transportation errors”;
- Special, difficult cases of Energy Meter error investigation;

Site / Customer

Laboratory / Utility

Meters Under Test on Site

