

## Testing whole measurement system!

Accuracy of all kind of  
 Electricity Meters  $\epsilon$ [%]

CT/PT burden,  
 ratio, phase shift  
 error



Electromechanical  
 Meters



Electronic (static)  
 Meters



4-Quadrants  
 Meters



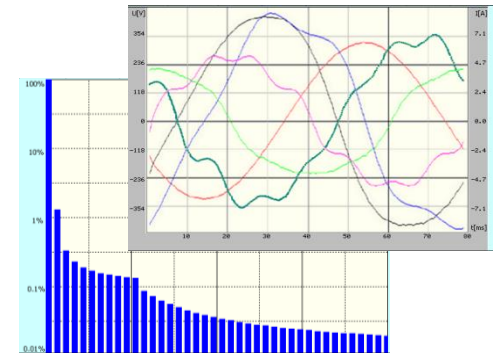
Max Demand  
 Meters



Connection  
 errors



Power Quality  
 in point of  
 measurement



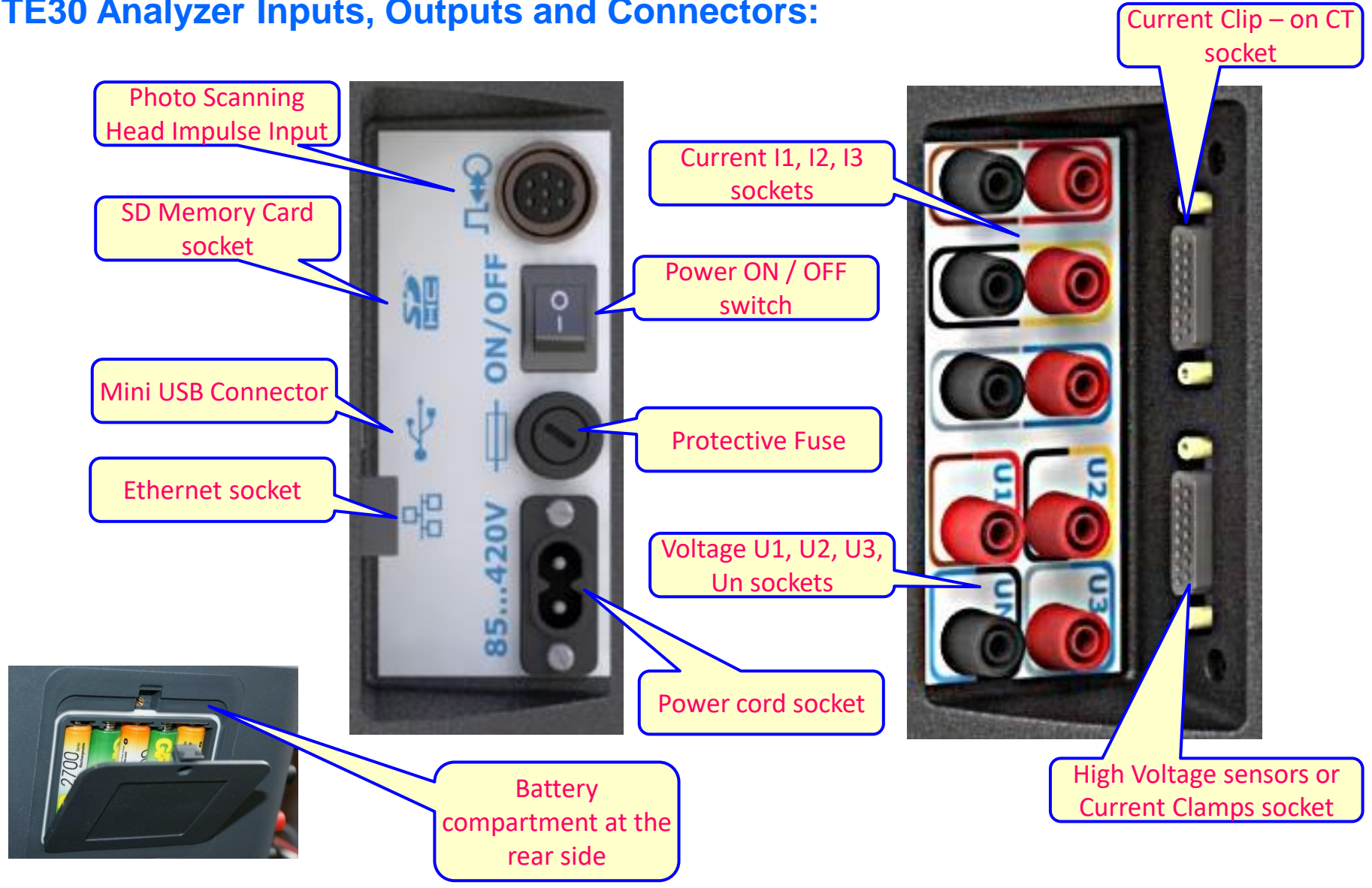
# TE30

- ▶ Measure of power network parameters and Meters testing in accuracy class **0,05** or **0,1**
- ▶ Voltage range **0,05...600V**
- ▶ 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 <sub>Δ</sub> :	398.526 V	398.487 V	398.388 V	U <sub>N</sub> :	0.14200 V
I:	12.0344 A	12.0032 A	11.9998 A	I <sub>N</sub> :	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 <sub>UV</sub> :	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		

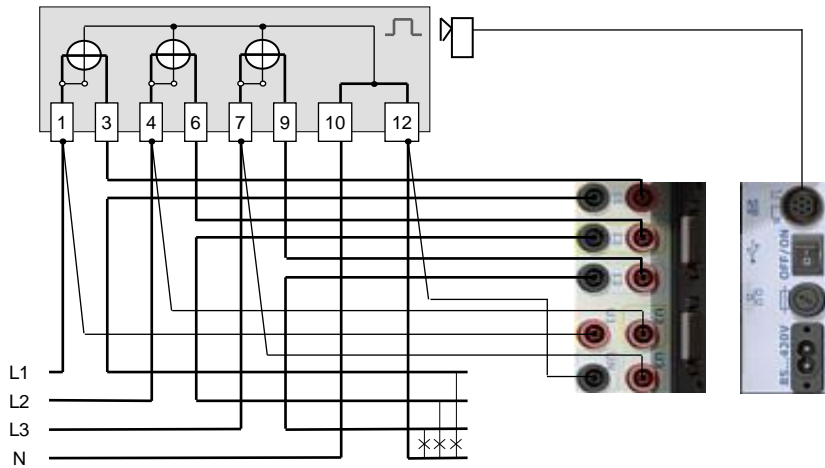
### TE30 Analyzer Inputs, Outputs and Connectors:



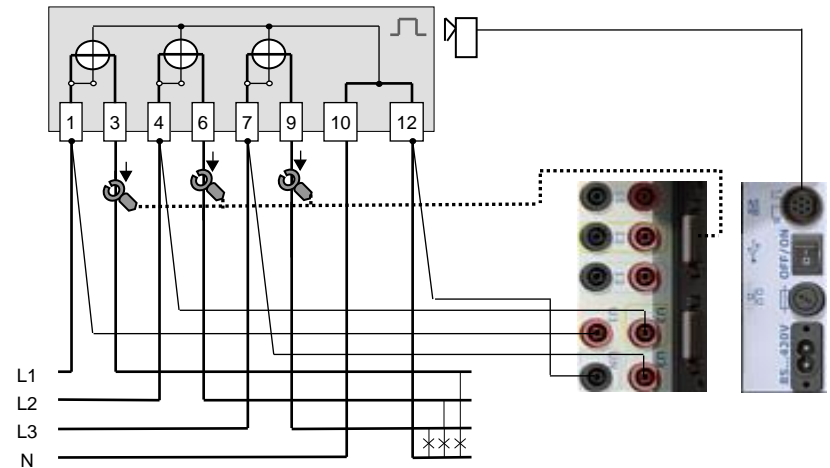


All possible types of connection: 1P2W, 3P4W, 3P3W, ... , direct or with clamps

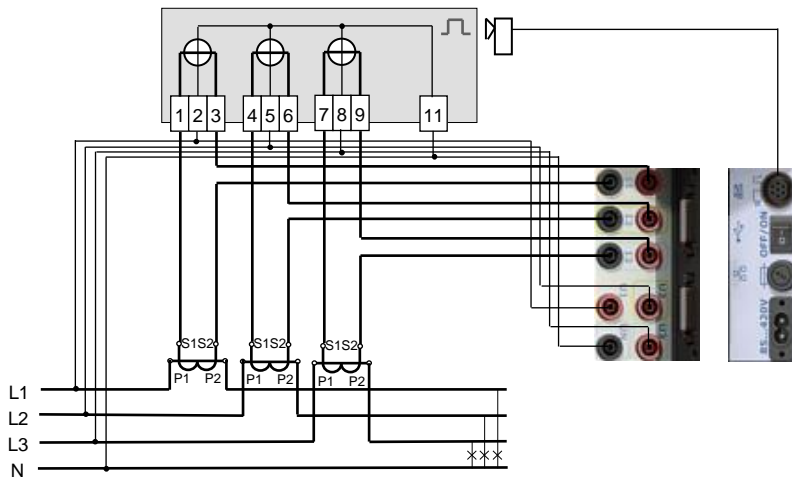
**Electricity meter testing – direct connection**



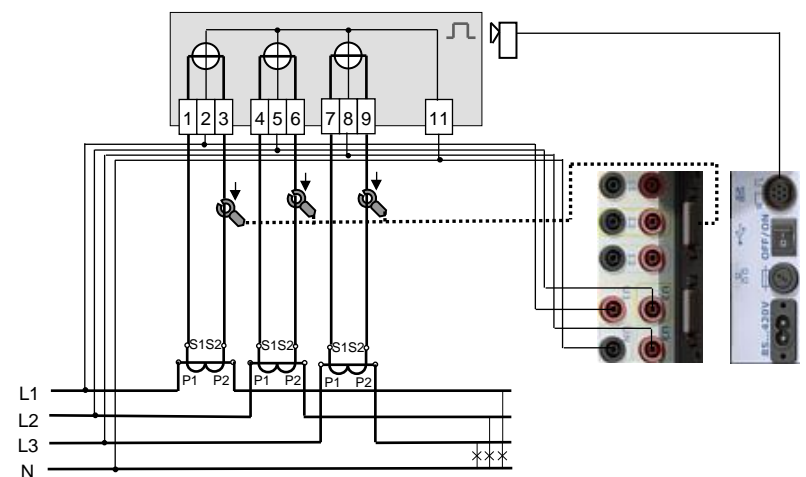
**Electricity meter testing – connection with clamps**



**Electricity meter (CT) testing – direct connection**



**Electricity meter testing (CT) – connection with clamps**



## RMS measurement results and TE30 Analyzer configuration:

**3-Phase Star or Delta connection**

**Voltage direct connection Current mesured by flexible clamps**

**Automatic or Costant range used for measurements**

**Actual Date and Time**

**Voltage Phase - Neutral**

**Voltage Phase - Phase**

**Current**

**Phase shift**

**Power Factor**

**Reactive Factor**

**Tangent  $\varphi$**

**Phase shift between Voltages**

**Active Power P**

**Reactive Power Q**

**Apparent Power S**

**Frequency**

**Neutral Voltage**

**Neutral Current**

**3-Phase Power Factor**

**3-Phase Reactive Factor**

**3-Phase Tangent  $\varphi$**

**3-Phase Vector Rotation**

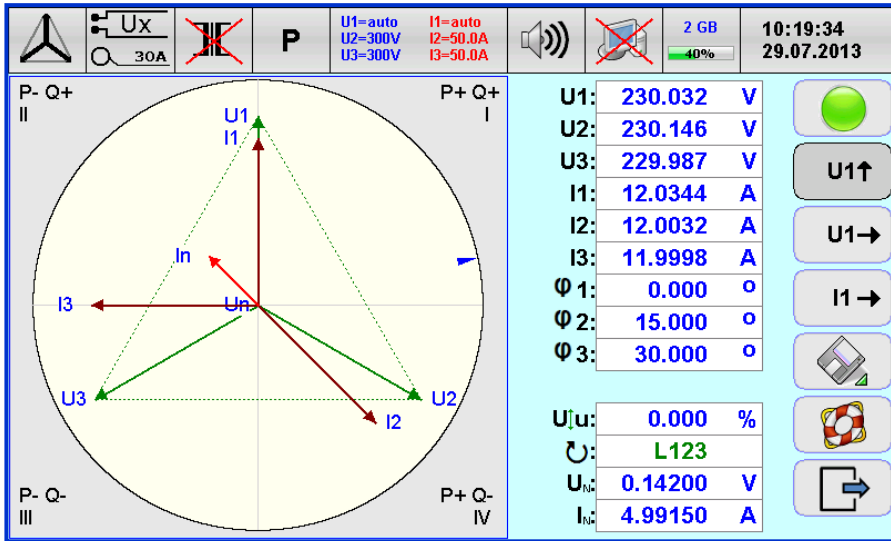
**3-Phase Active Power**

**3-Phase Reactive Power**

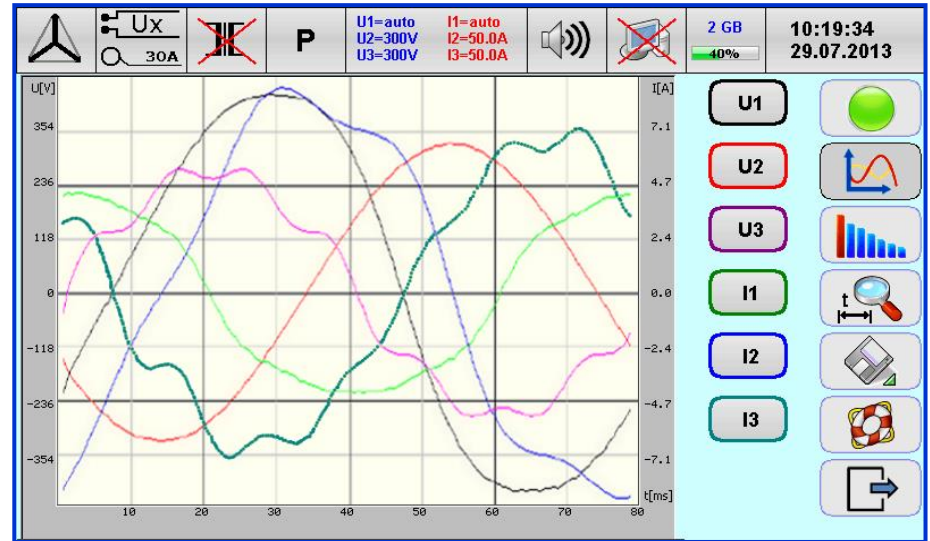
**3-Phase Apparent Power**

	L1	L2	L3		
U:	230.032 V	230.146 V	229.987 V	f:	50.001 Hz
U <sub>Δ</sub> :	398.526 V	398.487 V	398.388 V	U <sub>N</sub> :	0.14200 V
I:	12.0344 A	12.0032 A	11.9998 A	I <sub>N</sub> :	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	U:	L123
Φ <sub>uv</sub> :	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		

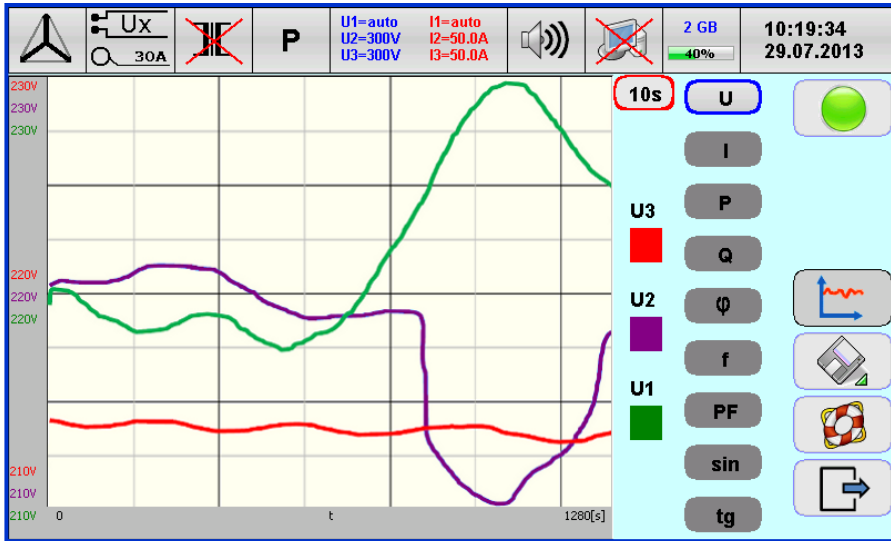
## Vector diagram with calculated Un & In



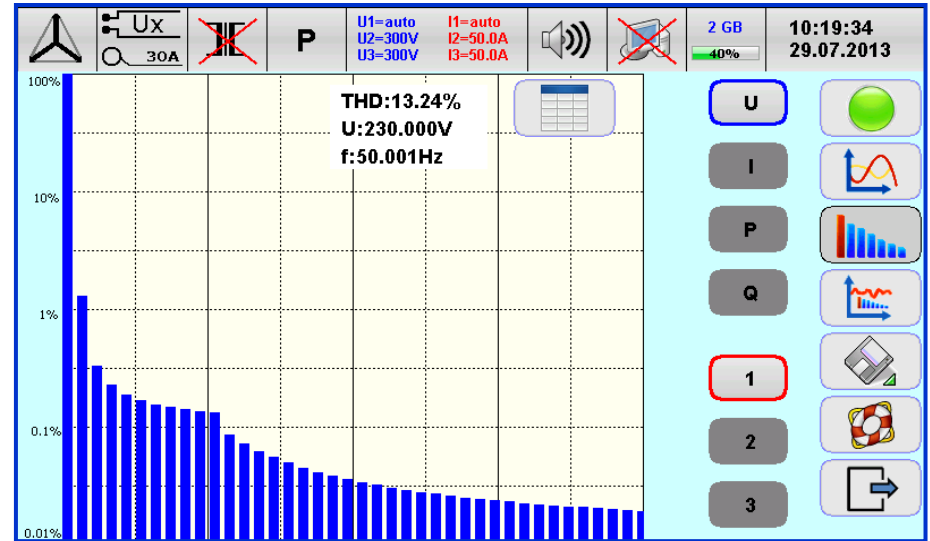
## Oscilloscope of U1, U2, U3, I1, I2, I3



## Time trend of U, I, P, Q, φ, f, PF, ....



## Harmonics table & bar diagram



## Energy meter testing on site and laboratory

**U<sub>x</sub>** 30A  
**P**  
 U1=auto U2=300V U3=300V  
 I1=auto I2=50.0A I3=50.0A  
 2 GB 40%  
 10:19:34 29.07.2013

**ε** 1.250%  
**ε<sub>s</sub>** 0.187% n: 100  
 -2.00% 0 2.00%  
 5%  
 t: 1 s  
 C: 1000000 imp/kWh auto  
 t/N: 20 s auto

**ΣP** 8870.23 W  
**ΣQ** 2374.38 var  
**ΣS** 9370.88 VA  
**ΣPF** 0.94399

**ε<sub>1</sub>** 1.500 %  
**ε<sub>2</sub>** 1.400 %  
**ε<sub>3</sub>** 1.300 %  
**ε<sub>4</sub>** 1.200 %  
**ε<sub>5</sub>** 1.100 %

**123.45**  
**345.67**  
**Pmax**

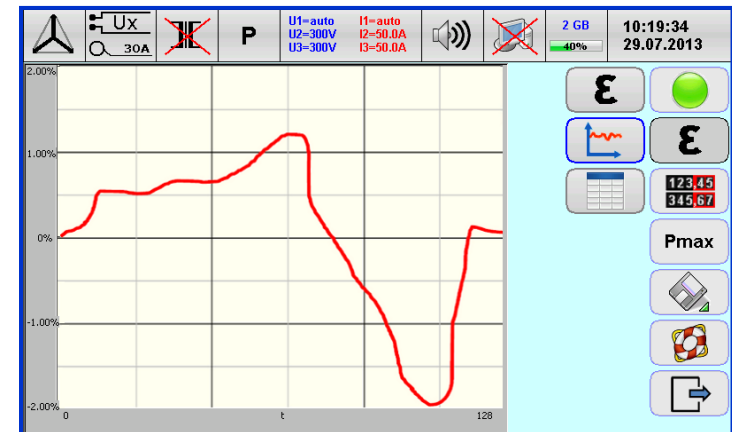
- ▶ function of computing meter error (partial errors, average error, standard deviation) directly in percentages [%] with method of setting time of measurement or number of impulses,
- ▶ function of automatic identification energy meter constant,
- ▶ function of automatic determining measurement time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

Ux 30A, U1=auto, U2=300V, U3=300V, I1=auto, I2=50.0A, I3=50.0A, 2 GB, 10:19:34, 29.07.2013

	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%

Buttons: CLEAR, Pmax, ε, P, P+, PH1

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

- ▶ 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

Ux 30A, U1=auto, U2=300V, U3=300V, I1=auto, I2=50.0A, I3=50.0A, 2 GB, 10:19:34, 29.07.2013

Pin: 80.000 kW, t: 0 min, Pref: 40.000 kW, T: 15 min

Date	Time	Pmax[kW]	Pmax-Pref
03.12.2013	12:34	80.032	0.032
03.12.2013	13:34	83.343	3.343
03.12.2013	14:34	60.002	-19.998
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	

Buttons: Pmax, ε, P, P+, PH1

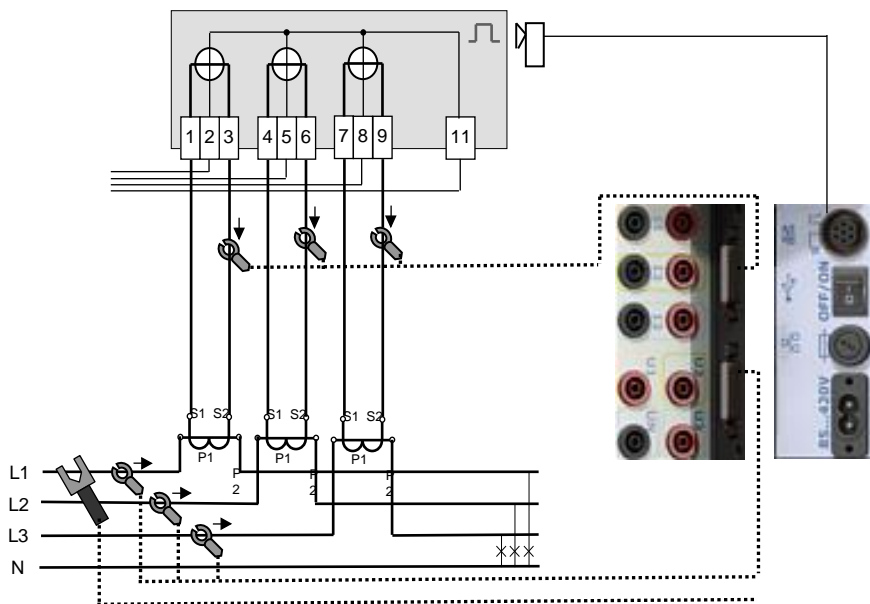
▶ function of maximum power measuring for testing of maximum demand energy meters,



## 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

CT Ratio error and phase error testing



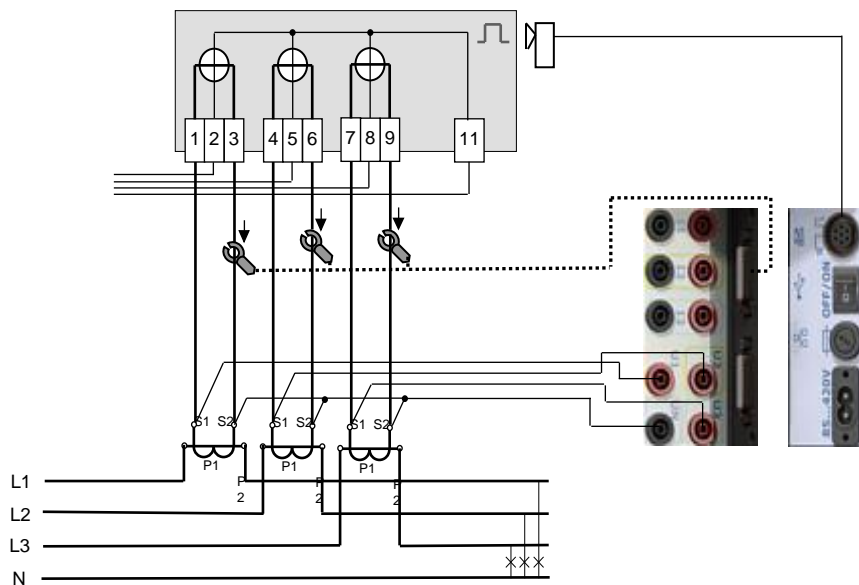
			<b>P</b>	U1=auto U2=300V U3=300V	I1=auto I2=50.0A I3=50.0A			2 GB 40%	10:19:34 29.07.2013
n: <input type="text" value="3"/>				<b>L1</b>	<b>L2</b>	<b>L3</b>			
Ip:	80.0320 A	79.0320 A	80.5320 A						
Is:	4.00234 A	3.99234 A	4.10234 A						
φ:	0.00100 °	0.00200 °	-0.00100 °						
Ip/Is:	19.9963	19.7959	19.6307						
δ:	0.01849 %	1.03097 %	1.88099 %						
δs:	0.00232 %	0.00893 %	0.01864 %						
δlim:	1.00 %	1.00 %	1.00 %						
Ipn:	100.000 A	100.000 A	100.000 A						
Ipn:	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

CT Burden testing



PT 
 CT

Ux  
30A

~~IE~~

P

U1=auto  
U2=300V  
U3=300V

I1=auto  
I2=50.0A  
I3=50.0A

2 GB  
40%

10:19:34  
29.07.2013

	L1	L2	L3
U:	2.64332 V	2.64332 V	2.64332 V
I:	5.00021 A	5.00001 A	4.99983 A
φ:	0.001 °	0.002 °	- 0.001 °
PF:	1.00000	1.00000	1.00000
S:	13.2167VA	13.2167VA	13.2167VA
Sn:	15VA	15VA	15VA
%Sn:	88.0991 %	88.0991 %	88.0991 %
S@n:	88.0991 %	88.0991 %	88.0991 %

L:  m

mm<sup>2</sup>

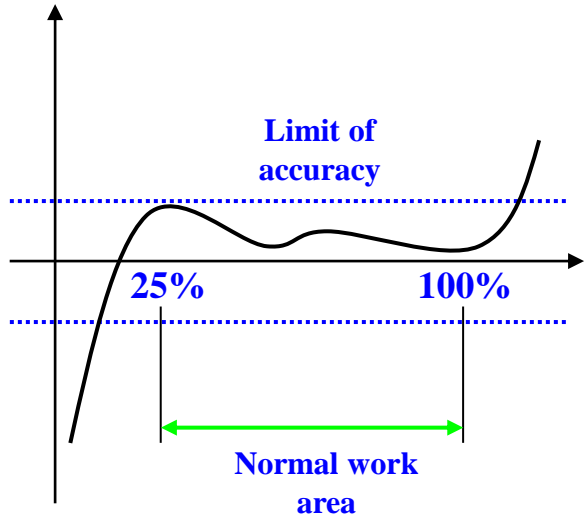
Rf:  Ω

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



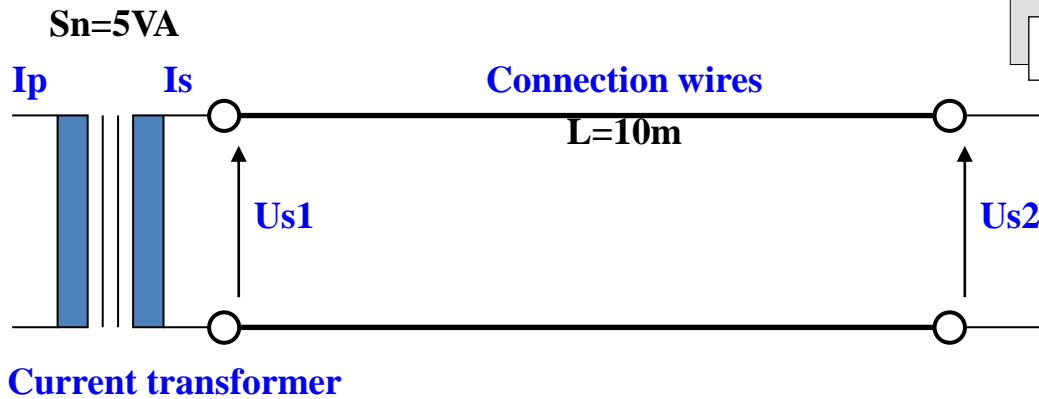
## CT Transformer testing: burden testing

$\varepsilon$  – ratio error [%]

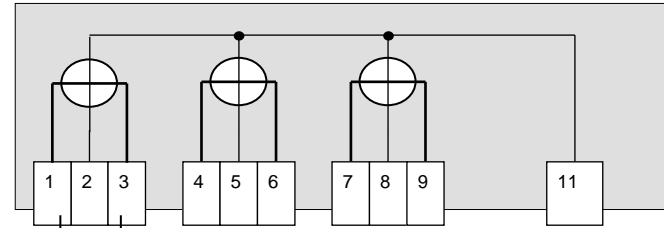


CT – current transformer can operate with stated accuracy only between 25% - 100% of burden (load). In case of **too long**, or **too thin** wire dimension or **too small load**, the result, secondary current can be **out of accuracy** limits

[%] transformer power rating  $S_n$



Current transformer

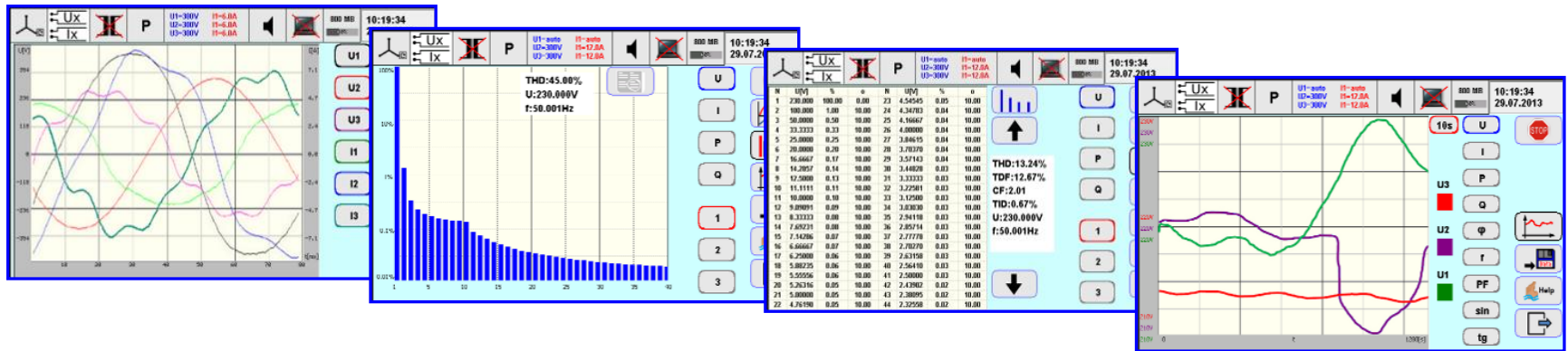


Example (power loss in cables):

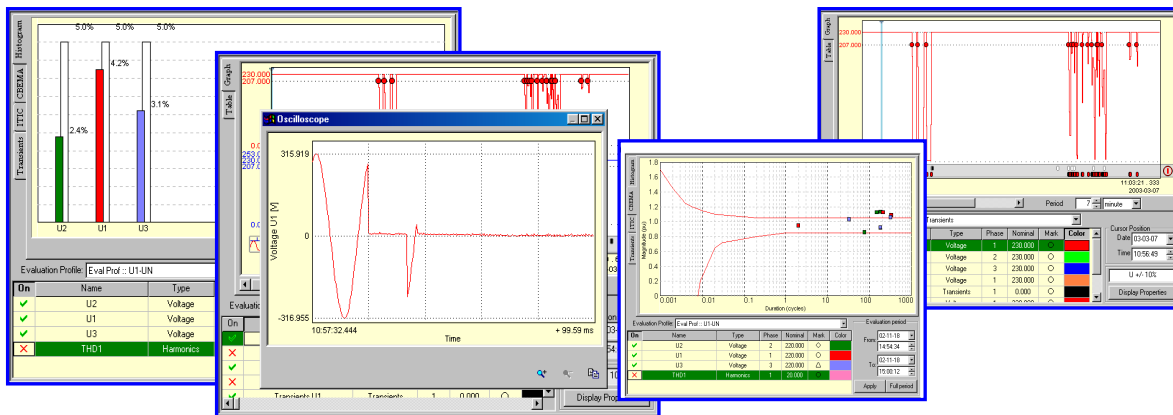
$$R_p = \frac{\rho_{Cu} \cdot l}{S} = \frac{0,0175\Omega \frac{mm^2}{m} \cdot 2 \cdot 10m}{1mm^2} = 0,35\Omega$$

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

## 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  $(8 \div 64) \times 10^6$  sets of network parameters or long-term registration of power quality



## Function of power quality analyser + recording

Ux 30A P U1=auto U2=300V U3=300V I1=auto I2=50.0A I3=50.0A 2 GB 10:19:34 29.07.2013

Parameter	Value	Unit	Operator	Limit	Unit	Time	Unit
U	20	ms	+	25	10	min	
I	20	ms	+	25	10	min	
PQS	10	s	+	63	10	s	
$\phi$	10	s		F	10	s	
THDU	10	s		TIDU	10	s	
THDI	10	s		TIDI	10	s	
SignU	10	s		Flick	10	min	
U <u>u</u>	10	s					

EN50160

Ux 30A P U1=auto U2=300V U3=300V I1=auto I2=50.0A I3=50.0A 2 GB 10:19:34 29.07.2013

$\bar{x}$  +  MIN MAX  
  $\bar{x}$  +  $U \geq 230.000$  V  $\pm 10.0000$  % +   
  $\bar{x}$  +  $I > 5.00000$  A +   
  $\bar{x}$  +  $\epsilon$  %

Ux 30A P U1=auto U2=300V U3=300V I1=auto I2=50.0A I3=50.0A 2 GB 10:19:34 29.07.2013

0%  66:22:22 hh:mm:ss

>> 1 week 4.44 MB

1 h

03.03.2014 dd.mm.yyyy 12:12 hh:mm

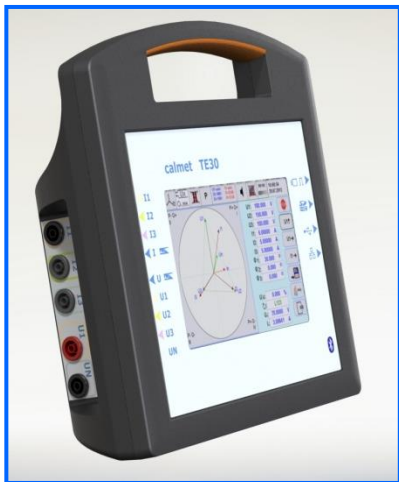
selecting recording method: average value, max / min value, outside limits, every Energy Meter error

selecting recorded parametrs and averaging times

selecting time length of recording and start date & time

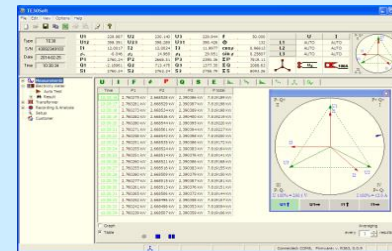
## TE30 Analyzer's equipment delivered in price:

- TE30 analyzer class 0.05 or 0.1 with Basic function;
- Power supply cord;
- Fuse T500mA 250V (2pcs),
- 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 and USB mini / USB A interface cable,



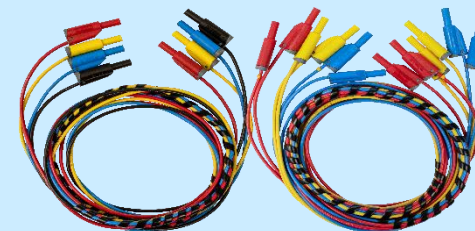
- REC function - recording of power network parameters,



- AD100EXT extension for powering TE30 from measurement network,



- EA34 set of safety measurement cables (10pcs),



## TE30 Analyzer's optional equipment:

- EA20 additional accessories (handlers and terminals 21pcs) of safety cables,



- CF106H photo head with holder for inductive meter and meter with LED,



- DR200D miniature thermal printer with Bluetooth,



- ET30 transportation case,
- ET32 transportation case for additional accessories,





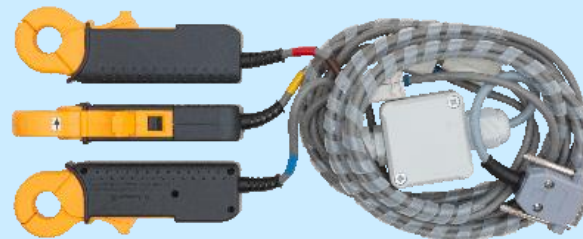


### TE30 Analyzer's optional equipment:

- CT10AC electronic compensated clamps up to 12A (1compl),



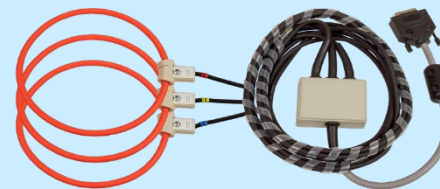
- CT100AC electronic compensated clamps up to 120A (1compl),



- CT1000AC electronic compensated clamps up to 1200A (1compl),

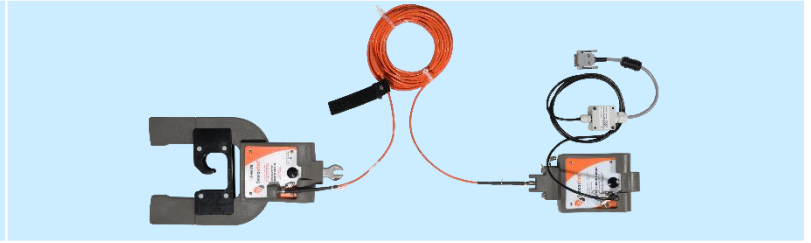


- FCT3000AC.B electronic compensated flexible clamps in ranges 30/300/3000A (1compl),

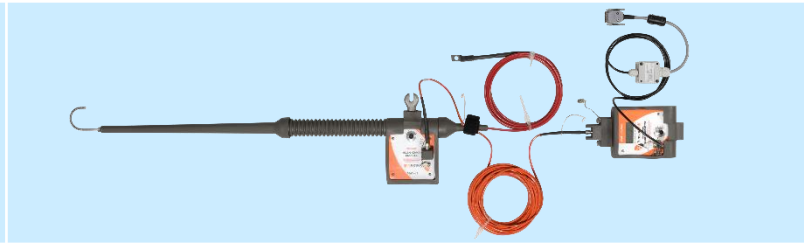


## TE30 Analyzer's optional equipment:

- 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),



- Calmet TE30 option set 01 (Calmet TE30+ET30+CT100AC+CF106H+EA34+EA20).



**TE30 Analyzer set  
ready for operation**



**Contact:**

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