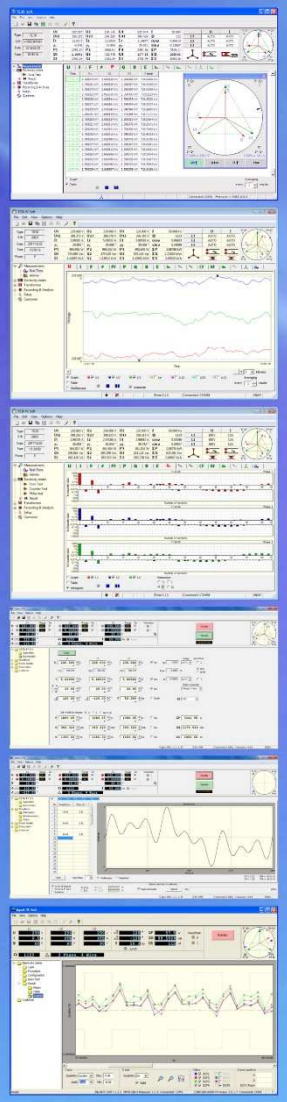
CALMET
www.calmet.com.pl

TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

CALMET
Smart Calibration Devices



Testing the entire energy measurement system!

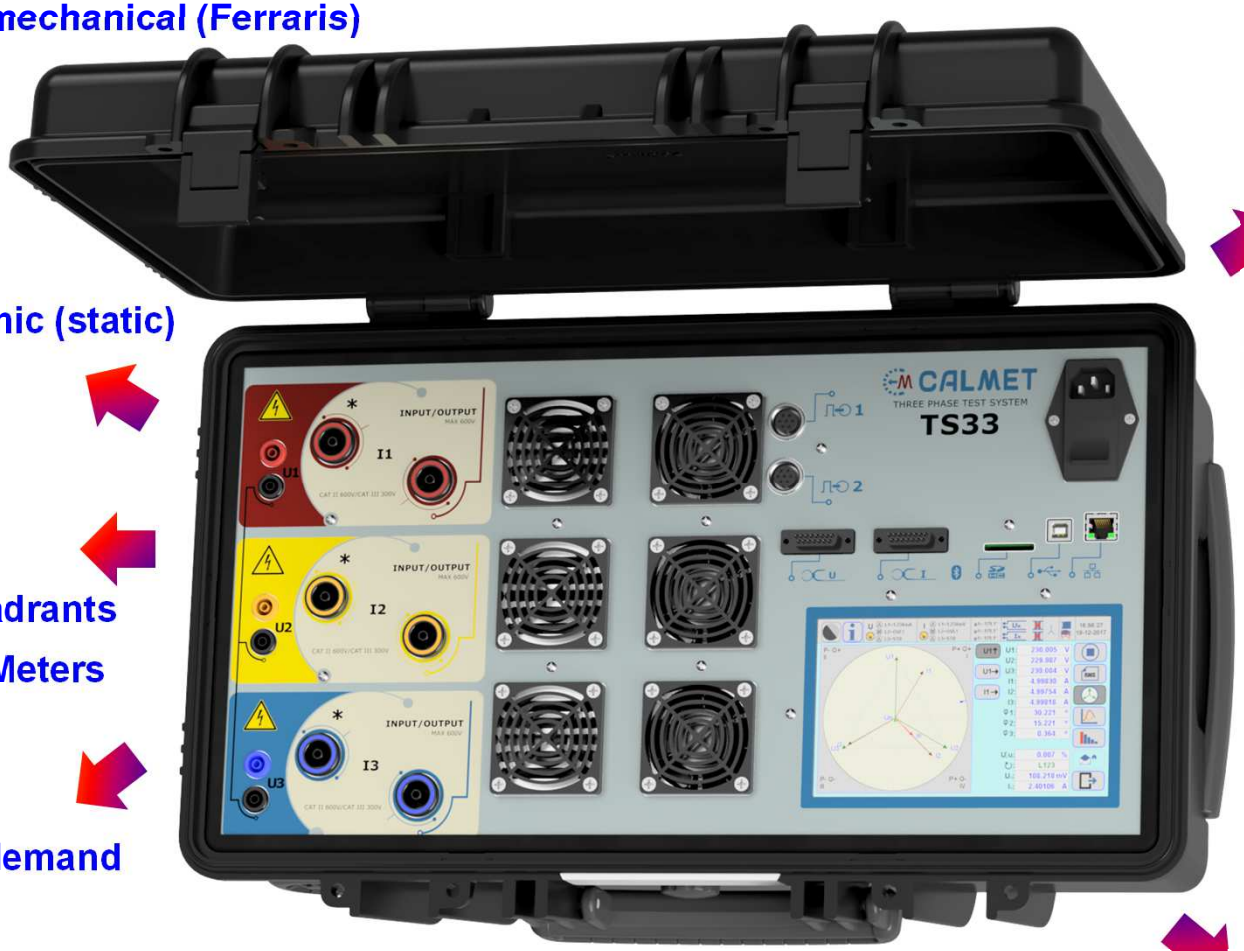
Accuracy of all kinds of meters ε[%]

Electromechanical (Ferraris)

Electronic (static)

4 – Quadrants Smart Meters

Max. demand



CT/PT burden, ratio, phase shift error

Wiring errors

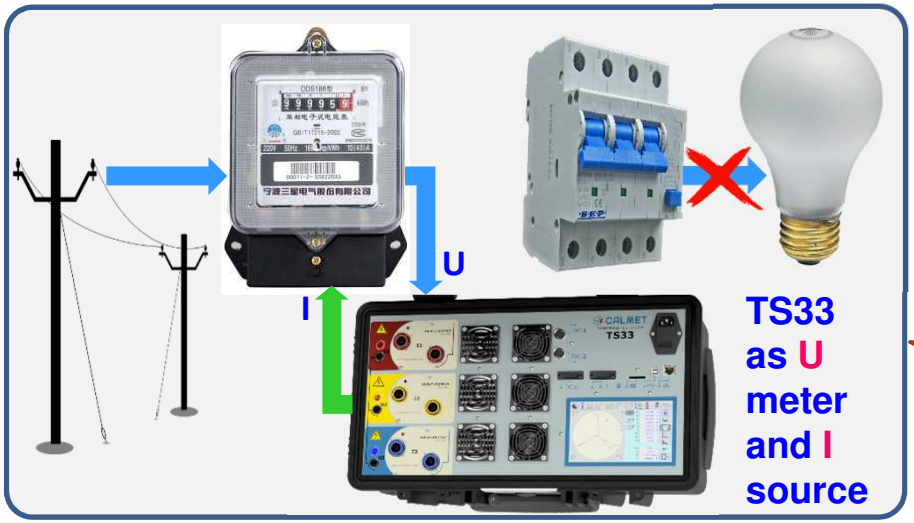
TS33

TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

Reference Meter & 3-phase U&I Source in one case! Modes of testing

Testing ON LINE – meter and load are connected to the network; the value of metering point depends on current load; TS33 works as portable reference meter

Testing OFF LINE – meter & load are not connected to the network; metering point can be set in whole range of load; TS33 works as source of U&I and reference meter

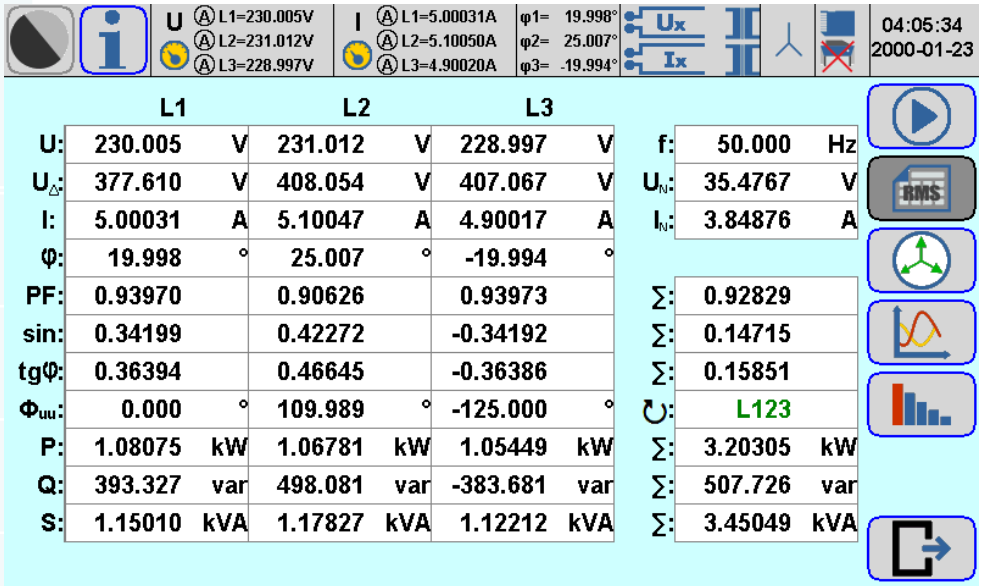


Testing U-ON/ I-OFF LINE – meter is connected to the network but load is disconnected; metering point can be set in whole range of current; TS33 works as U meter and I source with built in reference meter

Testing without meter disconnecting!

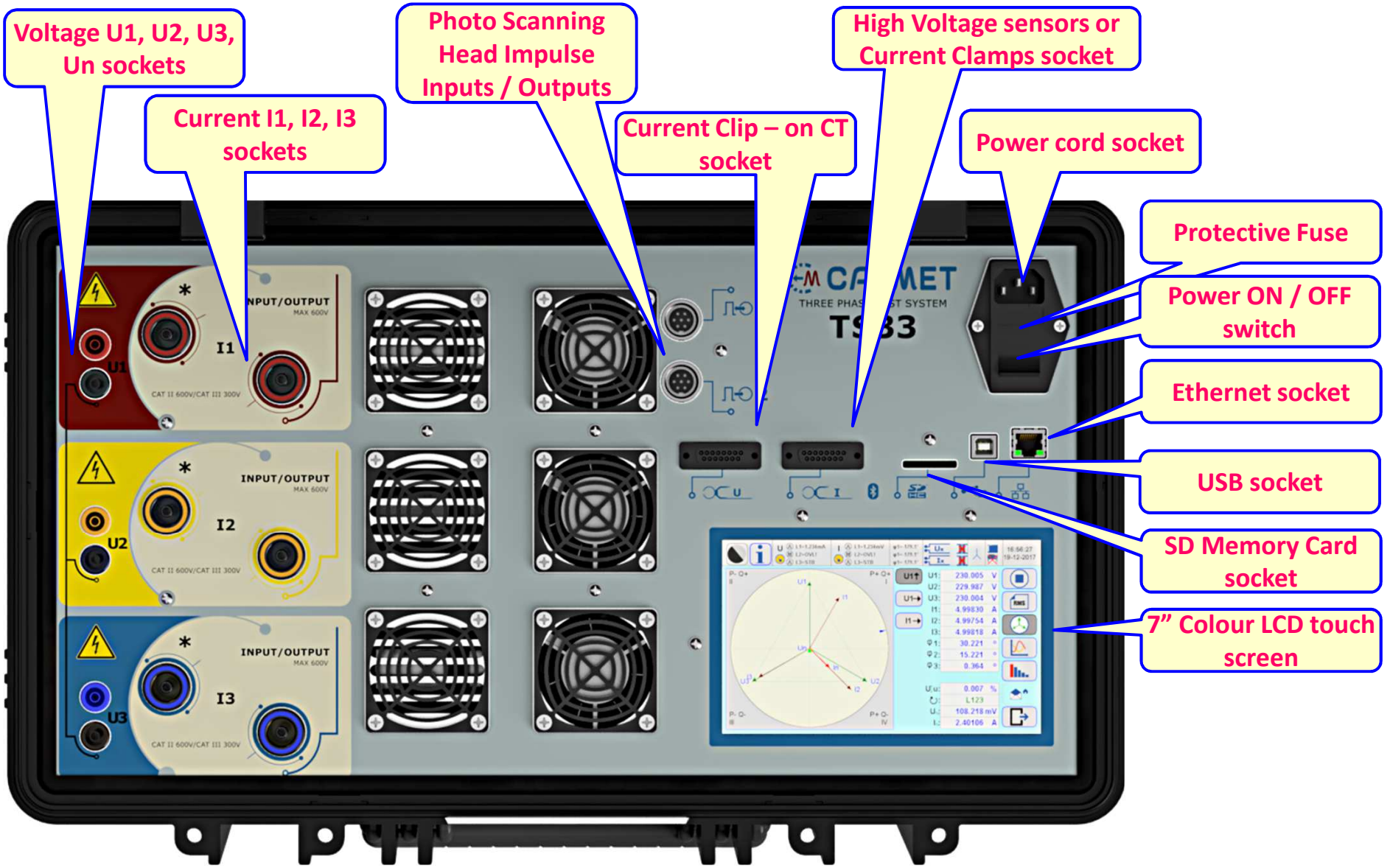
TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

- Easy verification of meters under precise load conditions, using integrated current and voltage source in class **0,04** or **0,1**
- Voltage range **0,05**…**600V**
- Current range **0,001**…**120A**(10)(100)(1000)(30/300/3000)**A**
- Testing of energy meters, potential and current transformers (**CT** / **PT**)
- **Automatic operation** with predefined load points without the need of an external PC
- **Vector**, **oscilloscope**, bar and trend charts of three phase network
- Automatic Meter Constant recognition
- Automatic setting of measurement conditions
- 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:	230.005	V	231.012	V	228.997	V	f:	50.000	Hz
U_Δ:	377.610	V	408.054	V	407.067	V	U_N:	35.4767	V
I:	5.00031	A	5.10047	A	4.90017	A	I_N:	3.84876	A
φ:	19.998	°	25.007	°	-19.994	°			
PF:	0.93970		0.90626		0.93973		Σ:	0.92829	
sin:	0.34199		0.42272		-0.34192		Σ:	0.14715	
tgφ:	0.36394		0.46645		-0.36386		Σ:	0.15851	
Φ_{uu}:	0.000	°	109.989	°	-125.000	°	↻:	L123	
P:	1.08075	kW	1.06781	kW	1.05449	kW	Σ:	3.20305	kW
Q:	393.327	var	498.081	var	-383.681	var	Σ:	507.726	var
S:	1.15010	kVA	1.17827	kVA	1.12212	kVA	Σ:	3.45049	kVA

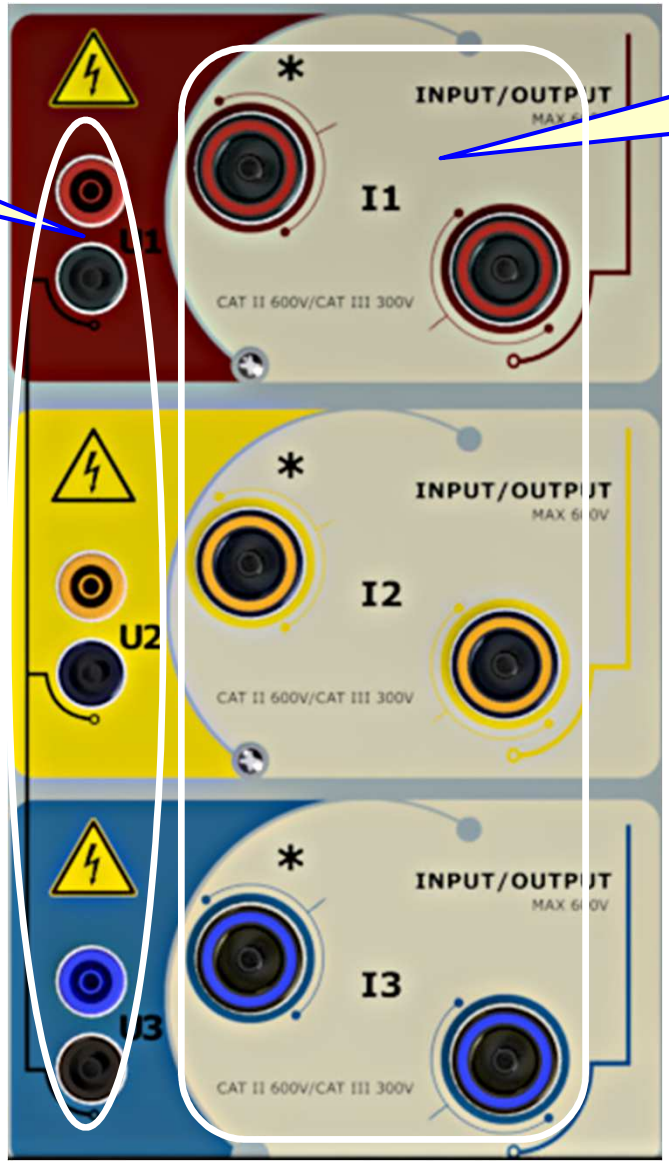
TS33 Inputs, Outputs and Connectors:

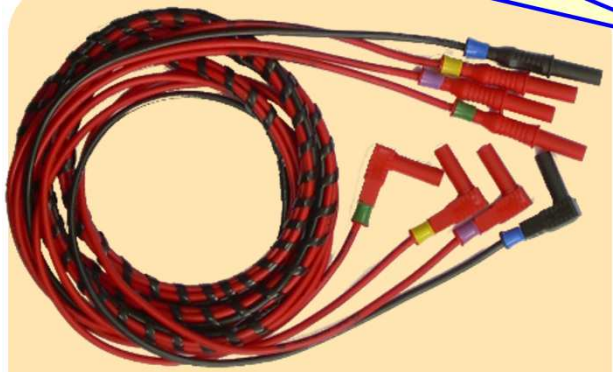


TS33 Voltage and Current Inputs:

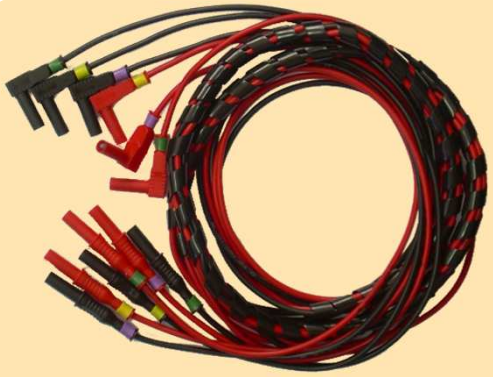
Voltage U1, U2, U3, Un Input / Output sockets
0.05…600V

Current I1, I2, I3, Un Input / Output sockets
0.001…120A



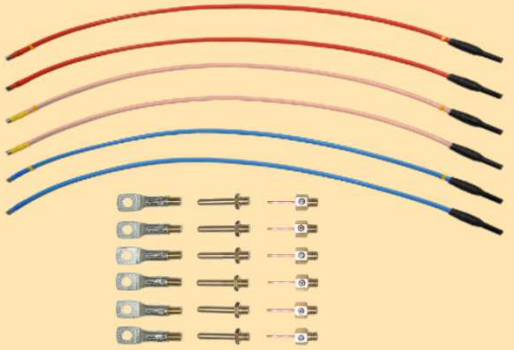


4mm Voltage Safety Cables
Length=2m



4mm Current Safety Cables
Length=2m, I ≤ 30A

Easy connection due to rich set of accessories for safety cables



25mm² High Current Cables
Length=1m, I ≤ 120A

TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

TS33 Pulse Input / Output;

can test all kinds of Electricity Meters

Electronic energy meter

- red, green or infrared LED blinking or LCD segment flashing
- photo head with photo sensor

0.0001Hz...200kHz

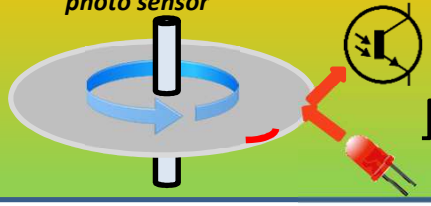
1. Pulse Input / Output socket

Electronic and Inductive energy meter

manual push – button and pulse generation

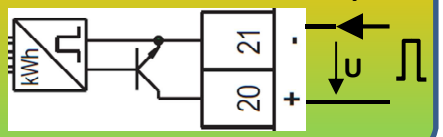
Inductive energy meter

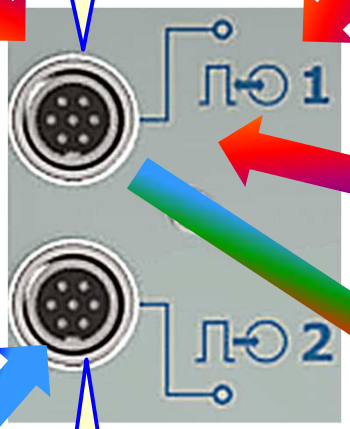
- disk with red or black mark
- photo head with LED lamp and photo sensor



Electronic and Inductive energy meter

S0 standard electric pulse



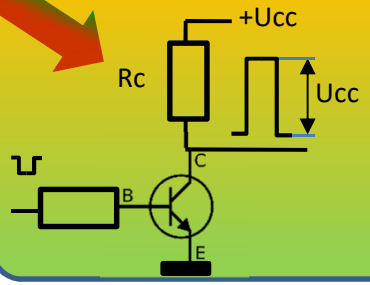


In case, that we need higher than offered by TS33 accuracy 0.04 or 0.1, we can use external reference easy way

Additional, external very, high accuracy Reference Meter

2. Pulse Input for external Reference Meter socket

Open collector pulse output + external Rc



$U_{cc}max \leq 27V$

$I_c max \leq 100mA$

0.0001Hz...200kHz

TS33 has pulse output with frequency proportional to the power, with freerly programmable constant imp/kWh

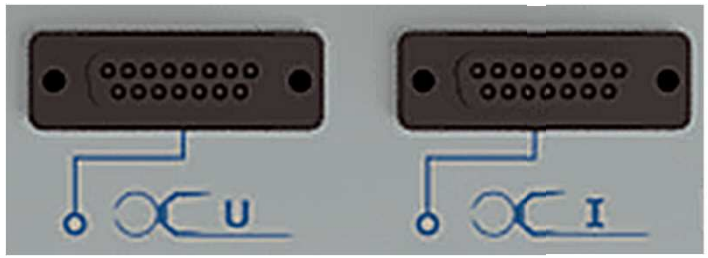
TS33 Current Clamps and Voltage Sensors; wide range of measured signals

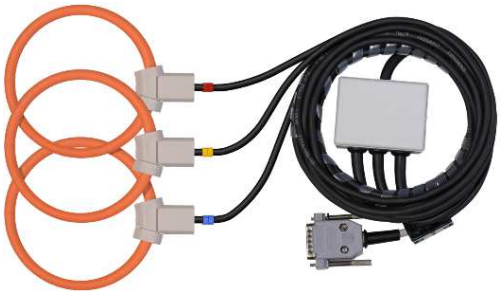
10mA…120A, length=2m
max ∅ cable 15mm

3mA…12A, max ∅ cable 20mm
length=2m

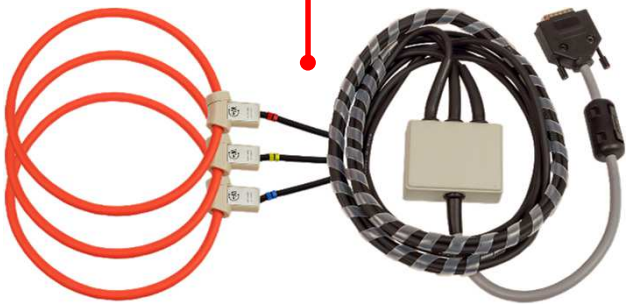
30A…2000A@150kV,
length=12m
max ∅ cable 98mm

300mA…1200A, length=2m
max ∅ cable 52mm

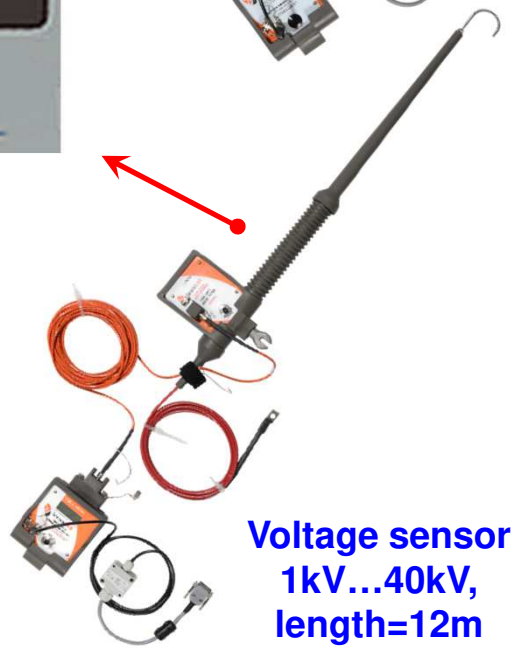




300mA…1200A, length=2m
max ∅ cable 85mm,
loop length 300mm



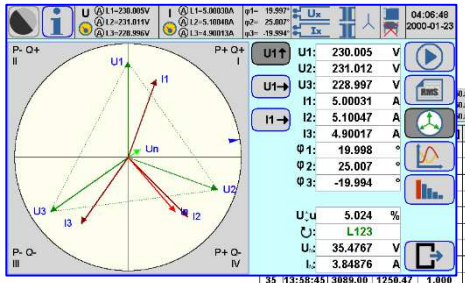
0.3..30A/3..300A/30..3000A, length=2m
max ∅ cable 150mm,
loop length 500mm



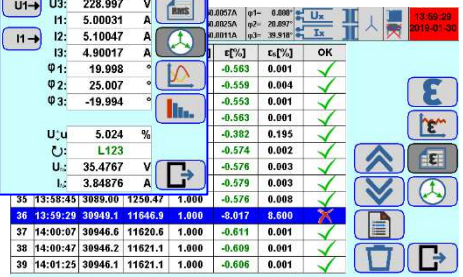
Voltage sensor
1kV…40kV,
length=12m

TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

TS33 Communication; many ways of printer, PC connection and data storage



Screenshoots

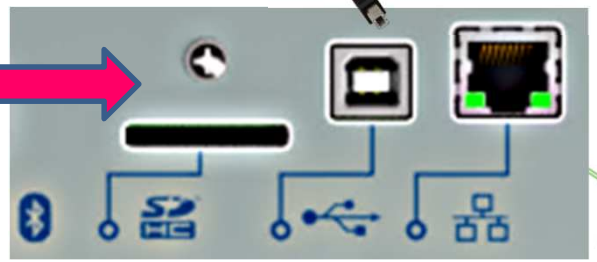


Results

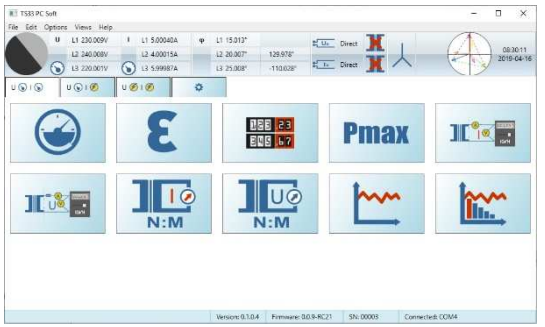
CalproTS33 PC Soft

USB

Removable SD cards 2..32GB



Ethernet



Remote control

Switch

Gate

WAN

INTERNET

Gate

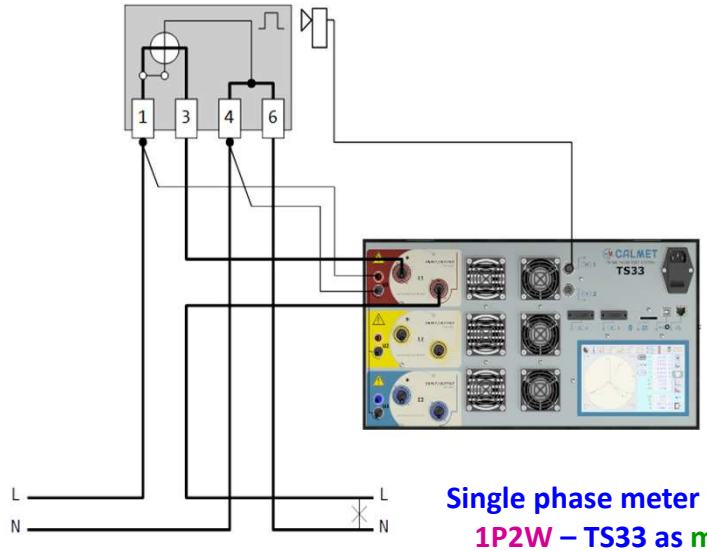
Switch

[10m]

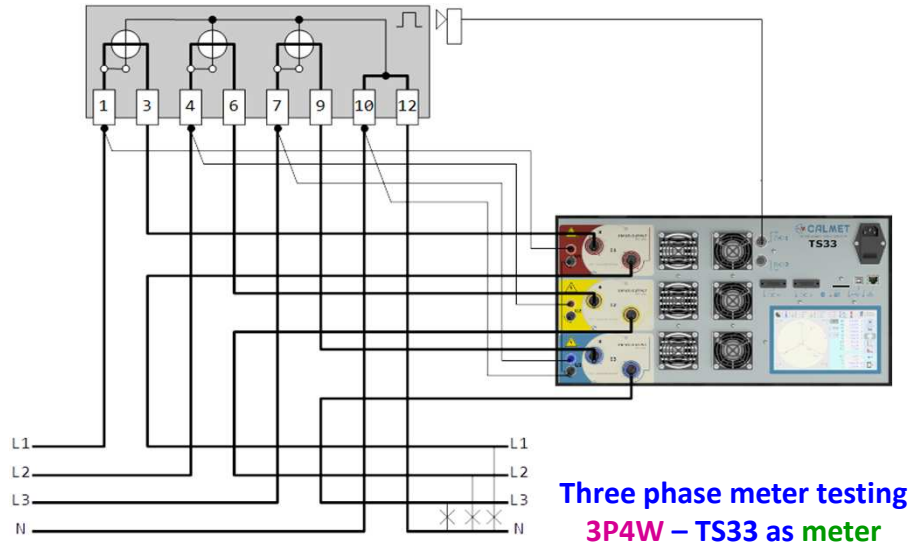
Bluetooth, wireless printer & laptop

TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

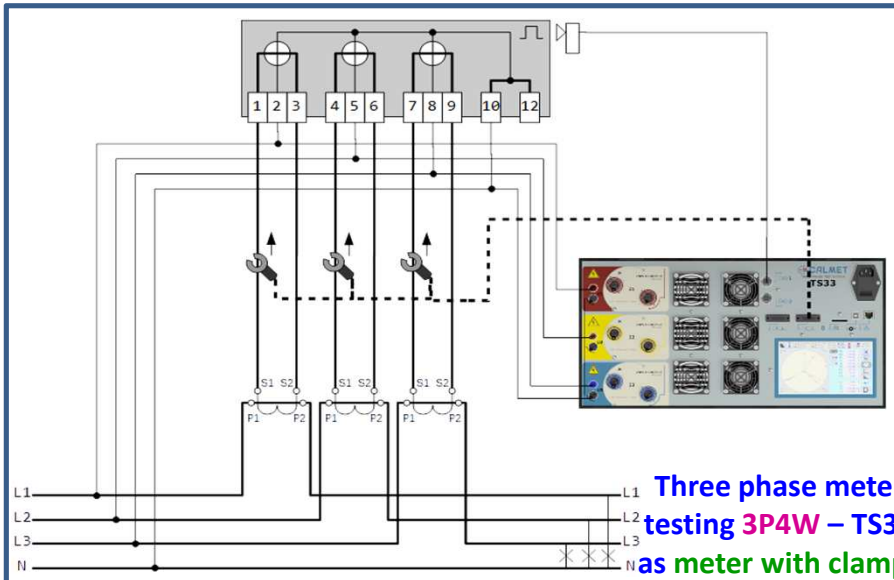
All possible types of connection: 1P2W, 3P4W, 3P3W, ... , direct or with clamps



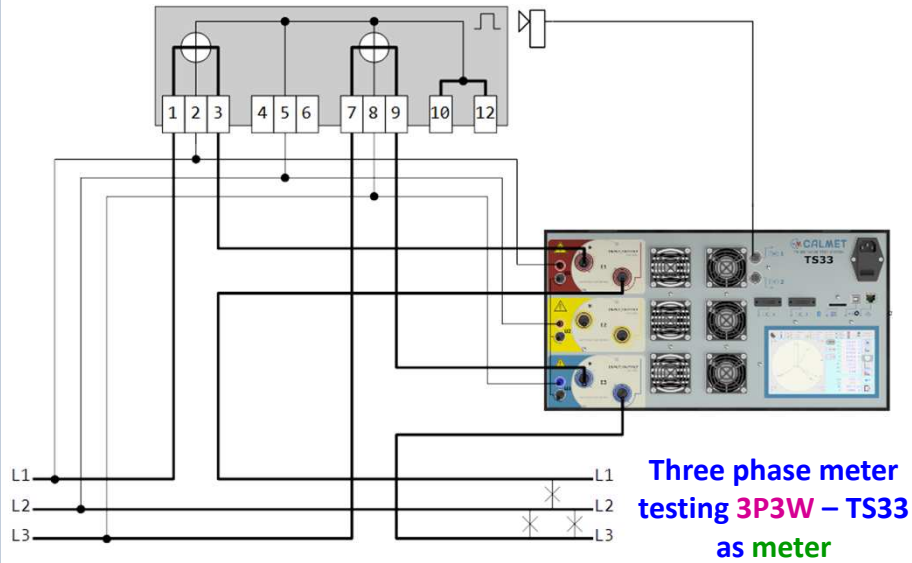
Single phase meter testing
1P2W – TS33 as meter



Three phase meter testing
3P4W – TS33 as meter



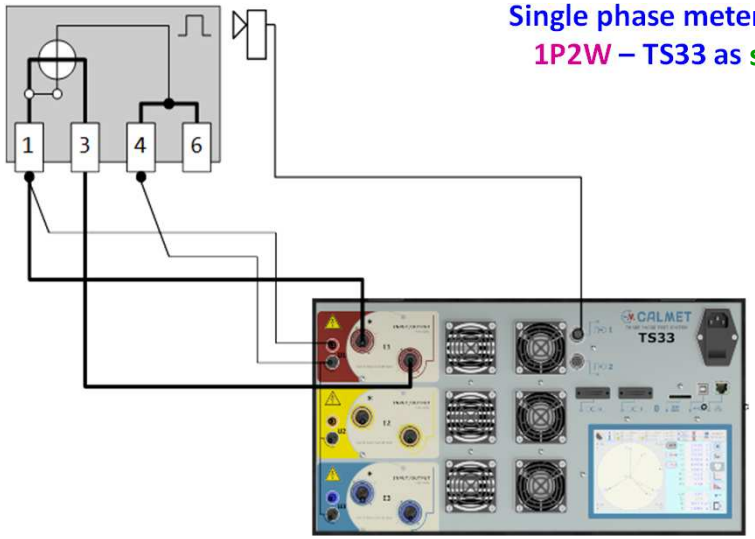
Three phase meter testing 3P4W – TS33 as meter with clamps



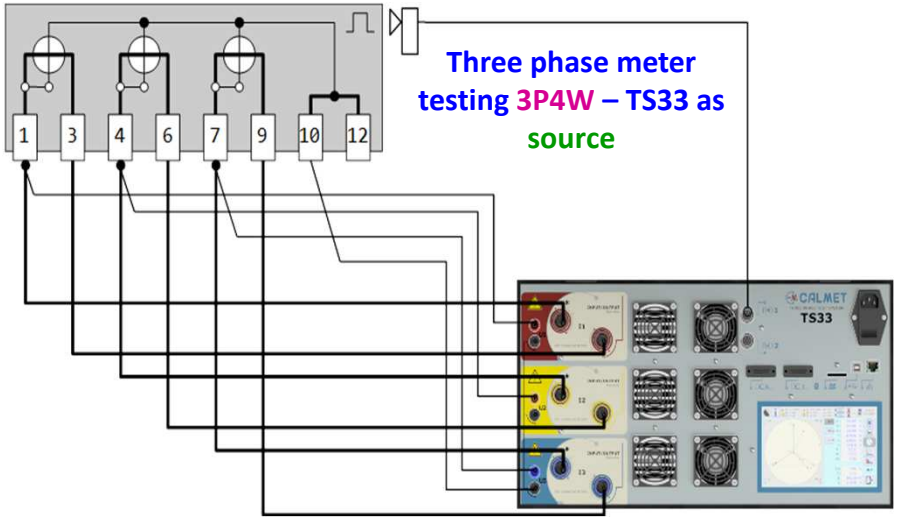
Three phase meter testing 3P3W – TS33 as meter

All possible types of meters: 1P2W, 3P4W, 3P3W. TS33 as source and reference

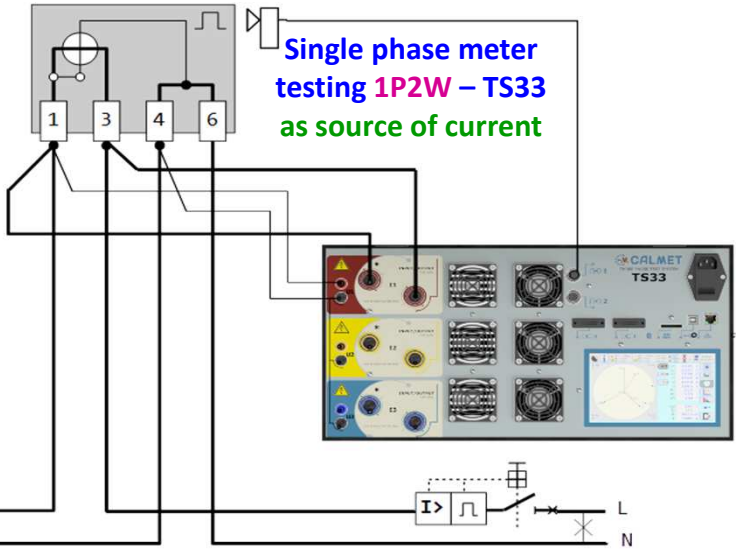
Single phase meter testing 1P2W – TS33 as source



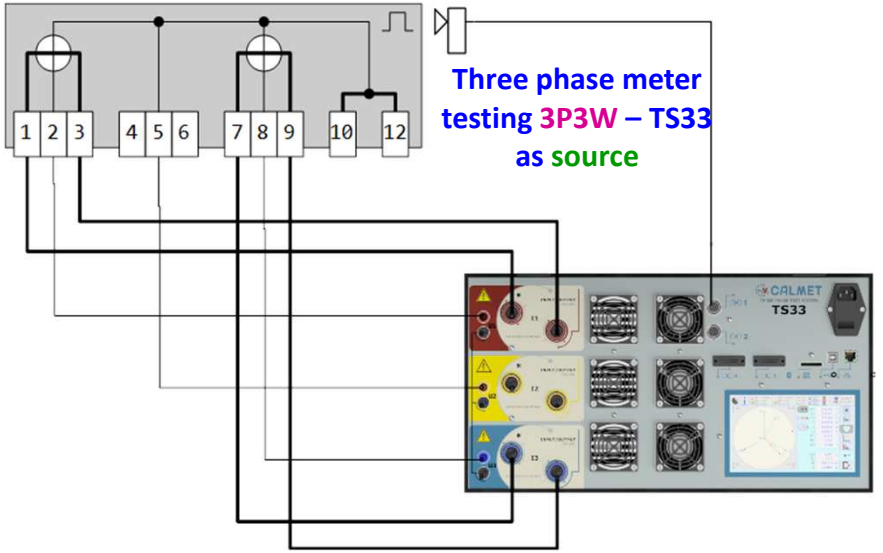
Three phase meter testing 3P4W – TS33 as source



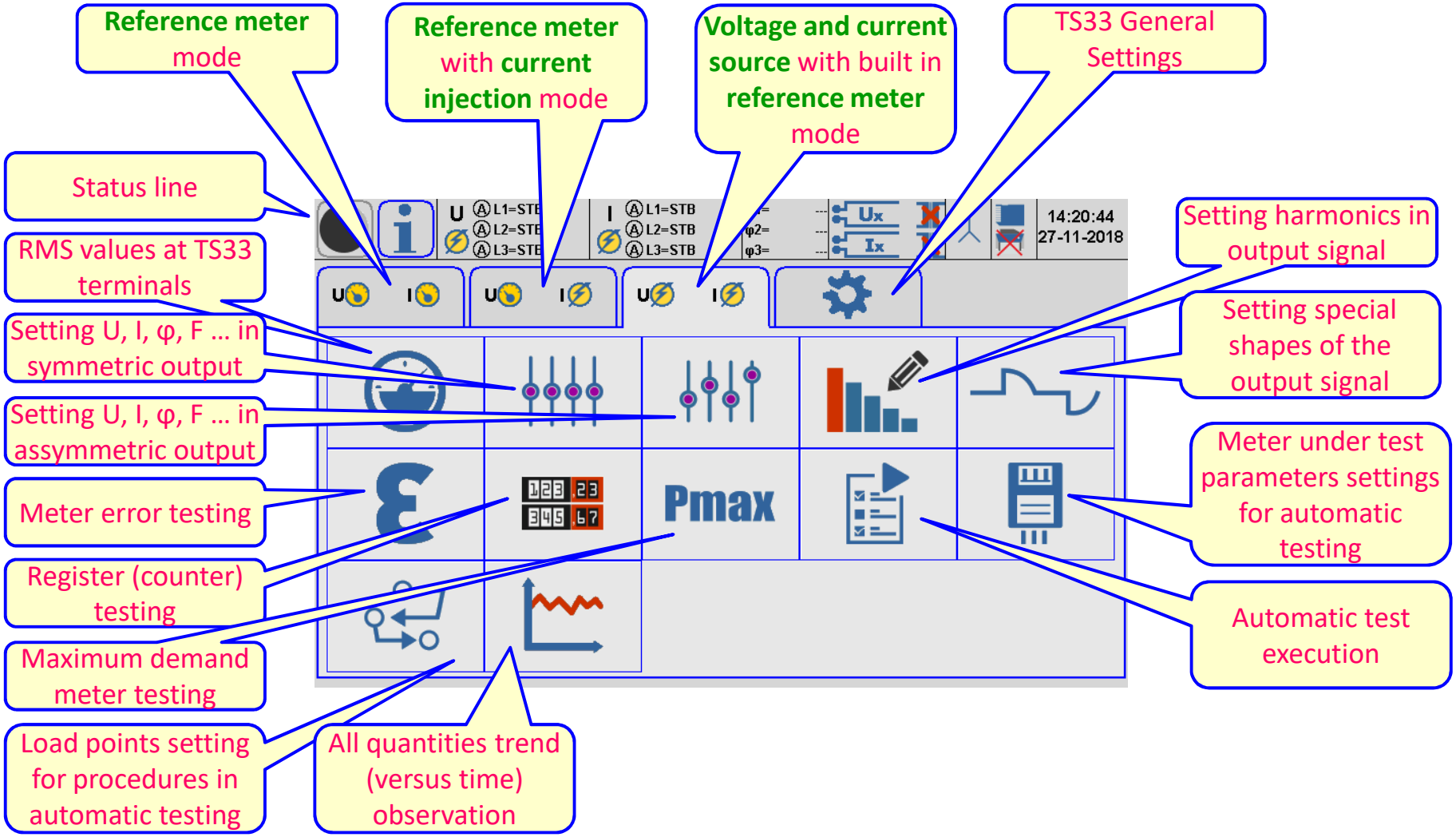
Single phase meter testing 1P2W – TS33 as source of current



Three phase meter testing 3P3W – TS33 as source



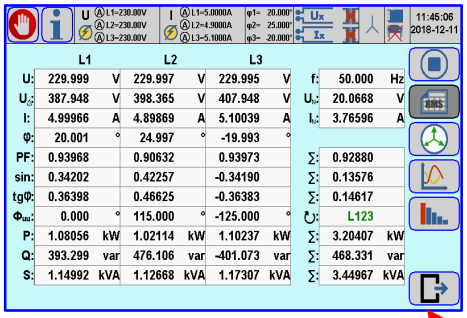
Functionality of TS33: as reference meter, as source of U&I, as U meter & I source



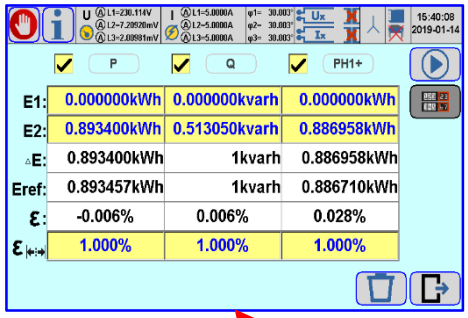
Easy, icon driven, operation on big 7” touch screen

TS33 reference meter mode: whole installation measurement „as it is”

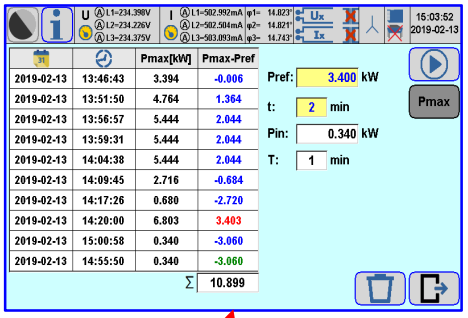
RMS values of U,I,φ,F,P,Q,S



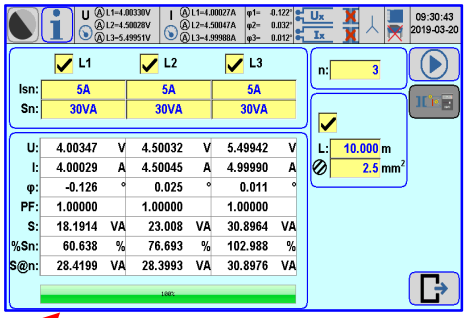
Counter (register) test



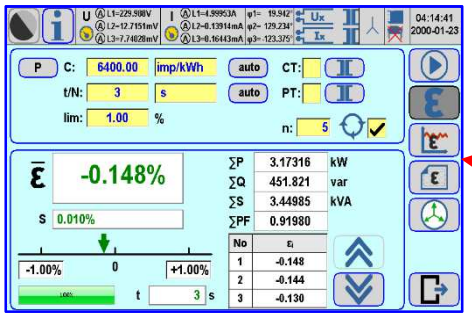
Maximum demand meter test

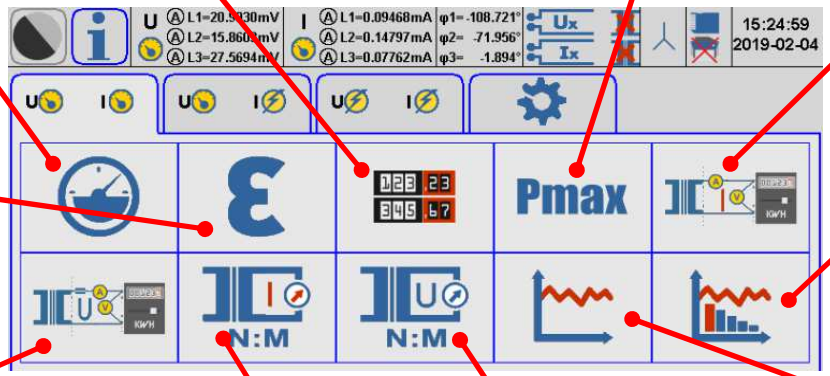


CT burden test

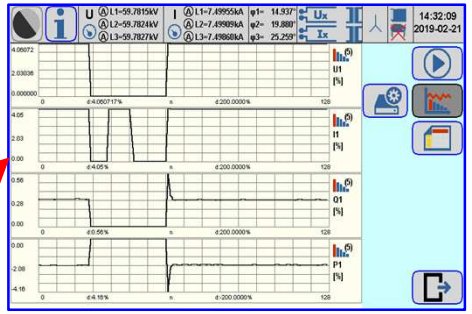


Meter error test in [%]

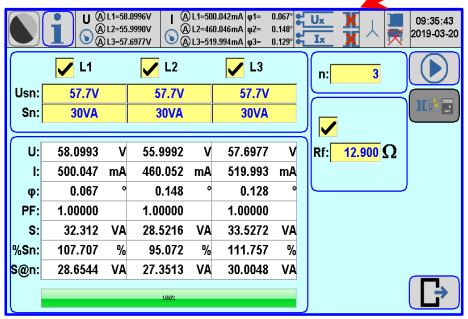




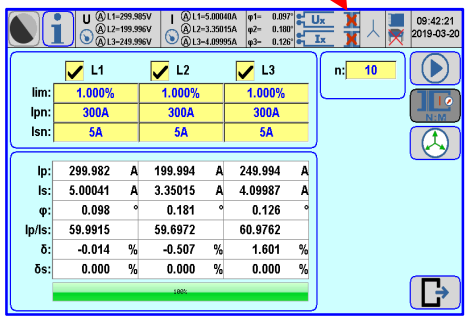
Harmonics trend test



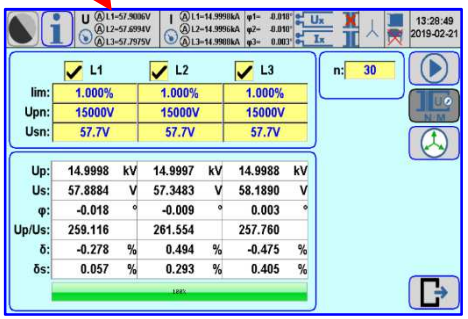
PT burden test



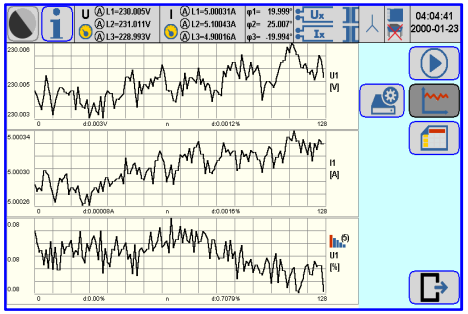
CT ratio test



PT ratio test



U,I,ϕ,F,P,Q,S trend test



TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

TS33 functionality: RMS values of U,I,ϕ,F,P,Q,S measurement results

Neutral Current

Neutral Voltage

Frequency

Voltage Phase - Neutral

Voltage Phase - Phase

Current

Phase shift

Power Factor

Reactive Factor

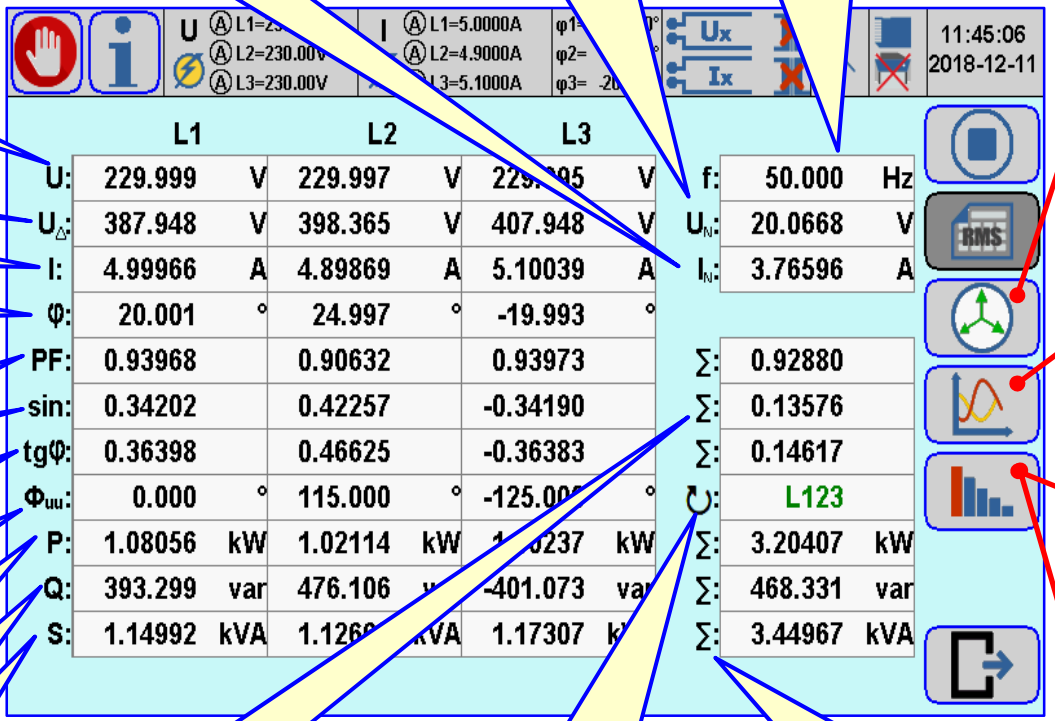
Tangent φ

Phase shift between Voltages

Active Power **P**

Reactive Power **Q**

Apparent Power **S**

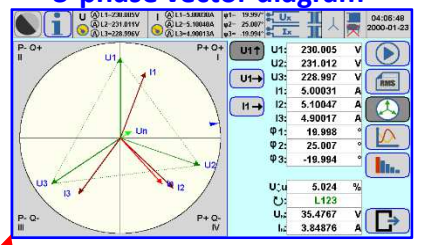


3-Phase Factors

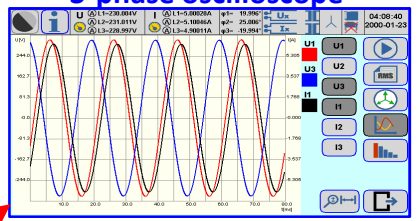
3-Phase Vector Rotation

3-Phase Powers

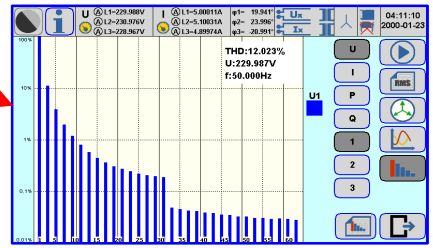
3-phase vector diagram



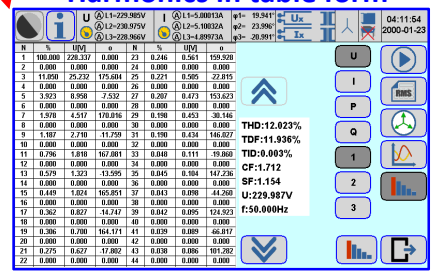
3-phase oscilloscope



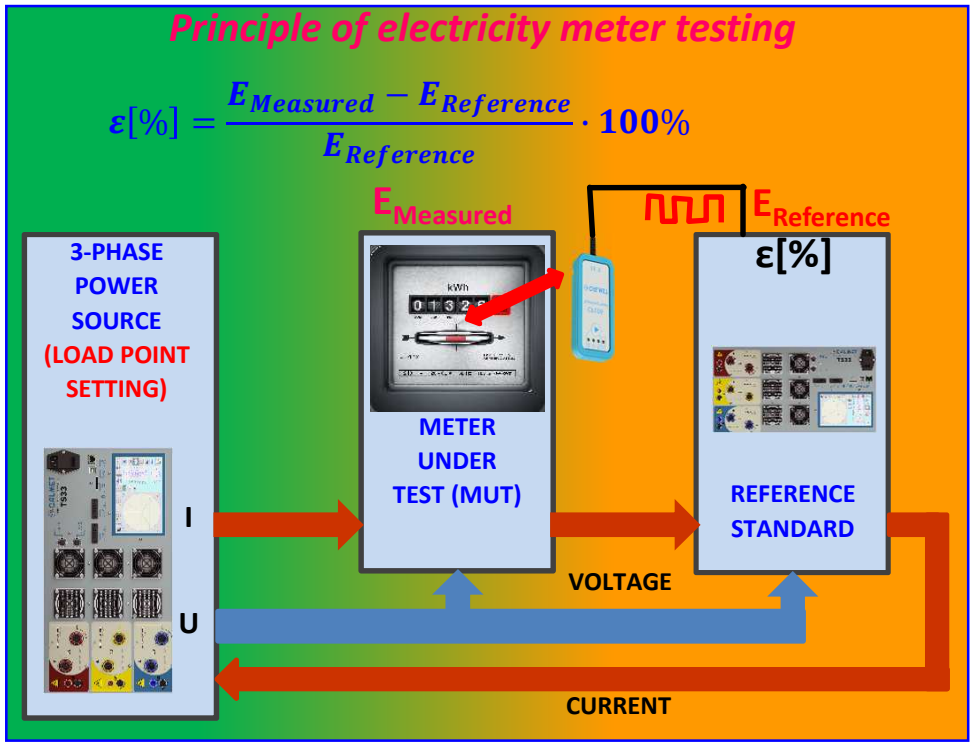
Harmonics bars



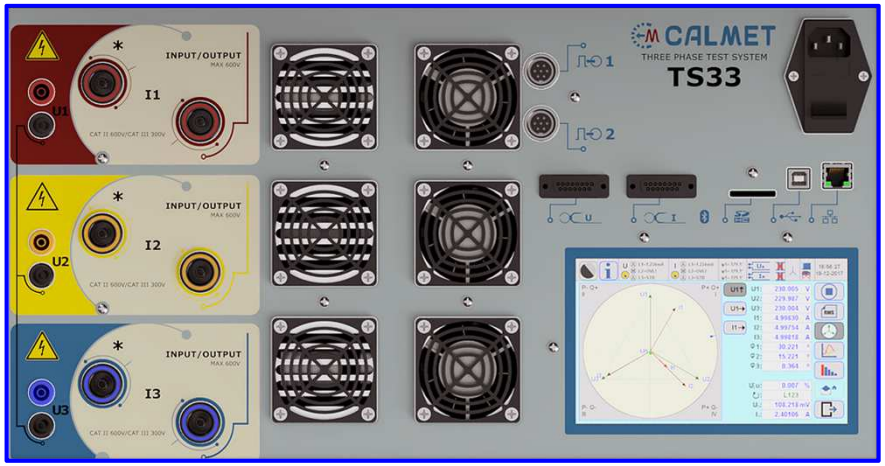
Harmonics in table form



TS33 functionality: energy meter error testing idea



TS33 works both:
- as programmable 3- phase source of voltage and current;
- as high accuracy reference meter.



Definition: energy meter testing (MUT) by energy comparison method consists in counting pulses from MUT and calculation of measured energy as:

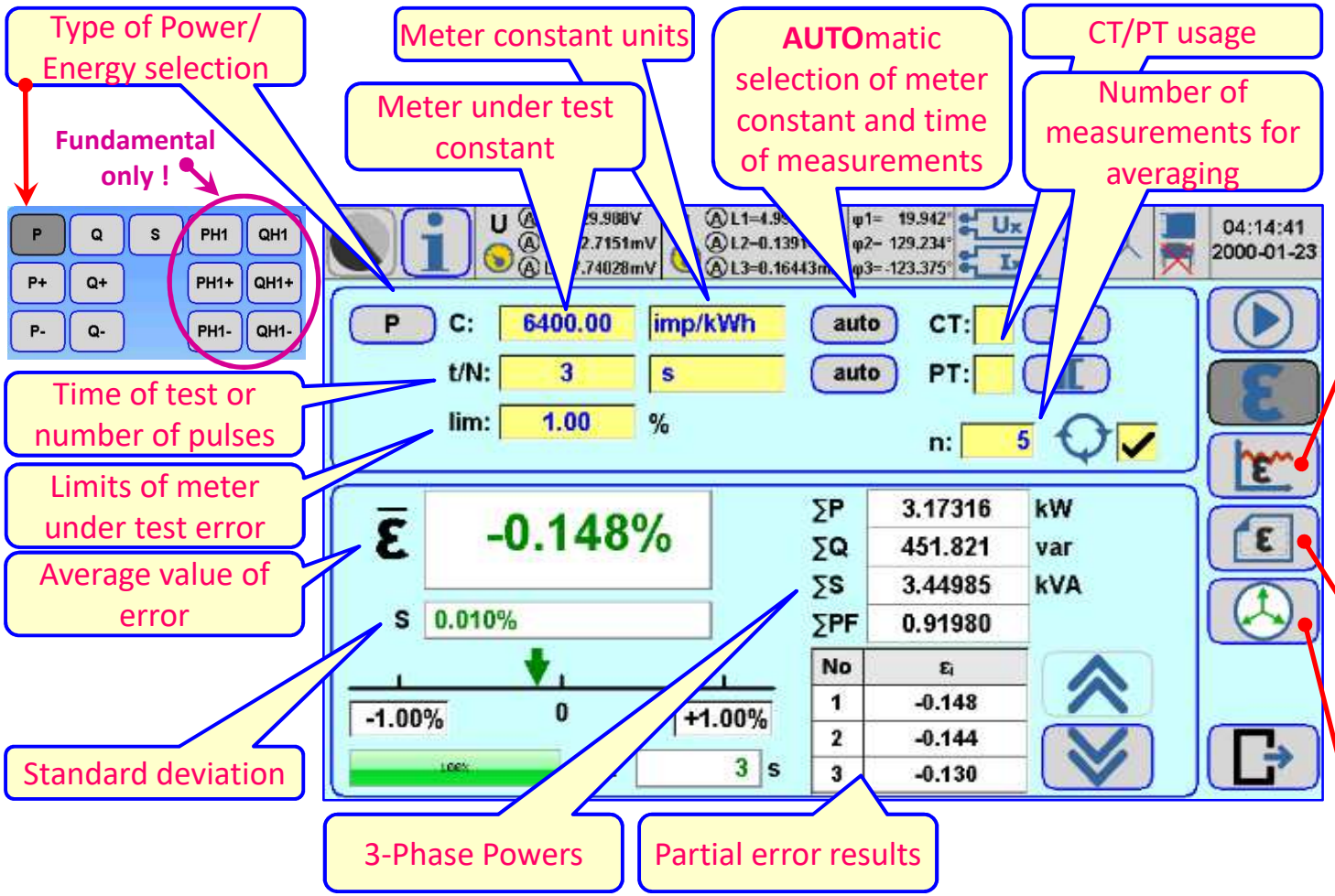
$$E_{Measured}[kWh] = \frac{N[pulses\ or\ turns\ number]}{C[imp/kWh](meter\ constant)}$$

and then compare it with, reference value measured by special, at least 5 times more accurate standard meter ($E_{reference}$).

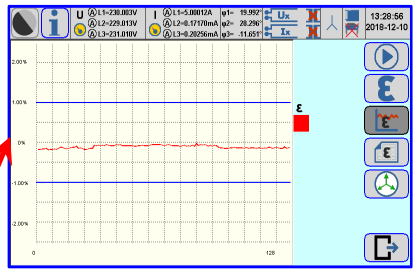
Example: counted were 500 pulses by meter with constant 375 turns/kWh. The measured energy is:

$$E_{Measured} = \frac{500}{375} kWh = 1.333kWh$$

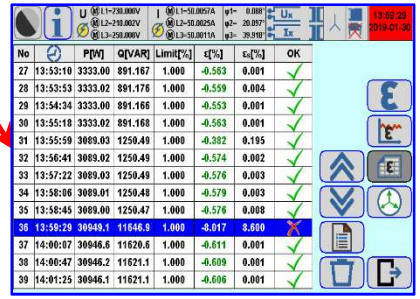
TS33 functionality: automatic energy meter error testing in [%]



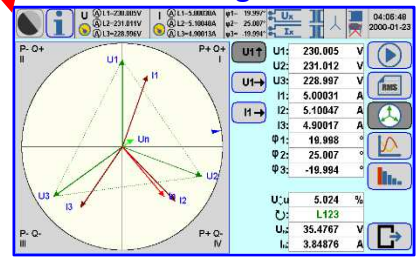
Error diagram ε=f(t)



Error table

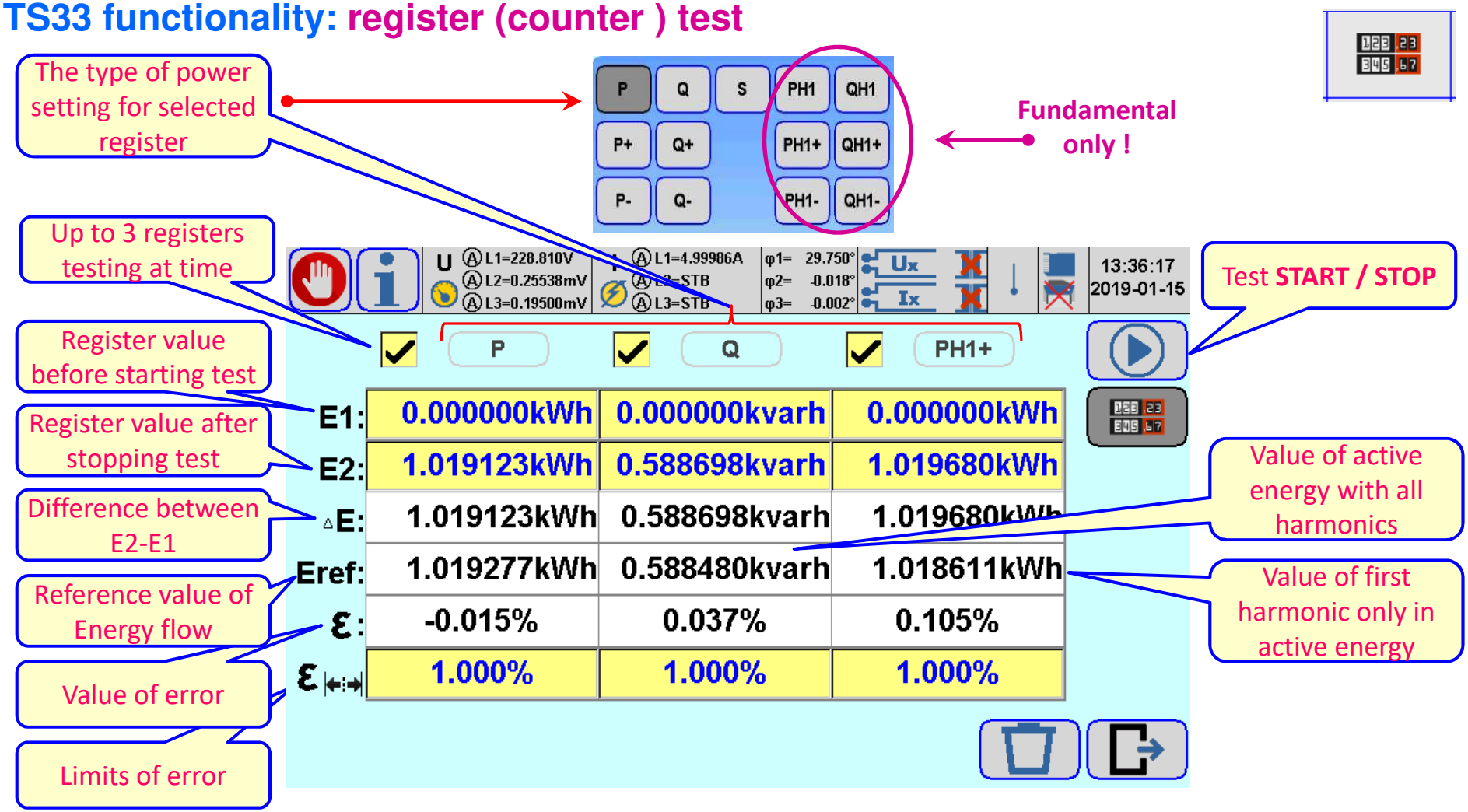


Vector diagram



- 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.

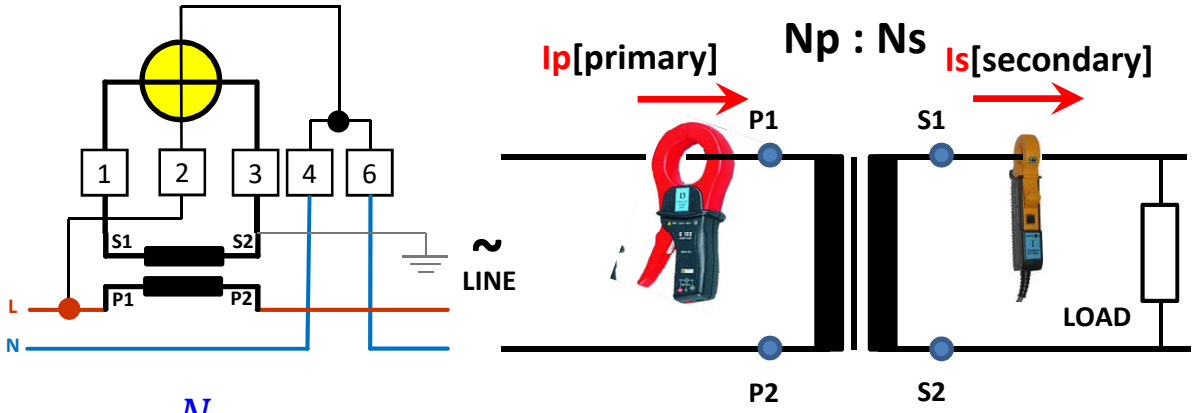
TS33 functionality: register (counter) test



- function of simultaneous testing up to three registers,
- function of every kind of power selection enables to test multi-quadrant meters,
- testing all harmonic energy or only fundamental (1-st harmonic) Energy, required for all new metres of reactive energy and active energy in near future

TS33 functionality: CT/PT ratio test idea;

small ratio and phase shift error are essential for reliable measurement

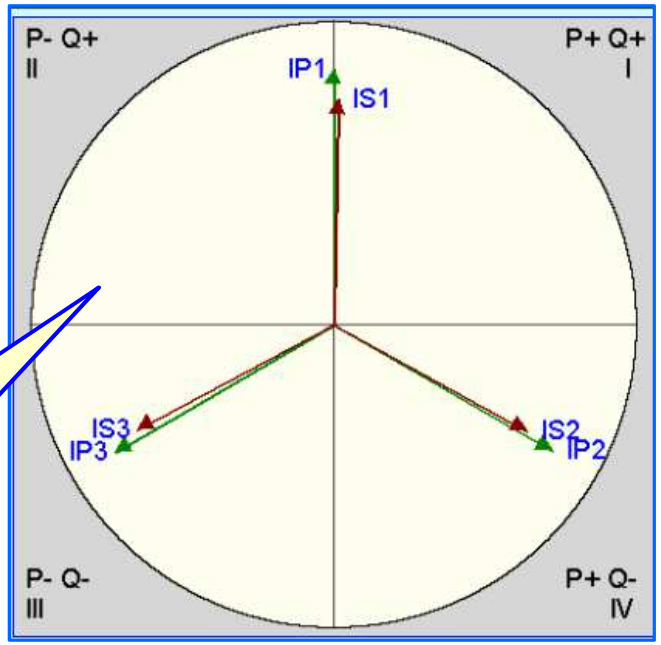


The test method is based on primary current measurement by means of current clamps from 0.1A to 3000A and secondary current measurement directly or also by means of clamps in 10mA to 10A range.

$$\delta I = \frac{\frac{N_P}{N_S} \cdot I_S - I_P}{I_P} \cdot 100\%$$

The ratio error is given by equation, where:

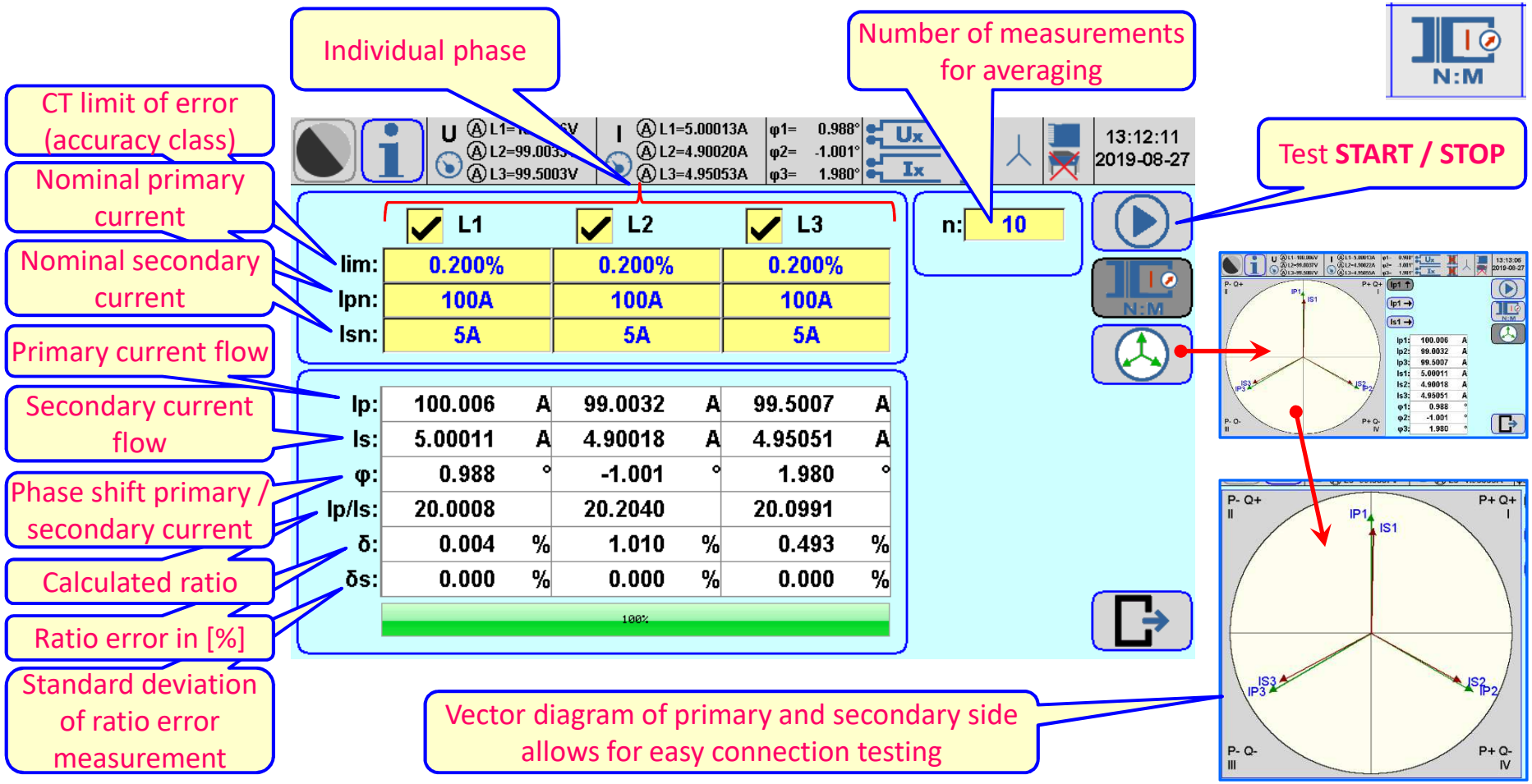
- ⍰I – current transformer error [%]
- N_P - number of primary turns
- N_S - number of secondary turns
- N_P / N_S – nominal CT ratio
- I_P - primary current
- I_S - secondary current



Three phase vector diagram of primary Ip and secondary Is currents

Expected value of ratio error is ⍰I=0% and phase shift error φ=0°

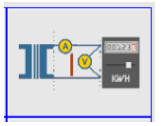
TS33 functionality: CT/PT ratio test; vector diagram with primary and secondary side

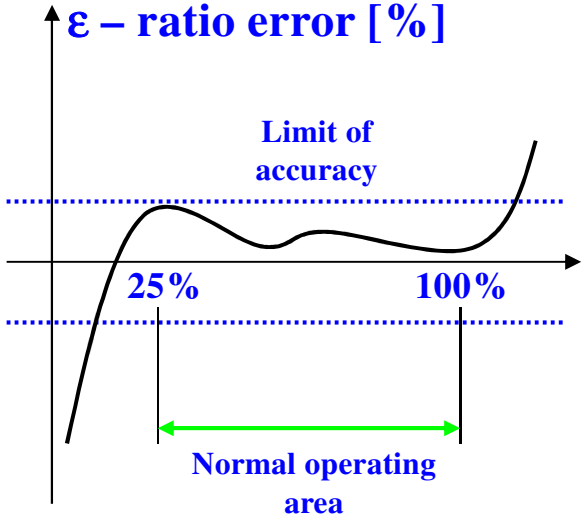


- testing CT / PT ratio and phase shift error simultaneously in three phases,
- ratio error measured directly in [%],
- vector diagram allows easy check of proper installation connections and error removing

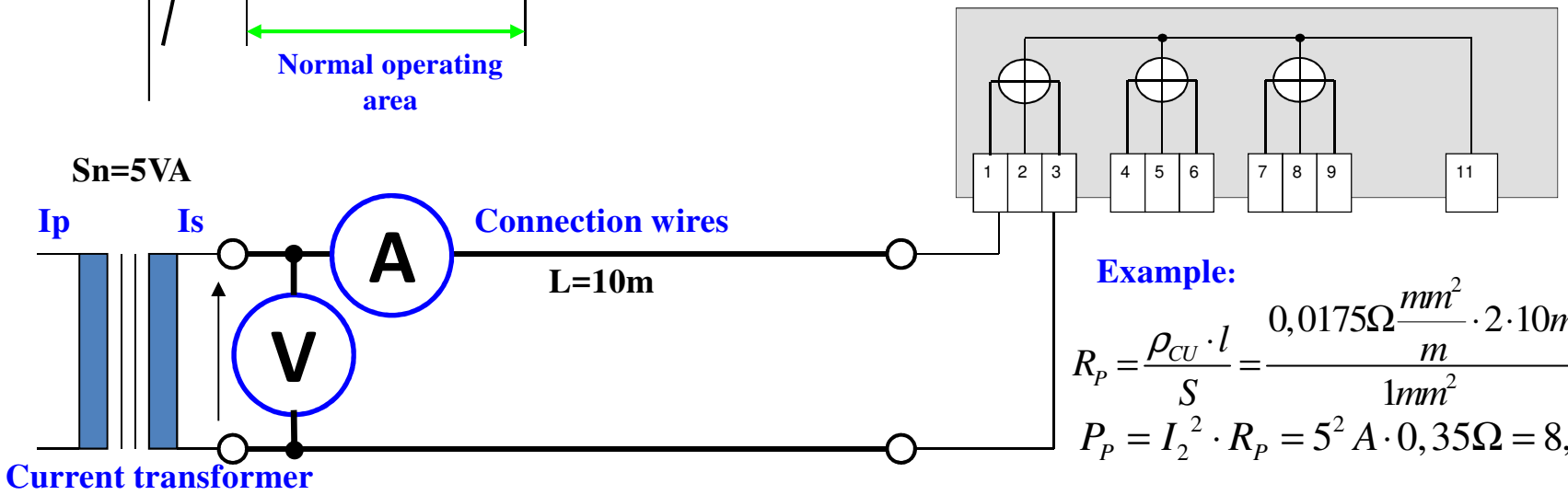
TS33 functionality: CT/PT burden test idea

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





[%] transformer power rating Sn



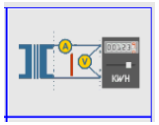
Example:

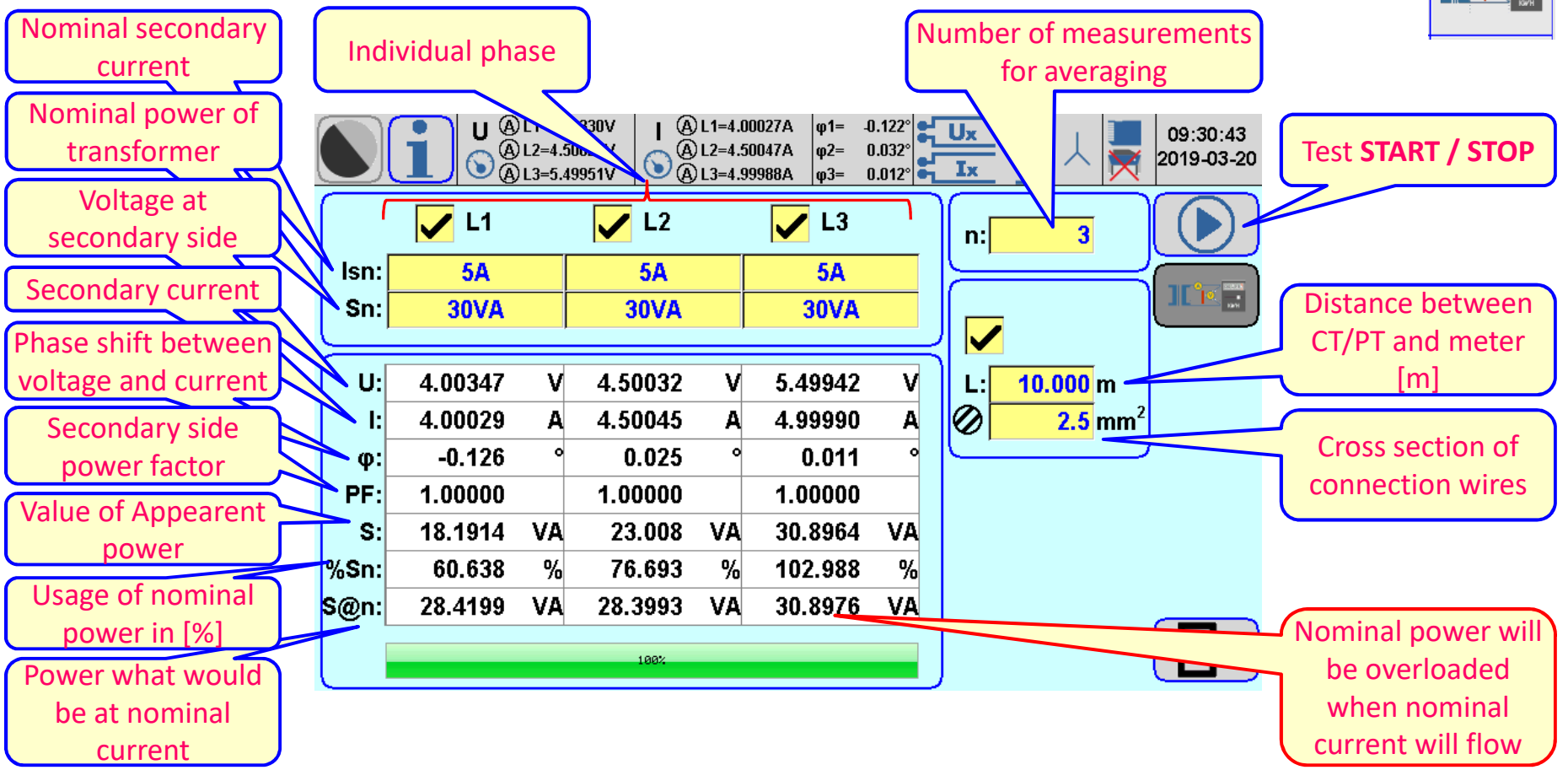
$$R_P = \frac{\rho_{CU} \cdot l}{S} = \frac{0{,}0175\Omega \frac{mm^2}{m} \cdot 2 \cdot 10m}{1mm^2} = 0{,}35\Omega$$

$$P_P = I_2^{\,2} \cdot R_P = 5^2 A \cdot 0{,}35\Omega = 8{,}75VA$$

Conclusion: transformer load (wires, connectors, fuses, meter) can influence on accuracy

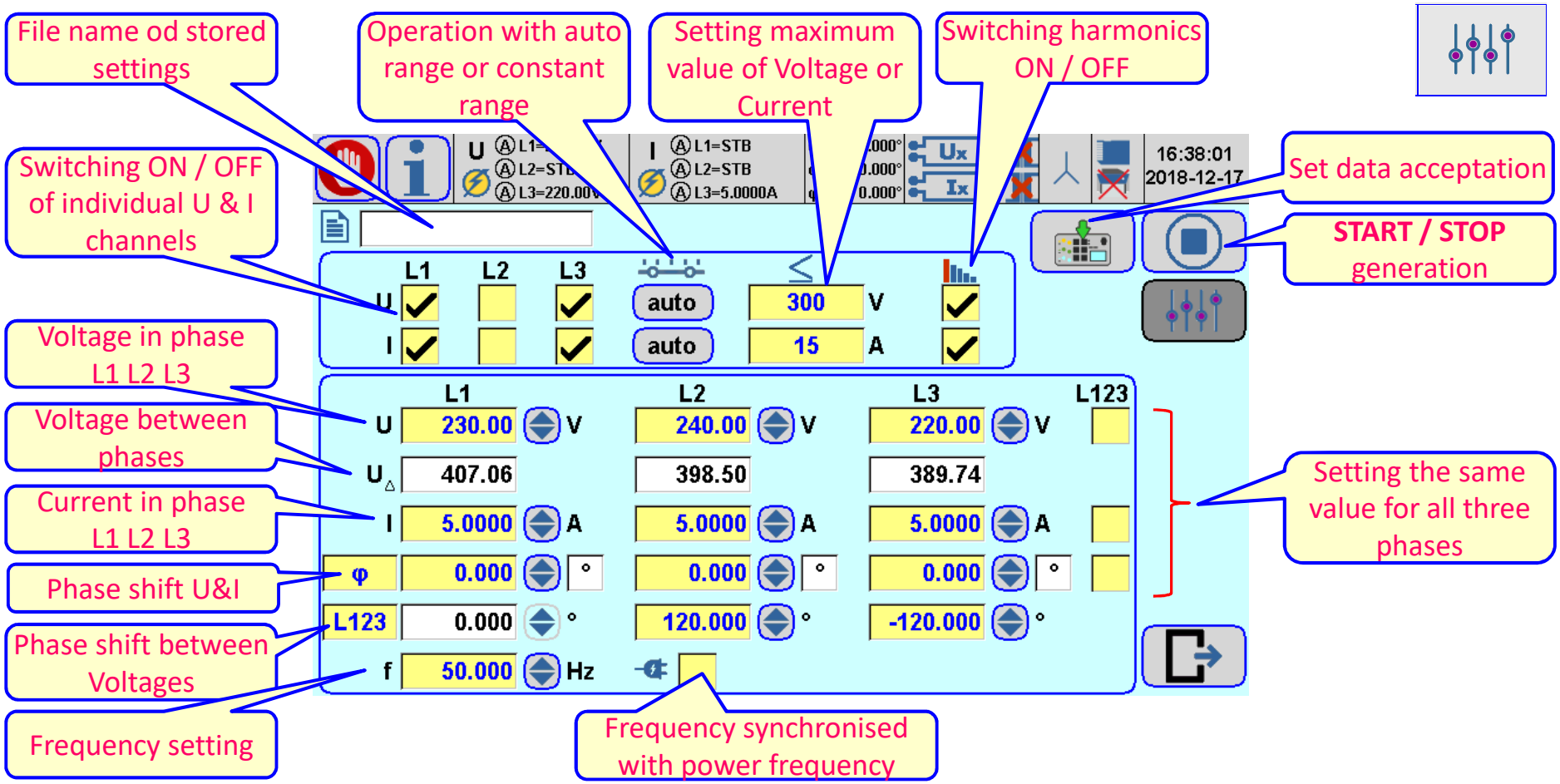
TS33 functionality: CT/PT burden test





- function of simultaneous testing up to three burdens,
- function of every kind of power selection enables to test multi-quadrant meters,
- testing all harmonic energy or only fundamental (1-st harmonic) Energy, required for all new metres of reactive energy and active energy in near future

TS33 functionality: Voltage and current source with built in reference meter mode



- Individual setting in each phase value of voltage, current, power factor and phase shift between voltages,
- Independent switching ON / OFF of each current and voltage in phase L1, L2, L3,
- Automatic or manual range selection,
- Protection against overvoltage or overcurrent
- Pure sinusoidal or harmonic distorted signal generation

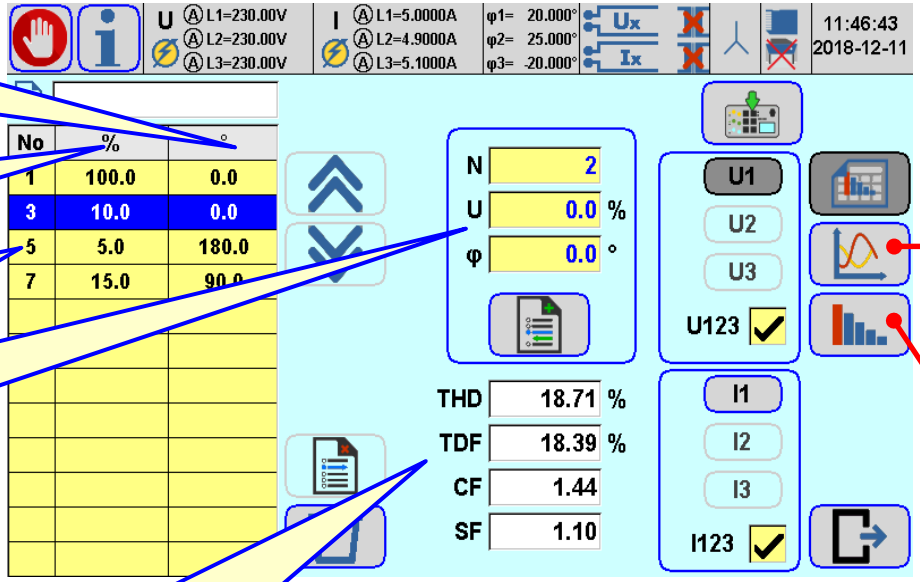
TS33 functionality: Voltage and current source – harmonic generation

Phase shift with reference to fundamantal

Amplitude in % of fundamental

Number of harmonic

Setting number of harmonic, its amplitude and phase shift



Signal parameters:

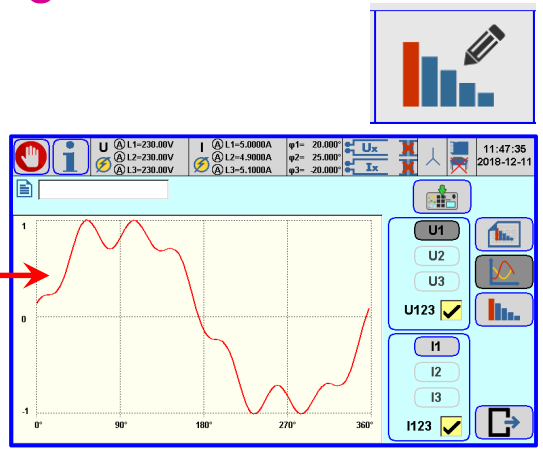
THD – total harmonic distortion (all harmonics to fundamental)

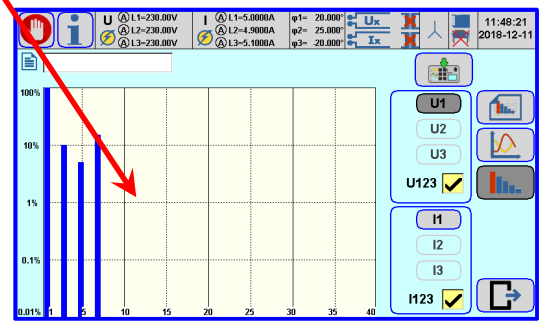
TDF – total distortion factor (all harmonics to RMS value)

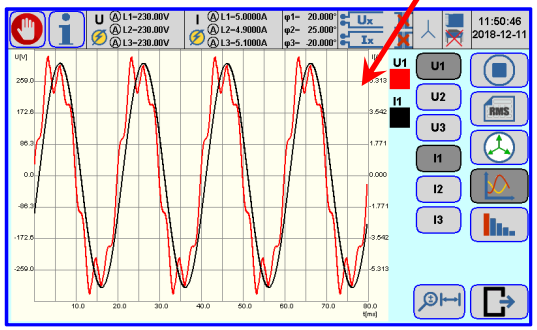
CF – crest factor (peak value to RMS value)

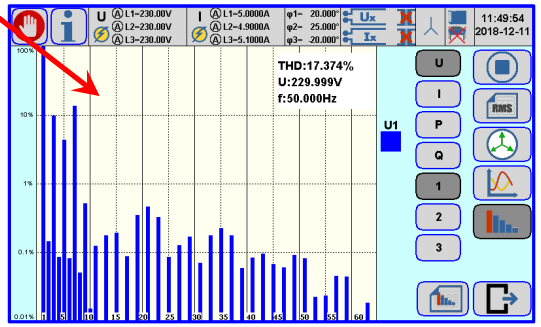
SF – shape factor (average rectified value to RMS value)

Real signal measured at TS33 output









TS33 functionality: Automatic energy meter test in whole range of loads idea

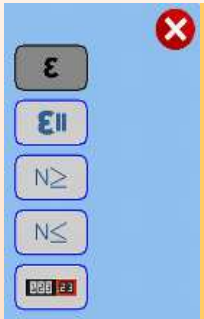
METER TYPE

U:230V
I:10(60)A
f:50Hz
C:375imp/kWh
Cl: 2

U:230V
I:0.25-5(60)A
f:50Hz
C:6400imp/kWh
Cl: A

Data base

TEST PROCEDURE



Type of test:
- error
- repeatability
- start up current
- no load test
- dial (register) test

Load points:
- value of current
- value of voltage
- power factor
- frequency
- harmonics

Data base

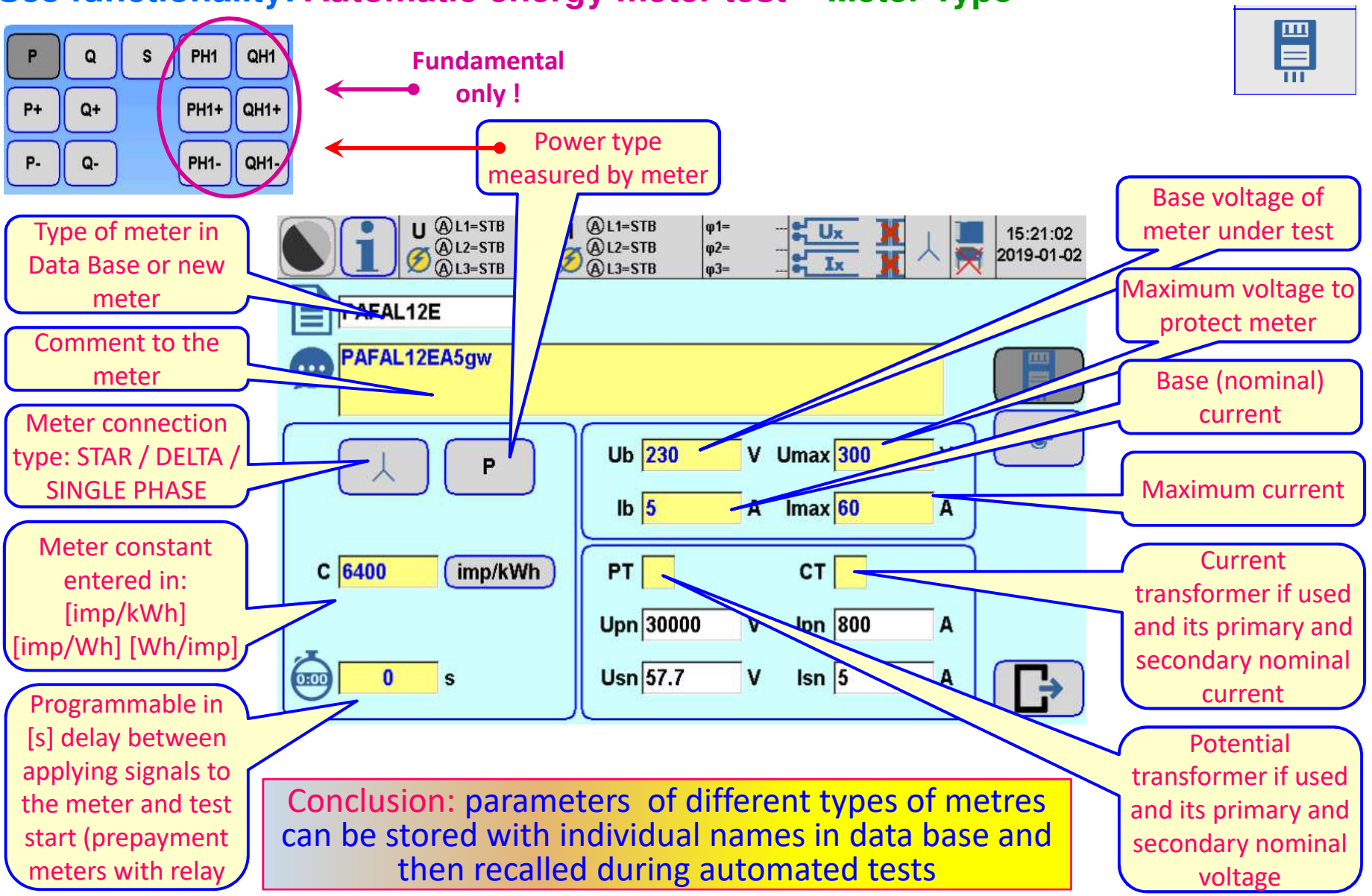
TEST EXECUTION

- load points for test selection
- serial number of meter under test
- test execution
- results table

No		P[W]	Q[VAR]	lim[%]	ε[%]	sε[%]	OK
1	11:43:27	172.502	-0.008651	1.000	0.660	0.022	✓
2	11:44:50	344.987	-0.013448	1.000	0.638	0.010	✓
3	11:45:35	689.912	-0.049329	1.000	0.505	0.107	✓
4	11:46:57	1725.03	-1.00918	1.000	0.628	0.003	✓
5	11:48:16	2760.15	-0.290766	1.000	0.616	0.006	✓
6	11:49:37	3450.06	-0.479581	1.000	0.600	0.004	✓
7	11:50:56	4139.97	-0.75882	1.000	0.589	0.001	✓

Data base

TS33 functionality: Automatic energy meter test – Meter Type



Conclusion: parameters of different types of metres can be stored with individual names in data base and then recalled during automated tests

TS33 functionality: Automatic energy meter test – Procedure

- error test
- repeatability
- start up current
- no load, creep test
- register (dial) test

Type of test

Error limit

Time of test

Number of measurements for averaging

Name of load point

Load point parameters in [%] of base value defined in Meter Type

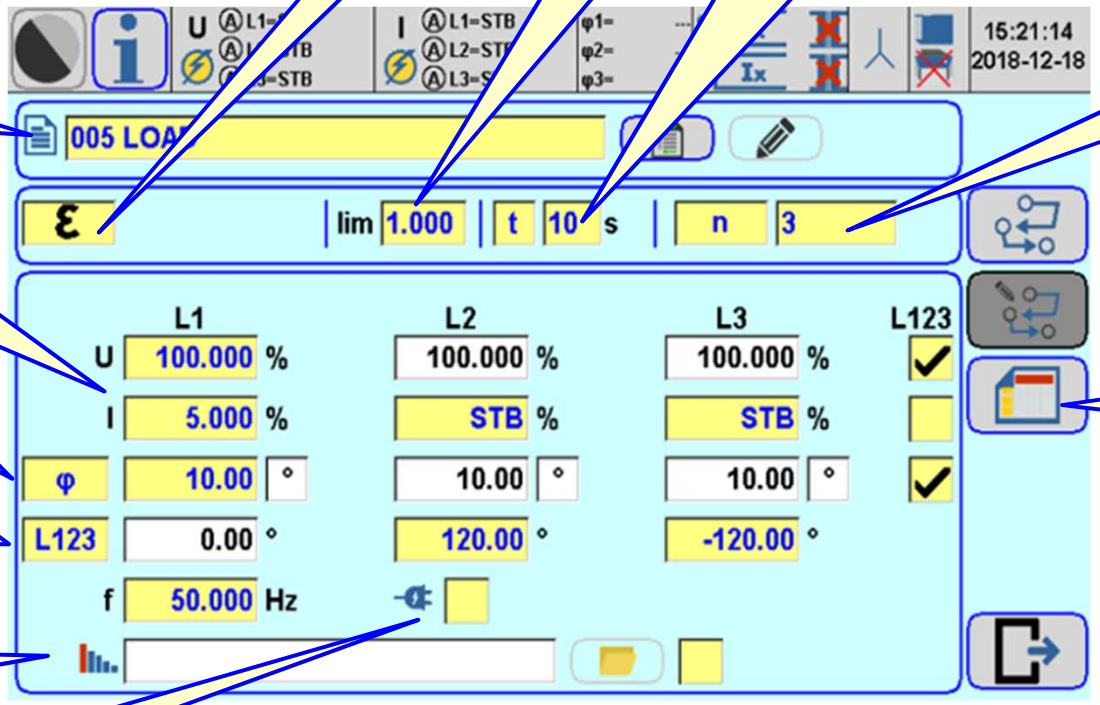
Phase shift or power factor

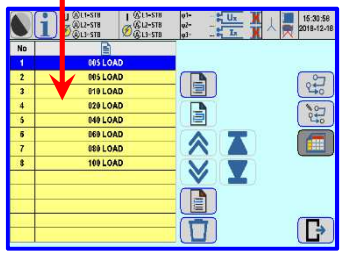
Symmetry of voltages and rotation direction

Harmonics in signal

Synchronization with network frequency

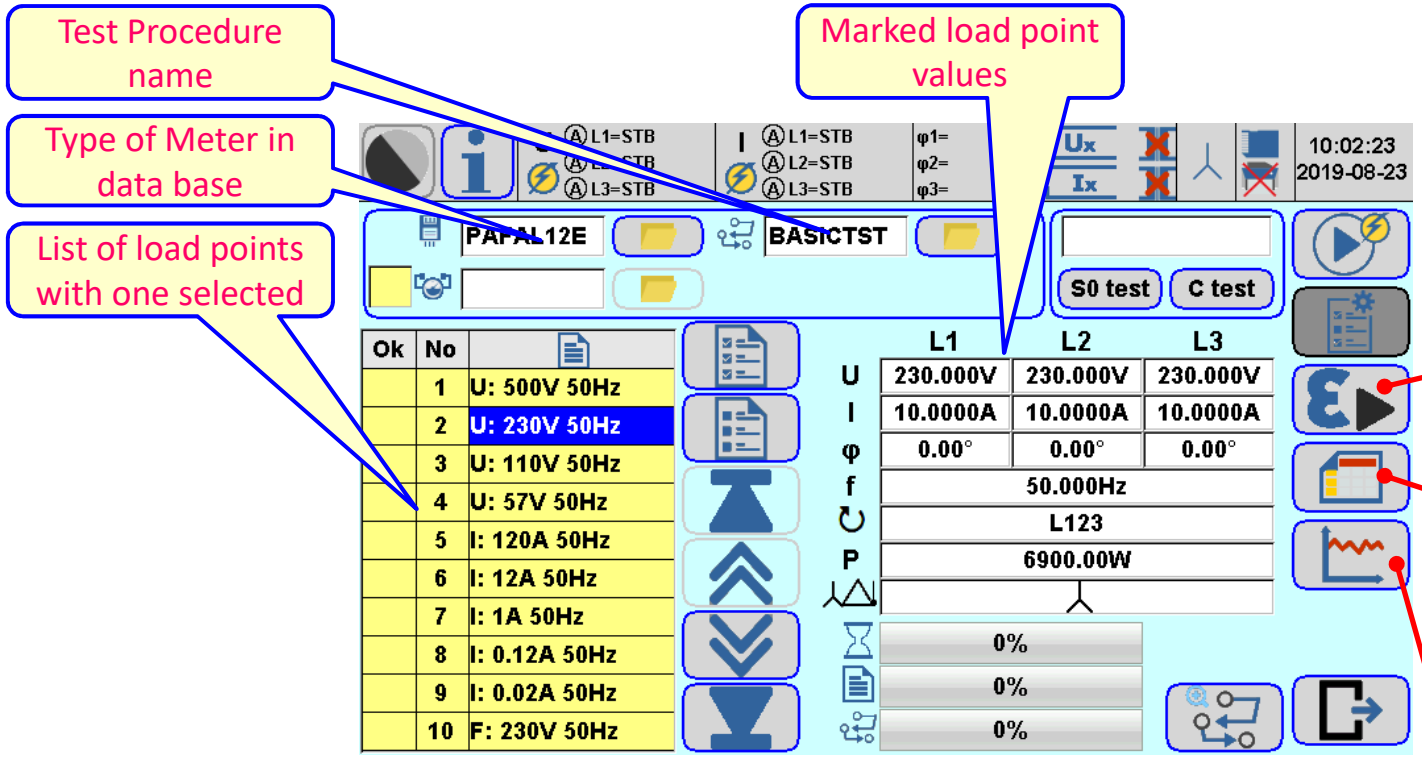
Table with load points



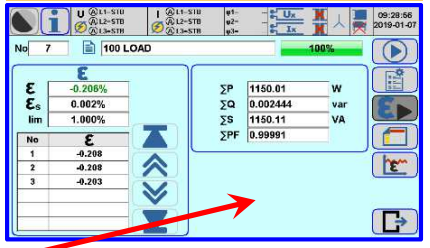


Conclusion: it is possible to define each load point and kind of test and then save the sequence of points in one procedure in data base, which can be recalled during automated tests

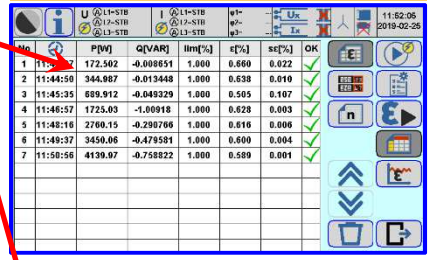
TS33 functionality: Automatic energy meter test – Execution



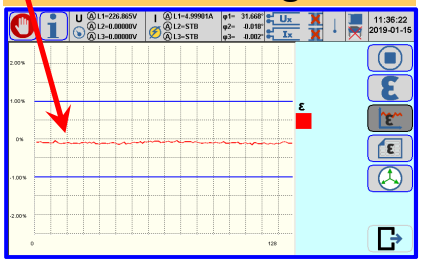
Load point execution and error results



Results in table format



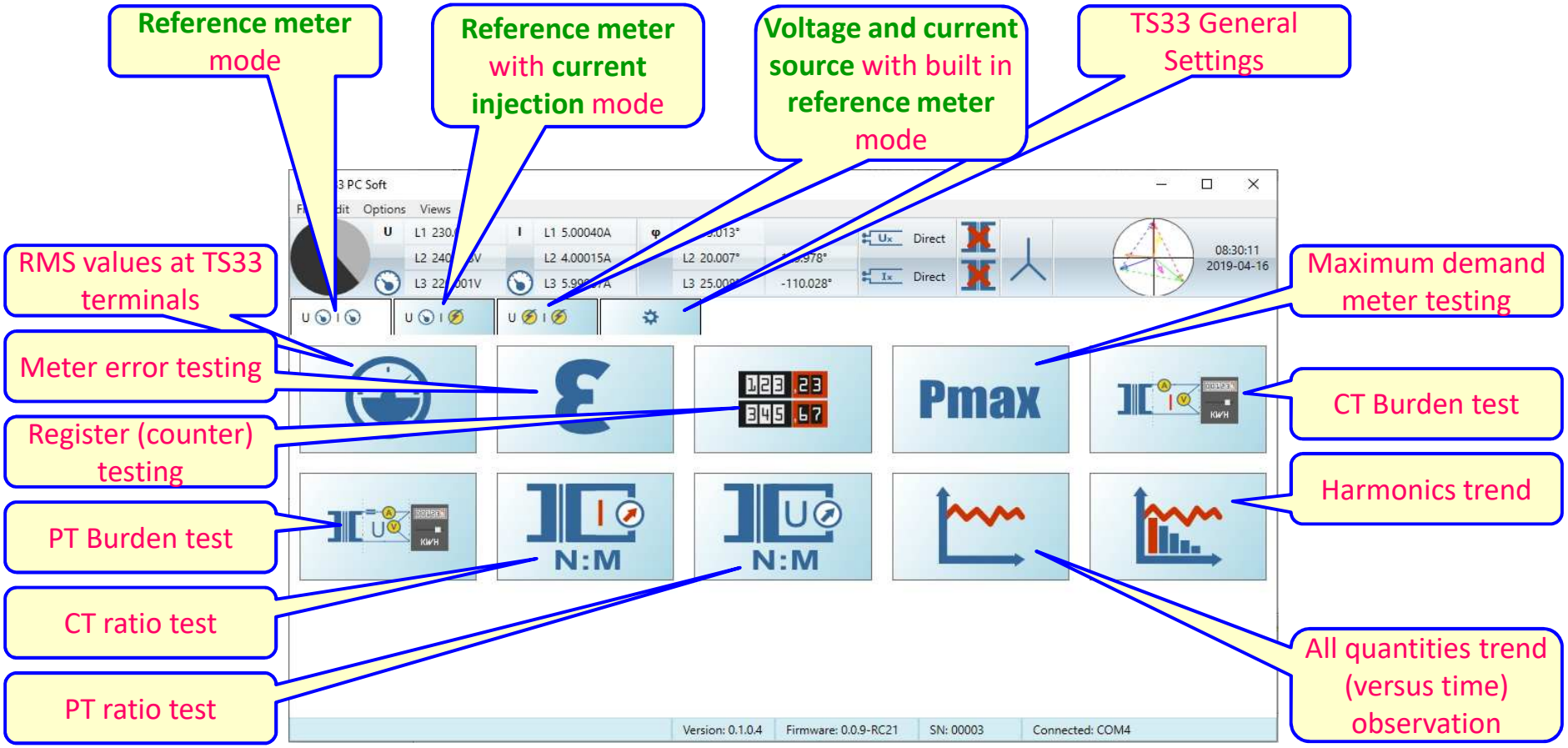
Results as diagram



Conclusion: Automatic testing allows to perform full test of Energy Meter on site due to Meter Type and Procedures stored in data base. As results are displayed:

- table, which can be stored in memory and transferred to PC
- diagram of error in [%] against load pint in the procedure

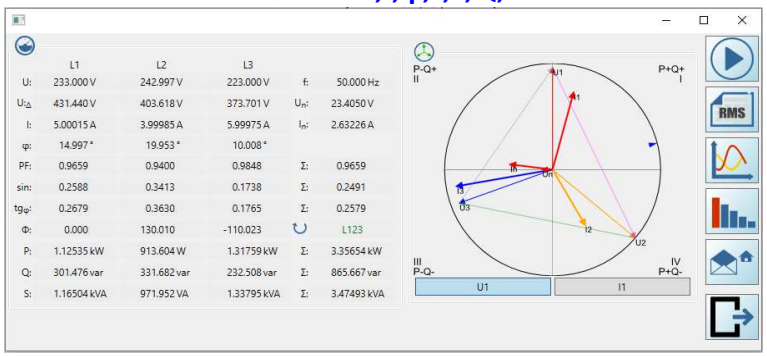
TS33 PC Soft functionality: all of TS33 functions can be accessed in remote way



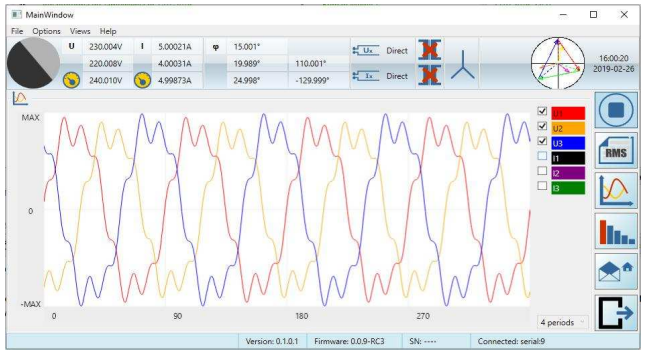
Conclusion: All functionality of the TS33 is available through **USB**, **Bluetooth** and **Ethernet** connection (including **Internet** remote control). TS33 PC Soft enables to download real time results of measurement made by TS33, download stored in memory results, readout the SD card memory and remote control of measurements. Results can be then saved in Data Base, printed or exported to eg. Excel sheet.

TS33 PC Soft functionality: example screenshots

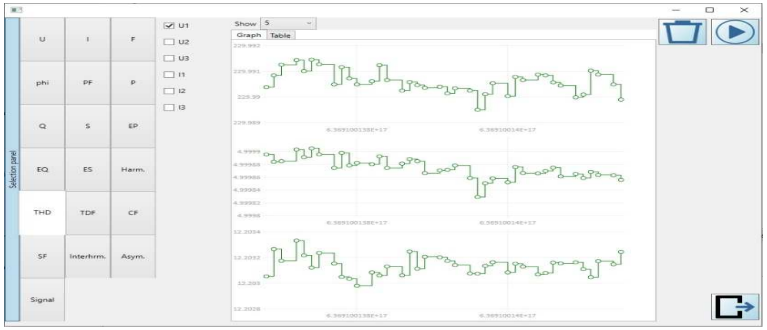
RMS values of U,I,φ,F,P,Q,S



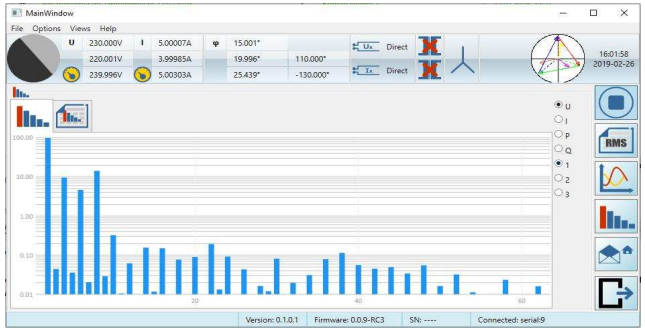
Voltage U1, U2, U3 oscilloscope



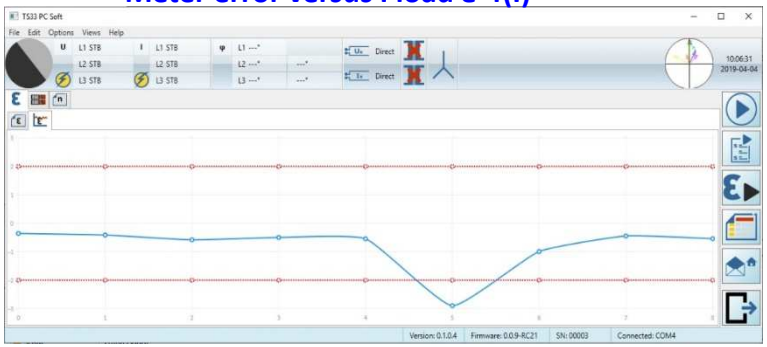
Voltage, current and THD trend



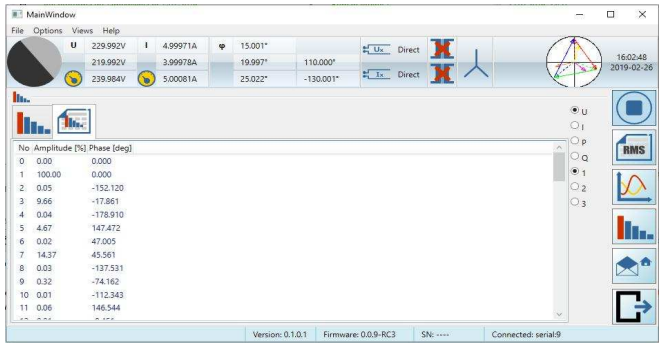
Harmonics in voltage U1



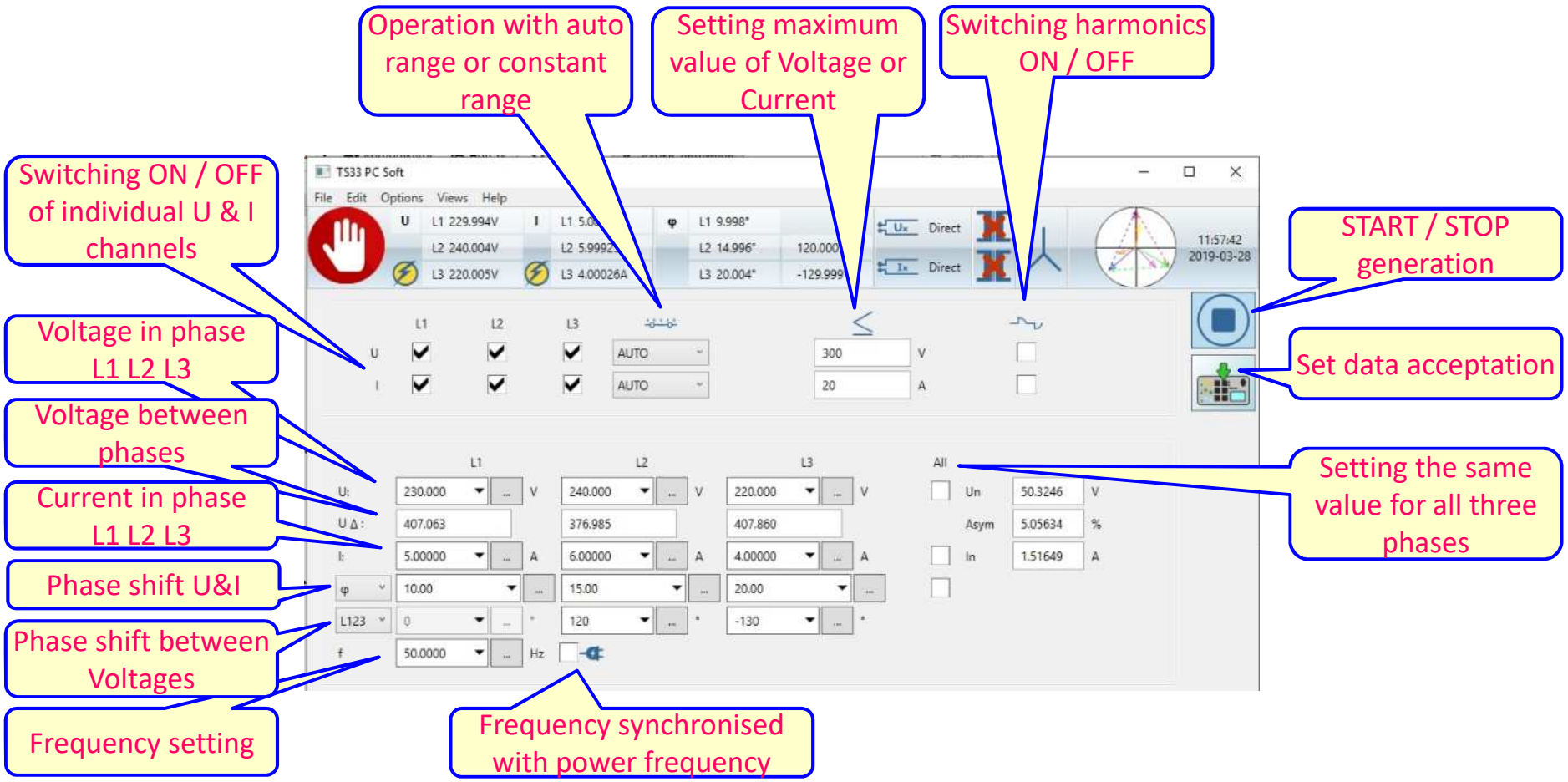
Meter error versus I load ε=f(I)



Harmonics in table form



TS33 PC Soft functionality: remote control of TS33 source



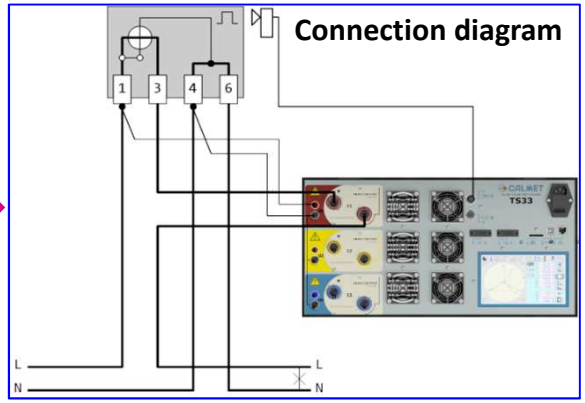
- Individual setting in each phase value of voltage, current, power factor and phase shift between voltages,
- Independent switching ON / OFF of each current and voltage in phase L1, L2, L3,
- Automatic or manual range selection,
- Protection against overvoltage or overcurrent
- Pure sinusoidal or harmonic distorted signal generation

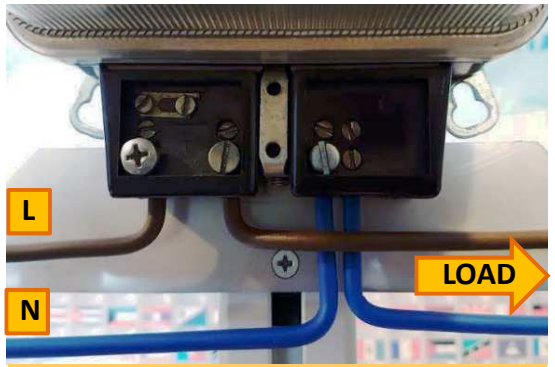
TS33: testing single phase electromechanical Energy Meter example (1)

TS33 as Reference Meter and meter under test directly connected

Meter parameters:
Base voltage: 230V
Base current: 5A
Max. current: 40A
Meter constant:
375 turns/kWh

Typical, „old fashioned", electromechanical meter and its parameters

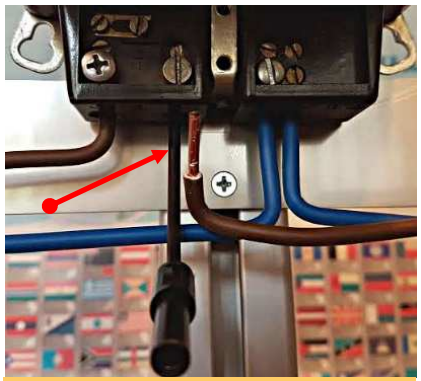




Wiring to meter terminals

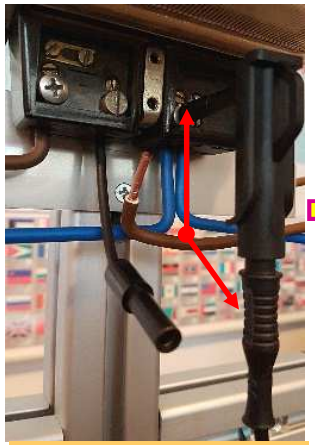
Disconnect phase wire connected to load

Magnetic plugs for safety cables

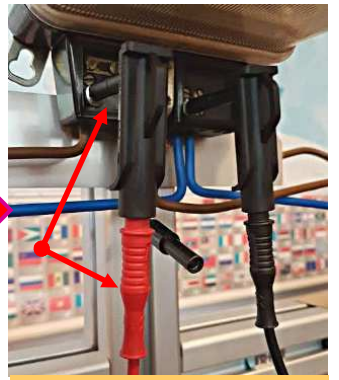


Connect instead „Cu" pin for safety cables

„Cu" pin for safety cables



Connect „Neutral" meter terminal to neutral safety cable by means of magnetic plug



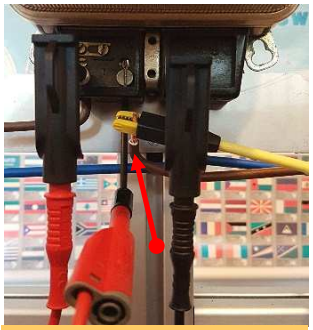
Connect „Phase" meter terminal to phase safety cable by means of magnetic plug

TS33 : testing single phase electromechanical Energy Meter example (2)

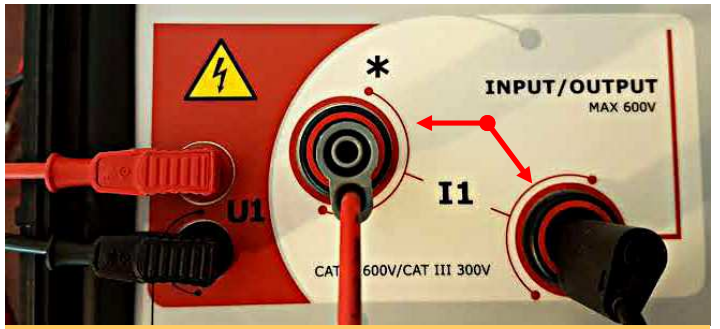
TS33 as Reference Meter and meter under test directly connected

Connect cables from meter to voltage inputs of TS33

Connect phase current cable to „Cu” pin (red)



Connect return current cable by means of crocodile clip (black)



Connect current cables from meter to current inputs of TS33

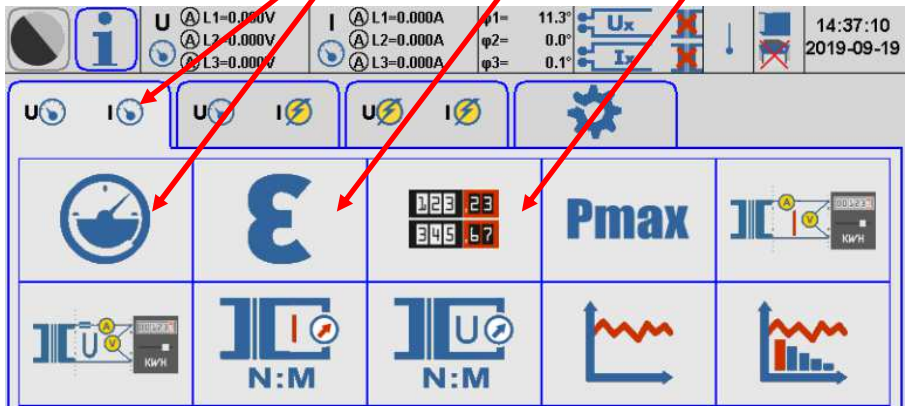
Crocodile clip

Scanning head assembly:

- place mechanical fixing device in front of rotor
- „click” scanning head into hole
- connect cable to TS33 scanning head input no1

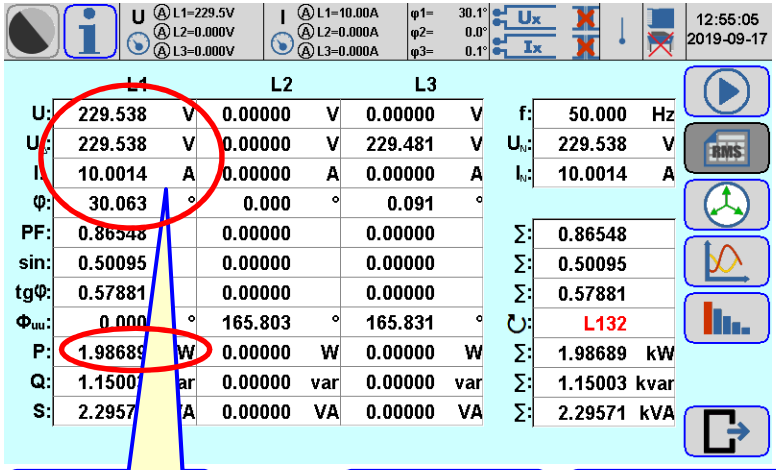
Now the measurement system is ready to test meter error and register test

In the TS33 LCD select U&I measurement mode and then RMS measurements, error test or register test

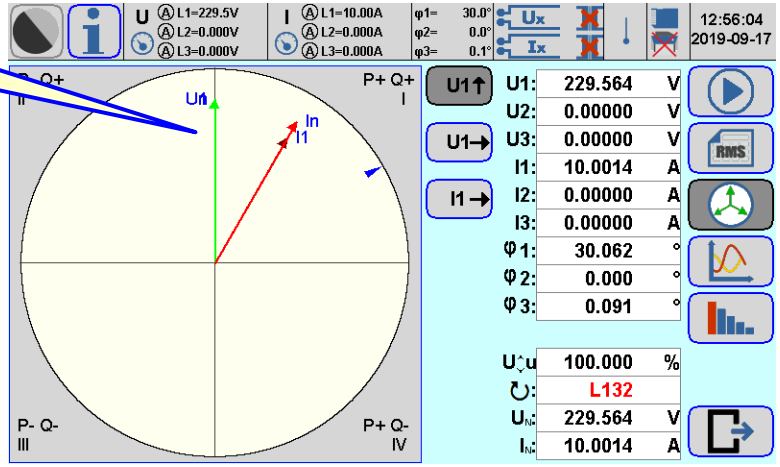


TS33 : testing single phase electromechanical Energy Meter example (3)

TS33 as Reference Meter and meter under test directly connected



Vector diagram



Testing schedule:

- connect meter
- check voltage current, PF and vector diagram
- enter meter parameters and start error measurement

Load point parameters

Meter constant

Class of Meter under test

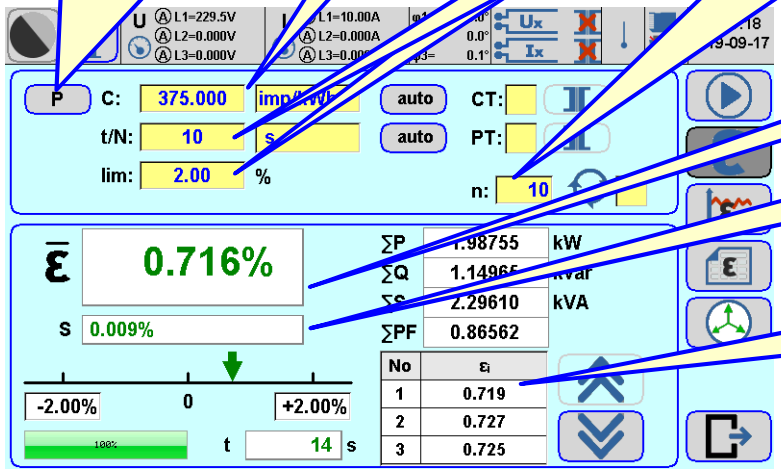
TS33 enables fast end efficient way of testing

Type of power measured by meter

Time of test

Number of results for averaging

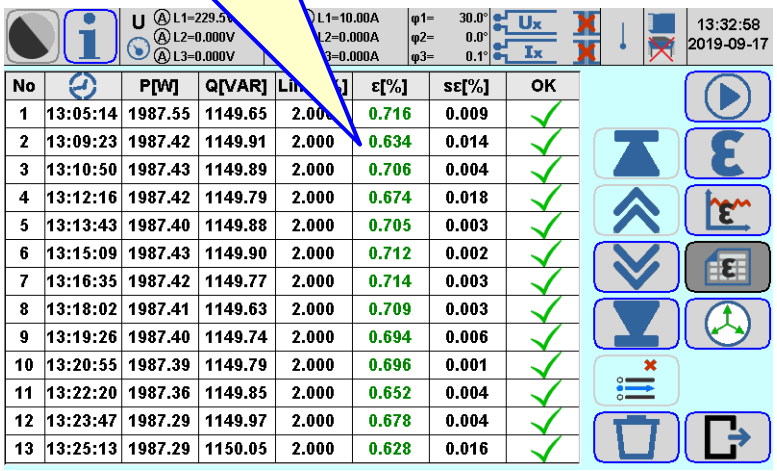
Table with recorded results versus time



Averaged error result

Standard deviation

Partial error results

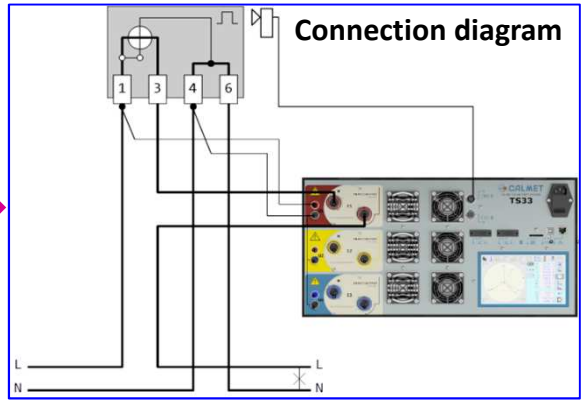


TS33 : testing single phase electronic (static) Energy Meter example (1)

TS33 as Reference Meter and meter under test directly connected

Meter parameters:
Base voltage: 230V
Base current: 5A
Max. current: 60A
Meter constant: 6400 imp/kWh

Typical single phase electronic meter with LED and its parameters



Wiring to meter terminals

Disconnect phase wire connected to load and connect „Cu” pin

Connect safety plug and crocodile clip to phase and load current accordingly

Connect voltage by safety magnetic plugs

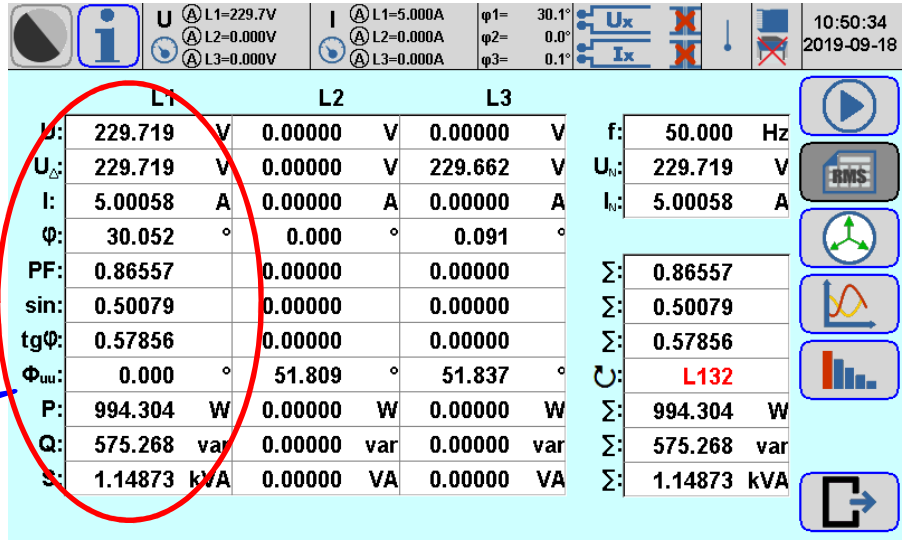
Connect voltage and current to TS33 inputs

TS33 : testing single phase electronic (static) Energy Meter example (2)

TS33 as Reference Meter and meter under test directly connected

Assembly scanning head fix to see LED in hole

„Click" scanning head and set LED sensing option



Meter constant

Time of test

Class of Meter under test

Averaged error result

START test button

Load point parameters

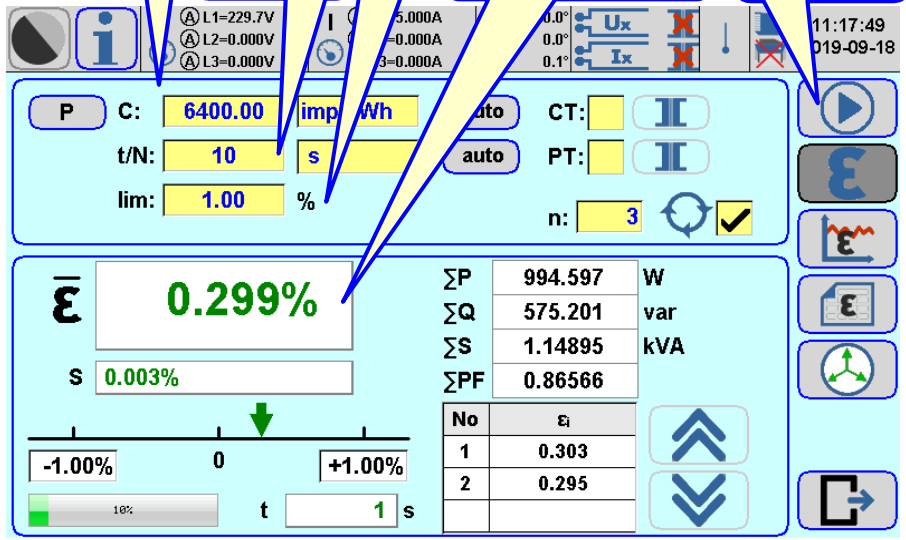
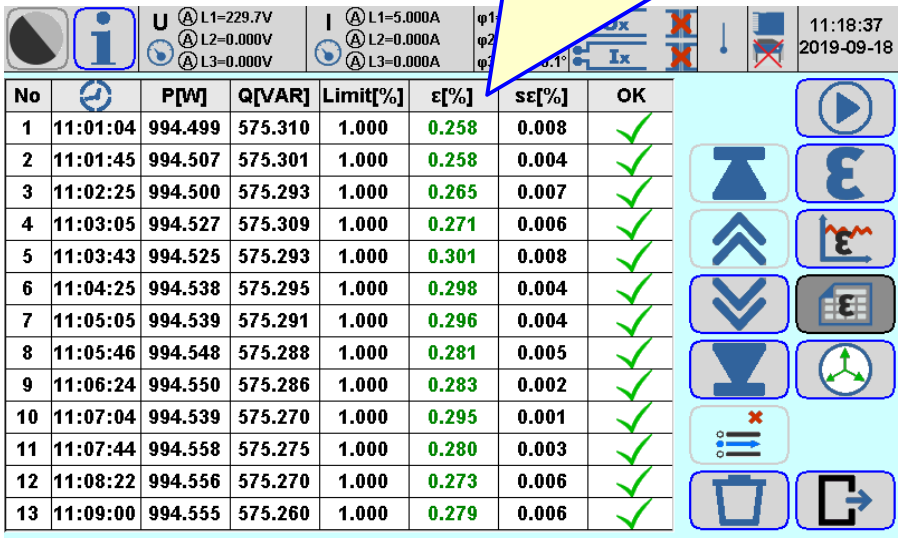


Table with recorded results versus time



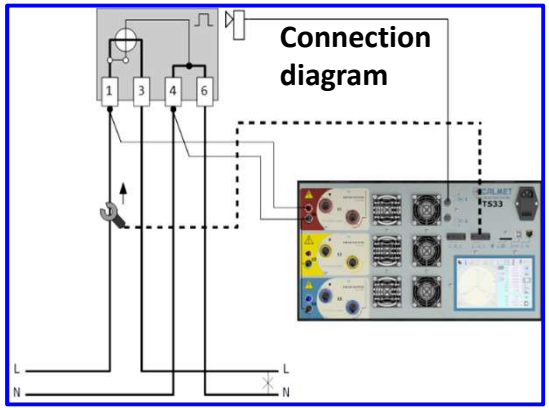
No		P[W]	Q[VAR]	Limit[%]	ε[%]	sε[%]	OK
1	11:01:04	994.499	575.310	1.000	0.258	0.008	✓
2	11:01:45	994.507	575.301	1.000	0.258	0.004	✓
3	11:02:25	994.500	575.293	1.000	0.265	0.007	✓
4	11:03:05	994.527	575.309	1.000	0.271	0.006	✓
5	11:03:43	994.525	575.293	1.000	0.301	0.008	✓
6	11:04:25	994.538	575.295	1.000	0.298	0.004	✓
7	11:05:05	994.539	575.291	1.000	0.296	0.004	✓
8	11:05:46	994.548	575.288	1.000	0.281	0.005	✓
9	11:06:24	994.550	575.286	1.000	0.283	0.002	✓
10	11:07:04	994.539	575.270	1.000	0.295	0.001	✓
11	11:07:44	994.558	575.275	1.000	0.280	0.003	✓
12	11:08:22	994.556	575.270	1.000	0.273	0.006	✓
13	11:09:00	994.555	575.260	1.000	0.279	0.006	✓

TS33 : testing single phase electronic (static) Energy Meter example (1)

TS33 as Reference Meter and meter under test connected by current clamps CT100AC

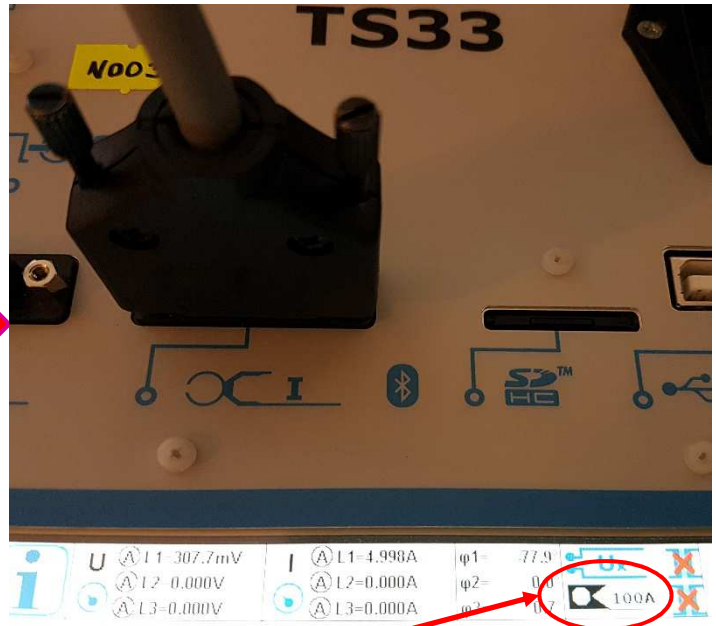
Meter parameters:
Base voltage: 230V
Base current: 5A
Max. current: 60A
Meter constant: 6400 imp/kWh

Typical single phase electronic meter with LED and its parameters



Wiring to meter terminals

Current clamp closed on phase to load cable. Note direction ⇨!

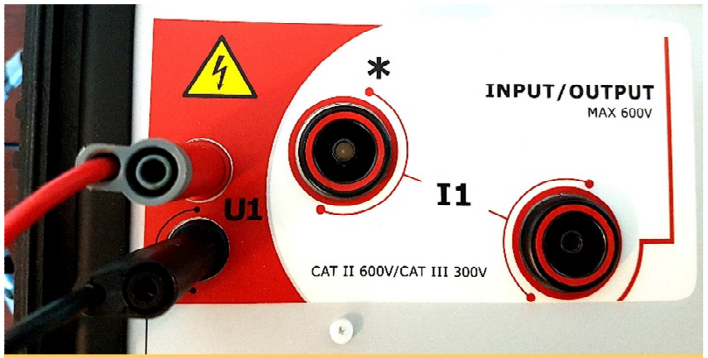


Connect current clamps plug into the socket on TS33. Clamp symbol appears on display.

Connect voltage magnetic plugs and assembly the scanning head

TS33 : testing single phase electronic (static) Energy Meter example (2)

TS33 as Reference Meter and meter under test connected by current clamps CT100AC



Connect voltage cables to TS33

Current clamps connected

Load point parameters

START test button

Meter constant

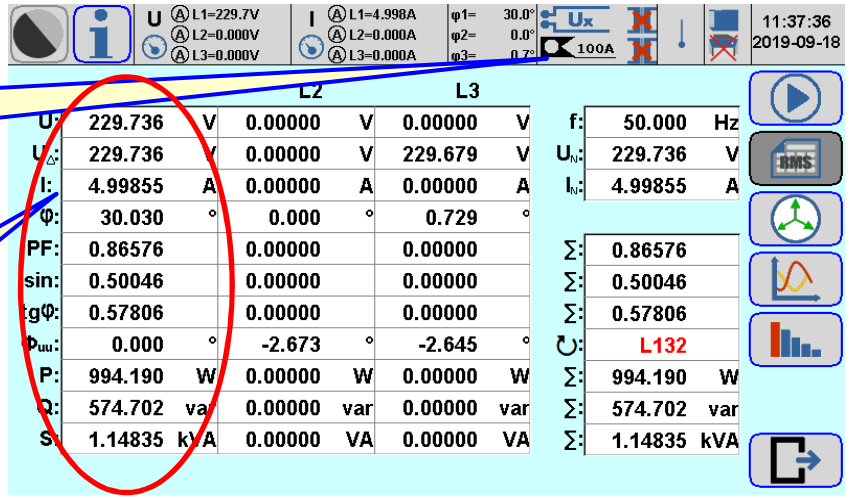
Class of Meter under test

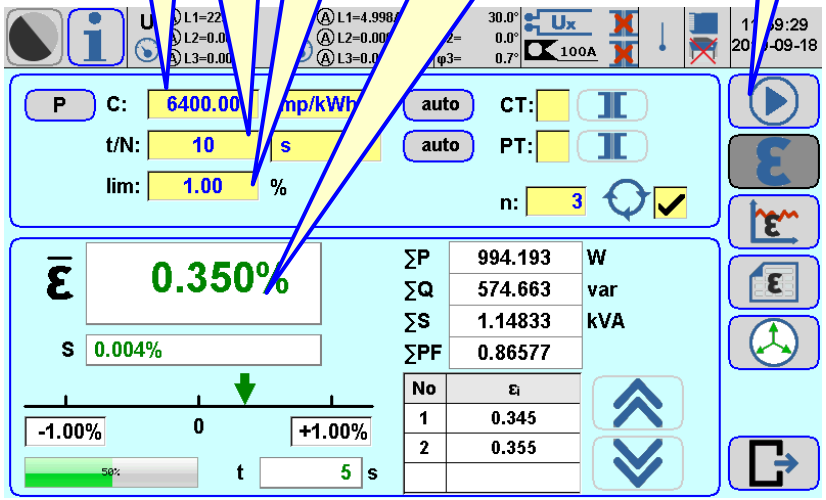
Time of test

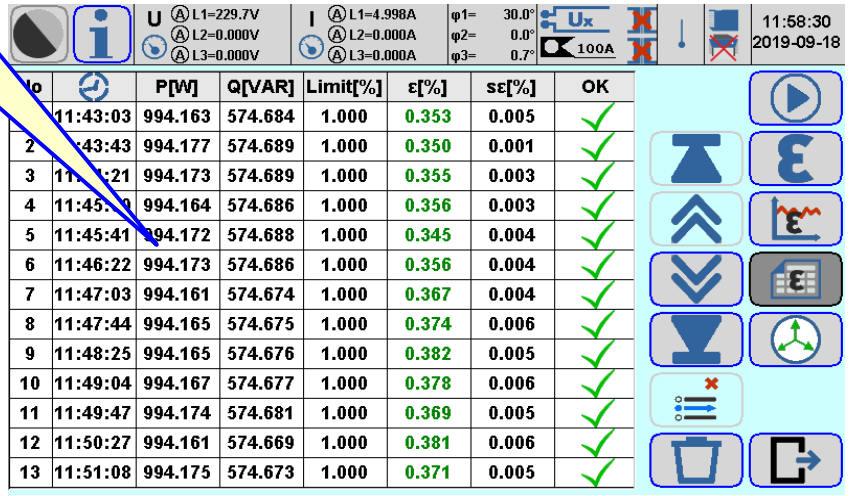
Averaged error result

Table with recorded results versus time

Current clamps do not require any break or modification of metering installation





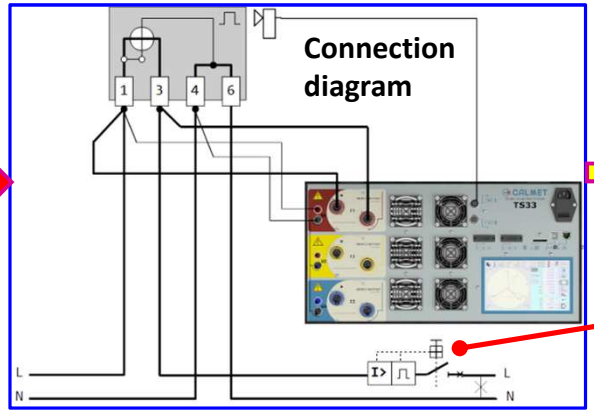


TS33 : testing single phase electronic (static) Energy Meter example (1)

TS33 as Current Source and Reference Meter and meter under test connected directly

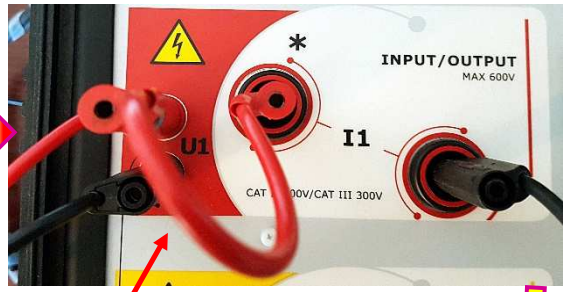
Meter parameters:
Base voltage: 230V
Base current: 5A
Max. current: 60A
Meter constant: 6400 imp/kWh

Typical single phase electronic meter with LED and its parameters



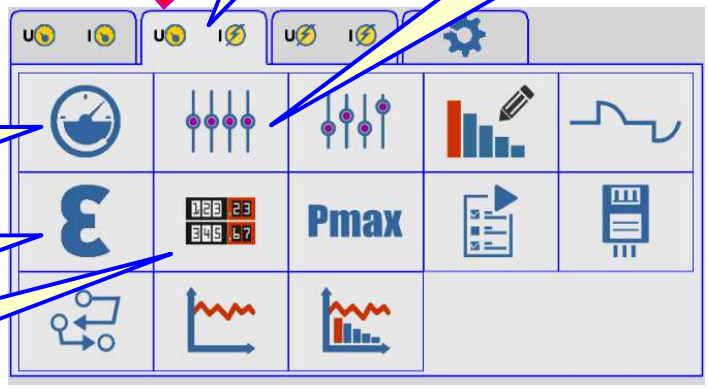
CAUTION!!!
Switch OFF the circuit breaker before TS33 connection
(voltage is taken from network, current is injected by TS33)

- **connect current input and output of the meter (eg. magnetic plugs) by means of safety cables to TS33 current inputs;**
- **connect neutral meter terminal to the neutral voltage input of TS33;**
- **Shunt TS33 voltage input and current output (*).**



In the TS33 LCD select U measurement and I generation mode

Setting value of current and phase sift



RMS measured values

Meter error test

Meter register test

TS33 : testing single phase electronic (static) Energy Meter example (2)

TS33 as Current Source and Reference Meter and meter under test connected directly

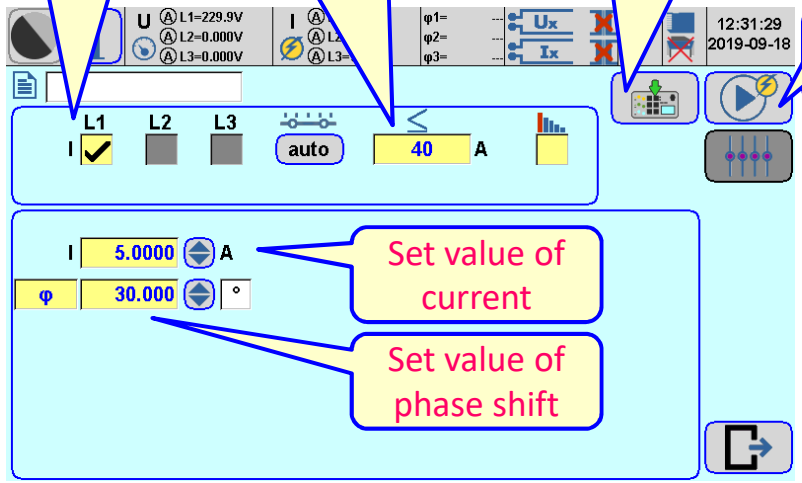
Single phase operation

Limit of maximum current

Send to the output

RMS values at the output

This mode doesn't require any meter disconnection!



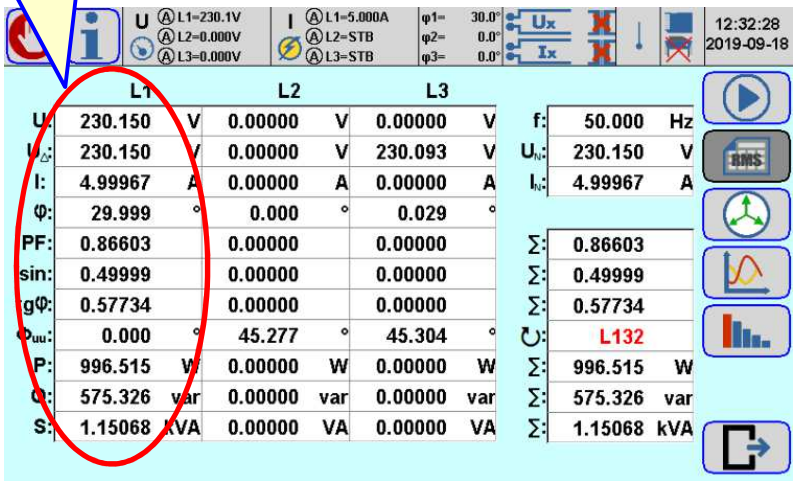
Generate signal

Set value of current

Set value of phase shift

Testing schedule:

- **connect meter**
- **set current and phase shift**
- **enter meter parameters and start error measurement**

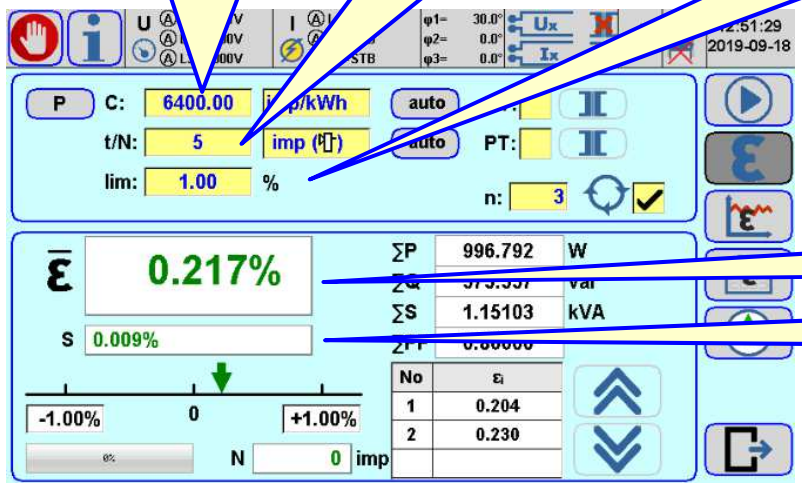


Meter constant

Number of pulses

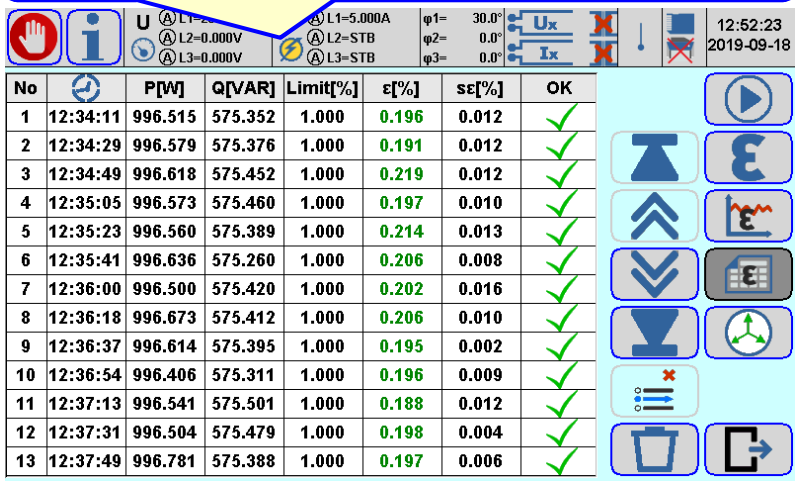
Class of Meter under test

Table with recorded results versus time



Averaged error result

Standard deviation



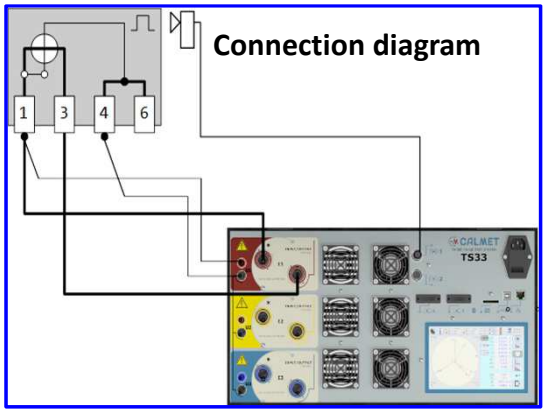
No		P[W]	Q[VAR]	Limit[%]	ε[%]	sε[%]	OK
1	12:34:11	996.515	575.352	1.000	0.196	0.012	✓
2	12:34:29	996.579	575.376	1.000	0.191	0.012	✓
3	12:34:49	996.618	575.452	1.000	0.219	0.012	✓
4	12:35:05	996.573	575.460	1.000	0.197	0.010	✓
5	12:35:23	996.560	575.389	1.000	0.214	0.013	✓
6	12:35:41	996.636	575.260	1.000	0.206	0.008	✓
7	12:36:00	996.500	575.420	1.000	0.202	0.016	✓
8	12:36:18	996.673	575.412	1.000	0.206	0.010	✓
9	12:36:37	996.614	575.395	1.000	0.195	0.002	✓
10	12:36:54	996.406	575.311	1.000	0.196	0.009	✓
11	12:37:13	996.541	575.501	1.000	0.188	0.012	✓
12	12:37:31	996.504	575.479	1.000	0.198	0.004	✓
13	12:37:49	996.781	575.388	1.000	0.197	0.006	✓

TS33 : testing single phase electronic (static) Energy Meter example (1)

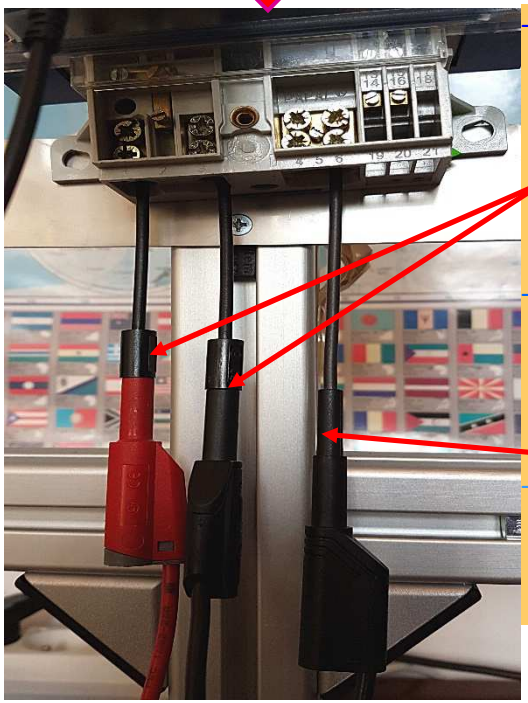
TS33 as Voltage and Current Source and Reference Meter and meter under test connected directly

Meter parameters:
Base voltage: 230V
Base current: 5A
Max. current: 60A
Meter constant: 6400 imp/kWh

Typical single phase electronic meter with LED and its parameters



CAUTION!!! Unconnect meter from network before connection to TS33
(voltage and current is delivered by TS33)

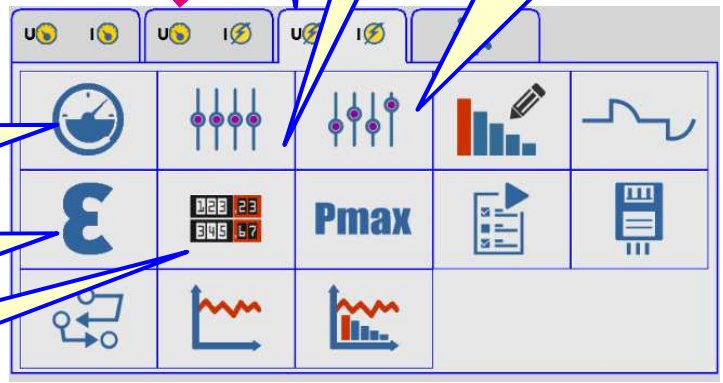


- **connect current input and output of the meter (eg. By „Cu" pins) by means of safety cables to TS33 current inputs;**
- **connect neutral meter terminal to the neutral voltage input of TS33;**
- **Shunt TS33 voltage input and current output (*).**

In the TS33 LCD select U and I generation mode

Setting value of voltage, current and phase sift

Setting value of U, I, φ, f in asymmetrical circuit



RMS measured values

Meter error test

Meter register test

TS33 : testing single phase electronic (static) Energy Meter example (2)

TS33 as Voltage and Current Source and Reference Meter and meter under test connected directly

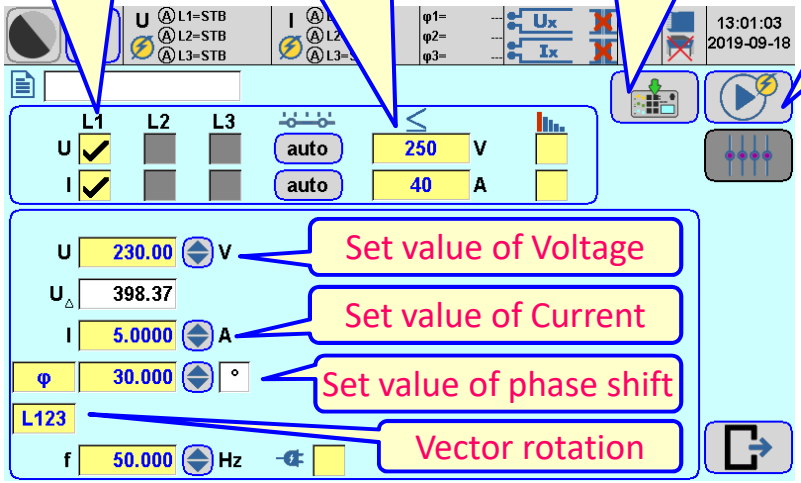
Single phase operation

Limit of maximum current

Send to the output

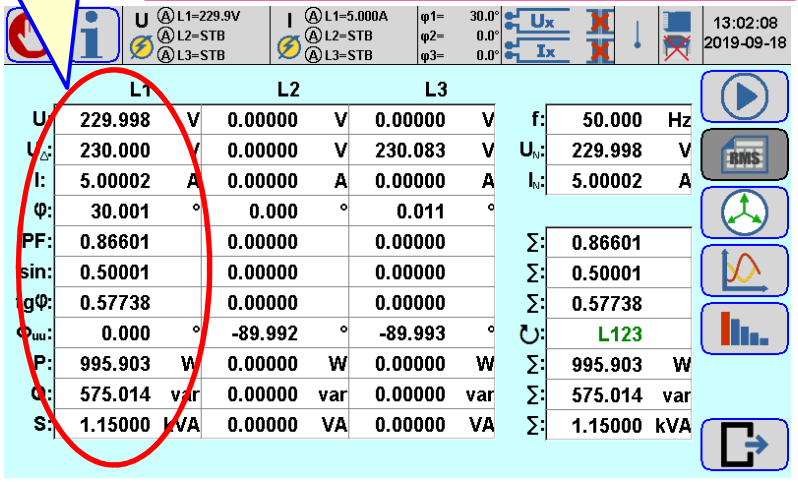
RMS values at the output

This mode doesn't require any meter disconnection!



Testing schedule:

- connect meter
- set current and phase shift
- enter meter parameters and start error measurement

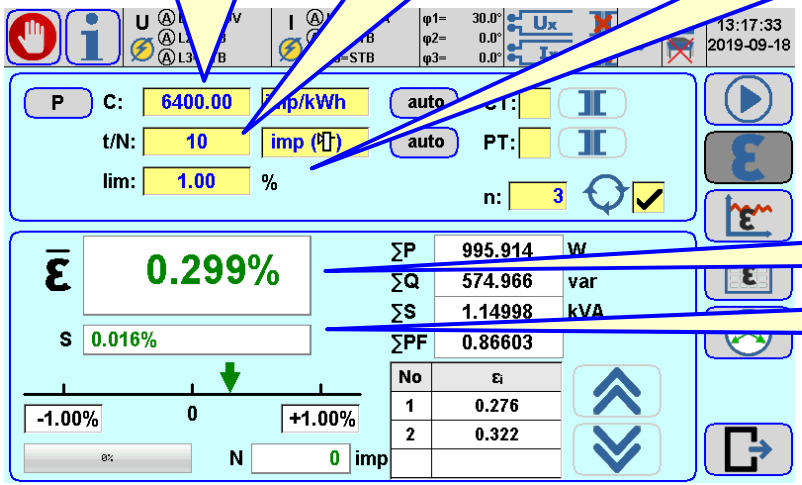


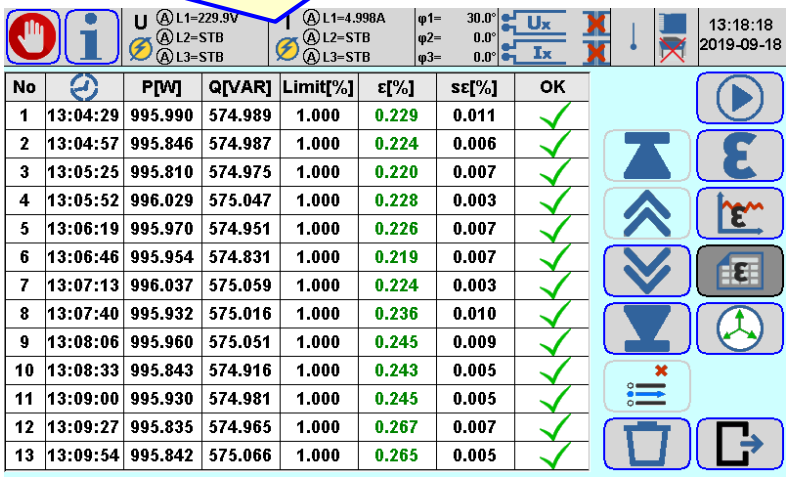
Meter constant

Number of pulses

Class of Meter under test

Table with recorded results versus time





No		P[W]	Q[VAR]	Limit[%]	ε[%]	sε[%]	OK
1	13:04:29	995.990	574.989	1.000	0.229	0.011	✓
2	13:04:57	995.846	574.987	1.000	0.224	0.006	✓
3	13:05:25	995.810	574.975	1.000	0.220	0.007	✓
4	13:05:52	996.029	575.047	1.000	0.228	0.003	✓
5	13:06:19	995.970	574.951	1.000	0.226	0.007	✓
6	13:06:46	995.954	574.831	1.000	0.219	0.007	✓
7	13:07:13	996.037	575.059	1.000	0.224	0.003	✓
8	13:07:40	995.932	575.016	1.000	0.236	0.010	✓
9	13:08:06	995.960	575.051	1.000	0.245	0.009	✓
10	13:08:33	995.843	574.916	1.000	0.243	0.005	✓
11	13:09:00	995.930	574.981	1.000	0.245	0.005	✓
12	13:09:27	995.835	574.965	1.000	0.267	0.007	✓
13	13:09:54	995.842	575.066	1.000	0.265	0.005	✓

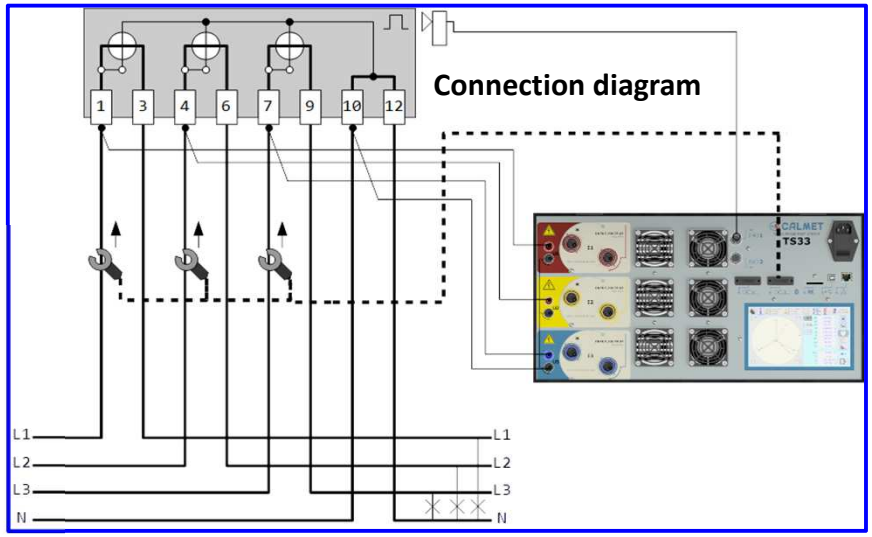
TS33 : testing three phase electronic (static) Energy Meter example (1)

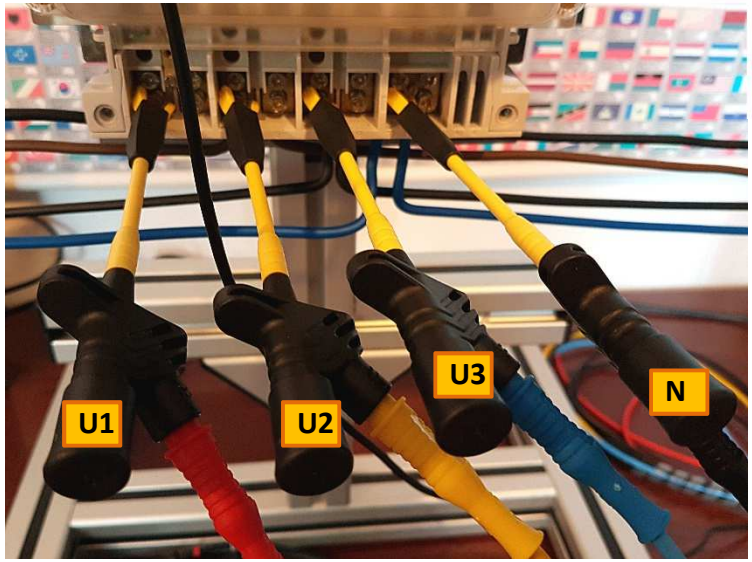
TS33 as Reference Meter and meter under test connected by means of current clamps

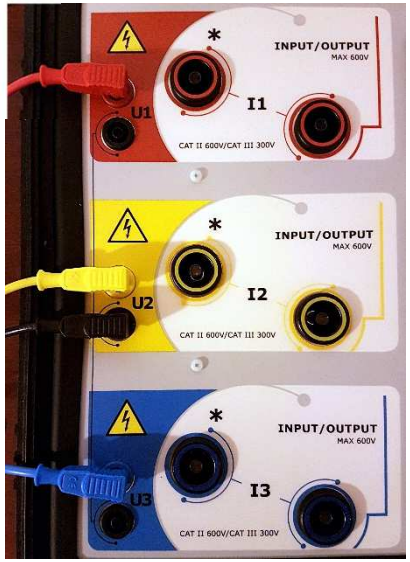
Meter parameters:
Base voltage: 230V
Base current: 5A
Max. current: 100A
Meter constant: 1000 imp/kWh

Typical three phase electronic meter with LED and its parameters

Connect voltage U1, U2, U3 and neutral N by means of crocodile clips



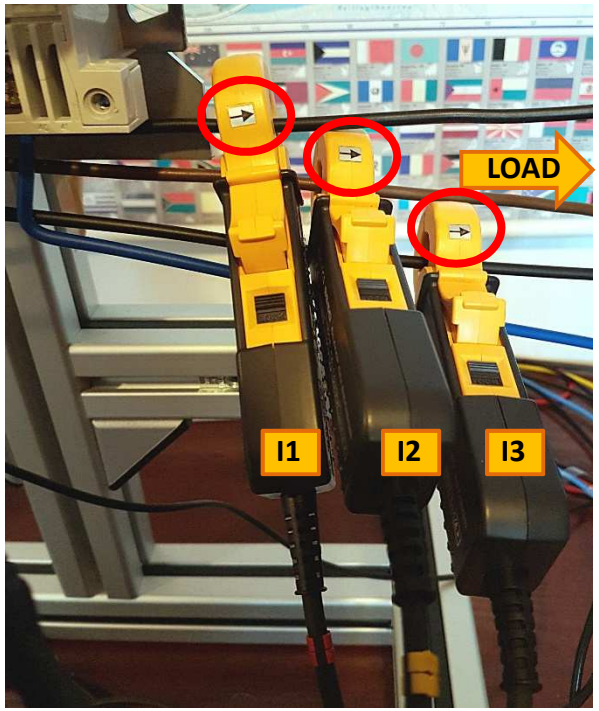




Connect voltage U1, U2, U2 and neutral N to voltage inputs of TS33.
Neutral inputs in the TS33 are internally connected between them.

TS33 : testing three phase electronic (static) Energy Meter example (2)

TS33 as Reference Meter and meter under test connected by means of current clamps

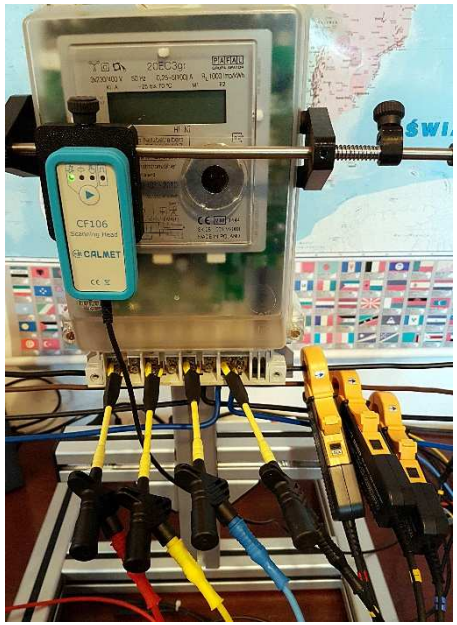


Close current clamps on load cables, respectively I1, I2, I3. Take care about clamps direction (⇨)

Open clamp jaws and place them on wire. Direction (⇨)!

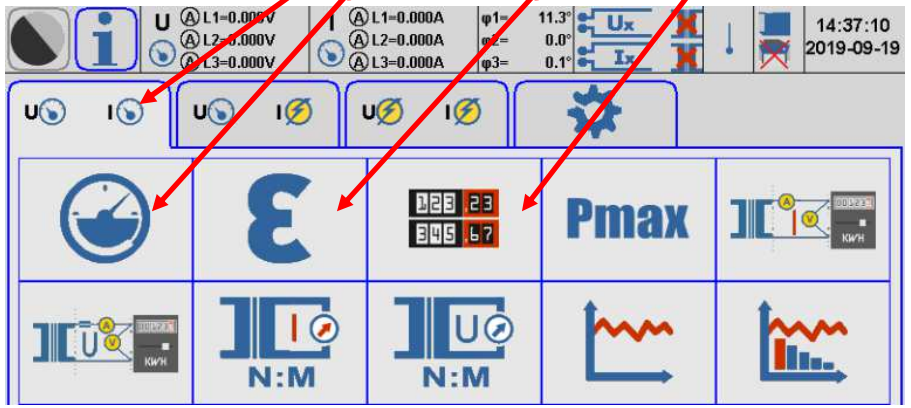
Close clamp jaws and lock them. Direction (⇨)!

Assembly to the meter and connect to the TS33 photo scanning head



Connect common current clamps output to the TS33 input

In the TS33 LCD select U&I measurement mode and then RMS measurements, error test or register test



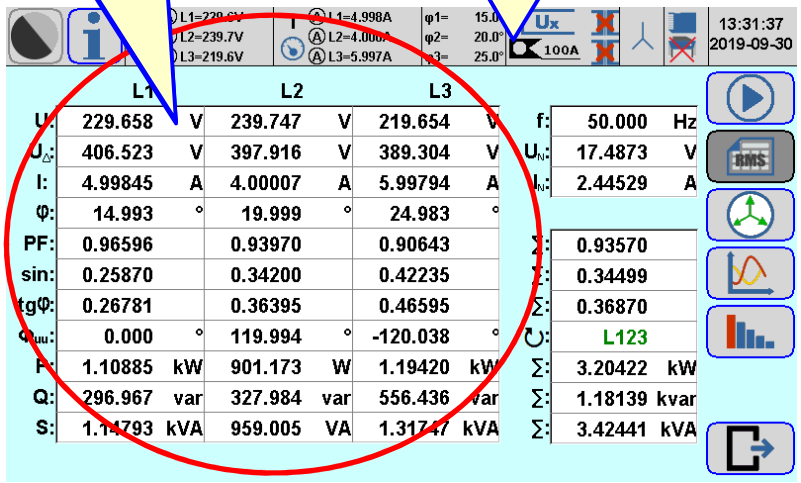
TS33 : testing three phase electronic (static) Energy Meter example (3)

TS33 as Reference Meter and meter under test connected by means of current clamps

Load point parameters

CT100AC current clamp

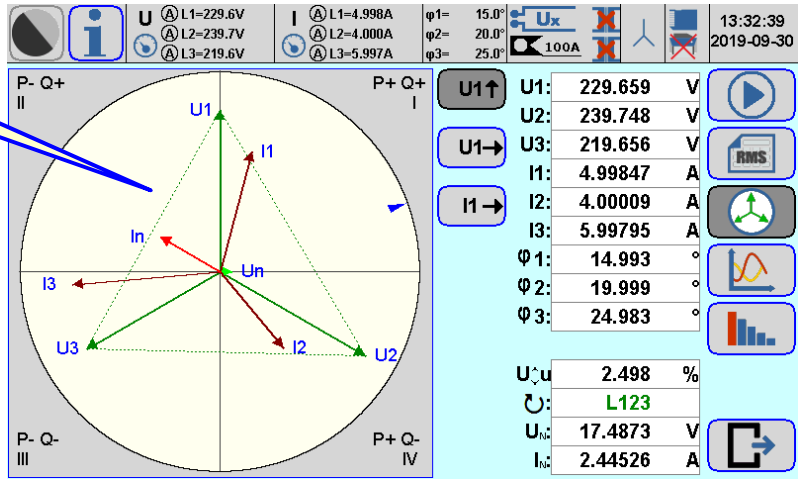
This mode doesn't require any meter disconnection!



Vector diagram

Testing schedule:

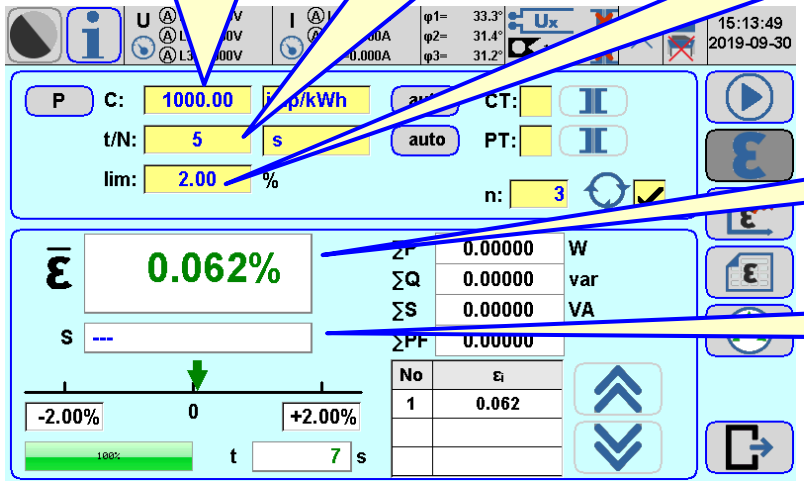
- connect voltage and current by clamps
- enter meter parameters and start error measurement



Meter constant

Time of test

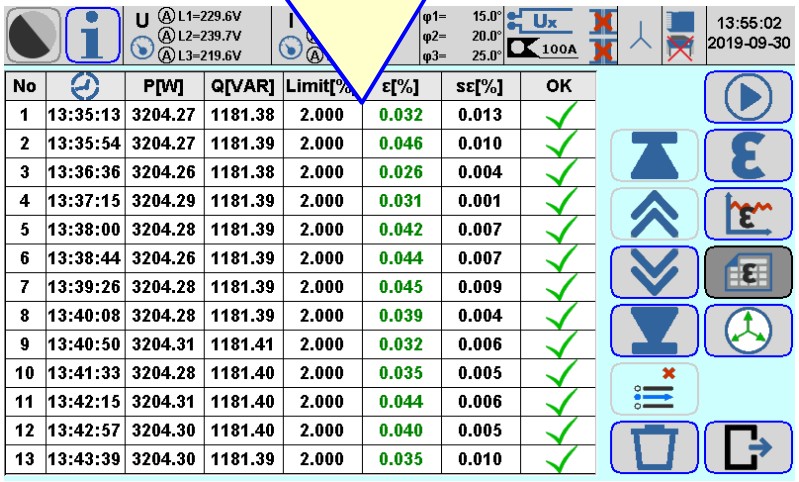
Class of Meter under test



Averaged error result

Standard deviation

Table with recorded results versus time



No		P[W]	Q[VAR]	Limit[%	ε[%]	sε[%]	OK
1	13:35:13	3204.27	1181.38	2.000	0.032	0.013	✓
2	13:35:54	3204.27	1181.39	2.000	0.046	0.010	✓
3	13:36:36	3204.26	1181.38	2.000	0.026	0.004	✓
4	13:37:15	3204.29	1181.39	2.000	0.031	0.001	✓
5	13:38:00	3204.28	1181.39	2.000	0.042	0.007	✓
6	13:38:44	3204.26	1181.39	2.000	0.044	0.007	✓
7	13:39:26	3204.28	1181.39	2.000	0.045	0.009	✓
8	13:40:08	3204.28	1181.39	2.000	0.039	0.004	✓
9	13:40:50	3204.31	1181.41	2.000	0.032	0.006	✓
10	13:41:33	3204.28	1181.40	2.000	0.035	0.005	✓
11	13:42:15	3204.31	1181.40	2.000	0.044	0.006	✓
12	13:42:57	3204.30	1181.40	2.000	0.040	0.005	✓
13	13:43:39	3204.30	1181.39	2.000	0.035	0.010	✓

TS33 : testing three phase electronic (static) Energy Meter example (1)

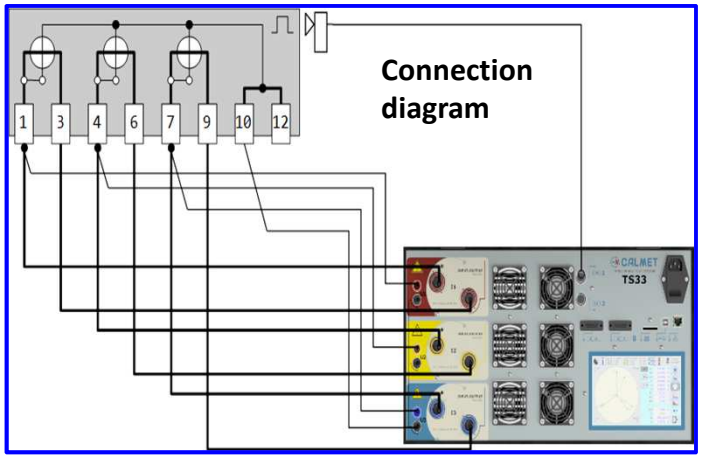
TS33 as Voltage and Current Source and Reference Meter and meter under test connected directly

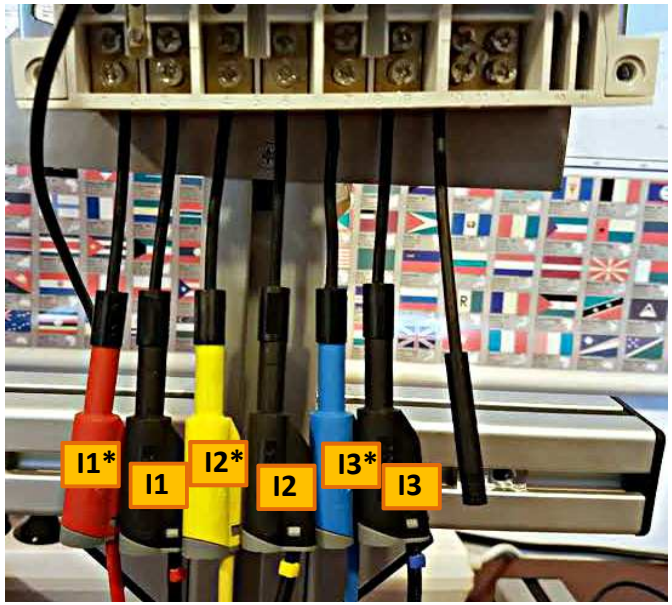
Meter parameters:
Base voltage: 230V
Base current: 5A
Max. current: 100A
Meter constant: 1000 imp/kWh

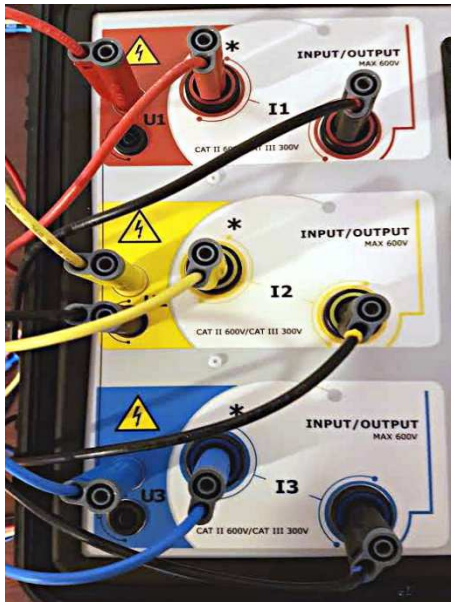
Typical three phase electronic meter with LED and its parameters

CAUTION!!!
Unconnect meter from network before connection to TS33
(voltage and current is delivered by TS33)

Connect current I1, I2, I3, N by means of „Cu" pins and then voltage U1, U2, U3 by stacked, safety plugs to I1*, I2*, I3* respectively and then to TE33 inputs U and I.





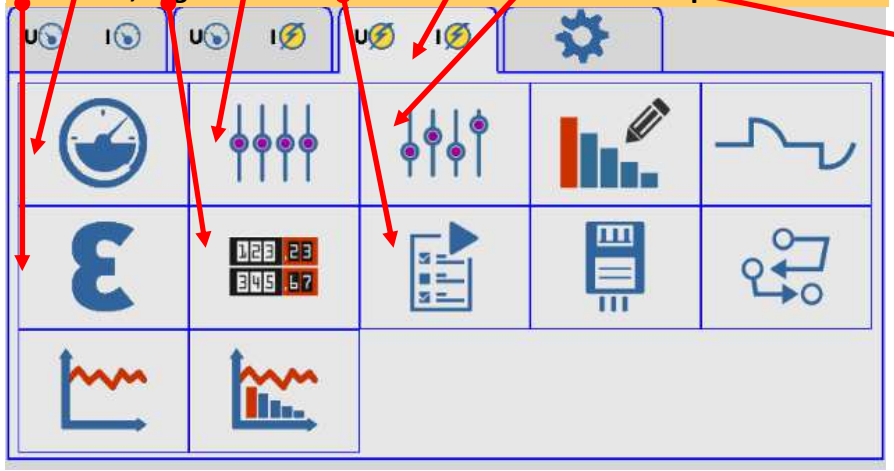


TS33 : testing three phase electronic (static) Energy Meter example (2)

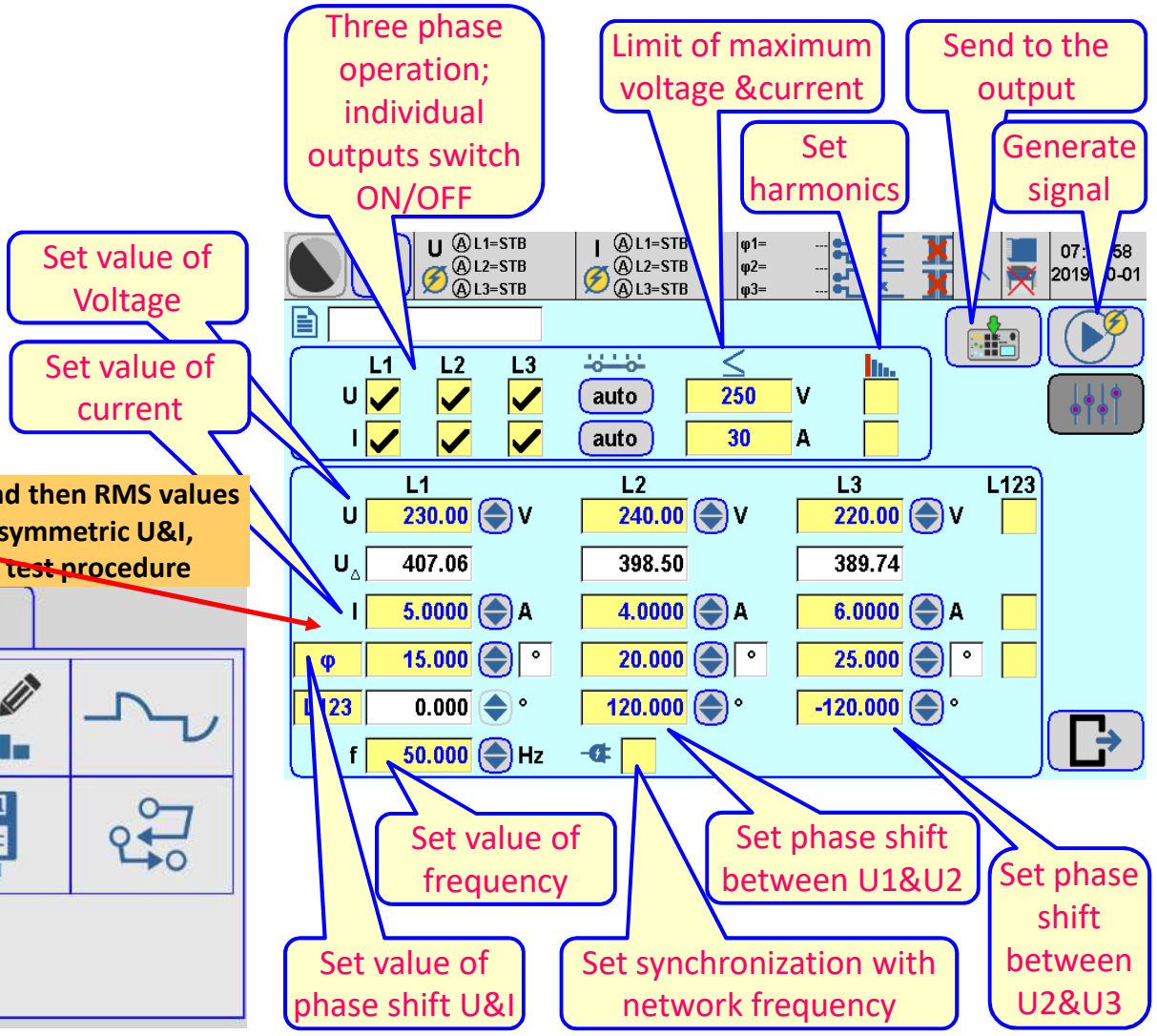
TS33 as Voltage and Current Source and Reference Meter and meter under test connected directly

Connected meter ready for testing

In the TS33 LCD select U&I generation mode and then RMS values at the output, setting symmetric U&I, setting asymmetric U&I, error test, register test or whole characteristics test procedure



Setting the output values (load point)

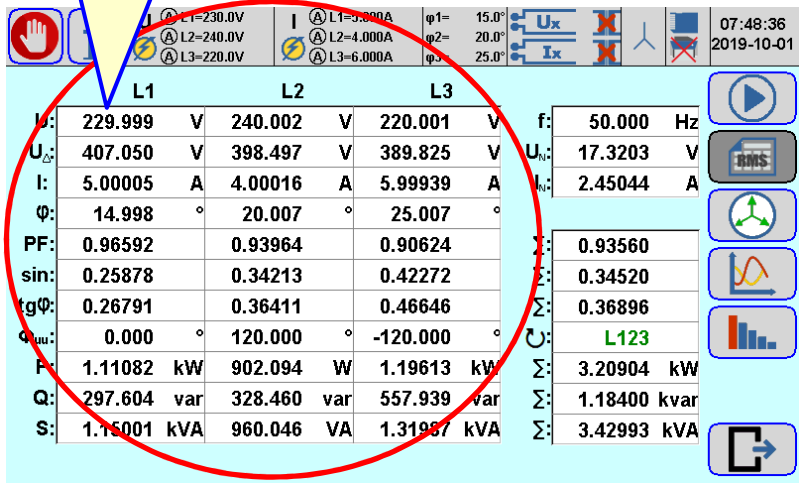


TS33 : testing three phase electronic (static) Energy Meter example (3)

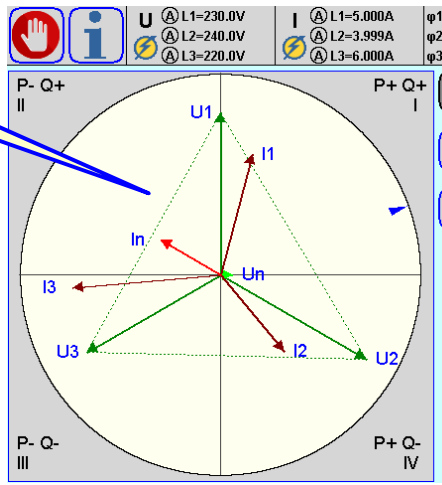
TS33 as Voltage and Current Source and Reference Meter and meter under test connected directly

Load point parameters

This mode requires meter disconnection!



Vector diagram



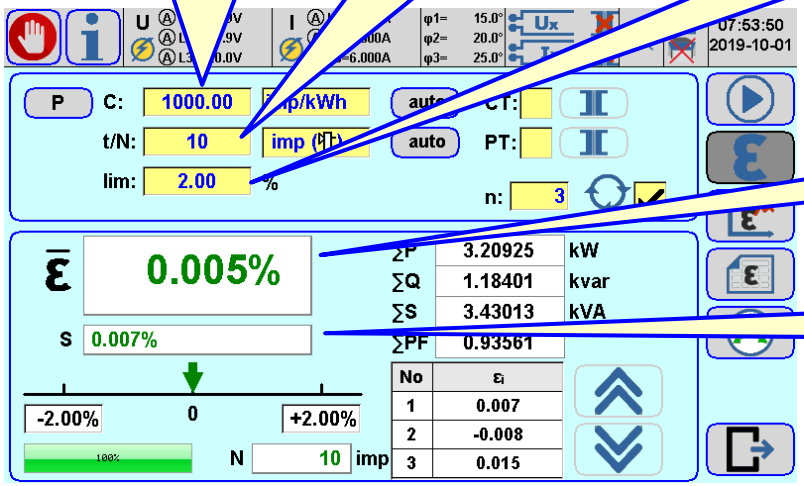
Testing schedule:

- connect voltage and current by clamps
- enter meter parameters and start error measurement

Meter constant

Time of test

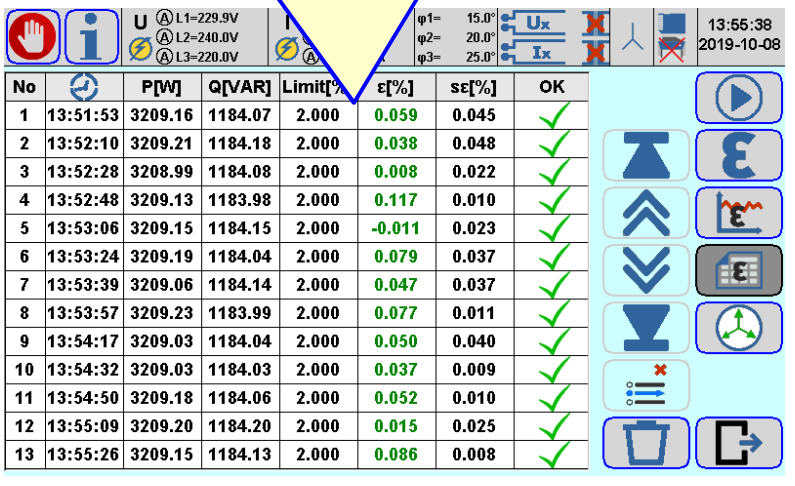
Class of Meter under test



Averaged error result

Standard deviation

Table with recorded results versus time



No		P[W]	Q[VAR]	Limit[%	ε[%]	sε[%]	OK
1	13:51:53	3209.16	1184.07	2.000	0.059	0.045	✓
2	13:52:10	3209.21	1184.18	2.000	0.038	0.048	✓
3	13:52:28	3208.99	1184.08	2.000	0.008	0.022	✓
4	13:52:48	3209.13	1183.98	2.000	0.117	0.010	✓
5	13:53:06	3209.15	1184.15	2.000	-0.011	0.023	✓
6	13:53:24	3209.19	1184.04	2.000	0.079	0.037	✓
7	13:53:39	3209.06	1184.14	2.000	0.047	0.037	✓
8	13:53:57	3209.23	1183.99	2.000	0.077	0.011	✓
9	13:54:17	3209.03	1184.04	2.000	0.050	0.040	✓
10	13:54:32	3209.03	1184.03	2.000	0.037	0.009	✓
11	13:54:50	3209.18	1184.06	2.000	0.052	0.010	✓
12	13:55:09	3209.20	1184.20	2.000	0.015	0.025	✓
13	13:55:26	3209.15	1184.13	2.000	0.086	0.008	✓

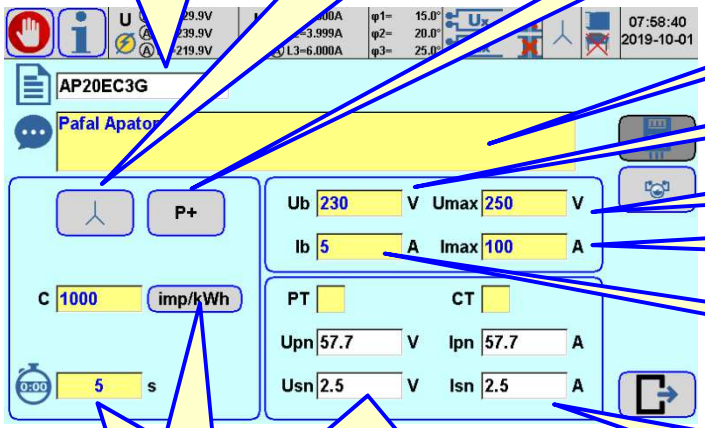
TS33 : testing three phase electronic (static) Energy Meter example (4)

TS33 as Voltage and Current Source and Reference Meter and meter under test connected directly

Automatic Procedure for whole load characteristics

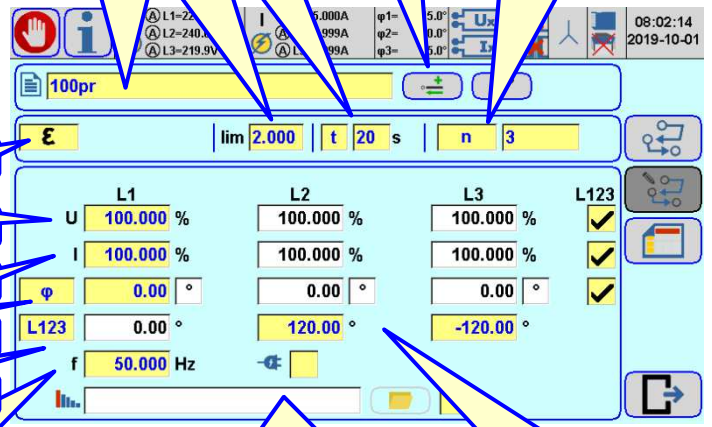
Meter Type Definition

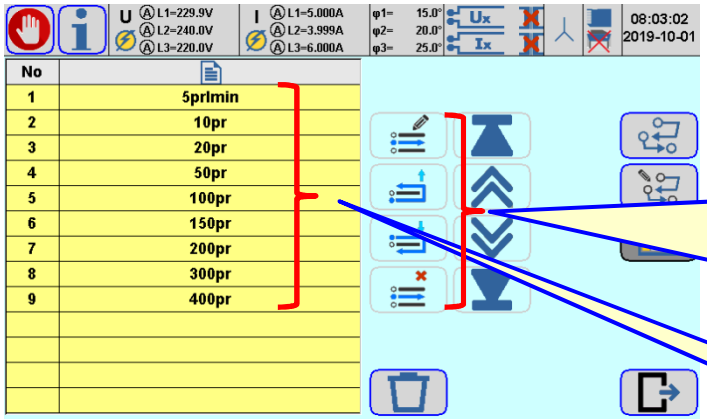
Meter name
Connection type
Power type
Comment
Base voltage
Max. voltage
Max. current
Base current
Delay time
Meter constant
PT primary & secondary voltage
CT primary & secondary current



Test Point and Procedure Definition

Add load point to list
Time of measurement
Load point name
Meter Class
Number of measurements per result
Meter error test
Voltage in [%]
Current in [%]
Phase shift U&I
Vector rotation
Frequency
Harmonics
Phase shift U&U

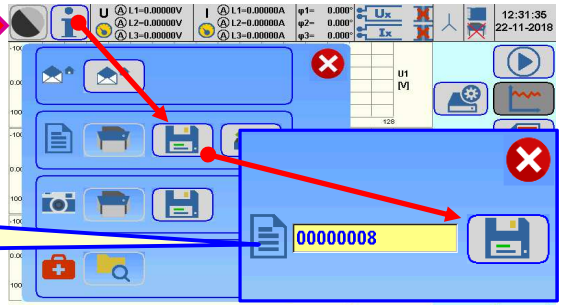




List edition insert, move up/down remove

List of load points

To save Meter Type and Procedure use i button and then button



Meter or Procedure name field

TS33 : testing three phase electronic (static) Energy Meter example (5)

TS33 as Voltage and Current Source and Reference Meter and meter under test connected directly

Automatic Procedure for whole load characteristics

Meter Test Execution

Meter type name

Test procedure name

Test starting

Load point name

Averaged error result

Standard deviation

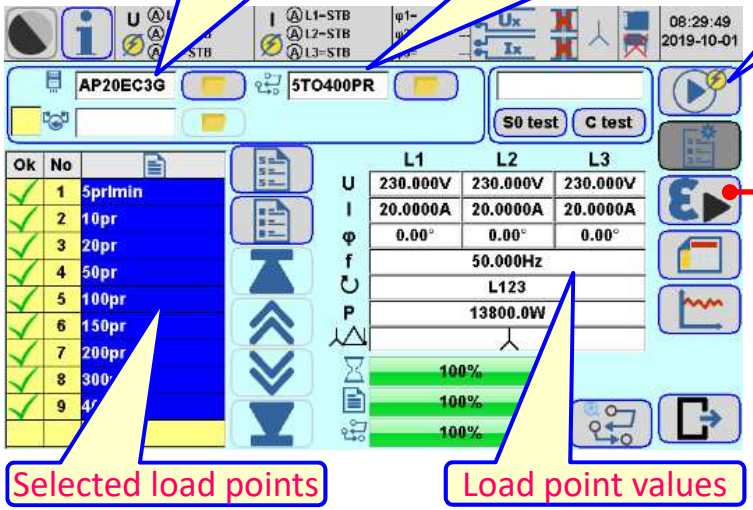
Error limit

Individual errors

Selected load points

Load point values

Individual load point test



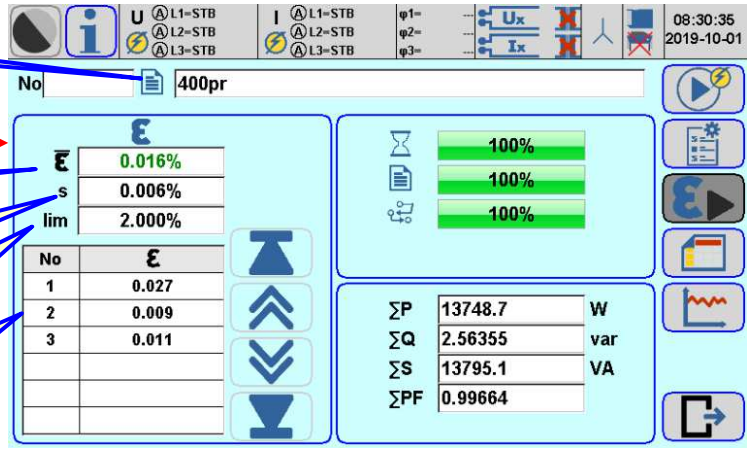
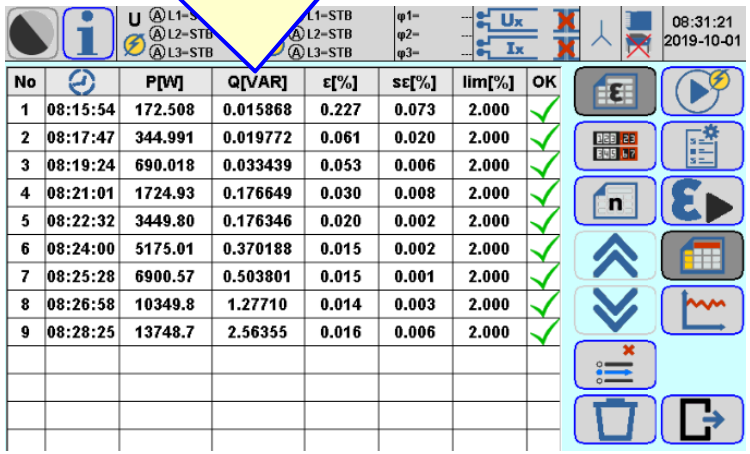
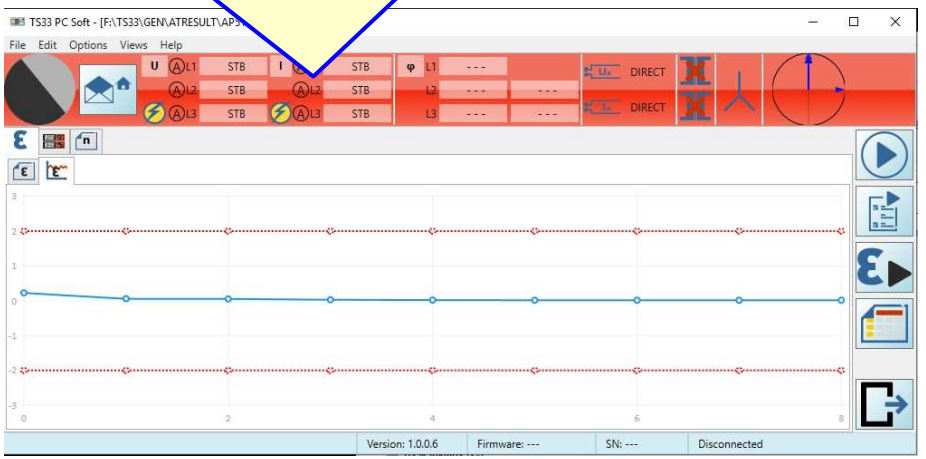


Table with results for each load point



No		P[W]	Q[VAR]	ε[%]	sε[%]	lim[%]	OK
1	08:15:54	172.508	0.015868	0.227	0.073	2.000	✓
2	08:17:47	344.991	0.019772	0.061	0.020	2.000	✓
3	08:19:24	690.018	0.033439	0.053	0.006	2.000	✓
4	08:21:01	1724.93	0.176649	0.030	0.008	2.000	✓
5	08:22:32	3449.80	0.176346	0.020	0.002	2.000	✓
6	08:24:00	5175.01	0.370188	0.015	0.002	2.000	✓
7	08:25:28	6900.57	0.503801	0.015	0.001	2.000	✓
8	08:26:58	10349.8	1.27710	0.014	0.003	2.000	✓
9	08:28:25	13748.7	2.56355	0.016	0.006	2.000	✓

Results transferred to the PC Soft as diagram

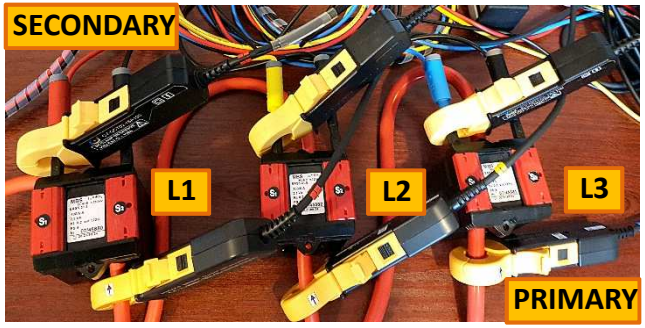


TS33 : testing current transformers CT ratio and phase shift error example (1)

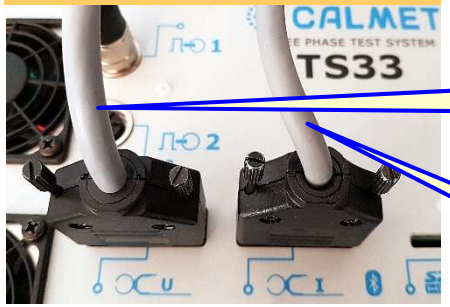
TS33 as Reference Meter and CT primary and secondary current measured by current clamps

CT parameters:
Ratio: 100/5A
Power:2.5VA
Class: 0.2

Typical current transformer CT in metering installation



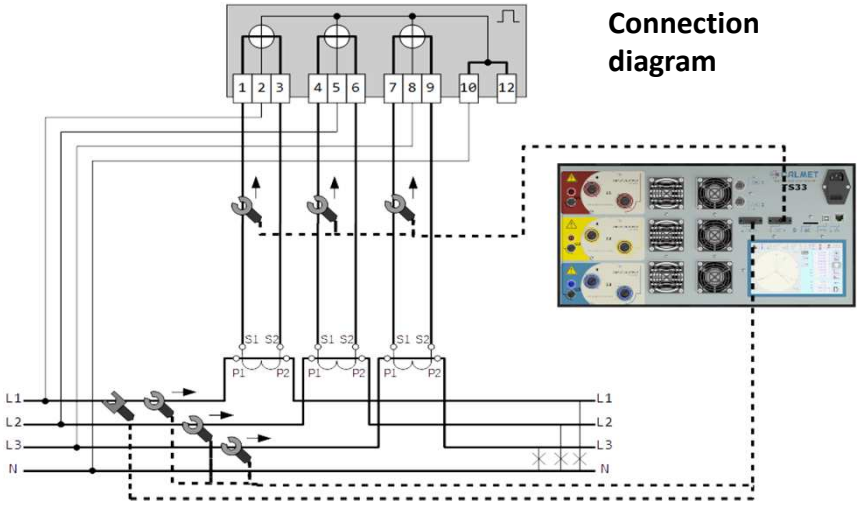
TS33 side clamps connetion



Primary clamps

Secondary clamps

Connection diagram



TS33 can test automatically up to 3 different CTs at time

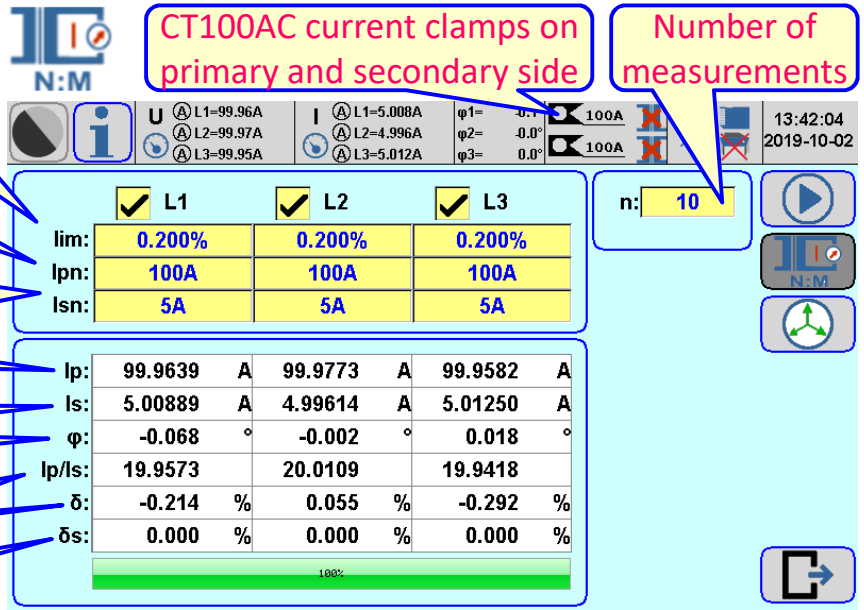
Accuracy class of current clamps

Nominal primary current

Nominal secondary current

CT100AC current clamps on primary and secondary side

Number of measurements



Primary current

Secondary current

Phase error

Actual ratio

Ratio error

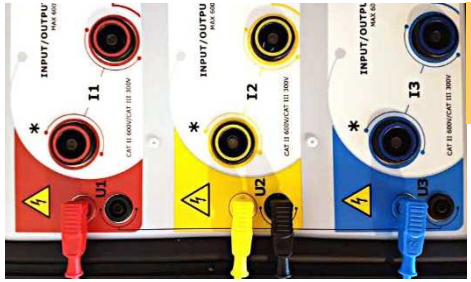
Standard deviation

TS33 : testing current transformers CT burden example (1)

TS33 as Reference Meter and CT secondary current measured by current clamps and voltage directly

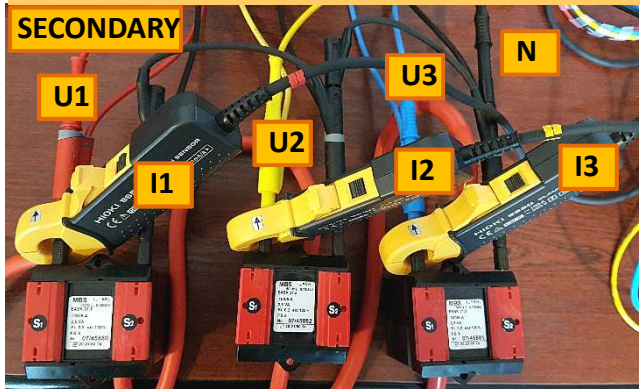
CT parameters:
Ratio: 100/5A
Power:2.5VA
Class: 0.2

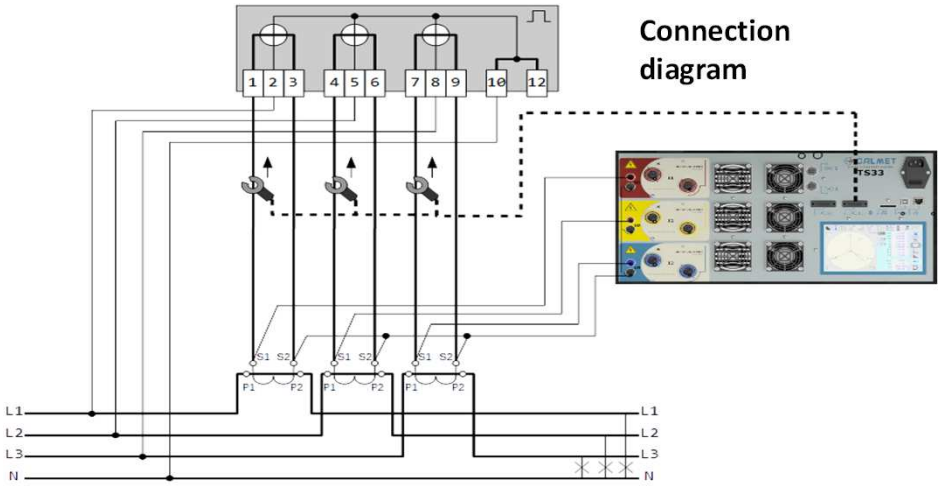
Typical current transformer CT in metering installation



TS33 side voltage connetion

Voltage and clamps connection to the CT





TS33 can test automatically up to 3 different CTs at time

Nominal secondary current

Nominal secondary power

Voltage at secondary CT side

Secondary current

Phase shift

Power factor

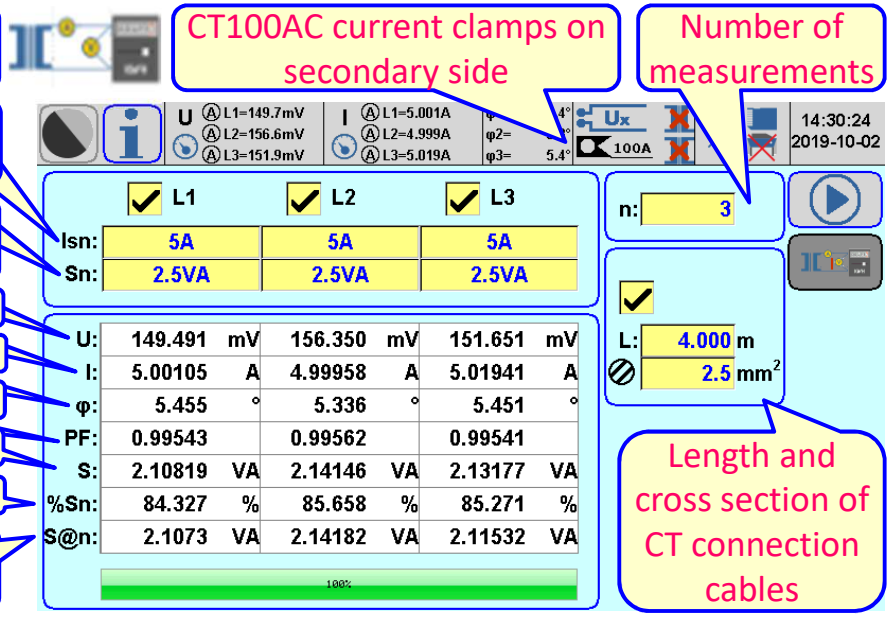
Apparent power

% of used power

S which would be at nominal current

CT100AC current clamps on secondary side

Number of measurements



Length and cross section of CT connection cables

TS33 : how to order – versions, options, accessories

TS33 versions: accuracy class 0.04% or accuracy class 0.1%

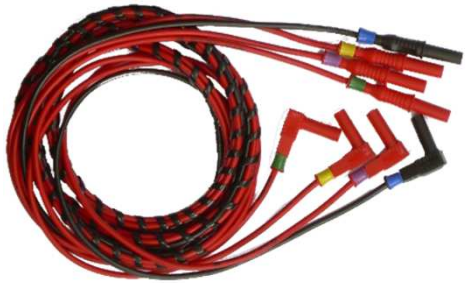
Standard scope of delivery

TS33 Automatic Test System

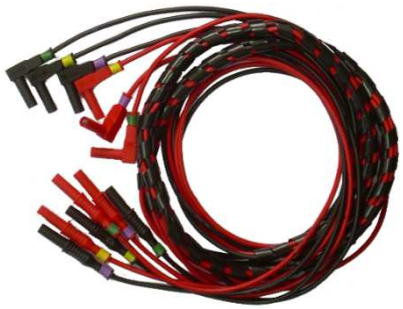
Power cord

Fuses

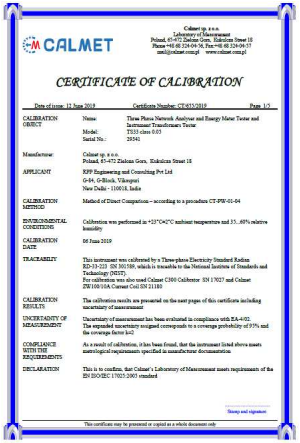
C091 Amphenol connector



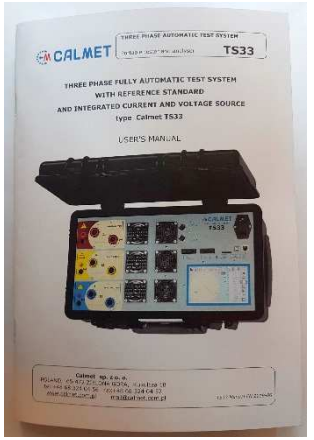
Voltage connection cables



Current connection cables



Manufacturer Calibration Certificate



Operation manual

TS33 : how to order – versions, options, accessories

TS33 optional accessories:

Optional scope of delivery 1

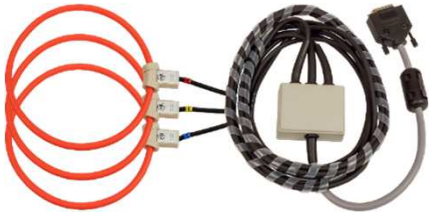
Laptop PC

TS33 PC Soft

CT10AC current clamps

CT100AC current clamps

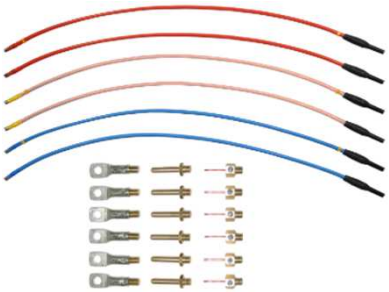
CT1000AC current clamps



FCT3000AC flexible clamps

AmpLiteWire 2000AC (@150kV)

VoltLiteWire 40kVC



AKD300 120A cable set

DR200 thermal printer

AKD100 accessories for safety cables

CF106H photo head for LED & mechanical meters

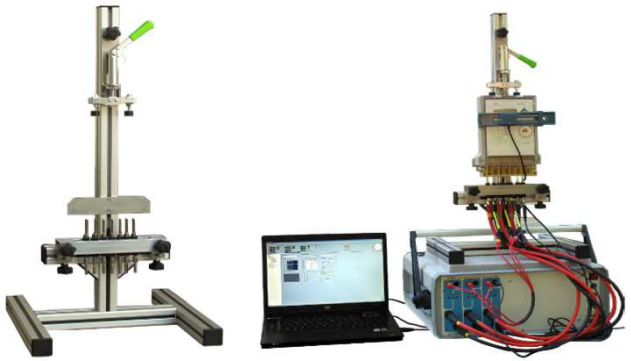
TS33 : how to order – versions, options, accessories

TS33 optional accessories:

Optional scope of delivery 2

ER10 single position rack for hanging meter

EH10.3 Quick Connector for meters



ER10H.3 single position rack with quick connector

ET32 case for additional accessories

DYREKTOR
OKRĘGOWEGO URZĘDU MIAR WE WROCŁAWIU

Regional Office of Measures in Wrocław
The Group of Certification Laboratories

CALIBRATION CERTIFICATE

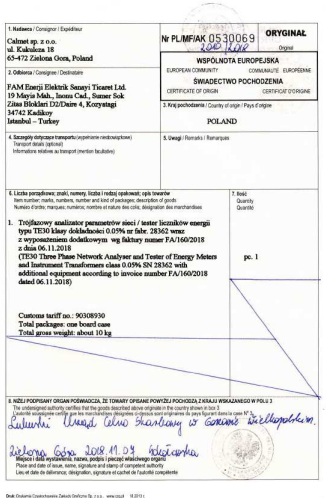
Date of issue: 18th July 2019 Certificate No: L3.601.238.2019 Page 1 / 6

OBJECT OF CALIBRATION	Three-Phase Fully Automatic Test System TS33, serial number 29464, producer Calmet, class 0.1.
APPLICANT	Calmet sp. z o.o. Kukułcza 18 65-472 Zielona Góra, Poland
USER	Scientific and Industrial Testing and Research Centre 83 & 84 Avarmpalayam Road, K R Puram Post, Coimbatore-641006 India
PLACE OF CALIBRATION	Calmet sp. z o.o. Kukułcza 18 65-472 Zielona Góra, Poland
CALIBRATION METHOD	Calibration of Electrical Energy Meter Alternating Current PW/W4/09, 5th issue of 6th June 2018 Calibration of digital meters PW/W4/02, 5th issue of 13th April 2018.
ENVIRONMENTAL CONDITIONS	Ambient temperature 22,5 °C ÷ 23,2 °C
DATE OF CALIBRATION	12th July 2019
TRACEABILITY	This certificate is issued under the agreement EA MLA in the field of calibration and provides traceability of measurement results to the International System of Units (SI).
CALIBRATION RESULTS	The results have been presented on pages 2/6, 3/6, 4/6, 5/6 6/6 of this certificate including uncertainty of measurement. This calibration certificate contains the results of the calibration covered by the scope of accreditation and outside the scope. The results of calibration outside the scope of accreditation are marked *.
UNCERTAINTY OF MEASUREMENT	Uncertainty of measurement has been evaluated in compliance with EA-4/02 M:2013. The expanded uncertainty corresponds to a coverage probability of 95% and the coverage factor k=2 of this certificate.

Per pro of Director

KIEROWNIK

Calibration Certificate from ISO17025 accredited lab



1. Nadawca / Consignor / Expéditeur
Calmet sp. z o.o.
ul. Kukułcza 18
65-472 Zielona Góra, Poland

Nr PL/MF/AK 0530069
ORYGINAL
WSPÓLNOTA EUROPEJSKA
EUROPEAN COMMUNITY
ŚWIADECTWO POCHODZENIA
CERTIFICATE OF ORIGIN

2. Odbiorca / Consignee / Destinataire
FAM Enerji Elektrik Sanayi Ticaret Ltd.
19 Mayıs Mah., Inonu Cad., Sumer Sok
Zitas Bloklari D2/Daire 4, Kozyatagi
34742 Kadikoy
Istanbul – Turkey

3. Kraj pochodzenia / Country of origin / Pays d'origine
POLAND

4. Szczegóły dotyczące transportu (wypełnienie nieobowiązkowe) / Transport details (optional) / Informations relatives au transport (mention facultative)

5. Uwagi / Remarks / Remarques

6. Liczba porządkowa; znaki, numery, liczba i rodzaj opakowań; opis towaru / Item number; marks, numbers, number and kind of packages; description of goods / Numéro d'ordre; marques, numéros; nombre et nature des colis; désignation des marchandises

7. Ilość / Quantity / Quantité

1. Trójfazowy analizator parametrów sieci / tester liczników energii typu TE30 klasy dokładności 0.05% nr fabr. 28362 wraz z wyposażeniem dodatkowym wg faktury numer FA/160/2018 z dnia 06.11.2018
(TE30 Three Phase Network Analyser and Tester of Energy Meters and Instrument Transformers class 0.05% SN 28362 with additional equipment according to invoice number FA/160/2018 dated 06.11.2018)

pc. 1

Customs tariff no.: 90308930
Total packages: one board case
Total gross weight: about 10 kg

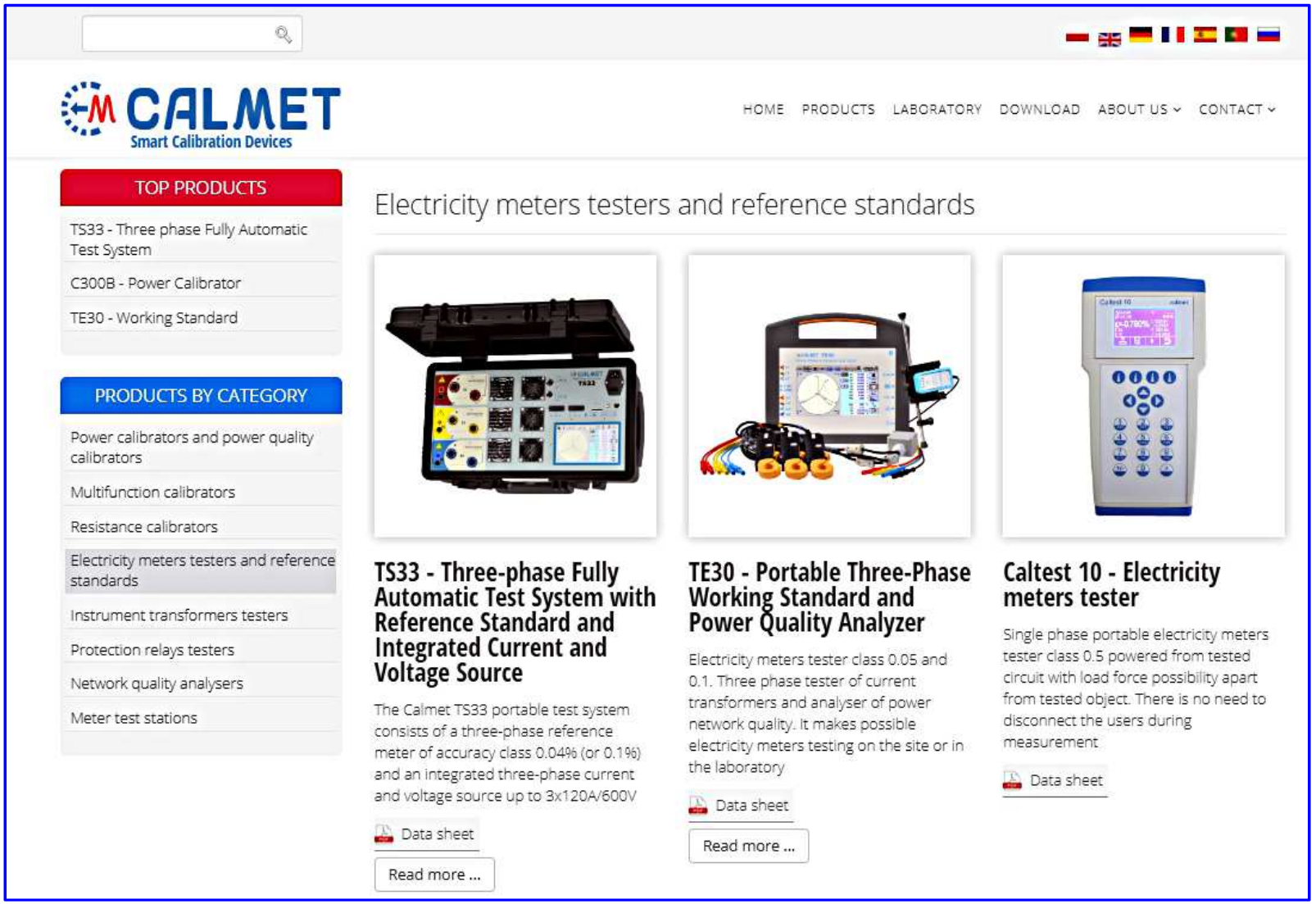
8. NIŻEJ PODPISANY ORGAN POŚWIADCZA, ŻE TOWARY OPISANE POWYŻEJ POCHODZĄ Z KRAJU WSKAZANEGO W POLU 3
The undersigned authority certifies that the goods described above originate in the country shown in box 3
Organe soussigné certifie que les marchandises désignées ci-dessus sont originaires du pays figurant dans la case N° 3

Zielona Góra 2018.11.24

Miejsce i data wystawienia; nazwa, podpis i pieczęć właściwego organu / Place and date of issue, name, signature and stamp of competent authority / Lieu et date de délivrance, désignation, signature et cachet de l'autorité compétente

Certificate of Origin from Customs and Chamber of Commerce

To see more devices and information visit our Web site: www.calmet.com.pl



or contact by e-mail: mail@calmet.com.pl