Calmet TS33

Three-phase Fully Automatic Test System with Reference Standard and Integrated Current and Voltage Source

Calmet Sp. z o.o.

- Calmet = **CAL**ibrators + **MET**rology
- founded in **1989**, roots come from LUMEL, big factory of measurement equipment in Poland, Zielona Gora
- designing, production, selling and servicing new kind of calibrators and electric equipment testers
- employs over 25 engineers, including 3 with Ph.D.
- cooperates with University of Zielona Gora; common projects and lectures
- since **1996** – electricity meters testing and power network parameters analysing
- since **2002** – generating and measuring network quality parameters
- since **2006** – automation of electro-utility automatic protective equipment testing
- since **2011** – automatic Test Benches for energy meter testing
- since **2019** – new group of Automatic Test Systems

Mesurement Equipment since 1989

Customer Support in problems solving

Energy meter testers, Current Transformers testers, Power quality analysers

1 phase, 0,2%

3 phase, 0.05%

3 phase, 120A, 0.02%

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

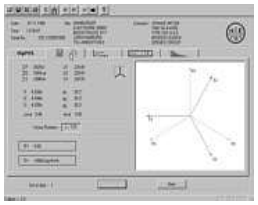
3 phase U,I,φ,P,Q,S,E

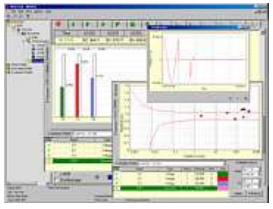
1 phase U,I,φ,P,Q,S,E

3 phase Test Bench

Multifunctions DC/AC

Control Software for measurement equipment





Current and Voltage Source with Integrated Reference Standard

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

Testing the entire energy measurement system!

Accuracy of all kinds of meters ε[%]

Electromechanical (Ferraris)

Electronic (static)

4 – Quadrants Smart Meters

Max. demand

TS33

CT/PT burden, ratio, phase shift error

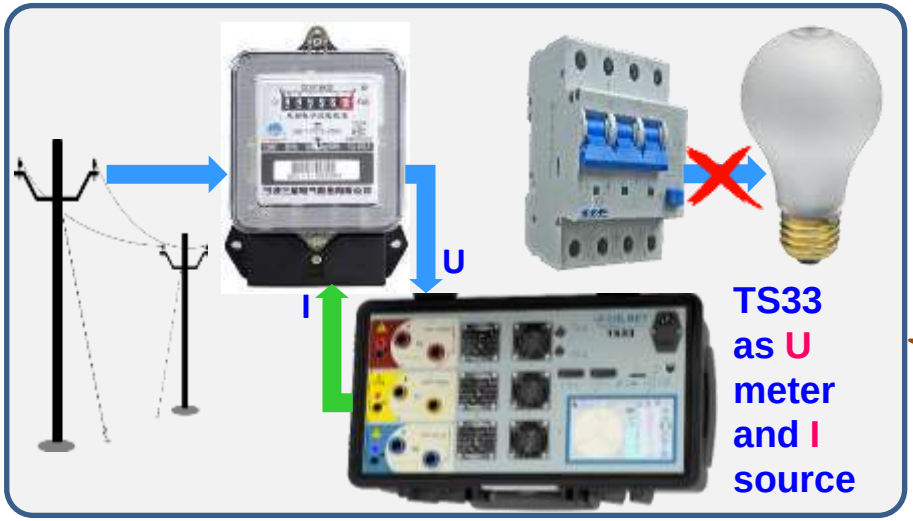
Wiring errors

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

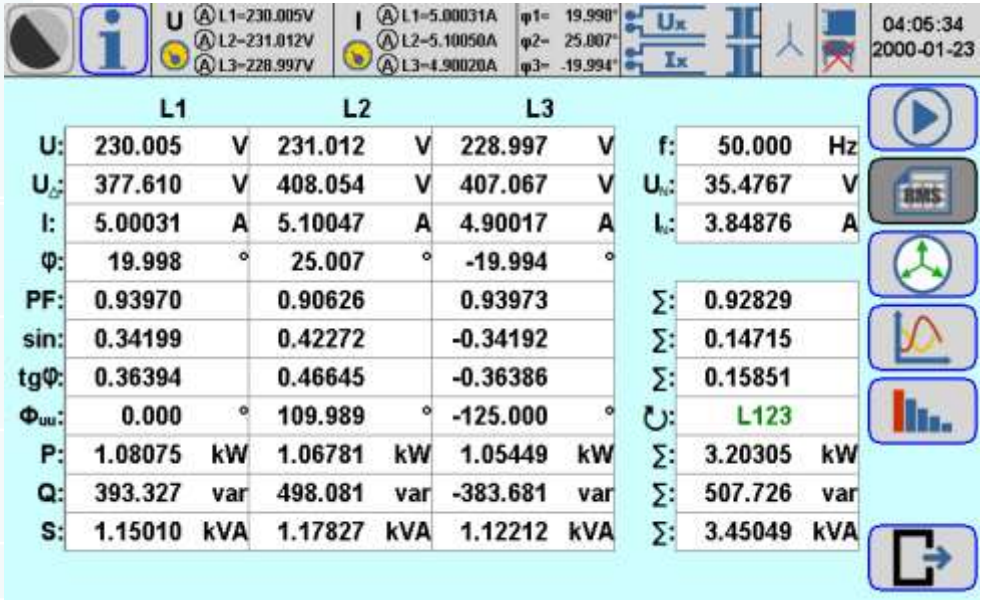


Testing U-ON/ I-OFF LINE – meter is connected to the network but load is disconnected; metering point can be set in whole range of current; TS33 works as U meter and I source with built in reference meter

Testing without meter disconnecting!

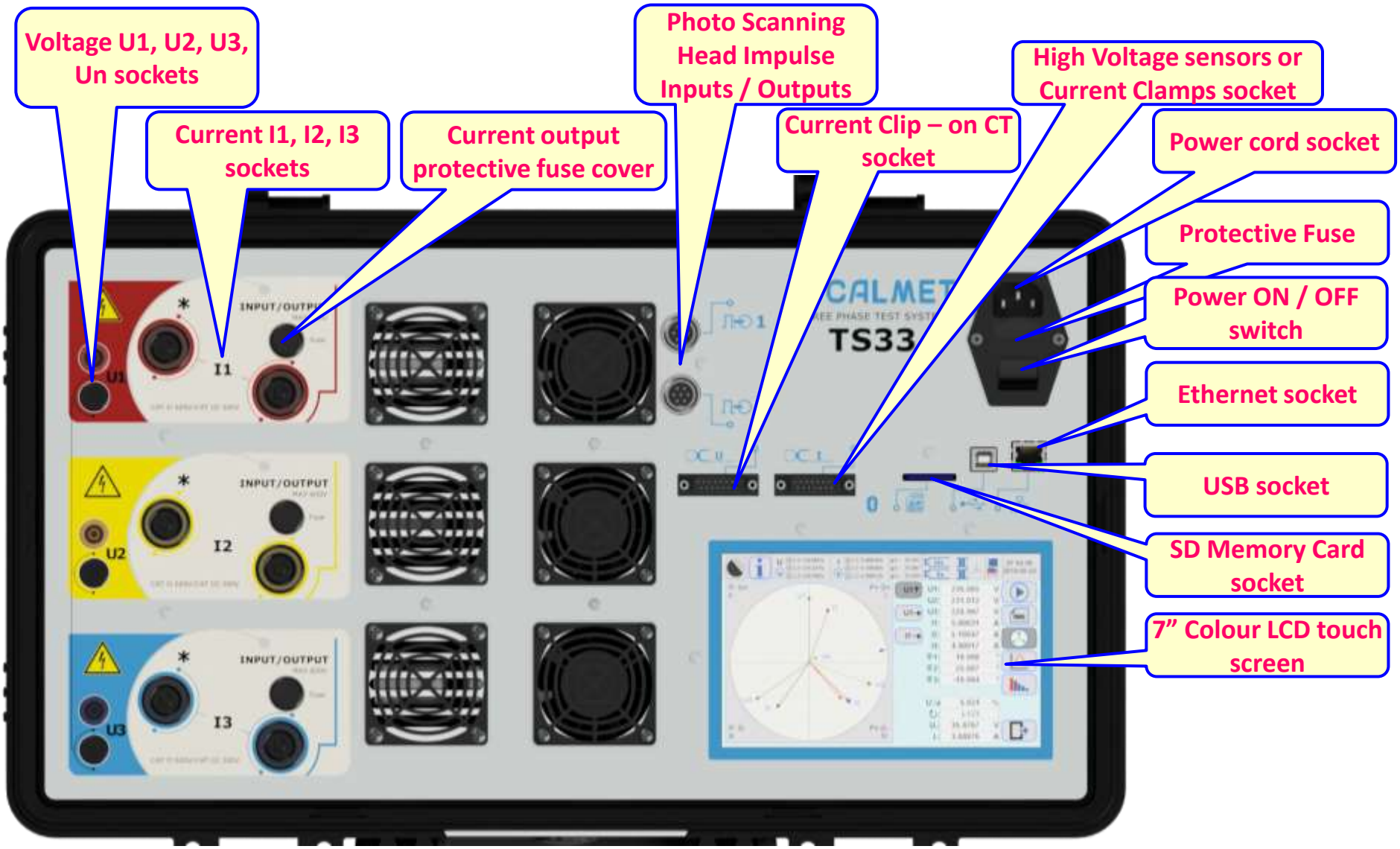
TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

- Easy verification of meters under precise load conditions, using integrated current and voltage source in class **0.02, 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 TS 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

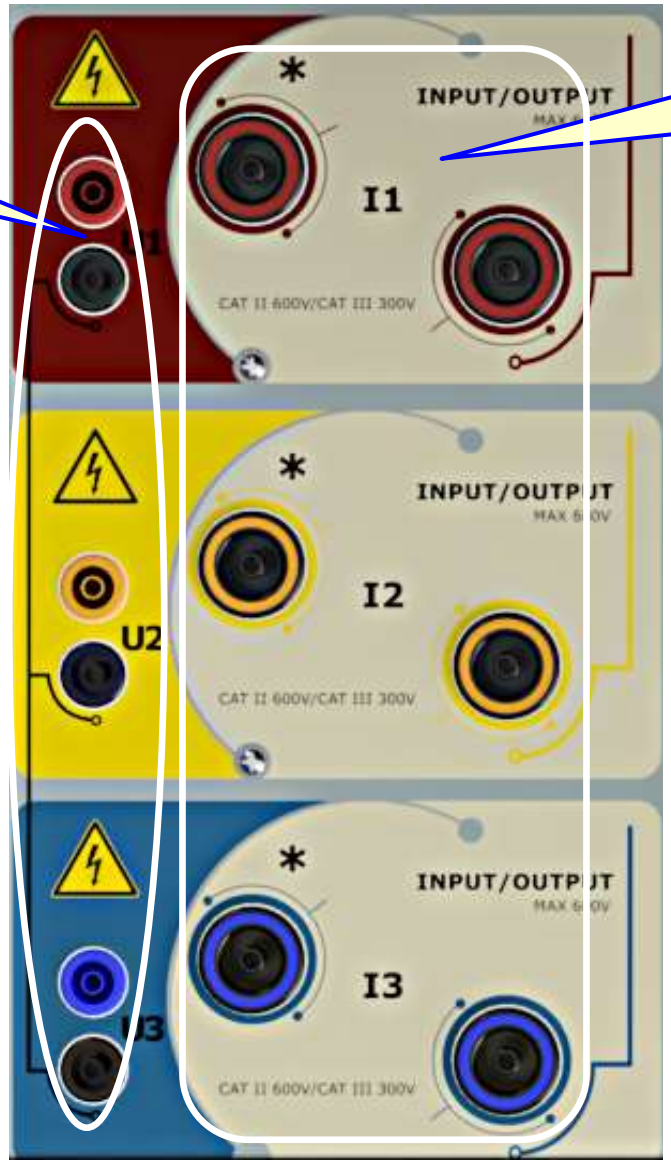
TS33 Inputs, Outputs and Connectors:

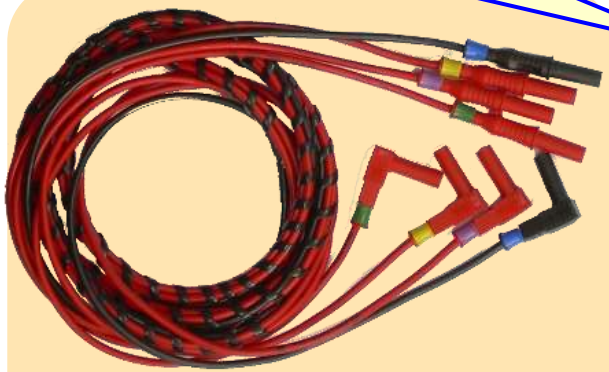


TS33 Voltage and Current Inputs:

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

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

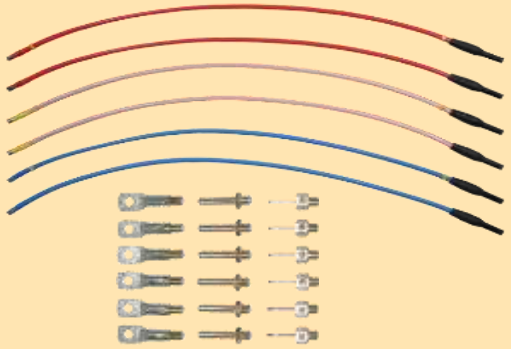




4mm Voltage Safety Cables
Length=2m

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

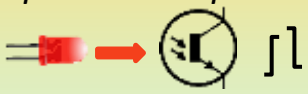
TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

TS33 Pulse Input / Output;

can test all kinds of Electricity Meters

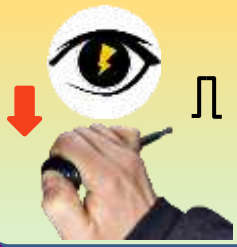
Electronic energy meter

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



0.0001Hz...200kHz

1. Pulse Input / Output socket

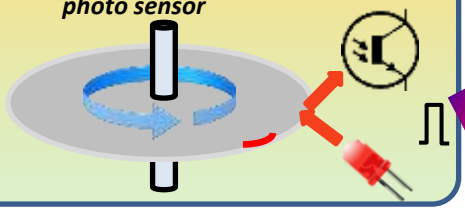


Electronic and Inductive energy meter

manual push – button and pulse generation

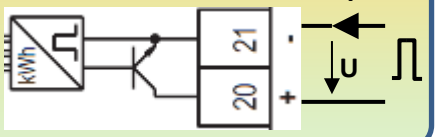
Inductive energy meter

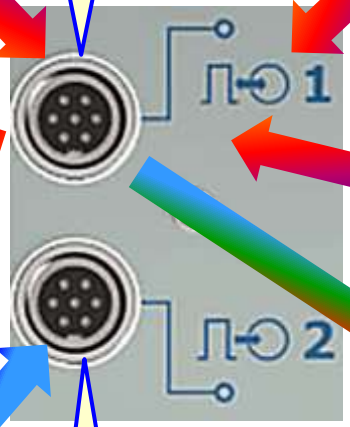
- disk with red or black mark
- photo head with LED lamp and photo sensor



Electronic and Inductive energy meter

S0 standard electric pulse



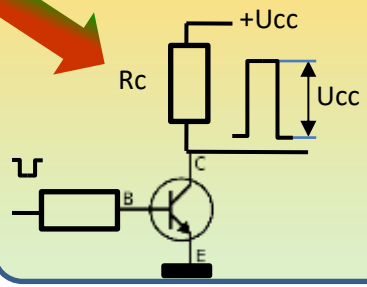


In case, that we need higher than offered by TS33 accuracy 0.04 or 0.1, we can use external reference easy way

Additional, external very, high accuracy Reference Meter

2. Pulse Input for external Reference Meter socket

Open collector pulse output + external Rc



$U_{cc}max \leq 27V$

$I_c max \leq 100mA$

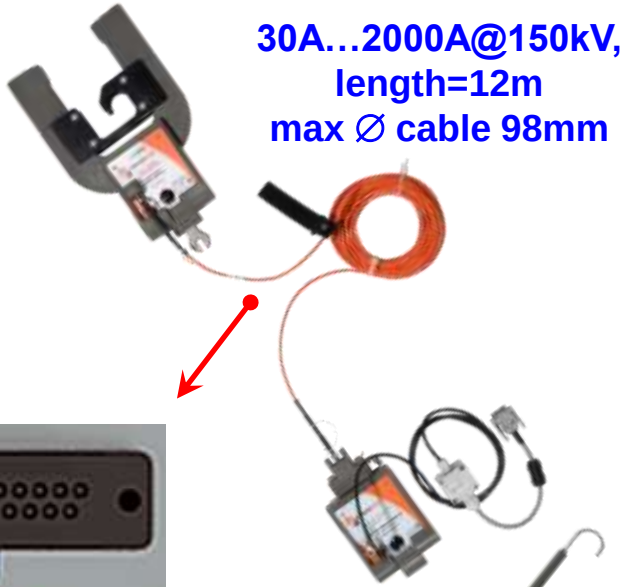
0.0001Hz...200kHz

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

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

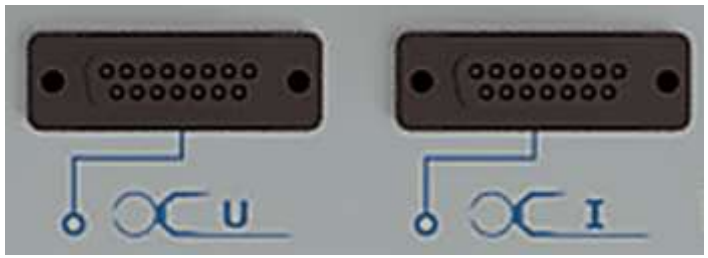
10mA…120A, length=2m
max ∅ cable 15mm

3mA…12A, max ∅ cable 20mm
length=2m

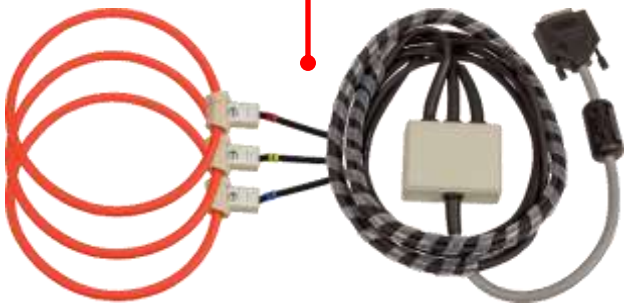


30A…2000A@150kV,
length=12m
max ∅ cable 98mm

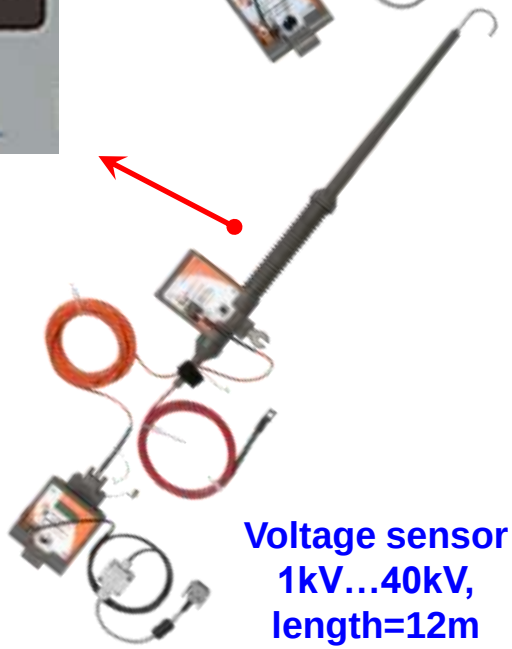
300mA…1200A, length=2m
max ∅ cable 52mm



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

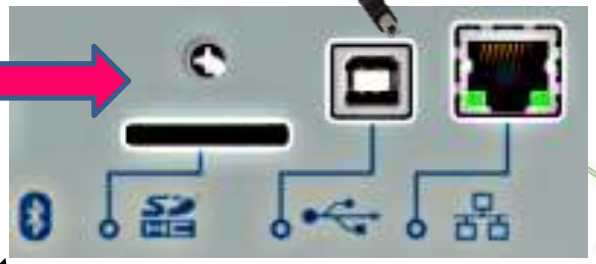
Screenshoots

Results

USB

CalproTS33 PC Soft

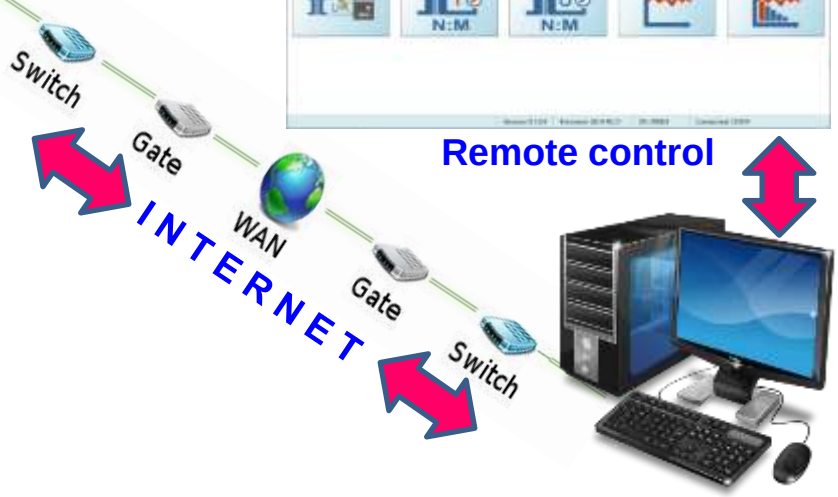
Removable SD cards 2..32GB



Ethernet

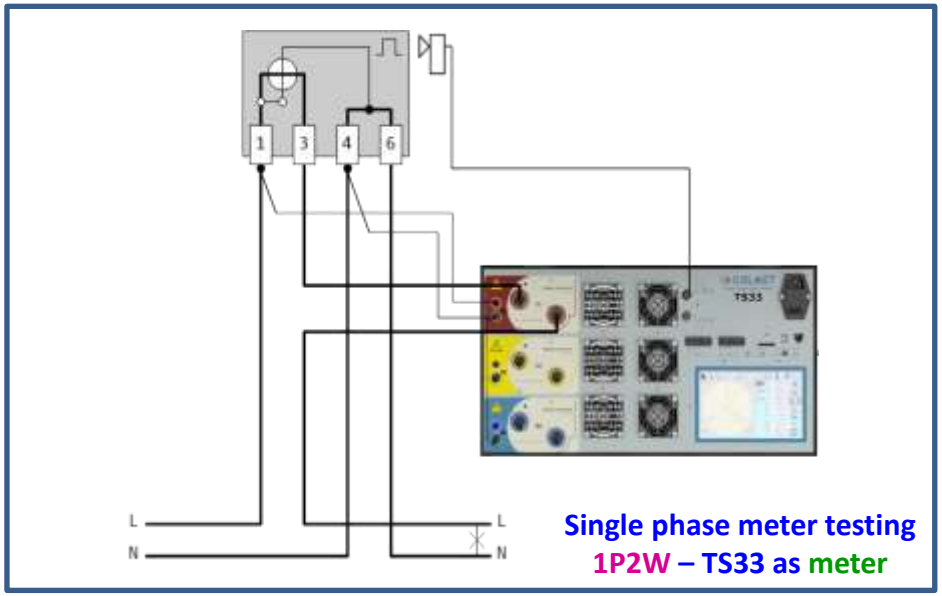
Remote control

Bluetooth, wireless printer & laptop

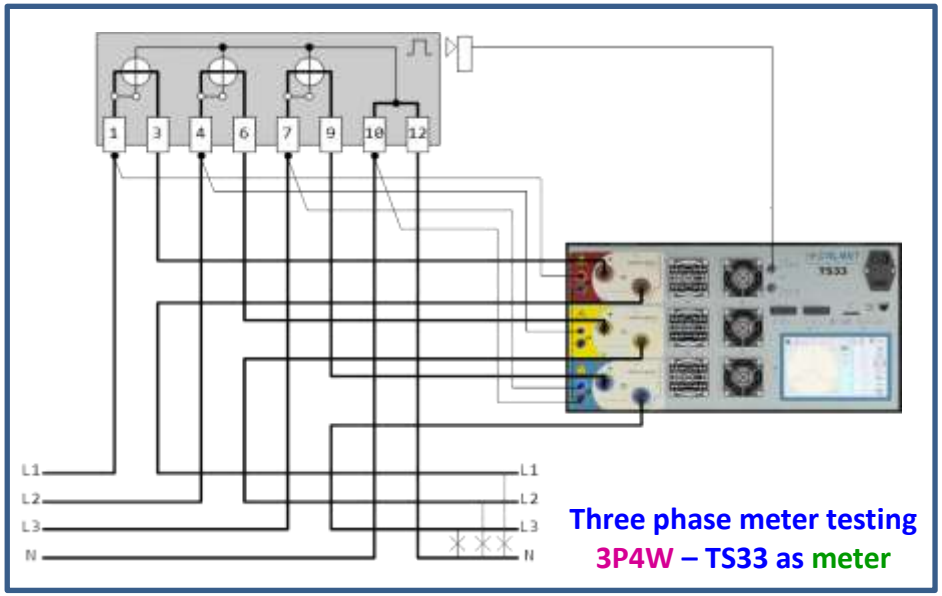


TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

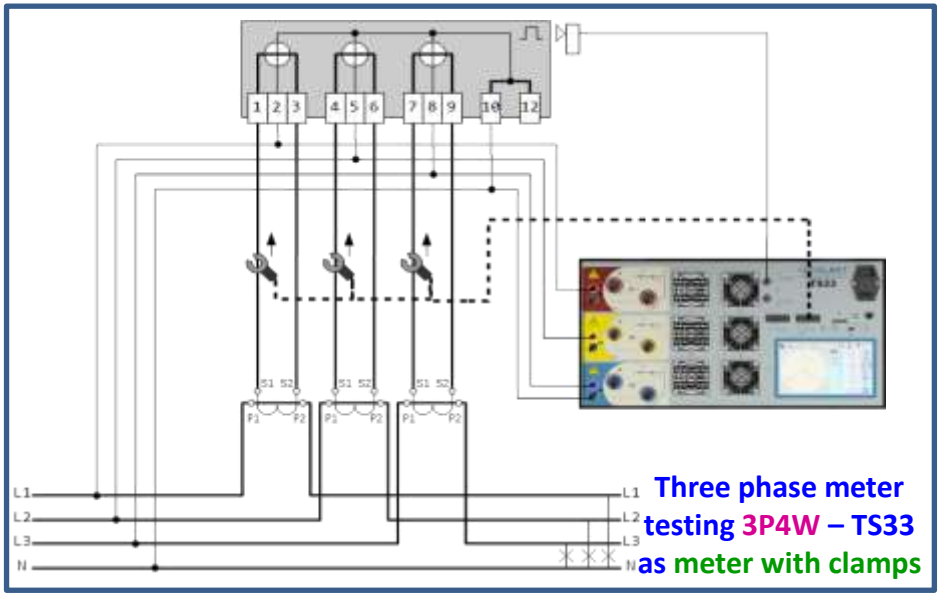
All possible types of connection: 1P2W, 3P4W, 3P3W, ... , direct or with clamps



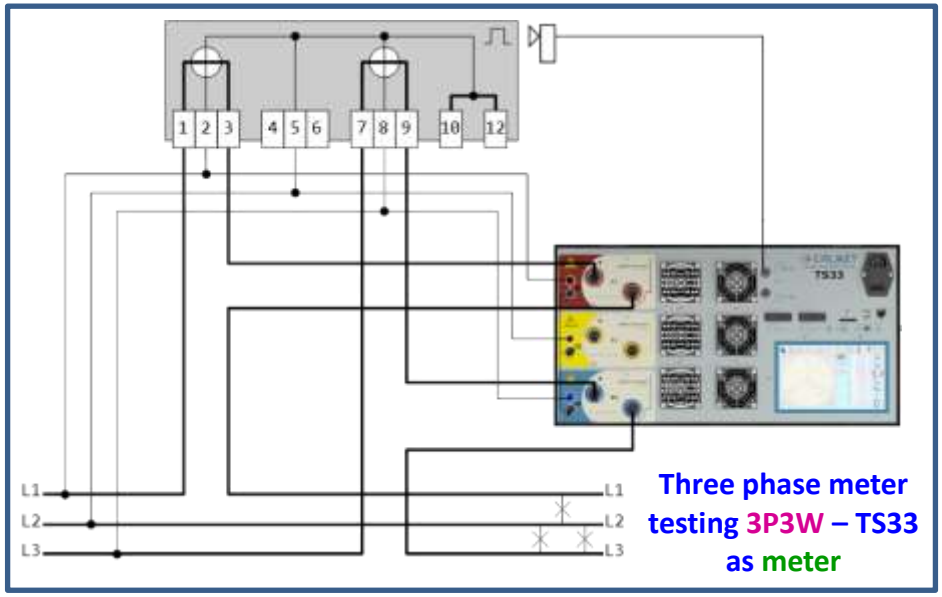
Single phase meter testing
1P2W – TS33 as meter



Three phase meter testing
3P4W – TS33 as meter



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

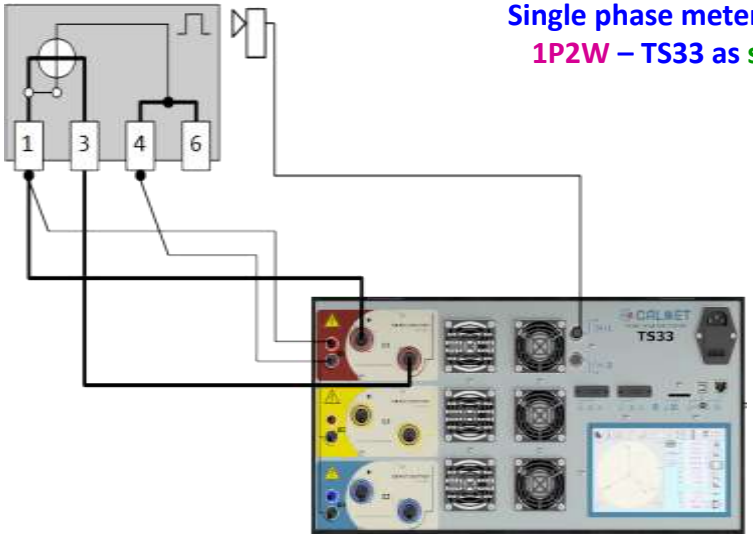


Three phase meter testing 3P3W – TS33 as meter

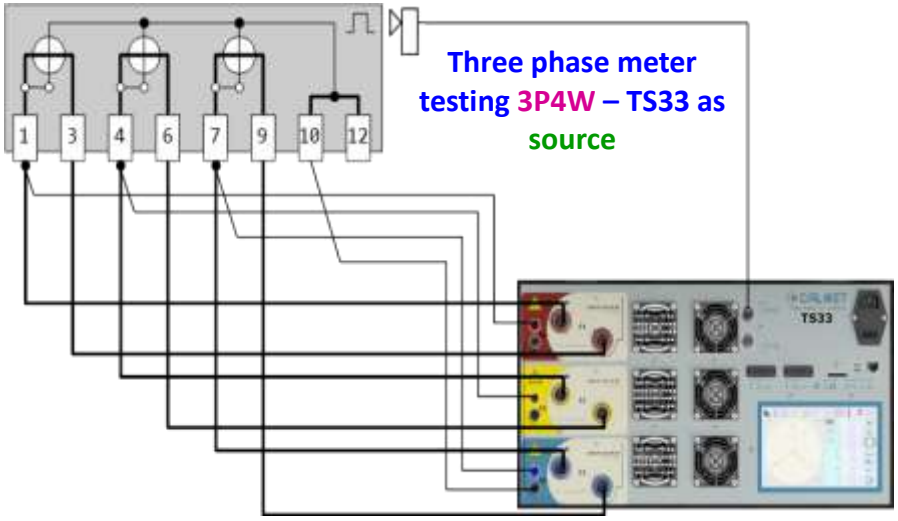
TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

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

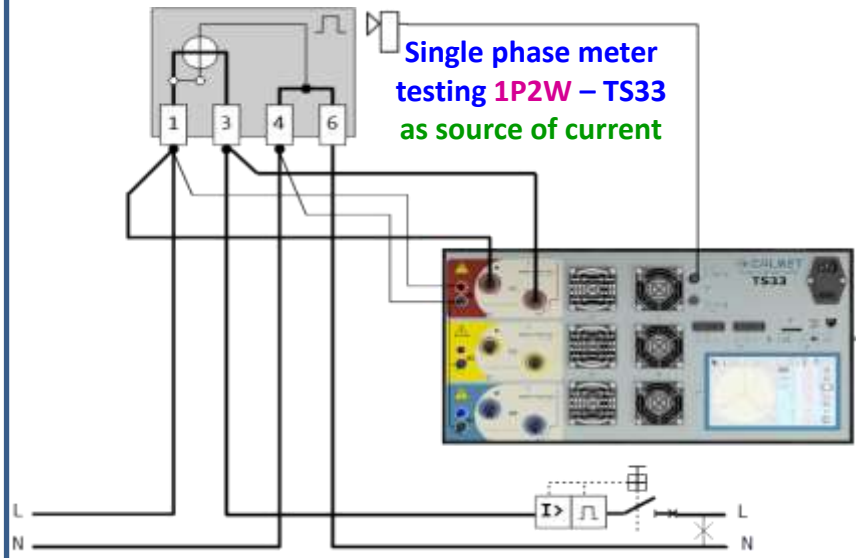
Single phase meter testing 1P2W – TS33 as source



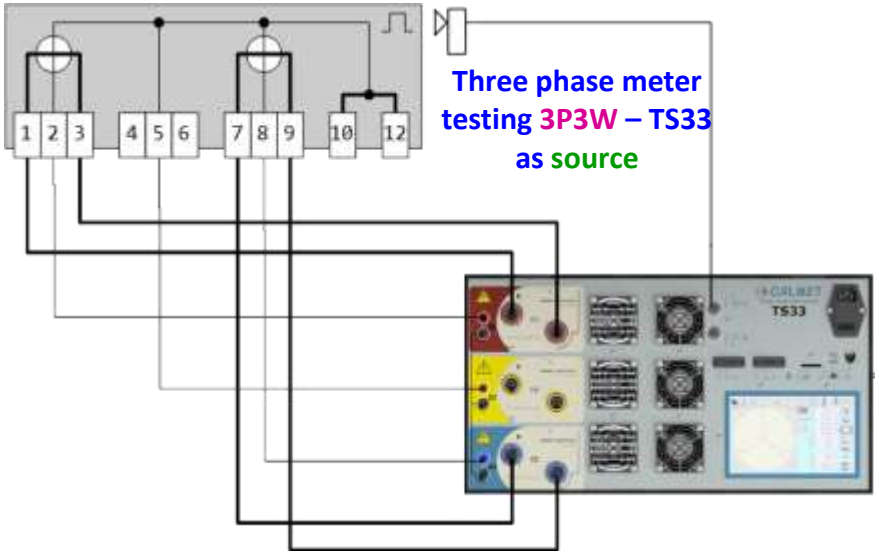
Three phase meter testing 3P4W – TS33 as source



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

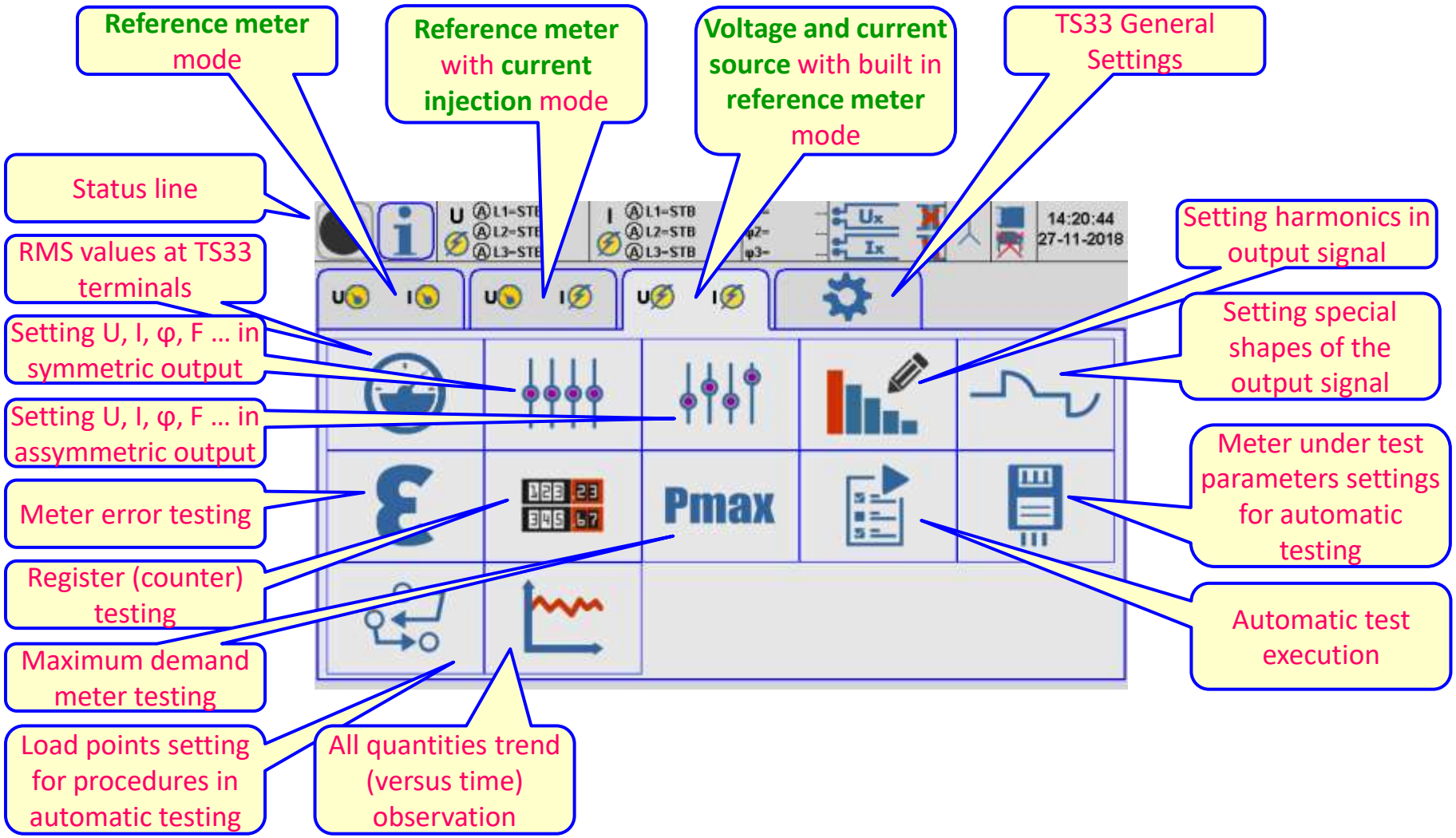


Three phase meter testing 3P3W – TS33 as source



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

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

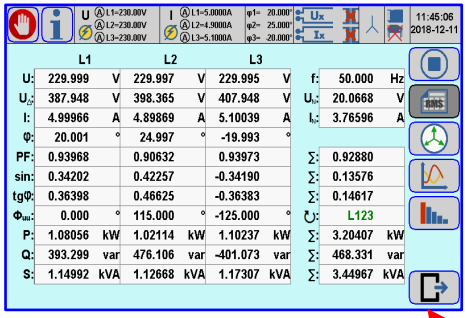


Easy, icon driven, operation on big 7” touch screen

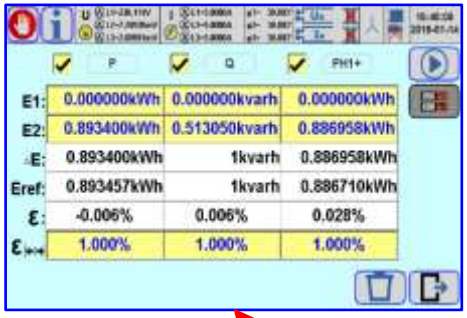
TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

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

RMS values of U,I,φ,F,P,Q,S

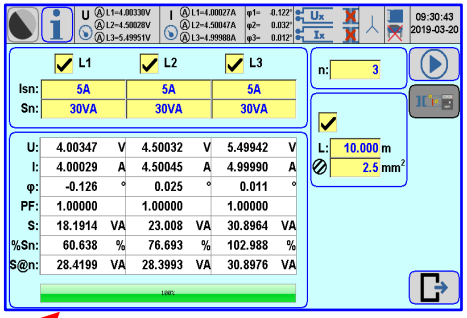


Counter (register) test

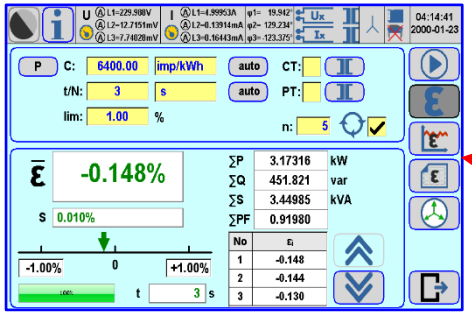


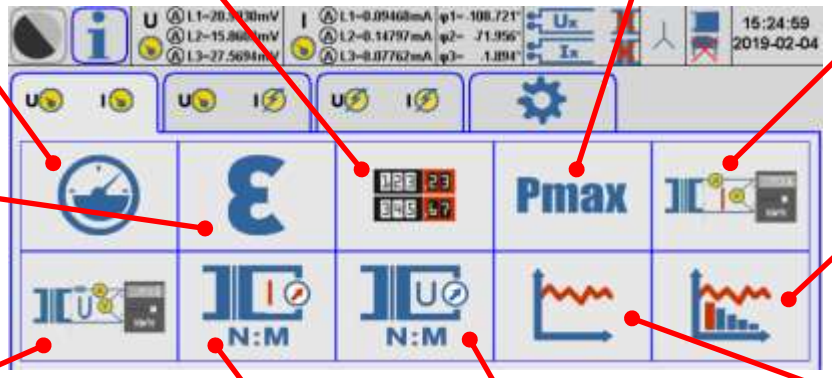
Maximum demand meter test

CT burden test



Meter error test in [%]

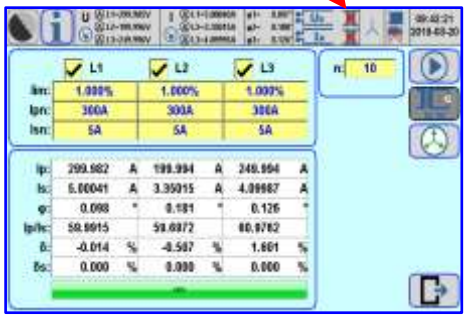




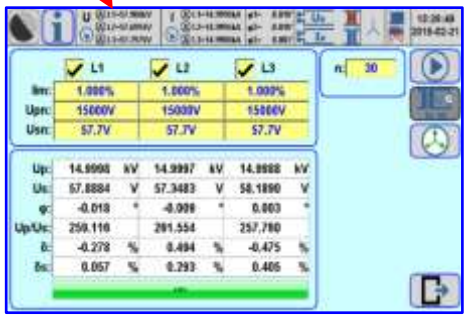
Harmonics trend test

PT burden test

CT ratio test



PT ratio test

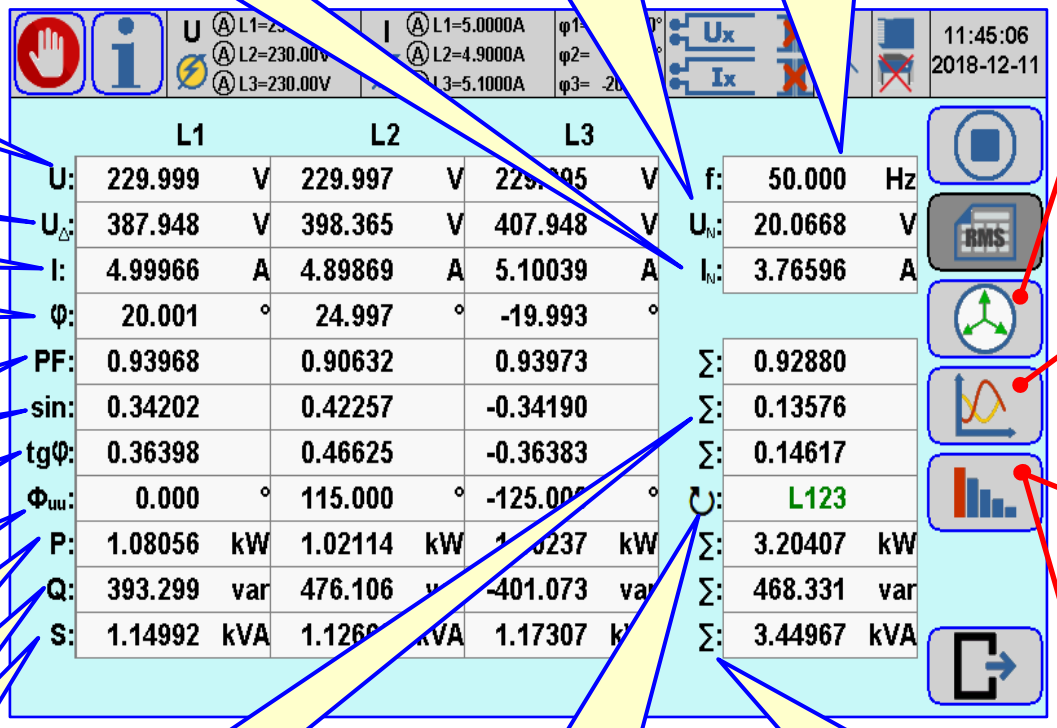


U,I,ϕ,F,P,Q,S trend test

TS33 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**

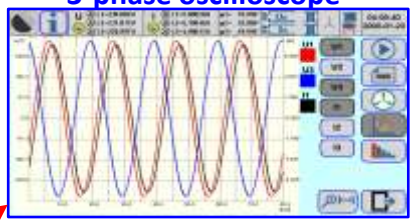


	L1		L2		L3				
U:	229.999	V	229.997	V	229.995	V	f:	50.000	Hz
U_Δ:	387.948	V	398.365	V	407.948	V	U_N:	20.0668	V
I:	4.99966	A	4.89869	A	5.10039	A	I_N:	3.76596	A
φ:	20.001	°	24.997	°	-19.993	°			
PF:	0.93968		0.90632		0.93973		Σ:	0.92880	
sin:	0.34202		0.42257		-0.34190		Σ:	0.13576	
tgφ:	0.36398		0.46625		-0.36383		Σ:	0.14617	
Φ_{uu}:	0.000	°	115.000	°	-125.000	°	↻:	L123	
P:	1.08056	kW	1.02114	kW	1.10237	kW	Σ:	3.20407	kW
Q:	393.299	var	476.106	var	-401.073	var	Σ:	468.331	var
S:	1.14992	kVA	1.12600	kVA	1.17307	kVA	Σ:	3.44967	kVA

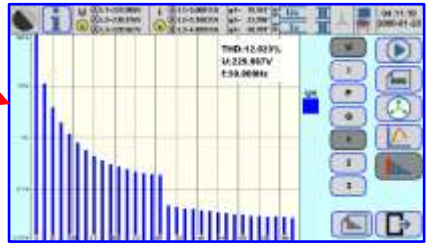
3-Phase Factors | 3-Phase Vector Rotation | 3-Phase Powers

3-phase vector diagram

3-phase oscilloscope



Harmonics bars



Harmonics in table form

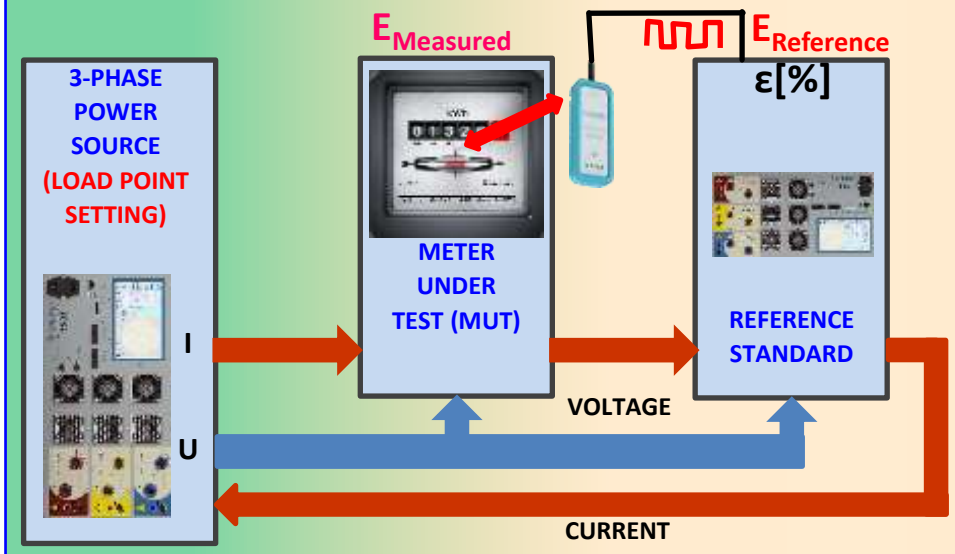
TS33 Automatic Test System for Electricity Meters Testing on Site and Lab: All-in-One

TS33 functionality: energy meter error testing idea

ε

Principle of electricity meter testing

$$\varepsilon[\%] = \frac{E_{Measured} - E_{Reference}}{E_{Reference}} \cdot 100\%$$



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:

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

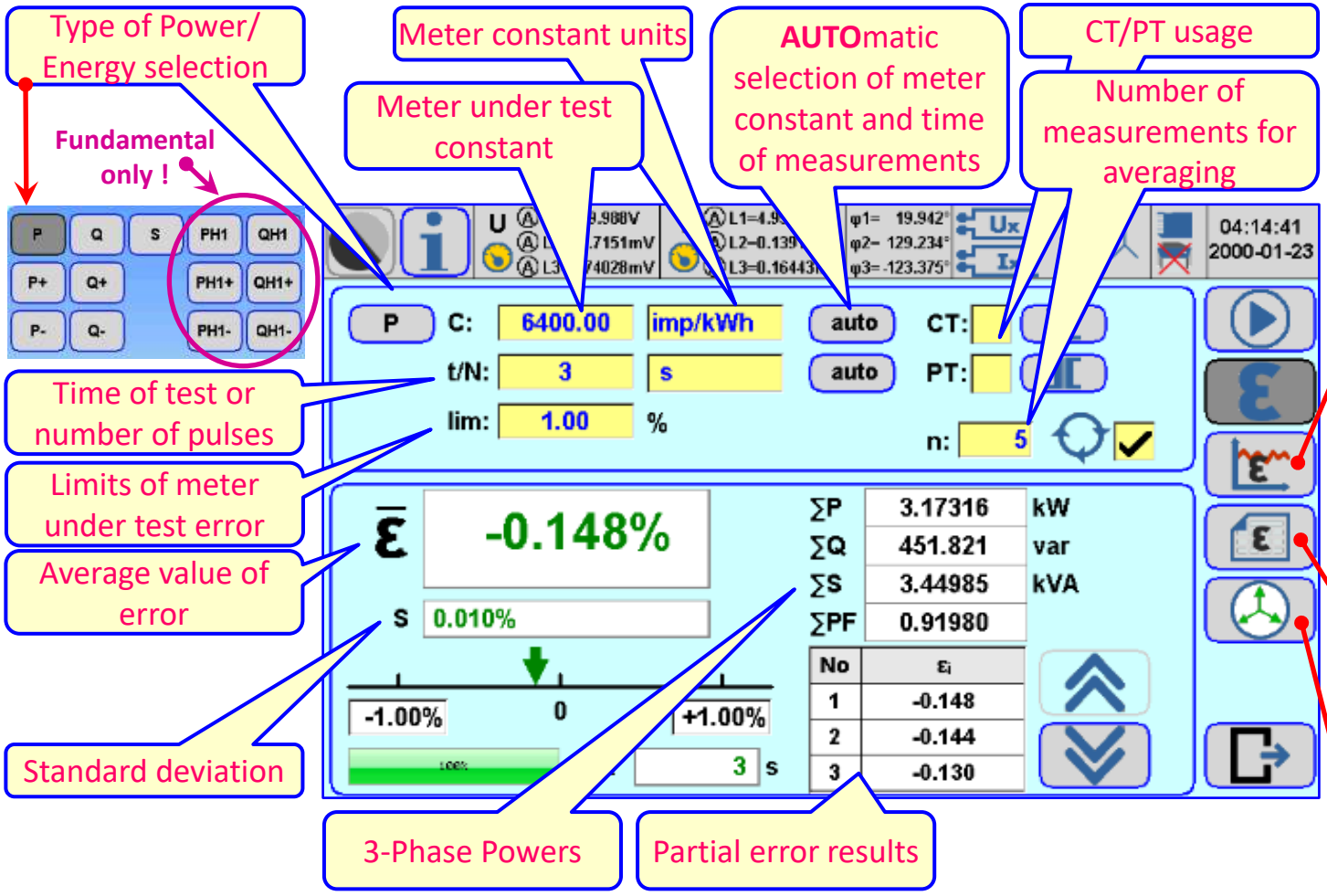
and then compare it with, reference value measured by special, at least 5 times more accurate standard meter ($E_{reference}$).

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

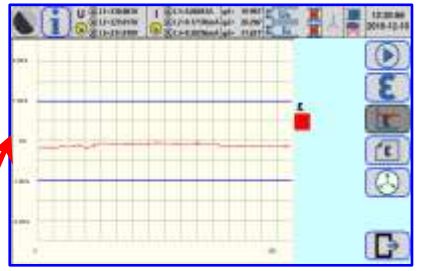
$$E_{Measured} = \frac{500}{375} kWh = 1.333kWh$$

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

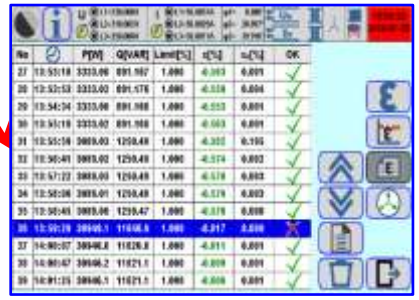
TS33 functionality: automatic energy meter error testing in [%]



Error diagram ε=f(t)



Error table



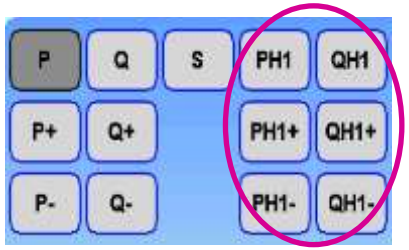
Vector diagram

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

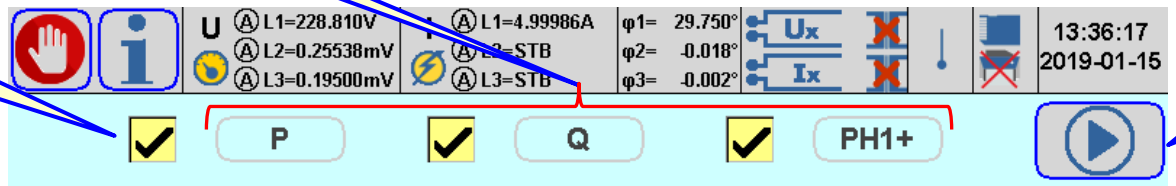
TS33 functionality: register (counter) test

The type of power setting for selected register



Fundamental only !

Up to 3 registers testing at time



Test **START / STOP**

Register value before starting test

Register value after stopping test

Difference between E2-E1

Reference value of Energy flow

Value of error

Limits of error

	P	Q	PH1+
E1:	0.000000kWh	0.000000kvarh	0.000000kWh
E2:	1.019123kWh	0.588698kvarh	1.019680kWh
ΔE:	1.019123kWh	0.588698kvarh	1.019680kWh
Eref:	1.019277kWh	0.588480kvarh	1.018611kWh
ε:	-0.015%	0.037%	0.105%
ε ⟷	1.000%	1.000%	1.000%

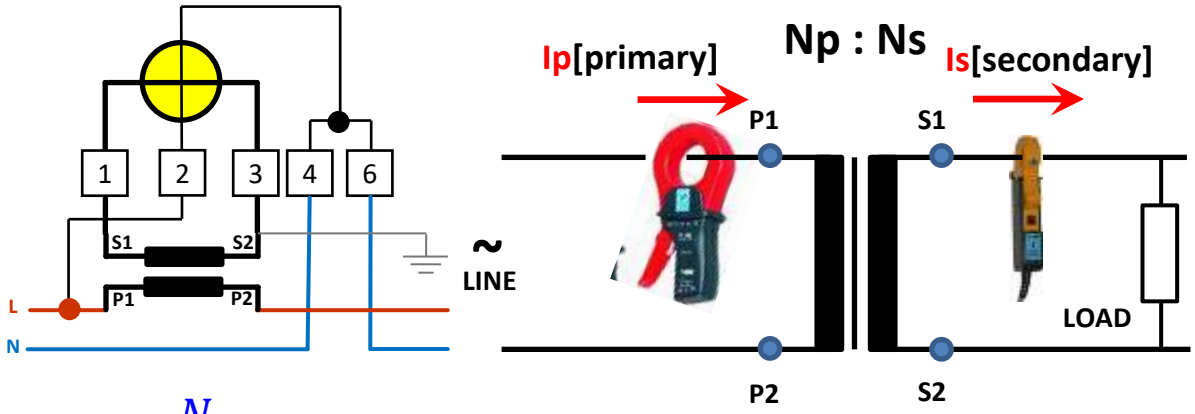
Value of active energy with all harmonics

Value of first harmonic only in active energy

- 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

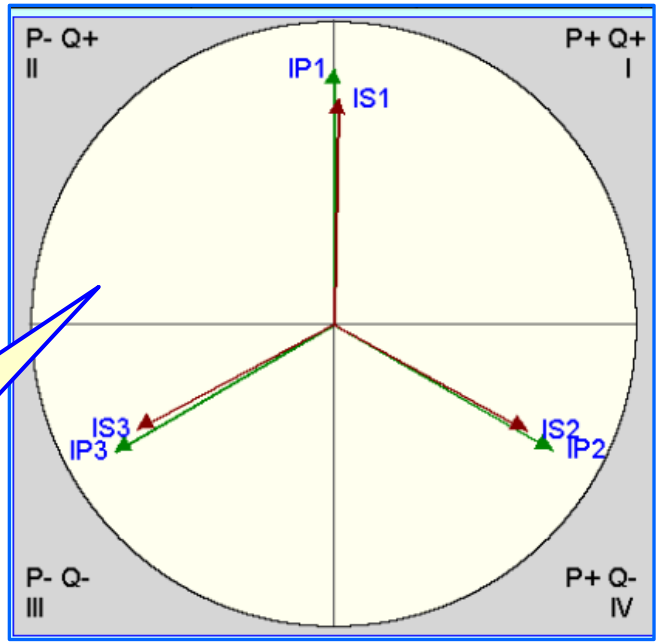


The test method is based on primary current measurement by means of current clamps from 0.1A to 3000A and secondary current measurement directly or also by means of clamps in 10mA to 10A range.

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

The ratio error is given by equation, where:

- δI – 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

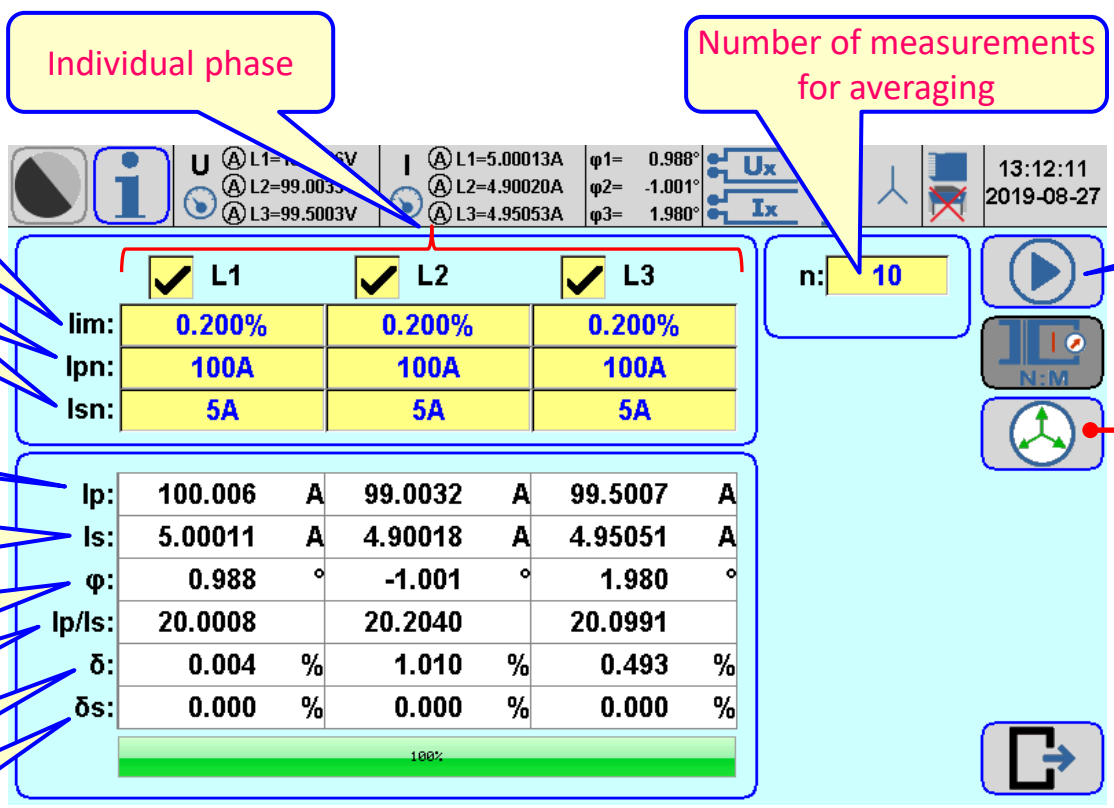


Three phase vector diagram of primary Ip and secondary Is currents

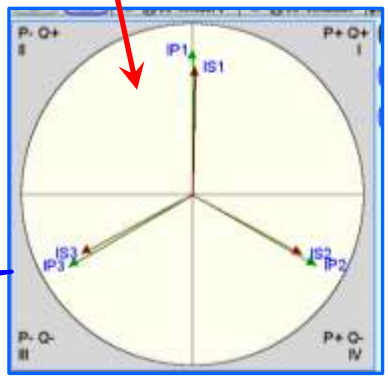
Expected value of ratio error is δI=0% and phase shift error φ=0°

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

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



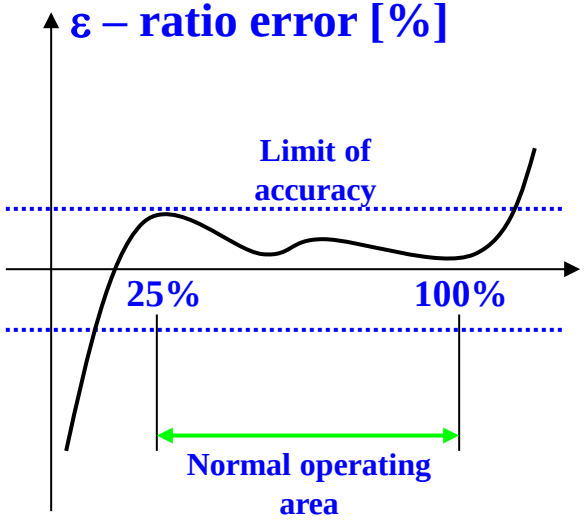
Vector diagram of primary and secondary side allows for easy connection testing



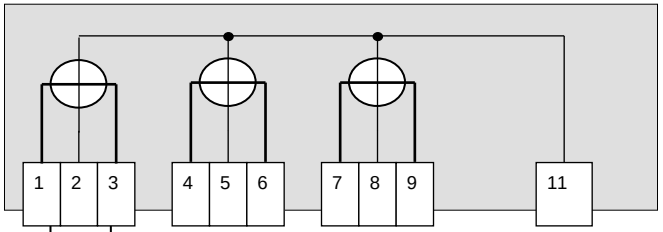
- testing CT / PT ratio and phase shift error simultaneously in three phases,
- ratio error measured directly in [%],
- vector diagram allows easy check of proper installation connections and error removing

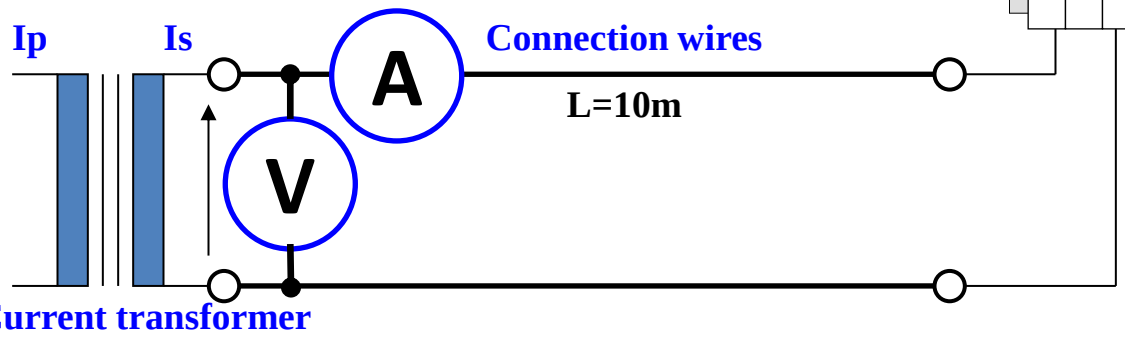
TS33 functionality: CT/PT burden test idea

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





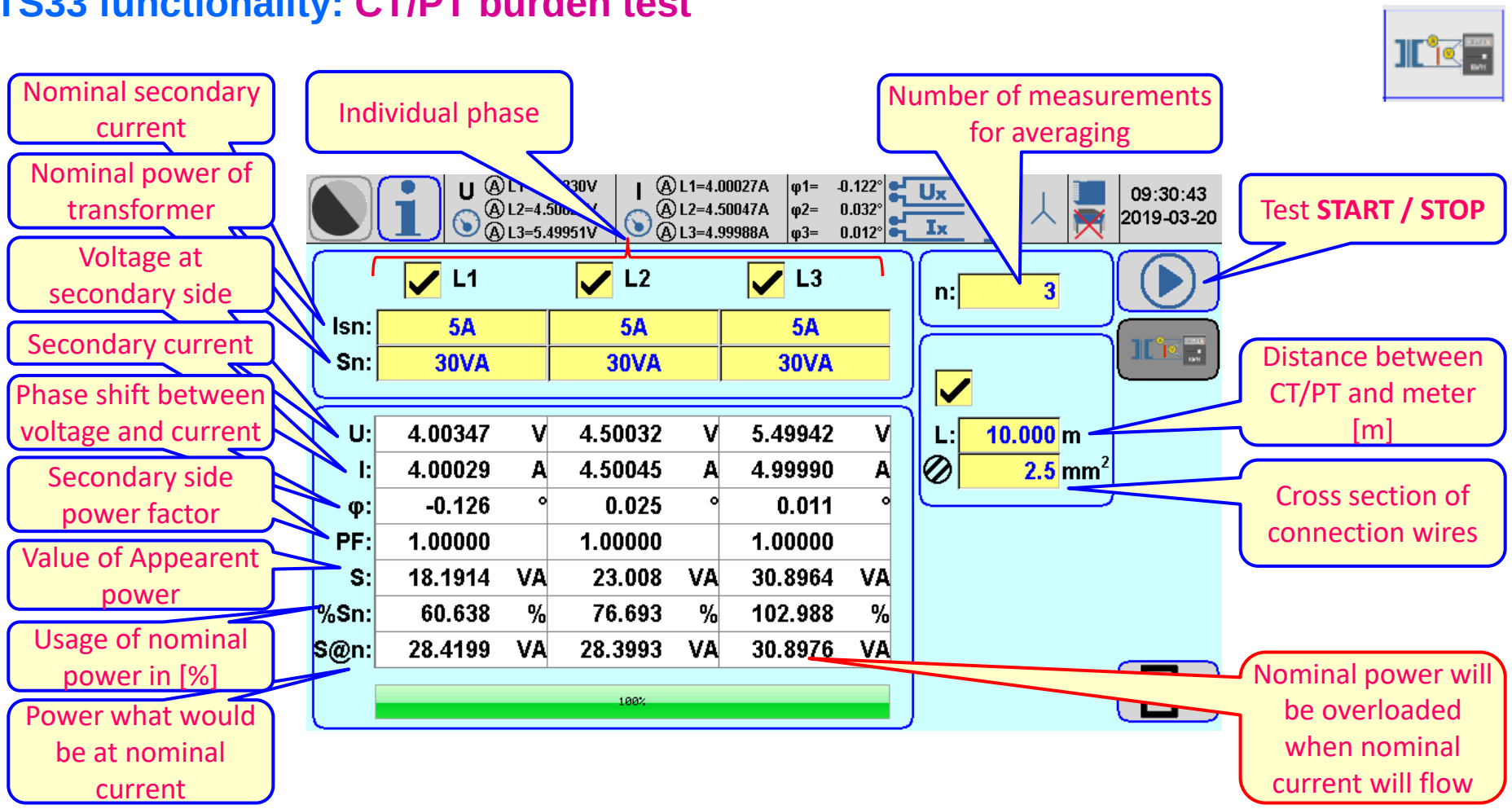
Example:

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

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

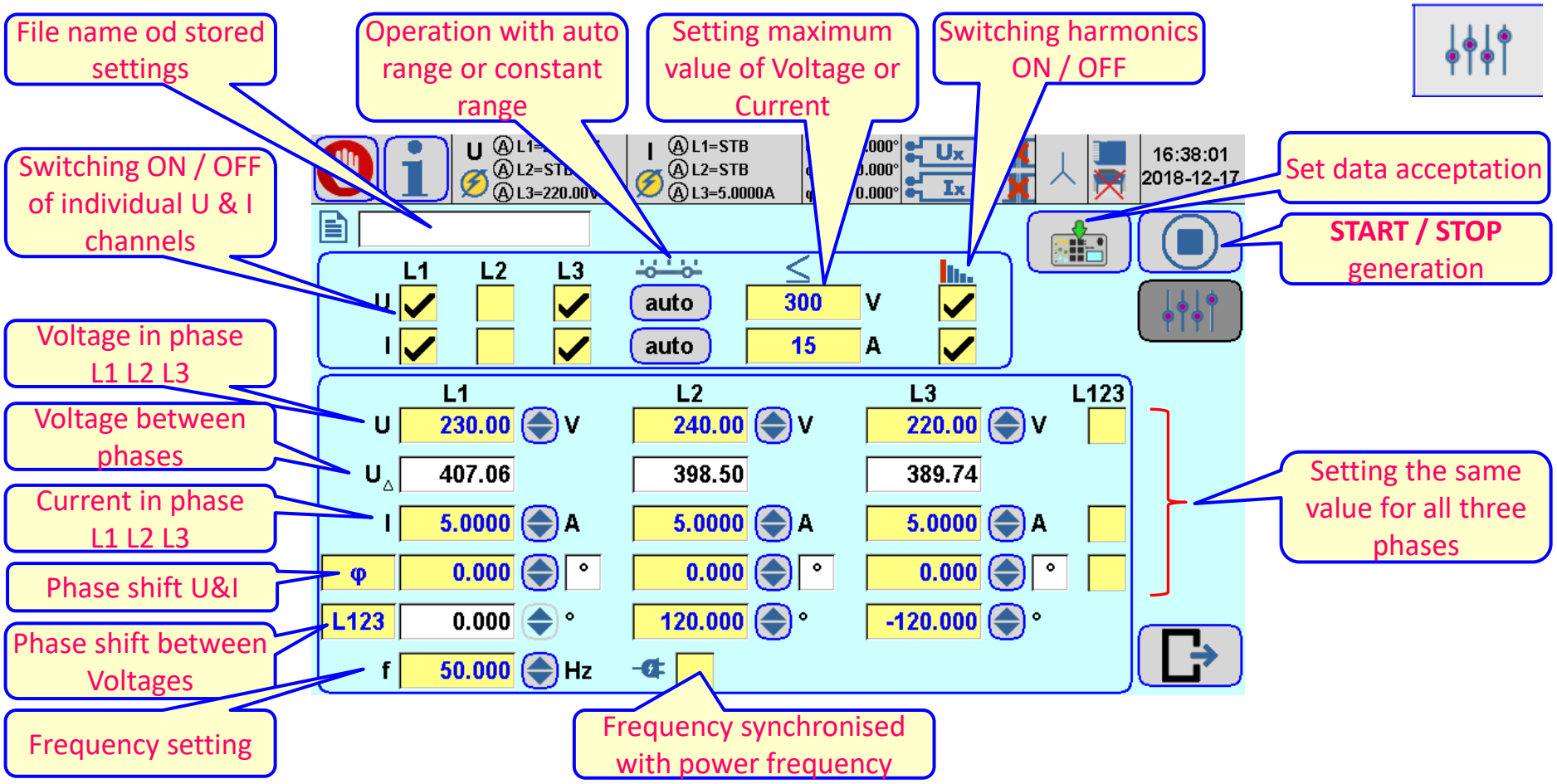
Conclusion: transformer load (wires, connectors, fuses, meter) can influence on accuracy

TS33 functionality: CT/PT burden test



- function of simultaneous testing up to three burdens,
- function of proper work prediction at nominal current and load,
- analysis of secondary side power factor

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

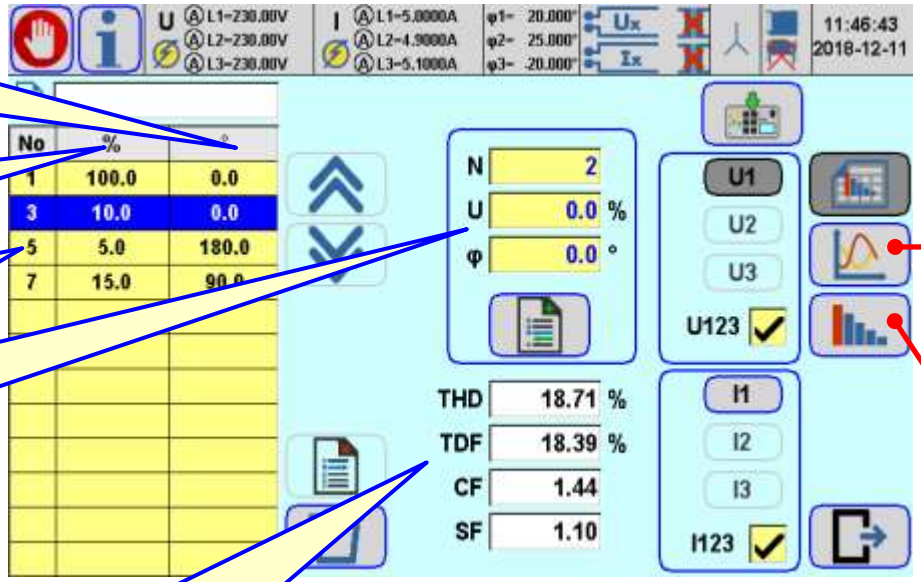
TS33 functionality: Voltage and current source – harmonic generation

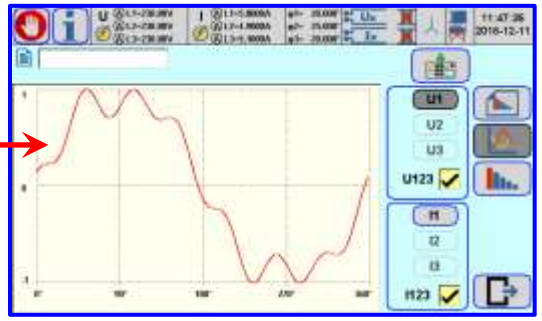
Phase shift with reference to fundamental

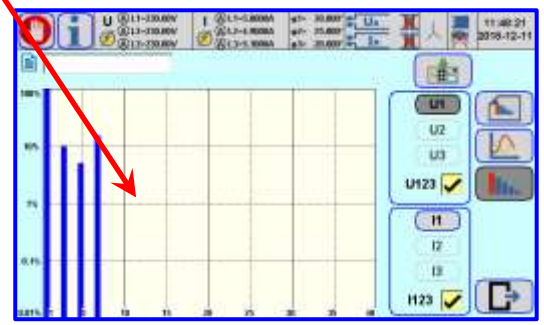
Amplitude in % of fundamental

Number of harmonic

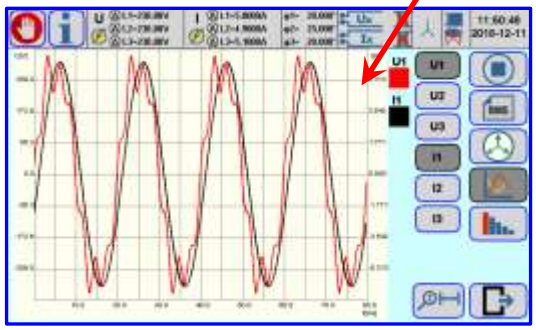
Setting number of harmonic, its amplitude and phase shift







Real signal measured at TS33 output



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)

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

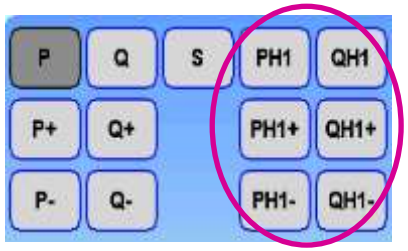
- load points for test selection
- serial number of meter under test
- test execution
- results table

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

TS33 functionality: Automatic energy meter test – Meter Type



Fundamental only !

Power type measured by meter

Type of meter in Data Base or new meter

Comment to the meter

Meter connection type: STAR / DELTA / SINGLE PHASE

Meter constant entered in: [imp/kWh] [imp/Wh] [Wh/imp]

Programmable in [s] delay between applying signals to the meter and test start (prepayment meters with relay

Base voltage of meter under test

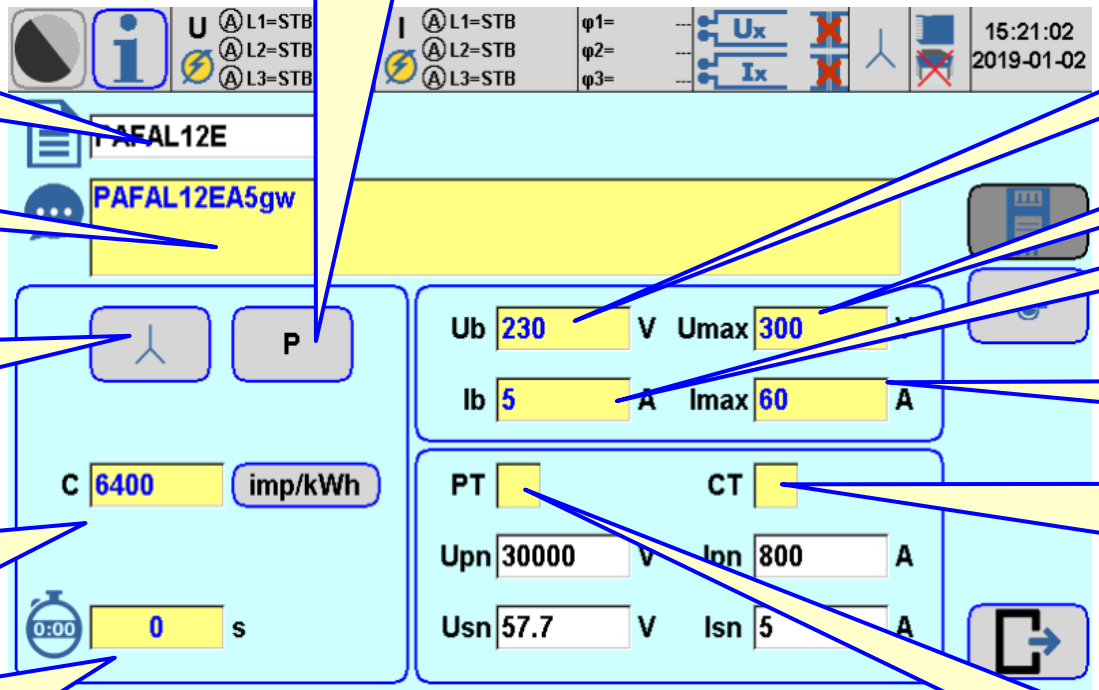
Maximum voltage to protect meter

Base (nominal) current

Maximum current

Current transformer if used and its primary and secondary nominal current

Potential transformer if used and its primary and secondary nominal voltage



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

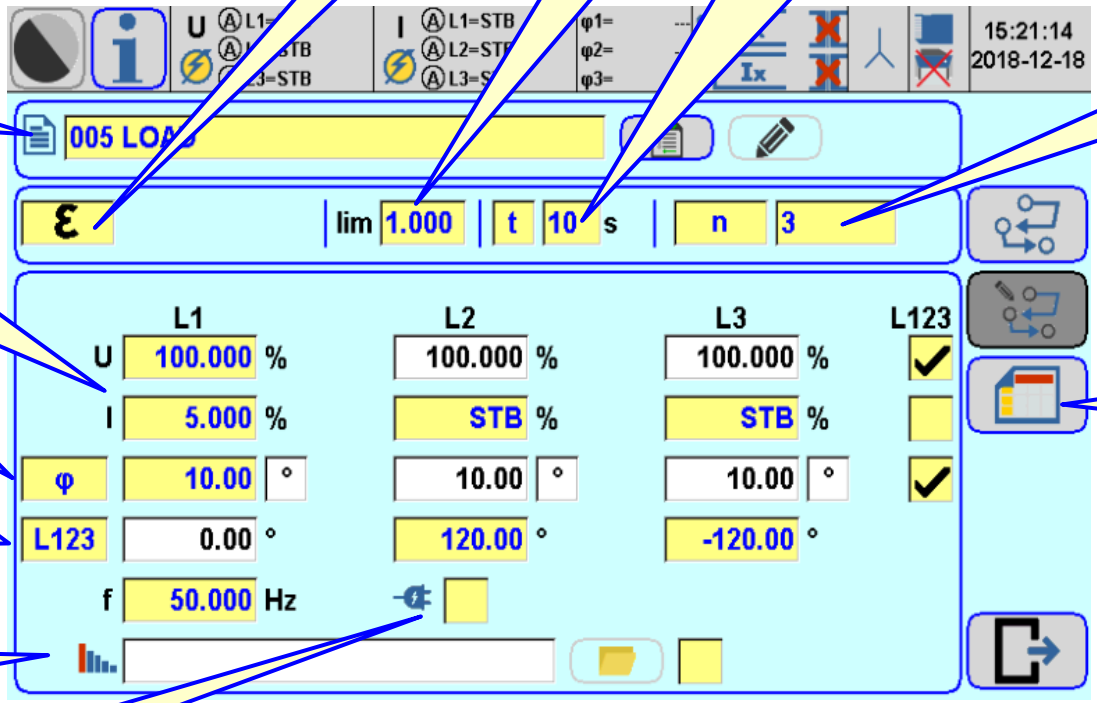
Phase shift or power factor

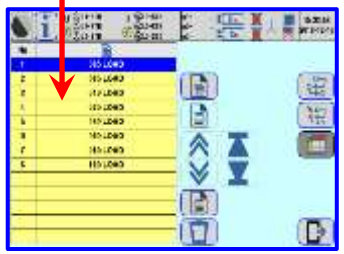
Symmetry of voltages and rotation direction

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

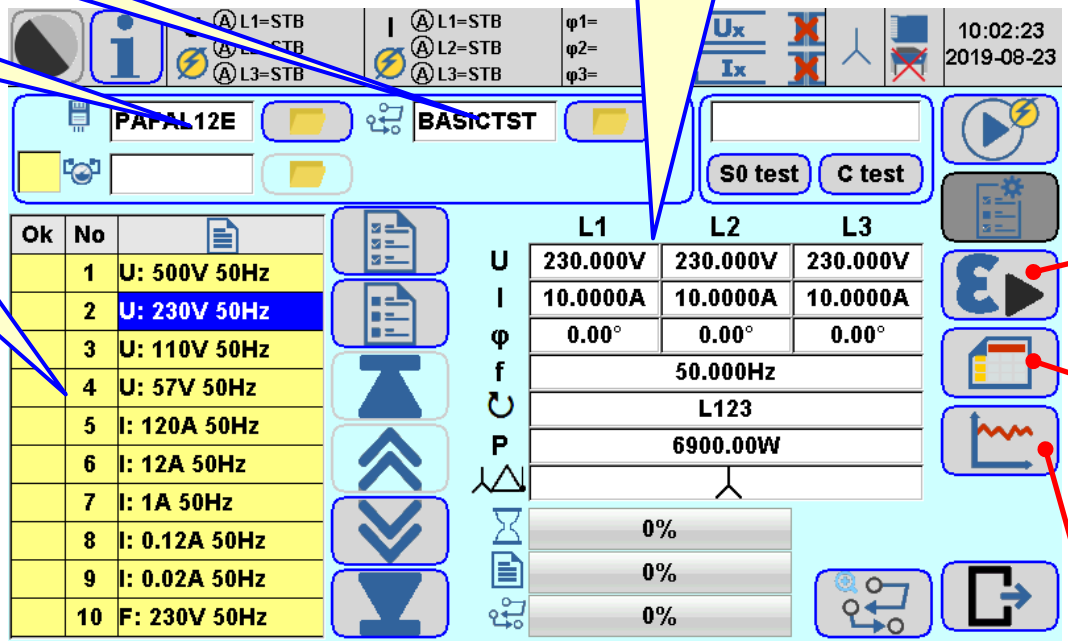
TS33 functionality: Automatic energy meter test – Execution

Test Procedure name

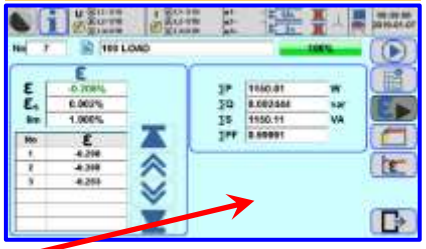
Type of Meter in data base

List of load points with one selected

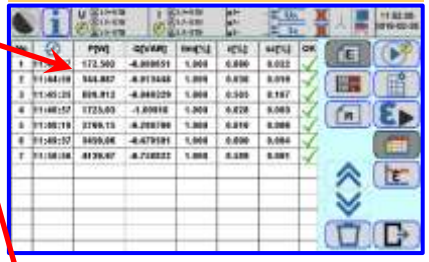
Marked load point values



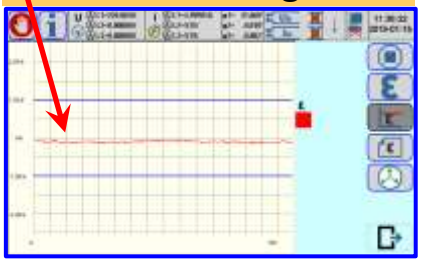
Load point execution and error results



Results in table format



Results as diagram

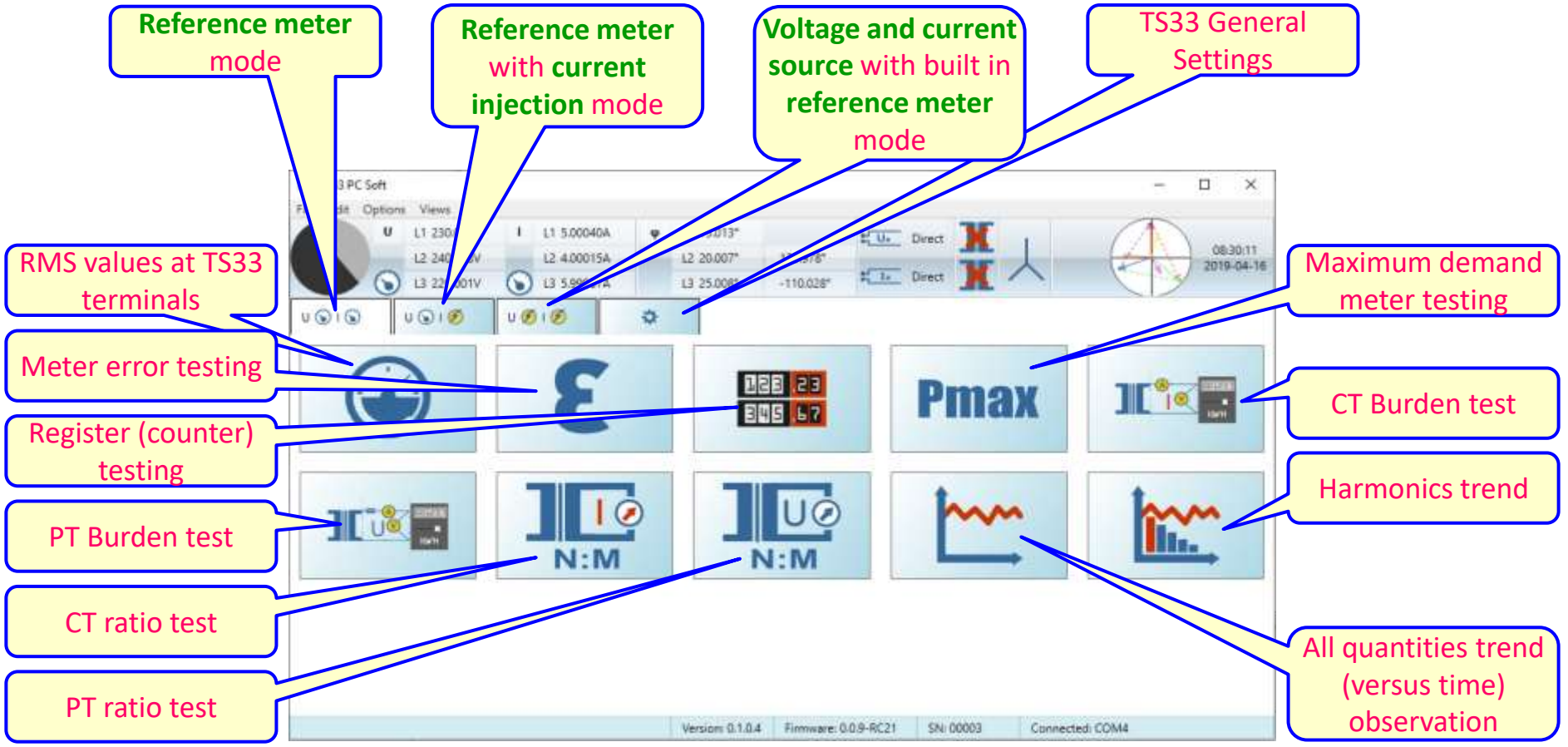


Conclusion: Automatic testing allows to perform full test of Energy Meter on site due to Meter Type and Procedures stored in data base. As results are displayed:

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

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

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

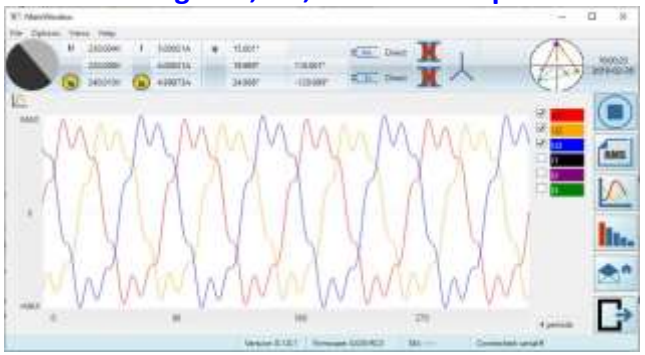


Conclusion: All functionality of the TS33 is available through **USB**, **Bluetooth** and **Ethernet** connection (including **Internet** remote control). TS33 PC Soft enables to download real time results of measurement made by TS33, download stored in memory results, readout the SD card memory and 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

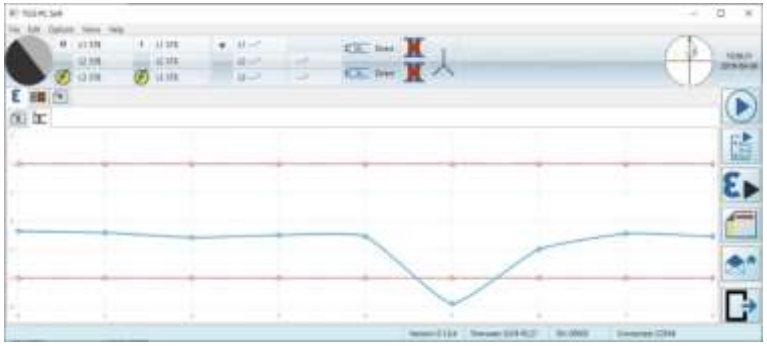
Voltage U1, U2, U3 oscilloscope



Voltage, current and THD trend

Harmonics in voltage U1

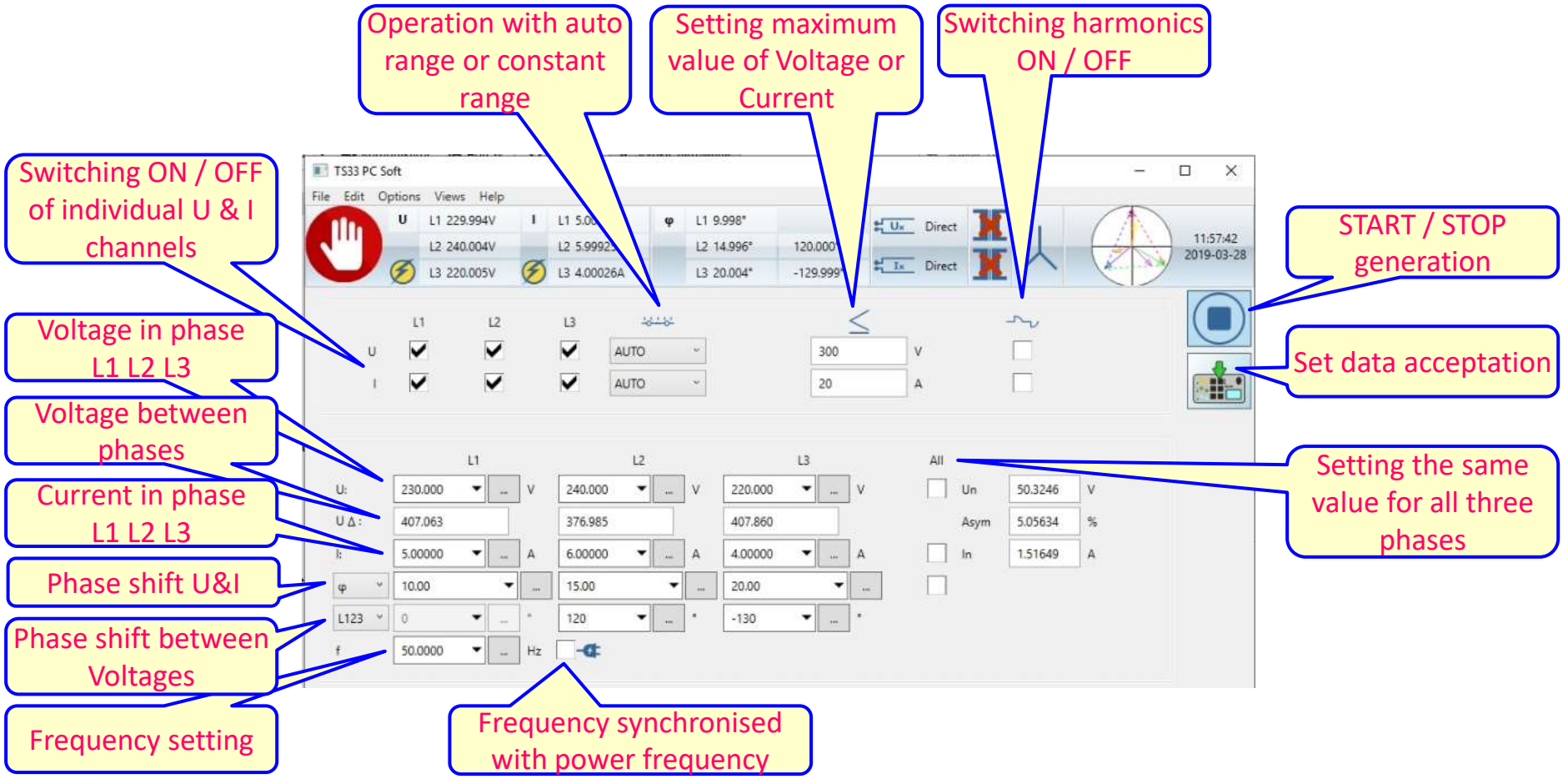
Meter error versus I load ε=f(I)



Harmonics in table form

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

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 three phase electronic (static) Energy Meter example (1)

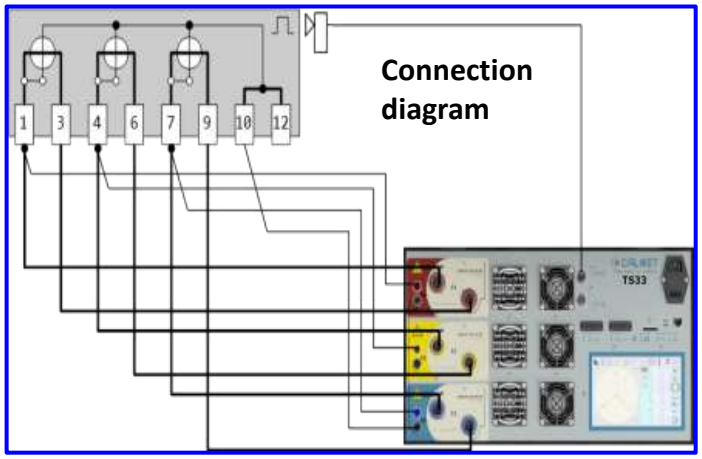
TS33 as Voltage and Current Source and Reference Meter and meter under test connected directly

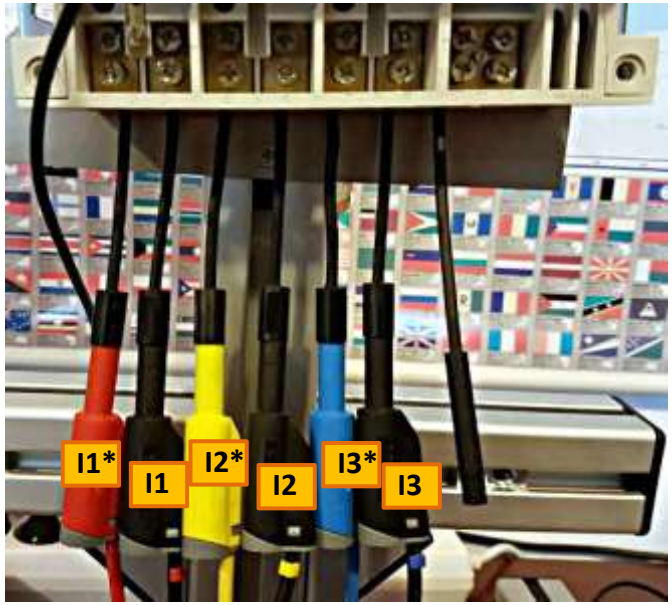
Meter parameters:
Base voltage: 230V
Base current: 5A
Max. current: 100A
Meter constant: 1000 imp/kWh

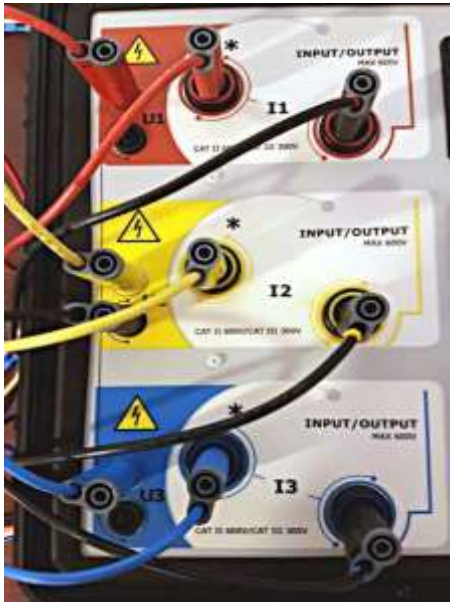
Typical three phase electronic meter with LED and its parameters

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.







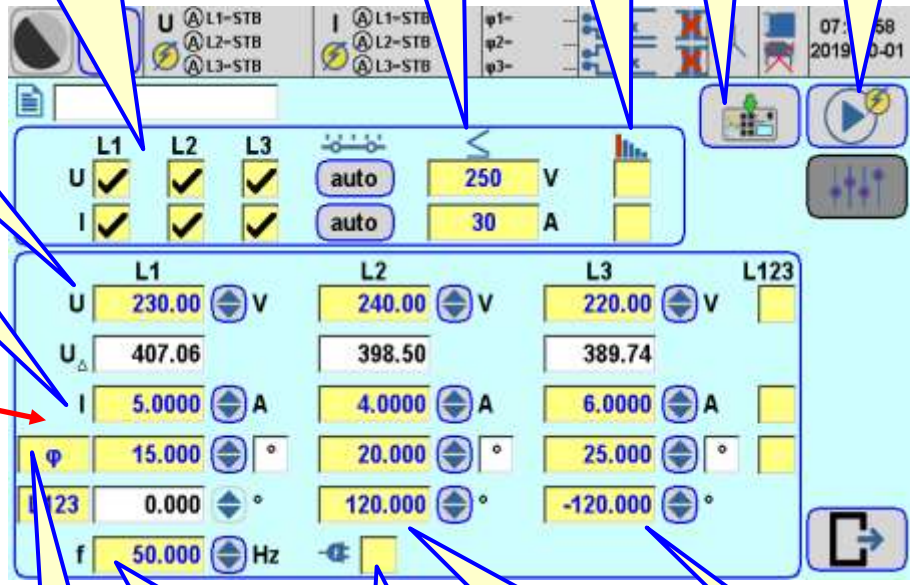
TS33: testing three phase electronic (static) Energy Meter example (2)

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)



Three phase operation; individual outputs switch ON/OFF

Limit of maximum voltage &current

Send to the output

Set harmonics

Generate signal

Set value of Voltage

Set value of current

Set value of frequency

Set phase shift between U1&U2

Set phase shift between U2&U3

Set value of phase shift U&I

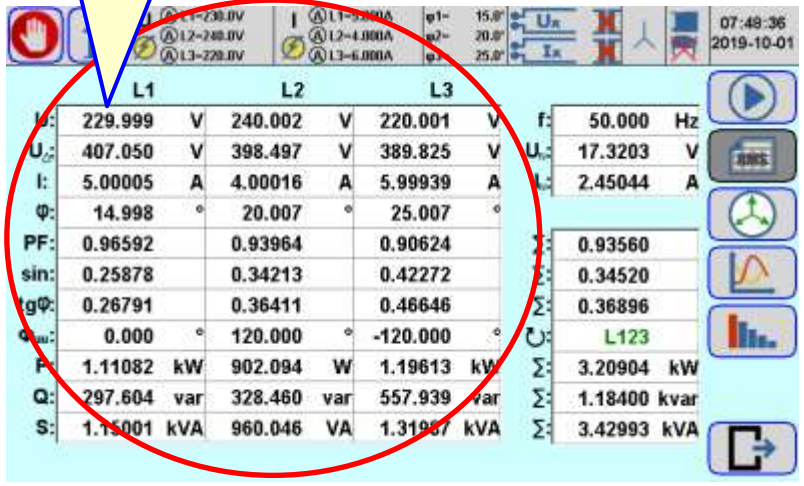
Set synchronization with network frequency

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

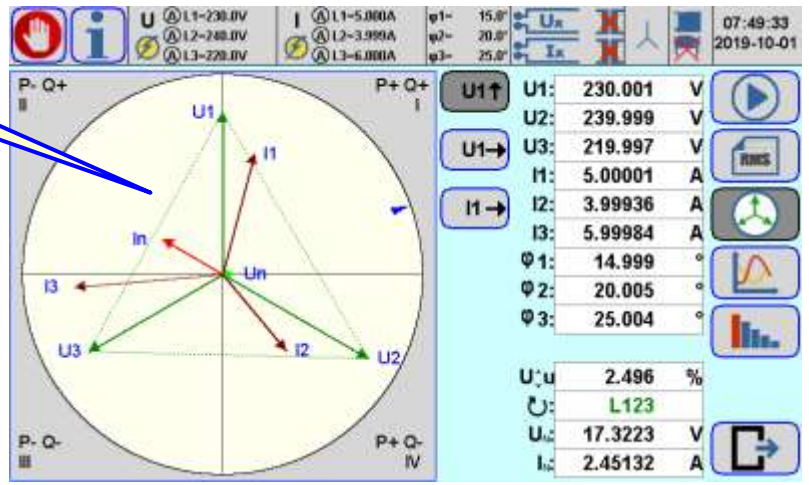
TS33 as Voltage and Current Source and Reference Meter and meter under test connected directly

Load point parameters

This mode requires meter disconnection!



Vector diagram



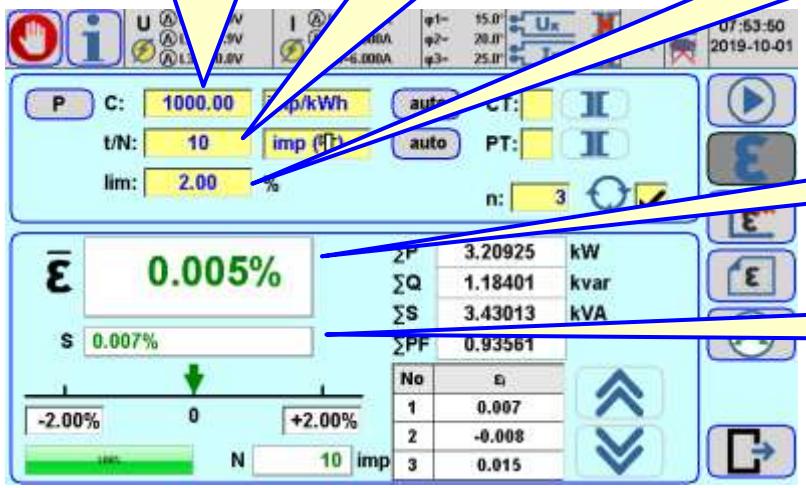
Testing schedule:

- 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

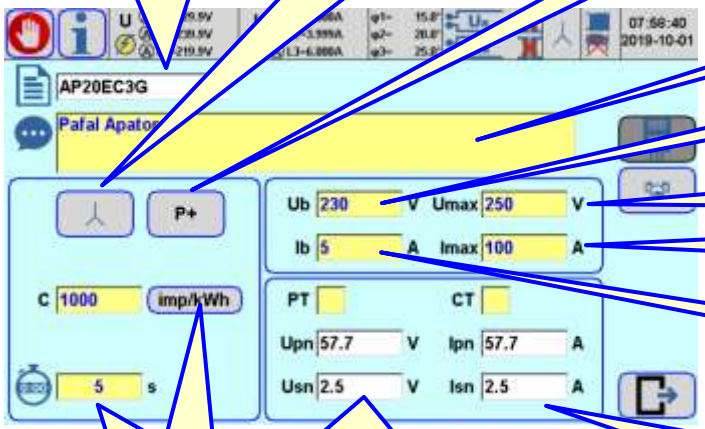
TS33: testing three phase electronic (static) Energy Meter example (4)

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

Automatic Procedure for whole load characteristics

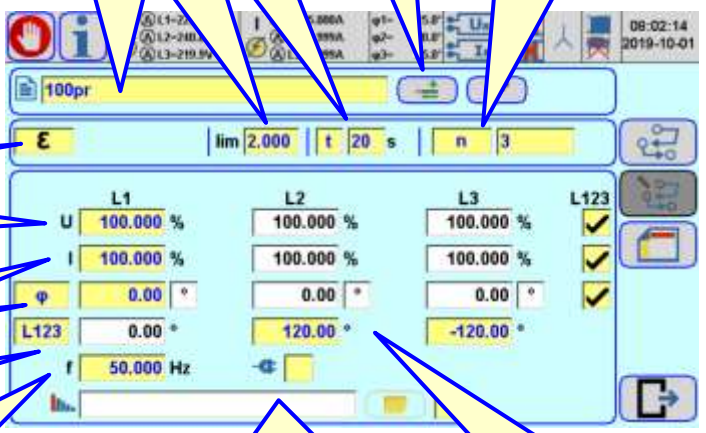
Meter Type Definition

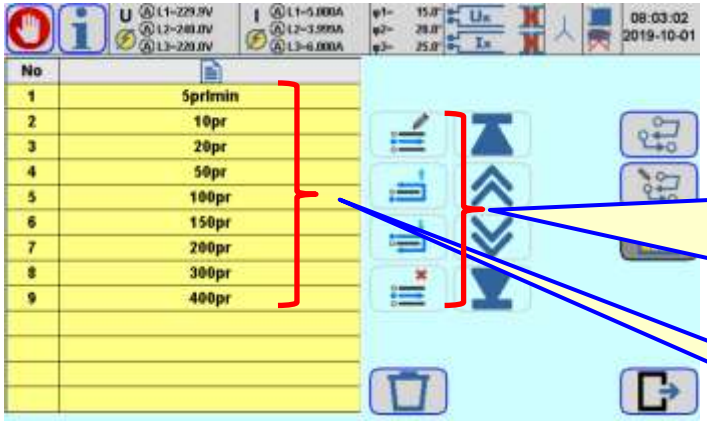
Meter name
Connection type
Power type
Comment
Base voltage
Max. voltage
Max. current
Base current
Delay time
Meter constant
PT primary & secondary voltage
CT primary & secondary current



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

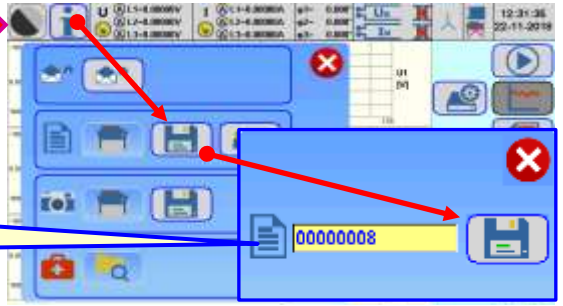




List edition insert, move up/down remove

List of load points

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



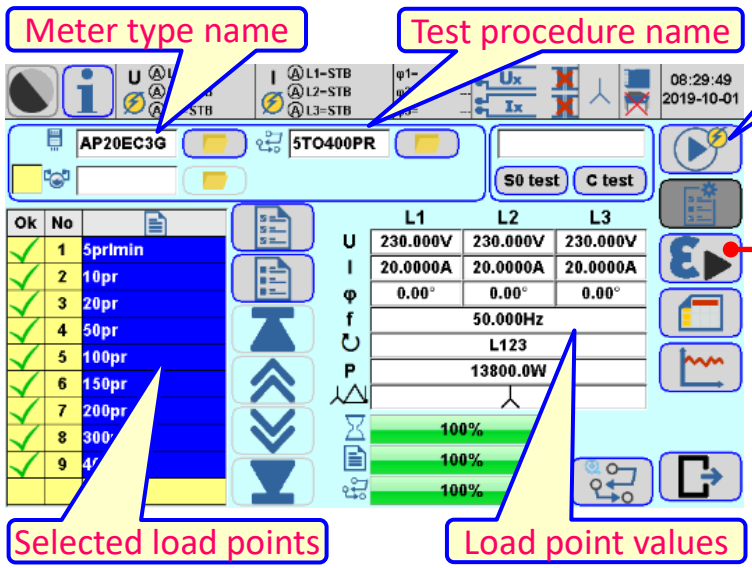
Meter or Procedure name field

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



Individual load point test

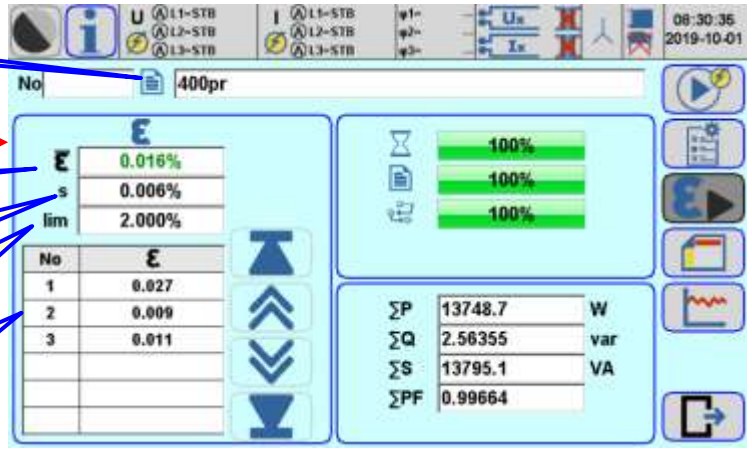
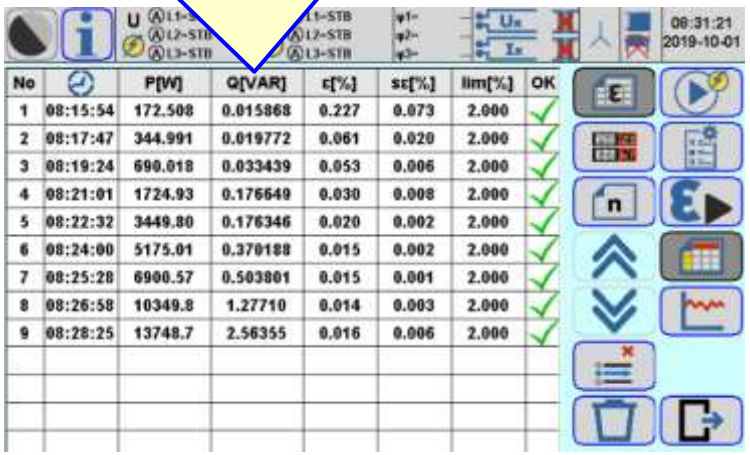


Table with results for each load point



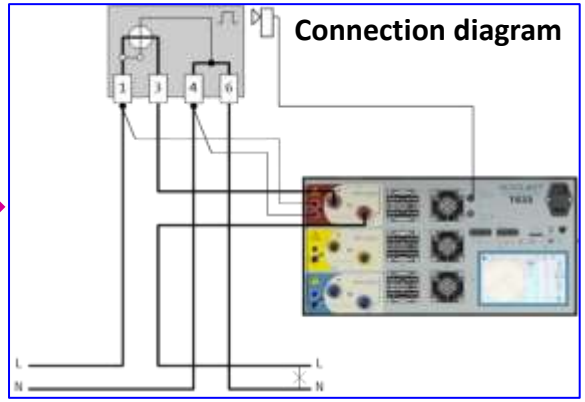
Results transferred to the PC Soft as diagram

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

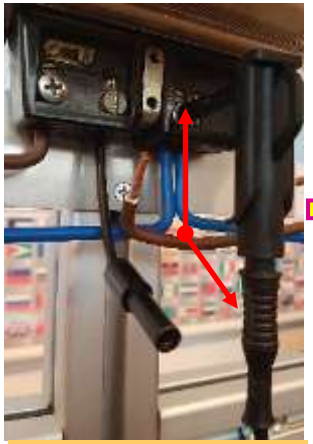
Typical, „old fashioned", electromechanical meter and its parameters



Wiring to meter terminals

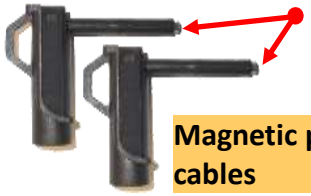
Disconnect phase wire connected to load

Connect instead „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



Magnetic plugs for safety cables

„Cu" pin for safety cables

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

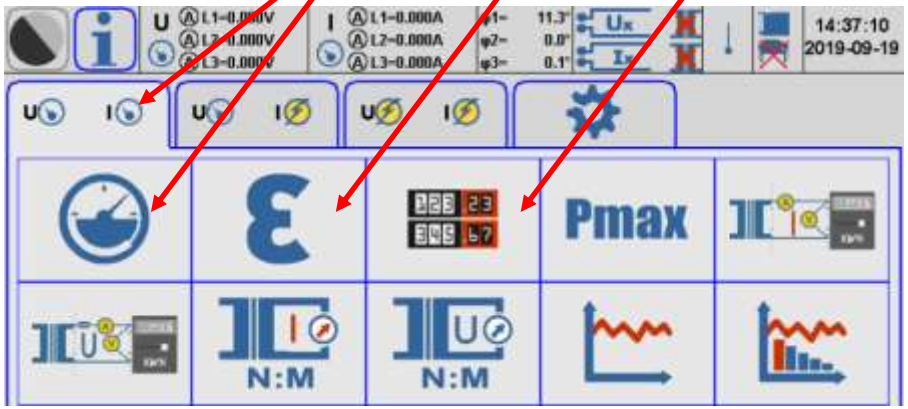
Crocodile clip

Scanning head assembly:

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

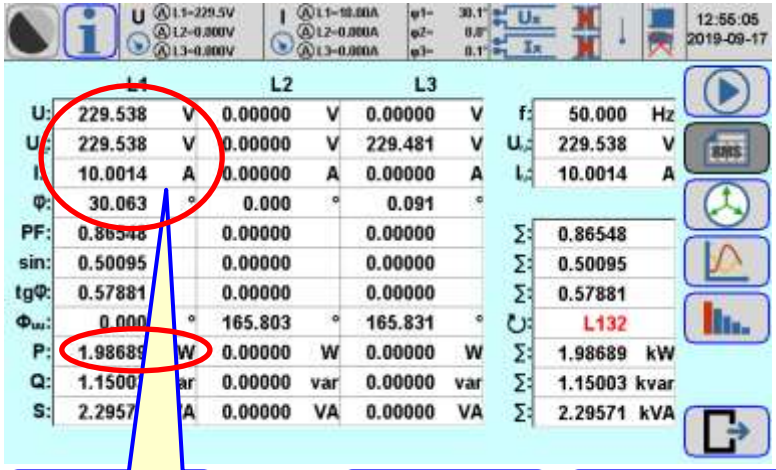
Now the measurement system is ready to test meter error and register test

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

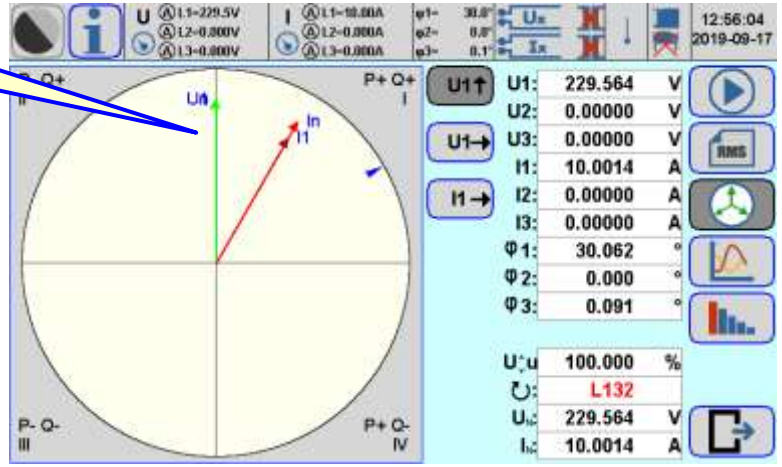


TS33 : testing single phase electromechanical Energy Meter example (3)

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

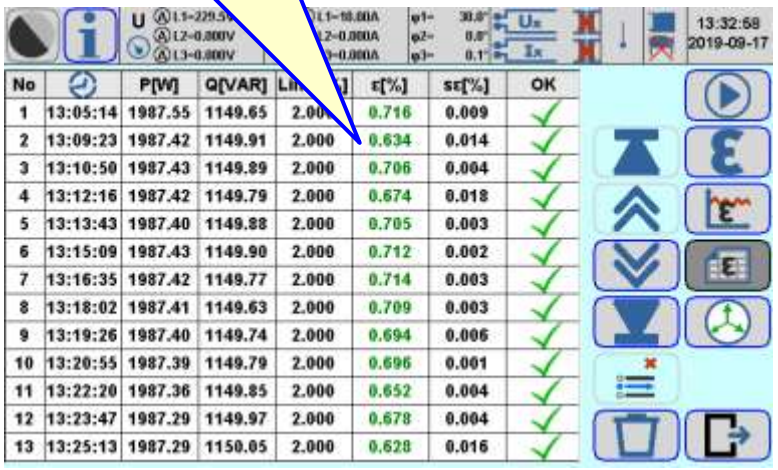
Number of results for averaging

Table with recorded results versus time

Averaged error result

Standard deviation

Partial error results



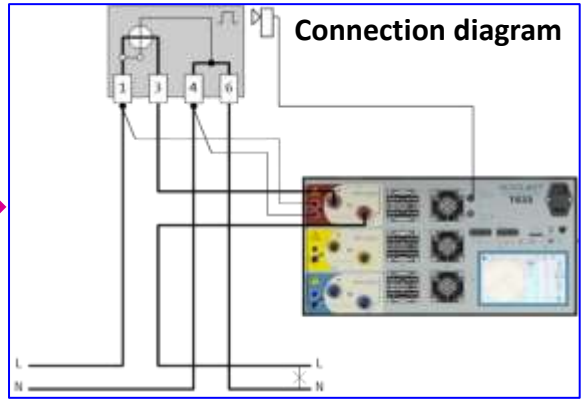
No		P[W]	Q[VAR]	Lin	ε[%]	sε[%]	OK
1	13:05:14	1987.55	1149.65	2.000	0.716	0.009	✓
2	13:09:23	1987.42	1149.91	2.000	0.634	0.014	✓
3	13:10:50	1987.43	1149.89	2.000	0.706	0.004	✓
4	13:12:16	1987.42	1149.79	2.000	0.674	0.018	✓
5	13:13:43	1987.40	1149.88	2.000	0.705	0.003	✓
6	13:15:09	1987.43	1149.90	2.000	0.712	0.002	✓
7	13:16:35	1987.42	1149.77	2.000	0.714	0.003	✓
8	13:18:02	1987.41	1149.63	2.000	0.709	0.003	✓
9	13:19:26	1987.40	1149.74	2.000	0.694	0.006	✓
10	13:20:55	1987.39	1149.79	2.000	0.696	0.001	✓
11	13:22:20	1987.36	1149.85	2.000	0.652	0.004	✓
12	13:23:47	1987.29	1149.97	2.000	0.678	0.004	✓
13	13:25:13	1987.29	1150.05	2.000	0.628	0.016	✓

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

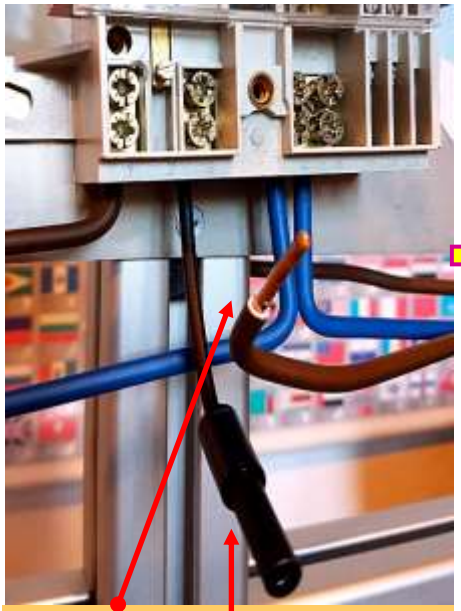
TS33 as Reference Meter and meter under test directly connected

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

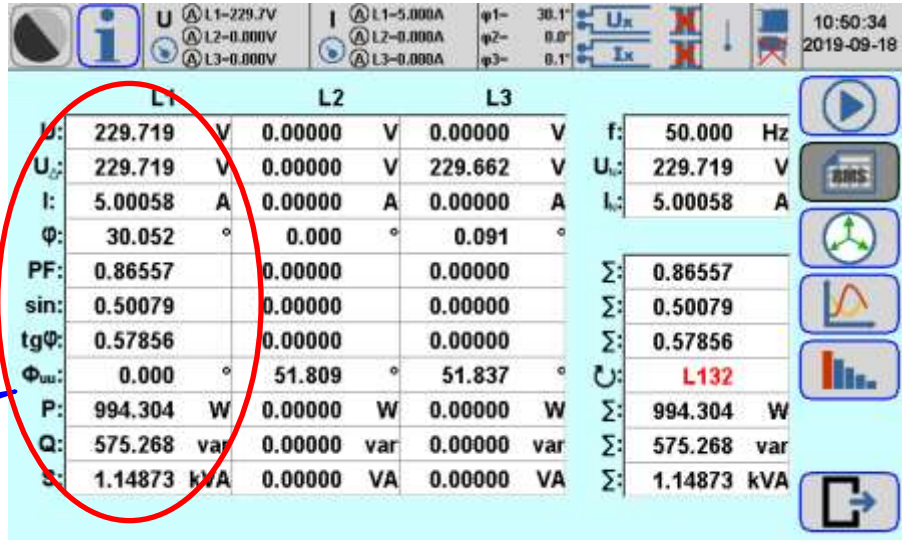
Connect voltage and current to TS33 inputs

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

Load point parameters

START test button

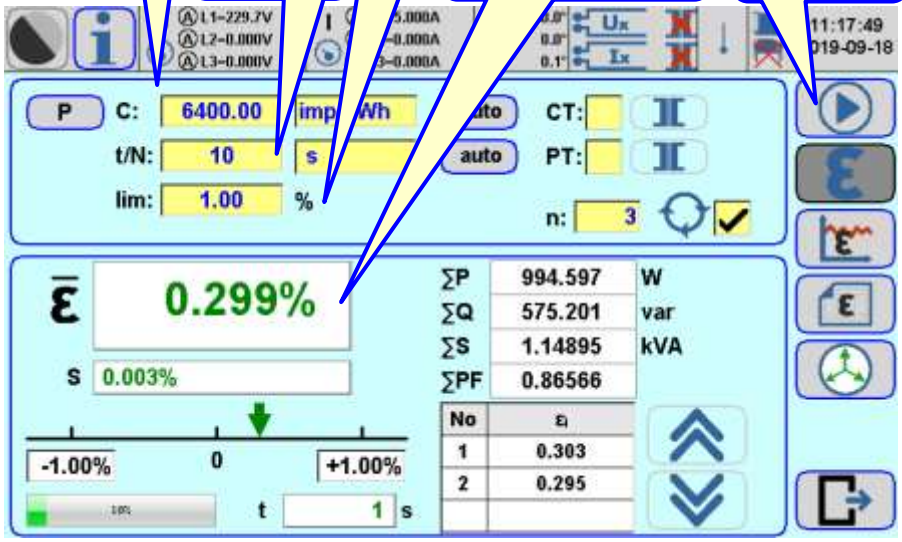
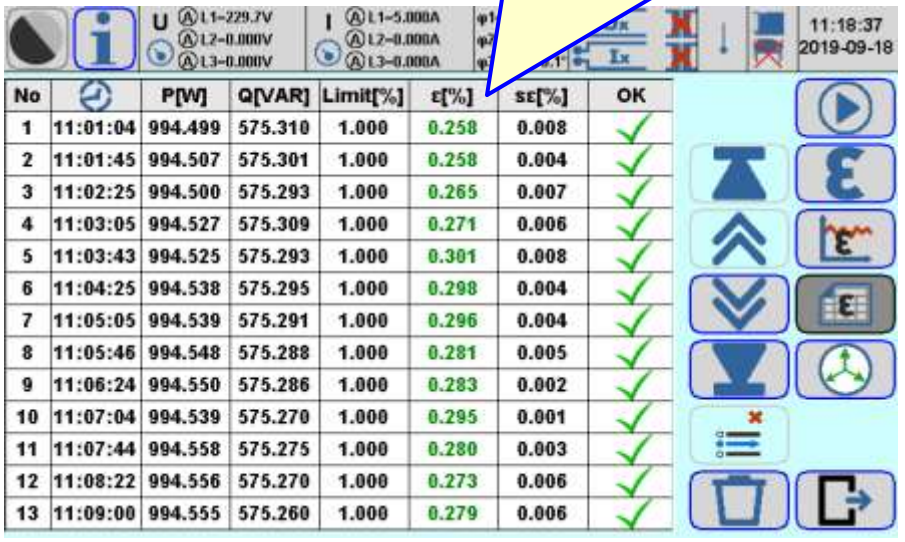


Table with recorded results versus time



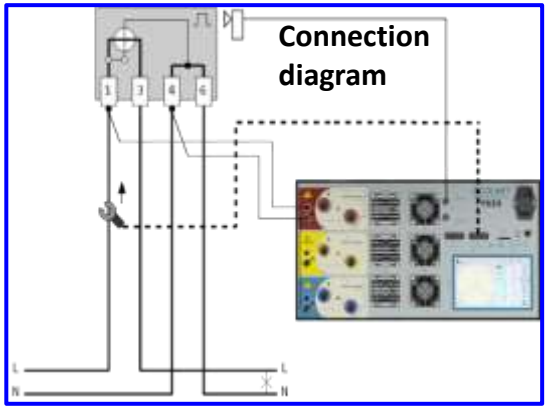
No		P[W]	Q[VAR]	Limit[%]	ε[%]	sε[%]	OK
1	11:01:04	994.499	575.310	1.000	0.258	0.008	✓
2	11:01:45	994.507	575.301	1.000	0.258	0.004	✓
3	11:02:25	994.500	575.293	1.000	0.265	0.007	✓
4	11:03:05	994.527	575.309	1.000	0.271	0.006	✓
5	11:03:43	994.525	575.293	1.000	0.301	0.008	✓
6	11:04:25	994.538	575.295	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.

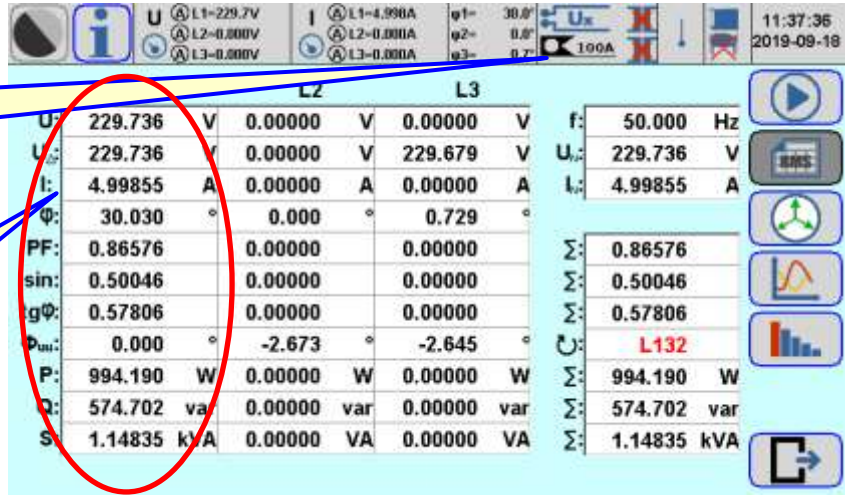
Connect voltage magnetic plugs and assembly the scanning head

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

Meter constant

Class of Meter under test

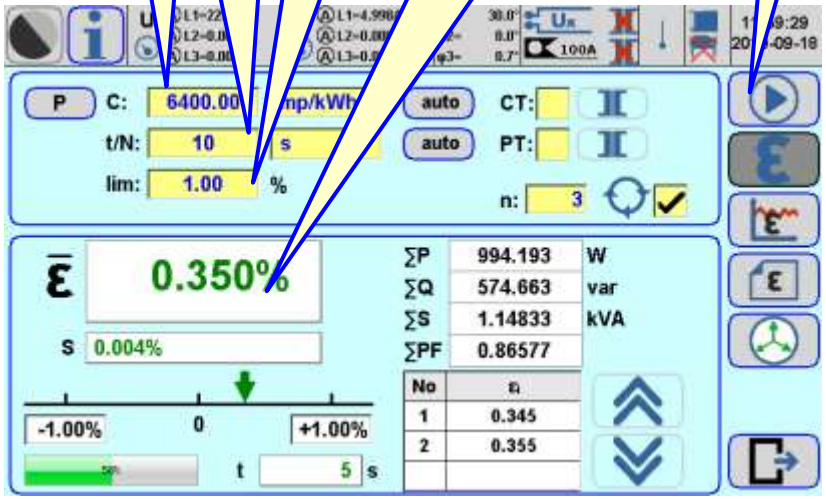
START test button

Time of test

Averaged error result

Table with recorded results versus time

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

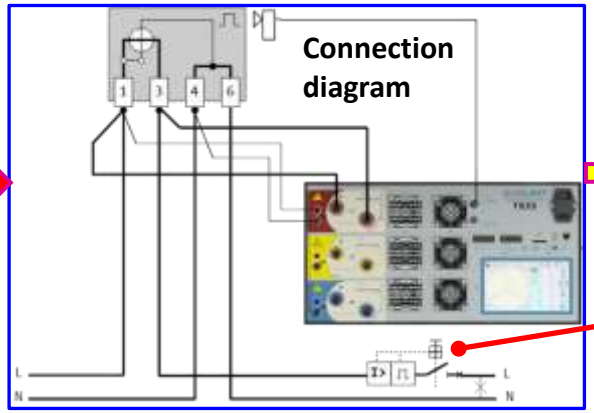


TS33 : testing single phase electronic (static) Energy Meter example (1)

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

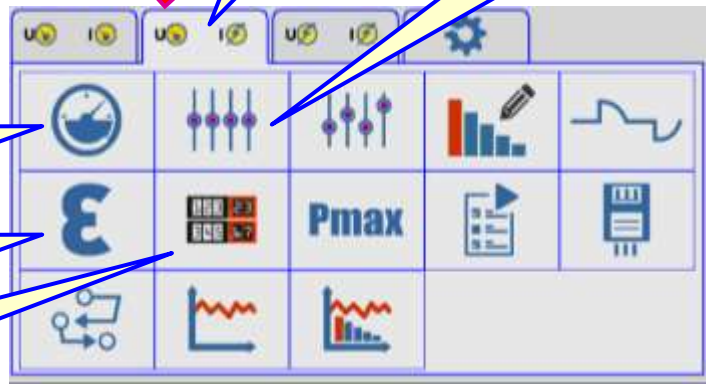


CAUTION!!!
Switch OFF the circuit breaker before TS33 connection
(voltage is taken from network, current is injected by TS33)

- **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

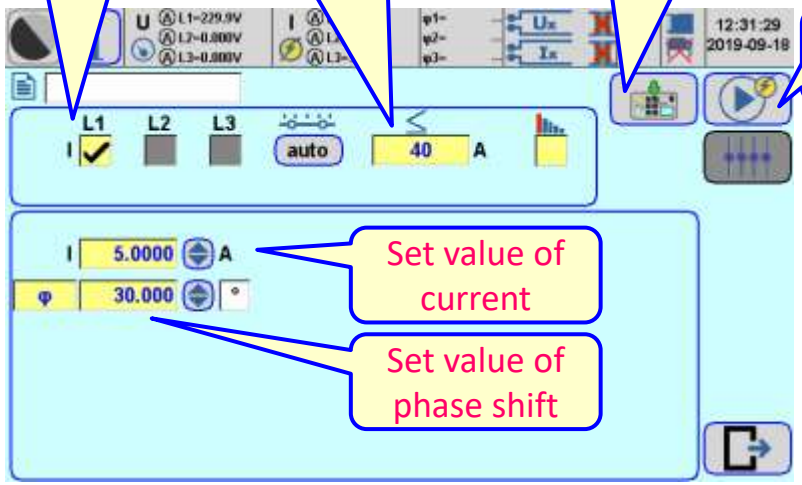
Single phase operation

Limit of maximum current

Send to the output

RMS values at the output

This mode doesn't require any meter disconnection!



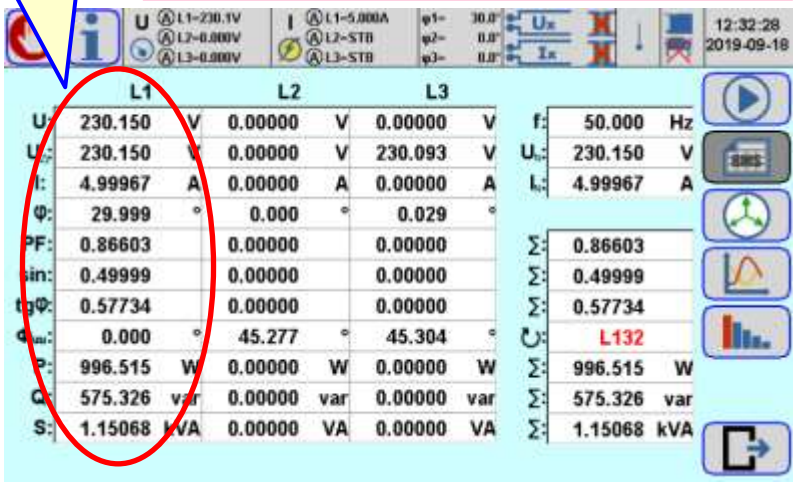
Generate signal

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**

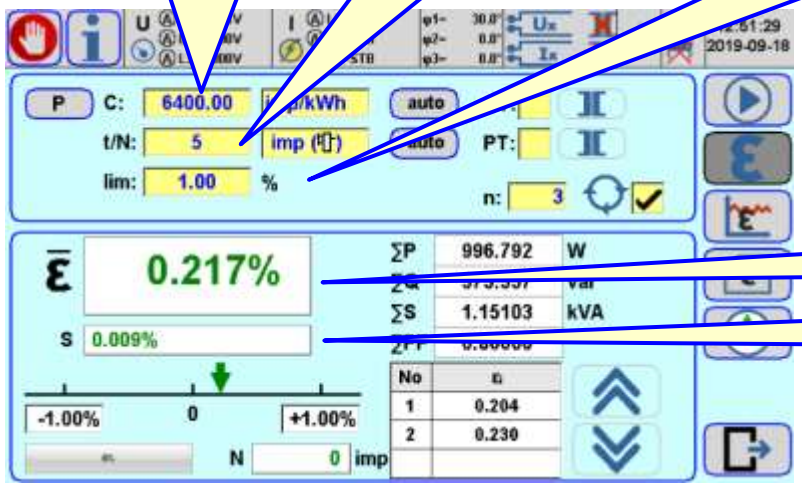


Meter constant

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	✓

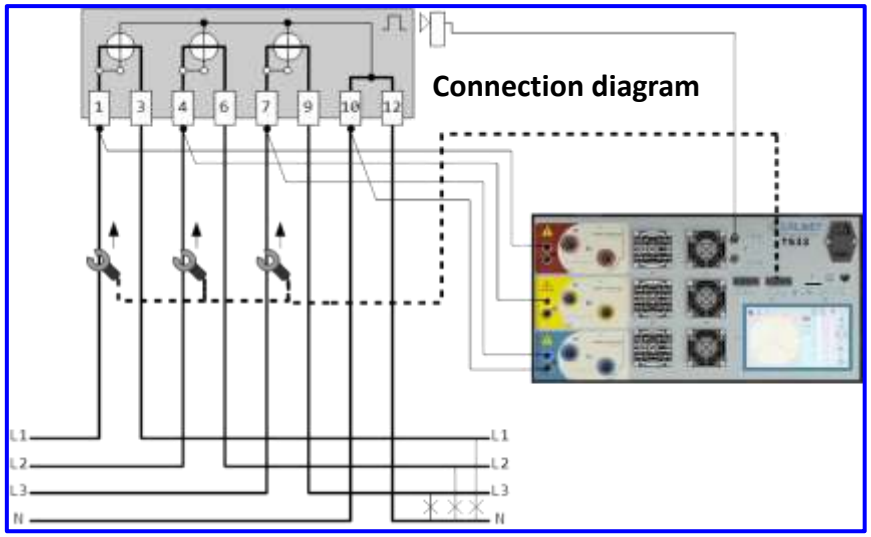
TS33: testing three phase electronic (static) Energy Meter example (1)

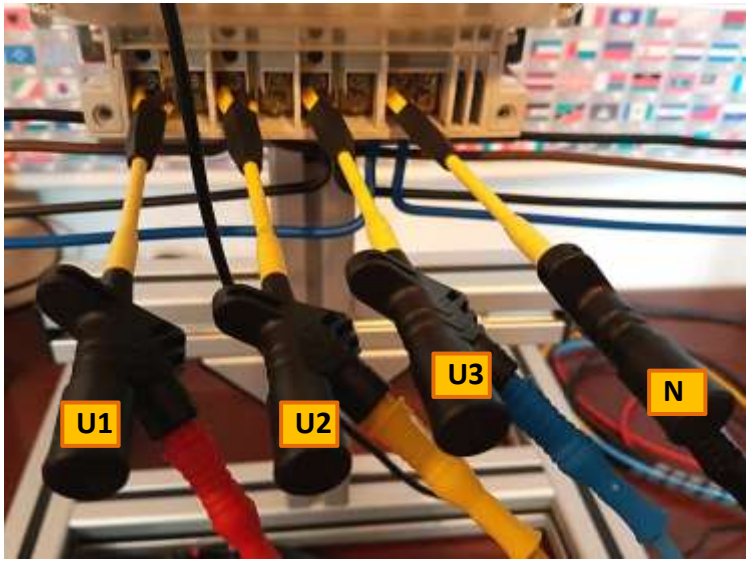
TS33 as Reference Meter and meter under test connected by means of current clamps

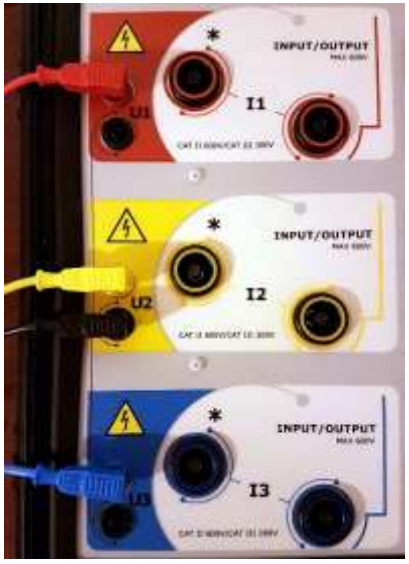
Meter parameters:
Base voltage: 230V
Base current: 5A
Max. current: 100A
Meter constant: 1000 imp/kWh

Typical three phase electronic meter with LED and its parameters

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



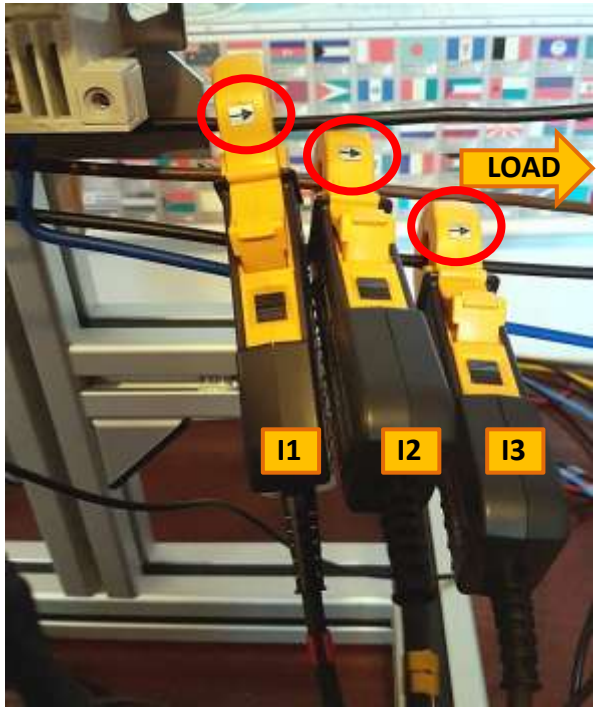




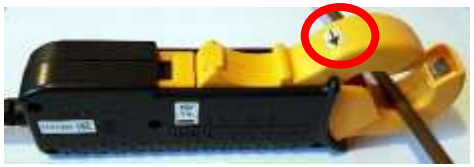
Connect voltage U1, U2, U2 and neutral N to voltage inputs of TS33.
Neutral inputs in the TS33 are internally connected between them.

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 (⇨)



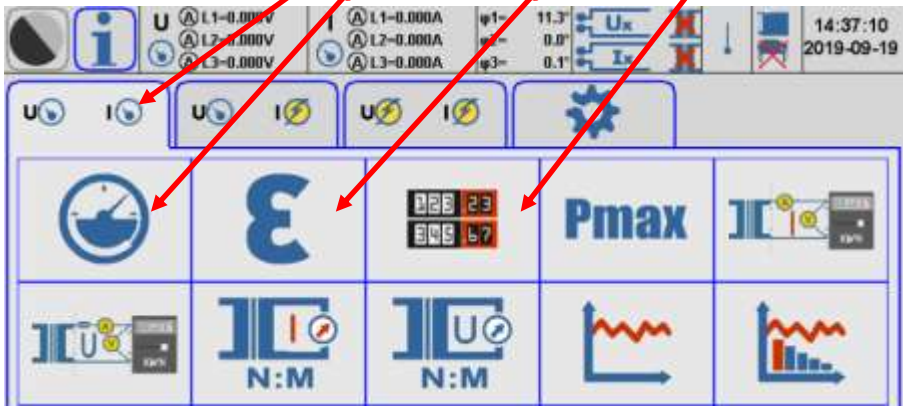
Open clamp jaws and place them on wire. Direction (⇨)!

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



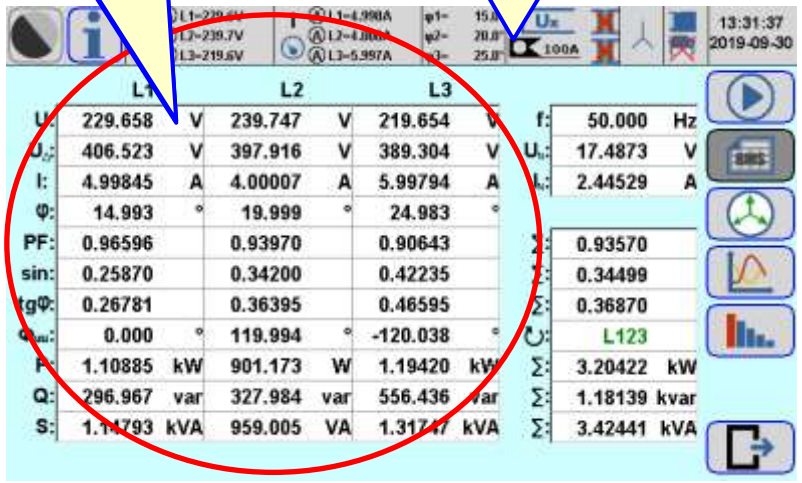
TS33: testing three phase electronic (static) Energy Meter example (3)

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

Load point parameters

CT100AC current clamp

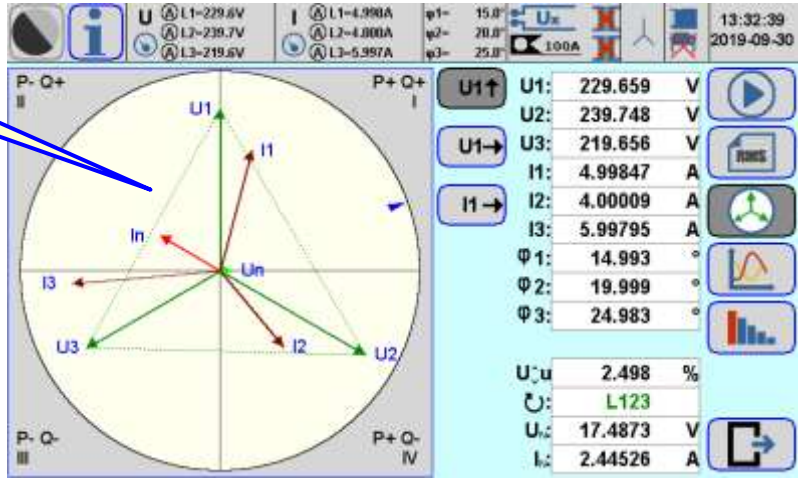
This mode doesn't require any meter disconnection!



Vector diagram

Testing schedule:

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

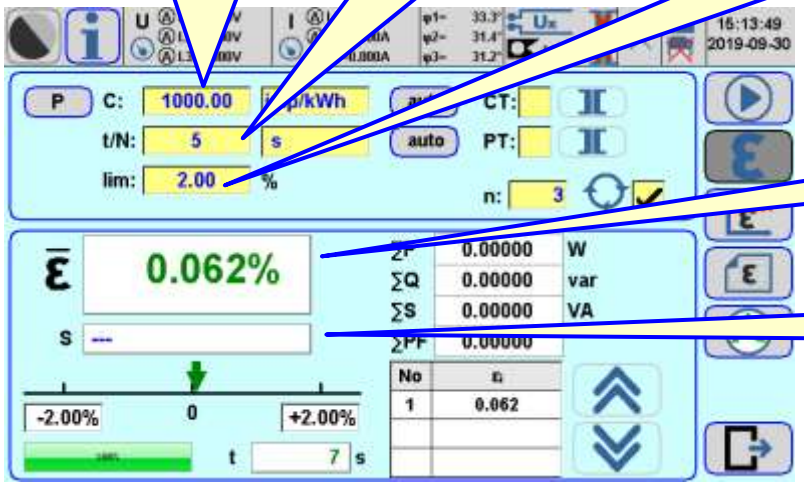


Meter constant

Time of test

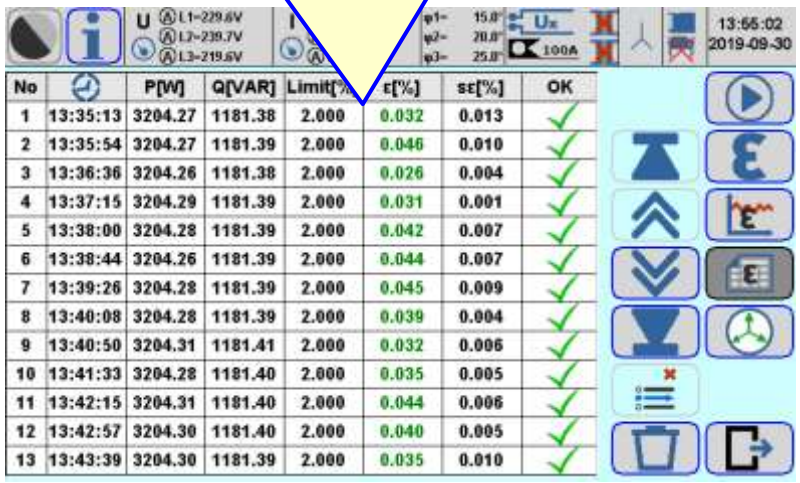
Class of Meter under test

Table with recorded results versus time



Averaged error result

Standard deviation

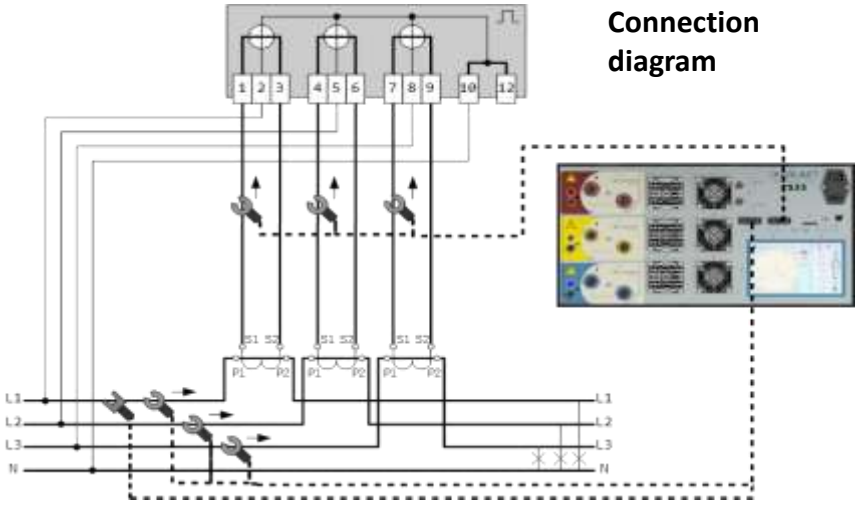


TS33: testing current transformers CT ratio and phase shift error example (1)

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

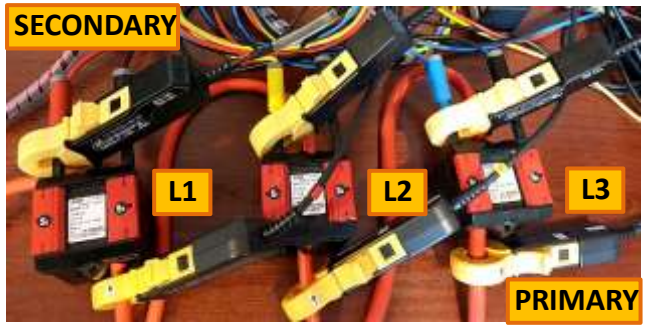
CT parameters:
Ratio: 100/5A
Power:2.5VA
Class: 0.2

Typical current transformer CT in metering installation



Connection diagram

TS33 can test automatically up to 3 different CTs at time



TS33 side clamps connetion

Primary clamps

Secondary clamps

Accuracy class of current transformer

Nominal primary current

Nominal secondary current

Primary current

Secondary current

Phase error

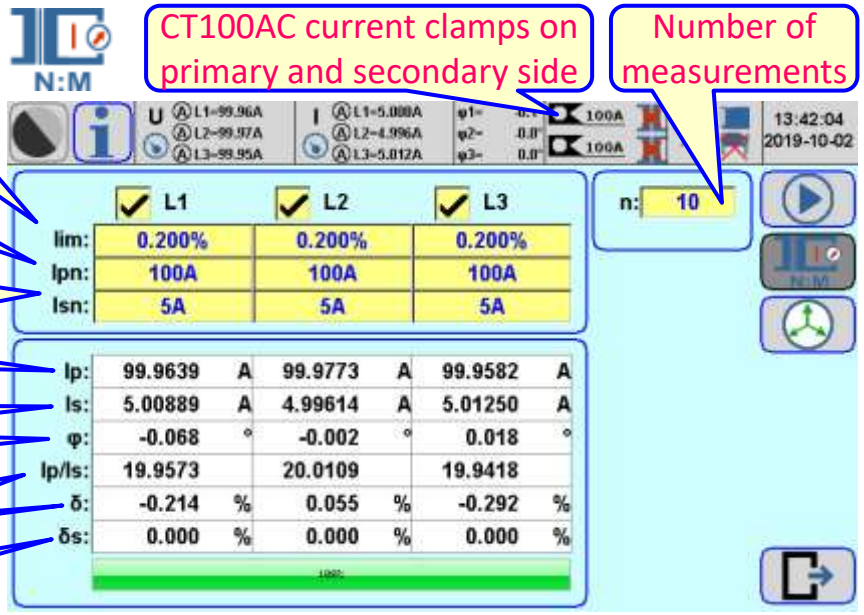
Actual ratio

Ratio error

Standard deviation

CT100AC current clamps on primary and secondary side

Number of measurements



TS33: testing current transformers CT burden example (1)

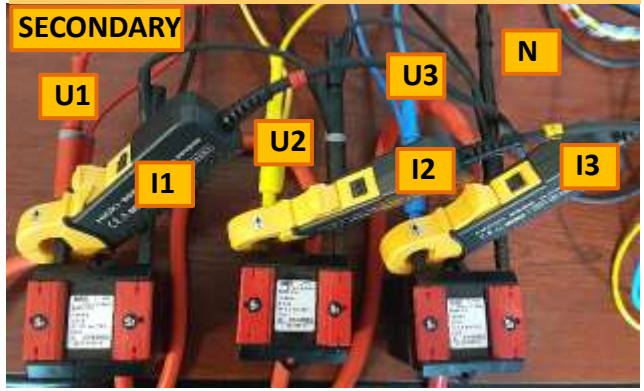
TS33 as Reference Meter and CT secondary current measured by current clamps and voltage directly

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

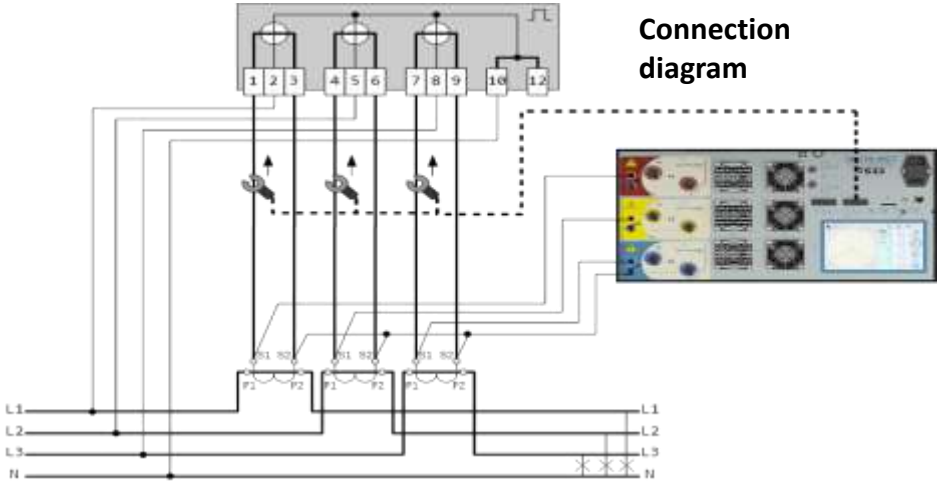
Typical current transformer CT in metering installation

TS33 side voltage connetion

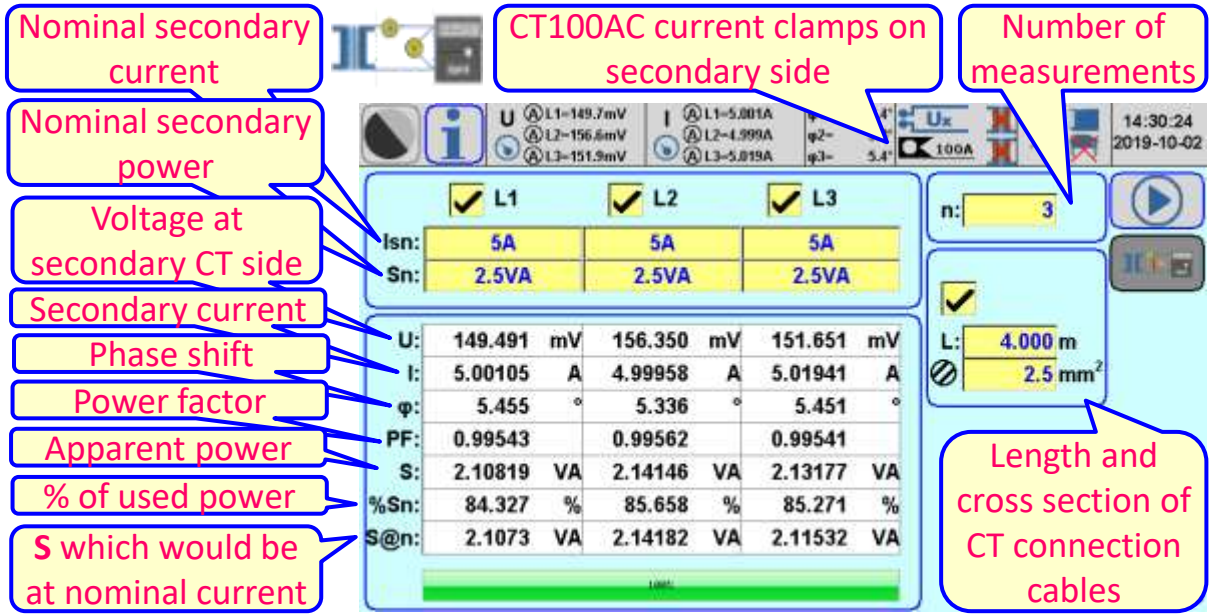
Voltage and clamps connection to the CT



Connection diagram



TS33 can test automatically up to 3 different CTs at time



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

TS33: how to order – versions, options, accessories

TS33 versions: accuracy class 0.02%, 0.04% or accuracy class 0.1%

Standard scope of delivery

TS33 Automatic Test System

Power cord

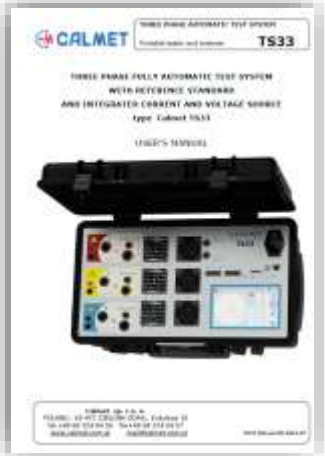
Fuses

C091 Amphenol connector

EA36

Voltage and current connection cables

Manufacturer Calibration Certificate



Operation manual

TS33: how to order – versions, options, accessories

TS33 optional accessories:

Optional scope of delivery 1

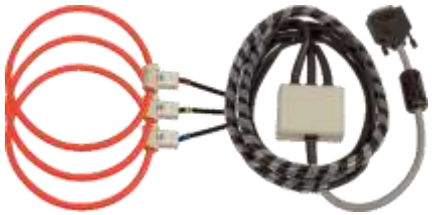
Laptop PC

TS33 PC Soft

CT10AC current clamps

CT100AC current clamps

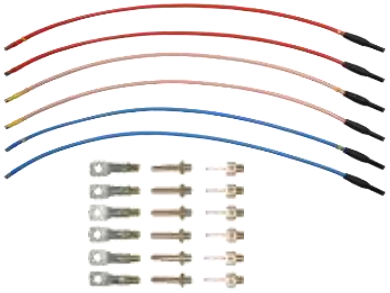
CT1000AC current clamps



FCT3000AC.B flexible clamps

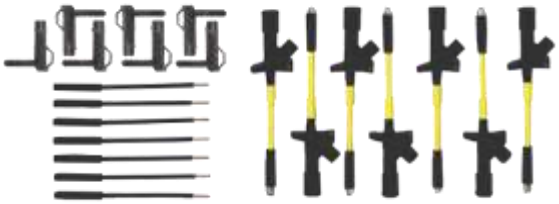
AmpLiteWire 2000AC (@150kV)

VoltLiteWire 40kVC



EA30 120A cable set

DR200D thermal printer



EA20 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

ET31 case for additional accessories

Calibration Certificate from ISO17025 accredited lab

Certificate of Origin from Customs and Chamber of Commerce

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

CALMET
Smart Calibration Devices

HOME PRODUCTS LABORATORY DOWNLOAD ABOUT US CONTACT

TOP PRODUCTS

- TS33 - Three phase Fully Automatic Test System
- C300B - Power Calibrator
- TE30 - Working Standard

PRODUCTS BY CATEGORY

- Power calibrators and power quality calibrators
- Multifunction calibrators
- Resistance calibrators
- Electricity meters testers and reference standards
- Instrument transformers testers
- Protection relays testers
- Network quality analysers
- Meter test stations

Electricity meters testers and reference standards

TS33 - Three-phase Fully Automatic Test System with Reference Standard and Integrated Current and Voltage Source

The Calmet TS33 portable test system consists of a three-phase reference meter of accuracy class 0.04% (or 0.1%) and an integrated three-phase current and voltage source up to 3x120A/600V

Data sheet

Read more ...

TE30 - Portable Three-Phase Working Standard and Power Quality Analyzer

Electricity meters tester class 0.05 and 0.1. Three phase tester of current transformers and analyser of power network quality. It makes possible electricity meters testing on the site or in the laboratory

Data sheet

Read more ...

Caltest 10 - Electricity meters tester

Single phase portable electricity meters tester class 0.5 powered from tested circuit with load force possibility apart from tested object. There is no need to disconnect the users during measurement

Data sheet

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