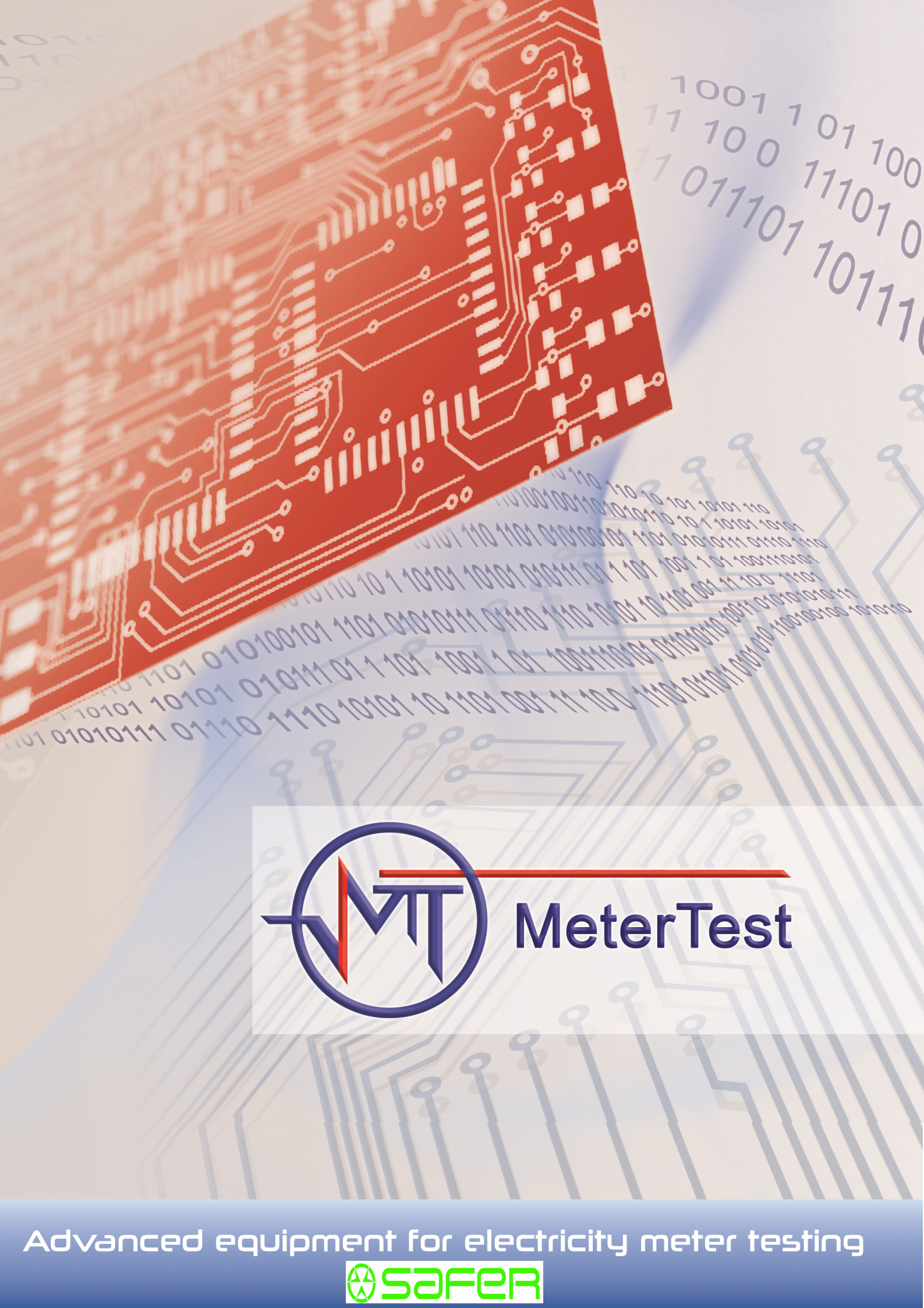


MeterTest

Advanced equipment for electricity meter testing

SAFER

Contents

MeterTest specializes in designing and manufacturing of professional meter tests equipment for the electricity meter testing and calibration. We provide a range of professional equipment for utility companies, energy meter manufacturers, governmental bureaus of metrology and other customers interested in electricity meters testing. Thanks to close cooperation with other engineers we can offer our customers:

- Stationary Meter Test Equipment
- Portable Meter Test Equipment
- Reference Standards
- Power Sources
- Racks
- Power Calibrators
- Network Analysers
- Optical Port Reader IEC1107
- And other meter test equipment components

MeterTest Sp. z o.o. is a producer of the highest quality professional meter tests equipment for the electricity meter industry. Thanks to a long-term experience in the industry and close cooperation with our customers we offer the most valuable products in the market which feature superb functionality and adjustment to clients needs and to law regulations.

Our engineers are outstanding and skilled experts in the field and our products are designed and manufactured utilizing the latest technologies for power conversion and energy measurement. The company research & development departments continuously raise technical advantages of our products as well as their quality and functionality.

We offer :

- 1- and 3-phase meter test equipment;
- power sources;
- reference standards;
- high-precision, electronically compensated current separating transformers;
- high-precision, electronically compensated voltage separating transformers;
- network test bench operating software;
- refurbishing of existing meter test benches;
- other equipment made to order;

CERTYFIKAT
CERTIFICATE

Przyznany organizacji:
Issued for:

„METERTEST"
SPÓŁKA Z OGRANICZONĄ ODPOWIEDZIALNOŚCIĄ

ul. Armii Krajowej 7
58-100 Świdnica

Biuro Certyfikacji Polskiego Rejestru Statków S.A., al. gen. Józefa Hallera 126, 80-416 Gdańsk, zaświadcza, że System Zarządzania Jakością wyżej wymienionej organizacji został oceniony i stwierdzono jego zgodność z wymaganiami:

Certification Bureau of Polski Rejestr Statków S.A., Al. Gen. Józefa Hallera 126, 80-416 Gdańsk, certifies that the Quality Management System of the above organization has been assessed and found to be in accordance with the requirements of:

ISO 9001:2008

Zakres certyfikacji:
PROJEKTOWANIE, PRODUKCJA, MONTAŻ U KLIENTA ORAZ SERWIS URZĄDZEŃ KONTROLNO-POMIAROWYCH DLA PRZEMYSŁU ENERGETYCZNEGO, W SZCZEGÓLNOŚCI URZĄDZEŃ DO WZORCOWANIA I LEGALIZACJI LICZNIKÓW ENERGII ELEKTRYCZNEJ ORAZ ICH KOMPONENTÓW

Scope of certification:
DESIGN, MANUFACTURE, INSTALLATION AT CUSTOMER SITE AND SERVICE OF TESTS AND MEASUREMENT EQUIPMENT FOR THE ENERGETIC INDUSTRY AND PARTICULARLY ELECTRICITY METER TEST EQUIPMENT AND ITS COMPONENTS

Pierwsze wydanie Certyfikatu: / Certificate first issue: 10.12.2008

Certyfikat jest ważny do: / The Certificate is valid until: 09.12.2011

Nr Certyfikatu: / Certificate No.: NC- 1788

Gdańsk, 09.02.2010

Jan Jankowski

Andrzej Kufel

AC 014
QMS

We are an ISO 9001:2008 certified company

All products come with technical support and assistance as well as with guarantee and after-guarantee service.

Single– and Three Phase Meter Test Equipment of ASTeL 2 Series

The ASTeL 2 meter testing system is a fully automatic system enabling simultaneous, multi-position calibration and legalization of **single-phase and three-phase electric energy meters**. The automatics include power sources, reference standards, stand controllers, photoelectric scanning heads, separating transformers and other elements of the system. All these elements are controlled through a Windows® based executive program.

The use of the-latest-design signal processors and advanced technologies of signals synthesis, as well as the unmatched precision, quality and functionality qualify the system for testing all kinds of electric energy meters available on the market, form the simplest electromechanical ones to multi-functional electronic meters, including the prepaid, multi-system, multi-quadrant meters with power recorders, and other.

For determining the tested meters errors, the ASTeL 2 system employs the *reference standard meter method*. The error of the tested meter is determined by counting impulses generated by the reference standard within gating time determined with the photoelectric scanning head, which detects the meter disc movement or with the LED flash of the tested meter. All kinds of other tests indicated in the subject norms are available, such as the test of no-load condition, the test of starting condition, the test of meter constant,the test of maximum power demand indicator, and many other.

An important feature of the system is the fact that it performs automatically additional operations facilitating the testing process, which are not defined in an open way, e.g. the system automatically sets tested meters in the mark-in-front position before performing the test of no-load condition or the test of starting condition.

The ASTeL 2 system is a modular construction and the user has a great influence on its final arrangement and functionality. The basic functional blocks are the power source, the reference standard, the suspension racks with stand controllers and the computer station with the operating software. A whole range of options and additional accessories are available. The table containing the list of the system basic performance, represented on the next page, may provide help in identifying own individual needs. There are, among others, single-phase systems, three-phase ones, of different class and different number of measuring positions. A list of available accessories is also presented in the table.

Thanks to excellent parameters, great functionality and flexibility the ASTeL 2 systems find application in utility companies, energy meter manufacturers, governmental bureaus of metrology and other customers interested in electricity meters testing.

Designation code:

ASTeL □ . 2 □ - □ □ - □ □ □ □ □ - □ □ □

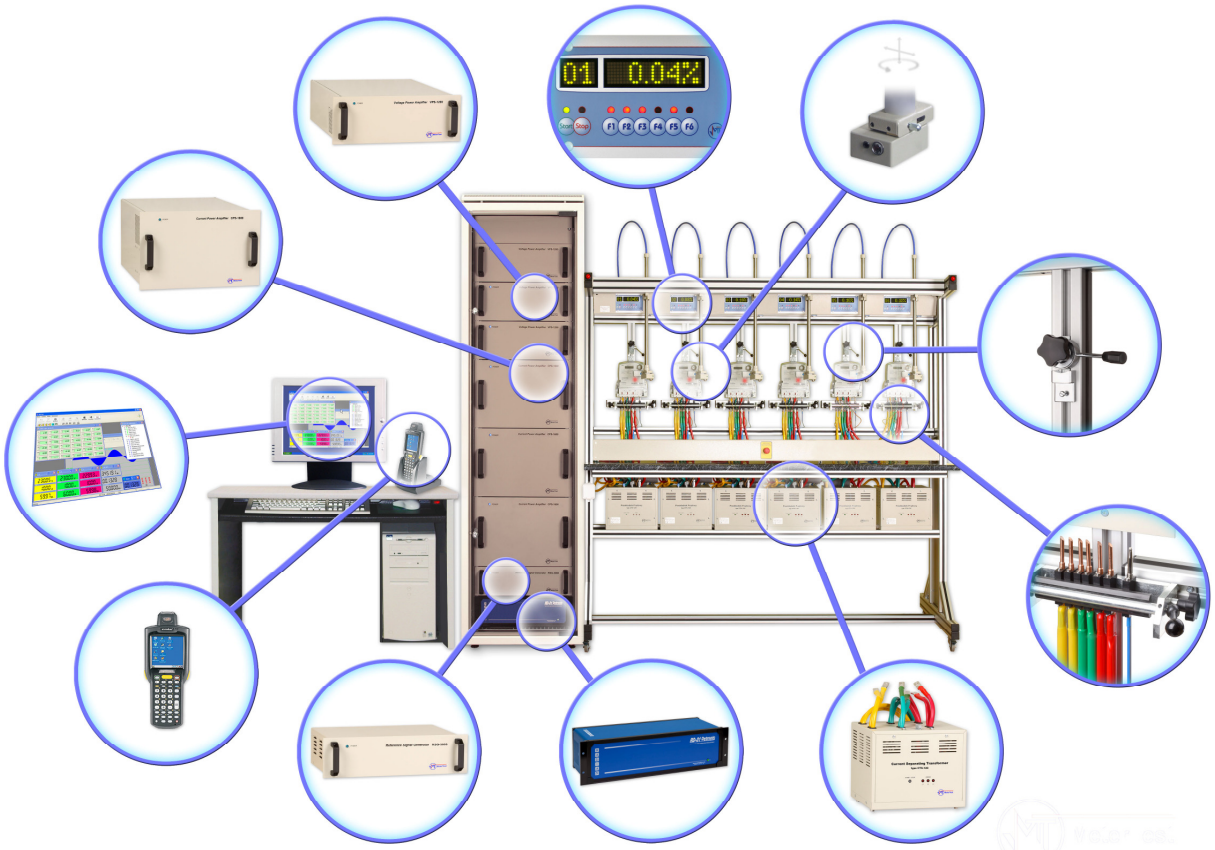
- Number of phases
  - 1 – single chase
  - 3 – three phase
- Reference Standard type
  - 4 – RD-20 / 30
  - 2 – RD-21 / 31
  - 1 – RD-23 / 33
- Voltage Integrated Source
  - 0 – VIS-400
  - 1 – VIS-1200
  - 2 – VIS-2600
- Current Integrated Source
  - 0 – CIS-600
  - 1 – CIS-1600
  - 2 – CIS-3000
- Rack arrangement
  - V – vertical bars
  - H – horizontal bars
- Rack arrangement
  - S – single sided
  - D – double sided
- Stand Controller
  - S – IPO standard
  - E – IPO extended
- Isolation transformer type
  - C – CTS
  - M – MSVT
- Number of positions
  - 2 ÷ 60 positions
- Reference Standard options
  - See RD' leaflets

Other available options:

1. Tamper conditions testing
2. Meter current and voltage circuits power consumption measuring
3. Current cross-connection panels
4. Optical port readers
5. Quick connecting devices
6. Hand-held terminals
7. Digital ThermoHygrometer

Example:
ASTeL 3.22-00-HSEC5-201
Three phase ASTeL system with class 0.02 Reference Standard, 400VA voltage and 600 VA current sources, 5-position rack, single sided with horizontal bars, equipped with extended position controllers and current isolating transformers, the Reference Standard version is 201.

Single– and Three Phase Meter Test Equipment of ASTeL 2 Series

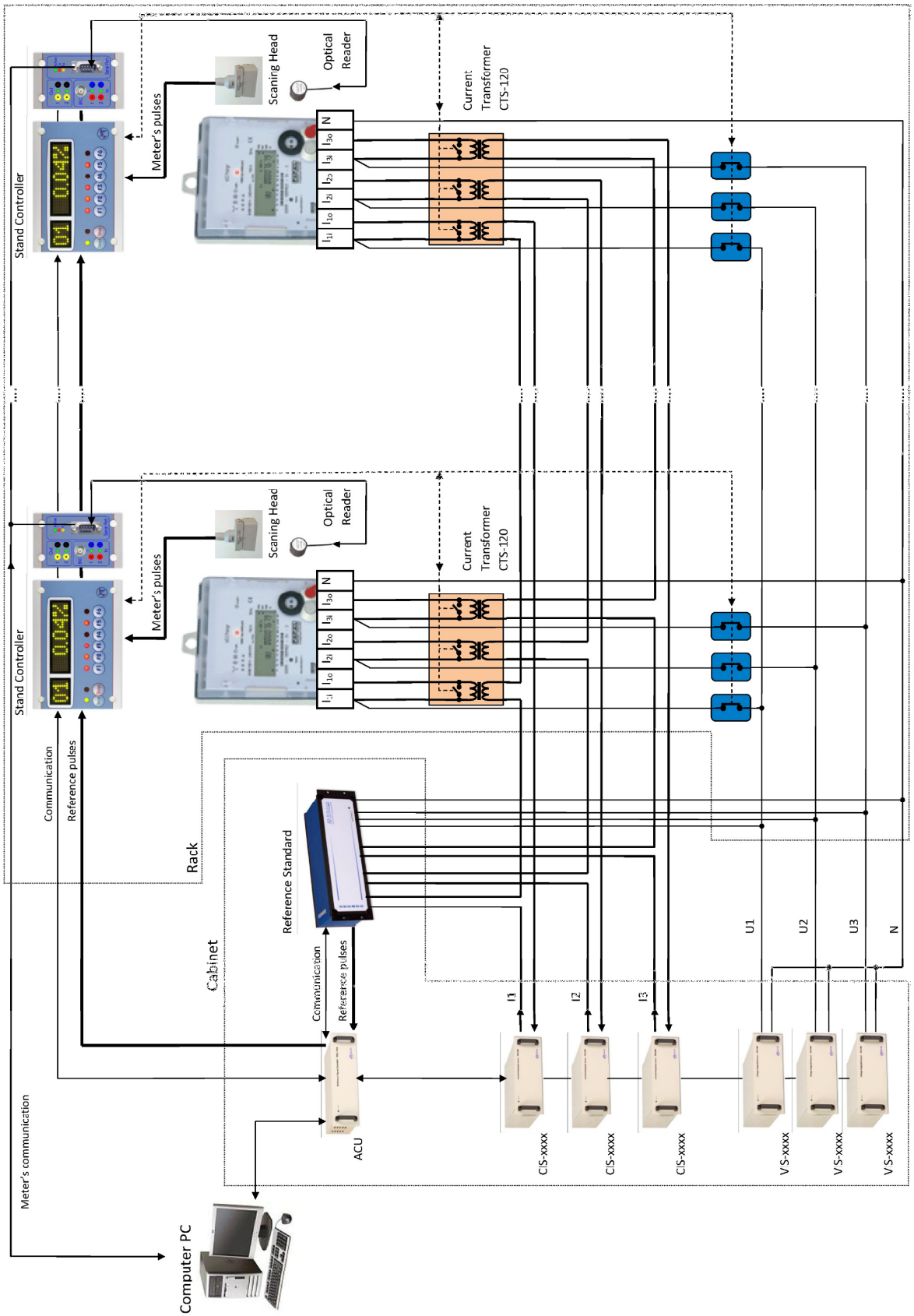


ASTeL system enables performing all tests required by norms

- ✓ basic error with the possibility of statistical analysis of the obtained results
- ✓ checking the starting current
- ✓ checking the no-load run
- ✓ testing energy registers
- ✓ testing maximum demand registers
- ✓ checking pulse outputs
- ✓ pre-heating
- ✓ testing the influence of frequency, harmonic distortion, voltage, current and other parameters on the meter error
- ✓ other

ASTeL system enables testing the following types of meters

- ✓ active and reactive energy
- ✓ single phase or three phase
- ✓ for 2, 3 or 4 wire systems
- ✓ electromechanical (also with impulse outputs) and electronic (static)
- ✓ meters with closed links
- ✓ multi-tariff, up to 16 tariffs
- ✓ with multifunctional inputs/outputs 8/4
- ✓ with maximum demand indicator
- ✓ multifunctional with active/reactive energy/power registers,
- ✓ with different arrangement of voltage and current terminals
- ✓ with non-homogenous output impulses
- ✓ other


Stand Controller
Meter's pulses
Scaning Head
Optical Reader
Current Transformer CTS-120
N
Communication
Reference pulses
Rack
Reference Standard
Cabinet
U1
U2
U3
N
I1
I2
I3
ACU
CIS-xxxx
VS-xxxx
Meter's communication
Computer PC

Features:

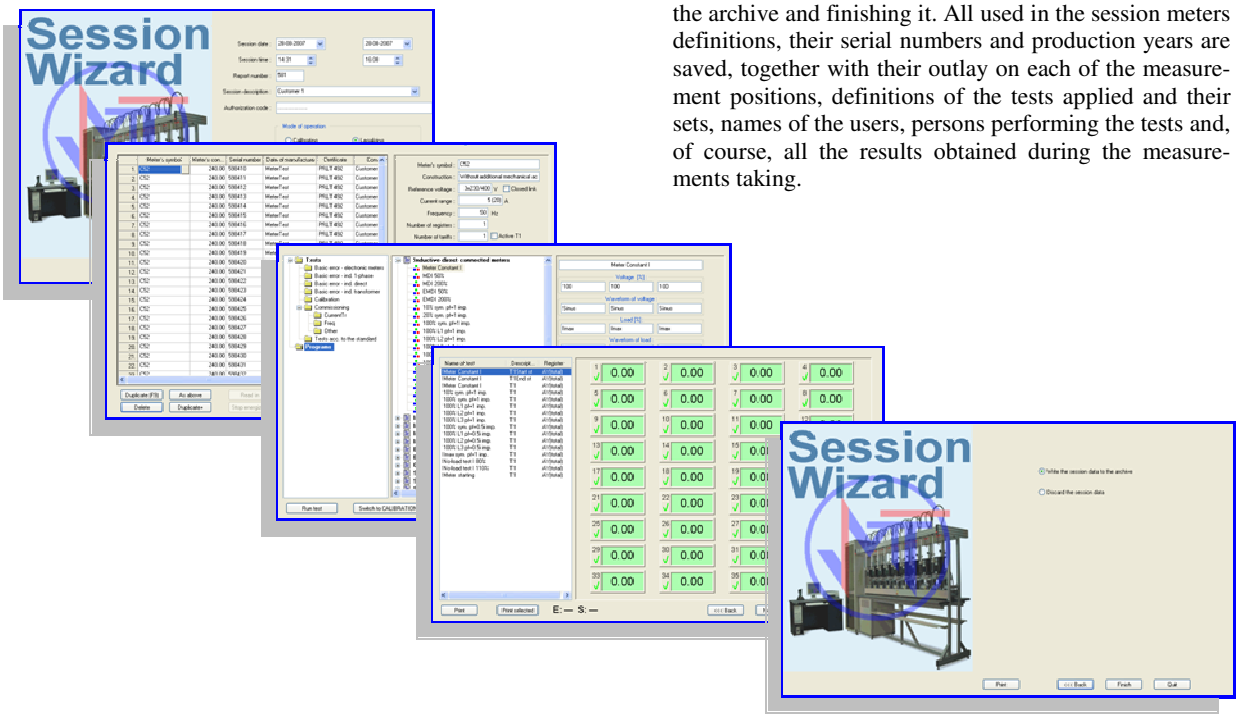
- Great flexibility and easy operation
- Automatic stations service
- Manual stations service
- All types of meters service
- Wide range of tests
- Work in a computer network
- Various language versions
- Wide range of accessories

The AsTest Software is designed for complex service of the electricity meters calibration and legalization processes. The built-in functions allow both for efficient service of various types of equipment and for advance data management. Parametrical libraries limit the need of new definitions creation to minimum, and various types of data visualisation notify about all events in the system on a current basis.

Esthetical graphic design and friendly visualisation of the measuring processes make working with the software, and thus operating on the system, in spite of its complexity, comparatively easy. The whole measuring process is controlled by the Session Wizard, which, even for a beginner, enables efficient and quick pass through the whole process of calibration and legalization.

SESSION WIZARD

The session wizard is a very convenient tool for guiding the user through the whole process of calibration and legalization, i.e. session, from declaring the meters for tests up to the report printout and data archiving. It consists of five steps. *Step one* defines general data: the date, time, word description, reference conditions and others. In the *second step*, the user declares the type of meters for tests on the individual measuring positions. The meters may differ from each other as to the number of tariffs and the constants. The *third step* serves for performing the tests or sets of tests. Among the offered operation modes, there is a single-test mode, semi-automatic and automatic set of tests. The sets of tests may be run from any position on the list. At any moment the user can switch from calibration to legalization mode, and, fulfilling certain conditions, from legalization to calibration mode. In *step four*, the user has the possibility of a cumulative viewing the results of all performed tests and printing one or a number of the available reports. The last, *fifth step*, is saving the whole session in the archive and finishing it. All used in the session meters definitions, their serial numbers and production years are saved, together with their outlay on each of the measurement positions, definitions of the tests applied and their sets, names of the users, persons performing the tests and, of course, all the results obtained during the measurements taking.



LIBRARIES

For a correct software operation, prior definition of the meters types, tests types and other parameters is necessary. These definitions are arranged in libraries, i.e. in suitably organised databases. Thank to an innovative approach to the databases structure, filling them is extremely easy and intuitive. A very useful feature of the AsTest software is defining the parameters in parametrical way, i.e. so as the same test definition could be used for testing different types of meters. Thanks to this feature, a small number of tests and their sets enables testing a wide range of the available meters.

The following libraries are available in AsTest software:

- meters,
- tests,
- sets of tests (programs),
- waveforms of measuring signals,
- users,
- repairers,
- supervisors,
- customers.

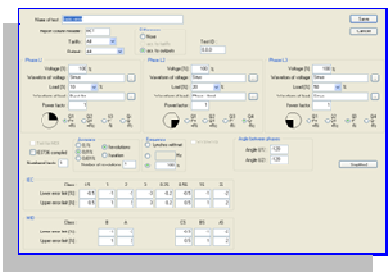
The elements of the libraries may be additionally arranged and stored in folders, according to the user's preferences. The number of the libraries elements is practically unlimited. The software is supplied with definitions of some popular meters and the basic definitions of tests and programs.

Meters Library enables easy defining of the meters, from the very simple induction ones to multitask electronic meters, including the prepaid, multi-system or multi-quadrant meters, also the ones with the maximum demand indicators, and others.

Tests library includes all types of tests:

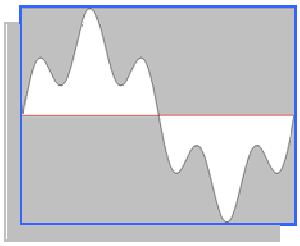
- *the basic error registration,* allowing for the type of output, the tariff, meter class, number of rotations/ impulses, number of tests, the required accuracy and other parameters; automatic calculation of the differences according to the tariffs or outputs is possible,
- *the no-load run test,* allowing for the type of output, the tariff and other parameters,
- *the starting current test,* with allowing for the type of output, the tariff, meter class, number of rotations/ impulses and other parameters,
- *the meter constant test*, possibility of placing on the printout the starting and final statuses of the tested meters counters; numerical result or in the form of + / -,
- *the maximum demand indicator check,* allowing for the type of output, the tariff, meter class, the required accuracy and other parameters; separate procedures for controlling the electromechanical and electronic indicators,
- *the impulse outputs test*,
- others.

During the tests performance, the software independently performs additional operations, facilitating the testing processes, which are not defined in an open way, e.g. while testing the starting current or the no-load run, the software automatically sets the meters on the "mark".



Library of programs allows for arranging the individual tests defined in the *tests library* in sets, i.e. tests programs. Such set may be next performed in automatic or semiautomatic mode.

Library of waveforms offers the possibility of defining various shapes of the measurement signals. Special *Waveform Editor* allows for creating the waveforms basing on the amplitudes and phases of individual harmonic and sub-harmonic. The work results are available in the form of a graph. The defined shapes may be used while defining the tests. The characteristic feature is the possibility of declaring different shapes for individual voltages and currents within one test. Flexibility of this function gives the possibility of defining all shapes required by international norms.



Library of the users serves for storing data of all users of the software and the system for calibration and legalization. The users may be assigned with suitable authorisations, i.e. access to different functions of the software. There is also the option of defining a collective user, which occurs when the system is operated by more than one person.

Library of repairers finds its application mainly in case of secondary circulation of meters. After dismounting from the grid, a meter requires technical check-up and perhaps tiny repairs. The data concerning the persons performing these operations may be stored just in the repairers library.

Library of supervisors persons fids its application in the case when the regulations require that the legalization process should be performed in the presence of a representative of the measures office (supervisor). This library allows for defining these representatives.

ARCHIVING THE DATA

AsTest Software provides the option of archiving the test results obtained during the preparation process before legalization and the legalization itself. Subject to archiving are all data related to the process of legalization and/or calibration: data on the meters, definitions of tests performed and detailed results of the tests. The archive may be searched according to different data: the date, type, serial number, producer, person performing legalization, repairer, etc. It is also possible to generate reports from the level of the archive.

REPORTS

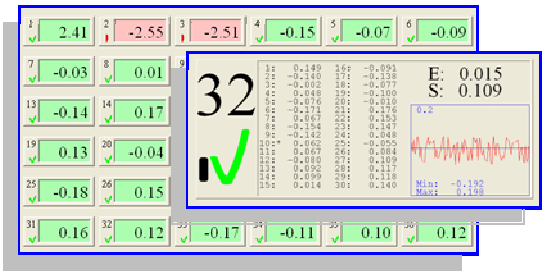
AsTest Software has a built-in very flexible module for creating reports. A user has the possibility of using ready templates, delivered with the installation, but they can also create their own, multilevel arrays. Reports may be generated individually for singular meters or collectively for all meters. In a report, may be included detailed parameters of the tested meters, the session parameters, tests outcomes and other data.

NETWORK OPERATION AND AsTest -VIEW

With network installation, it is possible to declare a common place for storing all databases and managing them from any computer in the network through a separate software, *AsTest-View*. From this software level all the operations on databases

VISUALIZATION

During the measurements, the user can, on current basis, watch the measurements results and the values of all measurement readings. These parameters may be displayed in different form defined by the user. Function **Positions** displays current results of the performed tests from all measurement positions at he same time.
Configurable user interface allows for defining and as-



signing colour schemes to different events, which may occur on the stand, e.g. a positive result, a negative result, blockage, hold up, stand failure and other. It is possible to enlarge any one chosen window with results. Then, additional information is available, related to the results on the given position: history of the 30 last measurements, the average, standard deviation and the trend graph.

Window **Tests to be carried out** includes the list of tests in the chosen set. The icons at individual positions inform the user about having performed or not having performed the given test and its result.

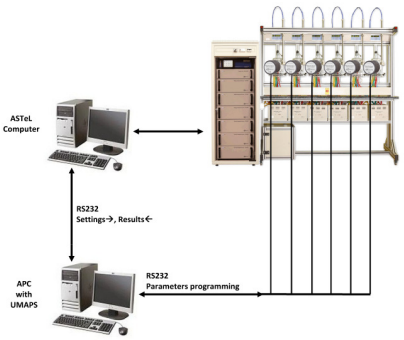
Meters are the set of definable by the user panel meters. Each may have up to five reading panels, and each panel may display the values chosen by the user. There are available: phase voltages, phase-to-phase voltages, currents, voltages phases, currents phases; active, reactive and apparent power; for each phase separately and in total, and many others.

Timer is another window facilitating the device operation. Depending on the currently performed test, it displays the time elapsed since the test start or the time remaining to its end.
The user has also the possibility of watching the supply parameters, in the form of graphs. The window **Vectors** displays a configurable vector chart of voltages and currents. Additionally, it depicts the power calculation method in the currently chosen measurement arrangement. Window **Table** displays in the form of a table the current values of voltages, currents, phase angles, and the active, reactive and apparent power. Window **Trends** acts as an oscilloscope. It records the history of actual values of any set of variables.

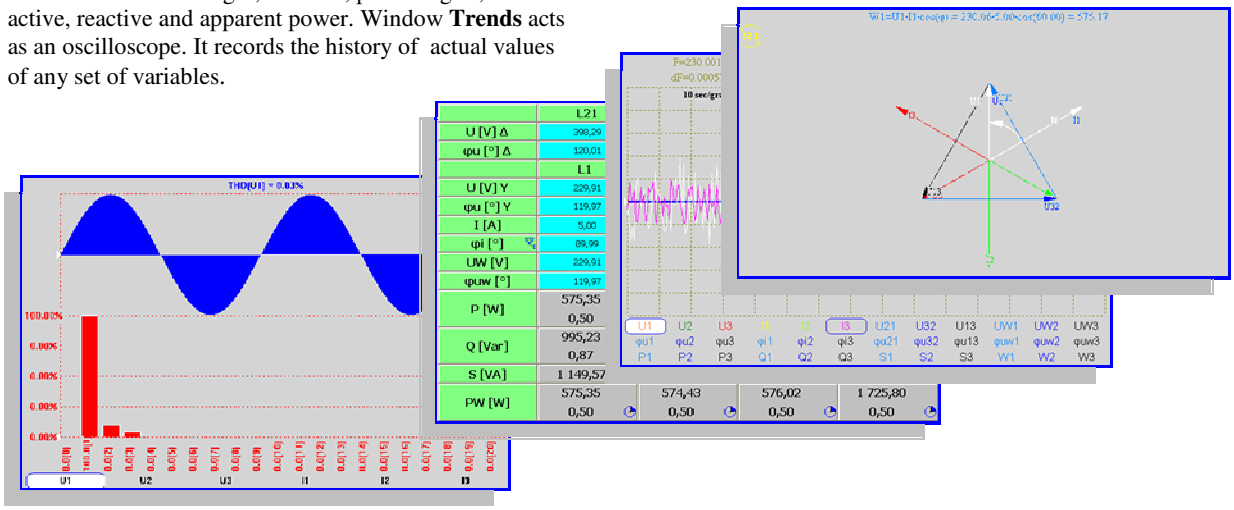
On the basis of these data, the statistical parameters of the run are calculated: average value and standard deviation.

Window **Harmonic** calculates, on the basis of the recorded actual shape of the signal, the values of its individual harmonics and the total harmonic distortion (THD). A very remarkable feature of this function is the possibility of entering the recorded waveform into the library of shapes and the option of using it in the tests definitions.

AUTOMATIC CALIBRATION



ASTeL System may be used for automatic calibration for the electronic meters. In this application, the control function is taken over by an additional **calibration computer**. This computer, by remote operation, activates suitable trials on the test bench and then, after receiving the results, corrects the settings of the meters through direct links with them. Communication with the meters may occur through RS232, RS485 links, compatible with IEC1107 and other. An important feature of the of this solution is the fact that the reference station does not participate in the communication process between the calibration computer and the meters, and thus has no access to the transmission protocols, which generally are kept top secret by the producers. In such solution, possible is the application of various methods of data protection and safety measures, such as coding the transmission with meters. The system for automatic calibration may be also used to perform automatic attestation of the meters.



COOPERATION WITH THE EQUIPMENT

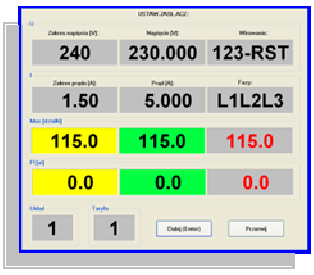
AsTest provides the possibility of cooperation with a wide range of peripheral devices.

Reference standards are the basic measurement instruments of the systems for calibrating and attesting. AsTest Software may service, in automatic mode, most of the available on the market types.

Portable terminals are very helpful at loading the data of the tested meters, such as the serial number or the production year, as well as the data related to the test being performed, e.g. the initial an final state of the counters. AsTest Software, in the present version, operates the portable terminals MC3000, PERCON and FALCON, and also the version with a bar codes reader.

Automatic power supplies are used in the test benches of the newest generations. AsTest Software allows for automatic service of all supplies from MeterTest.

Manual power supplies were used in the test benches of previous generations. AsTest Software has a suitable operation mode for cooperation with these supplies. Except for automatic setting of the power supply, all remaining functions of the software are still active. The automatic setting has been replaced with a number of dialogs and messages prompting the operator what operations he has to perform.



Transformers, current and voltage ones, are more and more commonly used equipment of the test benches. In spite of the fact that in the system there can be installed different types of transformers, the models offered by MeterTest give, beside very high accuracy, additional benefit, which consists of total integrity of these devices with the system and the possibility of controlling them through AsTest Software.

Stand controller is one of the most important elements of the system. Its primary tasks are: performing the tests, transferring data to the computer and displaying the results. Thank to equipping the controller with local keyboard, a remote operation of the power supply is possible and control of the auxiliary devices. AsTest Software operates all controllers produced by MeterTest, as well as the great majority of other types available on the market.

Serial ports in connection with *Special Trial* enable the software control from another PC. Using a special communication protocol, it is possible to start the tests remotely, read the results and others. This function finds application, among others, in the system for automatic meters calibration.

Network OPTO/RS232 enables communication with the tested meters through defined opto links, consistent with the requirements of norm IEC1107.

Internet is another modern tool operated by AsTest Softwae. Thank to it, a remote control of the system for calibrating and remote diagnostics are possible.

ASSISTANCE WITH RECALIBRATION

AsTest Software enables automatic or semiautomatic metrological acceptation of the test bench. There is possibility of defining the external reference standard. During the tests, the software automatically calculates constants, which significantly makes the acceptance easier and quicker. As a rule, definitions of most of the reference standards used in Poland for acceptation are supplied.

LANGUAGE VERSIONS

Having in mind each of our clients, AsTest Software is continually improved with new functions, including operation in various languages. At present, the Polish and English versions are available, and the Spanish, German and Russian versions are in preparation.

ASSISTANCE AND TRAINING

AsTest Software is delivered with a *Help* file, which contains detailed descriptions of all porgram functions, including detailed descriptions of tests, measurement methods and th ways of performimng them. A great help, especially for beginners, provides the set of *Manuals* for the software learning.

FUNCTIONAL SUPPLEMENTS

AsTest Software includes a whole range of functions, which significantly contribute to achieving more efficient and safer work. An example of such function is the possibility of quick change of load from the symmetrical to single-phase and back; quick switching the character of load from PF=1 to PF=0.5 and back. Other function is automatic checking whether in any of the meters there are no faults between the voltage and current circuits and whether an opening of the current circuits has not occurred. The software controls also the statuses of all other devices included in the test bench, such as voltage transformers, current transformers and other devices, and, in case of any problems, it reports them to the user.

PS2 Power Source

Features:

- Broad range of output voltages and currents
- Generating of harmonics
- Advanced DSP technology
- Low harmonic distortion
- High accuracy and stability
- Direct operating with broad range of linear and non-linear loads
- Full automation
- High efficiency
- Multilevel system of safeguards

The PS2 Power Source was designed to be used as a reference alternating current and voltage source in the electricity meter testing systems.

The basic functional parts of the PS2 Power Source are:

- Voltage Integrated Source VIS,
- Current Integrated Source CIS,

The power stages of the power amplifiers are made with PWM technology, which ensures high efficiency and what follows very small thermal loss.

The internal DSP controlled digital feedback loops ensure stability in time, quick setting time of required parameters and low non-linear distortions of the output current and voltage signals.

Additional precise regulation systems make the PS2 Power Source able to handle correctly and directly loads of a broad range of characters, from pure capacitive loads, through resistive to inductive ones. This feature makes it unnecessary to use any external load character compensators.

Thanks to a broad range of output voltages and currents, a possibility of setting any phase angle, generating of harmonics for every channel independently, the PS2 Power Source ensures efficiency in testing of all types of energy meters while retaining all required electrical parameters.

Operation reliability and safety are provided by a number of multilevel safeguards and separating transformers. Thanks to complete automatic settings and adjustments the PS2 Power Source is a highly reliable device and guarantees continuity of work.

In case of using the PS2 Power Source for work with stationary meter test equipment, it should be equipped additionally with ACU-3000 Control Unit for three-phase system and ACU-1000 for single-phase system. Its main tasks are: detecting of short-circuits between voltage and current circuits, controlling emergency switches, controlling tariff system, signaling presence of dangerous voltage on suspension racks and others.

The basic executions of the PS2 Power Source are listed in the table below. It is possible to arrange them to individual needs and demands.

Operating range		
Output voltage range (Phase-Neutral)	1 x 30 ÷ 350 V* 3 x 30 ÷ 350 V*	PS2-**1**xxx PS2-**3**xxx
Output current range	1 x 1mA ÷ 120 A* 3 x 1mA ÷ 120 A*	PS2-**1**xxx PS2-**3**xxx
Voltage output power for linear loads	400 VA* 1200 VA* 2600 VA*	PS2-x**0**xx PS2-x**1**xx PS2-x**3**xx
Current output power for linear loads	600 VA* 1600 VA* 3000 VA*	PS2-xx**0**x PS2-xx**1**x PS2-xx**3**x
Frequency of the fundamental component	45 Hz ÷ 65 Hz*	
Harmonics	preprogrammed acc. to norms + user programmable	
Phase angle range (independently for each voltage and current signal)	0° ÷ 360°	
Accuracy		
Resolution of output current/voltage adjustment	0.002%	
Resolution of phase angle adjustment	0.001°	
Resolution of frequency adjustment	0.001Hz	
Typical stability of the output current (T_{int}=150 s)	<< 0.005%	
Typical stability of the output voltage (T_{int}=150 s)	<< 0.005%	
The accuracy of the output voltage/current adjustment	≤ 0.02% ≤ 0.01% ≤ 0.01%	PS2-xxx**4** PS2-xxx**2** PS2-xxx**1**
The accuracy of phase angle adjustment	0.02° 0.01° 0.01°	PS2-xxx**4** PS2-xxx**2** PS2-xxx**1**
The accuracy of frequency adjustment	0.001Hz	
Total Harmonic Distortion (THD) of the output voltage and current	< 0.3%	
Functionality		
Efficiency of the output power stages	> 85%	
Protection	overcurrent, overvoltage, short circuit, open circuit, thermal, earth leakage	
Construction	19” standard cassette system	
Control	isolated RS422/RS232	

VIS Voltage Integrated Source

Features:

- Broad range of output voltages
- Broad range of allowable loads
- High accuracy and stability
- Low harmonic distortion
- Multilevel protection system
- Integrated Digital Signal Generator
- Generation of harmonics

The VIS Voltage Integrated Source is a single-phase alternating voltage source, designed for use in electricity meter testing systems and in laboratories. The output voltage is isolated and independent of mains voltage.

The power stage of the source utilizes the Power Width Modulation (PWM) technology, which ensures high efficiency and thus contributes very small heat losses. The stage is driven by an onboard Digital Signal Generator. The control signal may be composed of harmonics of independently defined amplitudes and phases. The internal feedback loop utilizes the DSP technology. Advanced algorithms applied ensure high stability of amplitude and phase angle as well as low distortions of the output voltage over a full range of allowable loads of various characters.

A multilevel protection system implemented protects the source against overload, short circuit, overheat and makes operation of the device reliable and safe.

The VIS device is equipped with an isolated serial interface and can be operated by a PC or other controlling device (host). A number of sources can be synchronized and operated together to form a poly-phase system. The communication protocol is provided to control output settings as well as to access all internal registers.

The VIS Voltage Integrated Source is accommodated in a 19 inch plug-in case.

	VIS-400	VIS-1200	VIS-2600
Technology of the power stage	PWM with digital feedback loop		
Output voltage range (Phase-Neutral) *	30 ÷ 350 V		
Output power for linear loads*	400 VA	1200 VA	2600 VA
Output voltage stability	<< 0.005% (integration time 150 s)		
Total Harmonic Distortion (THD)	< 0.3%		
Efficiency of the power stage	> 85%		
Frequency of the fundamental component*	45 Hz ÷ 65 Hz		
Phase angle**	0° ÷ 360°		
Harmonics	user programmable		
Control	isolated RS422/RS232		
Dimensions (H x W x D)	170 x 440 x 600 mm		300x440x600mm
Dimensions (H x W x D) with front panel and rear connectors	174 x 484 x 750 mm		307x484x750mm

*) other values available on request
**) for poly phase systems

Features:

- Broad range of output currents
- Low harmonic distortion
- High output power
- Digital control of the output parameters through DSP module
- High accuracy and stability
- Broad range of allowable loads
- Multilevel protection system

The CIS Current Integrated Source is a single-phase alternating current source, designed for use in electricity meter testing systems and in laboratories. The output current is isolated and independent of mains voltage.

The power stage of the source utilizes the Power Width Modulation (PWM) technology, which ensures high efficiency and thus contributes very small heat losses. The stage is driven by an onboard Digital Signal Generator. The control signal may be composed of harmonics of independently defined amplitudes and phases. The internal feedback loop utilizes the DSP technology. Advanced algorithms applied ensure high stability of amplitude and phase angle as well as low distortions of the output current over a full range of allowable loads of various characters.

A multilevel protection system implemented protects the source against overload, open circuit, overheat and makes operation of the device reliable and safe.

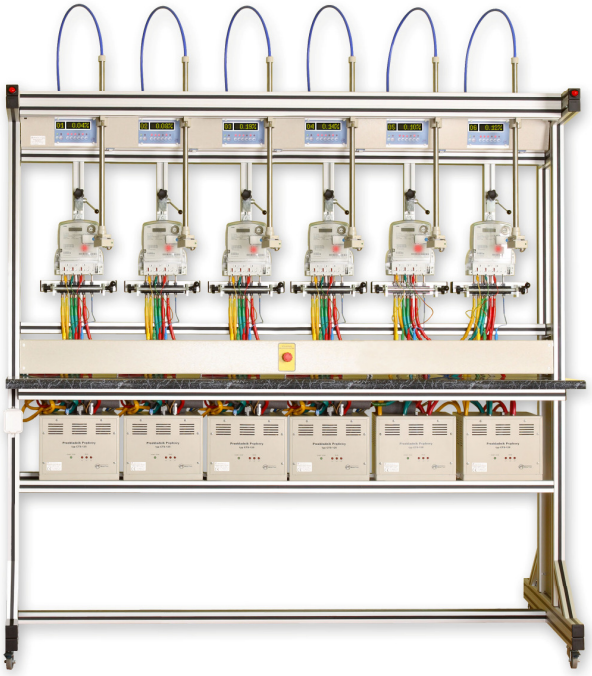
The CIS device is equipped with an isolated serial interface and can be operated by a PC or other controlling device (host). A number of sources can be synchronized and operated together to form a poly-phase system. The communication protocol is provided to control output settings as well as to access all internal registers.

The CIS Current Integrated Source is accommodated in a 19 inch plug-in case.

	CIS-600	CIS-1600	CIS-3000
Technology of the power stage	PWM with digital feedback loop		
Output current range*	1mA ÷ 120 A		
Output power for linear loads*	600 VA	1600 VA	3000 VA
Output current stability	<< 0.005% (integration time 150 s)		
Total Harmonic Distortion (THD)	< 0.3%		
Efficiency of the power stage	> 85%		
Frequency of the fundamental component*	45 Hz ÷ 65 Hz		
Phase angle**	0° ÷ 360°		
Harmonics	user programmable		
Control	isolated RS422/RS232		
Dimensions (H x W x D)	170x440x600mm	300 x 440 x 600 mm	
Dimensions (H x W x D) with front panel and rear connectors	174x484x750mm	307 x 484 x 750 mm	

*) other values available on request
**) for poly phase systems

SR Suspension Rack



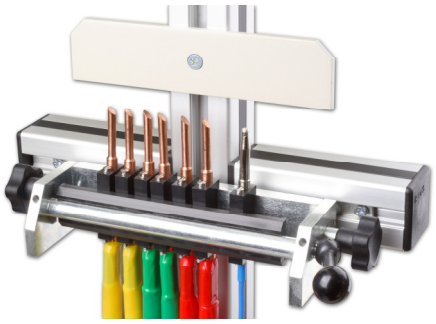
Features:

- Stable construction of light and rigid aluminum profiles
- Easy to assembly, disassembly and transport
- Controller with keyboard and error display on each position
- Universal photoelectric scanning head
- Optional quick fixing device on each position
- Relays for switching on and off the voltage on the tested meters, individual for each position
- Safety cut-outs
- Voltage presence optical signaling with red LEDs
- Additional sockets for mains power supply
- Board and shelf for placing the tested meters
- Possibility of installing current and voltage transformers

The SR Suspension Rack, constructed from light and rigid aluminum profiles, is easy to assembly, disassembly and transport. In standard execution, the rack is two-sided and has 12 test positions. Each test position is equipped with a stand controller, a photoelectric scanning head and relays for switching on and off the test voltage to the tested meter (necessary to put meter's rotating plate in the mark-in-front position for the starting current test and the no-load run test).

Moreover, in addition, the rack is equipped with safety cut-outs, indicators of voltage presence on the terminals of the tested meter and auxiliary power sockets. There is possibility of equipping the rack with current and/or voltage transformers allowing for testing meters with closed links.

A calibration and legalization system may consist of one or more racks.



	SR-3	SR-1
Type of tested meters	Three-phase, Single-phase	Single-phase
Material	aluminum profiles	
Number of positions	10, preferable **12,** 20*	
Single position width	280 mm*	200 mm*
Rack length	(number of positions/2 - 1)* width of one position+480 mm	(number of positions /2 – 1)* width of one position +370 mm
Rack height	2360 mm*	
Rack width	780 mm*	

*)other values available on request

Features:

- Readout of red and black marks from the electromechanical meters
- Readout of optical impulses from electronic meters
- Readout of 8 kHz modulated optical impulses
- Easy positioning
- Resistance to external light

The GS series Photoelectric Scanning Heads are very modern, multifunction devices enabling the readout of both marks from the electromechanical meters and impulses from the electronic meters. Their modern design allow for obtaining high operational efficiency and reliability under various ambient light conditions.

The GS-10 Photoelectric Scanning Head is designated for work in meter test equipment. In the system, for calibrating and legalizing electricity meters produced by MeterTest, its operation mode is changed automatically, and the sensitivity may be changed with the keyboard of the local stand controller. The mechanical construction of the instrument allows for its individual, and very easy, positioning up/down, right/left, forward/backward and rotating horizontally.

The GS-11 Photoelectric Scanning Head is designed for more general applications and for use in other systems for calibration and legalization.

Their operation mode and sensitivity are changed with the use of individual switches.

The GS-20 series Photoelectric Scanning Head enabling readout of optical impulses from the electronic meters.

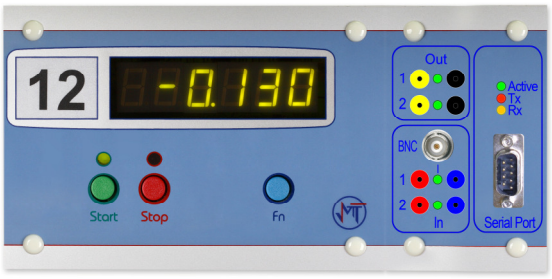
The GS-20 Photoelectric Scanning Head can be used with systems for calibration and legalization of electricity meters produced by MeterTest or as a standalone device. The GS-20 Photoelectric Scanning Head is able to detect LED flashes of green, yellow, orange, red and infrared light. Maximum frequency of incoming flashes of light is greater than 2.5 kHz. The device is highly immune to ambient light conditions.

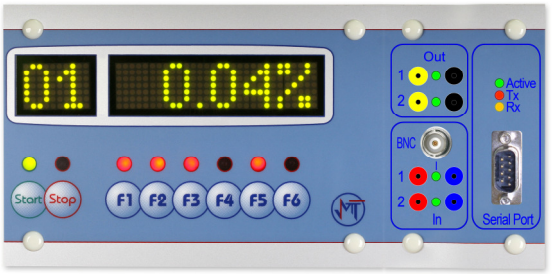
The GS-20 requires no adjustment.

	GS-10	GS-11
Method of switching the operation mode	automatically by the system	manual switch
Electromechanical meters		
Mark colour	red, black	
Type of surface	mat, shiny, knurled	
Sensitivity	3 level	
Electronic meters		
LED impulse colour	infrared, red, yellow, green	
8 kHz modulated light	yes	
Maximum frequency of input impulses	> 2 500 Hz	

	GS-20.1	GS-20.2
LED impulse colour	Infrared, red, orange, yellow, green	
8 kHz modulated light	yes	
Maximum frequency of input impulses	> 2 500 Hz	
Sensitivity distance	0...100 mm	
Voltage supply	5 V	10...30 V
Maximum supply current	15 mA	
Output	Open collector OC (max 30 V/80 mA)	
Dimension (H x W x D)	25 x 48 x 60 mm	

IPO Individual Stand Controller





Features:

- Legible presentation of the results
- Information on the test current status
- Control of the power source settings from a local keyboard
- Control of the operation mode and the sensitivity of the photoelectric scanning head
- Universal serial communication port
- Control of the auxiliary equipment, e.g. the current transformer
- High input frequency of the reference pulses Þ short test time

The IPO Individual Stand Controller is one of the most important components of the system. Its primary tasks are: performing tests, transferring data to the host computer and displaying results. Equipped with the local keyboard it enables remote control of the power source and the auxiliary equipment. An additional function is the communication with meter under test by means of serial port (in standard version RS232 and RS485 ports are avaiable).

- **Test performance** – it is a basic function of the controller. The controller performs the tests independently. Before performing them, it receives data related to the test parameters and the information which inputs/outputs of the meter are to be used. The tests results are presented on the local display and also transferred to the host computer. During the calibration and for possible intervention inside the meter, the test may be withheld (the voltage to the meter is cut off) and/or reset/ resumed and/or repeated using the controller keyboard.

- **Operation mode control –** the choice (electromechanical or static) is executed automatically, and the sensitivity of the photo-head may be adjusted with the local keyboard.

- **The power source remote control** – is a very useful function during the meters calibration. It enables remote switching of the load character, directly form the controller keyboard. There is no need for continual approaching the host computer to change the load parameters. The load type can be switched from balanced to single phase and vice verse and the power factor from PF=1 to PF=0.5 and vice verse.

- **Auxiliary equipment control** – The controller is equipped with 2 system links. One of them is used for controlling the voltage relays , and the other one enables further extension of the system, e.g. with a current or voltage separating transformer. The transformer becomes then an integral part of the system. It is switched on and off automatically, and in case of incorrect work, a suitable message appears on the controller display and on the host computer screen.

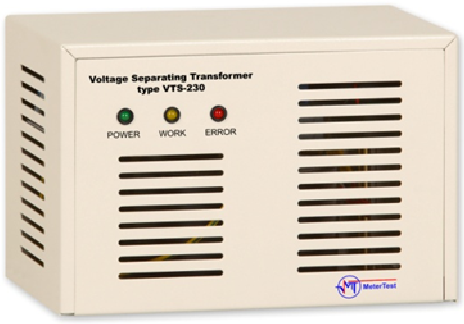
- **Communication with meters under test** – The controller is equipped with a RS232 and RS485 universal serial ports. Further extension to other standards like RS485, CS, ZigBee is possible by applying a dedicated adapter. Thank to this port, the tests can run fully automatically, e.g. while checking the registers, the initial and final register readouts may be obtained from the tested meter automatically, without engagement from the operator.

- **Pulse inputs/outputs** – The controller has the possibility of operating simultaneously a number of pulse outputs of the meter under test and controlling its inputs (e.g. t_m / t_e). The outputs can be used for tariff control. With two outputs up to 3 additional tariffs can be handled.

The IPO Individual Stand Controller is manufactured in modern technology utilizing programmable gate arrays FPGA (IPO-E). As the central unit, an up-to-date-technology microprocessor is used allowing for remote software replacement (In – Application Programming – IAP). Thank to this solution, any configuration of the terminal inputs/ outputs, high input frequency of the reference pulses and a future extension of the controller functionality, depending on new requirements, are possible. The display is made with clearly visible and legible LED matrixes. During tests, the status of the test is displayed, and in the time-dependent tests, the time remaining to the end of the test is shown.

		
General features	**IPO-E**	**IPO-S**
Display	35-dot matrix LED display (or LCD)	7-segment LED display
Display height	14.2 mm	
Number of characters	6	
Display resolution	X.X%, X.XX% or X.XXX% (user programmable with the system software)	
Keyboard	8 keys: RESET/START, STOP and 6 function keys whose allocation changes depending on the test being performed	3 keys: RESET/START, STOP and one function key whose allocation changes depending on the test being performed
Photoelectric scanning head input	1 (optionally 2)	1
Input for reference pulses	1	1
Maximum frequency from the Reference Standard	300 (optionally 600) kHz	100 kHz
Universal inputs / outputs		
S0 general purpose inputs (potential linked, open collector or potential free contact are acceptable; maximum input voltage 27V)	2 (optionally 8)	2
Fast pulse input (BNC connector) (potential linked, open collector or potential free contact are acceptable; maximum input voltage 27V)	1	none
Potential linked outputs (24V, 50mA electronic safeguard, can handle S0 inputs)	2	
Communication with meter under test		
Serial interface	1	
Interface type	RS232, RS485 (other standards can be handled with an appropriate adapter)	
Interface		
Communication with PC	RS422	
Voltage on/off control relay	yes	
Communication with Current Separating Transformer	yes	

VTS High-Precision Voltage Transformer



Features:

- Typical accuracy 0.01%
- Easy assembly
- Direct work with all types of meters
- High output power
- Resistance to non-linear loads
- Integration with the system

The VTS Voltage Separating Transformer was designed keeping in mind alternating current measurement systems requiring galvanic separation of the measuring circuits. The built-in electronic compensation system guarantees excellent parameters in the whole voltage range, ensuring at the same time high output power. Typical error 0.01% makes the device an ideal solution for a wide range of applications. Among them there is a possibility of using the transformer for testing electricity meters with closed I-P links i.e. meters with connected current and potential circuits. Broad range of working voltages, high output power and high accuracy enable the VTS transformer to be rigidly integrated with a meter testing system. Once integrated, it can handle all kinds of meters, also meters with open links, with negligible influence on the overall system accuracy.

Special attention deserves the fact that this device, unlike the passive transformers, excellently copes with non-linear loads, which typical modern electronic meters are, not deteriorating its accuracy.

This device is purposed for testing single-phase meters.

Operating range	
Rated voltage	110V, 220V, 230V, 240V or to individual order
Voltage range	±20 %
Ratio	1:1
Frequency range	45 ÷ 65 Hz
Output power	25 VA
Peak output current	108 mA at 230V
Input burden	<2 VA
Accuracy	
Typical ratio error	0.01%
Typical error of the phase shift	0.2’
Functionality	
Power ok/ready	green LED / yellow LED
Error and/or activation of the short-circuit protection	red LED + audible signal
Protection and safeguards	
The shot-circuit protection	yes – signalled
Sensing the difference between the primary and secondary voltage	yes – signalled

CTS-120 High-Precision Current Transformer

Features:

- Typical accuracy 0.01%
- Easy mounting
- Direct work with all types of meters
- Broad range of working currents
- High allowable load impedance
- High output power
- Integration with the system

The CTS-120 Current Separating Transformer was designed keeping in mind the alternating current measurement systems requiring galvanic separation of the measuring circuits. The built-in electronic compensation system guarantees excellent parameters in the whole current range, ensuring at the same time high output power. Typical error 0.01% makes the device an ideal solution for a wide range of applications. Among them there is a possibility of using the transformer for testing electricity meters with closed I-P links i.e. meters with connected current and potential circuits. Broad range of working currents, high output power, high allowable load impedance and high accuracy enable the CTS transformer to be rigidly integrated with a meter testing system. Once integrated, it can handle both self-contained and transformer connected meters, also meters with open links, with negligible influence on the overall system accuracy.

The CTS-120 transformer is available with local or remote control. The latter possibility is meant to be used in a meter testing system where the transformer can be controlled and supervised by the system software or by the individual stand controller of the system.

The CTS-120 Current Separating Transformer may be used for testing both three-phase and single-phase meters.

Operating range	CTS-120-1	CTS-120-2	CTS-120-3
Working current range	3 x (1mA ÷ 120A)		
Ratio	1:1		
Frequency range	45Hz ÷ 65 Hz		
Output power	1.3 V · I_{out}	0.8 V · I_{out}	0.5 V · I_{out}
Maximum load impedance in the range of 1mA…5A	200 mΩ	150 mΩ	100 mΩ
Maximum output voltage	1.3 V	0.8 V	0.5V
Maximum load impedance in the range of 5A…120A	1.3 V / I_{out}	0.8 V / I_{out}	0.5 V · I_{out}
Accuracy			
Typical ratio error in the range of 0.1A…120 A	0.01%		
Typical angle error in the range of 0.1A…120 A	0.1’		
Functionality			
Possibility of working with open secondary circuit	yes		
Local control	START/STOP, failure and/or error signals[1]		
Remote control	an option for the transformer to be controlled and supervised by a meter testing system. [1]		
Protection and safeguards			
Protection against the results of opening the secondary circuit	yes – signaled		
Sensing the difference between the primary and secondary currents	yes – signaled		

[1] The unit can be equipped with one control only, either local or remote

PVT Multisecondary Voltage Isolating Transformer

Features:

- Accuracy less than 0.1%
- Easy mounting
- High output power
- Integration with the system

The PVT Multisecondary Voltage Separating Transformer was designed keeping in mind the alternating current measurement systems requiring galvanic separation of the measuring circuits. Thanks to the unique winding technology applied excellent parameters have been achieved. Maximum ratio error 0.1% makes the instrument an ideal solution for a wide range of applications. Among them there is a possibility of using the transformer for testing electricity meters with closed I-P links i.e. meters with connected current and potential circuits.

The PVT Multisecondary Voltage Separating Transformer can be controlled either with a local switch or by the test bench control software. The control makes it possible to bypass the transformer.

The PVT Multisecondary Voltage Separating Transformer is intended for single-phase meter testing.

Operating Range	
Nominal voltage	230V or other on demand
Ratio	1:1
Nominal frequency	50 or 60 Hz
Number of secondaries	12, 24, 36 or other on demand
Output power	20 VA / secondary
Accuracy	
Maximum ratio error	≤ 0.1%
Maximum phase angle error	≤ 2 minutes
Maximum variation between any two secondary windings when equally loaded with rated burden:	± 0.03% ratio error and ± 1 minute phase angle error
Safety	
Maximum test voltage between primary and secondaries	2.5 kV
Maximum test voltage between secondary windings:	500 V
Phisical description	
Case	Light aluminum profiles and steel covers finished with
Connections	screw connector blocks

IEC1107/USB2.0 and IEC1107/RS232 Optical Port Reader

Features:

- Mounting to meter by magnet
- IEC 1107 standard
- Small dimensions and weight
- Requires no adjustment
- RS232 or USB 2.0 communication port

The Optical Port Reader IEC1107 is a device enabling communication between any type of electricity meter equipped with a port according to the IEC1107 standard and a reading device equipped with RS232 or USB 2.0 port.

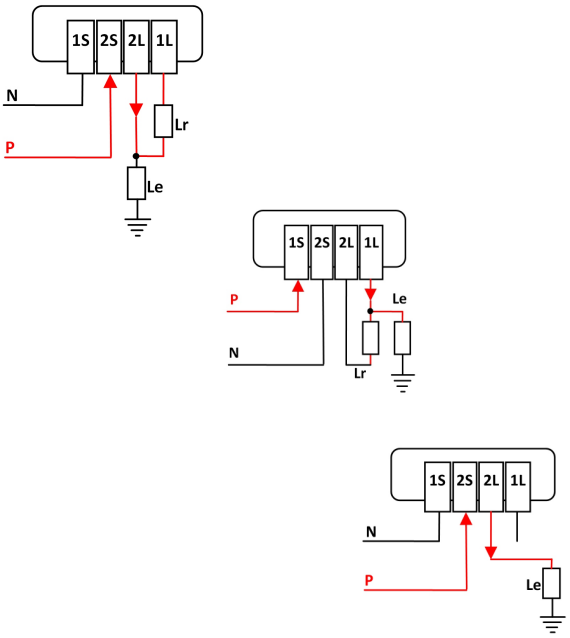
The Optical Port Reader IEC1107 can be used both with portable or stationary electricity meter test equipment.

		
	IEC1107 / RS232	**IEC1107 / USB 2.0**
Magnetic head	●	●
Sensitivity adjustment	○	○
Communication	RS232	USB 2.0

○ - No

● - Yes

Testing single phase meters under tamper conditions



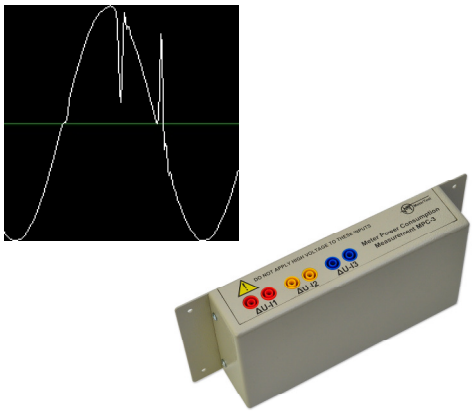
The source of utility revenue loss is not limited to generation, transmission, or distribution issues. Energy theft is a worldwide problem that contributes heavily to revenue losses. A large portion of these revenue losses can be recovered by installing electronic meters because they can detect tampering conditions and bill properly in their presence, unlike electromechanical meters.

ASTeL 3.x Meter Test Equipment makes it possible to test meters in the following tampering conditions:

- Misconnection Condition,
- Reverse Power Condition,
- Earth Fault Condition,
- Missing Neutral Condition.

The table below shows typical tamper conditions and how to simulate them on the test bench. It is assumed that I1,I2 and U1,U2 have been chosen to source the testing signals.

Meter Consumption Measuring Module



MPC-3 Meter Consumption Measuring Module is designed for measuring power consumption by voltage and current circuits of tested meters. The module is installed individually for each tested meter. This module actively cooperates with Connection Panel.

N°	Description	Value
1	**Voltage Circuits**	
1.1	Voltage range	350 rms
1.2	Current range	170 rms
1.3	Voltage accuracy	1%
1.4	Current accuracy	1%
1.5	Active Power accuracy	2%
1.6	Apparent Power accuracy	2%
2	**Current Circuits**	
2.1	Voltage range	1.7 V rms
2.2	Apparent Power accuracy	2%

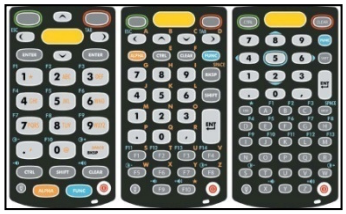
Features:

- Portable, wireless
- Optional laser barcode reader
- Docking port for communication
- Legible display
- Energy-saving
- Resistant to humidity
- Possibility of using one terminal for servicing a number of systems

Wireless portable terminal facilitates data collection from the tested meters during the tests on the meter test equipment being produced by MeterTest. The data may be read from the meter and entered into the terminal memory using integrated keyboard or a laser barcode reader. The docking port provides connection to a computer as well as fast and convenient data transmission. One terminal may be used for servicing a number of the meter test systems which are equipped with docking ports.

The SYMBOL® wireless hand-held terminal is a portable computer working under control of the Windows® CE operating system. The high resolution, touch LCD display with backlight makes operation of the unit very easy.

Fast and convenient entering the data is facilitated by a humidity-resistant keyboard with 28 or 38 keys or an alphanumeric keyboard with 48 keys.



The optional laser barcode reader significantly accelerates the operations of data collecting and makes the work far more effective. The rotating laser scanner head enables quick adjustment for left -handed as well as right-handed people.

RD-20 Dytronic Single-Phase Reference Standard

R A D I A N

TYPICAL ACCURACY = +/-0.01%
WORST CASE = +/-0.04%

OVERVIEW

PRODUCT HIGHLIGHTS: The Radian RD-20 Single-phase Electricity Reference Standard is one of the most versatile reference instruments ever. The RD-20 has a typical accuracy of 0.01% for all measurement functions across its entire operating range, with a maximum worst case accuracy of 0.04%. This worst case accuracy specification includes the variables of stability, power factor, traceability uncertainty and test system errors. The RD-20 utilizes Radian's new Dytronic measurement technology consisting of a Radian designed Integrating Analog to Digital Signal Converter. Unlike off-the-shelf A/D Converters used in other instruments, Radian's A/D Converter is specifically designed and optimized for power and energy measurement. This unique design makes the RD-20 absolutely unsurpassed in its ability to accurately measure "real world" waveforms. The RD-20's A/D Converter is combined with Radian's renowned electronically compensated voltage and current input transformers and a hermetically sealed reference set to provide the highest degree of accuracy, stability and versatility offered in a portable single-phase standard.

MEASUREMENTS: The RD-20 is a four quadrant single-phase, simultaneous measuring instrument that registers both forward and reverse energy flow and provides voltage, current, power and energy (Active, Reactive, Apparent) information. The Harmonic Analysis option makes available the analysis of customer load though the 50th harmonic order while the Built-in Comparator option provides for the automatic calculation of test results for the meters and standards being tested.

METER AND STANDARD TESTING: The compact light weight design of the RD-20 makes it an ideal reference standard for field testing applications. The RD-20 may be used with a controlled current source to accurately test revenue meters. In field applications the RD-20 can perform a single-phase meter accuracy test using existing service load. Pickups to sense meter disk rotation or calibration pulses of infrared, visible light, or KYZ signal plug directly into the RD-20. The RD-20 may be utilized to test reference standards of lesser accuracy and is also an ideal standard to be intergraded within a meter test bench where lesser accuracy is acceptable.

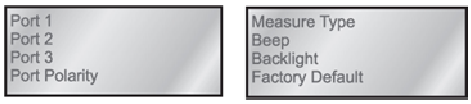
INTUITIVE USER INTERFACE: The RD-20's LCD and five-button keypad provides a direct interface to the end user while the RD-20's RS-232 port, utilized with the applicable software, allows for remote PC control and configuration of the RD-20. Utilizing the five-button keypad and observing the LCD, the user is able to scroll through the various measurement functions of the RD-20 and toggle between the different menu screens. The amount of measurement information and the number of menu screens viewable is determined by the model number of the RD-20.

MENU SCREENS: The key menu screens are the Measurement Screens, Run Test Screen, Harmonics Screen, and Setup Screen.

The Measurement Screens will display the measurement functions the RD-20 supports. There are different screens for Instantaneous Measurements, Accumulating Measurements, and Minimum & Maximum Measurements. Using the keypad, it is very simple to toggle between the various measurement screens and to scroll through the various measurement functions.

The Main Menu Screen allows users to gain access to the specific functionality of their RD-20. From the Main Menu, the user may select to run a meter or standard test, perform harmonics analysis, set-up/configure their RD-20, perform a self test, and review information pertinent to their RD-20.
The Run Test Screen allows the user to select the type of test they would like to run and then to enter the different variables for that specific test.
In the Harmonics Screen the user may select to view voltage or amperage harmonics, scroll through the harmonic order to observe the phase and magnitude of a specific harmonic, and view the total harmonic distortion.

The Setup Screen allows the user to custom configure their RD-20. The options available are changing the operation of the BNC ports, enabling or disabling the backlit display, selecting RMS or AVG measurement response, disabling or enabling the RD-20's audible beeps, auto-scrolling the screens, and returning the RD-20 to its original factory default settings.



The above features and functions may also be utilized via a PC running Radian Software packages. RR-Configure/Analyze allows for the custom configuration of the RD-20 along with data analysis and RR-Kit software is a set of commands, routines, and instructions for custom application development.

RD-20 Dytronic Single-Phase Reference Standard

OPERATING RANGE
• Current (Autoranging)
  - .02 to 67 amps per input (three input option),
  - .02 to 75 amps per input (three input extended range option),
  - .02 to 120 amps per input (one input option),
• Input voltage: 30 to 600 volts (Autoranging),
• Auxiliary power input: 60 to 600 volts (Autoranging),
• Frequency: 45 to 65 Hz,
• Phase Angle: 0 to 360° or -180 to 180°,
• Power Factor: -1 to 1,
• Temperature: –20° to +70°C (-4° to -158°F),
• Humidity: 0% to 95% non-condensing,
• Shock and vibration: Any that is not destructive.

PHYSICAL DESCRIPTION
• Weight: 2.5 kg (5.5 lbs); 3.6 kg (8lbs) shipping weight,
• Size 190.5 mm (7.5") H x 139.7 mm (5.5") D excluding strap,
• Backlit LCD, 4 line by 16 character,
• Current inputs: 6mm jacks,
• Potential and Aux power inputs: 4mm Banana type jacks,
• BNC connector (port 1) used for input/gating,
• BNC connector (port 2) used for pulse outputs,
• BNC connector (port 3) used for three phase SYNC or analog sense,
• 5 membrane button keypad: up/down/esc-reset/enter/mode,
• 8 pin RJ-45 jack for RS-232 communication,
• Pickup input for direct interface to RR-DS, RR-1H, or RR-KYZ,
• Clamp-on CT input for optional clamp-on current transformer.

TEST AND CALIBRATION
• No physical adjustments, all calibration performed with software,
• 50 or 60 Hz calibration can be provided,
• Orientation: Any within 90° of vertical,
• Re-calibration interval: 365 days,
• Warm up time: 30 seconds.

ACCURACY
Accuracy specifications apply to all supported measurement functions using sinusoidal waveforms and across the entire operating range of the product between the temperatures of –20°C to +70°C. Maximum worst case accuracy specification includes stability, traceability uncertainty, power factor, and test system errors.
- Typical Accuracy: ±0.01%
- Worst Case Accuracy: ±0.04%

For voltage and current typical accuracy: 0,005%
For voltage and current worst case accuracy: 0,02%
Temperature Influence outside normal operating temperature range per °C: ±0.0005% typical, ±0.001% maximum
For Power Factors of 100% and 50% output for Whrs, VARhrs, VAhrs there is no impact on accuracy.
For Power Factor of <0.5 (PF between - 60° and -90°) then Worse Case Accuracy is ± 0.04%/PF.

PROTECTION
• Isolation: Complete: Input/output/power/case/control,
• Dielectric withstand: 2.3 kVrms, 60Hz, 60 seconds,
• Surge withstand: IEEE 472 and ANSI 37.90,
• Fuses: #34.3117 for potential and auxiliary power INPUTS (Port 1),
• Display Gate: BNC with 150 ohms pull up to 5 volts, clamped at 5.7 volts,
• Gate Rate: 200 nS pulse width min, max 20 Hz repetition rate.

INPUTS (Port 1)
• Display Gate: BNC with 150 ohms pull up to 5 volts, clamped at 5.7 volts,
• Gate Rate: 200 nS pulse width min, max 20 Hz repetition rate.

OUTPUTS (Port 2)
• Type: BNC, Open collector, clamped at 27 volts (50mA max),
• Frequency: Max 2.1 MHz (200 nS pulse width minimum),
• Metrics: Selectable, i.e. Watt hours, VAR hours, VA Hours, etc.
• Pulse value: Programmable (0.00001 Wh/pulse Default).

QUALITY
• Meets all applicable ANSI and IEC specifications,
• Radian Research's calibration procedures are in compliance with MILSTD-45662A and ANSI/NCSL Z540-1-1994,
• Radian's primary transfer standards are traceable to NIST,
• Radian Research's quality system is ISO-9001-2000 certified,
• Warranty: Two years parts and labor.

RD-20 Menu for Measurements & Functionality: The last three digits determine the model. The first of the last three digits determines the measurement functions; the second of the last three digits determines if the unit has a comparator, harmonics analysis, and/or analog sense capability; the third of the last three digits determines the current input configuration.

MODEL	MEASUREMENT FUNCTIONS
Specifying the first of the last three digits: RD-20-Xxx	
RD-20-1xx	Whrs, Volts, Amps, VARhrs
RD-20-2xx	Whrs, Volts, Amps, VARhrs, VAhrs, Qhrs, Watts, VARs, VA, Phase Angle, Power Factor, Frequency
RD-20-3xx	Whrs, VARhrs, VAhrs, Qhrs, Volts, Amps, Watts, VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, Power Factor, Frequency Min & Max measurements: All indicating functions
RD-20-4xx	Whrs, Volts, Amps, VARhrs, Qhrs, VAhrs,Watts, VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, Power Factor, Frequency Min & Max: All indicating functions AVG response : VAhrs, VA, Volts, Vhrs, Amps, Ahrs
Specifying the second of the last three digits: RD-20-Xxx	
RD-20-x0x	No comparator, No harmonic analysis
RD-20-x1x	Built-in comparator
RD-20-x2x	Harmonic analysis (RR-Analyze Software included)
RD-20-x3x	Built-in comparator AND harmonic analysis
Specifying the third of the last three three digits: RD-20-Xxx	
RD-20-xx1	Clamp-on CT input and one 120 Amp current input (120A total)
RD-20-xx2	Clamp-on CT input and three 67 Amp current input (200A total)
RD-20-xx3	Clamp-on CT input and three 75 Amp current input (225Amps total)
RD-20-xx4	Rack Mount Enclosure and one 120 Amp current input (120 total)

ACCESSORIES

RR-Analyze	Software for Harmonics Analysis (included with harmonics option)
RR-Configure	Software for Custom Configuration of RD-2x
RR-Kit	Software for Custom Application Development
RR-1H	Optical Pickup for Infrared LED, 4-Pin plug
RR-DS./sm	Meter Disc Sensor with 4-Pin plug, suction mount
RR-DS./f	Meter Disc Sensor with 4-Pin plug, field mount
RR-DS./s	Meter Disc Sensor with 4-Pin plug, shop mount
RR-KYZ	Pulse Input Adapter with 4-Pin plug
RR# 352000	Soft Carrying Case for RD Standard and Test Accessories

WARRANTY
The RD-20 is warranted to be substantially stable in calibration over time. If within one year after factory calibration the RD-20 does not meet its specifications, Radian will repair and recalibrate the unit. Radian Research warrants the RD-20 to be free from defects in material and workmanship. Radian will repair or replace any instrument or component therein which, within two years after shipment, proves to be defective upon examination. For a period of ten years, Radian warrants the RD-20's autoranging feature from catastrophic failure resulting from failure to autorange.

RD-21 Dytronic Single-Phase Reference Standard

R A D I A N

TYPICAL ACCURACY = +/- 0.005%
WORST CASE = +/- 0.02%

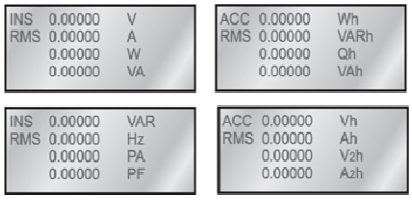
OVERVIEW

PRODUCT HIGHLIGHTS: The Radian RD-21 Single-phase Electricity Reference Standard is one of the most versatile reference instruments ever. The RD-21 has a typical accuracy of 0.005% for all measurement functions across its entire operating range, with a maximum worst case accuracy of 0.02%. This worst case accuracy specification includes the variables of stability, power factor, traceability uncertainty and test system errors. The RD-21 utilizes Radian's new Dytronic measurement technology consisting of a Radian designed Integrating Analog to Digital Signal Converter. Unlike off-the-shelf A/D Converters used in other instruments, Radian's A/D Converter is specifically designed and optimized for power and energy measurement. This unique design makes the RD-21 absolutely unsurpassed in its ability to accurately measure "real world" waveforms. The RD-21's A/D Converter is combined with Radian's renowned electronically compensated voltage and current input transformers and a hermetically sealed reference set to provide the highest degree of accuracy, stability and versatility offered in a portable single-phase standard.
ANALOG SENSE: The optional analog sense feature enables testing of transducers and energy meters that provide an analog current output from zero to 2 mA.
MEASUREMENTS: The RD-21 is a four quadrant single-phase, simultaneous measuring instrument that registers both forward and reverse energy flow and provides voltage, current, power and energy (Active, Reactive, Apparent) information. The Harmonic Analysis option makes available the analysis of customer load though the 50th harmonic order while the Built-in Comparator option provides for the automatic calculation of test results for the meters and standards being tested.
METER AND STANDARD TESTING: The compact design of the RD-21 makes it an ideal reference standard for field testing applications where optimal accuracy is required. The RD-21 can be used with a controlled current source to test revenue meters and reference standards. In field applications the RD-21 can perform a single-phase meter accuracy test using existing service load. Pickups to sense meter disk rotation or calibration pulses of infrared, visible light, or KYZ signal plug directly into the standard. The RD-21 is ideal for testing high end energy meters found in power plants, substations, inter-tie points and at large utility customer accounts. The RD-21 may serve as a secondary standard to test portable field standards or standards within meter test benches. The RD-21 is also deal to be integrated as the reference standard within a meter test bench.

INTUITIVE USER INTERFACE: The RD-21's LCD and five-button keypad provides a direct interface to the end user while the RD-21's RS-232 port, utilized with the applicable software, allows for remote PC control and configuration of the RD-21. Utilizing the five-button keypad and observing the LCD, the user is able to scroll through the various measurement functions of the RD-21 and toggle between the different menu screens. The amount of measurement information and the number of menu screens viewable is determined by the model number of the RD-21.

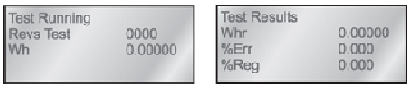
MENU SCREENS: The key menu screens are the Measurement Screens, Run Test Screen, Harmonics Screen, and Setup Screen.

The Measurement Screens will display the measurement functions the RD-21supports. There are different screens for Instantaneous Measurements, Accumulating Measurements, and Minimum & Maximum Measurements. Using the keypad, it is very simple to toggle between the various measurement screens and to scroll through the various measurement functions.



The Main Menu Screen allows users to gain access to the specific functionality of their RD-21. From the Main Menu, the user may select to run a meter, standard, or analog sense test, perform harmonics analysis, set-up/configure their RD-21, perform a self test, and review information pertinent to their RD-21.

The Run Test Screen allows the user to select the type of test they would like to run and then to enter the different variables for that specific test.



In the Harmonics Screen the user may select to view voltage or amperage harmonics, scroll through the harmonic order to observe the phase and magnitude of a specific harmonic, and view the total harmonic distortion.

The Setup Screen allows the user to custom configure their RD-21. The options available are changing the operation of the BNC ports, enabling or disabling the backlit display, selecting RMS or AVG measurement response, disabling or enabling the RD-21's audible beeps, auto-scrolling the screens, and returning the RD-21 to its original factory default settings.
The above features and functions may also be utilized via a PC running Radian Software packages. RR-Configure/Analyze allows for the custom configuration of the RD-21 along with data analysis and RR-Kit software is a set of commands, routines, and instructions for custom application development.

OPERATING RANGE
• Current (Autoranging)
- .02 to 67 amps per input (three input option),
- .02 to 75 amps per input (three input extended range option),
- .02 to 120 amps per input (one input option),
• Input voltage: 30 to 600 volts (Autoranging),
• Auxiliary power input: 60 to 600 volts (Autoranging),
• Frequency: 45 to 65 Hz,
• Phase Angle: 0 to 360° or -180 to 180°,
• Power Factor: -1 to 1,
• Temperature: –20° to +70°C (-4° to -158°F),
• Humidity: 0% to 95% non-condensing,
• Shock and vibration: Any that is not destructive.

PHYSICAL DESCRIPTION
• Weight: 2.5 kg (5.5 lbs); 3.6 kg (8lbs) shipping weight,
• Size 190.5 mm (7.5") H x 139.7 mm (5.5") D excluding strap,
• Backlit LCD, 4 line by 16 character,
• Current inputs: 6mm jacks,
• Potential and Aux power inputs: 4mm Banana type jacks,
• BNC connector (port 1) used for input/gating,
• BNC connector (port 2) used for pulse outputs,
• BNC connector (port 3) used for three phase SYNC or analog sense,
• 5 membrane button keypad: up/down/esc-reset/enter/mode,
• 8 pin RJ-45 jack for RS-232 communication,
• Pickup input for direct interface to RR-DS, RR-1H, or RR-KYZ,
• Clamp-on CT input for optional clamp-on current transformer.

TEST AND CALIBRATION
• No physical adjustments, all calibration performed with software,
• 50 or 60 Hz calibration can be provided,
• Orientation: Any within 90° of vertical,
• Re-calibration interval: 365 days,
• Warm up time: 30 seconds.

ACCURACY
Accuracy specifications apply to all supported measurement functions using sinusoidal waveforms and across the entire operating range of the product between the temperatures of –20°C to +70°C. Maximum worst case accuracy specification includes stability, traceability uncertainty, power factor, and test system errors.
- Typical Accuracy: ±0.005%
- Worst Case Accuracy: ±0.02%
For voltage and current typical accuracy: 0,0025%
For voltage and current worst case accuracy: 0,01%
Temperature Influence outside normal operating temperature range per °C: ±0.0005% typical, ±0.001% maximum
For Power Factors of 100% and 50% output for Whrs, VARhrs, VAhrs there is no impact on accuracy.
For Power Factor of <0.5 (PF between - 60° and -90°) then Worse Case Accuracy is ± 0.02%/PF.

PROTECTION
• Isolation: Complete: Input/output/power/case/control,
• Dielectric withstand: 2.3 kVrms, 60Hz, 60 seconds,
• Surge withstand: IEEE 472 and ANSI 37.90,
• Fuses: #34.3117 for potential and auxiliary power.

INPUTS (Port 1)
• Display Gate: BNC with 150 ohms pull up to 5 volts, clamped at 5.7 volts,
• Gate Rate: 200 nS pulse width min, max 20 Hz repetition rate.

OUTPUTS (Port 2)
• Type: BNC, Open collector, clamped at 27 volts (50mA max),
• Frequency: Max 2.1 MHz (200 nS pulse width minimum),
• Metrics: Selectable, i.e. Watt hours, VAR hours, VA Hours, etc.
• Pulse value: Programmable (0.00001 Wh/pulse Default).

QUALITY
• Meets all applicable ANSI and IEC specifications,
• Radian Research's calibration procedures are in compliance with MILSTD-45662A and ANSI/NCSL Z540-1-1994,
• Radian Research's primary transfer standards are traceable to NIST,
• Radian Research's quality system is ISO-9001-2000 certified,
• Warranty: Two years parts and labor.

RD-21 Menu for Measurements & Functionality: The last three digits determine the model. The first of the last three digits determines the measurement functions. The second digit determines if the unit has a built-in computer, power analysis option and/or analog sense input. The third of the last three digits determines the current input configuration and enclosure type.

MODEL	MEASUREMENT FUNCTIONS
Specifying the first of the last three digits: RD-21-Xxx	
RD-21-1xx	Whrs, Volts, Amps, VARhrs
RD-21-2xx	Whrs, Volts, Amps, VARhrs, VAhrs, Qhrs, Watts, VARs, VA, Phase Angle, Power Factor, Frequency
RD-21-3xx	Whrs, VARhrs, VAhrs, Qhrs, Volts, Amps, Watts, VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, Power Factor, Frequency Min & Max measurements: All indicating functions
RD-21-4xx	Whrs, Volts, Amps, VARhrs, Qhrs, VAhrs,Watts, VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, Power Factor, Frequency Min & Max: All indicating functions AVG response : VAhrs, VA, Volts, Vhrs, Amps, Ahrs
Specifying the second of the last three digits: RD-21-Xxx	
RD-21-x0x	No comparator, No harmonic analysis
RD-21-x1x	Built-in comparator
RD-21-x2x	Harmonic analysis (RR-Analyze Software)
RD-21-x3x	Built-in comparator AND harmonic analysis
RD-21-x4x	Analog Sense Testing (2 mA DC max)
RD-21-x5x	Built-in comparator and analog sense
RD-21-x6x	Harmonics analysis and analog sense
RD-21-x7x	Built-in komparator, harmonice analysis and analog sense
Specifying the third of the last three digits: RD-21-Xxx	
RD-21-xx1	Clamp-on CT input and one 120 Amp current input (120A total)
RD-21-xx2	Clamp-on CT input and three 67 Amp current input (200A total)
RD-21-xx3	Clamp-on CT input and three 75 Amp current input (225Amps total)
RD-21-xx4	Rack Mount Enclosure and one 120 Amp current input (120 total)

ACCESSORIES

RR-Analyze	Software for Harmonics Analysis (included with harmonics option)
RR-Configure	Software for Custom Configuration of RD-2x
RR-Kit	Software for Custom Application Development
RR-1H	Optical Pickup for Infrared LED, 4-Pin plug
RR-DS./sm	Meter Disc Sensor with 4-Pin plug, suction mount
RR-DS./f	Meter Disc Sensor with 4-Pin plug, field mount
RR-DS./s	Meter Disc Sensor with 4-Pin plug, shop mount
RR-KYZ	Pulse Input Adapter with 4-Pin plug
RR# 352000	Soft Carrying Case for RD Standard and Test Accessories

WARRANTY
The RD-21 is warranted to be substantially stable in calibration over time. If within one year after factory calibration the RD-21 does not meet its specifications, Radian will repair and recalibrate the unit. Radian Research warrants the RD- 21 to be free from defects in material and workmanship. Radian will repair or replace any instrument or component therein which, within two years after shipment, proves to be defective upon examination. For a period of ten years, Radian warrants the RD-21's autoranging feature from catastrophic failure resulting from failure to autorange.

RD-23 Dytronic Single-Phase Reference Standard

R A D I A N

WORST CASE = +/- 0.01%

OVERVIEW

PRODUCT HIGHLIGHTS: The Radian RD-23 Single-phase Reference Standard may be the most accurate measurement instrument ever designed for field use. The RD-23 has a worst case accuracy of 0.01% for all measurement functions across its entire operating range, with a typical accuracy that is within traceability uncertainties. The worst case accuracy specification includes the variables of stability, power factor, traceability uncertainty and test system errors.

The RD-23 utilizes Radian's new Dytronic measurement technology consisting of a Radian designed Integrating Analog to Digital Signal Converter. Unlike off-the-shelf A/D Converters used in other instruments, Radian's A/D Converter is specifically designed and optimized for power and energy measurement. This unique design makes the RD-23 absolutely unsurpassed in its ability to accurately measure "real world" waveforms. The RD-23's A/D Converter is combined with Radian's renowned electronically compensated voltage and current input transformers and a hermetically sealed reference set to provide the highest degree of accuracy, stability and versatility offered in a portable single-phase standard.

ANALOG SENSE: The optional analog sense feature enables testing of transducers and energy meters that provide an analog current output from zero to 2 mA.

MEASUREMENTS: The RD-23 is a four quadrant single-phase, simultaneous measuring instrument that registers both forward and reverse energy flow and provides voltage, current, power and energy (Active, Reactive, Apparent) information. The Harmonic Analysis option makes available the analysis of customer load though the 50th harmonic order while the Built-in Comparator option provides for the automatic calculation of test results for the meters and standards being tested.

METER AND STANDARD TESTING: The compact design of the RD-23 makes it an ideal reference standard for field testing applications where optimal accuracy is required. The RD-23 can be used with a controlled current source to test revenue meters and reference standards. In field applications the RD-23 can perform a single-phase meter accuracy test using existing service load. Pickups to sense meter disk rotation or calibration pulses of infrared, visible light, or KYZ signal plug directly into the standard. The RD-23 is ideal for testing high end energy meters found in power plants, substations, inter-tie points and at large utility customer accounts. The RD-23 may serve as a secondary standard to test portable field standards or standards within meter test benches. The RD-23 is also ideal to be integrated as the reference standard within a meter test bench.

INTUITIVE USER INTERFACE: The RD-23's LCD and five-button keypad provides a direct interface to the end user while the RD-23's RS-232 port, utilized with the applicable software, allows for remote PC control and configuration of the RD-23. Utilizing the five-button keypad and observing the LCD, the user is able to scroll through the various measurement functions of the RD-23 and toggle between the different menu screens. The amount of measurement information and the number of menu screens viewable is determined by the model number of the RD-23.

MENU SCREENS: The key menu screens are the Measurement Screens, Run Test Screen, Harmonics Screen, and Setup Screen.

The Measurement Screens will display the measurement functions the RD-23 supports. There are different screens for Instantaneous Measurements, Accumulating Measurements, and Minimum & Maximum Measurements. Using the keypad, it is very simple to toggle between the various measurement screens and to scroll through the various measurement functions.

The Main Menu Screen allows users to gain access to the specific functionality of their RD-23. From the Main Menu, the user may select to run a meter, standard, or analog sense test, perform harmonics analysis, set-up/configure their RD-23, perform a self test, and review information pertinent to their RD-23.

The Run Test Screen allows the user to select the type of test they would like to run and then to enter the different variables for that specific test.

In the Harmonics Screen the user may select to view voltage or amperage harmonics, scroll through the harmonic order to observe the phase and magnitude of a specific harmonic, and view the total harmonic distortion.

The Setup Screen allows the user to custom configure their RD-23. The options available are changing the operation of the BNC ports, enabling or disabling the backlit display, selecting RMS or AVG measurement response, disabling or enabling the RD-23's audible beeps, auto-scrolling the screens, and returning the RD-23 to its original factory default settings.

The above features and functions may also be utilized via a PC running Radian Software packages. RR-Configure/Analyze allows for the custom configuration of the RD-23 along with data analysis and RR-Kit software is set of commands, routines, and instructions for custom application development.

OPERATING RANGE
• Current (Autoranging)
- .02 to 67 amps per input (three input option),
- .02 to 75 amps per input (three input extended range option),
- .02 to 120 amps per input (one input option),
• Input voltage: 30 to 600 volts (Autoranging),
• Auxiliary power input: 60 to 600 volts (Autoranging),
• Frequency: 45 to 65 Hz,
• Phase Angle: 0 to 360° or -180 to 180°,
• Power Factor: -1 to 1,
• Temperature: +18° to +30°C,
• Humidity: 0% to 95% non-condensing,
• Shock and vibration: Any that is not destructive.

PHYSICAL DESCRIPTION
• Weight: 2.5 kg (5.5 lbs); 3.6 kg (8lbs) shipping weight,
• Size 190.5 mm (7.5") H x 139.7 mm (5.5") D excluding strap,
• Backlit LCD, 4 line by 16 character,
• Current inputs: 6mm jacks,
• Potential and Aux power inputs: 4mm Banana type jacks,
• BNC connector (port 1) used for input/gating,
• BNC connector (port 2) used for pulse outputs,
• BNC connector (port 3) used for three phase SYNC or analog sense,
• 5 membrane button keypad: up/down/esc-reset/enter/mode,
• 8 pin RJ-45 jack for RS-232 communication,
• Pickup input for direct interface to RR-DS, RR-1H, or RR-KYZ,
• Clamp-on CT input for optional clamp-on current transformer.

TEST AND CALIBRATION
• No physical adjustments, all calibration performed with software,
• 50 or 60 Hz calibration can be provided,
• Orientation: Any within 90° of vertical,
• Re-calibration interval: 365 days,
• Warm up time: 30 seconds.

ACCURACY
Accuracy specifications apply to all supported measurement functions using sinusoidal waveforms and across the entire operating range of the product between the temperatures of +18°C to +30°C. Maximum worst case accuracy specification includes stability, traceability uncertainty, power factor, and test system errors.
- Typical Accuracy: within traceability uncertainties
- Worst Case Accuracy: ±0.01%
Temperature Influence outside normal operating temperature range per °C:±0.0005% typical, ±0.001% maximum
For Power Factors of 100% and 50% output for Whrs, VARhrs, VAhrs there is no impact on accuracy.
For Power Factor of <0.5 (PF between - 60° and -90°) then Worse Case Accuracy is ± 0.01%/PF.

PROTECTION
• Isolation: Complete: Input/output/power/case/control,
• Dielectric withstand: 2.3 kVrms, 60Hz, 60 seconds,
• Surge withstand: IEEE 472 and ANSI 37.90,
• Fuses: #34.3117 for potential and auxiliary power.

INPUTS (Port 1)
• Display Gate: BNC with 150 ohms pull up to 5 volts, clamped at 5.7 volts,
• Gate Rate: 200 nS pulse width min, max 20 Hz repetition rate.

OUTPUTS (Port 2)
• Type: BNC, Open collector, clamped at 27 volts (50mA max),
• Frequency: Max 2.1 MHz (200 nS pulse width minimum),
• Metrics: Selectable, i.e. Watt hours, VAR hours, VA Hours, etc.
• Pulse value: Programmable (0.00001 Wh/pulse Default).

QUALITY
• Meets all applicable ANSI and IEC specifications,
• Radian Research's calibration procedures are in compliance with MILSTD-45662A and ANSI/NCSL Z540-1-1994,
• Radian Research's primary transfer standards are traceable to NIST,
• Radian Research's quality system is ISO-9001-2000 certified,
• Warranty: Two years parts and labor.

RD-23 Menu for Measurements & Functionality: The last three digits determine the model. The first of the last three digits determines the measurement functions; the second of the last three digits determines if the unit has a comparator, harmonics analysis, and/or analog sense capability; the third of the last three digits determines the current input configuration.

MODEL	MEASUREMENT FUNCTIONS
Specifying the first of the last three digits: RD-23-Xxx	
RD-23-1xx	Whrs, Volts, Amps, VARhrs
RD-23-2xx	Whrs, Volts, Amps, VARhrs, VAhrs, Qhrs, Watts, VARs, VA, Phase Angle, Power Factor, Frequency
RD-23-3xx	Whrs, VARhrs, VAhrs, Qhrs, Volts, Amps, Watts, VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, Power Factor, Frequency Min & Max measurements: All indicating functions
RD-23-4xx	Whrs, Volts, Amps, VARhrs, Qhrs, VAhrs,Watts, VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, Power Factor, Frequency Min & Max: All indicating functions AVG response : VAhrs, VA, Volts, Vhrs, Amps, Ahrs
Specifying the second of the last three digits: RD-23-Xxx	
RD-23-x0x	No comparator, No harmonic analysis
RD-23-x1x	Built-in comparator
RD-23-x2x	Harmonic analysis (RR-Analyze Software)
RD-23-x3x	Built-in comparator AND harmonic analysis
RD-23-x4x	Analog Sense Testing (2 mA DC max)
RD-23-x5x	Built-in comparator and analog sense
RD-23-x6x	Harmonics analysis and analog sense
RD-23-x7x	Built-in komparator, harmonice analysis and analog sense
Specifying the third of the last three digits: RD-23-Xxx	
RD-23-xx1	Clamp-on CT input and one 120 Amp current input (120A total)
RD-23-xx2	Clamp-on CT input and three 67 Amp current input (200A total)
RD-23-xx3	Clamp-on CT input and three 75 Amp current input (225Amps total)
RD-23-xx4	Rack Mount Enclosure and one 120 Amp current input (120 total)

ACCESSORIES

RR-Analyze	Software for Harmonics Analysis (included with harmonics option)
RR-Configure	Software for Custom Configuration of RD-2x
RR-Kit	Software for Custom Application Development
RR-1H	Optical Pickup for Infrared LED, 4-Pin plug
RR-DS./sm	Meter Disc Sensor with 4-Pin plug, suction mount
RR-DS./f	Meter Disc Sensor with 4-Pin plug, field mount
RR-DS./s	Meter Disc Sensor with 4-Pin plug, shop mount
RR-KYZ	Pulse Input Adapter with 4-Pin plug
RR# 352000	Soft Carrying Case for RD Standard and Test Accessories

WARRANTY
The RD-23 is warranted to be substantially stable in calibration over time. If within one year after factory calibration the RD-23 does not meet its specifications, Radian will repair and recalibrate the unit. Radian Research warrants the RD-23 to be free from defects in material and workmanship. Radian will repair or replace any instrument or component therein which, within two years after shipment, proves to be defective upon examination. For a period of ten years, Radian warrants the RD-23's autoranging feature from catastrophic failure resulting from failure to autorange.

RD-30 Dytronic Three-Phase Reference Standard

R A D I A N

TYPICAL ACCURACY = +/- 0.01%
WORST CASE = +/- 0.04%

OVERVIEW

PRODUCT HIGHLIGHTS: The Radian RD-30 Three-phase Electricity Reference Standard is one of the most versatile reference instruments ever. The RD-30 has a worst case accuracy of 0.04% for all measurment functions across its entire operating range, with typical accuracy of 0.01%. This worst case accuracy specification includes the variables of stability, power factor, and traceability uncertainty.

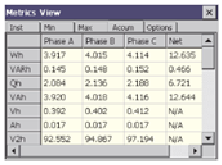
The RD-30 utilizes Radian's new Dytronic measurement technology consisting of a Radian designed Integrating Analog to Digital Signal Converter. Unlike off-the-shelf A/D Converters used in other instruments, Radian's A/D Converter is specifically designed and optimized for power and energy measurement. This unique design makes the RD-30 absolutely unsurpassed in its ability to accurately measure "real world" waveforms. The RD-30's A/D Converter is combined with Radian's renowned electronically compensated voltage and current input transformers and a hermetically sealed reference set to provide the highest degree of accuracy, stability and versatility offered in a portable three-phase standard.

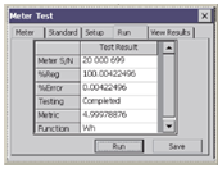
MEASUREMENTS: The RD-30 is a four quadrant three -phase measuring instrument that registers both forward and reverse energy flow and provides per phase voltage, current, power and energy (Active, Reactive, Apparent) information.

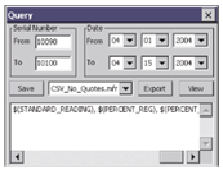
ANALOG SENSE: The optional analog sense feature enables testing of transducers and electronic energy meters that provide an analog current output from zero to 2 mA.

METER AND STANDARD TESTING: The RD-30 can be used with a controlled current source to test revenue meters and reference standards. In field applications the RD-30 can perform a true three phase meter accuracy test using existing service load. Pickups to sense meter disk rotation or calibration pulses of infrared, visible light or KYZ variety plug directly into the unit. The RD-30 is ideal for testing high end energy meters found in power plants, substations, inter-tie points and at large utility customer accounts. The RD-30 is also the perfect complement to relay test sets where it can serve as an active reference standard when testing meters or can be used to periodically certify the accuracy of the test set itself. The RD-30 is available in a portable or rack mount package.

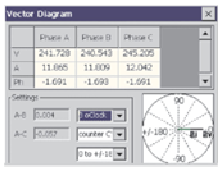
POWERFUL SOFTWARE: The RD-30 has an optional built in computer with color touchscreen display. Windows CE based RR-MobileSuite software powers the testing and analysis functions of the RD-30. RR-MobileSuite is a set of simple, yet extremely powerful, software tools. Metrics enables the user to view and manipulate views of all measurements including: Instantaneous, MIN/MAX, and Accumulating. Configure enables setting and control of various device parameters. Meter Test allows you to perform a test on a revenue meter. Standard Test allows you to test up to three secondary standards. Results for meter and standards testing are calculated, displayed, and can be saved. The use of standard memory cards makes data expansion unlimited. Data management features allow users to easily query, view and transfer saved test results to a PC. Customizable export files can be created using a flexible Comma Separated Variable (CSV) format that is easily imported into other PC applications. The RD-30 can also be controlled with an external computer using an RS-232 serial connection. RR-PCSuite is a PC based version of RR-MobileSuite software that adds the ability to directly save test results to a computer's hard disk. RR-Kit software is a set of commands, routines and instructions for developing custom software applications.

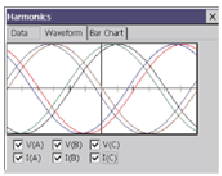


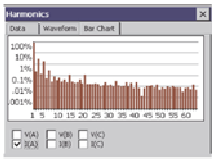


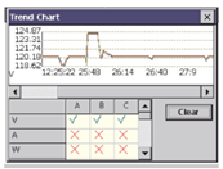


POWER ANALYSIS: This option to the RD-30 adds valuable tools to RR-MobileSuite. Vectors graphically displays three phase vector diagrams with flexible display settings. Harmonics provides Total Harmonic Distortion (THD) for all three phases of voltage and current waveforms, displays amplitude and relative phase angle data up to the 64th harmonic, and provides graphical representations of all harmonics information. Trend enables you to generate a trend chart for any of the instantaneous metrics. The unprecedented accuracy of measuring distorted waveforms combines with this power analysis capability to clearly distinguish the RD-30 as the definitive portable energy reference instrument for both testing and power quality applications.









RD-30 Dytronic Three-Phase Reference Standard

OPERATING RANGE
• Current input range is 0.02 to 120 (200 optional) amps per input autoranging - direct connection,
• Voltage input range is 30 to 630 volts autoranging,
• Auxiliary power input range is 60 to 630 volts autoranging,
• The BNC pulse output has a default value of 0.00001 Wh/pulse but may be reprogrammed with RR-MobileSuite or RR-PCSuite,
• Frequency range is 45 to 65 Hz. (Fundamental),
• Harmonic Analysis through the 64th harmonic order,
• Power Factor range is any,
• Operating temperature range is –20°C to +70°C,
• Shock and vibration withstand are any that is not destructive.

PHYSICAL DESCRIPTION
• Adjustable to Rack mount, Desktop or Field Applications,
• Weight is 16 pounds (7.2 kg). Shipping weight 28 pounds (12.6 kg),
• Dimensions are 5 inches H, 17.5 inches W, 6.25 inches D (127mm H, 444.5mm W, 158.75mm D.),
• Case Construction is a powder coated aluminum,
• The LCD is backlit,
• Current inputs are 6mm Multi-Contact brand sockets for 120 Amp version or 8mm bolt on for 200 Amp version,
• The potential input and auxiliary power inputs are insulated 4mm Multi-Contact brand sockets,
• 9 pin DB9 jack,
• Lemo connector for interface to sensors,
• 3 Clamp-on CT inputs. These connectors are for direct interface to an optional clamp-on current transformer, available from Radian.

TEST AND CALIBRATION
• The unit is calibrated by software,
• 50 and 60 Hz calibration sheets can be provided,
• Orientation is any,
• Re-calibration interval is 365 days,
• Warm up time is 15 seconds or less.

ACCURACY
Accuracy specifications apply to all supported measurement functions using sinusoidal waveforms and across the entire operating range of the product between the temperatures of –20°C to +70°C. Maximum worst case accuracy specification includes stability, traceability uncertainty, power factor, and test system errors.
- Typical Accuracy: ± 0.01%
- Worse Case Accuracy: ± 0.04%
For voltage and current typical accuracy: 0,005%
For voltage and current worst case accuracy: 0,02%
Temperature Influence outside normal operating temperature range per °C: ± 0.0005% typical ± 0.001% maximum
For Power Factors of 100% and 50% output for Whrs, VARhrs, VAhrs there is no impact on accuracy.
For Power Factor of <0.5 (PF between - 60° and -90°) then Worst Case Accuracy is ± 0.04%/PF.

PROTECTION
• Isolation: Complete: Input/output/power/case/control,
• Dielectric withstand: 2.3 kVrms, 60Hz 60 seconds,
• Surge withstand: IEEE 472 and ANSI 37.90,
• Fuses: Schurter #0342516 for potential and auxiliary power.

ENVIRONMENTAL
• Temperature: -20°C to 70°C (-4°F to 158°F) operation -20°C to 70°C (-4°F to 158°F) storage,
• Humidity: 0% to 95% non-condensing.

INPUTS 1, 2, 3
• Display Gate: BNC with 150 ohms pull up to 5 volts, clamped at 5.7 volts,
• Gate Rate: 200 nS pulse width minimum, maximum 20 Hz repetition rate.

OUTPUTS 1, 2, 3
• Type: Open collector, clamped at 27 volts,
• Frequency: Max 2.1 MHz (200 nS pulse width minimum),
• Metrics: Selectable, i.e. Watt Hours, VAR Hours, VA Hours, etc.

RD-30 Menu for Measurements & Functionality: The last three digits determine the model. The first of the last three digits determines the measurement functions. The second digit determines if the unit has a built-in computer, power analysis option and/or analog sense input. The third of the last three digits determines the current input configuration and enclosure type.

MODEL	MEASUREMENT FUNCTIONS
Specifying the first of the last three digits: RD-30-Xxx	
RD-30-2xx	Whrs, VARhrs, Volts, Amps, VAhrs, Qhrs, Watts, VARs, VA, Phase Angle, PF, Frequency
RD-30-3xx	Whrs, VARhrs, VAhrs, Volts, Amps, Qhrs, Watts, VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, PF, Frequency Min & Max measurements: All indicating functions
RD-30-4xx	Whrs, VARhrs, VAhrs, Volts, Amps, Qhrs, Watts, VARs, VA, Vhr, Ahr, V2h, A2h, Phase Angle, PF, Frequency Min& Max: All indicating functions AVG response: VA, VAhrs, Volts, Vhrs, Amps, Ahrs
Specifying the second of the last three digits: RD-30-Xxx	
RD-30-x0x	No computer, No Power analysis, No analog sense input
RD-30-x1x	Built-in computer (with color display and WIN CE MobileSuite software)
RD-30-x2x	Power analysis (Harmonics, Trending and Vector Analysis)
RD-30-x3x	Built-in computer and Power analysis
RD-30-x4x	Analog Sense Input (for Volts, Amps, Watts, VARs, VA); (2 mA DC max)
RD-30-x5x	Built-in computer and analog sense input
RD-30-x6x	Power analysis and analog sense input
RD-30-x7x	Built-in computer, Power analysis and analog sense input
Specifying the third of the last three digits: RD-30-Xxx	
RD-30-xx1	120 Amp (6mm insert) current inputs, Rack Mount
RD-30-xx2	200 Amp (bolt on) current inputs, Rack Mount
RD-30-xx3	120 Amp (6 mm insert) current inputs, Portable
RD-30-xx4	200 Amp (bolt on) current inputs, Portable

ACCESSORIES

RR-PCSuite	Testing and Analysis PC software for RD Standards
RR-Kit	Software for Custom Application Development
RR-1H	Optical Pickup for Infrared LED, 4-Pin plug
RR-DS./sm	Meter Disk Sensor with 4-Pin plug, suction mount
RR-DS./f	Meter Disk Sensor with 4-Pin plug, field mount
RR-DS./s	Meter Disk Sensor with 4-Pin plug, shop mount
RR-KYZ	Pulse Input Adapter with 4-Pin plug.

WARRANTY
The RD-30 is warranted to be substantially stable in calibration over time. If within one year after factory calibration the RD-30 does not meet its specifications, Radian will repair and recalibrate the unit. Radian Research warrants the RD-30 to be free from defects in material and workmanship. Radian will repair or replace any instrument or component therein which, within two years after shipment, proves to be defective upon examination. For a period of ten years, Radian warrants the RD-30's autoranging feature from catastrophic failure resulting from failure to autorange.

RD-31 Dytronic Three-Phase Reference Standard

R A D I A N

TYPICAL ACCURACY = +/- 0.005%
WORST CASE = +/- 0.02%

OVERVIEW

PRODUCT HIGHLIGHTS: The Radian RD-31 Three-phase Electricity Reference Standard achieves a level of accuracy and performance never before available in a portable standard. The RD-31 has a worst case accuracy of 0.02% for all measurment functions across its entire operating range, with typical accuracy of 0.005%. This worst case accuracy specification includes the variables of stability, power factor, and traceability uncertainty.

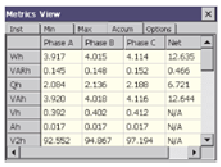
The RD-31 utilizes Radian's new Dytronic measurement technology consisting of a Radian designed Integrating Analog to Digital Signal Converter. Unlike off-the-shelf A/D Converters used in other instruments, Radian's A/D Converter is specifically designed and optimized for power and energy measurement. This unique design makes the RD-31 absolutely unsurpassed in its ability to accurately measure "real world" waveforms. The RD-31's A/D Converter is combined with Radian's renowned electronically compensated voltage and current input transformers and a hermetically sealed reference set to provide the highest degree of accuracy, stability and versatility offered in a portable three-phase standard.

MEASUREMENTS: The RD-31 is a four quadrant three -phase measuring instrument that registers both forward and reverse energy flow and provides per phase voltage, current, power and energy (Active, Reactive, Apparent) information.

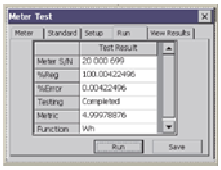
ANALOG SENSE: The optional analog sense feature enables testing of transducers and electronic energy meters that provide an analog current output from zero to 2 mA.

METER AND STANDARD TESTING: The RD-31 can be used with a controlled current source to test revenue meters and reference standards. In field applications the RD-31 can perform a true three phase meter accuracy test using existing service load. Pickups to sense meter disk rotation or calibration pulses of infrared, visible light or KYZ variety plug directly into the unit. The RD-31 is ideal for testing high end energy meters found in power plants, substations, inter-tie points and at large utility customer accounts. The RD-31 is also the perfect complement to relay test sets where it can serve as an active reference standard when testing meters or can be used to periodically certify the accuracy of the test set itself. The RD-31 is available in a portable or rack mount package.

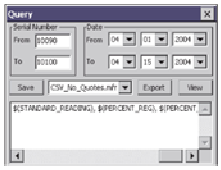
POWERFUL SOFTWARE: The RD-31 has an optional built in computer with color touchscreen display. Windows CE based RR-MobileSuite software powers the testing and analysis functions of the RD-31. RR-MobileSuite is a set of simple, yet extremely powerful, software tools. Metrics enables the user to view and manipulate views of all measurements including: Instantaneous, MIN/MAX, and Accumulating. Configure enables setting and control of various device parameters. Meter Test allows you to perform a test on a revenue meter. Standard Test allows you to test up to three secondary standards.



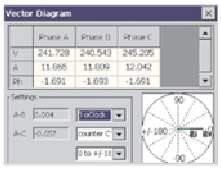
Results for meter and standards testing are calculated, displayed, and can be saved. The use of standard memory cards makes data expansion unlimited. Data management features allow users to easily query, view and transfer saved test results to a PC.

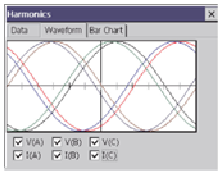


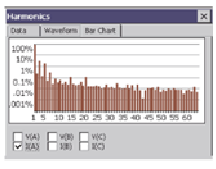
Customizable export files can be created using a flexible Comma Separated Variable (CSV) format that is easily imported into other PC applications. The RD-31 can also be controlled with an external computer using an RS-232 serial connection. RR-PCSuite is a PC based version of RR-MobileSuite software that adds the ability to directly save test results to a computer's hard disk. RR-Kit software is a set of commands, routines and instructions for developing custom software applications.

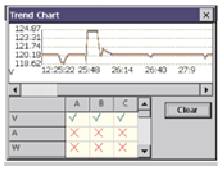


POWER ANALYSIS: This option to the RD-31 adds valuable tools to RR-MobileSuite. Vectors graphically displays three phase vector diagrams with flexible display settings. Harmonics provides Total Harmonic Distortion (THD) for all three phases of voltage and current waveforms, displays amplitude and relative phase angle data up to the 64th harmonic, and provides graphical representations of all harmonics information. Trend enables you to generate a trend chart for any of the instantaneous metrics. The unprecedented accuracy of measuring distorted waveforms combines with this power analysis capability to clearly distinguish the RD-31 as the definitive portable energy reference instrument for both testing and power quality applications.









OPERATING RANGE
• Current input range is 0.02 to 120 (200 optional) amps per input autoranging -direct connection,
• Voltage input range is 30 to 630 volts autoranging,
• Auxiliary power input range is 60 to 630 volts autoranging,
• The BNC pulse output has a default value of 0.00001 Wh/pulse but may be reprogrammed with RR-MobileSuite or RR-PCSuite,
• Frequency range is 45 to 65 Hz. (Fundamental),
• Harmonic Analysis through the 64th harmonic order,
• Power Factor range is any,
• Operating temperature range is –20°C to +70°C,
• Shock and vibration withstand are any that is not destructive.

PHYSICAL DESCRIPTION
• Adjustable to Rack mount, Desktop or Field Applications,
• Weight is 16 pounds (7.2 kg). Shipping weight 28 pounds (12.6 kg),
• Dimensions are 5 inches H, 17.5 inches W, 6.25 inches D (127mm H, 444.5mm W, 158.75mm D.),
• Case Construction is a powder coated aluminum,
• The LCD is backlit,
• Current inputs are 6mm Multi-Contact brand sockets for 120 Amp version or 8mm bolt on for 200 Amp version,
• The potential input and auxiliary power inputs are insulated 4mm Multi-Contact brand sockets,
• 9 pin DB9 jack,
• Lemo connector for interface to sensors,
• 3 Clamp-on CT inputs. These connectors are for direct interface to an optional clamp-on current transformer, available from Radian.

TEST AND CALIBRATION
• The unit is calibrated by software,
• 50 and 60 Hz calibration sheets can be provided,
• Orientation is any,
• Re-calibration interval is 365 days,
• Warm up time is 15 seconds or less.

ACCURACY
Accuracy specifications apply to all supported measurement functions using sinusoidal waveforms and across the entire operating range of the product between the temperatures of –20°C to +70°C. Maximum worst case accuracy specification includes stability, traceability uncertainty, power factor, and test system errors.
- Typical Accuracy: ± 0.005%
- Worse Case Accuracy: ± 0.02%

For voltage and current typical accuracy: 0,0025%
For voltage and current worst case accuracy: 0,01%
Temperature Influence outside normal operating temperature range per °C: ± 0.0005% typical ± 0.001% maximum
For Power Factors of 100% and 50% output for Whrs, VARhrs, VAhrs there is no impact on accuracy.
For Power Factor of <0.5 (PF between - 60° and -90°) then Worse Case Accuracy is ± 0.02%/PF.

PROTECTION
• Isolation: Complete: Input/output/power/case/control,
• Dielectric withstand: 2.3 kVrms, 60Hz 60 seconds,
• Surge withstand: IEEE 472 and ANSI 37.90,
• Fuses: Schurter #0342516 for potential and auxiliary power.

ENVIRONMENTAL
• Temperature: -20°C to 70°C (-4°F to 158°F) operation -20°C to 70°C (-4°F to 158°F) storage,
• Humidity: 0% to 95% non-condensing.

INPUTS 1, 2, 3
• Display Gate: BNC with 150 ohms pull up to 5 volts, clamped at 5.7 volts,
• Gate Rate: 200 nS pulse width minimum, maximum 20 Hz repetition rate.

OUTPUTS 1, 2, 3
• Type: Open collector, clamped at 27 volts,
• Frequency: Max 2.1 MHz (200 nS pulse width minimum),
• Metrics: Selectable, i.e. Watt Hours, VAR Hours, VA Hours, etc.

RD-31 Menu for Measurements & Functionality: The last three digits determine the model. The first of the last three digits determines the measurement functions. The second digit determines if the unit has a built-in computer, power analysis option and/or analog sense input. The third of the last three digits determines the current input configuration and enclosure type.

MODEL	MEASUREMENT FUNCTIONS
Specifying the first of the last three digits: RD-31-Xxx	
RD-31-2xx	Whrs, VARhrs, Volts, Amps, VAhrs, Qhrs, Watts, VARs, VA, Phase Angle, PF, Frequency
RD-31-3xx	Whrs, VARhrs, VAhrs, Volts, Amps, Qhrs, Watts, VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, PF, Frequency Min & Max measurements: All indicating functions
RD-31-4xx	Whrs, VARhrs, VAhrs, Volts, Amps, Qhrs, Watts, VARs, VA, Vhr, Ahr, V2h, A2h, Phase Angle, PF, Frequency Min& Max: All indicating functions AVG response: VA, VAhrs, Volts, Vhrs, Amps, Ahrs
Specifying the second of the last three digits: RD-31-Xxx	
RD-31-x0x	No computer, No Power analysis, No analog sense input
RD-31-x1x	Built-in computer (with color display and WIN CE MobileSuite software)
RD-31-x2x	Power analysis (Harmonics, Trending and Vector Analysis)
RD-31-x3x	Built-in computer and Power analysis
RD-31-x4x	Analog Sense Input (for Volts, Amps, Watts, VARs, VA); (2 mA DC max)
RD-31-x5x	Built-in computer and analog sense input
RD-31-x6x	Power analysis and analog sense input
RD-31-x7x	Built-in computer, Power analysis and analog sense input
Specifying the third of the last three digits: RD-31-Xxx	
RD-31-xx1	120 Amp (6mm insert) current inputs, Rack Mount
RD-31-xx2	200 Amp (bolt on) current inputs, Rack Mount
RD-31-xx3	120 Amp (6 mm insert) current inputs, Portable
RD-31-xx4	200 Amp (bolt on) current inputs, Portable

ACCESSORIES

RR-PCSuite	Testing and Analysis PC software for RD Standards
RR-Kit	Software for Custom Application Development
RR-1H	Optical Pickup for Infrared LED, 4-Pin plug
RR-DS./sm	Meter Disk Sensor with 4-Pin plug, suction mount
RR-DS./f	Meter Disk Sensor with 4-Pin plug, field mount
RR-DS./s	Meter Disk Sensor with 4-Pin plug, shop mount
RR-KYZ	Pulse Input Adapter with 4-Pin plug.

WARRANTY
The RD-31 is warranted to be substantially stable in calibration over time. If within one year after factory calibration the RD-31 does not meet its specifications, Radian will repair and recalibrate the unit. Radian Research warrants the RD-31 to be free from defects in material and workmanship. Radian will repair or replace any instrument or component therein which, within two years after shipment, proves to be defective upon examination. For a period of ten years, Radian warrants the RD-31's autoranging feature from catastrophic failure resulting from failure to autorange.

RD-33 Dytronic Three-Phase Reference Standard

WORST CASE = +/- 0.01%

R A D I A N

OVERVIEW

PRODUCT HIGHLIGHTS: The Radian RD-33 Three-phase Electricity Reference Standard achieves a level of accuracy and performance never before available in a portable standard. The RD-33 has a worst case accuracy of 0.01% for all measurement functions across its entire operating range, with a typical accuracy that is within traceability uncertainties. This worst case accuracy specification includes the variables of stability, power factor, and traceability uncertainty.

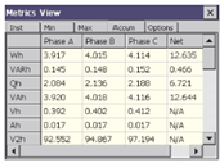
The RD-33 utilizes Radian's new Dytronic measurement technology consisting of a Radian designed Integrating Analog to Digital Signal Converter. Unlike off-the-shelf A/D Converters used in other instruments, Radian's A/D Converter is specifically designed and optimized for power and energy measurement. This unique design makes the RD-33 absolutely unsurpassed in its ability to accurately measure "real world" waveforms. The RD-33's A/D Converter is combined with Radian's renowned electronically compensated voltage and current input transformers and a hermetically sealed reference set to provide the highest degree of accuracy, stability and versatility offered in a portable three-phase standard.

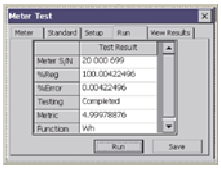
MEASUREMENTS: The RD-33 is a four quadrant three -phase measuring instrument that registers both forward and reverse energy flow and provides per phase voltage, current, power and energy (Active, Reactive, Apparent) information.

ANALOG SENSE: The optional analog sense feature enables testing of transducers and electronic energy meters that provide an analog current output from zero to 2 mA.

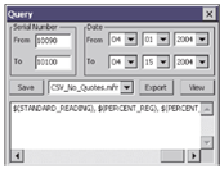
METER AND STANDARD TESTING: The RD-33 can be used with a controlled current source to test revenue meters and reference standards. In field applications the RD-33 can perform a true three phase meter accuracy test using existing service load. Pickups to sense meter disk rotation or calibration pulses of infrared, visible light or KYZ variety plug directly into the unit. The RD-33 is ideal for testing high end energy meters found in power plants, substations, inter-tie points and at large utility customer accounts. The RD-33 is also the perfect complement to relay test sets where it can serve as an active reference standard when testing meters or can be used to periodically certify the accuracy of the test set itself. The RD-33 is available in a portable or rack mount package.

POWERFUL SOFTWARE: The RD-33 has an optional built in computer with color touchscreen display. Windows CE based RR-MobileSuite software powers the testing and analysis functions of the RD-33. RR-MobileSuite is a set of simple, yet extremely powerful, software tools. Metrics enables the user to view and manipulate views of all measurements including: Instantaneous, MIN/MAX, and Accumulating. Configure enables setting and control of various device parameters. Meter Test allows you to perform a test on a revenue meter. Standard Test allows you to test up to three secondary standards. Results for meter and standards testing are calculated, displayed, and can be saved.

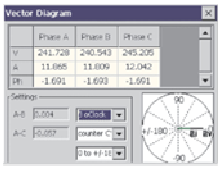


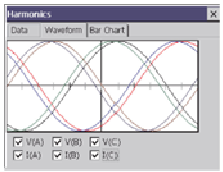


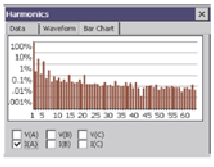
The use of standard memory cards makes data expansion unlimited. Data management features allow users to easily query, view and transfer saved test results to a PC. Customizable export files can be created using a flexible Comma Separated Variable (CSV) format that is easily imported into other PC applications. The RD-33 can also be controlled with an external computer using an RS-232 serial connection. RR-PCSuite is a PC based version of RR-MobileSuite software that adds the ability to directly save test results to a computer's hard disk. RR-Kit software is a set of commands, routines and instructions for developing custom software applications.

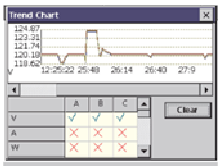


POWER ANALYSIS: This option to the RD-33 adds valuable tools to RR-MobileSuite. Vectors graphically displays three phase vector diagrams with flexible display settings. Harmonics provides Total Harmonic Distortion (THD) for all three phases of voltage and current waveforms, displays amplitude and relative phase angle data up to the 64th harmonic, and provides graphical representations of all harmonics information. Trend enables you to generate a trend chart for any of the instantaneous metrics. The unprecedented accuracy of measuring distorted waveforms combines with this power analysis capability to clearly distinguish the RD-33 as the definitive portable energy reference instrument for both testing and power quality applications.









OPERATING RANGE
• Current input range is 0.02 to 120 (200 optional) amps per input autoranging - direct connection,
• Voltage input range is 30 to 630 volts autoranging,
• Auxiliary power input range is 60 to 630 volts autoranging,
• The BNC pulse output has a default value of 0.00001 Wh/pulse but may be reprogrammed with RR-MobileSuite or RR-PCSuite,
• Frequency range is 45 to 65 Hz. (Fundamental),
• Harmonic Analysis through the 64th harmonic order,
• Power Factor range is any,
• Operating temperature range is +18°C to +30°C,
• Shock and vibration withstand are any that is not destructive.

PHYSICAL DESCRIPTION
• Adjustable to Rack mount, Desktop or Field Applications,
• Weight is 16 pounds (7.2 kg). Shipping weight 28 pounds (12.6 kg),
• Dimensions are 5 inches H, 17.5 inches W, 6.25 inches D (127mm H, 444.5mm W, 158.75mm D.),
• Case Construction is a powder coated aluminum,
• The LCD is backlit,
• Current inputs are 6mm Multi-Contact brand sockets for 120 Amp version or 8mm bolt on for 200 Amp version,
• The potential input and auxiliary power inputs are insulated 4mm Multi-Contact brand sockets,
• 9 pin DB9 jack,
• Lemo connector for interface to sensors,
• 3 Clamp-on CT inputs. These connectors are for direct interface to an optional clamp-on current transformer, available from Radian.

TEST AND CALIBRATION
• The unit is calibrated by software,
• 50 and 60 Hz calibration sheets can be provided,
• Orientation is any,
• Re-calibration interval is 365 days,
• Warm up time is 15 seconds or less.

ACCURACY
Accuracy specifications apply to all supported measurement functions using sinusoidal waveforms and across the entire operating range of the product between the temperatures of –20°C to +70°C. Maximum worst case accuracy specification includes stability, traceability uncertainty, power factor, and test system errors.
- Typical Accuracy: within traceability uncertainties
- Worse Case Accuracy: ± 0.01%
Temperature Influence outside normal operating temperature range per °C: ± 0.0005% typical ± 0.001% maximum
For Power Factors of 100% and 50% output for Whrs, VARhrs, VAhrs there is no impact on accuracy.
For Power Factor of <0.5 (PF between - 60° and -90°) then Worse Case Accuracy is ± 0.01%/PF.

PROTECTION
• Isolation: Complete: Input/output/power/case/control,
• Dielectric withstand: 2.3 kVrms, 60Hz 60 seconds,
• Surge withstand: IEEE 472 and ANSI 37.90,
• Fuses: Schurter #0342516 for potential and auxiliary power.

ENVIRONMENTAL
• Temperature: -20°C to 70°C (-4°F to 158°F) operation -20°C to 70°C (-4°F to 158°F) storage,
• Humidity: 0% to 95% non-condensing.

INPUTS 1, 2, 3
• Display Gate: BNC with 150 ohms pull up to 5 volts, clamped at 5.7 volts,
• Gate Rate: 200 nS pulse width minimum, maximum 20 Hz repetition rate.

OUTPUTS 1, 2, 3
• Type: Open collector, clamped at 27 volts,
• Frequency: Max 2.1 MHz (200 nS pulse width minimum),
• Metrics: Selectable, i.e. Watt Hours, VAR Hours, VA Hours, etc.

RD-33 Menu for Measurements & Functionality: The last three digits determine the model. The first of the last three digits determines the measurement functions. The second digit determines if the unit has a built-in computer, power analysis option and/or analog sense input. The third of the last three digits determines the current input configuration and enclosure type.

MODEL	MEASUREMENT FUNCTIONS
Specifying the first of the last three digits: RD-33-Xxx	
RD-33-2xx	Whrs, VARhrs, Volts, Amps, VAhrs, Qhrs, Watts, VARs, VA, Phase Angle, PF, Frequency
RD-33-3xx	Whrs, VARhrs, VAhrs, Volts, Amps, Qhrs, Watts, VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, PF, Frequency Min & Max measurements: All indicating functions
RD-33-4xx	Whrs, VARhrs, VAhrs, Volts, Amps, Qhrs, Watts, VARs, VA, Vhr, Ahr, V2h, A2h, Phase Angle, PF, Frequency Min& Max: All indicating functions AVG response: VA, VAhrs, Volts, Vhrs, Amps, Ahrs
Specifying the second of the last three digits: RD-33-Xxx	
RD-33-x0x	No computer, No Power analysis, No analog sense input
RD-33-x1x	Built-in computer (with color display and WIN CE MobileSuite software)
RD-33-x2x	Power analysis (Harmonics, Trending and Vector Analysis)
RD-33-x3x	Built-in computer and Power analysis
RD-33-x4x	Analog Sense Input (for Volts, Amps, Watts, VARs, VA); (2 mA DC max)
RD-33-x5x	Built-in computer and analog sense input
RD-33-x6x	Power analysis and analog sense input
RD-33-x7x	Built-in computer, Power analysis and analog sense input
Specifying the third of the last three digits: RD-33-Xxx	
RD-33-xx1	120 Amp (6mm insert) current inputs, Rack Mount
RD-33-xx2	200 Amp (bolt on) current inputs, Rack Mount
RD-33-xx3	120 Amp (6 mm insert) current inputs, Portable
RD-33-xx4	200 Amp (bolt on) current inputs, Portable

ACCESSORIES

RR-PCSuite	Testing and Analysis PC software for RD Standards
RR-Kit	Software for Custom Application Development
RR-1H	Optical Pickup for Infrared LED, 4-Pin plug
RR-DS./sm	Meter Disk Sensor with 4-Pin plug, suction mount
RR-DS./f	Meter Disk Sensor with 4-Pin plug, field mount
RR-DS./s	Meter Disk Sensor with 4-Pin plug, shop mount
RR-KYZ	Pulse Input Adapter with 4-Pin plug.

WARRANTY
The RD-33 is warranted to be substantially stable in calibration over time. If within one year after factory calibration the RD-33 does not meet its specifications, Radian will repair and recalibrate the unit. Radian Research warrants the RD-33 to be free from defects in material and workmanship. Radian will repair or replace any instrument or component therein which, within two years after shipment, proves to be defective upon examination. For a period of ten years, Radian warrants the RD-33's autoranging feature from catastrophic failure resulting from failure to autorange.

Calport100 Plus Portable Analyser and Tester

Features:

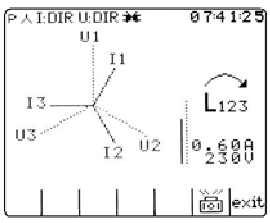
- Measure of power network parameters
- (class 0,1 or 0,2)
- Voltage range 0,05…480V I 0…40kV
- Current range 0,001… 10(100)(1000) (2000)(30/300/3000)
- Testing of energy meters
- Testing of Current Transformers (CT) in LV and MV nets
- Testing of Potential Transformers (PT) in MV nets
- Powering from measurement network
- Calibration Certificates

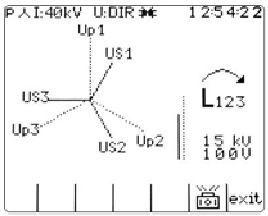
Calport 100 Plus Analyser is the universal solution with configurable six measuring inputs: 3xU+3xI or 6xI or 6xU. The Calport 100 Plus Analyser is designed for testing of single and three phase energy meters, Current Transformers (CT) and Potential Transformers (PT) in LV and MV power networks. It contains additional functions:

- verification of network wiring connection,
- measurements of power network parameters,
- multi-variant data tracing – digital and graphic display, internal memory, local printing, transmission by the interface and analysis on PC computer.

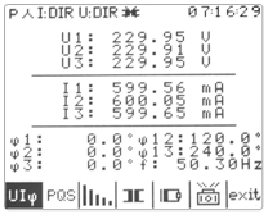
Verification of power network wiring in "star" and "delta" connection - graphical display of three phase voltage and current vector and direction of vector rotation and display of two stars of voltages or currents at instrument transformer testing.

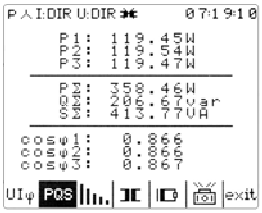
Complete measurements of three phase power net –





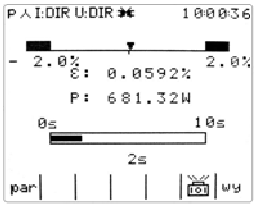
digital measure of voltages, currents, active, reactive and apparent power in one and three phase, phase shifts and power coefficients cosj and sinj, active and reactive energy and frequency. Programming of voltage and current transformers ratio.

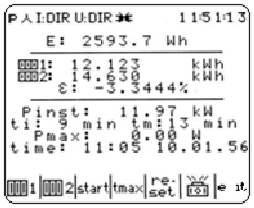




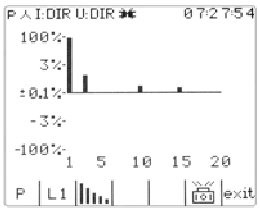
Testing of energy meters directly on site:
– functions of computing meter error directly in [%] with method of setting time of measurements or number of impulses,

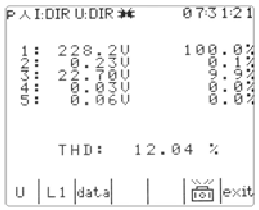
- functions of measuring energy with method of setting time periods for verification of energy meter counters directly in [%],
- functions of maximum power measuring for testing of maximum power meters.



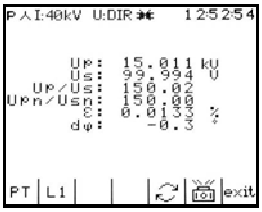


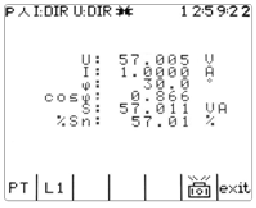
Full harmonics analysis of phase voltages, currents, active and reactive power up to 20th harmonics for diagnostic of distortion sources. Graphical and numerical presentation of results.





Testing of LV and MV instrument transformers directly on site: functions of computing transformer ratio error directly in [%], phase error and burden measurements of transformer.





TECHNICAL PARAMETRS OF THE CALPORT 100 PLUS

Function / parameter	Range	Error **	
		class 0,1	class 0,2
Direct voltage	30…480V 0,05…30V	±0,1% ±0,1%*	±0,2% ±0,2%*
Voltage with VoltLiteWire	0,5...40V	±0,2%±Em	±0,2%±Em
Direct current	0,04...12A 0,001...0,04A	±0,1% ±0,1%*	±0,2% ±0,2%*
Current with clamps 10A	0,1...10A 0,005...0,1A	±0,5% ±0,5%*	±0,5% ±0,5%*
Current with clamps 100A	0,5...100A 0,01…0,5A	±0,2% ±0,2%*	±0,2% ±0,2%*
Current with clamps 1000A	20...1000A 0,1…20A	±0,5% ±0,5%*	±0,5% ±0,5%*
Current with clamps 3000A	60...3000A 0,3…60A	±0,1% ±0,1%*	±0,1% ±0,1%*
Current with flex	0...30A/300A/3000A	±0,2%±Em	±0,2%±Em
Current with AmpLiteWire	30…2000A	±0,2%±Em	±0,2%±Em
Power and energy direct measure	0,04...12A / 30...480V 0,001...0,04A / 30...480V	±0,1% ±0,1%*	±0,2% ±0,2%*
Power and energy with clamps 10A	0,1...10A / 30...480V 0,005...0,1A / 30..480V	±0,5% ±0,5%*	±0,5% ±0,5%*
Power and energy with clamps 100A	0,5...100A / 30...480V 0,01…0,5A / 30…480V	±0,2% ±0,2%*	±0,2% ±0,2%*
Power and energy with clamps 1000A	20…1000A / 30…480V 0,1…20A / 30…480V	±0,5% ±0,5%*	±0,5% ±0,5%*
Power and energy with clamps 3000A	60…3000A / 30…480V 0,3…60A / 30…480V	±0,5% ±0,5%*	±0,1% ±0,1%*
Power and energy with flexible clamps	0…30A/300A/3000A / 30… 480V	±0,2%±Em	±0,2%±Em
Power and energy with clamps LiteWire	30…2000A / 0,5…40kV	±0,2%±Em	±0,2%±Em
Resolution of energy meter error measurement "ε"		0,0001%	0,0001%
Phase shift direct connection with clamps	0...±360,0°	±0,4° ±0,5°	±0,4° ±0,5°
Power factor cos φ and sin φ	0,000...±1,000	±0,01	±0,01
Frequency	45...65Hz	±0,05Hz	±0,05Hz
Ambient temperature	-5...+50°C operating, -20...+60°C transportation		
Power supply	85..230..265 / DC or 45..65Hz / 10VA		
Dimensions and weight of analyser		270 / 240 / 180 mm / 3,5 kg	
Dimensions and weight of analyser set		420 / 280 / 370 mm	

*) of range
**) power and energy errors with respect to apparent power
Em – sensor basic error, Em=1% for flexible clamps and Em=2% for LiteWire sensors

Caltest 10 Tester

Features:

- Energy meter testing
- Measuring of power network parameters
- Range 0,01… (10)(100)(1000) (30/300/3000) A and 85… 265 V
- Powering from measuring circuit
- Load changing function
- Printing results on the site
- Hand- held miniature case

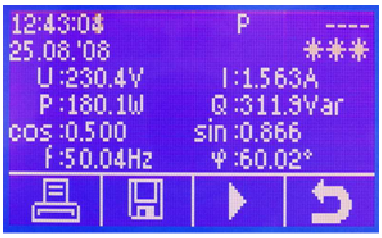
The Caltest 10 is a single phase portable device class 0,5 designed for electricity meter testing on site.

It contains:

- versatility – verification of network connection, power network parameters measuring, energy meter testing with load changing possibility,
- wide range of currents 0,01…3000A with clamps, without necessity of measured circuit opening,
- multi-variant data tracing – digital and graphic display, internal memory, local printing, transmission by interface and analysis on PC computer.

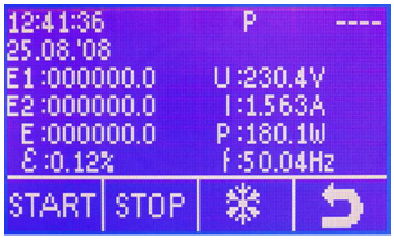
Powering from measuring circuit makes device independent from necessity of using additional supply and load changing function makes independent of meter testing from site load. Local printing on miniature printer makes possible reporting of measuring results in customer's presence.

Verification of power network connection with vector diagram displaying and measuring of voltage, current, active and reactive power, phase shift, power factor and frequency.



Energy meter testing on site – functions of computing meter error directly
in percentages with method of setting time of measurements or number of impulses. S0 standard is used for testing energy meters with impulse output. Miniature photo head CF101 is used for automatic counting of meter rotor turns for testing Ferrari meters. Photo head CF100 is used for automatic testing of meters with LED indicator and manual counting of rotor turns with using "start/stop" button.

Energy meter counters testing – functions of energy measuring in defined period of time and counter's error calculating, directly in percent.



TECHNICAL PARAMETERS OF CALTEST 10

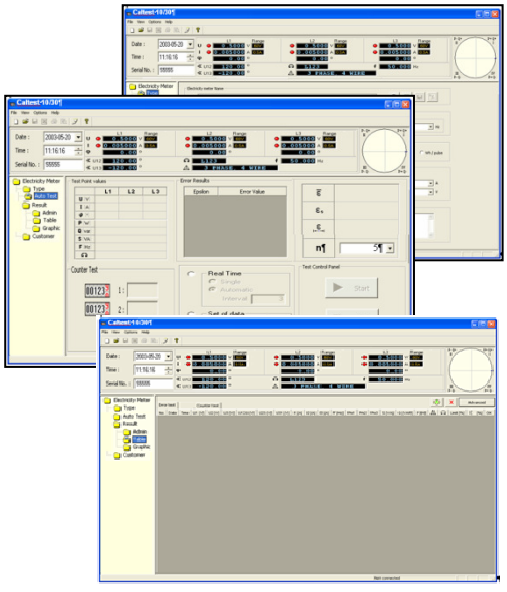
Function/ Parameter	Range	Error *)
Voltage	85,00...265,0V	±0,5%
Current with clamps 10A	0,010...10,00A	±0,5%
Current with clamps 100A	0,10...100,0A	±0,5%
Current with clamps 1000A	1,00...1000A	±0,5%
Current with flexible clamps	0...30A/300A/3000A	±1% of range
Power and energy measurement by clamps	0,01...1000A / 85...265V	±0,5%
Power and energy measurement by flexible clamps	0...30A/300A/3000A	1% of range
Resolution of energy meter error measurement "e"		0,001%
Phase shift	0,0...±360,0°	±1°
Power factor cos j and sin j	0,00...±1,00	±0,01
Frequency	45,0...65,0Hz	±0,1Hz
Ambient temperature	-5...+40°C operating, -25...+60°C transportation	
Power supply	85..230..265 / 45..65Hz / 8VA 12VA with printer and 2000VA with load	
Dimensions and weight of tester	125 / 240 / 40 mm / 1,0 kg	

*) Power and energy errors with respect to apparent power

View of Caltest 10 set

SOFTWARE CALSOFT 10

- reading actual measured values from the Caltest 10 via interface and their visualization on PC screen. The readings can be done automatically by user's defined period of time,
- reading data, earlier stored In meters's memory and their visualization on PC screen,
- export of measured data to Microsoft Excel, which enables later their processing according to user's requirements,
- printing data and charts on the printer,
- saving and reading data to and from files for ma king archives of measurements.



Caltest 300 Analyser

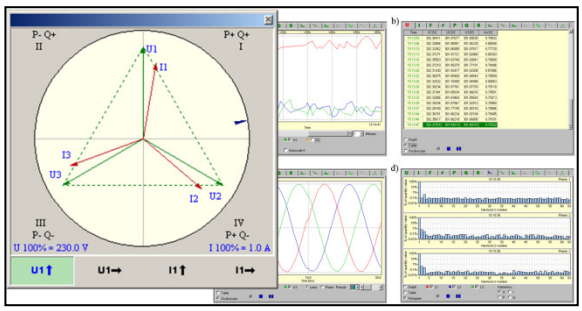
Features:

- Testing of energy meters
- Testing of three phase current transformer
- Measure of power network parameters (class 0,05 or 0,1)
- Range 0,001… 100(100)(1000) (30/300/3000)A & 0,5… 300V
- Vector and oscilloscope charts of three phase network
- Recording and analyze of power quality
- Powering from single phase measuring network

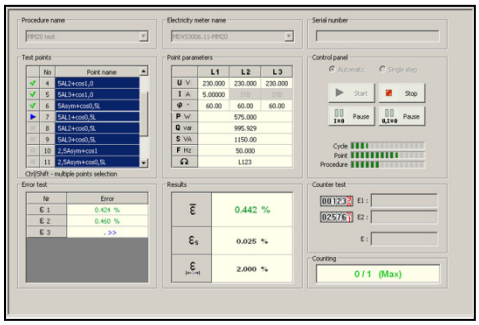
The Analyzer Caltest 300 is used for testing of single and three phase energy meters and current transformers:

- in accuracy class 0,05 and 0,1,
- in current range 0,001...3000A, with additional functions:
- verification of power network wiring,
- measure, recording and analyze of power network parameters and power quality,
- multi-variant data entering – digital and graphical display, internal memory, local printing, transmission by interface and analysis on PC computer.

Verification of power network wiring in "star" and "delta" connection – graphical display of three phase voltage and current vector and direction of vector rotation. Measure and recording of power network parameters – voltages, currents, frequency, phase shifts, angles between voltages, power factors, active, reactive and apparent powers. Digital and oscilloscope measurements with possibility of long time recording.

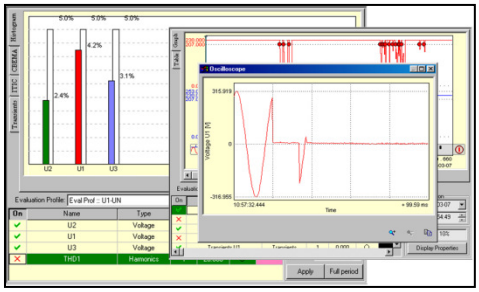


Energy meter testing on site – functions of computing meter error directly in percentages with method of setting time of measurements or number of impulses and functions for verification of energy meter counters. Input in S0 standard is used for testing energy meters with impulse output. Miniature photo head CF101 is used for automatic counting of meter rotor turns for testing Ferrari meters.
Photo head CF100 is used for automatic testing of meters with LED indicator and manual counting of rotor turns with using "start/stop" button. Three phase current transformer testing on site – functions of computing current and angle errors and burden of transformer.



Measure of power quality according to IEC 61000-4 -30:

- for voltage: voltage short/long interruptions, voltage dips, over voltage, harmonics, THD, interharmonics TID, signal voltage, flicker Pst i Plt, voltage asymmetry,
- for current: inrush current, harmonics, THD, interharminics TID,
- for power: harmonics.



Recording and analyzing of power quality according to the EN50160.

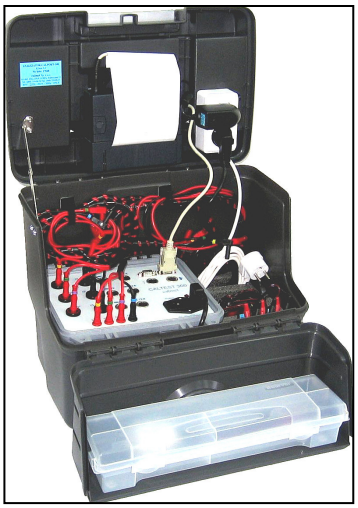
PARAMETERS OF THE CALTEST 300
SOFTWARE CALSOFT 300

Function / parameter	Range	Error **	
		class 0,05	class 0,1
Voltage	30...300V 0,5...30V	±0,05% ±0,05%*	±0,1% ±0,1%*
Direct current	0,1...100A 0,001...0,1A	±0,05% ±0,05%*	±0,1% ±0,1%*
Current with clamps 100A	5...100A 0,05...5A	±0,2% ±0,2%*	±0,2% ±0,2%*
Current with clamps 1000A	5,0...1000A	0,5%	0,5%
Current with flexible clamps	0...30A/300A/3000A	±1% of range	±1% of range
Power and energy direct measure	0,1...100A / 30...300V 0,001...0,1A / 30...300V	±0,05% ±0,05%*	±0,1% ±0,1%*
Power and energy measured by clamps 100A	5...100A / 30...300V 0,05...5A / 30..300V	±0,2%@cos=1 ±0,3%@cos=0,5 ±0,2%*@cos=1 ±0,2%*@cos=0,5	±0,2%@cos=1 ±0,3%@cos=0,5 ±0,2%*@cos=1 ±0,2%*@cos=0,5
Power and energy measured by clamps 1000A	5...1000A / 30...300V	0,5%	0,5%
Resolution of energy meter error measurement "ε"		0,001%	0,001%
Phase shift direct connection with clamps	0,0...±360,0°	±0,4° ±0,5°	±0,4° ±0,5°
Power factor cos φ and sin φ	0,00...±1,00	±0,01	±0,01
Frequency	45,00...65,00Hz	±0,05Hz	±0,05Hz
Ambient temperature	–5...+40°C operating, –25...+60°C transportation		
Power supply	85..230..265 / 45..65Hz / 8VA (12VA with printer)		
Dimensions and weight of analyzer		270 / 240 / 180 mm / 4,5 kg	
Dimensions and weight of analyzer set		420 / 280 / 370 mm / 8,2 kg	

*) of range,
**) power and energy errors with respect to apparent power

SOFTWARE CALSOFT 300

- Readout of actual measured values from the Caltest 300 using RS232 interface and their visualisation on PC screen. The Readout can be done automatically by user's defined period of time,
- readout of data, earlier stored in analyzer's memory and their visualisation on PC screen,
- export of measured data to Microsoft Excel, which enables their processing according to user's requirements,
- printing data and charts on the printer,
- saving and reading data to and from files for making archives of measurement's results.



CF100 Photoelectric Scanning Head

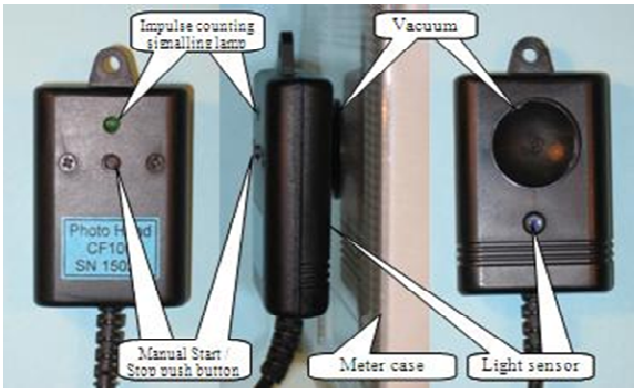
Features:

- LED green,…, red and infrared
- Mounting to meter by vacuum cup
- Small dimensions and weight
- Requires no adjustment
- Additional Manual Start/ Stop push button

The Photoelectric Scanning Head CF100 together with electricity meter tester Calport100 is designed for detecting LED flashing in electricity meters. It can detect typical colors of LED: red, orange, yellow, green and infrared.

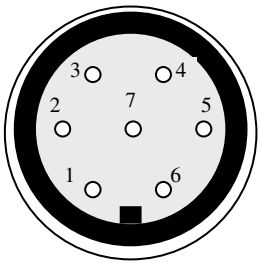
Mounting instruction and users manual:

- make the vacuum cup a little wet,
- put scanning head's vacuum cup in front of the flat part of the tested meter, in the way, that the light sensor will be in front of meter's LED,
- impulse counting signaling lamp should flash if there is no light from meter's LED and should be off in case of meter's LED flashing (impulse counting signaling lamp may not flash in case of direct sun shining or strong electric light),
- manual Start / Stop push button is designed for manual test of the scanning head circuit or „manual" turns counting of mechanical rotating disc,
- scanning head can be dismounted by means of small screwdriver pushed between vacuum cup and meter's case (attention: pulling the scanning head out by the case can destroy it).



PARAMETERS OF THE CF100 SCANNING HEAD

Power Supply Vcc	20...24...28V
Maximum supply current	15mA
Output	voltage U_{LO}=0...0,5V ; U_{HI}=5... (Vcc-4)V R_{OUT}=1,5k
Sensitivity distance	0...40mm
Connector type	C091A T3475-001 Amphenol



PIN	DESCRIPTION
1, 5	Power Supply +24V
2, 6	NC – not connected
3, 4	Ground
7	Output

CF101 Photoelectric Scanning Head

Features:

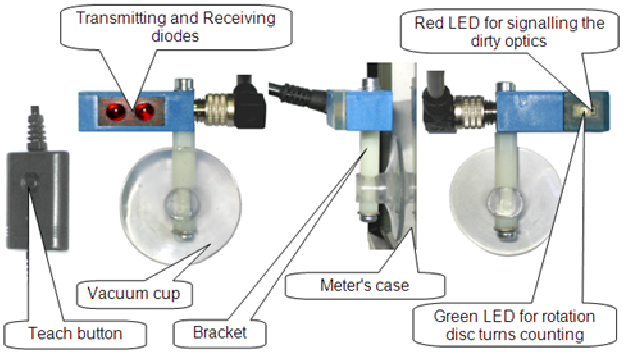
- Mounting to meter by vacuum cup
- Small dimensions and weight
- Requires no adjustment
- Teach function

The Photoelectric scanning head together with electricity meter tester Calport100 is designed for detecting number of rotating disc turns in Ferrari electricity meters. Scanning head can detect black or red mark on the meter's rotating disc and because of self teaching function it can be used in different watthour meter design.

Mounting instruction and users manual:

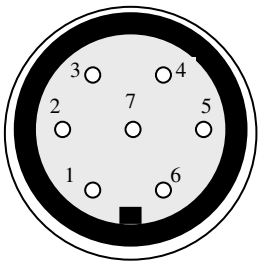
- make the vacuum cup a little wet,
- put scanning head's vacuum cup in front of the flat part of the tested meter, in the way, that the scanning head's case will be in parallel to the rotating disc and the light from the transmitting diode will illuminate the central part of rotating disc edge,
- if green LED doesn't flash in front of mark on rotating disc or LED flashes too often, one should start self teaching function by pressing button on the scanning head till the moment of fast green LED flashing,
- if green LED doesn't flash in front of mark on rotating disc or LED flashes too often, one should start self teaching function by pressing button on the scanning head till the moment of fast green LED flashing,
- scanning head can be dismounted by means of small screwdriver pushed between vacuum cup and meter's case (attention: pulling the scanning head out by the case can destroy it).

Attention: the red diode on the back of scanning head signals the dirty optics.



PARAMETERS OF THE CF101 SCANNING HEAD

Power Supply Vcc	10...30V
Maximum supply current	30mA
Output	voltage U_{LO}=0...0,5V ; U_{HI}=5... (Vcc-4)V R_{OUT}=2,2k
Sensitivity distance	0...10mm
Connector type	C091A T3475-001 Amphenol



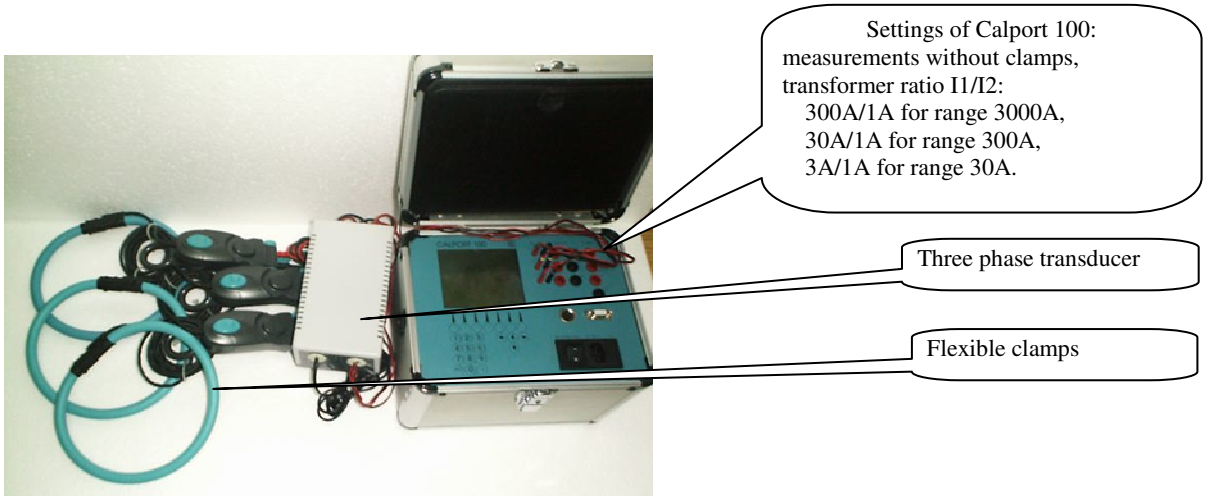
PIN	DESCRIPTION
1, 2, 3, 6	NC – not connected
4	Ground
5	Power Supply +24V
7	Output

Calprobe 100 Flexible Clamps with Converter

Features:

- Range of current measurement
- 30/30/3000 A
- Flexible loop for rails diameter up to
- 178 mm
- Maximum working voltage 600 V/ 50 Hz

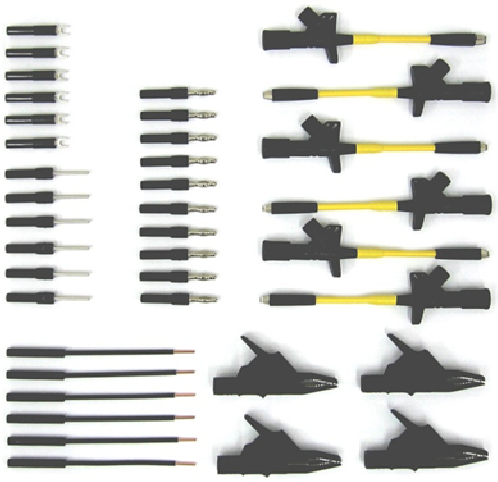
Set of three **Calprobe 100 flexible clamps** and three phase transducer together with electricity meter tester Calport100 are designed for power network connection verification, power quality parameters measurements, harmonics analysis and electricity meters testing in range of currents 0...30/300/3000A in hard accessed places, where traditional clamps can not be applied because of narrow distance between the rails.



PARAMETERS OF THE CALPROBE 100

Parameter	Value
Range of current measurement	0...30A/300A/3000A
Error of current measurement	1% value of range
Additional error caused by flexible loop location change	2% value of range
Error of phase shift measurement	1°
Length of open loop	610mm
Internal diameter of closed loop	178mm
Diameter of flexible cable	14,3mm
Diameter of flexible cable connector	22,2mm
Maximum working voltage	600V / 50Hz
Voltage strength	5550V / 50Hz / 1min

AKD100 Terminals, Plugs and Crocodiles



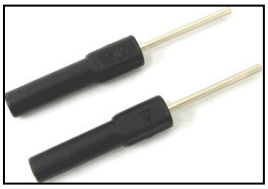
Features:

- Compatility with safety test leads
- Easy change of terminals

The AKD100 Additional Accessories are a set of terminals, plugs and crocodiles dedicated to work with the standard safety test leads which are delivered with Calport 100 Analyser.

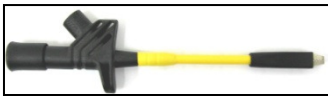
Adapter for standard safety test leads (banana plug) diameter 4 mm

Adapter for screw terminals

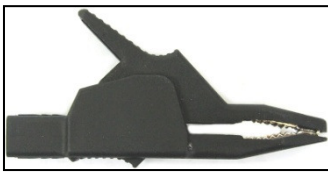


Adapter of rigid brass pin 20/25 for safety test leads

Adapter with flexible Cu wire



Safety test clip Kleps



Safety crocodile test clip

C200 Series Power Calibrators

Features:

- Voltage source up to 420 V
- Current source up to 20 A (100A)
- Frequency range 45,00… 52,50 Hz
- Phase shift range 0… ±90º

The C200 Series Power Calibrators are used for adjusting, checking and verification of measuring instruments used in power engineering: active and reactive power meters, phase meters, frequency meters, ammeters, voltmeters, transducers of these quantities, monitoring systems and frequency, voltage and current relays in single and three phase symmetrical and asymmetrical configurations for symmetrical and asymmetrical loads.

The C200 Calibrator is single phase and the C233 Calibrator is three phase source of alternating current and voltage. Enables generating alternating voltages up to 420V in four subranges 57-110-220-380V, alternating currents up to 20A (100A) in three (four) subranges 1-5-20-100A, frequency in range 45,00…52,50Hz (up to 70,00Hz in special option) and phase shift in range -90,0… 0,00…+90,0°.

Voltage and current output signals are set by multi-turn potentiometers and are simultaneously indicated on 4,5 digit LED displays. Frequency and phase shift are also set by multi-turn potentiometers and are displayed on 4 digit LED displays too.

Sinusoidal signals are generated on both voltage and current outputs. If required, between 1% and 15% harmonic distortion can be added to the signals. Distortion spectrum complains rectangular wave with triple frequency added to main signal.

Instruments to be calibrated can safely be connected to the outputs without changing the set values since the calibrator can be switched to "standby" mode to isolate the output terminals.

Series C200 Calibrators has been built in standard 19" aluminium case. The C233 Calibrator is constructed in three cases and consists of one calibrator basic configuration (phase L1) and two calibrators in special configuration (phase L2 and phase L3).

C200B single phase source up to 100A

C200 single phase source up to 20A

C233 three phase symmetrical source up to 20A

C233B three phase symmetrical source up to 100A

C233C three phase asymmetrical source up to 20A

C233BC three phase asymmetrical source up to 100A

PARAMETERS OF OPTIONS C 200 AND C 200B

Parameter	Range	Settings range	Resolution	Accuracy	Maximum Load
Voltage	57V	0,50...60,00V	0,01V	±0,05% of set value ±3 digits	250mA@60V
	110V	1,00...130,00V	0,01V		136mA@130V
	220V	2,0...250,0V	0,1V		68mA@250V
	380V	3,0...420,0V	0,1V		39mA@420V
Current	1A	0,0100...1,3000A	0,0001A	±0,05% of set value ±3 digits	12V@1,3A
	5A	0,050...6,000A	0,001A		3V@6A
	20A	0,200...19,999A	0,001A		1V@20A 2V@20A**)
	100A**)	1,00...100,00A	0,01A	±0,1% of set value ±3 digits	0,7V@50A 0,3V@100A
Frequency		45,00...52,50Hz	0,01Hz	±0,02Hz	
Phase shift		0,0...±90,0°	0,1°	±0,5°*)	
THD of voltage and current			0,5% of set value		
Weight and dimensions (with x height x depth)			14kg and (478x194x342)mm		
Power supply			230V±10% / 45…65Hz / 130VA (200VA for C200B)		

*) for settings greater then 10% of voltage and current range
**) C200B option with additional 100A range

PARAMETERS OF OPTIONS C 233 AND C 233B

Parameter	Range	Settings range	Resolution	Accuracy	Maximum Load
Voltage	57V	0,50...60,00V	0,01V	±0,05% of set value ±3 digits	250mA@60V
	110V	1,00...130,00V	0,01V		136mA@130V
	220V	2,0...250,0V	0,1V		68mA@250V
	380V	3,0...420,0V	0,1V		39mA@420V
Current	1A	0,0100...1,3000A	0,0001A	±0,05% of set value ±3 digits	12V@1,3A
	5A	0,050...6,000A	0,001A		3V@6A
	20A	0,200...19,999A	0,001A		1V@20A 2V@20A**)
	100A**)	1,00...100,00A	0,01A	±0,1% of set value ±3 digits	0,7V@50A 0,3V@100A
Frequency		45,00...52,50Hz	0,01Hz	±0,02Hz	
Phase shift		0,0...±90,0°	0,1°	±0,5°*)	
Phase shift between voltages		120,0°	0,1°	±1,0°*)	
THD of voltage and current			0,5% of set value		
Weight and dimensions (with x height x depth)			3x14kg and 3x(478x194x342)mm		
Power supply			230V±10% / 45…65Hz / 130VA (200VA for C233B)		

*) for setting greater then 10% of voltage and current range
**) C233B option with additional 100A range

C300 Series Power Calibrators

Features:

- Voltage source up to 500 V
- 3- phase current source up to 100A and 1- phase up to 300A
- Voltage and current harmonics programming up to 31
- Power quality parameters simulation
- Impulse input for electricity meters testing
- Start/ stop inputs for protective relay testing
- AC measurement input for transformers and clamps testing
- DC measurement input for transducer testing
- RS 232C interface and personal computer software Calpro 300

Calibrator / tester C300 is used for adjusting, checking and verification of measuring instruments used in power engineering. These include electricity meters, frequency, voltage and current protective relays, current transformers and clamps, active and reactive power meters, phase meters, frequency meters, ammeters, voltmeters, transducers, monitoring systems and power quality analyzers.

Calibrator C300 is three / one phase source of AC current and voltage with accuracy class 0,05% and programmable value of harmonics. It generates voltage up to 500V in sub ranges 60-130-250-500V, current up to 100A in sub ranges 0,5-6-20-100A, frequency in range 45...500Hz and phase shift in range 0...±360°. In one phase connection it can generate current up to 300A.

Calibrator C300 has possibility to get error characteristics of tested equipment in function of measurement value and time characteristics of protection relays in automatic way. For electricity meter testing is used impulse input S0 standard with possibility of photo scanning head connection. Testing of transducers, current transformers and clamps is made by means of DC input with ranges 10V/20mA and AC input with ranges 10V/100mA/5A. For protective relay testing are used three timers with start/ stop inputs and resolution 1ms. Two additional binary outputs are used for operate/standby calibrator state signalling.

Calibrator is controlled by means of personal computer with installed software Calpro 300 in Windows operating system.
Calibrator is constructed in a standard 19" rack-mount size case.

AUTOMATIC TESTING SYSTEM consists of:

- C300 Calibrator / Tester,
- computer with *Calpro 300* soft,
- device under test.

C300 Calibrator has three phase generator with accuracy 0.05% and auxiliary measurement inputs:

- S0 impulse counter for impulses from electricity meter or photo scanning head,
- ammeter for DC current measurement Idc from the output of measurement transducer,
- voltmeter for DC voltage measurement Udc from the output of measurement transducer or current clamp,
- ammeter for AC current measurement Iac from output of current transformer or clamps,
- timer for protective relaks switching time measurements.

PARAMETERS OF THE C 300 CALIBRATOR

Parameter	Range	Setting range	Resolution	Accuracy	Maximum Load
Voltage U	60V	0,5000...60,0000V	0,0001V	±0,04% of setting ±0,01% of range	460mA@60V
	130V	1,000...130,000V	0,001V		230mA@130V
	250V	2,000...250,000V	0,001V		115mA@250V
	500V	5,000...500,000V	0,001V		55mA@500V
Current I	0,5A	0,005000...0,500000A	0,000001A	±0,04% of setting ±0,01% of range	15V@0,5A
	6A	0,05000...6,00000A	0,00001A		7V@6A
	20A	0,2000...20,0000A	0,0001A		2,2V@20A
	100A	1,000...100,000A	0,001A	±0,1% of setting ±0,01% of range	0,6V@100A
Frequency f		45,000...99,999Hz	0,001Hz	±0,002Hz	
		100,000...500,000Hz	0,001Hz	±0,01Hz	
Phase shift φ		0,00...±360,00°	0,01°	±0,1° *)	
Active Power P		0...3x50000,0W	0,00001-1W	±0,05% *),**)	
Reactive Power Q		0...3x50000,0var	0,00001-1var	±0,05% *),**)	
Apparent Power S		0...3x50000,0VA	0,00001-1VA	±0,05%	
Time		1...36000s	1s	±0,01% *0,001s	
Energy	calc. from settings and resolution of power and time			±0,05% *),**)	
Harmonics	amplitude and phase of harmonics in range 0...100% and 0...360° up to 31 of harmonics or 3200Hz				

*) from 10% of current range, in frequency band 45-65Hz
**) power P (Q) error for cosφ (sin) = 1

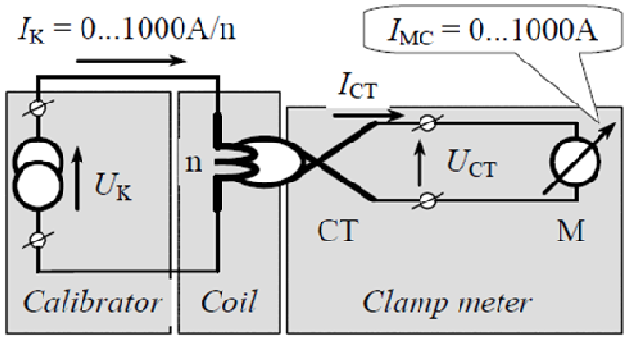
ZW 10/20 & ZW 100/10 Current Coils

Features:

- Extending range up to 1000A
- Coil ZW 10 for small clamps
- Coil ZW 100 for clamps up to 1000A
- It is possible to design coil for individual requirements

Current Coils ZW's series are wound by means of insulated cooper wire. Connected to the output of the current calibrator enables of clamps, clamps meters, power clamps meters and power quality analysers testing.

Idea of clamp meter testing On the drawing below is presented system for testing clamp meters compound of current calibrator and clamp meter. Tested clamp meter consists of current clamp CT and meter M. Indication of tested clamp meter I_{MC} in range 0...1000A are referenced to the set current I_K of current calibrator, which is treated as a standard source.



To the output terminals of calibrator is connected coil with n number of turns, on which are closed clamps. Required range of calibrator's settings is described by equation:

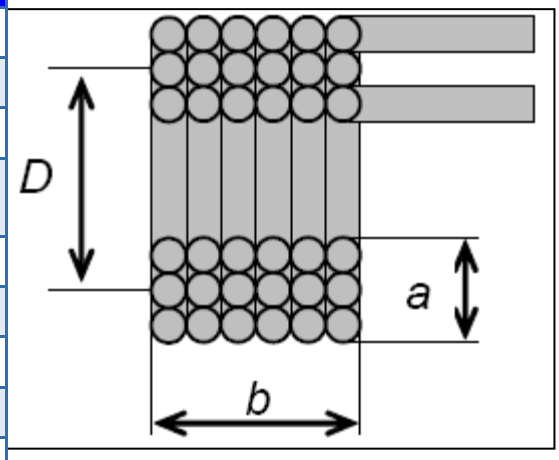
$$I_K = \frac{I_{MC}}{n}$$

where: I_{MC} – indication range of (upper limit of measurements) tested meter,
n – number of coil's turns.

As it can be seen from equation, by applying coil with number of turns n=100 and calibrator with settings range I_K=0...10A, it is possible to check clamp meter with measurement range I_{MC}=0...1000A, of course under condition, that calibrator has enough load power at the output terminals

In the presented circuit, it is also possible to test current clamps CT. In the case of current clamps with current output, the output clamp's current I_{CT} should be measured by means of reference ammeter M, in case of clamps with voltage output, the voltage U_{CT} should be measured by means of reference voltmeter M.

Parameter / coil type	ZW10/20A	ZW100/10A
Number of turns	10	10
Nominal Current [A]	20	10
Wire diameter	1,8	2,0
Coil crossec. *axb* [mm]	10x7	23x24
Coil diameter *D* [mm]	48	63
Leads length [mm]	190	230
Coil resistance [Ω]	0,012	0,120
Coil inductance [µH]	5	560
Coil weight [kg]	0,07	0,63



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