

## ⇒ Highlights

- Lightweight compact size
- Single- and three-phase versions, accuracy classes 0.2, 0.1, 0.05
- Color graphic display and alphanumeric keypad
- USB, RS-232 and optical interface for local data exchange with multifunctional meters according to IEC 62056-21
- Configuration and data stored in high capacity memory (min. 2 GB)
- Vector diagram and signal shape display (oscilloscope mode)
- Harmonics analysis in tabular and graphical format
- LED and TTL impulse outputs with programmable energy proportional meter constant or programmable frequency
- Enhanced internal database system for tested meters and measured results with search capabilities
- Enhanced self-adjusting optical scanning head
- Synchronous differential energy consumption measurement
- Two universal input channels for any combination of Voltage and Current probes for Power or CT / VT ratio, phase and burden measurement
- Optional wireless communication interface and wireless scanning head network for simultaneous testing of multiple delivery nodes
- Enhanced fast synchronization of measured data and configuration with PC
- PC software for MS Windows (Windows XP, 7, 8, 10, ...)
- Transport case with high protection degree
- Optional portable printer for printing of results and actual display content
- Optional universal isolated input/output (relay, logic signal)
- Configurable user interface (regional and functional modifications)



## ⇒ Description

The **Working Standard WS 2x10s** is a single-phase (WS 2110s) and three-phase (WS 2310s) precision reference meter for electrical power and energy measurement, dedicated to on-site meters testing. The device can be used also as hand-held unit for local data exchange with smart meters (programming and data readout of meters).

The device is designed for operation in single-, two- and three-phase systems, where it evaluates and displays all individual quantities per phase and cumulative three-phase ones as well.

Universal inputs can be equipped with any combination of interchangeable precision voltage sensors working up to 500 V and current sensors working up to 6000 A or more.

Measurement is based on precision A/D conversion and DSP technology and enables accurate high-speed real time evaluation of all main and informative quantities.

Beyond measurement of power, voltage, current and phase the device indicates voltage sequence, evaluates active, reactive and apparent energy and measures distortion and wave-form of measured signals.

The device can generate any programmed energy proportional or constant frequency on the impulse output. This unique feature allows precision error evaluation with minimum integration period. The device is equipped with integrated error calculator and meter scanner capturing LED, DISK or Closed Contact output of tested meters and snap switch for simple manual testing. Multiple optical scanners can be arranged to wireless network for simultaneous testing of complex distribution networks with single Working Standard. Synchronous differential mode of energy consumption is also possible.

The device can be supplied from internal rechargeable accumulators, from external power adapter, from car outlet or optionally also from measured voltage circuit.

Software for MS Windows enables transfer and presentation of measured data in PC.

Optional portable printer enables on-site printing of results or actual display content.



## ⇒ Technical Specification

Basic Error <sup>*1</sup>	WS 2110As WS 2310As	WS 2110Bs WS 2310Bs	WS 2110Cs WS 2310Cs
Current	dependent on type of current sensor		
Voltage	0.05 %	0.1 %	0.2 %
Apparent Power	0.05 %	0.1 %	0.2 %
Active Power <sup>*2</sup>	0.05 %	0.1 %	0.2 %
Reactive Power <sup>*2</sup>	0.05 %	0.1 %	0.2 %
Power Factor	0.001	0.002	0.002
Frequency	0.01 Hz	0.01 Hz	0.01 Hz
Distortion	0.2 %	0.5 %	0.5 %
Phase Angle	0.01 °	0.03 °	0.1 °

### Measured Quantities

Voltage, Current; Active, Reactive and Apparent Power; Active, Reactive and Apparent Energy, Power Factor, Phase Angle, Frequency, Distortion; Active Power of Harmonics; Burden, phase and transformation ratio of current and voltage transformers

### General Specifications

Basic Frequency	40 .. 70 Hz
Input Circuits	1-phase 2-wire (WS 2110s & WS 2310s) 1-phase 3-wire and 2-phase (WS 2310s) 3-phase 3-wire / 4-wire (WS 2310s)
Voltage Range	0.1 .. 500 V (phase to neutral)
Current Range	depending on type of current sensor - up to 20 A / 120 A / 240 A / 6000 A (or more)
Power Factor Range	-1 .. 0 .. 1
Phase Angle	0 .. 360 °
Communication Interfaces	USB and RS-232 (SCPI compatible comm. protocol), optical interface for communication with meters according to IEC 62056-21 (via OPTH 1200), optionally wireless (2.4 GHz)
Display	3.5" / 320 x 240 pixels / 256 colors
Memory for Data	min. 2 GB ( >1000 load points )
Oper. Temperature	-20 .. +50 °C
Storage Temperature	-25 .. +60 °C
Operating Humidity	max. 95% relative humidity (non-condensing)
Power Consumption	5 VA
Power Supply	from int. rechargeable accumulators (4 x NiMH / AA size) from Power Adapter (100 - 240 V <sub>AC</sub> / 12 V <sub>DC</sub> ) from Car Outlet Adapter (12 V) from measured voltage circuit (46 - 300 V / 45 - 65 Hz) <sup>*6</sup>
Applicable Standards	IEC 60736, IEC 62056-21, IEC 61010-2-032
Degree of Protection	IP-42 (device) IP-67 (transport case)
Safety Requirements	Isolation protection : EN 61010-1 Measurement category : CAT III Protection resistance: 2 MOhm (each voltage input)
Dimensions (W x D x H)	210 x 105 x 40 mm (basic device) 406 x 330 x 174 mm (transport case)
Weight (approx.)	0.55 kg (basic device), 6.5 kg (total standard setup)

### Impulse Output

Impulses Assigned to	Active, Reactive, Apparent Energy or programmable constant frequency
Meter Constant	programmable
Max. Imp. Frequency	70 kHz

### Standard Accessories (for WS 2x10sB and WS 2x10sC)

Voltage Transducer VT 2x50A, Current Clamps CC 2x12B, Optical Sensor OPTS 2100 with Fixing Clamp, Power Adapter, Car Outlet Adapter, Transport Case, Impulse Output Cable with BNC connector, Snap Switch with integrated Impulse Input Base, Impulse SO Cable, Neck Strap, USB Cable, Software for PC (Installation USB key)

### Optional Accessories

Voltage Transducer VT 3x50, Current Transducer CT 2x10s, Current Clamps CC 3x24C, Flexible Current Probe FCP 3x21, Optical Communication Head OPTH 1200, Portable Printer PP 1000, RS-232 Cable, Wireless Meter Scanner Network

### Voltage Transducer VT xx50

Voltage Range	0.1 .. 500 V phase to neutral
Basic Error <sup>*1</sup> (5 V – 500 V)	VT xx50A 0.05 % (with WS 2x10Cs/Bs/As)
Signal Cable Length <sup>*6</sup>	1.75 m

VT 2x50 is without power from measured circuit (PFMC) feature

VT 3x50 is with power from measured circuit (PFMC) feature

### Current Transducer CT 2x20

Current Range	1 mA .. 20 A
Basic Error <sup>*1</sup> (10 mA – 20 A)	CT 2x20A 0.05 %, 0.05 ° (with WS 2x10As)
	CT 2x20B 0.1 %, 0.1 ° (with WS 2x10Bs/As) 0.2 %, 0.2 ° (with WS 2x10Cs)
Signal Cable Length <sup>*6</sup>	1.5 m
Dimensions	100 x 40 x 85 mm
Weight	0.2 / 0.3 kg (CT 2110 / 2310)

### Current Clamps CC 2x12B

Current Range	1 mA .. 120 A
Basic Error <sup>*1*3</sup> (20 mA – 100 A)	0.1 %, 0.1 ° (with WS 2x10Bs/As) 0.2 %, 0.2 ° (with WS 2x10Cs)
Signal Cable Length <sup>*6</sup>	2 m
Max. Cable Size in Jaws	Ø 20 mm
Dimensions	140 x 50 x 25 mm
Weight	0.4 / 0.9 kg (CC 2112B / 2312B)

### Current Clamps CC 3x24C

Current Range	1 mA .. 240 A
Basic Error <sup>*1*3*4</sup> (50 mA-160 A)	0.2 %, 0.2 °
Signal Cable Length <sup>*6</sup>	2 m
Max. Cable Size in Jaws	Ø 20 mm
Dimensions	140 x 60 x 35 mm
Weight	0.3 / 0.7 kg (CC 3124C / 3324C)

### Flexible Current Probe FCP 3x21 / WS

Current Range <sup>*6</sup>	0.2 A .. 6000 A (or more)
Basic Error <sup>*1*5</sup> (1 A – 6000 A)	FCP 3x21C 0.2 %, 0.2 ° FCP 3x21D 0.5 %, 0.3 °
Sensor Cable Diameter / Minimum Bend Radius	6 mm / 50 mm (FCP 3x21)
Sensor Diameter <sup>*6</sup>	Ø 160 mm (FCP 3x21)
Signal Cable Length <sup>*6</sup>	1.5 m
Dimensions	160 x 160 x 10 mm
Weight	0.15 / 0.4 kg (FCP 3121 / 3321)

### Portable Printer PP 1000

Printing Method	Thermal, bidirectional
Character Matrix	8x8 and 12x8 dots, graphical
Printing Speed	37.5 char/s
Paper Width	112 mm (Ø 38 mm)
Interface	RS-232 (1200-9600 bps)
Dimensions (W x D x H)	165 x 135 x 50 mm
Weight	0.55 kg (inclusive batteries)
Supplied Accessories	• 1 roll of paper • batteries • 1.5 m cable (DIN / D-Sub)

<sup>\*1</sup> specified for temperature 23 °C

<sup>\*2</sup> related to apparent power

<sup>\*3</sup> specified for compensated ranges

<sup>\*4</sup> specified for cable position more than 15 mm away from the coupling area

<sup>\*5</sup> specified for cable position more than 25 mm away from the coupling area

<sup>\*6</sup> option contained only in VT 3x50 (have to be specified in order)

## ⇒ Measurement Error Tolerances (for Active and Reactive Energy)

Current Probe	Current [A]	Phase [°]		Maximal Measurement Error [%] *		
		Active Energy	Reactive Energy	WS 2x10As	WS 2x10Bs	WS 2x10Cs
CT 2x20A	0.01 - 20	0	90	± 0.05	± 0.1	± 0.2
		60	30	± 0.1	± 0.2	± 0.4
		300	150	± 0.1	± 0.2	± 0.4
CT 2x20B	0.01 - 20	0	90	± 0.1		± 0.2
		60	30	± 0.2		± 0.4
		300	150	± 0.2		± 0.4
CC 2x12B	0.01 - 0.02	0	90	± 0.2		± 0.4
		60	30	± 0.6		± 0.8
		300	150	± 0.6		± 0.8
	0.02 - 100	0	90	± 0.1		± 0.2
		60	30	± 0.3		± 0.4
		300	150	± 0.3		± 0.4
CC 3x24C**	0.05 - 160	0	90	± 0.2		
		60	30	± 0.6		
		300	150	± 0.6		
FCP 3x21C /WS**	1 - 6000	0	90	± 0.2		
		60	30	± 0.6		
		300	150	± 0.6		
FCP 3x21D /WS**	1 - 6000	0	90	± 0.5		
		60	30	± 1.0		
		300	150	± 1.0		

\* measured with symmetrical load on compensated ranges at 23 °C, 230 V, 50 and 60 Hz

\*\* current carrying wire positioned outside of coupling area (see technical specification)

x ... number of phases

## ⇒ Available Models

Model	Phases	Class
WS 2110As	1	0.05
WS 2110Bs	1	0.1
WS 2110Cs	1	0.2
WS 2310As	3	0.05
WS 2310Bs	3	0.1
WS 2310Cs	3	0.2

# Working Standard

Multifunction hand-held working standard of power and energy for on site meter testing

## ⇒ Options / Accessories

● ... standard / ○ ... optional / - ... not available

Code	Description	WS 2110As	WS 2110Bs	WS 2110Cs	WS 2310As	WS 2310Bs	WS 2310Cs
WSB 2110s	Working Standard device (single phase body)	●	●	●	-	-	-
WSB 2310s	Working Standard device (three phase body)	-	-	-	●	●	●
VT 2150A	Voltage Transducer (1 x 500 V, 0.05 %)	●	●	●	-	-	-
VT 2250A	Voltage Transducer (2 x 500 V, 0.05 %)	-	-	-	-	-	-
VT 2350A	Voltage Transducer (3 x 500 V, 0.05 %)	-	-	-	●	●	●
VT 3150A	Voltage Transducer (1 x 500 V, 0.05 %) with PFMC*	○	○	○	-	-	-
VT 3250A	Voltage Transducer (2 x 500 V, 0.05 %) with PFMC*	-	-	-	○	○	○
VT 3350A	Voltage Transducer (3 x 500 V, 0.05 %) with PFMC*	-	-	-	○	○	○
CT 2120A	Current Transducer (1 x 20 A, 0.05 %)	●	-	-	-	-	-
CT 2220A	Current Transducer (2 x 20 A, 0.05 %)	-	-	-	○	-	-
CT 2320A	Current Transducer (3 x 20 A, 0.05 %)	-	-	-	●	-	-
CT 2120B	Current Transducer (1 x 20 A, 0.1 %)	-	○	○	-	-	-
CT 2220B	Current Transducer (2 x 20 A, 0.1 %)	-	-	-	-	○	○
CT 2320B	Current Transducer (3 x 20 A, 0.1 %)	-	-	-	-	○	○
CC 2112B	Current Clamps (Ø 20 mm / 1 x 120 A)	●	●	●	-	-	-
CC 2212B	Current Clamps (Ø 20 mm / 2 x 120 A)	-	-	-	○	○	○
CC 2312B	Current Clamps (Ø 20 mm / 3 x 120 A)	-	-	-	●	●	●
CC 3124C	Current Clamps (Ø 20 mm / 1 x 240 A)	○	○	○	-	-	-
CC 3224C	Current Clamps (Ø 20 mm / 2 x 240 A)	-	-	-	○	○	○
CC 3324C	Current Clamps (Ø 20 mm / 3 x 240 A)	-	-	-	○	○	○
FCP 3121	Flexible Current Probe (1 x 6000 A)	○	○	○	-	-	-
FCP 3221	Flexible Current Probe (2 x 6000 A)	-	-	-	○	○	○
FCP 3321	Flexible Current Probe (3 x 6000 A)	-	-	-	○	○	○
WSCS 1100	Current Cables for CT (single phase set)	●	○	○	-	-	-
WSCS 1200	Current Cables for CT (two phase set)	-	-	-	○	○	○
WSCS 1300	Current Cables for CT (three phase set)	-	-	-	●	○	○
VC 1100	Standard Voltage Clips (single phase set)	●	●	●	-	-	-
VC 1200	Standard Voltage Clips (two phase set)	-	-	-	○	○	○
VC 1300	Standard Voltage Clips (three phase set)	-	-	-	●	●	●
VC 2100	Special Voltage Clips (single phase set)	○	○	○	-	-	-
VC 2200	Special Voltage Clips (two phase set)	-	-	-	○	○	○
VC 2300	Special Voltage Clips (three phase set)	-	-	-	○	○	○
VC 2110	Omega Voltage Clips (single phase set)	○	○	○	-	-	-
VC 2210	Omega Voltage Clips (two phase set)	-	-	-	○	○	○
VC 2310	Omega Voltage Clips (three phase set)	-	-	-	○	○	○
VC 2120	Spike Voltage Clips (single phase set)	○	○	○	-	-	-
VC 2220	Spike Voltage Clips (two phase set)	-	-	-	○	○	○
VC 2320	Spike Voltage Clips (three phase set)	-	-	-	○	○	○
WSIO 2000	Impulse Output Cable with BNC connector	●	●	●	●	●	●
WSSS 3000	Snap Switch with integrated Impulse Input Base	●	●	●	●	●	●
OPTI 2000	Impulse (SO) Cable	●	●	●	●	●	●
OPFC 1000	Fixing Clamp for Optical Sensor	●	●	●	●	●	●
OPTS 2100	Optical Sensor	●	●	●	●	●	●
WSSC 2000	Optical Sensor Cable	●	●	●	●	●	●
OPTH 1200	Optical Communication Head	○	○	○	○	○	○
PP 1000	Portable Printer	○	○	○	○	○	○
PPC 1000	Communication Cable for printer PP 1000	○	○	○	○	○	○
CCR 1000	Communication Cable RS-232	○	○	○	○	○	○
CCU 1000	Communication Cable USB	●	●	●	●	●	●
BAA 2000	Rechargeable Accumulators (4 x NiMH / AA size)	●	●	●	●	●	●
WSPA 2000	Power Adapter (100-240V)	●	●	●	●	●	●
WSCA 1000	Car Outlet Adapter (12V)	●	●	●	●	●	●
WSSW 1000	Software for PC (Installation USB key)	●	●	●	●	●	●
WSTC 2000	Transport Case	●	●	●	●	●	●
WSNS 1000	Neck Strap	●	●	●	●	●	●
WSUG 1000	Printed User's Guide	●	●	●	●	●	●
WSCC 1000	Calibration Certificate from manufacturer (AP)	●	●	●	●	●	●
WSCC 2000	Calibration Certificate from independent laboratory	○	○	○	○	○	○

\* PFMC = power from measured circuit