



**Guaranteed Accuracy = +/- 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 guaranteed accuracy of 0.01% for all measurement functions across its entire operating range, with a typical accuracy that is within traceability uncertainties. The guaranteed 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.

INS	0.00000	V
RMS	0.00000	A
	0.00000	W
	0.00000	VA

ACC	0.00000	Wh
RMS	0.00000	VARh
	0.00000	Qh
	0.00000	VAh

INS	0.00000	VAR
RMS	0.00000	Hz
	0.00000	PA
	0.00000	PF

ACC	0.00000	Vh
RMS	0.00000	Ah
	0.00000	V2h
	0.00000	A2h

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.

Run Test
Harmonics: Volt
Harmonics: Amp
Setup

Select Test Type
▼ Meter
Standard
Analog sense

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.

Test Running	
Revs Test	0000
Wh	0.00000

Test Results	
Whr	0.00000
%Err	0.000
%Reg	0.000

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.

Port 1
Port 2
Port 3
Port Polarity

Measure Type
Beep
Backlight
Factory Default

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-Analyze allows for the custom configuration of the RD-23 along with data analysis and RR-Kit software is a set of commands, routines, and instructions for custom application development.

# Technical Specifications

## 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 630 volts (Autoranging)
- Auxiliary power input: 60 to 630 volts (Autoranging)
- Frequency: 45 to 75 Hz (Fundamental)
- Harmonic Analysis through the 200th harmonic order.
- Phase Angle: 0 to 360° or -180 to 180°
- Power Factor: -1 to 1

## 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 Multi-Contact brand sockets
- Potential and Aux power inputs: Insulated 4mm Multi-Contact brand sockets
- 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 sec.

## ACCURACY

Accuracy specifications apply to all supported measurement functions using sinusoidal waveforms and across the normal operating range of the product between the temperatures of 20°C to 30°C. Maximum error specification for energy includes stability, traceability uncertainty, power factor, and test system errors.

Energy Accuracy: ±0.01%

Temperature Influence outside normal operating temperature range per °C: ±0.00025%. For Power Factor of <0.5 (PF between -60° and -90°) then maximum energy error is ±0.01%/2PF.

Voltage Accuracy: ±50ppm  
Current Accuracy: ±70ppm  
Phase Angle Accuracy: ±0.003°

## PROTECTION

- Isolation: Complete: Input/output/power/case/control
- Dielectric withstand: 2.3 kVrms, 60Hz, 60 seconds
- Fuses: #34.3117 for potential and auxiliary power

## ENVIRONMENTAL

- Temperature (Normal): +20°C to +30°C
- Temperature (Extended): +0°C to +50°C
- Humidity: 0% to 95% non-condensing
- Shock and vibration: Any that is not destructive

## 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 minimum, maximum 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

- Radian Research's calibration procedures are in compliance with MIL-STD-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.

## Specifying the first of the last three digits: RD-23-**Xxx**

### MODEL

### MEASUREMENT FUNCTIONS

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, PF, Frequency Min & Max: All indicating functions  
AVG response: VAhrs, VA, Volts, Whrs, Amps, Ahrs

## Specifying the second of the last three digits: RD-23-**xXx**

-x0x

No comparator, No harmonic analysis

-x1x

Built-in comparator

-x2x

Harmonic analysis (RR-PCSuite Software included)

-x3x

Built-in comparator AND harmonic analysis

-x4x

Analog Sense Testing (2mA DC max)

-x5x

Built-in comparator and analog sense

-x6x

Harmonic analysis and analog sense

-x7x

Built-in comparator, harmonic analysis and analog sense

## Specifying the third of the last three digits: RD-23-**xxX**

-xx1

Clamp-on CT input and one 120 Amp current input (120A total)

-xx2

Clamp-on CT input and three 67 Amp current inputs (200A total)

-xx3

Clamp-on CT input and three 75 amp current inputs (225 Amps total)

-xx4

Rack Mount Enclosure and one 120 Amp current input (120A total)

## ACCESSORIES

RR-CTT

CT Ratio and Burden Testing

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

RR-TABPC

Tablet PC for in-the-field control of RD analyzing standards

RR-BT

Bluetooth Communication Link (RD-3x)

RC-MN106

Electronically Compensated 0.2 to 150A AC Current Probe \*

RC-SR704

Electronically Compensated 0.01 to 800A AC Current Probe \*

RC-JM800A

Electronically Compensated 1.0 to 2400A AC Current Probe \*

RC-FLEX3000A

AC Flexible Current Probe

RC-HV2000A

High Voltage Current Probe

RC-100135

Test Switch Current Probe 25A

\* Please contact Radian Research for application and specification information regarding the compensated AC current probes

## 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.