

## RD-21 Dytronic Portable Single-Phase Standard



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**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 ideal 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-21 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	ACC 0.00000 Wh
RMS 0.00000 A	RMS 0.00000 VARh
0.00000 W	0.00000 Qh
0.00000 VA	0.00000 VAh
INS 0.00000 VAR	ACC 0.00000 Vh
RMS 0.00000 Hz	RMS 0.00000 Ah
0.00000 PA	0.00000 Vz
0.00000 PF	0.00000 Az

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.

Run Test Harmonics: Volt Harmonics: Amp Setup	Select Test Type ▼ Meter Standard
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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
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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
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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.

# 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 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:  $\pm 0.005\%$

- Worst Case Accuracy:  $\pm 0.02\%$

For voltage and current typical accuracy:  $\pm 0.0025\%$

For voltage and current worst case accuracy:  $\pm 0.01\%$

Temperature Influence outside normal operating temperature range per °C:  $\pm 0.0005\%$  typical,  $\pm 0.001\%$  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  $\pm 0.02\%/PF$ .

## 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 hour, 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-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-21-Xxx

<b>RD-21-1xx</b>	Whrs, Volts, Amps, VARhrs
<b>RD-21-2xx</b>	Whrs, Volts, Amps, VARhrs, VAhrs, Qhrs, Watts, VARs, VA, Phase Angle, Power Factor, Frequency
<b>RD-21-3xx</b>	Whrs, VARhrs, VAhrs, Qhrs, Volts, Amps, Watts, VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, Power Factor, Frequency Min & Max measurements: All indicating functions
<b>RD-21-4xx</b>	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, Whrs, Amps, Ahrs

### Specifying the second of the last three digits: RD-21-Xxx

<b>RD-21-x0x</b>	No comparator, No harmonic analysis
<b>RD-21-x1x</b>	Built-in comparator
<b>RD-21-x2x</b>	Harmonic analysis (+ RR-Analyze Software)
<b>RD-21-x3x</b>	Built-in comparator AND harmonic analysis
<b>RD-21-x4x</b>	Analog Sense Testing (2 mA DC max)
<b>RD-21-x5x</b>	Built-in comparator and analog sense
<b>RD-21-x6x</b>	Harmonics analysis and analog sense
<b>RD-21-x7x</b>	Built-in komparator, harmonice analysis and analog sense

### Specifying the third of the last three digits: RD-21-Xxx

<b>RD-21-xx1</b>	Clamp-on CT input and one 120 Amp current input (120A total)
<b>RD-21-xx2</b>	Clamp-on CT input and three 67 Amp current input (200A total)
<b>RD-21-xx3</b>	Clamp-on CT input and three 75 Amp current input (225Amps total)
<b>RD-21-xx4</b>	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.



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