Radian Research, Inc.

RS-933
Syntron Automated Calibration System

Operations Manual

RADIAN

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About This Manual

Radian Research, Inc. makes no warranty on the accuracy of the information contained in this manual and accepts no liability for its use.

The information contained in this manual remains the property of Radian Research, Inc. It is provided in good faith for the operation and servicing of this Radian Research, Inc. product. We reserve the right to take legal action where this information is divulged to third parties without our written consent or in circumstances that may cause us commercial harm.

The operation of this equipment requires training and experience in electric meter testing. The information in this manual is designed to supplement existing knowledge and experience already attained and practiced by journeyman-level meter test technicians. Beginning meter test technicians should not attempt to operate this equipment without first gaining the basic knowledge of meter testing and the application of meter testing equipment from a certified training course.

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1 Product Introduction and Specifications

This chapter provides an introduction to the RS-933 Syntron Automated Calibration System and contains the following sections:

1.1 Product Overview

The Radian Research, Inc. RS-933 Syntron Automated Calibration System (see Figure 1) is designed for calibrating wide variety of test equipment. It provides the accuracy and diverse functionality needed by today's metrology laboratories. The RS-933 offers:

- Optimum testing efficiency and increased productivity
- Simple operation
- Testing standardization that allows unsurpassed accuracy and linearity across the entire operating range
- Expansive testing capabilities, including:
    - Energy reference standards
    - Digital multimeters
    - Phase meters
    - Energy meters
    - Power meters
    - Revenue meters
    - Amp meters
    - Panel meters
    - Power quality meters

Figure 1. RS-933 Syntron Automated Calibration System

RD-22 Dytronic Primary Transfer Standard

When combined with the RD-22 Dytronic Primary Transfer Standard (see Figure 2), the RS-933 Syntron Automated Calibration System becomes a complete automated reference system. In this setup, a computer with the RD-22 is directly connected to the RS-940 Data Collection Module, and the Control Software receives processed measurement information from the standard. The pulse outputs of the portable standards are also connected to the RS-940 Data Collection Module. When the test is complete, the RS-933 Control Software displays test results in percent error or percent registration comparing the RD-22 to the unit being tested as well as comparing the RS-933 to the RD-22.

In this manner, the RS-933 and RD-22 together effectively serve as a check and balance to the proper functioning of the test sequence. In addition, primary references of DC voltage, resistance, and time can be tested against the RD-22. This is a useful feature for laboratories that desire to perform a DC to AC transfer.

Figure 2. RD-22 Dytronic Primary Transfer Standard

1.2 Product Features

The RS-933 Syntron Automated Calibration System offers the following features:

- Delivery of 1 mA–200 A from a single output eliminates the need to reconfigure test leads and reduces test time
- For all test points over 200mA, direct drive current output technology improves stability, repeatability, and settling time without the need for measurement feedback
- Guaranteed watt-hour accuracy of 50 ppm
- Ability to create user-defined waveforms; independent voltage and current harmonics relative to the fundamental are established using the provided RS-933 Control Software
- Automatically tests up to 16 meters simultaneously with automatic results calculation and automated saving of data
- More than 60 measurement parameters including multiple VAR-hours
- Flexibility of single or multiple phases with harmonic control of each independent phase and axis
- Microsoft Windows-based RS-933 Control Software provides full automation and documentation control
- TCP/IP interface protocol allows any local or remote terminal to be used for control or data access
- Based on Radian's proven Syntron technology

- Creates a complete automated AC reference test system when combined with the Radian RD-22 Dytronic Primary Transfer Standard
- Two-year warranty
- Purchase includes 1–2 day on-site training and setup assistance by Radian Research, Inc.

1.3 System Configurations

1.3.1 New System Configurations

The RS-933 Syntron Automated Calibration System is available in the following configurations:

Model Number	Features
931/8C/120A	Single phase, 8 channel data collection, 120 A
933/8C/120A	Three phase, 8 channel data collection, 120 A
931/8C/200A	Single phase, 8 channel data collection, 200 A
933/8C/200A	Three phase, 8 channel data collection, 200 A
931/16C/120A	Single phase, 16 channel data collection, 120 A
933/16C/120A	Three phase, 16 channel data collection, 120 A
931/16C/200A	Single phase, 16 channel data collection, 200 A
933/16C/200A	Three phase, 16 channel data collection, 200 A

1.3.2 Upgrade Configurations

The Syntron Automated Calibration System can be upgraded as shown below. Contact your Radian Research, Inc. representative for additional information.

Data Collection Upgrade Only*

Model Number	Features
UPG93X/16C DATA	16 channel data collection module

**Requires return to factory and new computer platform*

RS-600 System Upgrade*

Model Number	Features
600UPG/931/16C/120	Single phase, 16 channel data collection,120 A
600UPG/931/16C/200	Single phase, 16 channel data collection, 200 A
600UPG/933/16C/120	Three phase, 16 channel data collection,120 A
600UPG/933/16C/200	Three phase, 16 channel data collection, 200 A

**Requires return to factory and new computer platform*

RS-703A Single Phase System Upgrade

Model Number	Features
703/1P/UPG/931/16C/120	Single phase, 16 channel data collection,120 A
703/1P/UPG/931/16C/200	Single phase, 16 channel data collection, 200 A
703/1P/UPG/933/16C/120	Three phase, 16 channel data collection,120 A
703/1P/UPG/933/16C/200	Three phase, 16 channel data collection, 200 A

**Requires return to factory and new computer platform*

RS-703A Three Phase System Upgrade*

Model Number	Features
703/3P/UPG/933/16C/120	Three phase, 16 channel data collection,120 A
703/3P/UPG/933/16C/200	Three phase, 16 channel data collection, 200 A

**Requires return to factory and new computer platform*

1.3.3 Accessories

See Section 6 of this manual for accessories for the RS-933 Power and Energy Calibration System.

1.4 Safety Information

Review the information in this section to avoid injury and prevent equipment damage.

1.4.1 General Safety Summary

WARNING

- The operation of this equipment requires training and experience in electric meter testing. The information in this manual is designed to supplement existing knowledge and experience already attained and practiced by qualified electric utility personnel. The information in this manual is not intended to replace existing electric utility safety procedures and those listed in the Handbook for Electricity Metering.
- Operation of this equipment involves high voltage. **Always** wear the appropriate personal protective equipment and follow all safety precautions specified for high voltage activities.
- Follow proper grounding techniques when using this equipment.
- Follow all safety guidelines contained in this manual.

CAUTION

- **Do not** use this equipment for any purpose other than for which it was designed.
- **Do not** operate the equipment outside of the environmental conditions specified in this manual, including areas that are wet or damp or where flammable gases or fumes are present.
- **Do not** operate this equipment with covers or panels removed.
- Keep equipment surfaces clean and dry.
- Handle the RS-933 Syntron Automated Calibration System components with care; it is a precision instrument.
- Inspect the equipment before each use. Do not use the equipment if damage is observed.
- Use only the specified fuses.
- **Do not** attempt to service this equipment; contact Radian Research, Inc. for service or repairs.

1.4.2 Symbols Found on the Equipment

The following safety symbols appear on the RS-933 Syntron Automated Calibration System:

	Danger of electrical shock.
	Warning: Refer to manual.

1.4.3 Conventions Used in this Manual

The following conventions are used in this manual to highlight important information:

	Indicates an imminently hazardous situation that can result in death or a serious injury.
	Indicates a potentially hazardous situation that can result in an injury or equipment damage.
	Indicates important information you should review before proceeding.

1.5 Specifications

Operational

Test voltage	60–630 VAC at 60 Hz 60–525 VAC at 50 Hz [(10.5)*(F) not to exceed 630 VAC] (0.001 volt increments) (V < 60 VAC is at linearly derated accuracy) VA_{out} = 150 VA/phase at 120VAC or higher
Test current	1 mA to 200 A AC in 1mA increments
Test frequency	47–63 Hz (fundamental)
Test phase angle	0–360º in 0.00001º increments
Stability	Included within system accuracy specification
Recalibration interval	365 days
Warm-up time	30 minutes
Watthours Accuracy	± 0.005% ± traceability to NIST with fundamental waveforms This accuracy specification is listed as Percent of Reading and applies across the entire voltage and current operating range. Is also includes the variables of stability for one year after calibration, power factor, and test system errors.
Influences affecting accuracy	Temperature: +0.00006% typical, +0.0002% maximum/°C from 22 °C 21–25 °C (70–77 °F) for specified accuracy
Pulse input	BNC; up to 16 channels Pull-up resistor value of 150, 1K, 10K, 100K Ohms (programmable)
I/O Port	RJ45 jack; up to 16 channels

Physical

Size	Height: 63 in (1.6 m) Width: 47 in (1.2 m) Length: 25.5 in (0.7 m)
Maximum Weight	957 lbs (434 kg)
Warranty	2-year warranty against defects in material or workmanship; extended warranties are available

Electrical

Power requirements	240 VAC, 40 A
Supply frequency	48–62 Hz
Fuses	RS-711 Syntron Signal Source: Littelfuse KLKD004 Littelfuse 0312.125 RS-710 System Power Supply: Littelfuse 0314015.HXP (15 A 250 V ceramic) Littelfuse 0312.250HXP (.25 A 250 V fast acting)

Environmental

Operating temperature	21–25 °C (70–77 °F) for specified accuracy
Storage temperature	0º to 50 ºC (32º to 122 ºF)
Relative humidity	15–80%
Shock and vibration	Any that is nondestructive
Water resistance	Neither splash proof nor water resistant

Traceability

Calibration compliance	ISO 9001:2000 and ANSI/NCSL Z540-1 using applicable Radian Research, Inc. procedures
Test conditions	Temperature: 23 (+/-2) ºC Relative humidity: 15–80%
Reference to watthours	Calibrated to a bank of 3 RD-22-RTS Dytronic Primary Watthour Standards that are directly traceable to NIST, or by accuracies derived from the accepted values of natural physical constants, or by accuracies derived from accepted ratio type calibration techniques. Calibration is then confirmed across all ranges with RD-22-RTS Dytronic Transfer Standards.
Reference to frequency	Calibrated using a Hewlett Packard 100 MHz Universal Counter calibrated using the Arbiter Systems Model 1083B GPS Satellite-Controlled Frequency Standard. The frequency reference for the RS-933 is loaded within the RS-940.
Reference to volts	Calibrated to a bank of 3RD-22-RTS Dytronic Transfer Standards that is traceable to NIST.

Note: All references supporting this calibration system are calibrated on a schedule that is adjusted to maintain traceability at the required accuracy level.

Testing Capability

Reference standards	• Up to 8 SC-10 standards • Up to 4 IB-10 standards • Up to 16 Radian Research, Inc. standards
Watthour meters	• Up to 4 induction meters (typical) • Up to 4 solid state meters (typical)
Instruments	• Analog or digital AC voltmeter • Analog or digital AC ammeter • Wattmeter • Phase angle meter • Voltage chart recorder • Current chart recorder
Measurement functions	**Accumulated** • Wh (net) • Wh (delivered) • Wh (received) • VARh (net) • VARh (delivered) • VARh (received) • VARh INT (net) • VARh INT (delivered) • VARh INT (received) • VARh INT 50 • VARh INT 60 • Qh • VAh RMS • VAh AVE • Vh RMS • Vh AVG • Ah RMS • Ah AVE • V2h • A2h **Instantaneous** • W • VAR • VAR INT • VAR INT 50 • VAR INT 60 • VAR RMS • VA RMS • VA AVE • V RMS • V AVE • dV RMS • dV AVE • A RMS • A AVE • Phase • Phase OVR • Phase RMS • Phase AVG • PF • PF OVR • PF RMS • PF AVE • dPhase • Freq • Time

Delta

- Delta W
- Delta VA
- Delta VAR
- VAR Cross Connected
- Delta VAR Cross Connected
- Delta VAh
- Delta VARh
- Delta VARh Cross Connected
- VARh Cross Connected
- Delta Wh (net)
- Delta Wh (delivered)
- Delta Wh (received)
- Delta VARh (delivered)
- Delta VARh (received)
- Delta VARh Cross Connected (delivered)
- Delta VARh Cross Connected (received)
- VARh Cross Connected (delivered)
- VARh Cross Connected (received)

2 Operation Preparation

This chapter provides information on preparing the RS-933 Syntron Automated Calibration System for use and contains the following sections:

2.1 Getting Started

2.1.1 Thank You For Your Purchase

Thank you for purchasing this quality Radian Research, Inc. product. Radian reference standards are recognized throughout the world for their unparalleled accuracy, precision, and stability. We have taken every effort to ensure that your RS-933 Syntron Automated Calibration System reaches you in perfect condition.

Your satisfaction is very important to us, and your continued loyalty is greatly appreciated. If for any reason your Radian Research, Inc. product does not meet your expectations of exceptional performance, please contact your sales

representative or Radian Research, Inc.

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2.1.2 Preparing Equipment for Use

Follow these steps to prepare your RS-933 Syntron Automated Calibration System for use.

1. **Unpack and inspect:**

- Carefully remove the equipment from the packaging, and check for any signs of damage.

✓ NOTE	If you observe any damage to the equipment, immediately notify the carrier and your sales representative.

2. **Verify the contents:**

- Verify that your shipment includes the following items:
  - Tower assembly:
    - Double-wide cabinet
    - RS-940 Data Collection Module
    - RS-711 Syntron Signal Source (1 or 3, depending on model number)
    - RS-710 System Power Supply (2)
    - RS-932 Current Amplifier Modules (1 or 3, depending on model number)
    - RS-935 Potential/current connection panel
    - RS-936 Potential and current indicator panel
    - RS-937 System cooling module (2)

        - Power lock switch key (4)

    - Cables and cords:
        - Control computer interface cable
        - Un-terminated system power cord
        - External potential cable set (1 or 3, depending on model number)
        - External current cable set (1 or 3, depending on model number)
        - RM-1C 6' BNC cables (8 or 16, depending on model number)
        - Ethernet communication cables (9 or 17, depending on model number)
        - Syntron Cable Adaptor Kit
    - RS-933A tool kit, containing a 1/8” ball head Allen driver, bent-tip pliers, and a 12 mm hex L-key
    - Calibration report(s)
    - RS-933 Control Software
    - Optional accessories

✓ NOTE	If any items are missing from your shipment, contact Radian Research, Inc.

2.1.3 System Setup and Training

The purchase of the RS-933 Syntron Automated Calibration System includes on-site setup and training assistance by Radian Research, Inc. Contact Radian Research, Inc. to coordinate the site visit.

Prior to the site visit:

- Determine a suitable location for the equipment.
- Provide a suitable power source for the system.

See Section 2.2 in this manual for details on placement, cooling, and power.

⚠ CAUTION	Do not attempt to set up the RS-933 without a Radian Research, Inc. representative present.

2.1.4 Registering Your Equipment

Register your equipment to:

- Activate the equipment warranty.
- Receive firmware and software updates as well as product application notes from Radian Research, Inc.

✓ NOTE

You **must** register your equipment at www.radianresearch.com/reg to activate the two-year equipment warranty. **If you do not activate the warranty, the warranty period is reduced to one year.**

Follow these steps to register your RS-933 Syntron Automated Calibration System:

1. Navigate to www.radianresearch.com/reg.
2. Complete the online form.
   - The serial number can be found on the top left corner on the rear of the unit (see Figure 3).

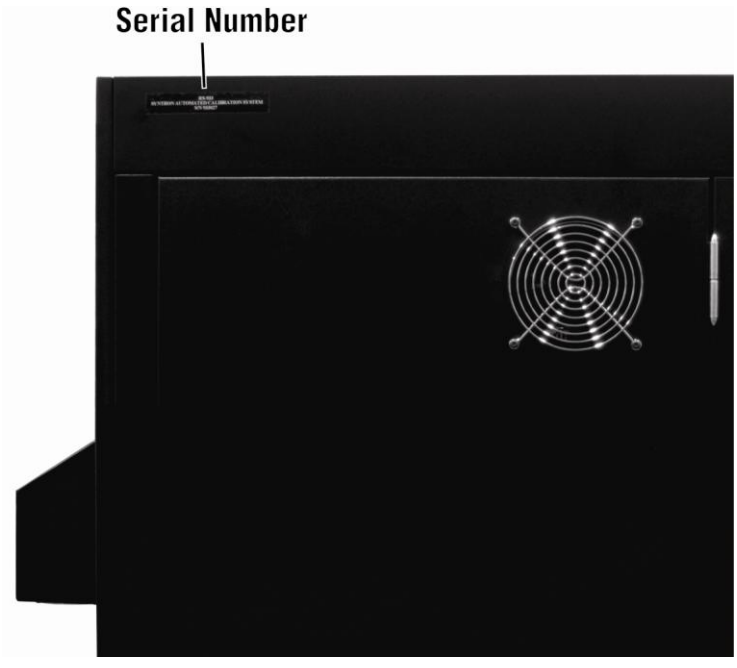

Figure 3. RS-933 Nameplate Containing Equipment Serial Number

2.2 Operational Considerations

To protect the RS-933 Syntron Automated Calibration System and ensure optimal performance, follow these guidelines:

- **Placement:** The RS-933 is designed for use in a dry, clean, temperature-controlled environment that is free from dust, debris, and flammable gases and fumes, such as a standards lab. The system should be placed in an area where space is available for the system control computer, the devices under test, and any accessories.

✓ NOTE	Operating this equipment in an unsuitable environment can affect equipment performance and shorten equipment life.

- **Cooling:** When placing the RS-933 for use, do not block the Cooling System Module on the lower front of the unit.

✓ NOTE	Ensure 6" of space exists between the front and rear of the unit and any wall or structure to allow adequate air flow to and from the cooling system.

- **Power:** The RS-933 requires 240 VAC, 40 A service.

3 System Components and Features

This chapter provides detailed information on the system components of the RS-933 Syntron Automated Calibration System and their features. It contains the following sections:

✓ NOTE	All components of the RS-933 include a power indicator light on the front panel. The indicator light is lit when power is present at that component.

3.1 RS-711 Syntron Signal Source

The RS-711 Syntron Signal Source generates voltage and current signals with extreme accuracy and extremely low distortion.

It has the following features:

- Accuracy of 0.0003 Hz; eliminates error of calibration on frequency-sensitive devices
- Test frequency of 48–63 Hz
- Test phase angle of 0–360° in 0.000001° increments
- Allows for true three-phase testing with 123/321 phase rotation as specified by the operator
- Can also be used for single-phase testing

- Synthesis and generation of arbitrary waveforms (first through sixty fourth harmonic) as specified by the operator via the RS-933 Control Software (useful for evaluation testing of electro-mechanical and solid-state meter designs)

3.2 RS-932 Current Amplifier Module

The gain error and the distortion of the RS-932 Current Amplifier Module is extremely small in proportion to the 50 ppm specification of the RS-933 Syntron Automated Calibration System.

The current amplifier module has the following features:

- Can source any current from 1 mA–200 A in 1 mA increments
- Extremely low output impedance, which minimizes burden errors
- Output power is 50 VA per phase at 50 A, which is sufficient for testing multiple reference standards

3.3 RS-935 Voltage/Current Amplifier Panel

The RS-935 Voltage/Current Amplifier Panel provides the external potential and current connection interfaces.

3.4 RS-710 System Power Supply

The RS-710 System Power Supply provides power to all components of the RS-933 Syntron Automated Calibration System. It provides high accuracy by:

- Coupling in the incoming power and removing the common ground between components of the RS-933, which makes it possible to send highly accurate signals to the components.
- Operating at 1 kHz, making individual power supplies more compact and easily shielded.

3.5 RS-940 Data Collection Module

The RS-940 Data Collection Module interfaces to the pulse outputs of the standards under test and transfers the data to the system computer. Figure 4 shows the front panel of the RS-940.

It has the following features:

- Connects directly to a personal computer for direct memory access, which permits rapid data collection from a large number of standards using the RS-933 Control Software
- Interfaces directly to the Radian Research, Inc. RM-1H optical pickup, which is used to sense the calibration LED on solid state meters
- Interfaces with the RM-DS Meter Disk Sensor, which is used to sense disk rotation when testing induction meters
- Available with 8 or 16 channels
- Serial interface connections

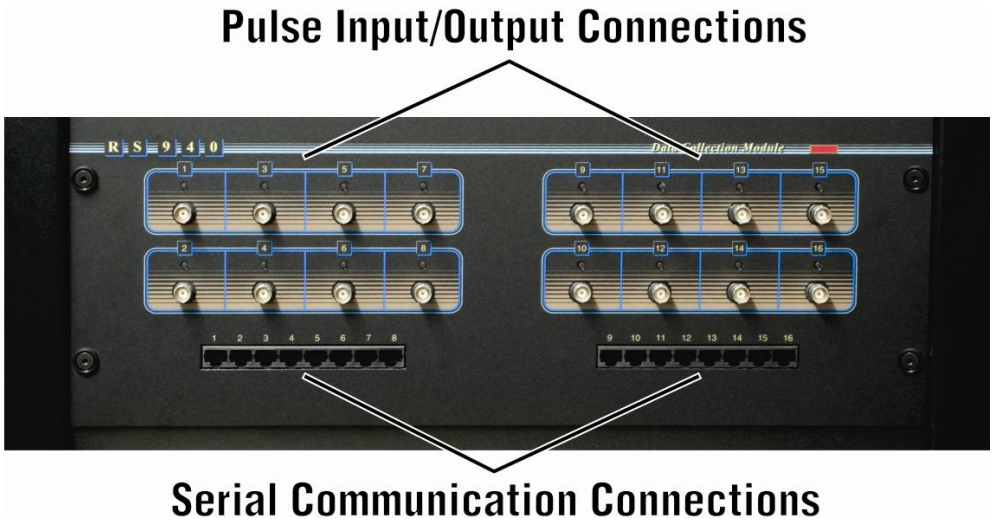

Figure 4. Front Panel of RS-940 Data Collection Module (16 channel version 8 channel not shown)

3.6 RS-936 Potential and Current Indicator Panel

The RS-936 Potential and Current Indicator Panel indicates the potential and current phases that are active during testing.

It also contains the main power switch for the RS-933 Syntron Automated Calibration System (see Figure 5). In the off position, this switch can be locked into place with a padlock or a lockout-tagout mechanism.

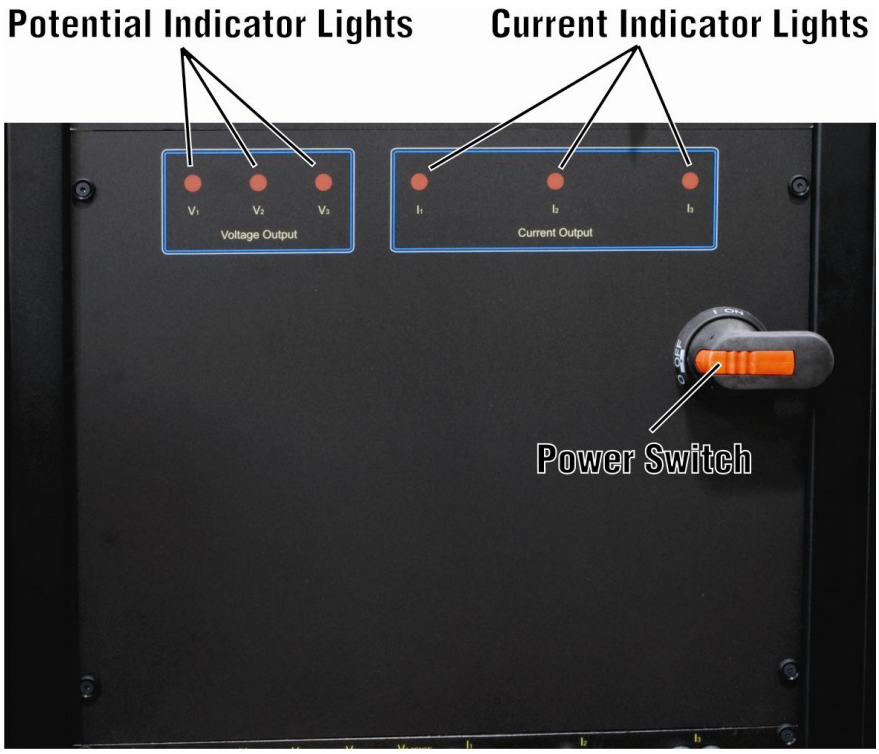

Figure 5. RS-933 Main Power Switch on Potential and Current Indicator Panel.

3.7 RS-937 System Cooling Module

The RS-933 Syntron Automated Calibration System includes two RS-937 System Cooling Modules located at the bottom of each tower. Each cooling module includes the following features:

- Three 24 V brushless DC fans that each produce over airflow of over 150 cfm
- Acoustical insulation to minimize noise
- A replaceable 10" x 16" x 1" air filter to reduce dust inside the unit (available from Radian Research, Inc.)

✓ NOTE	Ensure 6" of space exists between the front and rear of the unit and any wall or structure to allow adequate air flow to and from the cooling system.

4 RS-933 Control Software

This chapter describes the RS-933 Control Software and contains the following sections:

4.1 Software Overview

RS-933 Control Software is used to:

- Operate the RS-933 Syntron Automated Calibration System
- Develop test sequences for many types of equipment, including electrical energy reference standards, electro-mechanical and solid-state watthour meters, voltmeters, and ammeters
- Generate arbitrary waveforms
- Store, print, and export test data

✓ NOTE	A personal computer is required to operate the RS-933 Control Software. This computer is not included in the purchase of the RS-933.

4.2 Software Documentation

This manual section is intended to provide a brief overview of the control software, including an example test set-up.

See Section 5 of this manual for instruction for certifying a Radian Research, Inc. RD-2X series reference standard using the RS-933 Syntron Automated Calibration System.

Additional application notes, on testing a wide range of devices, can be found at Radian Research's website: www.radianresearch.com. Contact Radian Research, Inc. at (765) 449-5500 for additional support.

4.3 System Requirements

RS-933 Control Software can be run only on Microsoft Windows. The minimum system requirements are listed below. Additional disk space required, depending on amount of test results saved.

Component	Minimum Requirement
Computer and processor	1 GHz processor
Memory	1GB RAM (32-bit) or 2 GB RAM (64-bit)
Hard disk	16 GB (32-bit) or 20 GB (64-bit)
Display	DirectX 9 graphics device with WDDM 1.0 or higher driver
Operating system	Windows 7 32-bit or 64-bit
Additional requirements	Secondary LAN interface

4.4 Setting Up the RS-933

For all new system purchases, a Radian Research, Inc. representative will set up the RS-933 Syntron Automated Calibration System and install the RS-933 Control Software during the site visit. See Section 2.1.3 of this manual.

4.5 Installing the Software

Follow these steps to install the software:

1. Insert the disk into the computer's drive.
2. Locate file setup.exe, click and then follow the instructions on the screen.
   - When the installation is complete, the icon below (see Figure 5) will appear on the desktop.

Figure 6. RS-933 Control Software Icon

3. Double-click the icon to start the software.

✓ NOTE

During installation, the RS-933 Control Software will create a group of directories where device configurations, test setups, waveforms, and test results are stored.

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4. Download and run the setup program for "Microsoft SQL Server 2012 *Express with Tools"* from Microsoft's website.

    - Select "New SQL Server stand-alone installation or add features to an existing installation".
    - Accept license agreement, click Next.
    - Ensure selected features and installation directory are set to default, click Next.
    - Ensure instance configuration settings are set to defaults, click Next.
    - Ensure server configuration settings are set to defaults, click Next.
    - At database engine configuration:
      a. Select "Mixed Mode" under Authentication Mode.
      b. Enter a password for the administrator
      c. Click Next.
    - Click Next for Error Reporting.
    - Allow installation to run – this may take a few minutes.
    - Click Close – installation is finished. Close the setup program.
    - Launch SQL Server Management Studio.
    - Login using Windows Authentication as administrator
    - File | Open | File
    - Open "Generate933Database.sql".
    - Modify the path to "RadianRS933.mdf" and "RadianRS933_log.ldf" to the correct path for your installations.
    - Click "Execute Query" and ensure that the query executes successfully.

- Close SQL Server Management Studio

5. Configure the software by following the instructions in Section 4.7 of this manual.

4.6 Menu Structure

The RS-933 Control Software includes a series of ribbon tabs and associated buttons. A quick access toolbar is also included, which contains many of the most used functions (see Figure 6). Both are described below.

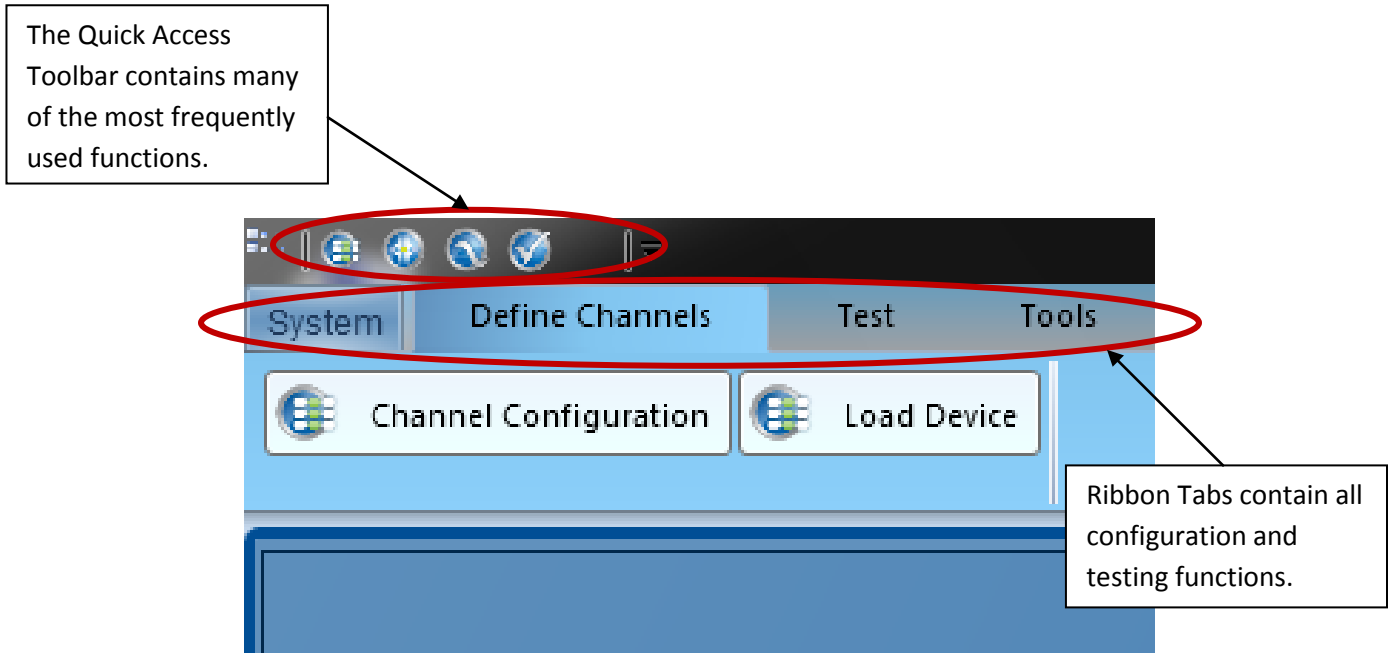

Figure 7. Ribbon Tabs and Quick Access Toolbar

4.6.1 Ribbon Tabs

The RS-933 Control Software ribbon tabs and the associated buttons allow easy access to all configuration and testing functions. Each ribbon tab is described below.

4.6.1.1 System

Information	Contains important system information such as module serial numbers, calibration dates, number of I/O channels, database connection, software version, and an error log (see Figure 7).

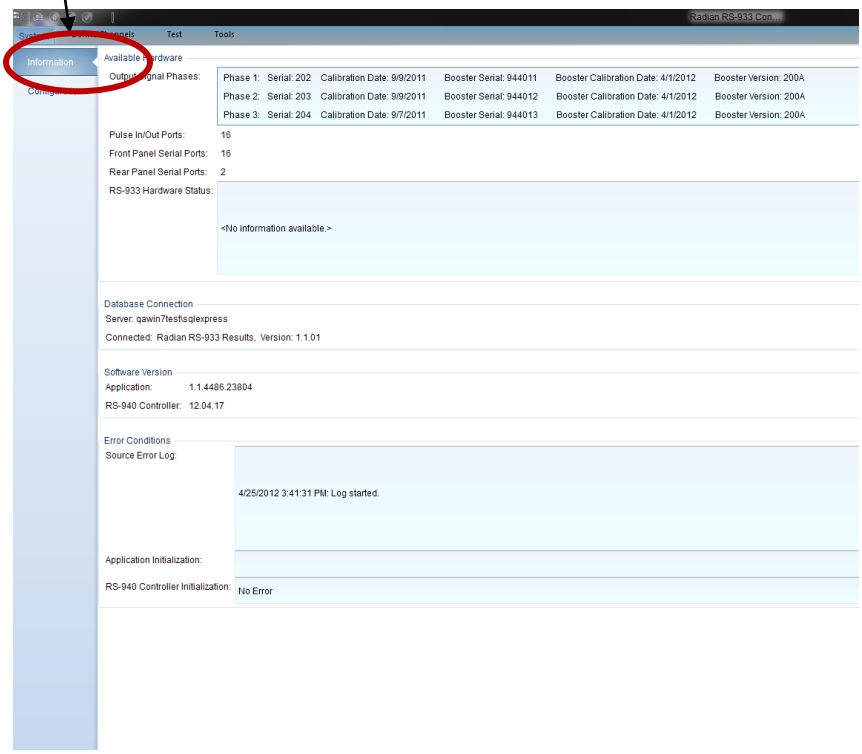

Figure8. Information Window

Configuration	Allows the user to configure various system parameters such as operator identification, comments, test settings, and the system IP address. This window also allows the user to select the location of saved database, test, waveform, device, and results files. An autonull can also be executed.

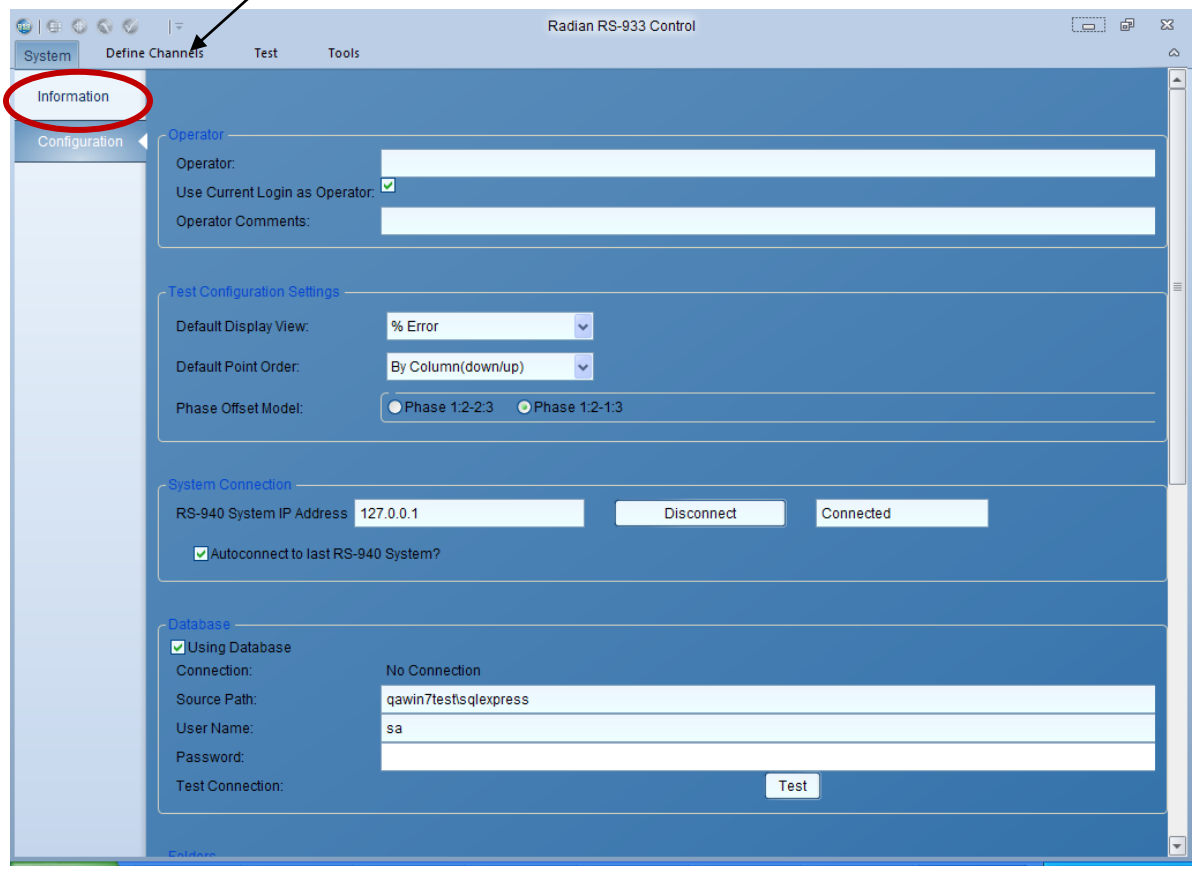

Figure9. Configuration Window

4.6.1.2 Define Channels

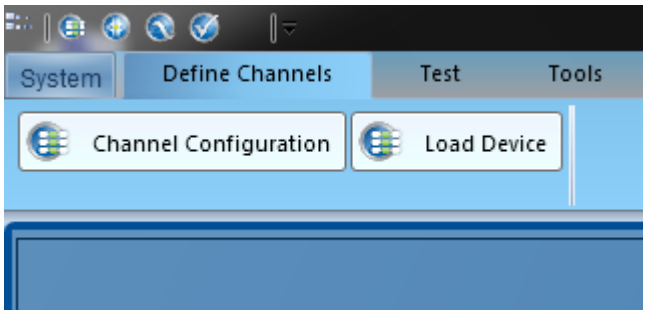

Figure 10. Define Channels Ribbon Tabs

Channel Configuration	Allows the user to associate and configure the devices under test (DUT's) to the available RS940 Data Collection Module channels (see Figure 10).

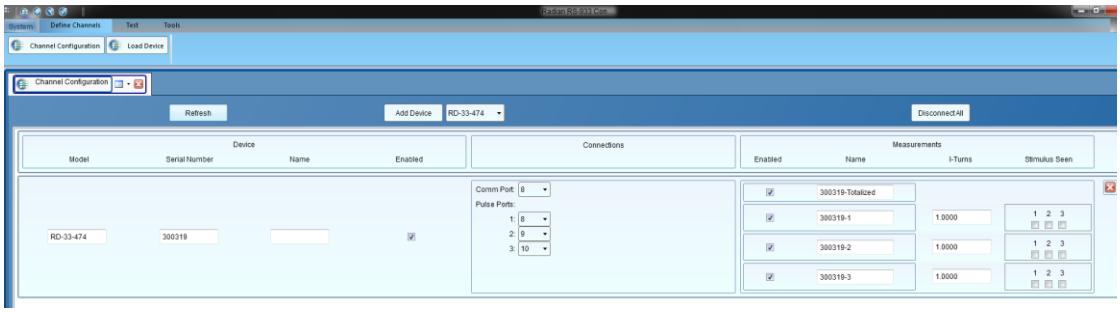

Figure10. Channel Configuration Window

- Refresh – Scans all the available channels and populates the channel table based on the connected DUT's
- Add Device – Allows the customer to add a device to the channel table
- Disconnect All – Removes all channel configurations

Device:

- Model – The DUT's model number
- Serial Number – The DUT's serial number
- Name – This field will auto-populate, if the DUT is an RD standard and has a name programmed (see the RD standard's Operations Manual for details)
- Enabled – Enables/disables the entire DUT

Connections:

- Comm Port – Establishes the specific RS-940 serial communications input channel for the DUT

- Pulse Ports – Establishes the specific RS-940 pulse input channel(s) for the DUT. Measurements:
- Enabled – Enables/disables a single phase of the DUT
- Name – Defaults to the device name, if programmed. If not programmed, it will set to the DUT's serial number. If no serial number is available, the model number is displayed.
- I-Turns – Establishes the scaling factor for the number of turns around the input CT of the DUT.
- Stimulus Seen – Allows the user of a single potential/current phase or combination of potential/current phases to apply stimuli to the DUT, enter the voltage, current, phase angle, and waveform into the appropriate phases and check Stimulus On.

Load Device	Opens a Select Device File window (see Figure 11) for browsing to a pre-configured device file (see Figure 11).

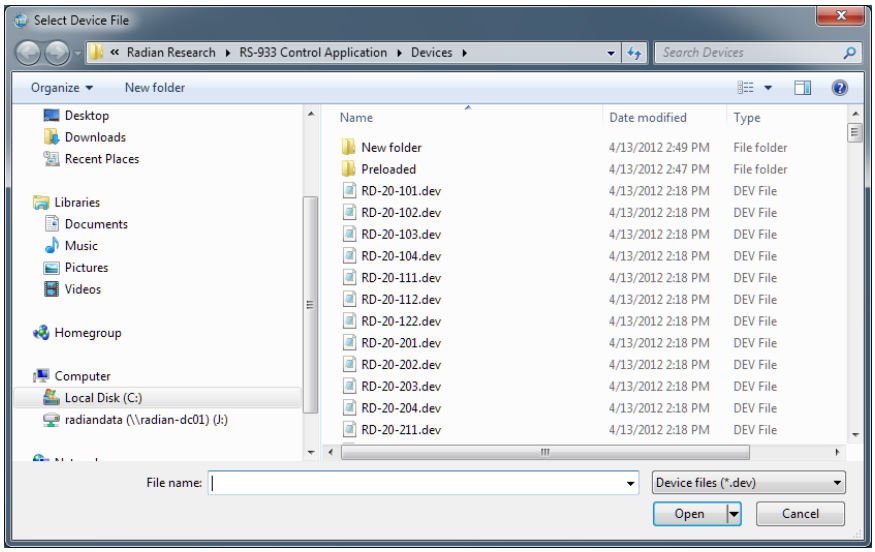

Figure 11. Load Device File Window

4.6.1.3 Test

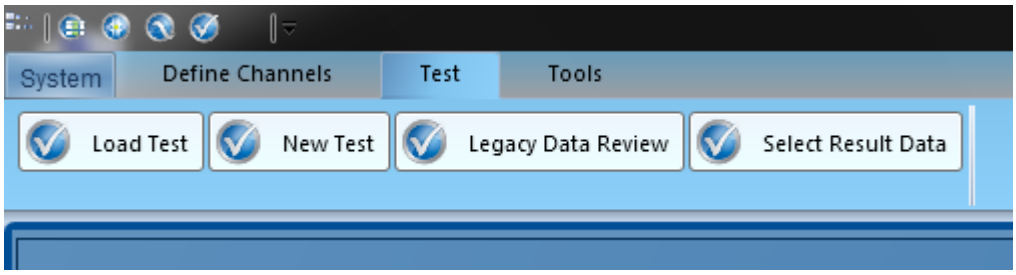

Figure 12. Test Ribbon Tabs

Load Test	Opens a Select Test File window for browsing to a pre-configured test file.

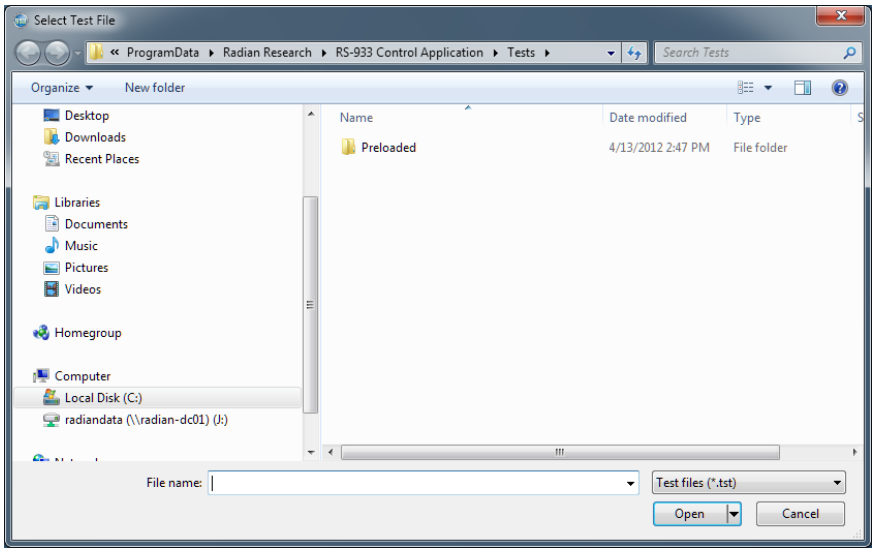

Figure13. Load Test File Window

New Test	Allows the user to create a new test sheet.

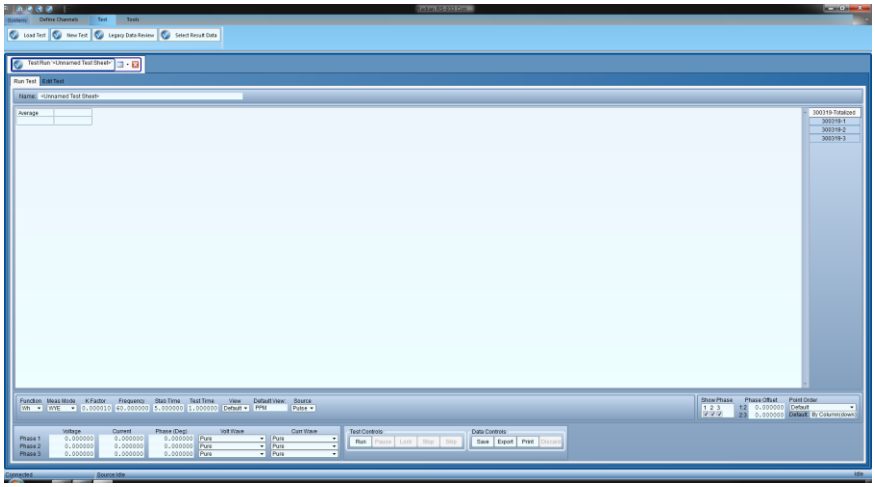

Figure 14. New Test Window

Legacy Data Review	Allows retrieval and review of archived RS-703 System Test Results

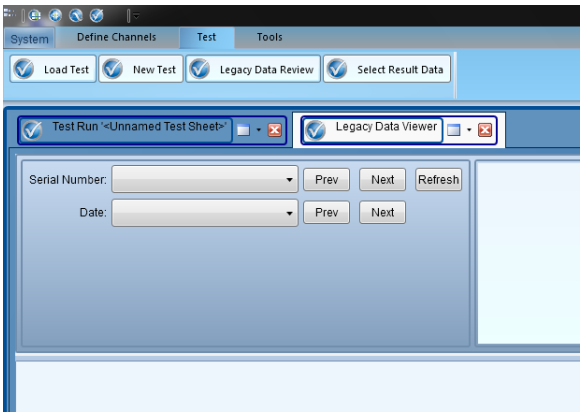

Figure 15. Legacy Data Review Window

Select Result Data	Allows the user to review saved test results.

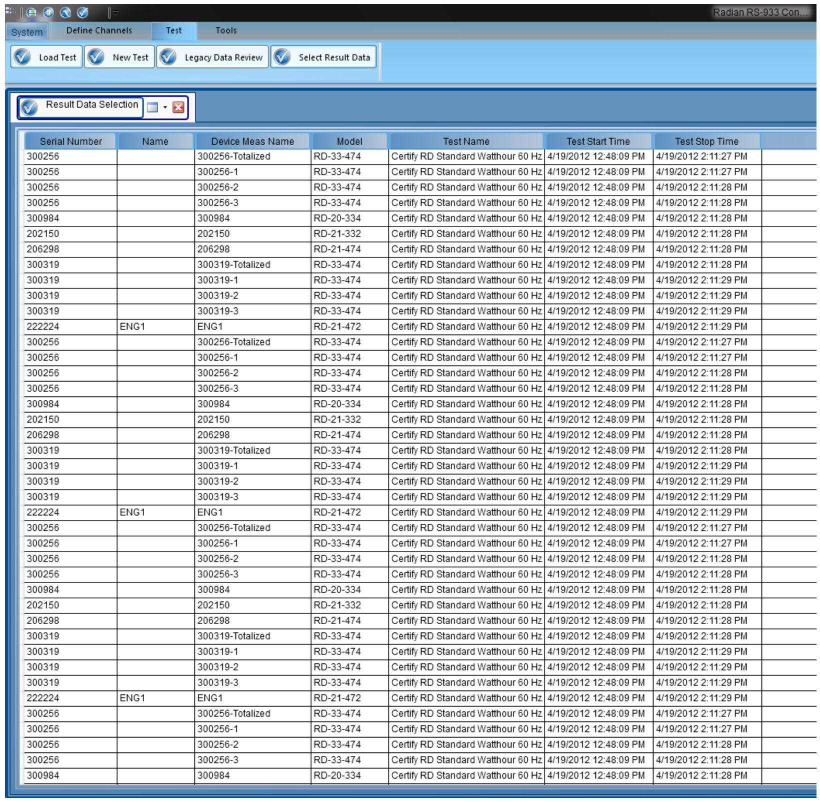

Figure 16. Select Result Data Window

4.6.1.4 Tools

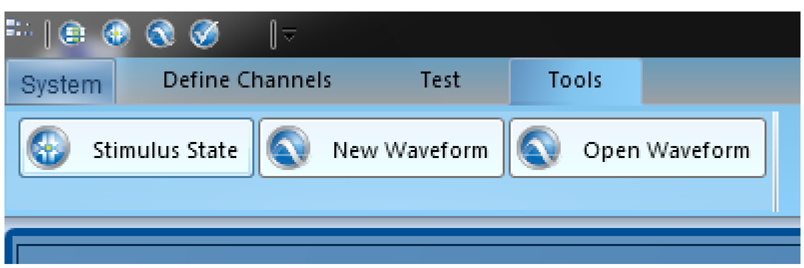

Figure 17. Tools Ribbon Tabs

Stimulus State	Allows the user to set and apply specific potential, current, phase, frequency, and harmonic stimuli to the DUT's

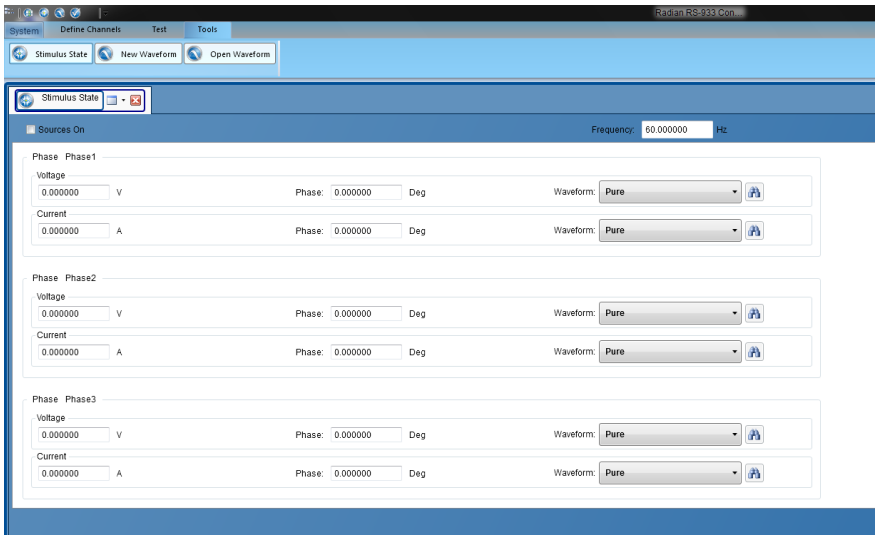

Figure 18. Stimulus State Window

New Waveform	Allows the user to create new potential and current waveforms, with various harmonic content.

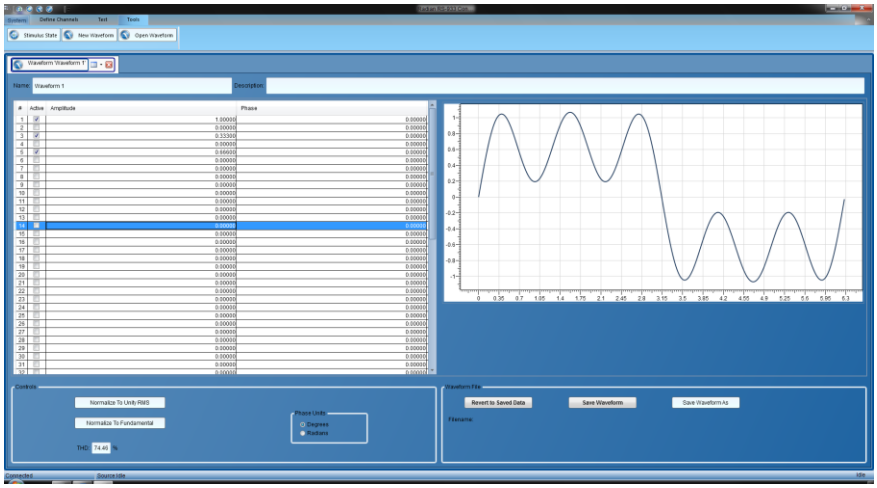

Figure19. New Waveform Window

- Name – The name of the waveform file
- Description – Description of the waveform
- Active – Allows the user to activate and deactivate each of the 64 harmonics indescriminately

- Amplitude – The strength of the harmonic component, as referenced to the fundamental
- Phase – The phase of the harmonic component, as referenced to the fundamental
Controls:
- Normalize To Unity RMS – Normalizes the harmonic values so that the waveform's total RMS is one.
- Normalize To Fundamental – Scales the harmonic values to a fundamental amplitude of one.
- THD – The total calculated THD for all the harmonic content and the fundamental
- Phase Units – Degrees or Radians
Waveform File:
- Revert to Saved Data – Clears all changes and restores original waveform
- Save Waveform – Saves the waveform changes to the original file
- Save Waveform As – Saves the waveform changes to a new file

Open Waveform	Opens a Select Harmonic Waveform File window for browsing to a pre-configured waveform file.

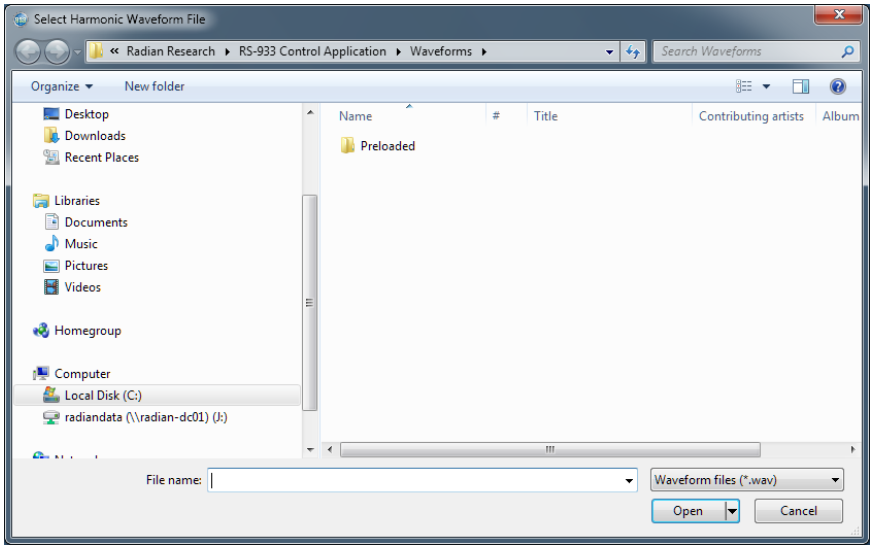

Figure20. Open Waveform File Window

4.6.2 Quick Access Toolbar

The RS-933 Control Software Quick Access Toolbar allow easy access to the most frequently used configuration and testing functions.

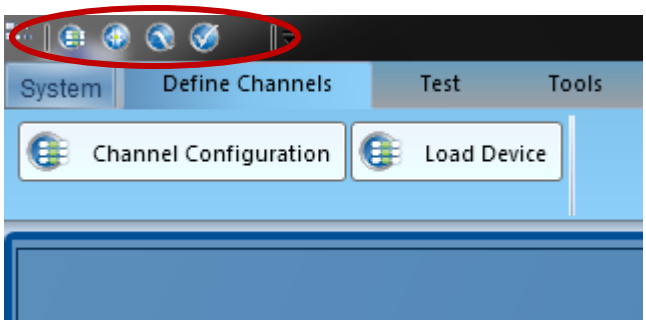

Figure 21. Quick Access Toolbar

4.7 Configuring the Software

The System/Configuration screen allows the user to configure various system parameters such as operator identification, comments, test settings, and the system IP address. This window also allows the user to select the location of saved database, test, waveform, device, and results files. An autonull can also be executed.

4.7.1 Operator

Use the Operator section fields to specify:

- The operator ID information
- Operator comments and notes

Figure 22. Operator Information

4.7.2 Test Configuration Settings

Use the **Test Configuration section** fields tab to specify:

- Default Display View - % Error, %Registration, PPM, Measured, Expected, Nulling PPM, or Correction Factor

  % Error: The percent error of a DUT is the difference between its percent registration and one hundred percent.
  % Registration: The percent registration of a DUT is the ratio of the actual registration of the meter to the true value of the quantity measured in a given time, expressed as a percent.
  PPM: The % Error expressed in parts per million (e.g. 0.001% error = 10ppm)
  Measured: The value of the stimuli measured by the DUT
  Expected: The expected reading, based on the selected waveform, voltage and current settings, and phase inputs
  Nulling PPM: % Registration expressed in PPM
  Correction Factor: The amount, normalized to one, to correct errors in the DUT.

- Default Point Order – By Row, By Column (down/up), or By Column (down)
- Phase Offset Model – Phase 1:2-2:3, or Phase 1:2-1:3

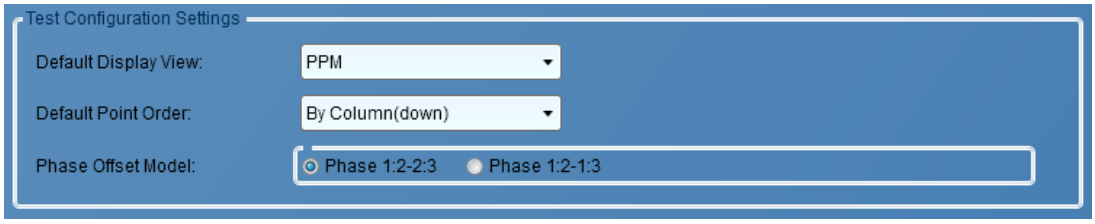

Figure 23. Test Configuration Information

4.7.3 System Connection

Use the **System Connection** section fields to specify:

- RS-940 System IP Address

✓ NOTE	**Each RS-940 has its own IP address. This address is typically determined at the time of purchase. If you do not know the system's address, please contact Radian Research, Inc. for further assistance.**

- Connect/Disconnect to the system
- Autoconnect to last RS-940 System

Figure 24. System Connection Information

4.7.4 Database

Use the **Database** section fields to:

- Source Path
- User Name
- Password
- Test Connection

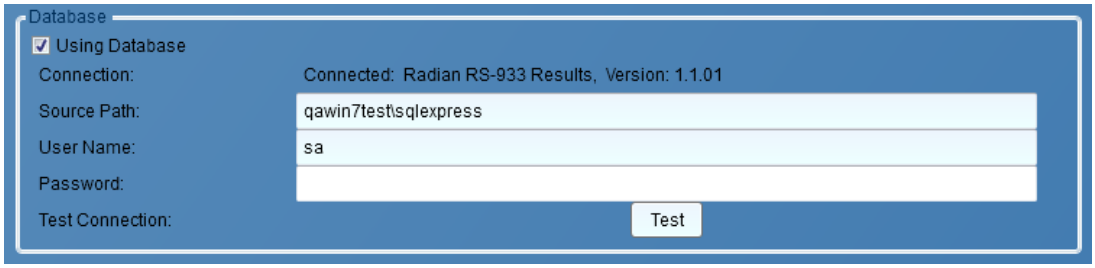

Figure 25. Database Information

4.7.5 Folders

Use the **Folders** section fields to:

- Select the location of Test files
- Select the location of Waveform files
- Select the location of Device files
- Select the location of Results files

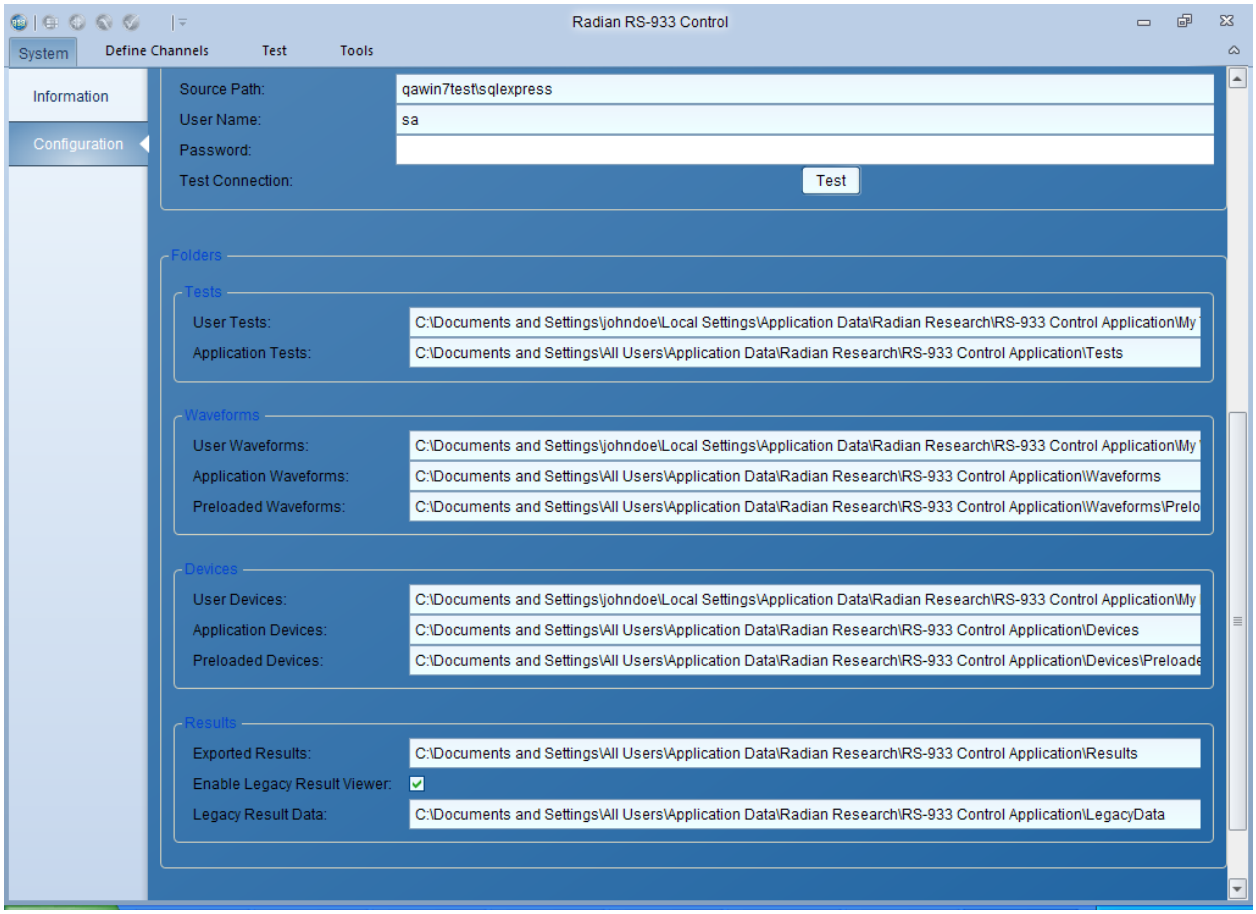

Figure 26. Folders Information

4.7.6 AutoNull

Use the AutoNull section to:

- Execute a AutoNull

✓ NOTE	**Auto Null: Eliminates any DC component in the potential and current output signals.**

Figure 27. Autonull

5 Applications Information

This chapter explains how to certify a Radian Research, Inc. RD-2X series reference standard using the RS-933 Syntron Automated Calibration System and contains the following sections:

NOTE

This section contains only instructions for certifying Radian Research, Inc. RD-2X series reference standards. Application notes on conducting instructions for additional tasks are available; see Section 7.4 in this manual.

5.1 Setting Up the Hardware

5.1.1 Hardware Requirements

The following equipment is needed to certify a RD-2X reference standard with the RS-933 Syntron Automated Calibration System:

1. RD-2X reference standard (device under test)
2. 120 VAC auxiliary power input cable (Radian Research, Inc. part number 194015)
3. Test connection kit (Radian Research, Inc. part number 109321 supplied)
4. RJ-45 cable (Radian Research, Inc. part number 194200)

5.1.2 Hardware Setup

Follow these steps to set up the hardware:

1. With the main power switch on the Potential and Current Indicator Panel in the off position, verify that:

- The personal computer with the RS-933 Control Software is connected to the RS-933 and ready for use.
- The main power cable of the RS-933 is connected to the power source.

2. Turn on the main power to the RS-933 using the main power switch on the Potential and Current Indicator Panel. Make sure both RS-710 key switches are in the on position.
3. Turn on the personal computer with the RS-933 Control Software.
4. Connect the hardware as shown in Figure:

Connect From	Connect To	Cable
120 VAC	Auxiliary power input of the DUT	120 VAC auxiliary power input cable
SERIAL PORT of the DUT	Channel 1 of the RS-940 Data Collection Module (front panel)	RJ-45 Cable
Potential output of the Voltage/Current Amplifier Panel	Potential input of the DUT	External potential cable
Current output of the Voltage/Current Amplifier Panel	B current input of the DUT	External current cable Right angle current adaptors (hardwired to RS-933)

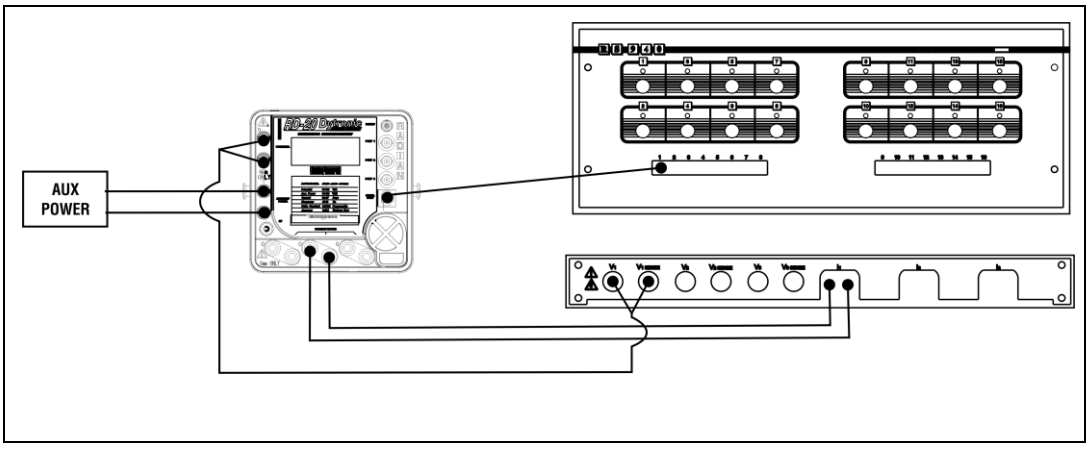

Figure 28. Hardware Connections for Certifying an RD-2X Radian Research, Inc. Reference Standard

5. Configure the DUT as follows:

Component	Setting
Port 2	Wh
Pulse constant	0.00001 Wh/pulse
Port polarity	+

✓ NOTE

For optimum accuracy and stability, the recommended warm-up time for the RS-933 system is 30 minutes.

✓ NOTE

Consult the user manual for the DUT for additional information on configuration.

5.2 Setting Up the Software and Running the Test

5.2.1 Start the Software

Follow these steps to start the software:

1. Double-click the RS-933 Control Software icon on the personal computer desktop.

Figure 29. RS-933 Control Software Icon

✓ NOTE

Upon power-up, the RS-940 module executes a diagnostic routine. This routine can take a few minutes. If the control software is opened prior to the completion of this routine, the software will either deny the connection or display an initializing message.

The software will start.

- Browse to System/Configuration screen and ensure that the system is connected

Figure 30. System Connected

5.2.2 Associate DUTs to Channels

Follow these steps to associate the DUTs to the appropriate channels:

1. Select Define Channels/Channel Configuration

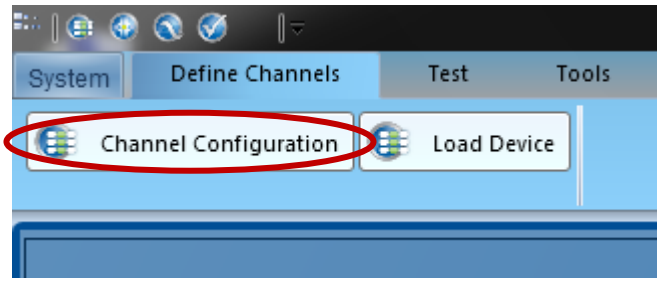

Figure 31. Select Channel Configuration

- The Channel Configuration window will appear.
- Select Refresh
- The RS-940 will scan all the available channels for communications with connected Radian RD Reference Standards and automatically associate them to the connected channel.

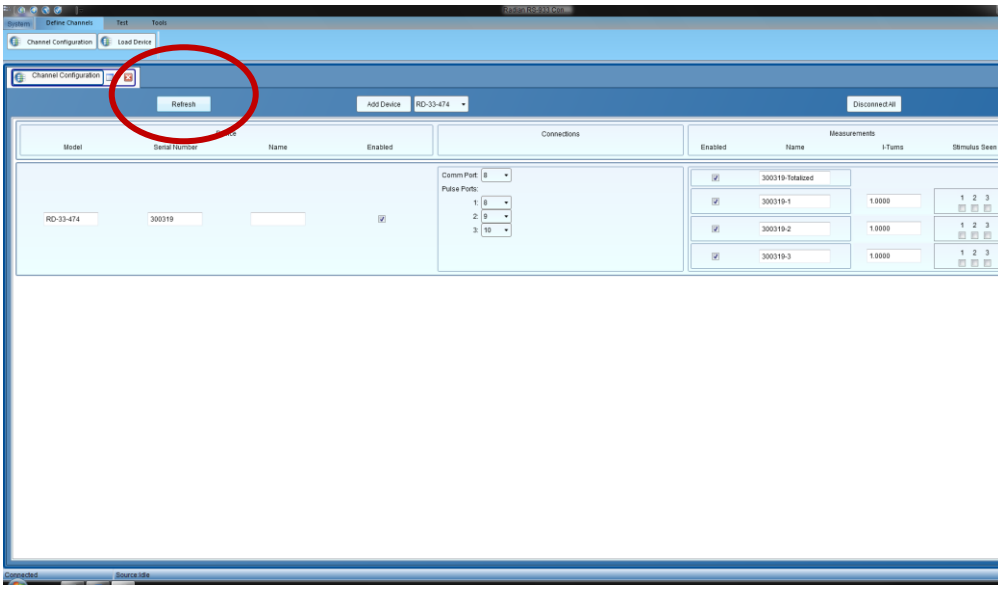

Figure 32. Select Refresh

- Enter an appropriate DUT name (optional).
- Select the number of I-Turns and the appropriate phases for Stimulus Seen.
  a. I-Turns = 1.0000
  b. Stimulus Seen = check Phase 1 only

✓ NOTE	**I-Turns: The number of current turns applied to the input of the DUT.**

5.2.3 Open and Run the Test

Follow these steps to open and run the test:

1. *Select Test/Load Test.*

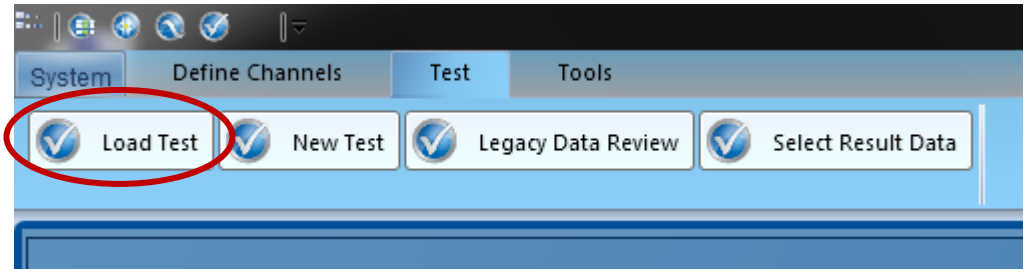

***Figure 33**. Select Load Test*

2. *Browse to and select **Certify RD Standard Watthour 60Hz**, and then click **Open**.*

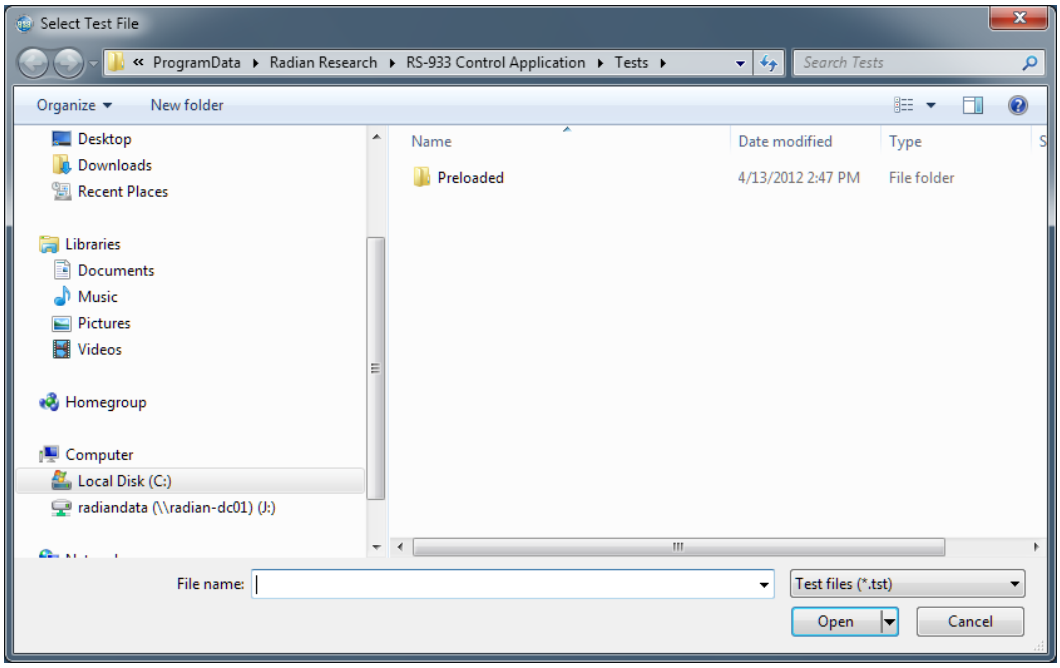

***Figure 34**. Select the Test File*

- *The **Test Run** screen will appear. The serial numbers or names of the previously associated DUTs are shown on tabs on the right.*
- *The screen displays the test points.*

3. *If necessary, click any of the current, voltage, or phase (degrees) values in the **Test Run** screen to make changes.*

4. *Configure the test options listed at the bottom of the **Test Run** screen as follows:*

Setting	***Selection or Value***
Meas Mode	*WYE*
K Factor	*0.000010*
Frequency	*60.000000*
Stab Time	*User Preference (1 second increments; 1to 9,999seconds)*
Test Time	*User Preference (1 second increments; 1sec to 49.77days)*

View	*User Preference*
Default View	*User Preference*
Source	*Comm (pulse, comm, or pulse/comm)*
Show Phase	*Check Phase 1 only*
Phase Offset	*1:2 = 0.000000; 2:3 = 0.000000*
Point Order	*User Preference*
Volt Wave	*All set to Pure*
Curr Wave	*All set to Pure*

5. *Select **Run**.*

   - *The test will automatically start with the first test point and continue until all test points have been executed.*

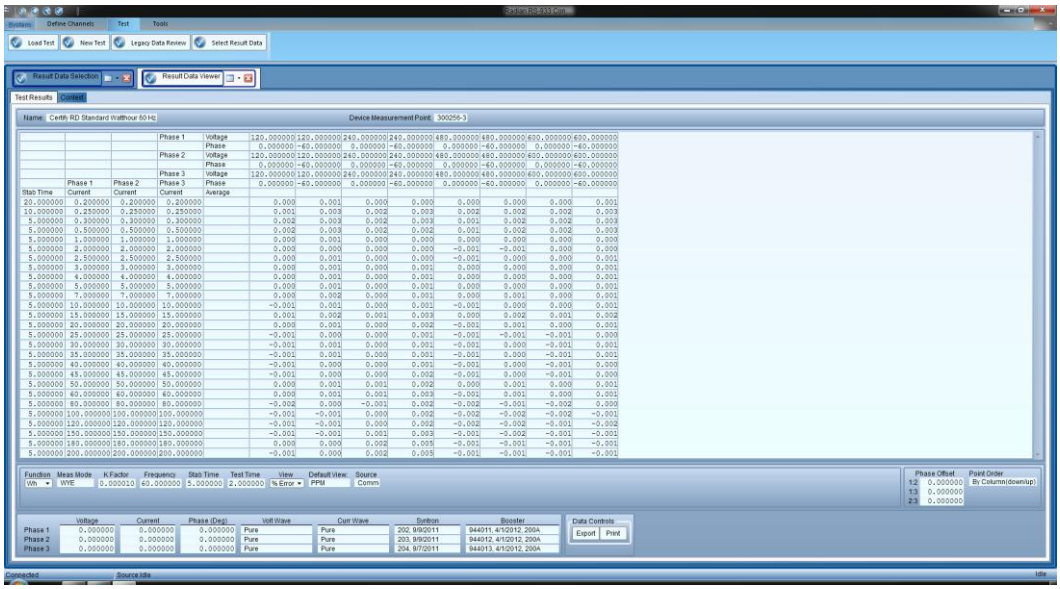

***Figure 35**. Test Screen*

5.2.4 Viewing Results

Follow these steps to view results:

1. Select **Test/Select Results Data**.

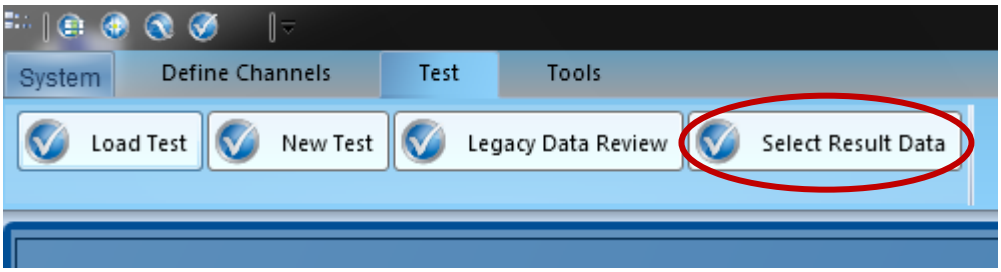

Figure 36. Select Test/Select Result Data

2. From the list, select the required test by locating the serial number and time/date of the test.

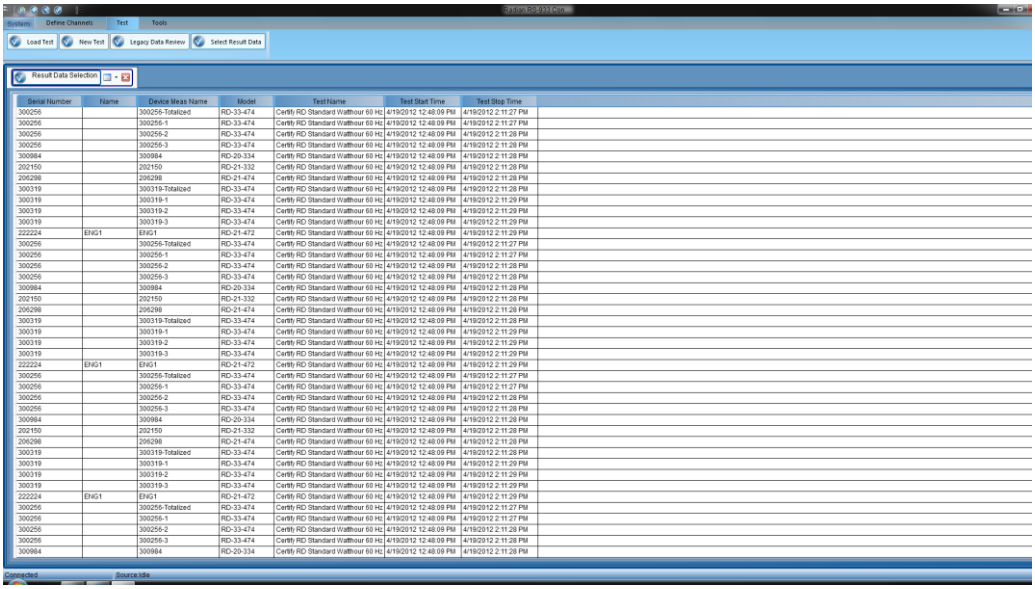

Figure 37. Select the Test Results

- The desired results data will appear.

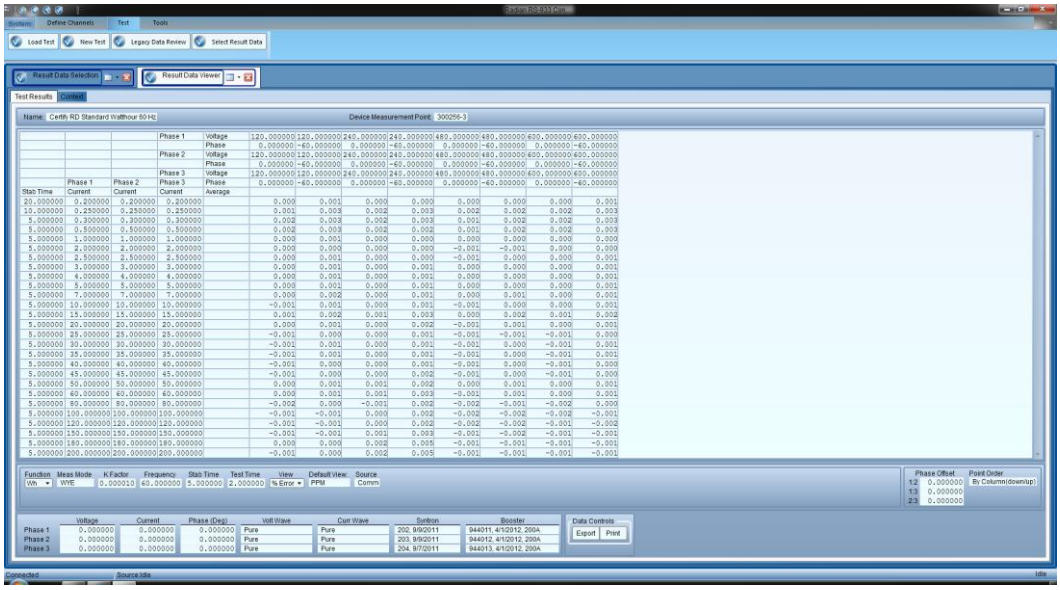

Figure 38. Test Results

5.2.5 Exporting Data

Data from the RS-933 Control Software can be exported easily by selecting the Export button from the Test/Select Result Data screen. This exports the data from the current test sheet or results within the database to an Excel compatible *.csv file.

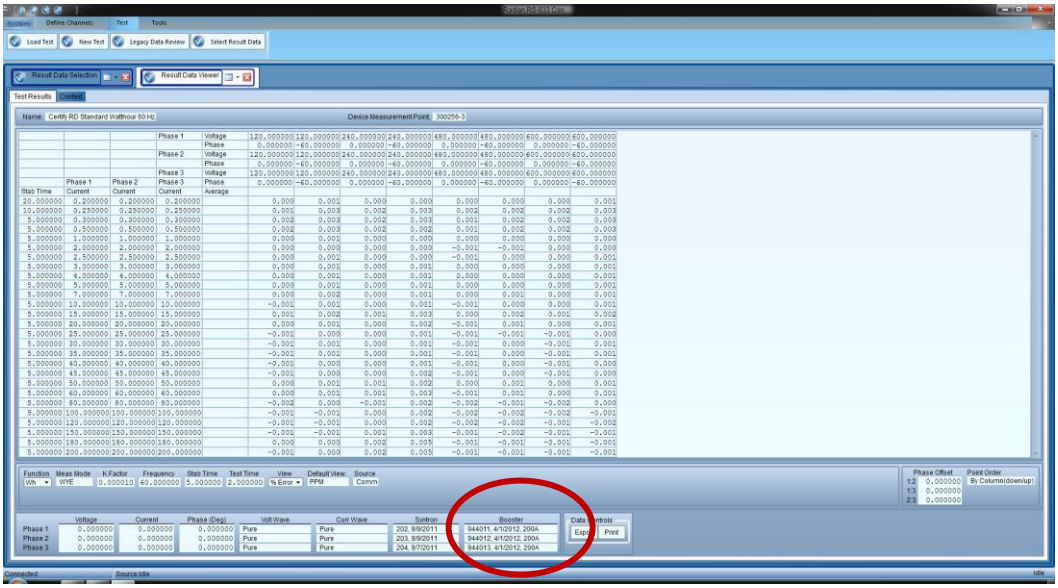

Figure 39. Exporting Test Results

6 Accessories

This chapter describes the available accessories for use with the RS-933 Syntron Automated Calibration System and contains the following sections:

6.1 RD-22 Dytronic Primary Transfer Standard

The RD-22 Dytronic Primary Transfer Standard (see Figure) represents state-of-the-art technology in a commercially available true DC to AC accuracy transfer reference. When combined with the RS-933 Syntron Automated Calibration System, it creates a complete automated reference system.

Figure 40. RD-22 Dytronic Primary Transfer Standard

6.2 RM-OA Optical Adapter

Used with solid-state meters whose infrared calibration pulses are emitted from the optical communications port.

- Magnetically couples to the communications port of solid-state meters.

- Suction cup of the Radian Research, Inc. RM-1H Infrared Optical Pickup attaches to the clear polycarbonate cover of the RM-OA.
- Incorporates a rare-earth permanent magnet for exceptional holding power over the life of the product.

Figure 41. RM-OA Optical Adapter

7 Routine Maintenance and Service

This chapter contains the following sections:

7.1 Contact Information

For questions related to maintenance and service, contact Radian Research, Inc.:

Radian Research, Inc.
3852 Fortune Drive
Lafayette, IN 47905 USA

Tel: (765) 449-5500

Fax: (765) 448-4614

Email: radian@radianresearch.com

Website: www.radianresearch.com

7.2 Routine Maintenance

The RS-933 Syntron Automated Calibration System requires the following routine maintenance:

Frequency	Activity
Before each use	• Ensure that the work area is clean and dry. • Ensure that the system power connection is secure and in good condition. • Ensure that the equipment is free from dust.
Yearly **Or as needed**	• Recalibrate and recertify the system. • Replace the cooling fan filters (see Section 3.7 in this manual).

7.3 Service

7.3.1 Service

The RS-933 Syntron Automated Calibration System is serviceable only by Radian Research, Inc.

WARNING

The RS-933 produces high voltages and is serviceable only by Radian Research, Inc. Attempts to service the equipment by unqualified personnel can result in personnel injury.

7.3.2 Warranty Service

Radian Research, Inc. warrants that each product is free from defects in material and workmanship. Our obligation under this warranty is to repair or replace any instrument or component therein that, within two years after shipment and with normal use, proves to be defective upon examination.

To Obtain Warranty Service

All warranty returns must have a return materials authorization (RMA) number. To obtain an RMA, visit www.radianresearch.com/forms/RMA/RMA-form.html.

Follow these guidelines to ensure prompt warranty service:

- Radian Research, Inc. must authorize all warranty replacements.
- Ship returned items prepaid, fully insured, and in the original packing to minimize the possibility of damage.
- Radian Research, Inc. will not accept collect shipments and does not accept liability for damage caused by improper packing or handling during shipment.
- Include in the shipment a detailed description of the problem and the events that led up to the development of the problem.
- Radian Research, Inc. will pay local domestic surface freight costs to return the product to the customer. Radian will not pay for overnight or express shipping service.

Use the following address for warranty returns:

Radian Research, Inc.
3852 Fortune Drive
Lafayette, IN 47905 USA
Attn: Service

7.3.3 After-Warranty Service

If after-warranty service by Radian Research, Inc. is needed:

- A purchase order is required.
- The owner must pay all shipping costs.
- If requested, Radian Research, Inc. can provide an estimate for the repair; however, if the repair is not made, the cost of labor required to obtain the estimate will be invoiced at the hourly repair rate.

To Obtain After-Warranty Service

All after-warranty service requests must have a return materials authorization (RMA) number. To obtain an RMA, visit www.radianresearch.com/forms/RMA/RMA-form.html. Payment information must also be provided (purchase order or credit card).

Please follow these guidelines to ensure prompt after-warranty service:

- Ship returned items prepaid, fully insured, and in the original packing to minimize the possibility of damage.

- Include in the shipment a detailed description of the problem and the events that led up to the development of the problem.
- Radian Research, Inc. will invoice return shipping costs to the customer.

7.4 Helpful Documentation and Resources

http://www.radianresearch.com/products/RS-933.php

http://www.radianresearch.com/brochures/RS-933.pdf