

Certifying a Radian RM-XX Series Reference Standard with the RS703 Laboratory Calibration System



Hardware and Software Requirements

1) RM-10, RM-11, RM-12, or RM-15 Reference Standard (Device Under Test - DUT's)

2)RS703 Automated Laboratory Test System

3)120V VAC Auxilliary Power Input Cable (Radian part no. 194015)

4) Insulated 4mm to Spade Adaptors (Radian part no.'s: 5300083 [black], 5300082 [red])

5) BNC-BNC Input Cable (Radian part no.'s RM-1C, RM-2C, RM-3C)

Any work with the RS-703A Automated Calibration System, RS-703A accessories, energized standards and energized meters can present the danger of electrical shock. The RS-703A and its accessories should be operated by qualified personnel. The information provided in this instruction set is intended to serve as a guide for properly qualified electric utility personnel. This instruction set is not intended to replace existing electric utility safety procedures and those listed in the Handbook for Electricity Metering.

Operation of the RS-703A should not be conducted if the work area is wet or damp. Operation should also not be conducted if flammable gases or fumes are present in the work area. When using the RS-703A never make voltage and current connections/disconnections when the system is live. For service or repairs to the RS-703A contact Radian Research, Inc. Do not attempt to service or make modifications to the RS-703A due to the risk of electrical shock.

Radian Research, Inc. assumes no liability for failure to comply with existing applicable safety precautions as well as those listed in this warning statement.



Hardware Setup

- 1. With the 703 System completely powered OFF, ensure the following:
 - a) the external potential (BNC and LEMO connectors) and current (locking connectors) cables are securely connected to the RS-733 front panel
 - b) the control PC's monitor, mouse, and keyboard are connected
 - c) the 703's main power cable is connected to the power source
- 2. Make all the necessary hardware connections, as shown in the diagram below.





Hardware Setup

2.a. Using a 120V VAC Auxilliary Power Input Cable and Insulated 4mm to Spade Adaptors, apply 120VAC to the DUT's auxiliary power input.

2.b. Using a BNC-BNC cable, connect the OUTPUT port of the DUT to channel one of the RS-740 front panel.

2.c. Using the External Potential Cable and Insulated 4mm to Spade Adaptors, connect the potential output to the DUT's potential input.

2.d. Using the External Current Cable, connect the current output to DUT's "B" current input.

3. Turn the system on by rotating the key switch 90° clockwise. The system will turn on and the cooling fan will start.

4. Turn on the computer by switching both the back and front power switches to the ON position.



Opening Application:

1. Open the 703 Control Software by double-clicking the application's icon, located on the computer's desktop. A pop-up screen will briefly flash on the screen, and a short delay will follow. The control application will then open and proceed with a self diagnostic routine.

2. Wait until the diagnostic routine is completely finished. The application opens with the *Channel Table* window open

🖾 RS-703A Control Program DEMO Mode	
Eile Edit View Iest Options Window Help	
🗷 Channel Table	
List Channel Device Type 1 2 3 2 3 2 3 3 4 5 6 7 6 7 9 11 12 13 14 15 16 Additional results: S/N or Ref 1 2 3 1 1 <t< th=""><th></th></t<>	
R2 None R3 None	
	CAPS NUM SCR. OVR



Associate DUT's to Channels:

1. Click on the Channel 1 selection box. A Select Device window will appear.

From this window, select the applicable device name. (If one does not exist for the DUT to be tested, select *New* - Follow the process for creating a new device, located in Appendix 1.) Select *OK*. This action will associate the specific device type with Channel 1.

🕰 RS-703A Control Program DEMO Mode	
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R Channel Table	
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1 RM-10-01	
	Edit
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5	
	Help
	Voltage Tap Changer
	Comm Connections:
	- Nellesh
Additional results: S/N or Ref 1 2 3 4 5 6	7 8 9 10 11 12 13 14
R1 None	
R2 None	
	CAPS NUM SCRL OVR



2. Re-click on the *Channel 1* selection box. The associated device's configuration card will be displayed. Ensure that the device is configured as follows:

Setup tab: Device Type: Standard Phases: Single phase Min Pulse Count: 100 Testing Method: Pulse Pulse Output Pullup: 150 Ohms (33ma) Standard Options: Ramp Rates (seconds): Up = 0.7, Down = 0.7

🖀 RS-703A Control Program DEMO Mode	
Ele Edit Yiew Iest Options Window Help	
🖪 Channel Table	
I Tap Phase Channel Device Type Serial Number 1 RD-20-102 Image: Phase	
2 DEVICES/RD-20-102	
Setup Ranges Functions	
5 Device Type Min Pulse Count Standard Options 6 Standard 100 High DC Sensitivi 8 Other Testing Method Run Autonull before te 9 Other Pulse Manu. 11 Phases Pulse Output Pulup Ramp Rates (seconds) 12 Single phase 10000 Nms (50 ua) None 13 Two phase 10000 Nms (50 ua) Down 0.7 15 Close Help Down 0.7 82 None Rone Rang None	
CAP	S NUM SCRL OVR



Ranges tab: Current Ranging: Auto Maximum Current: as specified by DUT's specifications Current Burden: 0.0 Voltage Ranging: Auto Maximum Voltage: as specified by DUT's specifications





Functions tab: Function: select functions applicable to DUT's supported measurement parameters Pulse Factor: 0.00001 Tolerance: as specified by DUT's specifications Measurement Modes: check Wye only

🗠 RS-703A Control Program DEMO Mode	
Eile Edit View Iest Options Window Help	
🖪 Channel Table	
I Tap Phase Channel Device Type Serial Number Changer A B C I Turns 1 RM-10-01 Image: Construction of the second	
2 DEVICESVRM-10-01	
3 Setup Ranges Functions	
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I6 Close Help Additional re R1 R2 None R3 None	
CAPS NUM	SCRL OVR



- Select *Close*. If prompted, save any unsaved changes.
 Enter the DUT's serial number.

🖾 RS-703A Control Program DEMO Mode	
Eile Edit View Iest Options Window Help	
🔣 Channel Table	
Later Channel Device Type Senial Number 1 RM-10-01 1234 2 3 6 7 16 17 18 19 10 10 11 12 13 14 15 16 16 17 18 19 10 11 12 13 14 15 16 16 17 18 19 10 10 11 12 13 14 15 16 17 18 19 10 11 12 13 14 15 16 17 18 19 10 11 12 13 14 15 16 17 18 19 11 11 12 13 14 15 15 16 17 18 19 11 11 11 12 13 14 15 15 16	
R3 None	
	CAPS NUM SCRL OVR

5. Ensure that *I Tap Changer* is unchecked, only *Phase A* is checked, and *I Turns* is set to 1.000.



Test Setup:

1. From the icon menu bar, select the Open a Test icon. A Open window will appear.

🖾 RS-703A Control Program DEMO Mode	
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Channel Open a Test	
Channel Device Type Serial Number Changer A B C I Turns	Close
2	Edit
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5	Uisconnect All
	Help
	Voltage Tap Changer
	Comm Connections:
	Refresh
Additional results: S/N or Ref 1 2 3 4 5 6 7 R1 None R2 None R3 None	8 9 10 11 12 13 14
-	
Open or create a test	

Ореп		
Test name:	Directories: Root	OK
Amp meter Meters NIST Padian Standarda	Radian Cal Tests RD-2x Tests	Cancel
RS-703A Certify SC Standards Volt meter		New
List Files of Type Test		Help



2. From this window, select *"Radian Standards"* from the list provided. Select *OK*. The selected *Test* window will appear, with the previously associated DUT's serial number listed on the right-hand tabs.

🖪 RS-703A Control P	rogram DEMO Mod	e			
<u>File Edit View Iest C</u>	ptions <u>W</u> indow <u>H</u> elp				
TESTS\Radian Sta	ndards Channel: 1	- RD-20-102 200123			
Degrees U.UUUU	-60.00000 0.00000	-60.00000 0.00000 -60.0000	0 0.00000 -60.00000	1-200123	
Tap Current	120.000 240.000	240.000 277.000 277.000	480.000 480.000		
A 0.500					
A 2.000					
A 4.000 A 5.000					
A 7.000					
A 15.000					
A 25.000					
A 30.000 A 35.000					
A 40.000 A 45.000					
A 50.000				ve	
Phase Func	ion Stabilizati	on Time Frequency	Voltage Wave Warm	Up Warm	
A Wh-Watt I	fours Net 6	60.000	Pure En vo	rmentel Cherob	
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Point Order Commo	utius Violena Tris Aug				
Default Consec	utive Currer Trim PF:	Doc Close	Help Bun Pause	Lack Skin	
				201	
					CAPS NUM SCRL OVR

3. This *Test screen* will include all the test points to be executed. Any of the Current, Voltage, and/or Phase values can be modified by clicking on that particular value.

1.000000								
All Phases								
	7	8	9					
	4	5	6	οĸ				
	1	2	3					
	0	+/-						
	<-B	kSp	Can	cel				
\diamondsuit No	ne	\diamond	2.0	\diamond	12.5			
\diamondsuit 0.1		\diamond	2.5	\diamond	15.0			
\diamondsuit 0.2		\diamond	3.0	\diamond	20.0			
\diamondsuit 0.2	5	\diamond	4.0	\diamondsuit	25.0			
\diamondsuit 0.3		\diamond	4.5	\diamond	30.0			
0.5		\diamond	5.0	\diamond	35.0			
\diamondsuit 0.7	5	\diamond	7.0	\diamond	40.0			
1.0		\diamond	10.0		45.0			
1.5		\diamond	12.0		50.0			

4. Ensure that the test options are configured as follows:

Phase: A Point Order: select per user's preference Function: Wh - Watt Hours Net A-B phase: 0.0 A-C phase: 0.0 Consecutive Voltage: unchecked Consecutive Current: unchecked Stabilization Time: select per user's preference Test Time: select per user's preference Frequency: 60.000 (US); 50.000 (International) Pulse Constant: 0.00001 Voltage Wave: Pure *see Appendix 3 Current Wave: Pure *see Appendix 3 Warm Up: unchecked



Running A Test

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



Saving, Veiwing, and Exporting Results Data

- 1. Once the test is complete, the resulting test data will automatically be saved in the 703's results database.
- 2. To view the results data, select the View test results icon. This will open a Report window.

RS-703A Control P	rogram DEM	O Mode		
Edit View Test (Options Window	Help		
.)			R	
Channel Table		View test results		
Channel Device Type	Serial Number	ITap Phase Changer A B C ITurns	Close	
1 RM-10-01	1234	1.000		
2	1	i ei eistel ^e i	Edit	
3	_)		Disconnect	
4				
5			Disconnect All	
6 1	T.		Help	
7.1			Voltage Tap Changer	
			Comm Connections:	
9	J			
10	J			
11				
12	_ <u></u>			
13	1			
14				
15			Refresh	
R1 None	S/N or Ref	1234 567	8 9 10 11 12 13 14	
R2 None		adda cada c		





2.a. From the *Serial Number* drop-down menu, select the desired serial number.

🖬 RS-703A Co	ntrol Program DEMO Mode		
Elle Edit Ylew			
B 1C5 TSVBad Degrees 0 10 0 10 10 11 0 12 0 13 0.01 14 0.01 15 0 16 0.01 17 0.01 18 0.01 19 0.01 10 10 <t< th=""><th>ian Standards Channel: 1 - RD-20-102 200123</th><th>1-200123</th><th></th></t<>	ian Standards Channel: 1 - RD-20-102 200123	1-200123	
← A ← B ← C Foint Crder Default	30		2
	Cluse Print	Graph	Help
			JUNES INOM JSURE JOVR

2.b. From the *Date* drop-down menu, select the desired date. The desired results data will appear.

Ele Edit ye	Control Pro w Iest Gol	tons <u>W</u> indo	EMO Mode w Help	₽_] (s R							(
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A 200 A 25.0 A 30.0 A 36.0 A 40.0 A 45.0 A 45.0	Ehose A Curr Trap A A A A	Current 0.500 1.000 2.000 3.000	Voltane Average -0.005	120.000 -0.005 -0.005	120.000	240.000	240.000	277 1100	277 (111	480 000	430.000		
Phase		5 000 7 000 10 000 15 000 20 000 25 000											
Point Order Default	 	35,000 40,000 45,000				Close		Print		raph	Ie		
											CAPS		



Saving, Veiwing, and Exporting Results Data

3. To export the data into an Excel spreadsheet, use the mouse to highlight the entire test results grid. Copy the data by simultaneously pressing the [Ctrl] key and the [C] key.

- 4. Open a new Microsoft Excel spreadsheet.
- 5. Paste the data by simultaneously pressing the [Ctrl] key and the [V] key.





- 1. To create a new test device, click on the *Channel 1* selection box.
- A *Select Device* window will appear.

RS-703A Control Program DEMO Mode	
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R Channel Table	
I Tap Phase Channel Device Type Serial Number Changer A B C I Turns 1 1 1 2 1 1 3 1 1 4 1 1 5 1 1 7 1 1 8 1 1 10 1 1 11 1 1 12 1 1 13 1 1 14 1 1 15 1 1 14 1 1 15 1 1 14 1 1 15 1 1 16 1 2 3 17 1 1 1 18 Nore 1 2 3 19 1 2 3 5 7 12 1 1 1 1 1 12 1 1 1 1 1 1 </th <th>Close Edit Disconnect Disconnect All Help Voltage Tap Changer am Connections:</th>	Close Edit Disconnect Disconnect All Help Voltage Tap Changer am Connections:
	CAPS NUM SCRL OVR

2. From this window, select the New button. A new device configuration window will appear.

Select Device		
Device name: Email_Q4 RD-20-001 RD-20-002 RD-20-032 RD-20-102 RD-20-103 RD-20-104	Directories: Radian Cal Devices Meters Radian Cal Devices Radian Standards Scientific Columbus	OK Cancel New
List Files of Type Device		Help



3. Ensure that the device is configured correctly:

Setup tab: Device Type: Standard Phases: Single phase Min Pulse Count: 100 Testing Method: Pulse Pulse Output Pullup: 150 Ohms (33ma) Standard Options: Ramp Rates (seconds): Up = 0.7, Down = 0.7





Ranges tab: Current Ranging: Auto Maximum Current: as specified by DUT's specifications Current Burden: 0.0 Voltage Ranging: Auto Maximum Voltage: as specified by DUT's specifications





Functions tab: Function: select functions applicable to DUT's supported measurement parameters Pulse Factor: 0.00001 Tolerance: as specified by DUT's specifications Measurement Modes: check Wye only

🕾 RS-703A Control Program DEMO Mode	
File Edit View Test Options Window Help	
🖪 Channel Table	
Channel Device Type Serial Number Changer A B C I Turns 1 RD-20-102 VV11.000 2 RDEVICESVRD-20-102	
4 Ectup Ranges Functions	
5 Function Puise Factor Toleranc 6 Wh 0.00001000000 0.0000 7 Wh 0.00001000000 0.0000 8 0.00001000000 0.0000 Integral VAR hours S0Hz fixed is an accumulating measurement of reactive aneugy. With his function they will be voltage as is integrated such that the voltage as is 30 degrees delayed from the VARh INT 50 10 VARh -0.000010000000 0.0000 11 VARh INT -0.000010000000 0.0000 12 VARh INT -0.000010000000 0.0000 13 VARh INT -0.000010000000 0.0000 14 VARh INT 50 With With With 13 VARh INT 60 VIth With With With 14 VARh INT 60 VIth With DELTA: DELTA DELTA 15 Integrate Integrate Integrate Integrate Integrate Integrate 16 Integrate Integrate Integrate Integrate Integrate Integrate 17 VARh INT 60 Integrate Integrate Integrate Inte	
	APS NUM SCRL OVR

4. Select Close. If prompted, save any unsaved changes.



Appendix 2: Options/Configure Menu

Result	Test	Hardware	Comm	Result]	Test) Hardw	vare	Com
Result Display Percent Error Percent Registra Correction Factor Measured Value Parts Per Million Calibration Value 	Resu sti r Print res Save re Save a Save e	It Digits sults at end of each tes sults to floppy at end of e ctual result values xpected result values	each te:	Test Sheet Style Standarc Poly Variable Phase Relationships AB-BC AB-A	Point Ord Col (down Col (alway Rov Time Out Multip	ter i/up vs down	Phase Vie Lead/la Degree: Radians Averag Mean Root-Sur	e s s s s s
lesult File Delimiter Comma <u> </u>	ompany Name: Ra	dian Research Inc. ancel	Help	Pause at the end	l of each te	incel		Help

This screen allows the user to select how the resulting data will be displayed, the file type, the number of significant digits in the results data, and the company name.

This screen allows the user to select the type of test (standard and polyvariable), the phase relationships, the test point order, the time-out delay, the power factor display, and the averaging method.



Appendix 2: Options/Configure Menu

Configuration	
Result	Test Hardware Comm
Active Phases	Optional Equipment Tap Changers Meter Adapter Env. Chamber Chamber Type Wattlow Chamber Com Port: Com 1 ▼ Chamber 3 KR-CF RR-CF RR-CR Com Port: Com 2 ▼
ок	Cancel Help

Result Test	Hardware Comm
Comm Enable mmunication cable types RM-PCA Rev 1 cable RM-PCA Rev 2 cable RD-xx Direct MTE Direct	Select Com Ports Com 1 Com 8 Com 15 Com 2 Com 9 Com 16 Com 3 Com 10 Com 17 Com 4 Com 11 Com 18 Com 5 Com 12 Com 20
M-PCA Rev 1 cable M-PCA Rev 2 cable D-xx Direct TE Direct mmunications Loop Testing Communications	Com 3 Com 10 Com 17 Com 4 Com 11 Com 18 Com 5 Com 12 Com 19 Com 6 Com 13 Com 20 Com 7 Com 14

This screen allows the user to select the active phases and configure a temperature chamber control.

This screen allows the user to configure the serial communications to the devices under test.



Appendix 3: Creating Voltage and Current Signals with Harmonic Content

1. Click on the Open a Wave icon. A Open window will appear.

Channel Table	Open a Wave		
Channel Device Type 1 2 3 3 5 6 7 8 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	Serial Number	I Tap Phase Changer A B C I Tuns	Close Edit Disconnect Disconnect Al Help Vollage Tap Changer Comm Connections:
9 10 11 12 13 14			Befresh
16 Additional results: R1 None R2 None R3 None	S/N or Ref 1		8 9 10 11 12 13 14

Wave name:	Directories: Radian Production	OK
Pure		Cancel
		Nev
ist Files of Tune		



Appendix 3: Creating Voltage and Current Signals with Harmonic Content

2. Select the New button. A new Wave configuration window will appear.





Appendix 3: Creating Voltage and Current Signals with Harmonic Content

3. Enter the harmonic amplitude and phase parameters. The displayed waveform will change accordingly. Select the *Close* button and save changes when prompted.

🗈 RS-703A Control Program DEMO Mode	
Elle Edit View Iest Options Window Help	
Channel Table	
2 3 Harm Active Anneliude Phase 1 4 000000 0 1 5 4 0.00000 0 6 5 0.00000 0 7 0.00000 0 8 0.00000 0 9 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.00000 0 1 1 0.000000 0	
	CAPS NUM SCRL OVR