

# Certificate of Calibration

Manufacturer **Radian Research, Inc.**  
Instrument Model: **RD-22-332 Dytronic Portable Standard**  
Serial Number 207410  
Firmware Revision: 07.10.35  
Error Specification .01% worst case



**Quality Management System  
ISO 9001 Certified**

Customer Name:  
Address:

P.O. Number: **Environmental Conditions**  
CE Number: Temperature: 23°C +/- 2°C  
RMA / Certificate Number: Humidity: between 35% and 60%  
Calibration Date: 12-Dec-13  
Based on the recommended calibration interval, the next calibration is due on: 12-Dec-14

**Radian Research's As-Found Test Results showed this Instrument to be:**

New  In Tolerance  Out of Tolerance  Inoperative  Limited Calibration  
For Out of Tolerance conditions, As-Found Data Reports are furnished.

Radian Research Inc. certifies the instrument listed above meets or exceeds all published specifications and was calibrated in compliance with ANSI/NCSL Z540-1 using applicable Radian Research procedures which meet the requirements of ISO 9001:2008. This instrument was calibrated by a Radian Research RS-703A Syntron Automated Calibration System which is traceable to the National Institute of Standards and Technology (NIST). The RS-703A Calibration System is traceable within the limitations of NIST's services, by accuracies derived from accepted values of natural physical constants, or by accuracies derived from accepted ratio type calibration techniques. The RS-703A Calibration System is cross checked and calibrated on a schedule which is adjusted to maintain required accuracies and traceability.

Procedure used for Calibration: 9912165  
Software used for Calibration: RS-703A Control Program Rel.04.30.03 Release Apr 6, 2010  
RS-703A serial numbers: 703143, 703144, 703146

***Applicable Traceability & Report Numbers for References used by Radian's Metrology Lab:***

**Watt-hour, VA-hour, VAR-hour, Q-hour, Amp-hour,  
Volt-hour, Volt-Squared hour, AC Volt**

Master Reference Bank consisting of (3) RD-22-RTS  
Serial Numbers: 200717, 200718, 200719, Calibration Due Date: 31-July-14  
Traceable to (3) RD-22-RTS SN's 202098, 202099, 202100 calibrated by NIST

**Time Base (Frequency)**

Arbiter Systems Model 1083B Satellite-Controlled Frequency Standard s/n B1057. GPS controlled system with an uncertainty of 0.000002ppm. No calibration required.

**DC Volts**

Fluke Model 732B DC Volt Standard s/n 7703004 with an uncertainty of  $\pm .1$ ppm.  
Fluke Certificate Number 11D5460; Calibration Due Date: 10-Aug-2014.

**Resistance**

Guilidine Standard Resistor Model 9330/10K s/n 62623, 62624 with an Expanded Uncertainty of  $\pm .320$ ppm.  
Test Certificate GCS14711, GCS14712. Calibration Due Dates: 23-Aug-2014.

**Other**

Hewlett Packard 8 Digit Multi-Meter Model 3458A s/n 2823A02816. Agilent Technologies  
Test Certificate Number 58602: Calibration Due Date 5-May-2014.

**Metrology Laboratory Technician Signature**

 **LAB  
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in full, without prior written approval of the  
Calibration Facility*

## Certificate of Calibration

Manufacturer **Radian Research, Inc.**  
Instrument Model: **RD-22-332 Dytronic Portable Standard**  
Serial Number 207410  
Firmware Revision: 07.10.35  
Error Specification .01% worst case



**Quality Management System  
ISO 9001 Certified**

Customer Name:  
Address:

P.O. Number:  
CE Number:  
RMA Number:

Calibration Date: 12-Dec-13  
Based on the recommended calibration interval, the next calibration is due on: 12-Dec-14

**Our As Found Test Results showed your instrument was:**

New  In Tolerance  Out of Tolerance  Inoperative  Limited Calibration

For out of tolerance conditions, As found Data Reports are furnished.

Radian Research recommends a 12 month Calibration interval for Standards.

Procedure used for Calibration: 9912165

**Applicable Traceability & Report Numbers for Radian Research Primary References:**

**DC Volts**

Fluke Model 732B DC Volt Standard s/n 7703004 with an uncertainty of  $\pm .1$ ppm.  
Fluke Certificate Number 11D5460; Calibration Due Date: 10-Aug-2014.

**DC Voltage Switch**

High Precision Devices Model 98113  
S/N:024

**Resistance**

Guildline Standard Resistor Model 9330/10K s/n 62623, 62624 with an Expanded Uncertainty of  $\pm .320$ ppm.  
Test Certificate C13947, C13948. Calibration Due Date:23-August-2014

**Time Base (Frequency)**

-Arbiter Systems Model 1083B Satellite-Controlled Frequency Standard s/n B1057. GPS controlled system with an uncertainty of 0.000002ppm. No calibration required.

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Technician Signature

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# Calibration Report

## RD-22-332 Dytronic Portable Standard

Mode..... DC Voltage  
Date..... 12-Dec-13  
Serial Number..... 207410

The following data was collected by comparing the device under test to the voltage of the Fluke DC Standard, Model 732B-100 using the Radian Research Model RR-TAD. Calibration temperature is 23 degrees Centigrade. Test time is 10 seconds per point with ten points taken and averaged. Voltage was reversed using the High Precision Devices Model 98113 Voltage Switch.

Reference Voltage            10.0000107    Volts

### DC Voltage

	Measured Volts	Error PPM	Std. Dev
<b>Volts</b>			
<b>10.00</b>	9.99997795	3.27	0.04
<b>0.00</b>	-0.00000184		
<b>-10.00</b>	-10.00004280	-3.21	0.09

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Mode..... DC Current  
Date..... 12-Dec-13  
Serial Number..... 207410

The following data was collected by comparing the device under test to the voltage of the Fluke DC Standard Model 732B-100 and Guildline Model 9330-10K Standard Resistors using the Radian Research Reference Converter Model RR-TAD. Calibration temperature is 23 degrees Centigrade. Test time is 10 seconds per point with ten points taken and averaged. Polarity was reversed using the High Precision Devices Model 98113 Voltage Switch.

Reference Voltage            10.00001070 Volts  
Reference Resistor a        10000.183 Ohms  
Reference Resistor b        10000.216 Ohms  
Reference Current Ia        0.99998277 mA  
Reference Current Ib        0.99997947 mA

### DC Current

Current	Measured Current mA	Error PPM	Std. Dev
+Ia	0.99998922	6.45	StdDev
+Ib	0.99998592	6.45	0.07
+(Ia + Ib)	1.99996868	3.22	0.03
0			
-Ia	-0.99998505	2.28	0.03
-Ib	-0.99998149	2.02	0.00
-(Ia + Ib)	-1.99996468	1.22	0.05

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Function..... Watt-hour 60 Hz

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A watt-hour calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards certified by the National Institute of Standards and Technology (NIST) to an uncertainty of 0.002% @ unity and 0.003% @ 60 degrees lagging Power Factor. Calibration temperature is 23 degrees Centigrade. The test time is 5 seconds and the stabilization time in between points is 5 seconds. For lagging power factors the current lags the voltage. All results are listed in Parts Per Million. The RS-703A has at least a 4 times greater accuracy than the Instrument under test.

### Voltage & Phase Angle

Amps	120	120	240	240	480	480	600	600
	Unity	60°Lag	Unity	60°Lag	Unity	60°Lag	Unity	60°Lag
0.2	5.36	-0.79	5.58	-0.45	1.67	-6.60	6.79	0.53
0.25	-1.53	-4.03	-1.35	-4.74	-4.21	-10.02	2.43	-2.22
0.3	5.73	-0.68	5.73	-1.20	2.53	-5.97	10.01	2.80
0.5	3.66	0.26	4.46	-0.27	0.98	-6.09	7.86	3.50
1.0	0.62	-3.14	0.71	-3.05	-2.42	-9.13	4.43	-0.01
2.0	5.18	1.33	5.27	1.16	2.14	-4.39	9.15	4.43
2.5	5.50	1.93	5.57	1.28	2.28	-4.01	9.75	4.94
3.0	13.70	8.10	13.82	7.62	10.72	2.32	15.49	9.29
4.0	7.50	4.64	7.41	4.37	4.55	-0.99	11.37	7.65
5.0	4.07	-0.15	3.93	-0.51	0.92	-6.01	8.26	3.00
7.0	2.85	0.10	2.85	-0.01	-0.52	-5.52	6.19	2.10
10.0	0.35	-3.37	0.28	-3.51	-2.72	-8.80	4.83	-0.32
15.0	5.00	4.62	4.91	4.33	1.85	-1.29	8.80	6.74
20.0	2.57	-0.29	2.64	-0.65	-0.58	-6.16	7.23	2.65
25.0	14.33	10.21	14.10	10.21	11.12	4.71	16.00	11.70
30.0	13.30	11.96	13.01	11.96	9.96	6.72	17.04	14.90
35.0	7.49	5.21	7.33	4.71	4.22	-0.44	11.70	8.36
40.0	3.78	0.07	3.21	-0.44	0.49	-5.80	8.03	3.00
45.0	5.60	1.79	5.10	1.54	2.23	-3.87	7.68	3.51
50.0	1.40	-15.54	0.94	-16.23	-2.04	-21.38	3.09	-14.58
60.0	-0.63	-14.93	-1.01	-15.41	-3.87	-20.94	3.30	-12.57
80.0	1.08	-2.99	1.58	-2.13	-0.99	-6.71	6.86	2.40
100.0	-2.57	-0.62	-2.11	0.98	-4.51	-3.60	0.55	4.30
120.0	-4.64	3.79	-4.09	5.62	-6.47	1.59	1.33	10.05
150.0	-4.78	1.47	-4.02	3.91	-6.31	0.10	1.41	8.98
180.0	-4.50	0.90	-3.49	3.32	-5.65	-0.05	-0.26	7.88
200.0	-4.18	-0.17	-3.26	2.23	-5.44	-1.20	-0.17	6.33
<b>Average</b>	<b>3.19</b>	<b>0.36</b>	<b>3.30</b>	<b>0.54</b>	<b>0.37</b>	<b>-4.58</b>	<b>7.01</b>	<b>3.68</b>
<b>Minimum</b>	-4.78	-15.54	-4.09	-16.23	-6.47	-21.38	-0.26	-14.58
<b>Maximum</b>	14.33	11.96	14.10	11.96	11.12	6.72	17.04	14.90

<b>Overall</b>	<b>Unity</b>	<b>60°Lag</b>
<b>Average</b>	3.47	0.00
<b>Minimum</b>	-6.47	-21.38
<b>Maximum</b>	17.04	14.90

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Function..... Watts      60 Hz

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A Watt calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards certified by the National Institute of Standards and Technology (NIST) to an uncertainty of 0.002% @ unity and 0.003% @ 60 degrees lagging Power Factor. Calibration temperature is 23 degrees Centigrade. The test time is 5 seconds and the stabilization time in between points is 5 seconds. For lagging power factors the current lags the voltage. All results are listed in Parts Per Million. The RS-703A has at least a 4 times greater accuracy than the Instrument under test.

### Voltage & Phase Angle

Amps	120	120	240	240	480	480	600	600
	Unity	60°Lag	Unity	60°Lag	Unity	60°Lag	Unity	60°Lag
0.2	5.36	-0.03	6.35	1.00	1.89	-5.54	6.45	0.78
0.25	-0.68	-4.17	-1.06	-4.05	-3.97	-9.87	2.21	-2.92
0.3	5.78	0.08	4.81	-1.30	2.50	-6.41	9.83	3.16
0.5	3.96	0.31	4.28	-0.04	1.20	-5.98	7.71	3.47
1.0	0.68	-2.77	1.06	-2.84	-2.15	-8.82	4.98	-0.32
2.0	5.44	1.32	5.48	0.81	2.34	-4.23	9.02	4.45
2.5	5.33	1.54	5.56	1.28	1.96	-4.07	9.69	4.92
3.0	13.68	8.11	13.94	7.86	10.62	2.23	15.51	9.96
4.0	7.55	4.67	7.54	4.35	4.67	-0.92	11.36	7.54
5.0	4.09	-0.42	3.93	-0.62	0.99	-5.91	8.19	2.82
7.0	3.09	-0.05	2.52	0.17	-0.62	-5.41	6.29	2.41
10.0	1.13	-3.19	0.74	-2.90	-2.29	-8.46	5.21	-0.02
15.0	4.47	4.32	4.33	3.61	1.36	-1.68	8.45	6.29
20.0	2.57	-0.11	2.82	-0.39	-0.13	-5.95	7.60	3.00
25.0	14.69	10.25	14.61	10.19	11.54	4.94	16.24	11.98
30.0	13.11	12.18	12.66	11.57	9.47	6.47	16.70	14.27
35.0	7.77	5.35	7.31	4.94	4.23	-0.39	11.89	8.65
40.0	3.88	0.28	3.14	-0.17	0.55	-5.71	8.02	3.25
45.0	5.36	1.75	4.95	1.18	1.93	-3.96	7.44	3.36
50.0	1.34	-15.18	0.86	-15.92	-1.75	-21.25	3.32	-14.55
60.0	-0.54	-14.65	-0.86	-15.39	-3.84	-21.00	3.27	-12.98
80.0	1.13	-2.99	1.59	-1.93	-0.97	-6.51	6.78	2.31
100.0	-2.56	-1.03	-1.91	0.78	-4.31	-3.22	0.76	4.65
120.0	-4.85	3.78	-3.91	5.64	-6.32	1.68	1.26	9.77
150.0	-4.64	1.29	-4.18	3.88	-6.33	-0.04	1.49	9.05
180.0	-4.53	0.68	-3.66	3.45	-5.75	-0.07	-0.29	8.00
200.0	-4.45	-0.17	-3.31	2.23	-5.38	-0.88	-0.17	6.65
<b>Average</b>	<b>3.27</b>	<b>0.41</b>	<b>3.32</b>	<b>0.64</b>	<b>0.42</b>	<b>-4.48</b>	<b>7.01</b>	<b>3.70</b>
<b>Minimum</b>	-4.85	-15.18	-4.18	-15.92	-6.33	-21.25	-0.29	-14.55
<b>Maximum</b>	14.69	12.18	14.61	11.57	11.54	6.47	16.70	14.27

<b>Overall</b>	<b>Unity</b>	<b>60°Lag</b>
<b>Average</b>	3.50	0.07
<b>Minimum</b>	-6.33	-21.25
<b>Maximum</b>	16.70	14.27

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Function..... VAR-hour 60 Hz

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A VAR-hour calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards certified by the National Institute of Standards and Technology (NIST) with the use of an ultra low distortion synthesis and digital delay. Uncertainty is 0.005% for VAR-hour. Calibration temperature is 23 degrees Centigrade. Test time is 5 seconds and the stabilization time in between points is 5 seconds. For lagging power factors the current lags the voltage. All results are listed in Parts Per Million. The RS-703A has at least a 4 times greater accuracy than the Instrument under test.

### Voltage & Phase Angle

Amps	120		240		480		600	
	90°Lag	30°Lag	90°Lag	30°Lag	90°Lag	30°Lag	90°Lag	30°Lag
0.2	-4.03	8.71	-4.03	9.61	-7.94	7.93	-2.42	9.38
0.25	-8.50	4.11	-9.13	3.30	-11.90	3.21	-8.30	6.22
0.3	-4.10	11.17	-3.88	11.99	-6.94	9.53	-0.60	14.18
0.5	-3.49	9.92	-3.31	9.83	-6.62	9.29	-1.51	13.66
1.0	-6.89	7.33	-6.62	7.24	-9.48	5.98	-4.01	11.65
2.0	-2.15	11.35	-1.79	12.51	-5.01	10.45	0.57	16.73
2.5	-3.08	12.30	-3.08	12.87	-5.87	10.94	1.51	16.27
3.0	5.36	21.57	5.24	22.29	2.56	21.57	8.91	25.98
4.0	0.62	13.14	0.35	13.76	-2.51	13.05	3.14	18.23
5.0	-4.30	11.01	-4.37	12.30	-7.30	10.79	0.25	15.70
7.0	-4.40	7.86	-4.30	9.70	-7.16	7.86	-1.58	14.20
10.0	-8.23	7.29	-8.23	8.86	-10.74	7.65	-3.64	12.38
15.0	-2.53	8.53	-2.34	9.86	-5.01	8.62	0.25	14.82
20.0	-6.01	9.86	-6.01	10.58	-8.59	9.65	-1.24	14.21
25.0	5.29	20.62	5.52	21.31	2.77	20.51	9.22	24.88
30.0	5.48	17.78	5.67	18.54	3.28	17.68	8.64	23.14
35.0	-1.50	13.13	-1.17	13.87	-3.95	13.05	3.06	18.56
40.0	-5.51	11.37	-5.37	12.08	-8.02	11.01	-0.44	15.82
45.0	-3.36	12.79	-3.17	13.49	-5.78	12.66	1.07	16.73
50.0	-7.87	20.97	-7.53	21.42	-10.16	20.74	-3.78	25.79
60.0	-8.35	17.59	-7.87	18.45	-10.74	17.49	-5.32	23.29
80.0	-6.64	6.73	-6.07	7.81	-8.93	7.66	-1.38	12.13
100.0	-9.89	-5.54	-9.32	-4.05	-11.72	-3.71	-5.22	0.36
120.0	-10.22	-10.04	-9.67	-8.21	-12.05	-7.93	-6.43	-2.69
150.0	-11.65	-9.29	-10.81	-7.84	-13.18	-7.23	-5.61	-2.43
180.0	-11.31	-9.46	-10.61	-7.81	-12.83	-7.05	-5.85	-3.00
200.0	-10.93	-9.44	-10.36	-6.92	-12.42	-6.35	-5.85	-2.19
<b>Average</b>	<b>-4.75</b>	<b>8.20</b>	<b>-4.53</b>	<b>9.14</b>	<b>-7.27</b>	<b>8.34</b>	<b>-0.98</b>	<b>13.11</b>
<b>Minimum</b>	-11.65	-10.04	-10.81	-8.21	-13.18	-7.93	-8.30	-3.00
<b>Maximum</b>	5.48	21.57	5.67	22.29	3.28	21.57	9.22	25.98

<u>Overall</u>	90°Lag	30°Lag
<b>Average</b>	-4.38	9.70
<b>Minimum</b>	-13.18	-10.04
<b>Maximum</b>	9.22	25.98

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Function..... VAR      60 Hz

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A VAR calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards certified by the National Institute of Standards and Technology (NIST) with the use of an ultra low distortion synthesis and digital delay. Uncertainty is 0.005% for VAR-hour. Calibration temperature is 23 degrees Centigrade. Test time is 5 seconds and the stabilization time in between points is 5 seconds. For lagging power factors the current lags the voltage. All results are listed in Parts Per Million. The RS-703A has at least a 4 times greater accuracy than the Instrument under test.

### Voltage & Phase Angle

Amps	120		240		480		600	
	90°Lag	30°Lag	90°Lag	30°Lag	90°Lag	30°Lag	90°Lag	30°Lag
0.2	-4.62	9.21	-4.07	8.00	-8.07	9.53	-2.92	9.56
0.25	-9.34	4.15	-9.44	2.61	-12.11	3.81	-8.33	5.48
0.3	-4.16	11.46	-3.76	10.68	-6.65	9.84	0.39	13.56
0.5	-2.96	10.01	-3.05	11.00	-6.68	8.96	-1.31	13.47
1.0	-6.83	6.45	-6.33	7.64	-9.15	6.28	-3.90	11.80
2.0	-1.81	11.59	-1.92	12.25	-4.92	11.21	0.65	17.06
2.5	-3.00	12.35	-2.95	12.61	-6.10	10.62	1.34	16.41
3.0	5.37	21.71	5.17	23.23	2.64	21.69	8.90	25.98
4.0	0.54	13.16	0.25	14.20	-2.30	12.63	3.03	18.32
5.0	-4.32	10.69	-4.43	12.27	-7.15	10.49	0.32	15.82
7.0	-4.55	8.16	-4.64	8.90	-7.15	8.44	-1.32	13.63
10.0	-7.67	7.76	-8.09	8.98	-10.36	8.52	-2.70	11.96
15.0	-2.78	8.35	-2.73	9.74	-5.75	8.24	-0.19	13.35
20.0	-6.01	9.00	-5.63	10.81	-8.27	9.88	-1.16	14.72
25.0	5.39	20.42	5.73	21.79	2.77	20.37	9.47	24.93
30.0	5.21	17.39	5.50	17.94	2.83	17.58	8.04	22.24
35.0	-1.66	13.85	-0.96	14.05	-3.63	13.01	3.13	18.75
40.0	-5.38	11.23	-5.10	12.26	-7.41	11.23	-0.25	15.84
45.0	-3.68	12.57	-3.31	13.17	-6.23	12.29	0.90	16.30
50.0	-7.71	21.34	-7.36	21.74	-9.80	20.81	-3.55	25.57
60.0	-8.40	18.37	-7.90	18.34	-10.66	17.51	-5.05	23.42
80.0	-6.33	7.15	-5.90	7.79	-8.53	8.23	-1.02	12.56
100.0	-9.88	-5.50	-9.25	-4.09	-11.63	-3.84	-5.16	0.33
120.0	-10.43	-10.33	-9.98	-8.67	-12.06	-8.22	-6.71	-3.21
150.0	-11.57	-9.81	-10.88	-7.55	-13.29	-7.49	-5.56	-2.03
180.0	-11.27	-9.89	-10.62	-7.69	-12.79	-7.67	-5.79	-3.97
200.0	-10.85	-8.83	-10.25	-7.23	-12.54	-5.37	-5.81	-2.36
<b>Average</b>	<b>-4.77</b>	<b>8.22</b>	<b>-4.51</b>	<b>9.07</b>	<b>-7.22</b>	<b>8.47</b>	<b>-0.91</b>	<b>12.94</b>
<b>Minimum</b>	<b>-11.57</b>	<b>-10.33</b>	<b>-10.88</b>	<b>-8.67</b>	<b>-13.29</b>	<b>-8.22</b>	<b>-8.33</b>	<b>-3.97</b>
<b>Maximum</b>	<b>5.39</b>	<b>21.71</b>	<b>5.73</b>	<b>23.23</b>	<b>2.83</b>	<b>21.69</b>	<b>9.47</b>	<b>25.98</b>

<b>Overall</b>	<b>90°Lag</b>	<b>30°Lag</b>
<b>Average</b>	-4.35	9.67
<b>Minimum</b>	-13.29	-10.33
<b>Maximum</b>	9.47	25.98



# Calibration Report

## RD-22-332 Dytronic Portable Standard

Function.....VA-hour RMS 60 Hz

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A VA-hour calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards certified by the National Institute of Standards and Technology (NIST) to an uncertainty of 0.002% @ unity and 0.003% @ 60 degrees lagging Power Factor. Calibration temperature is 23 degrees Centigrade. The test time is 5 seconds and the stabilization time in between points is 5 seconds. For lagging power factors the current lags the voltage. All results are listed in Parts Per Million. The RS-703A has at least a 4 times greater accuracy than the Instrument under test.

### Voltage & Phase Angle

Amps	120	120	240	240	480	480	600	600
	Unity	60°Lag	Unity	60°Lag	Unity	60°Lag	Unity	60°Lag
0.2	4.35	-2.13	4.69	-2.35	0.66	-8.84	8.13	-2.69
0.25	-1.62	-6.44	-1.44	-6.18	-4.21	-12.17	2.28	-5.87
0.3	5.58	-0.90	5.66	-0.23	2.45	-5.82	9.89	0.47
0.5	3.39	-1.08	4.29	-0.54	0.80	-5.37	7.65	1.57
1.0	0.44	-4.12	0.44	-3.40	-2.69	-7.52	4.21	-0.44
2.0	4.91	0.44	5.09	1.25	1.87	-2.42	8.86	4.79
2.5	4.36	0.49	4.50	1.14	1.21	-2.37	8.72	4.60
3.0	12.15	8.34	12.39	9.05	9.41	5.48	16.44	12.34
4.0	7.33	3.03	7.15	3.75	4.29	0.26	11.08	7.29
5.0	3.00	-0.58	2.78	-0.08	-0.22	-3.65	7.12	3.46
7.0	2.96	-1.44	2.96	-0.82	-0.41	-4.30	6.68	2.83
10.0	-0.72	-4.08	-0.86	-3.37	-3.87	-6.73	3.80	0.25
15.0	4.81	0.80	4.71	1.47	1.57	-2.06	8.57	5.06
20.0	1.42	-1.72	1.50	-1.08	-1.65	-4.51	6.09	2.43
25.0	12.84	8.61	12.73	9.41	9.64	6.09	16.91	13.07
30.0	13.11	8.82	12.82	9.67	9.77	6.34	16.88	13.37
35.0	7.33	3.32	7.09	3.90	3.98	0.71	11.43	7.58
40.0	2.64	-1.01	2.07	-0.29	-0.65	-3.73	7.00	3.23
45.0	4.08	0.45	3.57	1.34	0.71	-2.09	8.39	4.93
50.0	0.02	-4.10	-0.44	-3.41	-3.41	-6.84	4.01	0.25
60.0	-0.91	-4.54	-1.29	-4.06	-4.06	-7.40	3.07	-0.21
80.0	-0.06	-2.92	0.51	-1.85	-2.13	-4.78	5.72	2.51
100.0	-3.94	-7.26	-3.60	-6.00	-5.88	-8.97	1.55	-1.65
120.0	-4.91	-7.38	-4.27	-5.73	-6.74	-8.30	1.11	-1.08
150.0	-5.01	-8.52	-4.17	-6.92	-6.46	-9.51	1.17	-2.43
180.0	-5.97	-8.95	-4.95	-7.30	-7.11	-9.72	0.45	-2.50
200.0	-5.66	-8.53	-4.75	-6.81	-6.81	-9.10	0.74	-1.82
<b>Average</b>	<b>2.44</b>	<b>-1.53</b>	<b>2.56</b>	<b>-0.72</b>	<b>-0.37</b>	<b>-4.35</b>	<b>6.96</b>	<b>2.64</b>
<b>Minimum</b>	-5.97	-8.95	-4.95	-7.30	-7.11	-12.17	0.45	-5.87
<b>Maximum</b>	13.11	8.82	12.82	9.67	9.77	6.34	16.91	13.37

<b>Overall</b>	<b>Unity</b>	<b>60°Lag</b>
<b>Average</b>	2.90	-0.99
<b>Minimum</b>	-7.11	-12.17
<b>Maximum</b>	16.91	13.37

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Function..... VA RMS 60 Hz

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A VA calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards certified by the National Institute of Standards and Technology (NIST) to an uncertainty of 0.002% @ unity and 0.003% @ 60 degrees lagging Power Factor. Calibration temperature is 23 degrees Centigrade. The test time is 5 seconds and the stabilization time in between points is 5 seconds. For lagging power factors the current lags the voltage. All results are listed in Parts Per Million. The RS-703A has at least a 4 times greater accuracy than the Instrument under test.

### Voltage & Phase Angle

Amps	120	120	240	240	480	480	600	600
	Unity	60°Lag	Unity	60°Lag	Unity	60°Lag	Unity	60°Lag
0.2	4.38	-2.28	5.36	-2.27	0.86	-8.21	7.76	-2.77
0.25	-0.80	-6.87	-1.13	-5.54	-4.01	-11.59	2.06	-6.00
0.3	5.63	-0.44	4.76	-0.64	2.37	-5.92	9.70	0.95
0.5	3.77	-1.09	4.10	-0.70	0.98	-5.28	7.45	1.87
1.0	0.44	-4.01	0.79	-3.21	-2.38	-7.36	4.74	-0.38
2.0	5.16	0.41	5.22	1.25	2.10	-2.28	8.74	4.72
2.5	4.23	0.31	4.44	1.00	0.84	-2.54	8.60	4.36
3.0	12.19	8.40	12.50	9.24	9.20	5.53	16.47	12.67
4.0	7.30	3.10	7.32	3.85	4.44	0.27	11.08	7.31
5.0	3.01	-0.65	2.78	-0.11	-0.17	-3.64	7.08	3.38
7.0	3.24	-1.48	2.64	-0.83	-0.45	-4.26	6.74	2.94
10.0	0.04	-3.83	-0.43	-2.75	-3.36	-6.29	4.12	0.66
15.0	4.24	0.26	4.08	0.79	1.11	-2.40	8.23	4.35
20.0	1.46	-1.63	1.63	-0.89	-1.23	-4.25	6.50	2.87
25.0	13.29	8.68	13.18	9.55	10.14	6.32	17.21	13.21
30.0	12.84	9.10	12.41	9.16	9.23	6.05	16.55	12.89
35.0	7.60	3.50	7.11	4.10	4.07	0.81	11.63	7.85
40.0	2.76	-0.79	2.03	-0.10	-0.60	-3.64	6.94	3.48
45.0	3.85	0.32	3.46	0.99	0.42	-2.29	8.14	4.71
50.0	-0.06	-4.00	-0.53	-3.13	-3.15	-6.61	4.26	0.31
60.0	-0.80	-4.51	-1.14	-4.09	-4.07	-7.49	3.08	-0.43
80.0	0.04	-2.77	0.46	-1.72	-2.09	-4.67	5.71	2.62
100.0	-4.01	-7.36	-3.36	-6.02	-5.70	-8.80	1.70	-1.55
120.0	-5.10	-7.32	-4.11	-5.75	-6.54	-8.35	1.04	-1.22
150.0	-4.83	-8.56	-4.38	-6.97	-6.52	-9.55	1.22	-2.39
180.0	-6.02	-9.06	-5.17	-7.26	-7.26	-9.81	0.39	-2.51
200.0	-5.86	-8.50	-4.75	-6.83	-6.82	-9.04	0.77	-1.71
<b>Average</b>	<b>2.52</b>	<b>-1.52</b>	<b>2.57</b>	<b>-0.70</b>	<b>-0.32</b>	<b>-4.27</b>	<b>6.96</b>	<b>2.67</b>
<b>Minimum</b>	-6.02	-9.06	-5.17	-7.26	-7.26	-11.59	0.39	-6.00
<b>Maximum</b>	13.29	9.10	13.18	9.55	10.14	6.32	17.21	13.21

<b>Overall</b>	<b>Unity</b>	<b>60°Lag</b>
<b>Average</b>	2.93	-0.95
<b>Minimum</b>	-7.26	-11.59
<b>Maximum</b>	17.21	13.21

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Function..... Q-hour    60 Hz

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A Q-hour calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards certified by the National Institute of Standards and Technology (NIST) with the use of an ultra low distortion synthesis and digital delay. Uncertainty is 0.005% for Q-hour. Calibration temperature is 23 degrees Centigrade. Test time is 5 seconds and the stabilization time in between points is 5 seconds. For lagging power factors the current lags the voltage. All results are listed in Parts Per Million. The RS-703A has at least a 4 times greater accuracy than the Instrument under test.

### Voltage & Phase Angle

Amps	120	120	240	240	480	480	600	600
	60°Lag	Unity	60°Lag	Unity	60°Lag	Unity	60°Lag	Unity
0.2	-1.57	11.73	-1.79	10.83	-8.16	3.01	-2.78	2.85
0.25	-5.64	4.82	-5.46	2.68	-11.45	-1.79	-5.59	0.42
0.3	0.29	13.33	1.04	13.18	-4.55	7.89	0.29	11.68
0.5	-0.10	10.10	0.35	11.53	-4.57	8.04	2.07	12.51
1.0	-3.22	8.22	-2.51	9.02	-6.71	6.70	-0.01	11.29
2.0	1.25	13.32	2.05	13.94	-1.53	12.42	5.14	17.30
2.5	1.71	13.94	2.43	14.30	-1.08	12.80	4.49	17.99
3.0	8.58	23.60	9.41	24.31	5.84	22.88	12.53	25.70
4.0	4.02	14.92	4.73	15.37	1.25	14.66	7.79	19.16
5.0	0.92	12.80	1.21	13.51	-2.44	12.30	3.23	17.07
7.0	-0.72	10.21	-0.01	10.82	-3.48	9.39	3.08	14.52
10.0	-2.72	8.79	-2.01	9.65	-5.37	8.58	0.14	14.10
15.0	1.76	9.86	2.43	10.91	-1.10	10.15	5.44	15.28
20.0	-0.51	11.08	0.35	11.37	-3.15	10.72	2.31	15.93
25.0	9.06	22.68	9.86	23.25	6.43	22.68	13.07	25.79
30.0	9.86	19.31	10.63	19.69	7.48	19.02	13.83	24.28
35.0	4.06	14.61	4.80	15.10	1.53	14.44	8.10	19.87
40.0	0.35	12.37	1.07	12.58	-2.51	12.44	3.11	17.53
45.0	1.85	13.62	2.74	14.12	-0.56	14.00	5.03	17.14
50.0	-3.64	22.91	-2.95	23.25	-6.39	23.03	0.16	26.25
60.0	-3.58	18.92	-3.01	19.59	-6.44	19.21	0.10	25.05
80.0	-1.63	8.09	-0.49	9.74	-3.42	10.10	2.40	15.22
100.0	-6.80	-3.94	-5.54	-2.11	-8.29	-1.42	-1.56	1.92
120.0	-6.38	-11.32	-4.73	-9.21	-7.47	-8.11	-0.72	-2.26
150.0	-7.30	-10.58	-5.70	-7.76	-8.22	-7.38	-2.43	-1.82
180.0	-7.56	-10.74	-5.84	-7.94	-8.19	-6.67	-2.50	-3.21
200.0	-8.07	-9.10	-6.35	-6.47	-8.64	-4.98	-1.73	-1.64
<b>Average</b>	<b>-0.58</b>	<b>9.39</b>	<b>0.25</b>	<b>10.19</b>	<b>-3.38</b>	<b>9.04</b>	<b>2.78</b>	<b>13.33</b>
<b>Minimum</b>	-8.07	-11.32	-6.35	-9.21	-11.45	-8.11	-5.59	-3.21
<b>Maximum</b>	9.86	23.60	10.63	24.31	7.48	23.03	13.83	26.25

	60°Lag	Unity
<b>Average</b>	-0.23	10.49
<b>Minimum</b>	-11.45	-11.32
<b>Maximum</b>	13.83	26.25

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Function..... Volts RMS 60 Hz

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A Voltage Axis is calibrated to a bank of three RD-22-RTS Dytronic Transfer Standards certified by the National Institute of Standards and Technology (NIST) to an uncertainty of 0.0008%. Calibration temperature is 23 degrees Centigrade. Test time is 5 seconds per point with a 2 second stabilization time in between points. All readings are in Parts Per Million. The RS-703A has at least a 4 times greater accuracy than the Instrument under test.

### Voltage

	V RMS	Vh RMS	V2h RMS
60	-7.53	-7.52	-14.84
80	-6.44	-6.53	-12.81
100	-9.97	-10.02	-19.68
120	-5.17	-5.19	-10.26
140	-7.40	-7.49	-14.64
160	-12.55	-12.50	-24.72
180	-6.10	-6.15	-12.01
200	-5.85	-5.84	-11.38
220	-5.10	-5.24	-10.13
240	-5.09	-5.19	-10.16
260	-5.88	-6.06	-11.93
280	-5.38	-5.35	-10.50
300	-12.16	-12.09	-23.98
320	-12.22	-12.37	-24.40
340	-16.43	-16.27	-32.34
360	-11.88	-11.87	-23.54
380	-10.49	-10.47	-20.65
400	-9.61	-9.70	-19.14
420	-8.77	-8.90	-17.52
440	-8.20	-8.07	-15.92
460	-8.88	-8.90	-17.50
480	-8.46	-8.50	-16.65
500	-7.88	-7.87	-15.58
520	-6.60	-6.64	-12.98
540	-9.49	-9.54	-18.68
560	-5.49	-5.57	-10.92
580	-3.89	-3.95	-7.61
600	-1.28	-1.37	-2.50
<b>Average</b>	<b>-8.01</b>	<b>-8.04</b>	<b>-15.82</b>
<b>Minimum</b>	<b>-16.43</b>	<b>-16.27</b>	<b>-32.34</b>
<b>Maximum</b>	<b>-1.28</b>	<b>-1.37</b>	<b>-2.50</b>

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Function..... Amps RMS 60 Hz

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A Current Axis calibration is derived directly from the ratio of the (3) Radian RD-22-RTS Dytronic Transfer Standards which are certified by the National Institute of Standards and Technology (NIST) for an uncertainty of .0028%. Calibration Temperature is 23° Centigrade. Test time is 5 seconds per point with a 5 second stabilization time inbetween points. All readings are in Parts Per Million. The RS703A has at least a 4 times greater accuracy than the Instrument under test.

Amps	A RMS	Ah RMS	A2h RMS
0.2	3.97	3.92	8.01
0.25	-1.54	-2.41	-4.50
0.3	5.58	5.46	11.21
0.5	3.20	2.79	5.81
1.0	-0.24	-0.31	-0.31
2.0	4.38	4.21	8.74
2.5	4.04	4.13	8.54
3.0	12.32	12.29	24.73
4.0	6.72	6.73	13.68
5.0	2.85	2.79	5.75
7.0	2.51	2.36	5.07
10.0	-0.25	-0.90	-1.54
15.0	3.66	4.11	8.43
20.0	1.45	1.31	2.96
25.0	12.82	12.51	25.22
30.0	11.94	12.15	24.65
35.0	6.81	6.53	13.39
40.0	2.32	2.18	4.57
45.0	3.30	3.51	7.32
50.0	-0.55	-0.47	-0.73
60.0	-1.85	-1.88	-3.49
80.0	0.97	0.88	1.99
100.0	-2.79	-2.70	-5.11
120.0	-3.48	-3.43	-6.62
150.0	-2.82	-2.87	-5.42
180.0	-3.87	-3.82	-7.34
200.0	-3.60	-3.54	-6.68
<b>Average</b>	<b>2.51</b>	<b>2.43</b>	<b>5.12</b>
<b>Minimum</b>	<b>-3.87</b>	<b>-3.82</b>	<b>-7.34</b>
<b>Maximum</b>	<b>12.82</b>	<b>12.51</b>	<b>25.22</b>

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Mode..... Frequency

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A time base calibration (1/frequency) is derived directly from an Arbiter Systems Model 1083B GPS Satellite-Controlled Frequency Standard. Uncertainty of the GPS System is .00005 parts per million, traceable to United States Naval Observatory (USNO). Calibration temperature is 23 degrees Centigrade. Test time is 5 seconds with a stabilization of 5 seconds in between points. All Results are listed in Parts Per Million. The RS703A has at least a 4 times greater accuracy than the Instrument under test.

### Frequency

45	-2.39
46	-2.22
47	-2.26
48	-2.08
49	-2.14
50	-2.45
51	-2.23
52	-2.10
53	-2.14
54	-2.18
55	-2.46
56	-1.96
57	-2.26
58	-2.38
59	-2.31
60	-2.18
61	-2.24
62	-2.12
63	-2.35
64	-2.33
65	-2.08

Average -2.23

Minimum -2.46

Maximum -1.96

# Calibration Report

## RD-22-332 Dytronic Portable Standard

Function..... Phase    60 Hz

Date..... 12-Dec-13

Serial Number..... 207410

The following data was collected by a Radian Research RS-703A Automated Calibration System. The RS-703A watt-hour calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards certified by the National Institute of Standards and Technology (NIST) to an uncertainty of 0.003%. Calibration temperature is 23° Centigrade. The test time is 5 seconds and the stabilization time in between points is 5 seconds. For lagging power factors current lags the voltage. All results are listed in Parts Per Million of 360°. The RS703A has at least a 4 times greater accuracy than the Instrument under test..

### Voltage & Current

	120 1	120 5	120 15	120 30	120 50	240 1	240 5	240 15	240 30	240 50	480 1	480 5	480 15	480 30	480 50
<b>Phase</b>															
<b>-180</b>	-1.35	-1.39	-0.96	-1.15	-2.66	-1.41	-1.36	-1.07	-1.12	-2.61	-1.49	-1.47	-1.20	-1.26	-2.82
<b>-150</b>	-2.14	-1.89	-1.69	-1.82	-3.08	-2.10	-1.93	-1.76	-1.82	-3.05	-2.30	-2.14	-1.91	-1.93	-3.17
<b>-120</b>	-1.64	-1.56	-1.24	-1.30	-2.80	-1.63	-1.63	-1.26	-1.29	-2.84	-1.76	-1.71	-1.44	-1.46	-3.01
<b>-90</b>	-0.40	-0.38	-0.07	-0.10	-1.59	-0.39	-0.41	-0.06	-0.12	-1.61	-0.53	-0.56	-0.24	-0.29	-1.78
<b>-60</b>	-0.19	-0.19	0.10	0.06	-1.28	-0.19	-0.24	0.13	0.05	-1.24	-0.35	-0.34	-0.04	-0.13	-1.45
<b>-30</b>	-0.67	-0.82	-0.26	-0.31	-1.82	-0.71	-0.82	-0.31	-0.38	-1.88	-0.94	-0.97	-0.50	-0.50	-2.09
<b>0</b>	-0.92	-0.97	-0.55	-0.59	-2.09	-0.86	-0.91	-0.57	-0.63	-2.10	-1.02	-1.15	-0.72	-0.82	-2.32
<b>30</b>	-0.21	-0.35	-0.02	-0.06	-1.80	-0.24	-0.45	-0.03	-0.10	-1.80	-0.42	-0.54	-0.23	-0.29	-1.99
<b>60</b>	-0.82	-0.78	-0.48	-0.55	-2.01	-0.85	-0.83	-0.50	-0.57	-1.86	-0.98	-0.98	-0.61	-0.72	-2.17
<b>90</b>	-1.88	-1.88	-1.59	-1.63	-3.14	-1.86	-1.90	-1.55	-1.65	-3.14	-2.03	-2.05	-1.76	-1.82	-3.31
<b>120</b>	-1.94	-1.92	-1.66	-1.71	-3.35	-1.92	-1.97	-1.67	-1.73	-3.34	-2.12	-2.04	-1.78	-1.96	-3.52
<b>150</b>	-1.52	-1.56	-1.41	-1.44	-2.82	-1.61	-1.54	-1.37	-1.45	-2.85	-1.72	-1.70	-1.50	-1.69	-3.00
<b>180</b>	-1.29	-1.34	-1.06	-1.11	-2.59	-1.31	-1.39	-1.07	-1.11	-2.59	-1.58	-1.51	-1.23	-1.24	-2.77
<b>Average</b>	-1.15	-1.16	-0.84	-0.90	-2.39	-1.16	-1.18	-0.85	-0.92	-2.38	-1.33	-1.32	-1.01	-1.09	-2.57
<b>Minimum</b>	-2.14	-1.92	-1.69	-1.82	-3.35	-2.10	-1.97	-1.76	-1.82	-3.34	-2.30	-2.14	-1.91	-1.96	-3.52
<b>Maximum</b>	-0.19	-0.19	0.10	0.06	-1.28	-0.19	-0.24	0.13	0.05	-1.24	-0.35	-0.34	-0.04	-0.13	-1.45