

Certificate of Calibration

Manufacturer: **Radian Research, Inc.**
Instrument Model: **RD-22-332 Primary Transfer Standard**
Serial Number: XXXXXX
Firmware Revision: 07.22.04
Error Specification: 0.005% worst case

Customer Name: Radian Research, Inc.
Address: 3852 Fortune Drive
Lafayette, IN 47905

Calibration Lab Name: Radian Research, Inc.
Calibration Lab Address: 3852 Fortune Drive, Lafayette, IN 47905, USA
Calibration Date: 16-Oct-26
Report Issue Date: 16-Oct-26
CE Number: CE1234
P.O. Number: PO5678
RMA: RO98765



ISO 9001:2015 Certified Quality Management System
ISO/IEC 17025:2017 Accredited Laboratory

Environmental Conditions

Temperature: 23°C +/- 2°C
Humidity: between 30% and 60%

Physical Condition: Undamaged

Note: If the device is out of tolerance, it will be adjusted, unless otherwise requested by the customer. Results are considered out of tolerance if at any measurement, the magnitude of measured error + measurement uncertainty + the guard band of 0.001% error (10 ppm) is greater than the published error specification.

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

☒ New ☐ In Tolerance ☐ Out of Tolerance ☐ Inoperative ☐ Limited Calibration

Radian Research, Inc. certifies the instrument listed above meets or exceeds specifications and was calibrated in compliance with ANSI/NCSL Z540-1-1994. Identified results are accredited to ISO/IEC 17025:2017 "General Requirements for the Competence of Testing and Calibration laboratories", using applicable Radian Research procedures which meet the requirements of ISO 9001:2015 and ISO/IEC Guide 98-3 "Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)".

This instrument was calibrated by a Radian Research RS-933 Syntron Automated Calibration System which is traceable to the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). The Automated Calibration system is cross checked and calibrated on a schedule which is adjusted to maintain required accuracies and traceability. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2.

Procedure used for Calibration: 9912163
Software used for Calibration: Radian Research RS-933 Control Application Version 2.6.8312.21655
RS-933 / 703A Tool Number: 9911644

Standards Used in This Calibration:

<u>Description</u>	<u>Serial Number(s):</u>	<u>Cal. Source</u>	<u>Cal. Number:</u>	<u>Cal. Due Date:</u>
RS-940B Data Collection Module	933073	Radian Research	933073-20260413	4/13/2027
RS-711 Syntron with RS-932 Boost Module (Phase A)	703236	Radian Research	703236-20260308	3/8/2027
RS-711 Syntron with RS-932 Boost Module (Phase B)	703194	Radian Research	703194-20260310	3/10/2027
RS-711 Syntron with RS-932 Boost Module (Phase C)	703226	Radian Research	703226-20260309	3/9/2027

Laboratory Technician Signature

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Metrology Engineer Signature

Calibration Certificate Number:

A-XXXXXX-20261016

Calibration Report

Manufacturer: **Radian Research, Inc.**
Instrument Model: **RD-22-332 Primary Transfer Standard**
Serial Number: XXXXXX
Firmware Revision: 07.22.04
Error Specification: 0.005% DC to AC transfer worst case

ISO 9001:2015 Certified Quality Management System
ISO/IEC 17025:2017 Accredited Laboratory

Customer Name: Radian Research, Inc.
Address: 3852 Fortune Drive
Lafayette, IN 47905
Calibration Lab Name: Radian Research, Inc.
Calibration Lab Address: 3852 Fortune Drive, Lafayette, IN 47905, USA
Calibration Date: 16-Oct-26

Environmental Conditions	CE Number:	CE1234
Temperature: 23°C +/- 2°C	P.O.Number:	PO5678
Humidity: between 30% and 60%	RMA:	RO98765

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.

Applicable Traceability & Report Numbers for Radian Research Primary References:

DC Volts

Fluke Model 732B DC Volt Standard	Tool #:	9911381	Serial #:	7703004
Certificate #:	1500412815	Due Date:	11/7/2026	Uncertainty: ± 0.60 µV/V

Resistance

Guildline Standard Resistor Model 7330/10K	Tool #:	9922561	Serial #:	72776
Certificate #:	GCS20708	Due Date:	8/3/2027	Uncertainty: ± 0.3 µΩ/Ω

Guildline Standard Resistor Model 9330/10K	Tool #:	9911383	Serial #:	62623
Certificate #:	GCS20707	Due Date:	8/3/2027	Uncertainty: ± 0.3 µΩ/Ω

Time Base (Frequency)

Arbiter Model 1083B Frequency Standard	Tool #:	9911707	Serial #:	B1057
GPS Controlled System	No Calibration Required			Uncertainty: 0.000002 Hz/MHz

DC Voltage Switch

High Precision Devices Model 98113	Serial #:	155
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Laboratory Technician Signature

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

Calibration Report

RD-22-332 Primary Transfer Standard

Mode..... DC Voltage
Date..... 16-Oct-26
Serial Number..... XXXXXX

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 °C. Test time is 15 seconds per point with ten points taken and averaged. Voltage was reversed using the High Precision Devices Model 98113 Voltage Switch. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994. They are not within Radian's 17025 scope of accreditation.

Reference Voltage 9.999976 Volts

DC Voltage

	Measured Volts	Error PPM	Std. Dev
Volts			
10.00	9.99988065	14.51	0.05
0.00	0.00000369		
-10.00	-10.00007629	-5.06	0.01

Calibration Report

RD-22-332 Primary Transfer Standard

Mode..... DC Current
 Date..... 16-Oct-26
 Serial Number..... XXXXXX

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 °C. Test time is 15 seconds per point with ten points taken and averaged. Polarity was reversed using the High Precision Devices Model 98113 Voltage Switch. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994. They are not within Radian's 17025 scope of accreditation.

Reference Voltage	9.99997600	Volts
Reference Resistor a	10000.159	Ohms
Reference Resistor b	9999.979	Ohms
Reference Current Ia	0.99998170	mA
Reference Current Ib	0.99999970	mA

DC Current

Current	Measured Current mA	Error PPM	Std. Dev
+Ia	0.99998913	7.43	0.15
+Ib	1.00000637	6.67	0.06
+(Ia + Ib)	1.99997677	-2.32	0.06
-Ia	-0.99998608	4.38	0.06
-Ib	-1.00000256	2.86	0.04
-(Ia + Ib)	-1.99998794	3.27	0.02

Calibration Report

RD-22-332 Primary Transfer Standard

Function..... Watt-hour 60 Hz

Date..... 16-Oct-26 Uncertainty at Unity..... 13
 Serial Number..... XXXXXX Uncertainty at 60°Lag..... 23

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 Watt-hour calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). Test time is 15 seconds and stabilization time in between points is 15 seconds. For lagging power factors the current lags the voltage. All results are listed in $\mu\text{Wh/Wh}$. The Automated Calibration System has at least a 2 times greater accuracy than the instrument under test. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994 and accredited to ISO/IEC 17025:2017.

Voltage & Phase Angle

	120 Unity	120 60°Lag	240 Unity	240 60°Lag	480 Unity	480 60°Lag	600 Unity	600 60°Lag
Amps								
0.2	5.29	-11.19	4.74	-8.76	2.06	-15.11	4.43	-11.47
0.25	10.43	-11.01	10.47	-7.96	6.03	-12.36	6.22	-7.23
0.3	7.11	-11.42	8.64	-10.05	4.30	-13.71	4.29	-12.66
0.5	11.51	-3.12	11.03	-0.97	8.16	-5.14	7.76	-4.06
1.0	3.77	-25.22	2.92	-22.51	-0.62	-26.54	-0.86	-25.00
2.0	2.46	-18.83	1.69	-16.66	-2.00	-20.93	-2.06	-19.39
2.5	2.40	-21.06	2.35	-19.44	-1.71	-23.68	-1.24	-22.13
3.0	5.21	-23.03	5.62	-20.91	1.73	-25.02	-0.18	-24.92
4.0	3.66	-20.88	3.55	-19.20	-0.02	-22.45	-0.15	-21.12
5.0	6.38	-19.11	5.64	-18.07	1.18	-20.85	2.52	-18.09
7.0	7.18	-17.10	6.27	-16.98	2.50	-20.22	2.28	-18.88
10.0	2.21	-23.23	2.38	-22.61	-1.60	-25.34	-1.33	-23.86
15.0	6.18	-17.21	6.43	-16.48	2.89	-18.94	2.53	-18.11
20.0	2.39	-22.88	2.75	-22.24	-0.71	-25.03	-0.43	-22.96
25.0	8.06	-19.20	7.58	-17.16	4.29	-20.54	2.05	-20.20
30.0	6.87	-18.03	7.27	-16.06	3.81	-18.81	3.71	-17.55
35.0	4.63	-21.18	5.25	-19.62	2.07	-21.70	2.17	-20.15
40.0	4.56	-22.54	5.03	-21.13	1.37	-23.08	1.67	-21.28
45.0	5.72	-22.33	5.68	-21.41	2.43	-23.47	0.59	-22.99
50.0	10.35	-11.74	9.82	-10.96	7.08	-13.23	4.69	-13.03
60.0	10.59	-19.43	10.33	-17.95	7.51	-19.06	8.09	-17.01
80.0	10.39	-15.71	10.89	-20.01	7.53	-20.10	8.68	-18.38
100.0	13.74	-24.69	14.06	-28.50	11.34	-28.40	11.90	-26.18
120.0	13.38	-35.47	12.37	-31.76	11.24	-31.56	11.43	-29.95
150.0	11.48	-35.84	16.11	-22.31	9.79	-23.03	10.59	-31.16
180.0	10.29	-34.21	12.31	-32.79	10.15	-31.09	10.85	-28.44
200.0	8.65	-35.77	10.39	-33.74	8.78	-31.06	9.93	-28.60
Average	7.22	-20.79	7.47	-19.12	4.06	-21.50	4.08	-20.18
Minimum	2.21	-35.84	1.69	-33.74	-2.00	-31.56	-2.06	-31.16
Maximum	13.74	-3.12	16.11	-0.97	11.34	-5.14	11.90	-4.06

<u>Overall</u>	Unity	60°Lag
Average	5.71	-20.40
Minimum	-2.06	-35.84
Maximum	16.11	-0.97

Calibration Certificate Number:

A-XXXXXX-20261016

Calibration Report

RD-22-332 Primary Transfer Standard

Function..... Watt 60 Hz

Date..... 16-Oct-26 Uncertainty at Unity..... 13
 Serial Number..... XXXXXX Uncertainty at 60°Lag..... 23

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 Watt calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). Test time is 15 seconds and stabilization time in between points is 15 seconds. For lagging power factors the current lags the voltage. All results are listed in $\mu\text{W/W}$. The Automated Calibration System has at least a 2 times greater accuracy than the instrument under test. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994 and accredited to ISO/IEC 17025:2017.

Voltage & Phase Angle

	120 Unity	120 60°Lag	240 Unity	240 60°Lag	480 Unity	480 60°Lag	600 Unity	600 60°Lag
Amps								
0.2	5.41	-11.96	4.55	-9.30	2.46	-14.77	4.79	-11.61
0.25	10.58	-11.00	10.93	-7.65	5.95	-11.60	6.64	-7.20
0.3	7.88	-10.85	9.30	-8.77	5.54	-13.72	5.00	-11.92
0.5	11.31	-2.30	11.60	-0.92	8.35	-5.06	7.89	-3.21
1.0	3.31	-25.61	2.35	-22.60	-0.73	-26.61	-1.37	-25.37
2.0	2.79	-18.97	1.89	-16.55	-1.67	-20.70	-1.84	-19.17
2.5	2.76	-20.88	2.65	-19.27	-1.50	-23.17	-0.84	-21.59
3.0	5.13	-22.98	5.63	-20.83	1.71	-25.11	-0.19	-25.13
4.0	3.66	-20.64	3.77	-19.34	0.13	-22.39	-0.22	-20.98
5.0	6.23	-19.18	5.75	-17.91	1.34	-20.88	2.46	-17.90
7.0	7.39	-16.93	6.45	-17.04	2.59	-19.97	2.51	-18.98
10.0	1.69	-23.48	1.96	-23.04	-1.87	-26.11	-1.81	-24.17
15.0	6.89	-16.98	6.57	-16.03	3.49	-18.69	3.31	-17.99
20.0	2.30	-22.98	2.49	-22.02	-0.78	-25.00	-0.34	-23.18
25.0	7.88	-18.94	7.67	-16.76	4.40	-20.33	1.93	-19.99
30.0	7.07	-17.89	7.45	-15.67	4.35	-18.77	4.05	-17.16
35.0	4.46	-21.13	5.14	-19.58	1.73	-21.78	2.18	-20.09
40.0	4.69	-22.81	4.78	-21.42	1.48	-22.95	1.93	-21.35
45.0	5.93	-22.01	5.71	-21.10	2.53	-23.16	0.79	-22.80
50.0	10.52	-11.78	10.03	-10.80	7.39	-13.29	4.87	-12.81
60.0	10.52	-19.31	10.15	-17.98	7.83	-19.11	8.31	-17.02
80.0	9.93	-16.90	10.68	-20.15	7.47	-20.25	8.41	-18.40
100.0	13.36	-26.00	13.90	-28.44	12.34	-28.39	11.35	-26.11
120.0	13.24	-35.28	12.55	-31.04	11.30	-30.90	11.67	-29.90
150.0	11.76	-35.87	16.21	-21.89	9.90	-20.32	10.72	-31.01
180.0	10.61	-34.07	12.75	-32.82	10.36	-31.12	10.78	-28.42
200.0	8.71	-35.77	10.60	-33.85	8.97	-30.73	9.73	-28.75
Average	7.26	-20.83	7.54	-18.99	4.26	-21.29	4.17	-20.08
Minimum	1.69	-35.87	1.89	-33.85	-1.87	-31.12	-1.84	-31.01
Maximum	13.36	-2.30	16.21	-0.92	12.34	-5.06	11.67	-3.21

<u>Overall</u>	Unity	60°Lag
Average	5.81	-20.30
Minimum	-1.87	-35.87
Maximum	16.21	-0.92

Calibration Certificate Number:

A-XXXXXX-20261016

Calibration Report

RD-22-332 Primary Transfer Standard

Function..... VAR-hour 60 Hz

Date..... 16-Oct-26 Uncertainty 20

Serial Number..... XXXXXX

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 VAR-hour calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). Test time is 15 seconds and stabilization time in between points is 15 seconds. For lagging power factors the current lags the voltage. All results are listed in $\mu\text{VARh}/\text{VARh}$. The Automated Calibration System has at least a 2 times greater accuracy than the instrument under test. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994 and accredited to ISO/IEC 17025:2017.

Voltage & Phase Angle

	120 90°Lag	120 30°Lag	240 90°Lag	240 30°Lag	480 90°Lag	480 30°Lag	600 90°Lag	600 30°Lag
Amps								
0.2	-8.90	-4.73	-10.09	-4.74	-17.97	-17.75	-14.99	-17.19
0.25	-5.49	3.86	-6.20	-3.93	-14.44	-13.68	-9.74	-10.67
0.3	-6.50	2.65	-9.28	-4.28	-16.37	-13.66	-13.07	-13.79
0.5	-0.25	3.70	-3.11	-1.58	-11.69	-11.35	-7.69	-9.85
1.0	-20.22	-3.88	-22.31	-10.30	-30.92	-19.48	-28.14	-18.27
2.0	-10.95	0.83	-13.34	-6.91	-21.68	-15.54	-19.09	-13.92
2.5	-13.47	0.71	-16.43	-6.12	-24.71	-15.70	-21.03	-14.07
3.0	-16.13	1.31	-18.13	-5.45	-26.81	-14.60	-25.35	-14.76
4.0	-12.85	1.16	-14.32	-4.94	-23.04	-15.38	-20.47	-13.79
5.0	-10.50	5.49	-12.01	-1.67	-19.89	-11.94	-15.96	-9.93
7.0	-9.97	6.89	-12.21	-1.31	-20.58	-10.80	-19.39	-10.32
10.0	-16.28	3.00	-18.53	-6.20	-26.40	-14.89	-22.91	-13.74
15.0	-10.15	5.26	-11.83	-2.92	-20.16	-11.89	-18.23	-10.85
20.0	-15.31	1.72	-17.52	-5.57	-25.93	-14.97	-22.47	-14.14
25.0	-8.78	7.93	-11.39	0.26	-19.46	-8.55	-18.46	-8.93
30.0	-7.84	8.08	-10.04	-0.25	-18.38	-7.95	-16.28	-7.43
35.0	-11.23	7.12	-13.35	-2.31	-21.74	-10.16	-18.56	-9.15
40.0	-12.36	7.97	-14.30	-2.08	-22.48	-9.99	-18.61	-8.91
45.0	-12.05	8.85	-14.41	-0.91	-21.84	-7.57	-19.63	-7.95
50.0	-4.60	6.47	-6.29	-2.14	-14.24	-9.45	-13.66	-10.81
60.0	-15.56	3.00	-18.23	-6.99	-25.42	-12.34	-21.44	-12.08
80.0	-15.11	-1.26	-18.99	-8.02	-23.25	-12.26	-19.78	-15.29
100.0	-19.85	8.88	-23.83	-4.81	-29.01	-6.46	-26.05	-5.41
120.0	-21.69	10.78	-26.93	-2.72	-31.27	-4.13	-27.61	-3.76
150.0	-21.55	11.74	-26.60	-3.95	-30.04	-3.25	-26.45	-2.64
180.0	-20.24	11.55	-25.82	-5.55	-28.89	-2.48	-25.51	-4.01
200.0	-20.29	11.33	-26.04	-5.95	-28.59	-2.74	-25.46	-2.81
Average	-12.89	4.83	-15.61	-4.12	-22.79	-11.07	-19.85	-10.53
Minimum	-21.69	-4.73	-26.93	-10.30	-31.27	-19.48	-28.14	-18.27
Maximum	-0.25	11.74	-3.11	0.26	-11.69	-2.48	-7.69	-2.64

Overall	90°Lag	30°Lag
Average	-17.79	-5.23
Minimum	-31.27	-19.48
Maximum	-0.25	11.74

Calibration Certificate Number:

Calibration Report

RD-22-332 Primary Transfer Standard

Function..... VAR 60 Hz

Date..... 16-Oct-26 Uncertainty 20

Serial Number..... XXXXXX

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 VAR calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). Test time is 15 seconds and stabilization time in between points is 15 seconds. For lagging power factors the current lags the voltage. All results are listed in $\mu\text{VAR}/\text{VAR}$. The Automated Calibration System has at least a 2 times greater accuracy than the instrument under test. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994 and accredited to ISO/IEC 17025:2017.

Voltage & Phase Angle

	120 90°Lag	120 30°Lag	240 90°Lag	240 30°Lag	480 90°Lag	480 30°Lag	600 90°Lag	600 30°Lag
Amps								
0.2	-9.38	-5.00	-9.98	-4.70	-18.07	-18.25	-13.85	-15.48
0.25	-5.48	4.29	-5.82	-3.21	-13.86	-14.14	-9.58	-11.01
0.3	-5.96	3.18	-8.01	-3.67	-15.59	-12.33	-12.35	-12.81
0.5	0.14	4.26	-2.85	-0.20	-11.22	-11.16	-7.16	-9.59
1.0	-20.32	-4.21	-23.02	-10.37	-31.42	-20.29	-28.41	-19.03
2.0	-10.70	1.25	-13.20	-7.14	-21.36	-15.03	-18.92	-13.72
2.5	-13.31	1.79	-15.96	-5.55	-24.54	-14.62	-20.62	-13.83
3.0	-16.19	0.73	-18.18	-4.96	-26.96	-16.50	-25.64	-14.11
4.0	-12.59	1.26	-14.38	-4.79	-23.10	-15.21	-20.55	-14.24
5.0	-10.64	6.29	-12.15	-1.76	-19.77	-12.12	-15.92	-10.85
7.0	-9.74	6.67	-12.09	-1.67	-20.37	-10.73	-19.02	-9.28
10.0	-16.36	2.42	-19.11	-6.95	-26.82	-15.70	-23.45	-14.67
15.0	-9.98	6.36	-11.35	-2.26	-19.89	-10.97	-17.57	-9.45
20.0	-15.44	1.78	-17.52	-6.45	-26.04	-14.70	-22.47	-14.54
25.0	-8.56	7.48	-11.42	-0.20	-19.36	-8.95	-18.63	-9.61
30.0	-7.54	8.39	-10.15	0.72	-18.19	-7.85	-15.78	-6.46
35.0	-11.12	7.25	-13.49	-2.38	-21.62	-10.08	-18.56	-9.45
40.0	-12.51	8.04	-14.58	-2.38	-22.38	-10.40	-19.02	-9.17
45.0	-11.99	8.79	-14.18	0.10	-21.76	-7.93	-19.25	-7.50
50.0	-3.98	6.63	-6.10	-1.76	-14.16	-9.65	-13.49	-10.44
60.0	-15.41	3.47	-18.29	-7.69	-25.24	-11.87	-21.75	-12.40
80.0	-15.51	-0.56	-18.94	-8.49	-23.78	-12.43	-20.42	-14.83
100.0	-19.92	8.73	-23.62	-4.16	-28.97	-6.12	-25.97	-5.35
120.0	-21.55	11.21	-26.85	-3.14	-31.27	-3.66	-27.68	-4.14
150.0	-21.27	12.17	-26.44	-3.01	-29.93	-2.11	-26.37	-2.77
180.0	-20.05	10.59	-25.05	-5.98	-28.94	-2.55	-25.31	-3.38
200.0	-20.29	11.94	-25.82	-5.71	-28.64	-3.08	-25.61	-2.41
Average	-12.80	5.01	-15.50	-3.99	-22.71	-11.05	-19.75	-10.39
Minimum	-21.55	-5.00	-26.85	-10.37	-31.42	-20.29	-28.41	-19.03
Maximum	0.14	12.17	-2.85	0.72	-11.22	-2.11	-7.16	-2.41

<u>Overall</u>	90°Lag	30°Lag
Average	-17.69	-5.11
Minimum	-31.42	-20.29
Maximum	0.14	12.17

Calibration Certificate Number:

Calibration Report

RD-22-332 Primary Transfer Standard

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

Date..... 16-Oct-26 Uncertainty at Unity..... 13

Serial Number..... XXXXXX Uncertainty at 60°Lag..... 23

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 VA-hour calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). Test time is 15 seconds and stabilization time in between points is 15 seconds. For lagging power factors the current lags the voltage. All results are listed in $\mu\text{VAh}/\text{VAh}$. The Automated Calibration System has at least a 2 times greater accuracy than the instrument under test. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994 and accredited to ISO/IEC 17025:2017.

Voltage & Phase Angle

	120 Unity	120 60°Lag	240 Unity	240 60°Lag	480 Unity	480 60°Lag	600 Unity	600 60°Lag
Amps								
0.2	5.27	-15.05	4.74	-12.01	1.96	-17.50	4.41	-14.15
0.25	10.43	-6.76	10.38	-7.27	5.94	-12.83	6.17	-8.88
0.3	7.03	-8.27	8.67	-9.22	4.25	-14.44	4.25	-12.89
0.5	11.44	-2.42	11.10	-2.54	8.19	-8.89	7.78	-7.22
1.0	3.74	-18.48	2.98	-18.12	-0.55	-24.31	-0.82	-23.13
2.0	2.43	-12.76	1.66	-12.75	-2.03	-18.92	-2.17	-17.45
2.5	2.30	-14.16	2.28	-14.63	-1.77	-20.64	-1.20	-19.09
3.0	5.26	-14.66	5.64	-15.25	1.73	-21.31	-0.23	-21.39
4.0	3.63	-13.16	3.52	-13.86	0.03	-19.51	-0.23	-18.20
5.0	6.28	-11.24	5.54	-12.11	1.14	-16.92	2.51	-14.44
7.0	6.89	-10.17	5.97	-11.67	2.16	-16.74	1.97	-16.19
10.0	2.19	-15.69	2.35	-16.69	-1.70	-21.76	-1.29	-20.49
15.0	6.18	-10.20	6.40	-11.27	2.96	-16.31	2.50	-15.35
20.0	2.30	-14.51	2.69	-15.88	-0.74	-21.44	-0.41	-19.46
25.0	8.12	-9.07	7.52	-10.06	4.34	-15.54	2.03	-15.71
30.0	6.85	-8.28	7.25	-9.42	3.88	-14.25	3.69	-13.04
35.0	4.60	-10.75	5.30	-11.96	2.04	-16.87	2.22	-15.30
40.0	4.53	-11.25	4.93	-12.52	1.34	-17.34	1.71	-15.82
45.0	5.67	-10.11	5.65	-11.73	2.40	-16.59	0.67	-16.31
50.0	10.27	-3.89	9.90	-5.18	7.16	-10.15	4.66	-10.55
60.0	10.67	-11.29	10.32	-13.14	7.57	-16.51	8.07	-14.94
80.0	10.28	-11.41	10.79	-13.32	7.54	-16.84	8.72	-15.33
100.0	13.78	-12.00	14.12	-15.88	11.41	-18.51	11.84	-17.05
120.0	13.46	-15.08	12.37	-17.33	11.25	-19.85	11.41	-17.93
150.0	11.34	-15.01	16.05	-14.31	9.76	-16.48	10.64	-18.17
180.0	10.33	-15.02	12.29	-17.85	10.11	-18.71	10.80	-17.31
200.0	8.70	-15.44	10.33	-18.77	8.86	-18.47	10.01	-17.01
Average	7.18	-11.71	7.43	-12.77	4.05	-17.32	4.06	-16.03
Minimum	2.19	-18.48	1.66	-18.77	-2.03	-24.31	-2.17	-23.13
Maximum	13.78	-2.42	16.05	-2.54	11.41	-8.89	11.84	-7.22

Overall	Unity	60°Lag
Average	5.68	-14.46
Minimum	-2.17	-24.31
Maximum	16.05	-2.42

Calibration Certificate Number:

Calibration Report

RD-22-332 Primary Transfer Standard

Function..... VA RMS 60 Hz

Date..... 16-Oct-26 Uncertainty at Unity..... 13

Serial Number..... XXXXXX Uncertainty at 60°Lag..... 23

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 VA calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). Test time is 15 seconds and stabilization time in between points is 15 seconds. For lagging power factors the current lags the voltage. All results are listed in $\mu\text{VA}/\text{VA}$. The Automated Calibration System has at least a 2 times greater accuracy than the instrument under test. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994 and accredited to ISO/IEC 17025:2017.

Voltage & Phase Angle

	120 Unity	120 60°Lag	240 Unity	240 60°Lag	480 Unity	480 60°Lag	600 Unity	600 60°Lag
Amps								
0.2	5.37	-15.48	4.57	-12.02	2.42	-17.23	4.76	-13.96
0.25	10.52	-6.95	10.90	-6.71	5.96	-12.24	6.63	-8.78
0.3	7.86	-7.61	9.32	-8.31	5.51	-13.88	4.95	-12.08
0.5	11.22	-1.73	11.62	-2.37	8.36	-8.68	7.90	-6.56
1.0	3.32	-18.80	2.38	-18.52	-0.73	-24.62	-1.36	-23.53
2.0	2.76	-12.64	1.85	-12.56	-1.65	-18.67	-1.91	-17.32
2.5	2.69	-13.93	2.64	-14.33	-1.55	-20.29	-0.86	-18.68
3.0	5.17	-14.75	5.59	-15.29	1.70	-21.41	-0.20	-21.54
4.0	3.67	-12.95	3.79	-13.83	0.13	-19.35	-0.24	-18.04
5.0	6.12	-11.13	5.66	-12.02	1.26	-16.81	2.41	-14.39
7.0	7.02	-10.11	6.10	-11.64	2.17	-16.61	2.20	-16.13
10.0	1.61	-16.16	1.94	-17.18	-1.97	-22.28	-1.81	-20.97
15.0	6.92	-9.71	6.55	-10.80	3.51	-15.91	3.31	-14.99
20.0	2.23	-14.58	2.45	-15.90	-0.87	-21.50	-0.34	-19.55
25.0	7.94	-9.10	7.67	-9.96	4.43	-15.44	1.90	-15.62
30.0	7.08	-8.07	7.49	-9.12	4.36	-14.10	4.06	-12.74
35.0	4.51	-10.77	5.18	-11.90	1.76	-16.98	2.23	-15.26
40.0	4.65	-11.36	4.71	-12.64	1.41	-17.28	1.93	-15.87
45.0	5.90	-9.87	5.67	-11.46	2.47	-16.41	0.84	-16.05
50.0	10.48	-3.94	10.09	-5.12	7.38	-10.19	4.91	-10.52
60.0	10.53	-11.18	10.14	-13.07	7.81	-16.47	8.32	-14.78
80.0	9.83	-11.71	10.61	-13.52	7.42	-16.97	8.42	-15.46
100.0	13.39	-12.52	13.92	-15.76	12.38	-18.48	11.34	-17.00
120.0	13.29	-14.93	12.57	-16.90	11.37	-19.43	11.63	-17.83
150.0	11.69	-14.94	16.18	-14.05	9.90	-15.23	10.79	-18.09
180.0	10.61	-14.89	12.74	-17.72	10.35	-18.63	10.79	-17.16
200.0	8.71	-15.34	10.58	-18.69	9.02	-18.33	9.77	-17.08
Average	7.23	-11.67	7.52	-12.64	4.23	-17.16	4.16	-15.92
Minimum	1.61	-18.80	1.85	-18.69	-1.97	-24.62	-1.91	-23.53
Maximum	13.39	-1.73	16.18	-2.37	12.38	-8.68	11.63	-6.56

<u>Overall</u>	Unity	60°Lag
Average	5.78	-14.35
Minimum	-1.97	-24.62
Maximum	16.18	-1.73

Calibration Certificate Number:

Calibration Report

RD-22-332 Primary Transfer Standard

Function..... Q-hour 60 Hz

Date..... 16-Oct-26

Serial Number..... XXXXXX

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 Q-hour calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). Test time is 15 seconds and stabilization time in between points is 15 seconds. For lagging power factors the current lags the voltage. All results are listed in $\mu\text{Qh}/\text{Qh}$. The Automated Calibration System has at least a 2 times greater accuracy than the instrument under test. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994. They are not within Radian's 17025 scope of accreditation

Voltage & Phase Angle

	120 60°Lag	120 Unity	240 60°Lag	240 Unity	480 60°Lag	480 Unity	600 60°Lag	600 Unity
Amps								
0.2	-3.36	-1.80	2.56	1.89	1.56	2.68	4.93	3.77
0.25	-2.22	-1.95	-0.34	3.06	-1.33	3.68	2.95	6.17
0.3	-3.25	-2.88	-1.31	3.38	-2.20	3.09	-1.30	5.02
0.5	-4.37	-6.87	-1.77	-2.22	-3.20	-0.34	-1.06	0.52
1.0	-5.62	-6.87	-2.31	-3.56	-3.47	-1.33	-1.42	0.23
2.0	-3.56	-5.35	-0.52	-1.06	-1.42	-0.07	0.66	1.88
2.5	-3.42	-2.70	-1.13	1.80	-1.99	2.73	-0.81	4.11
3.0	-1.42	-0.82	0.73	3.59	-0.46	5.74	2.07	4.93
4.0	-3.11	-4.01	-1.15	-0.61	-1.42	0.46	0.87	2.38
5.0	-4.85	-2.63	-2.56	-0.63	-2.92	1.37	-1.62	2.62
7.0	-1.42	-1.21	0.42	2.26	0.32	3.69	2.24	5.10
10.0	-5.99	-5.92	-3.99	-0.99	-4.28	1.16	-3.45	1.70
15.0	-2.80	-2.80	-0.99	1.59	-1.18	3.02	0.83	4.79
20.0	-4.63	-3.85	-2.63	-0.70	-3.27	1.30	-1.84	3.19
25.0	-0.81	0.67	1.47	4.22	0.79	6.05	3.24	5.80
30.0	-0.03	-1.18	2.16	3.50	2.26	5.98	4.34	7.31
35.0	-2.66	-3.81	-0.70	0.77	-0.70	3.31	1.52	4.20
40.0	-4.06	-2.70	-2.13	-0.34	-1.92	2.88	-1.04	3.88
45.0	-2.73	0.95	-0.89	3.31	-1.08	6.42	0.11	5.81
50.0	0.10	-2.30	2.16	0.67	2.16	3.99	4.15	3.05
60.0	-0.22	-5.56	2.45	-0.89	2.64	1.59	4.26	2.81
80.0	-4.28	-8.07	-2.56	-4.28	-2.20	-0.63	-1.16	0.79
100.0	-2.99	-2.99	-2.76	1.82	-2.19	3.76	-0.15	3.69
120.0	-2.62	0.22	-0.13	0.25	0.44	7.72	2.27	7.69
150.0	-1.69	0.44	4.03	-0.24	4.03	8.07	1.68	8.64
180.0	-2.35	-0.64	0.32	3.37	0.76	7.25	1.74	6.22
200.0	-1.39	-0.13	0.67	4.91	2.05	9.49	3.88	8.46
Average	-2.81	-2.77	-0.40	0.92	-0.67	3.45	1.03	4.25
Minimum	-5.99	-8.07	-3.99	-4.28	-4.28	-1.33	-3.45	0.23
Maximum	0.10	0.95	4.03	4.91	4.03	9.49	4.93	8.64

	60°Lag	Unity
Average	-0.71	1.46
Minimum	-5.99	-8.07
Maximum	4.93	9.49

Calibration Certificate Number:

Calibration Report

RD-22-332 Primary Transfer Standard

Function..... Volts RMS 60 Hz
 Date..... 16-Oct-26
 Serial Number..... XXXXXX

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 Volt calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). Test time is 15 seconds and stabilization time in between points is 15 seconds. For lagging power factors the current lags the voltage. All results are listed in $\mu\text{V}/\text{V}$. The Automated Calibration System has at least a 2 times greater accuracy than the instrument under test. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994. They are not within Radian's scope of accreditation.

Voltage	V RMS	Vh RMS	V2h RMS
60	-2.53	-2.58	-4.99
80	-3.09	-3.16	-6.03
100	1.56	1.48	3.31
120	-3.16	-3.11	-5.85
140	-1.57	-1.65	-3.04
160	-4.31	-4.16	-8.17
180	-2.97	-3.08	-6.04
200	-0.08	-0.13	0.15
220	1.81	1.80	3.80
240	-1.42	-1.24	-2.32
260	0.70	0.57	1.39
280	0.28	0.19	0.68
300	-7.51	-7.64	-14.98
320	-7.97	-7.99	-15.68
340	-7.24	-7.35	-14.40
360	-7.09	-7.14	-13.92
380	-5.44	-5.71	-11.21
400	-3.62	-3.45	-6.65
420	-2.79	-2.95	-5.59
440	-3.29	-3.37	-6.53
460	-2.36	-2.35	-4.50
480	-2.65	-2.76	-5.18
500	-2.78	-2.70	-5.23
520	-1.78	-1.99	-3.73
540	-1.19	-1.18	-2.08
560	-1.56	-1.65	-3.04
580	0.02	-0.01	0.31
600	0.31	0.16	0.58
Average	-2.56	-2.61	-4.96
Minimum	-7.97	-7.99	-15.68
Maximum	1.81	1.80	3.80

Calibration Report

RD-22-332 Primary Transfer Standard

Function..... Amps RMS 60 Hz
 Date..... 16-Oct-26
 Serial Number..... XXXXXX

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 Amp calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). Test time is 15 seconds and stabilization time in between points is 15 seconds. For lagging power factors the current lags the voltage. All results are listed in $\mu\text{A/A}$. The Automated Calibration System has at least a 2 times greater accuracy than the instrument under test. They are not within Radian's scope of accreditation.

Amps	A RMS	Ah RMS	A2h RMS
0.2	5.89	5.84	11.92
0.25	3.03	2.84	5.94
0.3	1.94	1.19	2.54
0.5	0.12	0.16	0.58
1.0	-1.27	-0.76	-1.35
2.0	1.49	1.17	2.68
2.5	0.58	0.26	0.73
3.0	3.31	3.46	7.18
4.0	1.43	1.33	2.93
5.0	-0.45	-0.41	-0.56
7.0	3.65	3.49	7.32
10.0	-3.03	-2.56	-4.85
15.0	1.83	1.18	2.64
20.0	-1.28	-1.21	-2.17
25.0	3.87	3.95	8.32
30.0	4.18	3.95	8.26
35.0	1.33	1.42	3.06
40.0	-0.66	-0.74	-1.20
45.0	0.29	0.13	0.49
50.0	4.77	4.70	9.62
60.0	4.01	4.04	8.26
80.0	-1.53	-1.15	-1.95
100.0	0.91	1.37	3.03
120.0	1.35	1.42	3.03
150.0	1.89	1.73	3.69
180.0	1.04	0.85	1.93
200.0	3.04	2.98	6.33
Average	1.55	1.50	3.27
Minimum	-3.03	-2.56	-4.85
Maximum	5.89	5.84	11.92

Calibration Report

RD-22-332 Primary Transfer Standard

Mode..... Frequency

Date..... 16-Oct-26

Serial Number..... XXXXXX

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 time base calibration is derived directly from a Keysight Technologies 53220A Universal Counter/Timer, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). Test time is 15 seconds with a stabilization of 15 seconds in between points. All results are listed in Hz/MHz. The RS-933 has at least a 2 times greater accuracy than the Instrument under test. The results presented on this page are compliant with ANSI/NCSL Z540-1-1994. They are not within Radian's scope of accreditation

Frequency

45	-0.90
46	-0.99
47	-1.02
48	-1.15
49	-0.98
50	-0.81
51	-1.20
52	-1.13
53	-0.61
54	-0.91
55	-1.31
56	-0.91
57	-1.01
58	-1.06
59	-0.94
60	-0.99
61	-1.05
62	-0.96
63	-0.91
64	-1.06
65	-1.01
Average	-1.00
Minimum	-1.31
Maximum	-0.61

Calibration Report

RD-22-332 Primary Transfer Standard

Function..... Phase 60 Hz

Date..... 16-Oct-26

Serial Number..... XXXXXX

The following data was collected by a Radian Research RS-933 Automated Calibration System. The RS-933 phase calibration is derived directly from (3) Radian RD-22-RTS Dytronic Transfer Standards, traceable to the SI through the National Institute of Standards and Technology (NIST) and/or other National Metrology Institute (NMI). The test time is 15 seconds and the stabilization time in between points is 15 seconds. For lagging power factors the current lags the voltage. All results are listed in $\mu\text{rad}/\text{rad}$. The RS-933 has at least a 15 times greater accuracy than the Instrument under test.

The results presented on this page are compliant with ANSI/NC SL Z540-1-1994. They are not within Radian's 17025 scope of accreditation

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
Phase															
-180	-0.47	-0.36	-0.75	-0.35	-0.13	-0.24	-0.31	-0.57	-0.35	-0.13	-1.08	-0.32	-0.49	-0.29	-0.05
-150	-0.77	-1.10	-1.36	-0.94	-0.86	-0.75	-1.16	-1.09	-0.93	-0.82	-1.01	-1.02	-1.09	-0.87	-0.79
-120	-0.82	-0.70	-1.15	-0.73	-0.56	-0.53	-0.57	-0.89	-0.72	-0.60	-1.40	-0.63	-0.93	-0.71	-0.56
-90	0.12	0.30	-0.17	0.28	0.47	0.53	0.46	0.08	0.31	0.51	0.39	0.36	0.03	0.27	0.51
-60	0.47	0.46	0.01	0.40	0.49	0.77	0.58	0.21	0.45	0.57	0.60	0.49	0.16	0.38	0.47
-30	0.17	0.08	-0.31	-0.04	0.01	0.27	0.29	-0.15	0.15	0.25	0.26	0.25	-0.34	-0.09	-0.06
0	0.12	-0.05	-0.21	-0.24	-0.10	0.22	0.21	-0.11	0.09	0.29	0.11	0.03	-0.27	-0.14	-0.08
30	0.71	0.92	0.50	0.40	0.77	0.66	0.85	0.44	0.68	0.98	0.61	0.85	0.30	0.42	0.71
60	0.64	0.46	0.29	0.26	0.50	0.76	0.65	0.25	0.47	0.75	0.60	0.56	0.17	0.28	0.50
90	-0.55	-0.74	-0.89	-0.83	-0.60	-0.47	-0.54	-0.83	-0.60	-0.45	-0.52	-0.64	-0.95	-0.73	-0.62
120	-1.00	-0.81	-1.11	-0.92	-0.55	-0.86	-0.75	-1.00	-0.80	-0.50	-0.84	-0.78	-1.05	-0.85	-0.65
150	-0.47	-0.52	-0.81	-0.47	0.02	-0.14	-0.50	-0.58	-0.32	-0.01	-0.35	-0.34	-0.53	-0.36	-0.17
180	-0.37	-0.33	-0.72	-0.31	-0.14	-0.28	-0.29	-0.59	-0.21	-0.05	-0.23	-0.30	-0.47	-0.39	0.00
Average	-0.17	-0.18	-0.51	-0.27	-0.05	0.00	-0.08	-0.37	-0.14	0.06	-0.22	-0.11	-0.42	-0.24	-0.06
Minimum	-1.00	-1.10	-1.36	-0.94	-0.86	-0.86	-1.16	-1.09	-0.93	-0.82	-1.40	-1.02	-1.09	-0.87	-0.79
Maximum	0.71	0.92	0.50	0.40	0.77	0.77	0.85	0.44	0.68	0.98	0.61	0.85	0.30	0.42	0.71

Calibration Certificate Number: