

HOWARD INDUSTRIES
SVR-1 SINGLE PHASE STEP VOLTAGE REGULATORS
QUALIFICATION TEST RECORD
SYSTEM VOLTAGE 15 kV AND BELOW
CURRENT RATINGS 235 AMPS AND BELOW

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STEP VOLTAGE REGULATOR SVR-1 TEST DATA

Description: Radio influence voltage tests made on a single phase step voltage regulator 7620 Volt, 167 kVA, 219 Amp, $\pm 10\%$ range of regulation in $\frac{5}{8}\%$ steps. Test was made in the electrical test laboratory at Howard Industries in Laurel, Mississippi using the Eaton NM-21 FFT radio influence voltage test set.

**Catalog Number 2821-100000-007
Serial Number A-1 tested on 6/28/04**

Bushing	Voltage at Bushing	RIV (μVolts)
L	7200	3.0
L	7620	3.5
L	7970	10.0
L	8770	14.0
S	7200	4.0
S	7620	5.0
S	7970	6.0
S	8770	9.0

Howard Industries hereby certifies that this test report is a true and accurate record of radio influence voltage test that was conducted in accordance with current ANSI regulator test standards.

STEP VOLTAGE REGULATOR SVR-1 TEST DATA

Description: Single phase step voltage regulator 7620 Volt, 167 kVA, 219 Amp, ±10% range of regulation in 5/8% steps. Applicable Standards: ANSI C57.15-1999 and RUS Specification S-2

Serial Number 201339-1504 tested on 5/13/04

NO LOAD TEST

Note: Measured values are adjusted for waveform distortion as described in ANSI C57.15.

Set Condition (Volts)	LTC Position	Measured Values			
		Average Voltage	RMS Voltage	Amps	Watts
7620	Neutral	7618.34	7656.92	0.835	703
7620	1 Raise	7612.2	7650.62	0.484	604

LOAD TEST 16 RAISE

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
28.0	24.894	135.4	23.937	2127	0.19%

LOAD TEST 15 RAISE

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
28.0	23.174	131.04	22.4	1907	0.18%

LOAD TEST 15 LOWER

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
28.0	19.129	112.6	19.16	1301	0.16%

LOAD TEST 16 LOWER

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
28.0	20.286	114.2	20.15	1386	0.16%

Ratio Tests

Tap Position	Tested Ratio	Connection Notes
N/A	0.1148	Tested between full series winding and shunt winding.
2R	0.1115	Tested between tapped section and full series winding.
4R	0.2225	Tested between tapped section and full series winding.
6R	0.3334	Tested between tapped section and full series winding.
8R	0.4446	Tested between tapped section and full series winding.
10R	0.5555	Tested between tapped section and full series winding.
12R	0.6666	Tested between tapped section and full series winding.
14R	0.7778	Tested between tapped section and full series winding.
16R	0.8891	Tested between tapped section and full series winding.
4L	1.0258	Tested between tapped section and full series winding.
16R	0.8970	Tested between tapped section and full series winding.

WINDING RESISTANCES

Coil Temperature	Shunt Resistance (Ω)	16-L Series Resistance (Ω)	15-L Series Resistance (Ω)	15-R Series Resistance (Ω)	16-R Series Resistance (Ω)
28.0	1.3020	0.0141	0.0146	0.0147	0.0152
75.0	1.5439	0.0167	0.0173	0.0174	0.0180

Howard Industries hereby certifies that this test report is a true and accurate record of final production line tests that were conducted in accordance with current ANSI regulator test standards.

STEP VOLTAGE REGULATOR SVR-1 TEST DATA

Description: Single phase step voltage regulator 7620 Volt, 167 kVA, 219 Amp, ±10% range of regulation in 5/8% steps. Applicable Standards: ANSI C57.15-1999 and RUS Specification S-2

Serial Number 201339-1504 tested on 5/13/04

APPLIED POTENTIAL (HI-POT) TEST

Set Condition (Volts)	LTC Position	Measured Values	
		RMS Voltage	Amps
34000	1 Raise	34000	0.036

FIRST INDUCED TEST

Set Condition (Volts)	LTC Position	Measured Values		
		RMS Voltage	Amps	Watts
15240	15 Raise	15240	0.17	366

IMPULSE TEST - L BUSHING

Set Condition (Volts)	LTC Position	Description of Test	Status (Pass/Fail)
95000	16 Raise	Impulse test sequence: One at 60 kV, two at 95 kV, one at 60 kV. 60 kV oscillograms were compared for differences.	Pass

SECOND INDUCED TEST

Set Condition (Volts)	LTC Position	Measured Values		
		RMS Voltage	Amps	Watts
15240	15 Raise	15240	0.17	366

POWER FACTOR TEST

APPLIED VOLTAGE (Volts)	Measured Power Factor
1020	0.32%

INSULATION RESISTANCE TEST

Applied Voltage (Volts)	Insulation Resistance (O)
5000	1.173 X 10 ¹²

Howard Industries hereby certifies that this test report is a true and accurate record of final production line tests that were conducted in accordance with current ANSI regulator test standards.

STEP VOLTAGE REGULATOR SVR-1 TEST DATA

Description: Single phase step voltage regulator 7620 Volt, 167 kVA, 219 Amp, ±10% range of regulation in 5/8% steps. Applicable Standards: ANSI C57.15-1999 and RUS Specification S-2

Serial Number 201340-1504 tested on 5/13/04

NO LOAD TEST

Note: Measured values are adjusted for waveform distortion as described in ANSI C57.15.

Set Condition (Volts)	LTC Position	Measured Values			
		Average Voltage	RMS Voltage	Amps	Watts
7620	Neutral	7626.9	7675.1	0.82	665
7620	1 Raise	7609.8	7656.2	0.47	573

LOAD TEST 16 RAISE

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
24.6	24.894	134.8	24.82	2124	0.19%

LOAD TEST 15 RAISE

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
24.6	23.174	131.5	23.24	1895	0.18%

LOAD TEST 15 LOWER

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
24.6	19.129	109.7	19.21	1282	0.15%

LOAD TEST 16 LOWER

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
24.6	20.286	111.7	20.2	1360	0.15%

Ratio Tests

Tap Position	Tested Ratio	Connection Notes
N/A	0.1148	Tested between full series winding and shunt winding.
2R	0.1115	Tested between tapped section and full series winding.
4R	0.2225	Tested between tapped section and full series winding.
6R	0.3338	Tested between tapped section and full series winding.
8R	0.4445	Tested between tapped section and full series winding.
10R	0.5555	Tested between tapped section and full series winding.
12R	0.6665	Tested between tapped section and full series winding.
14R	0.7775	Tested between tapped section and full series winding.
16R	0.8886	Tested between tapped section and full series winding.
4L	1.0255	Tested between tapped section and full series winding.
16R	0.8980	Tested between tapped section and full series winding.

WINDING RESISTANCES

Coil Temperature	Shunt Resistance (Ω)	16-L Series Resistance (Ω)	15-L Series Resistance (Ω)	15-R Series Resistance (Ω)	16-R Series Resistance (Ω)
24.6	1.2780	0.0155	0.0138	0.0148	0.0166
75.0	1.5361	0.0186	0.0166	0.0178	0.0200

Howard Industries hereby certifies that this test report is a true and accurate record of final production line tests that were conducted in accordance with current ANSI regulator test standards.

STEP VOLTAGE REGULATOR SVR-1 TEST DATA

Description: Single phase step voltage regulator 7620 Volt, 167 kVA, 219 Amp, ±10% range of regulation in 5/8% steps. Applicable Standards: ANSI C57.15-1999 and RUS Specification S-2

Serial Number 201340-1504 tested on 5/13/04

APPLIED POTENTIAL (HI-POT) TEST

Set Condition (Volts)	LTC Position	Measured Values	
		RMS Voltage	Amps
34000	1 Raise	34000	0.0328

FIRST INDUCED TEST

Set Condition (Volts)	LTC Position	Measured Values		
		RMS Voltage	Amps	Watts
15240	15 Raise	15240	0.18	293

IMPULSE TEST - L BUSHING

Set Condition (Volts)	LTC Position	Description of Test	Status (Pass/Fail)
95000	16 Raise	Impulse test sequence: One at 60 kV, two at 95 kV, one at 60 kV. 60 kV oscillograms were compared for differences.	Pass

SECOND INDUCED TEST

Set Condition (Volts)	LTC Position	Measured Values		
		RMS Voltage	Amps	Watts
15240	15 Raise	15240	0.18	293

POWER FACTOR TEST

APPLIED VOLTAGE (Volts)	Measured Power Factor
1020	0.32%

INSULATION RESISTANCE TEST

Applied Voltage (Volts)	Insulation Resistance (O)
5000	1.44 X 10 ¹²

Howard Industries hereby certifies that this test report is a true and accurate record of final production line tests that were conducted in accordance with current ANSI regulator test standards.

STEP VOLTAGE REGULATOR SVR-1 TEST DATA

Description: Single phase step voltage regulator 7620 Volt, 167 kVA, 219 Amp, ±10% range of regulation in 5/8% steps. Applicable Standards: ANSI C57.15-1999 and RUS Specification S-2

Serial Number 201341-1504 tested on 5/13/04

NO LOAD TEST

Note: Measured values are adjusted for waveform distortion as described in ANSI C57.15.

Set Condition (Volts)	LTC Position	Measured Values			
		Average Voltage	RMS Voltage	Amps	Watts
7620	Neutral	7611.4	7660.4	0.854	703
7620	1 Raise	7619.9	7661.1	0.5	599

LOAD TEST 16 RAISE

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
24.0	24.894	137.8	24.805	2154	0.19%

LOAD TEST 15 RAISE

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
24.0	23.174	132.3	22.989	1922	0.18%

LOAD TEST 15 LOWER

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
24.0	19.129	110.9	19.174	1291	0.15%

LOAD TEST 16 LOWER

Note: Measured values are adjusted to set condition current to a reference temperature of 75° C as described in ANSI C57.15.

Coil Temperature (°C)	Set Condition (Amps)	Test Values			
		RMS Voltage	Amps	Watts	%Impedance
24.0	20.286	112.9	20.177	1409	0.16%

Ratio Tests

Tap Position	Tested Ratio	Connection Notes
N/A	0.1148	Tested between full series winding and shunt winding.
2R	0.1115	Tested between tapped section and full series winding.
4R	0.2225	Tested between tapped section and full series winding.
6R	0.3333	Tested between tapped section and full series winding.
8R	0.4446	Tested between tapped section and full series winding.
10R	0.5556	Tested between tapped section and full series winding.
12R	0.6666	Tested between tapped section and full series winding.
14R	0.7778	Tested between tapped section and full series winding.
16R	0.8899	Tested between tapped section and full series winding.
4L	1.0243	Tested between tapped section and full series winding.
16R	0.8980	Tested between tapped section and full series winding.

WINDING RESISTANCES

Coil Temperature	Shunt Resistance (Ω)	16-L Series Resistance (Ω)	15-L Series Resistance (Ω)	15-R Series Resistance (Ω)	16-R Series Resistance (Ω)
24.0	1.2800	0.0154	0.0145	0.0148	0.0159
75.0	1.5422	0.0186	0.0175	0.0179	0.0191

Howard Industries hereby certifies that this test report is a true and accurate record of final production line tests that were conducted in accordance with current ANSI regulator test standards.

STEP VOLTAGE REGULATOR SVR-1 TEST DATA

Description: Single phase step voltage regulator 7620 Volt, 167 kVA, 219 Amp, ±10% range of regulation in 5/8% steps. Applicable Standards: ANSI C57.15-1999 and RUS Specification S-2

Serial Number 201341-1504 tested on 5/13/04

APPLIED POTENTIAL (HI-POT) TEST

Set Condition (Volts)	LTC Position	Measured Values	
		RMS Voltage	Amps
34000	1 Raise	34000	0.032

FIRST INDUCED TEST

Set Condition (Volts)	LTC Position	Measured Values		
		RMS Voltage	Amps	Watts
15240	15 Raise	15240	0.15	366

IMPULSE TEST - L BUSHING

Set Condition (Volts)	LTC Position	Description of Test	Status (Pass/Fail)
95000	16 Raise	Impulse test sequence: One at 60 kV, two at 95 kV, one at 60 kV. 60 kV oscillograms were compared for differences.	Pass

SECOND INDUCED TEST

Set Condition (Volts)	LTC Position	Measured Values		
		RMS Voltage	Amps	Watts
15240	15 Raise	15240	0.17	342

POWER FACTOR TEST

APPLIED VOLTAGE (Volts)	Measured Power Factor
1020	0.32%

INSULATION RESISTANCE TEST

Applied Voltage (Volts)	Insulation Resistance (O)
5000	58 X 10 ¹²

Howard Industries hereby certifies that this test report is a true and accurate record of final production line tests that were conducted in accordance with current ANSI regulator test standards.

STEP VOLTAGE REGULATOR SVR-1 TEST DATA

Description: Winding temperature rise test made on a single phase step voltage regulator 7620 Volt, 167 kVA, 219 Amp, $\pm 10\%$ range of regulation in $\frac{5}{8}\%$ steps. Test was made in the electrical test laboratory at Howard Industries in Laurel, Mississippi. Applicable Standards: ANSI C57.15-1999 and RUS Specification S-2. Rated winding rise 55°C . Unit was tested at the higher current required for operation at rated kVA at 7.2 kV (reference Table 5, and 5.2.3 of ANSI C57.15-1999).

Serial Number B-2 tested on 3/16/04

Tap Position	Load	Series Winding Rise ($^{\circ}\text{C}$)	Shunt Winding Rise ($^{\circ}\text{C}$)
16 Raise	100%	50.27	53.45

Howard Industries hereby certifies that this test report is a true and accurate record of temperature rise test that was conducted in accordance with current ANSI regulator test standards.



HOWARD INDUSTRIES, INC.

LABORATORY TEST RECORD

SHORT-CIRCUIT TEST
REPORT #1677620-1

167 KVA 7620 VOLT SINGLE-PHASE
32-STEP VOLTAGE REGULATOR

Statements made and data shown herein are to the best of my knowledge and belief,
correct and within the usual limits of industrial testing practice.

Lee Matthews _____

Lee Matthews, P.E.
Product Development Engineer
Pole Type Transformer Division

6/3/04

Date

INTRODUCTION

A Howard Industries SVR-1 single-phase 32-step voltage regulator was taken to an independent laboratory and short-circuit tests were performed in accordance with American National Standards ANSI/IEEE C57.15. The short-circuit was created by shorting the series winding of the regulator. The source was applied to the shunt winding of the regulator. Table 1 gives a description of the regulator that was tested.

TABLE 1

TESTED REGULATOR DESCRIPTION

<u>RATED</u> <u>KVA</u>	<u>RATED</u> <u>VOLTAGE</u>	<u>ANSI</u> <u>TYPE</u>	<u>RATED LOAD</u> <u>CURRENT (AMPS)</u>	<u>SERIAL NUMBER</u>
167	7620	B	219	B-2

The standard requires a symmetrical current magnitude of 25 times the rated current for each test. The duration of each test is 0.25 seconds or 15 cycles. The standard also requires that two of the tests have an asymmetrical peak value of 2.26 times the required rms symmetrical short-circuit current. Table 2 gives a summary of the short-circuit test current requirements for the symmetrical and asymmetrical tests.

The regulator was subjected to standard production tests per ANSI/IEEE C57.15 prior to shipment to the laboratory for short-circuit tests.

TABLE 2

SHORT-CIRCUIT CURRENT REQUIREMENTS

<u>TAP</u> <u>POSITION</u>	<u>RATED</u> <u>LOAD</u> <u>CURRENT</u> <u>(AMPS)</u>	<u>SHORT-</u> <u>CIRCUIT</u> <u>LOAD</u> <u>CURRENT</u> <u>(AMPS)</u>	<u>RATED</u> <u>SHUNT</u> <u>WINDING</u> <u>CURRENT</u> <u>(AMPS)</u>	<u>REQUIRED</u> <u>SYM</u> <u>TEST</u> <u>CURRENT</u> <u>(AMPS)</u>	<u>REQUIRED</u> <u>ASYM</u> <u>TEST</u> <u>CURRENT</u> <u>(AMPS)</u>
16 RAISE	219	5475	24.9	622.5	1407
16 LOWER	219	5475	20.3	507.5	1147

TEST RESULTS

The regulator was subjected to a total of six short-circuit tests. Three tests were performed at the maximum boost position (16 Raise) of the regulator and three tests were performed at the maximum buck position (16 Lower) of the regulator. One test at each position was performed to satisfy the peak asymmetrical current requirements of the standard. A summary of short-circuit test values is shown in Table 3. Oscillograms of the actual tests are included in the appendix of this report.

TABLE 3

SUMMARY OF SHORT-CIRCUIT TEST DATA
FOR SERIAL NUMBER B-2

<u>TAP POSITION</u>	<u>TEST PLOT</u>	<u>TEST VOLTAGE (VOLTS)</u>	<u>TEST CURRENTS</u>		<u>DURATION (CYCLES)</u>
			<u>SYM (AMPS)</u>	<u>ASYM (AMPS)</u>	
16RAISE	6	4575	624	924	15
16RAISE	7	4575	624	938	15
16RAISE	8	5500	750	1490	15
16LOWER	9	3750	512	795	15
16LOWER	10	3750	512	786	15
16LOWER	11	4500	614	1210	15

The tap changer was operated through the neutral position and then to the next test position after each short-circuit test, as required in the standard. All tap changes indicated satisfactory operation.

After the short-circuit testing was completed, the unit was returned to Howard Industries and all standard production tests per ANSI/IEEE C57.15 were performed again. The regulator passed all production line loss and dielectric tests, including impulse tests. All of the results from the production line tests performed after the short-circuit test sequence were within acceptable limits of the original test data. The standard allows a 25% maximum change in excitation current between measurements before and after the short-circuit test. The standard also allows a 22.5% maximum change in impedance between measurements made before and after the short-circuit test. Table 4 summarizes the impedance and excitation test data before and after the short-circuit tests.

TABLE 4

COMPARISON OF PRODUCTION TEST DATA

	<u>BEFORE SHORT-CIRCUIT TEST</u>	<u>AFTER SHORT-CIRCUIT TEST</u>	<u>MEASURED CHANGE</u>	<u>ALLOWED CHANGE</u>
Excitation Current	0.859 Amps	0.884 Amps	2.91 %	25.0 %
Impedance	0.1858 %	0.1862 %	0.217 %	22.5 %

After satisfactory completion of all production tests, the internal assembly was removed from the tank. A visual inspection of the core and coil assembly was made. There was no indication of any change in the mechanical condition that would impair operation of the regulator. The tap changer was also inspected. There was no evidence of any change that would impair proper switch operation.

CONCLUSION

As described above, all tests performed after the short-circuit test were completed successfully. The visual inspection also confirmed no damage to the internal components of the regulator. The results prove that the Howard Industries SVR-1 single-phase 32-step voltage regulator meets the short-circuit test requirements of ANSI /IEEE C57.15.

APPENDIX

SHORT-CIRCUIT TEST
LABORATORY OSCILLOGRAMS



Rockwell Automation

Bringing Together Leading Brands in Industrial Automation

**Allen-Bradley Company
Test & Certification Laboratories
1201 South Second Street
Milwaukee, WI 53204
Telephone 414-382-4627
FAX 414-382-2255**

Lee Matthews
Howard Industries
P.O. Box 1588
Laurel, MS 39441

March 26, 2004

Dear Lee,

This letter is to confirm that short circuit tests were conducted on your tap changer and complete regulator on February 16-17, 2004. The short circuit tests were conducted per ANSI C57.131 and C57.15 with 4 shots symmetrical and 2 shots asymmetrical with a peak of at least 2.26 times the symmetrical rms rating

The first 3 tests (plots 1-3), are 10.85 times rated current of the tap changer for 1.7 seconds (adjusted to yield the equivalent I^2t value for 2 seconds) per the requirements of C57.131. These tests were conducted on the load tap changer only with an asymmetry factor of 2.5.

Tests 4 and 5 were calibration shots to get the required current and asymmetry for tests 6-11.

Tests 6-11 were conducted on a complete regulator. The current was measured through the shunt winding. They consist of 2 symmetrical shots and 1 asymmetrical shot at one tap setting and then the sequence was repeated at another tap setting. The tests are at 25 times rated current of the regulator for 15 cycles per the requirements of C57.15 with a 2.26 asymmetry factor for test 8 and 11.

Tests 12-17 were conducted on a complete regulator. The current was measured through the shunt winding. They consist of 2 symmetrical shots and 1 asymmetrical shot at one tap setting. Instead of repeating the sequence at another tap setting, 1 symmetrical shot was conducted followed by 1 asymmetrical shot, followed by 1 symmetrical shot for 0.9 seconds (adjusted to yield the equivalent I^2t value for 0.8 seconds) per the requirements of C57.15. Tests 12-17 were at 40 times rated current



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of the regulator per the requirements of C57.15. Tests 12-16 were for 15 cycles with a 2.26 asymmetry factor for tests 14 and 16. Test 17 was for a minimum of 0.8 seconds as described above.

Please reference the attached test log for a complete list of tests that were conducted and the circuit parameters for each tests.

Regards,

A handwritten signature in black ink that reads 'Mike Cibulka'.

Mike Cibulka
Project Engineering Supervisor
Rockwell Automation/Allen-Bradley
Test & Certification Laboratories

Attachment: Ct-1666.xls

Short Circuit Tests for Howard Industries
on February 16-17, 2004

Plot #	Primary Voltage Volts	Secondary Voltage Volts	Sym rms current		Closing Angle Degrees	I peak Amps	Target Current	
			1/2 cycle Amps	Duration cycles			Irms Amps	Ipeak Amps
1	4175	551	5520	103	0	13500	4069	10173
2	3200	422	4120	103	0	10100	4069	10173
3	3500	462	4590	103	0	11200	4069	10173
4	3500	3500	582	15	0	1030		
5	4500	4500	614	5	0	1170		
6	4575	4575	624	15	90	924	622	
7	4575	4575	624	15	90	938	622	
8	5500	5500	750	15	0	1490	622	1407
9	3750	3750	512	15	90	795	507	
10	3750	3750	512	15	90	786	507	
11	4500	4500	614	15	0	1210	507	1146
12	6550	6550	1010	15	90	1600	996	
13	6650	6650	1025	15	90	1510	996	
14	7800	7800	1212	15	0	2420	996	2250
15	5400	5400	833	15	90	1230	811	
16	6450	6450	995	15	0	1850	811	1834
17	5550	5550	856	55	90	1260	811	

CT-1666

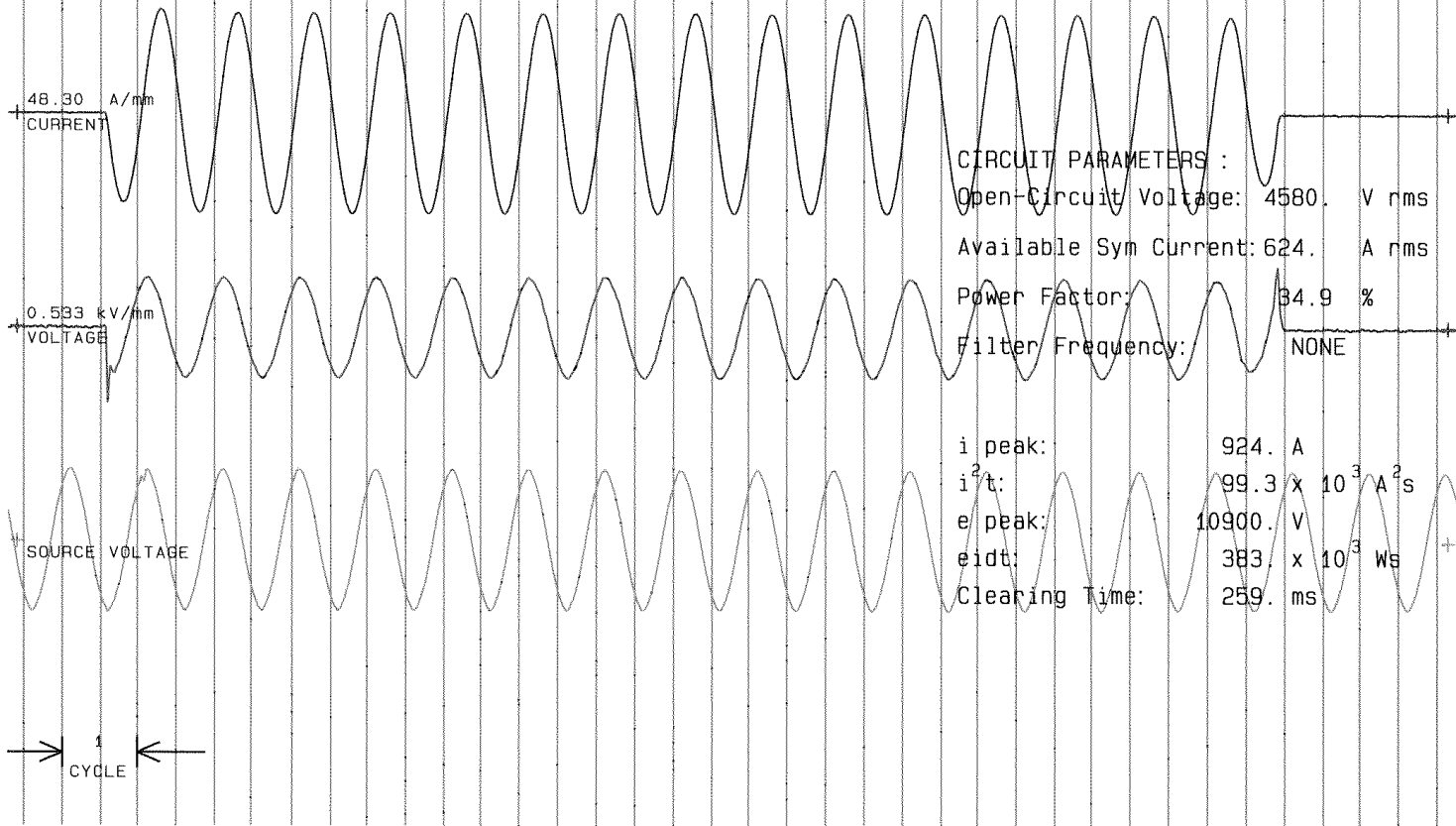
3/25/2004

**Rockwell
Automation**

**Allen-Bradley
High Current Laboratory**

Date: 2/17/04 9:24
Plot No. 6

Device: Unit B 167kVA 7620 Volt
Type of Test: 15 Cycle short circuit



CIRCUIT PARAMETERS :
Open-Circuit Voltage: 4580. V rms
Available Sym Current: 624. A rms
Power Factor: 34.9 %
Filter Frequency: NONE

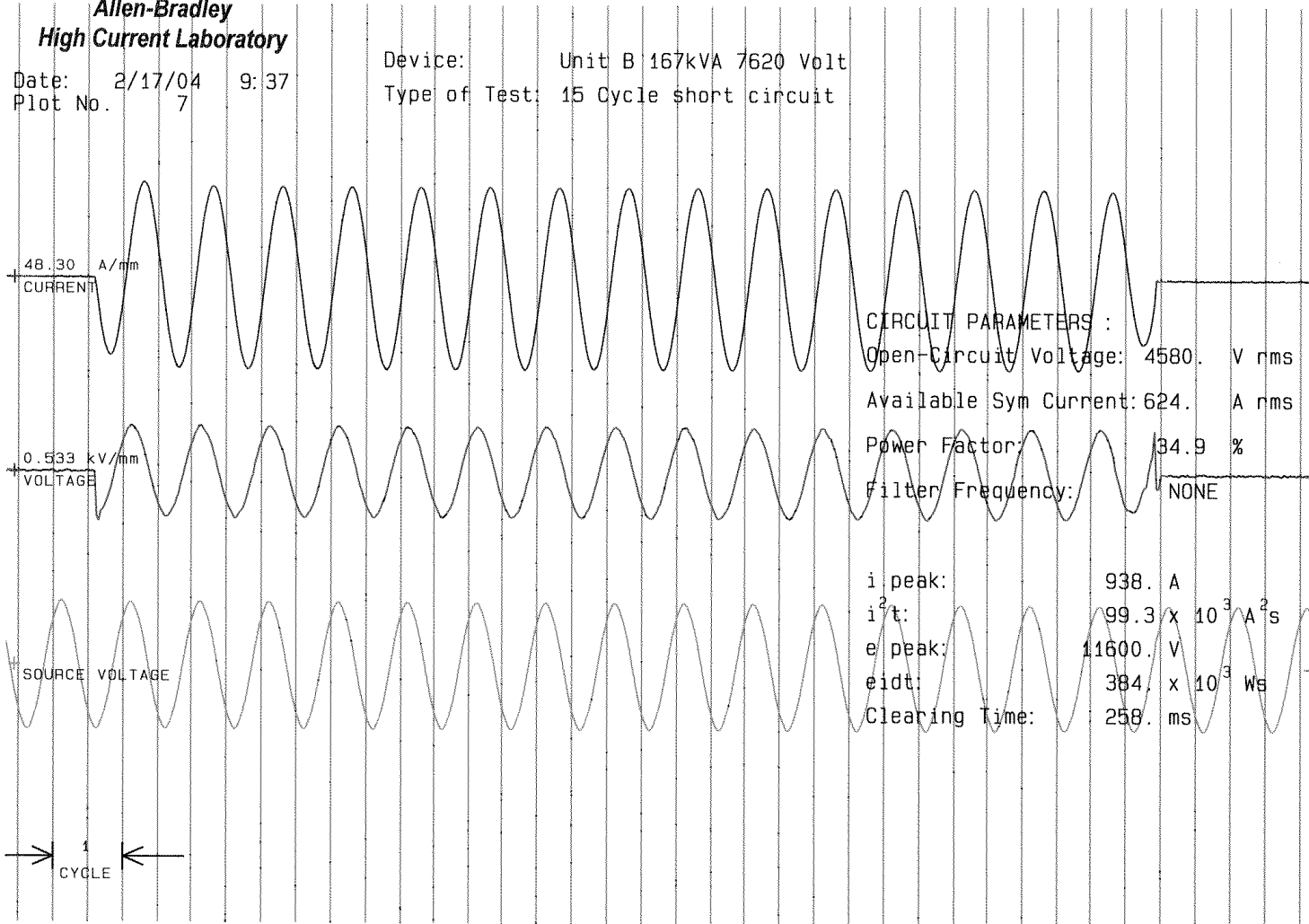
i peak: 924. A
 i^2t : $99.3 \times 10^3 \text{ A}^2\text{s}$
e peak: 10900. V
eidt: $383. \times 10^3 \text{ Ws}$
Clearing Time: 259. ms

Rockwell Automation

Allen-Bradley High Current Laboratory

Date: 2/17/04 9:37
Plot No. 7

Device: Unit B 167kVA 7620 Volt
Type of Test: 15 Cycle short circuit

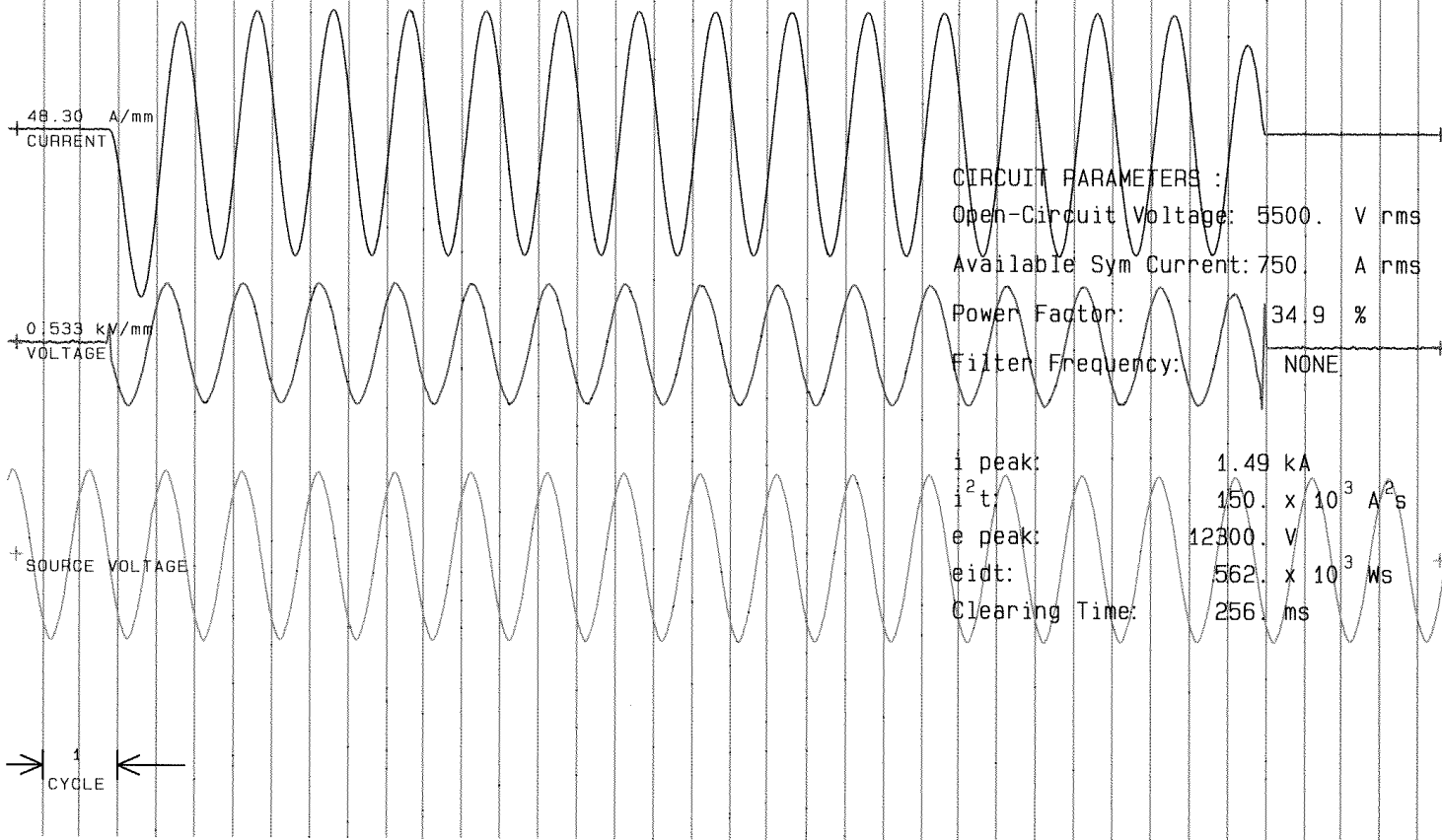


Rockwell Automation

Allen-Bradley High Current Laboratory

Date: 2/17/04 9:53
Plot No. 8

Device: Unit B 167kVA 7620 Volt
Type of Test: 15 Cycle short circuit



CIRCUIT PARAMETERS :
Open-Circuit Voltage: 5500. V rms
Available Sym Current: 750. A rms
Power Factor: 34.9 %
Filter Frequency: NONE

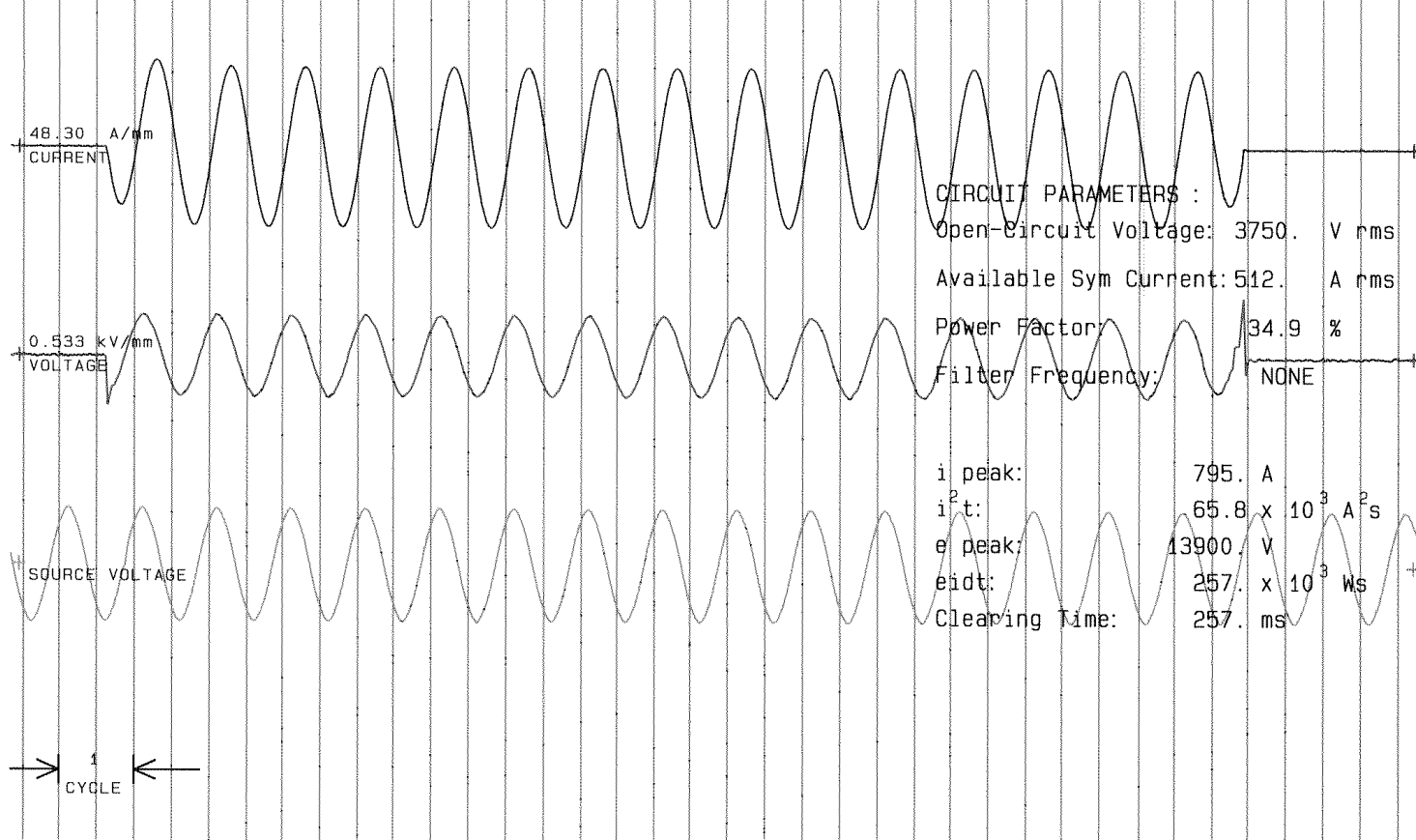
i peak: 1.49 kA
i²t: 150. x 10³ A²s
e peak: 12300. V
eidt: 562. x 10³ Ws
Clearing Time: 256. ms

Rockwell Automation

Allen-Bradley
High Current Laboratory

Date: 2/17/04 10:02
Plot No. 9

Device: Unit B 167kVA 7620 Volt
Type of Test: 15 Cycle short circuit

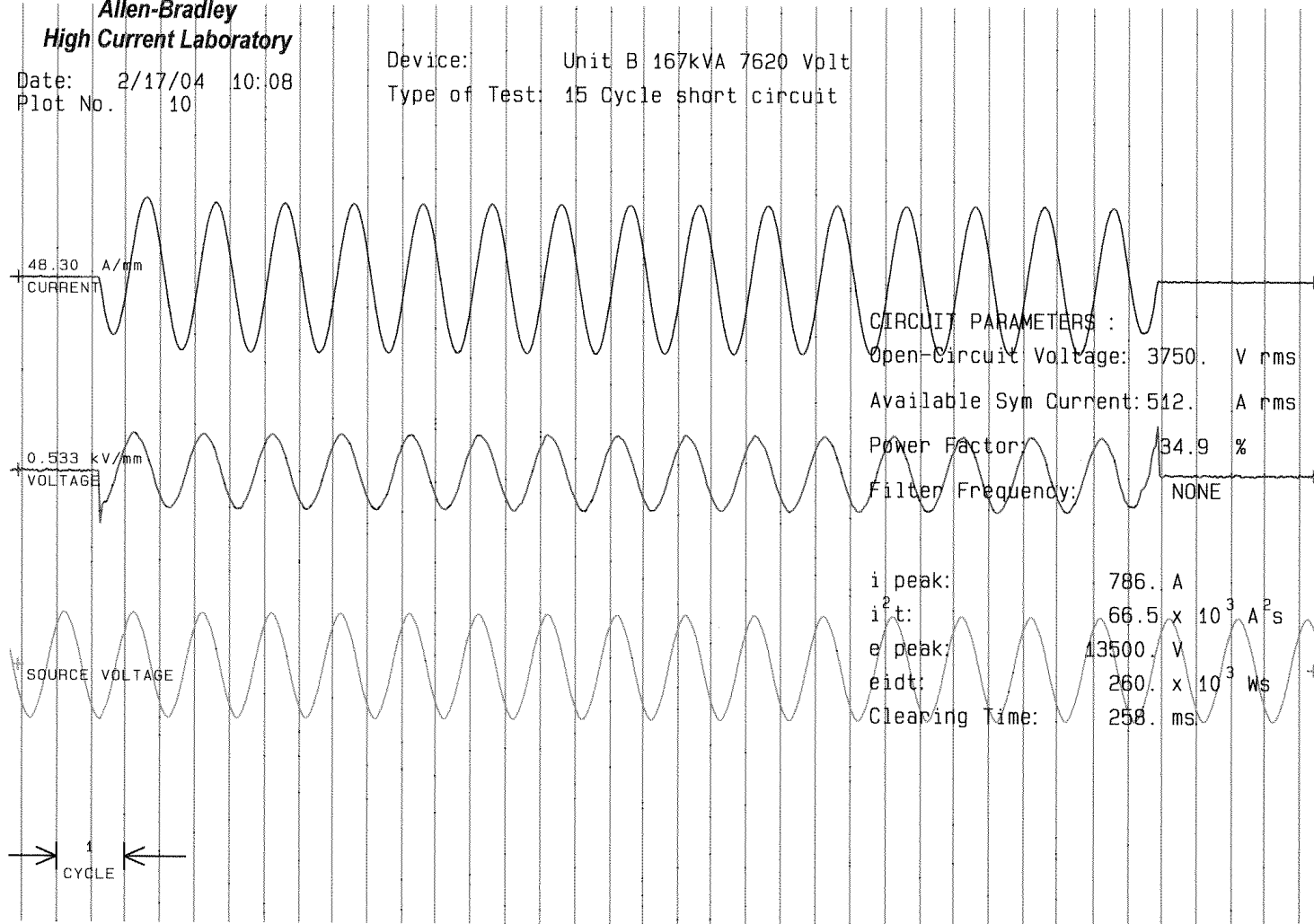


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Automation**

**Allen-Bradley
High Current Laboratory**

Date: 2/17/04 10:08
Plot No. 10

Device: Unit B 167kVA 7620 Volt
Type of Test: 15 Cycle short circuit



Rockwell Automation

Allen-Bradley High Current Laboratory

Date: 2/17/04 10:14
Plot No. 11

Device: Unit B 167kVA 7620 Volt
Type of Test: 15 Cycle short circuit

