

# Test Report No. 1530

Date Issued: 12 August, 2010

Product: "3MVA SafeARC MK1" Interrupter Module  
Fitted with Bussman 170M6208, 500A fuse-links  
(Eight fuse-links per phase)

Clients rating:  $U_c = 415 \text{ V } 50 \text{ Hz}$   
 $I_{cr} = 63, 40, 20, 15, 13, 12 \text{ kA}$   
 $I_n = 3200 \text{ A}$

Client: PACE Electrotech Pty Ltd  
Level 2, 28 Fortescue Street  
Spring Hill  
Queensland 4004  
Australia

Nature of tests: Testing of outgoing circuits according to  
Clause 8.2.3.2.3 a) of AS/NZS 3439.1:2002.  
and additional test to client's requirements


Result: Refer results herein.

Prepared by:



John Strugarek

NATA Approved Signatory:



Antony K. Milovac

Tested at: ITACS High Power

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ACCREDITATION No. 1700

**GENERAL:**

- a This report shall not be reproduced, except in full. Other details are in the testing record file No. 1530.
- b As detailed in this report, one specimen of the “3MVA SafeARC MK1” Interrupter Module labelled S1530/1 was tested.
- c The results detailed in this report were based on the sample submitted by the client with order No. 00422. ITACS disclaims any and all responsibility or obligation for any other item.
- d The test sample was subjected to the relevant clauses as stated herein.
- e Reporting of results herein is in accordance with NATA recommendations taking into account Uncertainty of Measurement. Where measurement is on the limit or below the limit it is deemed to comply. Where measurement is above the limit it is deemed not to comply.
- f Power supplies used were mains derived a.c. voltage sources of substantially sinusoidal waveform with a nominal frequency of 50 Hz unless otherwise noted.
- g Dates of high current tests are shown on oscillograms.
- h Note: N/R means Not Relevant, N/T means Not Tested, DNC means Did Not Comply, T.O. means Test Object.

**WITNESSES:**

Bob Fuller  
Brad Gradwell

PACE Electrotech  
PACE Electrotech

**TEST SPECIFICATION**

AS/NZS 3439.1: 2002

Low-voltage switchgear and controlgear assemblies  
Part 1: Type-tested and partially type-tested assemblies

**DATE OF TEST**

The testing was performed between the 31<sup>st</sup> of May and the 2<sup>nd</sup> of June 2010.

**DESCRIPTION**

**“3MVA SafeARC MK1” Interrupter Module**

The SafeARC Interrupter Module consists of a painted metal enclosure and lift off door approximately 1800 mm high by 900 mm wide by 800 mm deep. The single copper plated 200 mm by 25 mm incoming and outgoing phase connectors one each per phase were supported by Fibon supports bolted to brackets located inside the assembly.

The incoming phase connectors had provision for connecting bars exiting the back of the assembly for connecting the assembly to a transformer. The outgoing phase connectors were fitted with a busbar cable connector with provision for connecting cables entering the assembly through the base.

Bolted between the incoming and outgoing phase connectors were a set of eight fuse-links per phase on 80 mm centres between each pair and 135 mm between pairs.

Fuse-link specification

Bussmann 170M6208  
500 A  
690 V~ IEC  
700 V~ ЯU  
IR700-200kA  
3TN/110

Technical specification supplied by the Client:

Rated fused short-circuit current	63, 40, 20, 15, 13, 12 kA
Rated Voltage	415 V
Rated Frequency	50 Hz

**Drawing supplied by the manufacturer is included in the Appendix.**

**RESULTS**

**If not indicated, the following Clauses refer to AS/NZS 3439.1:2002**

Clause 8.2.3 Verification of short-circuit withstand strength

Clause 8.2.3.1 Circuits of ASSEMBLIES which are exempted from the verification of the short-circuit withstand strength

Clause 8.2.3.2 Circuits of ASSEMBLIES the short-circuit withstand strength of which shall be verified

Clause 8.2.3.2.1 Test arrangements

The ASSEMBLY was tested as in normal use

Clause 8.2.3.2.2 Performance of the test – General

The test circuit incorporated fuse-links of the type indicated by the manufacturer as being acceptable.

The supply conductors and short-circuit connections required for testing the ASSEMBLY had sufficient strength to withstand the short-circuit and were so arranged that they did not introduce any additional stresses.

The three-phase test circuit was connected to the input terminals.

The value of the prospective short-circuit current at a supply voltage equal to 1.05 times the rated operational voltage was determined from a calibration oscillogram which was taken with the supply conductors to the ASSEMBLY short-circuited by a connection of negligible impedance placed as near as possible to the input of the ASSEMBLY.

The test circuit included a fuse of copper wire 0.8 mm diameter and not less than 50 mm in length, for the detection of the fault current. The prospective fault current in the fusible-element circuit was 1500 A  $\pm$ 10%.

Clause 8.2.3.2.3 Testing of the main circuits

a) The outgoing circuits included components, which have not previously been subjected to the appropriate tests.

For testing the outgoing circuit, the associated outgoing terminals were provided with a bolted short-circuit connection located within the ASSEMBLY under test.

The test voltage was applied once and for a time sufficient long to enable the short-circuit protective device in the outgoing unit to operate to clear the fault, and in any case for not less than 10 cycles.

Clause 8.2.3.2.4 Value and duration of the short-circuit current

a) The ASSEMBLIE was protected by short-circuit protective devices, the test voltage was applies for a time sufficiently long to enable the short-circuit protective devices to operate to clear the fault and, in any case for not less than 10 cycles.

The required test values for tests

<b>Test Voltage (Ph-Ph): [V] (+5%,-0%)</b>	435.75					
<b>Prospective Current: [kA] (+5%,-0%)</b>	63	40	20	15	13	12
<b>n</b>	≥2.2	≥2.1	≥2.0			
<b>Power Factor: (+0, -0.05)</b>	0.20	0.25	0.30			
<b>Test Frequency: [Hz] (±25%)</b>	50					
<b>Protective Devices: 8 per phase</b>	Bussman 170M6208 fuse-links					

Test procedure:

The test supply was adjusted and calibrated to achieve the prospective current. The point of supply for all tests was at the 100 mm by 20 mm per phase copper bar connection located at the back of the assembly.

The test object was connected to the test supply and fuse-links replaced between tests.

The shorting link provided by the client was connected between the busbar cable connectors located at the bottom of the assembly.

The fusible-element was connected between the metal frame of the assembly and the neutral point of the test supply.

Calibration test values

		1530/Cal1/1	1530/Cal2/1	1530/Cal3/1
<b>Prospective Current [kA RMS]</b>	<b>R</b>	64.1	43.6	21.0
	<b>W</b>	63.4	42.9	20.6
	<b>B</b>	63.4	43.6	20.9
<b>Power Factor</b>	<b>R</b>	0.16	0.25	<0.25*
	<b>W</b>	0.16	0.25	<0.25*
	<b>B</b>	0.17	0.25	<0.25*
<b>Peak Current [kA]</b>	<b>R</b>	143	87.7	45.4
	<b>W</b>	97.8	65.6	33.4
	<b>B</b>	127.6	77.7	39.3
<b>Applied Voltage [V]</b>	<b>R</b>	262	261	260
	<b>W</b>	261	260	260
	<b>B</b>	261	261	260

		1530/Cal4/1	1530/Cal5/1	1530/Cal6/1
<b>Prospective Current [kA RMS]</b>	<b>R</b>	14.9	15.5	12.2
	<b>W</b>	13.9	15.3	12.1
	<b>B</b>	14.0	15.6	12.3
<b>Power Factor</b>	<b>R</b>	<0.25*	<0.25*	<0.25*
	<b>W</b>	<0.25*	<0.25*	<0.25*
	<b>B</b>	<0.25*	<0.25*	<0.25*
<b>Peak Current [kA]</b>	<b>R</b>	33.1	34.2	27.9
	<b>W</b>	22.4	22.7	20.1
	<b>B</b>	27.9	31.2	24.2
<b>Applied Voltage [V]</b>	<b>R</b>	260	261	262
	<b>W</b>	260	261	262
	<b>B</b>	260	261	262

Note: \* Customer agreed with lower power factors.

Clause 8.2.3.2.5 Results to be obtained

Requirements:

- No significant deformation of conductors.
- No significant deterioration of insulating parts.
- No indication of a fault current through the fusible-element.
- No loosening of connections.
- No significant distortion of assembly frame.
- Dielectric properties of T.O. are satisfied.
- Apparatus incorporated is in a condition as prescribed in the relevant standard.

Tests at 63 kA

Oscillogram Test No.		1530/1/1	1530/1/2	1530/1/3	1530/1/4
Oscillogram Calibration No.		1530/Cal1/1			
Peak Current [kA]	R	28.3	26.3	27.4	28.3
	W	34.3	34.5	34.7	34.7
	B	28.3	17.3	27.5	28.4
Applied Voltage [V] Phase to neutral	R	261	261	262	263
	W	261	261	262	263
	B	261	261	261	262
Current Duration [ms]	R	5.8	7.9	6.3	5.8
	W	3.7	3.6	3.9	3.9
	B	5.8	7.9	6.3	5.8
I <sup>2</sup> t [10 <sup>6</sup> A <sup>2</sup> s]	R	1.41	2.39	1.33	1.32
	W	1.49	1.85	1.65	1.61
	B	1.22	0.99	1.41	1.19
Fuse-links operated (phases)		R, W, B	R, W	R, W, B	R, W, B
Covers, doors and fasteners		Intact	Intact	Intact	Intact
Fine Wire Fuse (fault current)		Intact	Intact	Intact	Intact
Conductor Deformation		None	None	None	None
Insulation Deterioration		None	None	None	None
Loosening of Connections		None	None	None	None
Deformation of Enclosure		None	None	None	None

Note 1: Tests 1 & 2 torque of 50 Nm was applied to the fixing bolts of fuse-links by the client.

Note 2:

Average marked resistance value of fuse-links test 1530/1/2.

R Ø = 0.2478 mΩ (21 °C)

W Ø = 0.2527 mΩ (21 °C)

B Ø = 0.2508 mΩ (21 °C)

Average marked resistance value of fuse-links test 1530/1/3.

R Ø = 0.2483 mΩ (21 °C)

W Ø = 0.2501 mΩ (21 °C)

B Ø = 0.2524 mΩ (21 °C)

Tests at 40 kA and 20 kA

Oscillogram Test No.		1530/2/1	1530/3/1	1530/3/2	1530/3/3
Oscillogram Calibration No.		1530/Cal2/1	1530/Cal3/1		
Peak Current [kA]	R	27.0	24.4	23.7	23.7
	W	31.9	26.6	27.3	27.6
	B	27.2	14.0	15.4	23.8
Applied Voltage [V] Phase to neutral	R	260	260	259	259
	W	260	260	259	259
	B	260	260	259	259
Current Duration [ms]	R	7.0	10.0	10.4	9.5
	W	4.6	5.9	6.2	6.5
	B	7.0	10.0	10.4	9.5
I <sup>2</sup> t [10 <sup>6</sup> A <sup>2</sup> s]	R	1.52	1.91	2.03	2.39
	W	1.59	1.75	1.87	1.88
	B	1.38	0.63	0.83	1.37
Fuse-links operated (phases)		R, W, B	R, W	R, W	R, W, B
Covers, doors and fasteners		Intact	Intact	Intact	Intact
Fine Wire Fuse (fault current)		Intact	Intact	Intact	Intact
Conductor Deformation		None	None	None	None
Insulation Deterioration		None	None	None	None
Loosening of Connections		None	None	None	None
Deformation of Enclosure		None	None	None	None

Tests at 13 kA

Oscillogram Test No.		1530/4/1	1530/4/2	1530/4/3*
Oscillogram Calibration No.		1530/Cal4/1		
Peak Current [kA]	R	25.6	27.0	26.5
	W	23.0	22.6	21.5
	B	12.8	19.3	19.9
Applied Voltage [V] Phase to neutral	R	260	260	261
	W	260	260	261
	B	260	260	261
Current Duration [ms]	R	10.8	10.0	9.4
	W	12.6	> 190	>490
	B	12.6	> 190	>490
I <sup>2</sup> t [10 <sup>6</sup> A <sup>2</sup> s]	R	2.14	2.54	2.32
	W	1.93	N/R	N/R
	B	0.57	N/R	N/R
Fuse-links operated (phases)		R, W	R	R
Covers, doors and fasteners		Intact	Intact	Intact
Fine Wire Fuse (fault current)		Intact	Intact	Intact
Conductor Deformation		None	None	None
Insulation Deterioration		None	None	None
Loosening of Connections		None	None	None
Deformation of Enclosure		None	None	None

Note: \* Fuse-links in White and Blue phase were from previous tests.



Tests at 15 kA

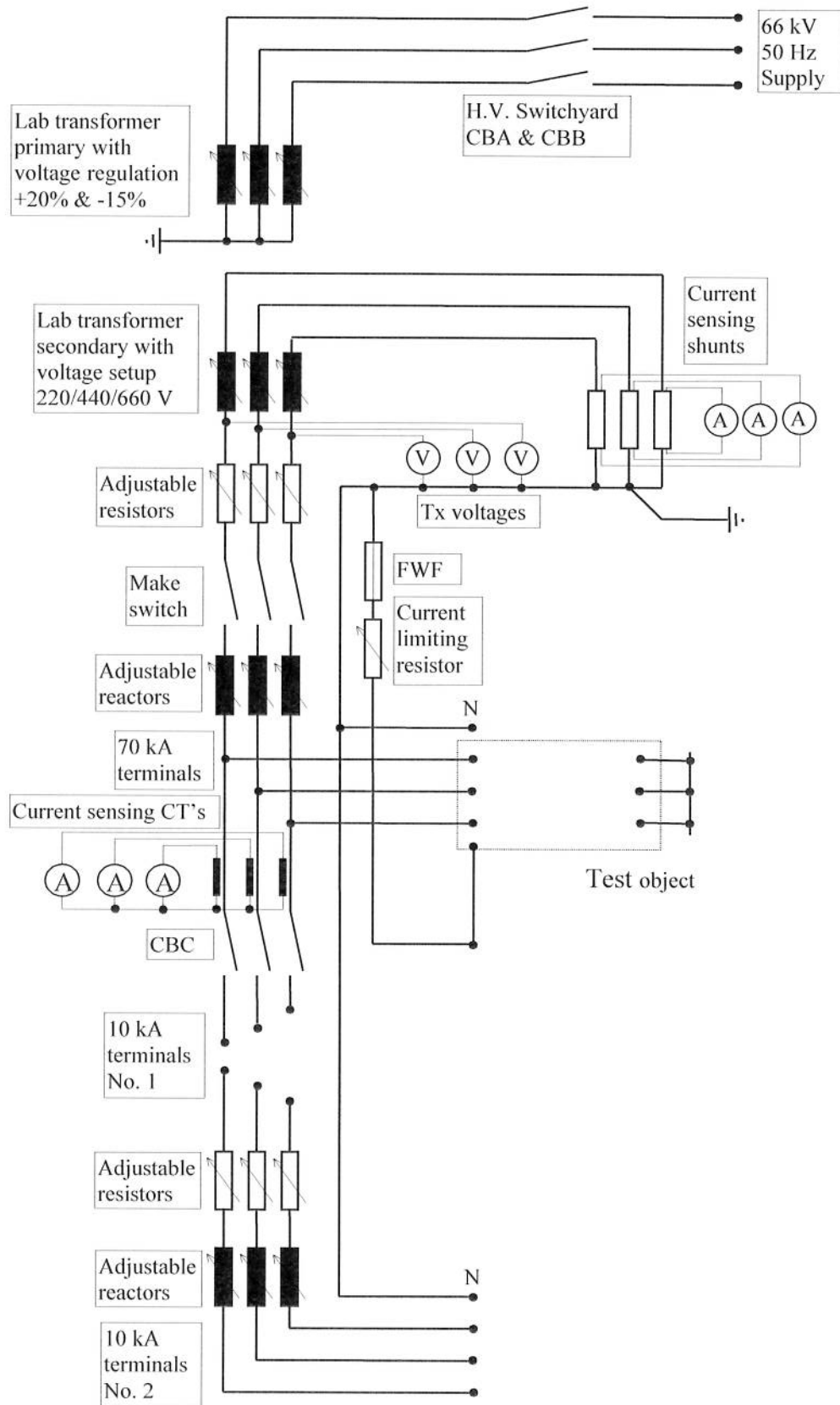
Oscillogram Test No.		1530/5/1	1530/5/2
Oscillogram Calibration No.		1530/Cal5/1	
Peak Current [kA]	R	27.2	26.9
	W	23.6	24.1
	B	21.7	12.5
Applied Voltage [V] Phase to neutral	R	260	261
	W	260	261
	B	260	261
Current Duration [ms]	R	9.7	10.4
	W	16.2	12.7
	B	16.2	12.7
I <sup>2</sup> t [10 <sup>6</sup> A <sup>2</sup> s]	R	2.42	2.21
	W	3.95	2.15
	B	1.95	0.54
Fuse-links operated (phases)		R, W	R, W
Covers, doors and fasteners		Intact	Intact
Fine Wire Fuse (fault current)		Intact	Intact
Conductor Deformation		None	None
Insulation Deterioration		None	None
Loosening of Connections		None	None
Deformation of Enclosure		None	None

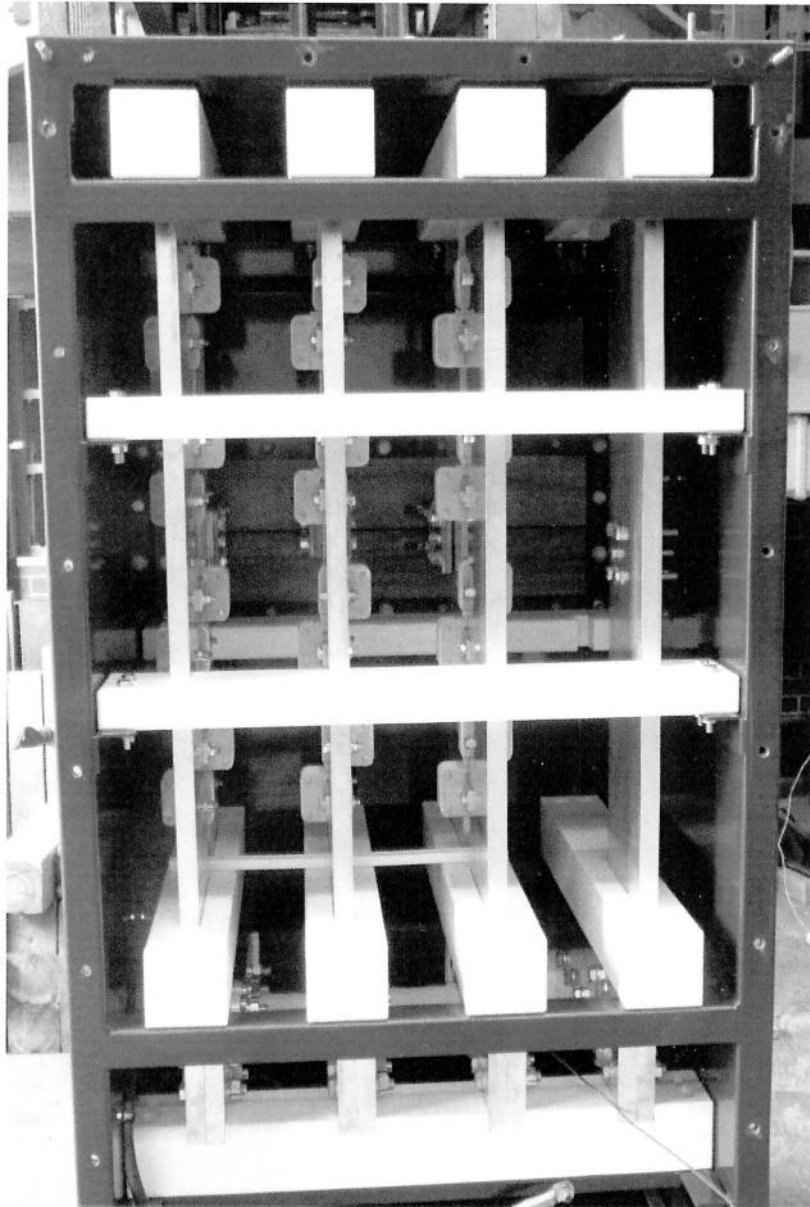
Tests at 12 kA

Oscillogram Test No.		1530/6/1	1530/6/2	1530/6/3
Oscillogram Calibration No.		1530/Cal6/1		
Peak Current [kA]	R	25.2	25.6	25.3
	W	18.6	19.0	19.2
	B	17.8	17.5	17.2
Applied Voltage [V] Phase to neutral	R	262	260	260
	W	262	260	259
	B	262	260	260
Current Duration [ms]	R	10.6	11.0	11.0
	W	5540	5606	6078
	B	5540	5606	6078
I <sup>2</sup> t [10 <sup>6</sup> A <sup>2</sup> s]	R	2.39	2.50	2.48
	W	610*	607*	655*
	B	610*	607*	655*
Fuse-links operated (phases)		R, B	R, B	R, W
Covers, doors and fasteners		Intact	Intact	Intact
Fine Wire Fuse (fault current)		Intact	Intact	Intact
Conductor Deformation		None	None	None
Insulation Deterioration		None	None	None
Loosening of Connections		None	None	None
Deformation of Enclosure		None	None	None

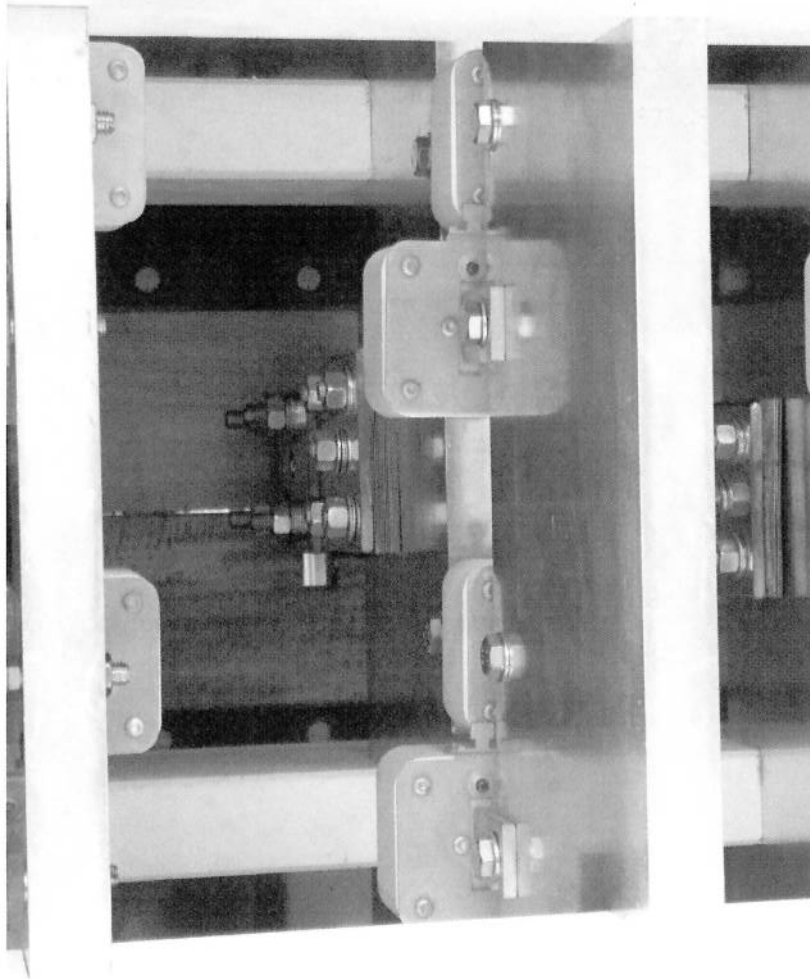
Note: \* Approximate values

The test circuit used for the tests:





**Photo 11035: Assembly door removed**



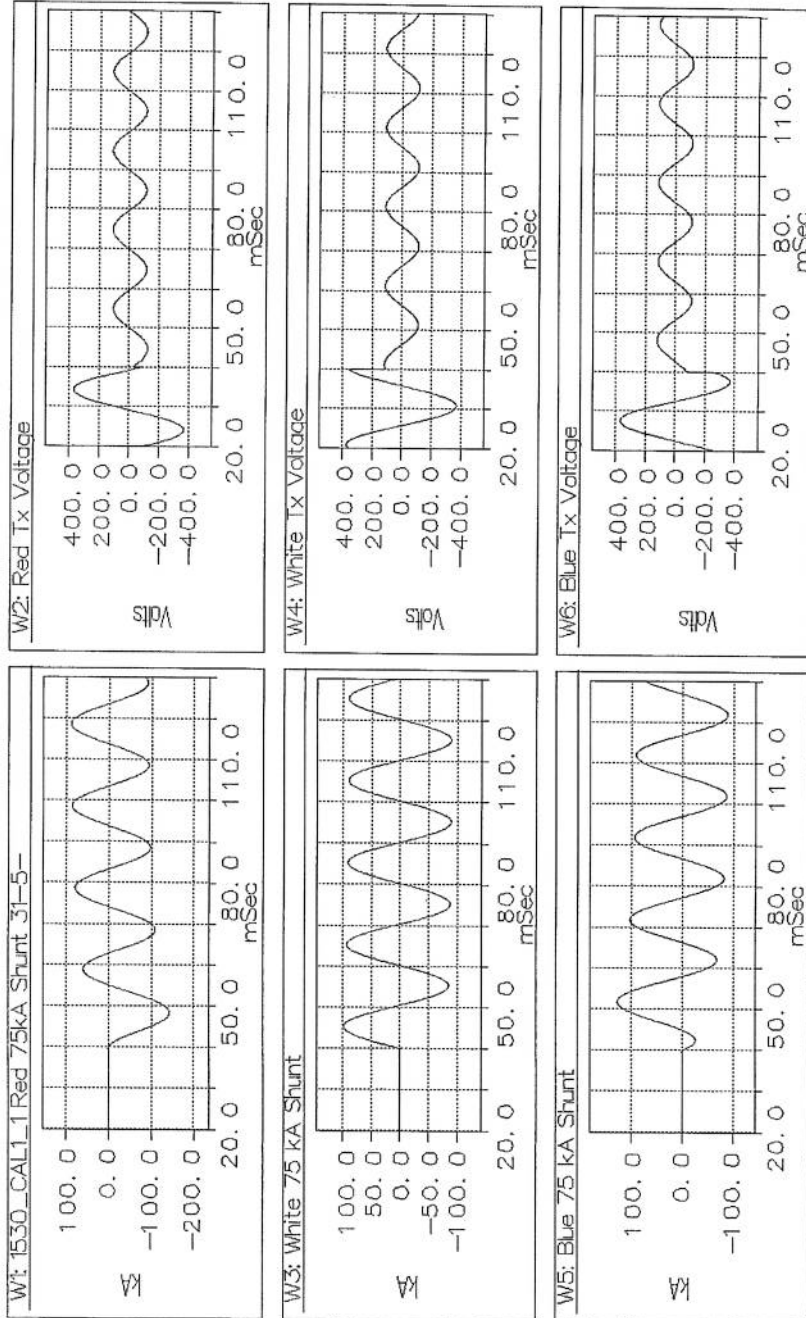
**Photo 11036: Fuse-links and incoming connection**

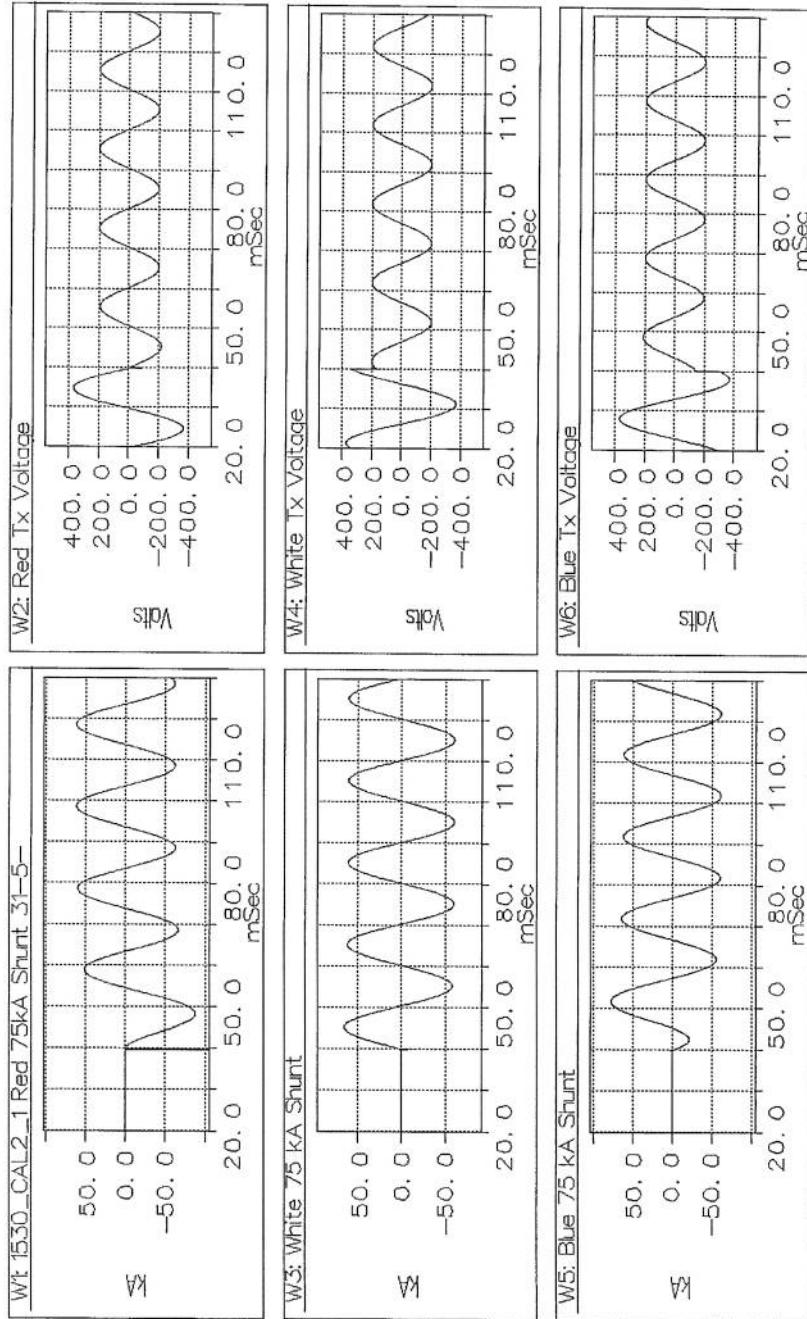


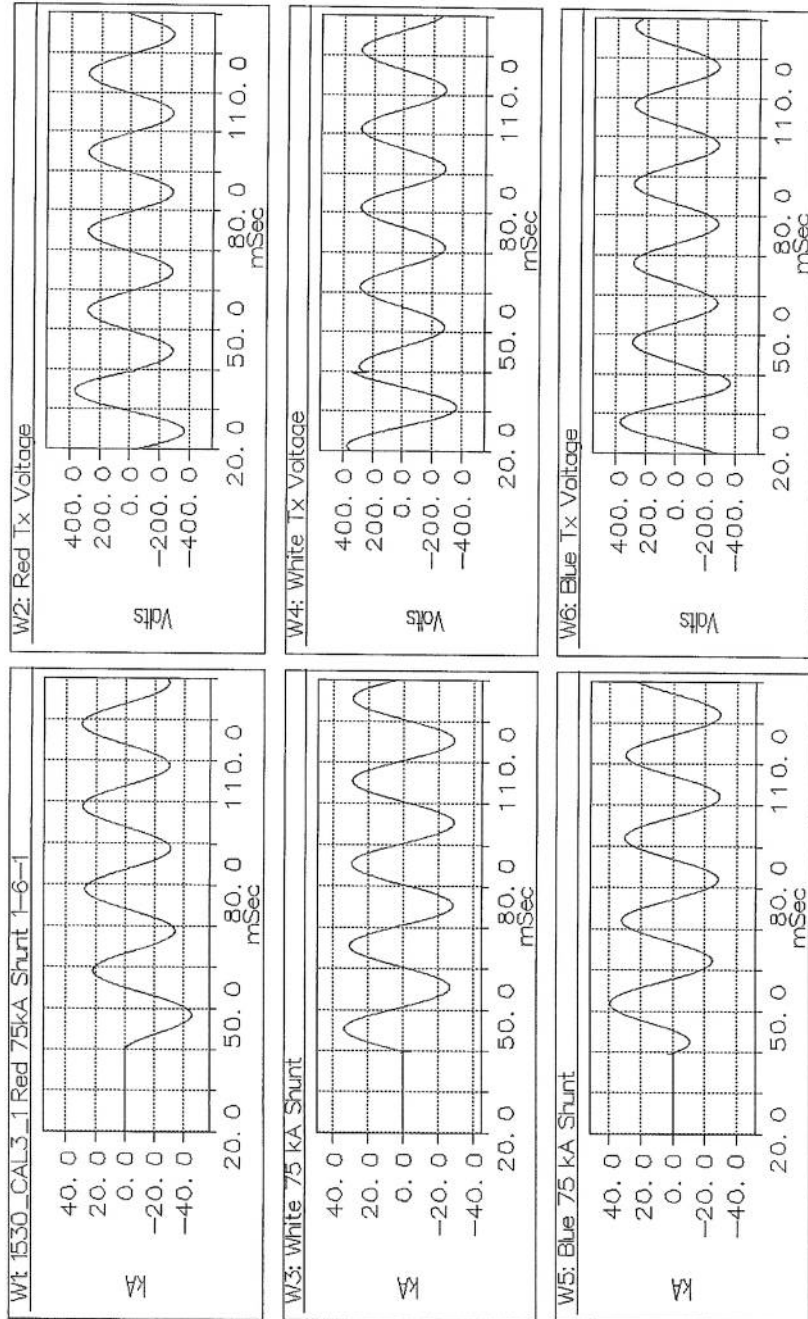
Photo 11037: Typical fuse-links fitted to assembly



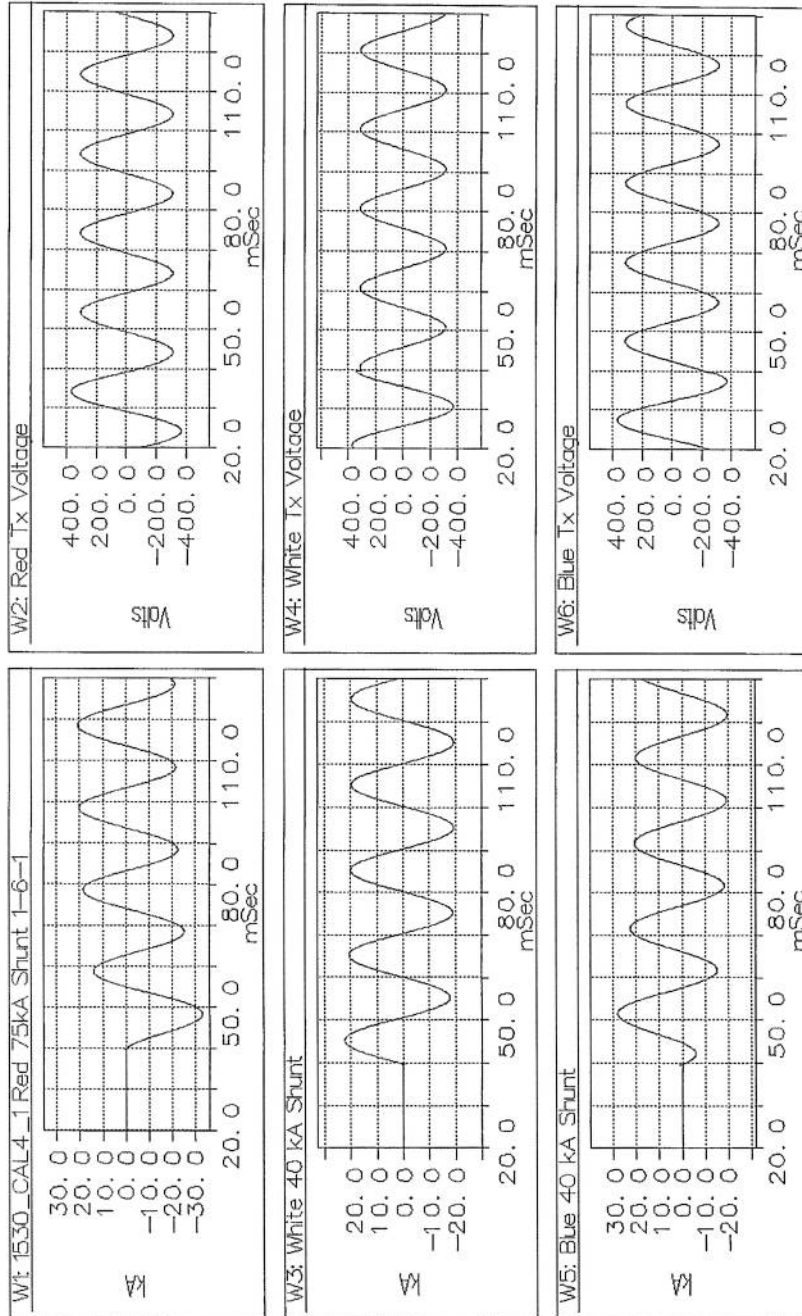
Photo 11038: Typical fuse-link

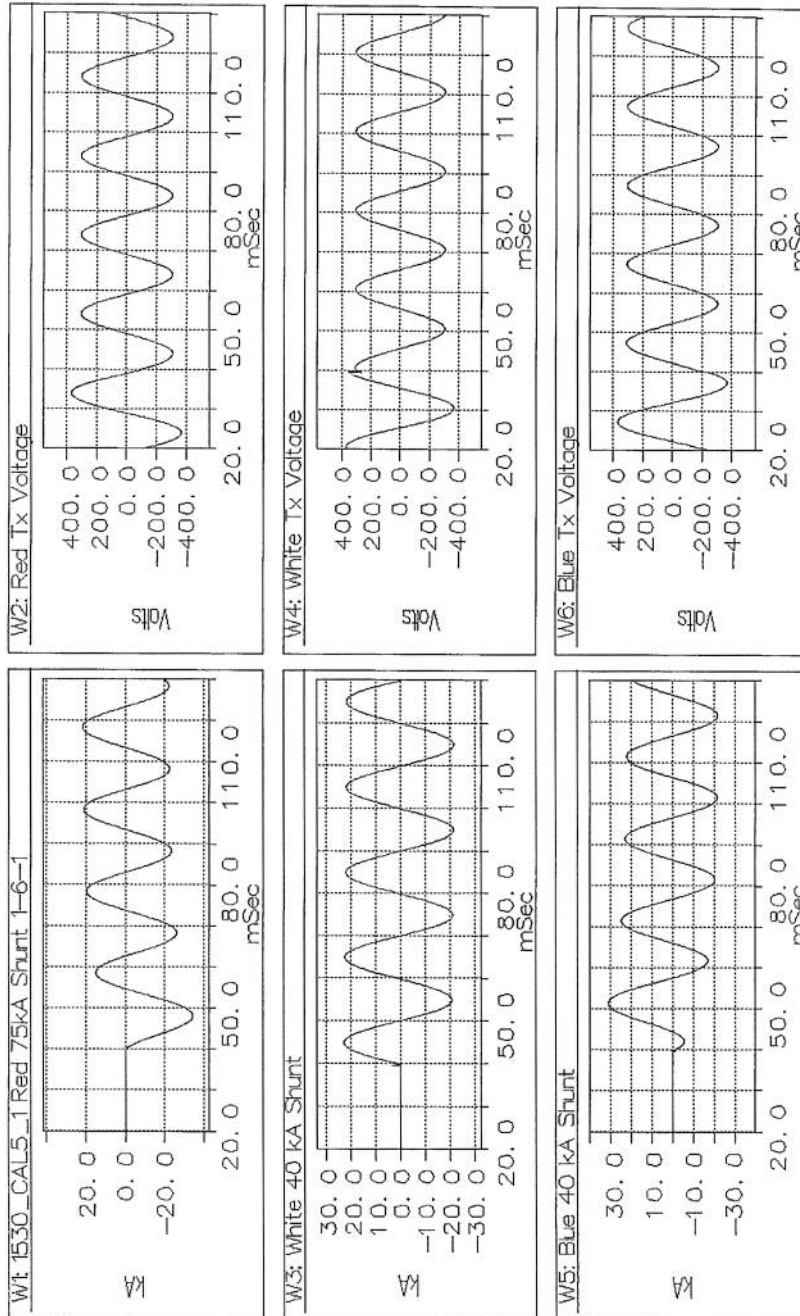


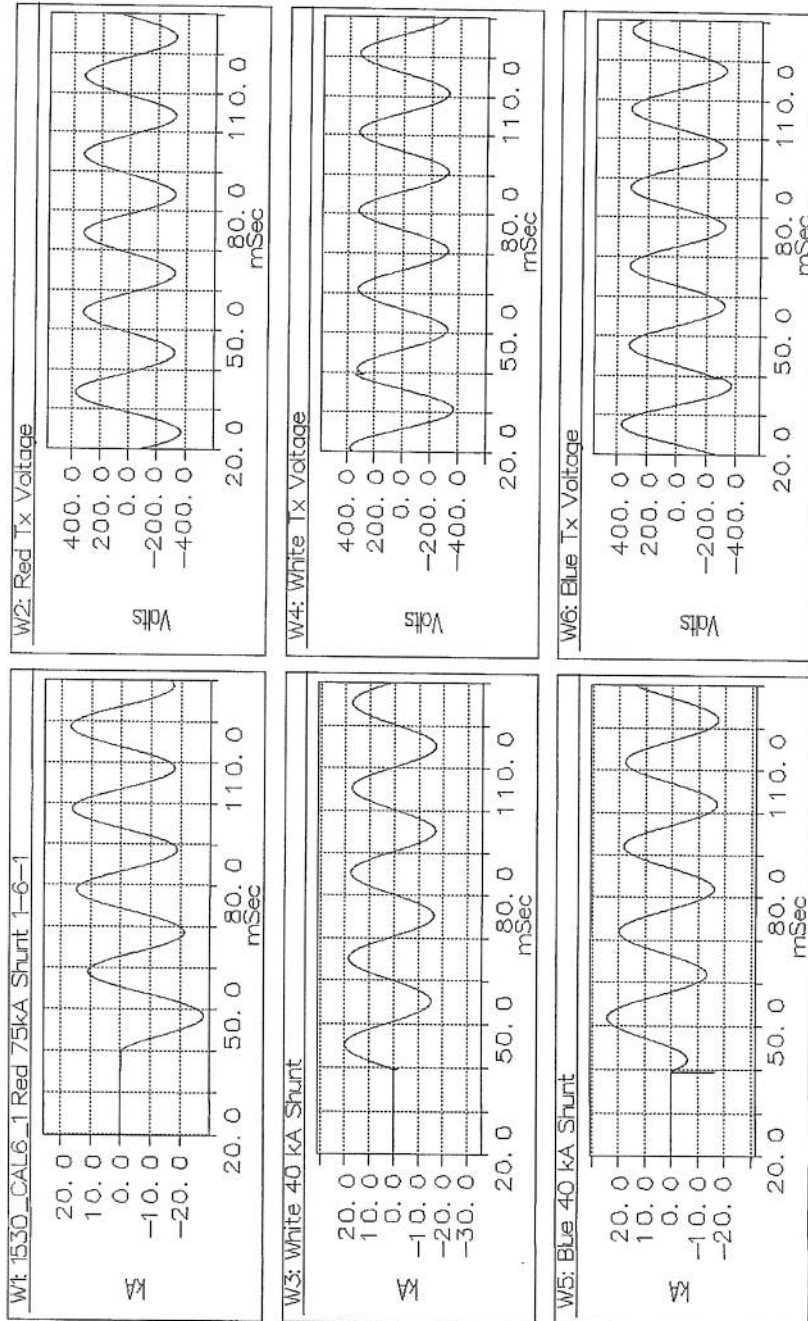


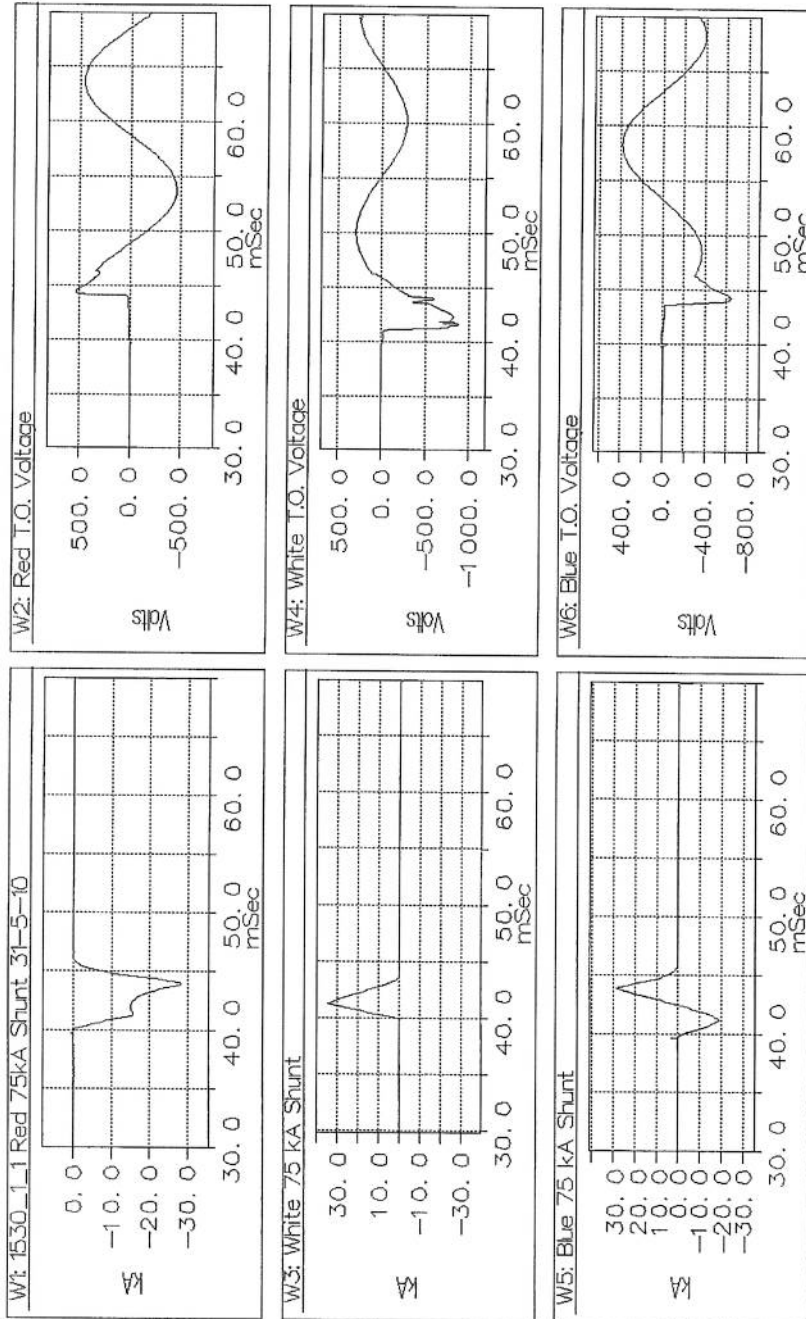


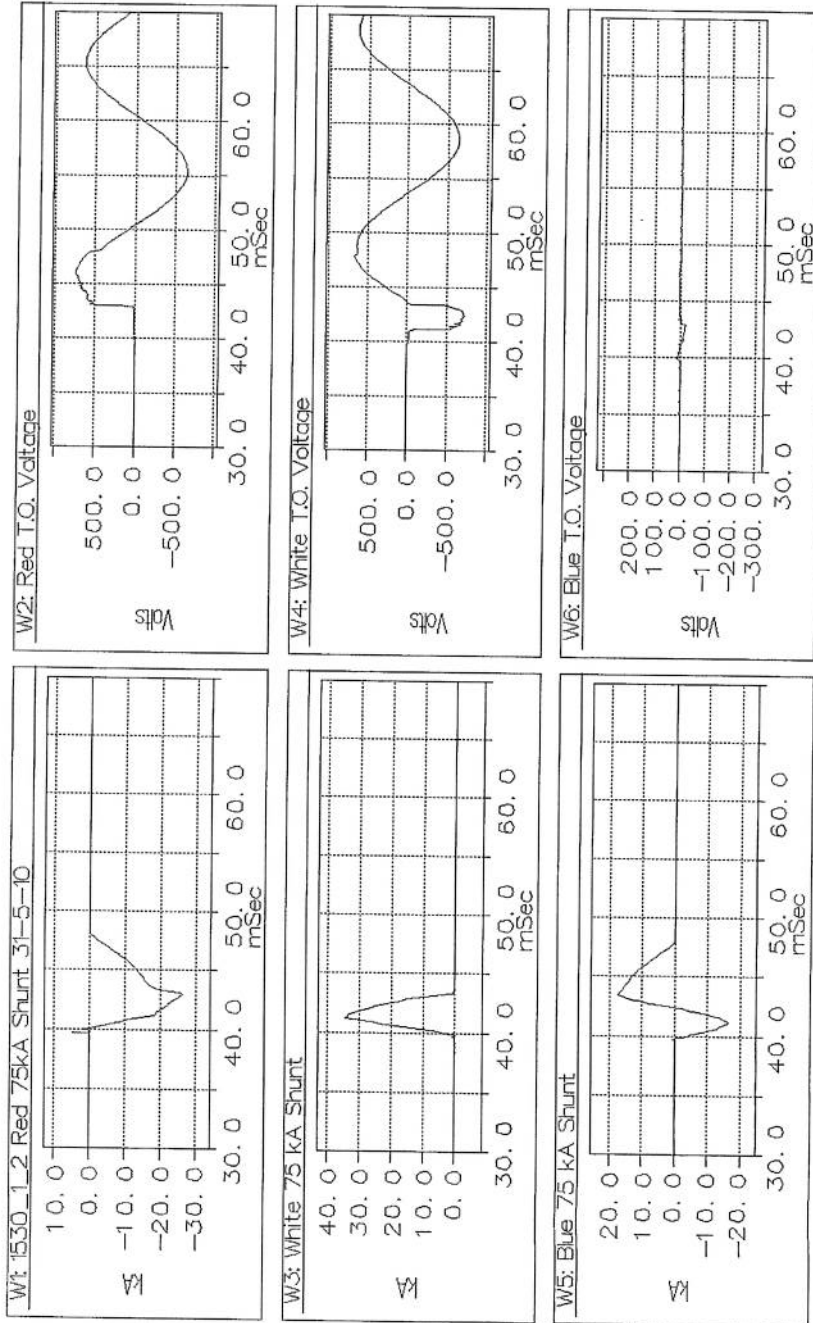


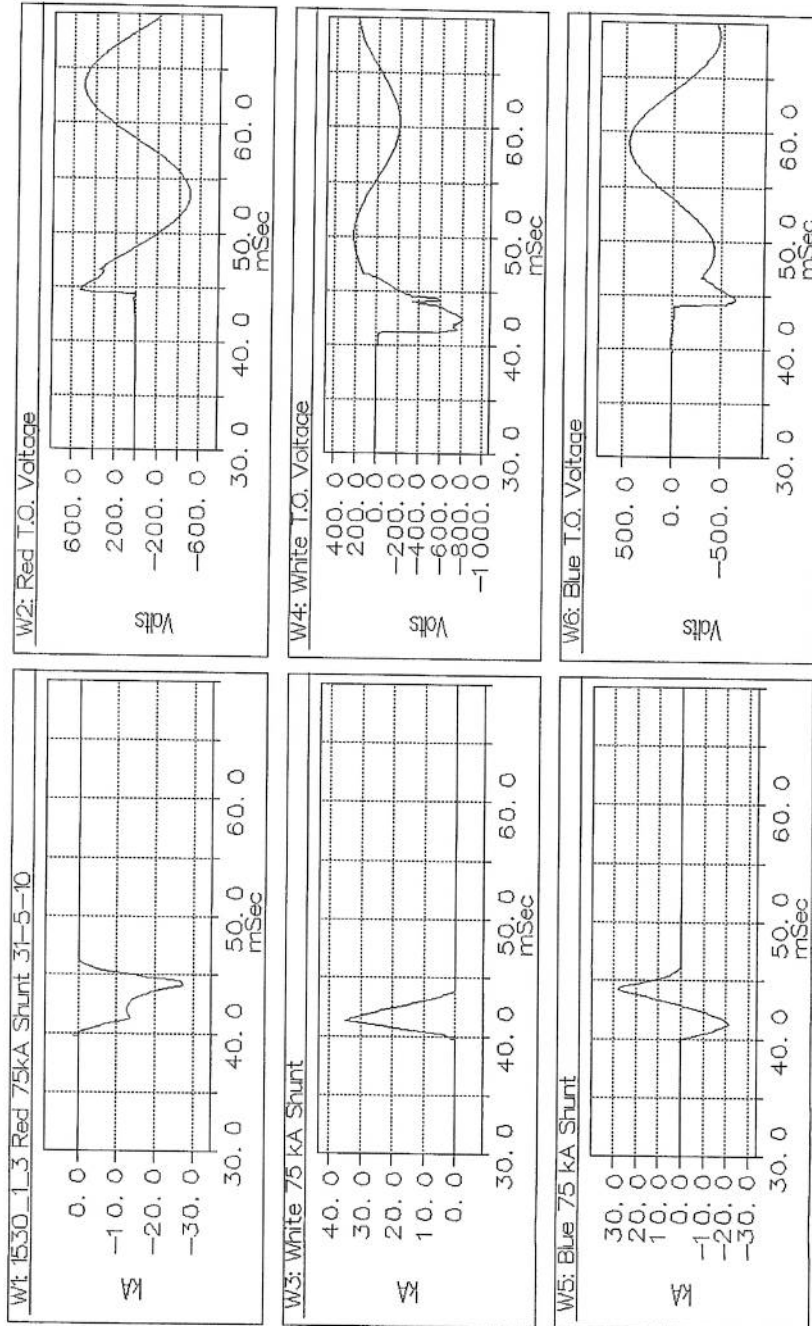


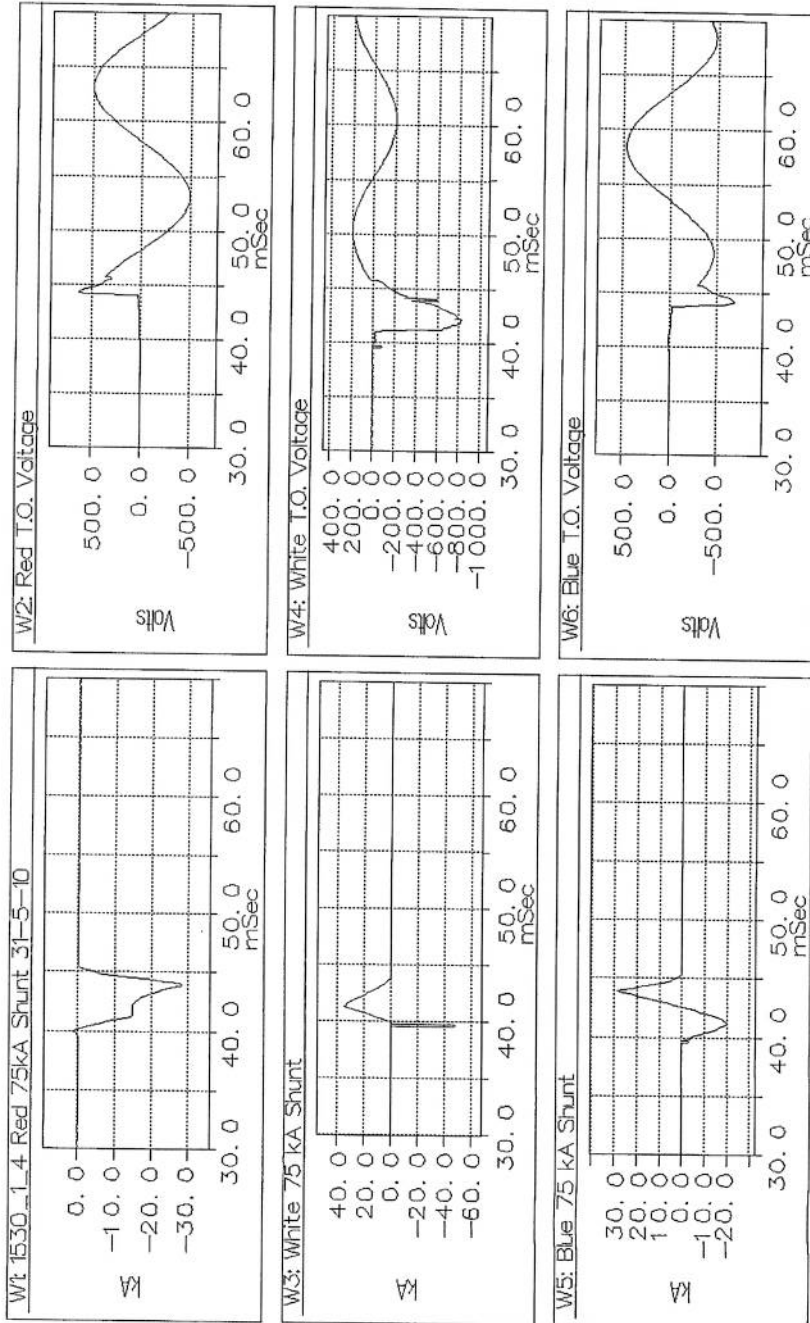


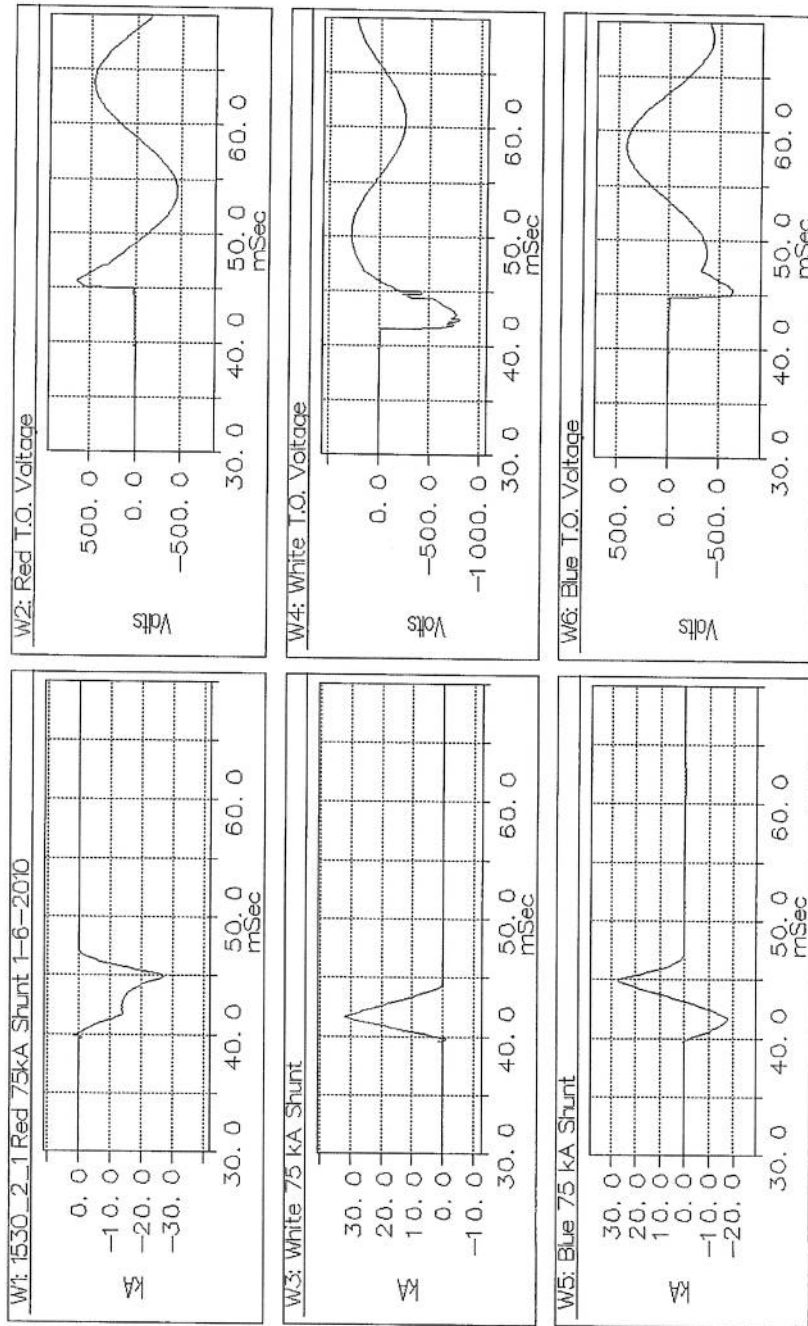




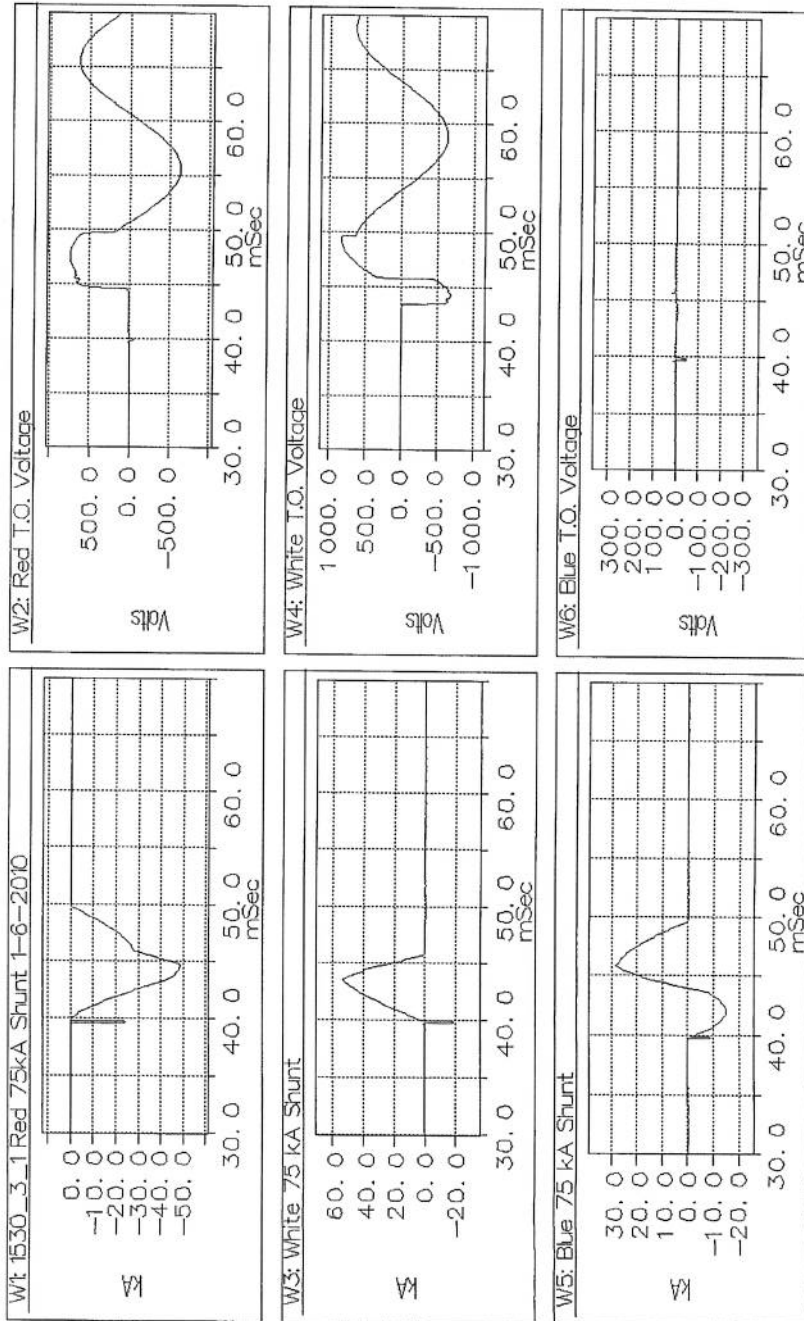


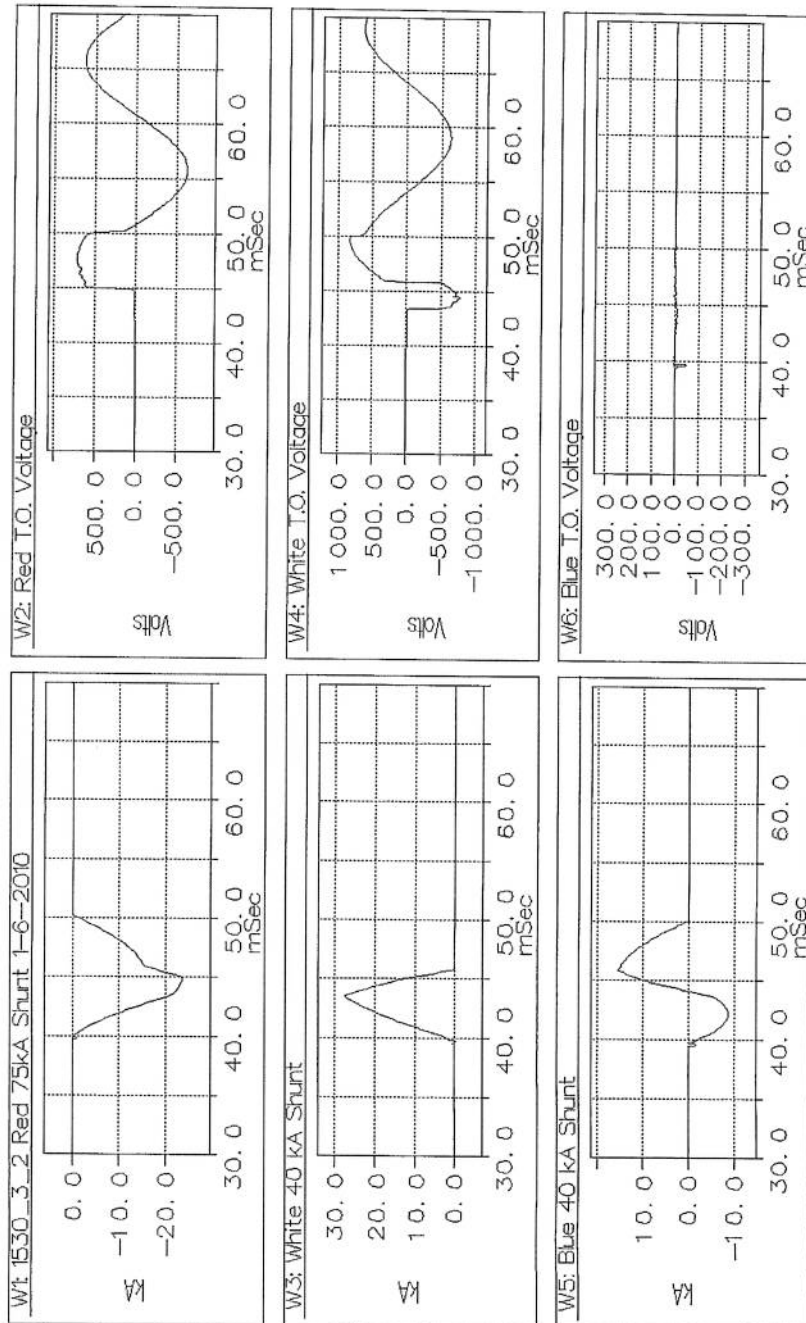


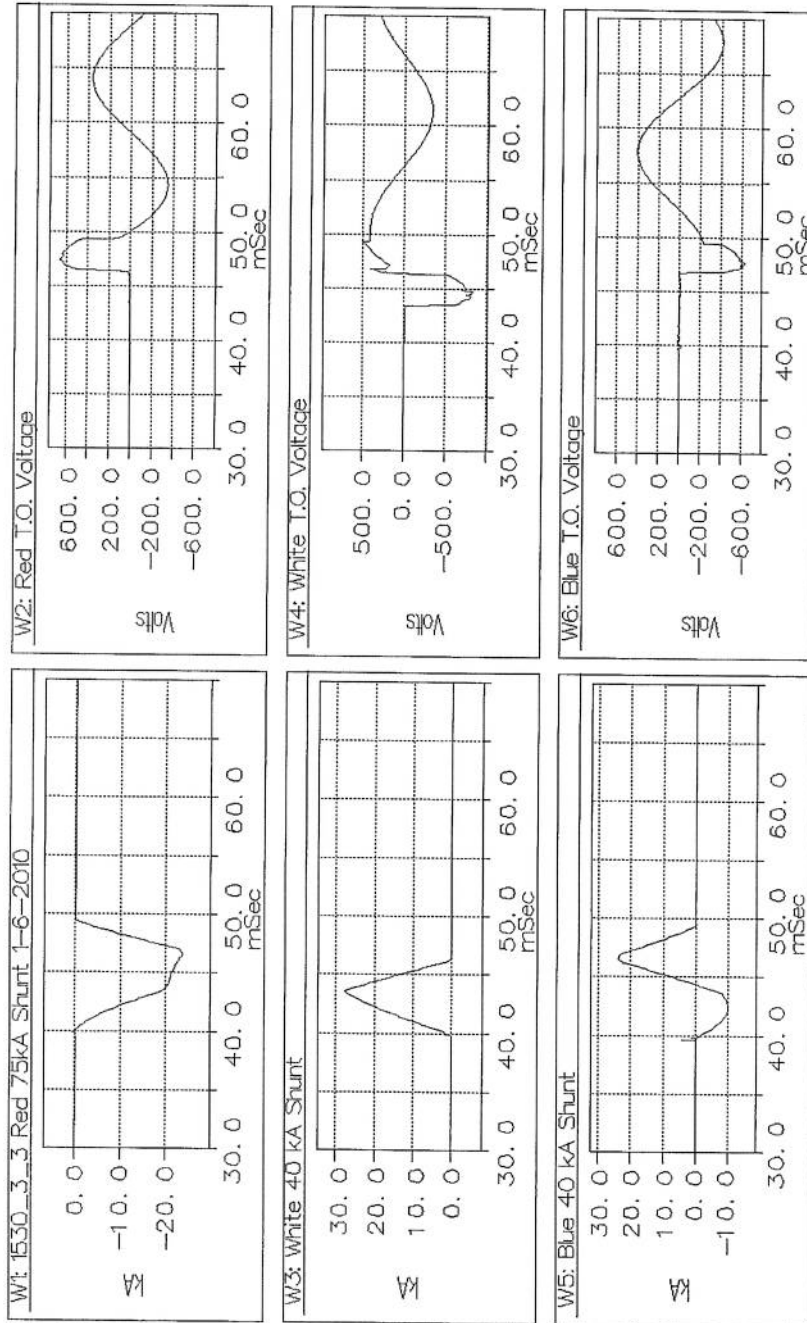


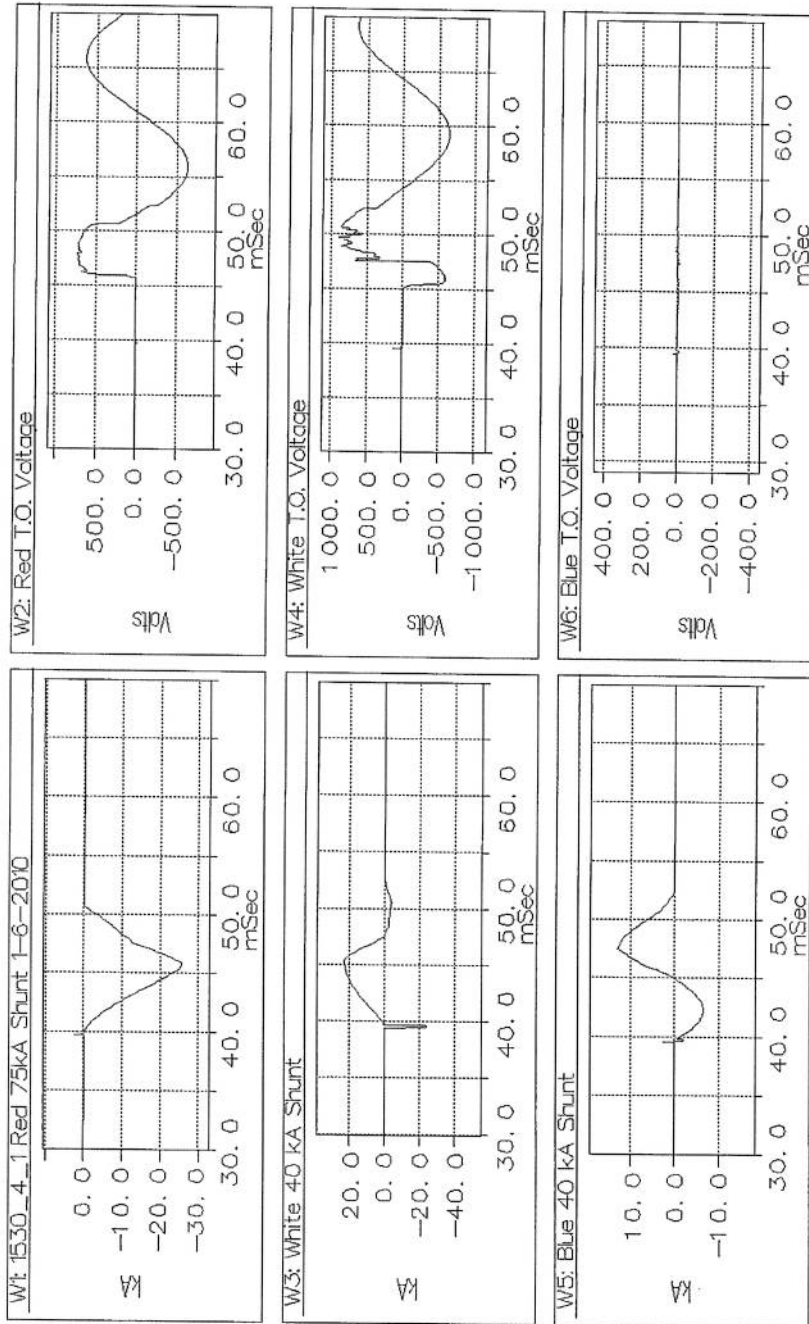


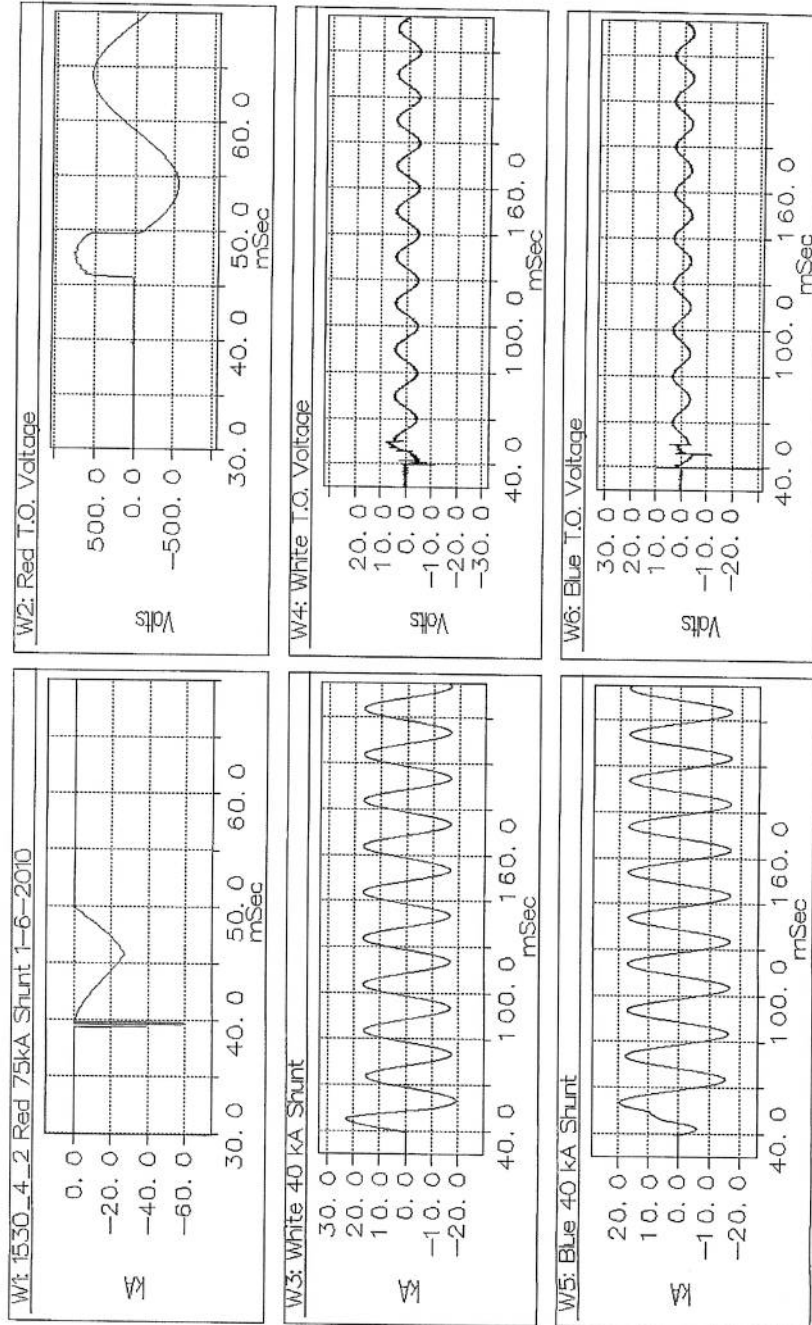


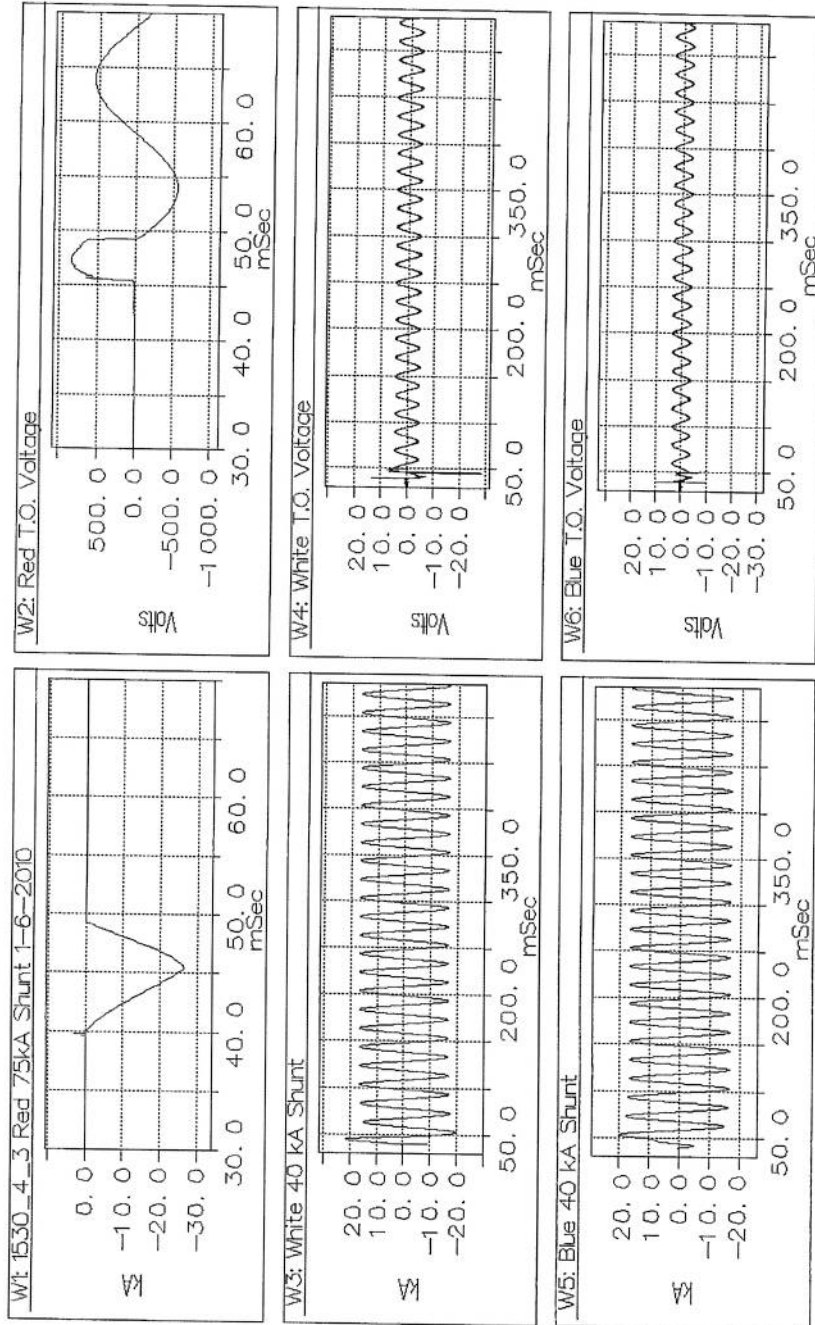


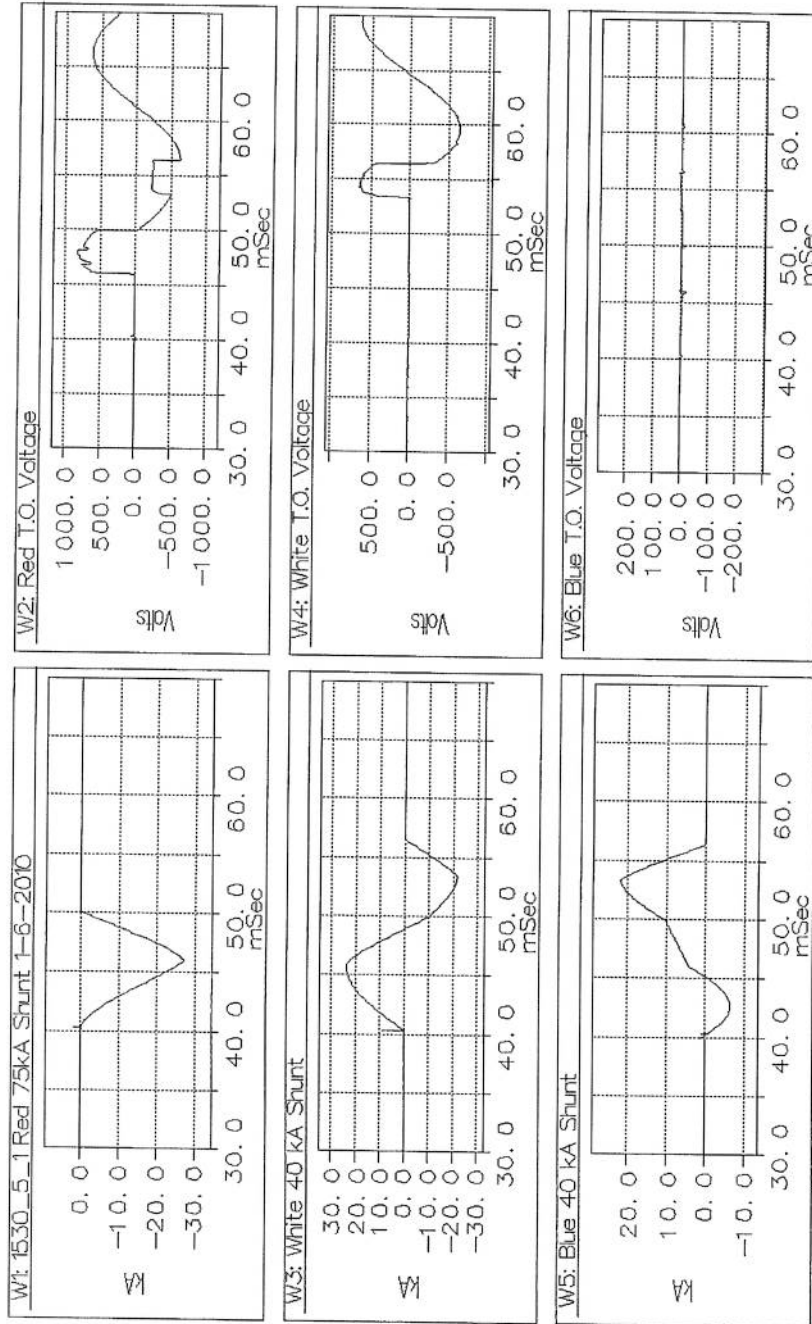


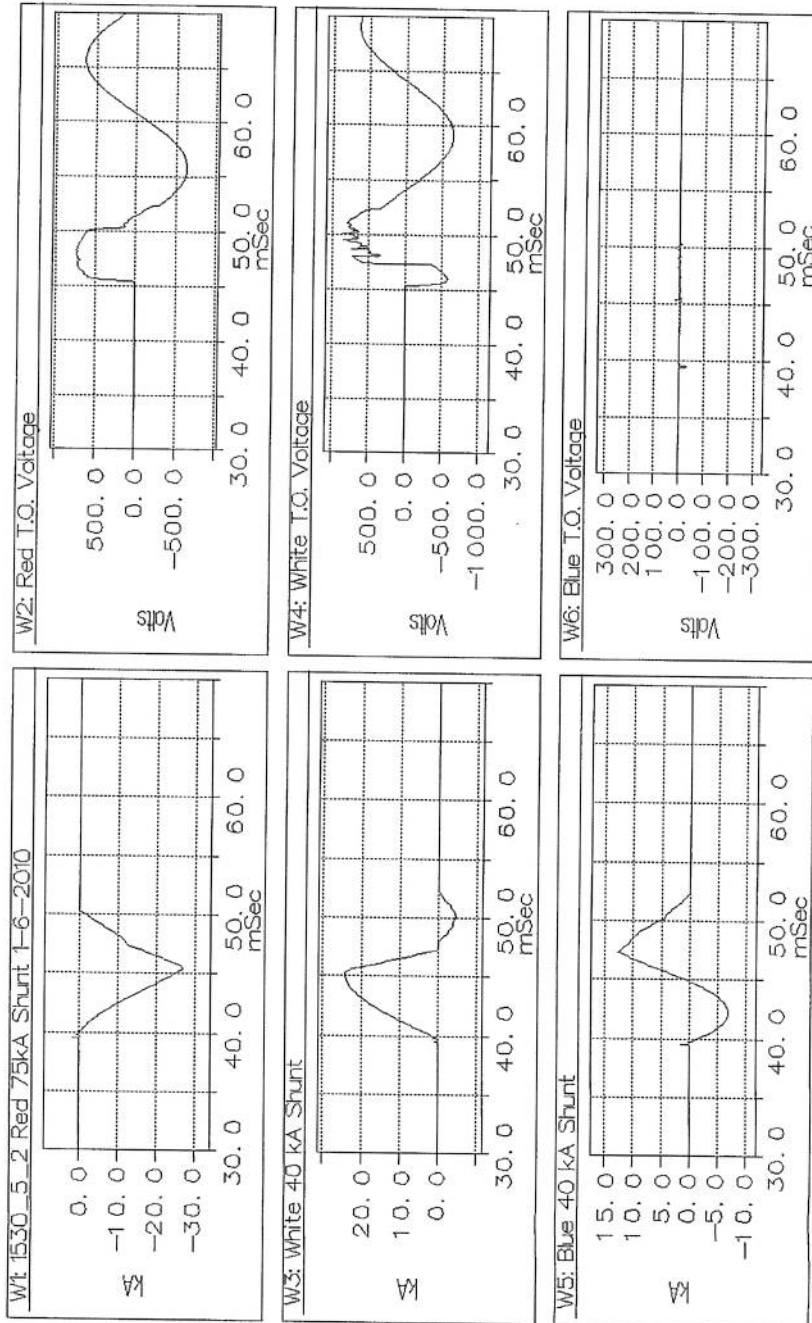




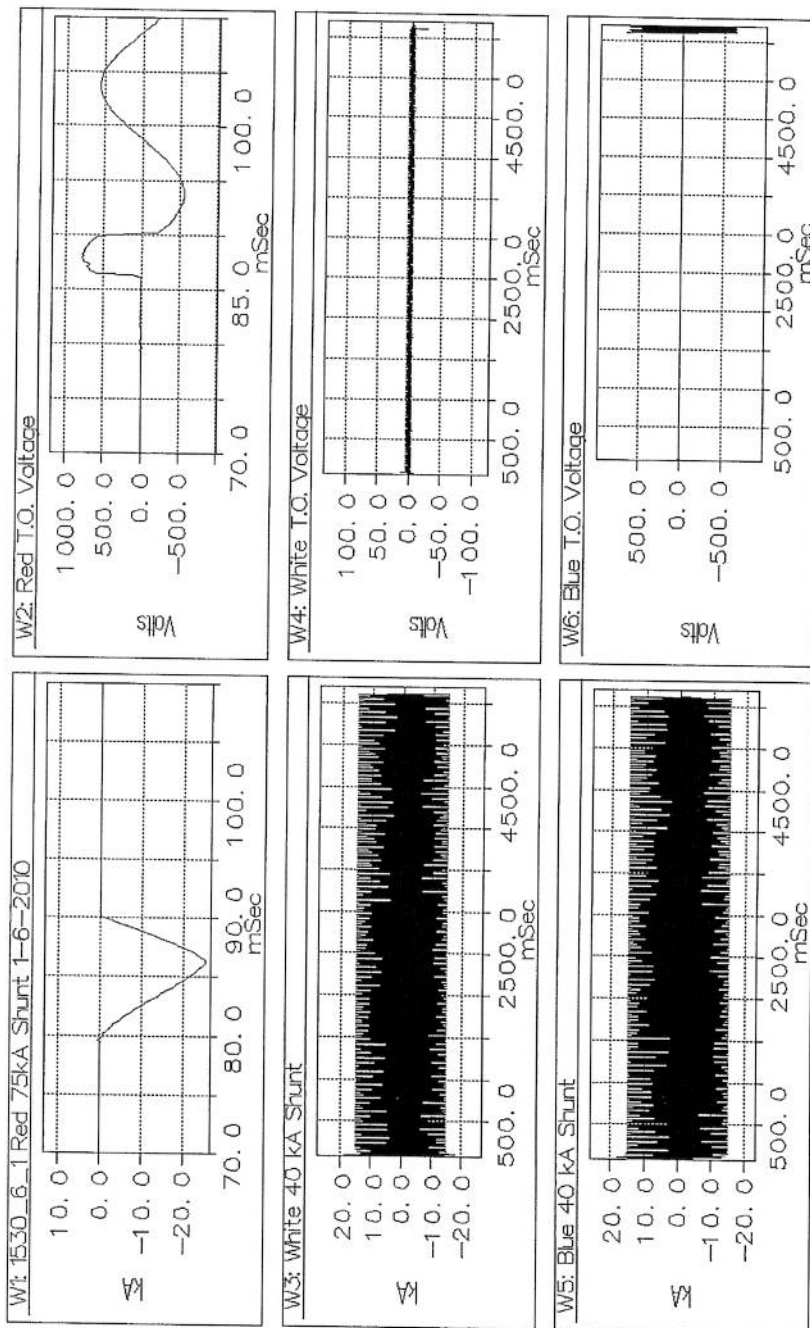


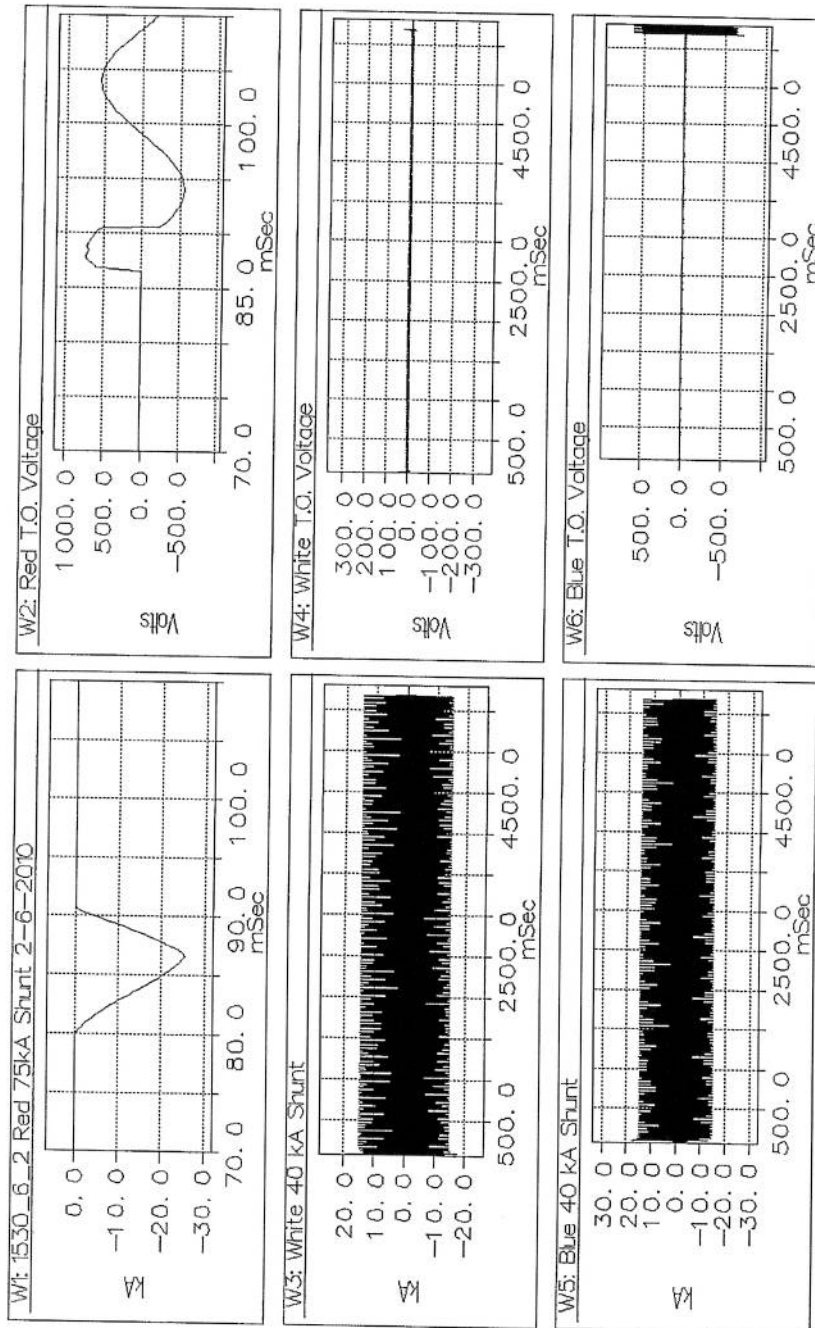


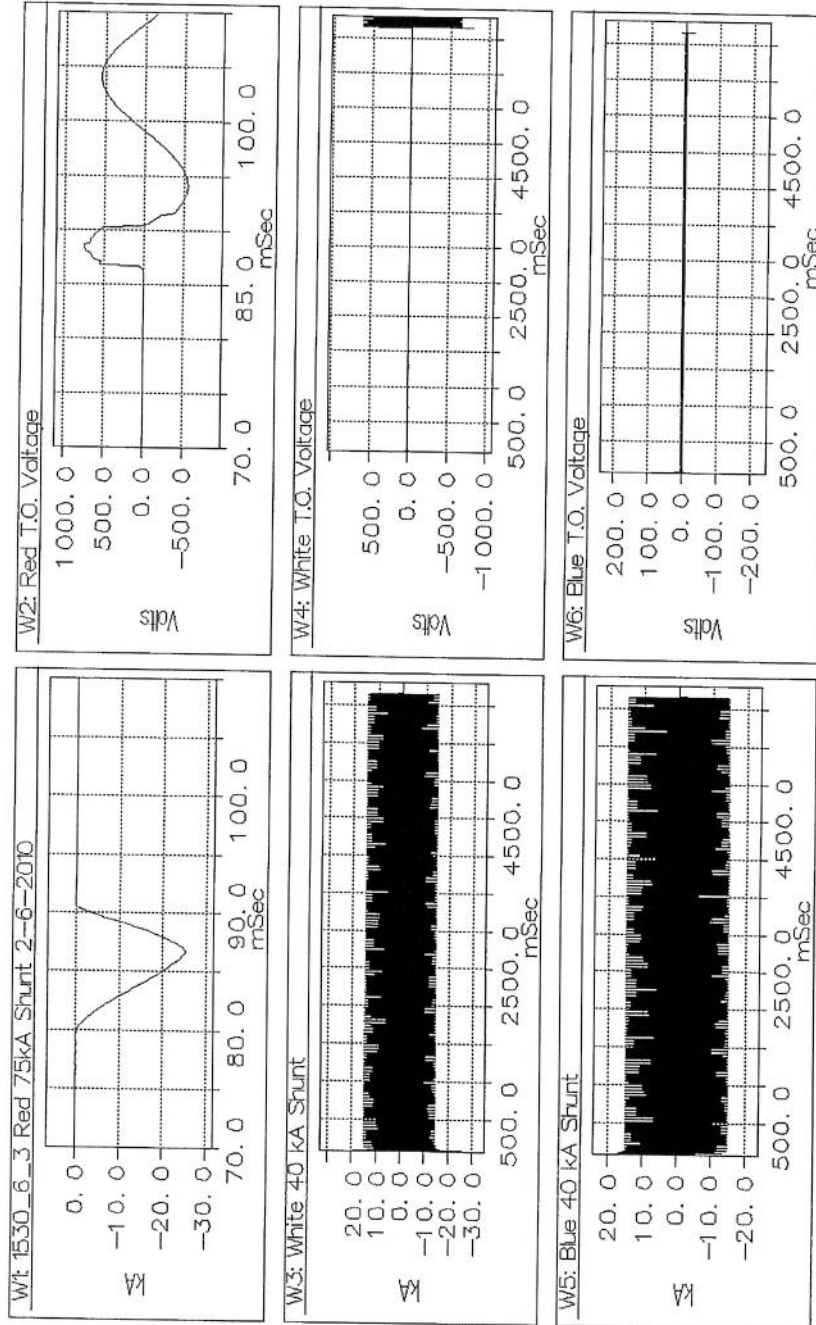












## Additional tests to clients requirements

The tests were performed to determine the time required for the fuse-links to operate when a current was passed through the assembly.

## Test arrangement

The SafeARC Interrupter Module sample No S1530/1 with new fuse-links fitted was connected with all covers in place. The current source was connected to the centre back incoming terminals of the assembly using four 125 mm by 6.3 mm copper bars per phase painted black.

Shorting links provided by the client were connected between the busbar cable connectors located at the bottom of the assembly with additional copper braids 240 mm<sup>2</sup> supplied and fitted by the test station.

The test current was supplied by a three phase step-down transformer with adjustment provided by three single phase variable transformers. Each phase was monitored using a current transformer connected to an ammeter.

## Results

<b>Test 1530/7/1</b>	<b>R Ø</b>	<b>W Ø</b>	<b>B Ø</b>
Test current at start [A]	7680	6288	7408
Average test current up to fuse-link operation [A]	6418	6150	6512
Time required for fuse links to operate [min' s'']	6' 10''	6' 10''	5' 6''

<b>Test 1530/8/1</b>	<b>R Ø</b>	<b>W Ø</b>	<b>B Ø</b>
Test current at start [A]	5232	4592	4992
Average test current during 40 min [A]	5056	5072	5072
Test current when fuse-links operated [A]	6896	6352*	6400
Time required for fuse links to operate [min' s'']	40' 5''	-	40' 50''

*Note 1: The test current was increased after 40 min.*

*Note 2: \* Fuse-links did not operate.*

**Appendix**

<b>Drawing No.</b>	<b>Rev.</b>	<b>Description</b>
1. 09SLT-PEN001-401SK317	0	3MVA SafeARC, General Arrangement Box Construction Front Lid
2. 09SLT-PEN001-401SK341	0	3MVA SafeARC, General Arrangement Busbar Phase – Incoming
3. 09SLT-PEN001-401SK342	0	3MVA SafeARC, General Arrangement Busbar Phase - Outgoing
4. 09SLT-PEN001-401SK301	0	3MVA SafeARC MK1, General Arrangement Insulation Phase Top
5. 09SLT-PEN001-402SK302	0	3MVA SafeARC MK1, General Arrangement Insulation Middle Phase
6. 09SLT-PEN001-402SK303	0	3MVA SafeARC MK1, General Arrangement Insulation Cross Support
7. 09SLT-PEN001-402SK304	0	3MVA SafeARC MK1, General Arrangement Insulation Cross Back
8. 09SLT-PEN001-402SK305	0	3MVA SafeARC MK1, General Arrangement Insulation Cross Front
9. 09SLT-PEN001-402SK310	0	3MVA SafeARC MK1, Bill of Materials Box Construction External Overview
10. 09SLT-PEN001-402SK311	0	3MVA SafeARC MK1, Bill of Materials Box Construction Internal Overview
11. 09SLT-PEN001-402SK330	0	3MVA SafeARC MK1, General Arrangement SafeARC Construction Sheet 1 of 1
12. 09SLT-PEN001-402SK340	0	3MVA SafeARC MK1, General Arrangement Busbar details Sheet 1 of 1
13. 09SLT-PEN001-402SK343	0	3MVA SafeARC MK1, General Arrangement Busbar Cable Connect