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Schweitzer Engineering Laboratories SEL-8317 LINAM® UGFI Faulted Circuit Indicator

IEEE Std 495-2007, Clause 4.4.7 and 4.4.8 and Client Specifications

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REPORT OF PERFORMANCE

CLIENT/ MANUFACTURER	Schweitzer Engineering Laboratories, Inc. 450 Enterprise Parkway, Lake Zurich, IL-60047
TEST OBJECTS	Faulted Circuit Indicator (FCI) Model Number: SEL-8317 LINAM® UGFI Sample Numbers: EUT #1, #2, #3, #4, #5 and their modifications
TESTED BY	Powertech Labs Inc. 12388 - 88th Ave, Surrey, BC Canada V3W 7R7 www.powertechlabs.com
DATE RECEIVED	2024-06-24
TEST DATE	2024-06-24 and 2024-06-25
TEST SPECIFICATION	IEEE Std 495-2007, Clause 4.4.7 and 4.4.8 and Client Specifications
TEST RESULT	See detailed test results in Sections 4, 5 and 6

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1 INTRODUCTION

At the request of Schweitzer Engineering Laboratories, Inc., short-time current tests and effect of current from adjacent conductor tests were performed on SEL-8317 LINAM® UGFI Faulted Circuit Indicator samples, in accordance with IEEE Std 495-2007, Clause 4.4.7 and 4.4.8 and client specifications. The tests were performed at the High Power Laboratory of Powertech Labs Inc.

2 TEST OBJECT INFORMATION

The test objects were provided and identified by the client as follows:

Faulted Circuit Indicator (FCI):

Manufacturer:	Schweitzer Engineering Laboratories, Inc.
Nominal Trip Current:	100 A
Model Number:	SEL-8317 LINAM® UGFI
Sample Numbers:	EUT #1, #2, #3, #4, #5 and their modifications by the client

3 GENERAL INFORMATION

3.1 Purpose

The purpose of the short-time current tests was to verify if the UGFI units are capable of withstanding short-time current.
The purpose of the effect of current from adjacent conductor tests was to verify if the UGFI units continue to indicate NORMAL (untripped) when the UGFI units are positioned in accordance with the manufacturer's recommended orientation and distance to an adjacent unshielded conductor (underground).

3.2 Witnesses

Name	Company
Lyssa Blood	Schweitzer Engineering Laboratories, Inc.
Erik Floden	Schweitzer Engineering Laboratories, Inc.
Miralem Cosic	Schweitzer Engineering Laboratories, Inc.
Hamza Waseem	Schweitzer Engineering Laboratories, Inc.
Andrew Armstrong	Schweitzer Engineering Laboratories, Inc.

3.3 Tests Performed

Test Standard	IEEE Std 495-2007 Clause 4.4.7 Short-time current test Clause 4.4.8 Effect of current from adjacent conductors Client Specifications
Test Date	2024-06-24 and 2024-06-25
Test Leader	Qian (Eric) Li

Environmental Conditions:

Ambient temperature	16 °C - 25 °C
Relative Humidity	39 % - 70 %

4 EFFECT OF CURRENT FROM ADJACENT CONDUCTORS TEST AT 25KA

Test Objects: EUT #1, #2, #3

Test Conditions:

Three SEL-8317 LINAM® UGFI units were tested simultaneously. Each unit was installed on a mini-current loop. The mini-current loops were powered by 110 V AC supply to simulate a conductor energized to the requirements necessary for FCIs to function. Three UGFI units, together with their mini-current loops were attached to a Φ2" round bus with minimum one foot apart from each other, and 4'' from the adjacent conductor, as shown in Figure C-5.

In each test shot, the three UGFI units were set at the same orientation on their mini-current loops. After every two test shots, the orientation of the UGFI units was changed per client specifications. In total six different orientations were configured, as shown in Figure A-2.

With each orientation, the test current was applied twice on the adjacent conductor. All tests were performed at 60 Hz in the circuit shown in Figure A-1. The test current parameters were summarized as below:

Short-time current on the adjacent conductor

Test Current:	25.2 kA_{rms}	(≥25 kA_{rms} is required)
X/R:	25	(≥20 is required)
Duration:	179 ms	(0.17 s is required)

The test started with all the three units in normal (untripped) state.

Requirements:
The UGFI units continue to indicate NORMAL (untripped) after each short-time current shot on the adjacent conductor.

Evaluation:
All three units continue to indicate NORMAL (untripped) after each short-time current test shot on the adjacent conductor.

Result:
Test data are presented in Table A-1.
The tested SEL-8317 LINAM® UGFI units passed the effect of current from adjacent conductor tests at 25 kA, in multiple configurations specified by the client.

5 SHORT-TIME CURRENT TEST AT 25 KA

Test Objects: EUT #1m[1)], #4, #5

Note: [1)] *EUT #1 was modified by the client to the same configuration as #4 and #5 before the tests.*

Test Conditions:

Three SEL-8317 LINAM® UGFI units were tested simultaneously. The units were installed on a Φ2" round aluminum bus conductor with minimum one foot apart from each other, as shown in Figure C-6.

The bus, mounted with FCIs, was subjected to two short-time current shots at a level of 25 kA. All tests were performed at 60 Hz in the circuit shown in Figure B-1. The test current parameters were summarized as below.

Short-time current on the bus mounted with FCIs

Test Current:	25.2 kArms	(≥25 kArms is required)
X/R:	25	(≥20 is required)
Duration:	179 ms	(0.17 s is required)

Before each shot, the FCIs were all in NORMAL (untripped) state.

Requirements:
The UGFI units are capable of withstanding the short-time current at 25 kA with 0.17 s duration.

Evaluation:
All three units turned into trip state after each test, as shown in Figure C-8. No visual damage was observed on the tested units after tests. The three units were able to be reset to normal state after the tests.

Result:
The tested SEL-8317 LINAM® UGFI units withstood 25 kA level short-time current with no visual damage.

6 SHORT-TIME CURRENT TEST AT 40 KA

Test Objects: EUT #1m[1)], #4, #5

Note: [1)] *EUT #1 was modified by the client to the same configuration as #4 and #5.*

Test Conditions:

Three SEL-8317 LINAM® UGFI units were tested simultaneously. The units were installed on a Φ2" round aluminum bus conductor with minimum one foot apart from each other, as shown in Figures C-6.

The bus, mounted with UGFI units, was subjected to two short-time current shots at a level of 40 kA. All tests were performed at 60 Hz in the circuit shown in Figure B-1. The test current parameters were summarized as below.

Short-time current on the bus mounted with FCIs

Test Current:	40.9 kArms	(≥40 kArms is required)
X/R:	37	(≥20 is required)
Duration:	179 ms	(0.17 s is required)

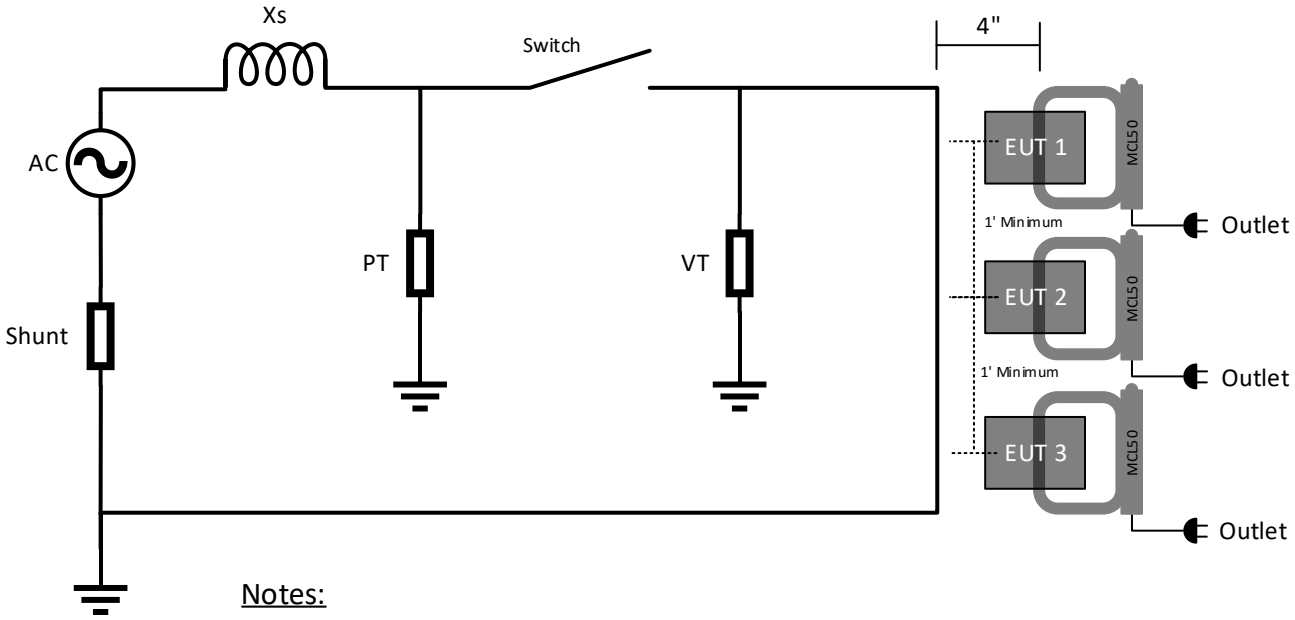
Before each shot, the UGFI units were all in NORMAL (untripped) state.

Requirements:
The UGFI units are capable of withstanding the short-time current at 40 kA with 0.17 s duration.

Evaluation:
All three units turned into trip state after the first test, as shown in Figure C-9. And they were able to be reset to normal state.
EUT #5 maintained normal state after the second test shot, as shown in Figure C-10. It turned to trip state after being pull off from the conductor.
No visual damage was observed on the tested units after tests.

Result:
The tested SEL-8317 LINAM® UGFI units withstood 40 kA level short-time current with no visual damage.

APPENDIX A – EFFECT OF CURRENT FROM ADJACENT CONDUCTORS TEST DATA



Notes:

1. Xs – Source Impedance
2. PT – Source Voltage Measurement
3. EUT – Equipment Under Test
4. Shunt – Current Measurement
5. VD – Source Voltage Measurement

Figure A-1: Setup Diagram for Effect of Current from Adjacent Conductors Test.

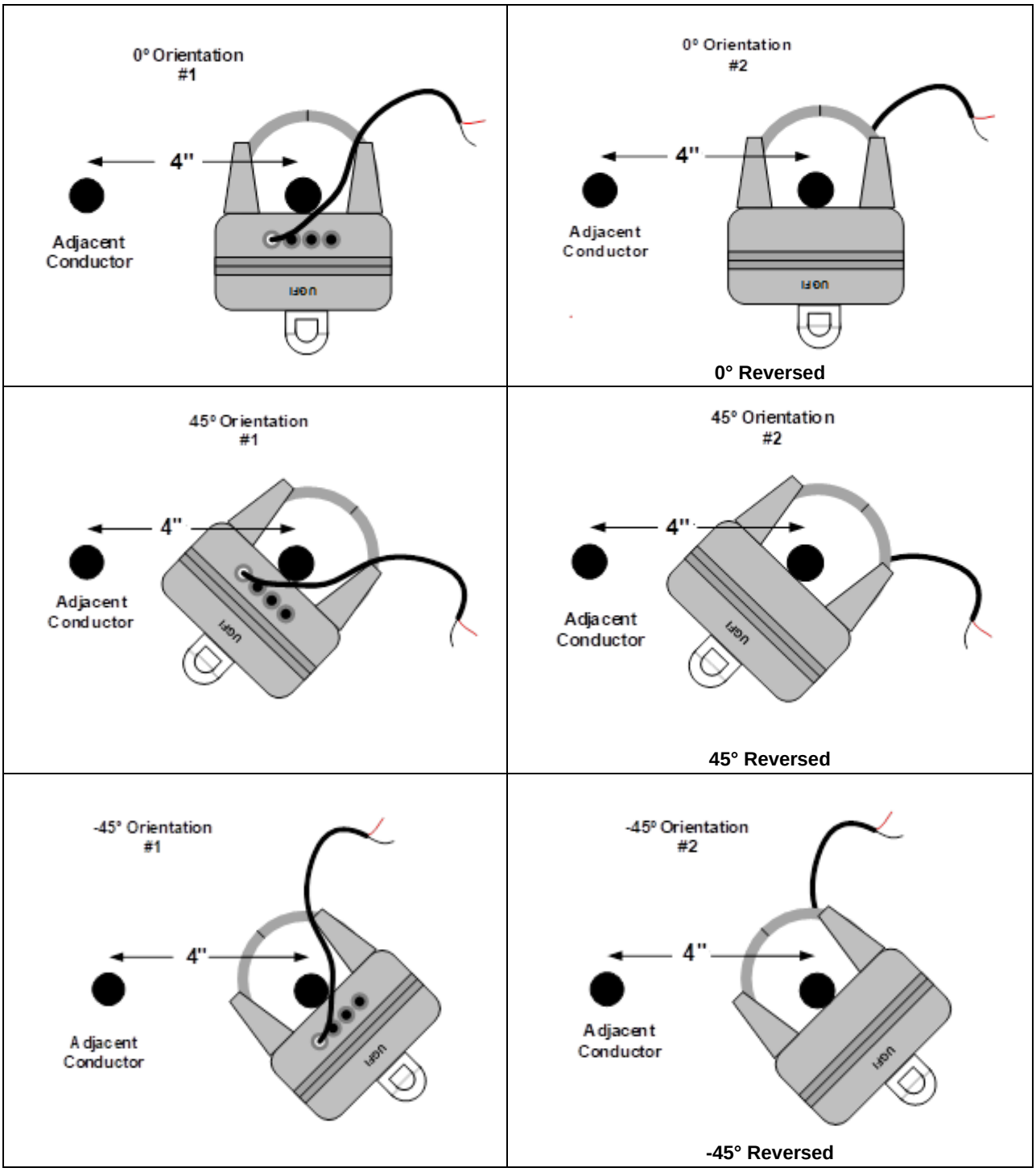


Figure A-2: Six Orientations of the FCIs for Effect of Current from Adjacent Conductors Test

Table A-1: Results of the effect of current from adjacent conductor tests on SEL-8317 LINAM® UGFI units at 25 kA

EUTs	Test	Orientation	Actual Current (kArms)	Peak Current (kApeak)	Duration (ms)	Did the EUT Maintain normal State After Test? (YES/NO)
#1 #2 #3	1-2	0°	25.3	67.2	179	YES
	1-3		25.2	66.8	179	YES
	1-4	45°	25.0	66.3	179	YES
	1-5		25.0	66.3	179	YES
	1-6	-45°	25.0	66.8	179	YES
	1-7		25.0	66.3	179	YES
	1-8	0° Reversed	25.2	67.0	179	YES
	1-9		25.2	66.9	179	YES
	1-10	45° Reversed	25.2	66.8	179	YES
	1-11		25.2	66.8	179	YES
	1-12	-45° Reversed	25.2	66.9	179	YES
	1-13		25.2	66.7	179	YES

APPENDIX B – SHORT-TIME CURRENT TEST DATA

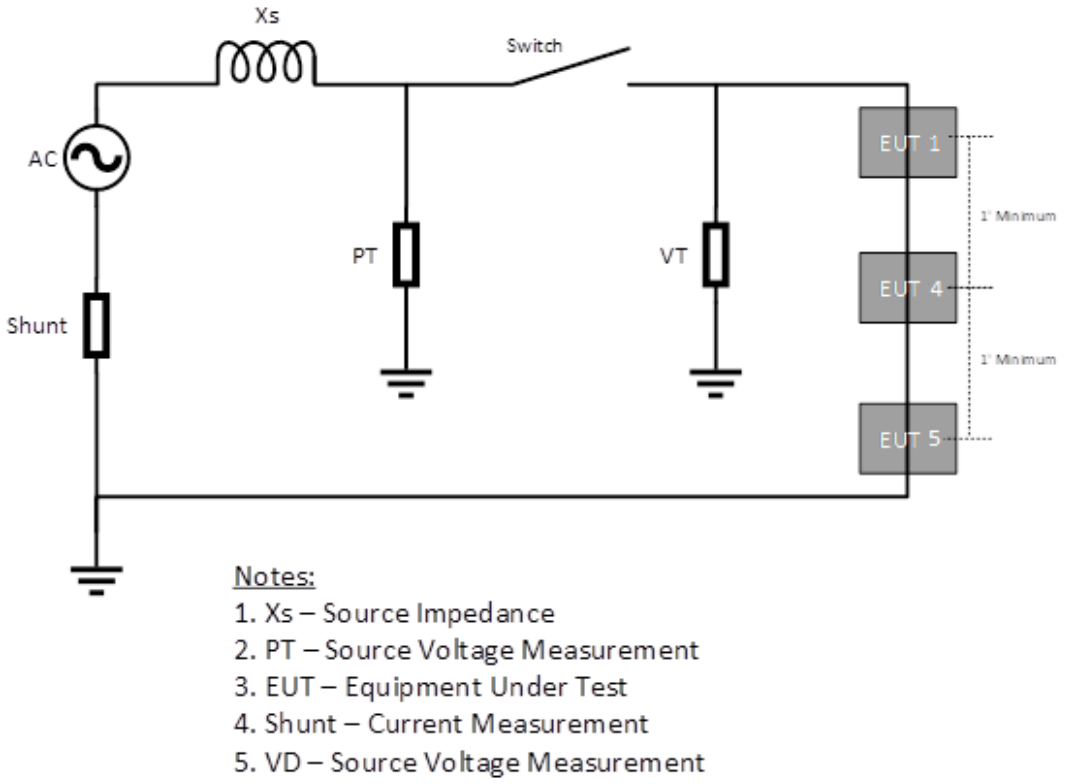


Figure B-1: Setup Diagram for Short-time Current Test

Table B-1: Results of short-time current tests on SEL-8317 LINAM® UGFI units at 25 kA

Samples	Test	Current	Peak Current	Duration	Photos	Samples turned to trip state after test?	Samples were able to be reset after test?
№	№	kA_{rms}	kA_{peak}	ms	№	Yes/No	Yes/No
1m, 4, 5	1-15	25.2	66.3	179	Figure A-2	Yes	Yes
	1-16	25.2	66.3	179	Figure A-3	Yes	Yes

Table B-2: Results of short-time current tests on SEL-8317 LINAM® UGFI units at 40 kA

Samples	Test	Current	Peak Current	Duration	Photos	Samples turned to trip state after test?	Samples were able to be reset after test?
№	№	kA_{rms}	kA_{peak}	ms	№	Yes/No	Yes/No
1m, 4, 5	3-3	40.9	110.6	179	Figure A-2	Yes	Yes
	3-4	40.9	110.6	179	Figure A-3	Not on #5	Yes

APPENDIX C – TEST WAVEFORMS AND PHOTOS

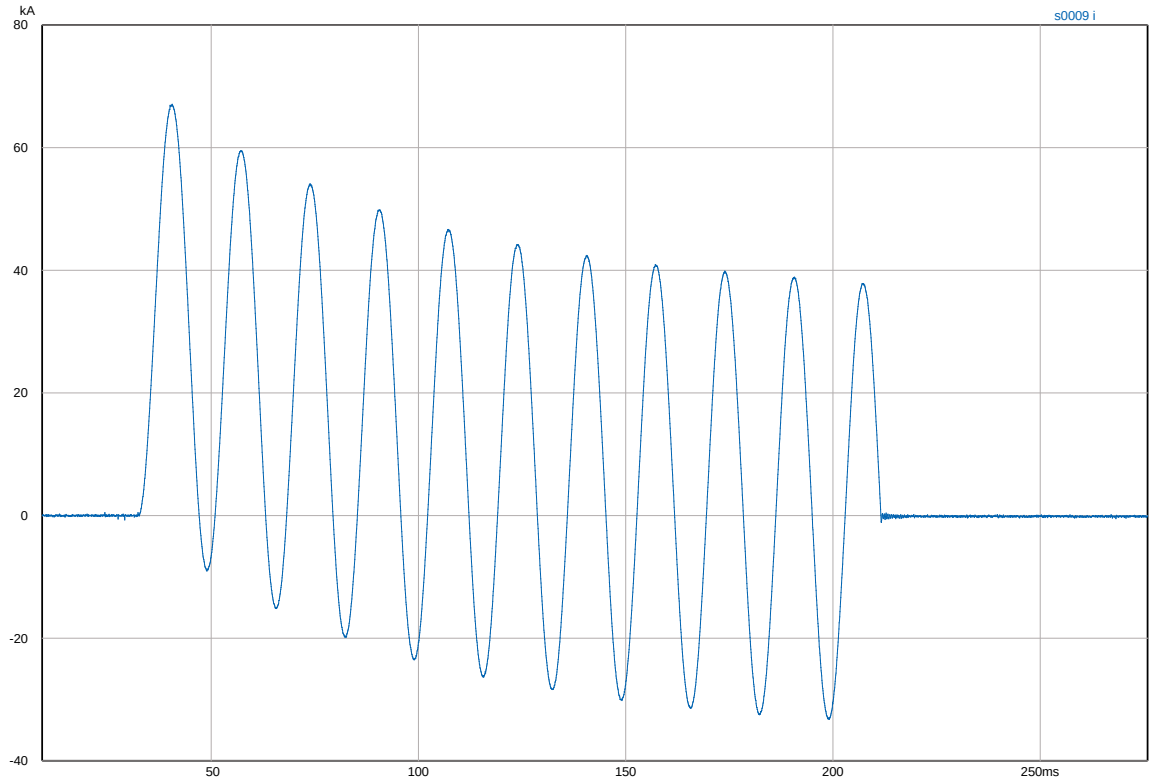


Figure C-1: Typical current waveforms at 25 kA.

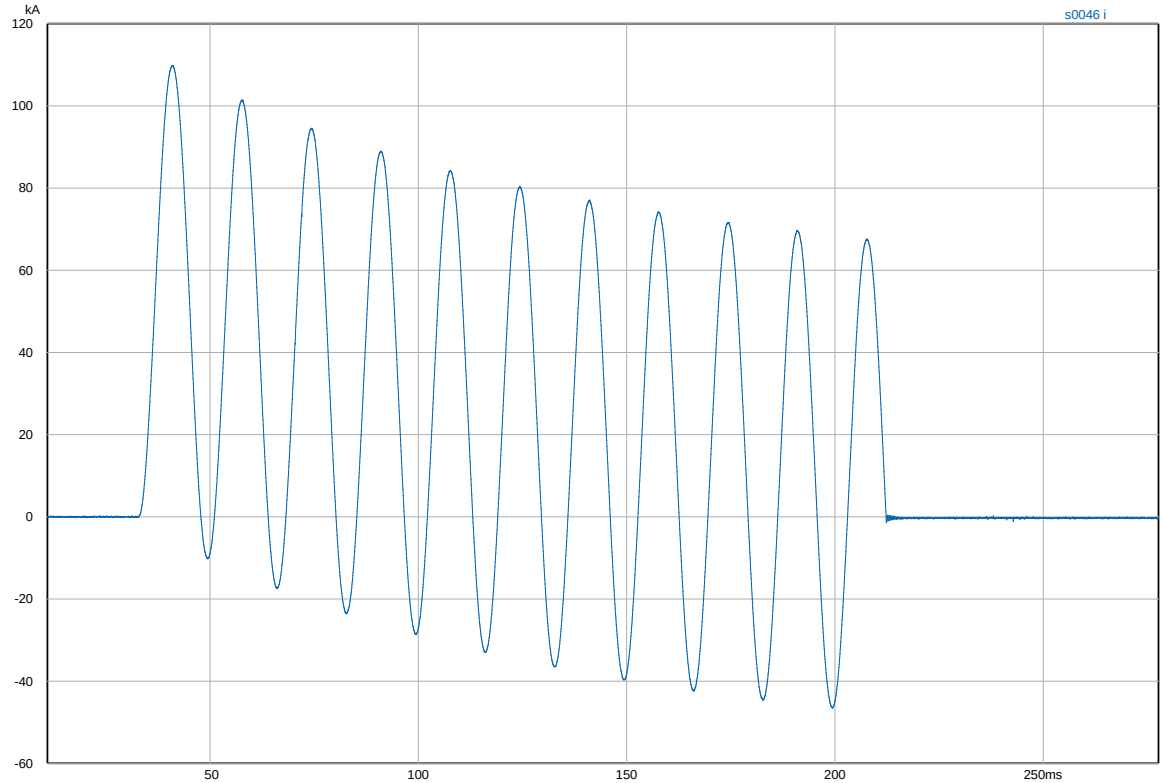


Figure C-2: Typical current waveforms at 40 kA.

Figure C-3: Tested SEL-8317 LINAM® UGFI FCI unit.

Figure C-4: Tested SEL-8317 LINAM® UGFI unit with mini-current loop.

Figure C-5: Test setup for effect of current from adjacent conductor tests.

Figure C-6: Test setup for the short-time current tests.

Figure C-7: Sample in normal state after all 25 kA effect of current from adjacent conductor tests

Figure C-8: Samples in trip state after all 25 kA short-time current tests

Figure C-9: Samples in trip state after the first 40 kA short-time current test

Figure C-10: Sample #5 in normal state after the second 40 kA short-time current test