

LCOE

LABORATORIO CENTRAL OFICIAL DE ELECTROTECNIA
FUNDACIÓN PARA EL FOMENTO DE LA INNOVACIÓN INDUSTRIAL
UPM Technological Center – Tecnogetafe
C/ Eric Kandel, 1 – 28906 Getafe (Madrid)
Telephone: +34 91 491 81 68
www.f2i2.net

TEST REPORT

2015073F0335

TESTED DEVICE	Lightning impulse current withstand test: 100 kA of 10/350µs waveform
MODEL	FOREND EU-M; PETEX-S; PETEX-M; PETEX-L; FOREND EU
SERIAL NUMBER	F1/11896; F1/2732; F1/3335; F1/21566; F1/1053
REQUESTED BY	FOREND Elektrik. Malz. Ve Dis. Tic A.S Halaskargazi cad. no:141 K:4 D:7 - Osmanbey - Sisli / Istanbul
APPLIED STANDARDS	See applied Standards in page 3 of this report
Beginning of tests date	13/07/2015
End of tests date	14/07/2015

This test report consists of pages 6 and 2 appendixes



Authorized signatory

Date of issue: 20th July, 2015

Mr. Abderrahim Khamlichi
Technical Responsible of HV Testing

Tested by: Mr. Juan Pablo Vega
HV Test Technician

CONDITIONS OF VALIDITY FOR THIS DOCUMENT:

- The results of the tests refer exclusively to the sample which was tested.
- The above mentioned sample is described in this report. If any modification of the sample has been made after it has been received, the details will also be given in the report and further documented in LCOE files.
- Partial reproduction of this document is prohibited
- This report will be considered void if it is altered in any way without prior authorization.

A. GENERAL DESCRIPTION

1. TESTED MATERIAL
 - 1.1. Marking
 - 1.2. Specimen description
2. TYPE OF TESTS
 - 2.1 Lightning impulse current withstand test:
100 kA of 10/350 μ s waveform.
3. APPLIED STANDARDS
4. GENERAL DETAILS
5. MEASUREMENT UNCERTAINTY

1. TESTED MATERIAL

Five (5) E.S.E. (Early Streamer Emission Lightning Conductor) samples were supplied to LCOE by FOREND Elektrik. Malz. Ve Dis. Tic A.S.

Test date: 13th and 14th July 2015

1.1. Marking

Manufacturer: FOREND Elektrik Malz. Ve Dis. Tic. A.S
Model: FOREND EU-M; PETEX-S; PETEX-M; PETEX-L;
FOREND EU.

1.2. Specimen description

Specimens according to the customer consist of Early Streamer Emission Lightning Conductor for large area protection.

2. TYPE OF TESTS

2.1 Lightning impulse current withstand test:
100 kA of 10/350 μ s waveform

$I_{peak} = 100 \text{ kA} \pm 10 \%$
 $W/R = 2500 \cdot \text{kJ}/\Omega \pm 35\%$
 $Q = 50 \text{ C} \pm 20 \%$
Duration < 5 ms.

3. APPLIED STANDARDS

The test referred in section 2 has been made with applied current impulses waveforms, 100 kA of 10/350 μ s, according to *UNE-EN 62561-1 Paragraph 6.3 Standard. These waveforms are the same as indicated in UNE 21.186 December 2011 Paragraph C.3.4 Standard, and NFC 17-102 September 2011 Article C.3.4 Standard.*

4. GENERAL DETAILS

Tests were carried out at the L.C.O.E. facilities in Getafe, located in Diesel Street No 13, Polígono Industrial El Lomo, 28906 Getafe, Madrid on 13th and 14th of July, 2015.

Tests were performed by:

Juan Pablo VEGA

FFII –LCOE

5. MEASUREMENT UNCERTAINTY

The uncertainty of the test is calculated and at the disposal of the applicant.

B. TESTS

- I. TEST PROCEDURE
- II. TEST RESULTS

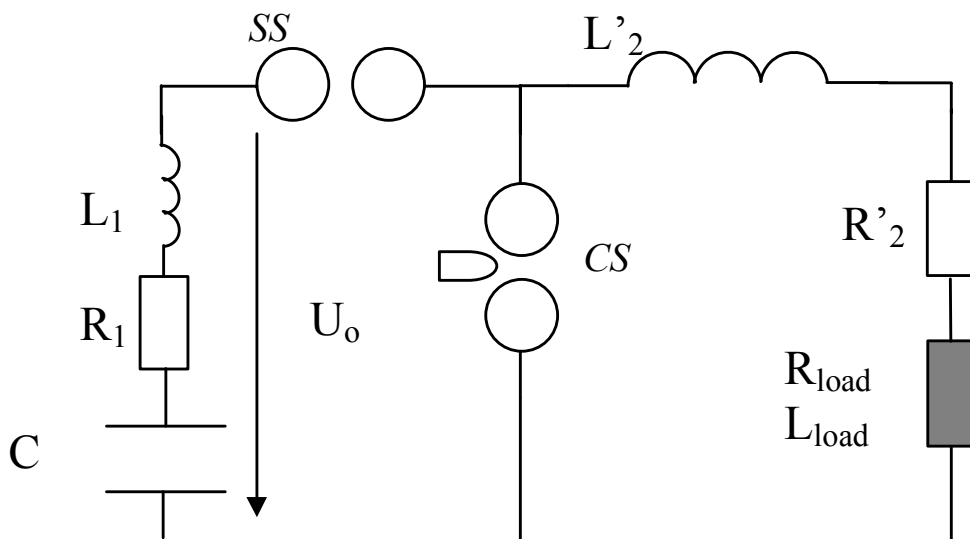
I. TEST PROCEDURE

I.1 INTRODUCTION

The purpose of the tests described in this report has been to test whether the tested samples have the ability to drain discharges of high current amplitude and high specific energy.

I.2 LIGHTNING TEST CURRENT GENERATION

It can be seen in figure 1 a schematic of the circuit generation for current impulses.



I.3 TEST PROCEDURE.

Each tested sample was subjected three times to a lightning impulse current of 100 kA of peak and 2500 kJ/Ω of specific energy. Sufficient time was allowed between each applied impulse in order to enable the sample to cool down at room-temperature.

THERE IS NO TEXT UNDER THIS LINE

II. TEST RESULTS

II.1. Tabulated results

Table 1. Tabulated results for the tests.

SAMPLE	Serie Nº	Test	I _{peak} (kA)	W/R (kJ/Ω)	Q (C)	Visual inspection
FOREND EU-M	F1/11896	ÑG14-02	99.99	2.06 10 ³	43.9	OK
		ÑG14-03	103.13	3.05 10 ³	56.0	OK
		ÑG14-04	101.70	2.93 10 ³	55.2	OK
PETEX-S	F1/2732	ÑG14-05	100.50	2.90 10 ³	51.9	OK
		ÑG14-06	99.35	2.89 10 ³	55.7	OK
		ÑG14-07	99.90	2.94 10 ³	56.4	OK
PETEX-M	F1/3335	ÑG14-08	98.35	2.83 10 ³	55.1	OK
		ÑG14-09	100.48	2.93 10 ³	56.6	OK
		ÑG14-10	100.10	2.84 10 ³	55.6	OK
PETEX-L	F1/21566	ÑG14-11	100.50	2.85 10 ³	55.0	OK
		ÑG14-12	100.30	2.89 10 ³	56.0	OK
		ÑG14-13	101.41	3.05 10 ³	58.1	OK
FOREND EU	F1/1053	ÑG14-14	100.88	2.70 10 ³	51.8	OK
		ÑG14-15	100.93	2.67 10 ³	51.7	OK
		ÑG14-16	100.80	2.62 10 ³	50.5	OK

II.2. Conclusions

All tested samples have passed successfully the test.

This test report was requested by FOREND Elektrik. Malz. Ve Dis. Tic A.S. and was issued in Madrid on July 20th, 2015.

Appendix I

To Test Report nº 2015073F0335

Photographs and current impulses waveforms.



Figure 1. Test rig.



Figure 2. Test rig



Figure 3. Test rig



Figure 4. Test rig

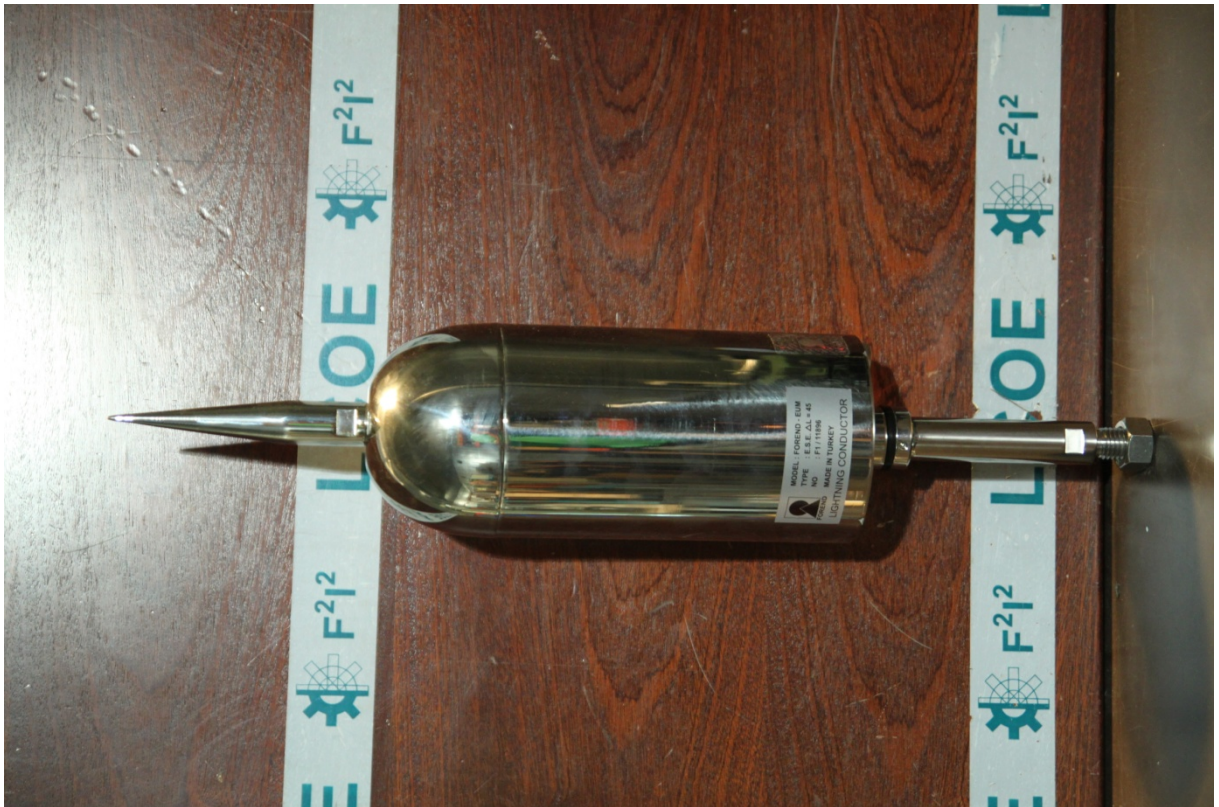


Figure 5. FOREND EU-M Specimen before any test.



Figure 6. FOREND EU-M Specimen before any test.



Figure 7. FOREND EU-M Specimen after all tests.



Figure 8. FOREND EU-M Specimen after all tests.



Figure 9. FOREND EU-M Specimen after all tests.



Figure 10. PETEX-S Specimen before any test.



Figure 11. PETEX-S Specimen before any test.



Figure 12. PETEX-S Specimen after all tests.

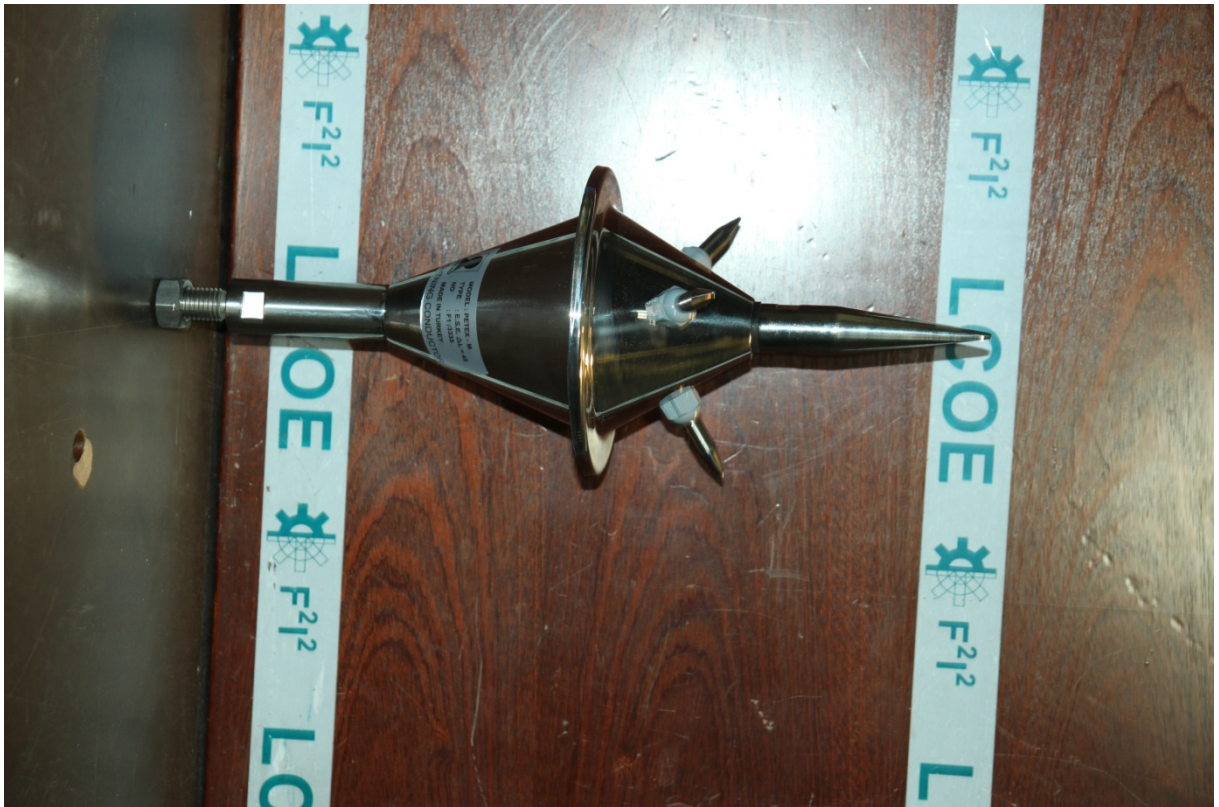


Figure 13. PETEX-M Specimen before any test.



Figure 14. PETEX-M Specimen before any test.



Figure 15. PETEX-M Specimen after all tests.

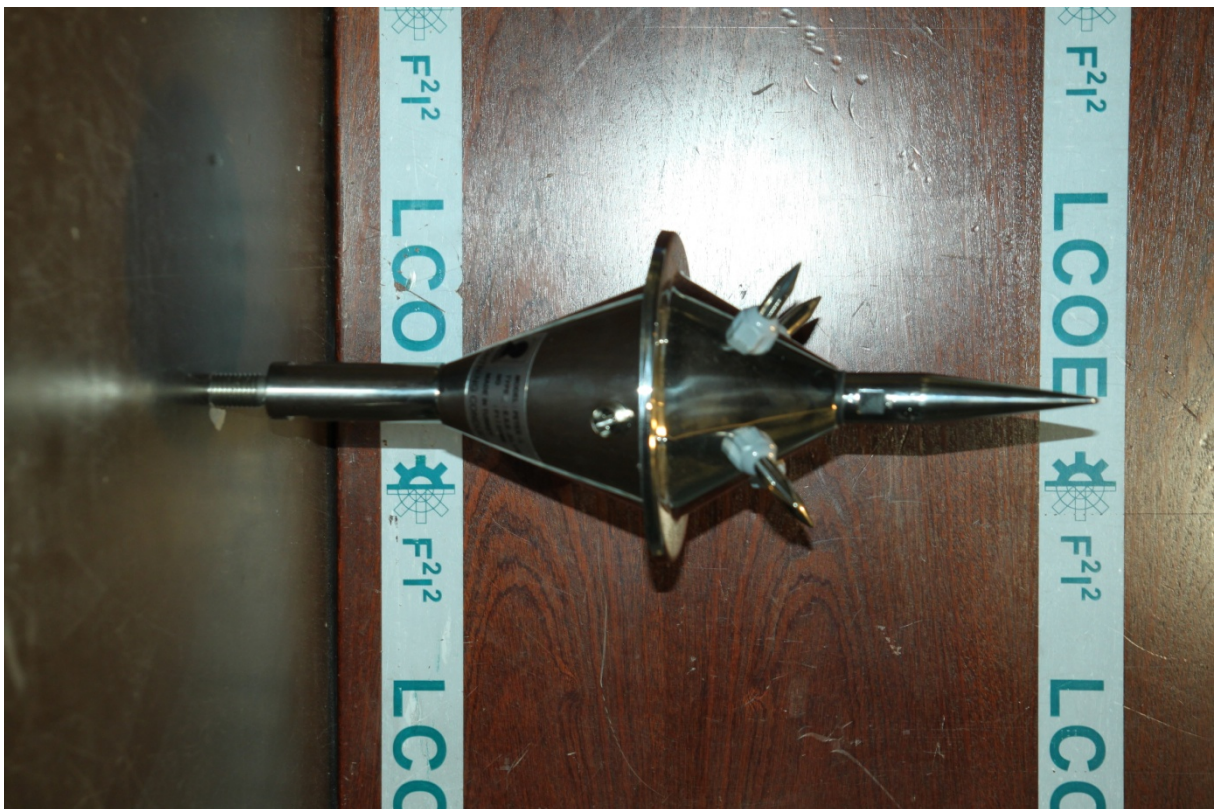


Figure 16. PETEX-L Specimen before any test.

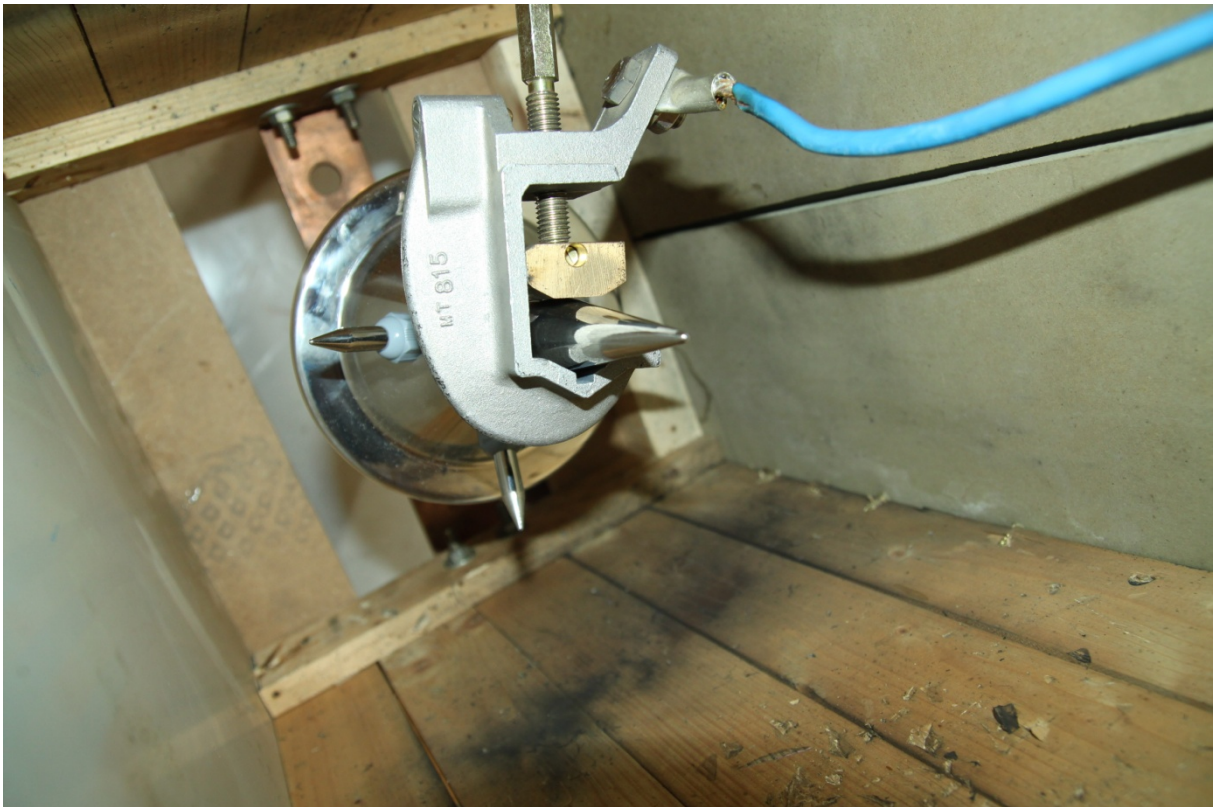


Figure 17. PETEX-L Specimen before any test.



Figure 18. PETEX-L Specimen after all tests.



Figure 19. FOREND EU Specimen before any test.



Figure 20. FOREND EU Specimen before any test.

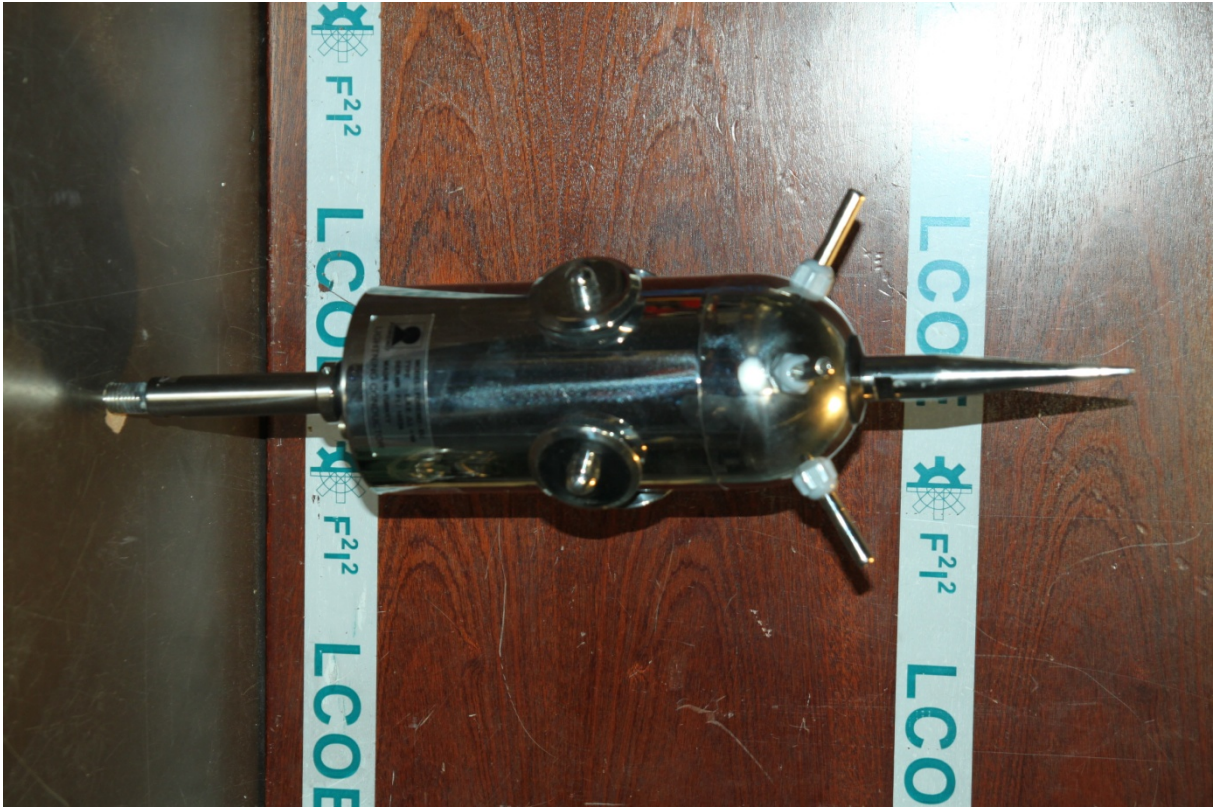


Figure 21. FOREND EU Specimen after all tests.

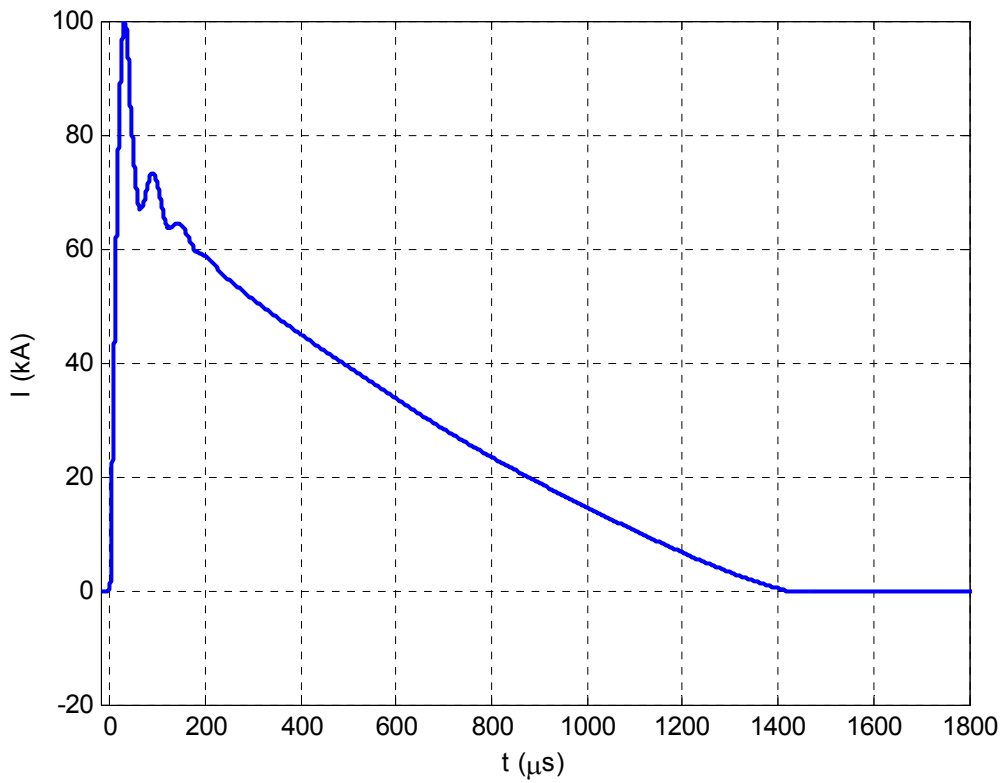


Figure 22. ÑG14-02. Current waveform

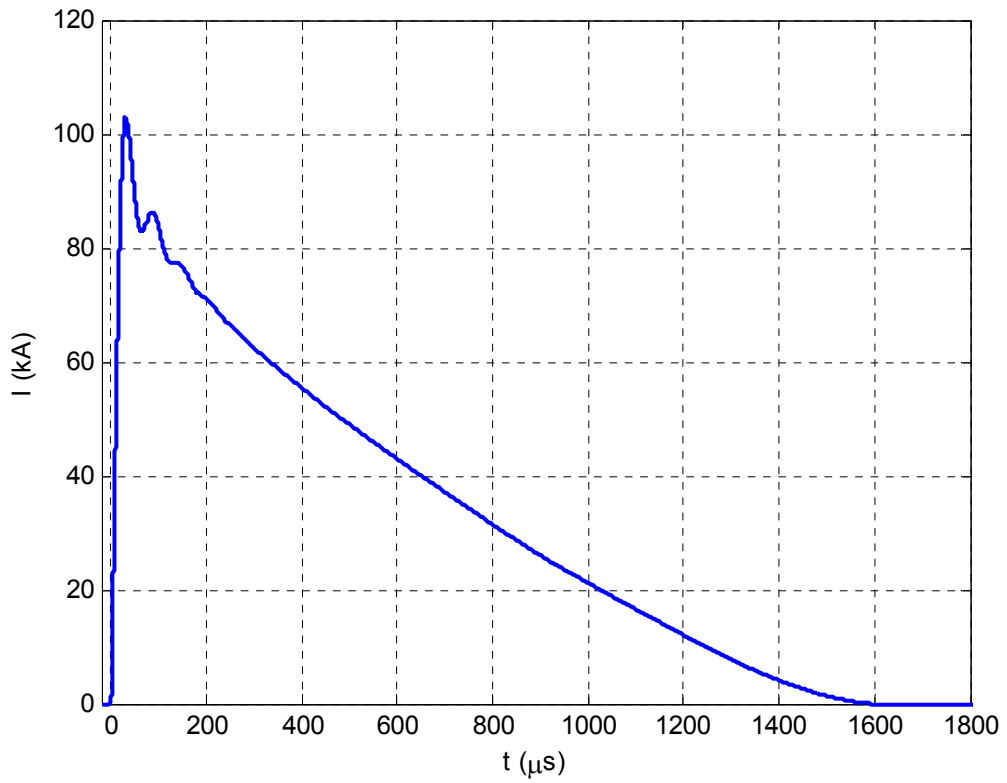


Figure 23. ÑG14-03. Current waveform

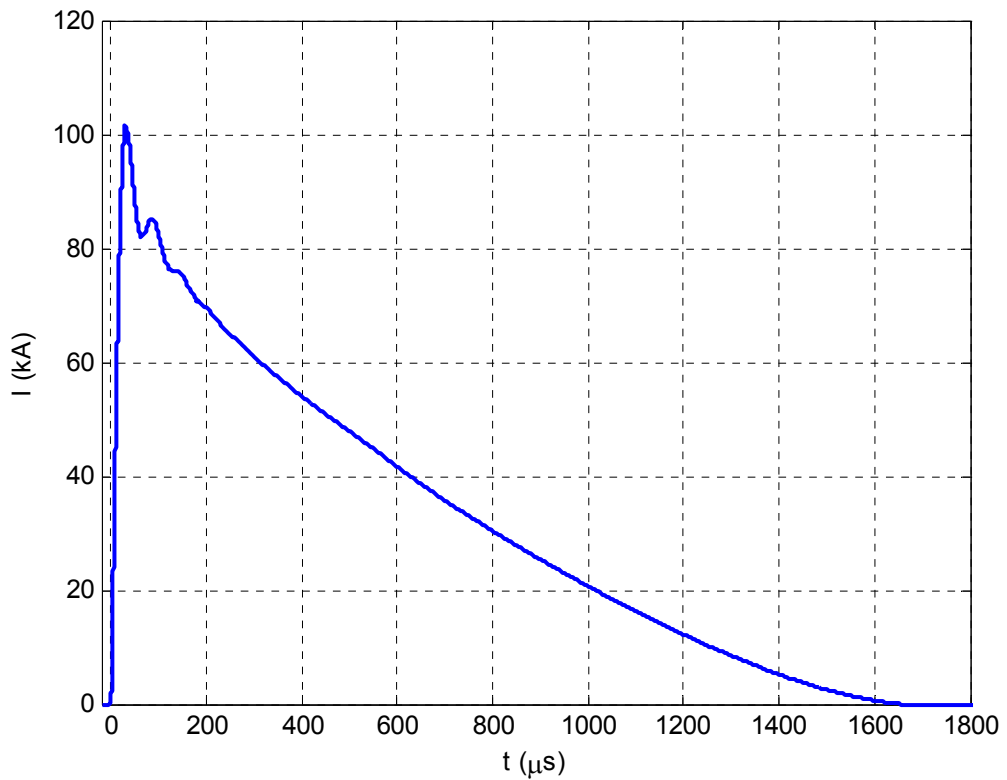


Figure 24. ÑG14-04. Current waveform

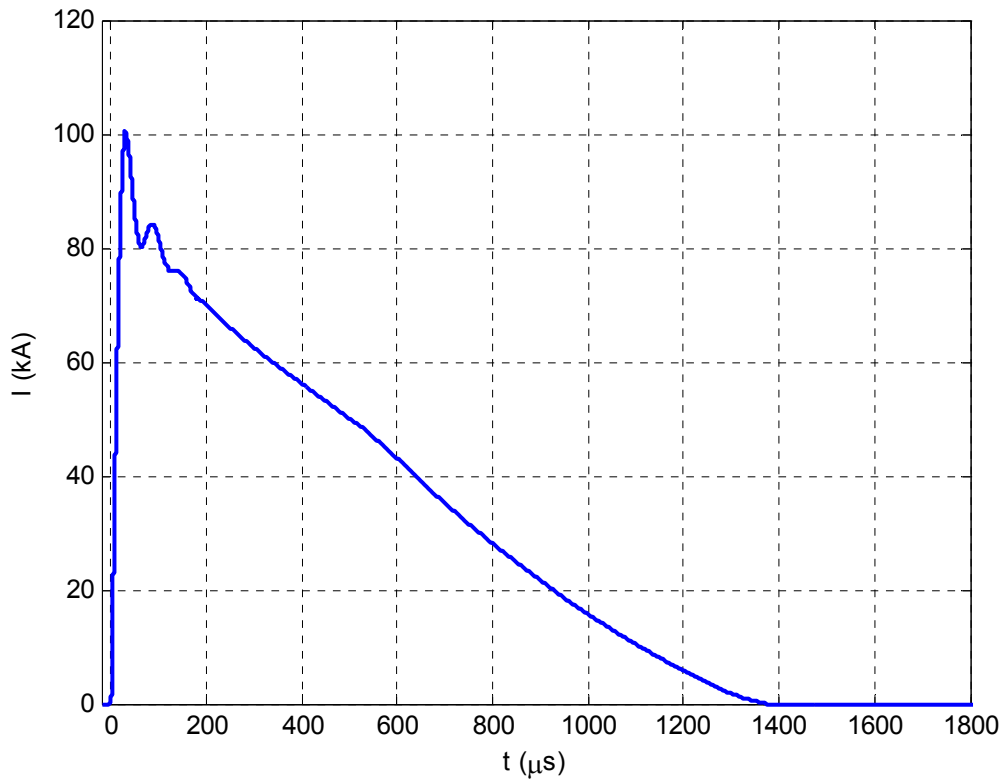


Figure 25. ÑG14-05. Current waveform

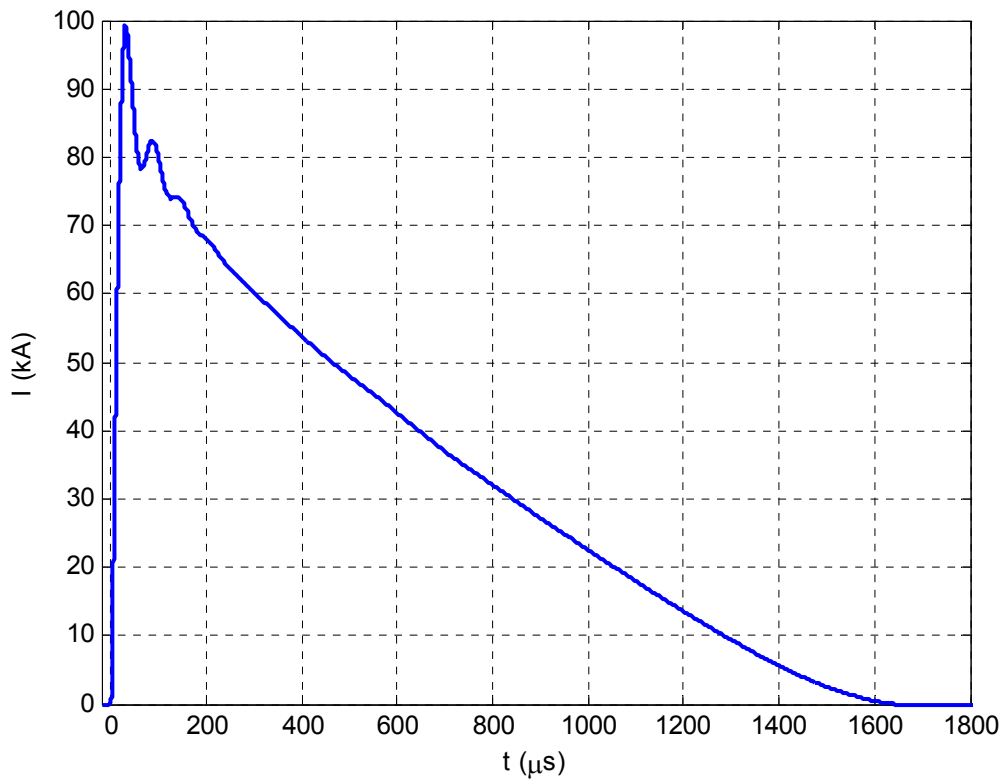


Figure 26. ÑG14-06. Current waveform

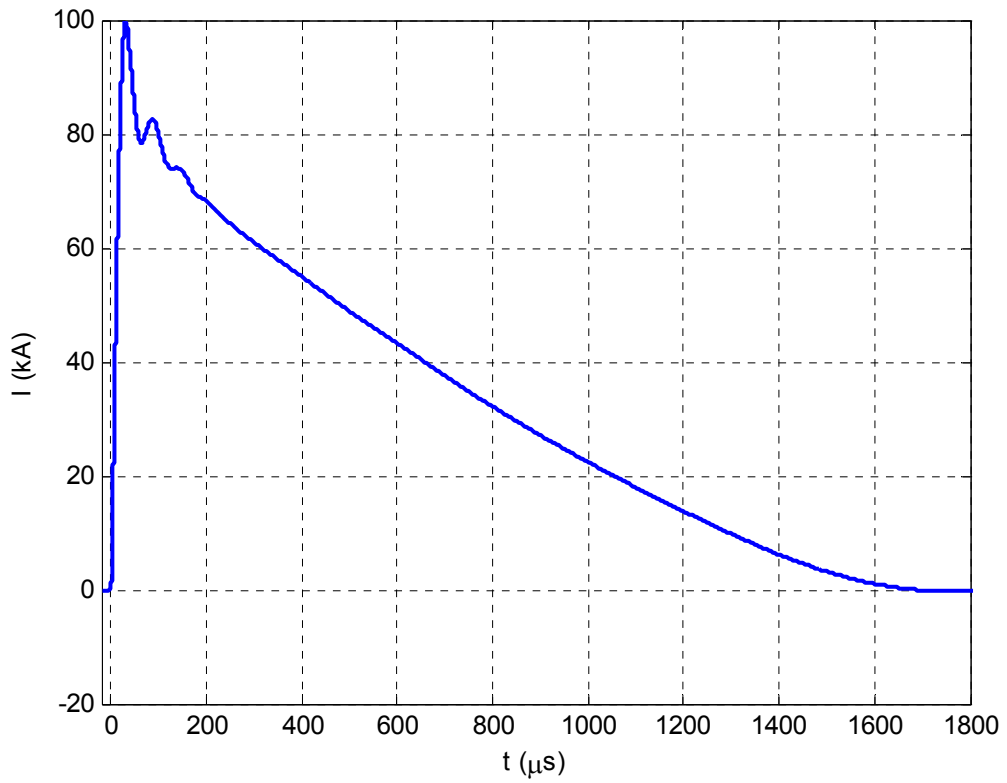


Figure 27. ÑG14-07. Current waveform

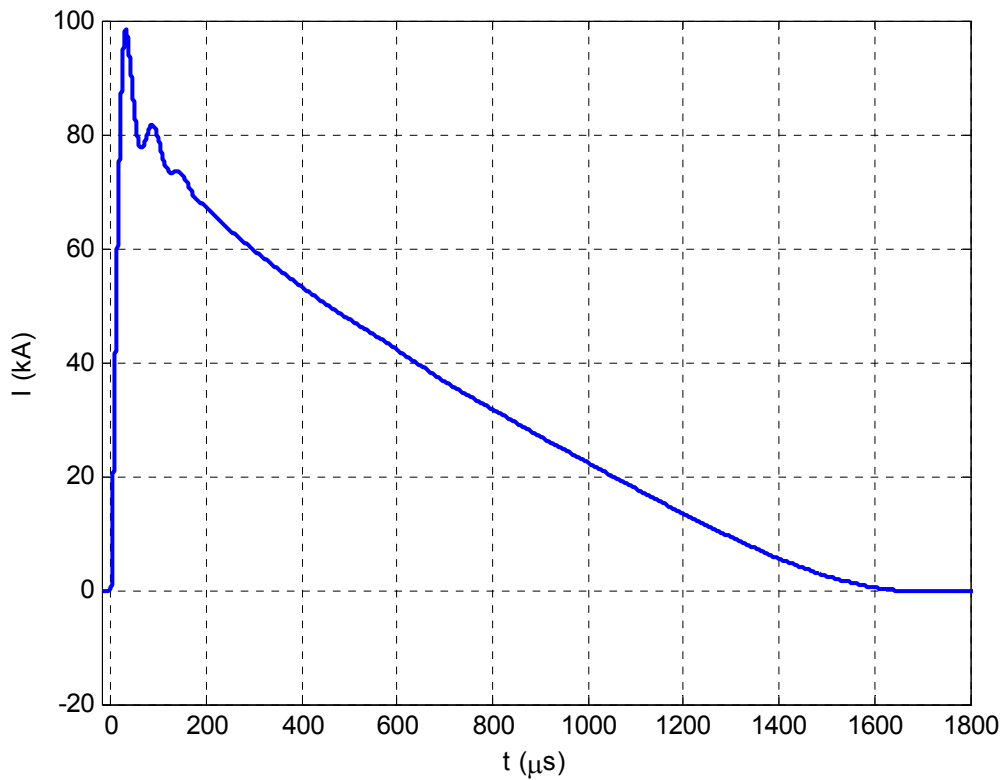


Figure 28. ÑG14-08. Current waveform

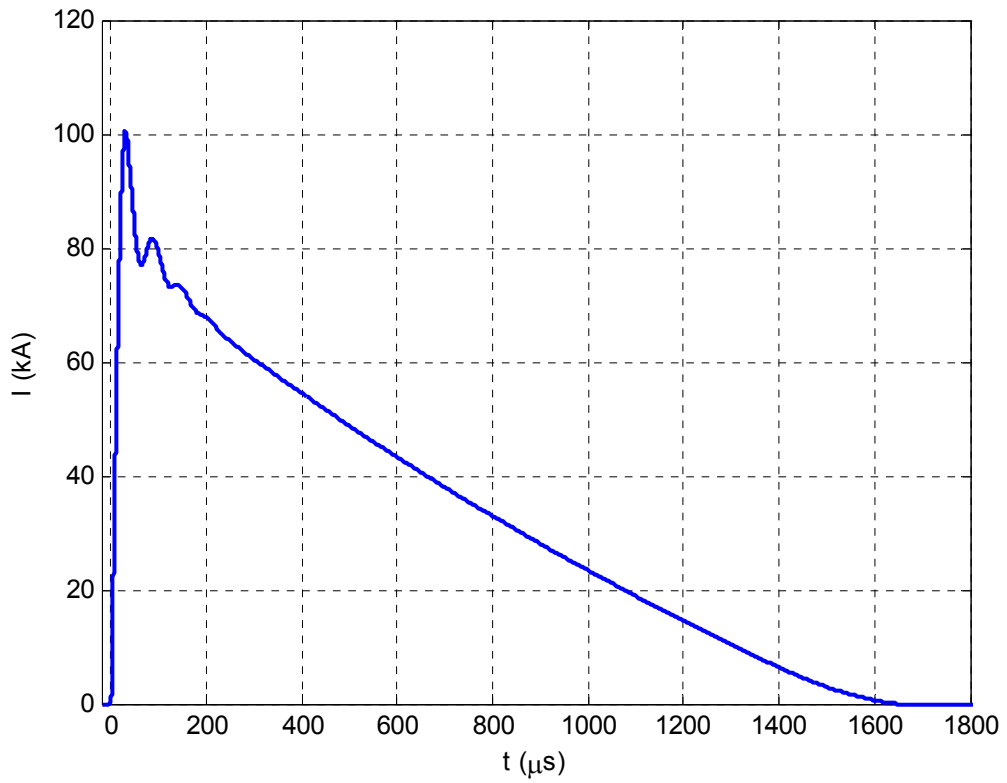


Figure 29. ÑG14-09. Current waveform

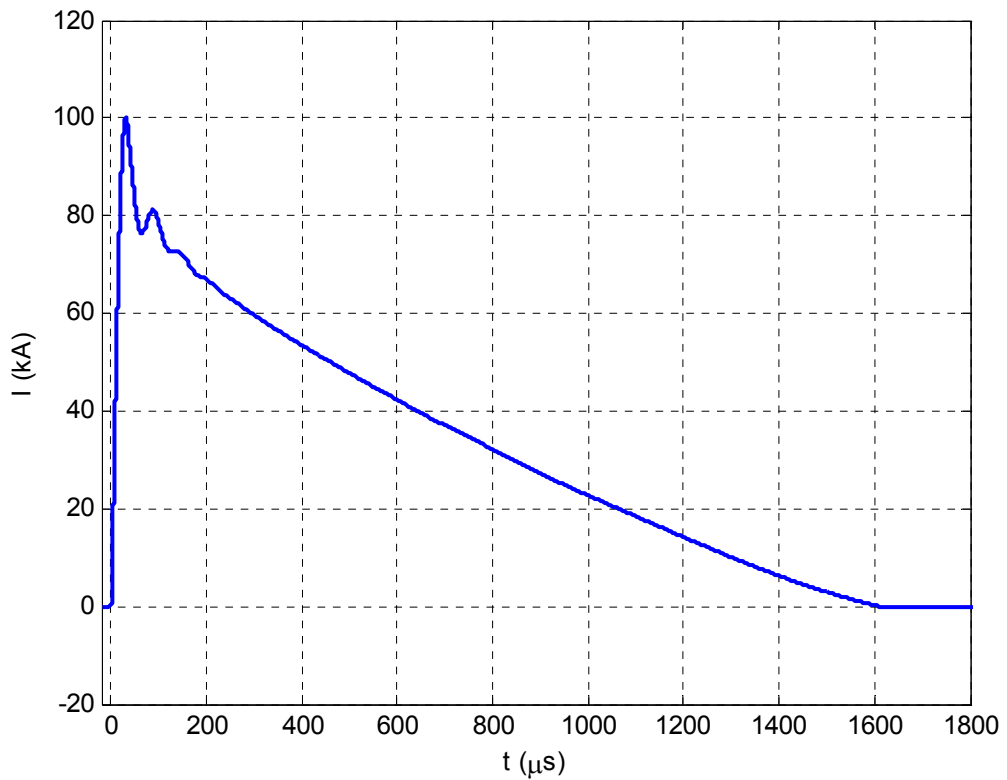


Figure 30. ÑG14-10. Current waveform

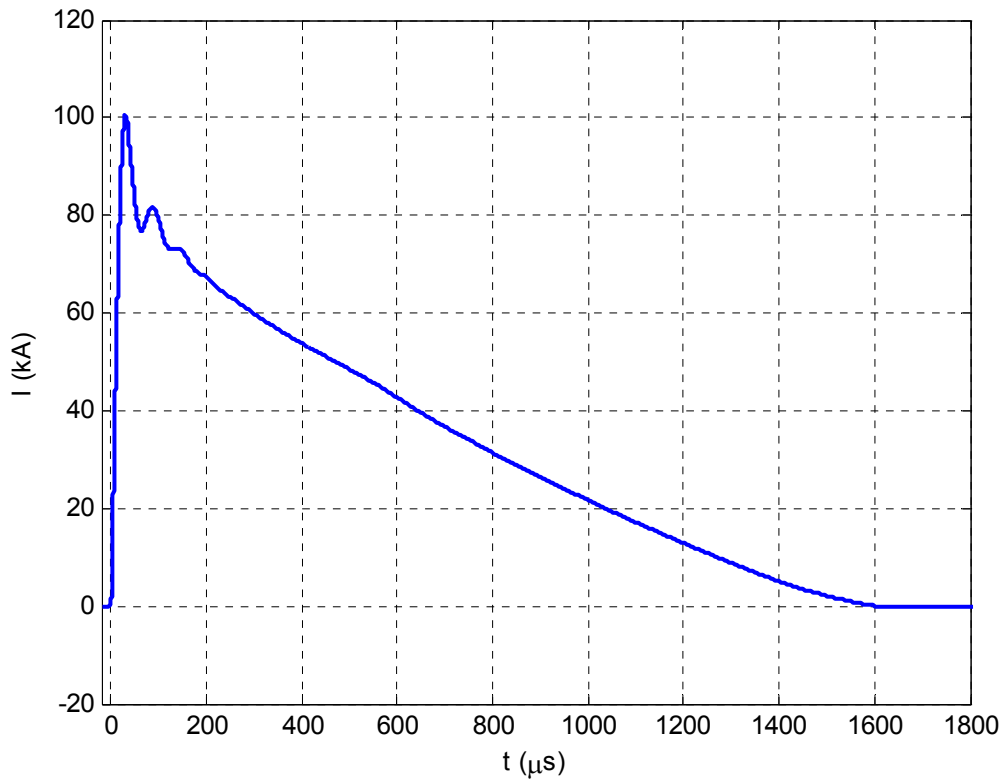


Figure 31. ÑG14-11. Current waveform

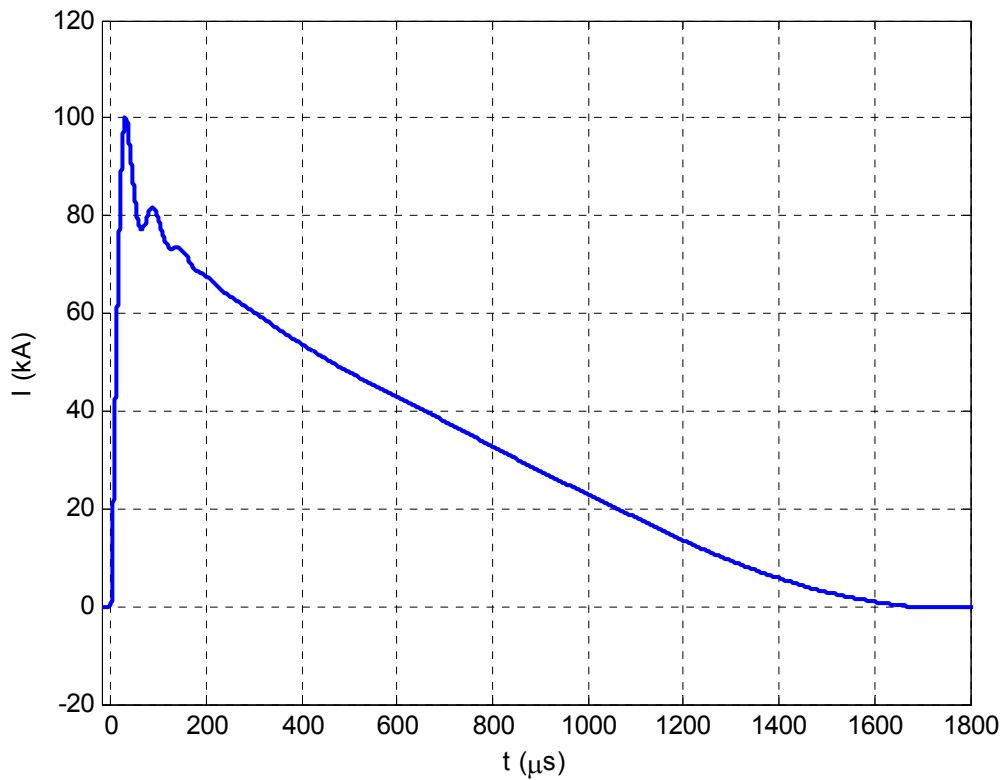


Figure 32. ÑG14-12. Current waveform

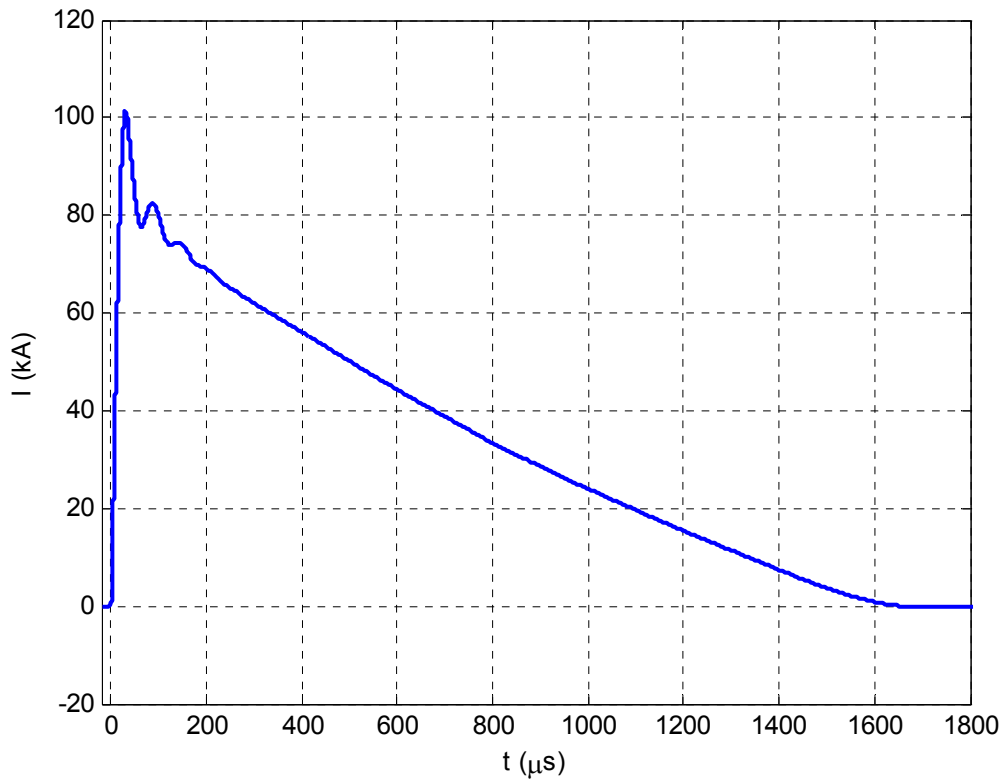


Figure 33. ÑG14-13. Current waveform

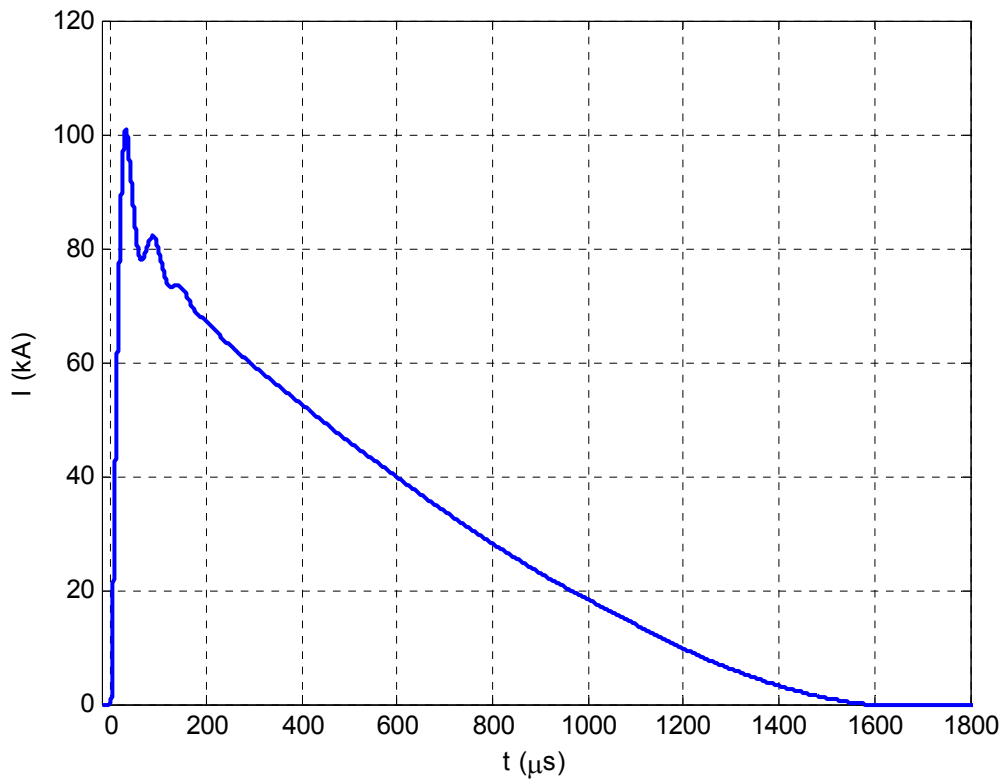


Figure 34. ÑG14-14. Current waveform

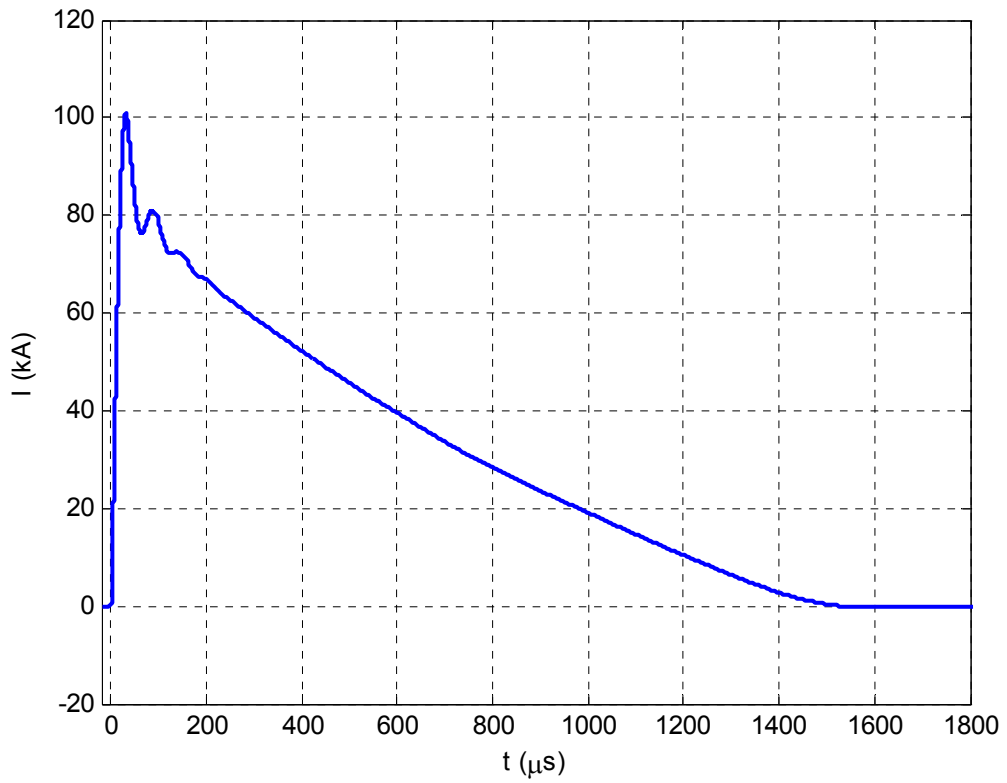


Figure 35. ÑG14-15. Current waveform

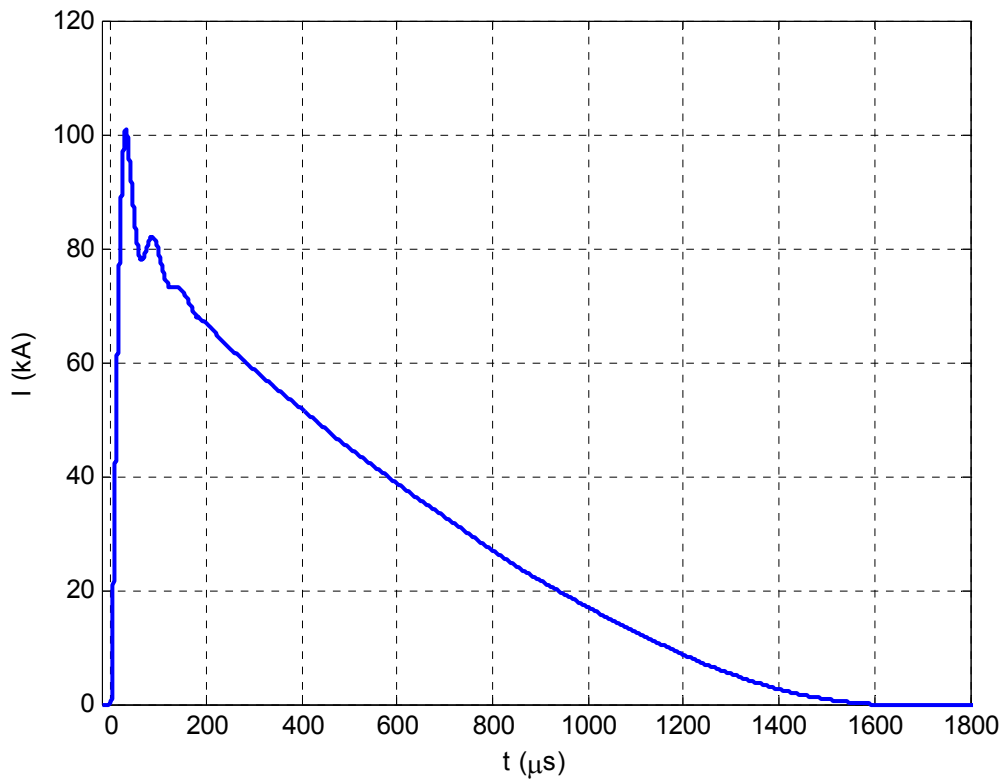


Figure 36. ÑG14-16. Current waveform

Appendix II

To Test Report nº 2015073F0335

Test Facility and Measurement Systems.

1. Test Facility

The component A and D waveforms were generated using a 52 μ F capacitor bank charged up to 75 kV and a crowbar device. The output current waveform can be modified by varying the inductance and resistance in the generator and load circuit.

2. Measurement Systems and Calibration

Current Measuring System

Reference Number: III-4-IC-04

Transducer:

Rogowski coil.
Model: BR-KH102
Reference number: III-2-IN44-130

Connections:

Cable S/n: III-4-IC-01-A1
Cable S/n: III-4-IC-01-A2
Cable S/n: III-4-IC-01-A3
Cable S/n: III-4-IC-01-A4
Cable S/n: III-4-IC-01-A5
Cable S/n: III-4-IC-01-A6
Cable S/n: III-4-IC-01-A7
Cable S/n: III-4-IC-01-A8

Conditioning:

Attenuator.
Model: ACB0501-003
Reference number: III-2-IN44-117

Filter S/n: III-1-FILT-005

Acquisition:

Digital Storage Oscilloscope
Manufacturer: Yokogawa
Model: DL-750
Serial Number: 701210-F-J1-HE/C8
Reference number: III-1-OS-006

Measurement Software:

Reference number: III-1-SOFT-016

Last Calibration Date:

November 2014

THERE IS NO TEXT UNDER THIS LINE