

# Test Report

Document No.	B6022563	Copy No.	1	Number of pages	24
Apparatus	Polymeric housing surge arresters				
Designation	PA-DM				
Serial Number	5401-5402-5403-5404				
Manufacturer	JSC "Polymer-Apparat"				
Client	JSC "Polymer-Apparat" 195427, Saint-Petersburg, Ak. Konstantinova Str.,1 - Russia Federation				
Tested for	-				
Date(s) of tests	October 21, 2016				
Tested by	CESI S.p.A. Via Rubattino, 54 20134 Milano – Italy				
Test performed	Short circuit tests				

PAD B6022563 (2296630) - CONFIDENTIAL USE

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this document has been subjected to the series of proving tests in accordance with:

IEC 60099-4 (2014-06)

The results are shown in the record of proving tests and the oscillograms attached hereto. The general performance is considered as mentioned above. The ratings assigned by the Manufacturer are listed on the ratings page. The document applies only to the apparatus tested. The responsibility for conformity of any apparatus having the same designations with that tested rests with the Manufacturer.

November 4, 2016

Date	Ghezzi Giuseppe <small>B6022563 2992 AUT</small> Test Engineer in charge	The Manager - Arcidiaco Lorenzo <small>B6022563 821814 APP</small> Approved By Document Digitally Signed
------	--	--

Partial reproduction of this document is permitted only with the written permissions from CESI Group. The authenticity of this document is guaranteed by the integrity of hologram.



LAB N° 0030

The laboratory meets the requirements of the Standard EN ISO/IEC 17025: 2005 "General Requirements for the Competence of Testing and Calibration Laboratories". The in force status of the accreditation and the list of accredited tests may be checked in the WEB site: [www.accredia.it](http://www.accredia.it)



# CESI

Trust the Power of Experience

## Notes

### **STL-Member**

CESI Group members are founder members of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in 1969. STL is a forum for voluntary international cooperation of testing organizations.

### **CESI Group Test Documents description**

#### **Type Test Certificate of .....**

Issued for type tests of high voltage products ( $> 1 \text{ kV}_{ac}$ ;  $> 1,5 \text{ kV}_{dc}$ ), which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of the test. The Type Test Certificate consists of documents unequivocally identifying the test object and describes all conditions under which the tests were conducted. It gives evidence of the unobjectionable behavior of the test object during the tests in line with the normative documents applied as well as of the results of successful testing.

#### **Test Certificate of (complete / selected) Type Tests**

Issued if type tests of low voltage products ( $< 1 \text{ kV}_{ac}$ ;  $< 1,5 \text{ kV}_{dc}$ ) requested by the relevant product standard were passed. For these tests the equipment under test must be clearly identified by technical description, drawings, and additional specifications.

#### **Certificate of Design Verification**

Issued for passed design verification tests according to IEC 61439. For these tests the equipment under test must be clearly identified by technical description, drawings, and additional specifications.

#### **Type Test Report**

Issued for high and low voltage products if parts of selected type tests have been passed; those shall be carried out in full compliance with the relevant standards but (for high voltage products) do not fulfill all STL requirements for issuing a Type Test Certificate. For these tests the equipment under test must be clearly identified by technical description, drawings, and additional specifications.

#### **Test Report**

Issued for all other tests on high and low voltage products which have been carried out according to specifications, standards and/or client instructions

#### **On-Site Test Record**

Issued as a record of results acquired during the on-site tests / measurements

#### **Test Award**

Can be additionally issued for all named types of test documents above if the tests to be referenced were passed

**Tests witnessed by**

Mr. Kolychev Alexandr                      Joint-Stock Company Polymer-Apparat

**Identification of the object**                      Effected.

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings. CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object. These drawing identified by CESI and numbered B6019249 No. 1 are annexed to this document.

**Test evaluation**

With reference to the Standards/Specifications listed in the first page and the characteristics of the tested sample assigned by manufacturer, the carried out tests passed SUCCESSFULLY

Only for laboratory requirement, in order to reproduce the test conditions, all the laboratory data are contained in the document marked B6021762 and in the following revisions:

Revision No.	Date	Reference

The reported expanded uncertainties are determined in accordance with the Publication JCGM 100 “Evaluation of measurement data - Guide to the expression of uncertainty in measurement” and are based on a standard uncertainty multiplied by a coverage factor  $k = 2$ , which for a normal distribution provides a level of confidence of approximately 95 %.

- Voltage a.c.  $\pm 3,0 \%$
- Current a.c.  $\pm 3,0 \%$
- Transient Recovery Voltage  $\pm 3,0 \%$
- Resistance d.c.  $\pm 1,5 \%$
- Time  $\pm 1,5 \%$

**Receipt date of the sample**                      October 2016

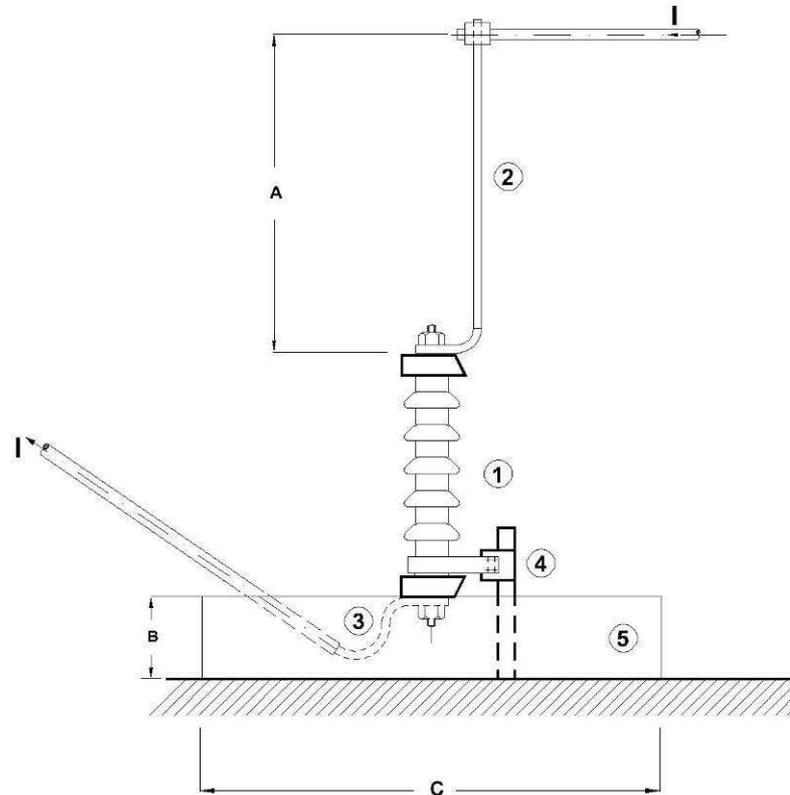


Contents	Page	Test date
<b>Rated characteristics of the tested object assigned by the Client</b>	5	
<b>Test arrangement</b>	6	
<b>Drawing</b>	7	
<b>Tests carried out</b>		
<i>Low-current short-circuit tests with 610 A for 1,01 s</i>	8	October 21, 2016
<i>High-current short-circuit tests with 6,10 kA for 0,21 s</i>	9	October 21, 2016
<i>High-current short-circuit tests with 12,1 kA for 0,21 s</i>	10	October 21, 2016
<i>High-current short-circuit tests with 20,2 kA for 0,21 s</i>	11	October 21, 2016
<b>Test circuits</b>	12	
<b>Photos</b>	13 to 17	
<b>Pages annexed</b>		
Oscillograms B6021762 (No. 7 pages)		

## Rated characteristics of the tested object assigned by the Client

<b>Metal-oxide surge arrester</b>	
Manufacturer	Joint-Stock Company Polymer-Apparat
Type	PA-DM
Drawing	
Rated voltage (Ur)	54,0 kV
Maximum continuous operating voltage (Uc)	43,2 kV
Rated frequency	50/60 Hz
Nominal discharge current (8/20 $\mu$ s impulse shape)	5 kA
Arrester classification	DM
Rated short circuit current	
High current	for 0,20 s ; 20,0 kA
Low current	for 1,00 s ; 0,6 kA

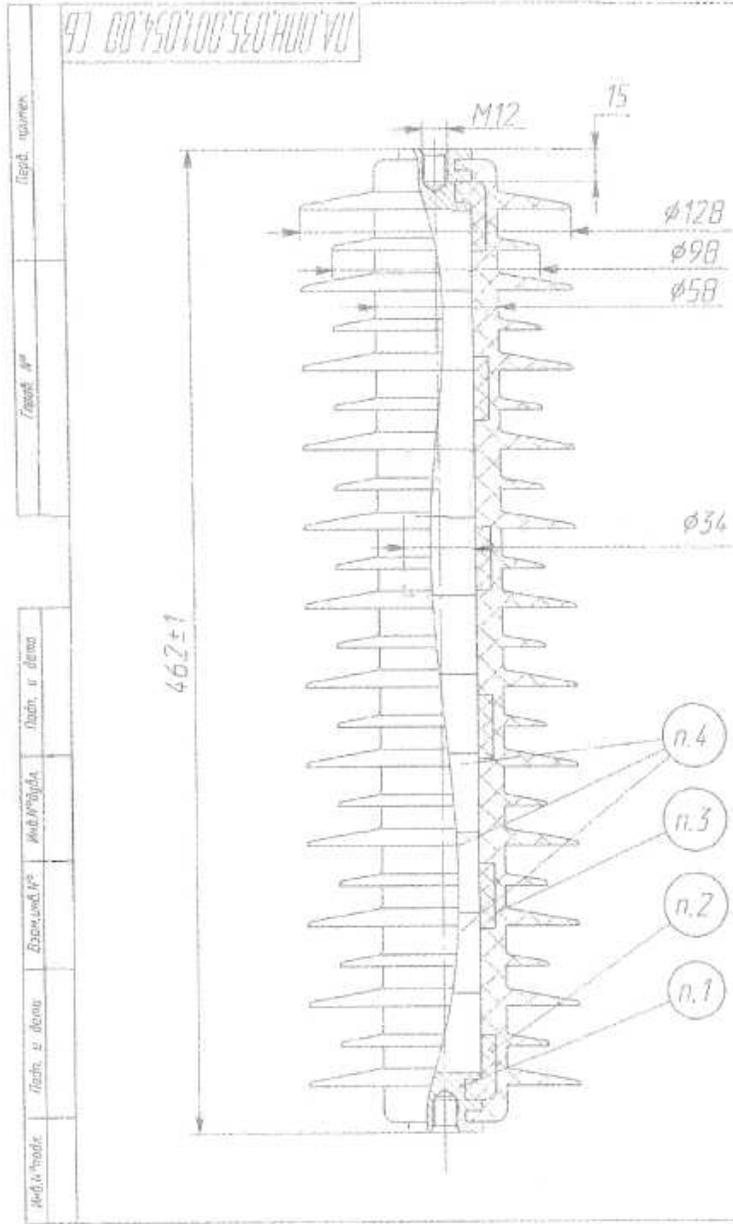
D8058 - Test arrangement



- 1 : Surge arrester
- 2 : Flexible conductor
- 3 : Flexible conductor
- 4 : Not metallic pole
- 5 : Enclosure

- A : 1,00 m
- B : 0,4 m
- C : 1,80 m

The arrester to be tested was installed by means of a crossarm on a not metallic pole at 0,4 m to ground in the middle of a square enclosure of 1,80 m in side.  
 The live side of the supply was connected to the upper end of the arrester while the return circuit, earthed, was connected to the lower end.  
 The live conductor was directed to the opposite direction as the earth conductor



№ п.	Наименование/Name	№ черт./drawing №	Примечания/remark
1	Металлический фланец/Metal flange	ПА.ОПН.035.001.14 Д	
2	Изоляционный корпус/Insulations tube	ПА.ОПН.035.010.01 Д	
3	Защитная силиконовая оболочка/Silicone tuober	ПА.ОПН.035.010.03 Д	
4	Варистор/Metal-oxide varistor	-	

1. Все размеры для справки. All dimensions for reference

ПА.ОПН.035.001.054.00 СБ					
Изм. лист	№ докум.	Дата	Внес	Метр	Масштаб
Рисунки	Иванов И.	11.06.16	С.В.	3.0	1:2
Проект	Попов А.	02.16	С.В.		
Технический	Колесов А.	02.16	С.В.		
Исполнитель	Виноградов С.В.	01.16	С.В.		
Удобр	Шибанов Н.	01.16	С.В.		
METAL-OXIDE SURGE ARRESTER				Лист 1	Из всего 1
РА-УМ-098-54-20/20				3А0	
Полимер-Аппарат				страница 45	

### Low-current short-circuit tests with 610 A for 1,01 s

**Test circuit :** See D0046      Power factor : <0,15      Frequency : 50 Hz

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	A	kA
2	1	611	1,57

### Under test surge arrester PA-DM Type

**Test arrangement :** See D8058

A photo detector was used to determine the venting time

In order to achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.

The voltage applied to the arrester was 64,8 kV and kept at this value or slightly adjusted till arrester failure.

The pre-failure process duration was 4 minutes and 10 seconds

The short-circuit test was performed 6 minutes and 05 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: October 21, 2016

Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
						Peak value	rms value			
	Sheets	No.	s	kV	kA	A	s	ms	No.	
1	3	1	5401	1,02	35,4	1,10	610	6,00	13,3	-

Condition of the apparatus after the tests:

- there was not violent shattering
- the arrester structure remained intact
- the arrester remained connected to the supply and return circuit
- no fragment were found inside or outside the enclosure
- the flame was extinguished by the operator after 6,0 seconds

**Acceptance criteria according to clause 8.7.6:** Satisfied

**Test result:** Positive

### High-current short-circuit tests with 6,10 kA for 0,21 s

**Test circuit :** See D0046      Power factor : <0,15      Frequency : 50 Hz

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
4	1	6,17	16.1

### Under test surge arrester PA-DM Type

**Test arrangement :** See D8058

A photo detector was used to determine the venting time

In order to achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.

The voltage applied to the arrester was 63,3 kV and kept at this value or slightly adjusted till arrester failure.

The pre-failure process duration was 4 minutes and 40 seconds

The short-circuit test was performed 5 minutes and 25 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: October 21, 2016

Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
	No.	Sheets				Peak value	rms value			
			No.	s	kV	kA	kA	s	ms	No.
2	5	1	5402	0,21	35,4	12,3	6,10	-	6,0	-

Condition of the apparatus after the tests:

- there was not violent shattering
- the arrester structure remained intact
- the arrester remained connected to the supply and return circuit
- no fragment were found inside or outside the enclosure
- no flame was noted

**Acceptance criteria according to clause 8.7.6:** Satisfied

**Test result:** Positive

### High-current short-circuit tests with 12,1 kA for 0,21 s

**Test circuit :** See D0046      Power factor : <0,15      Frequency : 50 Hz

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
-	-	-	-

### Under test surge arrester PA-DM Type

**Test arrangement :** See D8058

A photo detector was used to determine the venting time

In order to achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.

The voltage applied to the arrester was 63,4 kV and kept at this value or slightly adjusted till arrester failure.

The pre-failure process duration was 4 minutes and 15 seconds

The short-circuit test was performed 6 minutes and 30 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: October 21, 2016

Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
		Sheets				Peak value	rms value			
		No.	s	kV	kA	kA	s	ms	No.	
3	6	1	5403	0,21	35,4	26,8	12,1	-	6,30	-

Condition of the apparatus after the tests:

- there was not violent shattering
- the arrester structure remained intact
- the arrester remained connected to the supply and return circuit
- no fragment were found inside or outside the enclosure
- no flame was noted

**Acceptance criteria according to clause 8.7.6:** Satisfied

**Test result:** Positive

### High-current short-circuit tests with 20,2 kA for 0,21 s

**Test circuit :** See D0046      Power factor : <0,15      Frequency : 50 Hz

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
7	1	20,7	52,3

### Under test Surge arrester PA-DM Type

**Test arrangement :** See D8058

A photo detector was used to determine the venting time

In order to achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.

The voltage applied to the arrester was 63,0 kV and kept at this value or slightly adjusted till arrester failure.

The pre-failure process duration was 3 minutes and 55 seconds

The short-circuit test was performed 5 minutes and 10 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: October 21, 2016

Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
						Peak value	rms value			
	Sheets	No.	s	kV	kA	kA	s	ms	No.	
4	8	1	5404	0,21	35,4	45,5	20,2	-	4,6	-

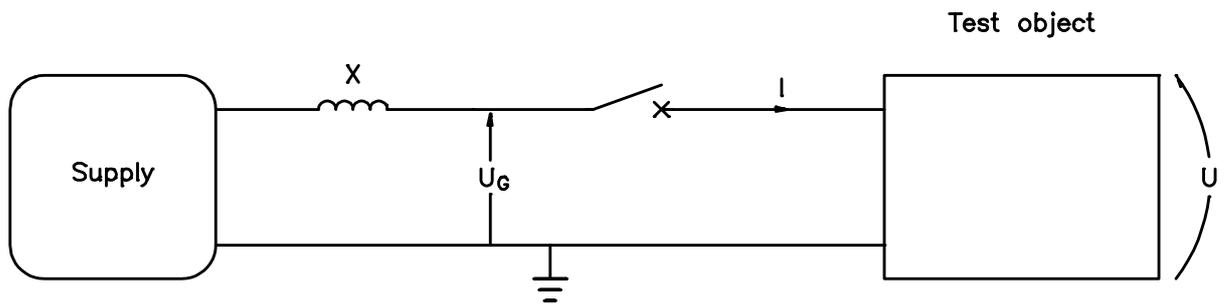
Condition of the apparatus after the tests:

- there was not violent shattering
- the arrester structure remained intact, only polymer housing slid down
- the arrester remained connected to the supply and return circuit
- no fragment were found outside the enclosure
- no flame was noted

**Acceptance criteria according to clause 8.7.6:** Satisfied

**Test result:** Positive

Test circuit D0046



Symbols used in this diagram are the same as those on the oscillograms.



Photo No.1  
Before the test No.1



Photo No.2  
After the test No.1



Photo No.3  
After test No. 1



Photo No.4  
After test No. 2



Photo No.5  
After test No. 2



Photo No.6  
After the test No.3



Photo No.7  
After the test No.3



Photo No.8  
After the test No.4

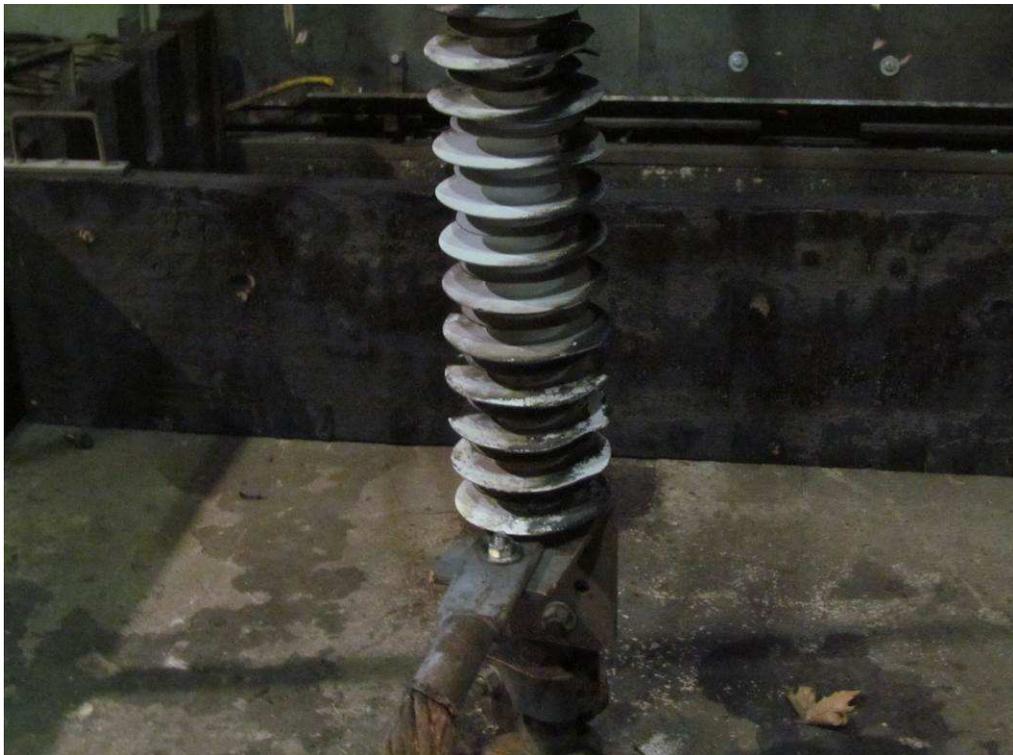


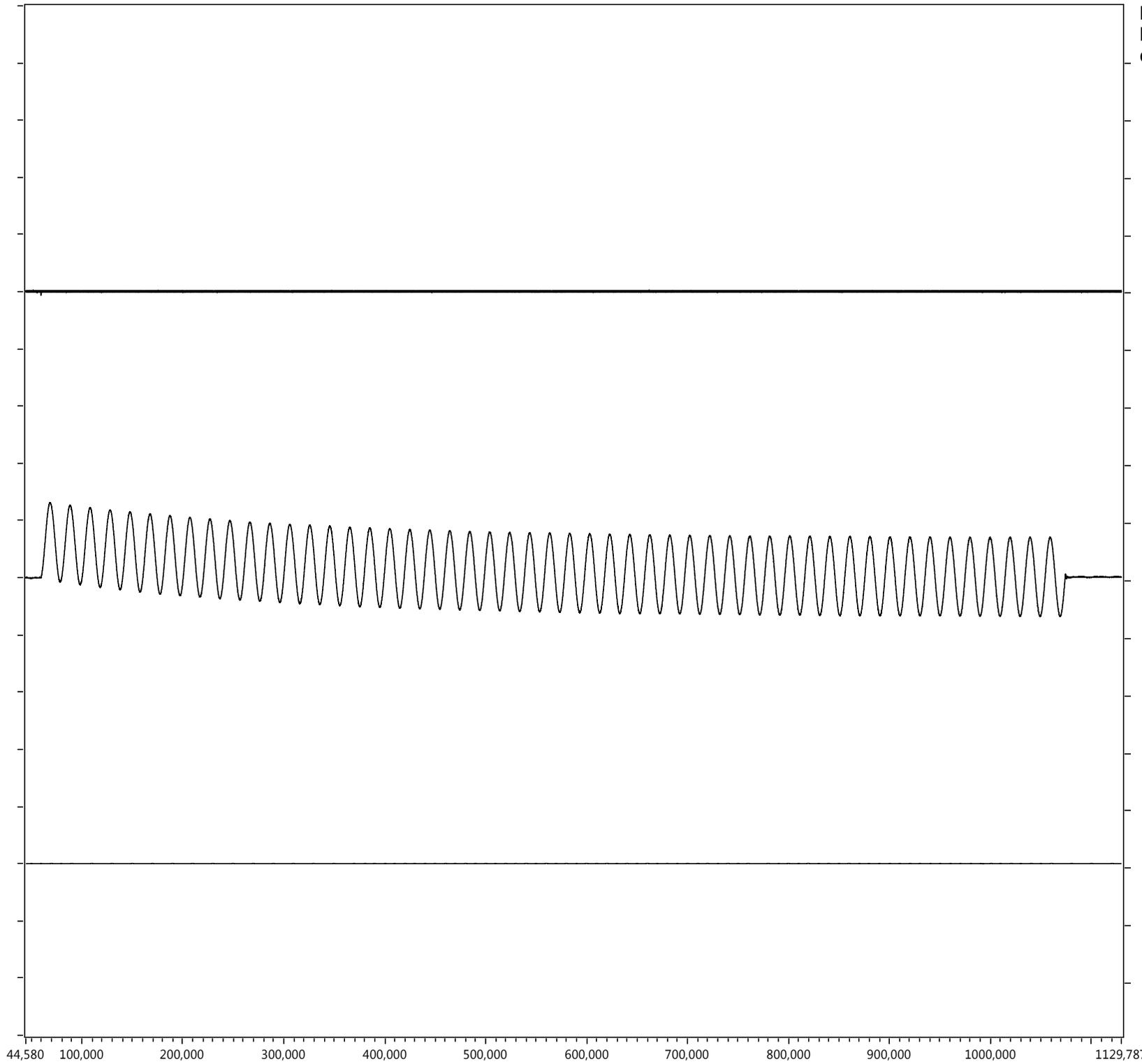
Photo No.9  
After the test No.4

I.peak= 1,57 kA  
I.rms= 611,27 A  
dT= 1,016 Sec

U 30 kV

I 1,20 kA

VENT 5 V

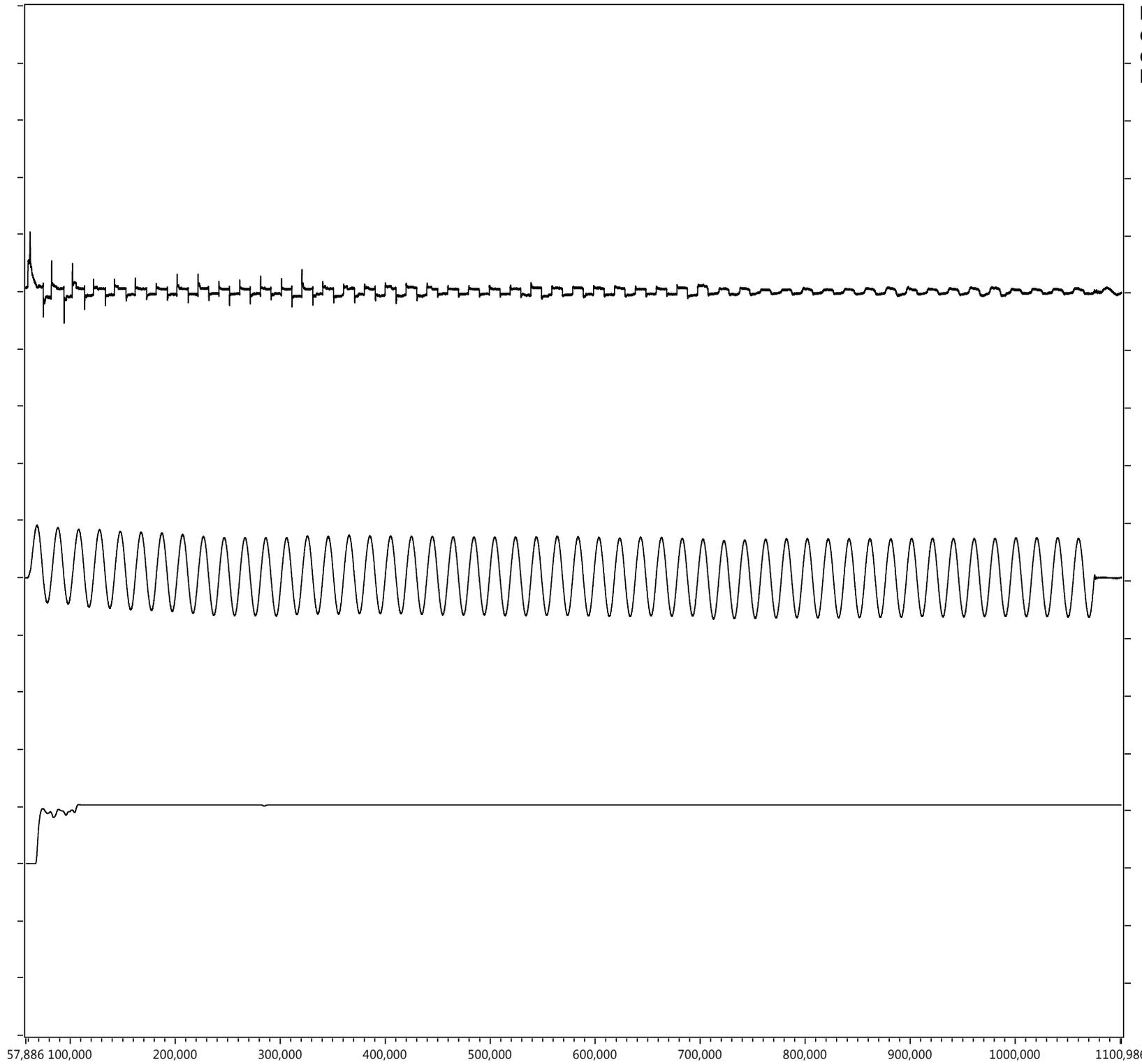


I.peak= 1,10 kA  
dT= 13,3 mSec  
dT= 1,019 Sec  
I.rms= 610,31 A

U 30 kV

I 1,20 kA

VENT 5 V



57,886 100,000 200,000 300,000 400,000 500,000 600,000 700,000 800,000 900,000 1000,000 1100,986

5,000 [msec/div.]

I.rms= 6,17 kA  
I.peak= 16,07 kA  
dT= 234,2 mSec

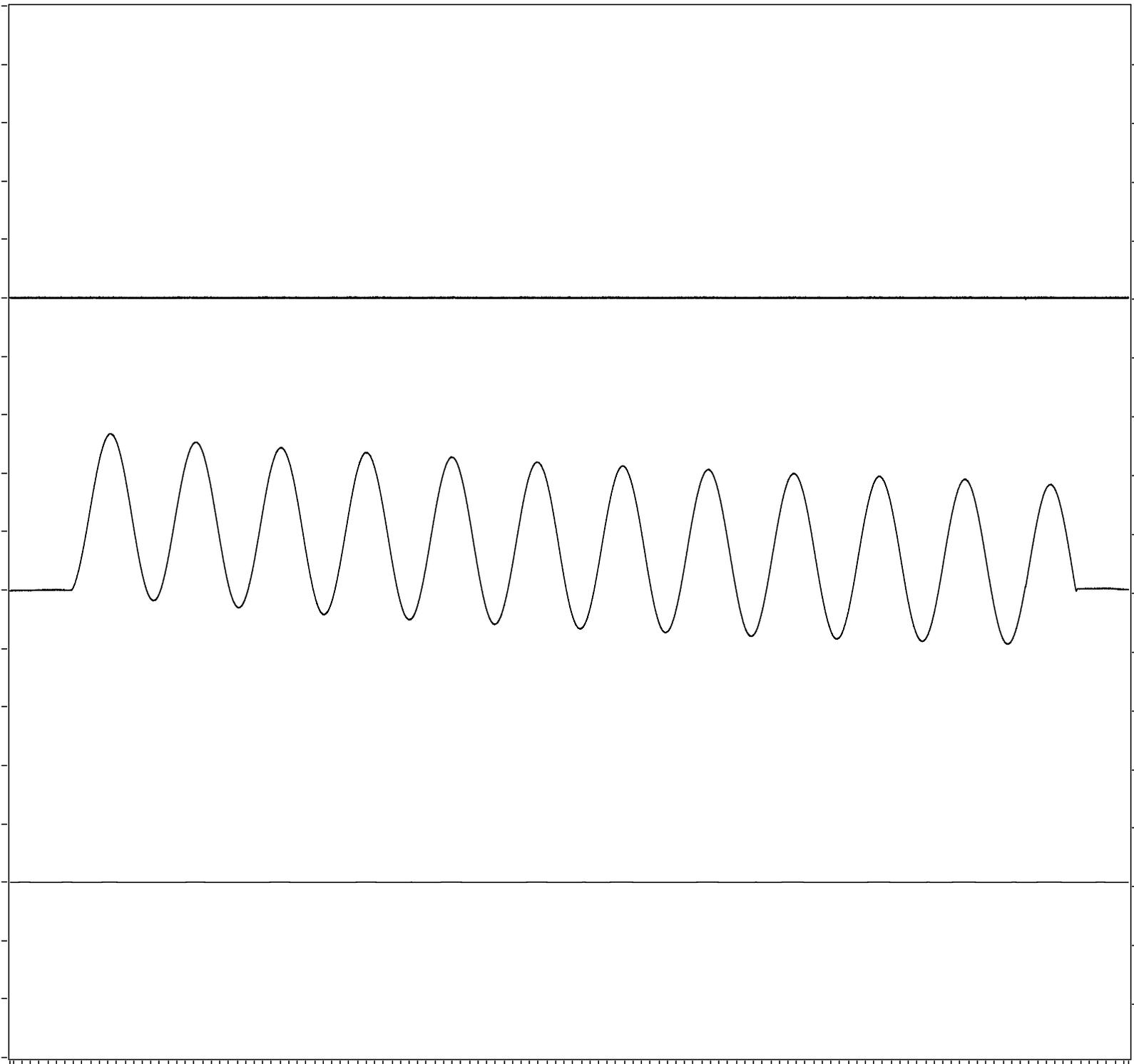
U 30 kV

I 6 kA

VENT 5 V

45,271 60,000 80,000 100,000 120,000 140,000 160,000 180,000 200,000 220,000 240,000 260,000 280,000 305,167

2,000 [msec/div.]

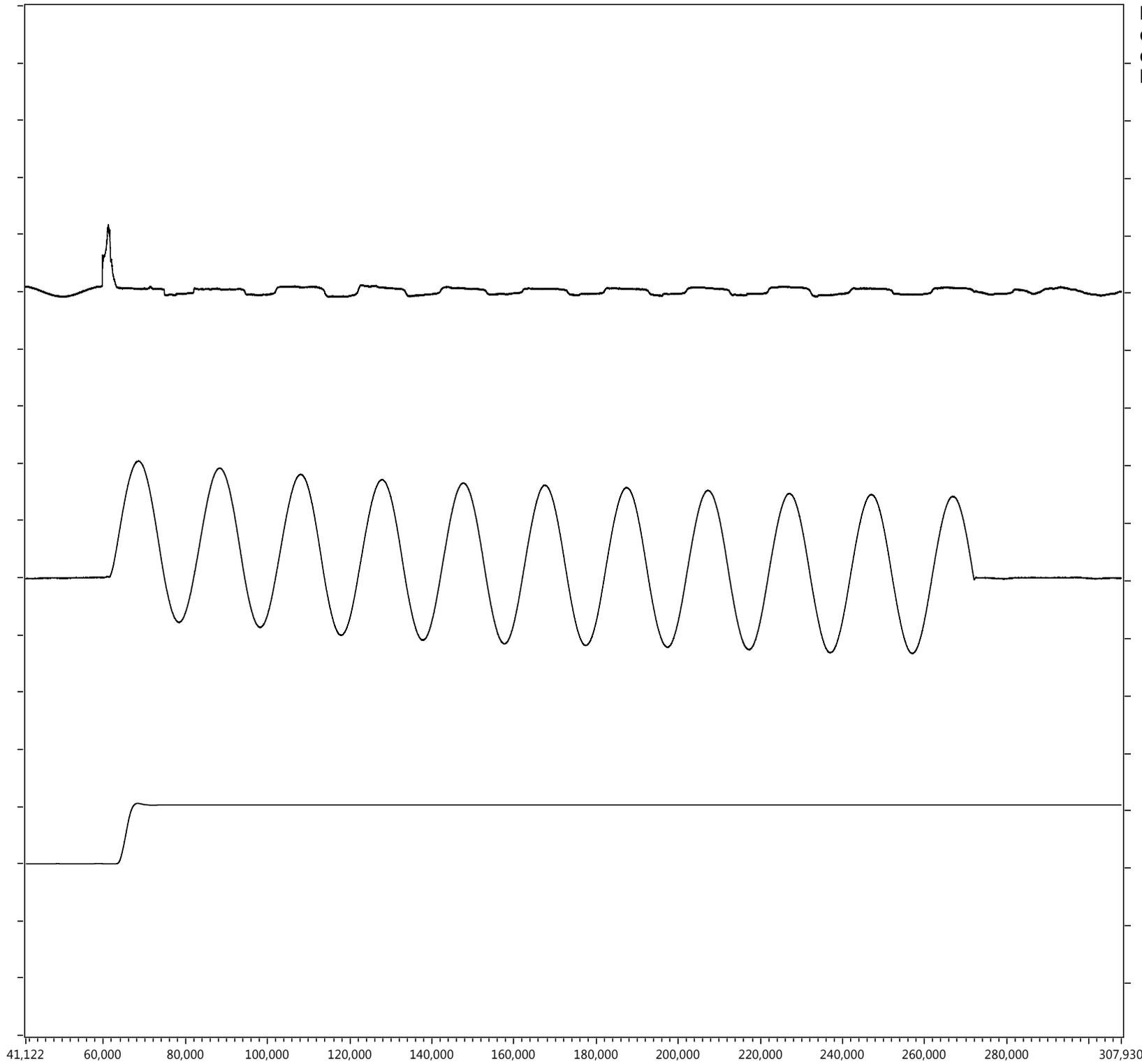


I.peak= 12,27 kA  
dT= 6,0 mSec  
dT= 210,7 mSec  
I.rms= 6,10 kA

U 30 kV

I 6 kA

VENT 5 V

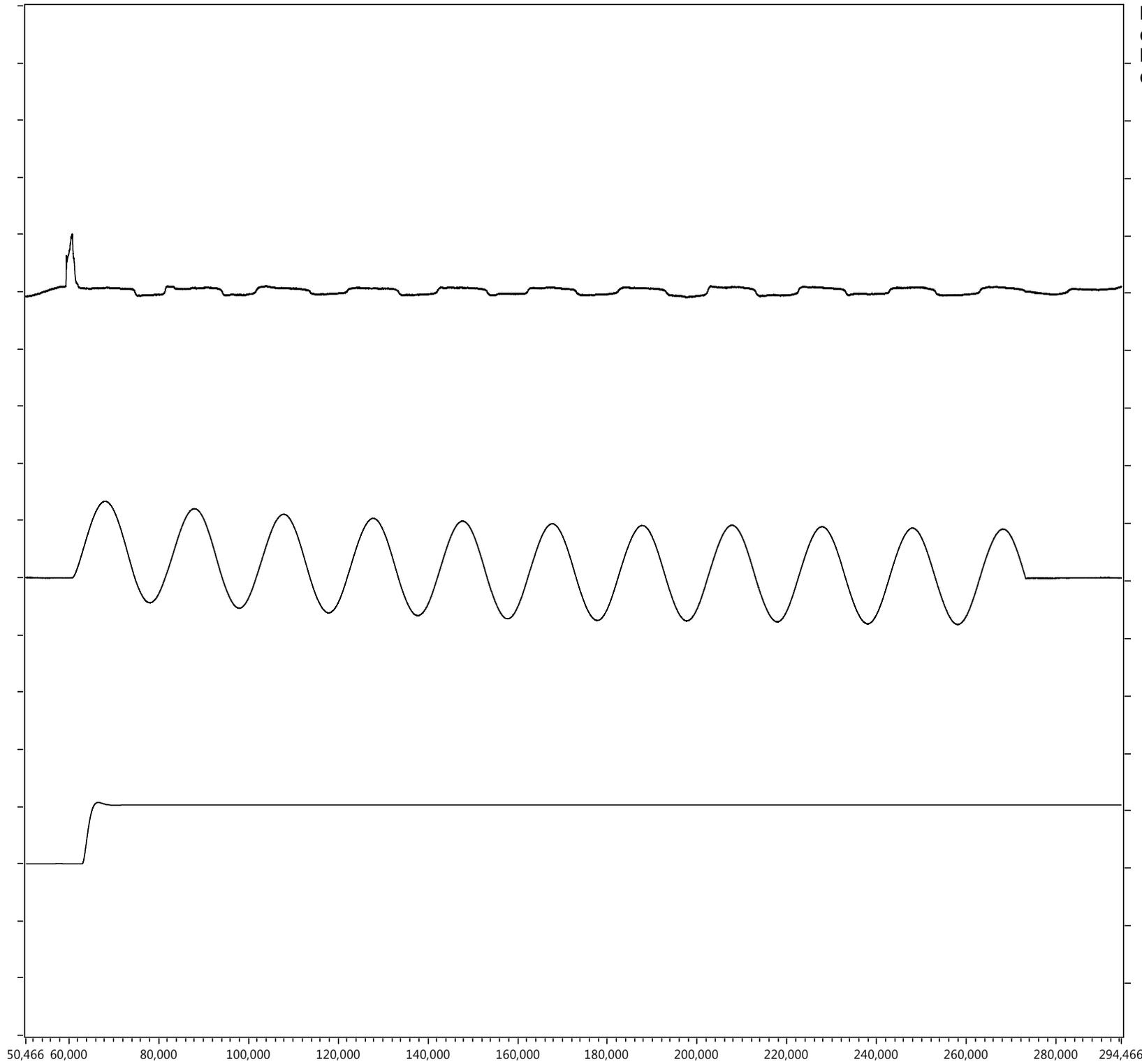


I.peak= 26,76 kA  
dT= 6,3 mSec  
I.rms= 12,14 kA  
dT= 212,2 mSec

U 30 kV

I 20 kA

VENT 5 V

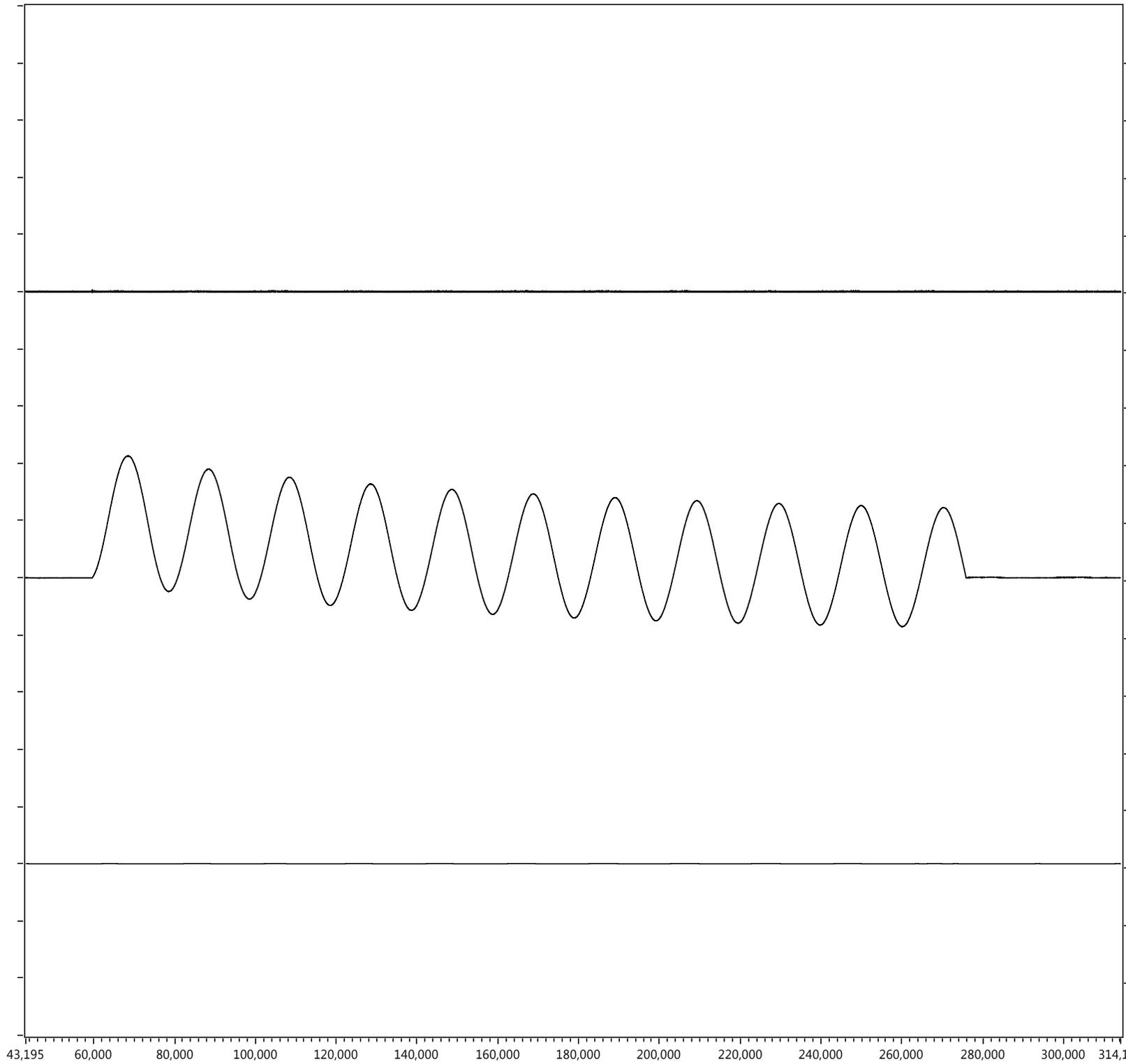


I.peak= 52,27 kA  
I.rms= 20,75 kA  
dT= 217,4 mSec

U 30 kV

I 25 kA

VENT 5 V



43,195 60,000 80,000 100,000 120,000 140,000 160,000 180,000 200,000 220,000 240,000 260,000 280,000 300,000 314,151

2,000 [msec/div.]

I.peak= 45,49 kA  
dT= 4,6 mSec  
dT= 214,8 mSec  
I.rms= 20,26 kA

U 30 kV

I 25 kA

VENT 5 V

