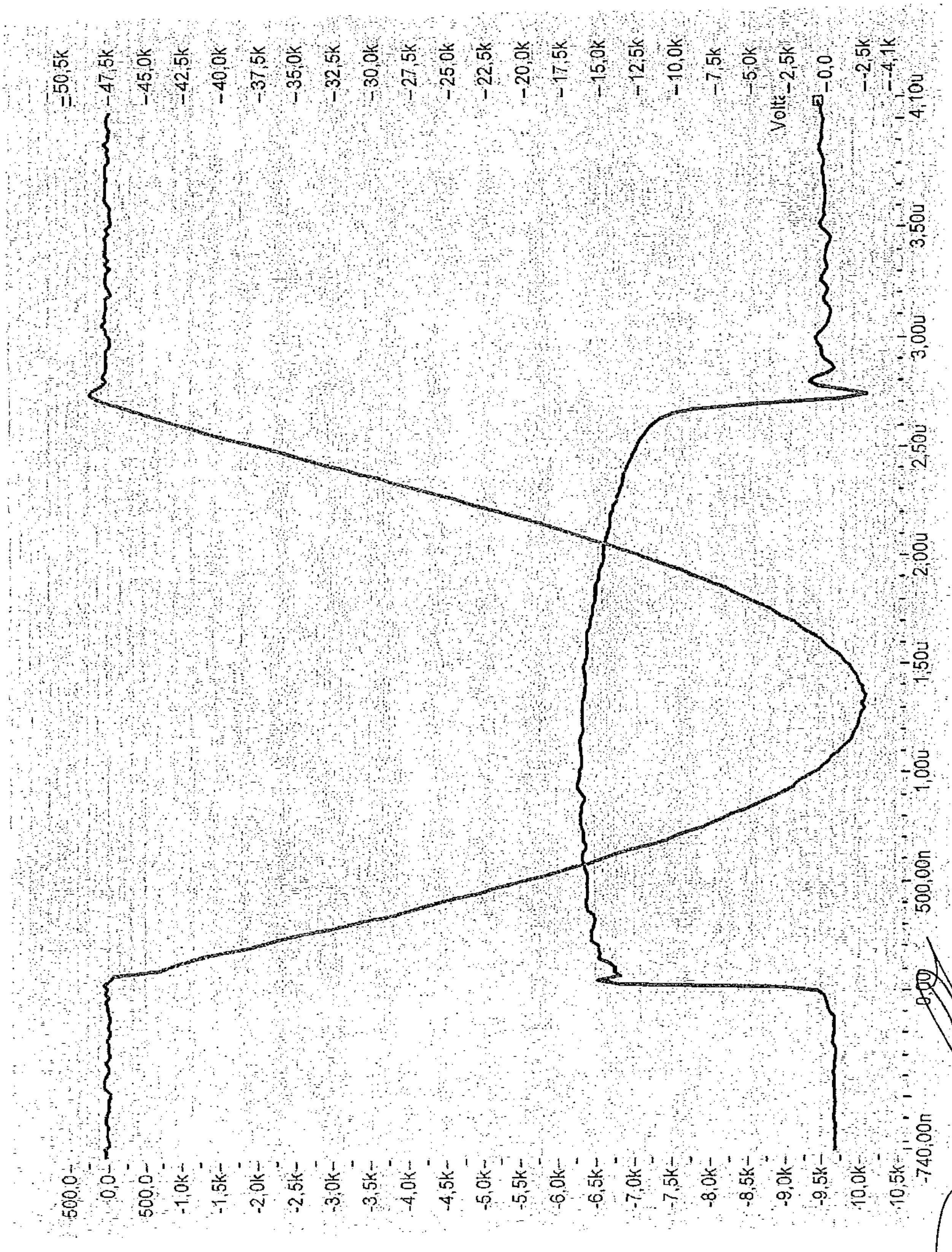
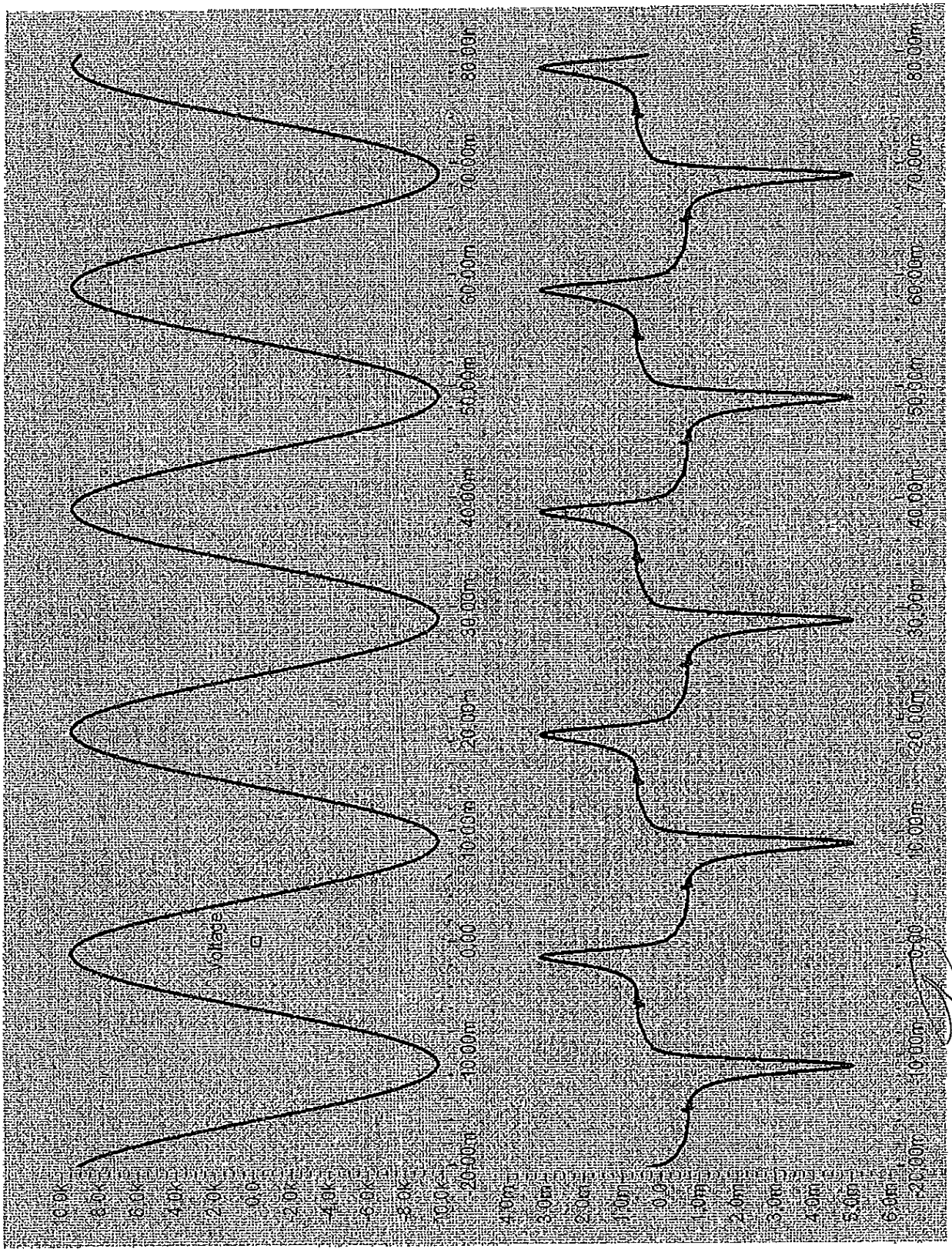


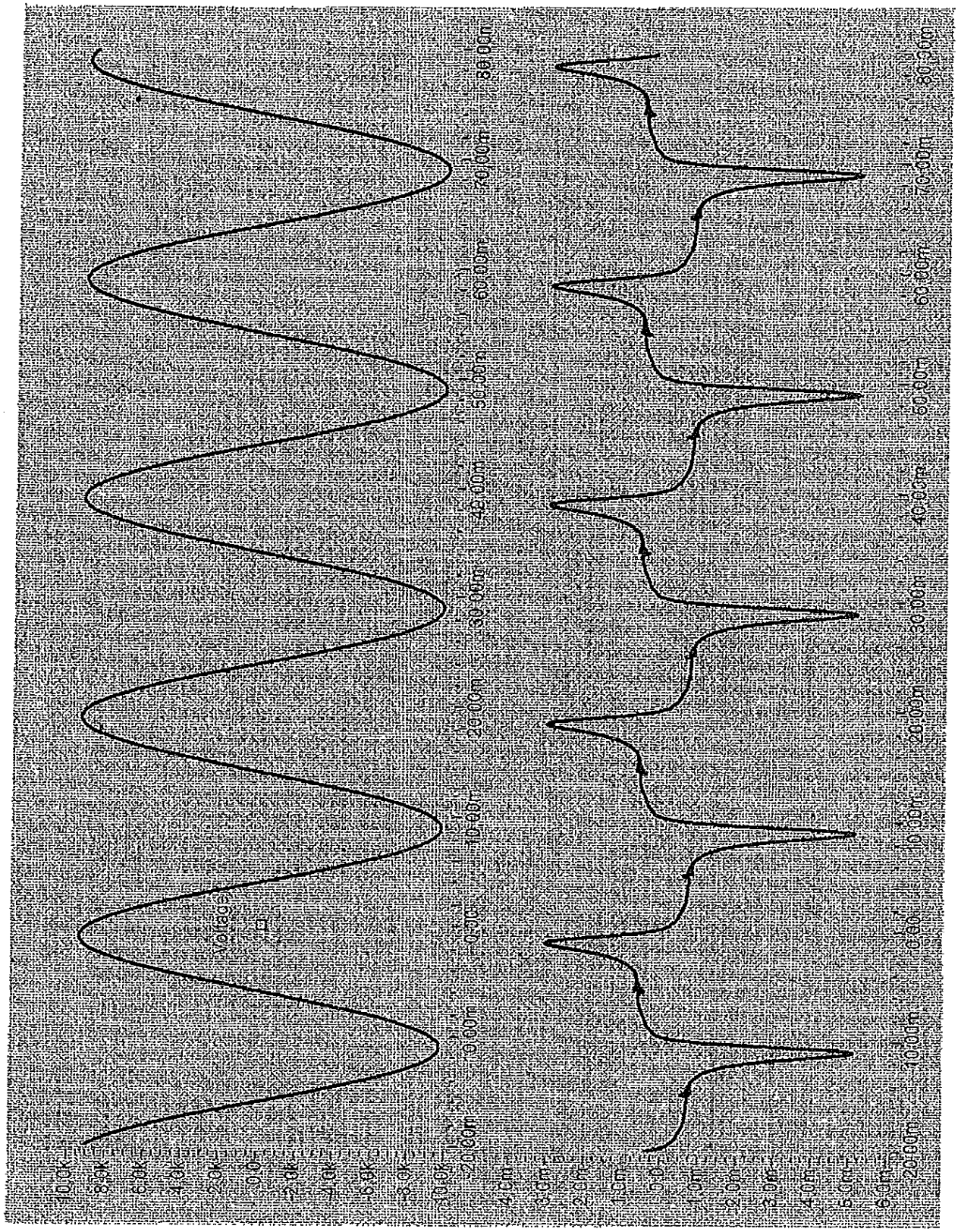
CESI A7020275 Oscillogram n. 18

ВЯРНО С ОРИГИНАЛА

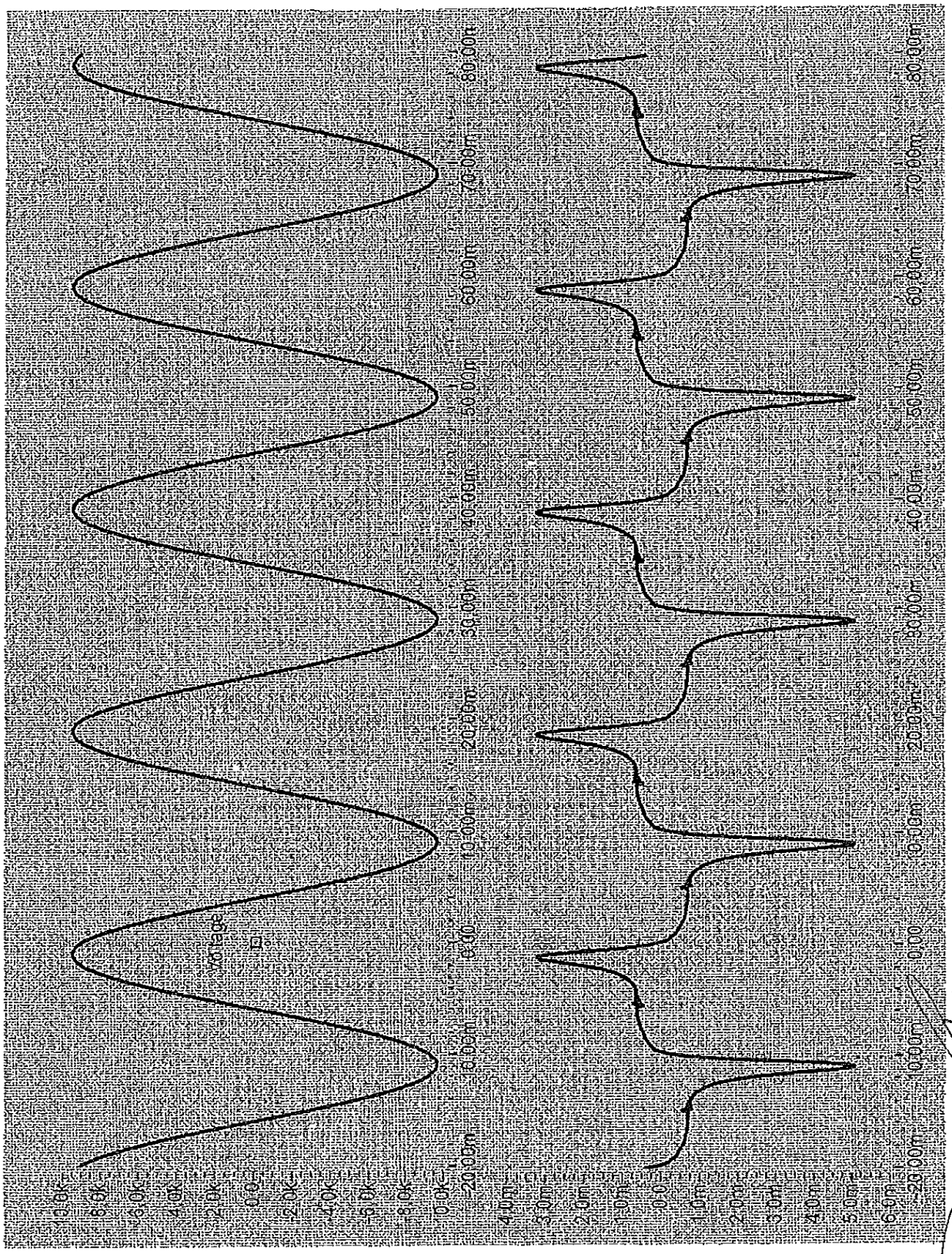
CESI A7020275 Oscillogram n. 19



CESI A7020275 Oscillogram n. 20



CESI A7020275 Oscillogram n. 21

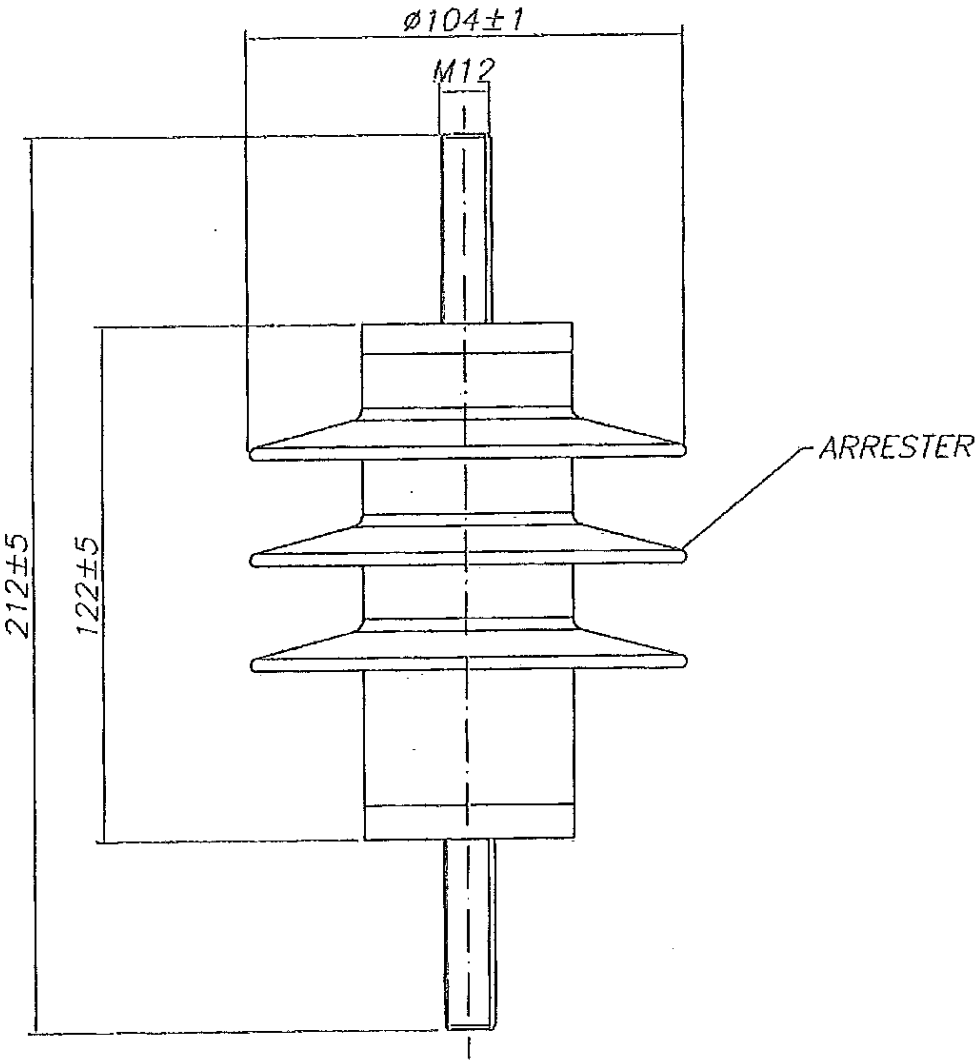


CESI A7020275 Oscillogram n. 22

ВЯРНО С ОРИГИНАЛА

АДМИНИСТРАТИВНО ДРУЖЕСТВО * ПЛОВДИВ * ОИПКАБ 16

SCD



На основание чл. 2
от ЗЗЛД

DATA
22 ОТТ. 2007

Uref = 6.22kV min
Ur = 6.5kV
Uc = 5.2kV
CREEPAGE = 254mm
DRY ARC DISTANCE = 127mm

Tyco Electronics

ENERGY DIVISION

Bowthorpe EMP Surge Arrester

BAY 100-109
SHANNON IND. EST.
SHANNON
CO. CLARE
IRELAND

DRN	J MULLIGAN	17/09/07	
CHECK	B NORMOYLE		
APP	B McGOWAN		
SCALE	1:1		

PCN

MAT'L

TITLE

DA1-6.5-NONONO SURGE ARRESTER

DRG NO	SHEET	REV
DA1-6.5-NONONO	1 OF 1	0

DA1 - Distribution Surge Arrester
Long duration current impulse withstand
Type Test Report

Tyco Electronics

Our commitment. Your advantage.

Tyco Electronics

Bowthorpe EMP

Test Report

Type	**DA1**
PPR Number	**PPR-2278**
Test Specification	Long duration current impulse withstand test IEC 60099-4 (2006-07) Ed. 2.1

Test Information:

Laboratory	CESI
Date	03/09/2007
External Test Ref	A7020276
Report Prepared by	M. Gregori
Test Verified by	A. Sironi
Test Approved by	V. Scarioni

Tyco Approvals:

R&D Manager

Brendan Normoyle

Date 28/11/2007

На основание чл. 2
от ЗЗЛД

Product Manager

Brian McGowan

Date 28/11/2007

For further information contact:
Tyco Electronics Energy Division
Bay 100-109
Shannon Industrial Estate
Co. Clare, Ireland
Tel:+ 353-61-472885
Fax: + 353-61-472676
Email: mvsurgearresters@tycoelectronics.com

Client	TYCO Electronics – Shannon (Ireland)
Tested equipment	Polymer- housed metal-oxide surge arrester sections type DA1 fitted with disconnector
Tests carried out	Long-duration current impulse withstand test
Standards/Specifications	IEC 60099-4 – Edition 2.1 (2006-07)
Test date	**from** July 24, 2007 **to** August 02, 2007

No. of pages	21	**No. of pages annexed**	25

Issue date

Prepared На основание чл. 2 от ЗЗЛД

Verified

Approved

CESI
Centro Elettrotecnico Sperimentale Italiano Giacinto Motta spa
Via R. Rubattino 54
20134 Milano - Italia
Telefono +39 022125.1
Fax +39 0221255440
http://www.cesi.it
Capitale sociale 8 550 000 Euro interamente versato
Codice fiscale e numero iscrizione CCIAA 00793580150
Registro Imprese di Milano Sezione Ordinaria N. R.E.A. 429222
P.I. IT00793580150

ВЯРНО С ОРИГИНАЛА

ФИЛИАЛ 16

Tests witnessed by: ---

Identification of the object: Requested

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawing.
CESI checked that this drawing adequately represents in shape and dimensions the essential details and the parts of the tested object.
This drawing, identified by CESI and numbered A7027909 No. 1, is annexed to this document.

The data necessary to permit repetition of the tests are contained in the document marked: ---

- dielectric tests with impulse voltage	: **peak voltage: ± 3 %; time parameters: ± 10 %**
- dielectric tests with impulse current	: **peak value: ± 3 %; time parameters: ± 10 %**
- dielectric tests with alternating voltage	: **voltage (rms): ± 3 %**
dielectric tests with direct voltage	: **voltage: ± 3 %**

The measurement uncertainties are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to confidence level of about 95%) and have to be considered as maximum values

Laboratory information

Receipt date of the sample	July 16 , 2007
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr L. Podavitte – Mr I. Guacci
Test laboratory	P177
Activity code	80090B

content	page a	test date
Test object characteristics	4	
Photograph of the test sample	5	
Reference standard	6	
Test carried out	6	
Test object identification	6	
Test procedure	7	
Visual Inspection and summary of the test result	8	
Power frequency voltage characteristics	9	July 24, 2007
Lightning impulse residual voltage measurement before the test	10	July 25, 2007
Switching impulse residual voltage test	11	July 25, 2007
Voltage correction factor and energy calculations	12	July 25, 2007
Long duration current impulse withstand test	from page 13 to 16	July 25, 2007
Lightning impulse residual voltage measurement after the test	17	August 02, 2007
Technical data of the test circuit	from page 18 to 21	

Pages annexed:

oscillograms n. 24 pages

Document annexed:

Tyco Electronics drawing no. DA1-6.5-NODONO; CESI no. A7027909 - n.1 page

Test object characteristics

type: Polymer-housed metal-oxide surge arrester section fitted with disconnector

electrical characteristics (assigned by the client)

Manufacturer's name	TYCO Electronics – Shannon (Ireland)
Type	DA1
Nominal discharge current – I_n [kA]	10
Rated voltage – U_r [kV]	1,045 x U_{ref}
Continuous operating voltage - U_c [kV]	0,836 x U_{ref}
Reference current - $I_{ref.}$ [mA]	5,0
Line discharge class	1
Standard rated frequency - [Hz]	50/60
year of manufacture	2007

ВЯРНО С ОРИГИНАЛА

View of the test object

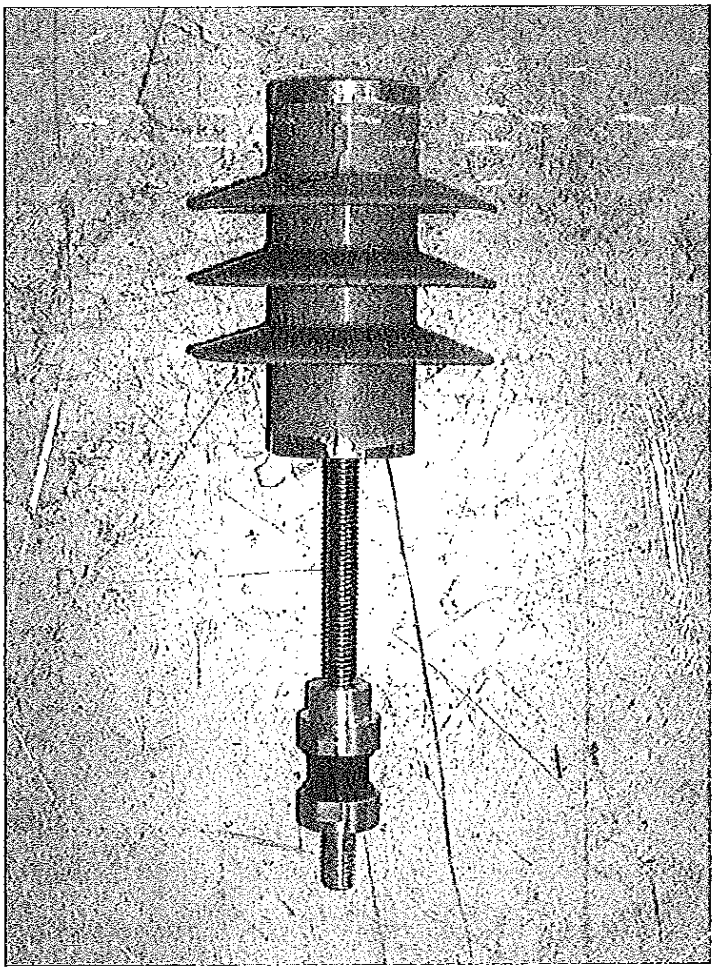


Photo no. 1

Polymer-housed metal-oxide surge arrester section fitted with disconnector

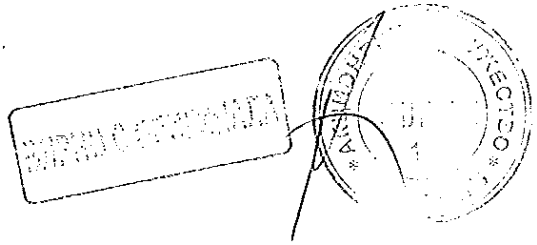
Reference Standard

IEC 60099-4 (2006-07) – Edition 2.1 - Clause 10.8.4
"Metal-oxide surge arresters without gaps for a.c. system"

Test carried out	Number of sample tested
Long-duration current impulse withstand test	3

Test object identification

Test object name	Identification of test sample (given by CESI)
Polymer- housed metal-oxide surge arrester section fitted with disconnector	LD1-LD2-LD3



Test procedure

The test procedure consisted of the following sequence:

a) Measurement of the power frequency reference voltage at the reference current

b) Measurement of the lightning impulse residual voltage at nominal discharge current

c) Measurement of the switching impulse residual voltage at the lowest current peak prescribed by the standard in table 4 that is 125 A

d) Calculation of the specified energy associated to each long duration current impulse according to clause 8.4.2 of the reference standard (see note 1)

e) Application of eighteen long duration current impulses with the specified energy (see note 1) and a virtual duration of 2000 µs
in six groups of three operations each.
- intervals between operations of the same group: 60 seconds
- interval between different groups: as required to cool down the samples to near ambient temperature

f) After cooling down to near ambient temperature cooling down to near ambient temperature application of a nineteenth impulse to check the sample integrity

g) Measurement of the lightning impulse residual voltage at nominal discharge current for comparison with initial value

Test result

The visual inspection of the sample after the test has revealed no sign of physical damage.
The variation of lightning impulse residual voltage before and after the test was less than 5% (maximum allowed variation according to reference standard is 5%).
The oscillographic record of the 19th impulse did not reveal any sign of internal discharge.
The disconnectors did not operate

The acceptance criteria are fulfilled. The test result is positive

(*) Note:
Upon Client request the test was carried out with a peak current of 325 A for each single shot applied.
The approach is different from the IEC for 10 kA class 1 surge arrester (based on the specified calculated energy see page 12). The applied energy exceed the IEC specified claculated energy and thus the test was more onerous

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ФИЛКАБ 16 * ПЛОВДИВ

Variation of lightning impulse residual voltage at I_n

sample	before test		after test		variation
	discharge current	residual voltage	discharge current	residual voltage	
	kA	kV	kA	kV	%
LD1	10,07	15,92	10,14	16,05	+ 0,82
LD2	10,09	15,72	10,17	15,94	+ 1,39
LD3	10,11	15,64	10,20	15,88	+1,53

Visual inspection after the test

The visual inspection of the surge arresters samples after the test has revealed no sign of physical damage

Long-duration current impulse withstand test.

Reference voltage test

Test circuit: A0019

Date: July 24, 2007

Sample No. LD1						
Oscillogram	Voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
1	6,65	4,62	5,11	1,66	6,98	---

Sample No. LD2						
oscillogram	Voltage	current	current	current	Power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
2	6,65	4,65	5,04	1,66	7,00	---

Sample No. LD3						
oscillogram	Voltage	current	current	current	Power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
3	6,61	4,72	5,03	1,66	6,91	---

ВЯРНО С ОРИГИНАЛА

ФИЛКАБ 16 ПЛОВДИВ

Long-duration current impulse withstand test.

Lightning impulse residual voltage measurement before the test

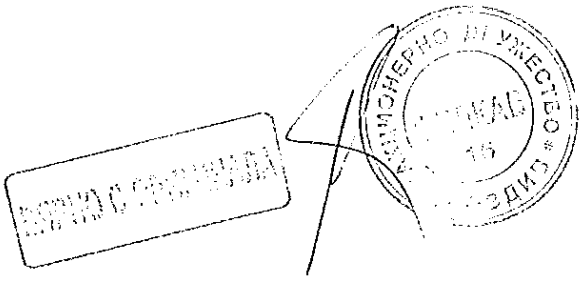
Test circuit: A0120

Date: July 25, 2007

Sample	Requested current	Charging Voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
LD1	I_n	30,0	4	8,8/18,8	10,07	15,92
LD2		30,0	5		10,09	15,72
LD3		29,9	6		10,11	15,64

	Oscilloscope settings		
	Sampling division	Input	attenuation
	µs	V_{div}	
Current	5	1,0	50:10
Voltage	5	1,0	20:5

Notes:



Long-duration current impulse withstand test.

Switching impulse residual voltage test.

Test circuit: A0122

Date: July 25 , 2007

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.	A	kV	No.	µs	A	kV
LD1	250	13,2	7	31,0/72,0	126	11,89
LD2		13,2	8		131	11,88
LD3		13,1	9		125	11,89

	Oscilloscope settings		
	sampling division	input	attenuation
	µs	V_{div}	
Current	20	0,5	10:10
Voltage	20	1,0	20:5

Notes:

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО ФИЛКАБ 16 * ПЛОВДИВ *

Long-duration current impulse withstand test.

Voltage correction factor and energy calculations

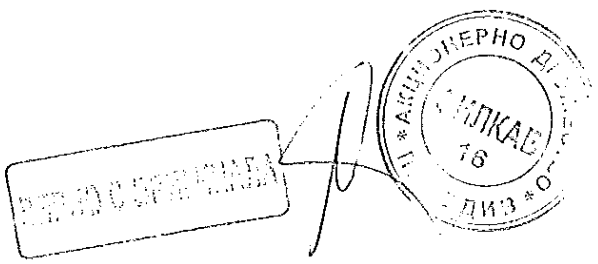
Date: June 25, 2007

Sample	U_{ref} [1]	KU_r [2]	KU_c [3]	U_r' [4]	U_c' [5]
No.	kV			kV	kV
LD1	6,65	1,045	0,836	6,949	5,559
LD2	6,65			6,949	5,559
LD3	6,61			6,907	5,526

[1] U_{ref} : measured reference voltage
[2] KU_r : maximum guaranteed factor for calculation of Ur
[3] KU_c : maximum guaranteed factor for calculation of Uc
[4] U_r' : corrected rated voltage [4] = [1] × [2]
[5] U_c' : corrected continuous operating voltage [5] = [1] × [3]

Sample	U_r'	U_L	U_{res}	T	Z	W	W'
No.	kV		kV	µs	Ω	kJ	kJ/kV
LD1	6,949	22,237	11,88	2000	34,050	7,227	1,040
LD2	6,949	22,237			34,050	7,227	1,040
LD3	6,907	22,102			33,844	7,168	1,038

U_{res} : switching impulse residual voltage
U_L , T , Z : see table 5 of IEC 60099-4 at clause 8.4.2
W : = $U_{res} \times (U_L - U_{res}) \times (T / Z)$



Long-duration current impulse withstand test.

Test circuit: A0017

Date: July 25, 2007

Sample	Impulse	Charging voltage U_c	Oscillogram	Peak current I	Residual voltage U_{res}	Energy E
No.	No.	kV	No.	A	kV	kJ
LD1	1	51,5		319	12,34	8,88
	2	52,0		326	12,44	8,98
	3	52,5	10	325	12,40	9,06
	4	52,5		329	12,38	9,10
	5	52,5		326	12,47	9,12
	6	52,5		327	12,48	9,17
	7	52,5		327	12,35	9,11
	8	52,5		326	12,38	9,10
	9	52,5	13	327	12,51	9,18
	10	52,5		327	12,35	9,12
	11	52,5		327	12,46	9,17
	12	52,5		326	12,45	9,17
	13	52,5		327	12,41	9,17
	14	52,5		327	12,45	9,14
	15	52,5		328	12,36	9,18
	16	52,5		328	12,45	9,12
	17	52,5		328	12,42	9,18
	18	52,5	16	327	12,46	9,18

Notes:

Measured waveshape	
virtual duration	virtual total duration
µs	µs
2010	2480

Oscilloscope settings			
	sampling division	Input	Attenuation
	µs	V_{div}	
Current	500	0,5	10:10
Voltage	500	1,0	10:5

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ФИЛКАБ 16 * ПЛОВДИВ

Continued

Continued

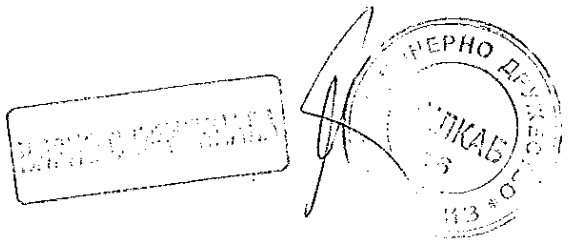
Date: July 25, 2007

Sample	Impulse	Charging voltage U_o	Oscillogram	Peak current I	Residual voltage U_{res}	Energy E
No.	No.	kV	No.	A	kV	kJ
LD2	1	52,0		323	12,40	8,98
	2	52,5		325	12,44	9,01
	3	52,5	11	326	12,43	9,11
	4	52,5		327	12,55	9,10
	5	52,5		328	12,40	9,18
	6	52,5		328	12,40	9,19
	7	52,5		328	12,36	9,11
	8	52,5		327	12,48	9,15
	9	52,5	14	327	12,40	9,13
	10	52,5		327	12,38	9,12
	11	52,5		327	12,47	9,13
	12	52,5		327	12,49	9,16
	13	52,5		328	12,39	9,17
	14	52,5		327	12,38	9,16
	15	52,5		327	12,41	9,16
	16	52,5		327	12,32	9,11
	17	52,5		326	12,36	9,14
	18	52,5	17	325	12,30	9,12

Notes:

Measured waveshape	
virtual duration	virtual total duration
µs	µs
2010	2480

Oscilloscope settings			
	sampling division	input	Attenuation
	µs	V_{div}	
Current	500	0,5	10:10
Voltage	500	1,0	10:5



Continued

Continued

Date: July 25, 2007

Sample	Impulse	Charging voltage U_c	Oscillogram	Peak current I	Residual voltage U_{res}	Energy E
No.	No.	kV	No.	A	kV	kJ
LD3	1	52,0		327	12,34	9,00
	2	52,5		329	12,30	9,10
	3	52,5	12	328	12,37	9,11
	4	52,5		328	12,26	9,10
	5	52,5		327	12,25	9,08
	6	52,5		328	12,26	9,13
	7	52,5		328	12,32	9,09
	8	52,5		327	12,36	9,10
	9	52,5	15	328	12,33	9,14
	10	52,5		328	12,32	9,12
	11	52,5		328	12,31	9,11
	12	52,5		328	12,32	9,16
	13	52,5		328	12,35	9,10
	14	52,5		328	12,30	9,14
	15	52,5		328	12,43	9,18
	16	52,5		326	12,26	9,02
	17	52,5		326	12,30	9,06
	18	52,5	18	325	12,33	9,07

Notes:

Measured waveshape	
Virtual duration	virtual total duration
µs	µs
2010	2480

Oscilloscope settings			
	sampling division	input	Attenuation
	µs	V_{div}	
Current	500	0,5	10:10
Voltage	500	1,0	10:5

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ОПТИКА 16 * ПЛОВДИВ *

Continued

Long -duration current impulse withstand test.

(check the integrity of the internal parts with an additional shot at ambient temperature)

Test circuit: A0017

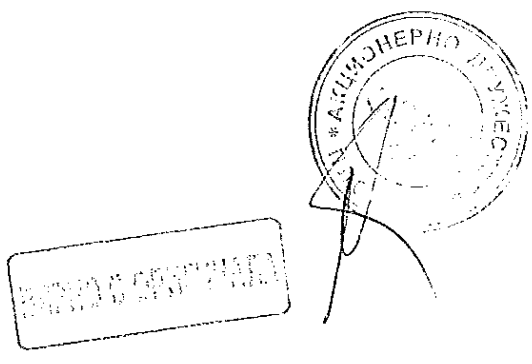
Date: July 25, 2007

Sample	Impulse	Charging voltage V_c	Oscillogram	Peak current I	Residual voltage V_r	Energy E
No.	No.	kV	No.	A	kV	kJ
LD1	19	52,5	19	327	12,36	9,12
LD2	19	52,5	20	327	12,33	9,11
LD3	19	52,5	21	328	12,27	9,08

Notes:

Measured waveshape	
virtual duration	virtual total duration
µs	µs
2010	2480

Oscilloscope settings			
	sampling division	input	attenuation
	µs	V_{div}	
Current	500	0,5	10:10
Voltage	500	1,0	10:5



continued

Long-duration current impulse withstand test.

Lightning impulse residual voltage measurement after the test

Test circuit: A0120

Date: August 02, 2007

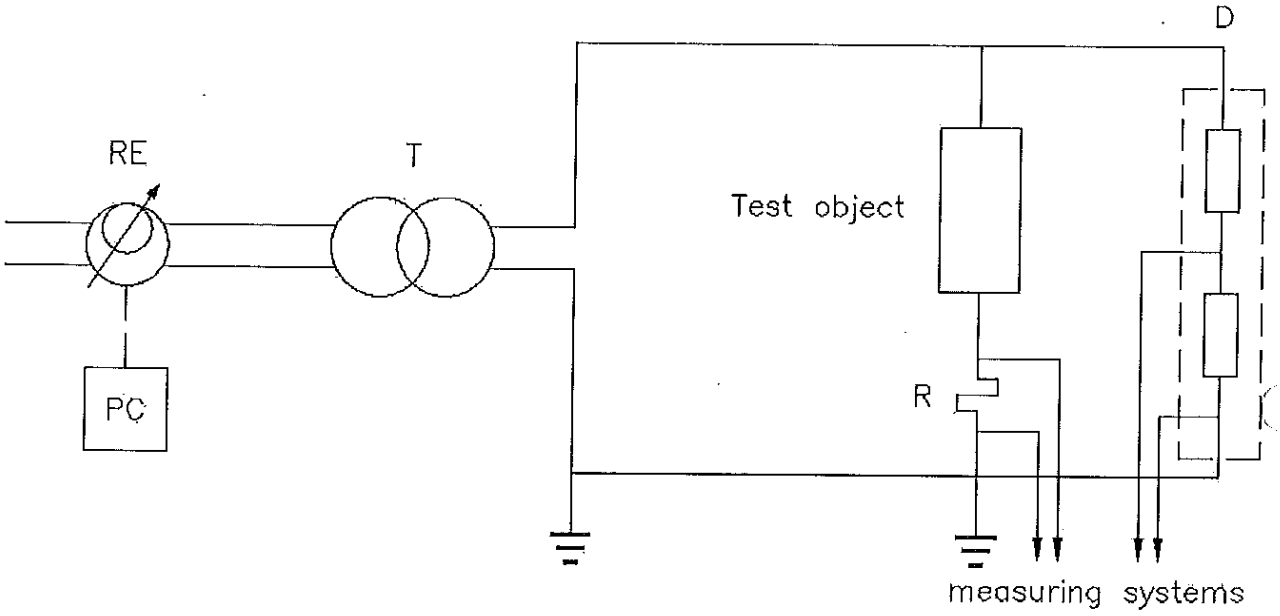
Sample	Requested Current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
LD1	I_n	30,1	22	8,8/18,8	10,14	16,05
LD2		30,1	23		10,17	15,94
LD3		30,1	24		10,20	15,88

	Oscilloscope settings		
	sampling division	input	attenuation
	µs	V_{div}	
Current	5	1,0	50:10
Voltage	5	1,0	20:5

Notes:

ВЯРНО С ОРИГИНАЛА

Circuit A0019



Power frequency supply

RE - programmable supply type LARCET A.C. Power Source 5000 P.S.; CESI no. 23702-32191
PC - personal computer
T - voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200 V/15-30 kV

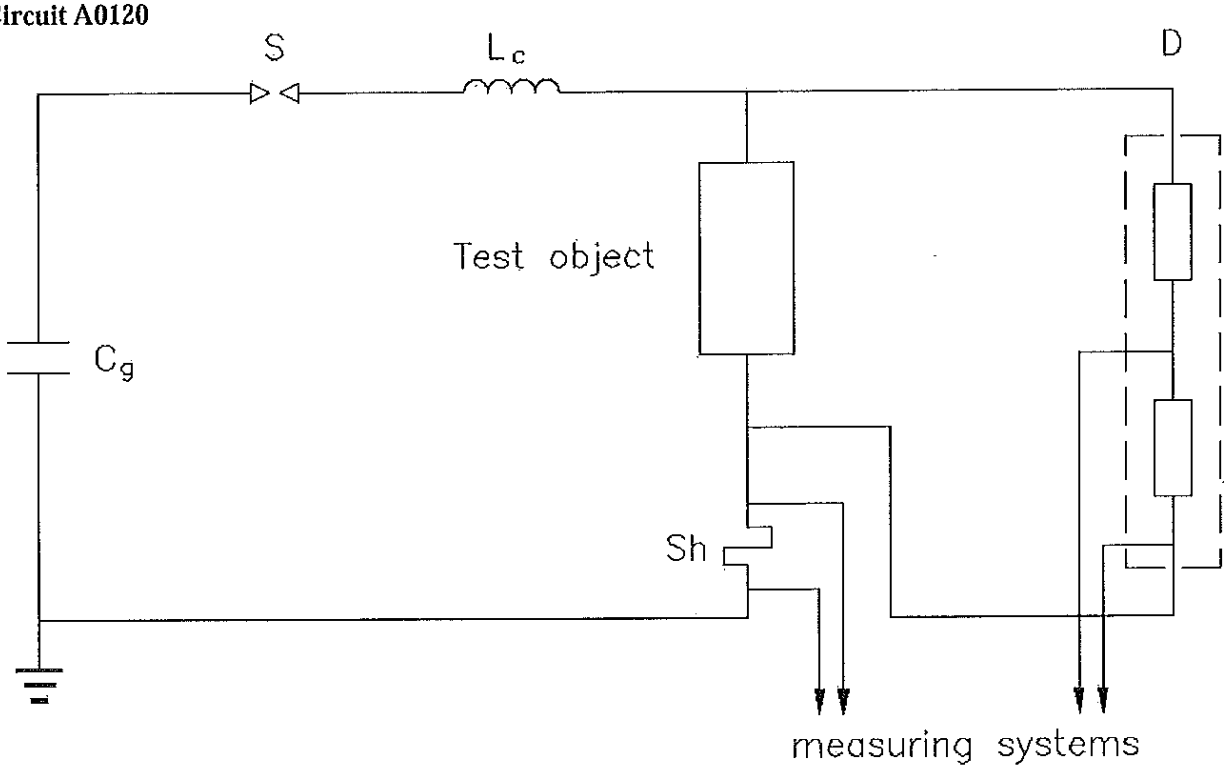
Current measuring system

R - Current shunt CESI No.31120; R= 941,4 Ω
- Electro optical system CESI No.11517/518; attenuation 5:5
OSC - Oscilloscope type SONY TEKTRONIX RTD 710A; CESI No.9090

Voltage measuring system

D - Voltage divider SAGI; CESI No.11120
- Electro optical system CESI No.11521/522; attenuation 50:5
OSC - Oscilloscope type SONY TEKTRONIX RTD 710A; CESI No.9090

Circuit A0120



Impulse generator

No. of stages	1
Cg	4,98 µF
Lc	10 µH
S	- Spark-gap

Voltage measuring system.

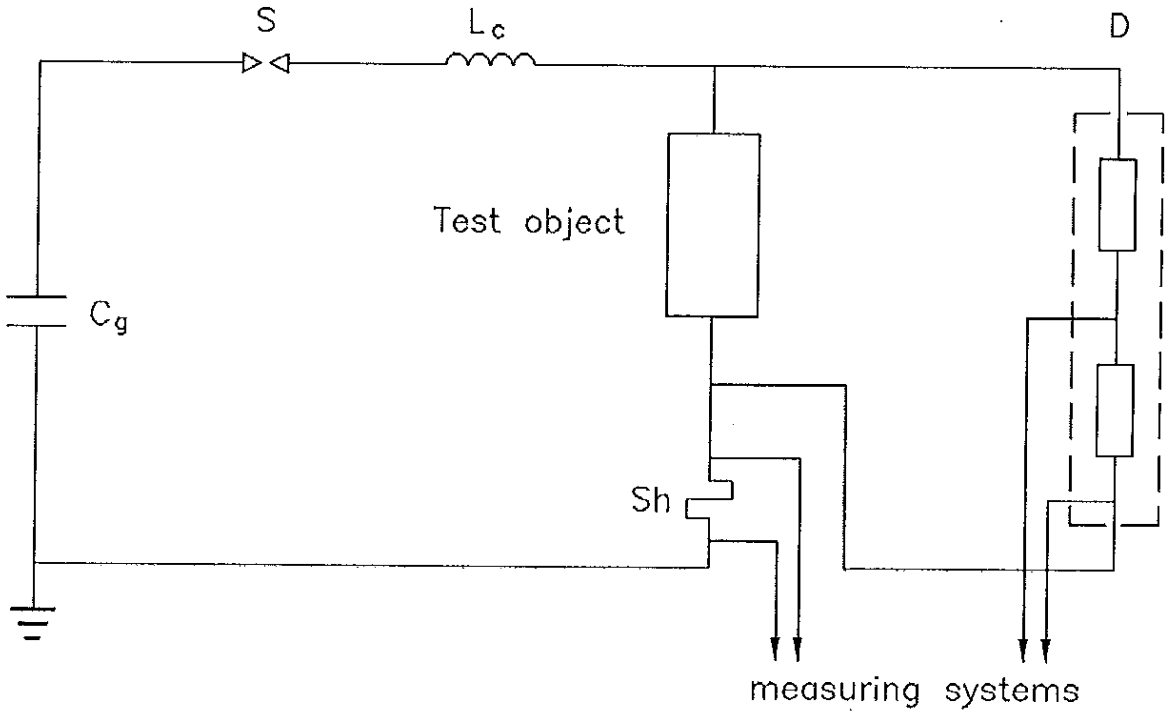
D	- Voltage divider SAGI; CESI No.13027
	- Electro optical system CESI No.11521/522;
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.2)

Current measuring system

Sh	- Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
	- Electro optical system CESI No.11517/518;
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.1)

ВЯРНО С ОРИГИНАЛА

Circuit A0122



Impulse generator

No. of stages	1
Cg	2,49 µF
Lc	100 µH
S	- Spark-gap

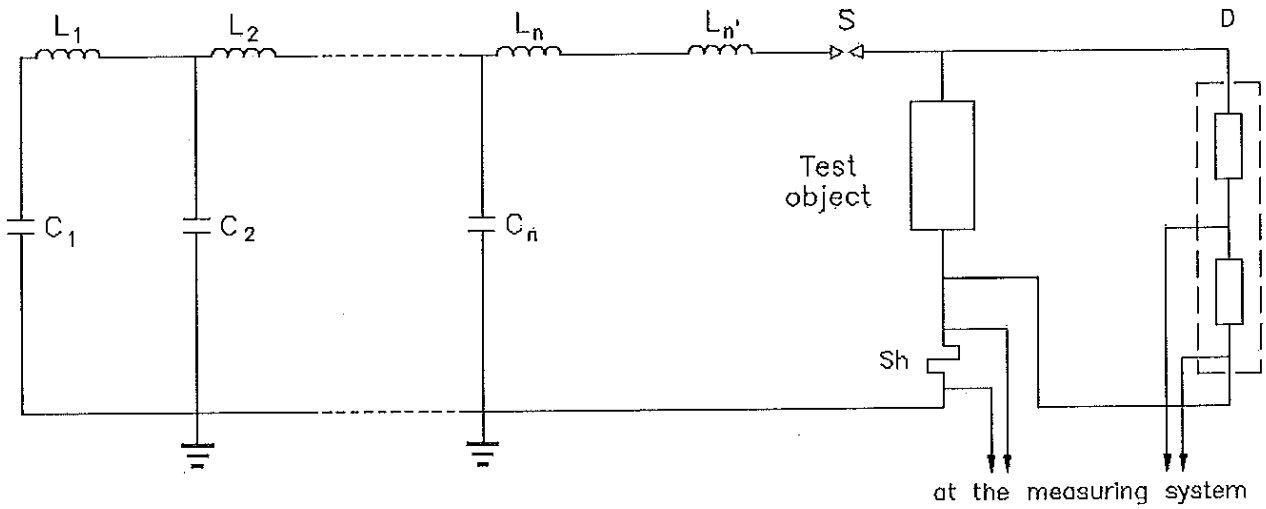
Voltage measuring system.

D	- Voltage divider SAGI; CESI No.11120
	- Electro optical system CESI No 11521/522
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.2)

Current measuring system

Sh	- Current shunt CESI No.6037; R= 20 mΩ; peak current= 250 kA
	- Electro optical system CESI No 11517/519
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.1)

Circuit A0017



Impulse generator

$C_1 \ldots C_{10}$	- capacitors 37,5 µF
C_{12}	- capacitors 18,75 µF
$L_1 \ldots L_{11}$	- inductors 666 µH
L_{12}	- inductor (600+500) µH
S :	- spark gap

Voltage measuring system.

D	- Voltage divider SAGI; CESI No.11120
	- Electro optical system CESI No
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.2)

Current measuring system

Sh	- Current shunt CESI No.6042; R= 2 m Ω
	- Electro optical system CESI No 11521/11522.
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.1)

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ФИЛКАБ 16 * ПЛОВДИВ *

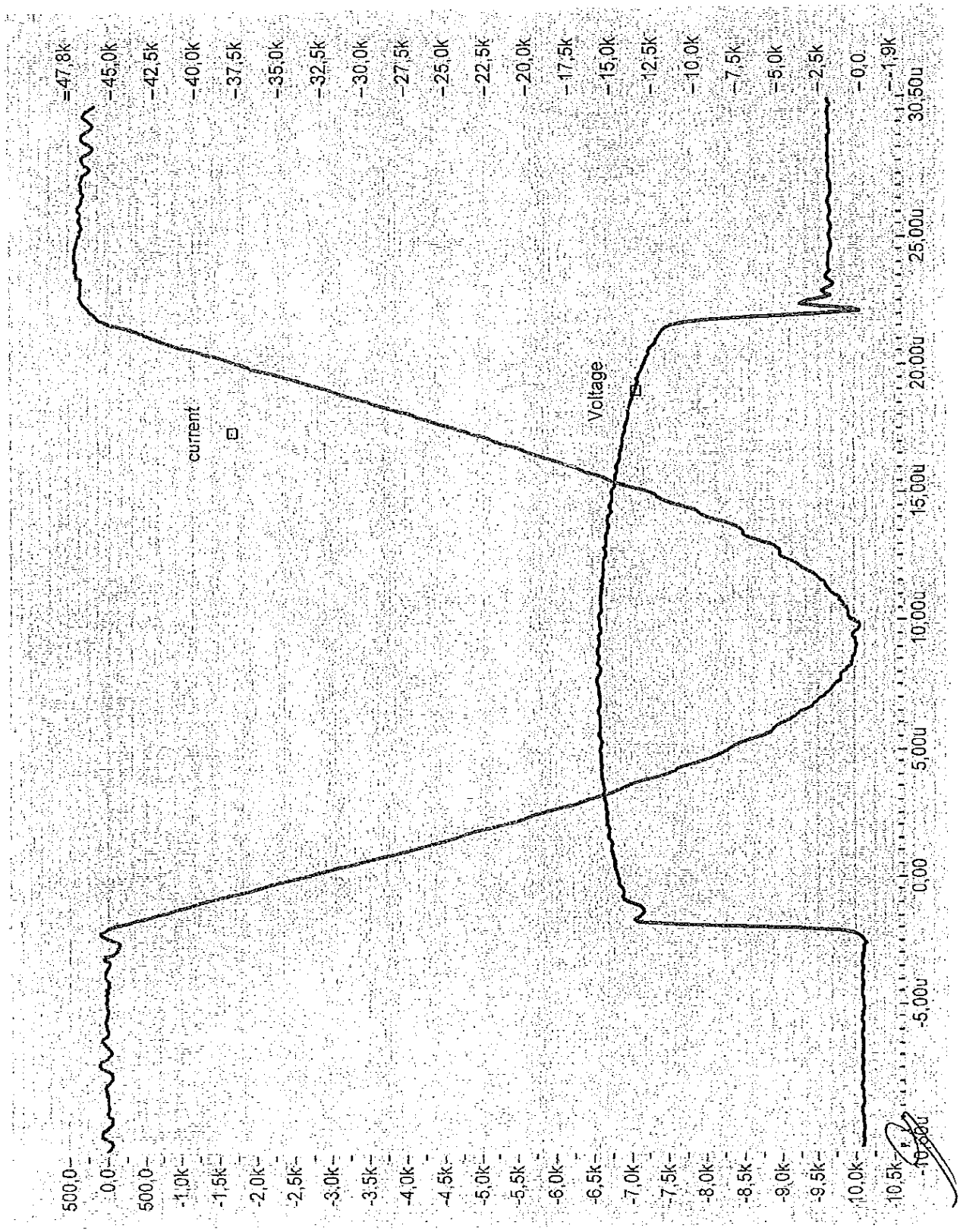
CESI A7020276 Oscillogram n. 1

CESI A7020276 Oscillogram n. 2

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ПЛОВДИВ * ФИЛКАБ 13

CESI A7020276 Oscillogram n. 3

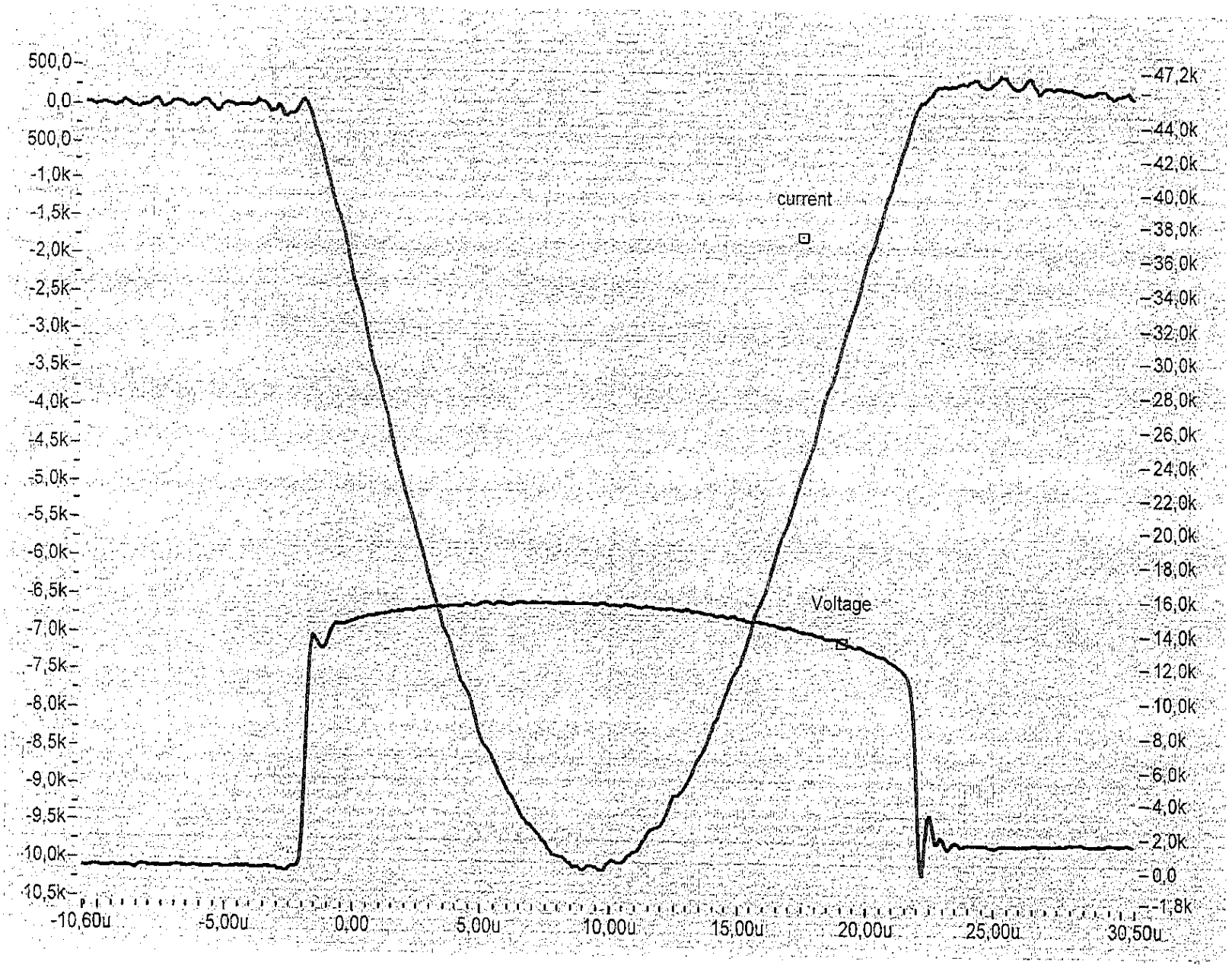


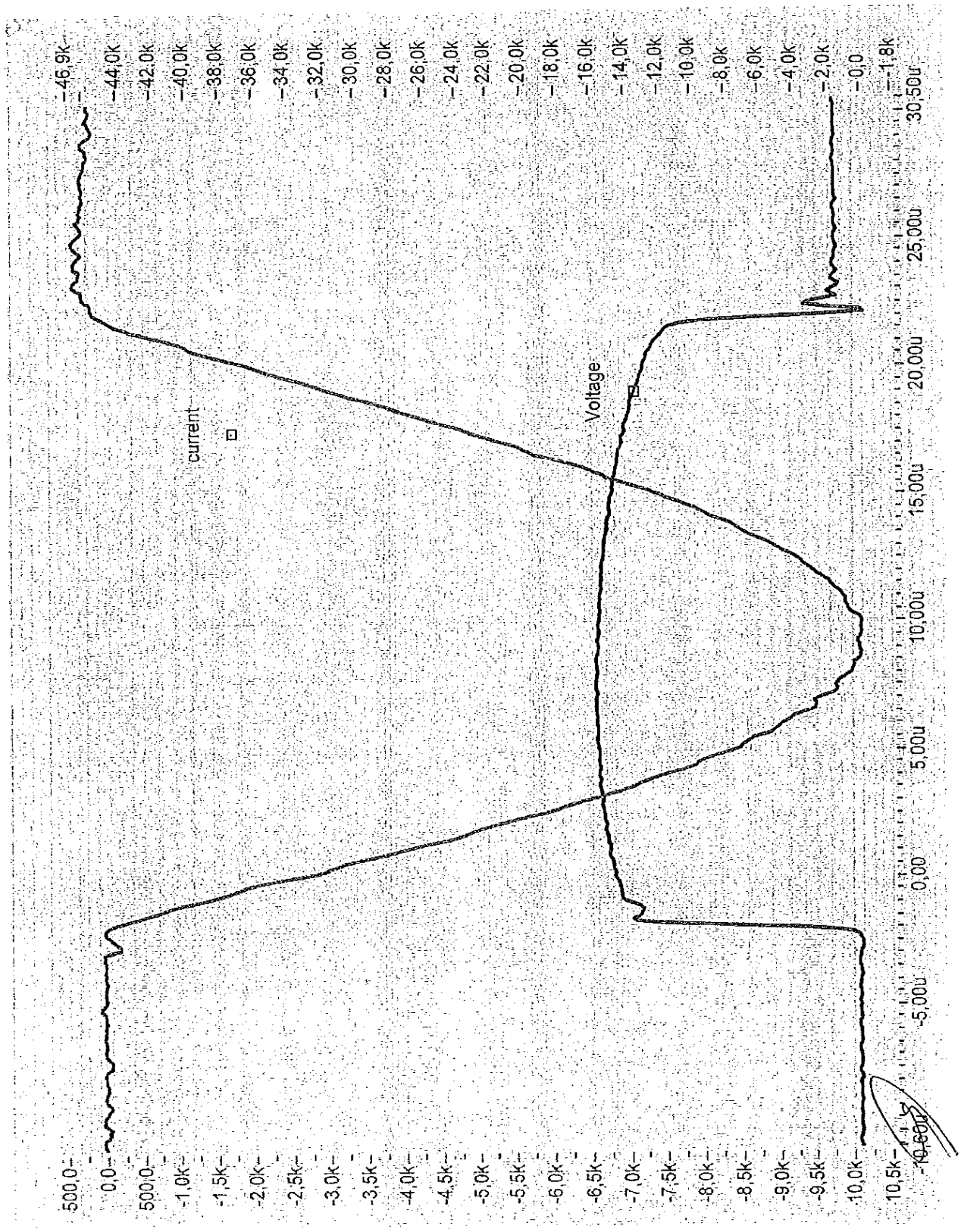
CESI A7020276 Oscillogram n. 4

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ПЛОВДИВ * ФИЛКАБ 16

CESI A7020276 Oscillogram n. 5



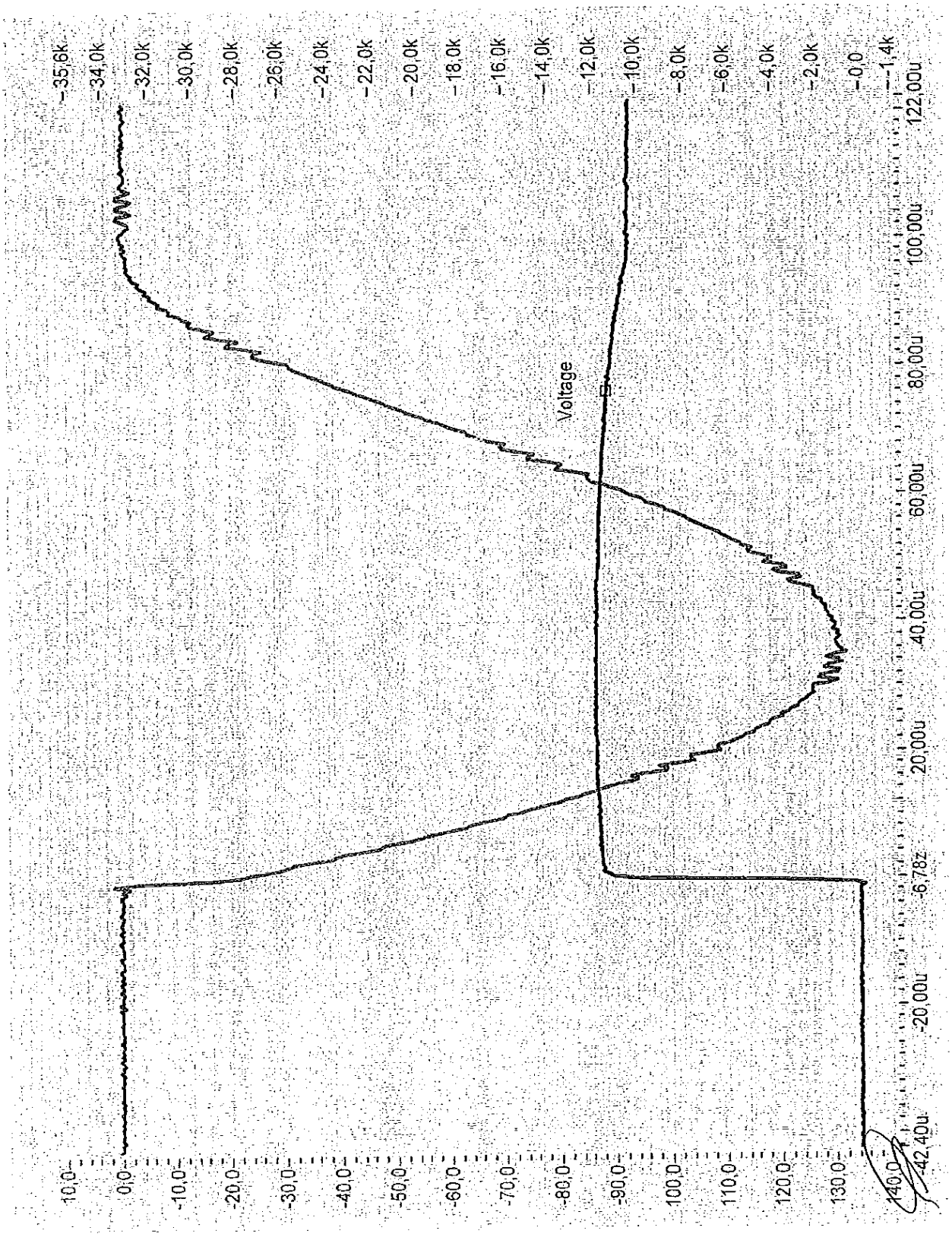


CESI A7020276 Oscillogram n. 6

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ПЛОВДИВ * ФИЛКАБ 16

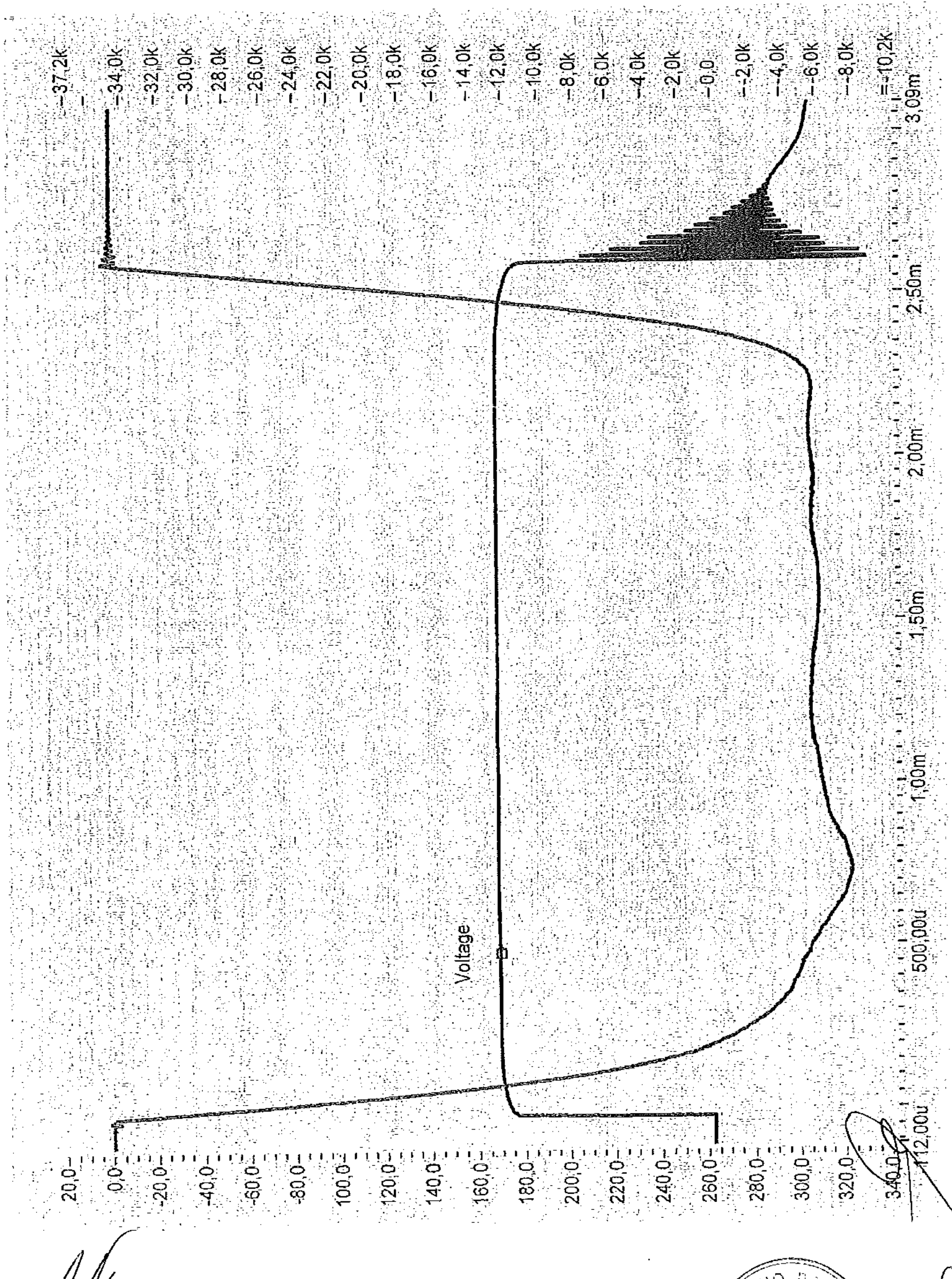
CESI A7020276 Oscillogram n. 7



CESI A7020276 Oscillogram n. 8

ВЯРНО С ОРИГИНАЛА

CESI A7020276 Oscillogram n. 9

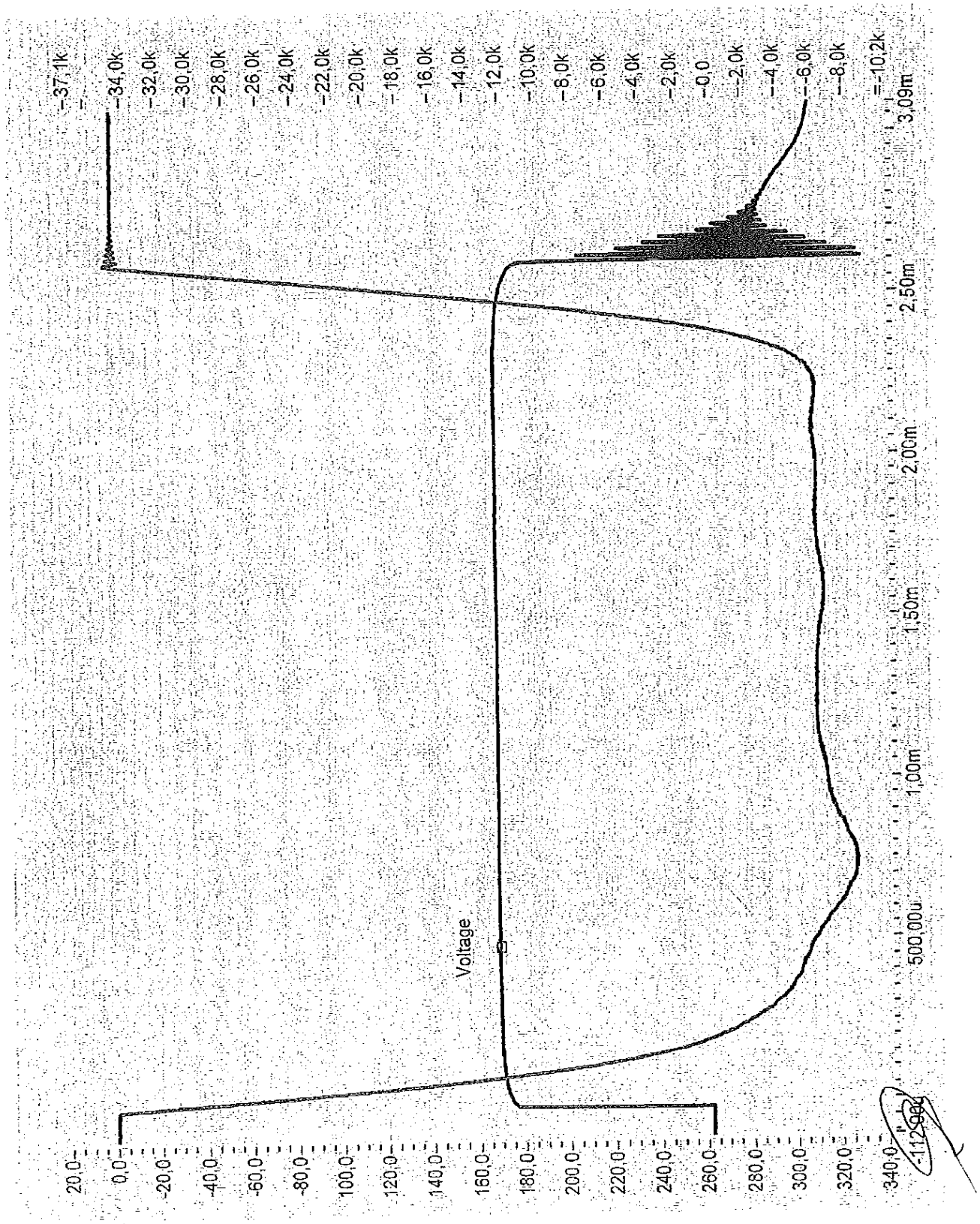


CESI A7020276 Oscillogram n. 10

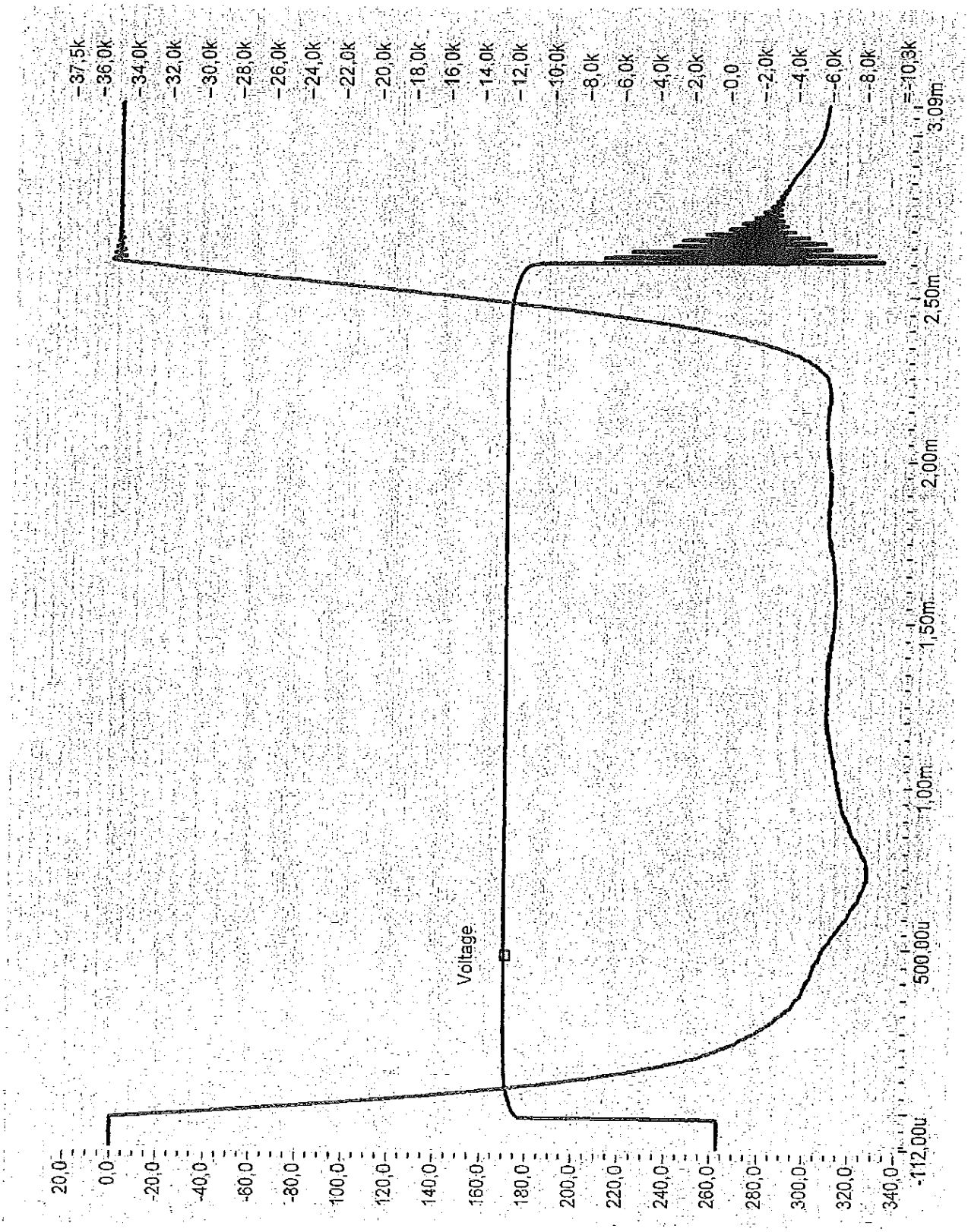
ВЯРНО С ОРИГИНАЛА

ФИЛКАБ

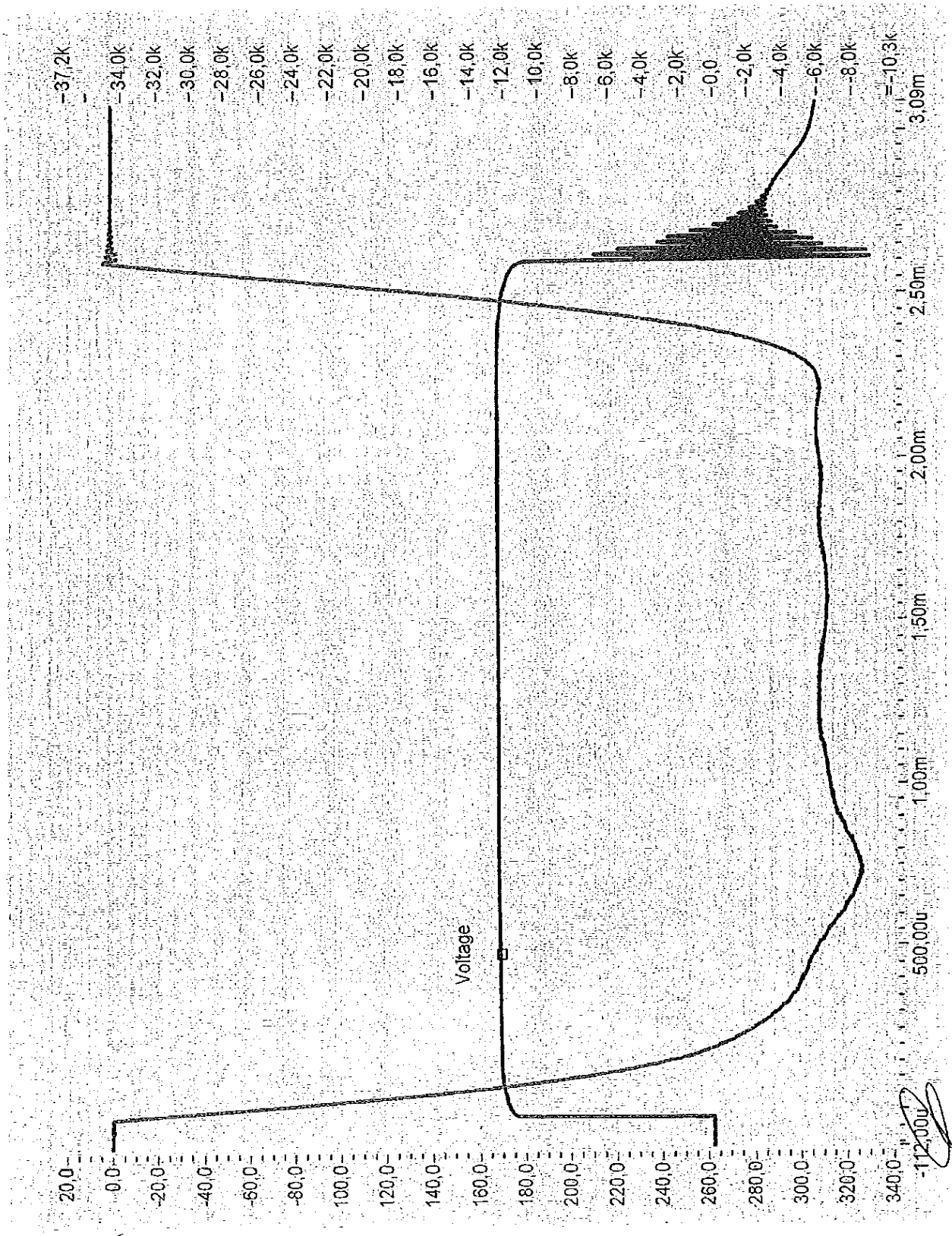
CESI A7020276 Oscillogram n. 11



CESI A7020276 Oscillogram n. 12



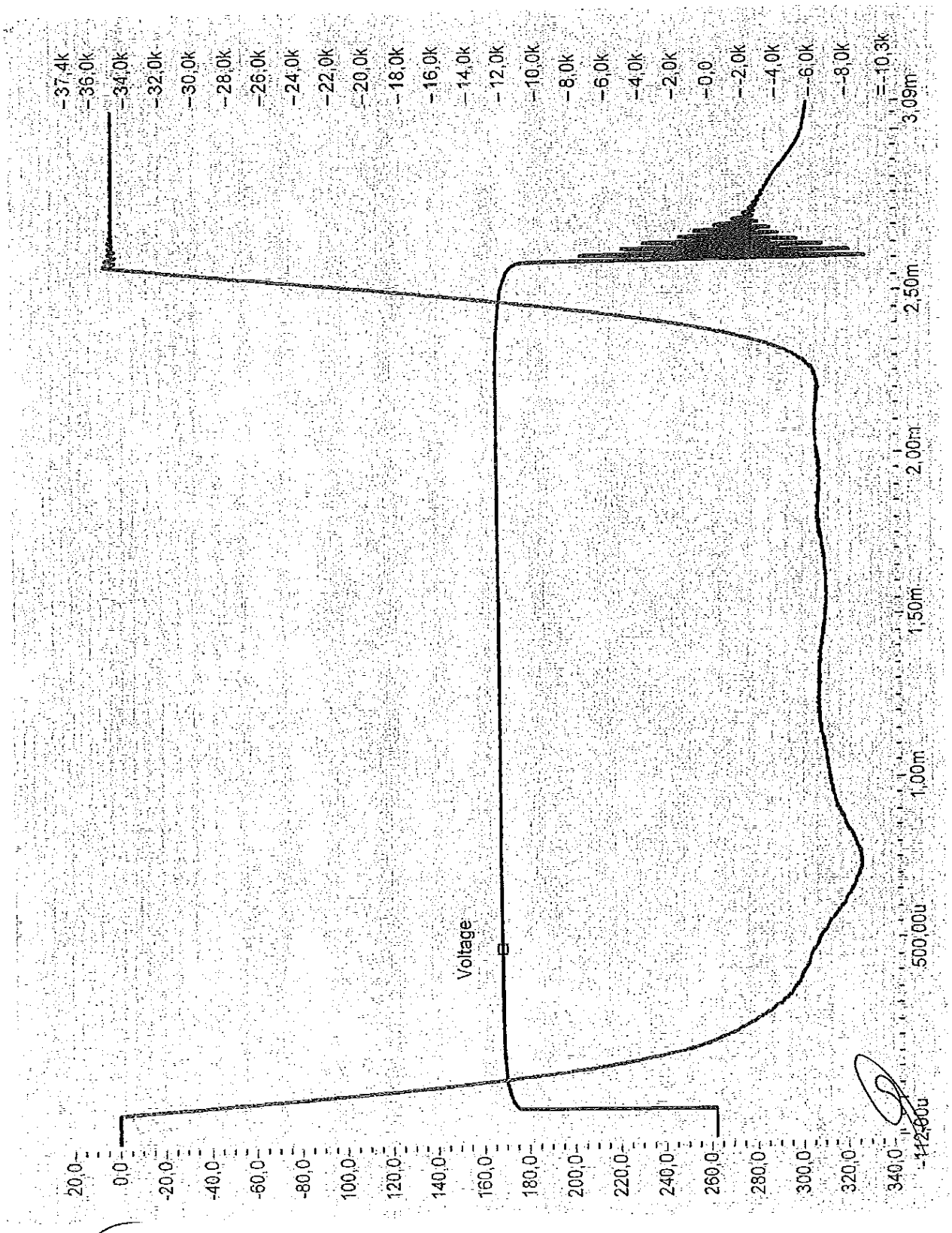
CESI A7020276 Oscillogram n. 13



CESI A7020276 Oscillogram n. 14

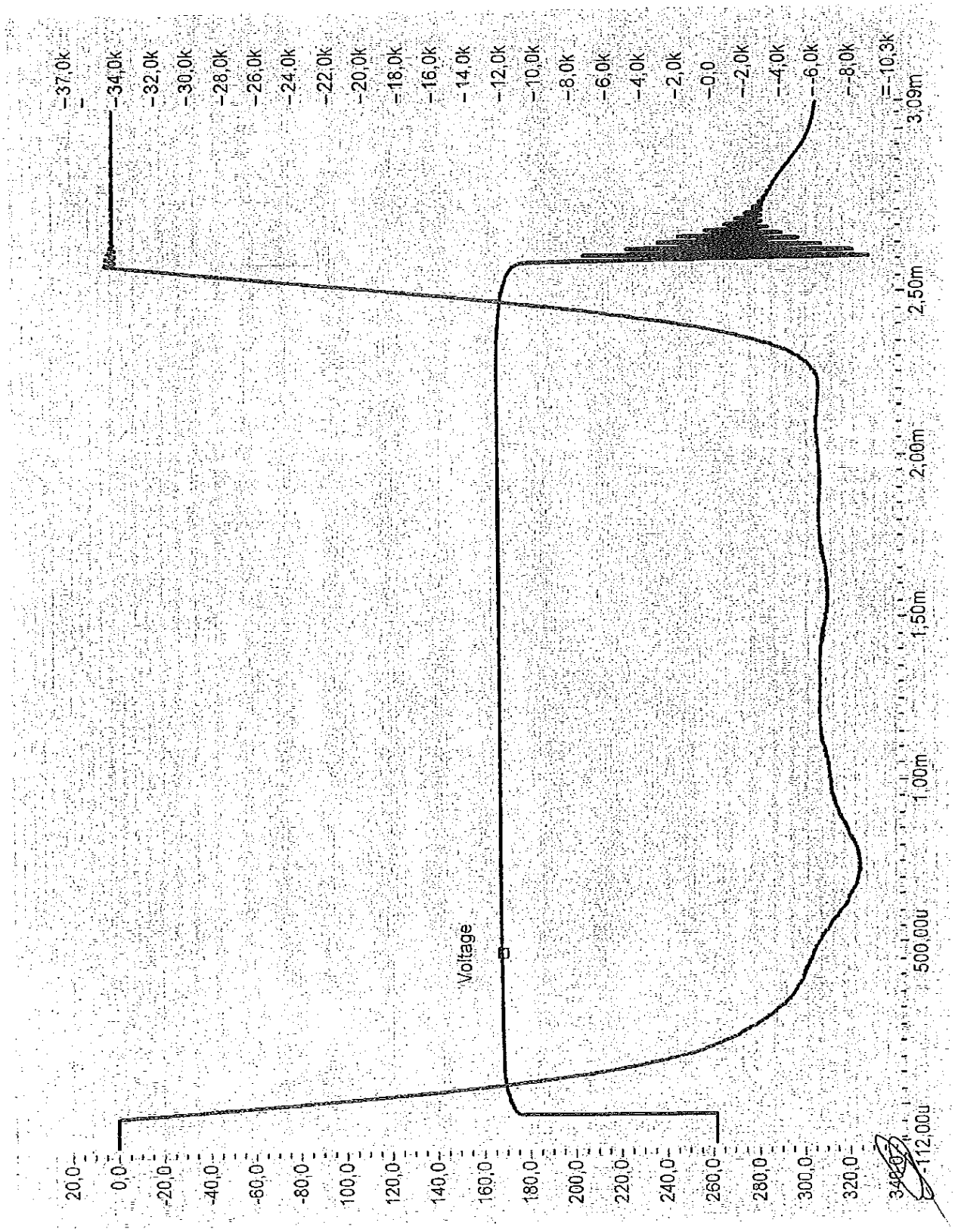
ВЯРНО С ОРИГИНАЛА

CESI A7020276 Oscillogram n. 15



CESI A7020276 Oscillogram n. 16

CESI A7020276 Oscillogram n. 17



CESI A7020276 Oscillogram n. 18

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО "ПЛОВДИВ" ФИЛИАЛ 5 16

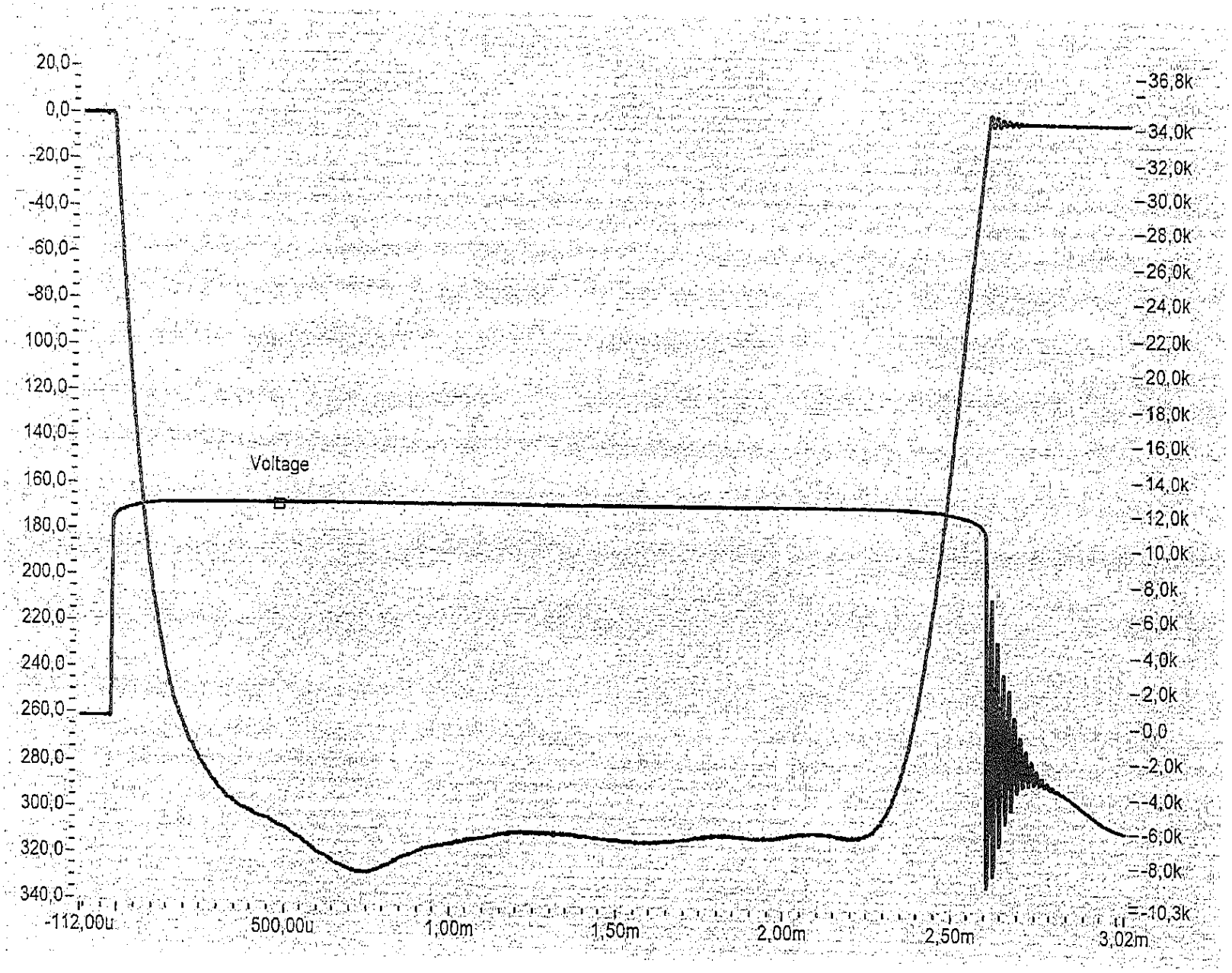
CESI A7020276 Oscillogram n. 19

CESI A7020276 Oscillogram n. 20

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО ФИЛКАБ 16 ПЛОВДИВ

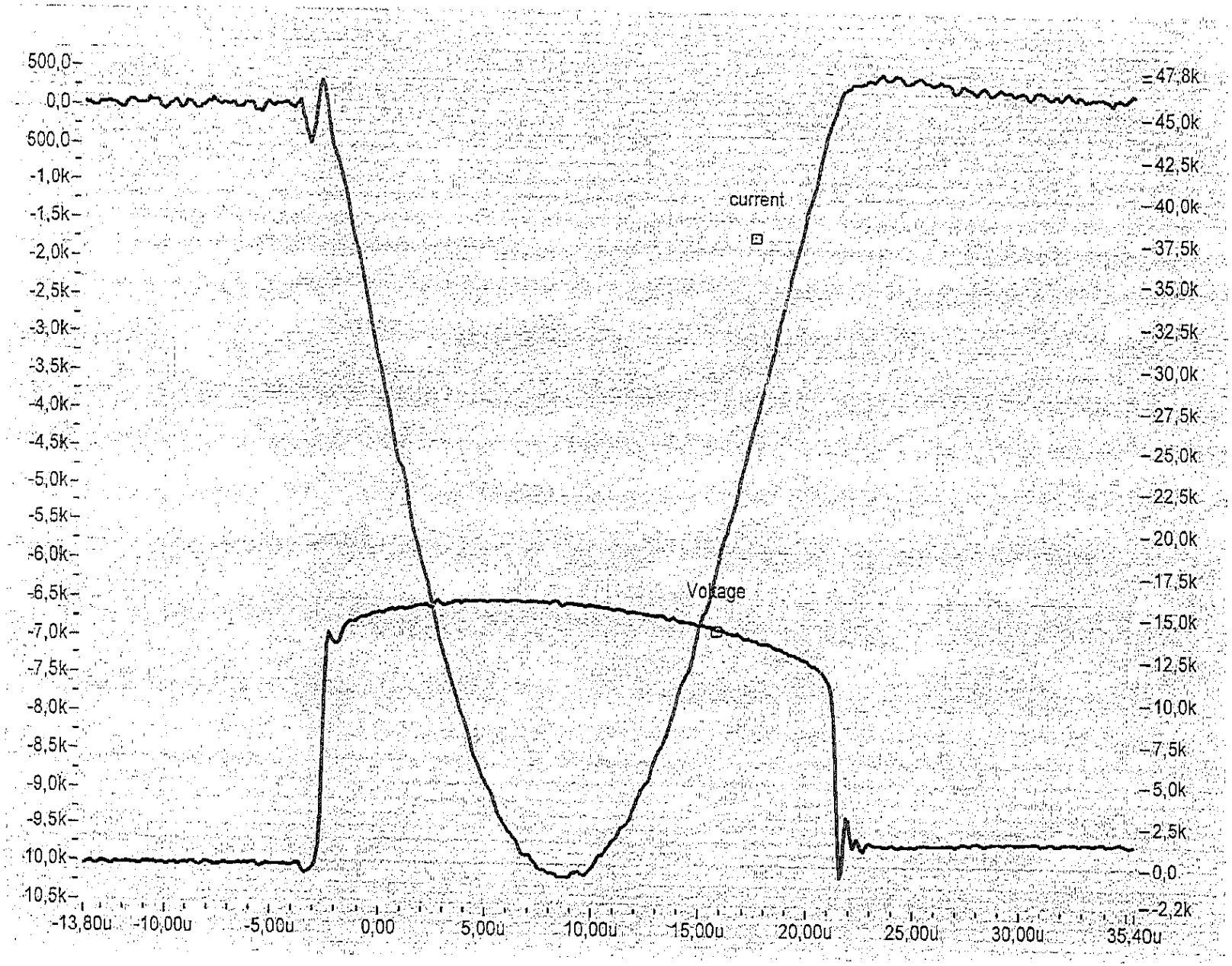
CESI A7020276 Oscillogram n. 21



CESI A7020276 Oscillogram n. 22

ВЯРНО С ОРИГИНАЛА

CESI A7020276 Oscillogram n. 23

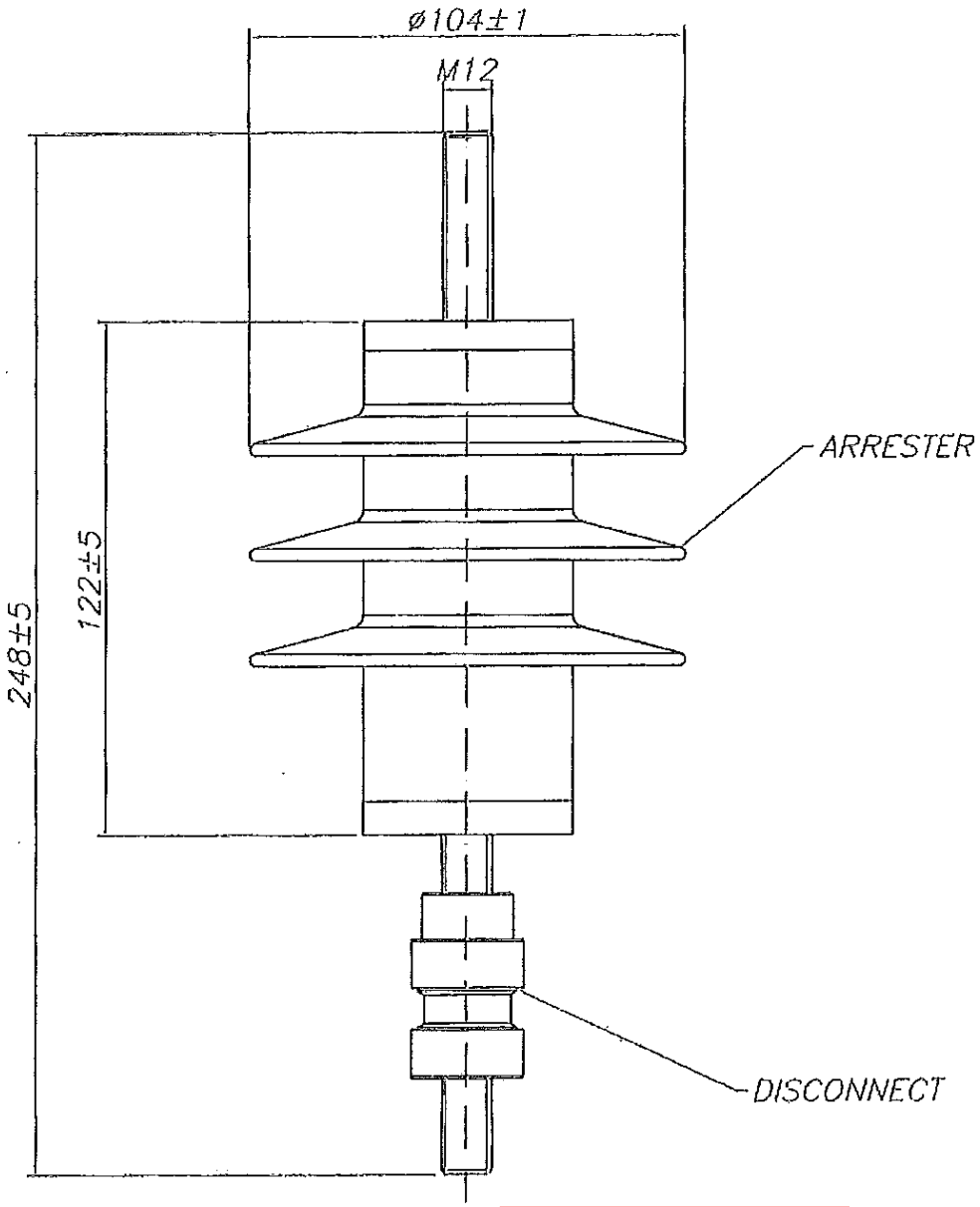


CESI A7020276 Oscillogram n. 24

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ПЛОВДИВ * ФИЛИАЛ 16

SCD



На основание чл. 2
от ЗЗЛД

2 2 ОТТ. 2007

Uref = 6.22kV min
Ur = 6.5kV
Uc = 5.2kV
CREEPAGE = 254mm
DRY ARC DISTANCE = 127mm

Tyco Electronics

ENERGY DIVISION

Bowthorpe EMP Surge Arrester

BAY 100-109
SHANNON IND. EST.
SHANNON
CO. CLARE
IRELAND

DRN	J HULLIGAN	17/09/07	PCN	
CHECK	B HORNDYLE		MATL	
APP	B McGOWAN			
SCALE	1:1			

TITLE

DA1-6.5-NODONO SURGE ARRESTER

DRG NO	SHEET	REV
DA1-6.5-NODONO	1 OF 1	0

ВЯРНО С ОРИГИНАЛА

DA1 - Distribution Surge Arrester
Operating Duty Test
Type Test Report

Tyco Electronics

Our commitment. Your advantage.

Tyco Electronics

Bowthorpe EMP

Test Report

Type	**DA1**
PPR Number	**PPR-2279**
Test Specification	Operating duty test IEC 60099-4 (2006-07) Ed. 2.1

Test Information:

Laboratory	CESI
Date	03/09/2007
External Test Ref	A7020582
Report Prepared by	M. Gregori
Test Verified by	A. Sironi
Test Approved by	V. Scarioni

Tyco Approvals:

R&D Manager

Brendan Normoyle S Date 28/11/2007

Product Manager

Brian McGowan S Date 28/11/2007

На основание чл. 2
от ЗЗЛД

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Co. Clare, Ireland
Tel:+ 353-61-472885
Fax: + 353-61-472676
Email: mvsurgearresters@tycoelectronics.com

ВЯРНО С ОРИГИНАЛА

ФИЛИАЛ 16 ПЛОВДИВ

Client	TYCO Electronics – Shannon (Ireland)
Tested equipment	Polymer-housed metal-oxide surge arrester section type DA1 fitted with disconnector assembled in thermal model
Tests carried out	High current operating duty test
Standards/Specifications	IEC 60099-4 – Edition 2.1 (2006-07)
Test date	**from** July 27, 2007 **to** August 02, 2007

No. of pages	25	**No. of pages annexed**	44
Issue date			
Prepared			
Verified			
Approved			

На основание чл. 2
от ЗЗЛД

Tests witnessed by:

---- ----

Identification of the object: Requested

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawing.
CESI checked that this drawing adequately represents in shape and dimensions the essential details and the parts of the tested object.
This drawing, identified by CESI and numbered A7027909 No. 1, is annexed to this document.

The data necessary to permit repetition of the tests are contained in the document marked: ----

The measurement uncertainties of the test results reported in this document are the following:

- dielectric tests with impulse voltage	: peak voltage: ± 3 %;	time parameters: ± 10 %
- dielectric tests with impulse current	: peak value: ± 3 %;	time parameters: ± 10 %
- dielectric tests with alternating voltage	: voltage (rms): ± 3 %	time: ± 3,5 %
- dielectric tests with direct voltage	: voltage: ± 3 %	time: ± 3,5 %
- atmospheric conditions	: temperature: ± 2 °C;	pressure: ± 0,133 kPa; humidity: ± 10 %

The measurement uncertainties are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to confidence level of about 95%) and have to be considered as maximum values.

Laboratory information

Receipt date of the sample	July 16, 2007
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr L. Podavitte
Test laboratory	P177
Activity code	80090B

content	page	test date
Test object characteristics	4	
Photograph of the test object	5	
Reference standard	6	
Test carried out	6	
Test object identification	6	
Test procedure	7	
Visual inspection and summary of test result	8	
High current operating duty test	from page 9 to 17	July 27 to August 02, 2007
Technical data	from page 18 to 25	

Pages annexed:

Oscillograms n. 42 pages

Document annexed:

Tyco Electronics drawing n.DA1-6.5-NODONO, CESI n. A7027909 - n. 1 page

Tyco Electronics Thermal equivalency; CESI n. A7027911 – n.1 page

Test object characteristics

type: Polymer-housed metal-oxide surge arrester section fitted with disconnector assembled in thermal model

electrical characteristics (assigned by the client)

Manufacturer's name	TYCO Electronics – Shannon (Ireland)
Type	DA1
Nominal discharge current – I_n [kA]	10
Rated voltage – U_r [kV]	1,045 x Uref
Continuous operating voltage - U_c [kV]	0,836 x Uref
Reference current - $I_{ref.}$ [mA]	5,0
Line discharge class	1
Standard rated frequency - [Hz]	50/60
year of manufacture	2007

NOTE:
The thermal model was supplied by the manufacturer
The verification of the thermal equivalency according to annexe B was carried out by the Client
(see Tyco Electronics document DA1 Class 1 Surge Arrester Thermal equivalency*; CESI no.A7027911)

View of the test object

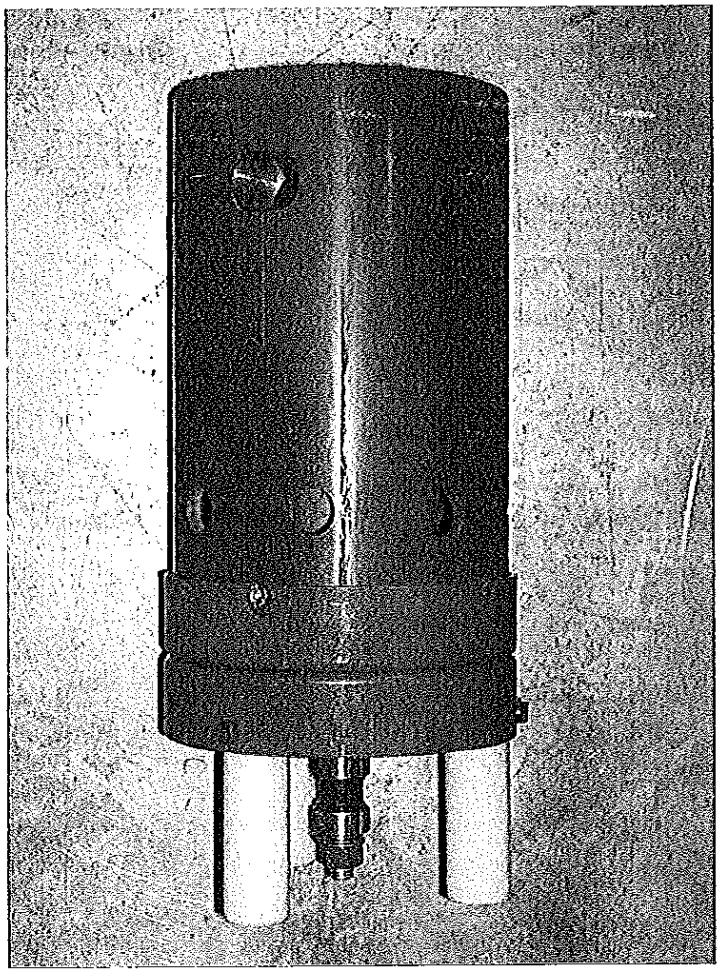


Photo no. 1

Polymer-housed metal-oxide surge arrester section fitted with disconnector assembled in thermal model

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ПЛОВДИВ * ФИЛИАЛ 16

Reference standard

IEC 60099-4 (2006-07) – Edition 2.1 – Clause 10.8.5

" Metal-oxide surge arresters without gaps for a.c. system "

Test carried out

test carried out	number of sample tested
High current operating duty test	3

Test object identification

test object names	identification of test sample (assigned by the CESI)
Polymer –housed surge arrester section assembled in thermal model fitted with disconnector	OD1-OD2-OD3

Test procedure

The test procedure consisted of the following sequence:

a) Measurement of the power frequency reference voltage at the reference current

b) Measurement of the lightning impulse residual voltage at the nominal discharge current

c) Calculation of the voltage correction factors according to the reference standard

d) Conditioning 1: application of twenty impulses 8/20 µs at the nominal discharge current superimposed to the power frequency voltage at 1,2 times U_c' in four groups of five impulses
   - interval between impulses of the same group: 50-60 seconds
   - interval between groups: 30 minutes
   - polarity of the impulses: same as that of the half cycle of power frequency voltage during which it occurred (positive)
   - synchronization of the impulses: 60 electrical degrees before the peak of the power frequency.

e) Conditioning 2: application of one high current impulse 4/10 µs at 100 kA

f) Heating in an oven at the temperature of 60 °C till thermal equilibrium

g) Application of a second high current impulse 4/10 µs at 100 kA. A time shorter than 100 ms after the application of the second high current shot energization at U_r' for 10 sec. and then at U_c' for 30 min. to verify the thermal stability.

h) Measurement of the lightning impulse residual voltage at nominal discharge current for comparison with initial value with two impulses at 50 sec to 60 sec. time interval in between

TEST RESULT

The visual inspection of the sample after the test has revealed no sign of physical damage.
The variation of lightning impulse residual voltage before and after the test was less than 5% (maximum allowed variation according to reference standard is 5%).
The oscillographic record of the two last lightning impulse at nominal discharge current did not reveal any sign of internal discharge.
The thermal stability was achieved
The disconnectors did not operate

The acceptance criteria are fulfilled. The test result is positive

ВЯРНО С ОРИГИНАЛА

Variation of lightning impulse residual voltage at I_n

Sample	before test		after test		Variation
	discharge current	residual voltage	discharge current	residual voltage	
	kA	kV	kA	kV	%
OD1	10,03	16,00	9,95	16,25	+ 1,50
OD2	10,02	16,09	10,10	16,23	+ 0,87
OD3	10,02	16,07	10,12	16,15	+0,50

Visual inspection after the test

The visual inspection of the surge arresters samples after the test has revealed no sign of physical damage

High current operating duty test.

Reference voltage test

Test circuit: A0019

Date: July 27, 2007

Sample No. OD1						
Oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
1	6,70	5,11	4,08	1,59	6,62	--

Sample No. OD2						
Oscillogram	voltage	current	current	Current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
2	6,72	4,90	5,13	1,69	7,12	--

Sample No. OD3						
Oscillogram	voltage	current	current	Current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
3	6,68	4,94	5,11	1,69	7,06	--

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО ФИЗЛКАБ 13 ПЛОВДИВ

High current operating duty test.

Lightning impulse residual voltage measurement before the test

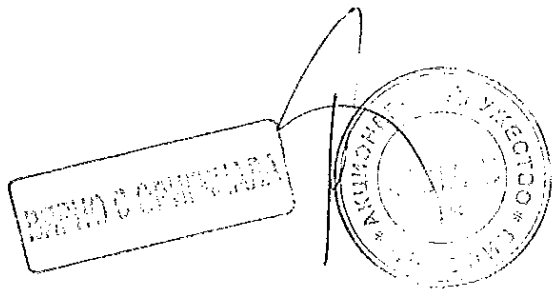
Test circuit: A0120

Date: July 27, 2007

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual Voltage
No.		kV	No.	µs	kA	kV
OD1	I_n	29,9	4	8,8/19,0	10,03	16,00
OD2		29,9	5		10,02	16,09
OD3		29,9	6		10,02	16,07

	Oscilloscope settings		
	sampling division	input	Attenuation
	µs	V_{div}	
Current	5	1,0	50:10
Voltage	5	0,5	20:5

Notes:



Voltage correction factor and energy calculations

Date: July 25, 2007

Sample	U_{ref} [1]	kU_r [2]	kU_C [3]	U_r' [4]	U_c' [5]	U_+' [6]
No.	kV			kV	kV	kV
OD1	6,70	1,045	0,836	7,00	5,60	6,720
OD2	6,72			7,02	5,62	6,744
OD3	6,68			6,98	5,58	6,701

[1] U_{ref} : measured reference voltage
[2] kU_r : factor claimbed by the manufacturer for calculation of U_r'
[3] kU_C : factor claimbed by the manufacturer for calculation of U_c'
[4] U_r' : corrected rated voltage [4] = [1] × [2]
[5] U_c' : corrected continuous operating voltage [5] = [1] × [3]
[6] U_+' : corrected voltage to be applied during the conditioning [6] = 1,2 × [5]

ВЯРНО С ОРИГИНАЛА

High current operating duty test.

Conditioning: application of twenty 8/20 µs current impulses (first part)

Test circuit: A0015

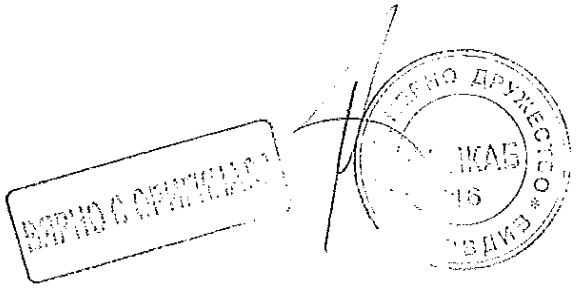
Date: July 27, 2007

Imp.	Osc.	Sample No. OD1		Osc.	Sample No. OD2		Osc.	Sample No. OD3	
		charging	peak current		Charging	peak current		charging	peak current
No.	No.	kV	kA	No.	kV	kA	No.	kV	kA
1	7	38,0	10,0		38,0	10,0		38,0	10,0
2		38,0	10,0		38,0	10,0		38,0	10,0
3		38,0	10,0		38,0	10,0		38,0	10,0
4		38,0	10,0		38,0	10,0		38,0	10,0
5	8	38,0	10,0	9	38,0	10,0	10	38,0	10,0
6		38,0	10,0		38,0	10,0		38,0	10,0
7		38,0	10,0		38,0	10,0		38,0	10,0
8		38,0	10,0		38,0	10,0		38,0	10,0
9		38,0	10,0		38,0	10,0		38,0	10,0
10	n.r.	38,0	10,0	12	38,0	10,0	13	38,0	10,0
11		38,0	10,0		38,0	10,0		38,0	10,0
12		38,0	10,0		38,0	10,0		38,0	10,0
13		38,0	10,0		38,0	10,0		38,0	10,0
14		38,0	10,0		38,0	10,0		38,0	10,0
15		38,0	10,0		38,0	10,0		38,0	10,0
16		38,0	10,0		38,0	10,0		38,0	10,0
17		38,0	10,0		38,0	10,0		38,0	10,0
18		38,0	10,0		38,0	10,0		38,0	10,0
19		38,0	10,0		38,0	10,0		38,0	10,0
20	14	38,0	10,0	15	38,0	10,0	16	38,0	10,0

Power frequency voltage applied to the test sample during current impulse applications [kV]	Sample No. OD1	Sample No. OD2	Sample No. OD3
	6,720	6,744	6,701

	Oscilloscope settings		
	sampling division	Input	attenuation
	ms	V_{div}	
Current	10	1,0	50:10
Voltage	10	1,0	20:5

Notes:



High current operating duty test.

Conditioning: Application of the first impulse 100 kA 4/10 µs high current impulses (second part)

Test circuit: A0121

Date: July 30, 2007

Sample	Impulse	Charging voltage	Oscillogram	Discharge current	Residual Voltage	Energy	current waveshape	Opposite polarity
No.	No.	kV	No.	kA	kV	kJ	µs	%
OD1	1	76,3 x 2	17	96,2	34,0	15,1	4,5/9,8	8,4
OD2	1	76,3 x 2	18	96,5	35,0	15,3		
OD3	1	76,3 x 2	19	97,5	35,0	15,6		

	Oscilloscope settings		
	sampling division	input	attenuation
	µs	V_{div}	
Voltage	2	1,0	50:5
Current	2	1,0	300:10

Notes:

High current impulse operating duty test.

Application of the second high current impulse, of the rated voltage U_r' and evaluation of thermal stability

Test circuit: A0123 – A0020 – A0131

Sample No.: OD1

Preheating temperature: 61 °C

Date: July 31, 2007

Second high current impulse application

Oscillogram	Charging voltage	Residual voltage	Discharge current	Energy	Current waveshape
No.	kV	kV	kA	kJ	µs
20	76,3 x 2	33,0	100,0	17,0	4,5/9,8

U_r' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	s	kV	$+mA_{cr}$	$-mA_{cr}$	W
21	0	7,00	61,0	78,0	---
22	10		25,0	38,0	---

U_c' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	min	kV	$+mA_{cr}$	$-mA_{cr}$	W
23	0	5,60	2,31	2,44	4,10
	5		2,13	2,25	2,18
	10		2,00	2,03	2,07
24	15		1,96	2,00	1,83
	20		1,94	1,98	1,70
	25		1,91	1,95	1,68
25	30		1,89	1,91	1,65

continued

continued

Sample No.: OD2

Preheating temperature: 61 °C

Date: July 31, 2007

Second high current impulse application

Oscillogram	Charging voltage	Residual voltage	Discharge current	Energy	Current
No.	kV	kV	kA	kJ	µs
26	76,3 x 2	33,0	100,0	17,0	4,5/9,8

U_r' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	s	kV	+ mA_{cr}	- mA_{cr}	W
27	0	7,02	37,0	49,0	---
28	10		24,0	37,0	---

U_c' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	min	kV	+ mA_{cr}	- mA_{cr}	W
29	0	5,60	2,18	2,19	3,10
	5		2,00	2,09	2,02
	10		1,94	2,01	1,74
30	15		1,92	1,99	1,65
	20		1,90	1,97	1,56
	25		1,89	1,96	1,53
31	30		1,90	1,95	1,51

ВЯРНО С ОРИГИНАЛА

continued

continued

Sample No.: OD3

Preheating temperature: 61 °C

Date: July 31, 2007

Second high current impulse application

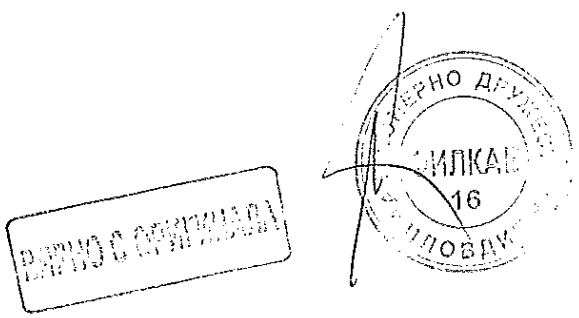
Oscillogram	Charging voltage	Residual voltage	Discharge current	Energy	Current
No..	kV	kV	kA	kJ	µs
32	76,0 x 2	32,5	100,0	14,8	4,5/9,8

U_r' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	s	kV	+ mA_{cr}	- mA_{cr}	W
33	0	6,98	58,0	74,0	---
34	10		15,0	27,0	---

U_c' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	min	kV	+ mA_{cr}	- mA_{cr}	W
35	0	5,58	2,10	2,10	2,89
	5		2,00	2,06	1,95
	10		1,96	1,98	1,89
36	15		1,95	1,97	1,84
	20		1,94	1,96	1,80
	25		1,93	1,95	1,78
37	30		1,91	1,94	1,69



continued

High current impulse operating duty test.

Lightning impulse residual voltage measurement after the test

Test circuit: A0120

Date: August 02, 2007

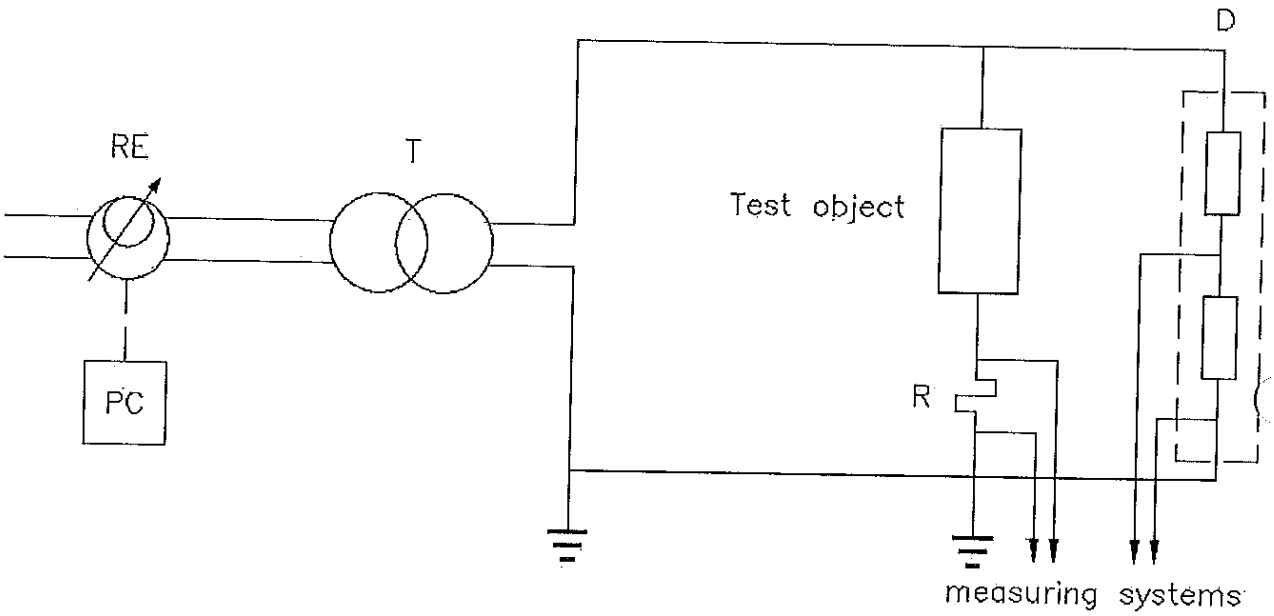
Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
OD1	I_n	29,9	38	8,8/19,0	9,90	16,14
		30,1	39		9,95	16,25
OD2		30,2	40		10,10	16,18
		30,2	41		10,10	16,23
OD3		30,2	42		10,20	16,12
		30,1	43		10,12	16,15

	Oscilloscope settings		
	sampling division	input	attenuation
	µs	V_{div}	
Current	5	0,5	50:5
Voltage	5	1,0	20:5

Notes:

ВЯРНО С ОРИГИНАЛА

Circuit A0019



Power frequency supply

RE - programmable supply type LARCET A.C. Power Source 5000 P.S.; CESI no. 23702-32191
PC - personal computer
T - voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200 V/15-30 kV

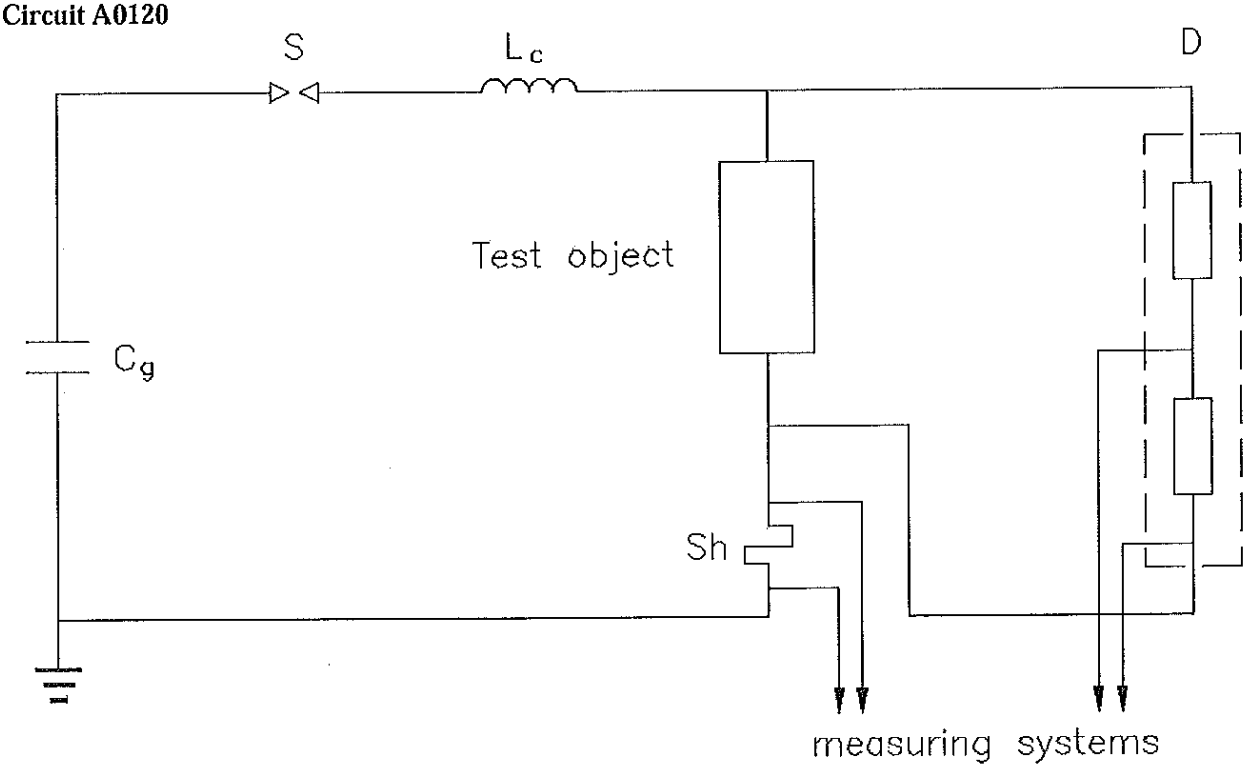
Current measuring system

R - Current shunt CESI N°.31120; R= 941,4 Ω
- Electro optical system CESI N°.--; attenuation 5:5
OSC - Oscilloscope type SONY TEKTRONIX RTD 710; CESI N°. 6318

Voltage measuring system

D - Voltage divider SAGI; CESI N°.11120
- Electro optical system CESI N°.11520/11524; attenuation 5:5
OSC - Oscilloscope type SONY TEKTRONIX RTD 710; CESI N°.6318

Circuit A0120



Impulse generator

No. of stages	1
Cg	4,98 µF
Lc	10 µH
S	- Spark-gap

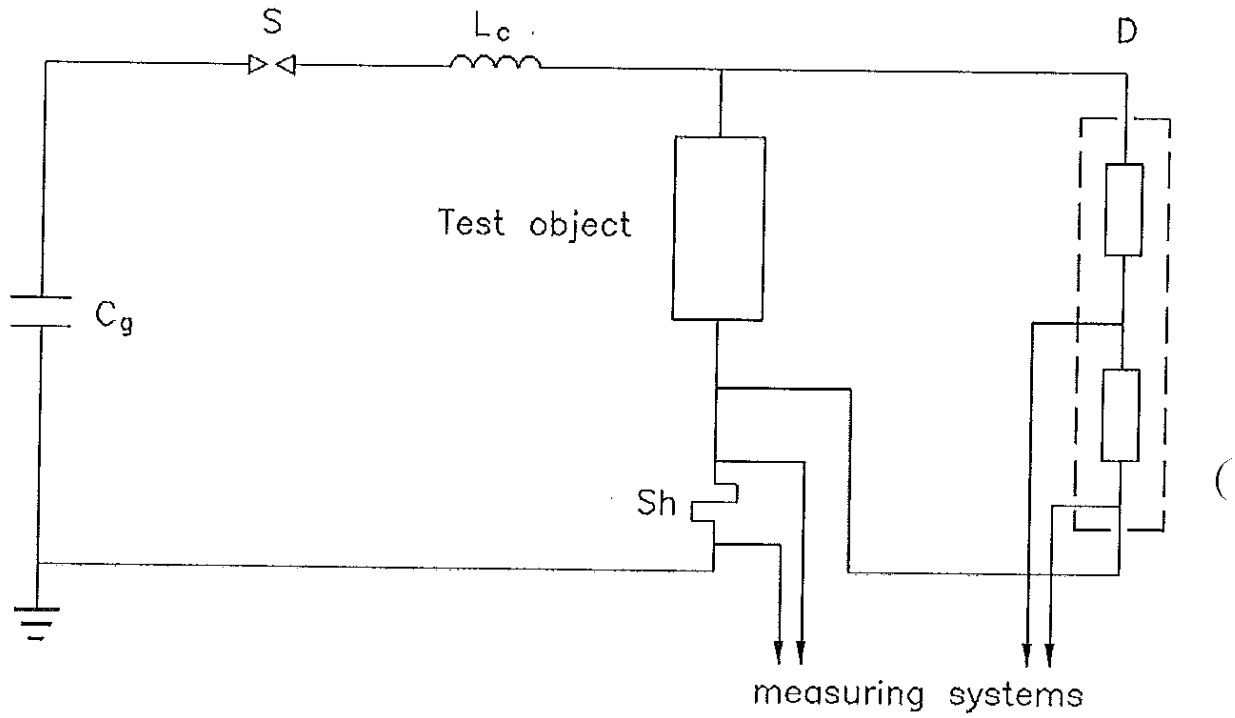
Voltage measuring system.

D	- Voltage divider SAGI; CESI No.11120
	- Electro optical system CESI No. 11521/522
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.2)

Current measuring system

Sh	- Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
	- Electro optical system CESI No. 11517/518
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.1)

Circuit A0122



Impulse generator

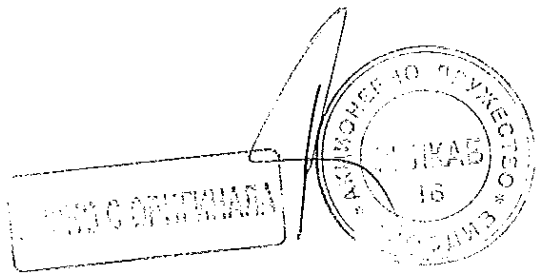
No. of stages	1
Cg	4,98 µF
Lc	100 µH
S	- Spark-gap

Voltage measuring system.

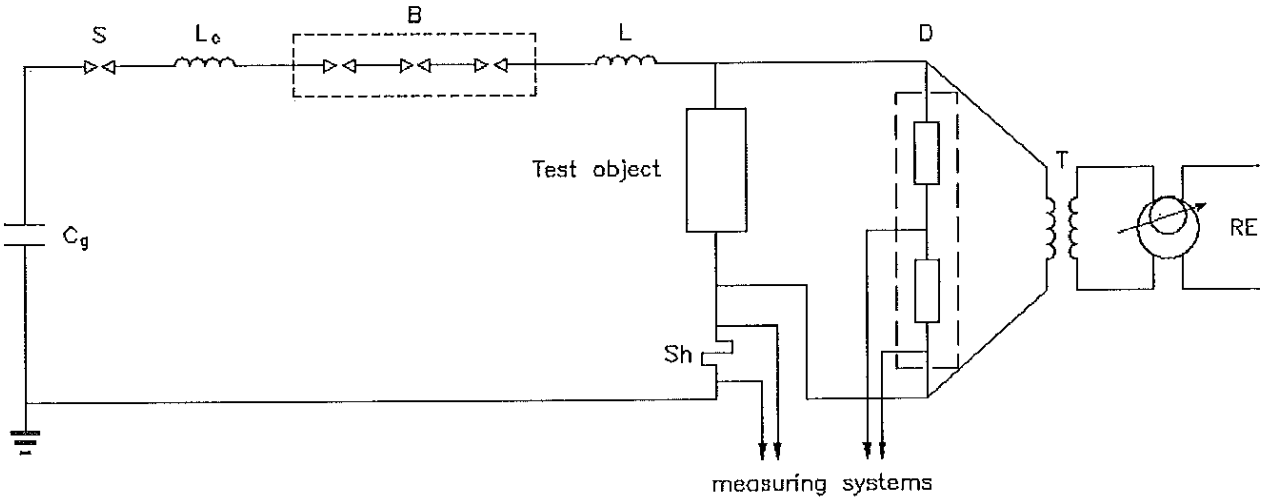
D	- Voltage divider SAGI; CESI No.11120
	- Electro optical system CESI No.11521/522; attenuation 5:5
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.2)

Current measuring system

Sh	- Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
	- Electro optical system CESI No.11517/518; attenuation 5:5
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.1)



Circuit A0015



Impulse generator

No. of stages: 1
C_g - Capacitor 2,49 µF
L - Inductance of the circuit
L_c - Inductor 10 µH
S - Spark gap
One resistor block has been added

Power frequency supply

RE - Regulator type specialtrasfo; power 20 kVA; voltage 380 V/ 220 V
T - Transformer type Pivi; power 30 kVA; voltage 220 V/ 15 kV
B - Blocking gap

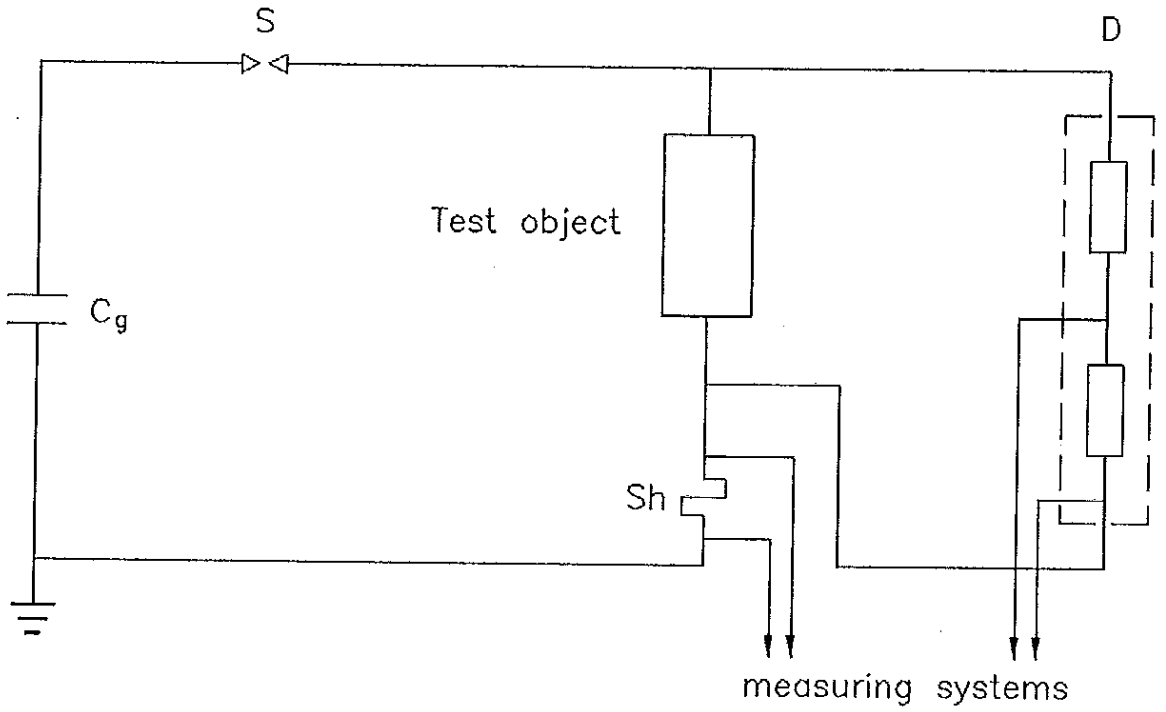
Current measuring system

Sh_1 - Current shunt CESI No.6042; R = 0,002 Ω
- Electro optical system CESI No.11517/11518; attenuation 20:5
OSC - Oscilloscope type Tektonix 540A; CESI No.13217 (on channel No.1)

Voltage measuring system

D - Voltage divider SAGI ; CESI No.1120; k = 1010
- Electro optical system CESI No.11520/11521; attenuation 50:5
OSC - Oscilloscope type Tektonix 540A; CESI No.13217 (on channel No.2)

Circuit A0121



Impulse generator

No. of stages	2
Cg	3,32 µF

S - Spark-gap

Three blocks in series have been added

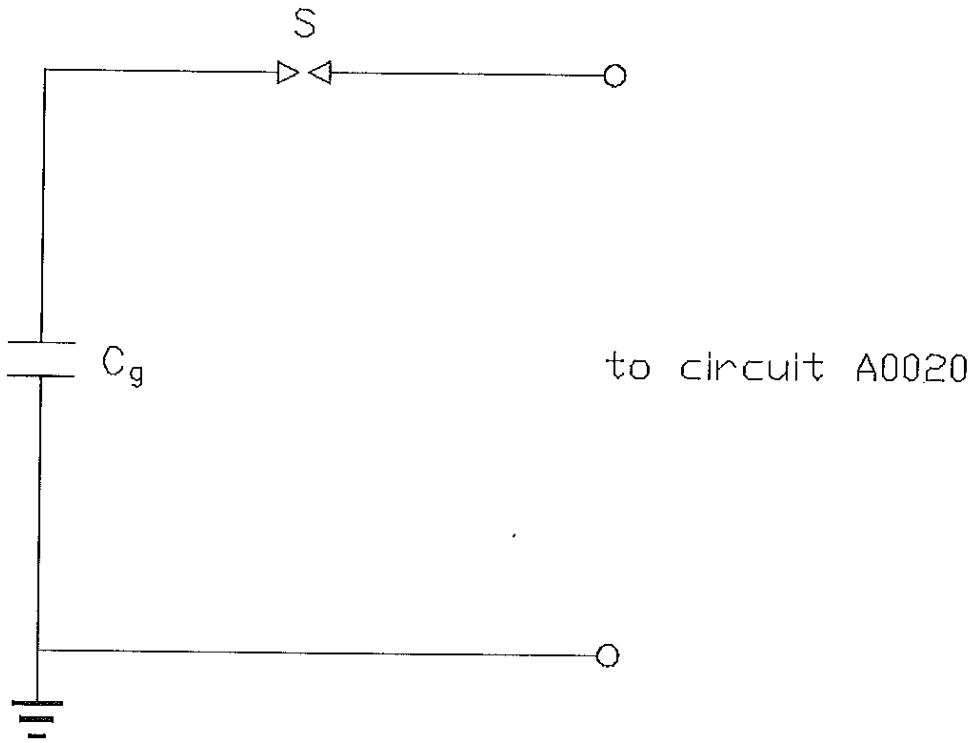
Voltage measuring system.

D	- Voltage divider SAGI; CESI No.11120
	- Electro optical system CESI No11517/518
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.2)

Current measuring system

Sh	- Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
	- Electro optical system CESI No11521/522
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.1)

Circuit A0123

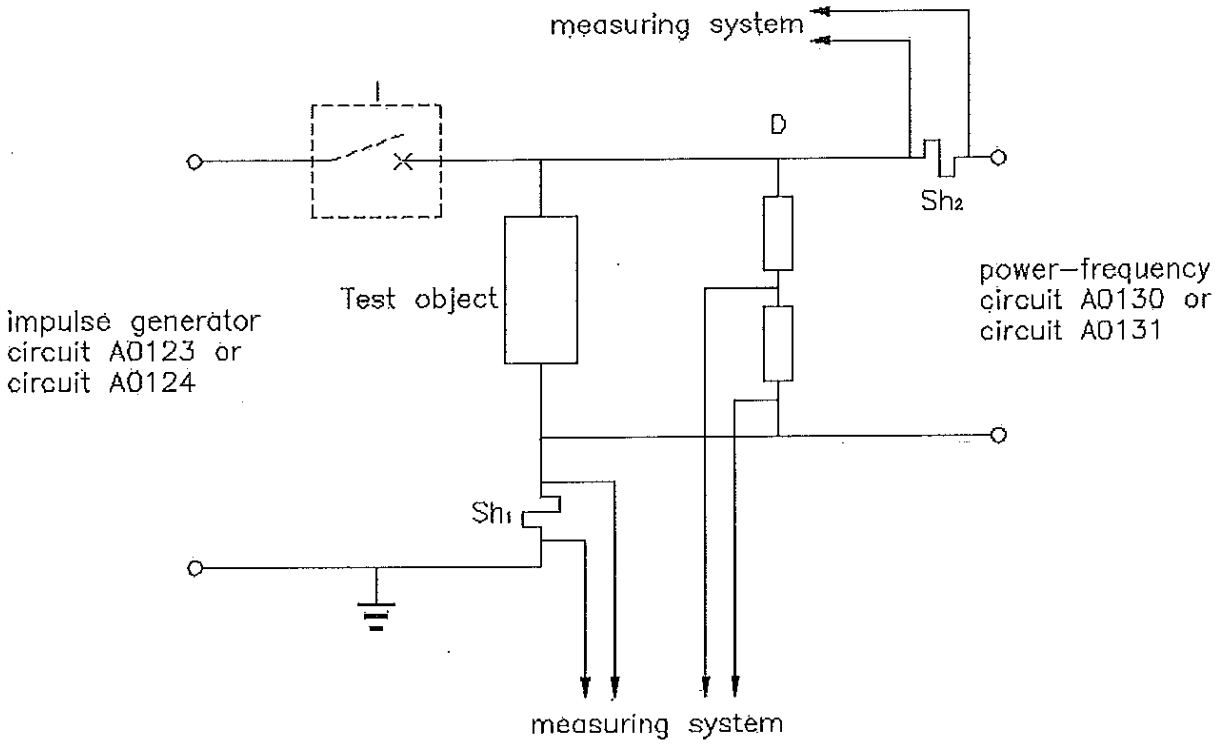


Impulse generator circuit

No. of stages 2
Cg 3,32 μF

S - spark-gap

Circuit A0020



Impulse generator circuit A0124

I - Circuit-breaker

Impulsive current measuring system

Sh_1 - Current shunt CESI No.6039; R= 20 m Ω
- Electro optical system CESI No.11517/518; attenuation 5:5

OSC_1 - Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.1)

Power frequency circuit A0130

Voltage measuring system.

D - Voltage divider SAGI; CESI No.11120
- Electro optical system CESI No.8009/8015; attenuation 50:5

OSC_1 - Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.2)

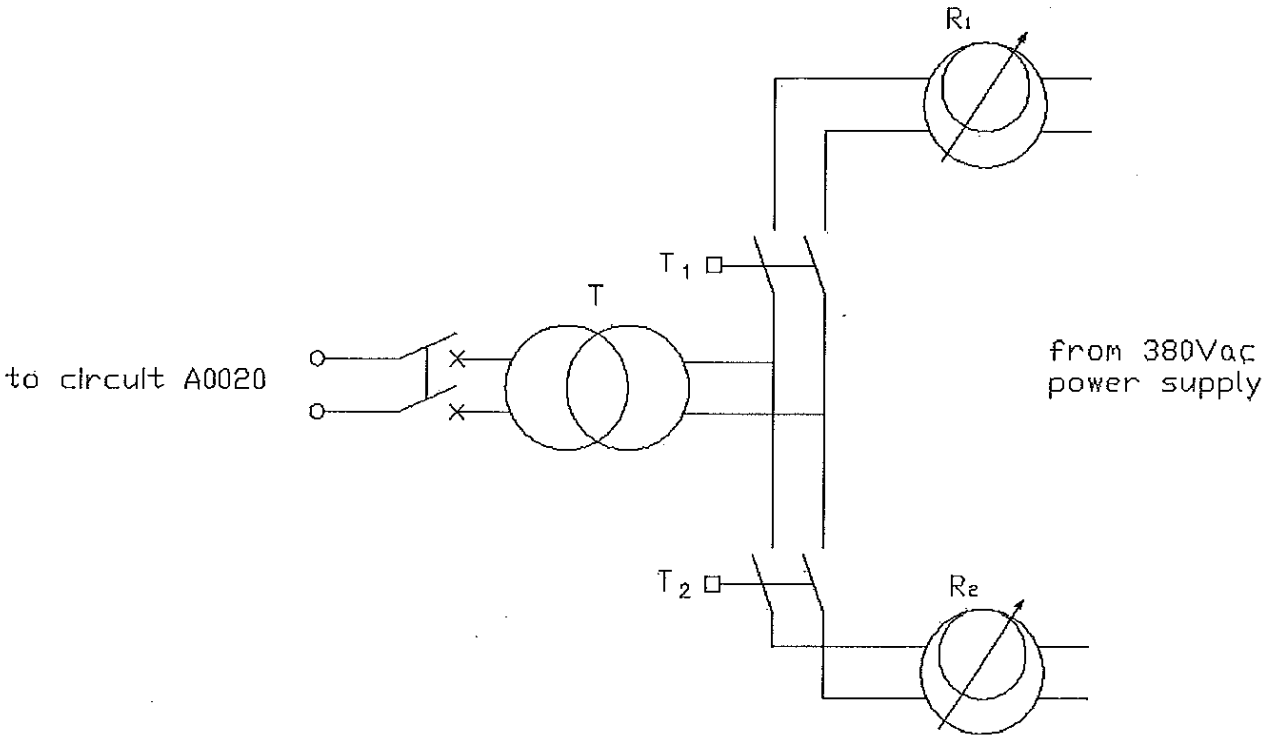
OSC_2 - Oscilloscope type SONY TEKTRONIX RTD 710A; CESI No.9090 (on channel No.2)

Power frequency current measuring system

Sh_2 (TOV) - Current shunt CESI R= 500 Ω - Electro optical system CESI No.8011/8017

OSC_2 - Oscilloscope type TEKTRONIX TDS 744A; CESI No.13937 (on channel No.1)

Circuit A0131



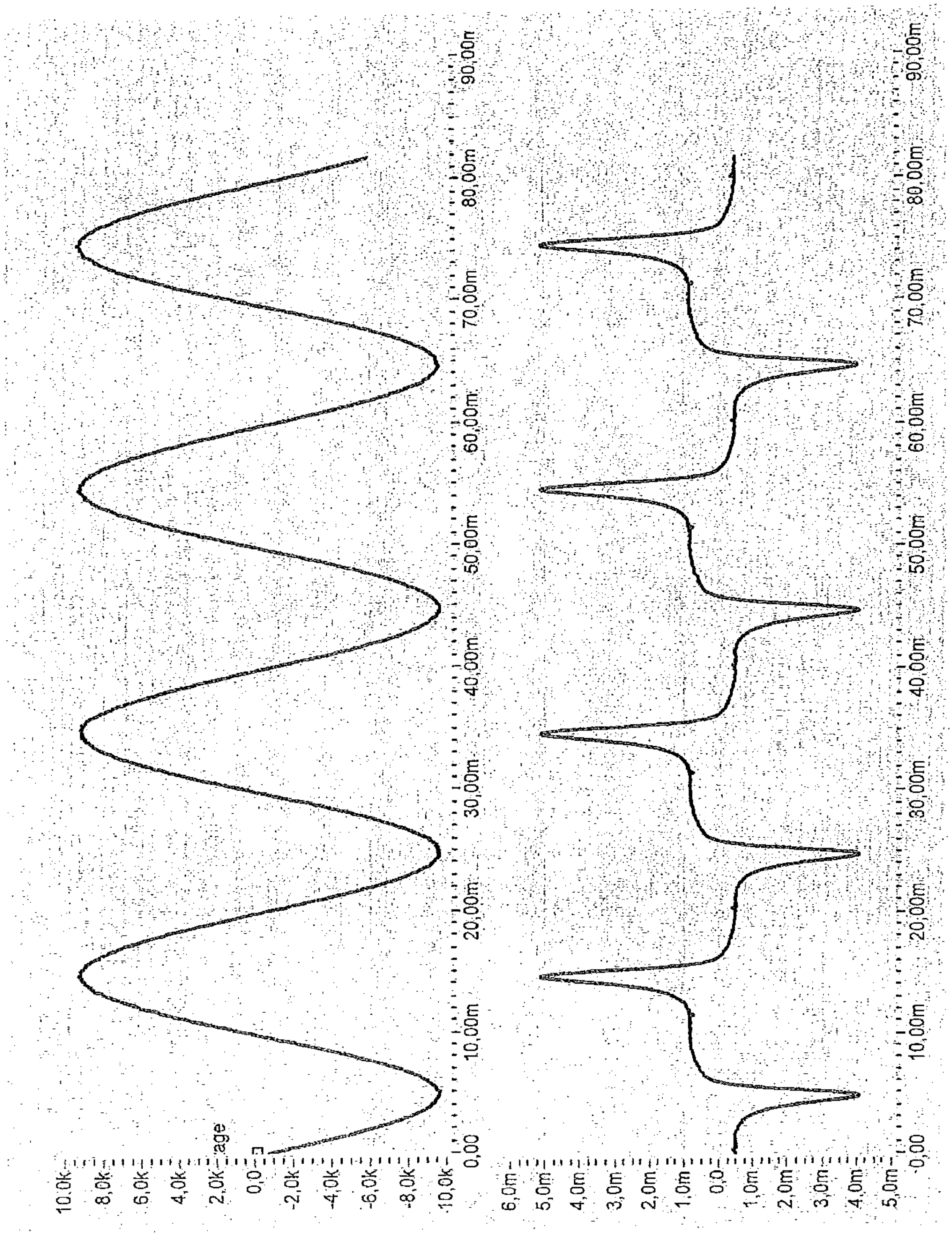
Power-frequancy circuit

from 380Vac power supply

R_1	single-phase voltage regulator CORMES; power 20 kVA; voltage 380/0÷220 Vac
R_2	single-phase voltage regulator CORMES; power 10 kVA; voltage 380/0÷220 Vac
T_1	voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200-400 V/15-30 kV

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО ФИЛКАБ 13 ПЛОВДИВ



CESI A7020582 Oscillogram n. 1

CESI A7020582 Oscillogram n. 2

ВЕРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ПЛОВДИВ * ФИЛИАЛ 16

CESI A7020582 Oscillogram n. 3

CESI A7020582 Oscillogram n. 4

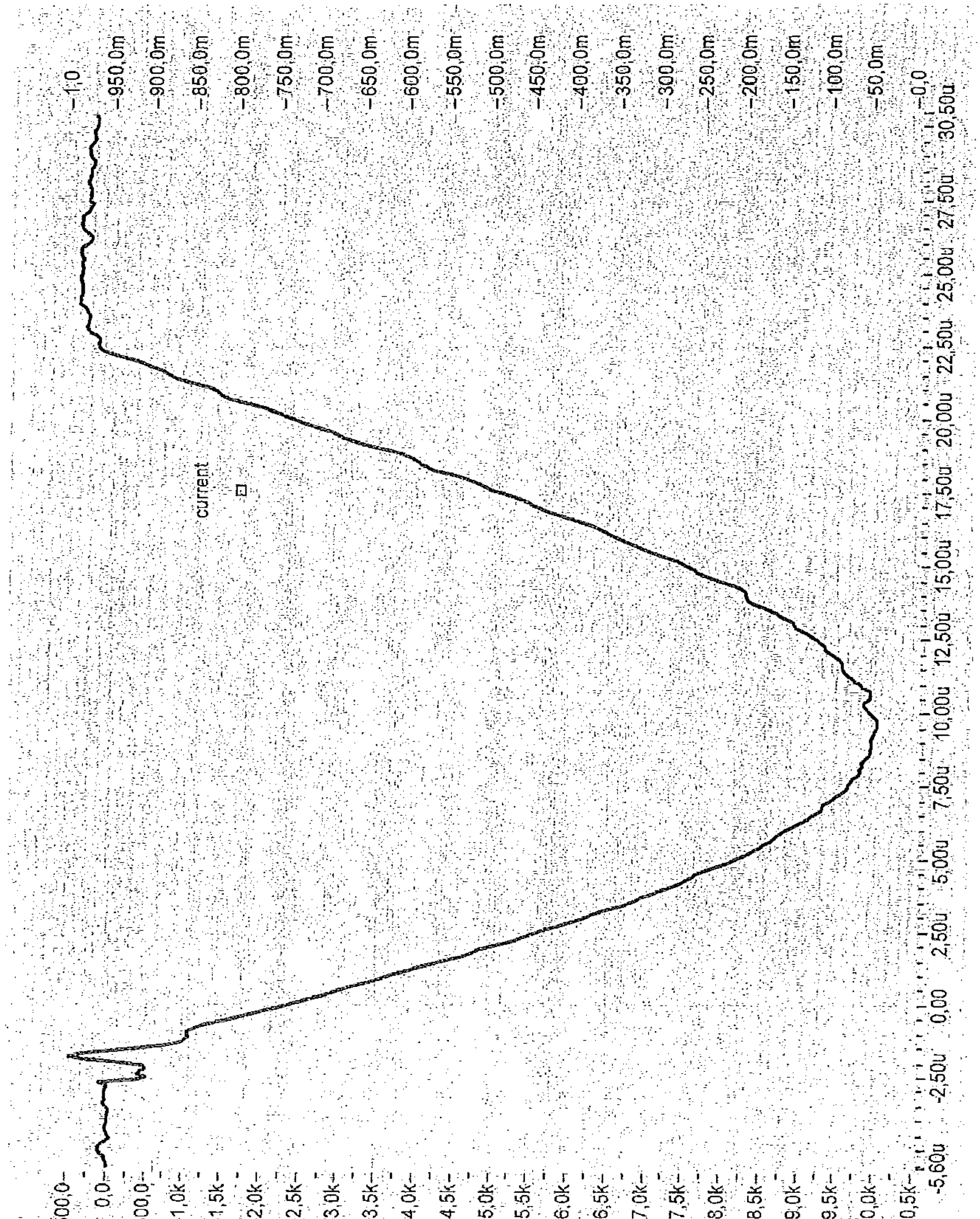
ВЯРНО С ОРИГИНАЛА

CESI A7020582 Oscillogram n. 5

CESI A7020582 Oscillogram n. 6

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ЕНЕРГИЯ * ПЛОВДИВ
ФИЛИАЛ 16



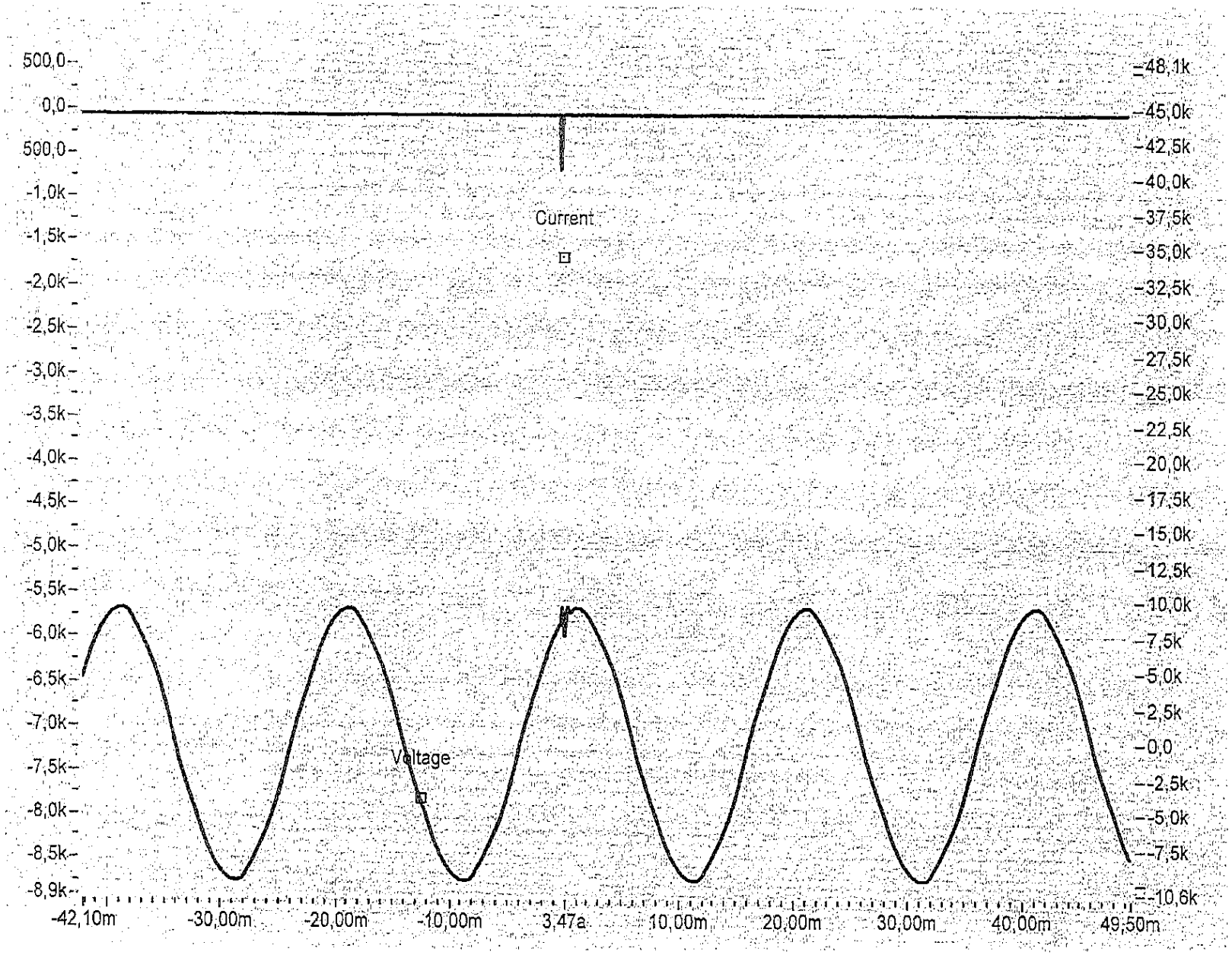
CESI A7020582 Oscillogram n. 7

CESI A7020582 Oscillogram n. 8

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ФИЛКАБ 16 * ПЛОВДИВ *

CESI A7020582 Oscillogram n. 9



CESI A7020582 Oscillogram n. 10

ВЯРНО С ОРИГИНАЛА

CESI A7020582 Oscillogram n. 12

CESI A7020582 Oscillogram n. 13

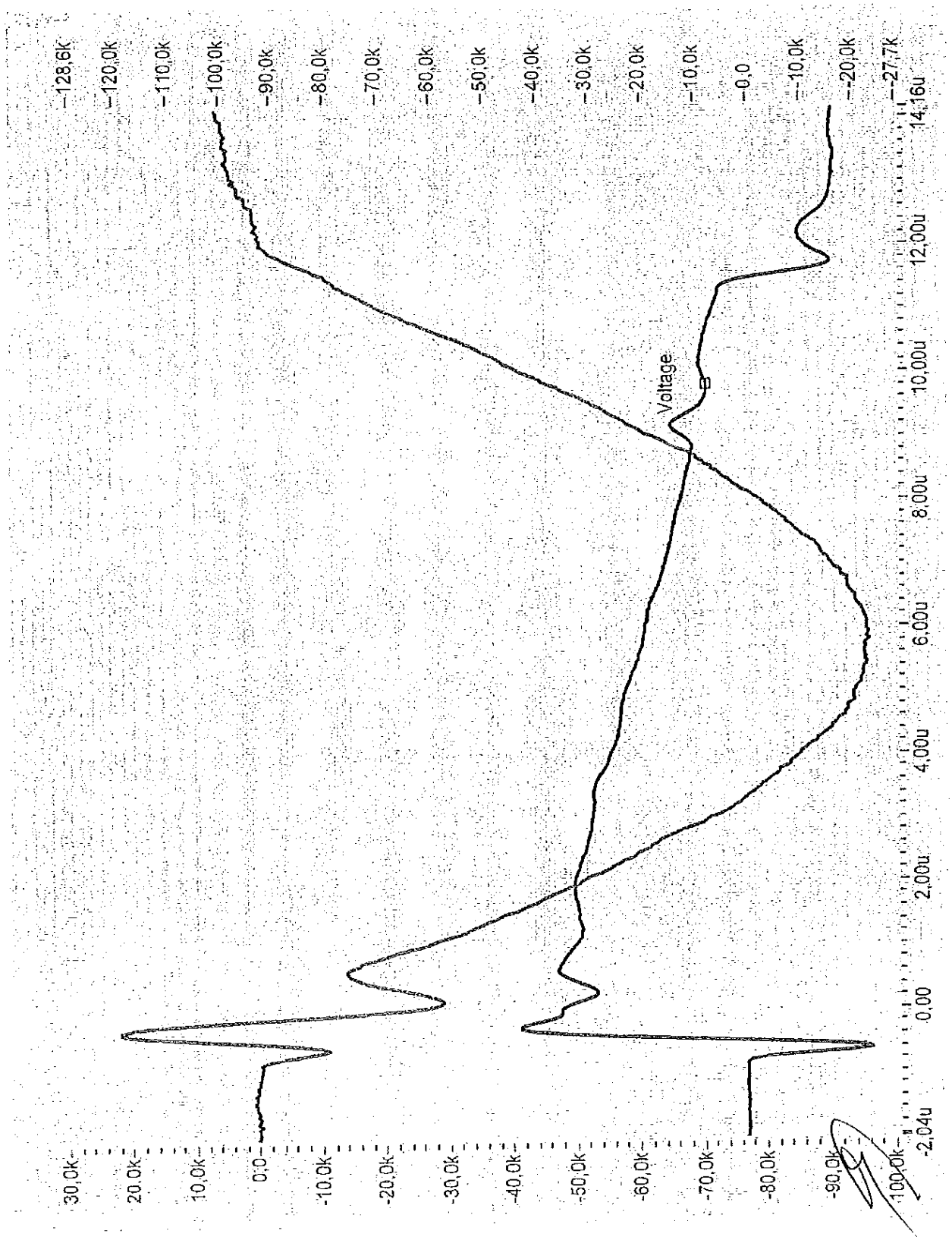
ВЯРНО С ОРИГИНАЛА

CESI A7020582 Oscillogram n. 14

CESI A7020582 Oscillogram n. 15

ВЯРНО С ОРИГИНАЛА

CESI A7020582 Oscillogram n. 16



CESI A7020582 Oscillogram n. 17

ВЯРНО С ОРИГИНАЛА

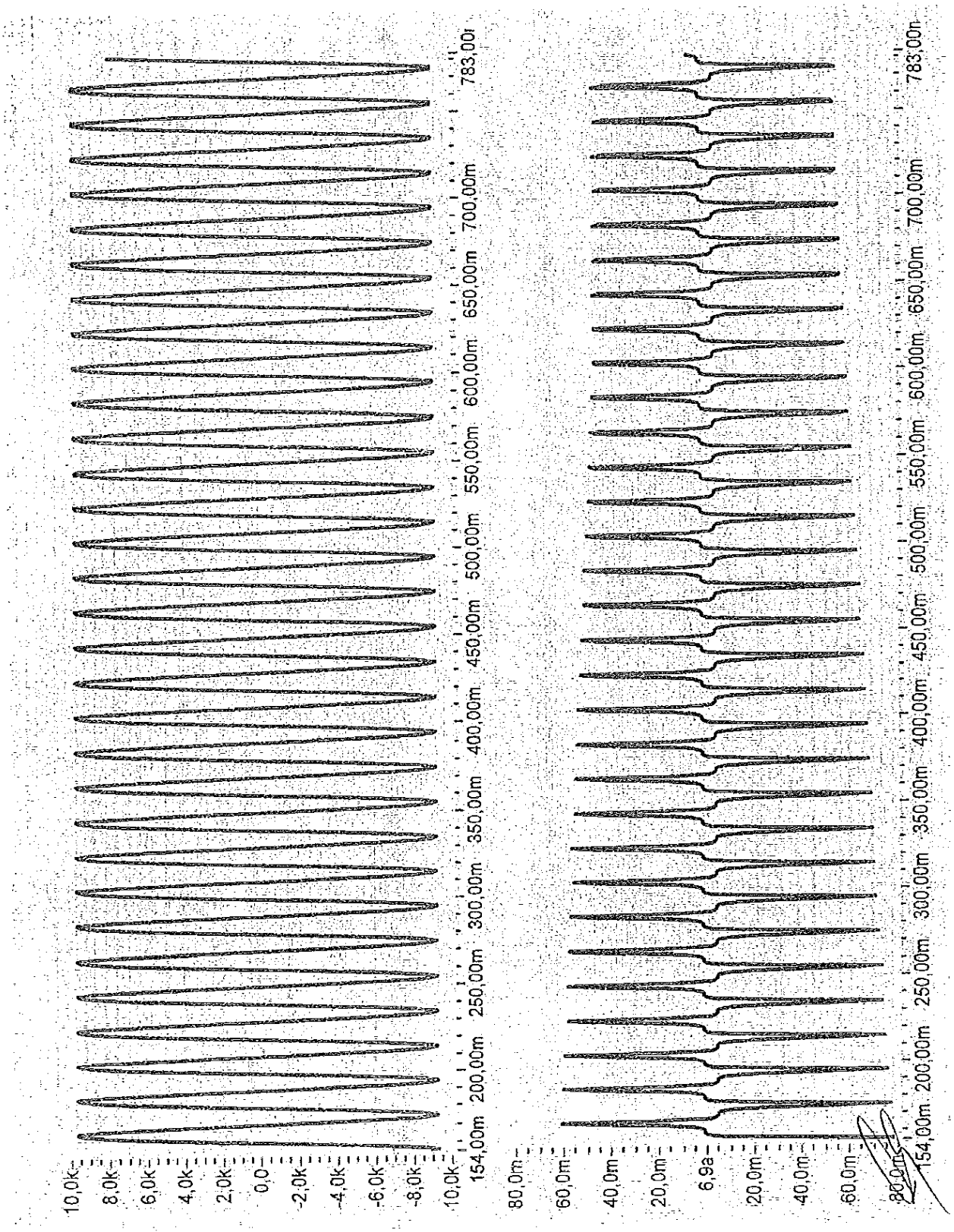
CESI A7020582 Oscillogram n. 18

CESI A7020582 Oscillogram n. 19

ВЯРНО С ОРИГИНАЛА

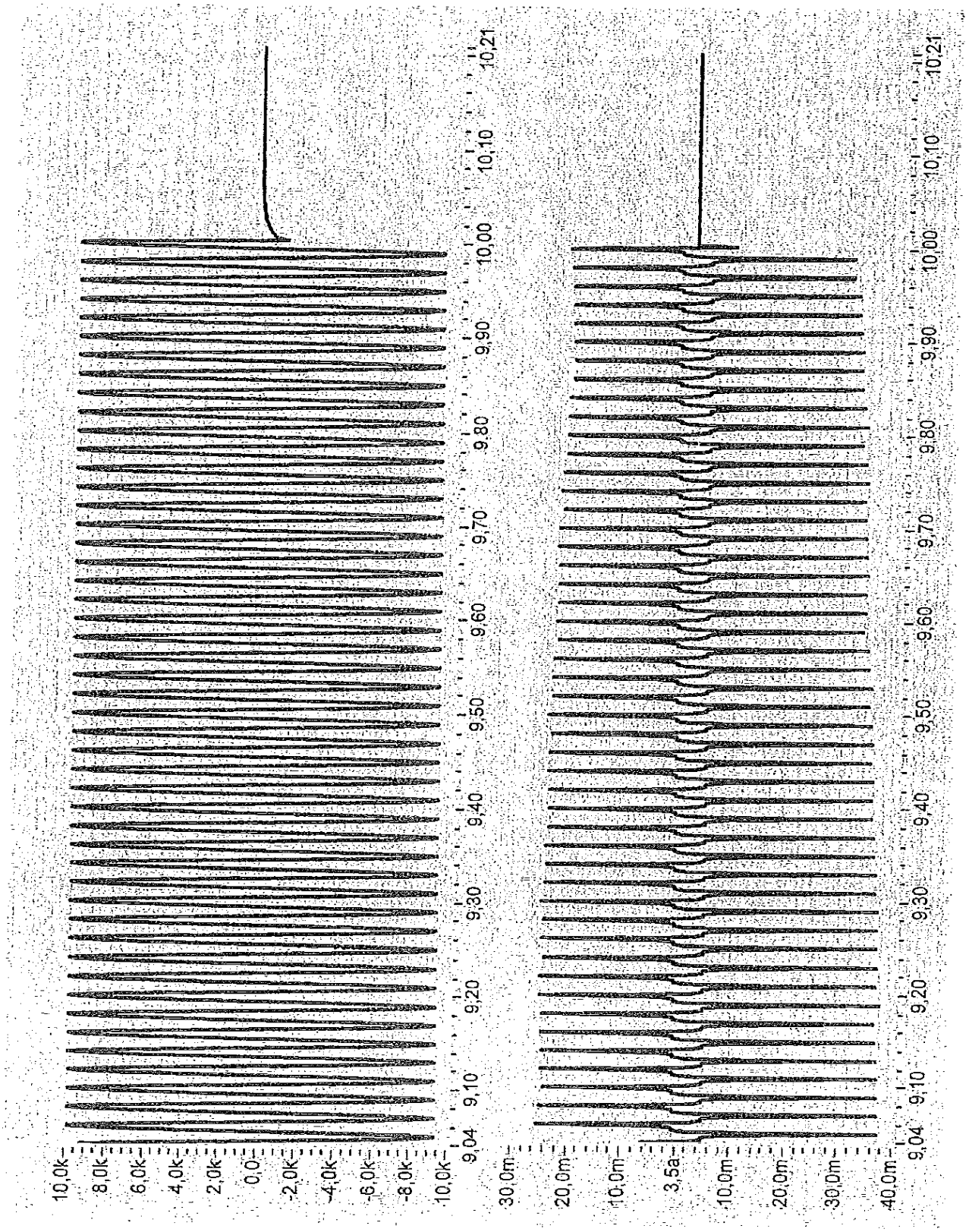
АКЦИОНЕРНО ДРУЖЕСТВО ПЛОВДИВ ФИЛИАЛ 13

CESI A7020582 Oscillogram n. 20



CESI A7020582 Oscillogram n. 21

ВЕРНО С ОРИГИНАЛА

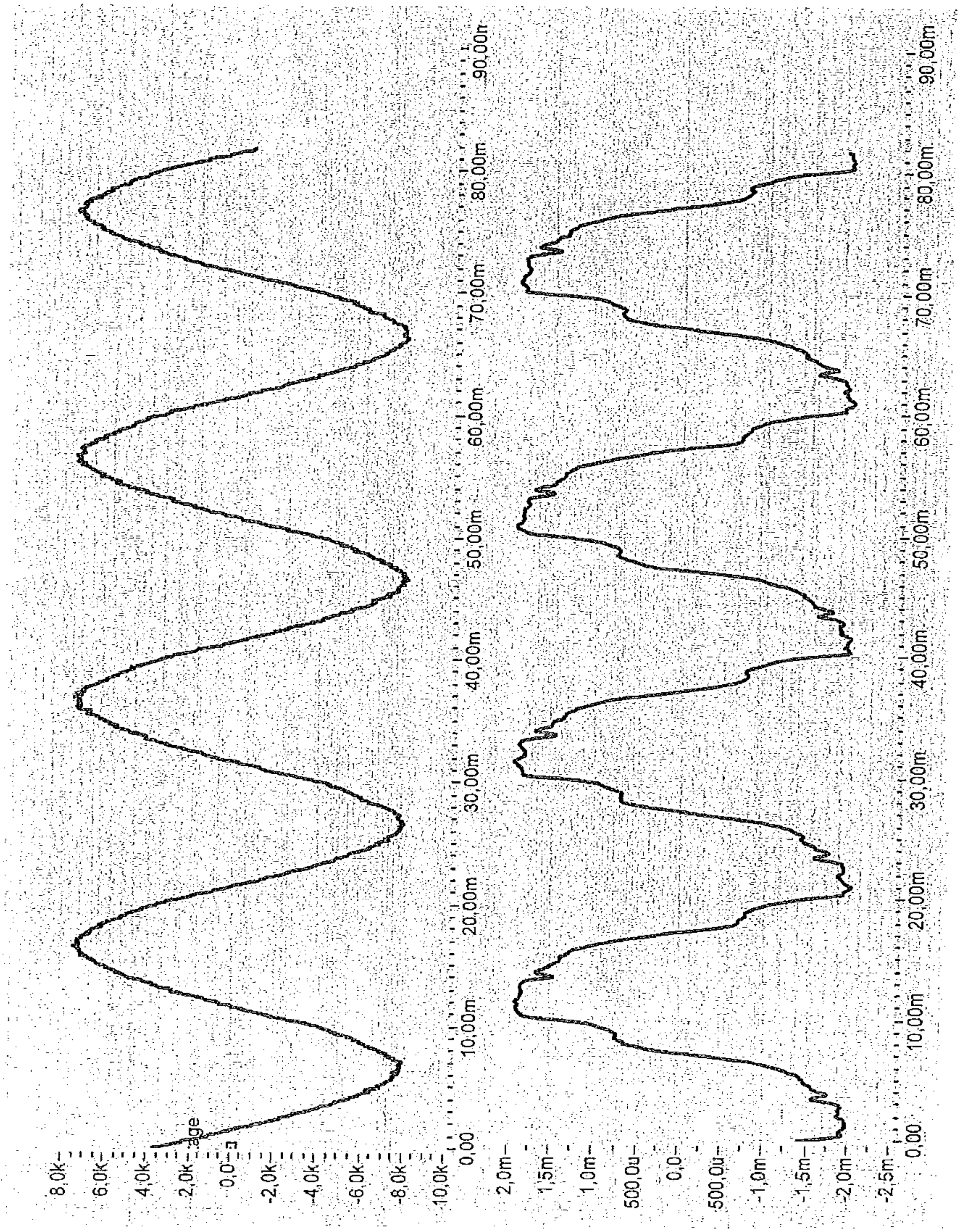


CESI A7020582 Oscillogram n. 22

CESI A7020582 Oscillogram n. 23

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ПЛОВДИВ * СУДЛКАС 13



CESI A7020582 Oscillogram n. 24

ВЯРНО С ОРИГИНАЛА

CESI A7020582 Oscillogram n. 25

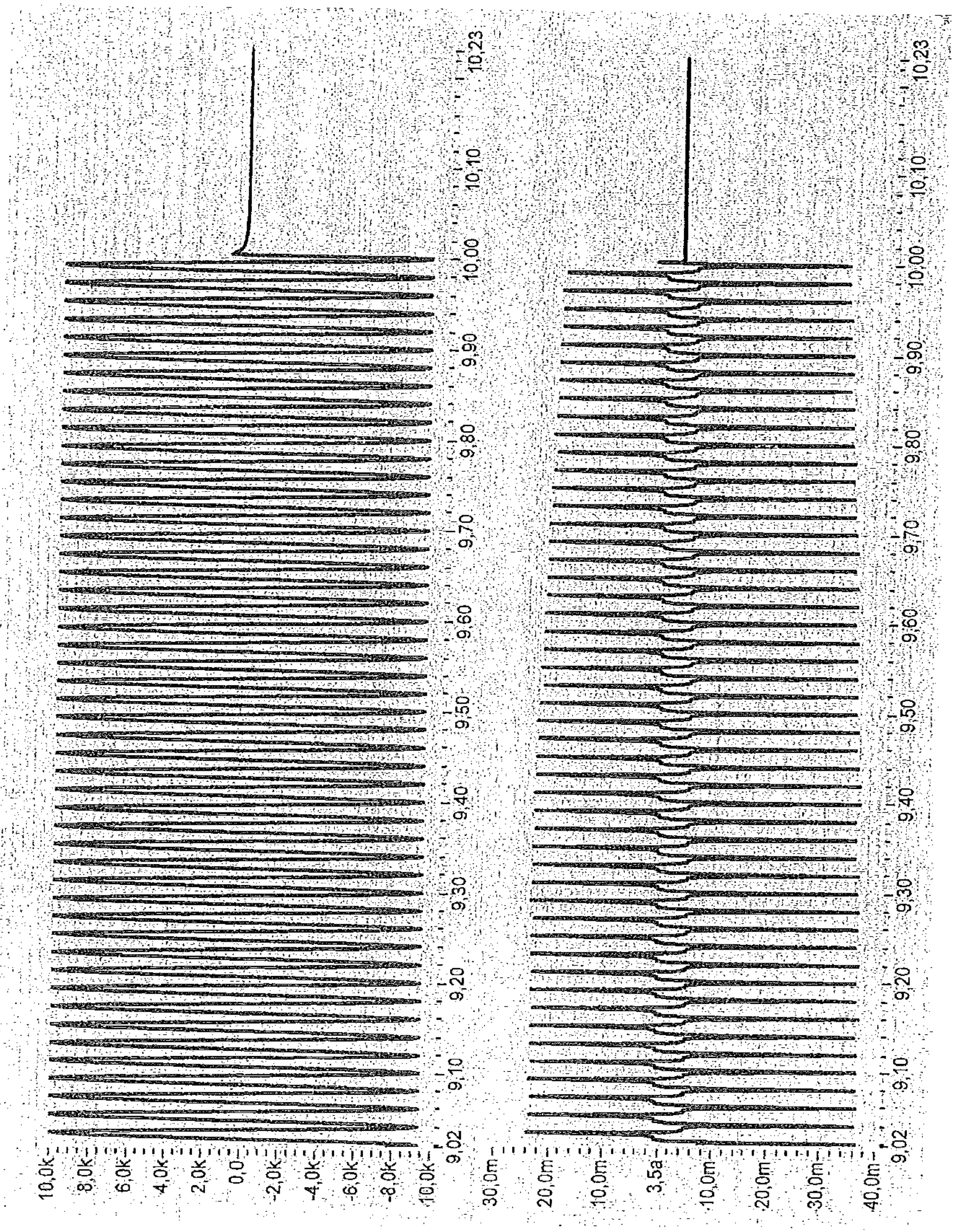
ВЯРНО С ОРИГИНАЛА

CESI A7020582 Oscillogram n. 26

CESI A7020582 Oscillogram n. 27

ВЯРНО С ОРИГИНАЛА

НАЦИОНЕРНО ДРУЖЕСТВО * ЕНЕРГИЯ * ПЛОВДИВ ФИЛИАЛ 16



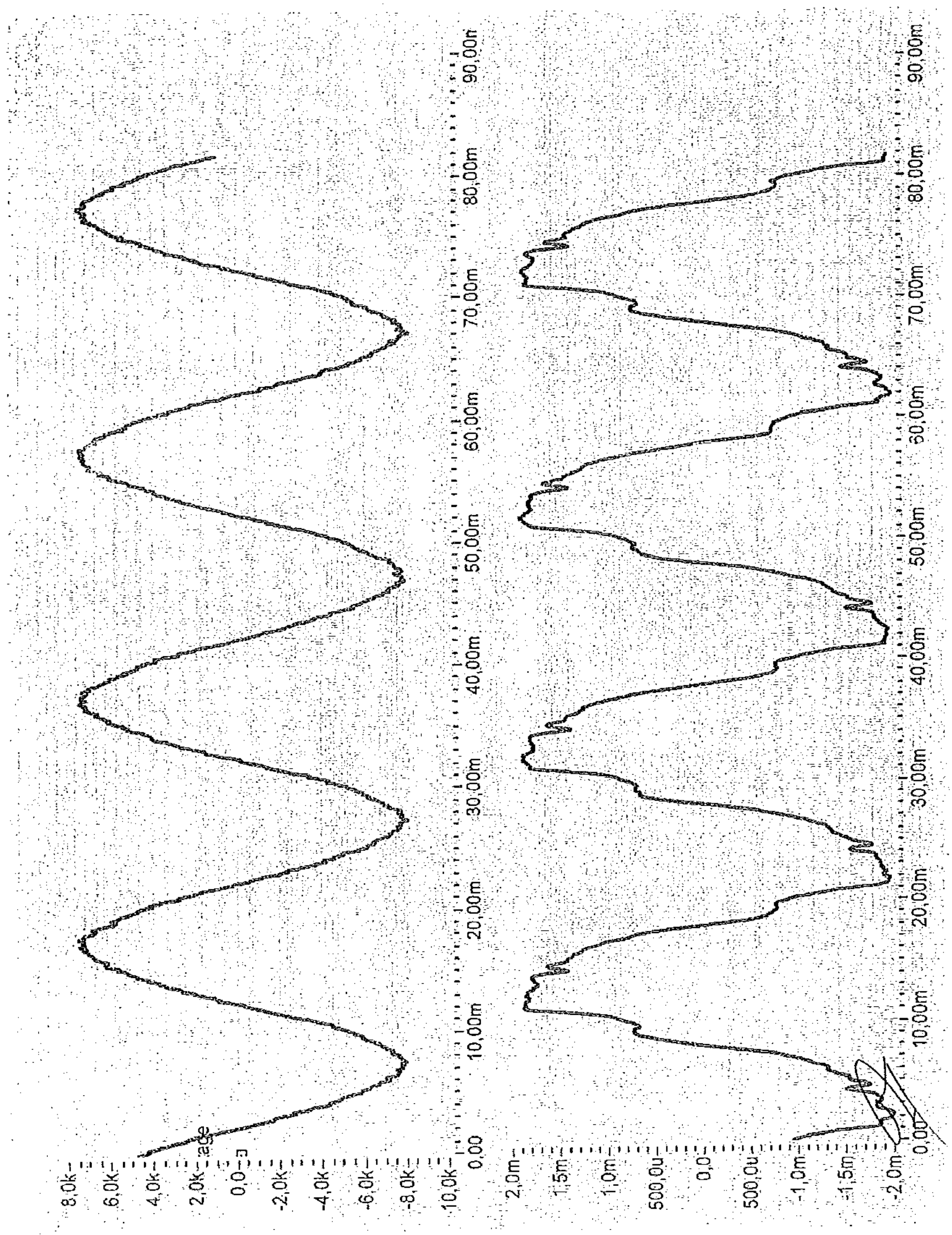
CESI A7020582 Oscillogram n. 28

CESI A7020582 Oscillogram n. 29

ВЯРНО С ОРИГИНАЛА

CESI A7020582 Oscillogram n. 30

ВЕРНО С ОРИГИНАЛА



CESI A7020582 Oscillogram n. 31

ВЯРНО С ОРИГИНАЛА

CESI A7020582 Oscillogram n. 32

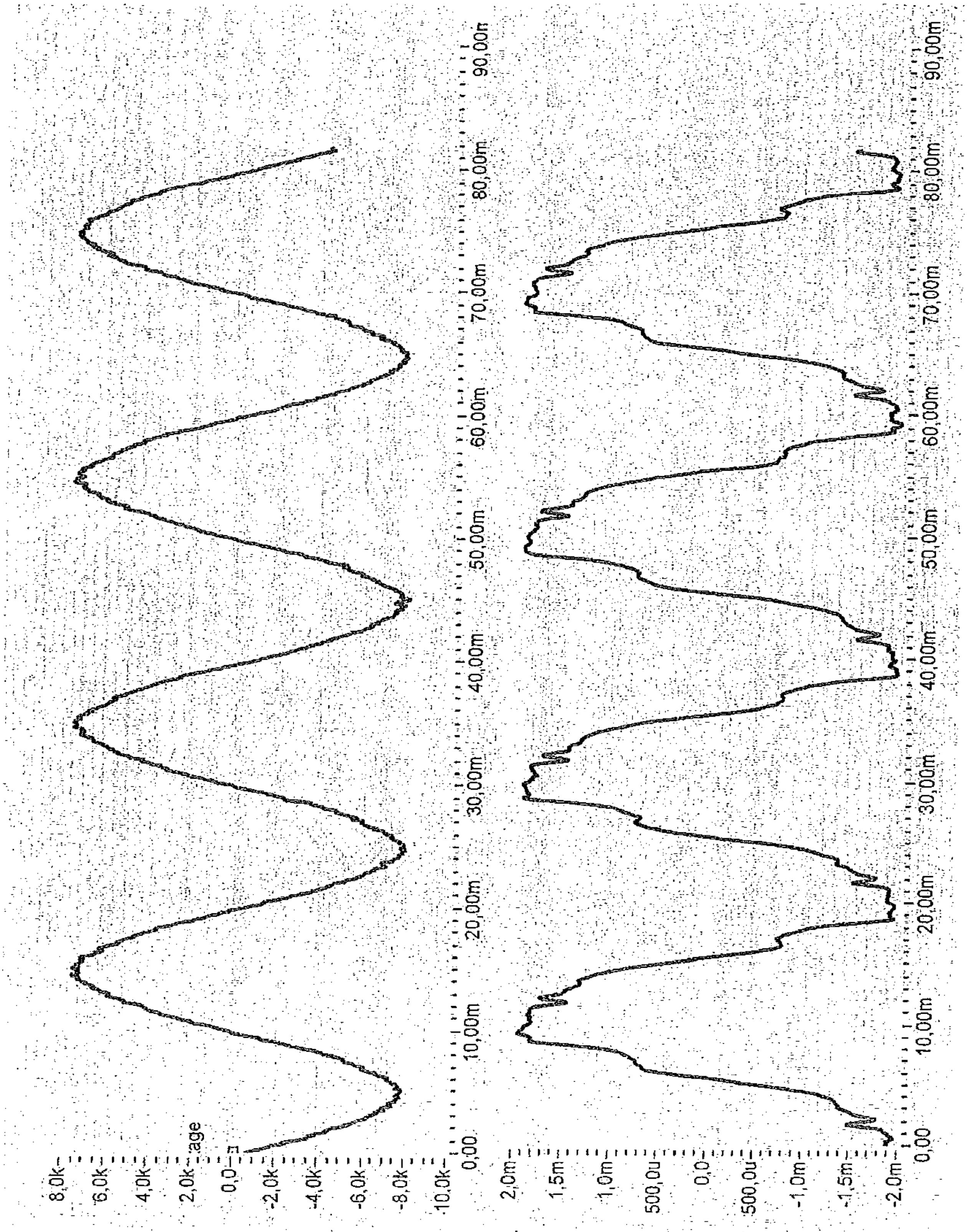
CESI A7020582 Oscillogram n. 33

ВЯРНО С ОРИГИНАЛА

CESI A7020582 Oscillogram n. 34

CESI A7020582 Oscillogram n. 35

ВЗЯТО С ОРИГИНАЛА

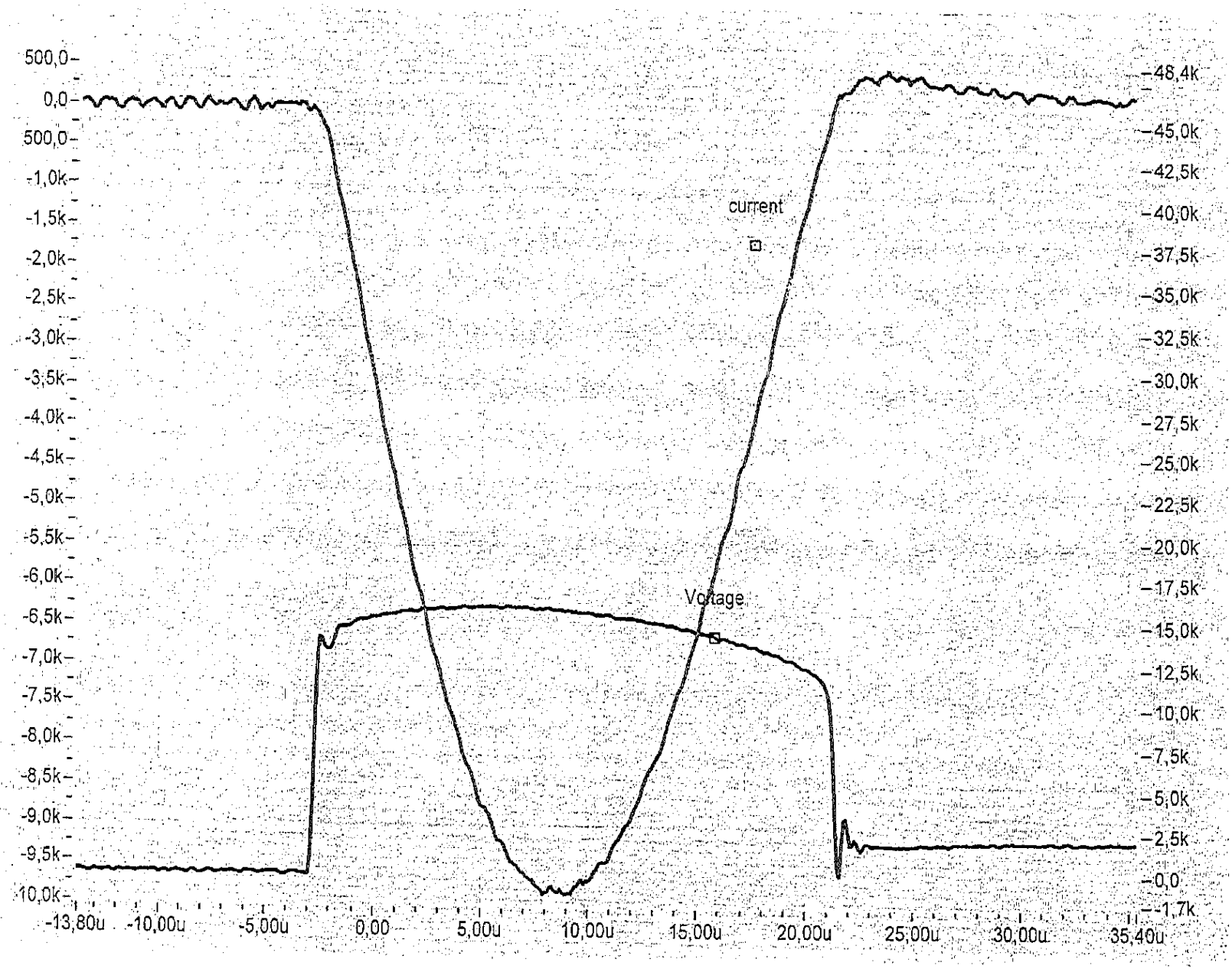


CESI A7020582 Oscillogram n. 36

CESI A7020582 Oscillogram n. 37

ВЯРНО С ОРИГИНАЛА

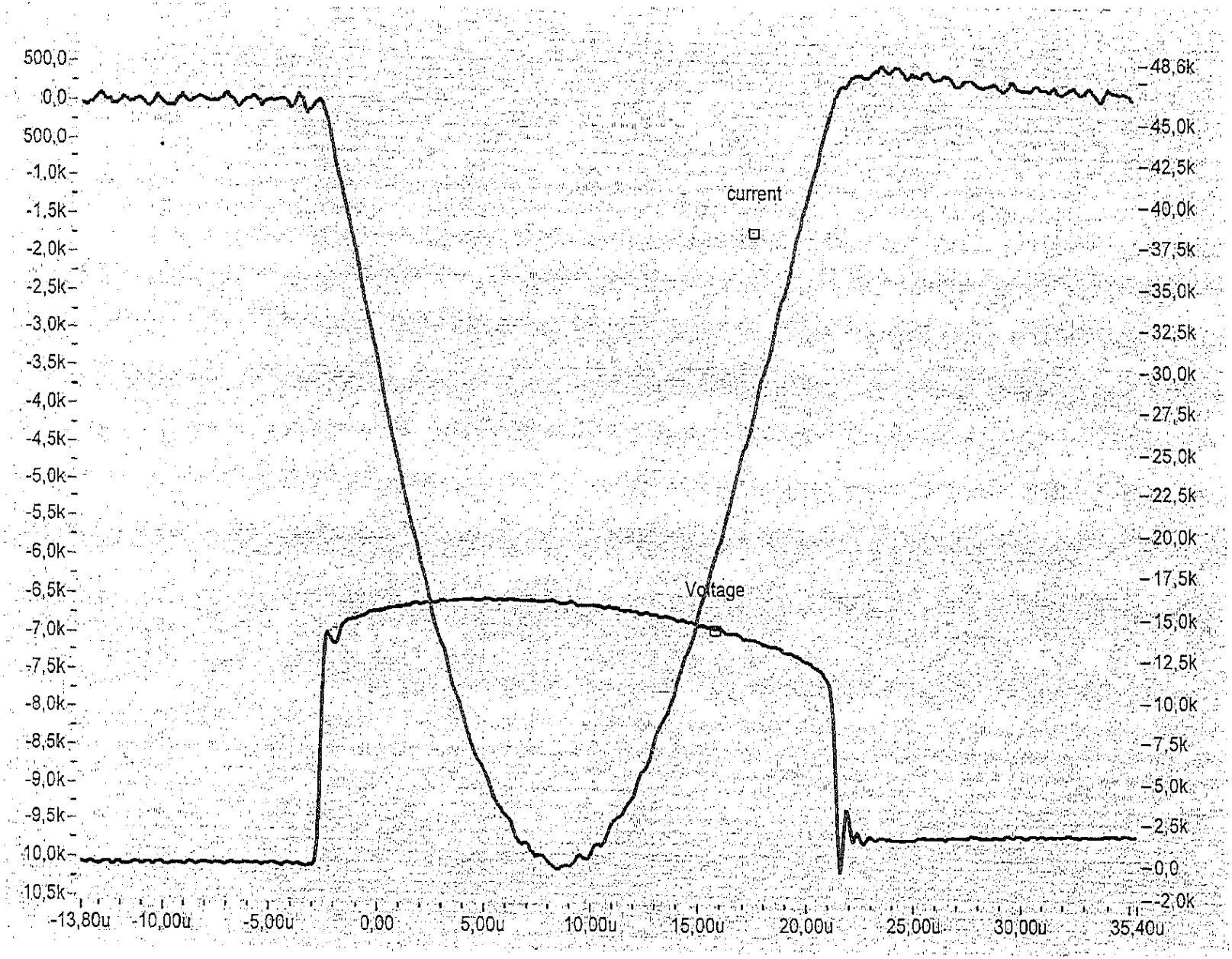
CESI A7020582 Oscillogram n. 38



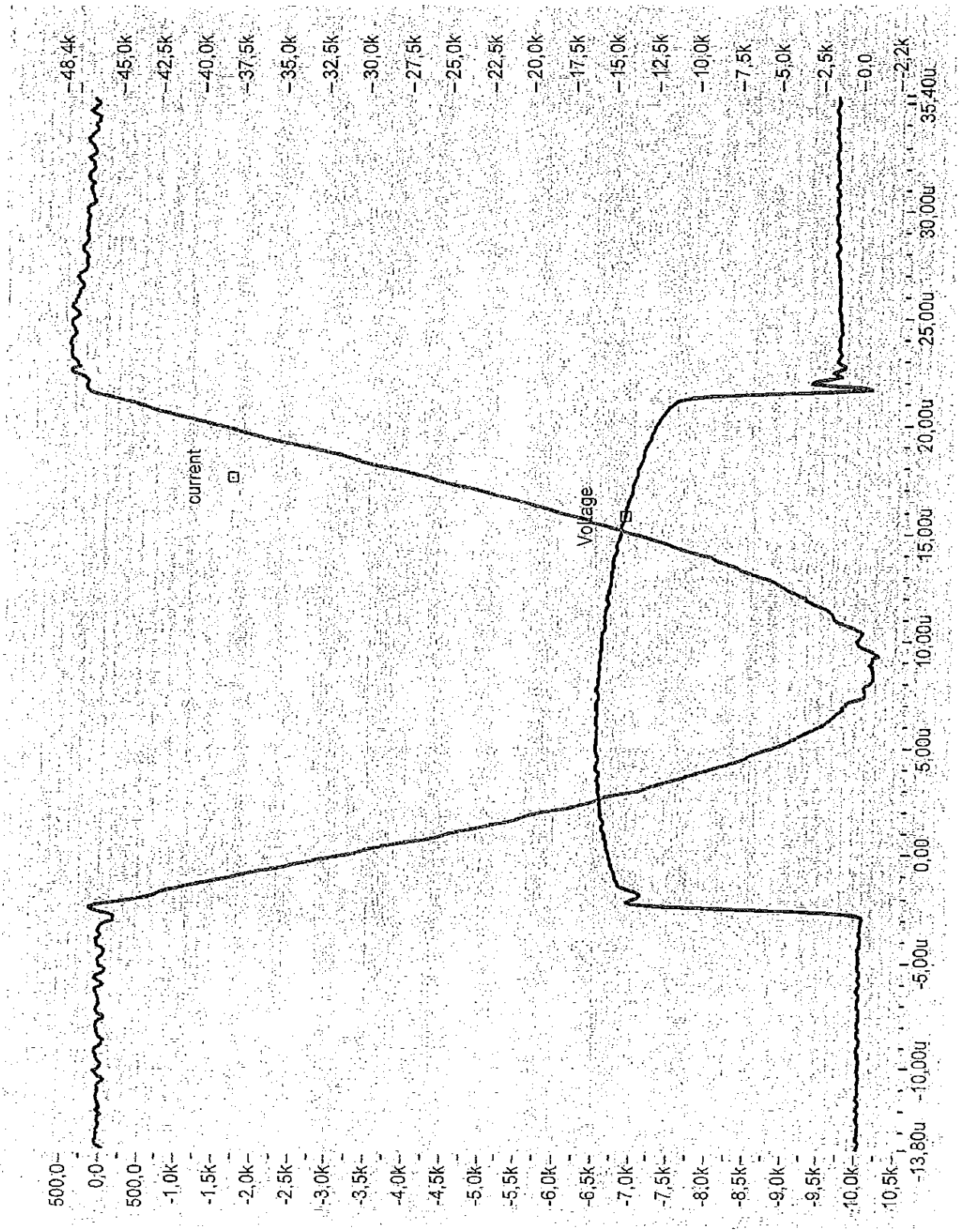
CESI A7020582 Oscillogram n. 39

ВЯРНО С ОРИГИНАЛА

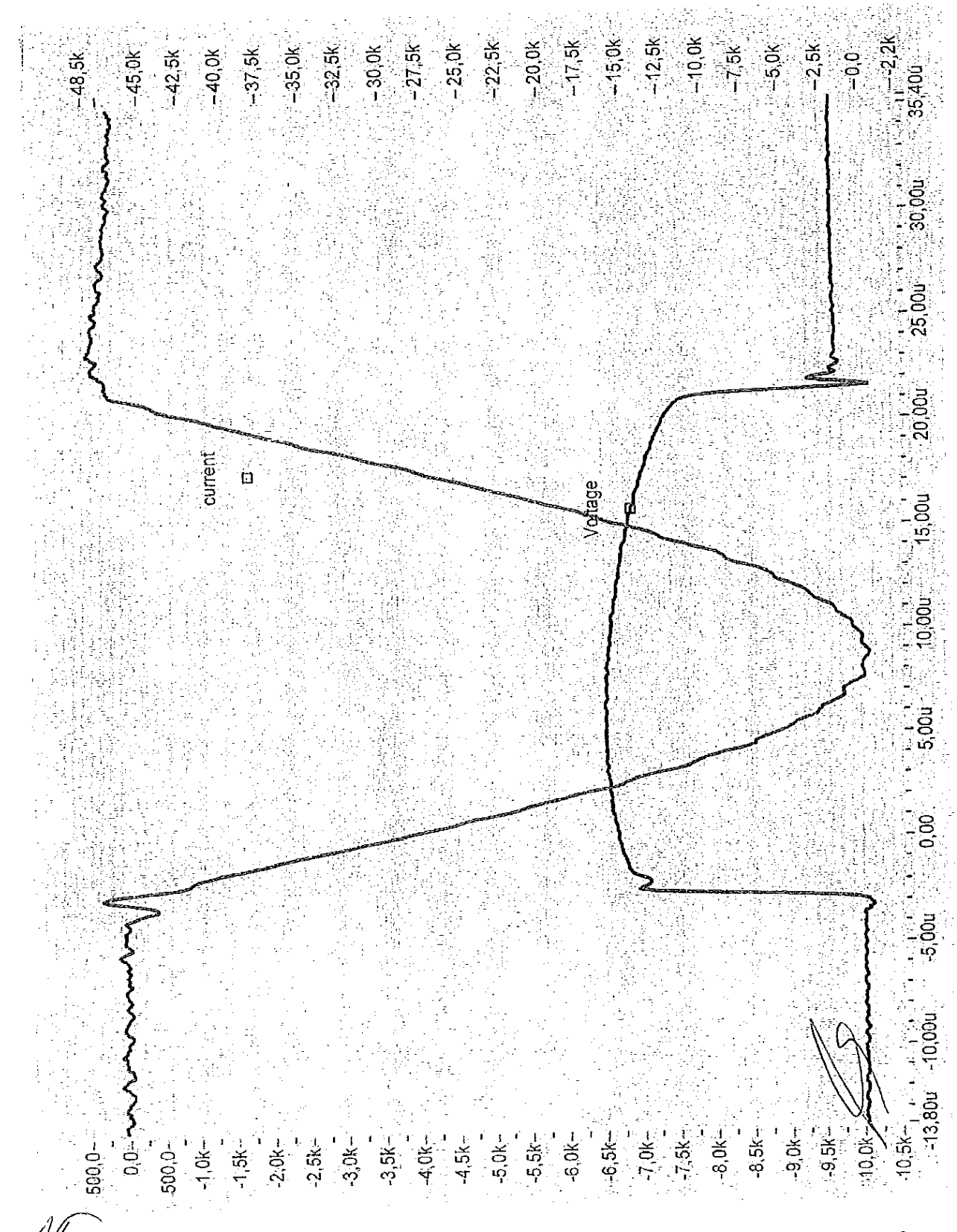
CESI A7020582 Oscillogram n. 40



CESI A7020582 Oscillogram n. 41



CESI A7020582 Oscillogram n. 42



CESI A7020582 Oscillogram n. 43

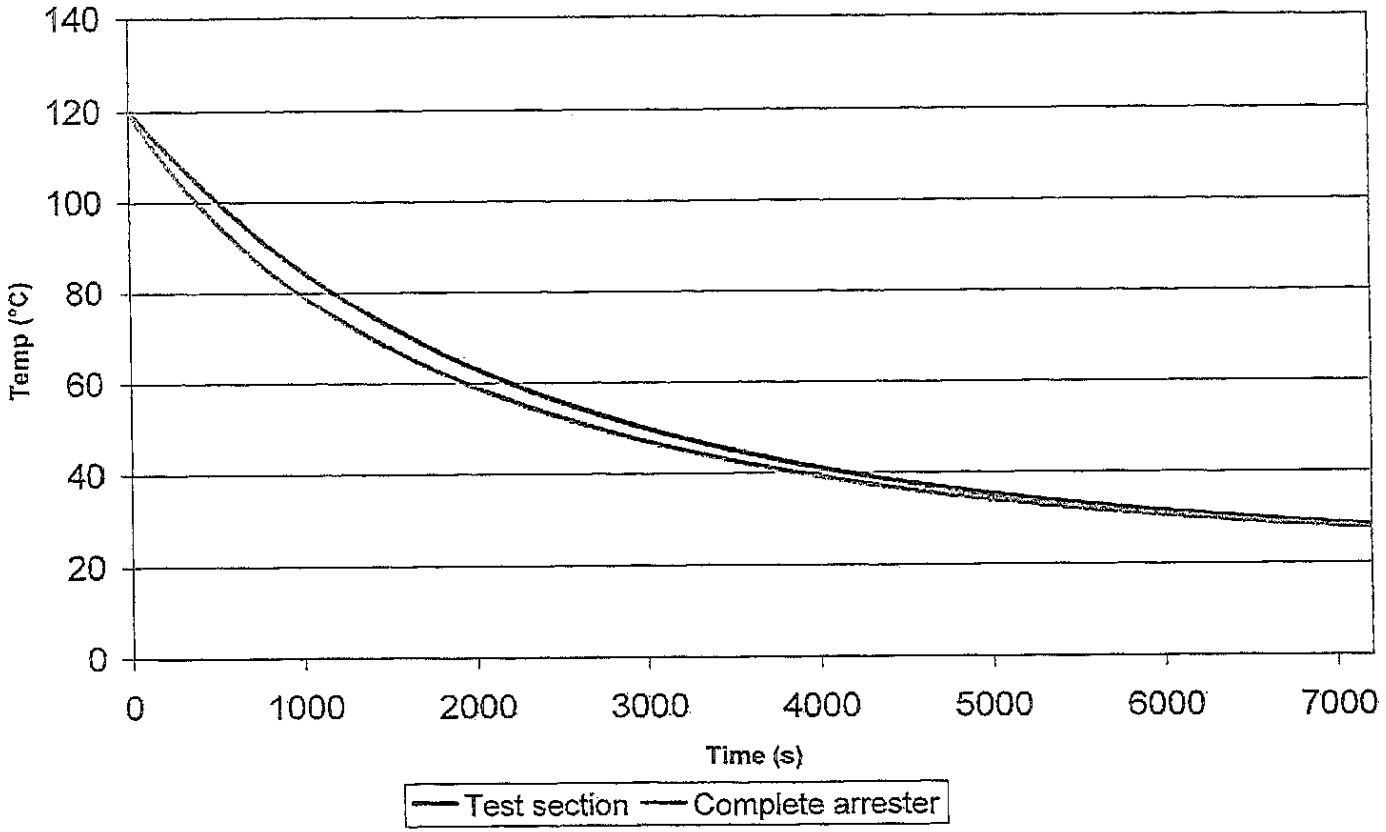
ВЯРНО С ОРИГИНАЛА

Tyco Electronics

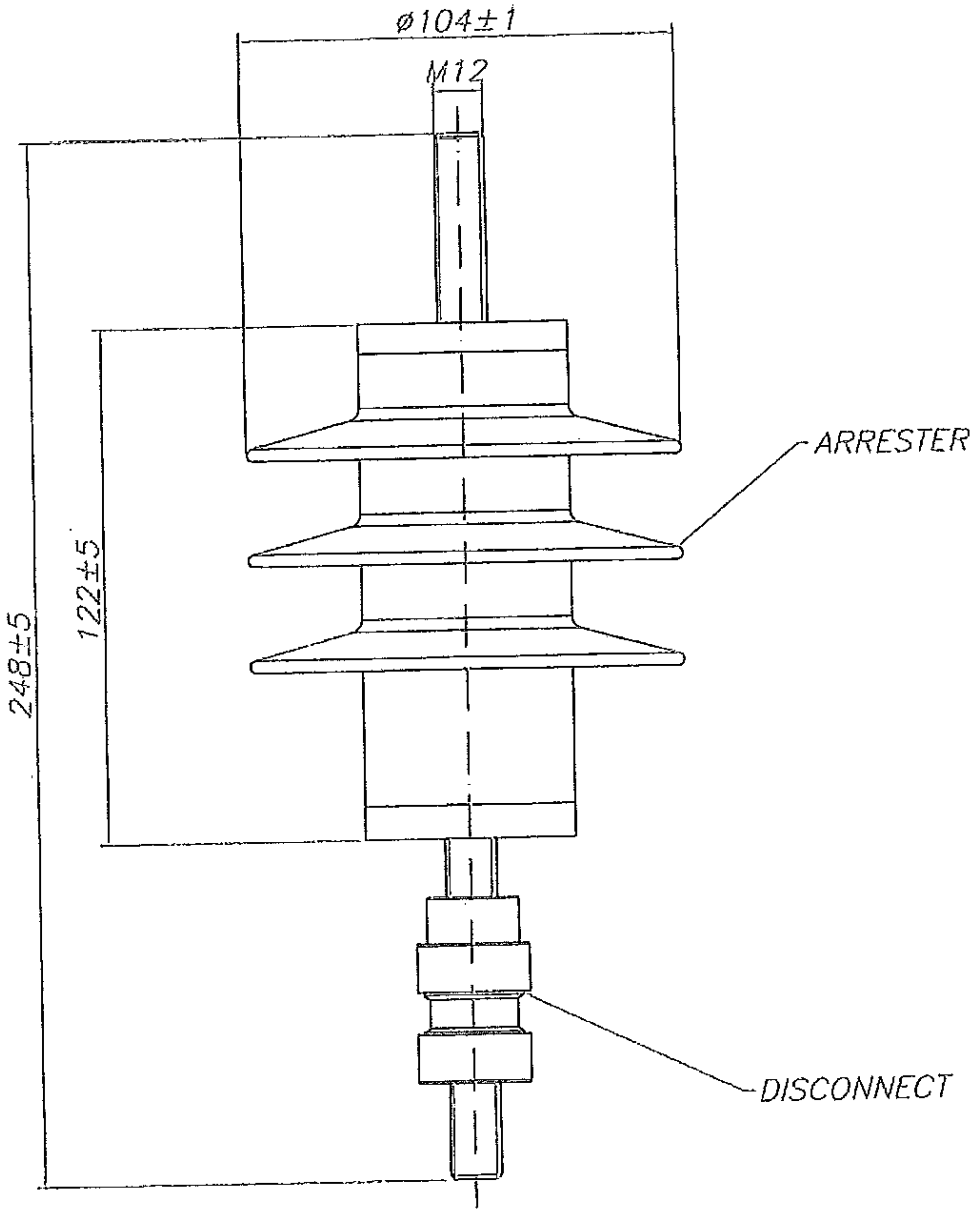
На основание чл. 2
от ЗЗЛД

DATA
22 ОТТ. 2007

DA1 Class 1 Surge Arrester Thermal equivalency



SCD



На основание чл. 2
от ЗЗЛД

Uref = 6.22kV min
Ur = 6.5kV
Uc = 5.2kV
CREEPAGE = 254mm
DRY ARC DISTANCE = 127mm

Tyco Electronics

ENERGY DIVISION

Bowthorpe EMP Surge Arrester

BAY 100-109
SHANNON IND. EST.
SHANNON
CO. CLARE
IRELAND

DRN	J HOLLIGAN	17/09/07	
CHECK	B HORNOYLE		
APP	B McGOWAN		
SCALE	1:1		

PCN

MAT'L

TITLE

DA1-6.5-NODONO SURGE ARRESTER

DRG NO. DA1-6.5-NODONO | SHEET 1 OF 1 | REV 0

ВЯРНО С ОРИГИНАЛА

DA1 - Distribution Surge Arrester
Short Circuit Tests
Type Test Report

Tyco Electronics

Our commitment. Your advantage.

Tyco Electronics

Bowthorpe EMP

Test Report

Type	**DA1**
PPR Number	**PPR-2280**
Test Specification	Short circuit tests IEC 60099-4 (2006-07) Ed. 2.1

Test Information:

Laboratory	CESI
Date	13/11/2007
External Test Ref	A7029908
Report Prepared by	P. Beccarini
Test Verified by	A. Sironi
Test Approved by	V. Scarioni

Tyco Approvals:

R&D Manager

Brendan Normoyle

Date 28/11/2007

На основание чл. 2
от ЗЗЛД

Product Manager

Brian McGowan

Date 28/11/2007

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Bay 100-109
Shannon Industrial Estate
Co. Clare, Ireland
Tel:+ 353-61-472885
Fax: + 353-61-472676
Email: mvsurgearresters@tycoelectronics.com

Client	TYCO ELECTRONICS Shannon – IRELAND
Tested equipment	Polymer housed metal-oxide surge arresters
Tests carried out	Short circuit tests
Standards/Specifications	IEC 60099-4 (2006-07)
Test date	**from** June 25, 2007 **to** June 26, 2007

No. of pages	20	**No. of pages annexed**	13
Issue date	November 13, 2007		
Prepared	Unit LABORATORIE		
Verified	Unit LABORATORIE		
Approved	Area COMPONENTS		

На основание чл. 2
от ЗЗЛД

CESI
Centro Elettrotecnico
Sperimentale Italiano
Giacinto Motta spa

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20134 Milano - Italia
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http://www.cesi.it

Capitale sociale 8 550 000 Euro
interamente versato
Codice fiscale e numero
iscrizione CCIAA 00793580150

Registro Imprese di Milano
Sezione Ordinaria
N. R.E.A. 429222
P.I. IT00793580150

Tests witnessed by

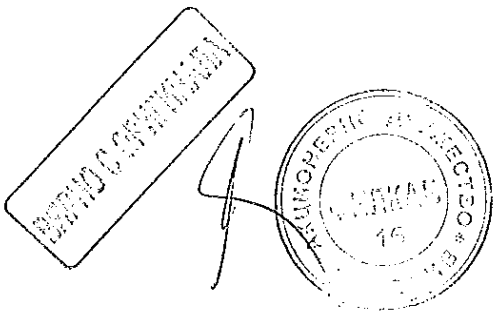
Mr. Tim Smith Tyco Electronics

Identification of the object Effected.
The Manufacturer guarantees that the tested object is manufactured according to the submitted drawing.
CESI checked that this drawing adequately represents in shape and dimensions the essential details and the parts of the tested object.
This drawing identified by CESI and numbered A7029970 No.1 is annexed to this document.

Only for laboratory requirement, in order to reproduce the test conditions, all the laboratory data are contained in the document marked: A7017386

The measurement uncertainties of the test results reported in the document are the following:
voltage: ± 5 % ; **current:** ± 5 % ; **time:** ± 5 % ; **temperature:** ± 2 °C
The measurement uncertainties are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to a confidence level of about 95 %) and have to be considered as maximum values.

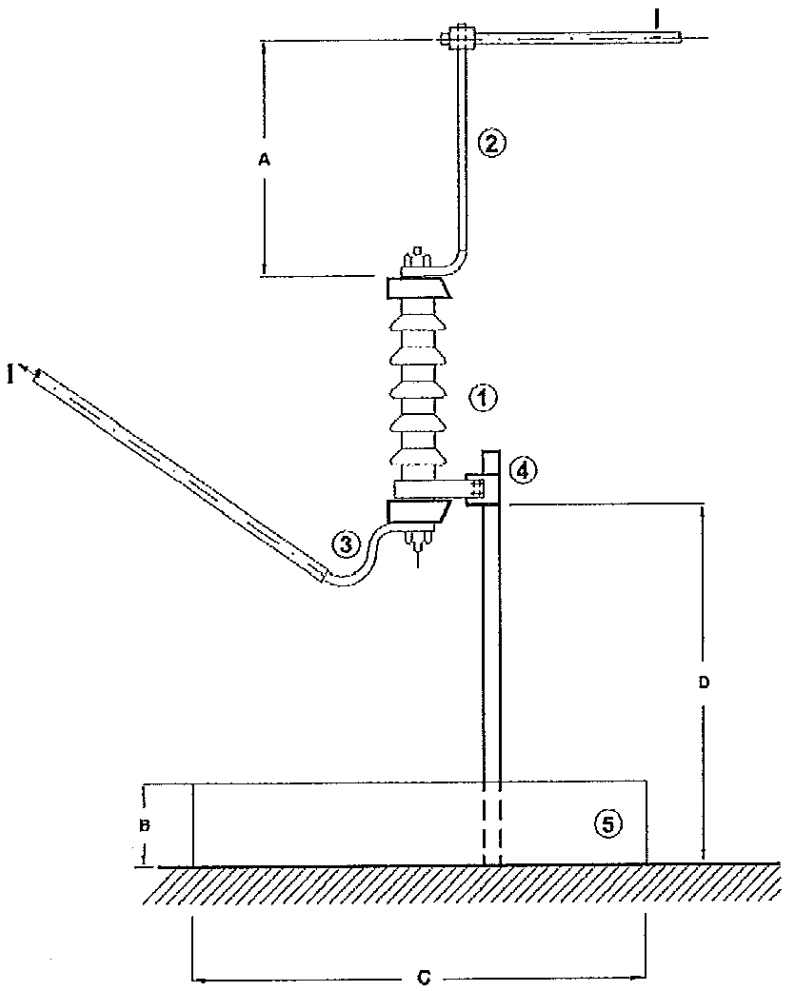
Receipt date of the sample June 25, 2007



Rated characteristics of the tested object assigned by the Client

Metal-oxide surge arrester	
Manufacturer	Tyco Electronics
Type	DA1
Drawing	DA1-39G-NONONO
Rated voltage (Ur)	39 kV
Maximum continuous operating voltage (Uc)	31,2 kV
Rated frequency	50/60 Hz
Nominal discharge current (8/20 µs impulse shape)	10 kA
Line discharge class	1
Pressure relief class	
High current	for 0,2 s ; 21 kA

D8058 - Test arrangement



1 : Surge arrester
2 : Flexible conductor
3 : Flexible conductor
4 : Support
5 : Squared enclosure

A : 1,0 m
B : 0,4 m
C : 1,8 m
D: 1,6 m

The arrester to be tested was installed on a support at 1,6 m to ground in the middle of a squared enclosure of 1,8 m each 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 earth conductor was directed to the opposite direction as the incoming live conductor

ВЯРНО С ОРИГИНАЛА

High-current short-circuit test with 21,3 kA for 0,21 s

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

Test arrangement : See D8058

To achieve the internal discharge, the surge arrester has been faulted by means of on overvoltage application using an auxiliary low power source

The short-circuit current of the auxiliary low power source has been set at about 12,0A

The voltage applied to the arrester was increased in order to get a current equal to 100mA (0-peak)(i.e.61 kVpk) and kept at this value till arrester failure

The pre-failure process duration was 3 minutes and 20 seconds

The short-circuit test was performed 4 minutes and 30 sec after the completion of the pre-failure process

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
2	1	21,3	59,6

Condition of the apparatus before the tests: new; see photos No.1 and 2 (taken after the pre-failure)

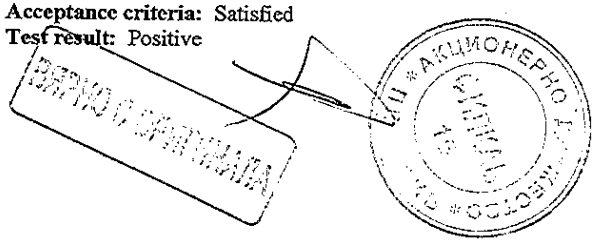
Date: June 25, 2007

Test	Oscillogram		Arrester Under test	Duration	Test voltage	Test current		Time of flame extinction after the test	Venting time	Notes
						Peak value	rms value			
No.	No.	Sheets	No.	s	kV	kA	kA	s	ms	No.
1	4	2	BE13	0,21	34,0	55,4	21,3	-	0,85	-

Condition of the apparatus after the tests: see photos No.3 and 4.

- There was no violent shattering.
- The arrester structure was not damaged.
- The arrester remained connected to the supply and return circuits.
- No resistor or housing fragments were ejected inside or outside the enclosure.
- The surge arrester did not catch fire.

Acceptance criteria: Satisfied
Test result: Positive



Low-current short-circuit test with 617 A for 1,00 s

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

Test arrangement : See D8058

To achieve the internal discharge, the surge arrester has been faulted by means of on overvoltage application using an auxiliary low power source
The short-circuit current of the auxiliary low power source has been set at about 12,0A
The voltage applied to the arrester was increased in order to get a current equal to 100mA (0-peak)(i.e.61 kVpk) and kept at this value till arrester failure

The pre-failure process duration was 3 minutes and 55 seconds
The short-circuit test was performed 4 minutes and 35 sec after the completion of the pre-failure process

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	A	kA
9	1	617	-

Condition of the apparatus before the tests: new; see photo No.5 (taken after the pre-failure)

Date: June 26, 2007

Test	Oscillogram		Arrester Under test	Duration	Test voltage	Test current		Time of flame extinction after the test	Venting time	Notes
						Peak value	rms value			
No.	No.	Sheets	No.	s	kV	A	A	s	ms	No.
2	11	2	BE12	1,00	34,0	-	617	30	6,10	-

Condition of the apparatus after the tests: see photo No.6

- There was no violent shattering.
- The arrester structure was not damaged.
- The arrester remained connected to the supply and return circuits.
- No resistor or housing fragments were ejected inside or outside the enclosure.

Acceptance criteria: Satisfied
Test result: Positive

High-current short-circuit test with 11,3 kA for 0,21 s

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

Test arrangement : See D8058
To achieve the internal discharge, the surge arrester has been faulted by means of on overvoltage application using an auxiliary low power source
The short-circuit current of the auxiliary low power source has been set at about 12,0A
The voltage applied to the arrester was increased in order to get a current equal to 100mA (0-peak)(i.e.61 kVpk) and kept at this value till arrester failure
The pre-failure process duration was 3 minutes and 55 seconds
The short-circuit test was performed 4 minutes and 30 sec after the completion of the pre-failure process

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
16	1	11,3	30,4

Condition of the apparatus before the tests: new; see photo No.7 (taken after the pre-failure)

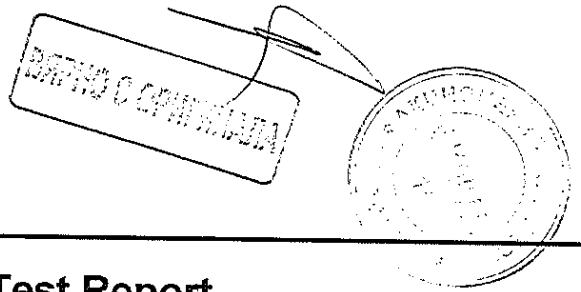
Date: June 26, 2007

Test	Oscillogram		Arrester Under test	Duration	Test voltage	Test current		Time of flame extinction after the test	Venting time	Notes
						Peak value	rms value			
No.	No.	Sheets	No.	s	kV	kA	kA	s	ms	No.
3	17	2	BE22	0,21	34,0	26,1	11,3	-	1,30	-

Condition of the apparatus after the tests: see photo No.8

- There was no violent shattering.
- The arrester structure was not damaged by the test.
- The arrester remained connected to the supply and return circuits.
- No resistor or housing fragments were ejected inside or outside the enclosure.
- The surge arrester did not catch fire.

Acceptance criteria: Satisfied
Test result: Positive



High-current short-circuit test with 6,28 kA for 0,21 s

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

Test arrangement : See D8058
To achieve the internal discharge, the surge arrester has been faulted by means of on overvoltage application using an auxiliary low power source
The short-circuit current of the auxiliary low power source has been set at about 12,0A
The voltage applied to the arrester was increased in order to get a current equal to 100mA (0-peak)(i.e.61 kVpk) and kept at this value till arrester failure

The pre-failure process duration was 4 minutes and 10 seconds
The short-circuit test was performed 4 minutes and 40 sec after the completion of the pre-failure process

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
21	1	6,28	16,5

Condition of the apparatus before the tests: new; see photo No.9 (taken after the pre-failure)

Date: June 26, 2007

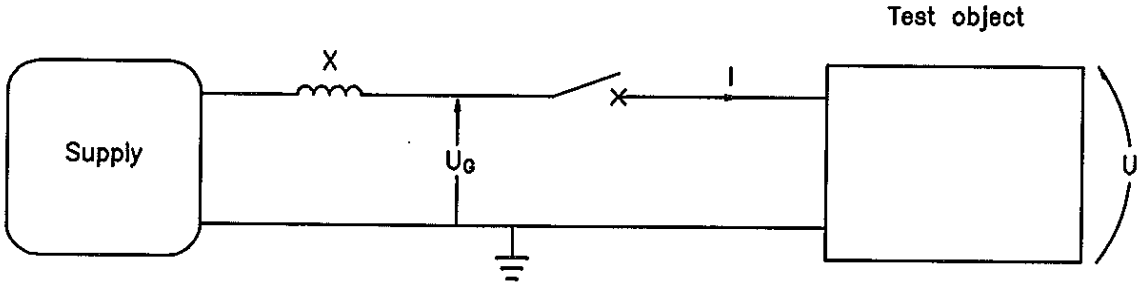
Test	Oscillogram		Arrester Under test	Duration	Test voltage	Test current		Time of flame extinction after the test	Venting time	Notes
						Peak value	rms value			
No.	No.	Sheets	No.	s	kV	kA	kA	s	ms	No.
4	22	2	BE16	0,21	34,0	13,7	6,20	-	1,10	-

Condition of the apparatus after the tests: see photo No.10

- There was no violent shattering.
- The arrester structure was not damaged by the test, the polymer housing was found partly detached from the arrester body.
- The arrester remained connected to the supply and return circuits.
- No resistor or housing fragments were ejected inside or outside the enclosure.
- The surge arrester did not catch fire.

Acceptance criteria: Satisfied
Test result: Positive

Test circuit D0046



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

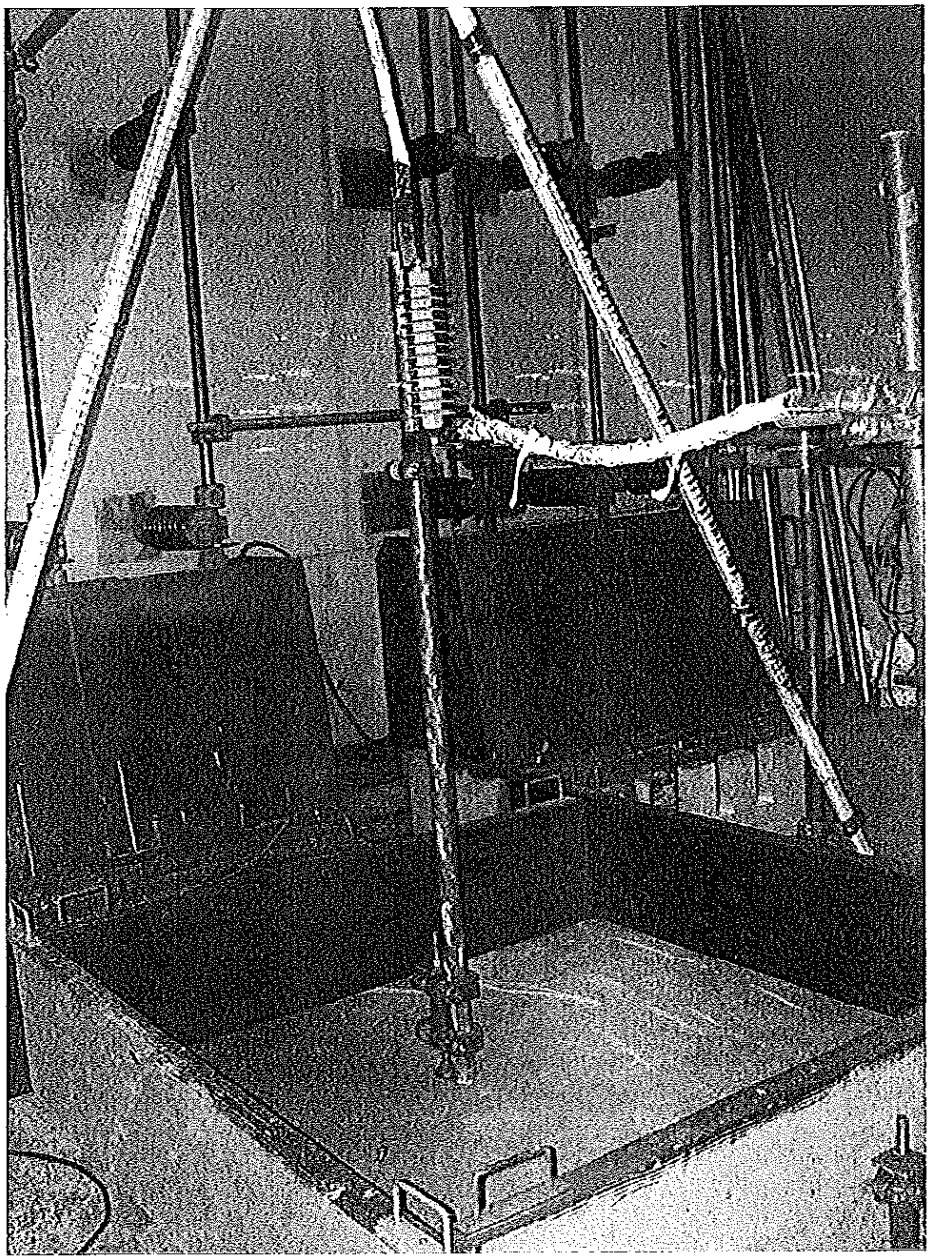


Photo No.1

ВЯРНО С ОРИГИНАЛА

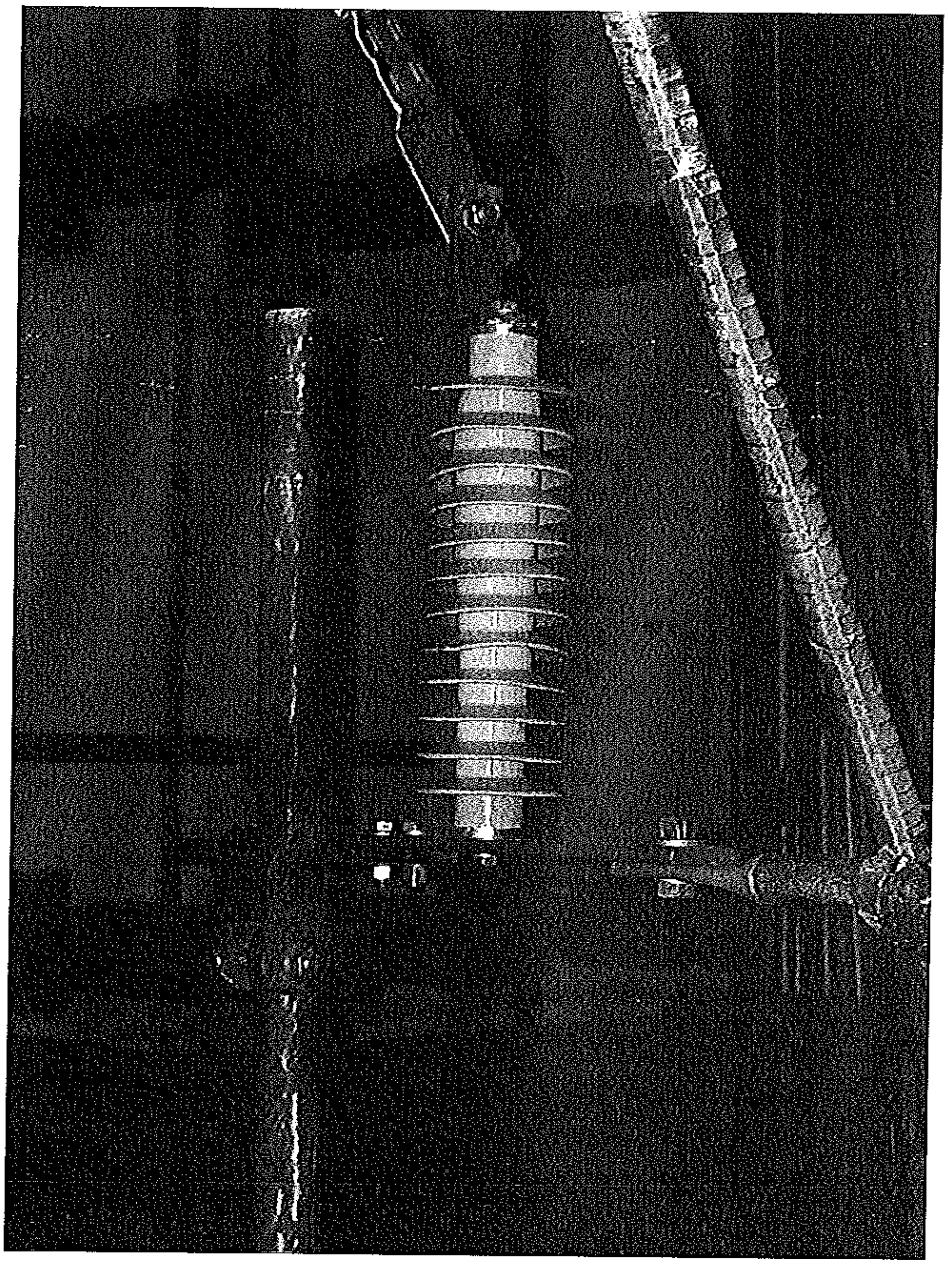


Photo No.2

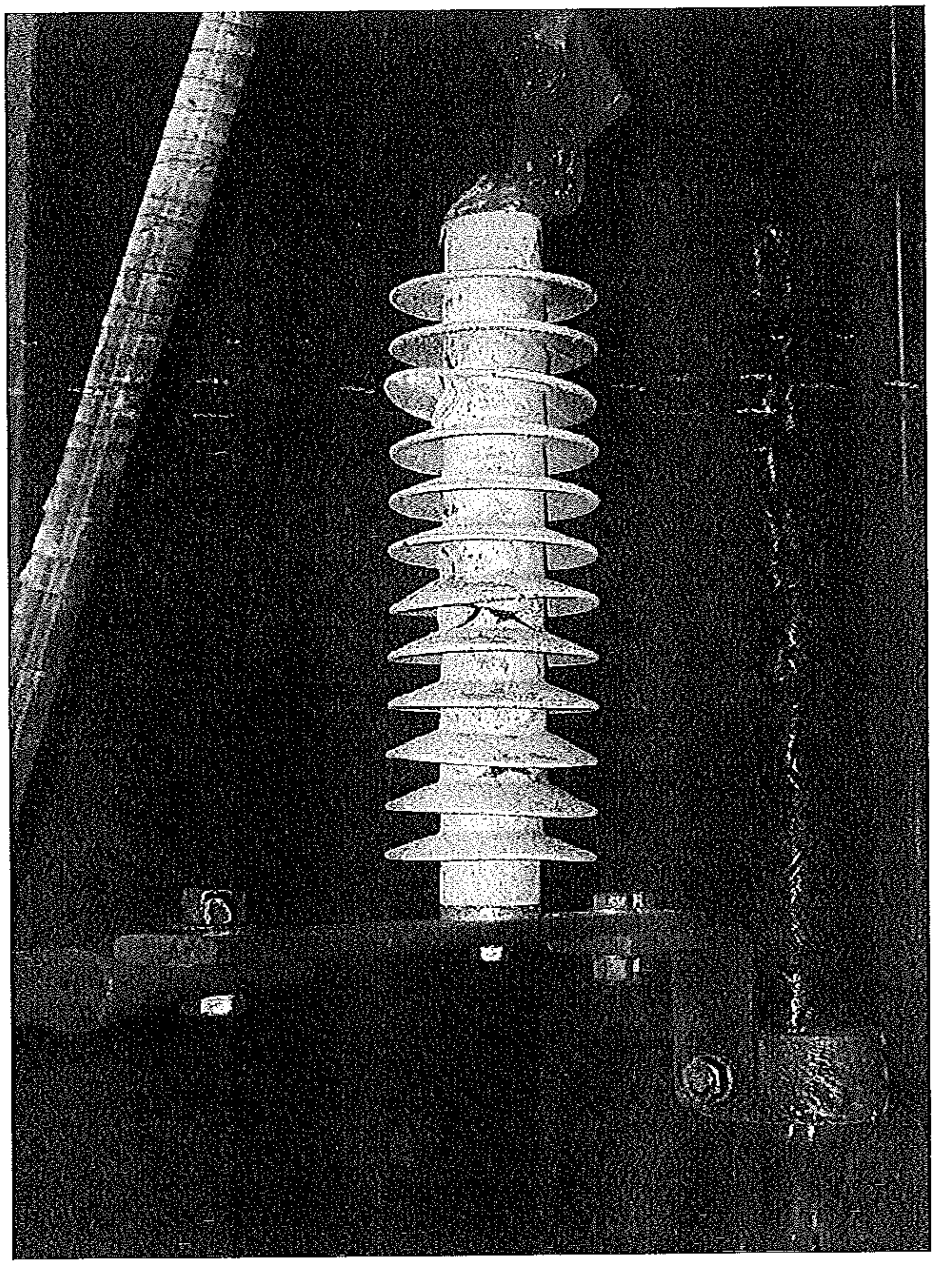


Photo No.3

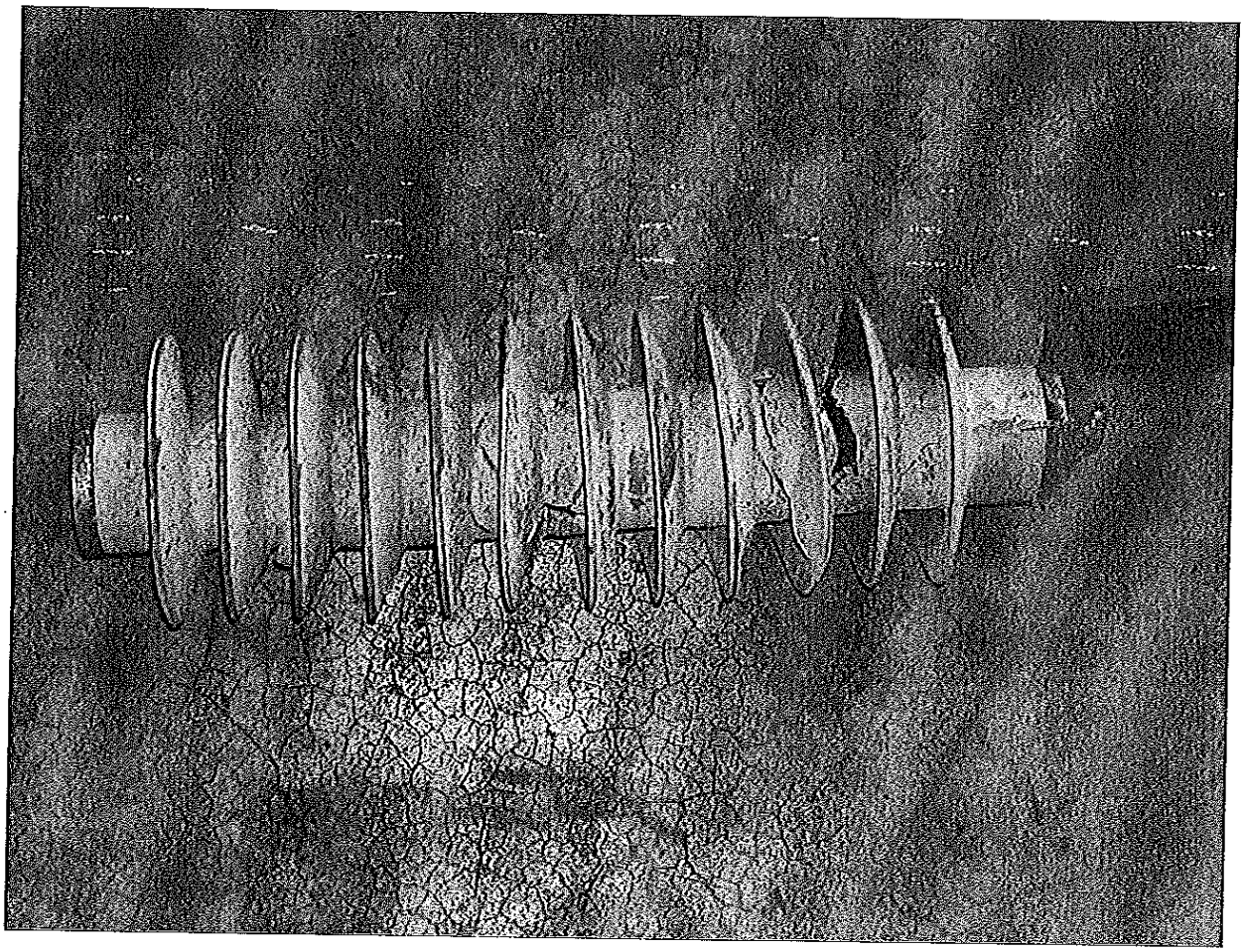


Photo No.4

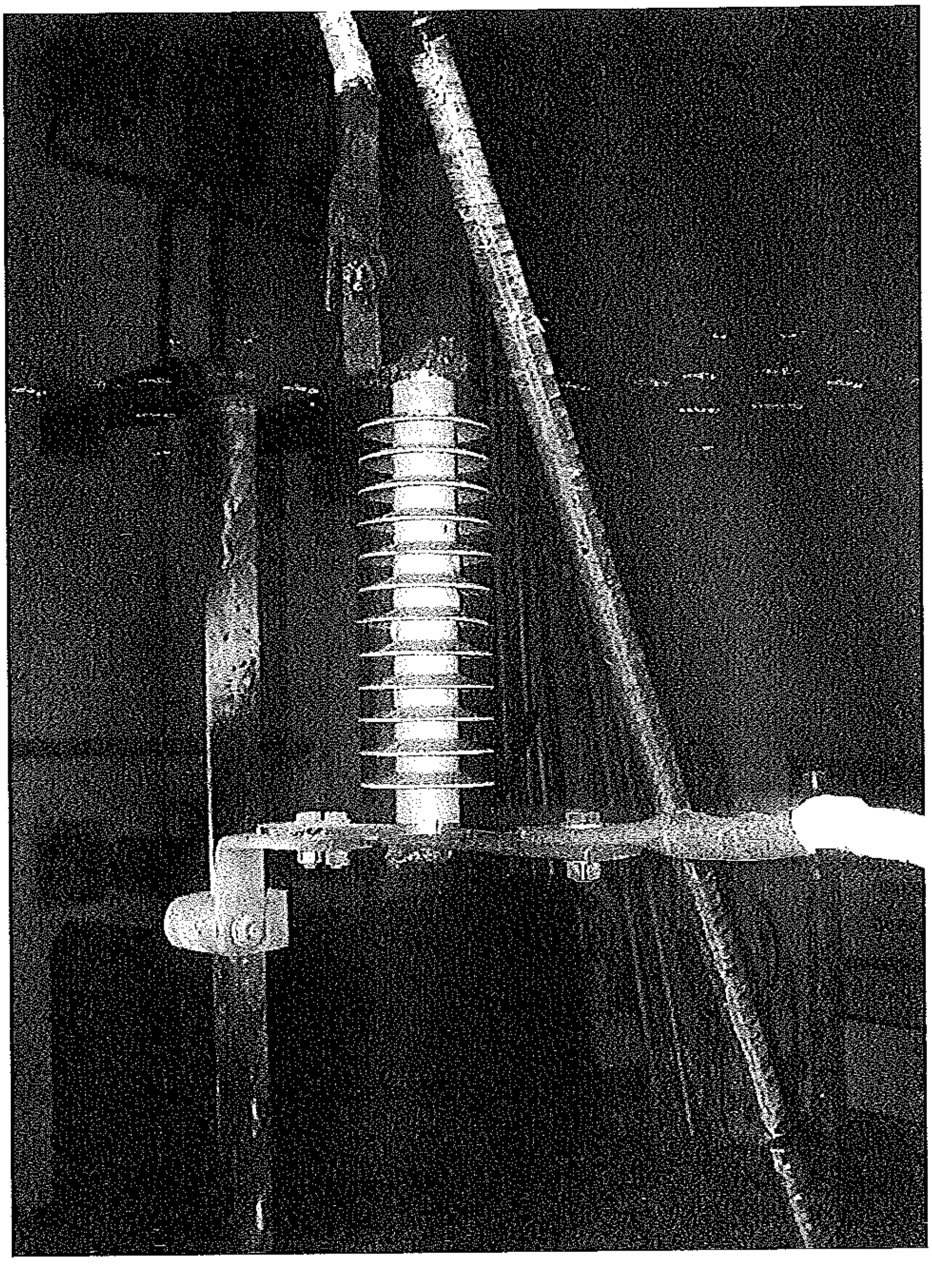


Photo No.5

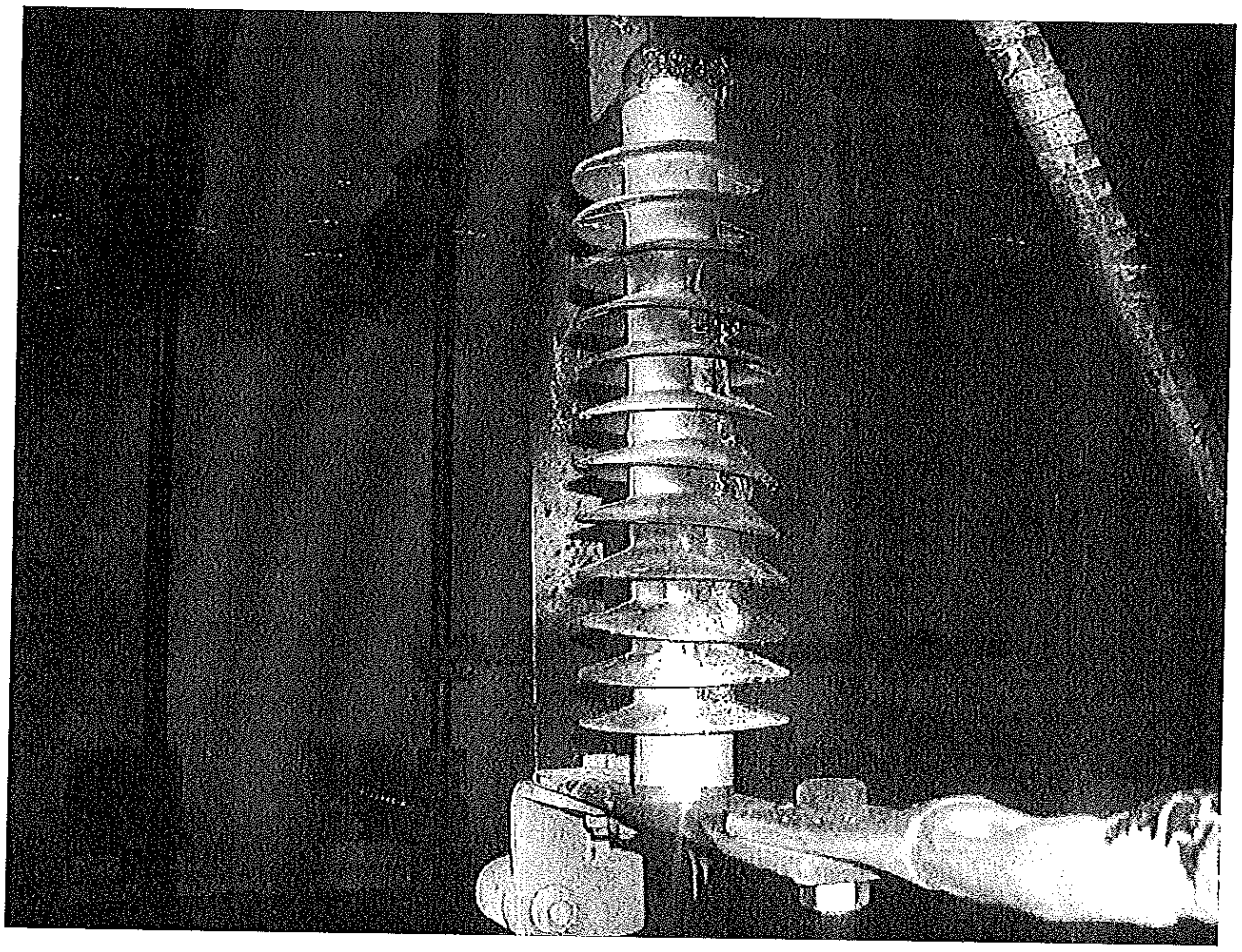


Photo No.6

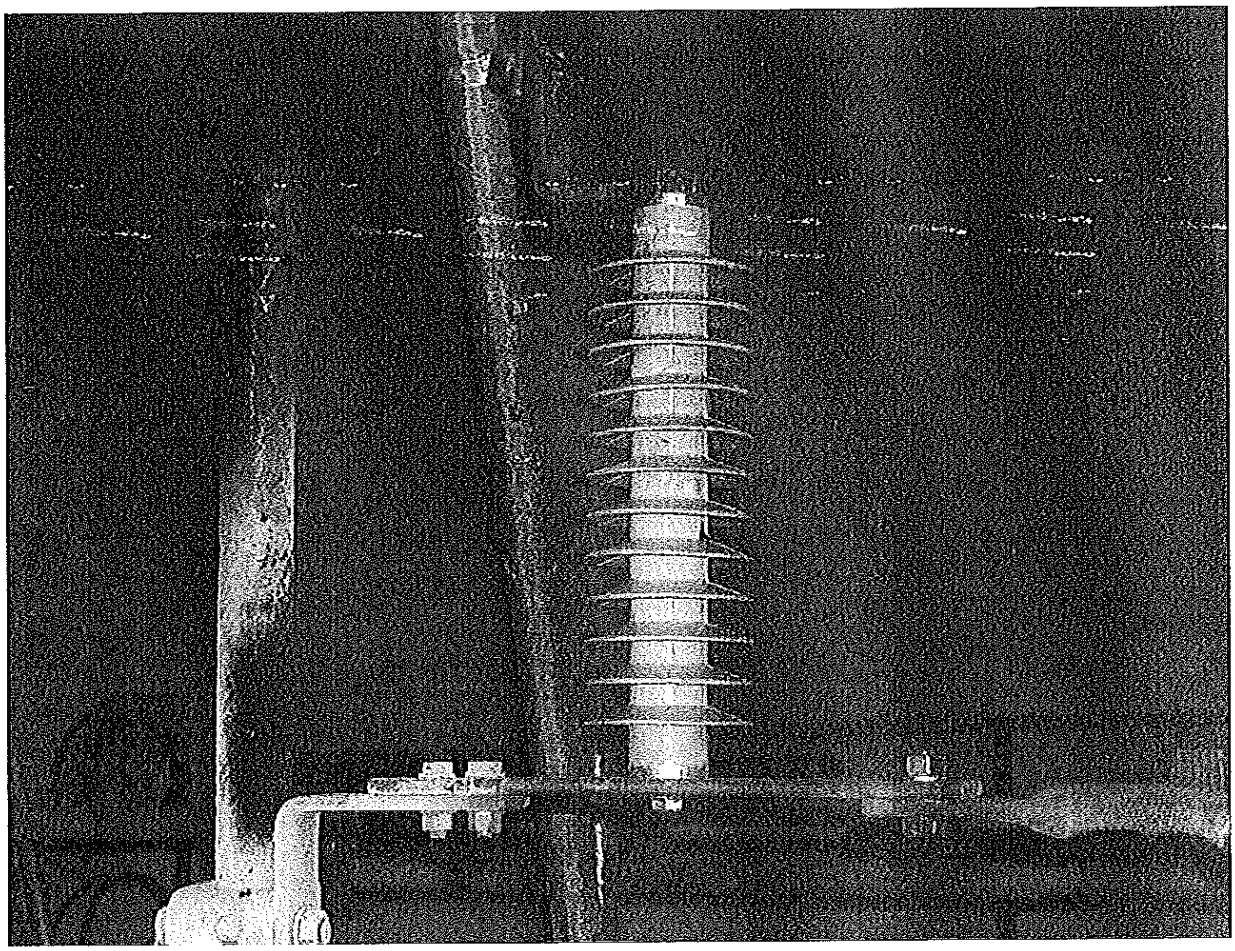


Photo No.7

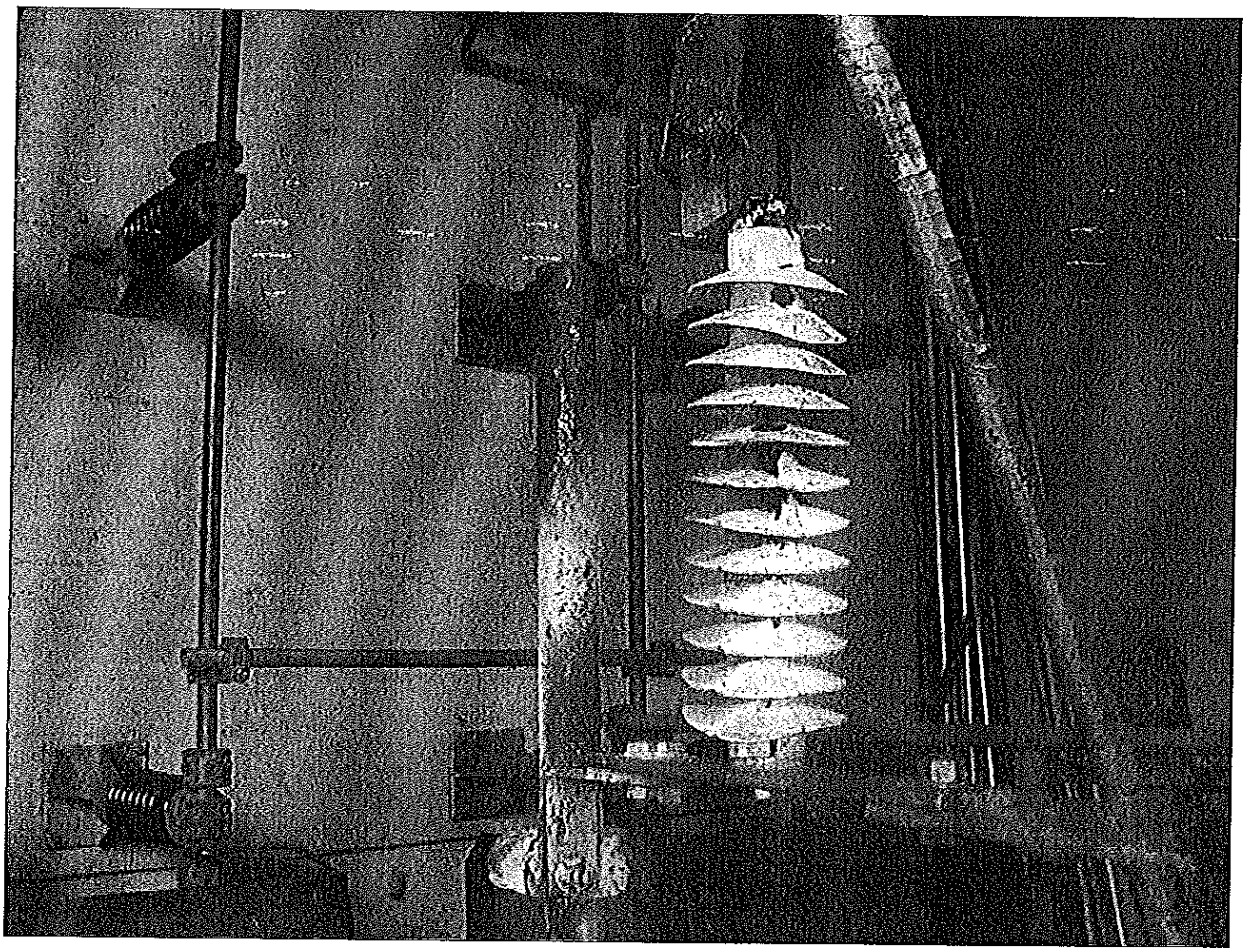


Photo No.8

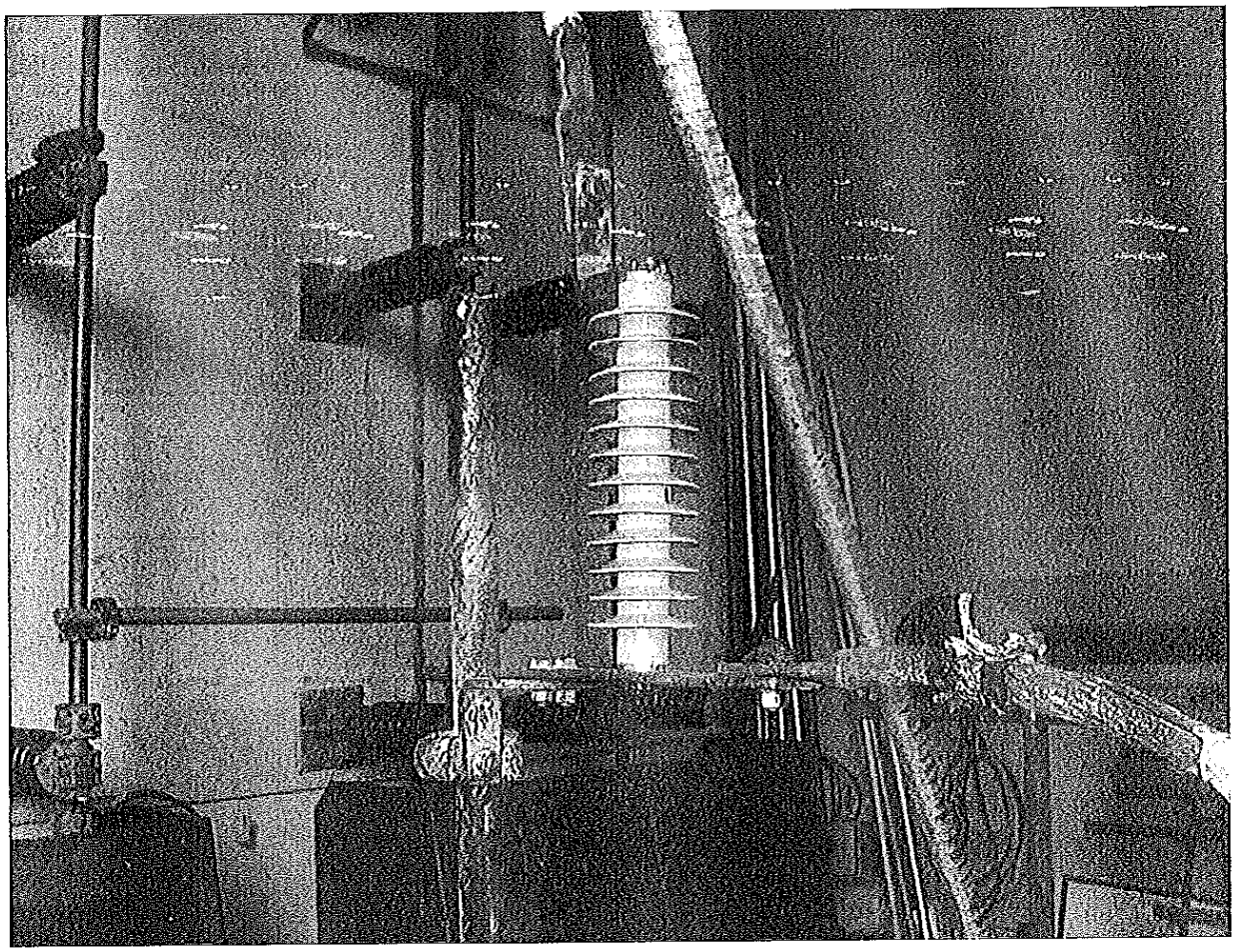


Photo No.9

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ПЛОВДИВ * ФИЛИАЛ 16

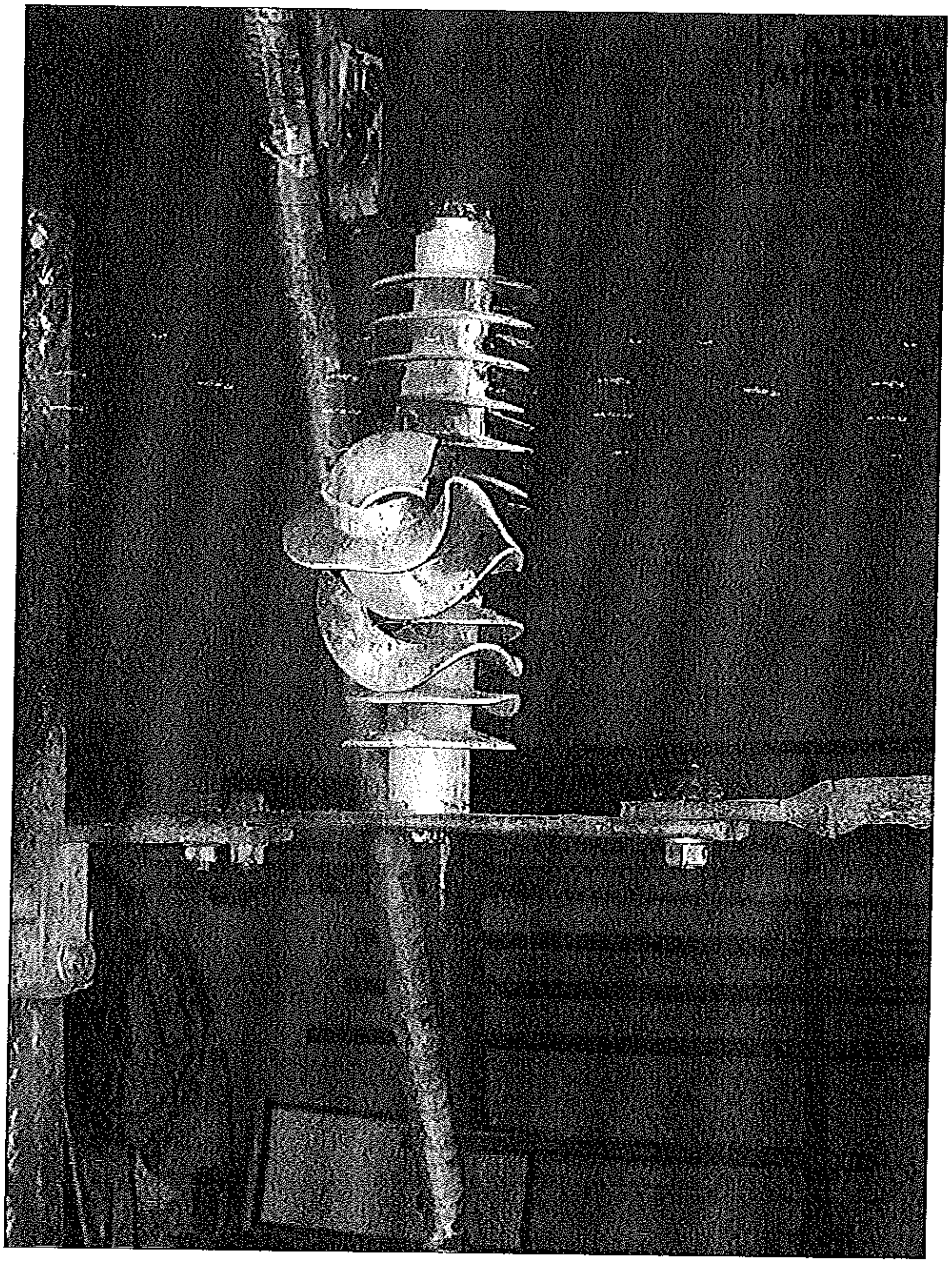
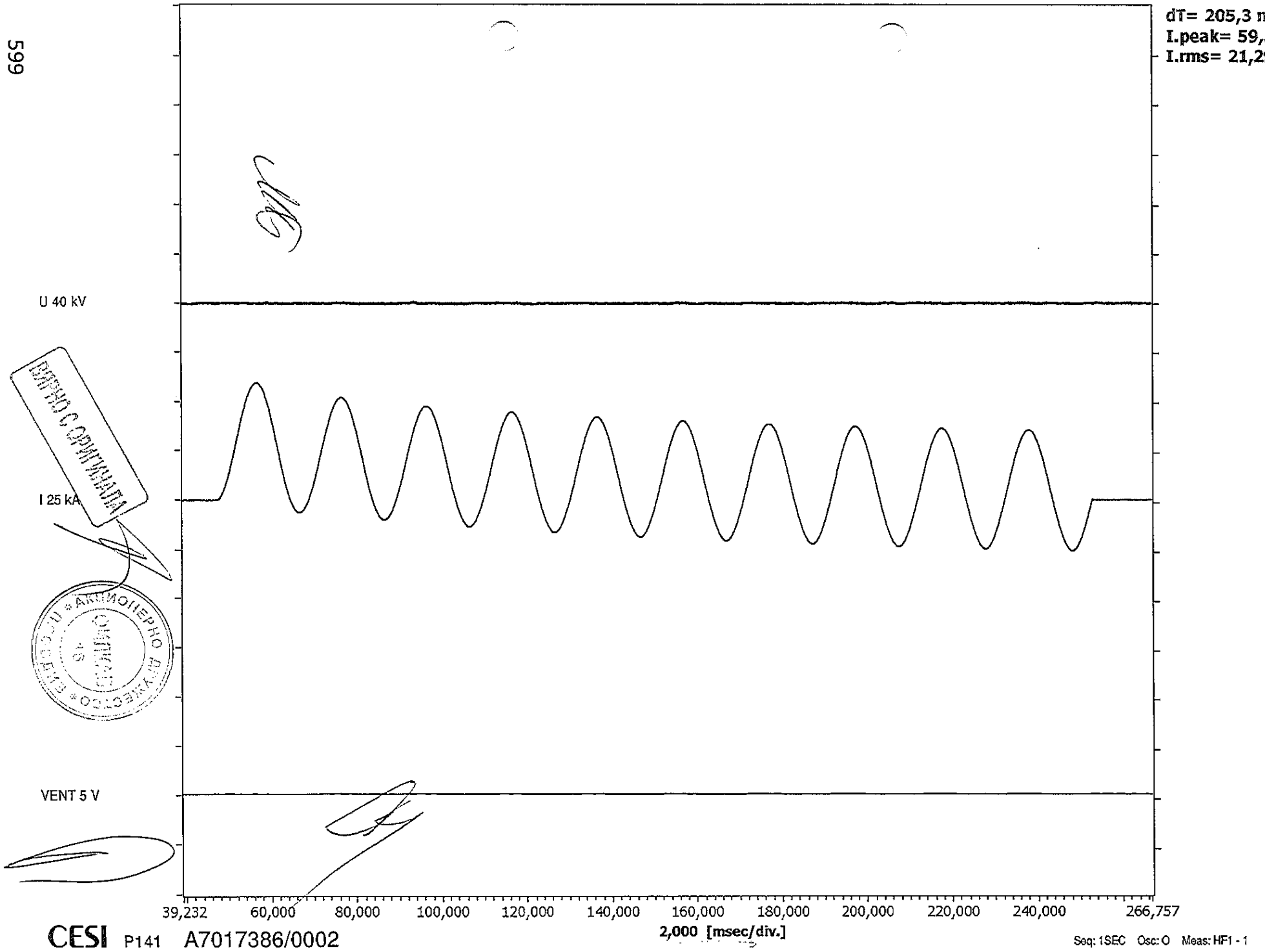


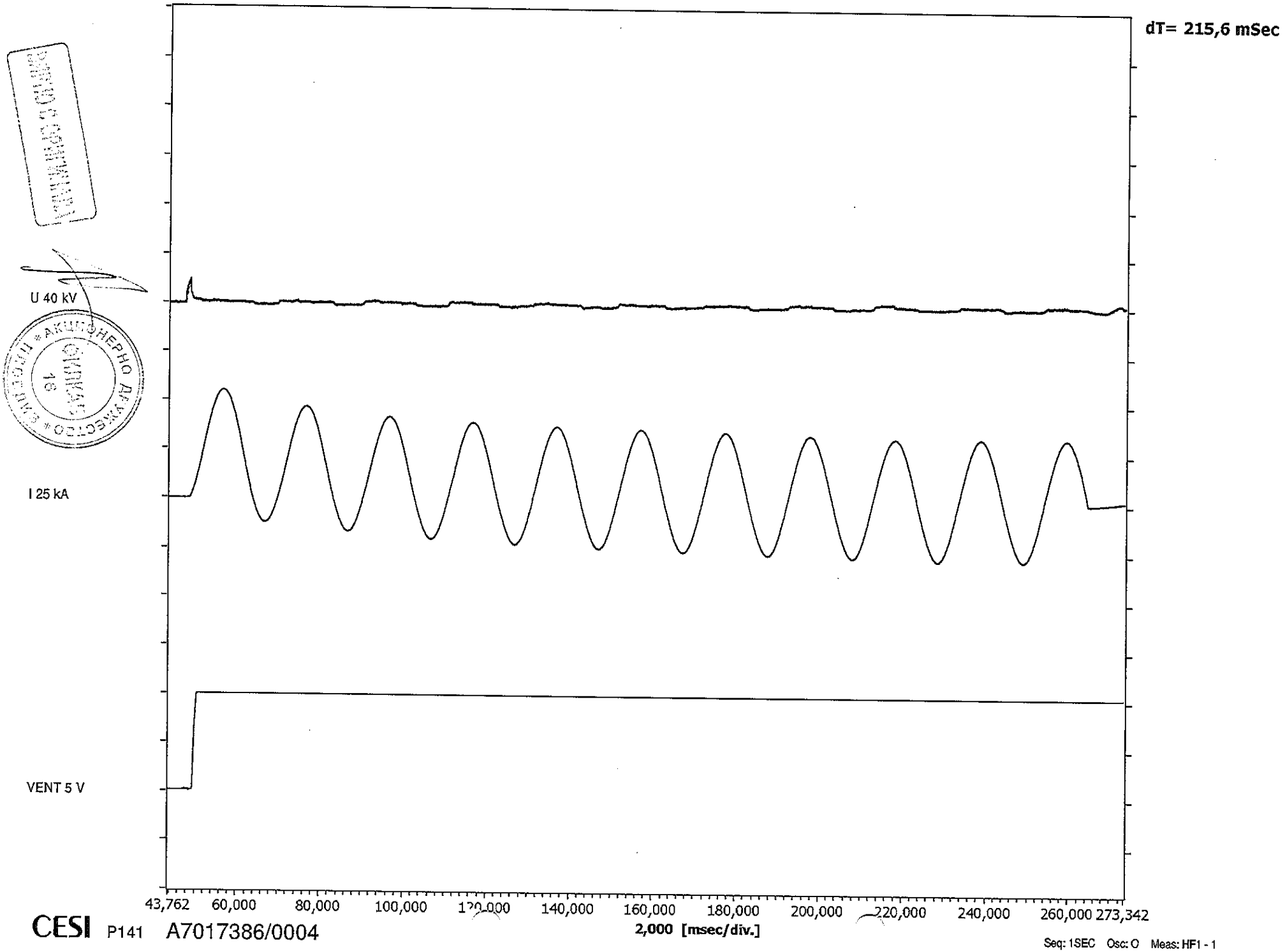
Photo No.10

599



CESI P141 A7017386/0002

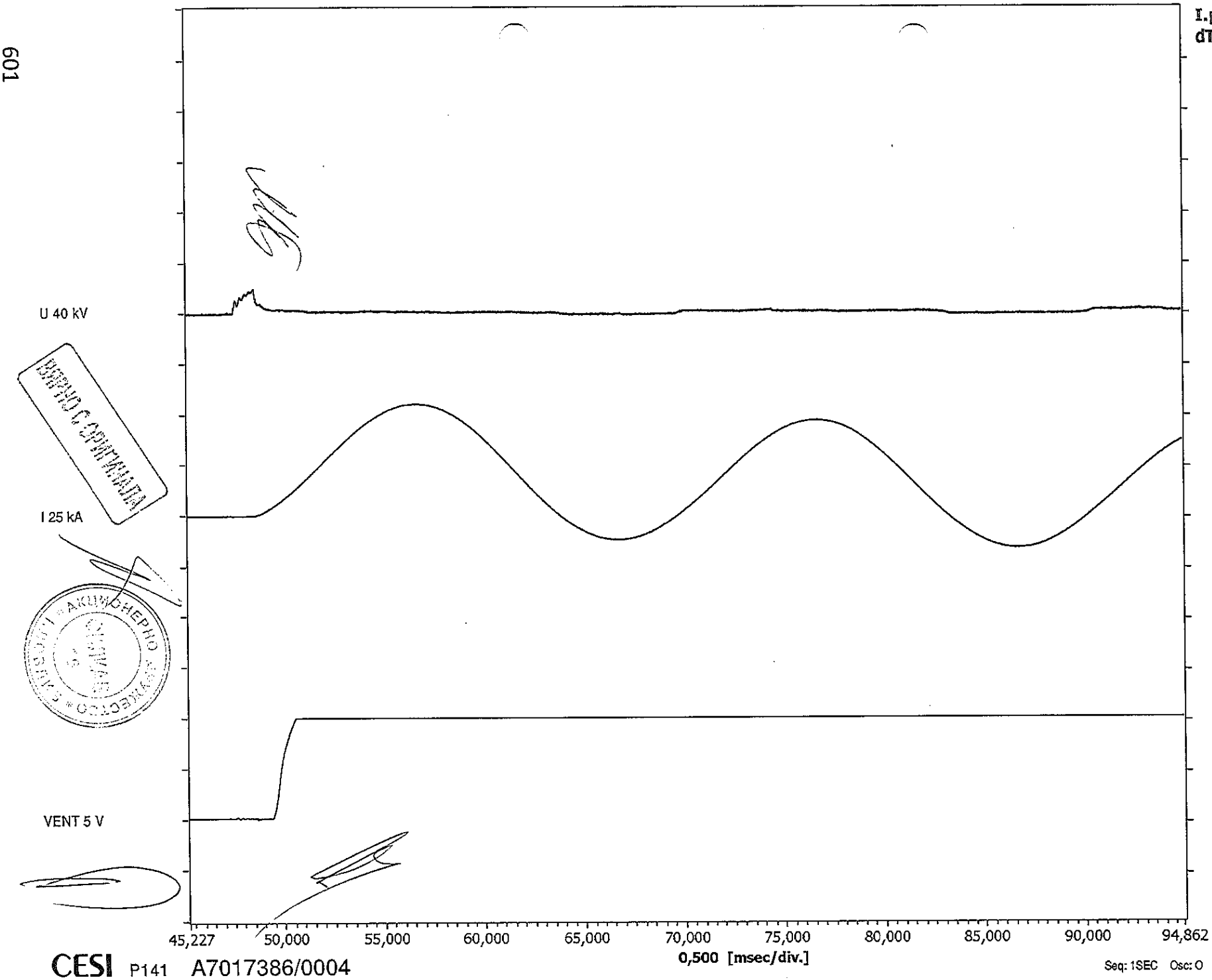
Seq: 1SEC Osc: O Meas: HF1 - 1



CESI P141 A7017386/0004

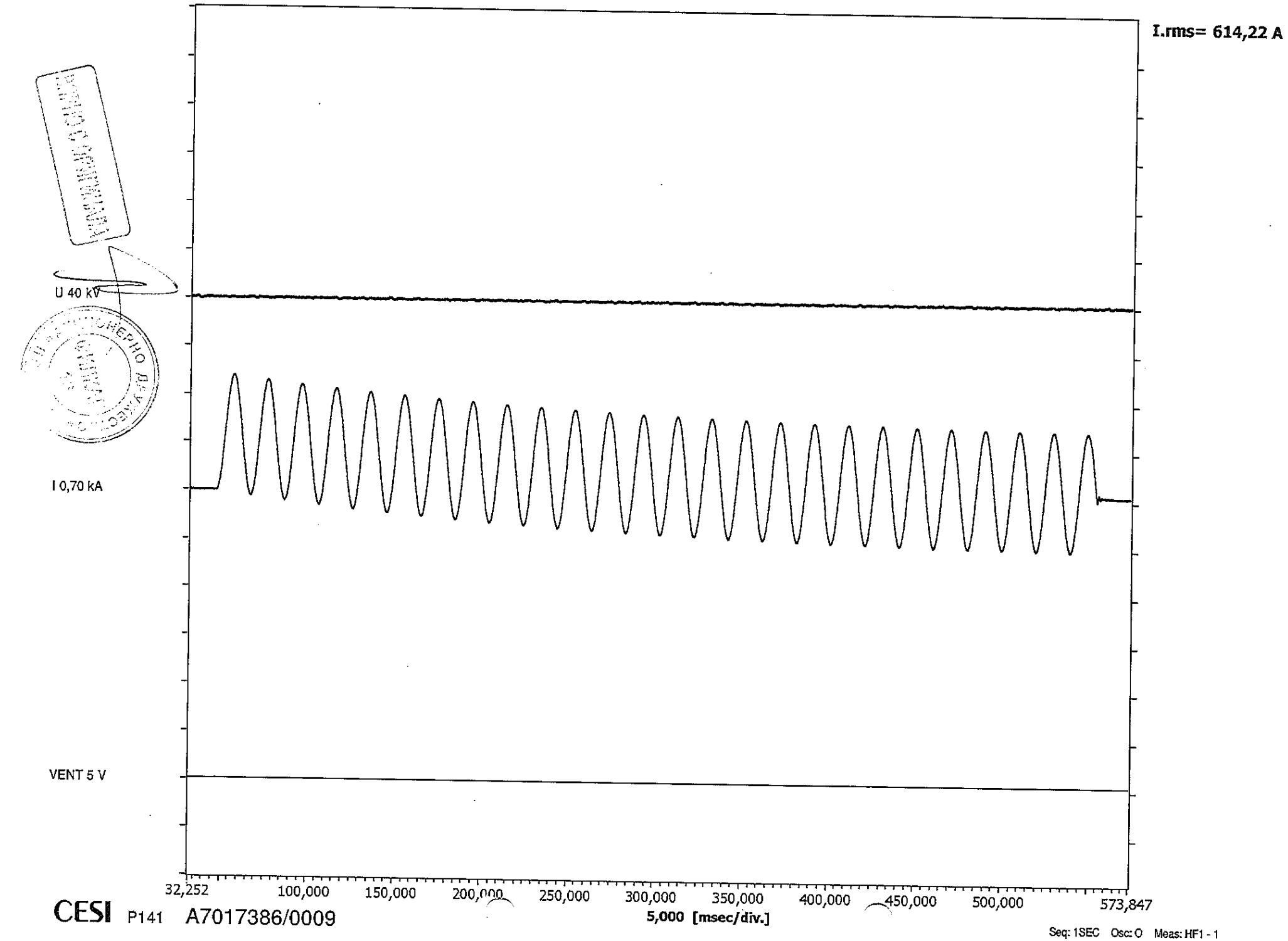
Seq: 1SEC Osc: O Meas: HF1 - 1

601



CESI P141 A7017386/0004

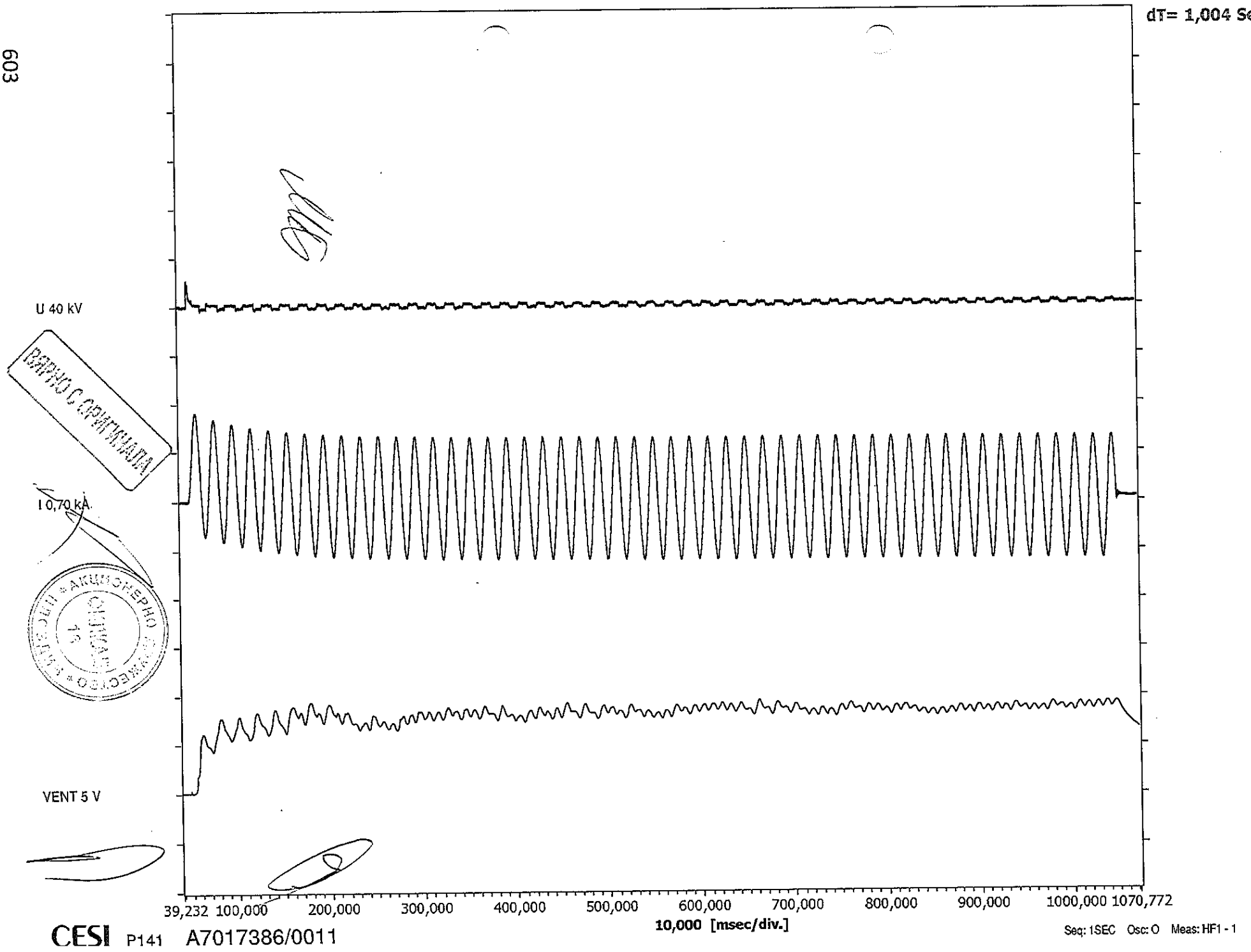
Seq: 1SEC Osc: 0 Meas: HF1 - 1



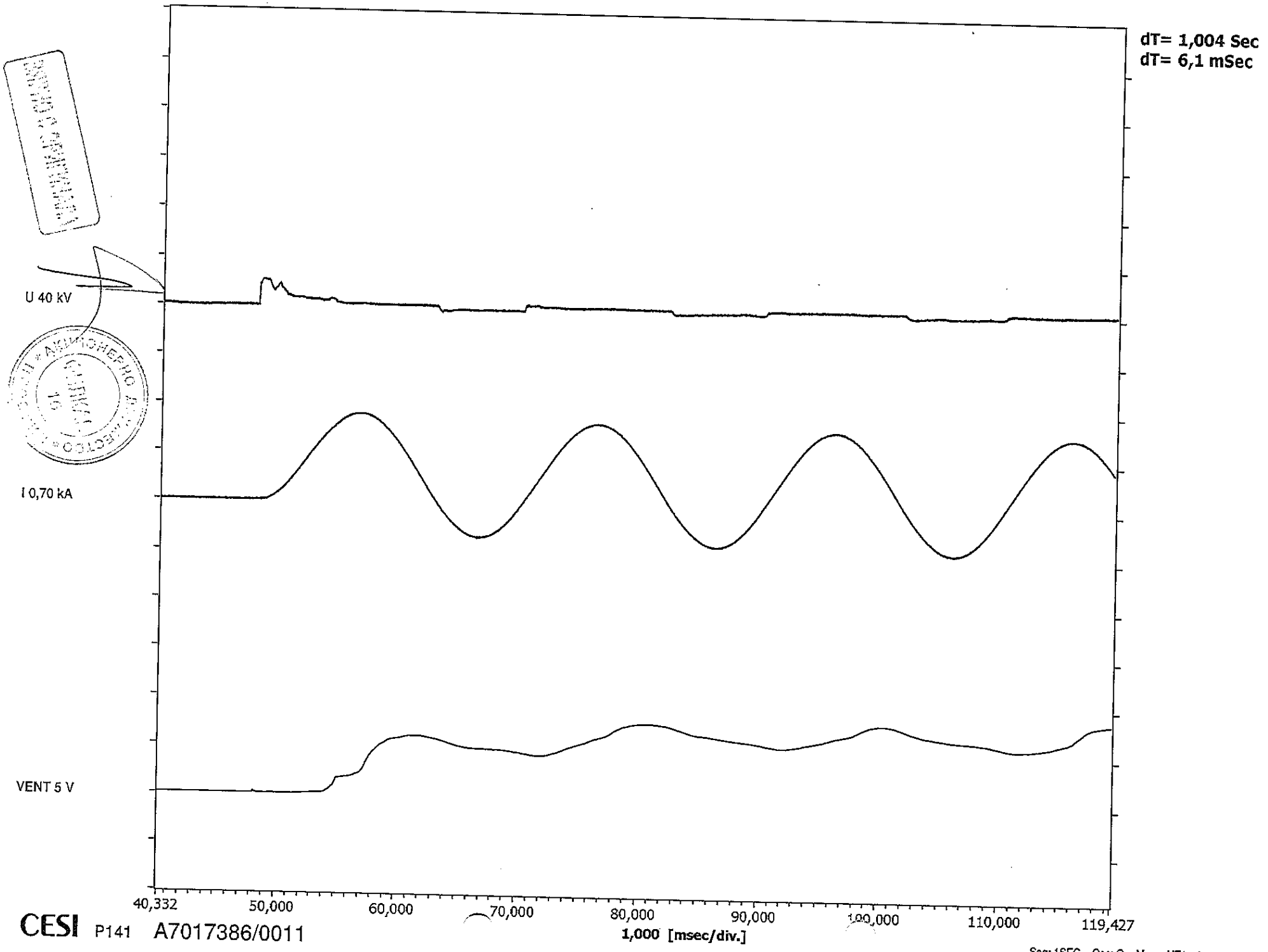
CESI P141 A7017386/0009

Seq: 1SEC Osc: O Meas: HF1 - 1

603

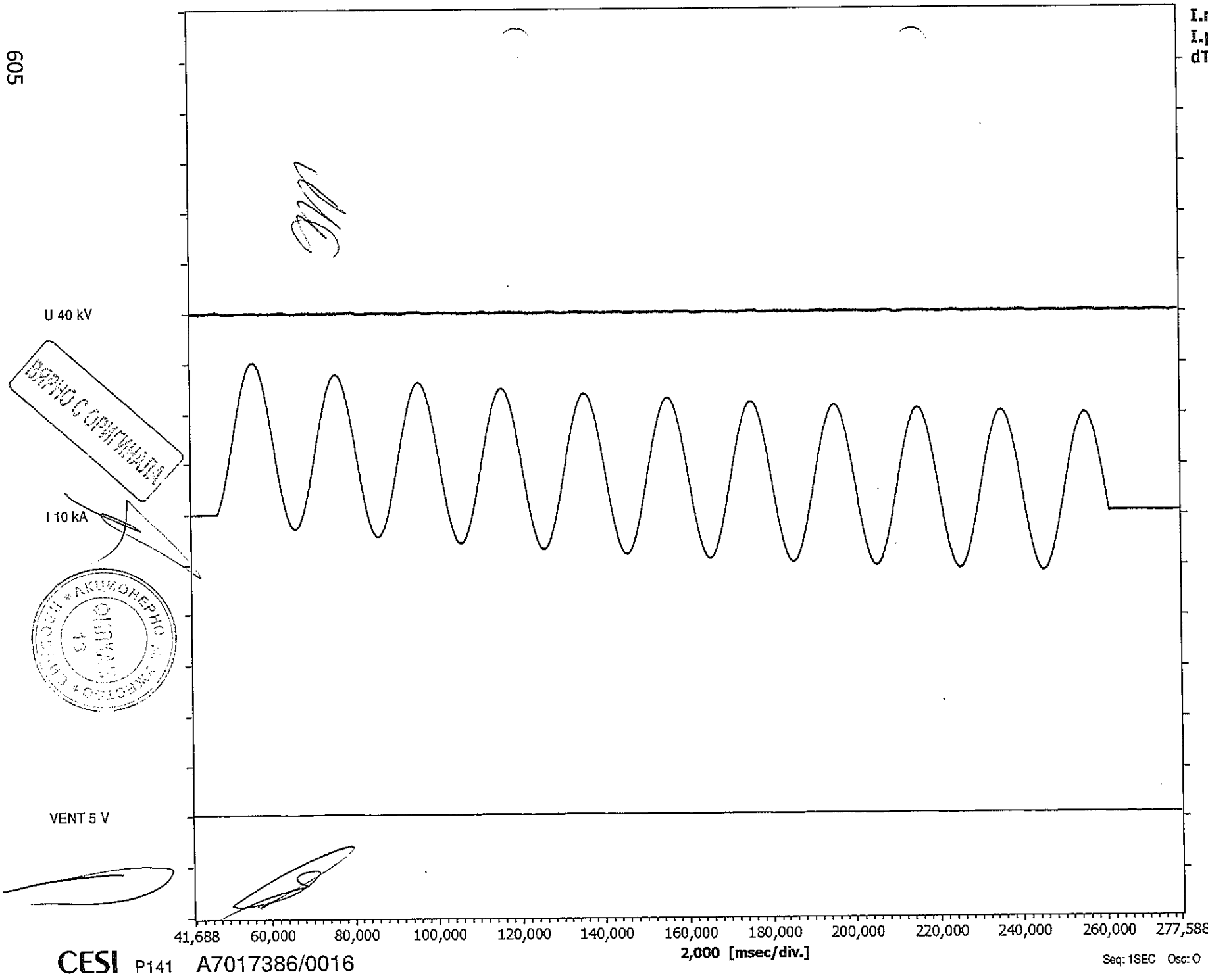


CESI P141 A7017386/0011



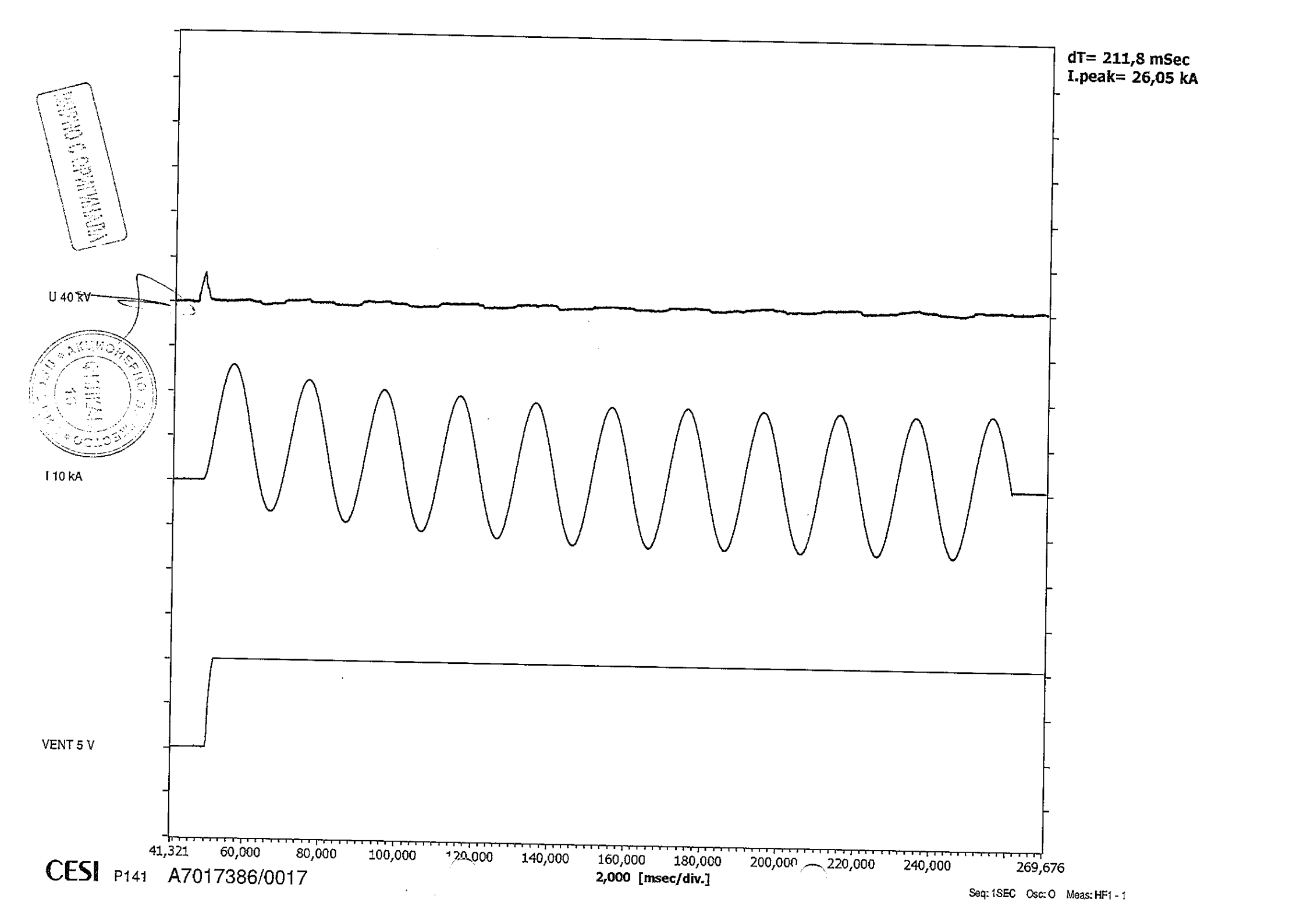
CESI P141 A7017386/0011

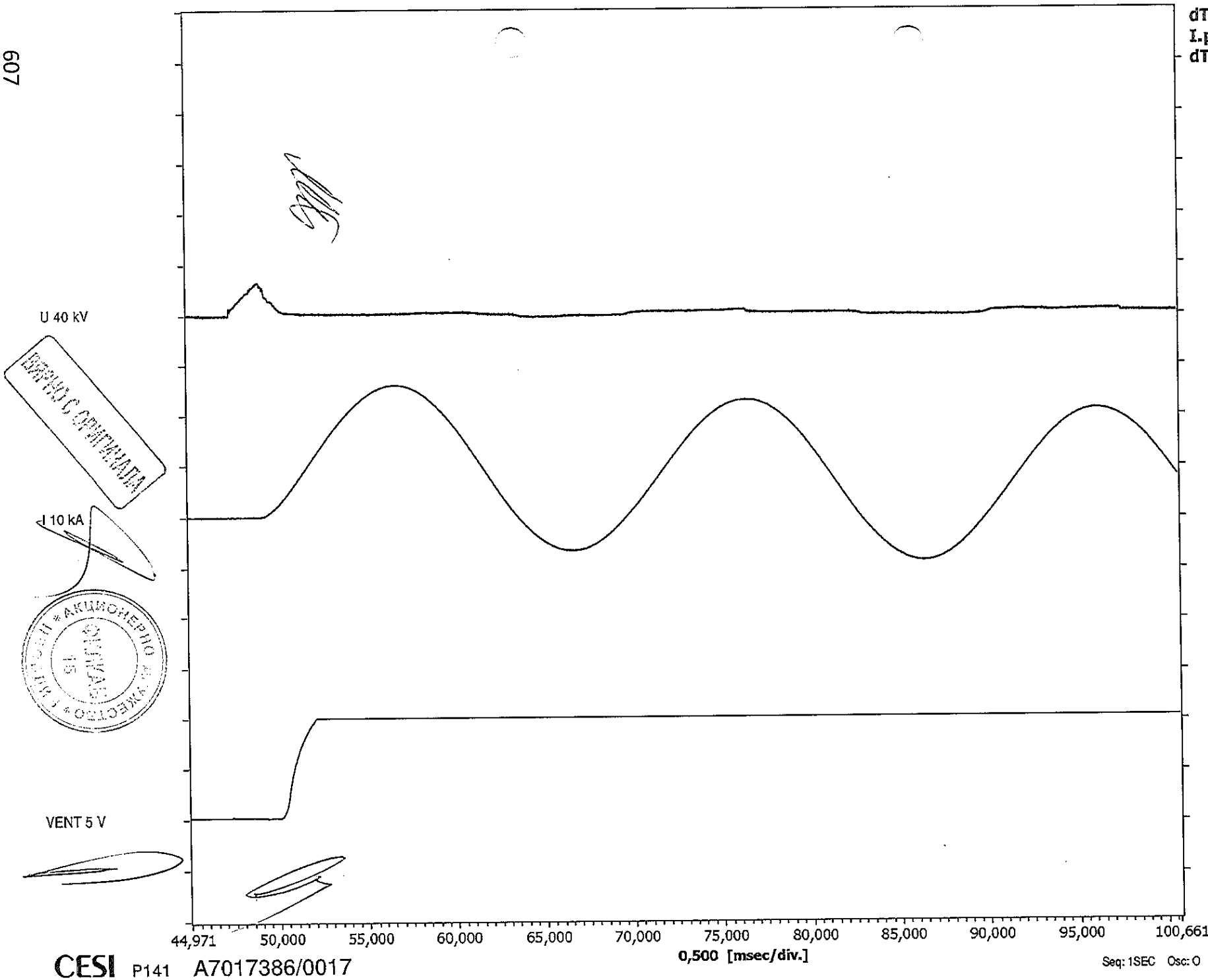
605



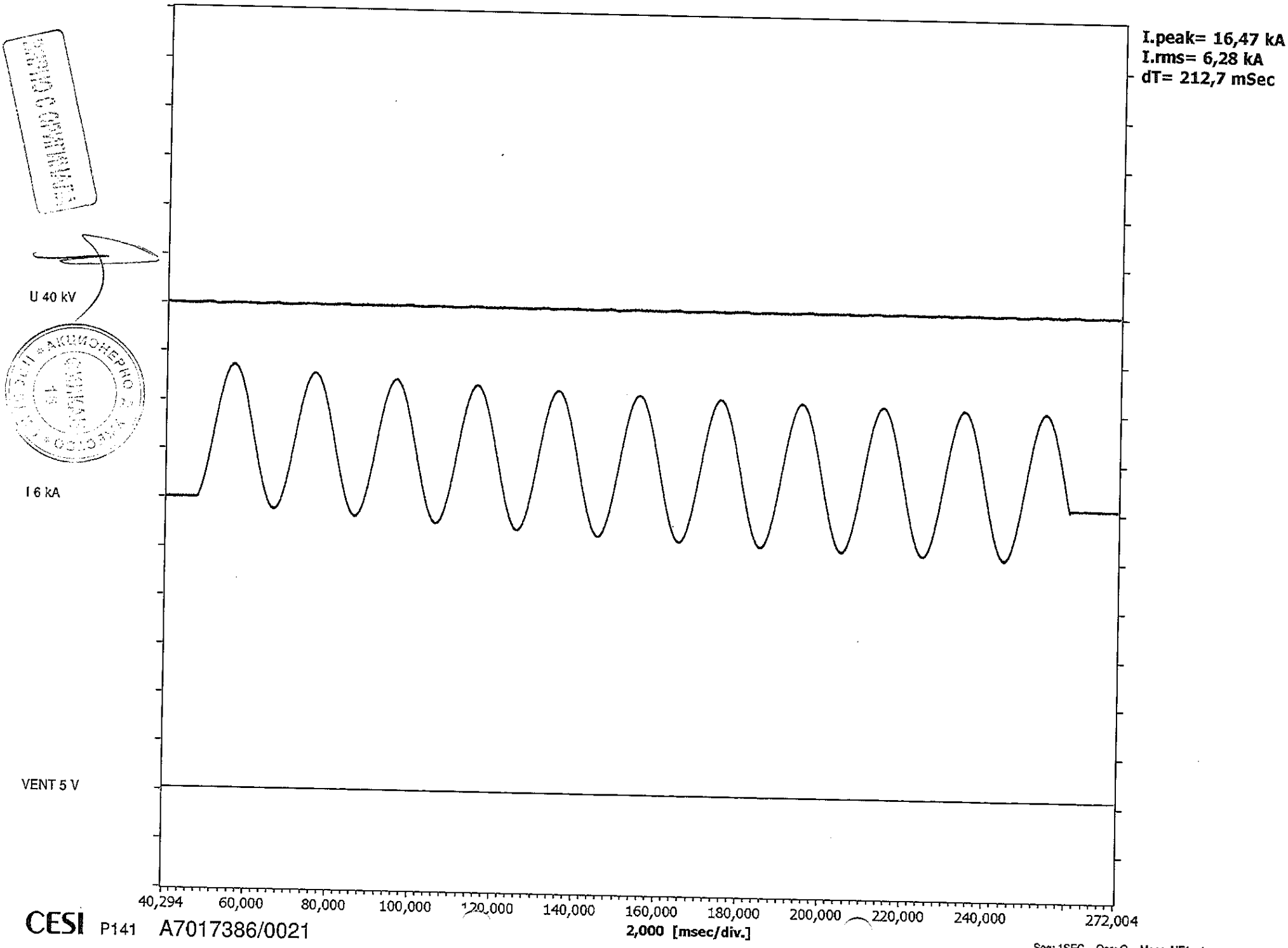
CESI P141 A7017386/0016

Seq: 1SEC Osc: 0 Meas: HF1 - 1


dT= 211,8 mSec
I.peak= 26,05 kA
U 40 kV
I 10 kA
VENT 5 V
41,321
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
220,000
240,000
269,676
2,000 [msec/div.]
CESI P141 A7017386/0017
Seq: 1SEC Osc: 0 Meas: HF1 - 1

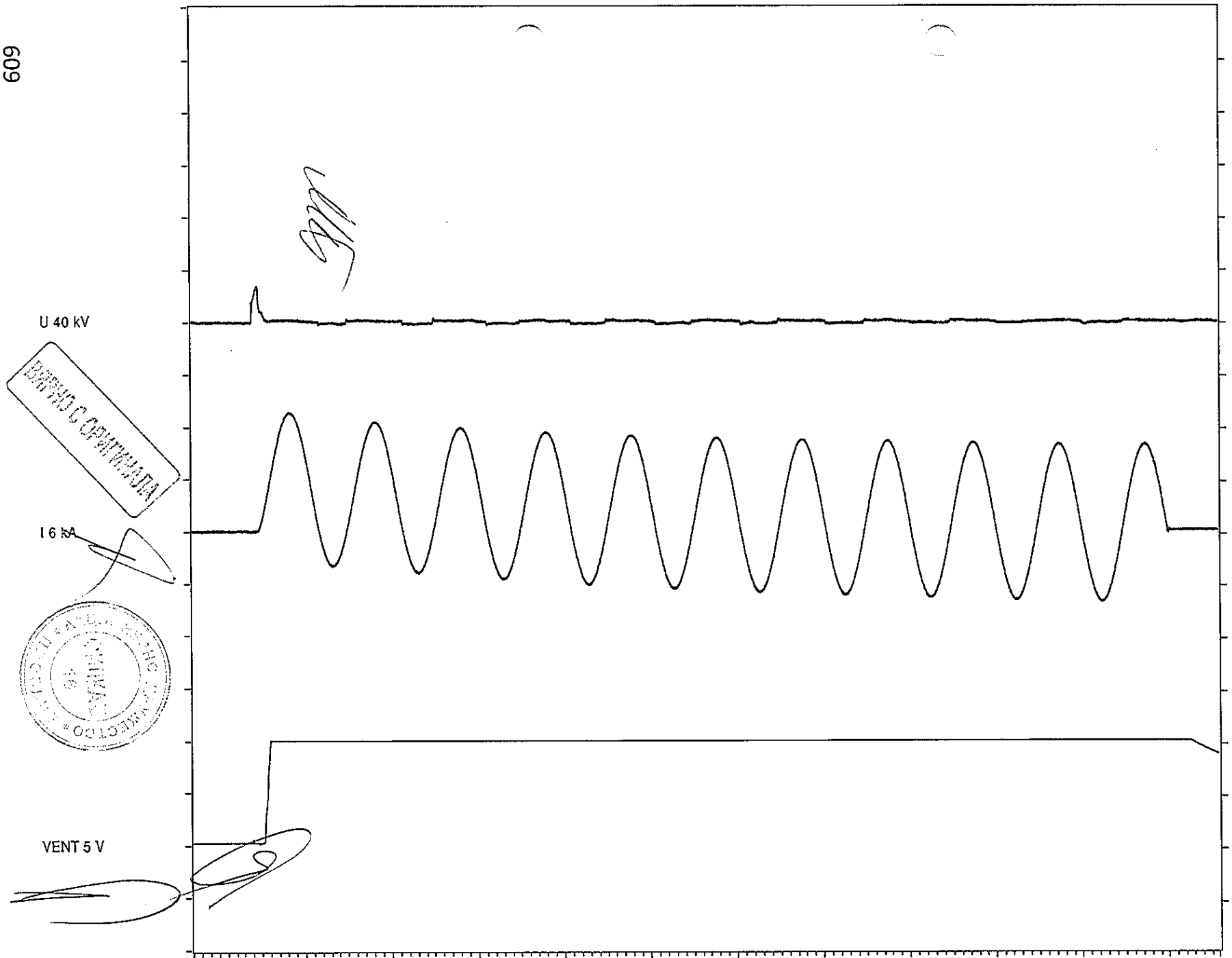


CESI P141 A7017386/0017


I.peak= 16,47 kA
I.rms= 6,28 kA
dT= 212,7 mSec
U 40 kV
I 6 kA
VENT 5 V
40,294
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
220,000
240,000
272,004
2,000 [msec/div.]
CESI P141 A7017386/0021
Seq: 1SEC Osc: 0 Meas: HF1 - 1

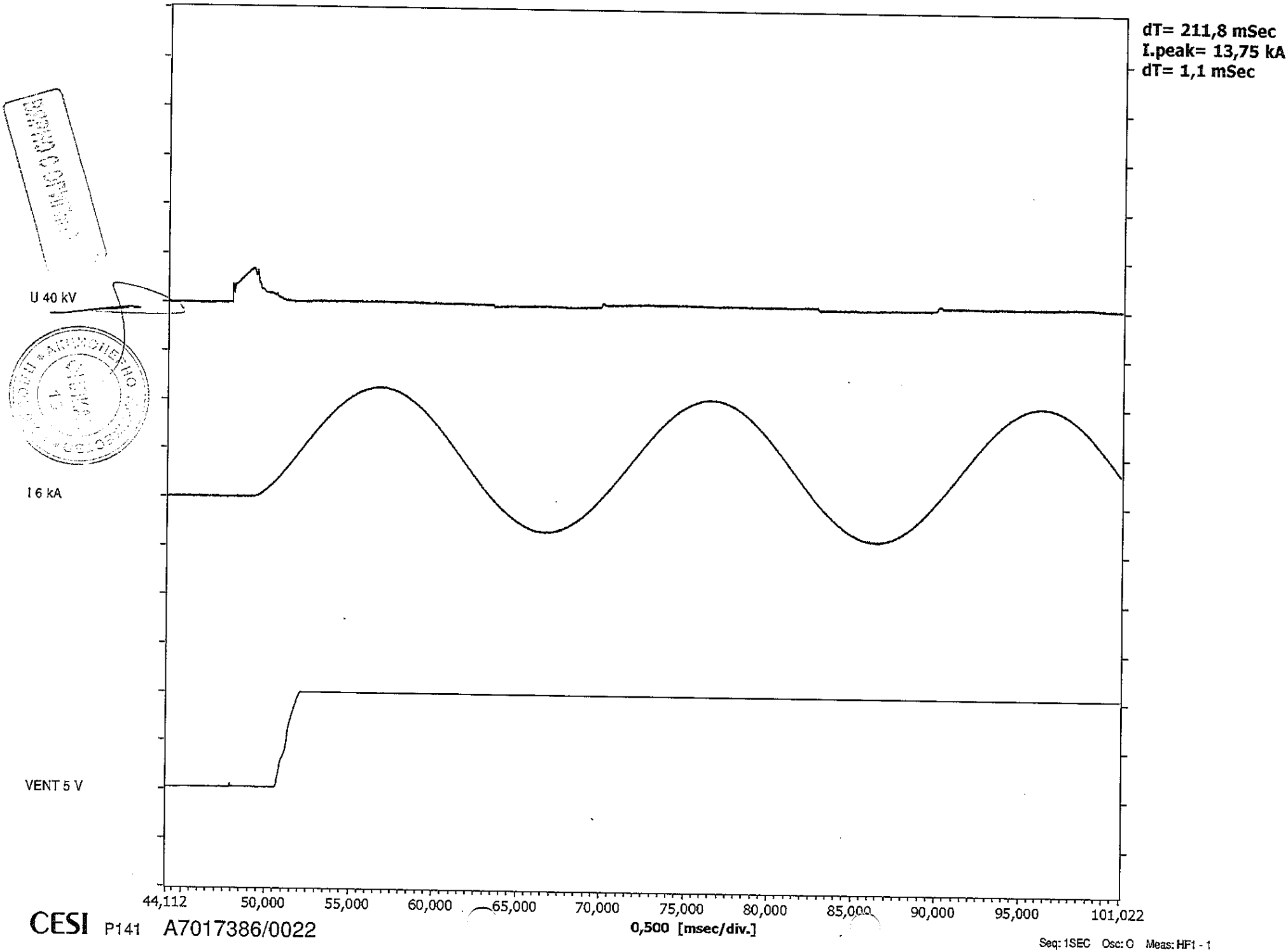
609

dT= 211,8 mSec



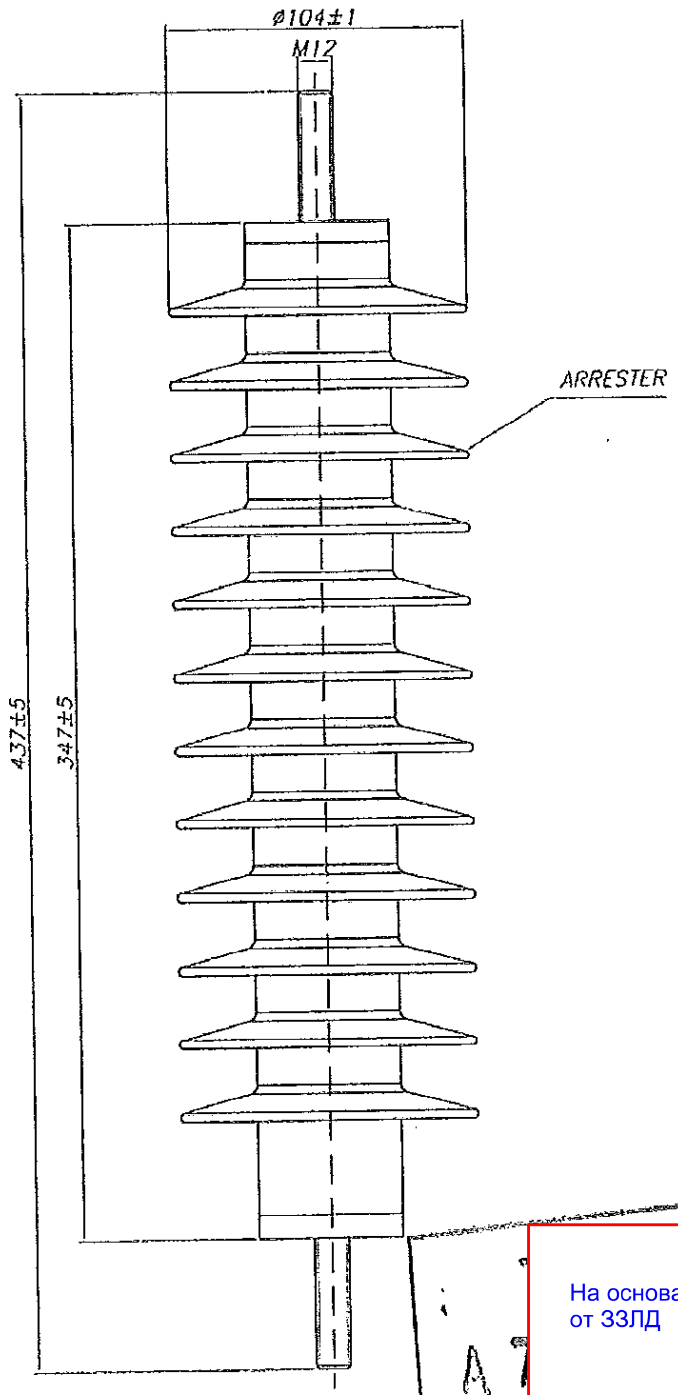
CESI P141 A7017386/0022

Seq: 1SEC Osc: 0 Meas: HF1 - 1



CESI P141 A7017386/0022

SCD



Ur = 39kV
Uc = 31.2kV
CANT. STRENGTH = 350Nm
TENSION STRENGTH = 2kN
TORQUE = 50Nm
HIGH SHORT CIRCUIT = 21kA
LOW SHORT CIRCUIT 600A
CREEPAGE = 925mm
DRY ARC DISTANCE = 352mm

Tyco Electronics
ENERGY DIVISION
Bauthorpe EMP Surge Arrester
TITLE DA1-39G-NONONO SURGE ARRESTER
DWG NO DA1-39G-NONONO

На основание чл. 2
от ЗЗЛД

ВЯРНО С ОРИГИНАЛА

PUBBLICATO A7029970 (PAD - 982593)

DA1 - Distribution Surge Arrester
Bending Moment
Type Test Report

Tyco Electronics

Our commitment. Your advantage.

ВЯРНО С ОРИГИНАЛА

Tyco Electronics

Bowthorpe EMP

Test Report

Type	**DA1**
PPR Number	**PPR-2281**
Test Specification	Test of the bending moment IEC 60099-4 (2006-07) Ed. 2.1

Test Information:

Laboratory	CESI
Date	26/11/2007
External Test Ref	A7031450
Report Prepared by	M. Gregori
Test Verified by	A. Sironi
Test Approved by	V. Scarioni

Tyco Approvals:

R&D Manager

Brendan Normoyle Sign Date 28/11/2007

Product Manager

Brian McGowan Sign Date 28/11/2007

На основание чл. 2 от ЗЗЛД

For further information contact:
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Shannon Industrial Estate
Co. Clare, Ireland
Tel:+ 353-61-472885
Fax: + 353-61-472676
Email: mvsurgearresters@tycoelectronics.com

Test Report

CESI

Client	**Tyco Electronics Energy Division – Shannon (Ireland)**
Tested equipment	Polymer-housed metal-oxide surge arrester type DA1
Tests carried out	Test of the bending moment
Standards/Specifications	IEC 60099-4 (2006-07)
Test date	**from** September 07, 2007 **to** October 17, 2007

No. of pages	No. of pages annexed 11
Issue date	
Prepared	
Verified	
Approved	

CESI
Centro Elettrotecnico
Sperimentale Italiano
Giacinto Motta spa

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20134 Milano - Italia
Telefono +39 022125.1
Fax +39 0221255440
http://www.cesi.it

Capitale sociale 8.550.000 Euro
interamente versato
Codice fiscale e numero
iscrizione CCIAA 00793580150

Registro Imprese di Milano
Sezione Ordinaria
N. R.E.A. 429222
P.I. IT00793580150

Tests witnessed by:----

Identification of the object: Requested

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawing.
CESI checked that this drawing adequately represents in shape and dimensions the essential details and the parts of the tested object.
This drawing, identified by CESI and numbered A7028193 No. 1, is annexed to this document.

The data necessary to permit repetition of the tests are contained in the document marked: ---

- dielectric tests with impulse voltage	**: peak voltage: ± 3 %; time parameters: ± 10 %**
- dielectric tests with impulse current	**: peak value: ± 3 %; time parameters: ± 10 %**
- dielectric tests with alternating voltage	**: voltage (rms): ± 3 %**
dielectric tests with direct voltage	**: voltage: ± 3 %**

The measurement uncertainties are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to confidence level of about 95%) and have to be considered as maximum values

Laboratory information

Receipt date of the sample	August 28, 2007
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr L. Podavitte
Test laboratory	P177
Activity code	80090B

content	page	test date
Test object characteristics	4	
Panoramic view of the test object	5	
Reference standard	6	
Test procedure	7	
Summary of test result	8	
Initial measurement	from page 9 to page 11	September 05, 2007
Preconditioning test	from page 12 to 14	October 12, 2007
Water immersion test	13	October 13 to 17, 2007
Final verification	from page 15 to page 17	October 17, 2007
Technical data of the test circuit	from page 18 to page 21	

Pages annexed:

oscillograms no.10 pages

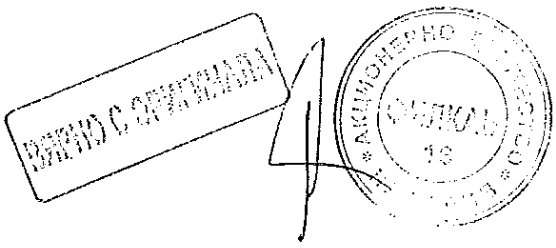
Document annexed:

TYCO Electronics drawing no. DA1-39G-NONONO , CESI no. A7028193 - no.1 page

Rated characteristics of the tested object assigned by the Client

Polymer housed Metal-oxide surge arrester	
Manufacturer	**Tyco Electronics - Shannon (Ireland)**
Year of manufacture	2007
type	DA1
Electrical characteristics	
Nominal discharge current (I_n)	10 kA
Rated voltage (U_r)	39 kV
Continuous operating voltage (U_c)	31,2 kV
Rated frequency	50/60 Hz
Mechanical characteristics	
dynamic cantilever (Nxm)	**350**
Geometrical characteristics	
Height	347 mm
Number of sheds	n° 12
Shed diameter	104 mm
Core diameter	50 mm
Other characteristics	
Housing material	Silicone
Housing color	Grey

Name and signature of Client's witness:



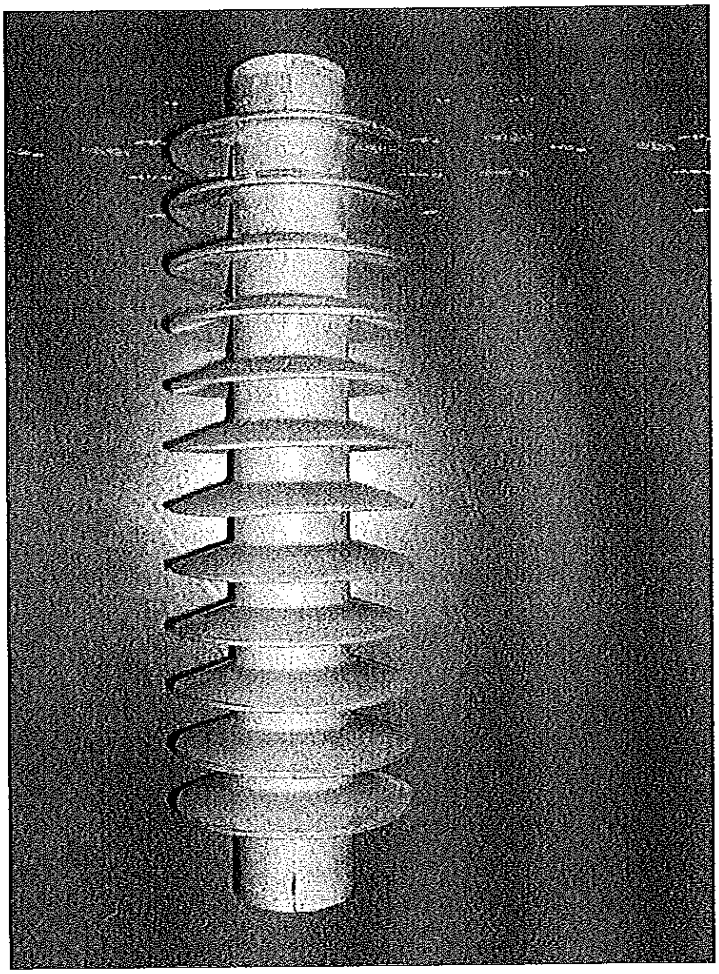


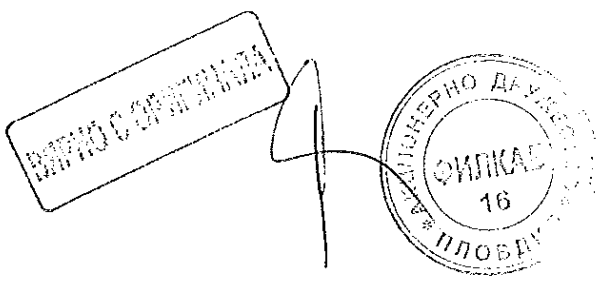
Photo no. 1
Photograph of the test object

Reference Standard

IEC 60099-4 (2006-07): "Metal-oxide surge arrester without gaps for a.c. system", clause 10.8.9

Test carried out and identification of the test objects

Test carried out	Number of test objects	Test object identification
initial measurements	1	B1
Bending application		
water immersion test		
verification tests		



Test procedure

The test procedure consisted of the following sequence:

a) Initial verifications
- measurement of the power losses at a test voltage in the range 0,8*Uc to Uc
- partial discharge test
- measurements of the residual voltage test at the nominal discharge current

b) Bending load application
- the bending load was increased to the test load within 30 sec to 90 sec and maintained at the test load of 350 Nm for 90 sec. the specified bending moment was obtained by applying a force of 970 N with a 365 mm arm
- the bending load was released smoothly and the residual deflection was recorded

c) Water immersion
- the sample was kept for 42 hours in boiling deionized water with 1 kg/m^3 of NaCl

d) Final verifications (same as initial verifications)
- measurement of the power losses at a test voltage in the range 0,8*Uc to Uc
- partial discharge test
- measurements of the residual voltage test at the nominal discharge current

TEST RESULT AND EVALUATION

The visual inspection of the sample after the test has revealed no sign of physical damage.
The force-deflection curve shows no significant discontinuity or residual deflection after load release
The variation of the power losses measured before and after the test was less than 20%.
The variation of the residual voltage measured before and after the test was less than 5% and the relevant oscillogram reveals no sign of breakdown.
The partial discharges measured before and after the test were below the specified limit of 10 pC

The acceptance criteria are fulfilled. The test result is positive

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО ОЛИКАБ 13 ПЛОВДИВ

Summary of test results

Electrical measurement

Variation of watt losses at $0,8 \times U_c$

sample	before test		after test		variation
	voltage	power	voltage	power	
	kV	W	kV	W	%
B1	25,12	0,650	25,12	0,664	+ 2,15

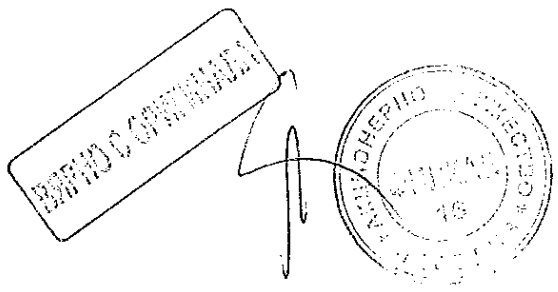
The variation of the watt losses before and after test was less than 20% (maximum allowed variation according to reference standard is 20%).

Variation of lightning impulse residual voltage at I_n

sample	before test		after test		variation
	discharge current	residual voltage	discharge current	residual voltage	
	kA	kV	kA	kV	%
B1	10,10	112,08	10,20	112,48	+ 0,36

The variation of the lightning impulse residual voltage before and after test was less than 5% (maximum allowed variation according to reference standard is 5%).

The measured partial discharges level was less than 1 pC (background noise) before and after the test



Tests of the bending moment

Initial measurement of watt losses

Test circuit: A0019

Date: September 05, 2007

Sample No. MI3						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
01	25,12	0,503	0,386	0,383	0,650	---

ВЯРНО С ОРИГИНАЛА

Test of the bending moment

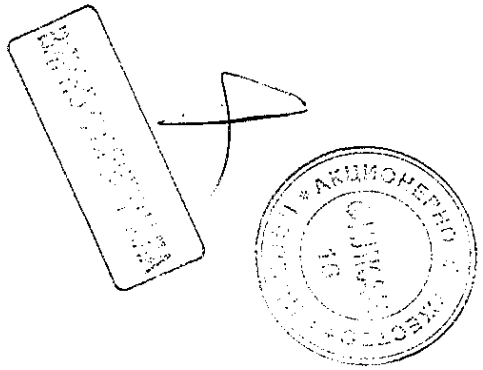
Measurement of partial discharges before the test

Test circuit: A012
Measurement circuit: A022 "direct" calibration:5 pC/mV, oscillogram no. 02 - background noise ≤ 1 oscillogram no. 03
Arrangement: ---

Atmospheric conditions and correction factor			
b	t_d/t_w	h	Relative umidity
kPa	°C	g / m³	%
100,23	18 / 11	6,21	40,49

Date: September 05, 2007

Test sample	Applied voltage	Duration of voltage application	Temperature of the test object	Partial discharge measurement		Oscillogram	Notes
				voltage increase Q max	voltage decrease Q max		
	kV_{rms}	s	°C	pC	pC	No.	
MI	39,0	2 ÷ 10	18	---	----	---	
MI	32,6	measure			≤ 1	04	



continued

Test of the bending moment

Lightning impulse residual voltage measurement before the test

Test circuit: A0120

Date: September 05, 2007

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
MI	I_n	95,8 x 5	5	7,1 /18,0	10,10	112,08

	Oscilloscope settings		
	sampling division	input	attenuation
	µs	V_{div}	
Current	5	0,5	50:10
Voltage	5	1,0	---

Notes:

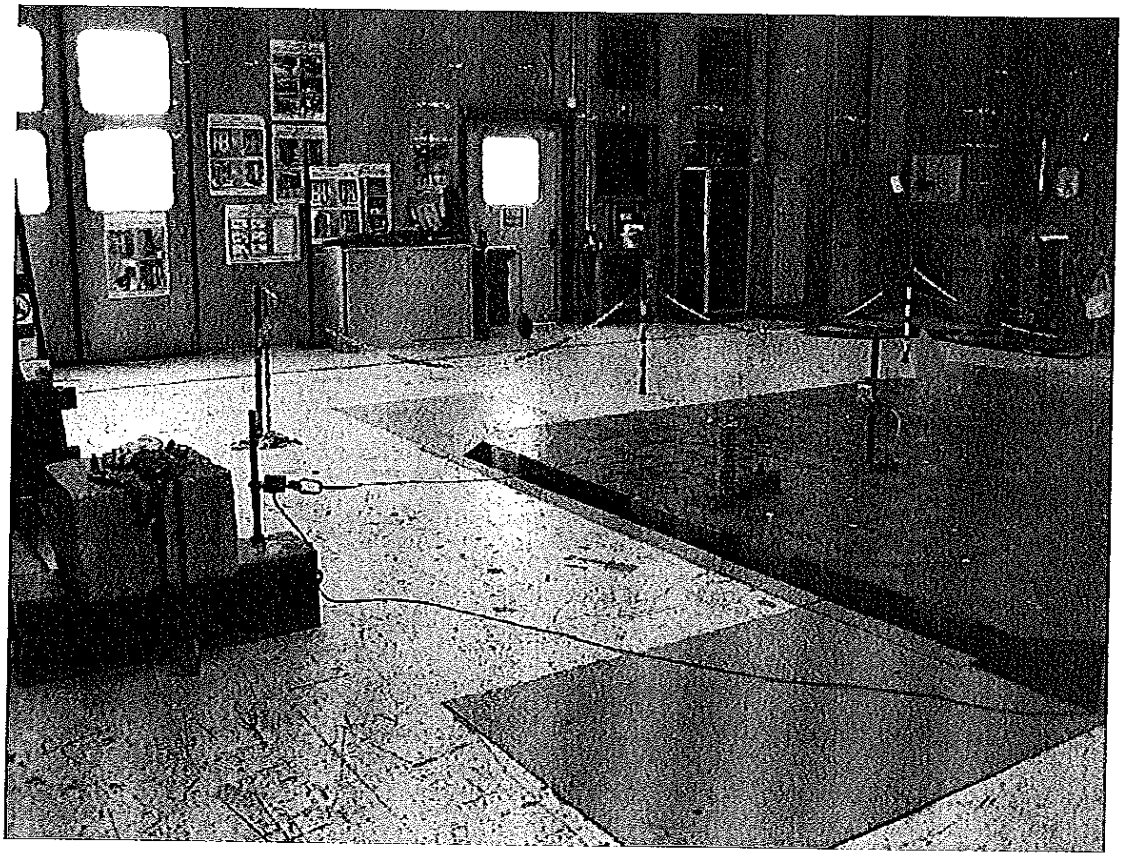


Photo no. 2
Test setting for bending application

Bending application

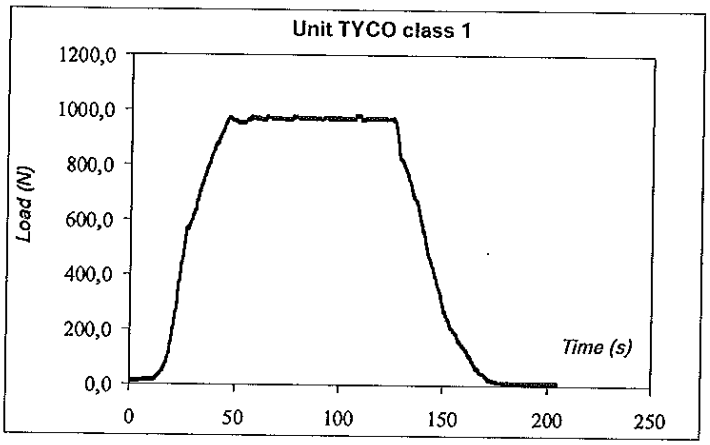
Test date: October 12, 2007

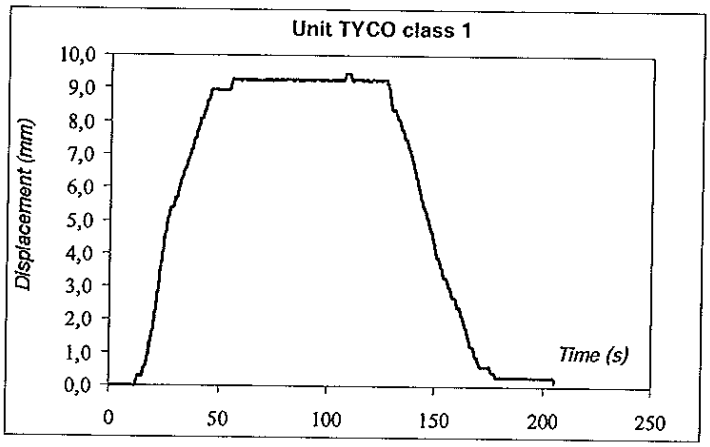
The test sample was mounted in upright position. The specified load (corresponding to the specified bending moment of 350 N×m) was applied perpendicular to the axis to the free end of the surge arrester. The load was increased at constant speed, maintained at the specified value for about 90 seconds and then decreased to zero.
A view of the test arrangement is shown in the photos pages no.12.
The curves of the load-deflection versus time and the load versus deflection are shown on page 14 .

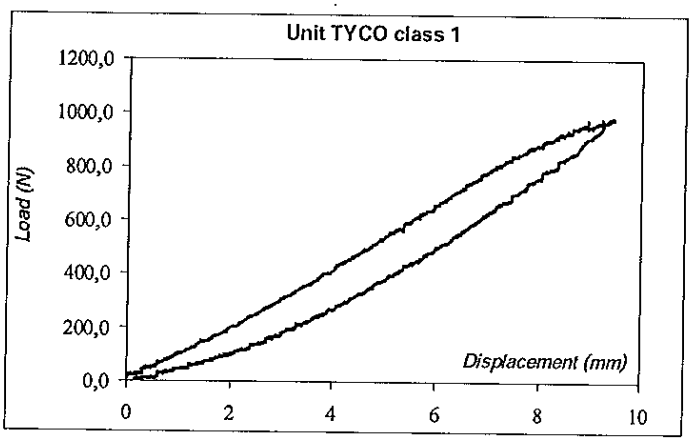
Water immersion test

Test date: from October 13 to October 17, 2007

The sample has been immersed in a vessel, in boiling deionized water with 1 kg/m^3 of NaCl, for 42 hours. At the end the sample remained in the vessel until the water cooled to 50 °C and maintained at this temperature in the vessel until verification tests.


Unit TYCO class 1
Load (N)
1200,0
1000,0
800,0
600,0
400,0
200,0
0,0
Time (s)
0
50
100
150
200
250


Unit TYCO class 1
Displacement (mm)
10,0
9,0
8,0
7,0
6,0
5,0
4,0
3,0
2,0
1,0
0,0
Time (s)
0
50
100
150
200
250


Unit TYCO class 1
Load (N)
1200,0
1000,0
800,0
600,0
400,0
200,0
0,0
Displacement (mm)
0
2
4
6
8
10

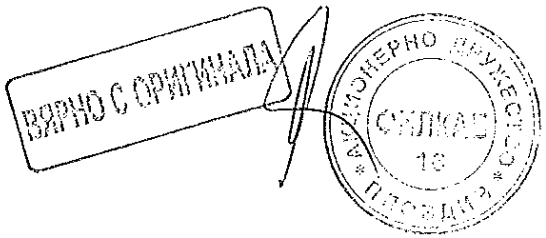
Test of the bending moment

Final measurement of watt losses

Test circuit: A0019

Date: October 17, 2007

Sample No. B1						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	$+mA_{cr}$	$-mA_{cr}$	mA_{rms}	W	µA
06	25,12	0,427	0,506	0,333	0,664	----



Test of the bending moment

Measurement of partial discharges after the test

Test circuit: A012
Measurement circuit: A022 "direct" calibration:50 pC/mV, oscillogram no. 07 - background noise ≤ 1 oscillogram no. 08
Arrangement: ---

Atmospheric conditions and correction factor			
b	t_d/t_w	h	Relative umidity
kPa	°C	g / m^3	%
99,97	18 / 13	8,59	56,07

Date: October 17, 2007

Test sample	Applied voltage	Duration of voltage application	Temperature of the test object	Partial discharge measurement		Oscillogram	Notes
				voltage increase Q max	voltage decrease Q max		
	kV_{rms}	s	°C	pC	pC	No.	
MI	39,0	2 ÷ 10	18	---	---		
MI	32,6	measure	18		≤ 1	09	

continued

Test of the bending moment

Lightning impulse residual voltage measurement after the test

Test circuit: A0120

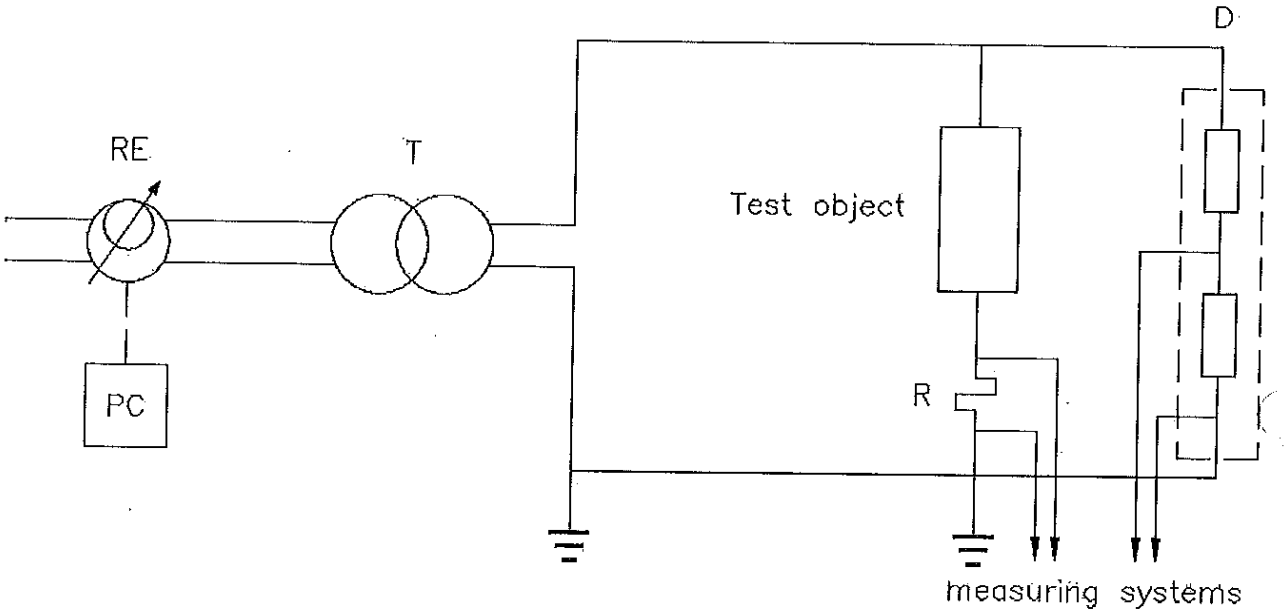
Date: October 17, 2007

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
MI	I_n	95,8 x 5	10	7,1 /18,0	10,20	112,48

	Oscilloscope settings		
	sampling division	input	attenuation
	µs	V_{div}	
Current	5	0,5	50:10
Voltage	5	1,0	100:5

Notes:

Circuit A0019



Power frequency supply

RE - programmable supply type LARCET A.C. Power Source 5000 P.S.; CESI no. 23702-32191
PC - personal computer
T - voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200 V/15-30 kV

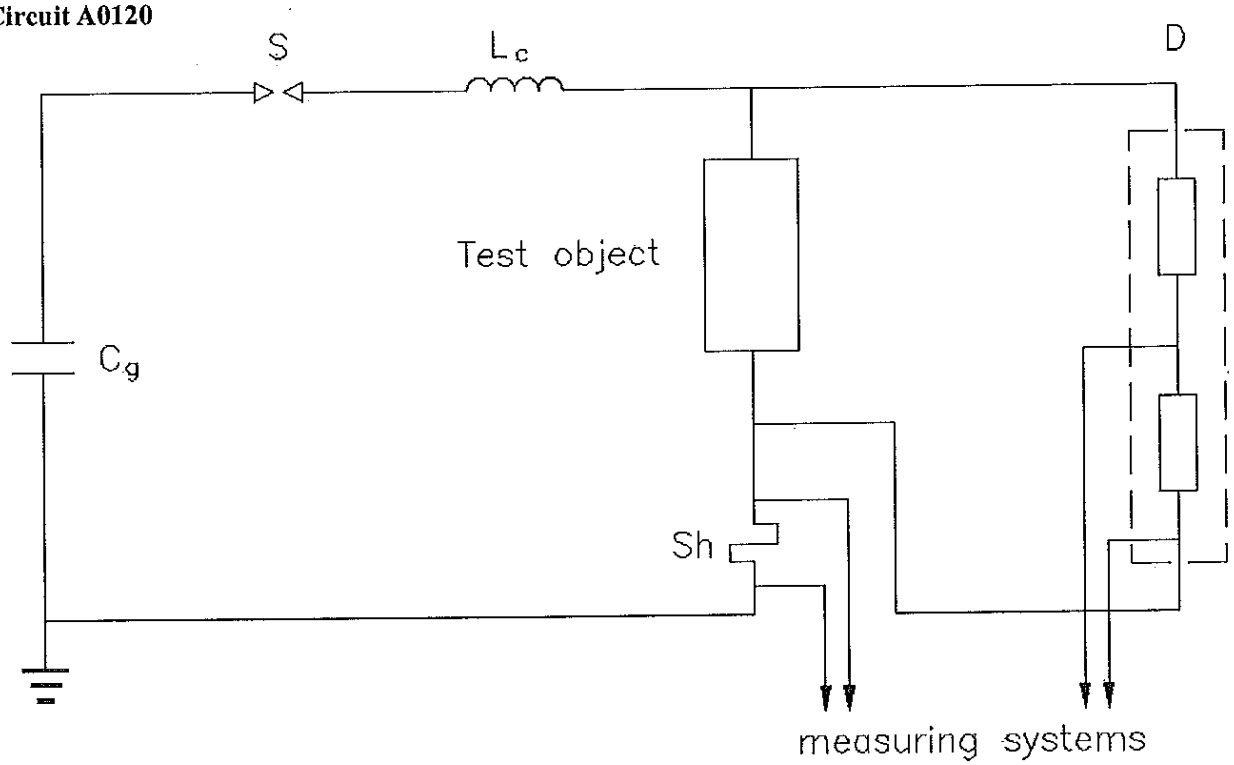
Current measuring system

R - Current shunt CESI No.31120; R= 941,4 Ω
- Electro optical system CESI No.11521/522; attenuation 5:5
OSC - Oscilloscope type SONY TEKTRONIX RTD 710A; CESI No.9090

Voltage measuring system

D - Voltage divider SAGI; CESI No.11120
- Electro optical system CESI No.11517/518; attenuation 5:5
OSC - Oscilloscope type SONY TEKTRONIX RTD 710A; CESI No.9090

Circuit A0120



Impulse generator

No. of stages	5//
Cg	250 µF
Lc	140 µH
S	- Spark-gap

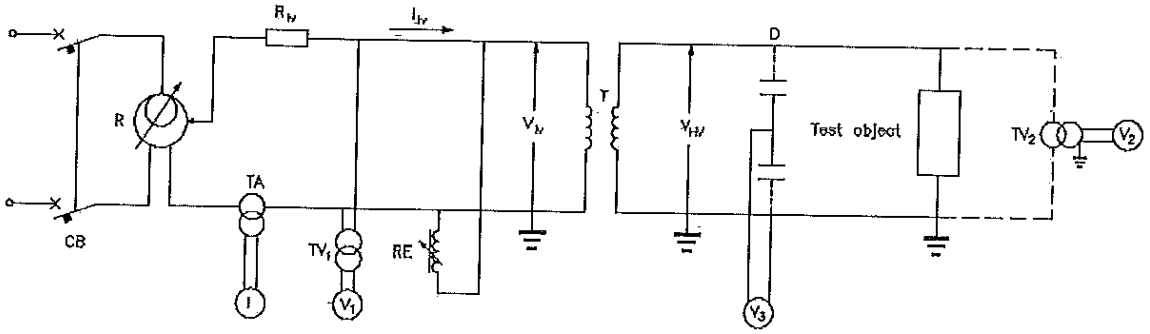
Voltage measuring system.

D	- Voltage divider P&V; CESI No.6700
	- Electro optical system CESI No.11521/522
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.2)

Current measuring system

Sh	- Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
	- Electro optical system CESI No11517/518
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.1)

Circuit A0012

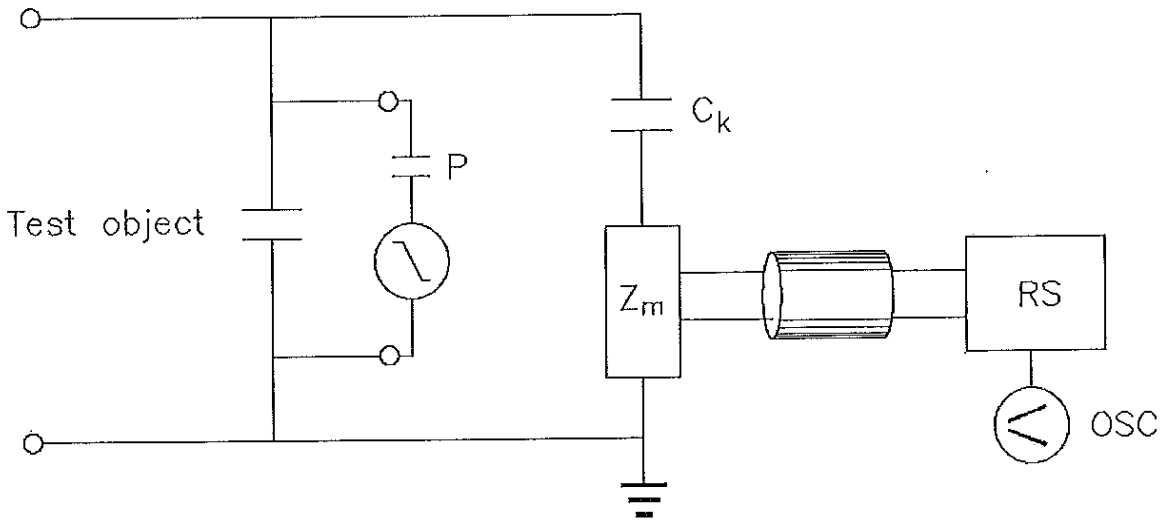


Power frequency test circuit

R	- regulator type CORMES; power 66 kVA; voltage 380 V/0-0,22 kV
TA	- current transformer CGS; ratio 150/5 A/300/5 A
I	- amperemeter
TV_1	- voltage transformer CGS; ratio 220-440 V/100 V
V_1	- voltmeter direct reading TSE
RE	- (not used)
T	- booster transformer PIVI; power 250 kVA; voltage 200-400V/250 kV
D	- (not used)
V_3	- (not used)
TV_2	- voltage transformer type PIVI; ratio 25000 V/100 V
V_2	- voltmeter CESI No.6393

Circuit A0022

Partial discharges measurement
Direct circuit - Scheme 1a



P - calibrator CESI; CESI No. 346
C_k - coupling capacitor 0,3 nF
Z_m - coupling impedance
RS - partial discharge detector HAEFELY TRENCH type TE 571; CESI No. 13281
OSC - (not used)

CESI A7031450 oscillogram n. 1

HAEFELY TRENCH TETTEX

PD-DETECTOR

Info: 1

Measurement name:

Comment:

1st PD Range: 10 pC

Noise Suppression: 5 %

Test Measuring Time: 15 s

Start date: 00.00.00

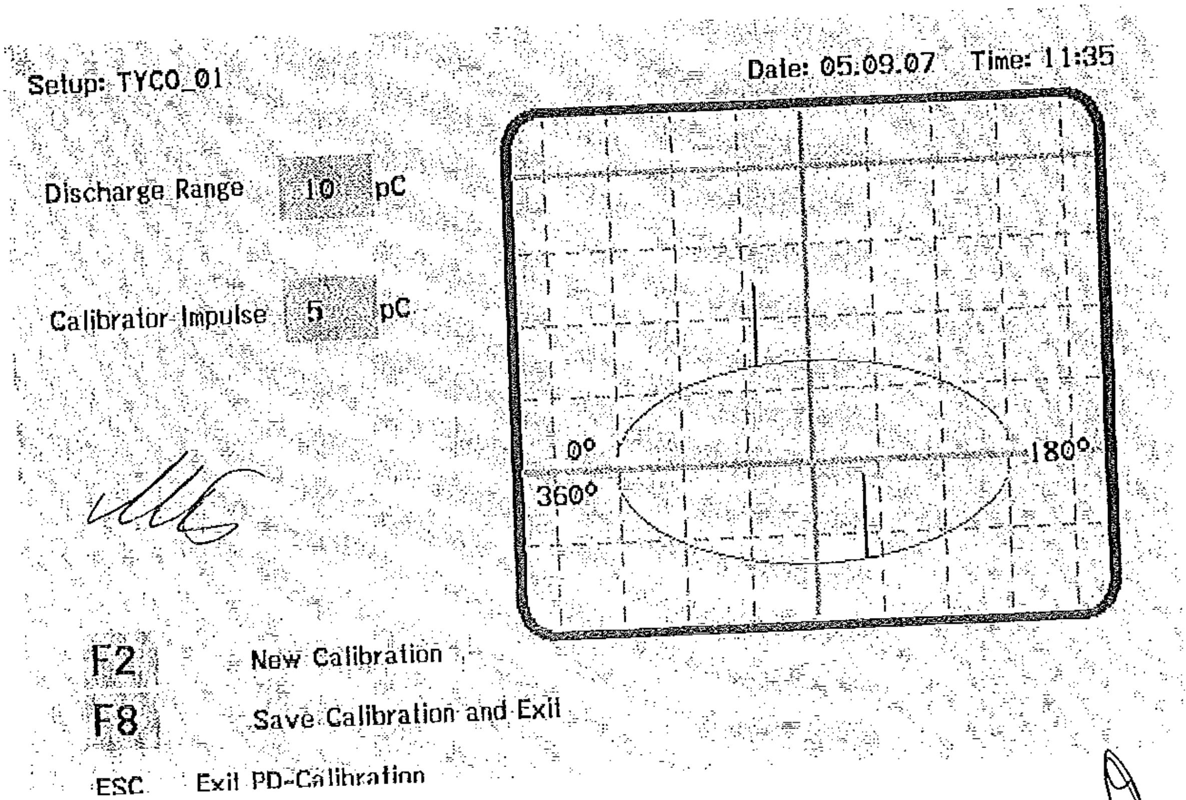
Start time: 00:00

2nd PD Range: Not applied

Lockout Time: 7.3 usec

Voltage Range: 50 kV

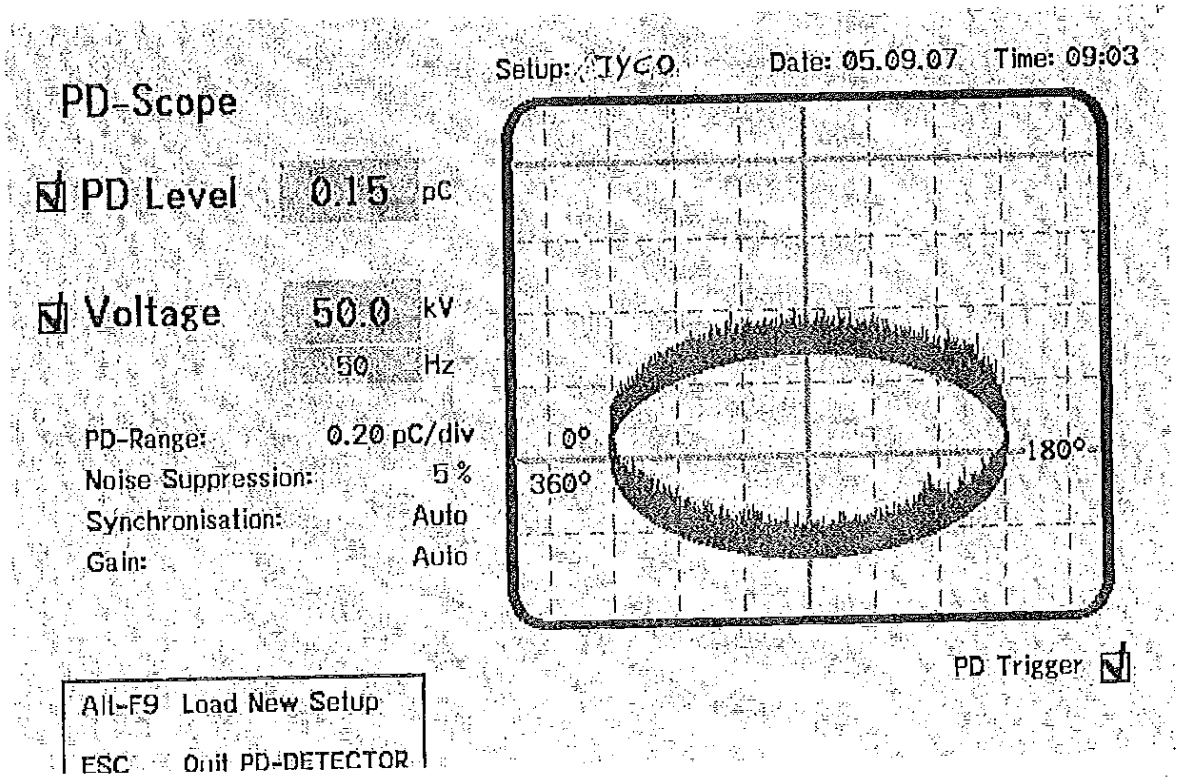
Remarks:



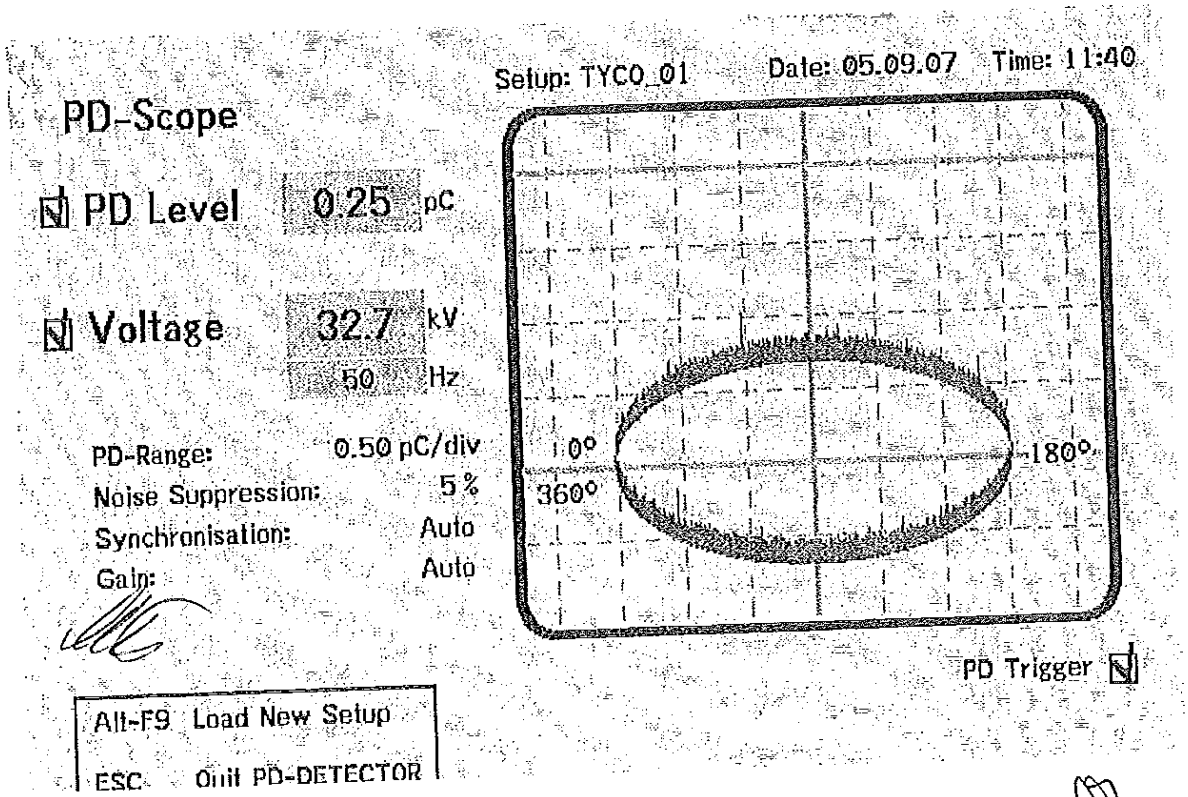
CESI A7031450 Oscillogram n. 2

АКЦИОНЕРНО ДРУЖЕСТВО ФИЛКАБ 16 ПЛОВДИВ

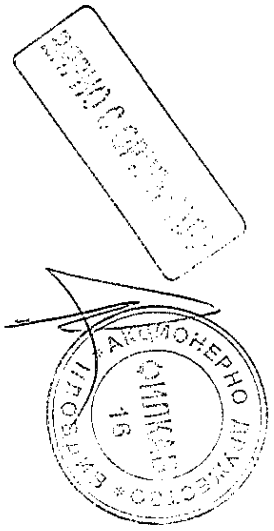
ВЯРНО С ОРИГИНАЛА

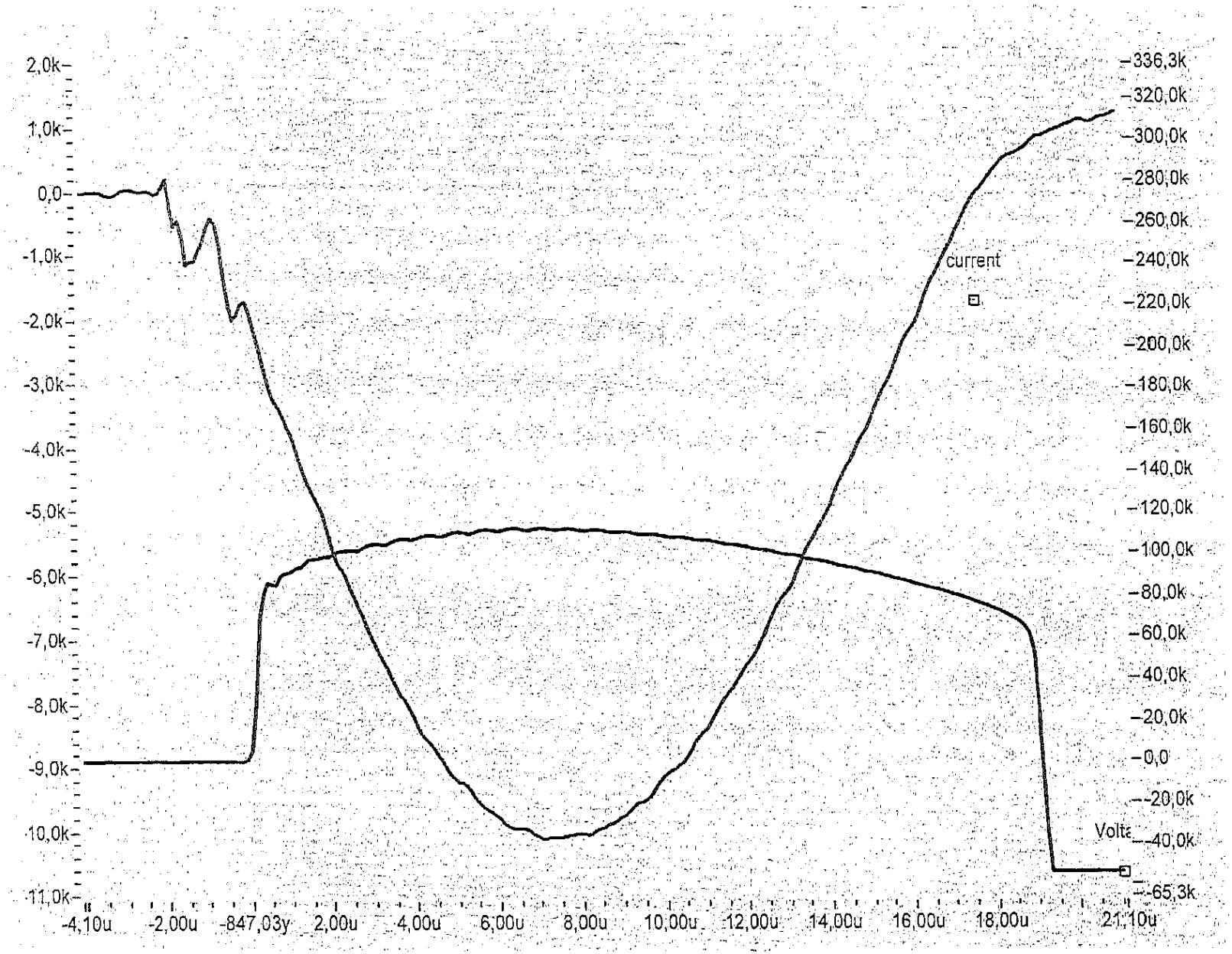


CESI A7031450 oscillogram n. 3



CESI A7031450 oscillogram n. 4





CESI A7031450 oscillogram n. 5

CESI A7031450oscillogram n. 6

ВЯРНО С ОРИГИНАЛА

HAEFELY TRENCH TETTEX

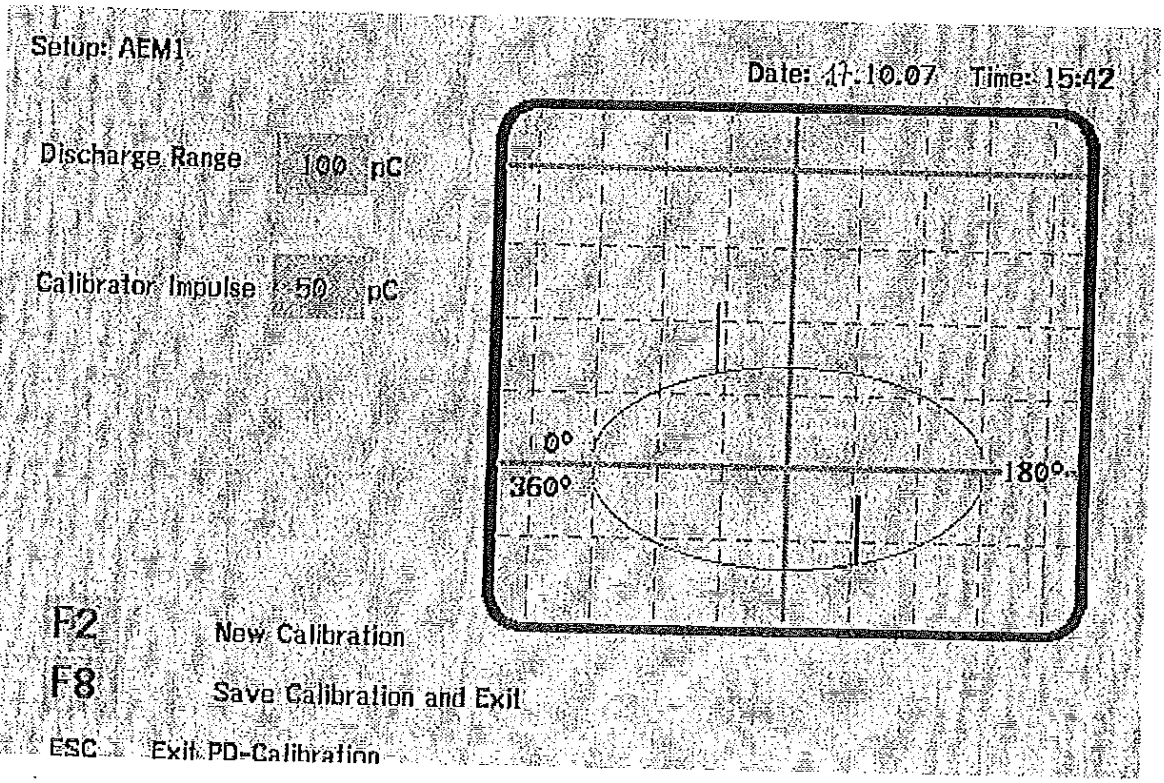
PD-DETECTOR

Info: 1
Measurement name:
Comment:
1st PD Range: 100 pC
Noise Suppression: 5 %
Test Measuring Time: 15 s

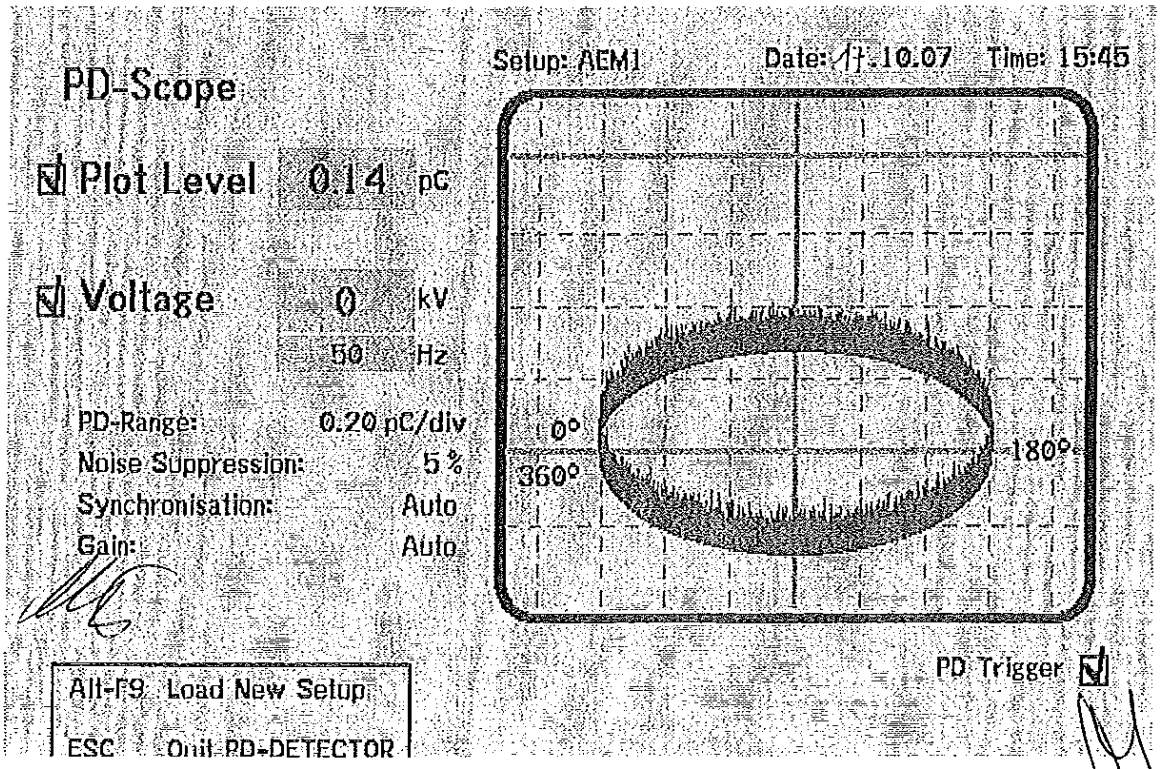
Start date: 00.00.00
Start time: 00:00

2nd PD Range: Not applied
Lockout Time: 7.5 usec
Voltage Range: 40 kV

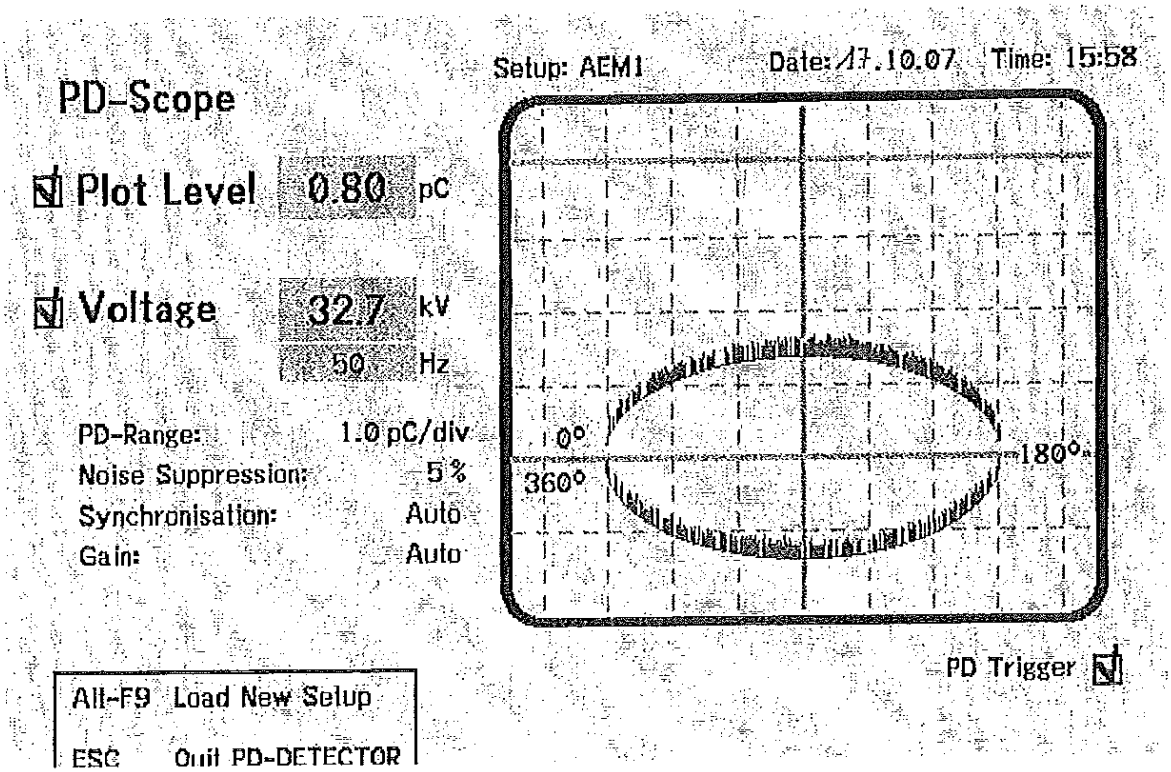
Remarks:



CESI A7031450 oscillogram n. 7

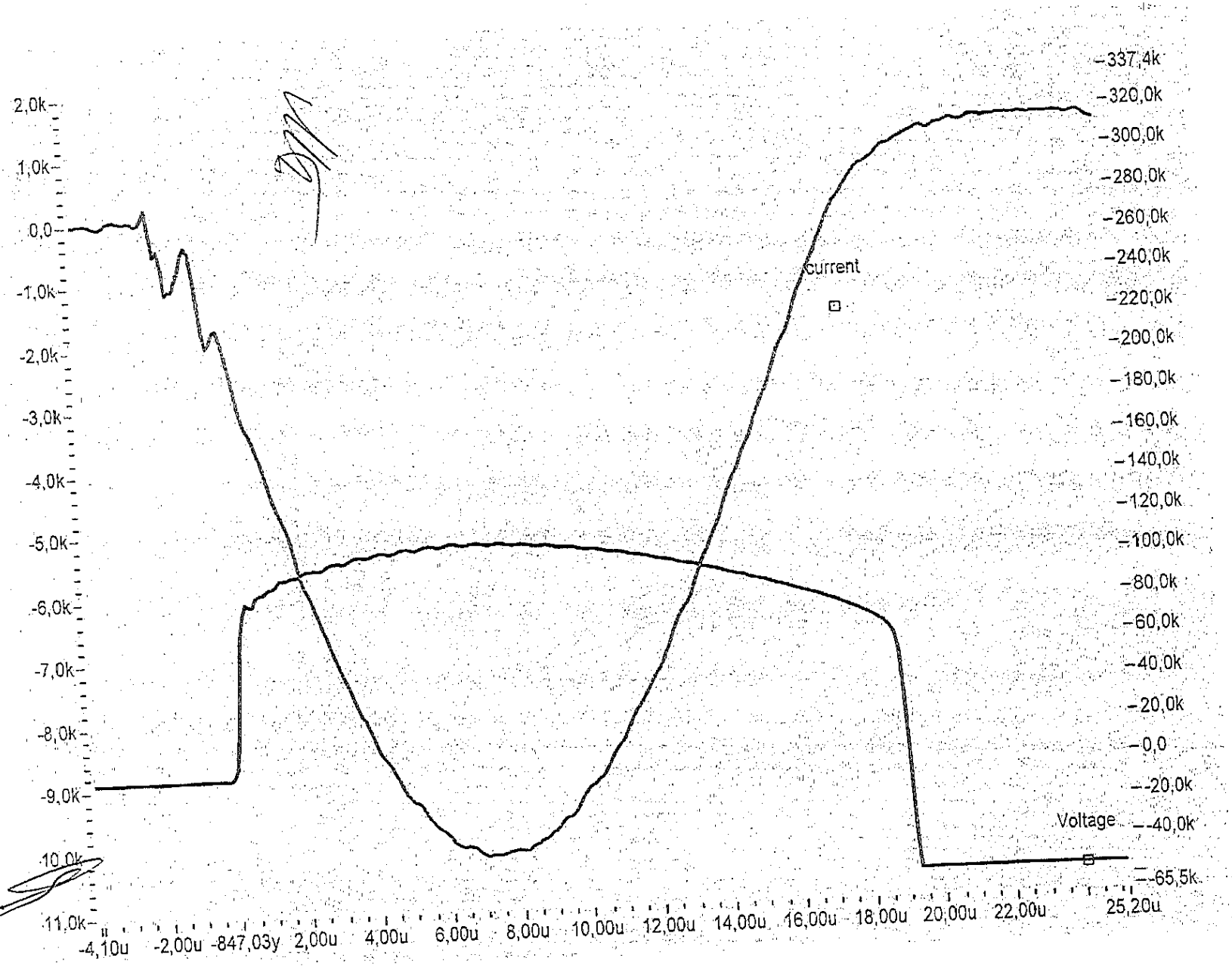


CESI A7031450 oscillogram n . 8

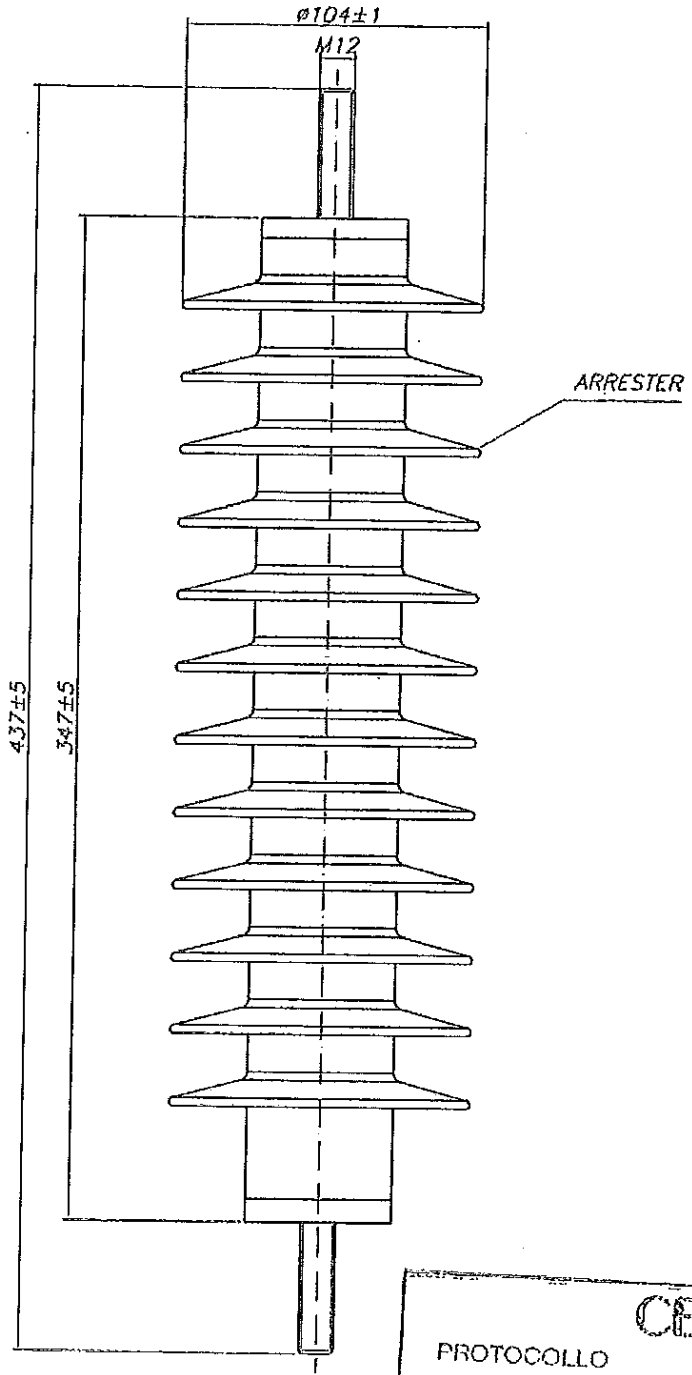


CESI A7031450 oscillogram n . 9

CESI A7031450 oscillogram n. 10



SCD



CESI

PROTOCOLLO DATA

A7/ 0 2 8 1 9 3 24 OTT. 2007

Firma Mario Pagani

Ur = 39kV
Uc = 31.2kV
CANT. STRENGTH = 350Nm
TENSION STRENGTH = 2kN
TORQUE = 50Nm
HIGH SHORT CIRCUIT = 21kA
LOW SHORT CIRCUIT 600A
CREEPAGE = 925mm
DRY ARC DISTANCE = 352mm

Tyco Electronics

ENERGY DIVISION

Bowthorpe EMP Surge Arrester

DRW			PEN
CHECK			DATE
APP			
SCALE			

TITLE
DA1-39G-NONONO
SURGE ARRESTER

DWG NO DA1-39G-NONONO SHEET 1 OF 1 ISS 0

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО ПЛОВДИВ СТИКЛАРИ 16

DA1 - Distribution Surge Arrester
Moisture Ingress
Type Test Report

Tyco Electronics

Our commitment. Your advantage.

Tyco Electronics

Bowthorpe EMP

Test Report

Type	**DA1**
PPR Number	**PPR-2282**
Test Specification	Moisture ingress test IEC 60099-4 (2006-07) Ed. 2.1

Test Information:

Laboratory	CESI
Date	26/11/2007
External Test Ref	A7031384
Report Prepared by	M. Gregori
Test Verified by	A. Sironi
Test Approved by	V. Scarioni

Tyco Approvals:

R&D Manager

Brendan Normoyle Signa Date 28/11/2007

Product Manager

Brian McGowan Signa Date 28/11/2007

На основание чл. 2 от ЗЗЛД

For further information contact:
Tyco Electronics Energy Division
Bay 100-109
Shannon Industrial Estate
Co. Clare, Ireland
Tel:+ 353-61-472885
Fax: + 353-61-472676
Email: mvsurgearresters@tycoelectronics.com

Client	**Tyco Electronics Energy Division – Shannon (Ireland)**
Tested equipment	Polymer-housed metal-oxide surge arrester type DA1
Tests carried out	Moisture ingress test
Standards/Specifications	IEC 60099-4 (2006-07)
Test date	**from** September 07, 2007 **to** October 17, 2007

The results reported in this document relate only to the tested equipment.

No. of pages	
Issue date	
Prepared	
Verified	
Approved	

На основание чл. 2
от ЗЗЛД

CESI
Centro Elettrotecnico
Sperimentale Italiano
Giacinto Motta spa

Via R. Rubattino 54
20134 Milano - Italia
Telefono +39 022125.1
Fax +39 0221255440
http://www.cesi.it

Capitale sociale 8 550 000 Euro
interamente versato
Codice fiscale e numero
iscrizione CCIAA-00793580150

Registro Imprese di Milano
Sezione Ordinaria
N. R.E.A. 429222
P.I. IT00793580150

ВЯРНО С ОРИГИНАЛА

Tests witnessed by:----

Identification of the object: Requested

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawing.
CESI checked that this drawing adequately represents in shape and dimensions the essential details and the parts of the tested object.
This drawing, identified by CESI and numbered A7028193 No. 1, is annexed to this document.

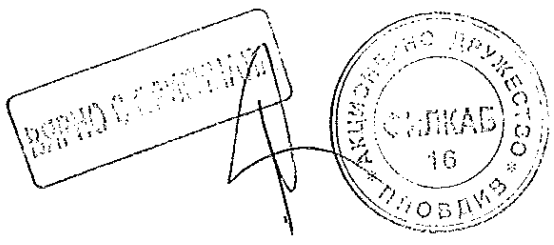
The data necessary to permit repetition of the tests are contained in the document marked: ---

- dielectric tests with impulse voltage	: **peak voltage: ± 3 %; time parameters: ± 10 %**
- dielectric tests with impulse current	: **peak value: ± 3 %; time parameters: ± 10 %**
- dielectric tests with alternating voltage	: **voltage (rms): ± 3 %**
dielectric tests with direct voltage	: **voltage: ± 3 %**

The measurement uncertainties are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to confidence level of about 95%) and have to be considered as maximum values

Laboratory information

Receipt date of the sample	August 28, 2007
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr L. Podavitte
Test laboratory	P177
Activity code	80090B



Pages annexed:

oscillograms n.10 pages

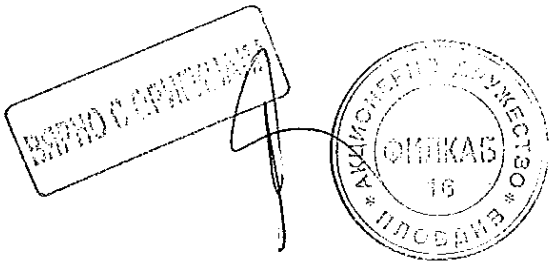
Document annexed:

TYCO Electronics drawing no. DA1-39G-NONONO , CESI no. A7028193 - no.1 page

Rated characteristics of the tested object assigned by the Client

Polymer housed Metal-oxide surge arrester	
Manufacturer	**Tyco Electronics - Shannon (Ireland)**
Year of manufacture	2007
type	DA1
Electrical characteristics	
Nominal discharge current (I_n)	10 kA
Rated voltage (U_r)	39 kV
Continuous operating voltage (U_c)	31,2 kV
Rated frequency	50/60 Hz
Mechanical characteristics	
terminal torque (Nxm)	**50**
static cantilever (Nxm)	**350 (corresponding to a load of 1010 N applied to the fitting)**
Geometrical characteristics	
Height	347 mm
Number of sheds	n° 12
Shed diameter	104 mm
Core diameter	50 mm
Other characteristics	
Housing material	Silicone
Housing color	Grey

Name and signature of Client's witness:



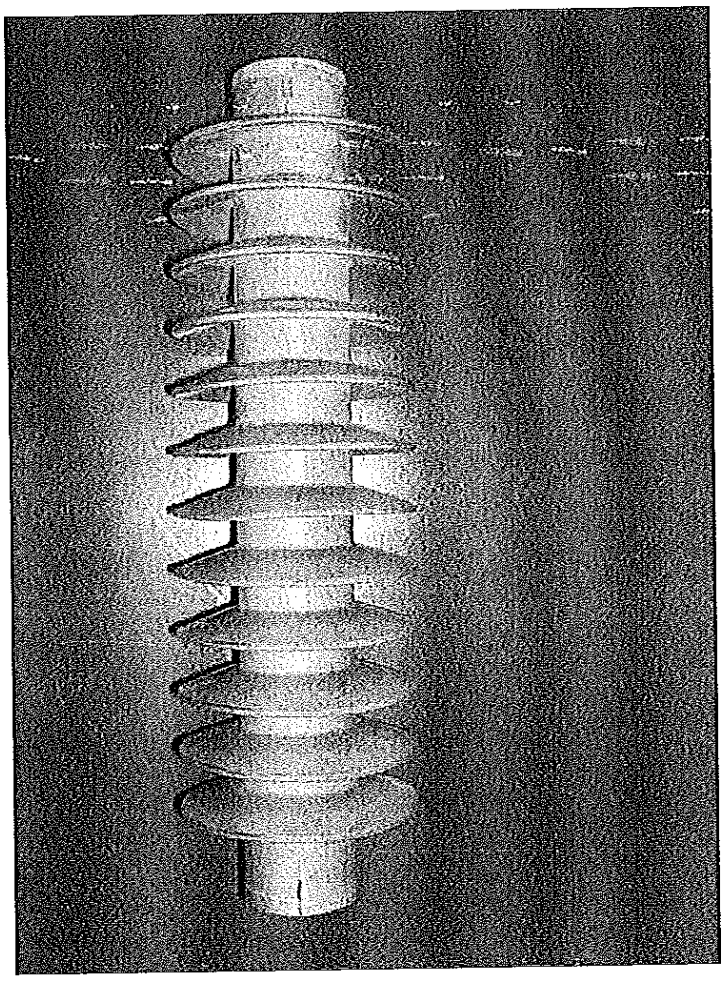


Photo no. 1
Photograph of the test object

Reference Standard

IEC 60099-4 (2006-07): "Metal-oxide surge arrester without gaps for a.c. system", clause 10.8.13

Test carried out and identification of the test objects

Test carried out	Number of test objects	Test object identification
initial measurements	1	MI
mechanical preconditioning		
water immersion test		
verification tests		

Test procedure

The test procedure consisted of the following sequence:

a) Initial verifications
- measurement of the power losses at a test voltage in the range 0,8*Uc to Uc
- partial discharge test
- measurements of the residual voltage test at the nominal discharge current

b) Terminal torque preconditioning
The terminal torque specified by the manufacturer was applied for 30 sec

c) Thermomechanical preconditioning
The test sample was submitted to two 48 hours thermal cycles as shown in fig. 6 of the reference standard while mechanically stressed at the maximum continuous cantilever (bending) load specified by the manufacturer equal to 350 Nm
The load direction was changed every 24 hours according to fig. 7 of the reference standard

d) Water immersion
The test sample was kept for 42 hours in boiling deionized water with 1 kg/m^3 of NaCl

d) Final verifications (same as initial verifications)
- measurement of the power losses at a test voltage in the range 0,8*Uc to Uc
- partial discharge test
- measurements of the residual voltage test at the nominal discharge current

Test result and evaluation

The visual inspection of the sample after the test has revealed no significant damage.
The variation of the power losses measured before and after the test was less than 20%.
The variation of the residual voltage measured before and after the test was less than 5% and the relevant oscillogram reveals no sign of breakdown.
The partial discharges measured before and after the test were below the specified limit of 10 pC

The acceptance criteria are fulfilled. The test result is positive

ВЯРНО С ОРИГИНАЛА

Summary of test results

Electrical measurement

Variation of watt losses at $0,8 \times U_c$

sample	before test		after test		variation
	voltage	power	voltage	power	
	kV	W	kV	W	%
MI	25,06	0,693	25,06	0,820	+ 18,32

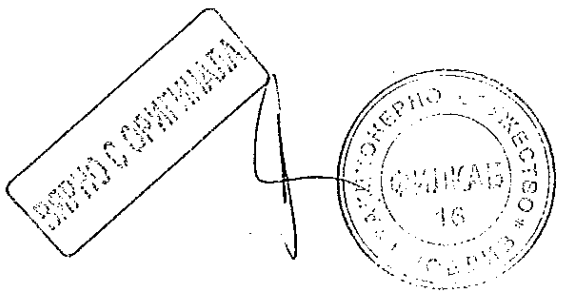
The variation of the watt losses before and after test was less than 20% (maximum allowed variation according to reference standard is 20%).

Variation of lightning impulse residual voltage at I_n

sample	before test		after test		variation
	discharge current	residual voltage	discharge current	residual voltage	
	kA	kV	kA	kV	%
MI	10,10	112,4	10,10	112,8	+ 0,36

The variation of the lightning impulse residual voltage before and after test was less than 5% (maximum allowed variation according to reference standard is 5%).

The measured partial discharges level was less than 1 pC (background noise) before and after the test



Moisture ingress test

Initial measurement of watt losses

Test circuit: A0019

Date: September 05, 2007

Sample No. MI3						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
01	25,06	0,502	0,392	0,321	0,693	---

Moisture ingress test

Measurement of partial discharges before the test

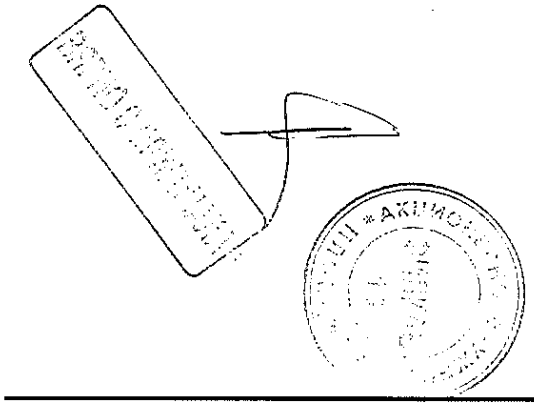
Test circuit: A012
Measurement circuit: A022 "direct" calibration:5 pC/mV, oscillogram no. 02 - background noise ≤ 1 oscillogram no. 03
Arrangement: ---

Atmospheric conditions and correction factor			
b	t_d/t_w	h	Relative umidity
kPa	°C	g / m^3	%
100,23	18 / 11	6,21	40,49

Date: September 05, 2007

Test sample	Applied voltage	Duration of voltage application	Temperature of the test object	Partial discharge measurement		Oscillogram	Notes
				voltage increase Q max	voltage decrease Q max		
	kV_{rms}	s	°C	pC	pC	No.	
MI	39,0	2 ÷ 10	18	---	---	---	
MI	32,6	measure			≤ 1	04	

continued



Moisture ingress test

Lightning impulse residual voltage measurement before the test

Test circuit: A0120

Date: September 05, 2007

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
MI	I_n	95,8 x 5	5	7,1 /18,0	10,10	112,4

	Oscilloscope settings		
	sampling division	input	attenuation
	µs	V_{div}	
Current	5	0,5	50:10
Voltage	5	1,0	---

Notes:

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ОМИКАБ 16 * ПЛОВДИВ *

Preconditioning tests

Terminal torque preconditioning

Test date: October 8, 2007

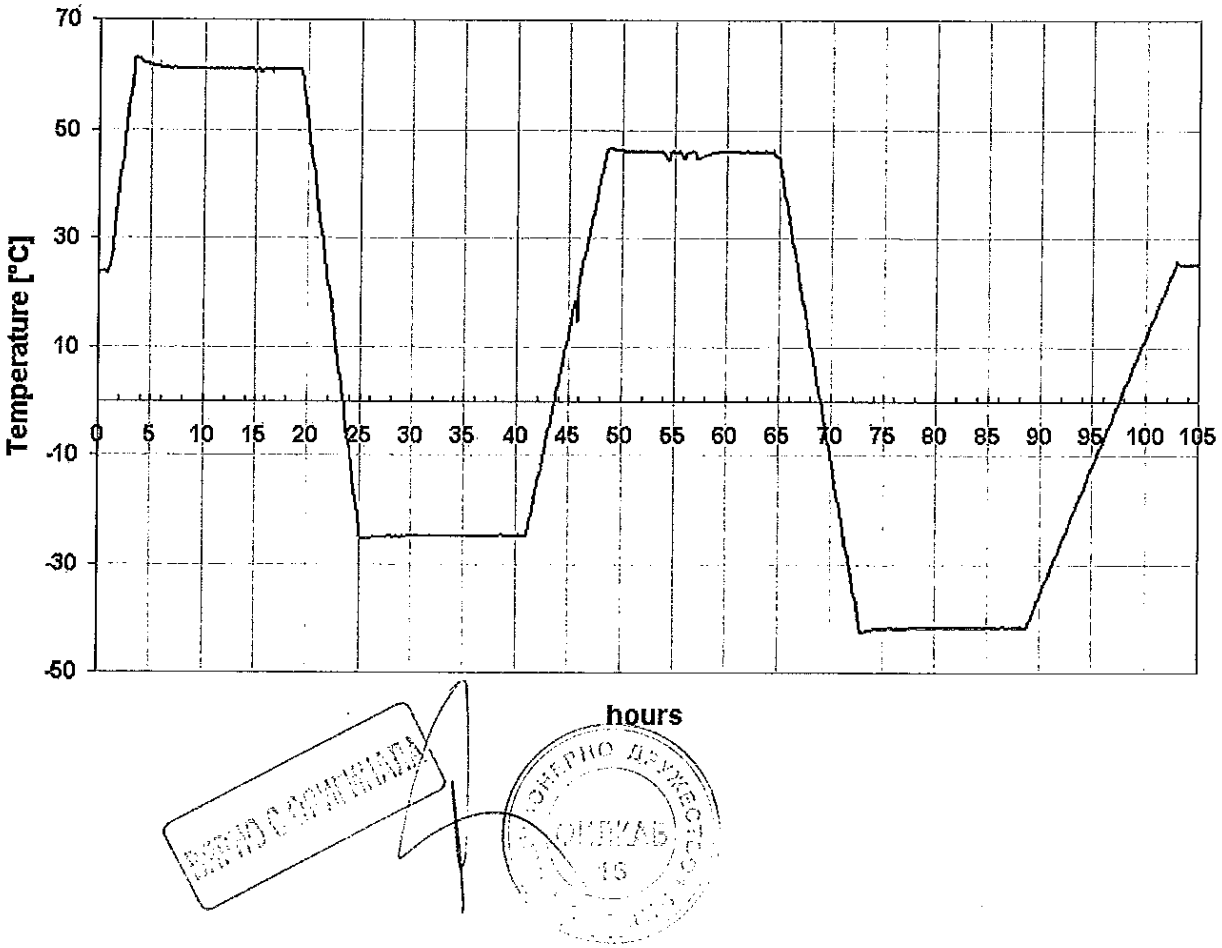
The terminal torque at the value, specified by the manufacturer (50 Nxm), has been applied for 30 seconds.

Thermomechanical preconditioning

Test date: from October 8 to October 12, 2007

sample	applied load	lower temperature	upper temperature	duration of temperature application	cycle	load duration
No.	Nxm	°C	°C	h	No.	degree
MI	350	---	+60	24	1	0
	350	-25	---	24	1	180
	350	---	+45	24	2	270
	350	-40	---	24	2	90

Thermomechanical preconditioning



Test set up for thermomechanical preconditioning

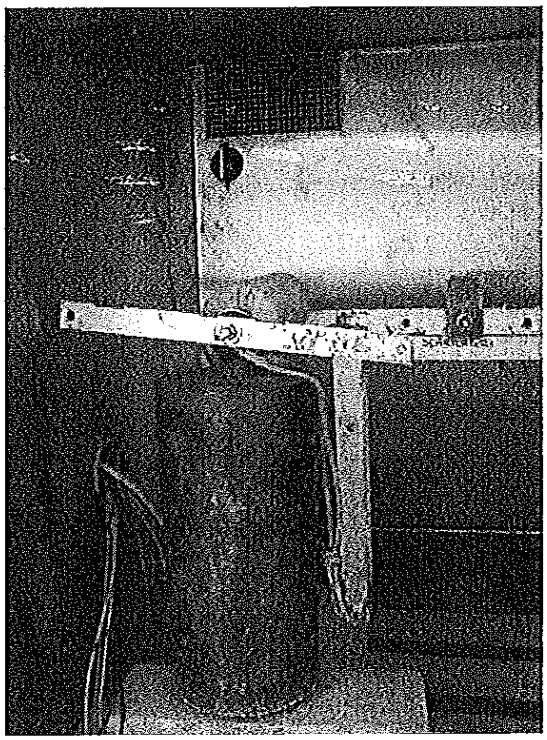
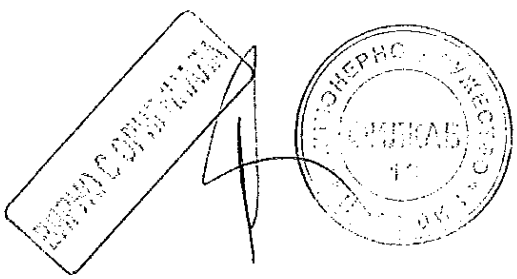


Photo no. 2

Water immersion test

Test date: from October 13 to October 17, 2007

The sample has been immersed in a vessel, in boiling deionized water with 1 kg/m^3 of NaCl, for 42 hours. At the end the sample remained in the vessel until the water cooled to 50 °C and maintained at this temperature in the vessel until verification tests.



Moisture ingress test

Final measurement of watt losses

Test circuit: A0019

Date: October 17, 2007

Sample No. MI3						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	$+mA_{cr}$	$-mA_{cr}$	mA_{rms}	W	μA
06	25,06	0,429	0,509	0,331	0,820	----

Moisture ingress test

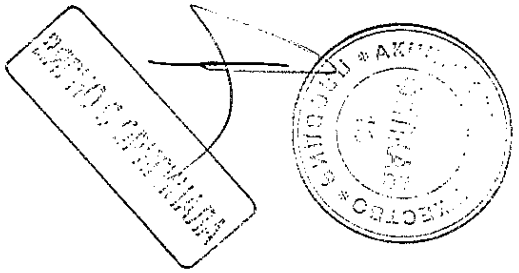
Measurement of partial discharges after the test

Test circuit: A012
Measurement circuit: A022 "direct" calibration: 50 pC/mV, oscillogram no. 07 - background noise ≤ 1 oscillogram no. 08
Arrangement: ---

Atmospheric conditions and correction factor			
b	t_d/t_w	h	Relative umidity
kPa	°C	g / m^3	%
99,97	18 / 13	8,59	56,07

Date: October 17, 2007

Test sample	Applied voltage	Duration of voltage application	Temperature of the test object	Partial discharge measurement		Oscillogram	Notes
				voltage increase Q max	voltage decrease Q max		
	kV_{rms}	s	°C	pC	pC	No.	
MI	39,0	2 ÷ 10	18	---	---		
MI	32,6	measure	18		≤ 1	09	



continued

Moisture ingress test

Lightning impulse residual voltage measurement after the test

Test circuit: A0120

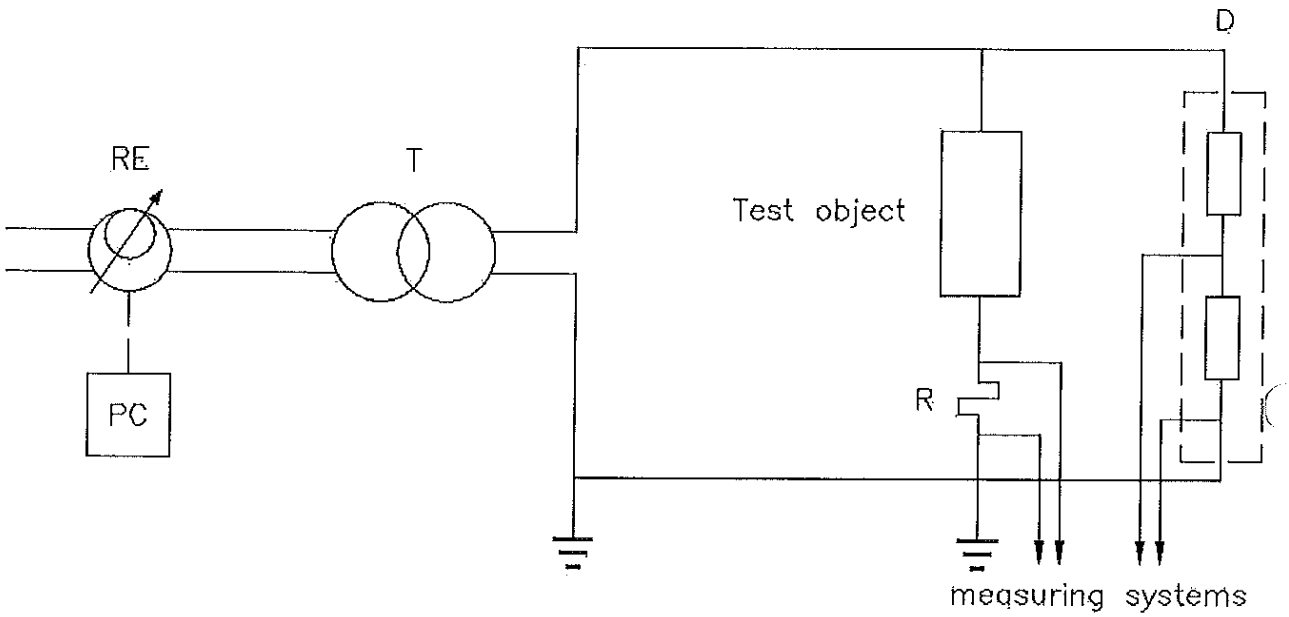
Date: October 17, 2007

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
MI	I_n	95,8 x 5	10	7,1 /18,0	10,10	112,80

	Oscilloscope settings		
	sampling division	input	attenuation
	µs	V_{div}	
Current	5	0,5	50:10
Voltage	5	1,0	100:5

Notes:

Circuit A0019



Power frequency supply

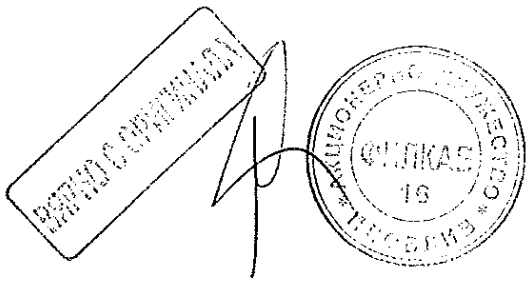
RE - programmable supply type LARCET A.C. Power Source 5000 P.S.; CESI no. 23702-32191
PC - personal computer
T - voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200 V/15-30 kV

Current measuring system

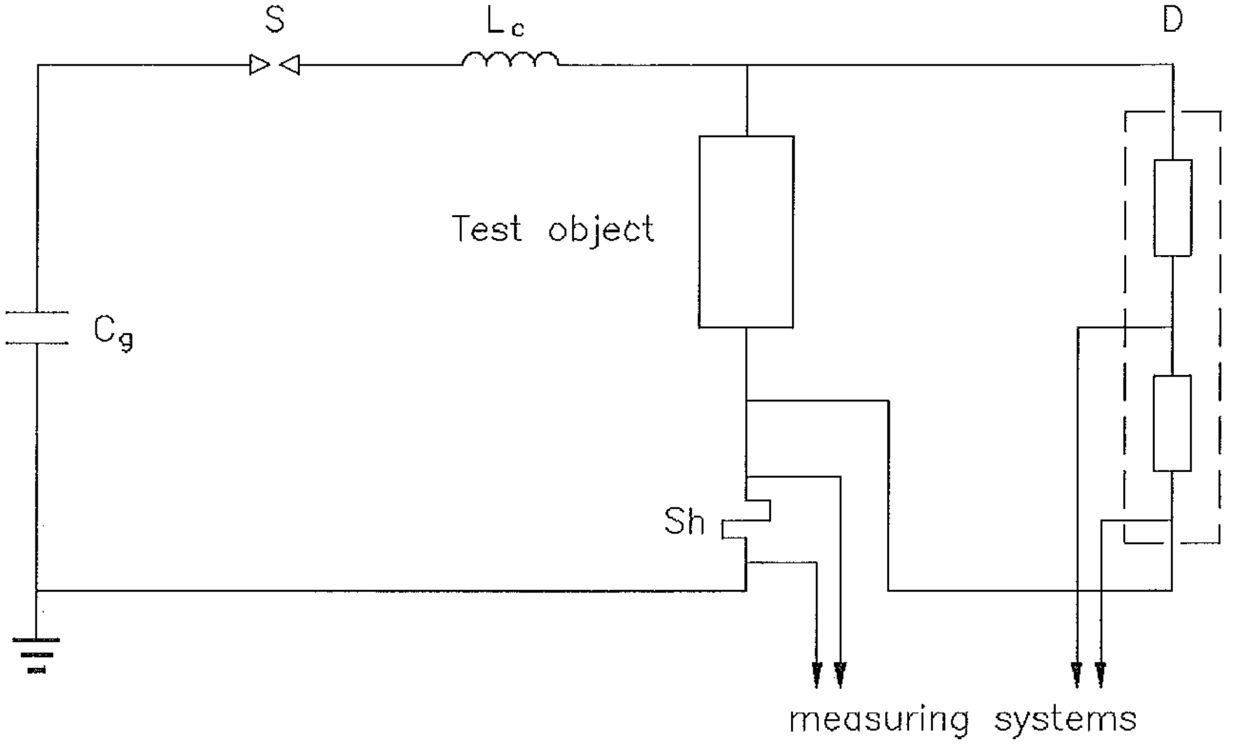
R - Current shunt CESI No.31120; R= 941,4 Ω
- Electro optical system CESI No.11521/522; attenuation 5:5
OSC - Oscilloscope type SONY TEKTRONIX RTD 710A; CESI No.9090

Voltage measuring system

D - Voltage divider SAGI; CESI No.11120
- Electro optical system CESI No.11517/518; attenuation 5:5
OSC - Oscilloscope type SONY TEKTRONIX RTD 710A; CESI No.9090



Circuit A0120



Impulse generator

No. of stages	2
Cg	3,32 µF
Lc	18 µH

S - Spark-gap

Voltage measuring system.

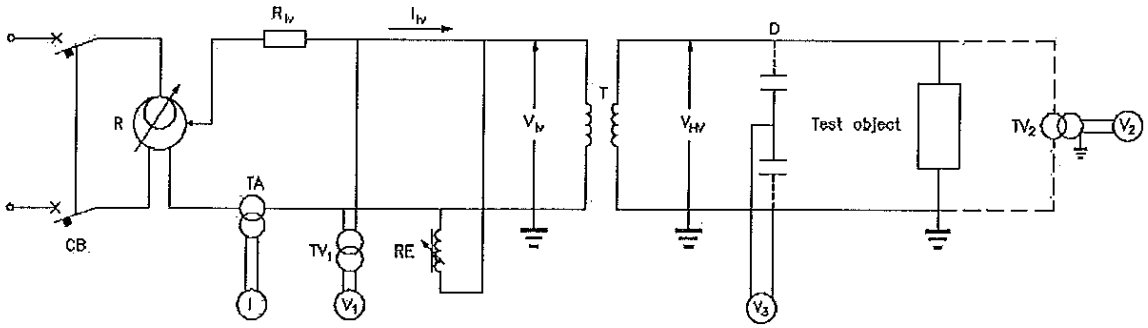
D	- Voltage divider SAGI; CESI No.13027
	- Electro optical system CESI No.11521/522
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.2)

Current measuring system

Sh	- Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
	- Electro optical system CESI No11517/518
OSC	- Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.1)

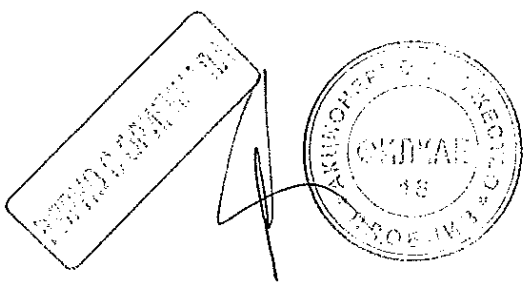
ВЯРНО С ОРИГИНАЛА

Circuit A0012



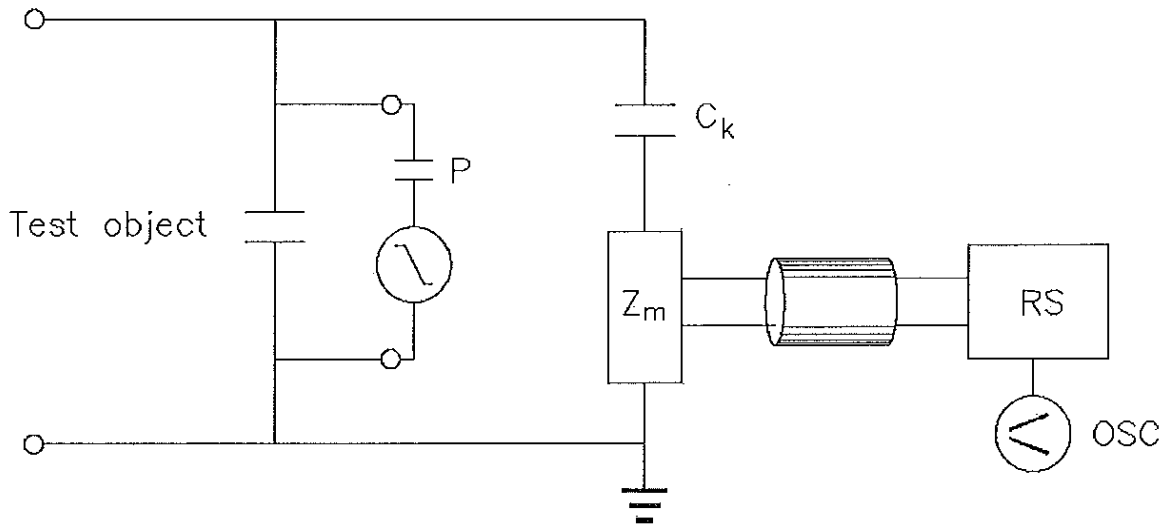
Power frequency test circuit

R	- regulator type CORMES; power 66 kVA; voltage 380 V/0-0,22 kV
TA	- current transformer CGS; ratio 150/5 A/300/5 A
I	- ampermeter
TV_1	- voltage transformer CGS; ratio 220-440 V/100 V
V_1	- voltmeter direct reading TSE
RE	- (not used)
T	- booster transformer PIVI; power 250 kVA; voltage 200-400V/250 kV
D	- (not used)
V_3	- (not used)
TV_2	- voltage transformer type PIVI; ratio 25000 V/100 V
V_2	- voltmeter CESI No.6393



Circuit A0022

Partial discharges measurement
Direct circuit - Scheme 1a



P - calibrator CESI; CESI No. 346
C_k - coupling capacitor 0,3 nF
Z_m - coupling impedance
RS - partial discharge detector HAEFELY TRENCH type TE 571; CESI No. 13281
OSC - (not used)

ВЯРНО С ОРИГИНАЛА

CESI A7031384 oscillogram n. 1

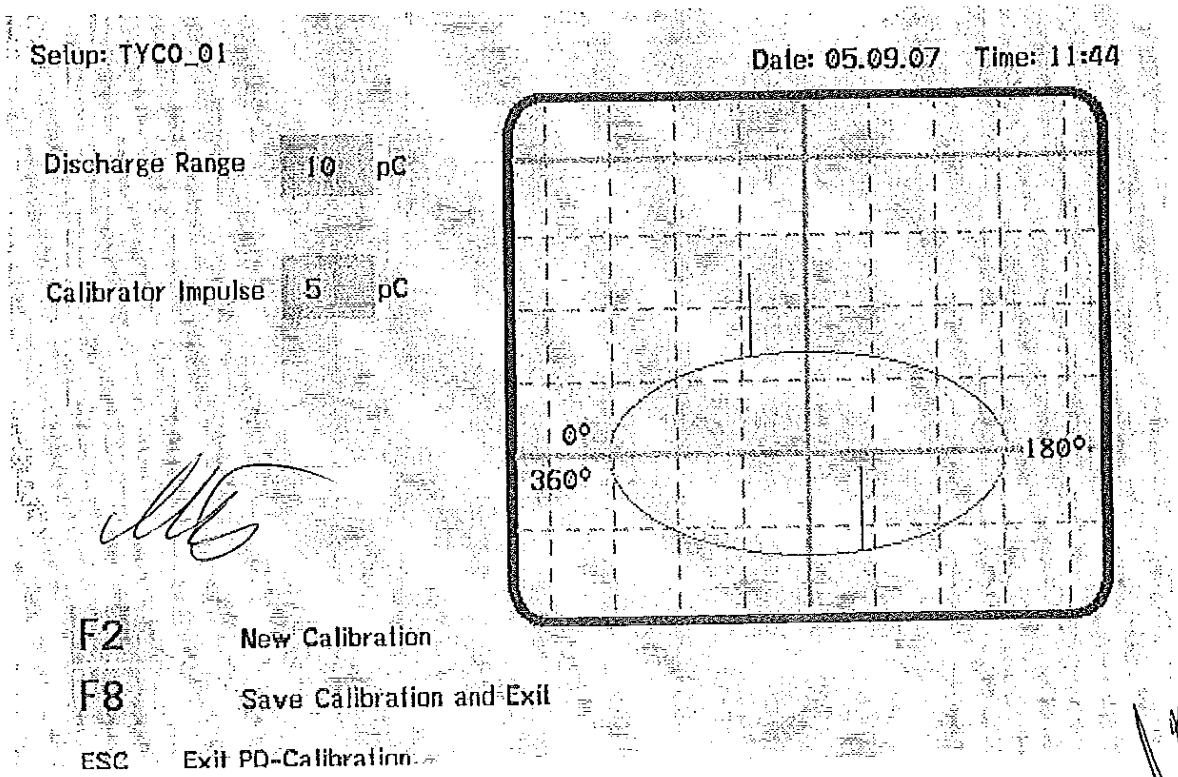
HAEFELY TRENCH TETTEX PD-DETECTOR

Info: 1
Measurement name:
Comment:
1st PD Range: 10 pC
Noise Suppression: 5 %
Test Measuring Time: 15 s

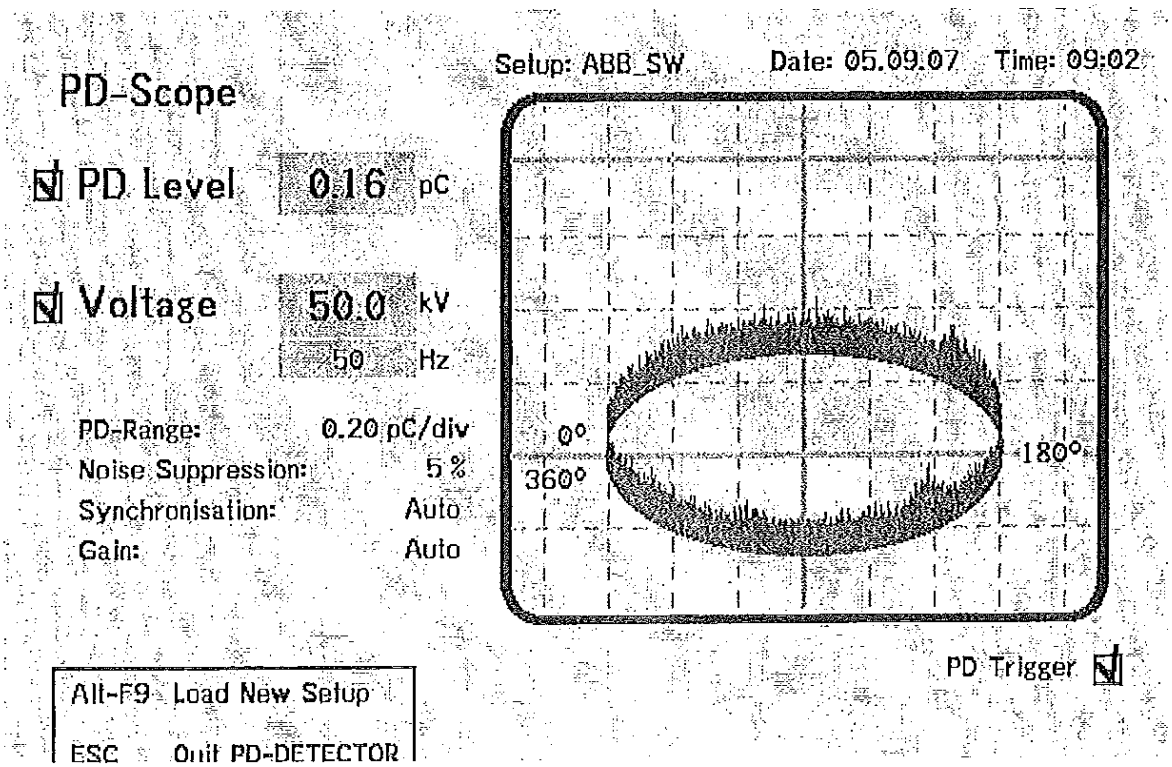
Start date: 00.00.00
Start time: 00:00

2nd PD Range: Not applied
Lockout Time: 7.3 usec
Voltage Range: 40 kV

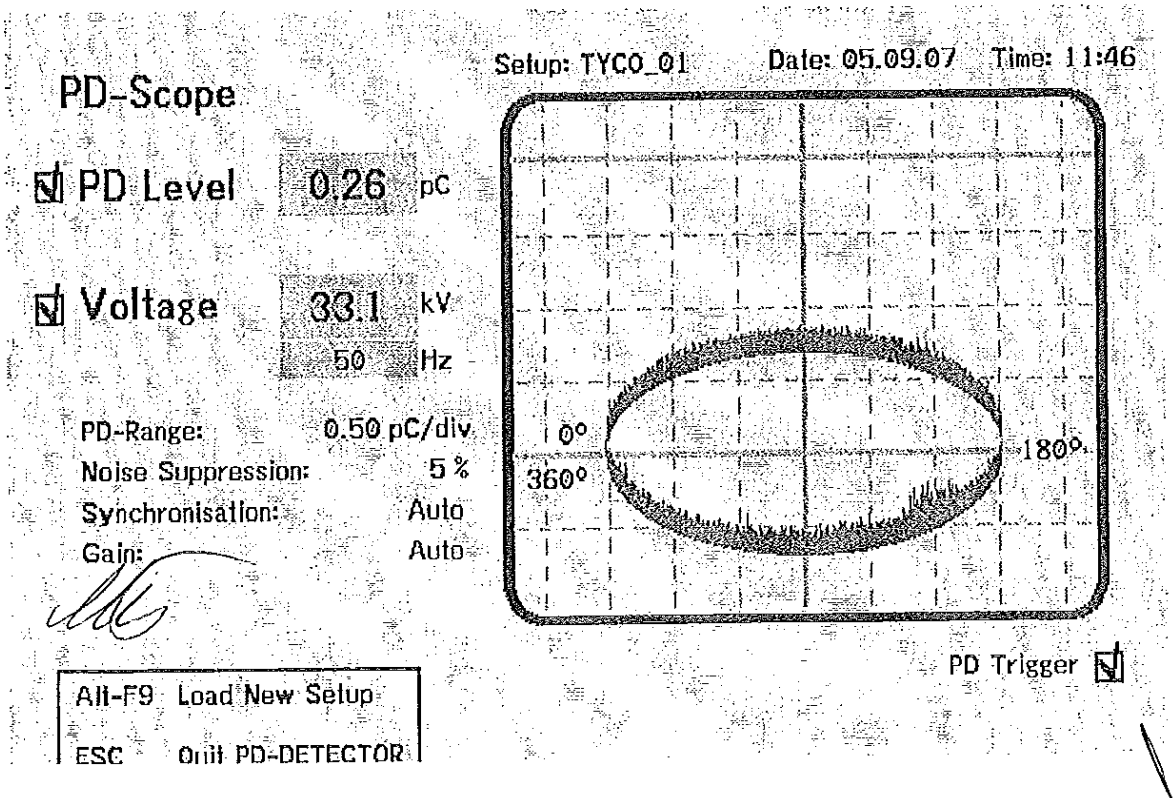
Remarks:



CESI A7031384 oscillogram n. 2



CESI A7031384 oscillogram n. 3



CESI A7031384 oscillogram p. 4

ВЕРНО С ОРИГИНАЛА

CESI A7031384 oscillogram n. 5

CESI A7031384 oscillogram n. 6

ВЕРНО С ОРИГИНАЛА

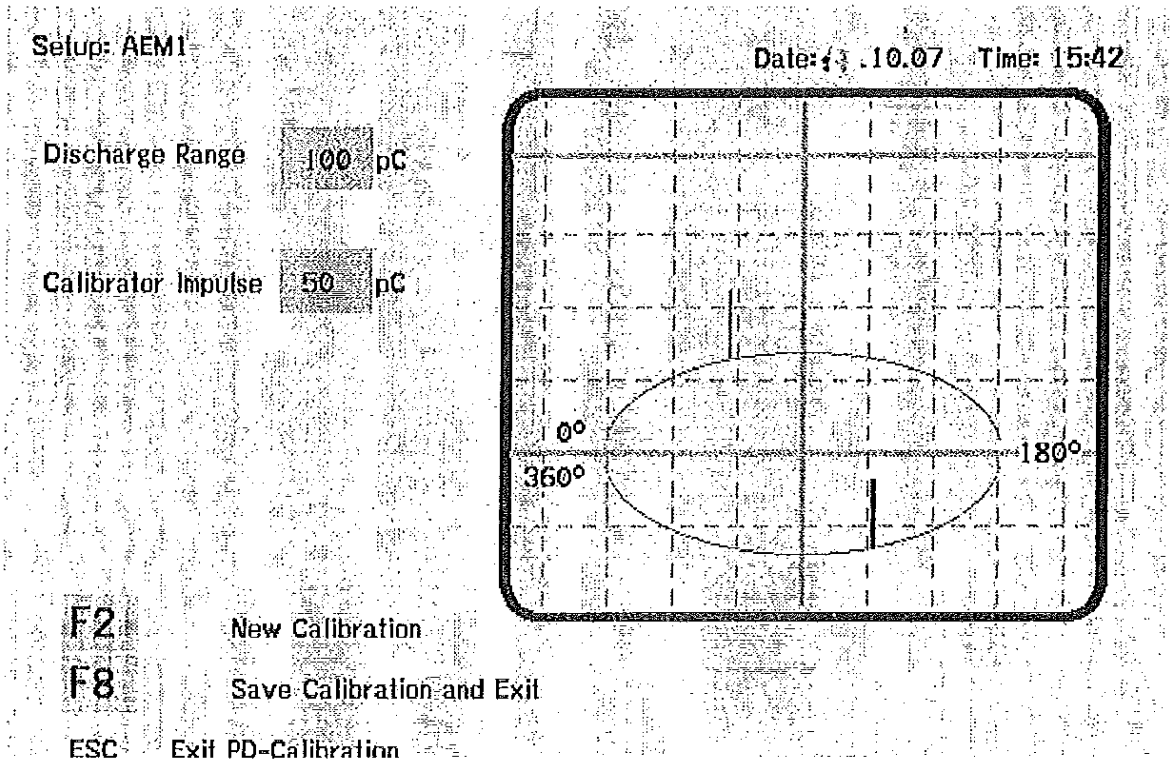
HAEFELY TRENCH TETTEX PD-DETECTOR

Info: 1
Measurement name:
Comment:
1st PD Range: 100 pC
Noise Suppression: 5 %
Test Measuring Time: 15 s

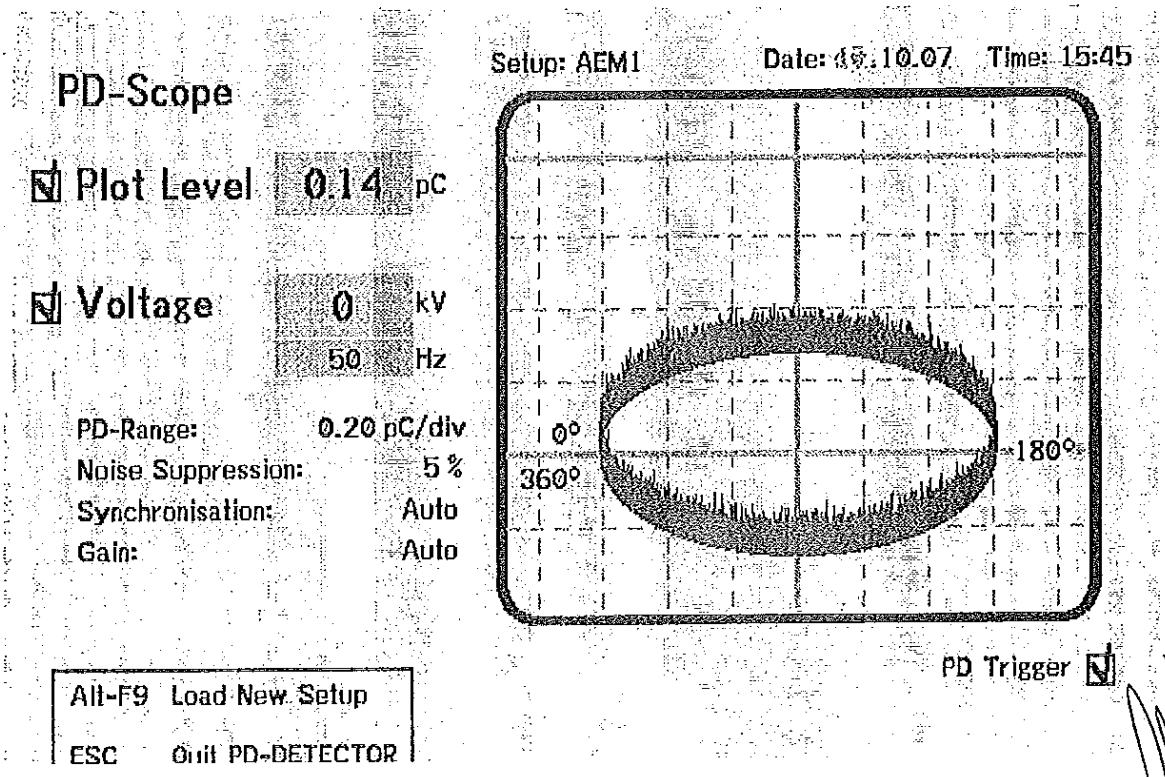
Start date: 00.00.00
Start time: 00:00

2nd PD Range: Not applied
Lockout Time: 7.5 usec
Voltage Range: 40 kV

Remarks:

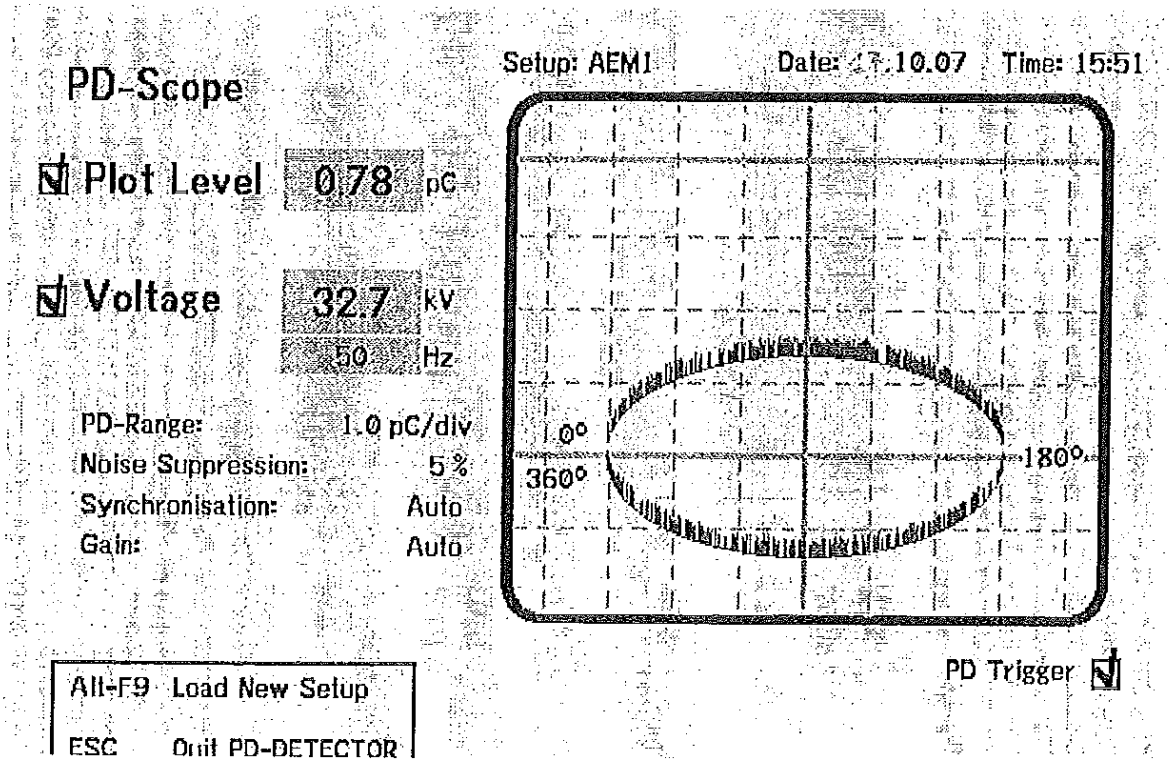


CESI A7031384 oscillogram n. 7



CESI A7031384 oscillogram n. 8

ВЯРНО С ОРИГИНАЛА

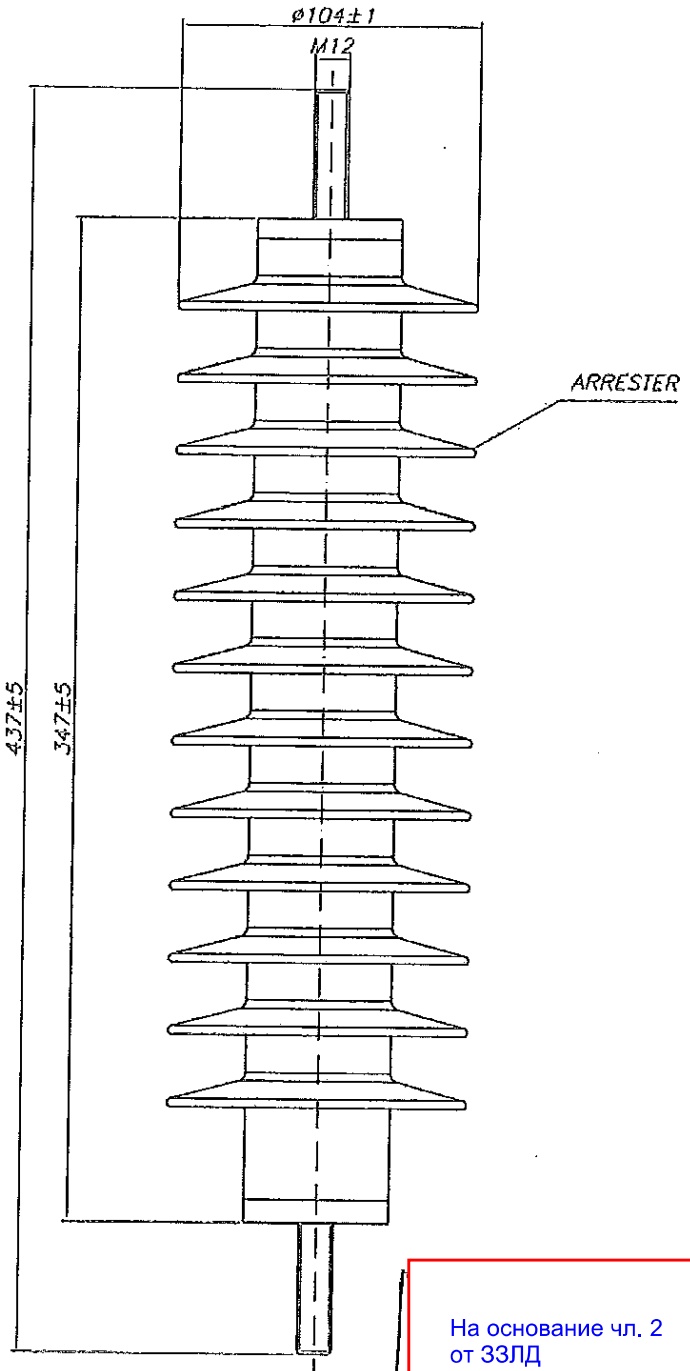


CESI A7031384 oscillogram n. 9

CESI A7031384 oscillogram n. 10

ВЕРНО С ОРИГИНАЛА

SCD



На основание чл. 2
от ЗЗЛД

Ur = 39kV
Uc = 31.2kV
CANT. STRENGTH = 350Nm
TENSION STRENGTH = 2kN
TORQUE = 50Nm
HIGH SHORT CIRCUIT = 21kA
LOW SHORT CIRCUIT 600A
CREEPAGE = 925mm
DRY ARC DISTANCE = 352mm

Tyco Electronics

ENERGY DIVISION

Bowthorpe EMP Surge Arrester

DRN			PDM	
CHECK			DATE	
APP				
SCALE				

TITLE: DA1-39G-NONONO SURGE ARRESTER

DRG NO: DA1-39G-NONONO

SHEET NO 1

REV 0

ВЯРНО С ОРИГИНАЛА

DA1 - Distribution Surge Arrester
Weather Ageing Test
Type Test Report

Tyco Electronics

Our commitment. Your advantage.

Tyco Electronics

Bowthorpe EMP

Test Report

Type	**DA1**
PPR Number	**PPR-2283**
Test	Weather ageing test
Specification	IEC 60099-4 (2006-07) Ed. 2.1

Test Information:

Laboratory	EGU
Date	12/11/2007
External Test Ref	7725/A/07
Report Prepared by	M. Brosch
Test Approved by	V. Sklenicka

Tyco Approvals:

R&D Manager

Brendan Normoyle

Date 28/11/2007

На основание чл. 2
от ЗЗЛД

Product Manager

Brian McGowan

Date 28/11/2007

For further Information contact:
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Co. Clare, Ireland
Tel:+ 353-61-472885
Fax: + 353-61-472676
Email: mvsurgearresters@tycoelectronics.com

E G U – HV Laboratory a.s.

190 11 Praha 9 – Běchovice

CUSTOMER:
Tyco Electronics
Shannon Industrial Estate
100-104 BAY
SHANNON
IRELAND

ORDER No.:
PO 2250310469
PO 2250310796

DATE OF TEST:
from 2007-07-16 till 2007-10-11

TEST No.:
7725/07

TEST REPORT

No.: 7725/A/07

TEST OBJECT:	Composite metal oxide surge arresters
TYPE SPECIFICATION:	DA1 Class 1 Surge Arrester
MANUFACTURER:	Tyco Electronics
TEST STANDARD:	IEC60099-4:2006-07 Ed. 2.1

TEST PERFORMED BY:
Marek Brosch

DIRECTOR OF EGU - HV Laboratory a.s.:
Václav Sklenička

COPIES: 3+1

PAGES: 8

In Prague 9 -Běchovice: 2007-11-12

ВЕРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО ФИЛКАБ 16 ПЛОВДИВ

TEST OBJECT

COMPOSITE METAL OXIDE SURGE ARRESTERS

Drawing No.: DA1 – 30F – N0N0N0 (see Figure 1)

DATE OF DELIVERY

2007-07-12

SCHEDULE OF TESTS

Test series A: 1000 hours IEC60099-4:2006-07, clause 10.8.14.2.1

TEST PROCEDURE

Test series A: 1000 hours

Metal oxide surge arrester samples were subjected to a salt fog test in accordance with IEC60099-4:2006-07, clause 10.8.14.2.1 (test series A).

The metal oxide surge arresters were energised at a voltage of 24 kV that is continuous operating voltage of tested metal oxide surge arresters.

The protection level of the tripping device was set at 1 A (r.m.s.).

During the test the salt fog was sprayed into the test chamber.

The characteristic of the salt fog were as follows:

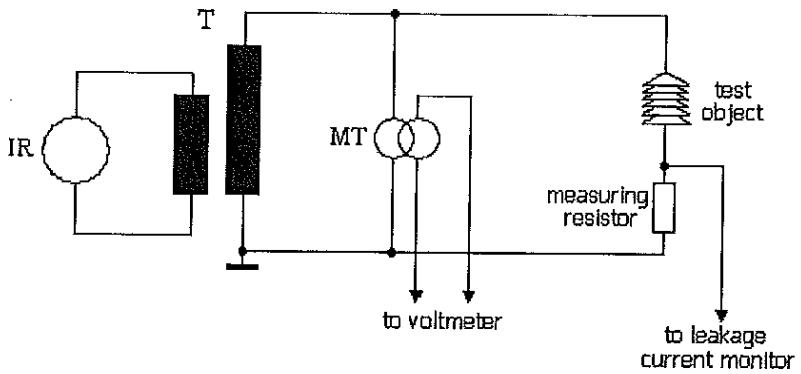
Water flow rate: (0,4 ±0,1) l/h/m^3

Starting salinity: 5 kg/m^3

Temperature: 20 °C ± 5 K

Duration of the test: 1000 hours (excluding duration of interruption)

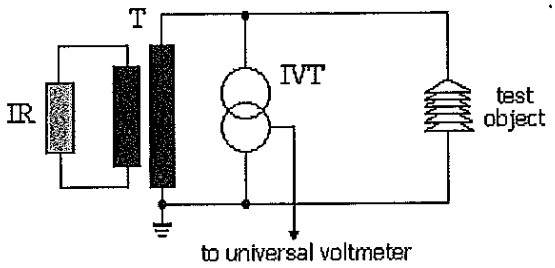
Testing and measuring equipment



IR - inductive regulator MEZ Vsetín type IR 37A-2, 20 kVA
T - test transformer BEZ Bratislava, 50 kV, 25 kVA
MT - voltage measuring transformer UZGT 30, 35 000/100 V, serial No. 02022
voltmeter Metra, type El 20, serial No. 9718268

Measurement of reference voltage

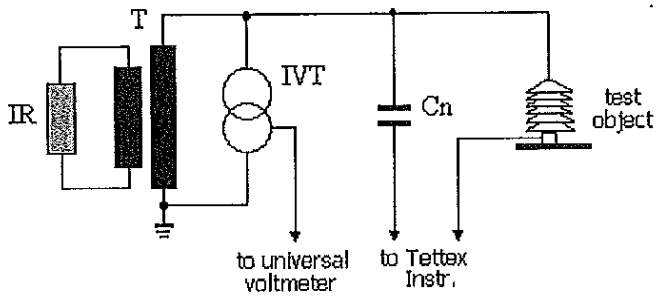
Testing and measuring equipment:



IR - induced regulator ČKD Praha, 3x380/0-760, 45 kVA
T – test transformer Fischer-Köln, 3-6/250 kV, 250 kVA
IVT – instrument voltage transformer Škoda, 380/√3 kV / 100/√3 V, serial No. 917355
digitizer ADAM Maurer, serial No. 9401.9620
universal voltmeter Siemens, type MU 15, serial No. 879953

Measurement of partial discharges

Testing and measuring equipment:



IR - induced regulator ČKD Praha, 3x380/0-760, 45 kVA
T – test transformer Fischer-Köln, 3-6/250 kV, 250 kVA
IVT – instrument voltage transformer Škoda, 380/√3 kV / 100/√3 V, serial No. 917355
PD measuring system Tettex, type 2801, serial No. 123989
universal voltmeter Siemens, type MU 15, serial No. 879953

UNCERTAINTY OF MEASUREMENTS

TYPE OF MEASUREMENT	UNCERTAINTY (k=2)
Power-frequency voltage	0,4 %
Partial discharges	8,0 %

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a Normal (Gaussian) distribution corresponds to a coverage probability of approximately 95 %.

TEST RESULTS

The results of the test are given in Table 1:

Beginning of the test: 2007-07-16 End of the test: 2007-08-27

The results of the verification tests before and after the weather ageing tests and evaluation of the test are given in Table 1.

Table 1

Sample No.:	Reference voltage (kV)		Partial discharges (pC)		Visual inspection after test	Evaluation of the test
	before test	after test	before test	after test		
#72	30,6	30,6	0,4	0,4	no tracking, erosion or puncture	passed
#84	30,4	30,6	0,4	0,4		

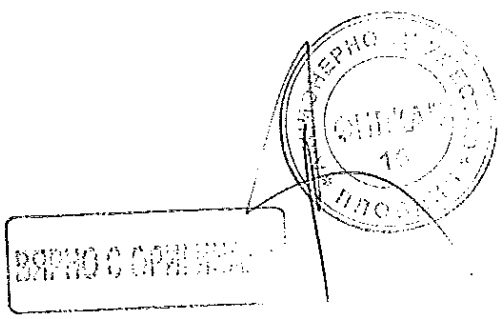
No flashovers occurred during the test.

No interruptions occurred during the test.

The leakage currents of tested insulators were measured as informative values. The records of the leakage currents are given in Figures 2 - 3.

The record of the test voltage during the tracking and erosion test is given in Figure 4.

The photographs of the wetted insulators immediately after finishing the test are shown in Figures 5 - 6.



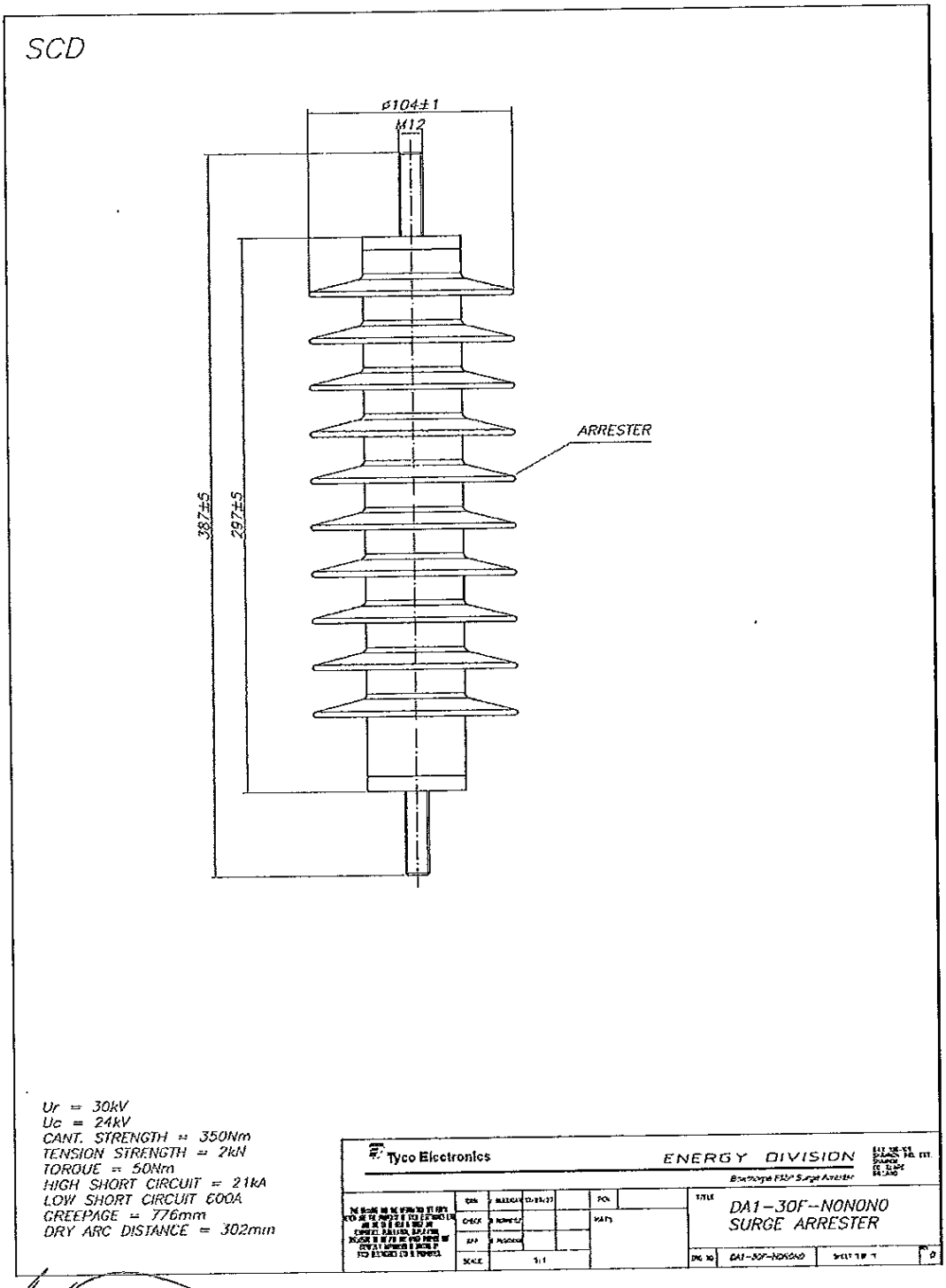


Figure 1
Technical drawing of composite metal oxide surge arrester type DA1

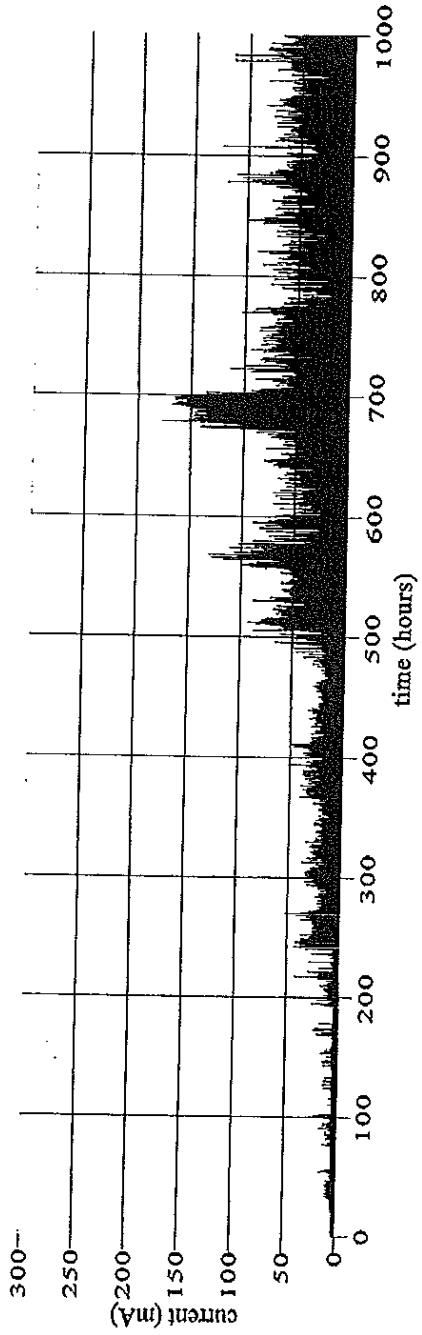


Figure 2: Leakage current - test sample No.72

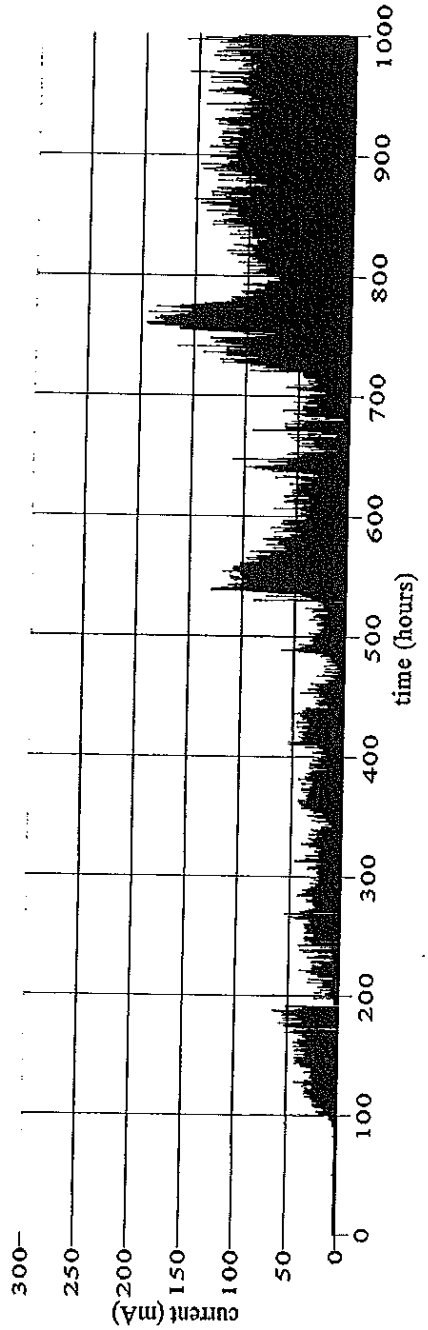


Figure 3: Leakage current - test sample No.84

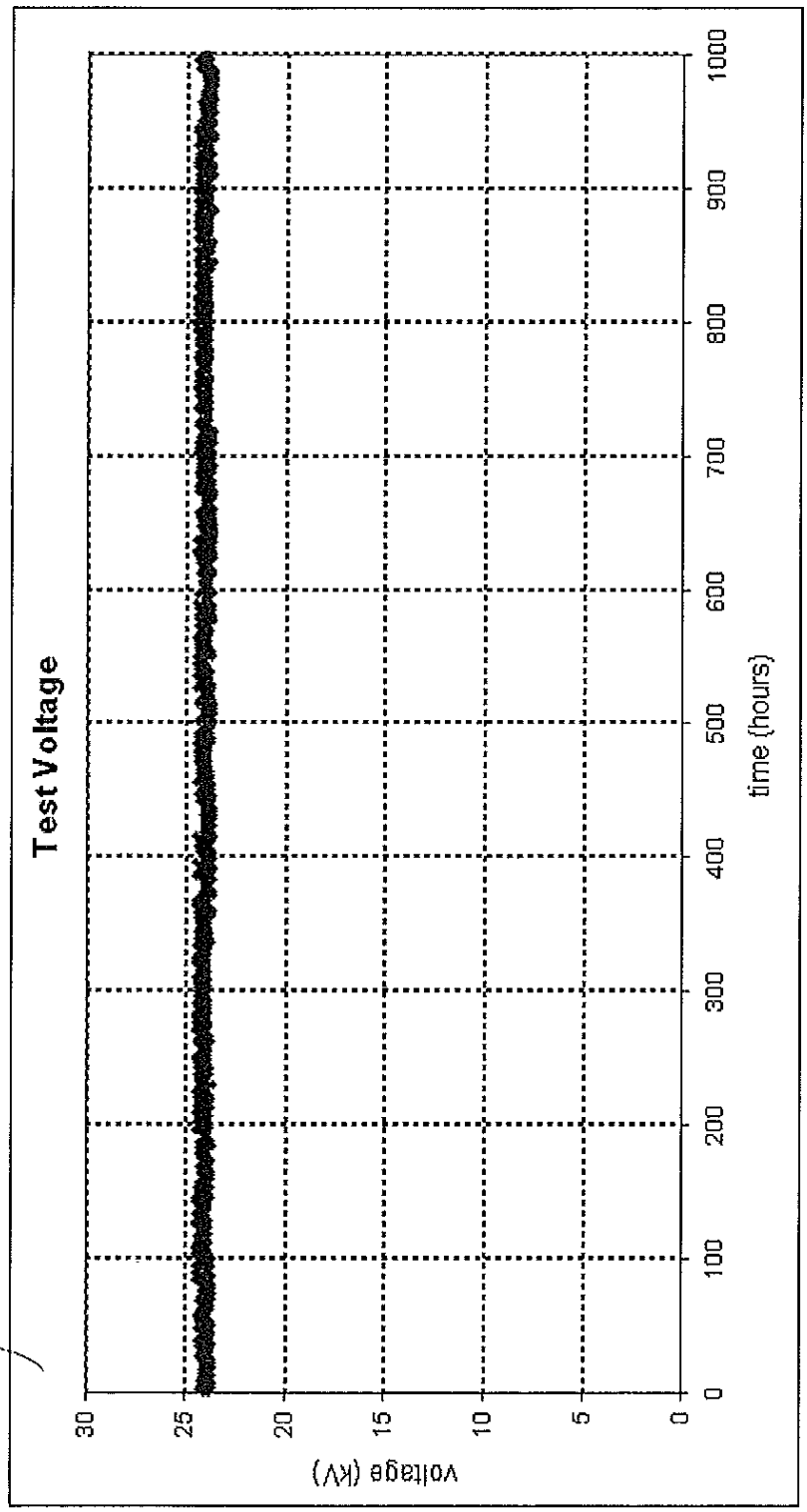


Figure 4
Record of the test voltage during 1000 hour test

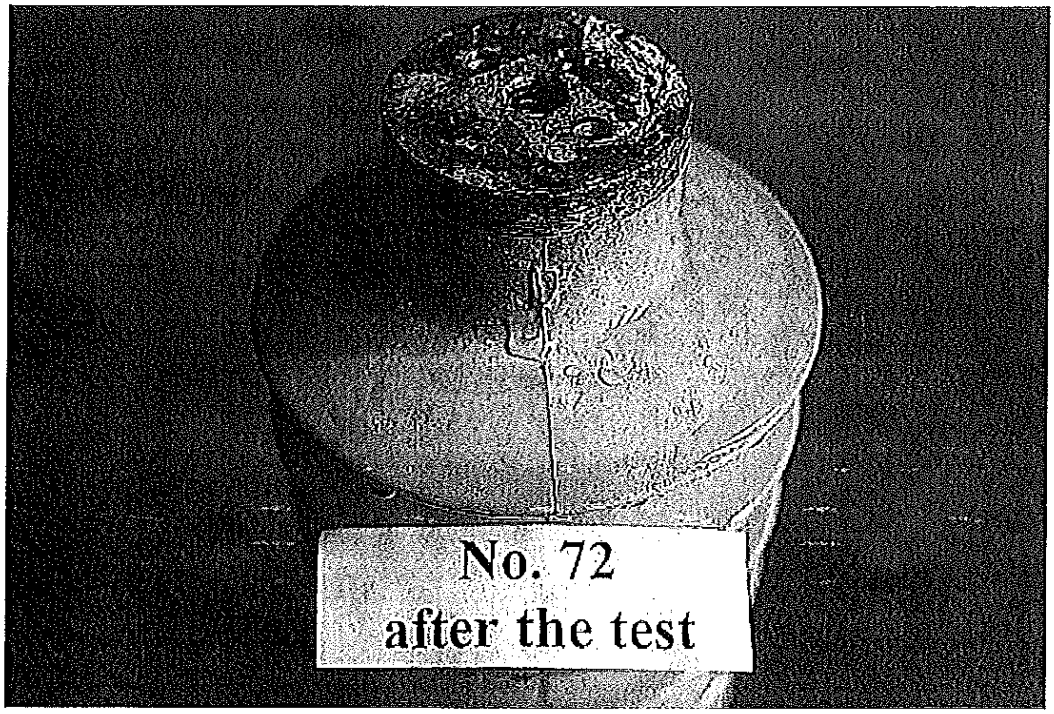
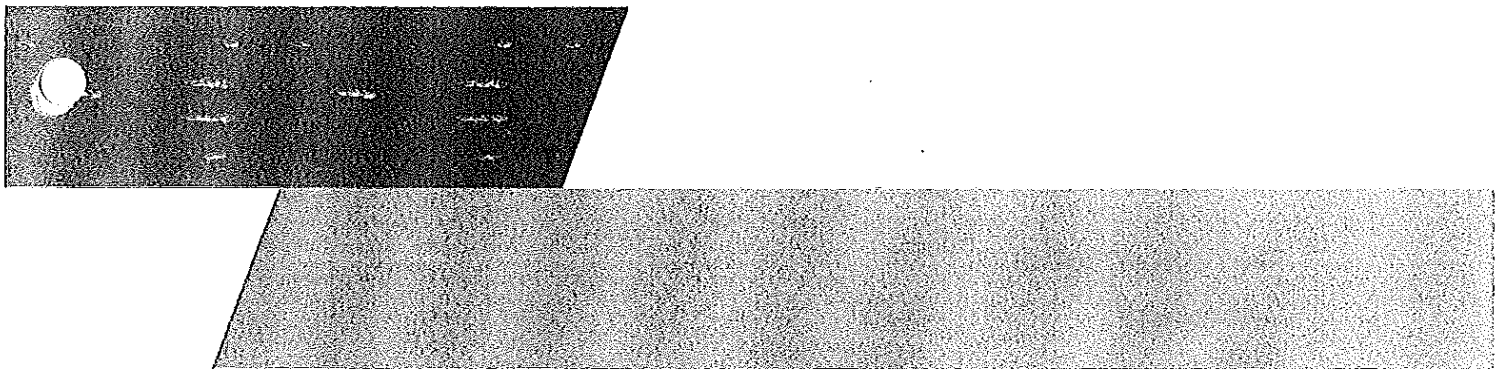


Figure 5
DA1 Class 1 Surge Arrester, test sample No.72 , after the test

Figure 6
DA1 Class 1 Surge Arrester, test sample No.84 , after the test



DA1 - Distribution Surge Arrester
Power frequency voltage versus time test
Type Test Report

Tyco Electronics

Our commitment. Your advantage.

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ФИЛКАБ 16 ПЛОВ

Tyco Electronics

Bowthorpe EMP

Test Report

Type	**DA1**
PPR Number	**PPR-2284**
Test Specification	Power frequency voltage versus time test IEC 60099-4 (2006-07) Ed. 2.1

Test Information:

Laboratory	EGU
Date	03/09/2007
External Test Ref	A7020280
Report Prepared by	M. Gregori
Test Verified by	A. Sironi
Test Approved by	V. Scarioni

Tyco Approvals:

R&D Manager

Brendan Normoyle Sig[illegible] Date 28/11/2007

На основание чл. 2
от ЗЗЛД

Product Manager

Brian McGowan Sig[illegible] Date 28/11/2007

For further information contact:
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Shannon Industrial Estate
Co. Clare, Ireland
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Fax: + 353-61-472676
Email: mvsurgearresters@tycoelectronics.com

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО ОМИКАБ 16 ПЛОВДИВ

Client	TYCO Electronics – Shannon (Ireland)
Tested equipment	Polymer-housed metal-oxide surge arrester section type DA1 assembled in thermal model
Tests carried out	Power frequency voltage versus time test
Standards/Specifications	IEC 60099-4 – Edition 2.1 (2006-07)
Test date	**from** July 24, 2007 **to** August 01, 2007

No. of pages	16	**No. of pages annexed**	24
Issue date	September 03, 20		
Prepared	Unit LABORAT		
Verified	Unit LABORAT		
Approved	Area COMPONE		

На основание чл. 2
от ЗЗЛД

CESI
Centro Elettrotecnico
Sperimentale Italiano
Giacinto Motta spa

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20134 Milano - Italia
Telefono +39 022125.1
Fax +39 0221255440
http://www.cesi.it

Capitale sociale 8 550 000 Euro
interamente versato
Codice fiscale e numero
iscrizione CCIAA 00793580150

Registro Imprese di Milano
Sezione Ordinaria
N. R.E.A. 429222
P.I. IT00793580150

ВЕРНО С ОРИГИНАЛА

Tests witnessed by: ---

Identification of the object: Requested

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawing.
CESI checked that this drawing adequately represents in shape and dimensions the essential details and the parts of the tested object.
This drawing, identified by CESI and numbered A7027907 No. 1, is annexed to this document.

The data necessary to permit repetition of the tests are contained in the document marked: ----

The measurement uncertainties of the test results reported in this document are the following:

- dielectric tests with impulse voltage	: peak voltage: ± 3 %;	time parameters: ± 10 %
- dielectric tests with impulse current	: peak value: ± 3 %;	time parameters: ± 10 %
- dielectric tests with alternating voltage	: voltage (rms): ± 3 %	time: ± 3,5 %
- dielectric tests with direct voltage	: voltage: ± 3 %	time: ± 3,5 %
- atmospheric conditions	: temperature: ± 2 °C;	pressure: ± 0,133 kPa; humidity: ± 10 %

The measurement uncertainties are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to confidence level of about 95%) and have to be considered as maximum values.

Laboratory information

Receipt date of the sample	July 16, 2007
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr L. Podavitte
Test laboratory	P177
Activity code	80090B

ВЯРНО С ОРИГИНАЛА

content	page	test date
Test object characteristics	4	
Panoramic view of the test object	5	
Reference standard	6	
Test carried out	6	
Test object identification	6	
Test procedure	7	
Test results	7	
Reference voltage test	8	July 24, 2007
Voltage correction factor	9	July 24, 2007
Power frequency voltage versus time test	from page 10 to 12	July 31 to August 01, 2007
Technical data of the test circuit	from page 13 to 16	

Pages annexed:

Oscillograms n. 21 pages

Document annexed:

Tyco Electronics drawing n.DA1-6.5-NONONO, CESI n. A7027907 - n. 1 page

Tyco Electronics TOV curve; CESI n.A7027910 – n.1 page

Tyco Electronics Thermal equivalency; CESI n. A7027911 – n.1 page

Test object characteristics

type: Polymer-housed metal-oxide surge arrester section assembled in thermal model

electrical characteristics (assigned by the client)

Manufacturer's name	TYCO Electronics – Shannon (Ireland)
Type	DA1
Nominal discharge current – I_n [kA]	10
Rated voltage – U_r [kV]	1,045 x Uref
Continuous operating voltage - U_c [kV]	0,836 x Uref
Reference current - $I_{ref.}$ [mA]	5,0
Line discharge class	1
Standard rated frequency - [Hz]	50/60
year of manufacture	2007

NOTE:
The thermal model was supplied by the manufacturer
The verification of the thermal equivalency according to annexe B was carried out by the Client
(see Tyco Electronics document DA1 Class 1 Surge Arrester Thermal equivalency*; CESI no.A7027911)

ВЯРНО С ОРИГИНАЛА

View of the test object

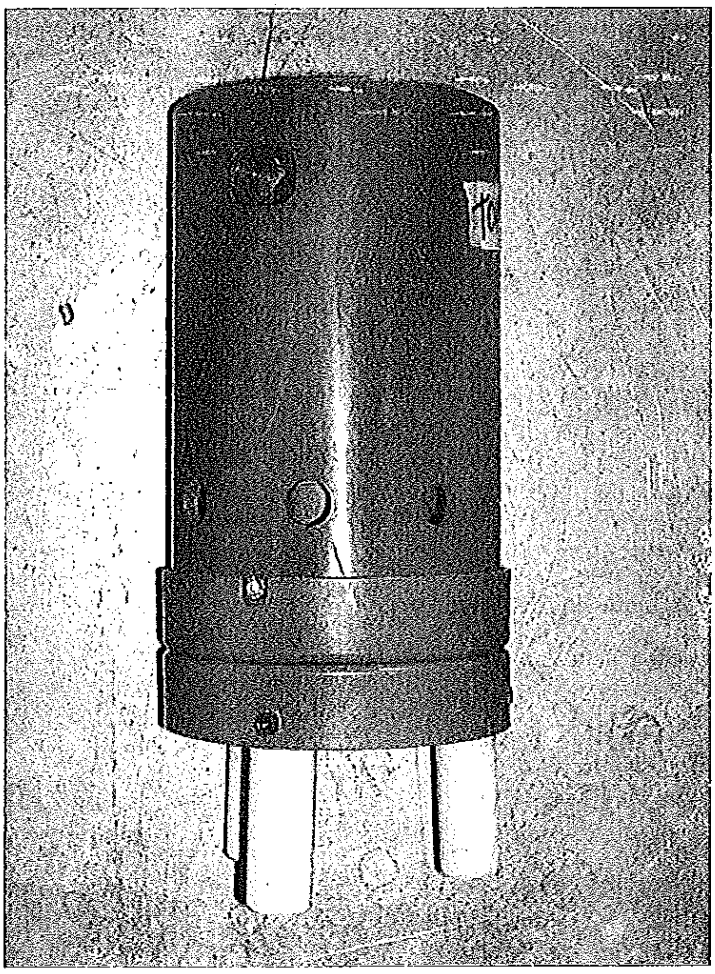


Photo no. 1

Polymer-housed metal-oxide surge arrester section assembled in thermal model

Reference standard

The test was carried according to the IEC 60099-4 (2006-07) Standard – Annexe D

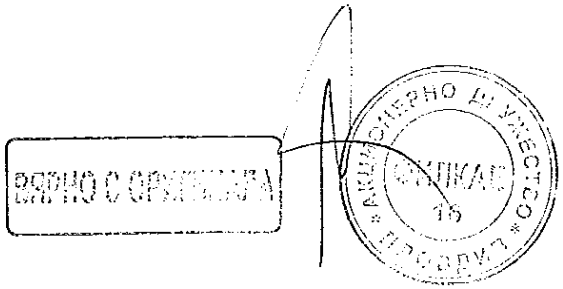
" Metal-oxide surge arrester without gaps for a.c. system "

Test carried out

test carried out	number of sample tested
power frequency voltage versus time test	3

Test object identification

test object names	identification of test sample (assigned by the CESI)
Polymer – housed metal-oxide surge arrester assembled in thermal model	TOV1-TOV2-TOV3



Test procedure

The test procedure consisted of the following sequence:

a) Measurement of the power frequency reference voltage at the reference current

b) Calculation of the voltage correction factors according to the reference standard

c) Heating in an oven at the temperature of 60 °C till thermal equilibrium

h) Application of one high current impulse 4/10 µs at 100 kA followed within 100 ms by the energization at the voltage U_{TOV} for a time T_{TOV} (according to the TOV curve to be proved as supplied by manufacturer) and then at the voltage U_c' for 30 min. in order to verify the thermal stability.

Three samples have been tested according to the table below

Sample	Voltage U_{TOV}	Time duration
TOV1	0,89 x Ur'	10000 sec.
TOV2	0,98 x Ur'	100 sec.
TOV3	1,10 x Ur'	1 sec.

Test results

The thermal stability was achieved for all tested sample.
The visual inspection of the test sample after the test has revealed no sign of physical damage.

<u>All acceptance criteria specified by the standard are satisfied and therefore the TOV curve claimed by the manufacturer are to be considered verified.</u>

Power frequency voltage versus time test.

Reference voltage test

Test circuit: A0019

Date: July 24 ,2007

Sample No.TOV1						
oscillogram	voltage	current	current	current	Power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
1	6,54	5,01	4,25	1,62	6,71	--

Sample No. TOV2						
oscillogram	voltage	current	current	current	Power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
2/B	6,68	5,00	4,27	1,62	6,96	--

Sample No.TOV3						
oscillogram	voltage	current	current	current	Power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
3	6,58	4,62	5,05	1,67	6,95	--

ВЕРНО С ОРИГИНАЛА

Power frequency voltage versus time test.

Voltage correction factor

Date: July 24, 2007

Sample	U_{ref} [1]	KU_r [2]	KU_c [3]	U_r' [4]	U_c' [5]
No.	kV			kV	kV
TOV1	6,54	1,045	0,836	6,834	5,467
TOV2	6,68			6,981	5,584
TOV3	6,58			6,876	5,501

[1] U_{ref} : measured reference voltage
[2] KU_r : maximum guaranteed factor for calculation of Ur
[3] KU_c : maximum guaranteed factor for calculation of Uc
[4] U_r' : corrected rated voltage [4] = [1] × [2]
[5] U_c' : corrected continuous operating voltage [5] = [1] × [3]

Power frequency voltage versus time.

Application of the high current impulse, of the rated voltage U_r' and evaluation of thermal stability

Test circuit: A0123 - A0131 – A0020

Sample No.: TOV 1

Preheating temperature: 61 °C

Date: July 31, 2007

Second high current impulse application

Oscillogram	Charging voltage	Residual voltage	Discharge current	Energy	Current waveshape
No.	kV	kV	kA	kJ	µs
4	78 x 2	---	99,0	---	4,5/9,8

Temporary overvoltage application
Amplitude claimed by the manufacturer U_r' x 0,89 = 6,834 x 0,89 = 6,082 kV
Duration claimed by the manufacturer 10000 sec.

U_r' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	s	kV	+ mA_{cr}	- mA_{cr}	W
5	0	6,082	17,0	23,0	---
6	10000		0,94	1,0	---

U_c' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	min	kV	+ mA_{cr}	- mA_{cr}	W
7	0	5,467	0,80	0,83	0,60
	5		0,79	0,82	0,54
	10		0,79	0,81	0,53
8	15		0,78	0,80	0,52
	20		0,77	0,79	0,51
	25		0,76	0,79	0,50
9	30		0,76	0,78	0,49

continued

continued

Sample No.: TOV3

Preheating temperature: 61 °C

Date: August 01, 2007

Second high current impulse application

Oscillogram	Charging voltage	Residual voltage	Discharge current	Energy	Current
No.	kV	kV	kA	kJ	µs
16	76,0 x 2	---	96,0	---	4,5/9,8

Temporary overvoltage application
Amplitude claimed by the manufacturer **U_r' x 1,10 = 6,876 x 1,1 = 7,563 kV**
Duration claimed by the manufacturer 1 sec.

U_r' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	s	kV	+ mA_{cr}	- mA_{cr}	W
17	0	7,563	140	217	---
18	1		133	214	---

U_c' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	min	kV	+ mA_{cr}	- mA_{cr}	W
19	0	5,501	1,00	1,00	1,16
	5		0,87	0,94	1,05
	10		0,84	0,91	0,96
20	15		0,83	0,90	0,94
	20		0,82	0,90	0,93
	25		0,81	0,89	0,92
21	30		0,80	0,87	0,90

ВЯРНО С ОРИГИНАЛА

continued

Sample No.: TOV2

Preheating temperature: 61 °C

Date: August 01, 2007

Second high current impulse application

Oscillogram	Charging voltage	Residual voltage	Discharge current	Energy	Current
No.	kV	kV	kA	kJ	µs
22	78 x 2	---	99,0	---	4,5/9,8

Temporary overvoltage application

Amplitude claimed by the manufacturer U_r' **x 0,98 = 6,981 x 0,98 = 6,841 kV**

Duration claimed by the manufacturer 100 sec.

U_r' voltage application

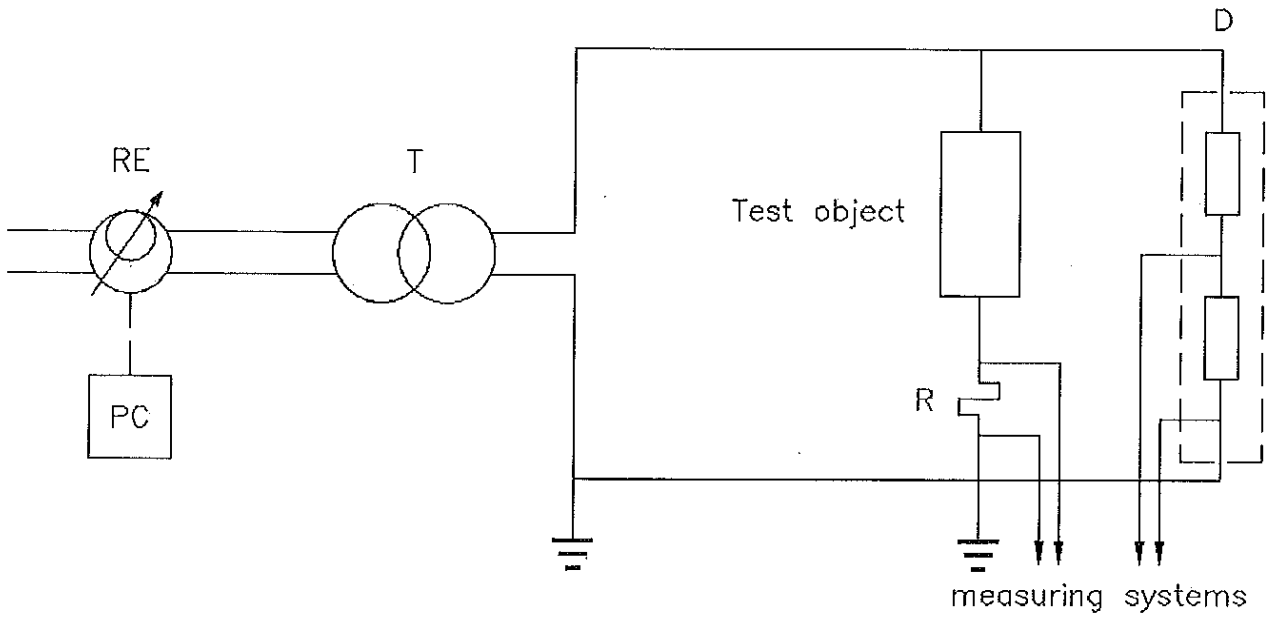
Oscillogram	Time	Voltage	Current	Current	Power
No.	s	kV	+ mA_{cr}	- mA_{cr}	W
23	0	6,841	54,0	63,0	---
24	100		9,0	16,5	---

U_c' voltage application

Oscillogram	Time	Voltage	Current	Current	Power
No.	min	kV	+ mA_{cr}	- mA_{cr}	W
25	0	5,58	0,96	1,00	1,49
	5		0,90	0,98	1,30
	10		0,86	0,96	1,15
26	15		0,84	0,93	1,02
	20		0,83	0,91	0,96
	25		0,82	0,90	0,94
27	30		0,81	0,89	0,90

ВЯРНО С ОРИГИНАЛА

Circuit A0019



Power frequency supply

RE - programmable supply type LARCET A.C. Power Source 5000 P.S.; CESI no. 23702-32191
PC - personal computer
T - voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200 V/15-30 kV

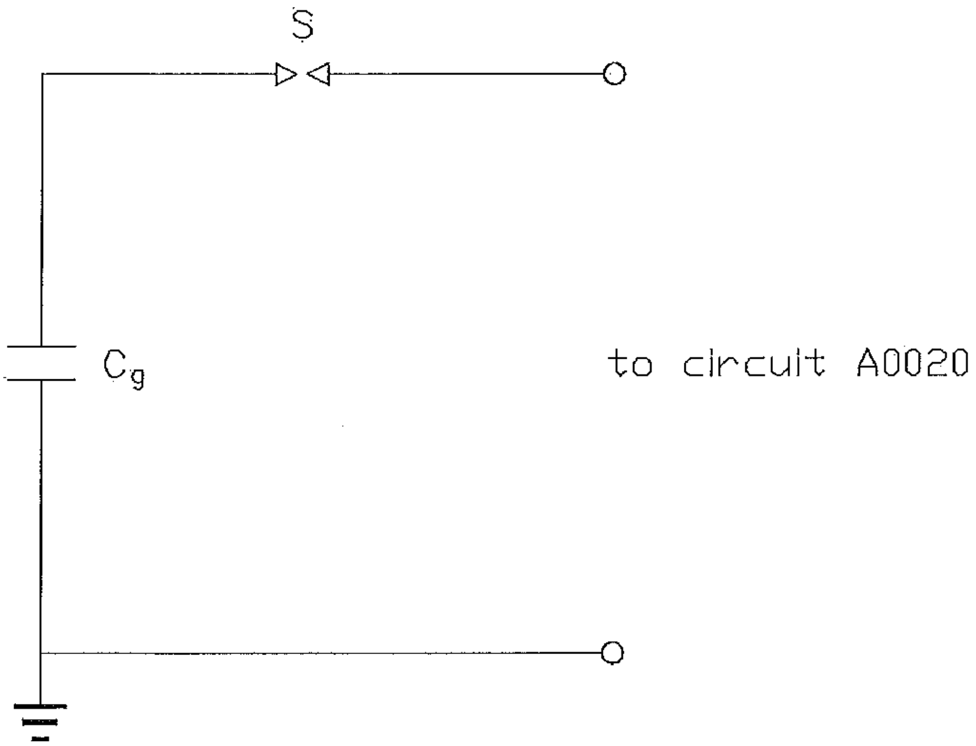
Current measuring system

R - Current shunt CESI No.31120; R= 941,4 Ω
- Electro optical system CESI No. -- ; attenuation
OSC - Oscilloscope type SONY TEKTRONIX RTD 710; CESI No.6318

Voltage measuring system

D - Voltage divider SAGI; CESI No.11120
- Electro optical system CESI No.11521/1522; attenuation 50:5
OSC - Oscilloscope type SONY TEKTRONIX RTD 710; CESI No.6318

Circuit A0123

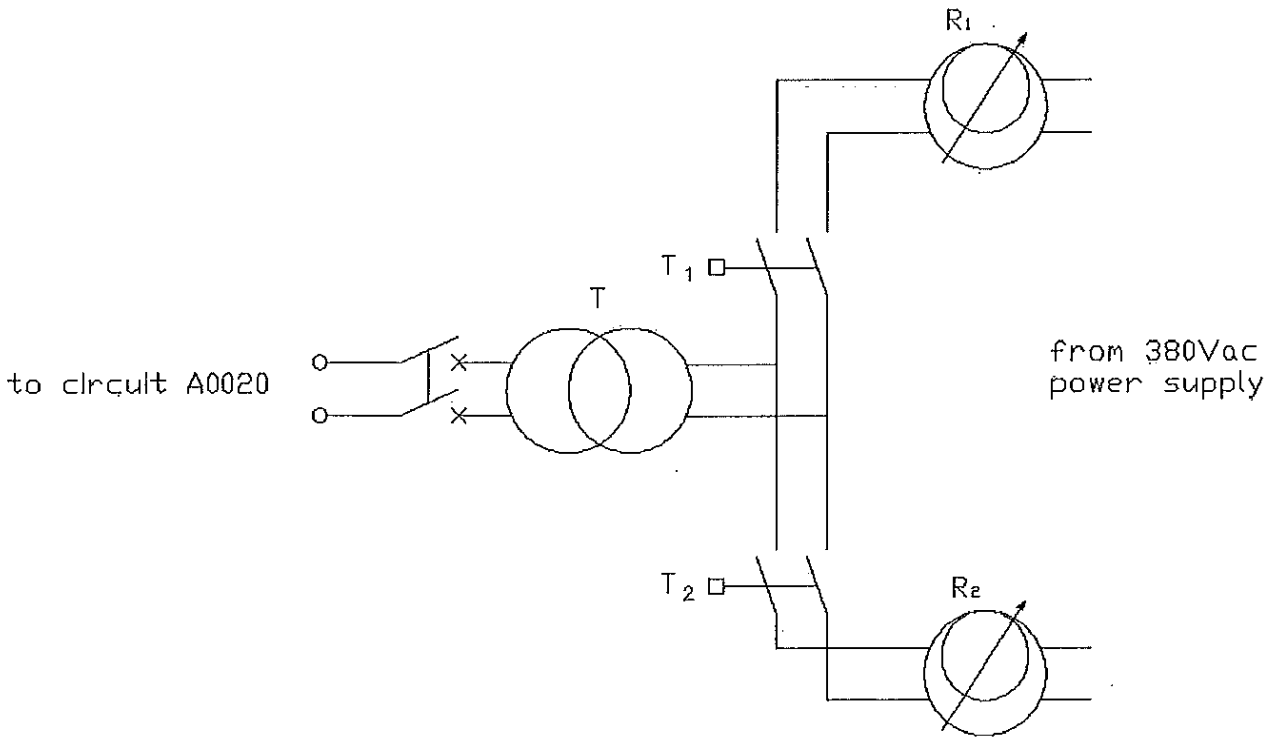


Impulse generator circuit

No. of stages 2
Cg 3,32 μF

S - spark-gap

Circuit A0131

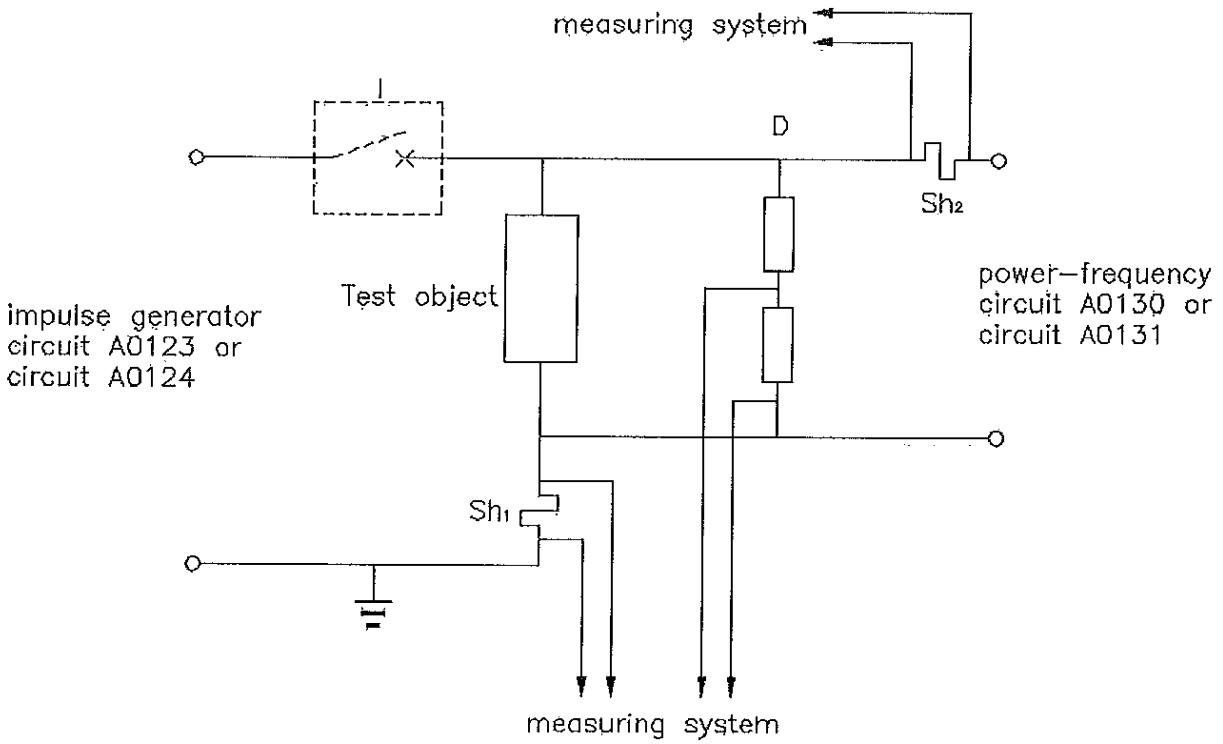


Power-frequancy circuit

from 380Vac power supply

R_1	single-phase voltage regulator CORMES; power 20 kVA; voltage 380/0÷220 Vac
R_2	single-phase voltage regulator CORMES; power 10 kVA; voltage 380/0÷220 Vac
T_1	voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200-400 V/15-30 kV

Circuit A0020



Impulse generator circuit A0123

I - Circuit-breaker

Impulsive current measuring system

Sh_1 - Current shunt CESI No.6042; R= 2 m Ω
- Electro optical system CESI No.11517/518; attenuation 300:5

OSC_1 - Oscilloscope type TEKTRONIX TDS 540A; CESI No.13217 (on channel No.1)

Power frequency voltage measuring system circuit A0131

D - Voltage divider SAGI; CESI No.13027
- Electro optical system CESI No.11521/522; attenuation 20:5

OSC_2 - Oscilloscope type TEKTRONIX TDS 460A; CESI No.14434 (on channel No.2)

OSC_3 - Oscilloscope type SONY TEKTRONIX RTD 710A ; CESI No.9090 (on channel No.1)

Power frequency current measuring system circuit A0131

Sh_2(TOV) - Current shunt CESI ; R= 100 Ω (TOV 1 s) – Current shunt CESI
- Current shunt CESI ; R= 1000 Ω (TOV 100/10000 s)
- Electro optical system CESI No. 8011/17; attenuation 300-5:5

OSC_2 - Oscilloscope type SONY TEKTRONIX RTD 710A ; CESI No.9090 ; CESI No.13217 (on channel No.2)

CESI A7020280 Oscillogram n. 1

CESI A7020280 Oscillogram n. 2/B

ВЯРНО С ОРИГИНАЛА

CESI A7020280 Oscillogram n. 3

CESI A7020280 Oscillogram n. 4

ВЯРНО С ОРИГИНАЛА

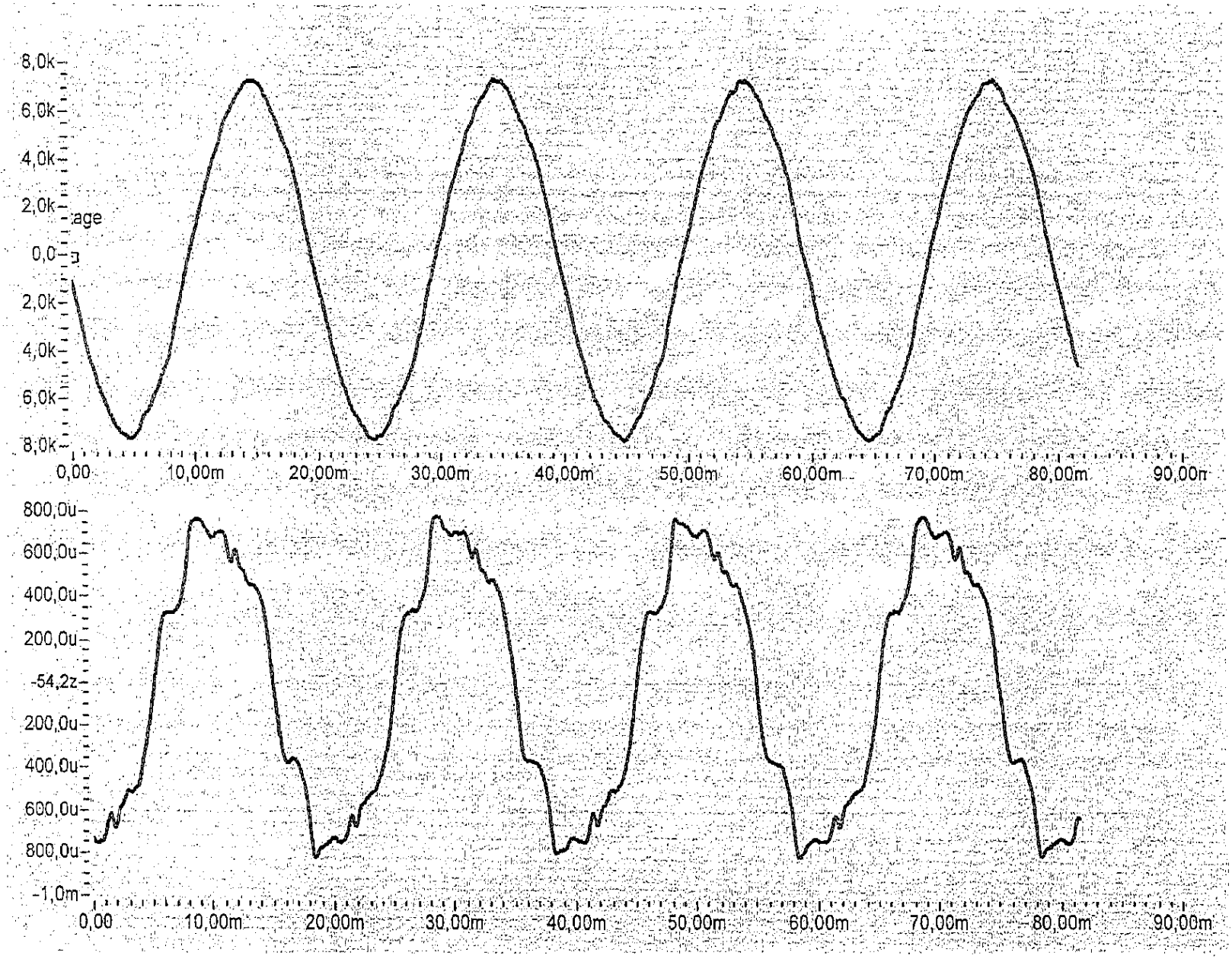
CESI A7020280 Oscillogram n. 5

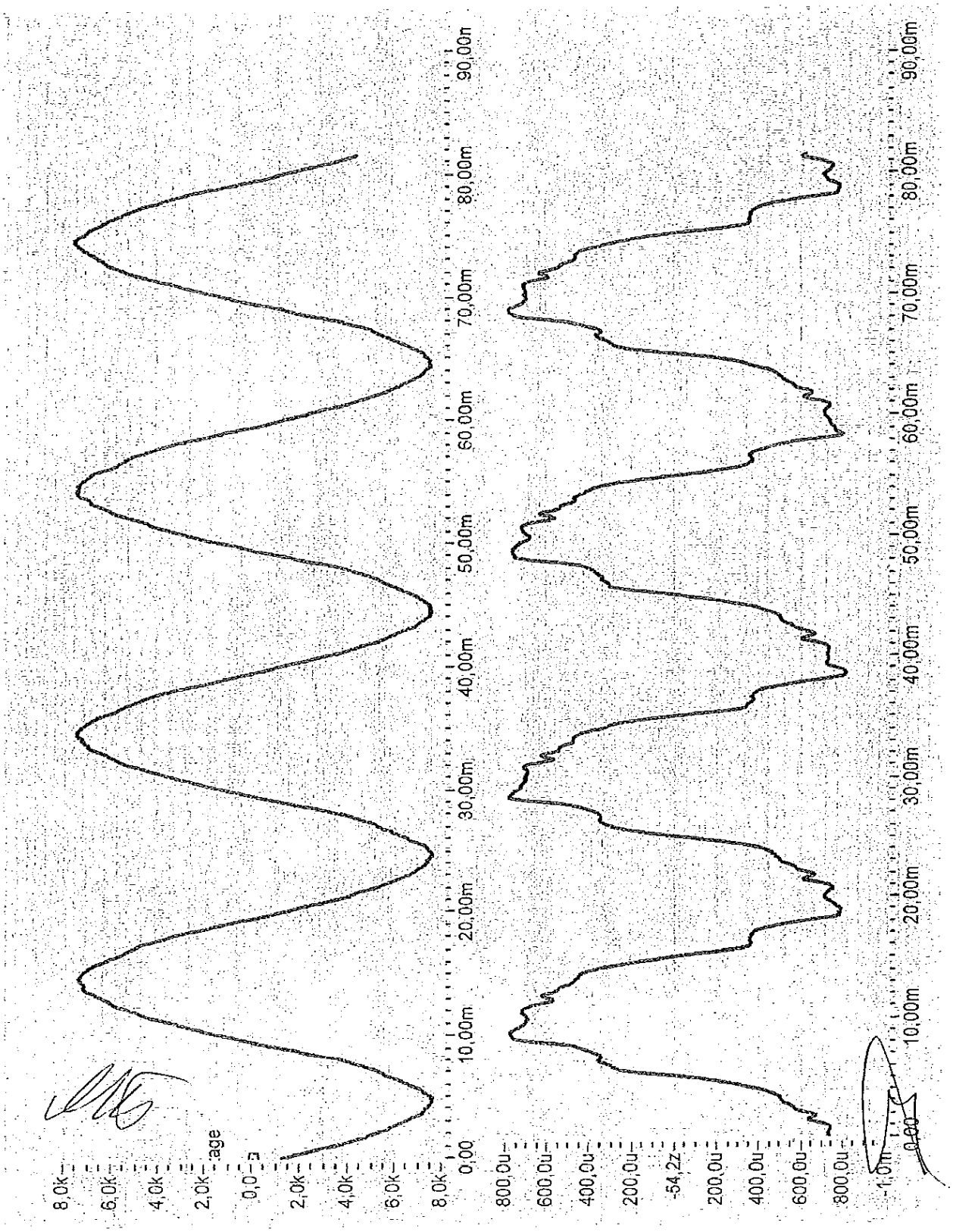
ВЕРНО С ОРИГИНАЛА

CESI A7020280 Oscillogram n. 6

CESI A7020280 Oscillogram n. 7

CESI A7020280 Oscillogram n. 8





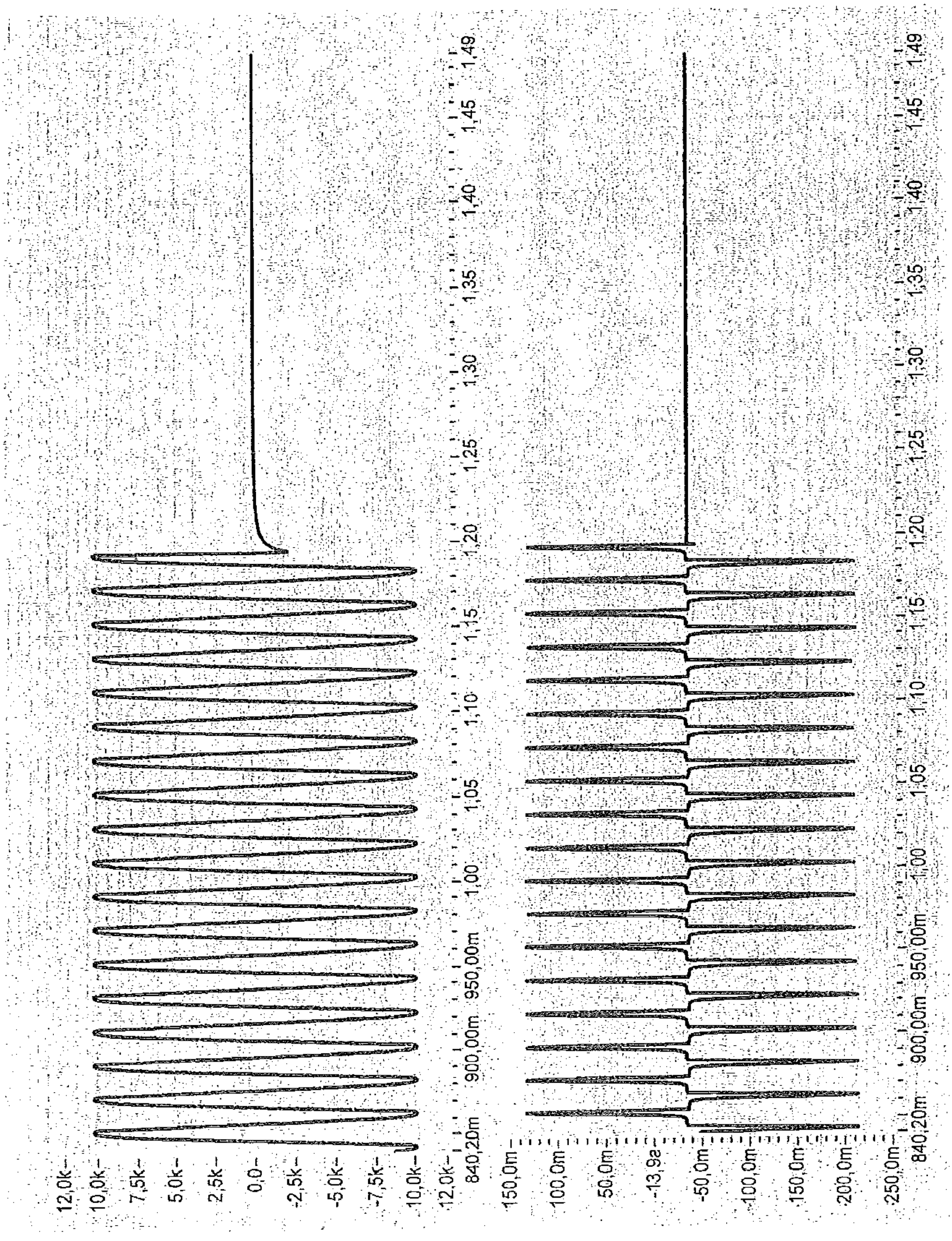
CESI A7020280 Oscillogram n. 9

ВЯРНО С ОРИГИНАЛА

CESI A7020280 Oscillogram n. 16

CESI A7020280 Oscillogram n. 17

ВЯРНО С ОРИГИНАЛА



CESI A7020280 Oscillogram n. 18

CESI A7020280 Oscillogram n. 19

ВЯРНО С ОРИГИНАЛА

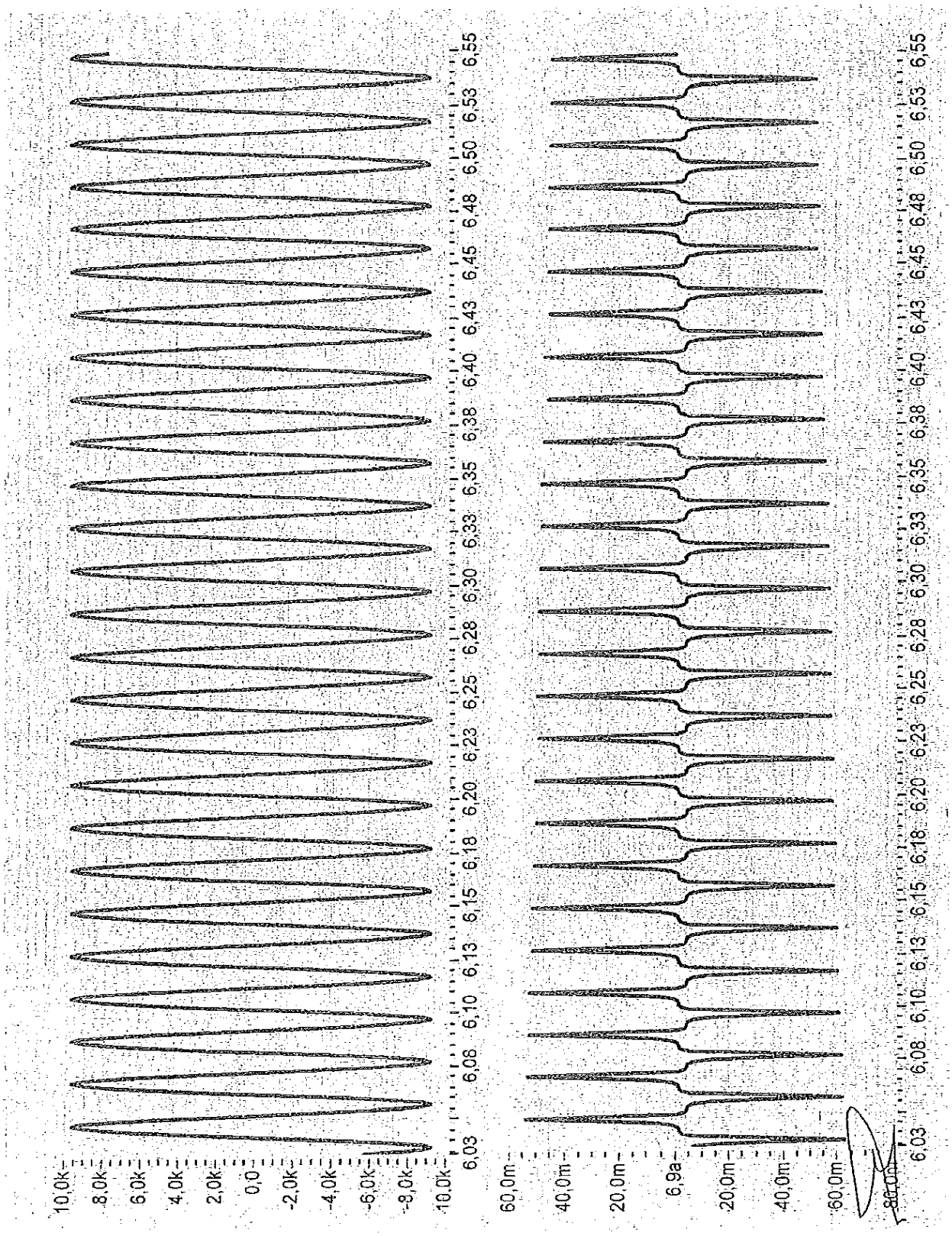
АКЦИОНЕРНО ДРУЖЕСТВО ПЛОВДИВ

CESI A7020280 Oscillogram n. 20

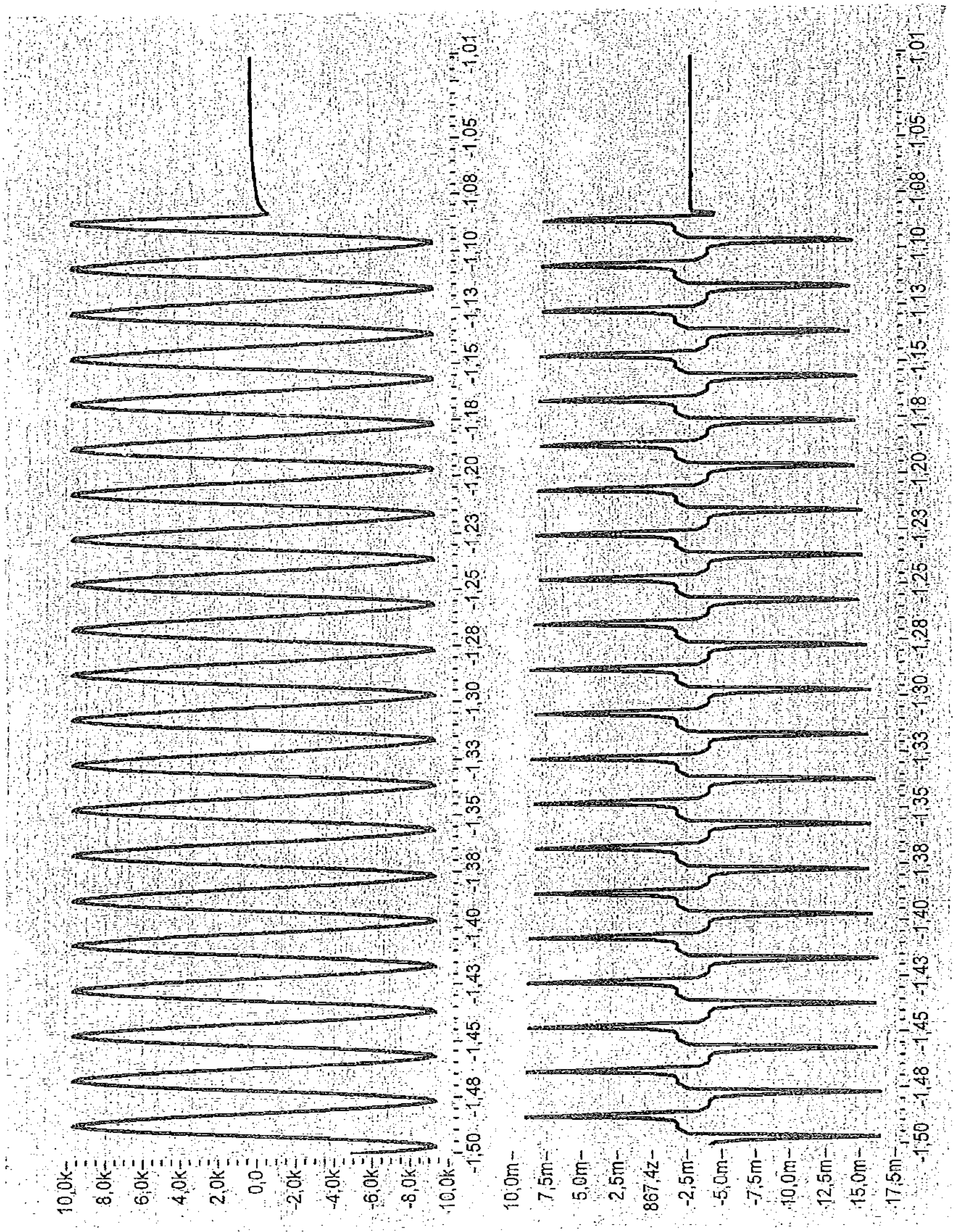
CESI A7020280 Oscillogram n. 21

ВЕРНО С ОРИГИНАЛА

CESI A7020280 Oscillogram n. 22



CESI A7020280 Oscillogram n. 23



CESI A7020280 Oscillogram n. 24

CESI A7020280 Oscillogram n. 25

CESI A7020280 Oscillogram n. 26

CESI A7020280 Oscillogram n. 27

ВЯРНО С ОРИГИНАЛА

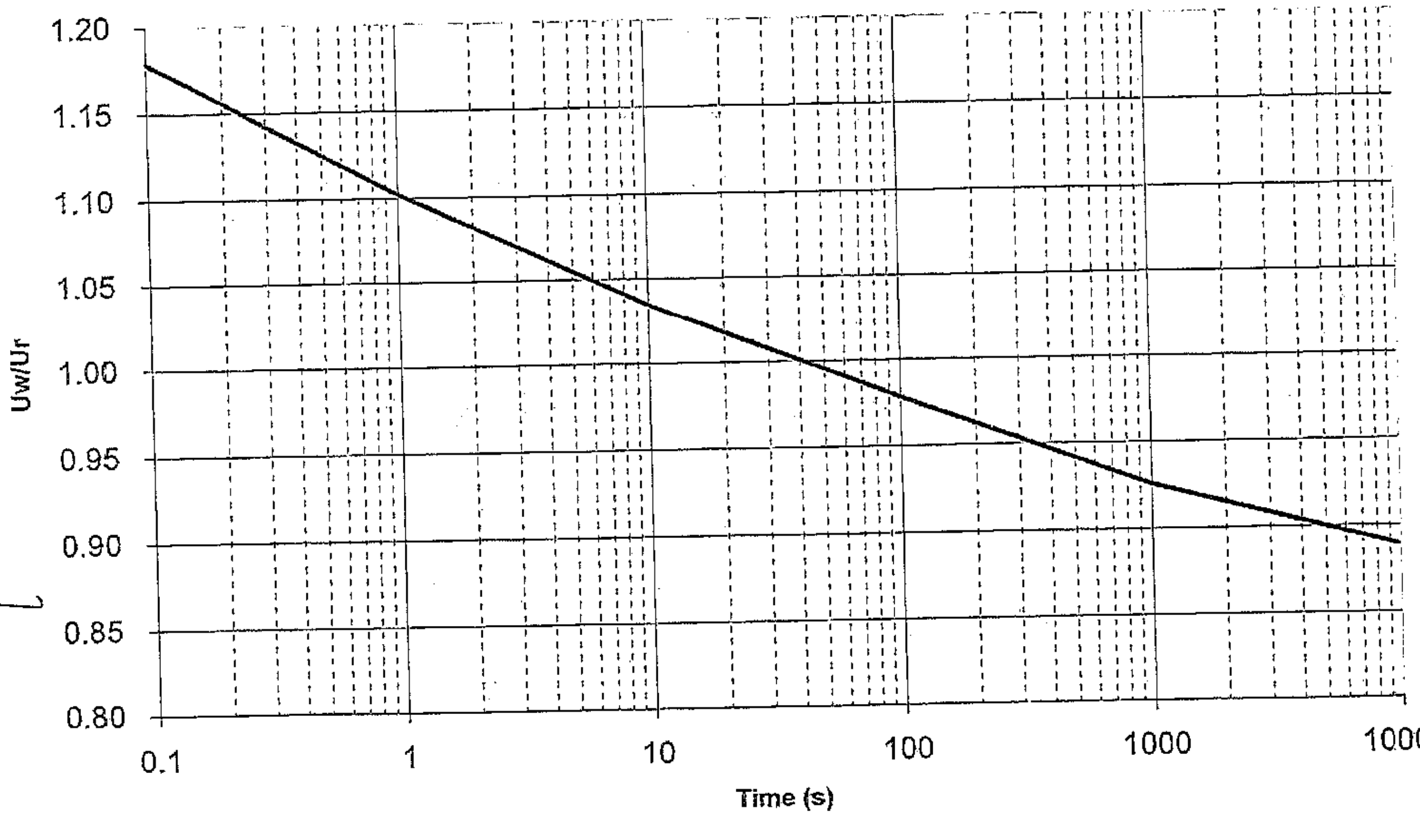
* АКЦИОНЕРНО ДРУЖЕСТВО * ОПИК 16 ПЛОВДИВ

На основание чл. 2
от ЗЗЛД

2 ОКТ. 2007

Tyco Electronics

DA1 Class 1 Surge arrester
TOV Uw/Ur @ 60°C with prior duty

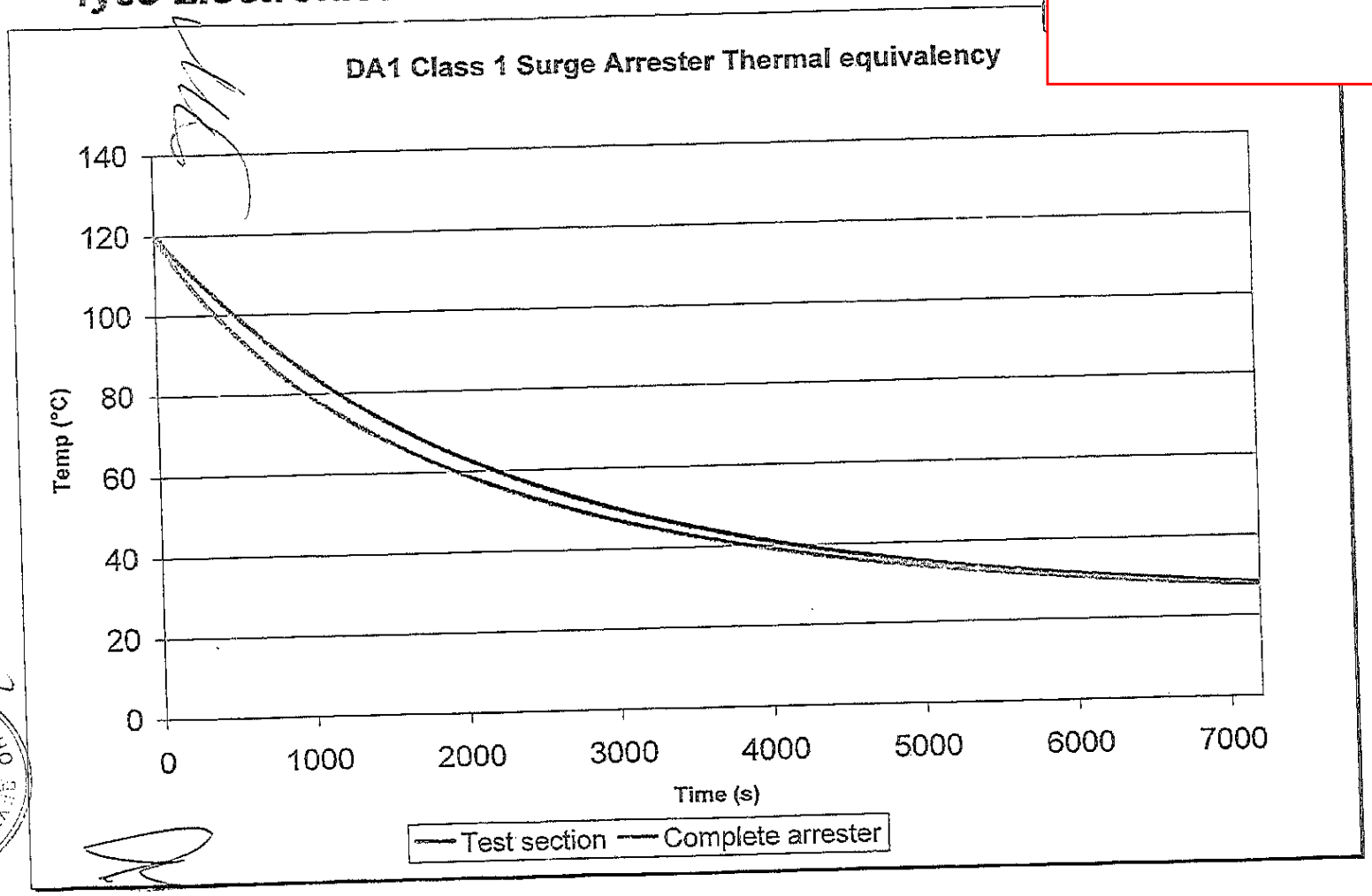


ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО ФИЛКАБ 16 ПЛОВДИВ

731

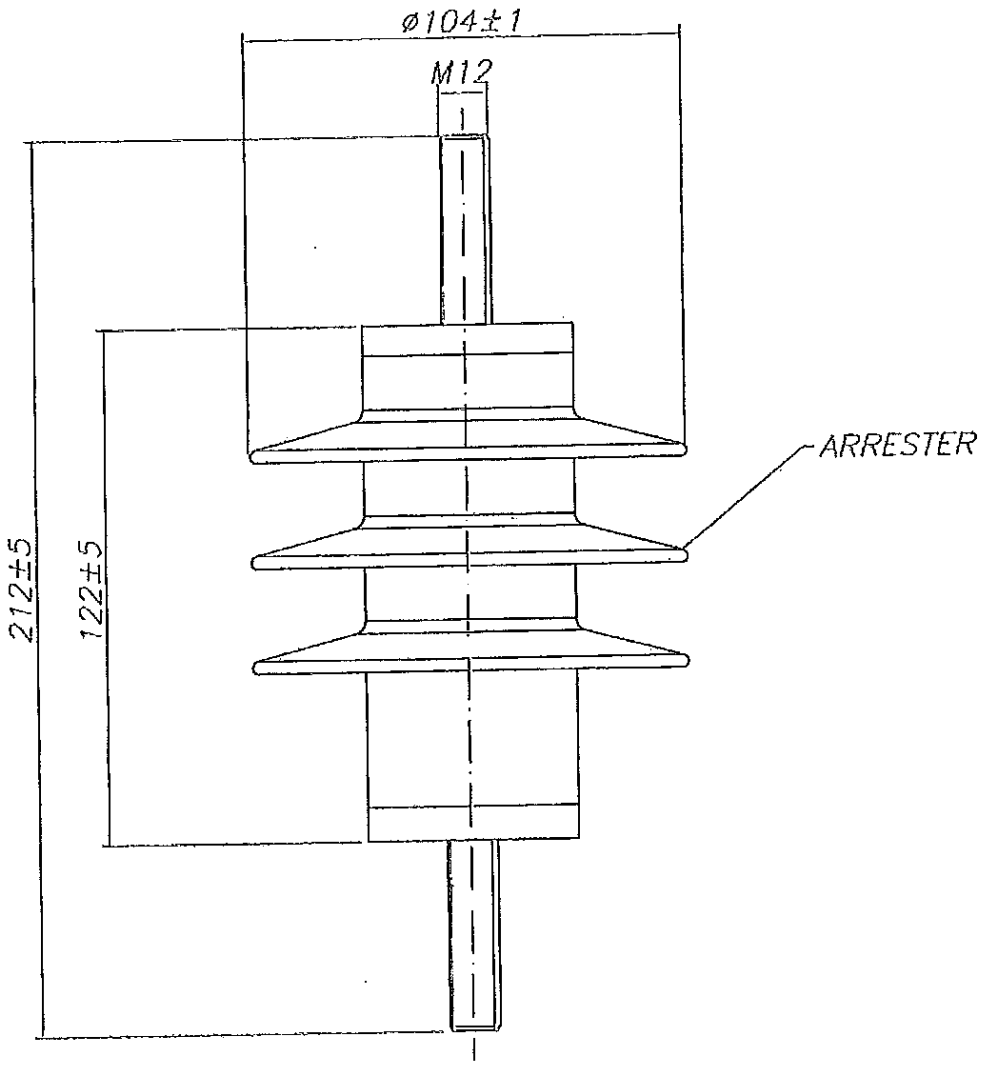
Tyco Electronics



На основание чл. 2
от ЗЗЛД

ОТТ. 2007

SCD



На основание чл. 2
от ЗЗЛД

Uref = 6.22kV min
Ur = 6.5kV
Uc = 5.2kV
CREEPAGE = 254mm
DRY ARC DISTANCE = 127mm

Tyco Electronics

ENERGY DIVISION

Bowthorpe EMP Surge Arrester

BAY 100-109
SHANNON IND. EST.
SHANNON
CO. CLARE
IRELAND

DRN	J HULLIGAN	17/09/07	
CHECK	B KORNOYLE		
APP	B McGOWAN		
SCALE	1:1		

PCN

MAT'L

TITLE: *DA1-6.5-NONONO SURGE ARRESTER*

DRG NO: *DA1-6.5-NONONO* | SHEET 1 OF 1 | REV: *0*

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ЗЛОВДЕН * 16

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www.filkab.com

Приложение 2 към Техническо предложение

ИЗИСКВАНИ ДОКУМЕНТИ ОТ ТЕХНИЧЕСКИ ИЗИСКВАНИЯ И СПЕЦИФИКАЦИИ

Приложение 2.8.

ACCREDIA

L'ENTE ITALIANO DI ACCREDITAMENTO

Membro degli Accordi di Mutuo Riconoscimento EA, IAF e ILAC
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ilac-MRA

Сертификат за акредитация

Номер на акредитация **0030** Ревизия **2**

Ние декларираме, че **CESI S.p.A.**
Седалище:
ул. Рубатино 54 - 20134 Милано

Отговаря на изискванията на стандарт *EN ISO/IEC 17025:2005 " Общи изисквания за компетентността на лаборатории за изпитване и калибриране"*

като ***Лабораториия за тестване***

Акредитацията удостоверява техническата компетентност на лабораторията, ограничена до обхвата, описан в Приложението. Обхватът може да варира във времето. Изискванията на системата за управление ISO/IEC 17025:2005 (раздел 4) са написани на език, съответстващ на операциите на лабораториите за изпитване и отговарят на принципите на ISO 9001:2008 и са съобразени с нейните съответни изисквания.
Настоящият сертификат е валиден само ако е свързан с приложенията и може да бъде ограничен или отнет по всяко време в случай на неизпълнение, както е установено от ACCREDIA.
Статусът на акредитацията в сила може да се провери на WEB сайта (www.accredia.it) или по директно заявление до посочения отдел.

Дата на

На основание чл. 2 от ЗЗЛД

На основание чл. 2 от ЗЗЛД

На основание чл. 2 от ЗЗЛД

Mod. C

ACCREDIA

Sede operativa e legale: Via Guglielmo Saliceto, 7/9 | 00161 Roma - Italy | Tel. +39 06 8440991 | Fax +39 06 8841199
info@accredia.it | www.accredia.it | Partita IVA - Codice Fiscale 10566361001

L'ENTE ITALIANO DI ACCREDITAMENTO

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Сертификат за акредитация

Номер на акредитация **0030** Rev. **2**

Ние декларираме, че

CESI S.p.A.
ул. Рубатино 54 - 20134 Милано
CESI S.p.A. – Седалище в Пиаченца
ул. Нино Биксио 39
29100 Пиаченца
CESI S.p.A. – Седалище в Сериате
ул. Пастренго 9
24068 Сериате

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info@accredia.it | www.accredia.it | Partita IVA - Codice Fiscale 10566361001

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Signatory of EA, IAF and ILAC Mutual Recognition Agreements

ilac-MRA

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

Accreditamento n° / *Accreditation n°* **0030** Rev. **2**

Si dichiara che / *We declare that* **CESI S.p.A.**
Sede/Headquarters:
Via Rubattino 54 - 20134 Milano MI

è conforme ai requisiti della norma / *meets the requirements of the standard* UNI CEI EN ISO/IEC 17025:2005 "Requisiti generali per la competenza dei Laboratori di prova e taratura" / *EN ISO/IEC 17025:2005 "General Requirements for the Competence of Testing and Calibration Laboratories" standard*

quale / *as* **Laboratorio di Prova** / ***Testing Laboratory***

L'accreditamento attesta la competenza tecnica del Laboratorio relativamente allo scopo riportato nelle schede allegate al presente certificato. Le schede possono variare nel tempo. I requisiti gestionali della ISO/IEC 17025:2005 (sezione 4) sono scritti in un linguaggio idoneo all'attività dei Laboratori di Prova, sono conformi ai principi della ISO 9001:2008 ed allineati con i suoi requisiti applicabili.
Il presente certificato non è da ritenersi valido se non accompagnato dalle schede allegate e può essere sospeso o revocato in qualsiasi momento nel caso di inadempienza accertata da parte di ACCREDIA.
La vigenza dell'accreditamento può essere verificata sul sito WEB (www.accredia.it) o richiesta direttamente ai singoli Dipartimenti .

The accreditation certifies the technical competence of the laboratory limited to the scope detailed in the attached Enclosure. The scope may vary in the time. The management system requirements in ISO/IEC 17025:2005 (Section 4) are written in a language relevant to Testing Laboratories operations and meet the principles of ISO 9001:2008 and are aligned with its pertinent requirements.
The present certificate is valid only if associated to the annexed schedule, and can be suspended or withdrawn at any time in the event of non fulfilment as ascertained by ACCREDIA.
The in force status of the accreditation may be checked in the WEB site (www.accredia.it) or on direct request to appointed Department.

На основание чл. 2
от ЗЗЛД

ACCREDIA
Sede operativa e legale: Via Guglielmo Saliceto, 7/9 | 00161 Roma - Italy | Tel. +39 06 8440891 | Fax +39 06 8841199
info@accredia.it | www.accredia.it | Partita IVA - Codice Fiscale 07978661006

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ПЛОВДИВ * ФИЛКАБ 16

ACCREDIA
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Membro degli Accordi di Mutuo Riconoscimento EA, IAF e ILAC
Signatory of EA, IAF and ILAC Mutual Recognition Agreements

ilac-MRA

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

Accreditamento n°
Accreditation n° **0030** Rev. **2**

Si dichiara che
We declare that

Sedi operative:

CESI S.p.A.
Via Rubattino 54
20134 Milano MI
CESI S.p.A. - Sede di Piacenza
Via Nino Bixio 39
29100 Piacenza PC
CESI S.p.A. - Sede di Seriate
Via Pastrengo 9
24068 Seriate BG

ACCREDIA
Sede operativa e legale: Via Guglielmo Saliceto, 7/9 | 00161 Roma - Italy | Tel. +39 06 8440991 | Fax +39 06 8841 99
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office@filkab.com
www.filkab.com

Приложение 2 към Техническо предложение

ИЗИСКВАНИ ДОКУМЕНТИ ОТ ТЕХНИЧЕСКИ ИЗИСКВАНИЯ И СПЕЦИФИКАЦИИ

Приложение 2.9.

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www.filkab.com

ИНСТРУКЦИЯ ЗА ТРАНСПОРТ, СЪХРАНЕНИЕ И СКЛАДИРАНЕ

За да се защитят от случайни повреди по време на транспорт и съхранение ограничителите за пренапрежение тип DA1 и OCP2 трябва да се транспортират и съхраняват в оригиналната опаковка на производителя. При транспорта да се използват закрити превозни средства за да не се допусне навлажняване на опаковките.

Съхранението са препоръчва да бъде в закрити и сухи складови помещения при температура до 40 °C.

Дата: 30.03.2018 г.

Подпис и печат:

На основание чл. 2
от ЗЗЛД

ФИЛКАБ 16

мощник на
отариално
06.12.2017
ова

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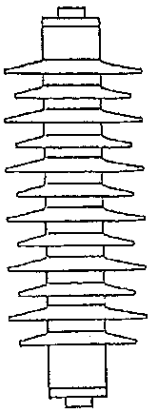
www.filkab.com

Приложение 2 към Техническо предложение

ИЗИСКВАНИ ДОКУМЕНТИ ОТ ТЕХНИЧЕСКИ ИЗИСКВАНИЯ И СПЕЦИФИКАЦИИ

Приложение 2.10.



Инструкция за монтаж

Полимерни ZnO Разрядници с отворен кожух

ISO 9001 & 14001

EC 60099-4; Преработка 2 2001

Bowthorpe EMP

Разрядник за защита от атмосферни пренапрежения за средни напрежения, серия OCP , DLA

Предупреждение за опасност

⚠ **Разрядниците за защита от атмосферни пренапрежения трябва да бъдат монтирани само от компетентен персонал, запознат с добрата практика за безопасност и с работите по високоволтово, електрическо оборудване.**

Включената инструкция за монтаж не замества подходящото обучение и опита по процедурите за безопасност, нито съществуващите процедури за безопасност, работа и поддръжка.

Забележка относно монтажа

Разрядниците за защита от атмосферни пренапрежения се монтират обикновено между фазовия проводник и "земя".
Единствено в някои специални случаи (защита на електродвигатели, защита на кабелни екрани ....) разрядниците могат да бъдат монтирани по различен начин. Ако е необходимо, консултирайте се с вашия системен администратор.

Преди да се започне

- Проверете дали всички части (разрядник и принадлежности) са поставени в кутията, съгласно описанието на етикета върху кутията.
- Ако принадлежностите са пристигнали в разглобено състояние, моля сглобете всички части по съответния начин преди да пристъпите към крайния монтаж. Моля погледнете съпровождащата документация (чертежи) за точния въртящ момент при завинтване.
- Проверете дали разрядникът или принадлежностите не са повредени по време на транспорта. Никога не монтирайте повреден разрядник. Монтажът на неизправни разрядници може да доведе до тежки персонални поражения.

Bowthorpe EMP

Разрядник за защита от атмосферни пренапрежения за средни напрежения, серия OCP, DLA

- На всички разрядници за защита от атмосферни пренапрежения има фабрична табелка, съдържаща информация за типа на разрядника и работното напрежение на същия. Проверявайте работното напрежение на всеки отделен разрядник. Не инсталирайте разрядници с работни напрежения, различни от зададените от вашия системен администратор.

- Проверете дали разрядникът за защита от атмосферни пренапрежения и принадлежностите отговарят на местните изисквания за механични размери. Не извършвайте изменени на разрядниците или на принадлежностите !!
  Не оставяйте не монтирани части !!

- Моля информирайте се от местния системен администратор за минималните разстояния между частите под напрежение и "земя". Прилагат се стойностите за външни подстанции (на открито).Ако нямате информация за стойностите, можете да направите справка с Таблица 1 вместо стойностите съгласно IEC 60071-2.

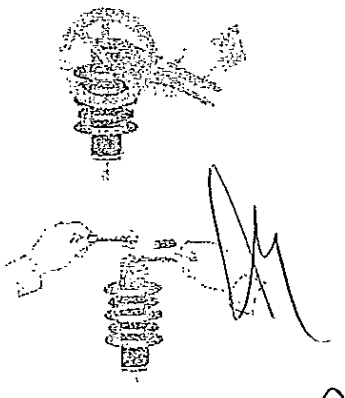
- Ако монтирате специален тип разрядници за защита от атмосферни пренапрежения като SPA-I с изолиран линеен проводник, тогава се допускат по-малки междини. Моля обърнете се към съответното приложение, описващо тези разрядници.

- Ако не сте сигурни за последователността на монтажа, моля питайте и направете справка със съответния монтажен чертеж.

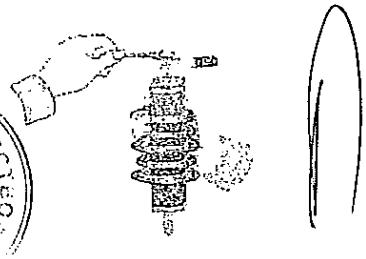
Разрядниците за защита от атмосферни пренапрежения използувани при напрежения, по високи от номиналните за конкретния тип, могат да предизвикат повреди и поражения. З да използувате разрядниците по предназначение, проверявайте номиналнит характеристики на същите, които са изписани ясно на фабричните табелки.

Монтаж

Не захващайте полимерните кожуси на разрядници за защита от атмосферни пренапрежения с механични инструменти. Някои типове разрядници имат монтажни издатъци в двата им края.



На предвидените за целта места разрядникът може да се захваща безопасно чрез втори ключ за притягане на гайките, включени към комплекта принадлежности. Използувайте издатъка в близост до гайката, която трябва да бъде притегната.



В случай, че разрядникът няма подобни технологични издатъци, дръжте същия на ръка.

Bowthorpe EMP

Разрядник за защита от атмосферни пренапрежения за средни напрежения, серия OCP, DLA

- Проверете дали захранването на електрическата система е изключено и дали същата е заземена.
- Спазвайте стриктно местните инструкции за безопасност и процедурите за техническо обслужване.
- Избирайте място на монтаж във възможно най-голяма близост до предпазваното оборудване (трансформатор, кабелни кутии и др.), за да се получи най-висока степен на защита.
- Свържете заземяващия кабел към заземителния извод на разрядника. Притегнете гайката с указания на съответния чертеж въртящ момент.
- Ако разрядникът бъде получен с присъединена метална скоба е възможно заземяващият кабел да бъде свързан към скобата. Линейният (фазовият) извод може да не бъде включен ако скобата или изводът на разрядника са монтирани директно върху заземения кожух или рама на апарата, при положение, че електрическият контакт е сигурен и са използувани подходящи заземителни връзки. Ако съществува съмнение за качеството на връзките, тогава моля използувайте отделен проводник за свързване на скобата или извода на разрядника към системната "земя".
- Свържете линейния кабел към линейния извод на разрядника. Притегнете гайката с указания на съответния чертеж въртящ момент.
- Връзките към земя и към линейните изводи трябва да бъдат възможно най-къси, без резки огъвания и контури. Ако връзката с линията (фазата) не може да бъде къса, помислете за свързване на линията директно към разрядника, след което същата да продължи към местоназначението.
- Продължителното механично натоварване на разрядника не трябва да надвишава спесифицираните стойности. Механичното претоварване може да доведе до значително съкращаване на срока на експлоатация на разрядника.
- Ако разрядникът е снабден с прекъсващо устройство (в средата на описанието е обозначено с "D", т.е ARR-ACC-BDM), тогава проверете дали заземителният извод е достатъчно гъвкав, така че прекъсвачът да може да работи безпрепятствено.
- Възстановете захранването на електрическата система. Избягвайте еднофазно включване, понеже то може да доведе до феро-резонанс на трансформатора ! Ако се налага да се извърши еднофазно включване, проверете дали е налице защита, понеже феро-резонансът може да доведе до повреда на разрядниците.

Техническо обслужване

Разрядниците за защита от атмосферни пренапрежения на Bowthorpe не се нуждаят от техническо обслужване. В разрядника няма части, които се нуждаят от техническо обслужване.

През време на срока на експлоатация не се налагат проверки на техническите характеристики.

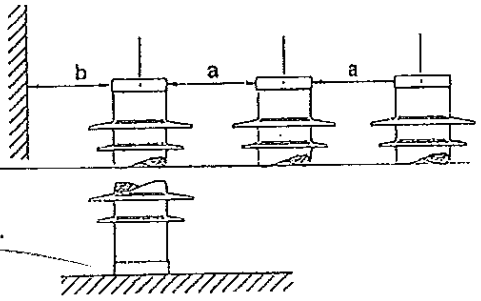
Демонтаж на разрядници за защита от атмосферни пренапрежения

Полимерният кожух на повредения разрядник за защита от атмосферни пренапрежения понякога е раздут. Такъв ефект може да се получи ако токът причиняващ повредата се изключи бързо преди кожухът да се разруши.

Обикновено това не е опасно ако разрядникът се остави да се охлади до околната температура. Все пак проявявайте внимание при демонтаж на пходобни видове разрядници.

- Проверете дали захранването на електрическата система е изключено и дали същата е заземена.
- Спазвайте стриктно местните инструкции за безопасност и процедурите за техническо обслужване.
- Откачете линейния извод от веригата.
- Откачете от веригата заземяващия извод.

Отстояния



Системно напрежение Um [kV]	фаза/фаза * (a) [mm]	фаза / земя* (b) [mm]
7.2	152	121
12	182	151
17.5	222	191
24	282	251
36	382	351

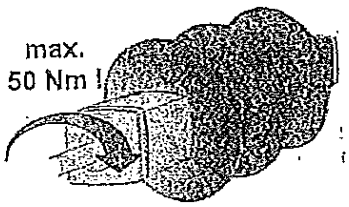
* местните технически норми могат да изискват по-големи отстояния

Допълнителна информация можете получите от : [illegible]

Bowthorpe EMP

Разрядник за защита от атмосферни пренапрежения за средни напрежения, серия OCP, DLA

Таблица 1: Минимални отстояния съгласно IEC 60071-2 за надморски височини до 1000 m.



Фиг. 1 Максимален въртящ момент на изводите на разрядника

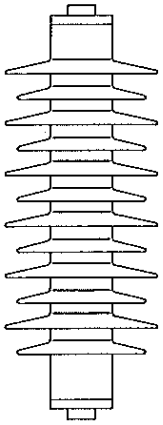
Други фактори: Надморска височина

Цитираните по-горе отстояния се препоръчвани минимални отстояния за приложения намиращи се на надморска височина до 1000 m. За инсталации на по-голяма надморска височина следва отстоянието да се увеличава с 3% на всеки 300 метра увеличение на надморското равнище. 3% се добавя също и към разстоянието за повърхностен разряд на външния кожух на самия разрядник.

Съдържащата се в настоящата инструкция за монтаж информация описва правилния начин за монтаж на продукта. Bowthorpe обаче не може да контролира природните условия, влияещи върху монтажа на продукта. Отговорност на потребителя е да определи приложимостта на метода на монтаж при конкретните природни условия. Единствените задължения на Bowthorpe са Стандартните условия на продажба на продукта и в никакъв случай Bowthorpe няма да носи отговорност за случайни, непреки или последващи поражения, произтичащи от неправилно използуване на продукта.

al Estate,
Ireland,
Тел.: +353-61-470839
Факс : +363-61-471169

Допълнителна информация можете получите от : [illegible] ХИЛКАБ



Installation Instruction

Open Cage Polymeric ZnO Surge Arresters

ISO 9001 & 14001

EC 60099-4; Ammedment 2 2001

For further information please contact: *surgearresters@tycoelectronics.com*

Safety Warning

Surge arresters should be installed only by competent personnel familiar with good safety practices and the handling of high voltage electrical equipment.

The enclosed installation instruction is not intended as a substitute for adequate training and experience in safe procedures nor to replace or supersede existing safety, operating and maintenance procedures.

Installation Note

Arresters are typically to be installed between the line conductor and ground.

Only in a few special cases (motor protection, cable sheath protection, ...) arresters may be installed in a different way. Please consult your system administrator for details if required.

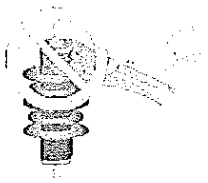
Before Starting

- ☑ Check if all parts (surge arrester & accessories) are included in the box according to the description printed on the carton label.
- ☑ If the accessories come disassembled please assemble all parts as appropriate prior to the final installation. Please refer to the enclosed drawings for the correct torque.
- ☑ Check if the arrester or the accessories have been damaged during transport. Never install a damaged arrester. It may fail violently, causing severe personal injury.
- ☑ All surge arresters carry a nameplate giving details of arrester type and voltage rating. Check the voltage rating of each single arrester. Do not install arresters with voltage ratings other than specified by your system administrator.
- ☑ Check if the arrester and the accessories fulfill the local requirements in terms of mechanical dimensions. Do not alter the arrangement of the accessories or the accessory itself! Do not leave out any parts!
- ☑ Please ask your local system administrator about the minimum clearances you have to meet between live parts and ground. The values for outdoor substations do apply. If not available you may refer to Table 1 instead showing the values according to IEC 60071-2.
- ☑ If you are installing a special kind of surge arresters like SPA-I with insulated line lead, shorter clearances may apply. Please refer to the relevant addendum covering those arresters.
- ☑ If unsure about assembly sequence, please request and refer to relevant assembly drawing.

Arresters applied at voltages higher than rating may cause damage and injury. Check the arrester rating, marked clearly on the name plate, to ensure correct application!

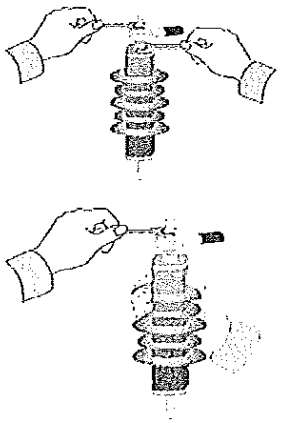
Installation

Do not handle the polymeric housing of the arrester with tools!



Certain type of arresters ave a protrusion at both ends of the arrester.

You can hold the arrester there safetly with a second wrench to fasten the nuts included with some accessories. Use the protrusion on the side close to the nut to be fastened.



In case the arrester hasn't got a protrusion please support the arrester by hand.

☑ Make sure that the electrical system is de-energized and earthed.

☑ Strictly follow the local safety instructions and maintenance procedures.

☑ Select a mounting position as close as practicable to the equipment (transformer, cable termination, ...) to be protect in order to obtain the highest degree of protection.

☑ Connect the ground lead to the arrester ground terminal stud or accessory. Fasten the nut to the torque indicated in the relevant drawing.

☑ In case the arrester comes with a metallic bracket attached it is possible to connect the ground lead to the bracket. The line lead may also be left out if the bracket or the arrester terminal is directly mounted on the earthed tank or frame of the apparatus provided that the electrical contact is reliable and earthing interconnections are suitable. In doubt please use separate conductor cables or strip to connect the bracket or the arrester terminal to system earth.

☑ Connect the line lead to the arrester line terminal stud or accessory. Fasten the nut to the torque indicated in the relevant drawing.

☑ Make the arrester ground and line connections as short as possible avoiding sharp bends and loops. If the line connection cannot be made short, consider connecting the line directly to the arrester and continue from there.

☑ The continuous mechanical stress applied to the arrester i.e. via the connection shall not exceed the specified values. Mechanical overload may shorten the arrester's service lifetime significantly.

☑ In case the arrester is equipped with a disconnector device (a „D" is shown in the middle of the description, e.g. ARR-ACC-BDM.) make sure that the ground lead is flexible enough to allow the disconnector to operate properly.

☑ Re-energize the electrical system. Avoid single-phase switching because this may lead to ferro-resonance of the transformer! If single-phase switching needs to be done, make sure that you are operating with protection as arresters may be destroyed in case of ferro-resonances.

Maintenance

Bowthorpe arresters are maintenance free. There are no serviceable parts inside.

Performance checks are not required during the expected service life.

⚠ Removing Arresters

The polymeric housing of failed surge arrester sometimes is inflated. This can happen if the fault current is switched off fast before the housing ruptures!

This typically does not represent a hazard if the arrester is allowed to cool down to ambient temperature. Be careful anyway when removing such kind of arresters.

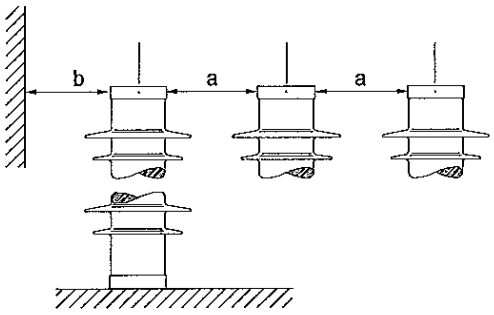
☑ Make sure that the electrical system is de-energized.

☑ Strictly follow the local safety instructions and maintenance procedures.

☑ Disconnect the line lead from the circuit.

☑ Disconnect the ground lead from the circuit.

Clearances



System Voltage U_m [kV]	ph/ph* (a) [mm]	ph/ground* (b) [mm]
7,2	152	121
12	182	151
17,5	222	191
24	282	251
36	382	351

* local regulations and standards may require wider clearances!

For further information please contact: *surgearresters@tycoelectronics.com*

Table 1: Minimum clearances following IEC60071-2 for altitudes up to 1000 m (3300 ft).

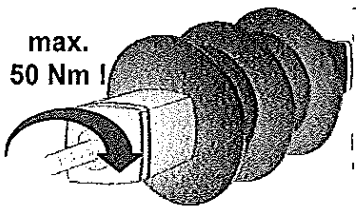


Fig 1: Max. torque at the terminals of the arreste

Other considerations: Altitude

The clearances quoted above are recommended min clearances required for applications up to 3,300 ft (1,000m metres). For installations at higher altitudes, the accepted practice is to add 3% to the clearance length for every 1,000 ft (300 metres) increase in altitude above 3,300 ft (1,000 metres). The 3% is also added to the external housing flashover distance of the arrester itself.

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Energy Division
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Shannon,
Co. Clare
Ireland
Tel: +353 61 470839
Fax: +353 61 471169

For further information please contact: *surgearresters@tycoelectronics.com*

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СРОКОВЕ ЗА ДОСТАВКА

№	Наименование	Мярка	Количества със срок на доставка до 7 кал. дни	Количества със срок на доставка до 30 кал. дни
1	*2*	*3*	*4*	*5*
1.	Вентилен отвод метало - оксиден тип без искрови разрядници, 10 kV, 10kA, клас 2	бр.	3	5
2.	Вентилен отвод метало - оксиден тип без искрови разрядници, 20 kV, 10kA, клас 1	бр.	20	50
3.	Вентилен отвод метало - оксиден тип без искрови разрядници, 20 kV, 10kA, клас 2	бр.	20	50

Забележки:

1/ Срокът на доставките започва да тече от датата на изпращане на поръчката.

2/ Количествата в колона 4, със срок на доставка до 7 /седем/ календарни дни, се доставят след SAP поръчка до посочените в обявлението складове на Възложителя за покриване на спешни нужди на Възложителя.

Възложителят може до поръчва посоченото спешно количество веднъж месечно.

3/ В случай, че крайният срок на доставката съвпада с празничен или неработен ден, то доставката се извършва не по-късно от първия работен ден след изтичането на срока.

4/ При поръчки на Възложителя на количества в рамките на потвърдените от Изпълнителя и недоставени в посочените срокове, ще бъдат налагани неустойки, съгласно условията на договора.

5/ Възложителят може да поръча количества по-малки от посочените в колони 4 и 5.

6/ Възложителят може да поръчва количества по-високи от посочените в колони 4 и 5, като това обстоятелство ще бъде посочено текстово в съответната поръчка изпратена към Изпълнителя. С потвърждението на поръчката, Изпълнителят вписва в същата очаквана дата за доставка на количествата надвишаващи посочените в колони 4 и 5.

7/ Количествата за доставка в колони 4 и 5 са отделни и независими едно от друго.

8/ Количествата за доставка в колона 5 не включват в себе си количествата за доставка в колона 4.

9/ Възложителят има право да направи едновременно поръчки за доставка на количества от колони 4 и 5.

Дата: 30.03.2018 г.

Декларатор:

На основание чл. 2 от ЗЗЛД

АКЦИОНЕРНО ДРУЖЕСТВО * ФИЛКАБ 16 * ПЛОВДИВ *

Пълномощник на
с нотариално
5487/06.12.2017 на
илова

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ПЪЛНОМОЩНО

Долуподписаният **АТАНАС ИВАНОВ ТАНЧЕВ,** На основание чл. 2 от ЗЗЛД ежаващ На основание чл. 2 от ЗЗЛД ена на 10.09.2014 г. от МВР - Пловдив, с постоянен адрес: гр. Пловдив, бул."Любен Каравелов" № 11, ет.7, ап. 55, в качеството си на Изпълнителен директор, представляващ, **„ФИЛКАБ" АД,** вписано в Търговския регистър при Агенцията по вписванията **ЕИК: 115328801**, със седалище и адрес на управление: гр. Пловдив,ул. „Коматевско шосе" № 92,

УПЪЛНОМОЩАВАМ:

АЛЕКСАНДЪР ВИКТОРОВ ПРИХОДКОВ, На основание чл. 2 от ЗЗЛД ежаващ На основание чл. 2 от ЗЗЛД дена на 11.05.2010 г. от МВР - Пловдив, **със следните права:**

Да представлява „ФИЛКАБ" АД, като от името и за сметка на представляваното от мен дружество има право:

Да подписва всички необходими тръжни документи в т.ч. и офертите за участие на дружеството в обявени процедури за всякакви обществени поръчки, търгове или други процедури по възлагане на доставки, монтажи, СМР и др.

Да получава и подава комплект от документи за участие на дружеството в обявени процедури за всякакви обществени поръчки, търгове или други процедури по възлагане на доставки монтажи, СМР и др., представлява дружеството при отваряне на подадените оферти, както и с правото да води преговори по тръжните процедури, да взема решения за възникване на права и задължения за сметка на дружеството, да подобрява офертата и подписва съответните протоколи от тях във връзка с участието на дружеството в тези процедури.

Да води преговори и сключва договори, свързани с предмета на дейност на дружеството.

Пълномощното следва да се тълкува разширително с оглед на предоставените на пълномощника права да представлява дружеството при извършване на посочените по-горе действия.

Настоящото пълномощно е със срок до 31.12.2

На основание чл. 2 от ЗЗЛД

Атанас

На основание чл. 2 от ЗЗЛД

На основание чл. 2
от ЗЗЛД

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Приложение № 4

ДЕКЛАРАЦИЯ

за приемане на условията в проекта на рамково споразумение и проекта на конкретен договор, неразделна част от рамковото споразумение

Долуподписаният Александър Викторов Приходков, , в качеството ми на Пълномощник на Изпълнителния директор с нотариално заверено пълномощно № 5487/06.12.2017 на нотариус № 473 – Мина Стоилова, представляващ „Филкаб" АД, участник в процедура за възлагане на обществена поръчка с реф. № PPD 17-158 и предмет: „**Доставка на вентилни отводи средно напрежение (СрН)**",

ДЕКЛАРИРАМ, ЧЕ:

1. Приемам условията в проекта на рамково споразумение, приложен в документацията за участие.
2. Приемам условията в проекта на конкретен договор, неразделна част от рамковото споразумение, приложен в документацията за участие.

ЕРНО ДРУЖЕСТВО ... ДИВ *

На основание чл. 2 от ЗЗЛД

Дата: 30.03.2018 г. Декларатор: .

Пълномощник на
с нотариално
5487/06.12.2017 на
илова

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Приложение № 5

ДЕКЛАРАЦИЯ

за срока на валидност на офертата

Долуподписаният Александър Викторов Приходков, притежаващ личн На основание чл. 2 от ЗЗЛД издадена на 11.05.2010 г. от МВР – гр. Пловдив, адрес: гр. Пловдив, бул. „Марица“ № 29, в качеството ми на Пълномощник на Изпълнителния директор с нотариално заверено пълномощно № 5487/06.12.2017 на нотариус № 473 – Мина Стоилова, представляващ „Филкаб“ АД,
участник в процедура за възлагане на обществена поръчка с реф. № PPD 17-158 и предмет: **„Доставка на вентилни отводи средно напрежение (СрН)“,**

ДЕКЛАРИРАМ, ЧЕ:

С подаване на настоящата оферта, направените от нас предложения и поети ангажименти са валидни за срока, посочен в обявлението, считано от крайния срок за подаване на офертите.

ЧЕРНО ДРУЖЕСТВО ФИЛКАБ 16 ПЛОВДИВ

Дата: 30.03.2018 г. Декларатор: На основание чл. 2 от ЗЗЛД

- Пълномощник на
р с нотариално
5487/06.12.2017 на
илова