Tests witnessed by:

Mr. Anton Potapov — Joint-Stock Company " Polymer-Apparat"
Mr. Alexander Kolychex — Joint-Stock Company " Polymer-Apparat"

Identification of the object: Requested

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings.
CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.
These drawings, identified by CESI and numbered B7023130 n.1 & B7024013 n.1, are annexed to this document.

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

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

Voltage a.c.	: ±3,0%
Residual peak voltage (impulse tests)	: ±3,0%
Current a.c.	: ±3,0%
Peak current (impulse tests)	: ±3,0%
Time (impulse tests)	: ±10,0%
Time (a.c. tests)	: ±1,5%

Laboratory information

Receipt date of the sample	September 2017
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr. L. Podavitte, Mr. I Guacci
Test laboratory	P177 (Surge Arrester laboratory)
ODV SAP	70006781

Test Report CESI B7018623 Approved Page 4

Rated characteristics of the tested objects assigned by the Client

Polymer-housed surge arrester

Manufacturer	**Joint-Stock Company " Polymer-Apparat"**
Type	PA-DM-54
MO resistors supplier	Joint-Stock Company " Polymer-Apparat"
Serial no.	000035
Drawing code	PA-OPN.035.001.054.01
Arrester class	Distribution
Designation	DH
Design	B
Rated voltage – U_r	54 kV
Continuous operating voltage - U_c	43,2 kV
Rated frequency	48÷62 Hz
Nominal discharge current (8/20 µs impulse shape)	10 kA
Reference current - $I_{ref.}$	1 mA
Year of manufacturer	08/2017

Polymer-housed surge arrester section assembled in thermal model

Manufacturer	**Joint-Stock Company " Polymer-Apparat"**
Type	PA-DM
MO resistors supplier	Joint-Stock Company " Polymer-Apparat"
Serial no.	000011
Drawing code	PA-DM.001.ST.01
Arrester class	Distribution
Designation	DH
Design	B
Rated voltage – U_r	1,25 x Uc
Continuous operating voltage - U_c	4,34 kV
Rated frequency	48÷62 Hz
Nominal discharge current (8/20 µs impulse shape)	10 kA
Reference current - $I_{ref.}$	1 mA
Year of manufacturer	08/2017

Reference Standard

IEC 60099-4 – Edition 3.0 (2014-06)– clause 8.6 & Annex B
" Metal-Oxide Surge Arresters without gaps for AC systems

Test carried out and identification of the test objects

Test carried out	Number of test objects	Test object identification
Heat dissipation behaviour of test sample	1	PA-DM-54 - s/n. 368162
	1	PA-DM (Section) - s/n. 368160

Test setting for the test

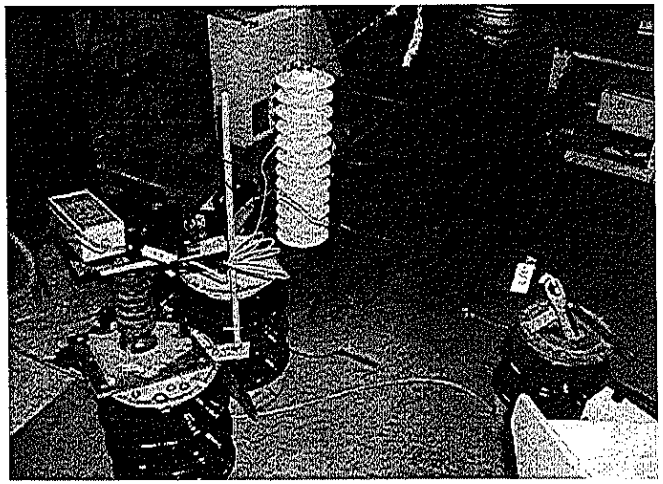


Photo no. 1

Complete arrester

Photo no. 2

Arrester section assembled in thermal model

A1267IG

Test procedure on complete arrester

The complete arrester was placed in the testing laboratory (see photograph no.1 on page 7) at still air ambient temperature of 21,1 °C. The ambient temperature was held at 21,1 °C ±3K during the test .
The complete arrester was supplied by the manufacturer fitted with a optical thermal sensors attached to the MO resistors (see drawing attached on this test report).

The surge arrester was heated to a temperature of approximately 140 °C by the application of a power frequency overvoltage with an amplitude above the reference voltage.
The heating time was 22 min. (the maximum time according to the reference standard is 60 min.).

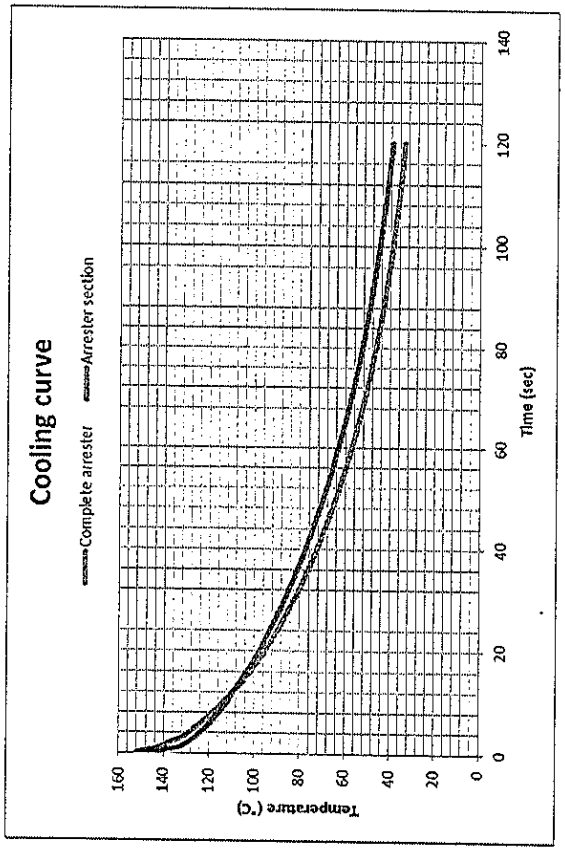
When the specified temperature of about 140 °C was reached the voltage source was disconnected and the cooling time curve was determined over a period of not less than 2 hours.

Test procedure on arrester section

The arrester section was placed in the testing laboratory (see photograph no.2 on page 8) at still air ambient temperature of 22,2 °C.
The ambient temperature was held at 22,2°C ±3K during the test .
The arrester section was supplied by the manufacturer and one optical thermal sensor has been used (see drawing attached on this test report).

The MO resistor was heated to a temperature of approximately 140 °C by the application of a power frequency overvoltage with an amplitude above the reference voltage.
The heating time has been of 22 min. (the maximum time according to the reference standard is 60 min.).

When the specified temperature of about 140 °C was reached the voltage source was disconnected and the cooling time curve was determined over a period of not less than 2 hours.



Test result and the calculation of the temperature compensation

The cooling curve (see pag.10) of the arrester section hasn't been for all instants equal or higher than the cooling curve of the arrester. The compensation may be made adding a ΔT to the start temperature ϑ_{start} of the prorated section during the preheating (thermal recovery part) for Operating duty test and Power-frequency voltage versus time test.

Sample	T	T_A	T_0	$T_0 - T_A$	Heating time	Date
Complete arrester	is the measured temperature during cooling every minute	21,1 °C	152,0 °C	130,9 °C	22 min	September 18, 2017
Arrester section	is the measured temperature during cooling every minute	22,2 °C	148,8 °C	125,8 °C	22 min	September 18, 2017

Legend:

T is the measured temperature instant by instant
T_A is the average ambient temperature during test
T_0 is the maximum heating temperature
Trel $(T-T_A) / (T_0-T_A)$
ΔT temperature compensation

The two relative temperatures T_{rel} arrester and T_{rel} arrester section have been plotted (see page 12) for the cooling time (≥7200s).
During the cooling time the difference T_{rel} arrester - T_{rel} arrester section has been calculated and the max value has to be considered.

K= max (T_{rel} arrester - T_{rel} arrester section)= 0,044329149

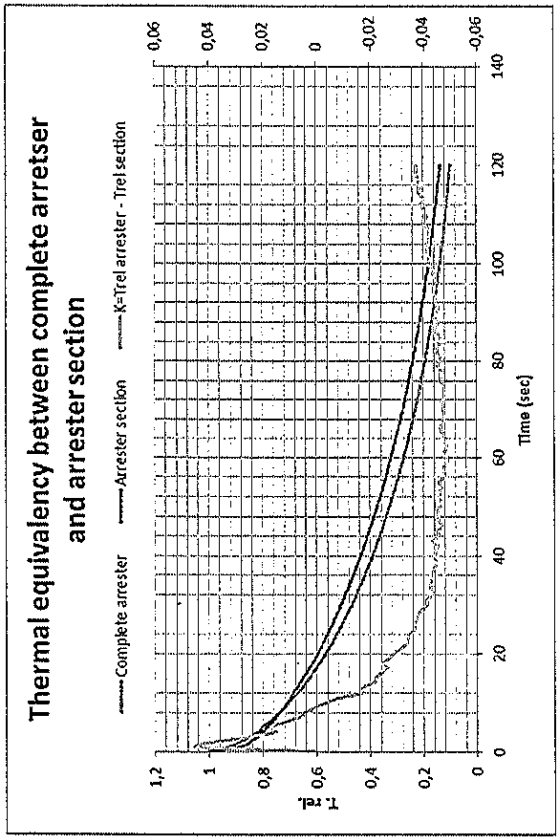
$\Delta T = K (T_0 - T_A)_{max} = 0{,}044329149 * 130{,}9 = 5{,}80$ °C

The compensation temperature ΔT resulting from the test is 5,80 °C.

$\vartheta_{start} = 60$ °C + 5,80 °C = 65,80°C

Therefore the ϑ_{start} for thermal recovery test in the Operating duty test and Power-frequency voltage versus time test is equal to 65,80 °C.

A1176IG

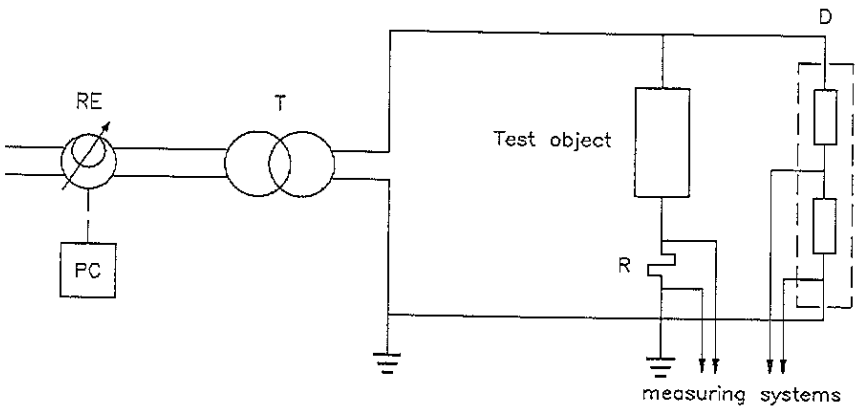


A1264IG

Instruments used for temperature measurement

Instrument type	CESI no.	Note:
ASKIVIANA	022469 - Rx 022468 - Tx	used surge arrester unit and surge arrester section temperature
FLUKE thermometer	030889	used for ambient temperature

Circuit A0019



Power frequency supply

RE - programmable supply type PACIFIC A.C. Power Source 140 ASX.; CESI no. 0560408
PC - personal computer
T - voltage transformer type SPECIALTRASFO; power 60 kVA; voltage 220 V/200 kV (used for complete arrester)

Current measuring system

R - Current shunt CESI No.31120; R= 941,4 Ω
- Electro optical system CESI No.55829/55828

OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

Voltage measuring system

D - Voltage divider SAGI; CESI No.11120 (used for arrester section)
- Voltage divider SAGI; CESI No 13027 (used for complete arrester)
- Electro optical system CESI No.11517/11518

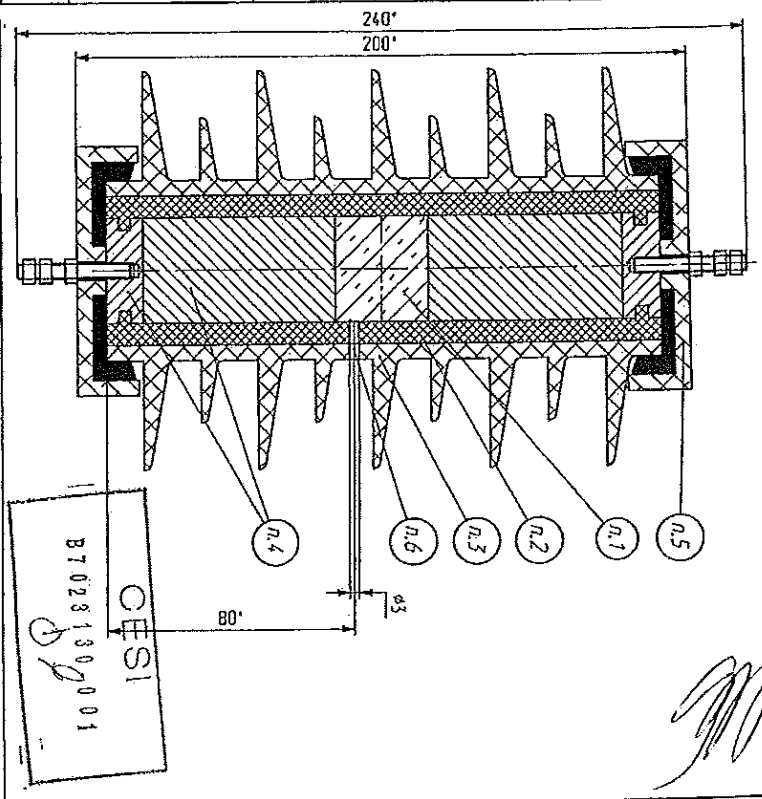
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.2)

Software system:

SW - S.A.D. Surge arrester version 2.0

781

№ п.п.	name	note
n.1	varistor B34/30	ООО
n.2	Housing	ООО
n.3	External insulation	ООО
n.4	Metal flanges and spacers	ООО
n.5	Additional thermal insulation	ООО
n.6	Aperture for a thermocouple	Form and size matching is required



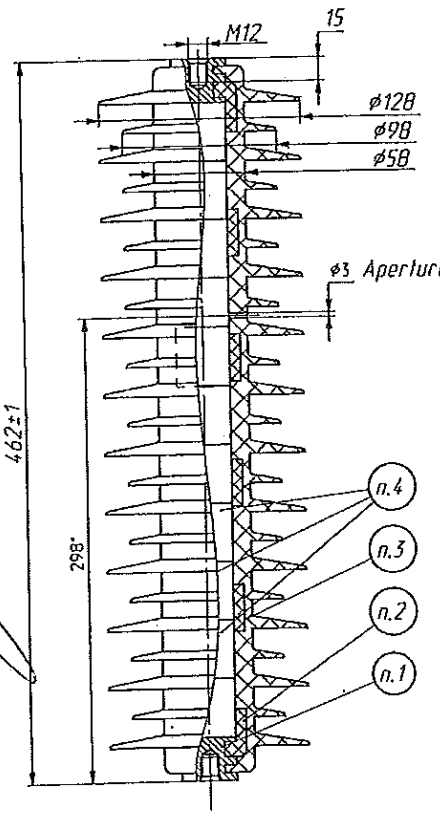
1. * - Dimensions for reference

PA-OM.001.ST.01

Section in thermal model. Surge Arrester PA-OM

ЗАО "Полимер-Аппарат"

PA-OM.001.ST.01



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

1. Все размеры для справок. All dimensions for reference

ПА.ОПН.035.001.054.01

METAL-OXIDE SURGE ARRESTER
PA-OM-660-51-20/10 Heat dissipation test

Лит.	Масса	Масштаб
	18	1:2

Лист 1 Листов 1

ЗАО "Полимер-Аппарат"

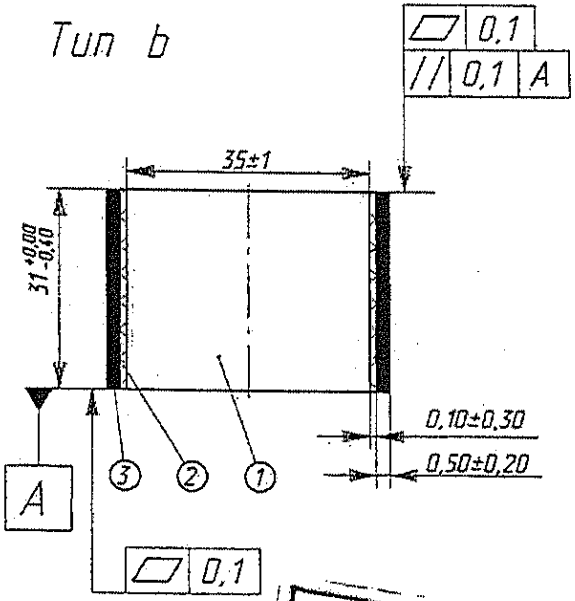
Разраб. Жилой И.
Пров. Пирогов А.
Т.контр. Уваров А.
Н.контр. Алексеев С.
Утв. Вебков К.

Копировал Формат А3

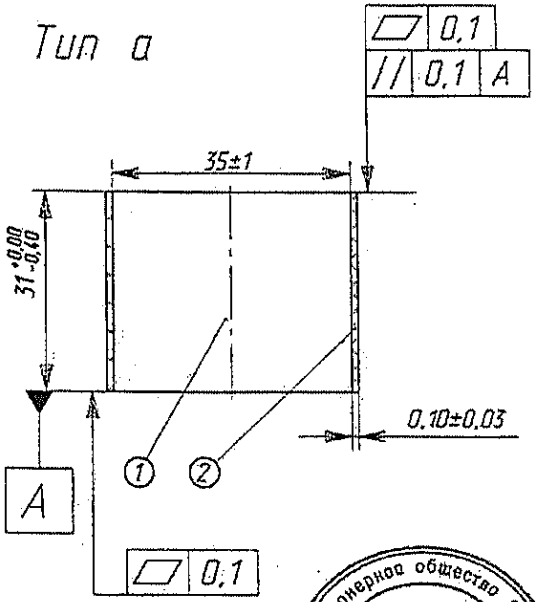
ПА.ОПН.035.001.054.01

РА.VAR.0400.30

Тип b



Тип a



1. Металлооксидный варистор (MOV disk)
2. Изоляционное покрытие стекло (Glass insulating collar)
3. Изоляционное покрытие полиуретан (PU insulating collar)
4. Алюминиевый электрод (Al – electrode)

CESI
B7020387-001

Закрытое акционерное общество "Полимер-Аппарат" • Санкт-Петербург •

Изм.	Лист	№ докум.	Подп.	Дата
Разраб.		Потапов А.В.		09.17
Пров.		Петухов А.П.		09.17
Т.контр.				
Н.контр.				
Утв.		Шевцов И.В.		09.17

РА.VAR.0400.30

Varistor B34/30

Оксид цинка

Лит.	Масса	Масшт.
	0.177	1:1
Лист 1	Листов 1	

ЗАО "Полимер-Аппарат"

Копировал

Формат А4

Инв. № подл. | Подп. и дата | Взам. инв. № | Инв. № дубл. | Подп. и дата

ВЯРНО С ОРИГИНАЛА

"EMTestrix" LTD

Type Test Report

Document No.	B7018645 Copy No, 1 Number of pages 24
Apparatus	Housing of polymer-housed surge arrester, classified "distribution DH", for outdoor installation. Rated voltage = 54 kV; Nominal discharge class = 10 kA
Designation	PA-DH-54
Serial Number	368160
Manufacturer	JSC Polymer-Apparat
Client	JSC Polymer-Apparat Ak. Konstantinova Strasse, 195427 Saint-Petersburg - Russia Federation
Tested for	---
Date(s) of tests	September 19, 2017
Tested by	CESI S.p.A. Via Rubattino, 54 20134 Milano – Italy
Test performed	Insulation withstand tests on polymer-housed surge arresters (sub-clause 10.8.2): - dry lightning impulse voltage test (clause 8.2.6) - wet power-frequency voltage test (clause 8.2.8)

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

IEC 60099-4 - Edition 3.0 (2014-06)

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

October 25, 2017

Date	Del Giorgio Carlo Test Engineer in charge	The Manager - Arcidiaco Lorenzo Approved By Document Digitally Signed

ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO
LAB N° 0030

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

CESI

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PAD B7018645 (2438-42) CONFIDENTIAL USE

Notes

STL-Member

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

CESI Group Test Documents description

Type Test Certificate of .....

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

Test Certificate of (complete / selected) Type Tests

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

Certificate of Design Verification

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

Type Test Report

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

Test Report

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

On-Site Test Record

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

Test Award

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

Tests witnessed by:

Mr Alexander Kolychev - JSC Polymer-Apparat
Mr Anton Potapov - JSC Polymer-Apparat

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 **B7021732 No.1**, is annexed to this document.

Test evaluation

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

Revision No.	Date	Reference
0	October 25, 2017	B7018645

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

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

Peak voltage (impulse tests)	± 3,0 %
Voltage a.c., d.c. (dielectric tests)	± 3,0 %
Peak current (impulse tests)	± 3,0 %
Time parameters (impulse tests)	± 10 %
Time parameters (a.c., d.c. dielectric tests)	± 3,5 %
Partial discharge measurement	up to 10 pC: ± 1,0 pC above 10 pC: ± 10 %
Atmospheric conditions:	
Temperature; Pressure; Relative Humidity (30 % to 95 % RH)	± 2,0 °C; ± 1,0 hPa; ± 5 %

Laboratory information

Receipt date of the sample	September 18, 2016
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr L. Tiziani
Test laboratory	P180 (100 kJ)
ODV	70006781

"EMI ELECTRIC" LTD "ЕМИ ЕЛЕКТРИК" ЕООД

ВЯРНО С ОРИГИНАЛА

A1001IG rev.2

content	page	test date
Rated characteristics of the tested object assigned by the Client	5	----
Test requirements	6	----
Test procedure and results	7	----
Lightning Impulse voltage test (dry)	8	September 19, 2017
Power-frequency voltage test (wet)	9	September 19, 2017
Circuit A0002 – impulse generator	10	----
Circuit A0058 – Power frequency test circuit	11	----
Circuit A0059 – Power frequency measuring circuit	12	----
Photograph of the test object	13	----
Photograph of the test arrangement	14	----
Pages annexed:		
- Oscillogram (total pages:9)		
Reference document annexed:		
Drawing identified by CESI and numbered **B7021732 No.1**		

A1002IG

Rated characteristics of the tested object assigned by the Client

Housing of polymer-housed surge arrester	
Manufacturer	**JSC Polymer-Apparat** -Ak. Konstantinova Str.,1 - 195427 Saint-Petersburg - Russia Federation
Type	PA-DH-54
Drawing No.	PA.0PN.035.002.054.H (dated 03.17)
Arrester classification	Distribution DH
Type of installation	outdoor
Serial number	368160
Rated voltage (U_r)	54 kV
Continuous operating voltage (U_c)	43,2 kV
Rated frequency	48÷62 Hz
Nominal discharge current (8/20 μs impulse shape)	10 kA
Maximum residual voltage of the arrester for the nominal discharge current (LIPL)	133,9 kV
IEC required dry lightning impulse withstand voltage (*)	174,1 kV_{peak}
IEC required wet power-frequency withstand voltage (**)	117,8 kV_{peak}
Test value declared by the Client of dry lightning impulse withstand voltage	240,0 kV_{peak}
Test value declared by the Client of wet power-frequency withstand voltage	150,0 kV_{peak}
Number of sheds of the housing	12

(*) calculated as 1,3 times the maximum residual voltage of the arrester at nominal discharge current (LIPL)

(**) calculated as 0,88 times the lightning impulse protection level (LIPL)

NOTE the lightning impulse protection level (LIPL or U_{pl}) is the maximum residual voltage of the arrester for the nominal discharge current

Test requirements

IEC 60099-4, Edition 3.0 (2014-06) – clause 2 "Normative references"
The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*
IEC 60060-2, *High-voltage test techniques – Part 2: Measuring systems*

Test requirements
Below is an excerpt of the reference standards regarding to insulation withstand tests on polymer-housed surge arrester object of this Test Report.

IEC 60099-4 clause 10 "Test requirements on polymer-housed surge arresters", sub-clause 10.8.2 "Insulation withstand tests" and sub-clause 8.2 "Insulation withstand tests".

The voltage withstand tests demonstrate the voltage withstand capability of the external insulation of the arrester housing. For other designs the test has to be agreed upon between the manufacturer and the user.

The outside surface of insulating parts shall be carefully cleaned and the internal parts removed or rendered inoperative to permit these tests.

For arresters intended for use on systems of $Us \leq 245$ kV, lightning impulse voltage tests according to 8.2.6 and power-frequency voltage tests according to 8.2.8 shall be performed on individual unit housings.

The applicable tests shall be run on the longest arrester housing. If this does not represent the highest specific voltage stress per unit length, additional tests shall be performed on the unit housing having the highest specific voltage stress. For the test, the MO resistors shall be removed from the housing or replaced by insulators.

The voltage to be applied during a withstand test is determined by multiplying the specified withstand voltage by the correction factor taking into account density and humidity (see IEC 60060-1).

Humidity correction shall not be applied for wet tests.

The external insulation of outdoor arresters shall be subjected to wet withstand tests under the test procedure given in IEC 60060-1.

Lightning impulse voltage test (sub-clause 8.2.6)
The arrester shall be subjected to a standard lightning impulse voltage dry test according to IEC 60060-1. The test voltage shall be at least 1,3 times the maximum residual voltage of the arrester at nominal discharge current.

Fifteen consecutive impulses at the test voltage value shall be applied for each polarity. The arrester shall be considered to have passed the test if no internal disruptive discharges occur and if the number of the external disruptive discharges does not exceed two in each series of 15 impulses. The test voltage shall be equal to the lightning impulse protection level of the arrester multiplied by 1,3.

Power-frequency voltage test (sub-clause 8.2.8)
The housings of arresters intended for outdoor use shall be tested in wet conditions, and housings of arresters intended for indoor use shall be tested in dry conditions.

Housings of distribution class arresters according to Table 1 shall withstand a power-frequency voltage with a peak value equal to the lightning impulse protection level multiplied by 0,88 for a duration of 1 min.

Test procedure and results

The Client had removed or rendered inoperative the internal parts of the surge arrester to permit these tests.
The outside surface of insulating parts was cleaned.

The arrester housing was arranged for the tests as shown on photograph No.3.
The end terminal of the arrester housing was fixed to the earth.

The test voltage was applied between the upper line terminal of the arrester housing and its end terminal connected to the metallic support and earth.

The sample was identified by its serial number 368160.

Lightning impulse voltage test (sub-clause 8.2.6)
The housing of surge arrester was subjected to a standard lightning impulse voltage dry test according to IEC 60060-1.

The applied voltage was the test voltage value declared by the Client corrected for atmospheric conditions at the time of the test.

The test voltage value declared by the Client was higher than the value calculated according to the procedure of IEC 60099-4 (1,3 times the maximum residual voltage of the arrester at nominal discharge current), therefore it is comply with the requirements of the relevant Standard.

Fifteen consecutive impulses at the determined test voltage value were applied for each polarity.

During the test no internal disruptive discharges and no external disruptive discharges occurred.

Therefore the housing of the surge arrester passed the lightning impulse voltage test

Power-frequency voltage test (sub-clause 8.2.8)
The housing of surge arrester was subjected to a power-frequency withstand voltage test in wet conditions.

The characteristics of the rain were according to IEC 60060-1.

The applied voltage was the test voltage value declared by the Client corrected for atmospheric conditions at the time of the test.

The test voltage value declared by the Client was higher than the value calculated according to the procedure of IEC 60099-4 (calculated as a peak value equal to the lightning impulse protection level multiplied by 0,88), therefore it is comply with the requirements of the relevant Standard.

The test sample withstood for one minute the applied voltage.

Therefore the housing of the surge arrester passed the wet power-frequency voltage test

A1176IG

A1017IG

Lightning impulse voltage test (dry)

Test object: Housing of polymer-housed surge arrester, classified "distribution DH", for outdoor installation
Test circuit: A0002
Arrangement: see photographs of the test set-up

Measured arcing distance = 483 mm

Atmospheric conditions and correction factor			
b	t_a	h	K_t
kPa	°C	g/m³	
99,76	18,8	9,88	0,979

Date: September 19, 2017

test sample	polarity	impulse generator charging voltage	voltage required U	voltage applied U x K_t	A: (o) withstand (x) flashover B: oscillogram No. C: peak voltage [kV] D: time to discharge (µs)																					
Serial No.		kV/stage	kV_{peak}	kV_{peak}																						
368160	positive	61,3	240,0	235,0	A	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
					B	3									4											5
					C	235,3	235,1	235,0	235,2	235,6	235,1	235,4	235,0			234,9	235,0	234,6	235,2	234,6	235,1	235,2				
					D																					
	negative	61,2	240,0	235,0	A	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
					B	6									7											8
					C	234,7	235,2	235,8	234,8	236,3	235,1	235,1	235,2			235,1	235,2	235,2	235,1	236,0	236,5	235,9				
					D																					

A1048IG

Power-frequency voltage test (wet)

Test object: Housing of polymer-housed surge arrester, classified "distribution DH", for outdoor installation

Test circuit: A0058 – A0059

Arrangement: see photographs of the test set-up

Atmospheric conditions and correction factor			
b	t_d	h	K_t
kPa	°C	g / m³	
99,76	20,3	9,71	0,993

Measured arcing distance = 485 mm

Precipitation conditions					
	Precipitation rate (mm/min)			Water temperature	Water conductivity
				°C	µS/cm
vertical	--	1,0	--	20,2	99,4
horizontal	--	1,0	--		

Date: September 19, 2017

test sample	voltage required U	voltage applied U x K_t	test voltage V_1	test voltage $V_{HV} = k_1 V_1$ (k_1 = ----)	test voltage V_3	test voltage $V_{HV} = k_D V_3$ (k_D = 25700)	test duration	Test result	Oscillogram	Notes
Serial No.	kV_{peak}	kV_{peak}	V_{peak}	kV_{peak}	V_{peak}	kV_{peak}	s		No.	
368160	150,0	148,95	----	----	5,80	148,95	60	withstand	9	

A0002IG

Impulse generator

No. of stages: 4
C_g: 125 nF
R_t: 520 Ω (3x140 + 2//200 Ω)
R_f: 410 Ω (2x140 Ω + 1x60 Ω + 2//60 Ω + 1x40 Ω)
C_c: ---- nF

Voltage measuring system CESI No. 9792

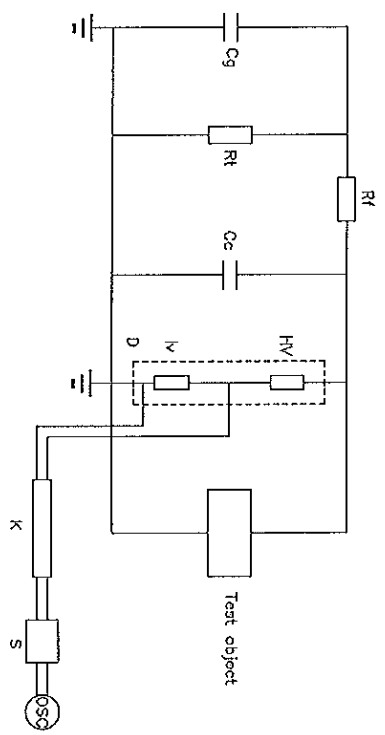
D - divider PASSONI & VILLA type RC series CESI No. 6700; scale factor 25600
HV - high voltage capacitance 600 pF
lv - low voltage unit CESI No. 6704
K - coaxial cable
S - attenuation and termination unit CESI No. 14924
OSC - digital oscilloscope LECROY type HD4096 CESI No. 58202
Data acquisition and calculation software PANDA rel.7.0 May 2017

Measured waveshape				
	polarity	time		oscillogram
		µs		No.
front	positive	1,17		1
tail		51,4		2

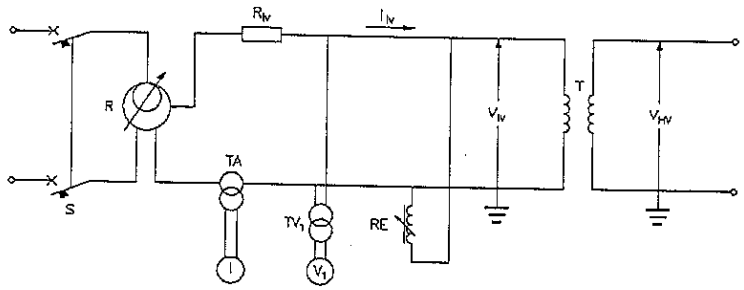
Check of the test circuit				
	Charging voltage V_c	Measured voltage V_m		
polarity	kV/stage	kV		$V_m / (V_c \cdot n_{stages})$
positive	57,3	220,4	η	0,962

Additional measurements:
Reading instruments for atmospheric conditions: Data logger E+E ELEKTRONIK type HUMLOG 20 CESI No.58065
Software for calculation of the correction factor: Fattori UR REL rel 3.4 January 2016

Circuit A0002



Circuit A0058



Power frequency test circuit

R - regulation group PIVI composed by:
- single-phase voltage converter PIVI; power 210 kVA; voltage 380 V/0÷610 V
- booster transformer PIVI; power 200 kVA; voltage 600 V /6 kV

R_{lv} - protection resistor TELEMA; R= 2 Ω
TA - current transformer type CGS; ratio 50 A/5 A; CESI No.33277
T - direct reading digital ammeter
TV_1 - voltage transformer type ALSTOM; ratio 6 kV/100 V; CESI No.33276
V_1 - digital voltmeter FLUKE type 8842A; CESI No.05735
RE - variable reactor (not used)
T - booster transformer CGE mod. KOC; secondary winding power 700 kVA; voltage 6 kV /350 kV; No. of units 1; ratio 58,33

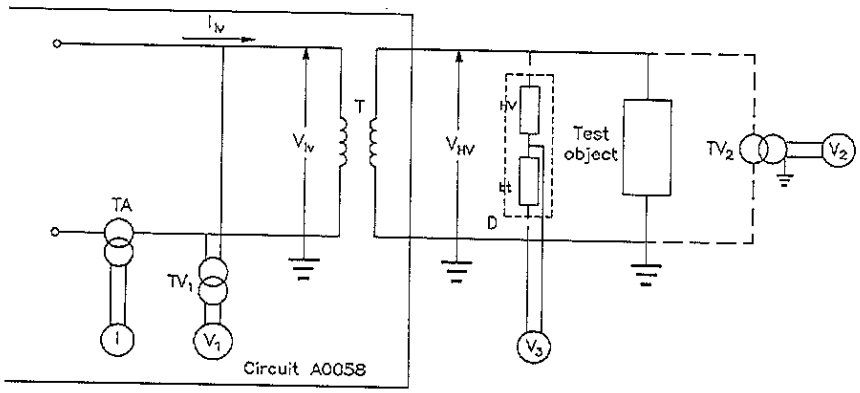
Tripping of the circuit breaker S

k_{TA}	setting of instantaneous tripping			setting of time delayed tripping		
	s_1	$s_1 \cdot k_{TA} \cdot I_N$	t_1	s_2	$s_2 \cdot k_{TA} \cdot I_N$	t_2
A/A		A	s		A	s
50	1	50	0,05	0,5	25	0,05

Additional measurements:

Reading instruments for atmospheric conditions: Data logger E+E ELEKTRONIK type HUMLOG 20 CESI No.58065
Software for calculation of the correction factor: Fattori UR REL rel 3.1 January 2016
Stopwatch CDC ELETTROMECCANICA type TDN46, CESI No.38203
Divided collecting vessel for measurement of precipitation rate CESI, CESI No.38234
Conductivity meter data logger DELTA-OHM type HD 2106.2, CESI No.56181

Circuit A0059



Power frequency measuring circuit

TA - current transformer type CGS; ratio 50 A/5 A; CESI No.33277
I - direct reading digital ammeter
TV_1 - voltage transformer type ALSTOM; ratio 6 kV/100 V; CESI No.33276
V_1 - digital voltmeter FLUKE type 8842A; CESI No.05735

D - divider PASSONI & VILLA type RC series CESI No.06700; scale factor 25700
HV - high voltage capacitance 600 pF
lv - low voltage unit CESI No.06704
K - coaxial cable
S - attenuation and termination unit CESI No.14924
V_3 - digital voltmeter AGILENT type 34401A; CESI No.55077

TV_2 - voltage transformer (not used)
V_2 - digital voltmeter (not used)

Functional check of the test circuit Date: September 19, 2017

Low voltage				High voltage				
				k_1 = ----		k_3 = 25700		k_0
V_1	V_{lv}	I	I_{lv}	V_2	V_{HV}	V_3	V_{HV}	V_{HV}/V_1
$V_{r.m.s.}$	$V_{r.m.s.}$	A	A	$V_{r.m.s.}$	$kV_{r.m.s.}$	$V_{r.m.s.}$	$kV_{r.m.s.}$	Kthco.= 3500
14,684	881,0	–	0,6	–	–	2,0096	51,65	3517

Photograph of the test object

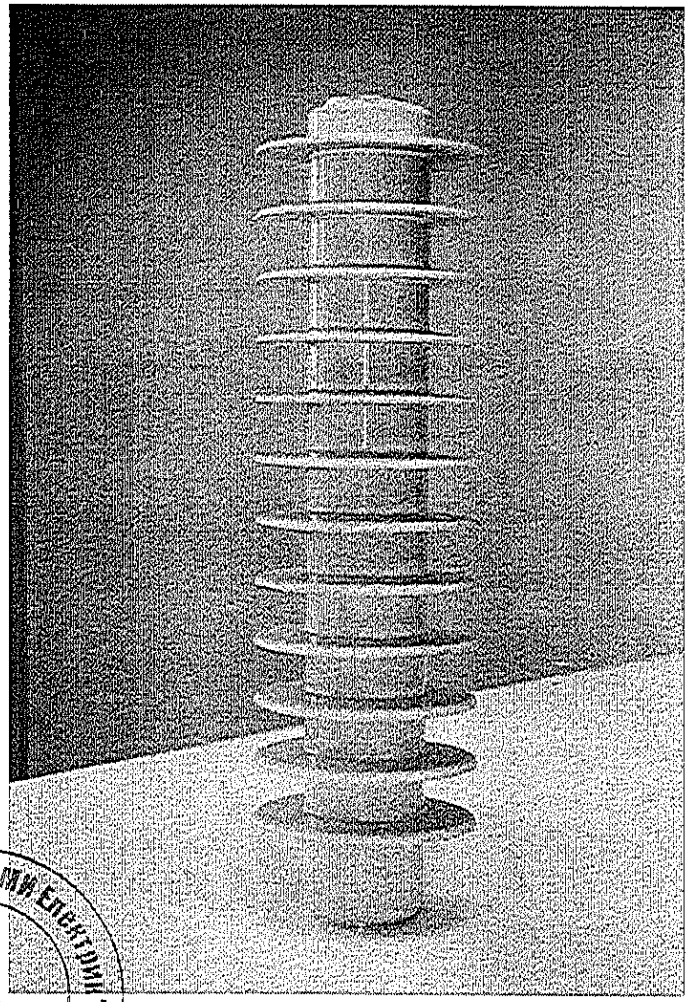


Photo No. 1

Photograph of the test arrangement

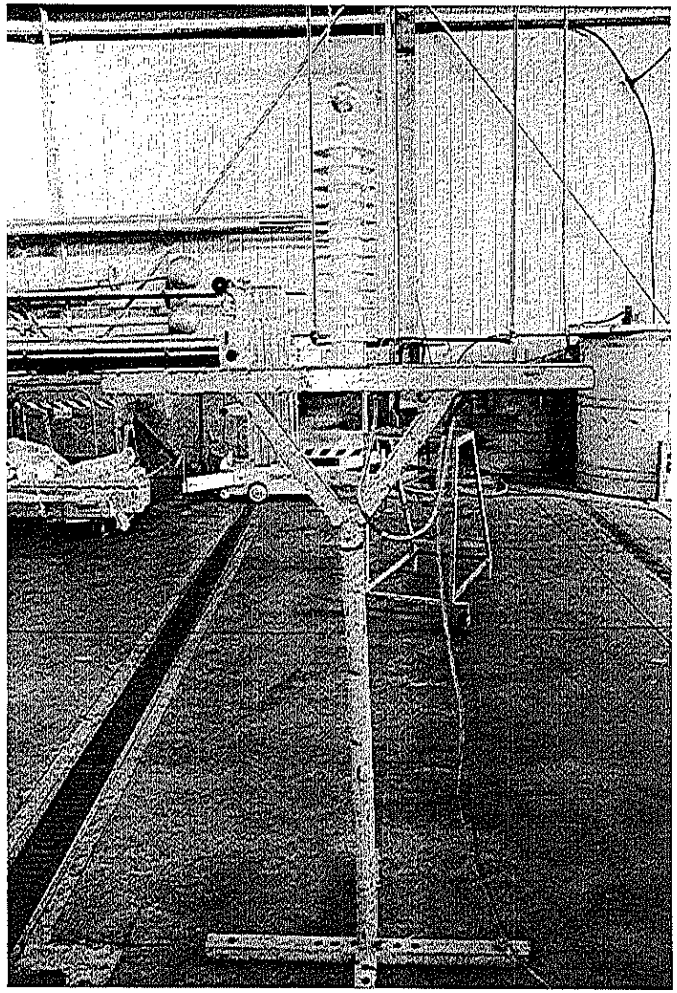
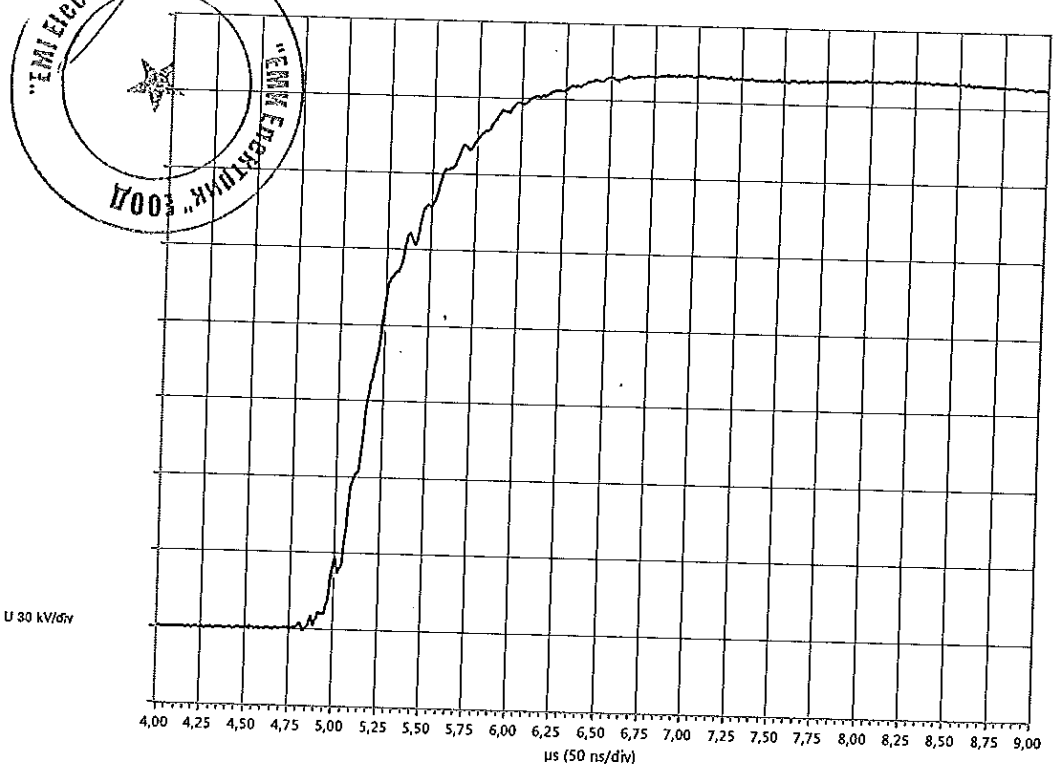
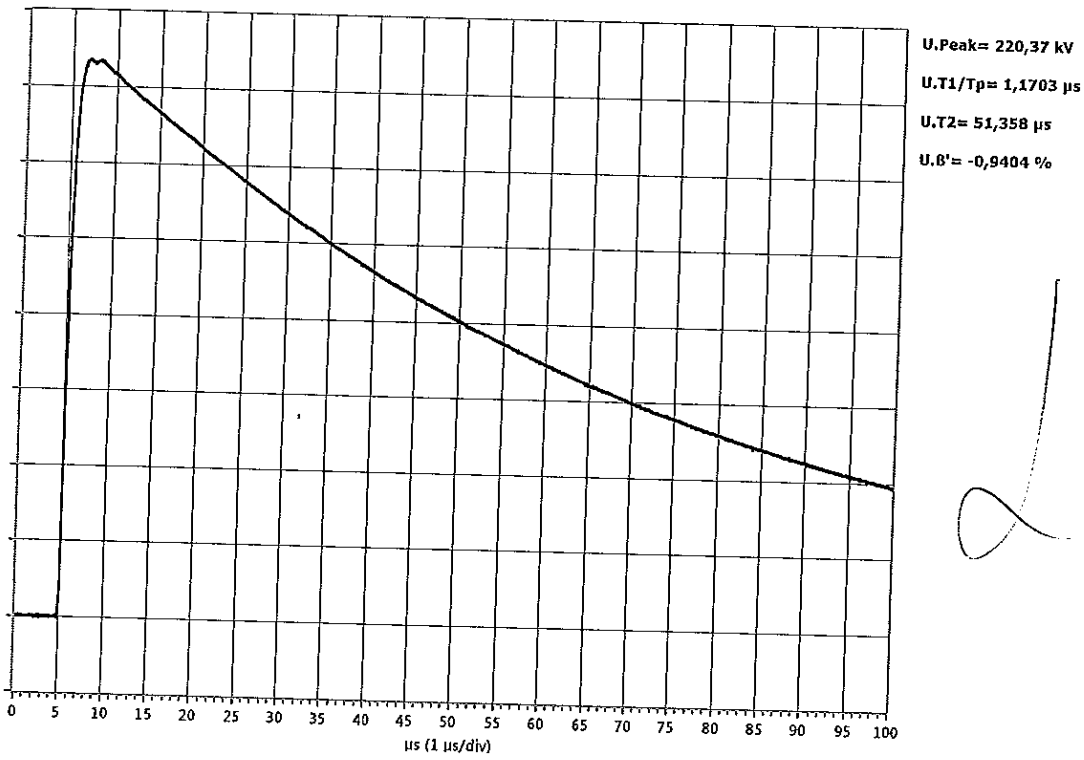


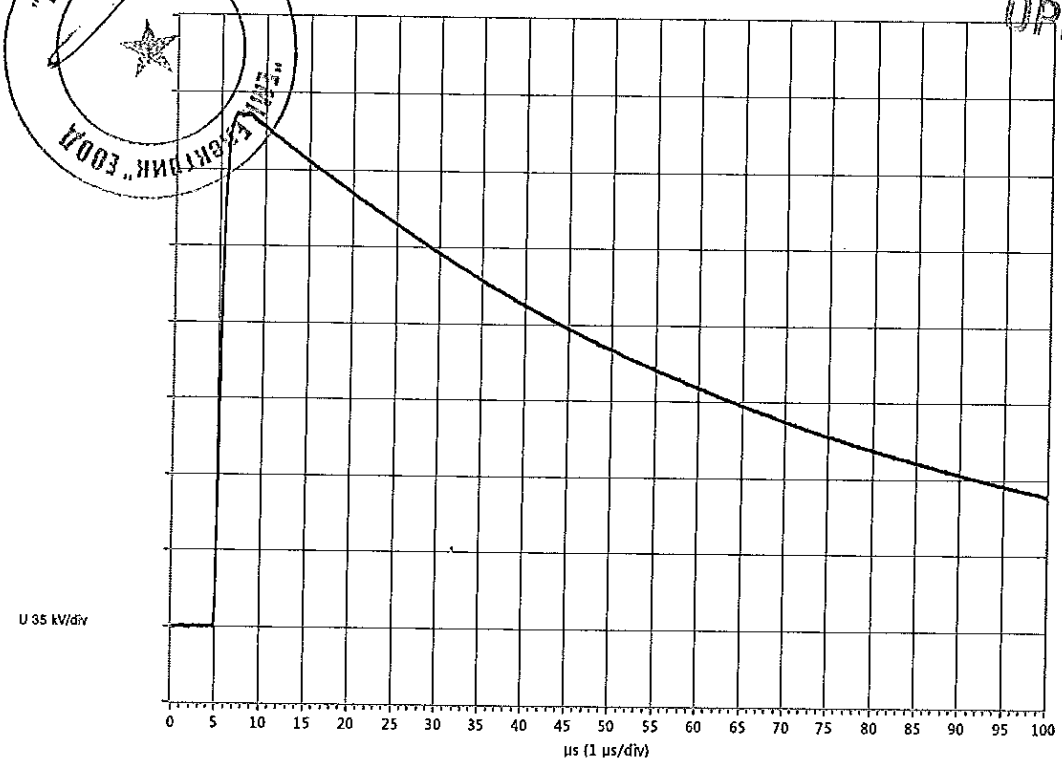
Photo No. 2



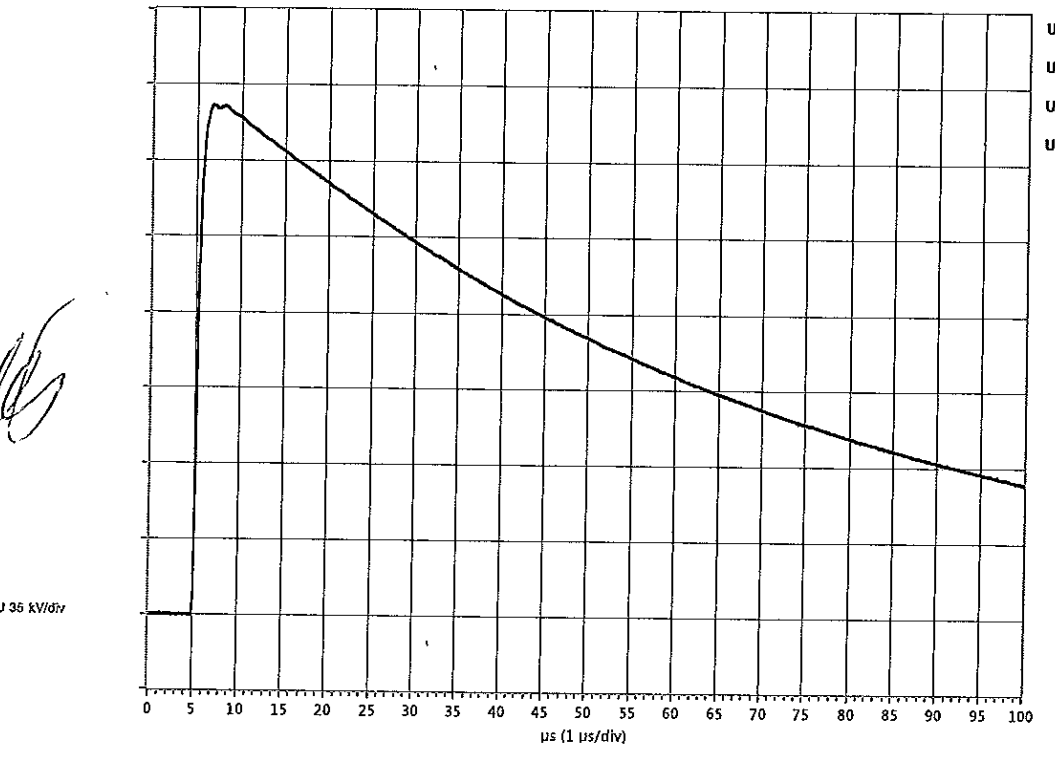
CESI P180 B7018645 , Oscill. No. 0001



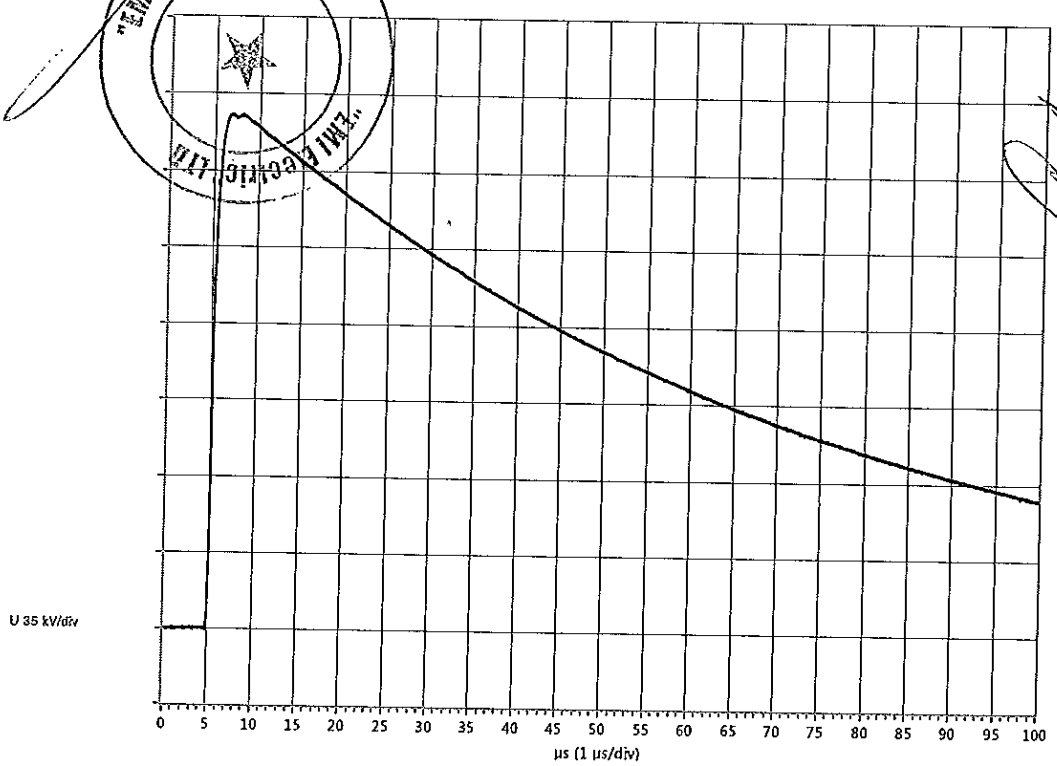
CESI P180 B7018645 , Oscill. No. 0002



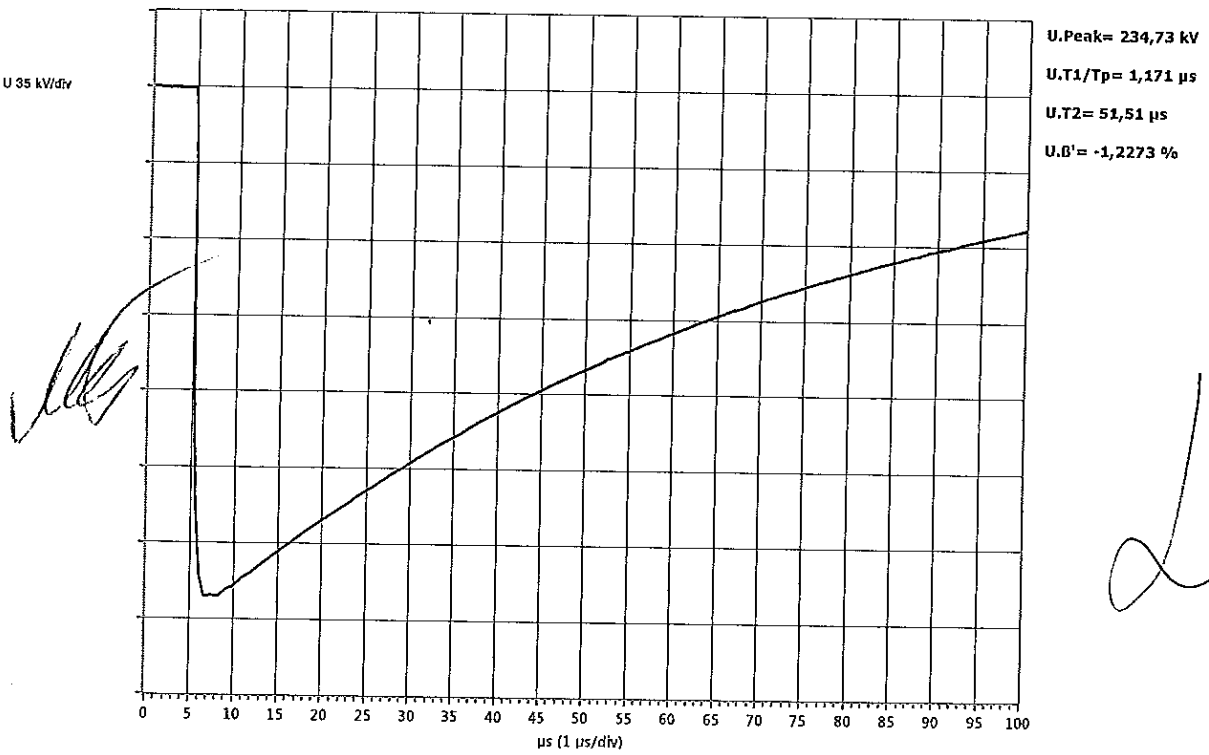
CESI P180 **B7018645** , Oscill. No. **0003**



CESI P180 **B7018645** , Oscill. No. **0004**

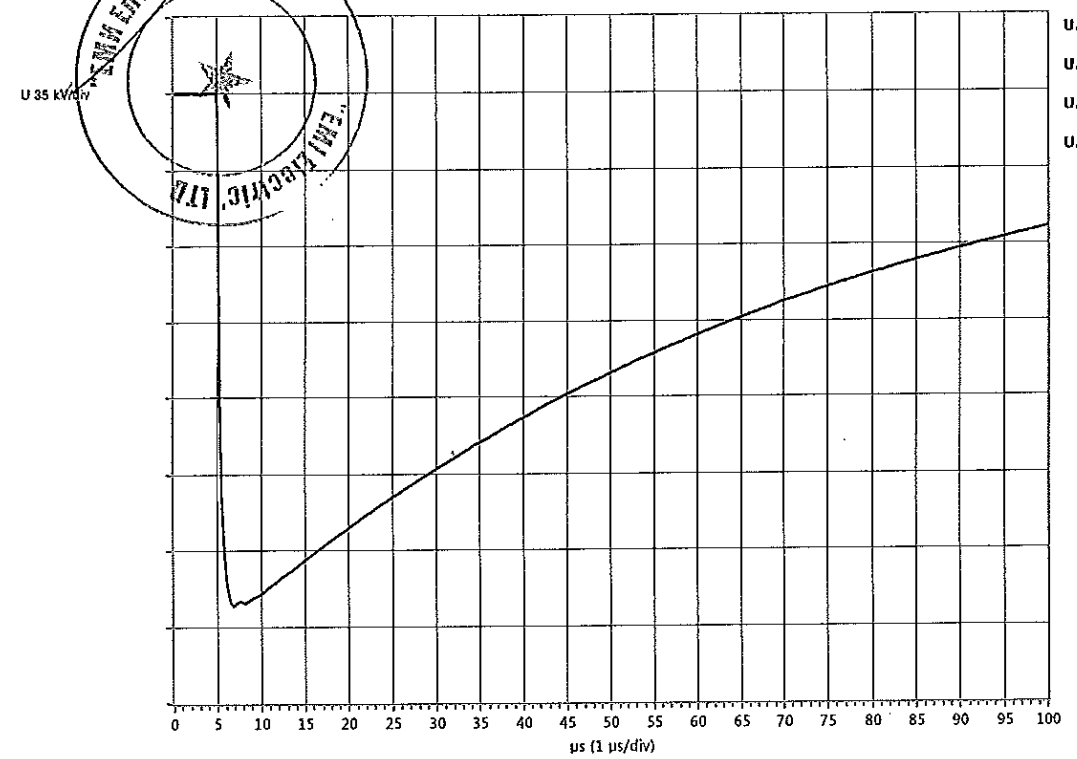


CESI P180 B7018645 , Oscil. No. 0005

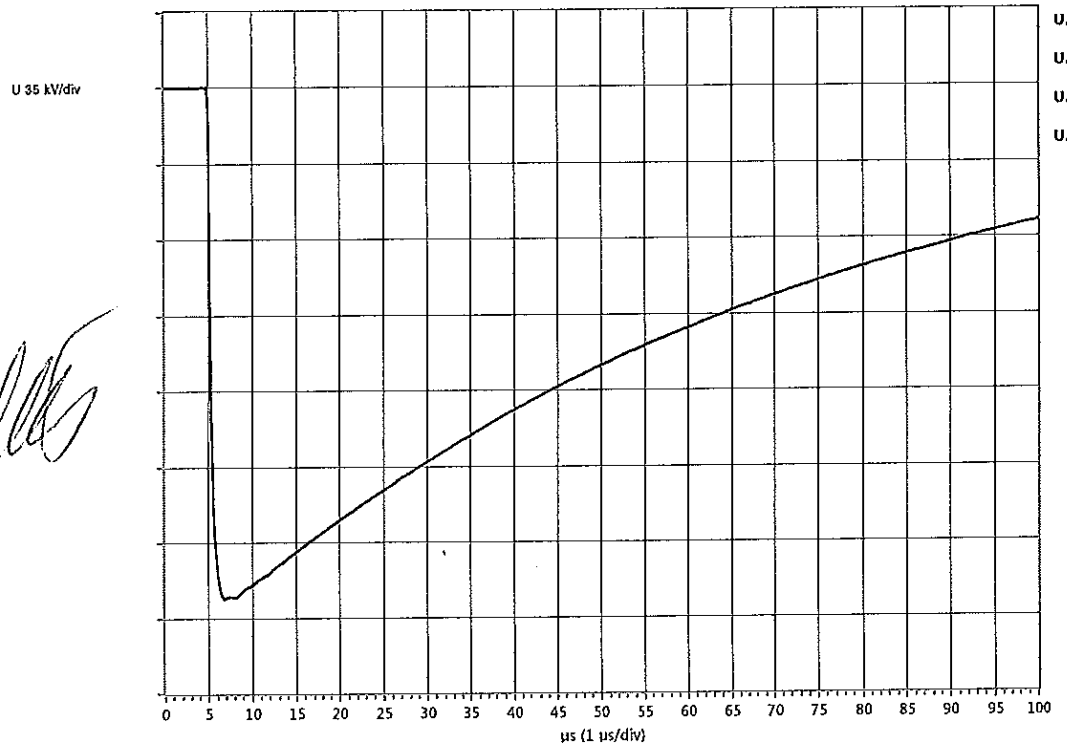


CESI P180 B7018645 , Oscil. No. 0006

ВЯРНО С ОРИГИНАЛА



CESI P180 B7018645 , OscEL No. 0007



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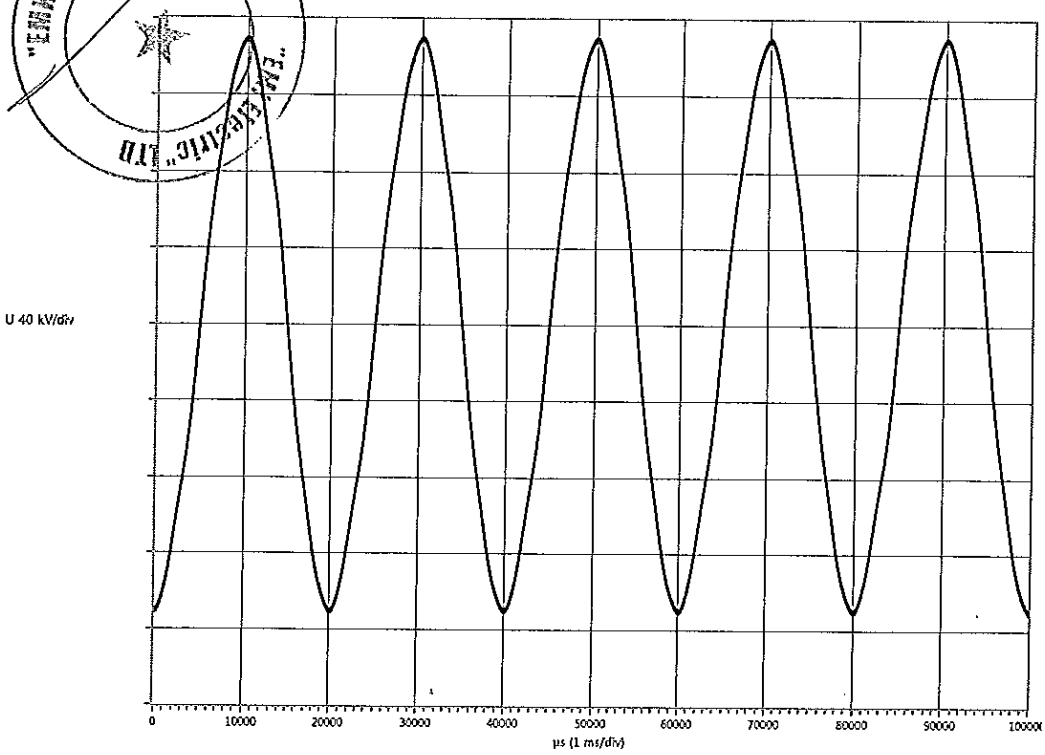
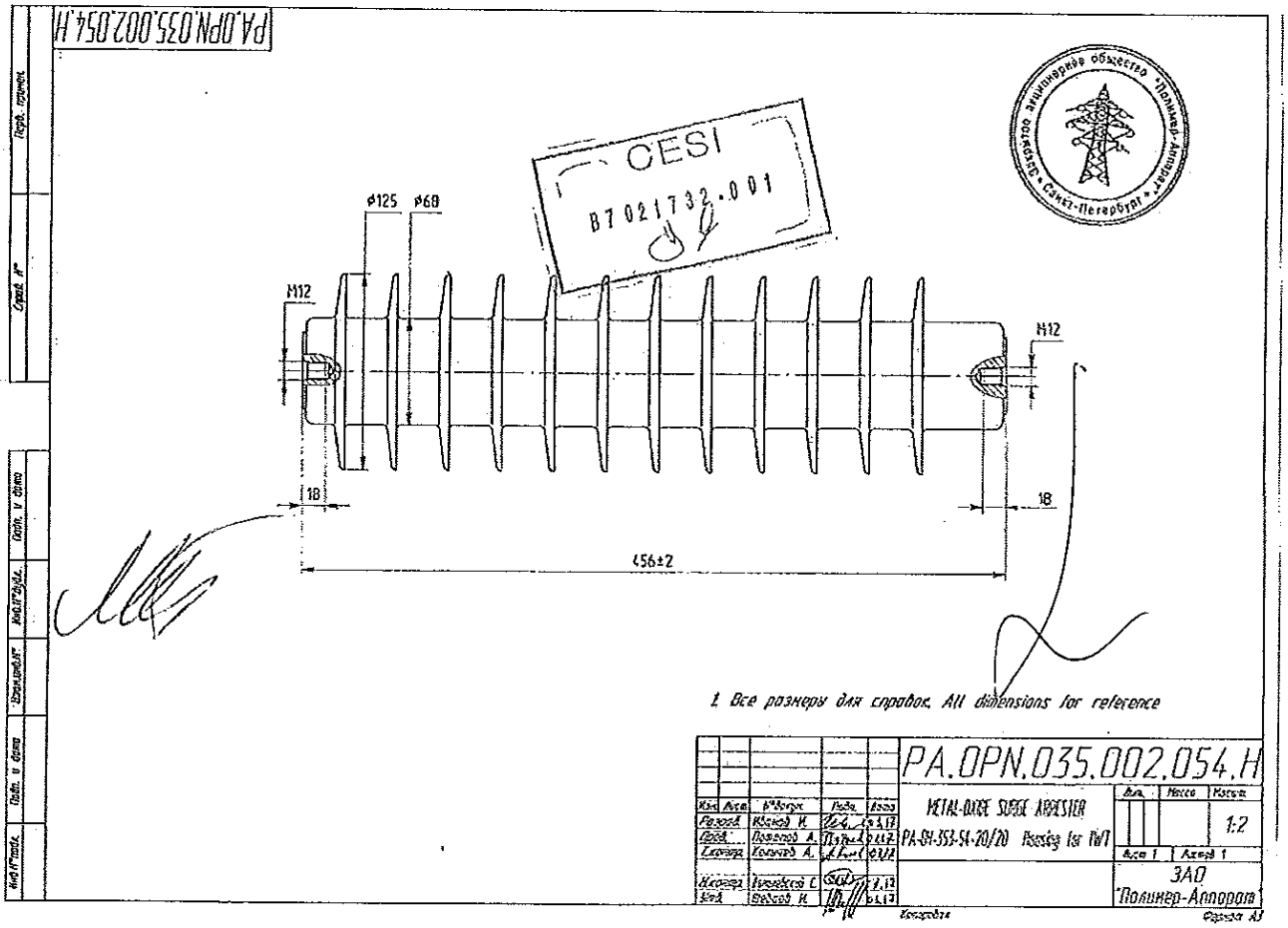


CESI P180 B7018645 , OscEl. No. 0009



Test Report

Document No.	87019592	Copy No. 1	Number of pages	28
Apparatus	MO resistors type B34/30			
Designation	—			
Serial Number	—			
Manufacturer	Joint-Stock Company " Polymer-Apparat"			
Client	Joint-Stock Company " Polymer-Apparat Ak. Kostantinova Strasse, 1 195427 – Saint-Petersburg - Russian Federation			
Tested for	---			
Date(s) of tests	September 27-28, 2017			
Tested by	CESI S.p.A. Via Rubattino, 54 20134 Milano - Italy			
Test performed	Residual voltage tests			

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this document has been subjected to the series of proving tests in accordance with:
IEC 60099-4 – Edition 3.0 (2014-06)

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

November 9, 2017

Date

Gregori Marco
Test Engineer in charge

The Manager - Arcidiaco Lorenzo
Approved By Document Digitally Signed

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO
CAB N° 0030

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

CESI

Trust the Power of Experience

Notes

STL-Member

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

CESI Group Test Documents description

Type Test Certificate of .....

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

Test Certificate of (complete / selected) Type Tests

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

Certificate of Design Verification

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

Type Test Report

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

Test Report

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

On-Site Test Record

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

Test Award

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

PAGES ANNEXED:

Oscillograms no. 13 pages

Client's drawing - CESI no.B7020387 no. 1 page

A1002IG

Test Report

CESI

Approved

Tests witnessed by:

—

Identification of the object: Requested

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings.
CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.
These drawing, identified by CESI and numbered B7020387 No. 1, is annexed to this document.

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

- Voltage a.c. : ± 3,0%
- Residual peak voltage (impulse tests) : ± 3,0%
- Current a.c. : ± 3,0%
- Peak current (impulse tests) : ± 3,0%
- Time (impulse tests) : ± 10,0%
- Time (a.c. tests) : ± 1,5%

Laboratory information

Receipt date of the sample: September 2017

Test location: CESI – Via Rubattino 54 – Milan

CESI testing team: Mr. L. Podavitte, Mr. I Gucci

Test laboratory: P177(Surge Arrester laboratory)

ODYSAP: 70006781

ВЯРНО С ОРИГИНАЛА

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Test object characteristics (assigned by the client)

Manufacturer's name	Joint-Stock Company " Polymer-Apparat"
Arrester class	Distribution
Designation	DH
MO resistor type	B34/30
Drawing code	PA.VAR.0400.30
Nominal discharge current - [kA]	10,0
Maximum residual voltage at 10 kA - [kV]	14,36
Reference current - I_{ref}, [mA]	1,0
Repetitive charge transfer rating – Q_{rs} [C]	0,4
Flat surface area [cm^2]	10,52
Rated frequency - [Hz]	48÷62
Year of manufacture	February 2017

geometrical characteristics measured on MO resistor

Total height [mm]	31,1 mm
Diameter [mm]	36,6 mm

Photograph of the test objects

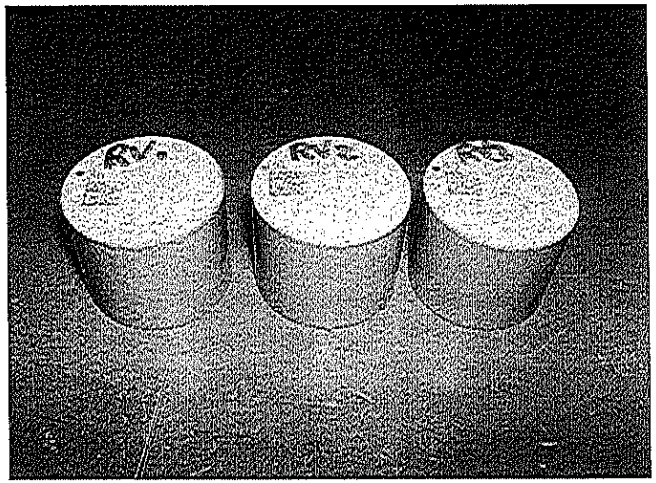


Photo no. 1

MO resistors type B34/30

Reference Standard

The test was carried out according to the IEC 60099-4 – Edition 3.0 (2014-06) – Clause 8.3 "Metal-oxide surge arresters without gaps for a.c. system"

Test carried out	Number of sample tested
Lightning impulse residual voltage test	3
Steep current impulse residual voltage test	

Test object identification

Test object name	Identification of test sample (given by CESI)	Lot number and /s/n of the test sample (given by JSC "Polymer Apparat")
MO resistors type B34/30	RV1	702.378b – 36
	RV2	702.378b – 86
	RV3	702.378b – 43

Test procedure

The following tests have been carried out on the same three samples:

a) Lightning impulse residual voltage test
- wave-shape 8/20 µs
- peak current $0,5xI_n$ =5,0 kA - I_n = 10,0 kA & $2xI_n$ = 20,0 kA

b) Steep current impulse residual voltage test
- wave-shape front time equal to 1 µs, tail time less than 20 µs
- peak current I_n = 10 kA

- note Correction of the inductive error
The inductive error was determined replacing the surge arrester section with a metal part having the same dimensions and measuring the voltage across the metal part in this condition.
Being the inductive error (peak value) in the range 2% to 20% of the measured residual voltage (peak value) the correction was applied by substracting the impulse voltage shape measured on the surge arrester section and the impulse voltage shape on the metal part.

Test result

See relevant pages.

Residual voltage tests

Lightning impulse residual voltage test.

Test circuit: A0120
Ambient temperature 22°C

Date: September 27, 2017

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage	Lightning impulse protection level
No.		kV	No.	µs	kA	kV	kV
RV1	$0,5 \times I_n$	18,4	7	8,4/18,4	5,09	13,21	14,32
	I_n	24,2	1	8,5/18,2	10,12	14,32	
	$2,0 \times I_n$	36,0	4	8,5/18,1	20,20	16,00	
RV2	$0,5 \times I_n$	18,4	8	8,4/18,4	5,00	13,21	
	I_n	24,2	2	8,5/18,2	9,99	14,19	
	$2,0 \times I_n$	36,0	5	8,5/18,1	20,14	16,01	
RV3	$0,5 \times I_n$	18,4	9	8,4/18,4	4,97	13,22	
	I_n	24,4	3	8,5/18,2	10,11	14,31	
	$2,0 \times I_n$	36,0	6	8,5/18,1	20,10	16,02	

Notes:

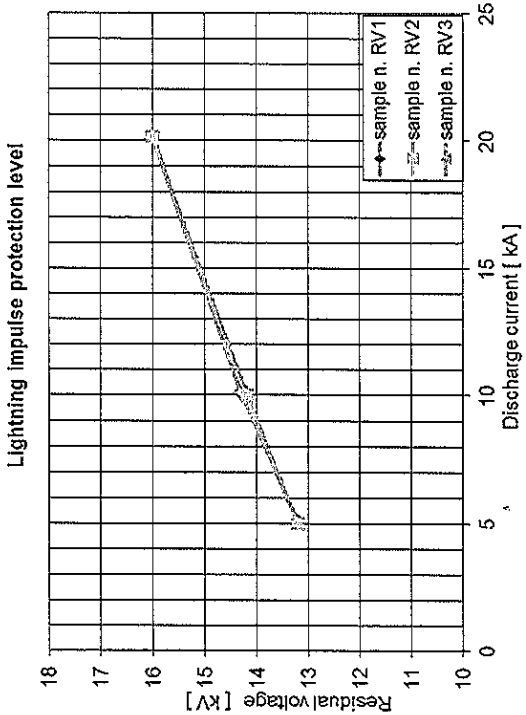
ВЯРНО С ОРИГИНАЛА

"ЕМИ ЕЛЕКТРИК" ЕООД

A1144IG

IAC-MRA ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO LAB N° 0030

A1264IG



ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO LAB N° 0030

IAC-MRA

Residual voltage tests

Steep current impulse residual voltage test.

Measurement of the inductive error

Test circuit: A0121B
Ambient temperature : 23°C

Date: September 28, 2017

Sample	Charging voltage	Oscillogram	Current waveshape	Discharge current	Peak voltage	Inductive error
No.	kV	No.	µs	kA	V	%
aluminium block	33,3	10	1,0/2,2	10,18	270,0	< 2 (1)

Notes: (1) correction is not required

Residual voltage tests

Steep current impulse residual voltage test.

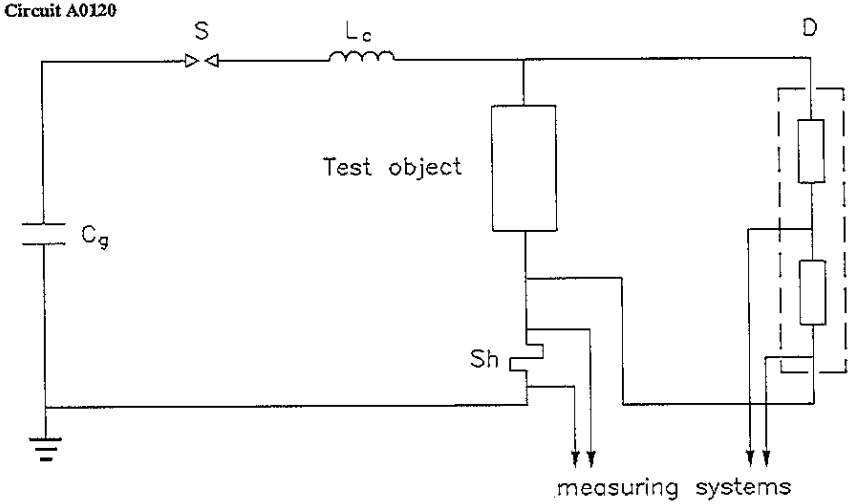
Test circuit: A0121B

Ambient temperature : 23°C
Date: September 28, 2017

Sample	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage	Steep current impulse protection level
No.	kV	No.	µs	kA	kV	kV
RV1	33,3	11	1,0/2,2	9,95	15,33	15,47
RV2	33,3	12		9,95	15,40	
RV3	33,4	13		9,95	15,47	

Notes:

Circuit A0120



Impulse generator

No. of stages	I
Cg	6,64 µF
	6 µH
	- Spark-gap

For 2xIn a resistor block has been added

Voltage measuring system.

D	- Voltage divider SAGI; CESI No.11120
	- Electro optical system type HBM CESI No. 57986(Rx) – 57991 (Tx)
OSC	- Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
	- CESI No 056227- 0562226 (on channel No.2)

Current measuring system

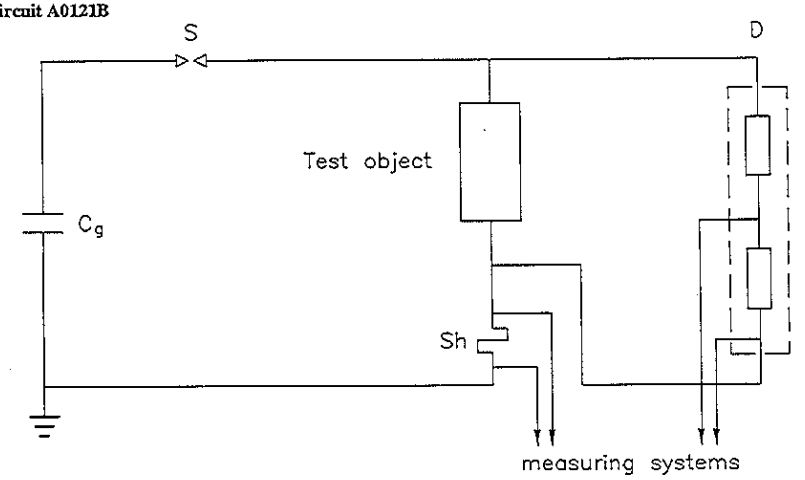
Sh	- Current shunt CESI No.6042; R= 1,98 mΩ; peak current= 250 kA
	- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)
OSC	- Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
	- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:

SW - S.A.D. Surge arrester version 2.0

A0120IG

Circuit A0121B



Impulse generator

No. of stages	1
Cg	0,500 µF
S	- Spark-gap

Voltage measuring system.

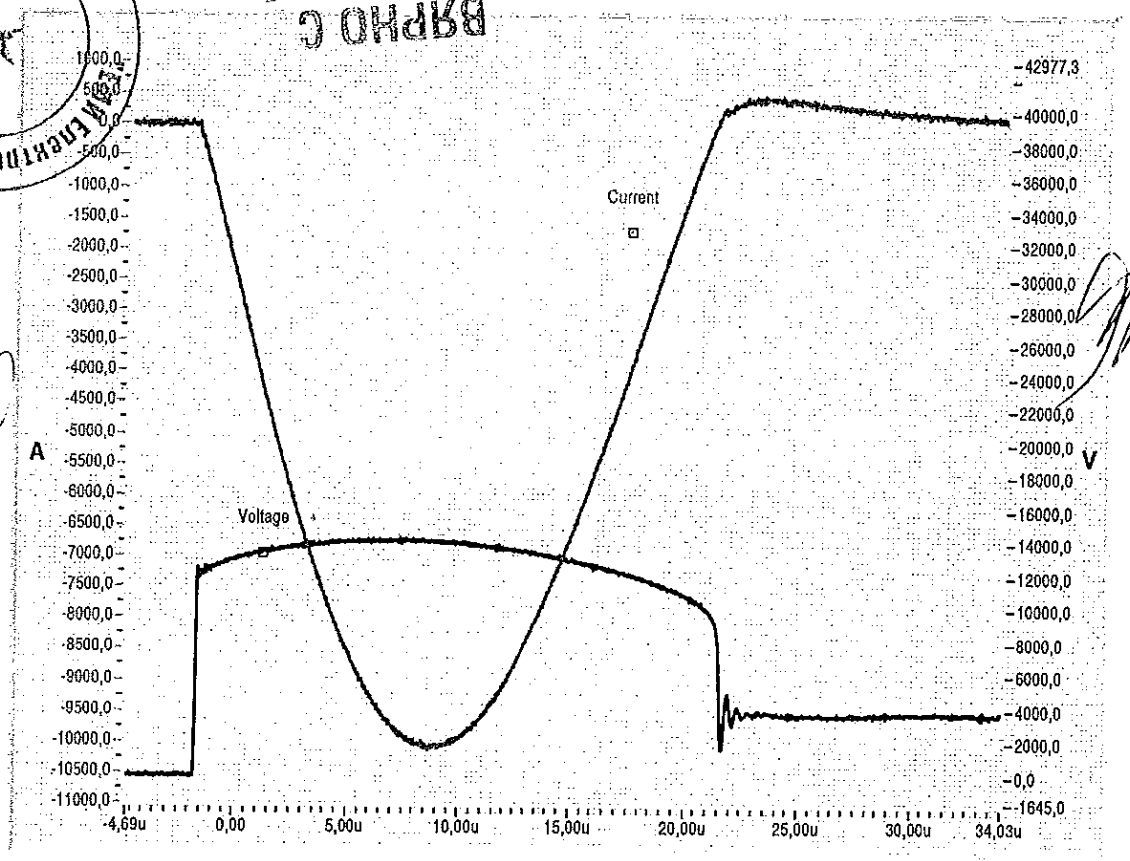
D	- Voltage divider SAGI; CESI No.11120
	- Electro optical system type HBM CESI No. 57986(Rx) – 57991 (Tx)
OSC	- Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
	- CESI No 056227- 0562226 (on channel No.2)

Current measuring system

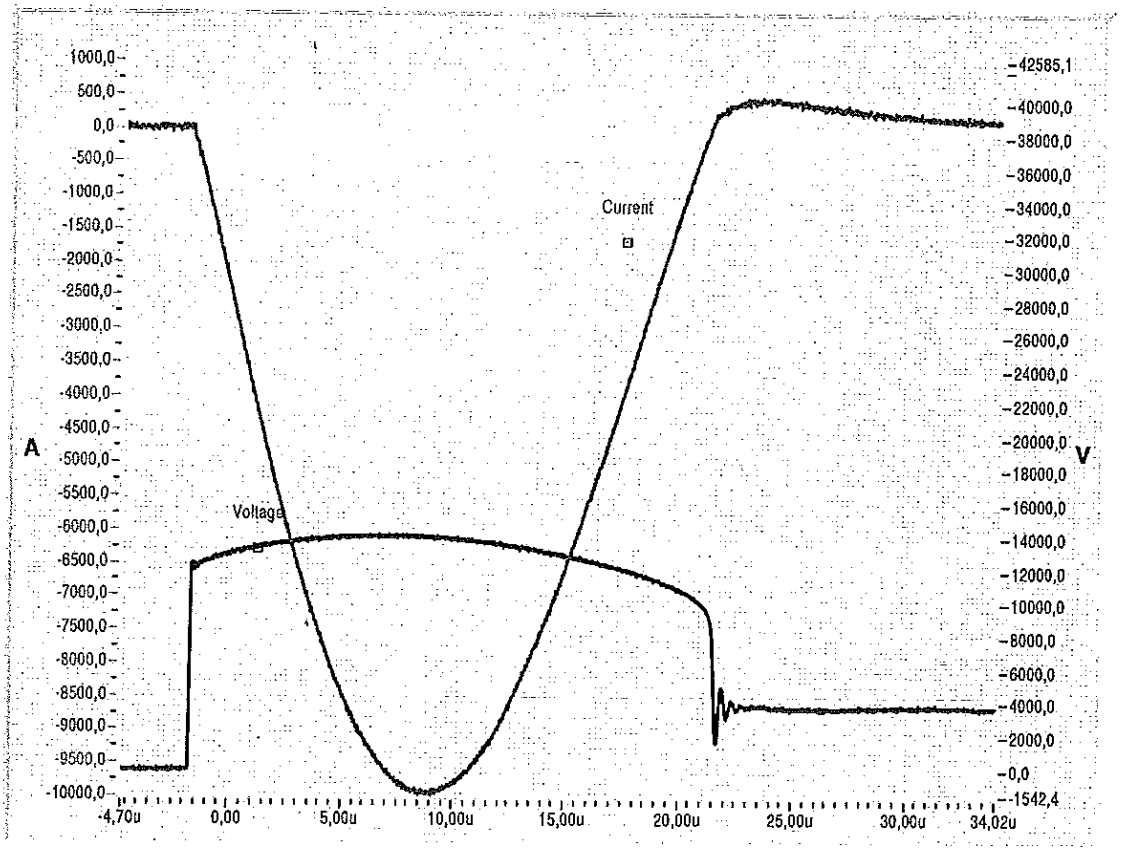
Sh	- Current Pearson CESI No.8252; 0,01 V x A
	- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)
OSC	- Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
	- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:

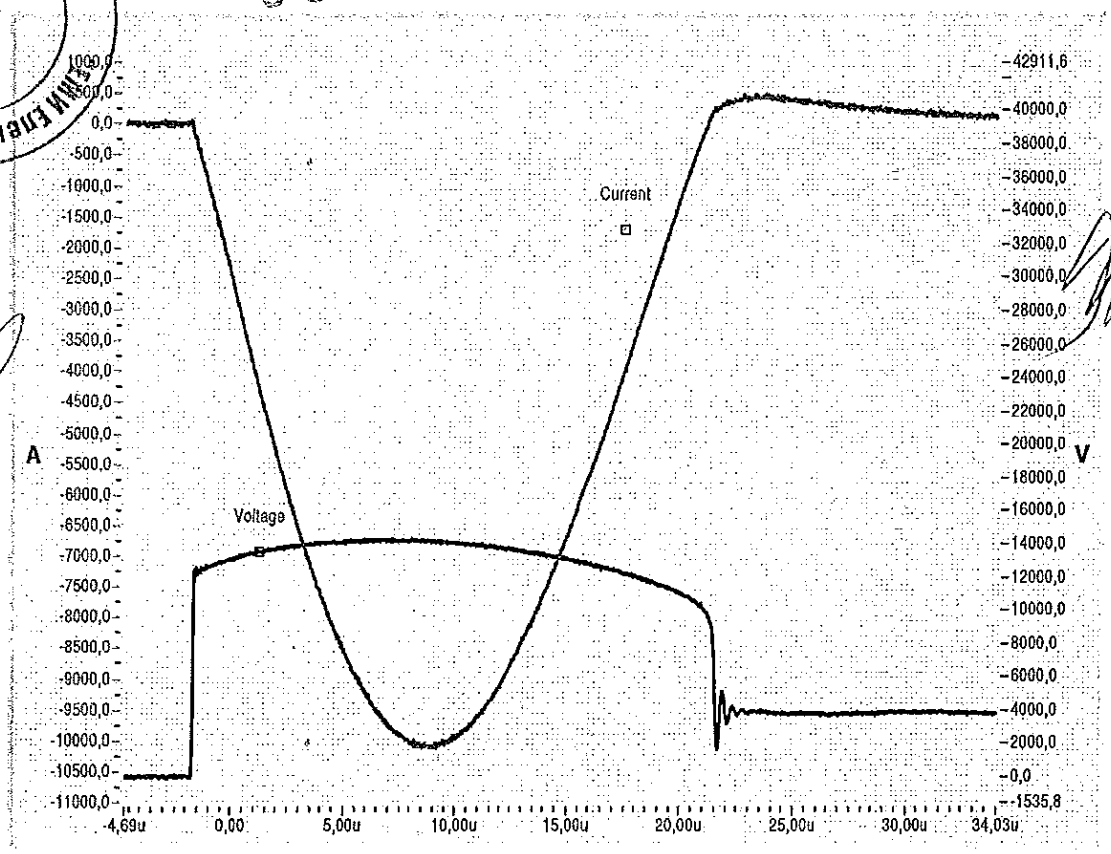
SW - S.A.D. Surge arrester version 2.0



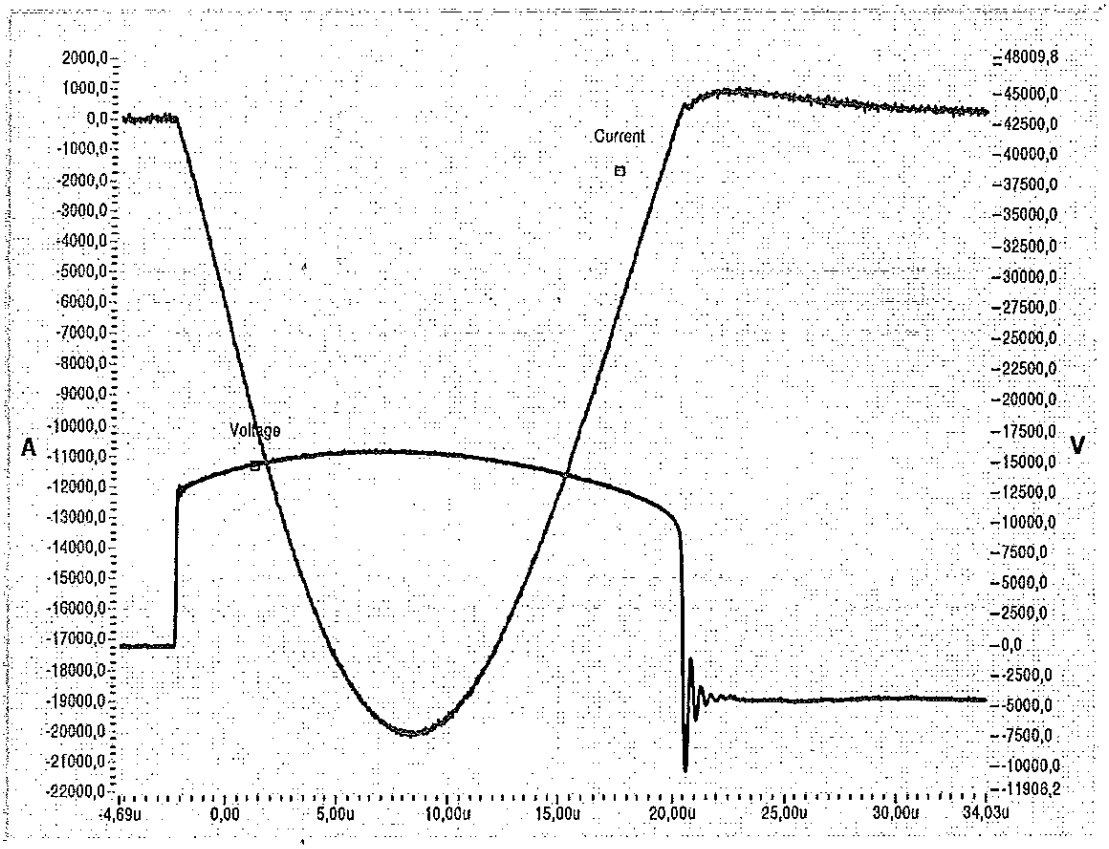
CESI B7019592 Oscillogram n. 1



CESI B7019592 Oscillogram n. 2

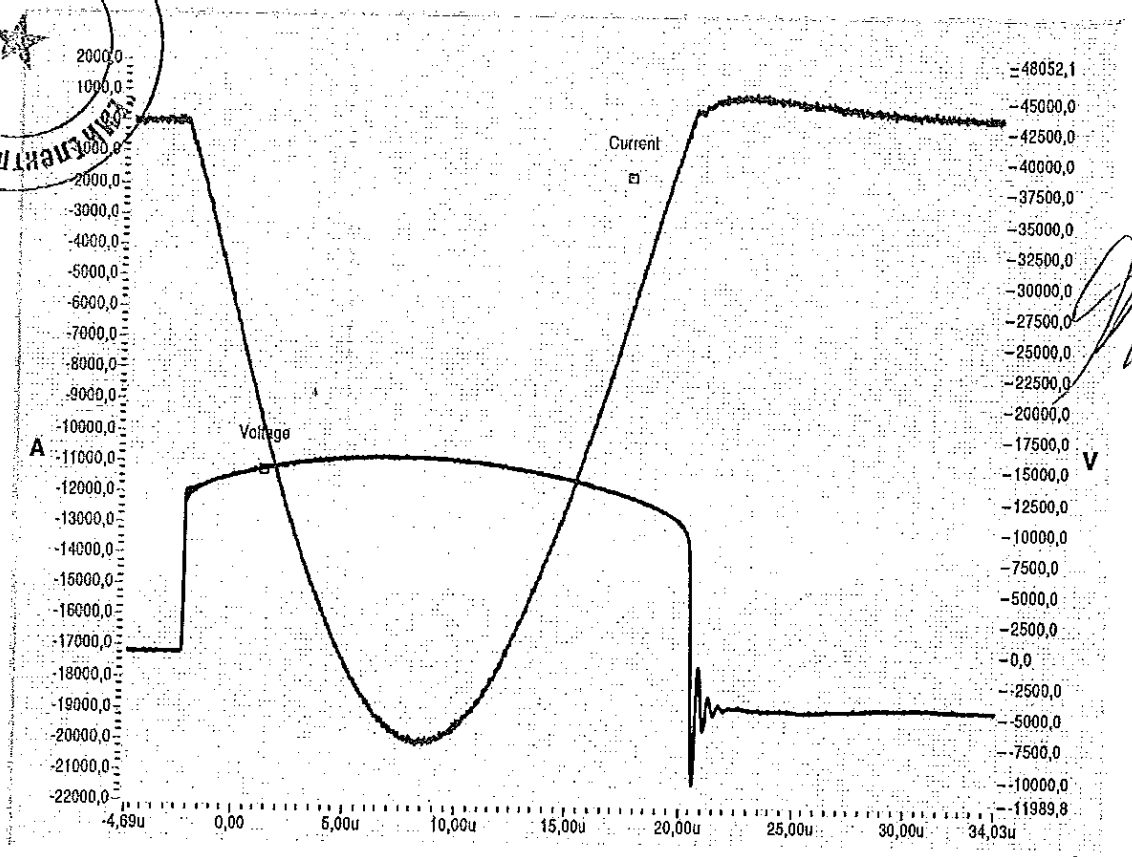


CESI B7019592 Oscillogram n. 3



CESI B7019592 Oscillogram n. 4

CESI B7019592 Oscillogram n. 5



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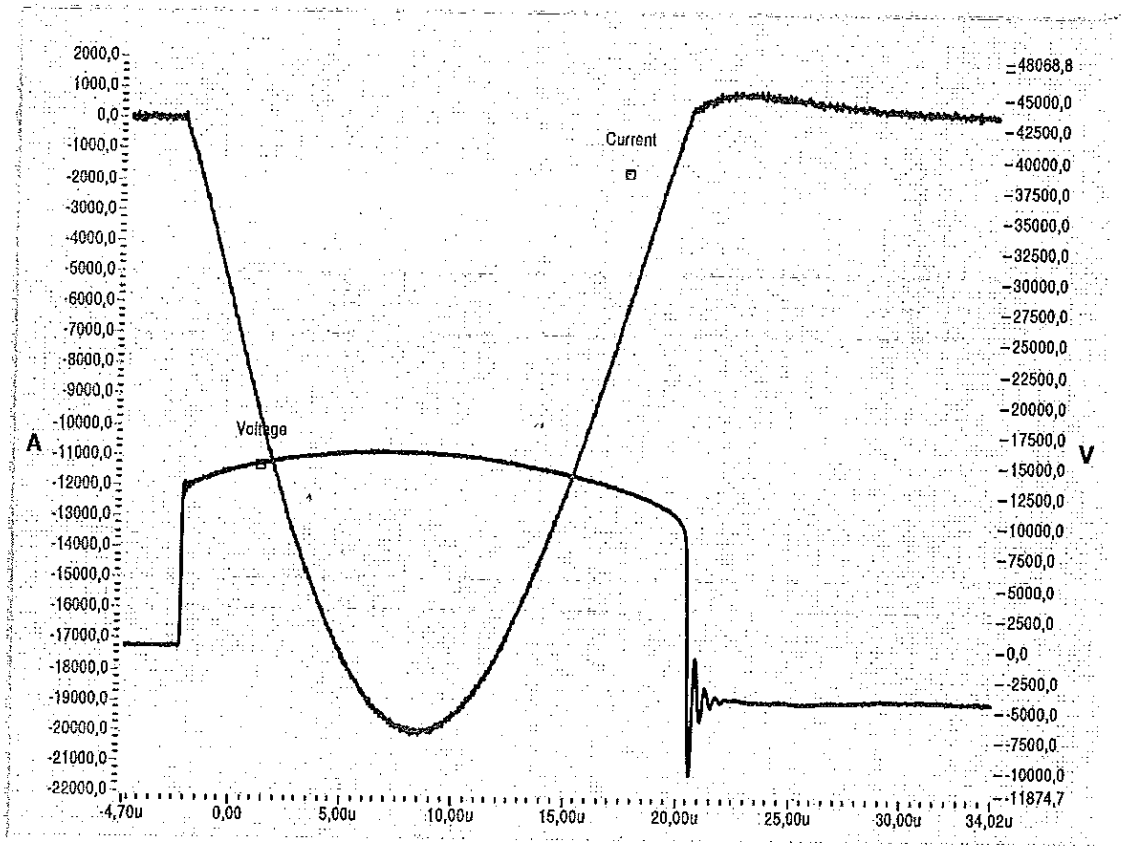
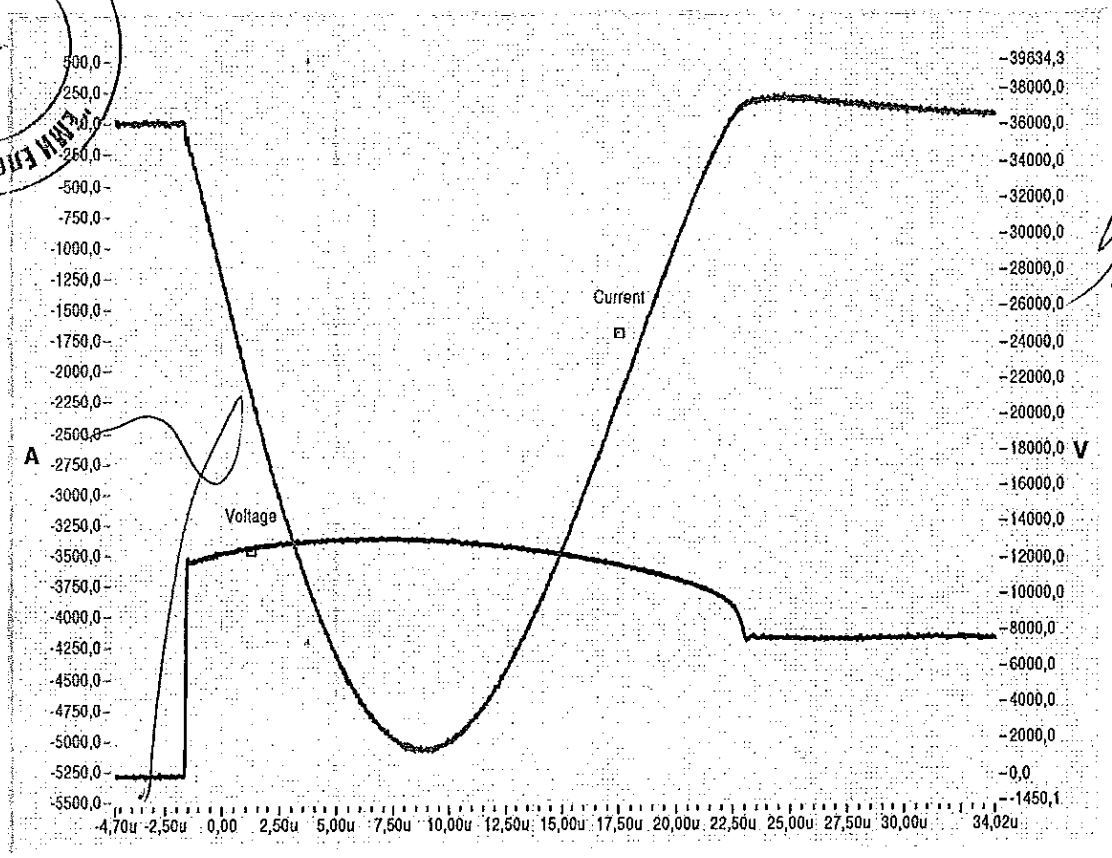
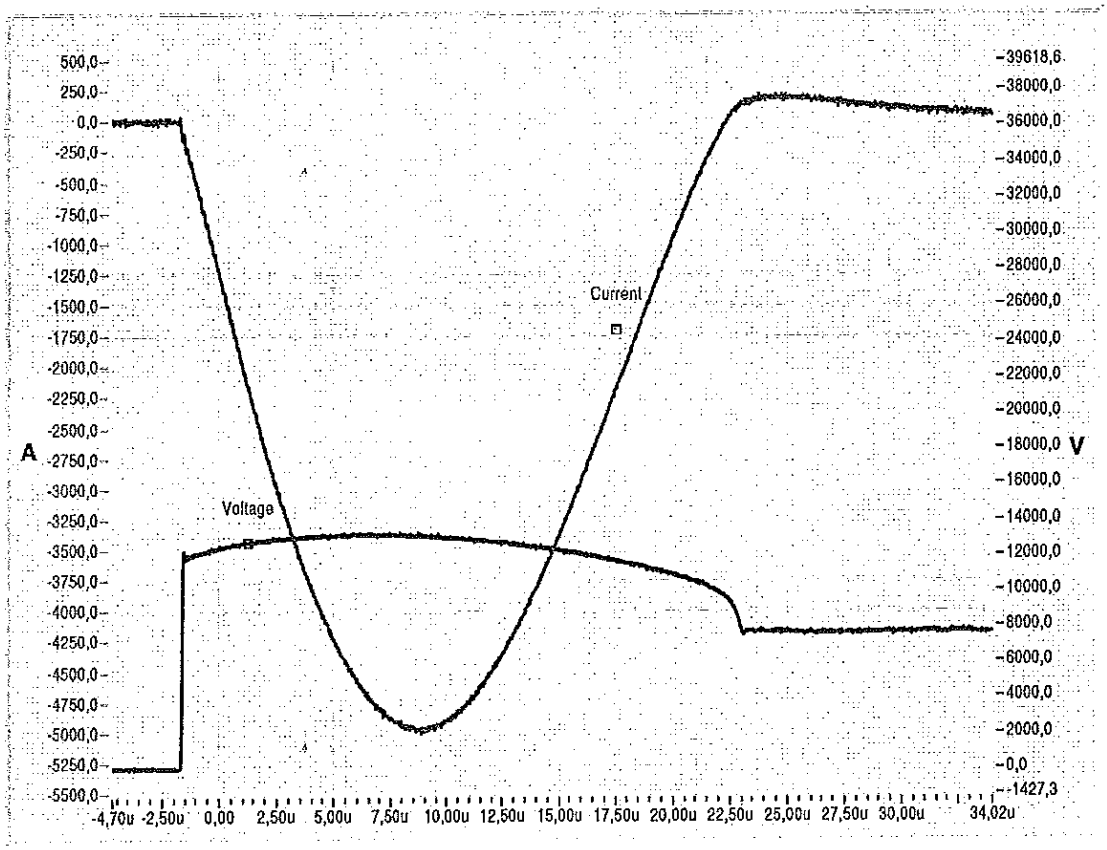


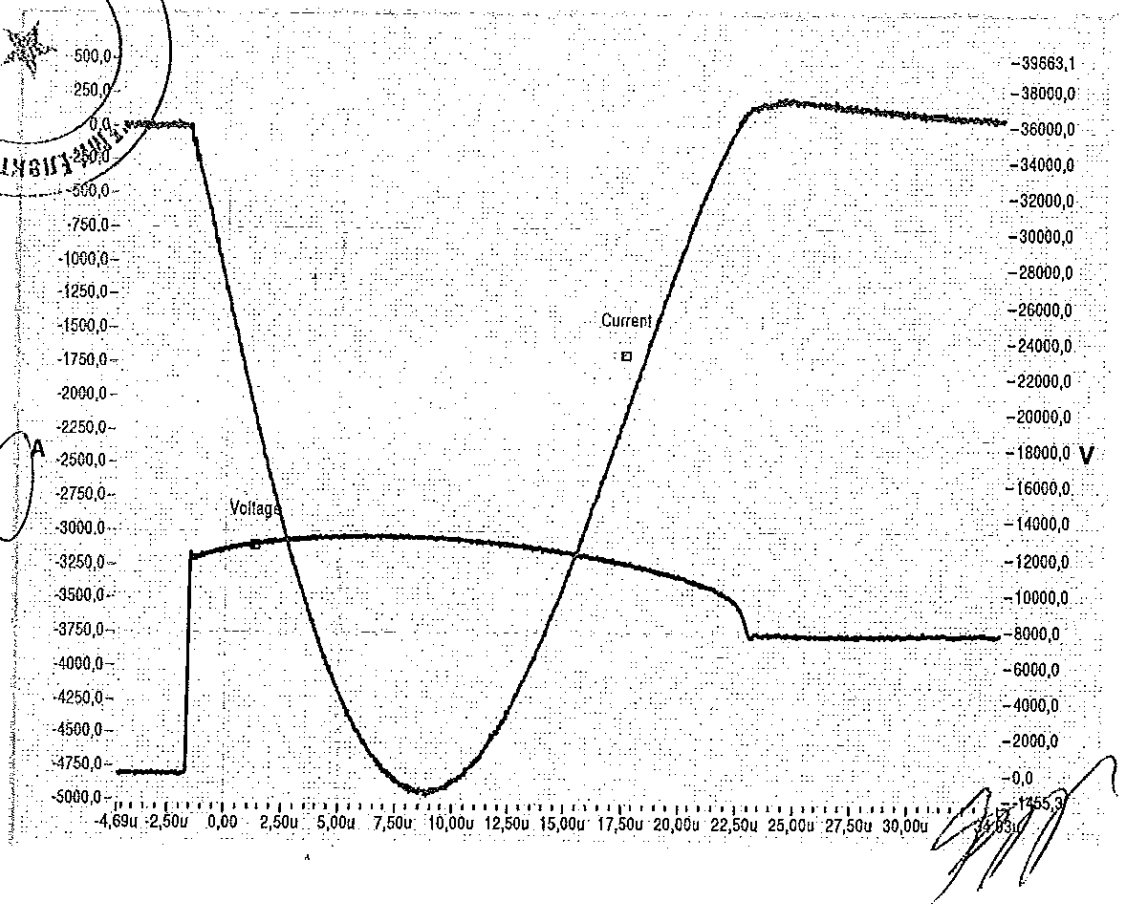


CESI B7019592 Oscillogram n. 7

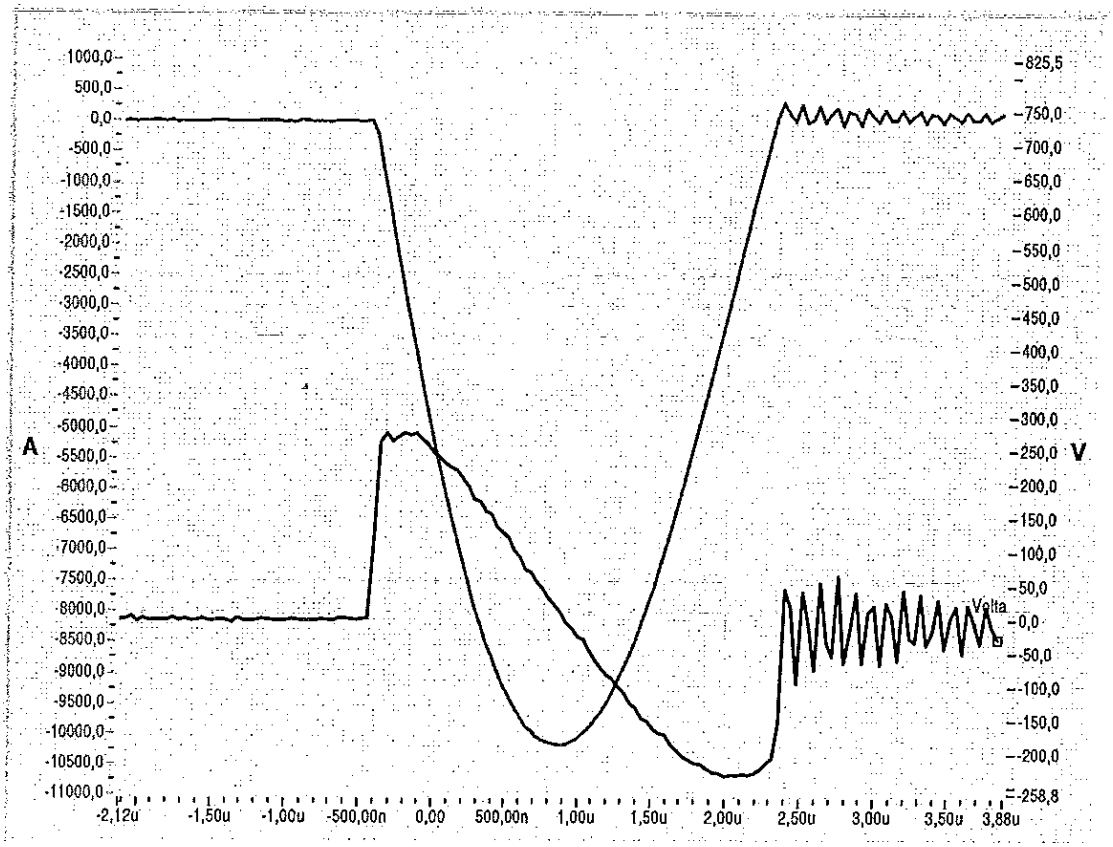


CESI B7019592 Oscillogram n. 8

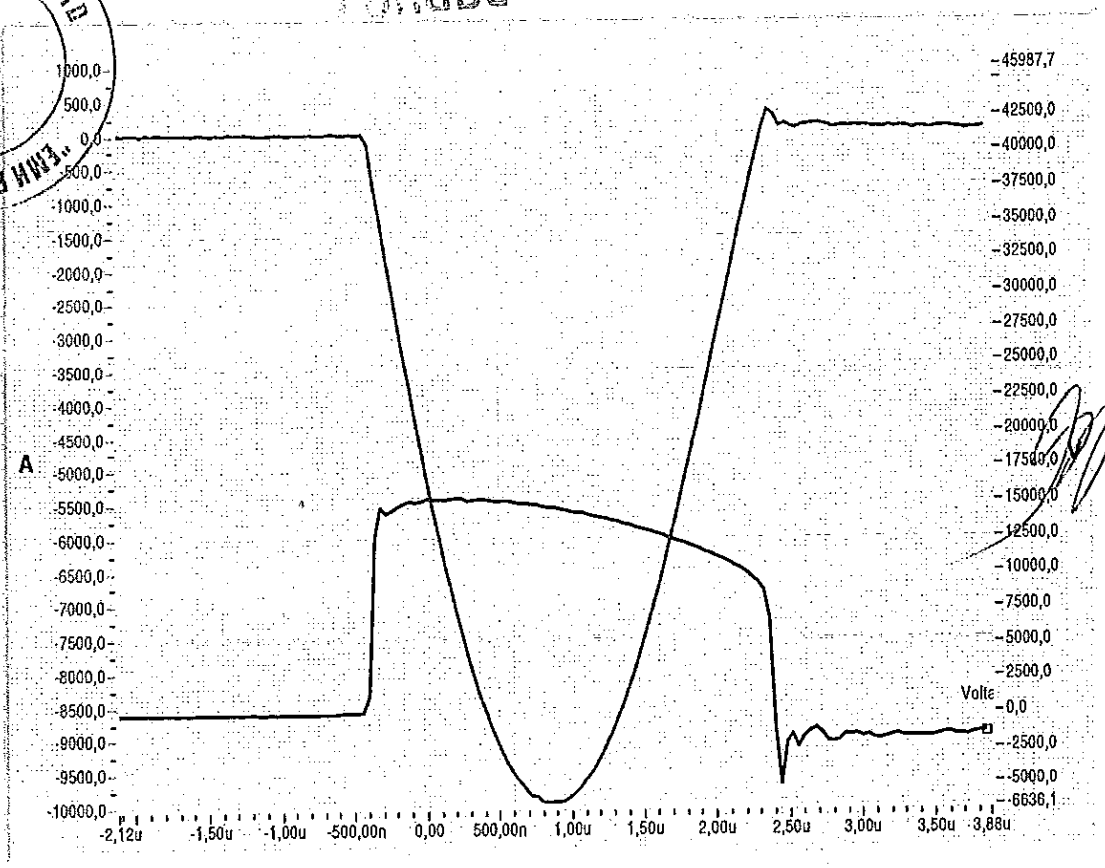
CESI B7019592 Oscillogram n. 9



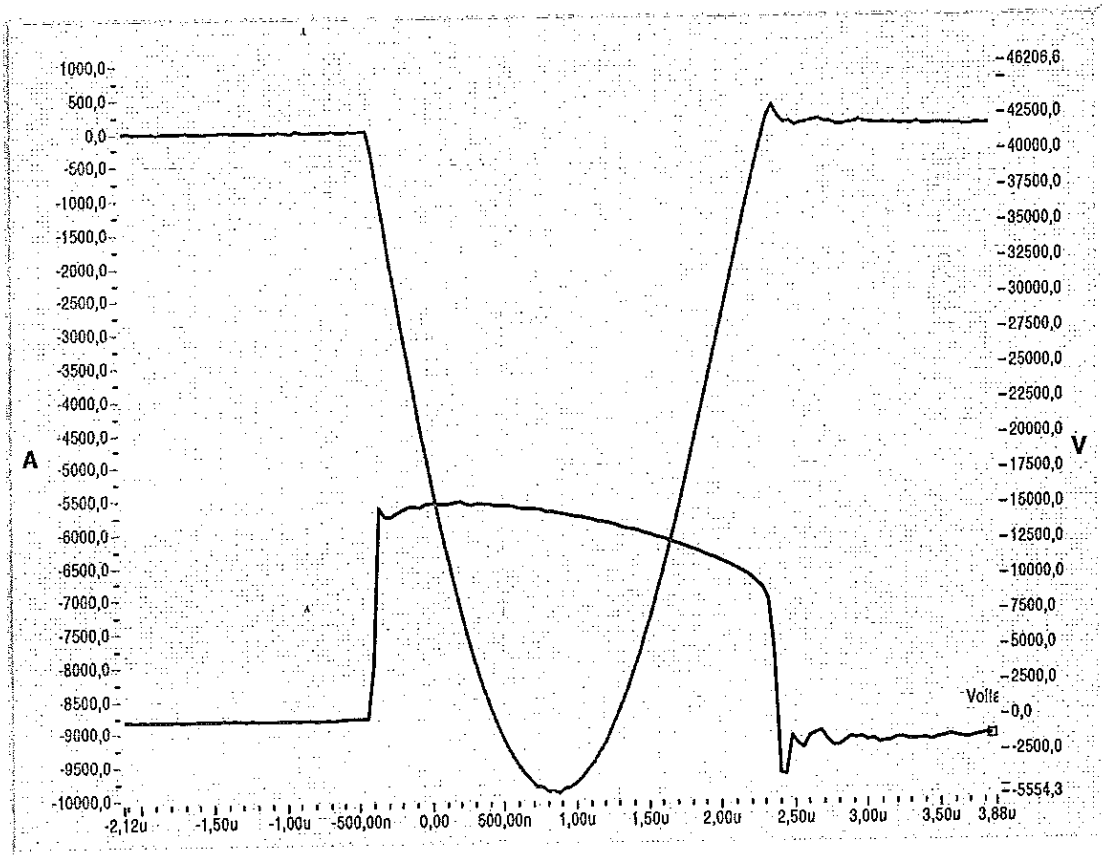
CESI B7019592 Oscillogram n. 10



CESI B7019592 Oscillogram n. 11



CESI B7019592 Oscillogram n. 12



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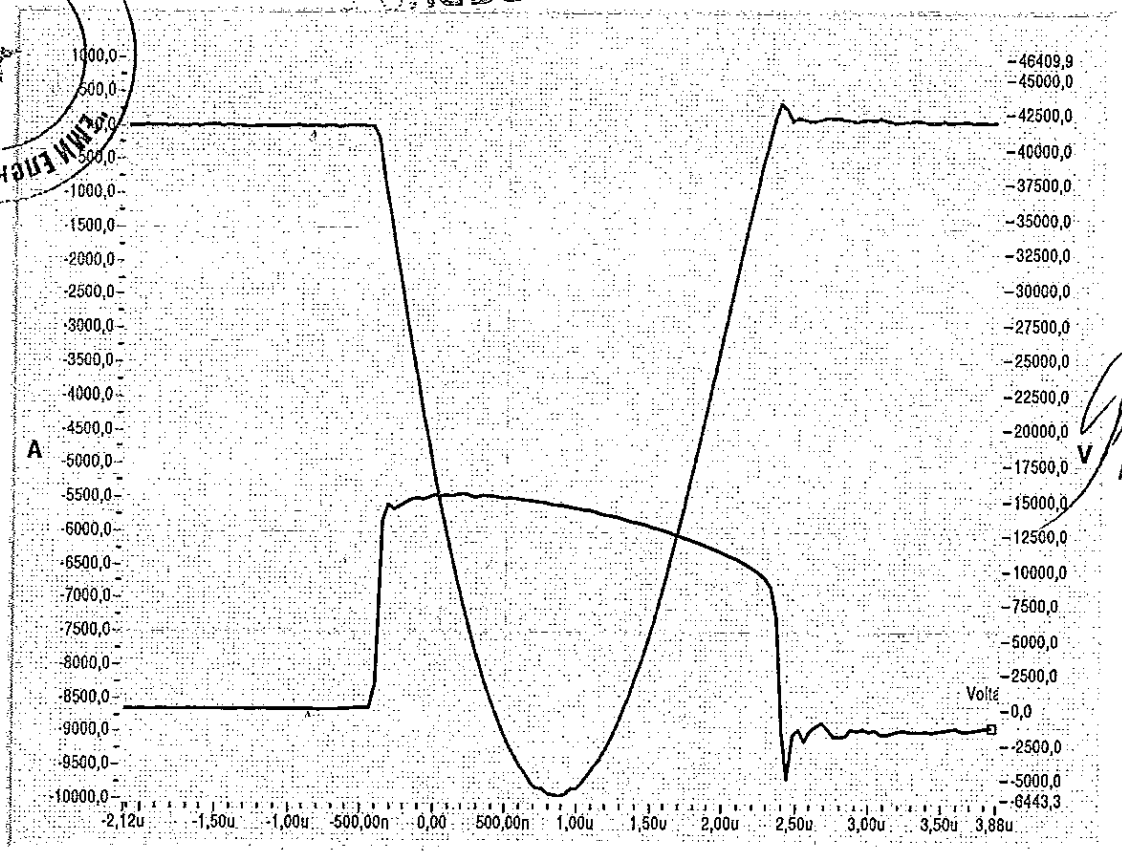
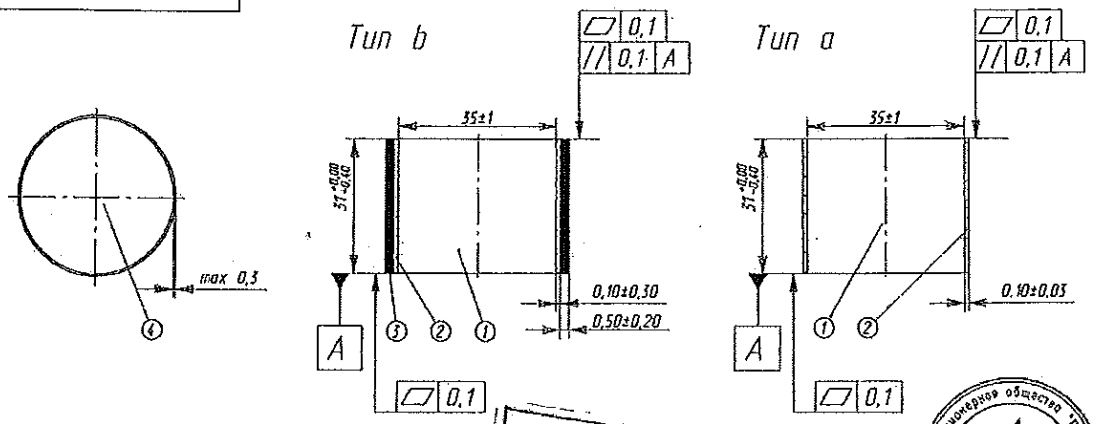
CESI B7019592 Oscillogram n. 13



РА.VAR.0400.30

Тип b

Тип a



1. Металлооксидный варистор (MOV disk)
2. Изоляционное покрытие стекло (glass insulating collar)
3. Изоляционное покрытие полиуретан (PU insulating collar)
4. Алюминиевый электрод (Al - electrode)

CESI B7020387.001

Открытое акционерное общество "Полимер-Аппарат" Санкт-Петербург

Изм.	Лист	N докум.	Подп.	Дата	PA.VAR.0400.30			
Разраб.		Лопатов А.В.		04.17	Varistor B34/30	Лит.	Масса	Масшт.
Пров.		Петухов А.Л.		04.17			0,177	1:1
Т.контр.						Лист 1	Листов 1	
Н.контр.					Оксид цинка	ЗАО "Полимер-Аппарат"		
Утв.		Шевцов И.В.		04.17				

Копировал

Формат А4

Инв. № подл. | Подп. и дата | Взам. инв. № | Инв. № дубл. | Подп. и дата

Test Report

Document No.	B7018719	Copy No. 1.	Number of pages 131
Apparatus	Metal-oxide resistors type B34/30		
Designation	—		
Serial Number	—		
Manufacturer	Joint-Stock Company " Polymer-Apparat"		
Client	Joint-Stock Company " Polymer-Apparat" Ak. Kostantinova Strasse 1 195427 Saint Petersburg - Russia Federation		
Tested for	—		
Date(s) of tests	September 19-21, 2017		
Tested by	CESI S.p.A. Via Rubattino, 54 20134 Milano - Italy		
Test performed	Test to verify the repetitive charge transfer rating, Qrs		

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this document has been subjected to the series of proving tests in accordance with:
IEC 60099-4 – Edition 3.0 (2014-05)

The results as shown in the record of proving tests and the oscillograms attached hereto, the ratings assigned by the Manufacturer are based on the ratings given.
This document applies only to the apparatus tested. The responsibility for conformity of any apparatus bearing the same designation with that tested rests with the Manufacturer.

November 10, 2017

Date

Giacomi Marco
Test Engineer in charge

The Manager - Andriano Lorenzo
Approved By Document Digitally Signed

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The authenticity of this document is guaranteed by the integrity of this page.

The laboratory meets the requirements of the standard UNI CEI EN ISO/IEC 17025:2018 "General requirements for the Competence of Testing and Calibration Laboratories" and, for the tests marked in the accredited scope, the list of accredited tests may be viewed on the www.accredia.it

Laboratory accredited by ACCREDIA with n° 0033

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Notes

STL-Member

CESI Group members are founder members of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in 1959. STL is a forum for voluntary international cooperation of testing organizations.

CESI Group Test Documents description

Type Test Certificate of .....

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

Test Certificate of (complete / selected) Type Tests

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

Certificate of Design Verification

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

Type Test Report

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

Test Report

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

On-Site Test Record

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

Test Award

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

Tests witnessed by:

Mr. Anton Potapov	Joint-Stock Company " Polymer-Apparat"
Mr. Alexander Kolychev	Joint-Stock Company " Polymer-Apparat"

Identification of the object: Requested

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings.
CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.
These drawing, identified by CESI and numbered B7020387 No. 1, is annexed to this document.

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

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

- Voltage a.c.	: ± 3,0 %
- Residual peak voltage (impulse tests)	: ± 3,0 %
- Current a.c.	: ± 3,0 %
- Peak current (impulse tests)	: ± 3,0 %
- Time (impulse tests)	: ± 10,0 %
- Time (a.c. tests)	: ± 1,5 %

Laboratory information

Receipt date of the sample	September 2017
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr. L. Podavitte, Mr. I Guecci
Test laboratory	P177 (Surge Arrester laboratory)
ODV SAP	70006781

A117510

ACCREDIA DGC N° 0033

Test object characteristics (assigned by the client)

Manufacturer's name	Joint-Stock Company " Polymer-Apparat"
Arrester class	Distribution
Designation	DH
MO resistor type	B34/30
Drawing code	PA.VAR.0400.30
Nominal discharge current - [kA]	10,0
Maximum residual voltage at 10 kA - [kV]	14,36
Reference current - I_{ref} [mA]	1,0
Repetitive charge transfer rating – Q_{rs} [C]	0,4
Flat surface area [cm^2]	10,52
Rated frequency - [Hz]	48÷62
Year of manufacture	February 2017

geometrical characteristics measured on MO resistor

Total height [mm]	31,1 mm
Diameter [mm]	36,6 mm

Photograph of the test object

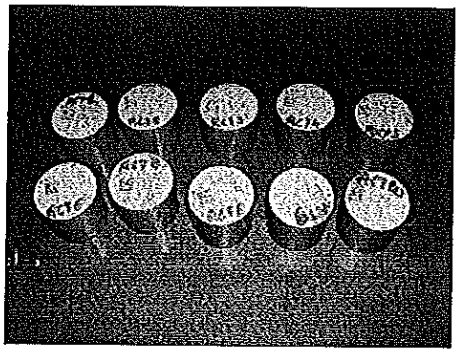

Photo no. 1

Metal-oxide resistor type B34/30

Reference Standard

The test was carried out according to the IEC 60099-4 – Edition 3.0 (2014-06) - Clause 8.5

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

Test carried out

Test carried out	Number of sample tested
Test to verify the repetitive charge transfer rating, Qrs	10

Test object identification

Test object name	Identification of the test sample (given by CESI)	Lot number and A/n of the test sample (given by JSC "Polymer Apparat)
Metal-oxide resistors type B34/30	RCT 1	702.378b – 30
	RCT 2	702.378b – 65
	RCT 3	702.378b – 47
	RCT 4	702.378b – 62
	RCT 5	702.378b – 87
	RCT 6	702.378b – 90
	RCT 7	702.378b – 78
	RCT 8	702.378b – 68
	RCT 9	702.378b – 22
	RCT 10	702.378b – 59

Test procedure

The test consisted of the following steps:

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

b) Measurement of the power frequency reference voltage at the reference current.

c) Calculation of the corrected values of Q_{rs} associated to each test sample according to clause 7.3.1 of the reference standard.

d) Application of twenty lightning impulses 8/20 µs delivered in ten groups of two operations each.
The interval between consecutive impulses of the same group has been about 60 seconds.
Between different groups the samples have been let to cool down to near ambient temperature.

e) Measurement of the power frequency reference voltage at the reference current for comparison with initial value.

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

g) Application of a current impulse 8/20 µs of an amplitude resulting in a current density of 0,5 kA/cm^2

h) Visual inspection

Test result

The first test sequence has been performed on 10 MO resistors without any failure.
The variation of the reference voltage at the reference current measured before and after the test was less than 5% (the maximum allowed variation according to reference standard is 5%).
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%).
After final application of a current impulse 8/20 µs no mechanical damage has been revealed by visual inspection.

The acceptance criteria are fulfilled and therefore the test result is positive.
The assigned repetitive charge transfer rating Q_{rs} equal to 0,4 C is proved.

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Summary of test results

Variation of residual voltage at the nominal discharge current

sample	before test		after test		variation
	discharge current	discharge voltage	discharge current	discharge voltage	
	kA	kV	kA	kV	%
RCT 1	9,95	14,11	10,08	14,38	+1,91
RCT 2	10,02	14,12	10,00	14,36	+1,67
RCT 3	9,95	14,07	10,09	14,42	+2,49
RCT 4	10,15	14,15	9,95	14,41	+1,84
RCT 5	10,11	14,15	10,06	14,34	+1,34
RCT 6	10,20	14,11	10,11	14,38	+1,91
RCT 7	9,96	14,15	10,01	14,44	+2,05
RCT 8	10,20	14,21	99,8	14,40	+1,33
RCT 9	10,02	14,25	9,95	14,43	+1,25
RCT 10	9,95	14,36	10,00	14,49	+0,91

Variation of the reference voltage at the reference current

sample	before test reference voltage	after test reference voltage	variation
	kV	kV	%
RCT 1	5,24	5,34	+1,91
RCT 2	5,24	5,32	+0,38
RCT 3	5,29	5,32	+0,57
RCT 4	5,28	5,26	-0,38
RCT 5	5,28	5,28	0
RCT 6	5,25	5,24	-0,19
RCT 7	5,28	5,33	+0,95
RCT 8	5,20	5,28	+1,54
RCT 9	5,21	5,31	+1,92
RCT 10	5,23	5,31	+1,53

Withstand capability to one 8/20 µs current level or of at least 0.5 kA/cm² peak current density after the test

sample	discharge current	discharge voltage	Note
	kA	kV	
RCT 1	5,41	13,40	no mechanical damage
RCT 2	5,36	13,39	no mechanical damage
RCT 3	5,33	13,33	no mechanical damage
RCT 4	5,21	13,42	no mechanical damage
RCT 5	5,37	13,39	no mechanical damage
RCT 6	5,38	13,39	no mechanical damage
RCT 7	5,31	13,54	no mechanical damage
RCT 8	5,56	13,40	no mechanical damage
RCT 9	5,41	13,45	no mechanical damage
RCT 10	5,38	13,47	no mechanical damage

Test to verify the repetitive charge transfer rating, Qrs.

Residual voltage test at nominal discharge current before the test.

Test circuit: A0120

Date: September 19, 2017

Sample	Requested current	Charging Voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.	kA	kV	No.	µs	kA	kV
RCT 1	10	24,2	1	8,4/18,4	9,95	14,11
RCT 2		24,2	2		10,02	14,12
RCT 3		24,2	3		9,95	14,07
RCT 4		24,2	4		10,15	14,15
RCT 5		24,2	5		10,11	14,15
RCT 6		24,2	6		10,20	14,11
RCT 7		24,2	7		9,96	14,15
RCT 8		24,2	8		10,20	14,21
RCT 9		24,2	9		10,02	14,25
RCT 10		24,2	10		9,95	14,36

Notes:

Test to verify the repetitive charge transfer rating, Qrs.

Reference voltage test at reference current before the test.

Test circuit: A0019

Date: September 19, 2017
Ambient temperature: 23 °C

Sample No. RCT 1

oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
11	5,24	0,938	1,000	0,5572	1,43	---

Sample No. RCT 2

oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
12	5,24	0,877	1,000	0,550	1,37	---

Sample No. RCT 3

oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
13	5,29	0,877	1,000	0,560	1,36	---

Sample No. RCT 4

oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
14	5,28	0,865	1,000	0,561	1,36	---

Sample No. RCT 5

oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
15	5,28	0,891	1,000	0,563	1,38	---

continued

continued

Date: September 19, 2017

Sample No. RCT 6

oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
16	5,25	0,882	1,000	0,562	1,37	---

Sample No. RCT 7

oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
17	5,25	0,853	1,000	0,558	1,53	---

Sample No. RCT 8

oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
18	5,20	0,855	1,000	0,563	1,37	---

Sample No. RCT 9

oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
19	5,21	0,921	1,000	0,571	1,39	---

Sample No. RCT 10

oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
20	5,23	0,860	1,000	0,559	1,34	---

ВЯРНО С ОРИГИНАЛА

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Test to verify the repetitive charge transfer rating, Qrs.

Date: September 19, 2017

Residual voltage correction factor and Q_{rs} calculations

Sample	U_{res} [1]	Length [2]	$U_{res,norm}$ [3]	Max $U_{res,norm}$ [4]	0,97 x Max $U_{res,norm}$ [5]	Correction factor [6]	Q_{rs} rating [7]	Corrected Q_{rs} [8]	Applicable range for Q_{rs} [9]
No.	kV	mm	kV/mm	kV/mm	kV/mm	kV	C	C	C
RC 1	14,31	30,92	0,456	0,469	0,455	1	0,4	0,4	0,44÷0,48
RC 2	14,12	30,91	0,457			1		0,4	0,44÷0,48
RC 3	14,07	30,91	0,455			1		0,4	0,44÷0,48
RC 4	14,15	30,89	0,458			1		0,4	0,44÷0,48
RC 5	14,15	30,60	0,462			1		0,4	0,44÷0,48
RC 6	14,11	30,62	0,461			1		0,4	0,44÷0,48
RC 7	14,15	30,61	0,462			1		0,4	0,44÷0,48
RC 8	14,21	30,64	0,464			1		0,4	0,44÷0,48
RC 9	14,25	30,87	0,462			1		0,4	0,44÷0,48
RC 10	14,36	30,87	0,465			1		0,4	0,44÷0,48

[1] U_{res} : residual voltage at 10 kA measured on each sample

[2] Length : length measured on each sample

[3] $U_{res,norm}$: residual voltage stress calculated for each sample [3] = [1] / [2]

[4] Max $U_{res,norm}$: Max residual voltage stress claimed by the manufacturer for the surge arrester design (Maximum residual voltage at 10 kA / minimal thickness h)

[5] 0,97 x Max $U_{res,norm}$: Lowest limit of the residual voltage stress without applying any correction factor

[6] Correction factor : Correction factor is calculated for each sample
- no correction factor applied if the [3] ≥ [5]
- correction factor applied if the [3] < [5]
- correction factor calculated [3] = [4] / [3]

[7] Q_{rs} rating : charge transfer rating selected from the list on the Reference Standard clause 8.5.4 by the manufacturer

[8] corrected Q_{rs} : corrected Q_{rs} [8] = [6] x [7]

[9] Applicable range for Q_{rs} : the lower value is calculated as 1,1 times [8], the higher value of the range is calculated as 1,2 times [8]

Note:

Max $U_{res,norm}$ declared by the manufacturer : 14,36 kV

Diameter Ø : 35,6 mm

Min. Thickness h declared by the manufacturer : 30,6 mm

Test configuration for application of 1,1 times Q_{rs}

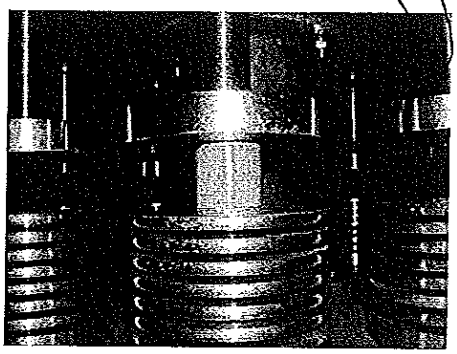


Photo no. 2

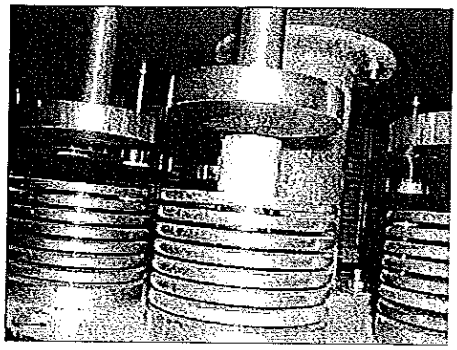


Photo no. 3

Test to verify the repetitive charge transfer rating, Qrs.

Application of twenty operations in ten groups of two lightning current impulse 8/20µs.

Test circuit: A0120

Date: September 19-21, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 1	1	54,0 x 2	21	31,10	0,44
	2	54,0 x 2		31,20	0,44
	3	55,0 x 2		32,10	0,45
	4	55,0 x 2		31,20	0,44
	5	55,0 x 2		31,80	0,45
	6	55,0 x 2		31,95	0,45
	7	55,0 x 2		31,40	0,44
	8	55,0 x 2		31,30	0,44
	9	55,0 x 2		32,60	0,45
	10	55,0 x 2	31	32,30	0,45
	11	55,0 x 2		32,50	0,45
	12	55,0 x 2		32,40	0,45
	13	55,0 x 2		32,40	0,45
	14	55,0 x 2		32,40	0,45
	15	55,0 x 2		32,30	0,45
	16	55,0 x 2		32,30	0,45
	17	55,0 x 2		31,90	0,45
	18	55,0 x 2		31,90	0,45
	19	55,0 x 2		31,70	0,45
	20	55,0 x 2	41	31,60	0,45

Current impulse waveshape
8,7/18,0 µs

Note:

continued

continued

Date: September 19-21, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 2	1	55,0 x 2	22	32,20	0,45
	2	55,0 x 2		32,70	0,45
	3	55,0 x 2		32,40	0,45
	4	55,0 x 2		31,20	0,44
	5	55,0 x 2		31,80	0,45
	6	55,0 x 2		32,13	0,45
	7	55,0 x 2		31,80	0,44
	8	55,0 x 2		32,20	0,45
	9	55,0 x 2		33,10	0,46
	10	55,0 x 2	32	32,80	0,46
	11	55,0 x 2		32,30	0,45
	12	55,0 x 2		32,50	0,45
	13	55,0 x 2		33,00	0,45
	14	55,0 x 2		32,70	0,46
	15	55,0 x 2		33,00	0,46
	16	55,0 x 2		32,57	0,45
	17	55,0 x 2		32,20	0,45
	18	55,0 x 2		32,80	0,45
	19	55,0 x 2		32,10	0,45
	20	55,0 x 2	42	31,94	0,45

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 3	1	55,0 x 2		32,62	0,45
	2	55,0 x 2	23	32,64	0,45
	3	55,0 x 2		32,60	0,45
	4	55,0 x 2		32,70	0,45
	5	55,0 x 2		32,50	0,45
	6	55,0 x 2		31,70	0,44
	7	55,0 x 2		32,35	0,45
	8	55,0 x 2		32,45	0,45
	9	55,0 x 2		33,36	0,46
	10	55,0 x 2	33	33,10	0,45
	11	55,0 x 2		33,00	0,45
	12	55,0 x 2		32,50	0,45
	13	55,0 x 2		33,20	0,46
	14	55,0 x 2		31,95	0,45
	15	55,0 x 2		32,85	0,45
	16	55,0 x 2		32,90	0,46
	17	55,0 x 2		32,30	0,45
	18	55,0 x 2		31,80	0,46
	19	55,0 x 2		32,20	0,45
	20	55,0 x 2	43	32,10	0,45

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

A133490

continued

Date: September 19-21, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 4	1	55,0 x 2		32,71	0,45
	2	55,0 x 2	24	32,70	0,45
	3	55,0 x 2		33,30	0,46
	4	55,0 x 2		33,21	0,45
	5	55,0 x 2		32,72	0,45
	6	55,0 x 2		32,74	0,45
	7	55,0 x 2		32,30	0,45
	8	55,0 x 2		33,30	0,45
	9	55,0 x 2		33,35	0,46
	10	55,0 x 2	34	33,24	0,45
	11	55,0 x 2		33,20	0,46
	12	55,0 x 2		32,70	0,45
	13	55,0 x 2		33,20	0,46
	14	55,0 x 2		33,24	0,46
	15	55,0 x 2		33,20	0,46
	16	55,0 x 2		32,70	0,45
	17	55,0 x 2		32,40	0,45
	18	55,0 x 2		32,61	0,45
	19	55,0 x 2		32,60	0,45
	20	55,0 x 2	44	32,30	0,45

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

A133503

continued

Date: September 19-21, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 5	1	55,0 x 2		33,38	0,45
	2	55,0 x 2	25	33,40	0,45
	3	55,0 x 2		33,22	0,45
	4	55,0 x 2		33,20	0,46
	5	55,0 x 2		33,50	0,46
	6	55,0 x 2		32,80	0,45
	7	55,0 x 2		33,50	0,47
	8	55,0 x 2		33,02	0,45
	9	55,0 x 2		33,80	0,47
	10	55,0 x 2	35	32,86	0,45
	11	55,0 x 2		33,04	0,46
	12	55,0 x 2		32,80	0,46
	13	55,0 x 2		33,30	0,45
	14	55,0 x 2		33,74	0,47
	15	55,0 x 2		33,80	0,47
	16	55,0 x 2		33,40	0,46
	17	55,0 x 2		33,30	0,46
	18	55,0 x 2		33,00	0,45
	19	55,0 x 2		33,09	0,46
	20	55,0 x 2	45	32,80	0,46

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

A133510

continued

Date: September 19-21, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 6	1	55,0 x 2		33,80	0,47
	2	55,0 x 2	26	33,00	0,46
	3	55,0 x 2		32,90	0,46
	4	55,0 x 2		33,29	0,46
	5	55,0 x 2		33,55	0,47
	6	55,0 x 2		33,25	0,46
	7	55,0 x 2		33,50	0,46
	8	55,0 x 2		33,20	0,46
	9	55,0 x 2		33,72	0,47
	10	55,0 x 2	36	33,70	0,47
	11	55,0 x 2		33,35	0,46
	12	55,0 x 2		33,40	0,46
	13	55,0 x 2		33,70	0,47
	14	55,0 x 2		33,74	0,47
	15	55,0 x 2		33,71	0,47
	16	55,0 x 2		33,65	0,47
	17	55,0 x 2		33,50	0,46
	18	55,0 x 2		32,80	0,45
	19	55,0 x 2		33,40	0,46
	20	55,0 x 2	45	33,50	0,46

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

A133520

ВЯРНО С ОРИГИНАЛА

"ЕМИ Електрик" ЕООД

"EMI Electric" LTD

continued

Date: September 19-21, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 7	1	55,0 x 2		33,94	0,47
	2	55,0 x 2	27	32,92	0,46
	3	55,0 x 2		33,20	0,46
	4	55,0 x 2		33,50	0,47
	5	55,0 x 2		33,63	0,47
	6	55,0 x 2		33,70	0,47
	7	55,0 x 2		34,30	0,47
	8	55,0 x 2		33,80	0,47
	9	55,0 x 2		33,61	0,47
	10	55,0 x 2	37	33,70	0,47
	11	55,0 x 2		33,50	0,46
	12	55,0 x 2		33,70	0,46
	13	55,0 x 2		33,90	0,47
	14	55,0 x 2		33,66	0,47
	15	55,0 x 2		33,75	0,47
	16	55,0 x 2		33,50	0,47
	17	55,0 x 2		33,47	0,47
	18	55,0 x 2		33,30	0,46
	19	55,0 x 2		33,50	0,47
	20	55,0 x 2	47	33,15	0,46

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 8	1	55,0 x 2		34,00	0,47
	2	55,0 x 2	28	33,50	0,46
	3	55,0 x 2		33,40	0,46
	4	55,0 x 2		32,65	0,45
	5	55,0 x 2		33,21	0,46
	6	55,0 x 2		33,30	0,46
	7	55,0 x 2		33,41	0,46
	8	55,0 x 2		32,90	0,46
	9	55,0 x 2		32,97	0,46
	10	55,0 x 2	38	33,10	0,46
	11	55,0 x 2		33,33	0,46
	12	55,0 x 2		33,00	0,45
	13	55,0 x 2		33,40	0,46
	14	55,0 x 2		33,28	0,46
	15	55,0 x 2		33,00	0,46
	16	55,0 x 2		32,90	0,46
	17	55,0 x 2		32,66	0,45
	18	55,0 x 2		32,80	0,45
	19	55,0 x 2		33,00	0,46
	20	55,0 x 2	48	32,70	0,45

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 9	1	55,0 x 2		31,80	0,44
	2	55,0 x 2	29	32,00	0,44
	3	55,0 x 2		31,30	0,45
	4	55,0 x 2		32,11	0,45
	5	55,0 x 2		31,50	0,44
	6	55,0 x 2		31,55	0,44
	7	55,0 x 2		31,94	0,44
	8	55,0 x 2		31,90	0,44
	9	55,0 x 2		31,30	0,44
	10	55,0 x 2	39	32,10	0,45
	11	55,0 x 2		32,10	0,45
	12	55,0 x 2		32,00	0,44
	13	55,0 x 2		31,60	0,44
	14	55,0 x 2		31,65	0,44
	15	55,0 x 2		31,40	0,44
	16	55,0 x 2		31,60	0,44
	17	55,0 x 2		31,60	0,45
	18	55,0 x 2		31,30	0,44
	19	55,0 x 2		31,50	0,44
	20	55,0 x 2	49	31,10	0,44

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 10	1	55,0 x 2		31,60	0,44
	2	55,0 x 2	30	31,70	0,44
	3	55,0 x 2		31,50	0,44
	4	55,0 x 2		31,70	0,44
	5	55,0 x 2		31,30	0,44
	6	55,0 x 2		31,35	0,44
	7	55,0 x 2		32,00	0,45
	8	55,0 x 2		32,40	0,45
	9	55,0 x 2		32,00	0,45
	10	55,0 x 2	40	31,95	0,45
	11	55,0 x 2		31,60	0,44
	12	55,0 x 2		31,80	0,44
	13	55,0 x 2		31,30	0,44
	14	55,0 x 2		31,70	0,44
	15	55,0 x 2		31,30	0,44
	16	55,0 x 2		31,50	0,44
	17	55,0 x 2		31,10	0,44
	18	55,0 x 2		31,30	0,44
	19	55,0 x 2		31,10	0,44
	20	55,0 x 2	50	31,00	0,44

Current impulse waveshape
8,7/18,0 µs

Notes:

ВЯРНО С ОРИГИНАЛА

"ЕЛИК ЕЛЕКТРИК" ЕООД

Test to verify the repetitive charge transfer rating, Qrs.

Reference voltage test at reference current after the test.

Test circuit: A0019

Date: September 21, 2017
Ambient temperature: 23 °C

Sample No. RC 1						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_w	- mA_w	mA_{rms}	W	
51	5,34	0,633	1,000	0,532	1,24	---

Sample No. RC 2						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_w	- mA_w	mA_{rms}	W	
52	5,22	0,572	1,000	0,510	1,11	---

Sample No. RC 3						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_w	- mA_w	mA_{rms}	W	
53	5,32	0,578	1,000	0,510	1,11	---

Sample No. RC 4						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_w	- mA_w	mA_{rms}	W	
54	5,26	0,579	1,000	0,508	1,09	---

Sample No. RC 5						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_w	- mA_w	mA_{rms}	W	
55	5,28	0,582	1,000	0,514	1,14	---

continued

continued

Date: September 21, 2017

Sample No. RC 6						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_w	- mA_w	mA_{rms}	W	
56	5,24	0,572	1,000	0,507	1,09	---

Sample No. RC 7						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_w	- mA_w	mA_{rms}	W	
57	5,33	0,573	1,000	0,506	1,09	---

Sample No. RC 8						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_w	- mA_w	mA_{rms}	W	
58	5,28	0,577	1,000	0,512	1,14	---

Sample No. RC 9						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_w	- mA_w	mA_{rms}	W	
59	5,31	0,588	1,000	0,525	1,18	---

Sample No. RC 10						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_w	- mA_w	mA_{rms}	W	
60	5,31	0,580	1,000	0,508	1,11	---

Test to verify the repetitive charge transfer rating, Qrs.

Residual voltage test at nominal discharge current after the test.

Test circuit: A0120

Date: September 21, 2017

Sample	Requested current	Charging Voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.	kA	kV	No.	µs	kA	kV
RC 1	10,0	24,6	61	8,9/18,1	10,08	14,38
RC 2		24,6	62		10,00	14,36
RC 3		24,6	63		10,09	14,42
RC 4		24,6	64		9,55	14,41
RC 5		24,6	55		10,06	14,34
RC 6		24,6	66		10,11	14,38
RC 7		24,6	67		10,01	14,44
RC 8		24,5	68		99,8	14,40
RC 9		24,5	69		9,95	14,43
RC 10		24,5	70		10,00	14,49

Notes:

Test to verify the repetitive charge transfer rating, Qrs.

Final application of a current impulse 8/20 µs (withstand capability)

Test circuit: A0120

Date: September 21, 2017

Sample	Requested current	Charging Voltage	Oscillogram	Current waveshape	Discharge current	Discharge voltage
No.	kA	kV	No.	µs	kA	kV
RC 1	5,14 (*)	19,0	71	8,3/19,0	5,41	13,40
RC 2		19,0	72		5,36	13,39
RC 3		19,0	73		5,33	13,33
RC 4		19,0	74		5,21	13,42
RC 5		19,0	75		5,37	13,39
RC 6		19,0	76		5,38	13,39
RC 7		19,0	77		5,31	13,54
RC 8		19,0	78		5,36	13,40
RC 9		19,0	79		5,41	13,45
RC 10		19,0	80		5,38	13,47

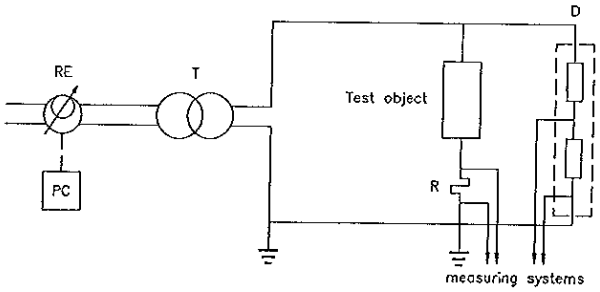
Notes:

(*) Requested current = 0,5 kA/cm² x 10,28 cm² = 5,14 kA
- where 0,5 kA/cm² is peak current density
- where 10,28 cm² is surface area on the metal-oxide resistor used for this test declared by the manufacturer

ВЯРНО С ОРИГИНАЛА

"ЕЛМА ЕЛЕКТРОНИК" ЕООД

Circuit A0019



Power frequency supply

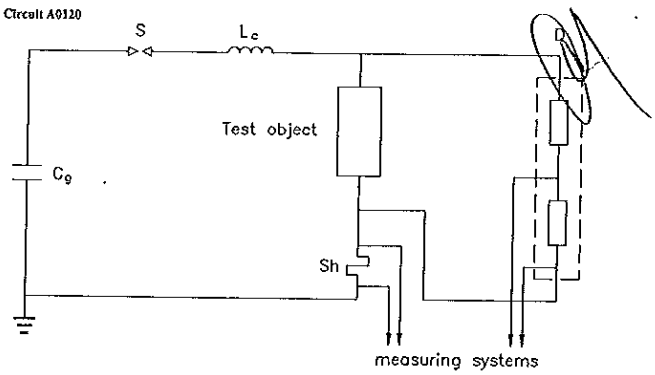
RE - programmable supply type PACIFIC A.C. Power Source 140 ASX ; CESI no. 0560408
PC - personal computer
T - voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200 V/15-30 kV

Current measuring system
R - Current shunt CESI No.31120; R= 941,4 Ω
-Electro optical system HBM CESI No. 57985(Rx) – 57987 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

Voltage measuring system
D - Voltage divider SAGI; CESI No.11120
Electro optical system type HBM CESI No. 57985(Rx) – 57991 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.2)

Software system:
SW - S.A.D. Surge arrester version 2.0

Circuit A0120



Impulse generator

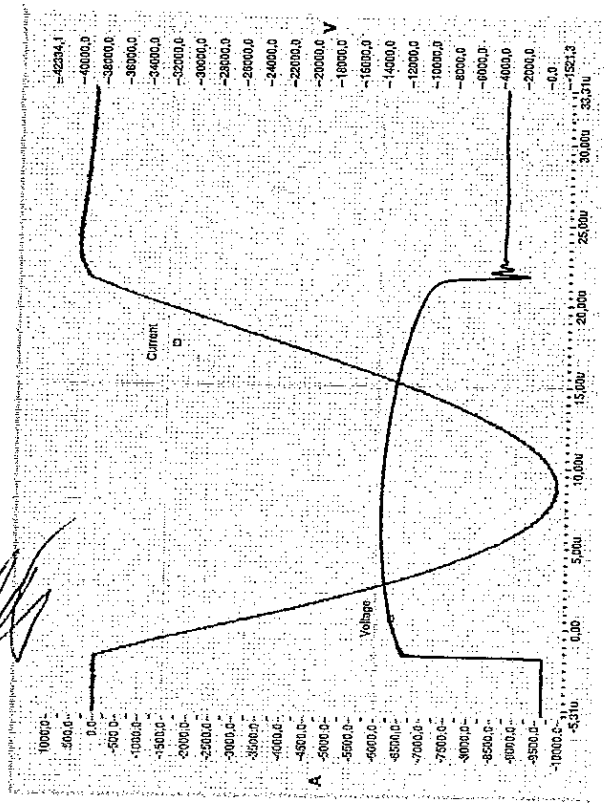
No. of stages 1 (for residual voltage at nominal current)
2 (for injection of Qrs)
Cg 6,64 μF (n.1 stage)
3,32 μF (n.2 stage)
Lc 12 μH (n.1 stage) - 20 μH (n.2 stages)

S - Spark-gap
Additional two MO block have been added (for injection of Qrs)

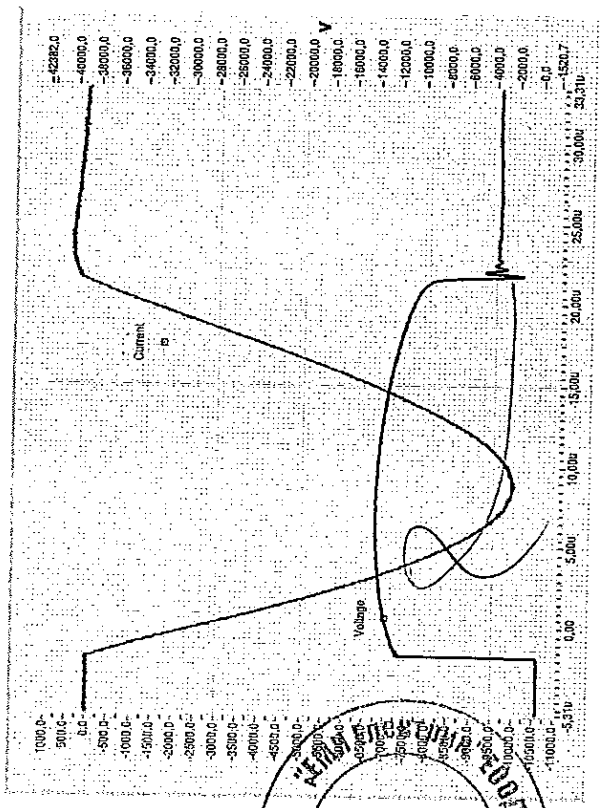
Voltage measuring system.
D - Voltage divider SAGI; CESI No.11120
-Electro optical system HBM CESI No. 57985(Rx) – 57987 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.2)

Current measuring system
Sh - Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
- Electro optical system type HBM CESI No. 57986(Rx) – 57991 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

Software system:
SW - S.A.D. Surge arrester version 2.0

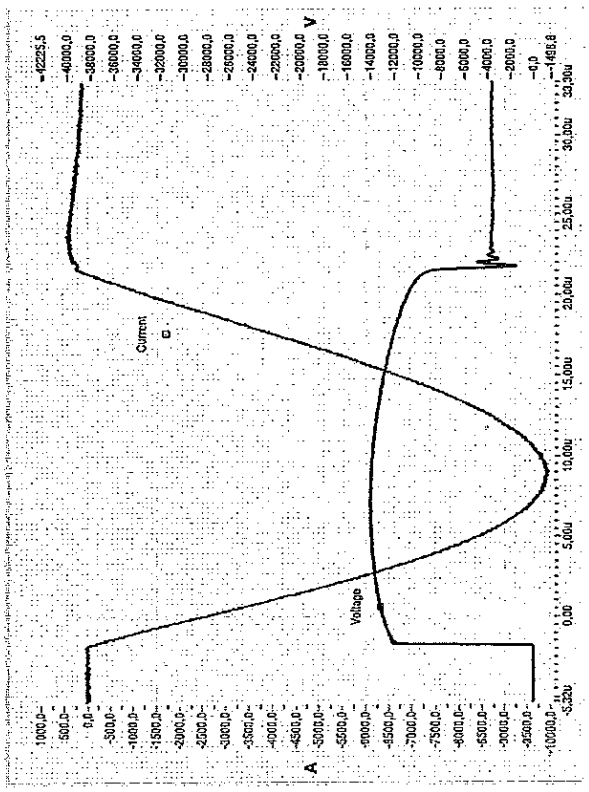


CESI B7018719 Oscillogram n. 1

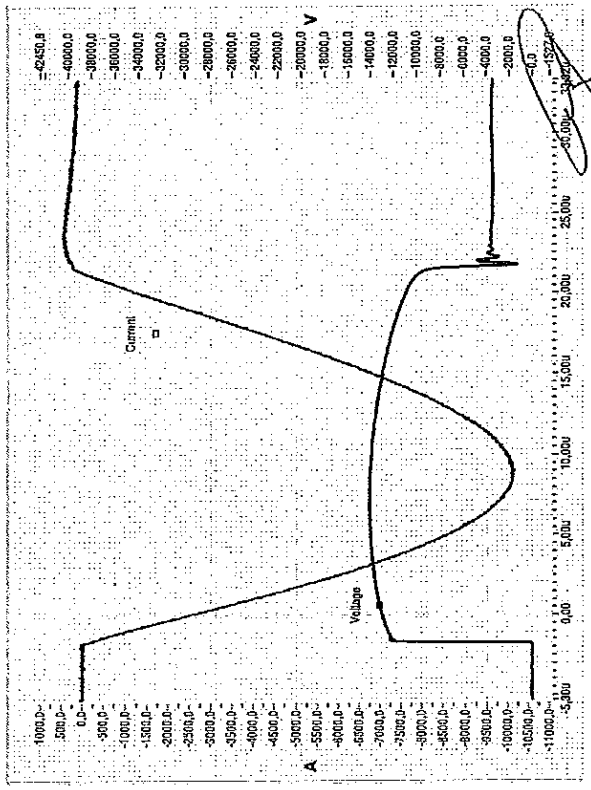


CESI B7018719 Oscillogram n. 2

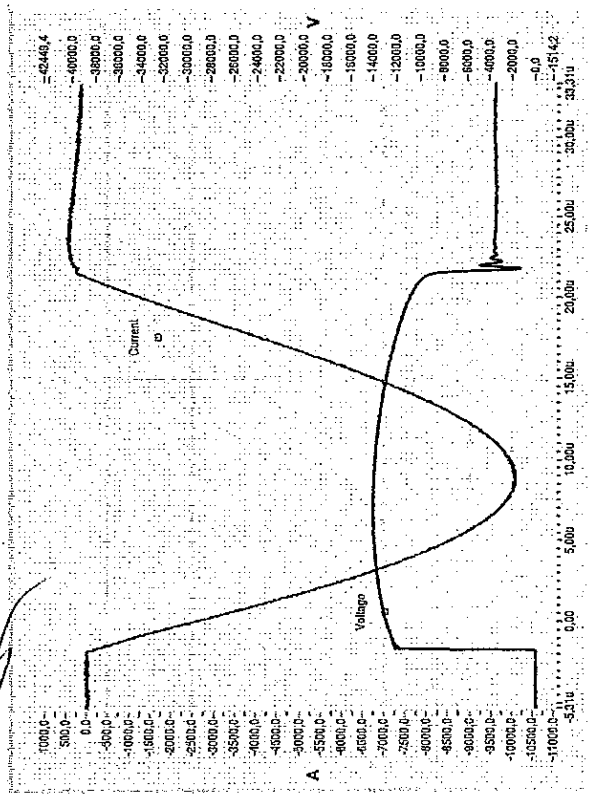
ВЯРНО С ОРИГИНАЛА



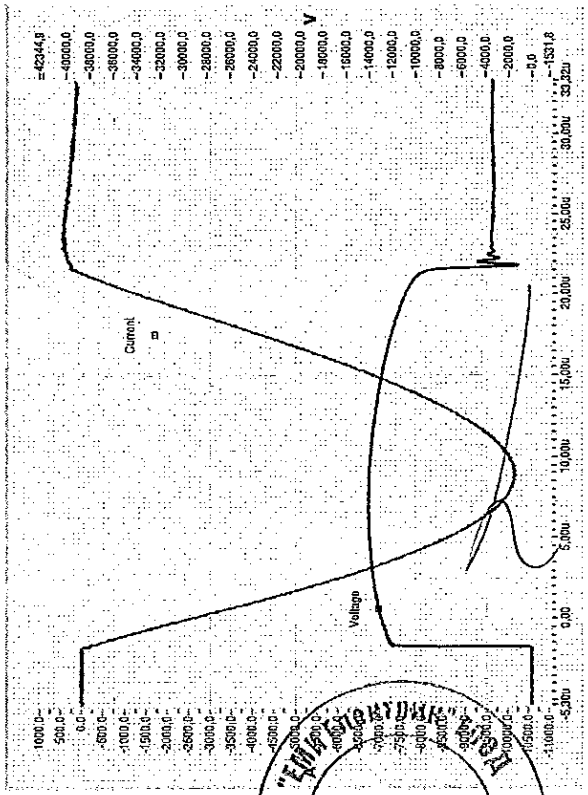
CESI B7018719 Oscillogram n. 3



CESI B7018719 Oscillogram n. 4

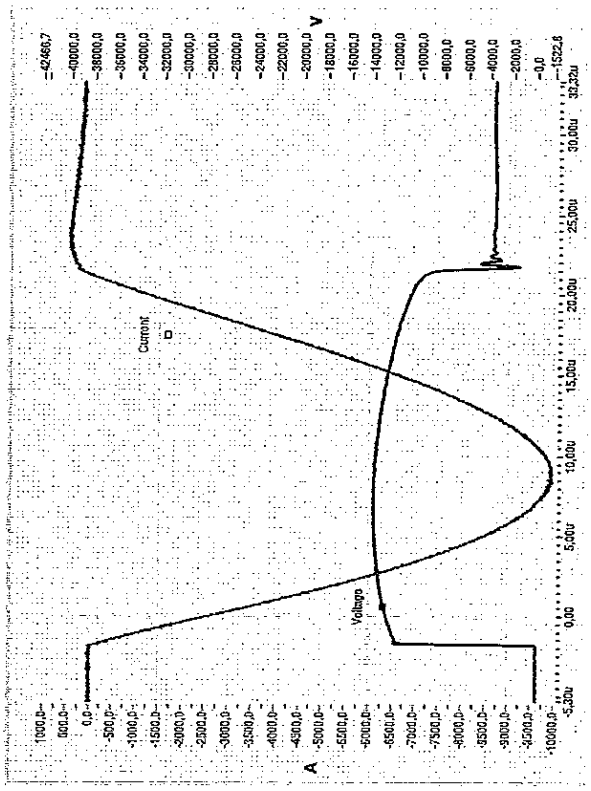


CESI B7018719 Oscillogram n. 5

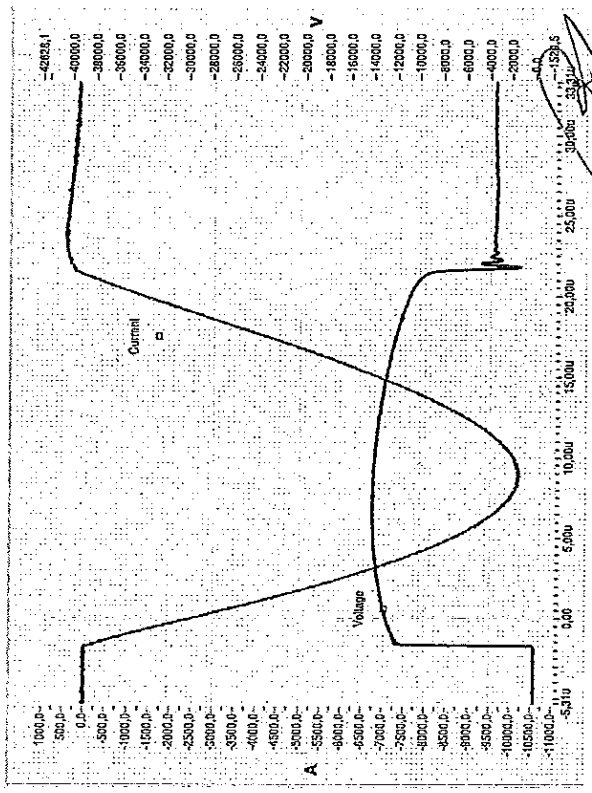


CESI B7018719 Oscillogram n. 6

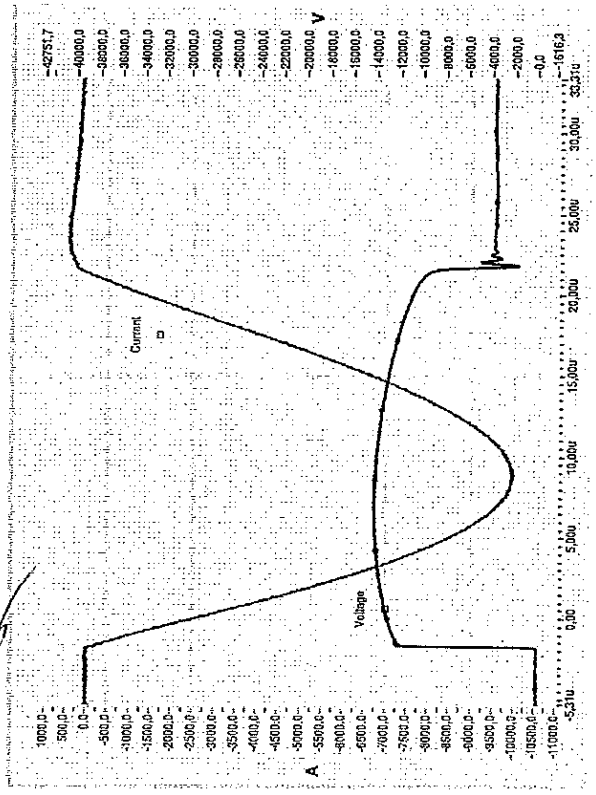
ВЯРНО С ОРИГИНАЛА



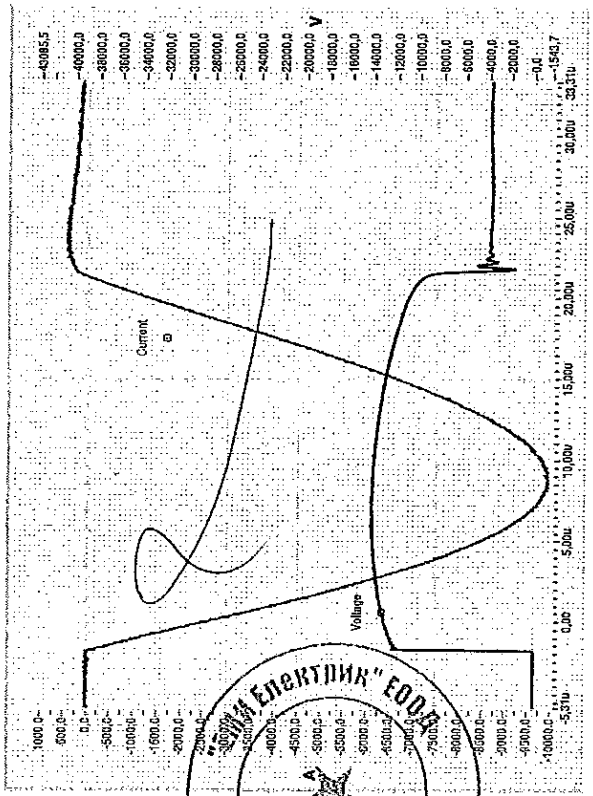
CESI B7018719 Oscillogramm n. 7



CESI B7018719 Oscillogramm n. 8



CESI B7018719 Oscillogramm n. 9

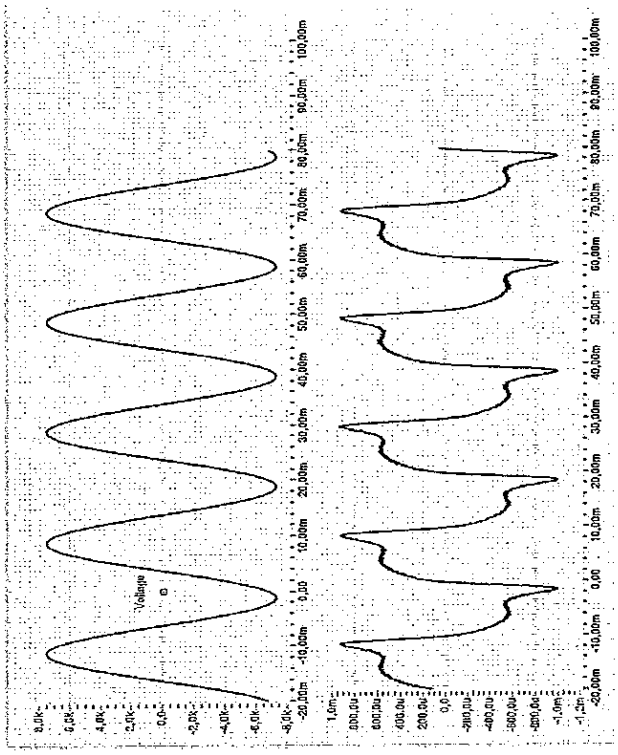


CESI B7018719 Oscillogramm n. 10

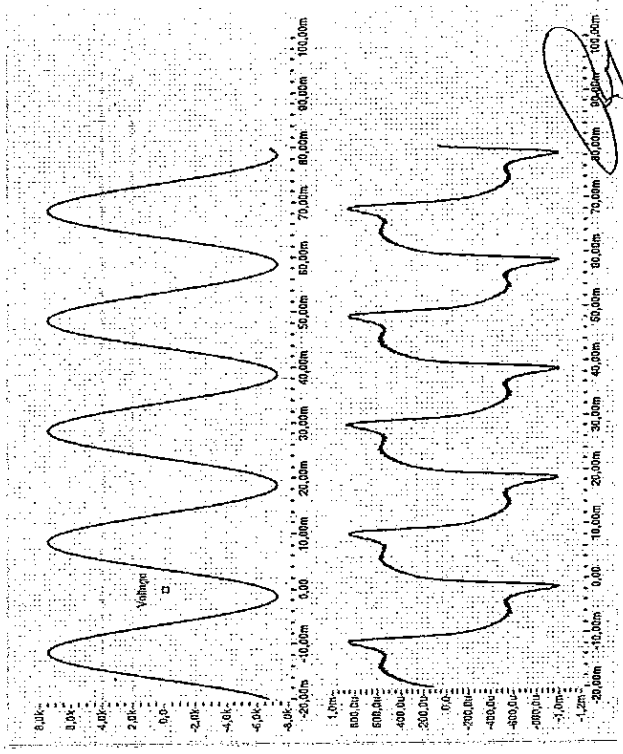
ВЯРНО С ОРИГИНАЛА

"ЕМ Електрик" ЕООД

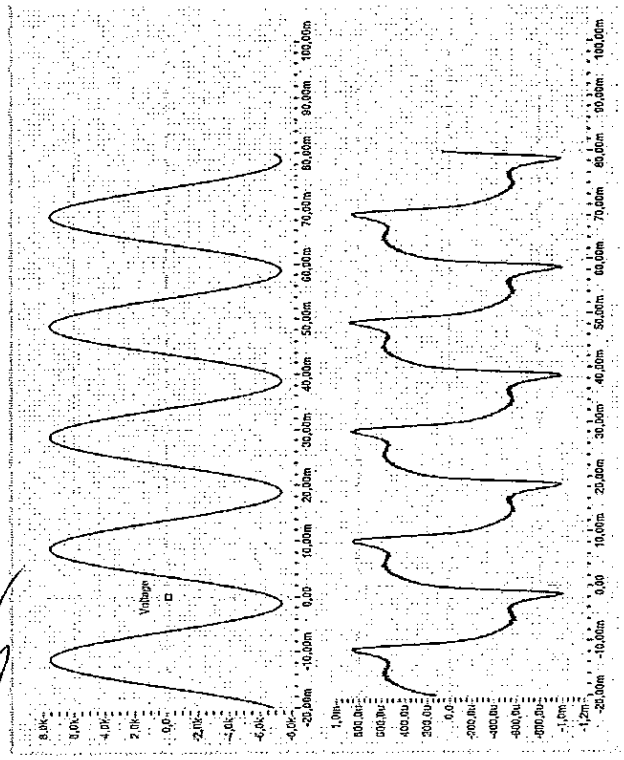
222



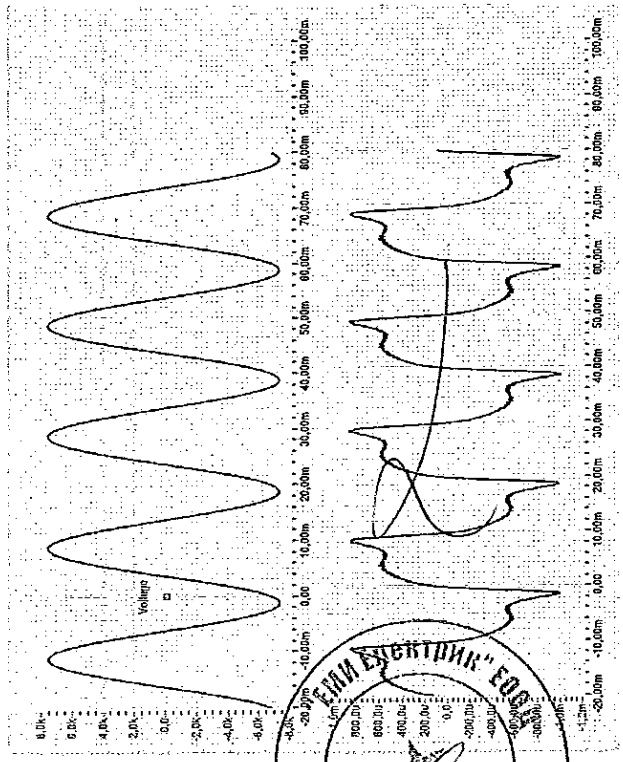
CESI B7018719 Oscillogramm n. 11



CESI B7018719 Oscillogramm n. 12



CESI B7018719 Oscillogramm n. 13

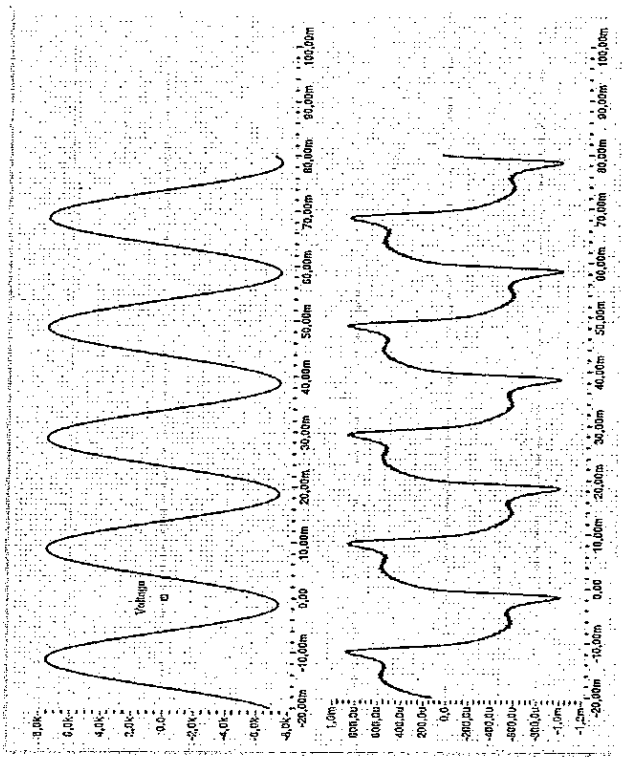


CESI B7018719 Oscillogramm n. 14

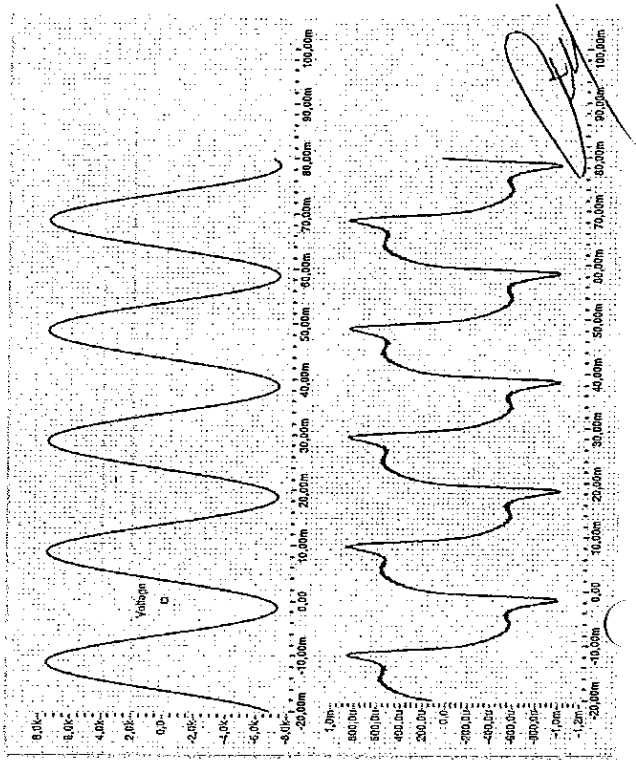
ВЯРНО С ОРИГИНАЛА

"ЕМИ ЕЛЕКТРИК" ЕООД

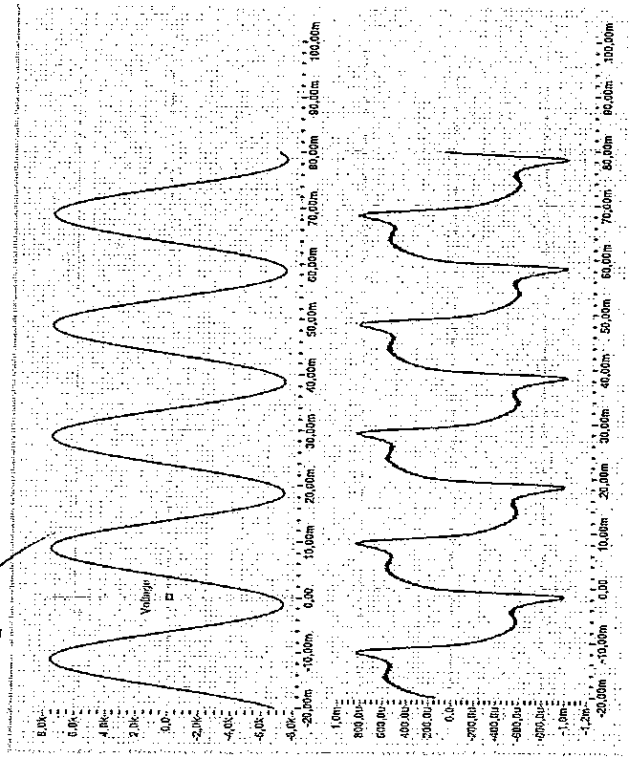
22



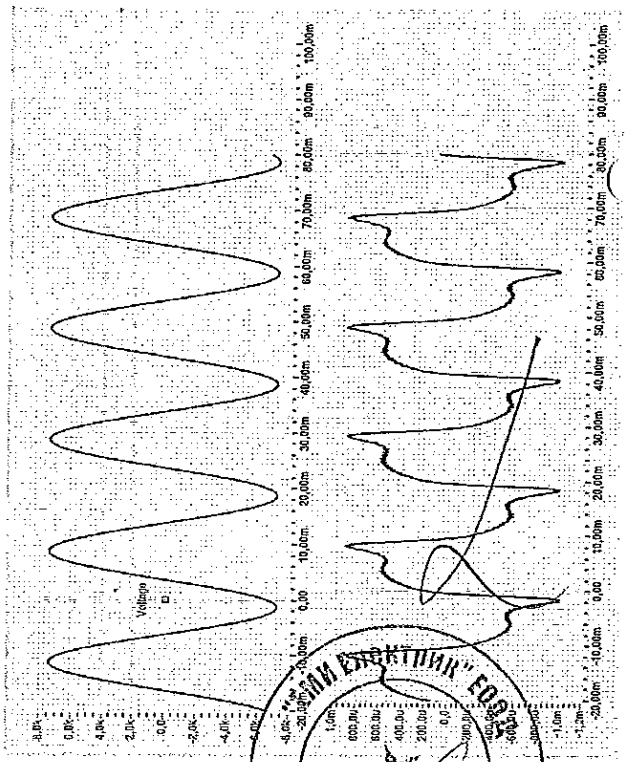
CESI B7018719 Oscillogram n. 15



CESI B7018719 Oscillogram n. 16



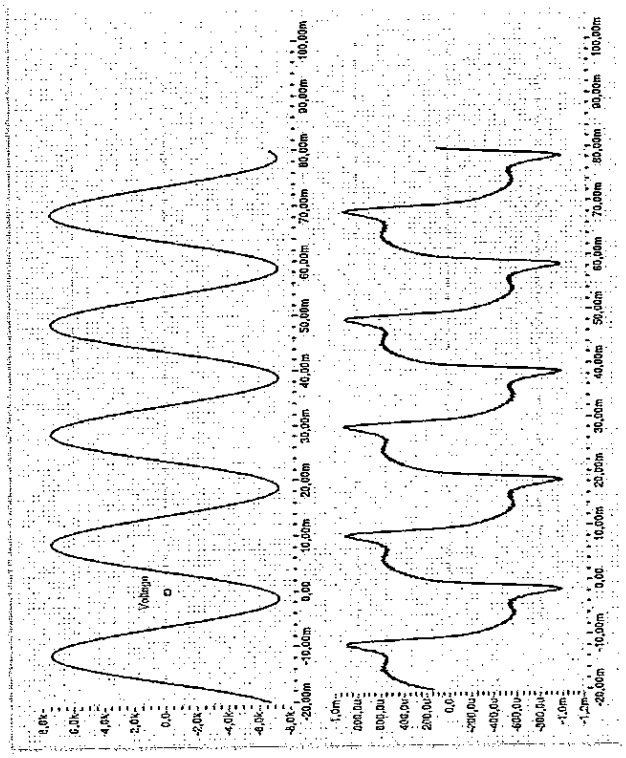
CESI B7018719 Oscillogram n. 17



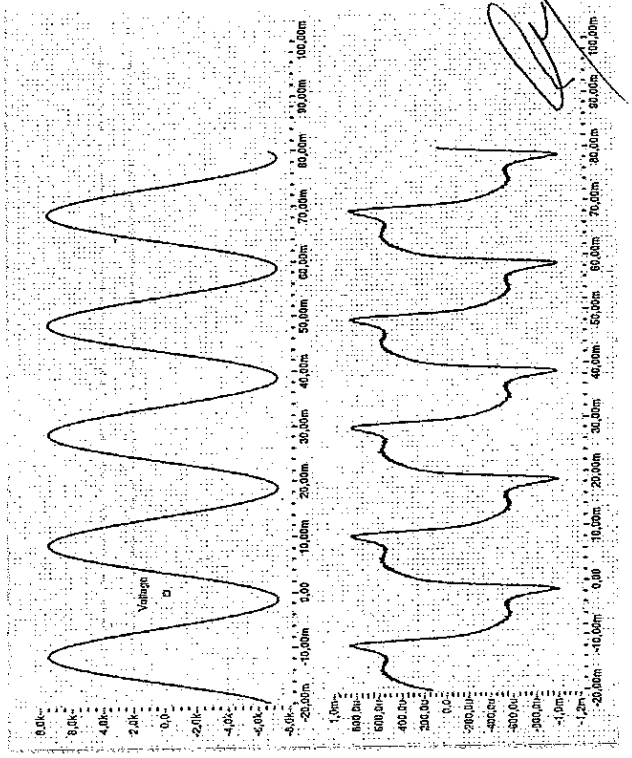
CESI B7018719 Oscillogram n. 18

ВЯРНО С ОРИГИНАЛА

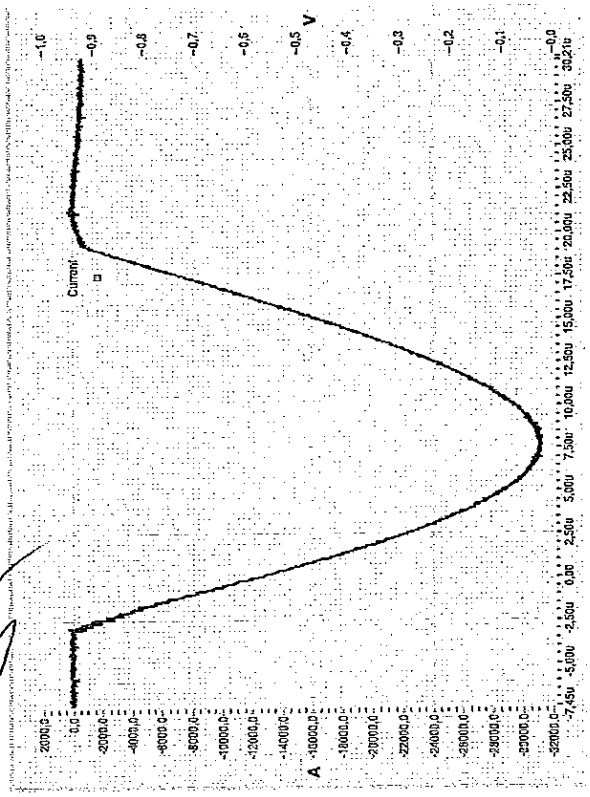
224



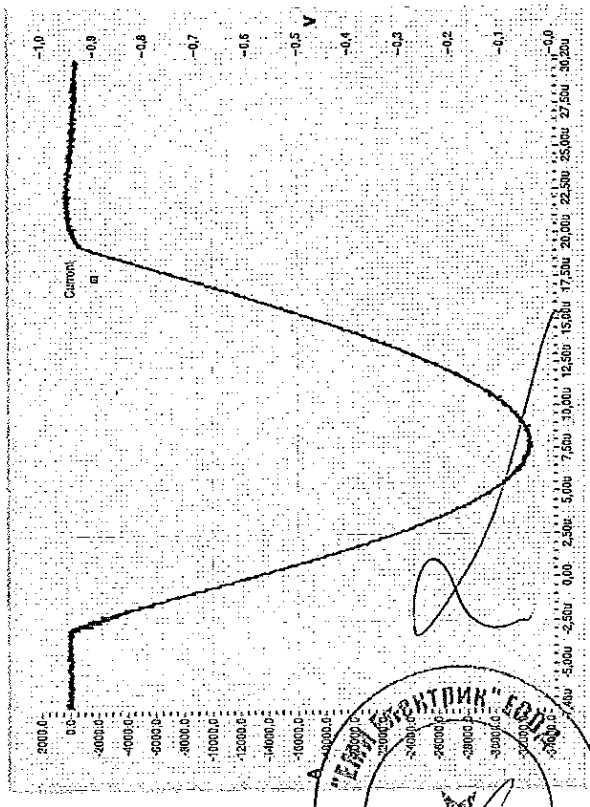
CESI B7018719 Oscillogram n. 19



CESI B7018719 Oscillogram n. 20



CESI B7018719 Oscillogram n. 21

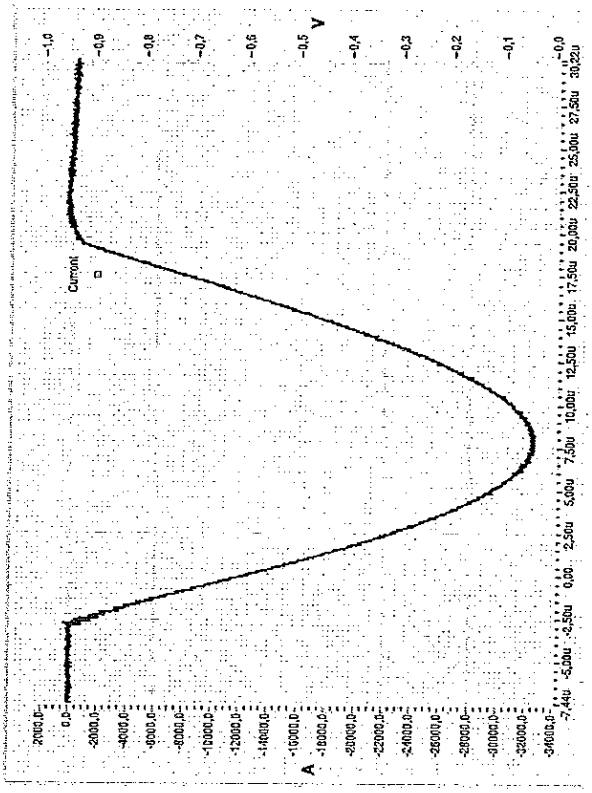


CESI B7018719 Oscillogram n. 22

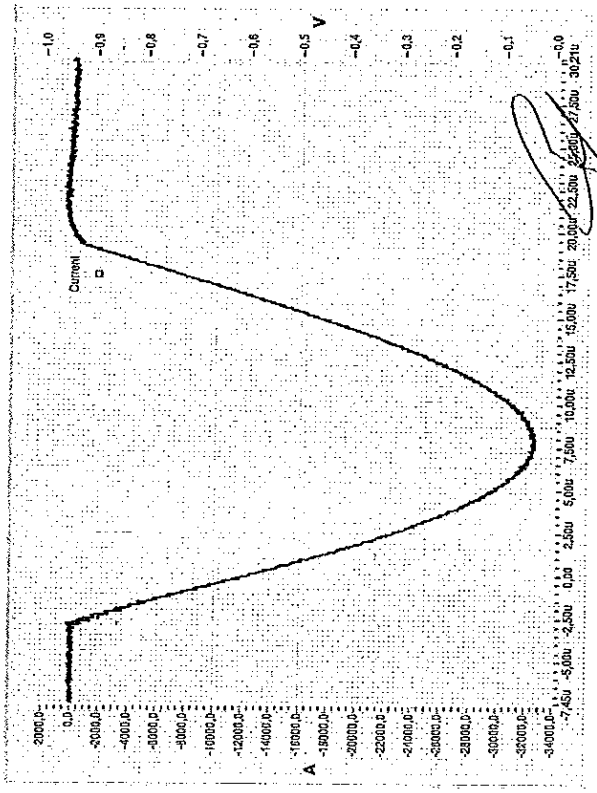
ВЯРНО С ОРИГИНАЛА

"ЕЛЕКТРОТЕХНИК" ЕООД

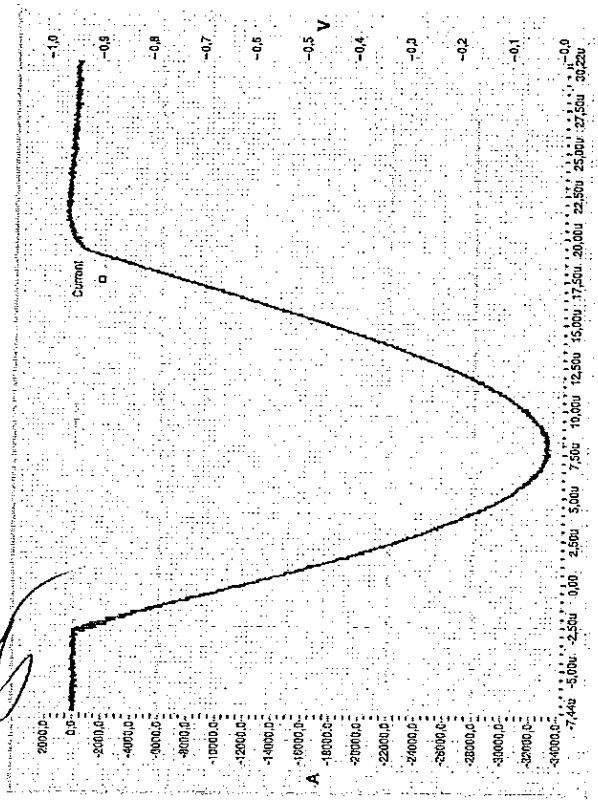
225



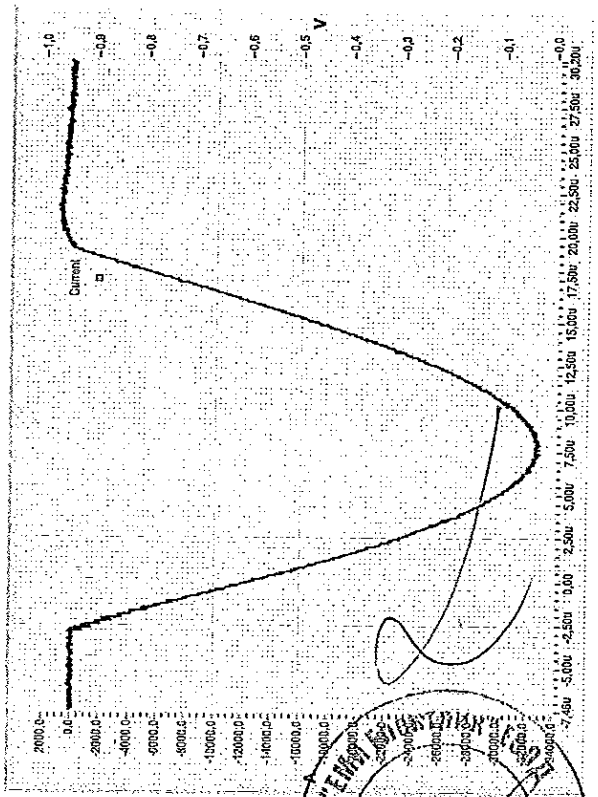
CESI B7018719 Oscillogram n. 23



CESI B7018719 Oscillogram n. 24

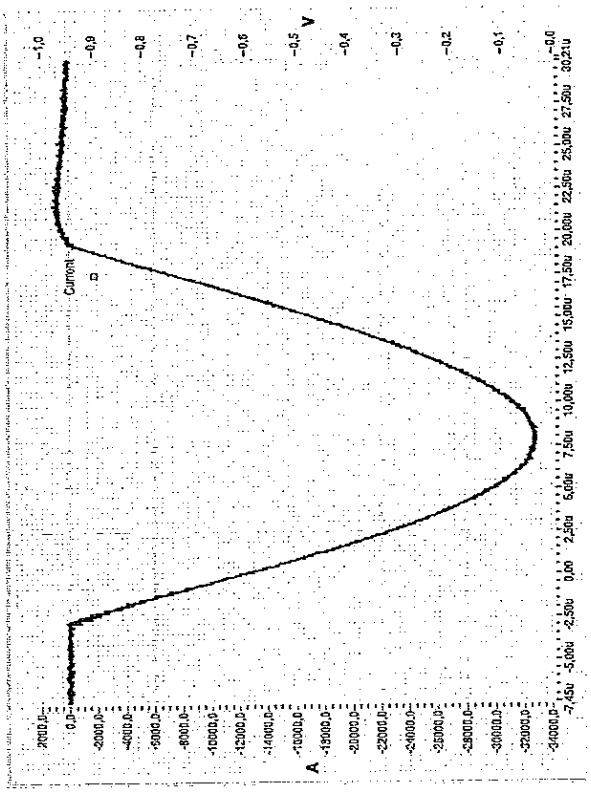


CESI B7018719 Oscillogram n. 25

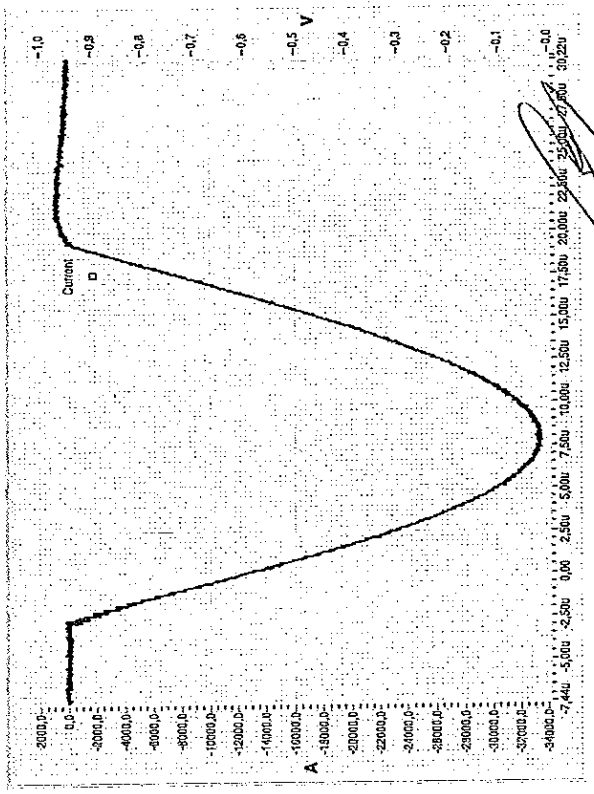


CESI B7018719 Oscillogram n. 26

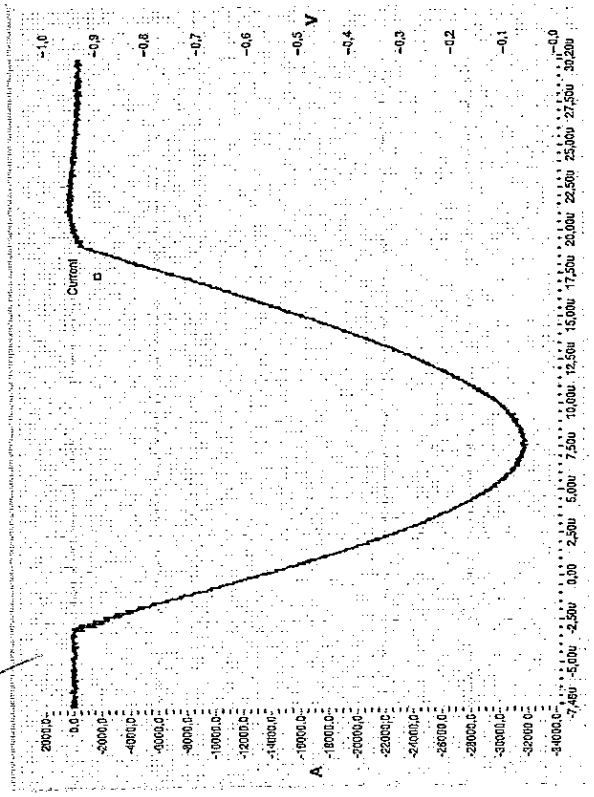
ВЯРНО С ОРИГИНАЛА



CESI B7018719 Oscillogramm n. 27



CESI B7018719 Oscillogramm n. 28



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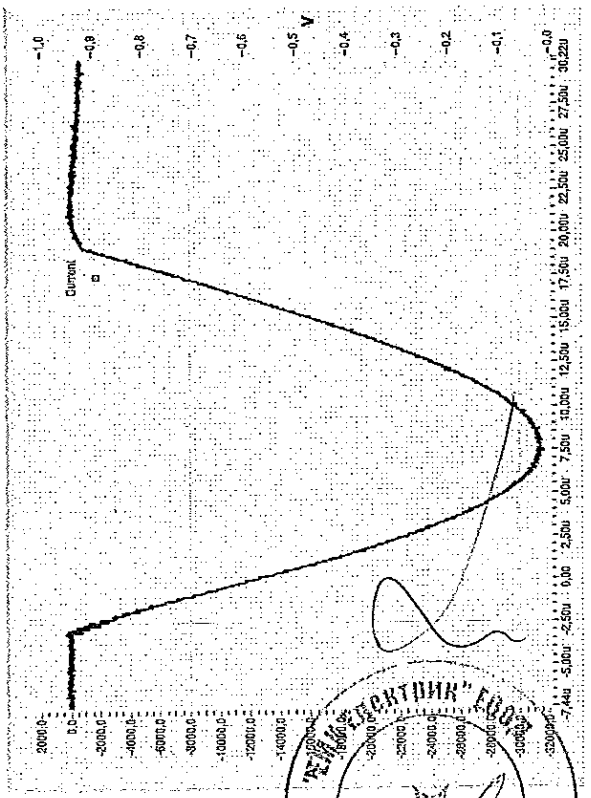
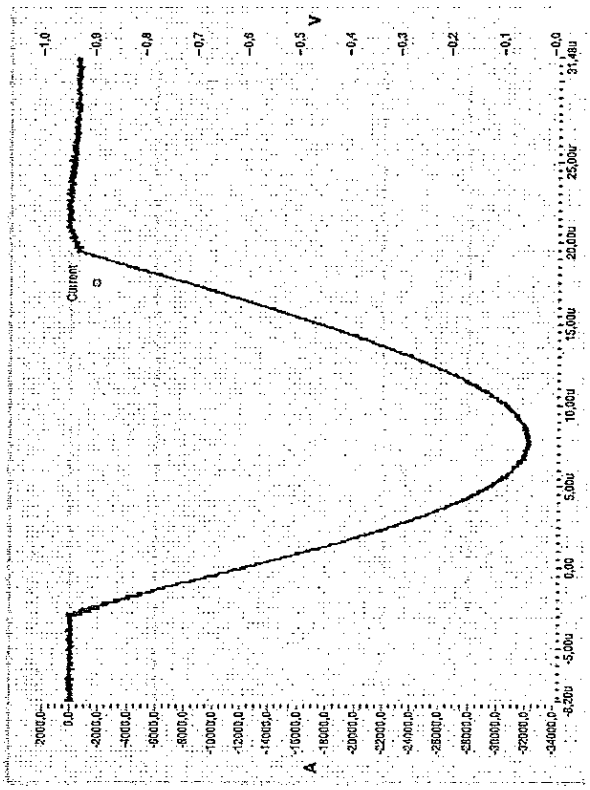
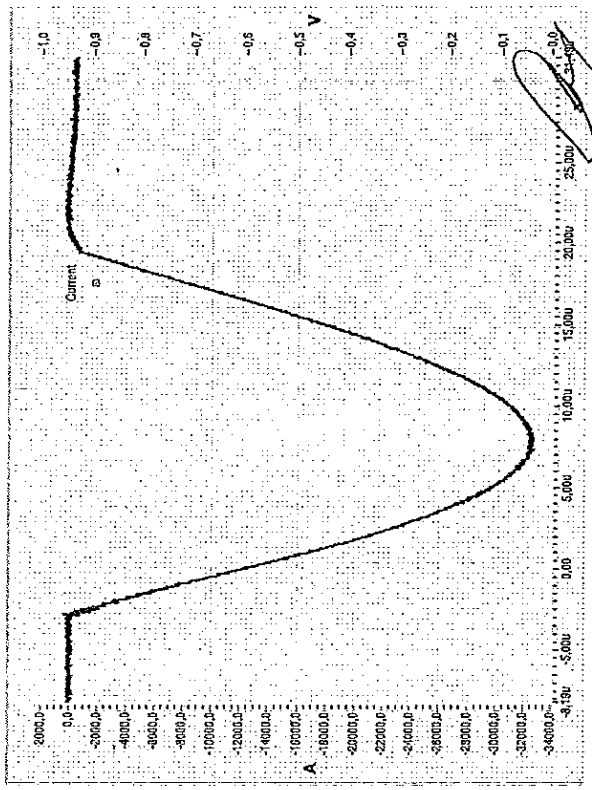


CESI B7018719 Oscillogramm n. 30

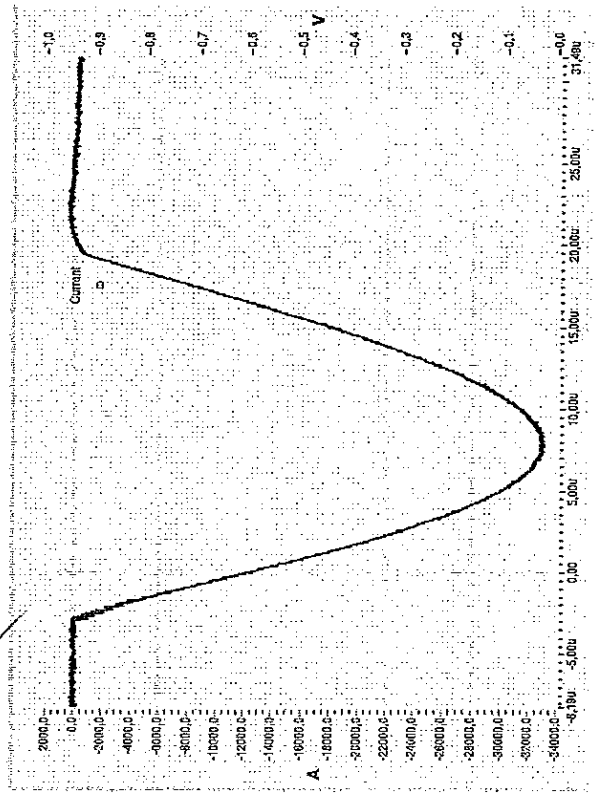
ВЯРНО С ОРИГИНАЛА



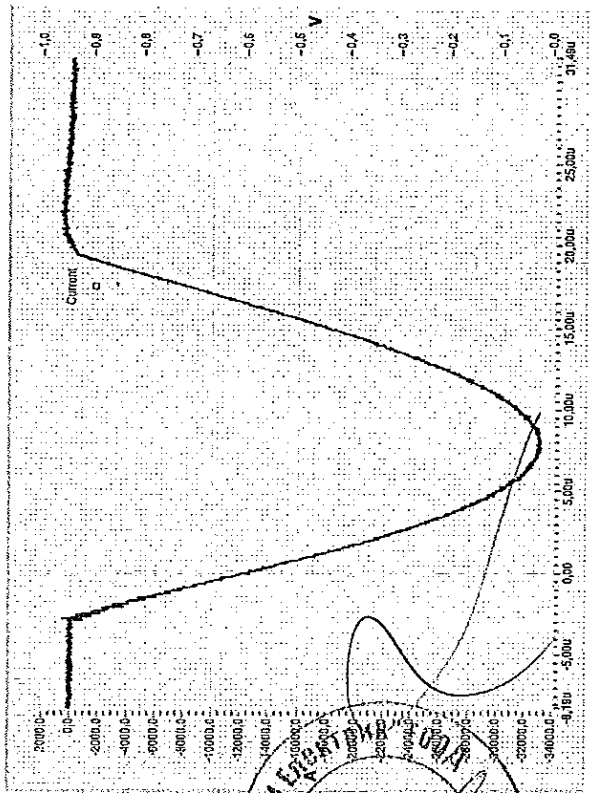
CESI B7018719 Oscillogram n. 31



CESI B7018719 Oscillogram n. 32



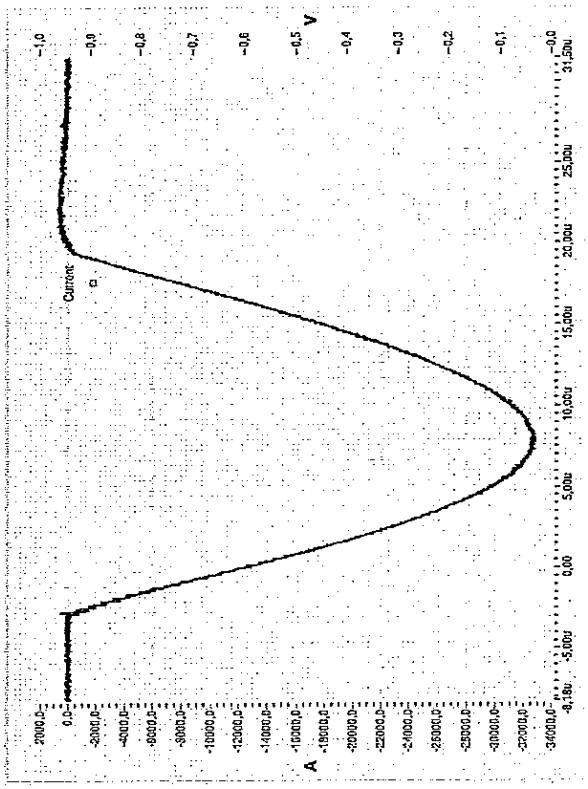
CESI B7018719 Oscillogram n. 33



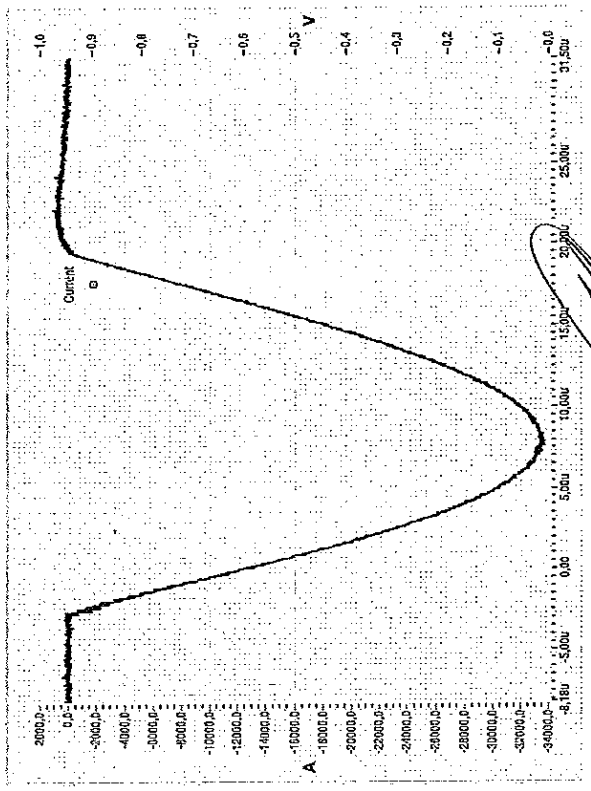
CESI B7018719 Oscillogram n. 34

ВЯРНО С ОРИГИНАЛА

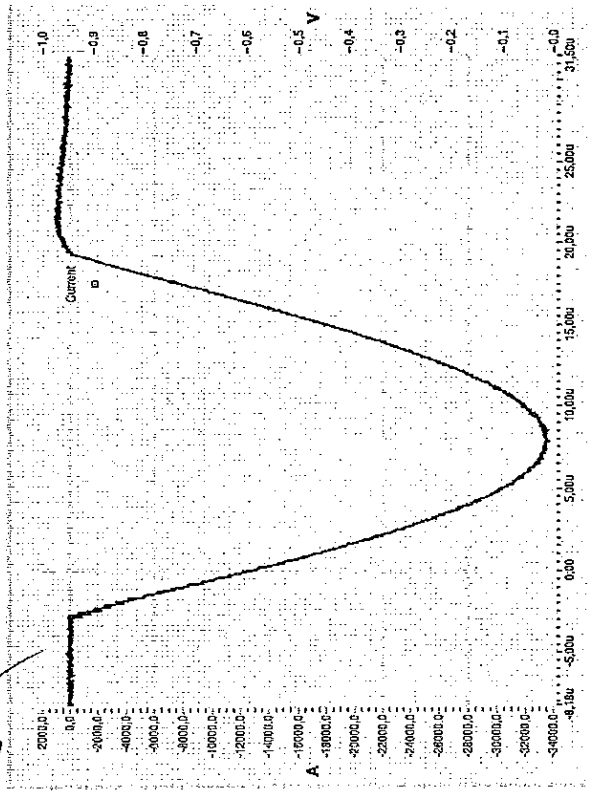
228



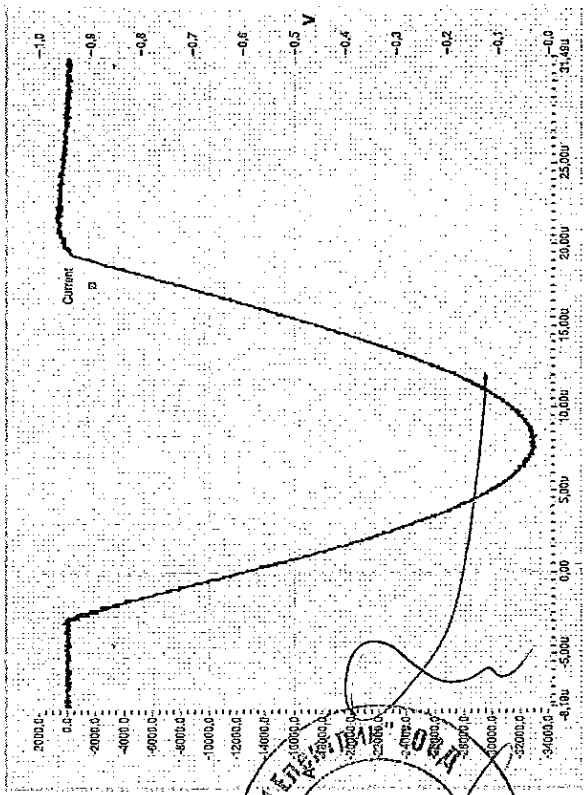
CESI B7018719 Oscillogramm n. 35



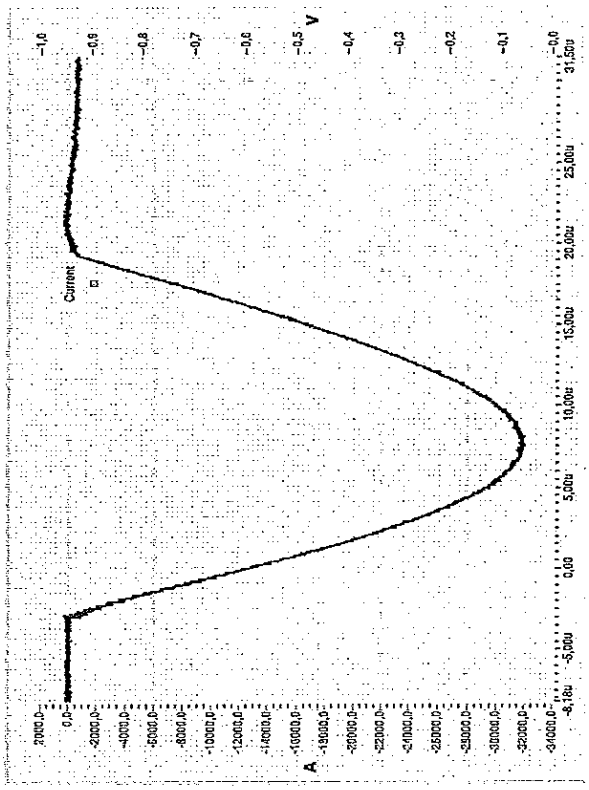
CESI B7018719 Oscillogramm n. 36



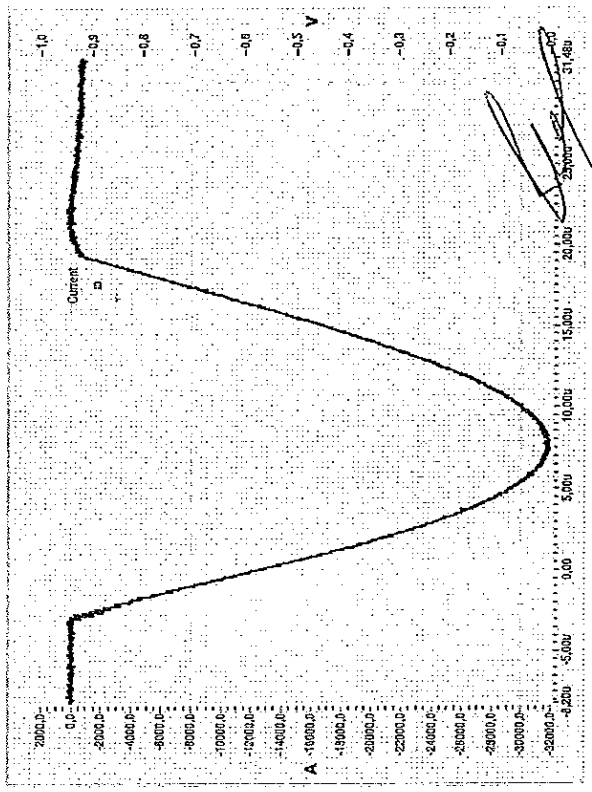
CESI B7018719 Oscillogramm n. 37



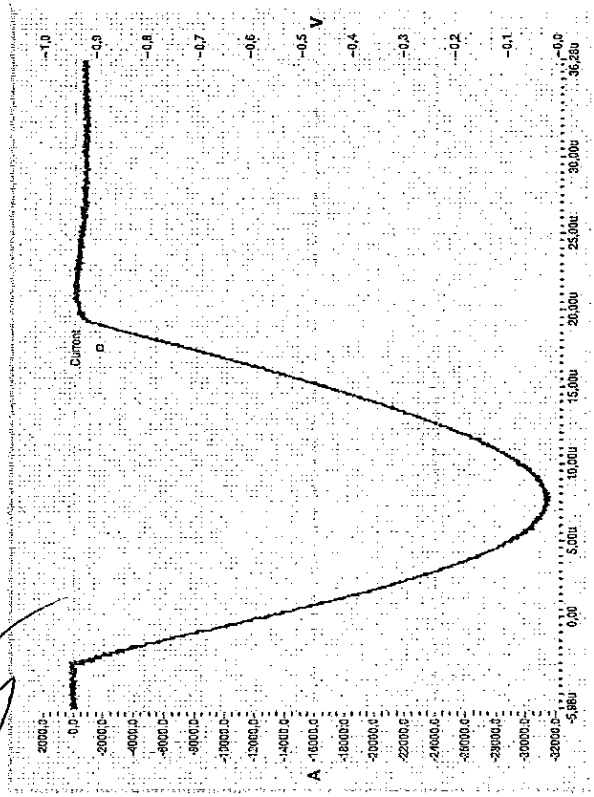
CESI B7018719 Oscillogramm n. 38



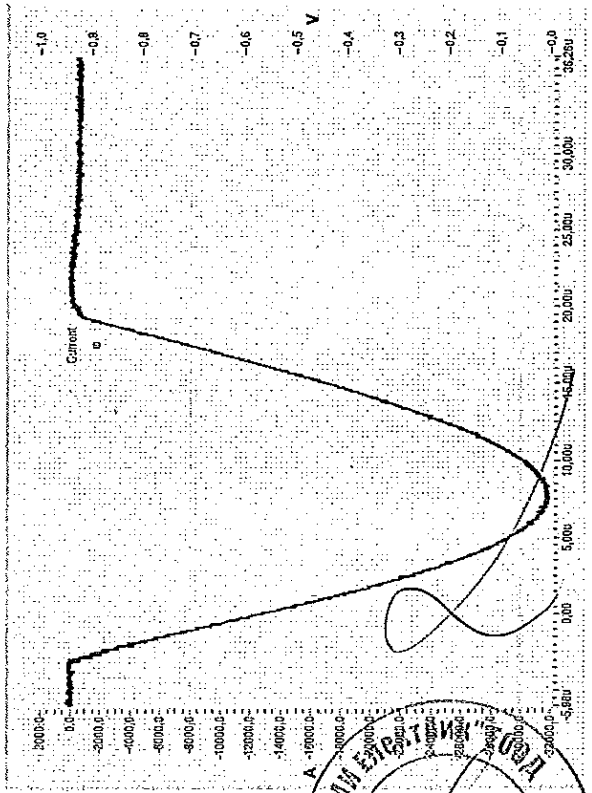
CESI B7018719 Oscillogram n. 39



CESI B7018719 Oscillogram n. 40



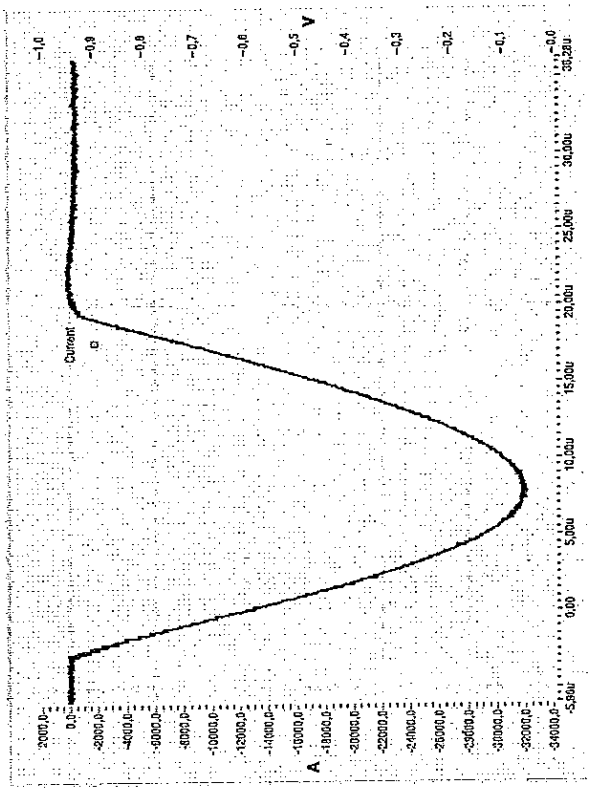
CESI B7018719 Oscillogram n. 41



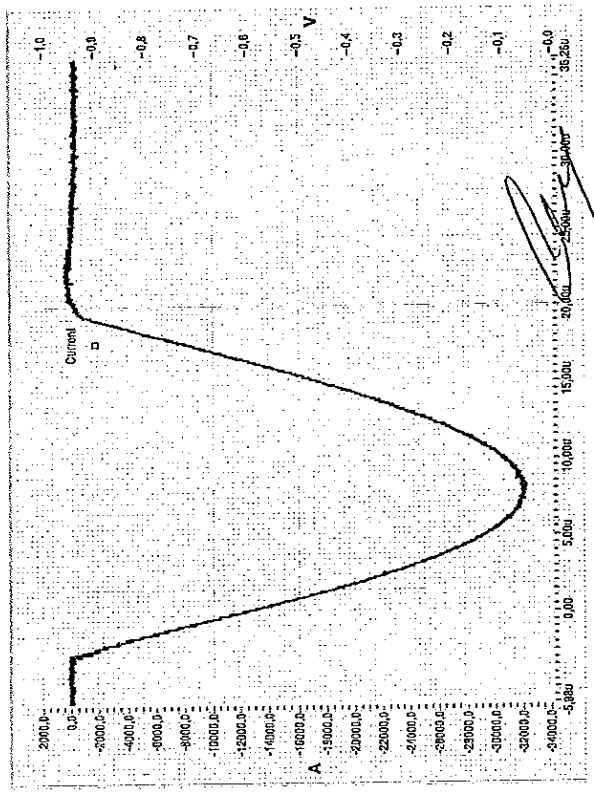
CESI B7018719 Oscillogram n. 42

ВЯРНО С ОРИГИНАЛА

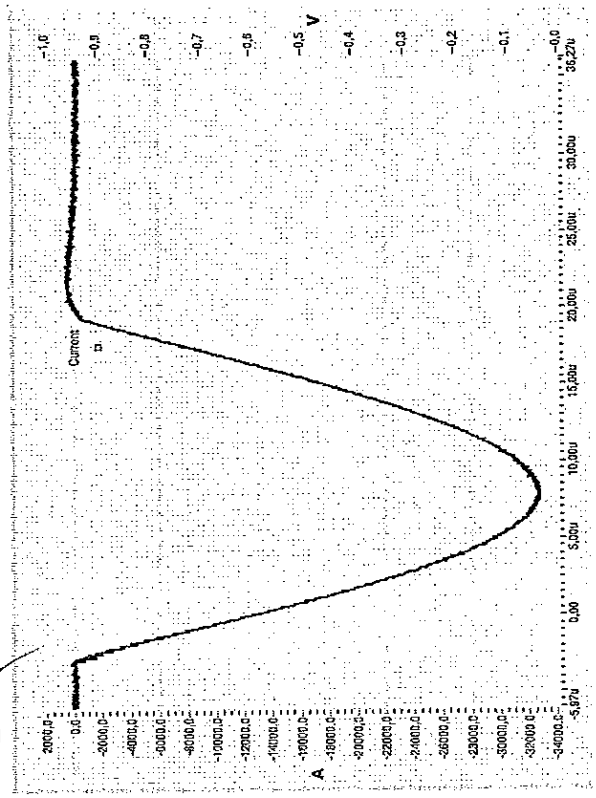
230



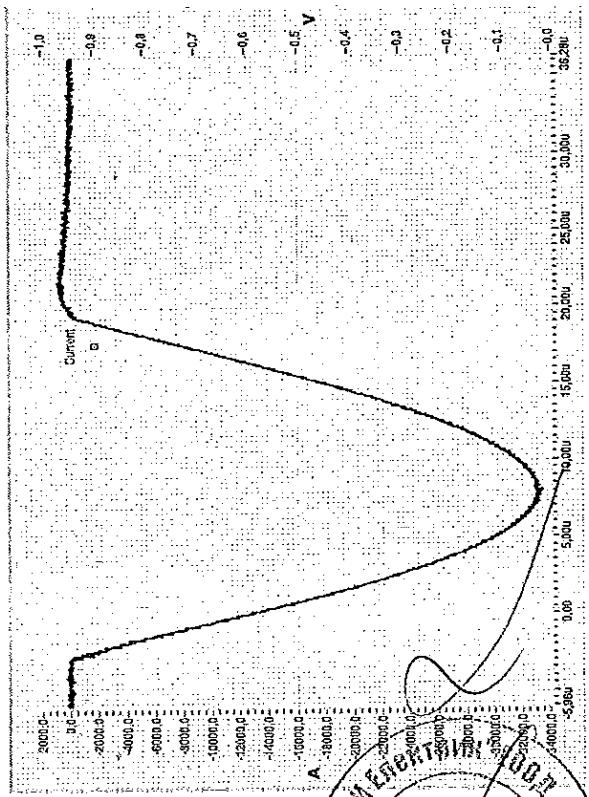
CESI B7018719 Oscillogram n. 43



CESI B7018719 Oscillogram n. 44



CESI B7018719 Oscillogram n. 45

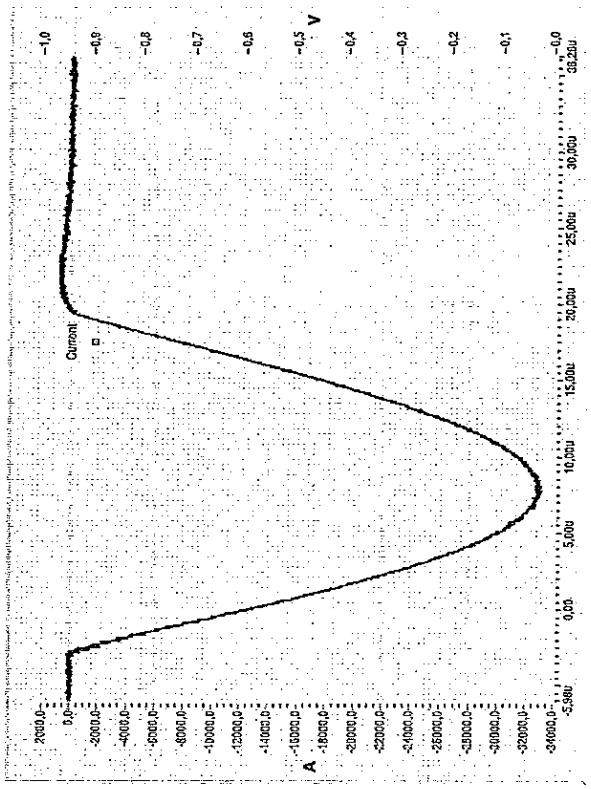


CESI B7018719 Oscillogram n. 46

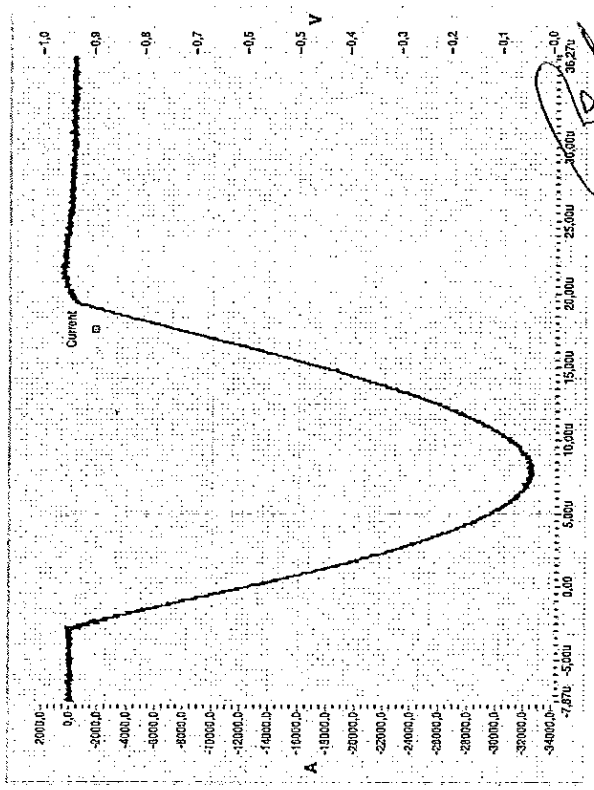
ВЯРНО С ОРИГИНАЛА

"ЕМИ Електрик" ООД

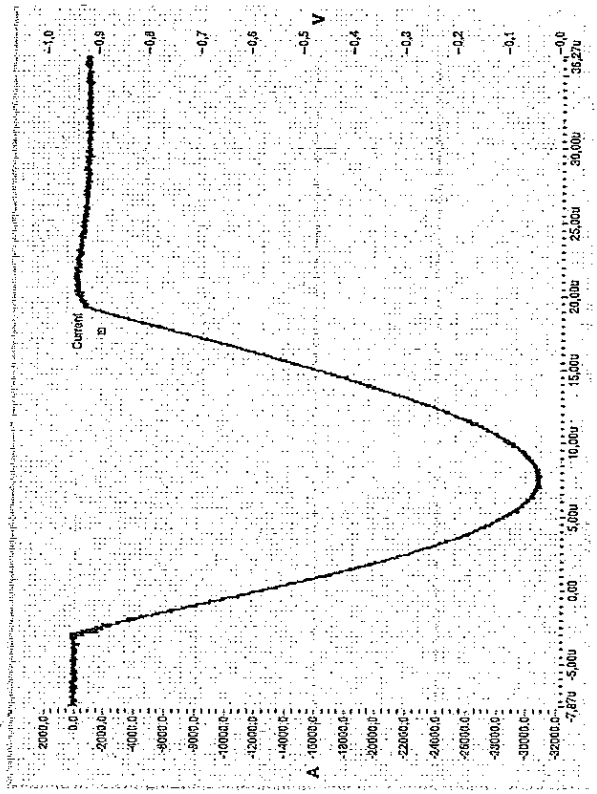
23



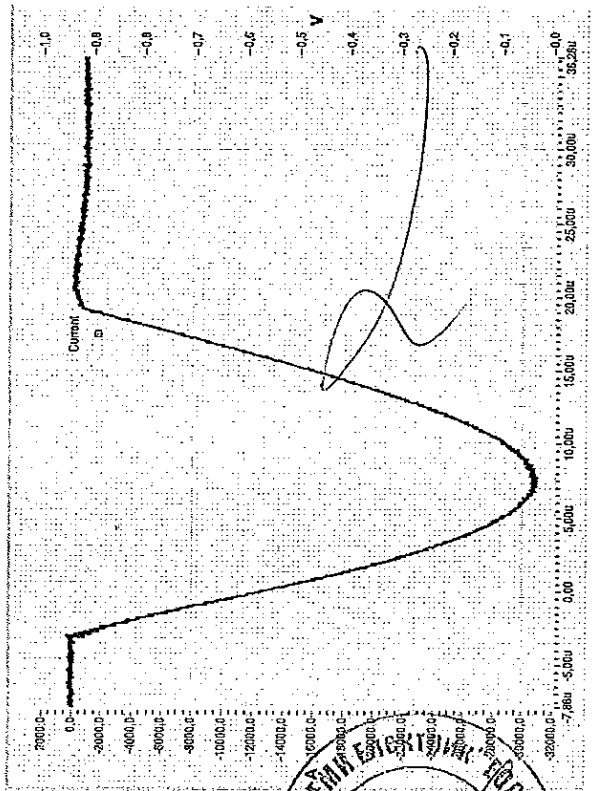
CESI B7618719 Oscillogram n. 47



CESI B7618719 Oscillogram n. 48



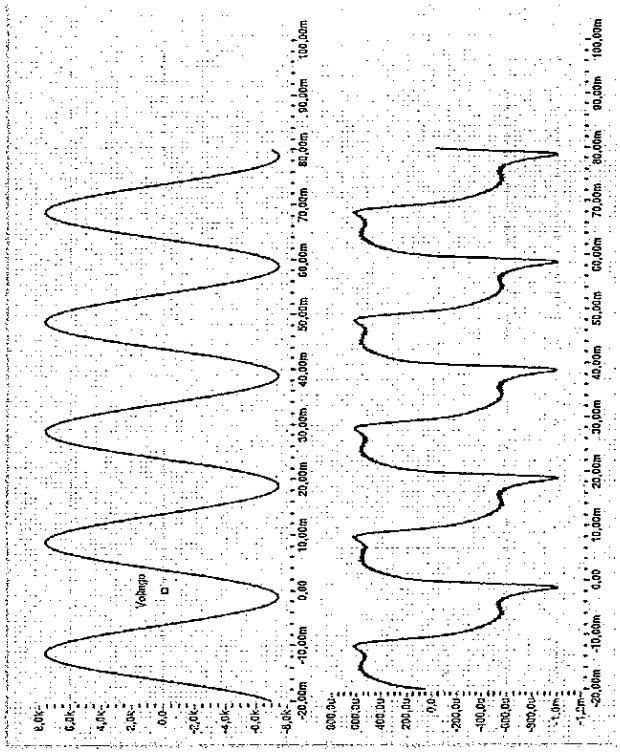
CESI B7618719 Oscillogram n. 49



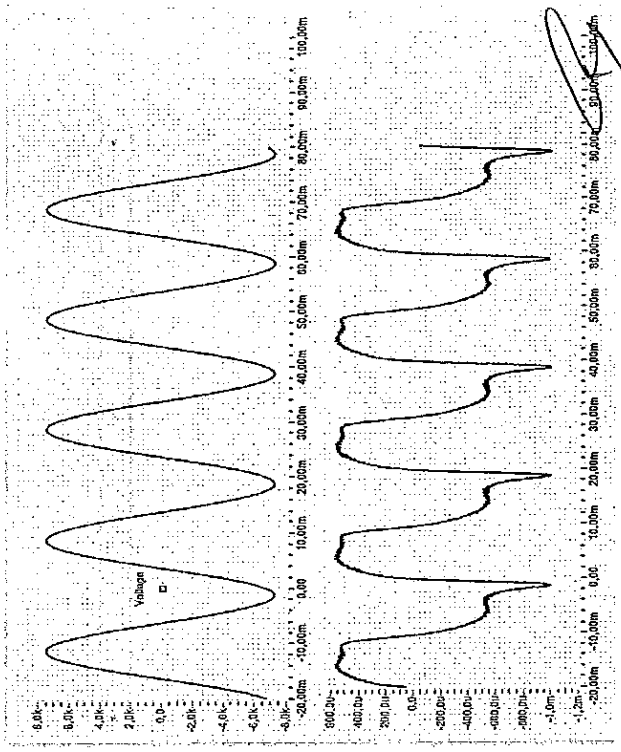
CESI B7618719 Oscillogram n. 50

ВЯРНО С ОРИГИНАЛА

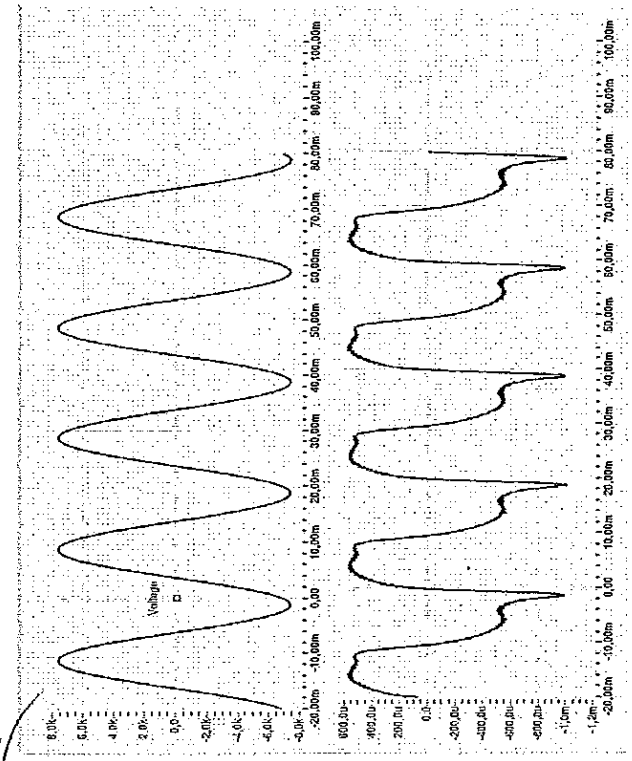
"ЕМА Електрик" ЕООД



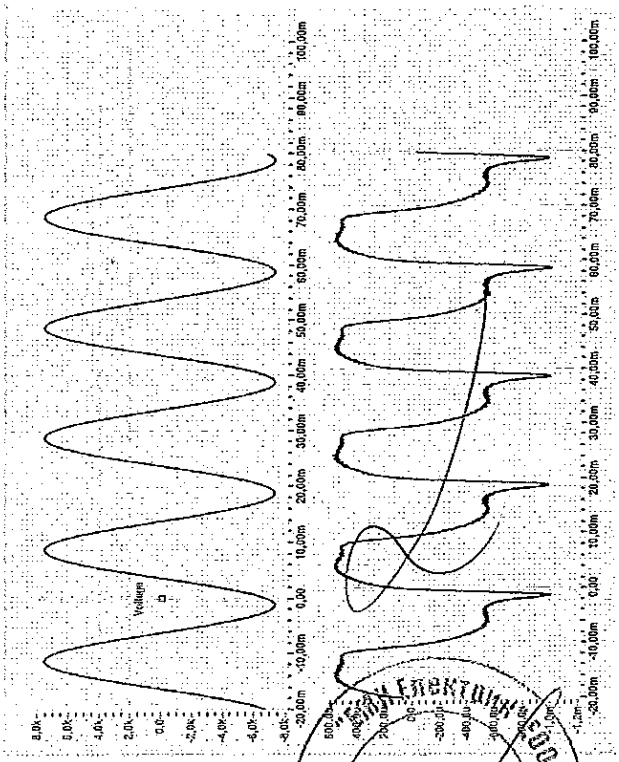
CESI B7018719 Oscillogramm n. 51



CESI B7018719 Oscillogramm n. 52



CESI B7018719 Oscillogramm n. 53



CESI B7018719 Oscillogramm n. 54

ВЯРНО С ОРИГИНАЛА

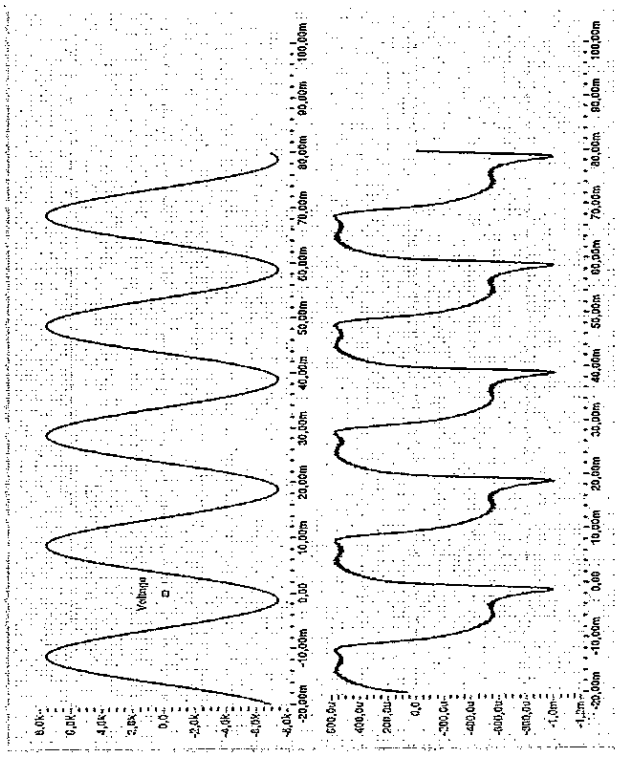
CESI B7018719 Oscillogram n. 56

CESI B7018719 Oscillogram n. 56

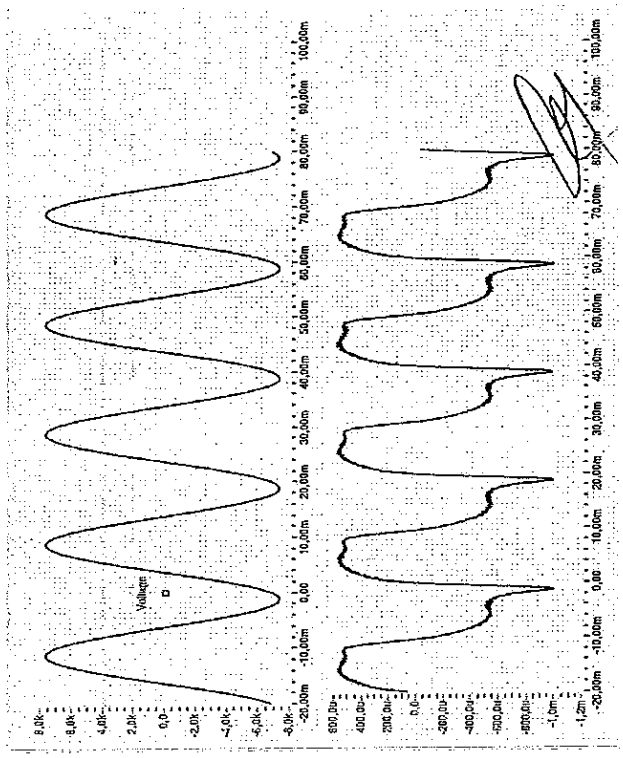
CESI B7018719 Oscillogram n. 57

CESI B7018719 Oscillogram n. 58

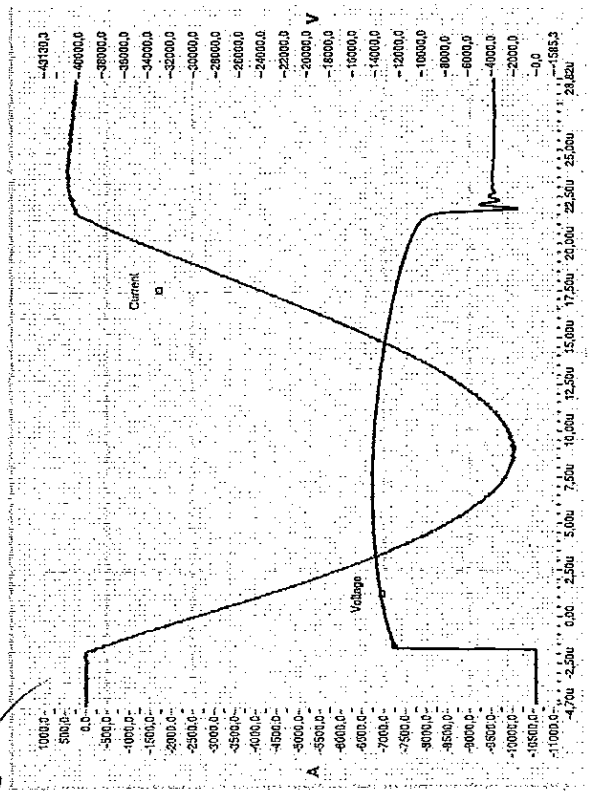
ВЯРНО С ОРИГИНАЛА



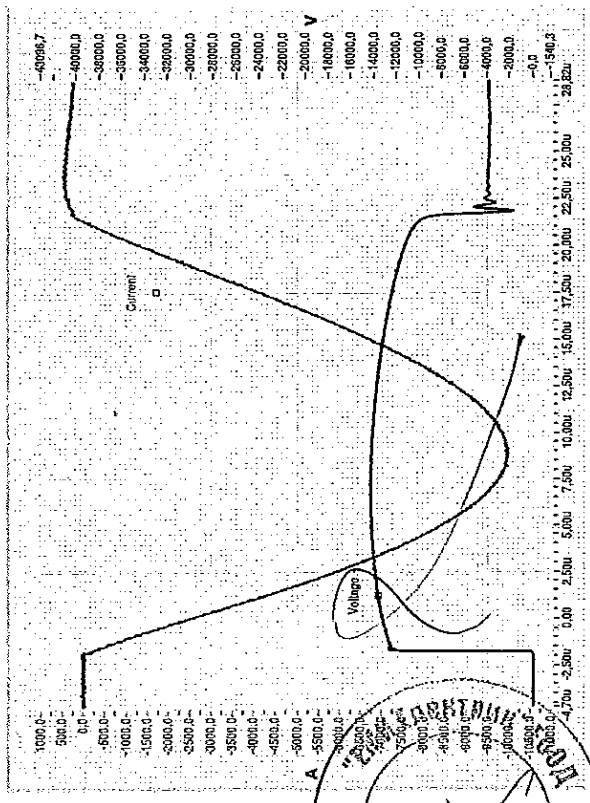
CESI B7018719 Oscillogram n. 59



CESI B7018719 Oscillogram n. 60



CESI B7018719 Oscillogram n. 61



CESI B7018719 Oscillogram n. 62

ВЯРНО С ОРИГИНАЛА

235

CESI B7018719 Oscillogram n. 63

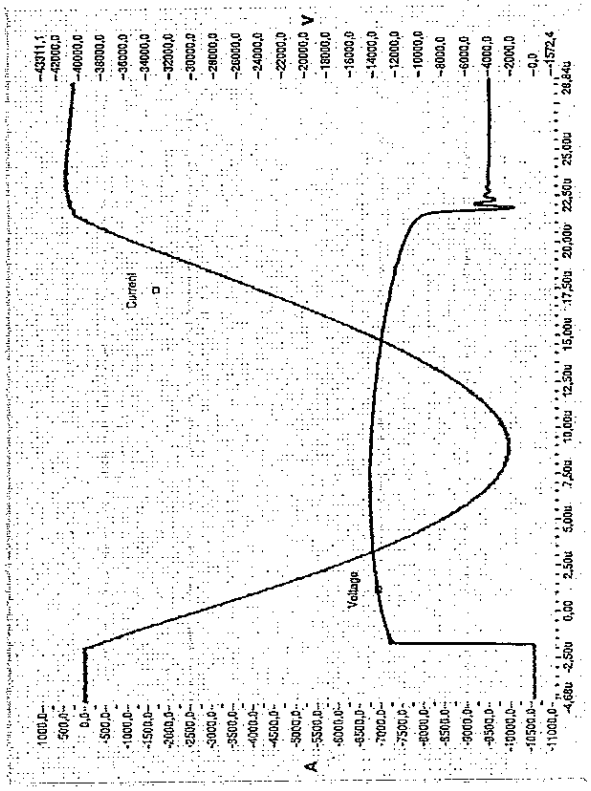
CESI B7018719 Oscillogram n. 64

CESI B7018719 Oscillogram n. 65

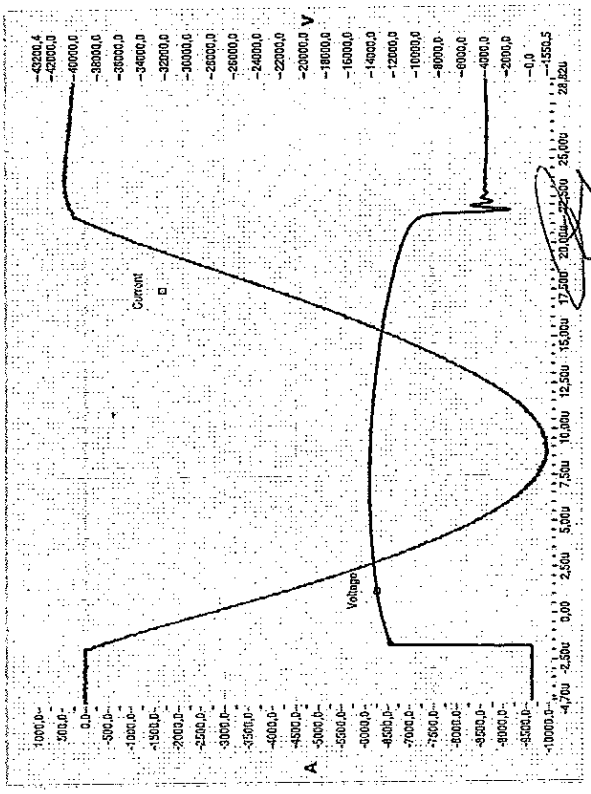
CESI B7018719 Oscillogram n. 66

ВЯРНО С ОРИГИНАЛА

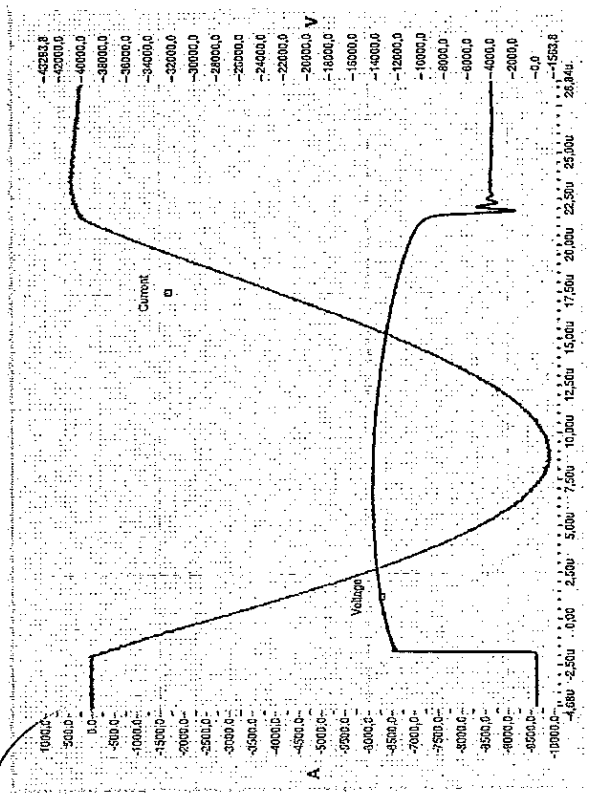
"ЕМКО ЕЛЕКТРОНИК" ЕООД



CESI B7018719 Oscillogramm n. 67



CESI B7018719 Oscillogramm n. 68



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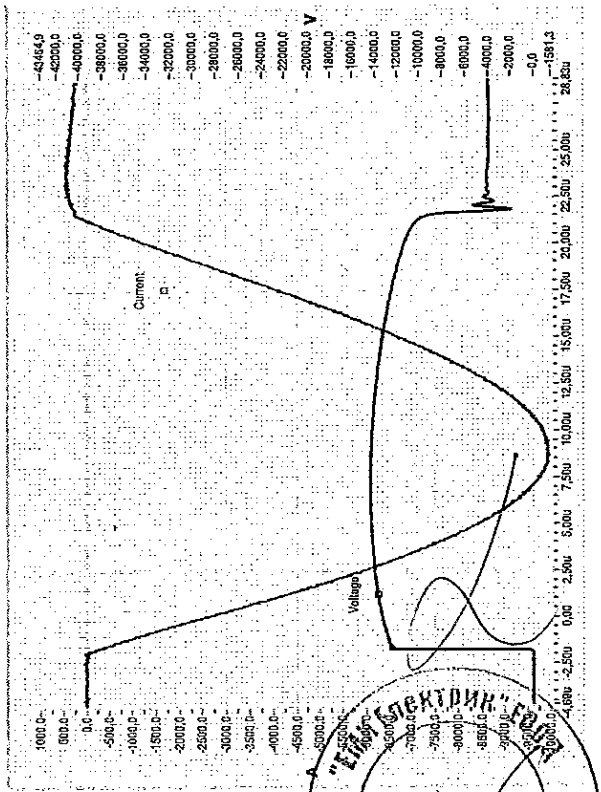

CESI B7018719 Oscillogramm n. 70

ВЯРНО С ОРИГИНАЛА

"ЕМЕ ЕЛЕКТРИК" ЕООД

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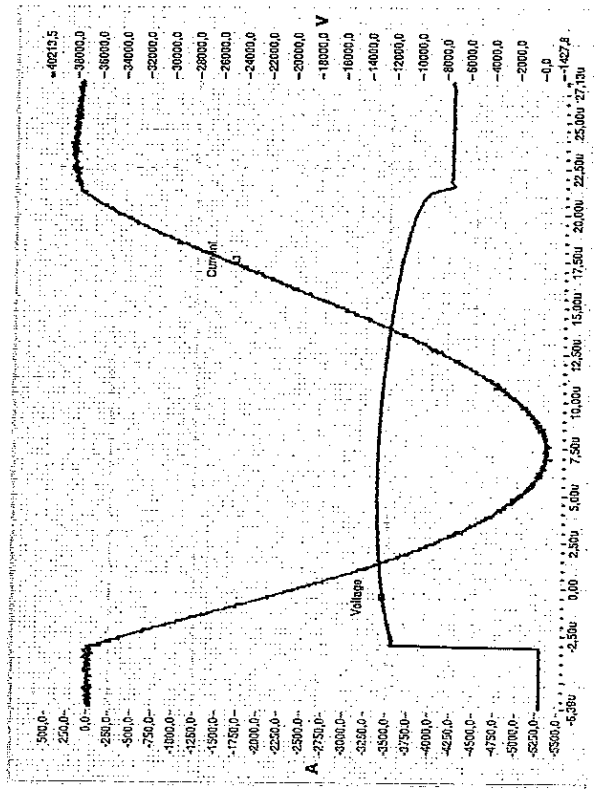
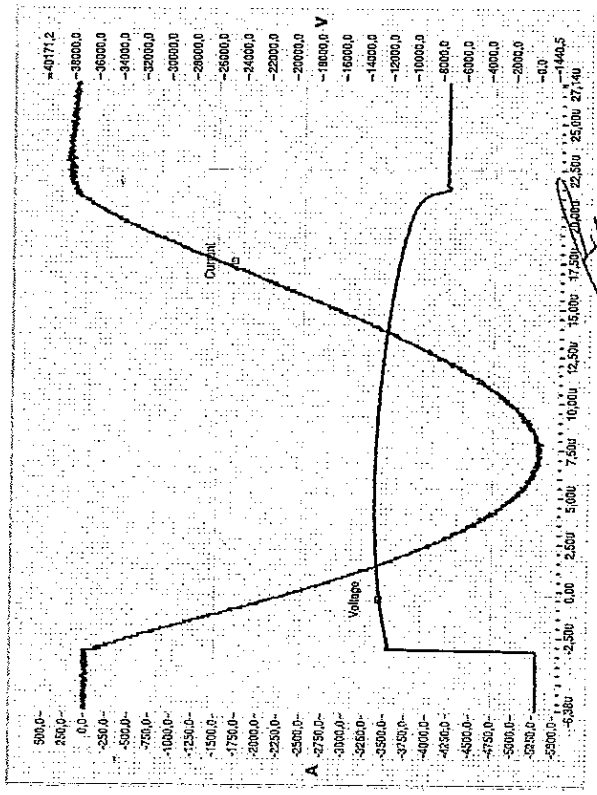


CESI B7018719 Oscillogram n. 71



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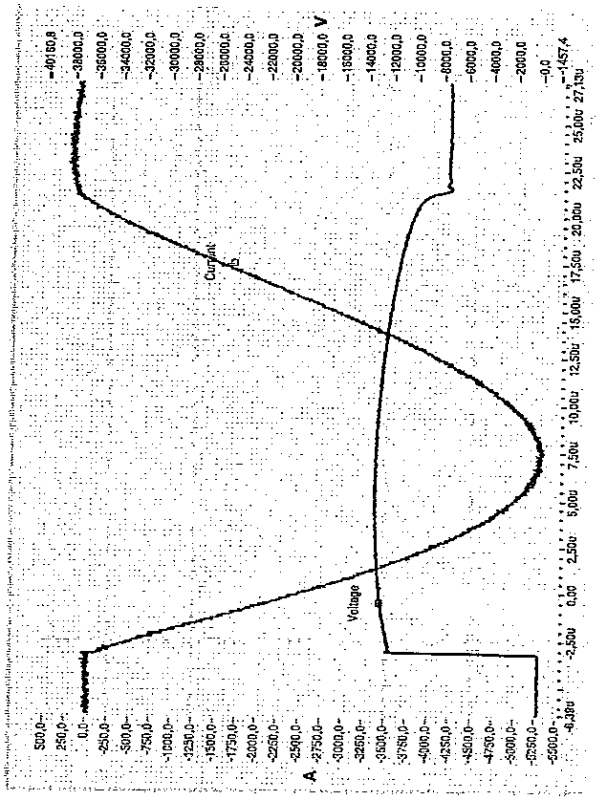

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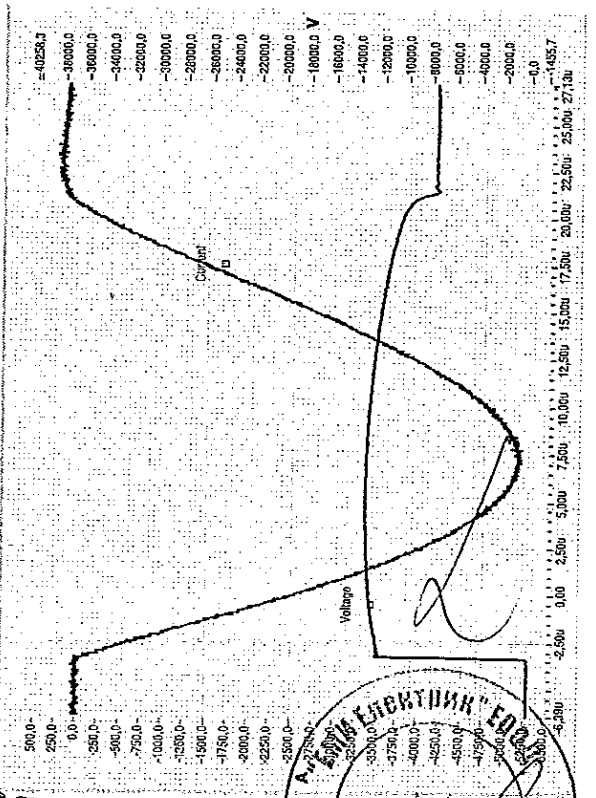

CESI B7018719 Oscillogram n. 74

ВЯРНО С ОРИГИНАЛА

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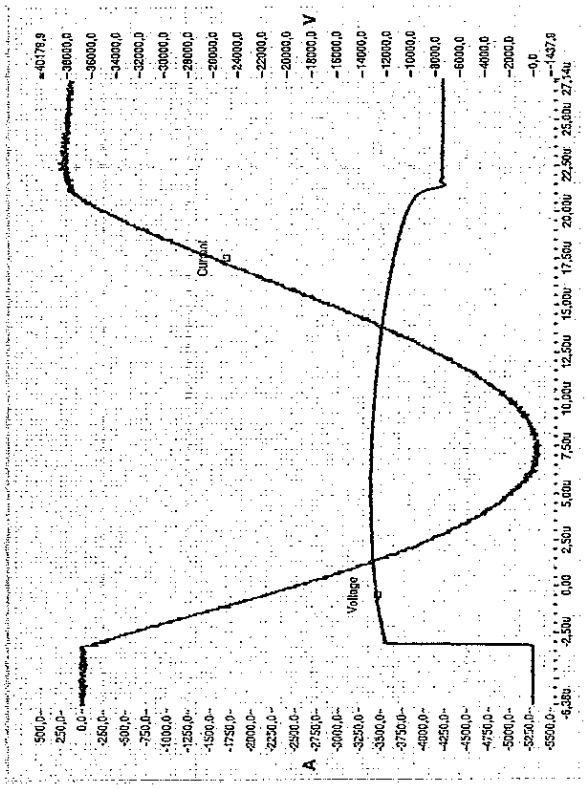

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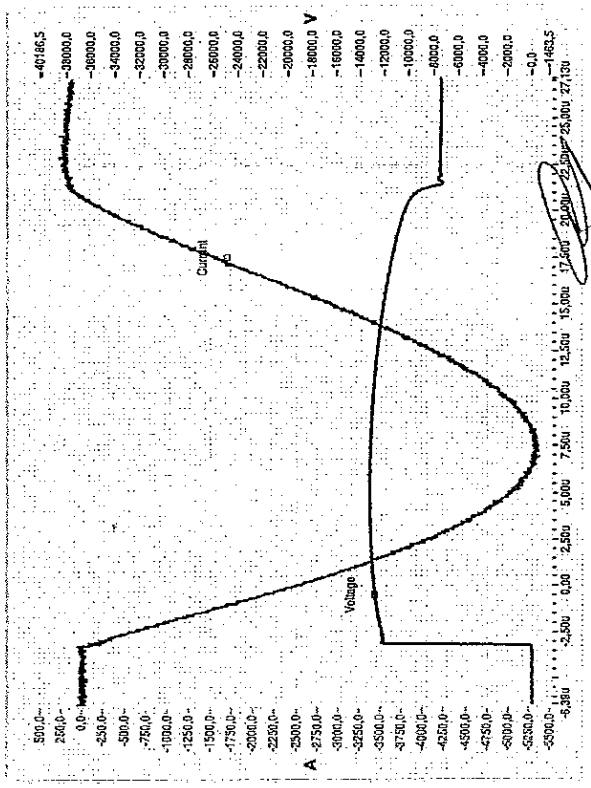

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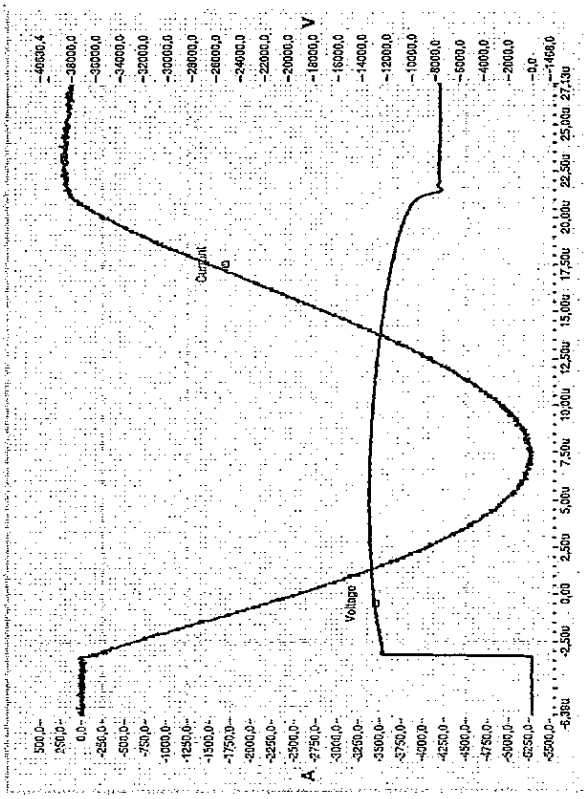

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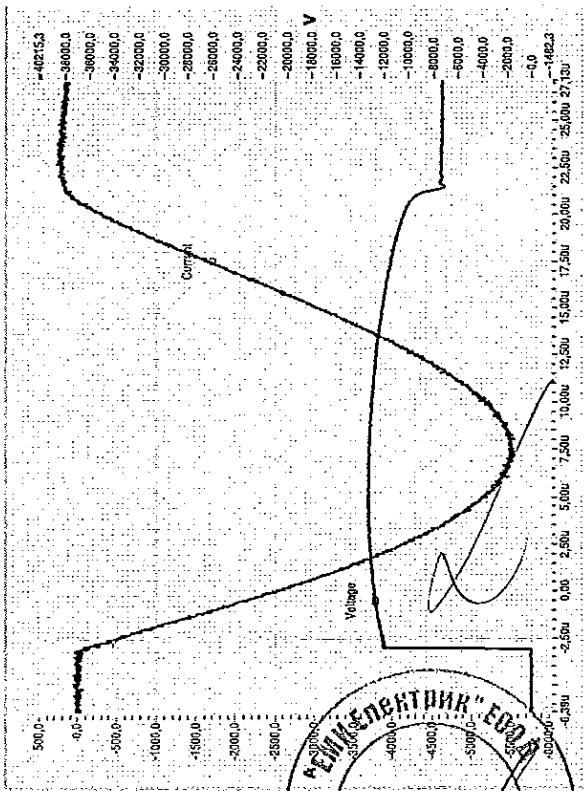

CESI B7018719 Oscillogramm n. 78

ВЯРНО С ОРИГИНАЛА

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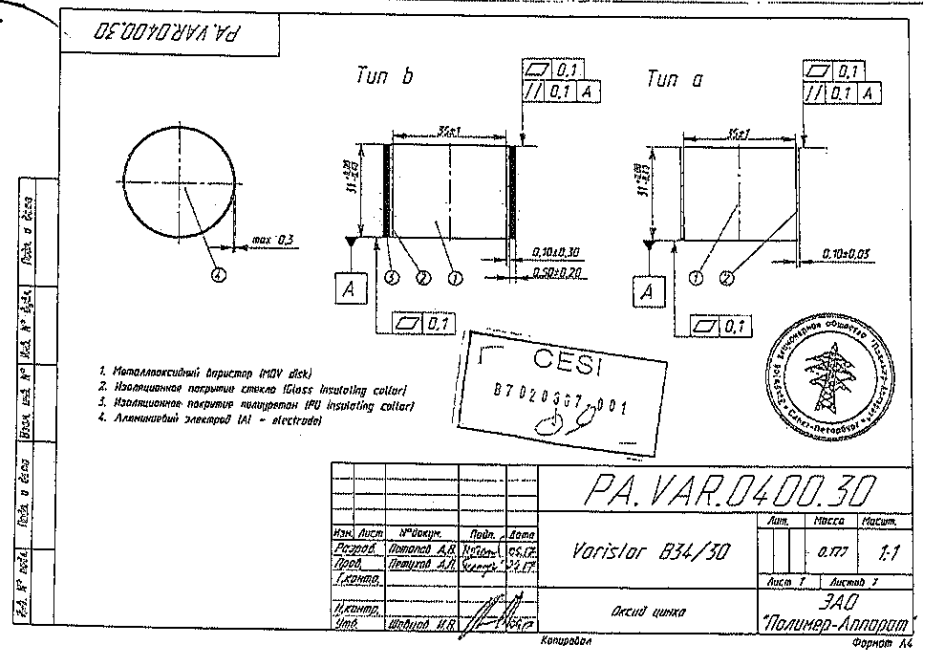

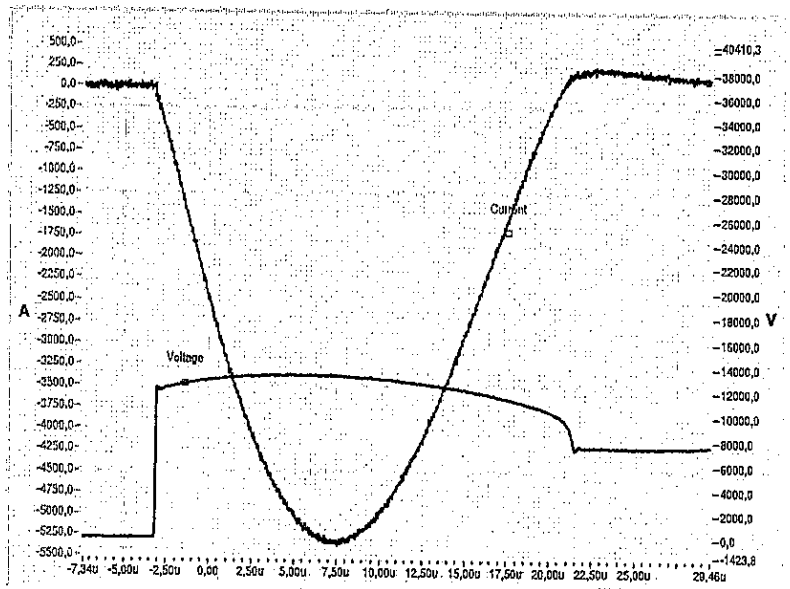

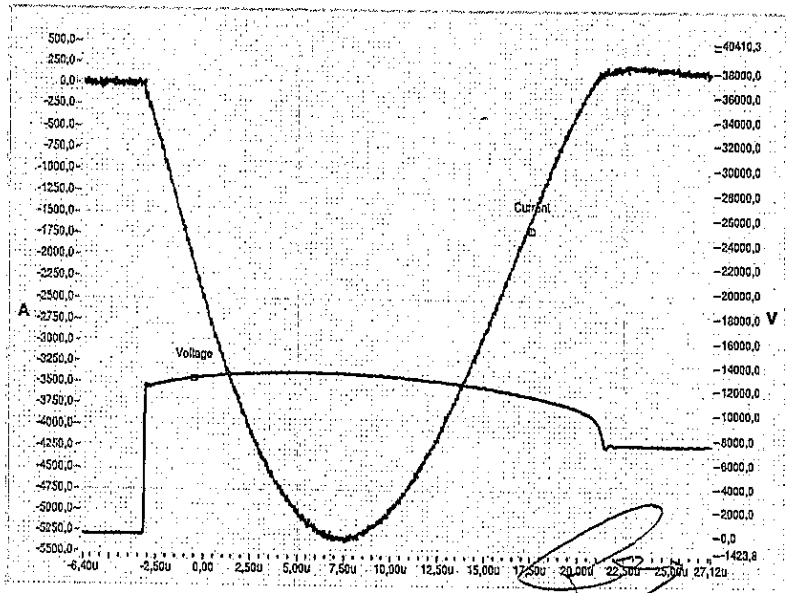

Test Report

Document No.	B7019962	Copy No. 1	Number of pages 65
Apparatus	Polymer-housed surge arrester section type PA-DM section ST with additional thermal insulation		
Designation	—		
Serial Number	—		
Manufacturer	Joint-Stock Company " Polymer-Apparat"		
Client	Joint-Stock Company " Polymer-Apparat" Ak. Kostantinova str.,1 195427 Saint-Petersburg - Russia Federation		
Tested for	—		
Date(s) of tests	October 3 – 4, 2017		
Tested by	CESI S.p.A. Via Rubattino, 54 20134 – Milano - Italy		
Test performed	Operating duty test		

The apparatus constructed in accordance with the description, drawings and photographs incorporated in this document has been subjected to the series of proving tests in accordance with:
IEC 60099-4 – Edition 3.0 (2014-06)

The results are shown in the report of proving tests and the oscillograms attached thereto. The ratings assigned by the Manufacturer are listed in the subsequent pages.
The declaration applies only to the apparatus tested. No responsibility for conformity of any apparatus having the same designation with that tested here rests with the manufacturer.

November 20, 2017

Date

Grassi Marco
Test Engineer in charge

The Manager - Arabbeo Lorenzo
Approved By Document Digitally Signed

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The authenticity of this document is guaranteed by the holographic.

The laboratory meets the requirements of the standard EN ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories". For the latest status of the accreditation and the list of accredited tests may be checked on the web site www.accredia.it

LAB N° 0030

CESI

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Notes

STL-Member

CESI Group members are founder members of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in 1959. STL is a forum for voluntary international cooperation of testing organizations.

CESI Group Test Documents description

Type Test Certificate of .....

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

Test Certificate of (complete / selected) Type Tests

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

Certificate of Design Verification

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

Type Test Report

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

Test Report

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

On-Site Test Record

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

Test Award

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

Tests witnessed by:
--- ---

Identification of the object: Requested

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings.
CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.
These drawing, identified by CESI and numbered B7024364 No. 1 , is annexed to this document.

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

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

- Voltage a.c.	: ± 3,0 %
- Residual peak voltage (impulse tests)	: ± 3,0 %
- Current a.c.	: ± 3,0 %
- Peak current (impulse tests)	: ± 3,0 %
- Time (impulse tests)	: ± 10,0 %
- Time (a.c. tests)	: ± 1,5 %

Laboratory Information

Receipt date of the sample	September 2017
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr L. Podavitte – Mr L Guacci
Test laboratory	P177
ODV SAP	70006781

A100103 rev.2

Pages annexed:
Oscillogram n. 97 pages
Client's drawing (Polymer-housed surge arrester section) – CESI no. B7024364 – n.1 page
Client's drawing (MO resistor) – CESI no. B7019187 – n.1 page

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Test object characteristics (assigned by the client)

Manufacturer's name	Joint-Stock Company " Polymer-Apparat"
Polymer-housed surge arrester section type	PA-DM section ST
Drawing code	PA-DM.001.ST.02
MO-resistor supplier's	Joint-Stock Company " Polymer-Apparat"
Metal-oxide resistor type	B34/90
Arrester class	Distribution
Designation	DH
Number of MO resistor fitted	1
Nominal discharge current - [kA]	10
Rated voltage - U_r [kV]	1,077 x U_{ac}
Continuous operating voltage - U_c [kV]	0,851 x U_{ac}
Repetitive charge transfer rating - Q_{rs} [C]	0,4
Rated thermal charge transfer rating - Q_{th} [C]	1,1
Reference current - I_{ref} [mA]	1,0
Rated frequency - [Hz]	48÷62
Year of manufacture	08/2017

geometrical characteristics measured on the MO resistor

Total height [mm]	31,1 mm
Diameter [mm]	35,6 mm

Photographs of the test object

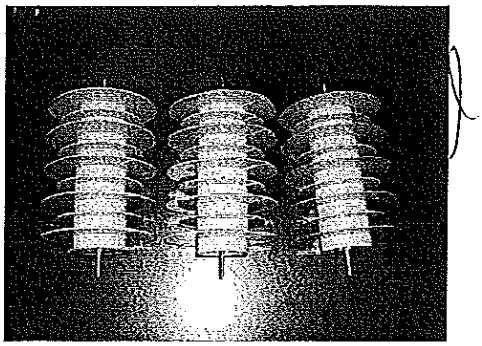

Photo no. 1

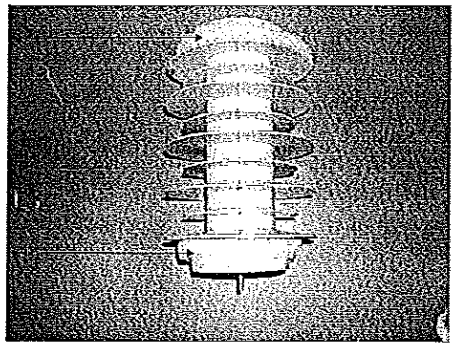

Photo no. 2

Polymer-housed surge arrester section type PA-DM section ST with additional thermal insulation

Reference Standard

IEC 60099-4 (2014/06) – Edition 3.0 - Clause 10.8.7
"Metal-oxide surge arresters without gaps for a.c. system"

Test carried out	Number of sample tested
Operating duty test	3

Test object identification

Test object name	Identification of test sample (given by CESI)	Identification of test sample (given by JSC "Polymer Apparat)
Polymer-housed surge arrester section type PA-DM section ST with additional thermal insulation	OD1	00006
	OD2	00007
	OD3	00008

Test procedure

1. Test performed on Polymer-housed metal-oxide surge arrester section in open air

The test procedure consisted of the following sequence:

Initial test
a) Measurement of the lightning impulse residual voltage at the nominal discharge current
b) Measurement of the power frequency reference voltage at the reference current
Conditioning
c) Application of a high current impulse 4/10 µs at 100 kA

2. Test performed on Polymer-housed metal-oxide surge arrester section assembled in thermal model

Thermal recovery test
d) Calculation of the voltage correction factors
e) The surge arrester sections were kept in an oven at the temperature of 65 °C (±) thermal equilibrium (not more than twenty hours)
f) Injection of two lightning current impulses 8/20 µs at the rated thermal charge transfer Q_{th}. A time shorter than 100 ms after the application of the second lightning current impulse energization at U_r for 10 sec. and then at U_c for 30 min. to verify the thermal stability.
Note:
- Intervals between lightning duration current impulses: 60 seconds
- nominal test frequency : 50 Hz

3. Test performed on Polymer-housed metal-oxide surge arrester section in open air

g) Measurement of the lightning impulse residual voltage at nominal discharge current for comparison with initial value
h) After that the sample has cooled to ambient temperature, two current impulses 8/20 at In have been applied for to check the integrity of the internal parts. The interval between impulses was 50-60 seconds.

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%). During the (f) and (h) tests the oscillograms not reveal any breakdown and the variation of lightning impulse residual voltage between the initial measurement and the last impulse was less than 5% (maximum allowed variation according to reference standard is 5%).
The thermal recovery was achieved.

The acceptance criteria are fulfilled and therefore the test result is positive.

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Summary of test results

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	10,12	14,24	10,12	14,50	+1,83
OD2	10,12	14,12	10,17	14,34	+1,56
OD3	10,13	14,13	10,18	14,25	+0,85

Variation of lightning impulse residual voltage between residual voltage measurement at In during initial test and residual voltage measurement at In during last impulse

sample	before test		after test (last impulse)		Variation
	discharge current	residual voltage	discharge current	residual voltage	
	kA	kV	kA	kV	%
OD1	10,12	14,24	9,95	14,47	+1,60
OD2	10,12	14,12	10,05	14,35	+1,70
OD3	10,13	14,13	10,13	14,27	+0,99

Visual inspection after the test

The visual external inspection of polymer-housed metal-oxide surge arrester section after the test has revealed no sign of physical damage

Operating duty test.

Lightning impulse residual voltage measurement before the test

Test circuit: A0120

Date: October 3, 2017

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual Voltage
No.		kV	No.	µs	kA	kV
OD1	I_n	24,6	1	8,5/18,2	10,12	14,24
OD2		24,5	2		10,12	14,12
OD3		24,5	3		10,13	14,13

Notes:

Operating duty test.

Reference voltage test

Test circuit: A0019

Date: October 3, 2017

Sample No. OD1						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{cap}	W	µA
4	5,48	0,852	1,000	0,561	1,43	--

Sample No. OD2						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{cap}	W	µA
5	5,42	0,850	1,00	0,556	1,38	--

Sample No. OD3						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{cap}	W	µA
6	5,40	0,887	1,00	0,561	1,41	--

Operating duty test.

Conditioning: Application of one 100 kA 4/10 µs high current impulses

Test circuit: A0121

Date: October 3, 2017

Sample	Impulse	Charging voltage	Oscillogram	Discharge current	Current waveshape	Opposite polarity
No.	No.	kV	No.	kA	µs	%
OD1	1	85,0 x 2	7	101,3	4,5/9,2	9,0
OD2	1	85,0 x 2	8	101,4		
OD3	1	85,0 x 2	9	101,3		

Notes:

ВЯРНО С ОРИГИНАЛА

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Operating duty test.

Voltage correction factor and thermal energy calculations

Date: October 4, 2017

Sample	U_{ref} [1]	KU_r [2]	KU_c [3]	U_r' [4]	U_c' [5]
No.	kV			kV	kV
OD1	5,48	1,077	0,861	5,902	4,718
OD2	5,42			5,837	4,667
OD3	5,40			5,816	4,649

[1] U_{ref} : measured reference voltage
[2] KU_r : maximum guaranteed factor for calculation of $Ur' = U_r/U_{ref\ max}$ (declared by the Manufacturer)
[3] KU_c : maximum guaranteed factor for calculation of $Uc' = U_c/U_{ref\ max}$ (declared by the Manufacturer)
[4] U_r' : corrected rated voltage [4] = [1] × [2]
[5] U_c' : corrected continuous operating voltage [5] = [1] × [3]

Sample	U_r'	Requested thermal charge transfer, Q_{rs}	Requested Q_{rs} per impulse
No.	kV	C	C
OD1	5,902	1,1	0,55 (±10%)
OD2	5,837		0,55 (±10%)
OD3	5,816		0,55 (±10%)

Operating duty test.

Application of the lightning current impulses 8/20 µs, corrected rated voltage U_r' and corrected continuous operating U_c' for evaluation of the thermal stability.

Test circuit: A0123-A0020-A0131

Sample No.: OD1

Ambient temperature: 23 °C
Preheating temperature: 66 °C

Date: October 4, 2017

Lightning current impulses 8/20 µs application

Oscillogram	Impulse	Charging voltage	Residual voltage	Discharge current	Q_{ls}	Applicable range for Q_{ls}
No.	No.	kV	kV	kA	C	C
10	1	61,0 x 2	---	38,70	0,55	0,495÷0,605
11	2	61,0 x 2	---	38,60	0,55	0,495÷0,605

Current impulse waveshape
(µs)
8,7 /18,2

Corrected rated voltage U_r' application

Oscillogram	Time	U_r'	Current	Current
No.	s	kV	+ mA_w	- mA_w
12	0	5,902	66,0	110,0
13	10		26,0	52,0

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram	Time	U_c'	Current	Current	Power	Temperature
No.	min	kV	+ mA_w	- mA_w	W	°C
14	0	4,718	1,08	1,60	2,10	---
	5		0,97	0,97	1,00	---
	10		0,95	0,95	0,88	---
15	15		0,94	0,94	0,82	---
	20		0,94	0,93	0,74	---
	25		0,93	0,92	0,69	---
16	30		0,91	0,91	0,65	---

continued

Note :

Continued

Sample No.: OD2

Ambient temperature: 23 °C
Preheating temperature: 66 °C

Date: October 4, 2017

Lightning current impulses 8/20 µs application

Oscillogram	Impulse	Charging voltage	Residual voltage	Discharge current	Q_{ls}	Applicable range for Q_{ls}
No.	No.	kV	kV	kA	C	C
17	1	61,0 x 2	---	38,55	0,55	0,495÷0,605
18	2	61,0 x 2	---	38,50	0,55	0,495÷0,605

Current impulse waveshape
µs
8,7/18,2

Corrected rated voltage U_r' application

Oscillogram	Time	U_r'	Current	Current
No.	s	kV	+ mA_w	- mA_w
19	0	5,837	66,0	109,0
20	10		25,0	49,0

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram	Time	U_c'	Current	Current	Power	Temperature
No.	min	kV	+ mA_w	- mA_w	W	°C
21	0	4,667	1,08	1,52	2,02	---
	5		1,07	1,04	1,10	---
	10		0,89	0,98	0,99	---
22	15		0,96	0,96	0,88	---
	20		0,94	0,94	0,77	---
	25		0,93	0,93	0,73	---
23	30		0,92	0,92	0,67	---

Note :

continued

Continued

Sample No.: OD3

Ambient temperature: 23 °C
Preheating temperature: 66 °C

Date: October 4, 2017

Lightning current impulses 8/20 µs application

Oscillogram	Impulse	Charging voltage	Residual voltage	Discharge current	Q_{ls}	Applicable range for Q_{ls}
No.	No.	kV	kV	kA	C	C
24	1	61,0 x 2	---	38,25	0,55	0,495÷0,605
25	2	61,5 x 2	---	38,50	0,55	0,495÷0,605

Current impulse waveshape
µs
8,7/18,2

Corrected rated voltage U_r' application

Oscillogram	Time	U_r'	Current	Current
No.	s	kV	+ mA_w	- mA_w
26	0	5,816	67,0	11,0
27	10		30,0	60,0

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram	Time	U_c'	Current	Current	Power	Temperature
No.	min	kV	+ mA_w	- mA_w	W	°C
28	0	4,649	1,08	1,65	2,05	---
	5		1,07	1,00	0,97	---
	10		0,85	0,92	0,85	---
29	15		0,95	0,96	0,80	---
	20		0,94	0,95	0,73	---
	25		0,93	0,94	0,68	---
30	30		0,92	0,91	0,60	---

Note :

Operating duty test.

Lightning impulse residual voltage measurement after the test

Test circuit: A0120

Date: October 4, 2017

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual Voltage
No.	kA	kV	No.	µs	kA	kV
OD1	10	24,6	31	8,6/18,3	10,12	14,50
OD2	10	24,6	32		10,17	14,34
OD3	10	24,6	33		10,18	14,25

Notes:

Operating duty test.

Additional two lightning impulses residual voltage measurement for check no damage occurred during the test

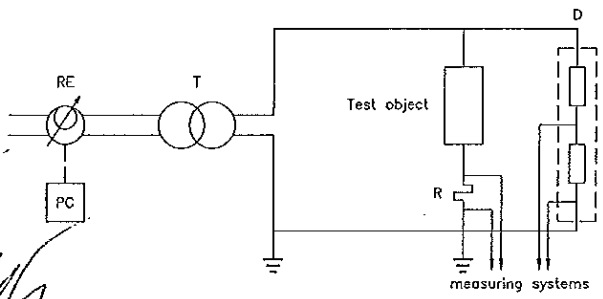
Test circuit: A0120

Date: October 4, 2017

Sample	Requested current	Charging voltage	Oscillogram	Correct waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
OD1	I_n	24,5	34	8,6/18,3	9,96	14,46
		24,5	35		9,95	14,47
OD2		24,5	36		10,10	14,31
		24,5	37		10,05	14,36
OD3		24,5	38		10,18	14,25
		24,5	39		10,13	14,27

Notes:

Circuit A0019



Power frequency supply

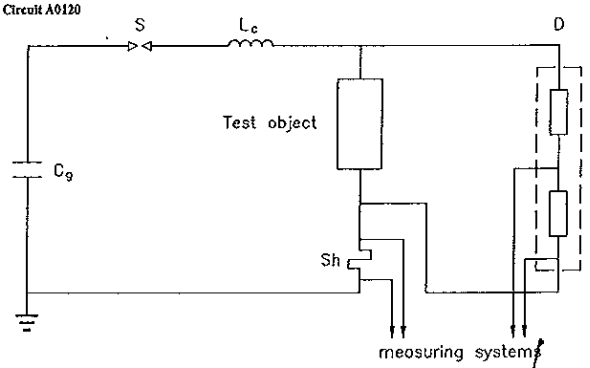
RE - programmable supply type PACIFIC A.C. Power Source 140 ASX ; CESI no. 0560408
PC - personal computer
T - voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200 V/15-30 kV

Current measuring system
R - Current shunt CESI No.31120; R= 940,5 Ω
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

Voltage measuring system
D - Voltage divider SAGI; CESI No.11120
- Electro optical system type HBM CESI No. 57986(Rx) – 57991 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.2)

SOFTWARE SYSTEM:
SW - S.A.D. Surge arrester version 2.0

Circuit A0120



Impulse generator

No. of stages 1
Cg 6,64 µF
Lc 6 µH

S - Spark-gap

Voltage measuring system
D - Voltage divider SAGI; CESI No.11120
- Electro optical system type HBM CESI No. 57986(Rx) – 57991 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.2)

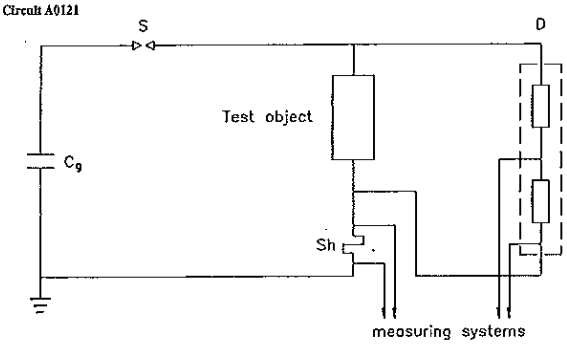
Current measuring system
Sh - Current shunt CESI No.5042; R= 2 mΩ; max current= 150 kA
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5152;
- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:
SW - S.A.D. Surge arrester version 2.0

ОРИГИНАЛ

245

Circuit A0121



Impulse generator

No. of stages 2
Cg 2,91 µF

S - Spark-gap

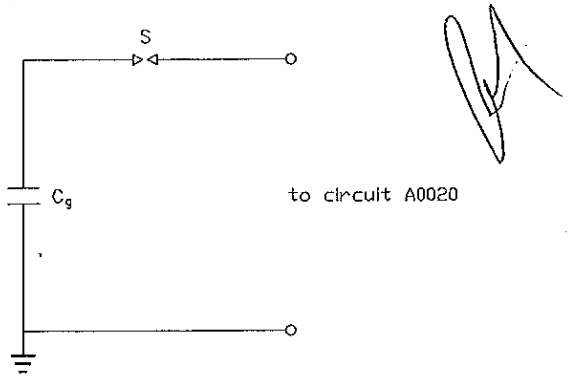
Two blocks in series have been added
Voltage measuring system(not used)
D - Voltage divider SAGI; CESI No.11120
- Electro optical system HBM CESI No. 57986(Rx) – 57991 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.2)

Current measuring system
Sh - Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:
SW - S.A.D. Surge arrester version 2.0

A012103

Circuit A0123



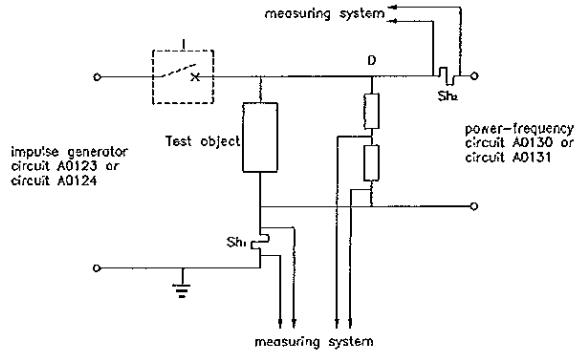
Impulse generator circuit for injection of Q_a

No. of stages 2
Cg 2,91 µF
Lc 12 µH

S - spark-gap

A012103

Circuit A0020



Impulse generator circuit A0123

Impulsive current measuring system
Sh_2 - Current shunt CESI No.6042; R= 2 m Ω
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)
$OSC_{2.2}$ - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.2)
I - Circuit-breaker

Power frequency circuit A0131

Voltage measuring system.
D - Voltage divider SAGI; CESI No.11120
- Electro optical system HBM CESI No. 57986(Rx) – 57991 (Tx)
$OSC_{2.3}$ - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.2)

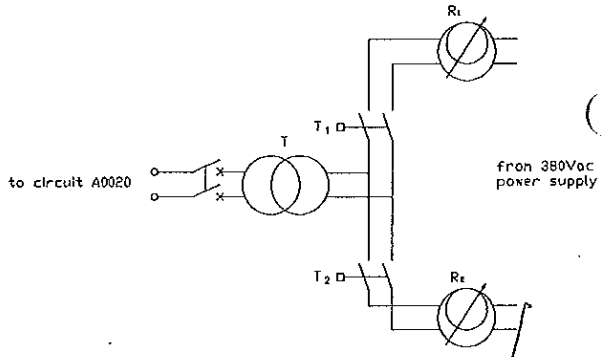
Current measuring system
Sh_2 (TOV - MCOV) - Current shunt type CESI n. 058315 R= 500 Ω
- Electro optical system CESI No. 57986(Rx) – 58294 (Tx)
$OSC_{2.3}$ - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:
SW - S.A.D. Surge arrester version 2.0

A002203

ВЯРНО С ОРИГИНАЛА
A117630

Circuit A0131

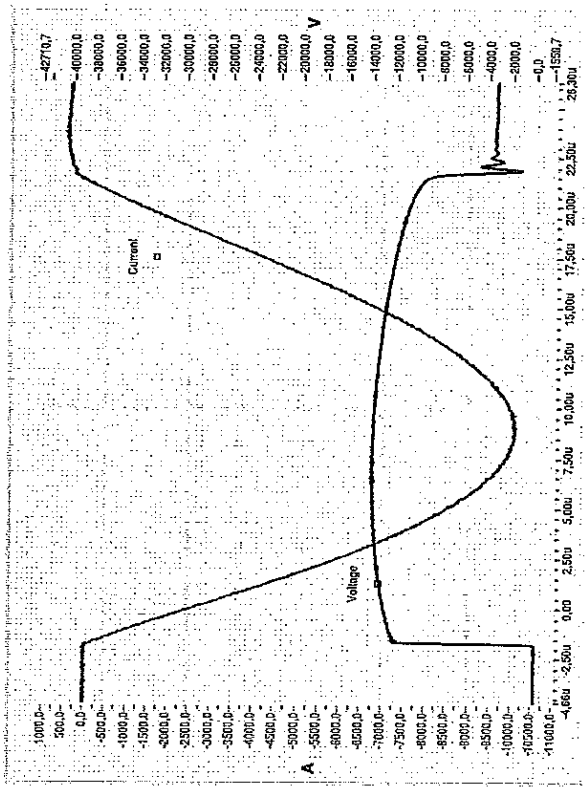


Power-frequency circuit

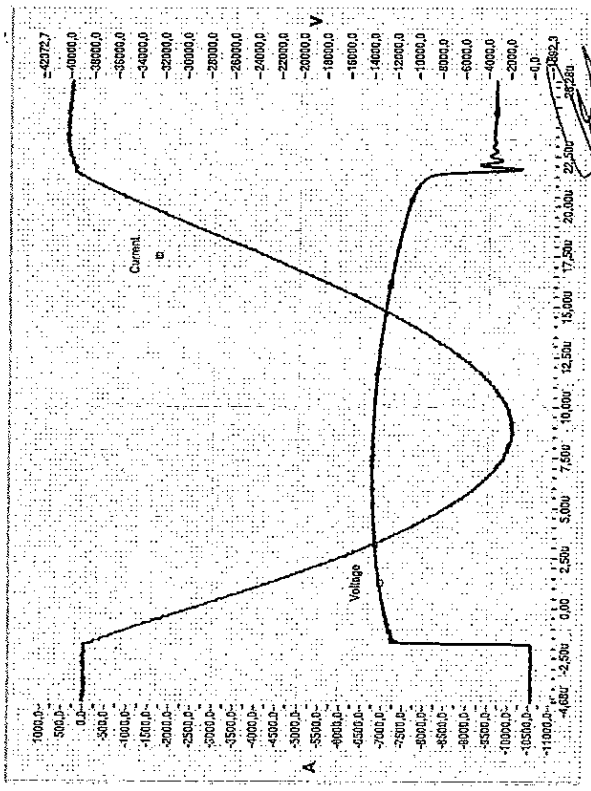
from 380Vac power supply
R_1 single-phase voltage regulator CORMES; power 20 kVA; voltage 380/04220 Vac
R_2 single-phase voltage regulator CORMES; power 10 kVA; voltage 380/04220 Vac
T_1 voltage transformer type SPECIAL TRASFO; power 30 kVA; voltage 200-400 V/15-30 kV

"ЕЛМА ЕЛЕКТРОНИК" ЕООД

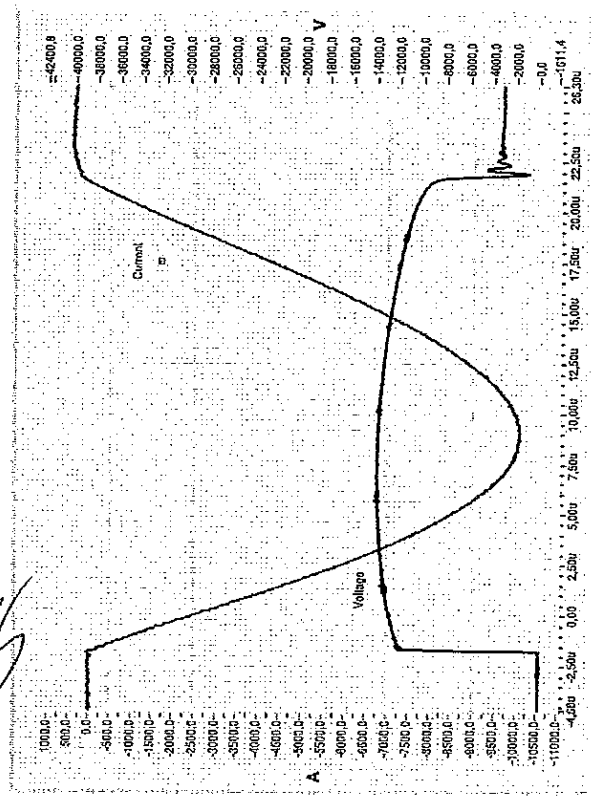
A117630



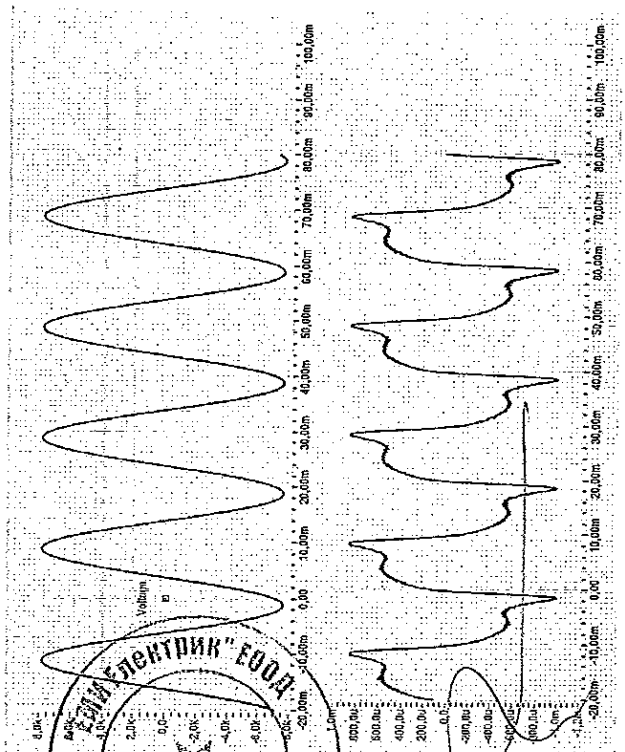
CESI B7019962 Oscillogram n. 1



CESI B7019962 Oscillogram n. 2



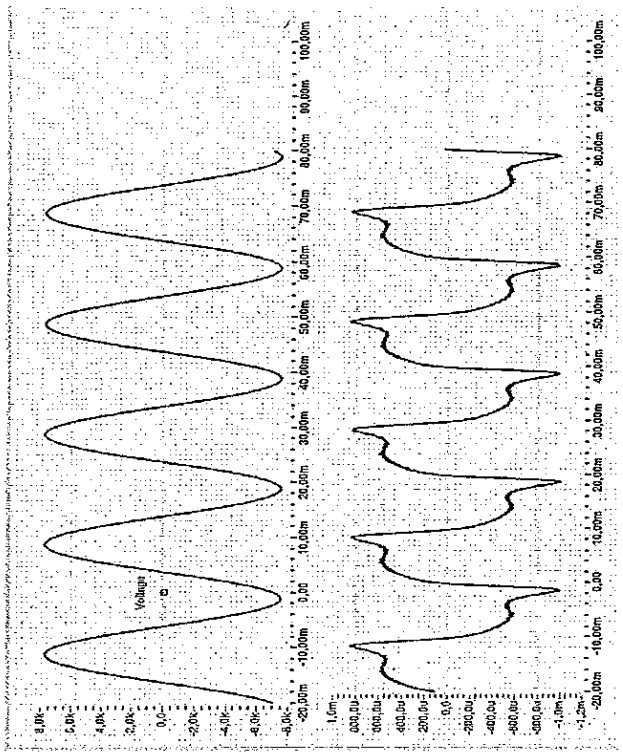
CESI B7019962 Oscillogram n. 3



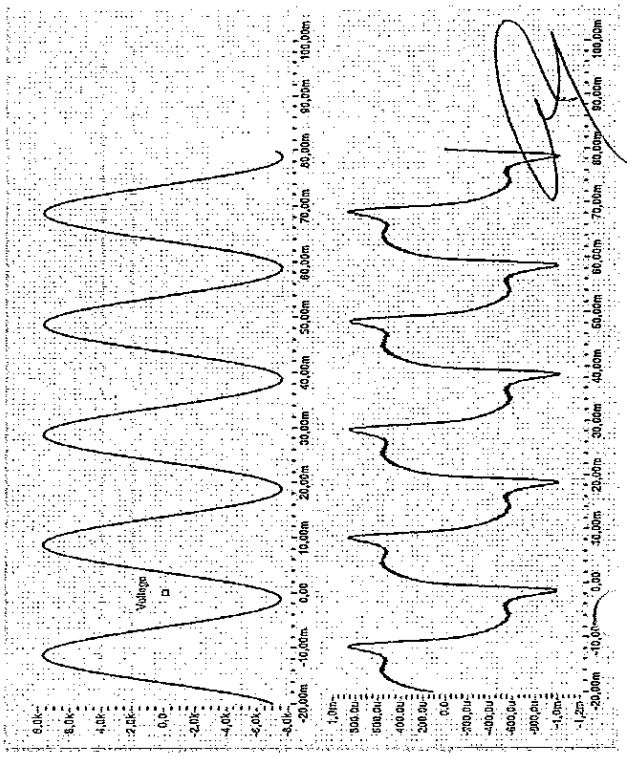
CESI B7019962 Oscillogram n. 4

ВЯРНО С ОРИГИНАЛА

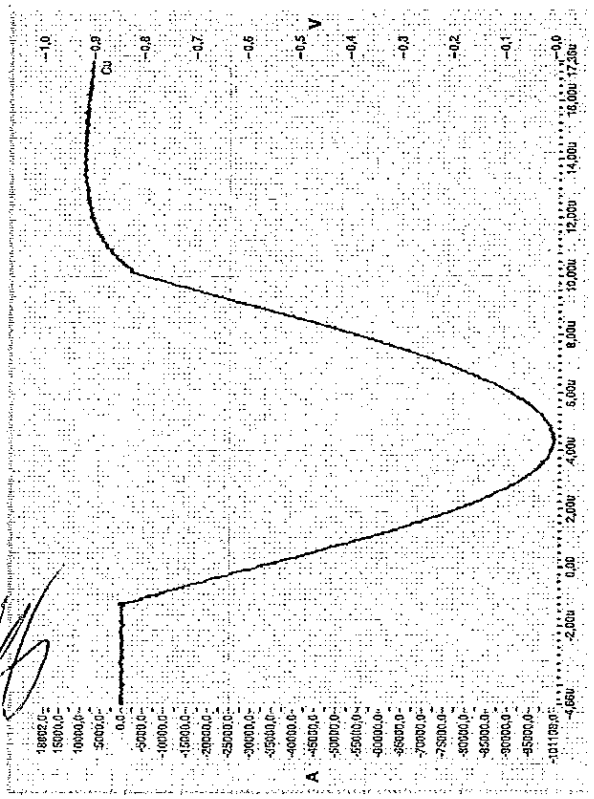
247



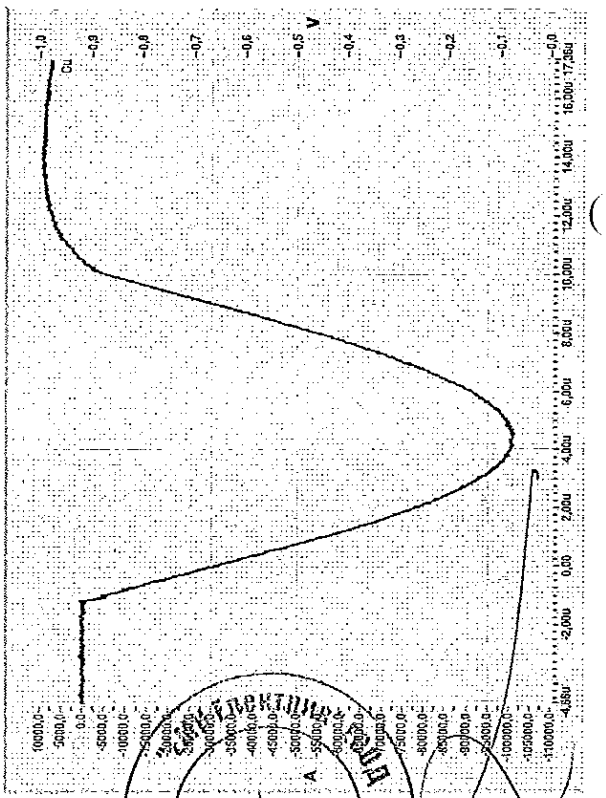
CESI B7019962 Oscillogram n. 5



CESI B7019962 Oscillogram n. 6



CESI B7019962 Oscillogram n. 7

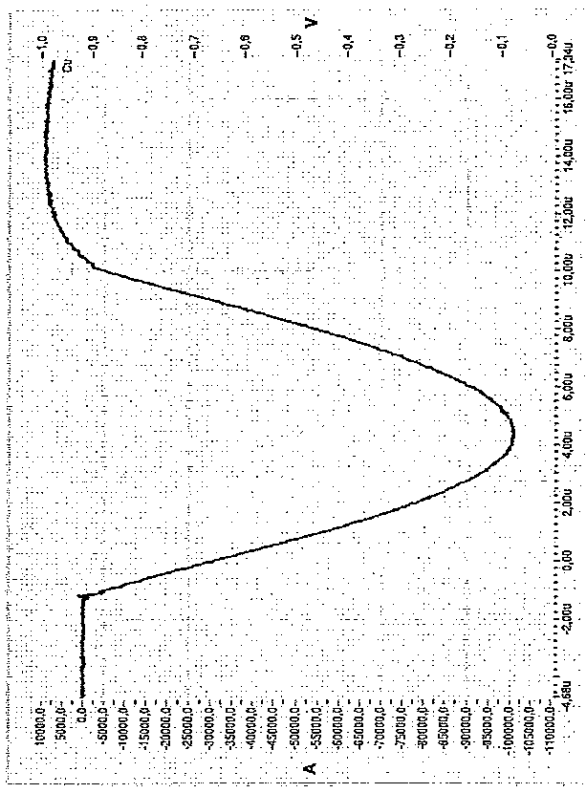


CESI B7019962 Oscillogram n. 8

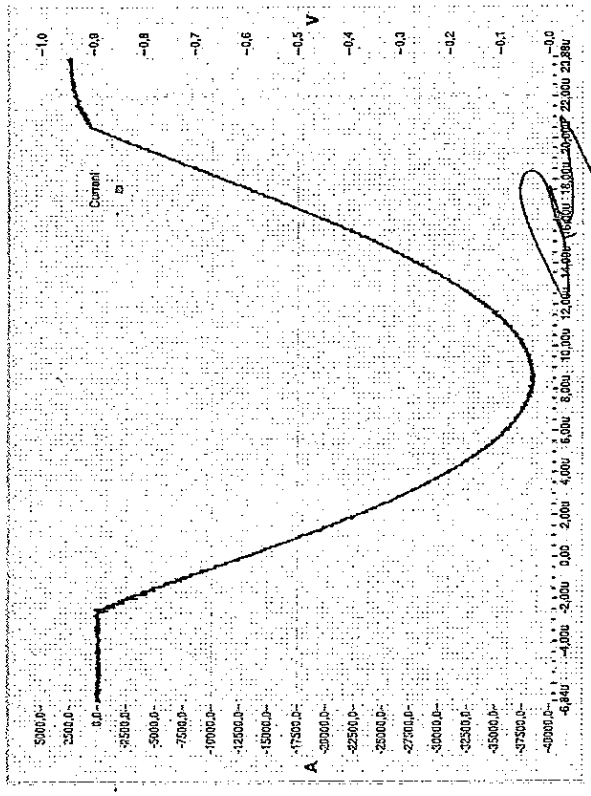
ВЯРНО С ОРИГИНАЛА

"ЕМ Електрик" ЕООД

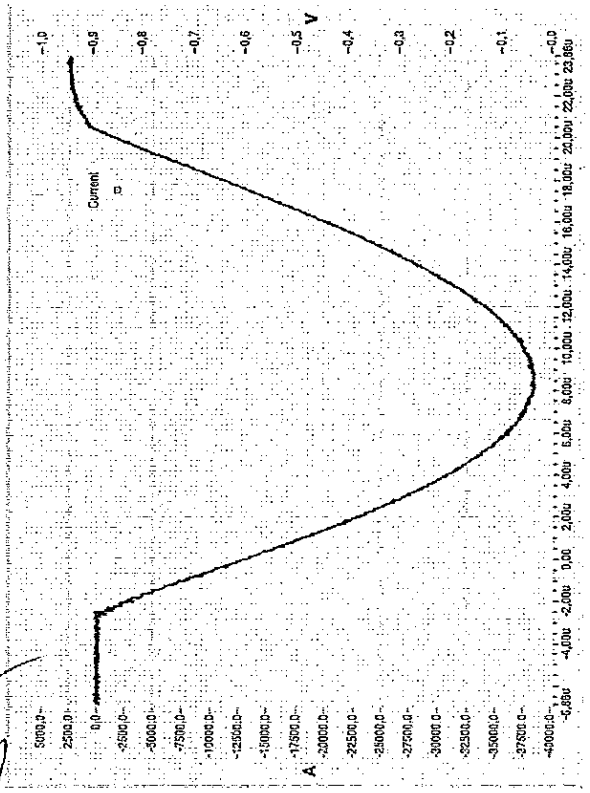
110



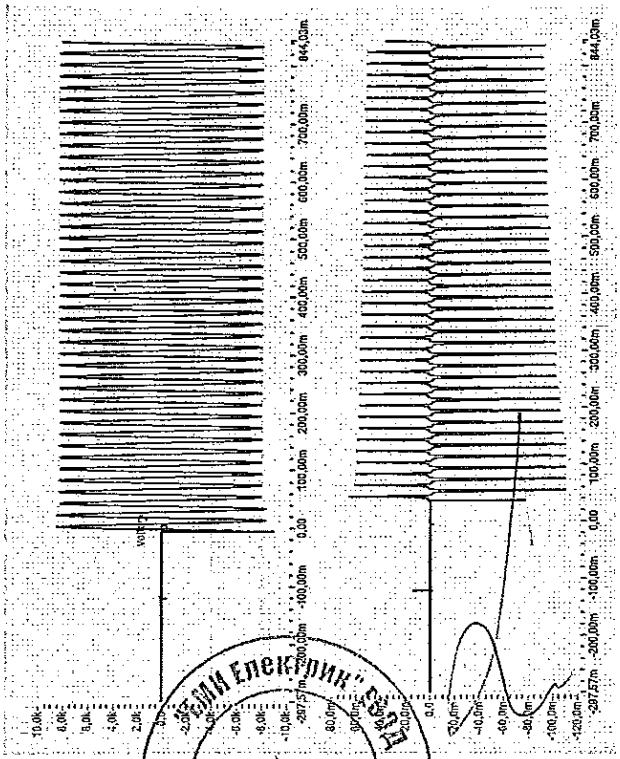
CESI B7019962 Oscillogramm n. 9



CESI B7019962 Oscillogramm n. 10



CESI B7019962 Oscillogramm n. 11



CESI B7019962 Oscillogramm n. 12

ВЯРНО С ОРИГИНАЛА

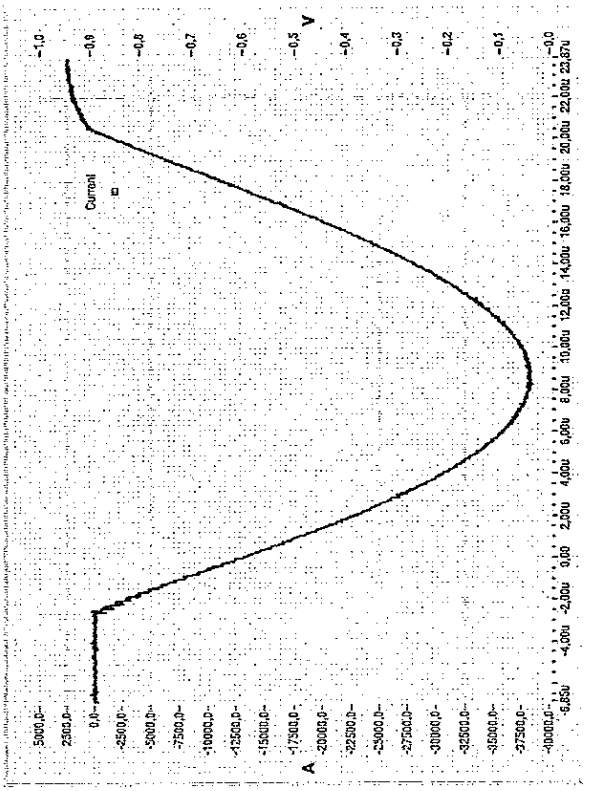
2 из 9

CESI B7015962 Oscillogram n. 13

CESI B7015962 Oscillogram n. 14

CESI B7015962 Oscillogram n. 15

CESI B7015962 Oscillogram n. 16



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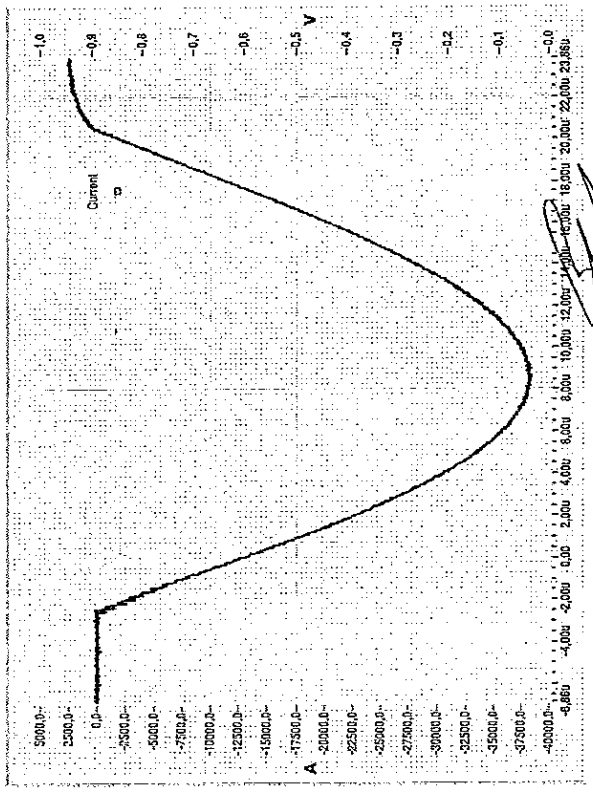
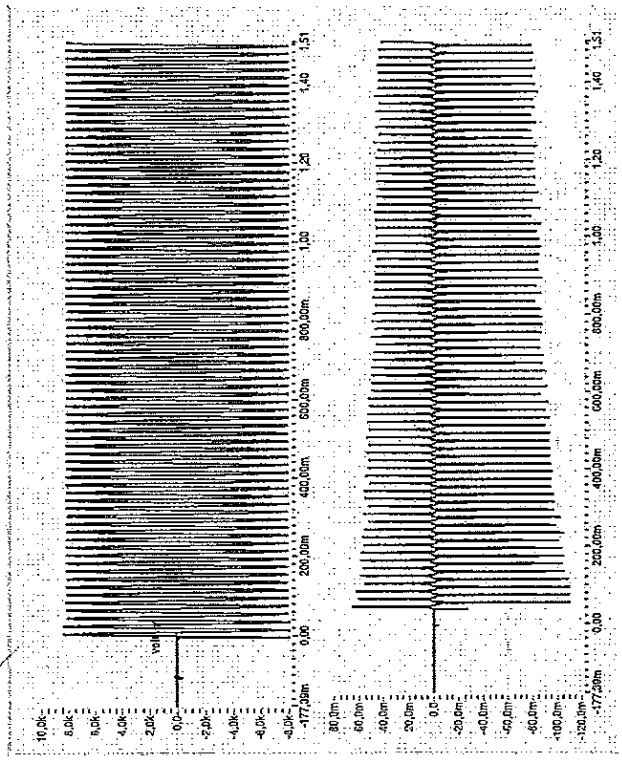


CESI B7019962 Oscillogram n. 18



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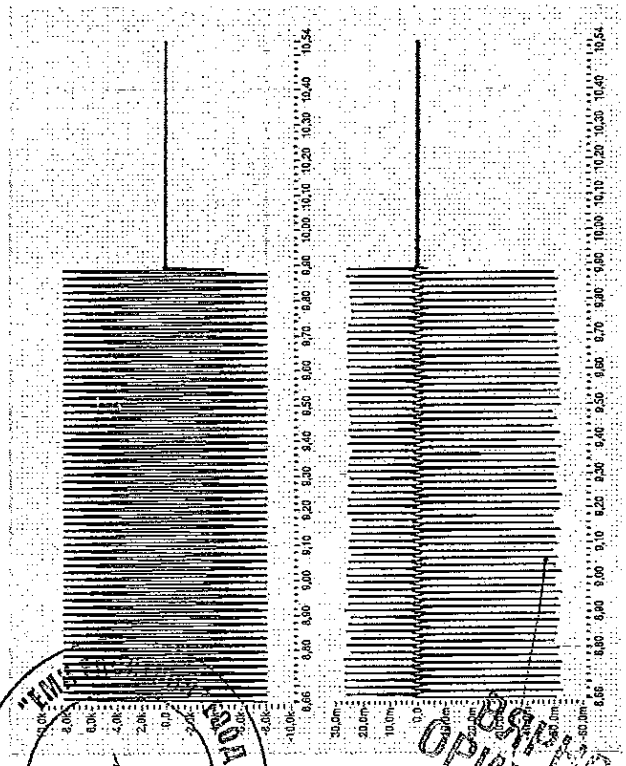
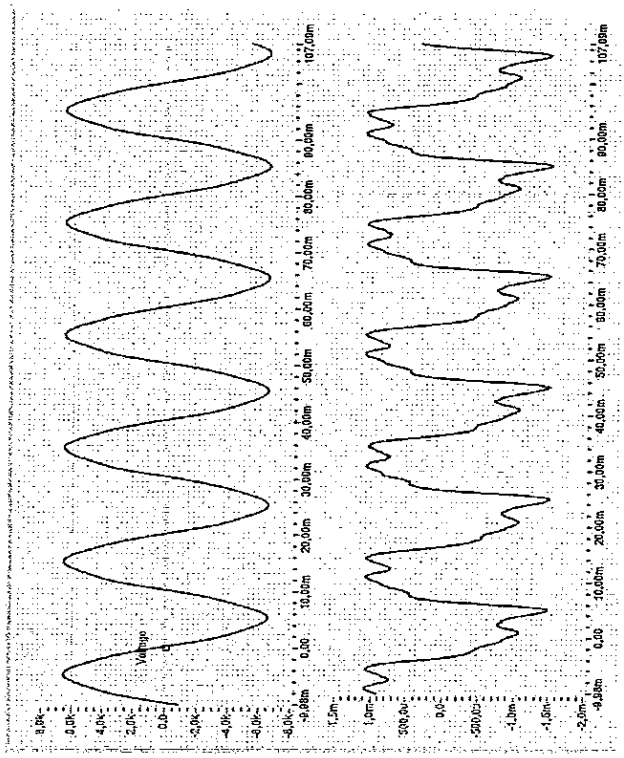


CESI B7019962 Oscillogram n. 20

251



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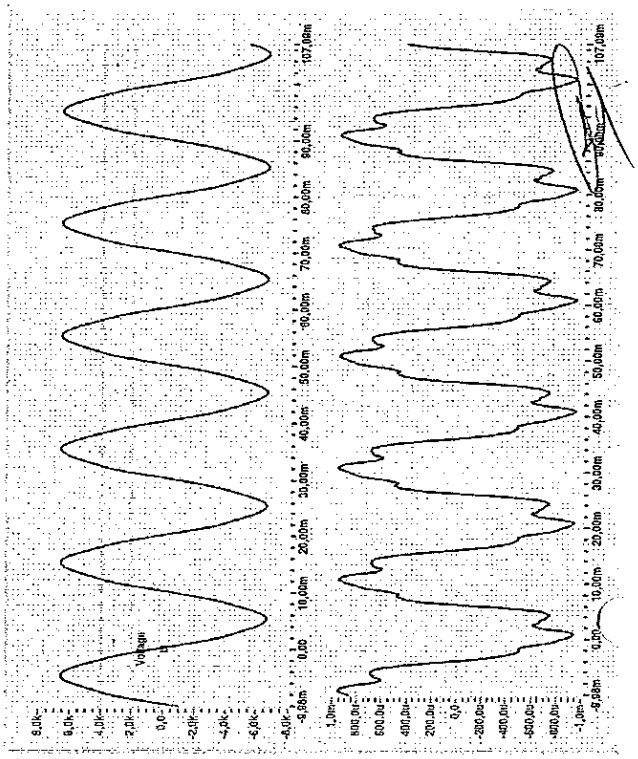

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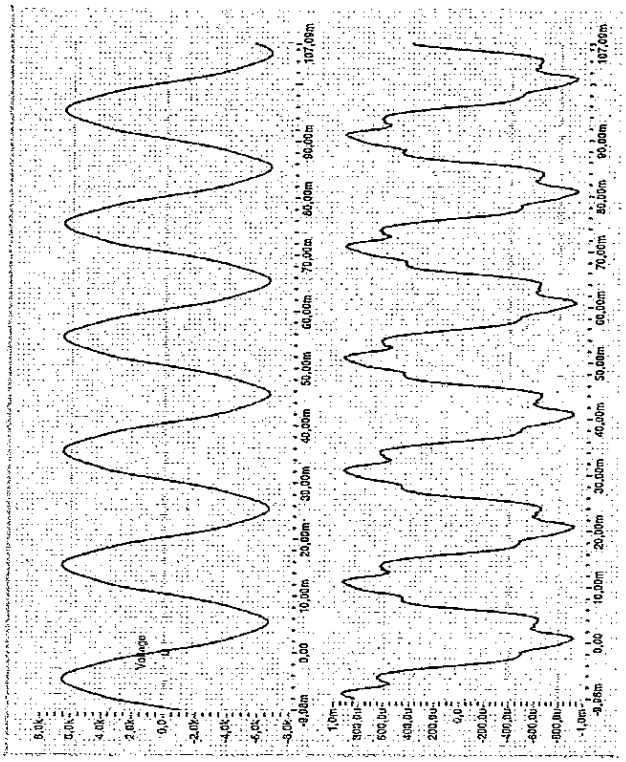

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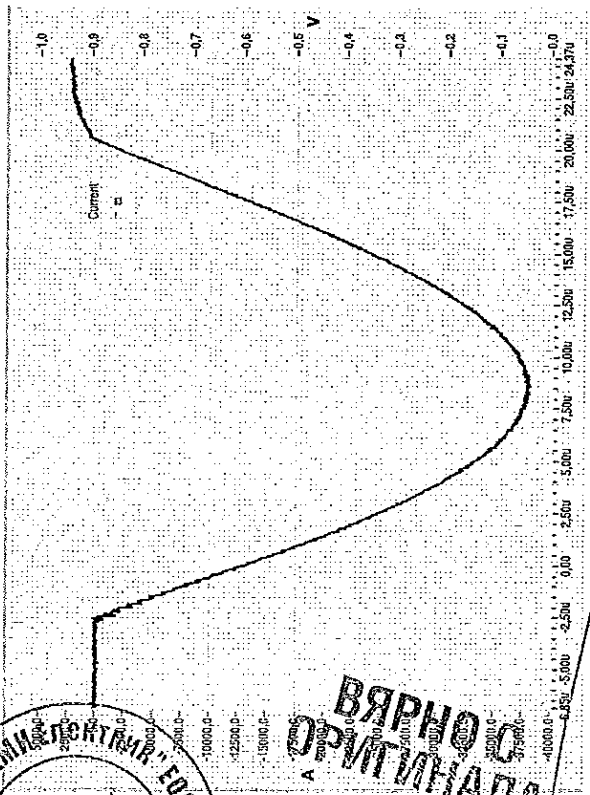
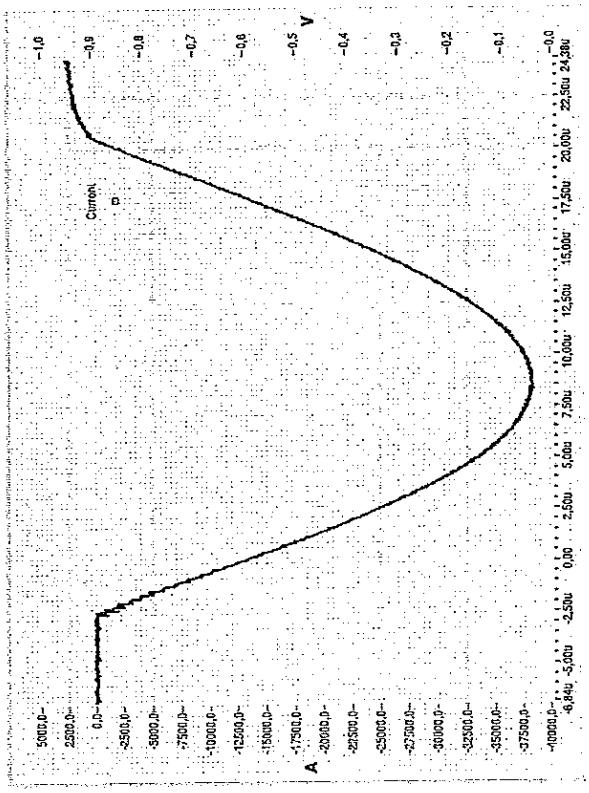


CESI B7019962 Oscillogram n. 24

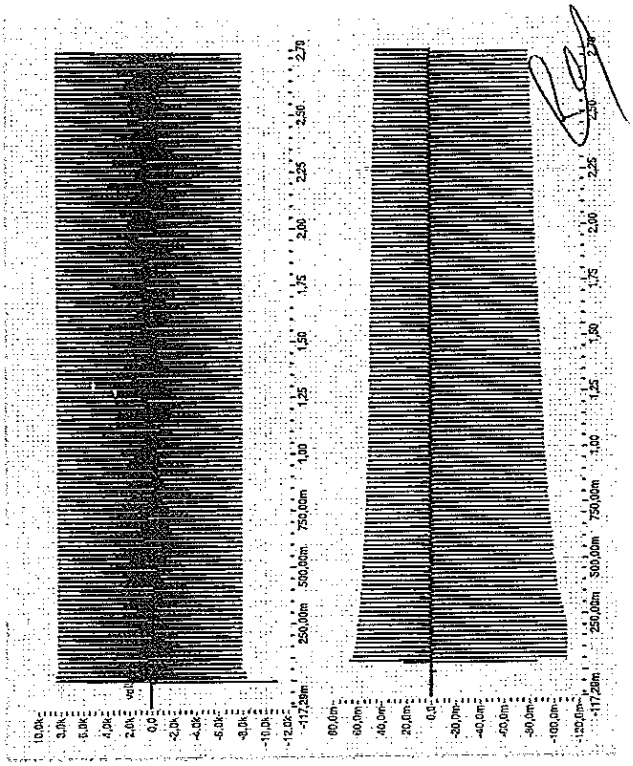
ВЯРНО С ОРИГИНАЛА

"ЕМИЛ ЕЛЕКТРИК" ЕООД

252



CESI B7015962 Oscillogramm n. 25



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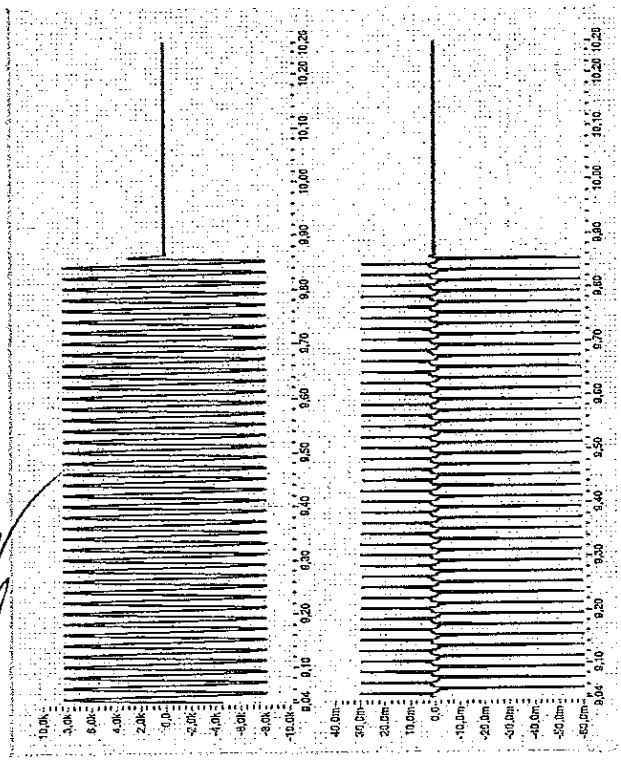
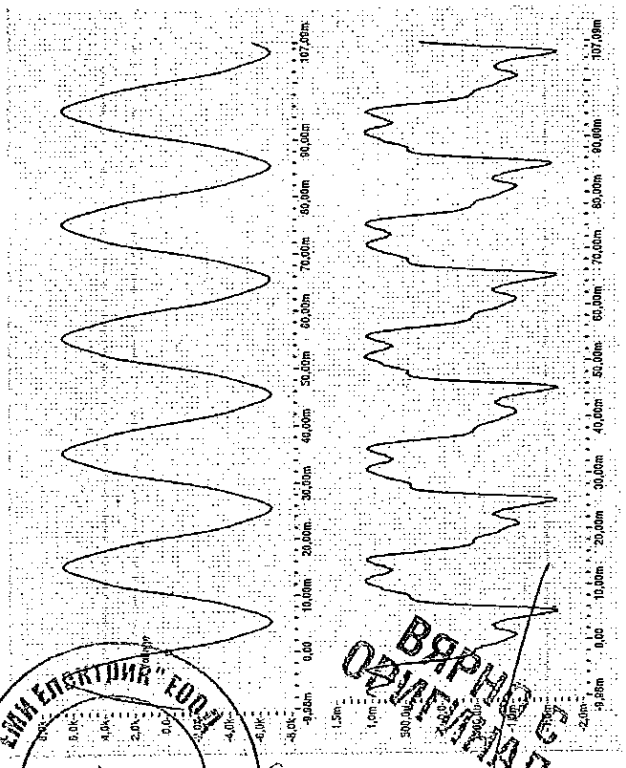
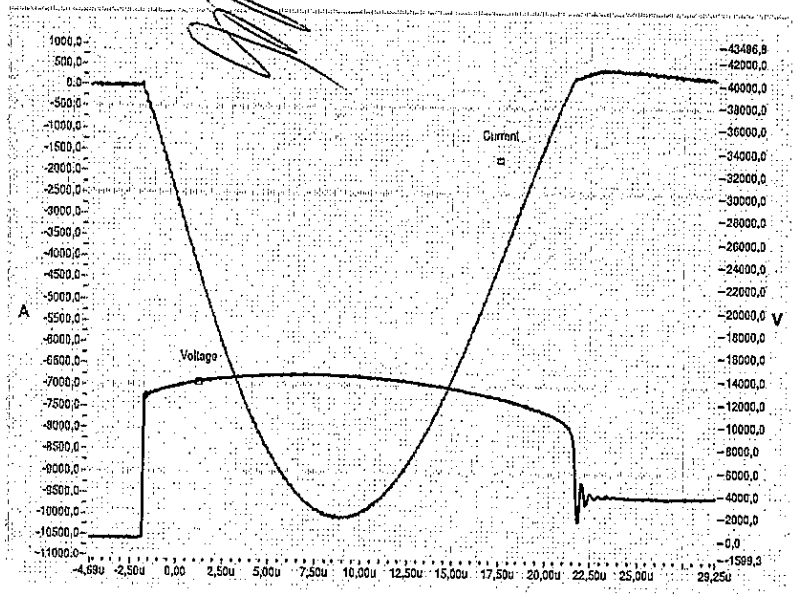


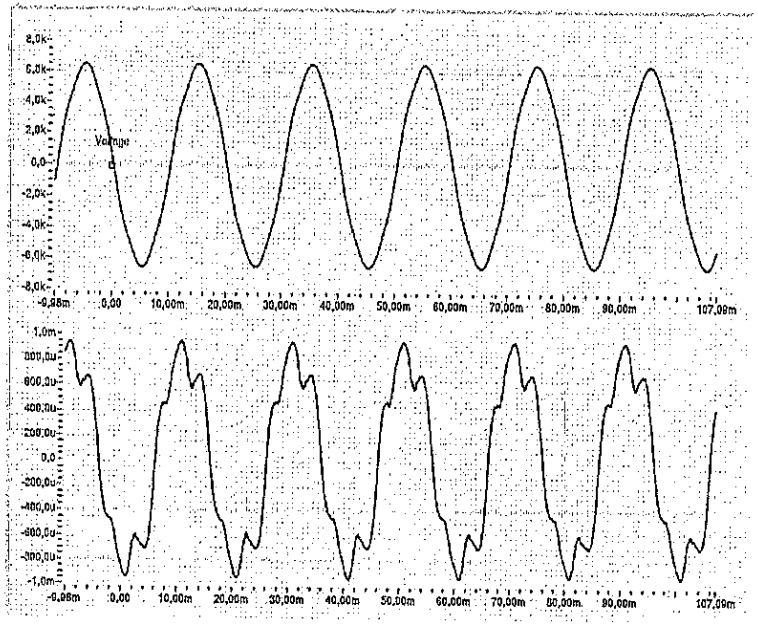
CESI B7015962 Oscillogramm n. 27



CESI B7015962 Oscillogramm n. 28



CESI B7619962 Oscillogramm n. 31



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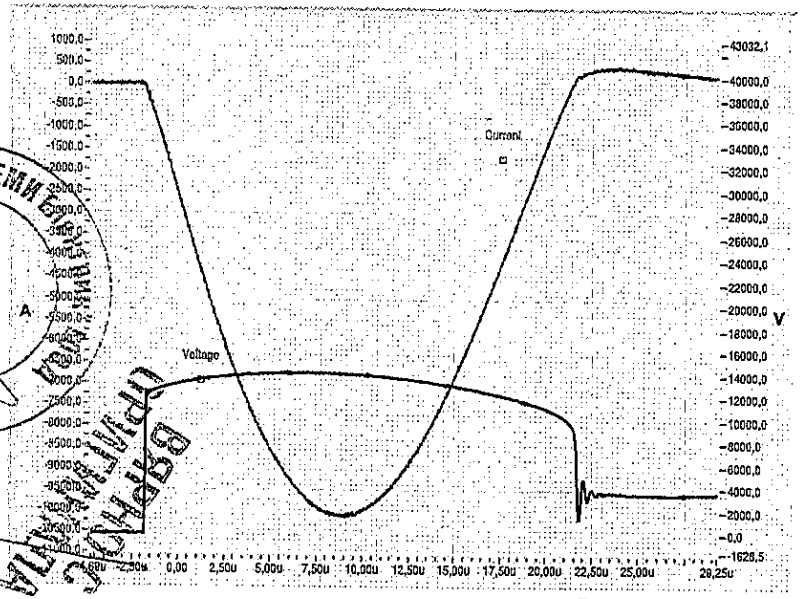
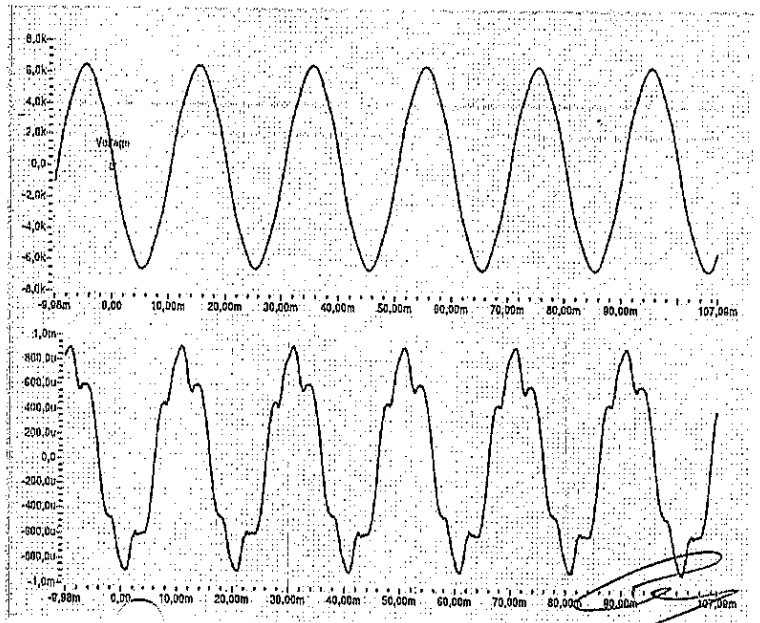
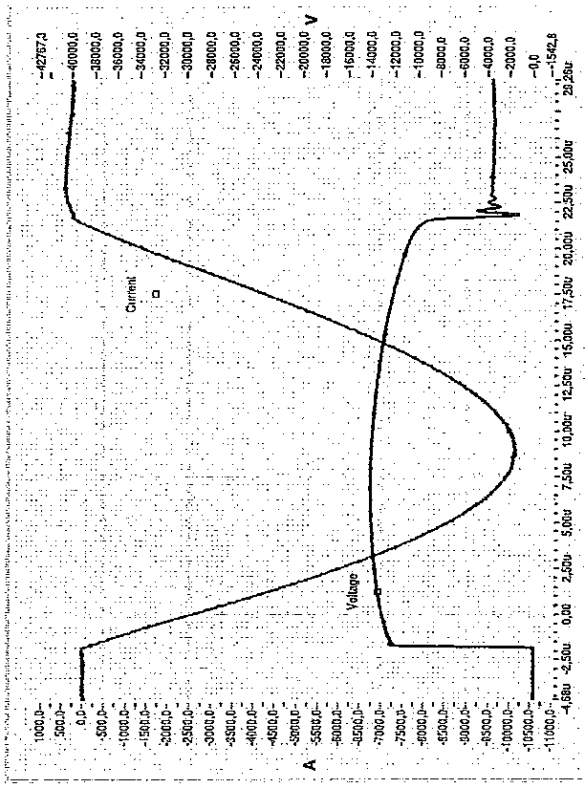


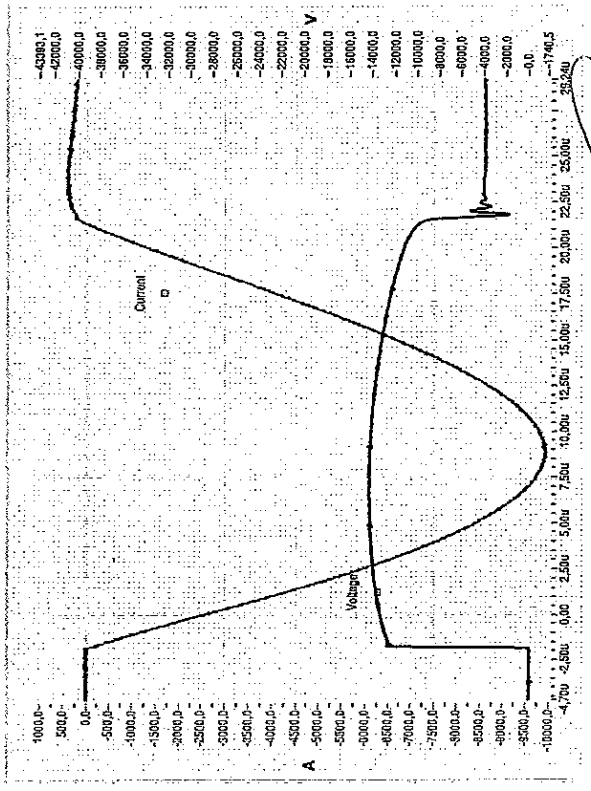
CESI B7619962 Oscillogramm n. 32



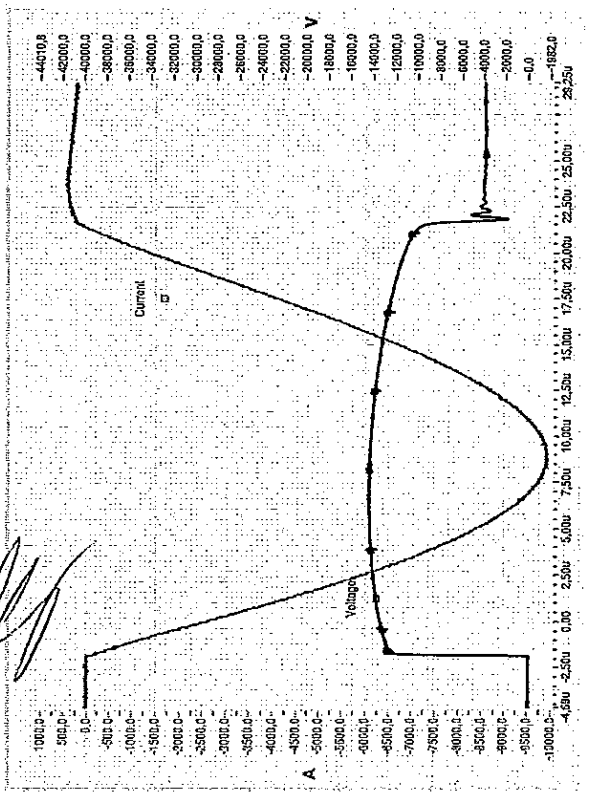
CESI B7619962 Oscillogramm n. 30



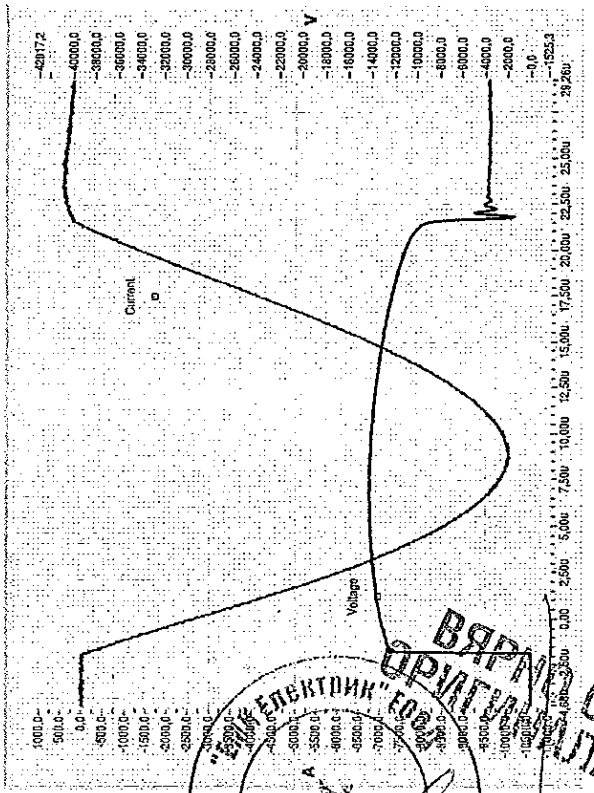
CESI B7019962 Oscillogramm n. 33



CESI B7019962 Oscillogramm n. 34



CESI B7019962 Oscillogramm n. 35



CESI B7019962 Oscillogramm n. 36

ВЯРНО С ОРИГИНАЛА

"ЕМИ ЕЛЕКТРОНИК" ЕООД

"EMI ELECTRONIC" LTD

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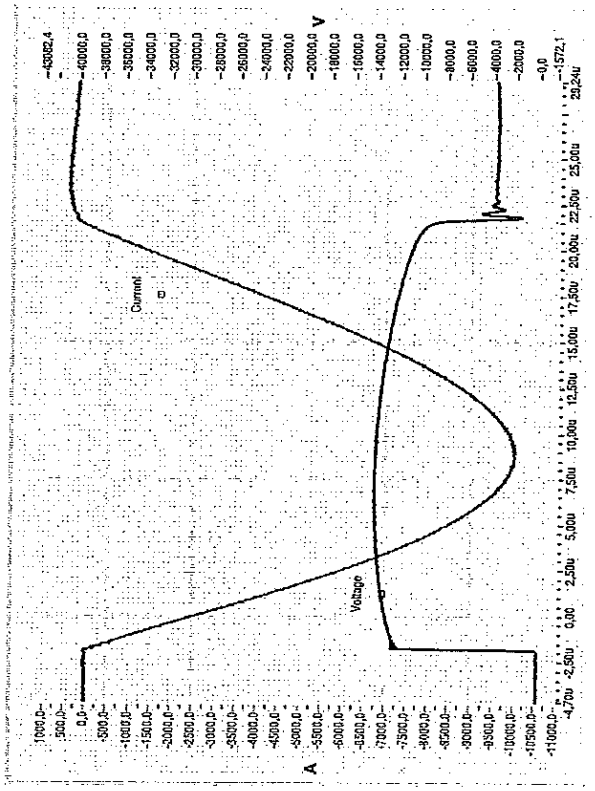
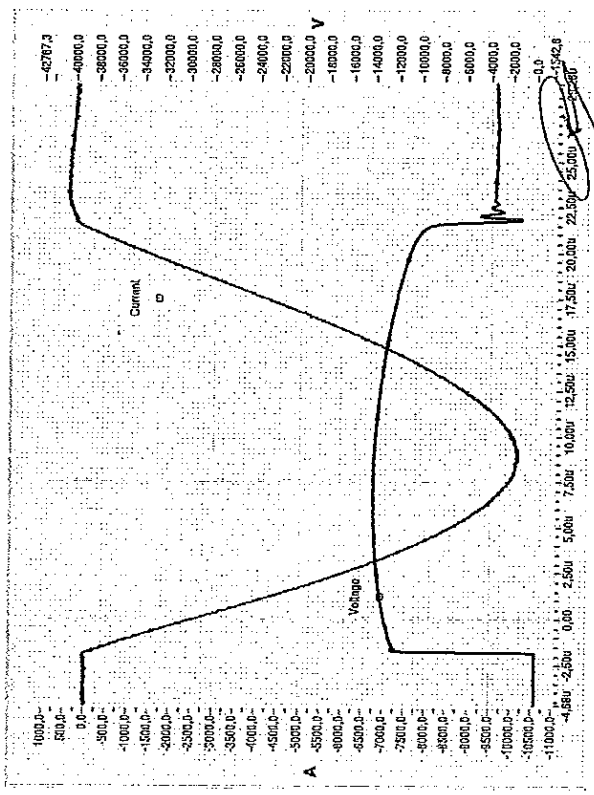
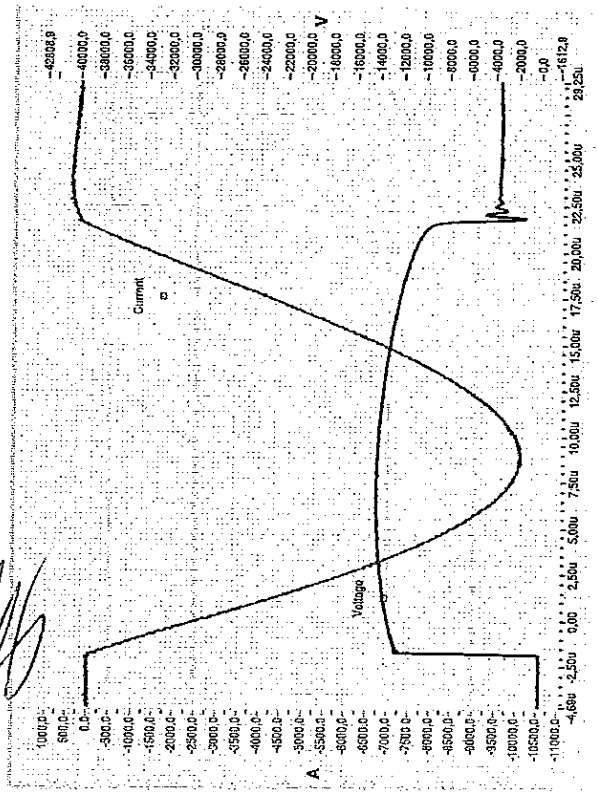


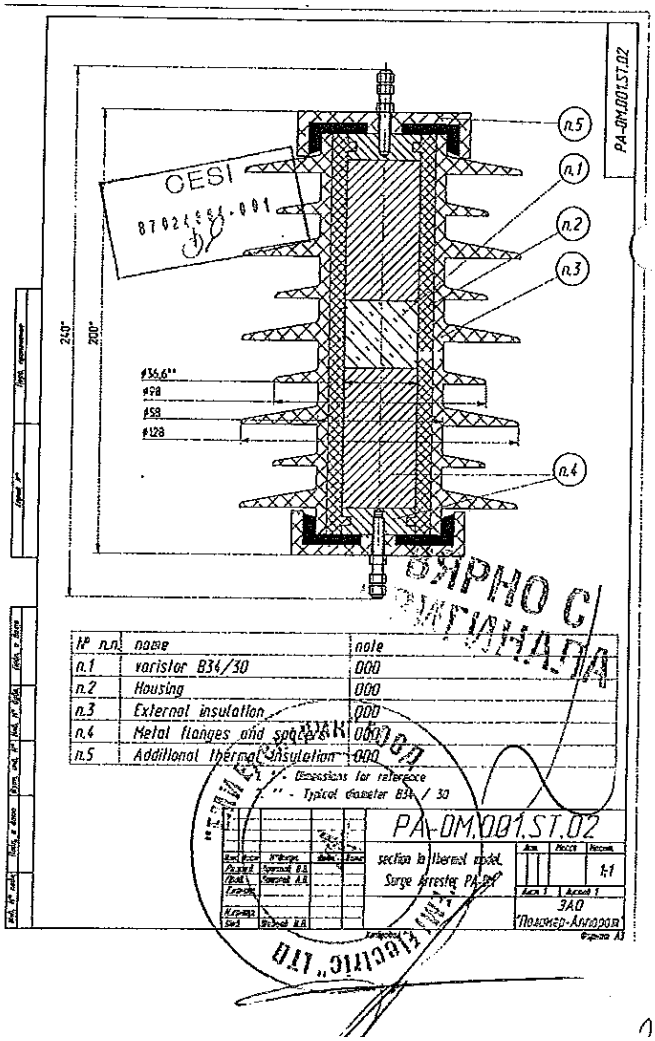
CESI B7019962 Oscillogram n. 37



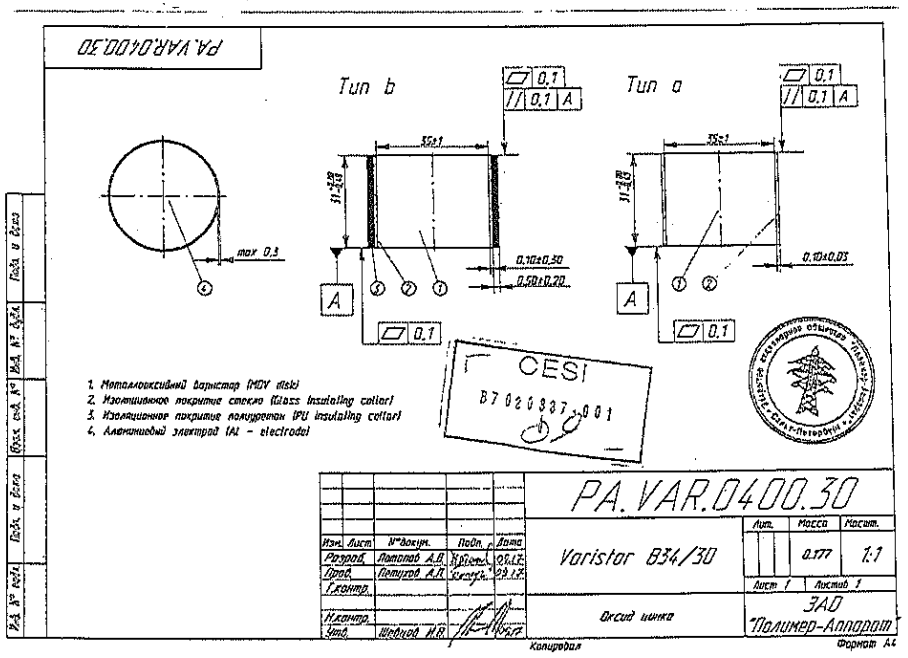
CESI B7019962 Oscillogram n. 38



CESI B7019962 Oscillogram n. 39



156



Test Report

Document No.	B7020147 Copy No. 1 Number of pages 96
Apparatus	Polymer-housed surge arrester section type PA-DM section ST with additional thermal insulation
Designation	—
Serial Number	—
Manufacturer	Joint-Stock Company " Polymer-Apparat"
Client	Joint-Stock Company " Polymer-Apparat" Ak. Kostantinova str., 1 195427 Saint-Petersburg - Russia Federation
Tested for	—
Date(s) of tests	October 4 – December 4, 2017
Tested by	CESI S.p.A. Via Rubattino, 54 20134 Milano - Italy
Test performed	Power-frequency voltage-versus-time

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this document has been subjected to the series of proving tests in accordance with:
IEC 60099-4 – Edition 3.0 (2014-06)

The results are shown in the record of proving test, and the oscillograms attached hereto. The ratings assigned by the manufacturer are listed on the nameplate.
The decision applies only to the apparatus tested. The responsibility for conformity of any apparatus having the same designation with the one tested rests with the manufacturer.

December 12, 2017

Date	Gerardi Marco Test Engineer in charge	The Manager - Andrea Lucarelli Approved By Document Digitally Signed

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CESI

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Notes

STL-Member

CESI Group members are founder members of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in 1959. STL is a forum for voluntary international cooperation of testing organizations.

CESI Group Test Documents description

Type Test Certificate of .....

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

Test Certificate of (complete / selected) Type Tests

Issued if type tests of low voltage products (< 1 $kV_{r.m.s}$; < 1,5 $kV_{d.c.}$) requested by the relevant product standard were passed. For these tests the equipment under test must be clearly identified by technical description, drawings, and additional specifications.

Certificate of Design Verification

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

Type Test Report

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

Test Report

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

On-Site Test Record

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

Test Award

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

Tests witnessed by:
— —

Identification of the object: Effected

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings.
CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.
These drawing, identified by CESI and numbered B7024364 No. 1, is annexed to this document.

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

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

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

- Voltage a.c.	± 3,0 %
- Residual peak voltage (impulse tests)	± 3,0 %
- Current a.c.	± 3,0 %
- Peak current (impulse tests)	± 3,0 %
- Time (impulse tests)	± 10,0 %
- Time (a.c. test)	± 1,5 %

Laboratory Information

Receipt date of the sample	September 2017
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr L. Podavitte
Test laboratory	P177
ODL SAP	70006781

A10CI10 rev.2

Page annexed:
Outline drawing – no. 1 page — CESI no. B7024364 – n.1 page
Short drawing (MO resistor) – CESI no. B7024367 – n.1 page
Technical document (TOV curve) CESI No. B7020147 – n.1 page

Test Report CESI

Test object characteristics (assigned by the client)

Manufacturer's name	Joint-Stock Company " Polymer-Apparat"
Polymer-housed surge arrester section type	PA-DM section ST
Drawing code	PA-DM.001.ST.02
MO-resistor supplier's	Joint-Stock Company " Polymer-Apparat"
Metal-oxide resistor type	B34/30
Arrester class	Distribution
Designation	DH
Number of MO resistor fitted	1
Nominal discharge current - [kA]	10
Rated voltage - U_r [kV]	1,077 x U_{ac}
Continuous operating voltage - U_c [kV]	0,861 x U_{ac}
Repetitive charge transfer rating – Q_s [C]	0,4
Rated thermal charge transfer rating - Q_{th} [C]	1,1
Flat surface area [cm^2]	10,52
Reference current - I_{ref} [mA]	1,0
Rated frequency - [Hz]	48÷62
Year of manufacture	08/2017

geometrical characteristics measured on the MO resistor

Total height [mm]	31,1 mm
Diameter [mm]	35,6 mm

Photographs of the test object

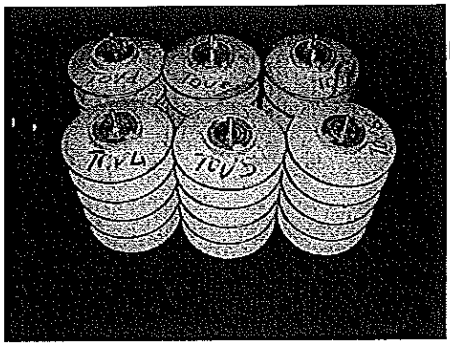


Photo no. 1

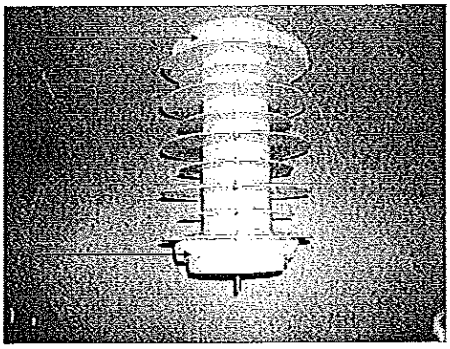


Photo no. 2

Polymer-housed surge arrester section type PA-DM section ST with additional thermal insulation

Reference Standard

IEC 60099-4 (2014/06) – Edition 3 - Clause 10.8.8.
"Metal-oxide surge arresters without gaps for a.c. system"

Test carried out	Number of sample tested
Power-frequency voltage-verses-time test	6

Test object identification

Test object name	Identification of test sample (given by CESI)	Identification of test sample (given by JSC "Polymer Apparat)
Polymer-housed surge arrester section type PA-DH section ST with additional thermal insulation	TOV1	00102
	TOV2	00103
	TOV3	00104
	TOV4	00005
	TOV5	00009
	TOV6	00010

Test procedure

The test procedure consisted of the following sequence:

1. Test performed on Polymer-housed metal-oxide surge arrester section in open air
Initial test
a) Measurement of the lightning impulse residual voltage at the nominal discharge current
b) Measurement of the power frequency reference voltage at the reference current

2. Test performed on Polymer-housed metal-oxide surge arrester section assembled in thermal model

Test with energy input (prior duty test)
c) The surge arrester sections were kept in an oven at the temperature of 65 °C (±) thermal equilibrium (not more than twenty hours)
d) Injection of two lightning current impulses 8/20 µs at the rated thermal charge transfer Q_{th}. A time shorter than 100 ms after the application of the second seceed lightning current impulses 8/20 µs energization at U_{TOV} (declared by the manufacturer) for a time t_{TOV} (declared by the manufacturer)and then at U_r for 30 min. to verify the thermal stability.

Note:
- Intervals between lightning duration current impulses: 60 seconds
- nominal test frequency : 50 Hz

Four samples were tested as specified below:

Sample	U_{TOV}	Duration	Note
TOV1	1,080 x U_r	1 sec	prior duty test
TOV2	1,040 x U_r	10 sec	
TOV3	1,000 x U_r	100 sec	
TOV4	0,960 x U_r	1000 sec	

Test without energy input (no-prior duty test)
e) The surge arrester sections were kept in an oven at the temperature of 65 °C (±) thermal equilibrium (not more than twenty hours)
f) Application of the overvoltage U_{TOV} (declared by the manufacturer) for a time t_{TOV} (declared by the manufacturer)and then at U_r for 30 min. to verify the thermal stability.

Note:
- nominal test frequency : 50 Hz

Two samples were tested as specified below:

Sample	U_{TOV}	Duration	Note
TOV5	1,130 x U_r	10 sec	no-prior duty test
TOV6	1,040 x U_r	1000 sec	

3. Test performed on Polymer-housed metal-oxide surge arrester section in open air
g) Measurement of the lightning impulse residual voltage at nominal discharge current for comparison with initial value
f) After that the sample has cooled to ambient temperature and two current impulses 8/20 at 0,5 kA each have been applied to check the integrity of the internal parts. The interval between impulses was 50-60 seconds.

Test result
The visual inspection of the sample after the test has revealed no signs 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%). During the two last impulses the oscillograms revealed any breakdown.
The thermal stability was achieved.

The acceptance criteria are fulfilled. The test result is positive.

Summary of test results

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	%
TOV1	10,15	14,04	10,18	14,26	+1,57
TOV2	10,10	14,06	10,14	14,24	+1,28
TOV3	10,07	14,16	10,10	14,38	+1,55
TOV4	10,15	14,30	10,07	14,35	+0,42
TOV5	10,14	14,17	10,04	14,00	+1,20
TOV6	10,08	14,35	10,05	14,25	-0,70

Power frequency voltage versus time test.

Lightning impulse residual voltage measurement before the test

Test circuit: A0120

Date: October 4, 2017

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual Voltage
No.		kV	No.	µs	kA	kV
TOV1	I_n	24,8	1	8,6/18,2	10,15	14,04
TOV2		24,8	2		10,10	14,06
TOV3		24,8	3		10,07	14,16
TOV4		24,8	4		10,15	14,30
TOV5		24,6	5		10,14	14,17
TOV6		24,6	6		10,08	14,35

Notes:

Power frequency voltage versus time test.

Reference voltage test.

Test circuit: A0019

Date: October 5, 2017

Sample No.TOV1						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
7	5,47	0,884	1,000	0,562	1,41	--

Sample No. TOV2						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
8	5,37	0,939	1,000	0,570	1,46	—

Sample No. TOV3						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
9	5,45	0,922	1,00	0,571	1,43	—

Sample No. TOV4						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
10	5,39	0,887	1,000	0,564	1,42	—

Sample No. TOV5						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
11	5,38	0,860	1,000	0,560	1,37	—

Sample No. TOV6						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
12	5,40	0,884	1,000	0,563	1,39	—

ВЯРНО С ОРИГИНАЛА

Power frequency voltage versus time test.

Voltage correction factor and thermal energy calculations

Date: October 5, 2017

Sample	U_{cr} [1]	KU_t [2]	KU_c [3]	U_t' [4]	U_c' [5]
No.	kV			kV	kV
TOV1	5,47	1,077	0,861	5,891	4,710
TOV2	5,37			5,783	4,624
TOV3	5,45			5,870	4,692
TOV4	5,39			5,805	4,641
TOV5	5,38			5,794	4,632
TOV6	5,40			5,816	4,694

[1] U_{cr} : measured reference voltage
[2] KU_t : maximum guaranteed factor for calculation of $U_t' = U_t/U_{cr\,max}$
[3] KU_c : maximum guaranteed factor for calculation of $U_c' = U_c/U_{cr\,max}$
[4] U_t' : corrected rated voltage [4] = [1] × [2]
[5] U_c' : corrected continuous operating voltage [5] = [1] × [3]

Sample	U_t'	Requested thermal charge transfer, Q_s	Requested Q_s per impulse
No.	kV	C	C
TOV1	5,891	1,1	0,55 (±10%)
TOV2	5,783		0,55 (±10%)
TOV3	5,870		0,55 (±10%)
TOV4	5,805		0,55 (±10%)

"ЕМАЙ ЕЛЕКТРИК" ЕООД

Power frequency voltage versus time test.

Application of two lightning current impulses 8/20µs, corrected rated voltage U_r' and corrected continuous operating U_c' for evaluation of the thermal stability.

Test circuit: A0124-A0020-A0130

Sample No.: TOV1

Ambient temperature: 20 °C
Preheating temperature: 65 °C

Date: December 2, 2017

Lightning current impulses 8/20 µs application

Oscillogram No.	Impulse No.	Charging voltage kV	Residual voltage kV	Discharge current kA	Q_a C	Applicable range for Q_a C
13	1	65,0 x 2	---	38,14	0,56	0,495÷0,605
14	2	65,0 x 2	---	38,07	0,55	0,495÷0,605

Current impulse waveshape (µs)
8,8 /18,2

Temporary overvoltage application

Amplitude claimed by the manufacturer $Ur' \times 1,050 = 5,891 \times 1,050 = 6,362$ kV
Duration claimed by the manufacturer 1 sec.

Oscillogram No.	Time s	U_r' kV	Current $+ mA_{cr}$	Current $- mA_{cr}$
15	0	6,362	145,0	221,0
16	1		132,0	164,0

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram No.	Time min	U_c' kV	Current $+ mA_{cr}$	Current $- mA_{cr}$	Power W	Temperature °C
17	0	4,710	0,98	0,99	1,10	---
	5		0,91	0,94	0,76	---
	10		0,90	0,93	0,64	---
18	15		0,88	0,91	0,59	---
	20		0,87	0,90	0,54	---
	25		0,86	0,89	0,50	---
19	30		0,85	0,88	0,48	---

Note : Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no.30889

continued

Continued

Sample No.: TOV2

Ambient temperature: 20 °C
Preheating temperature: 65 °C

Date: December 2, 2017

Lightning current impulses 8/20 µs application

Oscillogram No.	Impulse No.	Charging voltage kV	Residual voltage kV	Discharge current kA	Q_a C	Applicable range for Q_a C
20	1	65,0 x 2	---	37,80	0,55	0,495÷0,605
21	2	65,0 x 2	---	37,80	0,55	0,495÷0,605

Current impulse waveshape (µs)
8,8 /18,2

Temporary overvoltage application

Amplitude claimed by the manufacturer $Ur' \times 1,040 = 5,783 \times 1,040 = 6,014$ kV
Duration claimed by the manufacturer 10 sec.

Oscillogram No.	Time s	U_r' kV	Current $+ mA_{cr}$	Current $- mA_{cr}$
22	0	6,014	80,0	118,0
23	10		51,0	67,0

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram No.	Time min	U_c' kV	Current $+ mA_{cr}$	Current $- mA_{cr}$	Power W	Temperature °C
24	0	4,624	0,98	1,20	1,70	---
	5		0,90	0,93	0,76	---
	10		0,89	0,91	0,65	---
25	15		0,88	0,90	0,58	---
	20		0,87	0,88	0,53	---
	25		0,86	0,87	0,50	---
26	30		0,85	0,87	0,48	---

Note : Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no.30889

continued

Continued

Sample No.: TOV3

Ambient temperature: 20 °C
Preheating temperature: 66 °C

Date: December 2, 2017

Lightning current impulses 8/20 µs application

Oscillogram No.	Impulse No.	Charging voltage kV	Residual voltage kV	Discharge current kA	Q_a C	Applicable range for Q_a C
27	1	65,0 x 2	---	37,83	0,55	0,495÷0,605
28	2	65,0 x 2	---	37,90	0,55	0,495÷0,605

Current impulse waveshape (µs)
8,8 /18,2

Temporary overvoltage application

Amplitude claimed by the manufacturer $Ur' \times 1,000 = 5,870 \times 1,000 = 5,870$ kV
Duration claimed by the manufacturer 100 sec.

Oscillogram No.	Time s	U_r' kV	Current $+ mA_{cr}$	Current $- mA_{cr}$
29	0	5,870	43,0	65,0
30	100		87,0	17,0

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram No.	Time min	U_c' kV	Current $+ mA_{cr}$	Current $- mA_{cr}$	Power W	Temperature °C
31	0	4,692	0,92	0,93	0,70	---
	5		0,89	0,91	0,57	---
	10		0,88	0,90	0,52	---
32	15		0,88	0,89	0,48	---
	20		0,87	0,88	0,42	---
	25		0,86	0,87	0,40	---
33	30		0,85	0,86	0,37	---

Note : Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no.30889

continued

Continued

Sample No.: TOV4

Ambient temperature: 20 °C
Preheating temperature: 66 °C

Date: December 4, 2017

Lightning current impulses 8/20 µs application

Oscillogram No.	Impulse No.	Charging voltage kV	Residual voltage kV	Discharge current kA	Q_a C	Applicable range for Q_a C
34	1	65,0 x 2	---	38,06	0,56	0,495÷0,605
35	2	65,0 x 2	---	37,90	0,55	0,495÷0,605

Current impulse waveshape (µs)
8,8 /18,2

Temporary overvoltage application

Amplitude claimed by the manufacturer $Ur' \times 0,960 = 5,805 \times 0,960 = 5,573$ kV
Duration claimed by the manufacturer 1000 sec.

Oscillogram No.	Time s	U_r' kV	Current $+ mA_{cr}$	Current $- mA_{cr}$
36	0	5,573	30,0	55,0
37	1000		2,30	3,60

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram No.	Time min	U_c' kV	Current $+ mA_{cr}$	Current $- mA_{cr}$	Power W	Temperature °C
38	0	4,641	0,87	0,88	0,60	---
	5		0,86	0,88	0,56	---
	10		0,85	0,87	0,52	---
39	15		0,84	0,86	0,47	---
	20		0,83	0,85	0,44	---
	25		0,82	0,84	0,42	---
40	30		0,81	0,83	0,40	---

Note : Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no.30889

Power frequency voltage versus time test.

Application of the temporary overvoltage U_{TOV} and evaluation of thermal stability
(WITHOUT PRIOR DUTY TEST)

Test circuit: A0123-A0130-A0020

Sample No.: TOV5

Preheating temperature: 65 °C

Date: October 6, 2017

Temporary overvoltage application

Amplitude claimed by the manufacturer Ur' x 1,130 = 5,794 x 1,130 = 6,547 kV
Duration claimed by the manufacturer 10 sec.

Oscillogram	Time	Voltage	Current	Current	Power
No.	s	kV	+ mA_{cr}	- mA_{cr}	W
41	0	6,547	193,0	200,0	---
42	10		167,0	176,0	

Corrected continuous operating voltage U_r' application to evaluate the thermal stability

Oscillogram	Time	U_r'	Current	Current	Power	Temperature
No.	min	kV	+ mA_{cr}	- mA_{cr}	W	°C
43	0,5	4,632	0,74	0,76	0,47	---
	5		0,73	0,75	0,45	---
	10		0,72	0,74	0,43	---
44	15		0,71	0,74	0,40	---
	20		0,71	0,73	0,35	---
	25		0,70	0,72	0,35	---
45	31		0,69	0,71	0,33	---

Note 1 Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no 30839

continued
Sample No.: TOV6

Preheating temperature: 65 °C

Date: October 6, 2017

Temporary overvoltage application

Amplitude claimed by the manufacturer Ur' x 1,040 = 5,816 x 1,040 = 6,049 kV
Duration claimed by the manufacturer 1000 sec.

Oscillogram	Time	Voltage	Current	Current	Power
No.	s	kV	+ mA_{cr}	- mA_{cr}	W
45	0	6,049	42,0	56,0	---
47	1000		33,0	38,0	

Corrected continuous operating voltage U_r' application to evaluate the thermal stability

Oscillogram	Time	U_r'	Current	Current	Power	Temperature
No.	min	kV	+ mA_{cr}	- mA_{cr}	W	°C
48	0	4,694	0,80	0,84	0,84	---
	5		0,78	0,81	0,69	---
	10		0,77	0,79	0,62	---
49	15		0,75	0,77	0,55	---
	20		0,74	0,76	0,50	---
	25		0,73	0,75	0,47	---
50	30		0,72	0,75	0,45	---

Note 1 Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no 30839

continued

Power frequency voltage versus time test.

Lightning impulse residual voltage measurement after the test

Test circuit: A0120

Date: December 4, 2017

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual Voltage
No.		kV	No.	µs	kA	kV
TOV1	I_n	24,8	51	8,6/18,3	10,18	14,26
TOV2		24,8	52		10,14	14,24
TOV3		24,8	53		10,10	14,38
TOV4		24,8	54		10,07	14,36
TOV5		24,6	55		10,04	14,00
TOV6		24,7	56		10,05	14,25

Notes:

Power frequency voltage versus time test.

Additional two lightning impulses residual voltage measurement for check no damage occurred during the test

Test circuit: A0120

Date: December 4, 2017

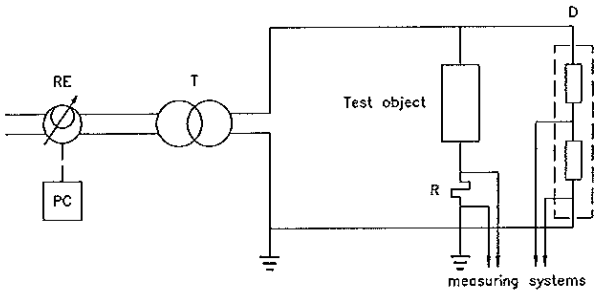
Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
TOV1	5,26(*)	19,4	57	7,8/20,0	5,44	13,22
		19,4	58		5,36	13,26
TOV2		19,4	59		5,46	13,21
		19,4	60		5,42	13,24
TOV3		19,4	67		5,33	13,33
		19,4	68		5,28	13,30
TOV4		19,4	61		5,27	13,31
		19,4	62		5,27	13,34
TOV5		19,4	63		5,48	13,12
		19,4	64		5,45	13,10
TOV6		19,4	65		5,31	13,35
		19,4	66		5,28	13,29

Notes:

Requested current = 0,5 kA/cm2 x 10,52 cm2 = 5,26 kA

- -where 0,5 kA/cm2 is peak current density
- where 10,52 cm2 is surface area on the metal-oxide resistor used for this test declared by the manufacturer

Circuit A0019



Power frequency supply

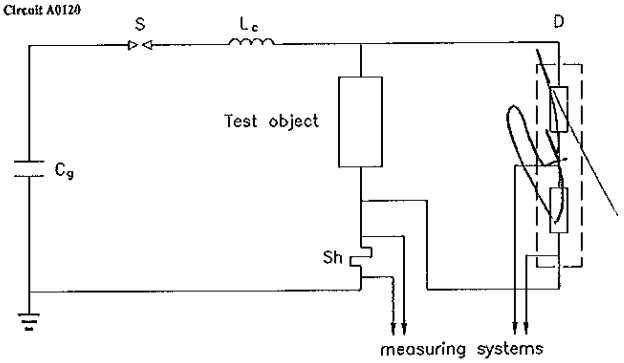
RE - programmable supply type PACIFIC A.C. Power Source 140 ASX.; CESI no. 0560408
PC - personal computer
T - voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200 V/15-30 kV

Current measuring system
R - Current shunt CESI No.31120; R= 940,5 Ω
- Electro optical system HBM CESI No. 57585(Rx) – 57587 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

Voltage measuring system
D - Voltage divider SAGI; CESI No.11120
- Electro optical system type HBM CESI No. 57585(Rx) – 57591 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.2)

SOFTWARE SYSTEM:
SW - S.A.D. Surge arrester version 2.0

Circuit A0120



Impulse generator

No. of stages 1
Cg 6,64 μF
Lc 6 μH

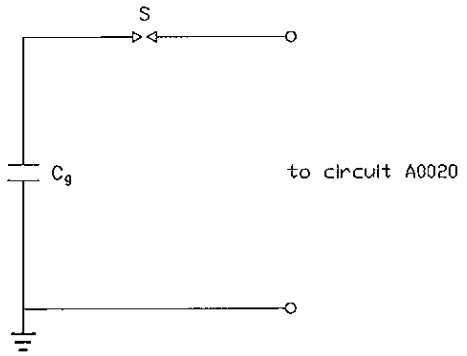
S - Spark-gap

Voltage measuring system.
D - Voltage divider SAGI; CESI No.11120
- Electro optical system type HBM CESI No. 57585(Rx) – 57591 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.2)

Current measuring system
Sh - Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
- Electro optical system HBM CESI No. 57585(Rx) – 57587 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5152;
- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:
SW - S.A.D. Surge arrester version 2.0

Circuit A0123

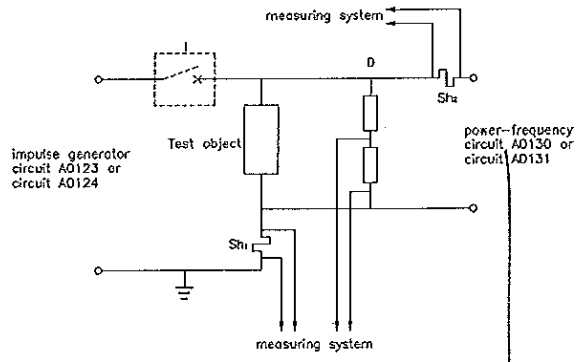


Impulse generator circuit for injection of Q_a

No. of stages 2
Cg 2,91 μF
Lc 12 μH

S - spark-gap

Circuit A0020



Impulse generator circuit A0123

Impulsive current measuring system
Sh_1 - Current shunt CESI No.6042; R= 2 m Ω
- Electro optical system HBM CESI No. 57586(Rx) - 57587 (Tx)
$OSC_{2.3}$ - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.2)
I - Circuit-breaker

Power frequency circuit A0131

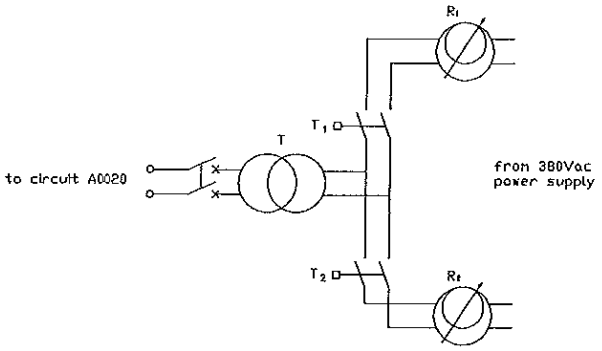
Voltage measuring system.
D - Voltage divider SAGI; CESI No.11120
- Electro optical system HBM CESI No. 57585(Rx) 57591 (Tx)
$OSC_{2.3}$ - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.2)

Current measuring system
Sh_2 (TOV - MCOV) - Current shunt type CESI n. 058315 R= 500 Ω
- Electro optical system CESI No. 57586(Rx) – 58294 (Tx)
$OSC_{2.3}$ - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:
SW - S.A.D. Surge arrester version 2.0

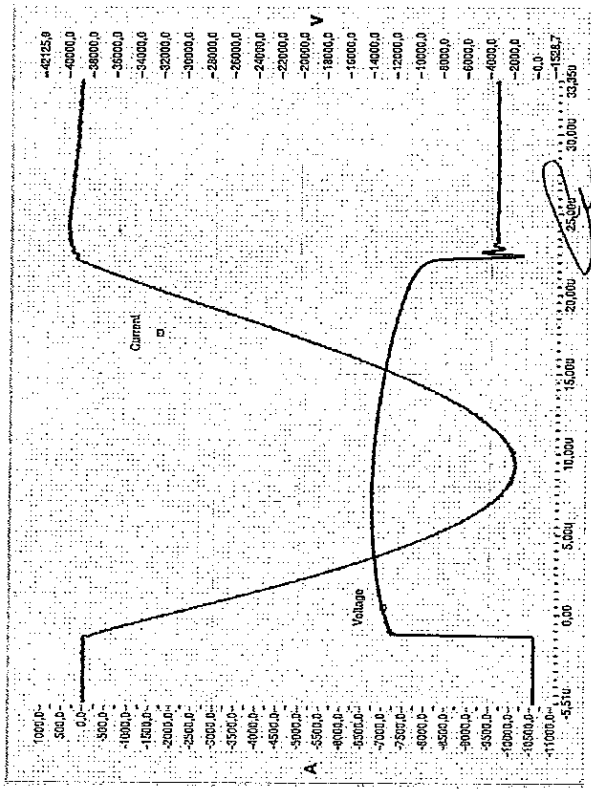
ВЯРНО С ОРИГИНАЛА

Circuit A0131



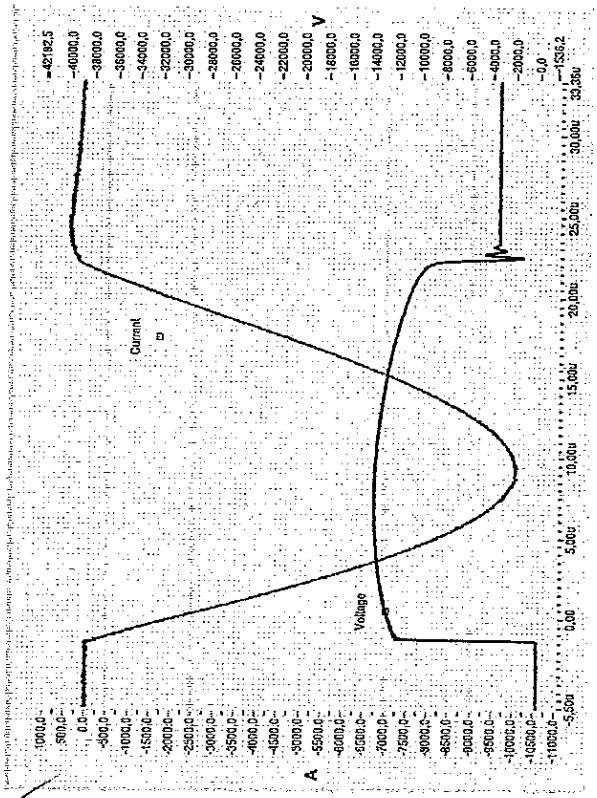
Power-frequency circuit

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

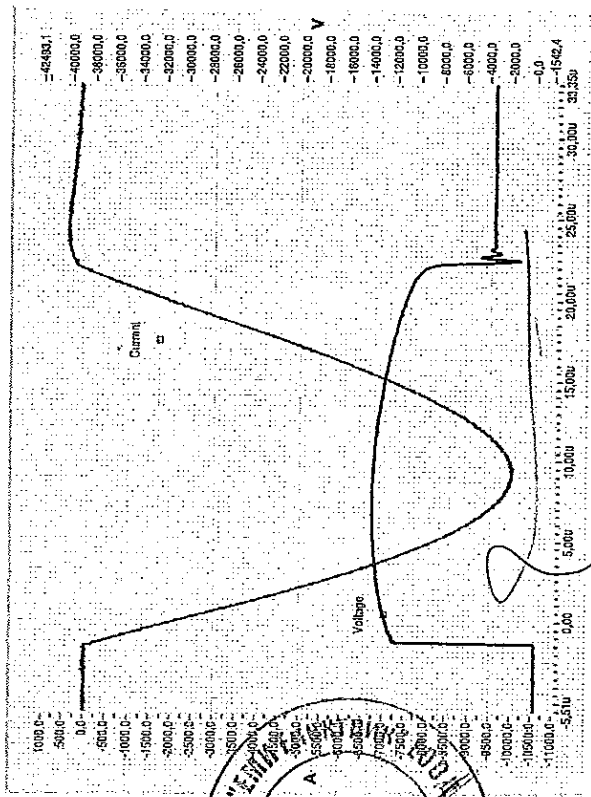


CESI B7020147 Oscillogram n. 1

A1179S0

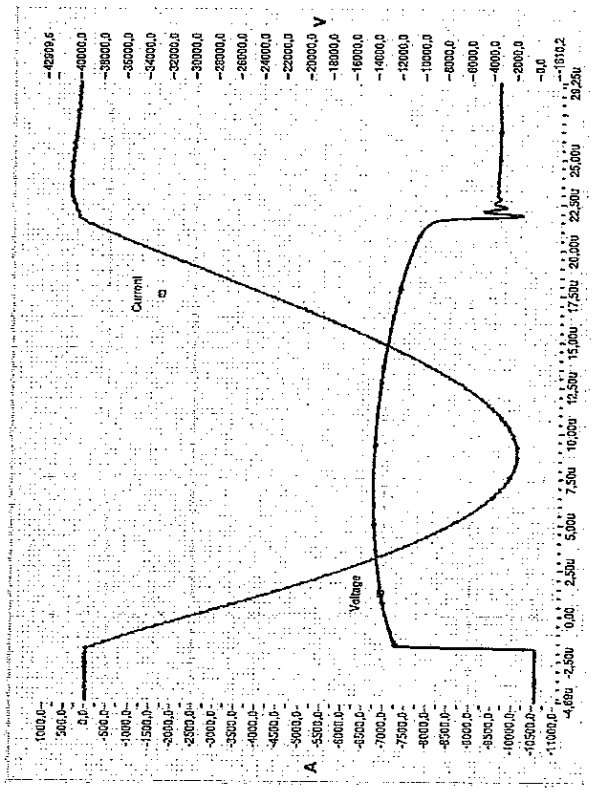


CESI B7020147 Oscillogram n. 2

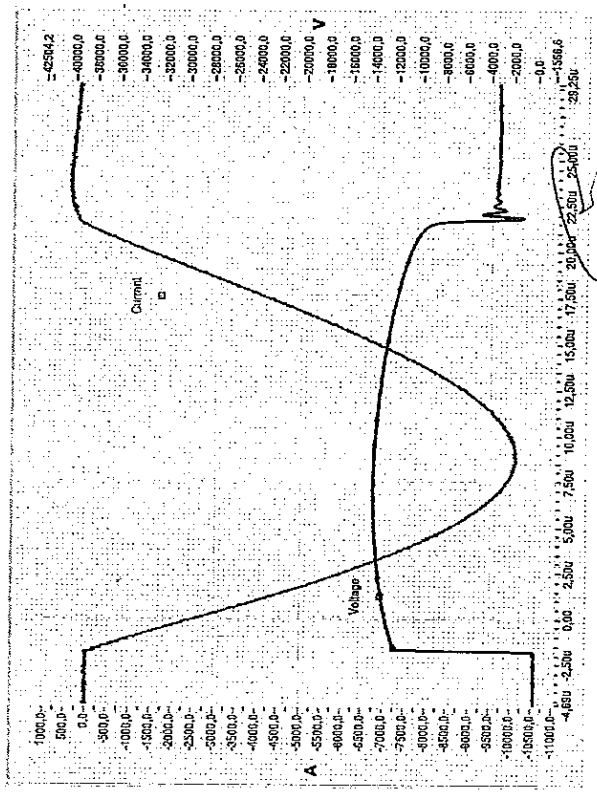


CESI B7020147 Oscillogram n. 3

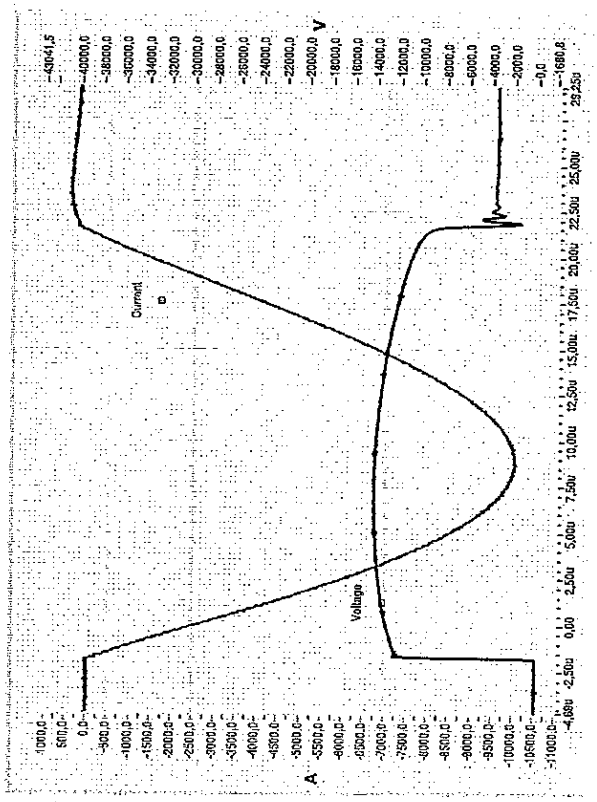
ВЯРНО С ОРИГИНАЛА



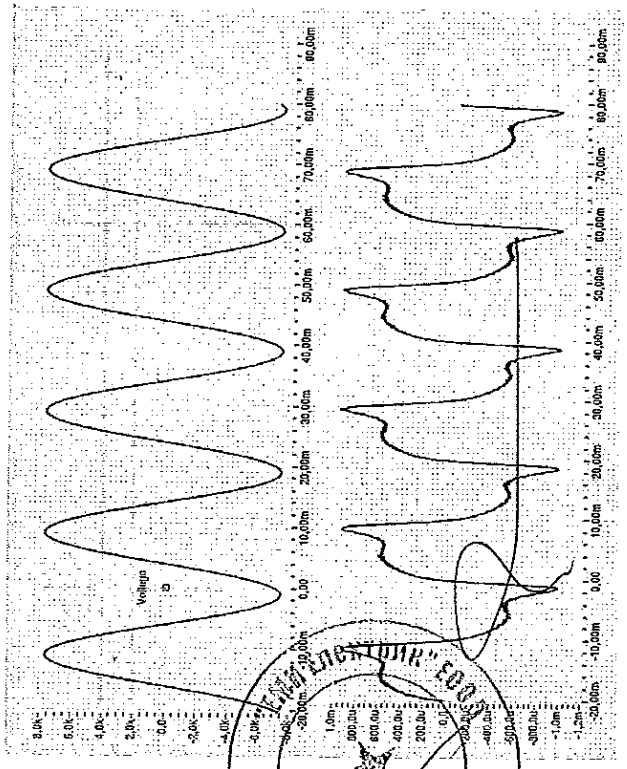
CESI B7020147 Oscillogramm n. 4



CESI B7020147 Oscillogramm n. 5



CESI B7020147 Oscillogramm n. 6



CESI B7020147 Oscillogramm n. 7

ВЯРНО С ОРИГИНАЛА

265

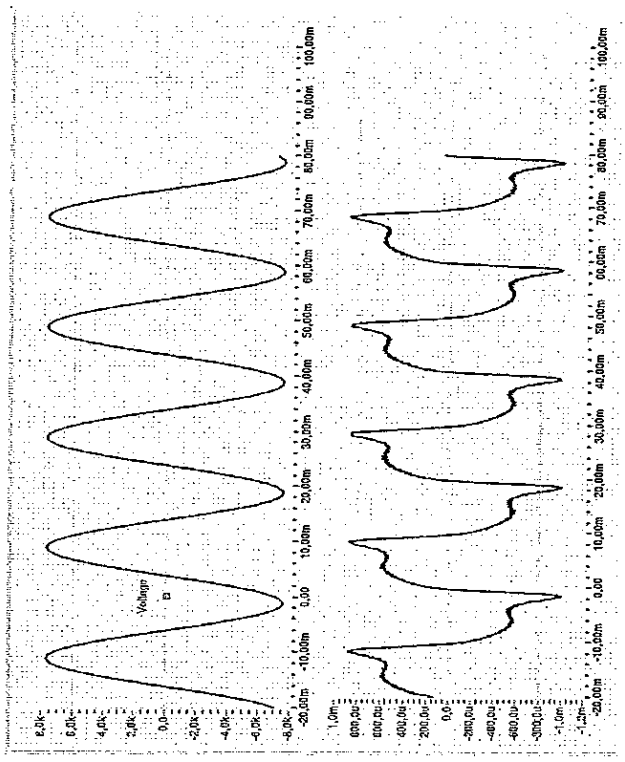
CESI B7026147 Oscillogram n. 8

CESI B7026147 Oscillogram n. 9

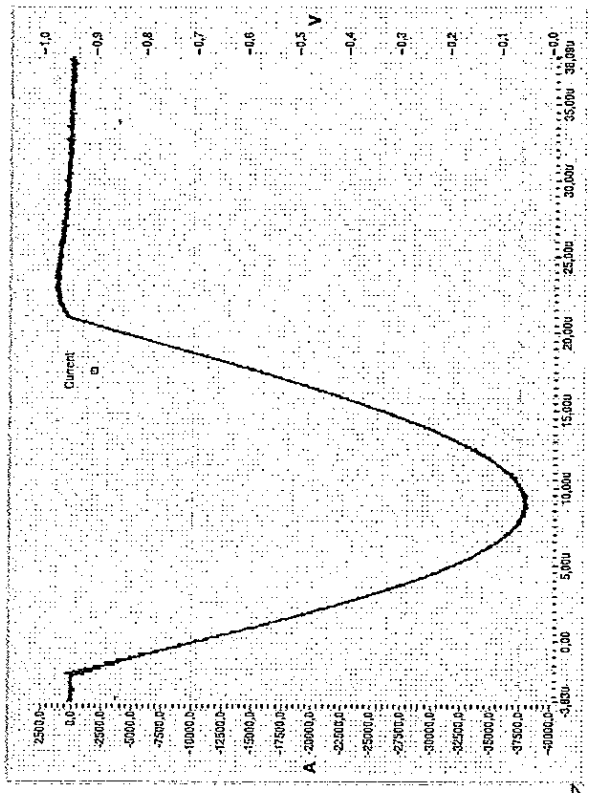
CESI B7026147 Oscillogram n. 10

CESI B7026147 Oscillogram n. 11

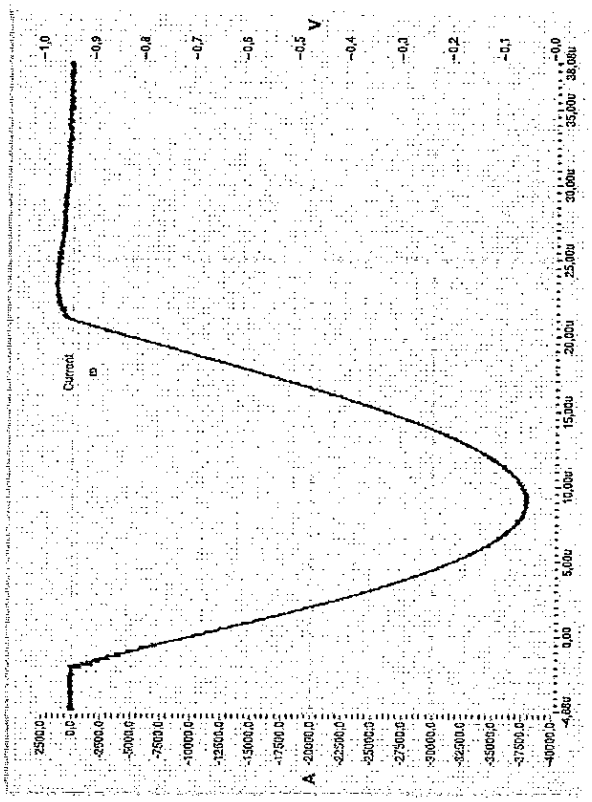
ВЯРНО С ОРИГИНАЛА



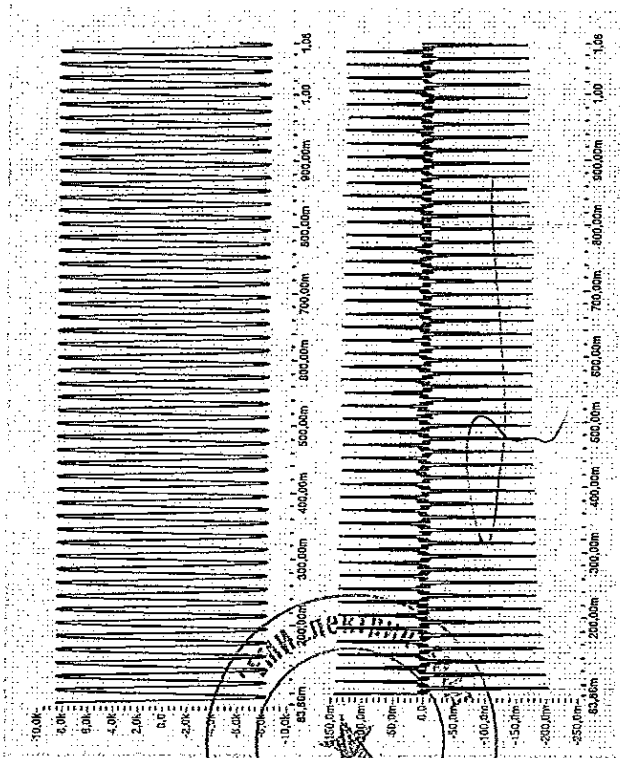
CESI B7020147 Oscillogramm n. 12



CESI B7020147 Oscillogramm n. 13



CESI B7020147 Oscillogramm n. 14



CESI B7020147 Oscillogramm n. 15

ВЯРНО С ОРИГИНАЛА

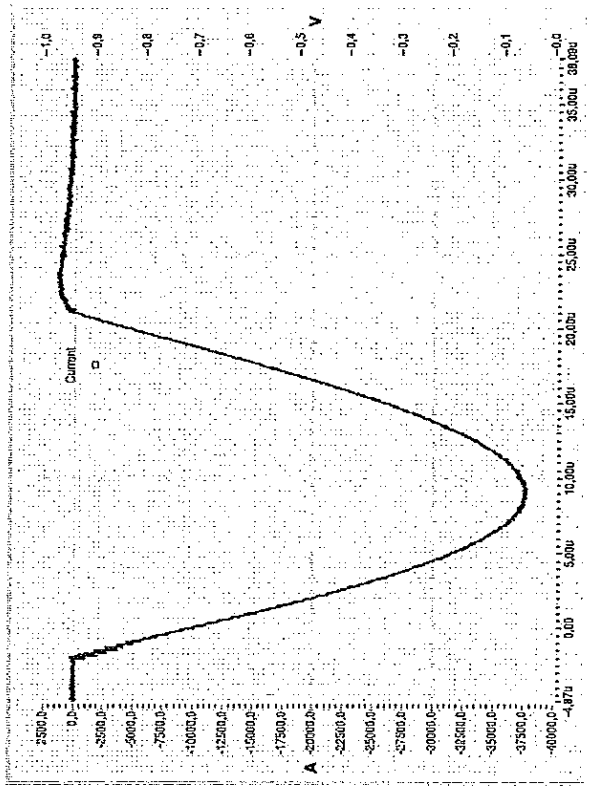
CESI B7020147 Oscillogram n. 16

CESI B7020147 Oscillogram n. 17

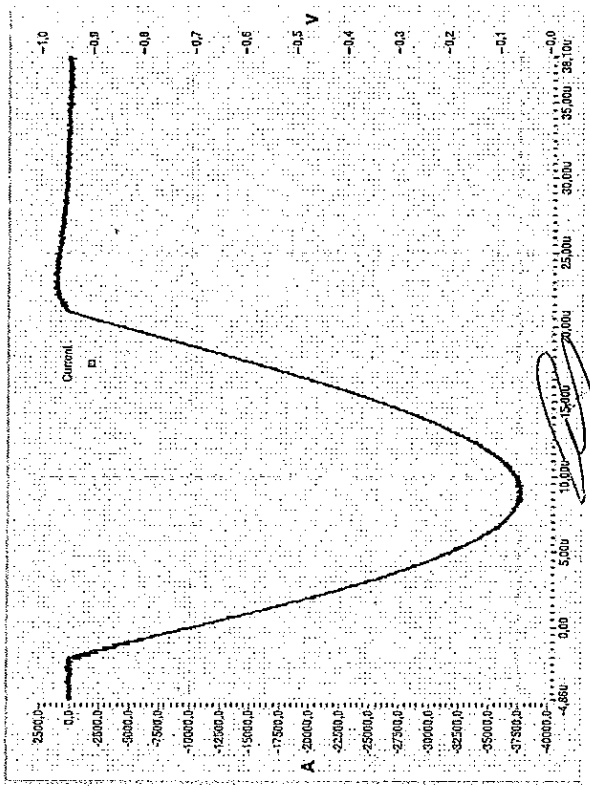
CESI B7020147 Oscillogram n. 18

CESI B7020147 Oscillogram n. 19

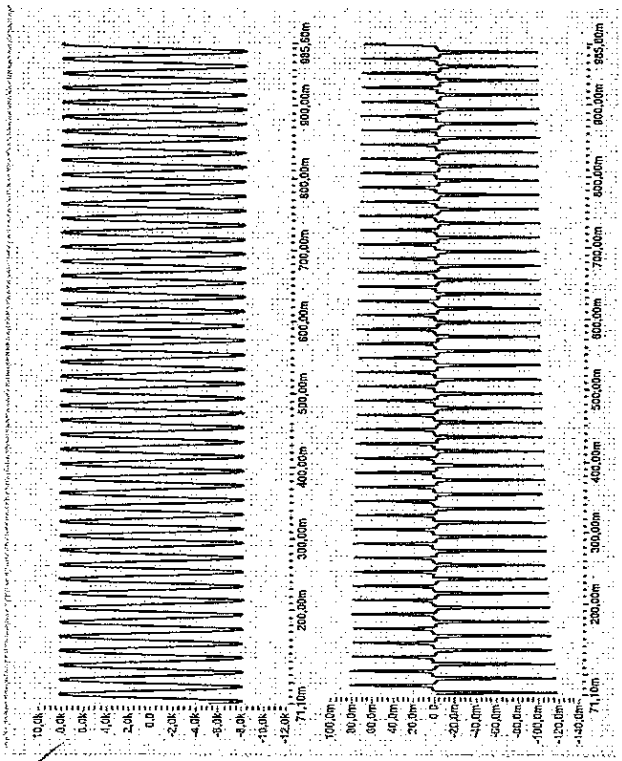
ВЯРНО С ОРИГИНАЛА



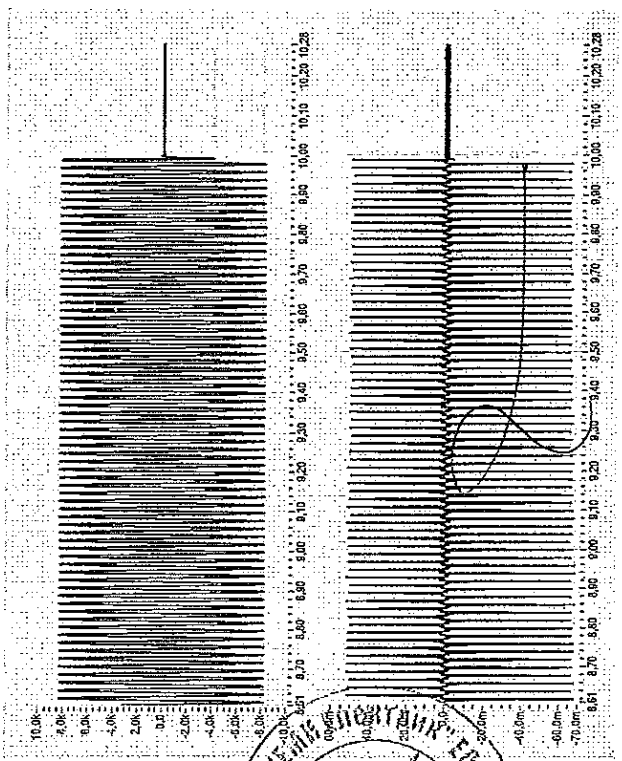
CESI B7020147 Oscillogram n. 20



CESI B7020147 Oscillogram n. 21



CESI B7020147 Oscillogram n. 22



CESI B7020147 Oscillogram n. 23

ВЯРНО С
ОРИГИНАЛА.

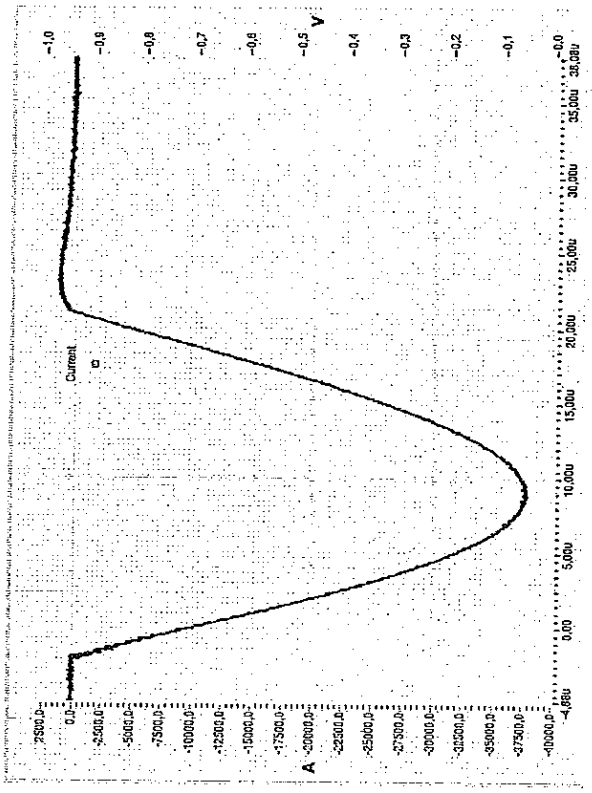
CESI B7020147 Oscillogram n. 24

CESI B7020147 Oscillogram n. 25

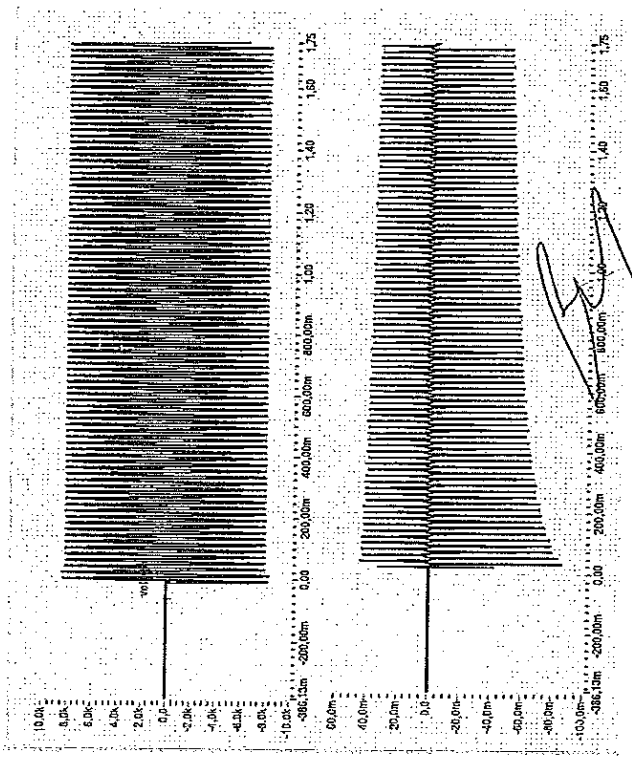
CESI B7020147 Oscillogram n. 26

CESI B7020147 Oscillogram n. 27

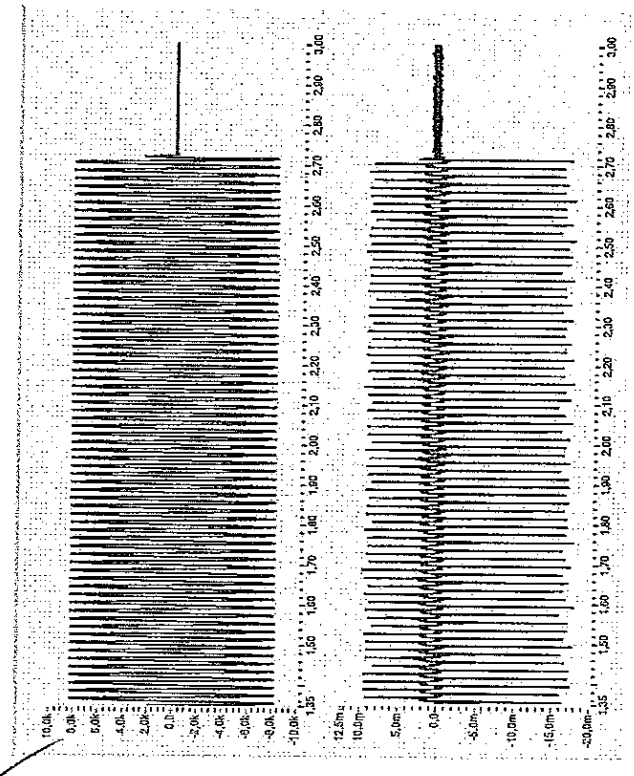
ВЯРНО С ОРИГИНАЛА



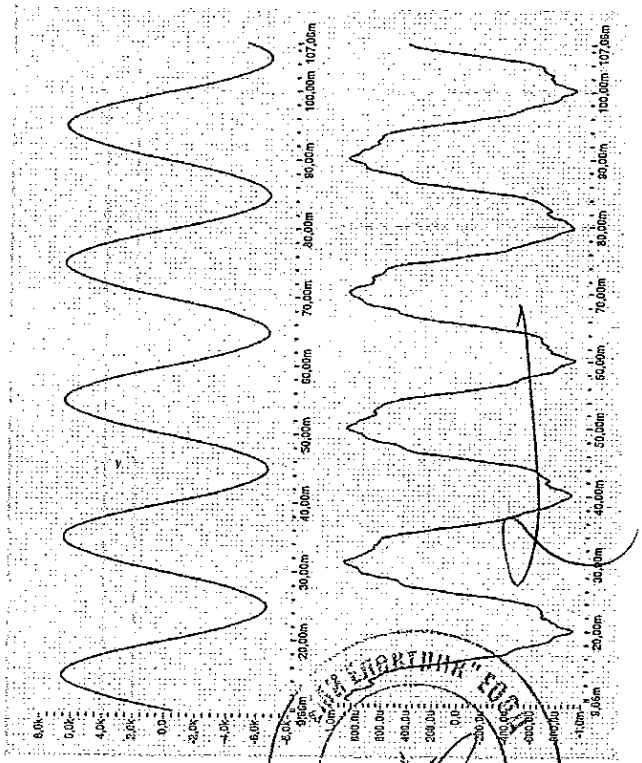
CESI B7020147 Oscillogramm n. 28



CESI B7020147 Oscillogramm n. 29

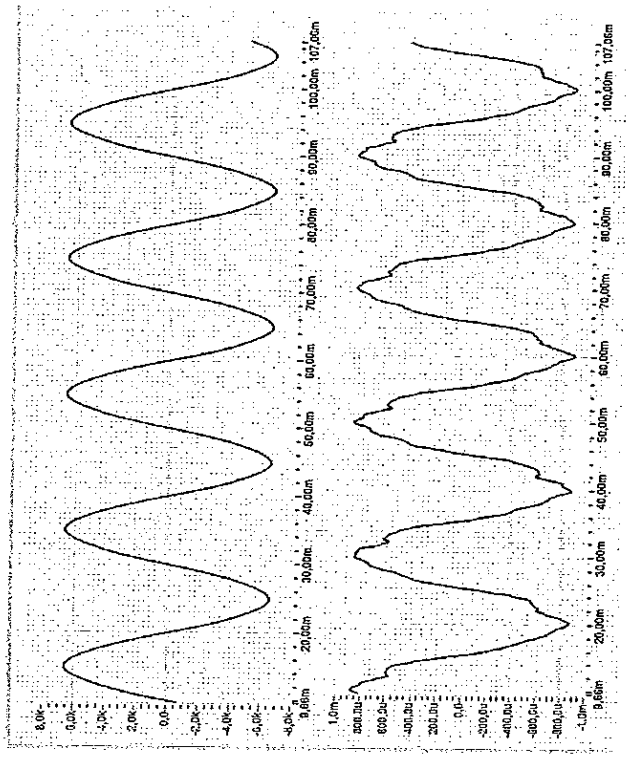


CESI B7020147 Oscillogramm n. 30

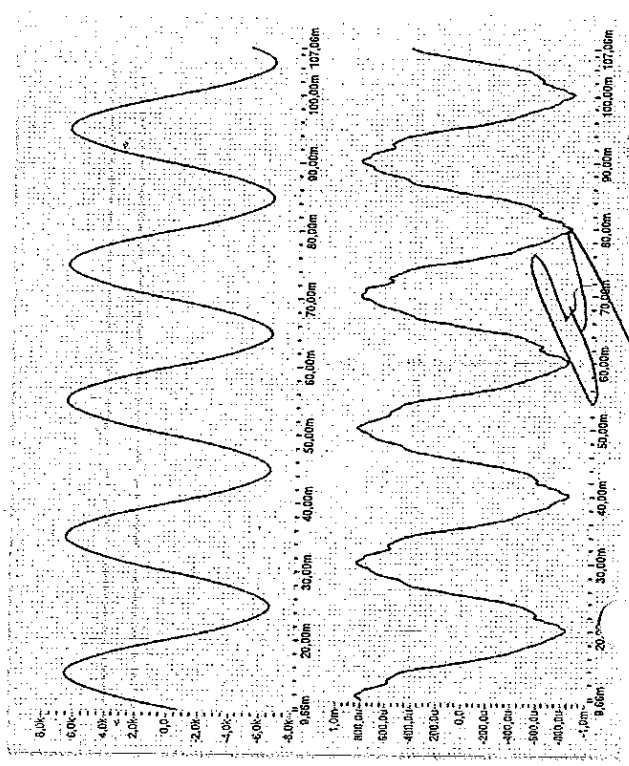


CESI B7020147 Oscillogramm n. 31

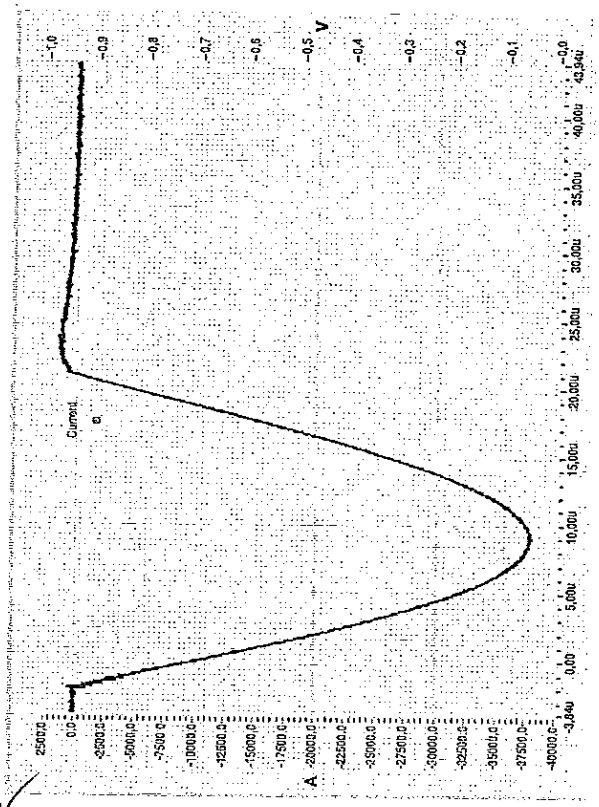
ВЯРНО С ОРИГИНАЛА



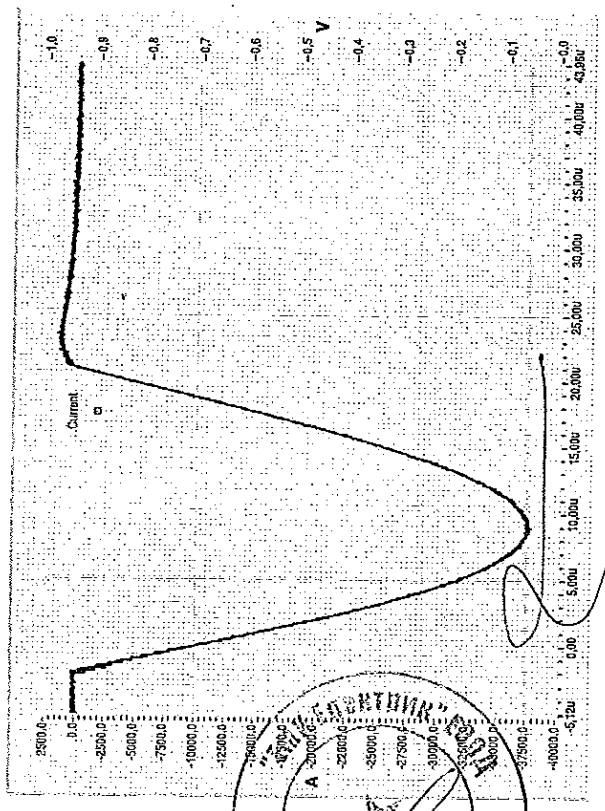
CESI B7020147 Oscillogram n. 32



CESI B7020147 Oscillogram n. 33

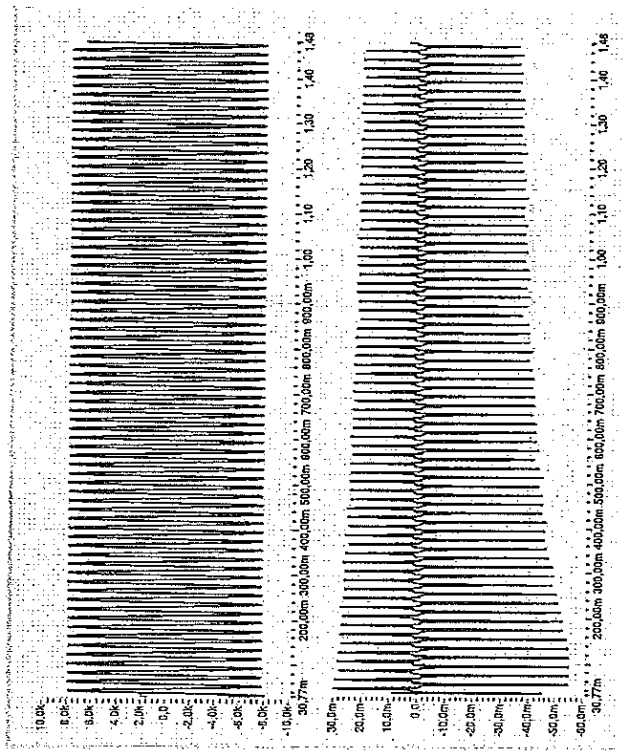


CESI B7020147 Oscillogram n. 34

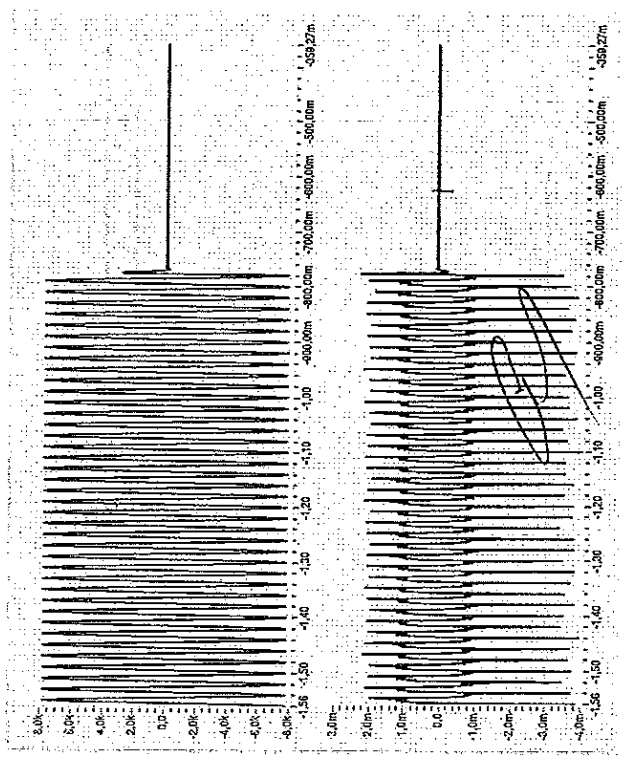


CESI B7020147 Oscillogram n. 35

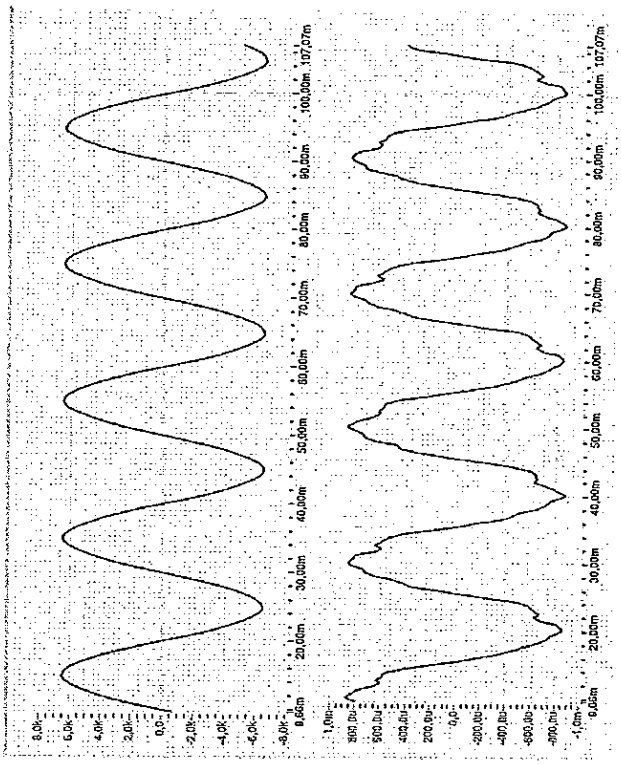
ВЯРНО С
ОРИГИНАЛА



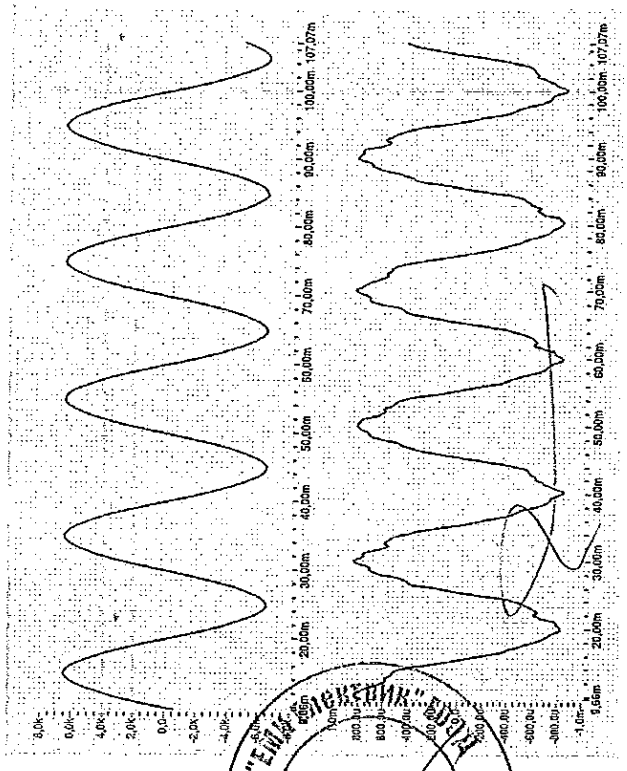
CESI B7020147 Oscillogramm n. 36



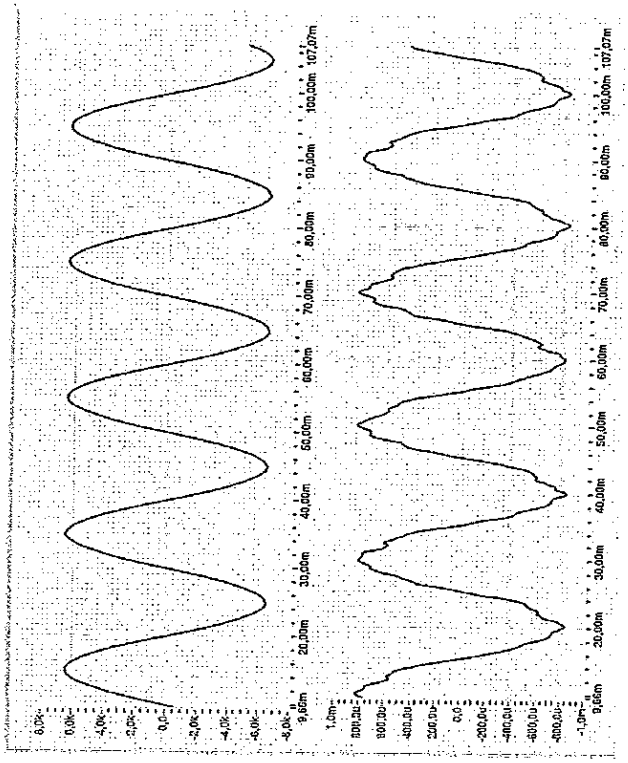
CESI B7020147 Oscillogramm n. 37



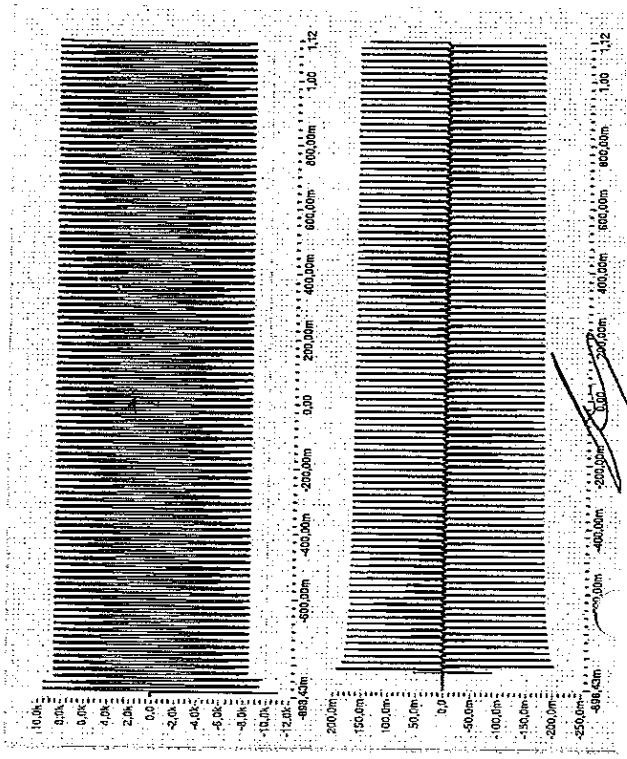
CESI B7020147 Oscillogramm n. 38



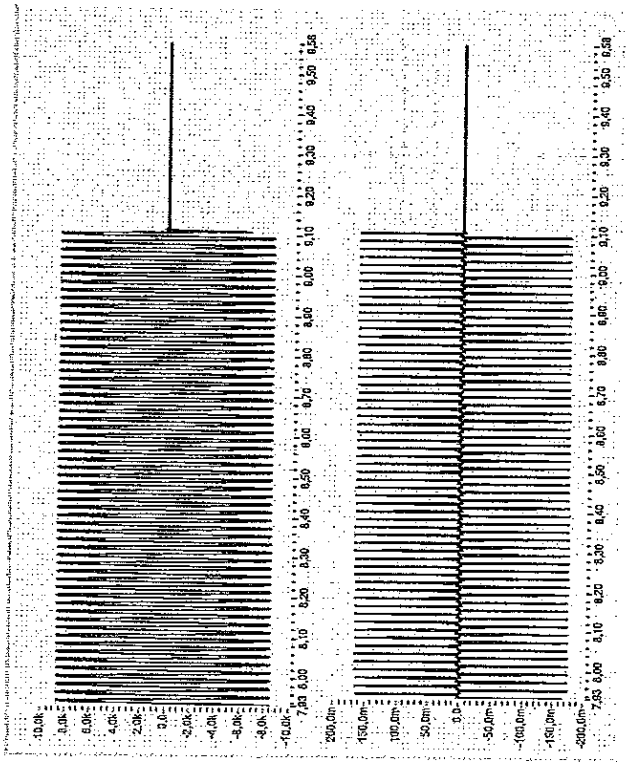
CESI B7020147 Oscillogramm n. 39



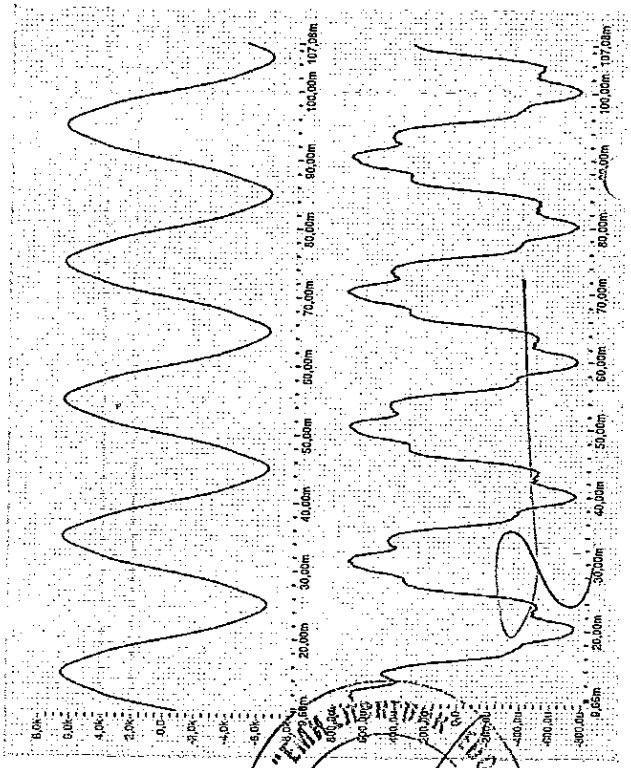
CESI B7020147 Oscillogramm n. 40



CESI B7020147 Oscillogramm n. 41

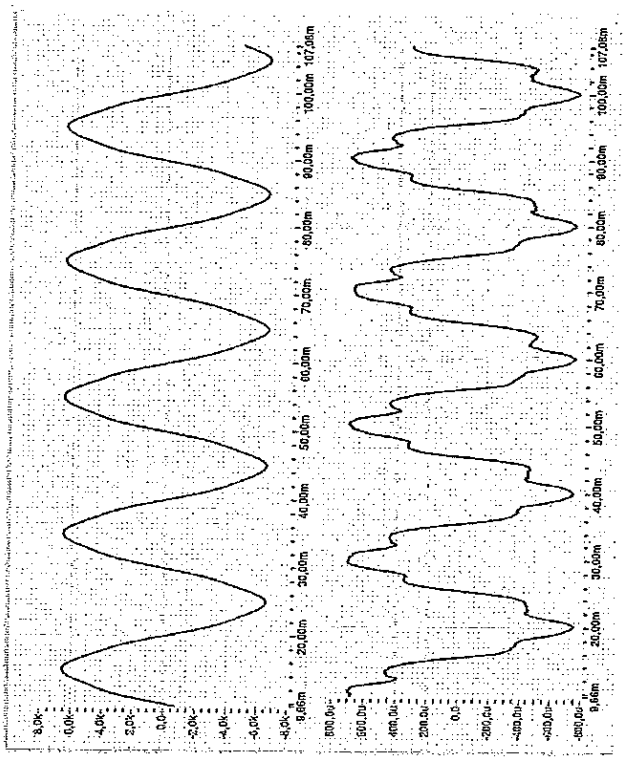


CESI B7020147 Oscillogramm n. 42

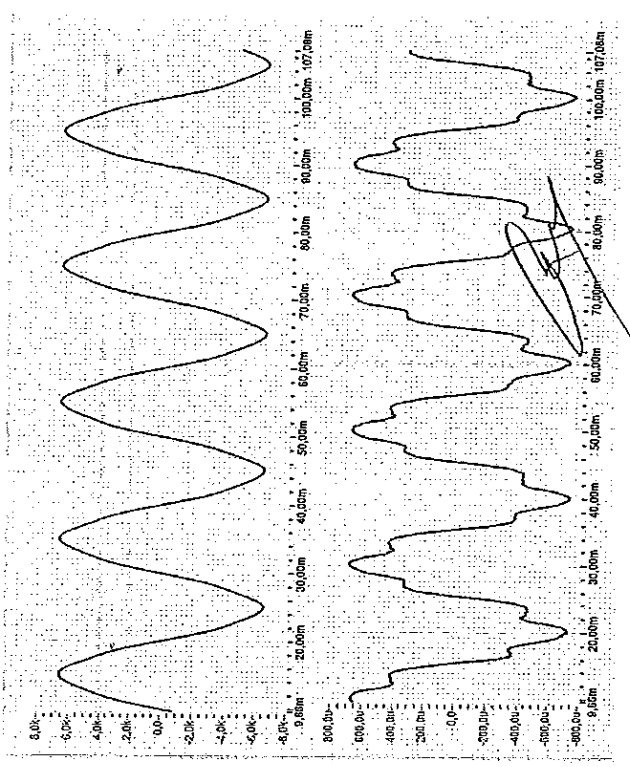


CESI B7020147 Oscillogramm n. 43

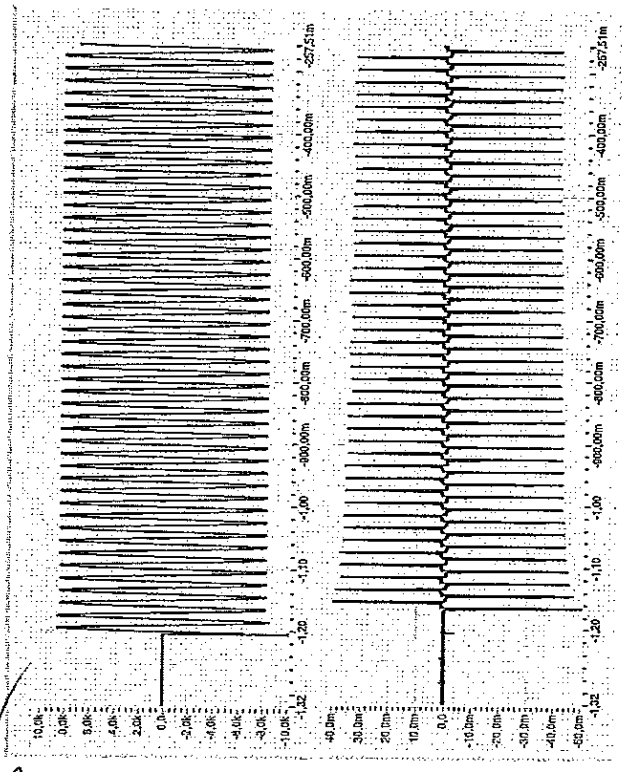
ВЯРНО С ОРИГИНАЛА



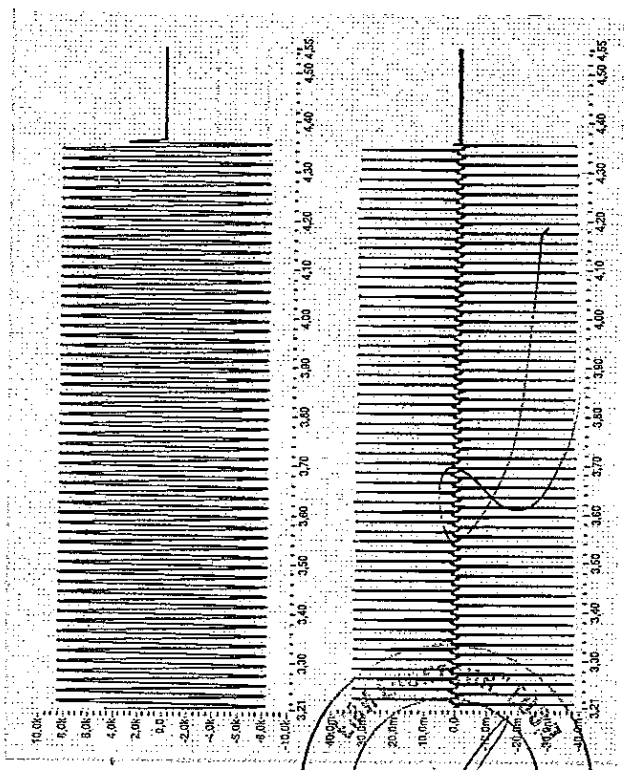
CESI B7020147 Oscillogram n. 44



CESI B7020147 Oscillogram n. 45

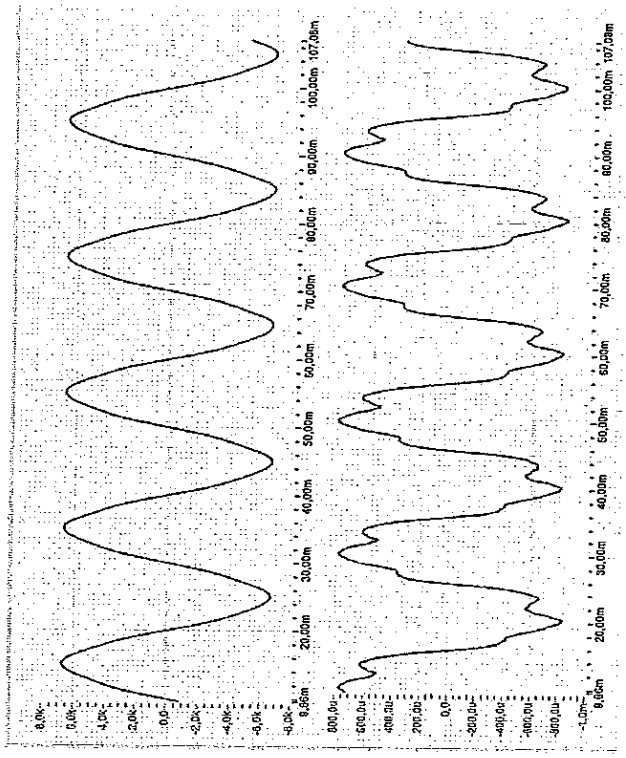


CESI B7020147 Oscillogram n. 46

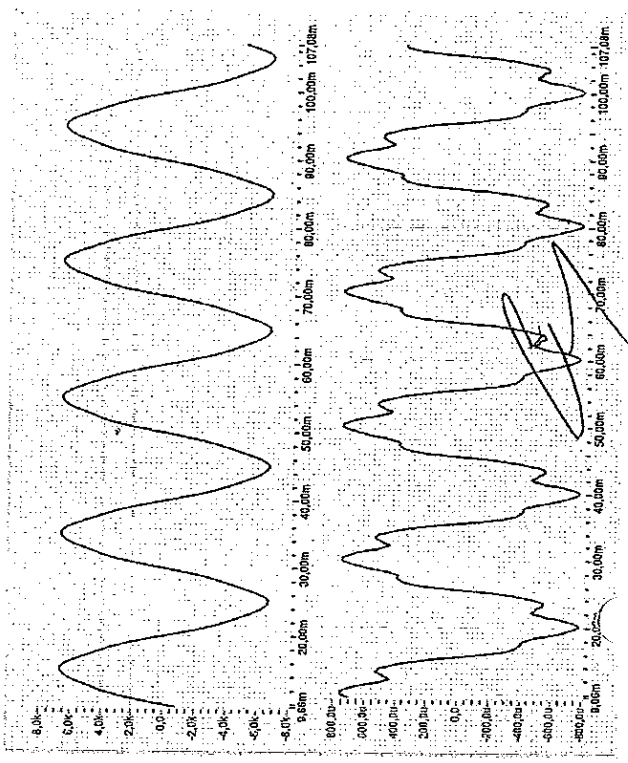


CESI B7020147 Oscillogram n. 47

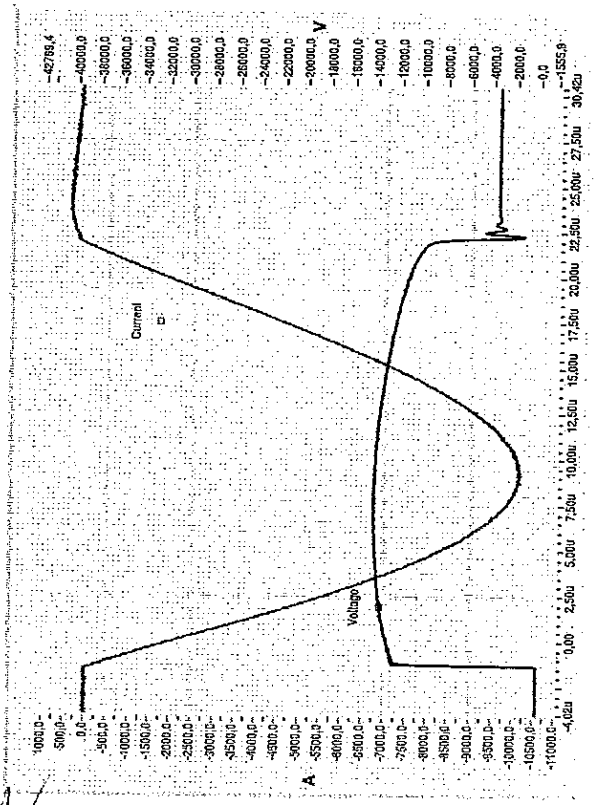
ВЯРНО С ОРИГИНАЛА



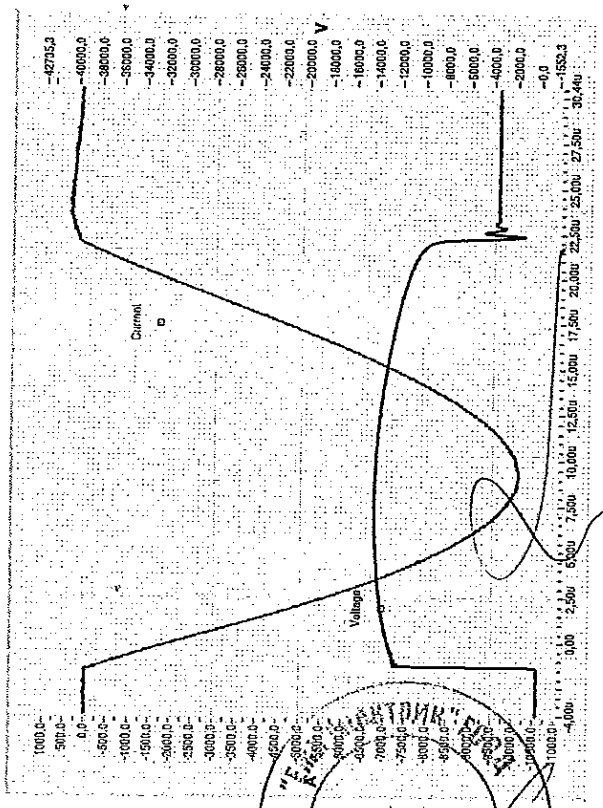
CESI B7020147 Oscillogram n. 48



CESI B7020147 Oscillogram n. 49



CESI B7020147 Oscillogram n. 51



CESI B7020147 Oscillogram n. 52

ВЯРНО С ОРИГИНАЛА

CESI B7020147 Oscillogram n. 53

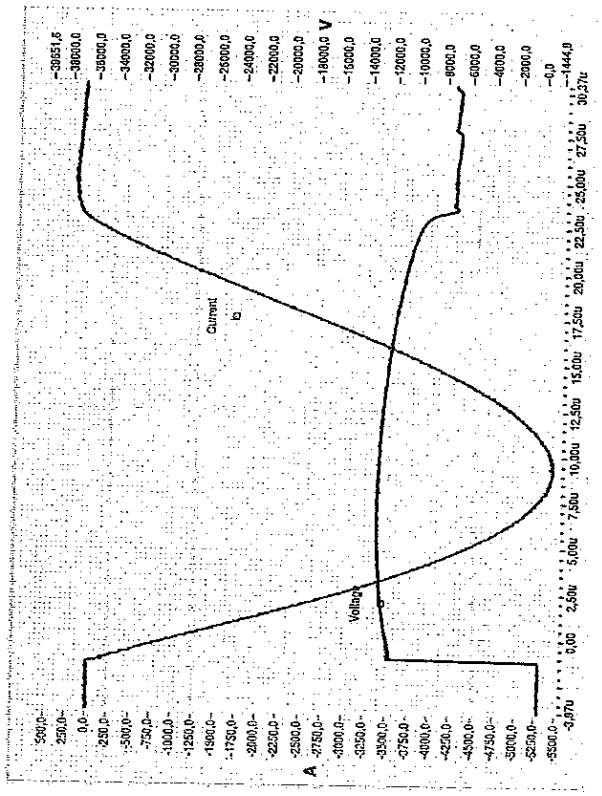
CESI B7020147 Oscillogram n. 54

CESI B7020147 Oscillogram n. 55

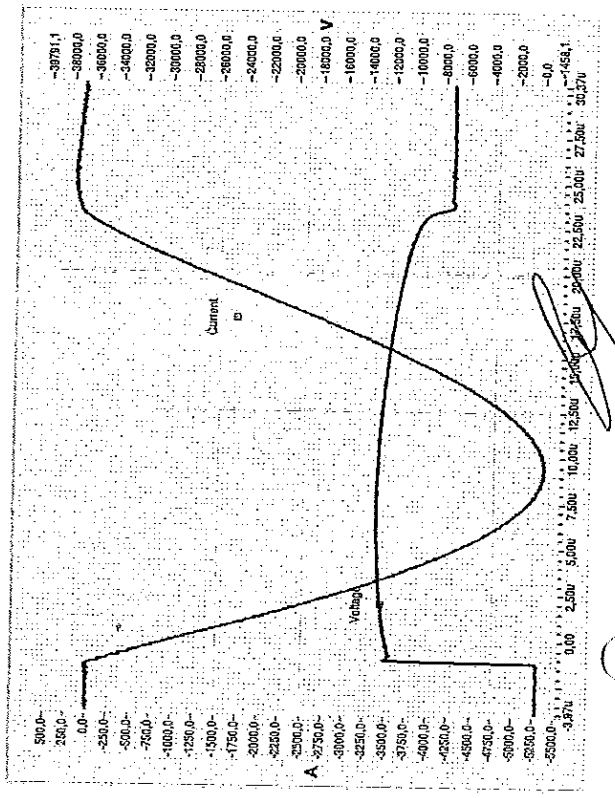
CESI B7020147 Oscillogram n. 56

ВЯРНО С ОРИГИНАЛА

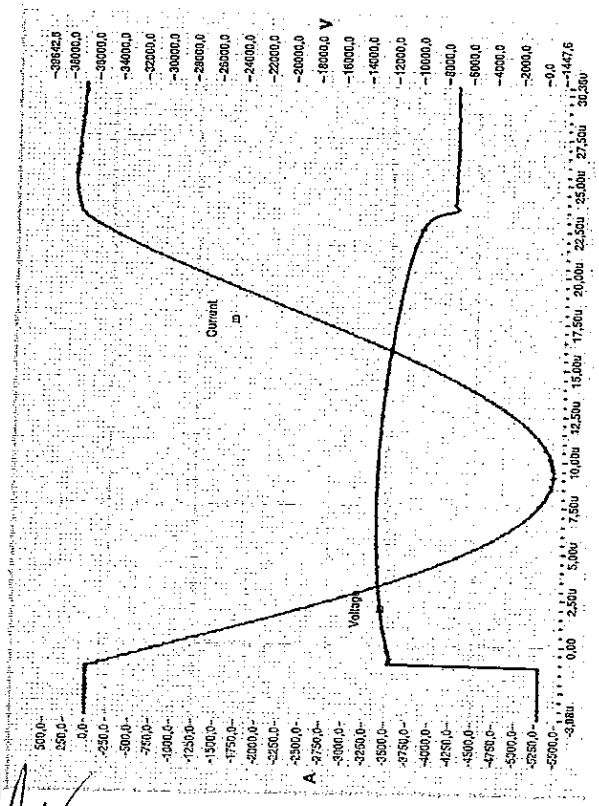
277



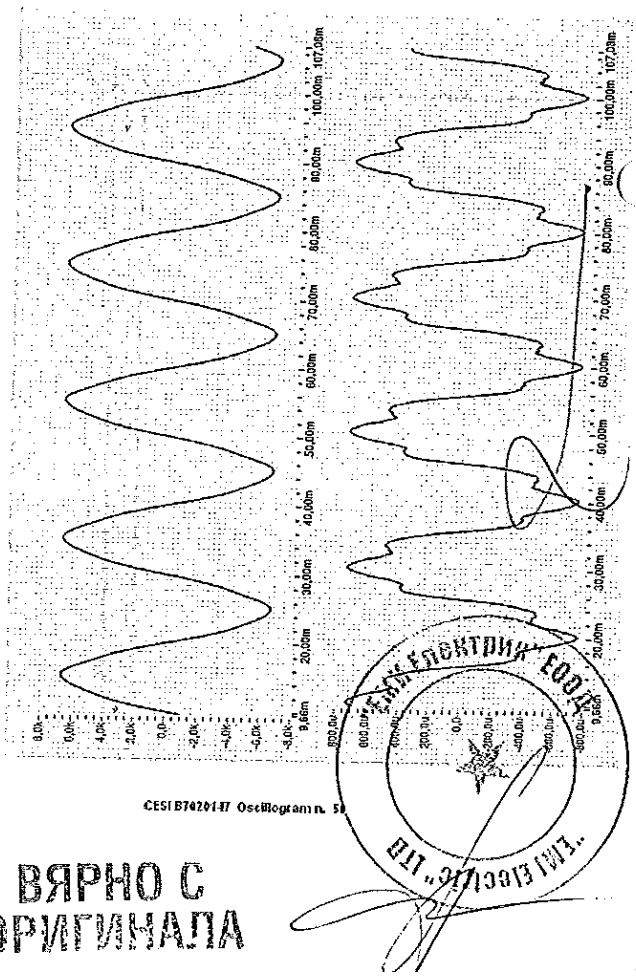
CESI B7020147 Oscillogramm n. 57



CESI B7020147 Oscillogramm n. 58



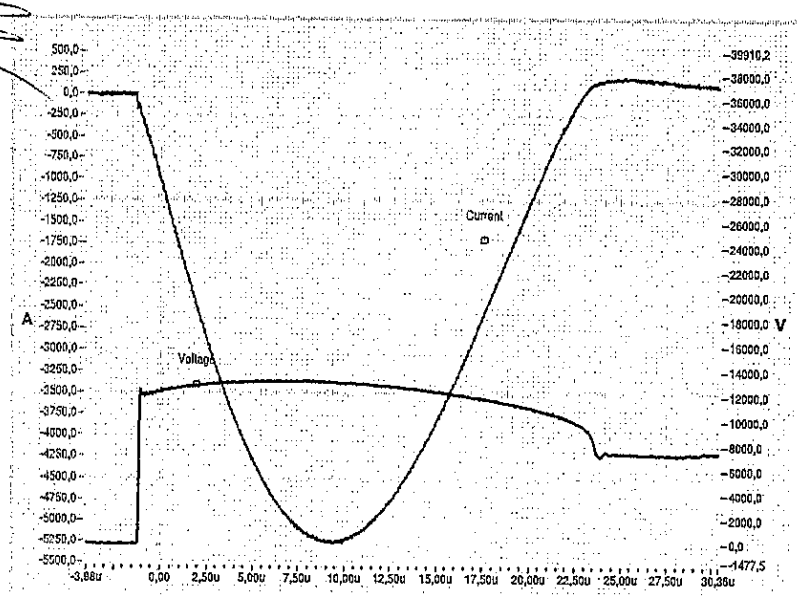
CESI B7020147 Oscillogramm n. 59



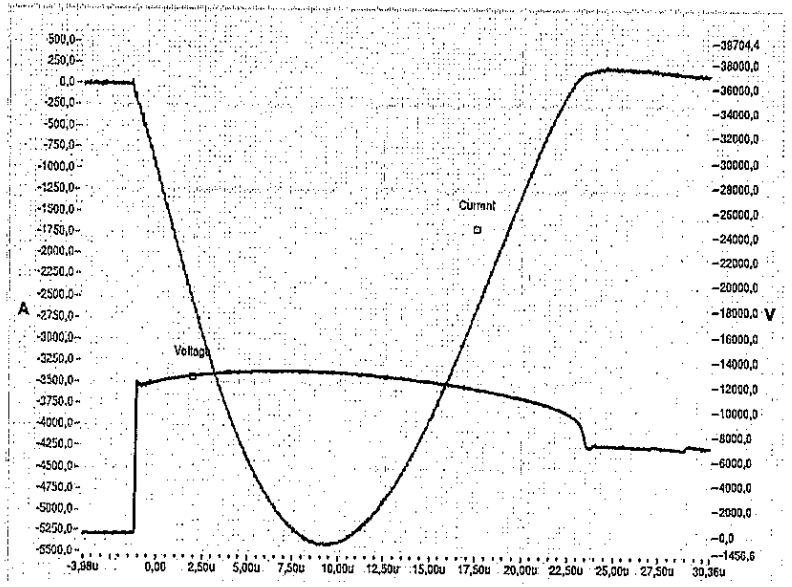
CESI B7020147 Oscillogramm n. 5

ВЯРНО С ОРИГИНАЛА

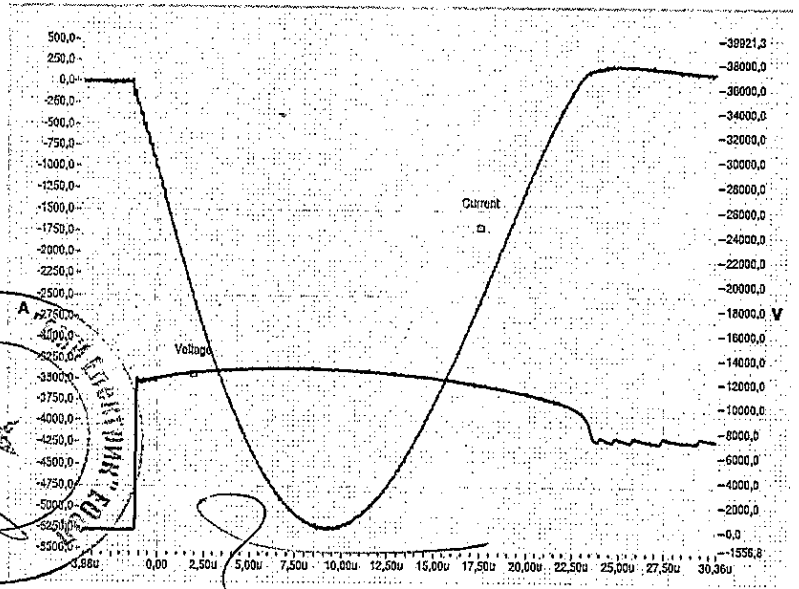
CESI B7020147 Oscillogram n. 62



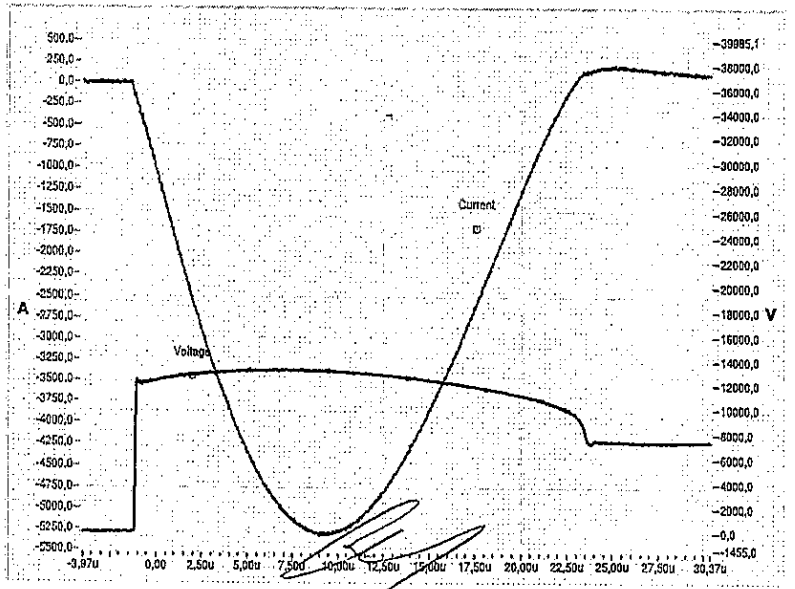
CESI B7020147 Oscillogram n. 60



CESI B7020147 Oscillogram n. 63



CESI B7020147 Oscillogram n. 61



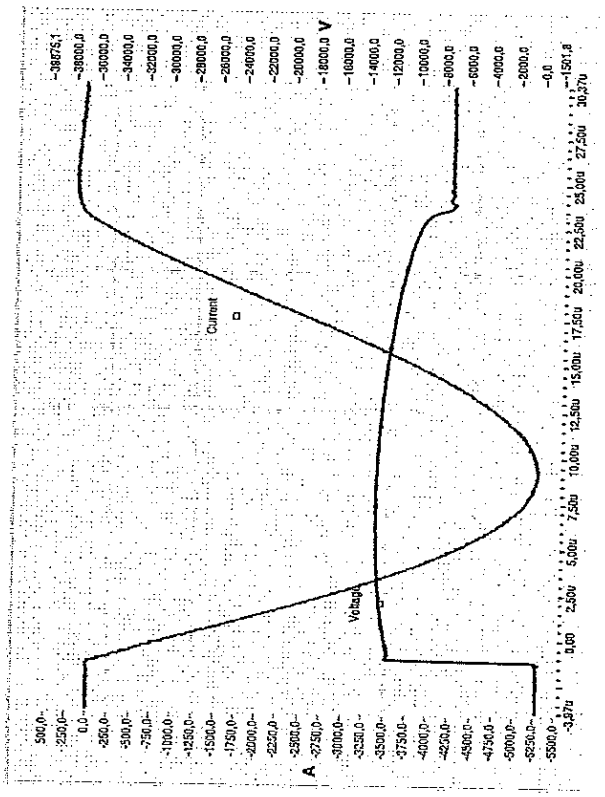
CESI B7020147 Oscillogram n. 64

CESI B7020147 Oscillogram n. 65

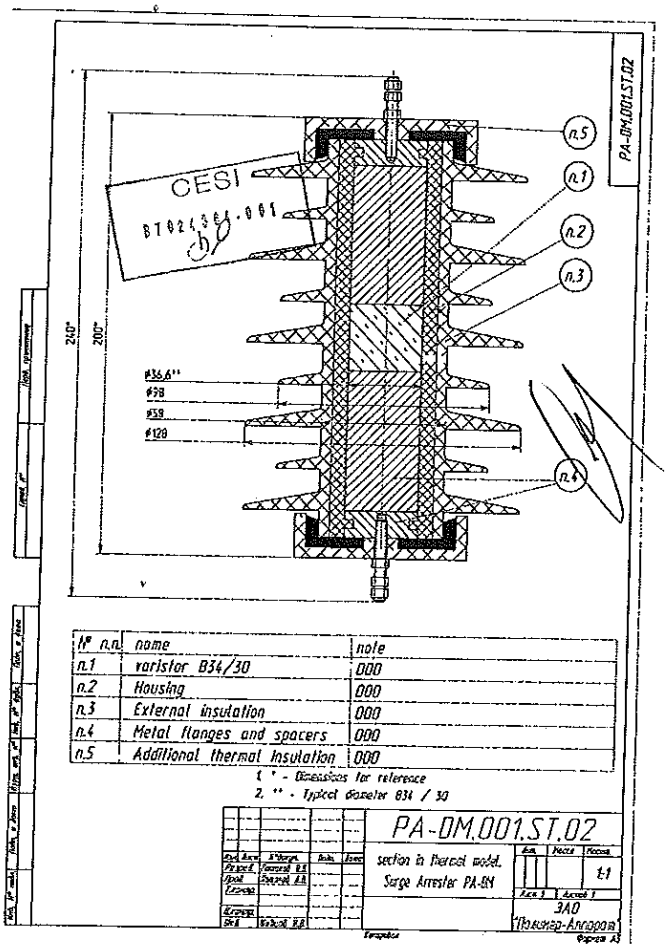
CESI B7020147 Oscillogram n. 66

CESI B7020147 Oscillogram n. 67

ВЯРНО С ОРИГИНАЛА



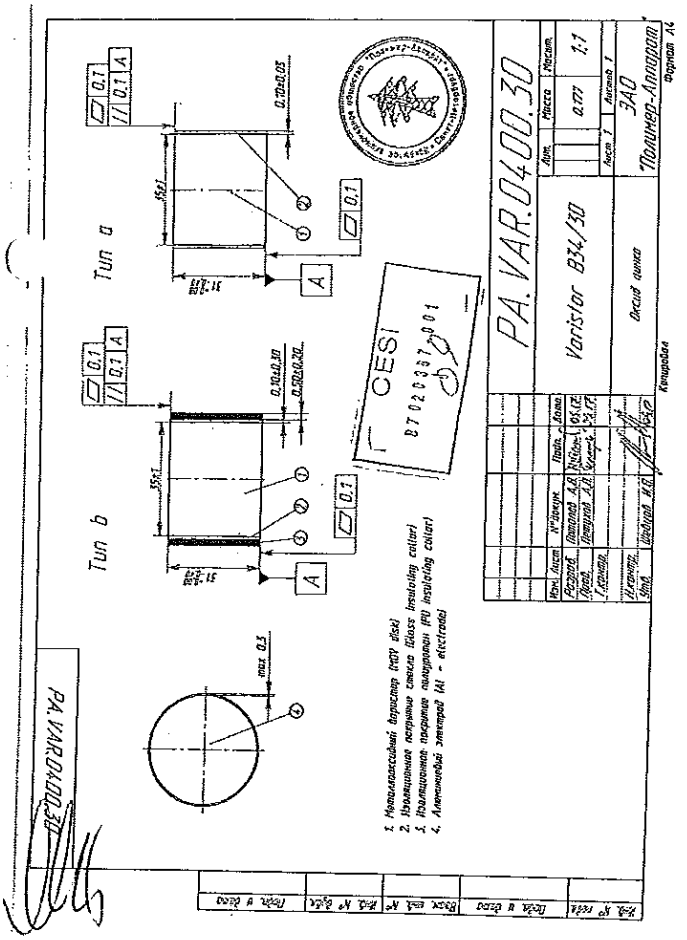
CESI B7020147 Oscillogram n. 68



№ п.п.	name	note
n.1	varistor B34/30	000
n.2	Housing	000
n.3	External insulation	000
n.4	Metal flanges and spacers	000
n.5	Additional thermal insulation	000

1 * - Dimensions for reference
2. ** - Typical diameter 834 / 30

PA-DM.001.ST.02
section in thermal model.
Surge Arrester PA-DM
1:1
ЗАО "Полимер-Аппарат"



The TOV characteristics of PA-DM surge arresters.

The TOV characteristics (in p.u. Ur) of PA-DM surge arresters "with prior duty" and "without prior duty" as per IEC 60099-4 Ed. 3.0 are presented in the Fig.2 below.

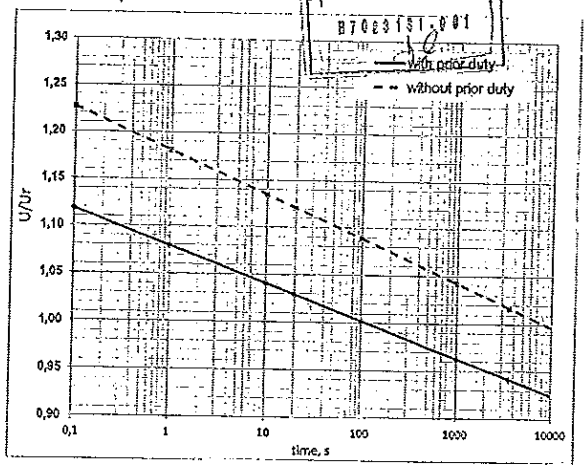


Figure 2. The TOV characteristics of PA-DM surge arresters.

The TOV values in per unit of Ur for times 0,1 s, 1 s, 10 s, 100 s, 1000 s and 3600 s are presented in the table 4.

Table 4.

Time, s	The TOV values in p.u. Ur	
	"with prior duty"	"without prior duty"
0,1	1,120	1,250
1	1,080	1,160
10	1,040	1,130
100	1,000	1,090
1000	0,960	1,040
3600	0,940	1,020

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Приложение 6

JSC "POLYMER-APPARAT"
St. Petersburg, Russian Federation

Добровольная сертификация

МЕТАЛО-ОКСИДНИ ВЕНТИЛНИ ОТВОДИ

PA-DM-093-27-22/22

ТЕХНИЧЕСКО РЪКОВОДСТВО

ТМ 3414-Е323-15207362-2018

ВЯРНО С ОРИГИНАЛА

"ЕМИ ЕЛЕКТРОНИК" ЕООД

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Това ръководство съдържа технически данни за метало-оксидни предпазители от свръхнапрежения в полимерни обвивки тип PA-DM-093-27-22/22

1. Приложение

1.1. Метало-оксидни вентилни отводи от пренапрежения без въздушна междина от тип PA-DM-093, по нататък наричани „отводи", са предназначени за предпазване на електрическо оборудване AC с 48÷62 Hz честота от пренапрежение при комутации и мълнии.

1.2. Класификация на вентилни отводи съгласно IEC 60099-4:2014 – Високо разпределение

2. Дизайн и работна информация

2.1. Вентилните отводи са направени като пакет от метало-оксидни варистори (MOV), затворени в полимерна обвивка с метални фланци.

2.2. Цялостни и монтажни размери са дадени в Приложение А.

2.3. Принципът на работа на ВО се базира на нелинейността на волт-амперната диаграма на цинк-оксидните варистори. При работно напрежение стойността на активните токове през варисторите е по-малка от милиампер, но при свръхнапрежение тези стойности се повишават до стотици и хиляди ампери.

3.Система за маркиране на породукта:

Пример за продуктов номер: **PA-DM-093-27-22/22**

PA - Търговска марка на производител - "Polymer-Apparat";

DM - Високо разпределенеие (класификация на предпазителя съгласно JSC "Polymer-Apparat");

093 - Тип обвивка;

27 - Номинално напрежение (rated voltage), kV;

22 - Високо-волтов вход (M12 type 2);

22 - Заземителна клема (M12 type 2).

4.Условия на работната среда

Работата на ВО се осигурява при следните условия на обслужване:

- На открито;
- Минимална работна температура на околната среда е -60^0 C;
- Минимална работна температура на околната среда е +50^0 C;

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- Надморска височина до 1000 m.

5. Основни характеристики и параметри

5.1. Вентилните отводи отговарят на спецификация: IEC 60099-4:2014. Основните характеристики и параметри са дадени в Таблица 1 по-долу.

Таблица 1

Параметри	Номинална стойност
1. Номинално напрежение, kV	27
2. Трайно напрежение на предпазител (MCOV), kV (rms)	21.6
3. Номинален разряден ток, A	10000
4. Остатъчно напрежение при мълниев импулс на тока с амплитуда 8/20 μs (kV, не повече от):	
5 кА	65.0
10 кА	69.1
20 кА	77.4
5. Остатъчно напрежение при превключващ импулс на ток с амплитуда 30/60 μs (kV, не повече от):	
125 А	50.5
500 А	52.7
6. Остатъчно напрежение при стръмен 1/10 μs токов импулс с амплитуда 10000 А (kV, не повече от)	75.3
7. Траен рейтинг за пренос на заряд Q_{rs}, C	0.4
8. Степен на пренос на топлинна енергия Q_{th}, C	1.1
9. Висок токов импулс 4/10 μs, kA	100
10. Продължителност на текущия импулс, A	300
11. Референтно напрежение (при референтен ток I_{ref} = 1.5 mA), kV, не по-малко от	25.1

5.2.Външни параметри на изолация:

– Обявено издържано мълниево импулсно напрежение 1.2/50 μs , не по-малко от 144 kV

– Обявено издържано мълниево импулсно напрежение 60 Hz, не по-малко от 90 kV

– Разстояние на утечка, не по-малко от 938mm

5.1.5.3. Изолацията на ВО е устойчива на ерозия и проникване на влага.

5.4.Сеизмична стабилност, MSK-64 номер 9.

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5.5.Ниво на частично разреждане в предпазителя при напрежение 1.05×U_{cont} –не повече от 10 pC.

5.6.TOV характеристики (отнесени към MCOV) представени в Таблица 3 по-долу

Продължителност на завишено напрежение	0.1 c	0.15 c	1.0 c	3.5 c	10 c	20 c	20 min	50 min	2 h	6 h
Допустимо съотношение на повишено напрежение на предпазителите по отношение на U_{cont}	1.48/ 1.56	1.47/ 1.55	1.43/ 1.50	1.40/ 1.47	1.37/ 1.45	1.36/ 1.43	1.26/ 1.33	1.23/ 1.30	1.22/ 1.29	1.19/ 1.26

Забележка:

– *Числителят отговаря на тест при предварително загрят предпазител до 60 ^{0}C изпитан чрез два правоъгълни импулса равни на рейтинга на устройството;*

– *Стойността на знаменателя съответства на тест при загрят до 60 ^{0}C предпазител без допълнителни импулси.*

6.Безопастност

6.1. Вентилните отводи са устойчиви на експлозия и издържат на следните токове на късо съединие без да експлодират:

- 20 kA (rms) за 0,2 с (не по-малко);
- 600 A (rms) за 2 с (не по-малко)

6.2. Вентилните отводи отговарят на IEC 60099-4:2014.

7. Експлоатационен живот

Очакван експлоатационен живот на Вентилните отводи (с 0.98 вероятност за безпроблемност) е 30+ години.

8.Стандартен набор и опции

Комплектът за доставка се състои от:

– Предпазител;

– QC сертификат за тест;

– Техническо упътване (3 копия за вид предпазител).

Вентилните отводи се състои от:

– Метало-оксиден предпазител от пренапрежение без пролуки тип PA-DM-93

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– Високо волтов вход тип 02 - пин М12×50 - 1 бр., шайба ∅12 - 2 бр.., пружинна шайба ∅12 - 1 бр;

– Заземителна клема тип 02 - пин М10×25 - 1 бр., шайба ∅12 - 2 бр., пружинна шайба ∅12 - 1 бр.

9.Обозначения

На долният фланец на предпазителя е отбелязано:

– Име на производителя;

– Тип на предпазител;

– MCOV, kV;

– Заводски номер;

– Дата на производство.

10.Транспортиране

Транспортирането се извършва в оригиналната опаковка с етикети:

– Чупливо;

– Да не се мокри;

– Нагоре

11.Съхранение

Вентилните отводи трябва да се съхраняват в оригиналната опаковка.Да се съхраняват на закрито.Няма необходимост от затопляне/охлаждане в диапазона от -60^0 С до $+50^0$ С.

При съхранение и транспорт Вентилните отводи не трябва да излагат на влага,маслени продукти, киселини, алкални, газове и други агресивни субстанции, които могат да навредпт на полимерната обвивка.

Приемането на продукта трябва да включва проверка на цялостта на опаковката и съответствие с поръчката.

12.Инсталация

12.1.Само квалифициран персонал, запознат с това техническо ръководство и правила за безопасност може да борави с тези вентилни отводи.

<u>ВНИМАНИЕ:</u> За да избегнете щети, ВО не трябва да се докосват до абразивни повърхности,остри ръбове или режещи инструменти.

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"ЕЙЧИ ЕЛЕКТРИК" ЕООД

12.1. Извадете ВО от опаковката и се уверете, че няма видими повреди, които да са се появили при транспортирането.

12.2. Инсталирайте ВО, като следвате диаграмата в Приложение А.

12.3. Заземяването на предпазителя се извършва чрез гъвкав меден проводник със сечение не по-малко от 6 mm^2.

13. Изисквания за поддръжка

Поддръжка на Вентилните отводи не е предвидена.

Вентилните отводи не подлежат на ремонт. Няма инструкция за ремонт.

14. Гаранция

Производитея ще замени повредени Вентилни отводи в срок от 5 години от датата на пускане в експлоатация, но не по-късно от 7 години от датата на експедиция от производителя, при условие, че повреденият ВО е бил транспортиран, съхраняван ,инсталиран и експлоатиран стриктно спазвайки това техническо ръководство.

15. Рециклиране

Вентилните отводи не съдържат опасни или агресивни материали, които могат да навредят на хора или животни, които имат контакс с тях. Рециклирайте в съответствие с местните разпоредби за индустриални отпадъци от метал и пластмаса.

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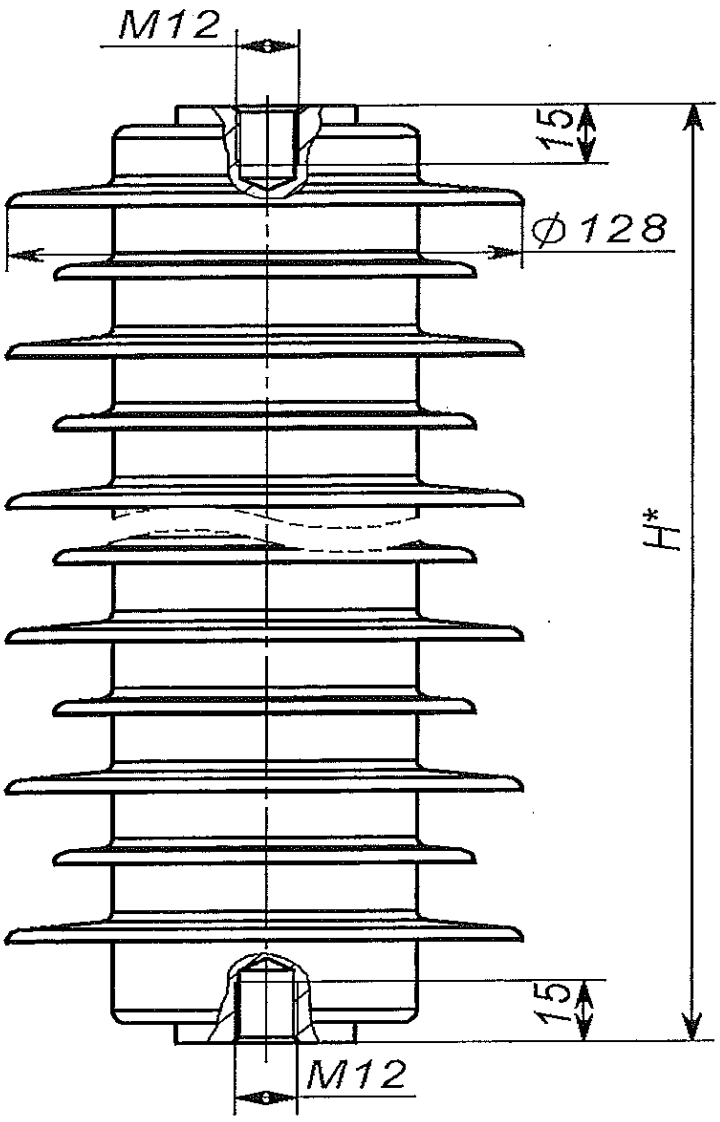
ПРИЛОЖЕНИЕ А

Външни и инсталационни размери и тегло на вентилни отводи тип PA- DM -093



Височина на ВО (Н) – 275 ± 1 mm.

Тегло на ВО– 2.8±0.1 kg

ВЯРНО С ОРИГИНАЛА

"ЕЛИ Електрик" ЕООД

Test Report

Document No.	B6020612	Copy No. 1	Number of pages	24
Apparatus	Polymeric housing surge arresters			
Designation	PA-DH			
Serial Number	3508-3509-3510-3511			
Manufacturer	JSC "Polymer-Apparat"			
Client	JSC "Polymer-Apparat" Ak. Konstantinova Str.,1 195427 Saint-Petersburg – Russia Federation			
Tested for	-			
Date(s) of tests	September 16, 2016			
Tested by	CESI S.p.A. Via Rubattino, 54 20134 Milano – Italy			
Test performed	Short circuit tests			

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

IEEE Std C62.11-2012

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

September 16, 2016

Ghezzi Giuseppe
Test Engineer in charg...

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The authenticity of this document is guaranteed by the integrity of hologram.

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO
LAB N° 0030

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

CESI

Trust the Power of Experience

На основание чл. 2 от ЗЗЛД

PAD B6020612 (29/LBV)–CONFIDENTIAL USE

Notes

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

CESI Group Test Documents description

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

Test Certificate of (complete / selected) Type Tests
Issued if type tests of low voltage products (< 1 kV_{ac}; < 1,5 kV_{dc}) requested by the relevant product standard were passed. For these tests the equipment under test must be clearly identified by technical description, drawings, and additional specifications.

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

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

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

On-Site Test Record
Issued as a record of results acquired during the on-site tests / measurements

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

Приложение 4

Tests witnessed by

Mr. Kolychev Alexandr Joint-Stock Company Polymer-Apparat

Identification of the object Effected.
The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings.
CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.
These drawing identified by CESI and numbered B6019250 No. 1 are annexed to this document.

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

Only for laboratory requirement, in order to reproduce the test conditions, all the laboratory data are contained in the document marked B6018837 and in the following revisions:

Revision No.	Date	Reference

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

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

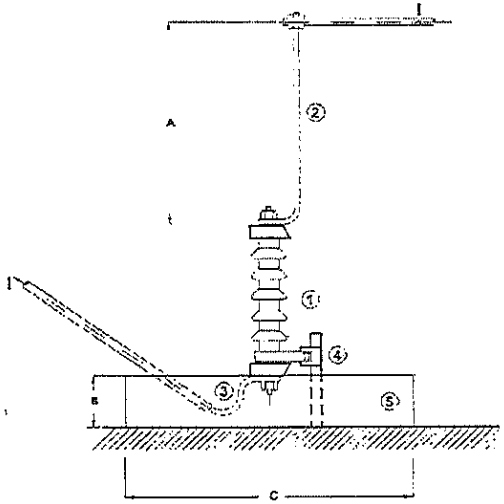
Receipt date of the sample September 2016

D10021G

Contents

Metal-oxide surge arrester	
Manufacturer	Joint-Stock Company Polymer-Apparat
Type	PA-DH
Drawing	
Rated voltage (Ur)	54,0 kV
Maximum continuous operating voltage (Uc)	43,2 kV
Rated frequency	50/60 Hz
Nominal discharge current (8/20 µs impulse shape)	10 kA
Arrester classification	DH
Rated short circuit current	
High current	for 0,20 s ; 20,0 kA
Low current	for 1,00 s ; 0,6 kA

D8058 - Test arrangement

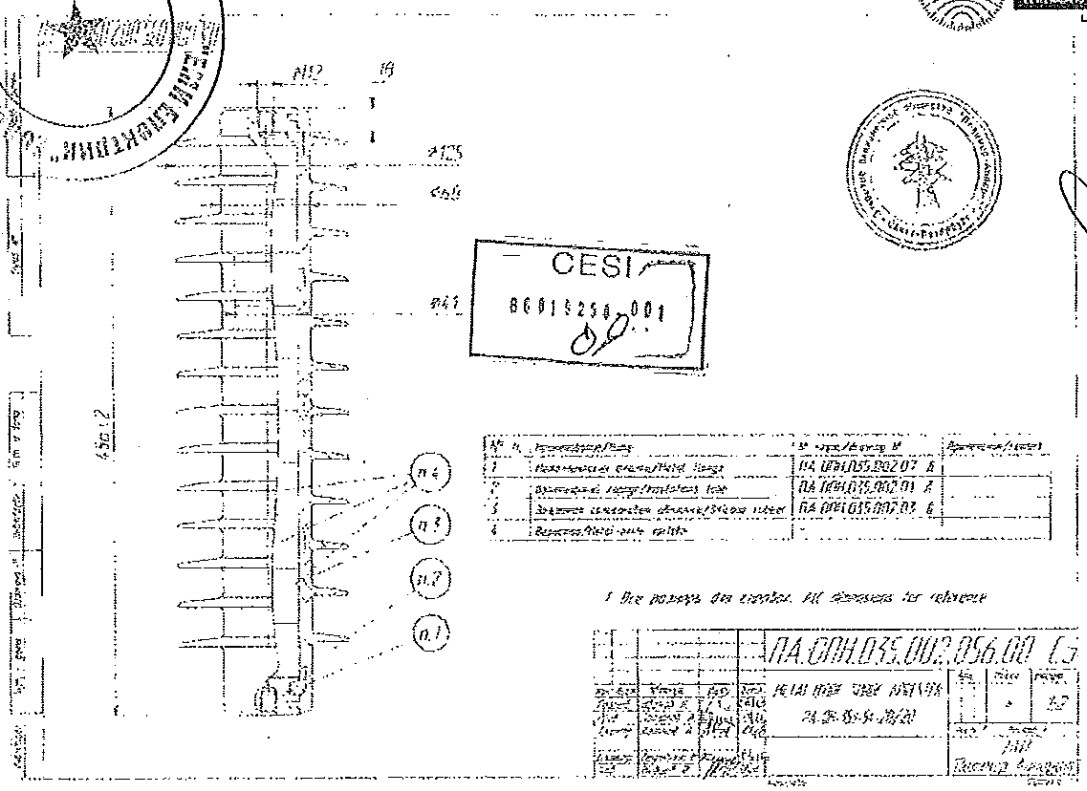


1 : Surge arrester
2 : Flexible conductor
3 : Flexible conductor
4 : Not metallic pole
5 : Enclosure

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

The arrester to be tested was installed by means of a crossarm on a not metallic pole at 0,4 m to ground in the middle of a square enclosure of 1.80 m in side.
The live side of the supply was connected to the upper end of the arrester while the return circuit, earthod, was connected to the lower end.
The live conductor was directed to the opposite direction as the earth conductor

D12321O



D12321O

High-current short-circuit tests with 12,1 kA for 0,22 s

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

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
6	1	12,6	33,7

Under test surge arrester PA-DH Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.
The voltage applied to the arrester was 63 kV and kept at this value or slightly adjusted till arrester failure.
The pre-failure process duration was 3 minutes and 12 seconds
The short-circuit test was performed 5 minutes and 40 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: September 16, 2016

Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
						Peak value	rms value			
		Sheets	No.	s	kV	kA	kA	s	ms	No.
2	10	1	3509	0,22	36.0	28,3	12,1	-	5,7	-

Condition of the apparatus after the tests:
- there was not violent shattering
- the arrester was found broken in two parts
- the arrester remained connected to the supply and return circuit
- some blocks fragment were found inside the enclosure. Polymer fragments found inside and outside the enclosure
- no flame was noted

Acceptance criteria according to clause 8.7.6: Satisfied
Test result: Positive

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D1232IG

High-current short-circuit tests with 6,06 kA for 0,22 s

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

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
11	1	6,23	16,5

Under test Surge arrester PA-DH Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to o achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.
The voltage applied to the arrester was 63 kV and kept at this value or slightly adjusted till arrester failure.
The pre-failure process duration was 4 minutes and 05 seconds
The short-circuit test was performed 4 minutes and 55 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: September 16, 2016

Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
						Peak value	rms value			
		Sheets	No.	s	kV	kA	kA	s	ms	No.
3	13	1	3510	0,22	36,0	13,8	6,06	-	6,1	-

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

Acceptance criteria according to clause 8.7.6: Satisfied
Test result: Positive

D1232IG

Low-current short-circuit tests with 602 A for 1,01 s

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

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

Under test surge arrester PA-DH Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to o achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.
The voltage applied to the arrester was 63 kV and kept at this value or slightly adjusted till arrester failure.
The pre-failure process duration was 5 minutes and 30 seconds
The short-circuit test was performed 5 minutes and 25 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

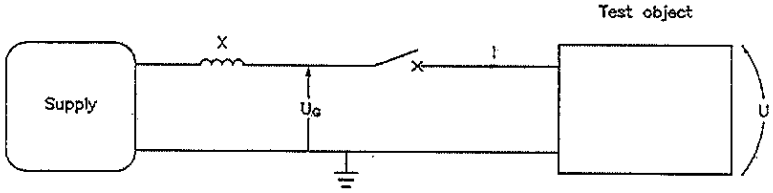
Date: September 16, 2016

Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
						Peak value	rms value			
		Sheets	No.	s	kV	kA	A	s	ms	No.
4	15	1	3511	1,01	36,0	1,19	602	25	8,30	-

Condition of the apparatus after the tests:
- there was not violent shattering
- the arrester structure remained intact
- the arrester remained connected to the supply and return circuit
- no fragment were found inside or outside the enclosure
- the flame self-extinguished after 25 seconds

Acceptance criteria according to clause 8.7.6: Satisfied
Test result: Positive

Test circuit D0046



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

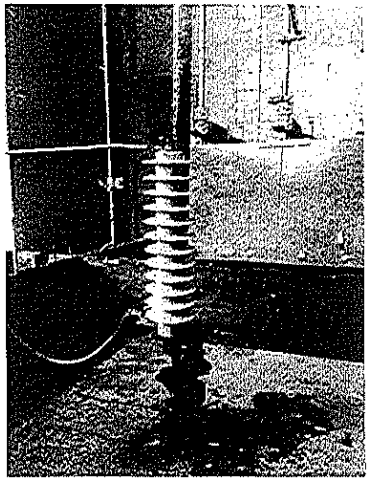


Photo No.1
Before test No. 1

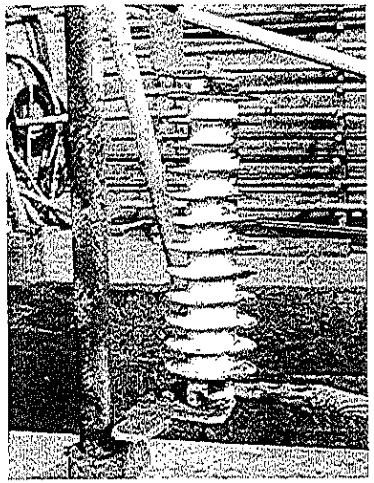


Photo No.2
After test No. 1

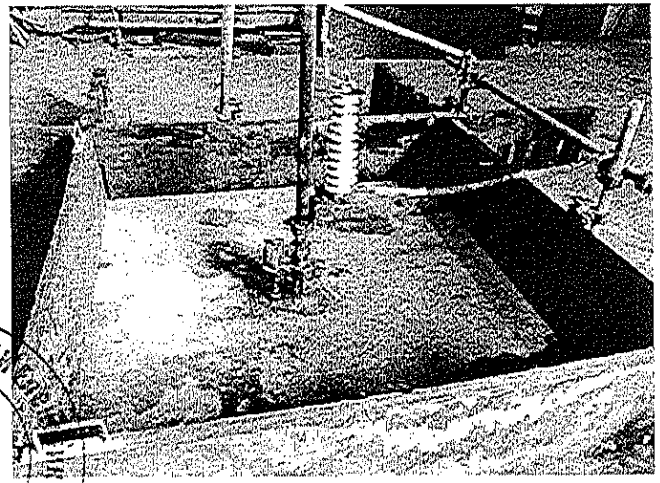


Photo No.3
After the test No.1

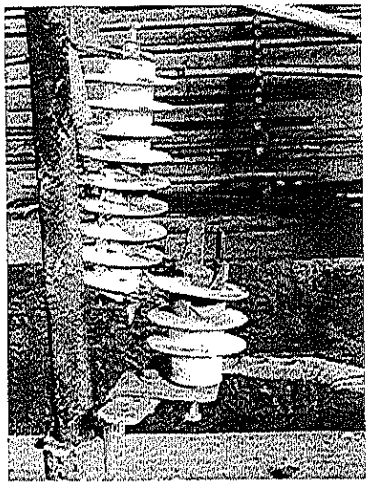


Photo No.4
After the test No.2

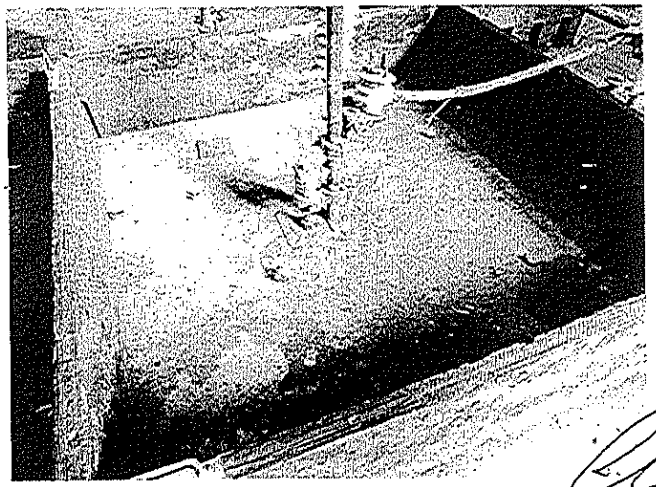


Photo No.5
After the test No. 2

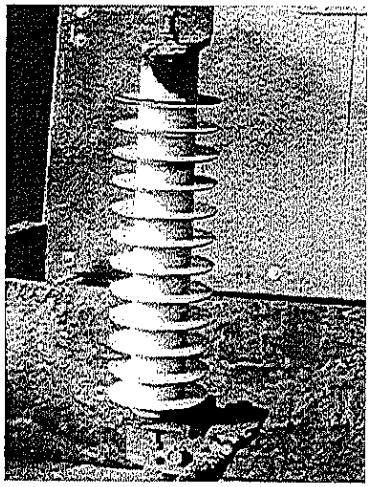


Photo No.6
After the test No.3

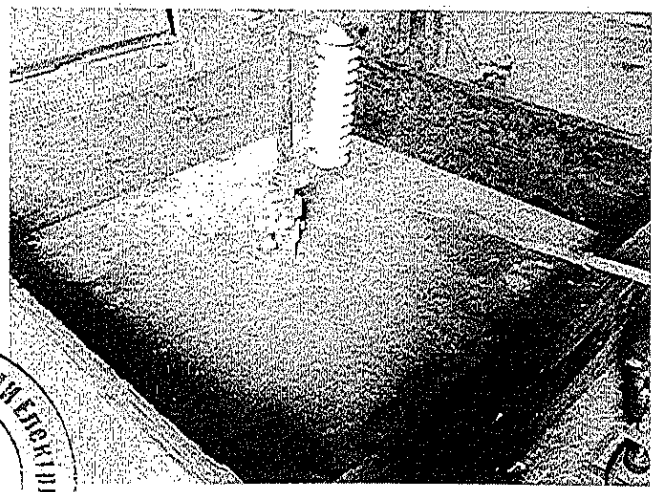


Photo No.7
After the test No.3

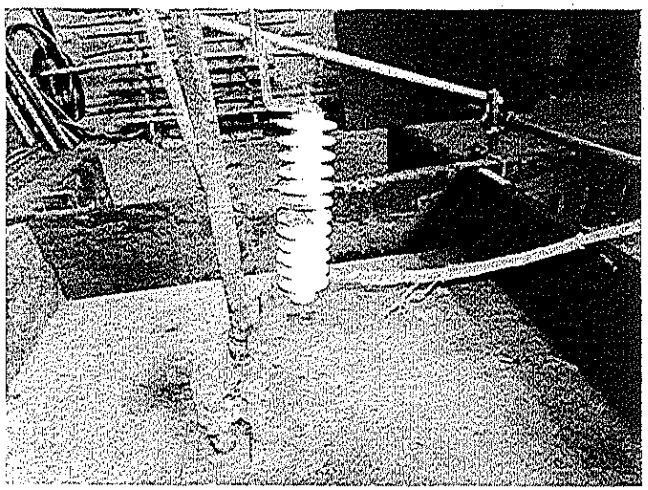


Photo No.8
After the test No.4

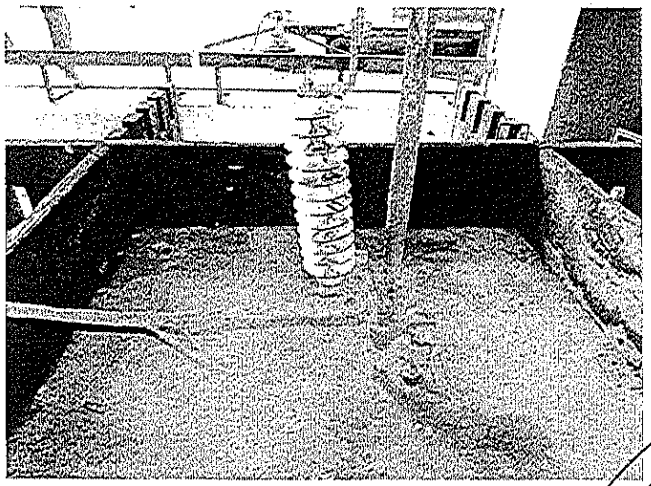
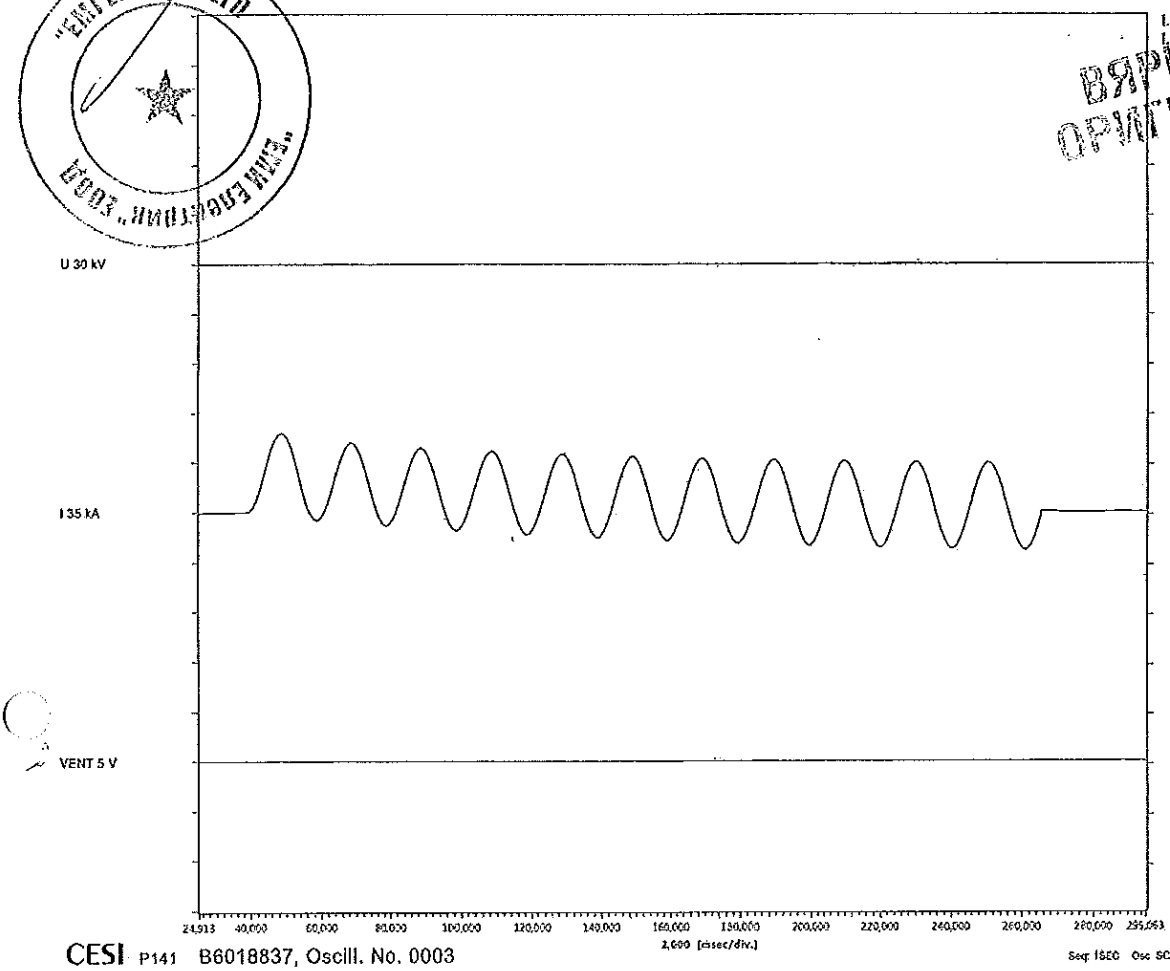
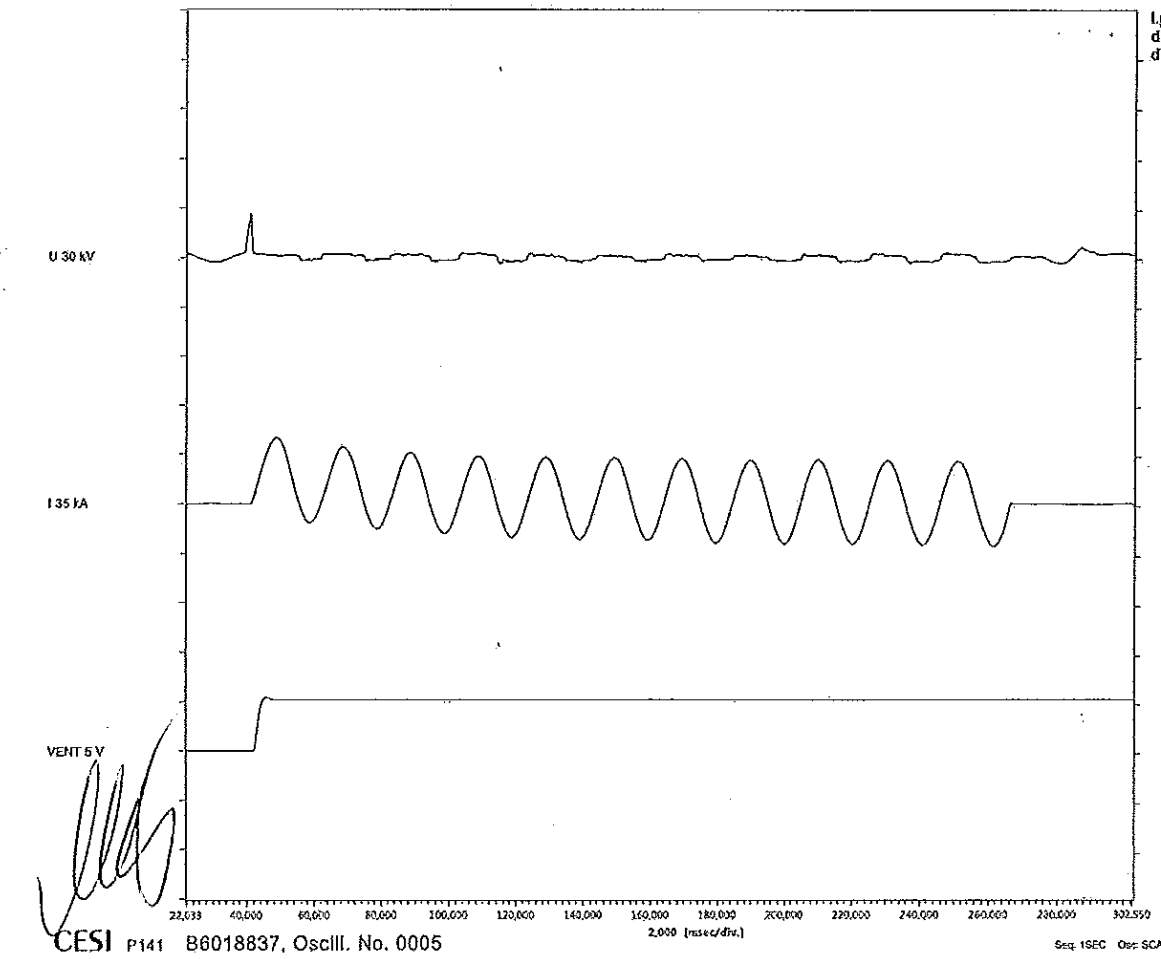


Photo No.9
After the test No.4



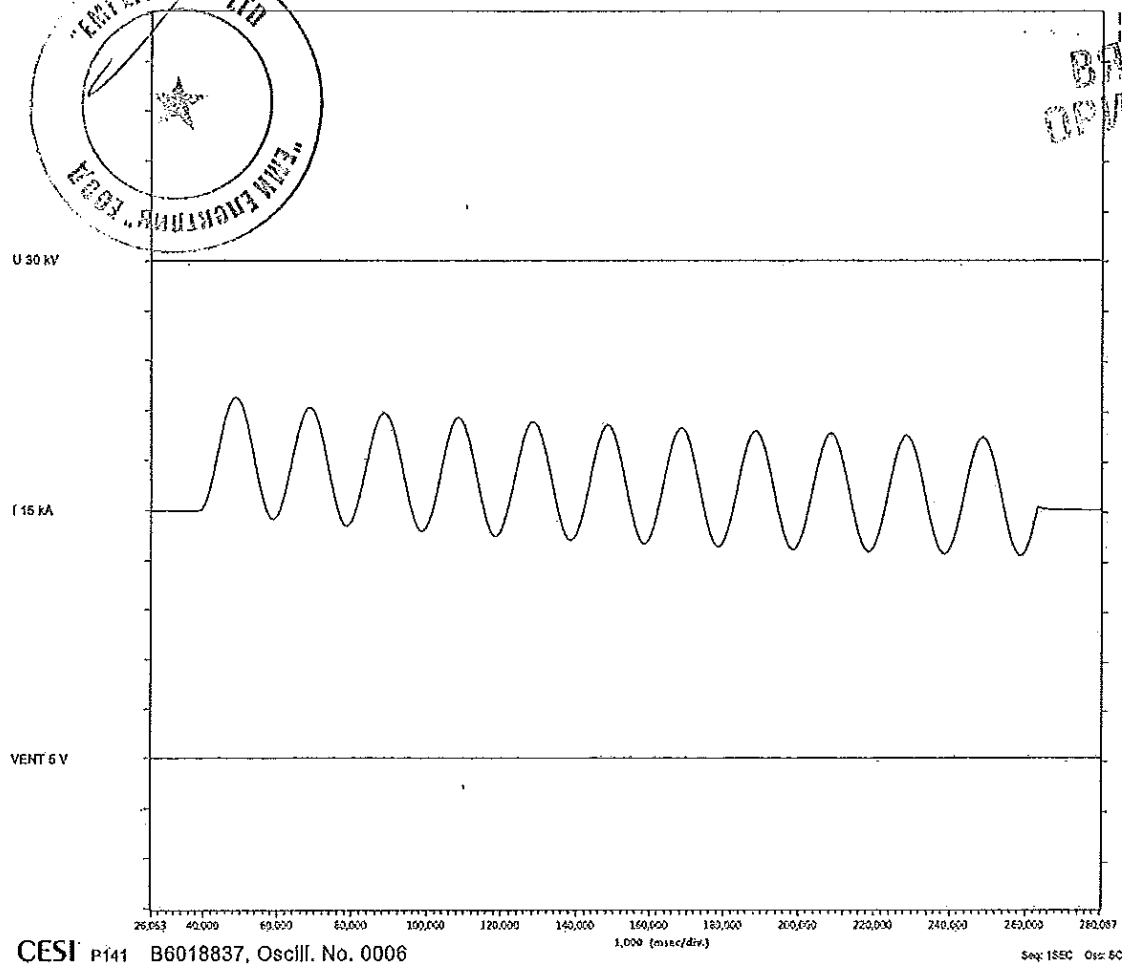
CESI P141 B6018837, Oscill. No. 0003

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



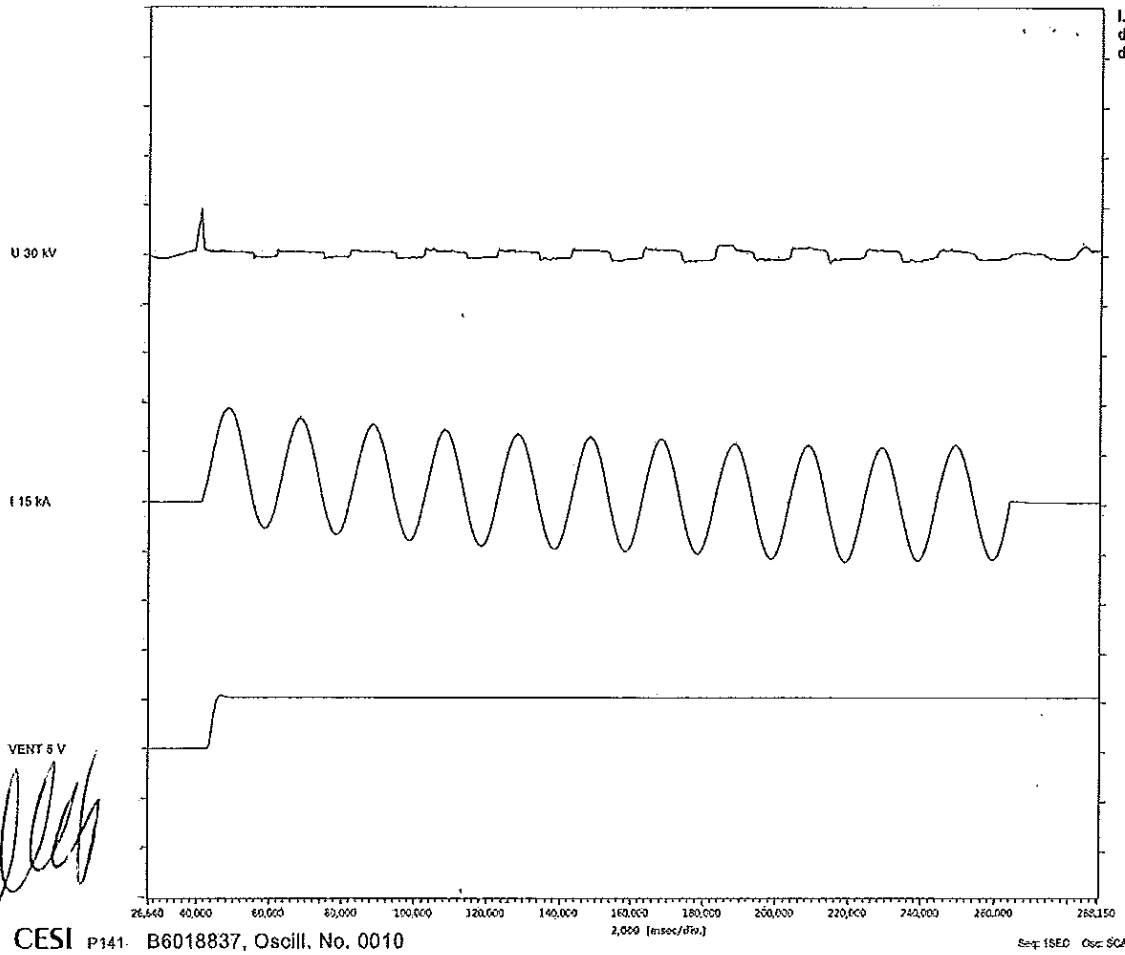
CESI P141 B6018837, Oscill. No. 0005

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



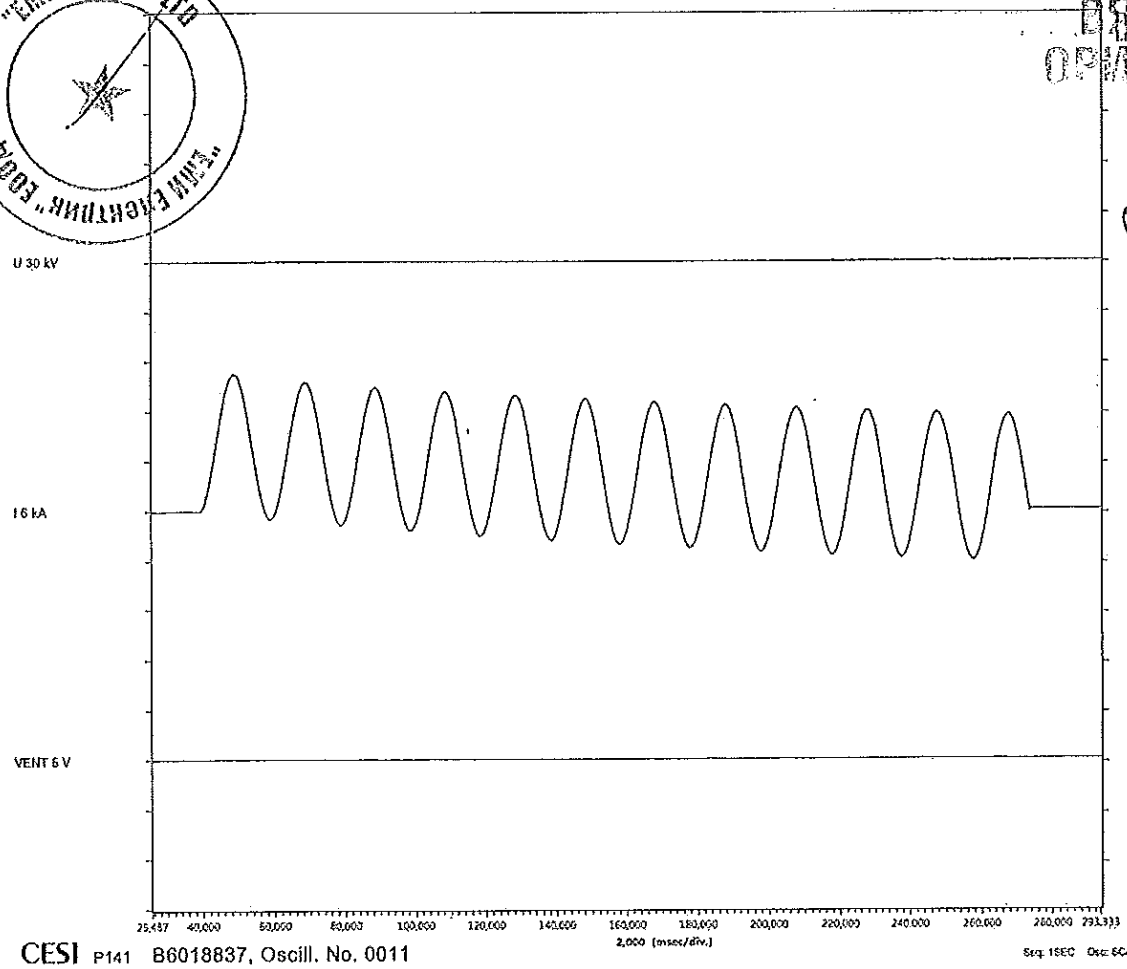
CESI P141 B6018837, Oscill. No. 0006

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



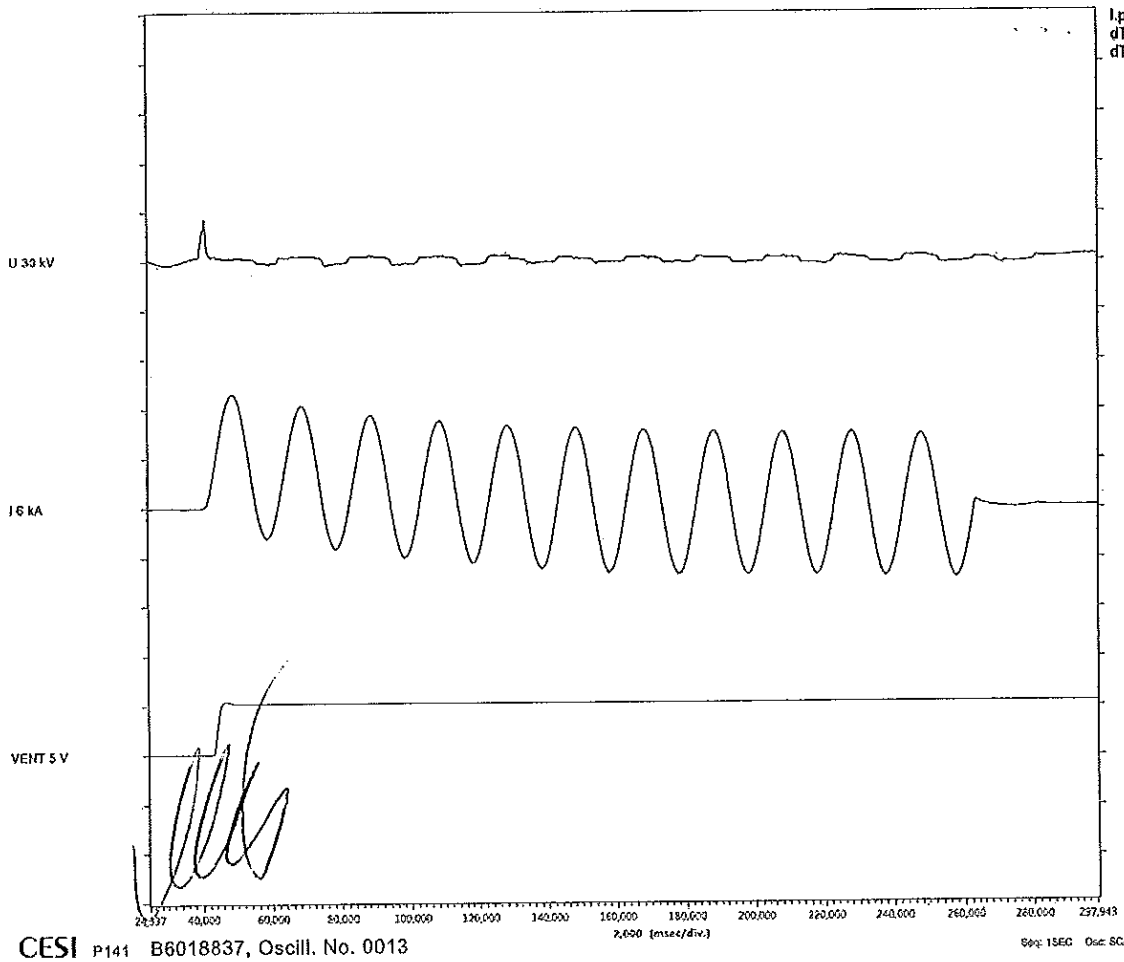
CESI P141 B6018837, Oscill. No. 0010

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



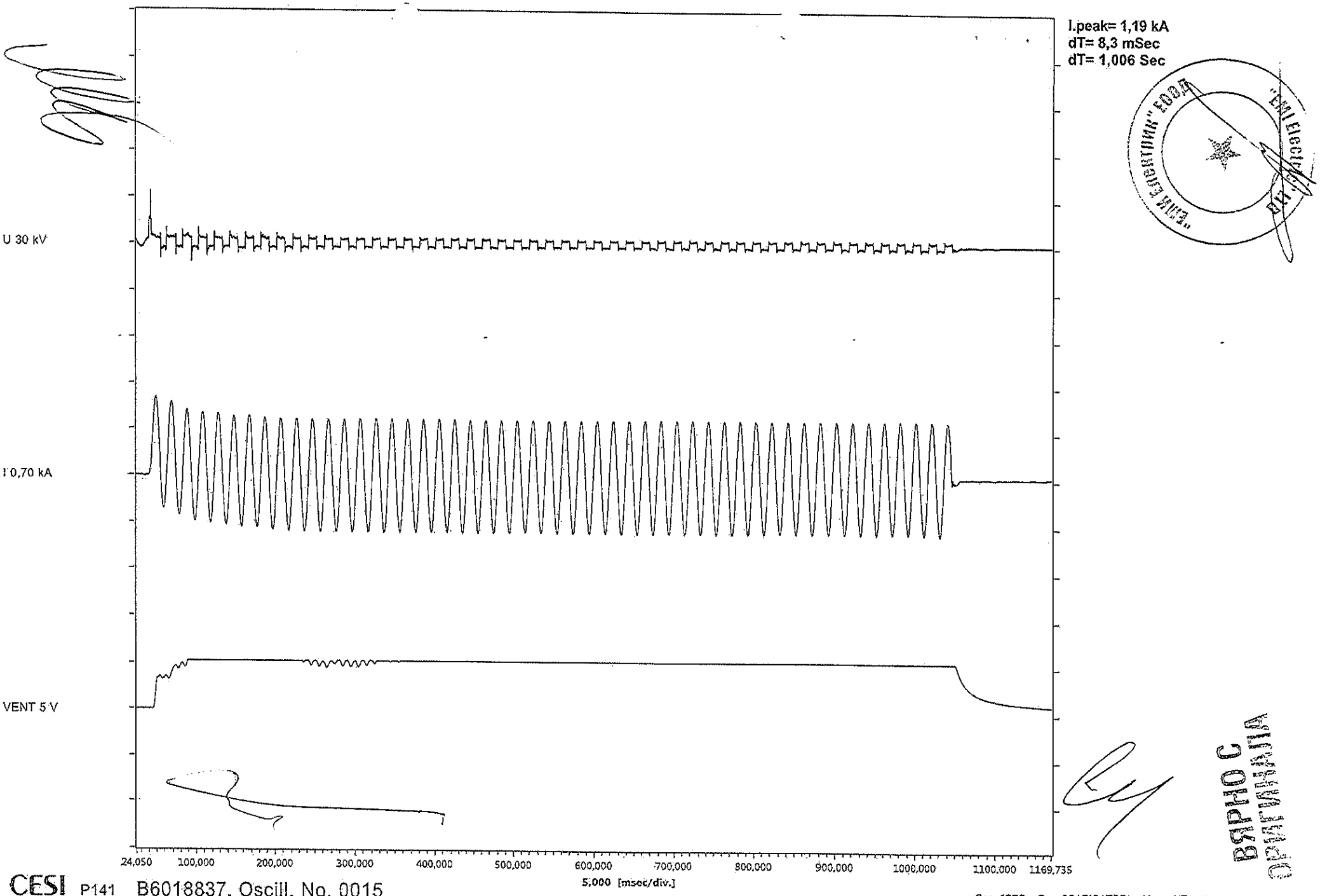
CESI P141 B6018837, Oscill. No. 0011

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



CESI P141 B6018837, Oscill. No. 0013

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


I.peak= 1,19 kA
dT= 8,3 mSec
dT= 1,006 Sec
U 30 kV
I 0,70 kA
VENT 5 V
24,050
100,000
200,000
300,000
400,000
500,000
600,000
700,000
800,000
900,000
1000,000
1100,000
1169,735
5,000 [msec/div.]
CESI P141 B6018837, Oscill. No. 0015
Seq: 1SEC Osc: SCARICATORI Meas: HF1 - 1

Test Report

Document No.	B6020613	Copy No.	1	Number of pages	24
Apparatus	Polymeric housing surge arresters				
Designation	PA-DH				
Serial Number	3508-3509-3510-3511				
Manufacturer	JSC "Polymer-Apparat"				
Client	JSC "Polymer-Apparat" Ak. Konstantinova Str.,1 195427 Saint-Petersburg – Russia Federation				
Tested for	-				
Date(s) of tests	September 16, 2016				
Tested by	CESI S.p.A. Via Rubattino, 54 20134 Milano – Italy				
Test performed	Short circuit tests				

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

IEC 60099-4 (2014-05)

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

September 16, 2016

Ghezzi Giuseppe
Test Engineer in charge

Date

ACCREDIA
ITALIAN BOARD FOR ACCREDITATION

LAB N° 0030

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

CESI

Trust the Power of Experience

Notes

STL-Member

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

CESI Group Test Documents description

Type Test Certificate of .....

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

Test Certificate of (complete / selected) Type Tests

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

Certificate of Design Verification

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

Type Test Report

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

Test Report

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

On-Site Test Record

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

Test Award

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

Tests witnessed by

Mr. Kolychev Alexandr Joint-Stock Company Polymer-Apparat

Identification of the object Effected.
The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings.
CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.
These drawing identified by CESI and numbered B6019250 No. 1 are annexed to this document.

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

Only for laboratory requirement, in order to reproduce the test conditions, all the laboratory data are contained in the document marked B6018837 and in the following revisions:

Revision No.	Date	Reference

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

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

Receipt date of the sample September 2016

IAC-MRA ACCREDIA ITALIAN BOARD OF ACCREDITATION LAB. N° 0030

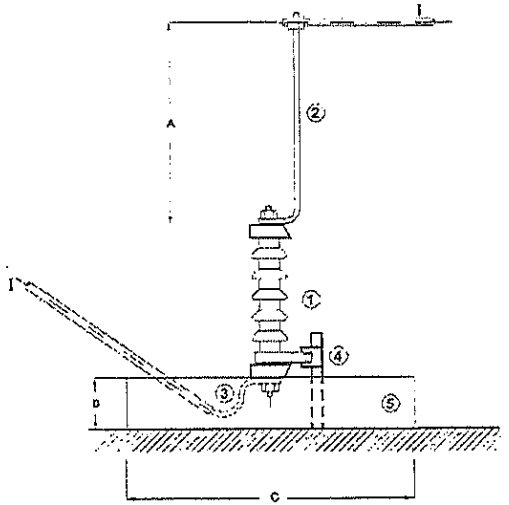
D1001IG
rev.07

D1002IG

Contents

Metal-oxide surge arrester	
Manufacturer	Joint-Stock Company Polymer-Apparat
Type	PA-DH
Drawing	
Rated voltage (Ur)	54,0 kV
Maximum continuous operating voltage (Uc)	43,2 kV
Rated frequency	50/60 Hz
Nominal discharge current (8/20 µs impulse shape)	10 kA
Arrester classification	DH
Rated short circuit current	
High current	for 0,20 s ; 20,0 kA
Low current	for 1,00 s ; 0,6 kA

D8058 - Test arrangement

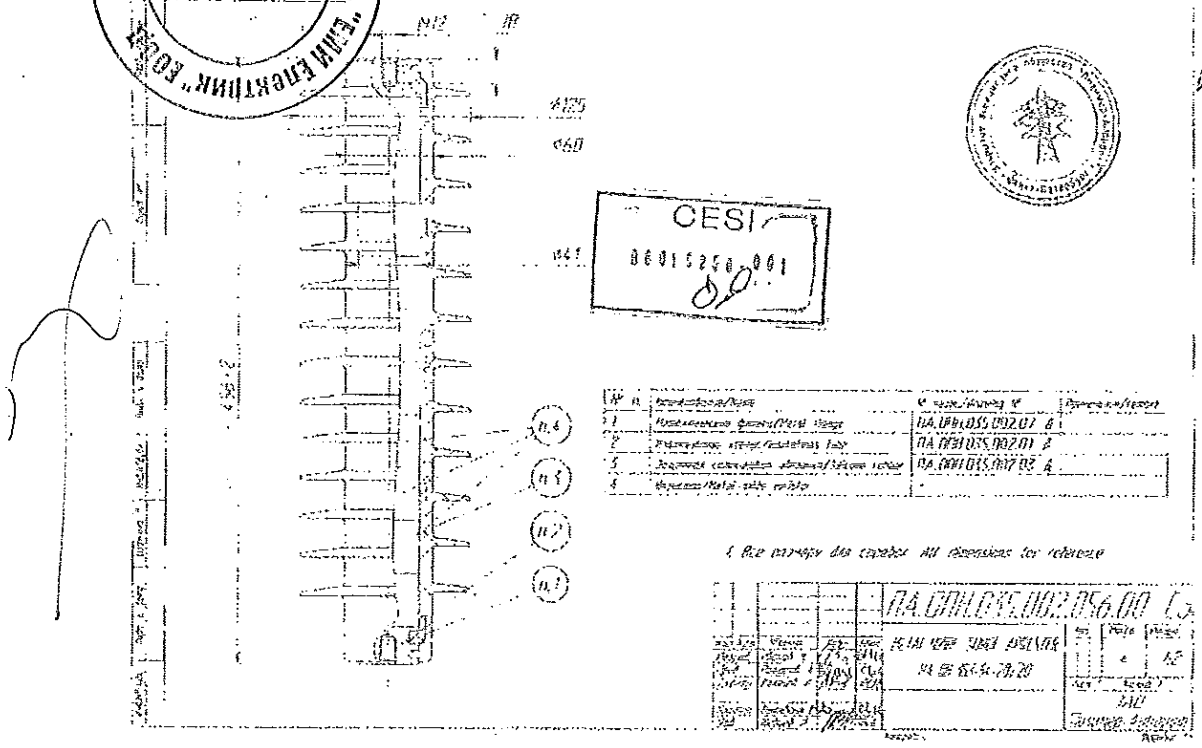


I : Surge arrester
2 : Flexible conductor
3 : Flexible conductor
4 : Not metallic pole
5 : Enclosure

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

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

D1232IG



D1232IG

High-current short-circuit tests with 20,2 kA for 0,23 s

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

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
3	1	21,0	55,8

Under test surge arrester PA-DH Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to o achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.
The voltage applied to the arrester was 63 kV and kept at this value or slightly adjusted till arrester failure.
The pre-failure process duration was 2 minutes and 45 seconds
The short-circuit test was performed 6 minutes and 10 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: September 16, 2016

Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
						Peak value	rms value			
		Sheets	No.	s	kV	kA	kA	s	ms	No.
1	5	1	3508	0,23	36,0	46,9	20,2	-	4,2	-

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

Acceptance criteria according to clause 8.7.6: Satisfied
Test result: Positive

D1232IG

High-current short-circuit tests with 12,1 kA for 0,22 s

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

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
6	1	12,6	33,7

Under test surge arrester PA-DH Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to o achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.
The voltage applied to the arrester was 63 kV and kept at this value or slightly adjusted till arrester failure.
The pre-failure process duration was 3 minutes and 12 seconds
The short-circuit test was performed 5 minutes and 40 sec after the completion of the pré-failure process.

Condition of the apparatus before the tests: new

Date: September 16, 2016

Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
						Peak value	rms value			
		Sheets	No.	s	kV	kA	kA	s	ms	No.
2	10	1	3509	0,22	36,0	28,3	12,1	-	5,7	-

Condition of the apparatus after the tests:
there was not violent shattering
- the arrester was found broken in two parts
- the arrester remained connected to the supply and return circuit
- some blocks fragment were found inside the enclosure. Polymer fragments found inside and outside the enclosure
- no flame was noted

Acceptance criteria according to clause 8.7.6: Satisfied
Test result: Positive

D1232IG

High-current short-circuit tests with 6,06 kA for 0,22 s

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

Prospective test current			
Oscillogram		rms value	Peak value
No.	Sheets	kA	kA
11	1	6,23	16,5

Under test Surge arrester PA-DH Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to o achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.
The voltage applied to the arrester was 63 kV and kept at this value or slightly adjusted till arrester failure.
The pre-failure process duration was 4 minutes and 05 seconds
The short-circuit test was performed 4 minutes and 55 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: September 16, 2016

Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
						Peak value	rms value			
		Sheets	No.	s	kV	kA	kA	s	ms	No.
3	13	1	3510	0,22	36,0	13,8	6,06	-	6,1	-

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

Acceptance criteria according to clause 8.7.6: Satisfied
Test result: Positive

D1232IG

Low-current short-circuit tests with 602 A for 1,01 s

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

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

Under test surge arrester PA-DH Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to o achieve the internal discharge the surge arrester has been electrically pre-failed by means of a power frequency over-voltage application using an auxiliary low power source.

The short-circuit current of the auxiliary low power source has been set at about 10 A.
The voltage applied to the arrester was 63 kV and kept at this value or slightly adjusted till arrester failure.
The pre-failure process duration was 5 minutes and 30 seconds
The short-circuit test was performed 5 minutes and 25 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: September 16, 2016

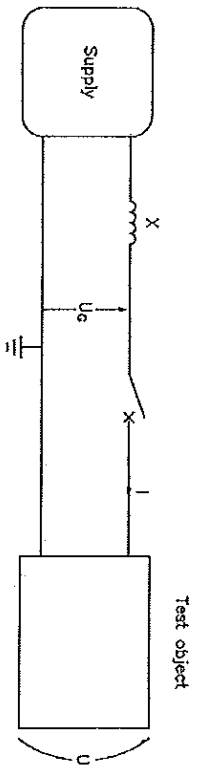
Test	Oscillogram		Arrester under test	Duration	Test voltage	Test current		Time to flame extinction after the test	Venting time	Notes
						Peak value	rms value			
		Sheets	No.	s	kV	kA	A	s	ms	No.
4	15	1	3511	1,01	36,0	1,19	602	25	8,30	-

Condition of the apparatus after the tests:
there was not violent shattering
- the arrester structure remained intact
- the arrester remained connected to the supply and return circuit
- no fragment were found inside or outside the enclosure
- the flame self-extinguished after 25 seconds

Acceptance criteria according to clause 8.7.6: Satisfied
Test result: Positive

D0046IG

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



Test circuit D0046

Test Report CESI Approved B6020613 Page 12

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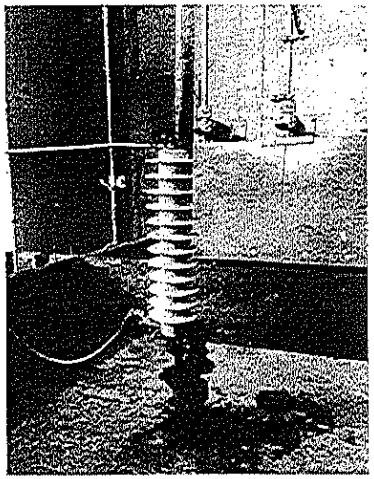


Photo No.1
Before test No. 1

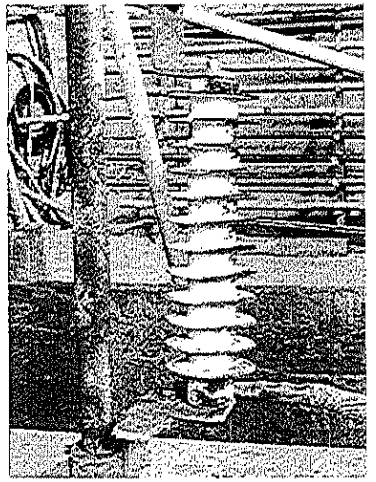


Photo No.2
After test No. 1

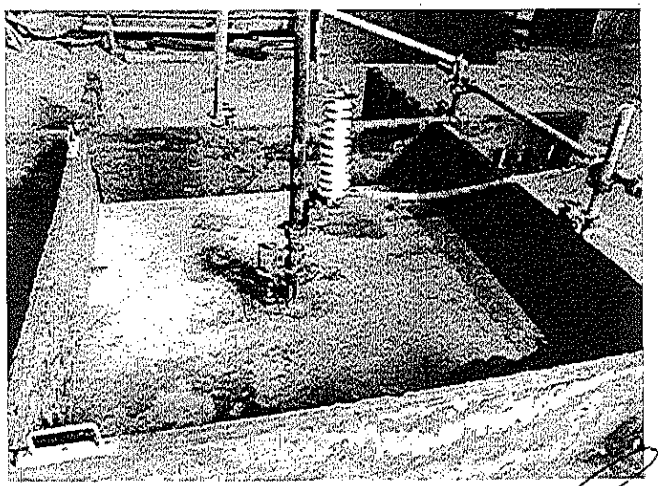


Photo No.3
After the test No.1

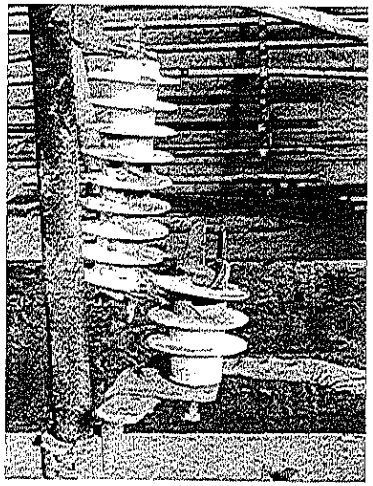


Photo No.4
After the test No.2

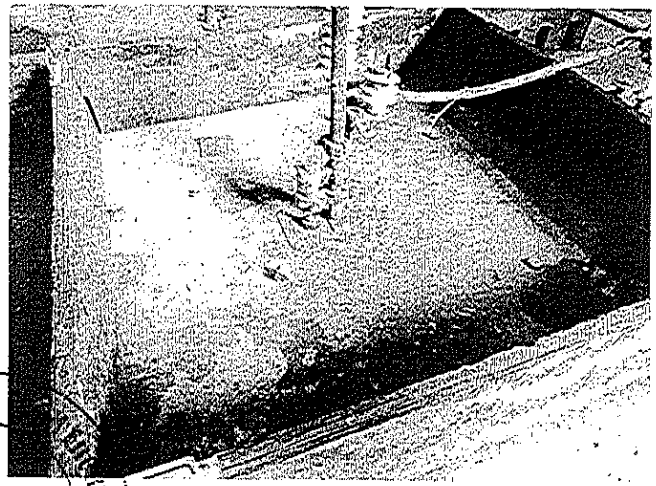


Photo No.5
After the test No. 2

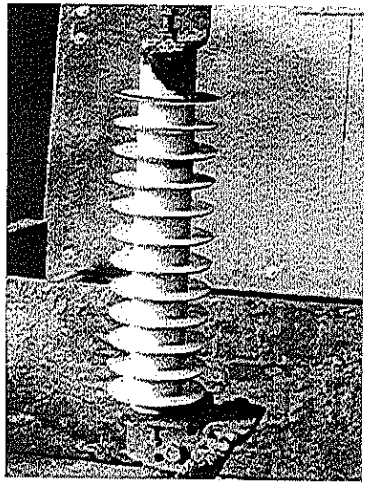


Photo No.6
After the test No.3

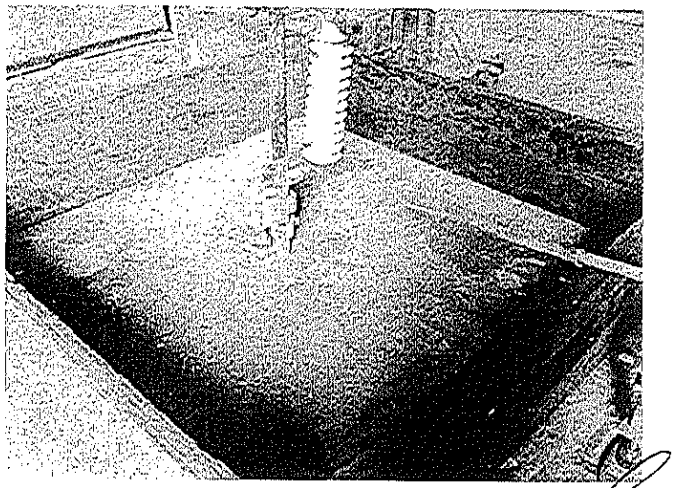


Photo No.7
After the test No.3

D16911G

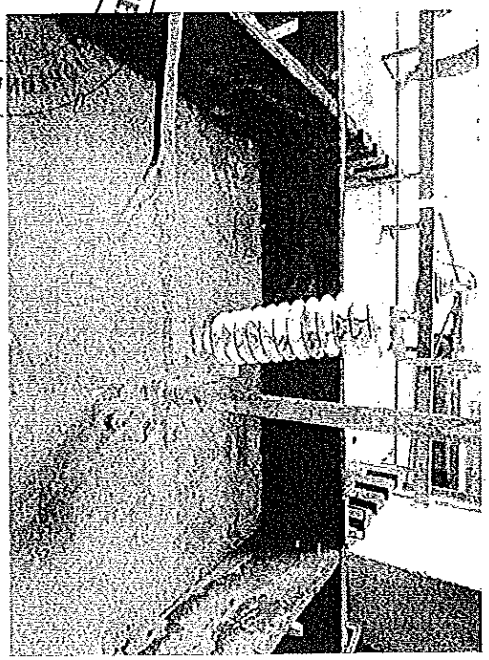


Photo No.9
After the test No.4

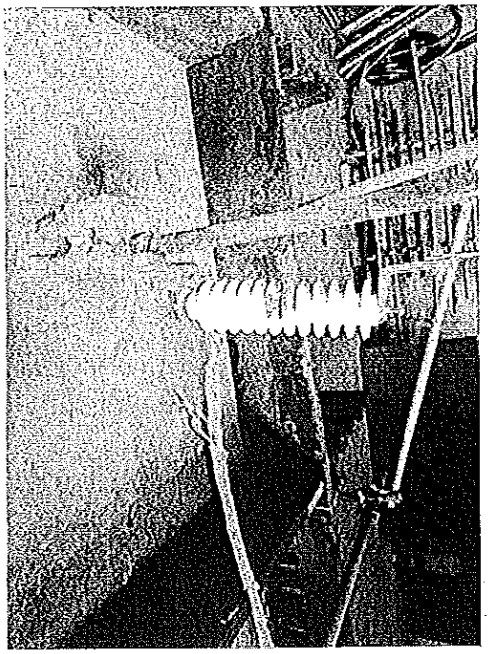
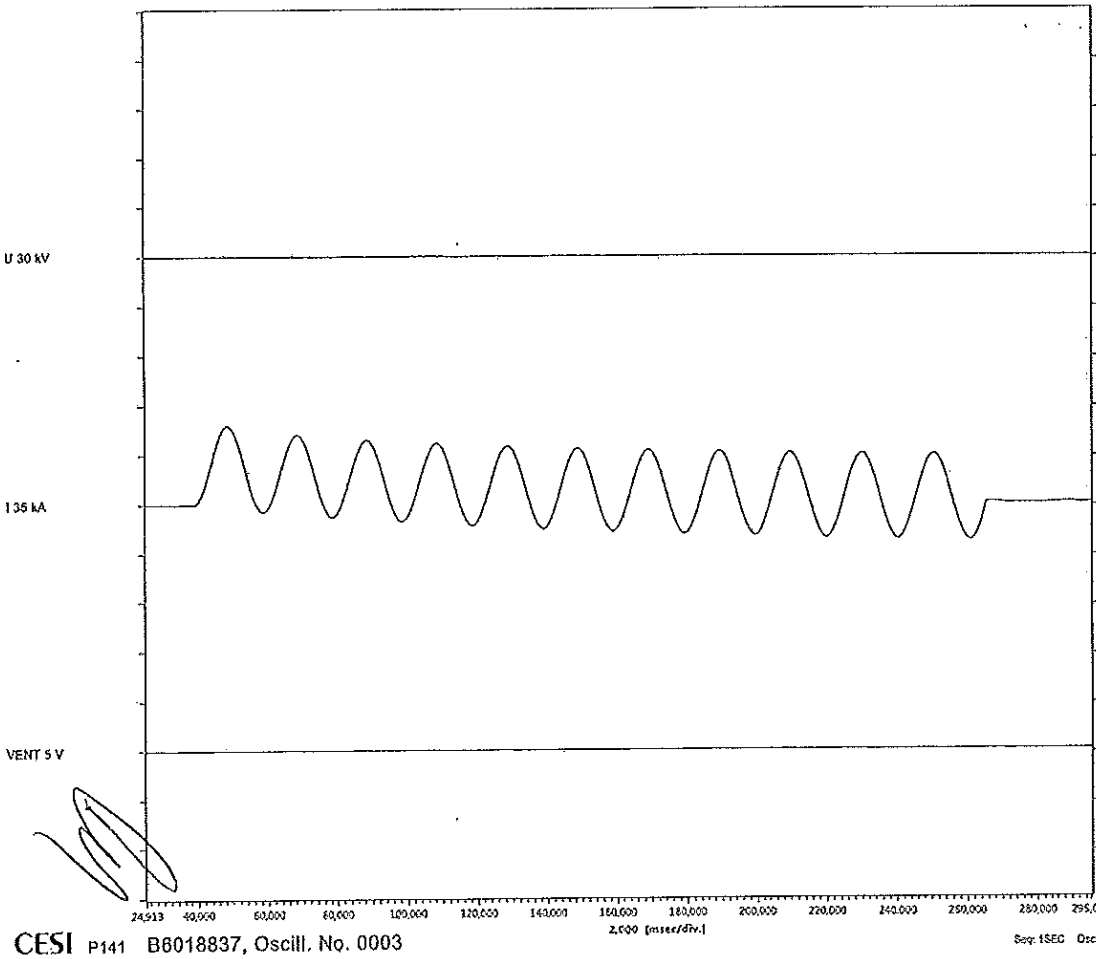
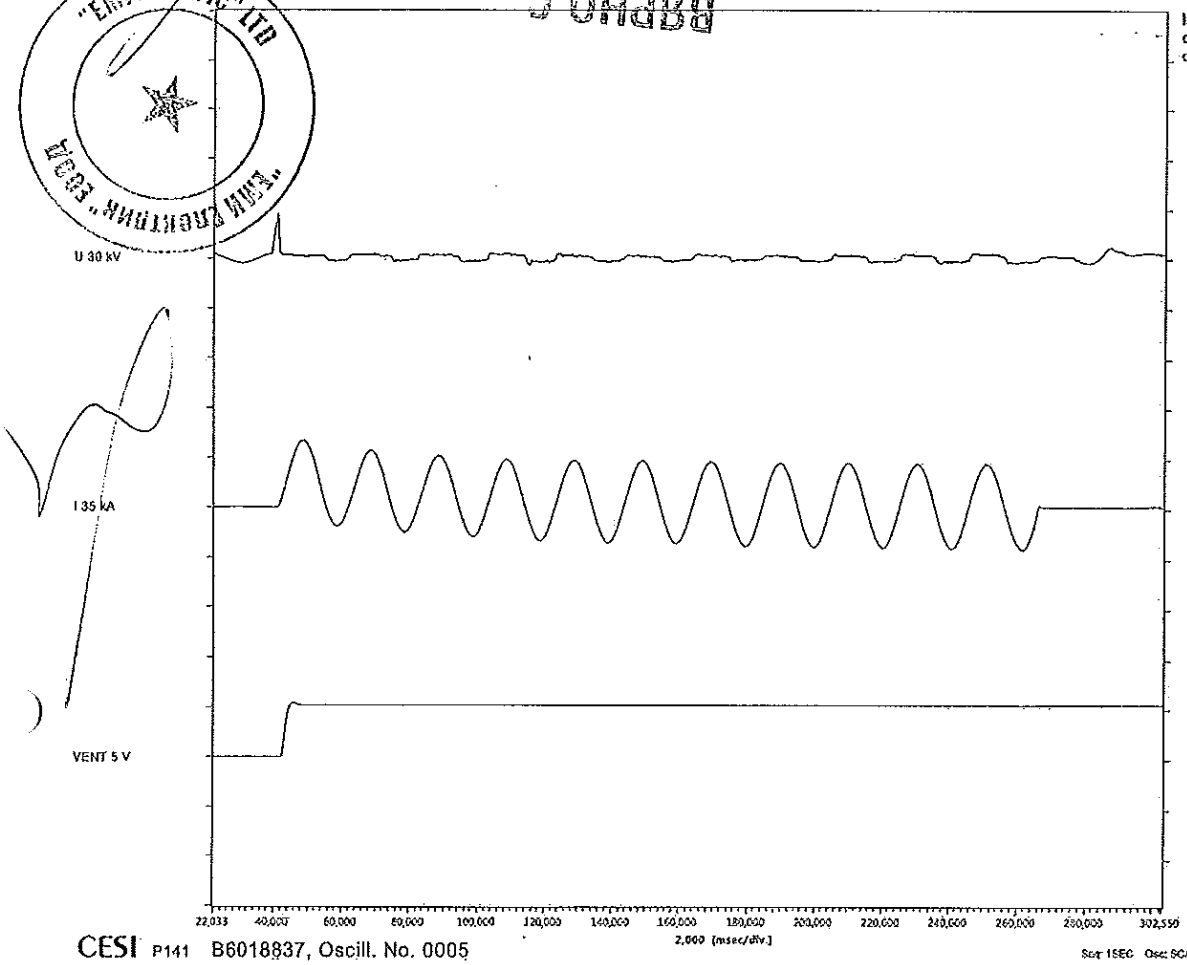


Photo No.8
After the test No.4



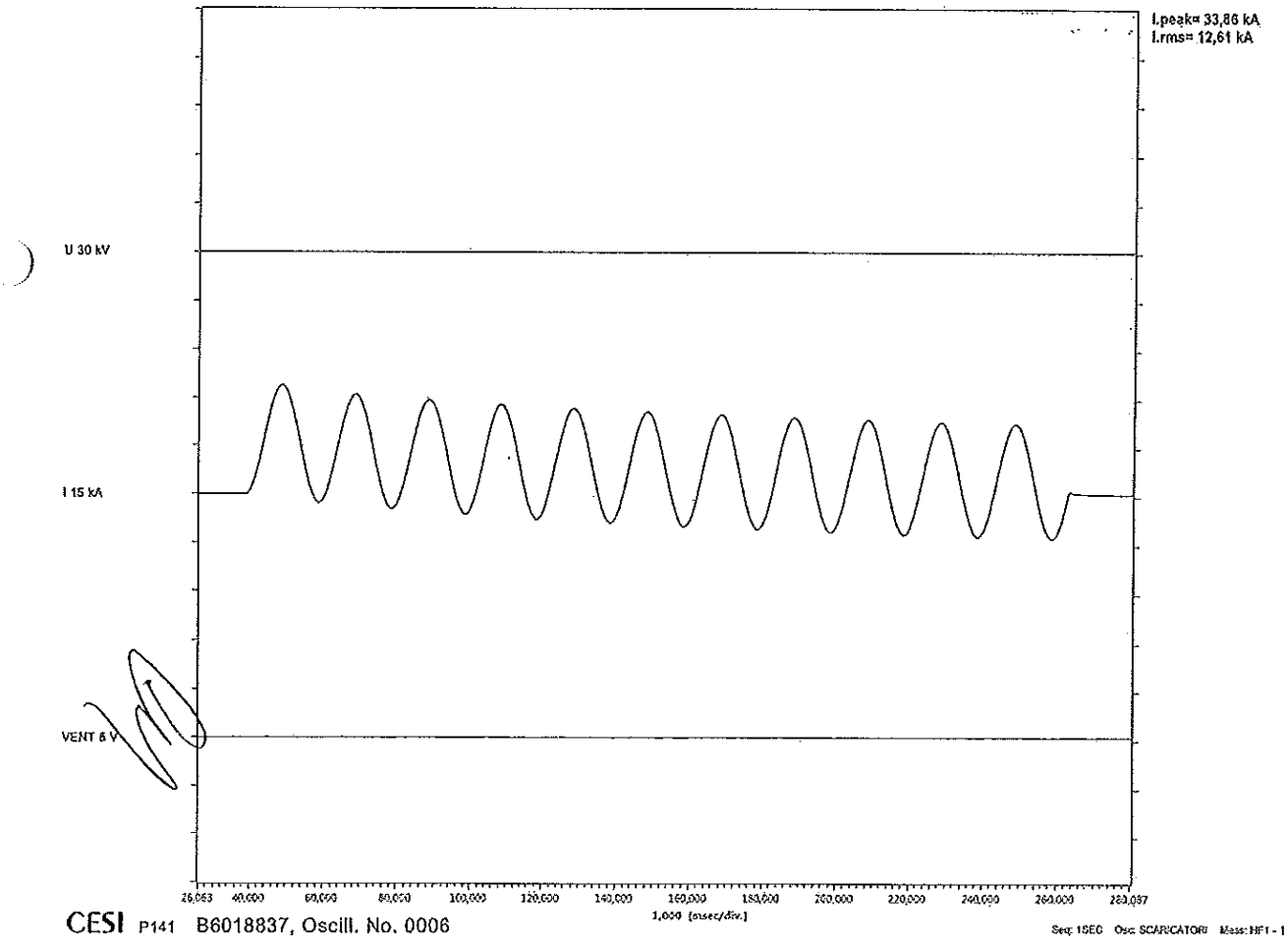
CESI P141 B6018837, Oscill. No. 0003

Seq: 1SEQ Osc: SCARICATORI Mess: HF1 - 1



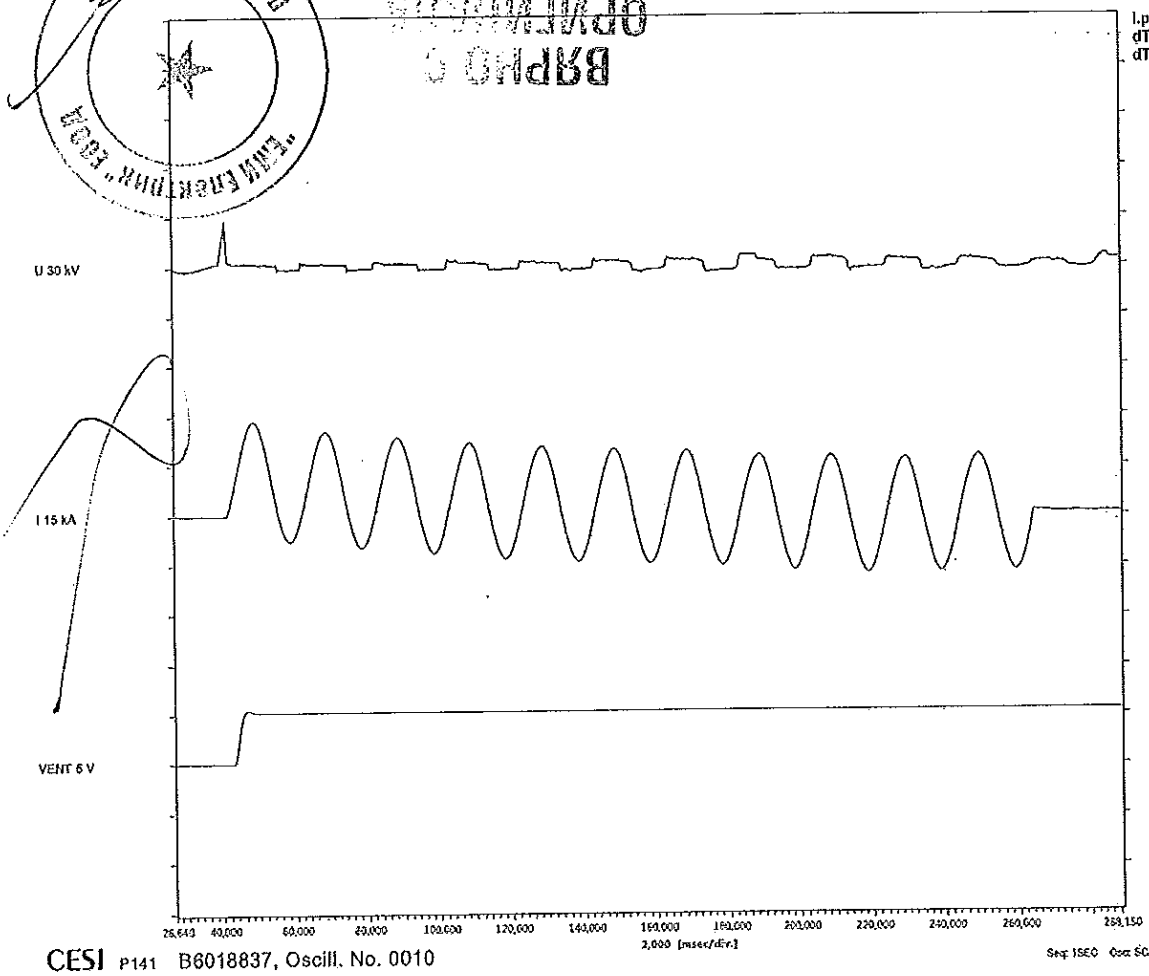
CESI P141 B6018837, Oscill. No. 0005

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



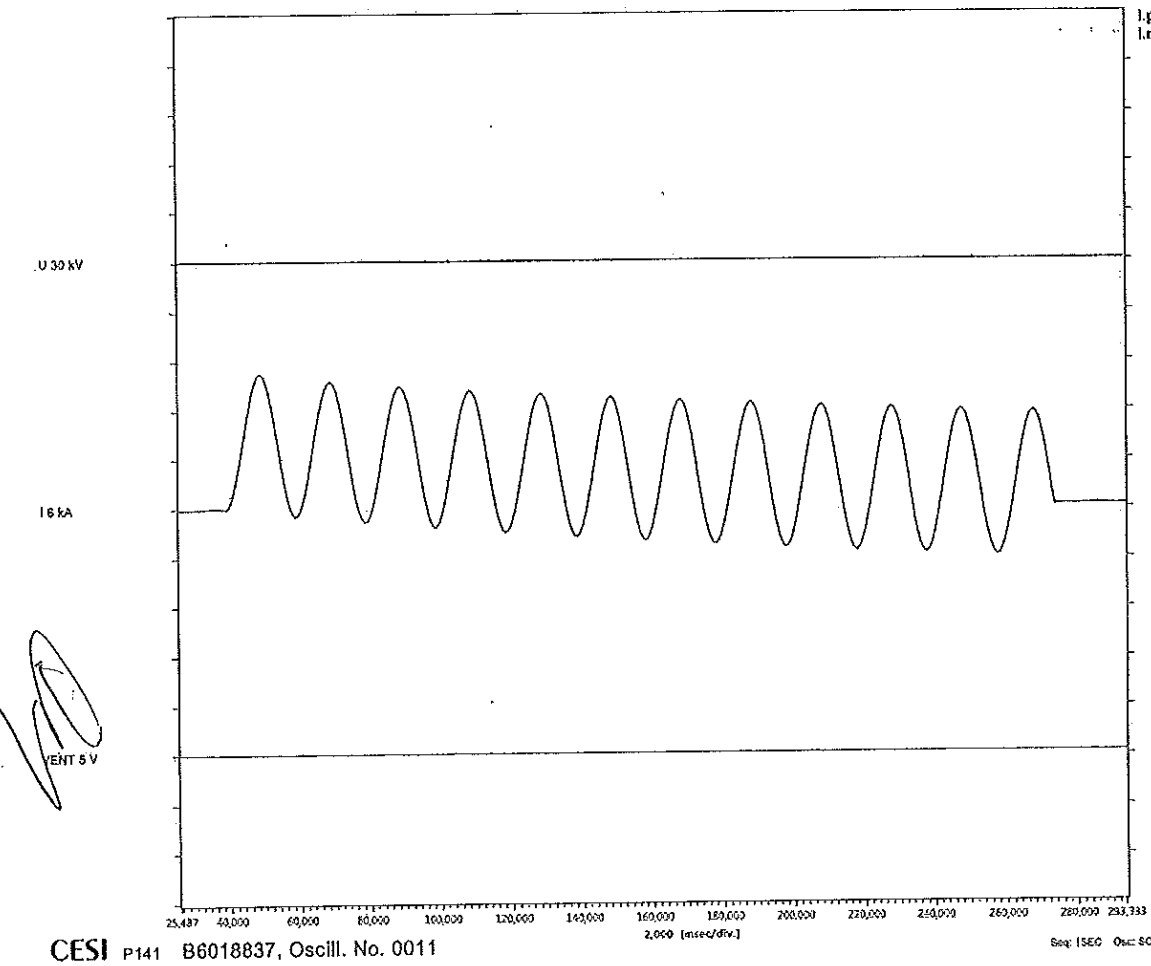
CESI P141 B6018837, Oscill. No. 0006

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



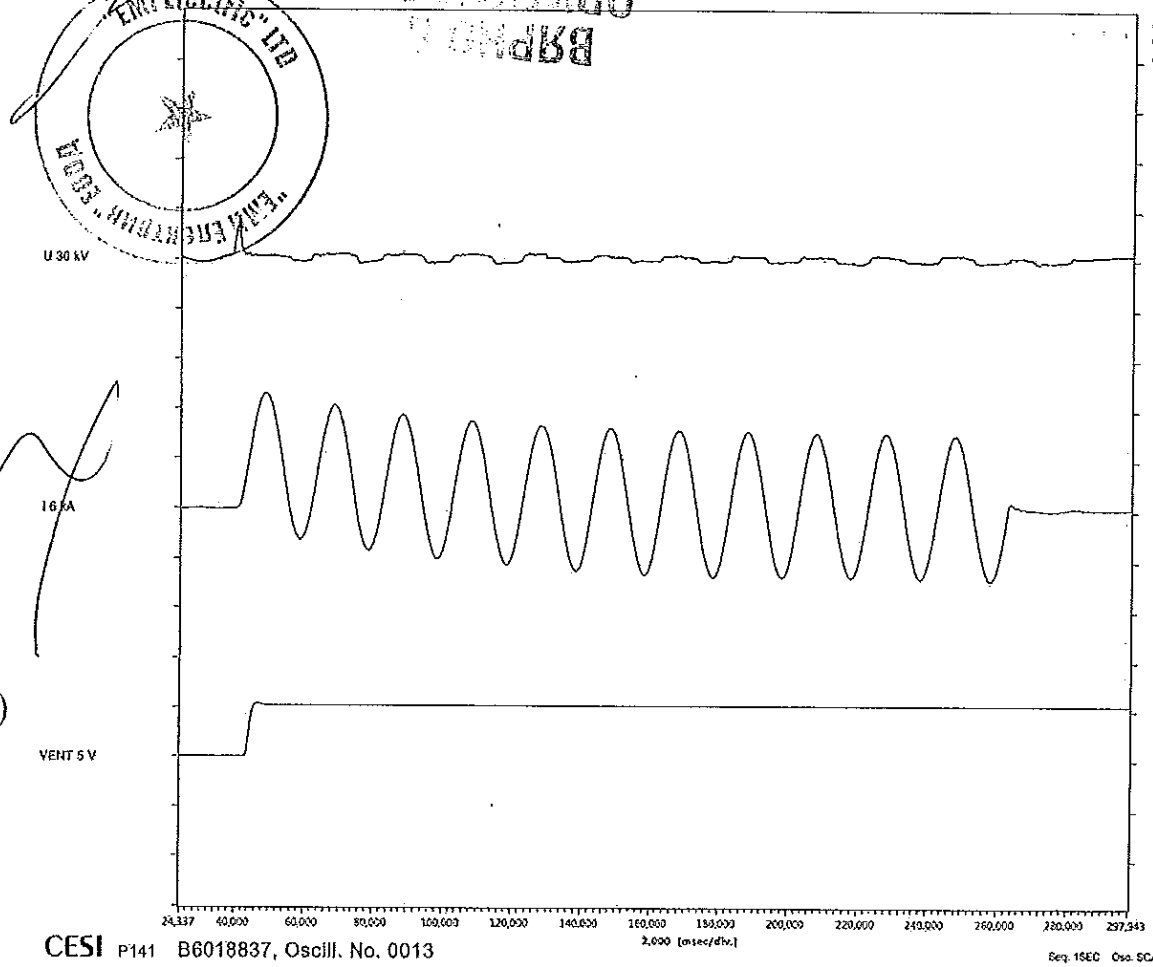
CESI P141 B6018837, Oscill. No. 0010

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



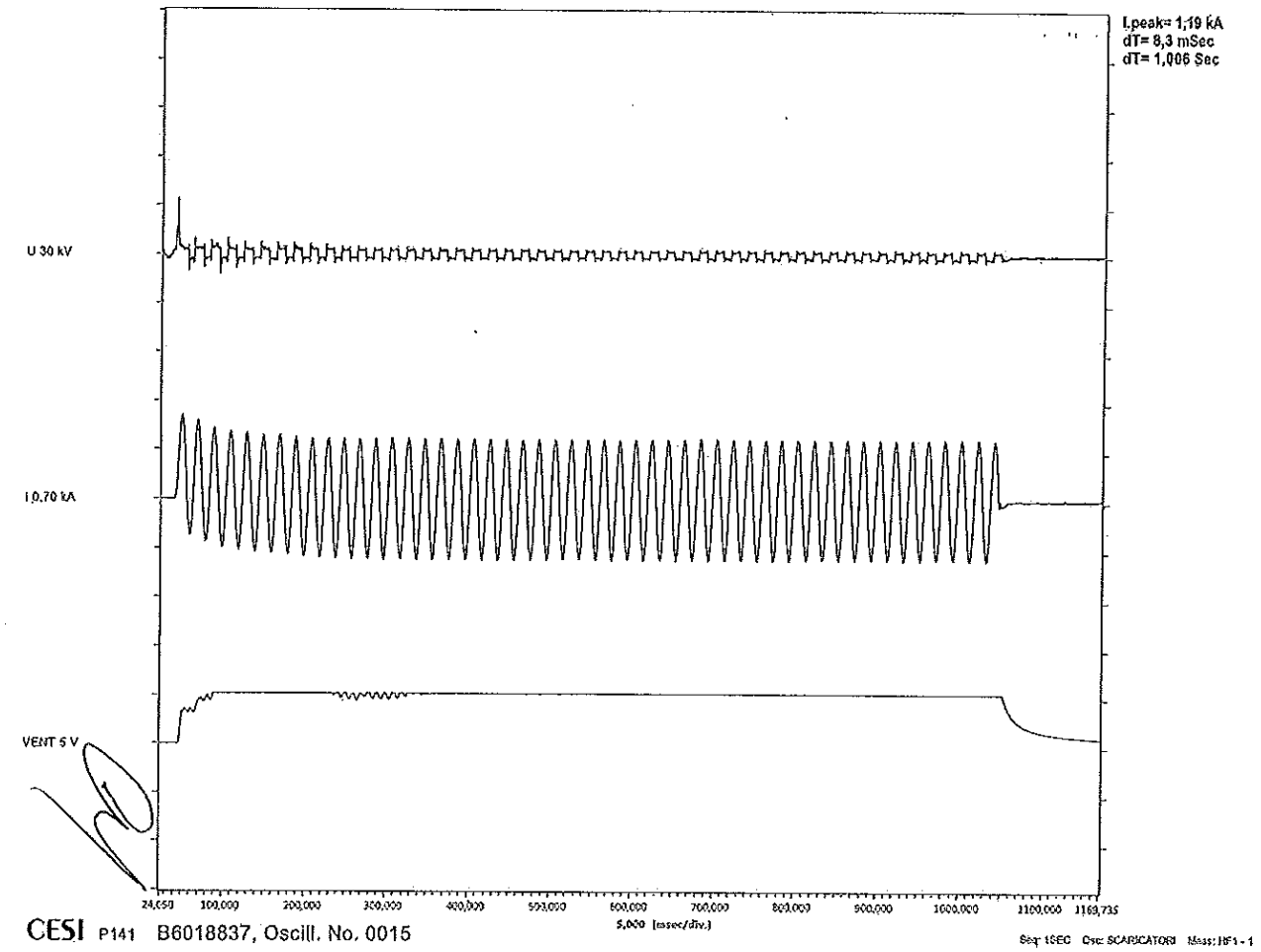
CESI P141 B6018837, Oscill. No. 0011

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



CESI P141 B6018837, Oscill. No. 0013

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



CESI P141 B6018837, Oscill. No. 0015

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

Test Report

Document No.	B7024813 Copy No. 1 Number of pages 96
Apparatus	Polymer-housed surge arrester section type PA-DH section ST with additional thermal insulation
Designation	—
Serial Number	—
Manufacturer	Joint-Stock Company " Polymer-Apparat"
Client	Joint-Stock Company " Polymer-Apparat" Ak. Kostantinova str.,1 195427 Saint-Petersburg - Russia Federation
Tested for	—
Date(s) of tests	December 4 - 14, 2017
Tested by	CESI S.p.A. Via Rubattino, 54 20134 Milano - Italy
Test performed	Power-frequency voltage-versus-time test

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

IEC 60099-4 – Edition 3.0 (2014-06)

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

December 21, 2017

Date

Gregori Marco
Test Engineer in charge

The Manager - Arcidiaco Lorenzo
Approved By Document Digitally Signed

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO
LAB N° 0030

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

CESI

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Notes

STL-Member

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

CESI Group Test Documents description

Type Test Certificate of .....

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

Test Certificate of (complete / selected) Type Tests

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

Certificate of Design Verification

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

Type Test Report

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

Test Report

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

On-Site Test Record

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

Test Award

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

Tests witnessed by:

Identification of the object: Effected

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings.
CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.
These drawing, identified by CESI and numbered B7026212 No. 1 , is annexed to this document.

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

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

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

- Voltage a.c.	: ± 3,0%
Residual peak voltage (impulse tests)	: ± 3,0%
Current a.c.	: ± 3,0%
Peak current (impulse tests)	: ± 3,0%
- Time (impulse tests)	: ± 10,0%
- Time (a.c. tests)	: ± 1,5%

Laboratory information

Receipt date of the sample	September 2017
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr L. Podavitte
Test laboratory	P177
ODL SAP	70006781

A10011G rev.2

A10021G rev.1

Test object characteristics (assigned by the client)

Manufacturer's name	Joint-Stock Company " Polymer-Apparat"
Polymer-housed surge arrester section type	PA-DH section ST
MO-resistor supplier's	Joint-Stock Company " Polymer-Apparat"
Metal-oxide resistor type	B41/30
Arrester class	Distribution
Designation	DH
Number of MO resistor fitted	1
Nominal discharge current - [kA]	10
Rated voltage - U_r [kV]	1,011 x $U_{ref.}$
Continuous operating voltage - U_c [kV]	0,809 x $U_{ref.}$
Repetitive charge transfer rating – Q_{rs} [C]	0,5
Rated thermal charge transfer rating - Q_{th} [C]	1,1
Reference current - $I_{ref.}$ [mA]	1,5
Rated frequency - [Hz]	48÷62
Year of manufacture	08/2017

geometrical characteristics on the MO resistor

Total height [mm]	29,50 mm
Diameter [mm]	41,80 mm

Photographs of the test object

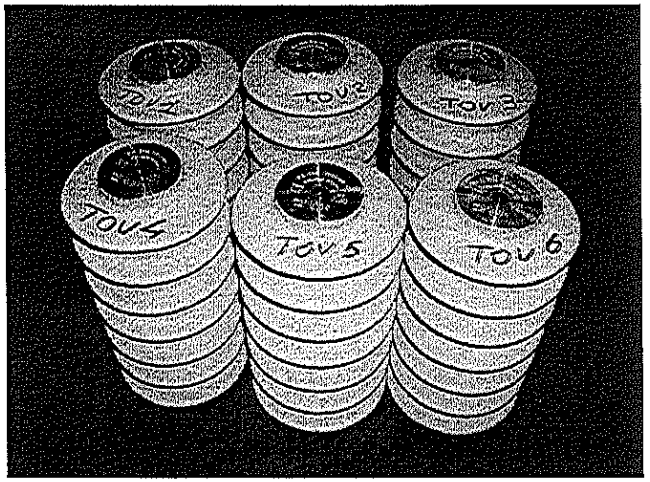

Photo no. 1

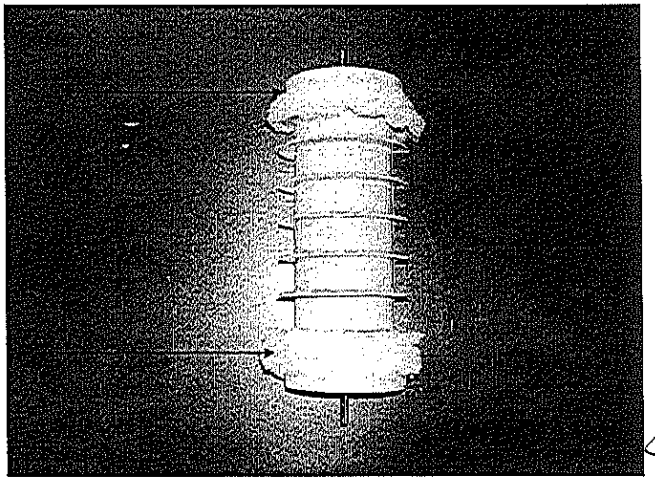

Photo no. 2

Polymer-housed surge arrester section type PA-DH section ST with additional thermal insulation

Reference Standard

IEC 60099-4 (2014/06) – Edition 3 - Clause 10.8.8.
"Metal-oxide surge arresters without gaps for a.c. system"

Test carried out	Number of sample tested
Power-frequency voltage-versus-time test	6

Test object identification

Test object name	Identification of test sample (given by CESI)	Identification of test sample (given by JSC "Polymer Apparat)
Polymer-housed surge arrester section type PA-DH section ST with additional thermal insulation	TOV1	00016
	TOV2	00037
	TOV3	00040
	TOV4	00057
	TOV5	00082
	TOV6	00089

Test procedure

1. Test performed on Polymer-housed metal-oxide surge arrester section in open air

The test procedure consisted of the following sequence:
Initial test

a) Measurement of the lightning impulse residual voltage at the nominal discharge current
b) Measurement of the power frequency reference voltage at the reference current

2. Test performed on Polymer-housed metal-oxide surge arrester section assembled in thermal model

Test with energy input (prior duty test)

c) The surge arrester sections were kept in an oven at the temperature of 65 °C till thermal equilibrium (not more than twenty hours)
d) Injection of two lightning current impulses 8/20 µs at the rated thermal charge transfer Q_{th}. A time shorter than 100 ms after the application of the second second lightning current impulses 8/20 µs energization at U_{TOV} (declared by the manufacturer) for a time t_{TOV} (declared by the manufacturer)and then at U_e' for 30 min. to verify the thermal stability.

Four samples were tested as specified below:

Sample	U_{TOV}	Duration	Note
TOV1	1,080 x U_r	1 sec	prior duty test
TOV2	1,040 x U_r	10 sec	
TOV3	1,000 x U_r	100 sec	
TOV4	0,960 x U_r	1000 sec	

Test without energy input (no-prior duty test)

e) The surge arrester sections were kept in an oven at the temperature of 65 °C till thermal equilibrium (not more than twenty hours)
f) Application of the overvoltage U_{TOV} (declared by the manufacturer) for a time t_{TOV} (declared by the manufacturer)and then at U_e' for 30 min. to verify the thermal stability.

Two samples were tested as specified below:

Sample	U_{TOV}	Duration	Note
TOV5	1,130 x U_r	10 sec	no-prior duty test
TOV6	1,040 x U_r	1000 sec	

3. Test performed on Polymer-housed metal-oxide surge arrester section in open air

g) Measurement of the lightning impulse residual voltage at nominal discharge current for comparison with initial value
f) After that the sample has cooled to ambient temperature and two current impulses 8/20 at 0,5 kA/cm^2 have been applied to check the integrity of the internal parts. The interval between impulses was 50-60 seconds.

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%). During the two last impulses the oscillograms not reveal any breakdown.
The thermal stability was achieved.

The acceptance criteria are fulfilled. The test result is positive.

Summary of test results

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	%
TOV1	10,11	13,37	10,09	13,56	+1,42
TOV2	10,12	13,37	10,20	13,54	+1,27
TOV3	10,15	13,38	10,11	13,61	+1,72
TOV4	10,18	13,28	10,19	13,43	+1,13
TOV5	10,06	13,24	10,08	13,32	+0,60
TOV6	10,09	13,49	10,08	13,50	+0,10

Power frequency voltage versus time test.

Lightning impulse residual voltage measurement before the test

Test circuit: A0120

Date: December 4, 2017

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual Voltage
No.		kV	No.	µs	kA	kV
TOV1	I_n	25,1	1	8,6/18,2	10,11	13,37
TOV2		25,1	2		10,12	13,37
TOV3		25,1	3		10,15	13,38
TOV4		25,1	4		10,18	13,28
TOV5		25,0	5		10,06	13,24
TOV6		25,1	6		10,09	13,49

Notes:

Power frequency voltage versus time test.

Reference voltage test.

Test circuit: A0019

Date: December 4, 2017

Sample No.TOV1						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
7	5,37	1,28	1,50	0,771	2,02	—

Sample No. TOV2						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
8	5,38	1,31	1,50	0,775	2,05	—

Sample No. TOV3						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
9	5,35	1,37	1,50	0,788	2,13	—

Sample No. TOV4						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
10	5,31	1,32	1,50	0,779	2,07	—

Sample No. TOV5						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
11	5,29	1,34	1,50	0,782	2,09	—

Sample No. TOV6						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
12	5,41	1,37	1,50	0,780	2,11	—

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A1176IG

ACCREDIA LAB N° 0030

Power frequency voltage versus time test.

Voltage correction factor and thermal energy calculations

Date: December 12, 2017

Sample	U_{ref} [1]	KU_r [2]	KU_C [3]	U_r' [4]	U_c' [5]
No.	kV			kV	kV
TOV1	5,37	1,011	0,809	5,429	4,344
TOV2	5,38			5,439	4,352
TOV3	5,35			5,409	4,328
TOV4	5,31			5,368	4,296
TOV5	5,29			5,348	4,280
TOV6	5,41			5,470	4,377

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

Sample	U_r'	Requested thermal charge transfer, Q_{th}	Requested Q_{th} per impulse
No.	kV	C	C
TOV1	5,429	1,1	0,55 (±10%)
TOV2	5,439		0,55 (±10%)
TOV3	5,409		0,55 (±10%)
TOV4	5,368		0,55 (±10%)

A1176IG

ACCREDIA LAB N° 0030

Power frequency voltage versus time test.

Application of two lightning current impulses 8/20μs, corrected rated voltage U_r' and corrected continuous operating U_c' for evaluation of the thermal stability.

Test circuit: A0123-A0020-A0131

Sample No.: TOV 1

Ambient temperature: 20 °C
Preheating temperature: 65 °C

Date: December 12, 2017

Lightning current impulses 8/20 μs application

Oscillogram No.	Impulse No.	Charging voltage kV	Residual voltage kV	Discharge current kA	Q_{th} C	Applicable range for Q_{th} C
13	1	65,0 x 2	—	38,60	0,56	0,495÷0,605
14	2	65,0 x 2	—	38,46	0,56	0,495÷0.605

Current impulse waveshape (μs)
8,8 /18,2

Temporary overvoltage application

Amplitude claimed by the manufacturer **Ur' x 1,080 = 5,429 x 1,080 = 5,863 kV**
Duration claimed by the manufacturer **1 sec.**

Oscillogram No.	Time s	U_r' kV	Current $+mA_{cr}$	Current $-mA_{cr}$
15	0	5,863	78,0	115,0
16	1		68,0	84,0

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram No.	Time min	U_c' kV	Current $+mA_{cr}$	Current $-mA_{cr}$	Power W	Temperature °C
17	0	4,344	0,98	0,99	0,61	---
	5		0,96	0,97	0,48	---
	10		0,94	0,96	0,43	—
18	15		0,93	0,95	0,40	---
	20		0,92	0,94	0,38	---
	25		0,91	0,93	0,36	—
19	30		0,90	0,92	0,34	—

Note: Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no.30889

continued

Continued

Sample No.: TOV2

Ambient temperature: 20 °C
Preheating temperature: 65 °C

Date: December 12, 2017

Lightning current impulses 8/20 μs application

Oscillogram No.	Impulse No.	Charging voltage kV	Residual voltage kV	Discharge current kA	Q_{th} C	Applicable range for Q_{th} C
20	1	65,0 x 2	—	38,18	0,55	0,495÷0,605
21	2	65,0 x 2	—	38,30	0,56	0,495÷0,605

Current impulse waveshape (μs)
8,8 /18,2

Temporary overvoltage application

Amplitude claimed by the manufacturer **Ur' x 1,040 = 5,439 x 1,040 = 5,656 kV**
Duration claimed by the manufacturer **10 sec.**

Oscillogram No.	Time s	U_r' kV	Current $+mA_{cr}$	Current $-mA_{cr}$
22	0	5,656	24,6	51,0
23	10		10,0	17,0

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram No.	Time min	U_c' kV	Current $+mA_{cr}$	Current $-mA_{cr}$	Power W	Temperature °C
24	0	4,352	1,05	1,04	0,70	---
	5		0,99	0,99	0,49	---
	10		0,92	0,98	0,45	---
25	15		0,97	0,97	0,41	---
	20		0,96	0,96	0,38	—
	25		0,95	0,95	0,36	—
26	30		0,94	0,94	0,35	—

Note : Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no.30889

continued

Continued

Sample No.: TOV3

Ambient temperature: 20 °C
Preheating temperature: 65 °C

Date: December 12, 2017

Lightning current impulses 8/20 µs application

Oscillogram	Impulse	Charging voltage	Residual voltage	Discharge current	Q_{th}	Applicable range for Q_{th}
No.	No.	kV	kV	kA	C	C
27	1	65,0 x 2	---	38,05	0,55	0,495÷0,605
28	2	65,0 x 2	---	38,15	0,56	0,495÷0,605

Current impulse waveshape (µs)
8,8 /18,2

Temporary overvoltage application

Amplitude claimed by the manufacturer **Ur' x 1,000= 5,409 x 1,000 = 5,409 kV**
Duration claimed by the manufacturer **100 sec.**

Oscillogram	Time	U_r'	Current	Current
No.	s	kV	+ mA_{cr}	- mA_{cr}
29	0	5,409	19,0	36,0
30	100		4,5	6,8

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram	Time	U_o'	Current	Current	Power	Temperature
No.	min	kV	+ mA_{cr}	- mA_{cr}	W	°C
31	0	4,328	1,02	1,04	0,58	---
	5		0,99	1,01	0,51	---
	10		0,98	1,00	0,46	---
32	15		0,97	0,99	0,44	---
	20		0,96	0,98	0,40	---
	25		0,95	0,97	0,37	---
33	30		0,94	0,96	0,35	---

Note : Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no.30889

continued

Continued

Sample No.: TOV4

Ambient temperature: 20 °C
Preheating temperature: 65 °C

Date: December 13, 2017

Lightning current impulses 8/20 µs application

Oscillogram	Impulse	Charging voltage	Residual voltage	Discharge current	Q_{th}	Applicable range for Q_{th}
No.	No.	kV	kV	kA	C	C
34	1	65,0 x 2	---	38,74	0,56	0,495÷0,605
35	2	65,0 x 2	---	38,20	0,56	0,495÷0,605

Current impulse waveshape (µs)
8,8 /18,2

Temporary overvoltage application

Amplitude claimed by the manufacturer **Ur' x 0,960 = 5,368 x 0,960 = 5,153 kV**
Duration claimed by the manufacturer **1000 sec.**

Oscillogram	Time	U_r'	Current	Current
No.	s	kV	+ mA_{cr}	- mA_{cr}
36	0	5,153	7,5	17,0
37	1000		1,3	1,8

Corrected continuous operating voltage U_c' application to evaluate the thermal stability

Oscillogram	Time	U_o'	Current	Current	Power	Temperature
No.	min	kV	+ mA_{cr}	- mA_{cr}	W	°C
38	0	4,296	0,99	1,01	0,46	---
	5		0,98	0,99	0,41	---
	10		0,97	0,98	0,38	---
39	15		0,96	0,97	0,35	---
	20		0,95	0,96	0,33	---
	25		0,94	0,94	0,31	---
40	30		0,93	0,93	0,29	---

Note : Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no.30889

Power frequency voltage versus time test.

Application of the temporary overvoltage U_{TOV} and evaluation of thermal stability

(WITHOUT PRIOR DUTY TEST)

Test circuit: A0131-A0020

Sample No.: TOV5

Preheating temperature: 65 °C

Date : December 13, 2017

Temporary overvoltage application

Amplitude claimed by the manufacturer **Ur' x 1,130 = 5,348 x 1,130 = 6,043 kV**
Duration claimed by the manufacturer **10 sec.**

Oscillogram	Time	Voltage	Current	Current	Power
No.	s	kV	$+mA_{cr}$	$-mA_{cr}$	W
41	0	6,043	77,0	87,0	—
42	10		65,0	66,0	

Corrected continuous operating voltage U_e' application to evaluate the thermal stability

Oscillogram	Time	U_e'	Current	Current	Power	Temperature
No.	min	kV	$+mA_{cr}$	$-mA_{cr}$	W	°C
43	0	4,280	0,84	0,86	0,40	—
	5		0,83	0,85	0,37	—
	10		0,83	0,84	0,35	—
44	15		0,82	0,83	0,33	—
	20		0,81	0,82	0,31	—
	25		0,80	0,81	0,29	—
45	30		0,79	0,80	0,27	—

Note : Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no.30889

continued

Sample No.: TOV6

Preheating temperature: 65 °C

Date: December 13, 2017

Temporary overvoltage application

Amplitude claimed by the manufacturer **Ur' x 1,040 = 5,470 x 1,040 = 5,689 kV**
Duration claimed by the manufacturer **1000 sec.**

Oscillogram	Time	Voltage	Current	Current	Power
No.	s	kV	$+mA_{cr}$	$-mA_{cr}$	W
46	0	5,689	13,0	13,5	—
47	1000		7,0	7,5	

Corrected continuous operating voltage U_e' application to evaluate the thermal stability

Oscillogram	Time	U_e'	Current	Current	Power	Temperature
No.	min	kV	$+mA_{cr}$	$-mA_{cr}$	W	°C
48	0	4,370	0,84	0,85	0,35	—
	5		0,82	0,83	0,33	—
	10		0,81	0,82	0,30	—
49	15		0,80	0,81	0,28	—
	20		0,80	0,80	0,26	—
	25		0,79	0,79	0,24	—
50	30		0,78	0,78	0,21	—

Note : Before the injection of the energy, the temperature of the test sample has been checked with instrument type FLUKE 52II thermometer CESI no.30889

continued

Power frequency voltage versus time test.

Lightning impulse residual voltage measurement after the test

Test circuit: A0120

Date: December 14, 2017

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual Voltage
No.		kV	No.	µs	kA	kV
TOV1	I_n	25,0	51	8,6/18,1	10,09	13,56
TOV2		25,0	52		10,20	13,54
TOV3		25,0	53		10,11	13,61
TOV4		25,0	54		10,19	13,43
TOV5		25,0	55		10,08	13,32
TOV6		25,0	56		10,08	13,50

Notes:

Power frequency voltage versus time test.

Additional two lightning impulses residual voltage measurement for check no damage occurred during the test

Test circuit: A0120

Date: December 14, 2017

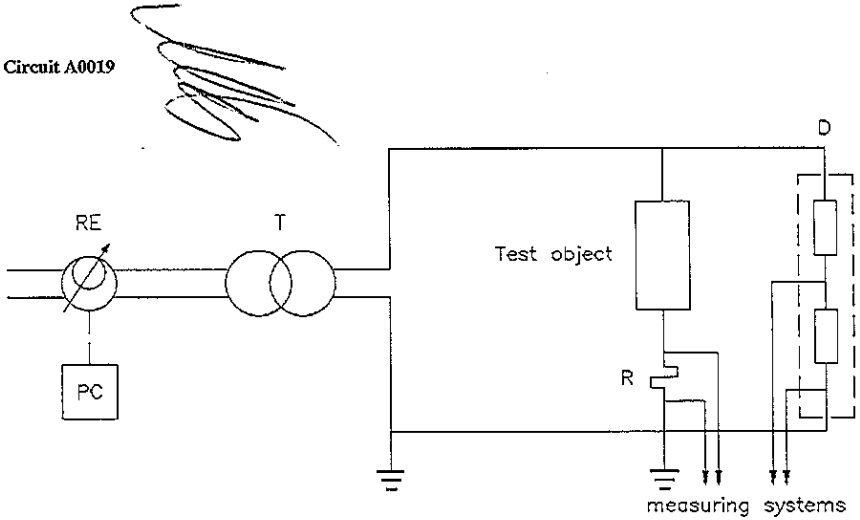
Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
TOV1	6,86 (*)	20,0	57	8,6/18,3	7,25	13,07
		20,0	58		7,20	13,08
TOV2		20,0	59		7,29	13,08
		20,0	60		7,21	13,02
TOV3		20,0	61		7,28	13,07
		20,0	62		7,21	12,97
TOV4		20,0	63		7,33	12,95
		20,0	64		7,34	12,82
TOV5		20,0	65		7,40	12,84
		20,0	66		7,42	12,85
TOV6		20,0	67		7,22	13,02
		20,0	68		7,24	13,01

Notes:

Requested current = 0,5 kA/cm2 x 13,72 cm2 = 6,86 kA

- -where 0,5 kA/cm2 is peak current density
- where 10,52 cm2 is surface area on the metal-oxide resistor used for this test declared by the manufacturer

Circuit A0019



Power frequency supply

RE - programmable supply type PACIFIC A.C. Power Source 140 ASX.; CESI no. 0560408
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 HBM CESI No. 57986(Rx) – 57987 (Tx)

OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

Voltage measuring system

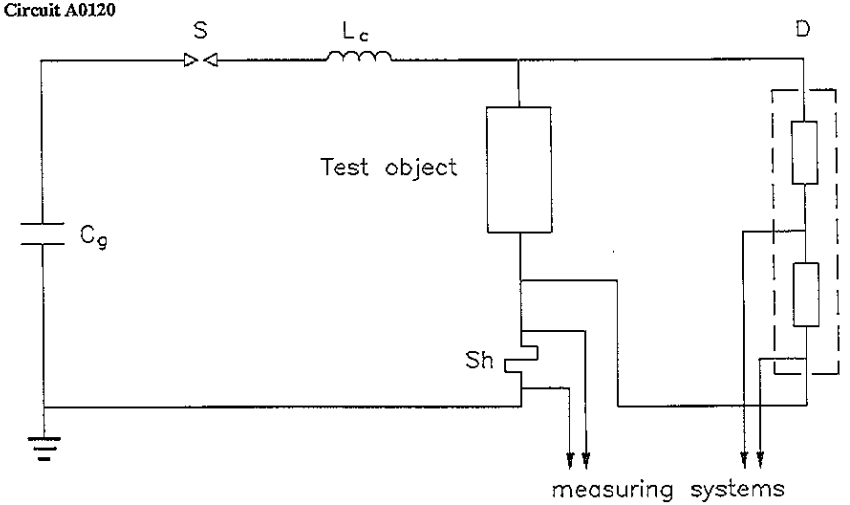
D - Voltage divider SAGI; CESI No.11120
- Electro optical system type HBM CESI No. 57986(Rx) – 57991 (Tx)

OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.2)

SOFTWARE SYSTEM:

SW - S.A.D. Surge arrester version 2.0

Circuit A0120



Impulse generator

No. of stages 1
Cg 6,64 µF
Lc 6 µH

S - Spark-gap

Voltage measuring system.

D - Voltage divider SAGI; CESI No.11120
- Electro optical system type HBM CESI No. 57986(Rx) – 57991 (Tx)

OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.2)

Current measuring system

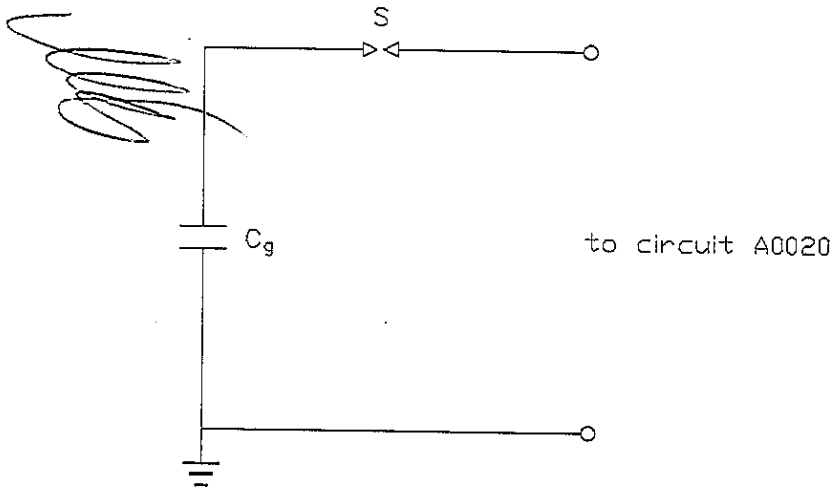
Sh - Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)

OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5152;
- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:

SW - S.A.D. Surge arrester version 2.0

Circuit A0123

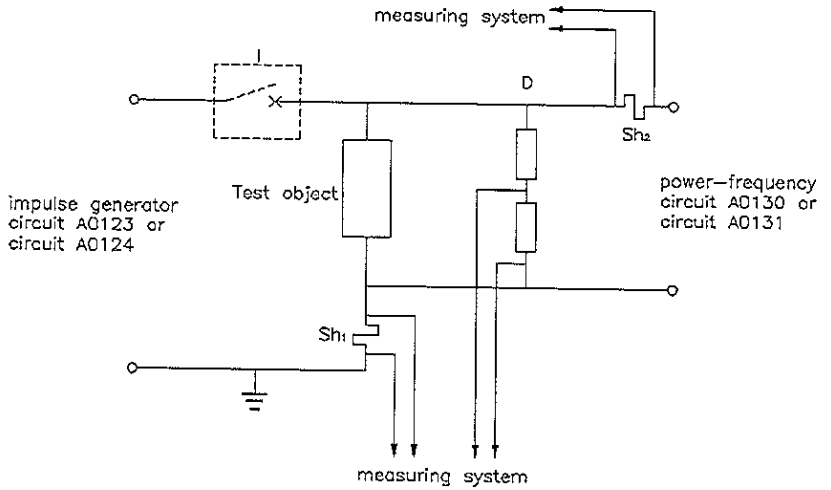


Impulse generator circuit for injection of Q_{th}

No. of stages 2
Cg 2,91 µF
Lc 12 µH

S - spark-gap

Circuit A0020



Impulse generator circuit A0123

Impulsive current measuring system

Sh_1 - Current shunt CESI No.6042; R= 2 m Ω
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)

$OSC_{2\div3}$ - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.2)

I - Circuit-breaker

Power frequency circuit A0131

Voltage measuring system.

D - Voltage divider SAGI; CESI No.11120
- Electro optical system HBM CESI No. 57986(Rx) – 57991 (Tx)

$OSC_{2\div3}$ - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.2)

Current measuring system

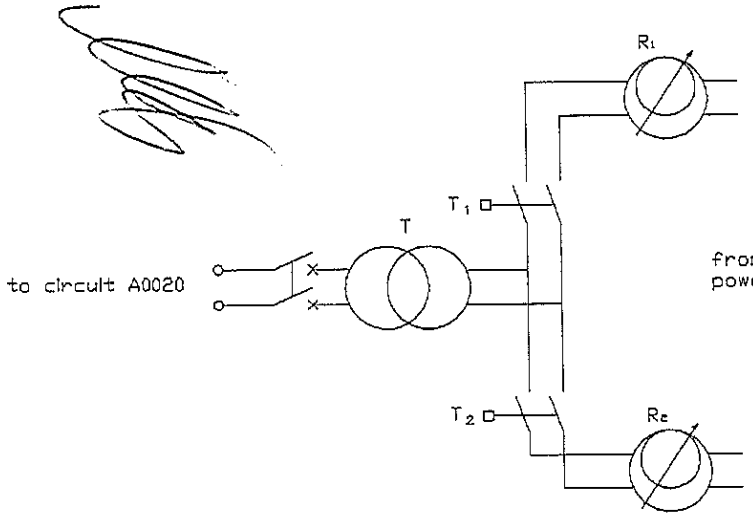
Sh_2 (TOV - MCOV) - Current shunt type CESI n. 058315 R= 500 Ω
- Electro optical system CESI No. 57986(Rx) – 58294 (Tx)

$OSC_{2\div3}$ - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:

SW - S.A.D. Surge arrester version 2.0

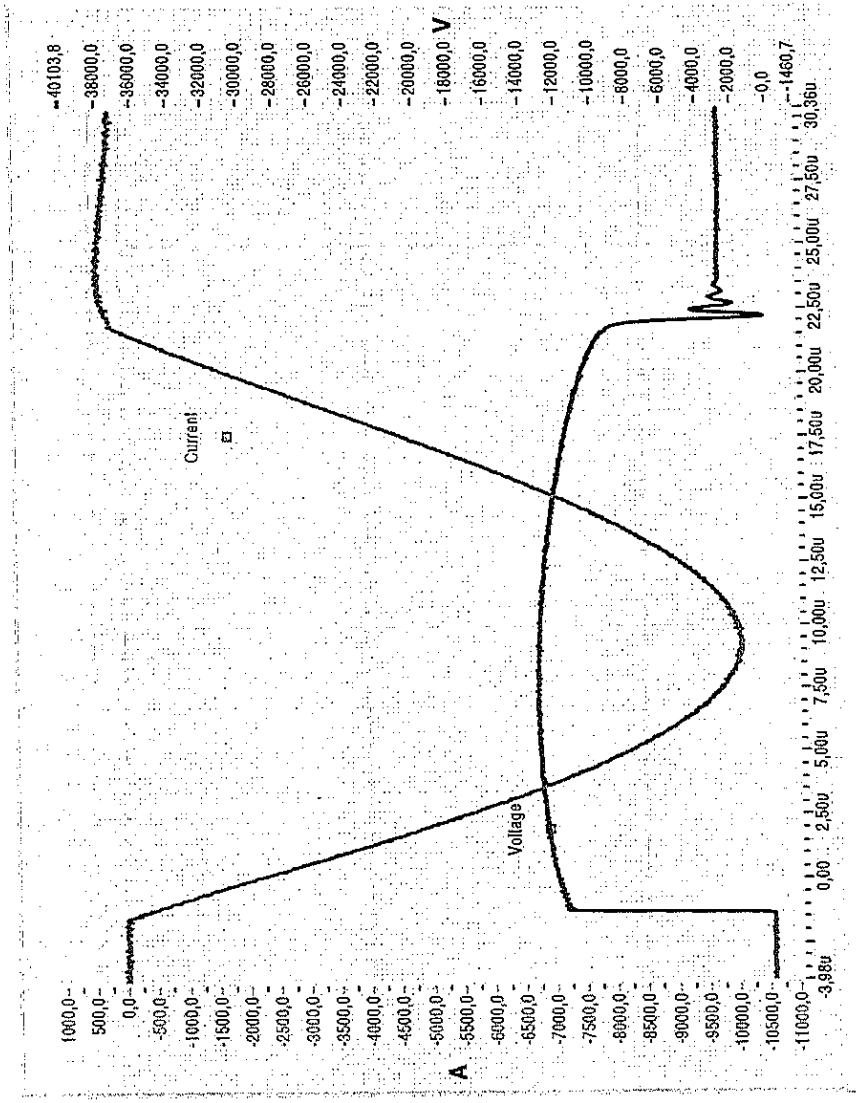
Circuit A0131



Power-frequancy circuit

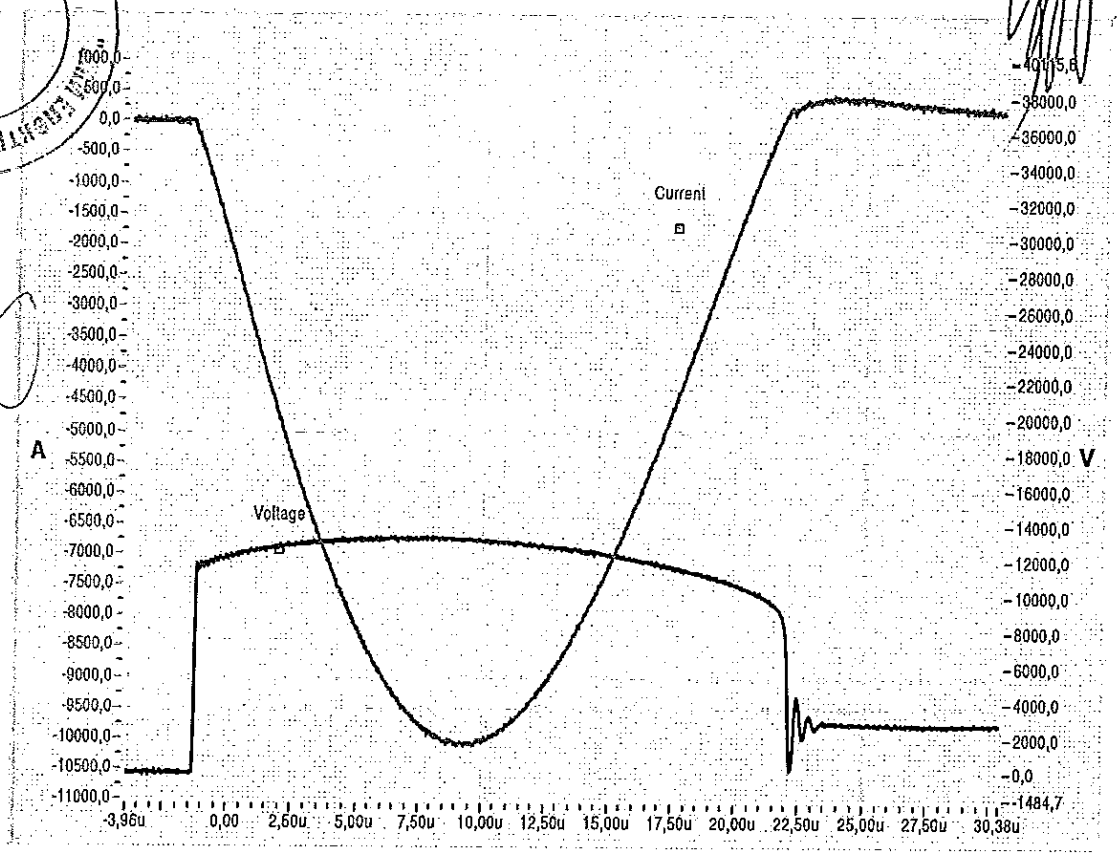
from 380Vac power supply

R_1	single-phase voltage regulator CORMES; power 20 kVA; voltage 380/04220 Vac
R_2	single-phase voltage regulator CORMES; power 10 kVA; voltage 380/04220 Vac
T_1	voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200-400 V/15-30 kV

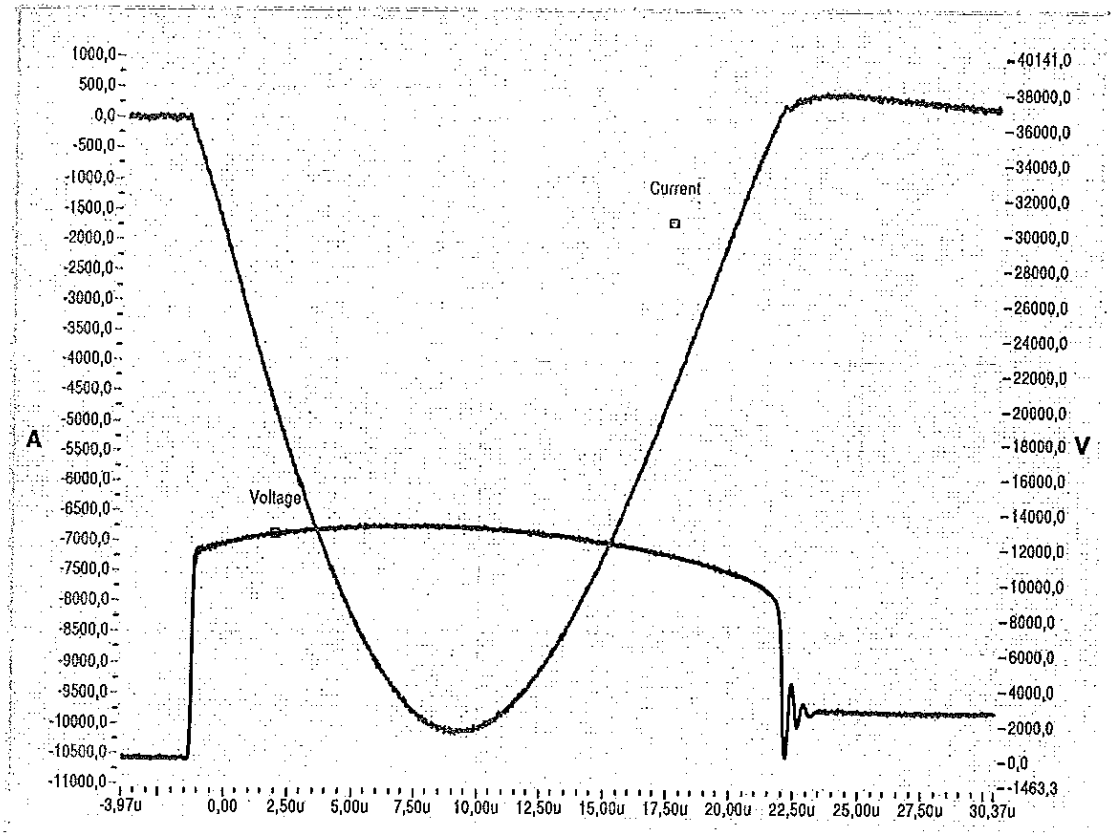


CESI B7024813 Oscillogram n. 1

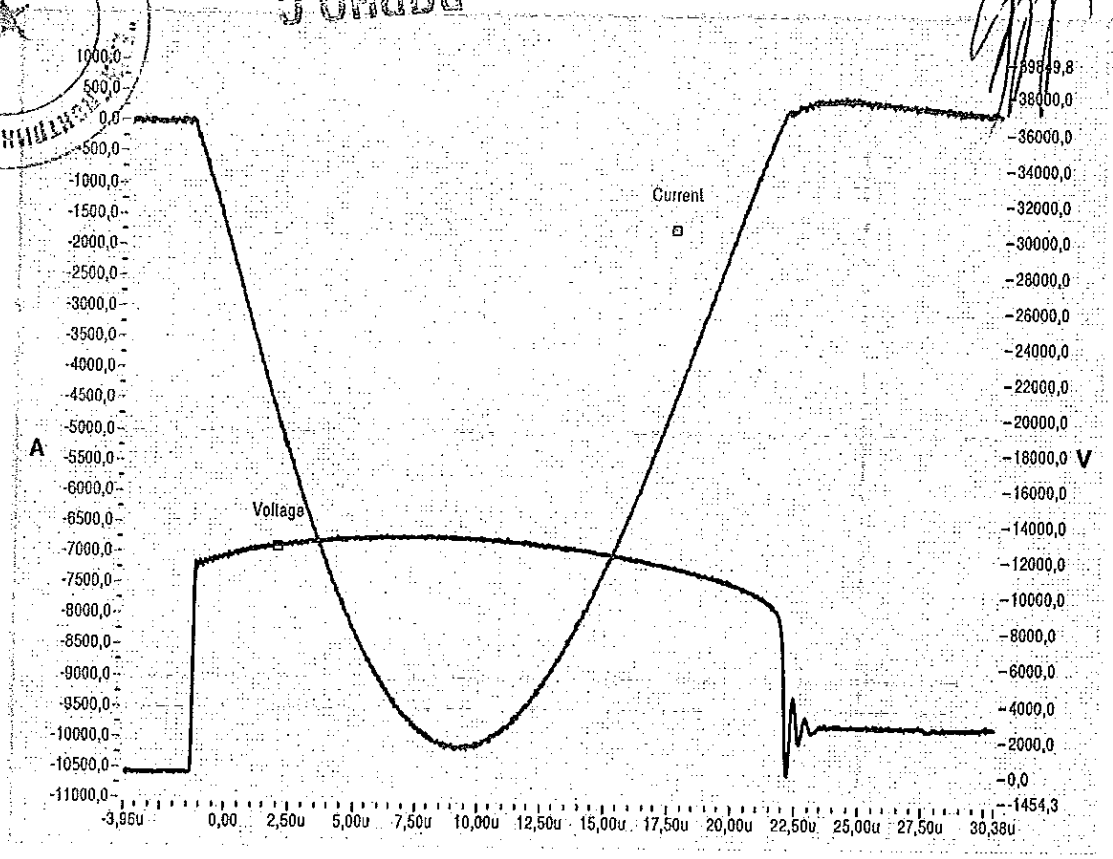
CESI B7024813 Oscillogram n. 2



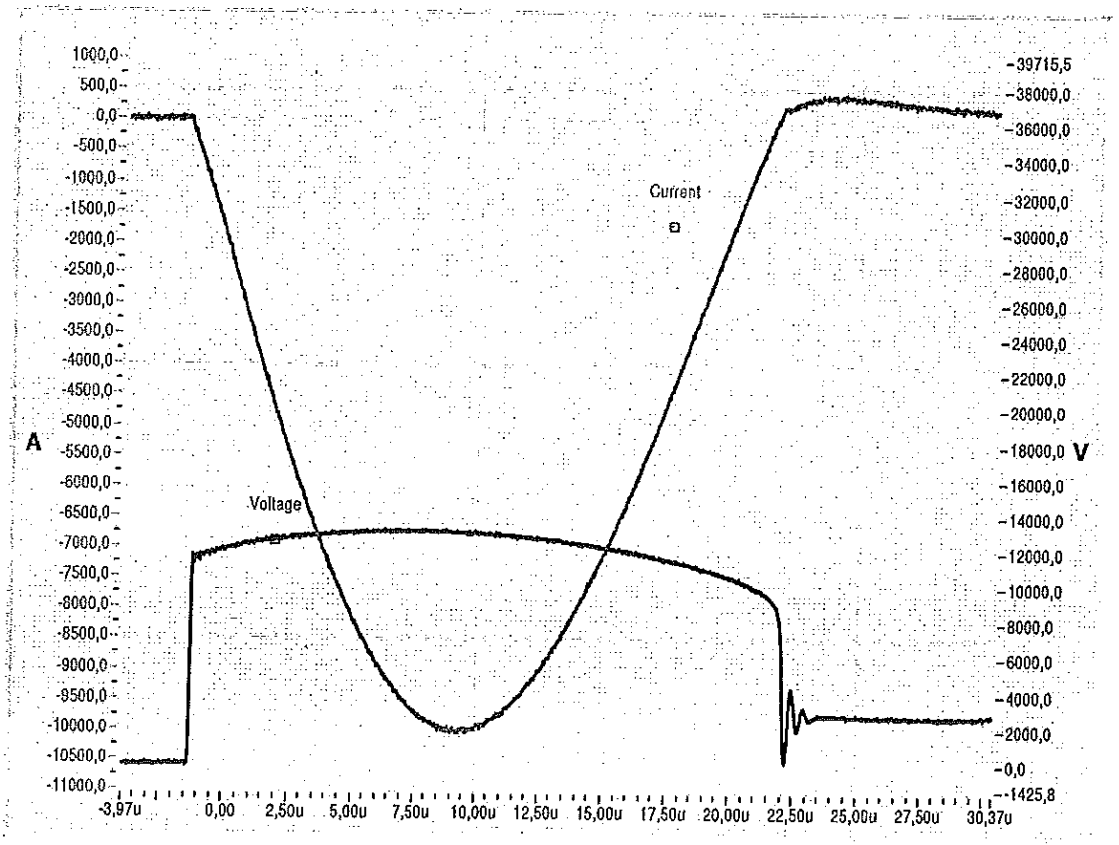
CESI B7024813 Oscillogram n. 3



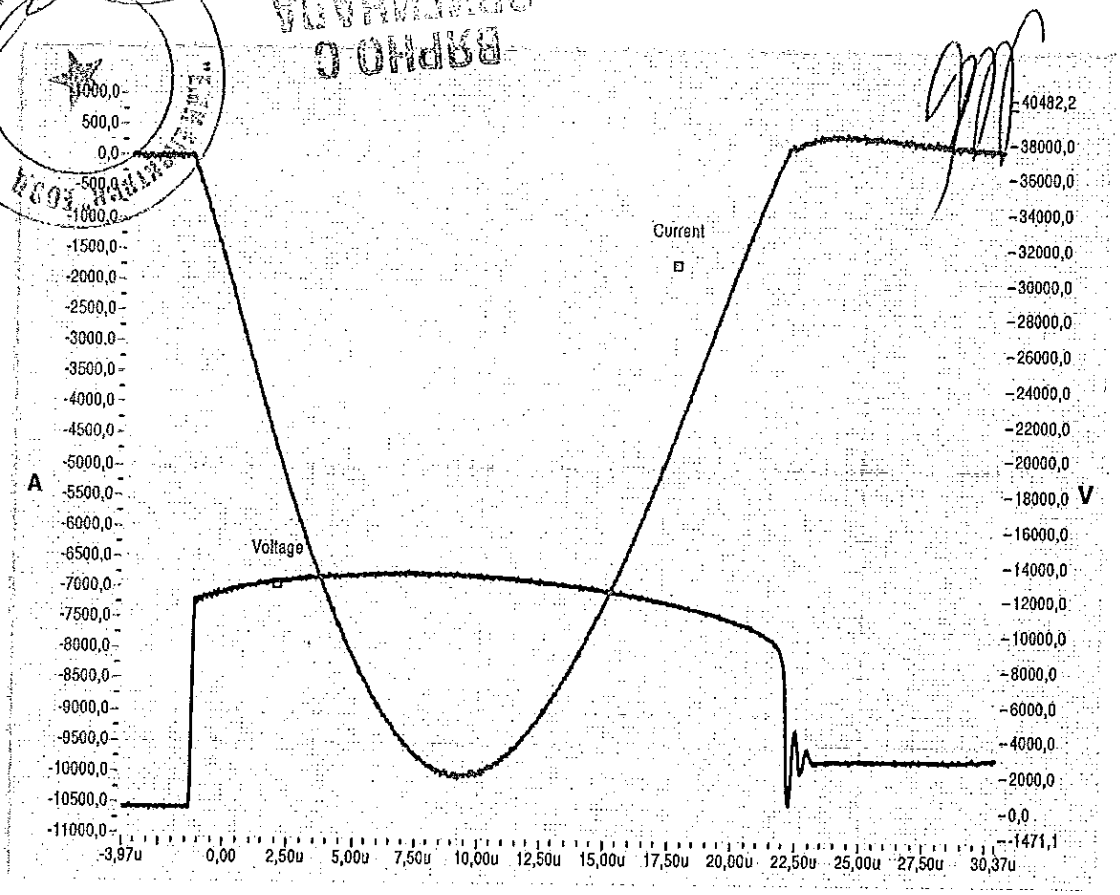
CESI B7024813 Oscillogram n. 4



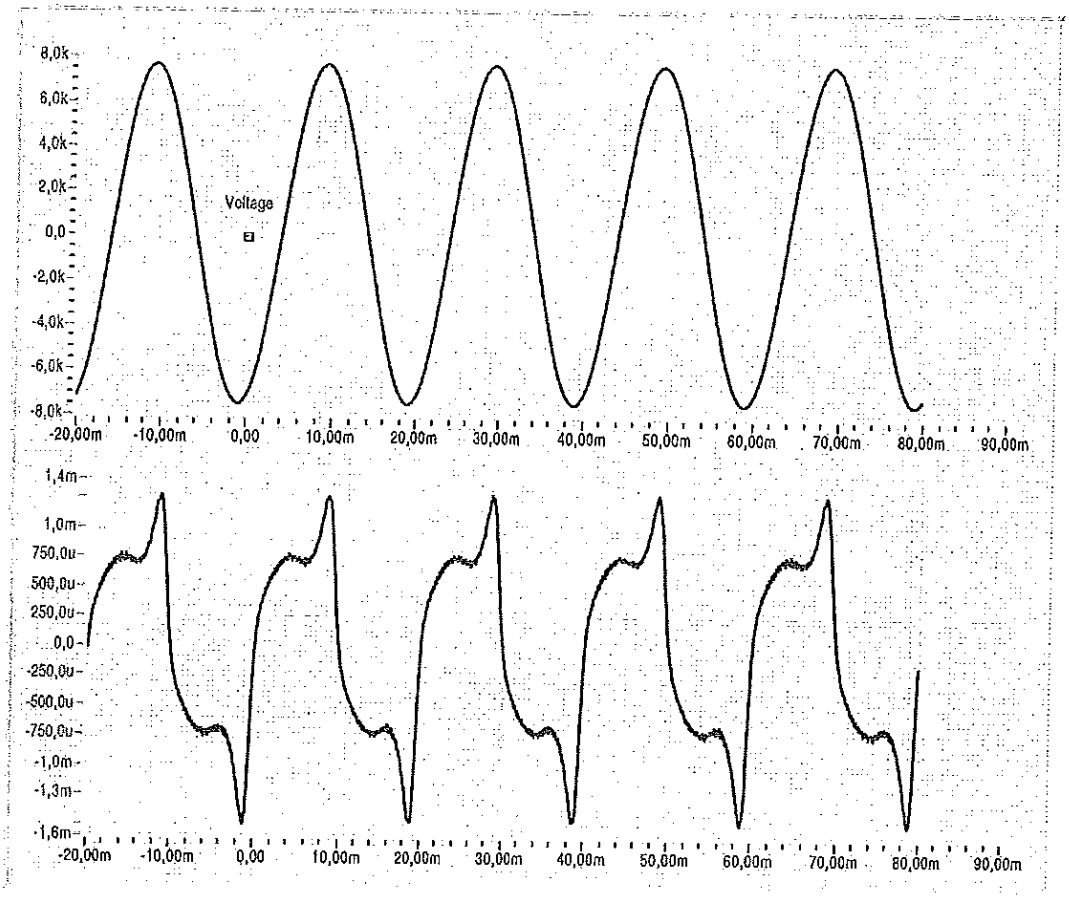
CESI B7024813 Oscillogram n. 5



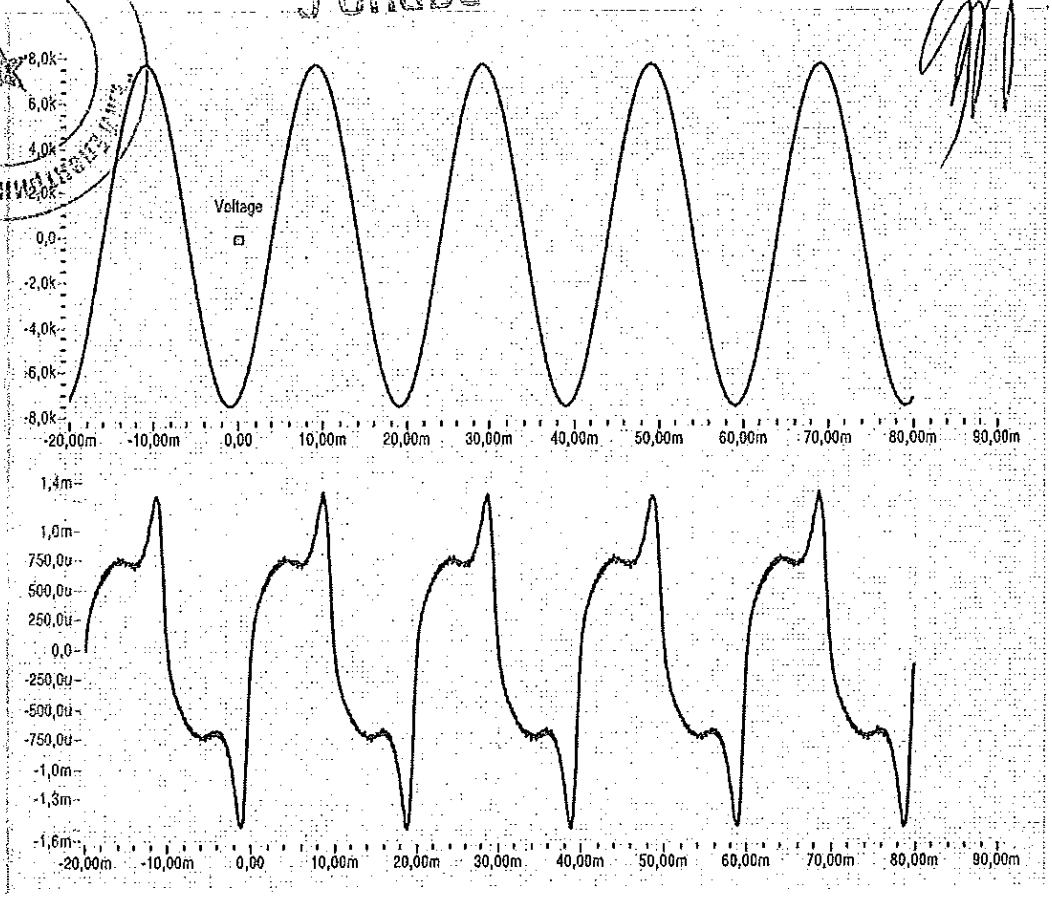
CESI B7024813 Oscillogram n. 6



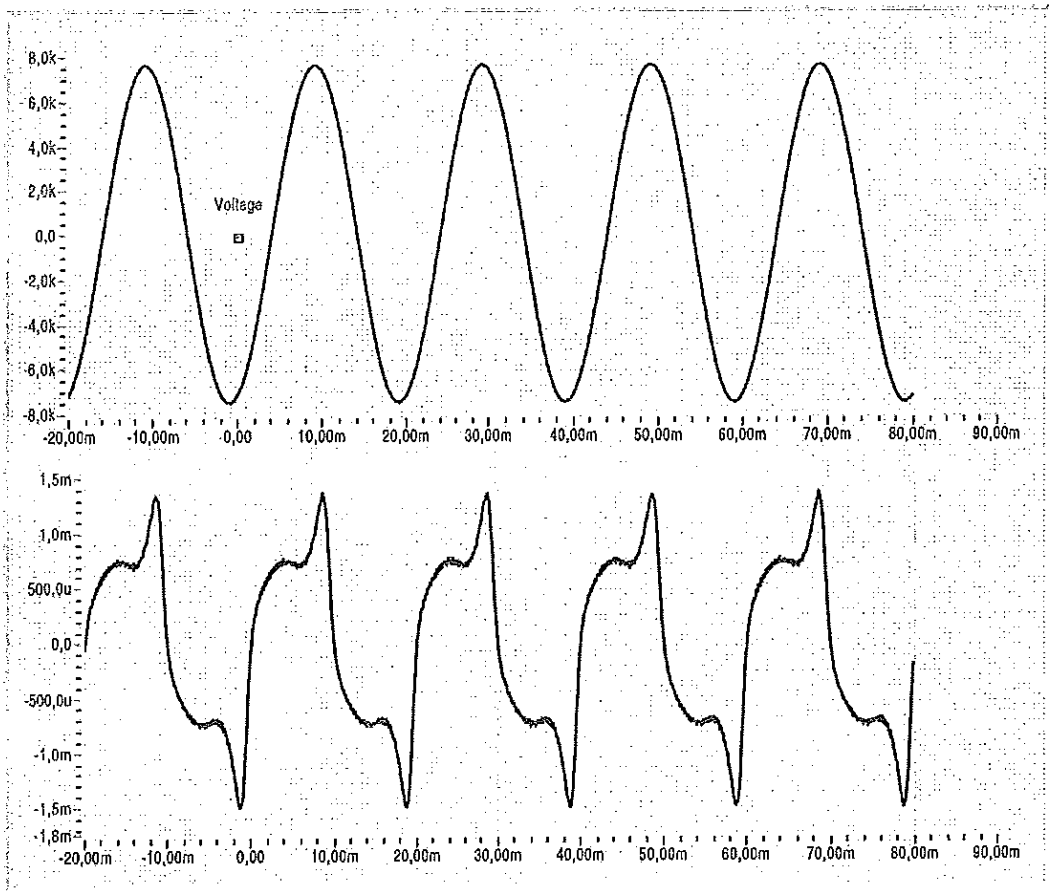
CESI B7024813 Oscillogram n. 7



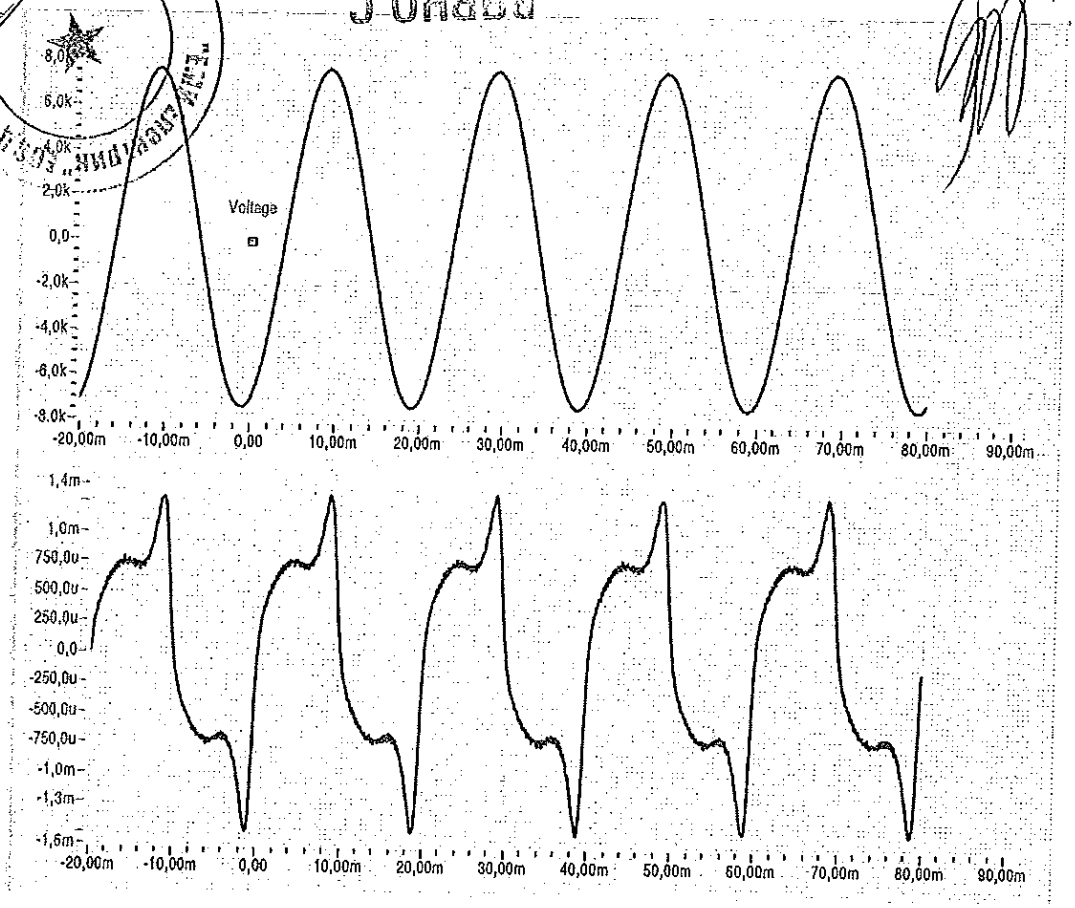
CESI B702-4813 Oscillogram n. 8



CESI B702-4813 Oscillogram n. 9



CESI B7024813 Oscillogram n. 10



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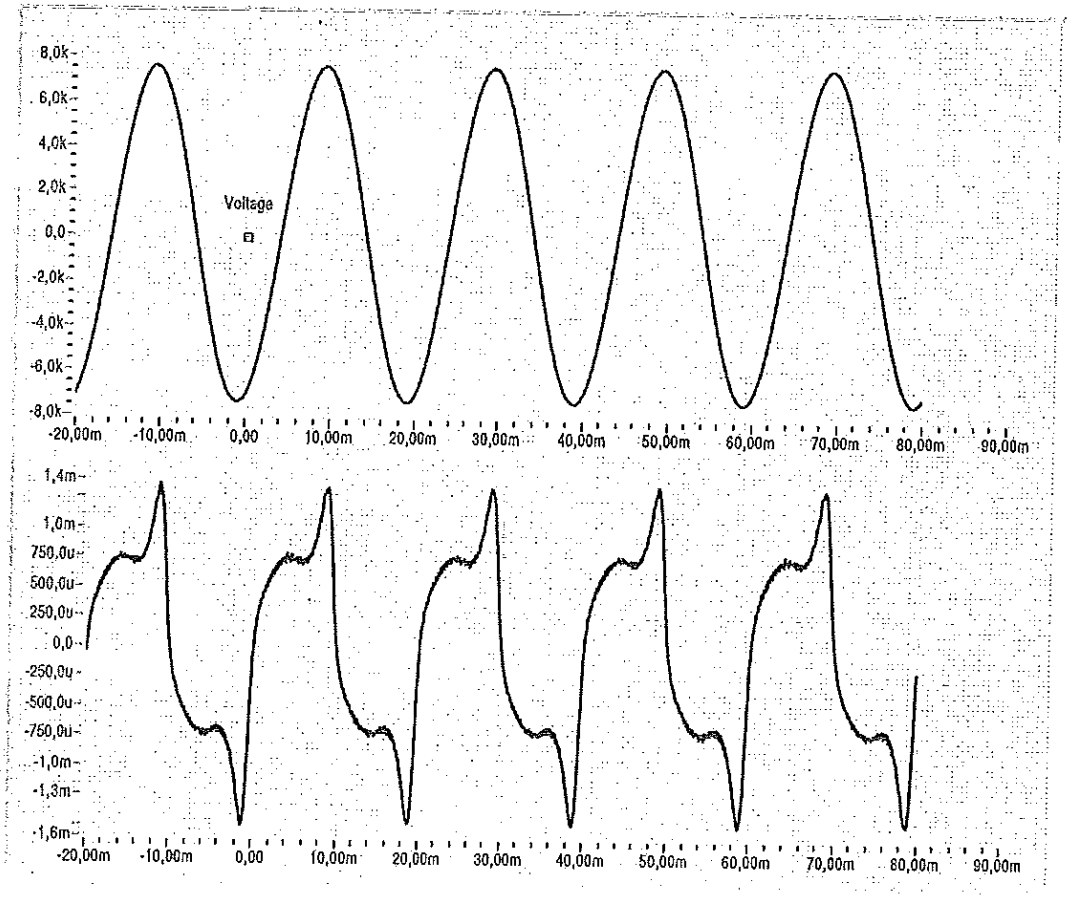

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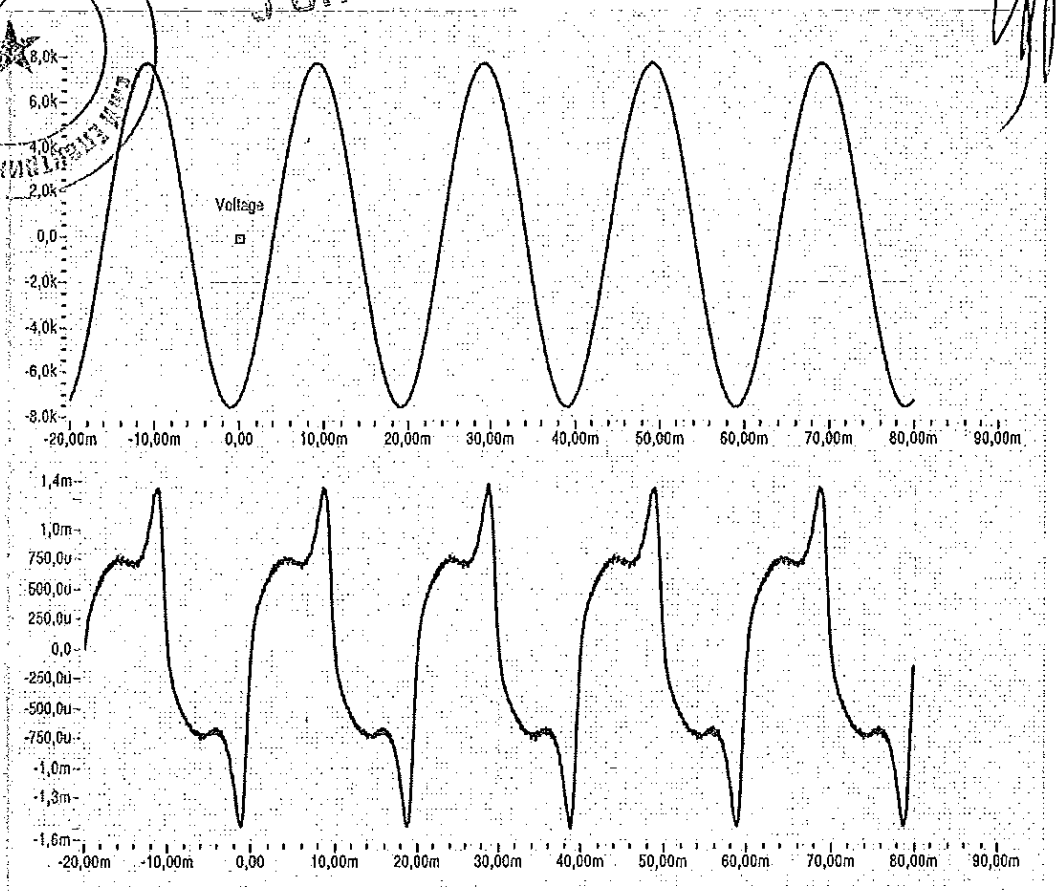
CESI B7024813 Oscillogram n. 12



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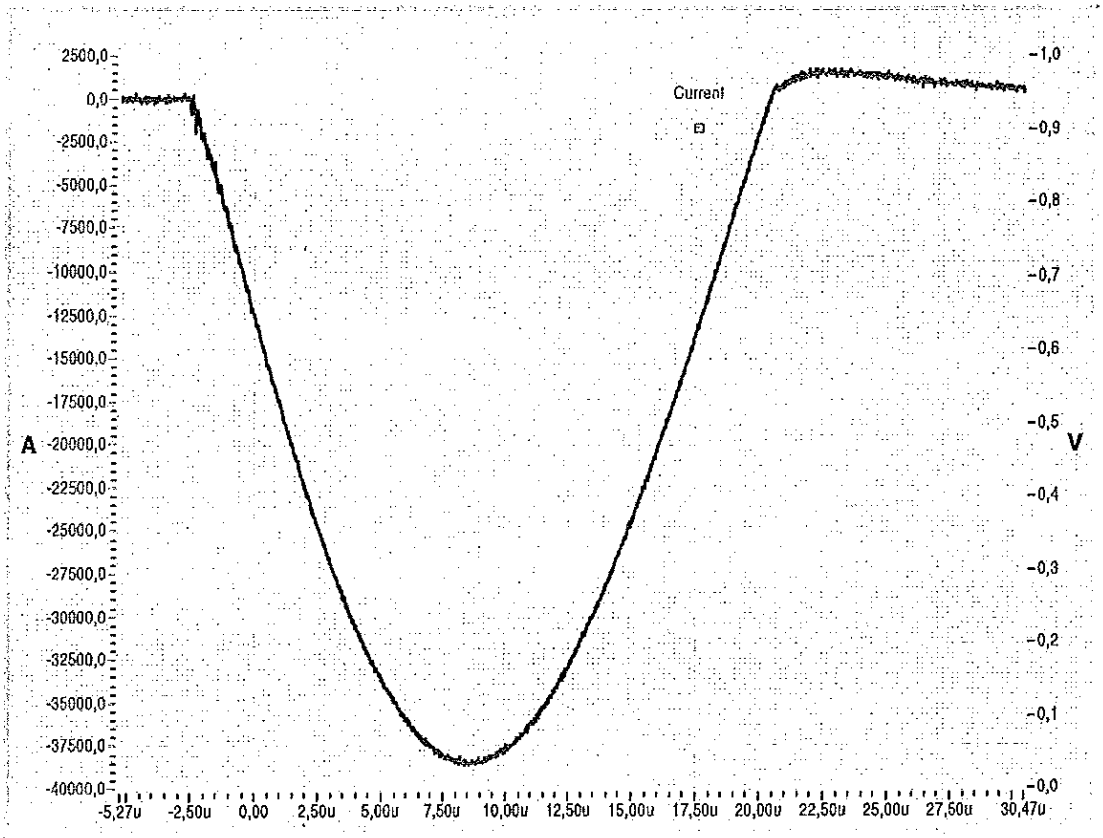

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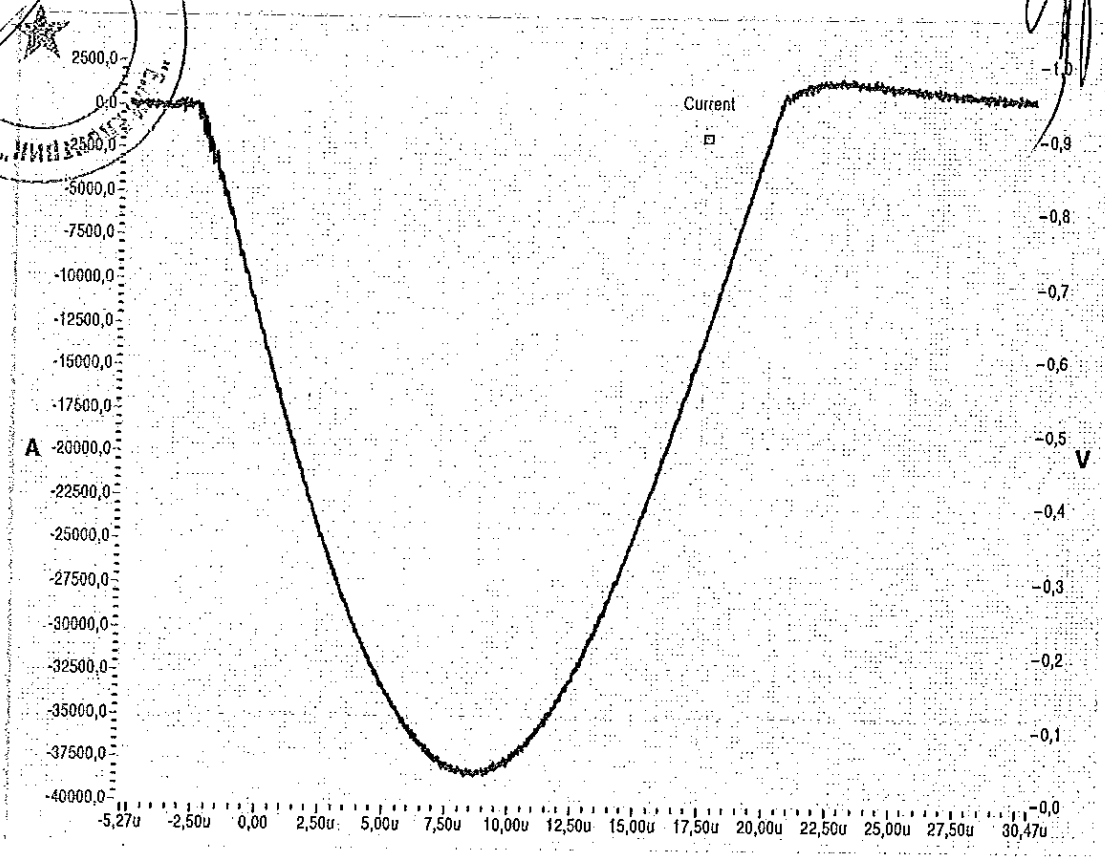

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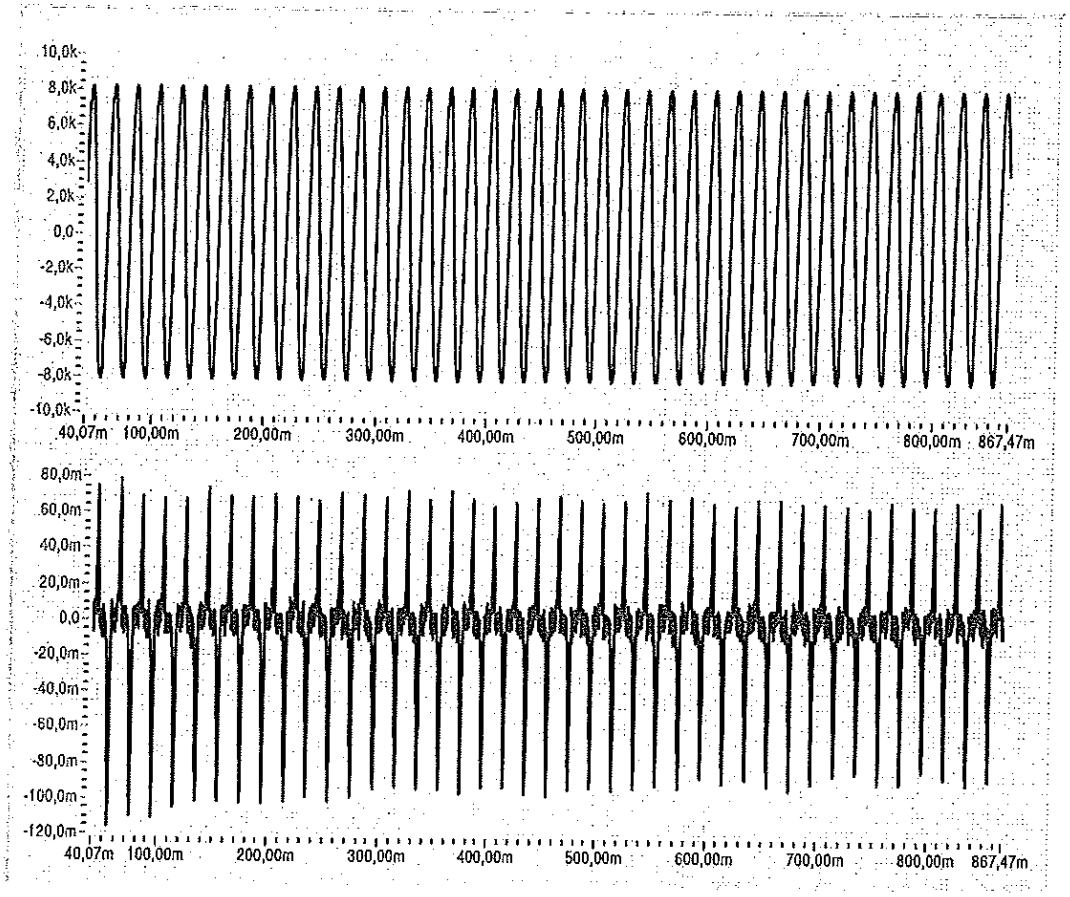

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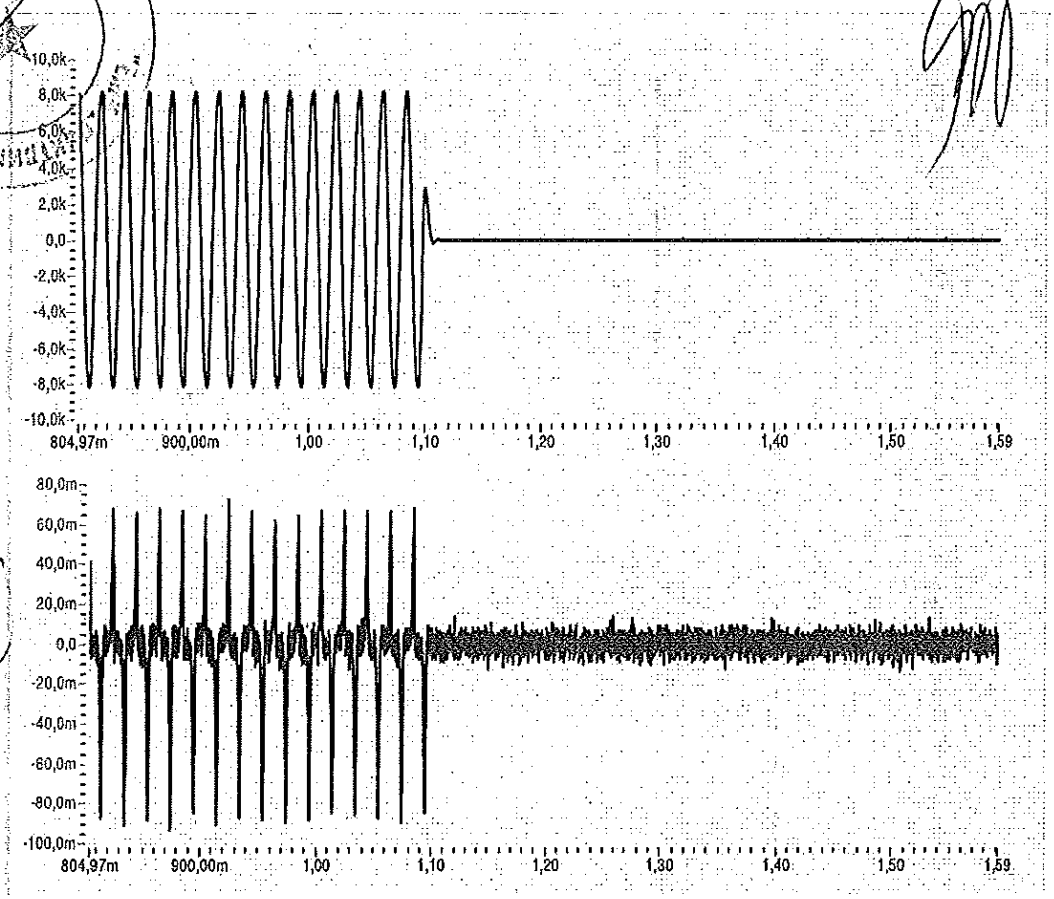

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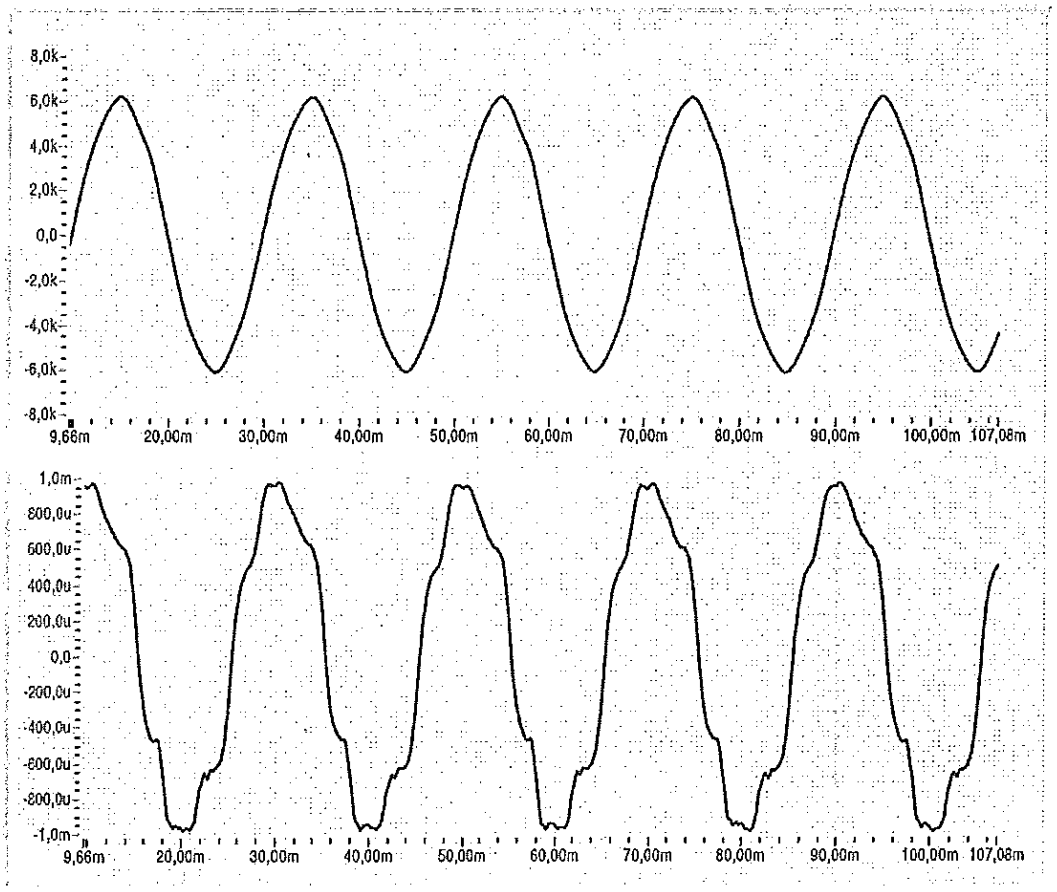

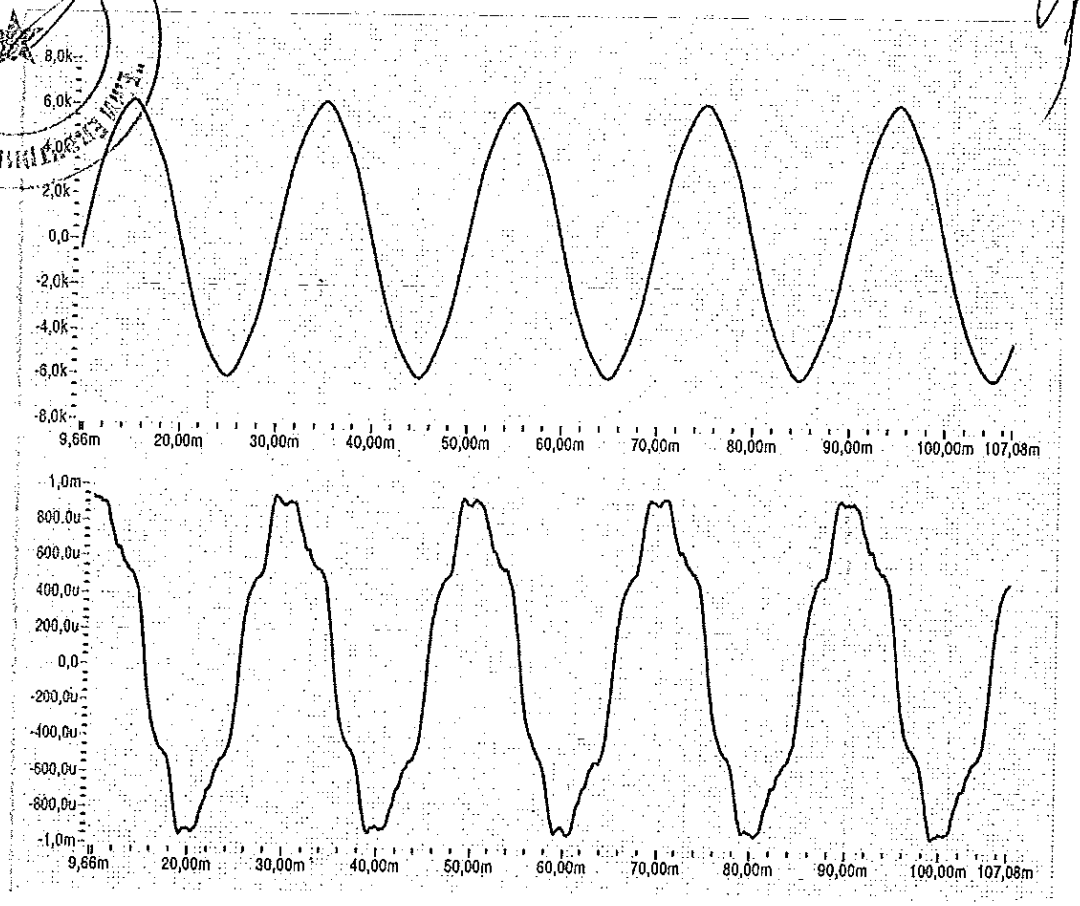

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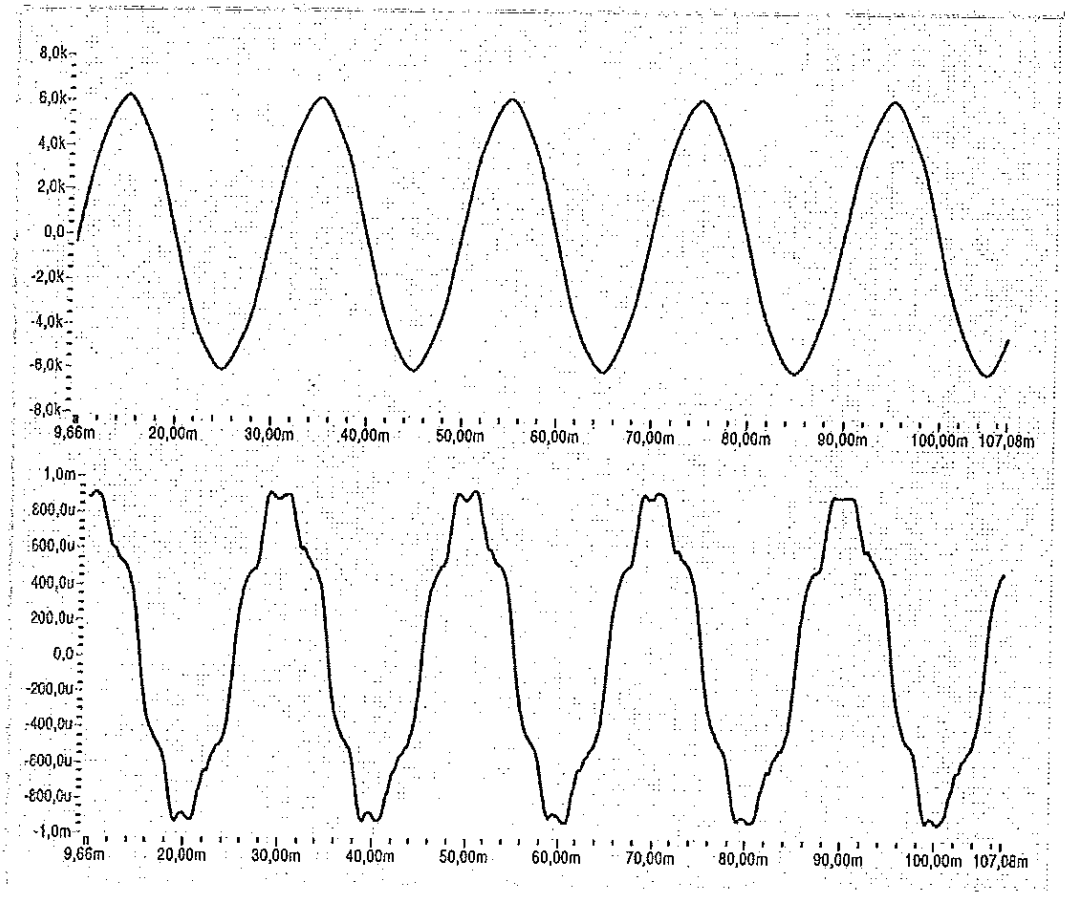
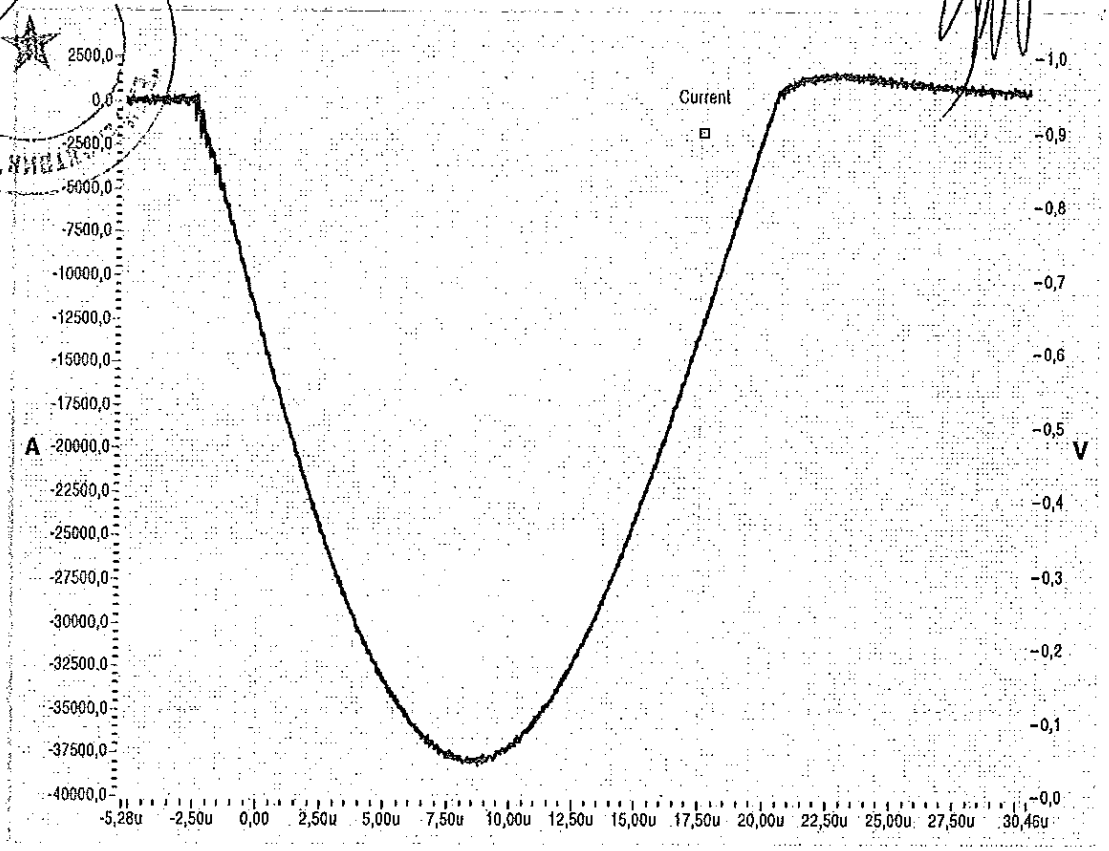


CESI B7024813 Oscillogram n. 19

CESI B7024813 Oscillogram n. 20



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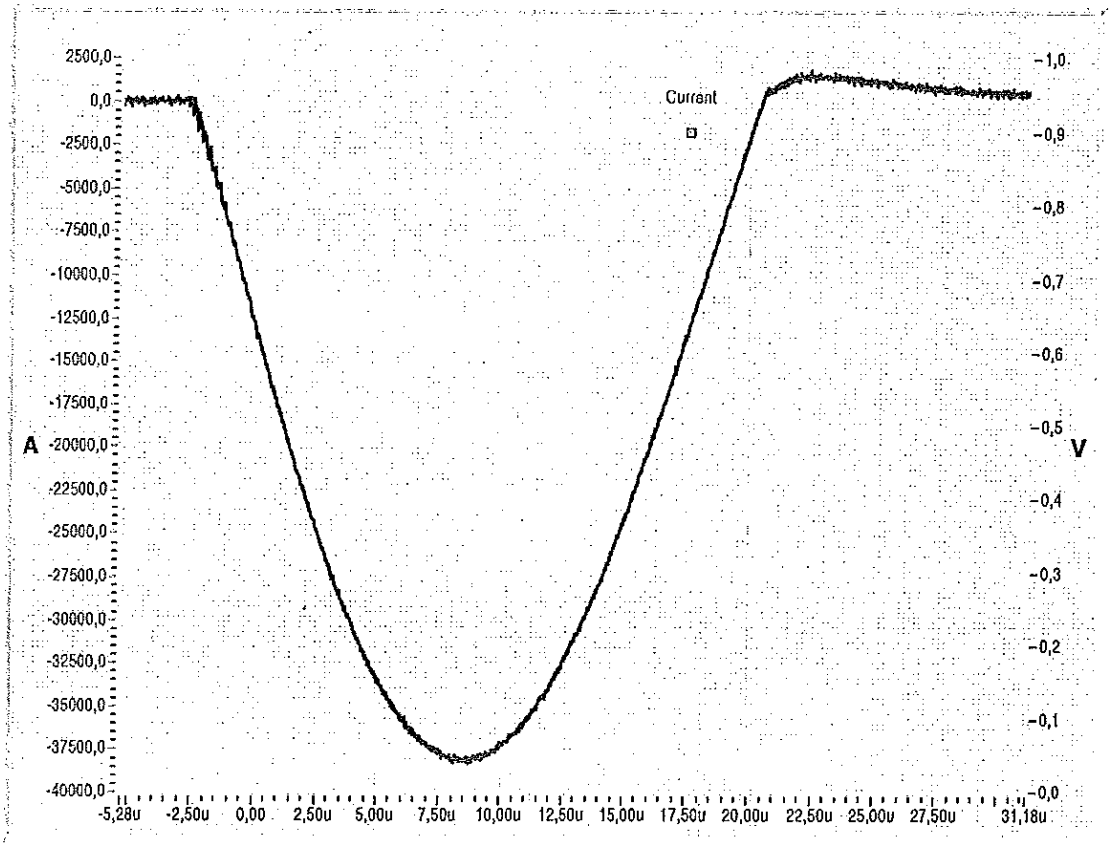

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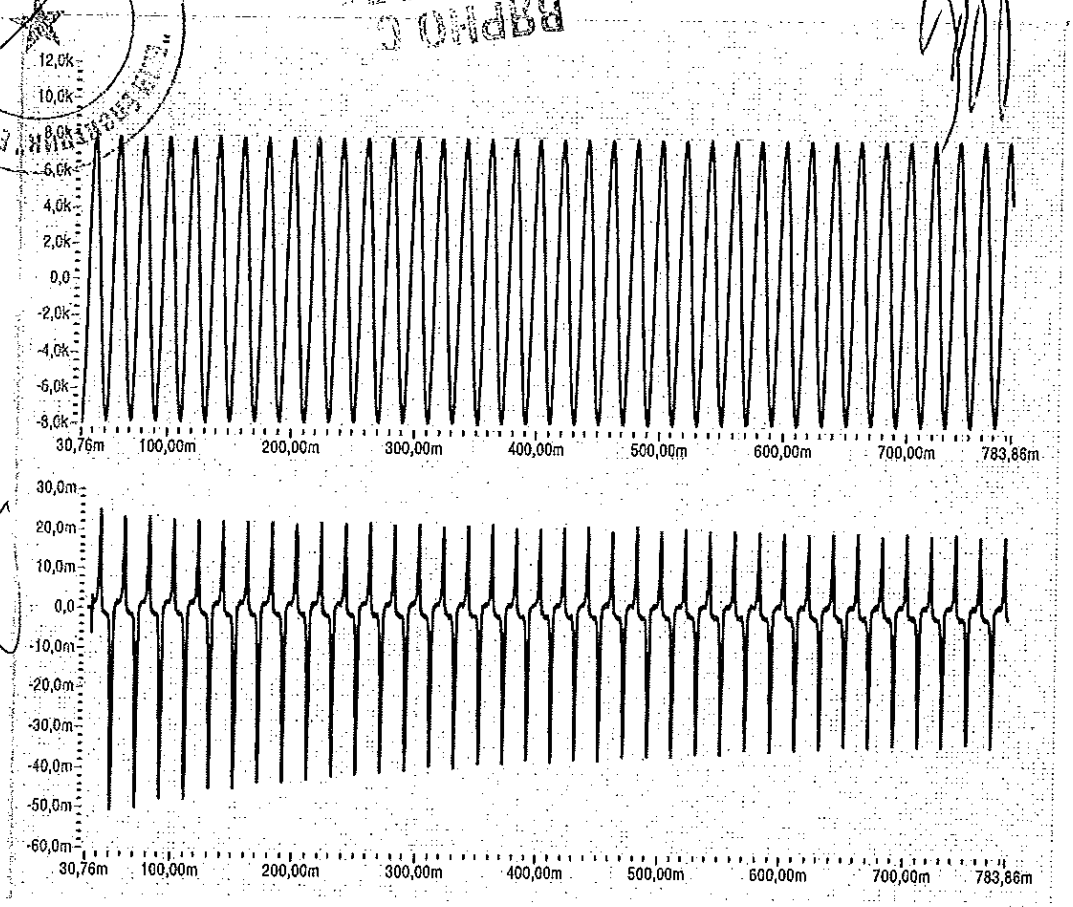

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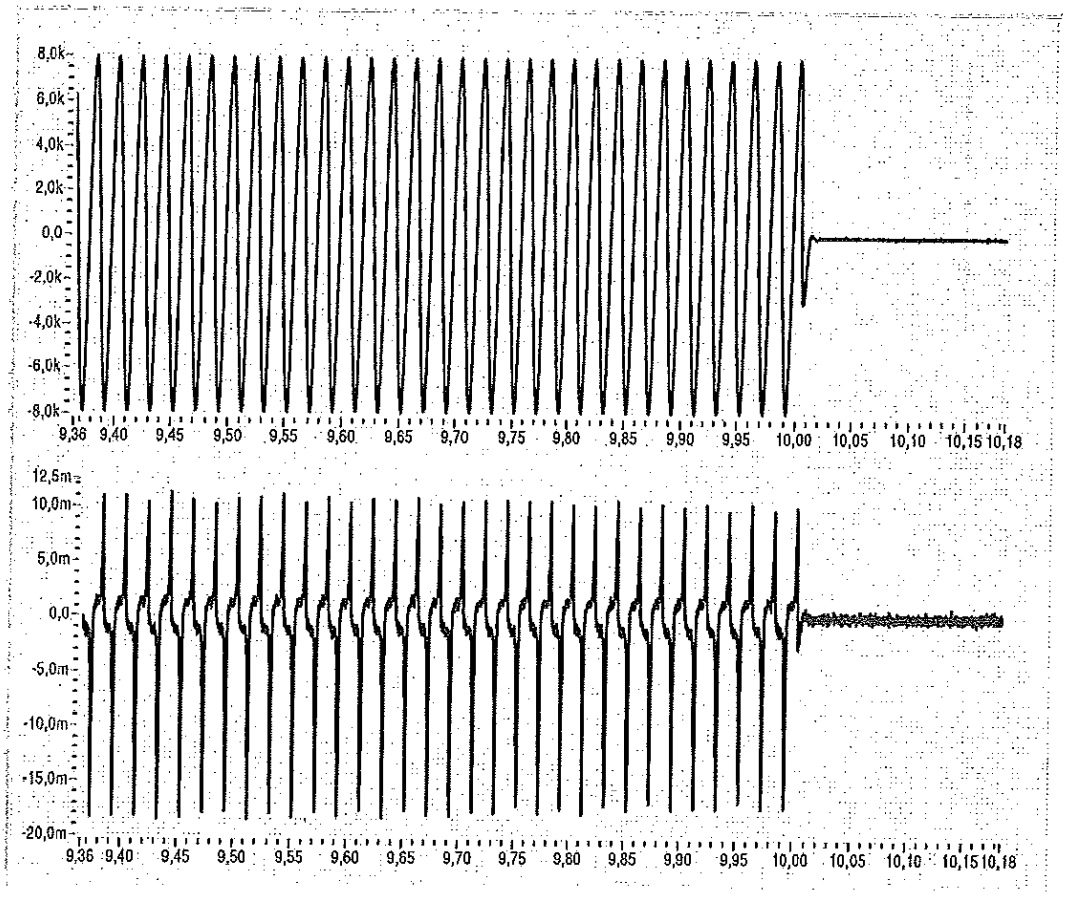

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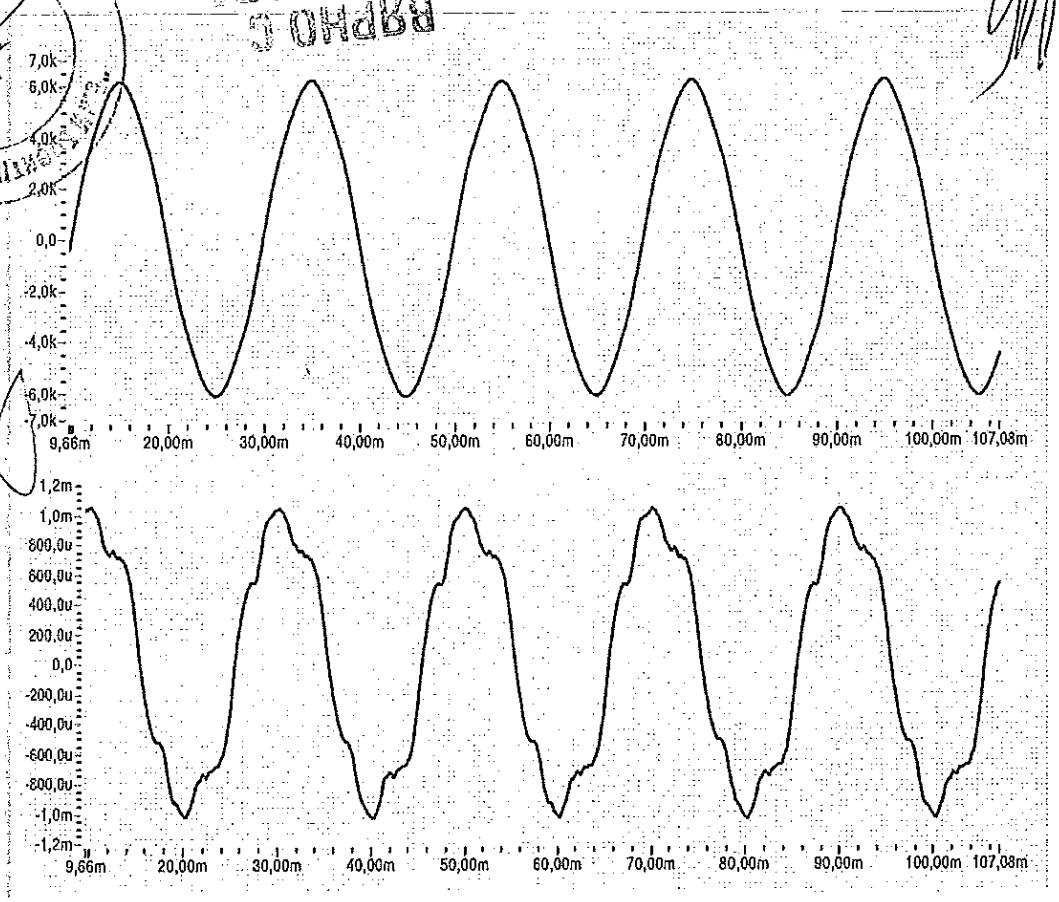
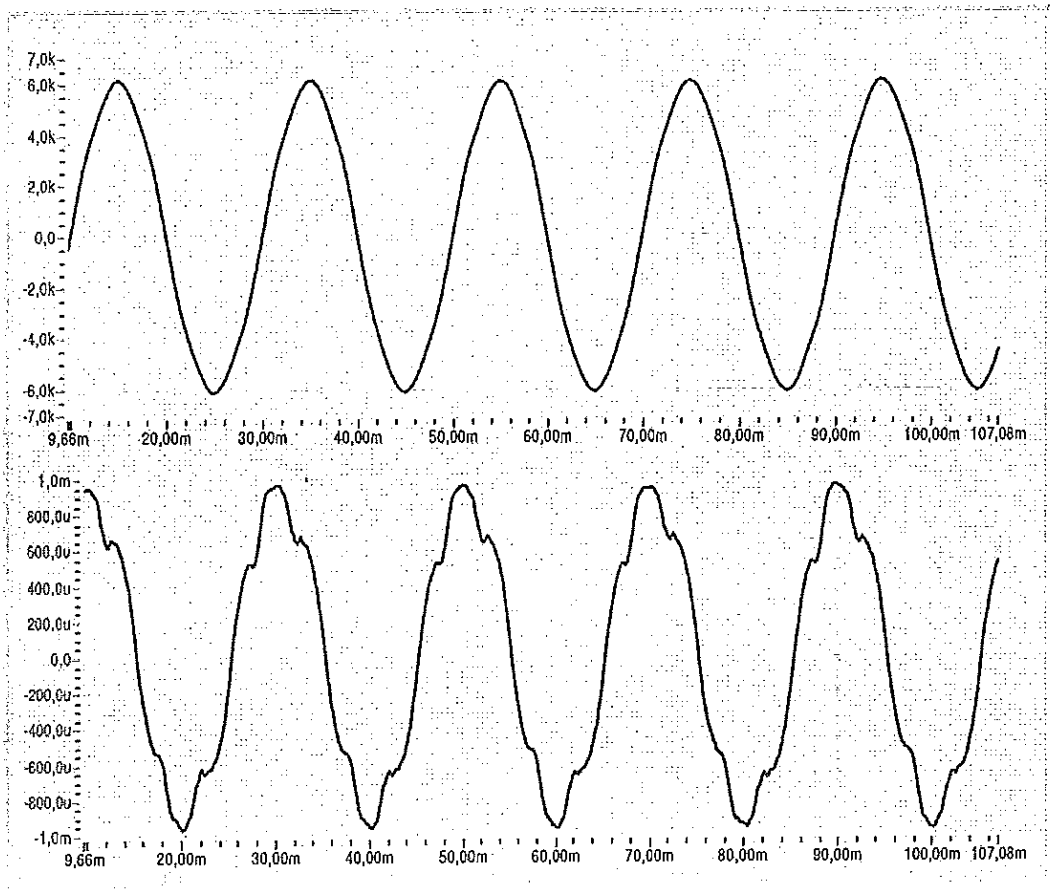
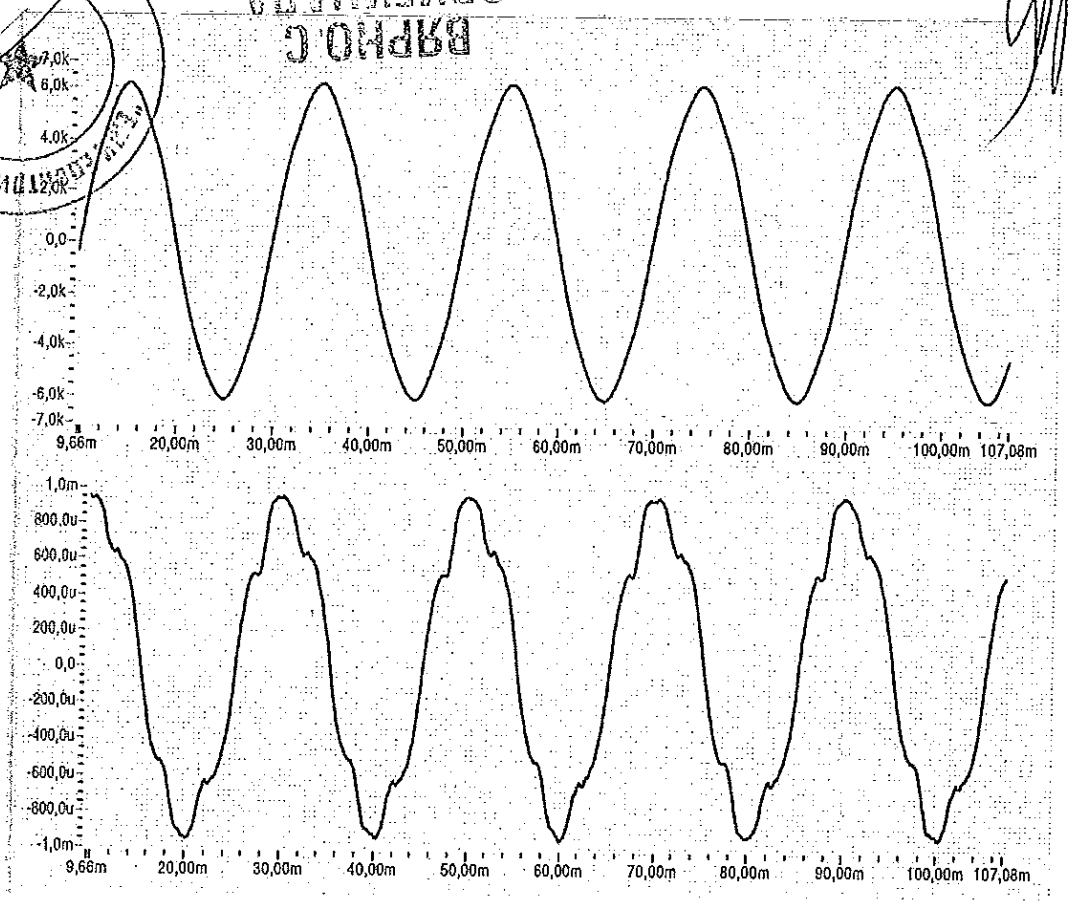
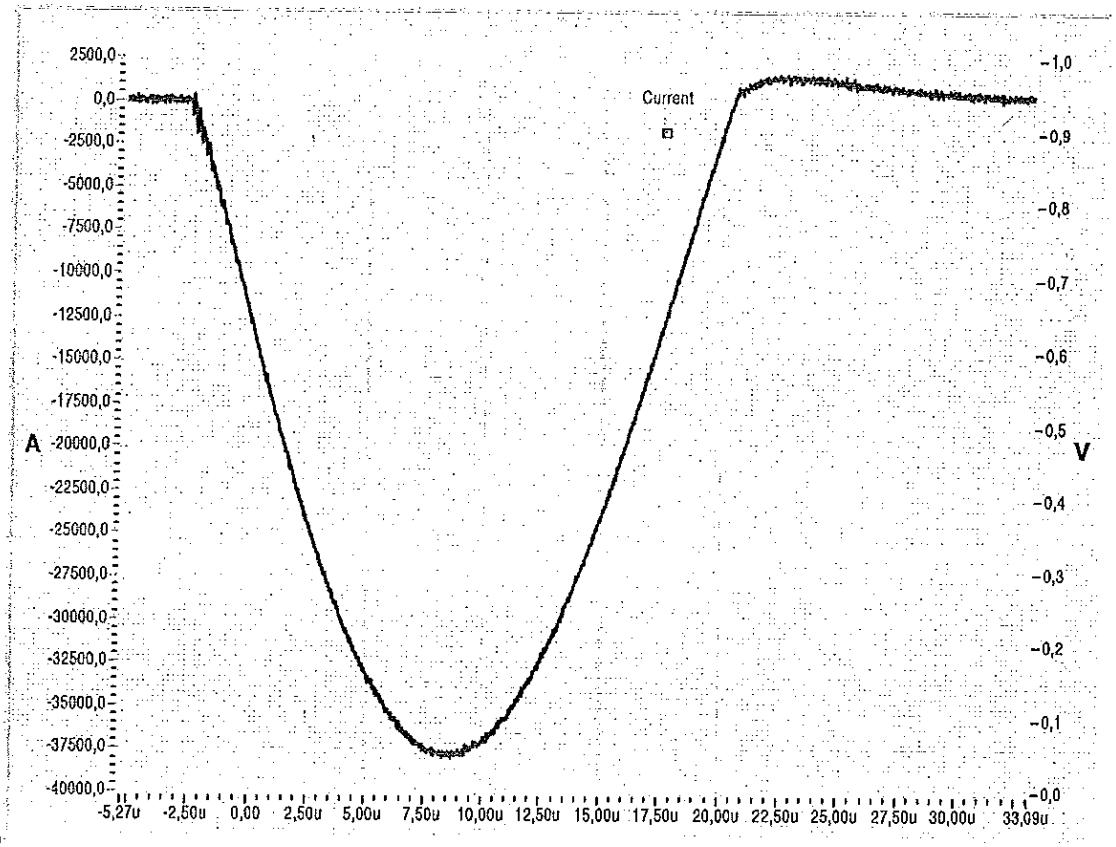


CESI B7024813 Oscillogram n. 25





CESI B7024813 Oscillogram n. 26



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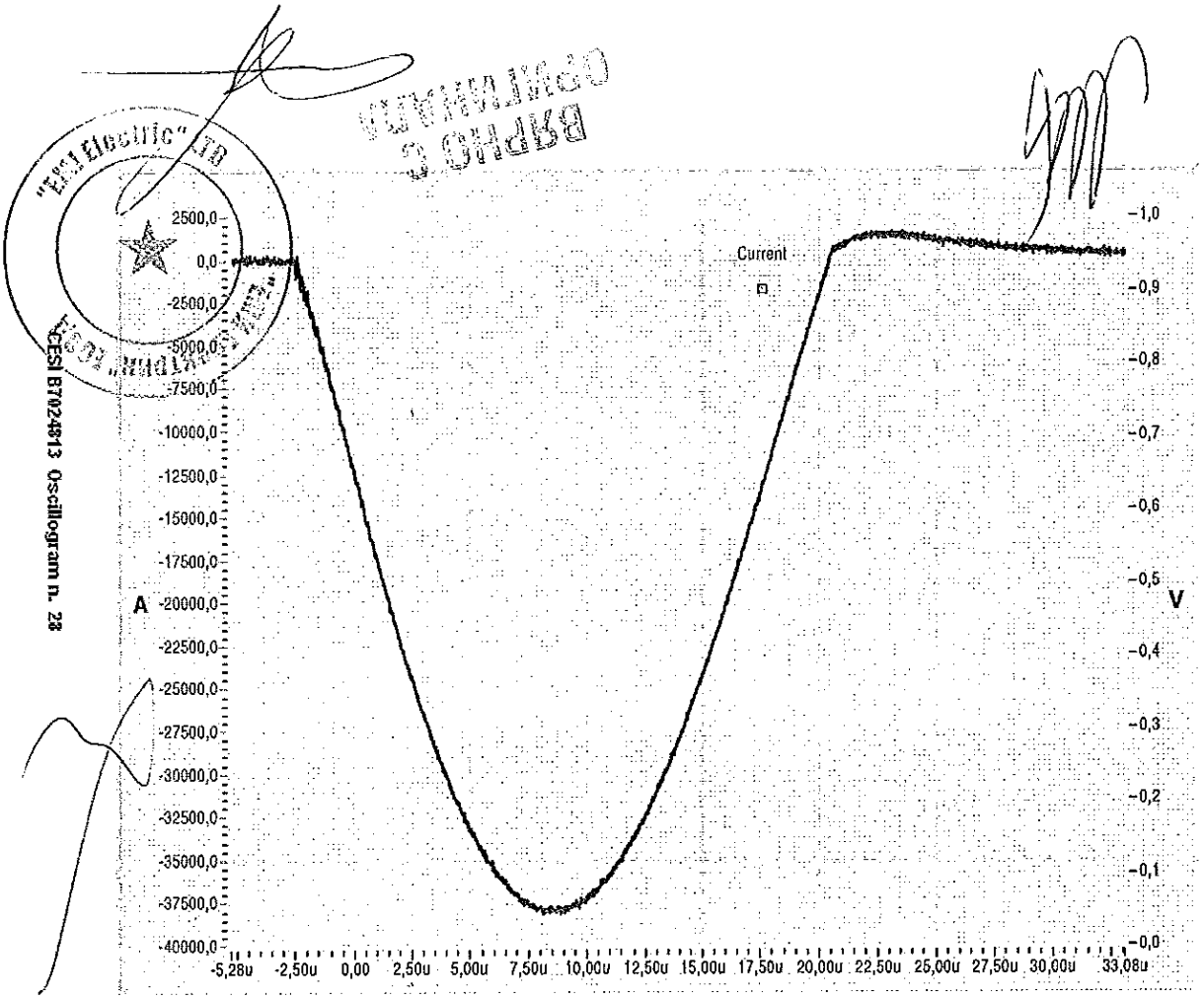

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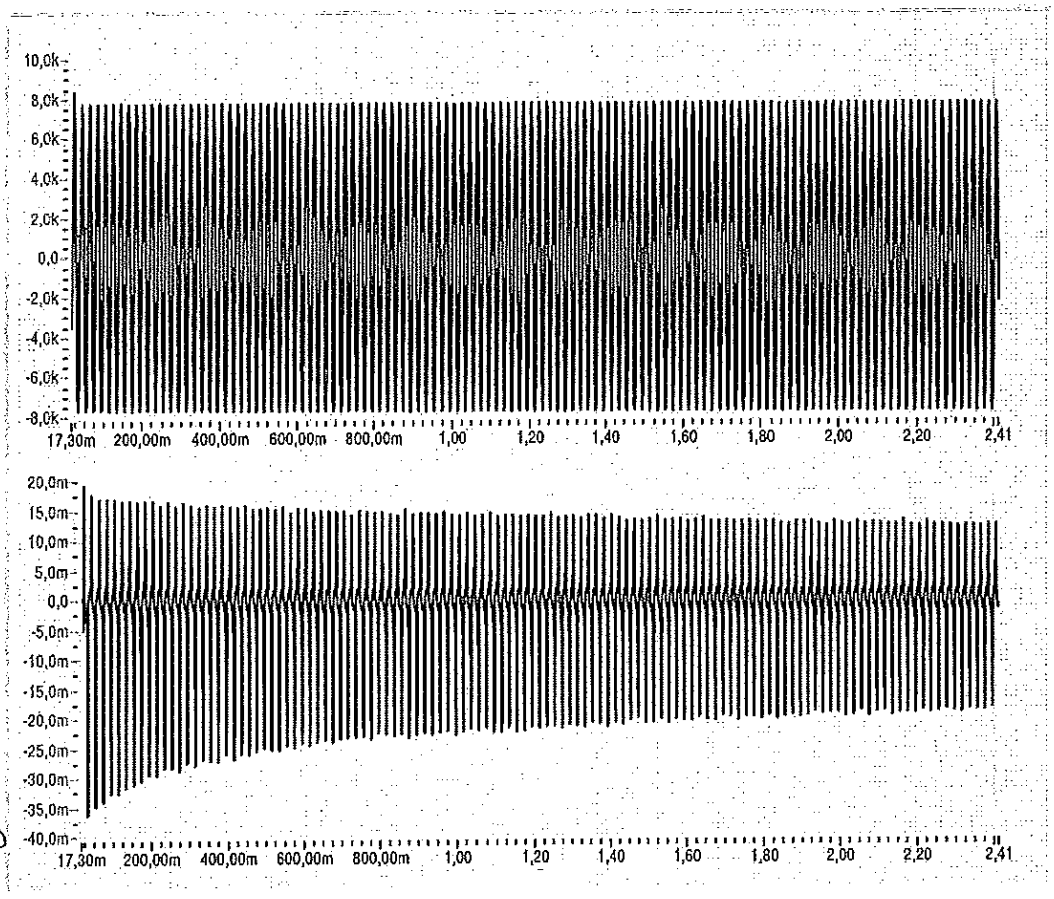
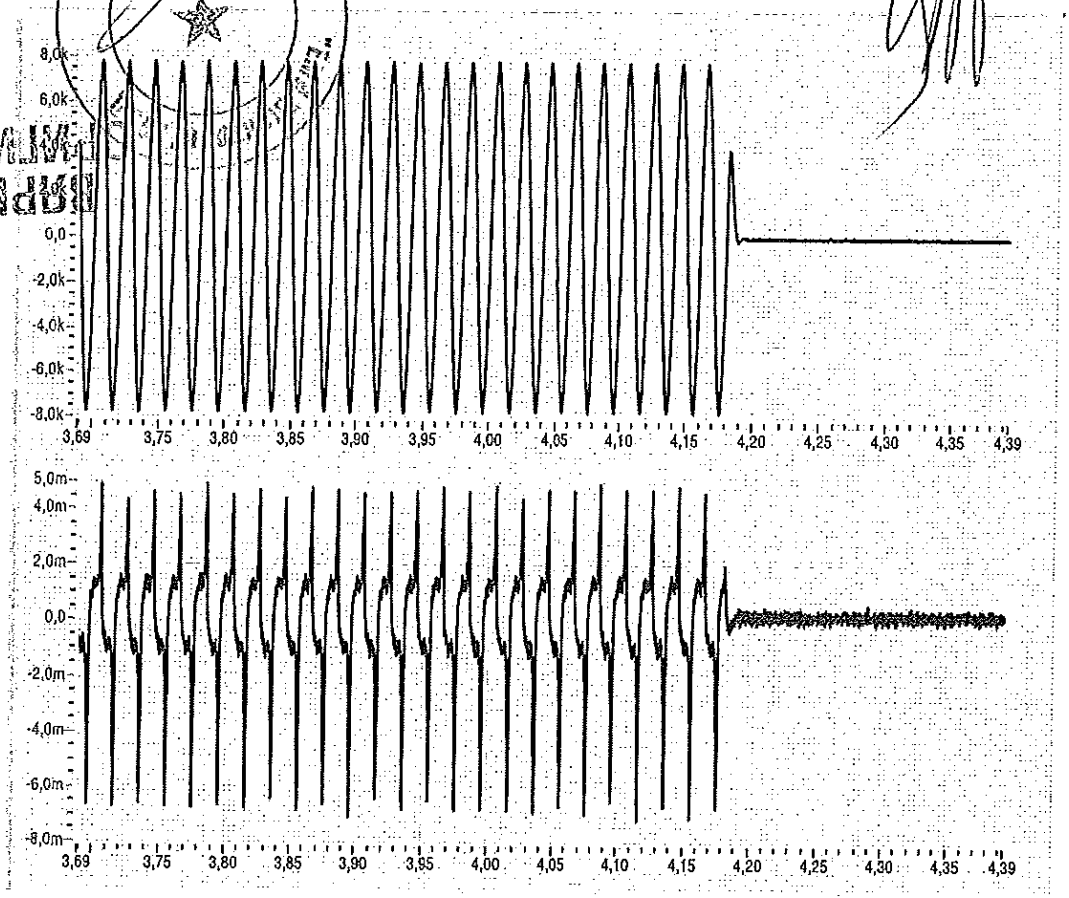


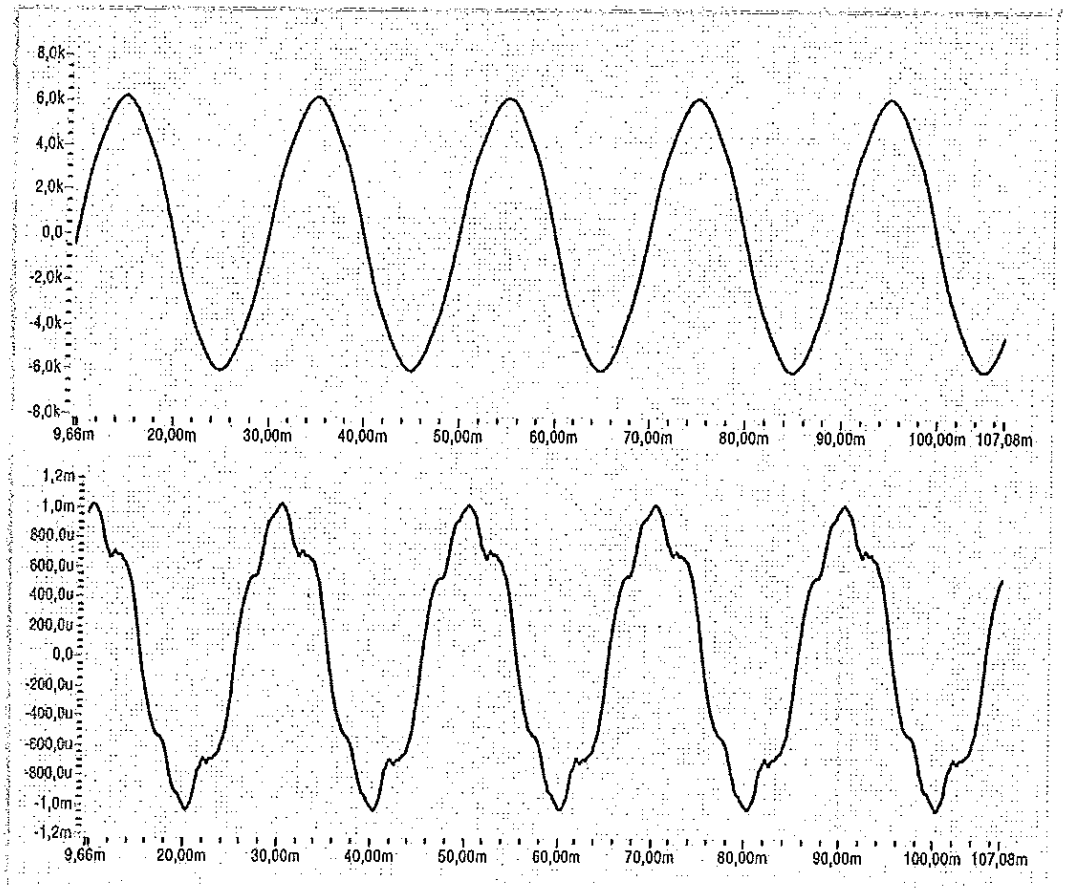
CESI B7024813 Oscillogram n. 29

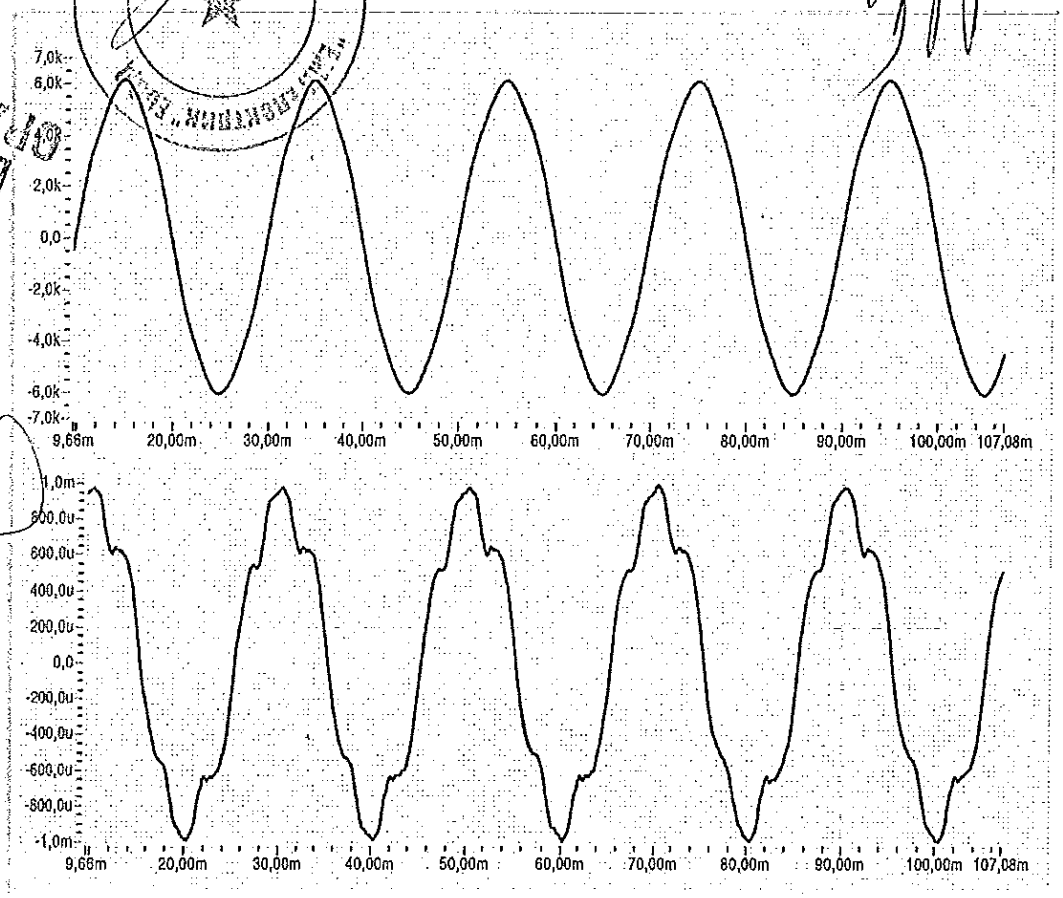
048

CESI B7024813 Oscillogramm. 30



CESI B7024813 Oscillogram n. 31





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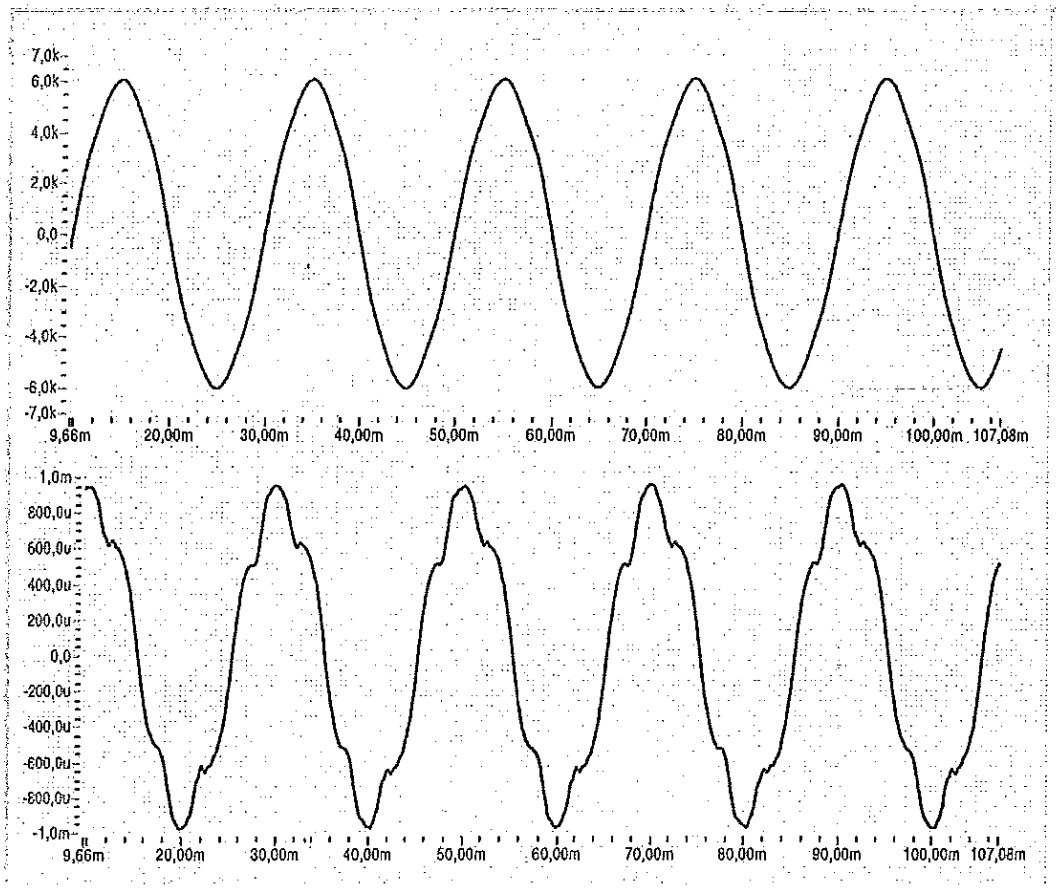

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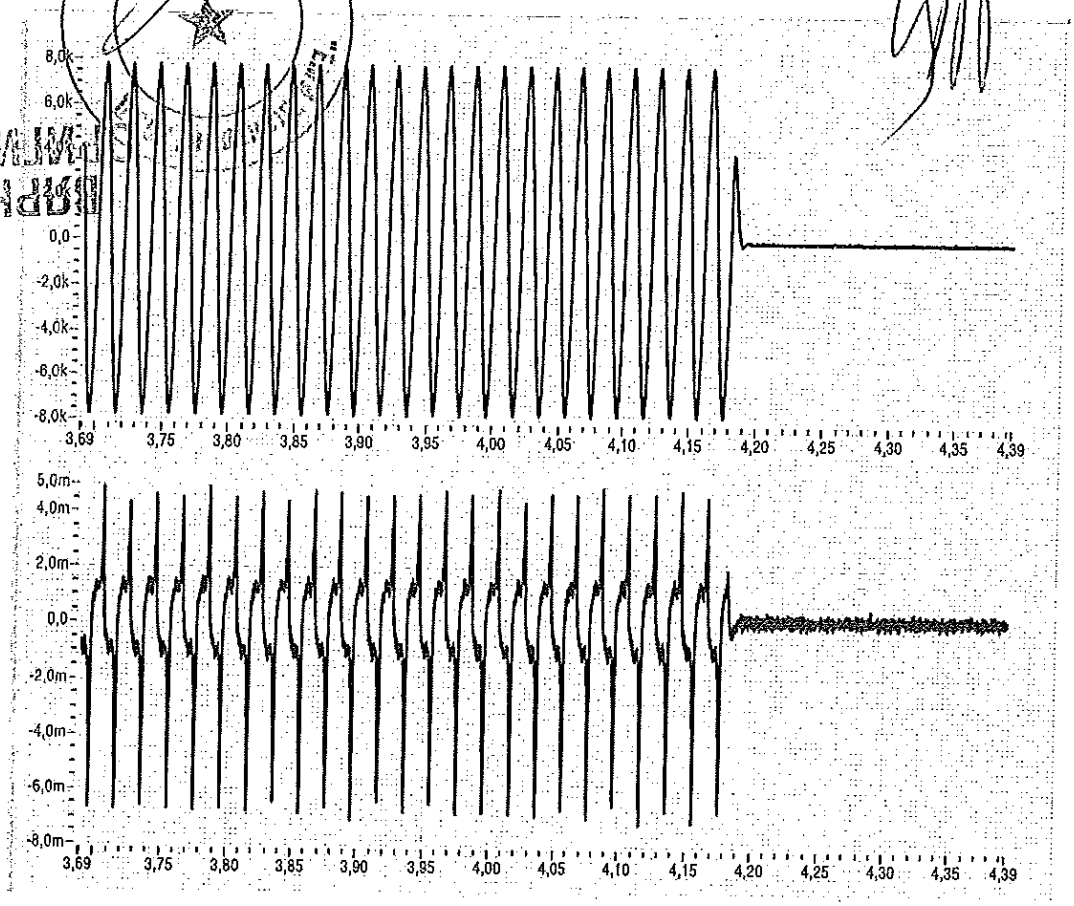

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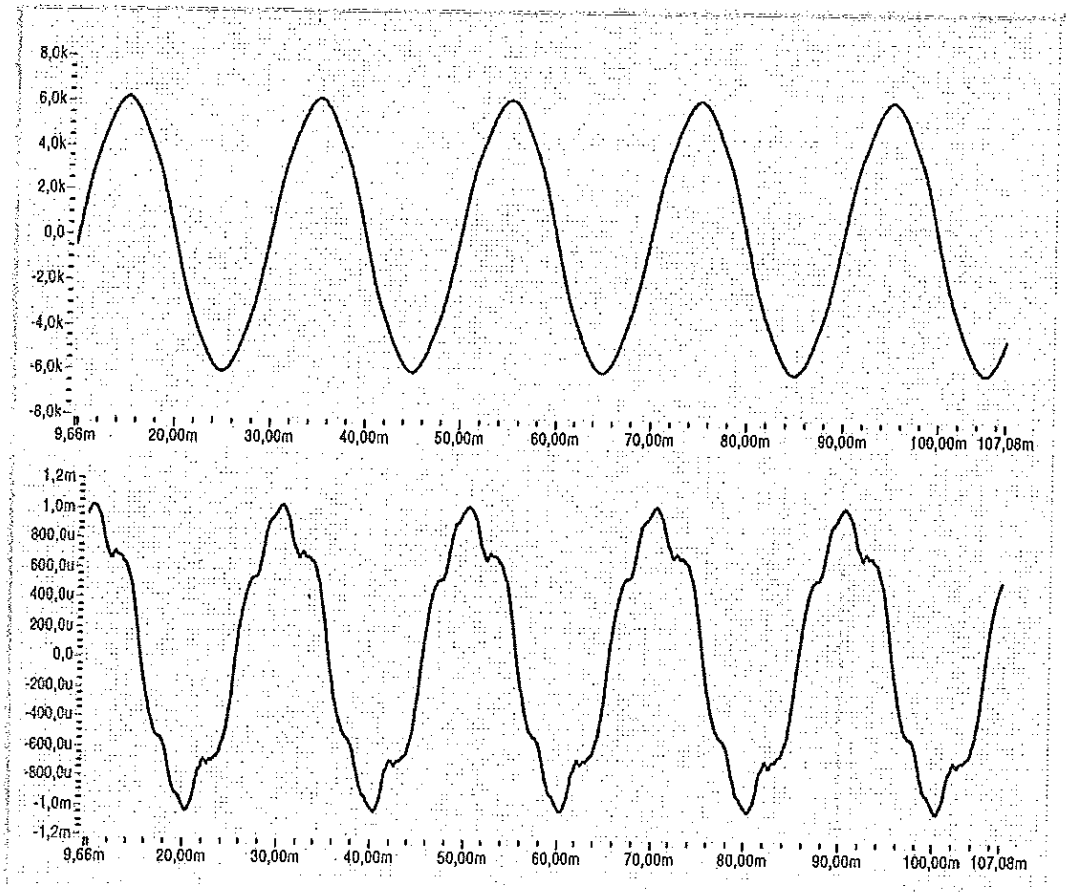
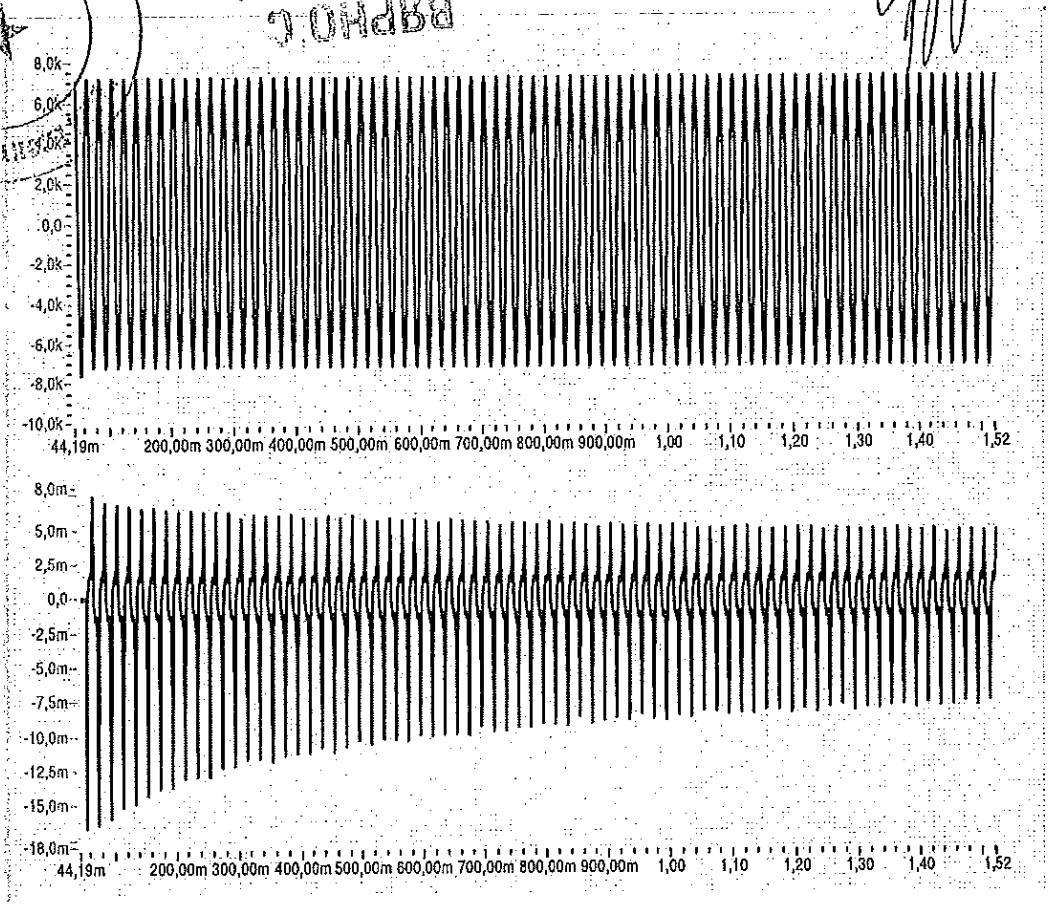


CESI B7024813 Oscillogram n. 31

348

CESI B7024813 Oscillogram n. 36



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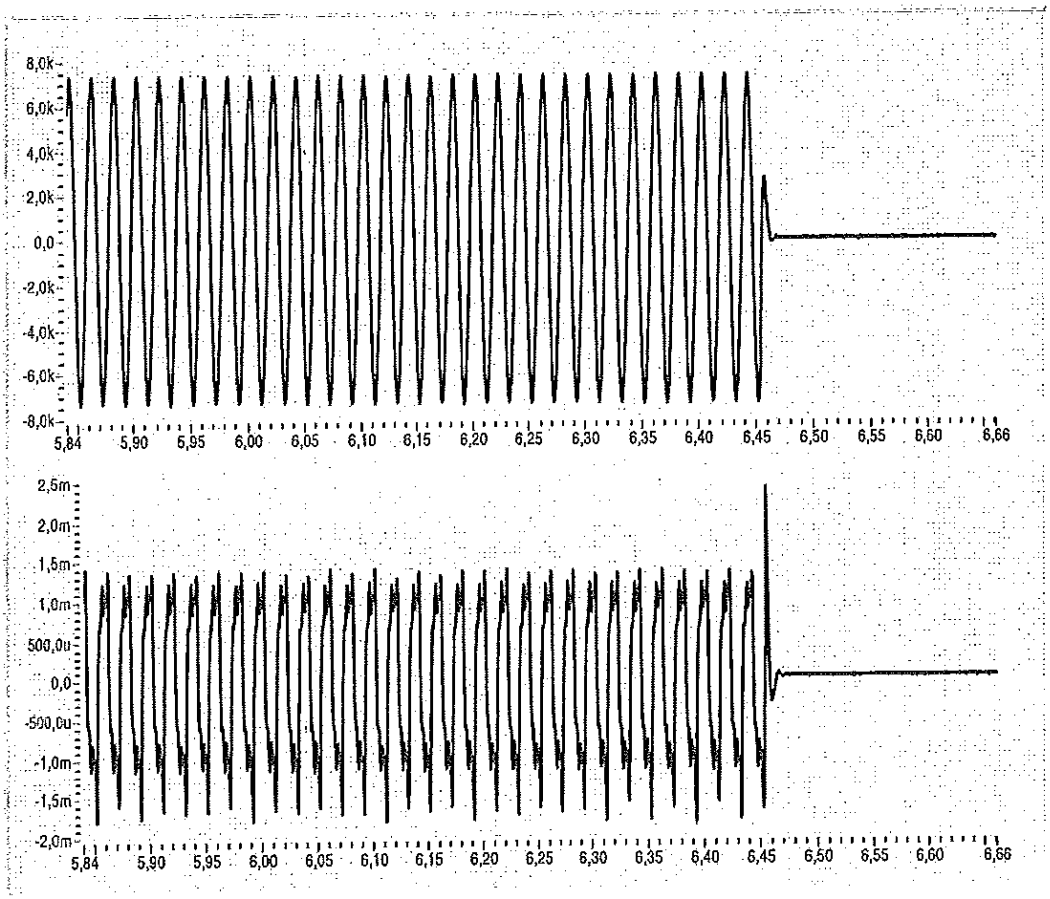

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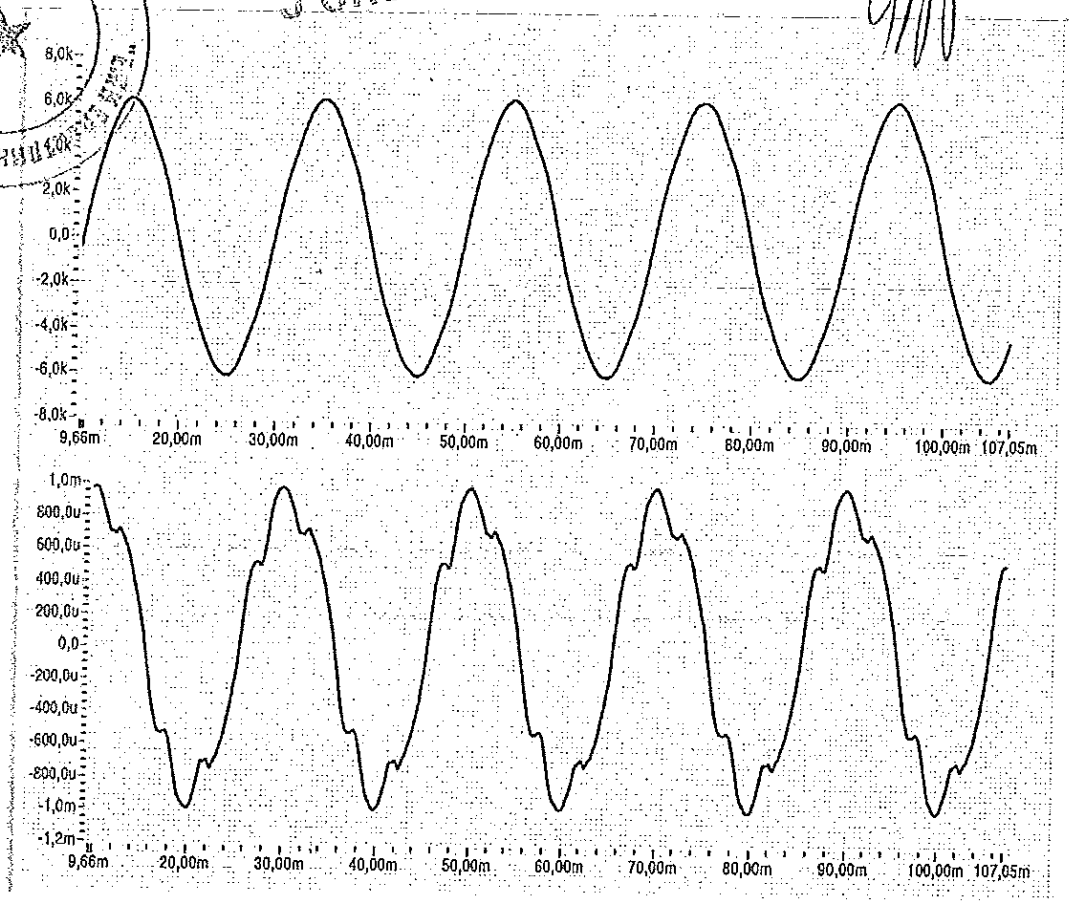

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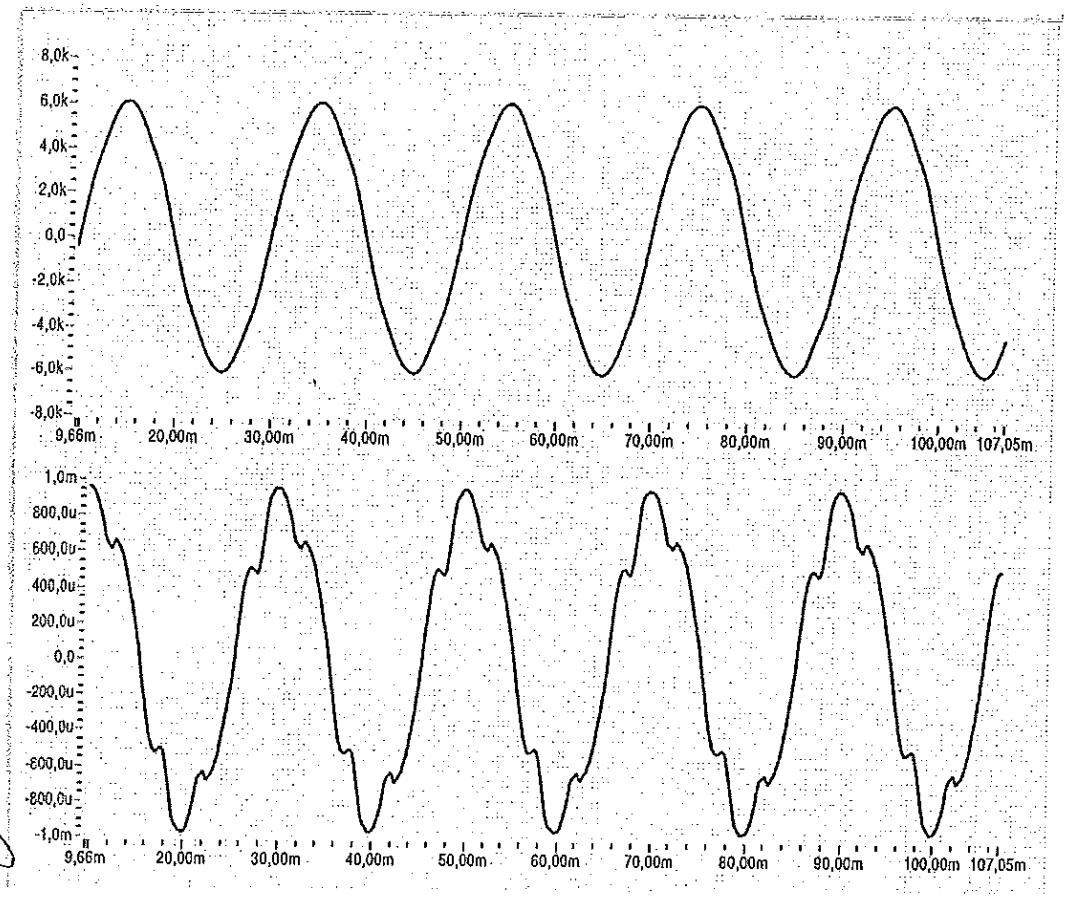

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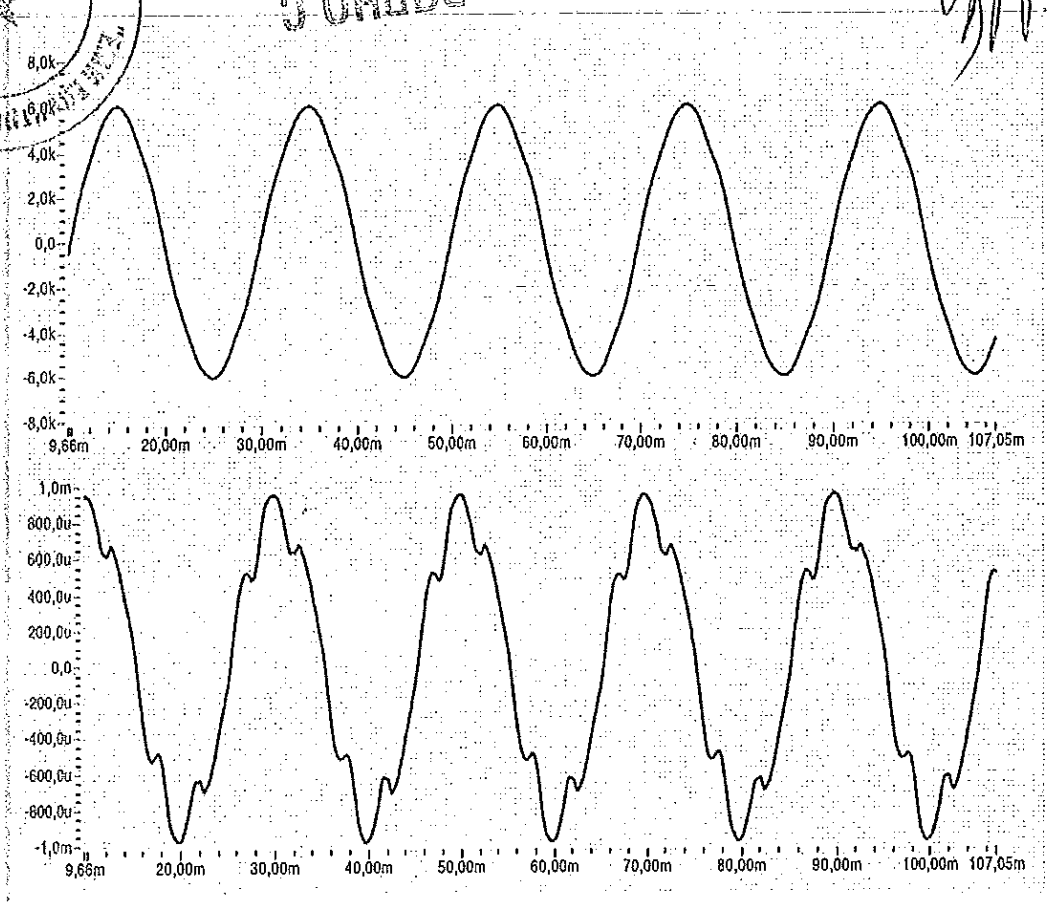

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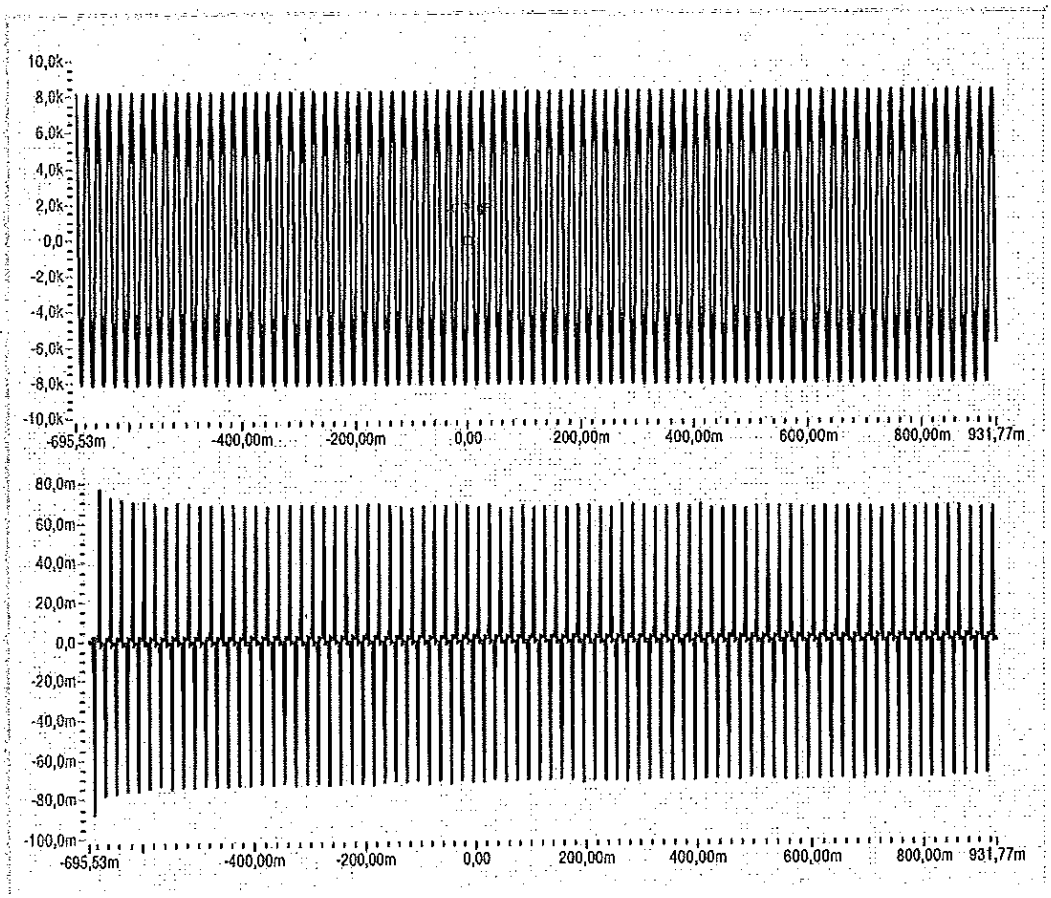

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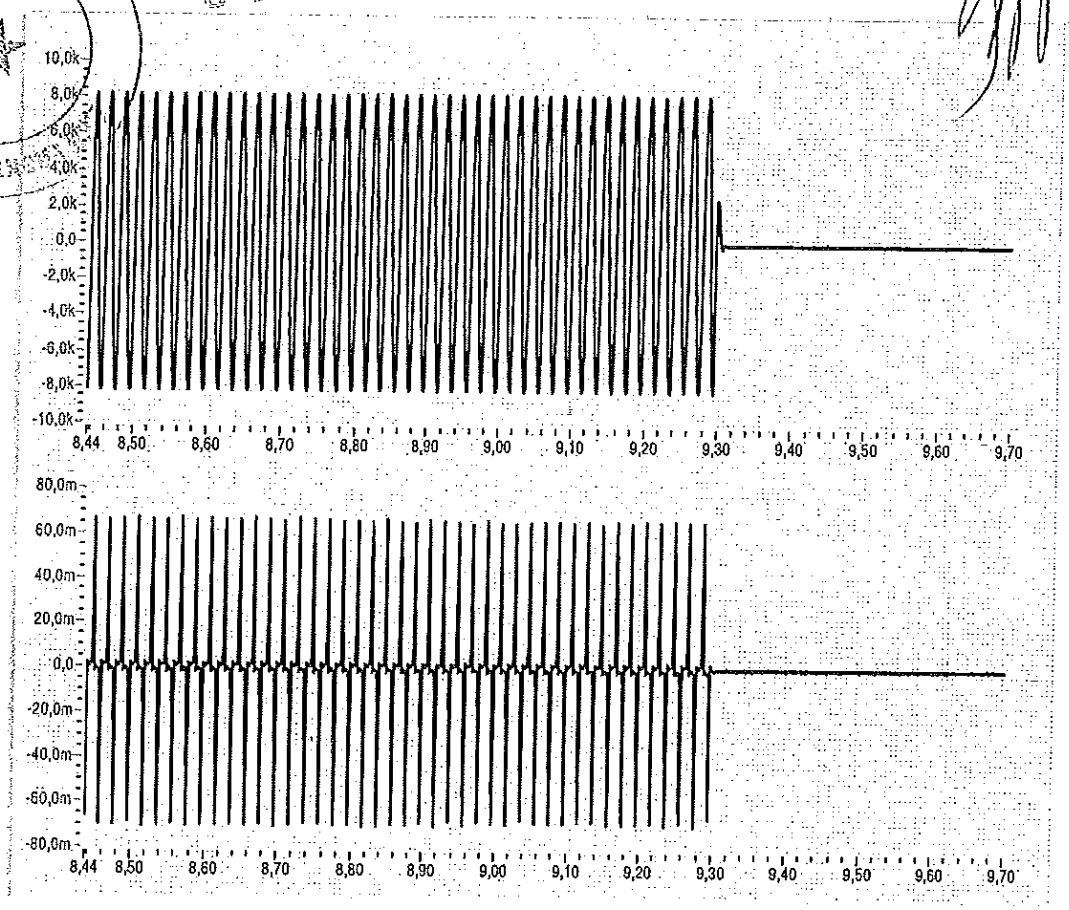

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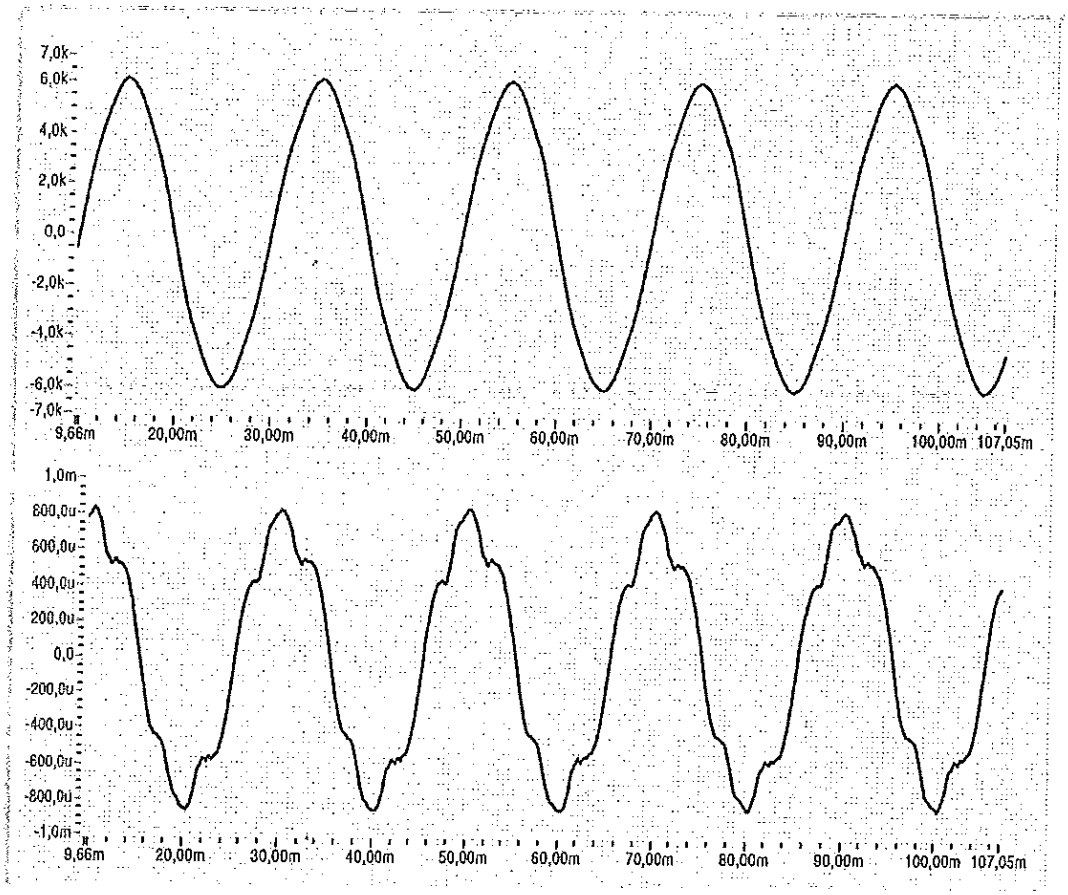

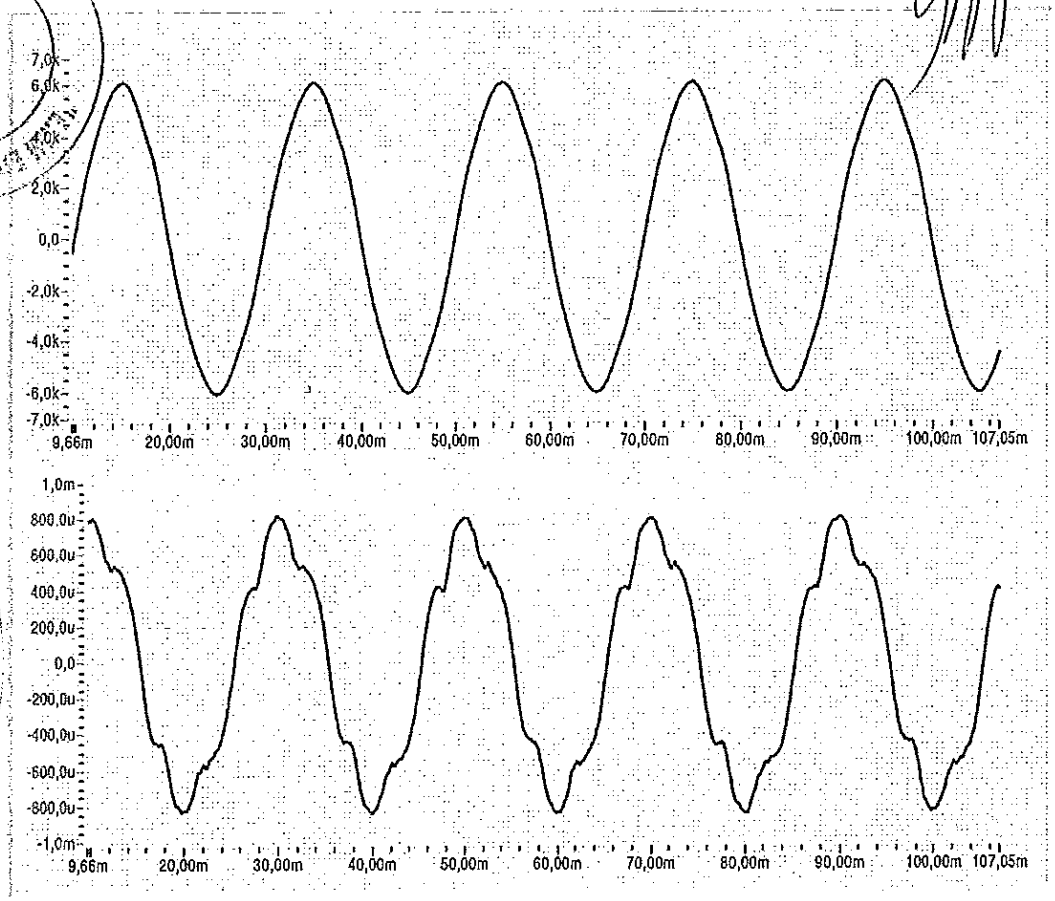

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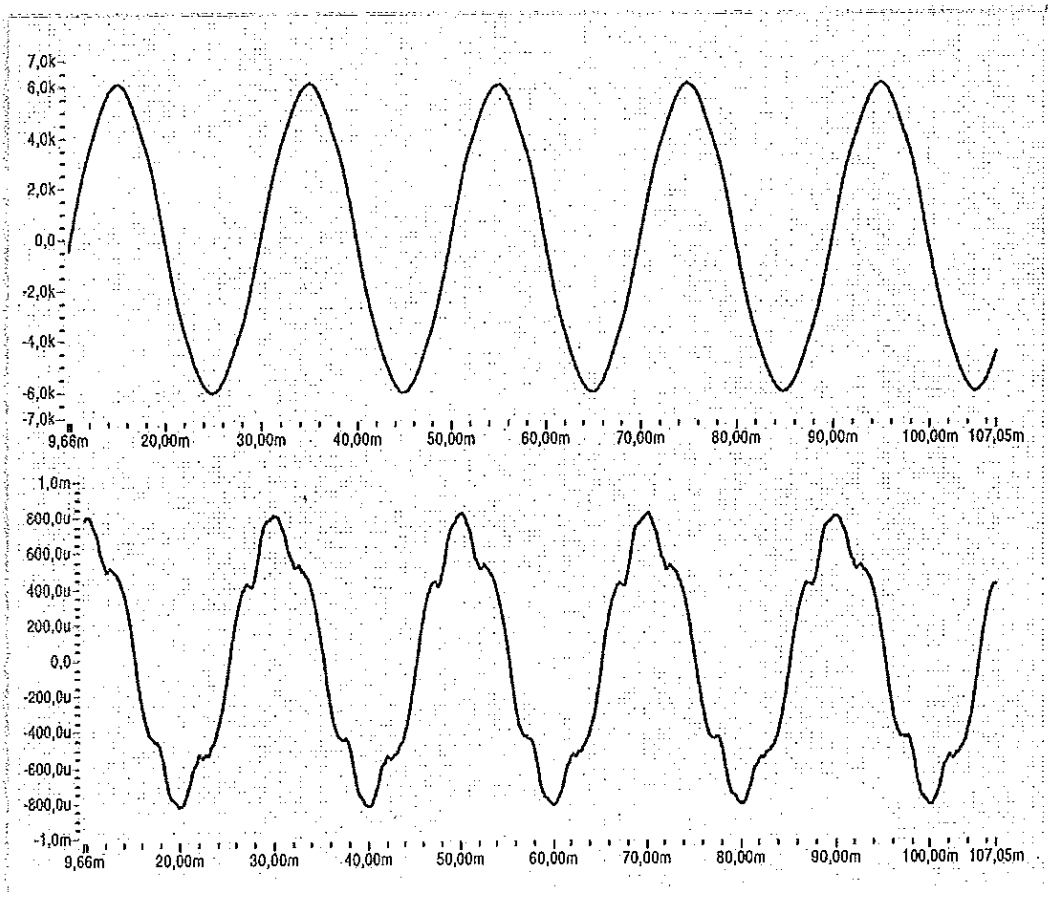
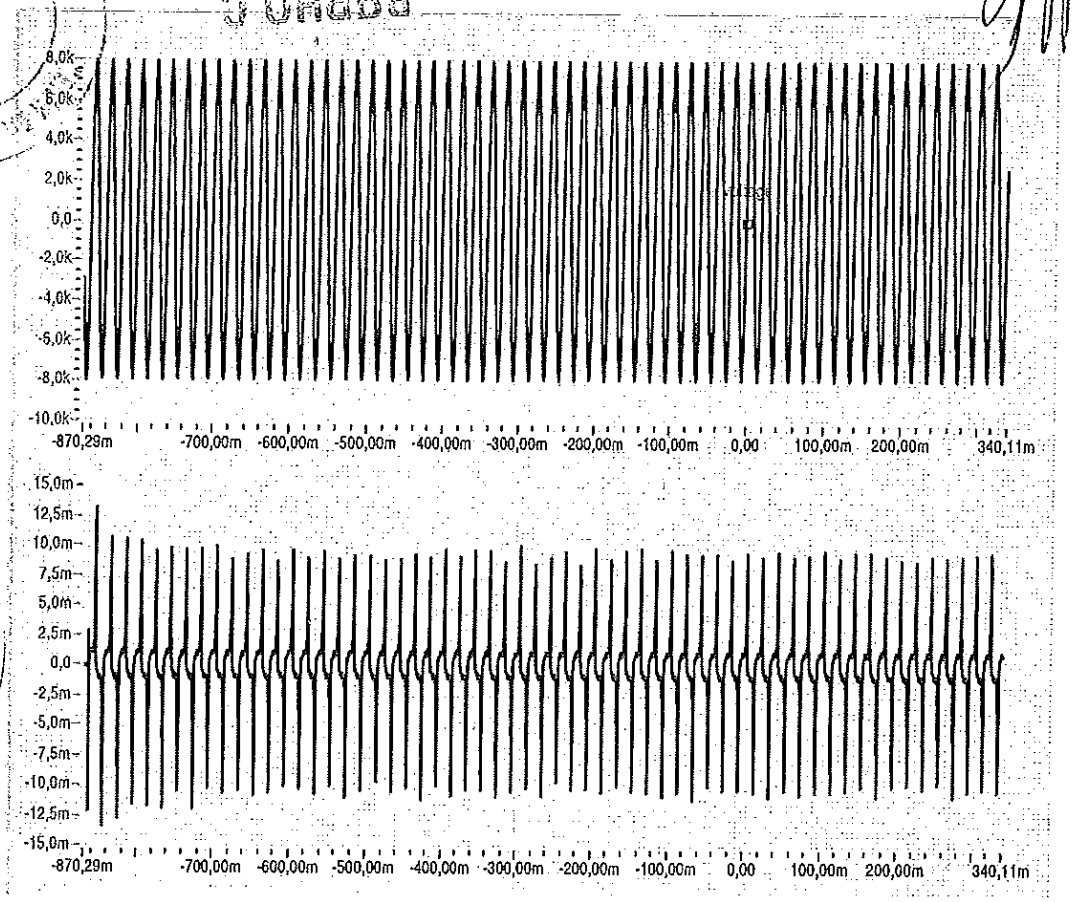


CESI B7024813 Oscillogram n. 45

CESI B7024813 Oscillogram n. 46



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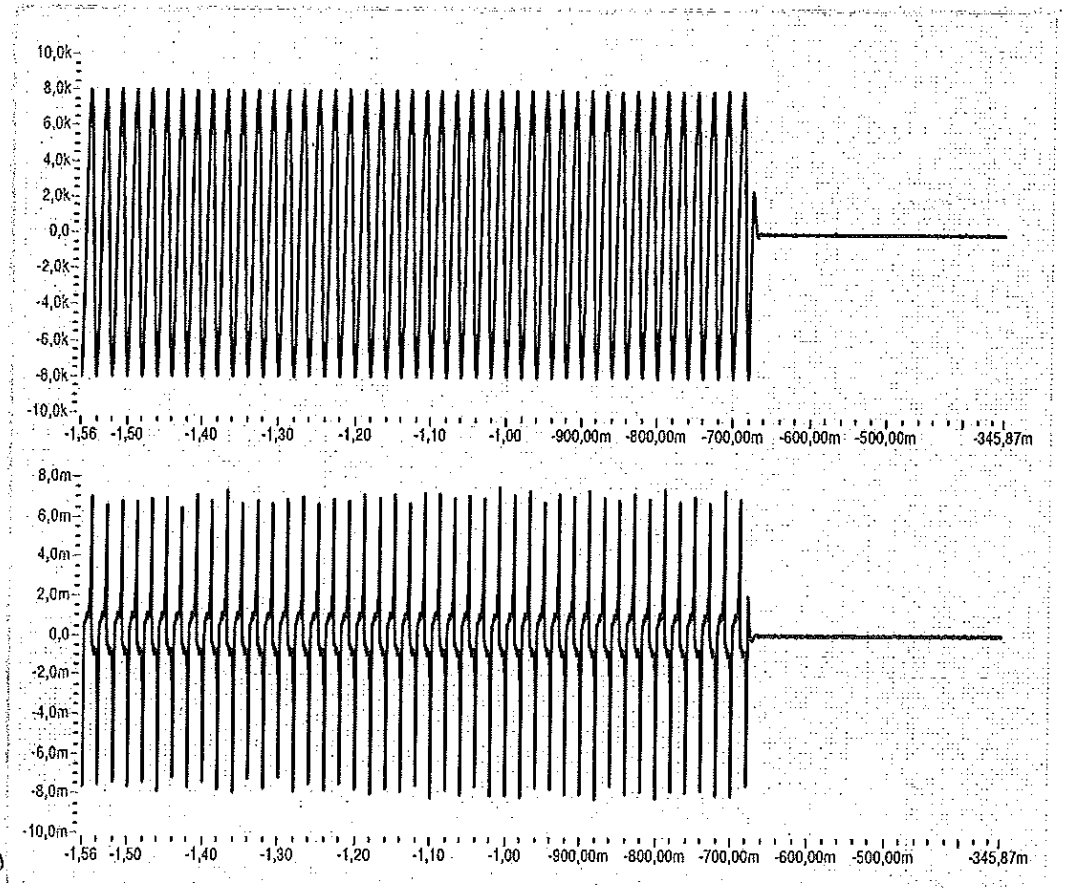

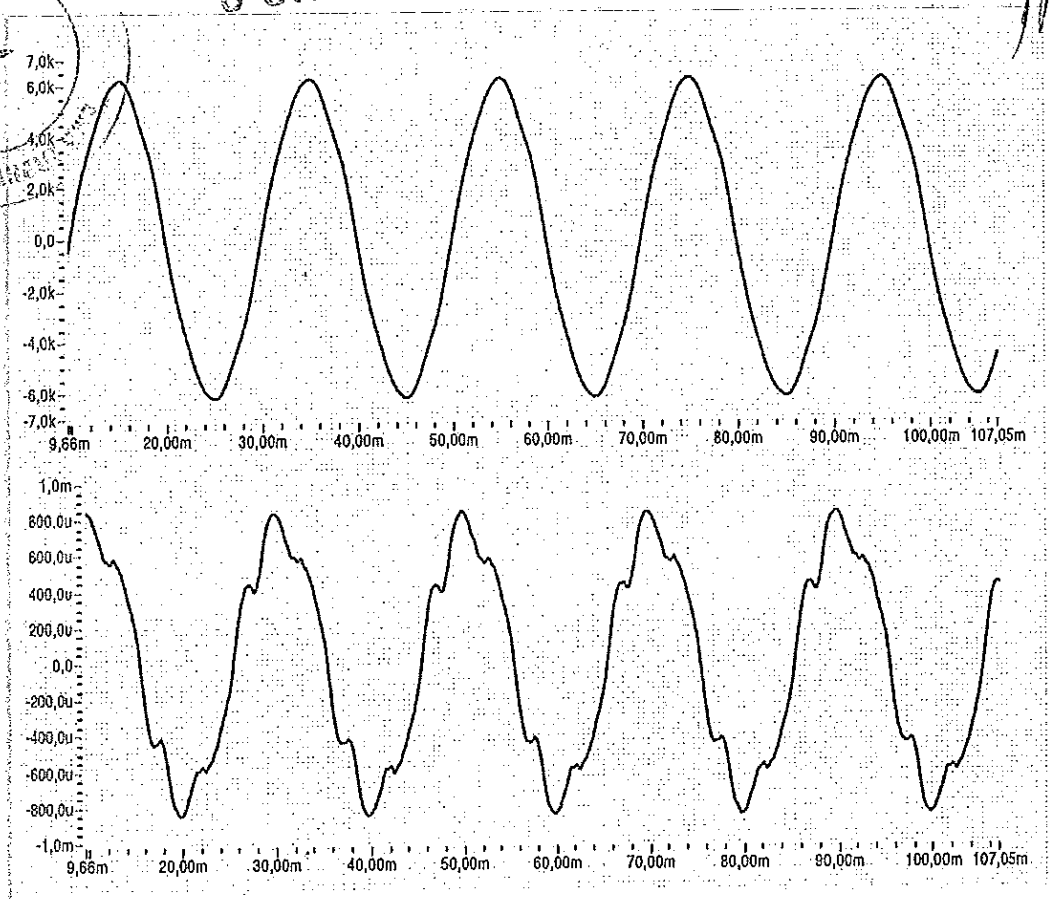

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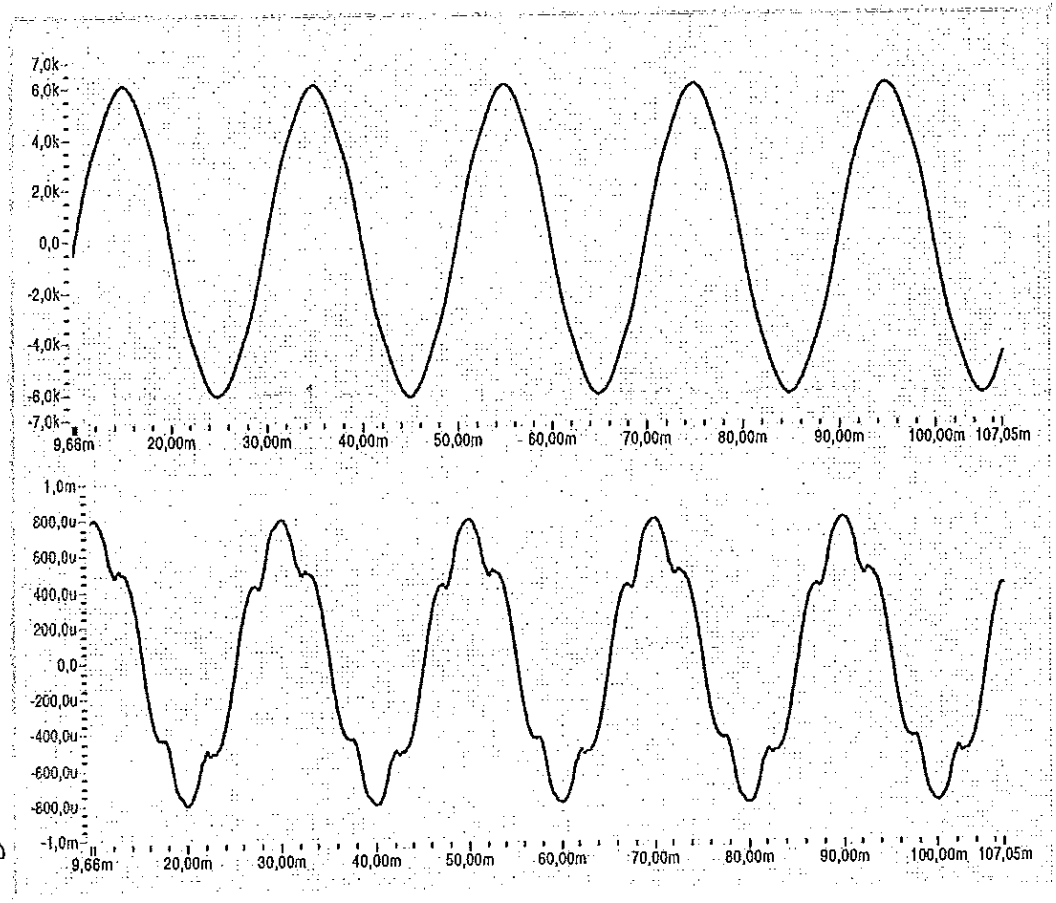
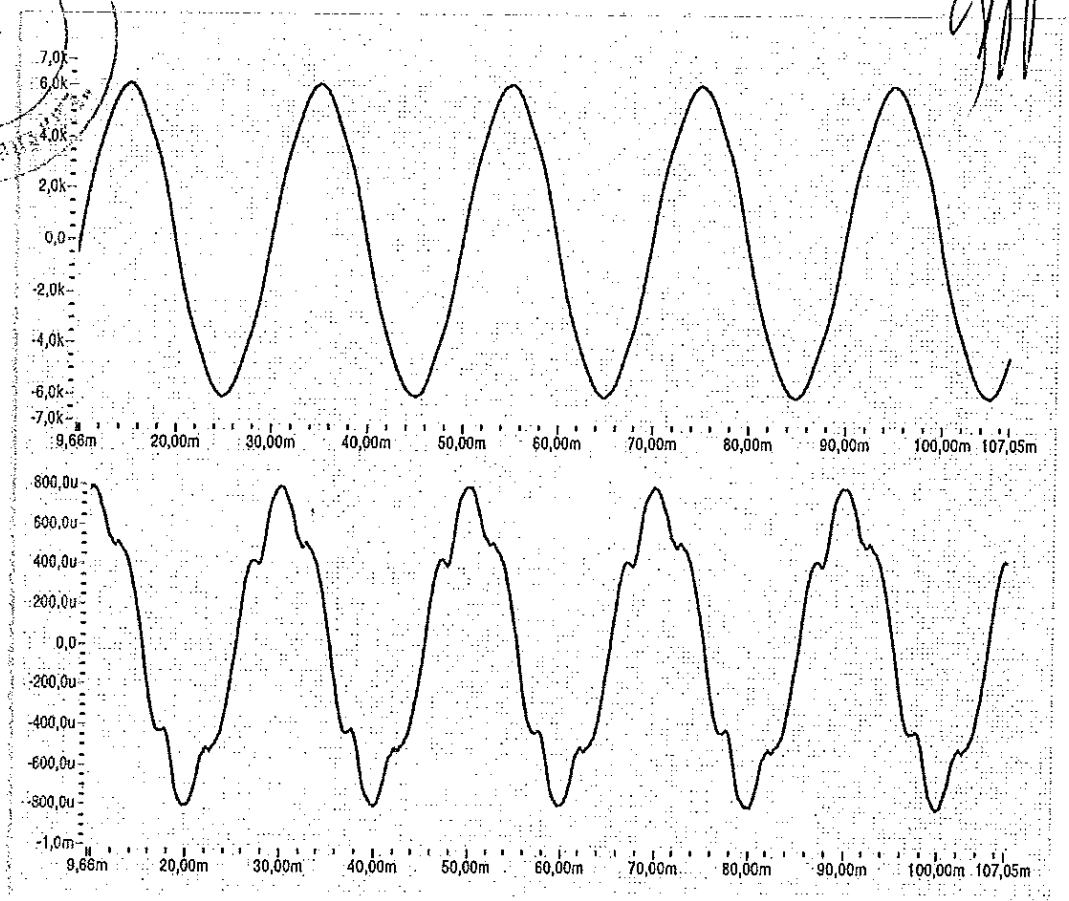


CESI B7024813 Oscillogram n. 49

CESI B7024813 Oscillogram n. 50



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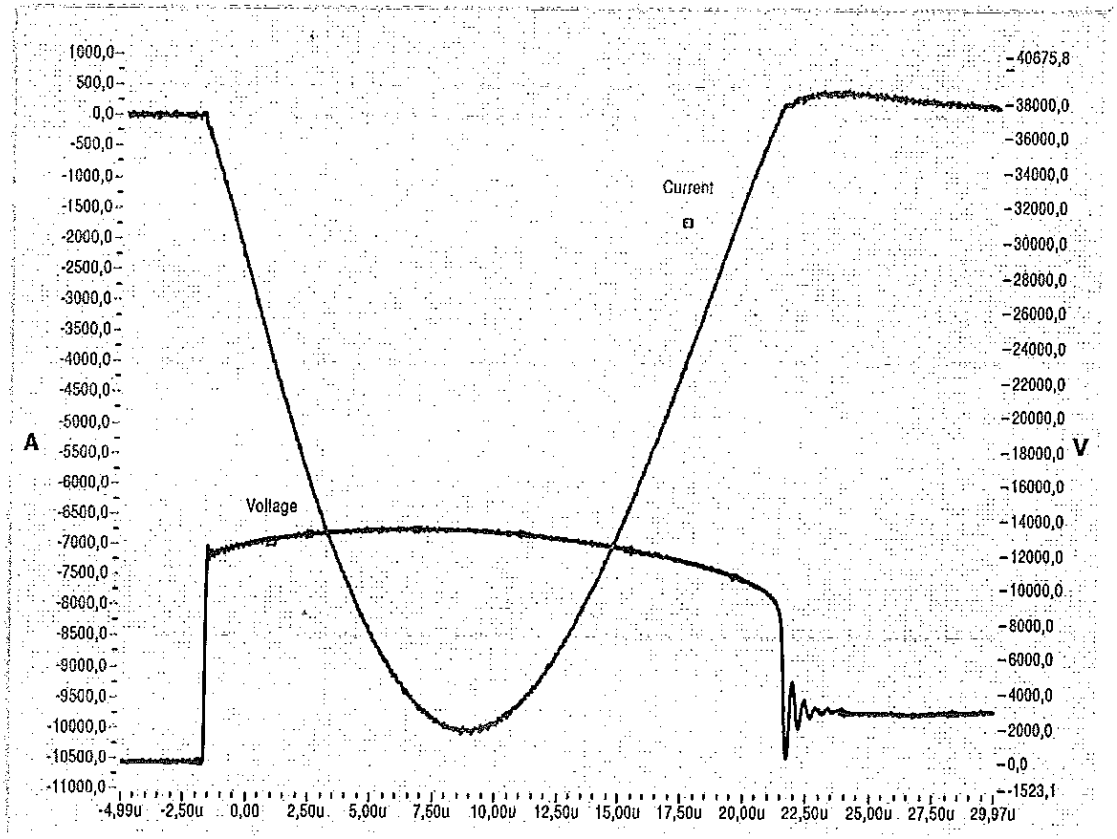

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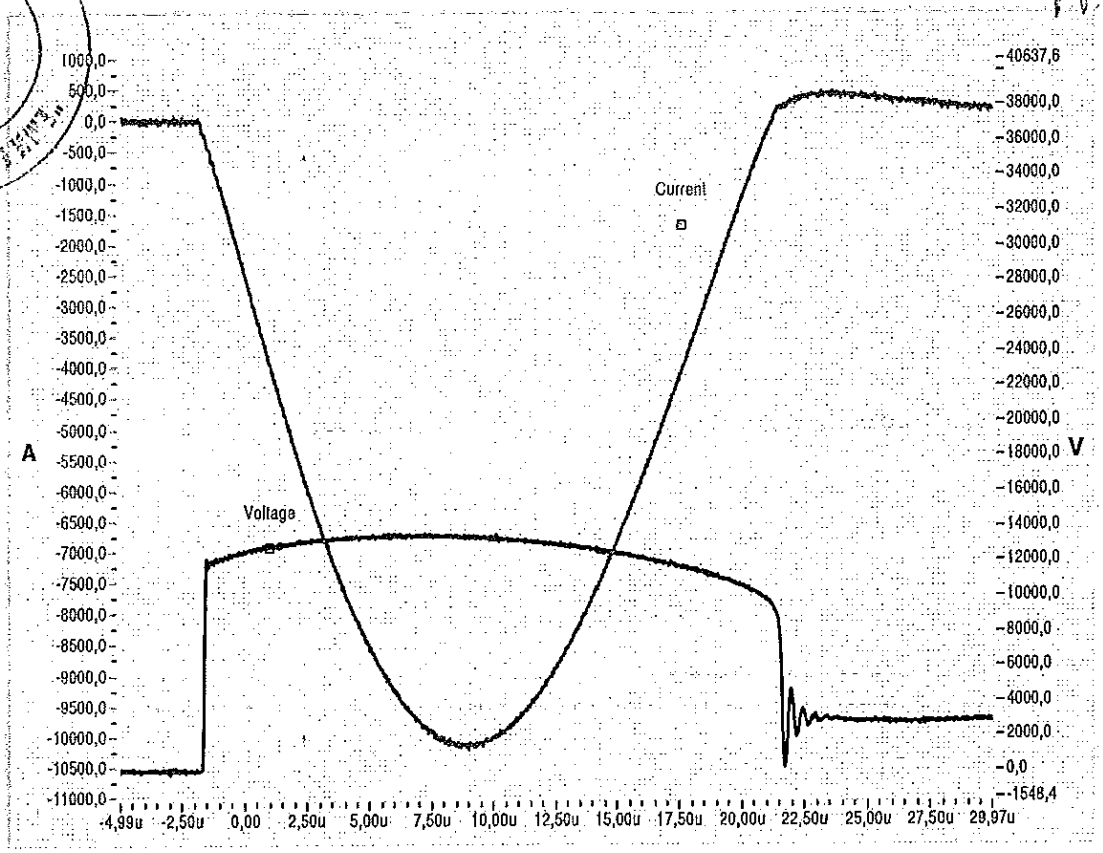

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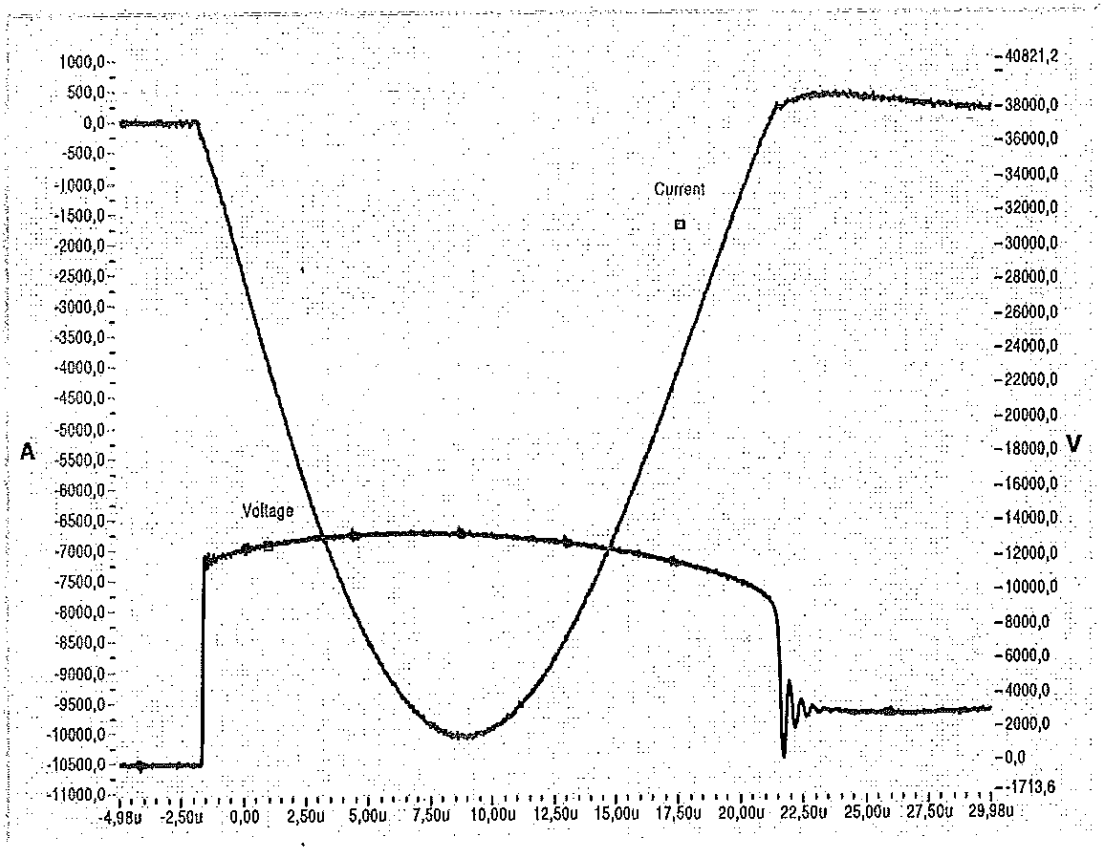

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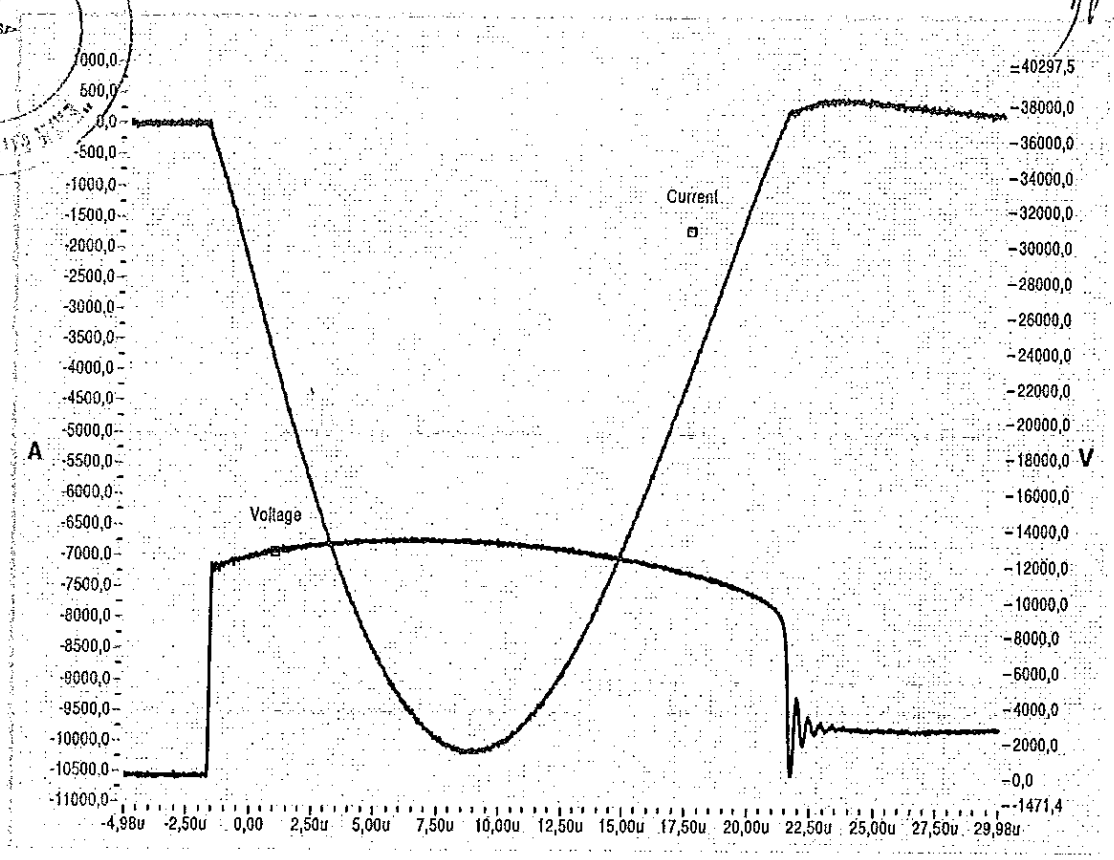

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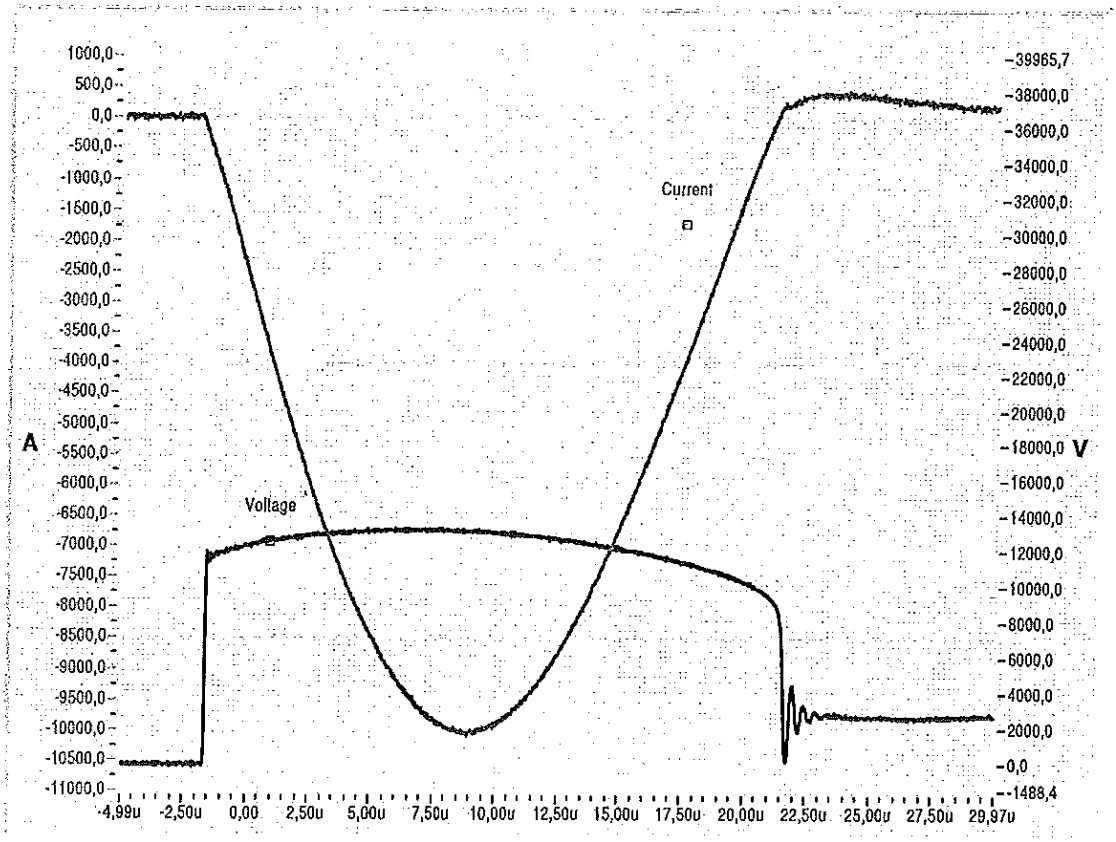

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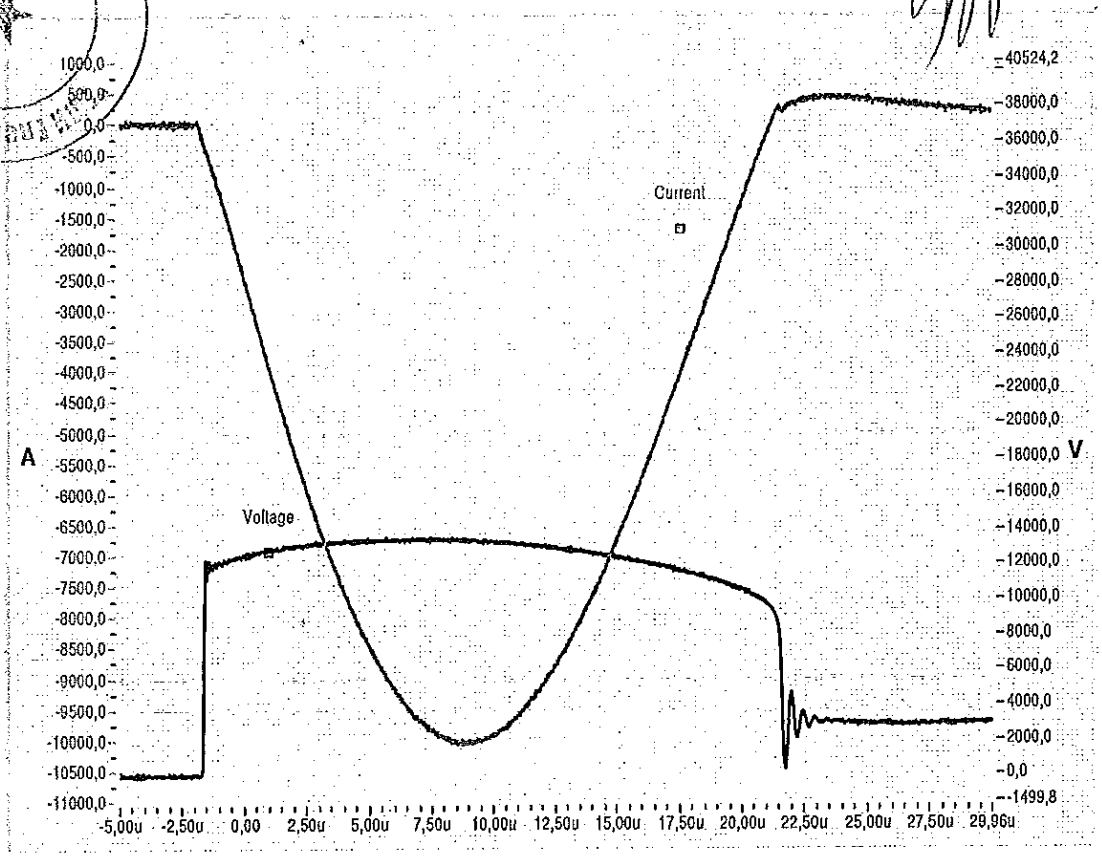

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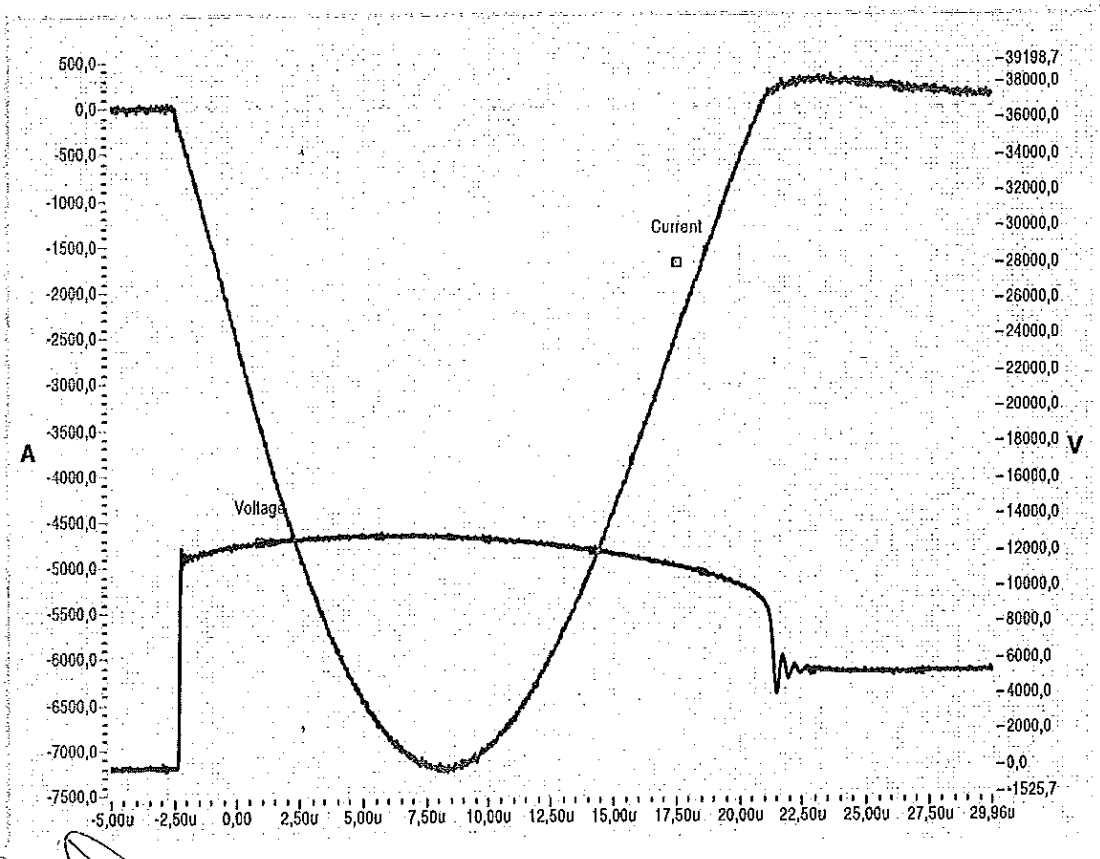

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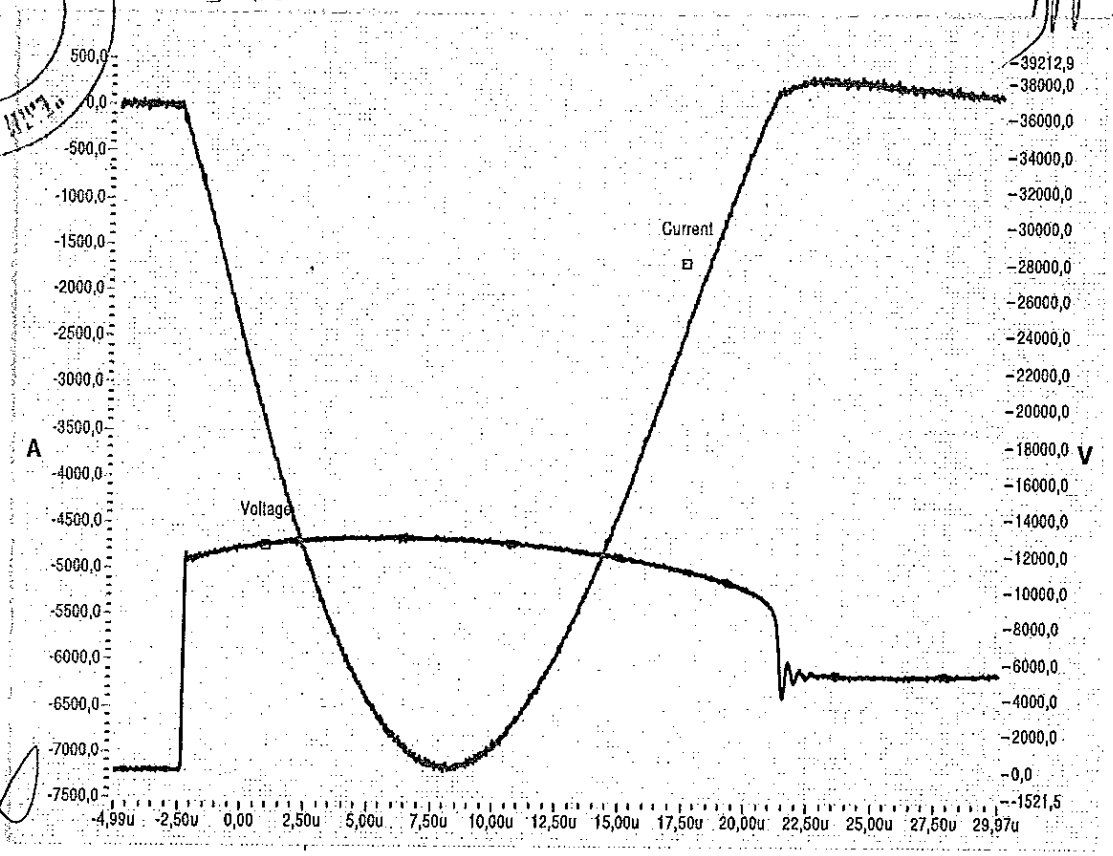

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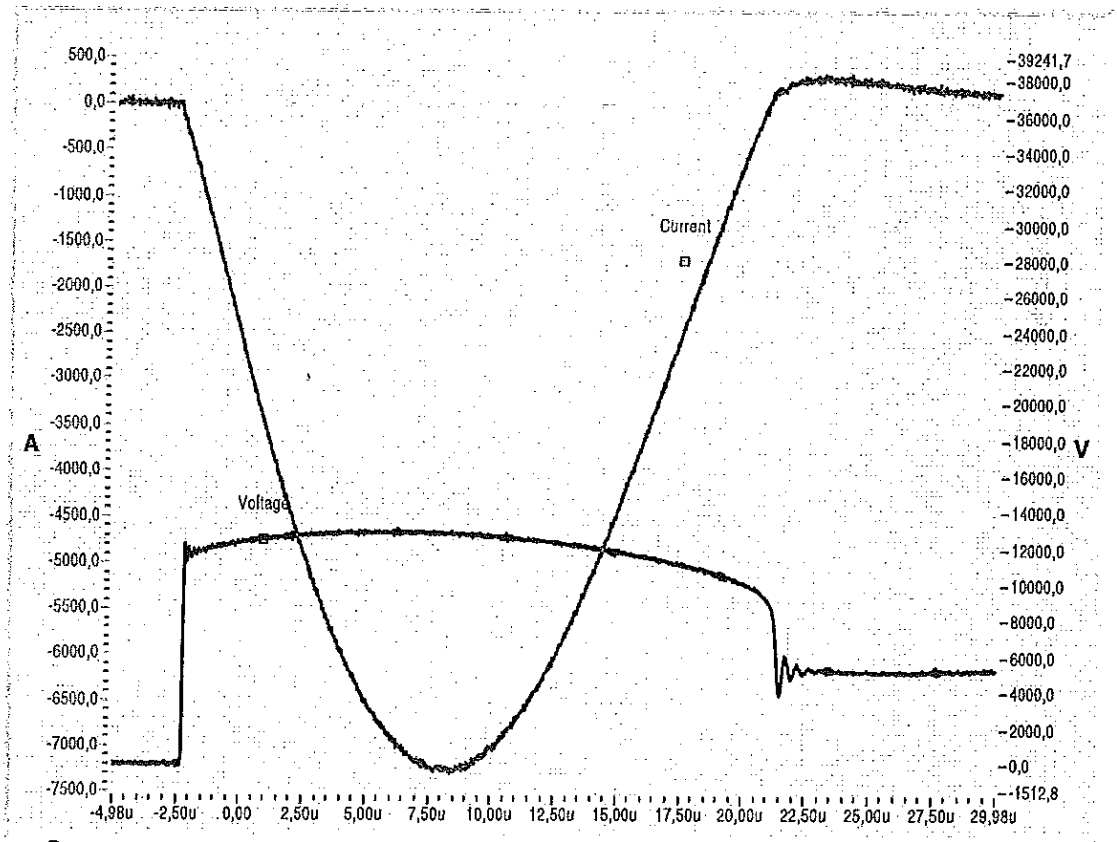

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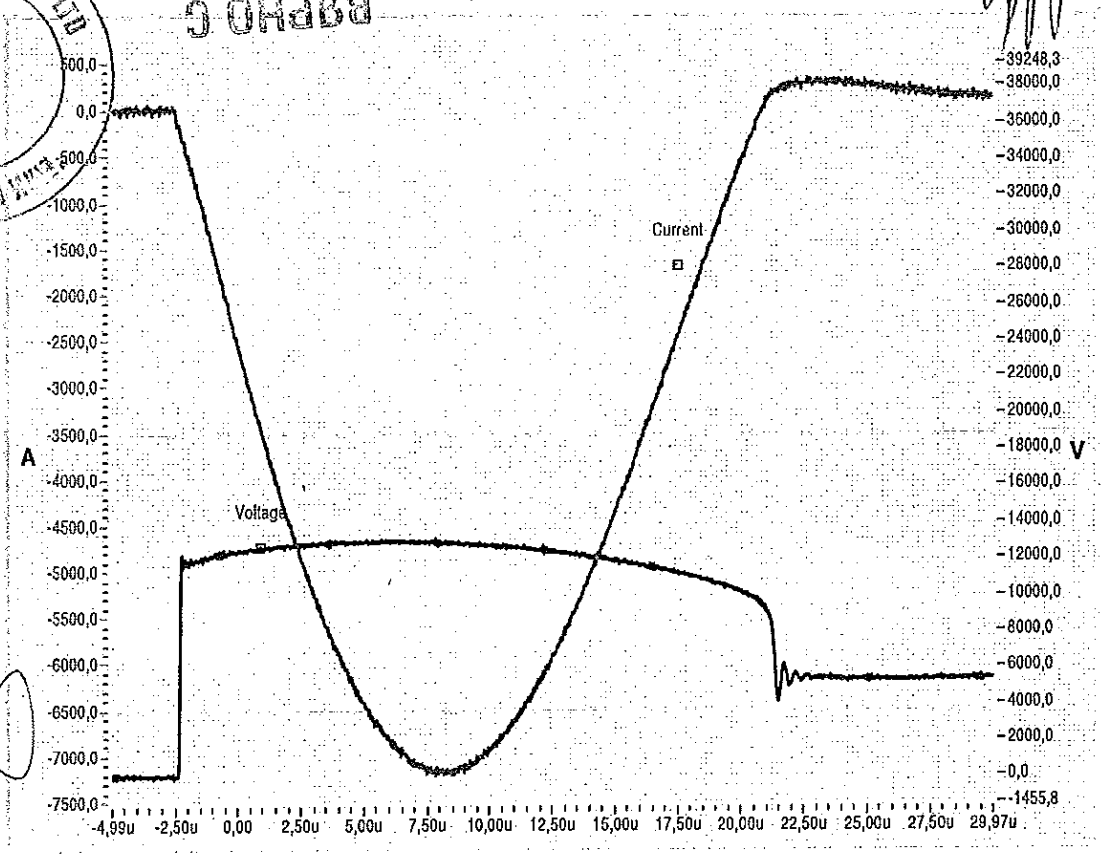

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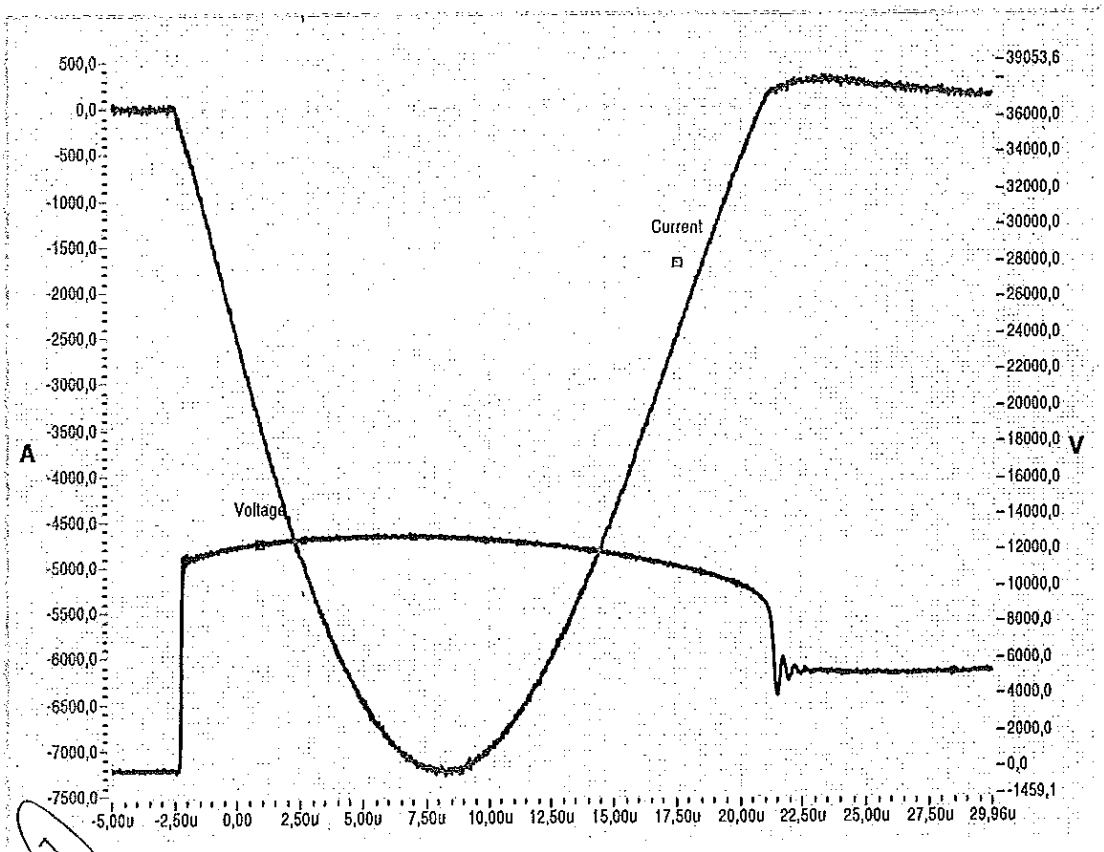

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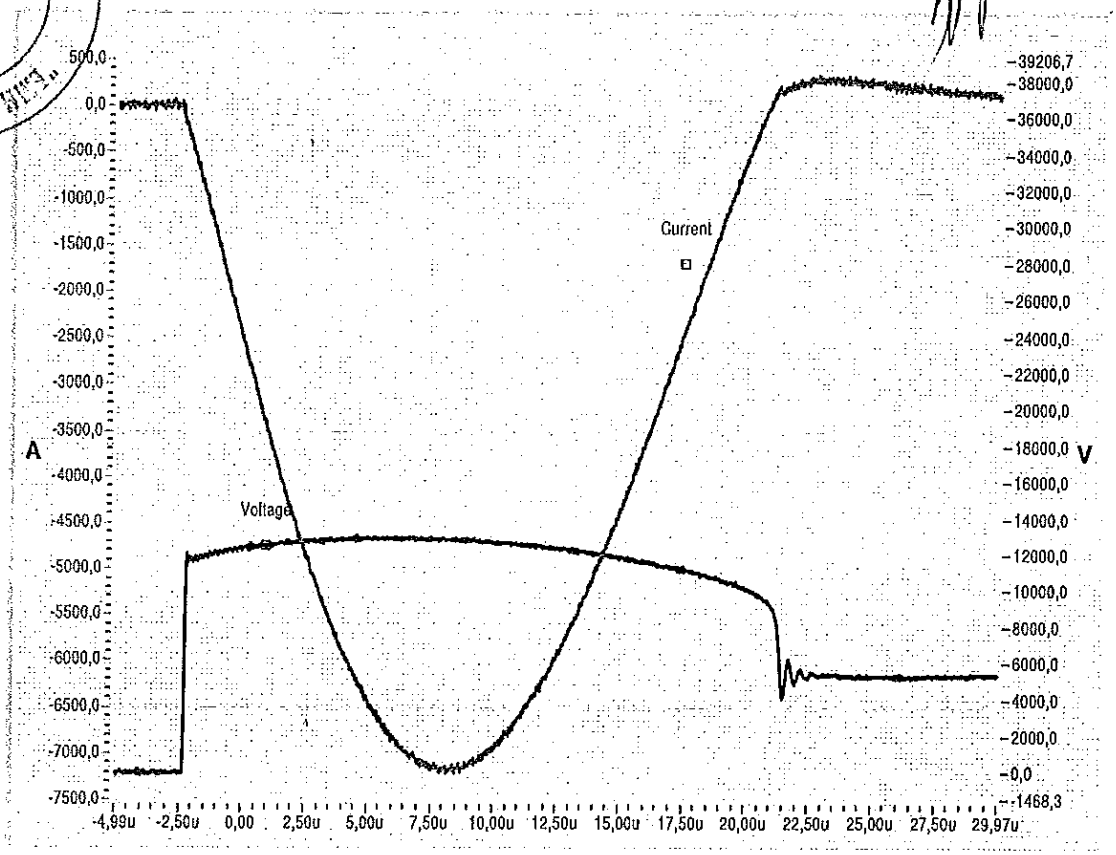

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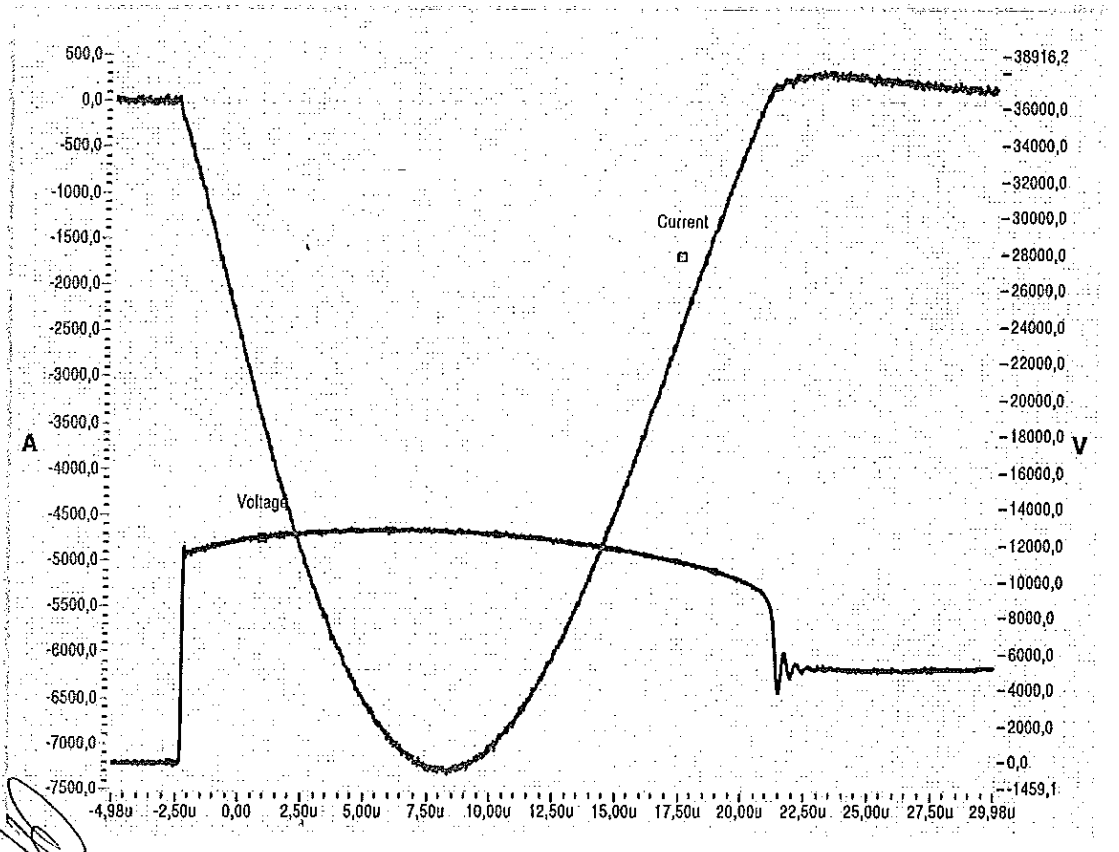

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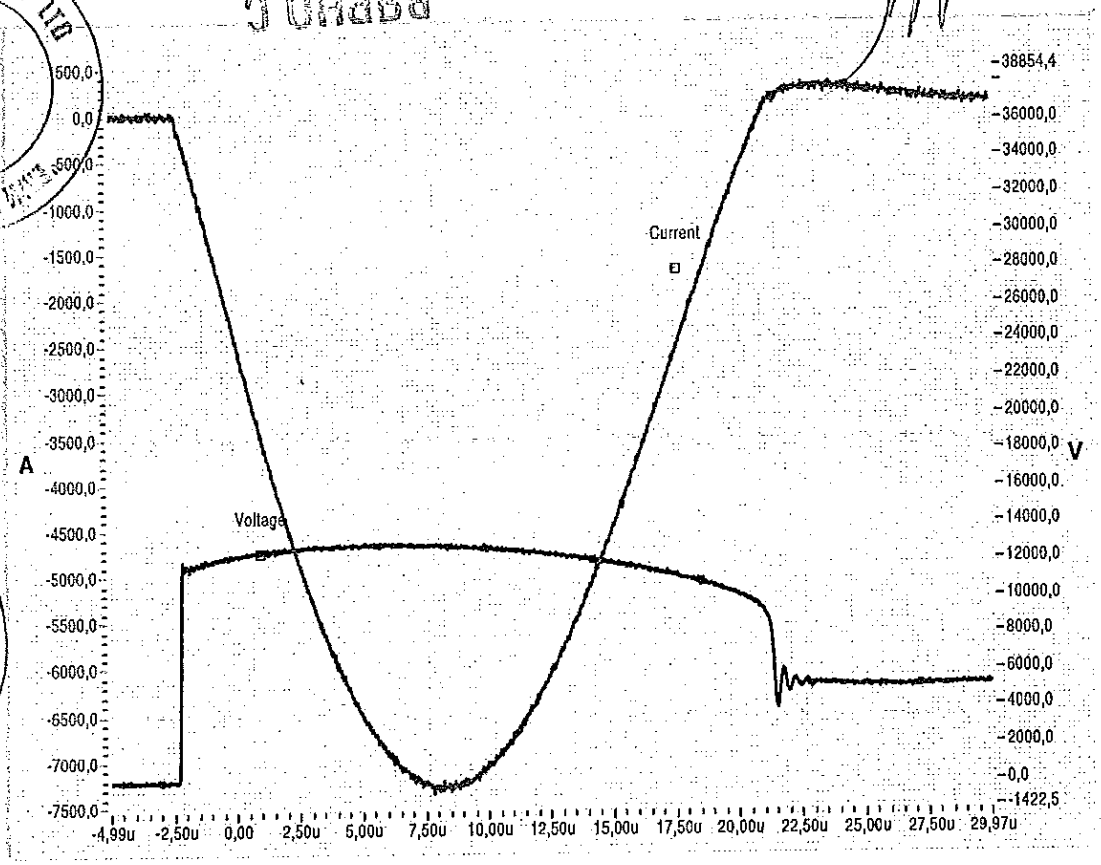

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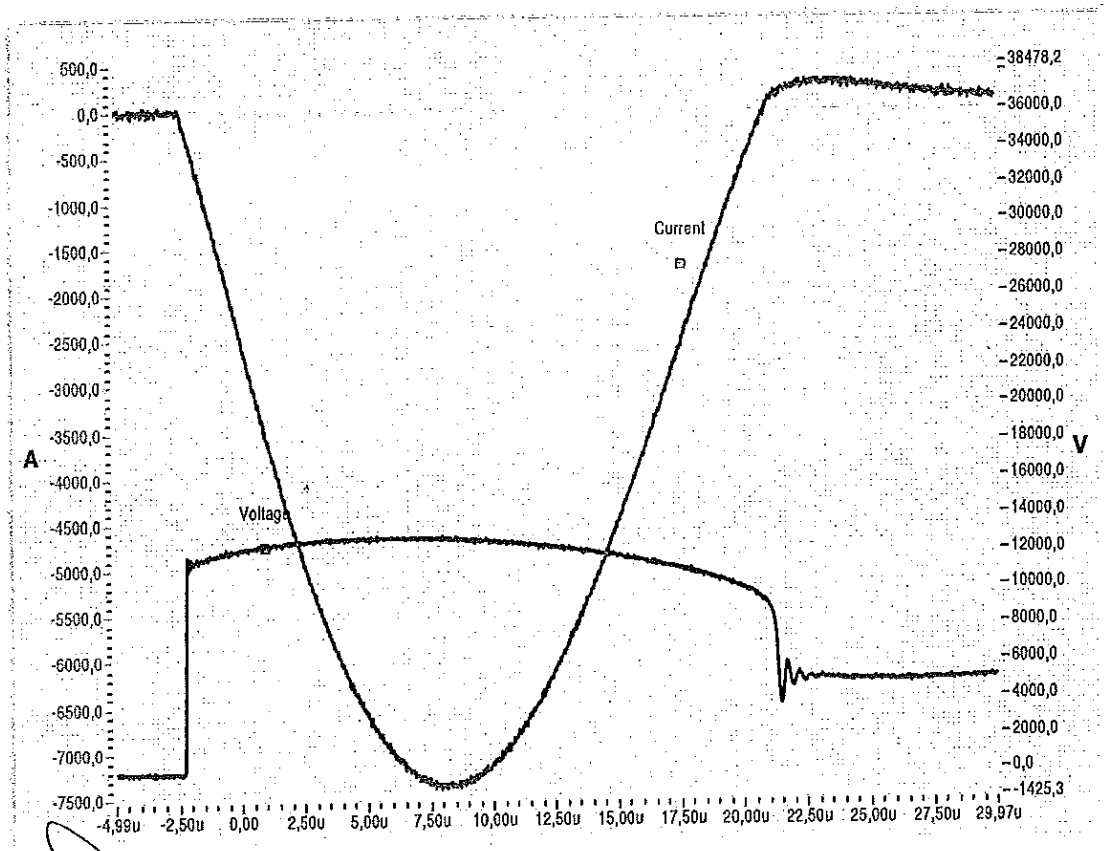

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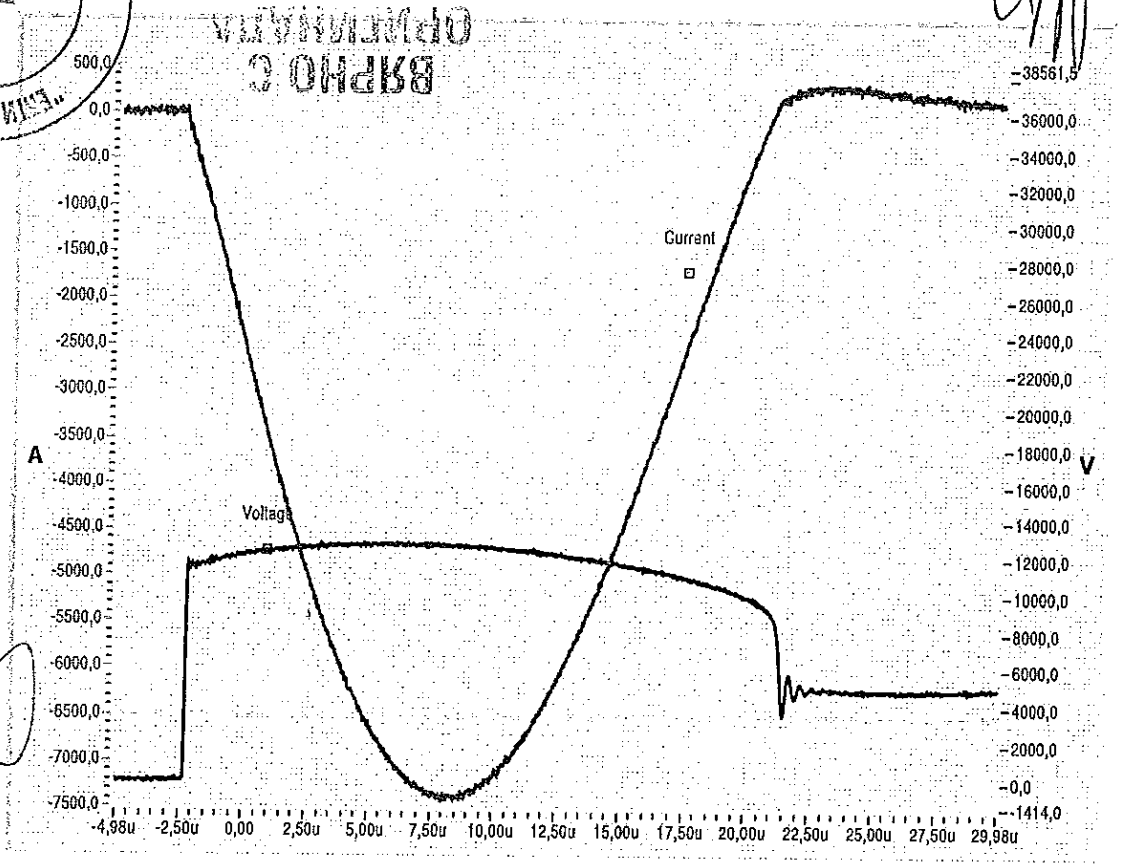

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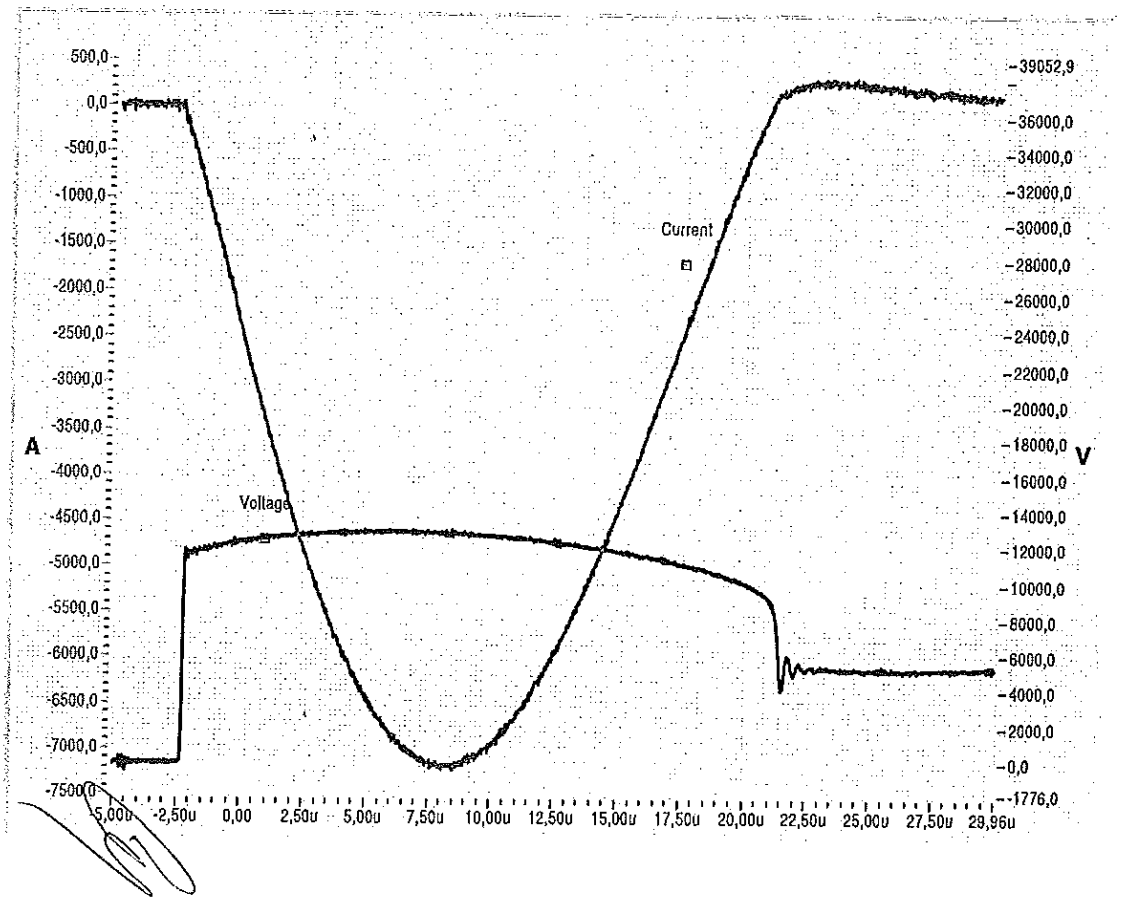

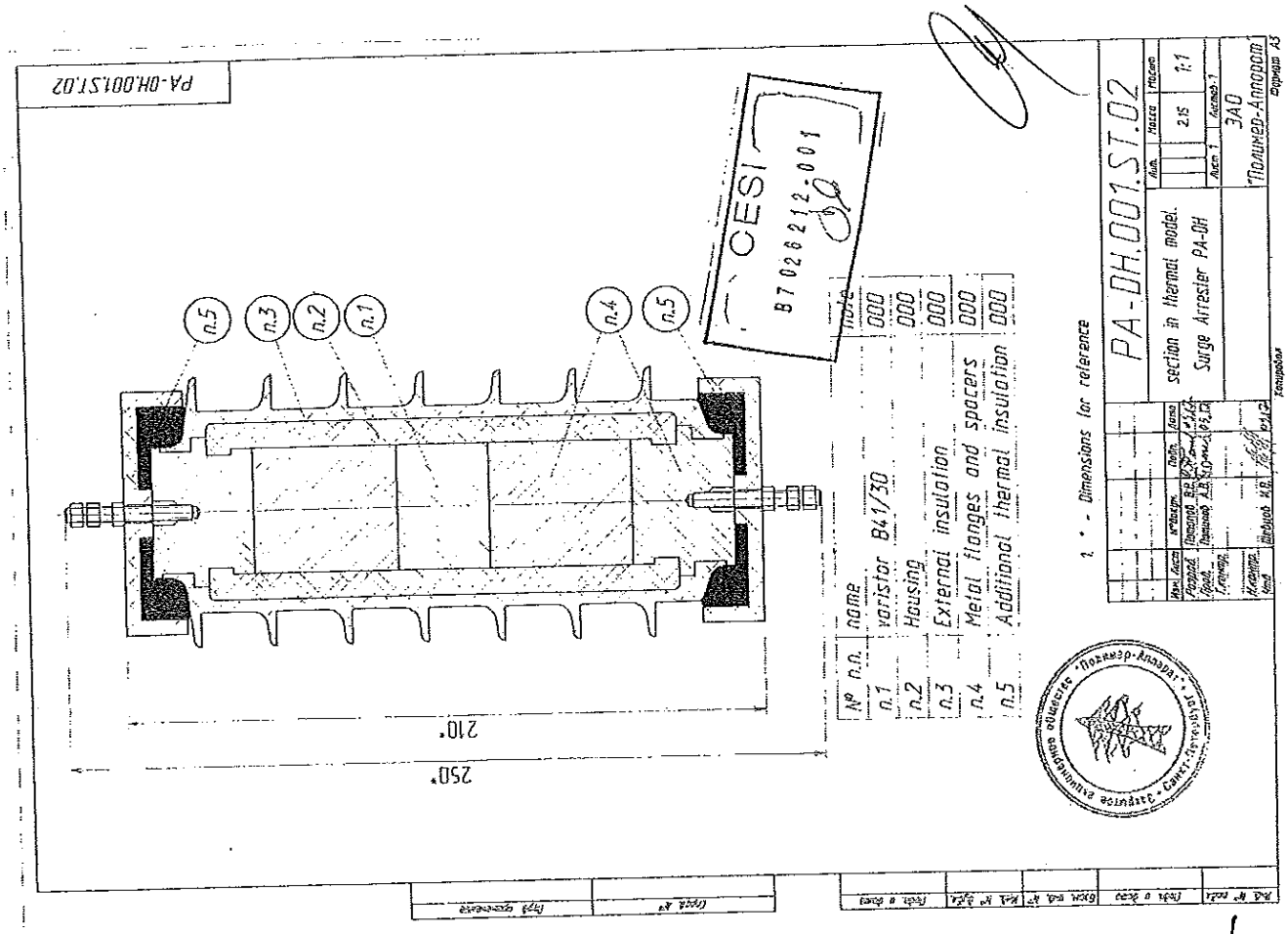

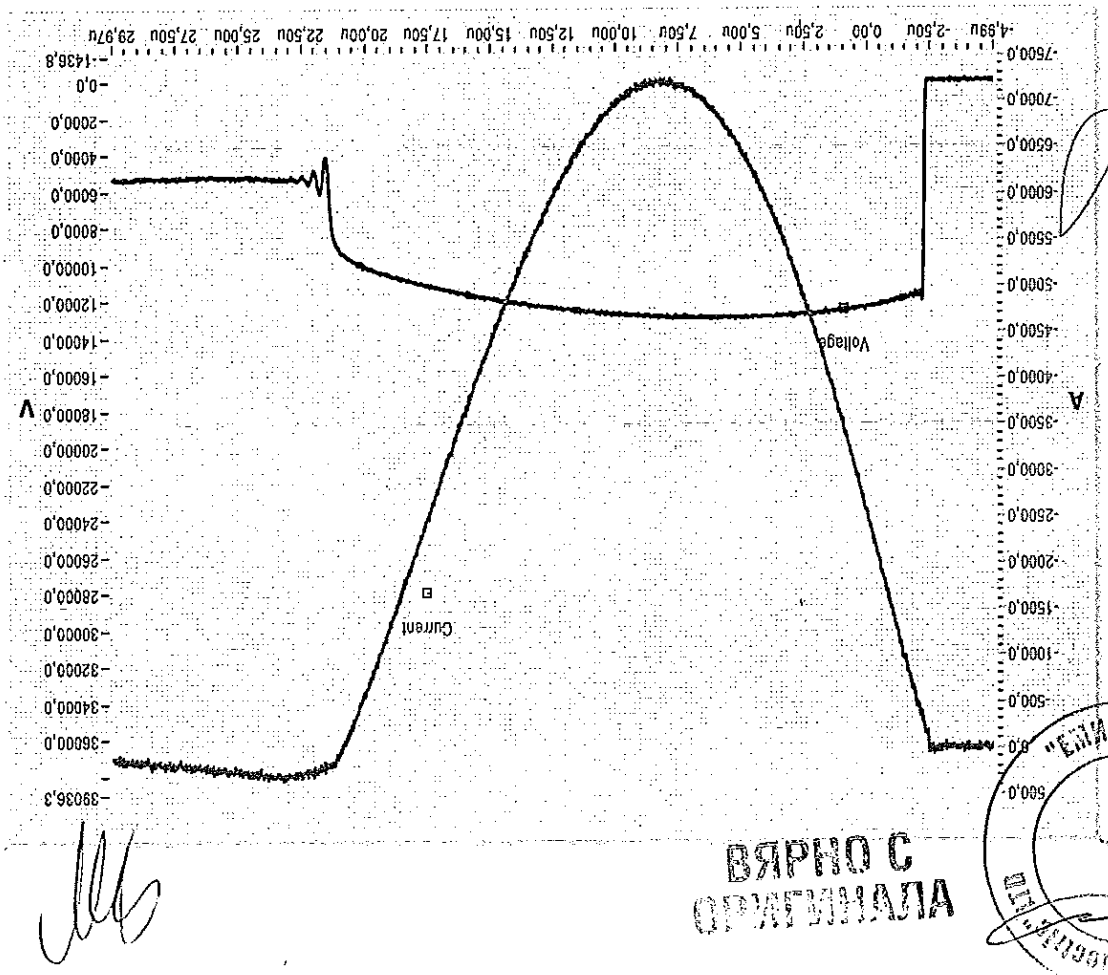

ВЯРНО С ОРИГИНАЛА

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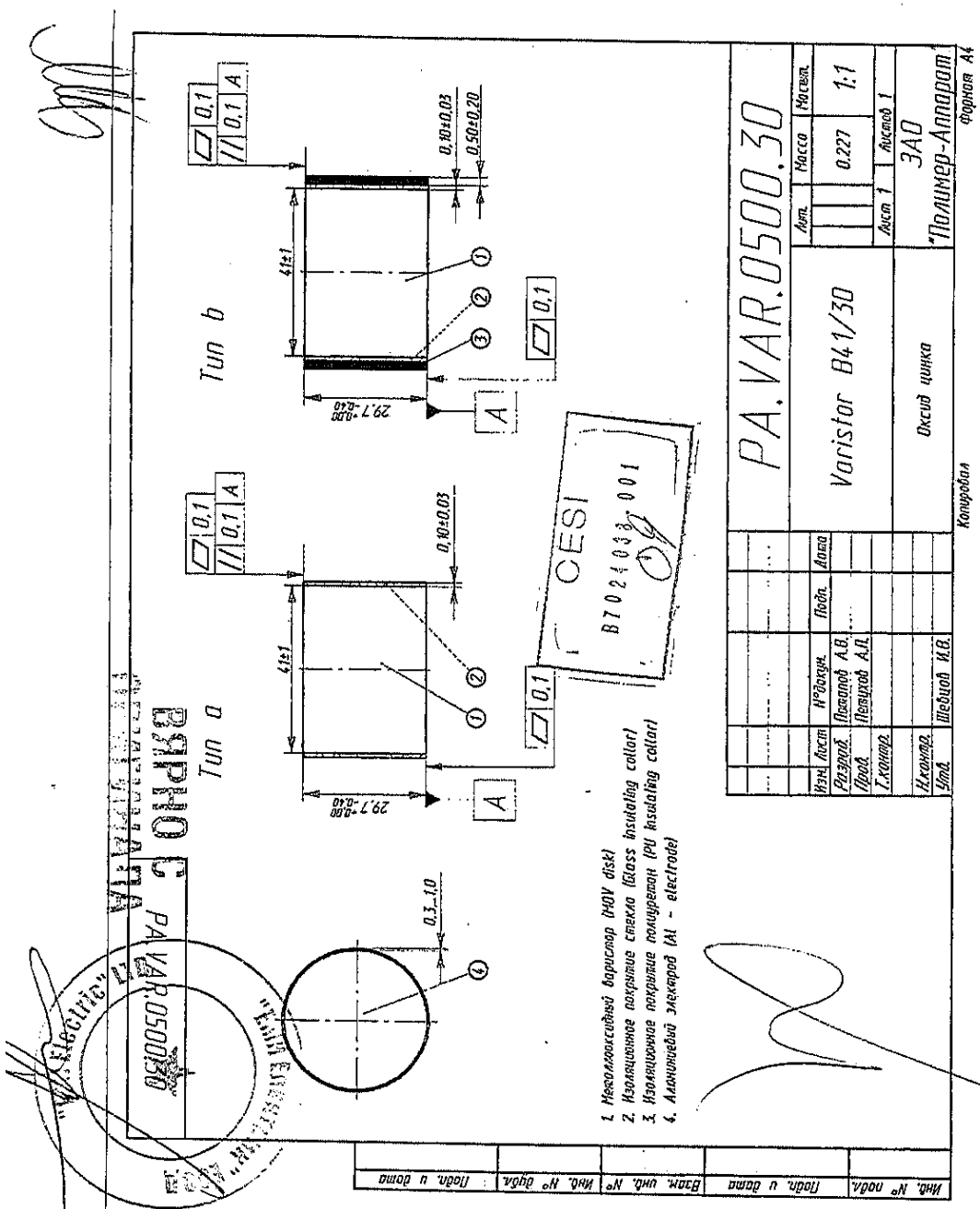

The TOV characteristics of PA-DH surge arresters.

The TOV characteristics (in p.u. Ur) of PA-DH surge arresters "with prior duty" and "without prior duty" as per IEC 60099-4 Ed. 3.0 are presented in the Fig.2 below.

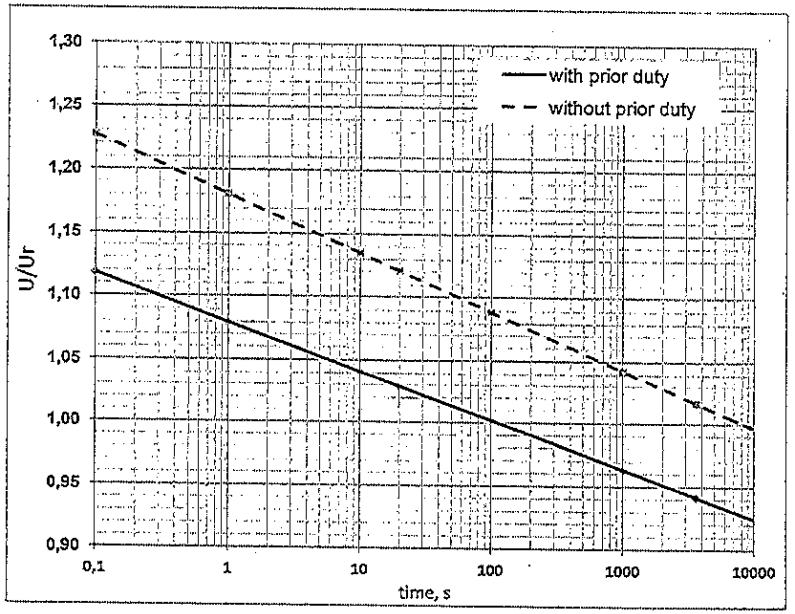

Figure 2. The TOV characteristics of PA-DH surge arresters.

The TOV values in per unit of Ur for times 0,1 s, 1 s, 10 s, 100 s, 1000 s and 3600 s are presented in the table 4.

Table 4.

Time, s	The TOV values in p.u. Ur	
	"with prior duty"	"without prior duty"
0,1	1,120	1,230
1	1,080	1,180
10	1,040	1,130
100	1,000	1,090
1000	0,960	1,040
3600	0,940	1,020

CESI B7 02 62 11 - 001

Test Report

Document No.	B7023423 Copy No. 1 Number of pages 17
Apparatus	Polymer-housed surge arrester unit type PA-DH and polymer-housed surge arrester section type PA-DH assembled in thermal model
Designation	—
Serial Number	—
Manufacturer	Joint-Stock Company " Polymer-Apparat"
Client	Joint-Stock Company " Polymer-Apparat" Ak. Kostantinova str., 1 195427 Saint-Petersburg - Russia Federation
Tested for	—
Date(s) of tests	November 16, 2017
Tested by	CESI.S.p.A. Via Rubattino, 54 20134 Milano - Italy
Test performed	Heat dissipation behaviour of test sample : Test to verify thermal equivalency between complete arrester and arrester section

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this document has been subjected to the series of proving tests in accordance with:
IEC 60099-4 – Edition 3.0 (2014-06)

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

December 22, 2017

Date

Gregori Marco
Test Engineer in charge

The Manager - Arcidiaco Lorenzo
Approved By Document Digitally Signed

ACCREDIA
ENTE ITALIANO DI ACCREDITAMENTO
LAB N° 0030

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

CESI

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Notes

STL-Member

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

CESI Group Test Documents description

Type Test Certificate of .....

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

Test Certificate of (complete / selected) Type Tests

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

Certificate of Design Verification

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

Type Test Report

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

Test Report

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

On-Site Test Record

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

Test Award

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

Pages annexed:

Client's drawing (arrester section assembled in thermal model) ; CESI n. B7002675 6-1 – n.1 page

Client's drawing (complete arrester) ; CESI n. B7002675 6-2 – n.1 page

Client's drawing (MO resistor) ; CESI n. B7024038 – n.1 page

A10021G rev.1

Tests witnessed by:

—

—

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings.
CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.
These drawings, identified by CESI and numbered B7026756 n.1 & 2, are annexed to this document.

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

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

- Voltage a.c. : ±3,0 %
- Residual peak voltage (impulse tests) : ±3,0 %
- Current a.c. : ±3,0 %
- Peak current (impulse tests) : ±3,0 %
- Time (impulse tests) : ±10,0 %
- Time (a.c. tests) : ±1,5 %

Laboratory information	
Receipt date of the sample	November 2017
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr. L. Podavitte, Mr. I Giacci
Test laboratory	P177 (Surge Arrester laboratory)
ODV S&P	70006781

A10013G rev.2

ВЯРНО С ОРИГИНАЛА

"ЕМ.ЕЛЕКТРИК" ЕООД

36.2

Rated characteristics of the tested objects assigned by the Client

Polymer-housed surge arrester

Manufacturer	**Joint-Stock Company " Polymer-Apparat"**
Type	PA-DH-54
MO resistors supplier	Joint-Stock Company " Polymer-Apparat"
Serial no.	00204
Drawing code	PA-OPN.035.002.056.01
Arrester class	Distribution
Designation	DH
Design	B
Rated voltage – U_r	54 kV
Continuous operating voltage - U_c	43,2 kV
Rated frequency	48÷62 Hz
Nominal discharge current (8/20 µs impulse shape)	10 kA
Reference current - $I_{ref.}$	1 mA
Year of manufacturer	10/2017

Polymer-housed surge arrester section assembled in thermal model

Manufacturer	**Joint-Stock Company " Polymer-Apparat"**
Type	PA-DH
MO resistors supplier	Joint-Stock Company " Polymer-Apparat"
Serial no.	00077
Drawing code	PA-DH.001.ST.01
Arrester class	Distribution
Designation	DH
Design	B
Rated voltage – U_r	1,25 x Uc
Continuous operating voltage - U_c	4,0 kV
Rated frequency	48÷62 Hz
Nominal discharge current (8/20 µs impulse shape)	10 kA
Reference current - $I_{ref.}$	1 mA
Year of manufacturer	10/2017

Reference Standard

IEC 60099-4 – Edition 3.0 (2014-06)– clause 8.6 & Annex B
" Metal-Oxide Surge Arresters without gaps for AC systems

Test carried out and identification of the test objects

Test carried out	Number of test objects	Test object identification
Heat dissipation behaviour of test sample	1	PA-DH-54 (s/n. 00204)
	1	PA-DH Section ST (s/n. 00077)

Test setting for the test

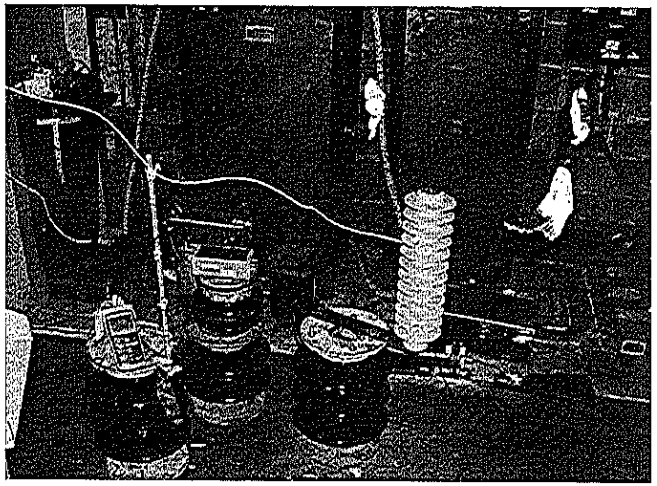


Photo no. 1

Complete arrester

Photo no. 2

Arrester section with thermal insulation

A12671G

Test procedure on complete arrester

The complete arrester was placed in the testing laboratory (see photograph no.1 on page 7) at still air ambient temperature of 19 °C. The ambient temperature was held at 19 °C ±3K during the test .
The complete arrester was supplied by the manufacturer fitted with a optical thermal sensors attached to the MO resistors (see drawing attached on this test report).

The surge arrester was heated to a temperature of approximately 140 °C by the application of a power frequency overvoltage with an amplitude above the reference voltage.
The heating time was 46 min. (the maximum time according to the reference standard is 60 min.).

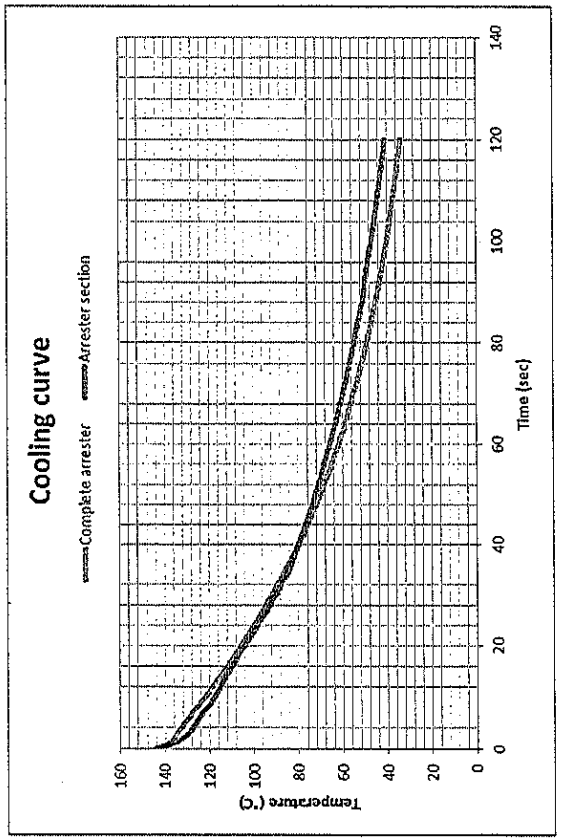
When the specified temperature of about 140 °C was reached the voltage source was disconnected and the cooling time curve was determined over a period of not less than 2 hours.

Test procedure on arrester section

The arrester section was placed in the testing laboratory (see photograph no.2 on page 8) at still air ambient temperature of 17,7 °C.
The ambient temperature was held at 17,7 °C ±3K during the test .
The arrester section was supplied by the manufacturer and one optical thermal sensor has been used (see drawing attached on this test report).

The MO resistor was heated to a temperature of approximately 140 °C by the application of a power frequency overvoltage with an amplitude above the reference voltage.
The heating time has been of 51 min. (the maximum time according to the reference standard is 60 min.).

When the specified temperature of about 140 °C was reached the voltage source was disconnected and the cooling time curve was determined over a period of not less than 2 hours.



Test result and the calculation of the temperature compensation

The cooling curve (see pag.10) of the arrester section hasn't been for all instants equal or higher than the cooling curve of the arrester. The compensation may be made adding a ΔT to the start temperature ϑ_{start} of the prorated section during the preheating (thermal recovery part) for Operating duty test and Power-frequency voltage versus time test.

Sample	T	T_A	T_0	$T_0 - T_A$	Heating time	Date
Complete arrester	is the measured temperature during cooling every minute	19,0 °C	144 °C	125 °C	46 min	November 16, 2017
Arrester section	is the measured temperature during cooling every minute	17,7 °C	143 °C	125,3°C	51 min	November 16, 2017

Legend:

T is the measured temperature instant by instant
T_A is the average ambient temperature during test
T_0 is the maximum heating temperature
Trel $(T-T_A) / (T_0-T_A)$
ΔT temperature compensation

The two relative temperatures $T_{rel.}$arrester and $T_{rel.}$ arrester section have been plotted (see page 12) for the cooling time (≥7200s).
During the cooling time the difference $T_{rel.}$arrester - $T_{rel.}$ arrester section has been calculated and the max value has to be considered.

K= max ($T_{rel.}$arrester - $T_{rel.}$ arrester section)= 0,034101197

$\Delta T = K (T_0 - T_A)_{max} = 0{,}034101197 * 125{,}3 = 4{,}27$ °C

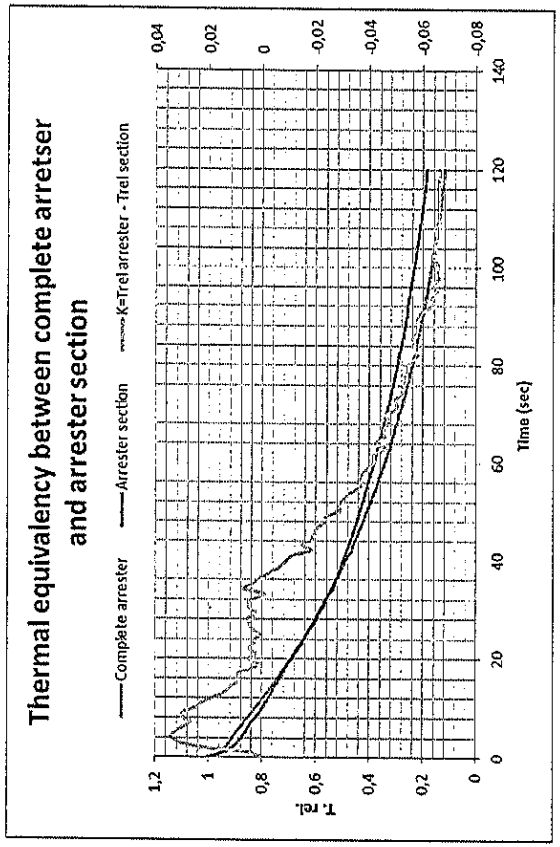
The compensation temperature ΔT resulting from the test is 4,27 °C.

$\vartheta_{start} = 60$ °C + 4,27 °C = 64,27 °C

Therefore the ϑ_{start} for thermal recovery test in the Operating duty test and Power-frequency voltage versus time test is equal to 65,80 °C.

A1176IG

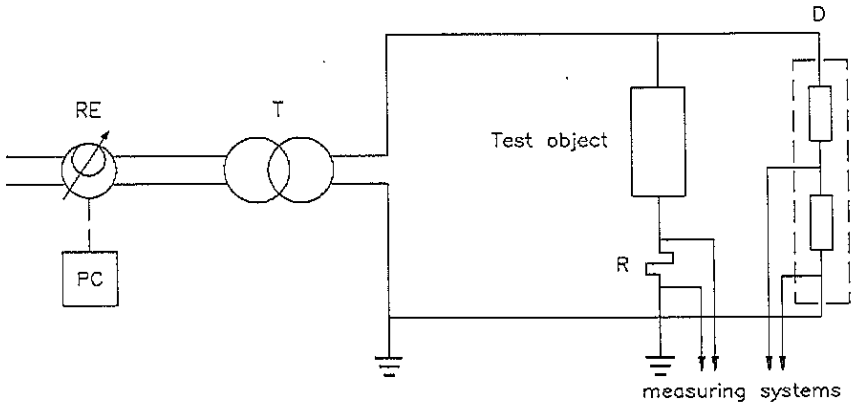
A1264IG



Instruments used for temperature measurement

Instrument type	CESI no.	Note:
ASKIVIANA	022469 - Rx 022468 - Tx	used surge arrester unit and surge arrester section temperature
FLUKE thermometer	030889	used for ambient temperature

Circuit A0019



Power frequency supply

RE - programmable supply type PACIFIC A.C. Power Source 140 ASX.; CESI no. 0560408
PC - personal computer
T - voltage transformer type SPECIALTRASFO; power 30 kVA; voltage 200 V/15-30 kV (used for arrester section)
T - voltage transformer type SPECIALTRASFO; power 60 kVA; voltage 220 V/200 kV (used for complete arrester)

Current measuring system

R - Current shunt CESI No.31120; R= 941,4 Ω
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)

OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

Voltage measuring system

D - Voltage divider SAGI; CESI No.11120 (used for arrester section)
- Voltage divider HAEFELY; CESI No 13455 (used for complete arrester)
- Electro optical system type HBM CESI No. 57986(Rx) – 57991 (Tx)

OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.2)

SOFTWARE SYSTEM:

SW - S.A.D. Surge arrester version 2.0

№ п.п.	name
n.1	varistor B41/30
n.2	Housing
n.3	External insulation
n.4	Metal flanges and spacers
n.5	Additional thermal insulation
n.6	Aperture for a thermocouple

250*

210*

95

n.5 n.4 n.6 n.1 n.2 n.3 n.5

Ø3

1. * - Dimensions for reference

CESI B7026756-001

PA-DH.001.ST.01

Section in thermal model. Surge Arrester PA-DH

ЗАО "Полимер-Аппарат"

PA.OPN.035.002.056.01 SB

The pressure relief window

M12 18

Ø125

Ø68

n.5

A A-A

n.2 n.4 n.3

The location of the pressure relief window

Ø3 Aperture for a thermocouple (form and size matching is required)

Ø41

456±2

580

n.4 n.3 n.2 n.1 n.5

2отв.M8

22

CESI B7026756-002

№ п.	Наименование/Name	№ черт./drawing №	Примечания/remark
1	Металлический фланец/Metal flange	ПА.ОПН.035.002.07 Д	
2	Изоляционный корпус/Insulation tube	ПА.ОПН.035.002.01 Д	
3	Защитная силиконовая оболочка/Silicone rubber	ПА.ОПН.035.002.03 Д	
4	Варистор/Metal-oxide varistor	-	
5	Металлическая прокладка/metal expansion joint	-	-

1. Все размеры для справок. All dimensions for reference

PA.OPN.035.002.056.01 SB

METAL-OXIDE SURGE ARRESTER

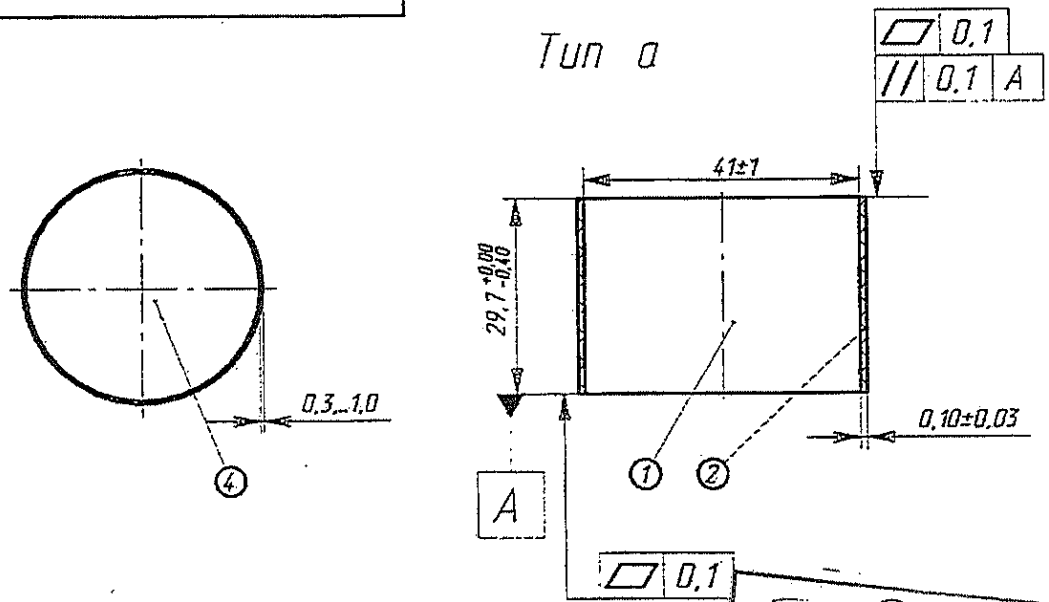
PA-B1-153-SL-20/D Heat dissipation test

Масса 6, Масштаб 1:2

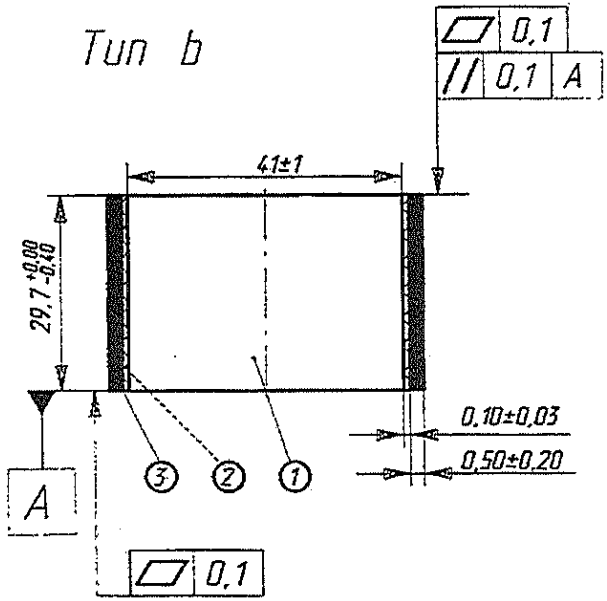
ЗАО "Полимер-Аппарат"

PA.VAR.0500.30

Тип a



Тип b



1. Металлооксидный варистор (MOV disk)
2. Изоляционное покрытие стекло (Glass insulating collar)
3. Изоляционное покрытие полиуретан (PU insulating collar)
4. Алюминиевый электрод (Al – electrode)

Изм.	Лист	N°докум.	Подп.	Дата
Разраб.		Потапов А.В.		
Пров.		Петухов А.П.		
Т.контр.				
Н.контр.				
Утв.		Шевцов И.В.		

PA.VAR.0500.30

Varistor B41/30

Оксид цинка

Лит.	Масса	Масшт.
	0.227	1:1

Лист 1 | Листов 1

ЗАО "Полимер-Аппарат"

Копировал

Формат А4

Подп. и дата | Инв. N° дубл. | Взам. инв. N° | Подп. и дата | Инв. N° подл.

Приложение 8

JSC "POLYMER-APPARAT"
St. Petersburg, Russian Federation

Добровольная сертификация

МЕТАЛО-ОКСИДНИ ВЕНТИЛНИ ОТВОДИ

PA-DH-204-27-22/22

ТЕХНИЧЕСКО РЪКОВОДСТВО

ТМ 3414-Е419-15207362-2018

%year%

ВЯРНО С ОРИГИНАЛА

"ЕЛЕКТРОСЕКЦИЯ" АД

3 Х 0

Това ръководство съдържа технически данни за метало-оксидни Вентилни Отводи (ВО) от свръхнапрежения в полимерни обвивки тип PA-DH-204-27-22 / 22

1. Приложение

1.1. Метало-оксидни ВО от свръхнапрежения без въздушна междина от тип PA-DH-204, по нататък наричани „Отводи", са предназначени за предпазване на електрическо оборудване АС с 48÷62 Hz честота от свръхнапрежение при превключване и мълнии.

1.2. Класификация на ВО съгласно IEC 60099-4:2014 - **Distribution High.**

2. Дизайн и работна информация

2.1. ВО са направени като пакет от метало-оксидни варистори (MOV), затворени в полимерна обвивка с метални фланци.

2.2. Цялостни и монтажни размери са дадени в Приложение А.

2.3. Принципът на работа на ВО се базира на нелинейността на волт-амперната диаграма на цинк-оксидните варистори. При работно напрежение стойността на активните токове през варисторите е по-малка от милиампер, но при свръхнапрежение тези стойности се повишават до стотици и хиляди ампери.

3. Система за маркиране на породукта:

Пример за продуктов номер: **PA-DH-204-27-22/22**

PA - Търговска марка на производител - "Polymer-Apparat";

DH - Distribution High (класификация на предпазителя съгласно JSC "Polymer-Apparat");

204 - Тип обвивка;

27 - Номинално напрежение, kV;

22 - Високо-волтов вход (M12 type 2);

22 - Заземителна клема (M12 type 2).

ВЯРНО С ОРИГИНАЛА

3/1

4. Условия на работната среда

Оперативност на предпазителите е гарантиране при следните условия :

- На открито;
- Минимална работна температура на околната среда е -60^0 C;
- Минимална работна температура на околната среда е $+50^0$ C;
- Надморска височина до 1000 m.

5. Основни характеристики и параметри

5.1. ВО отговарят на спецификация: IEC 60099-4:2014. Основните характеристики и параметри са дадени в Таблица 1 по-долу.

Таблица 1

Parameter	Rated value
1. Номинално напрежение, kV	27
2. Трайно напрежение на ВО (MCOV), kV (rms)	21.6
3. Номинален разряден ток, A	10000
4. Остатъчно напрежение при мълниев импулс на тока с амплитуда 8/20 μs (kV, не повече от):	
5 кА	63.6
10 кА	67.0
20 кА	72.3
5. Остатъчно напрежение при превключващ импулс на ток с амплитуда 30/60 μs (kV, не повече от):	
125 А	48.9
500 А	50.9
6. Остатъчно напрежение при стръмен 1/10 μs токов импулс с амплитуда 10000 А (kV, не повече от)	73.0
7. Траен рейтинг за пренос на заряд Q_{rs}, C	0.5
8. Степен на пренос на топлинна енергия Q_{th}, C	1.1
9. Висок токов импулс 4/10 μs, kA	100
10. Продължителност на токовия импулс, A	450
11. Референтно напрежение (при референтен ток I_{ref} = 1.5 mA), kV, не по-малко от	26.8

ВЯРНО С ОРИГИНАЛА

5.2. Външни параметри на изолацията:

– Обявено издържано мълниево импулсно напрежение 1.2/50 μs , не по-малко от 150 kV

– Обявено издържано мълниево импулсно напрежение 60 Hz, не по-малко от 50 kV

– Разстояние на утечка, не по-малко от 807 mm

5.3. Изолацията на ВО е устойчива на ерозия и проникване на влага.

5.4. Сеизмична стабилност, MSK-64 номер 9.

5.5. Ниво на частичните разряди във ВО при напрежение $1.05 \times U_{cont}$ –не повече от 10 pC.

5.6. TOV характеристики (отнесени към MCOV) представени в Таблица 3 по-долу.

Таблица 3

Продължителност на увеличеното напрежение	0.1 c	0.15 c	1.0 c	3.5 c	10 c	20 c	20 min	50 min	2 h	6 h
Допустимо съотношение на повишено напрежение на ВО по отношение на U_{cont}	1.48/ 1.56	1.47/ 1.55	1.43/ 1.50	1.40/ 1.47	1.37/ 1.45	1.36/ 1.43	1.26/ 1.33	1.23/ 1.30	1.22/ 1.29	1.19/ 1.26

Забележка:

– *Числителя отговаря на тест при предварително загрят ВО до 60 ^{0}C изпитан чрез два правоъгълни импулса равни на рейтинга на устройството;*

– *Стойността на знаменателя съответства на тест при загрят до 60 ^{0}C предпазител без допълнителни импулси.*

6. Безопастност

6.1. ВО са устойчиви на експлозия и издържат на следните токове на късо съединие без да експлодират:

– 20 kA (rms) за 0,2 с (не по-малко);

– 600 A (rms) за 2 с (не по-малко)

6.2. Вентилните отводи отговарят на IEC 60099-4:2014.

7. Експлоатационен живот

Очакваната продължителност на работа на Вентилния Отвод (с вероятност от 0.98 възможност за повреди) е над 30 години.

ВЯРНО С ОРИГИНАЛА

8. Стандартен комплект и опции

Комплекта за доставка се състои от:

- Вентилен Отвод;
- QC сертификат за тест;
- Техническо упътване (3 копия за всеки тип отвод).

Вентилния отвод се състои от:

- метало-оксидни вентилни отводи без въздушна междина тип PA-DH-204 ;
- Високо волтов вход тип 02 - пин М12×50 - 1 бр., шайба ∅12 - 2 бр.., пружинна шайба ∅12 - 1 бр;
- Заземителна клема тип 02 - пин М10×25 - 1 бр., шайба ∅12 - 2 бр., пружинна шайба ∅12 - 1 бр.

9. Обозначения

На долният фланец на предпазителя е отбелязано:

- Име на производителя;
- Тип на предпазител;
- MCOV, kV;
- Заводски номер;
- Дата на производство.

10. Транспортиране

Транспортирането се извършва в оригиналната опаковка с етикети:

- Чупливо;
- да не се мокри;
- нагоре .

11. Съхранение

Вентилните отводи трябва да се съхраняват в оригиналната опаковка.Да се съхраняват на закрито.Няма необходимост от затопляне/охлаждане в диапазона от -60^0 С до $+50^0$ С.

При съхранение и транспорт ВО не трябва да излагат на влага,маслени продукти, киселини, алкални, газове и други агресивни субстанции, които могат да навредпт на полимерната обвивка.

Приемането на продукта трябва да включва проверка на цялостта на опаковката и съответствие с поръчката.

ВЯРНО С ОРИГИНАЛА

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12. Монтаж

12.1. Само квалифициран персонал, запознат с това техническо ръководство и правила за безопастност може да борави с Вентилните Отводи.

<u>ВНИМАНИЕ:</u> За да избегнете щети, ВО не трябва да се докосват до абразивни повърхности, остри ръбове или режещи инструменти.

12.2. Извадете отвода от опаковката и се уверете, че няма видими повреди, които да са се появили при транспортирането.

12.3. Монтирайте отвода, като следвате диаграмата в Приложение А.

12.4. Заземяването на отвода се извършва чрез гъвкав меден проводник със сечение не по-малко от 6 mm^2.

13. Изисквания за поддръжка

Поддръжка на Вентилните Отводи не е предвидена.

Отводите не подлежат на ремонт. Няма инструкция за ремонт.

14. Гаранция

Производитея ще замени повредени ВО в срок от 5 години от датата на пускане в експлоатация, но не по-късно от 7 години от датата на експедиция от производителя, при условие, че повреденият отвод е бил транспортиран, съхраняван. монтиран и експлоатиран стриктно спазвайки това техническо ръководство.

15. Рециклиране

Вентилните Отводи не съдържат опасни или агресивни материали, които могат да навредят на хора или животни, които имат контакс с тях. Рециклирайте в съответствие с местните разпоредби за индустриални отпадъци от метал и пластмаса.

ВЯРНО С ОРИГИНАЛА

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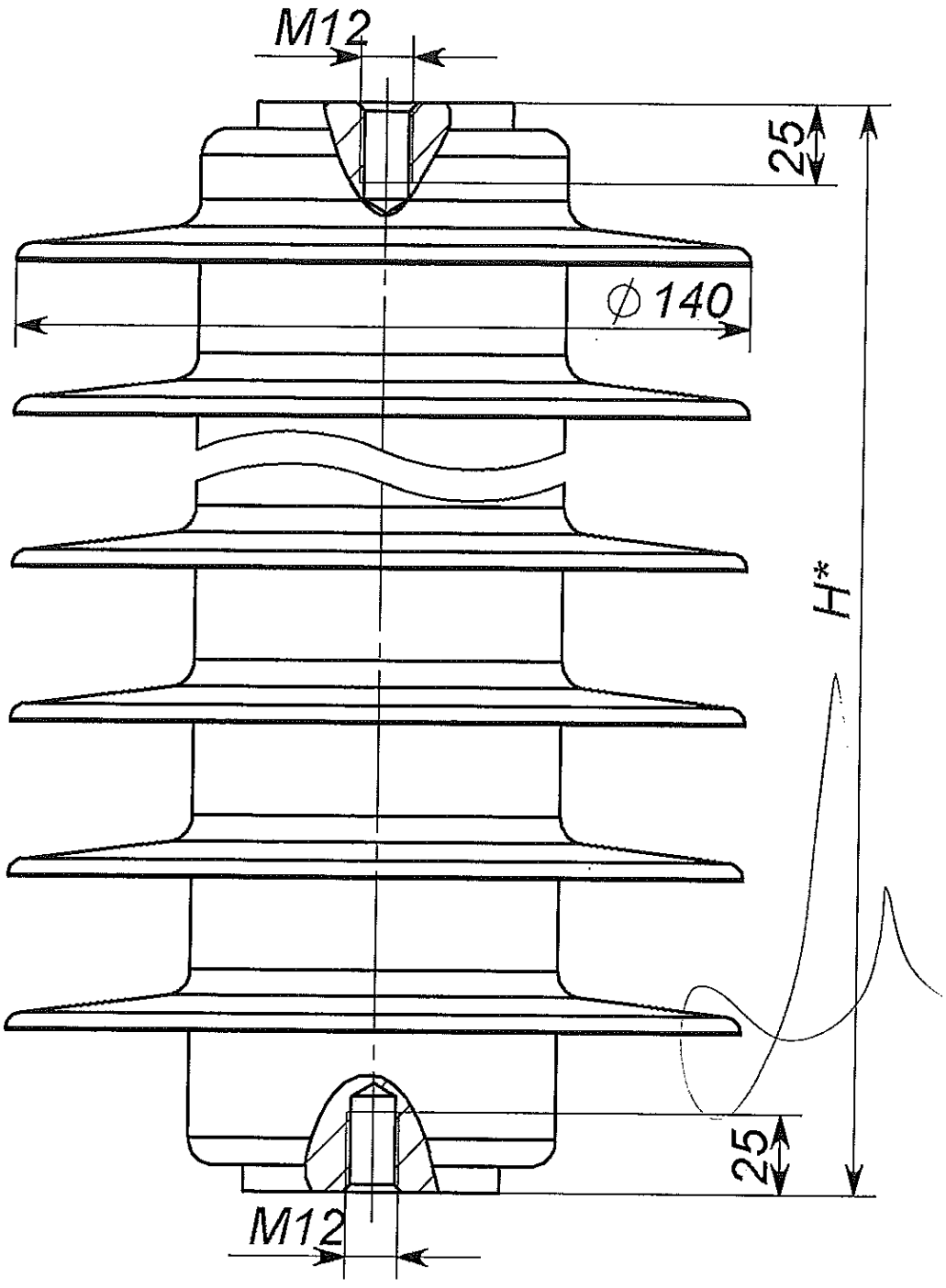
ПРИЛОЖЕНИЕ А

Външни и инсталационни размери и тегло на Вентилните Отводи **тип РА- DH -204**



Височина на ВО (Н) – 290 ± 1 mm.

Тегло на ВО – 3.5 ±0.1 kg

ВЯРНО С ОРИГИНАЛА

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Приложение №3 към Техническото предложение

СРОКОВЕ ЗА ДОСТАВКА

№	Наименование	Мярка	Количество със срок на доставка до 7 кал. дни	Количество 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 13.03.2018 г.

ПОДПИС и ПЕЧАТ:

на основание чл. 2 от ЗЗЛД

(длъжност на представляващия участника)

Референтен № PPD 17-158

Д Е К Л А Р А Ц И Я

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

Долуподписаният/-ната/ Алексей Николаевич Родин, в качеството ми на представляващ „ЕМИ ЕЛЕКТРИК" ЕООД, участник в процедура за възлагане на обществена поръчка с реф. № PPD17-158 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.

на основание чл. 2 от ЗЗЛД

Дата 13.03.2018 г.

ПОДПИС и ПЕЧАТ:

(име
Але

Референтен № PPD 17-158

Д Е К Л А Р А Ц И Я
за срока на валидност на офертата

Долуподписаният/ -ата Алексей Николаевич Родин,
(собствено, бащино, фамилно име)
на основание чл. 2 от ЗЗЛД

(посочва се длъжността)

на „ЕМИ ЕЛЕКТРИК" ЕООД,
(посочете наименованието на участника)
участник в процедура за възлагане на обществена поръчка с реф. № PPD17-158 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.

Дата 20.03.2018 г.

ПОДПИС и ПЕЧАТ:

на основание чл. 2 от ЗЗЛД

Забележка:
Декларацията се подписва от законния представител на участника или от надлежно упълномощено лице, което подава офертата.

Референтен № PPD 17-158

СИСТЕМА СЕРТИФИКАЦИИ ГОСТ Р

ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО ТЕХНИЧЕСКОМУ РЕГУЛИРОВАНИЮ И МЕТРОЛОГИИ

СЕРТИФИКАТ СООТВЕТСТВИЯ

№ РОСС RU.ME05.H00313

Срок действия с 11.12.2015 по 10.12.2018

№ 0060370

ОРГАН ПО СЕРТИФИКАЦИИ

АВТОНОМНАЯ НЕКОММЕРЧЕСКАЯ ОРГАНИЗАЦИЯ «НАУЧНО-ТЕХНИЧЕСКИЙ ЦЕНТР «ОРГАН ПО СЕРТИФИКАЦИИ ЭЛЕКТРИЧЕСКИХ МАШИН, ТРАНСФОРМАТОРОВ, ЭЛЕКТРООБОРУДОВАНИЯ И ПРИБОРОВ»
196105, Санкт-Петербург, ул.Благодатная, д. 2, тел.+7(812)369-91-67, факс +7(812)369-68-27, elmatep@mail.wplus.net,
Аттестат аккредитации № RA.RU.11ME05 от 27.01.2015г., выдан Федеральной службой по аккредитации

ПРОДУКЦИЯ

Ограничители перенапряжений нелинейные серии ОПНп для электрических сетей переменного тока классов напряжения 3, 6 и 10 кВ, категории размещения 2, ток взрывобезопасности 40кА
ТУ 3414-009-15207362-2006
Серийный выпуск

код ОК 005 (ОКП): 341400

СООТВЕТСТВУЕТ ТРЕБОВАНИЯМ НОРМАТИВНЫХ ДОКУМЕНТОВ

ГОСТ Р 52725-2007; ГОСТ 12.2.007.0-75 п.п. 3.3.1, 3.3.3, ГОСТ 12.2.007.3-75;
ТУ 3414-009-15207362-2006

код ТН ВЭД России: 8535400000

ИЗГОТОВИТЕЛЬ

Закрытое акционерное общество "Полимер-Аппарат", Адрес: 190068, СПб, ул.Большая Подъяческая д.1/3, литер А., Фактический адрес: 190068, СПб, ул.Большая Подъяческая д.1/3, литер А.

СЕРТИФИКАТ ВЫДАН

Закрытое акционерное общество "Полимер-Аппарат", Адрес: 190068, СПб, ул.Большая Подъяческая д.1/3, литер А., Фактический адрес: 190068, СПб, ул.Большая Подъяческая д.1/3, литер А., телефон: (812)33140402, факс: (812)3314040, E-mail: opn@polimer-apparat.ru

НА ОСНОВАНИИ

Протокол испытаний № ПИ 923 от 27.11.2015г., № РОСС RU.0001.21МВ01. Испытательный центр высоковольтной аппаратуры Акционерного общества «Научно-исследовательский и проектно-конструкторский институт высоковольтного аппаратостроения». Сертификат системы менеджмента качества ГОСТ ISO 9001-2011 (ISO 9001:2008) № СТ/СМК/ОС01 RU № 02/13-00360 от 14.11.2013.

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Маркирование продукции производится знаком соответствия по ГОСТ Р 50460-92 с надписью "Добровольная сертификация" на изделии [illegible] ке и в сопроводительной документации. Схема сертификации: [illegible]

на основание чл. 2 от ЗЗЛД

на основание чл. 2 от ЗЗЛД

Руководитель органа [illegible]

Эксперт [illegible]

Сертификат не применяется при [illegible] ьной сертификации

ДЕКЛАРАЦИЯ О СООТВЕТСТВИИ

Закрытое акционерное общество "Полимер-Аппарат"

(наименование организации или фамилия, имя, отчество индивидуального предпринимателя, принявших декларацию о соответствии)

Зарегистрирован(а) Межрайонная инспекция РФ по налогам и сборам № 7, дата регистрации 13.08.2003 , ОГРН: 1037861005401

(сведения о регистрации организации или индивидуального предпринимателя (наименование регистрирующего органа, дата регистрации, регистрационный номер)

Адрес:190068, РОССИЯ, город Санкт-Петербург, ул.Большая Подъяческая, д. 1/3, лит. А, Фактический адрес: 190068, РОССИЯ, город Санкт-Петербург, ул.Большая Подъяческая, д. 1/3, лит. А, телефон: (812)3314040, факс: (812)3314040, E-mail: opn@polimer-apparat.ru

(адрес, телефон, факс)

в лице Генерального директора Шевцова Ильи Владимировича

(должность, фамилия, имя, отчество руководителя организации, от имени которой принимается декларация)

заявляет, что Ограничители перенапряжений нелинейные серии ОПНп для электрических сетей перемнного тока классов напряжения 3, 6 и 10 кВ, категории размещения 2, ток взрывобезопасности 40кА, ТУ 3414-009-15207362-2006

(наименование, тип, марка продукции, на которую распространяется декларация)

Серийный выпуск, Код ОКП 341400, Код ТН ВЭД 8535400000

(сведения о серийном выпуске или партии (номер партии, номера изделий, реквизиты договора (контракта), накладная ,код ОК 005-93 и (или) ТН ВЭД ТС или ОК 002-93 (ОКУН))

Изготовитель: Закрытое акционерное общество "Полимер-Аппарат", Адрес: 190068, РОССИЯ, город Санкт-Петербург, ул.Большая Подъяческая, д. 1/3, лит. А, Фактический адрес: 190068, РОССИЯ, город Санкт-Петербург, ул.Большая Подъяческая, д. 1/3, лит. А

(наименование изготовителя, страны и т.п.)

соответствует требованиям ГОСТ Р 52725-2007 п.п. 6.4.10, 6.5; ГОСТ 12.2.007.0-75 п.п. 3.3.1, 3.3.3

(обозначение нормативных документов, соответствие которым подтверждено данной декларацией, с указанием пунктов этих нормативных документов, содержащих требования для данной продукции)

Декларация принята на основании: Протокол испытаний № ПИ 923 от 27.11.2015г. Испытательный центр высоковольтной аппаратуры Акционерного общества «Научно-исследовательский и проектно-конструкторский институт высоковольтного аппаратостроения». Аттестат аккредитации № РОСС RU.0001.21МВ01 от 06.06.2012 до 06.06.2017. Сертификат системы менеджмента качества ГОСТ ISO 9001-2011 (ISO 9001:2008) № СТ/СМК/ОС01 RU № 02/13-00360 от 14.11.2013

(информация о документах, являющихся основанием для принятия декларации)

Дата принятия декларации 11.12.2015

Декларация о соответствии действительна до 10.12.2018

на основание чл. 2 от ЗЗЛД

на основание чл. 2 от ЗЗЛД

(инициалы, фамилия)

Сведения о регистрации декларации о соответствии:

Регистрационный номер RA.RU.[illegible]05, Орган по сертификации электрических машин, трансформаторов, электрооборудования и приборов АНО "Научно-Технический Центр "Орган по сертификации электрических машин, трансформаторов, электрооборудования и приборов"

(наименование и адрес органа по сертификации, зарегистрировавшего декларацию)

Адрес: 196105, Россия, город Санкт-Петербург, Благодатная, дом [illegible]

на основание чл. 2 от ЗЗЛД

на основание чл. 2 от ЗЗЛД

Регистрационный номер декларации о соответствии РОСС RU.МВ[illegible] от 11.12.2015

(дата регистрации, регистрационный номер)

М.П.

(подпись, инициалы, фамилия руководителя органа по сертификации)

281

СИСТЕМА ЗА ДОБРОВОЛНА СЕРТЪИФИКАЦИЯ

“ СЕРТИФИКА-ТЕСТ ”

Въведени в единния регистър на доброволната система за сертифициране :
ФЕДЕРАЛНА АГЕНЦИЯ ЗА ТЕХНИЧЕСКИ РЕГЛАМЕНТИ И МЕТРОЛОГИЯ
Регистрационен номер: № РОСС RU.3285.04АЧ00

ISO 9000

СЕРТИФИКА-ТЕСТ

ОС01

Organization establishing the certification system “Sertifika-Test”
“Center of Certification and Elaborations on Quality”
CERTIFICATION BODY
“CSRK-Management”
Elektrodnyi proezd, 6, building 1, office 28, Moscow, 111123
Tel. +7 (495) 223-22-18

СЕРТИФИКАТ ЗА СЪОТВЕТСТВИЕ

СТ/СМК/ОС01 RU № 02/16-00521

CJSC “Polimer-Appart”
Bol’shaya Podyacheskaya street, 1/13, lit.A, St. Petersburg, 190068
INN 7838002312

ТОЗИ СЕРТИФИКАТ УДОСТОВЕРЯВА, ЧЕ СИСТЕМА ЗА УПРАВЛЕНИЕ НА КАЧЕСТВОТО

Във връзка с проектиране, инженеринг, производство и сглобяване на ограничители на пренапрежение и електрически уреди при при строително-монтажни работи по проектиране на електротехническо оборудване за сгради, енергетика и железопътни обекти

Съответства на изискванията на GOST R ISO 9001-2015 (ISO 9001:2015)

Сертификатът е издаден : 22.10.2016 Валиден до: 22.10.2019

на основание чл. 2 от ЗЗЛД

Romanenko M.A.
Head of the Organization

на основание чл. 2 от ЗЗЛД

The certificate obliges the organization to render services in compliance with the aforesaid standard, which will be under control of the organization of certification within the “Sertifika-Test” Certification System and shall be reconfirmed by annual inspection.

№ 013159

SYSTEM OF VOLUNTARY CERTIFICATION
"SERTIFIKA-TEST"

Introduced in the unified register of voluntary systems of certification of the
FEDERAL AGENCY ON TECHNICAL REGULATION AND METROLOGY
Registration number: № РОСС RU.3285.04АЧ00

ISO 9000

OC01

Organization establishing the certification system "Sertifika-Test"
"Center of Certification and Elaborations on Quality"

CERTIFICATION BODY
"CSRK-Management"
Elektrodnyi proezd, 6, building 1, office 28, Moscow, 111123
Tel. +7 (495) 223-22-18

CERTIFICATE OF CONFORMITY

CT/CMK/OC01 RU № 02/16-00521

CJSC "Polimer-Appart"

Bol'shaya Podyacheskaya street, 1/13, lit.A, St. Petersburg, 190068
INN 7838002312

THIS CERTIFICATE CERTIFIES THAT:
QUALITY MANAGEMENT SYSTEM

With reference to designing, engineering, production and assembling of excess-voltage suppressors and electrical devices, to construction-building works, to designing of electrotechnical equipment for building, energy and railway objects

COMPLIES WITH THE REQUIREMENTS OF
GOST R ISO 9001-2015 (ISO 9001:2015)

Cert

на основание чл. 2 от ЗЗЛД

r 22, 2016

Valid until November 22, 2019

В
ОР

на основание чл. 2 от ЗЗЛД

Head of the Organization

The certificate obliges the organization to render services in compliance with the aforesaid standard, which will be under control of the organization of certification within the "Sertifika-Test" Certification System and shall be reconfirmed by annual inspection.

№ 013159

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Закрытое акционерное общество
"Полимер-Аппарат"

ИНН/КПП 7838002312/783801001, р/с 40702810505000000096 в Филиале АО АКБ "НОВИКОМБАНК" в г. Санкт-Петербурге, к/с 30101810400000000902, БИК044030902,
Юридический адрес: 190068, г. Санкт-Петербург, ул.Б. Подъяческая, 1/3 литер А,
Почтовый адрес: 191144, г. Санкт-Петербург, а/я 1
Тел/факс.(812)331-40-40, http://www.polymer-apparat.ru

Исх.№ 288/17 от «29» августа 2017 г.

Информационное письмо

Ограничители перенапряжений, предлагаемые для поставки в Болгарию, имеют маркировку "О" и предназначены для эксплуатации на территории Евросоюза. Данные ограничители отличаются от ограничителей перенапряжений, применяемых в России.

на основание чл. 2 от ЗЗЛД

Генеральный директор Шевцов И.В.

ВЯРНО С ОРИГИНАЛА

ACCREDIA

L'ENTE ITALIANO DI ACCREDITAMENTO

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

CERTIFICATO __ Di ACCREDITAIVIENTO
Акредитационен сертификат

Accreditamento n°
Акредитация n°

0030 Rev. **2**

Si dichiara the
Ние декларираме, че

CESI S.p.A.
Sede/Headquarters:
Via Rubattino 54 - 20134 Milano MI

conforme ai requisiti della norma

UNI CEI EN ISO/IEC 17025:2005 "Requisiti generali per la competenza dei Laboratori di prova e taratura"

отговаря на изискванията на стандарта

EN 1SO/IEC 17025:2005 " Общи изисквания за компетентност на лабораториите за изпитване и калибриране "

quale

Laboratorio di Prova

като

Изпитвателна лаборатория

L'accreditamento attesta la competenza tecnica del Laboratorio relativamente alto 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'attivita dei Laboratori di Prova, sono conformi ai principi della ISO 9001:2008 ed allineati con i suoi requisiti applicabili.
Il presente certificato non 6 da ritenersi valido se non accompagnato dalle schede allegate e pue essere sospeso o revocato in qualsiasi momento nel caso di inadempienza accertata da parte di ACCREDIA.
La vigenza dell'accreditamento pu6 essere verificata sul sito WEB (www.accredia.it) o richiesta direttamente ai singoli Dipartimenti

Акредитацията удостоверява техническата компетентност на лабораторията, ограничена до обхвата, описан в приложеното Приложение. Обхватът може да варира във времето. Изискванията на системата за управление в 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 приложения график и може да бъде спрян 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.accre[redacted]о директно заявление до назначения отдел.

на основание чл. 2 от ЗЗЛД

Data di 1a emissione
Първа дата на издаване
1992.02.27

на основание чл. 2 от ЗЗЛД

Data di modifica
Дата на модификация
2016.04.14

на основание чл. 2 от ЗЗЛД

cadenza
иден до
020.03.09

(In [redacted] Rossi)

Генерален директор
(Dr. Filippo Trifiletti)

Директор на отдела
(Dr.ssa Silvia Tramontin)

Mod. CA- 01 rev. 01

Sede operativa e legale: Via Guglielmo Saliceto, 7/9 I 001 61 Roma - Italy I Tel. +39 06 8440991 I Fax +39 06 8841199
info@accredia.it www.accredia.it Partita IVA - Codice Fiscale 10566361001

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO
Membro degli Accordi di Mutuo Riconoscimento EA, IAF e ILAC
Signatory of EA, IAF and ILAC Mutual Recognition Agreements

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 .

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Data di 1ª emissione *1st issue date*	Data di modifica *Modification date*	Data di scadenza *Expiring date*
1992-02-27 на основание чл. 2 от ЗЗЛД	на основание чл. 2 от ЗЗЛД	на основание чл. 2 от ЗЗЛД

(Dr. Filippo Trifiletti)
Department Director
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The President
(Ing. Giuseppe Rossi)

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CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

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

Si dichiara che / *We declare that*

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ELENCO PROVE ACCREDITATE - CATEGORIA: 0

AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

Denominazione della prova / Campi di prova	*Metodo di prova*
Capacitor switching current tests	IEEE Std C37.09: 1999 R2007 / C37.09a (A1): 2005 / C37.04: 1999
Control voltage	IEEE Std C37.09: 1999 R2007
Dielectric withstand tests	IEEE Std C37.09: 1999 R2007 / C37.06: 2009
Interrupting time tests	IEEE Std C37.09: 1999 R2007 / C37.04: 1999
Line closing switching surge factor	IEEE Std C37.09: 1999 R2007 / C37.06: 2009
Load current	IEEE Std C37.09: 1999 R2007 / C37.06: 2009
Maximum voltage tests	IEEE Std C37.09: 1999 R2007 / C37.04: 1999 / C37.06: 2009
Out-of-phase switching current tests	IEEE Std C37.09: 1999 R2007 / C37.09b (A2): 2010
Short-circuit current interrupting tests	IEEE Std C37.09: 1999 R2007 / C37.09b (A2): 2010 / C37.04: 1999 / C37.06: 2009 / C37.081: 1981 / C37.081a: 1997
Standard operating duty tests	IEEE Std C37.09: 1999 R2007 / C37.04: 1999 / C37.06: 2009
Synthetic fault testing	IEEE C37.081: 1981 / C37.081a: 1997
TRV tests	IEEE Std C37.09: 1999 R2007 / C37.09b (A2): 2010 / C37.06: 2009

Apparati e sistemi elettronici per applicazioni civili ed industriali

Denominazione della prova / Campi di prova	*Metodo di prova*
Immunità ai disturbi condotti, indotti da campi a radiofrequenza (Solo su porte di alimentazione con CDN tipo M)	CEI EN 61000-4-6: 2014
Prova di immunità a transitori/treni elettrici veloci	CEI EN 61000-4-4: 2013
Prova di immunità agli impulsi (Solo impulsi 1,2/50 μs su porte di alimentazione)	CEI EN 61000-4-5: 2015
Prova di immunità alle onde oscillatorie smorzate (Solo 100 KHz e 1 MHz)	CEI EN 61000-4-18: 2007 / A1: 2011
Prove di immunità a scariche di elettricità statica	CEI EN 61000-4-2: 2011

Apparati e sistemi elettronici per applicazioni civili ed industriali - Apparecchi per la tecnologia dell'informazione

Denominazione della prova / Campi di prova	*Metodo di prova*
Limiti dei disturbi irradiati (Limiti al di sotto di 1 GHz)	CEI EN 55022: 2014
Metodo di misura dei disturbi condotti ai morsetti di alimentazione e alle porte di telecomunicazione (Solo morsetti di alimentazione)	CEI EN 55022: 2014

Apparati per la misura dell'enegia elettrica (a.c.) - Apparato di misura

Denominazione della prova / Campi di prova	*Metodo di prova*
Prova ai transitori/treni elettrici veloci	CEI EN 62052-11: 2003
Prova di immunità agli impulsi (Solo impulsi 1,2/50 μs su porte di alimentazione)	CEI EN 62052-11: 2003
Prova di immunità alle onde oscillatorie smorzate	CEI EN 62052-11: 2003
Prova di immunità alle scariche elettrostatiche	CEI EN 62052-11: 2003

Apparati per la misura dell'enegia elettrica (a.c.) - Apparato di misura (indici di classe A, B, C)

Denominazione della prova / Campi di prova	*Metodo di prova*
Immunità agli impulsi (Solo impulsi 1,2/50 μs su porte di alimentazione)	CEI EN 50470-1: 2007

Immunità ai disturbi condotti, indotti da campi a radiofrequenza (Solo su porte di alimentazione con CDN tipo M)	CEI EN 50470-1: 2007
Immunità ai transitori/treni elettrici veloci	CEI EN 50470-1: 2007
Immunità alle scariche elettrostatiche	CEI EN 50470-1: 2007
Soppressione dei radiodisturbi	CEI EN 50470-1: 2007

Apparati per la misura dell'enegia elettrica (a.c.) - Contatori statici di energia attiva (classe 1 e 2)

Denominazione della prova / Campi di prova	*Metodo di prova*
Costante del contatore	CEI EN 62053-21: 2003
Influenza del riscaldamento proprio	CEI EN 62053-21: 2003
Limiti di errore dovuti alla variazione della corrente	CEI EN 62053-21: 2003
Limiti di errore dovuti alle grandezze di influenza	CEI EN 62053-21: 2003
Prova di avviamento e marcia a vuoto	CEI EN 62053-21: 2003

Apparati per la misura dell'enegia elettrica (a.c.) - Contatori statici per energia attiva (indici di classe A, B, C)

Denominazione della prova / Campi di prova	*Metodo di prova*
Autoriscaldamento	CEI EN 50470-3: 2007
Costante del contatore	CEI EN 50470-3: 2007
Errore massimo tollerato (MPE)	CEI EN 50470-3: 2007
Limiti di errore percentuale addizionale dovuti alle grandezze di influenza	CEI EN 50470-3: 2007
Limiti di errore percentuale dovuti alla variazione del carico	CEI EN 50470-3: 2007
Prova di avviamento e marcia a vuoto	CEI EN 50470-3: 2007
Ripetibilità	CEI EN 50470-3: 2007
Sovracorrenti di breve durata	CEI EN 50470-3: 2007

Apparati per la misura dell'enegia elettrica (a.c.) - Contatori statici per energia reattiva (classi 2 e 3)

Denominazione della prova / Campi di prova	*Metodo di prova*
Costante del contatore	CEI EN 62053-23: 2003
Influenza del riscaldamento proprio	CEI EN 62053-23: 2003
Limiti di errore dovuti alla variazione della corrente	CEI EN 62053-23: 2003
Limiti di errore dovuti alle grandezze di influenza	CEI EN 62053-23: 2003
Prova di avviamento e marcia a vuoto	CEI EN 62053-23: 2003

Apparecchiatura ad alta tensione - Apparecchiatura di manovra con involucro metallico con isolamento in gas per tensioni nominali superiori a 52 kV,
High-voltage switchgear and controlgear - Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV

Denominazione della prova / Campi di prova	*Metodo di prova*
Misura della resistenza dei circuiti, Measurement of the resistance of circuits	CEI EN 62271-203: 2013, IEC 62271-203: 2011
Prove di isolamento, Dielectric tests	CEI EN 62271-203: 2013, IEC 62271-203: 2011
Prove di riscaldamento, Temperature-rise tests	CEI EN 62271-203: 2013, IEC 62271-203: 2011
Prove di tenuta alla corrente di breve durata e alla corrente di picco, Short-time withstand current and peak withstand current tests	CEI EN 62271-203: 2013, IEC 62271-203: 2011
Verifica dei poteri di stabilimento e di interruzione, Verification of making and breaking capacities	CEI EN 62271-203: 2013, IEC 62271-203: 2011

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Apparecchiatura ad alta tensione - Apparecchiatura prefabbricata con involucro metallico per tensioni da 1 kV a 52 kV
High-voltage switchgear and controlgear - AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV

Denominazione della prova / Campi di prova	*Metodo di prova*
Prove di isolamento, Dielectric tests	CEI EN 62271-200: 2013 / EC: 2015, IEC 62271-200: 2011 / EC: 2015

Apparecchiatura ad alta tensione - Apparecchiatura prefabbricata con involucro metallico per tensioni da 1 kV a 52 kV,
High-voltage switchgear and controlgear - AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV

Denominazione della prova / Campi di prova	*Metodo di prova*
Misura della resistenza dei circuiti, Measurement of the resistance of circuits	CEI EN 62271-200: 2013, IEC 62271-200: 2011
Prova d'arco interno, Internal arc fault – Method to verify the internal arc classification (IAC)	CEI EN 62271-200: 2013, IEC 62271-200: 2011
ve di riscaldamento, . .mperature-rise tests	CEI EN 62271-200: 2013, IEC 62271-200: 2011
Prove di tenuta alla corrente di breve durata e alla corrente di picco, Short-time withstand current and peak withstand current tests	CEI EN 62271-200: 2013, IEC 62271-200: 2011
Verifica dei poteri di stabilimento e di interruzione, Verification of making and breaking capacities	CEI EN 62271-200: 2013, IEC 62271-200: 2011

Apparecchiatura ad alta tensione - Interruttori a corrente alternata,
High-voltage switchgear and controlgear - Alternating-current circuit-breakers

Denominazione della prova / Campi di prova	*Metodo di prova*
Cicli di prova fondamentali di cortocircuito, Basic short-circuit test-duties	CEI EN 62271-100: 2013 / A1: 2014, IEC 62271-100: 2012
Misura della resistenza del circuito principale, Measurement of the resistance of the main circuit	CEI EN 62271-100: 2013 / A1: 2014, IEC 62271-100: 2012
Prove di guasto in linea, Short-line fault tests	CEI EN 62271-100: 2013 / A1: 2014, IEC 62271-100: 2012
Prove di guasto monofase e bifase a terra, Single-phase and double-earth fault tests	CEI EN 62271-100: 2013 / A1: 2014, IEC 62271-100: 2012
Prove di manovra di correnti capacitive, Capacitive current switching tests	CEI EN 62271-100: 2013 / A1: 2014, IEC 62271-100: 2012
.ove di sovratemperatura, Temperature-rise tests	CEI EN 62271-100: 2013 / A1: 2014, IEC 62271-100: 2012
Prove di stabilimento e di interruzione, Making and breaking tests	CEI EN 62271-100: 2013 / A1: 2014, IEC 62271-100: 2012
Prove di stabilimento e interruzione in discordanza di fase, Out-of-phase making and breaking tests	CEI EN 62271-100: 2013 / A1: 2014, IEC 62271-100: 2012
Prove di tenuta alla corrente di breve durata e alla corrente di picco, Short-time withstand current and peak withstand current tests	CEI EN 62271-100: 2013 / A1: 2014, IEC 62271-100: 2012
Prove dielettriche, Dielectric tests	CEI EN 62271-100: 2013 / A1: 2014, IEC 62271-100: 2012

Apparecchiatura ad alta tensione - Interruttori di manovra e interruttori di manovra sezionatori per tensioni nominali superiori a 1 kV fino a 52 kV compreso,
High-voltage switchgear and controlgear - Switches for rated voltages above 1 kV up to and including 52 kV

Denominazione della prova / Campi di prova	*Metodo di prova*
Misura della resistenza dei circuiti, Measurement of the resistance of circuits	CEI EN 62271-103: 2012, IEC 62271-103: 2011
Prove di isolamento, Dielectric tests	CEI EN 62271-103: 2012, IEC 62271-103: 2011
Prove di riscaldamento, Temperature-rise tests	CEI EN 62271-103: 2012, IEC 62271-103: 2011

Prove di stabilimento e di interruzione, Making and breaking tests	CEI EN 62271-103: 2012 / EC 2014, IEC 62271-103: 2011
Prove di tenuta alla corrente di breve durata e alla corrente di picco, Short-time withstand current and peak withstand current tests	CEI EN 62271-103: 2012, IEC 62271-103: 2011

Apparecchiatura ad alta tensione - Manovra di carichi induttivi
High-voltage switchgear and controlgear - Inductive load switching

Denominazione della prova / Campi di prova	*Metodo di prova*
Prove di manovra della corrente del reattore in derivazione, Shunt reactor current switching tests	CEI EN 62271-110: 2014, IEC 62271-110: 2012

Apparecchiatura ad alta tensione - Prove sintetiche,
High-voltage switchgear and controlgear - Synthetic testing

Denominazione della prova / Campi di prova	*Metodo di prova*
Specific requirements for synthetic tests for making and breaking performance related to the requirements of 6.102 through 6.111 of IEC 62271-100: 2008	CEI EN 62271-101: 2013, IEC 62271-101: 2012
Synthetic testing techniques and methods for short-circuit breaking tests	CEI EN 62271-101: 2013, IEC 62271-101: 2012
Synthetic testing techniques and methods for short-circuit making tests	CEI EN 62271-101: 2013, IEC 62271-101: 2012

Apparecchiatura ad alta tensione - Sezionatori e sezionatori di terra a corrente alternata per alta tensione,
High-voltage switchgear and controlgear - Alternating current disconnectors and earthing switches

Denominazione della prova / Campi di prova	*Metodo di prova*
Misura della resistenza dei circuiti, Measurement of the resistance of circuits	CEI EN 62271-102: 2003 / EC: 2008 / A1: 2012, IEC 62271-102: 2013
Prova per dimostrare la prestazione di stabilimento di corrente di cortocircuito dei sezionatori di terra, Test to prove the short-circuit making performance of earthing switches	CEI EN 62271-102: 2003 / EC: 2008 / A1: 2012 / A2: 2014, IEC 62271-102: 2013
Prove di isolamento, Dielectric tests	CEI EN 62271-102: 2003 / EC: 2008 / A1: 2012 / A2: 2014, IEC 62271-102: 2013
Prove di manovra di corrente indotta, Induced current switching tests	CEI EN 62271-102: 2003 / EC: 2008 / A1: 2012 / A2: 2014, IEC 62271-102: 2013
Prove di manovra su corrente di commutazione di sbarra, Bus transfer current switching tests	CEI EN 62271-102: 2003 / EC: 2008 / A1: 2012 / A2: 2014, IEC 62271-102: 2013
Prove di sovratemperatura, Temperature-rise tests	CEI EN 62271-102: 2003 / EC: 2008 / A1: 2012, IEC 62271-102: 2013
Prove di tenuta alla corrente di breve durata e alla corrente di picco, Short-time withstand current and peak withstand current tests	CEI EN 62271-102: 2003 / EC: 2008 / A1: 2012 / A2: 2014, IEC 62271-102: 2013

Apparecchiatura di manovra e di comando ad alta tensione,
High-voltage switchgear and controlgear

Denominazione della prova / Campi di prova	*Metodo di prova*
Misura della resistenza dei circuiti, Measurement of the resistance of circuits	CEI EN 62271-1: 2010 / A1: 2012, IEC 62271-1: 2011
Prove di riscaldamento, Temperature-rise tests	CEI EN 62271-1: 2010 / A1: 2012, IEC 62271-1: 2011
Prove di tenuta alla corrente di breve durata e alla corrente di picco, Short-time withstand current and peak withstand current tests	CEI EN 62271-1: 2010 / A1: 2012, IEC 62271-1: 2011
Prove dielettriche, Dielectric tests	CEI EN 62271-1: 2010 / A1: 2012, IEC 62271-1: 2011

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Applicazioni ferroviarie, tranviarie, filoviarie e metropolitane - Impianti fissi - Apparecchiatura a corrente continua - Interruttori a corrente continua,
Railway applications - Fixed installations - D.C. switchgear - Circuit breakers

Denominazione della prova / Campi di prova	*Metodo di prova*
Prova di durata elettrica, Electrical endurance test	CEI EN 50123-2: 2003, EN 50123-2: 2003
Ricerca delle correnti critiche ed esecuzione dei cicli di prova l) ed lr), Search for critical currents and performing test duty l) and lr)	CEI EN 50123-2: 2003, EN 50123-2: 2003
Verifica del comportamento con corrente di tenuta di breve per il ciclo di prova s, Verification of behaviour under short-time withstand current for test duty s	CEI EN 50123-2: 2003, EN 50123-2: 2003
Verifica del potere di chiusura e di interruzione in cortocircuito e delle caratteristiche H, V o S, Verification of the making and breaking capacity in short-circuit conditions and of the H, V or S characteristic	CEI EN 50123-2: 2003, EN 50123-2: 2003

Applicazioni ferroviarie, tranviarie, filoviarie e metropolitane - Impianti fissi - Apparecchiatura a corrente continua - Sezionatori, interruttori di manovra-sezionatori e sezionatori di terra a corrente continua per interno,
Railway applications - Fixed installations - Indoor d.c. disconnectors, switch-disconnectors and earthing switches

Denominazione della prova / Campi di prova	*Metodo di prova*
Prova di durata elettrica, Electrical endurance test	CEI EN 50123-3: 2003, EN 50123-3: 2003
Ricerca delle correnti critiche ed esecuzione delle prove di tipo a bassa corrente, Search for critical currents and performing the low current type test	CEI EN 50123-3: 2003, EN 50123-3: 2003
Verifica del comportamento sotto corrente ammissibile di breve durata, Verification of the behaviour during short-time withstand current test	CEI EN 50123-3: 2003, EN 50123-3: 2003
Verifica del potere di chiusura e di interruzione di targa, Verification of the rated making and breaking capacities	CEI EN 50123-3: 2003, EN 50123-3: 2003

Atmosfere esplosive - Parte 0:
Apparecchi e sistemi di protezione destinati a essere utilizzati in atmosfera potenzialmente esplosiva

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 26.13 Prova di resistenza superficiale di parti di custodie in materiale non metallico / Surface resistance tests of parts of enclusyures of non-metallic materials	EN 60079-0: 2012, IEC 60079-0: 2011
6.14 Prove ci carica / Measurement of capacitance	EN 60079-0: 2012, IEC 60079-0: 2011
§ 26.4.2 Resistenza all'urto / resistance to impact	EN 60079-0: 2012, IEC 60079-0: 2011
§ 26.4.3 Prova di resistenza alla caduta / drop test	EN 60079-0: 2012, IEC 60079-0: 2011
§ 26.4.5 grado di protezione (IP) fornito dalle custodie / degree of protection (IP) by enclosures	EN 60079-0: 2012, IEC 60079-0: 2011
§ 26.5.1 misura della temperatura / temperature measurements	EN 60079-0: 2012, IEC 60079-0: 2011
§ 26.5.2 prova agli sbalzi termici / thermal shock test	EN 60079-0: 2012, IEC 60079-0: 2011
§ 26.6 Prova di rotazione dei passanti / Torque test for bushing	EN 60079-0: 2012, IEC 60079-0: 2011
§ 26.8 resistenza termica al calore / thermal endurance to hea	EN 60079-0: 2012, IEC 60079-0: 2011
§ 26.9 resistenza termica al freddo / thermal resistance to cold	EN 60079-0: 2012, IEC 60079-0: 2011
A.3.1.4 Prove di trazione / Tensile Tests	EN 60079-0: 2012, IEC 60079-0: 2011

A.3.1.5 Resistenza meccanica	EN 60079-0: 2012, IEC 60079-0: 2011

Atmosfere esplosive - Parte 1: Apparecchiature protette mediante custodia a prova di esplisione 'd'

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 15.1.2 Determinazione della pressione di esplosione / Determination of explosion pressure (reference pressure) (Prove con Metano, Etilene Acetilene, Idrogeno. Test with Methane, Ethylene, acetylene, Hydrogen)	EN 60079-1:2007, IEC 60079-1:2007
§ 15.1.3.1 Prove di sovrapressione (Metodo statico) / Overpressure test (Static method)	EN 60079-1:2007, IEC 60079-1:2007

Atmosfere esplosive - Parte 1: Apparecchiature protette mediante custodia a prova di esplosione 'd'

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 15.1.3.2 Prove di sovrapressione (Metodo dinamico) / Overpressure test (Dynamic method)	EN 60079-1:2007, IEC 60079-1:2007
§ 15.2 Prove di tenuta alla fiamma / Test for non-transmission of an internal ignition (Prove con Metano, Etilene Acetilene, Idrogeno. Test with Methane, Ethylene, acetylene, Hydrogen)	EN 60079-1:2007, IEC 60079-1:2007
§ 15.4.1 Prova di tenuta alla pressione della custodia / Tests of ability of the enclosure to withstand pressure (Prove con Metano, Etilene Acetilene, Idrogeno. Test with Methane, Ethylene, acetylene, Hydrogen)	EN 60079-1:2007, IEC 60079-1:2007

Atmosfere esplosive - Parte 7: Apparecchiature con modo di protezione a sicurezza aumentata 'e'

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 4.4 distanze di isolamento superficiali (limitatamente alla verifica dell'indice di resistenza alla traccia) / ceepage distances (only verify for comparative tracking index)	IEC 60079-7: 2006 / IEC 60079-7: 2007
§ 4.9 gradi di protezione delle custodie / degree of protection provided by enclosures	IEC 60079-7: 2006 / IEC 60079-7: 2007
§ 6.1 Prova di rigidità dielettrica / dielectric strength	IEC 60079-7: 2006 / IEC 60079-7: 2007

Atmosfere esplosive Parte 11: apparecchiature con modo di protezione a sicurezza intrinseca 'i'

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 10.2 prove di temperatura / temperatures	EN 60079-11: 2012, IEC 60079-11: 2011

Atmosfere esplosive Parte 15: apparecchiature con modo di protezione 'n'

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 22.13 Prove di innsesco per grandi macchine o macchine ad alta tensione / Ignition tests for large or high-voltage machines	EN 60079-15: 2010, IEC 60079-15: 2010
§ 22.6 Type tests on testricted -breatghing enclusures	EN 60079-15: 2010, IEC 60079-15: 2010

Atmosfere esplosive Parte 18: Protezione mediante incapsulamento 'm'

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 8.1.1 Prova assorbimento di acqua / water absorption test	EN 60079-15: 2010, IEC 60079-15: 2010
§ 8.2.4 Prova di rigidità dielettrica / Dielectich strengh test	EN 60079-15: 2010, IEC 60079-15: 2010

§ 8.2.5 Prova di trazione del cavo / Cable pull test	EN 60079-15: 2010, IEC 60079-15: 2010

Atmosfere esplosive Parte 2: apparecchiature con modo di protezione a sovrapressione 'p'

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 16.1 Prova di sovrapressione massima / Maximum overpressure test;	EN 60079-2: 2007, IEC 60079-2: 2007

Atmosfere esplosive Parte 31: apparecchi con modo di protezione mediante custodie 't' destinati ad essere utilizzati in presenza di polveri combustibili

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 16.2 Prove di tenuta Leakage test;	EN 60079-2: 2007, IEC 60079-2: 2007
§ 16.3 Prove di lavaggio / Purging test;	EN 60079-2: 2007, IEC 60079-2: 2007
§ 6.1.1.3 prova di pressione / pressure test	EN 60079-31: 2014, IEC 60079-31: 2013
§ 6.1.2 prove termiche / thermal test	EN 60079-31: 2014, IEC 60079-31: 2013

Batterie / Cells and Batteries

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 10.5 prove su batterie / Test for cells and batteries	EN 60079-11: 2012, IEC 60079-11: 2011

Custodie a prova di esplosione con dispositivi di respirazione e drenaggio

Denominazione della prova / Campi di prova	*Metodo di prova*
15.4.2 Thermal tests (Prove con Metano, Etilene Acetilene, Idrogeno. Test with Methane, Ethylene, acetylene, Hydrogen)	EN 60079-1:2007, IEC 60079-1:2007
15.4.3 / Prove di tenuta alla fiamma per i dispositivi di respirazione e drenaggio / Test for non-transmission of an internal ignition of breathing and ignition devices (Prove con Metano, Etilene Acetilene, Idrogeno. Test with Methane, Ethylene, acetylene, Hydrogen)	EN 60079-1:2007, IEC 60079-1:2007

Dispositivi ed unità riscaldanti a resistenza / resistance heating devices and resistance heating units

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 6.8.3 - Verifica isolamento elettrico / Electrical insulatiomn test	IEC 60079-7: 2006 / IEC 60079-7: 2007
§ 6.8.4 - Stabilità termica / Thermal stability test	IEC 60079-7: 2006 / IEC 60079-7: 2007
§ 6.8.6 - Prova corrente di avviamento a freddo/ Cold start current	IEC 60079-7: 2006 / IEC 60079-7: 2007

Flameproof cable glands, Ex blanking elememts, Ex thread adaprors

Denominazione della prova / Campi di prova	*Metodo di prova*
C.3.1 Sealing test	EN 60079-1:2007, IEC 60079-1:2007 - ANNEX C
C.3.2 Test of mechanical test strength	EN 60079-1:2007, IEC 60079-1:2007 - ANNEX C
C.3.3 Type test for Ex blanking elements	EN 60079-1:2007, IEC 60079-1:2007 - ANNEX C

C.3.4 Type test for Ex thread adapters	EN 60079-1:2007, IEC 60079-1:2007 - ANNEX C

Fusibili ad alta tensione - Fusibili limitatori di corrente,
High-voltage fuses - Current-limiting fuses

Denominazione della prova / Campi di prova	*Metodo di prova*
Breaking tests	CEI EN 60282-1: 2011, IEC 60282-1: 2009

Isolatori di materiale ceramico o di vetro per linee aeree con tensione nominale superiore a 1000 V,
Insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1000 V

Denominazione della prova / Campi di prova	*Metodo di prova*
Impulse voltage puncture test on insulators in air	CEI EN 61211: 2005, IEC 61211: 2004

atori passanti per tensioni alternate oltre 1000 V,
ulated bushings for alternating voltages above 1000 V

ominazione della prova / Campi di prova	*Metodo di prova*
Prova di tenuta a secco con tensione a impulso atmosferico (BIL), Dry lightning impulse voltage withstand test (BIL)	CEI EN 60137: 2009, IEC 60137: 2008
Prova di tenuta a secco o sotto pioggia con tensione a frequenza industriale, Dry or wet power-frequency voltage withstand test	CEI EN 60137: 2009, IEC 60137: 2008

Isolatori per linee aeree con tensione nominale superiore a 1000 V - Isolatori in materiale ceramico o in vetro per sistemi in corrente alternata,
Insulators for overhead lines with a nominal voltage above 1000 V - Ceramic or glass insulator units for a.c. systems

Denominazione della prova / Campi di prova	*Metodo di prova*
Prova di tenuta alla frequenza di esercizio sotto pioggia, Wet power-frequency voltage tests	CEI EN 60383-1: 1998, IEC 60383-1: 1993

Isolatori portanti per interno ed esterno di ceramica o di vetro, per impianti con tensione nominale superiore a 1000 V,
Indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V

Denominazione della prova / Campi di prova	*Metodo di prova*
Prova di tensione di tenuta a impulso di manovra sotto pioggia o a secco, Dry or wet switching-impulse withstand voltage tests	CEI EN 60168: 1996 / A1: 1998, IEC 60168: 2001
Prova di tenuta a frequenza di esercizio a secco, power-frequency withstand voltage test	CEI EN 60168: 1996 / A1: 1998, IEC 60168: 2001
ova di tenuta a frequenza di esercizio sotto pioggia, t power-frequency withstand voltage test	CEI EN 60168: 1996 / A1: 1998, IEC 60168: 2001
Prova di tenuta a impulso atmosferico a secco, Dry lightning-impulse withstand voltage test	CEI EN 60168: 1996 / A1: 1998, IEC 60168: 2001

Line traps for a.c. power systems

Denominazione della prova / Campi di prova	*Metodo di prova*
Short-time current tests	IEC 60353: 1989

Morsetti / Terminals

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 6.9 prove sui materiali isolanti (trazione) / insulating test (tensile test)	IEC 60079-7: 2006 / IEC 60079-7: 2007

Non-electrical equipment for use in potentially explosive atmospheres - Part 5: Protection by constructional safety 'c'

Denominazione della prova / Campi di prova	*Metodo di prova*
B.1 'Dry run' test for lubricated sealing arrangements	UNI EN 13463-5: 2011
B.2 Type test for determining the maximum engaging time of clutch assembly	UNI EN 13463-5: 2011
B.3 Conductivity criteria for trasmission belts	UNI EN 13463-5: 2011

Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification

Denominazione della prova / Campi di prova	*Metodo di prova*

DATO DI ORIGINALE

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Test for first characteristic numeral;	IEC 60034-5:2006
Test for second characteristic numeral (Only IPX3, IPX4, IPX5, IPX6, IPX8 and IPX9)	IEC 60034-5:2006

Scaricatori - Scaricatori a resistori non lineari con spinterometri per sistemi a corrente alternata,
Surge arresters - Non-linear resistor type gapped surge arresters for a.c. systems

Denominazione della prova / Campi di prova	*Metodo di prova*
Insulation withstand tests	CEI EN 60099-4: 2015, IEC 60099-4: 2014
Operating duty tests	CEI EN 60099-4: 2015, IEC 60099-4: 2014
Power-frequency voltage-versus-time test	CEI EN 60099-4: 2015, IEC 60099-4: 2014
ıidual voltage tests	CEI EN 60099-4: 2015, IEC 60099-4: 2014
Short-circuit tests	CEI EN 60099-4: 2015, IEC 60099-4: 2014
Test to verify the repetitive charge transfer rating, Qrs	CEI EN 60099-4: 2015, IEC 60099-4: 2014

Trasformatori / Transformers

Denominazione della prova / Campi di prova	*Metodo di prova*
§ 10.10 Prove su trasformatori / Transformer test	EN 60079-11: 2012, IEC 60079-11: 2011

Trasformatori di potenza - Capacità di tenuta al cortocircuito,
Power transformers - Ability to withstand short circuit

Denominazione della prova / Campi di prova	*Metodo di prova*
Capacità di resistenza al cortocircuito dal punto di vista dinamico, Ability to withstand the dynamic effects of short circuit	CEI EN 60076-5: 2007, IEC 60076-5: 2006

Trasformatori di potenza - Livelli di isolamento, prove dielettriche e distanze isolanti in aria,
Power transformers - Insulation levels, dielectric tests and external clearances in air

Denominazione della prova / Campi di prova	*Metodo di prova*
›va ad impulso atmosferico (LI), _ghtning impulse tests (LI)	CEI EN 60076-3: 2015, IEC 60076-3: 2013
Prova di tensione applicata (AV), Applied voltage test (AV)	CEI EN 60076-3: 2015, IEC 60076-3: 2013
Prove a tensione indotta (IVW), Induced voltage tests (IVW)	CEI EN 60076-3: 2015, IEC 60076-3: 2013

Trasformatori di potenza - Trasformatori di tipo a secco,
Power transformers - Dry-type transformers

Denominazione della prova / Campi di prova	*Metodo di prova*
Misura del livello di rumore, Measurement of sound level	CEI EN 60076-11: 2006, IEC 60076-11: 2004
Misura del rapporto di tensione e controllo dello spostamento angolare, Measurement of voltage ratio and check of phase displacement	CEI EN 60076-11: 2006, IEC 60076-11: 2004
Misura della resistenza degli avvolgimenti, Measurement of winding resistance	CEI EN 60076-11: 2006, IEC 60076-11: 2004
Misura della tensione di corto circuito e delle perdite a carico, Measurement of short-circuit impedance and load loss	CEI EN 60076-11: 2006, IEC 60076-11: 2004
Misura delle perdite e della corrente a vuoto, Measurement of no-load loss and current	CEI EN 60076-11: 2006, IEC 60076-11: 2004

ВЯРНО С ОРИГИНАЛА

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Prova ad impulso atmosferico, Lightning impulse test	CEI EN 60076-11: 2006, IEC 60076-11: 2004
Prova di cortocircuito, Short-circuit test	CEI EN 60076-11: 2006, IEC 60076-11: 2004
Prova di sovratemperatura, Temperature-rise test	CEI EN 60076-11: 2006, IEC 60076-11: 2004
Prova di tenuta a tensione applicata in c.a., Separate-source AC withstand voltage test	CEI EN 60076-11: 2006, IEC 60076-11: 2004
Prova di tenuta a tensione indotta in c.a., Induced AC withstand voltage test	CEI EN 60076-11: 2006, IEC 60076-11: 2004

Trasformatori di potenza,
Power transformers

ominazione della prova / Campi di prova	*Metodo di prova*
Determinazione dei livelli di rumore (Metodo per la misura della pressione stica), Determination of sound levels (Sound pressure method)	CEI EN 60076-10: 2002, IEC 60076-10: 2001
Misura del rapporto di trasformazione e verifica dello sfasamento, Measurement of voltage ratio and check of phase displacement	CEI EN 60076-1: 2015, IEC 60076-1: 2011
Misura dell'impedenza di cortocircuito e delle perdite dovute al carico, Measurement of short-circuit impedance and load loss	CEI EN 60076-1: 2015, IEC 60076-1: 2011
Misura della resistenza degli avvolgimenti, Measurement of winding resistance	CEI EN 60076-1: 2015, IEC 60076-1: 2011
Misura delle perdite e della corrente a vuoto, Measurement of no-load loss and current	CEI EN 60076-1: 2015, IEC 60076-1: 2011
Prove di riscaldamento, Temperature rise tests	CEI EN 60076-2: 2015, IEC 60076-2: 2011

Legenda

ACCREDIA
Il Direttore del Dipartimento
(*Dr.ssa Silvia Tramontin*)

ВЯРНО С ОРИГИНАЛА

WACKER SILICONES

ИЗПИТАТЕЛЕН ПРОТОКОЛ

Ускорено изпитване на атмосферни влияния на **POWERSIL® XLR® 630**
(Xenon- дъга изпитване съгласно ISO 4892-2 *)

*) тест, проведен в Wacker-Chemie AG през август 2012 г. Времето на цикъла е 120 минути с дъжд от 18 минути и 102 мин сухо лъчение. Черната стандартна температура на повърхността на пробите беше 65°C.

Свойства	Стандарт	Единици	Преди теста	След 3000 часа
Твърдост	DIN 53505	ShoreA	34	36
Издръжливост на опън	ISO 37	N/mm²	5,6	4,2
Устойчивост на разкъсване	ASTM D 624 B	N/mm	23	20
Удължаване	ISO 37	%	353	196
Съпротивление на дъгата	IEC 61621	S	380	375
Диелектрична константа	IEC 60250		2,7	2,7
Хидрофобност	STRI Class	HC	1	1

След продължителност на теста от 3000 часа не са наблюдавани повърхностни разгради като пукнатини и пов стъци.

Bur arch 2018

Dr echt

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WACKER SILICONES

TEST REPORT

Accelerated weathering test of POWERSIL® XLR® 630
(Xenon-arc test according ISO 4892-2 *)

*) test carried out at Wacker-Chemie AG in August 2012. The cycle time was 120min with 18min rain and 102min dry radiation. The black-standard-temperature on the surface of the samples was 65°C.

Property	Standard	Unit	Virgin	After 3000h
Hardness	DIN 53505	ShoreA	34	36
Tensile strength	ISO 37	N/mm²	5,6	4,2
Tear resistance	ASTM D 624 B	N/mm	23	20
Elongation	ISO 37	%	353	196
Arc resistance	IEC 61621	S	380	375
Dielectric Constant	IEC 60250		2,7	2,7
Hydrophobicity	STRI Class	HC	1	1

After 3000h of exposition no surface degradations such as cracks and raised areas have been observed.

March 2018

На основание чл. 2 от ЗЗЛД

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