П Р Е Д Л О Ж Е Н И Е

за участие в „открита" по вид процедура за сключване на рамково споразумение с предмет:
„Доставка на вентилни отводи средно напрежение (СрН)", реф. № PPD17-158

ДО: „ЧЕЗ РАЗПРЕДЕЛЕНИЕ БЪЛГАРИЯ" АД,

ОТ: „ЕМИ ЕЛЕКТРИК" ЕООД
(участник)
адрес: гр. Варна, ул. Сливница № 26
тел.: 052 / 803 528, факс: 052 / 801 955; e-mail: office@emielectric.bg
Единен идентификационен код: 204501480,
Представлявано от Алексей Николаевич Родин – Управител (*длъжност*)
Лице за контакти: Алексей Николаевич Родин, тел.: 052 / 803 528, факс: 052 / 801 955, e-mail: office@emielectric.bg

УВАЖАЕМИ ГОСПОЖИ И ГОСПОДА,
Предоставяме на Вашето внимание предложението ни за изпълнение на обществена поръчка с реф. №**PPD17-158** и предмет:**„Доставка на вентилни отводи средно напрежение (СрН)",**
1. Запознат съм и приемам изискванията на Възложителя, като представям техническите спецификации от раздел II на документацията за участие с попълнени всички изисквани стойности за всички позиции от предмета на поръчката и изискванията, описани в рамковото споразумение и приложенията към него.
2. Представям всички изисквани данни и документи, посочени в Приложение 2 от настоящото техническо предложение. Запознат съм с изискването, че представените документи трябва да бъдат на български език или с превод на български език, придружени с оригиналните документи, с изключение на протоколите от типовите изпитвания, които могат да се представят и само на английски език.
3. Запознат съм, че представените от нас технически документи (протоколи от изпитания, каталози и др.) са доказателство за декларираните от мен технически данни и параметри в техническите спецификации на стоката.
4. Потвърждавам, че представяните от нас стоки, описани в Техническото ни предложение, ще отговарят на посочените от Възложителя стандарти или на еквивалентни. В случай, че даден материал отговаря на стандарт, еквивалентен на посочения, се задължаваме да го отразим в отделен документ и да представим доказателства за еквивалентността на двата стандарта.
5. Всички стойности, попълнени в колона **„Гарантирано предложение"** на приложените таблици от Технически спецификации от раздел II от документацията за участие, са точни и истински.
6. Предлагам следният гаранционен срок за предлаганите стоки – 24 месеца */ не по-малко от 24 месеца /*, от датата на приемо - предавателен протокол за получаване на стоката от Възложителя.
7. Запознат съм, че видовете стоки и прогнозните количества за доставка ще бъдат посочени от Възложителя при провеждане на вътрешен конкурентен избор.
8. Приемам количества със срокове за доставка на стоката, съгласно Приложение 3 към настоящото Техническо предложение.
9. Приемам, че в срок до 14 *(не повече от 14 дни)* от датата на подписване на рамково споразумение с Възложителя, ще сключа договор с посочения/те в офертата подизпълнител/и (*попълва се, ако участникът е декларирал, че ще използва подизпълнител/и*).
10. Запознат съм, че при последваща обществена поръчка чрез вътрешен конкурентен избор за сключване на конкретен договор, изборът на изпълнител при определяне на икономически най-изгодната оферта ще бъде направен по критерий „най-ниска цена".
11. Запознат съм, че максималният срок за изпълнение на конкретен договор ще бъде определен от Възложителя в поканата за участие при последващата обществена поръчка чрез вътрешен конкурентен избор.

Приложения към настоящото техническо предложение:

1. *Технически изисквания и спецификации за изпълнение на поръчката – раздел IV от документацията за участие – попълнени на съответните места;*
2. *Изисквани документи от Технически изисквания и спецификации;*
3. *Срокове за доставка.*

на основание чл. 2 от ЗЗЛД

Дата 20.03.2018 г.

ПОДПИС и ПЕЧАТ:

Алексей Родин
Управител
(длъжност на представляващия участника

II. ТЕХНИЧЕСКИ СПЕЦИФИКАЦИИ И ИЗИСКВАНИЯ НА ВЪЗЛОЖИТЕЛЯ ЗА ИЗПЪЛНЕНИЕ НА ПОРЪЧКАТА

Наименование на материала: Вентилен отвод метало-оксиден тип без искрови разрядници, 10 kV, 10 kA, клас 2

Съкратено наименование на материала (40 знака): Вентилен отвод ZnO, 10 kV / 10 кА / клас 2

Област: В – Въздушни електропроводни линии СрН
Н – Трансформаторни постове

Категория: 20 – Защита от пренапрежения

Мерна единица: Брой

Аварийни запаси: Да

Характеристика на материала:

Метало-оксиден (ZnO) вентилен отвод без искрови разрядници, за монтиране на закрито и открито, с трайно работно напрежение min 10,8 kV, с номинален разряден ток 10 kA, с разряден клас на линията 2, с полимерна изолационната обвивка, с принадлежности (аксесоари) за свързване между тоководещи части и земя. Конфигурацията на стрехите на полимерната изолационна обвивка съответстват на изискванията на IEC/TS 60815-3.

Използване:

Вентилният отвод е предназначен за използване в електроразпределителни мрежи с номинално напрежение 10 kV с изолирана неутрала, със заземена през дъгогасителна бобина неутрала, със заземена през активно съпротивление неутрала или с комбинирано заземяване на неутралата през дъгогасителна бобина и активно съпротивление.

Съответствие на предлаганото изделие със стандартизационните документи:

Вентилният отвод трябва да отговаря на приложимите български и международни стандарти, включително на посочените по-долу и на техните валидни изменения и поправки или еквиваленти:

- БДС EN 60099-4:2014 „Вентилни отводи. Част 4: Металооксидни вентилни отводи без разрядници за електрически системи за променливо напрежение (IEC 60099-4:2014)"; и
- IEC/TS 60815-3:2008 „Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems".

Изисквания към документацията и изпитванията:

№ по ред	Наименование	Приложение № (или текст)
1.	Точно обозначение на типа, производителя и страна на произход	**РА-DH-103-14-22/22 Русия**
2.	Техническо описание, гарантирани параметри, волт-секундна характеристика, използвани материали и принадлежности (аксесоари)	**Приложение 1 Каталог**
3.	Чертежи с размери и надлъжен разрез	**Приложение 1 Каталог**
4.	Протоколи от типови изпитвания на английски или български език, проведени от независима изпитвателна лаборатория – заверени копия, с приложен списък на отделните изпитвания на български език	**Приложение 2**
5.	Сертификат/акредитация на независимата изпитвателна лаборатория, провела типовите изпитвания по т. 4 – заверено копие	**Приложение 3**
6.	Изисквания за транспортиране и манипулиране	**Приложение 4**
7.	Инструкции за монтиране и за експлоатация и обслужване	**Приложение 4**
8.	Експлоатационна дълготрайност, год.	**30**

Забележка: Всички оригинални документи трябва да бъдат на български език или с превод на български език. Каталозите и изпитвателните протоколи могат да бъдат и само на английски език.

Технически данни:

1. Характеристики на работната среда

№ по ред	Характеристика	Стойност
1.1	Място на монтиране	На открито/закрито
1.2	Максимална околна температура	+ 40°C
1.3	Минимална околна температура	Минус 25°C
1.4	Относителна влажност	До 100 %
1.5	Надморска височина	До 1000 m
1.6	Други работни условия	Съгласно т. 5.4.1 от БДС EN 60099-4

2. Параметри на електроразпределителната мрежа

№ по ред	Параметър	Стойност
2.1	Номинално напрежение	10 000 V
2.2	Най-високо напрежение на съоръженията	12 000 V
2.3	Най-високо напрежение на системата	10 800 V
2.4	Номинална честота	50 Hz
2.5	Брой на фазите	3
2.6	Заземяване на звездния център	• През дъгогасителна бобина; • изолиран звезден център; • през активно съпротивление; или • през дъгогасителна бобина комбинирана с активно съпротивление.
2.7	Максимална стойност на временните пренапрежения (при земно съединение) / максимална продължителност на временните пренапрежения:	-
2.7a	заземяване през дъгогасителна бобина; или изолиран звезден център	11,8 kV/2 часа
2.7b	заземяване през активно съпротивление; или през дъгогасителна бобина комбинирана с активно съпротивление	10,8 kV/3 s
2.8	Изолационно ниво:	-
2.8a	Обявено издържано мълниево импулсно напрежение (върхова стойност)	75 kV
2.8b	Обявено краткотрайно (1 min) издържано напрежение с промишлена честота (50 Hz) (ефективна стойност)	28 kV
2.9	Ток на късо съединение в мястото на монтиране на вентилния отвод - максимален ток при трифазно късо съединение	15 kA

3. Свързване в системата и защитавани съоръжения

№ по ред	Наименование	Изискване
3.1	Свързване в системата	Между фаза и земя

3.2	Защитавани съоръжения	• Разпределителни трансформатори 10/0,4 kV, свързани директно към въздушна електропроводна линия (ВЛ) или чрез присъединена към ВЛ кабелна линия; • кабелни линии 10 kV; • входове на разпределителните уредби; • КРУ в елегазова изолационна среда (GIS)

4. Технически характеристики

№ по ред	Характеристика	Изискване	Гарантирано предложение
4.1	Обявено издържано напрежение при атмосферни пренапрежения 1,2/50 μs	min 75 kV	90 kV
4.2	Обявено издържано 1 min напрежение с промишлена честота 50 Hz при мокра изолация	min 28 kV	40 kV
4.3	Ниво на частичните разряди при 1,05 U_c	max 10 pC	10 pC
4.4	Материал, от който е изработено нелинейното съпротивление (варистора)	ZnO	ZnO
4.5	Материал, от който е изработена изолационната обвивка	Полимер	Полимер
4.6	Материал, от който са изработени принадлежностите (аксесоарите)	Неръждаема стомана	Неръждаема стомана
4.7	Якост на опън	min 1 kN	12 kN
4.8	Якост на усукване	min 50 Nm	50 Nm
4.9	Якост на огъване	min 200 Nm	200 Nm

5. Принадлежности (аксесоари)

№ по ред	Наименование	Изискване	Гарантирано предложение
5.1	Аксесоари за присъединяване на вентилния отвод към тоководещи части и към заземителния контур	Резбови съединения (шпилки) с резба М12, съоръжени съответно с две гайки и две подложни шайби и средства срещу самоотвиване	Резбови съединения (шпилки) с резба М12, съоръжени съответно с две гайки и две подложни шайби и средства срещу самоотвиване
5.2	Възможност на резбовите съединения за присъединяване на две кабелни обувки	Да	Да

6. Технически параметри

№ по ред	Параметър	Изискване	Гарантирано предложение
6.1	Трайно работно напрежение, U_c	min 10,8 kV	11,2 kV
6.2	Обявено напрежение, U_r	min 13,5 kV	14 kV
6.3	Номинален разряден ток, I_n (8/20 μs)	10 kA	10 kA
6.4	Силнотоков импулс (4/10 μs)	100 kA	100 kA
6.5	Разряден клас на линията	2	2
6.6	Устойчивост на ток на късо съединение	min 20 kA/0,2 s	20 kA/0,2 s
6.7	Остатъчно напрежение при номинален разряден ток I_n, U_{res}	max 42 kV	34,7 kV

6.8	Устойчивост на продължителен токов импулс	min 250 A/2000 μs	450 A
6.9	Стойност на временните пренапрежения съгласно приложение D на БДС EN 60099-4:	-	-
6.9a	с продължителност 3 s	min 14 kV	14,3 kV
6.9b	с продължителност 100 s	min 13 kV	13,3 kV
6.9c	с продължителност 7200 s	min 11,8 kV	12,2 kV
6.10	Изолационно разстояние по повърхността	min 370 mm	443 mm
6.11	Височина без аксесоарите за присъединяване	max 350 mm	180 mm
6.12	Тегло, kg	Да се посочи	2,2 kg

Наименование на материала: Вентилен отвод метало-оксиден тип без искрови разрядници, 20 kV, 10 kA, клас 1

Съкратено наименование на материала: Вентилен отвод ZnO, 20 kV / 10 кА / клас 1

Област: В – Въздушни електропроводни линии СрН
Н – Трансформаторни постове

Категория: 20 – Защита от пренапрежения

Мерна единица: Брой

Аварийни запаси: Да

Характеристика на материала:

Метало-оксиден (ZnO) вентилен отвод без искрови разрядници, за монтиране на закрито и открито, с трайно работно напрежение min 21,6 kV, с номинален разряден ток 10 kA, с разряден клас на линията 1, с полимерна изолационната обвивка, с принадлежности (аксесоари) за свързване между тоководещи части и земя. Конфигурацията на стрехите на полимерната изолационна обвивка съответстват на изискванията на IEC/TS 60815-3.

Използване:

Вентилният отвод е предназначен за използване в електроразпределителни мрежи с номинално напрежение 10 kV с изолирана неутрала, със заземена през дъгогасителна бобина неутрала, със заземена през активно съпротивление неутрала или с комбинирано заземяване на неутралата през дъгогасителна бобина и активно съпротивление в райони с интензивност на мълниеносната дейност до 100 часа годишно.

Съответствие на предлаганото изделие със стандартизационните документи:

Вентилният отвод трябва да отговаря на приложимите български и международни стандарти, включително на посочените по-долу и на техните валидни изменения и поправки или еквиваленти:

- БДС EN 60099-4:2014 „Вентилни отводи. Част 4: Металооксидни вентилни отводи без разрядници за електрически системи за променливо напрежение (IEC 60099-4:2014)"; и
- IEC/TS 60815-3:2008 „Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems".

Изисквания към документацията и изпитванията:

№ по ред	**Наименование**	**Приложение № (или текст)**
1.	Точно обозначение на типа, производителя и страна на произход	**РА-DM-093-27-22/22 Русия**
2.	Техническо описание, гарантирани параметри, волт-секундна характеристика, използвани материали и принадлежности (аксесоари)	**Приложение 1 Каталог**
3.	Чертежи с размери и надлъжен разрез	**Приложение 1 Каталог**

№ по ред	Наименование	Приложение № (или текст)
4.	Протоколи от типови изпитвания на английски или български език, проведени от независима изпитвателна лаборатория – заверени копия, с приложен списък на отделните изпитвания на български език	**Приложение 5**
5.	Сертификат/акредитация на независимата изпитвателна лаборатория, провела типовите изпитвания по т. 4 – заверено копие	**Приложение 3**
6.	Изисквания за транспортиране и манипулиране	**Приложение 6**
7.	Инструкции за монтиране и за експлоатация и обслужване	**Приложение 6**
8.	Експлоатационна дълготрайност, год.	**30 години**

Забележка: Всички оригинални документи трябва да бъдат на български език или с превод на български език. Каталозите и изпитвателните протоколи могат да бъдат и само на английски език.

Технически данни:

1. Характеристики на работната среда

№ по ред	Характеристика	Стойност
1.1	Място на монтиране	На открито/закрито
1.2	Максимална околна температура	+ 40°C
1.3	Минимална околна температура	Минус 25°C
1.4	Относителна влажност	До 100 %
1.5	Надморска височина	До 1000 m
1.6	Интензивност на мълниеносната дейност	До 100 часа годишно
1.7	Други работни условия	Съгласно т. 5.4.1 от БДС EN 60099-4

2. Параметри на електроразпределителната мрежа

№ по ред	Параметър	Стойност
2.1	Номинално напрежение	20 000 V
2.2	Най-високо напрежение на съоръженията	24 000 V
2.3	Най-високо напрежение на системата	21 600 V
2.4	Номинална честота	50 Hz
2.5	Брой на фазите	3
2.6	Заземяване на звездния център	• През дъгогасителна бобина; • изолиран звезден център; • през активно съпротивление; или • през дъгогасителна бобина комбинирана с активно съпротивление.
2.7	Максимална стойност на временните пренапрежения (при земно съединение) / максимална продължителност на временните пренапрежения:	-
2.7a	заземяване през дъгогасителна бобина; или изолиран звезден център	23,7 kV/2 часа

№ по ред	Параметър	Стойност
2.7b	заземяване през активно съпротивление; или през дъгогасителна бобина комбинирана с активно съпротивление	21,6 kV/3 s
2.8	Изолационно ниво:	-
2.8a	Обявено издържано мълниево импулсно напрежение (върхова стойност)	125 kV
2.8b	Обявено краткотрайно (1 min) издържано напрежение с промишлена честота (50 Hz) (ефективна стойност)	50 kV
2.9	Ток на късо съединение в мястото на монтиране на вентилния отвод - максимален ток при трифазно късо съединение	15 kA

3. Свързване в системата и защитавани съоръжения

№ по ред	Наименование	Изискване
3.1	Свързване в системата	Между фаза и земя
3.2	Защитавани съоръжения	• Разпределителни трансформатори 20/0,4 kV, свързани директно към въздушна електропроводна линия (ВЛ) или чрез присъединена към ВЛ кабелна линия; • кабелни линии 20 kV; • входове на разпределителните уредби; • КРУ в елегазова изолационна среда (GIS)

4. Технически характеристики

№ по ред	Характеристика	Изискване	Гарантирано предложение
4.1	Обявено издържано напрежение при атмосферни пренапрежения 1,2/50 μs	min 125 kV	144 kV
4.2	Обявено издържано 1 min напрежение с промишлена честота 50 Hz при мокра изолация	min 50 kV	90 kV
4.3	Ниво на частичните разряди при 1,05 U_c	max 10 pC	10 pC
4.4	Материал, от който е изработено нелинейното съпротивление (варистора)	ZnO	ZnO
4.5	Материал, от който е изработена изолационната обвивка	Полимер	Полимер
4.6	Материал, от който са изработени принадлежностите (аксесоарите)	Неръждаема стомана	Неръждаема стомана
4.7	Якост на опън	min 1 kN	6 kN
4.8	Якост на усукване	min 50 Nm	50 Nm
4.9	Якост на огъване	min 200 Nm	200 Nm

5. Принадлежности (аксесоари)

№ по ред	Наименование	Изискване	Гарантирано предложение
5.1	Аксесоари за присъединяване на вентилния отвод към тоководещи части и към заземителния контур	Резбови съединения (шпилки) с резба M12, съоръжени съответно с две гайки и две подложни шайби и средства срещу самоотвиване	Резбови съединения (шпилки) с резба M12, съоръжени съответно с две гайки и две подложни шайби и средства срещу самоотвиване
5.2	Възможност на резбовите съединения за присъединяване на две кабелни обувки	Да	Да

6. Технически параметри

№ по ред	Параметър	Изискване	Гарантирано предложение
6.1	Трайно работно напрежение, U_C	min 21,6 kV	21,6 kV
6.2	Обявено напрежение, U_r	min 27 kV	27 kV
6.3	Номинален разряден ток, I_n (8/20 μs)	10 kA	10 kA
6.4	Силнотоков импулс (4/10 μs)	100 kA	100 kA
6.5	Разряден клас на линията	1	1
6.6	Устойчивост на ток на късо съединение	min 20 kA/0,2 s	20 kA/0,2 s
6.7	Остатъчно напрежение при номинален разряден ток I_n, U_{res}	max 80 kV	69,1 kV
6.8	Устойчивост на продължителен токов импулс	min 250 A/2000 μs	300 A
6.9	Стойност на временните пренапрежения съгласно приложение D на БДС EN 60099-4:	-	-
6.9a	с продължителност 3 s	min 28 kV	28 kV
6.9b	с продължителност 100 s	min 25 kV	26 kV
6.9c	с продължителност 7200 s	min 23,7 kV	24 kV
6.10	Изолационно разстояние по повърхността	min 540 mm	938 mm
6.11	Височина без аксесоарите за присъединяване	max 350 mm	275 mm
6.12	Тегло, kg	Да се посочи	2.8 kg

Наименование на материала: Вентилен отвод метало-оксиден тип без искрови разрядници, 20 kV, 10 kA, клас 2

Съкратено наименование на материала: Вентилен отвод ZnO, 20 kV / 10 kA / клас 2

Област: В – Въздушни електропроводни линии СрН
Н – Трансформаторни постове

Категория: 20 – Защита от пренапрежения

Мерна единица: Брой

Аварийни запаси: Да

Характеристика на материала:

Метало-оксиден (ZnO) вентилен отвод без искрови разрядници, за монтиране на закрито и открито, с трайно работно напрежение min 21,6 kV, с номинален разряден ток 10 kA, с разряден клас на линията 2, с полимерна изолационната обвивка, с принадлежности (аксесоари) за свързване между тоководещи части и земя. Конфигурацията на стрехите на полимерната изолационна обвивка съответстват на изискванията на IEC/TS 60815-3.

Използване:

Вентилният отвод е предназначен за използване в електроразпределителни мрежи с номинално напрежение 20 kV с изолирана неутрала, със заземена през дъгогасителна бобина неутрала, със

заземена през активно съпротивление неутрала или с комбинирано заземяване на неутралата през дъгогасителна бобина и активно съпротивление в райони с интензивност на мълниеносната дейност над 100 часа годишно или с преобладаващ брой потребители с повишени изисквания за осигуреност на електроснабдяването.

Съответствие на предлаганото изделие със стандартизационните документи:

Вентилният отвод трябва да отговаря на приложимите български и международни стандарти, включително на посочените по-долу и на техните валидни изменения и поправки или еквиваленти:

- БДС EN 60099-4:2014 „Вентилни отводи. Част 4: Металооксидни вентилни отводи без разрядници за електрически системи за променливо напрежение (IEC 60099-4:2014) "; и
- IEC/TS 60815-3:2008 „Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems".

Изисквания към документацията и изпитванията:

№ по ред	Наименование	Приложение № (или текст)
1.	Точно обозначение на типа, производителя и страна на произход	**PA-DH-204-27-22/22 Русия**
2.	Техническо описание, гарантирани параметри, волт-секундна характеристика, използвани материали и принадлежности (аксесоари)	**Приложение 1 Каталог**
3.	Чертежи с размери и надлъжен разрез	**Приложение 1 Каталог**
4.	Протоколи от типови изпитвания на английски или български език, проведени от независима изпитвателна лаборатория – заверени копия, с приложен списък на отделните изпитвания на български език	**Приложение 7**
5.	Сертификат/акредитация на независимата изпитвателна лаборатория, провела типовите изпитвания по т. 4 – заверено копие	**Приложение 3**
6.	Изисквания за транспортиране и манипулиране	**Приложение 8**
7.	Инструкции за монтиране и за експлоатация и обслужване	**Приложение 8**
8.	Експлоатационна дълготрайност, год.	**30 години**

Забележка: Всички оригинални документи трябва да бъдат на български език или с превод на български език. Каталозите и изпитвателните протоколи могат да бъдат и само на английски език.

Технически данни:

1. Характеристики на работната среда

№ по ред	Характеристика	Стойност
1.1	Място на монтиране	На открито/закрито
1.2	Максимална околна температура	+ 40°C
1.3	Минимална околна температура	Минус 25°C
1.4	Относителна влажност	До 100 %
1.5	Надморска височина	До 1000 m
1.6	Интензивност на мълниеносната дейност	Над 100 часа годишно
1.7	Други работни условия	Съгласно т. 5.4.1 от БДС EN 60099-4

2. Параметри на електроразпределителната мрежа

№ по ред	Параметър	Стойност
2.1	Номинално напрежение	20 000 V

№ по ред	Параметър	Стойност
2.2	Най-високо напрежение на съоръженията	24 000 V
2.3	Най-високо напрежение на системата	21 600 V
2.4	Номинална честота	50 Hz
2.5	Брой на фазите	3
2.6	Заземяване на звездния център	• През дъгогасителна бобина; • изолиран звезден център; • през активно съпротивление; или • през дъгогасителна бобина комбинирана с активно съпротивление.
2.7	Максимална стойност на временните пренапрежения (при земно съединение) / максимална продължителност на временните пренапрежения:	-
2.7a	заземяване през дъгогасителна бобина; или изолиран звезден център	23,7 kV/2 часа
2.7b	заземяване през активно съпротивление; или през дъгогасителна бобина комбинирана с активно съпротивление	21,6 kV/3 s
2.8	Изолационно ниво:	-
2.8a	Обявено издържано мълниево импулсно напрежение (върхова стойност)	125 kV
2.8b	Обявено краткотрайно (1 min) издържано напрежение с промишлена честота (50 Hz) (ефективна стойност)	50 kV
2.9	Ток на късо съединение в мястото на монтиране на вентилния отвод - максимален ток при трифазно късо съединение	15 kA

3. Свързване в системата и защитавани съоръжения

№ по ред	Наименование	Изискване
3.1	Свързване в системата	Между фаза и земя
3.2	Защитавани съоръжения	• Разпределителни трансформатори 20/0,4 kV, свързани директно към въздушна електропроводна линия (ВЛ) или чрез присъединена към ВЛ кабелна линия; • кабелни линии 20 kV; • входове на разпределителните уредби; • КРУ в елегазова изолационна среда (GIS)

4. Технически характеристики

№ по ред	Характеристика	Изискване	Гарантирано предложение
4.1	Обявено издържано напрежение при атмосферни пренапрежения 1,2/50 μs	min 125 kV	150 kV
4.2	Обявено издържано 1 min напрежение с промишлена честота 50 Hz при мокра изолация	min 50 kV	50 kV
4.3	Ниво на частичните разряди при 1,05 U_c	max 10 pC	max 10 pC
4.4	Материал, от който е изработено нелинейното съпротивление (варистор)	ZnO	ZnO

4.5	Материал, от който е изработена изолационната обвивка	Полимер	Полимер
4.6	Материал, от който са изработени принадлежностите (аксесоарите)	Неръждаема стомана	Неръждаема стомана
4.7	Якост на опън	min 1 kN	12 kN
4.8	Якост на усукване	min 50 Nm	50 Nm
4.9	Якост на огъване	min 200 Nm	200 Nm

5. Принадлежности (аксесоари)

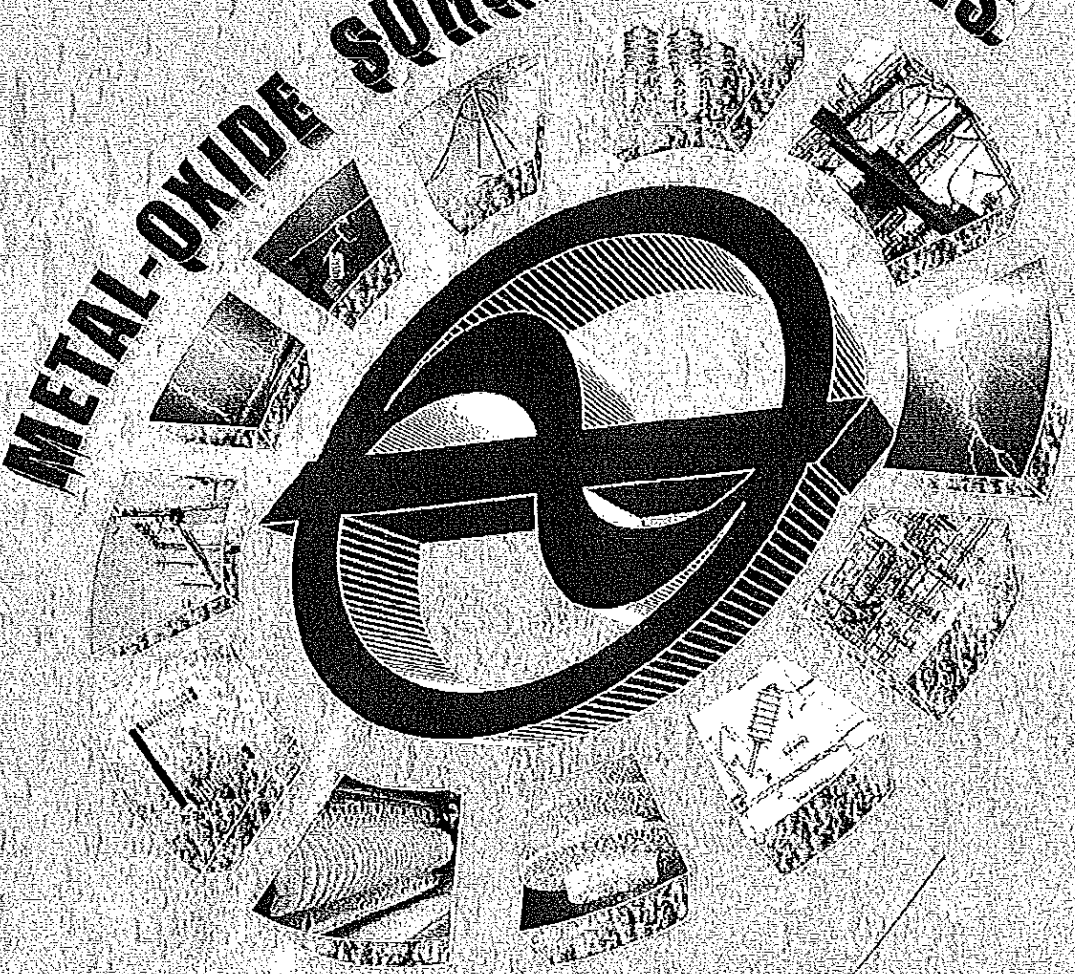
№ по ред	Наименование	Изискване	Гарантирано предложение
5.1	Аксесоари за присъединяване на вентилния отвод към тоководещи части и към заземителния контур	Резбови съединения (шпилки) с резба М12, съоръжени съответно с две гайки и две подложни шайби и средства срещу самоотвиване	Резбови съединения (шпилки) с резба М12, съоръжени съответно с две гайки и две подложни шайби и средства срещу самоотвиване
5.2	Възможност на резбовите съединения за присъединяване на две кабелни обувки	Да	

6. Технически параметри

№ по ред	Параметър	Изискване	Гарантирано предложение
6.1	Трайно работно напрежение, U_c	min 21,6 kV	21,6 kV
6.2	Обявено напрежение, U_r	min 27 kV	27 kV
6.3	Номинален разряден ток, I_n (8/20 μs)	10 kA	10 kA
6.4	Силнотоков импулс (4/10 μs)	100 kA	100 kA
6.5	Разряден клас на линията	2	2
6.6	Устойчивост на ток на късо съединение	min 20 kA/0,2 s	20 kA/0,2 s
6.7	Остатъчно напрежение при номинален разряден ток I_n, U_{res}	max 75 kV	67 kV
6.8	Устойчивост на продължителен токов импулс	min 250 A/2000 μs	450A
6.9	Стойност на временните пренапрежения съгласно приложение D на БДС EN 60099-4:	-	-
6.9a	с продължителност 3 s	min 28 kV	28 kV
6.9b	с продължителност 100 s	min 26 kV	26 kV
6.9c	с продължителност 7200 s	min 23,7 kV	24 kV
6.10	Изолационно разстояние по повърхността	min 540 mm	807 mm
6.11	Височина без аксесоарите за присъединяване	max 425 mm	290 mm
6.12	Тегло, kg	Да се посочи	3,5 kg

Приложение 1

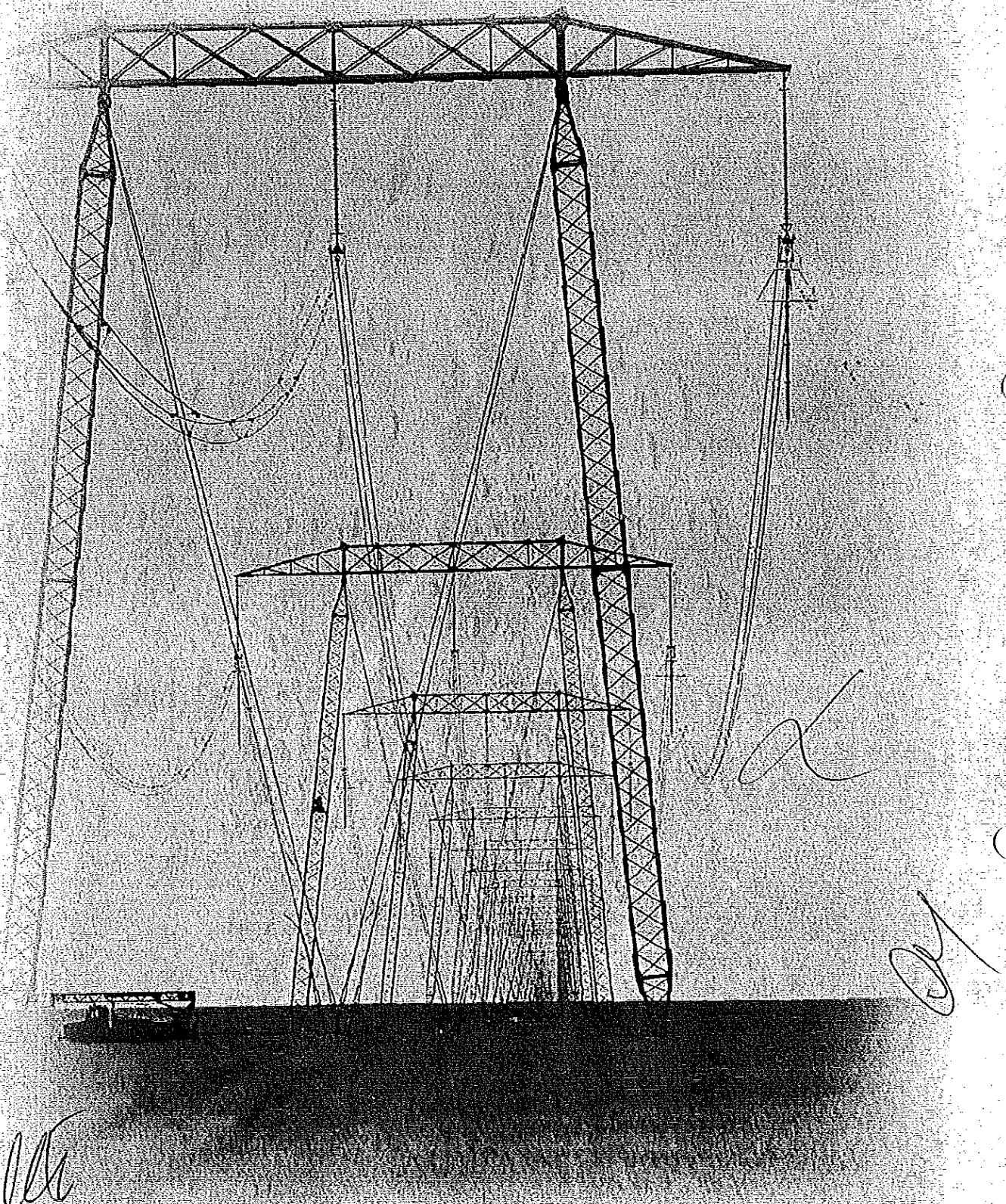
METAL-OXIDE SURGE ARRESTERS



CATALOGUE

JSC «POLYMER-APPARAT»

ВЯРНО С ОРИГИНАЛА



ВЯРНО С
ОРИГИНАЛА

"ЕМИ ЕЛЕКТРИК" ЕООД

CONTENTS

ABOUT THE COMPANY

During operational process, not only the operating voltage of industrial frequency, but also all kinds of overvoltage affect the isolation of all electrical appliances. Overvoltage can be caused by switching of power grids or under the influence of lightning currents. Repeated exposure to surge can lead to rupture or closure of isolation, as well as gradual aging of isolation and premature failure of equipment. Lightning surges repeatedly exceed permissible voltage and may damage the isolation of new equipment, even with a single exposure. Limiting surge reduces the costs of transmission and distribution of electric energy. In order to limit surge level protective devices like metal-oxide surge arresters without gaps (MOSA) are used.

Modern surge arresters are the most effective means of protection against overvoltage. Surge arrester is a column highly non-linear resistors (varistors), enclosed in a sealed housing.

Surge arresters should be installed in all distribution facilities for the protection of expensive equipment - the power and measuring transformers, electric machines, etc. Sometimes nonlinear surge arresters are installed on towers or wires of overhead power lines to protect the isolation from lightning surges. The need for their use is dictated by the increasing demands on the quality of transmitted energy, reduction in number of disconnections of overhead lines and interruption in electricity supply.

Depending on the number and position of devices application of surge arresters on overhead lines allows you to:

- ensure uninterrupted power supply to consumer under any lightning effect on overhead lines;
- significantly reduce the number of trips throughout the overhead lines during protection of areas prone to lightning strikes (areas of overhead lines in the rocky soil, high intermediate flies over water reservoir, sections of overhead lines with weak isolation);
- abandon lightning protector line, where its use is not practical (glaze-ice and coastal marine areas).

The main products of scientific- production association «Polymer-Apparat» are metal-oxide surge arresters without gaps in polymeric isolation. Majority of engineering personnel of SPA «Polymer-Instrument» were involved in research and production of MOSA at the high-voltage engineering department of Saint-Petersburg State Polytechnical University in early 80-ies of past century.

Company «Polymer-Apparat» is constantly developing using the most modern technology in the production of MOSA. Currently, «Polymer-Apparat» produces surge arresters of any voltage class from 220 V to 750 kV. The scientific-production association «Polymer-Apparat» can offer protective devices of different designs: traditional tower structures, suspended design, for outdoor and indoor applications, for operation in conditions of polluted atmosphere, as well as in coastal marine regions. Surge arresters can be equipped with a diagnosis system that could allow monitoring the device state without disconnecting it from the network. Company «Polymer-Apparat» can also offer solutions for installation of surge arresters on any overhead lines of any voltage class taking features of protected objects and their operational conditions into consideration while manufacturing arresters. Our arresters are installed in all regions of Russia, Baltic countries, Ukraine, Kazakhstan, Belarus. Our surge arresters have been used to ensure uninterrupted power supply to Olympic facilities in Sochi. Also we have experience in supplying our products to Europe, South America, Asia and Africa.

ВЕРНО С ОРИГИНАЛОМ

1. LOW-VOLTAGE ARRESTERS – LVA TYPE

- Specification IEC 61643-1:2005
- Low-voltage surge protective devices - class II tests.
- Nominal discharge current - 10 кА.
- Nominal discharge current - 10 кА.
- Maximal discharge current - 40 кА.
- Long Duration Current Impulse, 300 A

Characteristics are presented in the Tables 1.
Options are presented in the Tables 2.

Product Marking System

Example of arresters title: PA - LVA - 280 - ...

- Manufacturer's trademark – "Polymer-Apparat";
- Low-voltage arrester;
- Continuous voltage of arrester (MCOV), V;
- Options.

Table 1

Product number	MCOV, V	Specific energy, kJ	Residual voltage 8/20 μs, kV, no more than		
			5 kA	10 kA	20 kA
PA-LVA-280	280	0.75	0.8	0.95	1.2
PA-LVA-440	440	1.10	1.2	1.45	1.75
PA-LVA-500	500	1.25	1.35	1.65	2.00
PA-LVA-660	660	1.65	1.75	2.10	2.55

Table 2

Options:	Integrated disconnector	Adapter & insulation piercing connector	Bracket for transformer bushing	Figure number
PA-LVA-(MCOV)	-	-	-	1
PA-LVA-(MCOV)-O	+	-	-	1
PA-LVA-(MCOV)-C	+	+	-	2
PA-LVA-(MCOV)-T	+	-	+	3

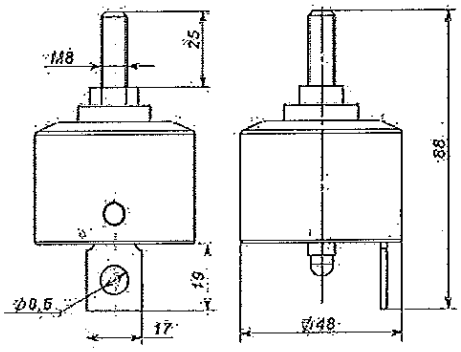
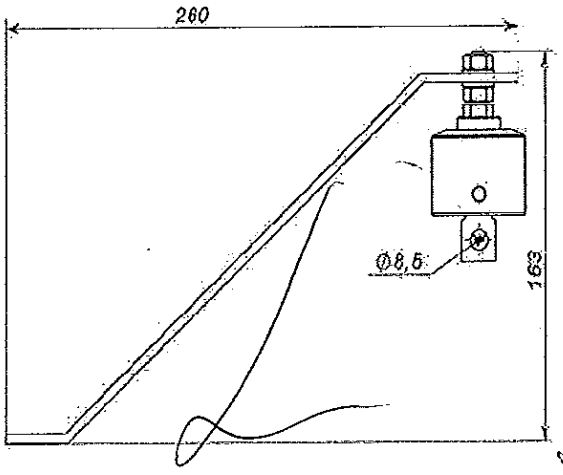
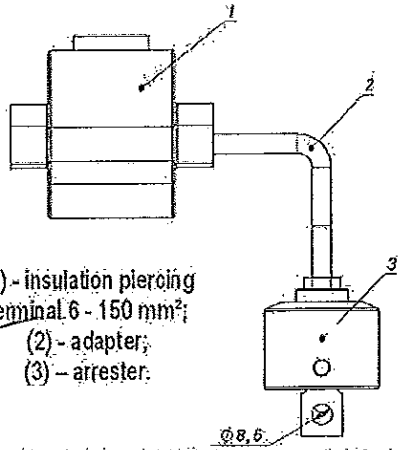


Fig. 1 PA-LVA-(MCOV)





(1) - insulation piercing terminal 6 - 150 mm²;
(2) - adapter;
(3) – arrester.

Fig. 2 Arresters for installation on insulated conductors

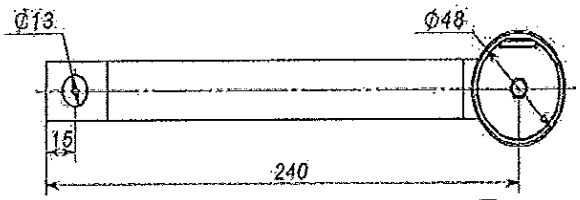


Fig. 3 Arresters for installation on the transformer bushings

2. METAL-OXIDE SURGE ARRESTERS FOR DISTRIBUTION SYSTEMS.

2.1 PA-DM type

Specification IEC 60099-4:2014 Metal-oxide surge arresters without gaps for a.c. systems.

Arrester classification – Distribution Medium.
The main parameters and characteristics:
- Rated voltage – from 3 to 54 kV;
- Continuous voltage of arrester (MCOV) – from 2,4 to 43,2 kV (rms);
- Nominal discharge current – 10000 A;
- High current impulse 4/10μs - 100 kA;
- Long Duration Current Impulse – 300 A;
- Repetitive Charge Transfer Rating Qrs – 0,5 C
- Specific energy (two impulse 2000 μs) – 2,3 kJ/kV (Ur);
- Thermal Charge Transfer Rating Qth – 1,1 C.

Operability of arresters is ensured under the following operating conditions:
- Outdoor and indoor;
- Lower operating value of ambient temperature is -60°C;
- Upper operating value of ambient temperature is +50° C;
- Altitude above sea level is up to 1000 m.

TOV characteristics (relative to the Rated voltage) are presented in the Fig 5. below:

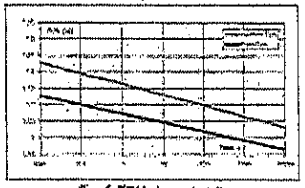


Fig. 5 TOV-characteristics

Arresters are explosion-proof and withstand the following short-circuit currents without exploding:
- 20 kA (rms) during 0,2 c (no less than);
- 600 A (rms) during 2 c (no less than).

The arresters insulation is tracking-erosion stable and resistant to moisture penetration.

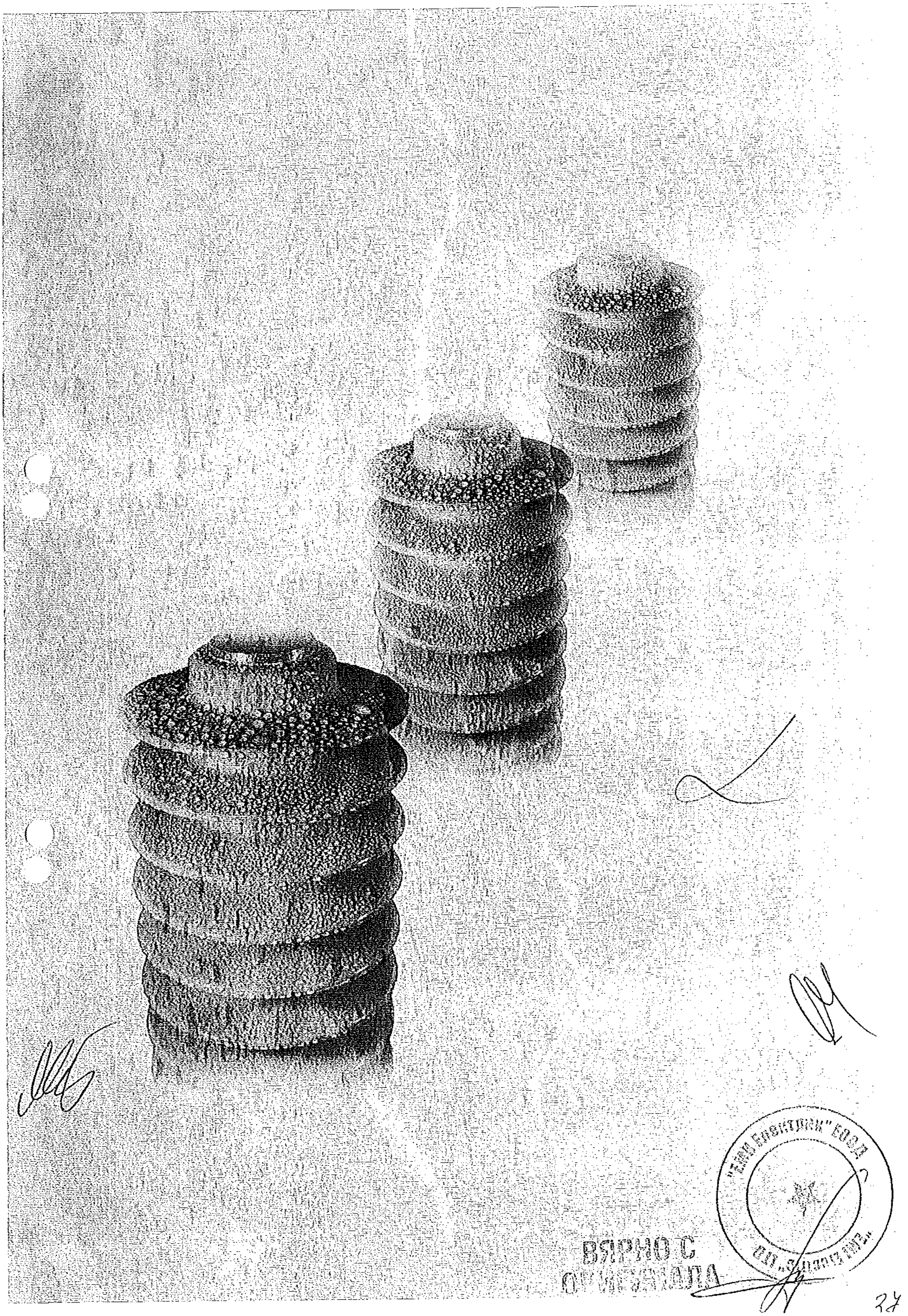
Permissible horizontal stress – 300 H.

Characteristics are presented in the Tables 3, below:

Table 3

Rated voltage, kV	Product number*	MCOV, kV	Residual voltage, kV, no more than							Figure	H, mm	Weight, kg	Leakage distance, mm	Housing insulation	
			8/20 μs 5 kA	8/20 μs 10 kA	8/20 μs 20 kA	30/60 μs 125 A	30/60 μs 250 A	30/60 μs 500 A	1/10 μs 10 kA					1,2/50 μs, kV	1 min 50 Hz, kV
3	PA-DM-051-03	2,6	7,2	7,7	8,6	5,6	5,7	5,9	8,4	6	109	0,8	190	60	21
4	PA-DM-051-04	3,2	9,6	10,2	11,5	7,6	7,8	7,9	11,2	6	109	0,8	190	60	21
5	PA-DM-051-05	4	12	12,8	14,3	9,4	9,6	9,8	14	6	109	0,8	190	60	21
6	PA-DM-051-06	5,6	14,4	15,4	17,2	11,2	11,4	11,7	16,7	6	109	0,8	190	60	21
7	PA-DM-051-07	5,6	16,8	17,9	20,1	13,1	13,3	13,7	19,5	6	109	0,8	190	60	21
8	PA-DM-051-08	6,4	19,3	20,5	22,9	15	15,2	15,6	22,3	6	109	0,8	190	60	21
9	PA-DM-051-09	7,2	21,7	23	25,8	16,8	17,1	17,6	25,1	6	109	0,8	190	60	21
10	PA-DM-051-10	8	24,1	25,6	28,7	18,7	19,0	19,5	27,9	6	109	0,8	190	60	21
11	PA-DM-101-11	8,8	26,5	28,2	31,5	20,6	20,9	21,5	30,7	7	153	1,2	265	80,3	35,7
12	PA-DM-101-12	9,6	28,9	30,7	34,3	22,5	22,8	23,4	33,5	7	153	1,2	265	80,3	35,7
13	PA-DM-101-13	10,4	31,3	33,3	37,3	24,3	24,7	25,4	36,3	7	153	1,2	265	80,3	35,7
14	PA-DM-101-14	11,2	33,7	35,8	40,1	26,2	26,6	27,3	39,1	7	153	1,2	265	80,3	35,7
15	PA-DM-101-15	12	36,1	38,4	43	28,1	28,5	29,3	41,9	7	153	1,2	265	80,3	35,7
16	PA-DM-101-16	12,8	38,5	41	45,9	29,9	30,4	31,2	44,6	7	153	1,2	265	80,3	35,7
17	PA-DM-091-17	13,6	40,9	43,5	48,7	31,8	32,3	33,2	47,4	8	200	1,5	649	105	46,7
18	PA-DM-091-18	14,4	43,3	46,1	51,6	33,7	34,2	35,1	50,2	8	200	1,5	649	105	46,7
19	PA-DM-091-19	15,2	45,7	48,6	54,5	35,6	36,1	37,1	53	8	200	1,5	649	105	46,7
20	PA-DM-091-20	16	48,1	51,2	57,3	37,4	38,0	39	55,8	8	200	1,5	649	105	46,7
21	PA-DM-092-21	16,8	50,5	53,8	60,2	39,3	39,9	41	58,6	8	238	1,8	785	125	55,5
22	PA-DM-092-22	17,6	52,9	56,3	63,1	41,2	41,8	42,9	61,4	8	238	1,8	785	125	55,5
23	PA-DM-092-23	18,4	55,3	58,9	65,9	43	43,7	44,9	64,2	8	238	1,8	785	125	55,5
24	PA-DM-092-24	19,2	57,8	61,4	68,8	44,9	45,6	46,8	67	8	238	1,8	785	125	55,5
25	PA-DM-092-25	20	60,2	64	71,7	46,8	47,5	48,8	69,8	8	238	1,8	785	125	55,5
26	PA-DM-093-26	20,8	62,6	66,6	74,5	48,7	49,4	50,7	72,6	8	275	2,2	920	144	64,2
27	PA-DM-093-27	21,6	65	69,1	77,4	50,5	51,3	52,7	75,3	8	275	2,2	920	144	64,2
28	PA-DM-093-28	22,4	67,4	71,7	80,3	52,4	53,2	54,6	78,1	8	275	2,2	920	144	64,2
29	PA-DM-093-29	23,2	69,9	74,2	83,1	54,3	55,1	56,6	80,9	8	275	2,2	920	144	64,2
30	PA-DM-093-30	24	72,2	76,8	86	56,1	57,0	58,5	83,7	8	275	2,2	920	144	64,2
33	PA-DM-094-33	26,4	79,4	84,5	94,6	61,8	62,7	64,4	92,1	8	313	2,5	1059	164	73,0
36	PA-DM-095-36	28,8	86,6	92,1	103,2	67,4	68,4	70,2	101	8	350	2,8	1192	184	81,7
39	PA-DM-095-39	31,2	93,8	99,8	111,8	73	74,1	76,1	109	8	350	2,8	1192	184	81,7
42	PA-DM-096-42	33,6	101,1	107,5	120,4	78,6	79,8	81,9	117	8	388	3,2	1325	204	90,5
45	PA-DM-096-45	36	108,3	115,2	129	84,2	85,5	87,8	125	8	388	3,2	1325	204	90,5
48	PA-DM-097-48	38,4	115,5	122,8	137,6	89,8	91,2	93,6	134	8	425	3,5	1457	223	99,2
51	PA-DM-098-51	40,8	122,7	130,5	146,2	95,4	96,9	99,5	142	8	463	3,8	1589	243	108
54	PA-DM-098-54	43,2	129,9	138,2	154,8	101,1	102	105	151	8	463	3,8	1589	243	108

* according to the customer type of housing can be changed



Dimensions of arresters of PA-DM

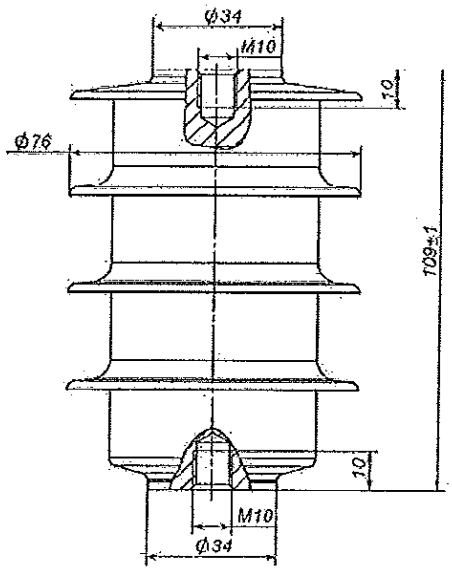


Fig. 6 Dimensions of arresters of PA-DM-061 type

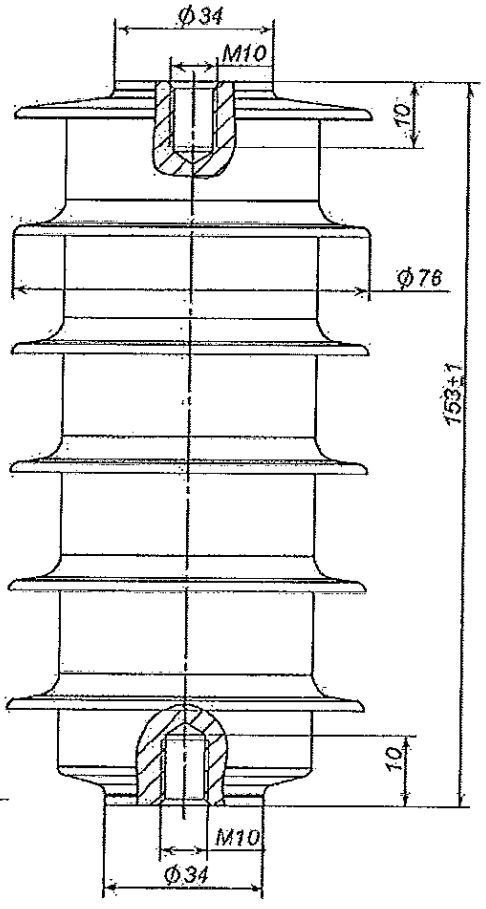


Fig. 7 Dimensions of arresters of PA-DM-101 type

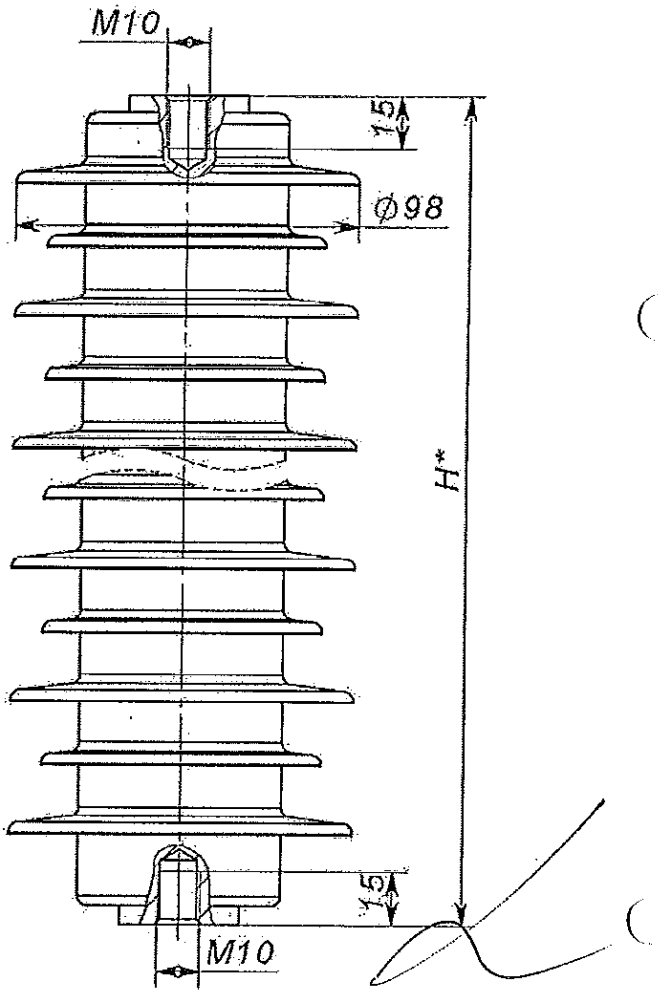


Fig. 8 Dimensions of arresters of PA-DM-091 PA-DM-098 types

2.2 PA-DH types

Arrester classification – Distribution class.
The main parameters and characteristics:
- Rated voltage – from 3 to 51 kV;
- Continuous voltage of arrester (MCOV) – from 2.4 to 43.2 kV (rms);
- Nominal discharge current – 10000 A;
- High current impulse 4/10 μs – 100 kA;
- Long Duration Current Impulse – 250 A;
- Repetitive Charge Transfer Rating Qrs – 0.6 C;
- Specific energy IEC 60099-4 (two impulse 2000 μs) – 3.96 kJ/kV (U/C);
- Thermal Charge Transfer Rating Qth – 1.1 C.

Operability of arresters is ensured under the following servicing conditions:
- Outdoor and indoor;
- Lower operating value of ambient temperature is -60° C;
- Upper operating value of ambient temperature is +50° C;
- Altitude above sea level is up to 1000 m.

TOV characteristics (relative to the Rated voltage) are presented in the Fig 5. below.

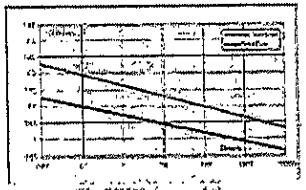


Fig. 5 TOV characteristics

Arresters are explosion-proof and withstand the following short-circuit currents without exploding:
- 20 kA (rms) during 0,2 c (no less than);
- 600 A (rms) during 2 c (no less than).

The arresters insulation is tracking-erosion stable and resistant to moisture penetration.

Permissible horizontal stress – 300 H.

Characteristics are presented in the Tables 4. below.

Table 4

Rated voltage, kV	Product number*	MCOV, kV	Residual voltage, kV, no more than							Figure	H, mm	Weight, kg	Leakage distance, mm	Housing insulation	
			8/20 μs 5 kA	8/20 μs 10 kA	8/20 μs 20 kA	30/60 μs 125 A	30/60 μs 250 A	30/60 μs 500 A	30/60 μs 1000 A					1,2/50 μs, kV	1 min 50 Hz, kV
3	PA-DH-052-03	2,4	7,9	7,44	8	5,4	6,6	5,66	8,1	9	141	1,4	230	74,2	32,9
4	PA-DH-052-04	3,2	9,8	9,82	10,7	7,2	7,4	7,5	10,8	9	141	1,4	230	74,2	32,9
5	PA-DH-052-05	4	11,8	12,4	13,4	9,1	9,2	9,4	13,5	9	141	1,4	230	74,2	32,9
6	PA-DH-052-06	4,8	14,1	14,9	16,1	10,9	11,1	11,3	16,2	9	141	1,4	230	74,2	32,9
7	PA-DH-052-07	5,6	16,5	17,4	18,7	12,7	12,9	13,2	18,9	9	141	1,4	230	74,2	32,9
8	PA-DH-052-08	6,4	18,9	19,8	21,4	14,5	14,7	15,1	21,6	9	141	1,4	230	74,2	32,9
9	PA-DH-052-09	7,2	21,2	22,3	24,1	16,3	16,5	17	24,3	9	141	1,4	230	74,2	32,9
9	PA-DH-063-09	7,2	21,2	22,3	24,1	16,3	16,5	17	24,3	12	180	1,5	320	100	37
10	PA-DH-052-10	8	23,6	24,8	26,8	18,1	18,4	18,8	27	9	141	1,4	230	74,2	32,9
11	PA-DH-102-11	8,8	25,9	27,3	29,5	19,9	20,3	20,7	29,7	10	191	1,9	310	101	44,6
12	PA-DH-102-12	9,6	28,3	29,8	32,1	21,7	22,1	22,6	32,4	10	191	1,9	310	101	44,6
13	PA-DH-102-13	10,4	30,6	32,2	34,8	23,5	23,9	24,5	35,1	10	191	1,9	310	101	44,6
14	PA-DH-102-14	11,2	33	34,7	37,5	25,3	25,7	26,4	37,8	10	191	1,9	310	101	44,6
14	PA-DH-163-14	11,2	33	34,7	37,5	25,3	25,7	26,4	37,8	12	180	2,2	445	90	40
15	PA-DH-102-15	12	35,3	37,2	40,2	27,2	27,6	28,3	40,5	10	191	1,9	310	101	44,6
16	PA-DH-102-16	12,8	37,7	39,7	42,9	29	29,5	30,2	43,3	10	191	1,9	310	101	44,6
17	PA-DH-151-17	13,6	40,1	42,2	45,5	30,8	31,3	32	46	11	205	2,7	595	108	47,8
18	PA-DH-151-18	14,4	42,4	44,6	48,2	32,6	33,1	33,9	48,7	11	205	2,7	595	108	47,8
19	PA-DH-151-19	15,2	44,8	47,1	50,9	34,4	34,9	35,8	51,4	11	205	2,7	595	108	47,8
20	PA-DH-151-20	16	47,1	49,6	53,6	36,2	36,8	37,7	54,1	11	205	2,7	595	108	47,8
21	PA-DH-152-21	16,8	49,5	52,1	56,2	38	38,7	39,6	56,8	11	225	2,9	615	118	52,5
22	PA-DH-152-22	17,6	51,8	54,5	58,9	39,8	40,5	41,5	59,5	11	225	2,9	615	118	52,5
23	PA-DH-152-23	18,4	54,2	57	61,6	41,6	42,3	43,4	62,2	11	225	2,9	615	118	52,5
24	PA-DH-203-24	19,2	56,5	59,5	64,3	43,4	44,1	45,2	64,9	11	261	3,3	778	137	60,9
25	PA-DH-203-25	20	58,9	62	67	45,3	46,0	47,1	67,6	11	261	3,3	778	137	60,9
26	PA-DH-203-26	20,8	61,3	64,5	69,6	47,1	47,9	49	70,3	11	261	3,3	778	137	60,9
27	PA-DH-204-27	21,6	63,6	67	72,3	48,9	49,7	50,9	73	11	280	3,5	807	152	67,7
28	PA-DH-204-28	22,4	66	69,4	75	50,7	51,5	52,8	75,7	11	280	3,5	807	153	67,7
29	PA-DH-204-29	23,2	68,3	71,9	77,7	52,5	53,3	54,7	78,4	11	280	3,5	807	153	67,7
30	PA-DH-204-30	24	70,7	74,4	80,4	54,3	55,2	56,6	81,1	11	280	3,5	807	153	67,7
33	PA-DH-204-33	26,4	77,8	81,8	88,4	59,7	60,7	62,2	89,2	11	280	3,5	807	205	91,0
36	PA-DH-351-36	28,8	84,8	89,3	96,4	65,2	66,3	67,9	97,3	11	456	6,0	1060	240	106
39	PA-DH-351-39	31,2	91,9	96,7	105	70,6	71,8	73,5	106	11	456	6,0	1060	240	106
42	PA-DH-351-42	33,6	99	104	113	76	77,3	79,2	114	11	456	6,0	1060	240	106
45	PA-DH-351-45	36	106	112	121	81,5	82,8	84,8	122	11	456	6,0	1060	240	106
48	PA-DH-351-48	38,4	113	119	128	86,9	88,3	90,5	130	11	456	6,0	1060	240	106
51	PA-DH-351-51	40,8	120	127	137	92,3	93,9	96,1	138	11	456	6,0	1060	240	106
54	PA-DH-351-54	43,2	127	134	145	97,8	99,4	102	146	11	456	6,0	1060	240	106

* according to the customer's type of housing can be changed

Dimensions of arresters of PA-DH

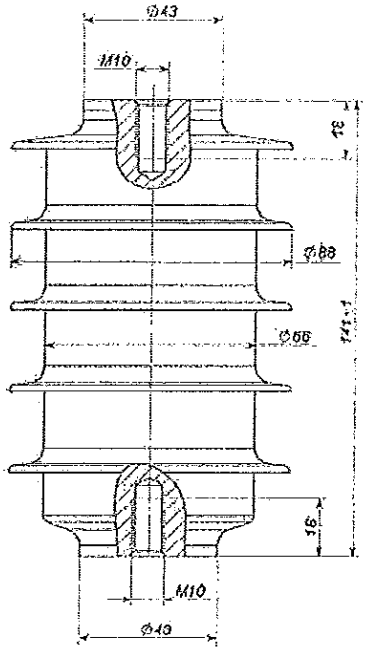


Fig. 9 Dimensions of arresters of PA-DH-062 type

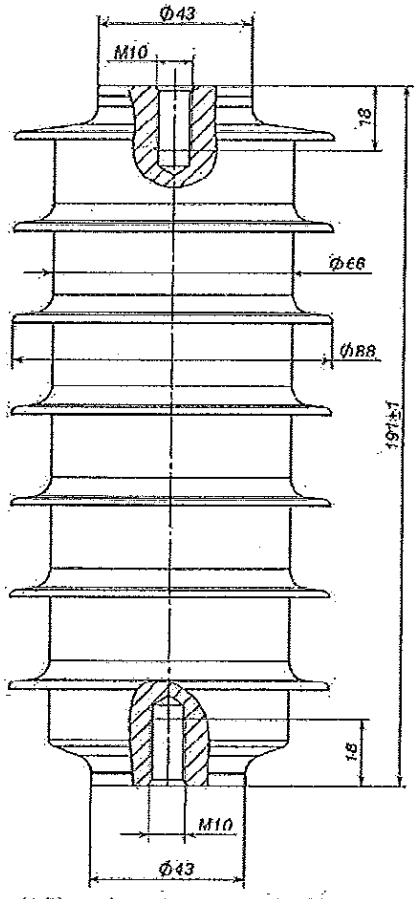


Fig. 10 Dimensions of arresters of PA-DH-102 type

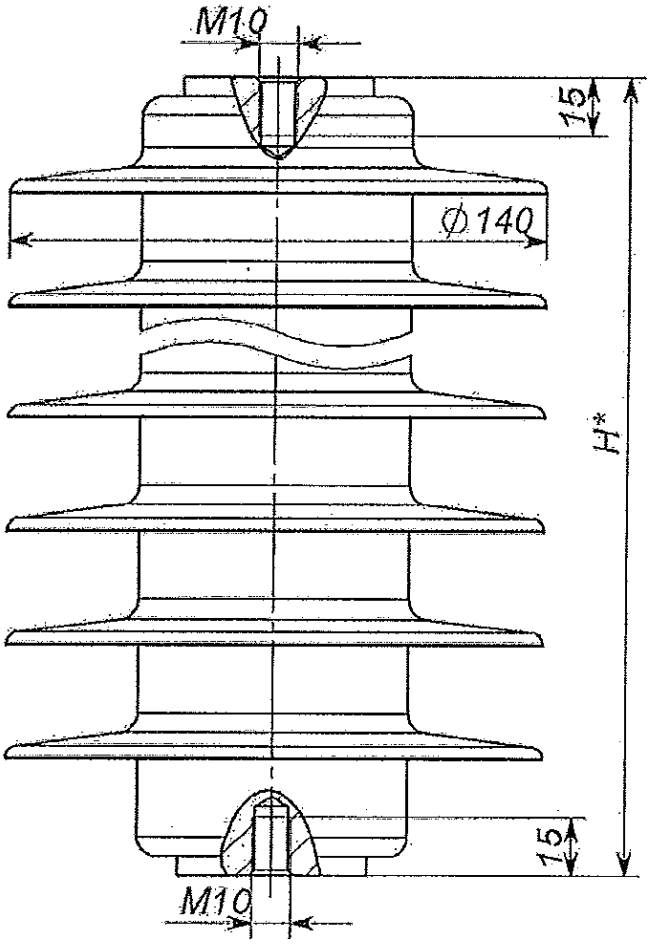


Fig. 11 Dimensions of arresters of PA-DH-151, 152, 203, 204, 351 types

2.3 Options for PA-DM & PA-DH types

Product Marking System

Example of a product number: PA - DH - 062 - 03 - 02 / 11D2C3

- Manufacturer's trademark
- Arrester classification
  DM - Distribution Medium
  DH - Distribution High
- Type of housing
- Rated voltage, kV
- High-voltage input: type
- Ground terminal: options

High-voltage input: type & options

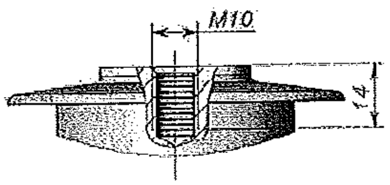


Fig. 11 High-voltage input «00» tape

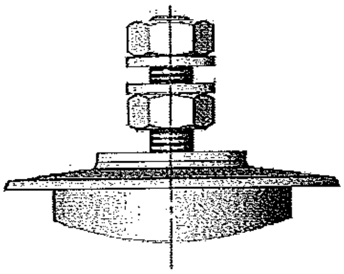


Fig. 12 High-voltage input «02» tape (M10)

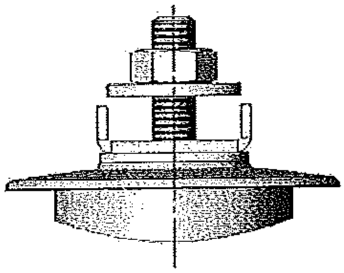


Fig. 13 High-voltage input «03» tape (6 to 50 mm2)

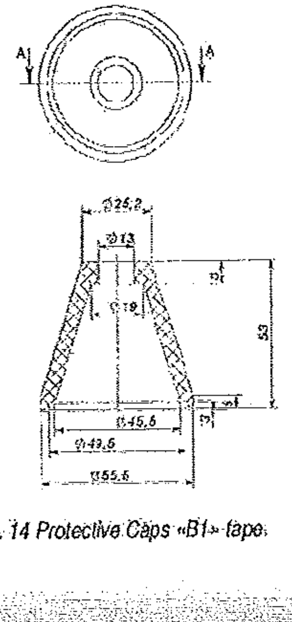


Fig. 14 Protective Caps «B1» tape

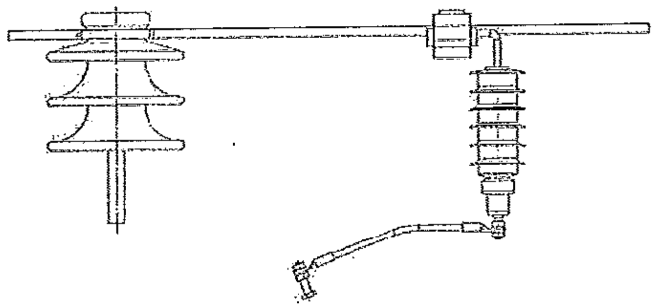
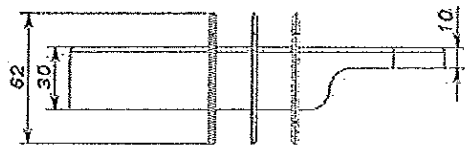
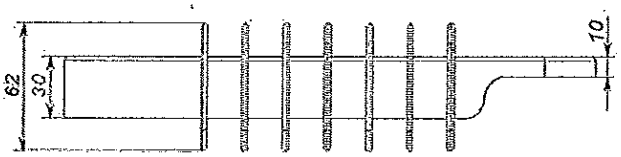


Fig. 15 Set of fittings for installation on insulated conductor «F1» tape (Conductors size of 35 to 150 mm2).





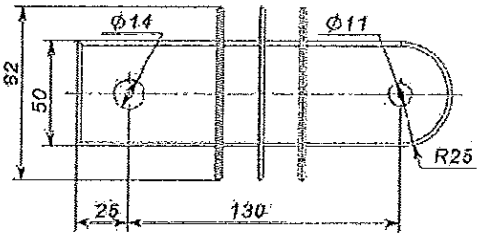


Fig. 16 Insulation bracket «I1» tape. MCOV 2.55 to 15.3 kV

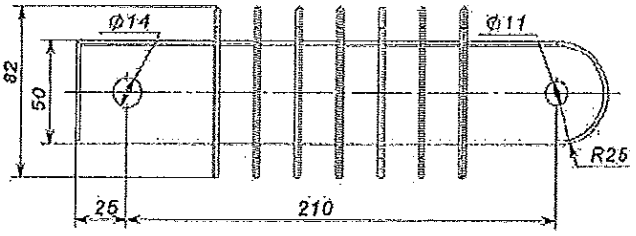


Fig. 17 Insulation bracket «I2» tape. MCOV 2.55 to 29 kV

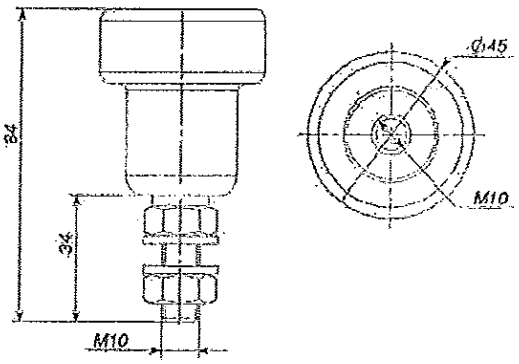


Fig. 19 Disconnector «D2» tape

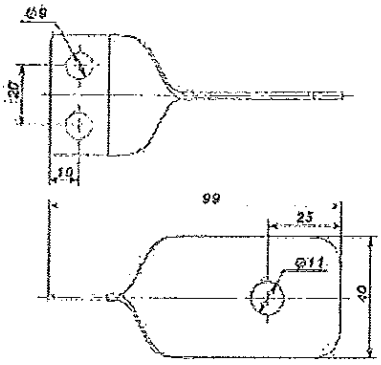


Fig. 18 Metal bracket «M1» tape

Tape	Sectional area of the wire, mm2	Dia Hole, mm	Long, mm
C1	6	11 or more on request	450 or more on request
C2	16		
C3	25		
C4	35		
C5	50		

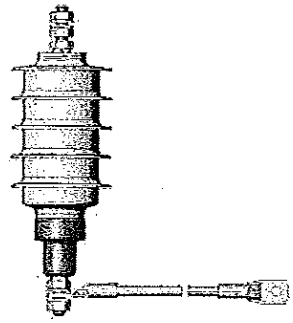


Fig. 20 Example of a product number: PA-HD-062-03-02/D2C3

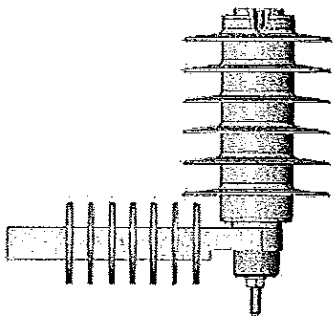


Fig. 21 Example of a product number: PA-HD-152-18-00/1D2

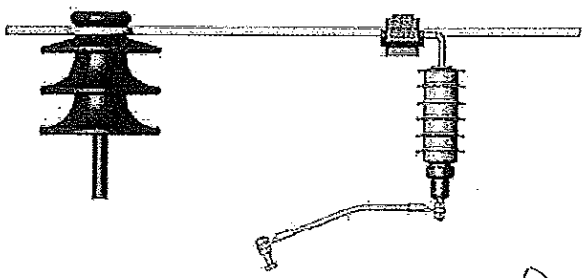
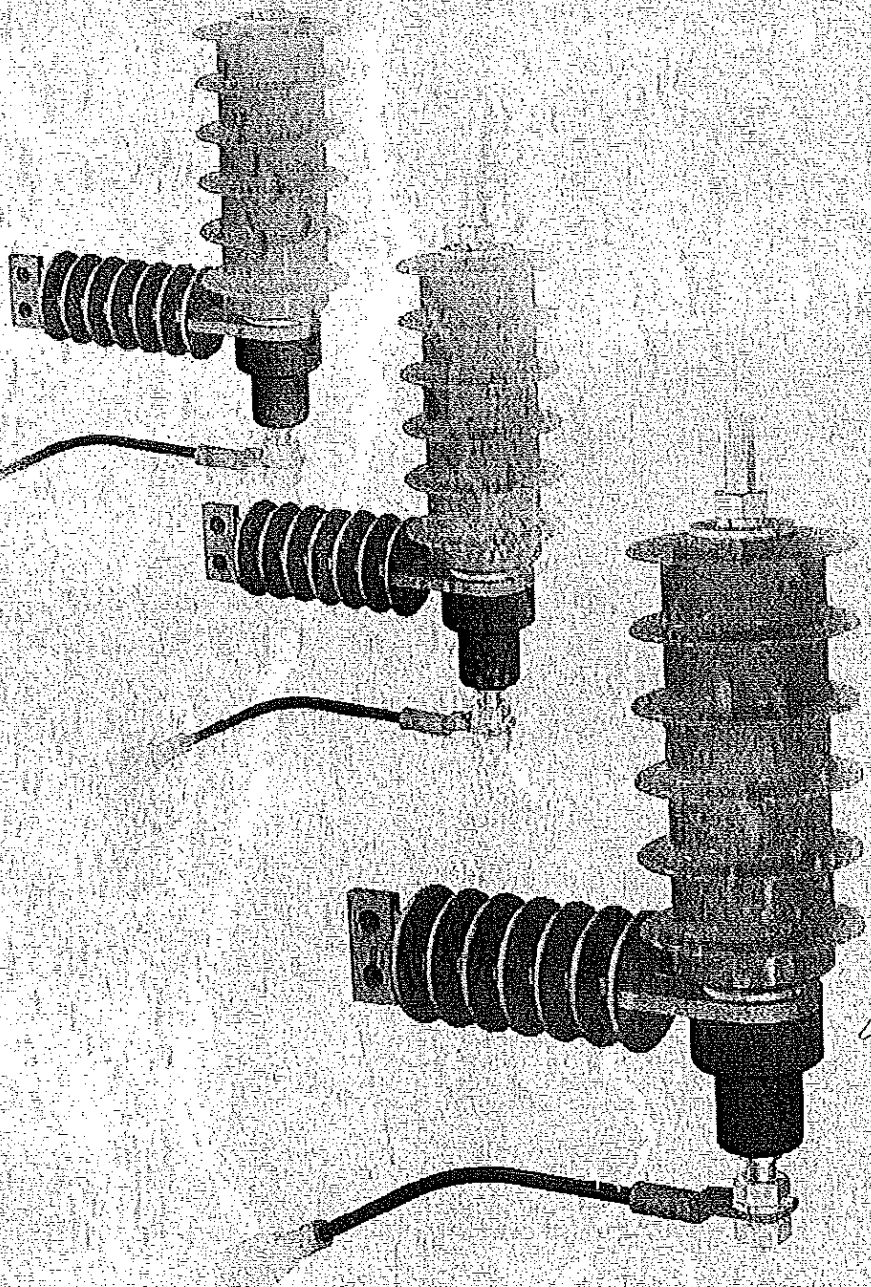


Fig. 22 Example of a product number: PA-HD-102-09-00B1/D2C2(1000)



ВЯР
ОРМ

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

Del Giorgio Carlo
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 UNI 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.it

CESI
Trust the Power of Experience

[PAD 87018645 (2436542) - 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

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

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

Measured arcing distance = 485 mm

Date: September 19, 2017

test sample	polarity	impulse generator charging voltage	voltage required U	voltage applied U x K_t
Serial No.		kV/stage	kV_{peak}	kV_{peak}
368160	positive	61,3	240,0	235,0
368160	negative	61,2	240,0	235,0

A: (o) withstand (x) flashover
B: oscillogram No.
C: peak voltage [kV]
D: time to discharge (µs)

positive	A	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	A	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
	B	6							7							R
	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_a	h	K_t
kPa	°C	g / m³	
99,76	20,3	9,71	0,993

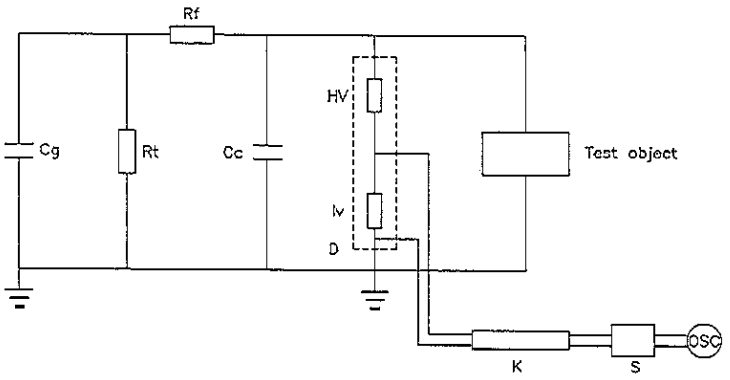
Measured arcing distance = 485 mm

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		test voltage				test duration	Test result	Oscillogram	Notes
	required	applied	V_1	$V_{INV} = k_1 V_1$ (k_1 = ----)	V_3	$V_{INV} = k_0 V_3$ (G_0 = 25700)				
Serial No.	U kV_{peak}	U x K_t kV_{peak}	V_{peak}	kV_{peak}	V_{peak}	kV_{peak}	s		No.	
368160	150,0	148,95	----	----	5,80	148,95	60	withstand	9	

Circuit A0002



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

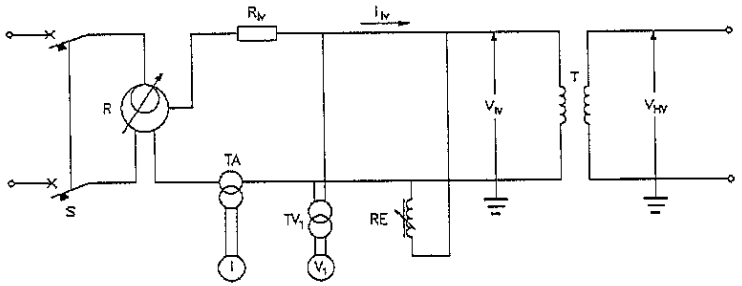
Voltage measuring system CESI No. 9792
D - divider PASSONI & VILLA type RC series CESI No. 6700; scale factor 25600
HV - high voltage capacitance 600 pF
lv - low voltage unit CESI No. 6704
K - coaxial cable
S - attenuation and termination unit CESI No. 14924
OSC - digital oscilloscope LECROY type HD4096 CESI No. 58202
Data acquisition and calculation software PANDA rel.7.0 May 2017

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

Check of the test circuit			
	Charging voltage V_c	Measured voltage V_m	η $V_m / (V_c \cdot n_{stages})$
polarity	kV/stage	kV	
positive	57,3	220,4	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 3.1 January 2016

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
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
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

I_N	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		A	s		A	s
5	10	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

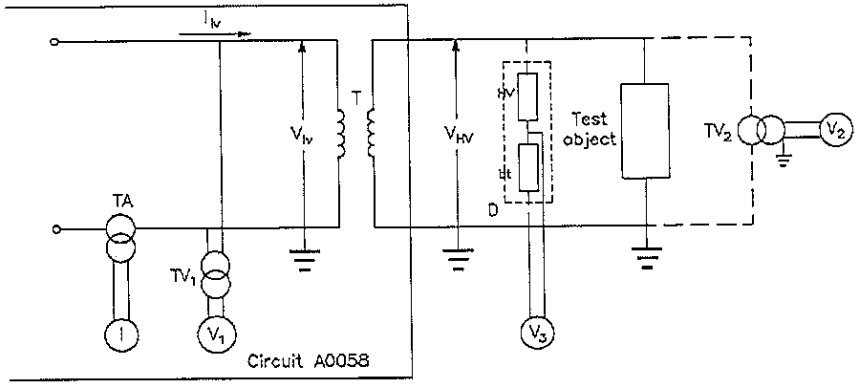
Stopwatch CDC ELETTROMECCANICA type TDN46, CESI No.38203

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

A00581G

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_2 = —		k_3 = 25700		k
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	$V_{r.m.s.}$	$kV_{r.m.s.}$	$V_{r.m.s.}$	$kV_{r.m.s.}$	Ktheo.= 3500
14,684	881,0	–	0,6	–	–	2,0096	51,65	3517

A00591G

Photograph of the test object

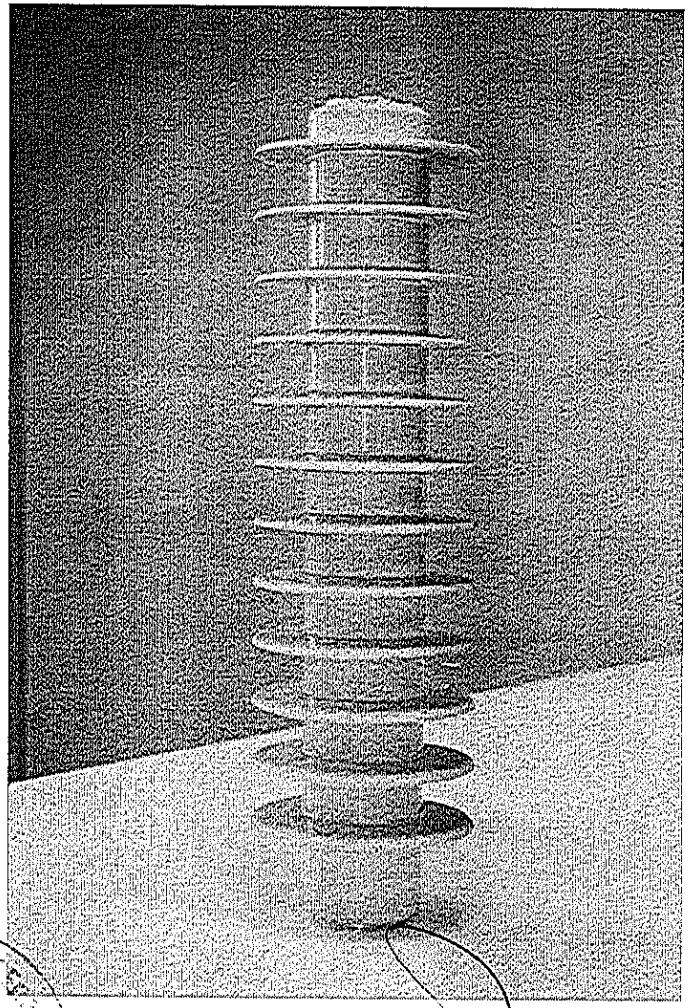


Photo No. 1

Photograph of the test arrangement

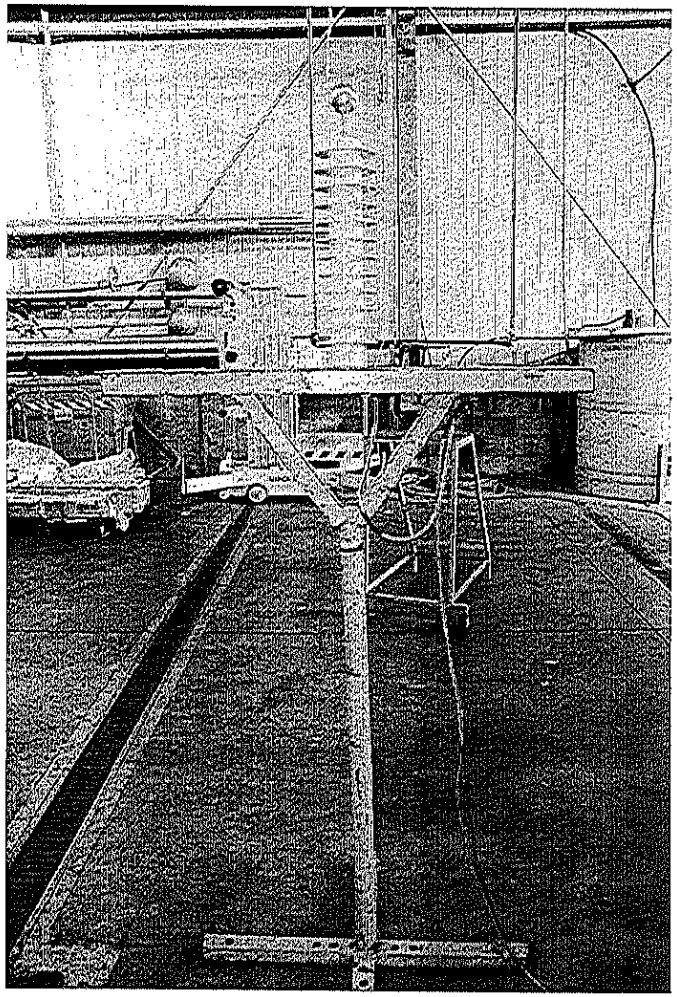
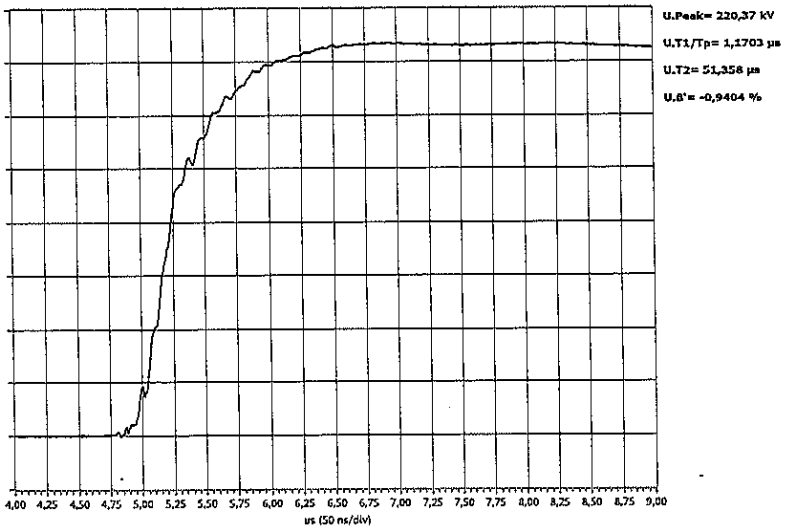
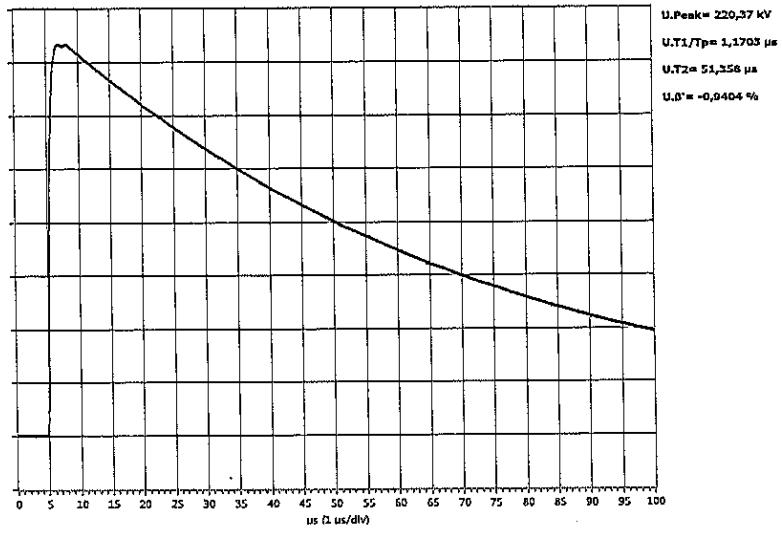


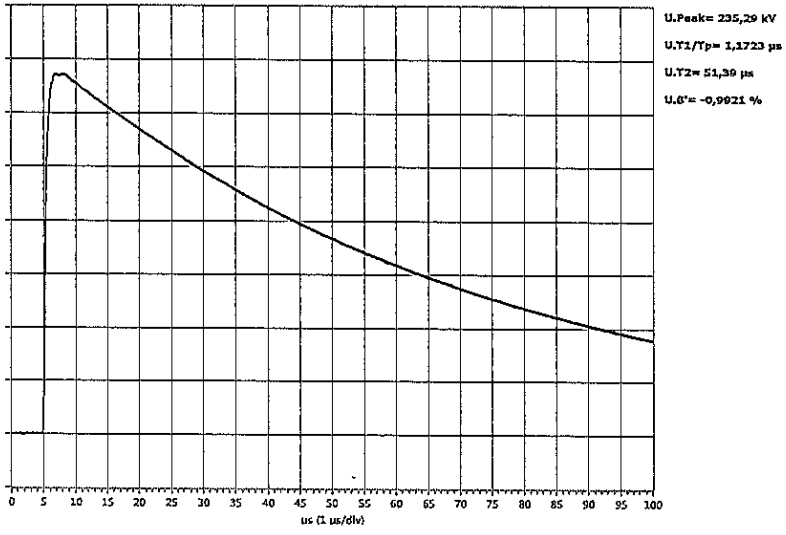
Photo No. 2



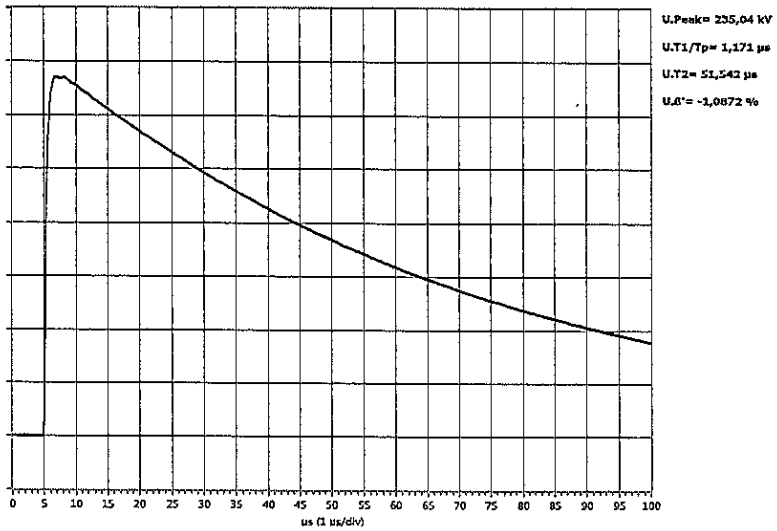
CESI P180 B7018645 , Oscill. No. 0001



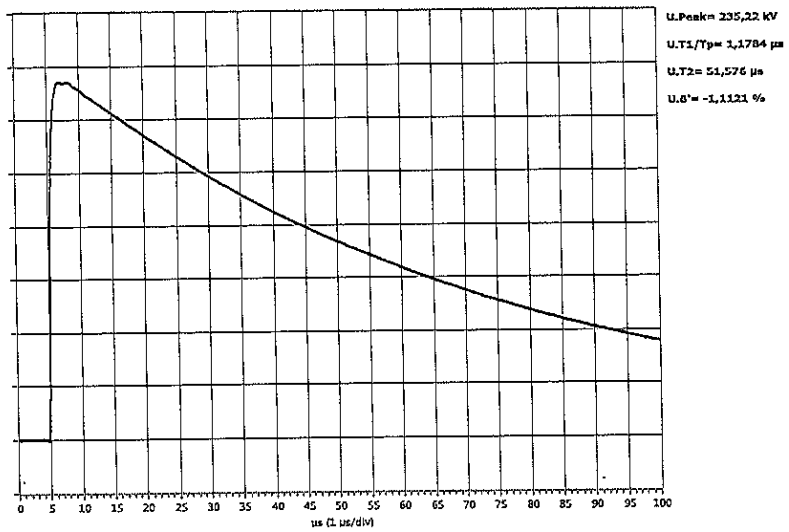
CESI P180 B7018645 , Oscill. No. 0002



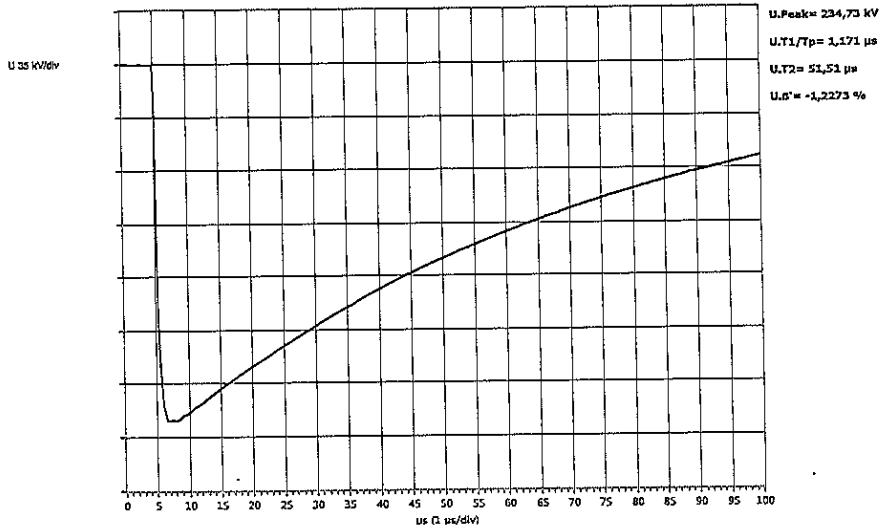
CESI P180 B7018645 , Oscill. No. 0003



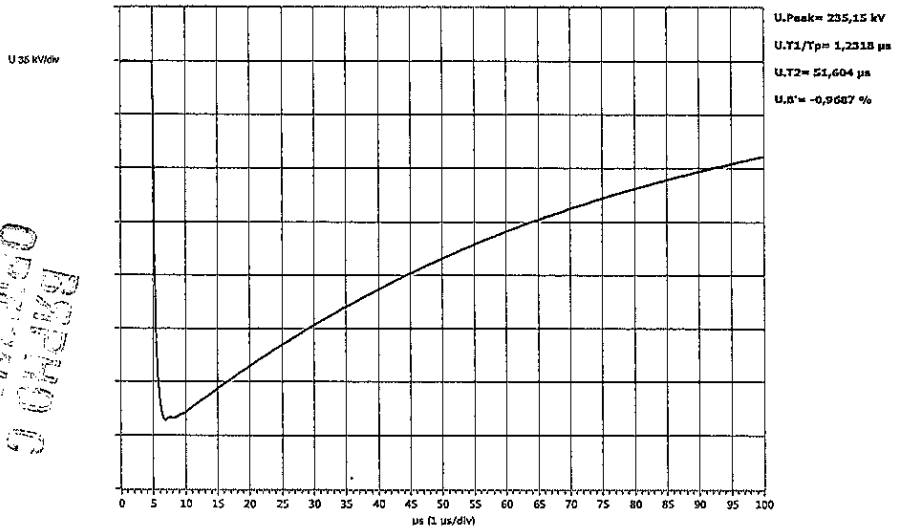
CESI P180 B7018645 , Oscill. No. 0004



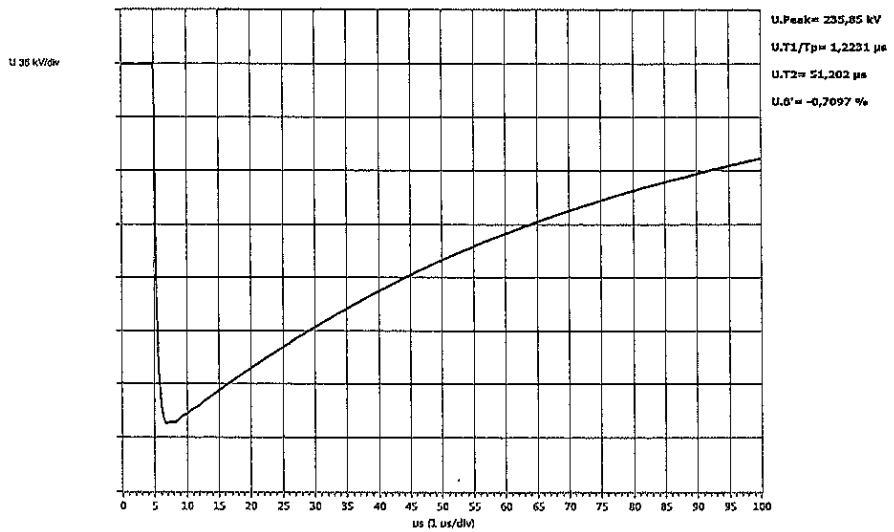
CESI P180 B7018645 , Oscill. No. 0005



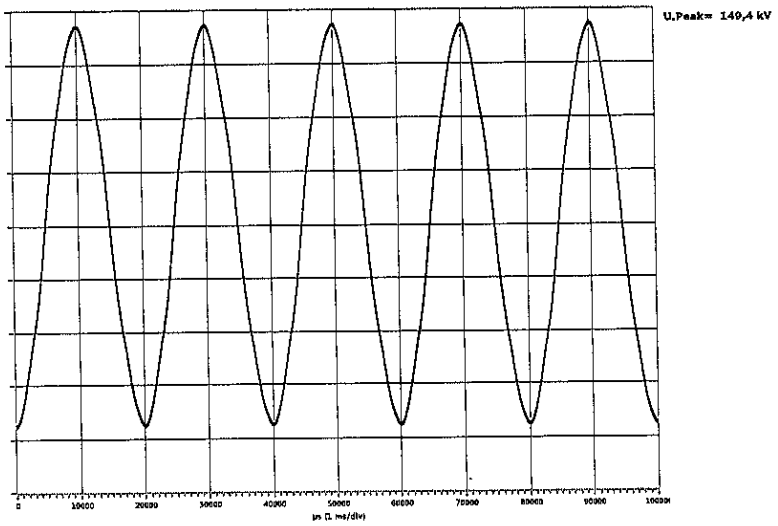
CESI P180 B7018645 , Oscill. No. 0006



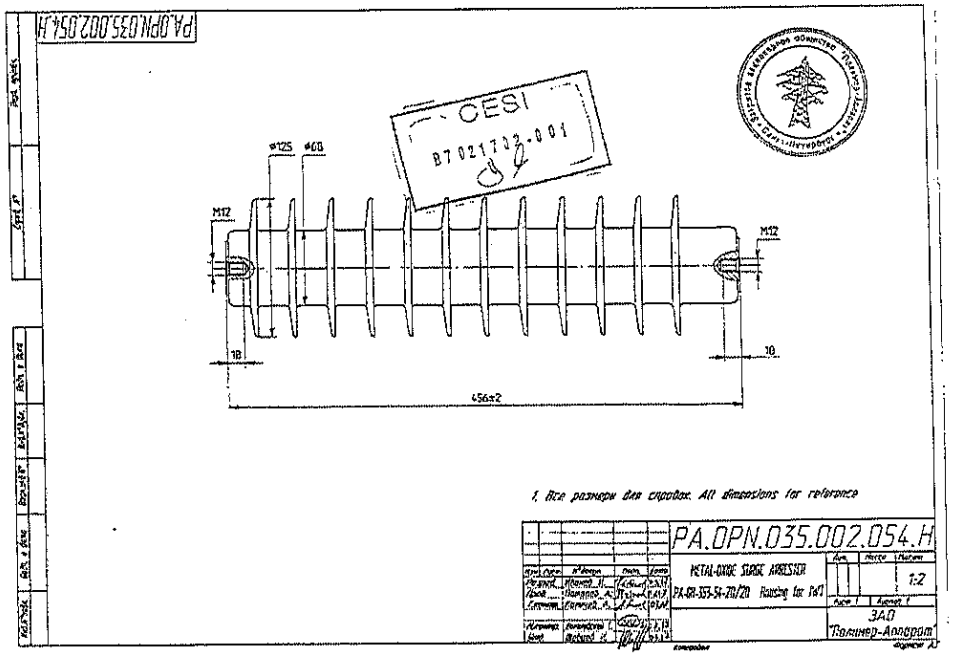
CESI P180 B7018645 , Oscill. No. 0007



CESI P180 B7018645 , Oscill. No. 0008



CESI P180 B7018645 , Oscil. No. 0009



Test Report

Document No.	B7023620	Copy No. 1	Number of pages	28
Apparatus	MO resistors type B41/30			
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 20-21, 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 27, 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 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:

—

—

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 B7024038 No. I , 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	November 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

content	page	test date
Test object characteristics	5	
Photo of the test sample	6	
Reference standard	7	
Test carried out	7	
Test object identification	7	
Test procedure	8	
Lightning impulse residual voltage test	9 to 10	November 20, 2017
Steep current impulse residual voltage test (measurement of inductive error)	11	November 21, 2017
Steep current impulse residual voltage test	12	November 21, 2017
Technical data	from page 13 to 14	

PAGES ANNEXED:

Oscillograms no. 13 pages
Client's drawing - CESI no.B7024038 no. 1 page

Test object characteristics (assigned by the client)

Manufacturer's name	Joint-Stock Company " Polymer-Apparat"
Arrester class	Distribution
Designation	DH
MO resistor type	B41/30
Drawing code	PA.VAR.0500.30
Nominal discharge current - [kA]	10,0
Maximum residual voltage at 10 kA - [kV]	13,60
Reference current - $I_{ref.}$ [mA]	1,5
Repetitive charge transfer rating – Q_{rs} [C]	0,5
Flat surface area [cm^2]	13,72
Rated frequency - [Hz]	48÷62
Year of manufacture	2017

geometrical characteristics measured on MO resistor

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

Photograph of the test objects

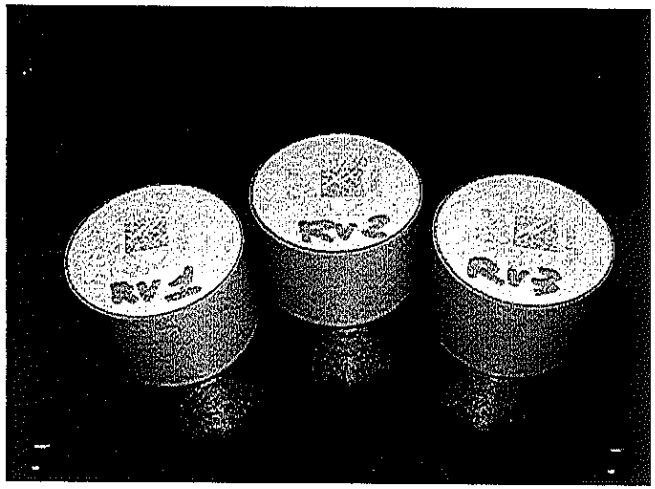


Photo no. 1

MO resistors type B41/30

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 B41/30	RV1	709.637b – 8
	RV2	709.637b – 18
	RV3	709.637b – 19

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

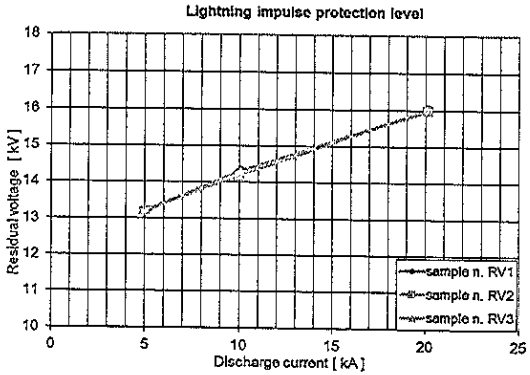
Date: November 20, 2017

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	5,10	12,69	13,60
	I_n	24,2	1	8,6/18,1	10,07	13,59	
	$2,0 \times I_n$	35,5	4	8,6/18,1	20,12	14,98	
RV2	$0,5 \times I_n$	18,4	8	8,4/18,4	5,09	12,71	
	I_n	24,2	2	8,6/18,1	9,95	13,59	
	$2,0 \times I_n$	35,5	5	8,6/18,0	20,17	14,99	
RV3	$0,5 \times I_n$	18,4	9	8,4/18,4	5,10	12,69	
	I_n	24,2	3	8,6/18,1	10,03	13,60	
	$2,0 \times I_n$	35,5	6	8,6/18,0	20,19	15,03	

Notes:

A1144IG

A1264IG



Residual voltage tests

Steep current impulse residual voltage test.

Measurement of the inductive error

Test circuit: A0121B
Ambient temperature : 23°C

Date: November 21, 2017

Sample	Charging voltage	Oscillogram	Current waveshape	Discharge current	Peak voltage	Inductive error
No.	kV	No.	µs	kA	V	%
aluminium block	34,2	10	1,0/2,2	10,07	294	< 2 (1)

Notes: (1) correction is not required

Residual voltage tests

Steep current impulse residual voltage test.

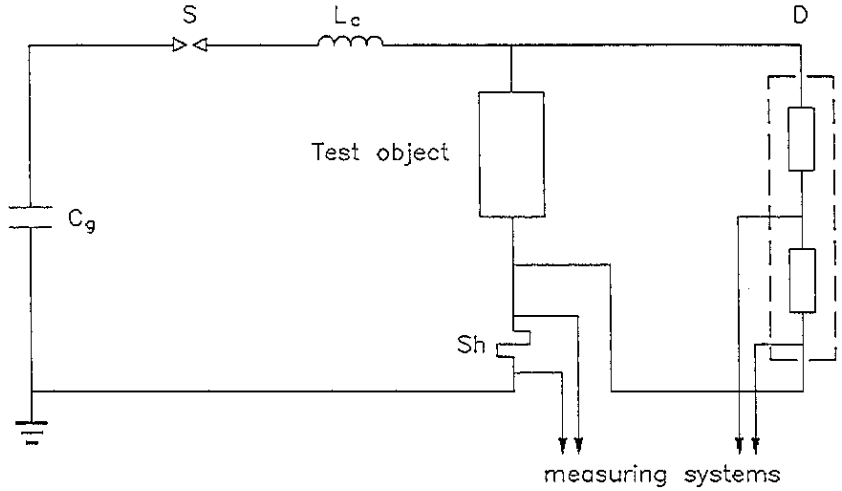
Test circuit: A0121B

Ambient temperature : 23°C
Date: November 21, 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	10,10	14,85	14,85
RV2	33,3	12		10,08	14,77	
RV3	33,4	13		10,07	14,82	

Notes:

Circuit A0120



Impulse generator

No. of stages 1
Cg 6,64 µF
Lc 6 µH

S - 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

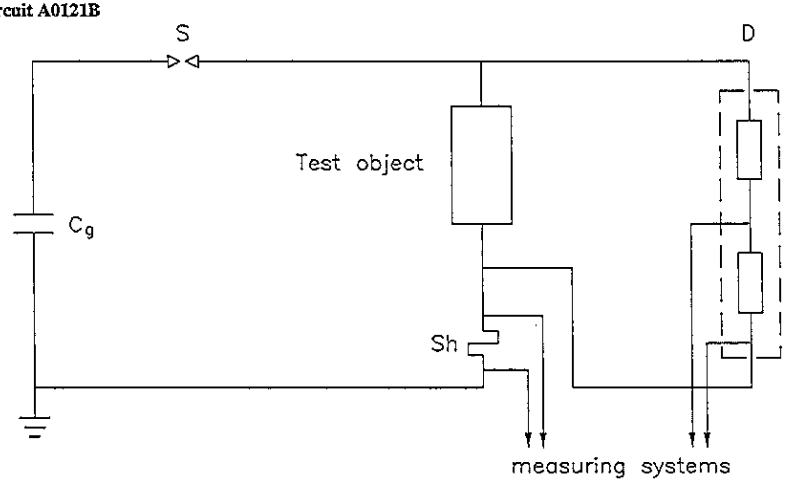
Sh - Current shunt CESI No.6042; R= 1,98 mΩ; peak current= 250 kA
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)

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

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)

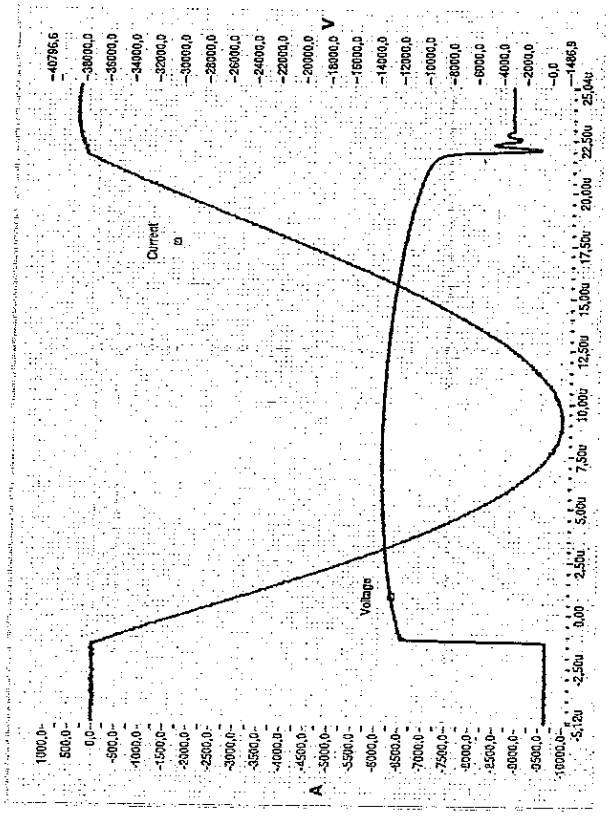
Current measuring system

Sh - Current Pearson CESI No.8252; 0,01 V x A
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)

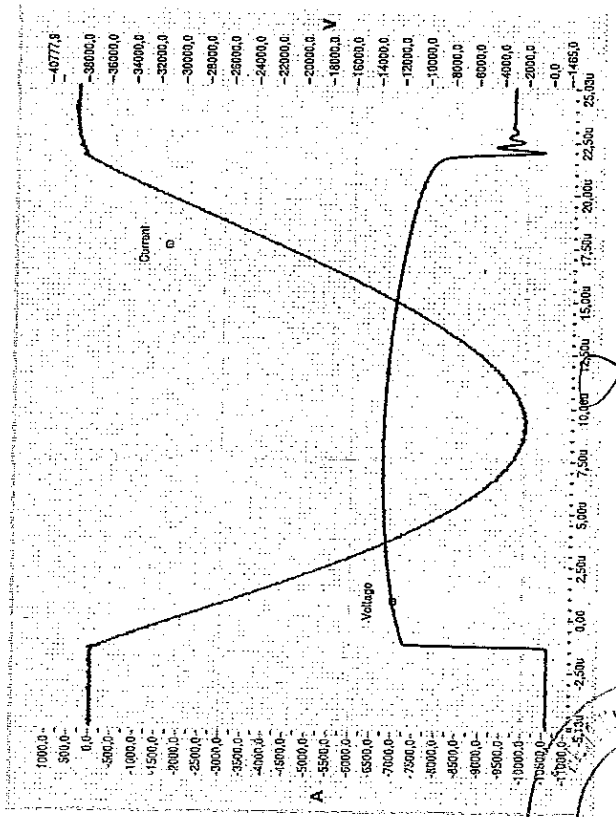
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:

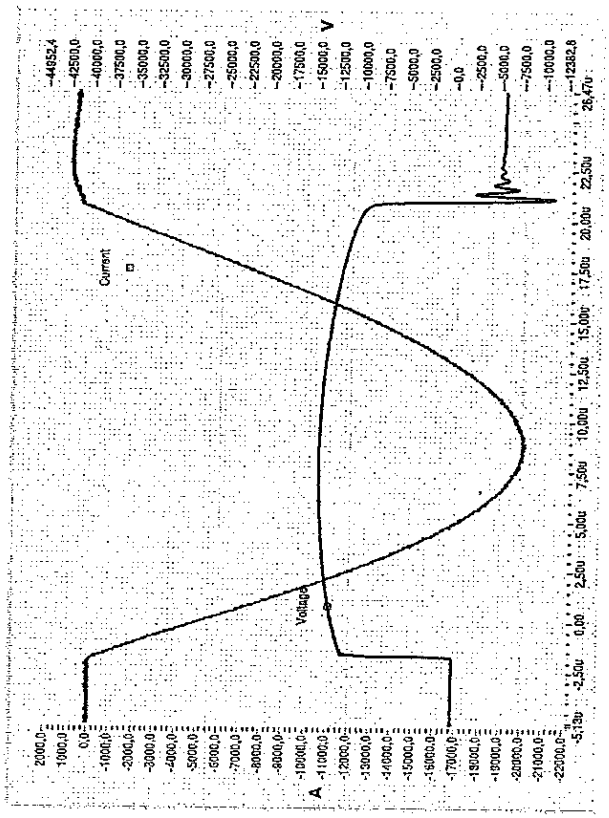
SW - S.A.D. Surge arrester version 2.0



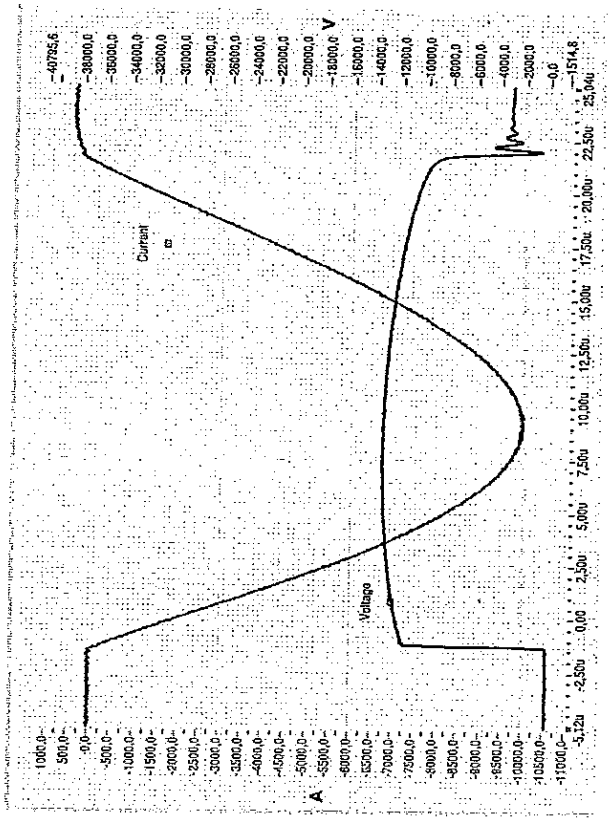
CESI B7023620 Oscillogram n. 2



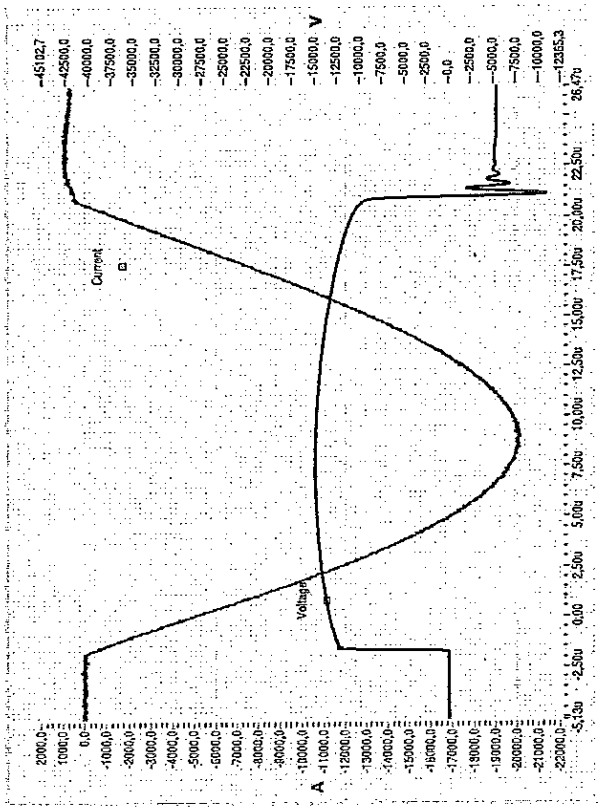
CESI B7023620 Oscillogram n. 1



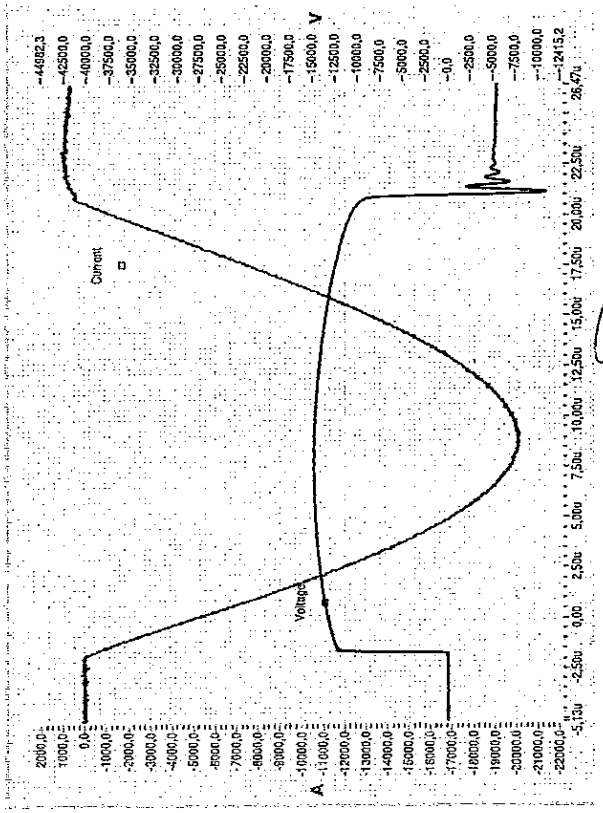
CESI B7023620 Oscillogram n. 4



CESI B7023620 Oscillogram n. 3

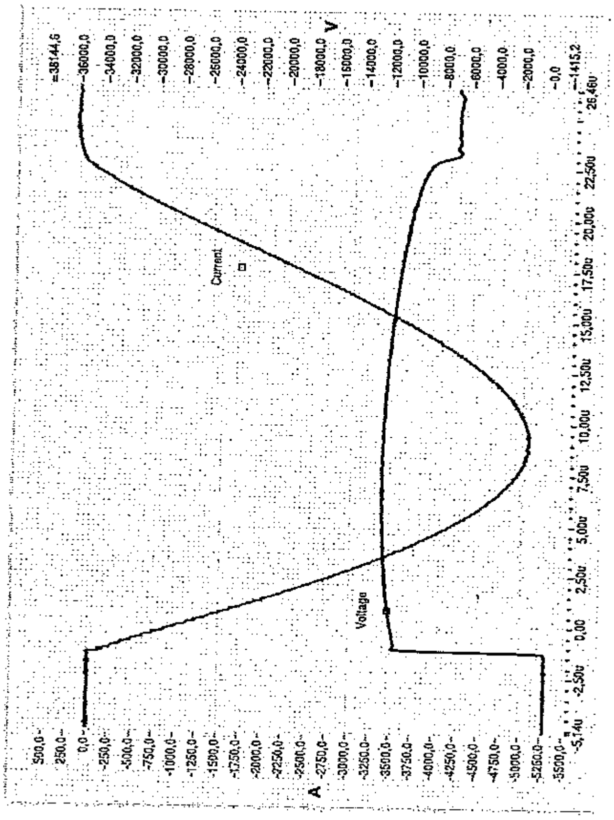


CESI B7023620 Oscillogram n. 6

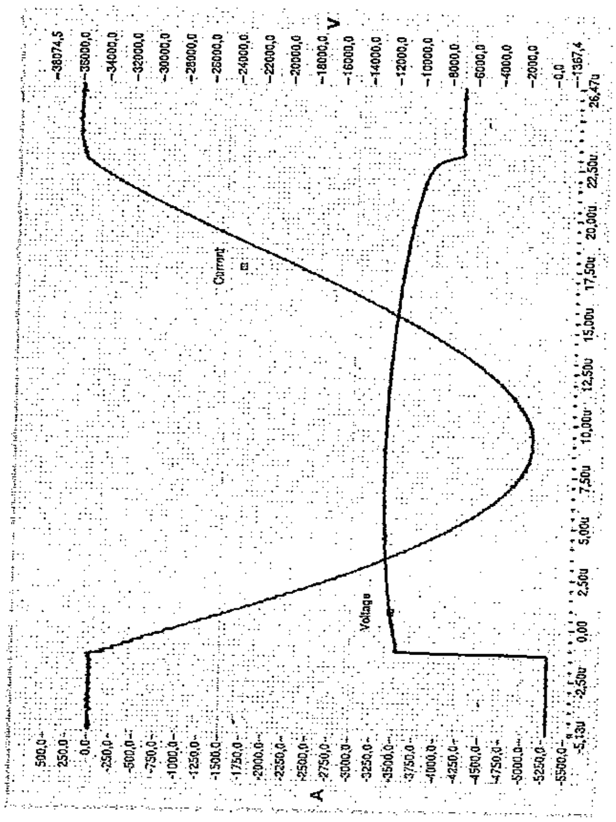


CESI B7023620 Oscillogram n. 5

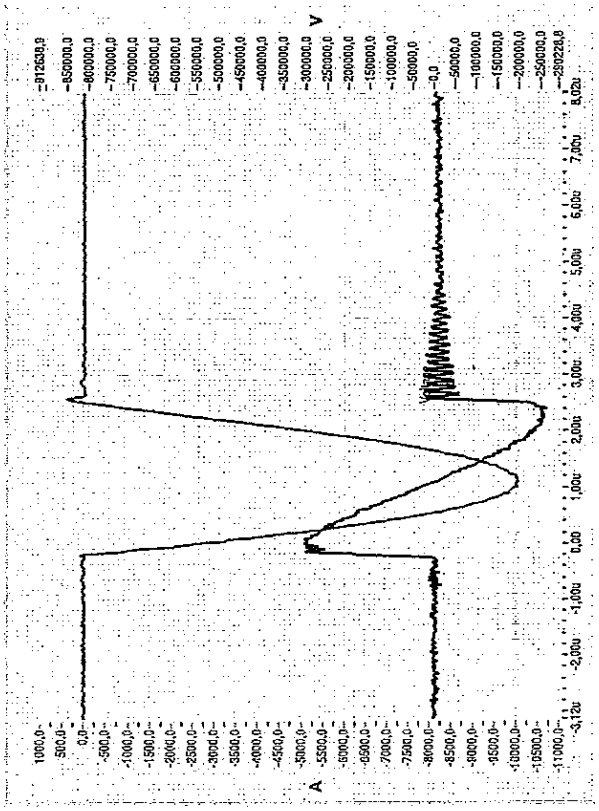
6



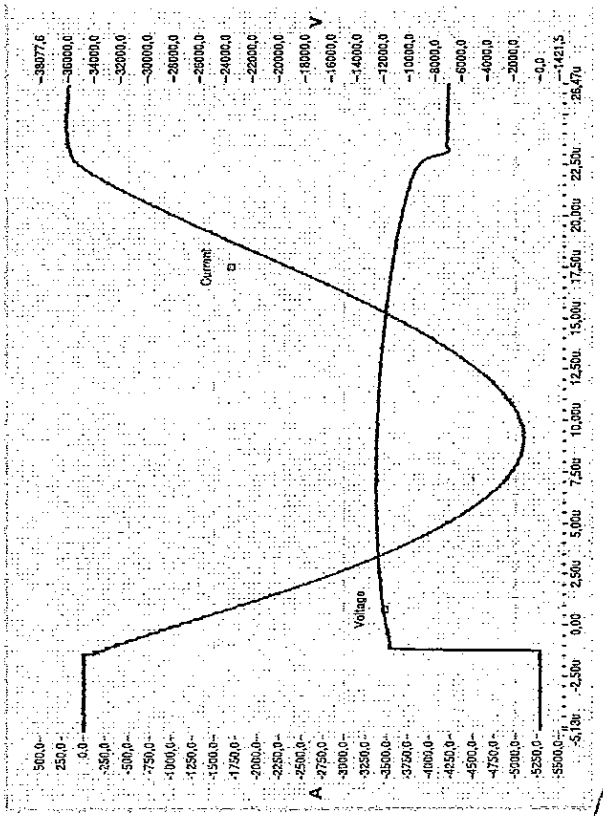
CESI B7023620 Oscillogram n. 8



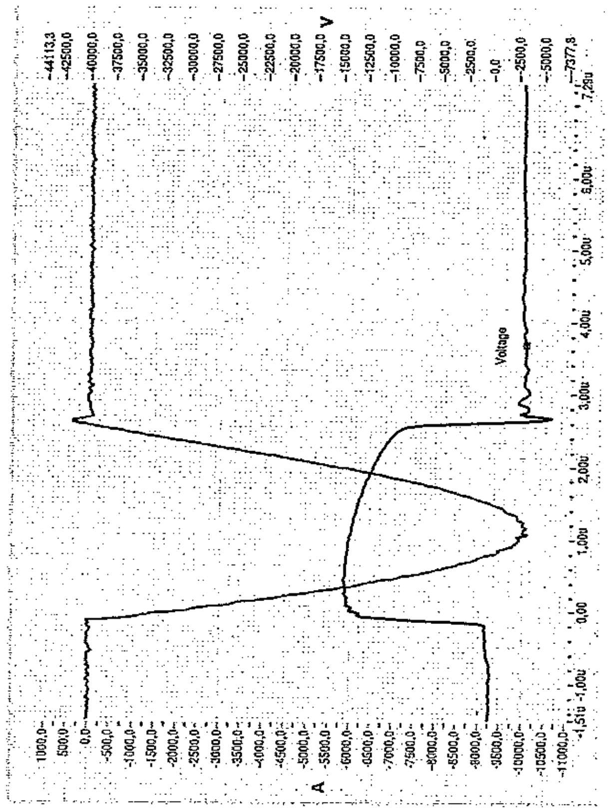
CESI B7023620 Oscillogram n. 7



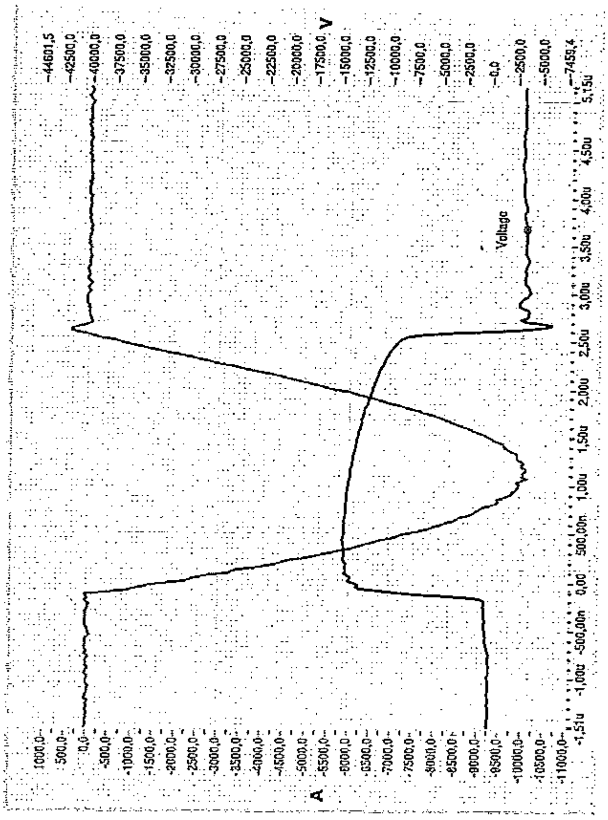
CESI B7023620 Oscillogram n. 10



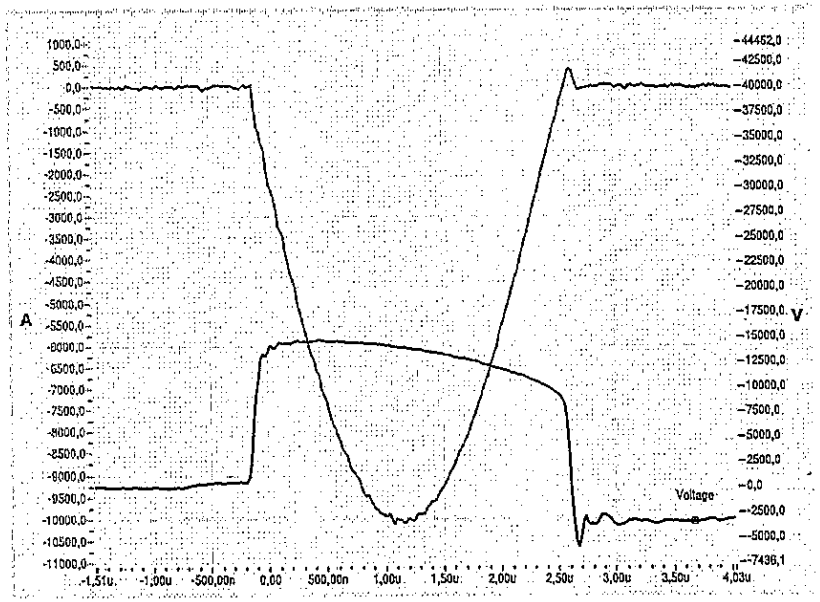
CESI B7023620 Oscillogram n. 9



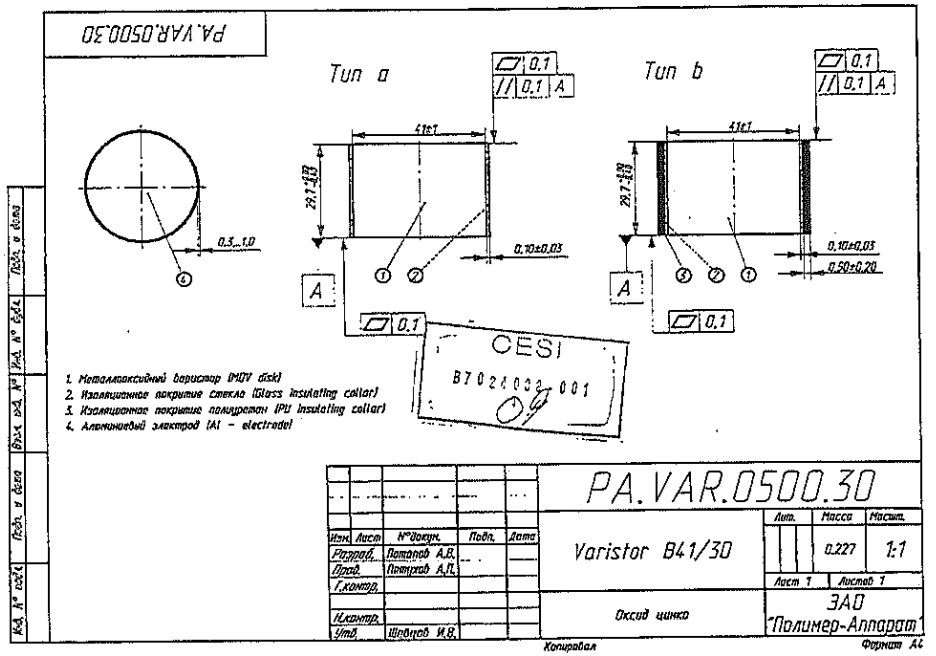
CESI B7023620 Oscillogram n. 12



CESI B7023620 Oscillogram n. 11



CESI B7023620 Oscillogram No.13



Test Report

Document No.	B7023946	Copy No. 1	Number of pages	108
Apparatus	Metal-Oxide resistors type B41/30			
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 23-28, 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 (2014-06)

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 28, 2017

Date

Gregori Marco
Test Engineer in charge

The Manager - Arcidiaco Lorenzo
Approved By Document Digitally Signed

ilac-MRA

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

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: 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 B7024038 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	November 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

content	page n	test date
Test object characteristics	5	
Photographs of the test samples	6	
Reference standard	7	
Test carried out	7	
Test object identification	7	
Test procedure	8	
Summary of the test result	9	
Residual voltage test at nominal discharge current	10	November 23, 2017
Reference voltage test before the test	11 to 12	November 23, 2017
Application of 1,1 times Q_{th}	13 to 25	November 23-27, 2017
Reference voltage test after the test	26 to 27	November 28, 2017
Residual voltage test at nominal discharge current	28	November 28, 2017
Withstand capability	29	November 28, 2017
Technical data of the test circuit	from page 30 to 31	
Pages annexed:		
Oscillograms : n.76 pages		
Client's drawing - CESI no. B7024038 – no. 1 page		

Test object characteristics (assigned by the client)

Manufacturer's name	Joint-Stock Company " Polymer-Apparat"
Arrester class	Distribution
Designation	DH
MO resistor type	B41/30
Drawing code	PA.VAR.0500.30
Nominal discharge current - [kA]	10,0
Maximum residual voltage at 10 kA - [kV]	13,60
Reference current - $I_{ref.}$ [mA]	1,5
Repetitive charge transfer rating – Q_{rs} [C]	0,5
Flat surface area [cm^2]	13,72
Rated frequency - [Hz]	48÷62
Year of manufacture	2017

geometrical characteristics measured on MO resistor

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

Photograph of the test object

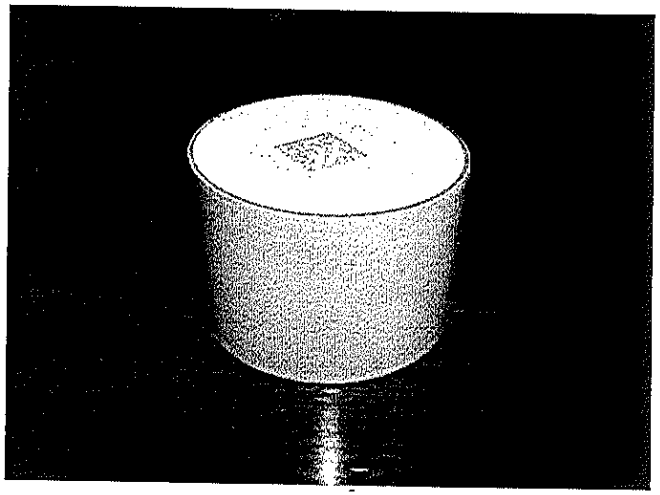


Photo no. 1

MO resistor type B41/30

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 /s/n of the test sample (given by JSC "Polymer Apparat)
Metal-oxide resistors type B41/30	RCT 1	709637b - 7
	RCT 2	709637b – 10
	RCT 3	709637b – 14
	RCT 4	709637b – 20
	RCT 5	709637b – 44
	RCT 6	709637b – 29
	RCT 7	709637b – 30
	RCT 8	709637b – 34
	RCT 9	709637b – 38
	RCT 10	709637b - 48

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_n 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 m 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 with only one 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_n equal to 0,5 C is proved.

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	10,20	13,54	9,98	13,82	2,07
RCT 2	10,16	13,36	10,11	13,65	2,17
RCT 3	10,16	13,30	10,16	13,56	1,95
RCT 4	9,93	13,63	9,93	13,89	1,90
RCT 5	10,13	13,42	10,00	13,75	2,45
RCT 6	10,20	13,28	—	—	—
RCT 7	10,09	13,44	9,98	13,81	2,75
RCT 8	10,10	13,42	10,06	13,81	2,90
RCT 9	9,94	13,61	9,95	13,97	2,64
RCT 10	10,13	13,36	10,05	13,71	2,62

Variation of the reference voltage at the reference current

sample	before test reference voltage	after test reference voltage	variation
	kV	kV	%
RCT 1	5,41	5,33	-1,47
RCT 2	5,32	5,24	-1,50
RCT 3	5,30	5,25	-0,94
RCT 4	5,48	5,42	-1,09
RCT 5	5,39	5,41	0,37
RCT 6	5,30	—	—
RCT 7	5,37	5,30	-1,30
RCT 8	5,36	5,28	-1,49
RCT 9	5,48	5,42	-1,09
RCT 10	5,33	5,38	0,94

Withstand capability to one 8/20 µs current impulse of at least 0,5 kA/cm^2 peak current density after the test

sample	discharge current	discharge voltage	Note
	kA	kV	
RCT 1	6,96	13,23	no mechanical damage
RCT 2	7,14	13,10	no mechanical damage
RCT 3	7,13	13,12	no mechanical damage
RCT 4	6,90	13,36	no mechanical damage
RCT 5	6,98	13,28	no mechanical damage
RCT 7	7,00	13,21	no mechanical damage
RCT 8	7,05	13,18	no mechanical damage
RCT 9	6,98	13,42	no mechanical damage
RCT 10	7,04	13,17	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: November 23, 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	8,6/18,2	10,20	13,54
RCT 2		24,1	2		10,16	13,36
RCT 3		24,1	3		10,16	13,30
RCT 4		24,1	4		9,93	13,63
RCT 5		24,1	5		10,13	13,42
RCT 6		24,1	6		10,20	13,28
RCT 7		24,1	7		10,09	13,44
RCT 8		24,1	8		10,10	13,42
RCT 9		24,1	9		9,94	13,61
RCT 10		24,1	10		10,13	13,36

Notes:

Test to verify the repetitive charge transfer rating, Qrs.

Reference voltage test at reference current before the test.

Test circuit: A0019

Date: November 23, 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	5,41	1,27	1,50	0,773	2,06	—

Sample No. RCT 2						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
12	5,32	1,52	1,51	0,783	2,09	—

Sample No. RCT 3						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
13	5,30	1,32	1,50	0,782	2,08	—

Sample No. RCT 4						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
14	5,48	1,30	1,50	0,782	2,12	—

Sample No. RCT 5						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
15	5,39	1,37	1,50	0,781	2,12	—

continued

continued

Date: November 23, 2017

Sample No. RCT 6						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
16	5,30	1,28	1,50	0,771	2,03	—

Sample No. RCT 7						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
17	5,37	1,36	1,50	0,786	2,14	—

Sample No. RCT 8						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
18	5,36	1,32	1,50	0,784	2,11	—

Sample No. RCT 9						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
19	5,48	1,35	1,50	0,785	2,14	—

Sample No. RCT 10						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
20	5,33	1,36	1,50	0,788	2,12	—

Test to verify the repetitive charge transfer rating, Qrs.

Date: November 23, 2017

Residual voltage correction factor and Q_{rs} calculations

Sample	$U_{res.}$	Length	$U_{res.stress}$	Max $U_{res.stress}$	0,97 x Max $U_{res.stress}$	Correction factor	Q_{rs} rating	Corrected Q_{rs}	Applicable range for Q_{rs}
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
No.	kV	mm	kV/mm	kV/mm	kV/mm	kV	C	C	C
RC 1	13,54	29,62	0,457	0,464	0,450	1,000	0,5	0,50	0,55÷0,60
RC 2	13,36	29,72	0,450			1,000		0,50	0,55÷0,60
RC 3	13,30	29,73	0,447			1,038		0,52	0,57÷0,62
RC 4	13,60	29,54	0,460			1,000		0,50	0,55÷0,60
RC 5	13,42	29,51	0,455			1,000		0,50	0,55÷0,60
RC 6	13,28	29,80	0,446			1,040		0,52	0,57÷0,62
RC 7	13,44	29,58	0,454			1,000		0,50	0,55÷0,60
RC 8	13,42	29,59	0,454			1,000		0,50	0,55÷0,60
RC 9	13,60	29,55	0,460			1,000		0,50	0,55÷0,60
RC 10	13,36	29,63	0,451			1,000		0,50	0,55÷0,60

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

[2] Length : length measured on each sample

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

[4] Max $U_{res.stress}$: 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 $U_{res.stress}$: 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 $U_{res.stress}$ declared by the manufacturer : 13,60 kV

Diameter Ø : 41,80 mm

Min. Thickness h declared by the manufacturer : 29,30 mm

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

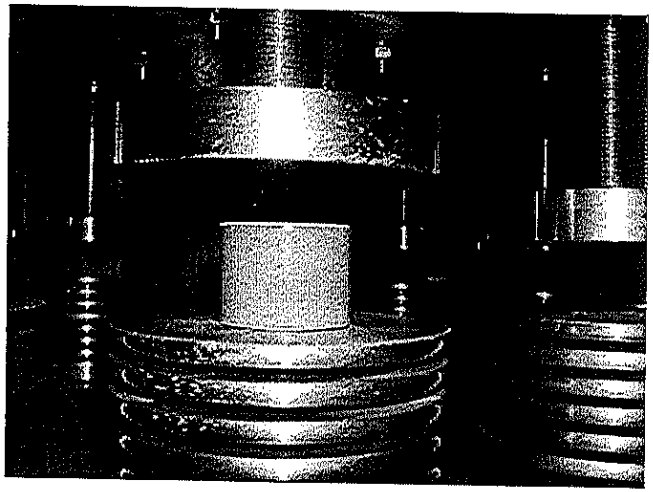


Photo no. 2

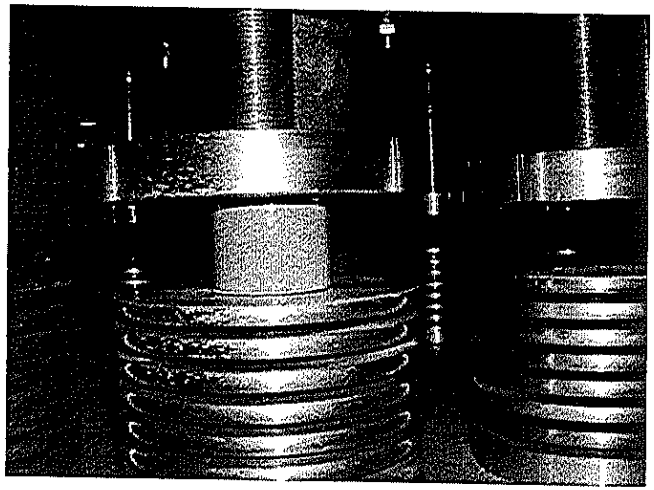


Photo no. 3

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: November 23÷27, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 1	1	67,0		38,70	0,570
	2	67,0	21	38,50	0,570
	3	66,9		38,20	0,565
	4	66,9		38,20	0,563
	5	66,9		38,05	0,563
	6	66,9		38,00	0,560
	7	66,8		38,65	0,570
	8	66,7		38,25	0,565
	9	66,6		37,70	0,560
	10	66,6	31	37,68	0,555
	11	66,6		37,30	0,555
	12	66,6		37,15	0,550
	13	66,6		37,30	0,555
	14	66,6		37,20	0,550
	15	66,6		37,95	0,560
	16	66,6		37,90	0,555
	17	66,6		37,40	0,555
	18	66,6		37,36	0,555
	19	66,6		37,26	0,550
	20	66,6	41	37,15	0,550

Current impulse waveshape
8,7/18,0 μs

Note:

continued

continued

Date: November 23÷27, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 2	1	67,0		38,65	0,570
	2	67,0	22	38,78	0,573
	3	66,9		38,60	0,570
	4	66,9		38,42	0,570
	5	66,9		38,50	0,570
	6	66,9		38,40	0,570
	7	66,8		38,50	0,575
	8	66,8		38,40	0,575
	9	66,7		38,01	0,565
	10	66,7	32	37,85	0,560
	11	66,7		37,75	0,560
	12	66,7		37,40	0,555
	13	66,7		37,52	0,560
	14	66,7		37,55	0,560
	15	66,7		38,19	0,565
	16	66,7		37,97	0,560
	17	66,7		37,63	0,560
	18	66,7		37,47	0,555
	19	66,7		37,49	0,555
	20	66,7	42	37,36	0,555

Current impulse waveshape
8,7/18,0 μs

Notes:

continued

continued

Date: November 23÷27, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 3	1	67,1		39,25	0,580
	2	67,1	23	39,16	0,579
	3	67,1		39,10	0,580
	4	67,1		39,05	0,580
	5	67,1		39,02	0,580
	6	67,1		38,85	0,578
	7	67,1		38,38	0,575
	8	67,1		38,30	0,575
	9	67,0		38,65	0,575
	10	67,0	33	38,50	0,575
	11	67,0		38,26	0,573
	12	67,0		38,15	0,570
	13	67,0		38,24	0,570
	14	67,0		38,22	0,570
	15	67,0		38,50	0,575
	16	67,0		38,31	0,570
	17	67,0		38,29	0,571
	18	67,0		38,26	0,570
	19	67,0		38,25	0,570
	20	67,0	43	38,20	0,570

Current impulse waveshape
8,7/18,0 µs

Notes:

"EMI Electric" LTD

continued

continued

Date: November 23÷27, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 4	1	67,1		39,38	0,580
	2	67,0	24	39,04	0,575
	3	66,9		38,85	0,577
	4	66,9		38,90	0,580
	5	66,9		38,80	0,577
	6	66,9		38,73	0,575
	7	66,8		38,98	0,580
	8	66,8		38,70	0,575
	9	66,7		38,15	0,565
	10	66,7	34	38,00	0,565
	11	66,7		37,85	0,563
	12	66,7		37,75	0,560
	13	66,7		37,76	0,560
	14	66,7		37,82	0,562
	15	66,7		37,96	0,565
	16	66,7		37,83	0,560
	17	66,7		37,82	0,560
	18	66,7		37,78	0,560
	19	66,7		37,70	0,560
	20	66,7	44	37,68	0,560

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: November 23÷27, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 5	1	67,0		39,40	0,580
	2	67,0	25	39,30	0,580
	3	66,9		39,40	0,580
	4	66,9		39,30	0,583
	5	66,8		39,07	0,579
	6	66,8		38,95	0,578
	7	66,7		38,90	0,575
	8	66,7		38,60	0,575
	9	66,6		38,55	0,575
	10	66,5	35	38,20	0,570
	11	66,5		38,36	0,570
	12	66,5		38,28	0,570
	13	66,5		38,41	0,570
	14	66,5		38,33	0,570
	15	66,5		38,45	0,570
	16	66,5		38,29	0,570
	17	66,5		38,39	0,570
	18	66,5		38,24	0,570
	19	66,5		38,32	0,570
	20	66,5	45	38,20	0,569

Current impulse waveshape
8,7/18,0 µs

Notes:

"ЕМИ Електрик" ЕООД
ВЯРНО С ОРИГИНАЛА

continued

continued

Date: November 23÷27, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 6	1	67,0		39,87	0,585
	2	67,0	26	39,65	0,582
	3	67,0		39,62	0,585
	4	66,9		39,33	0,583
	5	66,9	36	failure occurred during 8/20 impulse application	
	6	—		—	—
	7	—		—	—
	8	—		—	—
	9	—		—	—
	10	—		—	—
	11	—		—	—
	12	—		—	—
	13	—		—	—
	14	—		—	—
	15	—		—	—
	16	—		—	—
	17	—		—	—
	18	—		—	—
	19	—		—	—
	20	—		—	—

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

Test sample RCT 6 after the test

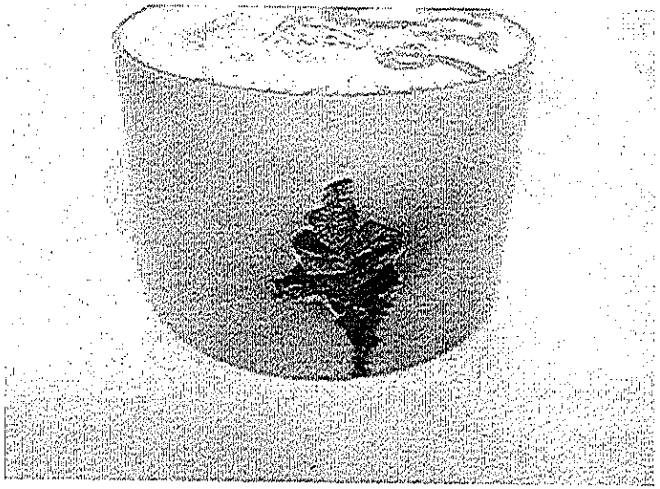


Photo no. 4

continued

Date: November 23÷27, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 7	1	66,8		39,61	0,580
	2	66,8	27	39,30	0,578
	3	66,8		39,40	0,580
	4	66,8		39,22	0,580
	5	66,7		39,00	0,580
	6	66,5		38,73	0,577
	7	66,5		38,87	0,577
	8	66,5		38,67	0,575
	9	66,4		38,50	0,575
	10	66,4	37	38,30	0,570
	11	66,4		38,26	0,570
	12	66,4		38,09	0,567
	13	66,4		38,30	0,570
	14	66,4		38,15	0,567
	15	66,4		38,36	0,570
	16	66,4		38,24	0,570
	17	66,4		38,32	0,570
	18	66,4		38,30	0,570
	19	66,4		38,20	0,570
	20	66,4	47	38,19	0,570

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: November 23÷27, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 8	1	66,8		38,65	0,570
	2	66,8	28	38,60	0,570
	3	66,8		38,70	0,575
	4	66,8		38,55	0,572
	5	66,7		38,26	0,569
	6	66,7		38,30	0,569
	7	66,7		38,35	0,569
	8	66,7		38,40	0,570
	9	66,6		37,80	0,560
	10	66,6	38	37,67	0,560
	11	66,6		37,84	0,560
	12	66,6		37,50	0,555
	13	66,6		37,65	0,560
	14	66,6		37,60	0,550
	15	66,6		37,80	0,560
	16	66,6		37,75	0,555
	17	66,6		37,70	0,560
	18	66,6		37,55	0,555
	19	66,6		37,57	0,555
	20	66,6	48	37,59	0,555

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: November 23÷27, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 9	1	67,0		37,40	0,550
	2	67,0	29	37,35	0,550
	3	67,0		37,48	0,550
	4	67,0		37,45	0,550
	5	67,0		37,27	0,550
	6	67,0		37,39	0,550
	7	67,0		37,89	0,555
	8	67,0		37,83	0,555
	9	67,0		37,25	0,550
	10	67,0	39	37,24	0,550
	11	67,0		37,10	0,550
	12	67,0		37,12	0,550
	13	67,0		37,25	0,550
	14	67,0		37,30	0,550
	15	67,0		37,25	0,550
	16	67,0		37,40	0,550
	17	67,0		37,45	0,550
	18	67,0		37,24	0,550
	19	67,0		37,10	0,550
	20	67,0	49	37,15	0,550

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: November 23÷27, 2017

Sample No.	Impulse No.	Charging voltage kV	Oscillogram No.	Peak current kA	Charge C
RCT 10	1	66,9		37,40	0,550
	2	66,9	30	37,50	0,550
	3	67,0		37,68	0,555
	4	67,0		37,62	0,555
	5	67,0		37,55	0,555
	6	67,0		37,50	0,555
	7	67,0		37,90	0,560
	8	67,0		37,86	0,560
	9	67,0		37,50	0,555
	10	67,0	40	37,35	0,550
	11	67,0		37,36	0,550
	12	67,0		37,32	0,550
	13	67,0		37,30	0,550
	14	67,0		37,28	0,550
	15	67,0		37,46	0,550
	16	67,0		37,36	0,550
	17	67,0		37,20	0,550
	18	67,0		37,31	0,550
	19	67,0		37,20	0,550
	20	67,0	50	37,18	0,550

Current impulse waveshape
8,7/18,0 µs

Notes:

Test to verify the repetitive charge transfer rating, Qrs.

Reference voltage test at reference current after the test.

Test circuit: A0019

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

Sample No. RC 1						
oscillogram No.	voltage kV	current $+mA_{cr}$	current $-mA_{cr}$	current mA_{rms}	power W	note:
51	5,33	0,859	1,50	0,721	1,76	—

Sample No. RC 2						
oscillogram No.	voltage kV	current $+mA_{cr}$	current $-mA_{cr}$	current mA_{rms}	power W	note:
52	5,24	0,909	1,50	0,733	1,80	—

Sample No. RC 3						
oscillogram No.	voltage kV	current $+mA_{cr}$	current $-mA_{cr}$	current mA_{rms}	power W	note:
53	5,25	0,903	1,50	0,731	1,80	—

Sample No. RC 4						
oscillogram No.	voltage kV	current $+mA_{cr}$	current $-mA_{cr}$	current mA_{rms}	power W	note:
54	5,42	0,862	1,50	0,723	1,78	—

Sample No. RC 5						
oscillogram No.	voltage kV	current $+mA_{cr}$	current $-mA_{cr}$	current mA_{rms}	power W	note:
55	5,41	0,875	1,50	0,725	1,79	—

continued

continued

Date: November 28, 2017

Sample No. RC 6						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
56	-	-	-	-	-	—

Sample No. RC 7						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
57	5,30	0,909	1,50	0,731	1,82	—

Sample No. RC 8						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
58	5,28	0,897	1,50	0,728	1,81	—

Sample No. RC 9						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
59	5,42	0,878	1,50	0,728	1,81	---

Sample No. RC 10						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
60	5,38	1,08	1,50	0,762	1,88	---

"EMI Electric" Ltd "ЕМИ Електрик" ЕООД

ВЯРНО С ОРИГИНАЛА

ilac-MRA ACCREDIA LAB N° 0030

Test to verify the repetitive charge transfer rating, Qrs.

Residual voltage test at nominal discharge current after the test.

Test circuit: A0120

Date: November 28, 2017

Sample	Requested current	Charging Voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.	kA	kV	No.	µs	kA	kV
RC 1	10,0	24,2	61	8,9/18,1	9,98	13,82
RC 2		24,2	62		10,11	13,65
RC 3		24,2	63		10,16	13,56
RC 4		24,2	64		9,93	13,89
RC 5		24,2	65		10,00	13,75
RC 6		-	66		—	—
RC 7		24,2	67		9,98	13,81
RC 8		24,2	68		10,06	13,81
RC 9		24,2	69		9,95	13,97
RC 10		24,2	70		10,05	13,71

Notes:

ilac-MRA ACCREDIA LAB N° 0030

83

Test to verify the repetitive charge transfer rating, Qrs.

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

Test circuit: A0120

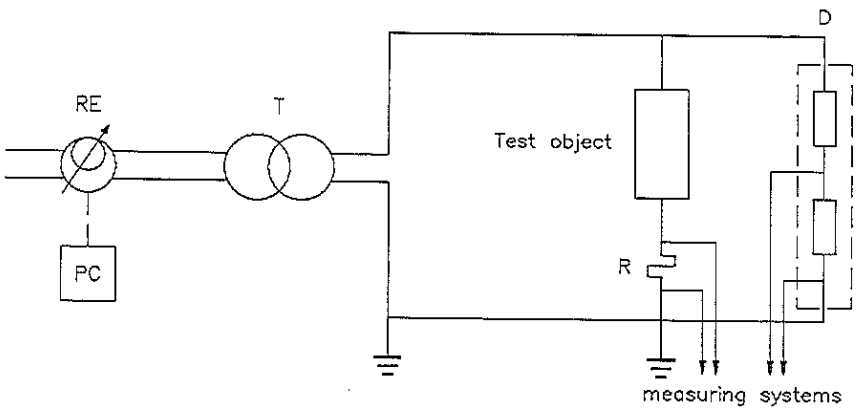
Date: November 28, 2017

Sample	Requested current	Charging Voltage	Oscillogram	Current waveshape	Discharge current	Discharge voltage
No.	kA	kV	No.	µs	kA	kV
RC 1	6,86 (*)	20,1	71	8,3/19,0	6,96	13,23
RC 2		20,1	72		7,14	13,10
RC 3		20,1	73		7,13	13,12
RC 4		20,1	74		6,90	13,36
RC 5		20,1	75		6,98	13,22
RC 6		-	76		-	-
RC 7		20,1	77		7,00	13,21
RC 8		20,1	78		7,05	13,18
RC 9		20,2	79		6,98	13,42
RC 10		20,1	80		7,04	13,17

Notes:

(*) Requested current = 0,5 kA/cm^2 x 13,72 cm^2 = 6,86 kA
- where 0,5 kA/cm^2 is peak current density
- where 13,72 cm^2 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

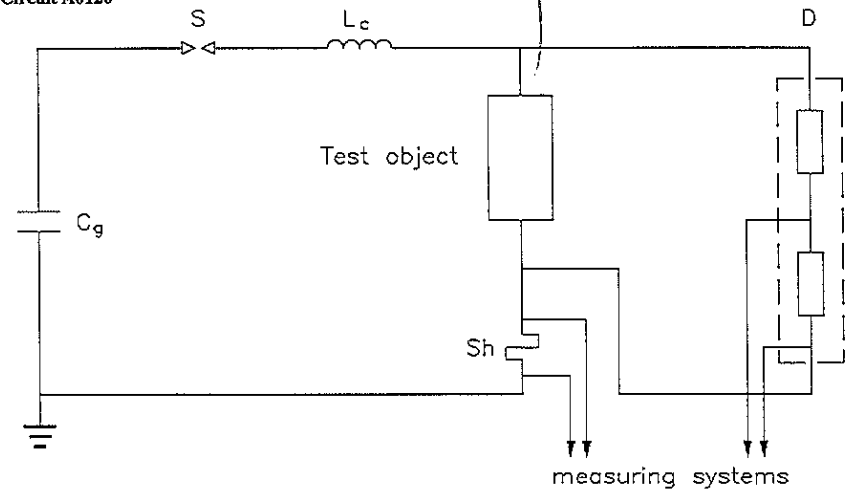
D - Voltage divider SAGI; CESI No.11120
Electro optical system type HBM CESI No. 57986(Rx) – 57991 (Tx)

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

Software systems

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.

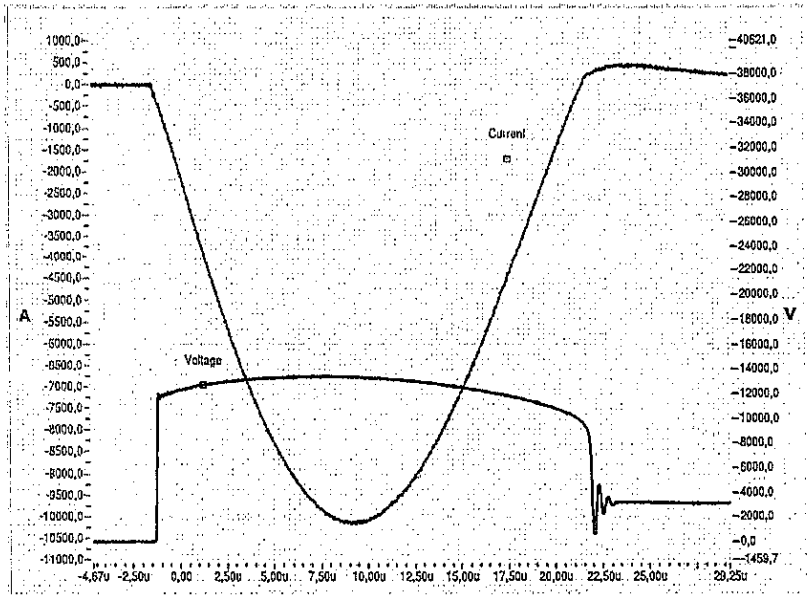
D - Voltage divider SAGI; CESI No.11120
-Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)
- Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.2)

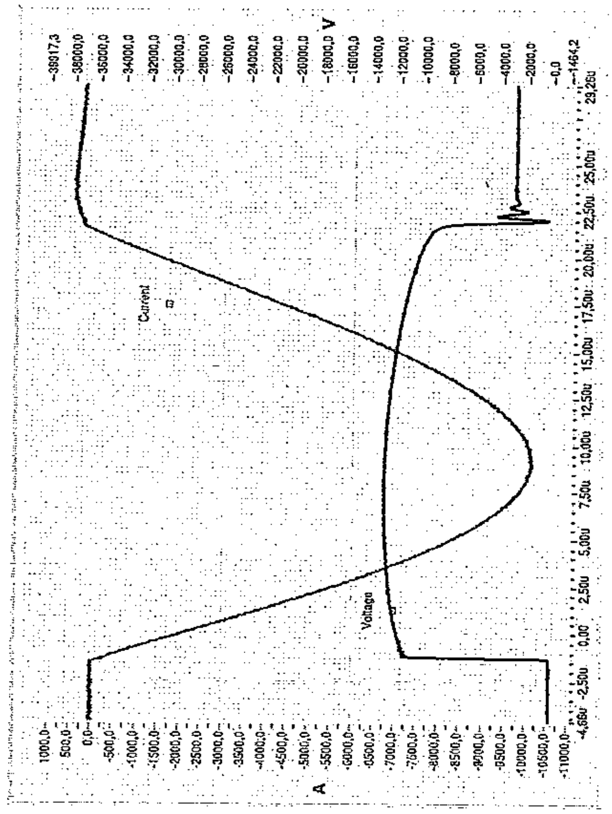
Current measuring system

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

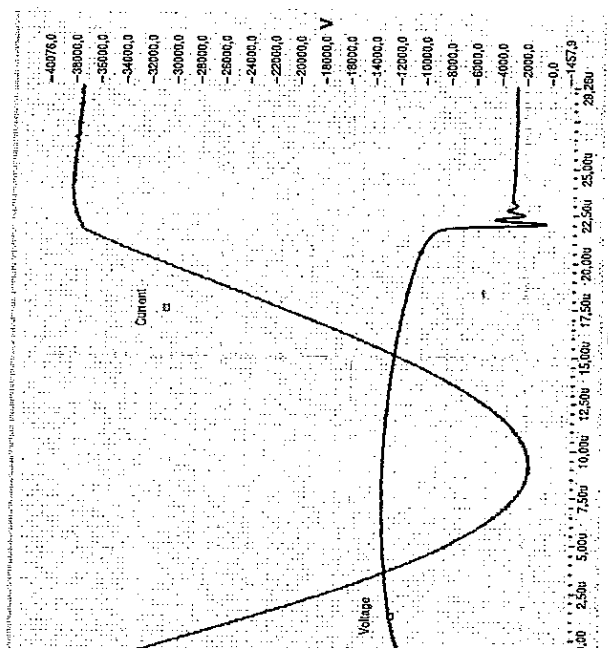
Software system:
S.A.D. Surge arrester version 2.0

CESI B7023946 Oscillogram n. 1





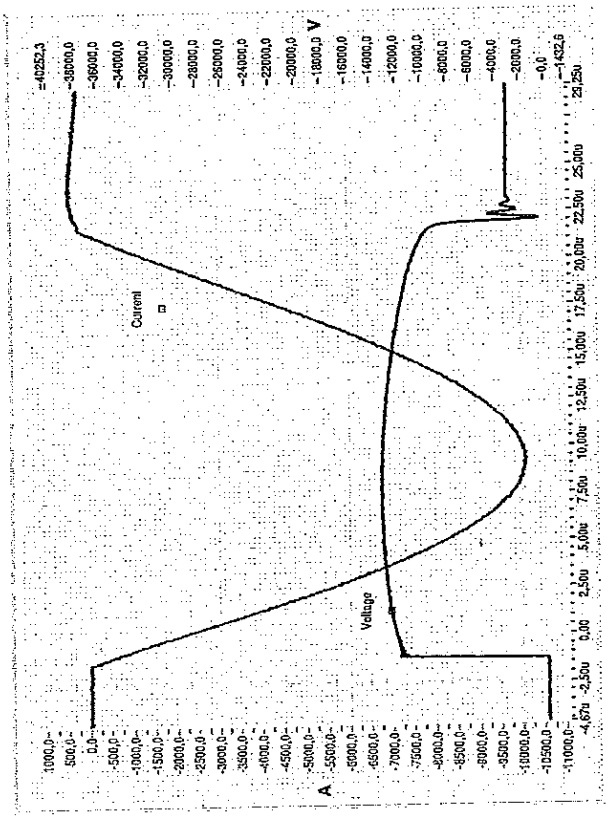
CESI B7023946 Oscillogram n. 3



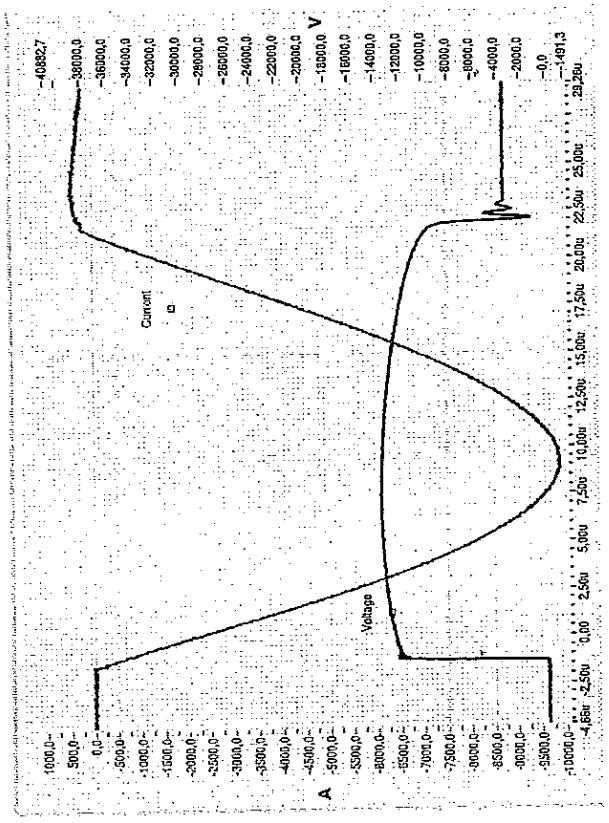
CESI B7023946 Oscillogram n. 2

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ ЕЛЕКТРИК" ЕООД



CESI B7023945 Oscillogram n. 5

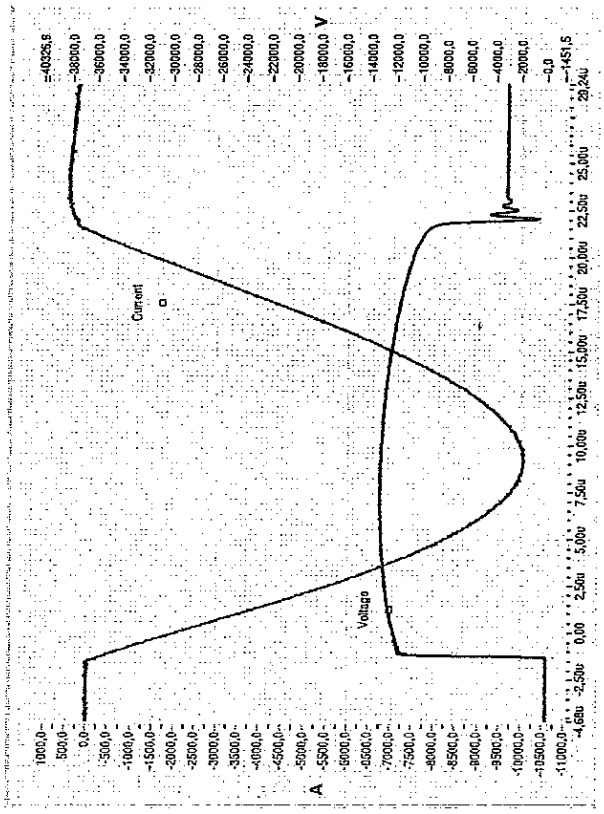


CESI B7023946 Oscillogram n.

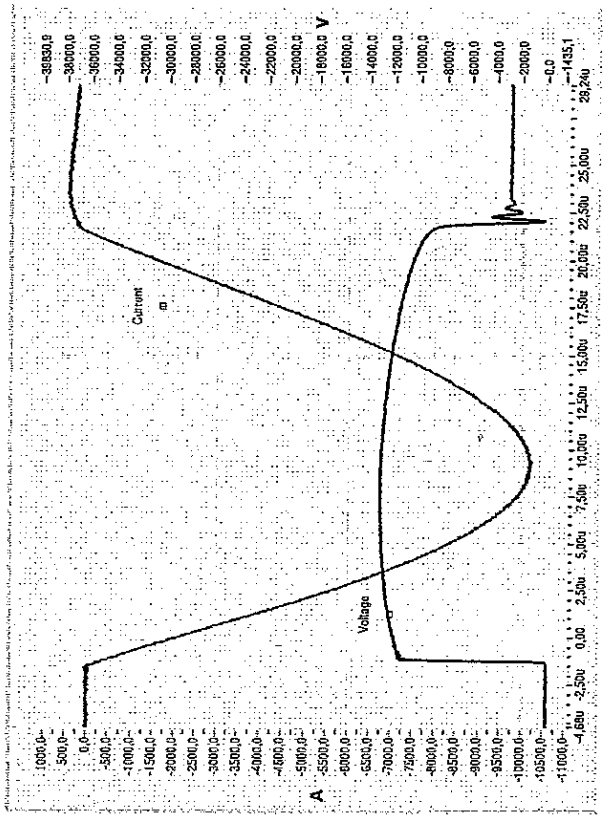
ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD

87



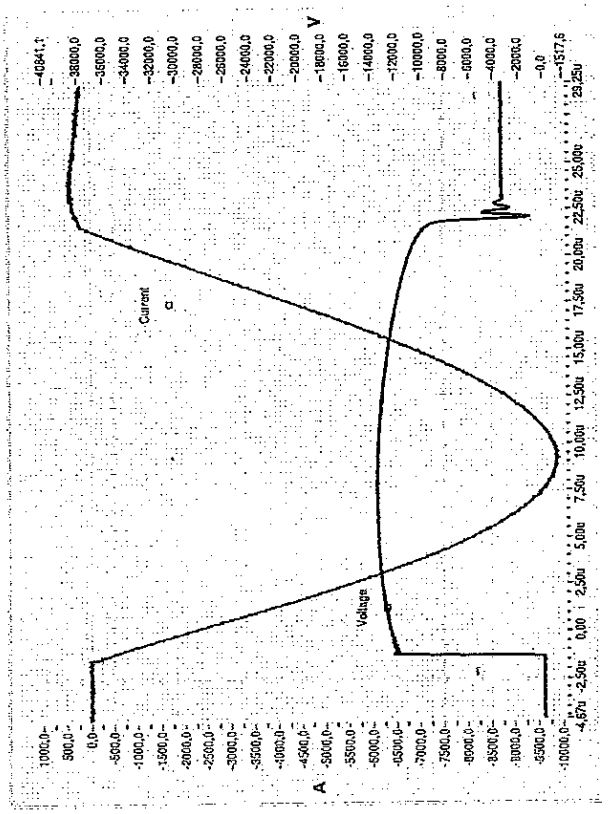
CESI B7023946 Oscillogram n. 7



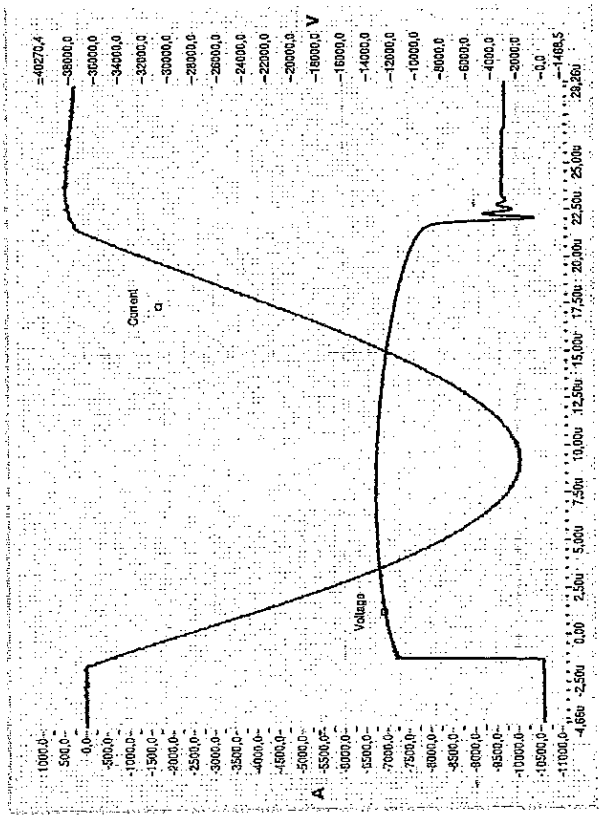
CESI B7023946 Oscillogram n. 6

ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD



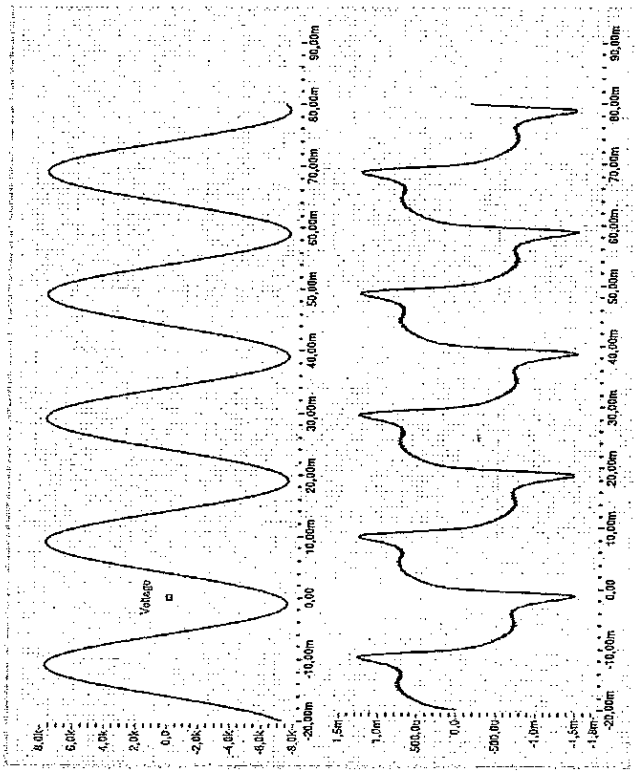
CESIB7023946 Oscillogram n. 9



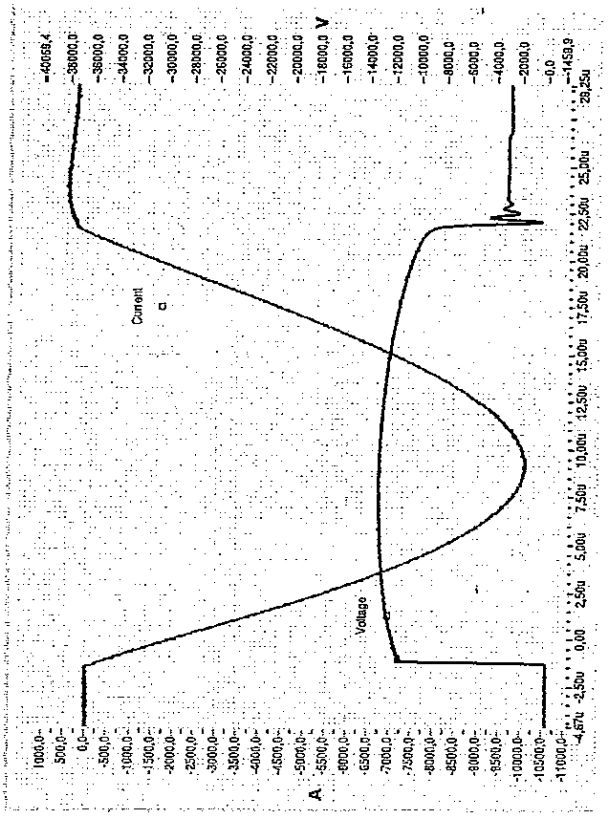
CESIB7023946 Oscillogram n. 8

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD



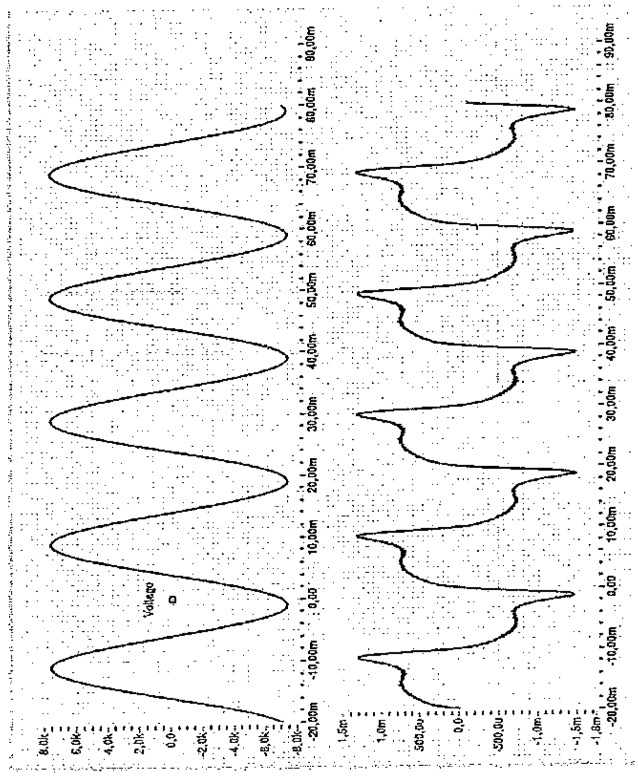
CESI B7023946 Oscillogramm n. 11



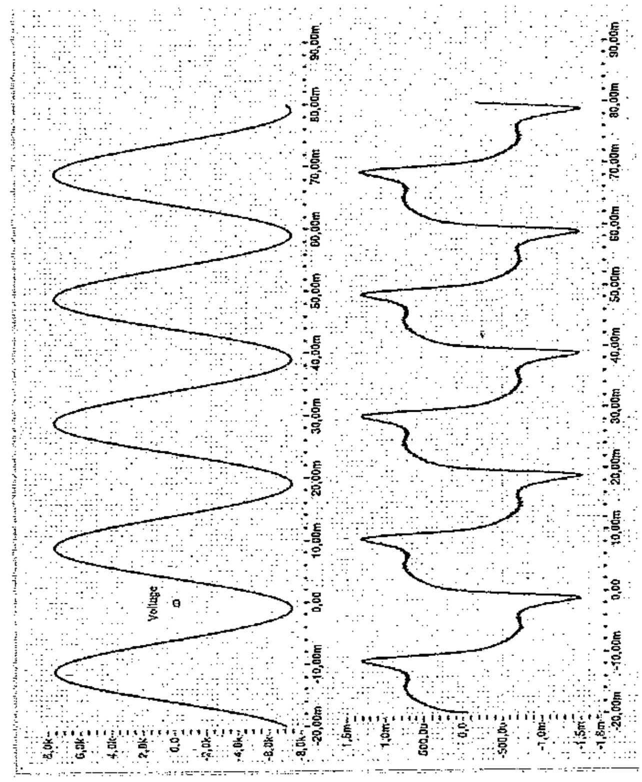
CESI B7023946 Oscillogramm n. 10

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ ЕЛЕКТРИК" ЕООД



CESI B7023946 Oscillogram n. 13

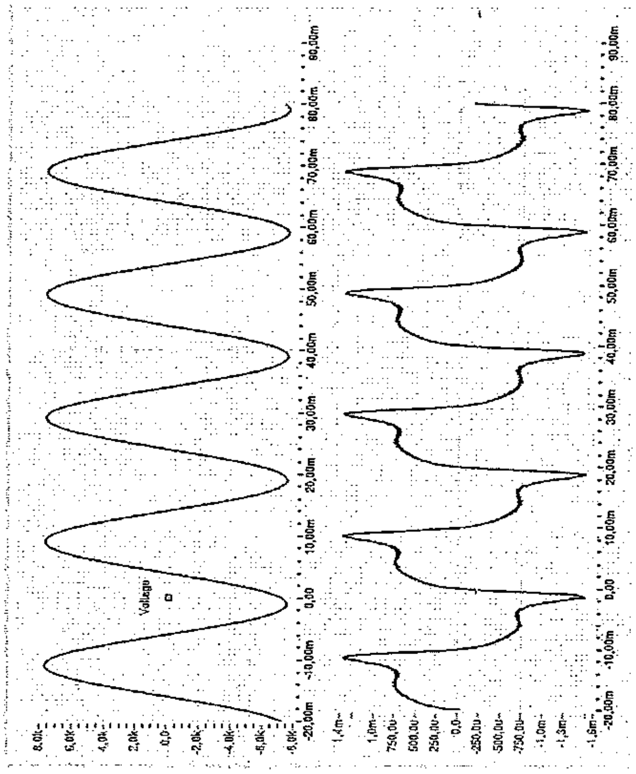


CESI B7023946 Oscillogram n. 12

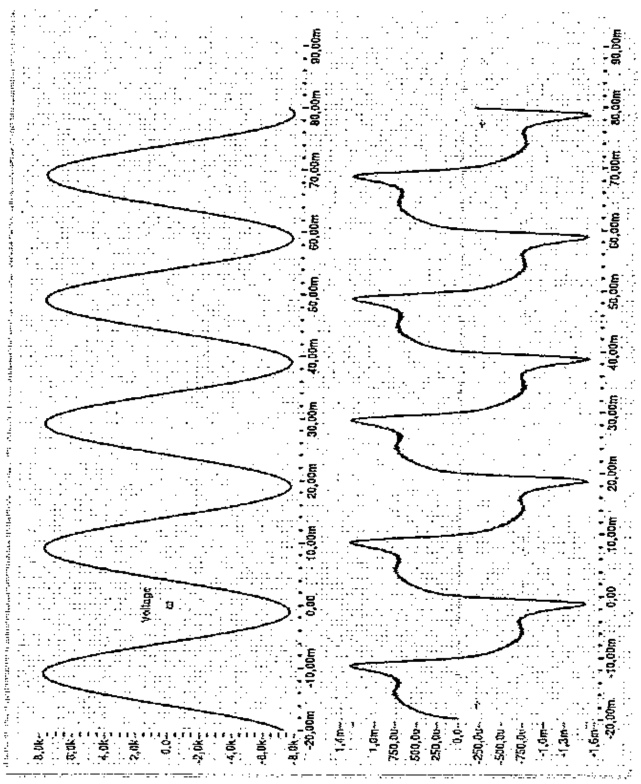
ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD
„ЕМИ ЕЛЕКТРИК" ЕООД

91



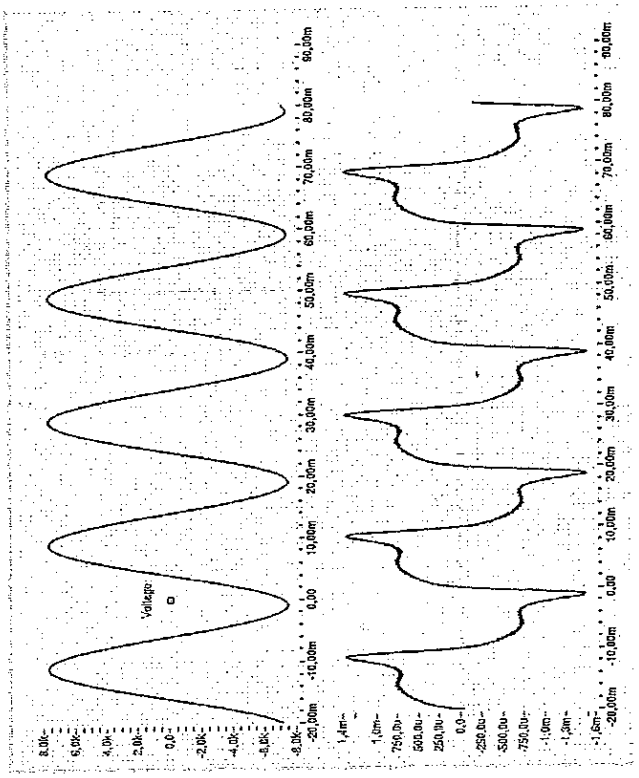
CESI B7023946 Oscillogram n. 15



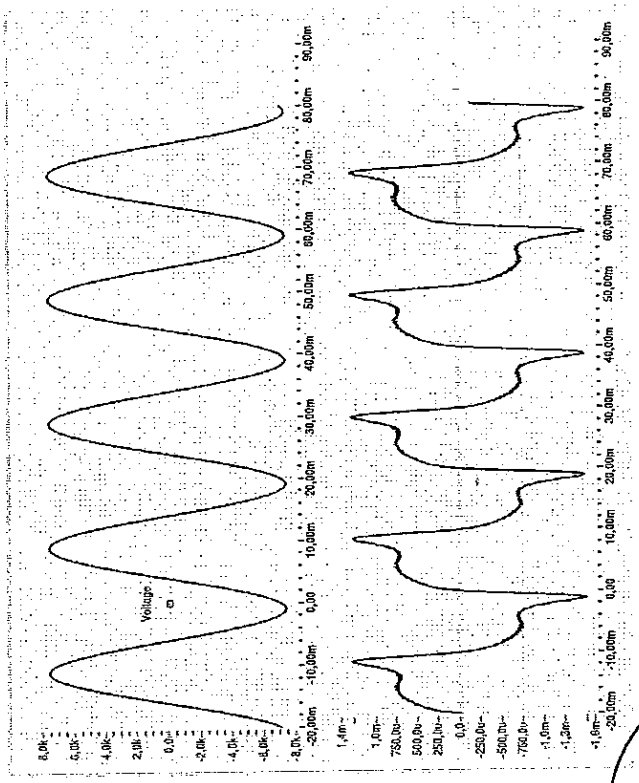
CESI B7023946 Oscillogram n. 14

ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ ЕЛЕКТРИК" ЕООД



CESI B7023946 Oscillogramm n. 17

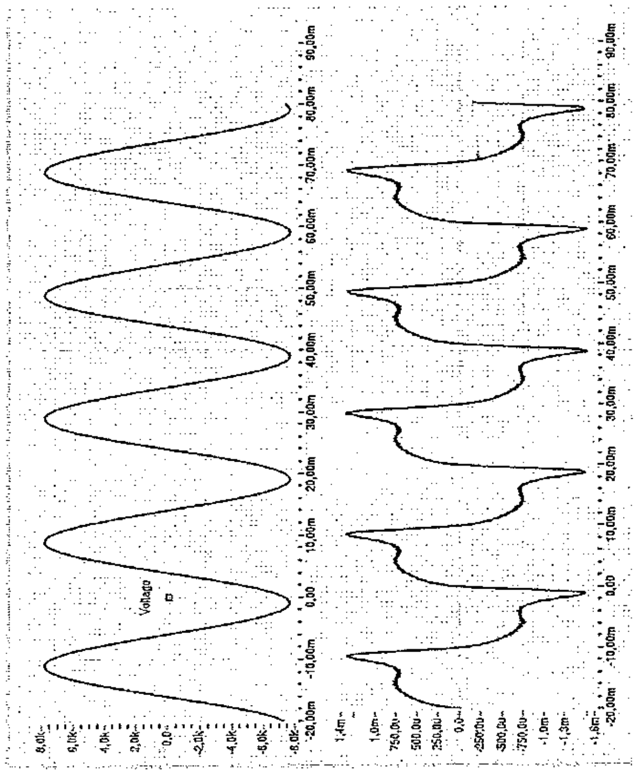


CESI B7023946 Oscillogramm n. 16

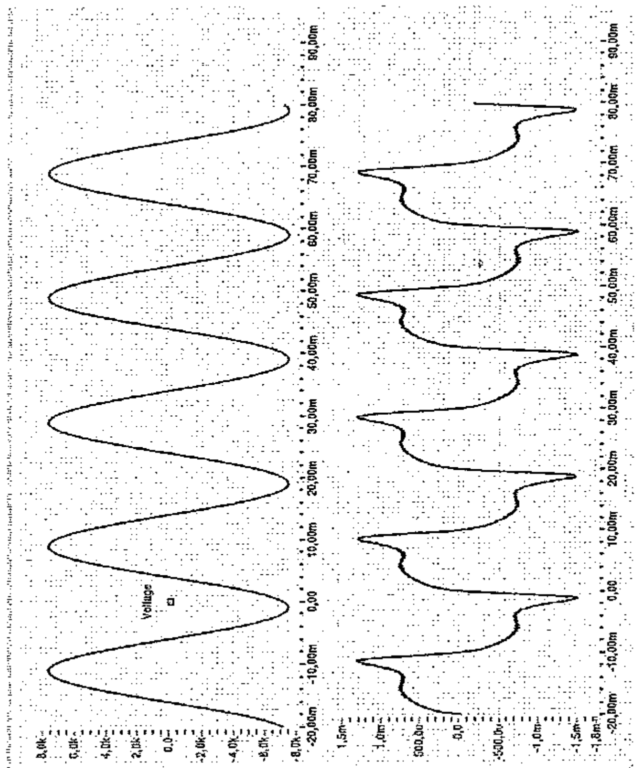
ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD

.93



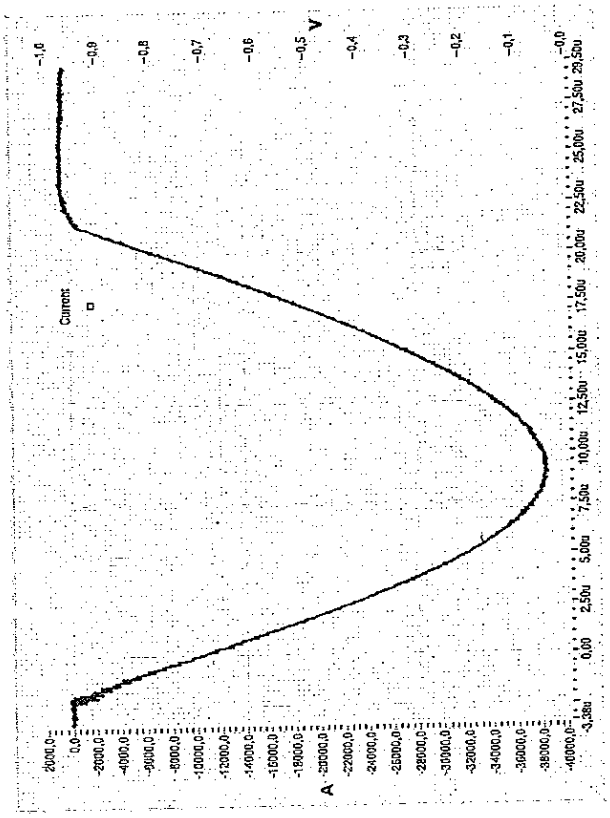
CESI B7023946 Oscillogram n. 19



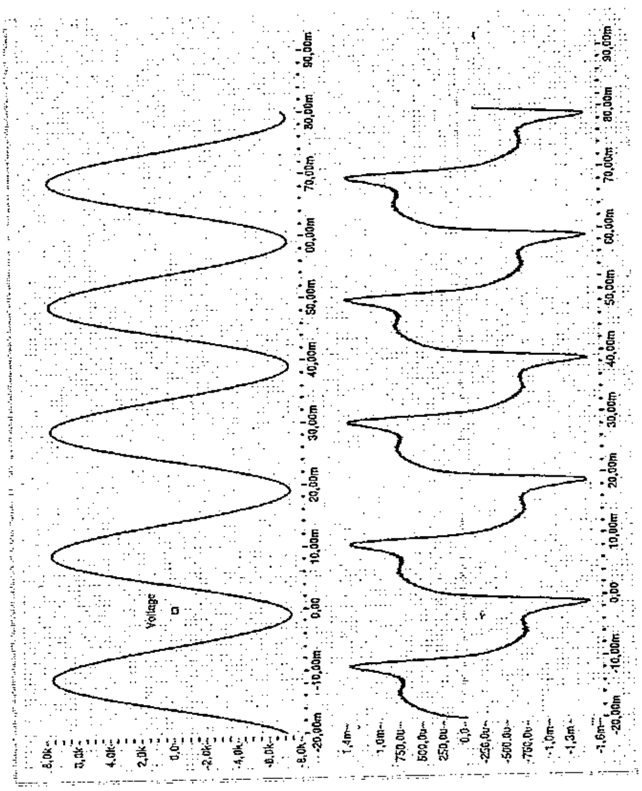
CESI B7023946 Oscillogram n. 18

ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ ЕЛЕКТРИК" ЕООД



CESI B7023946 Oscillogram n. 21

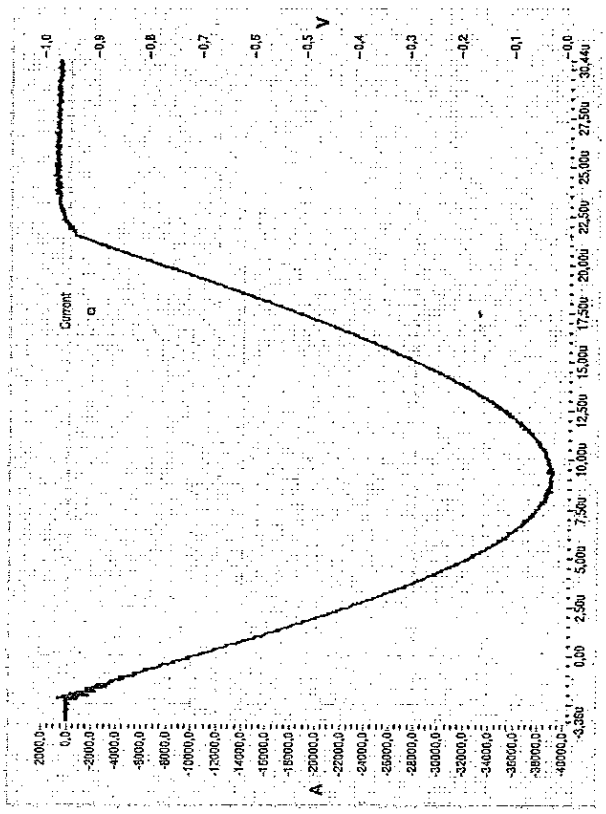


CESI B7023946 Oscillogram n. 20

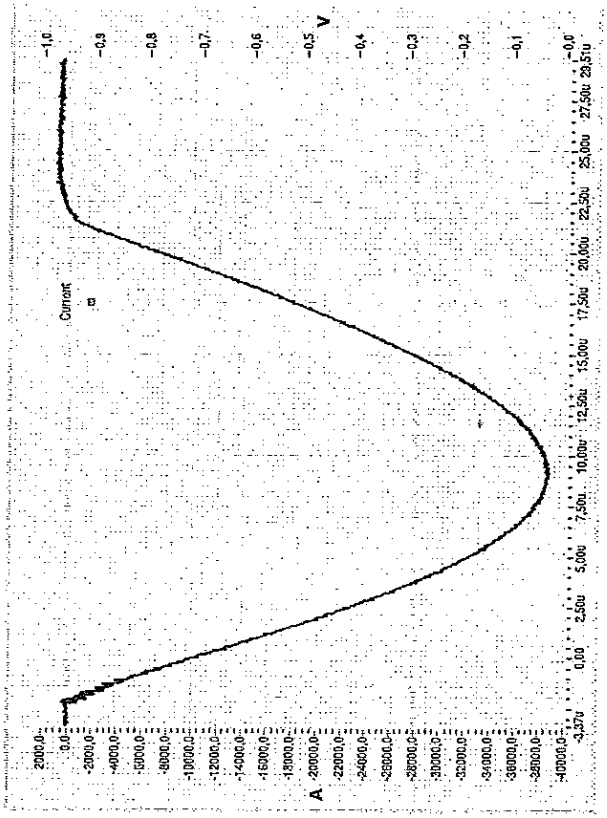
ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD

9.



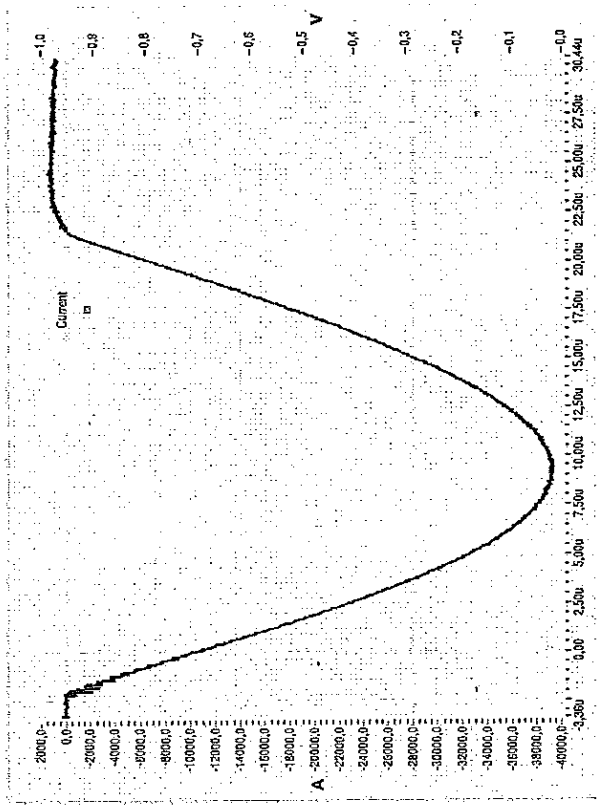
CESI B7023946 Oscillogram n. 23



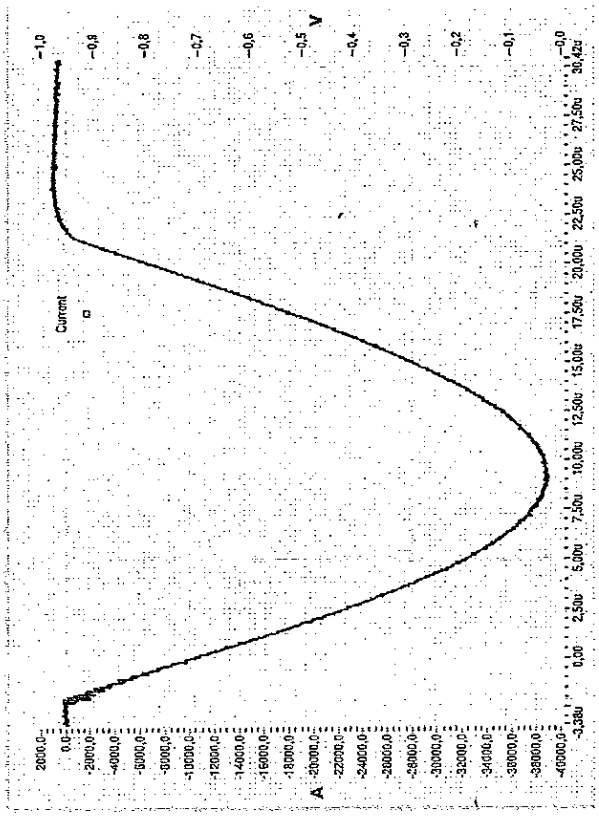
CESI B7023946 Oscillogram n. 22

ВЯРНО
ОРИГИНА

"EMI Electric" LTD



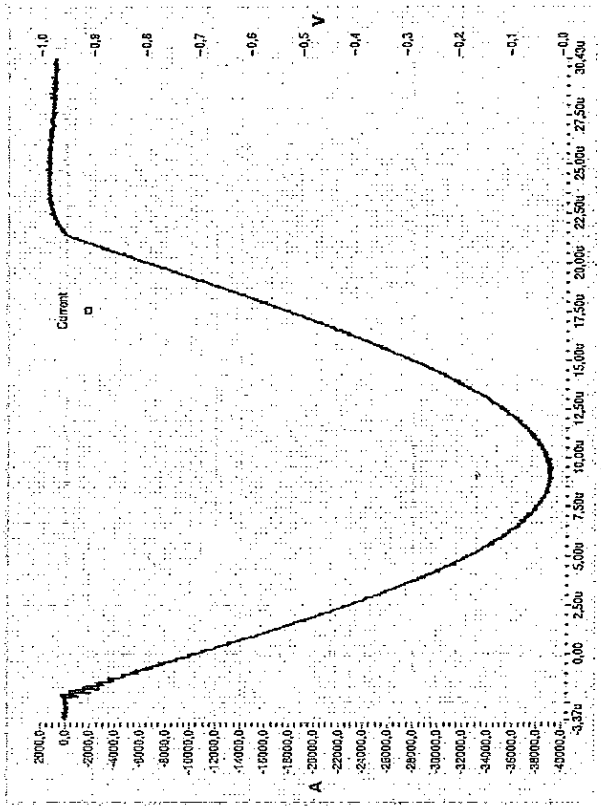
CESI B7023946 Oscillogramm n. 25



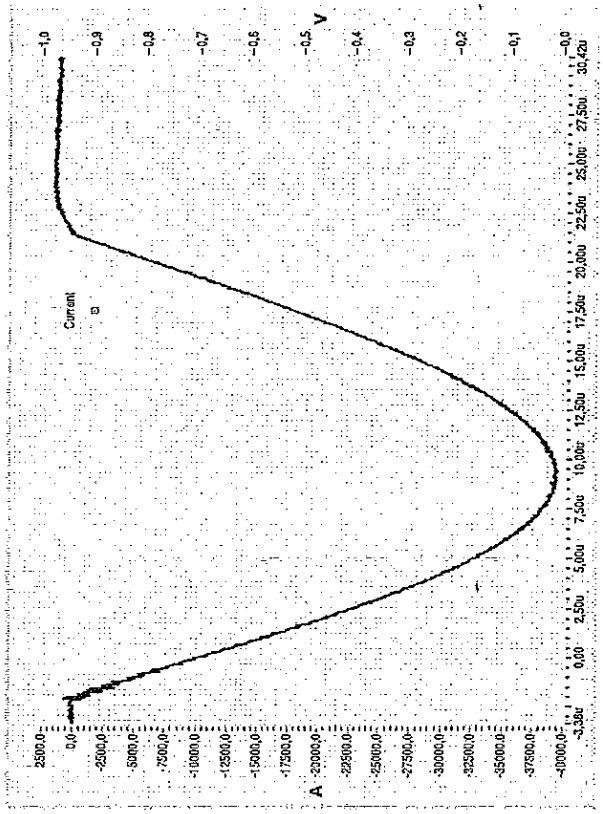
CESI B7023946 Oscillogramm n. 24

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD



CESI B7023946 Oscillogram n. 27

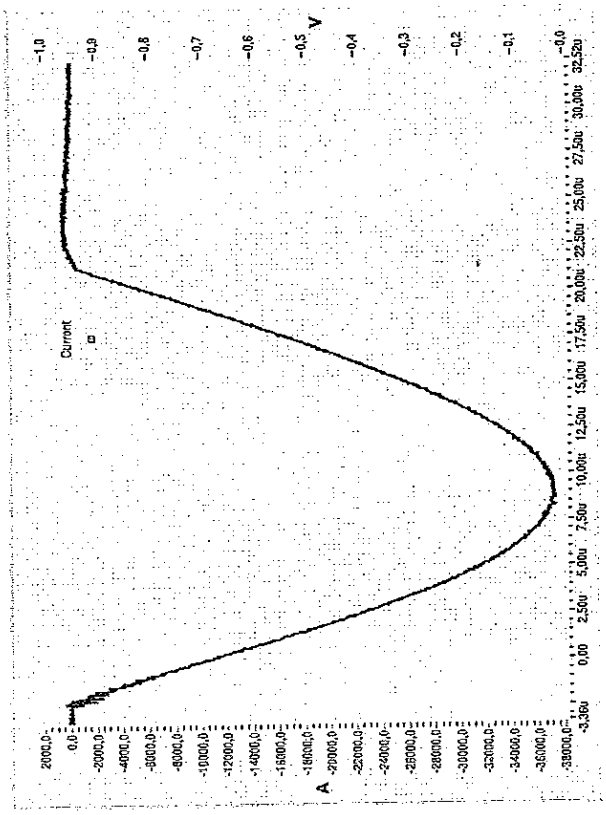


CESI B7023946 Oscillogram n. 28

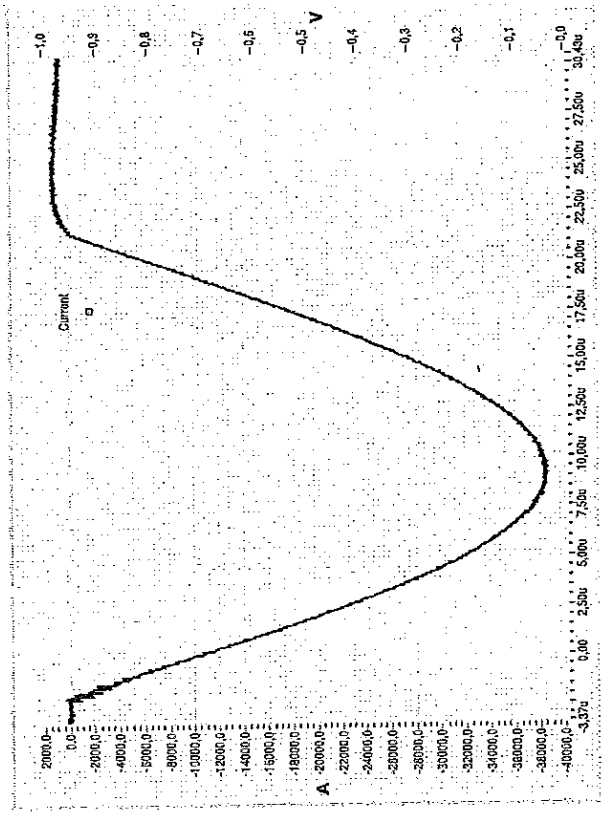
ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ Електрик" ЕООД

9B



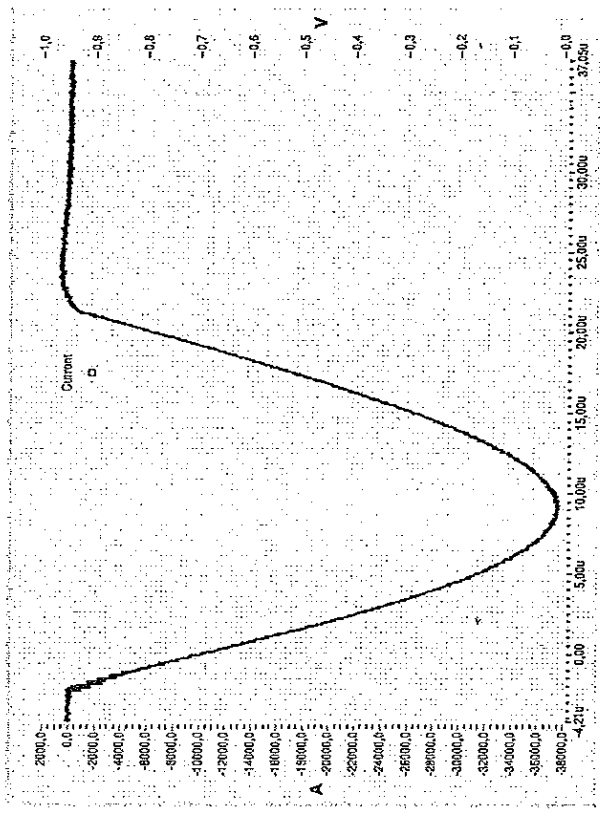
CESI B7023946 Oscillogram n. 29



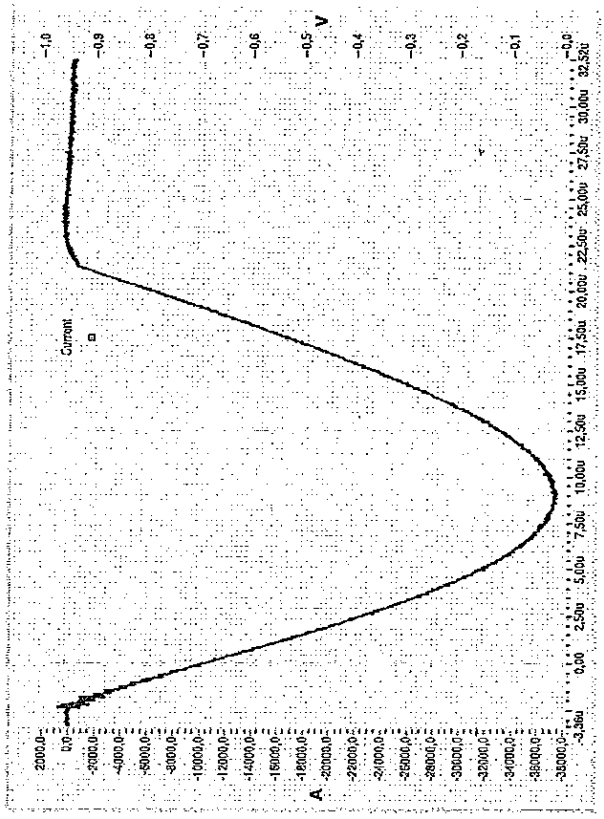
CESI B7023946 Oscillogram n. 28

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD



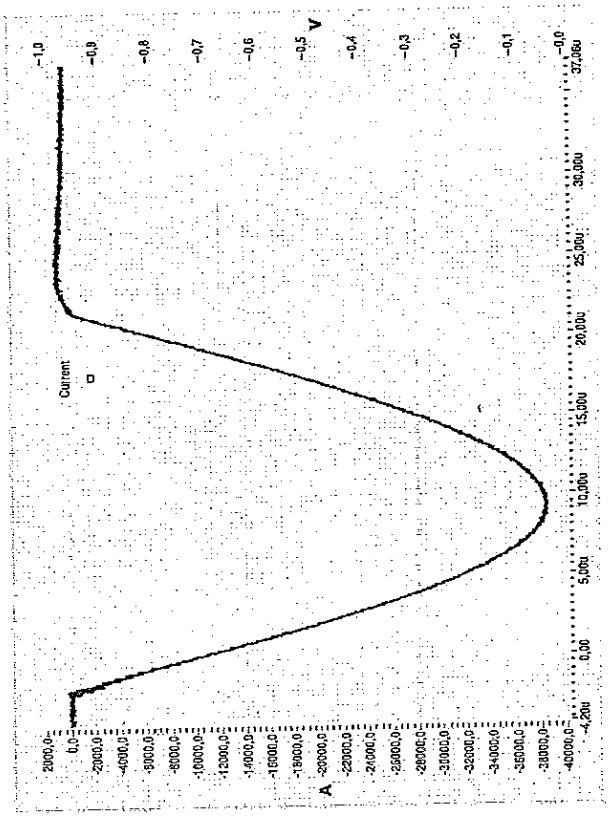
CESI B7023946 Oscillogram n. 31



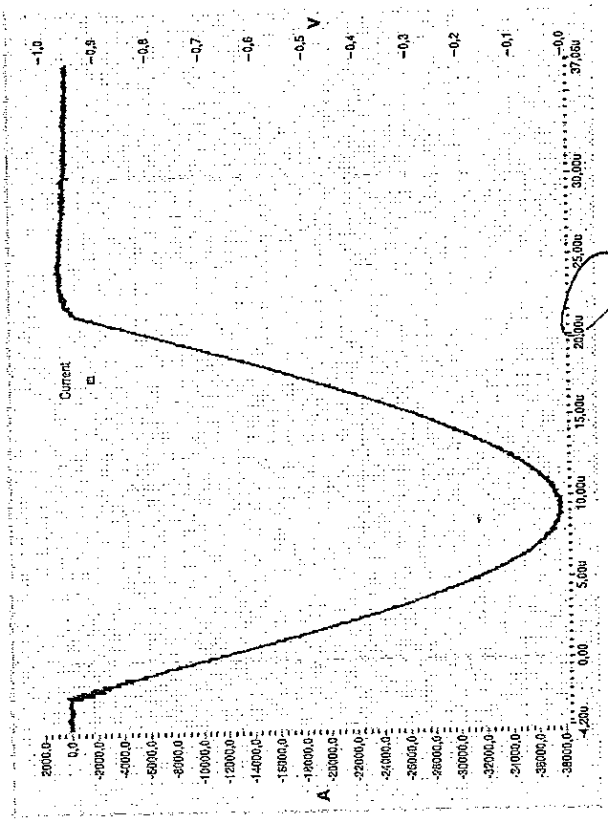
CESI B7023946 Oscillogram n. 30

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ ЕЛЕКТРИК" ЕООД



CESI B7023946 Oscillogramm n. 33

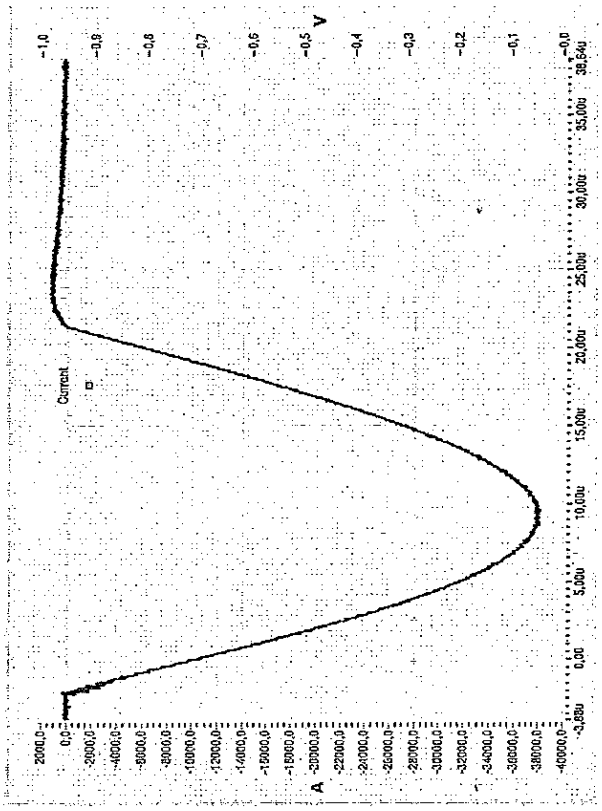


CESI B7023946 Oscillogramm n. 32

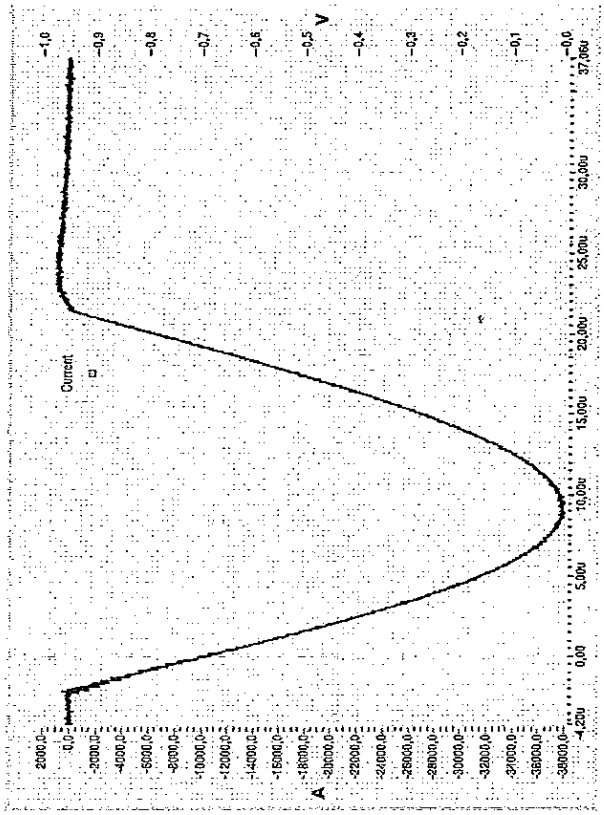
ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ Електрик" ЕООД

10



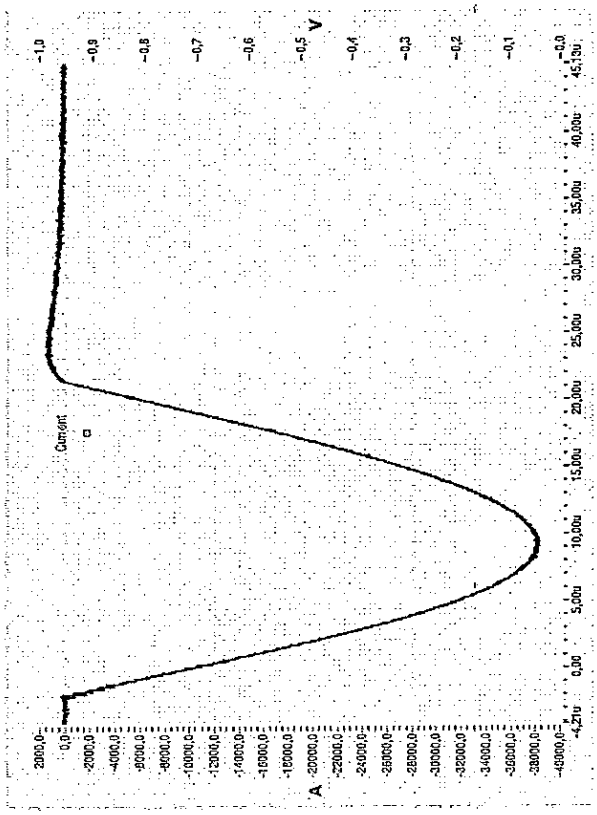
CESI B7023946 Oscillogram n. 35



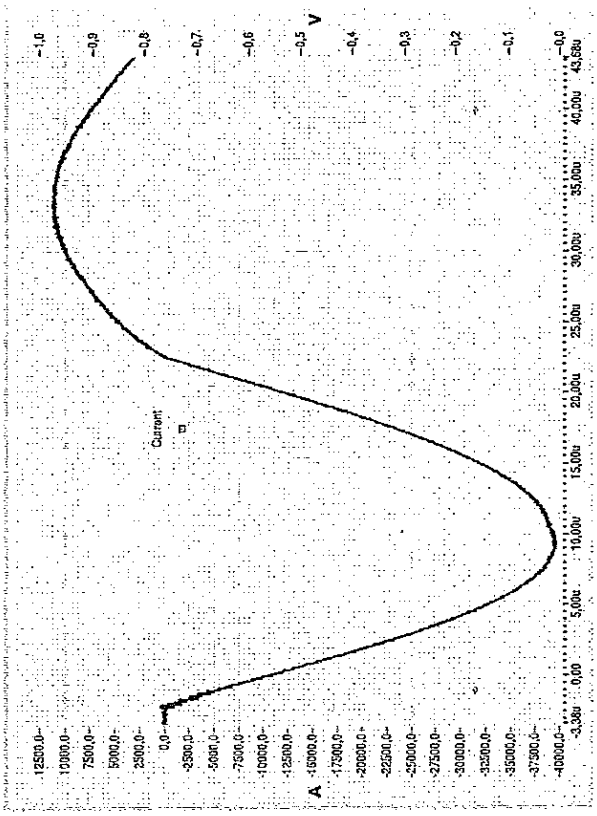
CESI B7023946 Oscillogram n. 34

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD



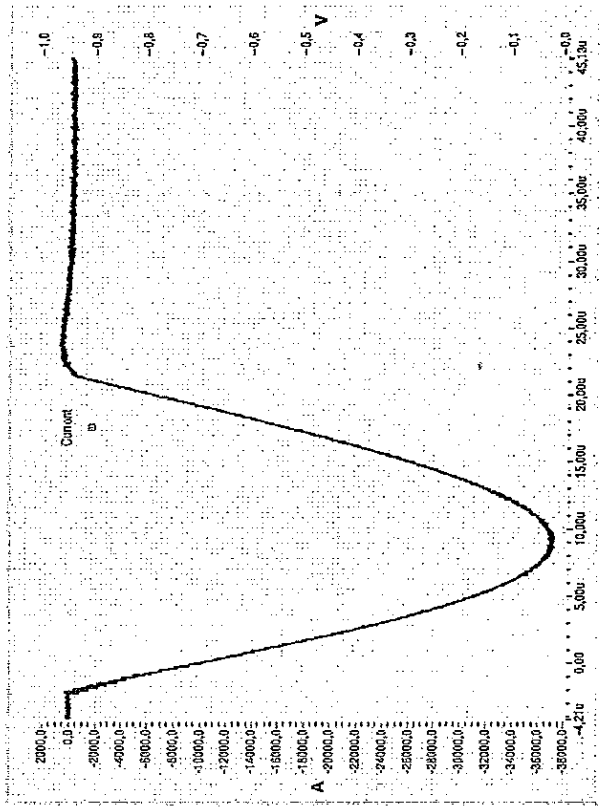
CESI B7023946 Oscillogram n. 37



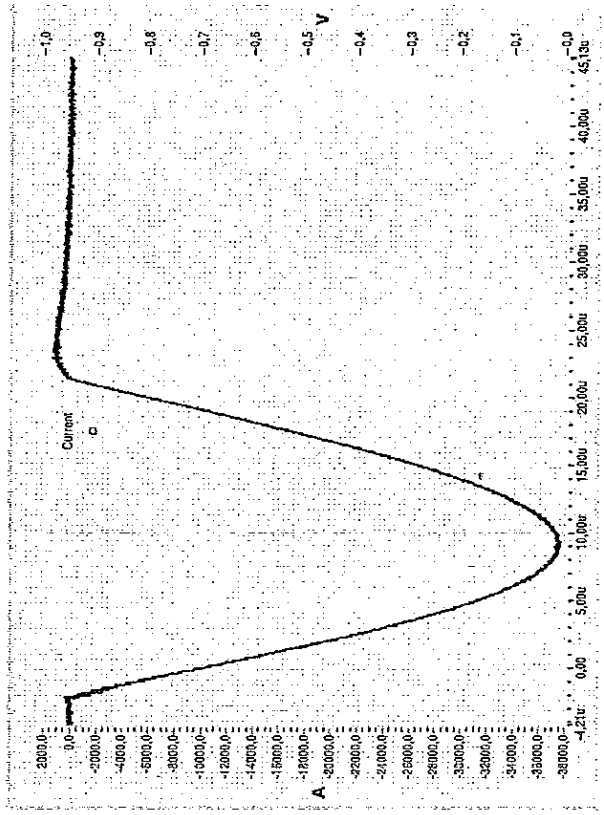
CESI B7023946 Oscillogram n. 36

ВЯРНО С ОРИГИНАЛА

"EMI Electric" EOOD



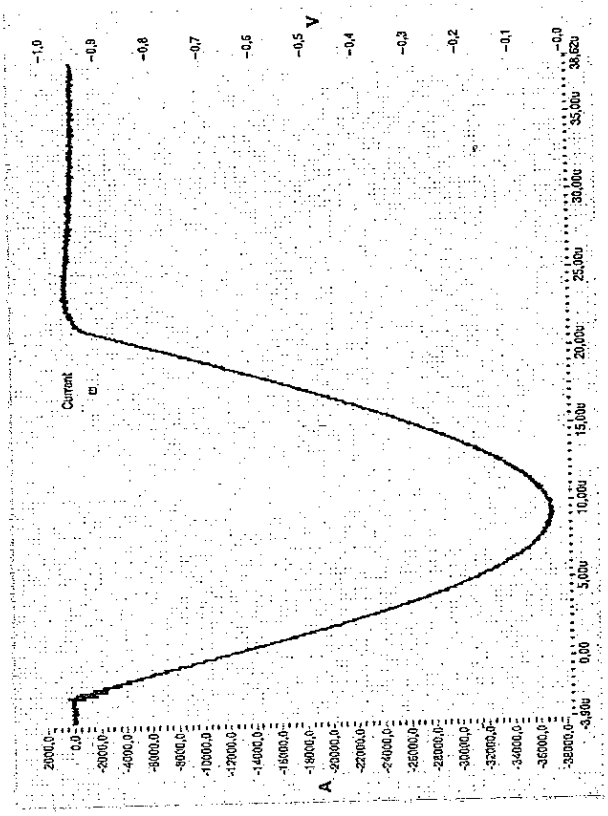
CESIB7023946 Oscillogramm n. 39



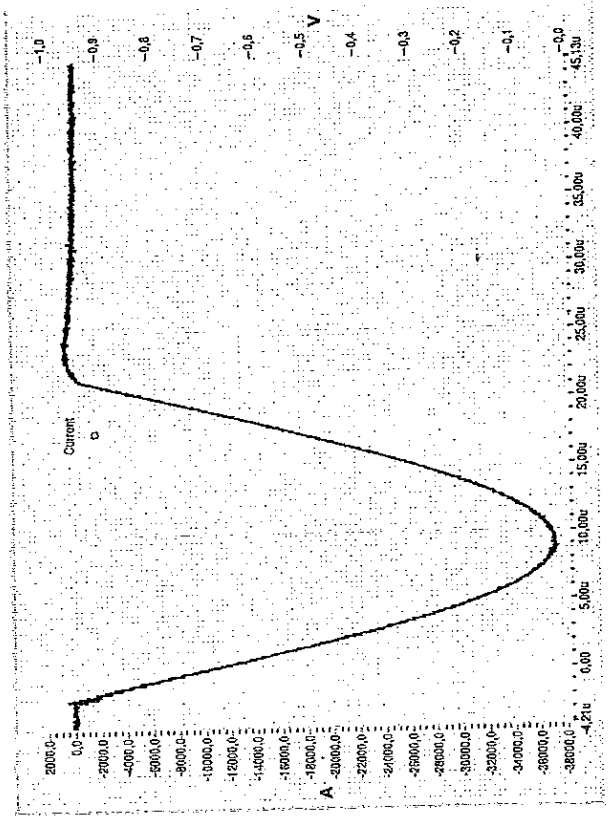
CESIB7023946 Oscillogramm n. 38

ВЯРНО С
ОРИГИНАЛ

"EMI Electric" LTD
"ЕМИ Електрик" ЕООД



CESI B7023946 Oscillogram n. 41

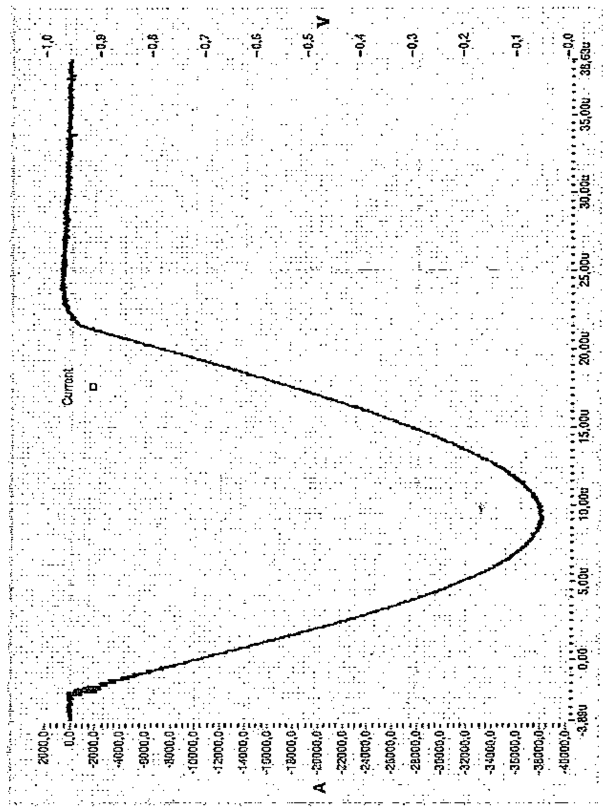


CESI B7023946 Oscillogram n. 42

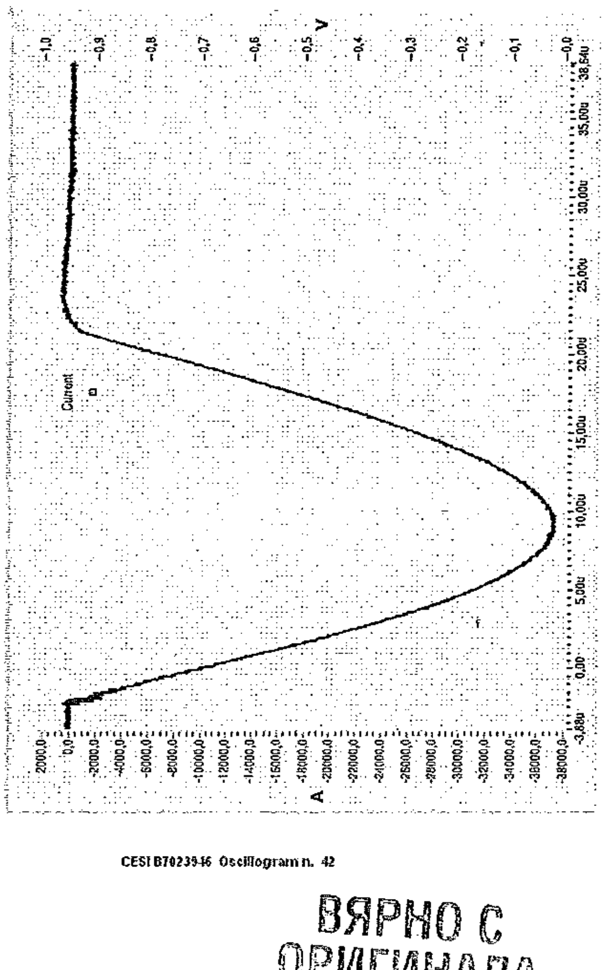
ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD

105



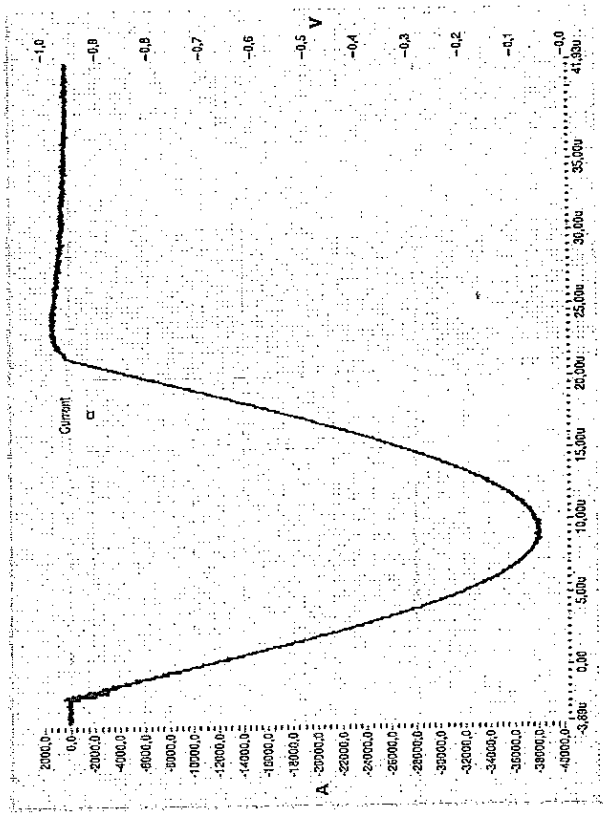
CESI B7023946 Oscillogram n. 43



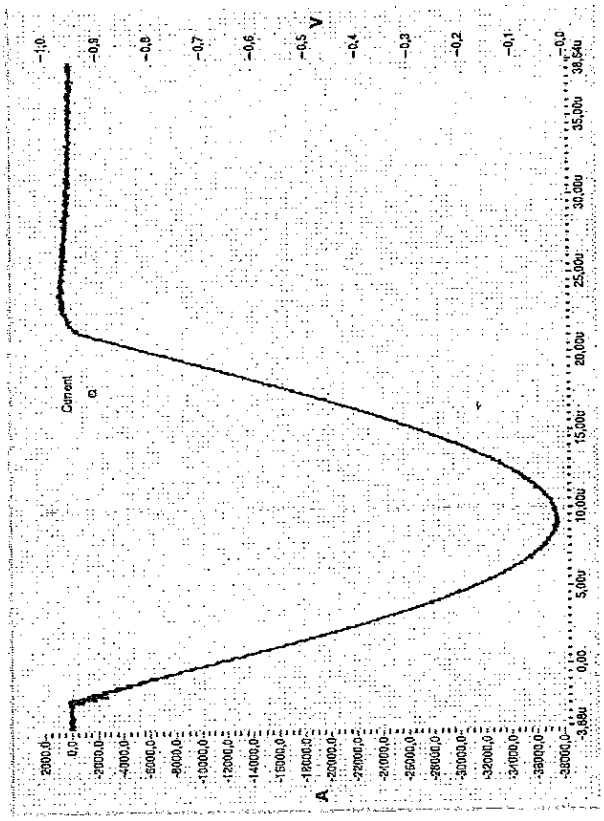
CESI B7023946 Oscillogram n. 42

ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD
„ЕМИ ЕЛЕКТРИК" ЕООД



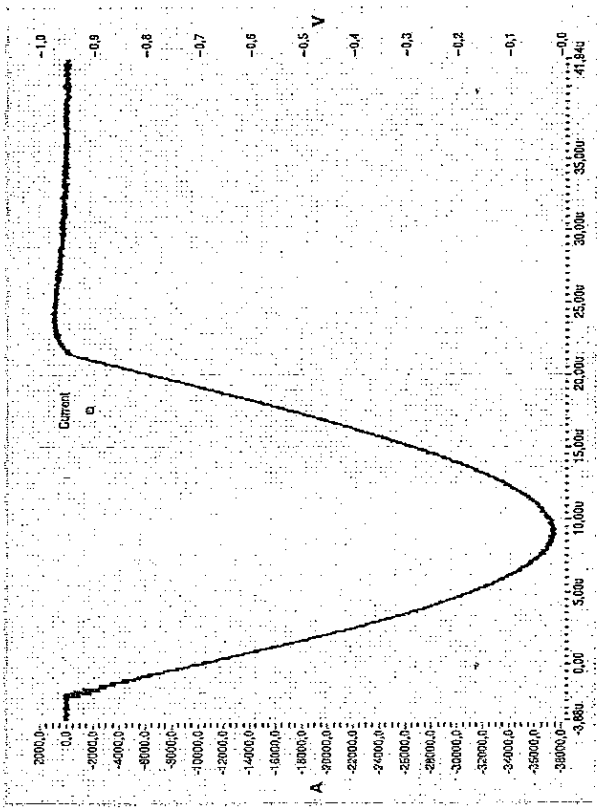
CESI B7023946 Oscillogram n. 45



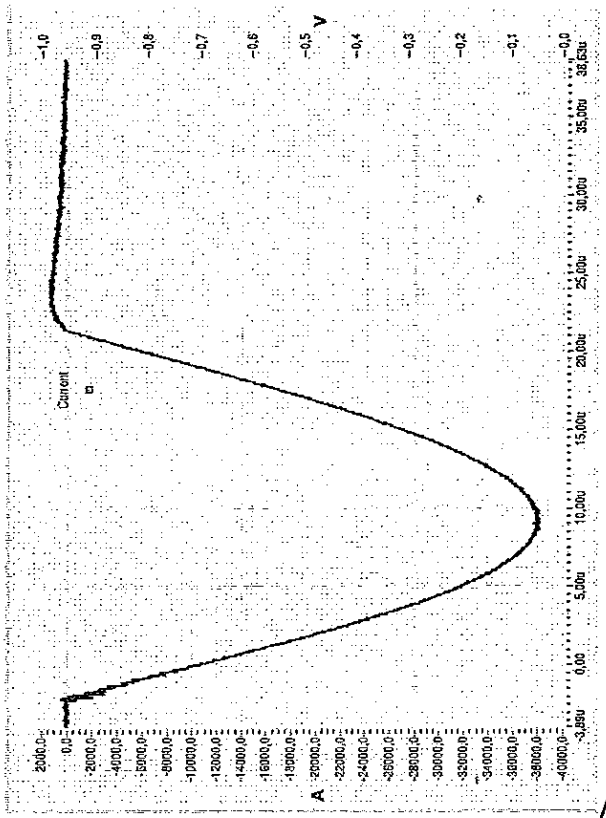
CESI B7023946 Oscillogram n. 44

ВЯРНО С ОРИГИНАЛА

"EMI Electric" EAD



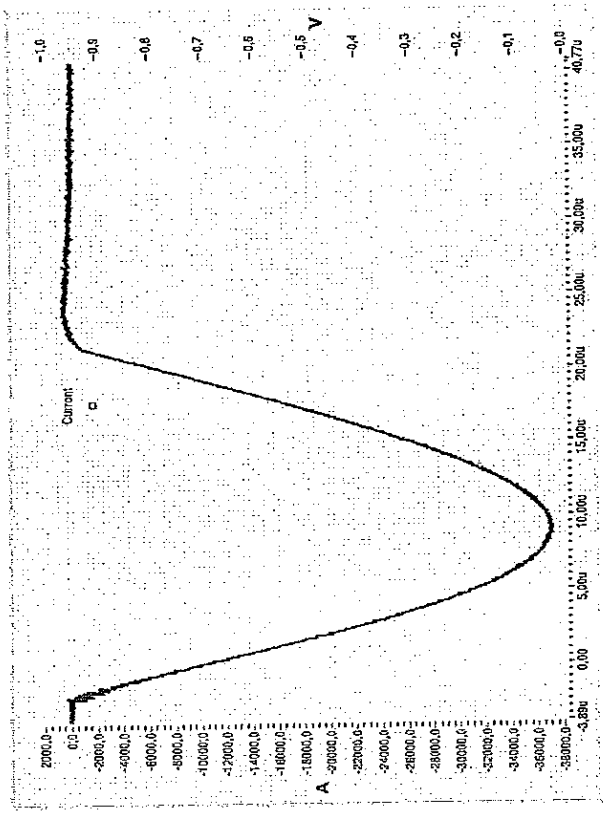
CESI B7023946 Oscillogram n. 48



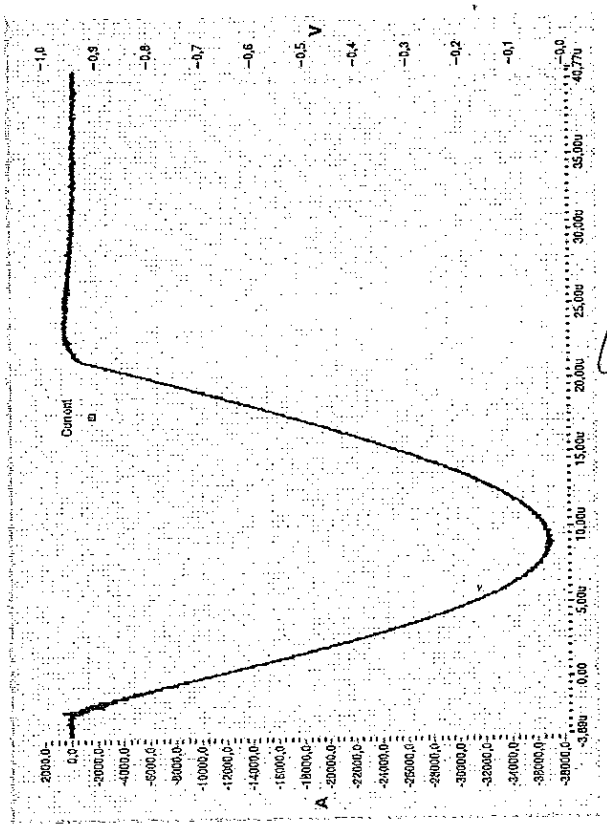
CESI B7023946 Oscillogram n. 47

ВЯРНО С ОРИГИНАЛ

"EMI Electric" ЕООД



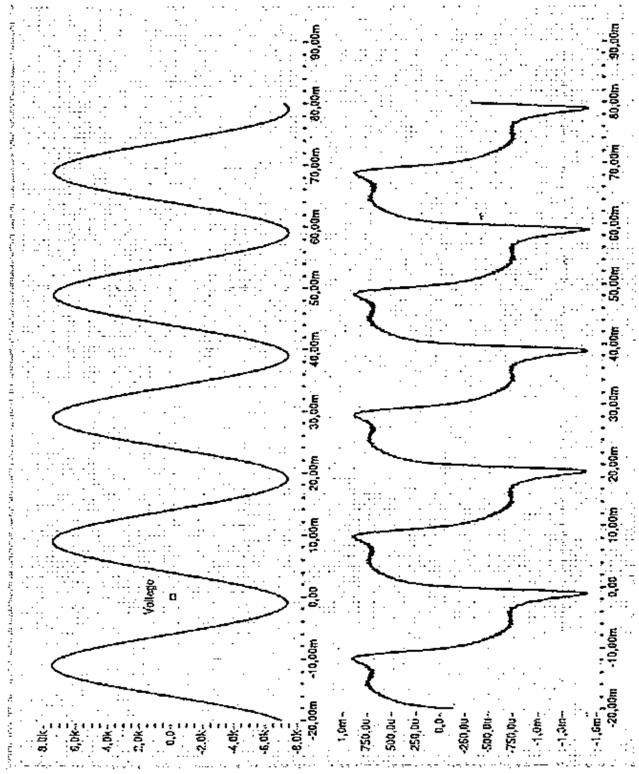
CESI B7023946 Oscillogram n. 50



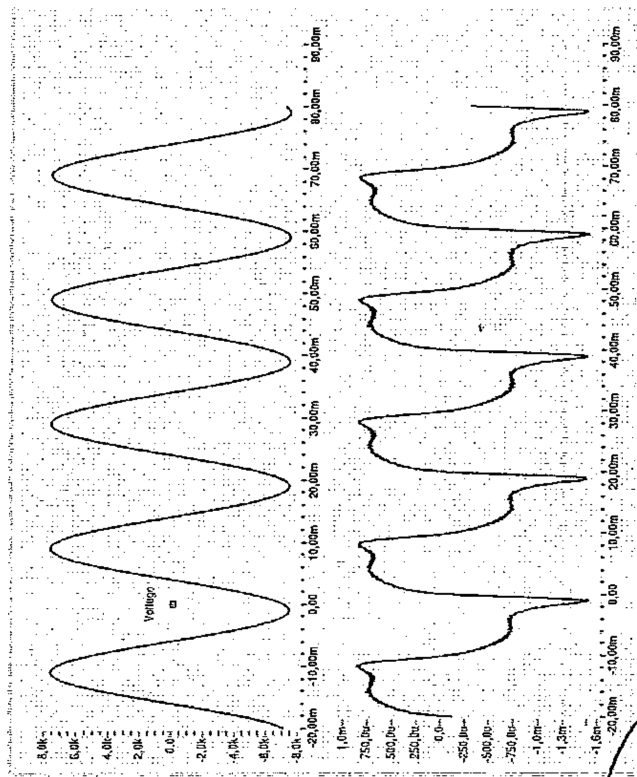
CESI B7023946 Oscillogram n. 49

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD



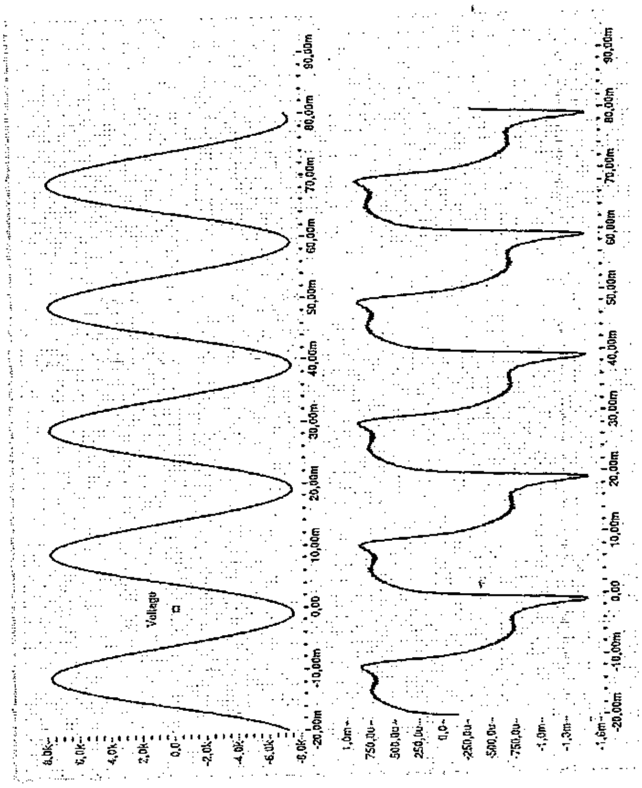
CESI B7023946 Oscillogram n. 52



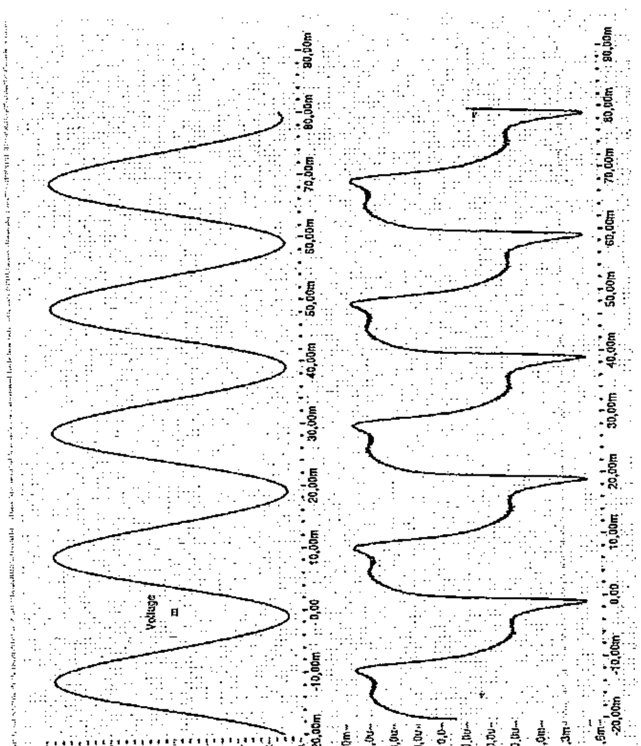
CESI B7023946 Oscillogram n. 51

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD
„ЕМИ ЕЛЕКТРИК" ЕООД



CESI B7023946 Oscillogram n. 54

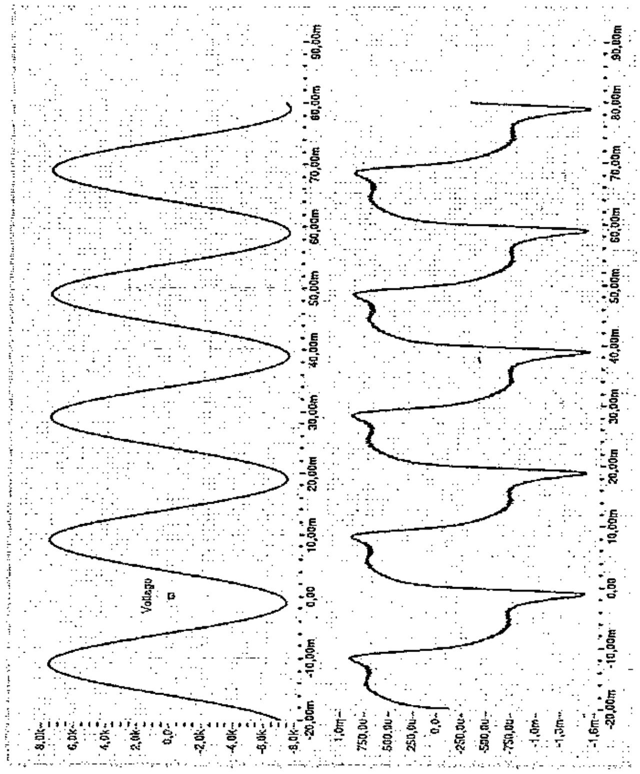


CESI B7023946 Oscillogram n. 5

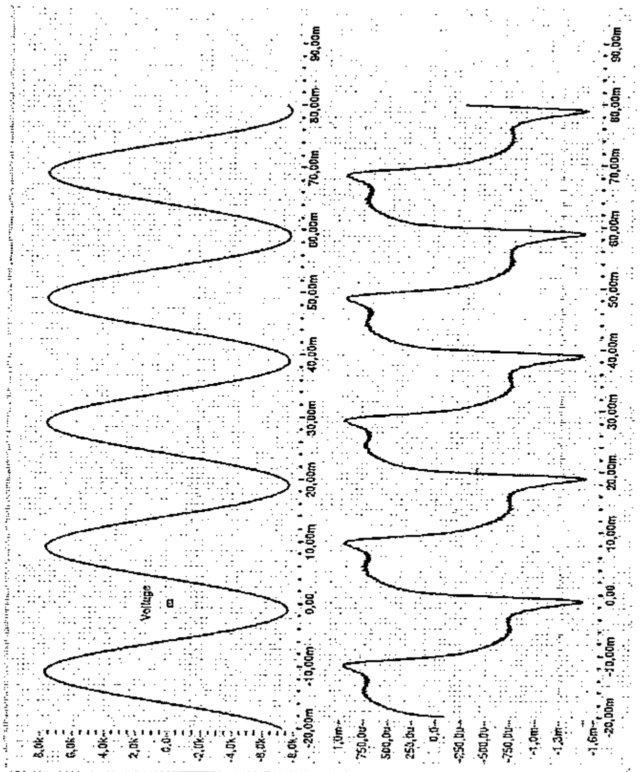
ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ Електрик" ЕООД

111



CESI B7023946 Oscillogram n. 57

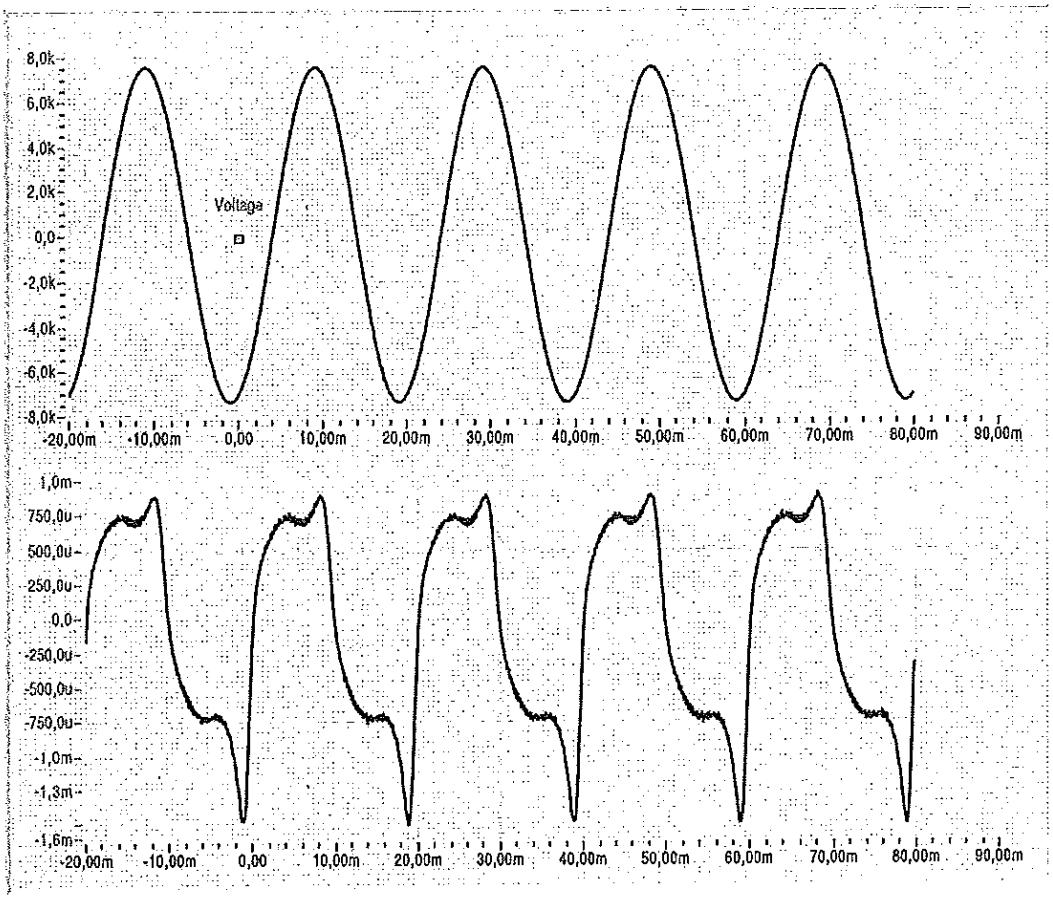


CESI B7023946 Oscillogram n. 55

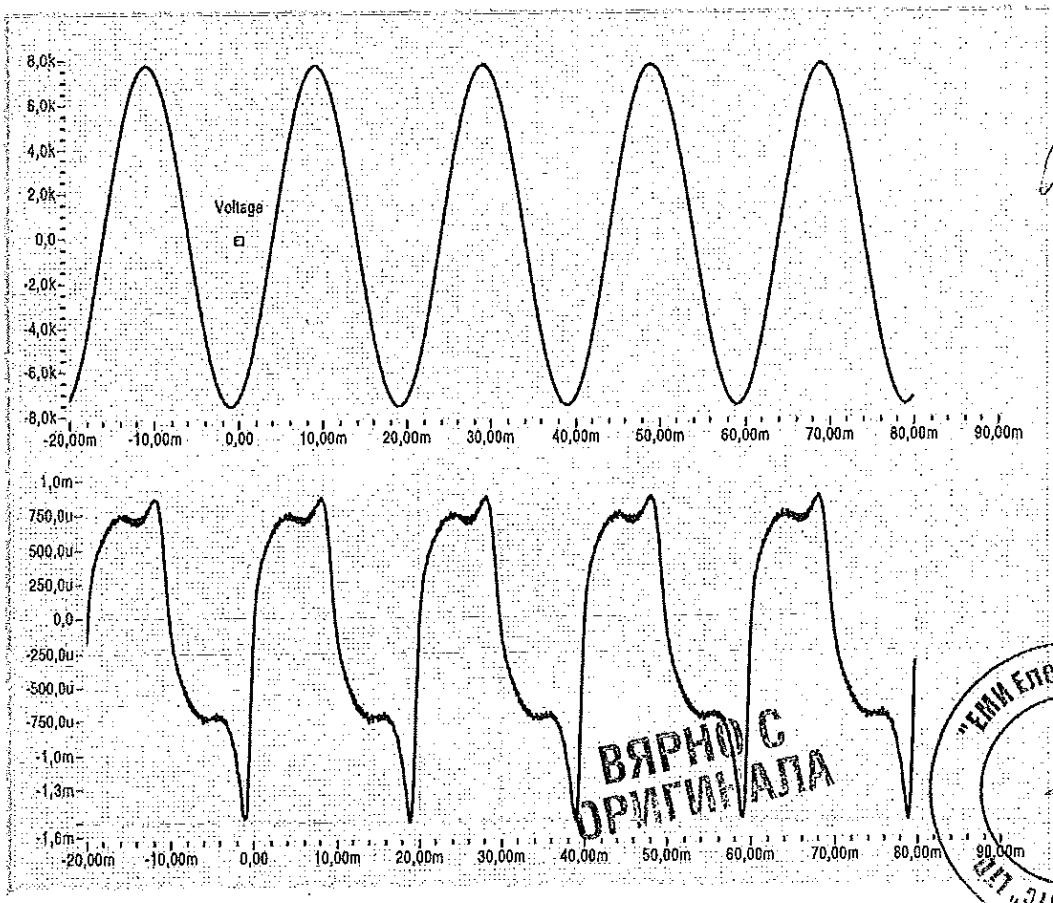
ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ ЕЛЕКТРИК" ЕООД

CESI B7023946 Oscillogram n. 58



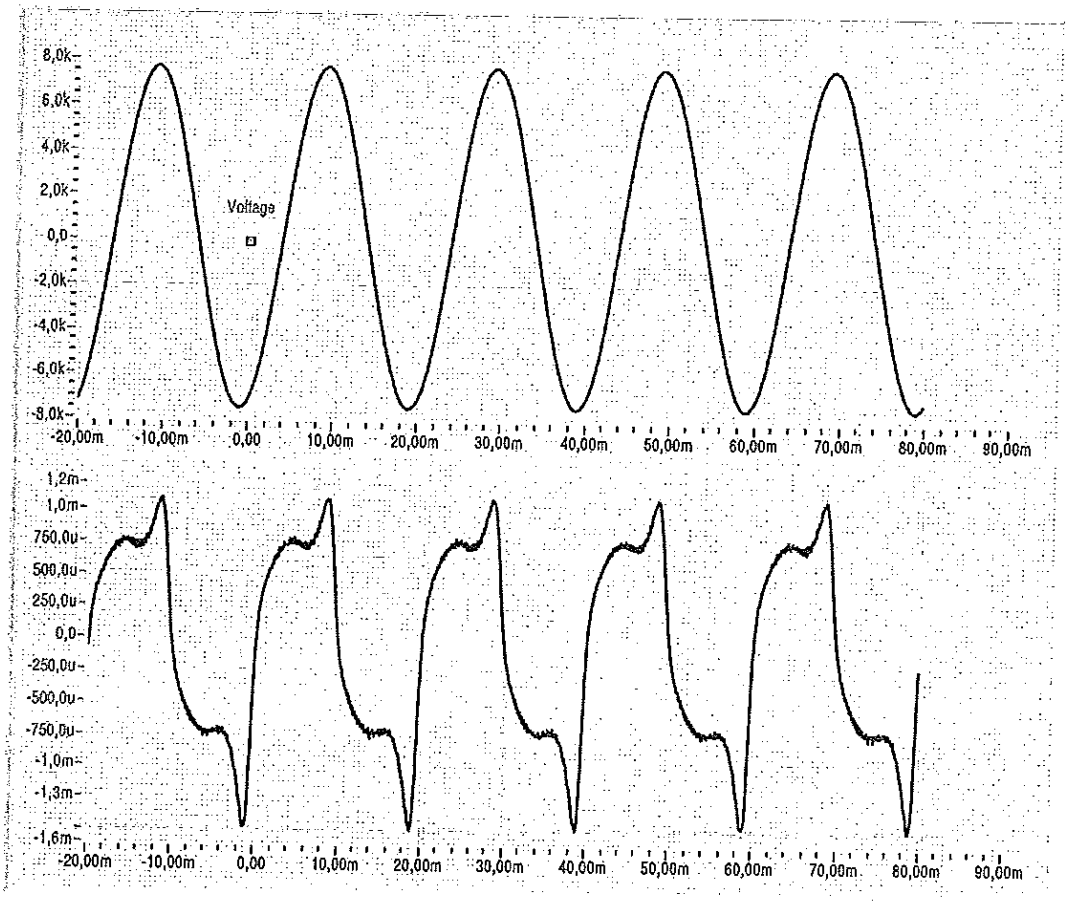
CESI B7023946 Oscillogram n. 59



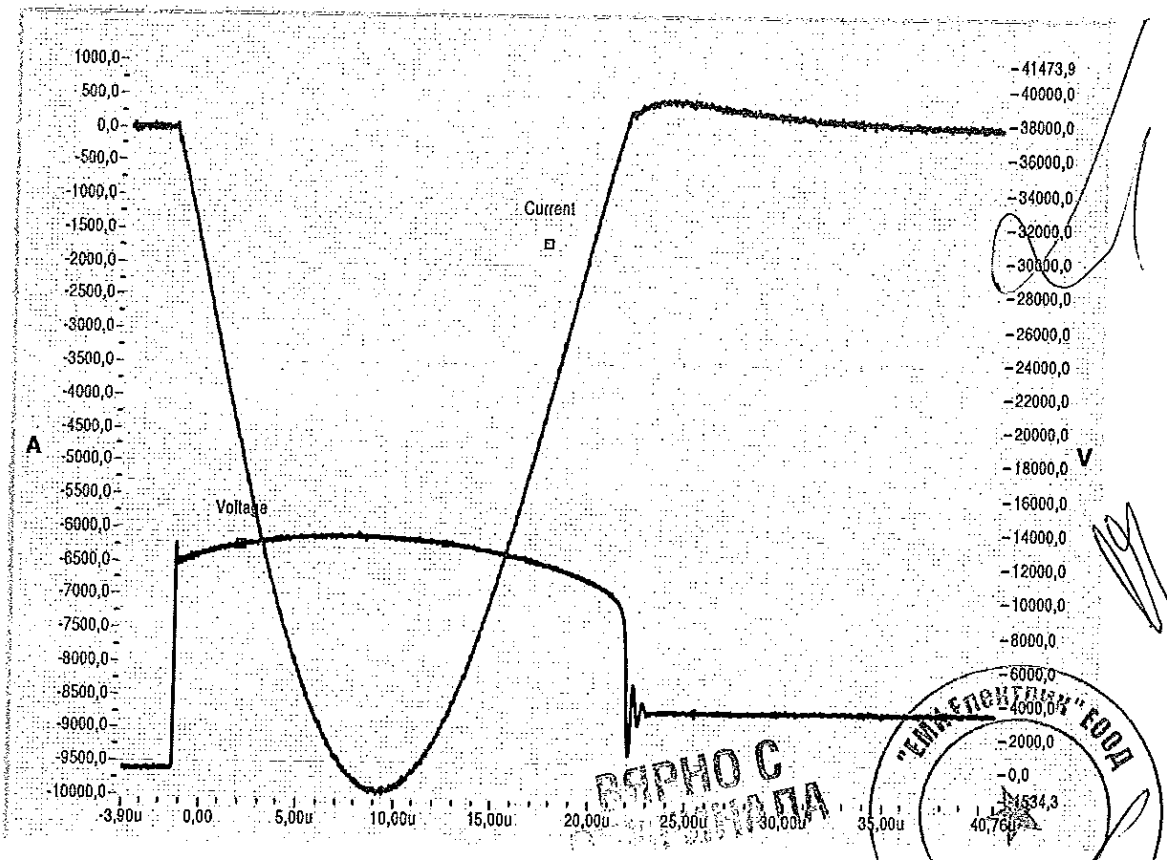
ВЯРНО С ОРИГИНАЛА

"ЕМИ Електрик" ЕООД

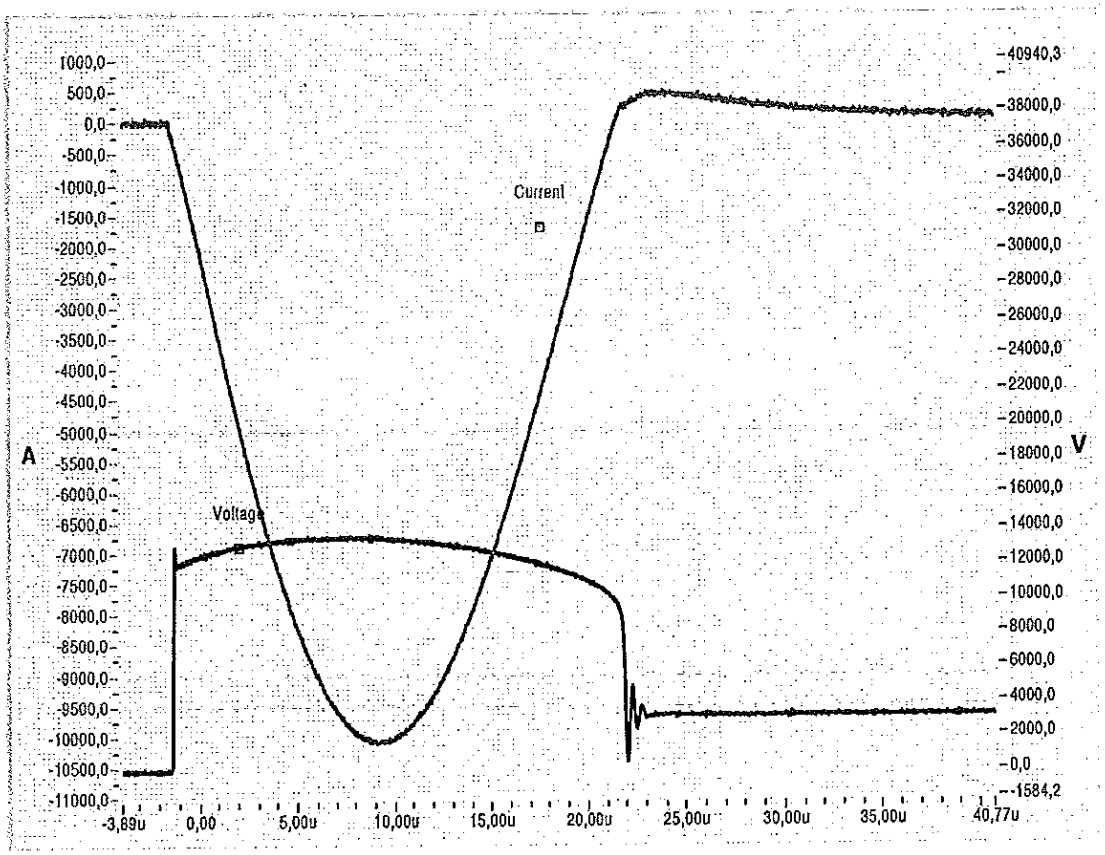
CESI B7023946 Oscillogram n. 60



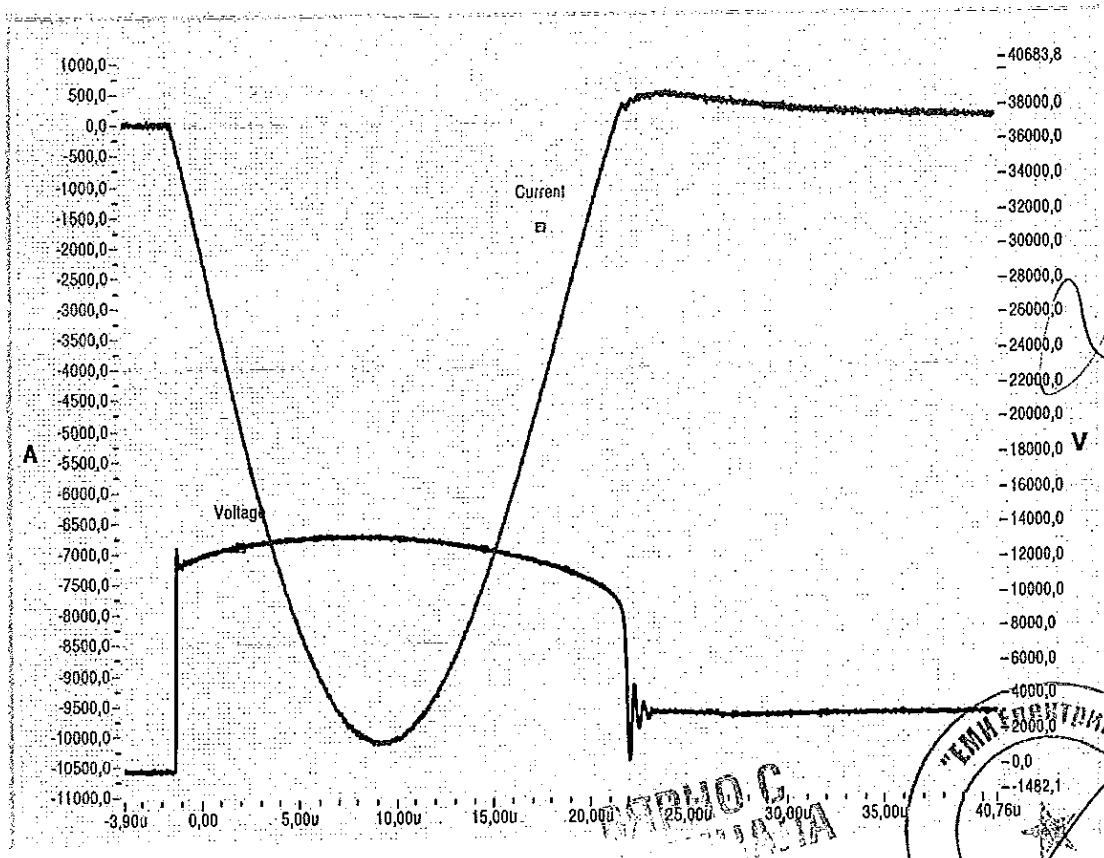
CESI B7023946 Oscillogram n. 61



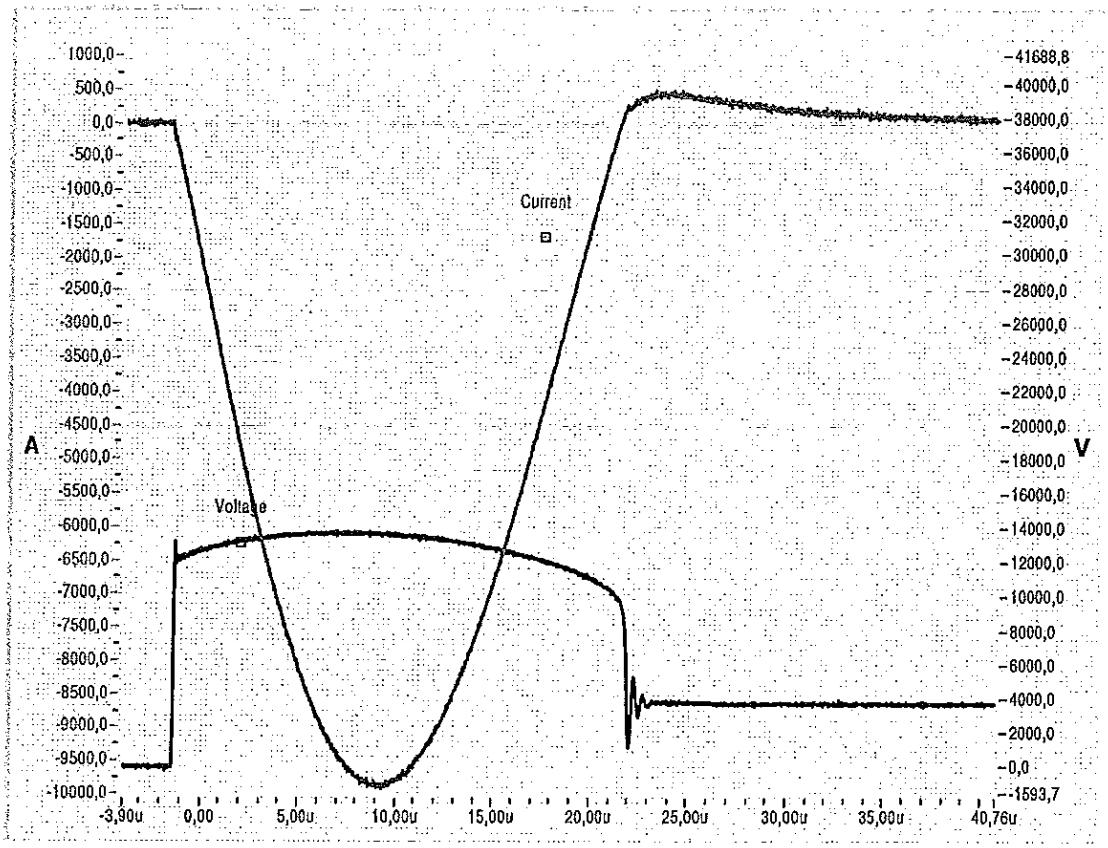
CESI B7023946 Oscillogram n. 62



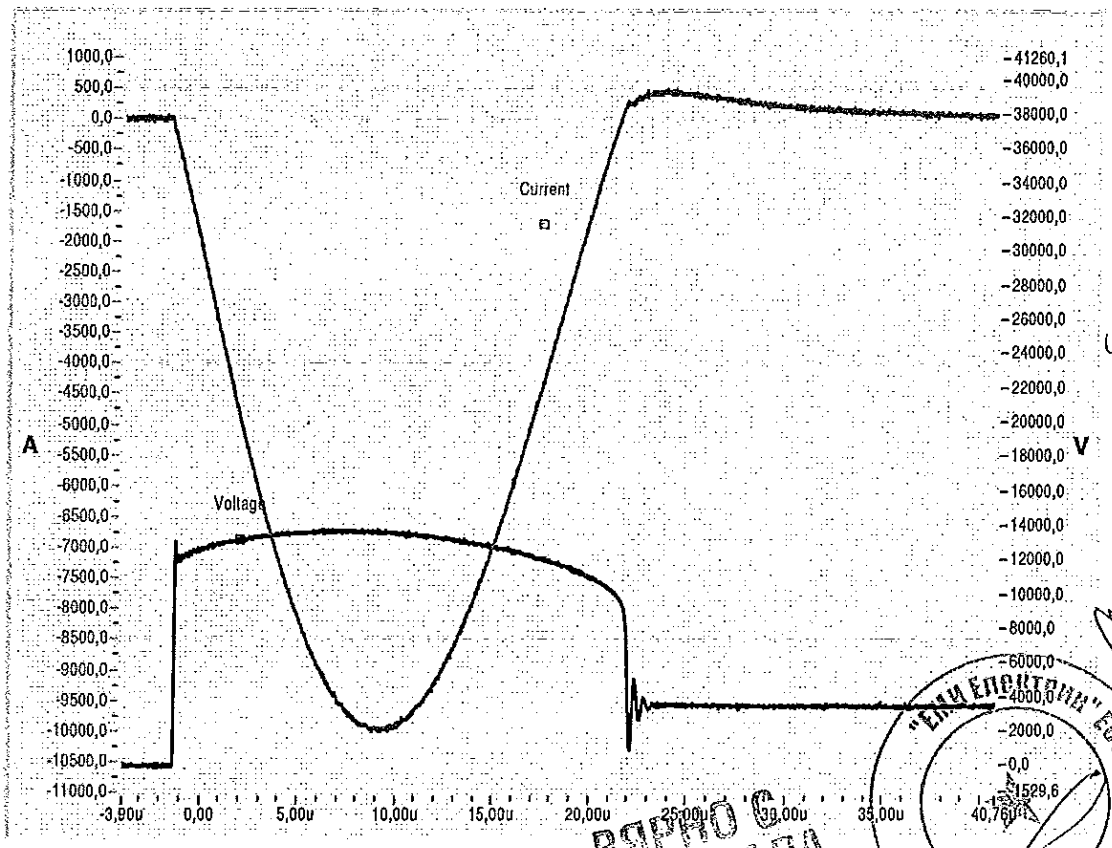
CESI B7023946 Oscillogram n. 63



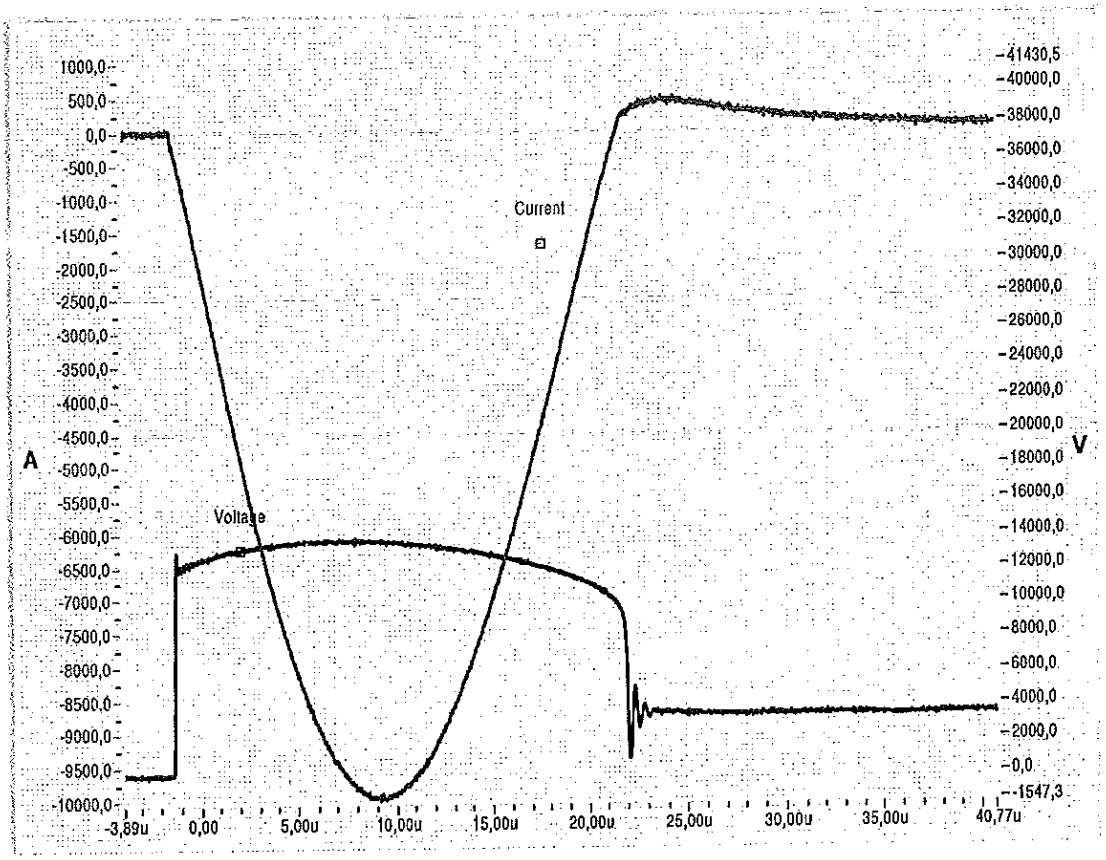
CESI B7023946 Oscillogram n. 64



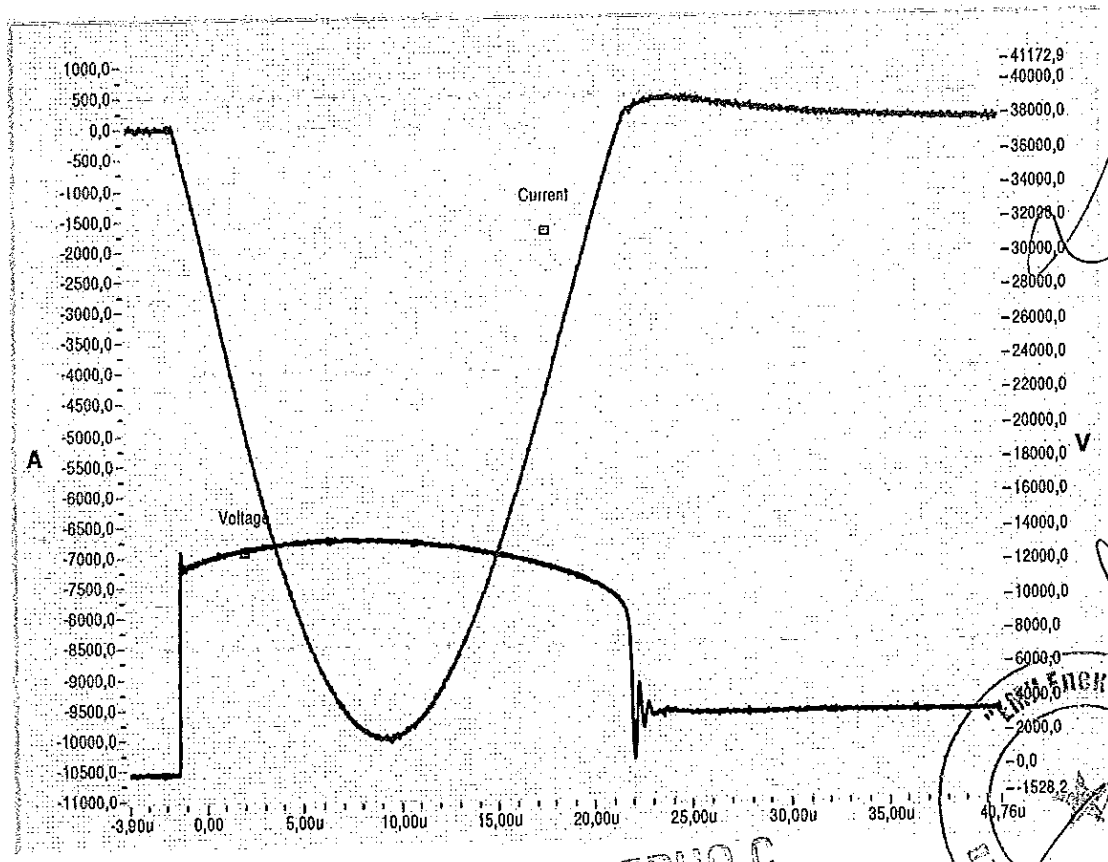
CESI B7023946 Oscillogram n. 65



CESI B7023946 Oscillogram n. 67



CESI B7023946 Oscillogram n. 68

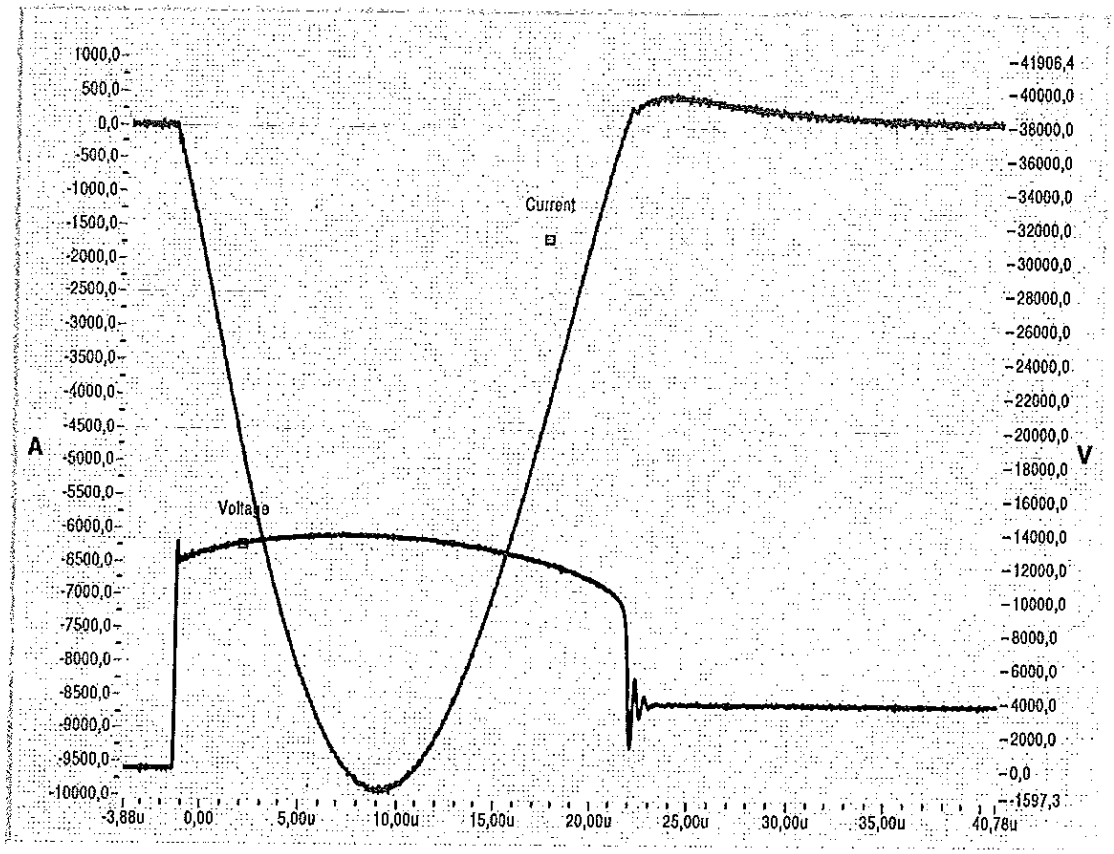


ВЯРНО С ОРИГИНАЛА

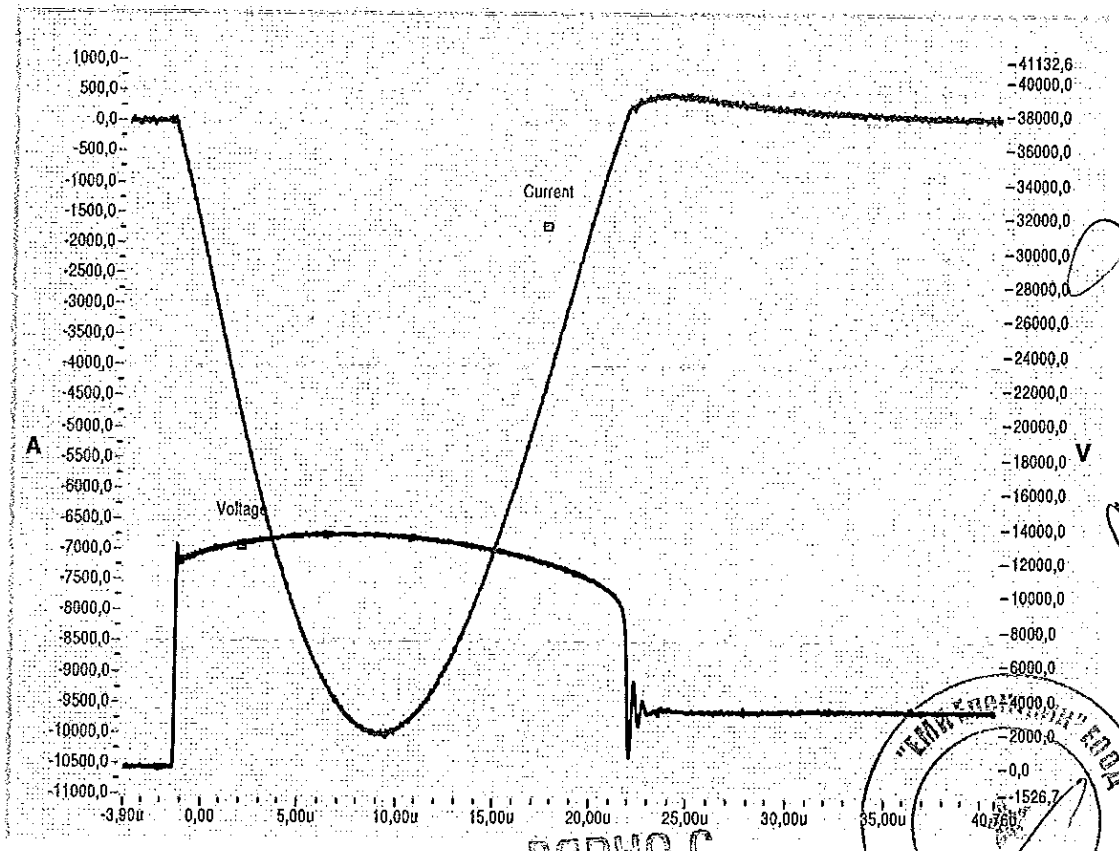
"ЕЛЕКТРОЕЛЕКТРОНИК" ЕООД

117

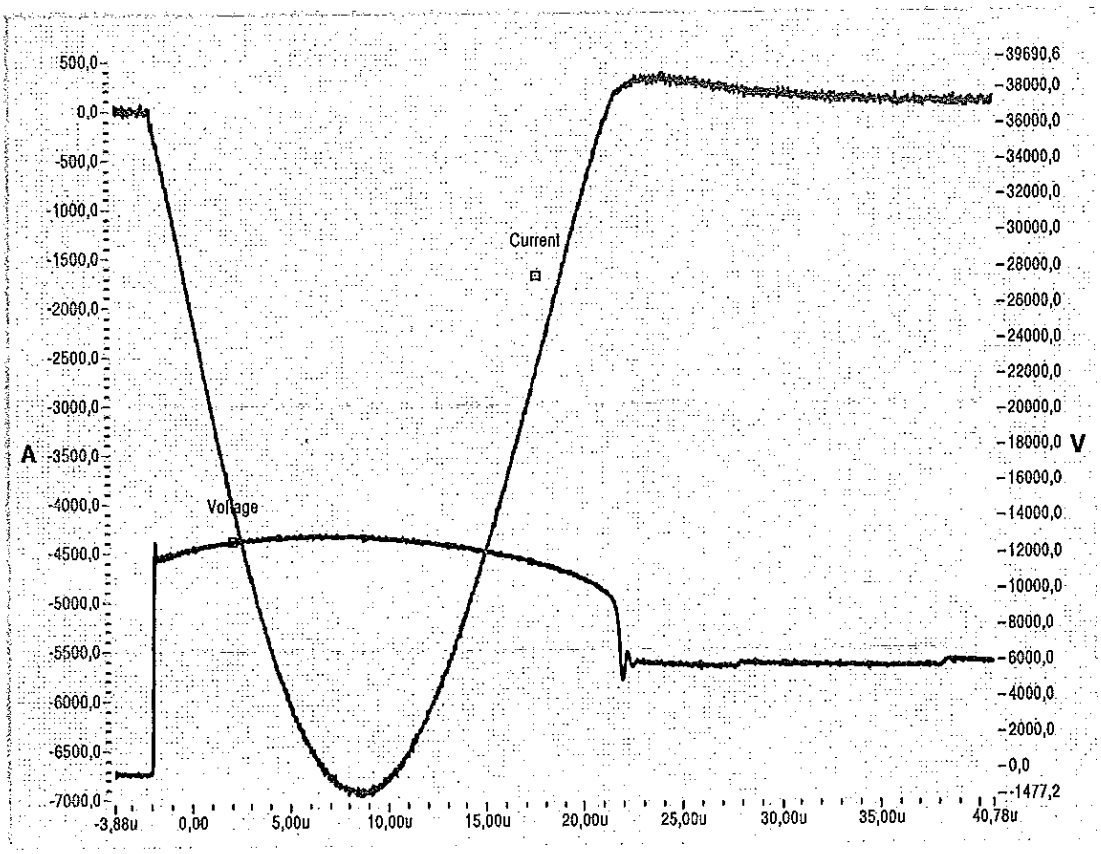
CESI B7023946 Oscillogram n. 69



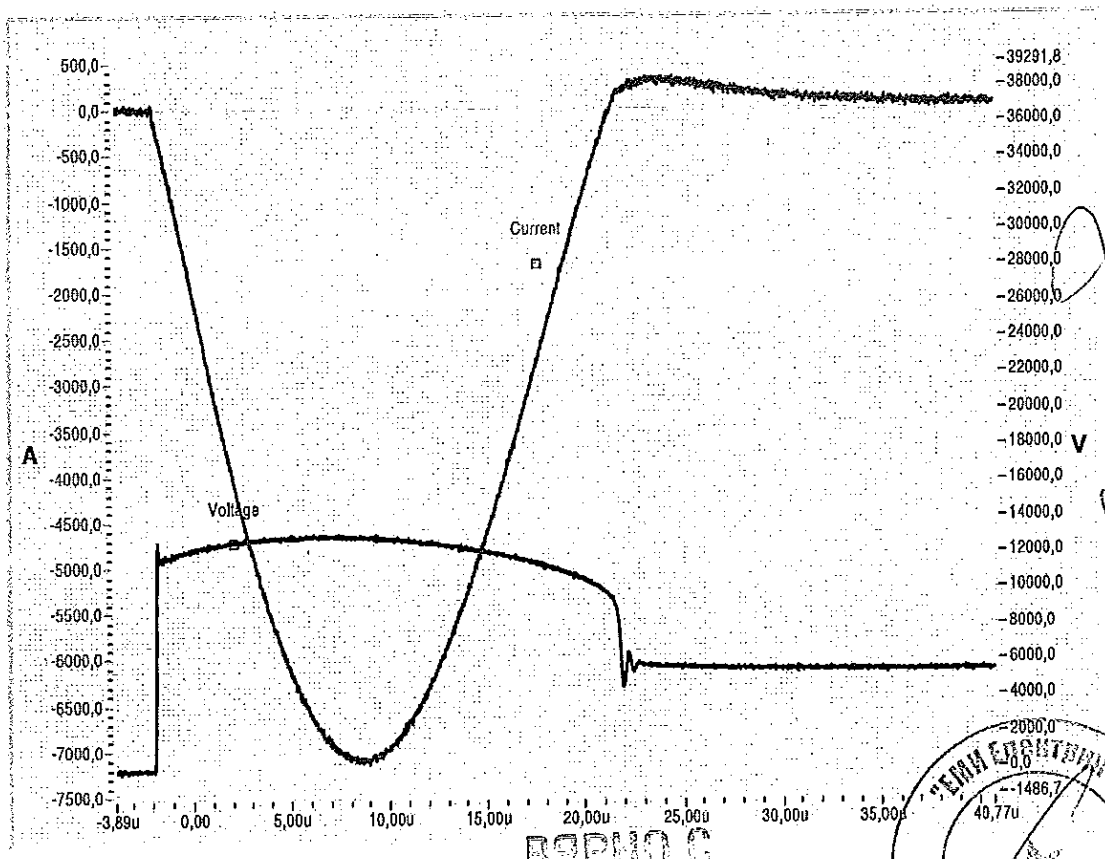
CESI B7023946 Oscillogram n. 70



CESI B7023946 Oscillogram n. 71



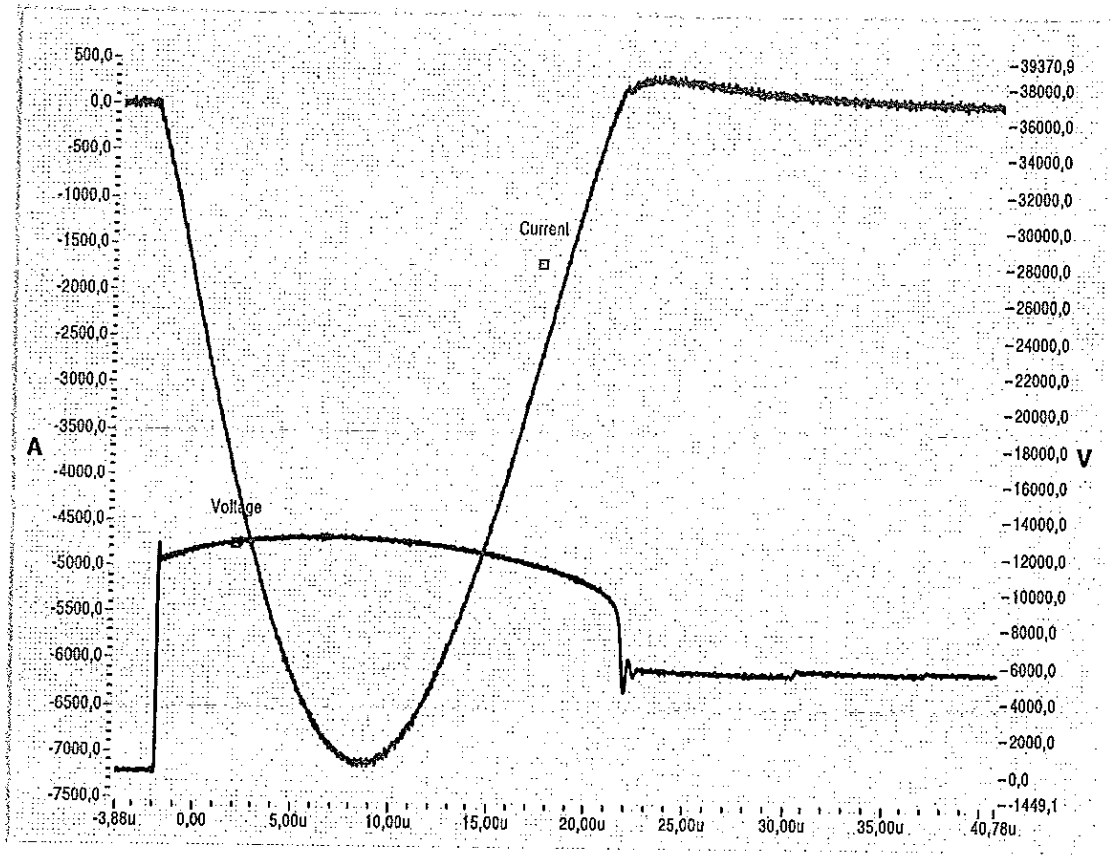
CESI B7023946 Oscillogram n. 72



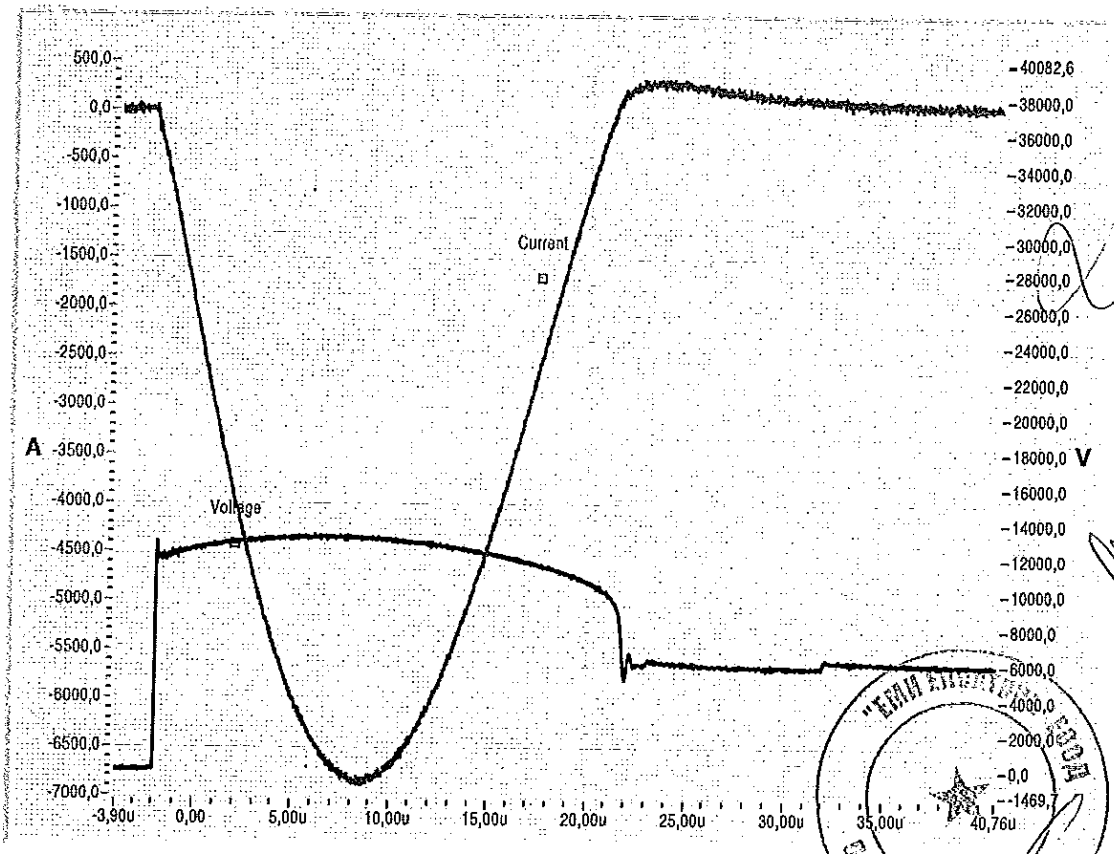
ВЯРНО С ОРИГИНАЛА

"ТЕРЕМ ЕЛЕКТРОНИК" ЕООД

CESI B7023946 Oscillogram n. 73

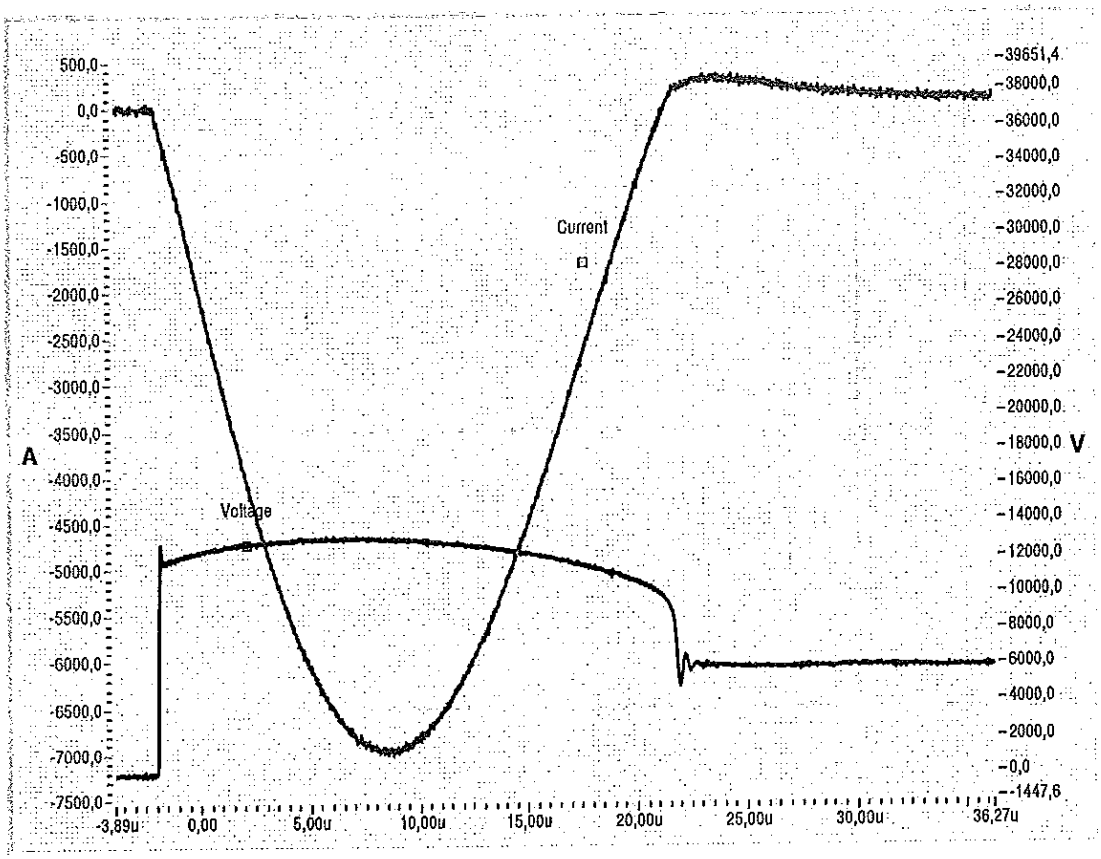


CESI B7023946 Oscillogram n. 74

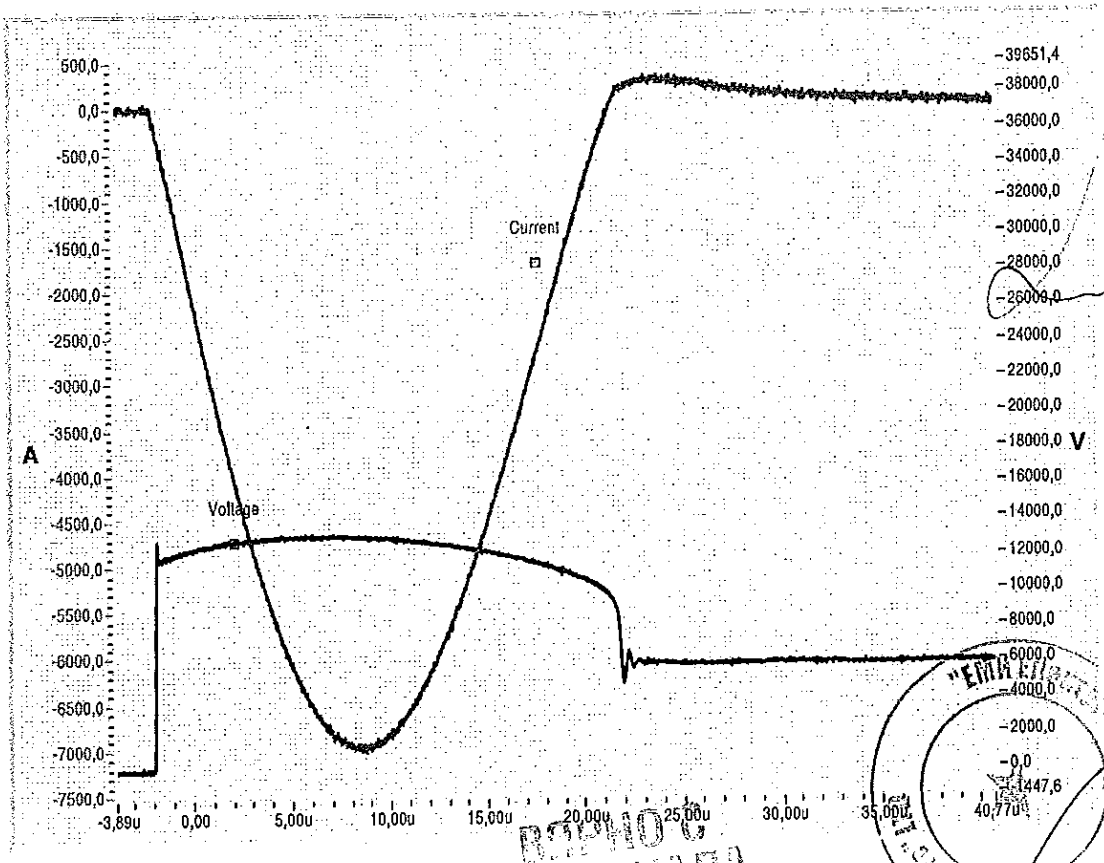


BAPNO C
OTEYMANA

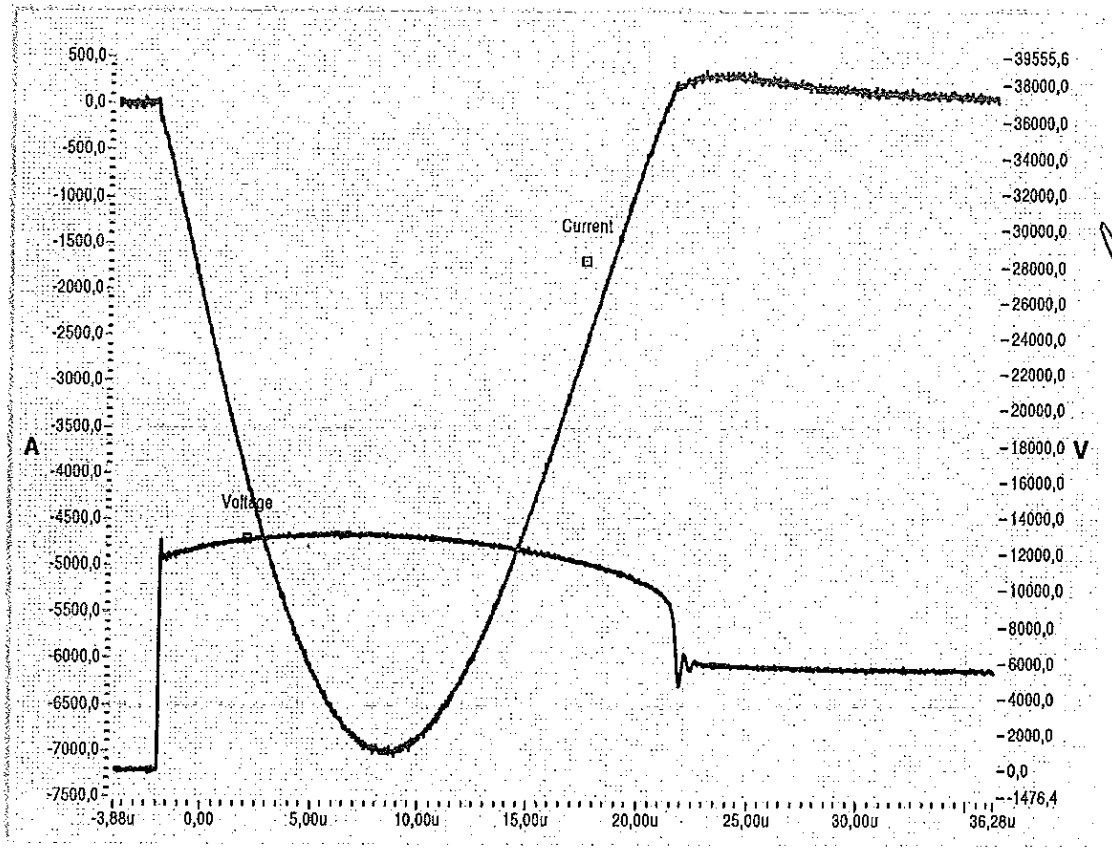
CESI B7023946 Oscillogram n. 75



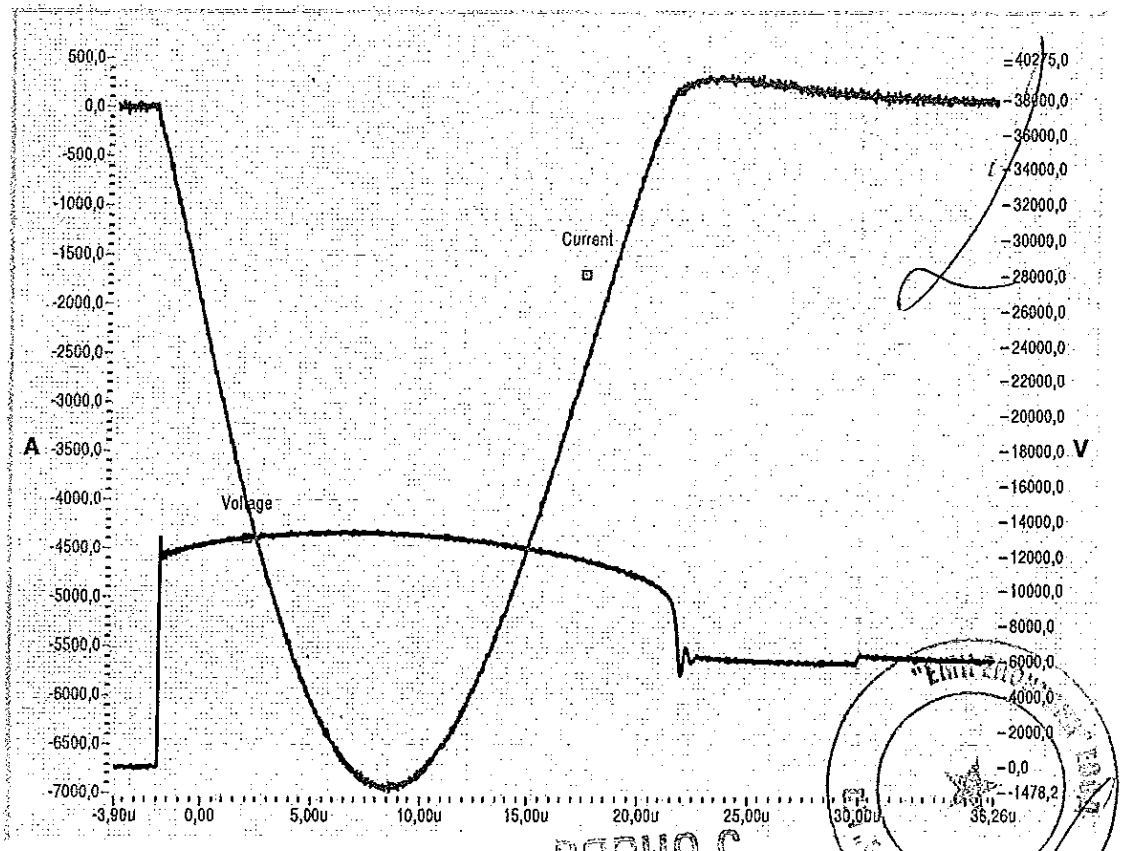
CESI B7023946 Oscillogram n. 77



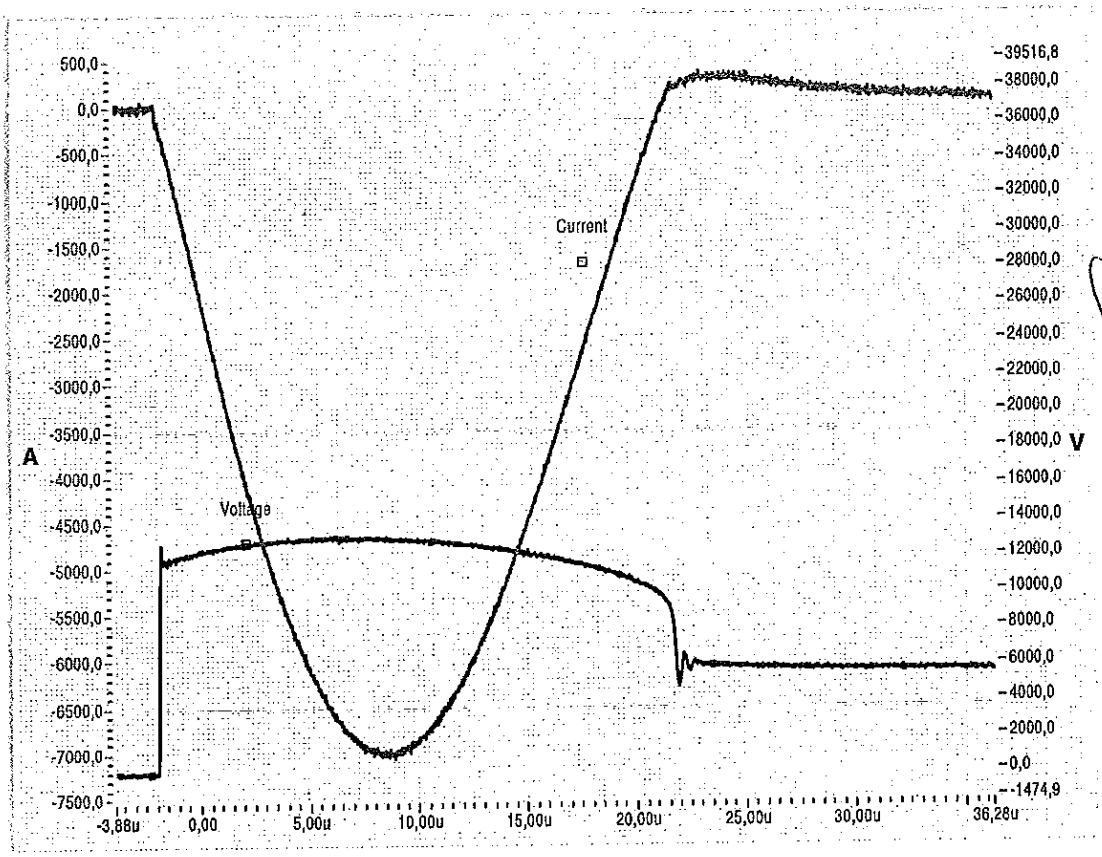
CESI B7023946 Oscillogram n. 78



CESI B7023946 Oscillogram n. 79



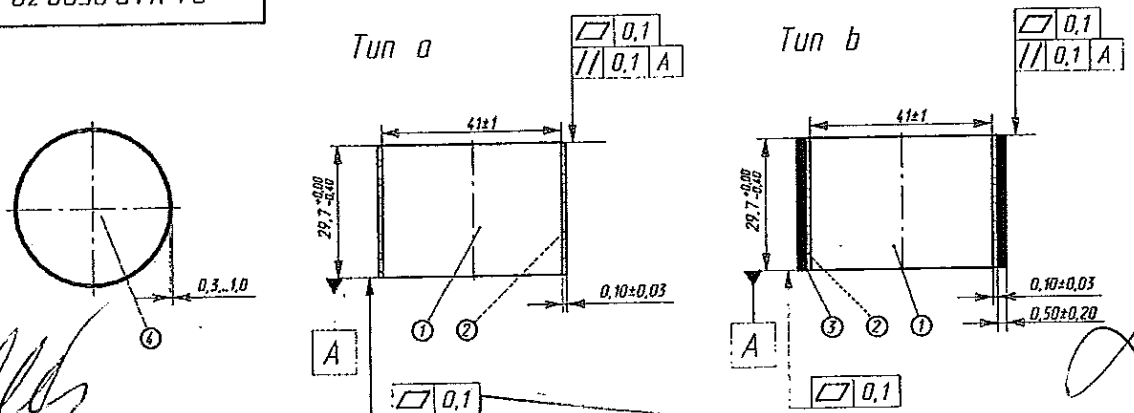
CESI B7023946 Oscillogram n. 30



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)

CESI B7024030 001

Изм.	Лист	№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	Масштаб
	0.227	1:1

Лист 1 / Листов 1

ЗАО "Полимер-Аппарат"

Копировал

Формат А4

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

Test Report

Document No.	B7024361 Copy No. 1 Number of pages 65
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" 195427, Saint- Petersburg, Ak. Kostantinova str.,1- Russian Federation
Tested for	—
Date(s) of tests	November 29 – November 30, 2017
Tested by	
Test performed	Operating duty test

ОРИГИНАЛА ВЗРНО С

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 reponsibility for conformity of any apparatus having the same designations with that tested rests with the Manufacturer.

December 18, 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

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:

— —

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 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 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. Guacci
Test laboratory	P177
ODV SAP	70006781

"ZEM ELECTRIC LTD" B003

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
Drawing code	PA-DH.001.ST.02
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

"EMI Electric" LTD "ЕМИ Електрик" ЕООД

Photographs of the test object

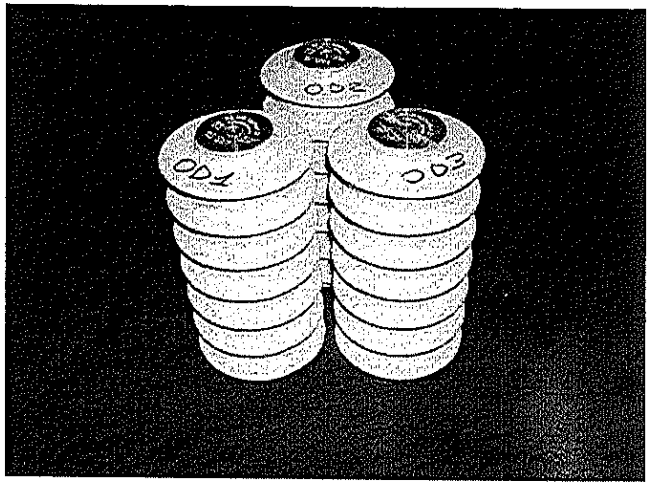


Photo no. 1

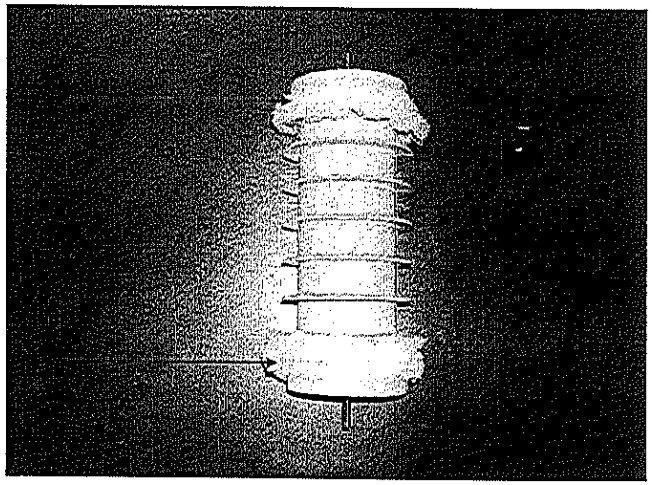


Photo no. 2

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

Reference Standard

IEC 60099-4 (20014/06) – 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-DH section ST with additional thermal insulation	OD1	00065
	OD2	00085
	OD3	00080

ОРИГИНАЛ
ВЭРНО С

"EMI Electric" Ltd. "EMI Electric" Ltd.

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 66 °C till thermal equilibrium (not more than twenty hours)
f) Injection of two lightning current impulses 8/20 µs at the rated thermal charge transfer Q_{rs}. 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 two last impulses 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.

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	10,14	13,40	10,11	13,51	+0,82
OD2	10,10	13,51	10,07	13,54	+0,22
OD3	10,14	13,44	10,13	13,50	+0,45

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	10,14	13,40	10,12	13,46	+0,45
OD2	10,10	13,51	10,03	13,55	+0,30
OD3	10,14	13,44	10,10	13,51	+0,52

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

"EMI Electric" LTD "ЕМИ Електрик" ЕООД

A1441IG

Operating duty test.

Lightning impulse residual voltage measurement before the test

Test circuit: A0120

Date: November 29, 2017

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual Voltage
No.		kV	No.	µs	kA	kV
OD1	I_n	25,1	1	8,6/18,2	10,14	13,40
OD2		25,1	2		10,10	13,51
OD3		25,1	3		10,14	13,44

Notes:

Operating duty test.

Reference voltage test

Test circuit: A0019

Date: November 29, 2017

Sample No. OD1						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
4	5,35	1,28	1,50	0,773	2,03	--

Sample No. OD2						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
5	5,37	1,37	1,50	0,786	2,13	--

Sample No. OD3						
oscillogram	voltage	current	current	current	power	3rd harmonic amplitude
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	µA
6	5,35	1,38	1,50	0,789	2,12	--

Operating duty test.

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

Test circuit: A0121

Date: November 29, 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	100,7	4,5/9,1	11,0
OD2	1	85,0 x 2	8	100,6		
OD3	1	86,0 x 2	9	103,8		

Notes:

129

Operating duty test.

Voltage correction factor and thermal energy calculations

Date: November 30, 2017

Sample	U_{ref} [1]	KU_r [2]	KU_c [3]	U_r' [4]	U_c' [5]
No.	kV			kV	kV
OD1	5,35	1,011	0,809	5,409	4,328
OD2	5,37			5,429	4,392
OD3	5,35			5,409	4,328

[1] U_{ref} : measured reference voltage
[2] KU_r : maximum guaranteed factor for calculation of $Ur' - U_r/U_{ref.min.}$ (declared by the Manufacturer)
[3] KU_C : maximum guaranteed factor for calculation of $Uc' - U_c/U_{ref.min.}$ (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_{th}	Requested Q_{th} per impulse
No.	kV	C	C
OD1	5,409	1,1	0,55 (±10%)
OD2	5,429		0,55 (±10%)
OD3	5,409		0,55 (±10%)

"EMI Electric" LTD "EMI ENERGY" EOOD

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: November 30, 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
10	1	64,5 x 2	—	39,23	0,57	0,495÷0,605
11	2	64,5 x 2	—	38,73	0,56	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	$+ mA_{cr}$	$- mA_{cr}$
12	0	5,409	18,00	40,00
13	10		6,50	13,50

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

Oscillogram	Time	U_c'	Current	Current	Power	Temperature
No.	min	kV	$+ mA_{cr}$	$- mA_{cr}$	W	°C
14	0	4,328	1,08	1,16	1,06	—
	5		1,06	1,08	0,70	—
	10		1,04	1,06	0,62	—
15	15		1,03	1,05	0,58	—
	20		1,02	1,04	0,53	—
	25		1,02	1,03	0,49	—
16	30		1,00	1,03	0,46	—

continued

Note :

Continued

Sample No.: OD2

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

Date: November 30, 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
17	1	64,5 x 2	—	39,03	0,55	0,495÷0,605
18	2	64,5 x 2	—	38,95	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_{cr}	- mA_{cr}
19	0	5,429	18,00	42,00
20	10		7,00	13,50

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

Oscillogram	Time	U_c'	Current	Current	Power	Temperature
No.	min	kV	+ mA_{cr}	- mA_{cr}	W	°C
21	0	4,392	1,13	11,4	1,05	—
	5		1,06	1,07	0,73	—
	10		1,03	1,05	0,63	—
22	17		1,01	1,04	0,58	—
	20		1,00	1,04	0,56	—
	25		0,99	1,03	0,51	—
23	30		0,98	1,01	0,49	—

Note :

continued

Continued

Sample No.: OD3

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

Date: November 30, 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
24	1	64,5 x 2	—	39,11	0,57	0,495÷0,605
25	2	64,5 x 2	—	39,00	0,56	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_{cr}	- mA_{cr}
26	0	5,409	23,00	44,00
27	10		9,00	16,00

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

Oscillogram	Time	U_c'	Current	Current	Power	Temperature
No.	min	kV	+ mA_{cr}	- mA_{cr}	W	°C
28	0	4,328	1,15	1,15	1,22	—
	5		1,08	1,08	0,73	—
	10		1,03	1,07	0,65	—
29	15		1,01	1,03	0,59	—
	20		1,01	1,03	0,54	—
	25		1,00	1,02	0,53	—
30	30		0,98	1,01	0,49	—

Note :

Operating duty test.

Lightning impulse residual voltage measurement after the test

Test circuit: A0120

Date: November 30, 2017

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual Voltage
No.	kA	kV	No.	µs	kA	kV
OD1	10	25,1	31	8,8/18,4	10,11	13,51
OD2	10	25,1	32		10,07	13,54
OD3	10	25,1	33		10,13	13,50

Notes:

Operating duty test.

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

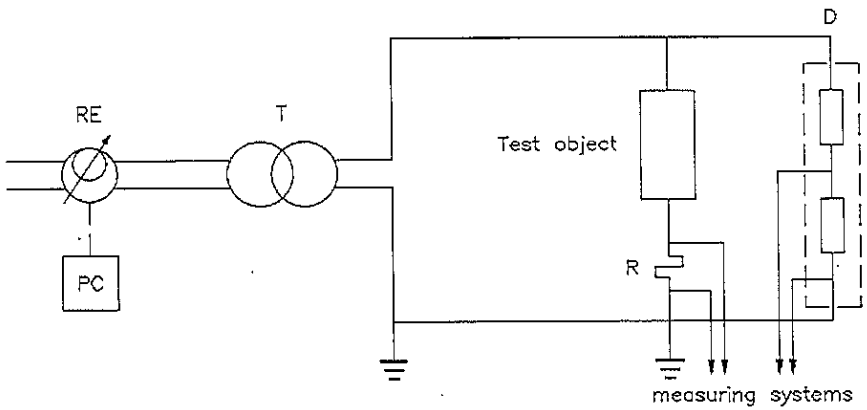
Test circuit: A0120

Date: November 30, 2017

Sample	Requested current	Charging voltage	Oscillogram	Current waveshape	Discharge current	Residual voltage
No.		kV	No.	µs	kA	kV
OD1	I_n	25,1	34	8,6/18,3	10,13	13,48
		25,1	35		10,12	13,46
OD2		25,1	36		10,04	13,49
		25,1	37		10,03	13,55
OD3		25,1	38		10,11	13,50
		25,1	39		10,10	13,51

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= 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 - Voltge 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:

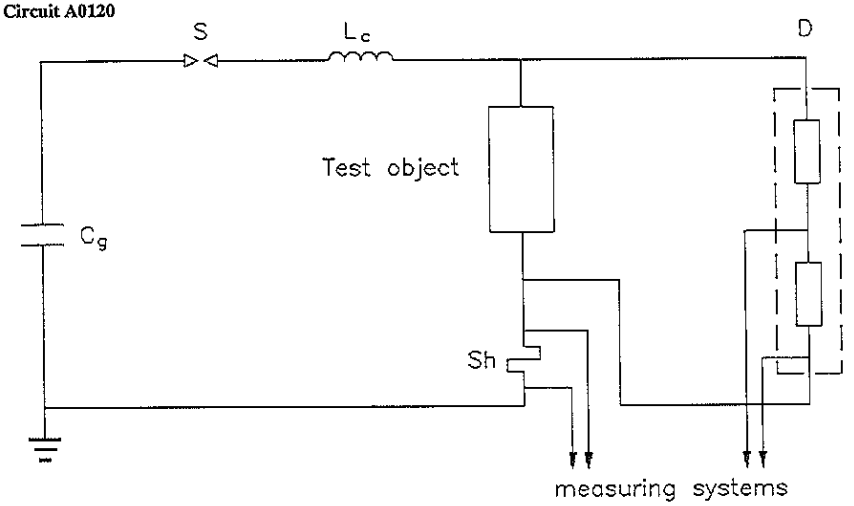
SW - S.A.D. Surge arrester version 2.0

ОРИГИНАЛА ВЯРНО С

"EMC Electric" LTD

A0019IG

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

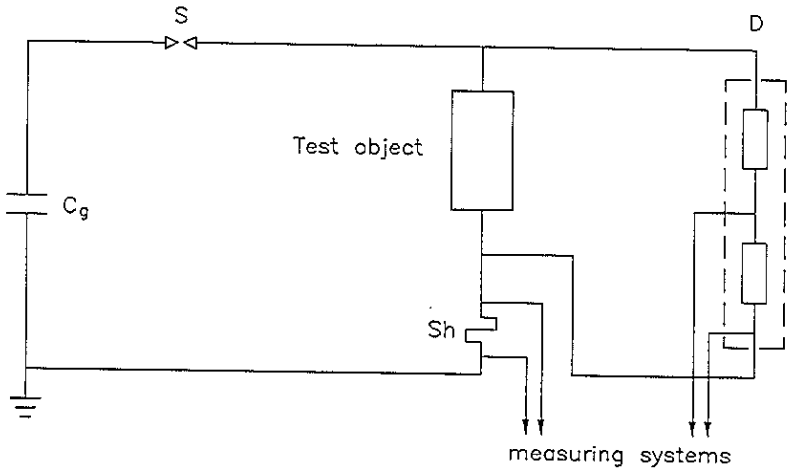
Sh - Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)
OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5152;
- CESI No 056227- 0562226 (on channel No.1)

SOFTWARE SYSTEM:

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

A0120IG

Circuit A0121



Impulse generator

No. of stages 2
Cg 2,91 µF

- 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

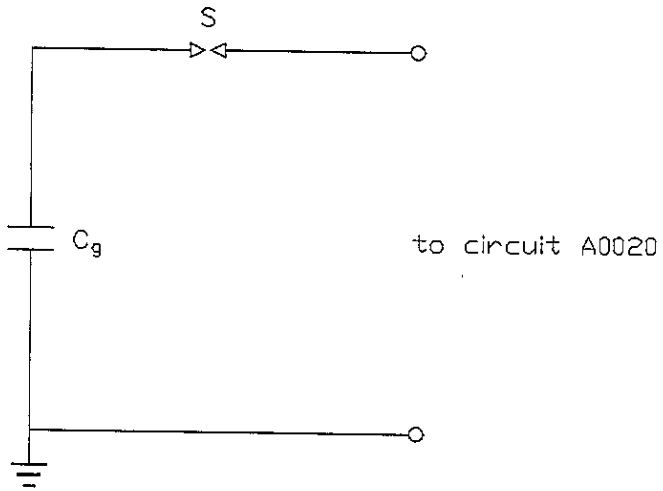
Sh - Current shunt CESI No.6042; R= 2 mΩ; peak current= 250 kA
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)

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

Circuit A0123

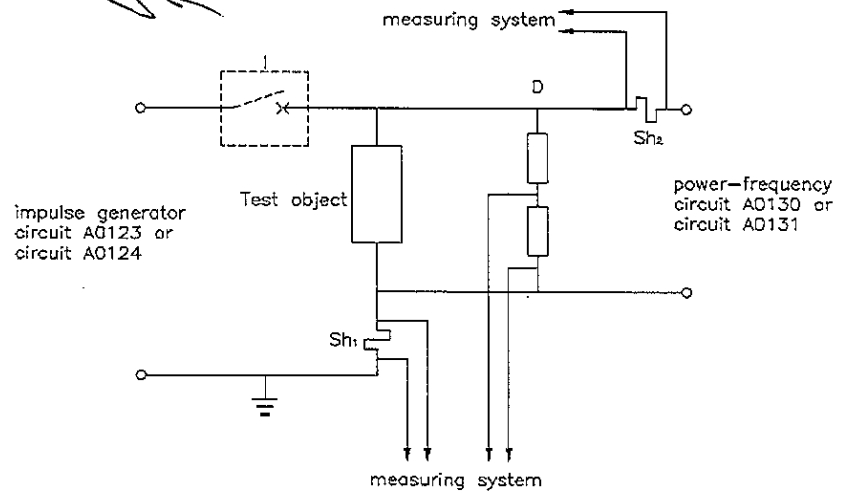


Impulse generator circuit for injection of Q_{ea}

No. of stages 2
Cg 2,91 µF
Le 12 µH

S - spark-gap

Circuit A0020



Impulse generator circuit A0123

Impulsive current measuring system

Sh1 - Current shunt CESI No.6042; R= 2 m Ω
- Electro optical system HBM CESI No. 57986(Rx) – 57987 (Tx)

OSC1 - 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)

OSC2,3 - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122
- CESI No 056227- 0562226 (on channel No.2)

Current measuring system

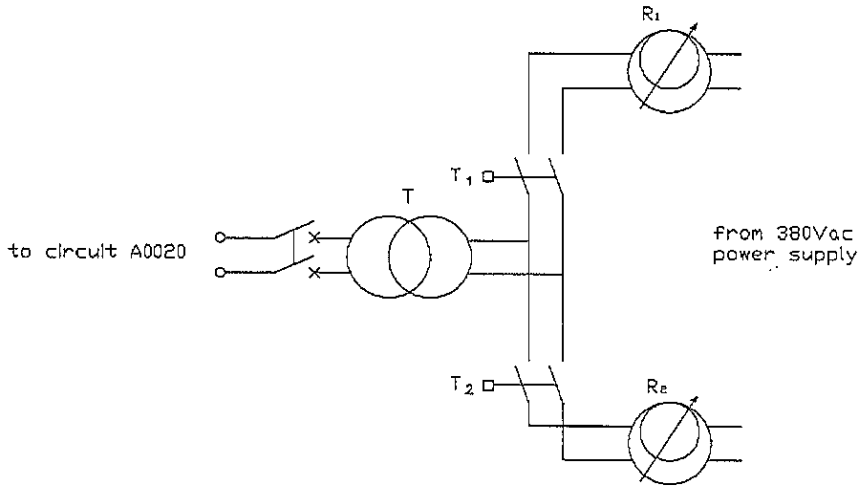
Sh2 (TOV - MCOV) - Current shunt type CESI n. 058315 R= 500 Ω
- Electro optical system CESI No. 57986(Rx) – 58294 (Tx)

OSC2,3 - 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

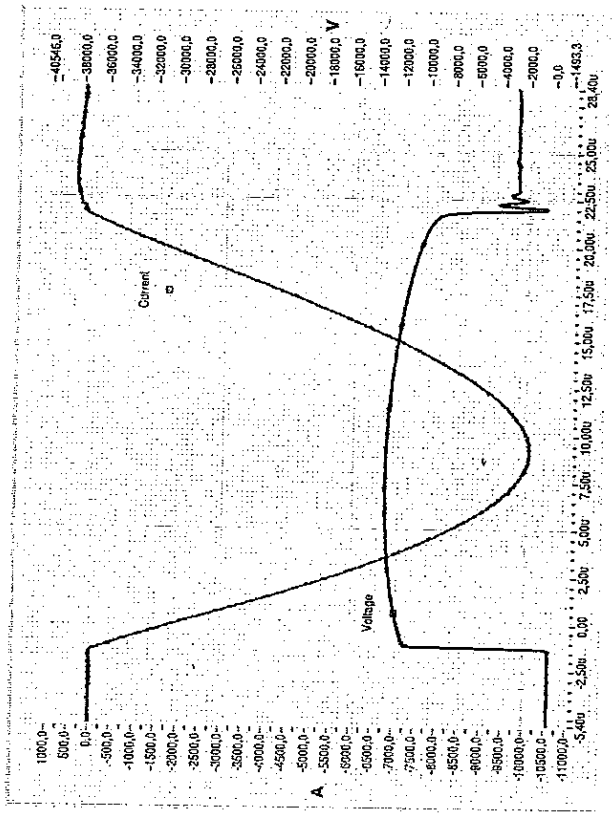
Circuit A0131



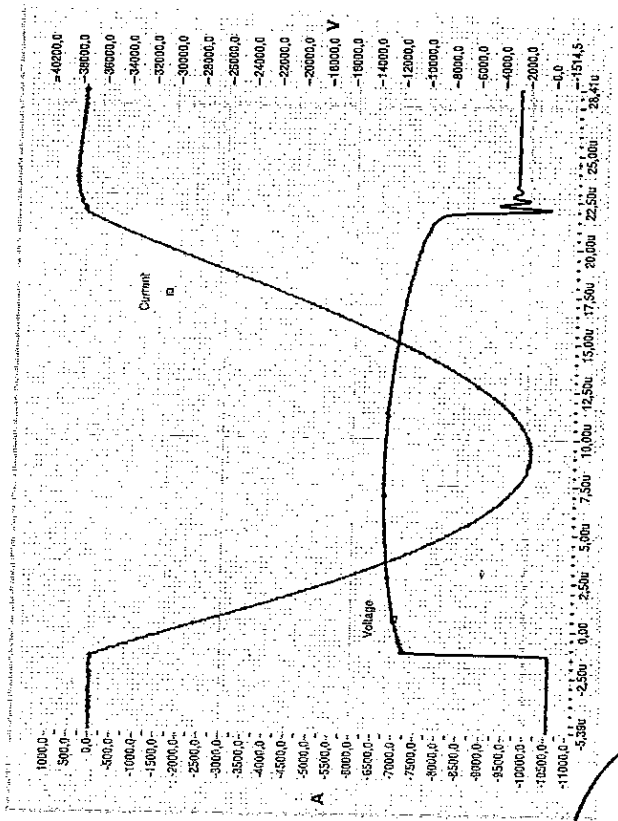
Power-frequancy circuit

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



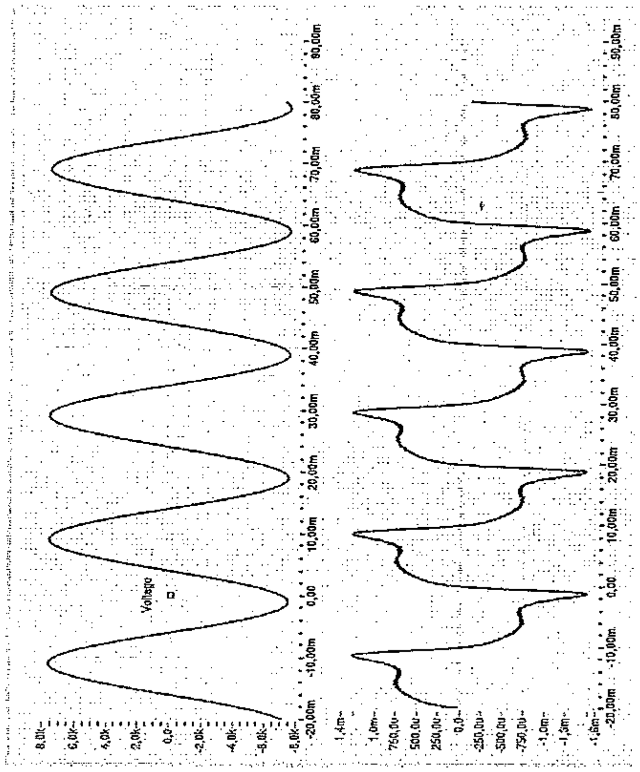
CESI B7024361 Oscillogram n. 2



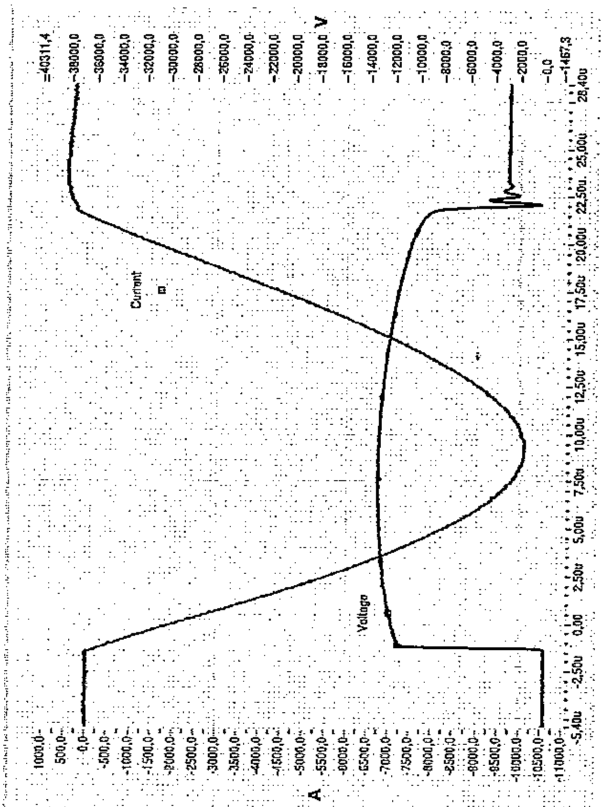
CESI B7024361 Oscillogram n. 1

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD



CESI B7024361 Oscillogram n. 4



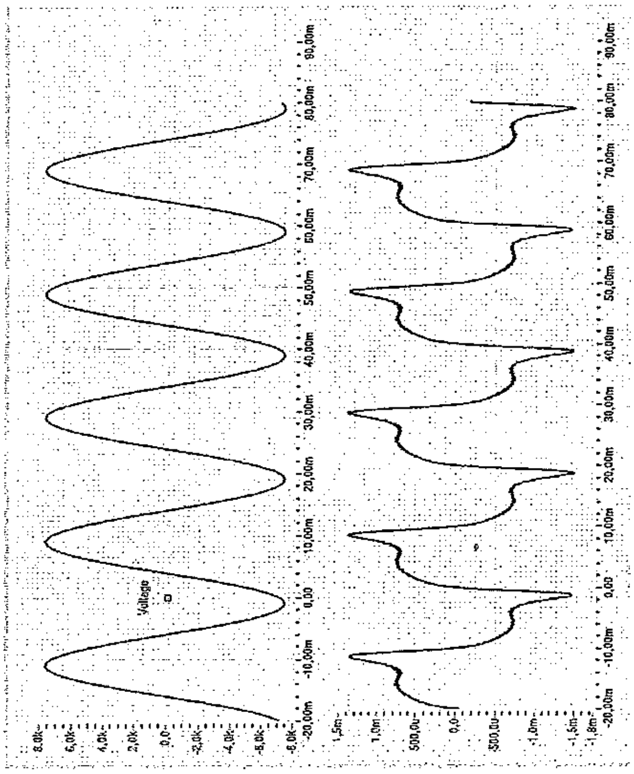
CESI B7024361 Oscillogram n. 3

ВЯРНО С ОРИГИНАЛА

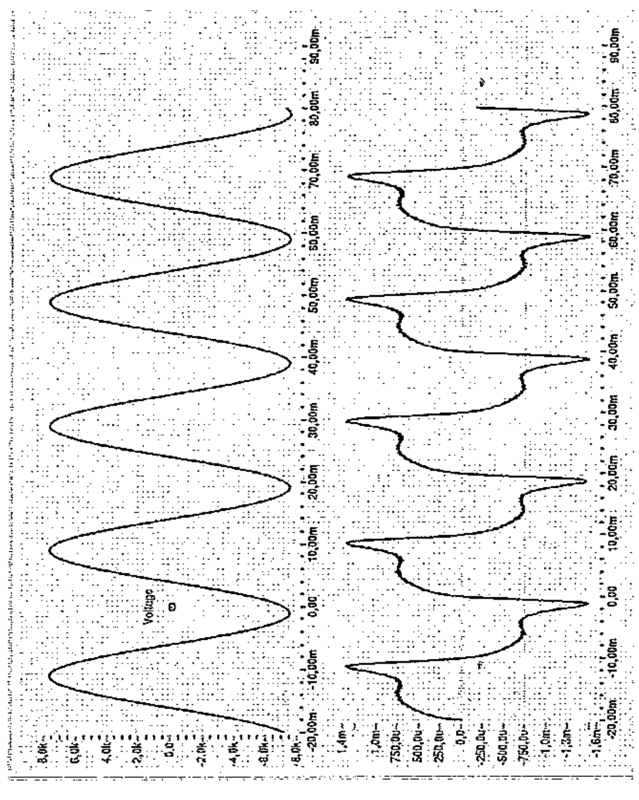
"EMI Electric" LTD

"ЕМИ ЕЛЕКТРИК" ЕООД

137



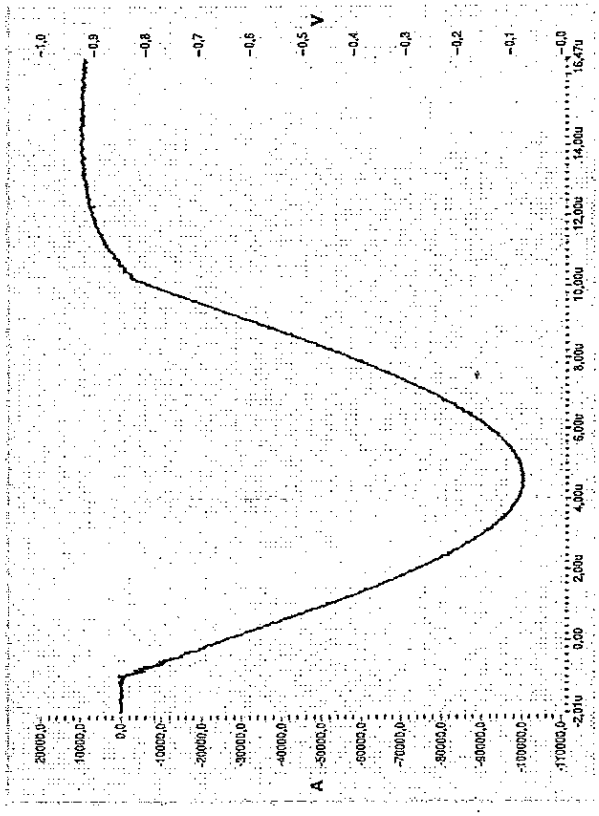
CESI B7024361 Oscillogram n. 6



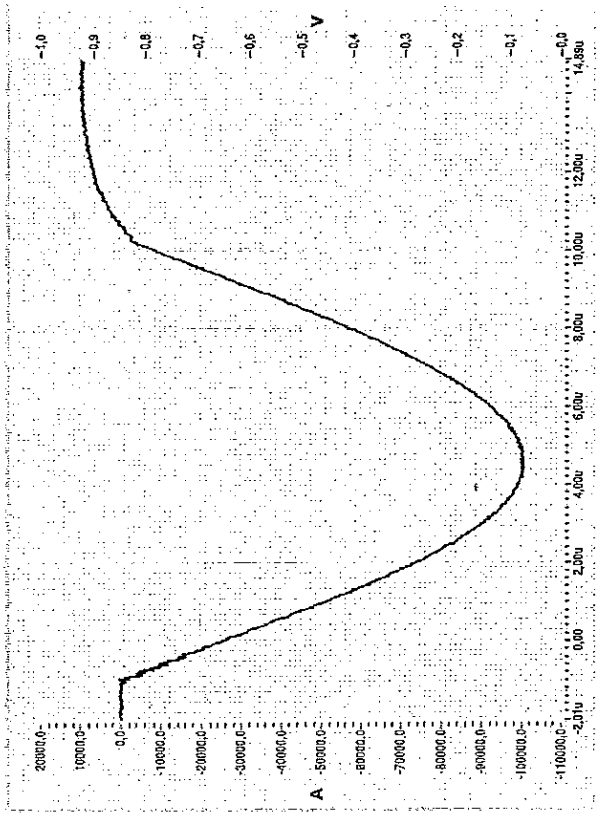
CESI B7024361 Oscillogram n. 5

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ Електрик" ЕООД



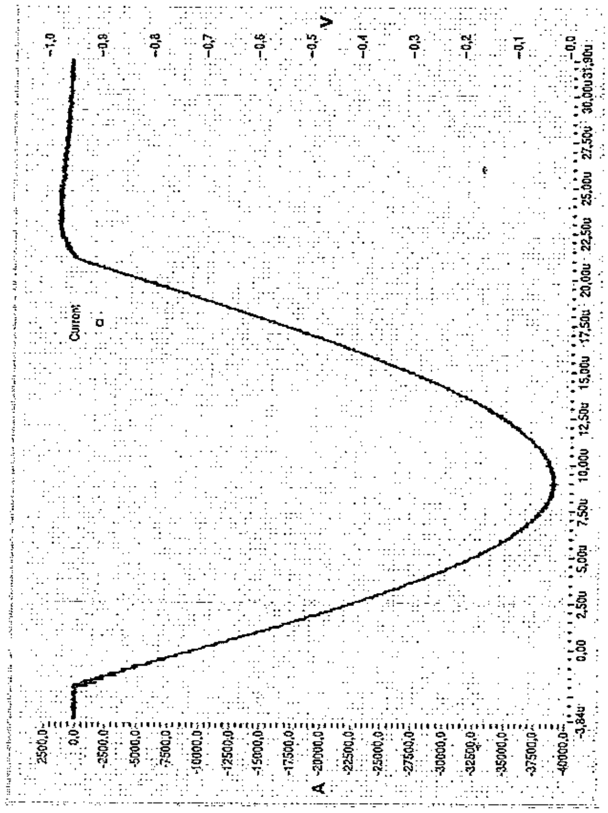
CESIB7024361 Oscillogram n. 8



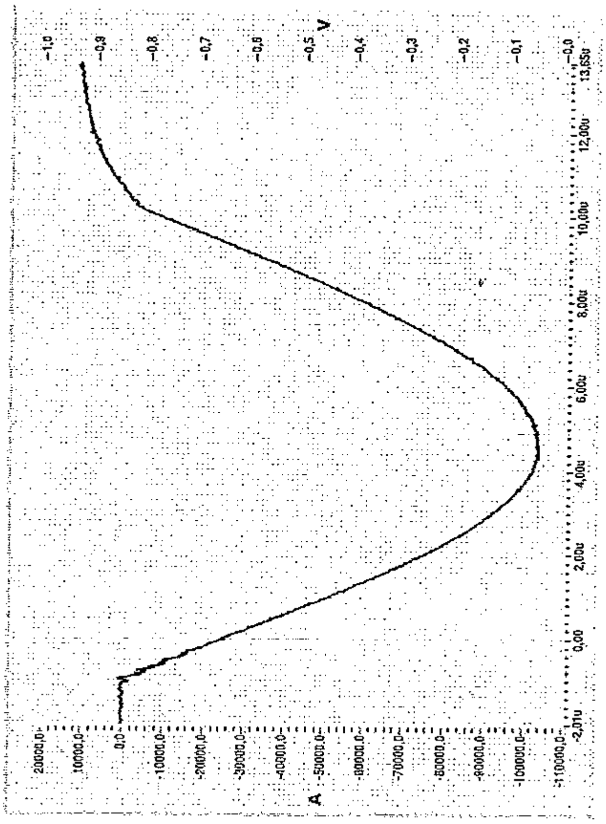
CESIB7024361 Oscillogram n. 7

ВЯРНО С
ОРИГИНАЛА

"ЕМИ Electric" LTD



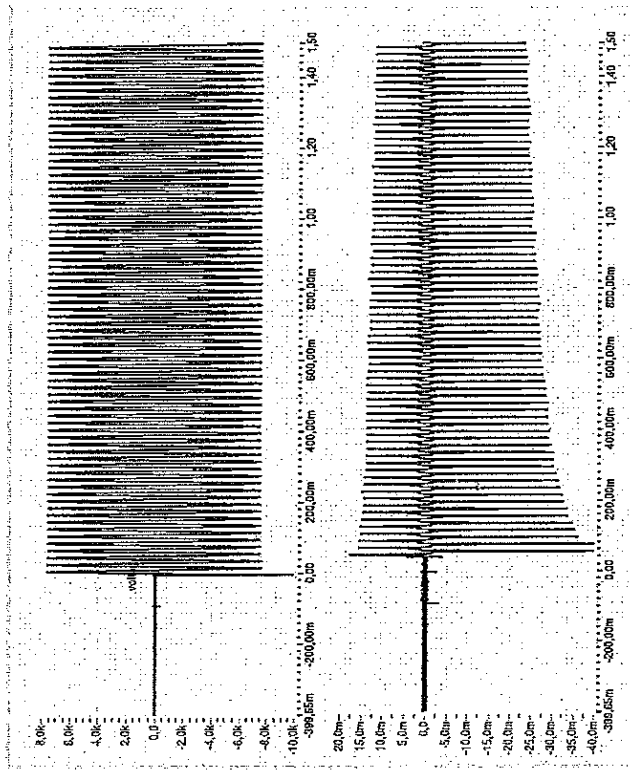
CESI B7024361 Oscillogram n. 10



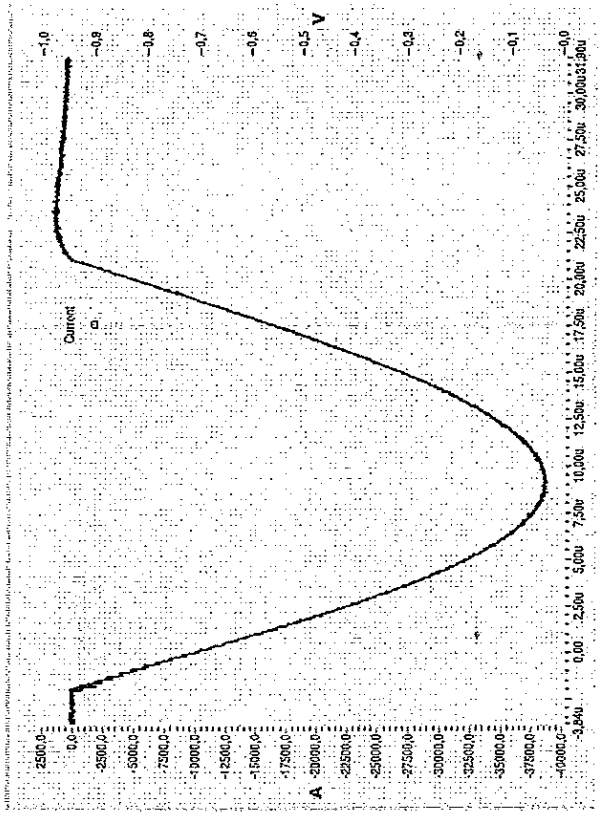
CESI B7024361 Oscillogram n. 9

ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD



CESI B7024361 Oscillogram n. 12

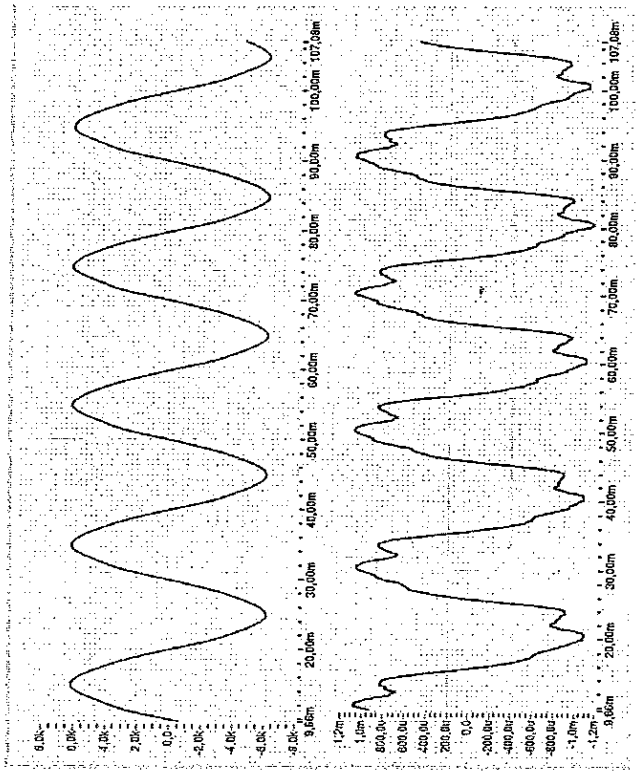


CESI B7024361 Oscillogram n. 11

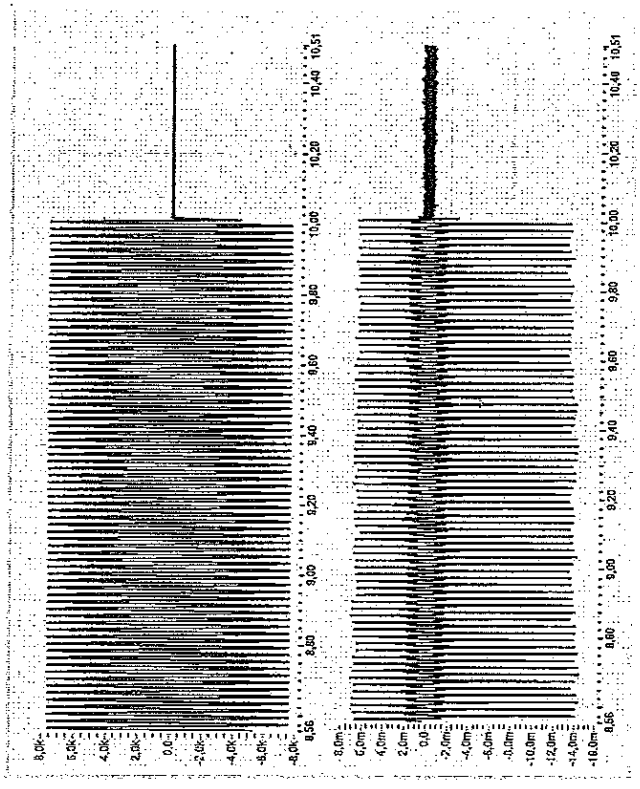
ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD

1H1



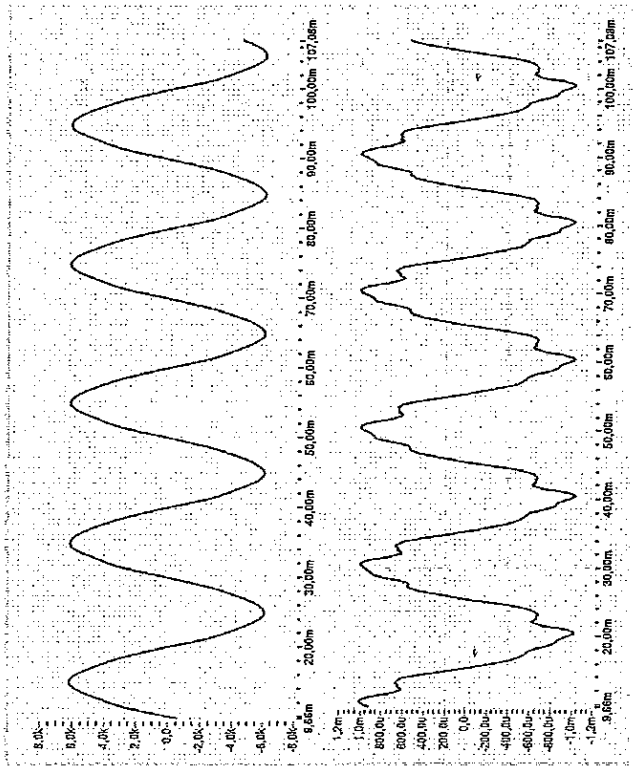
CESI B7024361 Oscillogramm n. 14



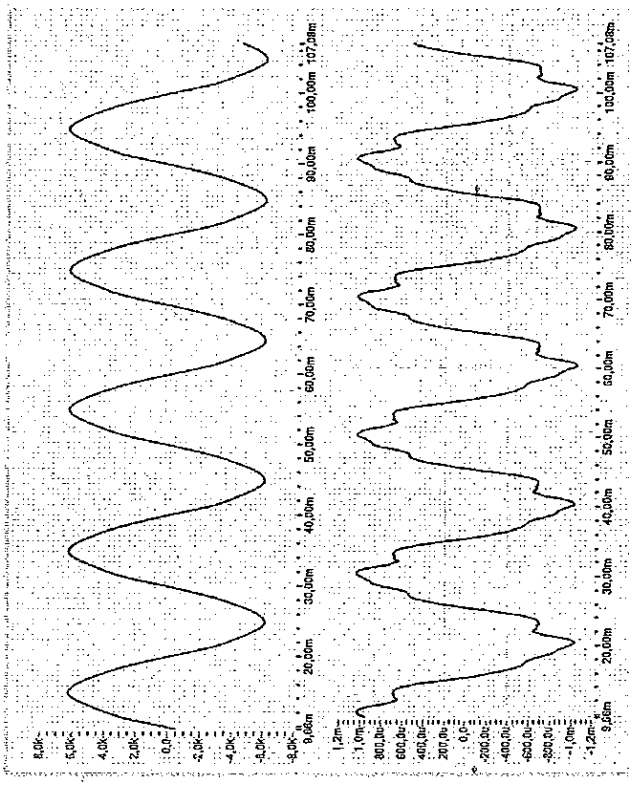
CESI B7024361 Oscillogramm n. 13

ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ ЕЛЕКТРИК" ЕООД



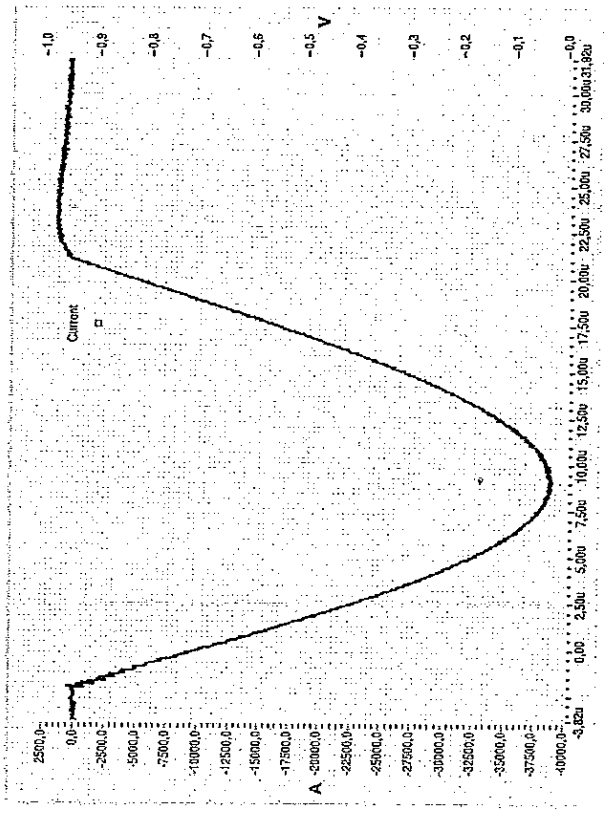
CESI B7024361 Oscillogram n. 16



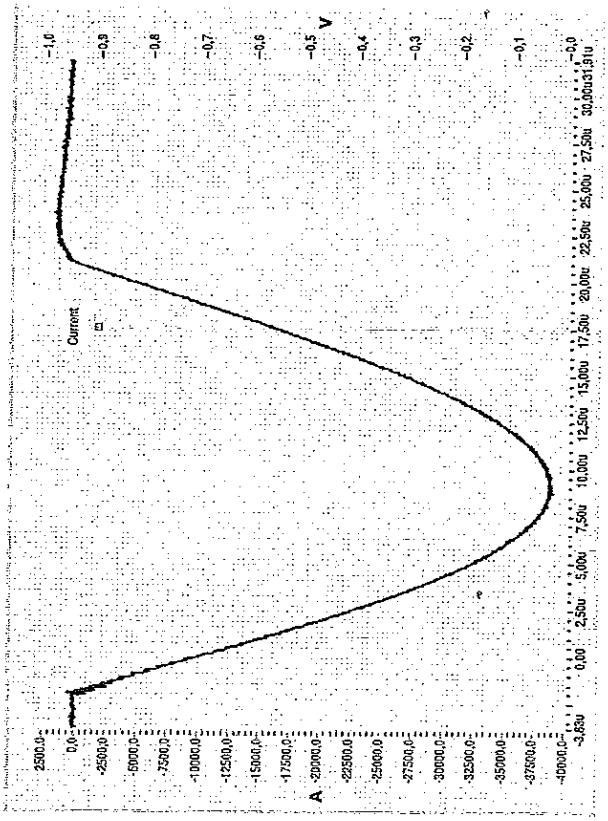
CESI B7024361 Oscillogram n. 15

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD



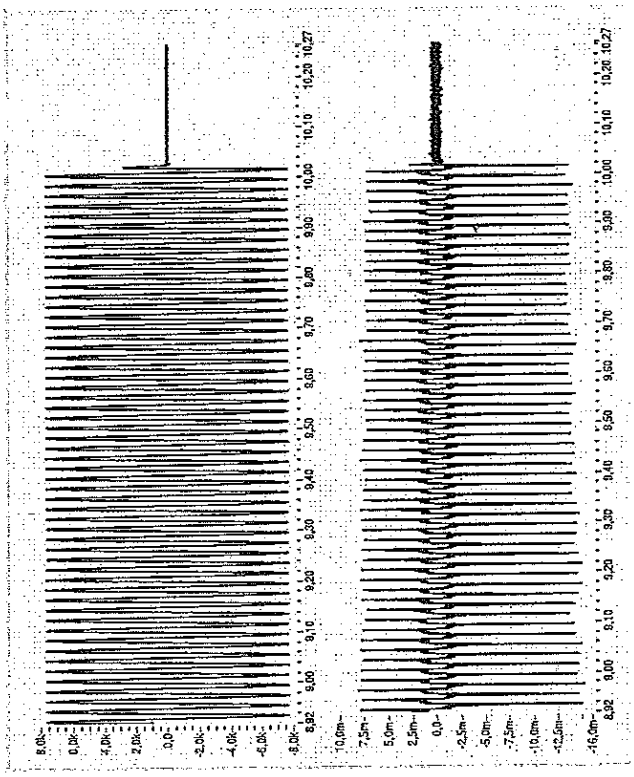
CESI B7024361 Oscillogramm n. 18



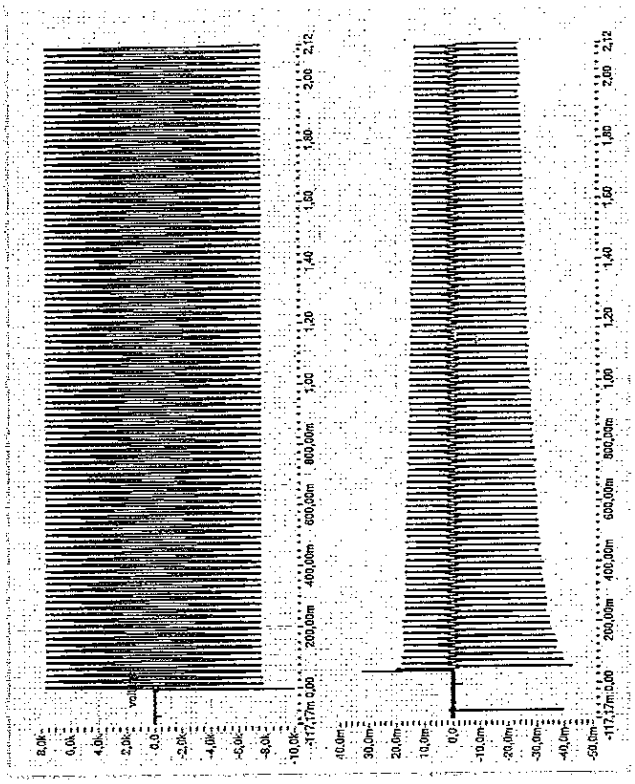
CESI B7024361 Oscillogramm n. 17

ВЯРНО С
ОРИГИНАЛ

"EMI Electric" LTD



CESI B7024361 Oscillogram n. 20

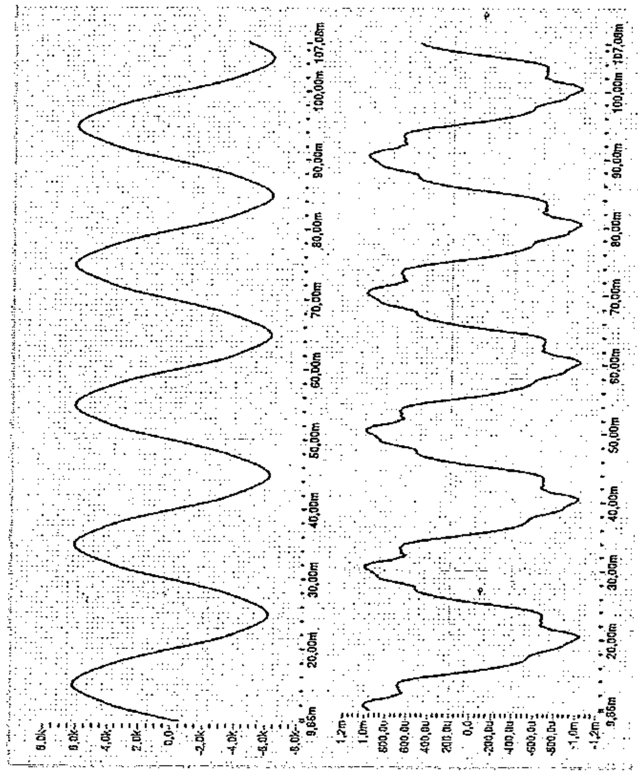


CESI B7024361 Oscillogram n. 19

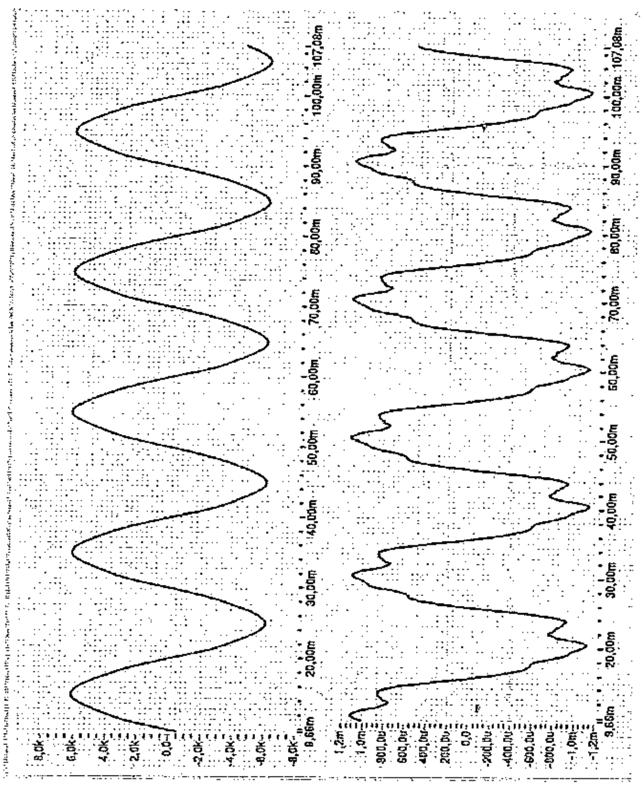
"EMI Electric" LTD

ВЯРНО С ОРИГИНАЛА

1145



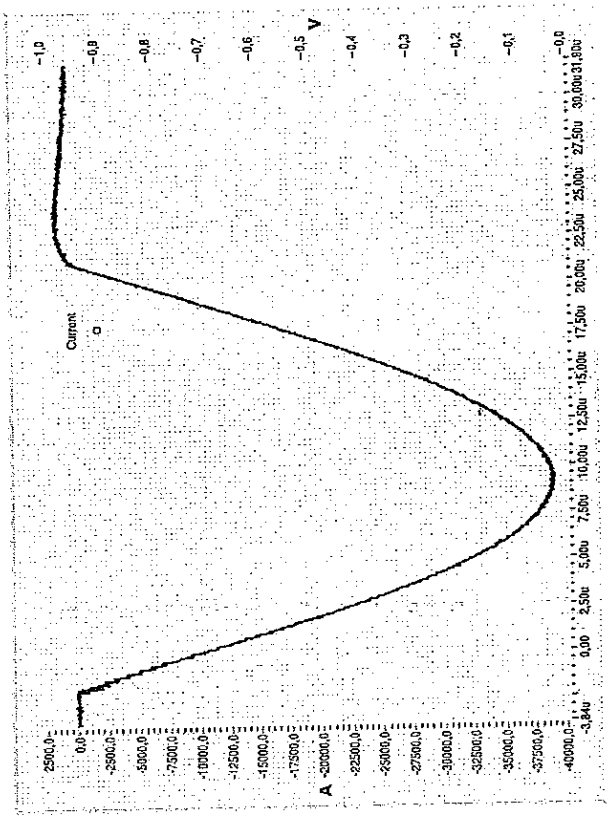
CESI B7024361 Oscillogram n. 22



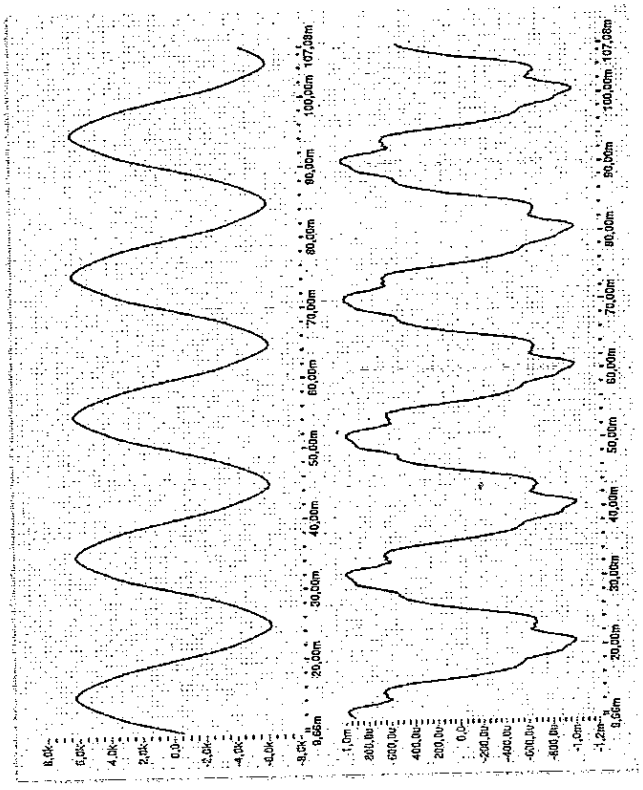
CESI B7024361 Oscillogram n. 21

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ ЕЛЕКТРИК" ЕООД



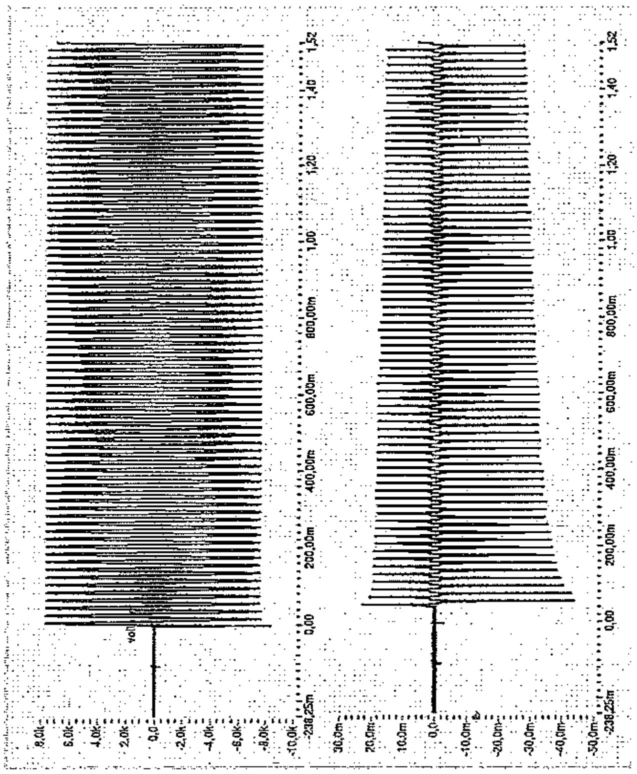
CESI B7024361 Oscillogram n. 24



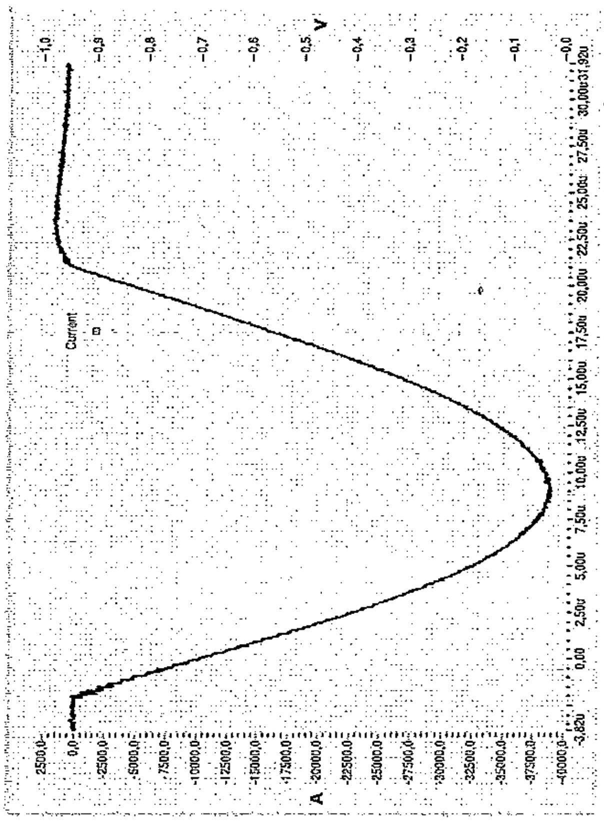
CESI B7024361 Oscillogram n. 23

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD



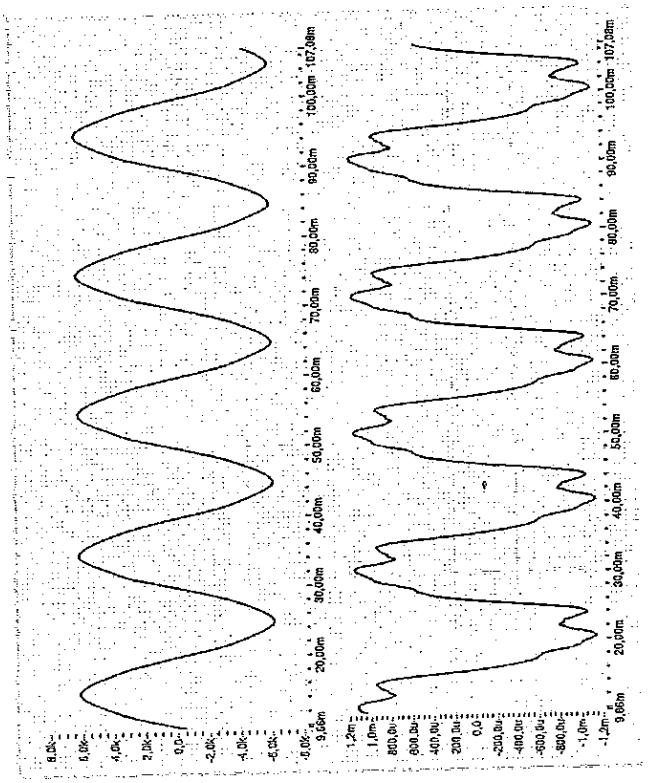
CESI B7024361 Oscillogram n. 26



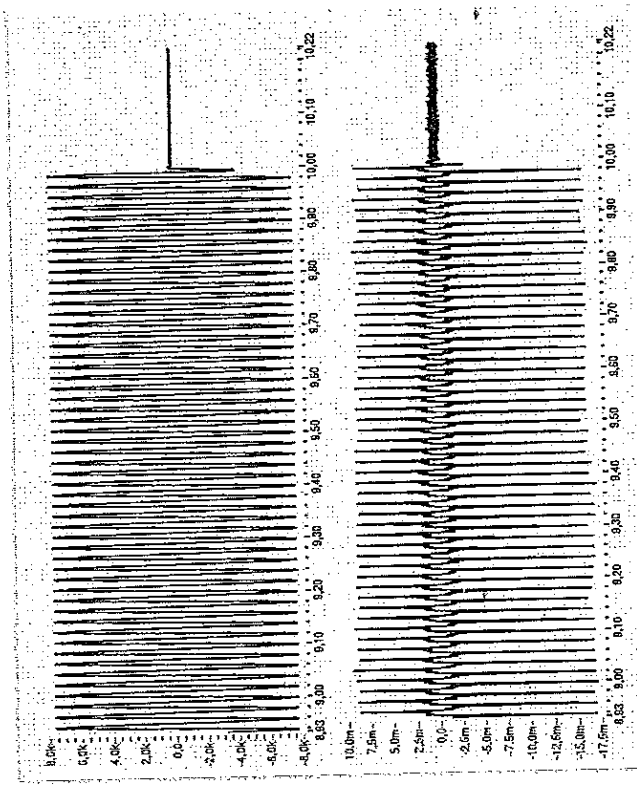
CESI B7024361 Oscillogram n. 25

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD
"ЕМИ Електрик" ООД



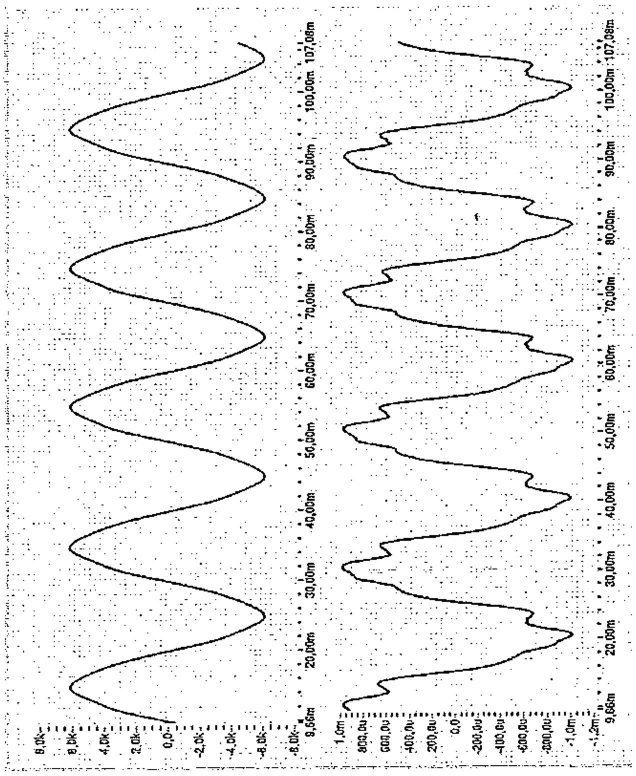
CESI B7024361 Oscillogram n. 28



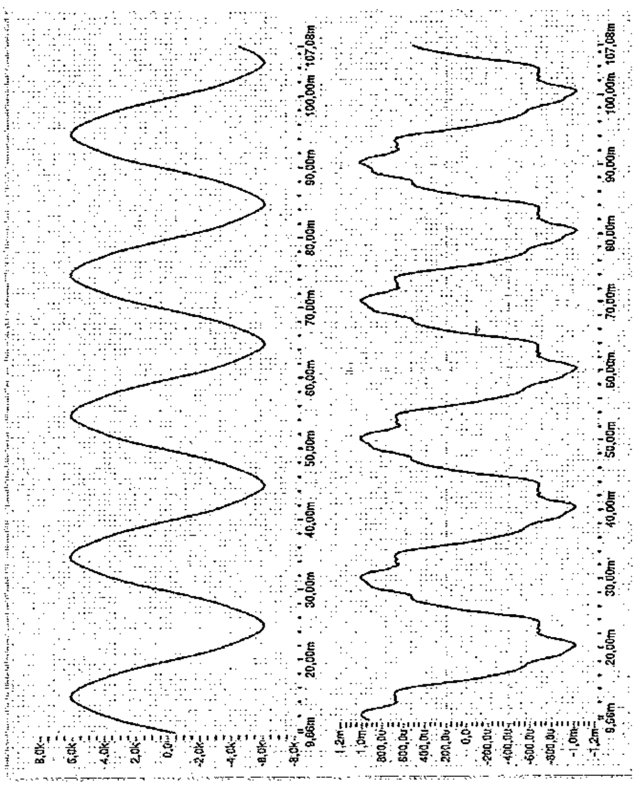
CESI B7024361 Oscillogram

ВЯРНО С ОРИГИНАЛА

"ERI Electric" LTD



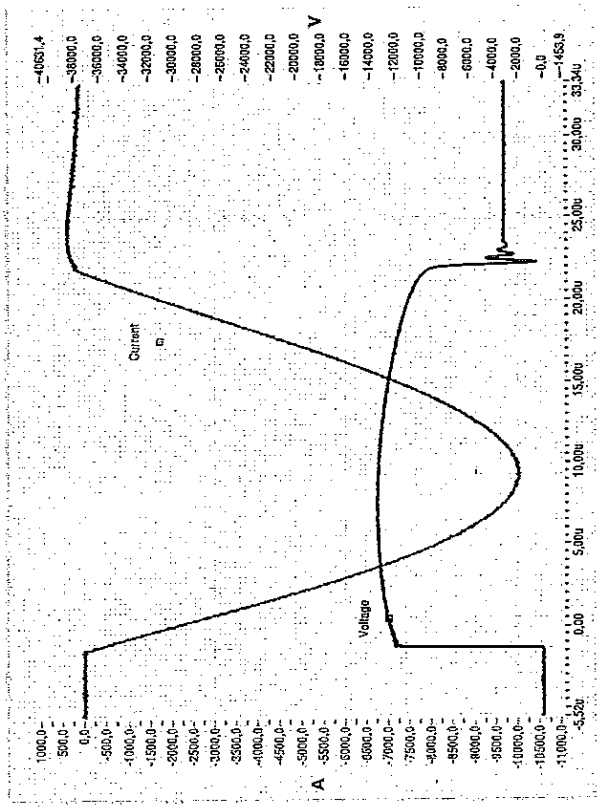
CESI B7024361 Oscillogram n. 30



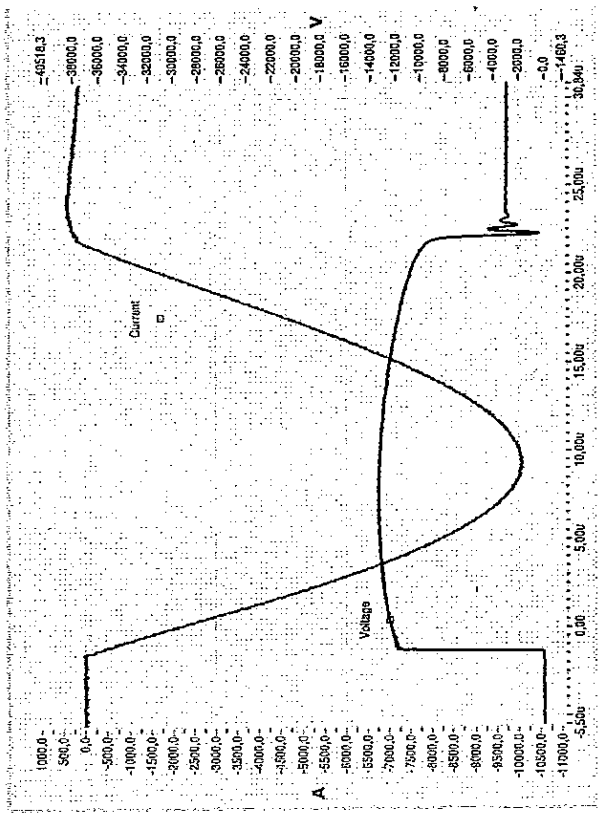
CESI B7024361 Oscillogram n. 29

ВЯРНО С
ОРИГИНАЛА

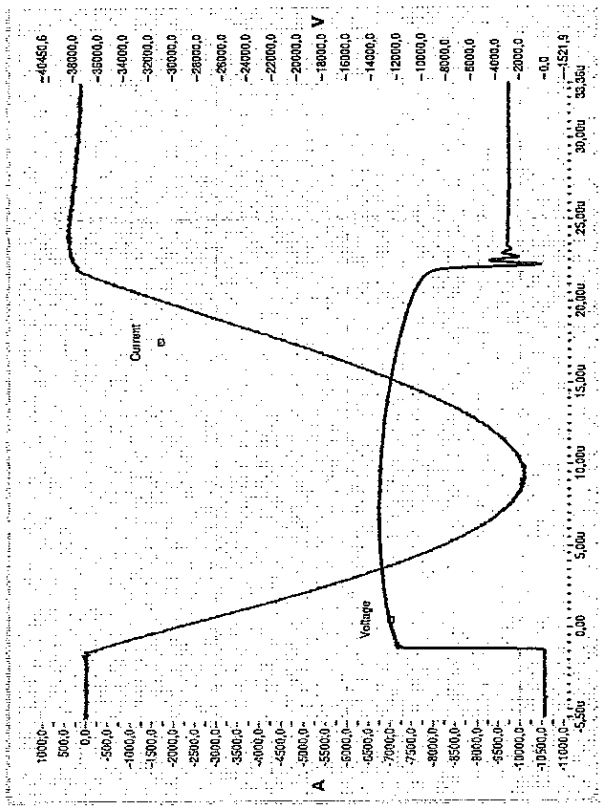
"EMI Electric" LTD
"ЕМИ ЕЛЕКТРИК" ЕООД



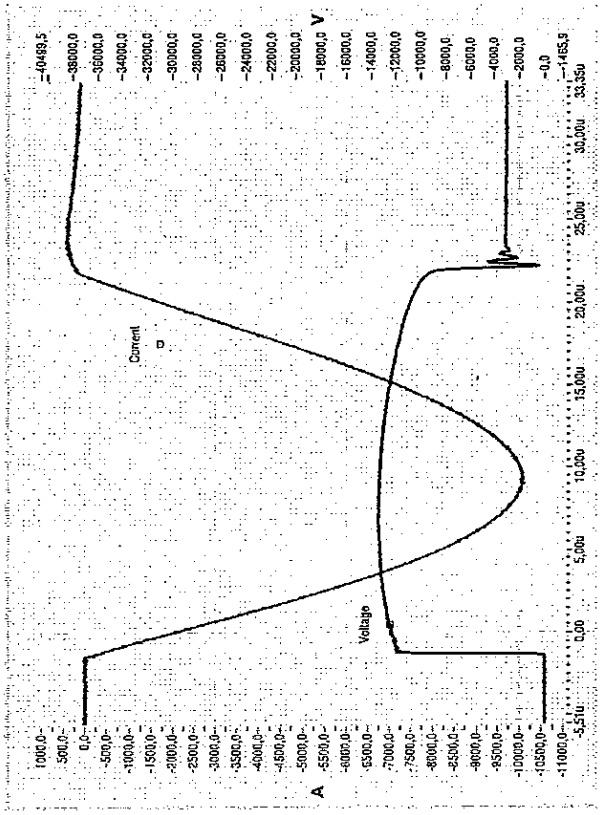
CESI B7024361 Oscillogram n. 32



CESI B7024361 Oscillogram n. 31



CESI B7024361 Oscillogram n. 34

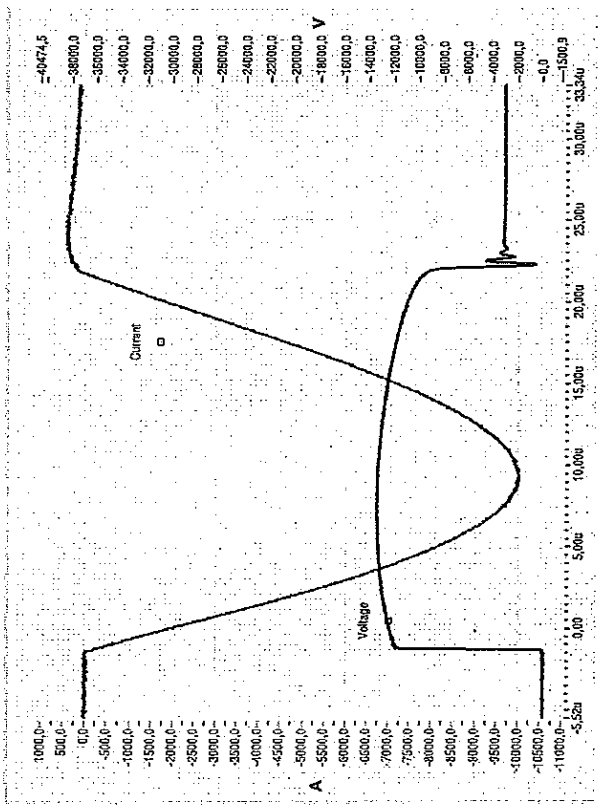


CESI B7024361 Oscillogram n. 33

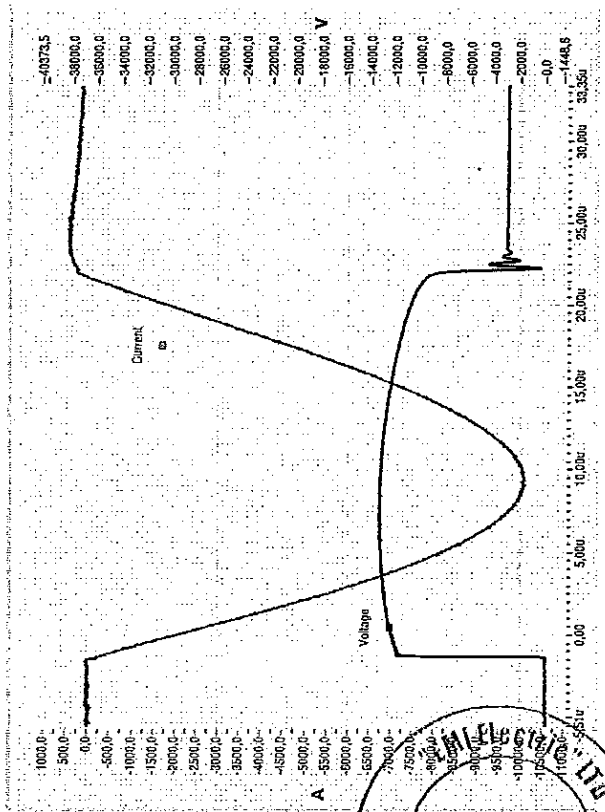
ВЯРНО С
ОРИГИНАЛА

"EMI Electric" EAD

152



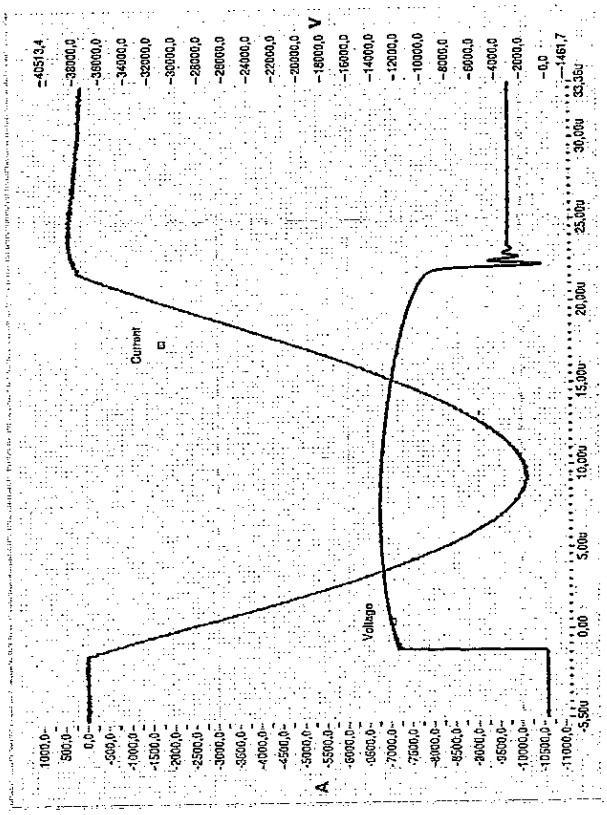
CESI B7024361 Oscillogram n. 36



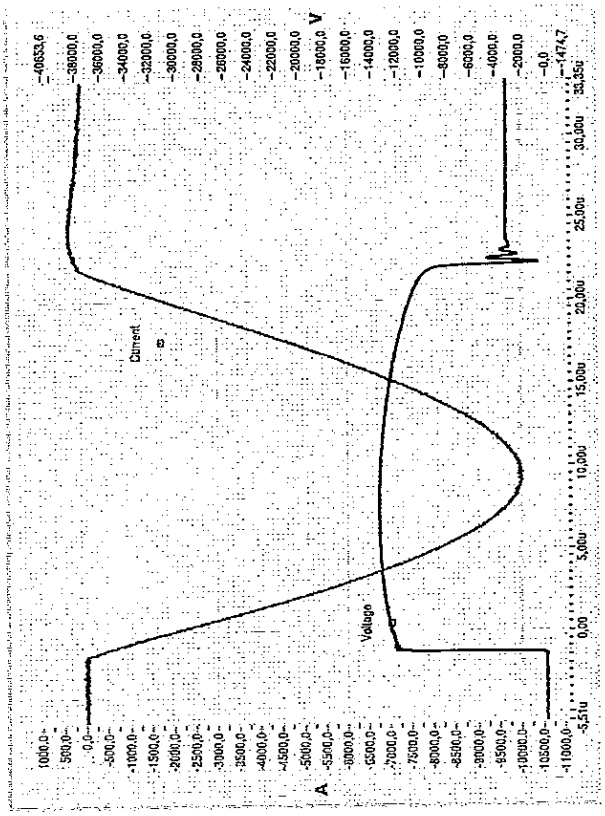
CESI B7024361 Oscillogram n. 35

ВЯРНО С ОРИГИНАЛА

153



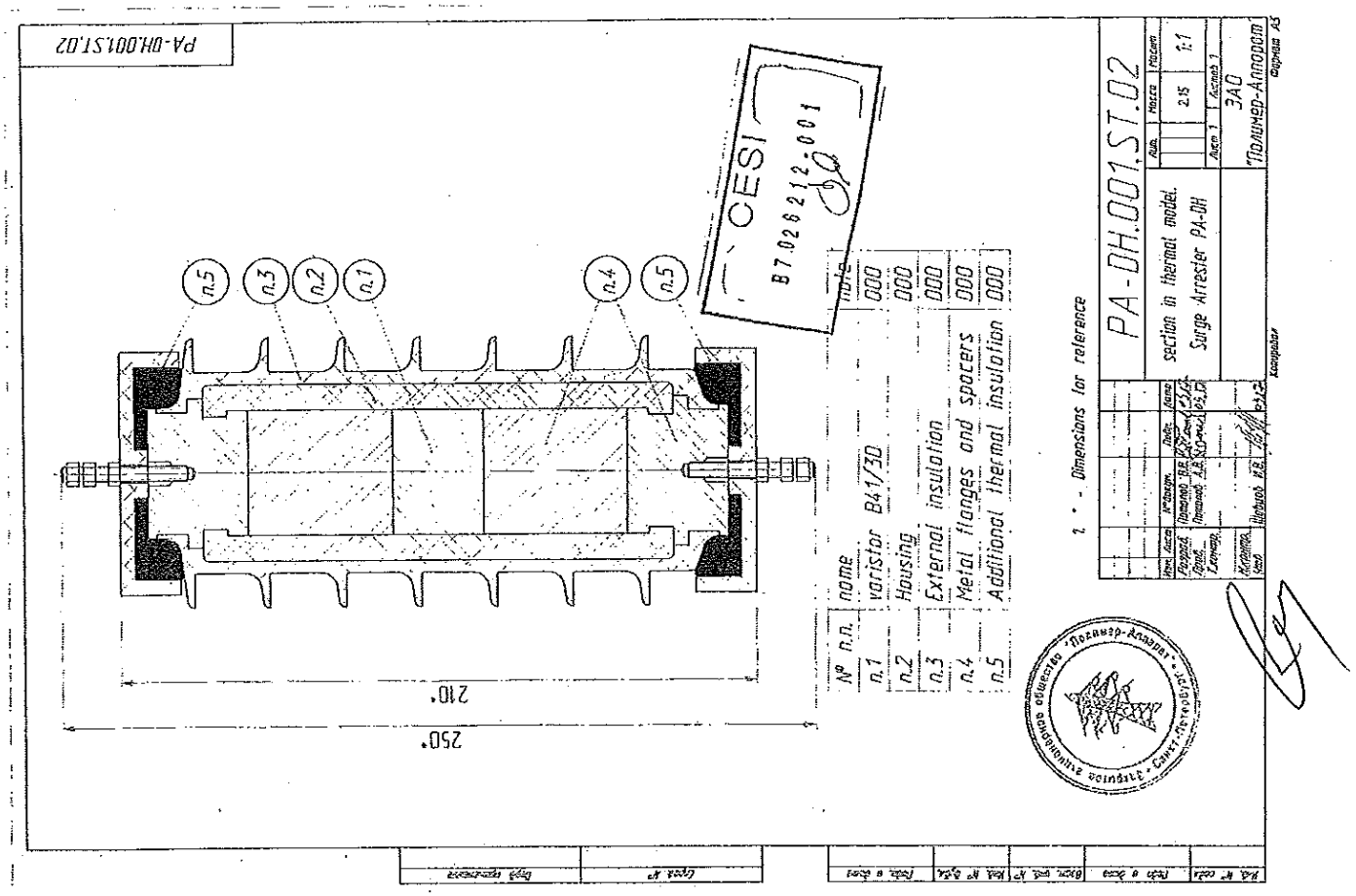
CESI B7024361 Oscillogram n. 38

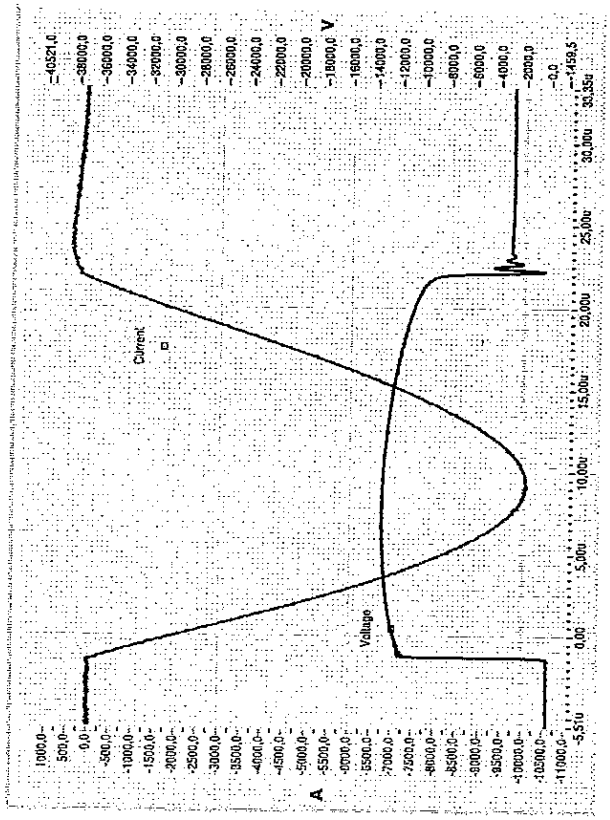


CESI B7024361 Oscillogram n. 37

"EMI Electric" LTD

154



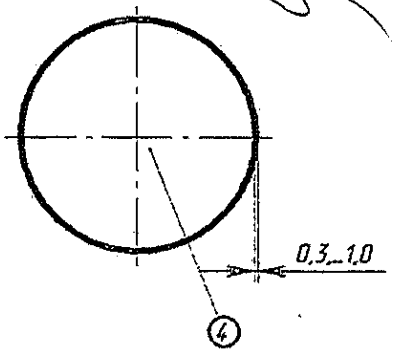


ВЯРНО С ОРИГИНАЛА

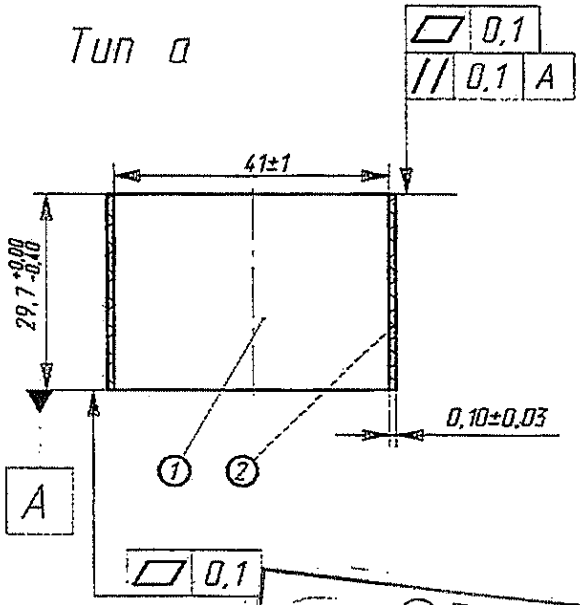
"EMI Electric" LTD

155

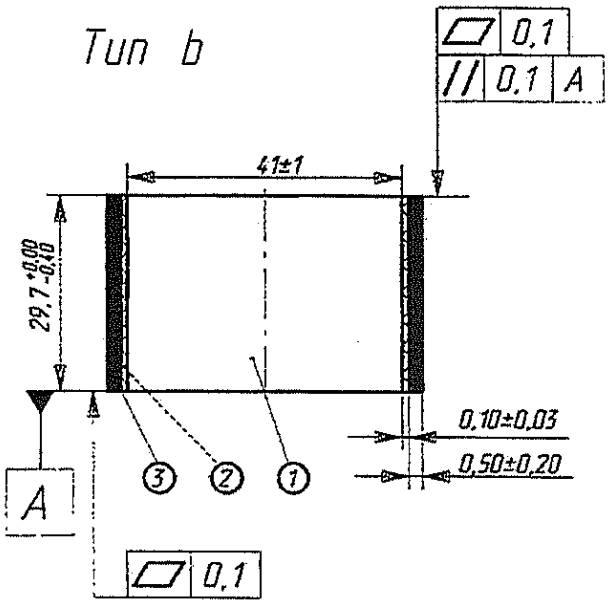
PA.VAR.0500.30



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

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

941

Приложение 3

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 .

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

Data di 1ª emissione *1st issue date*	Data di modifica *Modification date*	Data di scadenza *Expiring date*
1998-02-27	[illegible]	[illegible]
на основание чл. 2 от ЗЗЛД	на основание чл. 2 от ЗЗЛД	на основание чл. 2 от ЗЗЛД

[illegible] Generale
The General Director
(Dr. Filippo Trifiletti)

Il Direttore di Dipartimento
Department Director
(Dr.ssa Silvia Tramontin)

[illegible]
The President
(Ing. Giuseppe Rossi)

"EMI Electric" LTD

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

ВЯРНО Г.
ЗА ИМАПА

154

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*

Sedi operative:

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

"EMI Electric" LTD

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

Приложение 4

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

Добровольная сертификация

МЕТАЛО-ОКСИДНИ ВЕНТИЛНИ ОТВОДИ

PA-DH-103-14-22/22

ТЕХНИЧЕСКО РЪКОВОДСТВО

ТМ 3414-Е412-15207362-2018

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD

Това ръководство съдържа технически данни за метало-оксидни Вентилни Отводи (ВО) от пренапрежения в полимерни обвивки тип PA-DH-103-14-22/22

1. Приложение

1.1. Метало-оксидни вентилни отводи от пренапрежения без въздушна междина от тип PA-DH-103, по нататък наричани „отводи", са предназначени за предпазване на електрическо оборудване АС 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-DH-103-14-22/22**

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

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

103 - Тип обвивка;

14 - 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;

ВЯРНО С ОРИГИНАЛА

- 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.

Параметър	Номинална стойност
1. Номинално напрежение, kV	14
2. Трайно напрежение на предпазител (MCOV), kV (rms)	11.2
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	33.0
10 кА	34.7
20 кА	37.5
5. Остатъчно напрежение при превключващ импулс на ток с амплитуда 30/60 μs (kV, не повече от):	
125 А	25.3
500 А	26.4
6. Остатъчно напрежение при стръмен 1/10 μs токов импулс с амплитуда 10000 А (kV, не повече от)	37.8
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 текущия импулс, A	450
11. Референтно напрежение (при референтен ток I_{ref} = 1.5 mA), kV, не по-малко от	13.9

5.2.Външни параметри на изолацията:

– Обявено издържано мълниево импулсно напрежение 1.2/50 μs , не по-малко от 90 kV

– Обявено издържано мълниево импулсно напрежение 60 Hz, не по-малко от 40 kV

– Разстояние на утечка, не по-малко от 443 mm

ВЯРНО С ОРИГИНАЛА

"EMI Electric" LTD "ЕМИ ЕЛЕКТРИК" ЕООД

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 частично разреждане в предпазителя 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.

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

Компелтът за доставка се състои от:

– Предпазител;

– QC сертификат за тест;

– Техническо упътване (3 копия за тип предпазител).

Вентилните отводи се състоят от:

"EMI Electric" LTD "ЕМИ ЕЛЕКТРИК" ЕООД

ВЯРНО С ОРИГИНАЛА

162

– Метало-оксиден ВО от пренапрежение без въздушни междини тип PA-DH-103;

– 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 ВО е отбелязано:

– Име на производителя;

– Тип на ВО;

– 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 безопастност може да борави с тези предпазители.

ВЯРНО С ОРИГИНАЛА

"ЕМ-ЕЛЕКТРИК" ЕООД

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

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

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

12.4.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

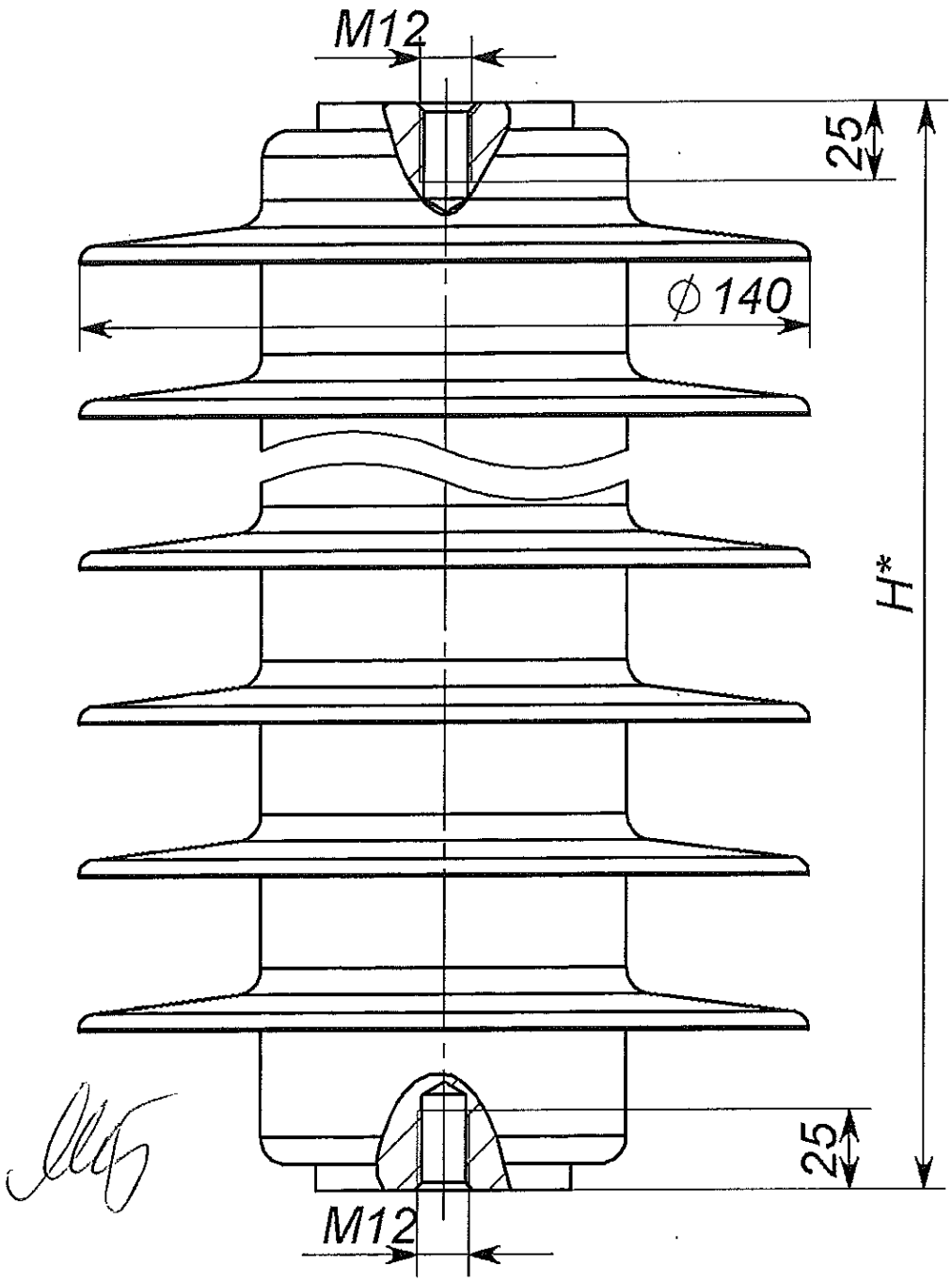
Производитея ще замени повредени Вентилни отводи в срок от 5 години от датата на пускане в експлоатация, но не по-късно от 7 години от датата на експедиция от производителя, при условие, че повреденият ВО е бил транспортиран, съхраняван ,инсталиран и експлоатиран стриктно спазвайки това техническо ръководство.

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.

ПРИЛОЖЕНИЕ А

Външни и инсталационни размери и тегло на Вентилните отводи тип РА- DH -103



Височина на ВО (Н) – 180 ± 1 mm.

Тегло на ВО – 2.2±0.1 kg

ВЯРНО С ОРИГИНАЛА

"ЕМИ Електрик" ЕООД

Test Report

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

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

IEC 60099-4 (2014-06)

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

November 4, 2016

Date	Ghezzi Giuseppe Test Engineer in charge	The Manager - Arcidiacо Lorenzo Approved By Document Digitally Signed

ACCREDIA
ENTE ITALIANO DI ACCREDITAMENTO
LAB N° 0020

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 B6019249 No. 1 are annexed to this document.

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

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

Revision No.	Date	Reference

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

- Voltage a.c. ± 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 October 2016

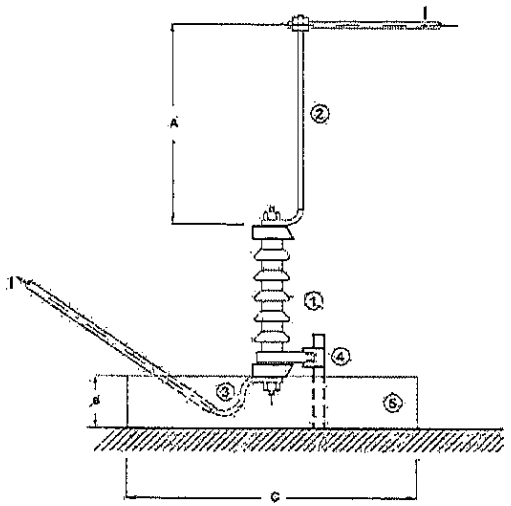
D1002IG

Contents

Rated characteristics of the tested object assigned by the Client

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

D8058 - Test arrangement



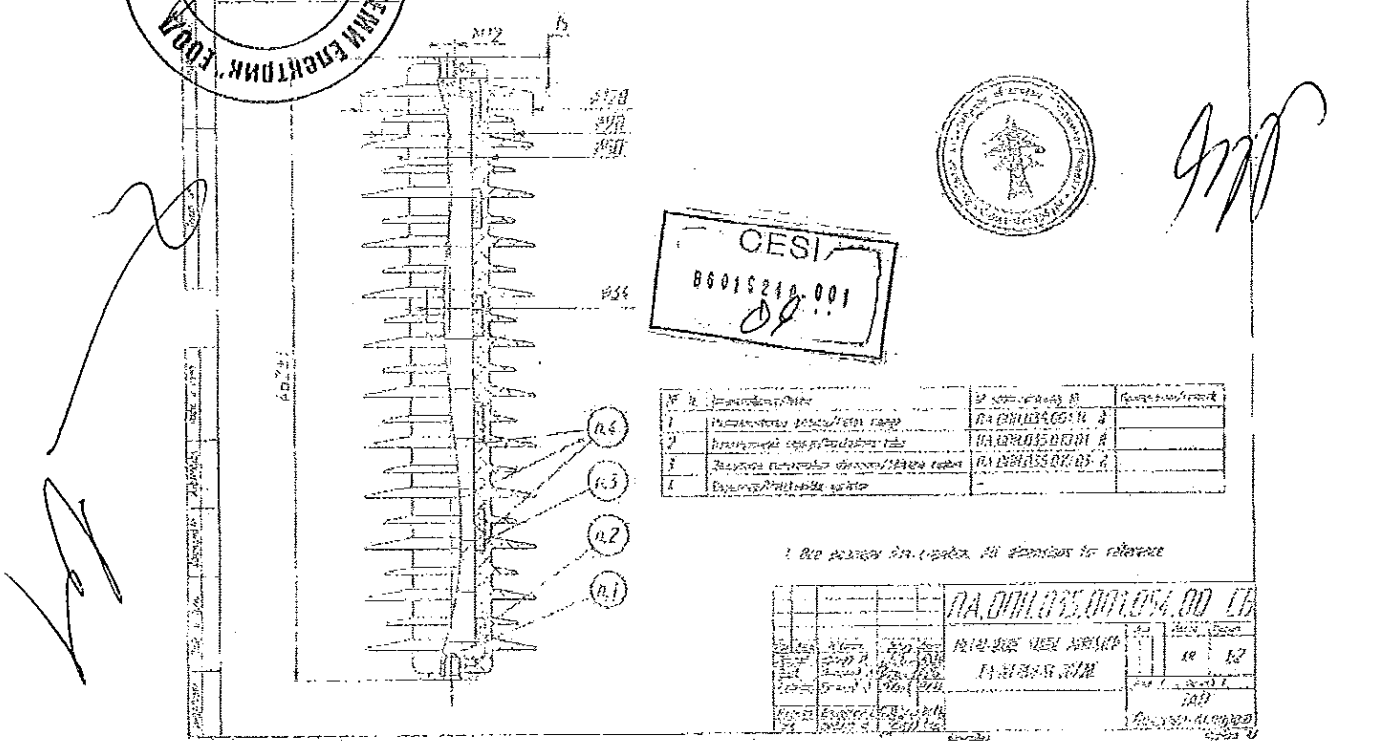
1 : Surge arrester
2 : Flexible conductor
3 : Flexible conductor
4 : Not metallic pole
5 : Enclosure

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

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

691

D1232IG



D1232IG

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

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

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

Under test surge arrester PA-DM Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to 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 64,8 kV and kept at this value or slightly adjusted till arrester failure.
The pre-failure process duration was 4 minutes and 10 seconds
The short-circuit test was performed 6 minutes and 05 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: October 21, 2016

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

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

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

D12321G

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

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

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

Under test surge arrester PA-DM Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to 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 63,3 kV and kept at this value or slighly adjusted till arrester failure.
The pre-failure process duration was 4 minutes and 40 seconds
The short-circuit test was performed 5 minutes and 25 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: October 21, 2016

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

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

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

D12321G

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

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

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

Under test surge arrester PA-DM Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to 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 63,4 kV and kept at this value or slighly adjusted till arrester failure.
The pre-failure process duration was 4 minutes and 15 seconds
The short-circuit test was performed 6 minutes and 30 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

Date: October 21, 2016

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

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

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

170

D1079IG rev.01

"ЕМИ Електрик" ЕООД "EMI Electric" LTD

ВЯРНО С ОРИГИНАЛА

ACCREDIA LAB N° 0030

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

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

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

Under test Surge arrester PA-DM Type

Test arrangement : See D8058
A photo detector was used to determine the venting time
In order to 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 63,0 kV and kept at this value or slightly adjusted till arrester failure.
The pre-failure process duration was 3 minutes and 55 seconds
The short-circuit test was performed 5 minutes and 10 sec after the completion of the pre-failure process.

Condition of the apparatus before the tests: new

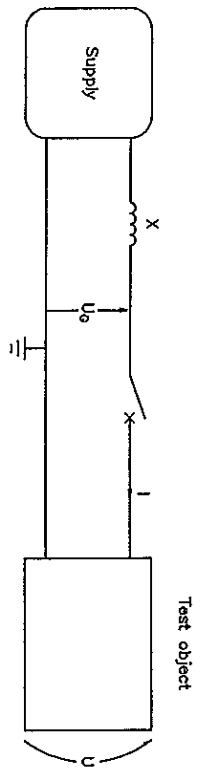
Date: October 21, 2016

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

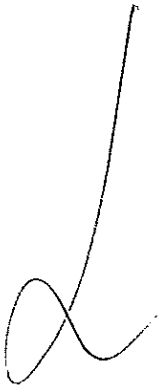
ndition of the apparatus after the tests:
.ere was not violent shattering
the arrester structure remained intact, only polymer housing slided down
the arrester remained connected to the supply and return circuit
- no fragment were found outside the enclosure
- no flame was noted
Acceptance criteria according to clause 8.7.6: Satisfied
Test result: Positive

D0046IG

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



Test circuit D0046



Test Report CESI Approved B6022563 Page 12

ACCREDIA LAB N° 0030

171

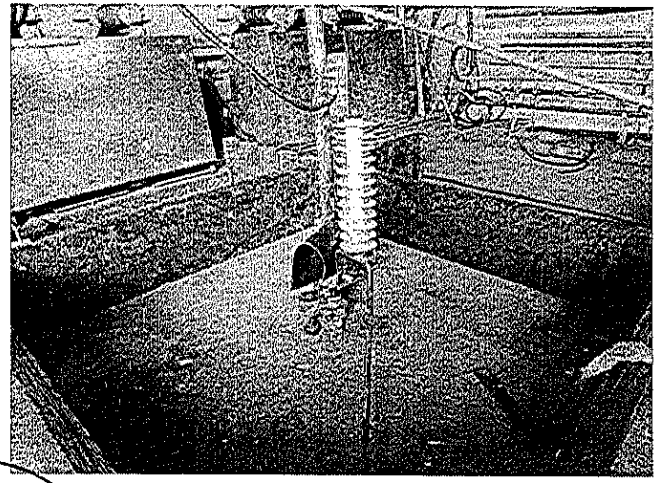


Photo No.1
Before the test No.1

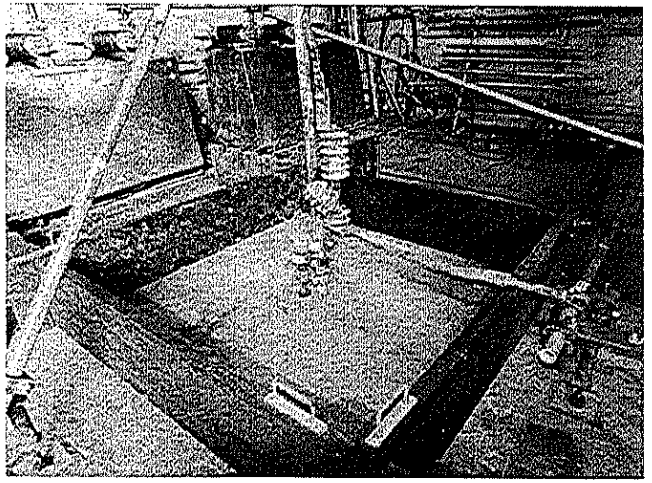


Photo No.2
After the test No.1

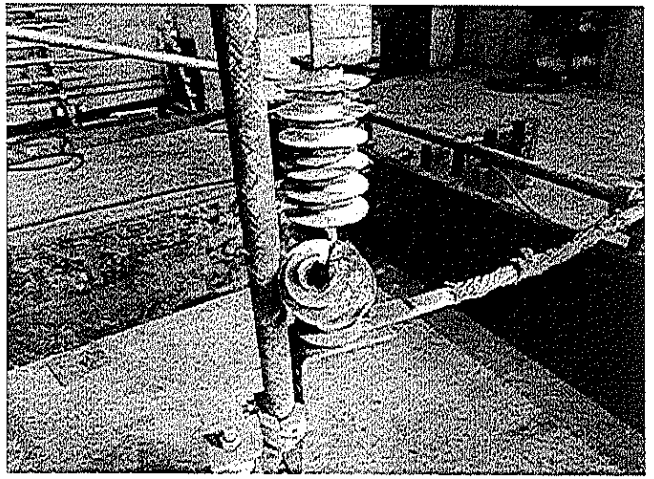


Photo No.3
After test No. 1

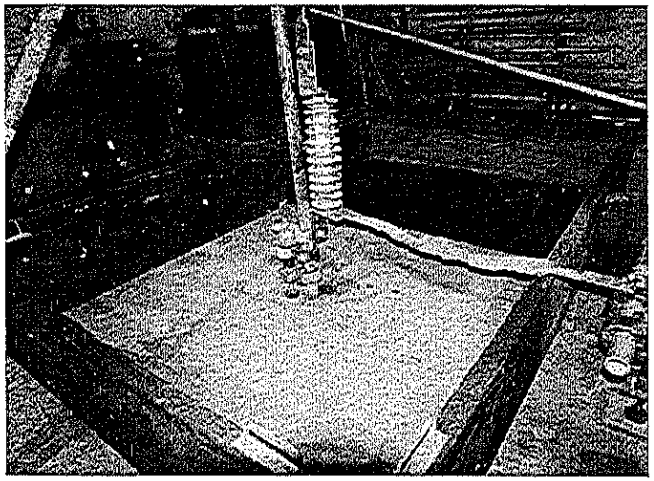


Photo No.4
After test No. 2

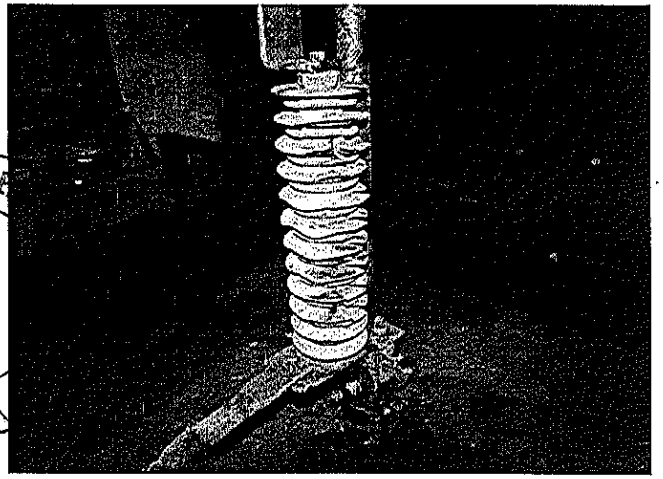


Photo No.5
After test No. 2

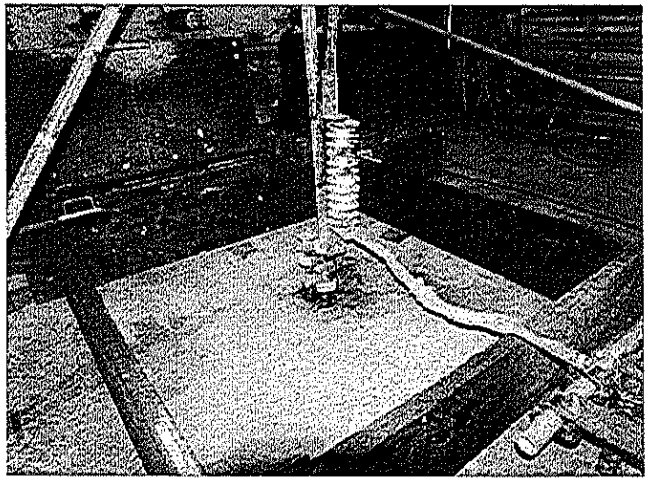


Photo No.6
After the test No.3

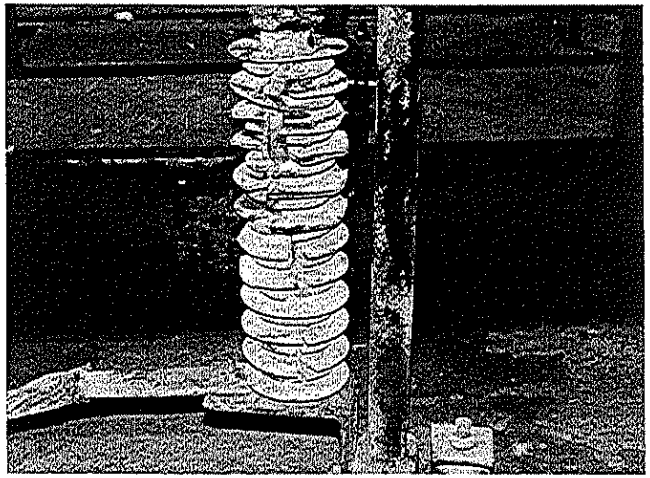


Photo No.7
After the test No.3

D1091IG

ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO LAB N° 0030

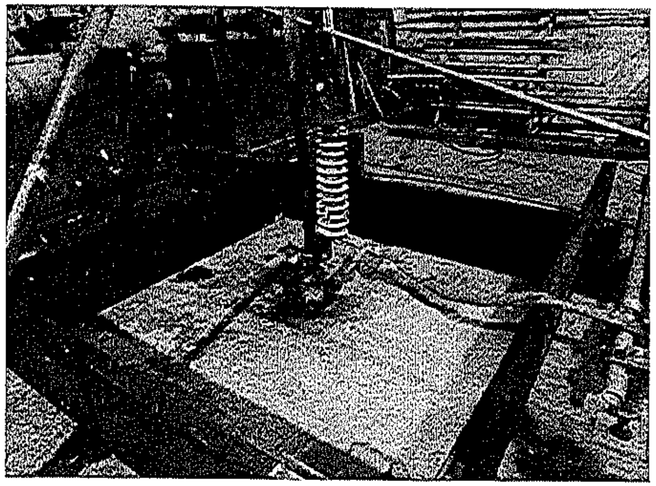


Photo No.8
After the test No.4

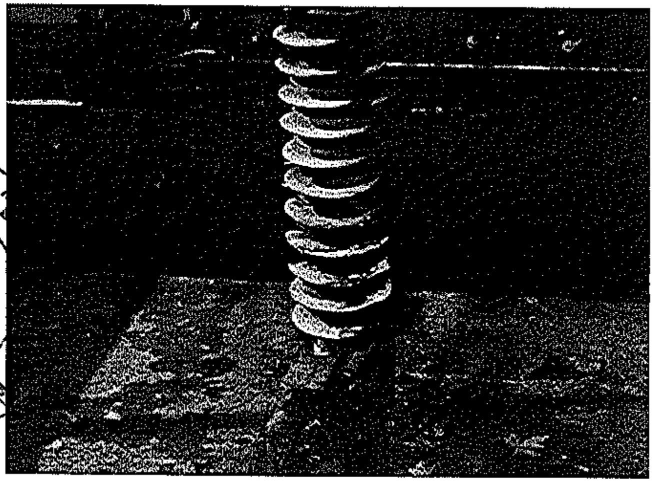
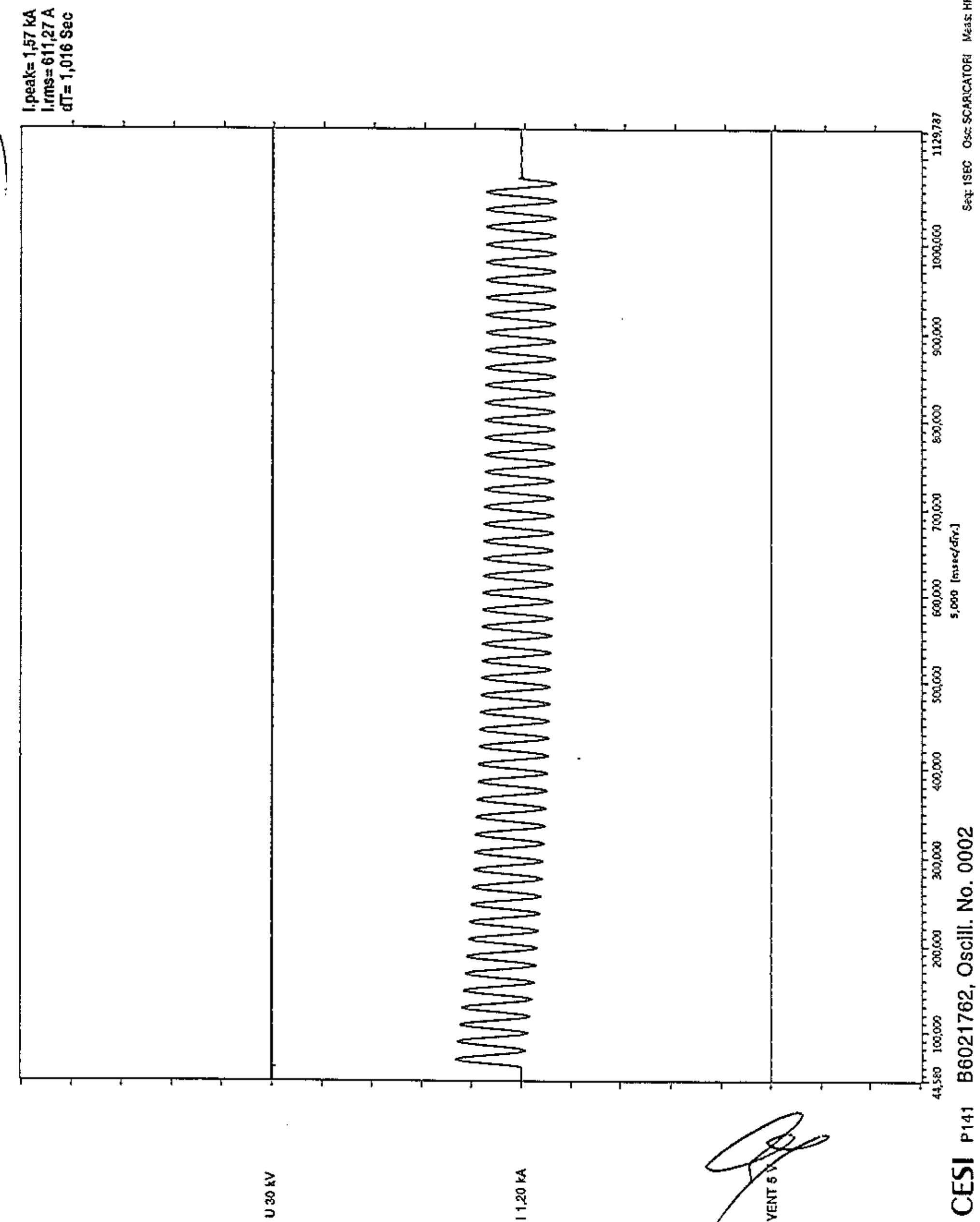


Photo No.9
After the test No.4

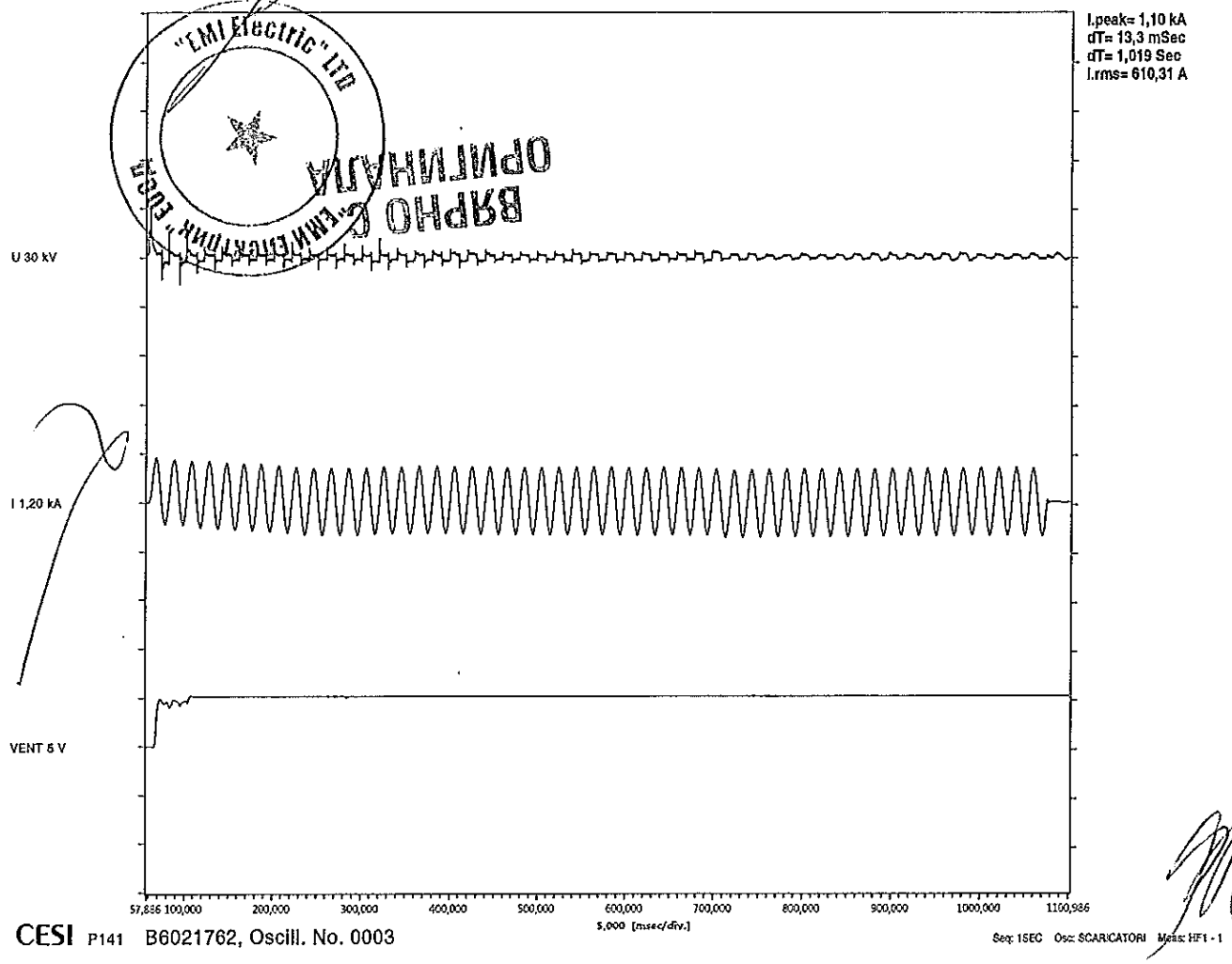


ВЯРНО С
ОРИГИНАЛА

"EMI Electric" LTD ЕООД

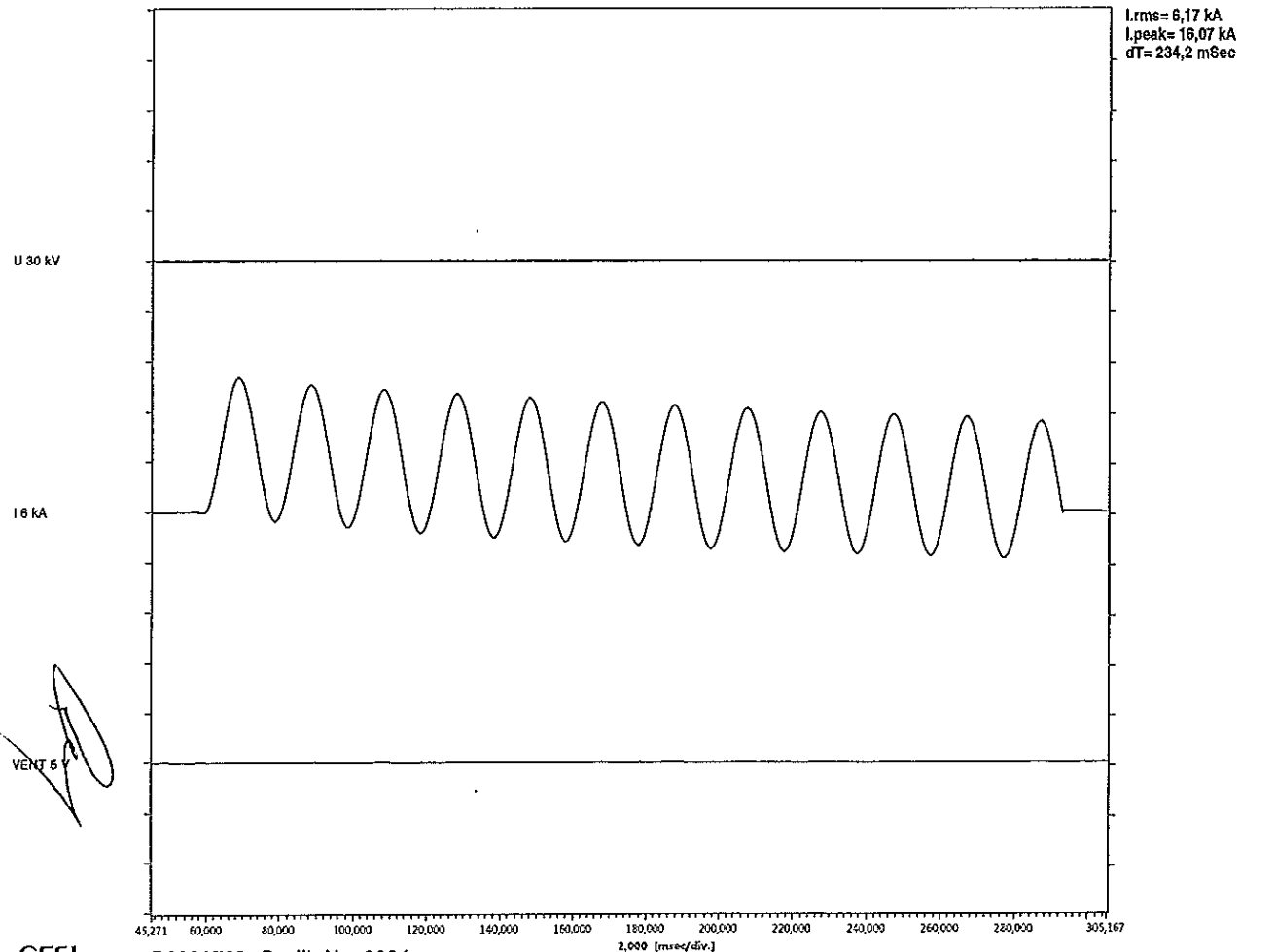
ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO LAB N° 0020

174



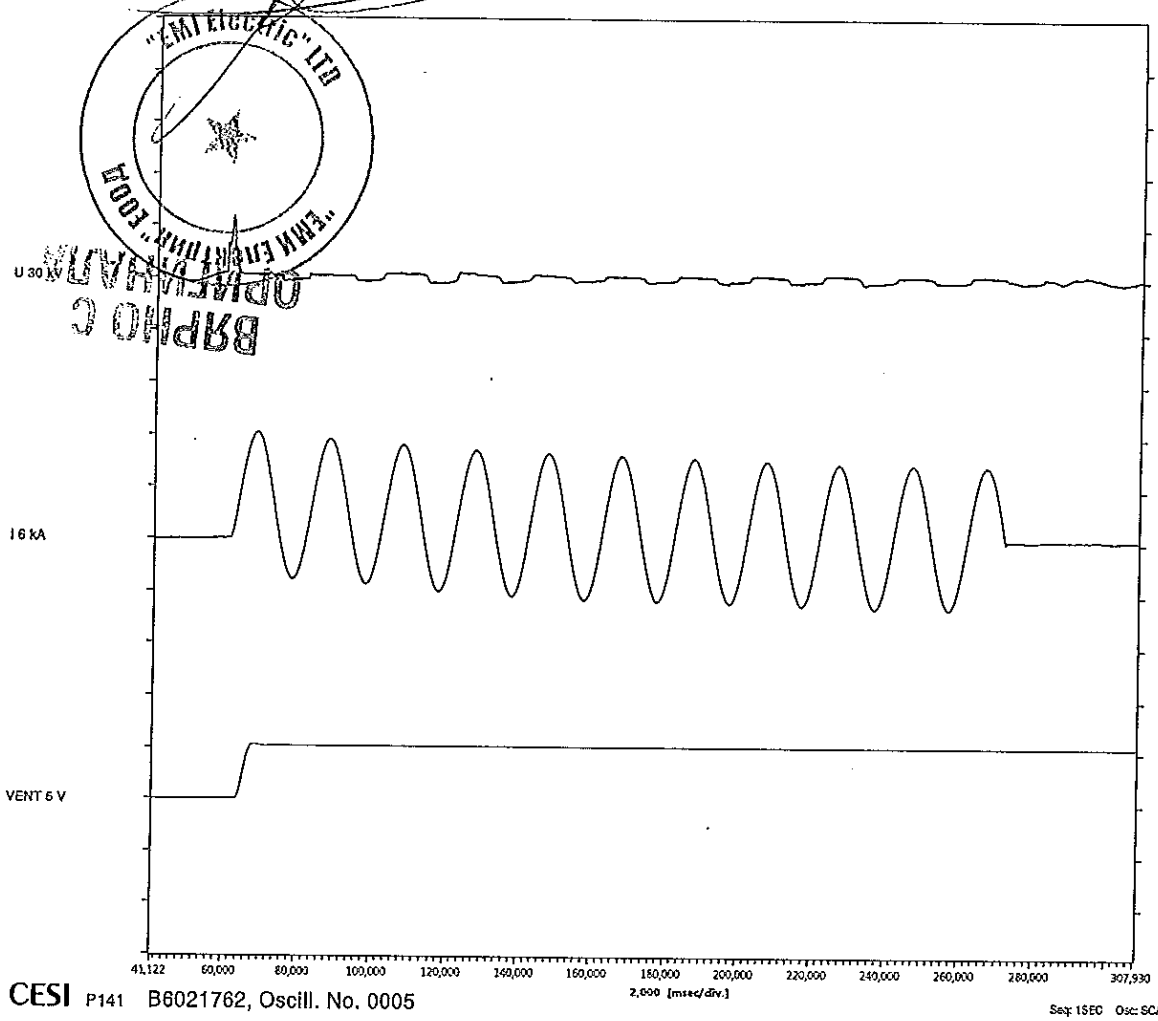
CESI P141 B6021762, Oscill. No. 0003

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



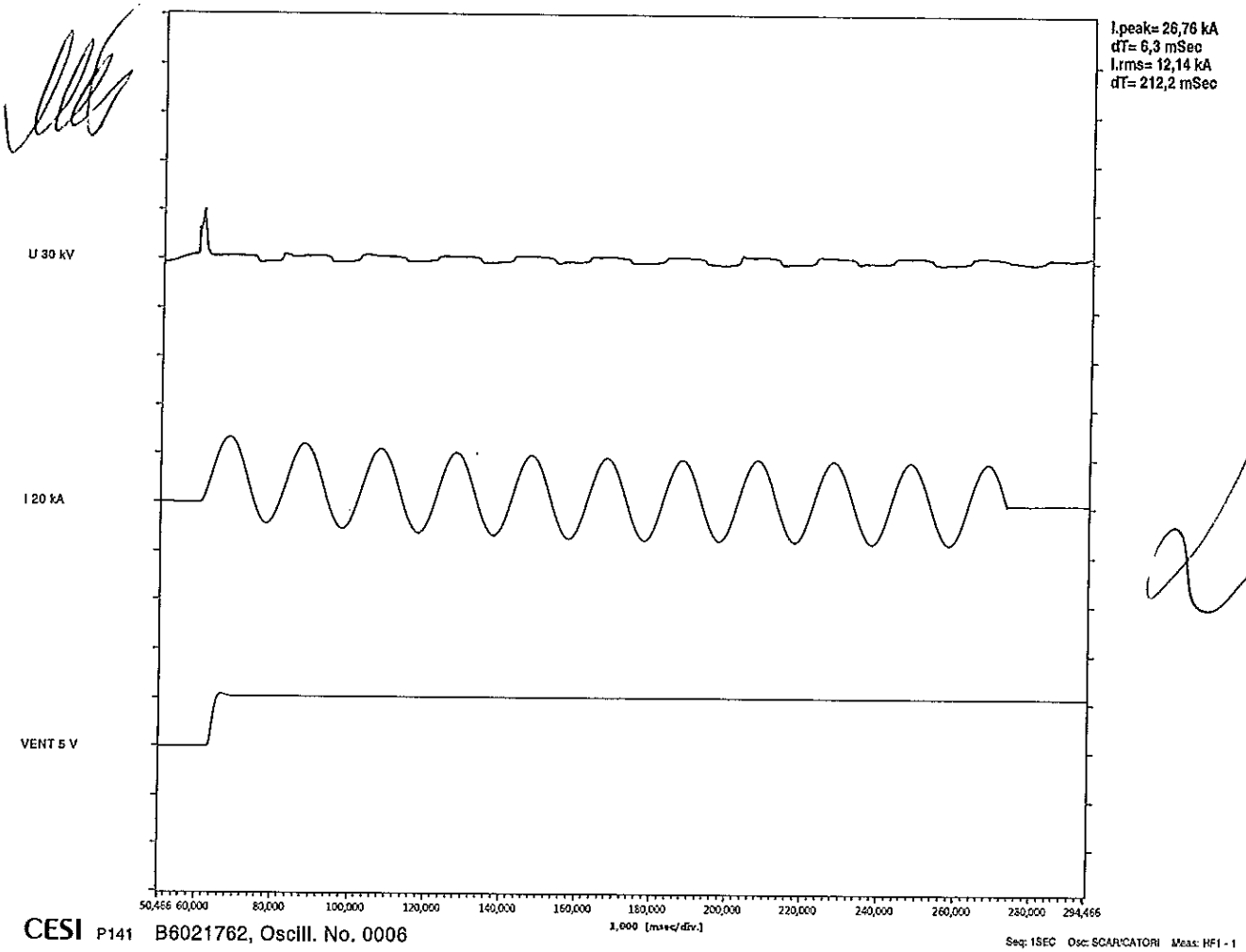
CESI P141 B6021762, Oscill. No. 0004

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



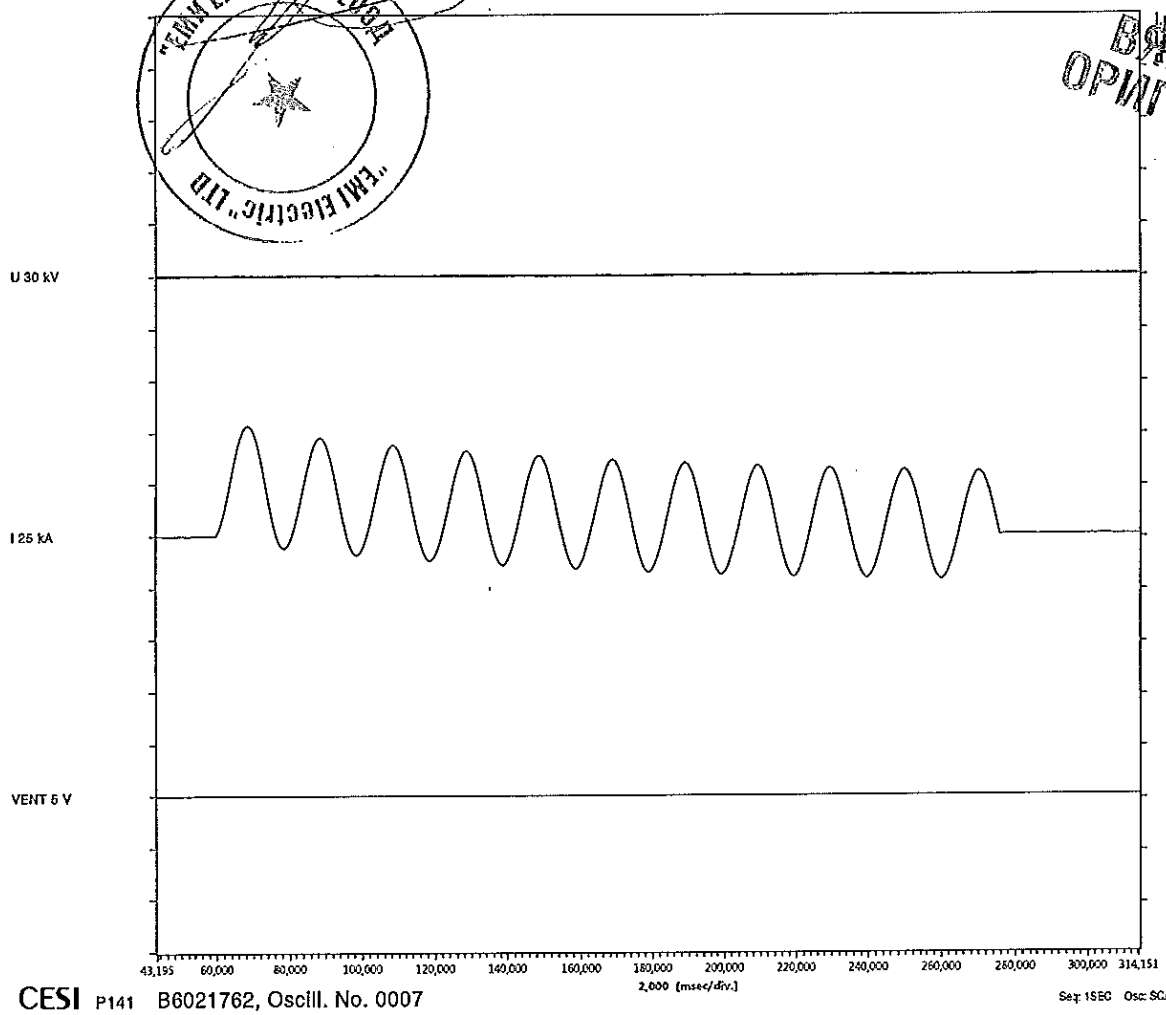
CESI P141 B6021762, Oscill. No. 0005

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



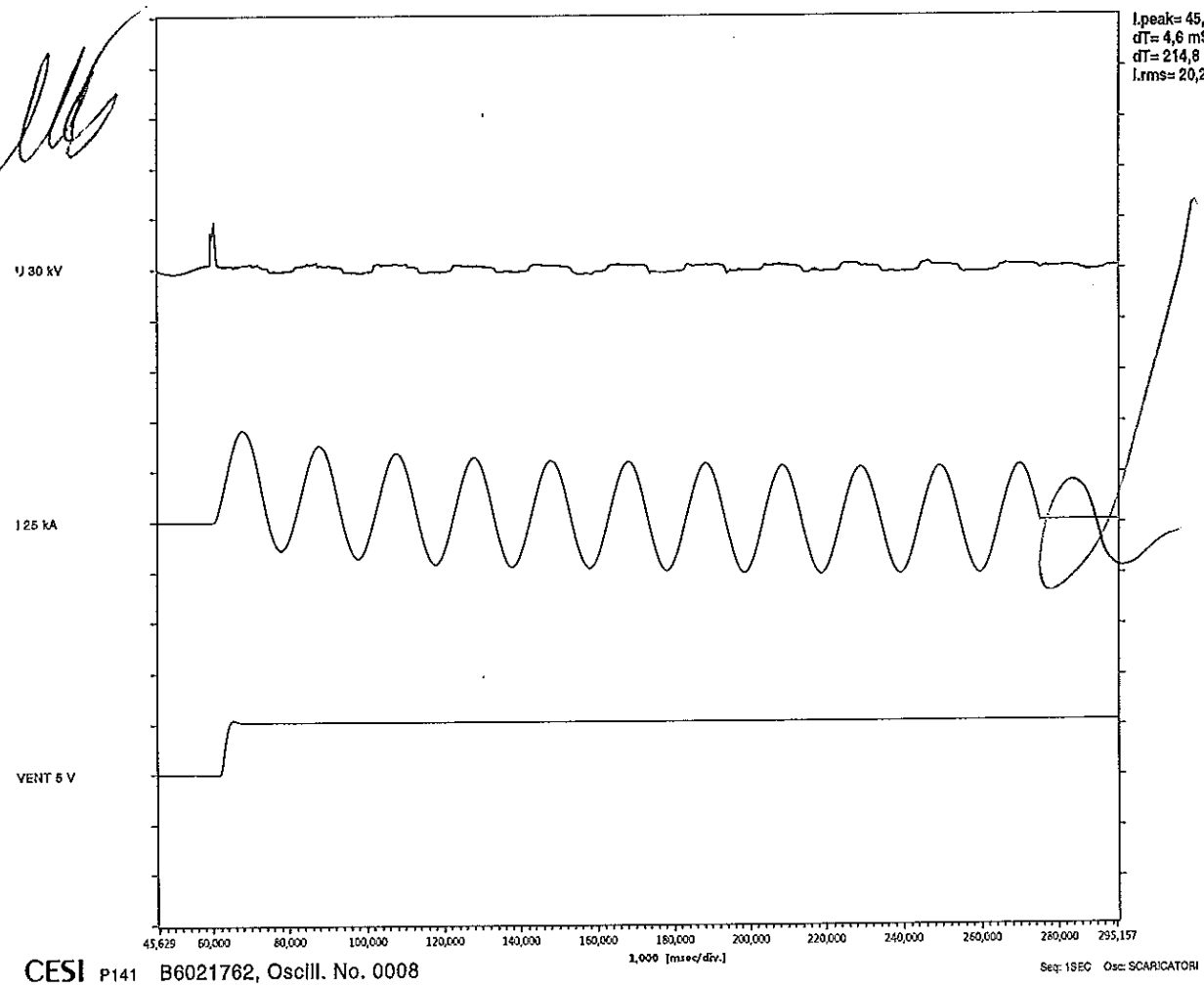
CESI P141 B6021762, Oscill. No. 0006

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



CESI P141 B6021762, Oscill. No. 0007

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



CESI P141 B6021762, Oscill. No. 0008

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

Test Report

Document No.	B7018623 Copy No. 1 Number of pages 17
Apparatus	Polymer-housed surge arrester unit type PA-DM-54 and polymer-housed surge arrester section type PA-DM assembled in thermal model
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 18, 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.

November 27, 2017

Date

Grogod 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

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