Test Report

Document No.	B7018719	Copy No.	1	Number of pages	111
Apparatus	Metal-oxide resistors type B34/30				
Designation	---				
Serial Number	---				
Manufacturer	Joint-Stock Company " Polymer-Apparat"				
Client	Joint-Stock Company " Polymer-Apparat" Ak. Kostantinova Strasse 1 195427 Saint Petersburg - Russia Federation				
Tested for	---				
Date(s) of tests	September 19-21, 2017				
Tested by	CESI S.p.A. Via Rubattino, 54 20134 Milano - Italy				
Test performed	Test to verify the repetitive charge transfer rating, Qrs				

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

IEC 60099-4 – Edition 3.0 (2014-06)

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 10, 2017

Date	Gregori Marco B7018719 3059 AUT Test Engineer in charge	The Manager - Arcidiaco Lorenzo B7018719 821814 APP 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

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CESI

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Notes

STL-Member

CESI Group members are founder members of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in 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. Anton Potapov	Joint-Stock Company " Polymer-Apparat"
Mr. Alexander Kolychex	Joint-Stock Company " Polymer-Apparat"

Identification of the object: Requested

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

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

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

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

Laboratory information

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

Test object characteristics (assigned by the client)

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

geometrical characteristics measured on MO resistor

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

Photograph of the test object

Photo no. 1

Metal-oxide resistor type B34/30

Reference Standard

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

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

Test carried out

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

Test object identification

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

Test procedure

The test consisted of the following steps:

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

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

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

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

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

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

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

h) Visual inspection

Test result

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

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

Summary of test results

Variation of residual voltage at the nominal discharge current

sample	before test		after test		variation
	discharge current	discharge voltage	discharge current	discharge voltage	
	kA	kV	kA	kV	%
RCT 1	9,95	14,11	10,08	14,38	+1,91
RCT 2	10,02	14,12	10,00	14,36	+1,67
RCT 3	9,95	14,07	10,09	14,42	+2,49
RCT 4	10,15	14,15	9,95	14,41	+1,84
RCT 5	10,11	14,15	10,06	14,34	+1,34
RCT 6	10,20	14,11	10,11	14,38	+1,91
RCT 7	9,96	14,15	10,01	14,44	+2,05
RCT 8	10,20	14,21	99,8	14,40	+1,33
RCT 9	10,02	14,25	9,95	14,43	+1,26
RCT 10	9,95	14,36	10,00	14,49	+0,91

Variation of the reference voltage at the reference current

sample	before test reference voltage	after test reference voltage	variation
	kV	kV	%
RCT 1	5,24	5,34	+1,91
RCT 2	5,24	5,22	+0,38
RCT 3	5,29	5,32	+0,57
RCT 4	5,28	5,26	-0,38
RCT 5	5,28	5,28	0
RCT 6	5,25	5,24	-0,19
RCT 7	5,28	5,33	+0,95
RCT 8	5,20	5,28	+1,54
RCT 9	5,21	5,31	+1,92
RCT 10	5,23	5,31	+1,53

Withstand capability to one 8/20 µs current 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	5,41	13,40	no mechanical damage
RCT 2	5,36	13,39	no mechanical damage
RCT 3	5,33	13,33	no mechanical damage
RCT 4	5,21	13,42	no mechanical damage
RCT 5	5,37	13,39	no mechanical damage
RCT 6	5,38	13,39	no mechanical damage
RCT 7	5,31	13,54	no mechanical damage
RCT 8	5,56	13,40	no mechanical damage
RCT 9	5,41	13,45	no mechanical damage
RCT 10	5,38	13,47	no mechanical damage

Test to verify the repetitive charge transfer rating, Qrs.

Residual voltage test at nominal discharge current before the test.

Test circuit: A0120

Date: September 19, 2017

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

Notes:

Test to verify the repetitive charge transfer rating, Qrs.

Reference voltage test at reference current before the test.

Test circuit: A0019

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

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

Sample No. RCT 2						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
12	5,24	0,877	1,000	0,560	1,37	---

Sample No. RCT 3						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
13	5,29	0,877	1,000	0,560	1,36	---

Sample No. RCT 4						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
14	5,28	0,865	1,000	0,561	1,36	---

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

continued

continued

Date: September 19, 2017

Sample No. RCT 6						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
16	5,25	0,882	1,000	0,562	1,37	---

Sample No. RCT 7						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
17	5,25	0,853	1,000	0,558	1,53	---

Sample No. RCT 8						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
18	5,20	0,856	1,000	0,563	1,37	---

Sample No. RCT 9						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
19	5,21	0,921	1,000	0,571	1,39	---

Sample No. RCT 10						
oscillogram	voltage	current	current	current	power	note:
No.	kV	+ mA_{cr}	- mA_{cr}	mA_{rms}	W	
20	5,23	0,860	1,000	0,559	1,34	---

Test to verify the repetitive charge transfer rating, Qrs.

Date: September 19, 2017

Residual voltage correction factor and Q_{rs} calculations

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

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

[2] Length : length measured on each sample

[3] $U_{res.stress}$: 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 : 14,36 kV

Diameter Ø : 36,6 mm

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

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

Photo no. 2

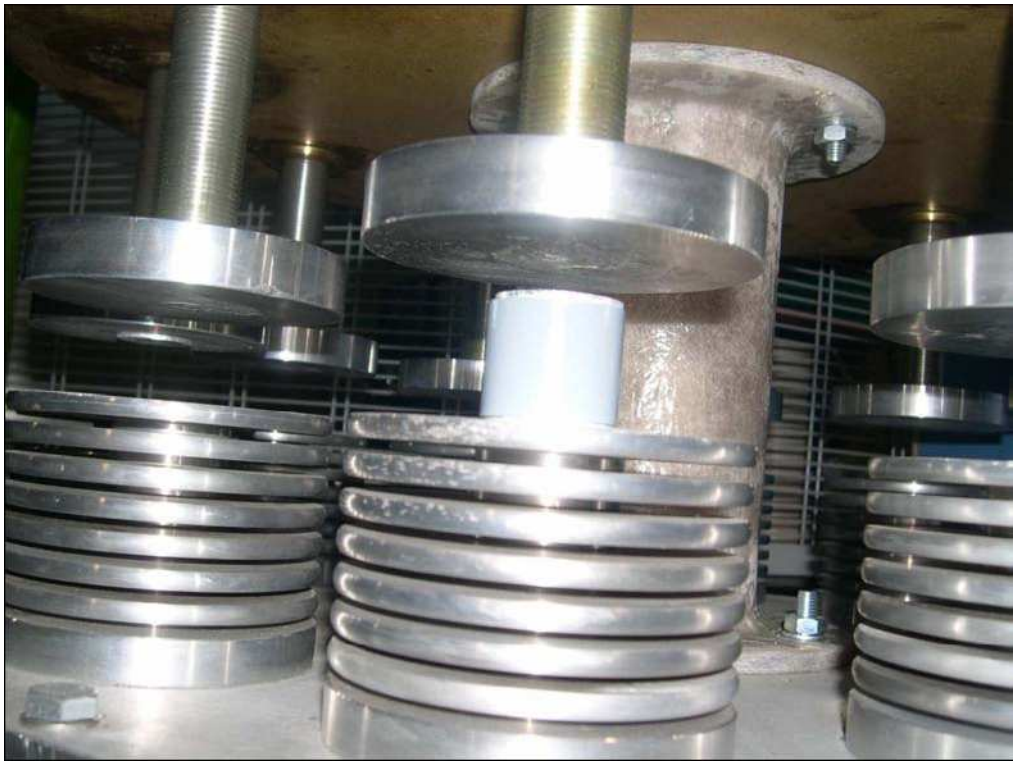


Photo no. 3

Test to verify the repetitive charge transfer rating, Qrs.

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

Test circuit: A0120

Date: September 19-21, 2017

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

Current impulse waveshape
8,7/18,0 µs

Note:

continued

continued

Date: September 19-21, 2017

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

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

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

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

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

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

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

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

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

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

Sample	Impulse	Charging voltage	Oscillogram	Peak current	Charge
No.	No.	kV	No.	kA	C
RCT 7	1	55,0 x 2		33,94	0,47
	2	55,0 x 2	27	32,92	0,46
	3	55,0 x 2		33,20	0,46
	4	55,0 x 2		33,50	0,47
	5	55,0 x 2		33,62	0,47
	6	55,0 x 2		33,70	0,47
	7	55,0 x 2		34,30	0,47
	8	55,0 x 2		33,80	0,47
	9	55,0 x 2		33,62	0,47
	10	55,0 x 2	37	33,70	0,47
	11	55,0 x 2		33,50	0,46
	12	55,0 x 2		33,70	0,46
	13	55,0 x 2		33,90	0,47
	14	55,0 x 2		33,66	0,47
	15	55,0 x 2		33,75	0,47
	16	55,0 x 2		33,50	0,47
	17	55,0 x 2		33,47	0,47
	18	55,0 x 2		33,30	0,46
	19	55,0 x 2		33,50	0,47
	20	55,0 x 2	47	33,15	0,46

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

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

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

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

Current impulse waveshape
8,7/18,0 µs

Notes:

continued

continued

Date: September 19-21, 2017

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

Current impulse waveshape
8,7/18,0 µs

Notes:

Test to verify the repetitive charge transfer rating, Qrs.

Reference voltage test at reference current after the test.

Test circuit: A0019

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

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

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

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

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

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

continued

continued

Date: September 21, 2017

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

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

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

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

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

Test to verify the repetitive charge transfer rating, Qrs.

Residual voltage test at nominal discharge current after the test.

Test circuit: A0120

Date: September 21, 2017

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

Notes:

Test to verify the repetitive charge transfer rating, Qrs.

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

Test circuit: A0120

Date: September 21, 2017

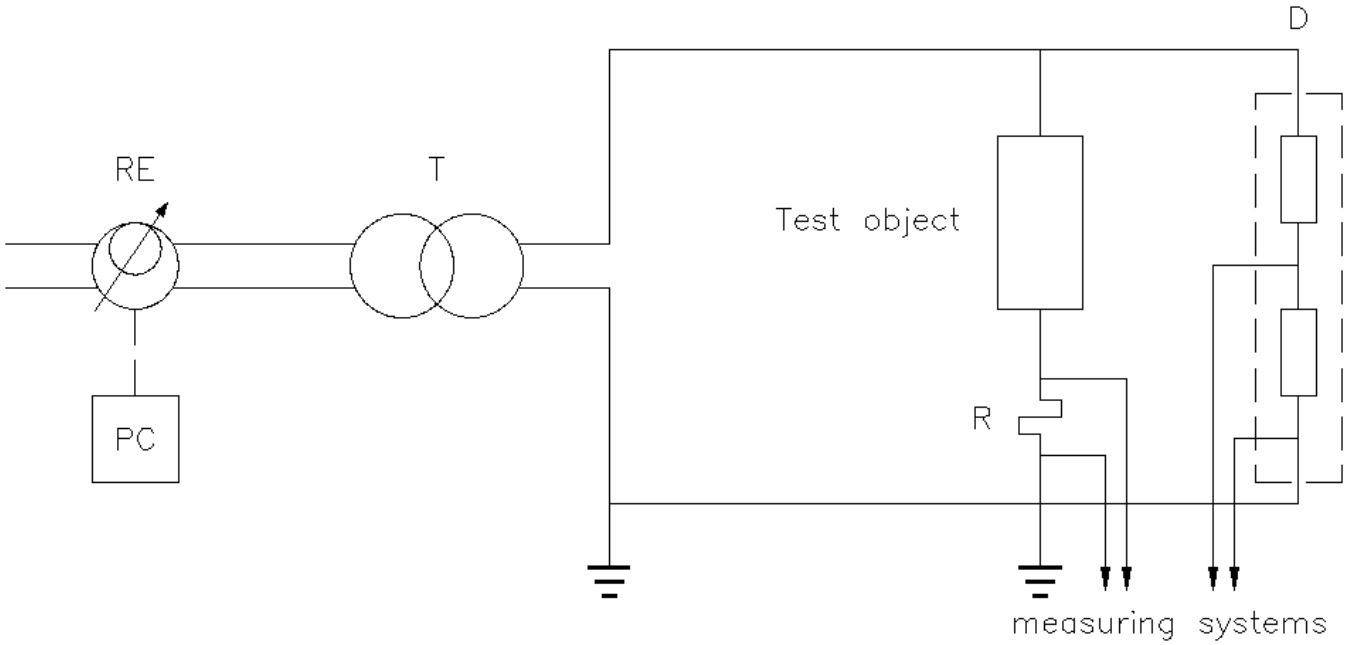
Sample	Requested current	Charging Voltage	Oscillogram	Current waveshape	Discharge current	Discharge voltage
No.	kA	kV	No.	µs	kA	kV
RC 1	5,14 (*)	19,0	71	8,3/19,0	5,41	13,40
RC 2		19,0	72		5,36	13,39
RC 3		19,0	73		5,33	13,33
RC 4		19,0	74		5,21	13,42
RC 5		19,0	75		5,37	13,39
RC 6		19,0	76		5,38	13,39
RC 7		19,0	77		5,31	13,54
RC 8		19,0	78		5,56	13,40
RC 9		19,0	79		5,41	13,45
RC 10		19,0	80		5,38	13,47

Notes:

(*) Requested current = 0,5 kA/cm^2 x 10,28 cm^2 = 5,14 kA

- where 0,5 kA/cm^2 is peak current density
- where 10,28 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

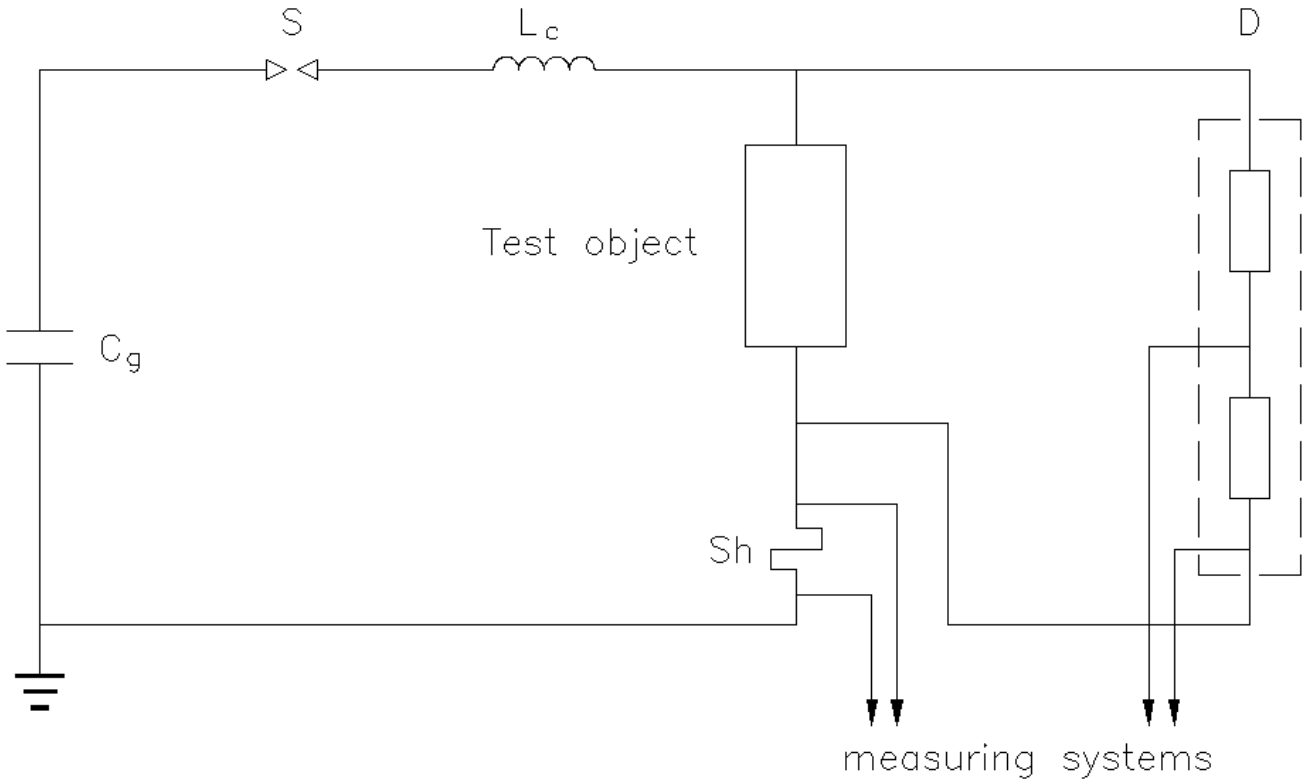
D - Voltage divider SAGI; CESI No.11120
Electro optical system type HBM CESI No. 57986(Rx) – 57991 (Tx)

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

Software system:

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

Circuit A0120



Impulse generator

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

Additional two MO block have been added (for injection of Qrs)

Voltage measuring system.

D	- Voltage divider SAGI; CESI No.11120 -Electro optical system HBM CESI No. 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.2)

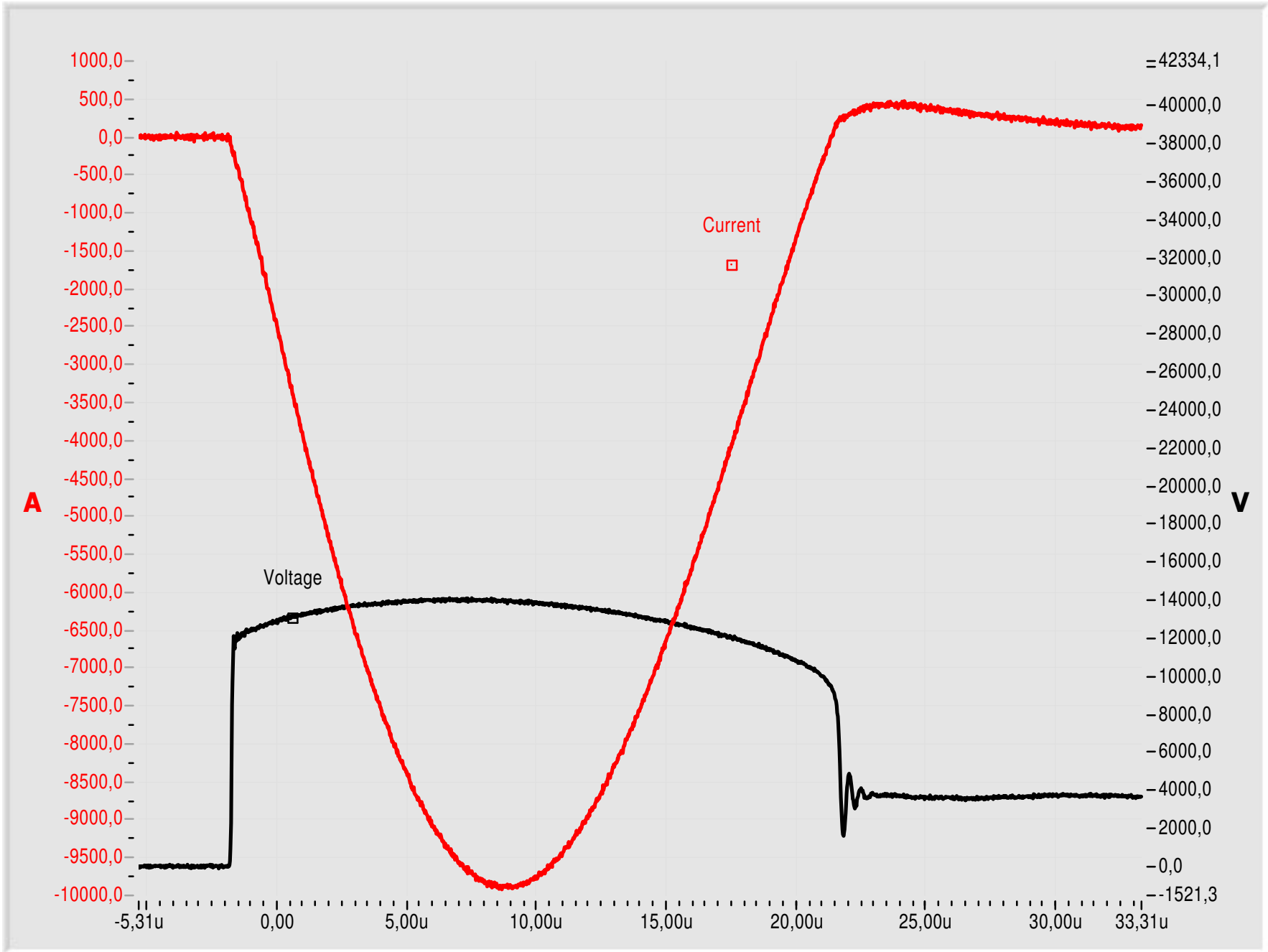
Current measuring system

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

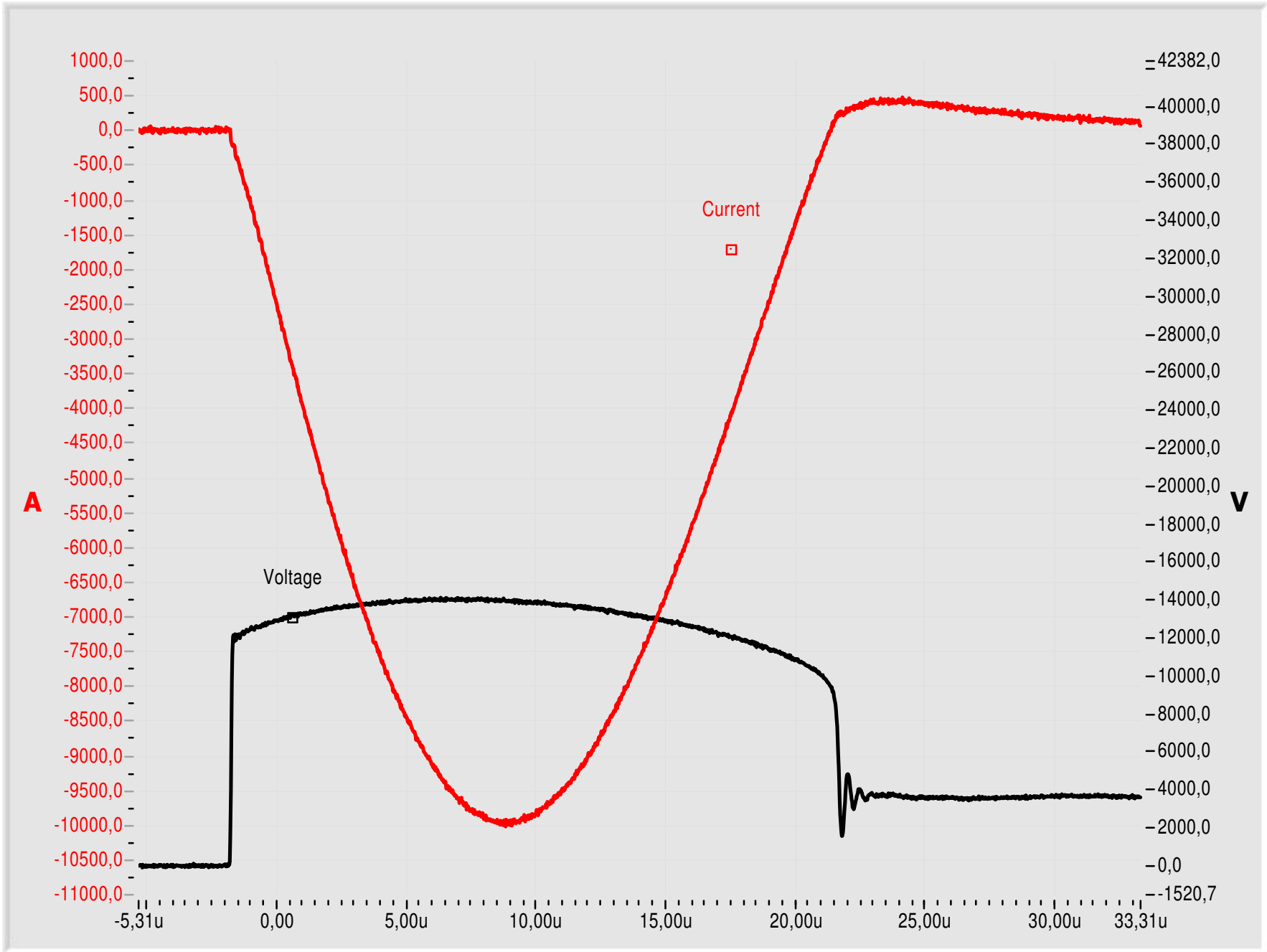
Software system:

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

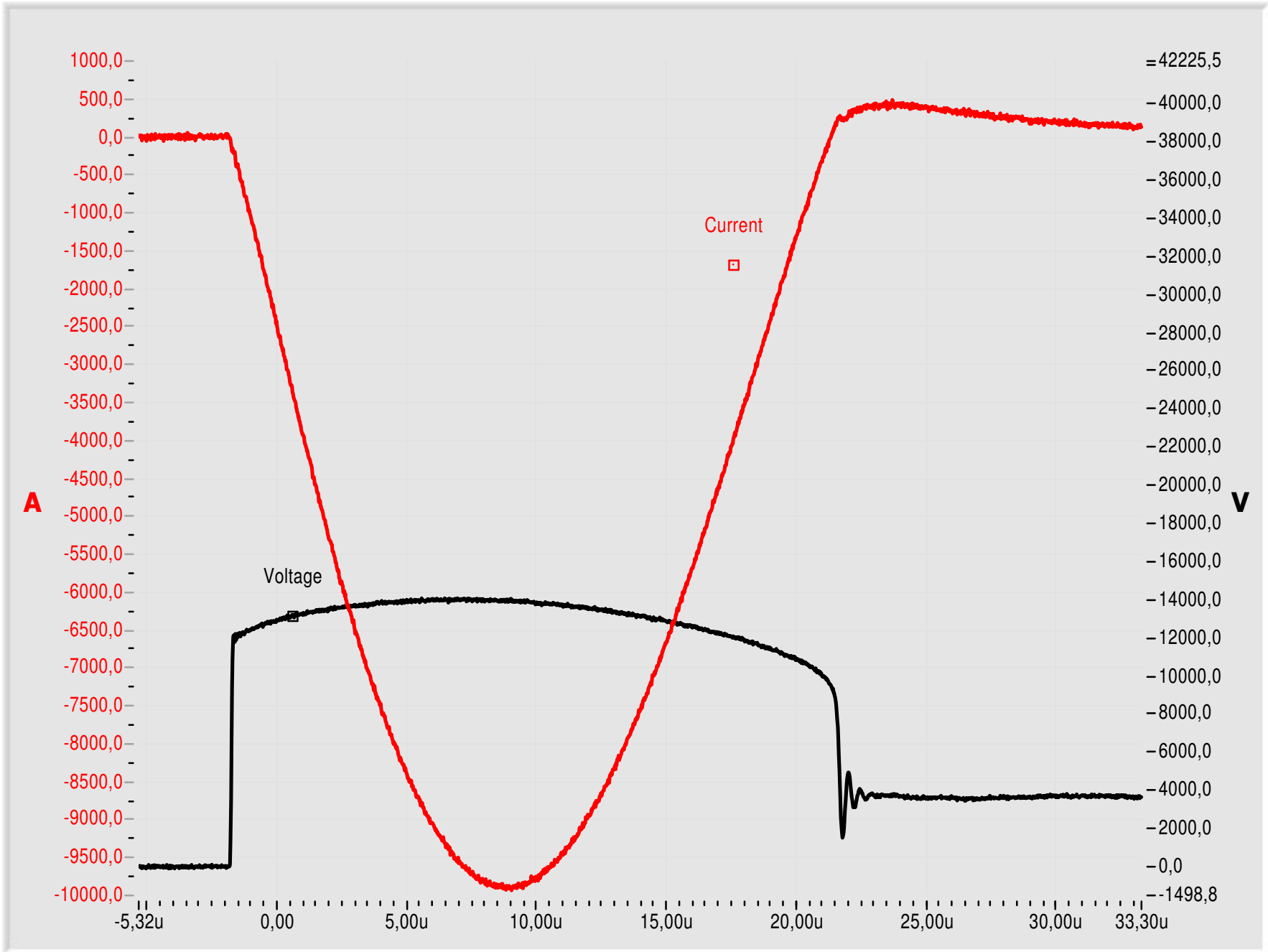
CESI B7018719 Oscillogram n. 1



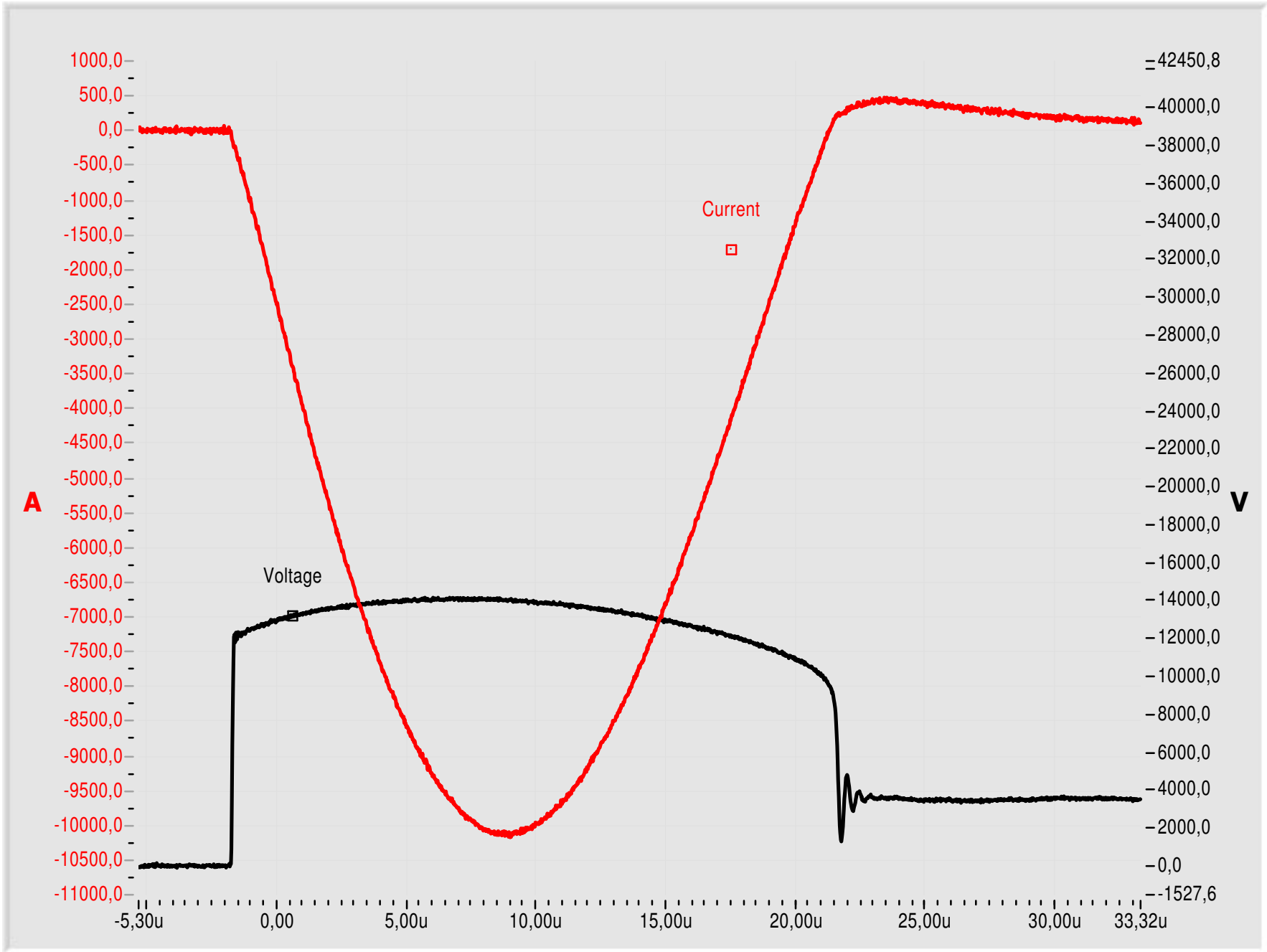
CESI B7018719 Oscillogram n. 2



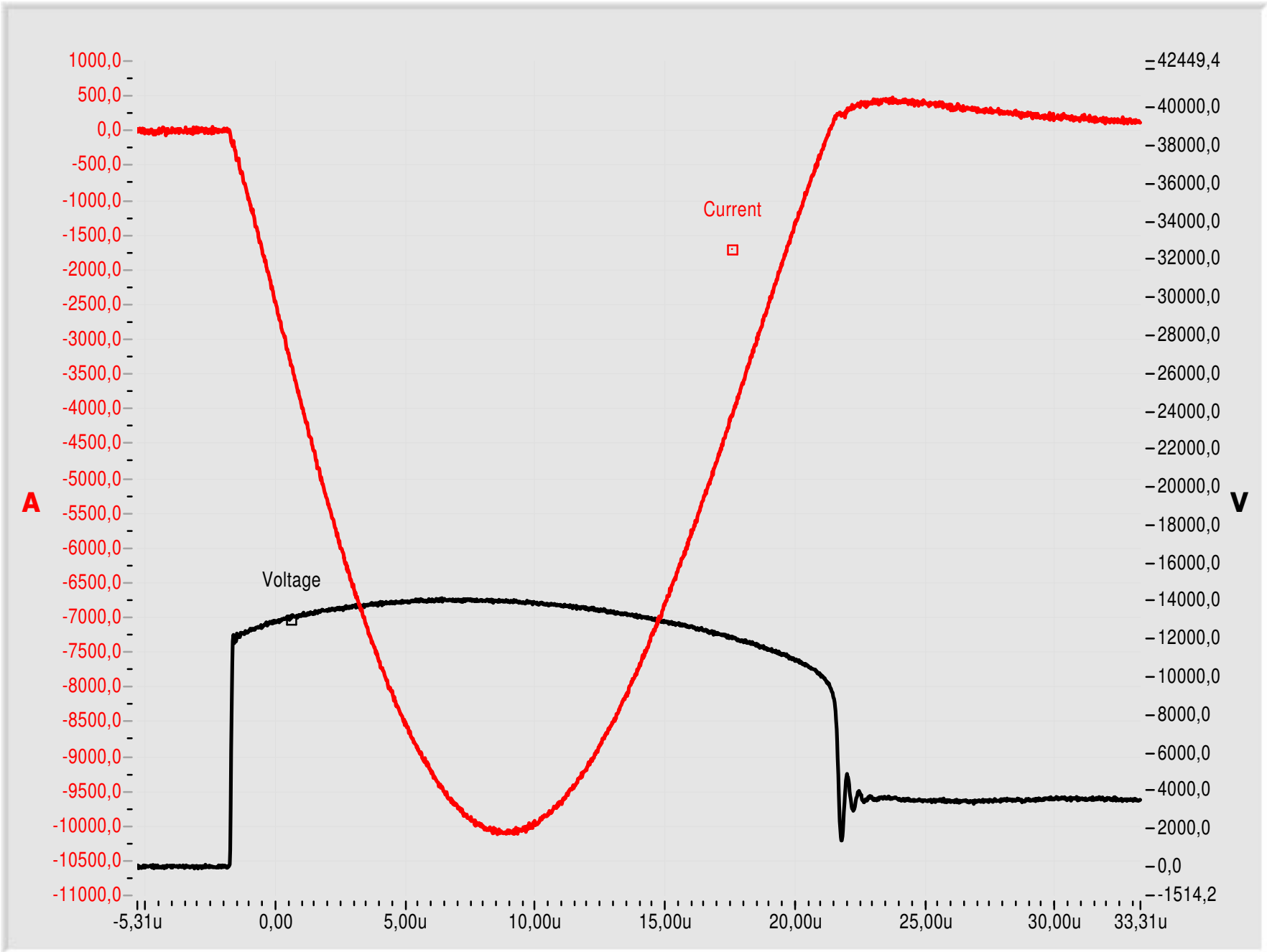
CESI B7018719 Oscillogram n. 3



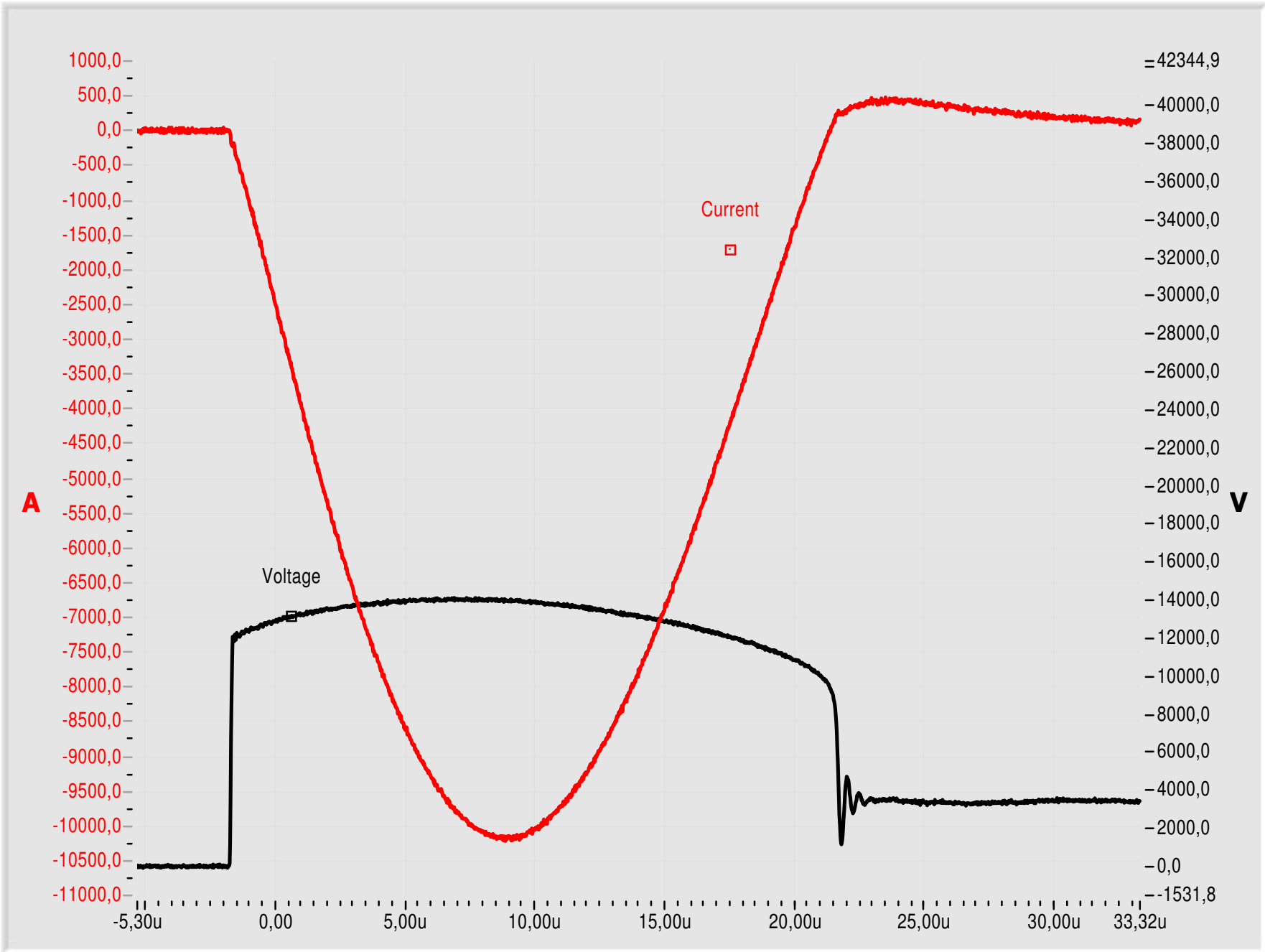
CESI B7018719 Oscillogram n. 4



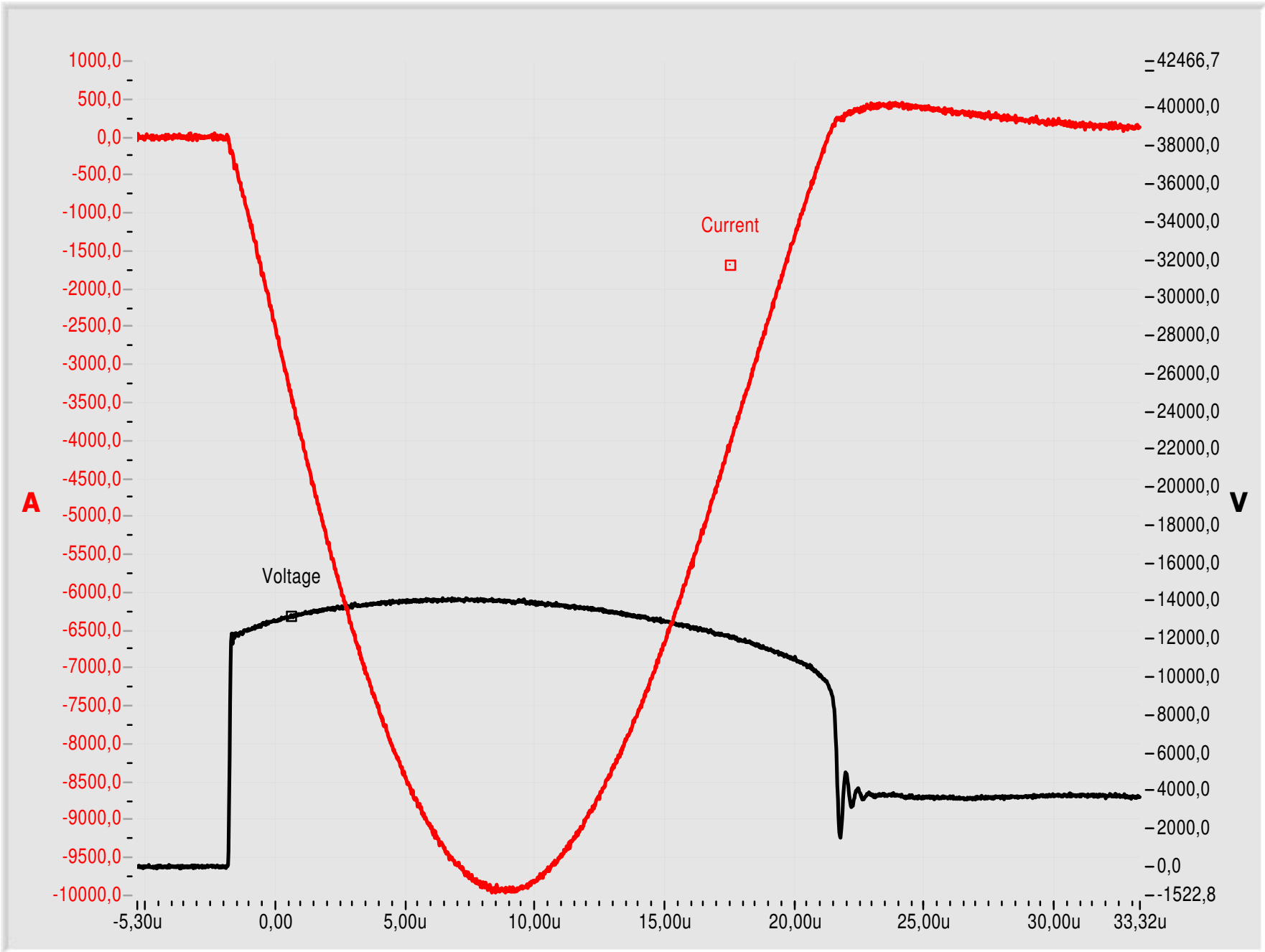
CESI B7018719 Oscillogram n. 5



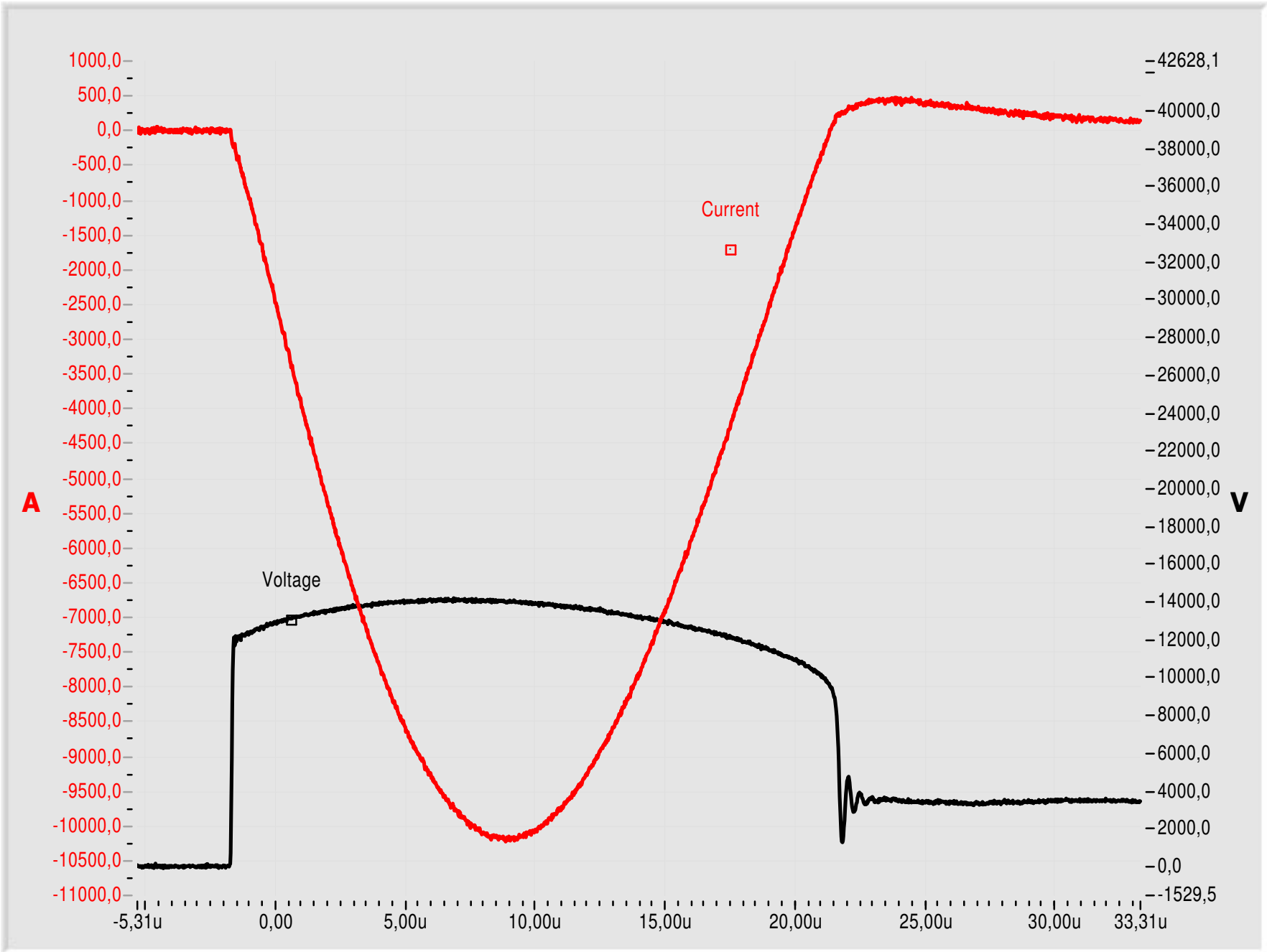
CESI B7018719 Oscillogram n. 6



CESI B7018719 Oscillogram n. 7



CESI B7018719 Oscillogram n. 8



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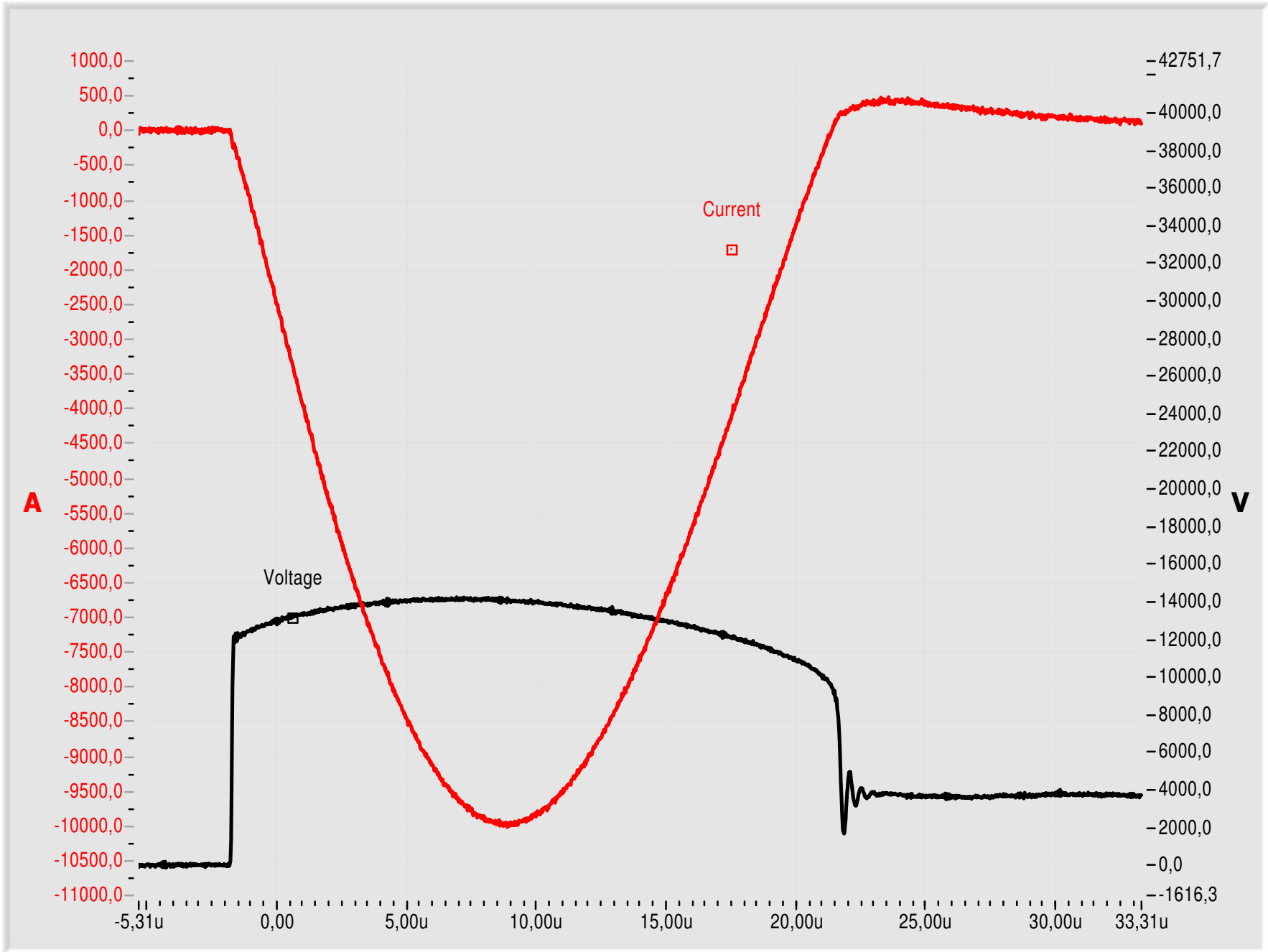

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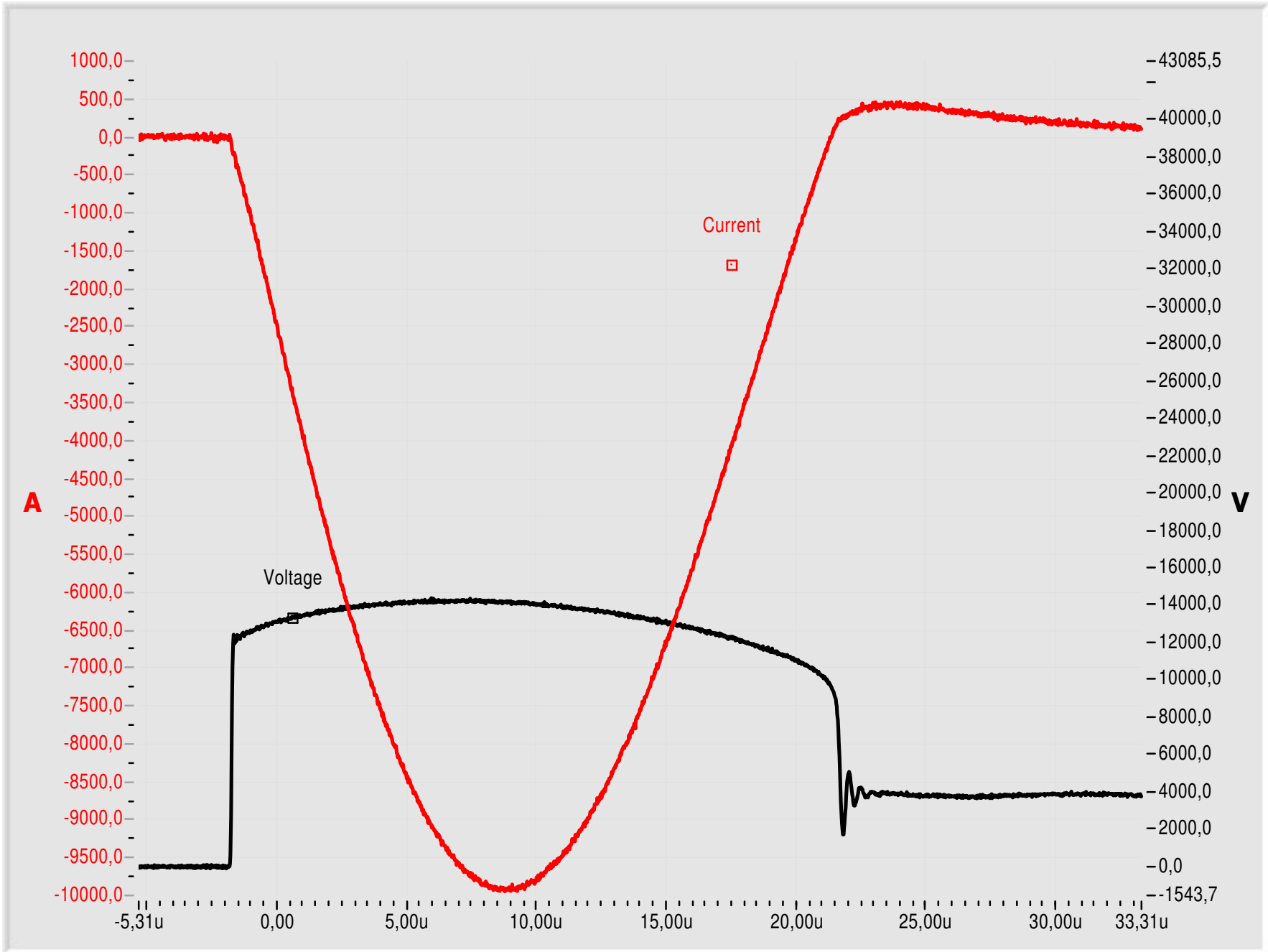
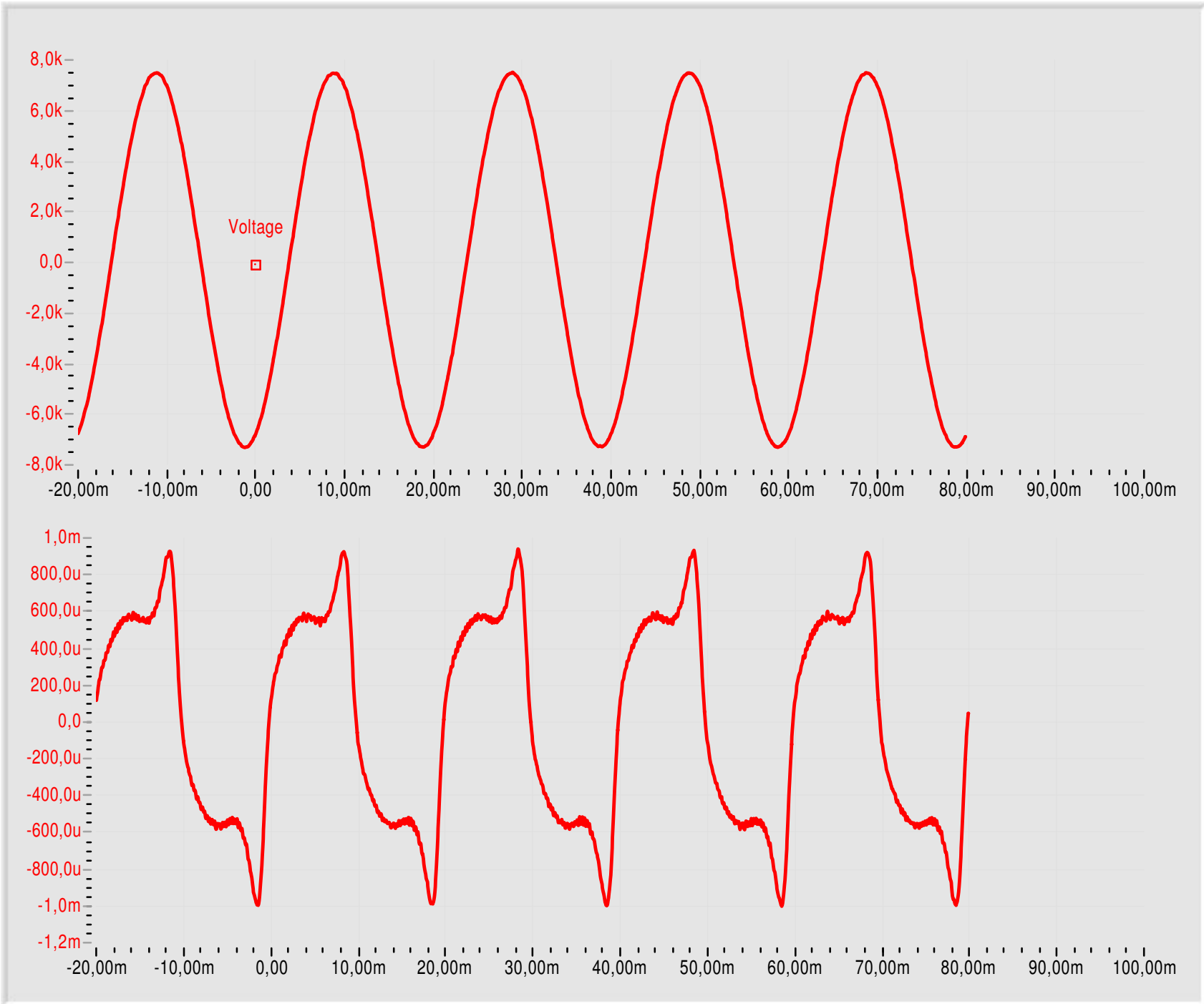
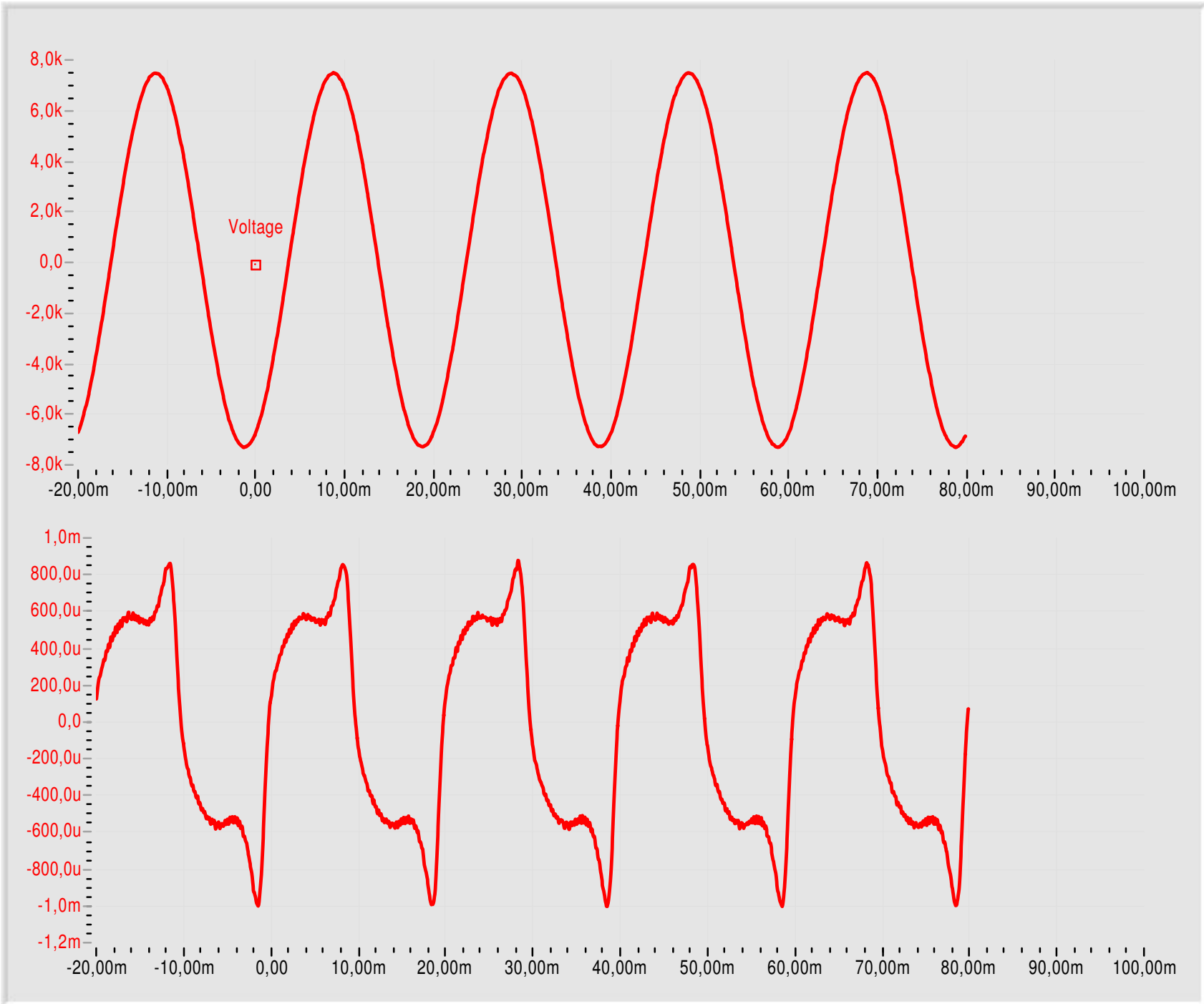


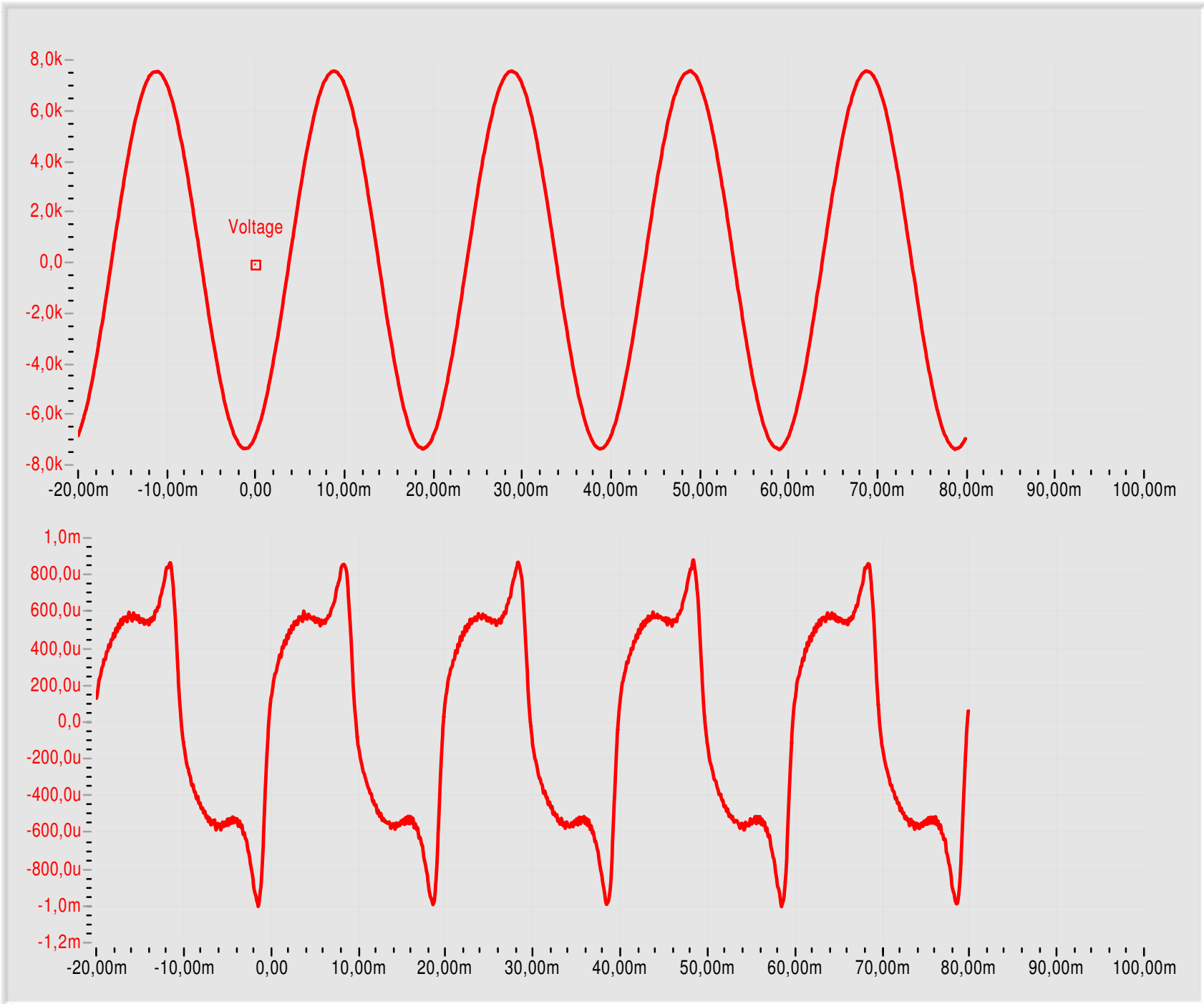
CESI B7018719 Oscillogram n. 11



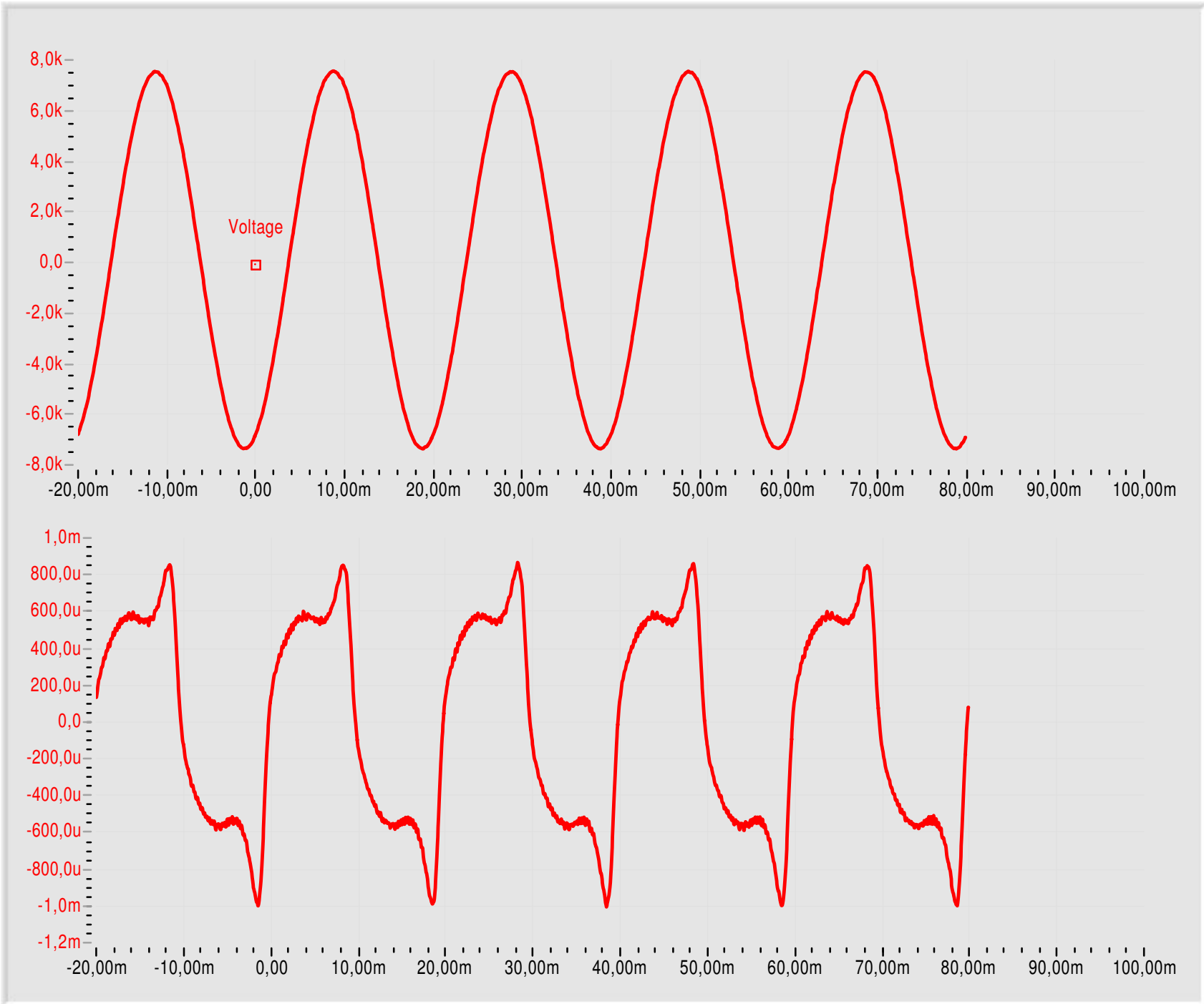
CESI B7018719 Oscillogram n. 12



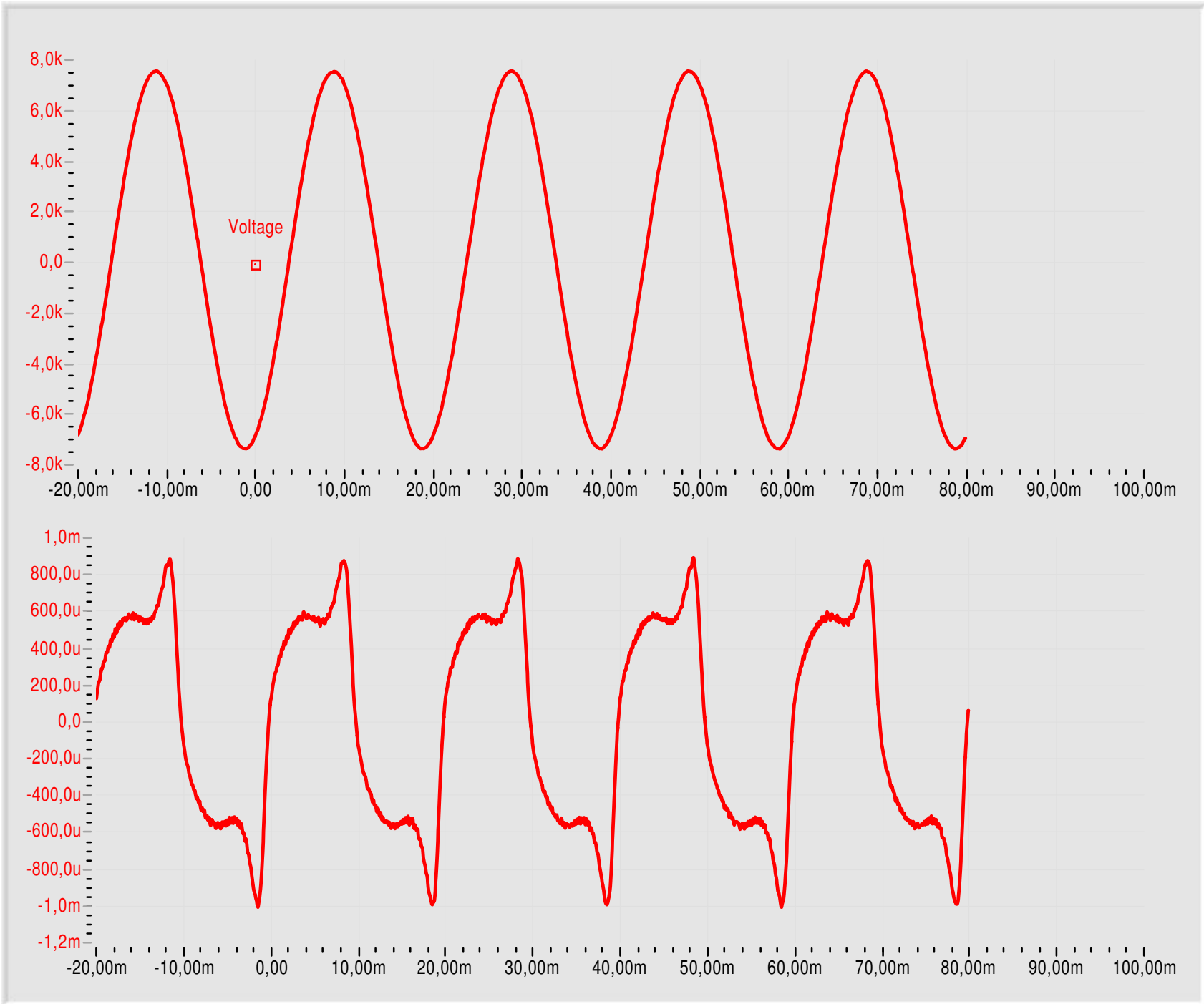
CESI B7018719 Oscillogram n. 13



CESI B7018719 Oscillogram n. 14



CESI B7018719 Oscillogram n. 15



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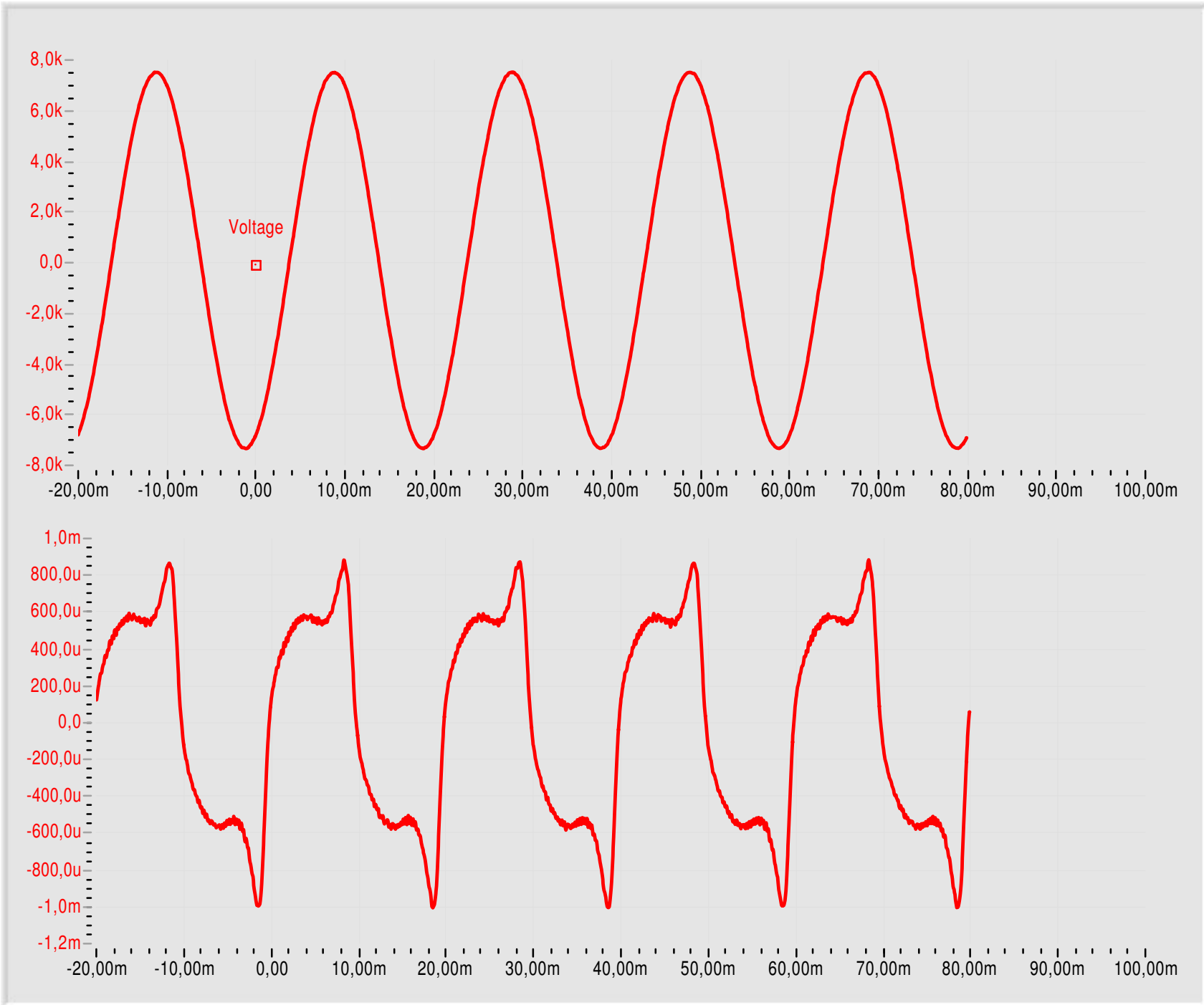
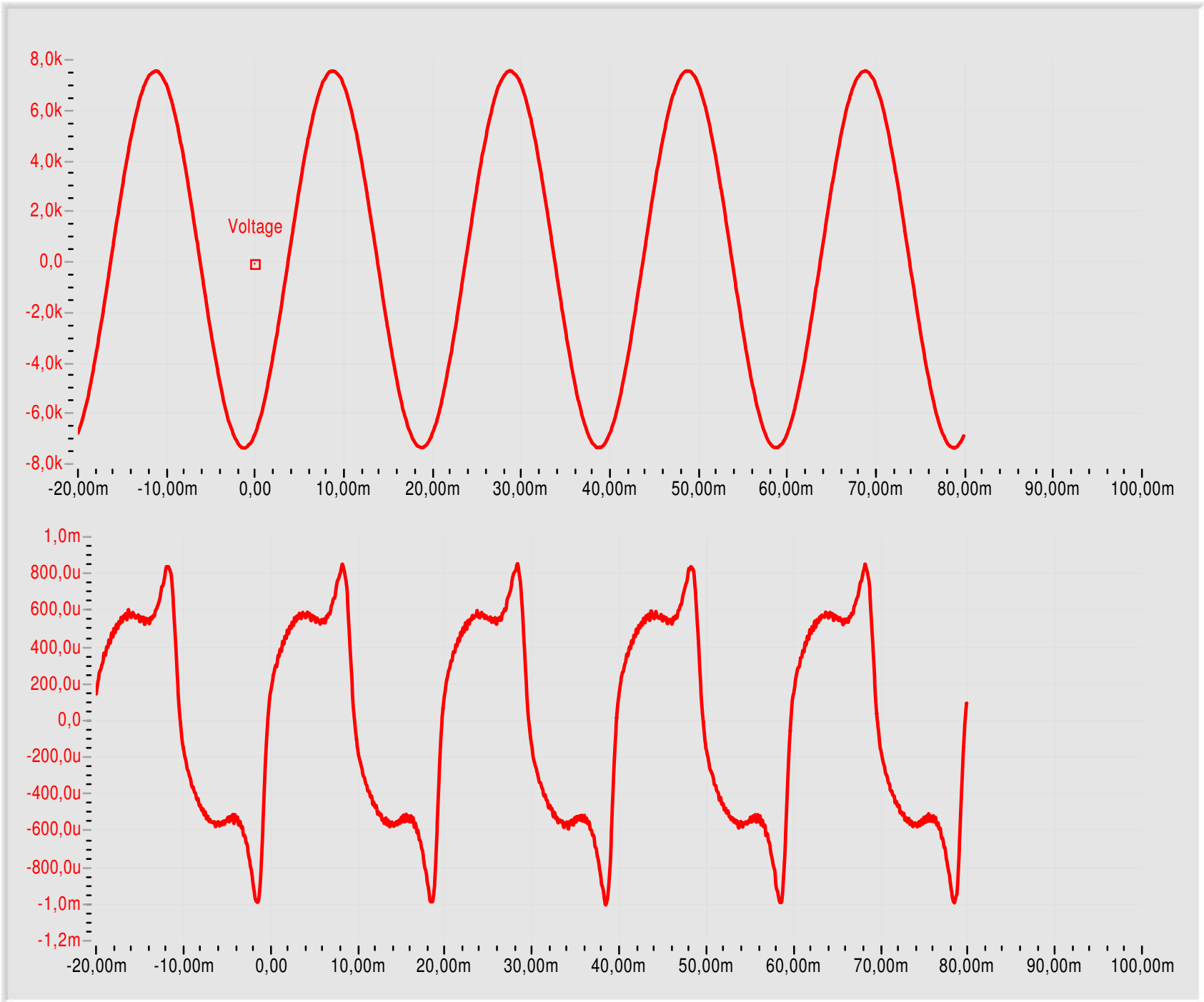
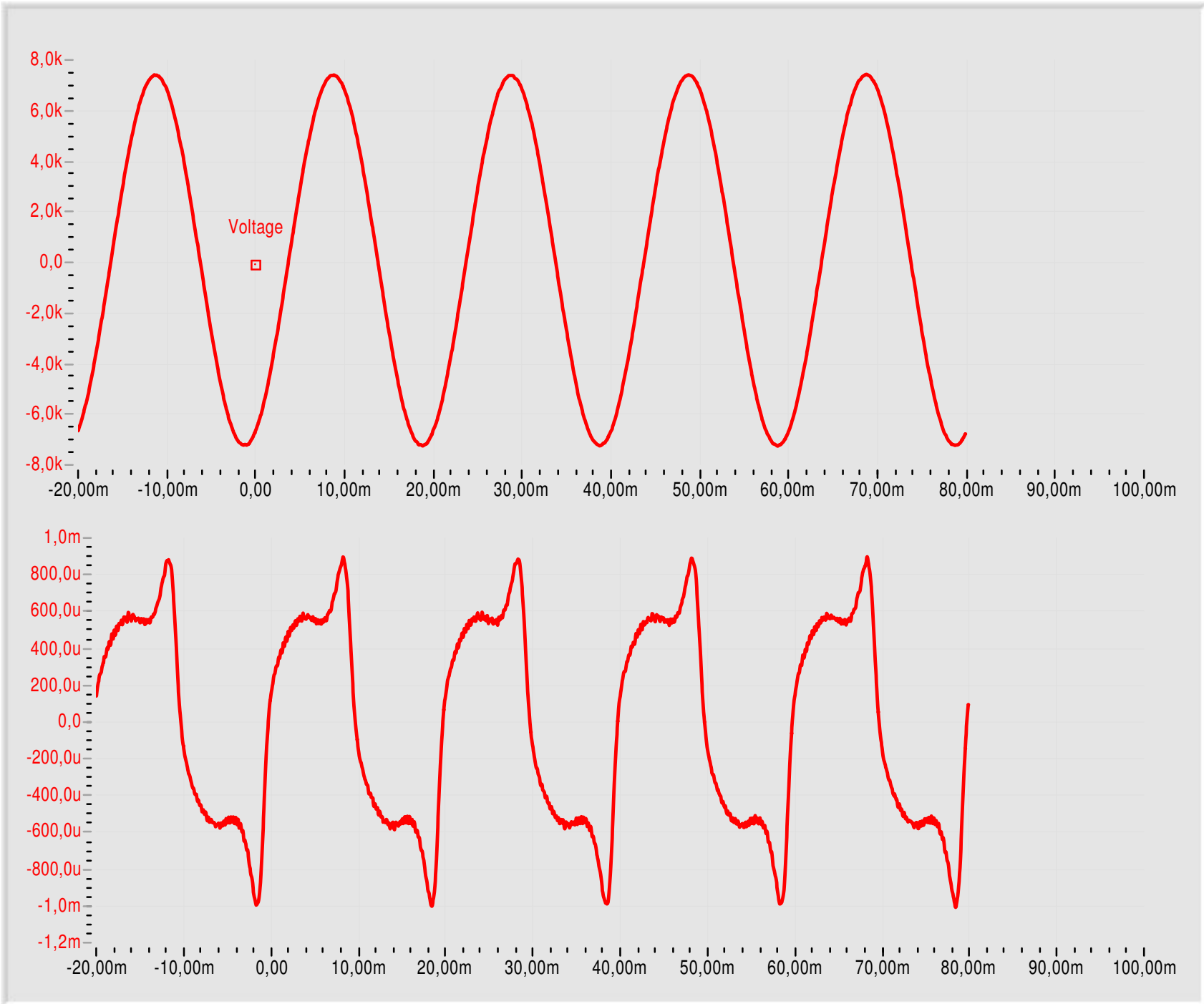


CESI B7018719 Oscillogram n. 17



CESI B7018719 Oscillogram n. 18



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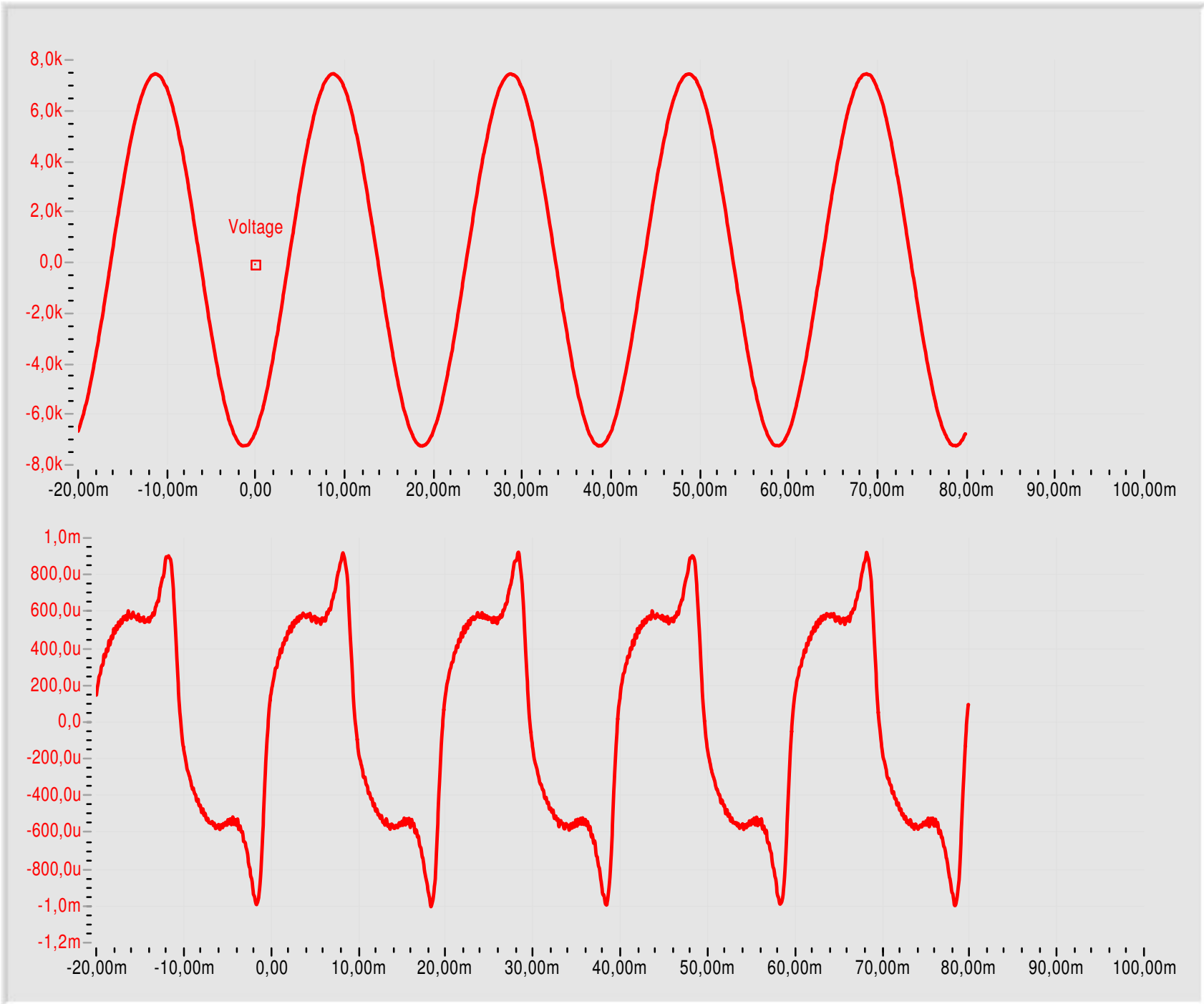
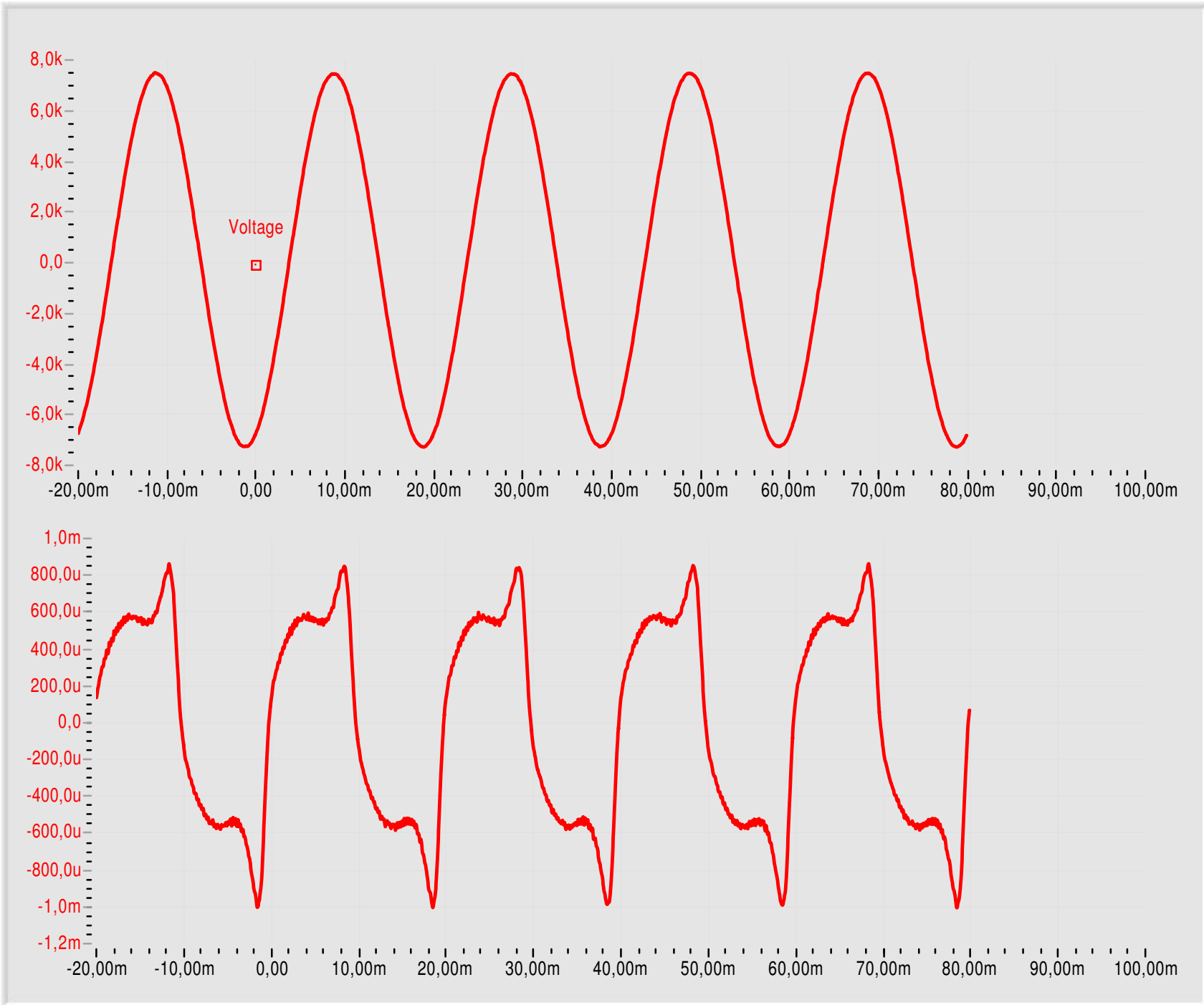


CESI B7018719 Oscillogram n. 20



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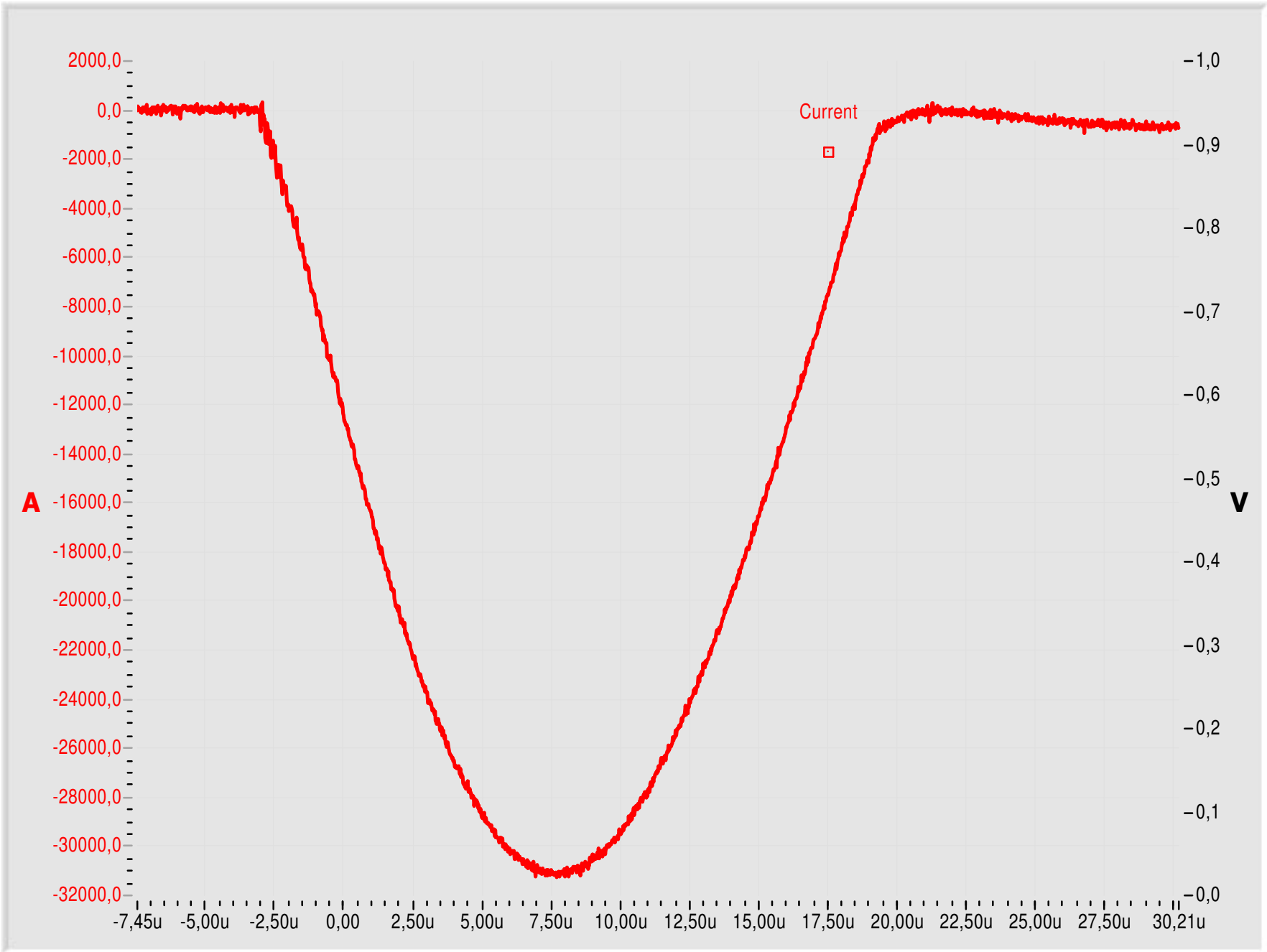

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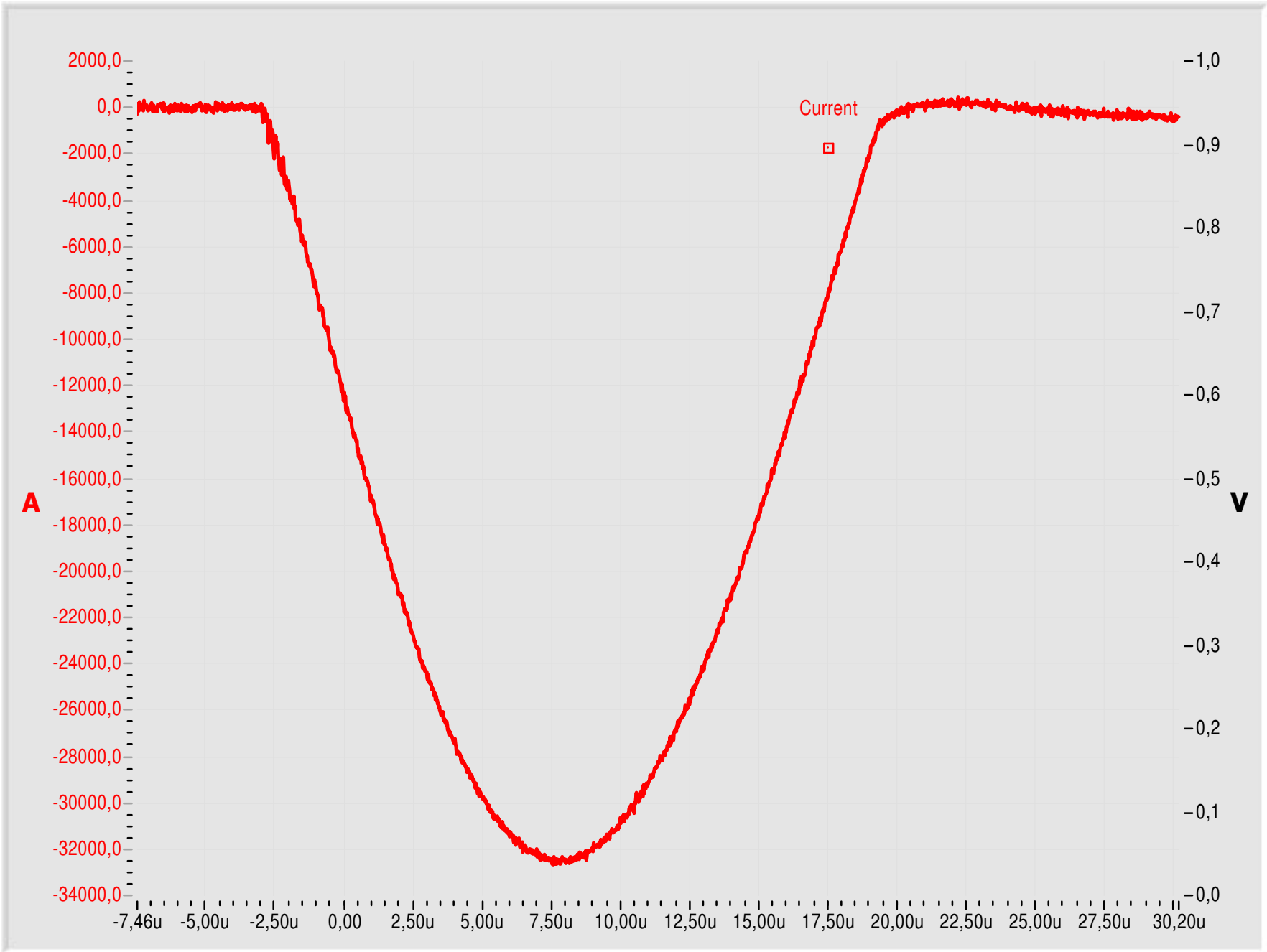

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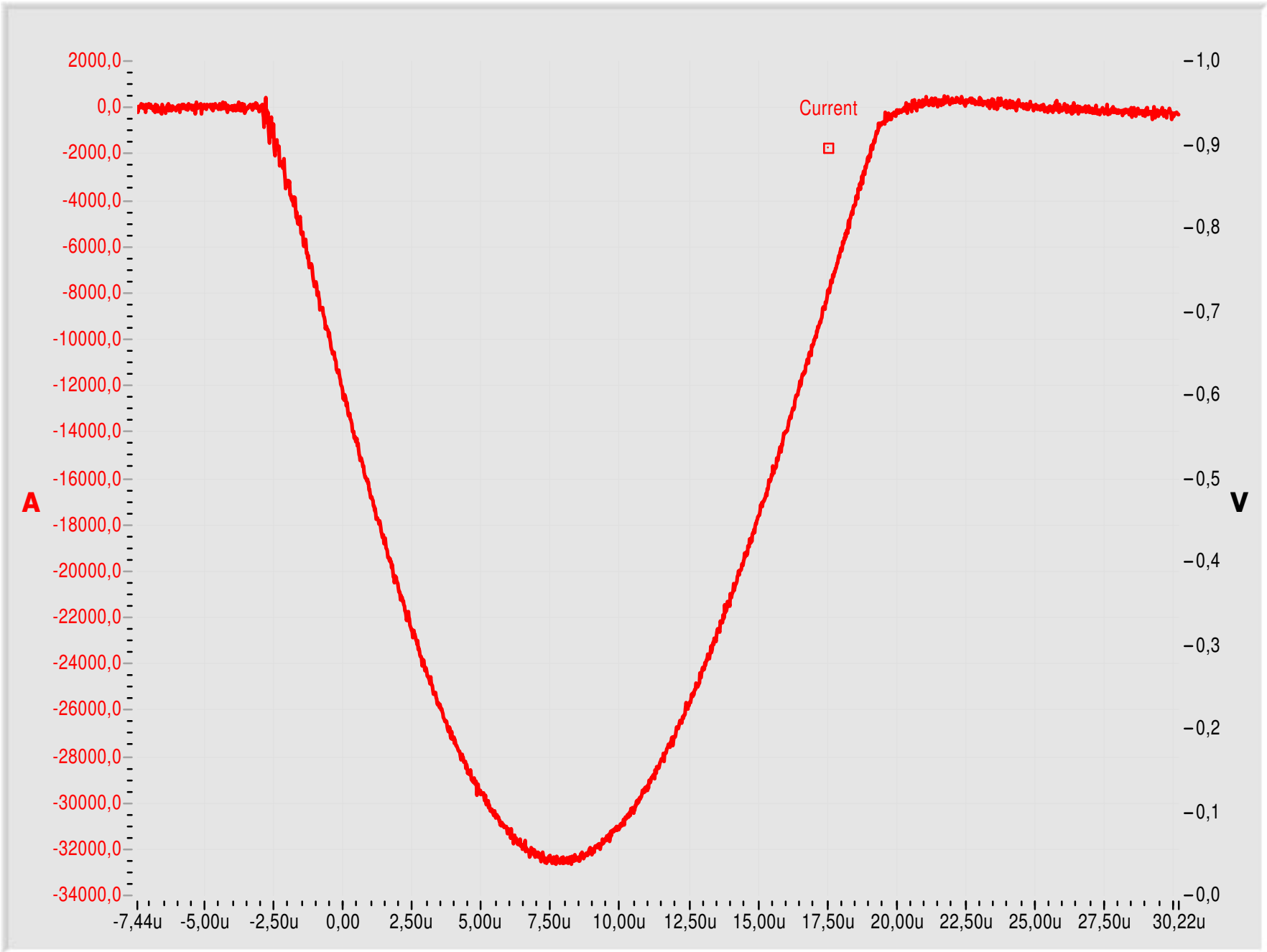
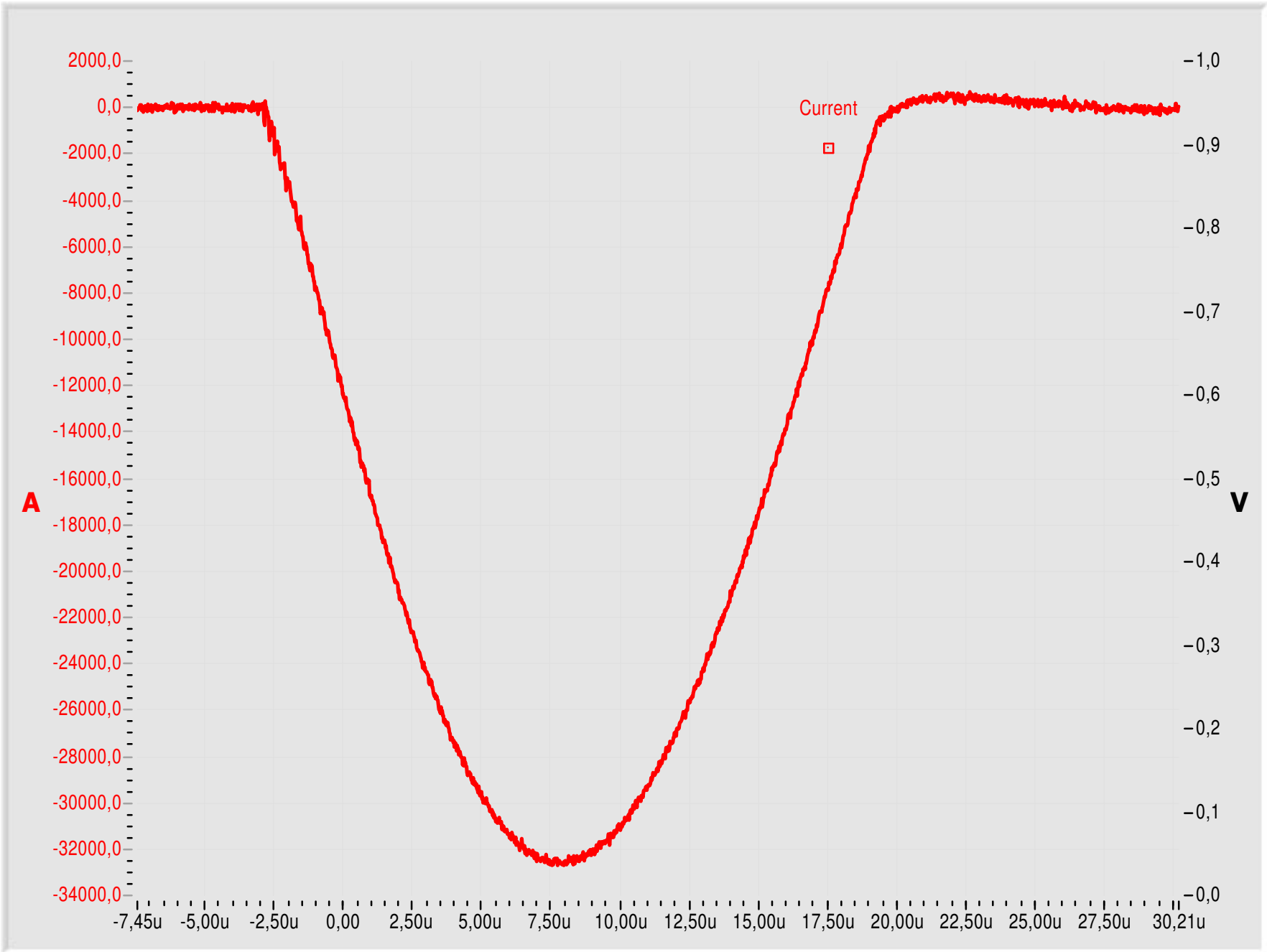
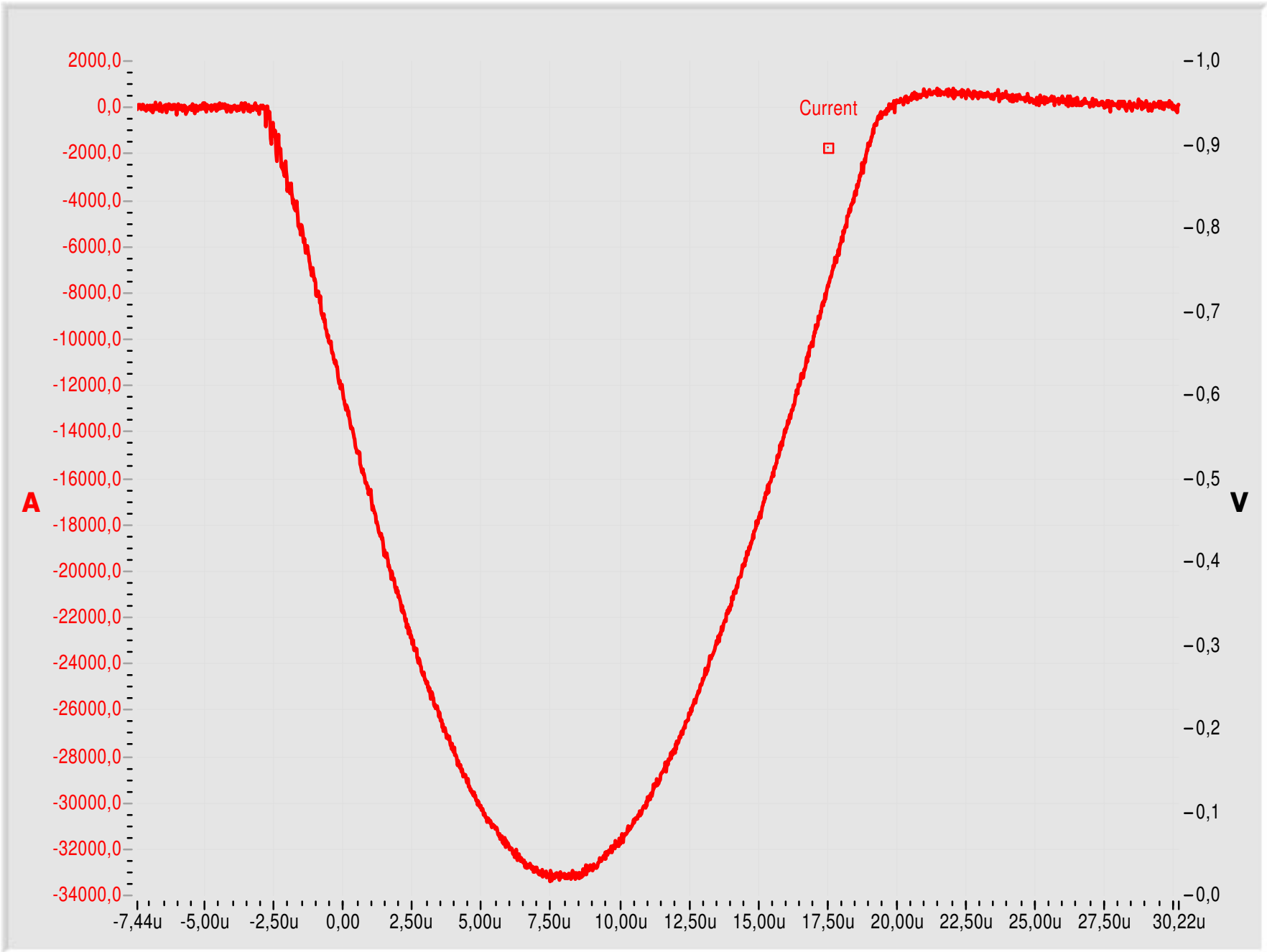


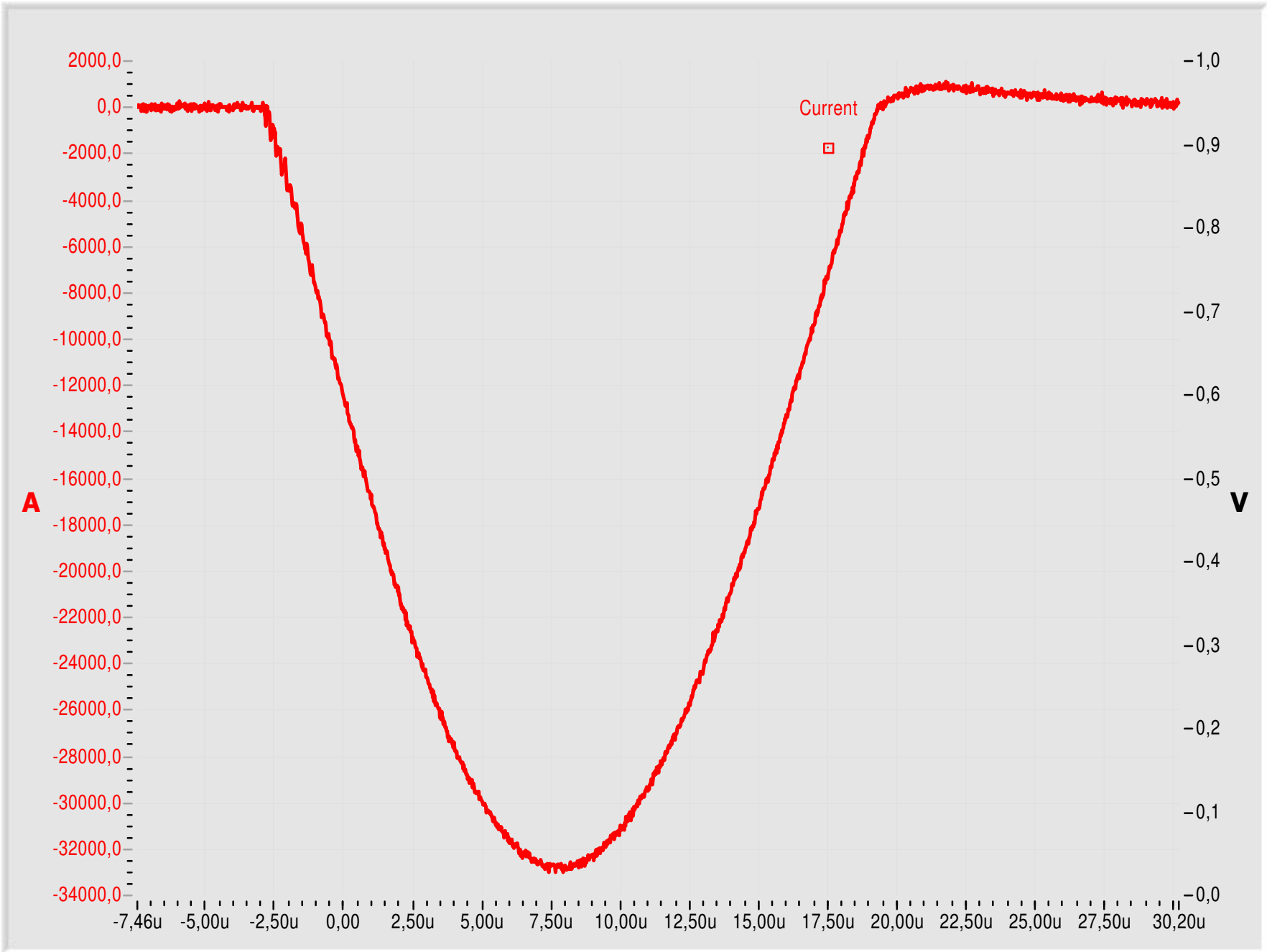
CESI B7018719 Oscillogram n. 24



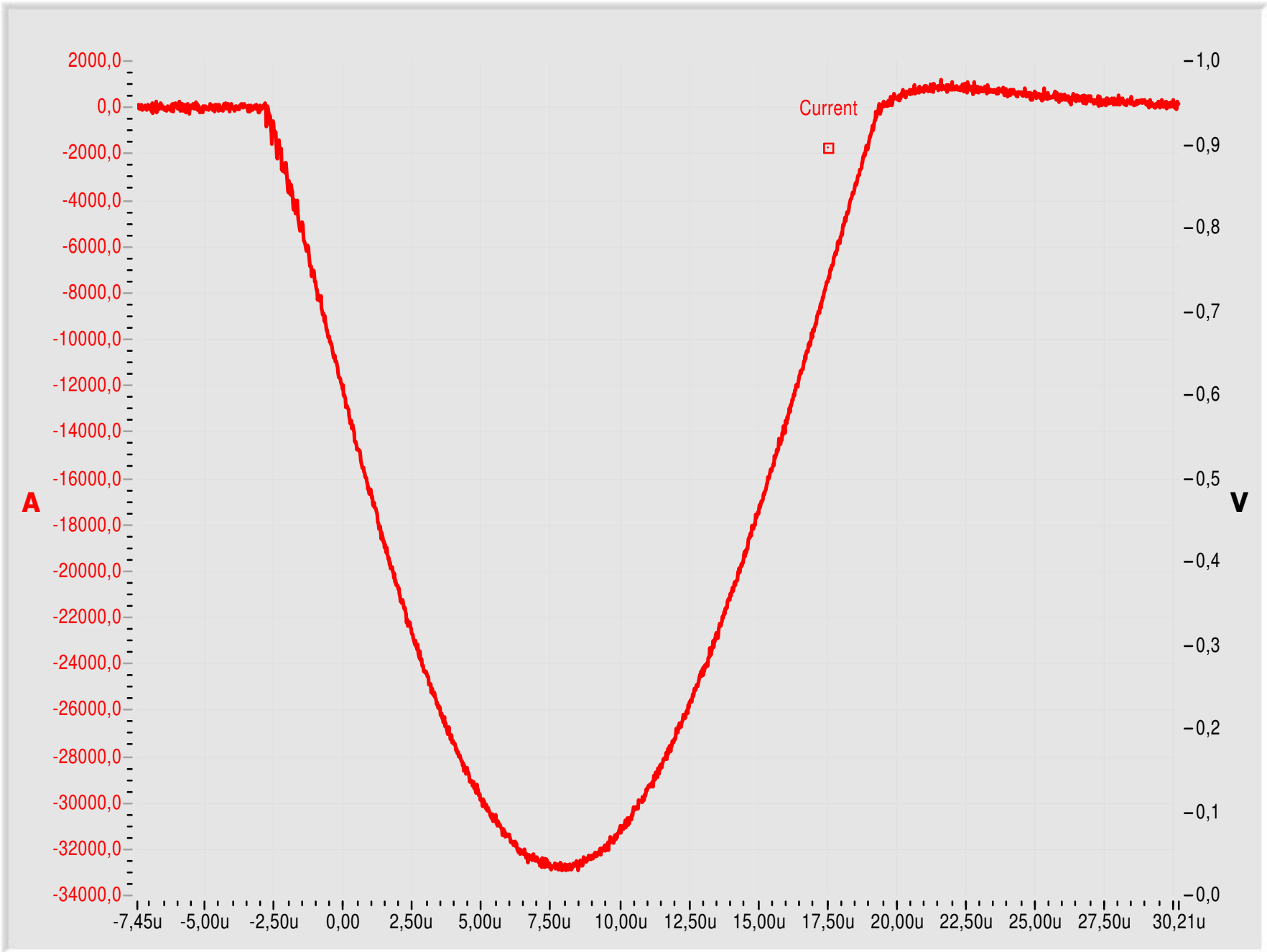
CESI B7018719 Oscillogram n. 25



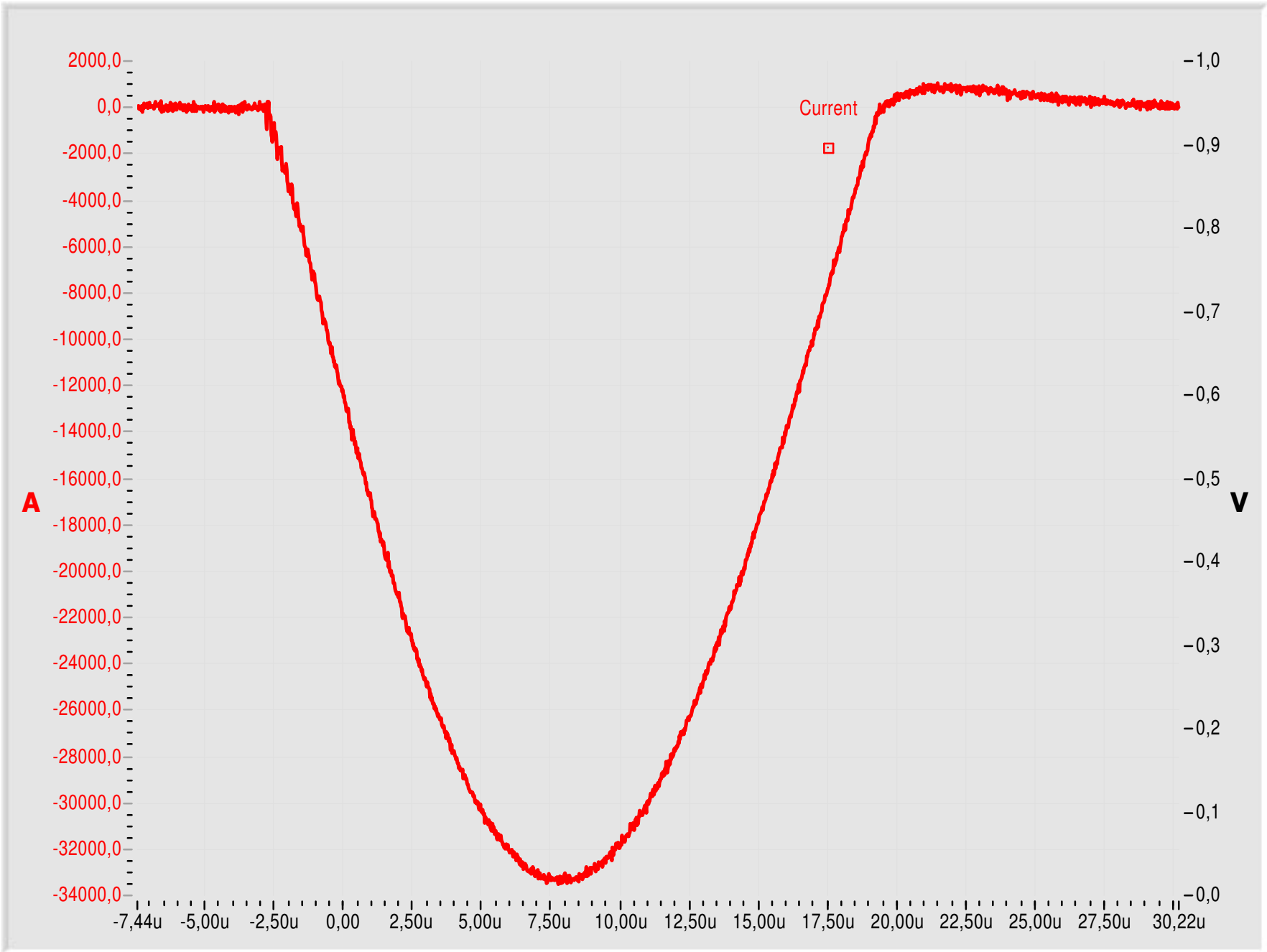
CESI B7018719 Oscillogram n. 26



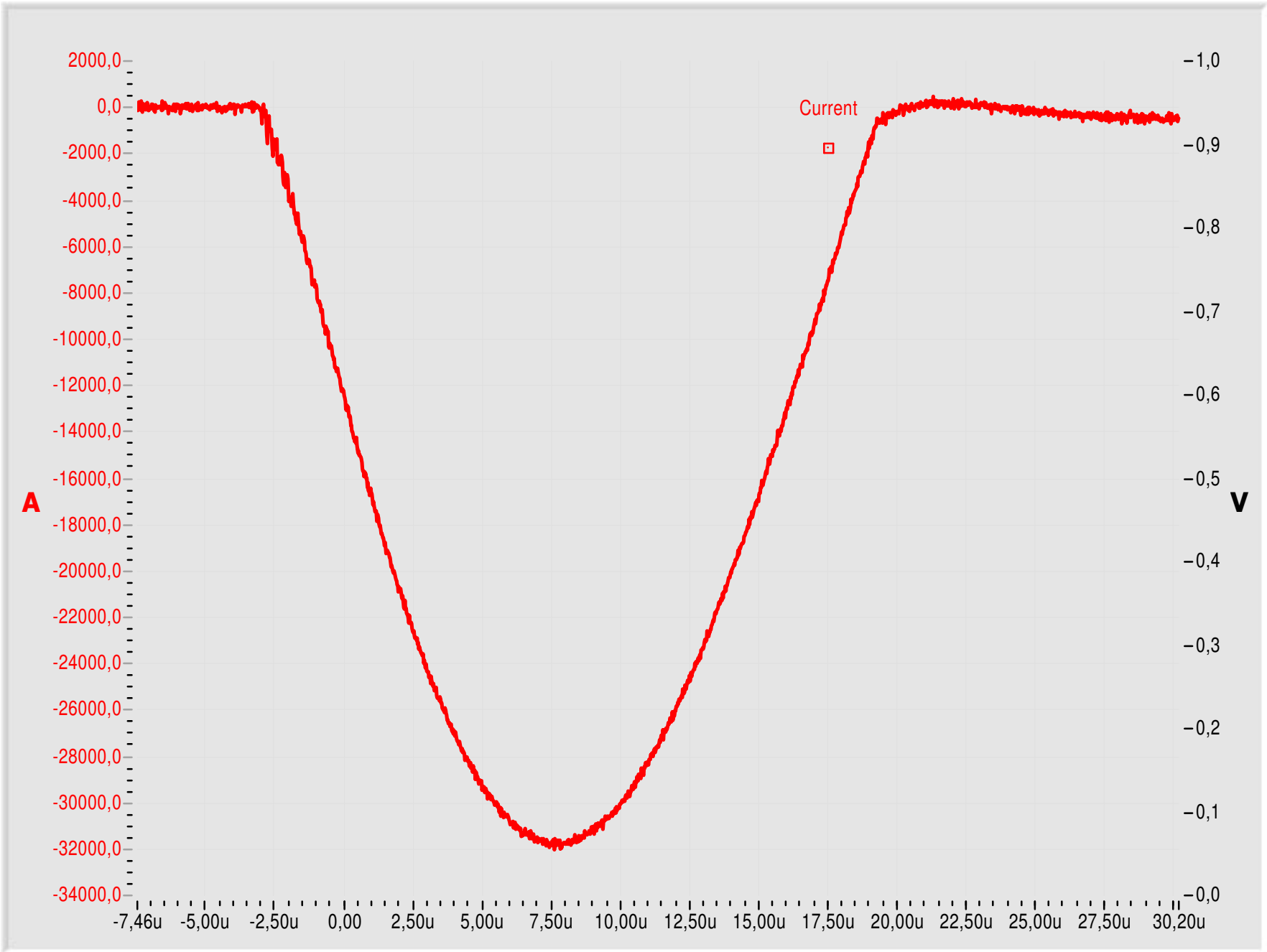
CESI B7018719 Oscillogram n. 27



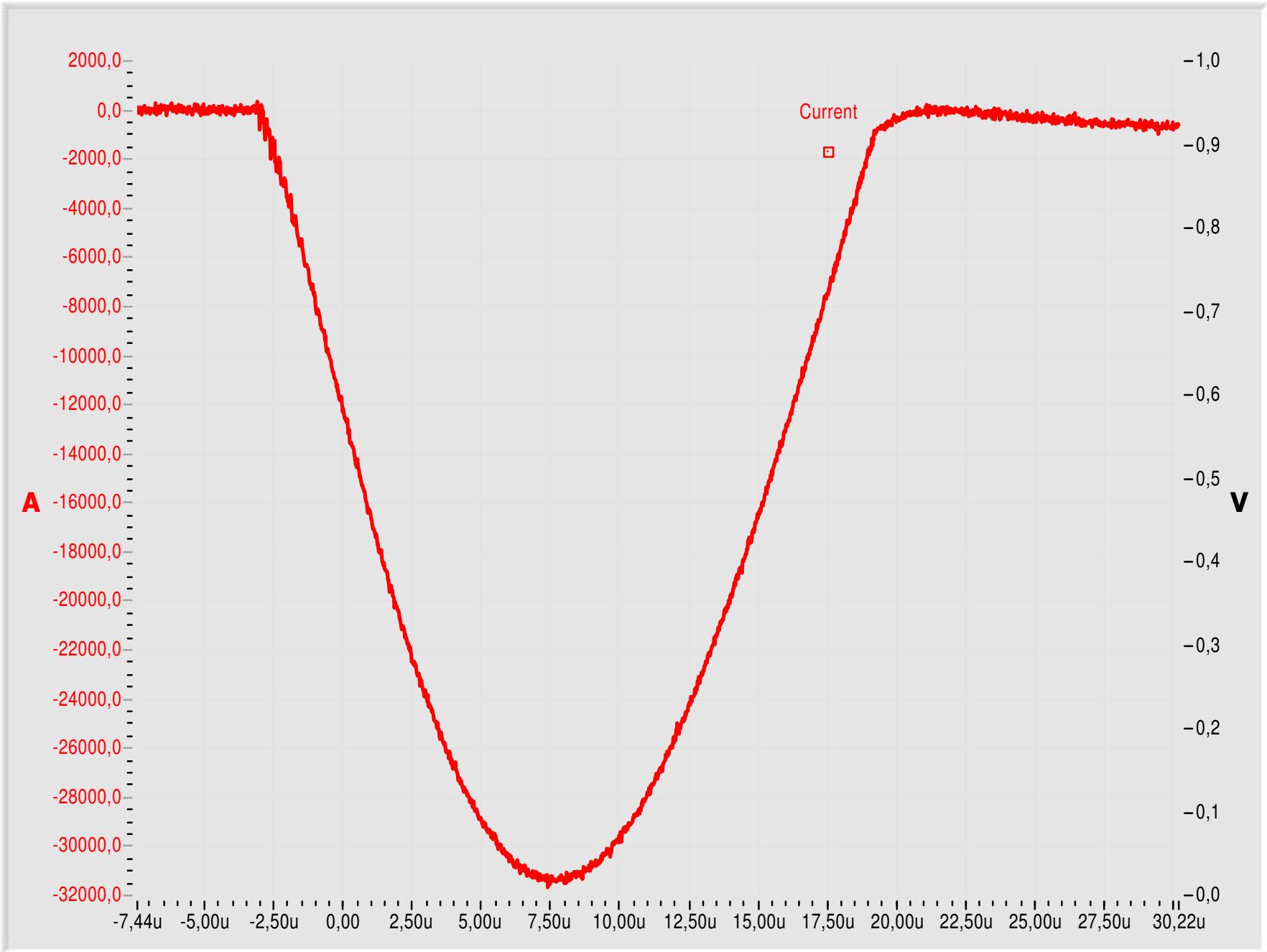
CESI B7018719 Oscillogram n. 28



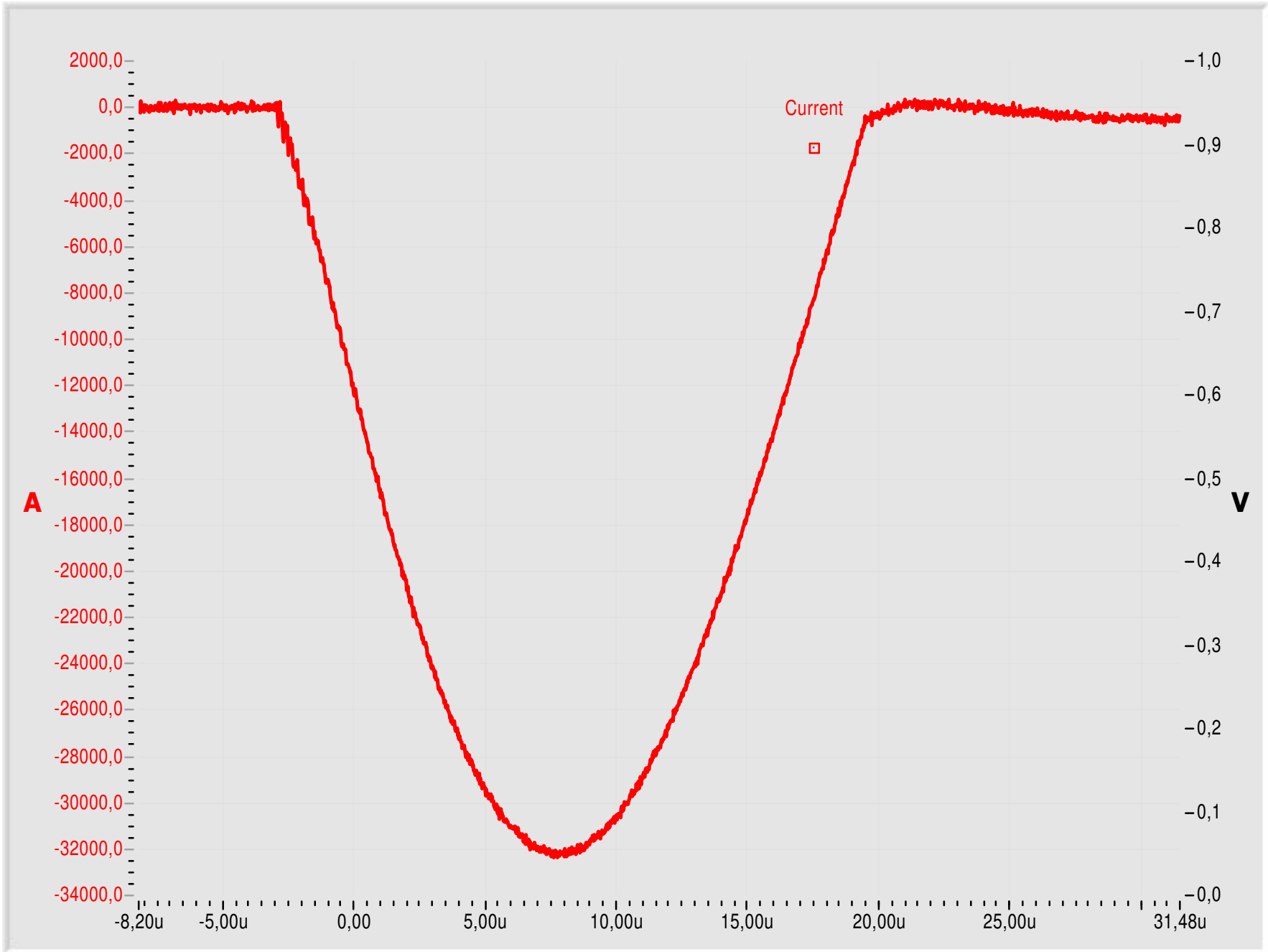
CESI B7018719 Oscillogram n. 29



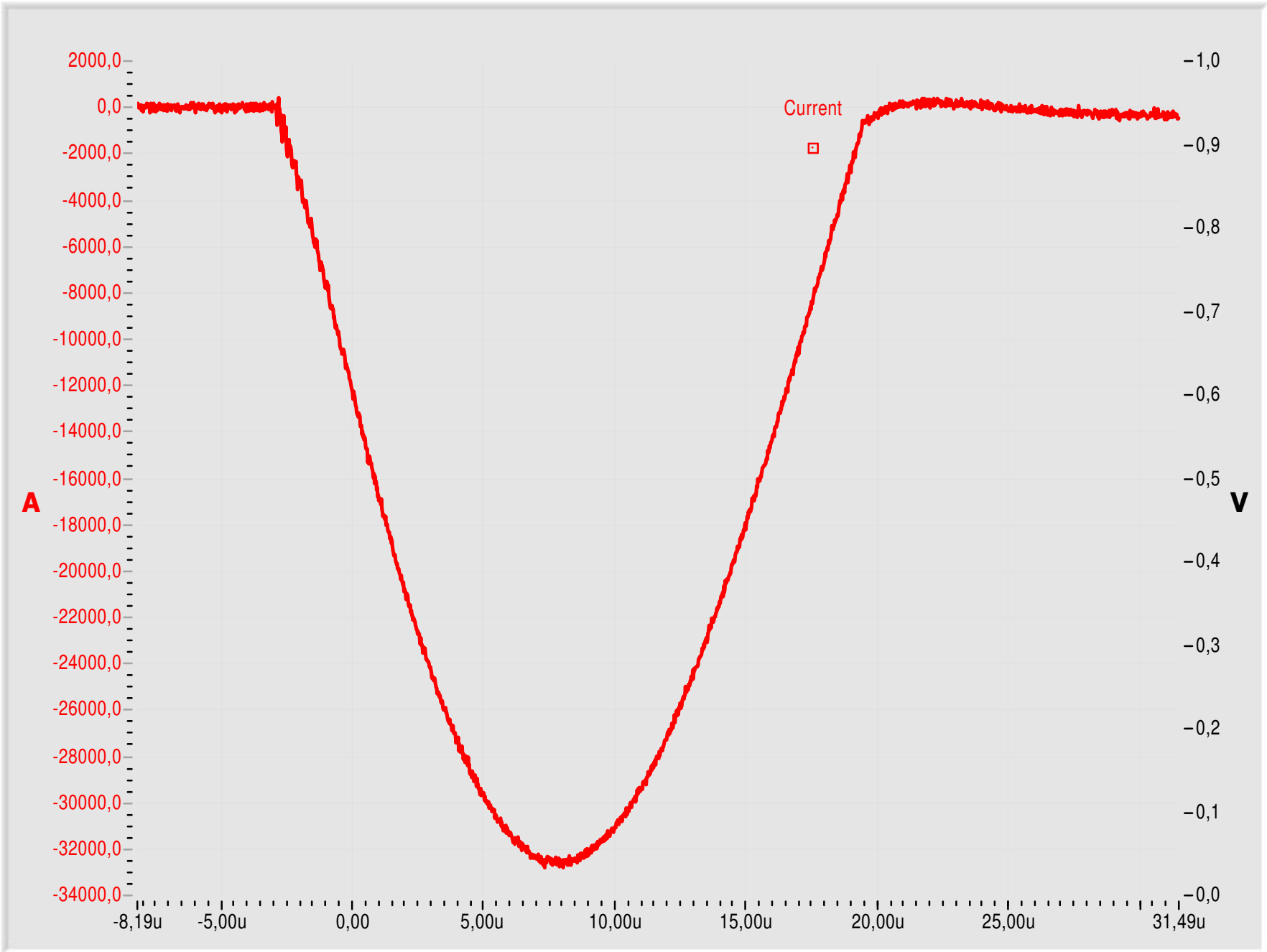
CESI B7018719 Oscillogram n. 30



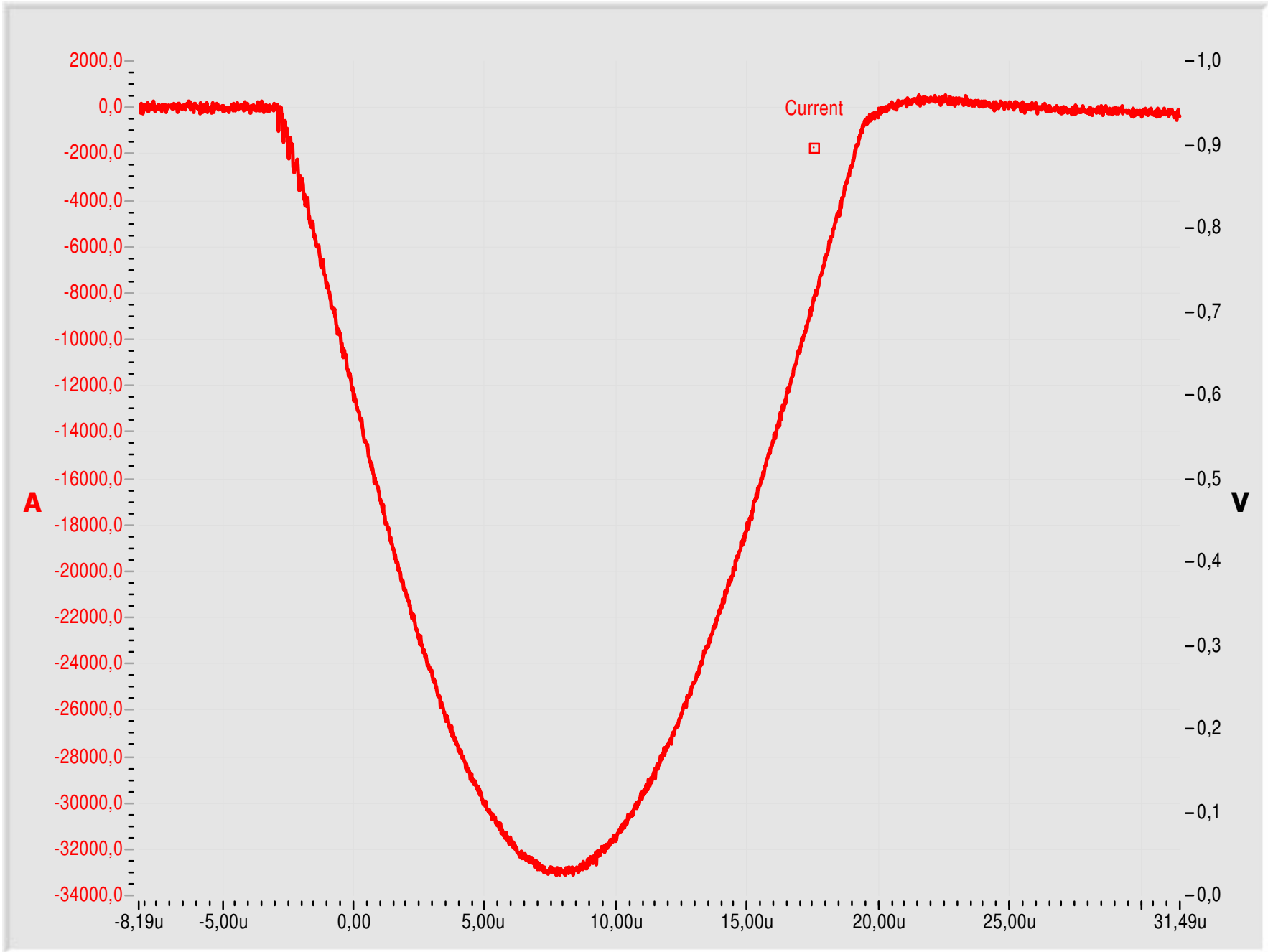
CESI B7018719 Oscillogram n. 31



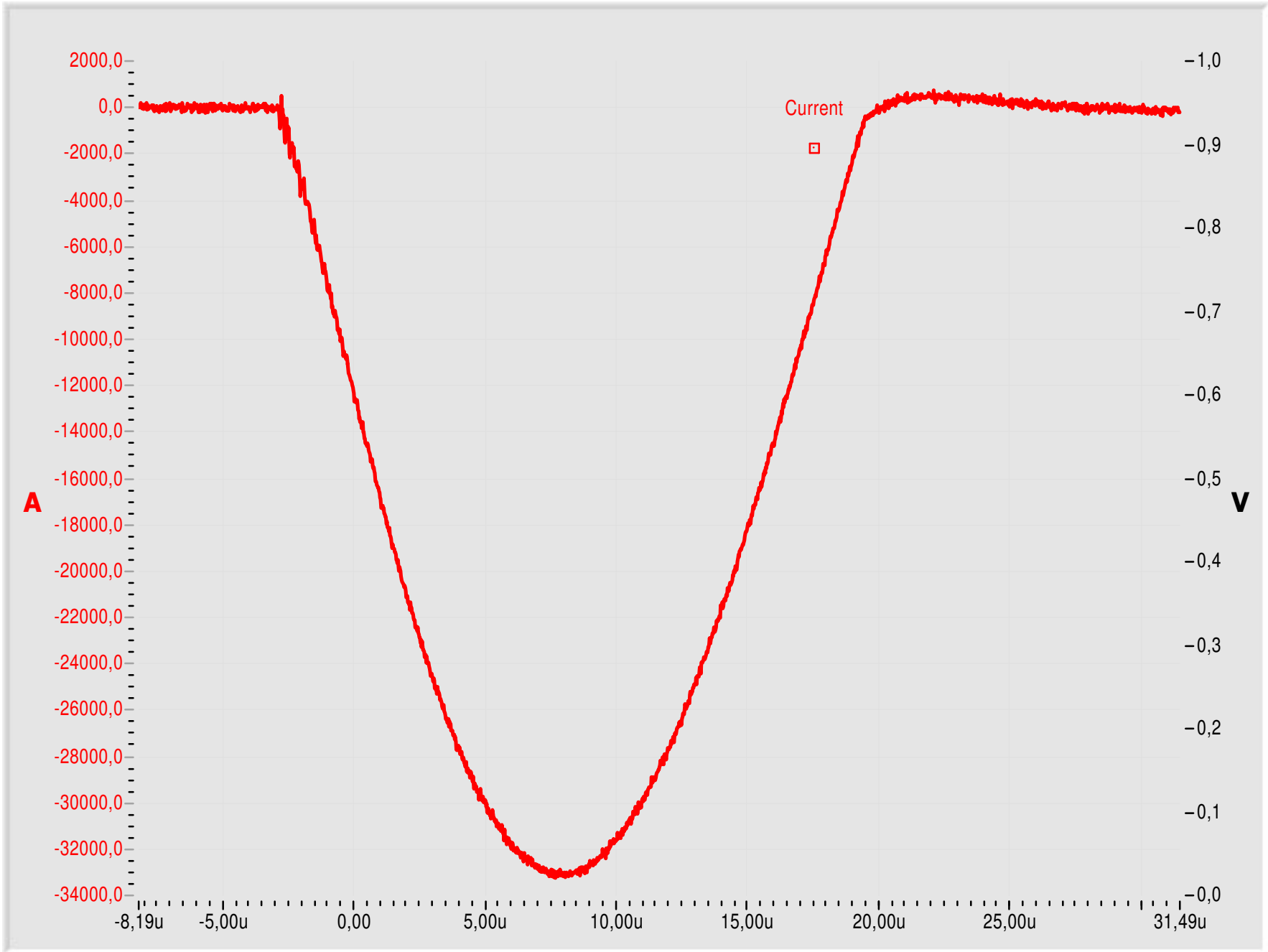
CESI B7018719 Oscillogram n. 32



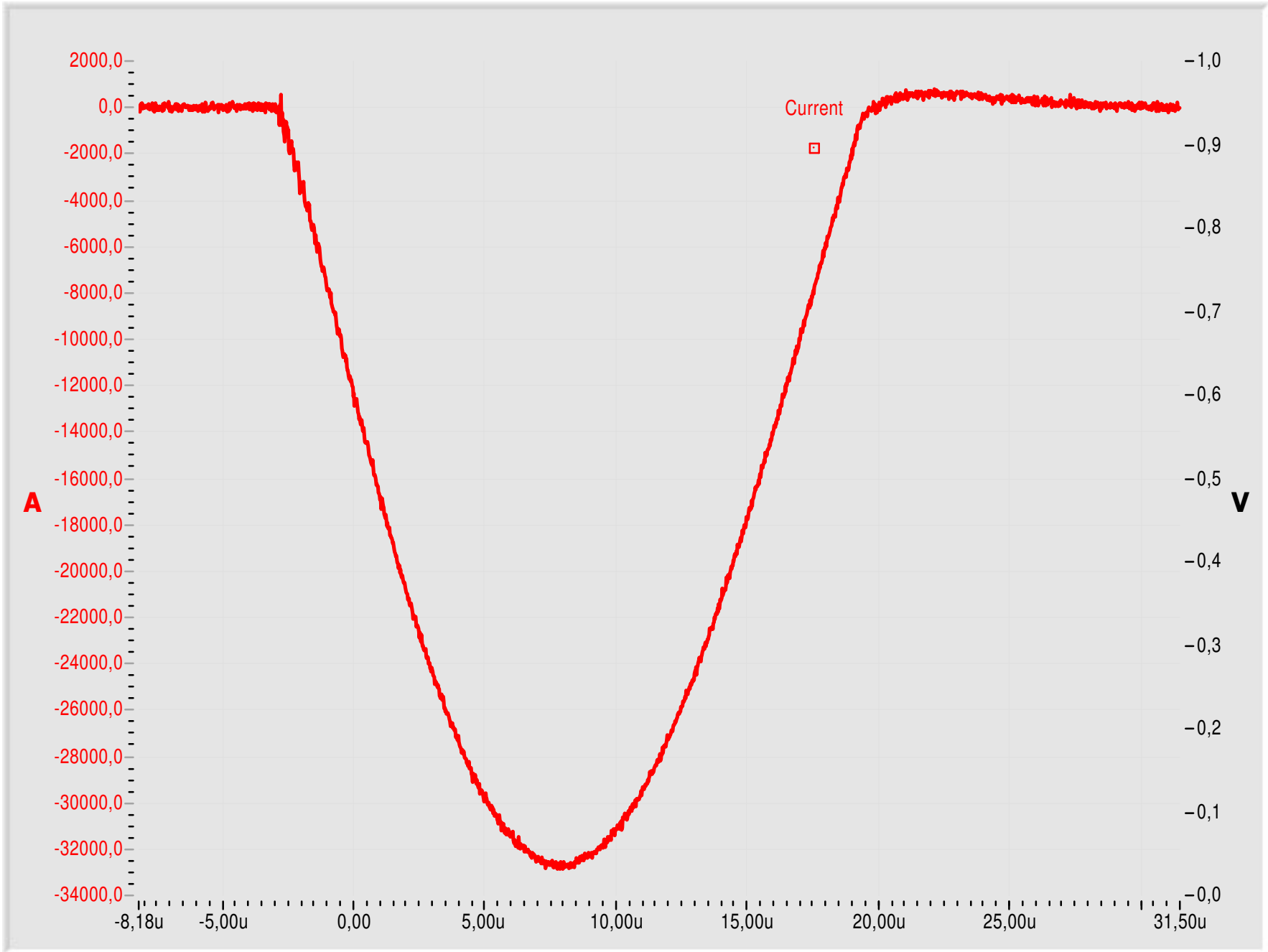
CESI B7018719 Oscillogram n. 33



CESI B7018719 Oscillogram n. 34



CESI B7018719 Oscillogram n. 35



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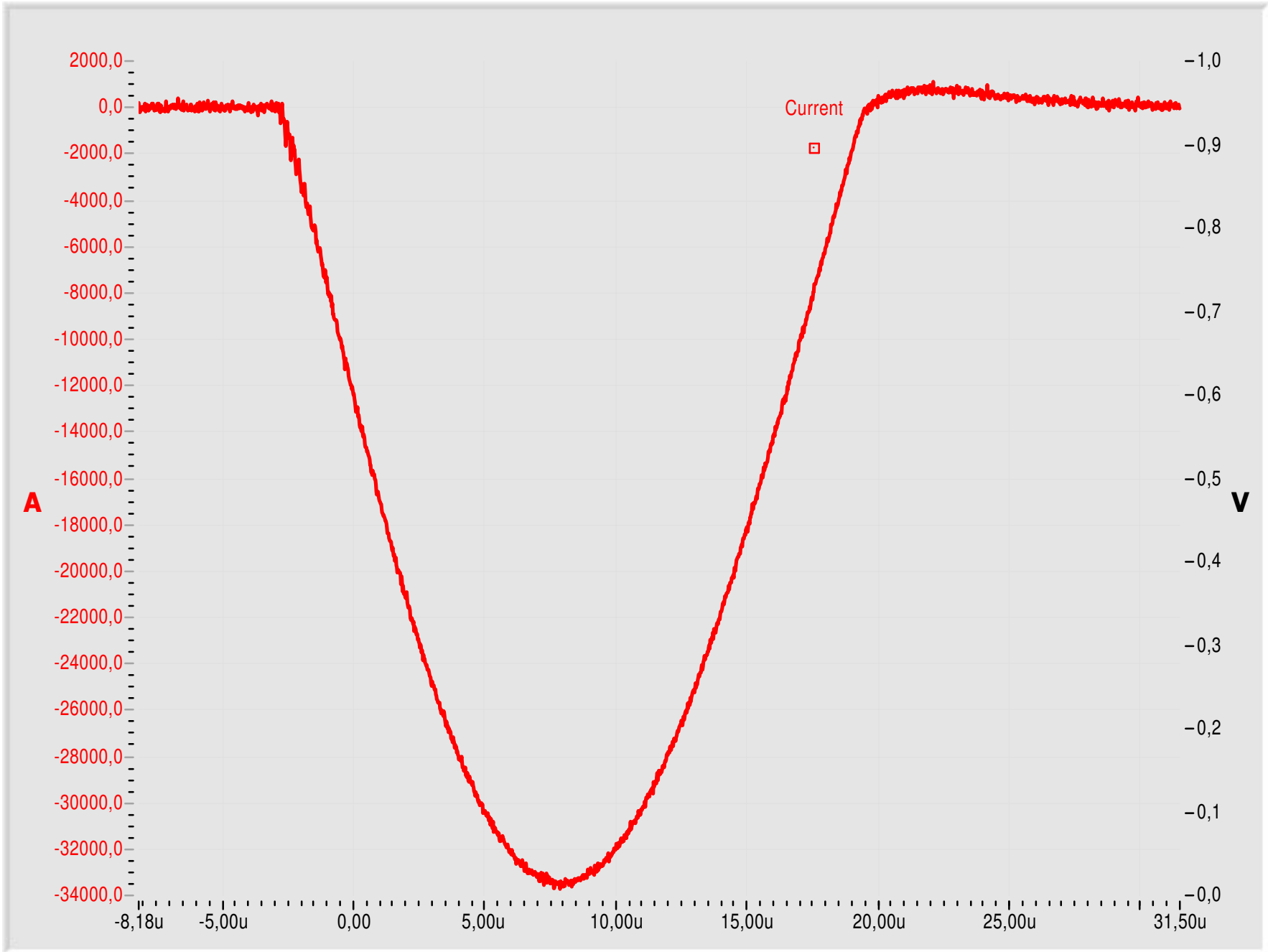

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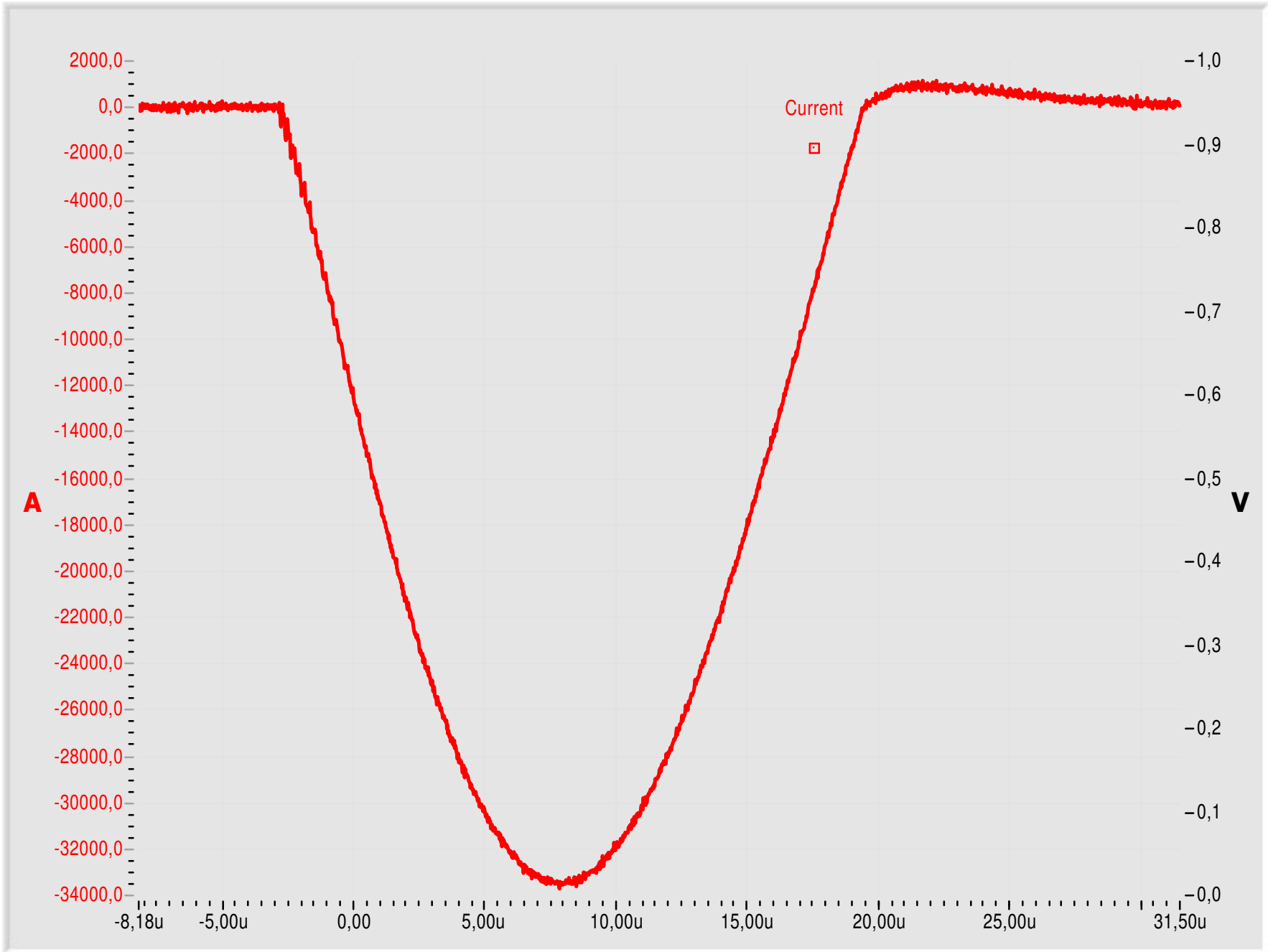

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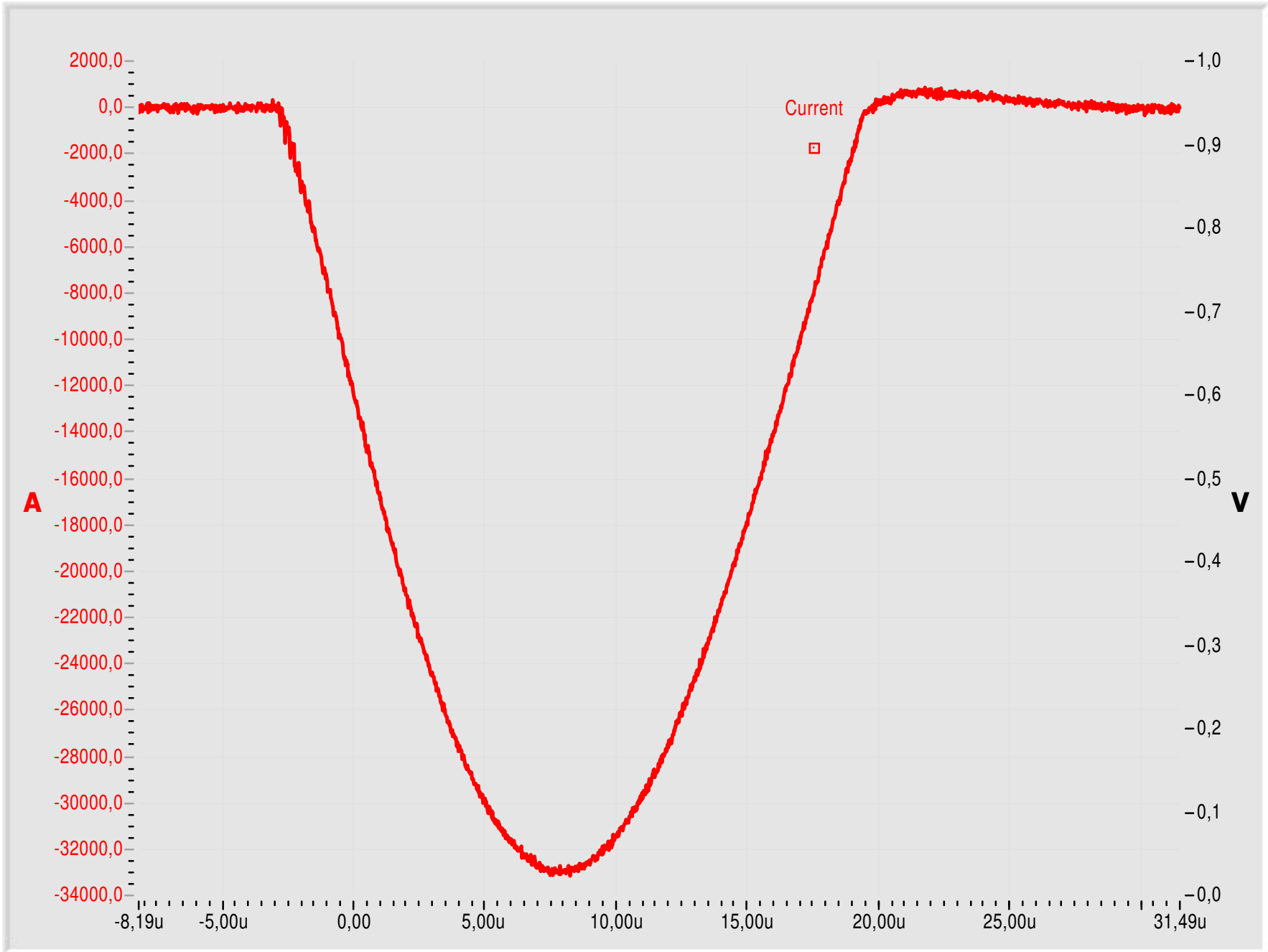
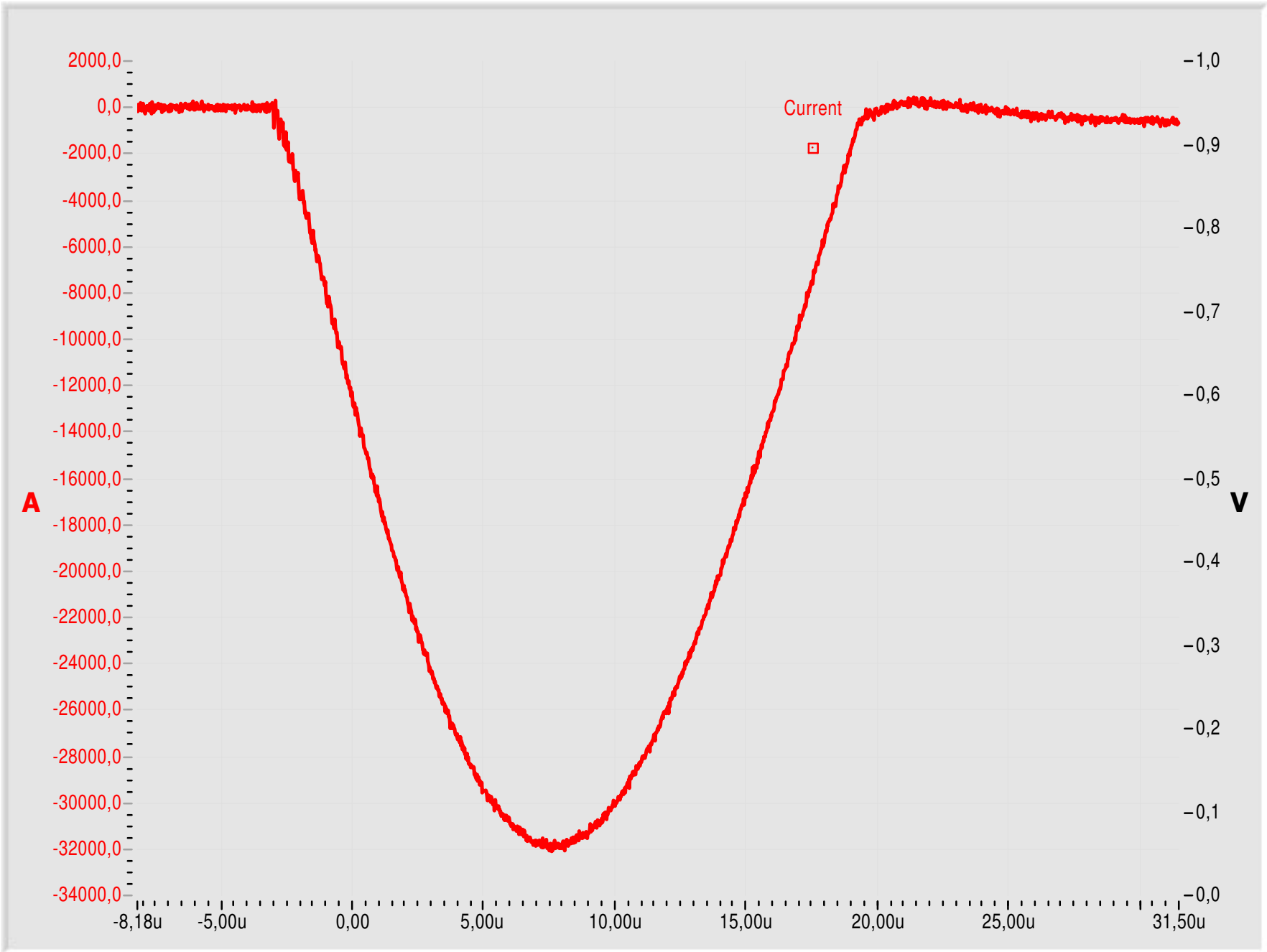
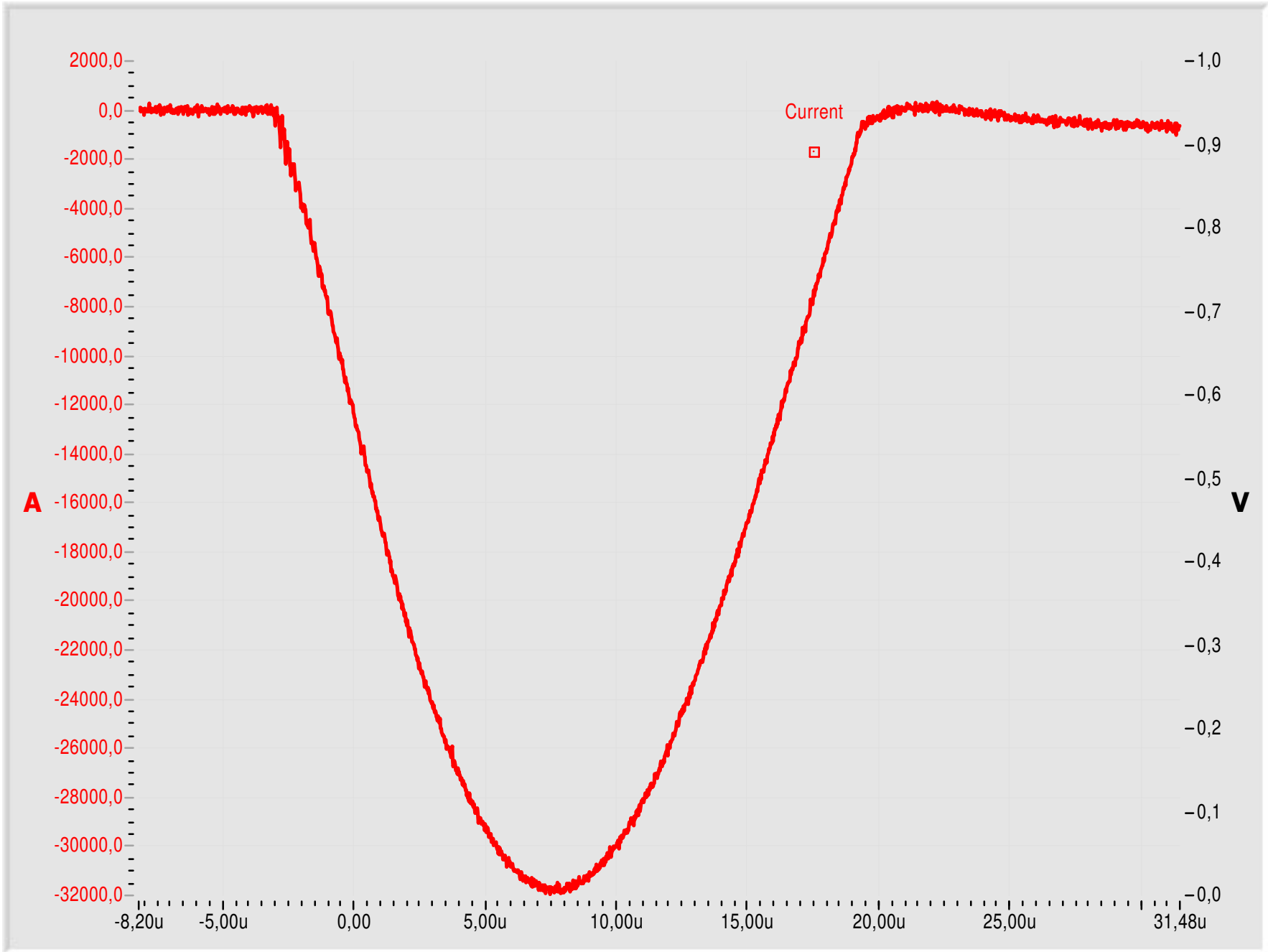


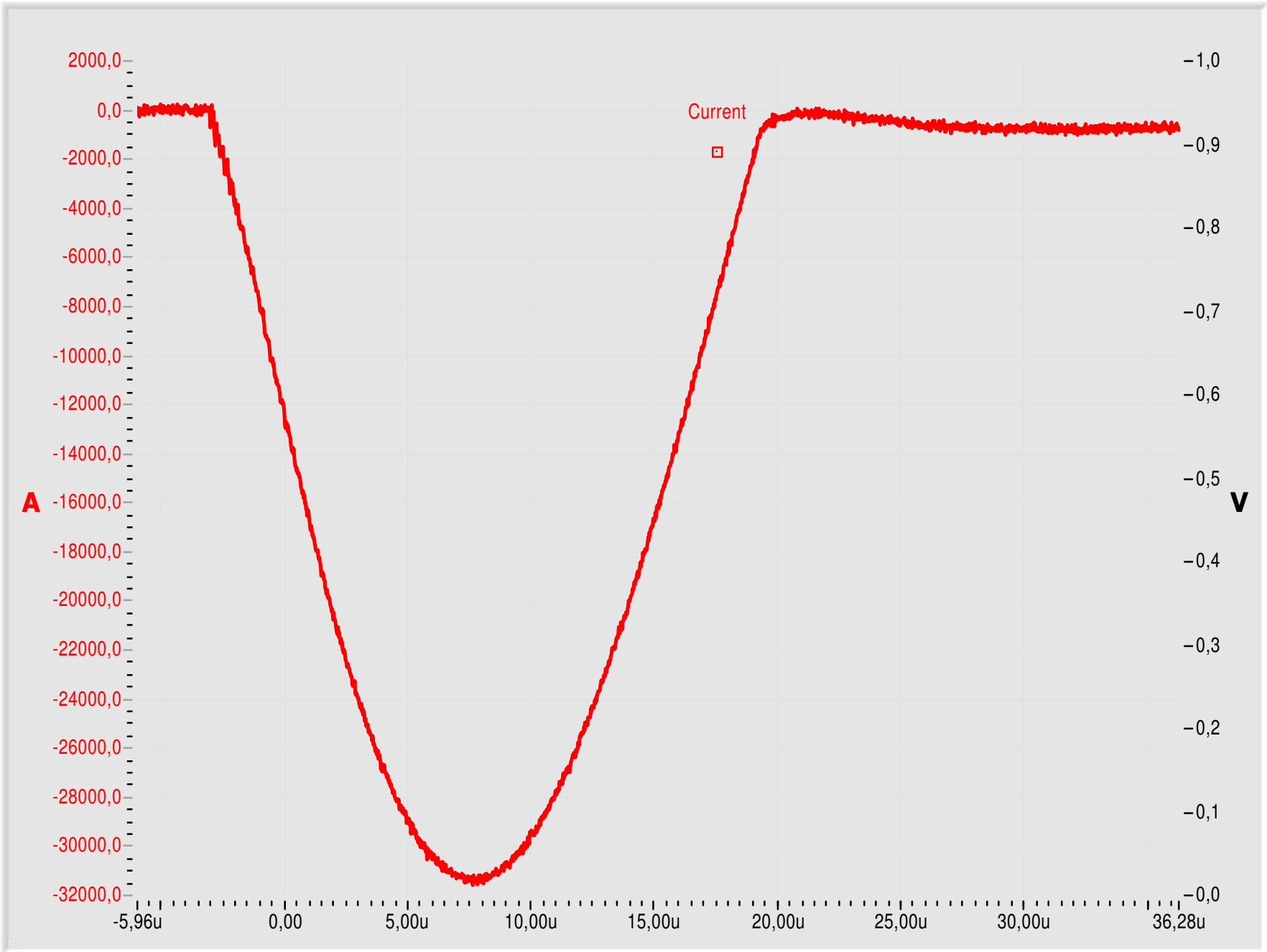
CESI B7018719 Oscillogram n. 39



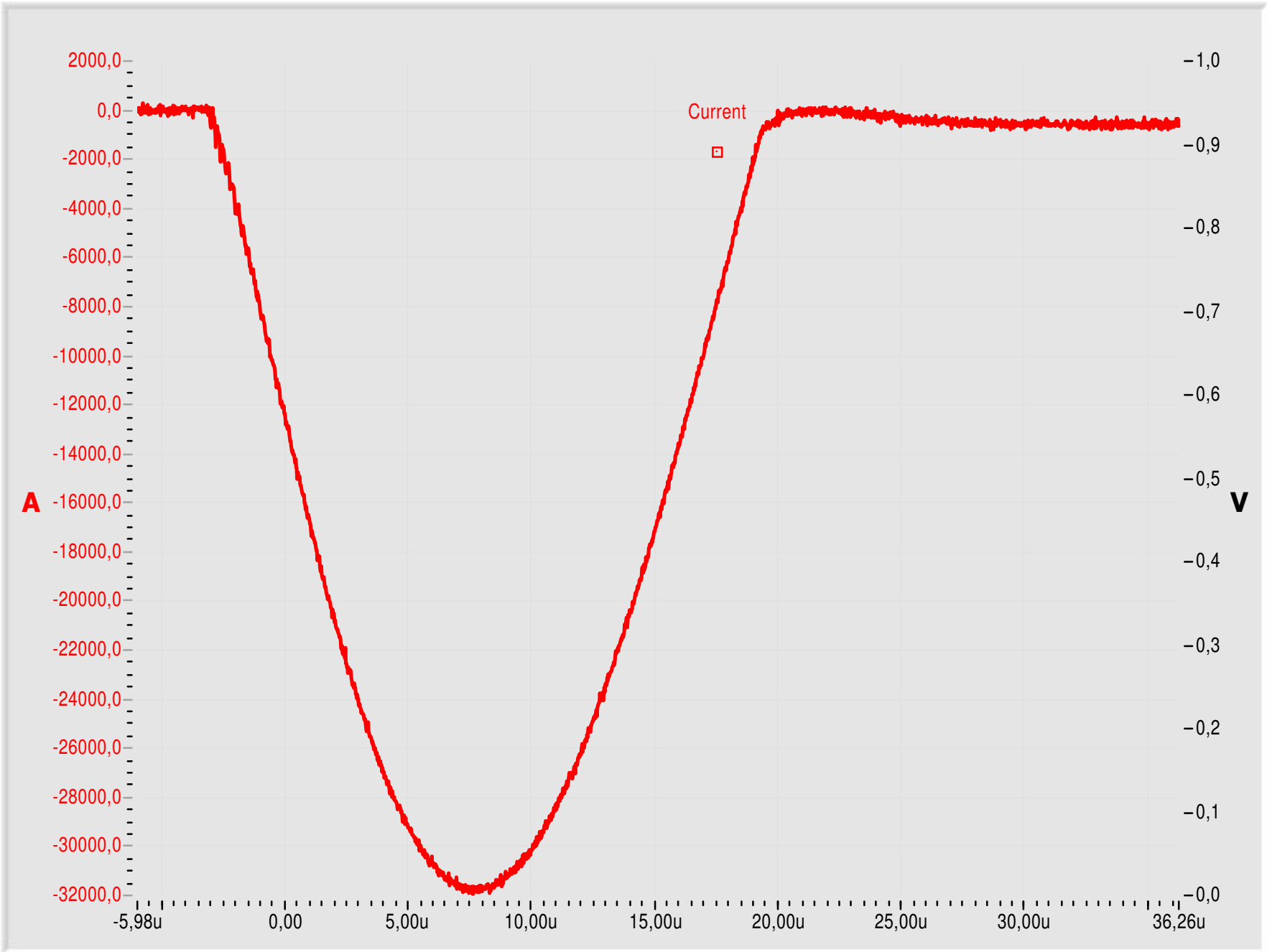
CESI B7018719 Oscillogram n. 40



CESI B7018719 Oscillogram n. 41



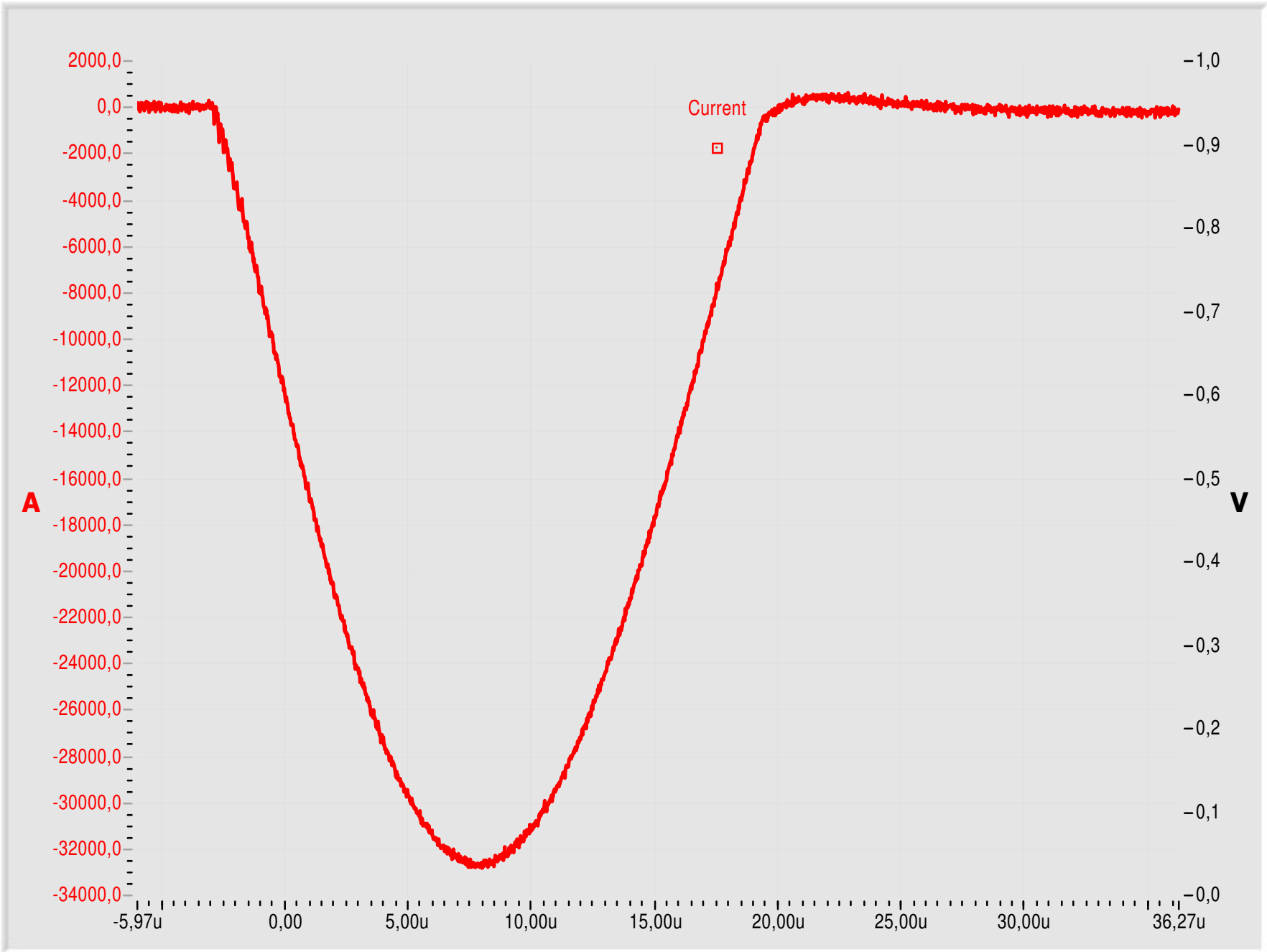
CESI B7018719 Oscillogram n. 42



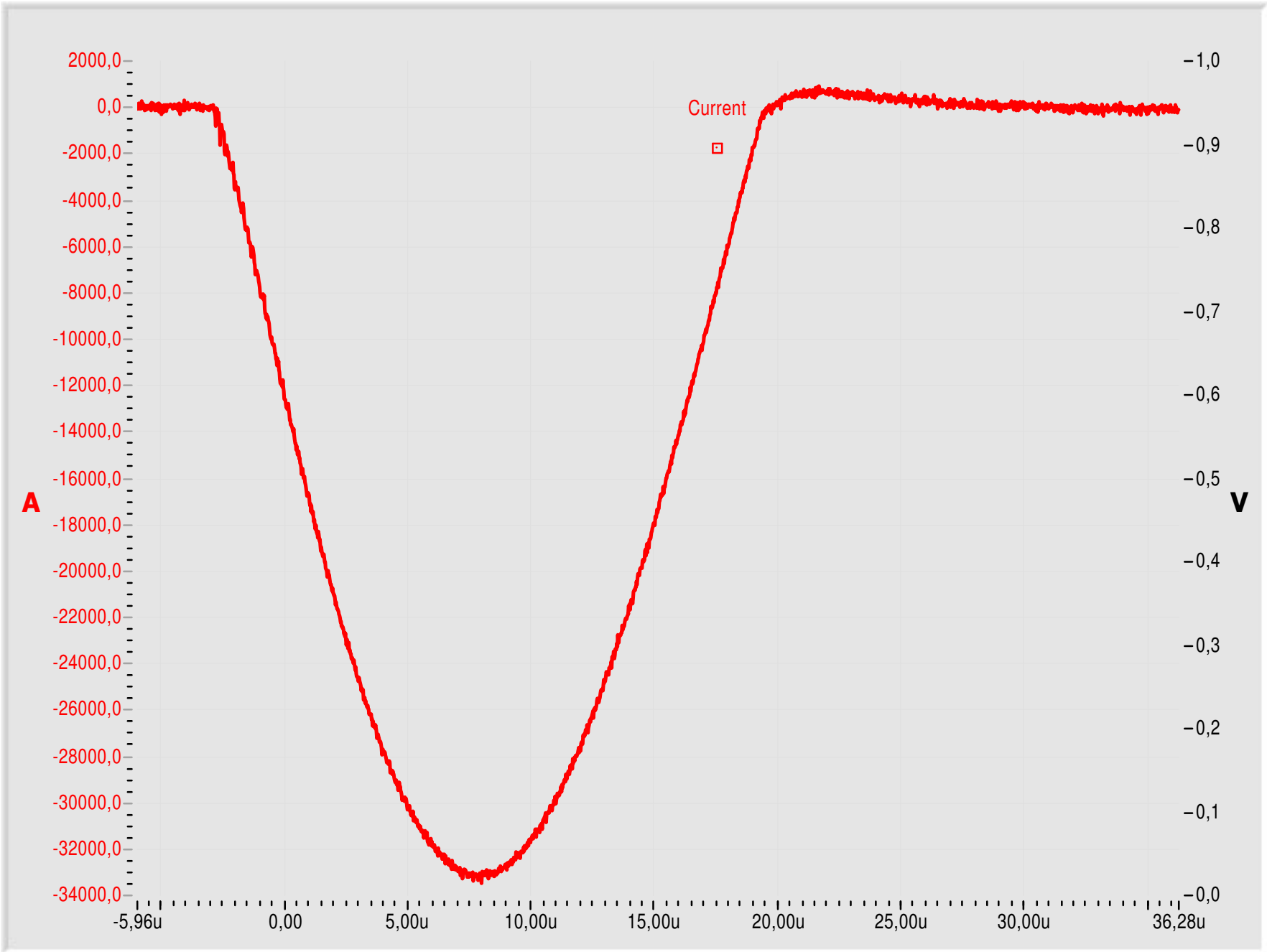
CESI B7018719 Oscillogram n. 43

CESI B7018719 Oscillogram n. 44

CESI B7018719 Oscillogram n. 45



CESI B7018719 Oscillogram n. 46



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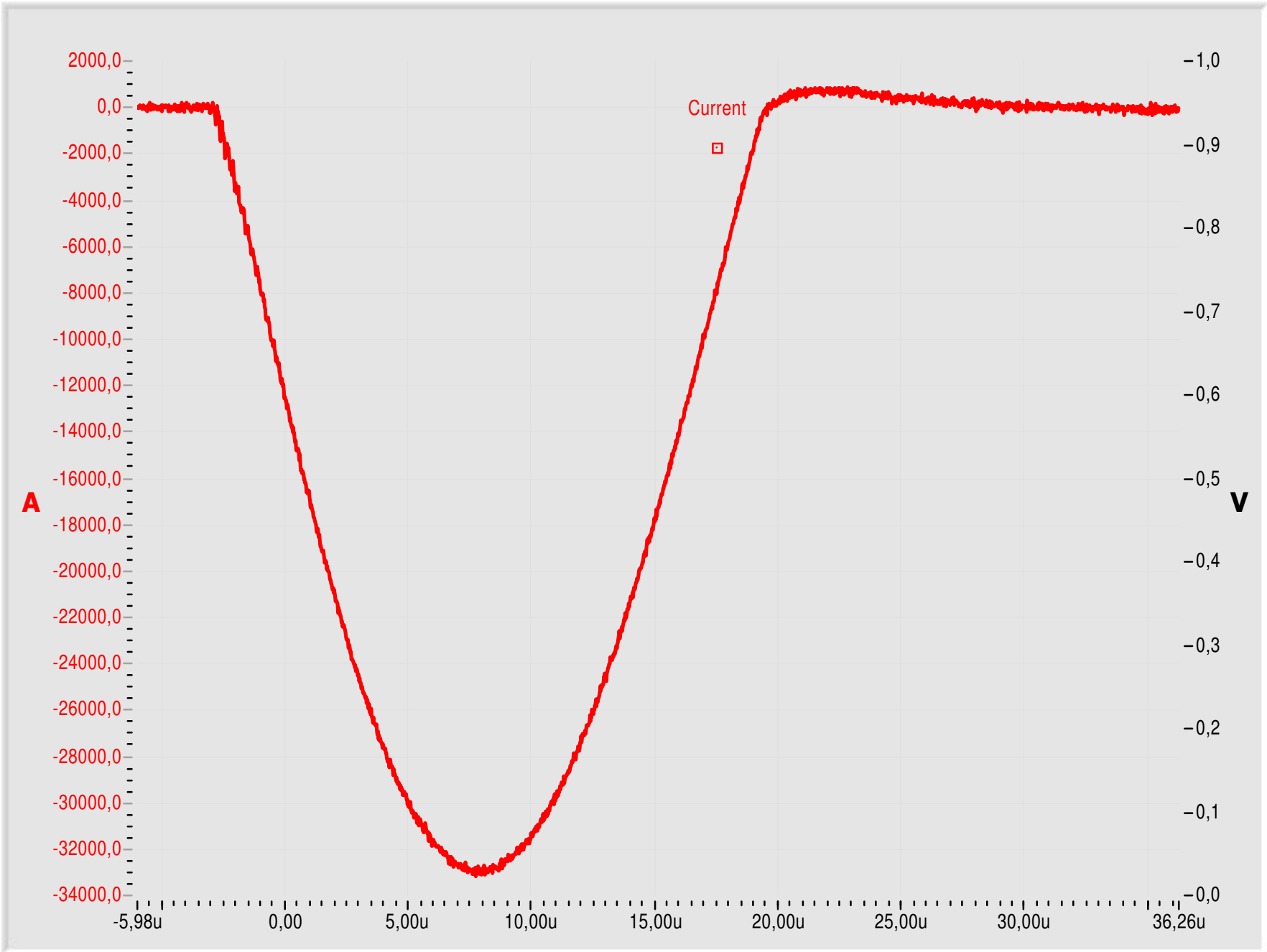

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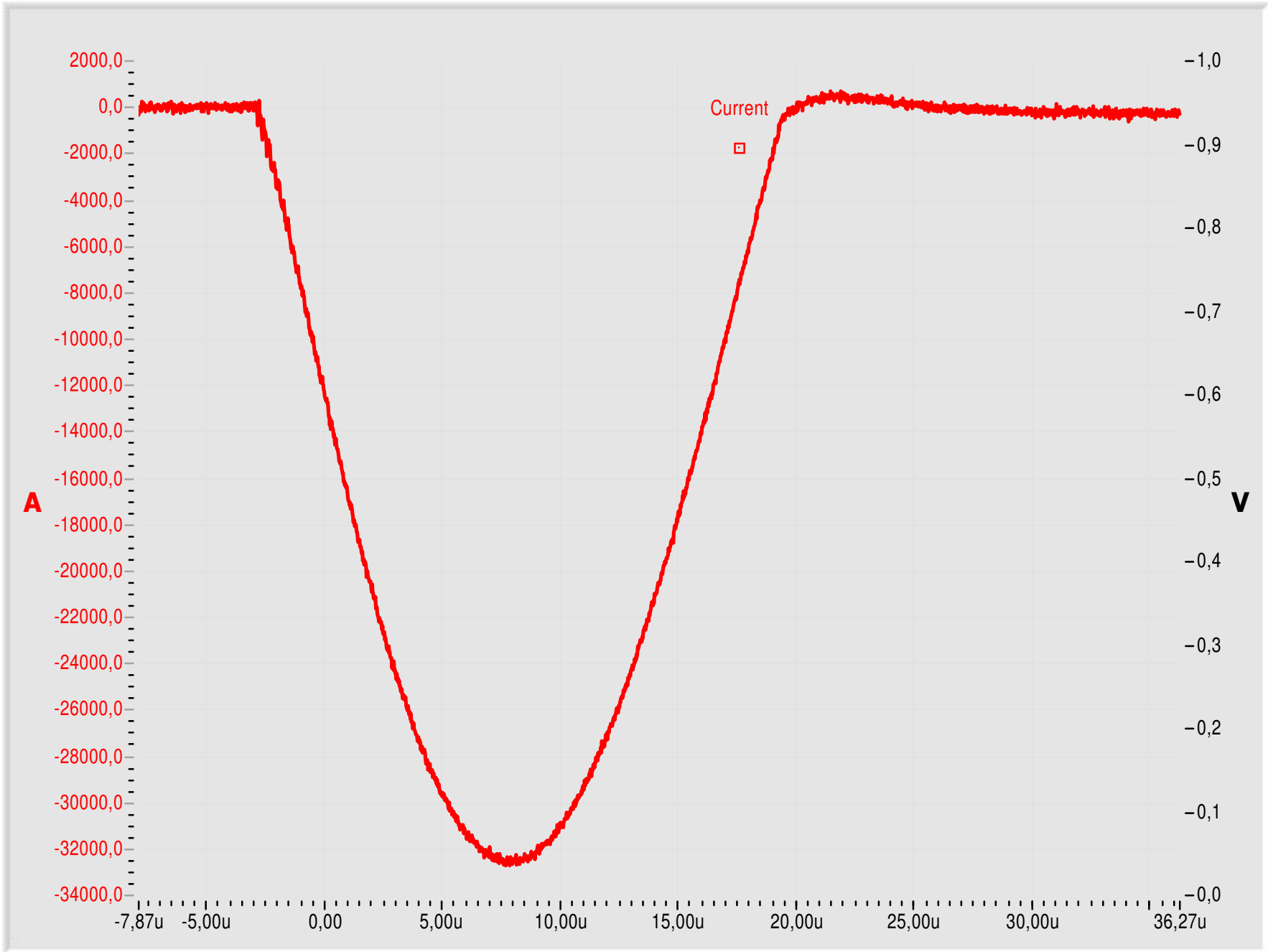

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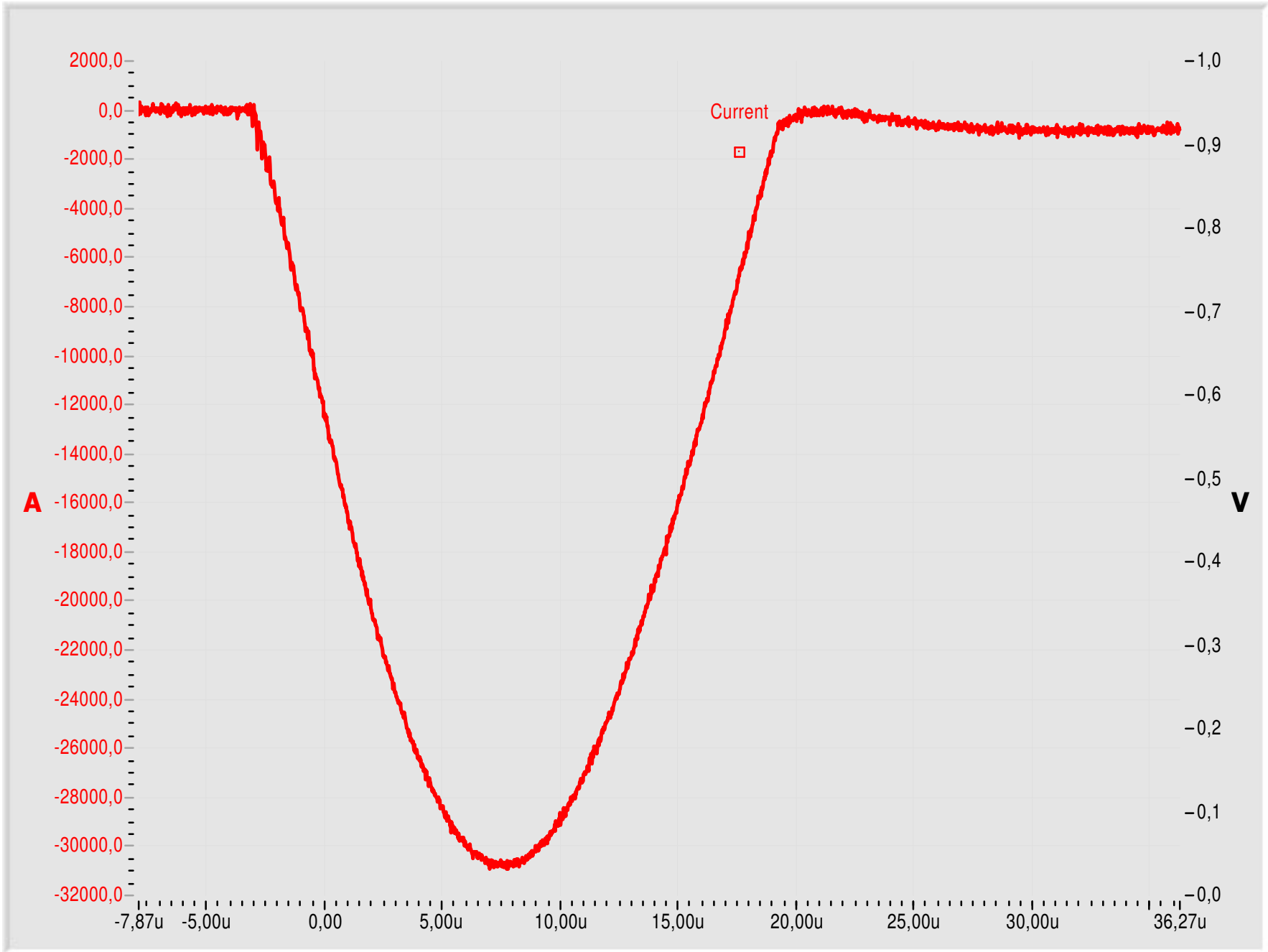

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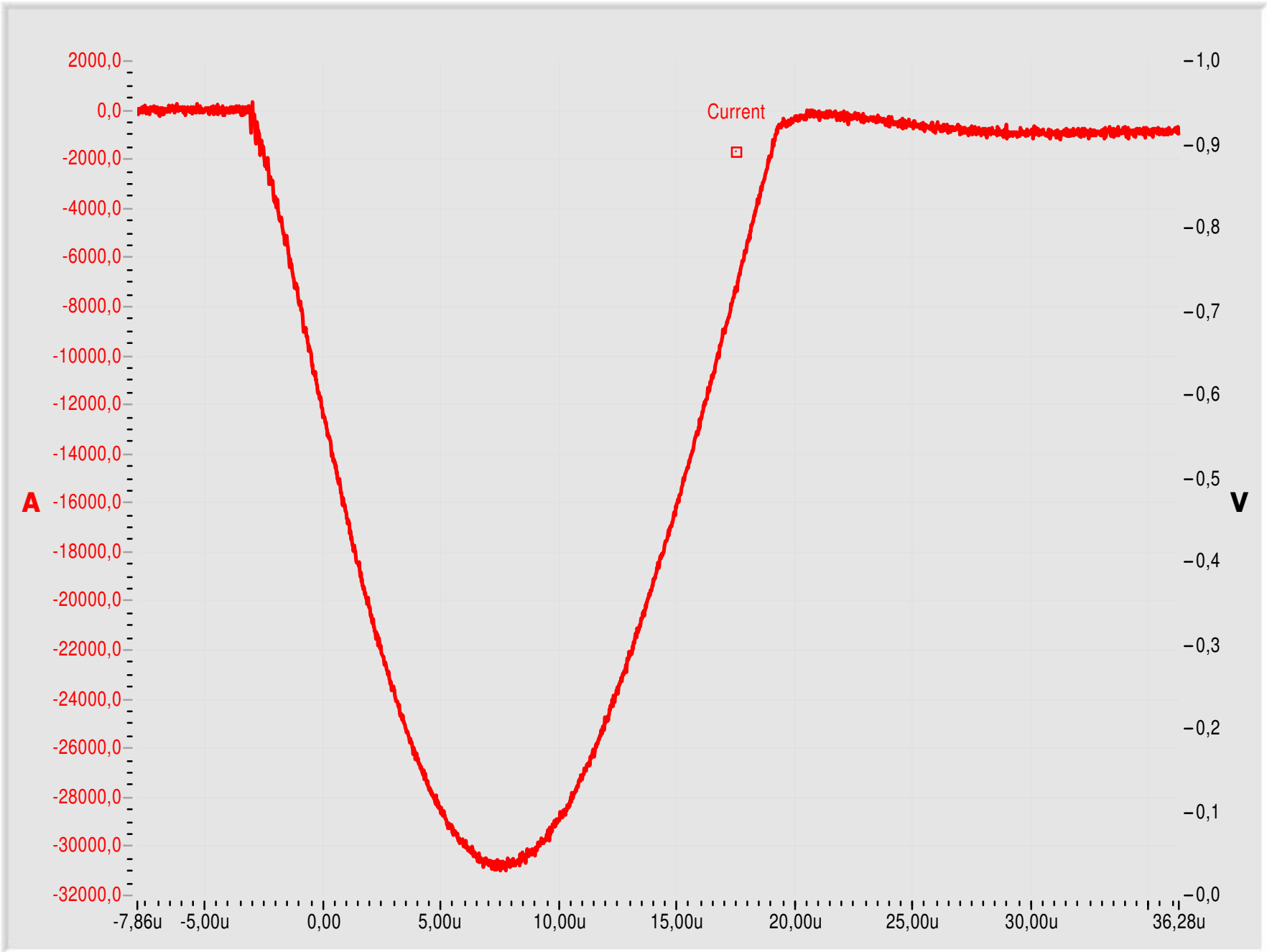

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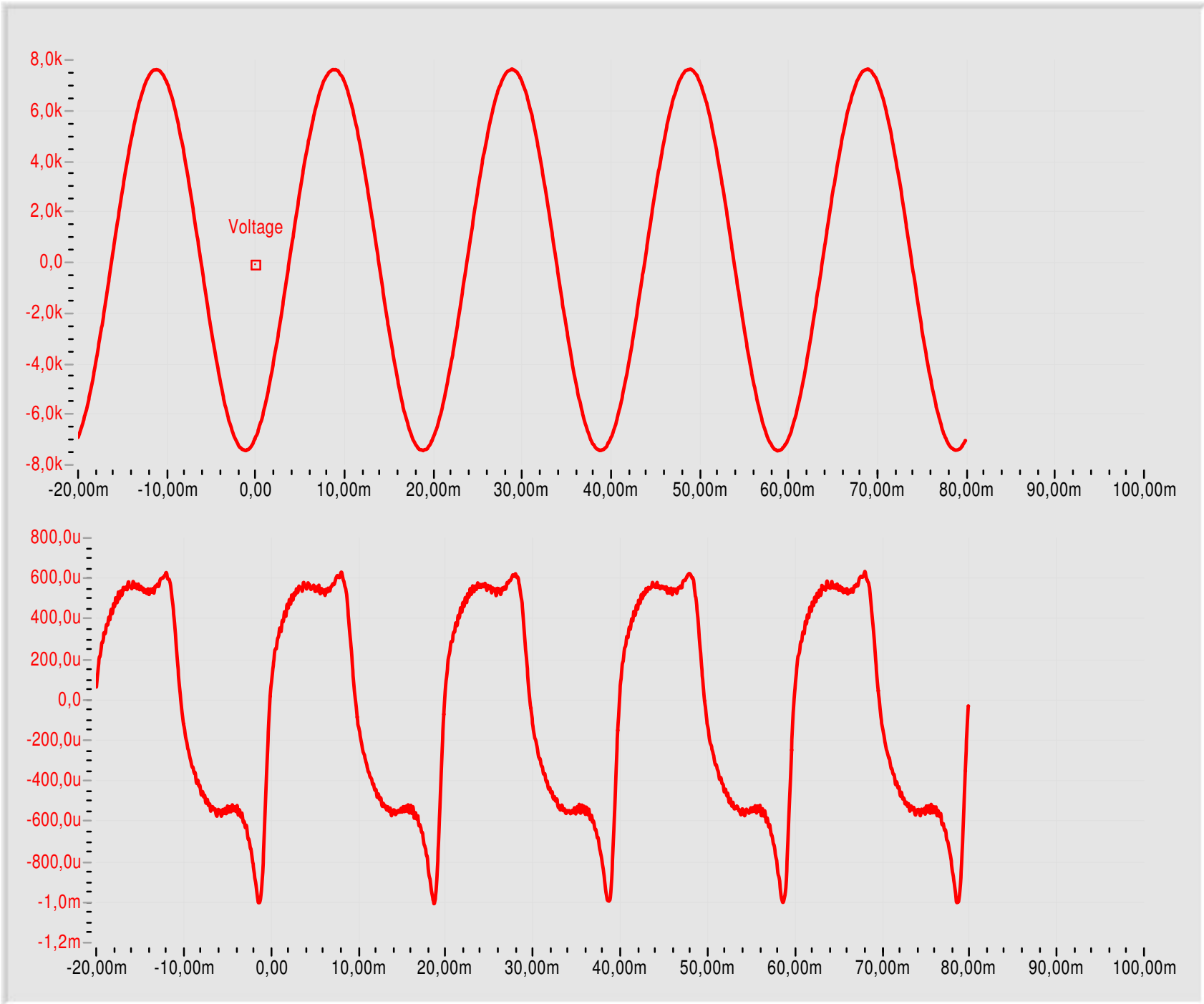

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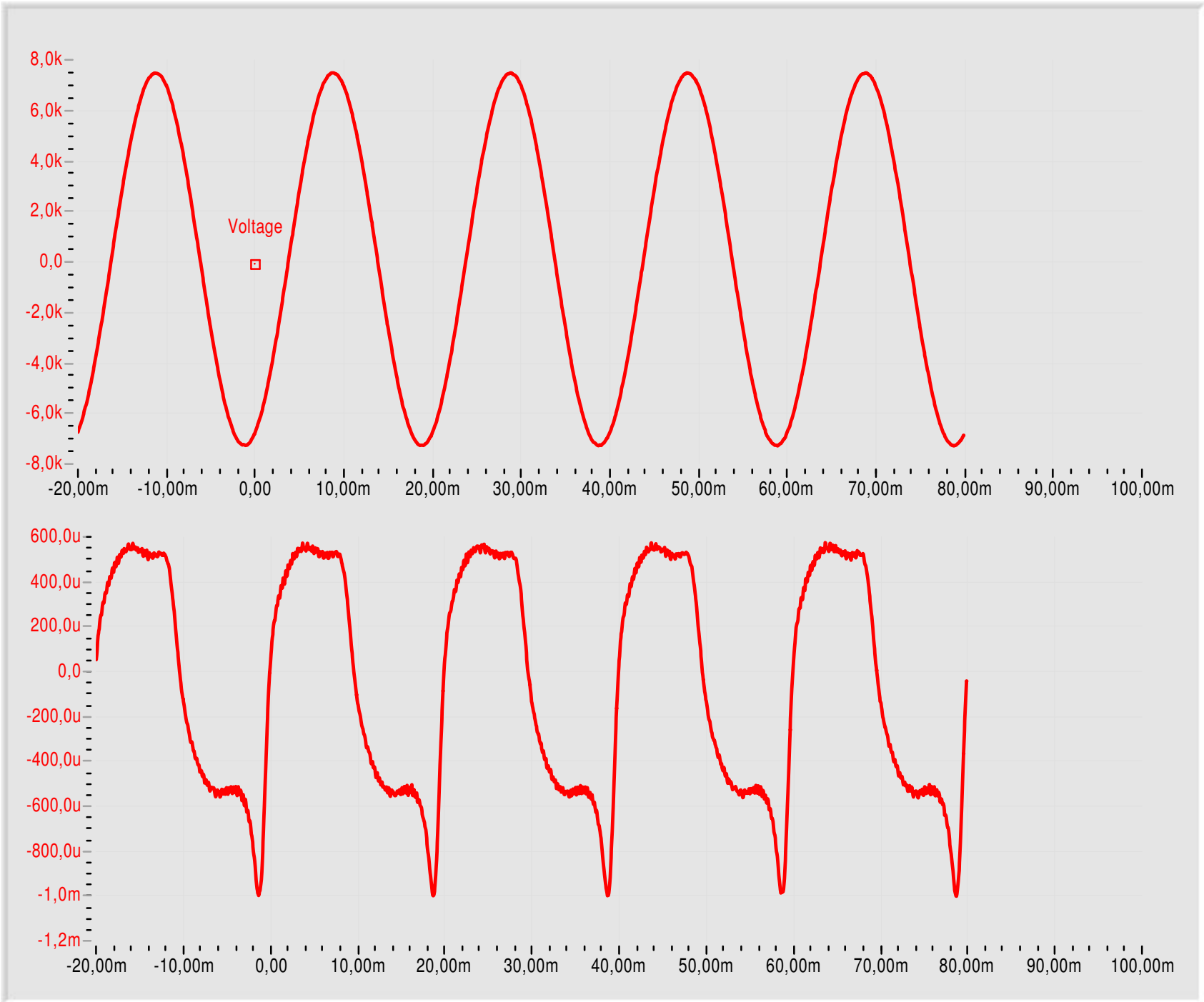

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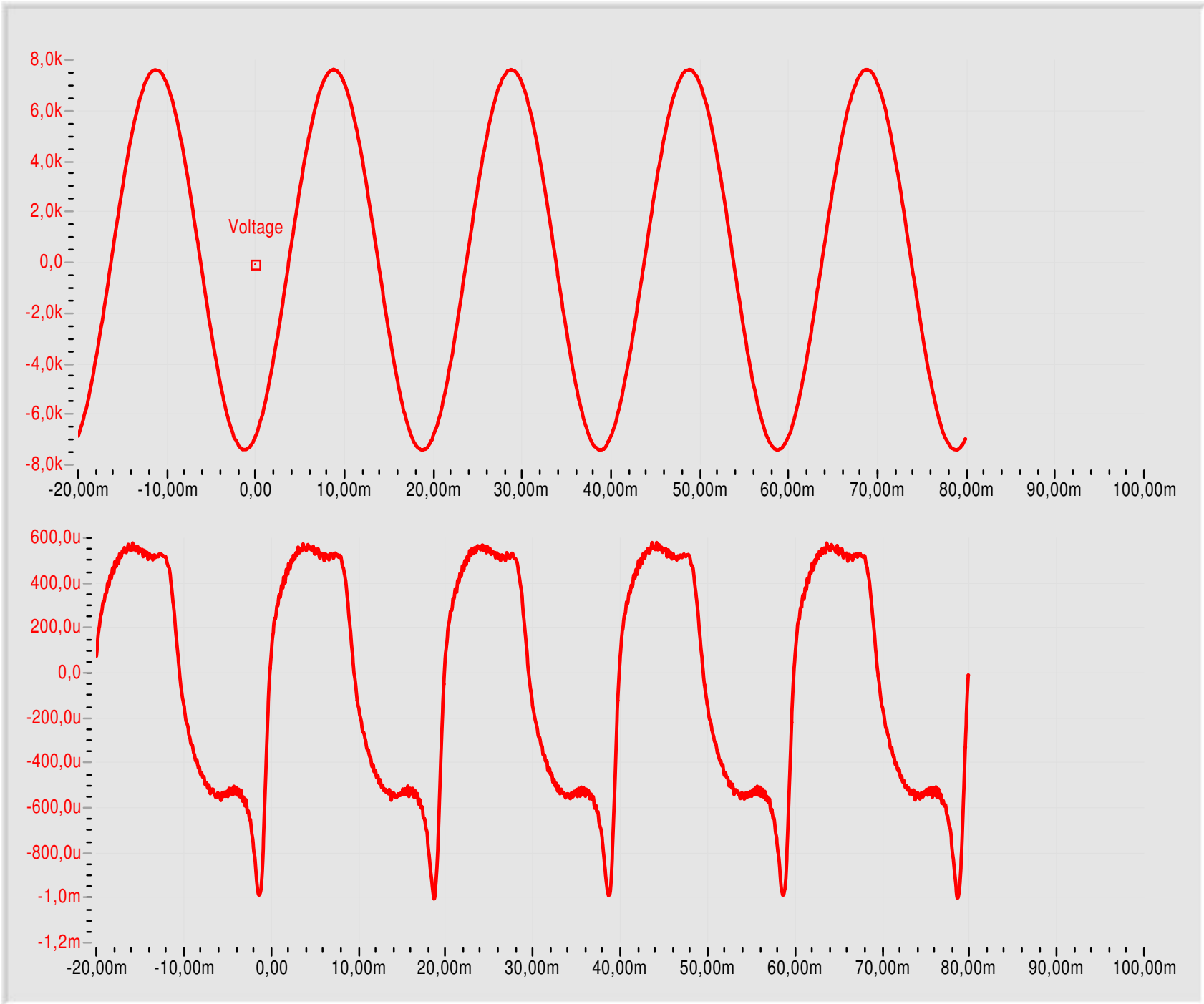

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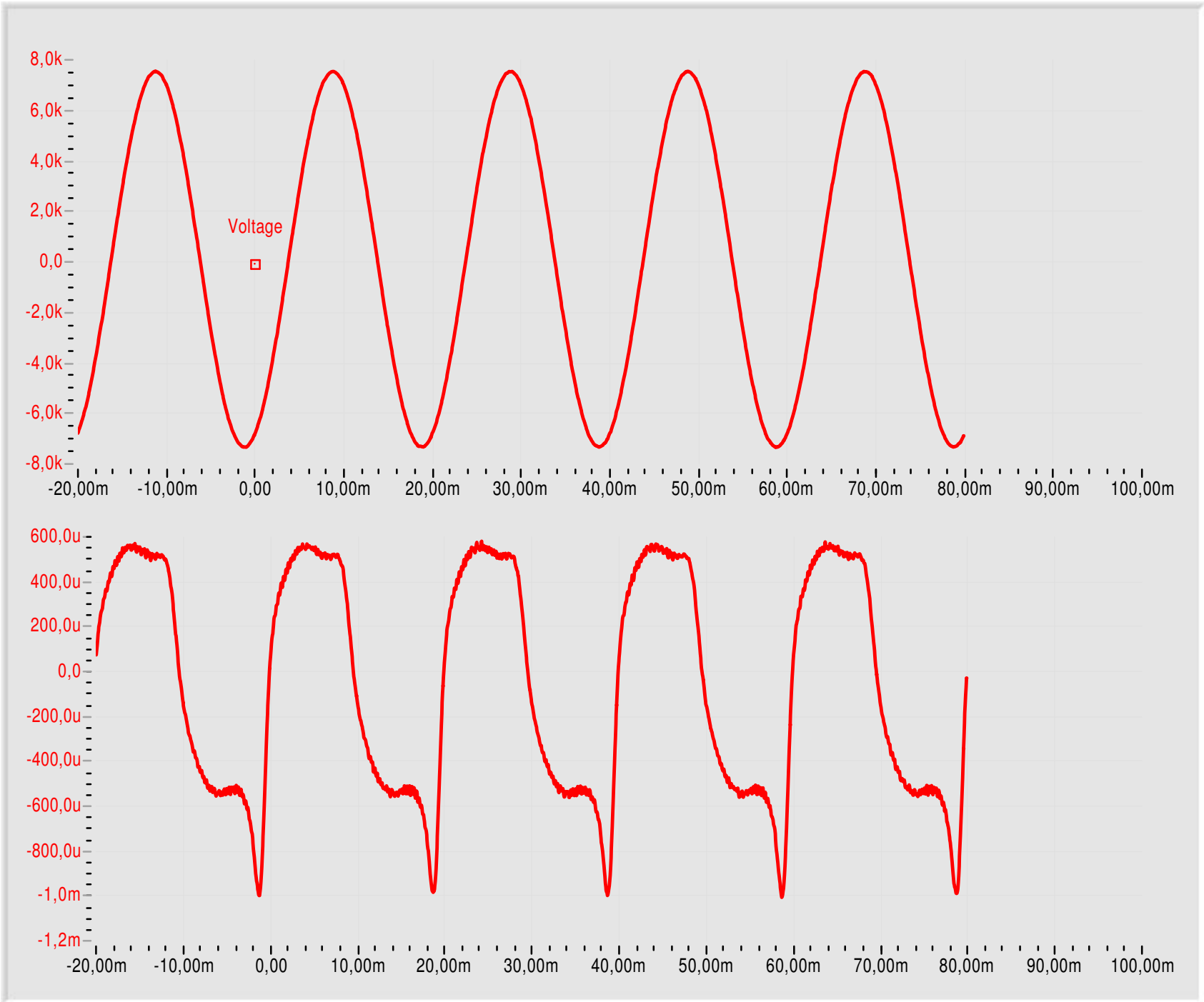

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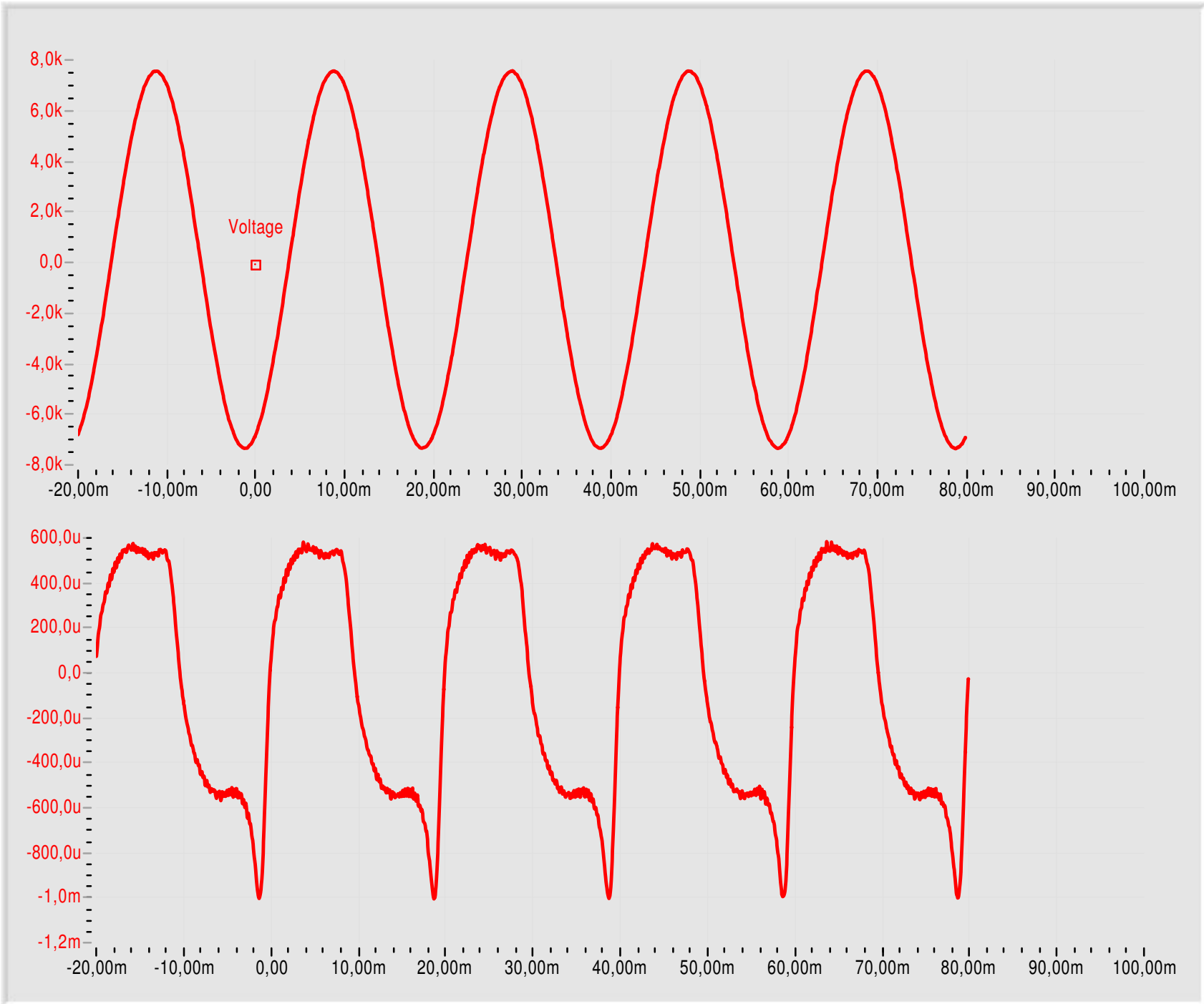

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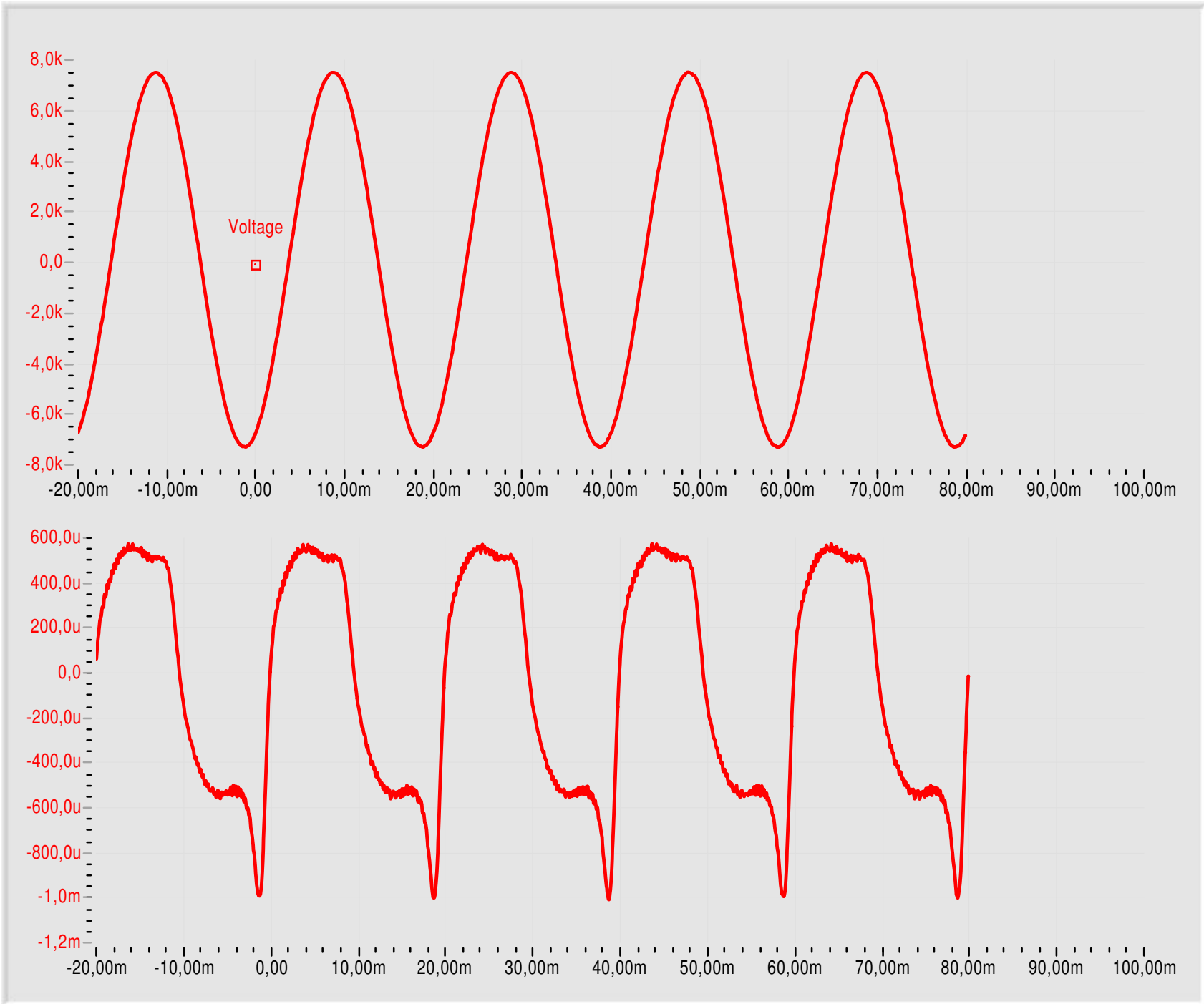

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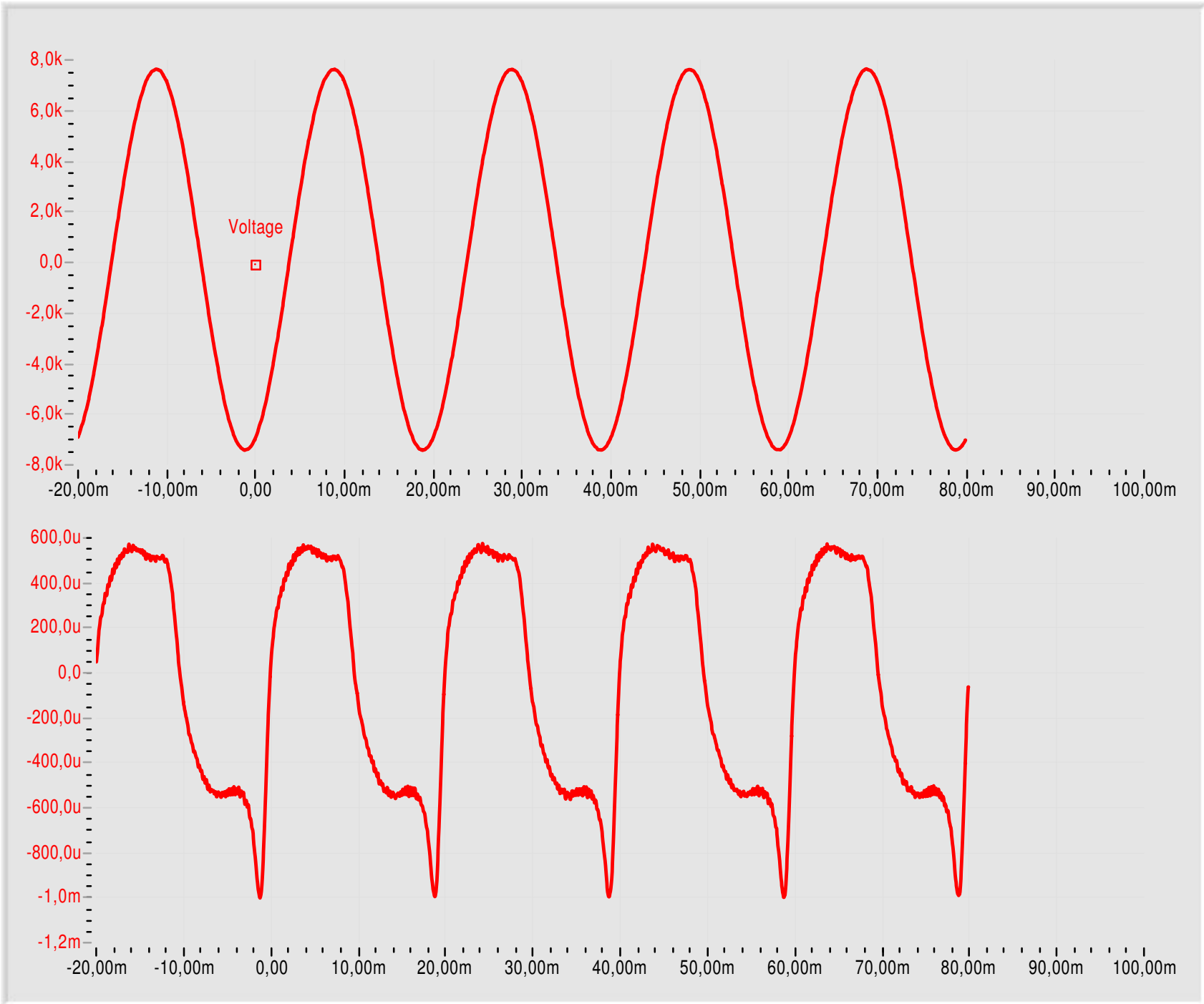
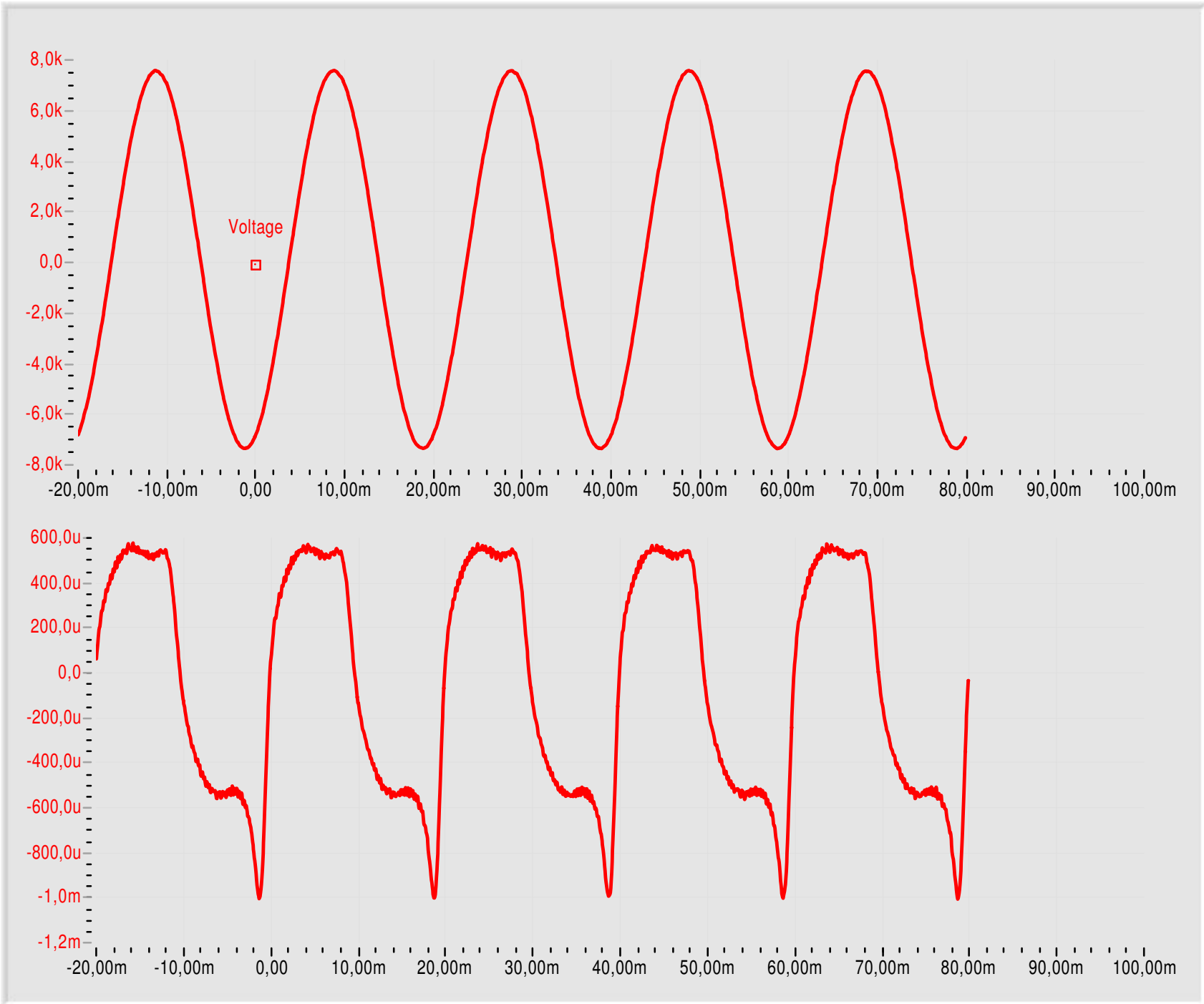


CESI B7018719 Oscillogram n. 58



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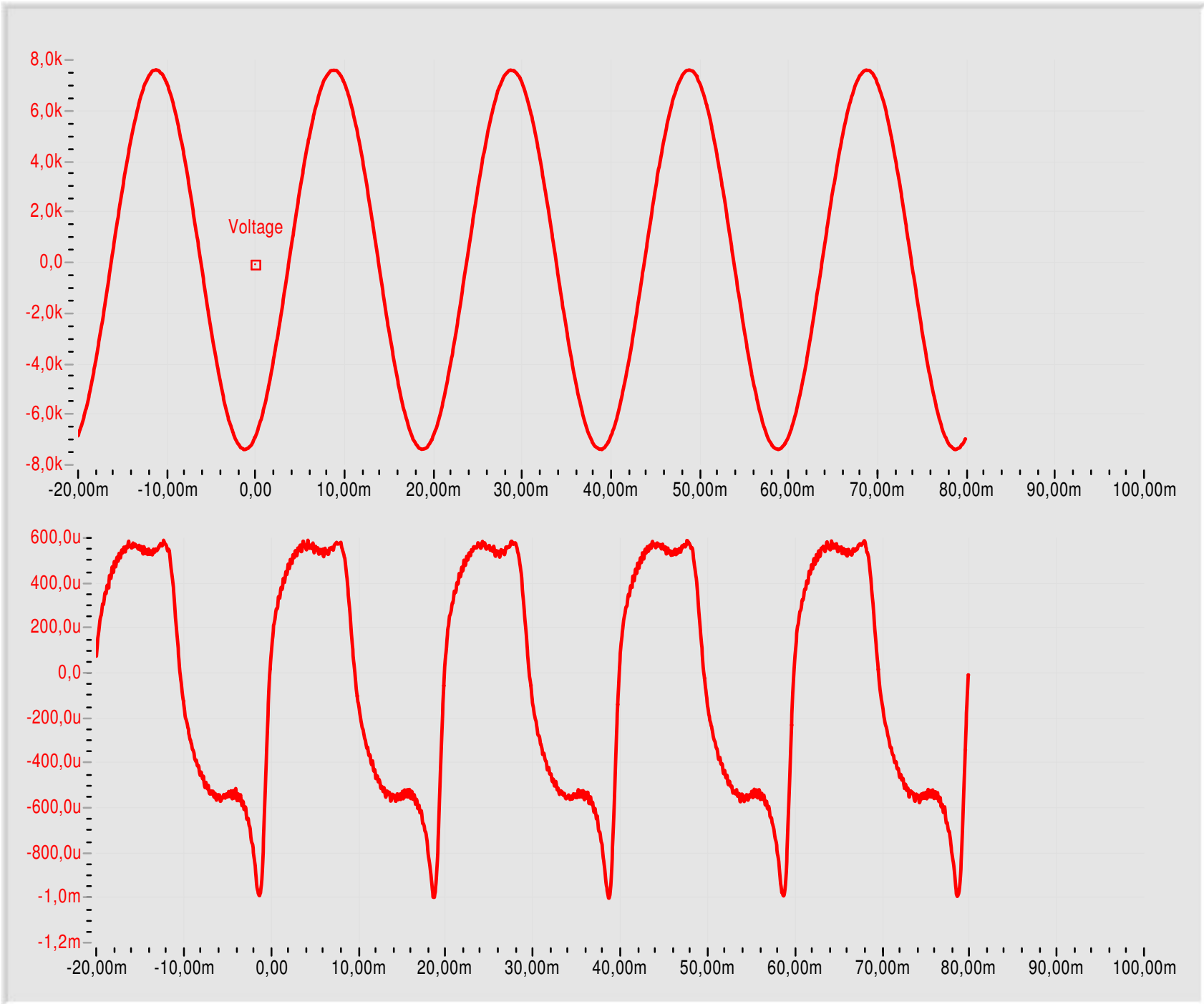

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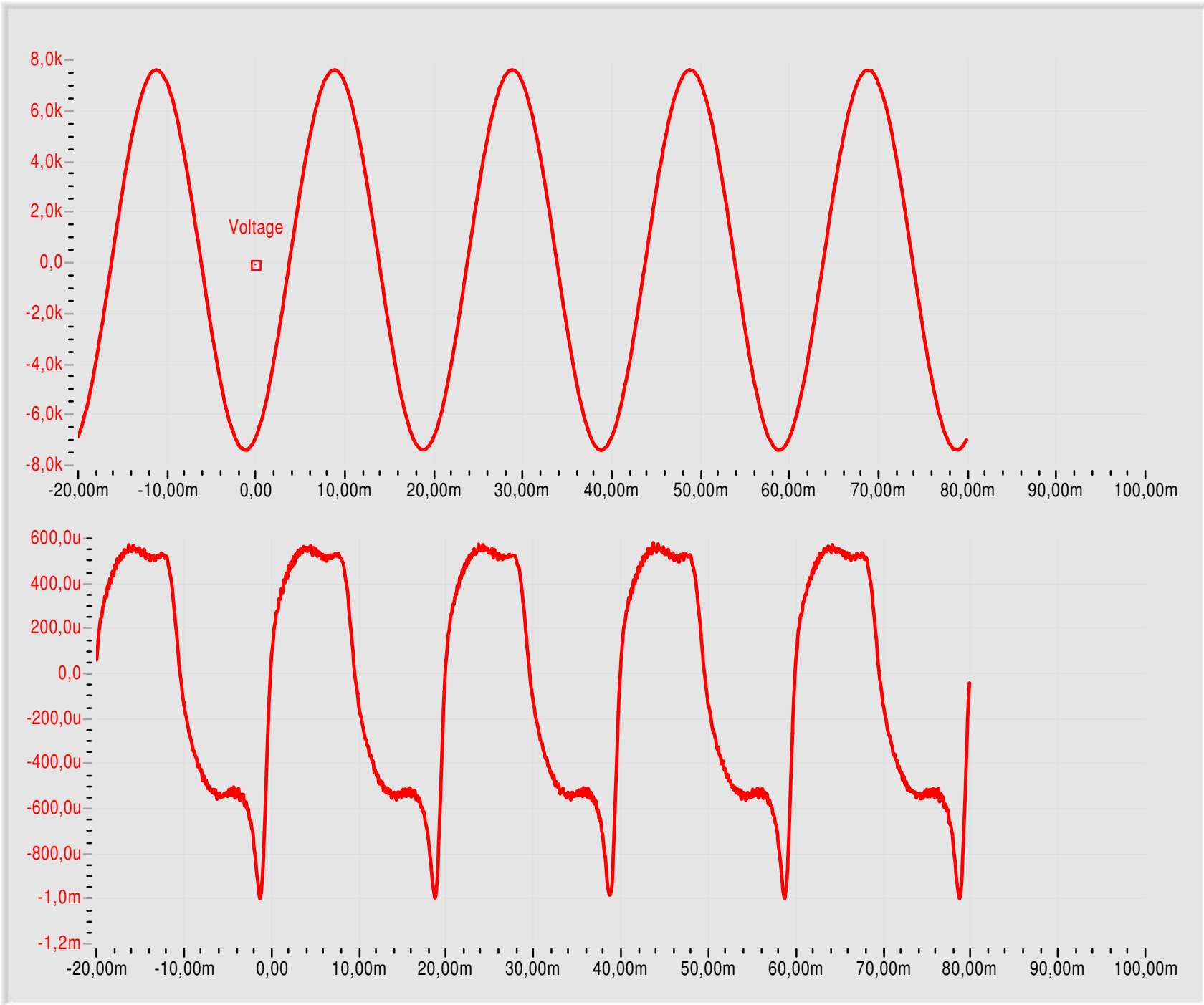
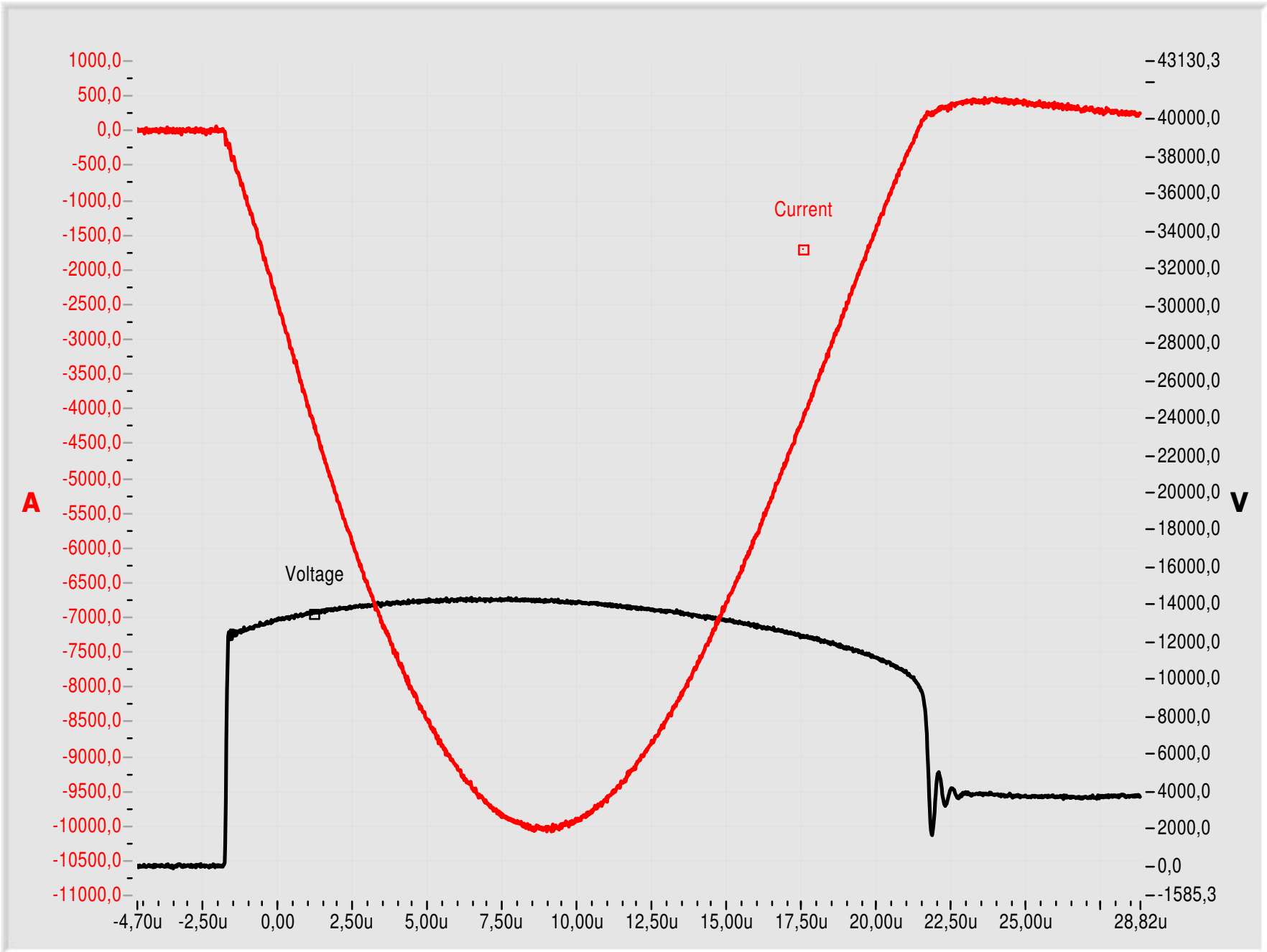


CESI B7018719 Oscillogram n. 61



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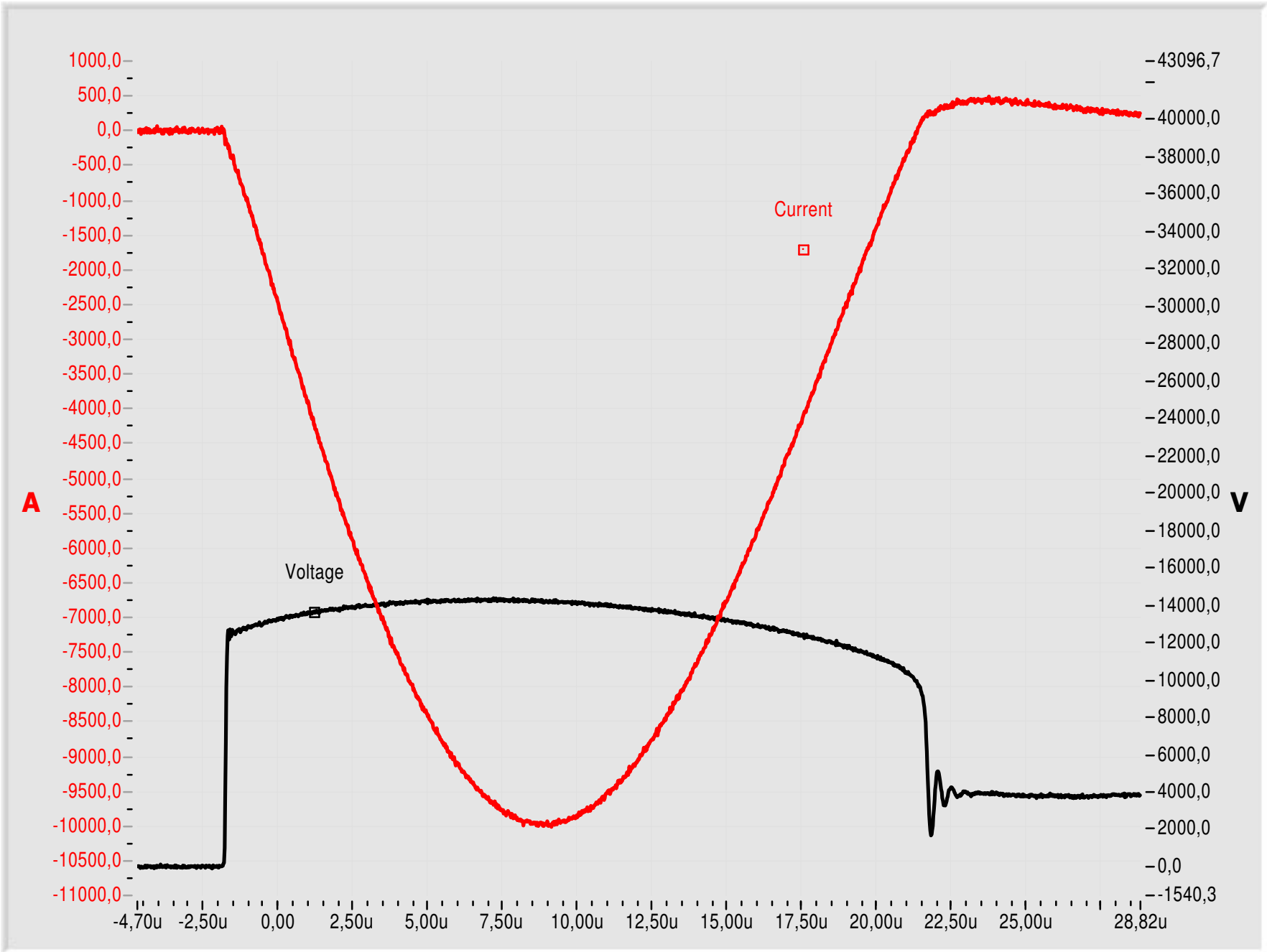
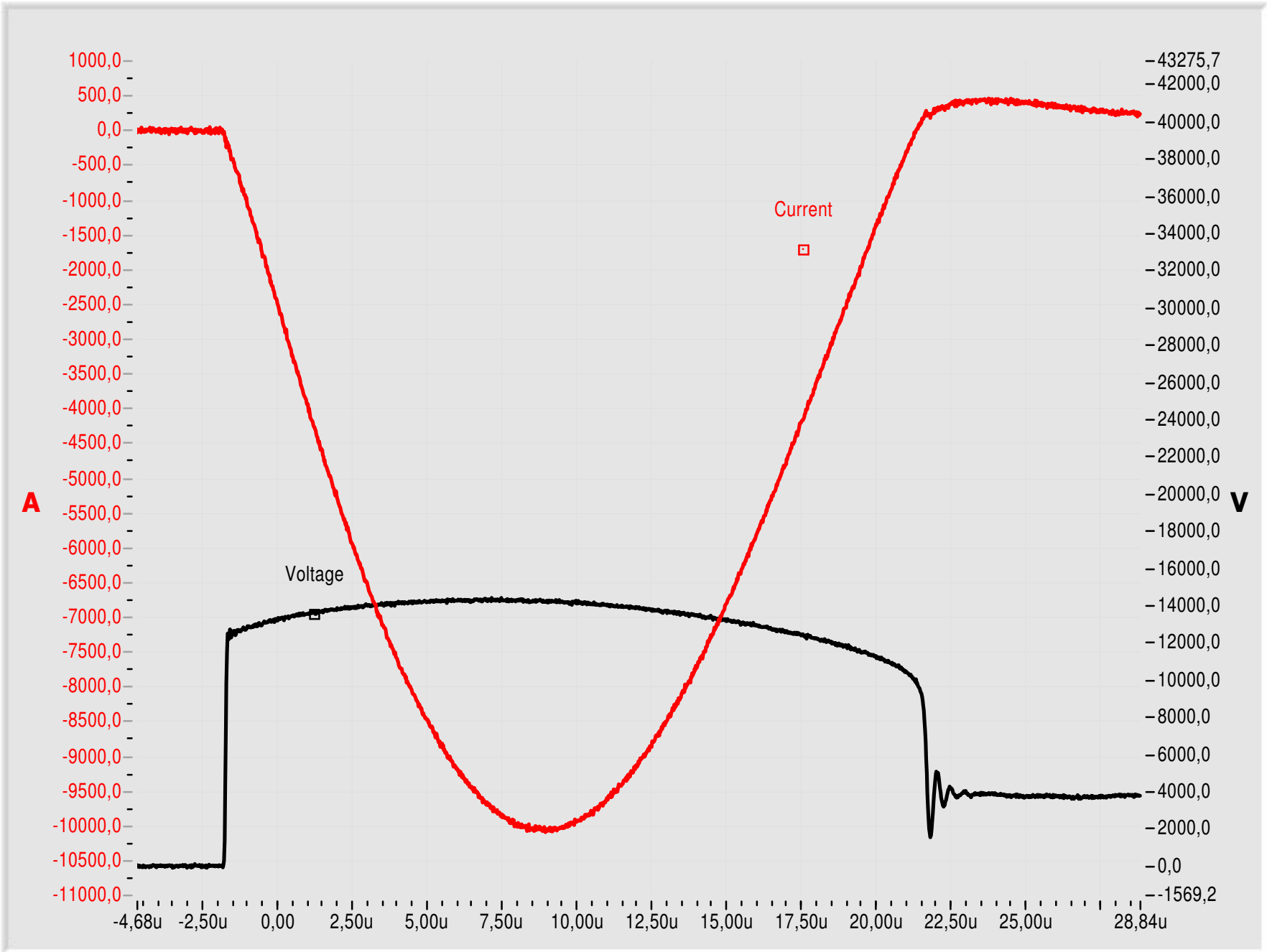
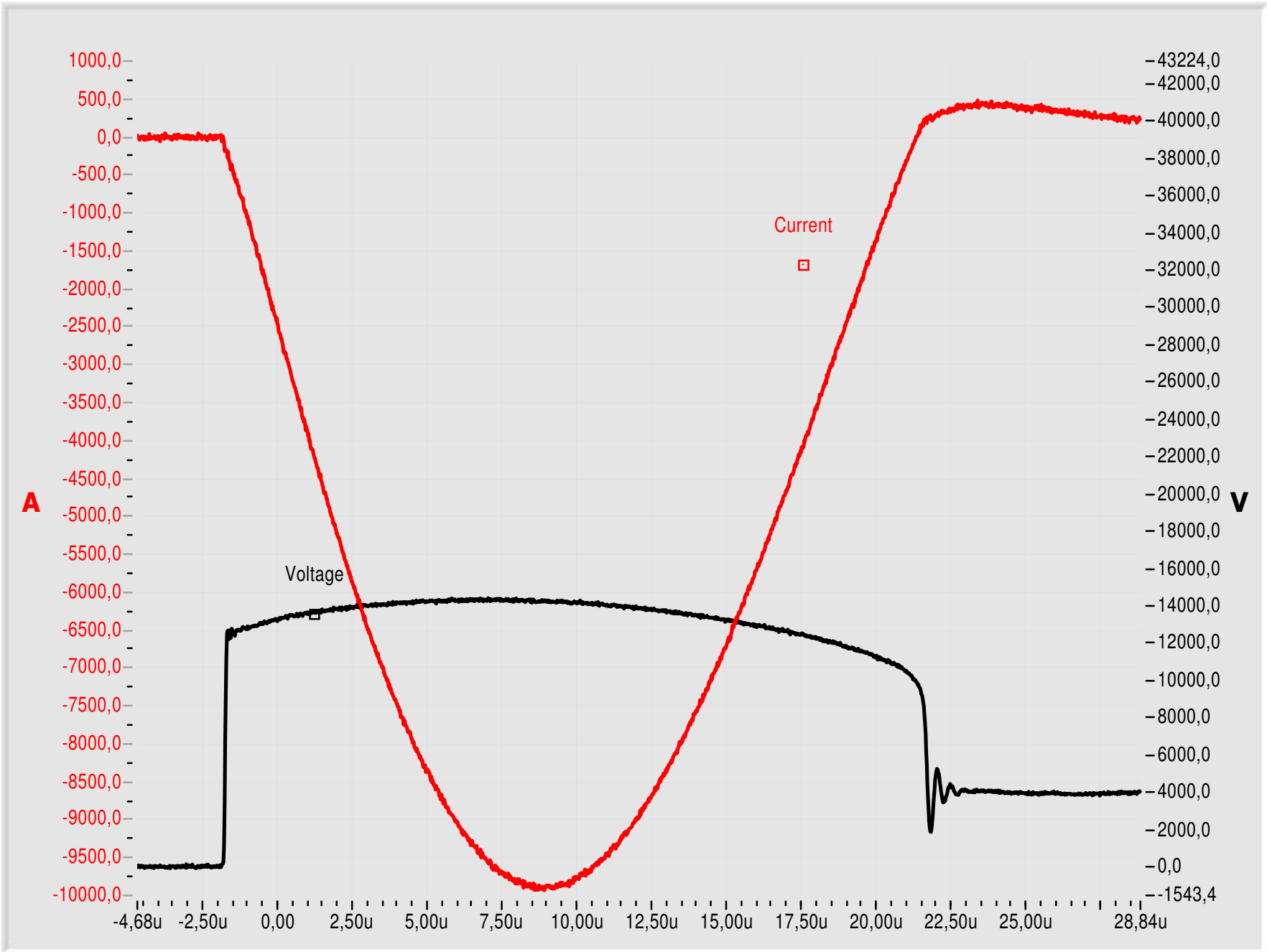


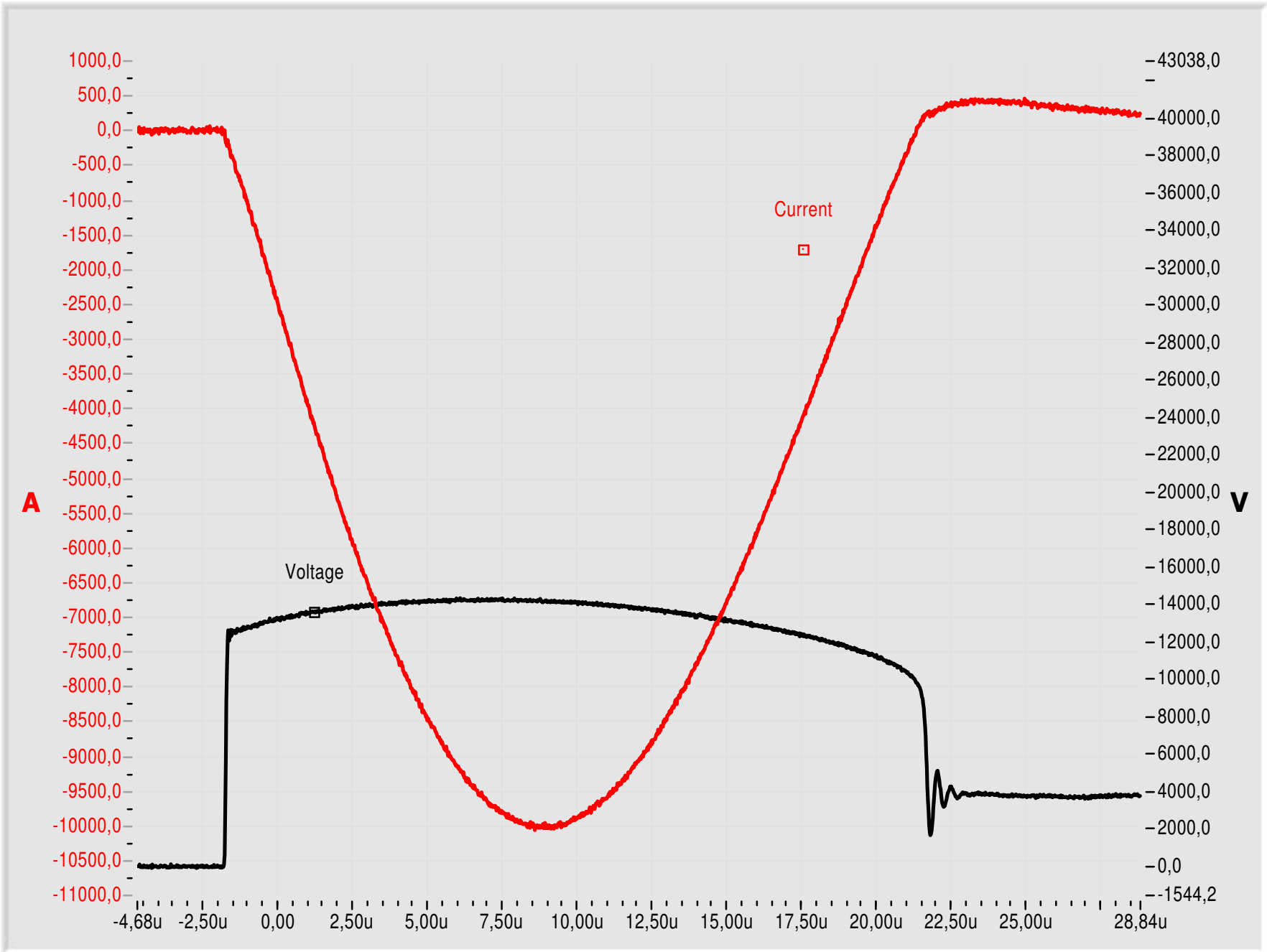
CESI B7018719 Oscillogram n. 63



CESI B7018719 Oscillogram n. 64



CESI B7018719 Oscillogram n. 65



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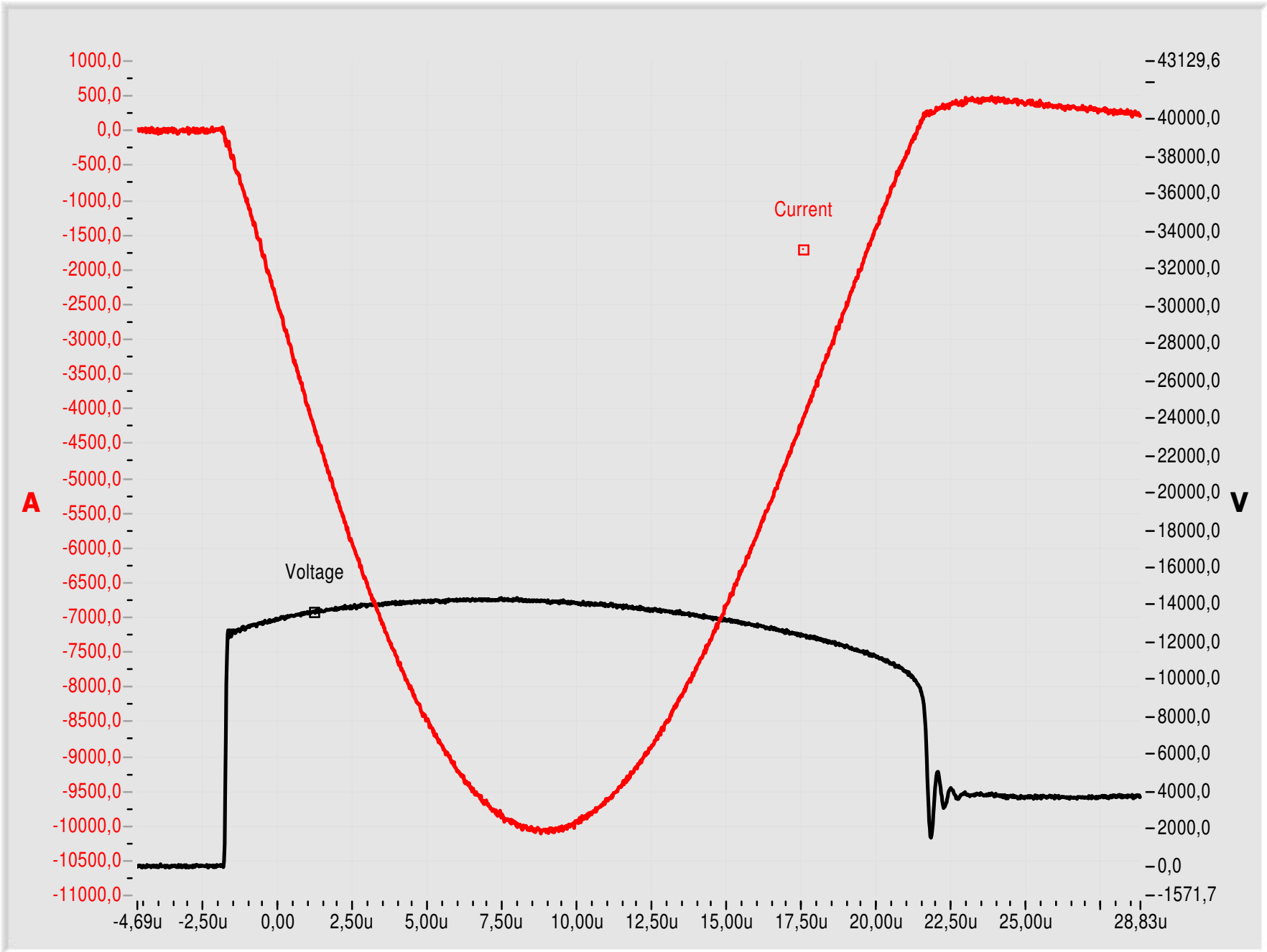

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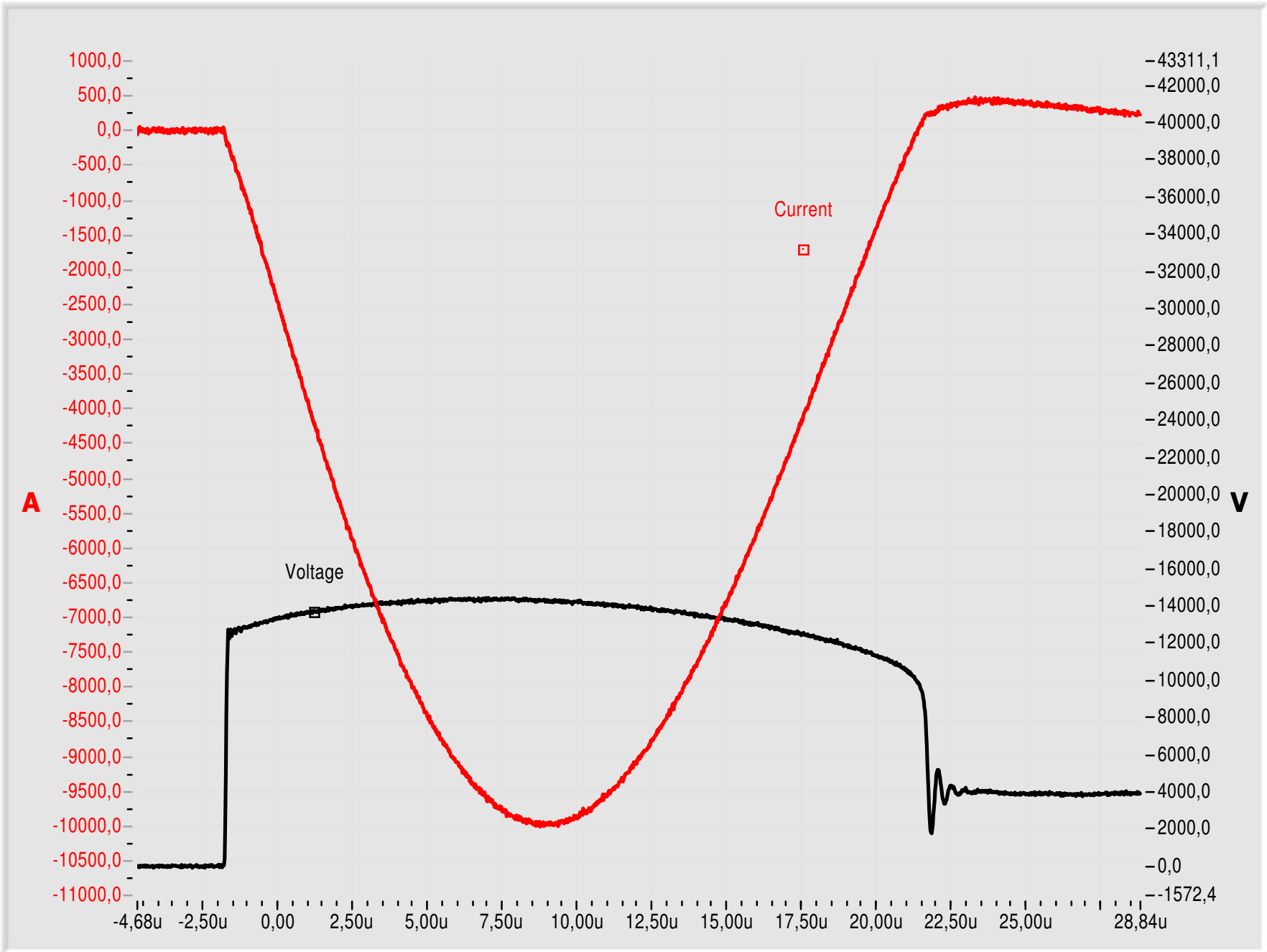

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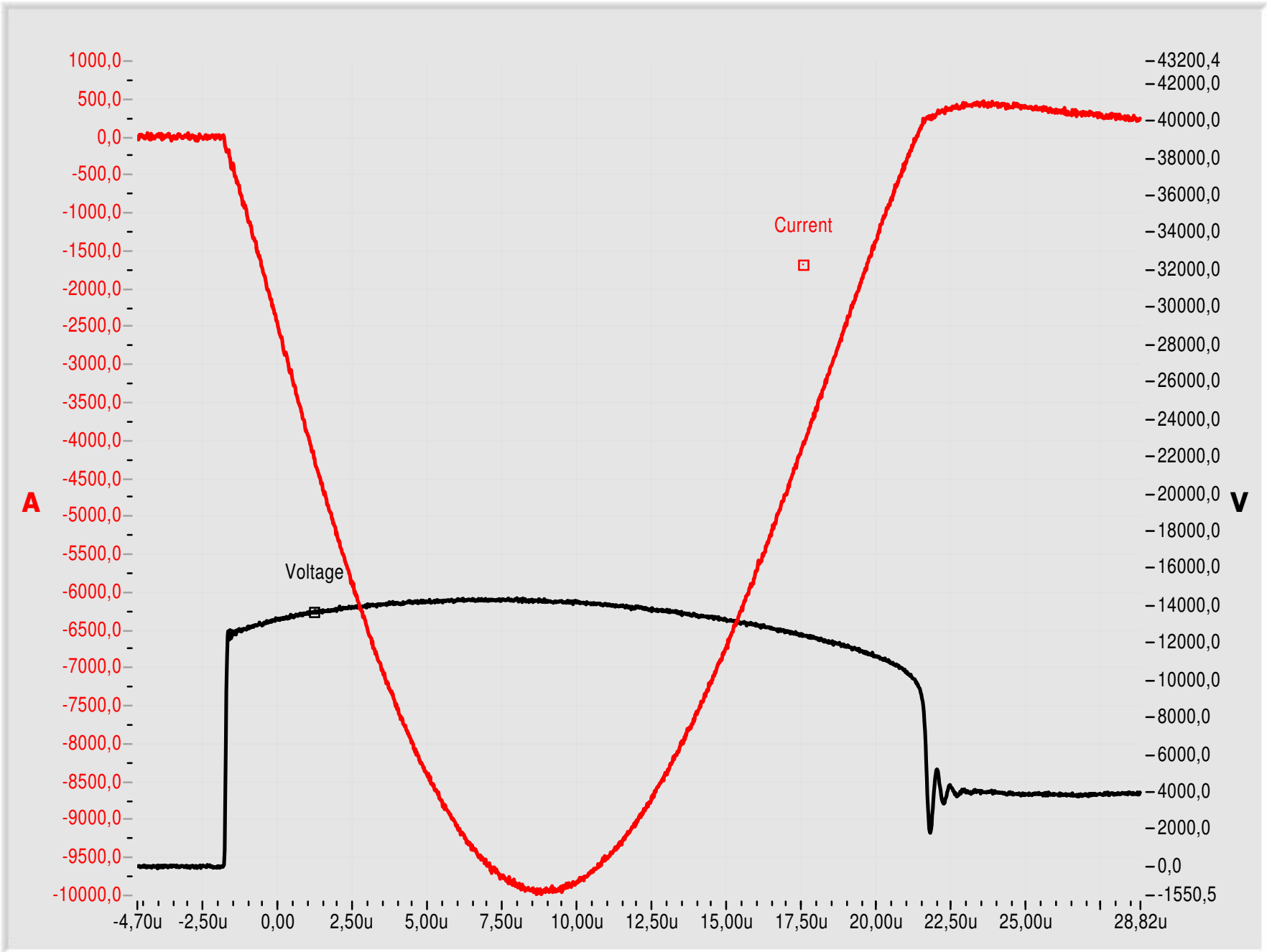
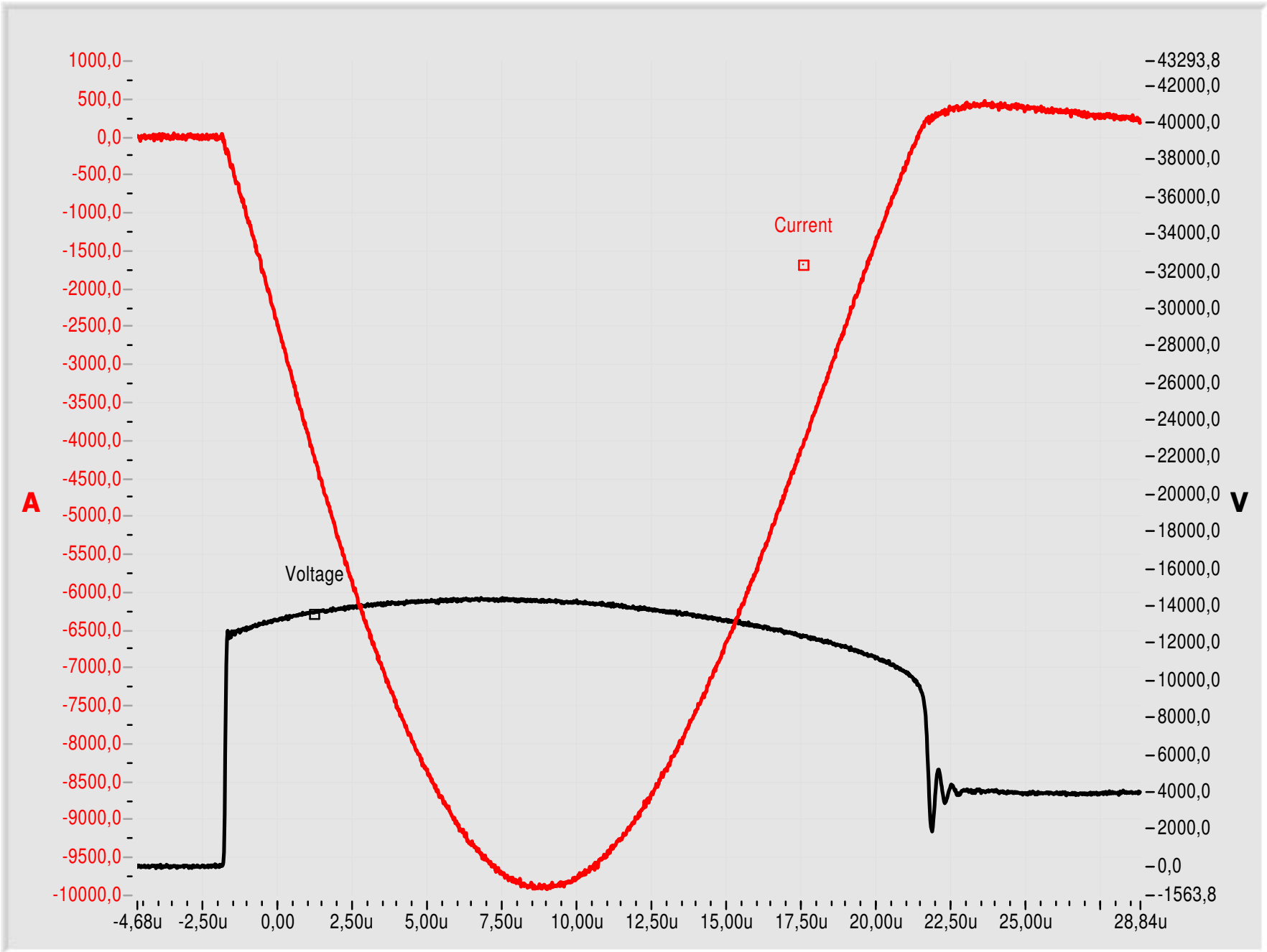
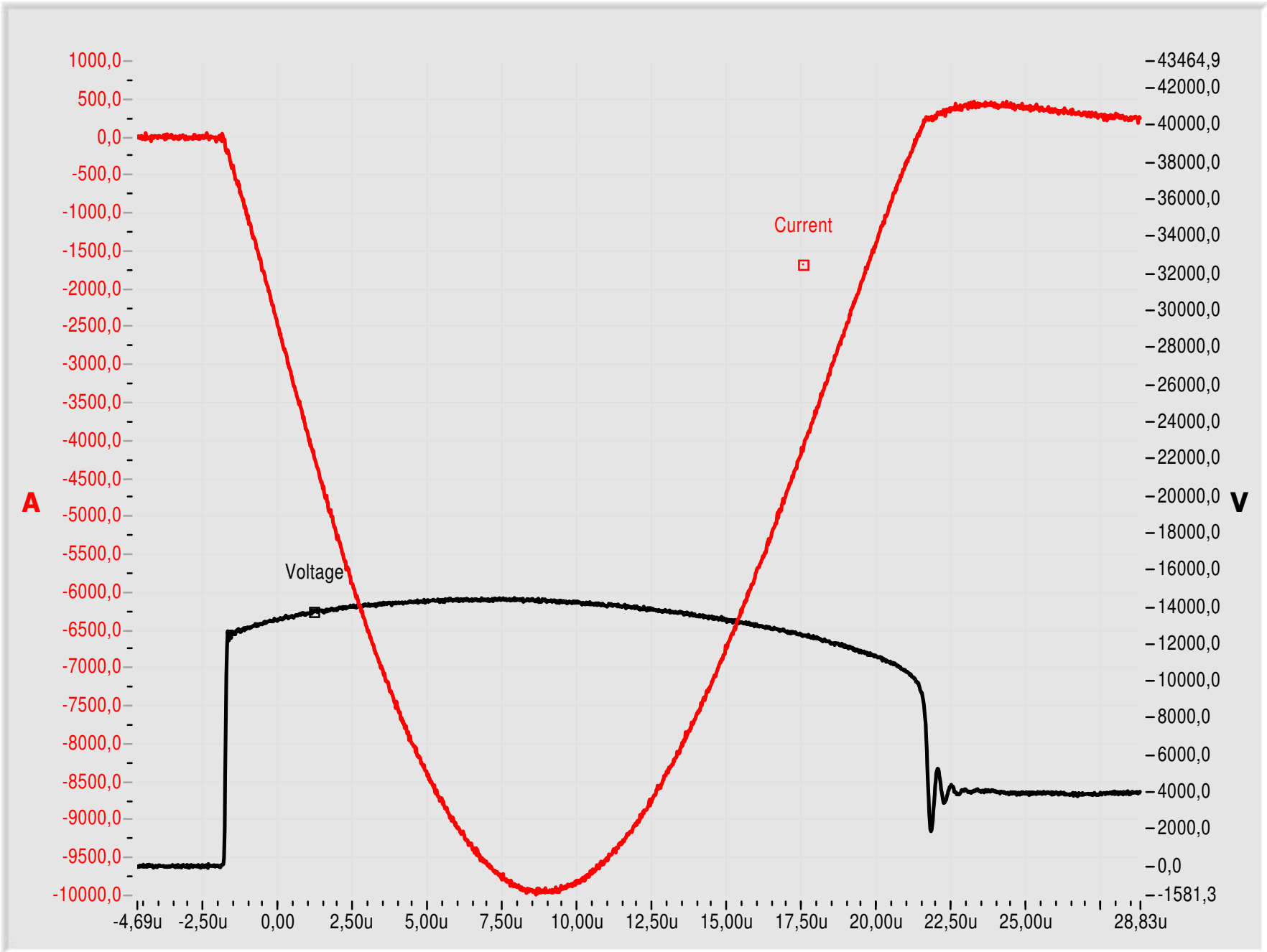


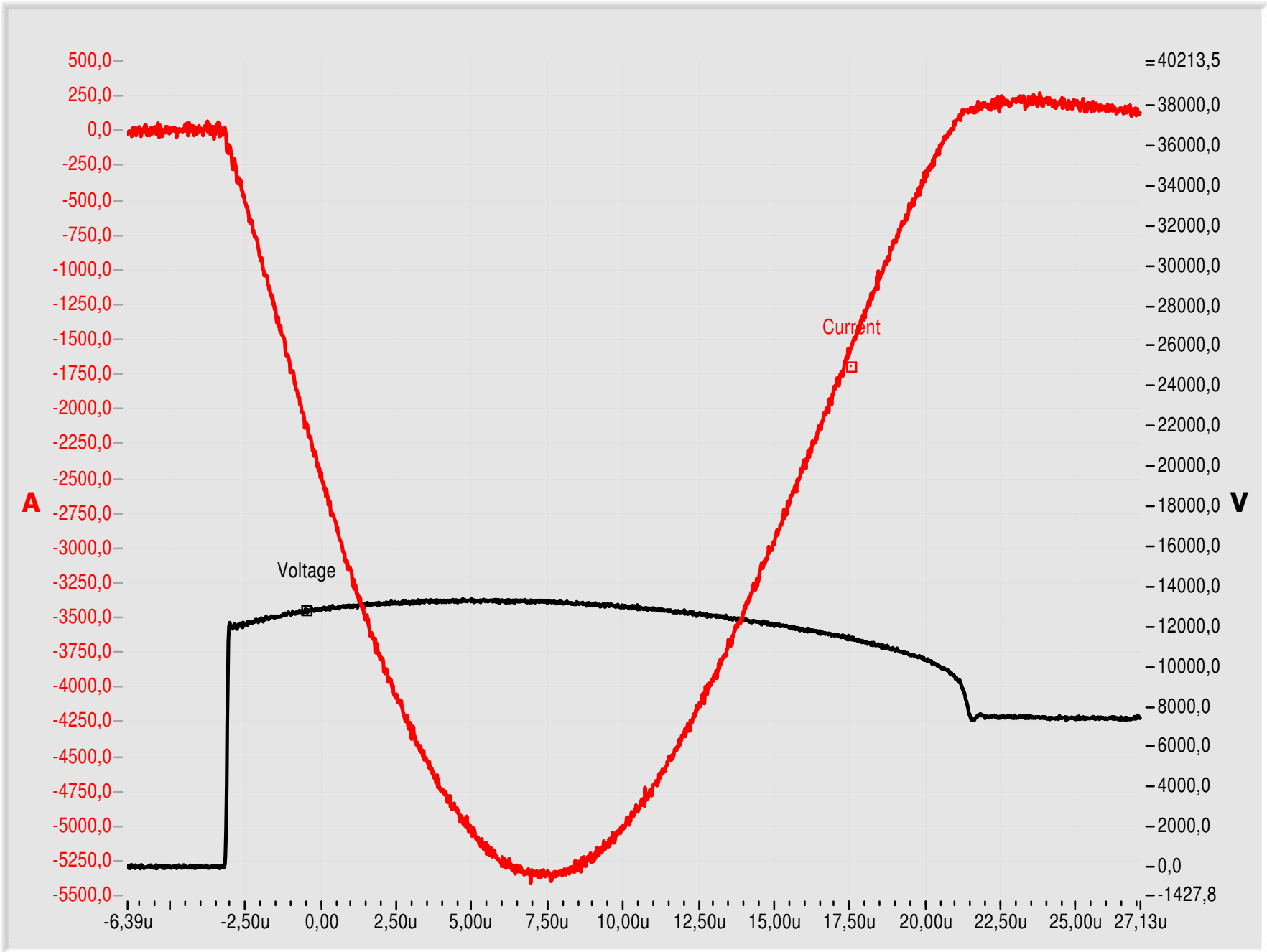
CESI B7018719 Oscillogram n. 69



CESI B7018719 Oscillogram n. 70



CESI B7018719 Oscillogram n. 71



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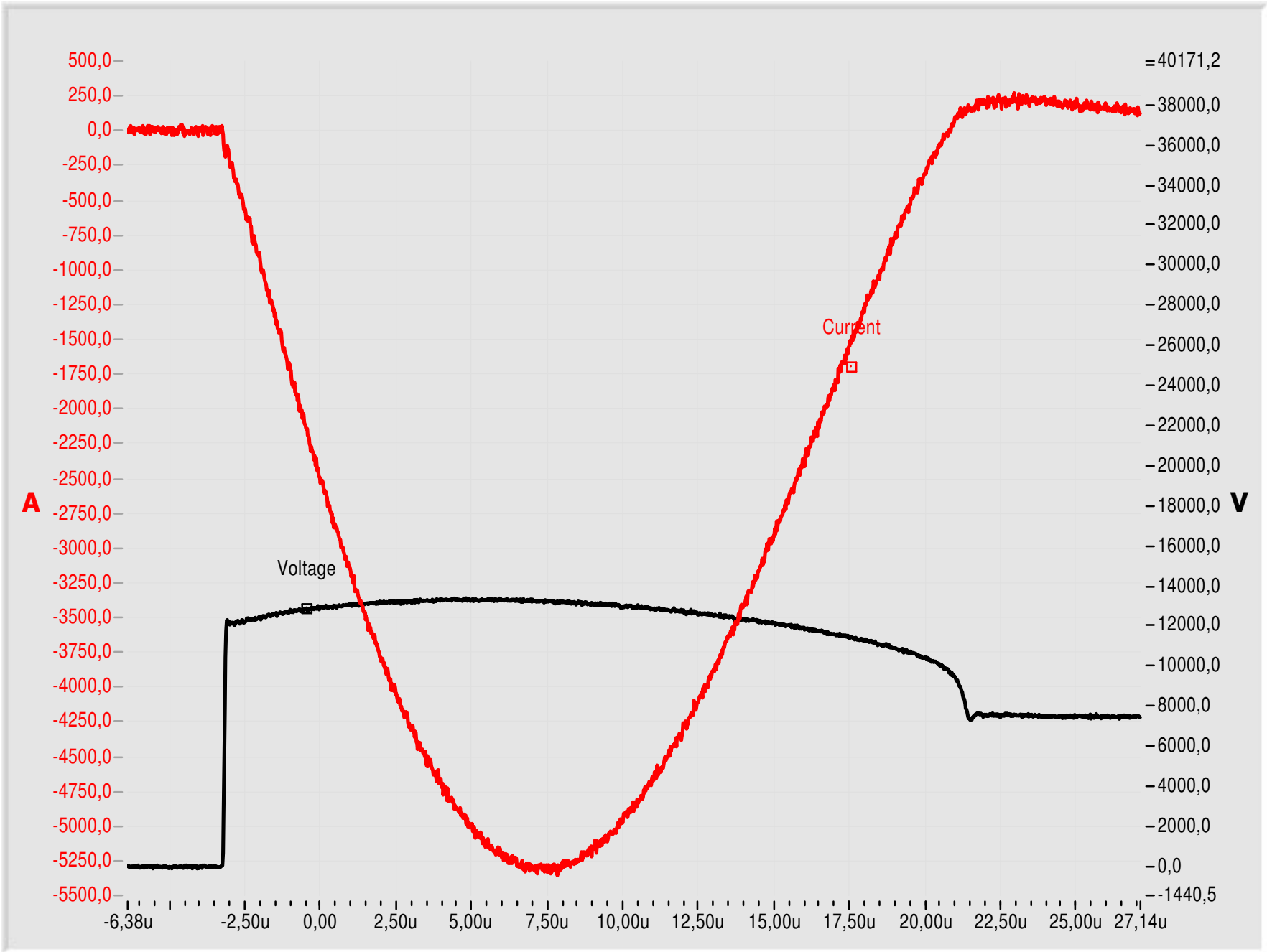

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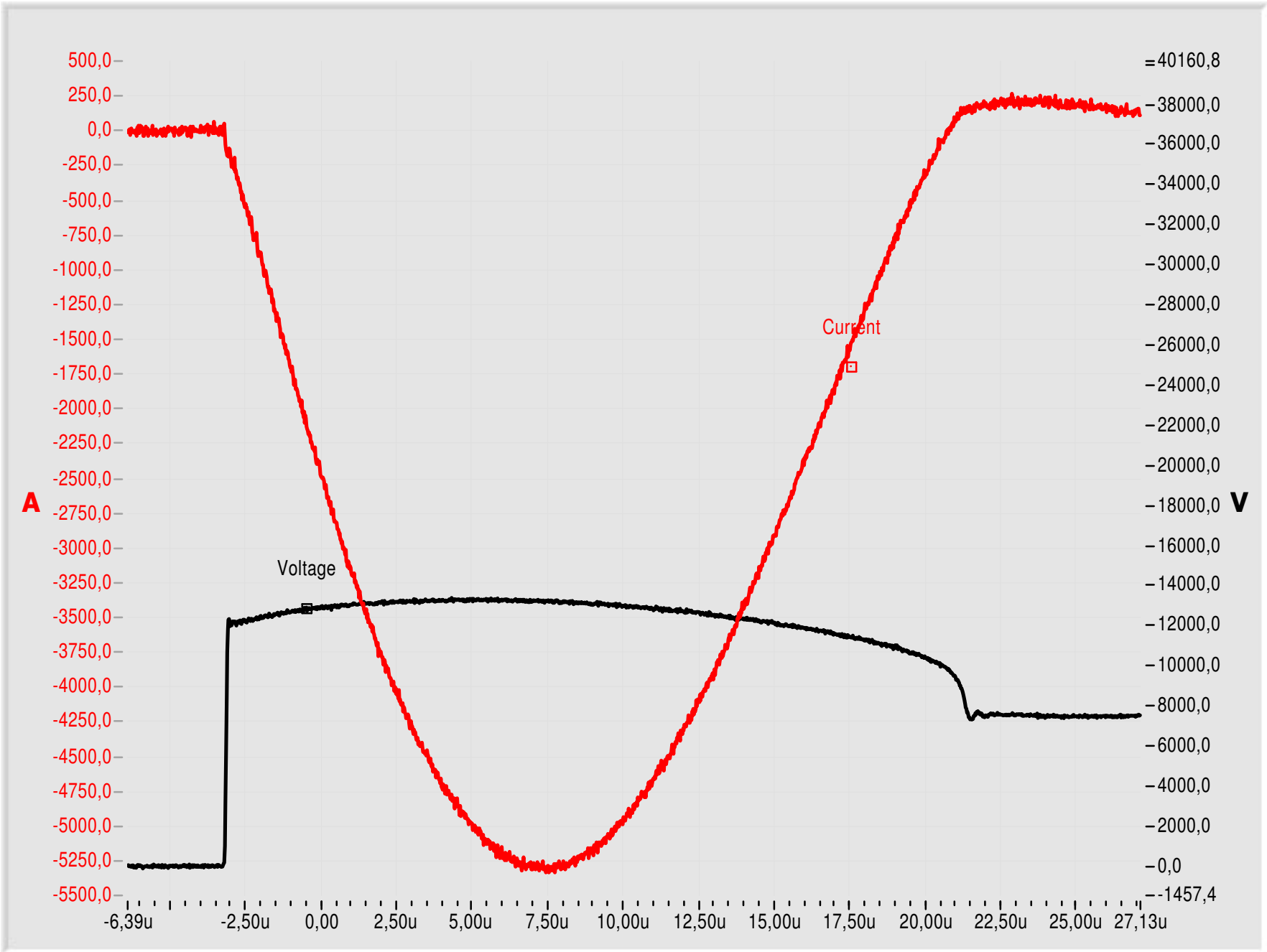
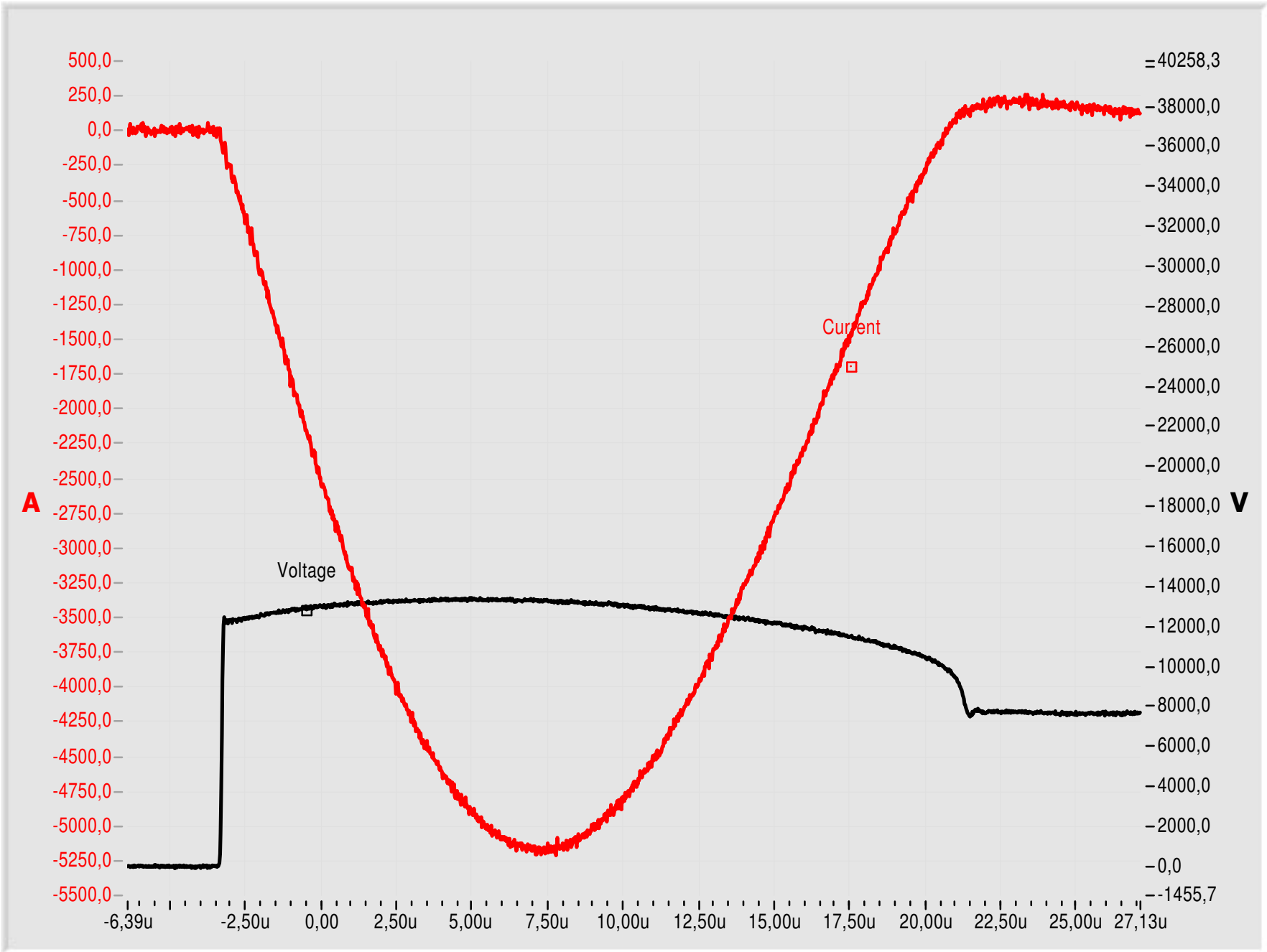


CESI B7018719 Oscillogram n. 74



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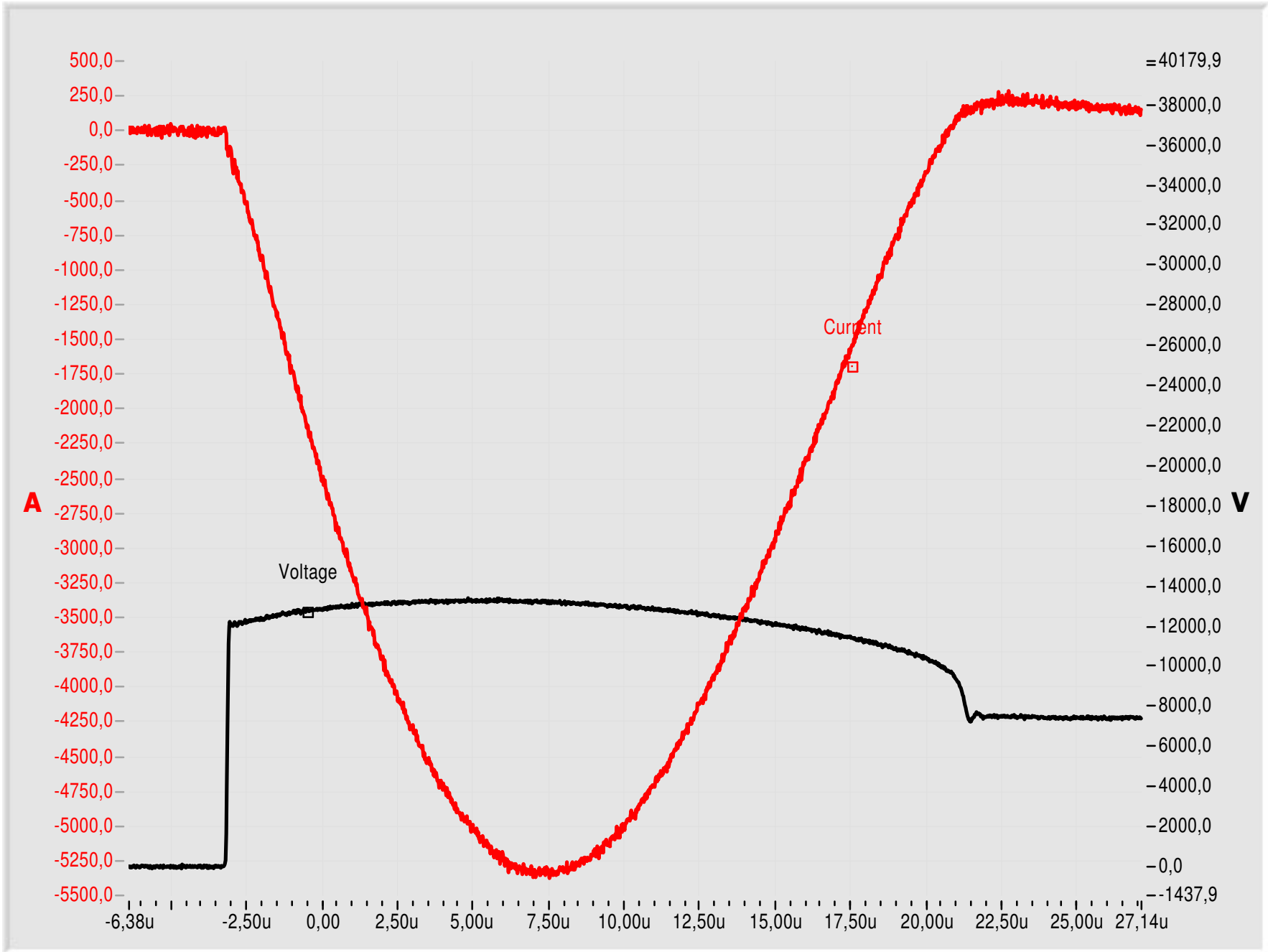

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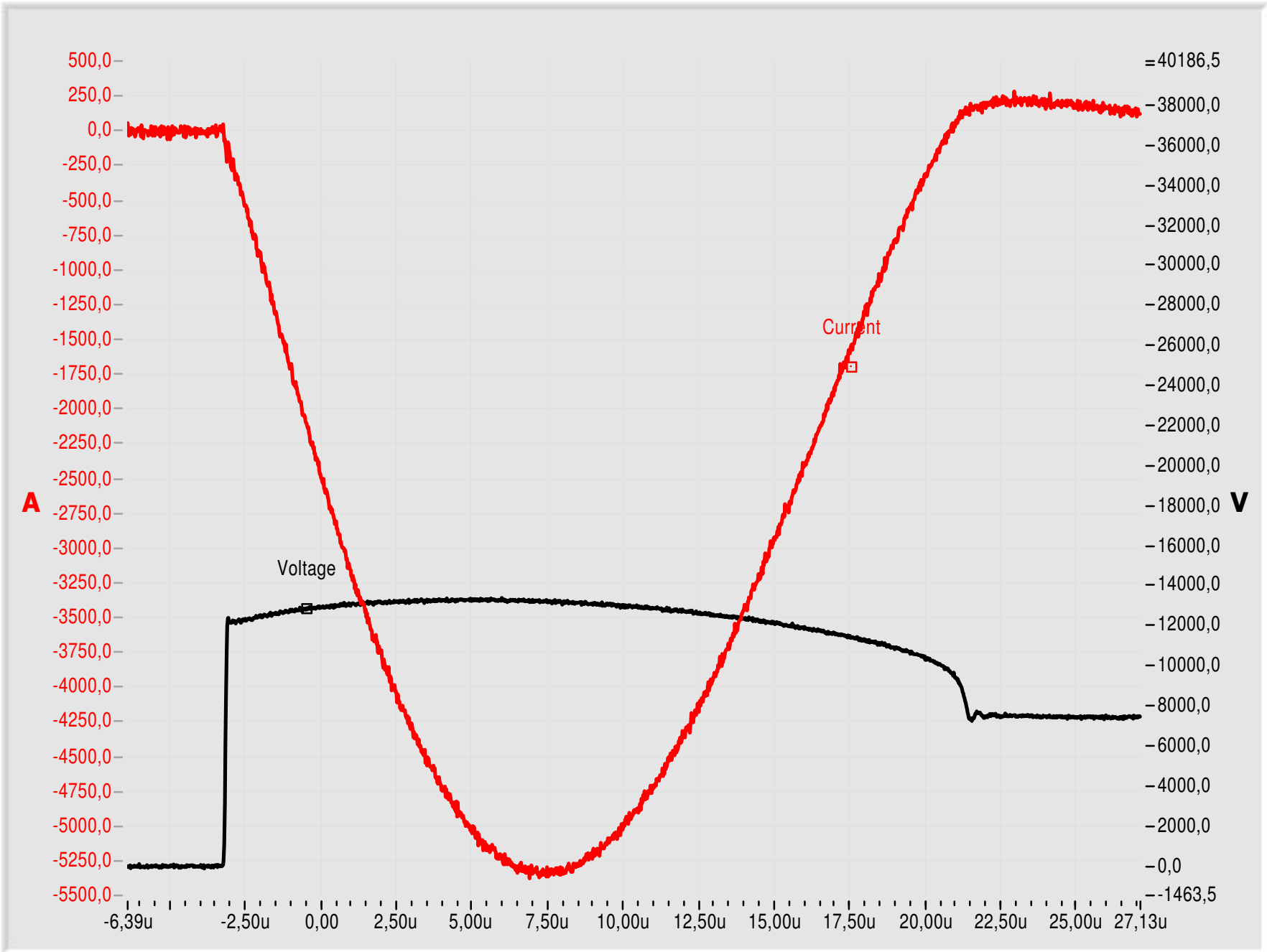

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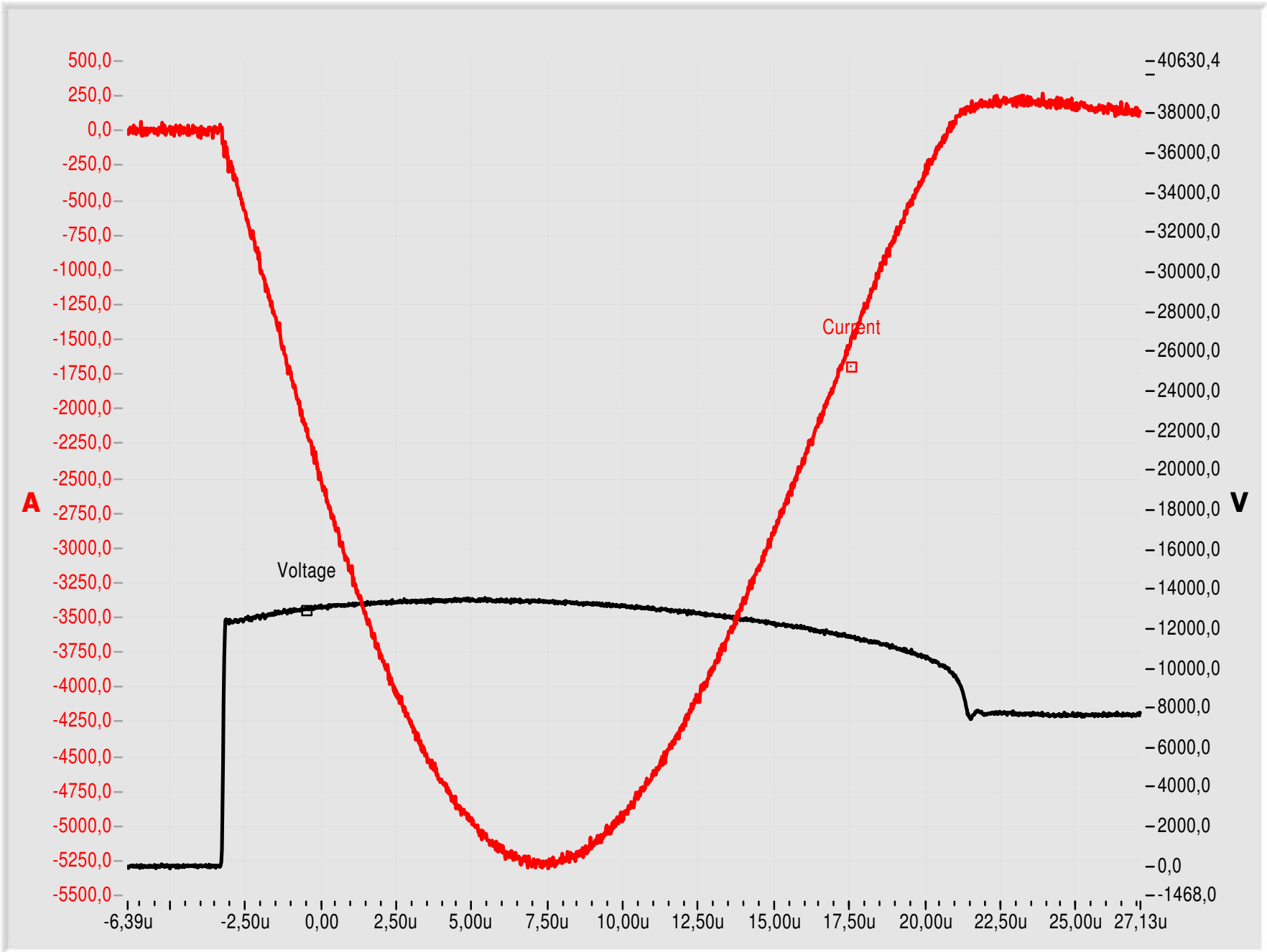

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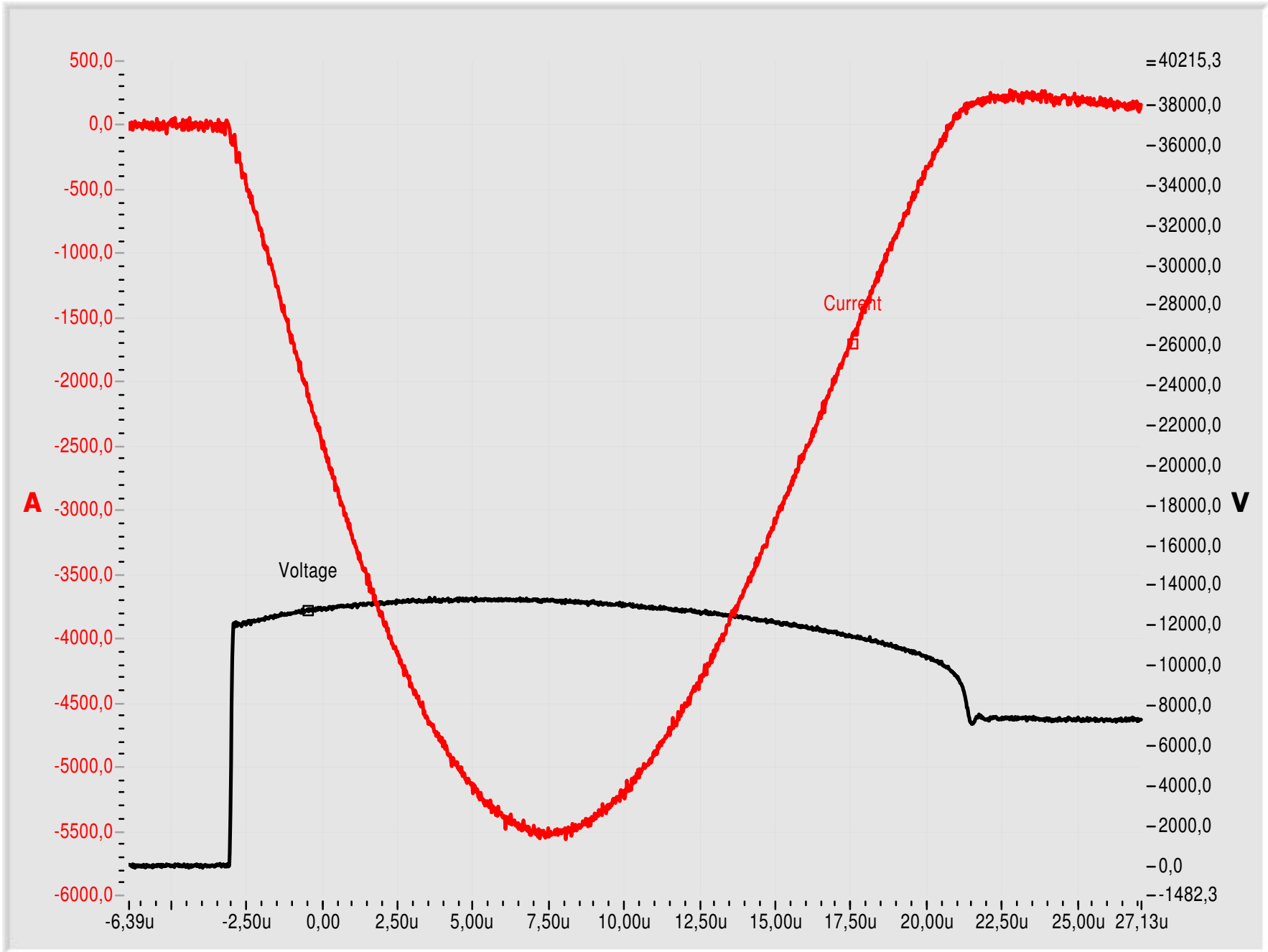

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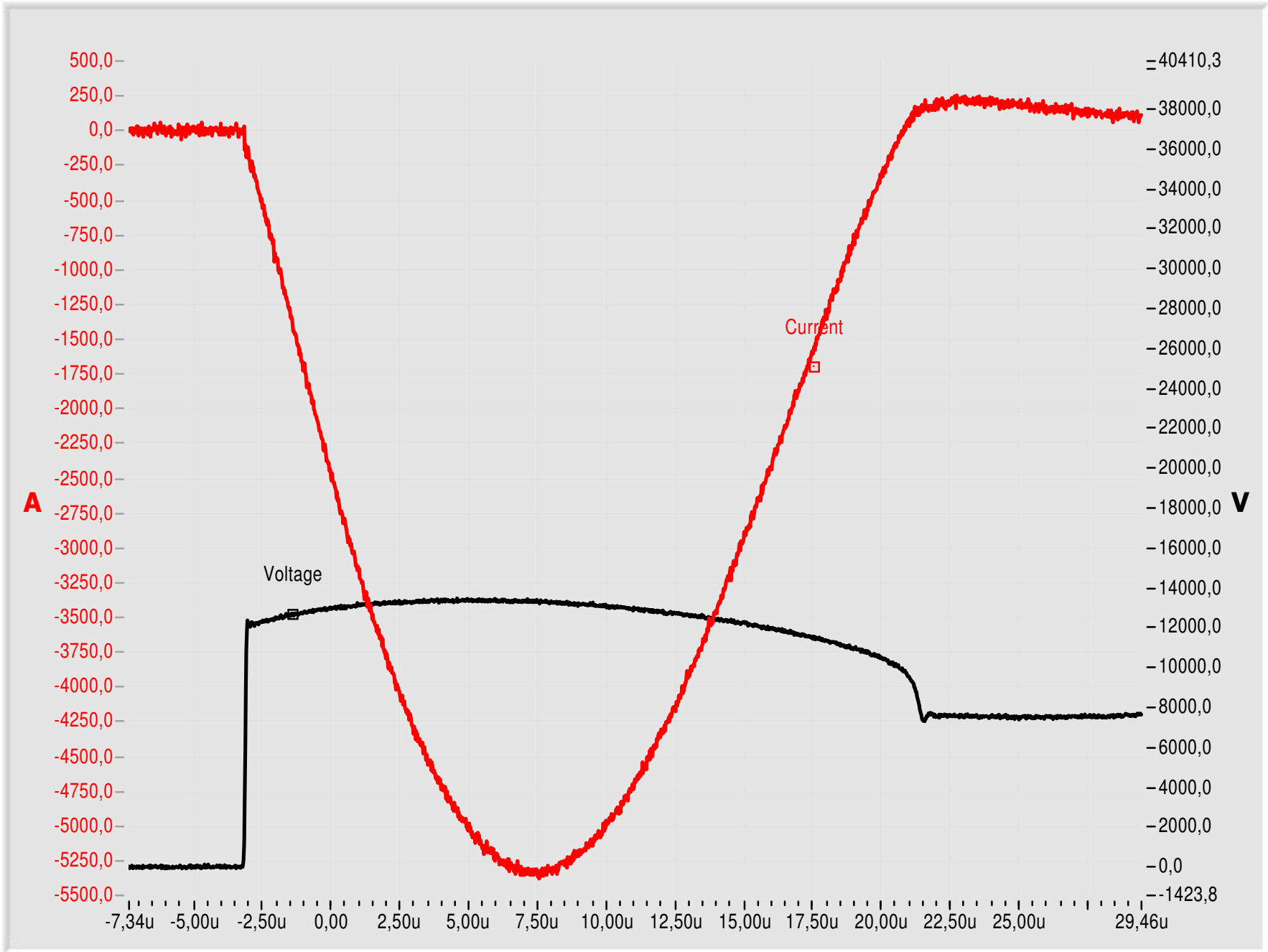

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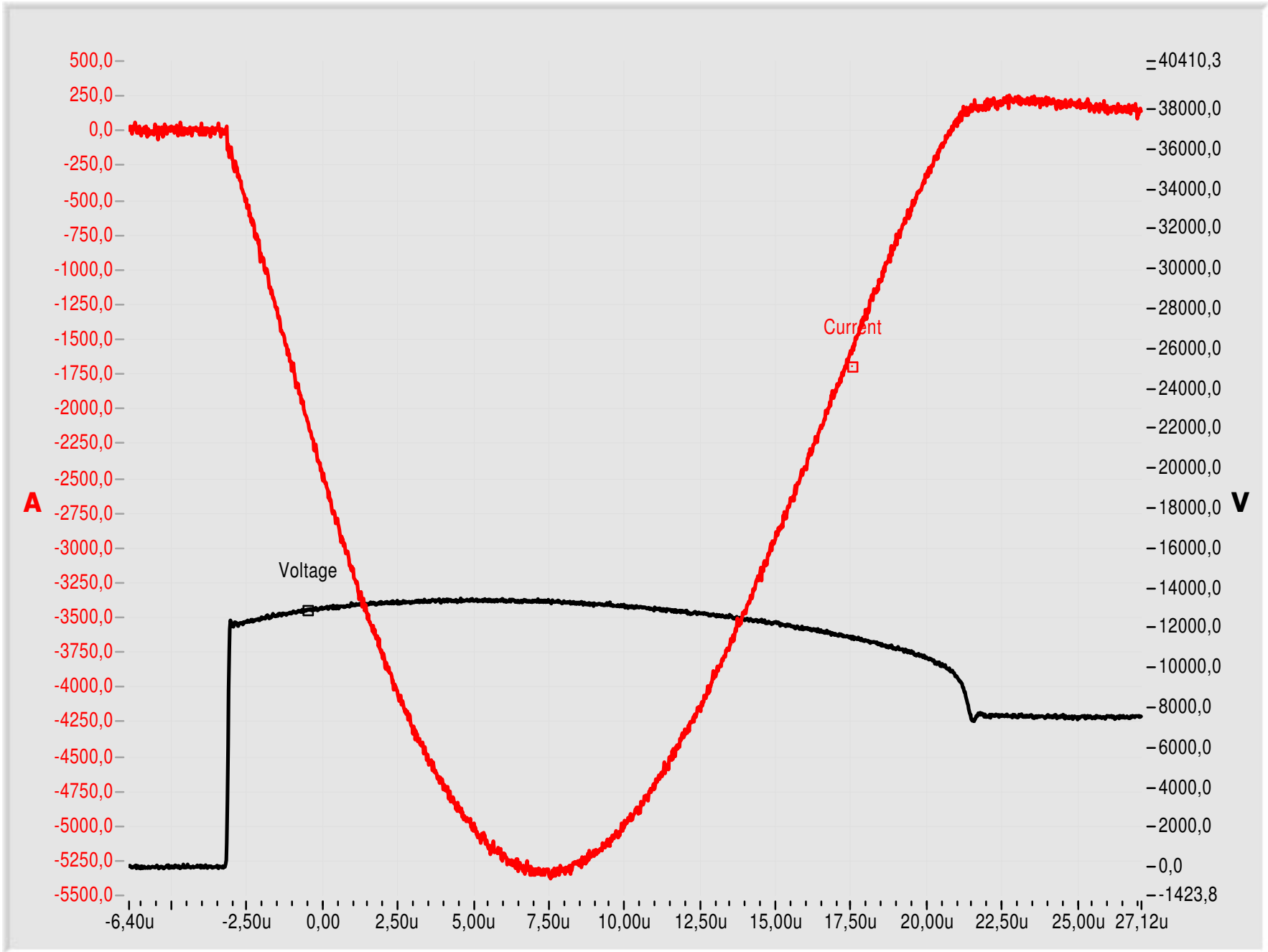
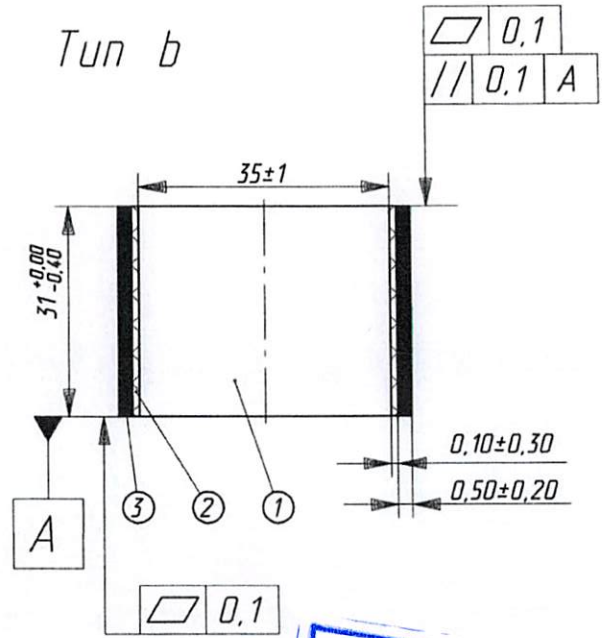
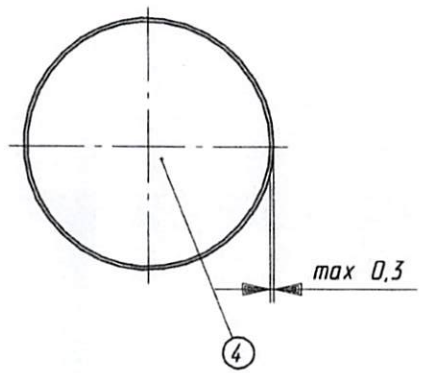


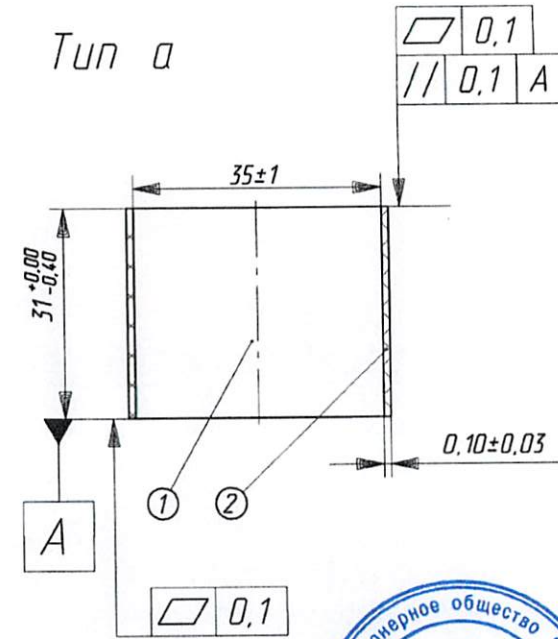
PA.VAR.0400.30

Тип b





Тип a



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

CESI
B7020387-001

Закрытое акционерное общество "Полимер-Аппарат" Санкт-Петербург

Изм.	Лист	N°докум.	Подп.	Дата
Разраб.		Потапов А.В.		09.17
Пров.		Петухов А.П.		09.17
Т.контр.				
Н.контр.				
Утв.		Шевцов И.В.		09.17

PA.VAR.0400.30

Varistor B34/30

Оксид цинка

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

ЗАО "Полимер-Аппарат"

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

Копировал

Формат А4