Type Test Report

Document No.	06430-23-0074	Copy No.	1	Number of pages	46

Apparatus	Cast-resin metal-enclosed voltage transformer
Designation	4MT34XD Fuse

Rated insulation level	24/50/125	kV
Rated primary voltage A-N	20000/√3	V
Rated secondary voltage 1a-1n/2a-2n	100/√3 / 100/√3	V
Rated secondary voltage da-dn	100/3	V
Rated output 1a-1n/2a-2n/da-dn	15/15/100	VA
Rated accuracy class 1a-1n/2a-2n	0.2/0.2	
Rated accuracy class da-dn	3P	
Rated frequency	50	Hz

Serial Number	22/31362605
Manufacturer	Ritz Instrument Transformers GmbH
Client	Ritz Instrument Transformers GmbH (Standort Hamburg) Wandsbeker Zollstr. 92 - 98, 22041 Hamburg, GERMANY
Tested for	Siemens AG (Schaltwerk Frankfurt) Carl-Benz-Str. 22, 60386 Frankfurt, GERMANY
Date(s) of test(s)	17 January to 10 March 2023
Tested by	IPH Institut „Prüffeld für elektrische Hochleistungstechnik“ GmbH Landsberger Allee 378A, 12681 Berlin, GERMANY
Test(s) performed	• Impulse voltage withstand test on primary terminals • Short-circuit withstand capability test • Temperature-rise test • Test for accuracy

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 61869-3: 2011-07

The rated characteristics related to the range of tests performed have been verified.
The tests have been PASSED.

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.

26 April 2023	Dagmar Hauschild	Ronald Borchert
Date	Test Engineer in charge	Approved by

DAkkS Deutsche Akkreditierungsstelle D-PL-12107-01-00

IPH Institut "Prüffeld für elektrische Hochleistungstechnik" GmbH is accredited testing laboratory by DAkkS according to DIN EN ISO/IEC 17025:2018. The accreditation is valid only for the scope listed in the annex of the accreditation certificate D-PL-12107-01-00.
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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

Decision rule for conformity assessment

The decision rule for conformity assessment is based on the 'simple acceptance method' according to ILAC-G8:09/2019 – Ch. 4.2.1.

Ratings and characteristics assigned by the manufacturer and proven by test

Description		Rating	Verified
Rated primary voltage A-N	U_{pr}	20000/√3 V	
Rated secondary voltage	U_{sr}		
1a-1n		100/√3 V	
2a-2n		100/√3 V	
da-dn		100/3 V	
Rated insulation level			
Highest voltage for equipment	U_m	24 kV	
Rated power-frequency withstand voltage		50 kV	X
Rated lightning impulse withstand voltage		125 kV	X
Rated accuracy class			
1a-1n		0.2	X
2a-2n		0.2	X
da-dn		3P	X
Rated output	S_r		
1a-1n		15 VA	X
2a-2n		15 VA	X
da-dn		100 VA	X
Rated thermal limiting output	S_{th}		
1a-1n		200 VA	X
2a-2n		200 VA	X
da-dn		105 VA	X
Rated voltage factor	F_v	1.9 U_{pr} (8 h)	X
Duration of short circuit		1 s	X
Rated frequency	f_R	50 Hz	X
Temperature category		-5/+55 °C	
Class of insulation		E	
Burden range		II	X

The ratings of the test object marked with **X** and related to the scope of test(s) performed have been proved.

Contents Sheet

Distribution Copy No. 1

Copy No. 1 in English: Ritz Instrument Transformers GmbH

1. Present at the test

Mrs.	Hauschild	IPH test engineer in charge
Mr.	Fischer	IPH test engineer
Mr.	Ebert	IPH operator

2. Test performed

- Impulse voltage withstand test on primary terminals
- Short-circuit withstand capability test
- Temperature-rise test
- Test for accuracy

3. Identity of the test object

3.1 Technical data and characteristics

The technical data and characteristics of the test object are defined by the following parameters and specified by the client.

Test object:	Cast-resin metal-enclosed voltage transformer
Type:	4MT34XD Fuse
Manufacturer:	Ritz Instrument Transformers GmbH
Serial No.:	22/31362605
Year of manufacture:	2022

Characteristics:	Mass	Approx. 34 kg
	Fuse	
	Manufacturer	SIBA
	Type	HSW 4089
	Ratings	20/24 kV/1 A, 63 kA
	Cross-section of windings:	
	Primary winding	0.02355 mm^2
	Secondary winding 1a-1n	1.463 mm^2
	Secondary winding 2a-2n	1.463 mm^2
	Secondary winding da-dn	1.385 mm^2

3.2 Identity documents

The manufacturer confirms that the test object has been manufactured in compliance with the drawings given in this document. IPH did not verify this compliance in detail.
The identity of the test object is fixed by the following drawings and data submitted by the client:

Name of drawing	Drawing No.	Date of drawing	Author	Notes
4 MT 32, 34 Fuse XD Metal-clad indoor cast resin voltage transformer	MBS3.6720.01…99	14.12.2021 Index: 11	SIEMENS	Sheet 46

Entry of test object at IPH: 16 December 2022

Condition of test object: New

4. Impulse voltage withstand test on primary terminals

4.1 Test laboratory

High-voltage test laboratory, high-voltage hall 2

4.2 Normative document

IEC 61869-3: 2011-07, Sub-clause 7.2.3.2

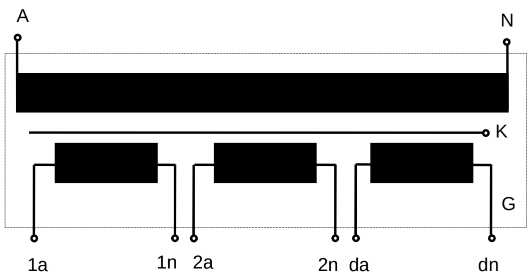
4.3 Required test parameters

Lightning impulse voltage test on primary terminals

Test voltage (1.2/50 μs)	125 kV	Peak value for internal insulation
Polarity		Positive and negative
Number of impulses per polarity	1 impulse	Between 50 % and 75 % of test voltage (reference impulse)
	15 impulses	100 % of test voltage
Atmospheric correction		Without

4.4 Test arrangement

Voltage application was between the high-voltage terminal of the primary winding and the earth-sided terminal of this winding. The neutral primary terminal and both terminals of the secondary windings 1a-1n and 2a-2n were directly earthed. The secondary terminals da-dn were connected over a shunt with the test earth in order to obtain an additional measuring quantity (current from this point to earth). This was useful for the assessment of the impulses ranging between 50 % and 100 % of test voltage.

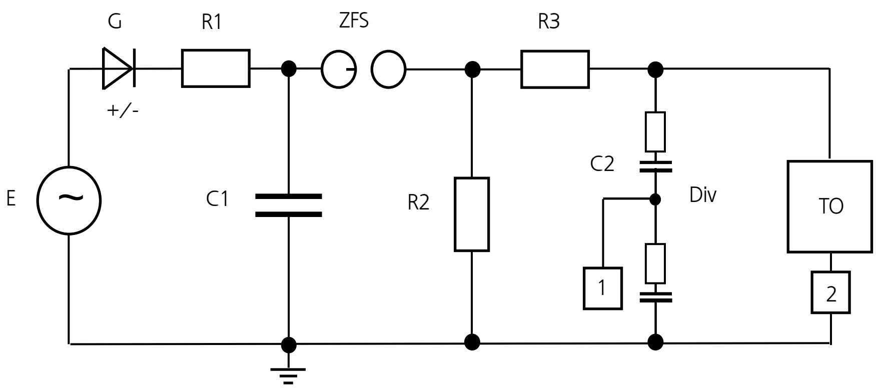


Voltage applied to: A
Earthed: N, 1a, 1n, 2a, 2n, da, dn, G

Figure 1: Circuit diagram of the test object

4.5 Test and measuring circuits

Technical data of test circuit



E	Supply charging voltage	C1	Impulse capacitance
G	Rectifier	C2	Load capacitance
ZFS	Spark gap	Div	Low-damped capacitive divider
R1	Charge resistance	TO	Test object
R2	Discharge resistance	1	Impulse voltage measurement
R3	Damping resistance	2	Impulse current measurement

Figure 2: Test and measuring circuits for the lightning impulse voltage test on primary terminals

Technical data of measuring circuit

Measuring point	Measured quantity	Measuring sensor/device
1	Test voltage	Low-damped capacitive divider SMC 1600/500 type and measurement impulse analysis system MIAS 100-14/4B type channel 1 (made by HIGHVOLT)
2	Impulse current	Coaxial shunt and measurement impulse analysis system MIAS 100-14/4B type channel 2 (made by HIGHVOLT)

4.6 Test results

Date of test: 17 January 2023

Air temperature: 16.6 °C
Air pressure: 980 hPa
Air humidity (relative): 43.5 %
Atmospheric correction of test voltage: Without

Test No.	Impulse [1]	Test voltage [kV]	Front time T_1 [µs]	Time to half-value T_2 [µs]	Current to earth [A]	Evaluation
3	60% LI RW	75.6	1.15	48.4	16.4	OK
4	100% LI FW	124.3	1.15	48.5	-25.9	OK
5	100% LI FW	124.3	1.15	48.6	-24.7	OK
6	100% LI FW	124.4	1.15	48.5	-25.5	OK
7	100% LI FW	124.4	1.15	48.5	26.0	OK
8	100% LI FW	124.5	1.15	48.5	-25.5	OK
9	100% LI FW	124.5	1.15	48.6	-25.3	OK
10	100% LI FW	124.5	1.15	48.6	-25.5	OK
11	100% LI FW	124.0	1.15	48.6	25.1	OK
12	100% LI FW	124.5	1.15	48.6	26.1	OK
13	100% LI FW	124.5	1.15	48.6	26.4	OK
14	100% LI FW	124.5	1.15	48.6	-26.0	OK
15	100% LI FW	124.4	1.15	48.6	-25.0	OK
16	100% LI FW	124.4	1.15	48.6	-25.1	OK
17	100% LI FW	124.4	1.15	48.6	-24.1	OK
18	100% LI FW	124.5	1.15	48.6	25.2	OK
19	60% LI RW	-74.4	1.15	48.5	-13.2	OK
20	100% LI FW	-124.2	1.16	48.6	21.7	OK
21	100% LI FW	-124.0	1.16	48.6	21.5	OK
22	100% LI FW	-124.0	1.16	48.6	20.9	OK
23	100% LI FW	-124.2	1.16	48.6	21.4	OK
24	100% LI FW	-124.0	1.16	48.6	-22.4	OK
25	100% LI FW	-124.0	1.16	48.6	21.9	OK
26	100% LI FW	-124.0	1.16	48.6	22.7	OK
27	100% LI FW	-124.1	1.15	48.6	21.7	OK
28	100% LI FW	-124.2	1.15	48.6	21.8	OK
29	100% LI FW	-124.2	1.16	48.6	21.6	OK
30	100% LI FW	-124.1	1.16	48.6	21.9	OK
31	100% LI FW	-124.2	1.16	48.6	-22.2	OK
32	100% LI FW	-124.0	1.15	48.6	22.2	OK
33	100% LI FW	-124.0	1.16	48.7	21.4	OK
34	100% LI FW	-124.2	1.15	48.6	22.3	OK

Notes:

1) RW - Reference impulse; FW - Full impulse

Evaluation:

OK - The requirements specified by IEC 61869-3 have been met.

There were no disruptive discharges. The recorded voltage curves did not present any significant variation between the recordings of reference impulse and full impulse level.

4.7 Dielectric routine tests after the lightning impulse voltage test on primary terminals

The routine tests to Sub-clause 7.3 of the normative document are part of the type test - lightning impulse voltage test on primary terminals - and serve to assess the latter.

Results

Date of test: 17 January 2023

Test parameters	Required	Tested	Permitted values	Test results	Evaluation
7.3.1: Power-frequency voltage withstand test on primary terminals (induced voltage withstand test)					
Test voltage: Test frequency: Duration of test:	50 kV 150 Hz 40 s	50 kV 150 Hz 40 s	No disruptive discharge	No disruptive discharge	OK
7.3.2: Partial discharge (PD) measurement (combined with induced voltage withstand test)					
Procedure A					
Prestress duration:	30 s	30 s			
Measuring voltage (points 1 to 3):					
$1.2 \times U_m =$	28.8 kV	28.8 kV	PD ≤ 50 pC	PD 15 pC	OK
$U_m =$	24.0 kV	24.0 kV	PD ≤ 50 pC	PD 2 pC	OK
$1.2 \times U_m/\sqrt{3} =$	16.6 kV	16.6 kV	PD ≤ 20 pC	PD 2 pC	OK
Test frequency: Measuring time:	150 Hz 40 s	150 Hz 40 s			
7.3.3: Power-frequency voltage withstand test between sections					
Test voltage: Test frequency: Duration of test:	3 kV 50 Hz 60 s	3 kV 50 Hz 60 s	No disruptive discharge	No disruptive discharge	OK
7.3.4: Power-frequency voltage withstand test on secondary terminals					
Test voltage: Test frequency: Duration of test:	3 kV 50 Hz 60 s	3 kV 50 Hz 60 s	No disruptive discharge	No disruptive discharge	OK
7.3.1.302: Common mode (separate source) power-frequency withstand test					
Test voltage: Test frequency: Duration of test:	3 kV 50 Hz 60 s	3 kV 50 Hz 60 s	No disruptive discharge	No disruptive discharge	OK

Evaluation:

OK - The requirements specified by IEC 61869-1 and IEC 61869-3 have been met.

The routine tests did not show anything that could have indicated a damage done to the test object during the previous lightning impulse voltage test on primary terminals.

5. Short-circuit withstand capability test

5.1 Test laboratory

Low-voltage test laboratory, test room 4

5.2 Normative document

IEC 61869-3: 2011-07, Sub-clause 7.2.301

5.3 Required test parameters

First test:
The test voltage of $100/\sqrt{3}$ V has to be applied to the secondary side 1a-1n while the primary side A-N is short circuited. Duration of short circuit: 1 s.

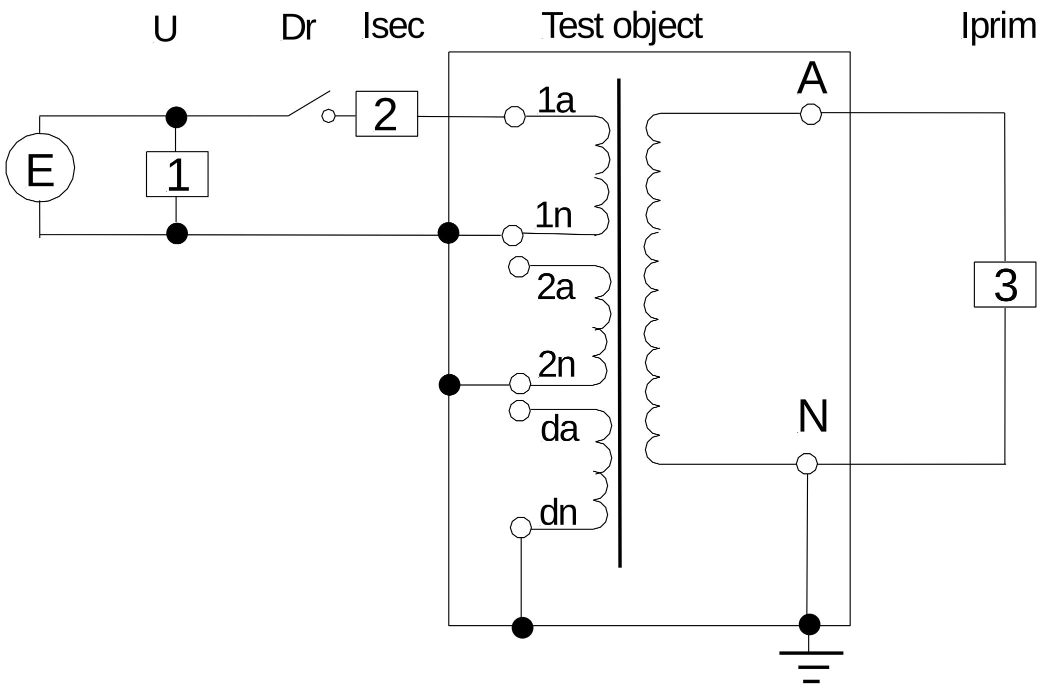
Second test:
The test voltage of $100/\sqrt{3}$ V has to be applied to the secondary side 2a-2n while the primary side A-N is short circuited. Duration of short circuit: 1 s.

Third test:
The test voltage of $100/3$ V has to be applied to the secondary side da-dn while the primary side A-N is short circuited. Duration of short circuit: 1 s.

5.4 Test arrangement

The connection to the test current source was on the secondary terminals of the voltage transformer. The voltage transformer was short-circuited on its primary side by copper conductor of 6-mm^2 cross section.

5.5 Test and measuring circuits



E	Power supply	U	Test voltage measurement
Dr	Making switch	Isec	Current measurement, secondary side
1 - 3	Measuring points	Iprim	Current measurement, primary side

Figure 3: Test circuit for the short-circuit withstand capability test (exemplary for the first test)

Technical data of measuring circuits

Test No.	Measuring point	Measured quantity	Measuring sensor/device
423 0121 to 423 0123	1	Voltage measurement	Divider
	2	Secondary current	Shunt
	3	Primary current	Shunt
Recording instrument: Transient recorder system			

5.6 Test results

5.6.1 Short-circuit withstand capability test

Date of test:	26 January 2023
Condition of test object before test:	Prestressed by previous tests, see Sub-clause 4, Sheet 9 and 10
Connection of test object:	By copper cable of 6 mm^2
Ambient air temperature:	23.9 °C

Test values:

Test No.		423 0121	423 0122	423 0123
Test voltage	V	58.0	57.9	34.0
Symmetrical short-circuit current, secondary side	A	109	111	124
Joule integral, secondary side	kA^2s	12.3	12.7	15.9
Symmetrical short-circuit current, primary side	A	0.545	0.554	0.366
Joule integral, primary side	A^2s	0.309	0.319	0.137
Duration of current flow	ms	1025	1029	1048
Terminals		1a-1n	2a-2n	da-dn
Current density (primary/secondary)	A/mm^2	23.1/74.5	23.5/75.9	15.5/89.5
Evaluation		OK	OK	OK

Note:

Supply at secondary terminals

Evaluation:

OK - The test object is capable of properly carrying the short-circuit current.

Condition of test object after test:

a) The test object did not show any visible damage.
b) Its errors do not differ from those recorded before the tests by more than half the limits of error in its accuracy class (see Sub-clause 5.6.2.1, Sheet 14 to 17).
c) It withstands the dielectric tests specified in 7.3.1, 7.3.2, 7.3.3 and 7.3.4, but with the test voltage reduced to 90 % of those given (see Sub-clause 5.6.2.2, Sheet 18).

5.6.2 Routine tests after the short-circuit withstand capability test

5.6.2.1 Comparison between the accuracy measured before and after the short-circuit withstand capability test

Date of tests: 26 January 2023 (before short-circuit withstand capability test)
10 March 2023 (after short-circuit withstand capability test)

- **Winding 1a-1n**

Test burden on 1a-1n	As percentage of rated voltage	Difference between the errors measured before and after the short-circuit withstand capability test		Permissible differences for accuracy class 0.2		Evaluation
		Voltage error ε_U	Phase displacement $\Delta\varphi$	Voltage error ε_U	Phase displacement $\Delta\varphi$	
	[%]	[%]	[Minutes]	[%]	[Minutes]	
15 VA, power factor = 0.8	80	0.00	0.1	± 0.1	± 5	OK
	100	0.00	0.1			
	120	0.00	0.1			
3.75 VA, power factor = 0.8	80	0.00	0.0	± 0.1	± 5	OK
	100	0.00	0.1			
	120	0.00	0.1			

Notes:

The windings 2a-2n and da-dn were unloaded.

Test burden on 1a-1n	As percentage of rated voltage	Difference between the errors measured before and after the short-circuit withstand capability test		Permissible differences for accuracy class 0.2		Evaluation
		Voltage error ε_U	Phase displacement $\Delta\varphi$	Voltage error ε_U	Phase displacement $\Delta\varphi$	
	[%]	[%]	[Minutes]	[%]	[Minutes]	
15 VA, power factor = 0.8	80	0.00	0.1	± 0.1	± 5	OK
	100	0.00	0.1			
	120	0.01	0.0			
3.75 VA, power factor = 0.8	80	0.00	0.0	± 0.1	± 5	OK
	100	0.00	0.0			
	120	0.01	0.1			

Notes:

The winding 2a-2n was loaded with 15 VA (power factor = 1) and winding da-dn was unloaded.

Evaluation:

OK - The calculated differences as well as the measured values of ratio error and phase displacement are within the limits permissible for accuracy class 0.2. The test object is able to comply with the requirements of accuracy class 0.2 after the short-circuit withstand capability test.

Test results (continued)

Date of tests: 26 January 2023 (before short-circuit withstand capability test)
10 March 2023 (after short-circuit withstand capability test)

- **Winding 2a-2n**

Test burden on 2a-2n	As percentage of rated voltage	Difference between the errors measured before and after the short-circuit withstand capability test		Permissible differences for accuracy class 0.2		Evaluation
		Voltage error ε_U	Phase displacement $\Delta\varphi$	Voltage error ε_U	Phase displacement $\Delta\varphi$	
	[%]	[%]	[Minutes]	[%]	[Minutes]	
15 VA, power factor = 0.8	80	0.00	0.1	± 0.1	± 5	OK
	100	0.00	0.1			
	120	0.01	-0.1			
3.75 VA, power factor = 0.8	80	0.00	0.0	± 0.1	± 5	OK
	100	0.00	0.0			
	120	0.01	0.0			

Notes:

The windings 1a-1n and da-dn were unloaded.

Test burden on 2a-2n	As percentage of rated voltage	Difference between the errors measured before and after the short-circuit withstand capability test		Permissible differences for accuracy class 0.2		Evaluation
		Voltage error ε_U	Phase displacement $\Delta\varphi$	Voltage error ε_U	Phase displacement $\Delta\varphi$	
	[%]	[%]	[Minutes]	[%]	[Minutes]	
15 VA, power factor = 0.8	80	0.00	0.1	± 0.1	± 5	OK
	100	0.01	0.1			
	120	0.01	0.0			
3.75 VA, power factor = 0.8	80	0.00	0.0	± 0.1	± 5	OK
	100	0.00	0.0			
	120	0.01	0.1			

Note:

The winding 1a-1n was loaded with 15 VA (power factor = 1) and winding da-dn was unloaded.

Evaluation:

OK - The calculated differences as well as the measured values of ratio error and phase displacement are within the limits permissible for accuracy class 0.2. The test object is able to comply with the requirements of accuracy class 0.2 after the short-circuit withstand capability test.

Test results (continued)

Date of tests: 26 January 2023 (before short-circuit withstand capability test)
10 March 2023 (after short-circuit withstand capability test)

- **Winding da-dn**

Test burden on da-dn	As percentage of rated voltage [%]	Difference between the errors measured before and after the short-circuit withstand capability test: Voltage error ε_U [%]	Difference between the errors measured before and after the short-circuit withstand capability test: Phase displacement $\Delta\varphi$ [Minutes]	Permissible differences for accuracy class 3P: Voltage error ε_U [%]	Permissible differences for accuracy class 3P: Phase displacement $\Delta\varphi$ [Minutes]	Evaluation
100 VA, power factor = 0.8	2	-0.07	1.3	± 3	± 120	OK
	5	-0.06	1.3	± 1.5	± 60	
	100	-0.05	1.3			
	190	-0.04	1.2			
25 VA, power factor = 0.8	2	0.01	0.3	± 3	± 120	OK
	5	-0.01	0.3	± 1.5	± 60	
	100	0.01	0.4			
	190	-0.02	0.4			
Unloaded	2	0.00	0.0	± 3	± 120	OK
	5	0.00	0.1	± 1.5	± 60	
	100	0.00	0.0			
	190	0.00	0.0			

Note:

The windings 1a-1n and 2a-2n were unloaded.

Evaluation:

OK - The calculated differences as well as the measured values of voltage error and phase displacement are within the limits permissible for accuracy class 3P for the residual voltage winding. The test object is able to comply with the requirements of accuracy class 3P after the short-circuit withstand capability test.

Test results (continued)

Date of tests: 26 January 2023 (before short-circuit withstand capability test)
10 March 2023 (after short-circuit withstand capability test)

- **Winding da-dn**

Test burden on da-dn	As percentage of rated voltage	Difference between the errors measured before and after the short-circuit withstand capability test		Permissible differences for accuracy class 3P		Evaluation
		Voltage error ε_U	Phase displacement $\Delta\varphi$	Voltage error ε_U	Phase displacement $\Delta\varphi$	
	[%]	[%]	[Minutes]	[%]	[Minutes]	
100 VA, power factor = 0.8	2	-0.05	1.0	± 3	± 120	OK
	5	-0.05	1.0	± 1.5	± 60	
	100	-0.03	1.1			
	190	-0.03	1.1			
25 VA, power factor = 0.8	2	0.01	0.3	± 3	± 120	OK
	5	0.01	0.3	± 1.5	± 60	
	100	0.01	0.3			
	190	0.02	0.3			
Unloaded	2	0.00	0.1	± 3	± 120	OK
	5	0.00	0.1	± 1.5	± 60	
	100	0.01	0.0			
	190	0.01	0.0			

Notes:

The windings 1a-1n and 2a-2n were loaded with 15 VA (power factor = 1).

Evaluation:

OK - The calculated differences as well as the measured values of voltage error and phase displacement are within the limits permissible for accuracy class 3P for the residual voltage winding. The test object is able to comply with the requirements of accuracy class 3P after the short-circuit withstand capability test.

5.6.2.2 Dielectric routine tests

Date of test: 31 January 2023
Air temperature: 17.1 °C
Air pressure: 1010 hPa
Air humidity (relative): 29.1 %

The dielectric routine tests to Sub-clause 7.3 of the normative document are part of the type test - short-circuit withstand capability test - and serve to assess the latter. The tests have to be performed with a reduced test voltage of 90 %.

Test results

Test parameters	Required	Tested	Permitted values	Test results	Evaluation
7.3.1: Power-frequency voltage withstand test on primary terminals (induced voltage withstand test)					
Test voltage: Test frequency: Duration of test:	45 kV 150 Hz 40 s	45 kV 150 Hz 40 s	No disruptive discharge	No disruptive discharge	OK
7.3.2: Partial discharge (PD) measurement (combined with induced voltage withstand test)					
Procedure A					
Prestress duration:	30 s	30 s			
Measuring voltage (points 1 to 3):					
$1.2 \times U_m \times 0.9$ =	25.9 kV	28.8 kV	PD ≤ 50 pC	PD 5 pC	OK
$U_m \times 0.9$ =	21.6 kV	24.0 kV	PD ≤ 50 pC	PD 1 pC	OK
$1.2 \times U_m / \sqrt{3} \times 0.9$ =	15.0 kV	16.6 kV	PD ≤ 20 pC	PD 1 pC	OK
Test frequency: Measuring time:	150 Hz 40 s	150 Hz 40 s			
7.3.3: Power-frequency voltage withstand test between sections					
Test voltage: Test frequency: Duration of test:	2.7 kV 50 Hz 60 s	2.7 kV 50 Hz 60 s	No disruptive discharge	No disruptive discharge	OK
7.3.4: Power-frequency voltage withstand test on secondary terminals					
Test voltage: Test frequency: Duration of test:	2.7 kV 50 Hz 60 s	2.7 kV 50 Hz 60 s	No disruptive discharge	No disruptive discharge	OK
7.3.1.302: Common mode (separate source) power-frequency withstand test					
Test voltage: Test frequency: Duration of test:	2.7 kV 50 Hz 60 s	2.7 kV 50 Hz 60 s	No disruptive discharge	No disruptive discharge	OK

Evaluation:

OK - The requirements specified by IEC 61869-1 and IEC 61869-3 have been met.

The routine tests did not show anything that could have indicated a damage done to the test object during the previous short-circuit withstand capability test.

6. Temperature-rise test

6.1 Test laboratory

Low-voltage test laboratory, test room 7

6.2 Normative document

IEC 61869-3: 2011-07, Sub-clause 7.2.2

6.3 Required test parameters

	1.2 times rated primary voltage	1.9 times rated primary voltage for 8 h
Test voltage	1.2 * 20000/√3 V	1.9 * 20000/√3 V
Output at winding 1a-1n	15 VA	15 VA
Output at winding 2a-2n	15 VA	15 VA
Output at winding da-dn	- VA	105 VA 1)
Frequency	50 Hz	50 Hz

	1.0 times rated primary voltage	1.0 times rated primary voltage for 8 h
Test voltage	1.0 * 20000/√3 V	1.0 * 20000/√3 V
Output at winding 1a-1n	200 VA	15 VA
Output at winding 2a-2n	15 VA	200 VA
Output at winding da-dn	- VA	- VA
Frequency	50 Hz	50 Hz

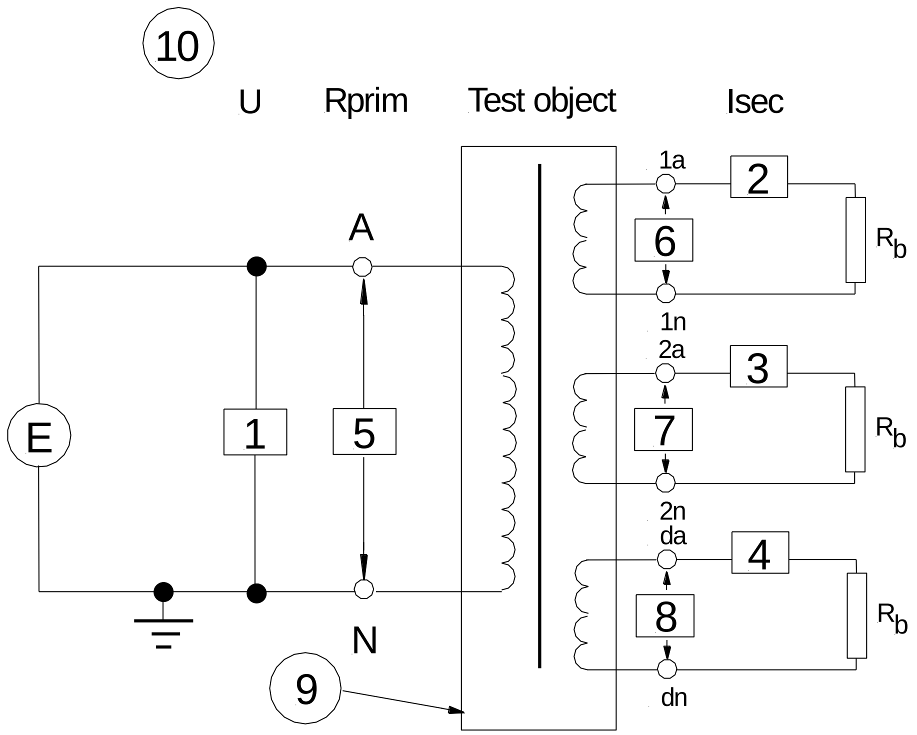
Note:
1) This value corresponds to the thermal limiting output for the residual voltage winding.

6.4 Test arrangement

According to IEC 61869-3: 2011-07, Sub-clause 7.2.2

The test object was set up in a room which was draught-free to a large extent. Voltage application was between the high-voltage terminal of the primary winding and the earth-sided terminal of this winding.

6.5 Test and measuring circuits



E	Power supply - 50 Hz
1	Measurement of primary voltage
2 to 4	Current measurement on the secondary side
5 to 8	Resistance measurement
9 and 10	Temperature measurement
Rb	Burden

Figure 4: Test circuit for the temperature-rise test

Technical data of measuring circuits

Measuring point	Measured quantity	Measuring sensor/device
1	Test voltage	Digital Multimeter
2 to 4	Secondary current	Amperemeter
5 to 8	Winding resistance	Resistance measuring bridge
9 and 10	Temperature	Almemo 2390-5 Cu/constantan thermocouples and surface sensor

6.6 Test results

Date of test: 02 to 03 March 2023

The test voltage was 13.9 kV (50 Hz). This is equivalent to 1.2times rated primary voltage of the transformer. The voltage transformer was tested at 15 VA on winding 1a-1n and 2a-2n until the steady state temperature was reached.

Meas. point	Designation of the part	Material	Permissible temperature-rise limit K	Measured final temperature at $\Delta T \leq 1 K/h$ °C	Final temperature rise (related to average ambient air temperature) K
5	Primary winding A-N	Cu wire	60	25.7	5.8
6	Secondary winding 1a-1n	Cu wire	60	32.9	13.0
7	Secondary winding 2a-2n	Cu wire	60	33.8	13.9
8	Secondary winding da-dn	Cu wire	60	32.7	12.8
9	Transformer case	Insulating material	60	22.9	3.0
10	Ambient air temperature	Air	-	19.9	-

Determination of the voltage transformer's winding temperature rise

The temperature rise θ of the voltage transformer winding was determined on the basis of the rise of winding resistance from the cold state to the steady state of temperature rise using the following formula.

$$\theta_w = \frac{R_w}{R_k}(234.5 + \theta_k) - 234.5$$

R_k Cold resistance of the winding at reference temperature

R_w Warm resistance of the winding at 19.9 °C of ambient air temperature

θ_k Reference temperature = 23.1 °C

θ_w Final temperature of the winding

θ Final temperature-rise of the winding

The hot resistance of the secondary winding was calculated on the basis of the measurement of the cooling curve.

1.2times rated primary voltage	R_k Ω	R_w Ω	θ_w °C	θ K	Permissible temperature rise K	Evaluation
Primary winding A-N	6062	6124	25.7	5.8	60	OK
Secondary winding 1a-1n	0.3518	0.3652	32.9	13.0	60	OK
Secondary winding 2a-2n	0.3326	0.3464	33.8	13.9	60	OK
Secondary winding da-dn	0.2073	0.215	32.7	12.8	60	OK

Note:

OK - The final winding temperature-rise limit of 60 K permissible for the class of insulation "E" at 55 °C maximum value of ambient air temperature was not exceeded. The final winding temperature rise of 13.9 K is permissible for the class of insulation "E".

Test results (continued)

Date of test: 03 March 2023

After the steady state temperature was reached, the test voltage was 21.9 kV (50 Hz). This is equivalent to 1.9times rated primary voltage of the transformer. The voltage transformer was tested at rated burden on winding 1a-1n and 2a-2n and the thermal limiting output on the residual winding da-dn for 8 h.

Meas. point	Designation of the part	Material	Permissible temperature-rise limit K	Measured final temperature at ΔT≤1K/h °C	Final temperature rise (related to average ambient air temperature) K
5	Primary winding A-N	Cu wire	70	60.8	40.2
6	Secondary winding 1a-1n	Cu wire	70	51.6	31.0
7	Secondary winding 2a-2n	Cu wire	70	53.8	33.2
8	Secondary winding da-dn	Cu wire	70	47.5	26.9
9	Transformer case	Insulating material	70	32.6	12.0
10	Ambient air temperature	Air	-	20.6	-

Determination of the voltage transformer's winding temperature rise

The temperature rise θ of the voltage transformer winding was determined on the basis of the rise of winding resistance from the cold state to the steady state of temperature rise using the following formula.

$$\theta_w = \frac{R_w}{R_k}(234.5 + \theta_k) - 234.5$$

R_k Cold resistance of the winding at reference temperature

R_w Warm resistance of the winding at 20.6 °C of ambient air temperature

θ_k Reference temperature = 23.1 °C

θ_w Final temperature of the winding

θ Final temperature-rise of the winding

The hot resistance of the secondary winding was calculated on the basis of the measurement of the cooling curve.

1.9times rated primary voltage	R_k Ω	R_w Ω	θ_w °C	θ K	Permissible temperature rise K	Evaluation
Primary winding A-N	6062	6947	60.8	40.2	70	OK
Secondary winding 1a-1n	0.3518	0.3906	51.6	31.0	70	OK
Secondary winding 2a-2n	0.3326	0.3721	53.8	33.2	70	OK
Secondary winding da-dn	0.2073	0.2269	47.5	26.9	70	OK

Note:

OK - The final winding temperature-rise limit of 70 K permissible for the class of insulation "E" at 55 °C maximum value of ambient air temperature was not exceeded. The final winding temperature rise of 40.2 K is permissible for the class of insulation "E".

Test results (continued)

Date of test: 28 February to 01 March 2023

The test was performed with 11.5 kV (50 Hz) and loaded with 200 VA at measuring winding 1a-1n, this is equivalent to the thermal limiting output for this winding and 15 VA at measuring winding 2a-2n until the steady state temperature was reached. The residual voltage winding da-dn was unloaded.

Meas. point	Designation of the part	Material	Permissible temperature-rise limit K	Measured final temperature at ΔT≤1K/h °C	Final temperature rise (related to average ambient air temperature) K
5	Primary winding A-N	Cu wire	60	45.8	25.5
6	Secondary winding 1a-1n	Cu wire	60	39.1	18.8
7	Secondary winding 2a-2n	Cu wire	60	39.4	19.1
8	Secondary winding da-dn	Cu wire	60	43.4	23.1
9	Transformer case	Insulating material	60	25.6	5.3
10	Ambient air temperature	Air	-	20.3	-

Determination of the voltage transformer's winding temperature rise

The temperature rise θ of the voltage transformer winding was determined on the basis of the rise of winding resistance from the cold state to the steady state of temperature rise using the following formula.

$$\theta_w = \frac{R_w}{R_k}(234.5 + \theta_k) - 234.5$$

R_k Cold resistance of the winding at reference temperature

R_w Warm resistance of the winding at 20.3 °C of ambient air temperature

θ_k Reference temperature = 23.1 °C

θ_w Final temperature of the winding

θ Final temperature-rise of the winding

The hot resistance of the secondary winding was calculated on the basis of the measurement of the cooling curve.

1.0 times rated primary voltage and thermal limiting output 1a-1n	R_k Ω	R_w Ω	θ_w °C	θ K	Permissible temperature rise K	Evaluation
Primary winding A-N	6062	6594	45.8	25.5	60	OK
Secondary winding 1a-1n	0.3518	0.3736	39.1	18.8	60	OK
Secondary winding 2a-2n	0.3326	0.3536	39.4	19.1	60	OK
Secondary winding da-dn	0.2073	0.2236	43.4	23.1	60	OK

Note:

OK - The final winding temperature-rise limit of 60 K permissible for the class of insulation "E" at 55 °C maximum value of ambient air temperature was not exceeded. The final winding temperature rise of 25.5 K is permissible for the class of insulation "E".

Test results (continued)

Date of test: 28 February to 01 March 2023

The test was performed with 11.5 kV (50 Hz) and loaded with 200 VA at measuring winding 2a-2n, this is equivalent to the thermal limiting output for this winding and 15 VA at measuring winding 1a-1n until the steady state temperature was reached. The residual voltage winding da-dn was unloaded.

Meas. point	Designation of the part	Material	Permissible temperature-rise limit K	Measured final temperature at ΔT≤1K/h °C	Final temperature rise (related to average ambient air temperature) K
5	Primary winding A-N	Cu wire	60	44.8	24.3
6	Secondary winding 1a-1n	Cu wire	60	40.5	20.0
7	Secondary winding 2a-2n	Cu wire	60	41.2	20.7
8	Secondary winding da-dn	Cu wire	60	51.0	30.5
9	Transformer case	Insulating material	60	26.5	6.0
10	Ambient air temperature	Air	-	20.5	-

Determination of the voltage transformer's winding temperature rise

The temperature rise θ of the voltage transformer winding was determined on the basis of the rise of winding resistance from the cold state to the steady state of temperature rise using the following formula.

$$\theta_w = \frac{R_w}{R_k}(234.5 + \theta_k) - 234.5$$

R_k Cold resistance of the winding at reference temperature

R_w Warm resistance of the winding at 20.5 °C of ambient air temperature

θ_k Reference temperature = 23.1 °C

θ_w Final temperature of the winding

θ Final temperature-rise of the winding

The hot resistance of the secondary winding was calculated on the basis of the measurement of the cooling curve.

1.0 times rated primary voltage and thermal limiting output 2a-2n	R_k Ω	R_w Ω	θ_w °C	θ K	Permissible temperature rise K	Evaluation
Primary winding A-N	6062	6572	44.8	24.3	60	OK
Secondary winding 1a-1n	0.3518	0.3755	40.5	20.0	60	OK
Secondary winding 2a-2n	0.3326	0.3559	41.2	20.7	60	OK
Secondary winding da-dn	0.2073	0.2297	51.0	30.5	60	OK

Note:

OK - The final winding temperature-rise limit of 60 K permissible for the class of insulation "E" at 55 °C maximum value of ambient air temperature was not exceeded. The final winding temperature rise of 30.5 K is permissible for the class of insulation "E".

7. Test for accuracy

7.1 Test laboratory

IPH calibration laboratory

7.2 Normative document

IEC 61869-3: 2011-07, Sub-clause 7.2.6

7.3 Required test parameters

Measuring winding: The voltage errors shall be determined at 80 %, 100 %, 120 % of rated voltage and 25 % and 100 % of rated burden with a power factor of cos β = 0.8.

Protective winding: The voltage errors shall be determined at 2 %, 5 %, 100 % and 190 % of rated voltage as well as at 25 % and 100 % of rated burden at a power factor of cos β = 0.8 for burden range II.

The test frequency shall be equal to the rated frequency of 50 Hz.

Maximum permissible error limits of voltage transformers for measuring and protective purposes:

Accuracy class	Percentage voltage error at percentage of rated voltage %				Phase displacement at percentage of rated voltage Minutes			
0.2	80	100		120	80	100		120
	± 0.2				± 10			
3P	2	5	100	190	2	5	100	190
	± 6	± 3			± 240	± 120		

7.4 Test arrangement

According to IEC 61869-3: 2011-07, Sub-clauses 7.2.6.301 and 7.2.6.302

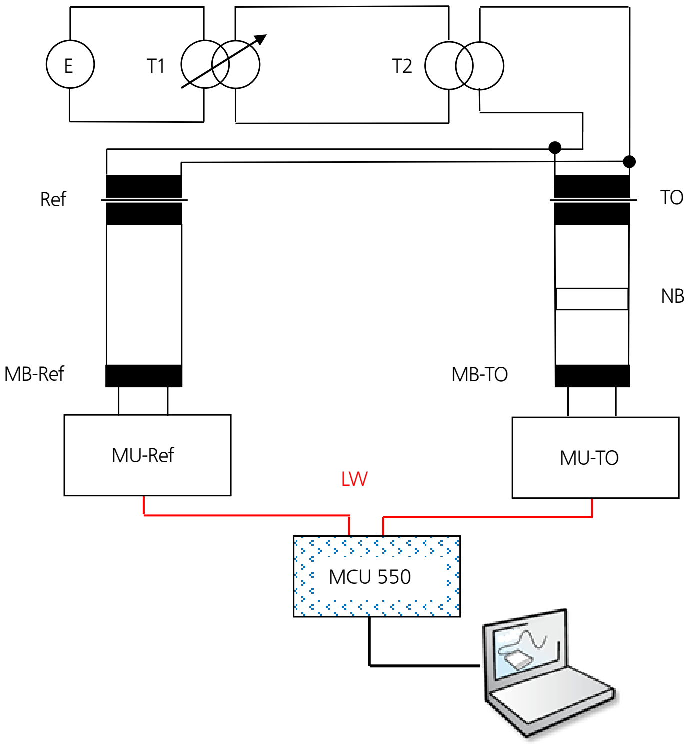
The test voltage source was connected to the primary sides of the test object and to the measurement standard transformer in parallel. Their secondary sides were connected to an instrument transformer measuring device.

The test object was subjected to the prescribed test conditions by connection of a standard burden.

7.5 Test and measuring circuits

Technical data of test and measuring circuits

Device	**Type**	**Technical data**
Standard voltage transformer (Ref)	NOTE 60 (Ritz Messwandlerwerk GmbH) NUZO 30 (Ritz Messwandlerwerk GmbH)	Ratio 30 ... 60 kV/100 V, resp. Class 0.1 Ratio 3 ... 20 kV/100 V, resp. Class 0.1
Standard burden of voltage transformer (NB)	Electronically Compensated Voltage Burden ESVB200 (ZERA)	50 Hz and 60 Hz; cos β 0.7 - 1 = 1 ... 200 VA cos β 0.5 - 1 = 2.5 ... 200 VA cos β 0.3 - 1 = 5 ... 120 VA cos β 0.2 - ‹0.3 = 7.5 ... 120 VA cos β 0.1 - ‹0.2 = 10 ... 25 VA
Instrument transformer measuring bridge	Omicron MCV 700	16 $^2/_3$, 50 Hz and 60 Hz



E	Power supply	Ref	Reference transformer
T1	Adjusting transformer	MU-Ref	Measuring unit reference
T2	High-voltage transformer	MU-TO	Measuring unit test object
LW	Optical fibre	MB-Ref	Measuring burden reference
NB	Standard burden of voltage transformer	MB-TO	Measuring burden test object
TO	Test object	MCU 550	Control unit

Figure 5: Test and measuring circuits for the test of accuracy

7.6 Test results

Date of test: 10 March 2023

The measurement was carried out under the following conditions:

Test object in thermal equilibrium
Air temperature: (23 ± 2) °C
Relative humidity: (50 ± 10) %

- **Winding 1a-1n**

Test burden on 1a-1n	As percentage of rated voltage [%]	Errors: Voltage error ε_U [%]	Errors: Phase displacement $\Delta\varphi$ [Minutes]	Permissible errors for accuracy class 0.2: Voltage error ε_U [%]	Permissible errors for accuracy class 0.2: Phase displacement $\Delta\varphi$ [Minutes]	Evaluation
15 VA, power factor = 0.8	80	-0.04	5.1	± 0.2	± 10	OK
	100	-0.04	5.1			
	120	-0.04	5.2			
3.75 VA, power factor = 0.8	80	0.12	3.0	± 0.2	± 10	OK
	100	0.12	3.1			
	120	0.12	3.1			

Notes:

The windings 2a-2n and da-dn were unloaded.

Test burden on 1a-1n	As percentage of rated voltage [%]	Errors: Voltage error ε_U [%]	Errors: Phase displacement $\Delta\varphi$ [Minutes]	Permissible errors for accuracy class 0.2: Voltage error ε_U [%]	Permissible errors for accuracy class 0.2: Phase displacement $\Delta\varphi$ [Minutes]	Evaluation
15 VA, power factor = 0.8	80	-0.11	2.8	± 0.2	± 10	OK
	100	-0.11	2.8			
	120	-0.11	2.9			
3.75 VA, power factor = 0.8	80	0.02	0.7	± 0.2	± 10	OK
	100	0.05	0.8			
	120	0.05	0.8			

Notes:

The winding 2a-2n was loaded with 15 VA (power factor = 1) and winding da-dn was unloaded.

Evaluation:

OK - The measured values have met the requirements of standard. The measured ratio error and phase displacement values are within the limits permissible for accuracy class 0.2 for measuring voltage transformers.

Test results (continued)

Date of test: 10 March 2023

The measurement was carried out under the following conditions:

Test object in thermal equilibrium
Air temperature: (23 ± 2) °C
Relative humidity: (50 ± 10) %

- **Winding 2a-2n**

Test burden on 2a-2n	As percentage of rated voltage [%]	Errors: Voltage error ε_U [%]	Errors: Phase displacement $\Delta\varphi$ [Minutes]	Permissible errors for accuracy class 0.2: Voltage error ε_U [%]	Permissible errors for accuracy class 0.2: Phase displacement $\Delta\varphi$ [Minutes]	Evaluation
15 VA, power factor = 0.8	80	-0.05	4.7	± 0.2	± 10	OK
	100	-0.05	4.7			
	120	-0.05	4.8			
3.75 VA, power factor = 0.8	80	0.11	2.9	± 0.2	± 10	OK
	100	0.11	2.9			
	120	0.11	3.0			

Notes:

The windings 1a-1n and da-dn were unloaded.

Test burden on 2a-2n	As percentage of rated voltage [%]	Errors: Voltage error ε_U [%]	Errors: Phase displacement $\Delta\varphi$ [Minutes]	Permissible errors for accuracy class 0.2: Voltage error ε_U [%]	Permissible errors for accuracy class 0.2: Phase displacement $\Delta\varphi$ [Minutes]	Evaluation
15 VA, power factor = 0.8	80	-0.12	2.4	± 0.2	± 10	OK
	100	-0.12	2.4			
	120	-0.12	2.9			
3.75 VA, power factor = 0.8	80	0.05	2.5	± 0.2	± 10	OK
	100	0.05	0.6			
	120	0.04	0.7			

Notes:

The winding 1a-1n was loaded with 15 VA (power factor = 1) and winding da-dn was unloaded.

Evaluation:

OK - The calculated differences as well as the measured values of ratio error and phase displacement are within the limits permissible for accuracy class 0.2. The test object is able to comply with the requirements of accuracy class 0.2 after the short-circuit withstand capability test.

Test results (continued)

Date of test: 10 March 2023

The measurement was carried out under the following conditions:

Test object in thermal equilibrium
Air temperature: (23 ± 2) °C
Relative humidity: (50 ± 10) %

- **Winding da-dn**

Test burden on da-dn	As percentage of rated voltage	Errors		Permissible errors for accuracy class 3P		Evaluation
		Voltage error ε_U	Phase displacement $\Delta\varphi$	Voltage error ε_U	Phase displacement $\Delta\varphi$	
	[%]	[%]	[Minutes]	[%]	[Minutes]	
100 VA, power factor = 0.8	2	-0.58	37.2	± 6	± 240	OK
	5	-0.54	36.0	± 3	± 120	
	100	-0.45	32.6			
	190	-0.48	34.4			
25 VA, power factor = 0.8	2	1.08	14.6	± 6	± 240	OK
	5	1.12	13.0	± 3	± 120	
	100	1.19	10.1			
	190	1.15	12.1			
Unloaded	2	1.74	0.9	± 6	± 240	OK
	5	1.74	1.3	± 3	± 120	
	100	1.75	2.4			
	190	1.71	3.4			

Notes:

The windings 1a-1n and 2a-2n were unloaded.

Evaluation:

OK - The measured values have met the requirements of standard. The measured ratio error and phase displacement values are within the limits permissible for accuracy class 3P for protective voltage transformers.

Test results (continued)

Date of test: 10 March 2023

The measurement was carried out under the following conditions:

Test object in thermal equilibrium
Air temperature: (23 ± 2) °C
Relative humidity: (50 ± 10) %

- **Winding da-dn**

Test burden on da-dn	As percentage of rated voltage	Errors		Permissible errors for accuracy class 3P		Evaluation
		Voltage error ε_U	Phase displacement $\Delta\varphi$	Voltage error ε_U	Phase displacement $\Delta\varphi$	
	[%]	[%]	[Minutes]	[%]	[Minutes]	
100 VA, power factor = 0.8	2	-0.77	34.7	± 6	± 240	OK
	5	-0.72	33.0	± 3	± 120	
	100	-0.63	29.8			
	190	-0.65	31.4			
25 VA, power factor = 0.8	2	0.91	11.5	± 6	± 240	OK
	5	0.94	10.1	± 3	± 120	
	100	1.01	7.2			
	190	0.98	9.0			
Unloaded	2	1.56	-2.2	± 6	± 240	OK
	5	1.57	-1.7	± 3	± 120	
	100	1.58	-0.7			
	190	1.54	0.5			

Notes:

The windings 1a-1n and 2a-2n were loaded with 15 VA (power factor = 1).

Evaluation:

OK - The measured values have met the requirements of standard. The measured ratio error and phase displacement values are within the limits permissible for accuracy class 3P for protective voltage transformers.

8. Evaluation of all tests

- **Impulse voltage withstand test on primary terminals**

The voltage transformer was tested at 125-kV lightning impulse voltage on the primary side. There were no disruptive discharges and the recorded voltage and current curves did not present any significant variation between the recordings of reference impulse and full impulse level which could indicate an insulation failure.

The routine tests have successfully been repeated without errors.

The requirements specified by IEC 61869-3: 2011-07, Sub-clause 7.2.3 have been met.

The test object has PASSED the type test.

- **Short-circuit withstand capability test**

After test, the voltage transformer was not visibly damaged.
The errors determined after test differed from those recorded before test by less than half the limits of error appropriate to its accuracy class. All dielectric routine tests were repeated without errors.

The requirements specified by IEC 61869-3: 2011-07, Sub-clause 7.2.301 have been met.

The test object has PASSED the type test.

- **Temperature-rise test**

Class of insulation "E" allows a winding temperature-rise limit of 60 K at a maximum permissible ambient air temperature of 55 °C. The primary winding reached a temperature rise of 40.2 K. The secondary windings reached a temperature rise of 33.2 K. The final temperature-rise values of the windings are permissible for the class of insulation "E".

The requirements specified by IEC 61869-3: 2011-07, Sub-clause 7.2.2 have been met.

The test object has PASSED the type test.

- **Test for accuracy**

The voltage errors and phase displacements were within the permissible error limits of accuracy class 0.2 (winding 1a-1n and winding 2a-2n) and class 3P (winding da-dn).

The requirements specified by IEC 61869-3: 2011-07, Sub-clause 7.2.6 have been met.

The test object has PASSED the type test.

9. Photos

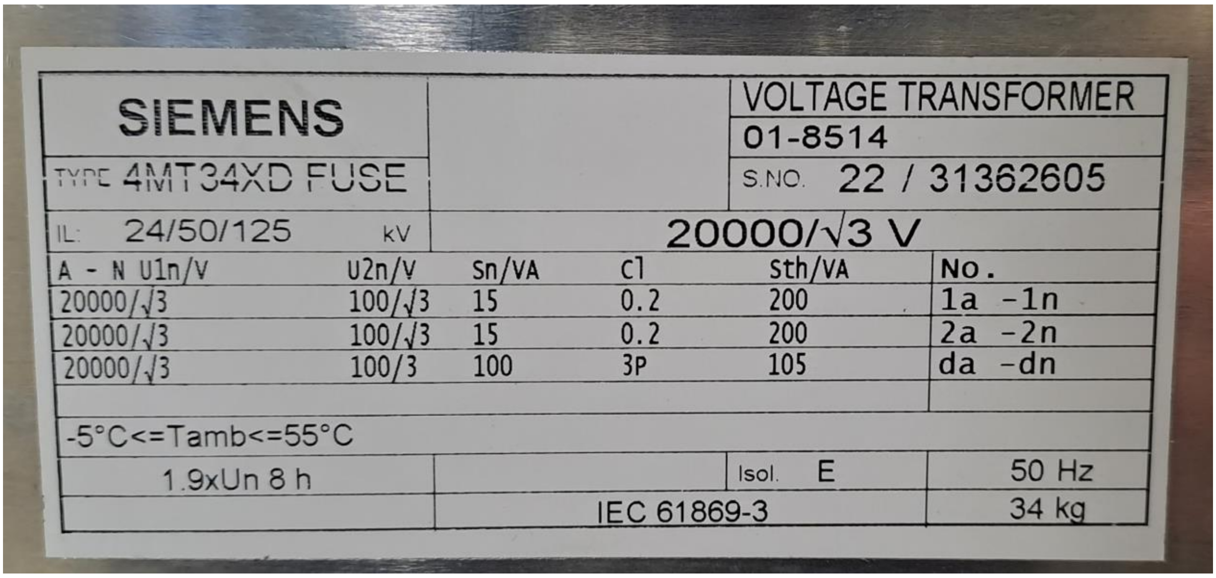


Photo 1: Rating plate of the test object

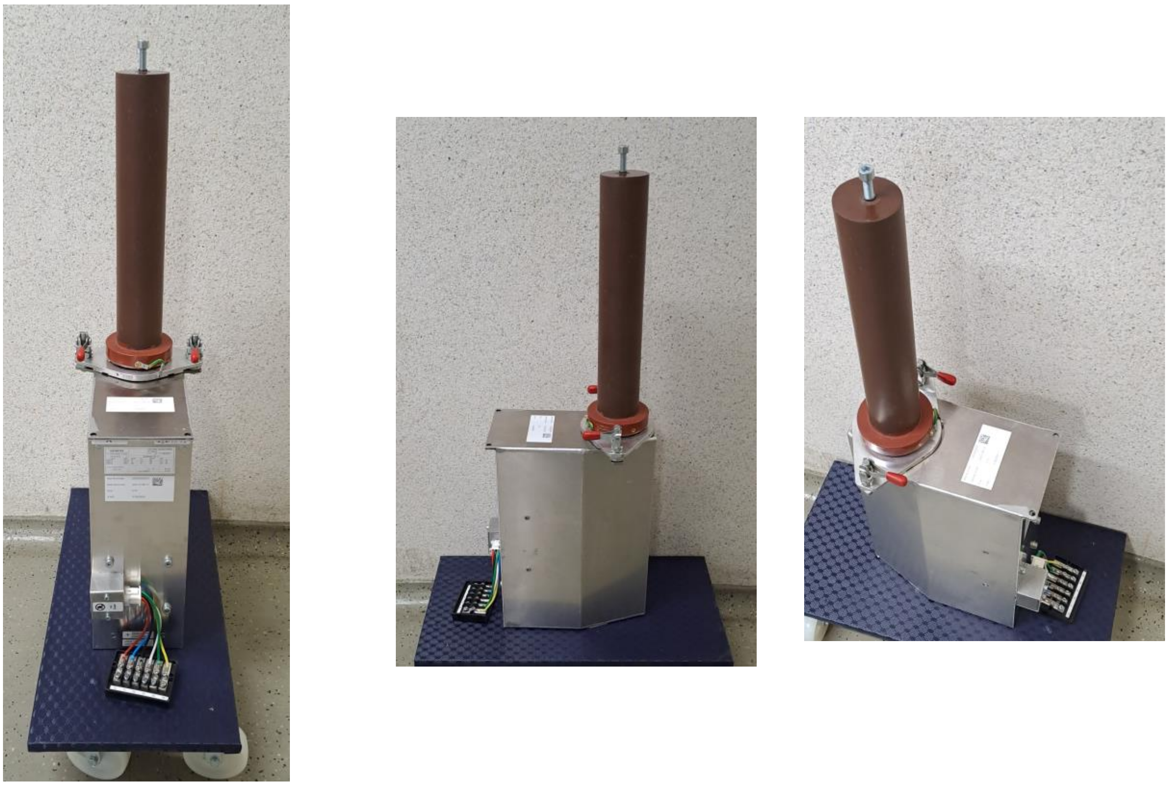
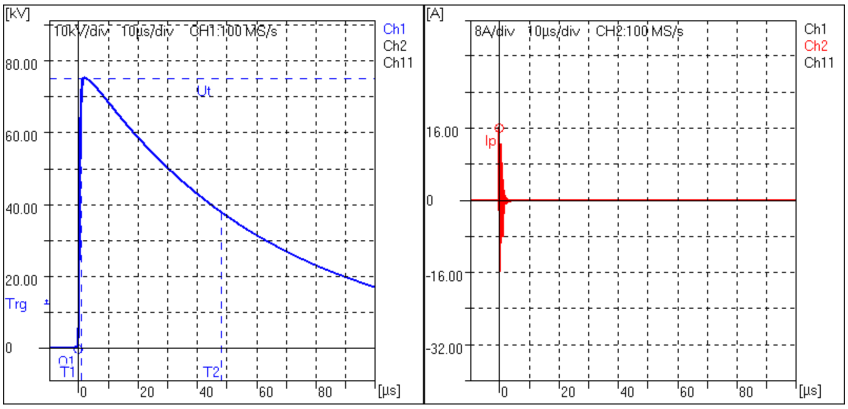


Photo 2: View of the test object

Photo 3: Test object after the short-circuit withstand capability test

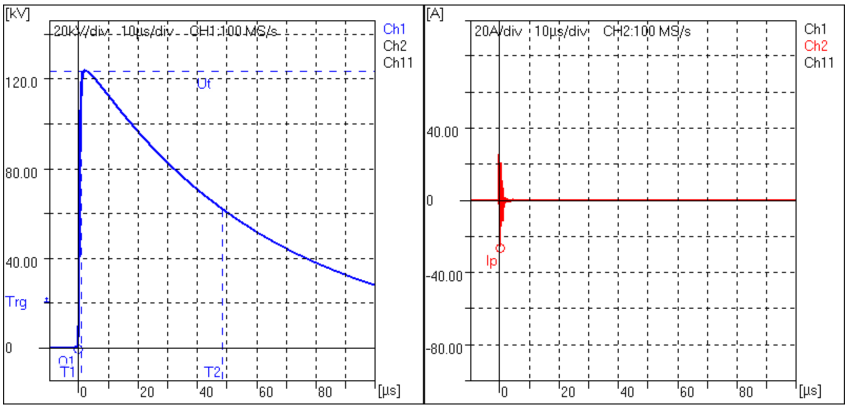
10. Oscillograms



60% LI RW

No. 3

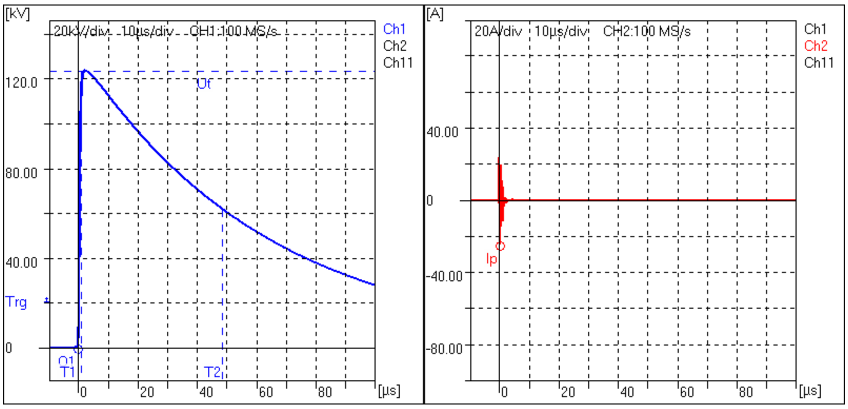
U_t = 75.6 kV
T_1 = 1.15 µs
T_2 = 48.4 µs
I_p = 16.4 A



100% LI FW

No. 4

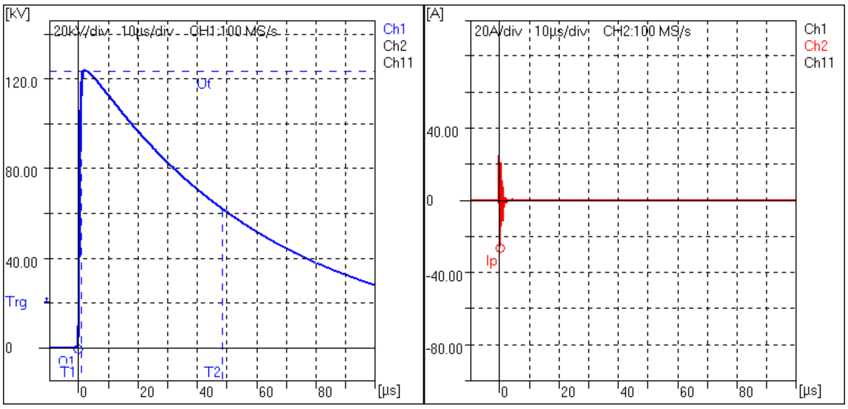
U_t = 124.3 kV
T_1 = 1.15 µs
T_2 = 48.5 µs
I_p = -25.9 A



100% LI FW

No. 5

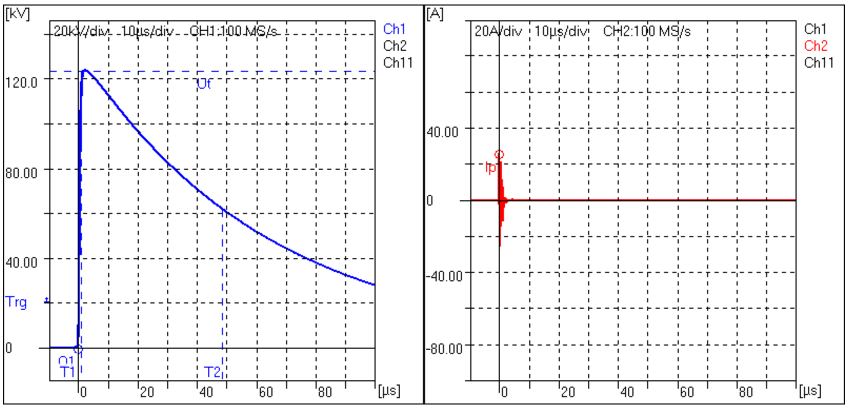
U_t = 124.3 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = -24.7 A



100% LI FW

No. 6

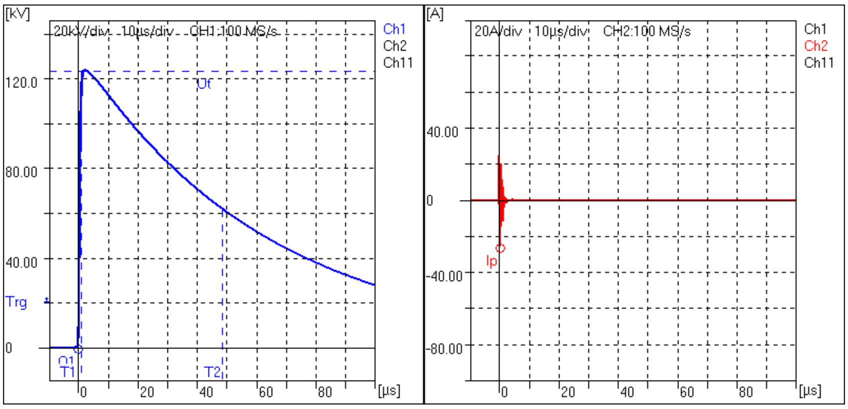
U_t = 124.4 kV
T_1 = 1.15 µs
T_2 = 48.5 µs
I_p = -25.5 A



100% LI FW

No. 7

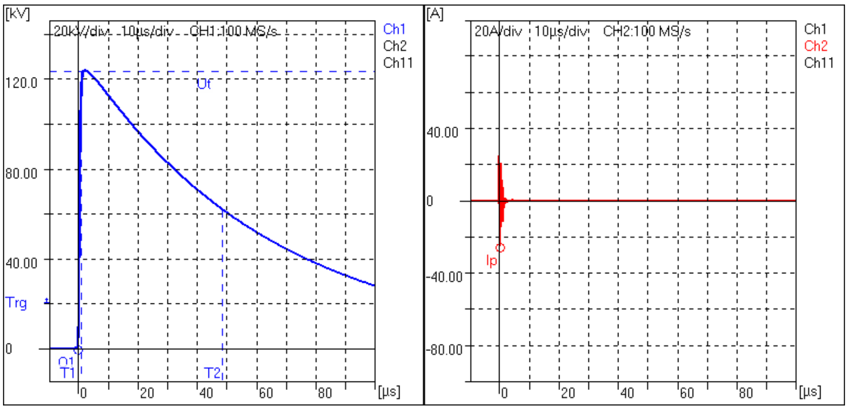
U_t = 124.4 kV
T_1 = 1.15 µs
T_2 = 48.5 µs
I_p = 26.0 A



100% LI FW

No. 8

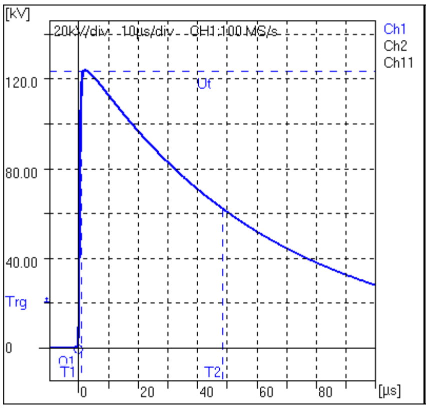
U_t = 124.5 kV
T_1 = 1.15 µs
T_2 = 48.5 µs
I_p = -25.5 A

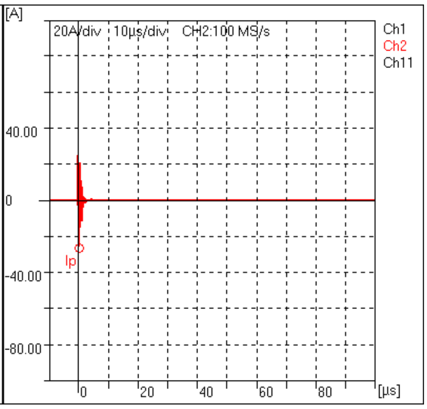


100% LI FW

No. 9

U_t = 124.5 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = -25.3 A

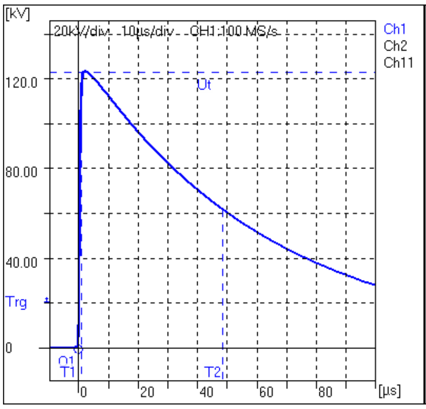


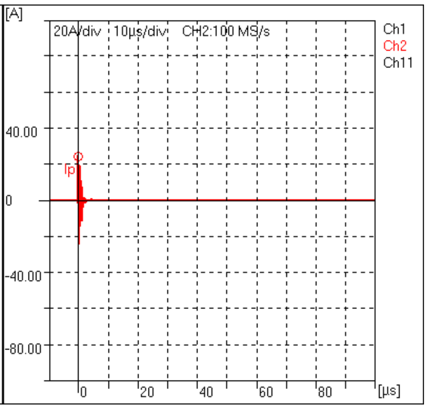


100% LI FW

No. 10

U_t = 124.5 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = -25.5 A

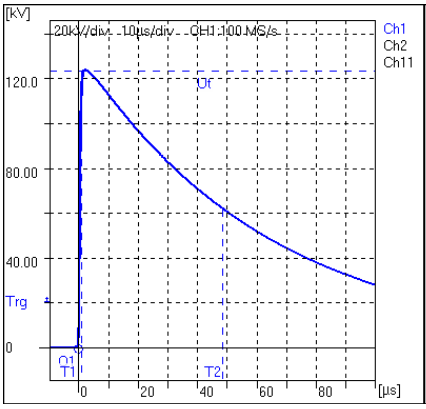


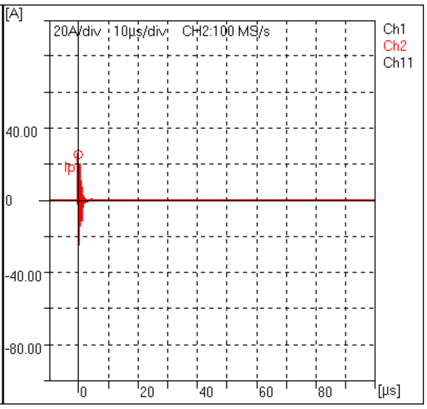


100% LI FW

No. 11

U_t = 124.0 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = 25.1 A

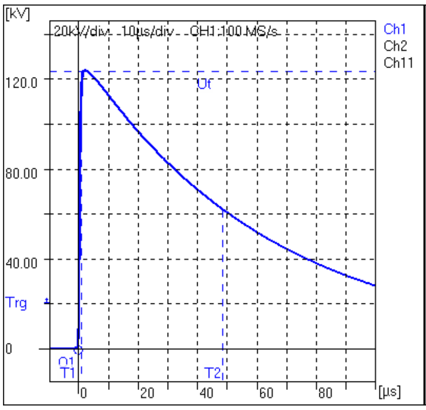


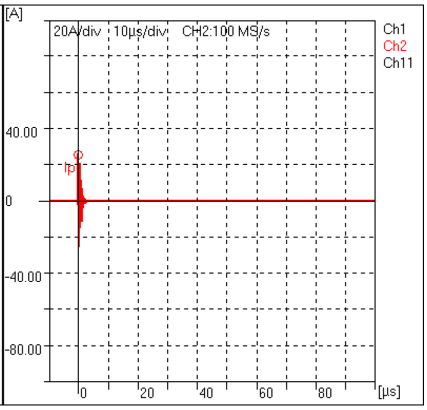


100% LI FW

No. 12

U_t = 124.5 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = 26.1 A

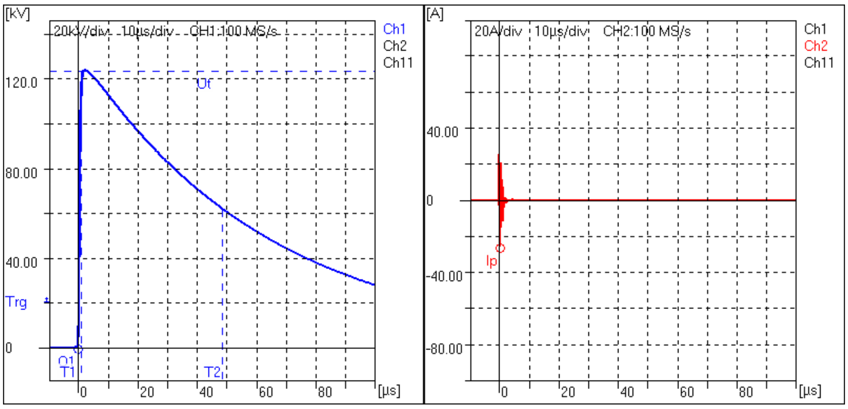




100% LI FW

No. 13

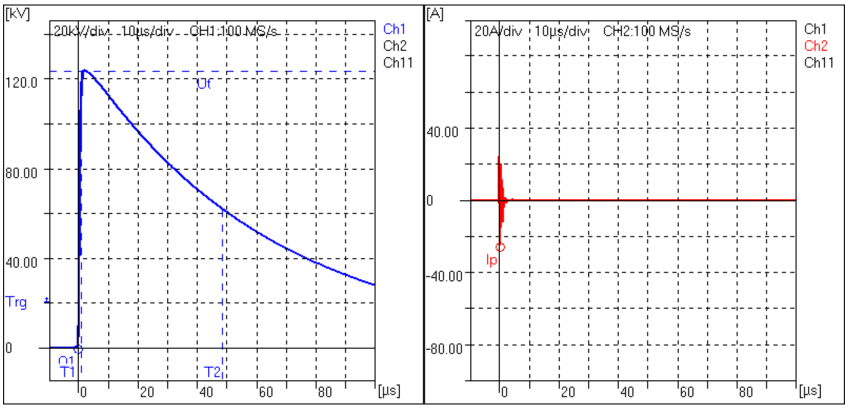
U_t = 124.5 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = 26.4 A



100% LI FW

No. 14

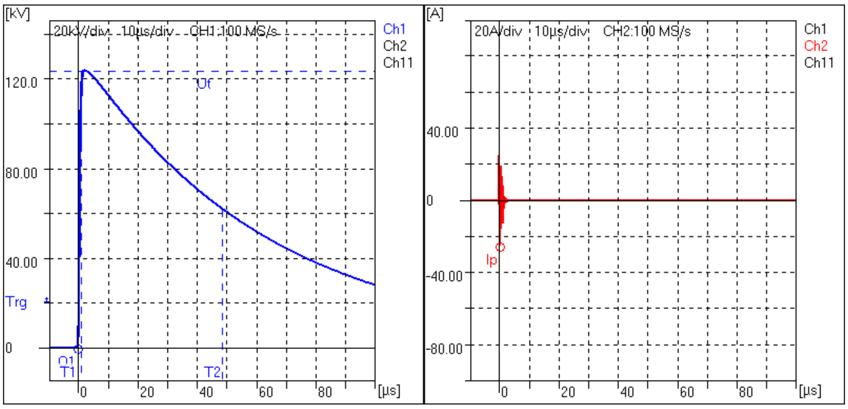
U_t = 124.5 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = -26.0 A



100% LI FW

No. 15

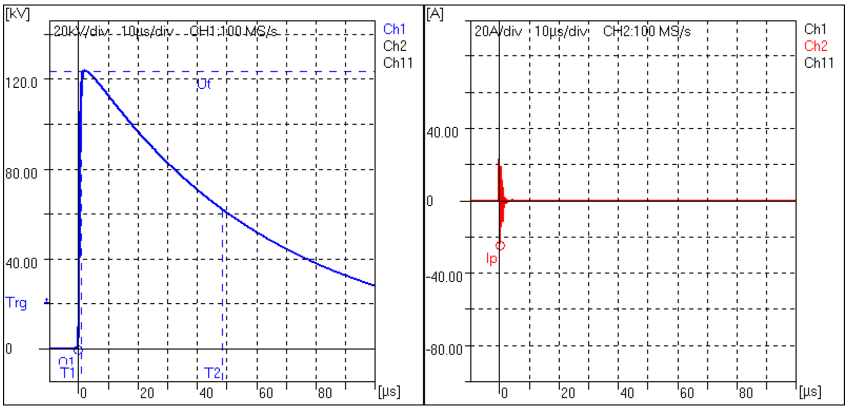
U_t = 124.4 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = -25.0 A



100% LI FW

No. 16

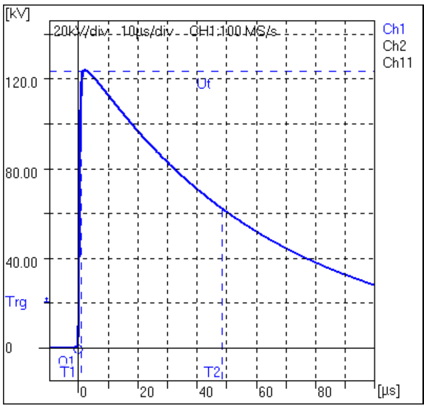
U_t = 124.4 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = -25.1 A

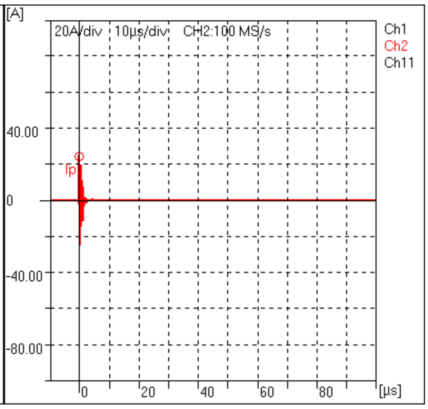


100% LI FW

No. 17

U_t = 124.4 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = -24.1 A

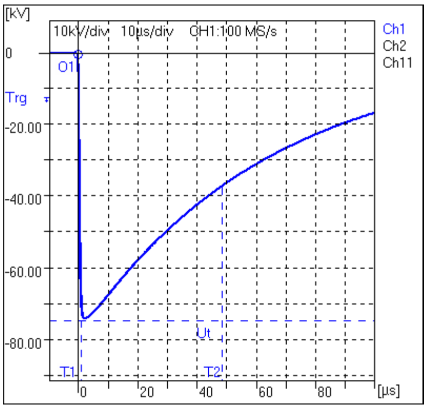


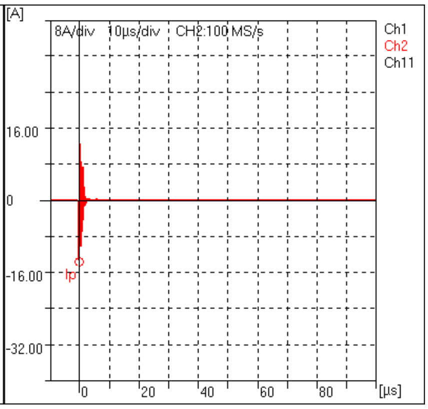


100% LI FW

No. 18

U_t = 124.5 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = 25.2 A

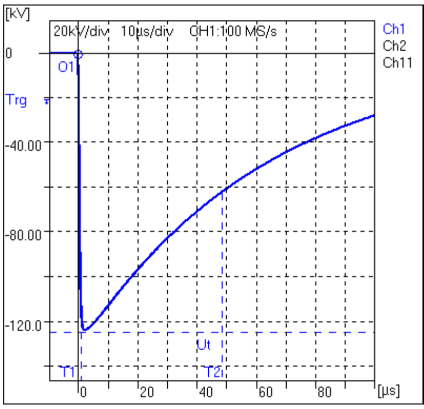


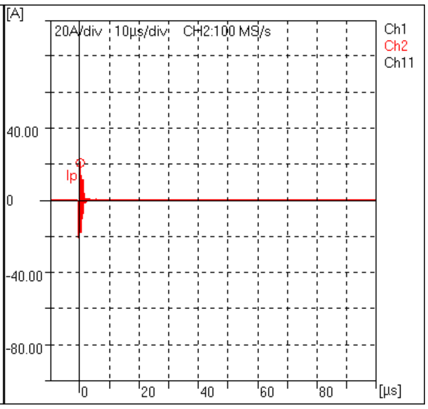


60% LI RW

No. 19

U_t = -74.4 kV
T_1 = 1.15 µs
T_2 = 48.5 µs
I_p = -13.2 A

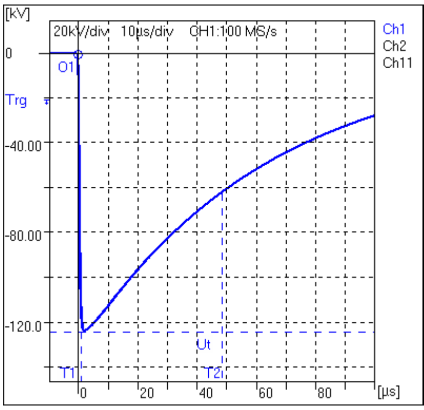


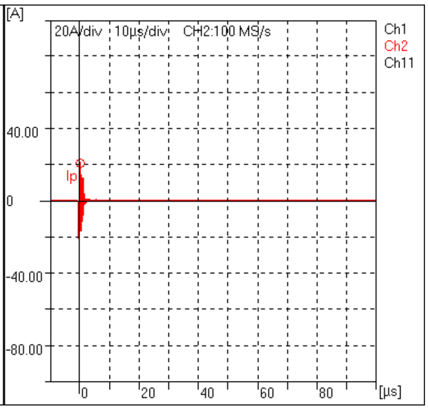


100% LI FW

No. 20

U_t = -124.2 kV
T_1 = 1.16 µs
T_2 = 48.6 µs
I_p = 21.7 A

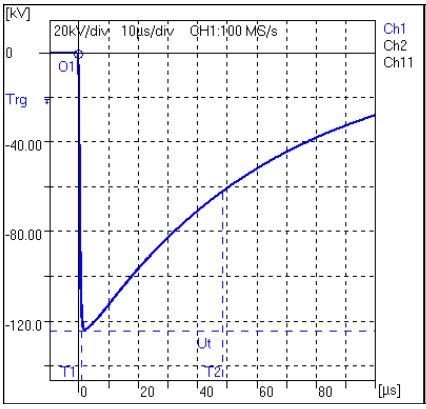


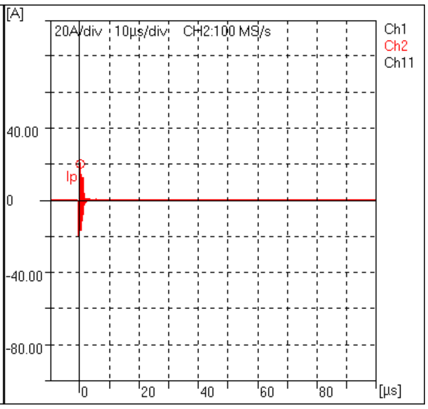


100% LI FW

No. 21

U_t = -124.0 kV
T_1 = 1.16 µs
T_2 = 48.6 µs
I_p = 21.5 A

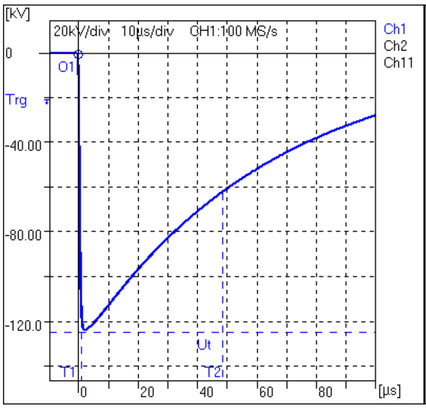


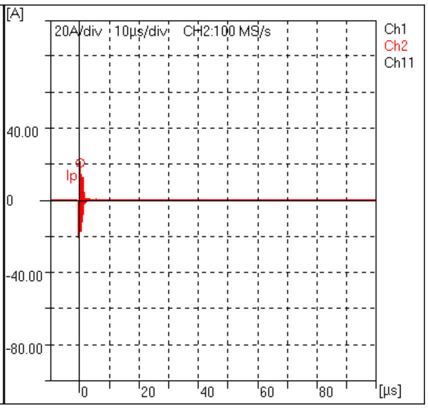


100% LI FW

No. 22

U_t = -124.0 kV
T_1 = 1.16 µs
T_2 = 48.6 µs
I_p = 20.9 A

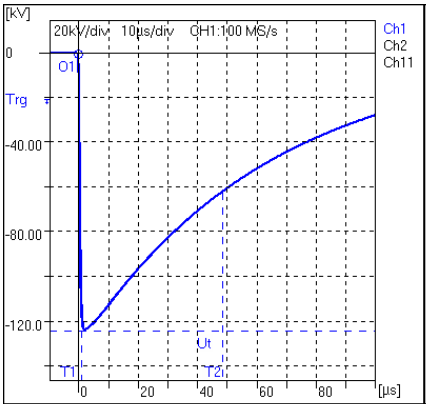


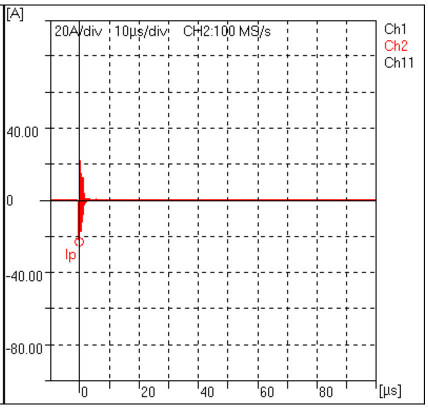


100% LI FW

No. 23

U_t = -124.2 kV
T_1 = 1.16 µs
T_2 = 48.6 µs
I_p = 21.4 A

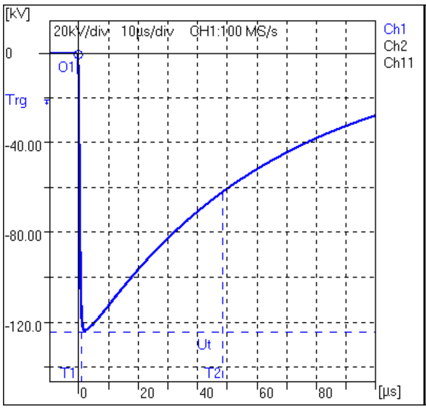


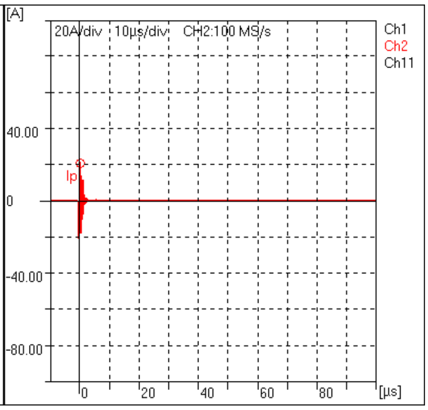


100% LI FW

No. 24

U_t = -124.0 kV
T_1 = 1.16 µs
T_2 = 48.6 µs
I_p = -22.4 A

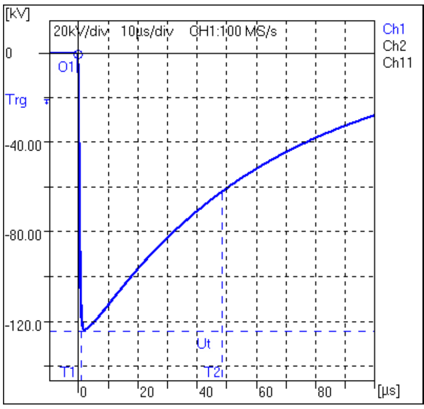


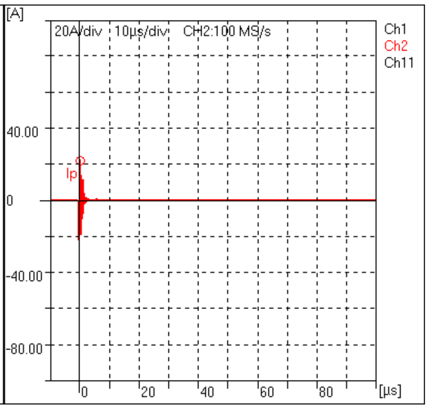


100% LI FW

No. 25

U_t = -124.0 kV
T_1 = 1.16 µs
T_2 = 48.6 µs
I_p = 21.9 A

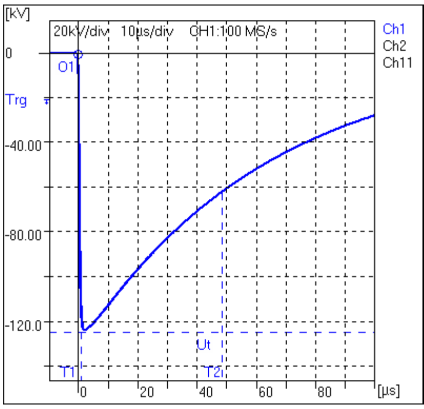


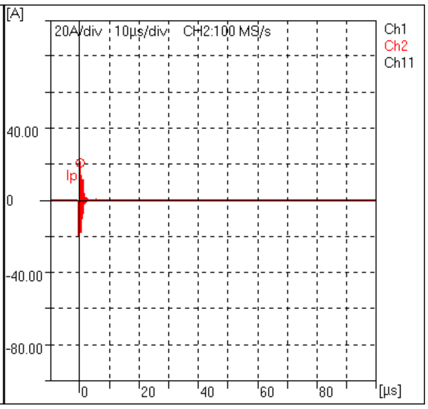


100% LI FW

No. 26

U_t = -124.0 kV
T_1 = 1.16 µs
T_2 = 48.6 µs
I_p = 22.7 A

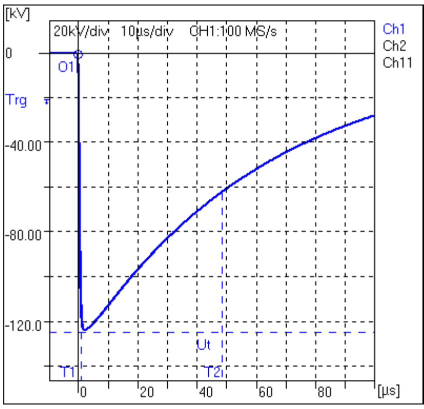


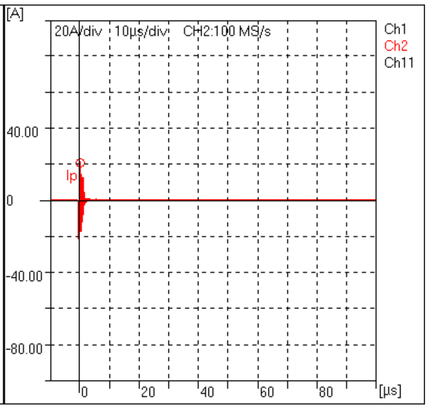


100% LI FW

No. 27

U_t = -124.1 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = 21.7 A

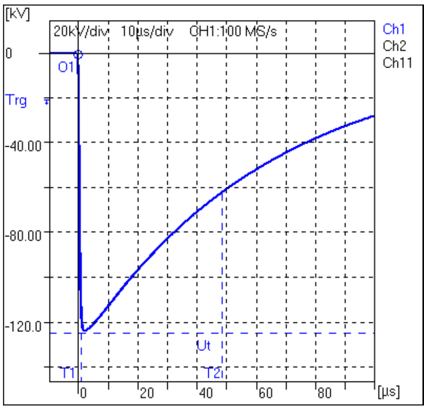


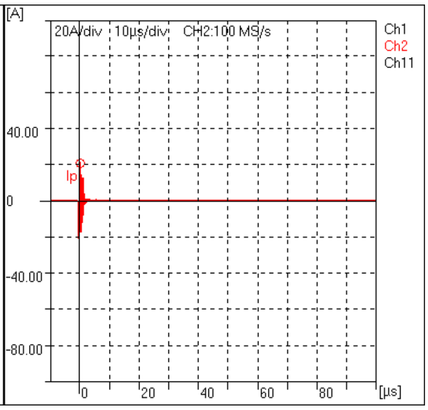


100% LI FW

No. 28

U_t = -124.2 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = 21.8 A

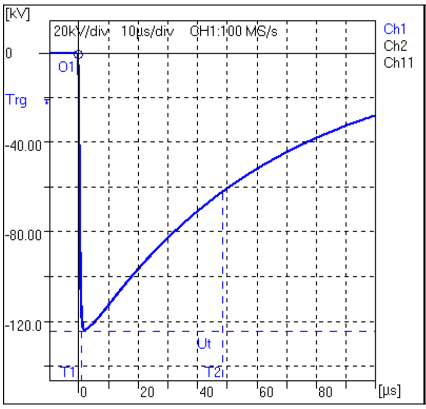


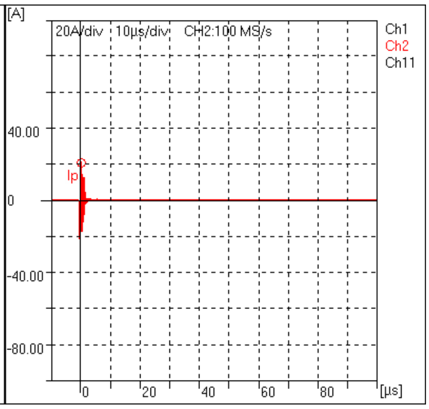


100% LI FW

No. 29

U_t = -124.2 kV
T_1 = 1.16 µs
T_2 = 48.6 µs
I_p = 21.6 A

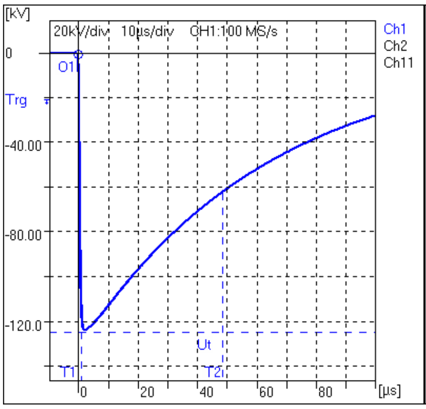


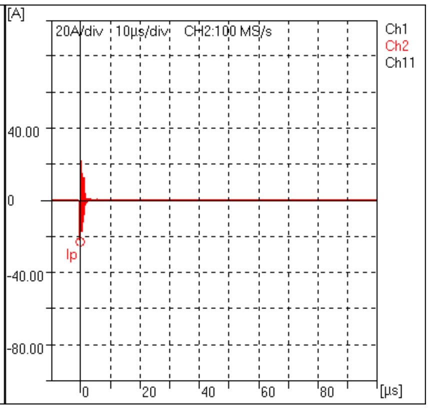


100% LI FW

No. 30

U_t = -124.1 kV
T_1 = 1.16 µs
T_2 = 48.6 µs
I_p = 21.9 A

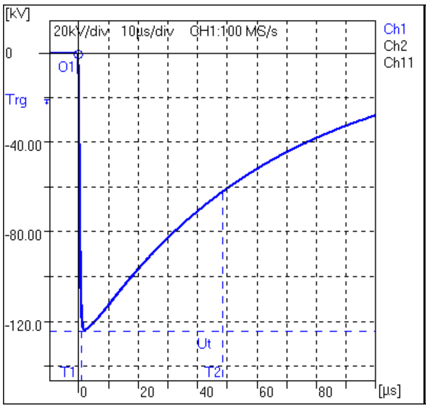


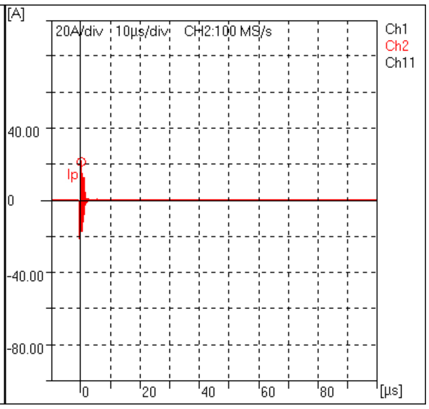


100% LI FW

No. 31

U_t = -124.2 kV
T_1 = 1.16 µs
T_2 = 48.6 µs
I_p = -22.2 A

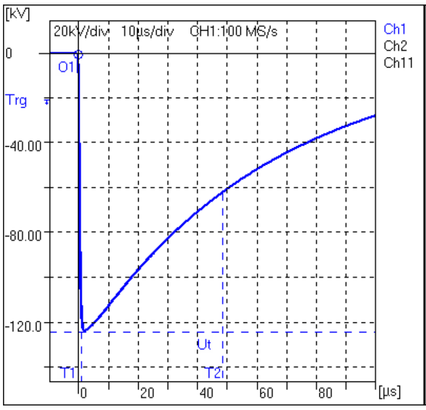


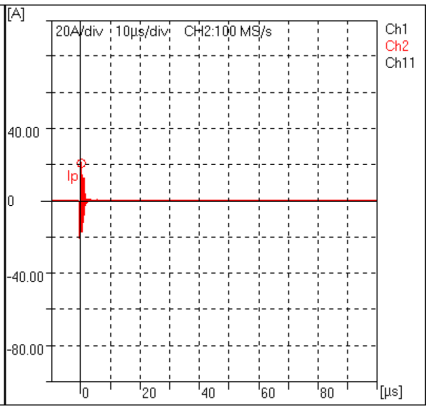


100% LI FW

No. 32

U_t = -124.0 kV
T_1 = 1.15 µs
T_2 = 48.6 µs
I_p = 22.2 A

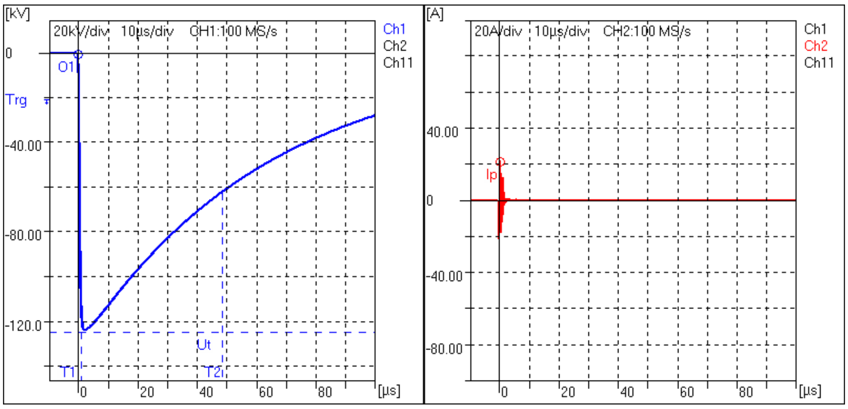




100% LI FW

No. 33

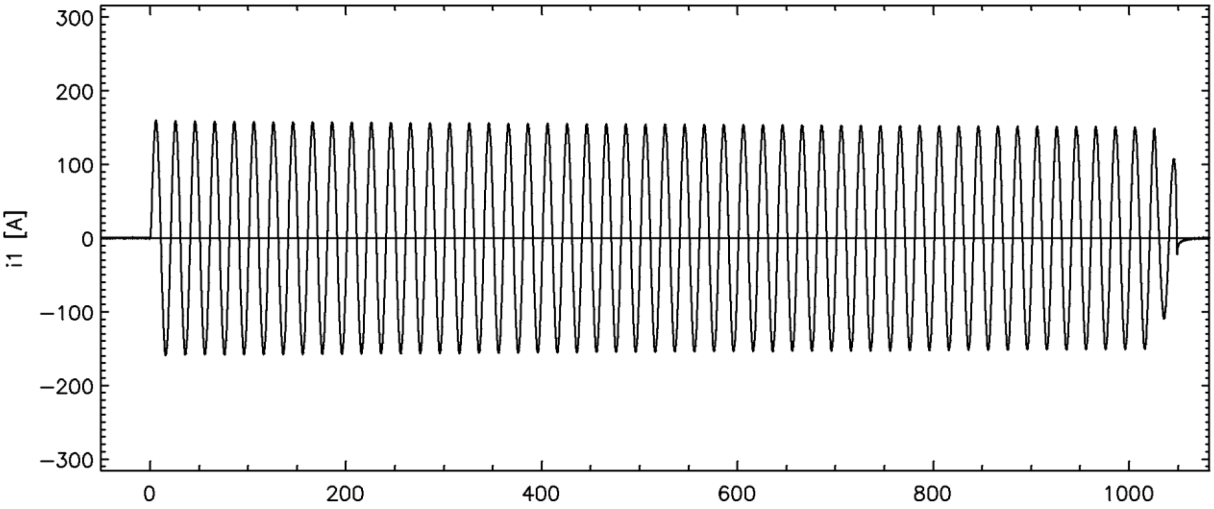
U_t = -124.0 kV
T_1 = 1.16 µs
T_2 = 48.7 µs
I_p = 21.4 A

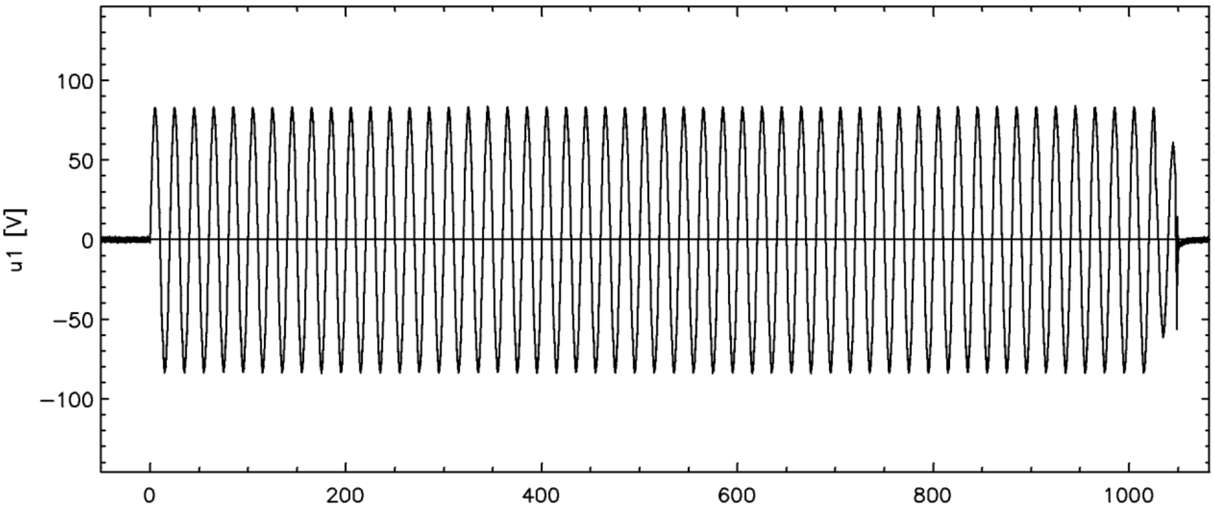


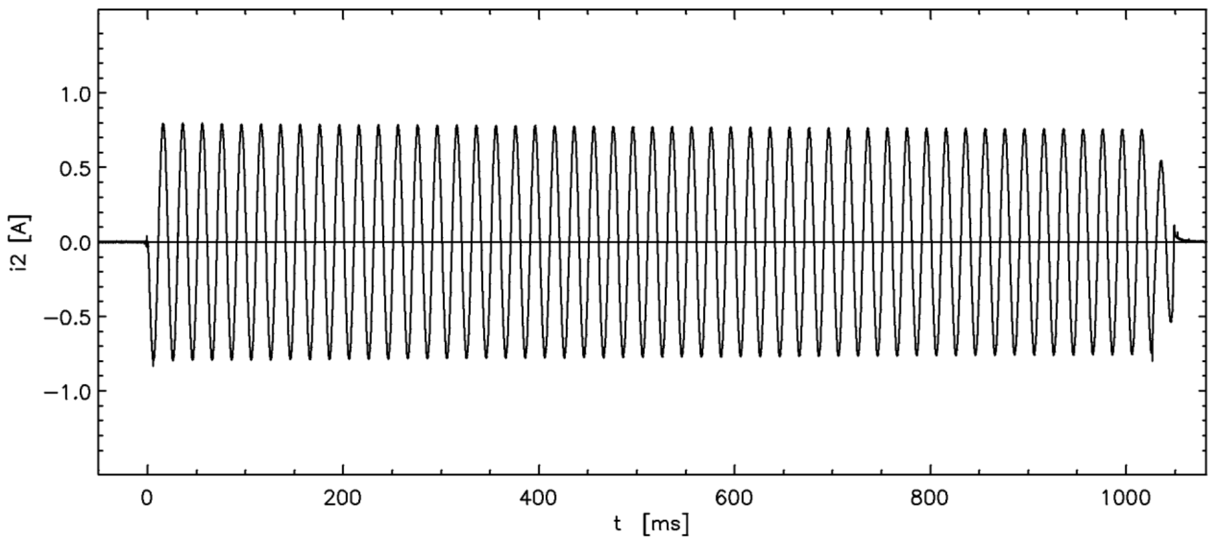
100% LI FW

No. 34	
U_t = -124.2 kV	
T_1 = 1.15 µs	
T_2 = 48.6 µs	
I_p = 22.3 A	

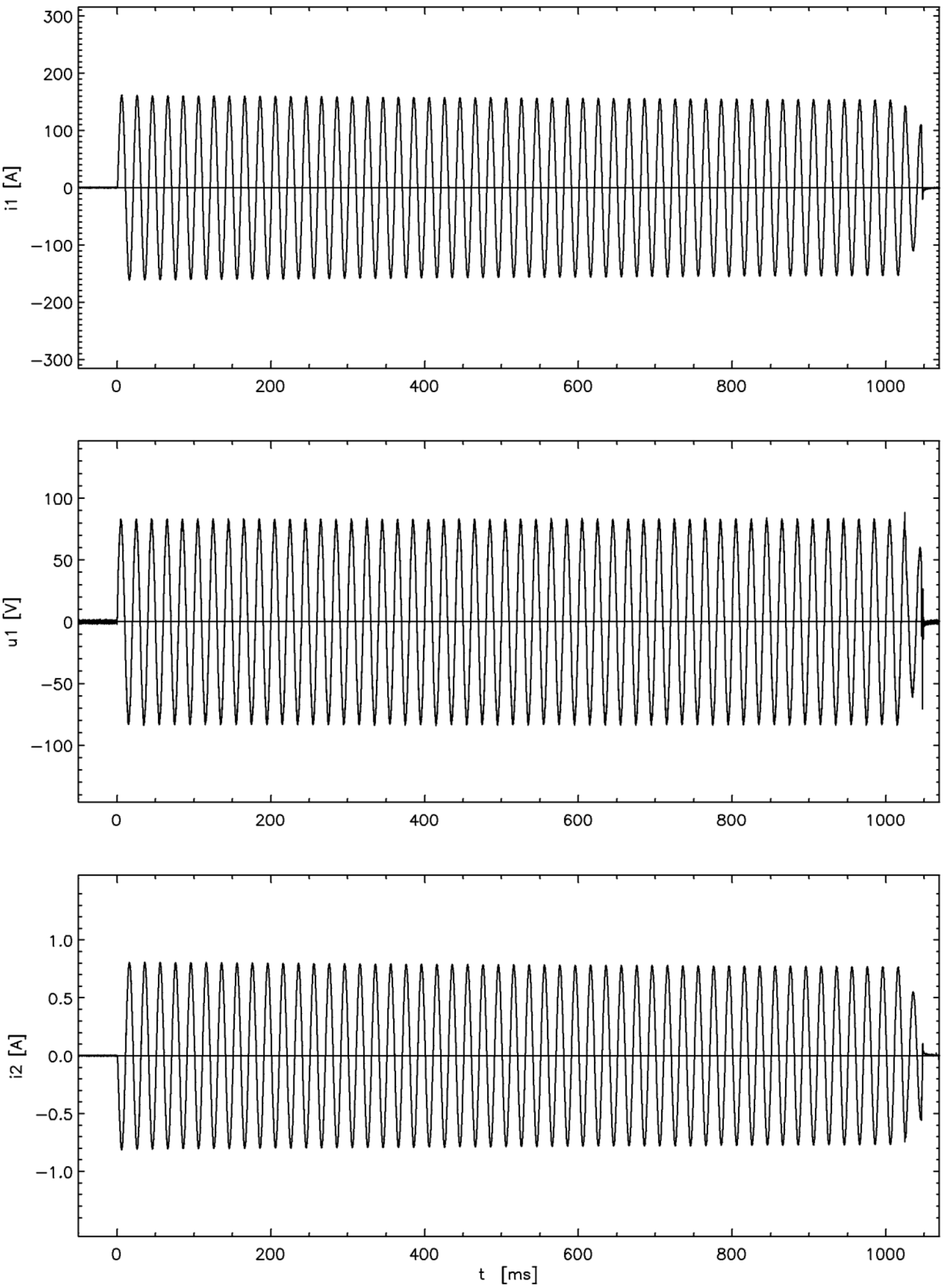
Test–No. 4230121



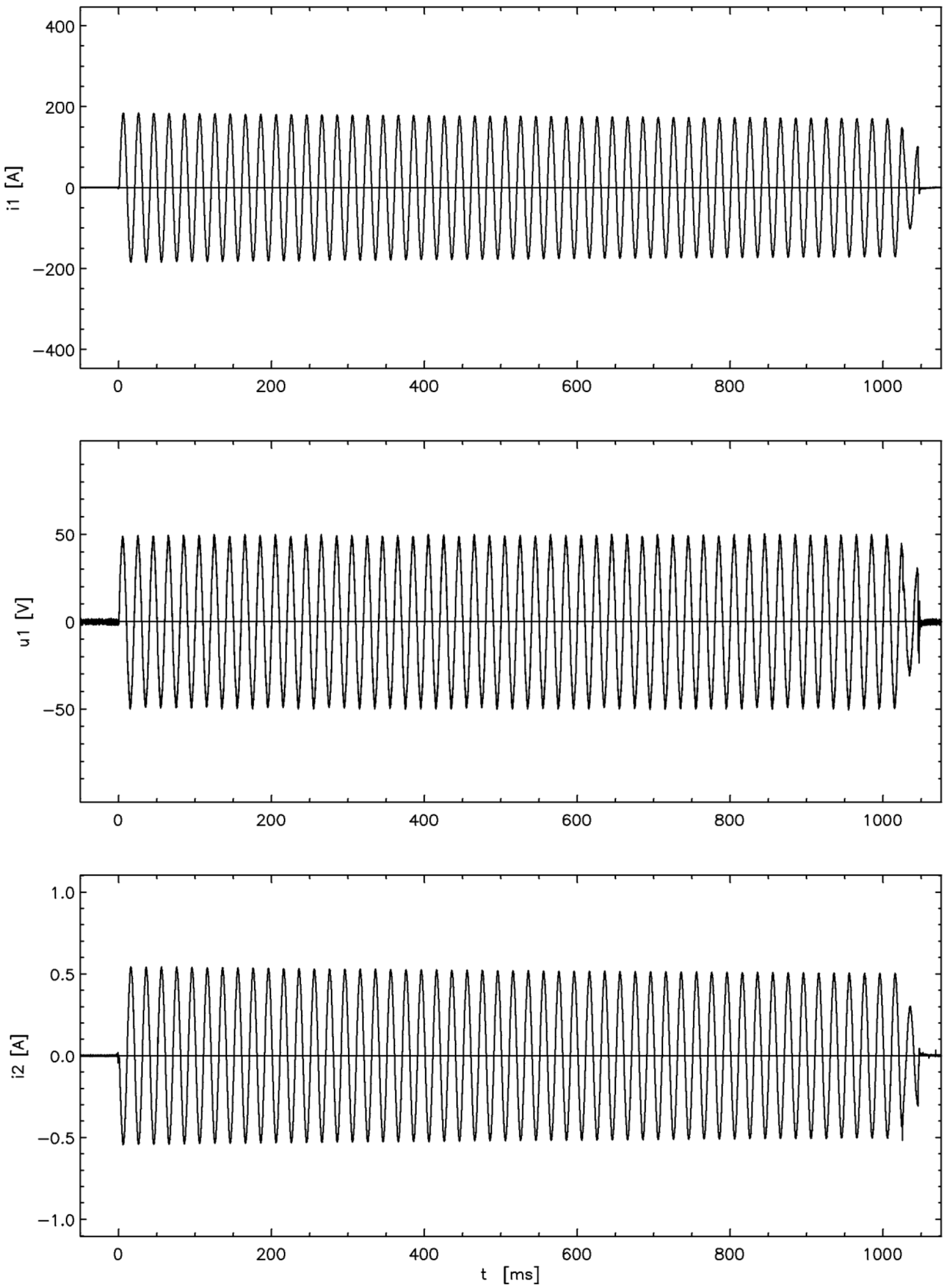




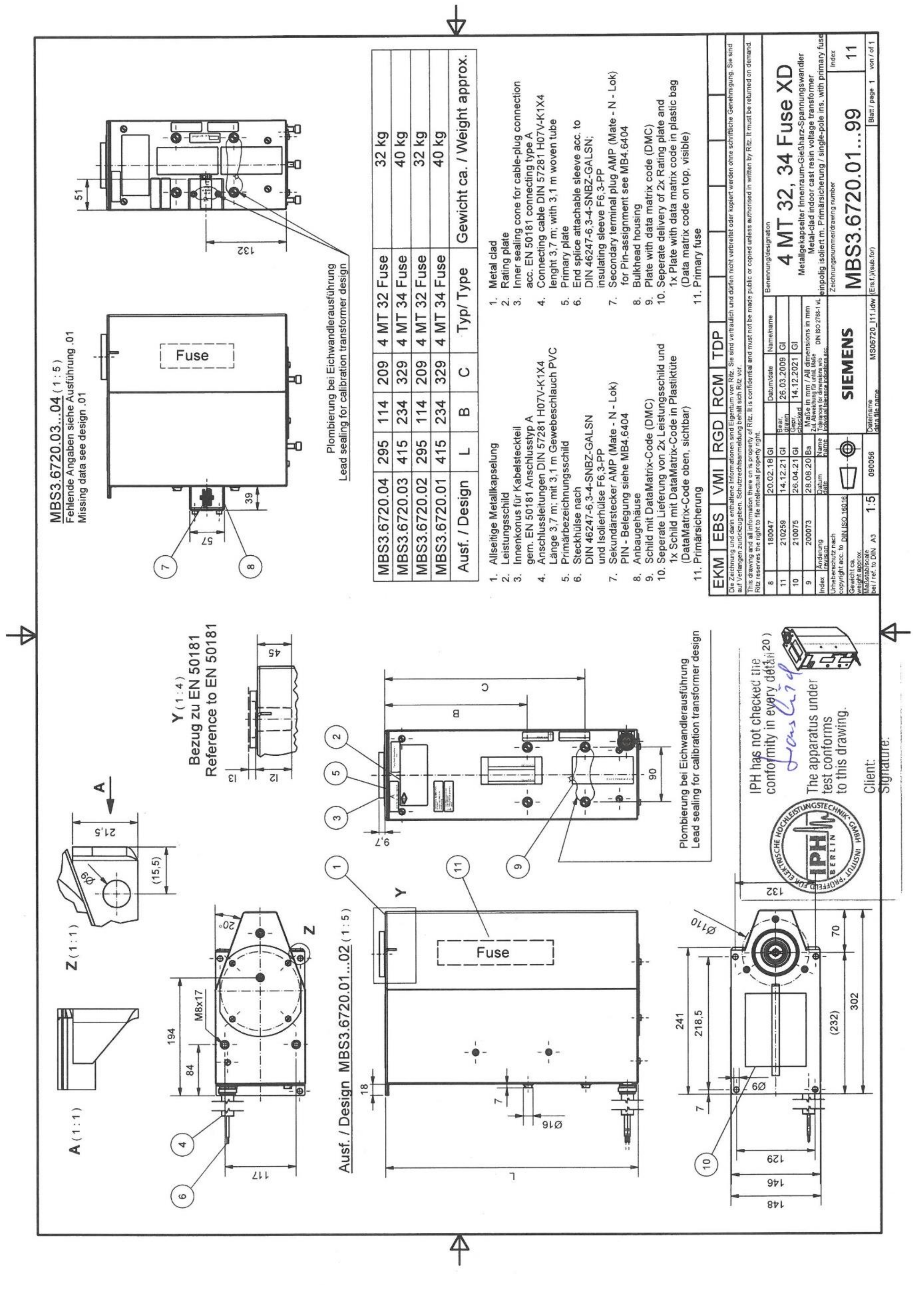
Test–No. 4230122



Test–No. 4230123



11. Drawing



MBS3.6720.03...04 (1:5)
Fehlende Angaben siehe Ausführung .01
Missing data see design .01
Fuse
Plombierung bei Eichwandlerausführung
Lead sealing for calibration transformer design
MBS3.6720.04 | 295 | 114 | 209 | 4 MT 32 Fuse | 32 kg
MBS3.6720.03 | 415 | 234 | 329 | 4 MT 34 Fuse | 40 kg
MBS3.6720.02 | 295 | 114 | 209 | 4 MT 32 Fuse | 32 kg
MBS3.6720.01 | 415 | 234 | 329 | 4 MT 34 Fuse | 40 kg
Ausf. / Design | L | B | C | Typ/ Type | Gewicht ca. / Weight approx.
1. Allseitige Metallkapselung
2. Leistungsschild
3. Innenkonus für Kabelsteckteil gem. EN 50181 Anschlusstyp A
4. Anschlussleitungen DIN 57281 H07V-K1X4 Länge 3,7 m; mit 3,1 m Gewebeschlauch PVC
5. Primärbezeichnungsschild
6. Steckhülse nach DIN 46247-6,3-4-SNBZ-GALSN und Isolierhülse F6,3-PP
7. Sekundärstecker AMP (Mate - N - Lok) PIN - Belegung siehe MB4.6404
8. Anbaugehäuse
9. Schild mit DataMatrix-Code (DMC)
10. Seperate Lieferung von 2x Leistungsschild und 1x Schild mit DataMatrix-Code in Plastiktüte (DataMatrix-Code oben, sichtbar)
11. Primärsicherung
1. Metal clad
2. Rating plate
3. Inner sealing cone for cable-plug connection acc. EN 50181 connecting type A
4. Connecting cable DIN 57281 H07V-K1X4 lenght 3,7 m; with 3,1 m woven tube
5. Primary plate
6. End splice attachable sleeve acc. to DIN 46247-6,3-4-SNBZ-GALSN; insulating sleeve F6,3-PP
7. Secondary terminal plug AMP (Mate - N - Lok) for Pin-assignment see MB4.6404
8. Bulkhead housing
9. Plate with data matrix code (DMC)
10. Seperate delivery of 2x Rating plate and 1x Plate with data matrix code in plastic bag (Data matrix code on top, visible)
11. Primary fuse
EKM EBS VMI RGD RCM TDP
4 MT 32, 34 Fuse XD
Metallgekapselter Innenraum-Gießharz-Spannungswandler
Metal-clad indoor cast resin voltage transformer
einpolig isoliert m. Primärsicherung / single-pole ins. with primary fuse
MBS3.6720.01...99
11
SIEMENS
1:5
Y (1:4)
Bezug zu EN 50181
Reference to EN 50181
Z (1:1)
A (1:1)
Ausf. / Design MBS3.6720.01...02 (1:5)
IPH has not checked the conformity in every detail.
The apparatus under test conforms to this drawing.
Client:
Signature: