230008349512

中国认可
国际互认
检测
TESTING
CNAS L0681

CHPTL

Type Test Certificate

No:CTQC/H-23.0013

Client: Lugao Power Co.,Ltd.

Production unit: Lugao Power Co.,Ltd.

Sample Name: Voltage Transformer

Sample Model: JDQXH-252

Sample Number: XJ23010017-1

Test Items: Routine test, type test, insulation resistance measurement, winding DC resistance measurement, mechanical strength test, zero gauge voltage power frequency withstand test, and transmission overvoltage test.

Test Basis: CB/T20840.1-2010, GB/T20840.3-2013, IBC61869-1:2007, IBC61869-3:2011, Technical Service Contract.

Test Conclusion: The test results of the routine test, type test, insulation resistance measurement, winding DC resistance measurement, mechanical strength test, zero gauge voltage power frequency withstand test, and transmission overvoltage test of the voltage transformer (model: JDQXH-252) meet the requirements of the inspection basis standards and technical service contract, and the above tests of the sample are qualified.

Approved: Zhou Jingwei 2023.04.13

Shenyang Transformer Research Institute Co., Ltd

National Transformer Quality Inspection and Testing Center

230008349512

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CNAS L0681

CHPTL

Type Test Report

No:CTQC/H-23.0013

Sample Name: Voltage Transformer

Sample model: JDQXH-252

Entrusting Unit: Lugao Power Co.,Ltd.

Production Unit: Lugao Power Co.,Ltd.

Inspection Category: Type Test

Shenyang Transformer Research Institute Co., Ltd

National Transformer Quality Inspection and Testing Center

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11. Attachment 2: Schematic Diagram of Test Circuit (6 pages in total)

12. Attachment 3: Drawings related to transformers (2 pages in total)

Shenyang Transformer Research Institute Co., Ltd
National Transformer Quality Inspection and Testing Center
Type Test Report

No:CTQC/H-23.0013

Sample name	voltage transformer	Enterpriseapplication model	JDQXH-252
		Confirm model	/
Client	Lugao Power Co.,Ltd.	Test category	Type Test
Manufacturer	Lugao Power Co.,Ltd.	Sample arrival date	March 20th, 2023
		Test date	March 23, 2023 to April 1, 2023
Manufacturer's address	19# Keaisi Road, Xiangyang Industrial Park, Liushi Town, Yueqing City, Wenzhou of China.	Original number or production date	XJ23010017-1
Inspection basis	GB/T20840.1-2010 GB/T20840.3-2013 IEC61869-1:2007 IEC61869-3:2011 Technical Service Contract	检验项目	Routine test Type test Insulation resistance measurement Measurement of DC resistance of winding Mechanical strength test Power frequency withstand voltage test under zero gauge pressure Transmission overvoltage test
Test conclusion	The test results of the routine test, type test, insulation resistance measurement, winding DC resistance measurement, mechanical strength test, zero gauge voltage power frequency withstand test, and transmission overvoltage test of the voltage transformer (model: JDQHH-252) meet the requirements of the inspection basis standards and technical service contract, and the above tests of the sample are qualified. Date of Issue: 2023 年 04 月 13 日		
Remark			

Approved: Audited: Cross checking: Prepared by:

Declaration: 1. The inspection report is invalid without the "Inspection Special Seal", the official seal of the inspection unit, and the seal on each page. 2. The inspection report is invalid without the signature of the preparer, reviewer, and approver. 3. The inspection (monitoring) conclusion is only valid for the sample. 4. Without written approval from the laboratory, certificates or inspection reports shall not be reproduced (except for complete reproduction). 5. If the sample meets the requirements of insulation special test, type test, and short-circuit performance test specified in the standard, a type inspection report shall be issued.

Test Report

Summary of experimental results

No.	Test item	specified value	measured value	Project Conclusion
1	Primary power frequency withstand voltage test(Routine)	Primary external construction frequency withstand voltage test Applied voltage (kV): 5 Duration (s): 60	5 60	Pass
		Primary end induction withstand voltage test Induced voltage (kV): 460 Duration (s): 120(f_r/f) Frequency (Hz):>100	460 30 200	
2	Partial discharge measurement (routine)	Measurement voltage (kV): U_m Duration (s): 30 Allowable discharge capacity: (pC): ≤ 10	252 30 3	Pass
		Measurement voltage: (kV): $1.2U_m/\sqrt{3}$ Duration (s): 30 Allowable discharge capacity (pC): ≤ 5	174.6 30 3	
3	Secondary end power frequency withstand voltage test (routine)	Applied voltage: (kV): 3 Duration (s): 60	3 60	Pass
4	Inspection of Signs (Routine)	Terminal marking correctness verification polarity relationship verification	Terminal markings are correct Subtractive polarity	Pass
5	Excitation characteristic measurement (type, routine)	According to the provisions of Article 7.2.302 and 7.3.301 of GB/T20840.3-2013 standard	Refer to experiments 4.5 and 4.14.2.4	Pass
6	Accuracy test (routine)	According to Article 7.3.7 of GB/ T20840.3-2013 standard	Refer to Experiment 4.6	Pass
7	Gas Dew Point Measurement (Routine)	Dew point at 20 ℃ (℃)≤ -30	-52.2	Pass
8	Sealing performance test at ambient temperature (routine)	Applied pressure (MPa): 0.4 Test time (h): 24 Annual gas leakage rate (%): ≤ 5	0.4 24 0.0011	Pass
9	Pressure test (routine)	Welding shell Applied pressure (MPa): 1800 Test time (s): 1.0 No rupture or permanent deformation	1.0 1800 No rupture or permanent deformation	Pass

No.	Test item	Specified value Standard (Technical Service Contract)	Measured values	Project Conclusion
10	Temperature rise test (type)	1.0 U_{pr} Winding temperature rise limit (K): 75	1.0U_{pr} la-1n with maximum output Primary winding A-N: 6.3 Secondary winding 1a-1n: 7.8 2a-2n:6.3 3a-3n:7.3 da-dn:7.3	Pass
		1.2 U_{pr} Winding temperature rise limit (K): 75	1.2U_{pr} Primary winding A-N: 5.1 Secondary winding la-1n:8.1 2a-2n:7.2 3a-3n:8.3 da-dn:8.0	
		1.5 U_{pr} Winding temperature rise limit (K): 65	1.5U_{pr} Primary windingA-N: 5.5 Secondary winding1a-1n:9.4 2a-2n:8.3 3a-3n:9.1 da-dn:8.6	
11	Primary end impact resistance test (type)	Primary terminal rated lightning impulse withstand voltage test Full-wave voltage (kV): 1050 ±3% 15 times each for positive and negative polarities	1022～1057 15 times each	Pass
		Primary-end cutoff lightning impulse withstand voltage test Chop voltage (kV): 1208 ±3% Negative polarity 2nd time	1206～1208 2times	
12	Accuracy test (type)	According to Clause 7.2.6 of GB/T20840.3-2013.	See test 4.12	Pass
13	Radio interference voltage measurement (type)	Measured voltage (kV): 1.1Uw/√3 Radio interference level (μV): ≤500	160.0 355	Pass
14	Short circuit withstand capability test (type)	Applied voltage (V): 100/√3 Duration (s): 1.0 Test items after short-circuit withstand capability test Meets standard requirements	58.21 1.0 Meets standard requirements	Pass

No.	Test item	Specified value Standard (Technical Service Contract)	Measured values	Project Conclusion
15	Testing of enclosure protection rating (type)	According to IP55 and IK07 protection level requirements	See test 4.15	Pass
16	Pressure test (type)	Welding the outer casing Applied pressure (MPa): 1.53 Duration (s): 300 No cracks or permanent deformation	1.53 300 No cracks or permanent deformation	Pass
17	Power frequency withstand voltage test under zero gauge pressure (special)	Applied voltage (kV): 1.3Uw/√3 Duration (s): 300	189.1 300	Pass
18	Transmitted overvoltage test (special)	Transmitted overvoltage (V): ≤1600	516.2~868.4	Pass

Note: During the insulation test, accuracy test, temperature rise test, sealing test, gas dew point measu rement, and short-circuit withstand capability test, the internal SF6 gas pressure of the sample met the req uirements specified in Table 12 of Clause 7.1.2 of GB/T20840.1-2010 and Table 11 of Clause 7.1.2 of IE C61869-1:2007.

(The following is blank)

1. Sample Parameters
Maximum Voltage (kV): 252
Rated Frequency (Hz): 50
Insulation Level (kV): 252/460/1050/1208
Insulation Heat Resistance Class: E
Usage Conditions: Outdoor
Altitude (m): ≤1000
Enclosure Protection Rating: IP65, IK07

Rated voltage factor:1.2□√ 1.5□√ 1.9□(30s□√8h□)

winding / Project	primary winding	Secondary winding			
		Measuring winding		Measuring(protection) winding	Residual voltage winding
Terminal markings	A-N	1a-1n	2a-2n	3a-3n	da-dn
Rated voltage (kV)	220~3	0.1N3	0.1N3	0.1N3	0.1
Accuracy level	/	0.2	0.5	0.5(3P)	3P
Rated output (VA)	/	100	100	100	300
Maximum Output (VA)	/	1000	/	/	/
cosφ	/	0.8	0.8	0.8	0.8

Minimum operating pressure (20℃) (MPa): 0.35 Rated working pressure (20℃) (MPa): 0.4; Design pressure (MPa): 0.5
Permissible annual leakage rate (%): ≤0.5

2. Sample Condition Description
The sample's appearance, structure, and main dimensions (length, width, height) conform to the product outline drawings.
Actual Measured Dimensions: Length 910mm, Width 610mm, Height 965mm.
Drawing Confirmation

Appearance	Nameplate
OBFH.300.8565.20	8BFH.860.8565.31

The nameplate and outline drawings are attached to the inspection report.
The format, performance data, and specifications of the sample nameplate conform to the requirements of the nameplate design drawings.
The primary and secondary side markings of the sample are clear and accurate.
The sample has no signs of collision or damage.

3. Inspection Basis
GB/T20840.1-2010, IEC61869-1:2007 Instrument Transformers-Part 1: General Technical RequirementsGB/ T20840.3-2013, IEC61869-3:2011 Instrument Transformers-Part 3: Supplementary Technical Requirements for Voltage Transformers
Technical Service Contract

4. Test Items and Results

4.1 Primary Terminal Power Frequency Withstand Voltage Test (Routine)

4.1.1 Primary Terminal External Power Frequency Withstand Voltage Test

The test circuit is shown in Appendix 2-a.

Test date: March 23, 2023

Instrument and equipment name	Model	serial number	Accuracy level	Validity period
Power frequency test transformer	YDTW-150/150	SB-102021	/	/
Power frequency high voltage measurement system	TRF150-0.001	YB-116141	3.0	2024.12.13
	PV2-1	YB-219709		

Relative humidity: 37.1%; Ambient temperature: 15.6℃; Atmospheric pressure: 100.1kPa

Pressure terminal	Apply voltage (kV)	Frequency (Hz)	Duration (s)	Conclusion
AN	5	50	60	Pass

4.1.2 Primary Terminal Inductive Withstand Voltage Test

The test circuit is shown in Appendix 2-b.

Test date: March 23, 2023

Instrument and equipment name	Model	serial number	Accuracy level	Validity period
Synchronous generator	TF4000-24	SB-318713	/	1
Power frequency test transformer	YDTCW-4500/3×500	SB-318709	/	/
Power frequency high voltage measurement system	TRF1500-0.001	YB-318890	3.0	2024.12.13
	PV2-1			

Relative humidity: 37.1%; Ambient temperature: 15.6℃; Atmospheric pressure: 100.1kPa

Pressure terminal	Apply voltage (kV)			Frequency (Hz)	Duration (s)	Conclusion
	Standard value	Atmospheric correction value	Apply value			
A	460	/	460	200	30	Pass

4.2 Partial Discharge Measurement (Routine)

The test circuit is shown in Appendix 2-c.

Test date: March 23, 2023

Instrument and equipment name	Model	serial number	Accuracy level	Validity period
Synchronous generator	TF4000-24	SB-318713	/	/
Power frequency test transformer	YDTCW-4500/3×500	SB-318709	/	/
Power frequency high voltage measurement system	TRF1500-0.001	YB-318890	3.0	2024.12.13
	PV2-1			
Partial Discharge Testing System	TWPD-02	YB-320115	10	2023.09.20
	TWPD-2B	YB-114208	10	2023.06.26

Relative humidity: 37.1%; Ambient temperature: 15.6℃; Atmospheric pressure: 100.1kPa

Pressure terminal	Pre-applied voltage(kV)	Frequency (Hz)	Duration (s)	Measuring voltage (kV)	Duration (s)	Discharge (pC)	Conclusion
A	460	200	30	252	30	3	Pass
				174.6	30	3	

Note: The test method was conducted according to procedure A in section 7.3.3.2 of GB/T20840.1-2010.

The background noise level before and after the test was <2pC.

4.3 Secondary terminal power frequency withstand voltage test (routine)

The test circuit is shown in Appendix 2-a.

Test date: March 23, 2023

Instrument and equipment name	Model	serial number	Accuracy level	Validity period
Power frequency test transformer	YDTW-150/150	SB-102021	/	/
Power frequency high voltage measurement system	TRF150-0.001	YB-116141	3.0	2024.12.13
	PV2-1	YB-219709		

Relative humidity: 37.1%; Ambient temperature: 15.6℃; Atmospheric pressure: 100.1kPa

Pressure terminal	Apply voltage (kV)	Frequency (Hz)	Duration (s)	Conclusion
laln	3	50	60	Pass
2a2n	3	50	60	
3a3n	3	50	60	
dadn	3	50	60	

4.4 Inspection of Marks (Routine)

Test date: March 23, 2023

Ambient temperature: 15.6℃

Equipment Name	Equipment Model	Serial number	Accuracy level	Validity period
Power frequency test transformer	YDTCW-4500/3×500	SB-318709	/	/
Standard voltage transformer	HJ-220(110)	YB-110199	0.02	2023.09.27
Voltage Transformer Calibrator	PT101	YB-319400	2.0	2023.08.25

Test conclusion: Terminal markings are correct, polarity is correct, and the test is successful.

4.5 Excitation Characteristic Measurement (Type, Routine)

Test date: March 23, 2023

Equipment Name	Equipment Model	Serial number	Accuracy level	Validity period
功率分析仪	WT3000	YB-114160	0.5	2023.06.25

Relative humidity: 37.1%; Ambient temperature: 15.6℃; Atmospheric pressure: 100.1kPa

Voltage multiple(U_{pr}%)	Voltage should be applied(V)	Apply voltage (V)	Measuring current (mA)	Measured loss (W)
		U	I	P
20	25.40	25.55	0.166	1.720
50	63.51	63.61	0.436	9.422
80	101.6	101.7	0.714	23.06
100	127.0	127.2	0.860	35.71
120	152.4	152.4	1.009	54.04
150	190.5	190.6	1.301	98.51

Note: For excitation characteristic measurement (routine), see test 4.14.2.4.

Test result: Pass.

4.6 Accuracy Test (Routine)

See test 4.12.

Test result: Pass.

4.7 Gas Dew Point Measurement (Routine) Test date: March 30, 2023

Instrument and equipment name	Model	Accuracy level	Serial number	Validity period
SF6 quantitative leak detector	JY231	2.0	YB-319513	2024.03.26
SF6 Trace Moisture Analyzer	DMT-152P	2.0	YB-319512	2023.04.04

The dew point measured at 20℃ is -52.2℃.

Test result: Pass.

4.8 Sealing performance test at ambient temperature (routine) Test date: March 31, 2023

Instrument and equipment name	Model	Accuracy level	Serial number	Validity period
SF6 quantitative leak detector	JY231	2.0	YB-319513	2024.03.26
SF6 Trace Moisture Analyzer	DMT-152P	2.0	YB-319512	2023.04.04

inflation pressure(MPa)	Duration (h)	Annual leakage rate (%)	Conclusion
0.4	24	0.0011	Pass

4.9 Pressure Test (Routine) Test date: April 1, 2023

Instrument and equipment name	Model	Serial number	Accuracy level	Validity period
pressure gauge	(0-6)MPa	20210948439	1.6	2023.04.12

Casing manufacturing category	welding						
Test methods	Test site	Design pressure (MPa)	Voltage should be applied(V)	Actual applied pressure(MPa)	Test time (s)	Residual pressure (MPa)	Post-test visual inspection
Hydraulic method	Welded shell	0.5	1.0	1.0	1800	1.0	No cracks or permanent deformation

Note: Calculated test pressure = 1.3 × design pressure = 1.3 × 0.5 = 0.65 MPa.

Test result: Pass.

4.10 Temperature Rise Test (Type)

Test dates: March 27-28, 2023

Instrument and equipment name	Model	Serial number	Accuracy level	Validity period
Power frequency test transformer	YDTCW-4500/3×500	SB-318709	/	/
Power frequency high voltage measurement system	TRF1500-0.001	YB-318890	3.0	2024.12.13
	PV2-1			
Wireless temperature monitoring device	DT1000	YB-320138	0.5	2023.08.30
Voltage transformer temperature rise test system	JYR0508	YB-328971-1	0.2	2023.10.06
Transformer DC Resistance Tester	SR3301	YB-104203	0.2	2023.04.05

$1.0U_{pr}$: Apply a voltage of 127.0kV to the primary winding, and the secondary windings la-ln have a 1000VA limit output. Other windings have no output until the temperature rise stabilizes.

$1.2U_{pr}$: Apply a voltage of 152.4kV to the primary winding, and the secondary windings la-1n, 2a-2n, and 3a-3n each have a rated output of 100VA, while da-dn have no output. Continue until the temperature rises to a stable level.

$1.5U_{pr}$: Apply a voltage of 152.4kV (1.2Um) to the primary winding, with the secondary windings la-ln, 2a-2n, and 3a-3n each carrying a rated output of 100VA, and da-dn carrying no output, for a duration of 4 hours; Apply a voltage of 190.5kV (1.5Ug) to the primary winding, with the secondary windings la-1n, 2a-2n, and 3a-3n each carrying a rated output of 100VA, and da-dn carrying a rated output of 300VA, for a test duration of 30 seconds.

$1.0U_{pr}$

Winding	Resistance measurement (Ω)		Ambient temperature (°C)	
	Resistance Temperature Detector	Cold resistance	When measuring resistance temperature	When measuring cold resistance
A-N	43079	42050	15.0	15.2
la-1n	0.01808	0.01754		
2a-2n	0.04109	0.04009		
3a-3n	0.03967	0.03857		
da-dn	0.06418	0.06242		

1.2U_{pr}

Winding	Resistance measurement (Ω)		Ambient temperature (°C)	
	Resistance Temperature Detector	Cold resistance	When measuring resistance temperature	When measuring cold resistance
A-N	42960	42050	15.5	15.2
1a-1n	0.01813	0.01754		
2a-2n	0.04129	0.04009		
3a-3n	0.03990	0.03857		
da-dn	0.06449	0.06242		

1.5U_{pr}

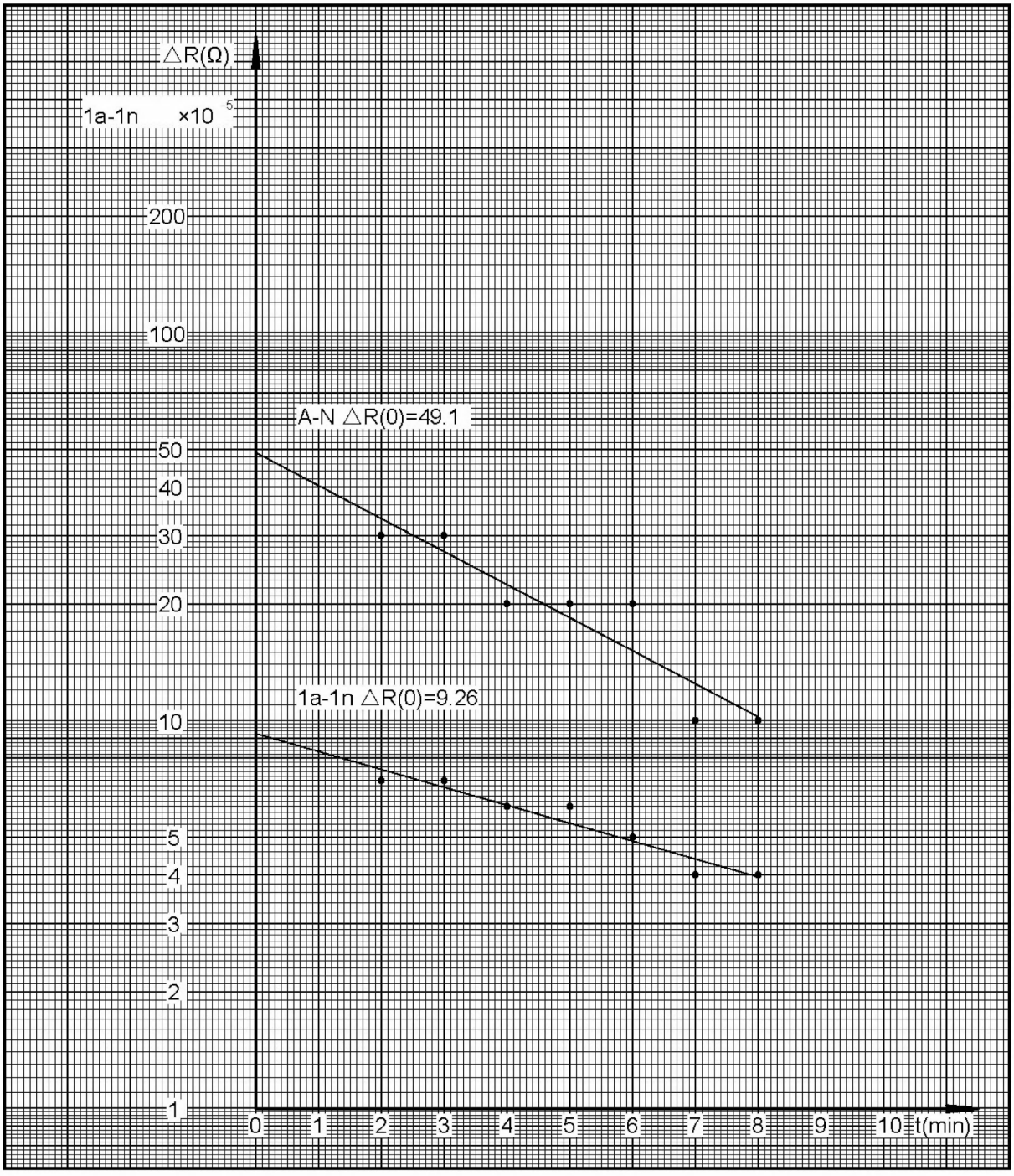
Winding	Resistance measurement (Ω)		Ambient temperature (°C)	
	Resistance Temperature Detector	Cold resistance	When measuring resistance temperature	When measuring cold resistance
A-N	43070	42050	15.8	15.2
la-1n	0.01824	0.01754		
2a-2n	0.04152	0.04009		
3a-3n	0.04006	0.03857		
da-dn	0.06471	0.06242		

Temperature rise calculation results (K)

Winding	1.0 U_{pr}	1.2 U_{pr}	1.5 U_{pr}
A-N	6.3	5.1	5.5
la-1n	7.8	8.1	9.4
2a-2n	6.3	7.2	8.3
3a-3n	7.3	8.3	9.1
da-dn	7.3	8.0	8.6

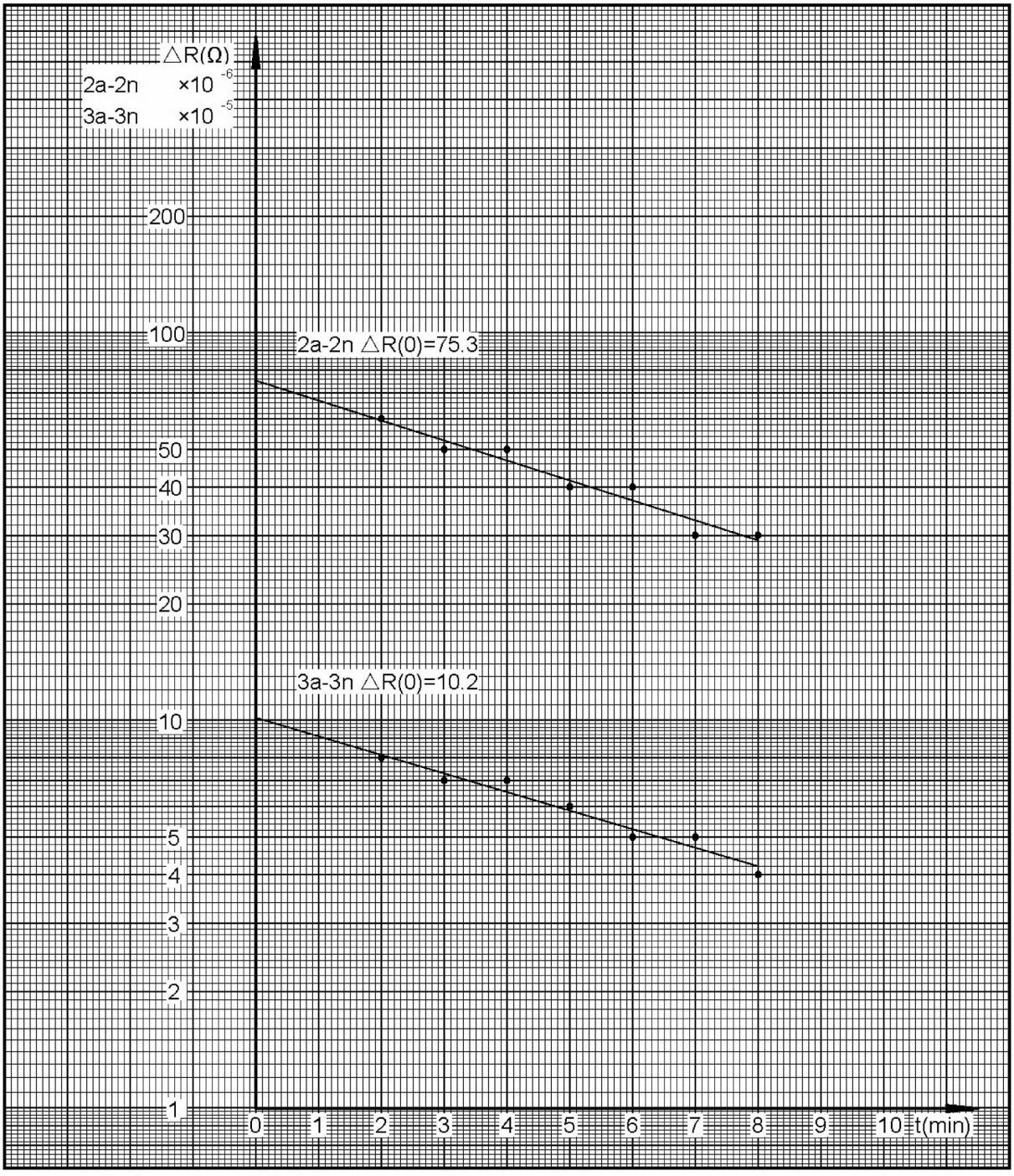
Test result: Pass.

Resistance Curve



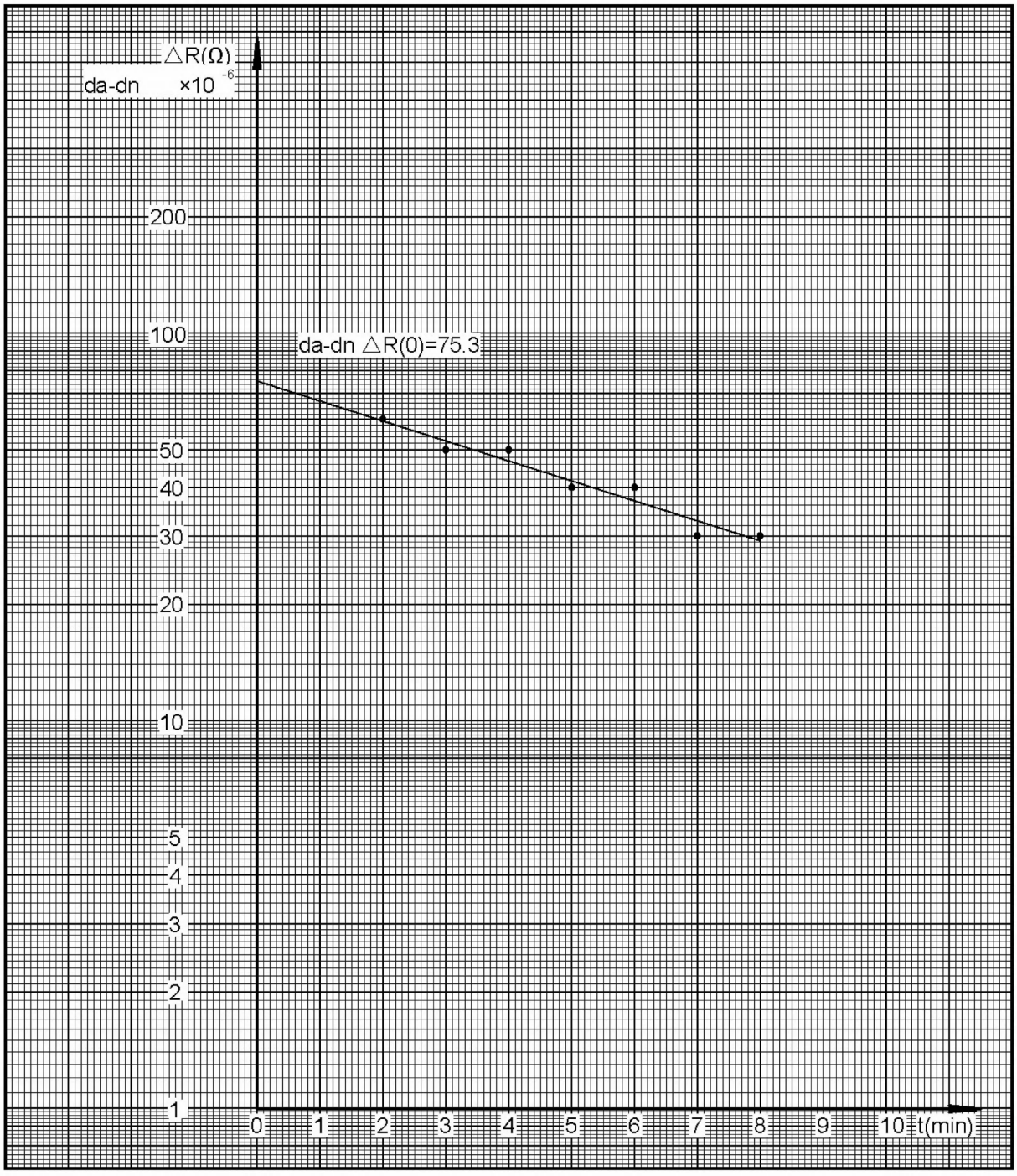
1.0 U_{pr}

Resistance Curve



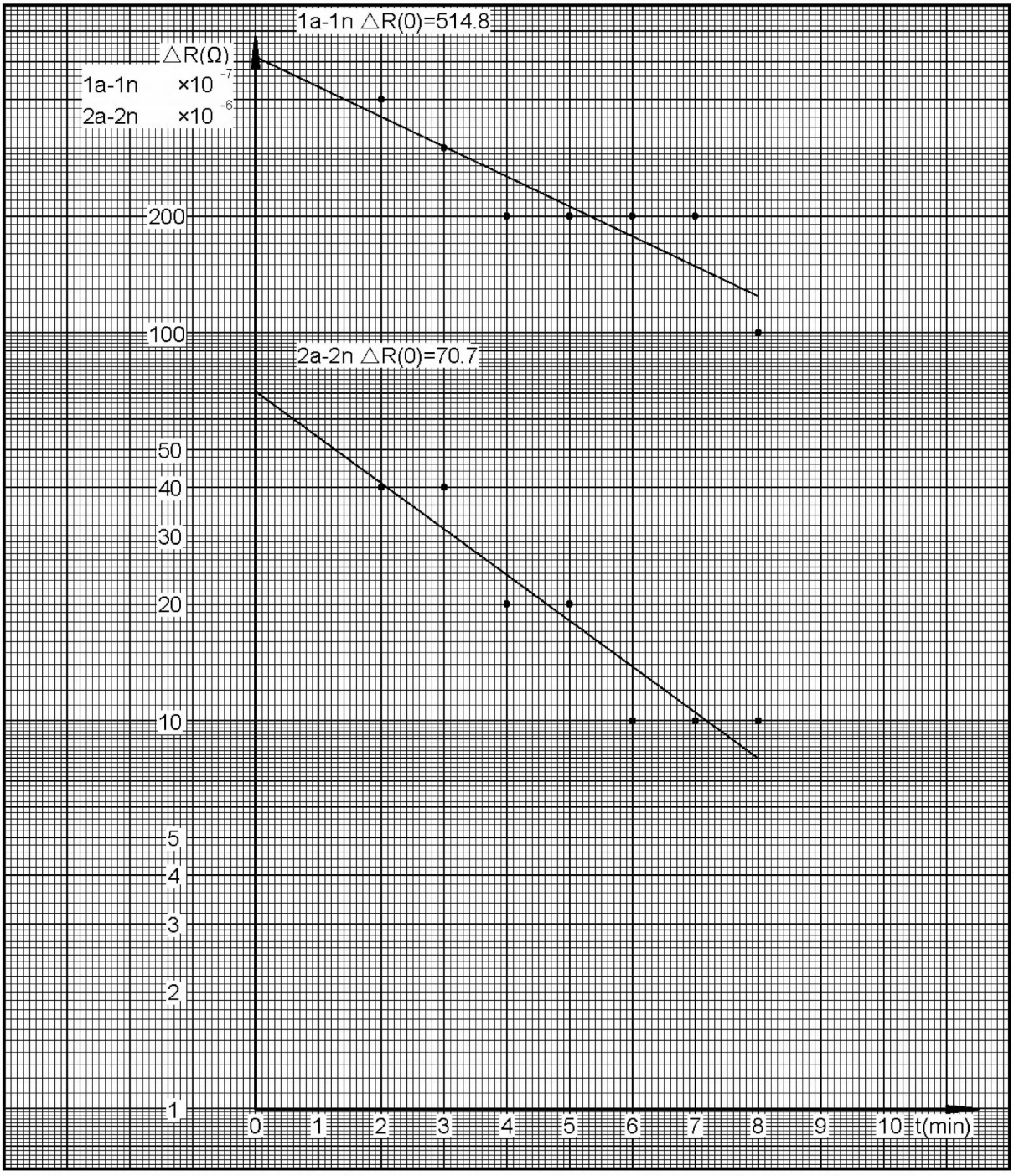
1.0 U_{pr}

Resistance Curve



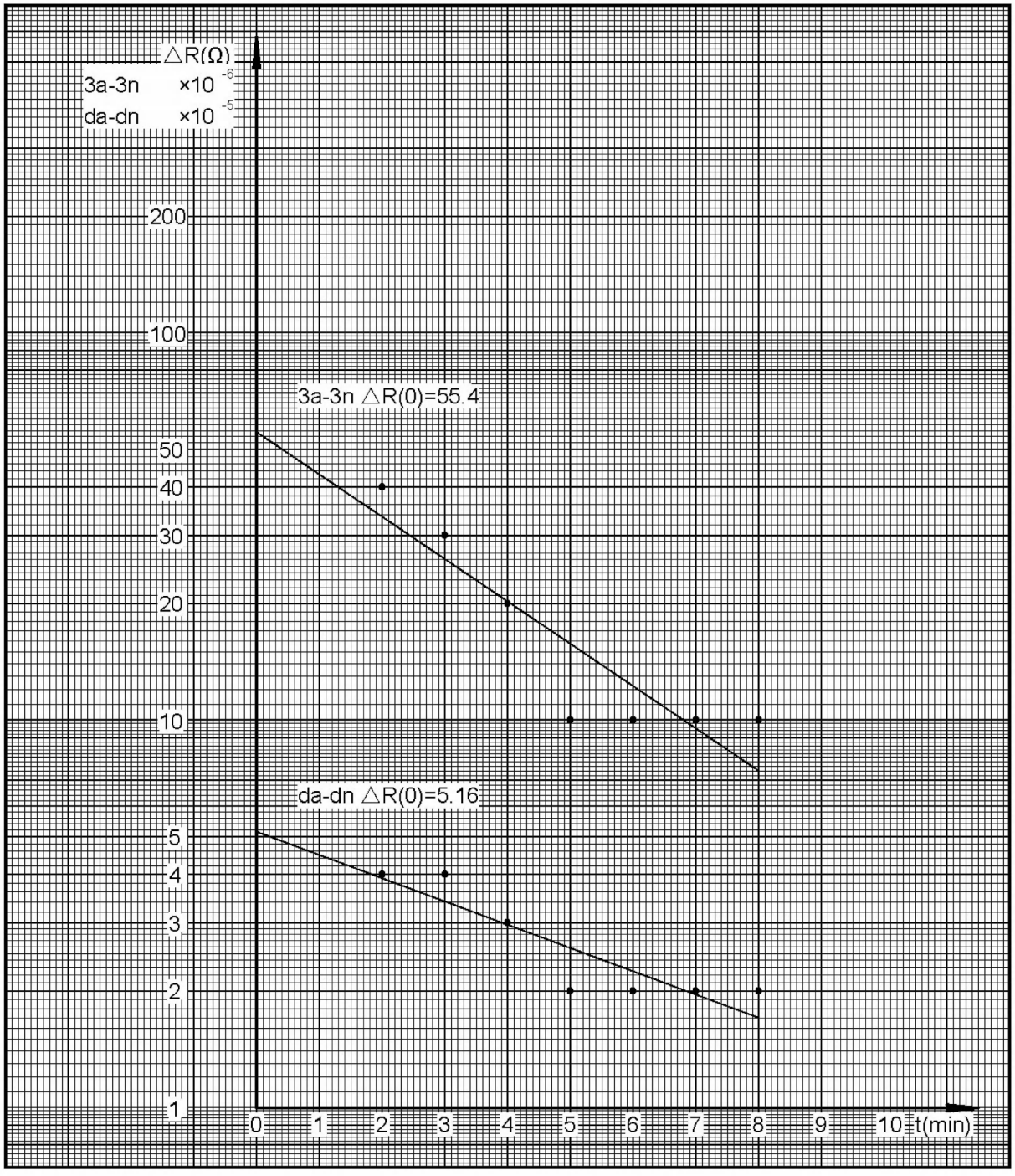
1.0 U_{pr}

Resistance Curve



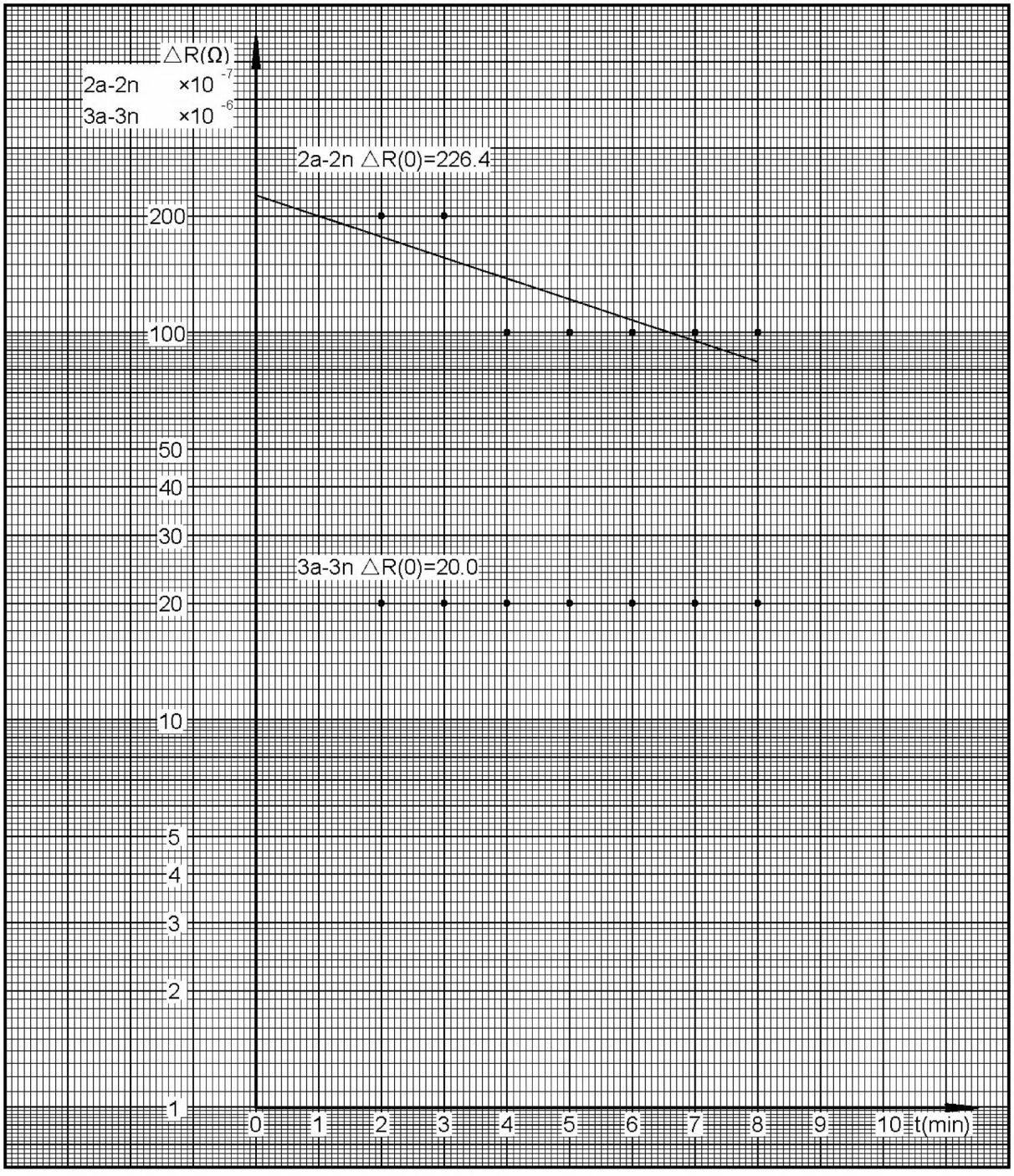
1.2 U_{pr}

Resistance Curve



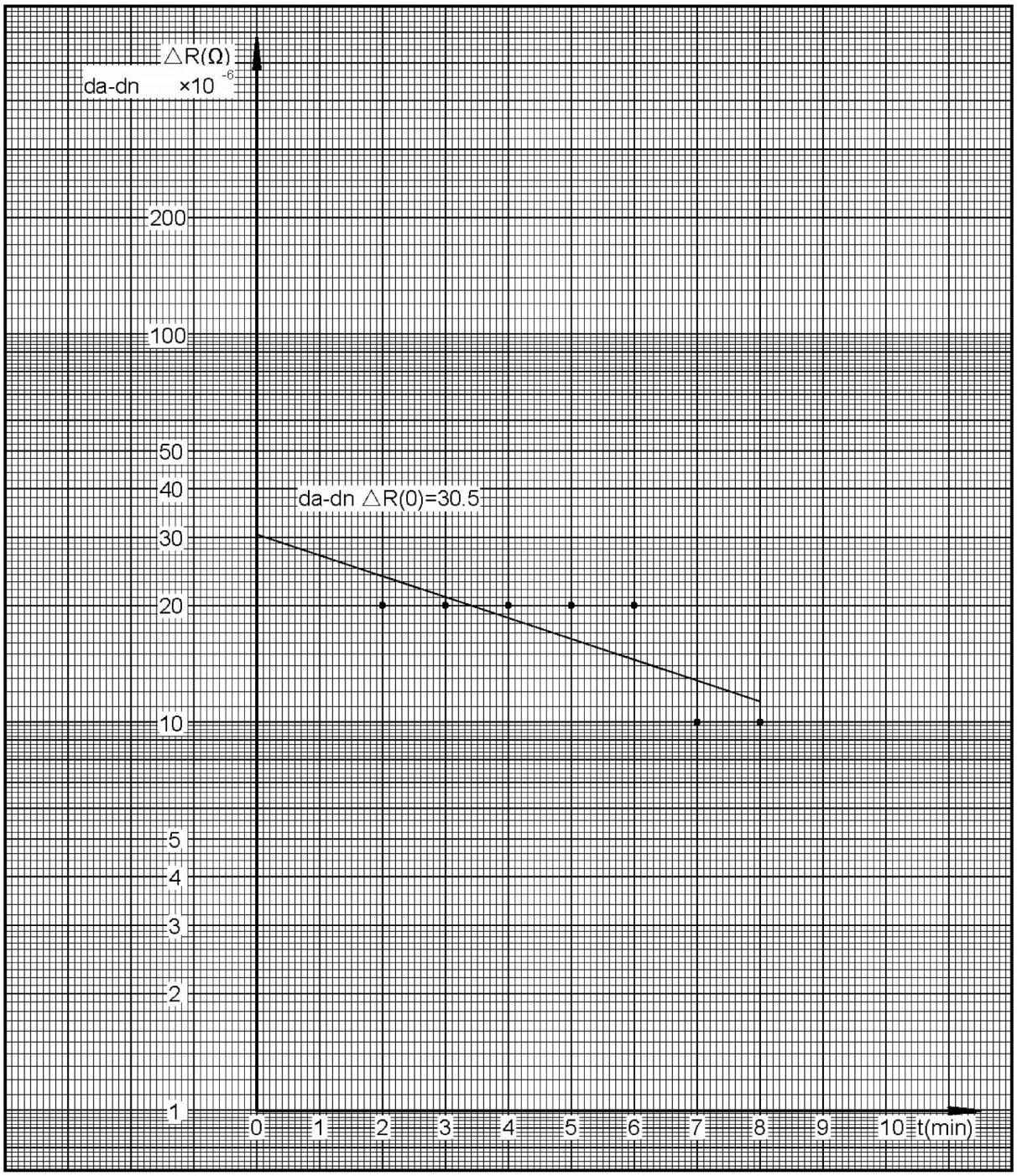
1.2 U_{pr}

Resistance Curve



1.5 U_{pr}

Resistance Curve



1.5 U_{pr}

4.11 Primary end impact resistance test (type) Test date: March 21, 2023

The test circuit is shown in Appendix 2-d.

4.11.1 Primary Terminal Rated Lightning Impulse Withstand Voltage Test

Instrument and equipment name	Model	Serial number	Accuracy level	Validity period
Impulse voltage measurement system	4800kV Capacitor Divider	YB318891	3.0	2024.12.14
	TR-AS Oscilloscope			

Test atmospheric conditions
Relative humidity: 33.8%; Ambient temperature: 16.4℃; Atmospheric pressure: 101.0kPa.

Impact applied voltage value and number of times

Rated lightning impulse withstand voltage: 1050kV

Lightning impulse withstand voltage: 1208kV

15 times for both positive and negative polarities, 2 times for each negative polarity

Procedure for applying voltage to an impact

Negative polarity	Positive polarity
One full-wave impulse at reference voltage; One full-wave impulse at rated voltage; Two chopped impulses at rated voltage; Two full-wave impulses at rated voltage.	One full-wave impulse at the reference voltage; Three full-wave impulses at the rated voltage.

Test waveform recording

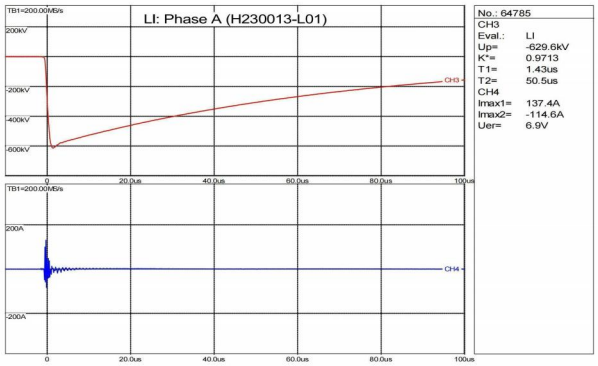
T1: Wavefront time; T2: Half-peak time; Tc: Cutoff time; Up2: Zero-crossing coefficient; Up: Peak voltage. See pages 31-32 for experimental waveform diagrams.

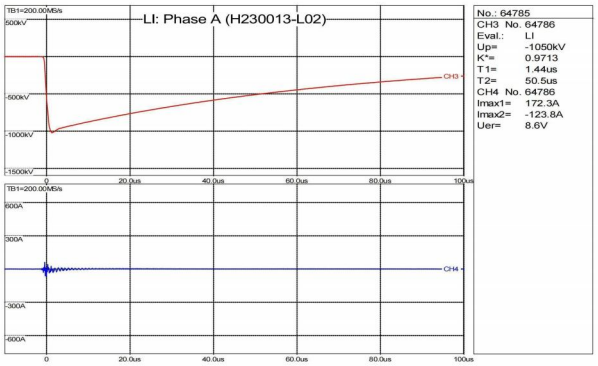
Test result: Pass.

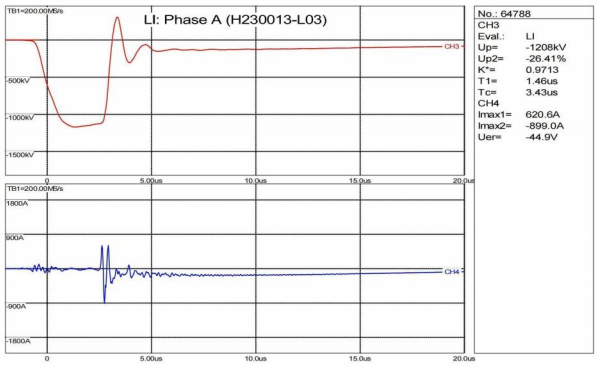
4.11.2 Primary-terminal cutoff lightning impulse withstand voltage test

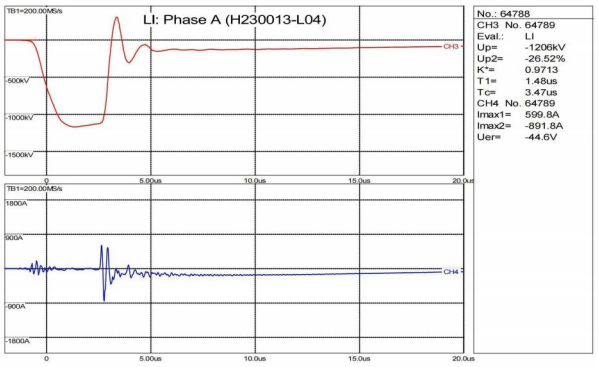
See test 4.11.1.
Test conclusion: Pass.

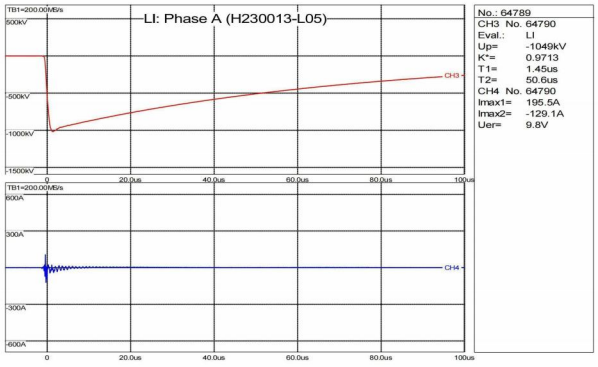
Test terminal: A; Test polarity: negative; Channel 1: Voltage waveform; Channel 2: Capacitive current waveform

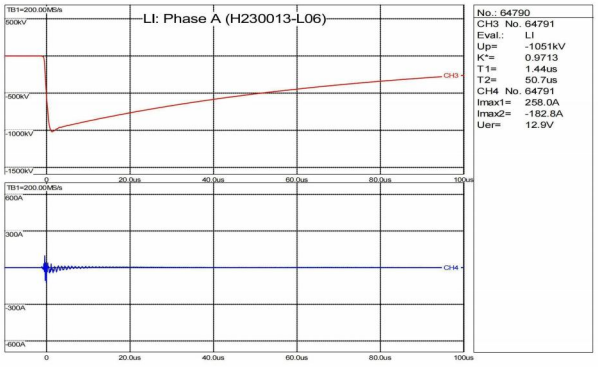


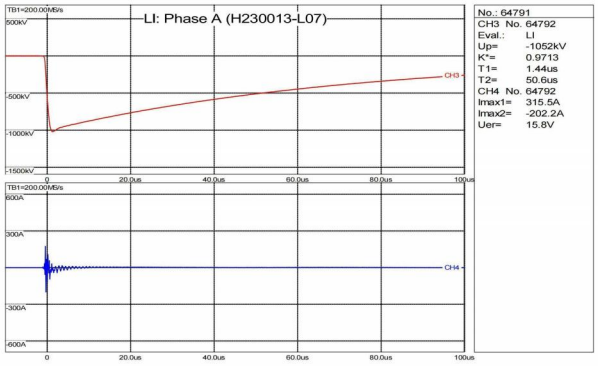


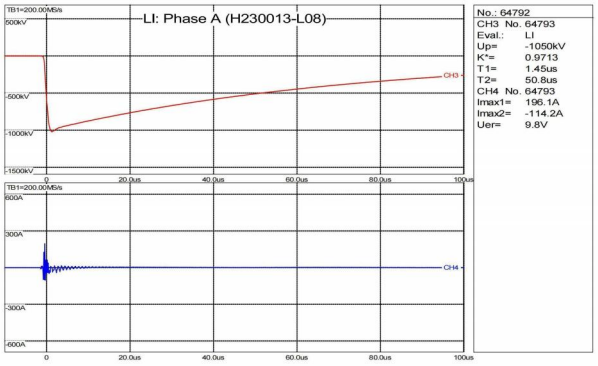




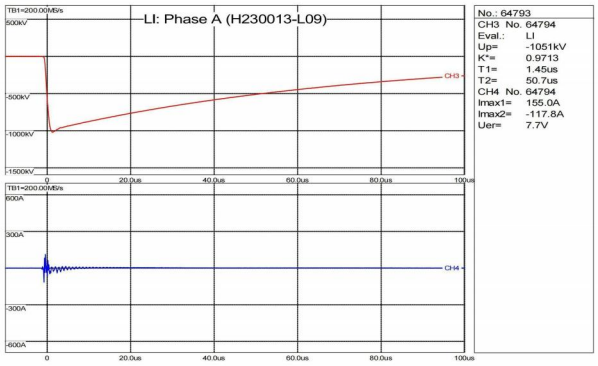


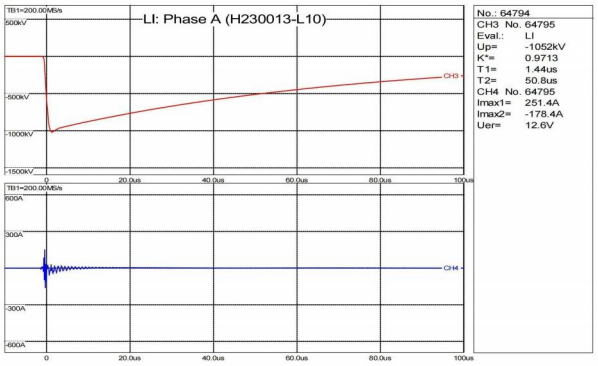


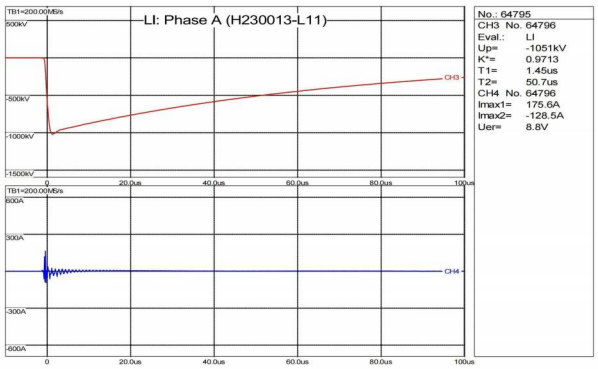


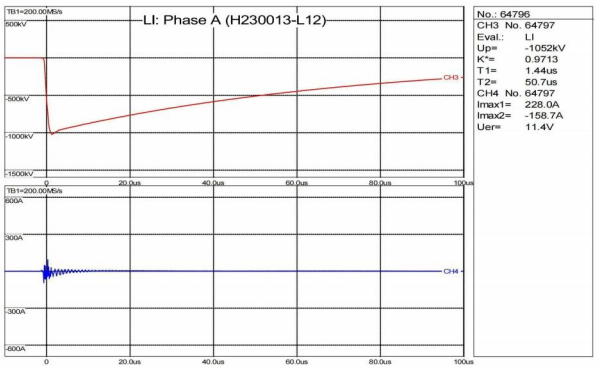


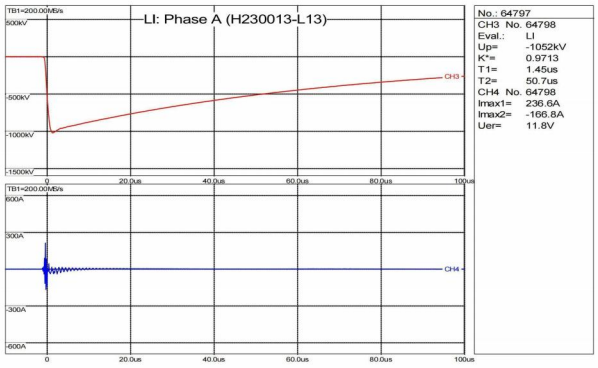
Test terminal: A; Test polarity: negative; Channel 1: Voltage waveform; Channel 2: Capacitive current waveform

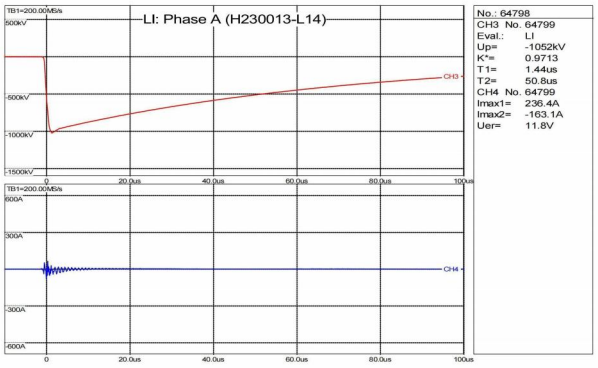


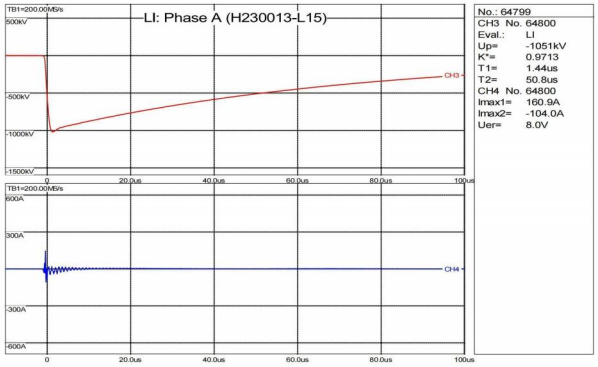


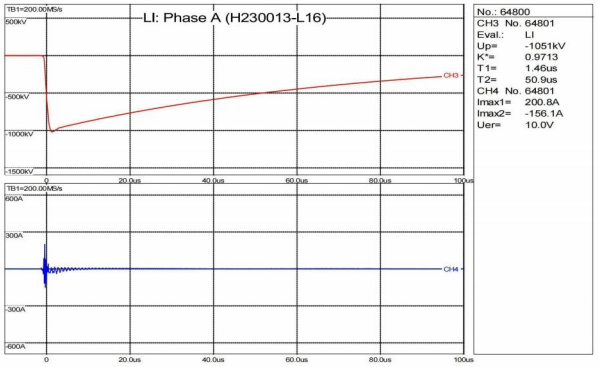




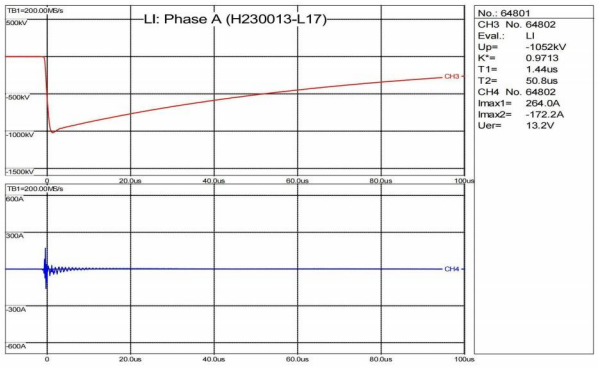


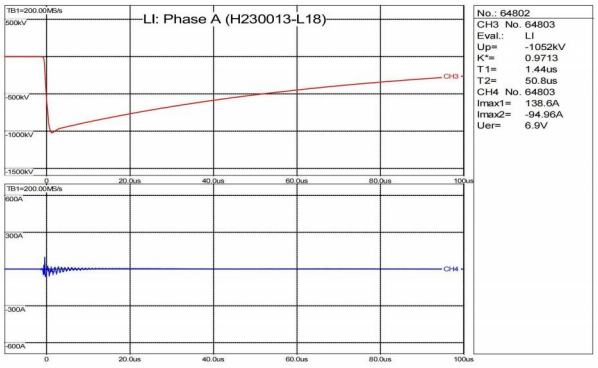




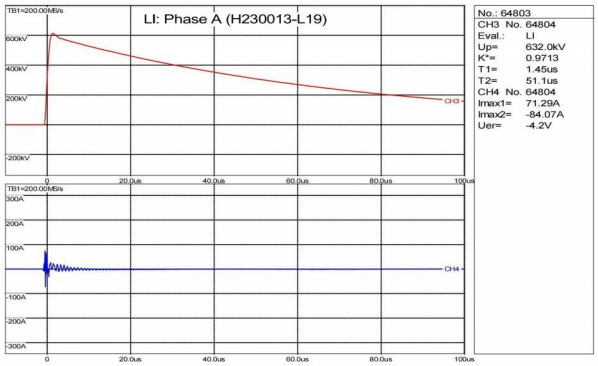


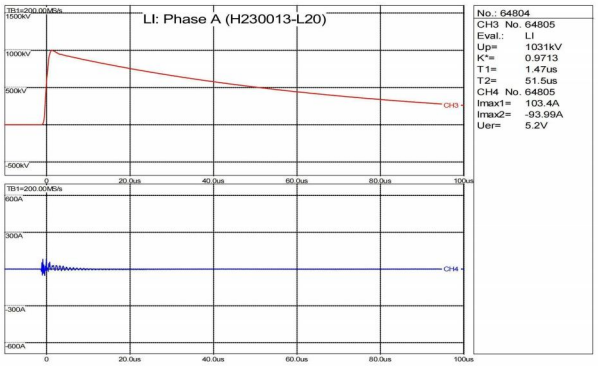
Test terminal: A; Test polarity: negative; Channel 1: Voltage waveform; Channel 2: Capacitive current waveform

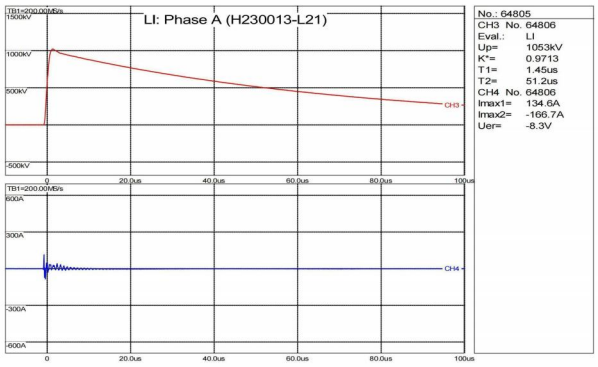


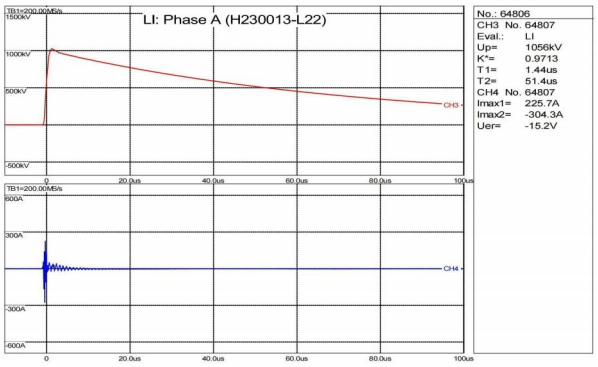


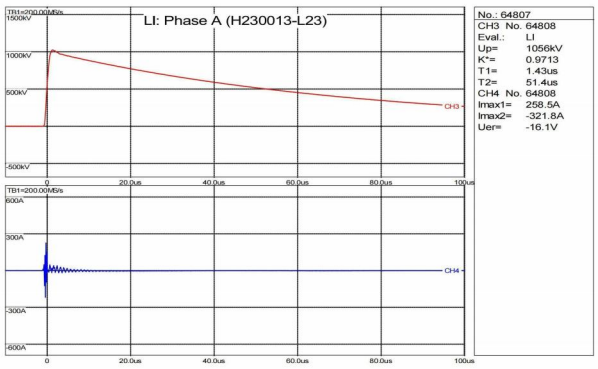
Test terminal: A; Test polarity: positive; Channel 1: Voltage waveform; Channel 2: Capacitive current waveform

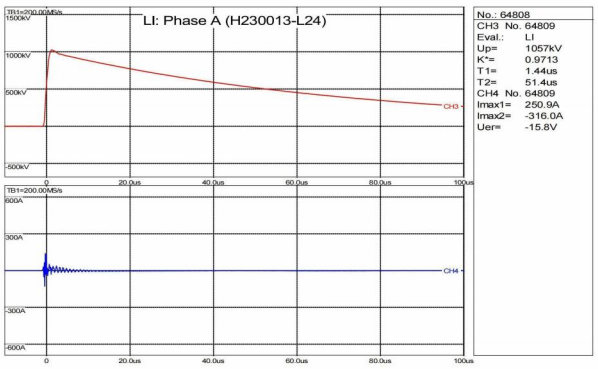


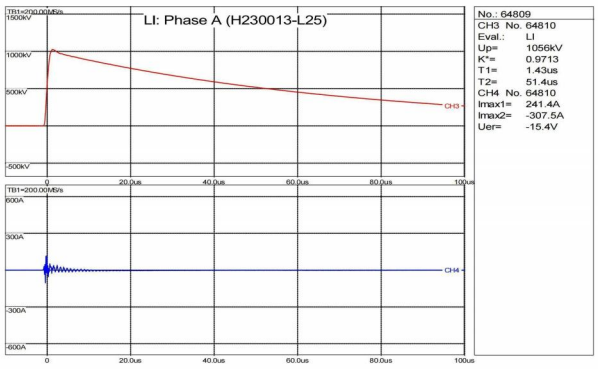


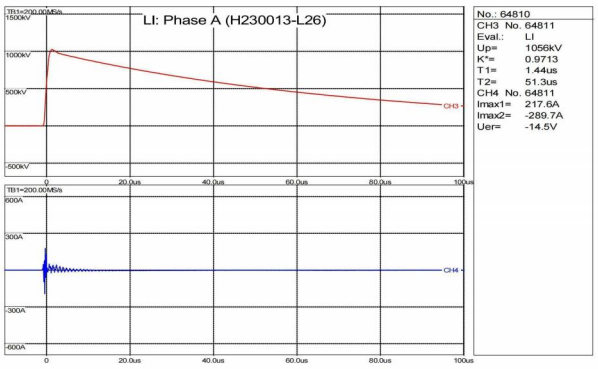




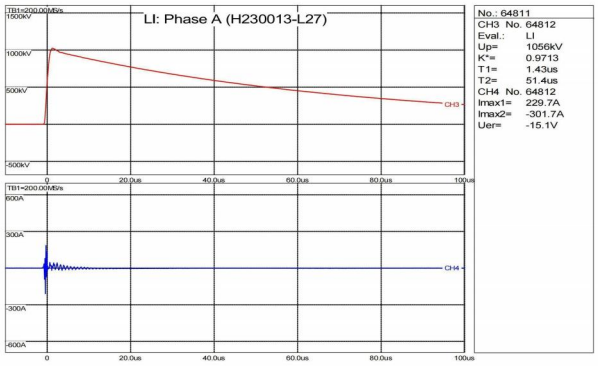


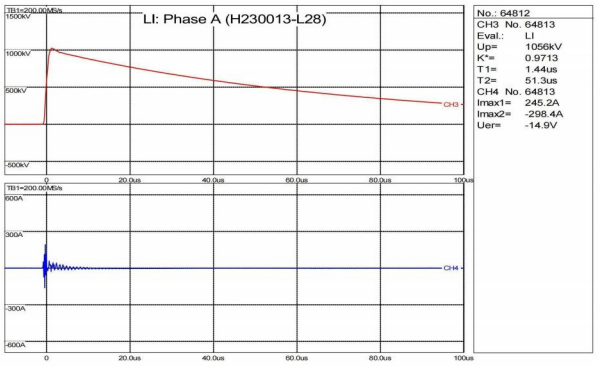


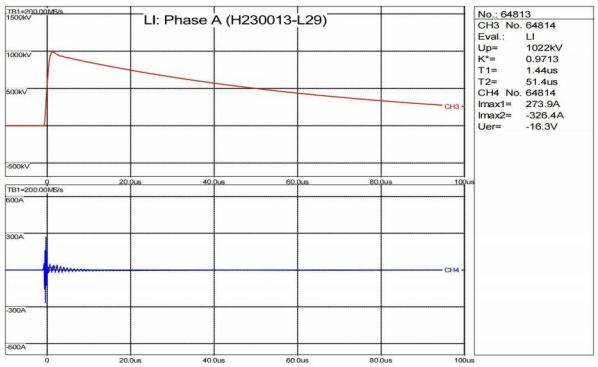


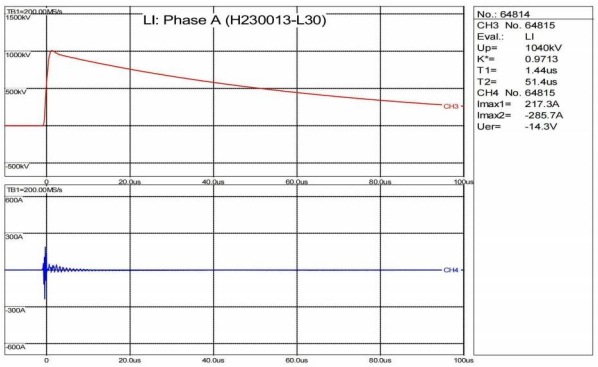


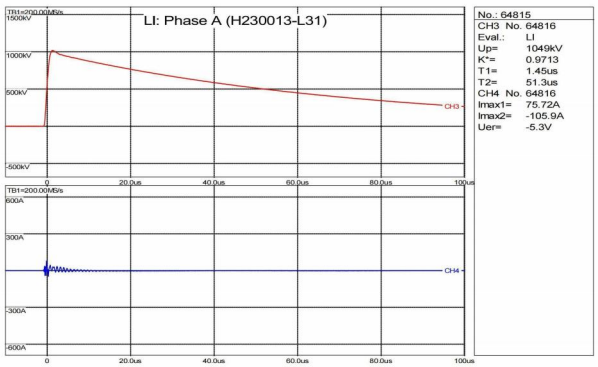
Test terminal: A; Test polarity: positive; Channel 1: Voltage waveform; Channel 2: Capacitive current waveform

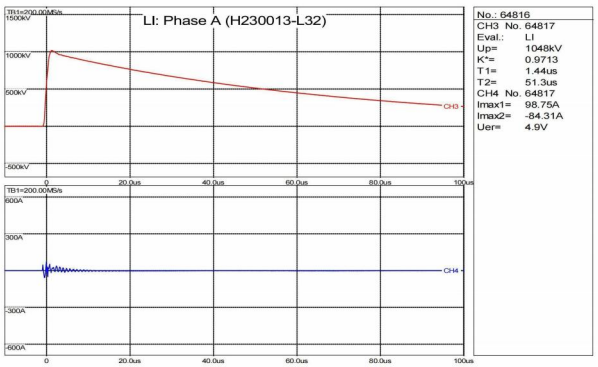


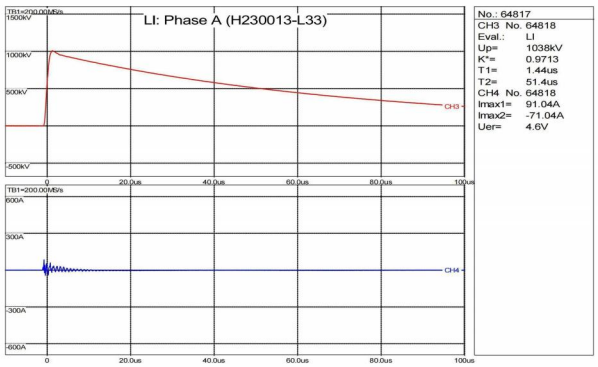


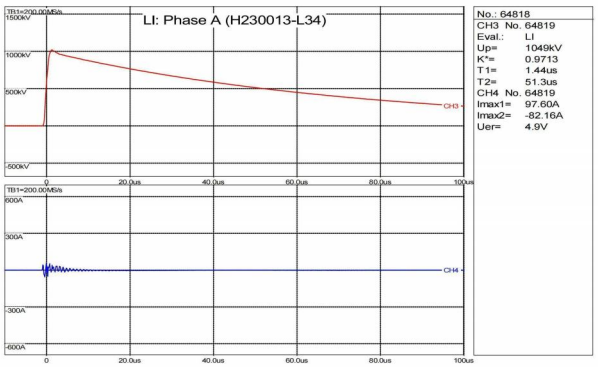












4.12 Accuracy Test (Type)

Test date: March 23, 2023

The test circuit is shown in Annex 2-e.

Ambient temperature: 15.6℃

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Power frequency test transformer	YDTCW-4500/3×500	SB-318709	/	/
Standard voltage transformer	HJ-220(110)	YB-110199	0.02	2023.09.27
Voltage Transformer Calibrator	PT101	YB-319400	2.0	2023.08.25
Voltage transformer load bank	FY60	YB-331040	3.0	2023.08.17
		YB-331041		
		YB-331042		
	FY56	YB-111090	3.0	2023.08.25

Winding	Accuracy level	Rated voltage ratio (kV)	Rated voltage percentage (%)	Load (VA) cosφ=0.8				Ratio difference (%)	Phase difference (′)	Load(VA) cosφ=0.8				Ratio difference (%)	Phase difference (′)
				la-1n	2a-2n	3a-3n	da-dn			1a-1n	2a-2n	3a-3n	da-dn		
la-1n	0.2	$\frac{220/\sqrt{3}}{0.1/\sqrt{3}}$	120	100	100	100	0	-0.18	-7	25	0	0	0	0.12	-1
			100					-0.18	-7					0.16	-1
			80					-0.18	-7					0.16	-1
2a-2n	0.5	$\frac{220/\sqrt{3}}{0.1/\sqrt{3}}$	120	100	100	100	0	-0.30	-6	0	25	0	0	0.10	0
			100					-0.25	-6					0.15	0
			80					-0.25	-6					0.15	0
3a-3n	0.5 (3P)	$\frac{220/\sqrt{3}}{0.1/\sqrt{3}}$	150	100	100	100	300	-0.60	-16	0	0	25	0	0.05	0
			120				0	-0.25	-6					0.10	0
			100					-0.25	-6					0.15	-2
			80					-0.25	-6					0.15	-2
			5					-0.25	-8					0.15	-2
			2					-0.25	-8					0.15	-4
da-dn	3P	$\frac{220/\sqrt{3}}{0.1}$	150	100	100	100	300	-0.13	-14	0	0	0	75	0.55	-1
			100				0	0.47	-10				0	0.78	-1
			5					0.47	-10					0.78	-1
			2					0.47	-13					0.82	-5

Test result: Pass.

4.13 Radio Interference Voltage Measurement (Type) Test date: March 23, 2023

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Power frequency test transformer	YDTCW-4500/3×500	SB-318709	/	/
Power frequency high voltage measurement system	TRF1500-0.001	YB-318890	3.0	2024.12.13
	PV2-1			
Electromagnetic interference measurement receiver	ZN3950	YB-114147	1.5dB	2023.07.01
Signal generator	EGC-3230	YB-114775	2.5dB	2023.07.03

Relative humidity: 15.6%; Ambient temperature: 37.1℃; Atmospheric pressure: 100.1kPa

Pre-applied voltage (kV)	Time (s)	Measuring voltage (kV)	Time (s)	Test frequency (MHz)	Test circuit attenuation coefficient Bc(dB)	Attenuation coefficient of resistive network Bg(dB)	Radio interference voltage meter readingsBm(dB)	Test sample radio interference voltage(μV)
218.2	30	160.0	30	1.0	5	22	51	355

Test result: Pass.

4.14 Short-circuit withstand capability test (type)

4.14.1 Short-circuit withstand capability test Test date: March 24, 2023

The test circuit is shown in Appendix 2-f Ambient temperature: 14.2℃

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Transient recorder	DL850	SB-322093	12bit	2023.11.10
Diverter	FL-5/5000(12)	YB-320328	0.1	2023.07.07
Current transformer	LMAJ1-10(1000/5)	YB-309795	0.5	2025.02.24
Voltage transformer	JDZ-10	YB-328991	0.1	2024.11.28

With the primary winding A-N short-circuited, a rated voltage is applied between the secondary windings 1a-1n, and the short-circuit current of the secondary winding is measured for a duration of 1.0s. The test waveform showed no abnormalities; see the waveform diagram on page 36. Visual inspection revealed no damage; see before and after photos on page 37.

	Specified value	Measured values
Winding	la-1n	1a-1n
Rated voltage(V)	100N3	58.21
Power-on time(s)	1.0	1.0
RMS value of secondary winding current(A)	/	1110.91

The product's windings are made of copper wire, with a conductivity of 58 m/2 mm² at 20℃, which is greater than 0.97% of 58 m/2 mm². The calculated short-circuit current density of the primary winding is 25.12 A/mm², which is less than 180 A/mm²; the short-circuit current density of the secondary winding is 47.68 A/mm², which is also less than 180 A/mm². Therefore, disassembly and inspection were not performed.

4.14.2 Test items after short circuit

4.14.2.1 Primary terminal power frequency withstand voltage test

4.14.2.1.1 Primary external construction frequency withstand voltage test

Test date: March 29, 2023

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Power frequency test transformer	YDTW-150/150	SB-102021	/	/
Power frequency high voltage test system	TRF150-0.001	YB-116141	3.0	2024.12.13
	PV2-1	YB-219709		

Relative humidity: 29.1%; Ambient temperature: 17.4℃; Atmospheric pressure: 100.2kPa

Pressure terminal	Apply voltage (kV)	Frequency (Hz)	Duration (s)	Conclusion
AN	4.5	50	60	合格

4.14.2.1.2 Primary Terminal Inductive Withstand Voltage Test

Test date: March 29, 2023

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Synchronous generator	TF4000-24	SB-318713	/	/
Power frequency high voltage measurement system	TRF1500-0.001	YB-318890	3.0	2024.12.13
	PV2-1			

Relative humidity: 29.1%; Ambient temperature: 17.4℃; Atmospheric pressure: 100.2kPa

Pressure terminal	Apply voltage (kV)	Frequency (Hz)	Duration (s)	Conclusion
A	414	200	30	Pass

4.14.2.2 Partial Discharge Measurement Test date: March 29, 2023

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Synchronous generator	TF4000-24	SB-318713	/	/
Power frequency high voltage measurement system	TRF1500-0.001	YB-318890	3.0	2024.12.13
	PV2-1			
Partial Discharge Testing System	TWPD-02	YB-320115	10	2023.09.20
	TWPD-2B	YB-114208	10	2023.06.26

Relative humidity: 29.1%; Ambient temperature: 17.4℃; Atmospheric pressure: 100.2kPa

Pressure terminal	Pre-applied voltage (kV)	Frequency (Hz)	Duration (s)	Measuring voltage (kV)	Duration (s)	Discharge (pC)	Conclusion
A	414	200	30	252	30	3	Pass
				174.6	30	3	

Note: The test method was conducted according to procedure A in section 7.3.3.2 of GB/T20840.1-2010.

The background noise level before and after the test was <2pC.

4.14.2.3 Secondary terminal power frequency withstand voltage test Test date: March 29, 2023

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Power frequency high voltage measurement system	TRF1500-0.001	YB-318890	3.0	2024.12.13
	PV2-1			

Relative humidity: 29.1%; Ambient temperature: 17.4℃; Atmospheric pressure: 100.2kPa

Pressure terminal	Apply voltage (kV)	Frequency (Hz)	Duration (s)	Conclusion
laln	2.7	50	60	Pass
2a2n	2.7	50	60	
3a3n	2.7	50	60	
dadn	2.7	50	60	

4.14.2.4 Measurement of excitation characteristics

Test date: March 29, 2023

Relative humidity: 29.1%; Ambient temperature: 17.4℃; Atmospheric pressure: 100.2kPa

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Power Analyzer	WT3000	YB-114160	0.5	2023.06.25

Voltage multiplier (Ug%)	Voltage should be applied(V)	Applied voltage(V)	Measure current(mA)	Actual measured loss (W)
		U	I	P
100	127.0	127.4	0.864	35.80
150	190.5	190.5	1.299	97.91

Test conclusion: Pass.

4.14.2.5 Accuracy Test

Test date: March 29, 2023

Environmental temperature: 17.4 ℃

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Power frequency test transformer	YDTCW-4500/3×500	SB-318709	/	/
Standard voltage transformer	HJ-220(110)	YB-110199	0.02	2023.09.27
Voltage Transformer Calibration Device	PT101	YB-319400	2.0	2023.08.25
Voltage load box	FY56	YB-331040	3.0	2023.08.17
		YB-331041		
		YB-331042		
	FY60	YB-111090	3.0	2023.08.25

Winding	Accuracy level	Rated voltage ratio (kV)	Rated voltage percentage (%)	Load (VA) cosφ=0.8				Ratio difference (%)	Phase difference (′)	Load(VA) cosφ=0.8				Ratio difference (%)	Phase difference (′)
				1a-1n	2a-2n	3a-3n	da-dn			1a-1n	2a-2n	3a-3n	da-dn		
1a-1n	0.2	$\frac{220/\sqrt{3}}{0.1/\sqrt{3}}$	120	100	100	100	0	-0.18	-7	25	0	0	0	0.12	-1
			100					-0.16	-7					0.16	-1
			80					-0.16	-7					0.16	-1
2a-2n	0.5	$\frac{220/\sqrt{3}}{0.1/\sqrt{3}}$	120	100	100	100	0	-0.25	6	0	25	0	0	0.10	0
			100					-0.25	6					0.15	0
			80					-0.25	6					0.15	2
3a-3n	0.5 (3P)	$\frac{220/\sqrt{3}}{0.1/\sqrt{3}}$	150	100	100	100	300	-0.62	-15	0	0	25	0	0.07	-1
			120				0	-0.25	-8					0.15	-2
			100					-0.20	-8					0.15	-2
			80					-0.20	-8					0.15	-2
			5					-0.14	-7					0.21	-2
			2					-0.12	-5					0.23	-2
da-dn	3P	$\frac{220/\sqrt{3}}{0.1}$	150	100	100	100	300	-0.13	-13	0	0	0	75	0.55	-2
			100				0	0.46	-9				0	0.78	-1
			5					0.47	-10					0.78	-1
			2					0.49	-13					0.82	-5

Test conclusion: Pass.

4.14.3 Test conclusion

The short-circuit withstand capability test was passed.

4.15 Inspection of Enclosure Protection Rating (Type)

4.15.1 Inspection of IP Code

Test date: March 28, 2023

Protection rating: IP55

4.15.1.1 Protection level test for preventing access to hazardous components and preventing the ingress of solid foreign objects

4.15.1.1.1 Protection level test for preventing access to dangerous parts

The test is conducted on the secondary terminal box of the voltage transformer that is consistent with the secondary terminal box of the voltage transformer body. The test tool with a diameter of 1.0 mm does not enter the secondary terminal box of the voltage transformer.

Test result: Pass.

4.15.1.1.2 Protection level test for preventing the ingress of solid foreign objects

The test was conducted on the secondary terminal box of the voltage transformer, which is compatible with the voltage transformer body. The secondary terminal box was placed in the test chamber in its normal operating position. A powder circulation pump inside the test chamber suspended and allowed talc powder to settle. The amount of talc powder used was 2 kg per cubic meter of test chamber volume. The pressure inside the tested secondary terminal box was maintained at atmospheric pressure using a vacuum pump. The test lasted for 8 hours. After the test, there was no dust inside the secondary terminal box of the voltage transformer.

Test result: Pass.

4.15.1.2 Protection level test against water ingress

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Rotor flow meter	LZT-1005M-V	YB-320298	2.5	2023.06.26

Nozzle inner diameter (mm)	6.3
Flow rate (L/min)	12.4～12.5
Distance between nozzle and sample surface (m)	2.5
Test time (min)	3
Sample temperature (°C)	15.9
Spray water temperature (°C)	15.7
Sample secondary terminal box surface area (m^2)	<0.32

The test is conducted on the secondary terminal box of the voltage transformer, which is compatible with the voltage transformer body.

A water spray test device is used to perform a spray test on the secondary terminal box of the voltage transformer. After spraying, the test specimen is checked for water ingress, or if water does enter.

The water was insufficient to affect the normal operation of the equipment or compromise its safety; water did not accumulate on insulating components that could cause tracking along the creepage distance. No water was found inside the sample's secondary terminal box after the test.

Test result: Pass.

4.15.2 Mechanical impact test

Test date: March 28, 2023

Mechanical impact rating: IK07

The test was conducted on the secondary terminal box of the voltage transformer, which is consistent with the secondary terminal box attached to the voltage transformer body. During the test, the impact hammer dropped from a height of 400 mm each time, and the impact force generated by each impact was 2J. Three impacts were applied to each of the weakest points on the outer casing (the front, top, and one side of the secondary terminal box of the voltage transformer), for a total of nine impacts.

After the test, obvious marks appeared on the front, top, and one side of the secondary terminal box of the instrument transformer at the impact point. The impact did not affect the normal performance of the instrument transformer, nor did it reduce the specified protection level.

Test result: Pass.

4.15.3 Experimental Conclusions

The enclosure protection rating has passed inspection.

4.16 Pressure Test (Type)

Test Date: April 1, 2023
Relative Humidity: 27.1%; Ambient Temperature: 18.9℃

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
pressure gauge	(0-6)MPa	20210948439	1.6	2023.04.12

Casing manufacturing category	Welding	Welding effect coefficient			0.75			
Test methods	Test site	Design pressure (MPa)	Calculate test pressure (MPa)	Pressure should be increased (MPa)	Actual applied pressure (MPa)	Test time (s)	Residual pressure (MPa)	Post-test visual inspection
Hydraulic method	Welded shell	0.5	1.53	1.53	1.53	300	1.53	No cracks or permanent deformation

Note: Calculated test pressure = 1.3 × design pressure = 1.3 × 0.5 = 0.65 MPa.
Test result: Pass.

4.17 Power Frequency Withstand Voltage Test at Zero Gauge Pressure (Special)

Test date: March 29, 2023

Instrument and equipment name	Model	Center Number	Accuracy level	Validity period
Power frequency test transformer	YDTCW-4500/3×500	SB-318709	/	/
Power frequency high voltage measurement system	TFE1500-0.001	YB-318890	3.0	2024.12.13
	PV2-1			

Relative humidity: 29.1%; Ambient temperature: 17.4℃; Atmospheric pressure: 100.2kPa

Pressure terminal	Apply voltage (kV)	Frequency (Hz)	Duration (s)	Conclusion
A	189.1	200	300	Pass

4.18 Transmitted Overvoltage Test (Special)

Test date: March 29, 2023Relative humidity: 17.4%;
Ambient temperature: 29.1℃; Atmospheric pressure: 100.2kPa

Instrument and equipment name	Model	Serial numter	Accuracy level	Validity period
Digital phosphor oscilloscope	TDS3014B	YB-112132	9bit	2023.04.05

Voltage applied to the primary terminal U_1(V)	Secondary measuring terminals	Voltage transmitted at the secondary terminal U_2(mV)	Transmitted overvoltage $Us=(U_2/U_1)\times U_p$(V)
100	la	157.4	518.2
100	la	156.8	516.2
100	2a	162.5	535.0
100	2a	263.8	868.4

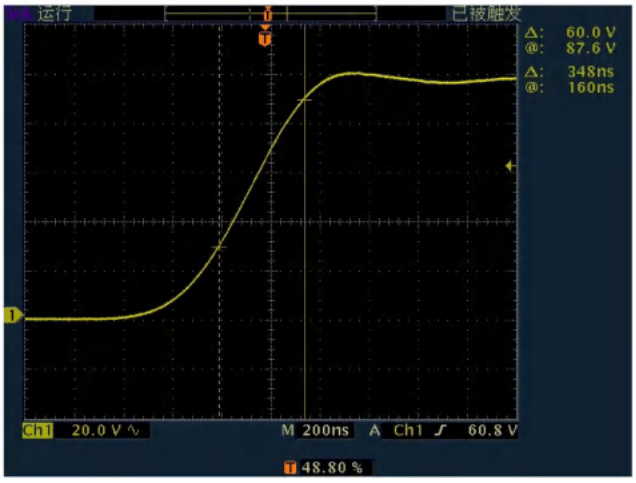
Up=(1.6×√2√3)×252=3292kV

Note: All secondary non-measuring terminals are grounded; the transmitted overvoltage Us ≤ 1600V.

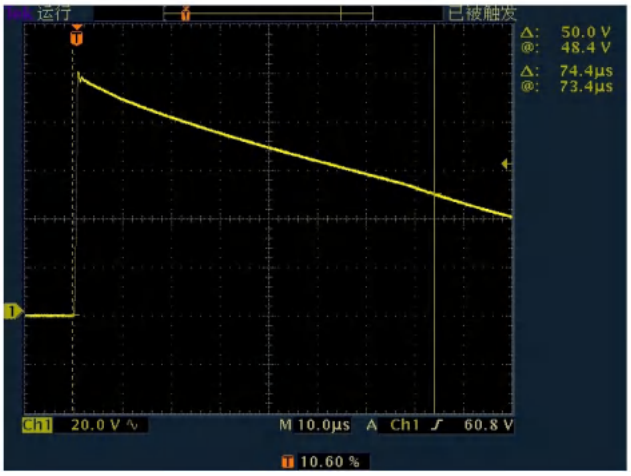
Test Conclusion: Pass.

Channel CH2: Secondary transfer voltage

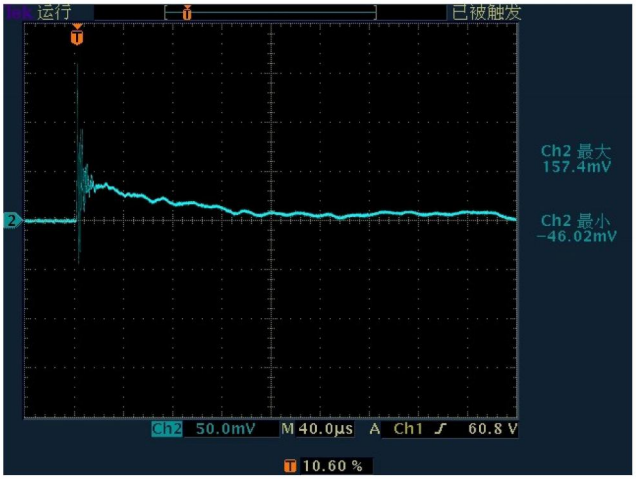
Wavefront time (μs): 0.581 Half-peak time (μs): 74.4



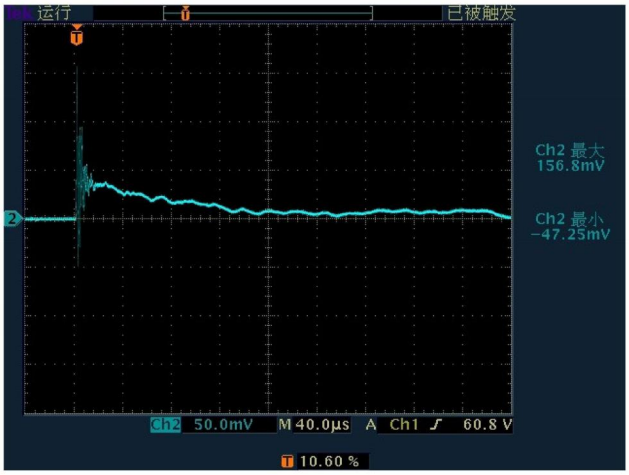
Wavefront



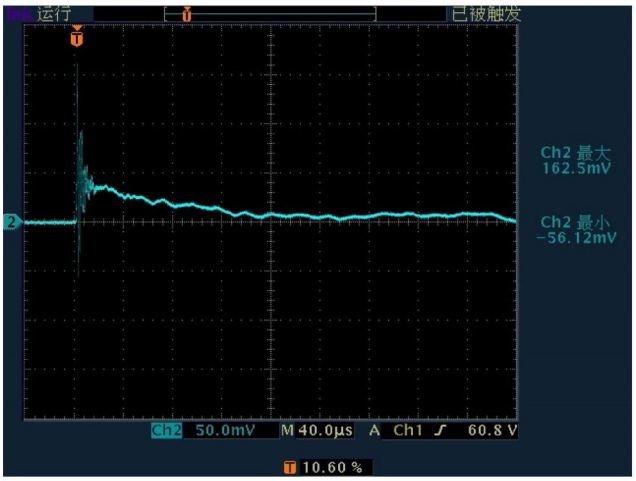
Wavetail


运行
已被触发
Ch2 最大
157.4mV
Ch2 最小
-46.02mV
Ch2 50.0mV M 40.0µs A Ch1 60.8 V
10.60 %

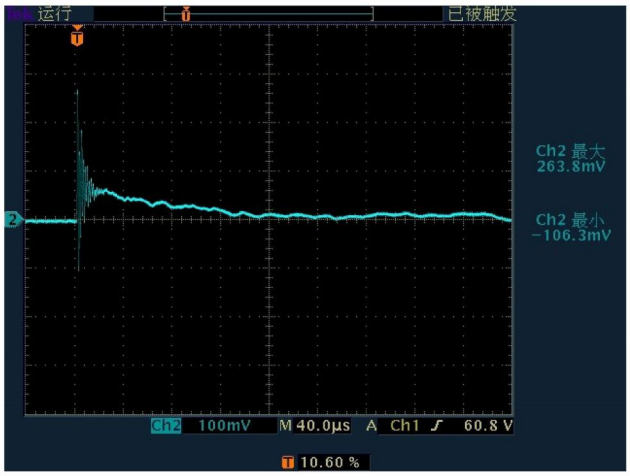
1a


运行
已被触发
Ch2 最大
156.8mV
Ch2 最小
-47.25mV
Ch2 50.0mV M 40.0µs A Ch1 60.8 V
10.60 %

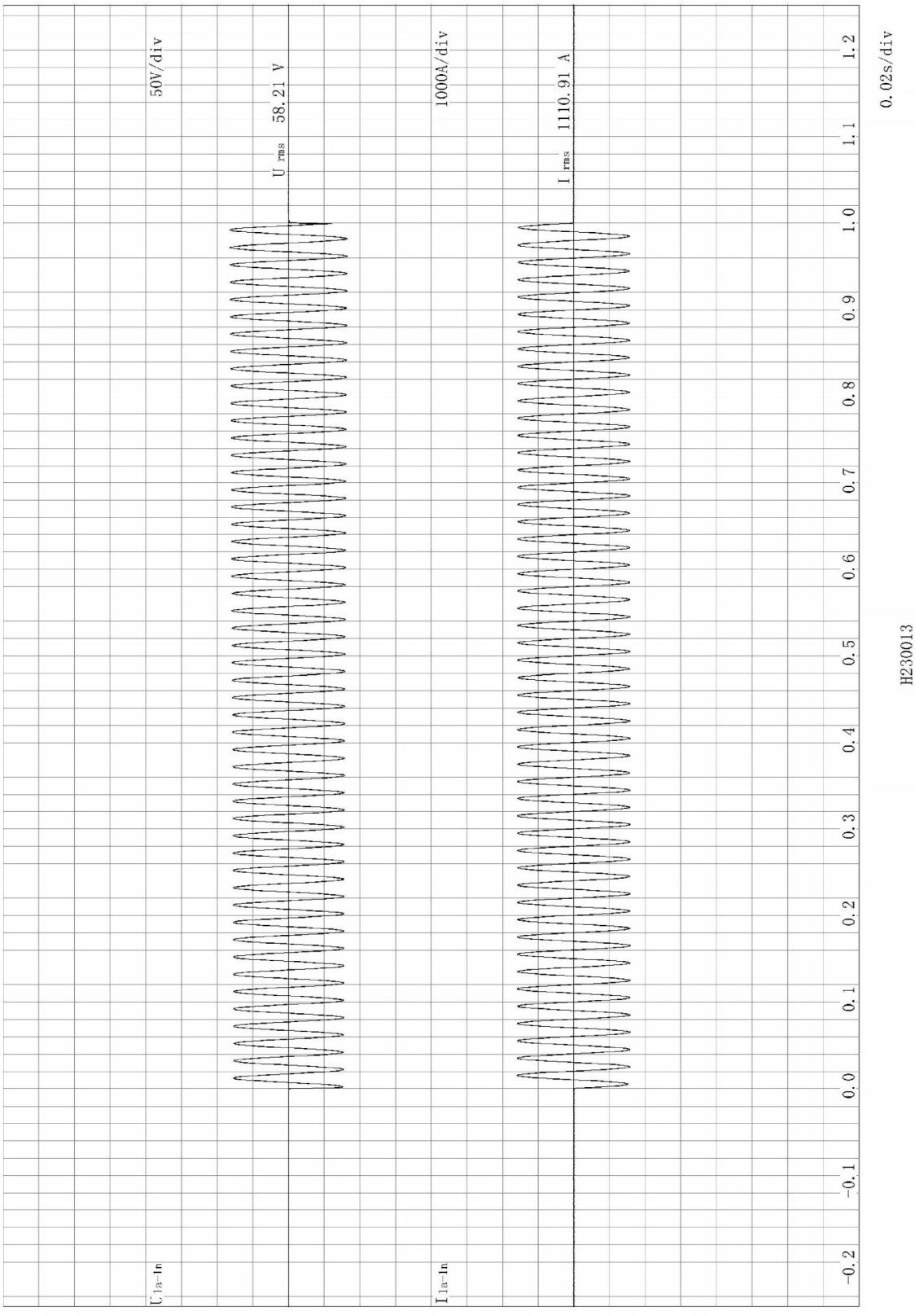
2a


运行
已被触发
Ch2 最大
162.5mV
Ch2 最小
-56.12mV
Ch2 50.0mV M 40.0µs A Ch1 60.8 V
10.60 %

3a


运行
已被触发
Ch2 最大
263.8mV
Ch2 最小
-106.3mV
Ch2 100mV M 40.0µs A Ch1 60.8 V
10.60 %

da


50V/div
U rms 58.21 V
1000A/div
I rms 1110.91 A
0.02s/div
H230013
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2

Before test:



After test:

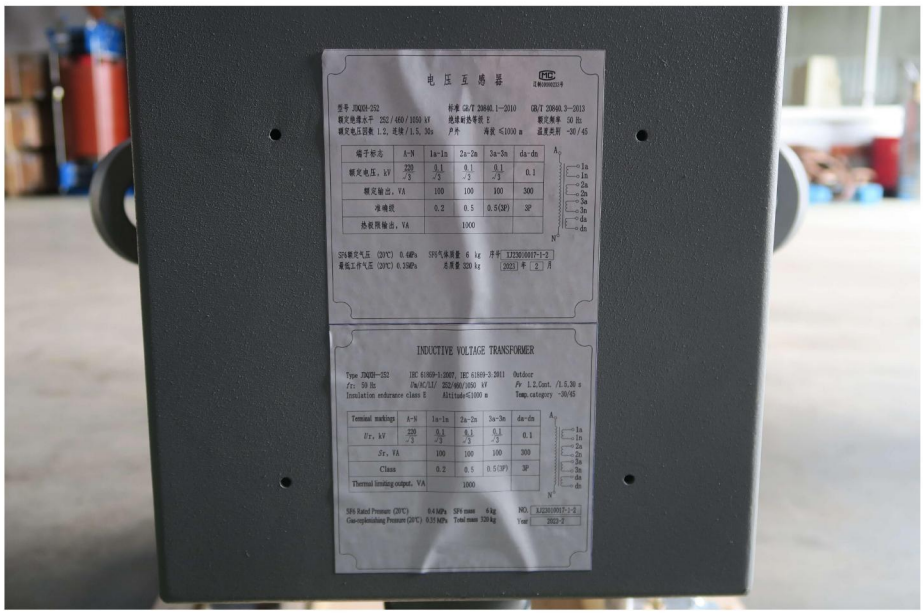


Appendix 1

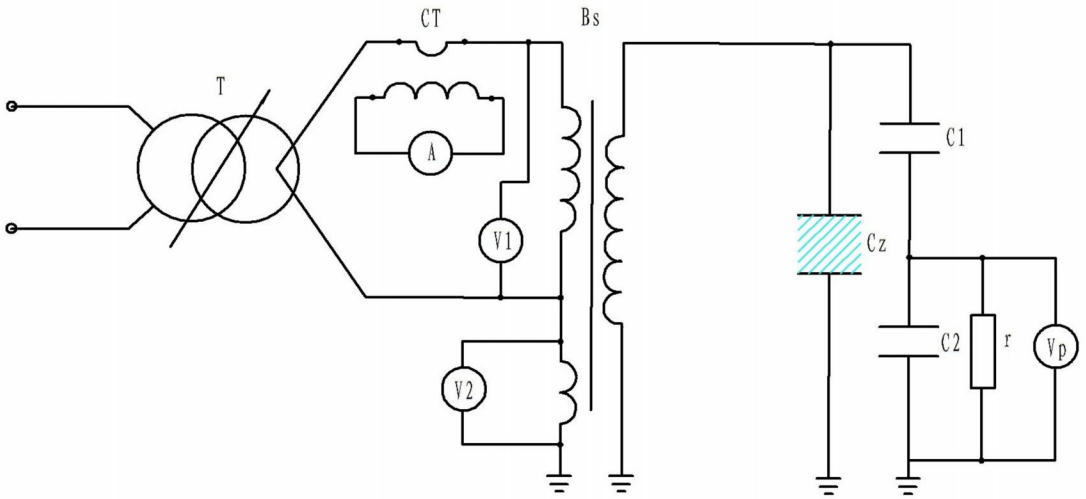
Nameplate Photo

No:CTQC/H-23.0013

Nameplate:



Schematic Diagram of Test Circuit



工频耐压试验线路图

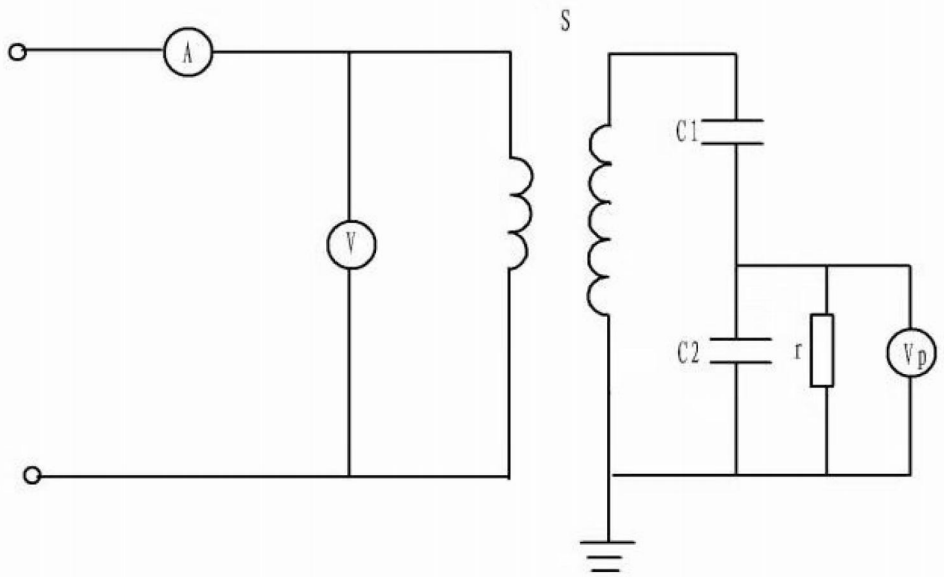
Separate-source voltage withstand diagram

T-调压器 Regulator　　A-电流表 Ampremeter　　Bs-试验变压器 Testing transformer

CT-电流互感器 Current transformer　　V1,V2-电压表 Voltmeter

C1,C2-分压电容 Capactor devider　　Cz-试品 Sample

r-放电电阻 Discharge resistance　　Vp-峰值电压表 Peak value voltmeter



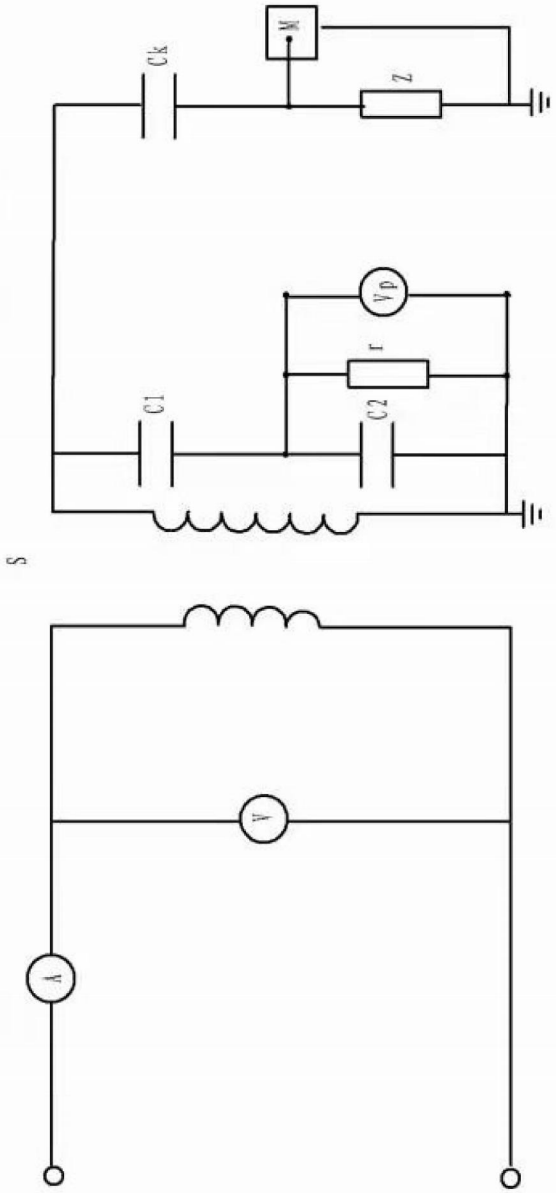
感应耐压试验线路图

Inter-turn overvoltage test

A-电流表 Amperemeter　　V-电压表 Voltmeter

S-试品 Sample　　C1,C2-分压电容 Capactor devider

r-放电电阻 Discharge resistance　　Vp-峰值电压表 Peak value voltmeter



局部放电测量线路图

Partial discharge measurement circuit

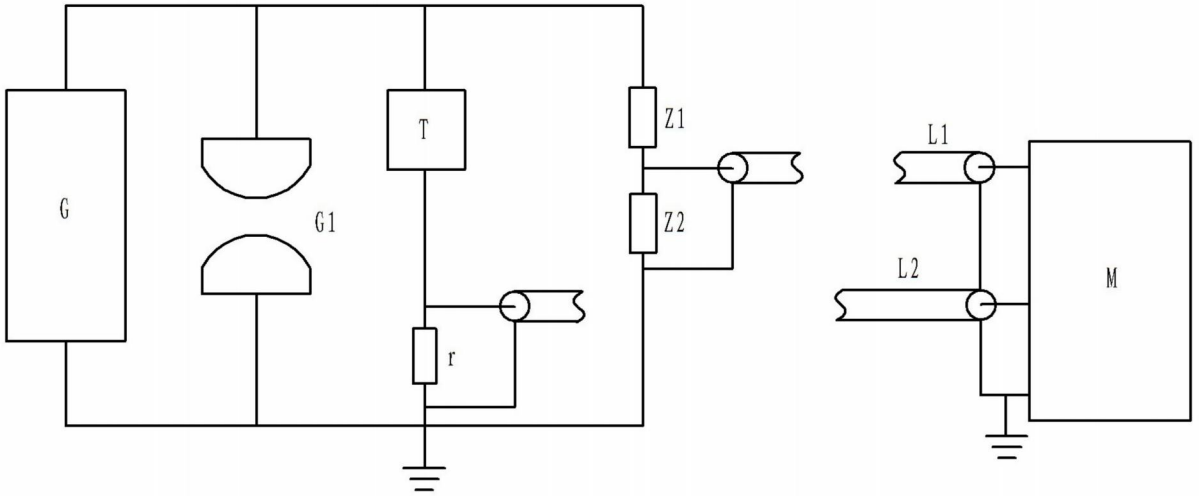
A-电流表 Amperemeter　　V-电压表 Voltmeter

C1, C2-分压电容 Capactor devider　　S-试品 Sample

r-放电电阻 Discharge resistance　　Vp-峰值电压表 Peak value voltmeter

Ck-耦合电容 Coupling capacitor　　Z-测量阻抗 Measured impedance

M-测量仪器 Measurement instrument



雷电冲击试验线路图
Lightning impulse withstand test system circuit

G-冲击电压发生器 Impulse generator

Z1,Z2-阻容分压器 Voltage divider

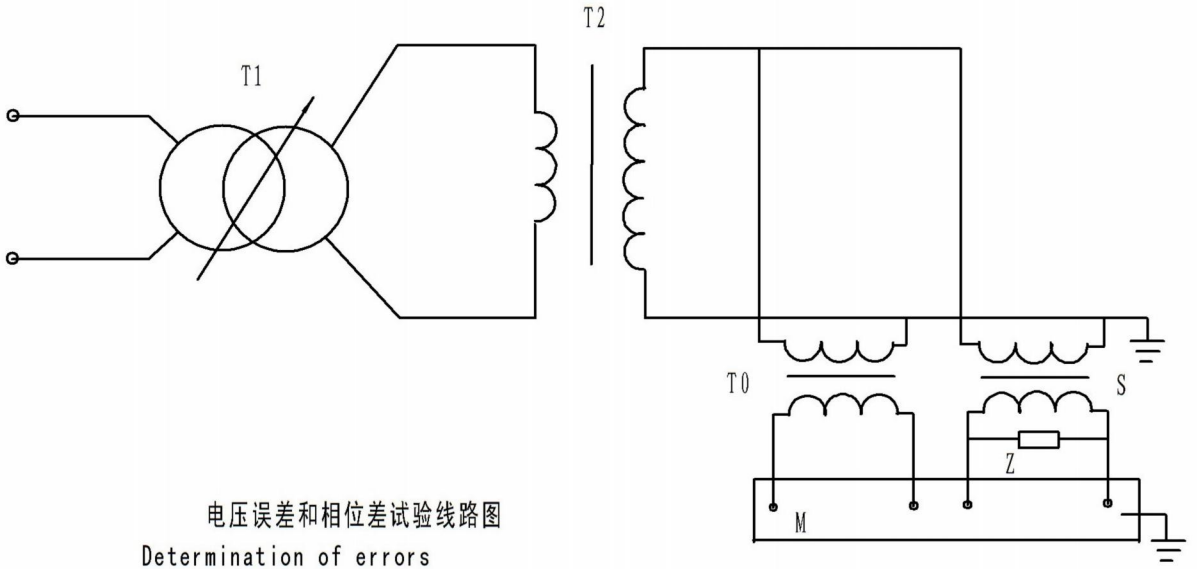
L1,L2-高频传输电缆 High frequency transmission cable

r-分流器 Shunt

G1-截断装置 Chopping device

M-测量仪器 Measurement instrument

T-试品 Sample



电压误差和相位差试验线路图

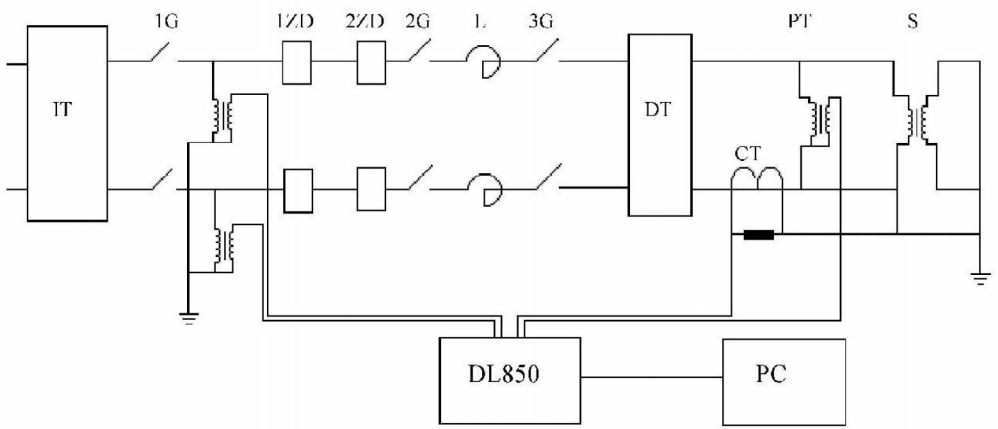
Determination of errors

T1-调压器 Regulator　　T2-升压器 Voltage regulator

T0-标准电压互感器 Standard voltage transformer

S-试品 Sample　　Z-负载 Load

M-标准校验仪 Standard analyzer



电压互感器短路承受能力试验接线图

Short circuit test diagram of voltage transformer

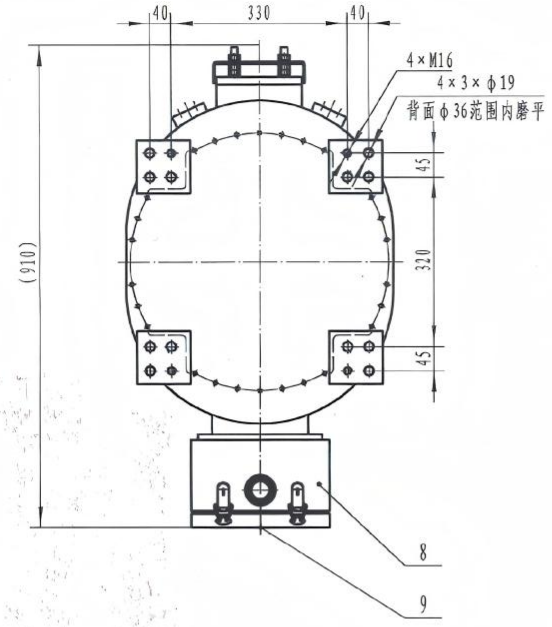
IT：5000kVA 中变 5000kVA INTERMEDIATE TRANSFORMER　1G、2G、3G：隔离开关 SWITCH　1ZD、2ZD：真空断路器 SYNCHRONIZE SWITCH

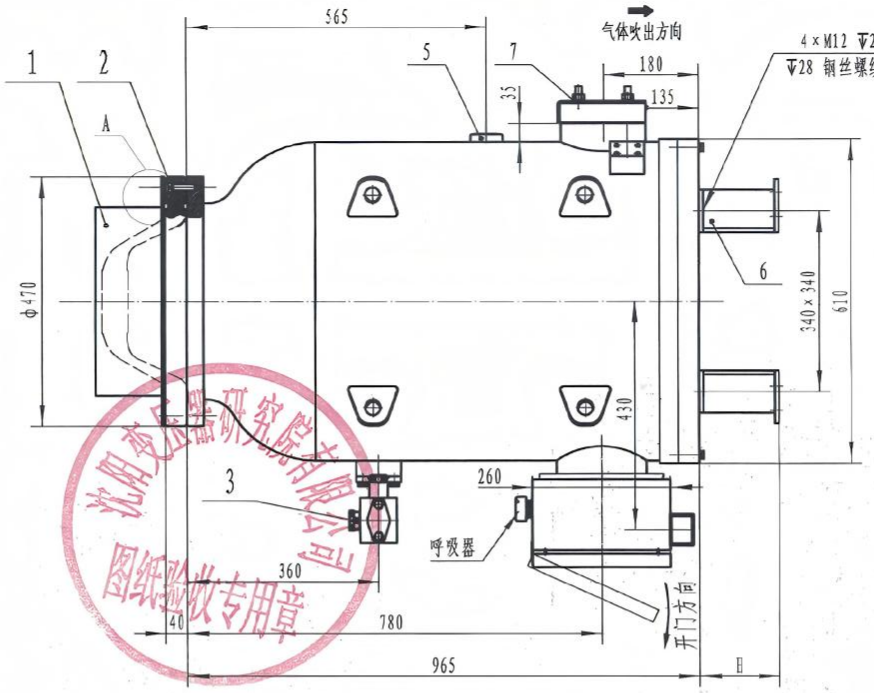
L：电抗器 REACTOR　DT：大电流变压器 HEAVY CURRENT TRANSFORMER　PT：标准电压互感器 STANDARD VOTAGE TRANSFORMER　PC：计算机 PERSONNAL COMPUTER

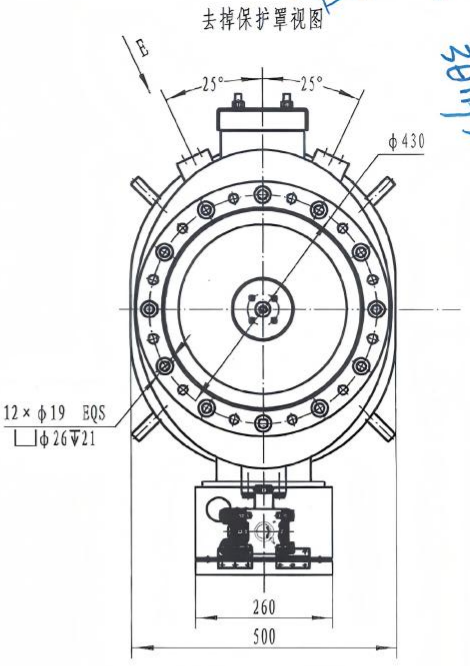
CT：标准电流互感器 STANDARD CURRENT TRANSFORMER　S：被试电压互感器 SAMPLE　DL850：16 通道记录仪 16CH CHANNELS ANALYZER

Relevant Drawings for Voltage Transformers

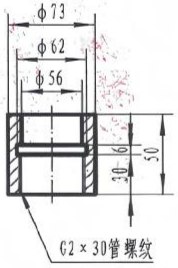
OBFH.300.8565.20



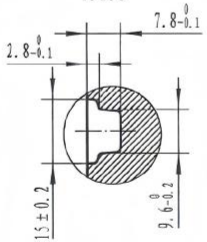




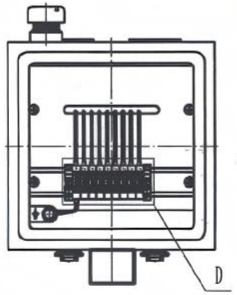
出线管尺寸



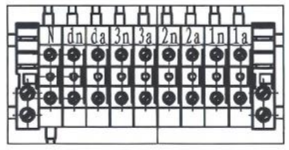
B
1:2.5



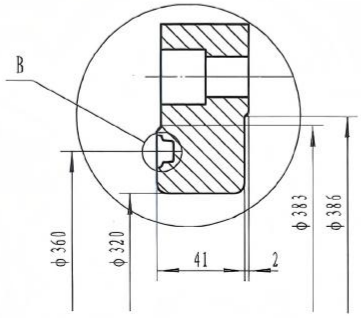
C
旋转



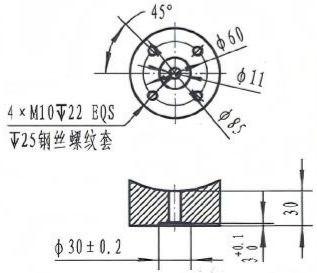
D
1:3.3



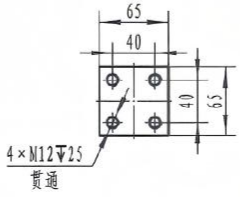
A
1:2.5



充气阀座尺寸



E
接地端子



9	铭牌	Rating plate
8	二次出线盒	Tarminal box
7	防爆装置	Pressure relief device
6	安装架	Mounting brackets
5	运输方向指示牌	Transport direction indicator
4	接地端子	Earthing terminal
3	充气阀座	Gas valve
2	盆式绝缘子	Spacer with gaskets
1	保护罩	Protection cover
序号	名称	Name

总重：320kg　气体重：6kg　迎风面积：0.6m²

技术要求

1. 运输及保管时VT内SF6气体压力应保证在微正压0.02－0.05MPa;
2. VT运输过程中加装10g的防震动标签;
3. 额定气压、参数、涂装要求、安装姿态“上”“下”、温度冶拔等数值详见各站投制设通;
4. 安装单阀、三通阀还是组合阀，以提供的配套件为准;
5. 盆式绝缘子图示环面居中粘贴3M公司宽30mm红色绝缘胶带，盆子浇注口位置不粘贴;
6. VT说明书随产品附带两份;
7. 壳体进行超声波探伤试验，交货时提供超声波探伤报告.

标记	处数	分区	更改文件号	签名	年、月、日
设计			标准化		2023.02.01
审核			审定		2023.02.01
工艺			批准		2023.02.01

外形图（正立）

阶段标记	重量	比例
S A B		1:10
共　张　第　张		

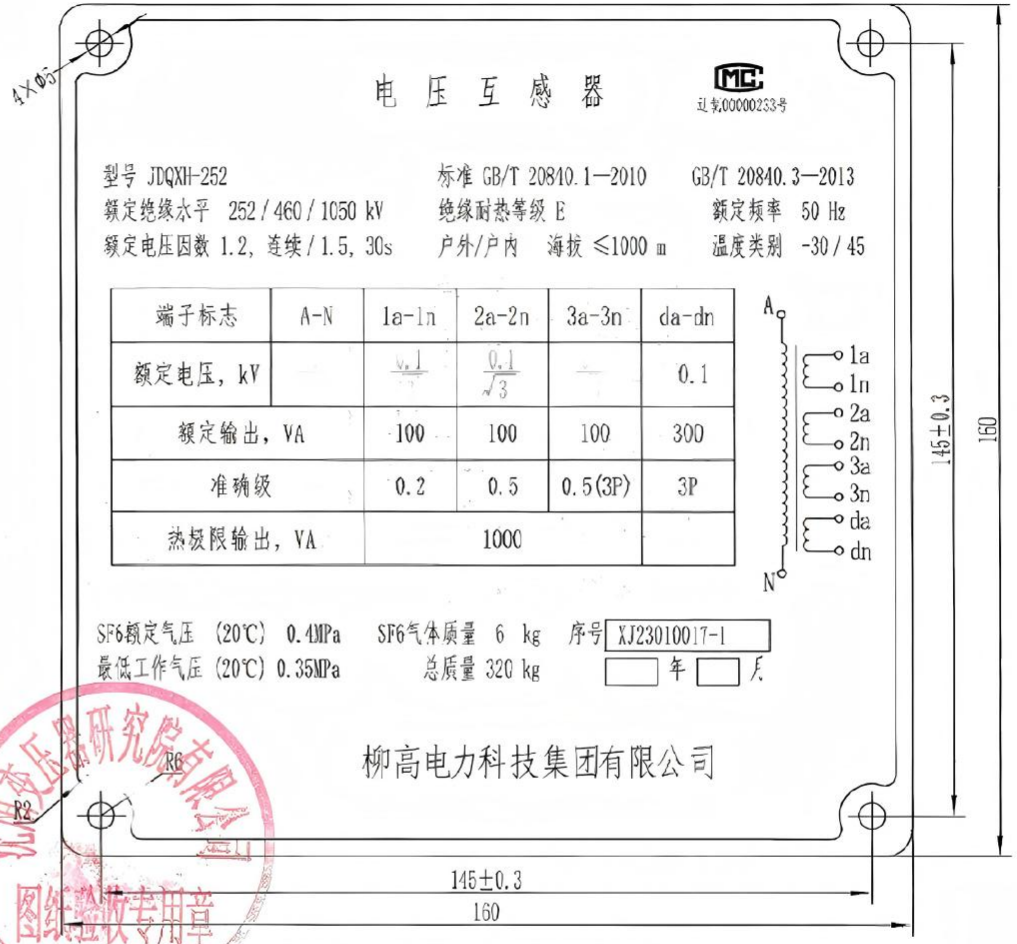
柳高电力科技集团有限公司

JDQXH-252

GIS用六氟化硫气体绝缘电压互感

OBFH.300.8565.20

借（通）用件登记	
旧底图总号	
底图总号	
签字	
日期	
抄案员	日期



沈阳变压器研究院有限公司
图纸验收专用章

技术要求

1. 字高：产品名称、公司名称5，图号≤2.5，其余均为3.5（注意正体、斜体及角标）；
2. 打字框高度不小于6，长度按图实际尺寸；
3. 颜色：“大北互”商标图形及字体为青色，二维码（如有）区域颜色按电子版，其余为黑色；
4. 图号：打在框内右下角处；
5. 图形和文字深度≥0.3mm并选用抗紫外线油墨填充；
6. 激光设备功率不低于20W；
7. 铭牌表面用丙烯酸清漆封装，清漆厚度≥100μm；
8. 满足户外环境十年以上的使用要求。

						0.7不锈钢板06Cr19Ni10		
						阶段标记	重量	比例
						S	A	B
审核						共 张 第 张		
工艺								

铭牌

SBFH.860.8565.31

CHPTL

中国大容量试验联盟（简称 CHPTL）是中国同类试验机构的唯一协作组织，隶属于中国电工技术学会。其主要目标是规范国家标准、行业标准及 IEC 标准在电力设备(交流 1000V 以上，直流 1200V 以上)型式试验中的协调应用。

China High Power Testing liaison (CHPTL) is the only organization in China which is formed to promote and coordinate the application of IEC/GB standard as well as industry standards in power electrical equipment type test (AC above 1000V, DC above 1200V). CHPTL is under the leadership and management of China Electro-technical Society.

CHPTL 成员单位如下:

The members of CHPTL are as follows:

西安高压电器研究院有限责任公司(XIHARI)

Xi'an High Voltage Apparatus Research Institute Co., Ltd. (XIHARI)

中国电力科学研究院(CEPRI)

China Electrical Power Research Institute (CEPRI)

辽宁高压电器产品质量检测有限公司(AQTC)

Liaoning High Voltage Apparatus Quality Test Co., Ltd. (AQTC)

沈阳变压器研究院有限公司变压器实验室(STRI)

Shenyang Transformer Institute Co., Ltd Transformer Laboratory (STRI)

上海电气输配电试验中心有限公司(SETC)

Shanghai Electric Power Transmission & Distribution Testing Center Co., Ltd. (SETC)

电力工业无功补偿成套装置质量检验测试中心(PRCIQTC)

Power Industry Reactive Compensation Equipment Quality Inspection & Test Center(PRCIQTC)

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CHPTL as a collaboration does not itself issue test reports. Each CHPTL member issuing a test report is responsible for the validity and contents of that report.