№:AK1300904-2025(1)

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检测
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检 验 检 测 报 告

TEST REPORT

Sample：DRY-TYPE TRANSFORMER

Model, Type：SCB18-2500/10-NX1　2500kVA

Client：Sichuan Zhongxin General Electric Energy Co.,Ltd.

Test Kind：Type test

山 东 省 产 品 质 量 检 验 研 究 院

Shandong Institute for Product Quality Inspection

国家输配电设备质量检验检测中心（山东）

National Inspection and Testing Center for Power Transmission and Distribution Equipment (Shandong)

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National Inspection and Testing Center for Power Transmission and Distribution Equipment (Shandong)

Test Report

Sample	DRY-TYPE TRANSFORMER	**Test Kind**	Type test
Client	Sichuan Zhongxin General Electric Energy Co.,Ltd	**Model, Type**	SCB18-2500/10-NX1 2500kVA
Manufacturer	Sichuan Zhongxin General Electric Energy Co.,Ltd	**Grade**	Qualified, Energy efficiency grade 1
Address of Client	(Industrial Zone) No.998,Xinghua 5 Road,Xinjin District,Chengdu City,Sichuan Province,China	**Registered Trademark**	/
Sampling Location	/	**Client Representative**	Xia Fawan
Sample Batch	/	**Receipt Date**	2025-10-16
Sample Quantity	1	**Producing Date**	2025-08
Sample Description	Intact	**Batch No.**	B250162
Environmental for Test	See the test	**Test Date**	2025-10-17 to 2025-10-21
Test Standard	GB/T 1094.1-2013、GB/T 1094.3-2017、GB/T 1094.5-2008、GB/T 1094.10-2022、GB/T 1094.11-2022、JB/T 501-2021、JB/T 501-2006、GB/T 35710-2017、IEC 60076-1:2011、IEC 60076-3:2013、IEC 60076-5:2006、IEC 60076-10:2016、IEC 60076-11:2018		
Decision Standard	GB/T 1094.1-2013、GB/T 1094.3-2017、GB/T 1094.5-2008、GB/T 1094.11-2022、GB/T 10228-2023、GB 20052-2024、JB/T 501-2006、GB/T 35710-2017、IEC 60076-1:2011、IEC 60076-3:2013、IEC 60076-5:2006、IEC 60076-11:2018、*Technique service contract of Dry-type Power Transformer- SDQI(G)0402-2025*		
Test Item	Measurement of voltage ratio and check of phase displacement + Measurement of winding resistance + Measurement of d.c. insulation resistance each winding to earth and between windings + Applied voltage test(AV) + Induced voltage withstand tests(IVW) + Measurement of no-load loss and current + Measurement of no-load loss and current at 90% and 110% of rated voltage + Measurement of short-circuit impedance and load loss + Partial discharge measurement + Measurement of the harmonics of the no-load current + Measurement of sound level + Temperature-rise test + Power transformer rated power evaluation test + Short-circuit withstand test + Lightning impulse test+Measurement of zero-sequence impedance(s) on three-phase transformers+Measurement of the power taken by the fan and liquid pump motors		
Test Conclusion	The inspection items of the sample were qualified according to GB/T 1094.1-2013、IEC 60076-1:2011、GB/T 1094.3-2017、IEC 60076-3:2013、GB/T 1094.5-2008、IEC 60076-5:2006、GB/T 1094.11-2022、IEC 60076-11:2018、GB/T 10228-2023、GB 20052-2024、JB/T 501-2006、GB/T 35710-2017、*Technique service contract of Dry-type Power Transformer-SDQI(G)0402-2025*. (Chapter Inspection Unit)		
Note	1.This report contains the cover and second cover."/" Indicates no content. 2.Testing Address: No.31000, Jingshidong Road, Jinan, Shandong. Testing Address: No.1, Chidong Avenue, Chiping District, Liaocheng City. 3.At the request of client,the measurement of the harmonics of the no-load current item should be tested according to JB/T 501-2006. 4.Test data extracted from AK1300904-2025.		

Approved by: 陈大伟 **Reviewed by:** 李春霞 **Tested by:** 刘兴贵

Date: 2025-11-24 **Date: 2025-11-24** **Date: 2025-11-24**

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Test Report (continued)

Test results

No.	Test item	Test requirements Guarantee value (tolerance)	Test results		Verdict
			Before short circuit	After short circuit	
1	Measurement of voltage ratio and check of phase displacement (Routine test)	Voltage ratio at no load no more than: the lower value between a and b on principal tapping or the extreme tappings: a. ±0.5%of the specified ratio. b.±1/10 of the actual percentage impedance on the principal tapping: (±0.594%) Other taps: ±0.5% of the design value of turns ratio. Phase displacement:Dyn11	Principal tapping: 0.02%~0.04% Other tappings: 0.03%~0.07% Dyn11	Principal tapping: 0.03%~0.04% Other tappings: 0.04%~0.08% Dyn11	Pass
2	Measurement of winding resistance (Routine test)	DC Resistance Unbalance Rate: Line (%):≤2	h.v.: ≤0.36 l.v.:1.03	h.v.: ≤0.33 l.v.:1.21	Pass
3	Measurement of d.c. insulation resistance each winding to earth and between windings (Routine test)	Provide insulation resistance (GΩ) :/	H-L.E：516 L-H.E：558 H.L-E：532	H-L.E：493 L-H.E：537 H.L-E：519	No verdict
4	Applied voltage test(AV) (Routine test)	h.v.:35kV 60s l.v.:3 kV 60s No voltages collapse occurred.	35kV 60s 3 kV 60s No voltages collapse occurred.	35 kV 60s 3 kV 60s No voltages collapse occurred.	Pass
5	Induced voltage withstand tests(IVW) (Routine test)	Applied voltage(kV):0.8 Induced AC voltage (kV):20 Test time (s): 120×(f_n/f) Frequency(Hz): ＞50 No voltages collapse occurred.	0.8 20 30 200 No voltages collapse occurred.	0.8 20 30 200 No voltages collapse occurred.	Pass
6	Measurement of zero-sequence impedance(s) on three-phase transformers (Special test)	Provide zero-sequence impedance(Ω) :/	0.00380	/	No verdict
7	Measurement of no-load loss and current (Routine test)	I_0（%）: ≤ 0.6（1+30%） P_0（W）: ≤2080	0.18 2045.46	0.18 2046.57	Pass
8	Measurement of no-load loss and current at 90 % and 110 % of rated voltage (Type test)	at 90 % of rated voltage: I_0（%）:/ P_0（W）:/ at 110 % of rated voltage: I_0（%）:/ P_0（W）:/	0.13 1433.39 0.28 3070.82	/	No verdict
9	Measurement of short-circuit impedance and load loss (Routine test)	t:145℃ Z（%）:6.0 (1±10%) P_k（W）:≤16605 P_{Total}（W）:≤18685	Tapping:3 5.94 16323.86 18369.32	Tapping:3 5.95 16348.37 18394.94	Pass

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Test Report (continued)

No.	Test item	Test requirements Guarantee value (tolerance)	Test results		Verdict
			Before short circuit	After short circuit	
10	Partial discharge measurement (Routine test)	Applied voltage（kV）:1.3Ur Test time（min）:3 The maximum level of partial discharges（pC）:≤5	3 A：<4 B：<4 C：<4	3 A：<4 B：<4 C：<4	Pass
11	Measurement of the power taken by the fan and liquid pump motors（Type test）	the power taken by the fan motors（W）: /	535.29		No verdict
12	Measurement of the harmonics of the no-load current (Special test)	Provide the harmonics of the no-load current each phase	See 4.12 I_1-I_{20} the harmonics of the no-load current		No verdict
13	Measurement of sound level（Type test）	Sound pressure level $\overline{L_{pA}}$dB（A）:/ Sound power level L_{WA}dB（A）:≤62	41.9 57.8		Pass
		method of cooling:AF Sound pressure level $\overline{L_{pA}}$dB（A）:/ Sound power level $L_{WA,SN}$dB（A）:/	43.4 62.6		No verdict
14	Temperature-rise test（Type test）	Winding temperature rise limit（K）:≤125	h.v.:92.9 l.v.:106.0		Pass
15	Power transformer rated power evaluation test（Entrust test）	See GB/T 35710-2017	See 4.15		Evaluation power 2500kVA
16	Short-circuit withstand test (Special test)	Three tests on each phase The duration of each test: (s): 0.5(1±10%) the oscillograms no anomalies indication. The biggest reactance difference(%):≤2.0 The out-of-tank inspection not reveal any defects The dielectric tests and other routine tests,have been successfully repeated	3 0.495~0.508 Pass 0.96 Pass Pass		Pass
17	Lightning impulse test (Type test)	Full impulse (kV):75(1±3%)	74.59~75.14 Transients record no significant differences		Pass

Note:There are no technical requirement in the standard, so Measurement of d.c. insulation resistance each winding to earth and between windings and Measurement of no-load loss and current at 90 % and 110 % of rated voltage , Measurement of the harmonics of the no-load current , Measurement of the power taken by the fan and liquid pump motors,Measurement of zero-sequence impedance(s) on three-phase transformers and method of cooling:AF Measurement of sound level test items have no single verdict.

1. Samper parameters

Rated power:	2500kVA
Rated voltages:	10/0.4kV
Rate currents:	144.3/3608.4A
Number of phases:	3
Rated frequency:	50Hz
Tapping range:	±2×2.5%
Connection symbol:	Dyn11
Type of cooling:	AN/AF
Coil structure:	circular concentric coil
Temperature class of insulation:	H
Insulation level:	h.v. Um/LI/AC 12/75/35kV
	l.v. AC 3kV

2. The sample describes

（1）Indoor.

（2）The sample phase sequence marking of high and low winding is clear and accurate.

（3）The sample external appearance has no collision, damage.

3. Test Standard

GB/T 1094.1-2013 *Power transformers-Part 1:General*
GB/T 1094.3-2017 *Power transformers -Part 3: Insulation levels, dielectric tests and external clearances in air*
GB/T 1094.5-2008 *Power transformers-Part 5:Ability to withstand short circuit*
GB/T 1094.10-2022 *Power transformers-Part 10:Determination of sound levels*
GB/T 1094.11-2022 *Power transformers-Part 11:Dry-type transformers*
GB/T10228-2023 *Specification and technical requirements for dry-type power transformers*
JB/T 501-2021 *Test guide for power transformers*
JB/T 501-2006 *Test guide for power transformers*
GB 20052-2024 *Minimum allowable values of energy efficiency and the energy efficiency grades for power transformers*
GB/T 35710-2017 *Rated power evaluation guide for 35 kV and below power transformers*
Technique service contract of Dry-type Power Transformer-SDQI(G)0402-2025
IEC 60076-1:2011 *Power transformers - Part 1: General*
IEC 60076-3:2013 *Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air*
IEC 60076-5:2006 *Power transformers - Part 5: Ability to withstand short circuit*
IEC 60076-10:2016 *Power transformers - Part 10: Determination of sound levels*
IEC 60076-11:2018 *Power transformers - Part 11:Dry-type transformers*

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Test Report (continued)

4. Test items and results

4.1 Measurement of voltage ratio and check of phase displacement(routine test)

Date: 2025-10-17

Ambient temperature:17.0℃; RH:63.9 %; Barometric pressure:100.30kPa

H.V. winding		L.V. winding	Voltage ratio	Voltage ratio Deviation（%）			Connection symbol
Tapping	Voltage（kV）	Voltage（kV）		AB/ab	BC/bc	CA/ca	
1	10.5	0.4	26.250	0.06	0.07	0.06	Dyn11
2	10.25		25.625	0.04	0.05	0.04	
3	10		25.000	0.02	0.04	0.03	
4	9.75		24.375	0.03	0.05	0.04	
5	9.5		23.750	0.05	0.06	0.05	

4.2 Measurement of winding resistance (routine test) Date: 2025-10-17

Winding temperature:17.0℃;Ambient temperature: 17.0℃; RH:63.9 %; Barometric pressure:100.30kPa

Winding	Tapping	Winding resistance			Resistance Unbalance Rate (%)
		A–B（Ω） a–b（mΩ）	B–C（Ω） b–c（mΩ）	C–A（Ω） c–a（mΩ）	
High-voltage	1	0.1843	0.1846	0.1849	0.32
	2	0.1771	0.1773	0.1775	0.23
	3	0.1701	0.1704	0.1707	0.35
	4	0.1642	0.1645	0.1648	0.36
	5	0.1586	0.1588	0.1590	0.25
Low-voltage	/	0.2323	0.2335	0.2347	1.03
		a–o（mΩ）			0.1275

4.3 **Measurement of d.c. insulation resistance each winding to earth and between windings** (routine test)

Date: 2025-10-17

Ambient temperature:16.8℃; RH:64.1 %; Barometric pressure:100.28kPa

Measurement position	Insulation resistance (GΩ)
High-voltage winding—low-voltage winding, iron core, clamp, oil tank and earth	516
Low-voltage winding—high-voltage winding, iron core, clamp, oil tank and earth	558
High-voltage winding,low-voltage winding—iron core, clamp, oil tank and earth	532

4.4 **Applied voltage test(AV)** (routine test) Date: 2025-10-17

Ambient temperature:16.8℃; RH:64.1 %; Barometric pressure:100.28kPa

Position	Test voltage（kV）	Time(s)	Test result
High-voltage winding—earth and low-voltage	35	60	Pass
Low-voltage winding—earth and high-voltage	3	60	

4.5 **Induced voltage withstand tests(IVW)** (routine test) Date: 2025-10-17

Ambient temperature:16.8℃; RH:64.1 %; Barometric pressure:100.28kPa

Tapping	Applied voltage（kV）	Induced AC voltage（kV）	Induction factor	Frequency (Hz)	Test time (s)	Test result
	L.V.	H.V.				
3	0.8	20	2	200	30	Pass

4.6 **Measurement of zero-sequence impedance(s) on three-phase transformers** (special test)

Date: 2025-10-17

Ambient temperature:16.4 ℃; RH: 64.5 %; Barometric pressure:100.24 kPa

Connection symbol	Power supply terminal	Open circuit terminal	Short circuit terminal	Applied current(A)	Measuring voltage(V)	Impedance(Ω)
Dyn11	abc-o	A，B，C	/	3000	3.801	0.00380

The test current for each phase is I/3

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Test Report (continued)

4.7 **Measurement of no-load loss and current** (routine test) Date: 2025-10-17

Ambient temperature:16.6℃; RH:64.3 %; Barometric pressure:100.26kPa ; Transformer temperature :16.6℃

Test voltage（V）		No-load current		No-load loss （W）	
The mean value of voltage	The r.m.s. value of voltage	（A）	（%）	The measured	The corrected
401.46	400.68	6.63	0.18	2041.49	2045.46

4.8 **Measurement of no-load loss and current at 90 % and 110 % of rated voltage** （Type test） Date: 2025-10-17

Ambient temperature:16.6℃; RH:64.3 %; Barometric pressure:100.26kPa ; Transformer temperature :16.6℃

Proportion of rated voltage	Test voltage（V）		No-load current		No-load loss （W）	
	The mean value of voltage	The r.m.s. value of voltage	（A）	（%）	The measured	The corrected
90%	360.95	360.14	4.65	0.13	1430.18	1433.39
110%	441.27	440.39	9.97	0.28	3064.71	3070.82

4.9 **Measurement of short-circuit impedance and load loss** (routine test) Date: 2025-10-17

Ambient temperature:16.6℃; RH:64.3 %; Barometric pressure:100.26kPa

Winding	Tapping	The supplied current		The measured voltage（V）	Short-circuit impedance		Load loss （W）		Total loss (W)
		（A）	I/Ir(%)		(%)	（Ω）	The measured	The corrected	The corrected
					t=145℃ I=Ir		/	t=145℃ I=Ir	t=145℃ I=Ir
H.V. – L.V.	1	109.68	79.8	503.71	6.03	2.66	8260.31	16117.29	18162.75
	3	116.24	80.6	477.17	5.94	2.38	8544.83	16323.86	18369.32
	5	123.45	81.3	450.32	5.85	2.11	8769.28	16582.73	18628.19

4.10 **Partial discharge measurement**(routine test) Date: 2025-10-17

Ambient temperature:16.4℃; RH:64.5 %; Barometric pressure:100.24kPa

The background noise level （pC）		Applied voltage			Time	Partial discharge level （pC）		
Before the test	After the test	Factor	Frequency（Hz）	（kV）		A	B	C
A：＜2	A：＜2	1.8Ur	200	0.72	30s	/	/	/
B：＜2	B：＜2							
C：＜2	C：＜2	1.3Ur	200	0.52	3min	<4	<4	<4

4.11 **Measurement of the power taken by the fan and liquid pump motors（Type test）** Date: 2025-10-17

Ambient temperature:16.4℃; RH:64.5 %; Barometric pressure:100.24kPa

Voltage（V）	Current (A)	The measured power (W)
220.26	2.4548	535.29

Test Report (continued)

4.12 **Measurement of the harmonics of the no-load current (**Special test**)**

Date: 2025-10-17

Ambient temperature:16.5℃; RH:64.5 %; Barometric pressure:100.25kPa

harmonic order	A（%）	B（%）	C（%）
1	100.00	100.00	100.00
2	1.56	1.39	1.49
3	3.81	3.72	3.81
4	1.75	1.93	1.26
5	5.32	5.47	5.16
6	1.26	1.32	1.12
7	2.92	2.99	2.95
8	0.78	0.82	0.73
9	1.62	1.65	1.42
10	0.44	0.49	0.47
11	0.85	0.92	0.16
12	0.44	0.42	0.38
13	0.17	0.25	0.21
14	0.02	0.01	0.01
15	0.00	0.00	0.01
16	0.00	0.01	0.01
17	0.00	0.00	0.00
18	0.00	0.00	0.00
19	0.00	0.00	0.00
20	0.00	0.00	0.00
Apply voltage（V）	401.06	frequency, rate（Hz）	50

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Test Report (continued)

4.13 **Determination of sound level for each method of cooling**（Type test）

Date: 2025-10-17

Ambient temperature: 16.2 ℃; RH:64.7 %; Barometric pressure:100.22 kPa; Transformer temperature :16.2℃

4.13.1 **Determination of sound level for method of cooling:AN**

4.13.1.1 **The load current sound power level:**

Equation: $L_{WA,Ir} \approx 39 + 18 \times \lg \frac{S_r}{S_p} =$ 46.2 dB(A)

Where: $L_{WA\,Ir}$ —— the A-weighted sound power level of the transformer at rated current, rated frequency and impedance voltage, dB（A）.

S_r——the rated power in megavolt amperes, 2.5 MVA

S_p—the reference power ,1MVA.

The calculated value is 10 dB or more below the sound power level estimated 62 dB(A) at no-load excitation, load current sound measurements are not appropriate.

4.13.1.2 **The sound power level measurements**

The L.V. Winding test voltage:400V; Frequency:50Hz; Tapping:3;

Measuring point:14; Measuring point height:0.900m; Distance of measuring point:1.000m.

Environmental conditions

The total area of the surface of the test room S_{Vi}（m²）		The average acoustic absorption coefficient a_i		The sound absorption area of the test room A（m²）	Distance to the principal radiating surface（m）	The area of the measurement surface S（m²）	Environmental correction K（dB）
Hard ground	Ceiling and walls	Hard ground	Ceiling and walls				
66.93	266.13	0.1	0.3	86.532	1.0	39.2	4.49

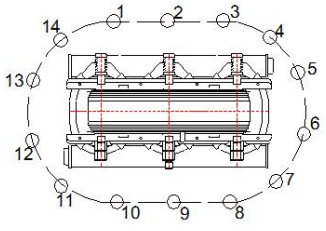
Result dB（A）

Type of cooling	$\overline{L_{pA0}} = 10 \times \lg(\frac{1}{N}\sum_{i=1}^{N} 10^{0.1 L_{pAi}})$	$\overline{L_{pA}} = 10 \times \lg\left(10^{0.1\overline{L_{pA0}}} - 10^{0.1\overline{L_{bgA}}}\right) - K$	$L_{WA} = \overline{L_{pA}} + 10 \times \lg \frac{S}{S_0}$
AN	46.5	41.9	57.8

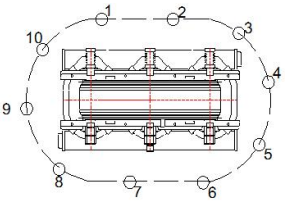
Note: The initial average background noise pressure levels:28.4dB(A),The final average background noise pressure levels:28.4dB(A).

$\overline{L_{bgA}}$: The lower of the two total spatially average A-weighted background noise levels.

Layout of sound pressure level measuring points



Layout of background noise measuring points



4.13.2 **Determination of sound level for method of cooling:AF**

4.13.2.1 **The load current sound power level:**

Equation: $L_{WA,Ir} \approx 39+18\times\lg\frac{S_r}{S_p}$ = 46.2 dB(A)

Where: $L_{WA\,Ir}$ —— the A-weighted sound power level of the transformer at rated current, rated frequency and impedance voltage, dB（A）.

S_r——the rated power in megavolt amperes, 2.5 MVA

S_p—the reference power ,1MVA.

4.13.2.2 **The sound power level measurements**

The L.V. Winding test voltage:400V; Frequency:50Hz; Tapping:3;

Measuring point:24; Measuring point height:0.900m; Distance of measuring point:0.917m.

Environmental conditions

The total area of the surface of the test room S_{Vi} （m²）		The average acoustic absorption coefficient a_i		The sound absorption area of the test room A（m²）	Distance to the principal radiating surface（m）	The area of the measurement surface S （m²）	Environmental correction K（dB）
Hard ground	Ceiling and walls	Hard ground	Ceiling and walls				
66.93	266.13	0.1	0.3	86.532	2.0	83.6	6.87

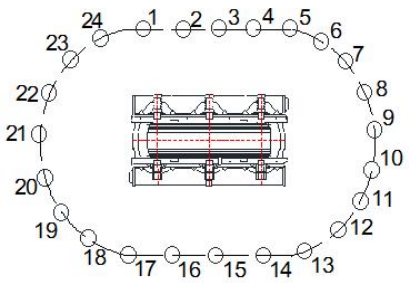
Result dB（A）

Type of cooling	$\overline{L_{pA0}}=10\times\lg(\frac{1}{N}\sum_{i=1}^{N}10^{0.1L_{pAi}})$	$\overline{L_{pA}}=10\times\lg\left(10^{0.1\overline{L_{pA0}}}-10^{0.1\overline{L_{bgA}}}\right)-K$	$L_{WA}=\overline{L_{pA}}+10\times\lg\frac{S}{S_0}$
AF	50.3	43.4	62.6

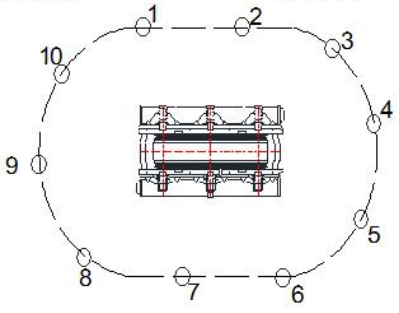
Note: The initial average background noise pressure levels:28.4dB(A),The final average background noise pressure levels:28.4dB(A).

$\overline{L_{bgA}}$: The lower of the two total spatially average A-weighted background noise levels.

Layout of sound pressure level measuring points



Layout of background noise measuring points



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Test Report (continued)

4.14 **Temperature-rise test**(Type test) Date: 2025-10-17 to 2025-10-18

Ambient temperature: 13.2-17.1 ℃

Test by simulated load method, tapping:3, Open-circuit test time:13h, Rated voltage: 0.4kV, The supplied voltage: 401.73V. The winding short-circuited test time:10h, Rated current :144.3A, The supplied current :144.68A . method of cooling :AN.

Open-circuit test carried out until stabilisation of the core and the winding temperature. Subsequently, the winding short-circuited test shall be carried out until stabilisation of the core and winding temperature is reached.

Measurement data of the open-circuit test

Winding	Ambient temperature（℃）		Measurement of resistance（Ω）		The winding average temperature rise（K）
	During cold resistance	During thermal resistance	Cold resistance	Thermal resistance	
H.V.（BC）	17.0	15.3	0.1704	0.1759	25.1
L.V.（bc）			0.0002335	0.0002518	36.7

Sequence	1	2	3	4	5	6	7	8	9	10
H.V.（BC）（Ω）	0.1759	0.1759	0.1759	0.1759	0.1759	0.1759	0.1759	0.1759	0.1758	0.1758
L.V.（bc）（mΩ）	0.2518	0.2518	0.2518	0.2518	0.2518	0.2518	0.2518	0.2518	0.2517	0.2517

Measurement data of the winding short-circuited test

Winding	Ambient temperature（℃）		Measurement of resistance（Ω）		The winding average temperature rise（K）
	During cold resistance	During thermal resistance	Cold resistance	Thermal resistance	
H.V.（BC）	17.0	15.6	0.1704	0.2292	104.0
L.V.（bc）			0.0002335	0.0003197	110.0

Sequence	1	2	3	4	5	6	7	8	9	10
H.V.（BC）（Ω）	0.2286	0.2281	0.2277	0.2272	0.2268	0.2265	0.2261	0.2258	0.2256	0.2253
L.V.（bc）（mΩ）	0.3189	0.3182	0.3176	0.3169	0.3164	0.3159	0.3155	0.3150	0.3146	0.3143

Temperature rise calculation results

The winding average temperature rise of the open-circuit test（K）		The winding average temperature rise of the short-circuited test（K）	
H.V.（BC）	L.V.（bc）	H.V.（BC）	L.V.（bc）
9.8	21.4	88.4	94.4

The winding average temperature rise（K）		
High-voltage	92.9	
Low-voltage	106.0	

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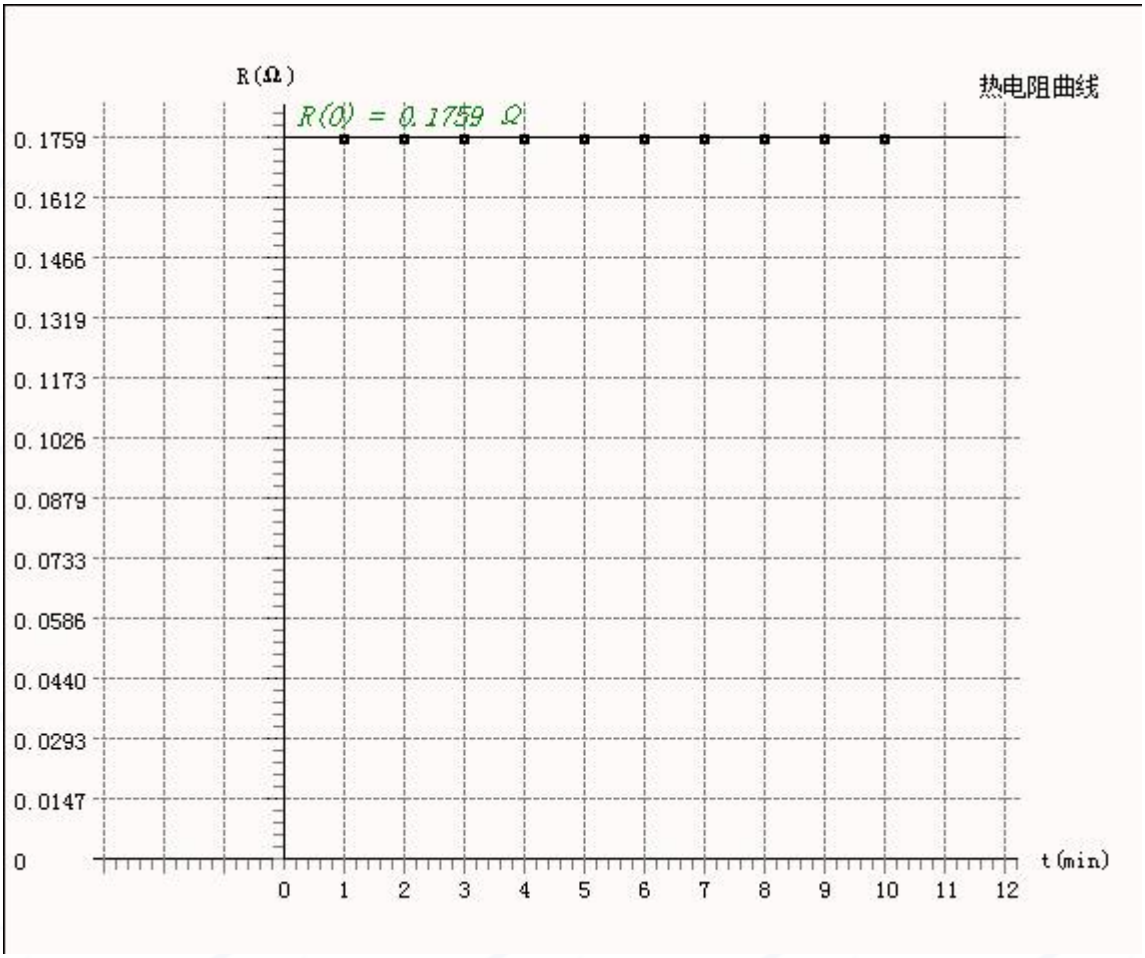
Test Report (continued)

Temperature-rise test-the open-circuit test

Hot resistance curve of High-voltage winding: F1



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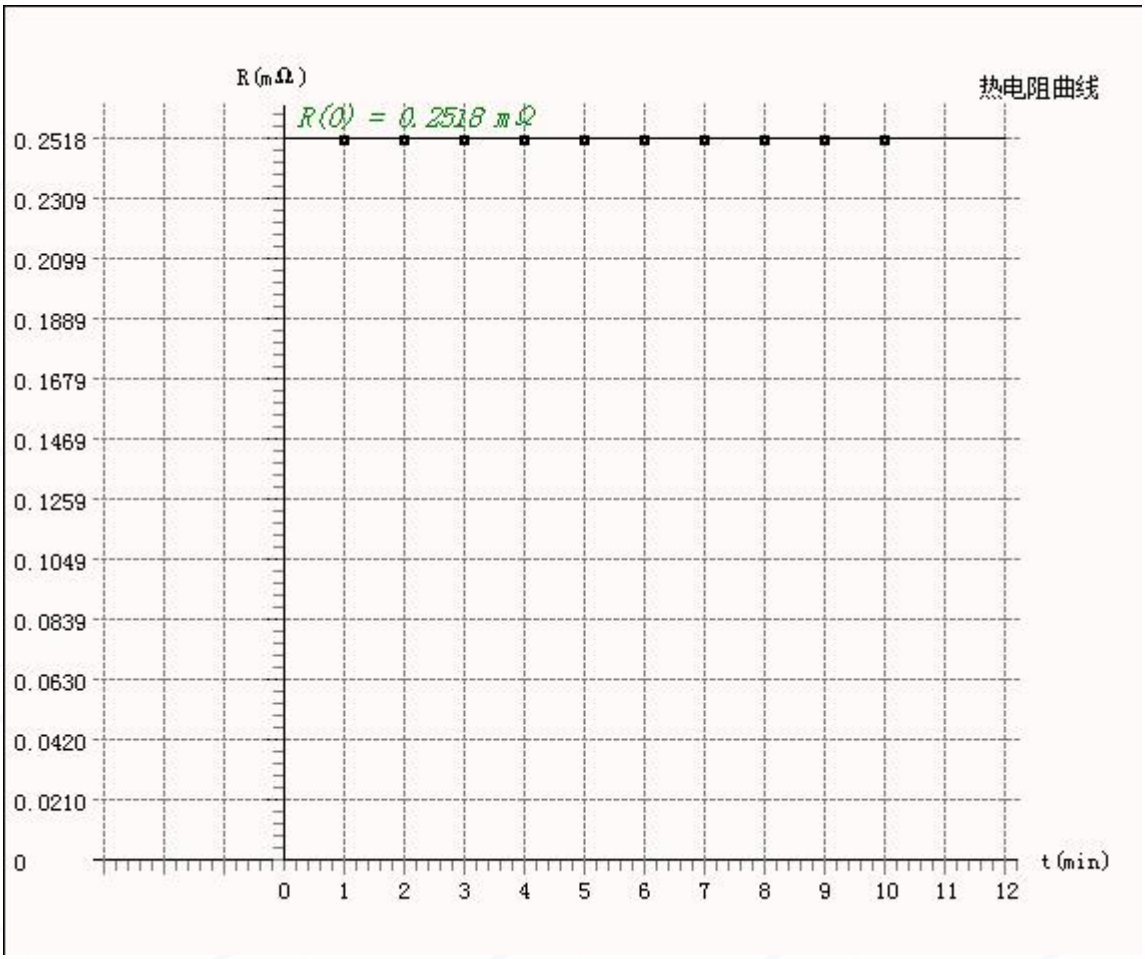
Test Report (continued)

Temperature-rise test-the open-circuit test

Hot resistance curve of Low-voltage winding: F2



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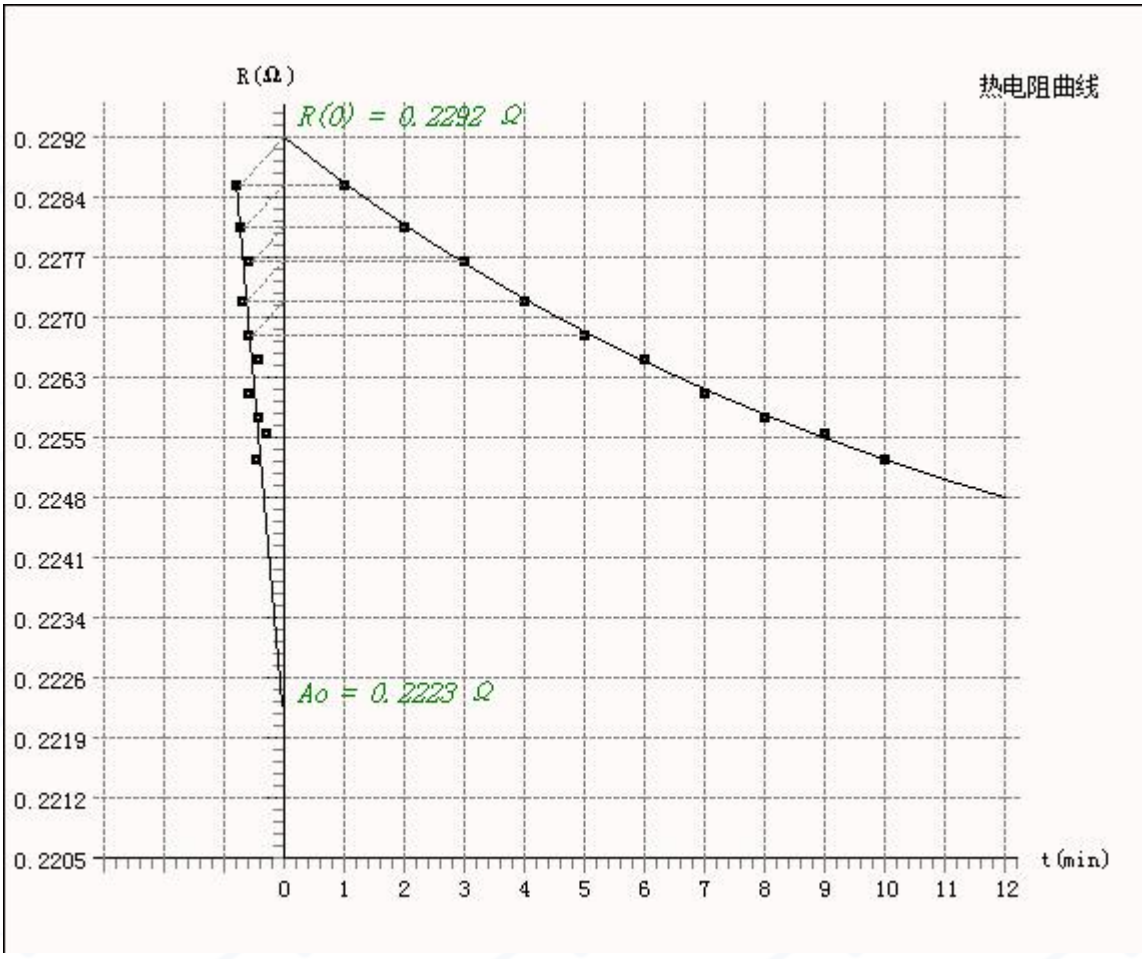
Test Report (continued)

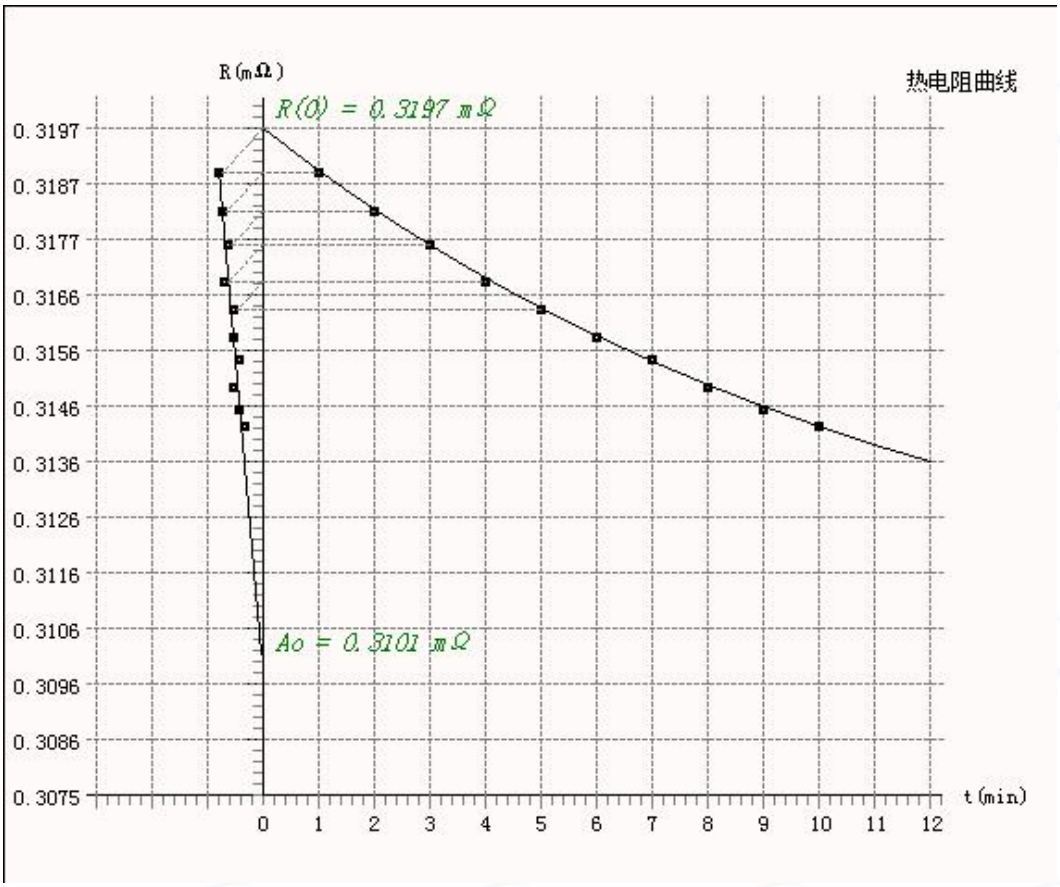
Temperature-rise test-the winding short-circuited test

Hot resistance curve of High-voltage winding: F3



Temperature-rise test-the winding short-circuited test

Hot resistance curve of Low-voltage winding: F4



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Test Report (continued)

4.15 Power transformer rated power evaluation test（Entrust test） Date: 2025-10-17 to 10-18

Ambient temperature:16.6℃;RH:64.3%;Barometric pressure:100.26kPa

Winding	Tapping	The supplied current		The measured voltage（V）	Short-circuit impedance	Load loss（W）
		（A）	I/Ir（%）		（%）	The corrected
					t=145℃ I=Ir	t=145℃ I=Ir
H.V. – L.V.	3	116.24	80.6	477.17	5.94	16323.86

Assumed rated power 2500kVA	Calibration to rated current and reference temperature 145℃ short- circuit impedance%	5.94
Whether short-circuit impedance Z_k is within the allowable range of standard short-circuit impedance(6.0%) error corresponding to the assumed rated power 2500kVA	Yes	
Assumed rated power 1600kVA	Calibration to rated current and reference temperature 145℃ short- circuit impedance%	3.80
Whether short-circuit impedance Z_k is within the allowable range of standard short-circuit impedance(6.0%) error corresponding to the assumed rated power 1600kVA	No	
Assumed rated power 2000kVA	Calibration to rated current and reference temperature 145℃ short- circuit impedance%	4.75
Whether short-circuit impedance Z_k is within the allowable range of standard short-circuit impedance(6.0%) error corresponding to the assumed rated power 2000kVA	No	
Assumed rated power 2500kVA temperature-rise test	See 4.14	
Whether the temperature rise test results meet the standard requirements corresponding to the preset capacity of 2500kVA	yes	
Appraisal results	The measured power of this transformer is 2500kVA, and the power marked on the nameplate is 2500kVA.Conform to reality.	

Note: The maximum power of the distribution transformer in the standard GB/T 10228-2023 is 2500 kVA, with only one adjacent capacity above the preset capacity.

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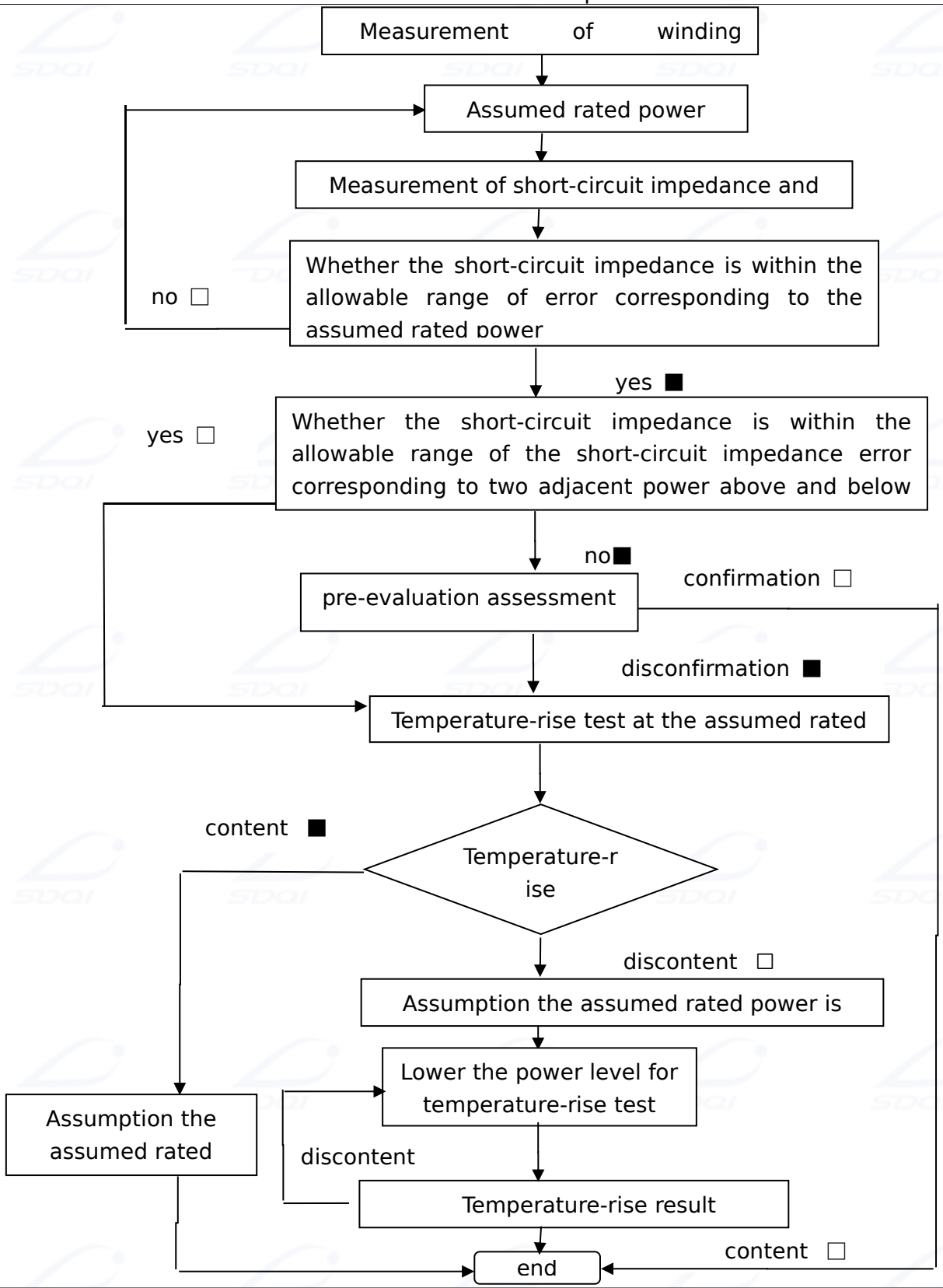
Test Report (continued)

Process of transformer rated power evaluation test



Appraisal conclusion: The assumed rated power 2500kVA is transformer power, evaluation over.

4.16**Short-circuit withstand test**(special test) Date: 2025-10-20

Ambient temperature:18.6℃;RH:43%;Barometric pressure:101.1kPa

4.16.1 **Calculation of short circuit current**（Reference temperature 145℃）

Tapping	The peak value of the current（kA）	Value of symmetrical short-circuit current （kA）	Values for factor （$K\sqrt{2}$）
1	5.152（1±5%）	2.120（1±10%）	2.43
3	5.423（1±5%）	2.241（1±10%）	2.42
5	5.717（1±5%）	2.372（1±10%）	2.41

4.16.2 Short-circuit test apply current

Using a three-phase current test with a short circuit on the low-voltage side, the supply voltage is applied to the outer winding (high-voltage side).

Tapping	Phase	Sequence	Current				Duration (ms)	Oscillogram No.
			The peak value of the current		Value of symmetrical short-circuit current			
			（kA）	（%）	（kA）	（%）		
1	A	1	5.334	103.53	2.148	101.32	503	B1
		2	5.357	103.98	2.155	101.65	495	B2
		3	5.342	103.69	2.151	101.46	503	B3

Sequence	Reactance					
	Reactance（Ω）			Tolerance（%）		
	A	B	C	A	B	C
Before the test	2.6419	2.6440	2.6462	/	/	/
1	2.6468	2.6514	2.6521	0.19	0.28	0.22
2	2.6483	2.6536	2.6542	0.24	0.36	0.30
3	2.6507	2.6553	2.6567	0.33	0.43	0.40

The biggest reactance difference is0.43%.

Test Report (continued)

4.16.2 Short-circuit test apply current

Tapping	Phase	Sequence	Current				Duration (ms)	Oscillogram No.
			The peak value of the current		Value of symmetrical short-circuit current			
			(kA)	(%)	(kA)	(%)		
3	B	1	5.568	102.67	2.263	100.98	500	B4
		2	5.593	103.13	2.275	101.52	500	B5
		3	5.574	102.78	2.272	101.38	508	B6

Sequence	Reactance					
	Reactance (Ω)			Tolerance (%)		
	A	B	C	A	B	C
Before the test	2.3594	2.3616	2.3638	/	/	/
1	2.3684	2.3743	2.3751	0.38	0.54	0.48
2	2.3706	2.3768	2.3775	0.47	0.64	0.58
3	2.3724	2.3785	2.3762	0.55	0.72	0.52

The biggest reactance difference is 0.72%.

4.16.2 Short-circuit test apply current

Tapping	Phase	Sequence	Current					
			The peak value of the current		Value of symmetrical short-circuit current		Duration (ms)	Oscillogram No.
			(kA)	(%)	(kA)	(%)		
5	C	1	5.824	101.87	2.365	99.70	505	B7
		2	5.853	102.38	2.378	100.25	505	B8
		3	5.846	102.26	2.374	100.08	505	B9

Sequence	Reactance					
	Reactance (Ω)			Tolerance (%)		
	A	B	C	A	B	C
Before the test	2.0953	2.0982	2.1012	/	/	/
1	2.1084	2.1146	2.1157	0.63	0.78	0.69
2	2.1104	2.1165	2.1171	0.72	0.87	0.76
3	2.1123	2.1183	2.1198	0.81	0.96	0.89

The biggest reactance difference is 0.96%.

The biggest reactance difference is 0.96 %.After Short circuit test, reveal no defects such as displacements,deformation of windings,connections or supporting structures. No traces of internal electrical discharge were found.

The oscillograms no anomalies indication.

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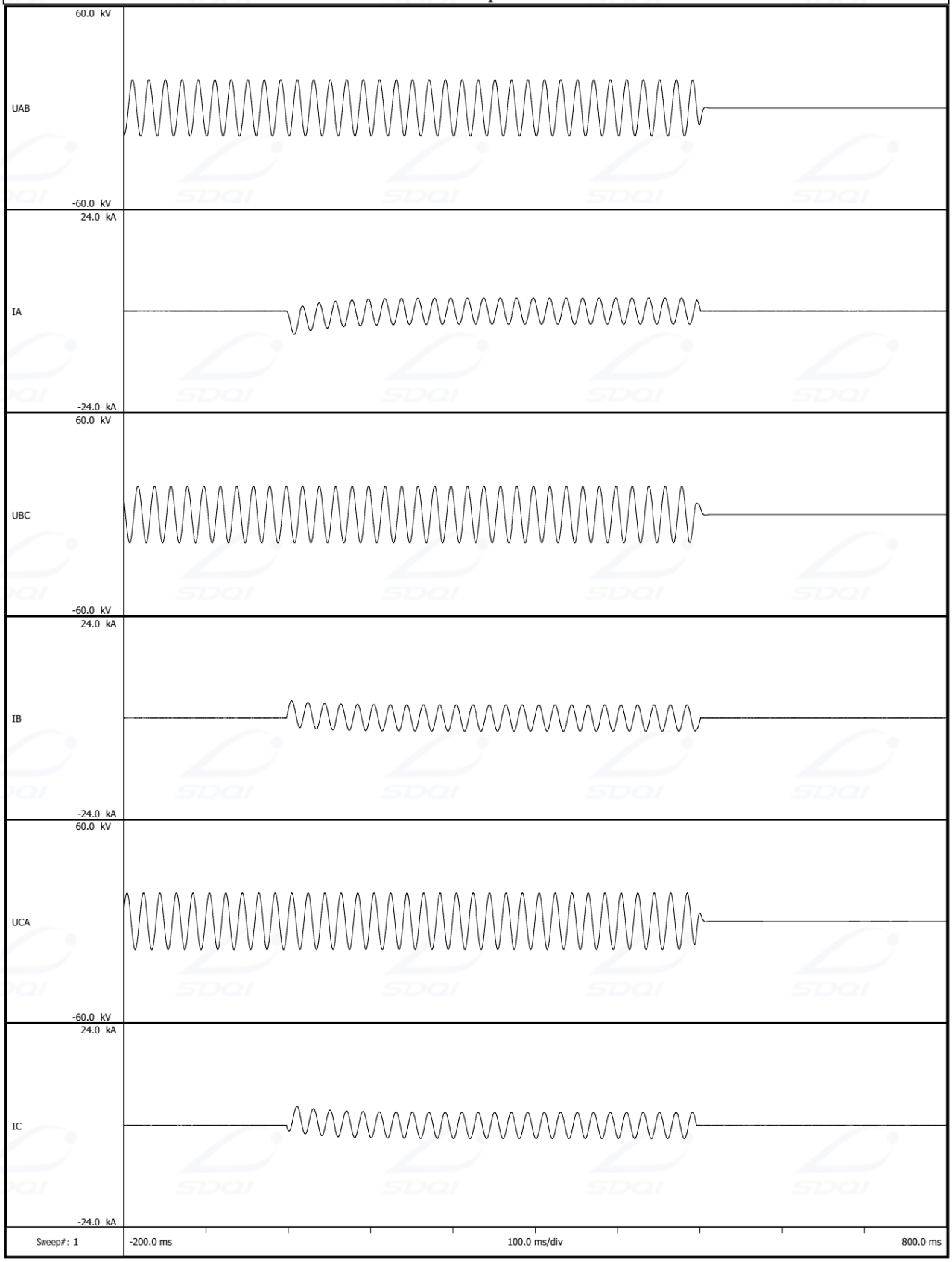
Test Report (continued)

Short-circuit test Oscillogram No. B1

I=2.148kA I_P=5.334kA t=503ms



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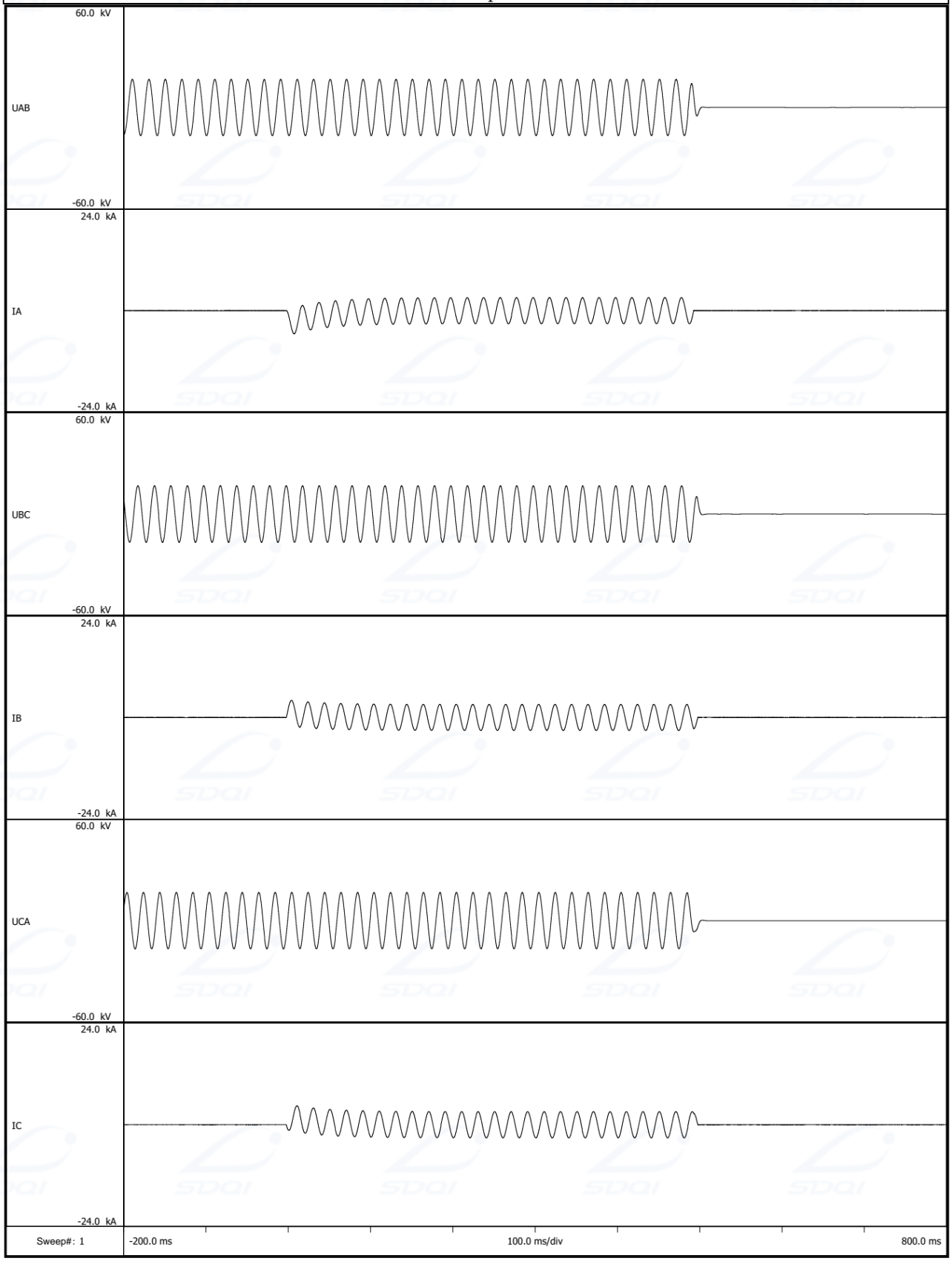
Test Report (continued)

Short-circuit test Oscillogram No. B2

I=2.155kA I_P=5.357kA t=495ms



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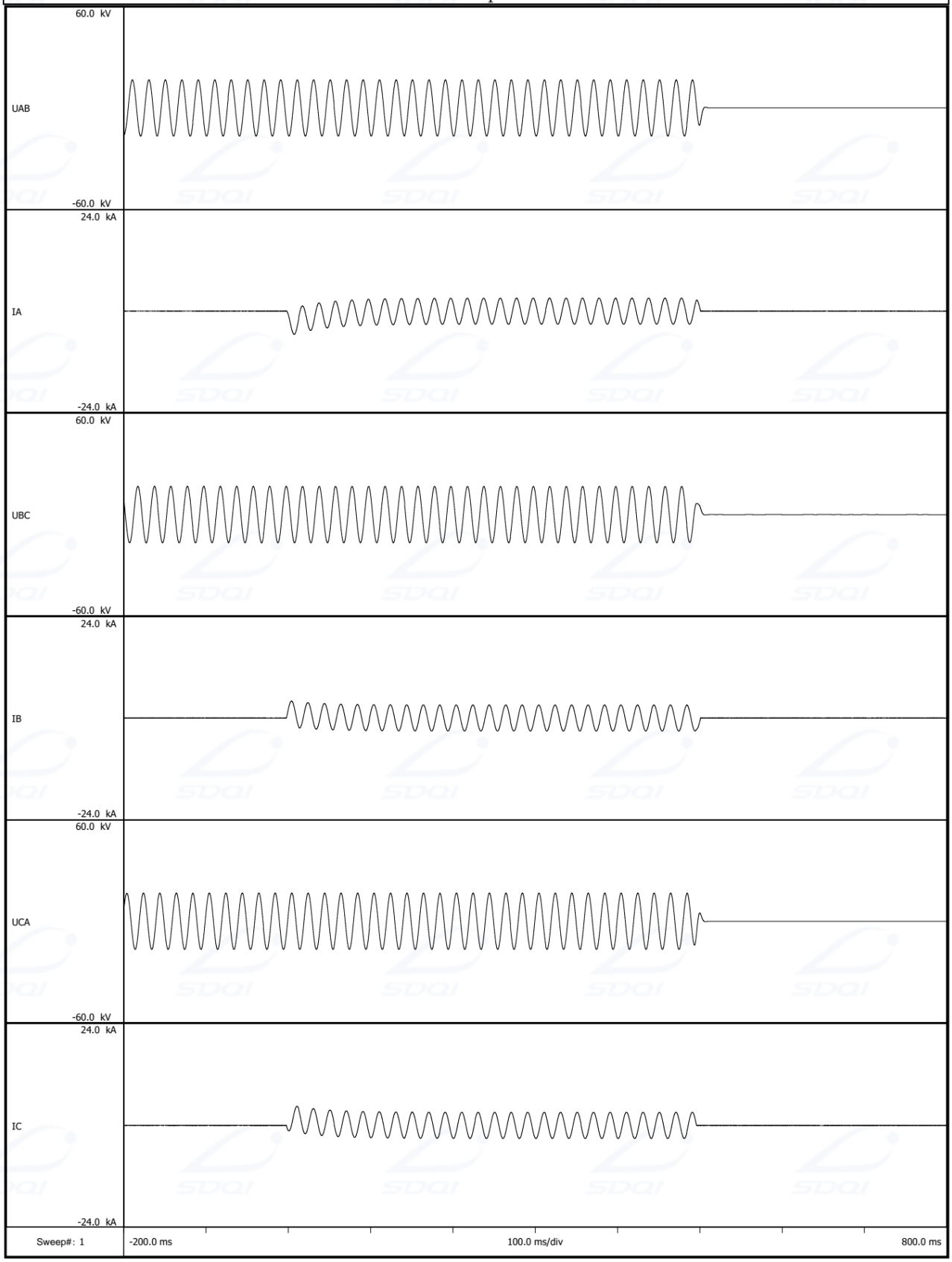
Test Report (continued)

Short-circuit test Oscillogram No. B3

I=2.151kA I_P=5.342kA t=503ms



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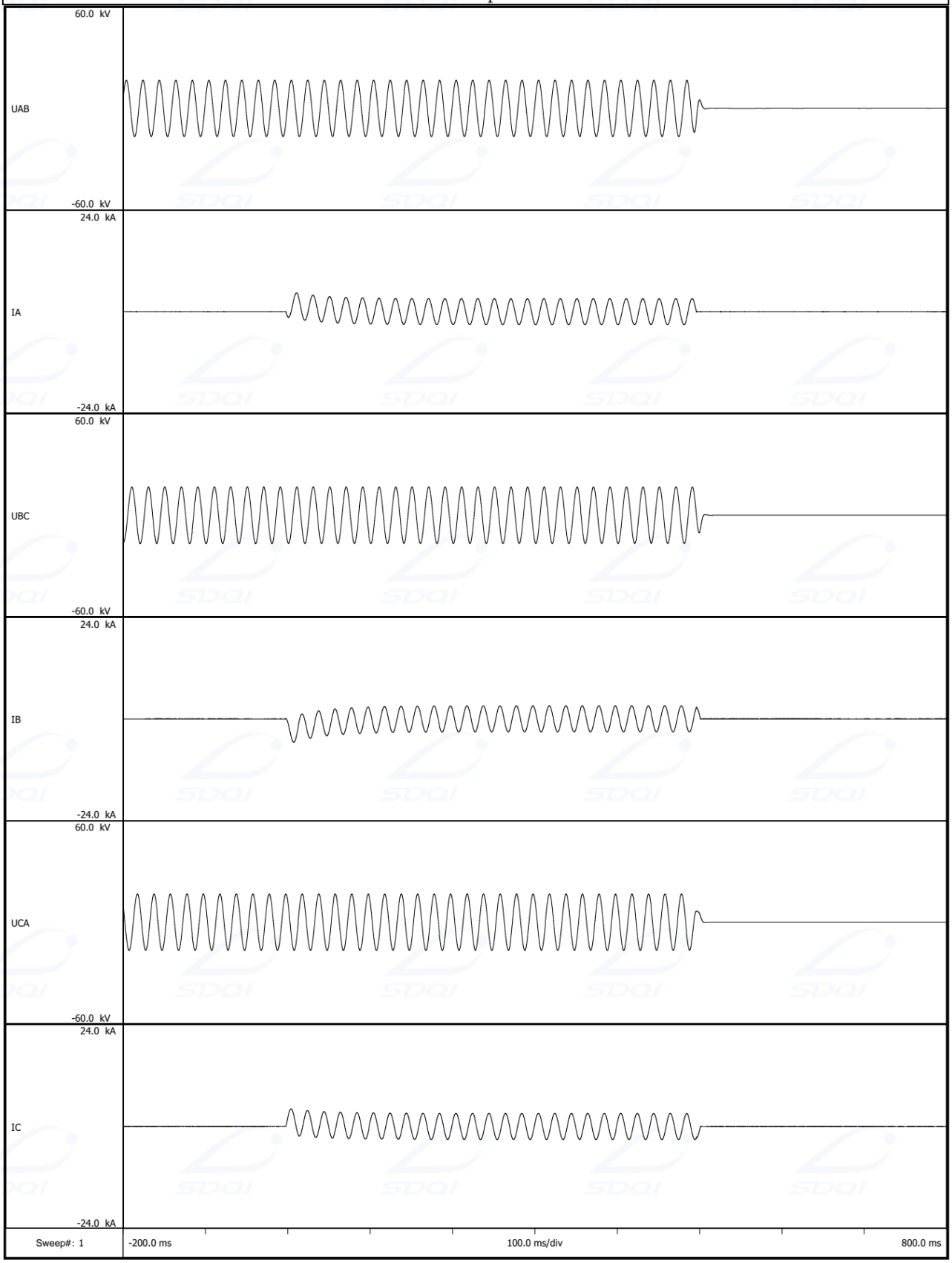
Test Report (continued)

Short-circuittest Oscillogram No. B4

I=2.263kA I_P=5.568kA t=500ms



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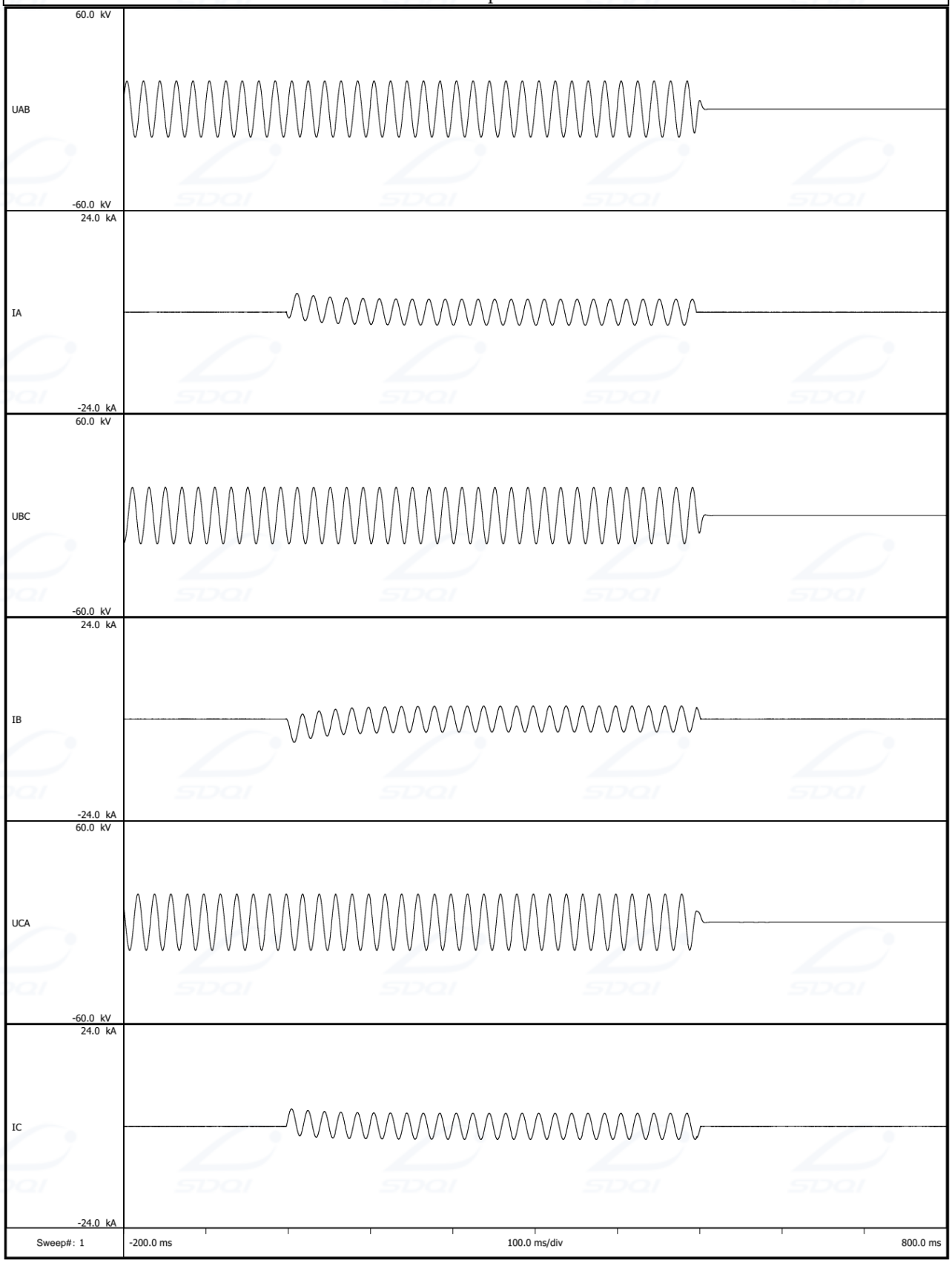
Test Report (continued)

Short-circuittest Oscillogram No. B5

I=2.275kA I_P=5.593kA t=500ms



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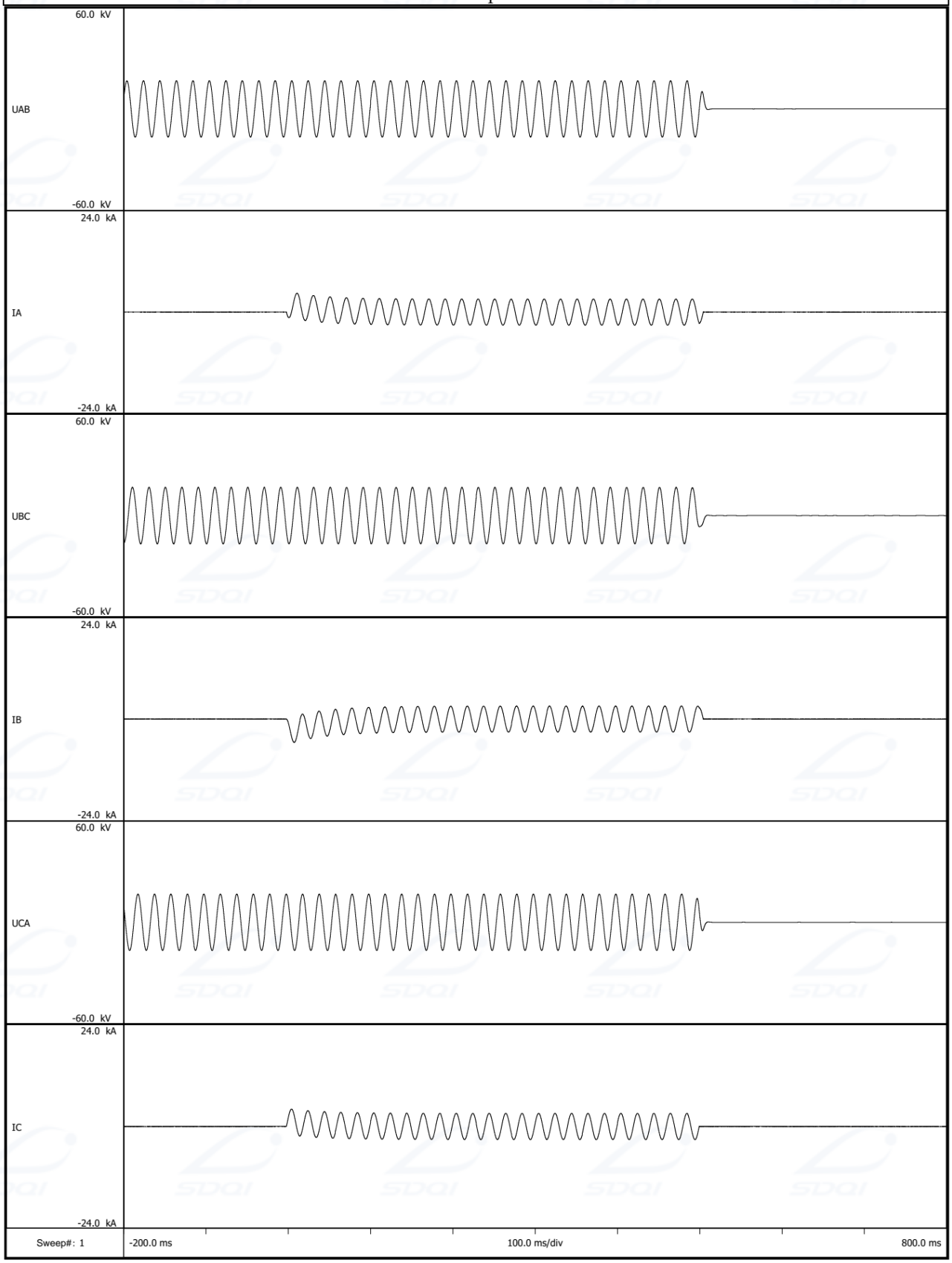
Test Report (continued)

Short-circuittest Oscillogram No. B6

I=2.272kA I_P=5.574kA t=508ms



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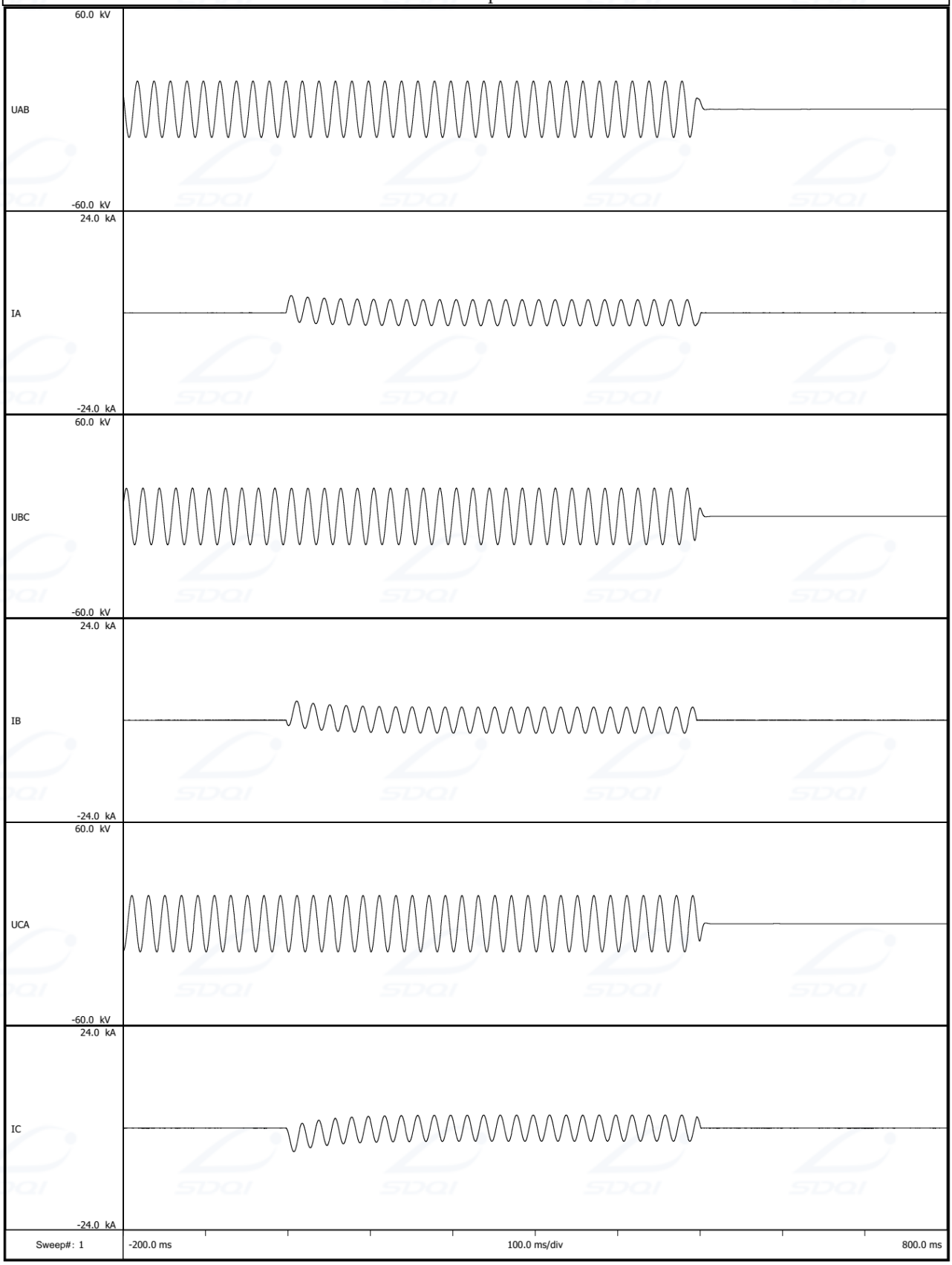
Test Report (continued)

Short-circuittest Oscillogram No. B7

I=2.365kA I_P=5.824kA t=505ms



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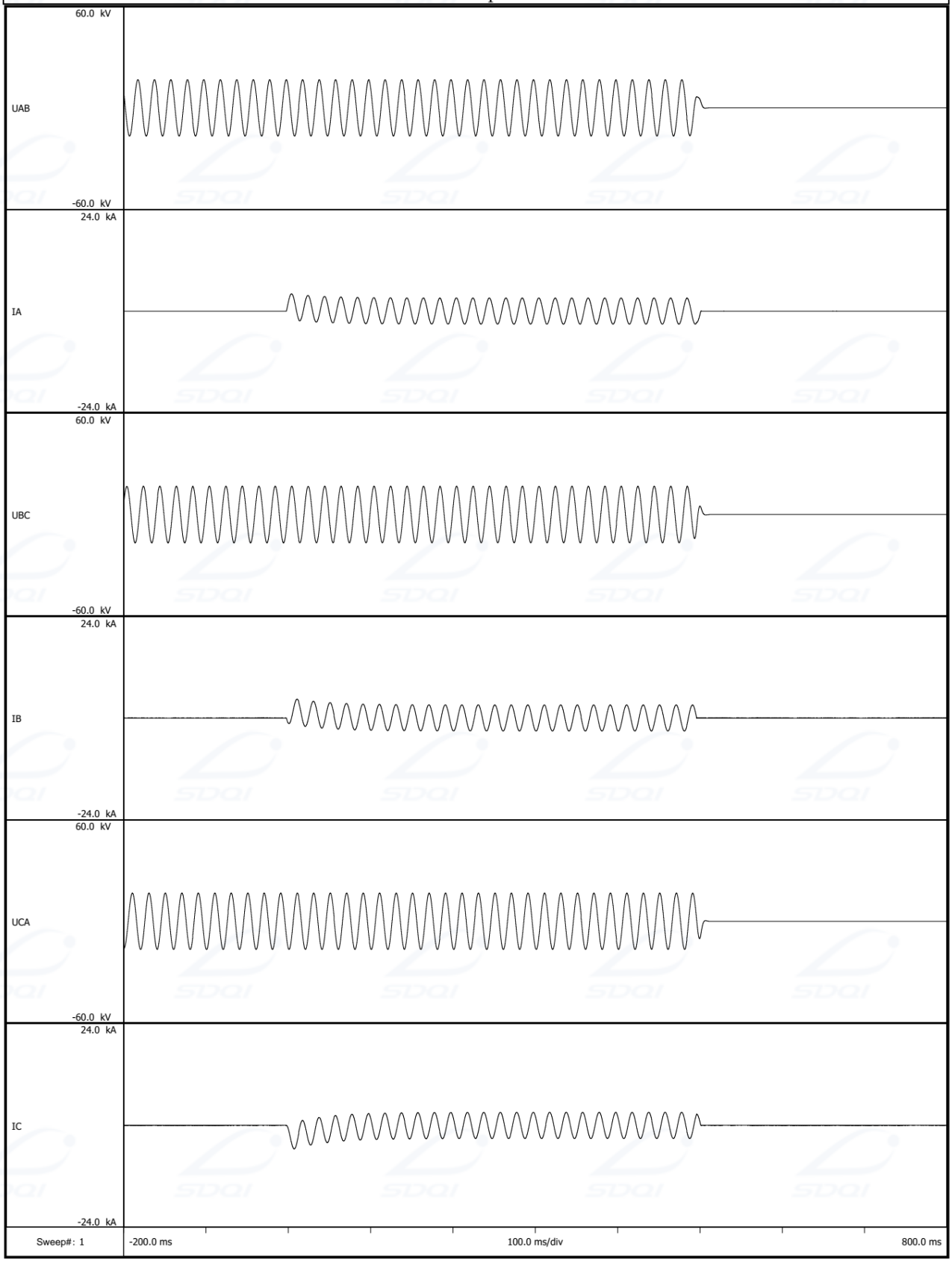
Test Report (continued)

Short-circuittest Oscillogram No.B8

I=2.378kA I_P=5.853kA t=505ms



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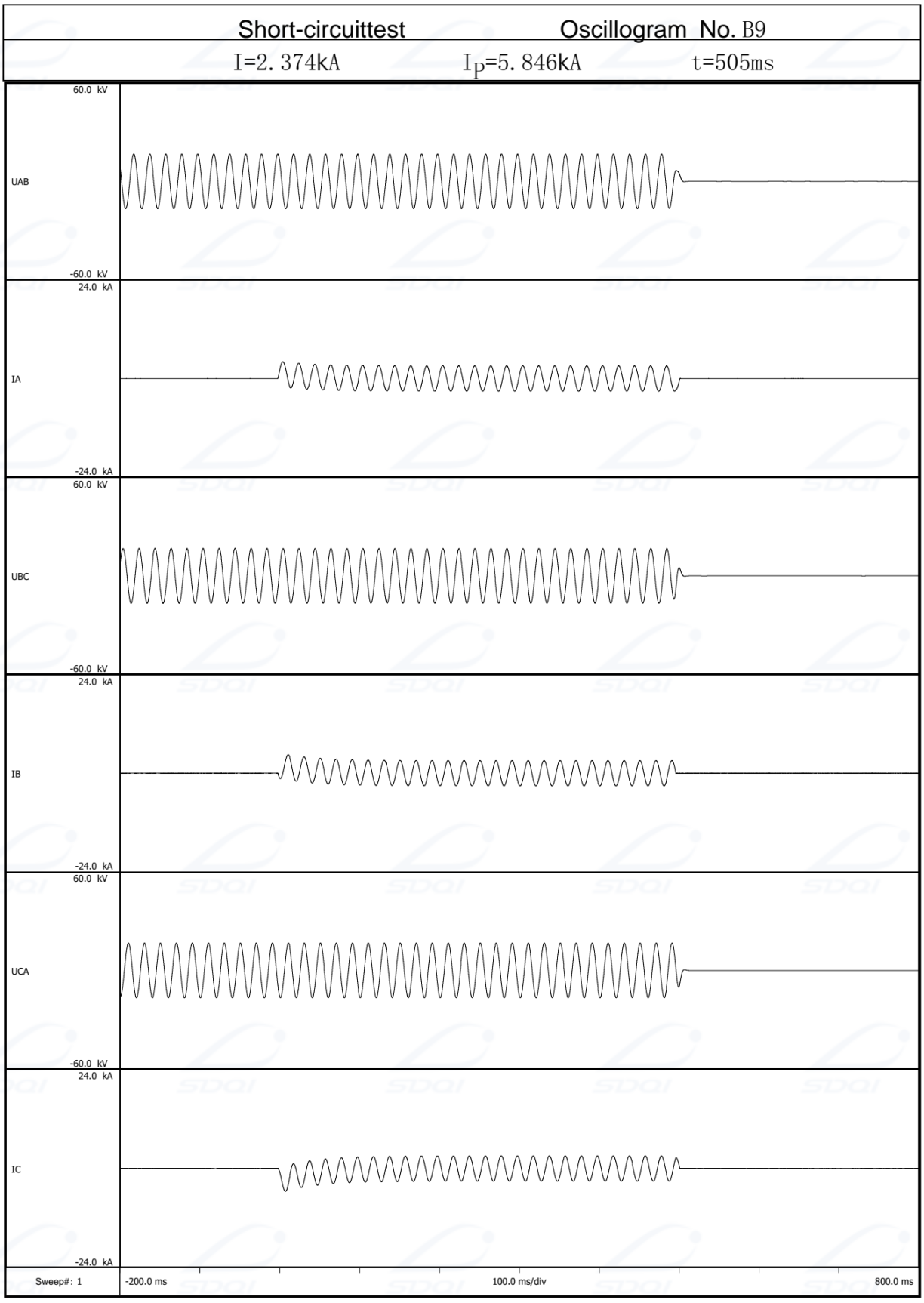
Test Report (continued)



Check before low voltage side short-circuit withstand test

Check after low voltage side short-circuit withstand test

Check before the high voltage side short-circuit withstand test

Check after the high voltage side short-circuit withstand test

4.16.3 **Routine test retest**

4.16.3.1 **Measurement of voltage ratio and check of phase displacement** (routine test) Date: 2025-10-21

Ambient temperature:14.1℃; RH:42.9%; Barometric pressure:100.50kPa

High-voltage winding		Low-voltage winding	Voltage ratio	Voltage ratio Deviation（%）			Connection symbol
Tapping	Voltage（kV）	Voltage（kV）		AB/ab	BC/bc	CA/ca	
1	10.5	0.4	26.250	0.06	0.08	0.07	Dyn11
2	10.25		25.625	0.04	0.06	0.05	
3	10		25.000	0.03	0.04	0.04	
4	9.75		24.375	0.04	0.06	0.05	
5	9.5		23.750	0.05	0.07	0.06	

4.16.3.2 **Measurement of winding resistance** (routine test)

Date: 2025-10-21

Winding temperature:14.1℃;Ambient temperature: 14.1℃; RH:42.9%; Barometric pressure:100.50kPa

Winding	Tapping	Winding resistance			Resistance Unbalance Rate（%）
		A–B（Ω） a–b（mΩ）	B–C（Ω） b–c（mΩ）	C–A（Ω） c–a（mΩ）	
High-voltage	1	0.1821	0.1824	0.1827	0.33
	2	0.1751	0.1753	0.1755	0.23
	3	0.1682	0.1683	0.1685	0.18
	4	0.1625	0.1627	0.1629	0.25
	5	0.1567	0.1569	0.1571	0.25
Low-voltage	/	0.2299	0.2313	0.2327	1.21
		a－o（mΩ）			0.1259

4.16.3.3 **Measurement of d.c. insulation resistance each winding to earth and between windings** (routine test)

Date: 2025-10-21

Ambient temperature:13.9℃; RH:43.1%; Barometric pressure:100.48kPa

Measurement position	Insulation resistance (GΩ)
High-voltage winding—low-voltage winding, iron core, clamp, oil tank and earth	493
Low-voltage winding—high-voltage winding, iron core, clamp, oil tank and earth	537
High-voltage winding,low-voltage winding—iron core, clamp, oil tank and earth	519

4.16.3.4 **Applied voltage test(AV)**(routine test) Date: 2025-10-21

Ambient temperature:13.9℃; RH:43.1%; Barometric pressure:100.48kPa

Position	Test voltage（kV）	Time(s)	Test result
High-voltage winding—earth and low-voltage	35	60	Pass
Low-voltage winding—earth and high-voltage	3	60	

4.16.3.5 **Induced voltage withstand tests(IVW)** (routine test) Date: 2025-10-21

Ambient temperature:13.9℃; RH:43.1%; Barometric pressure:100.48kPa

Tapping	Applied voltage（kV）	Induced AC voltage（kV）	Induction factor	Frequency (Hz)	Test time(s)	Test result
	L.V.	H.V.				
3	0.8	20	2	200	30	Pass

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Test Report (continued)

4.16.3.6 **Measurement of no-load loss and current** (routine test) Date: 2025-10-21

Ambient temperature: 13.7℃; RH:43.3%; Barometric pressure:100.46kPa;Transformer temperature:13.7℃

Test voltage（V）		No-load current		No-load loss （W）	
The mean value of voltage	The r.m.s. value of voltage	（A）	（%）	The measured	The corrected
401.77	400.94	6.64	0.18	2042.35	2046.57

4.16.3.7 **Measurement of short-circuit impedance and load loss** (routine test) Date: 2025-10-21

Ambient temperature: 13.7℃; RH:43.3%; Barometric pressure:100.46kPa;

Winding	Tapping	The supplied current		The measured voltage（V）	Short-circuit impedance		Load loss（W）		Total loss (W)
					（%）	（Ω）	The measured	The corrected	The corrected
		（A）	I/Ir（%）		t=145℃ I=Ir		/	t=145℃ I=Ir	t=145℃ I=Ir
H.V. – L.V.	1	110.16	80.1	506.73	6.04	2.66	7538.23	16134.63	18181.20
	3	116.57	80.8	479.31	5.95	2.38	7799.65	16348.37	18394.94
	5	123.69	81.4	451.95	5.86	2.12	8025.95	16599.44	18646.01

4.16.3.8 **Partial discharge measurement**(routine test) Date: 2025-10-21

Ambient temperature: 13.7℃; RH:43.3%; Barometric pressure:100.46kPa;

The background noise level（pC）		Applied voltage			Time	Partial discharge level（pC）			Test result
Before the test	After the test	Factor	Frequency（Hz）	（kV）		A	B	C	
A:<2	A:<2	1.8Ur	200	0.72	30s	/	/	/	Pass
B:<2	B:<2								
C:<2	C:<2	1.3Ur	200	0.52	3min	<4	<4	<4	

4.17 **Lightning impulse test**(Type test) Date: 2025-10-21

Ambient temperature:13.5℃;RH:43.5%;Barometric pressure:100.44kPa

The line terminals	A，B，C
Test polarity	Negative polarity
Tapping	3
Full impulse voltage（kV）	75（1±3%）
The front time T_1（μs）	1.2（1±30%）
The time to half-value T_2（μs）	50（1±20%）
Test sequence	a) One reference impulse of a voltage between 50 % and 70 % of the full test voltage. b) Three subsequent impulses at full voltage.

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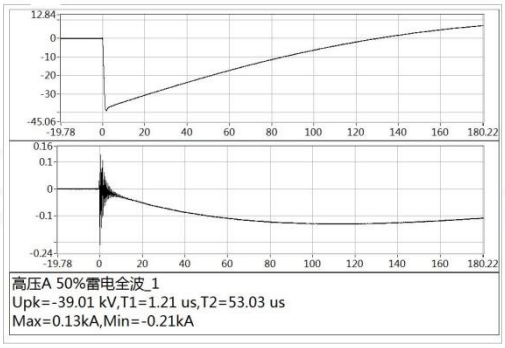
Test Report (continued)

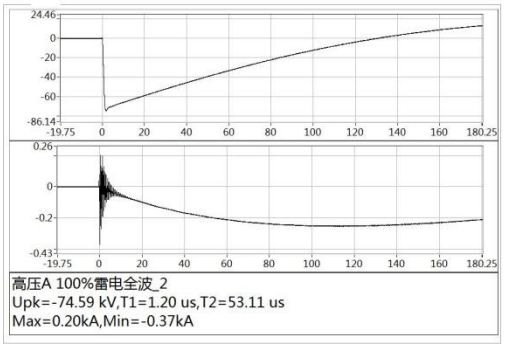
Subject terminal: A

Test polarity: negative

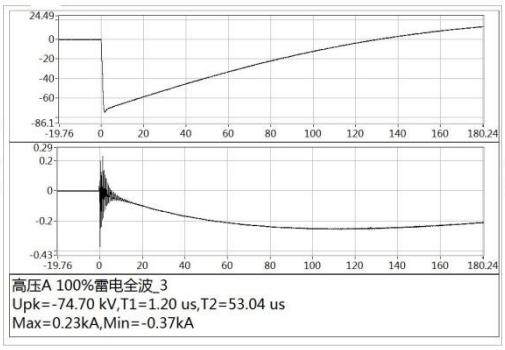
50%～70%full impulse



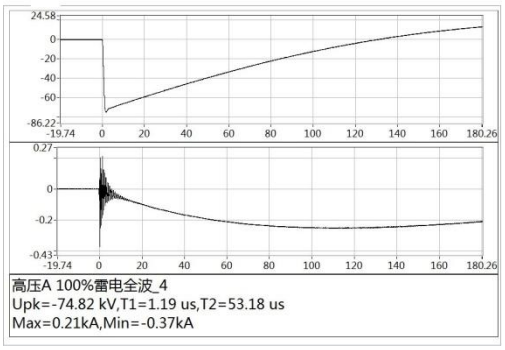
100%full impulse



100%full impulse



100%full impulse



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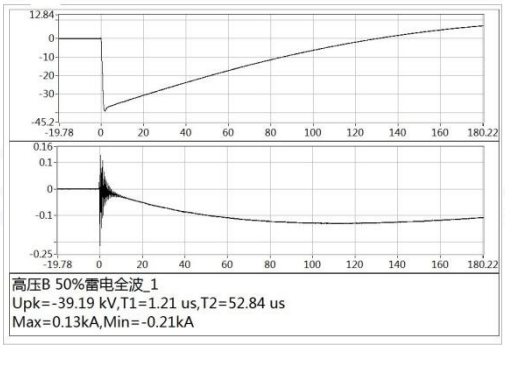
Test Report (continued)

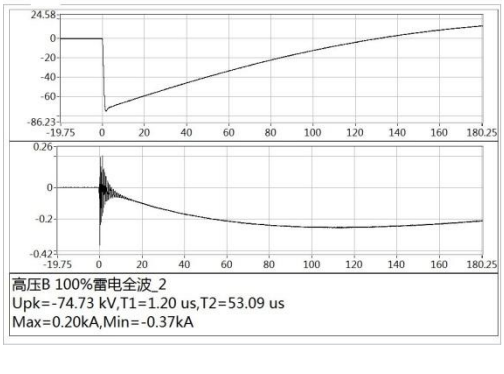
Subject terminal:B

Test polarity: negative

50%～70%full impulse



100%full impulse



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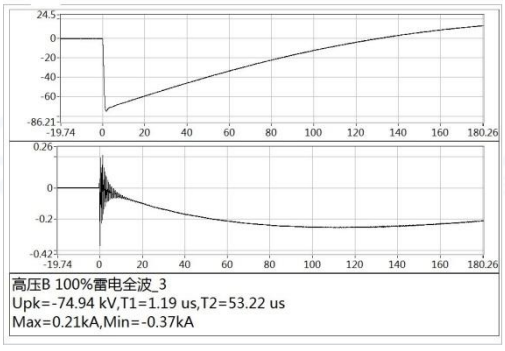
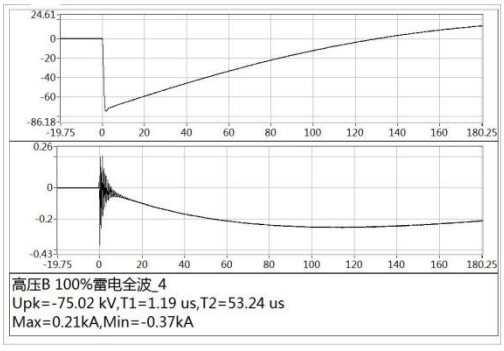


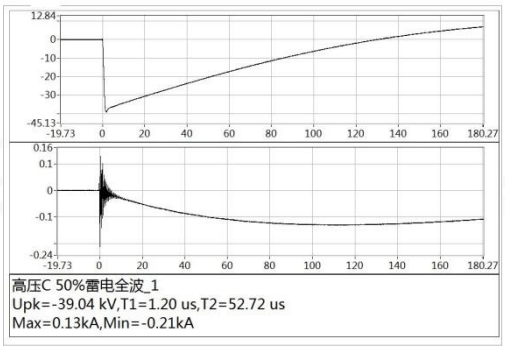
100%full impulse



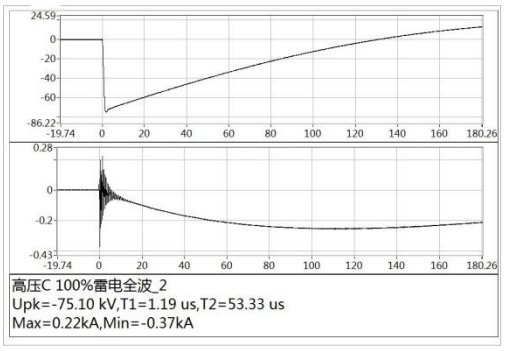
Subject terminal: C

Test polarity: negative

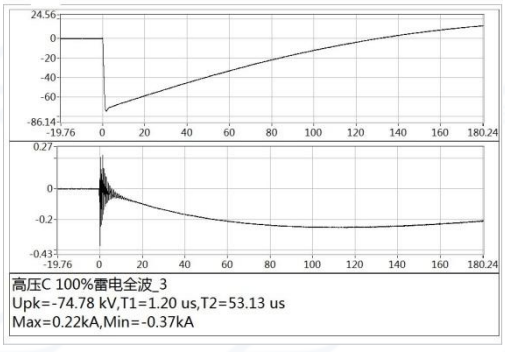
50%～70%full impulse



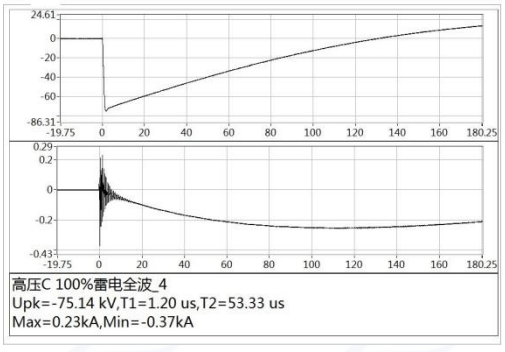
100%full impulse



100%full impulse



100%full impulse



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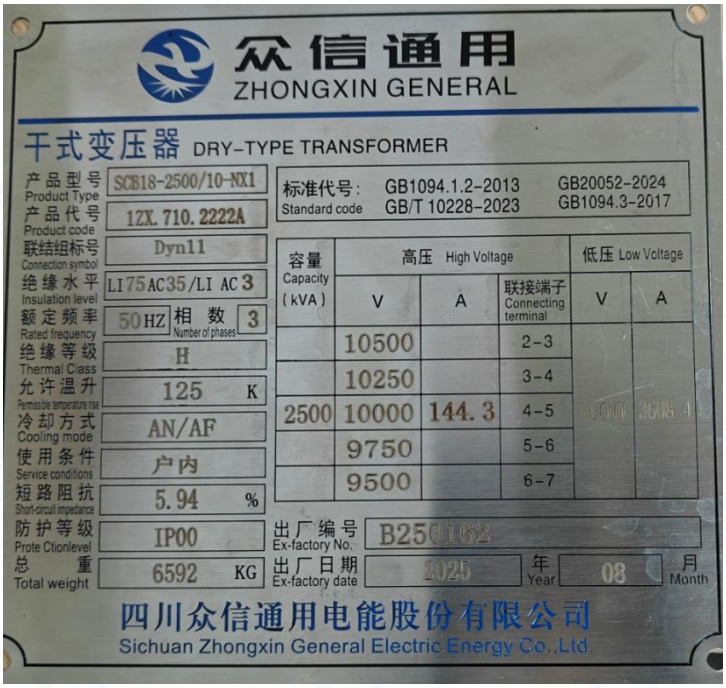
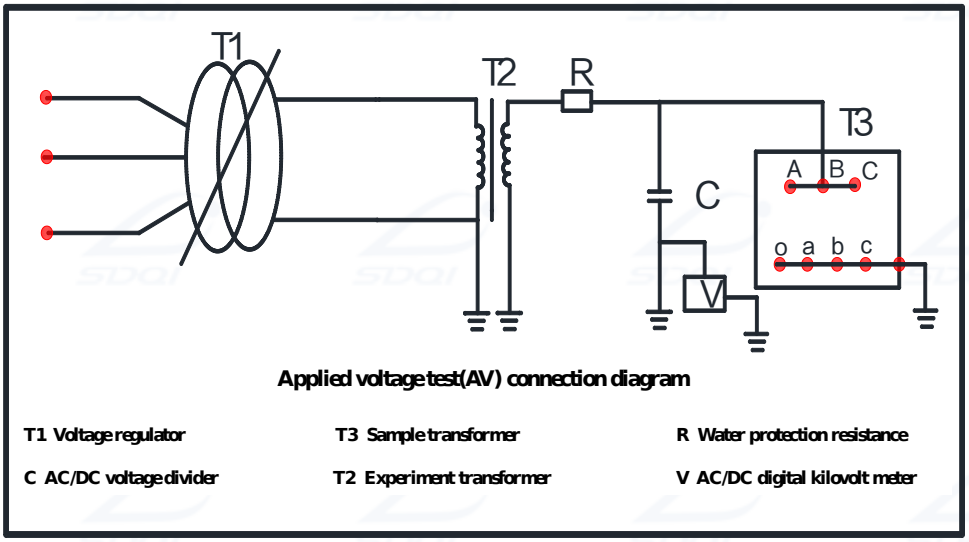
Test Report (continued)

Sample and nameplate photos



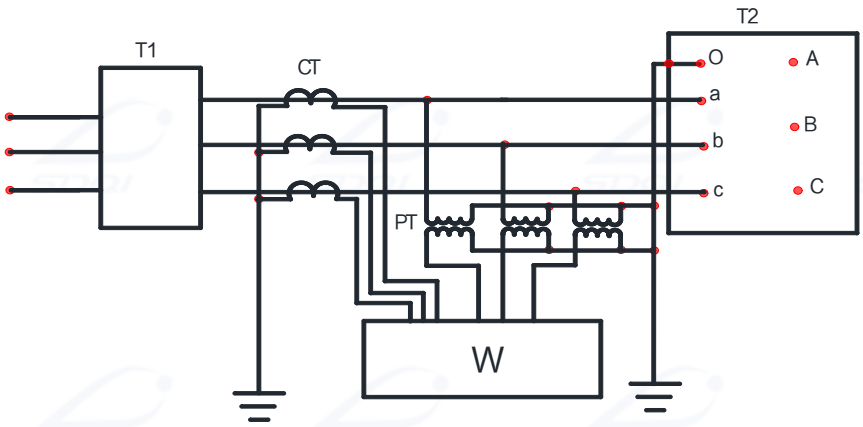
Annex: Test principle diagram



Applied voltage test(AV) connection diagram

T1 Voltage regulator — T3 Sample transformer — R Water protection resistance

C AC/DC voltage divider — T2 Experiment transformer — V AC/DC digital kilovolt meter



Measurement of no-load loss and current & Induced voltage withstand test(IVW) connection diagram

T1 Digital variable frequency power supply — CT Current transformer

PT Voltage transformer — T2 Sample transformer — W Power analyzer

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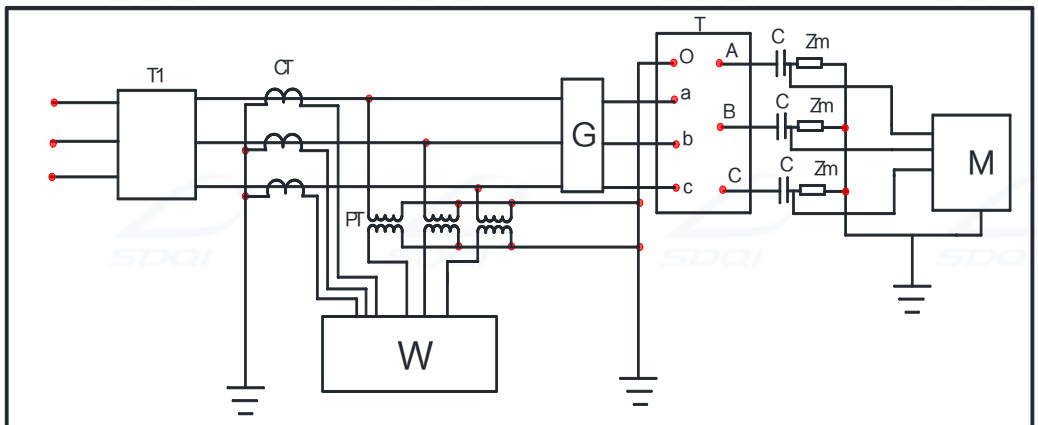
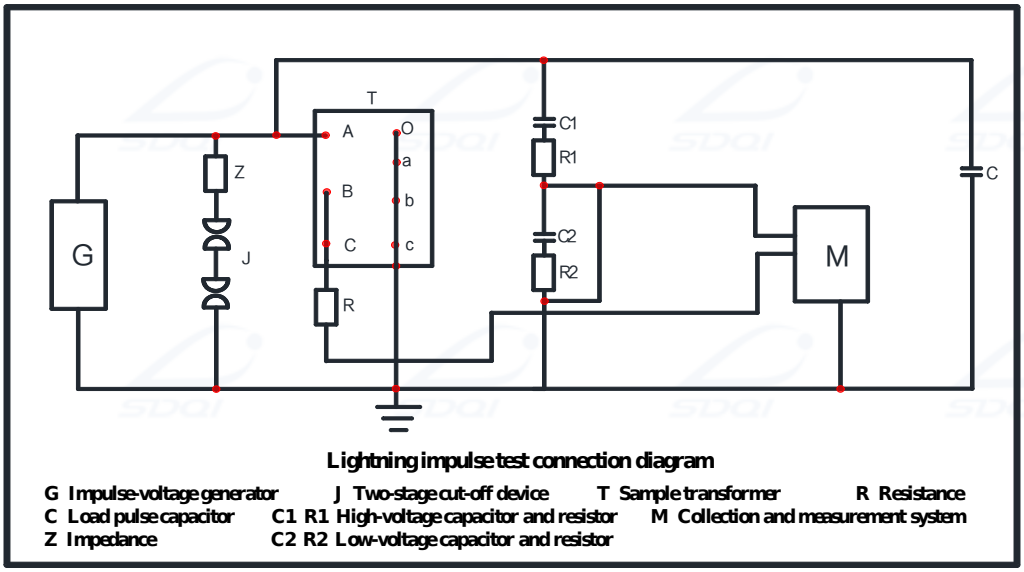
Test Report (continued)



Partial discharge measurement connection diagram

T1 Digital variable frequency power supply — G Power isolation filter of frequency doubling generator
CT Current transformer — PT Voltage transformer — T Sample transformer — W Power analyzer
C Coupling capacitor — Zm measured impedance — M Multichannel digital partial discharge general-purpose tester



Lightning impulse test connection diagram

G Impulse-voltage generator — J Two-stage cut-off device — T Sample transformer — R Resistance
C Load pulse capacitor — C1 R1 High-voltage capacitor and resistor — M Collection and measurement system
Z Impedance — C2 R2 Low-voltage capacitor and resistor

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