

TEST REPORT

Name: Power Transformer

Type: SFSZ-50000/115

Series No.: 233512011001

Production No.: 1.710.2784.1

Zhejiang Jiangshan Transformer Co., Ltd.



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1. Production Specifications

Type: SFSZ-50000/115

Number of Phase: Three phases

Rated Frequency: 50 Hz

Rated Power: 50000 kVA

Rated Voltage: $(115 \pm 8 \times 1.5\%) / (37.5 \pm 2 \times 2.5\%) / 20.8/6.3\text{kV}$

Connection Symbol: YNyn0yn0 (d11)

Cooling Method: ONAN/ONAF 40/50MVA

Using Condition: Outdoor

Insulation Level:

HV: Um 123/ LI 550/AC 230 kV

HVN: Um 123/ LI 550/AC 230 kV

MV: Um 36/ LI 170/AC 70 kV

MVN: Um 36/ LI 170/AC 70 kV

LV: Um 24/ LI 125/AC 50 kV

LVN: Um 24/ LI 125/AC 50 kV

TV: Um 7.2/ LI 60/AC 20 kV

2、 Test Criteria

IEC 60076-1 2011 《Power Transformer Part 1 General》

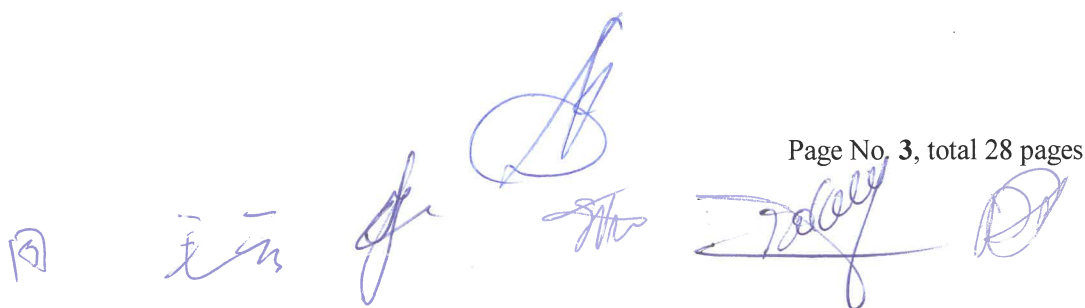
IEC 60076-2 2011 《Power Transformer Part 2 Temperature rise》

IEC 60076-3 2013 《Power Transformer Part 3 Insulation levels, dielectric tests and external clearances in air》

IEC 60076-10 2016 《Determination of sound levels》

Technical Guarantee File of Sales Contract

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3、Test Items and results

3.1 Measurement of insulation resistance, absorption ratio and $\tan\delta$ of windings to earth

Oil Temperature 13.9℃

Test Position	Measurement of insulation resistance (GΩ)		Measurement of absorption ratio	Dielectric loss factor	
	R ₆₀	R ₁₅	R ₆₀ /R ₁₅	tg δ (%)	C _x (pF)
h.v./m.v.、l.v.、t.v. & ground	71.6	51.8	1.44	0.253	12370
m.v./ h.v.、l.v.、t.v.& ground	41.2	29.4	1.40	0.211	19400
l.v./ h.v.、m.v.、t.v.& ground	42.3	25.4	1.66	0.201	21130
t.v./ h.v.、m.v.、l.v.& ground	52.1	32.7	1.59	0.189	21880
h.v. 、m.v./l.v.、t.v.& ground	49.6	39.0	1.27	0.221	14140
h.v. 、l.v./m.v.、t.v.& ground	31.9	20.6	1.55	0.228	33370
h.v. 、t.v./m.v.、l.v.& ground	39.3	20.6	1.91	0.221	34190
m.v. 、l.v./h.v.、t.v.& ground	40.0	27.9	1.43	0.245	22310
h.v. 、m.v.&l.v. / t.v.& ground	55.2	38.3	1.44	0.240	16830
h.v. 、m.v.&l.v. &t.v./ ground	50.0	34.1	1.47	0.209	16850
Core	35.1	/			

3.2 Measurement of voltage ratio and check of connection symbol

H.V. Windings			L.V. Windings		Theoretical Transformation Ratio	Measured Tolerances of Voltage Ratio (%) [(Tested value-Theoretical value)/ Theoretical value]			Connection Symbol
Tapping position	Theoretical Value		Theoretical Value			AB/ ab	BC/ bc	CA/ ca	
	(kV)	(A)	(kV)	(A)					
1	128.800	224.1	20.8	1387.9	6.192	0.19	0.22	0.23	YNyn0
2	127.075	227.2			6.109	0.23	0.26	0.27	
3	125.350	230.3			6.026	0.27	0.29	0.31	
4	123.625	233.5			5.944	0.12	0.15	0.16	
5	121.900	236.8			5.861	0.16	0.19	0.21	
6	120.175	240.2			5.778	0.01	0.03	0.05	

7	118.450	243.7			5.695	0.05	0.08	0.09	
8	116.725	247.3			5.612	0.10	0.12	0.14	
9B	115.000	251.0			5.529	0.13	0.16	0.18	
10	113.275	254.8			5.446	0.18	0.21	0.23	
11	111.550	258.8			5.363	0.23	0.25	0.27	
12	109.825	262.9			5.280	0.07	0.09	0.12	
13	108.100	267.0			5.197	0.11	0.13	0.16	
14	106.375	271.4			5.114	-0.07	-0.04	-0.02	
15	104.650	275.8			5.031	-0.02	0.00	0.03	
16	102.925	280.5			4.948	0.03	0.05	0.08	
17	101.200	285.3			4.865	0.08	0.10	0.13	

M.V. Windings			L.V. Windings		Theoretical Transformation Ratio	Measured Tolerances of Voltage Ratio (%) [(Tested value-Theoretical value)/ Theoretical value]			Connection Symbol
Tapping position	Theoretical Value		Theoretical Value			AB/ ab	BC/ bc	CA/ ca	
	(kV)	(A)	(kV)	(A)					
1	39.375	733.1	20.8	1387.9	1.893	0.25	0.26	0.27	YNyn0
2	38.438	751.0			1.848	0.21	0.21	0.22	
3	37.500	769.8			1.803	0.16	0.17	0.18	
4	36.563	789.5			1.758	0.11	0.12	0.12	
5	35.625	810.3			1.713	0.06	0.07	0.08	

H.V. Windings			M.V. Windings		Theoretical Transformation Ratio	Measured Tolerances of Voltage Ratio (%) [(Tested value-Theoretical value)/ Theoretical value]			Connection Symbol
Tapping position	Theoretical Value		Theoretical Value			AB/ ab	BC/ bc	CA/ ca	
	(kV)	(A)	(kV)	(A)					
9/3	115.000	251.0	37.5	769.8	3.067	-0.01	0.01	0.02	YNyn0

3.3 Measurement of winding resistance

Oil Temperature:13.9℃

H.V. Windings				
Tap \ Item No.	AN (Ω)	BN (Ω)	CN (Ω)	Unbalanced rate (%)

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1	0.4550	0.4538	0.4528	0.48
2	0.4479	0.4468	0.4457	0.49
3	0.4409	0.4397	0.4387	0.50
4	0.4329	0.4317	0.4307	0.51
5	0.4259	0.4248	0.4238	0.49
6	0.4179	0.4168	0.4158	0.50
7	0.4109	0.4099	0.4088	0.51
8	0.4039	0.4030	0.4018	0.52
9 B	0.3953	0.3950	0.3942	0.28
10	0.4039	0.4030	0.4019	0.50
11	0.4108	0.4099	0.4088	0.49
12	0.4188	0.4179	0.4168	0.48
13	0.4258	0.4249	0.4238	0.47
14	0.4338	0.4328	0.4317	0.49
15	0.4408	0.4398	0.4388	0.45
16	0.4479	0.4468	0.4457	0.49
17	0.4550	0.4538	0.4527	0.51

M.V. Windings				
Item No. Tap	AmNm (Ω)	BmNm (Ω)	CmNm (Ω)	Unbalanced rate (%)
1	0.04173	0.04150	0.04141	0.77
2	0.04028	0.04002	0.03992	0.90
3	0.03830	0.03823	0.03827	0.18
4	0.04028	0.04001	0.03991	0.92
5	0.04173	0.04146	0.04138	0.84

L.V winding	an (Ω)	bn (Ω)	cn (Ω)	Unbalanced rate (%)
	0.011139	0.011183	0.011212	0.65

Tertiary winding	Wx-Wc(Ω)
	0.02109

3.4 Oil leakage test

Test Method	Applied Pressure (MPa)	Duration (h)	Residual Pressure (MPa)	Result
Top static gas pressure	0.04	24	0.04	No leakage and damage

3.5 Applied voltage Test

Test Position	AC Voltage (kV)	Testing duration (s)	Frequency (Hz)	Conclusions
h.v./m.v、l.v、t.v. & ground	230.0	60	50	Passed
m.v./ h.v、l.v、t.v.& ground	70.0			
l.v./ h.v、m.v、t.v.& ground	50.0			
t.v./ h.v、m.v、l.v.& ground	20.0			

3.6 Induced voltage withstand test

Tap Position		Applied voltage (kV)	Induced Voltage (kV)	Induced times	Frequency (Hz)	Testing Duration (s)	Conclusions
H.V.	M.V.	L.V.	H.V.				
9	3	41.6	230	2	200	30	Passed

3.7 Induced voltage withstand test with partial discharge measured (IVPD)

Frequency (Hz): 200 Tapping position: 9

HV		Testing Continuance	Partial Discharge Value (pC)		
			Measured Point		
Times	Phase to earth (kV)	Min	A	B	C
0.4Ur	46.0	/	20	20	15
1.2Ur	138.0	1	22	30	20
1.58Ur	181.7	5	30	40	25
1.8Ur	207.0	30Sec	/	/	/
1.58Ur	181.7	5	25	37	29
1.58Ur	181.7	5	25	37	29
1.58Ur	181.7	5	25	37	29
1.58Ur	181.7	5	25	37	29
1.58Ur	181.7	5	25	37	29
1.58Ur	181.7	5	25	37	29
1.58Ur	181.7	5	25	37	29
1.58Ur	181.7	5	25	37	29
1.58Ur	181.7	5	25	37	29

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1.58Ur	181.7	5	25	37	29
1.58Ur	181.7	5	25	37	29
1.58Ur	181.7	5	25	37	29
1.2 Ur	138.0	1	20	30	20
0.4 Ur	46.0	/	15	15	15

3.8 No-load loss and no-load current

Frequency (Hz): 50

Tapping position: 9

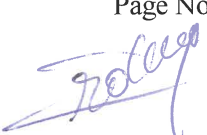
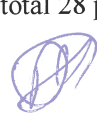
U/Ur	Voltage (kV)		No-load current (A)					No-load loss (kW)		
	Reading of mean value volt meter	Reading of R.M.S. value volt meter	Phase			(%)	Guaranteed value (%)	Measured value	Corrected value	Guaranteed value
			Ia	Ib	Ic					
0.9	18.714	18.709	1.150	0.742	1.179	0.07	/	29.513	29.52	/
1.0	200.799	20.777	1.671	1.186	1.788	0.11	≤0.3	40.036	40.08	≤41.0
1.1	22.890	22.749	6.203	4.933	6.412	0.42	/	60.434	60.81	/

3.9 Measurement of short-circuit impedance and load loss

Oil Temperature: 14.2℃

Frequency (Hz): 50

Cooling Method	Tested winding	TAP	Measured Voltage (kV)	Applied Current (A)	Short-circuit impedance			Load loss(kW)	
					(Ω)	(%)	Guaranteed value (%)	Corrected value	Guaranteed value
					t=75℃	t=75℃	t=75℃	t=75℃	t=75℃
ONAN 40MVA	H.V-M.V	1	6.265	149.5	24.19	5.83	/	122.38	/
		9	5.861	183.8	18.41	5.57	/	126.01	/
		17	4.742	184.6	14.83	5.79	/	156.27	/
	H.V-L.V.	1	12.467	172.3	41.77	10.07	/	131.73	≤135.0
		9	9.458	168.0	32.49	9.83	/	134.17	≤141.0
		17	8.942	200.1	25.80	10.08	/	165.22	≤172.0
	M.V-L.V.	1	0.857	343.3	1.44	3.72	/	111.65	/
		3	0.765	354.1	1.25	3.55	/	108.88	/
		5	0.765	380.2	1.16	3.66	/	120.09	/
ONAF 50MVA	H.V-M.V	1	6.265	149.5	24.19	7.29	/	191.18	/
		9	5.861	183.8	18.41	6.96	7.0±10%	196.88	/
		17	4.742	184.6	14.83	7.24	/	244.09	/

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	H.V- L.V.	1	12.467	172.3	41.77	12.59	/	205.78	/
		9	9.458	168.0	32.49	12.28	12.25 ± 7.5%	209.65	/
		17	8.942	200.1	25.80	12.59	/	258.08	/
	M.V- L.V.	1	0.857	343.3	1.44	4.65	/	174.44	/
		3	0.765	354.1	1.25	4.44	4.5 ± 10%	170.14	/
		5	0.765	380.2	1.16	4.58	/	187.62	/

3.10 OLTC tests

Operation test:

- With the transformer un-energized, eight complete cycles of operation.
- With the transformer un-energized, and with the auxiliary voltage reduced to 85% of its rated value, one complete cycle of operation.
- With the transformer energized at rated voltage and frequency at no load, one complete cycle of operation.
- With one winding short-circuited and, as far as practicable, rated current in the tapped winding, 10 cycles of tap-change operations across the range of two steps on each side from reversing changeover selector at tapping position 9B.

3.11 Transformer Oil Test

1. General Physics and Chemistry Test

Appearance: Light Yellow Transparent Liquid

Flash Point: 161.7 °C

Acid Value: 0.008 mgKOH/g

2.

Oil No.	Corner Tangent of Dielectric Loss (tg δ %)	Breakdown Voltage (kV)	Water Containing mg/L
I-10°C	0.044	72.5	13.0

3. Chromatographic Analysis

Before all test

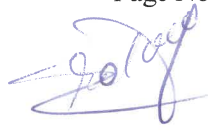
Gas composition		H ₂	CO	CO ₂	CH ₄	C ₂ H ₆	C ₂ H ₄	C ₂ H ₂	C ₁ +C ₂
Before test	μL/L	0.00	0.84	732.99	0.30	0.00	0.00	0.00	0.30
before rise test		0.00	1.31	693.10	0.34	0.00	0.00	0.00	0.34
after Rise test		1.21	2.99	866.42	0.40	0.00	0.00	0.00	0.40

3.12 Measurement of zero sequence impedance

Applied	Tap	Shorted	Opened	Measured value		
				Voltage (V)	Current (A)	zero-sequence impedance (Ω)
ABC-N	9	M.V&L.V	/	742.1	132.8	16.77
		L.V	M.V	1282.6	136.8	28.12
		M.V	L.V	781.5	139.2	16.84
		/	M.V&L.V	1619.4	140.4	34.60
AmBmCm-Nm	3	H.V&L.V	/	34.3	140.3	0.73
		L.V	H.V	59.4	147.7	1.21
		H.V	L.V	48.6	141.7	1.03
		/	H.V&L.V	92.2	134.6	2.06
abc-n	/	H.V&M.V	/	9.3	140.6	0.20
		M.V	H.V	9.6	145.4	0.20
		H.V	M.V	11.8	1400.3	0.25
		/	H.V&M.V	13.5	137.0	0.30







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3.14 Bushing Test

Oil Temperature 13.9℃

Manufacturer	JIANGSU ZHIDA H.V. ELECTRIC Co., LTD.			
Terminal	HV A	HV B	HV C	HV N
serial number	208247	208245	208250	208252
tg δ %	0.320	0.332	0.351	0.351
Capacitance (pF)	329	319	327	330

3.15 Auxiliary wiring insulation test

Test Position	AC Voltage (kV)	Testing duration (s)	Frequency (Hz)	Conclusions
Auxiliary power, control circuit and earth	2	60	50	Passed
CT secondary windings and earth	2.5	60	50	Passed

3.16 Ratio and polarity of CT

Tested Phase	S.No. of CT	Tested terminal	Ratio	Polarity
HV Phase A	2059648	1S1-1S2	300/1	Negative
	2059651	2S1-2S2	300/1	Negative
HV Phase B	2059649	1S1-1S2	300/1	Negative
	2059652	2S1-2S2	300/1	Negative
	2059654	3S1-3S2	300/5	Negative
HV Phase C	2059650	1S1-1S2	300/1	Negative
	2059653	2S1-2S2	300/1	Negative
HV Neutral	2059655	1S1-1S2	200/1	Negative
	2059656	2S1-2S2	200/1	Negative

3.17 Lightning Impulse Test

Test Program:

- One negative polarity reduced full wave (between 50% and 75% of the lightning impulse level);
- Three negative polarity full waves.

Lightning impulse waveshapes

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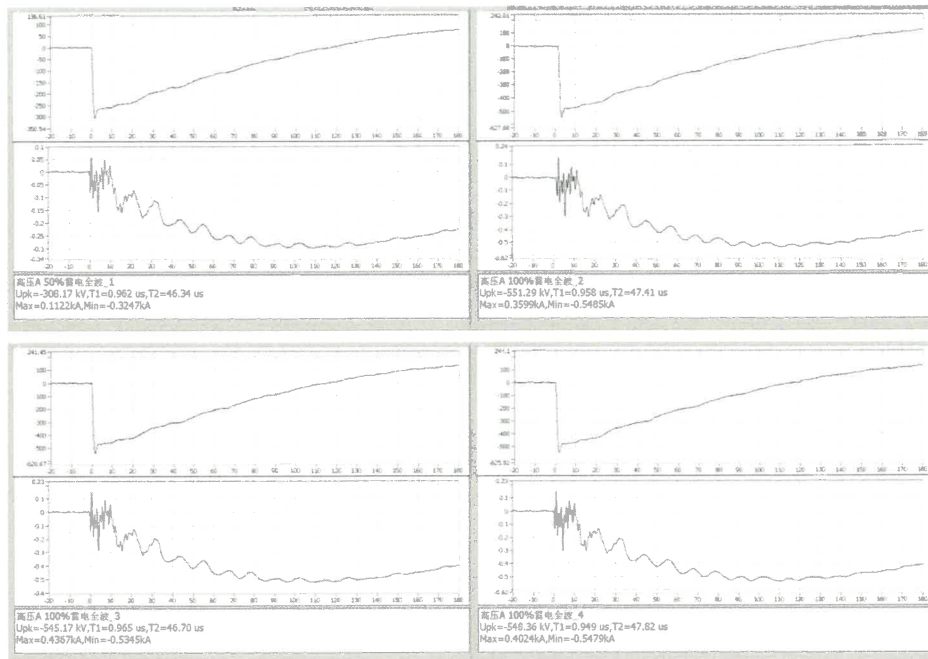
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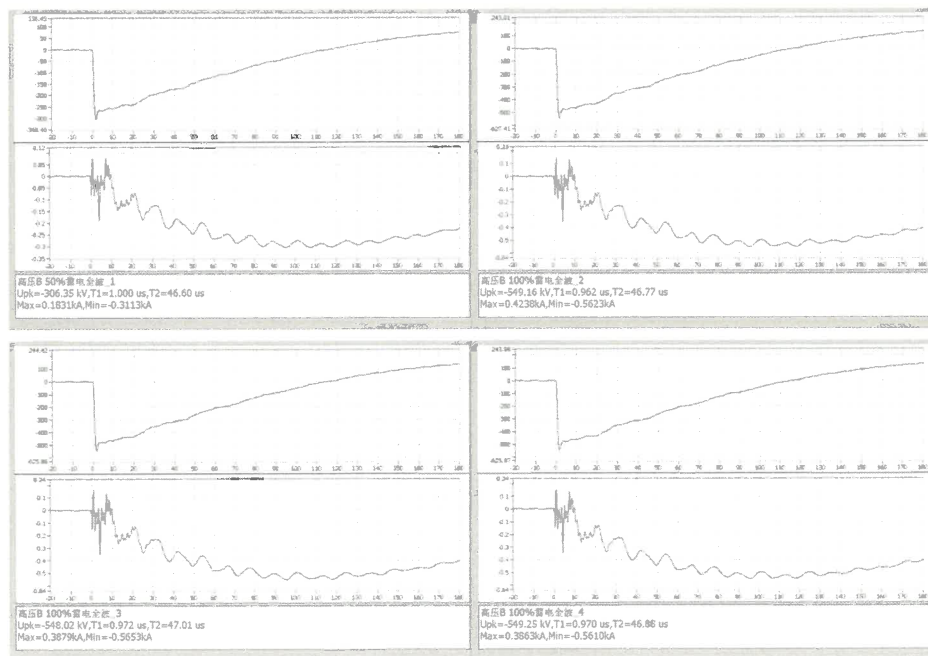
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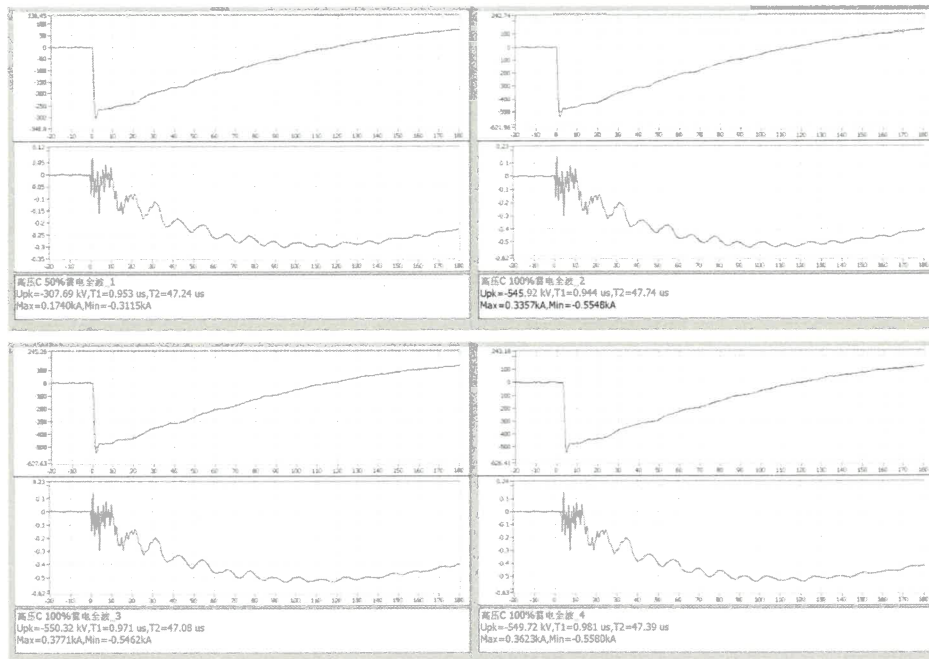


h.v. phase A

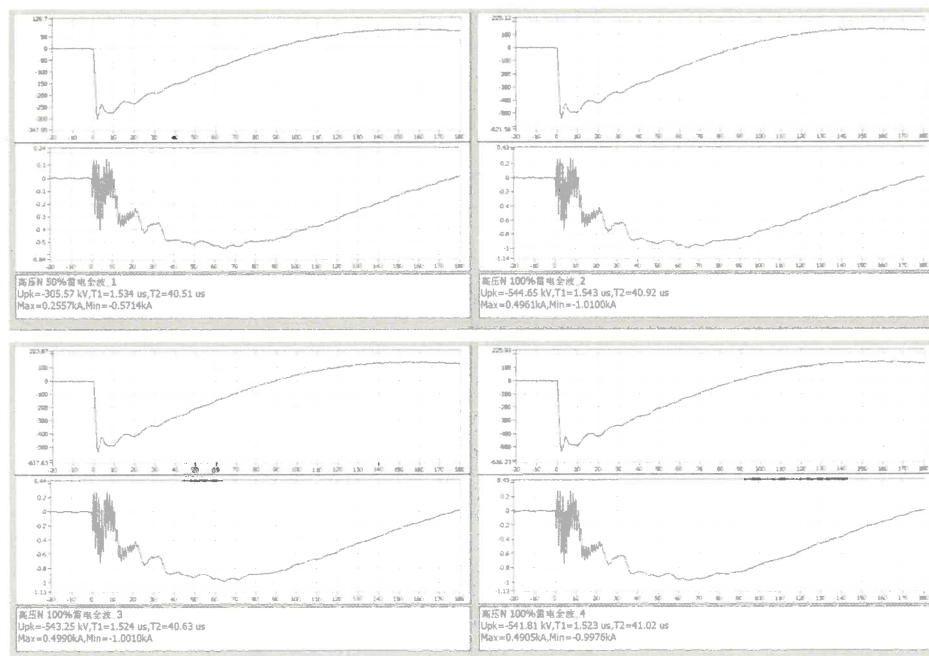


h.v. phase B

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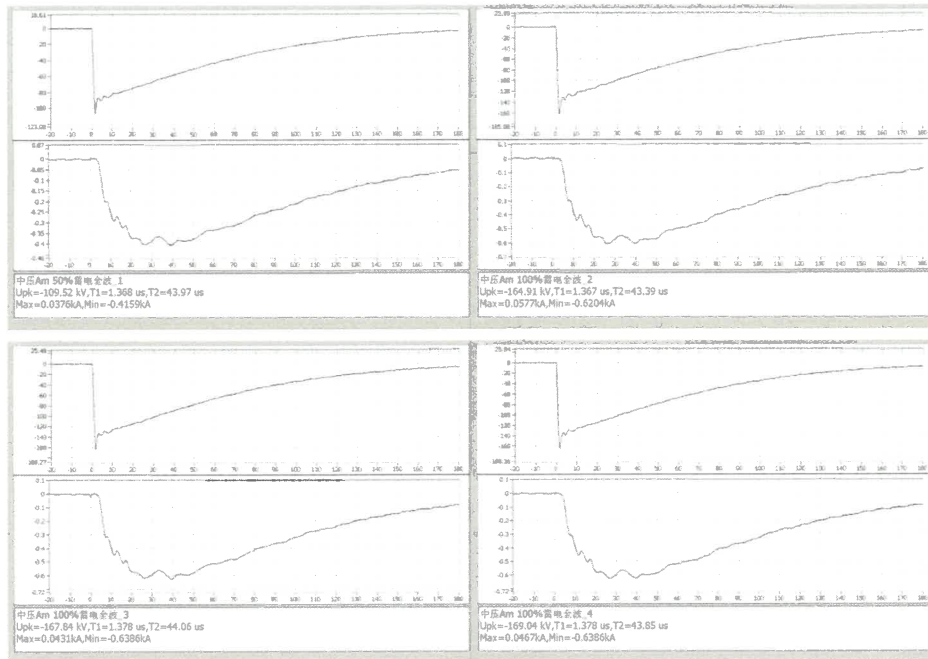


h.v. phase C

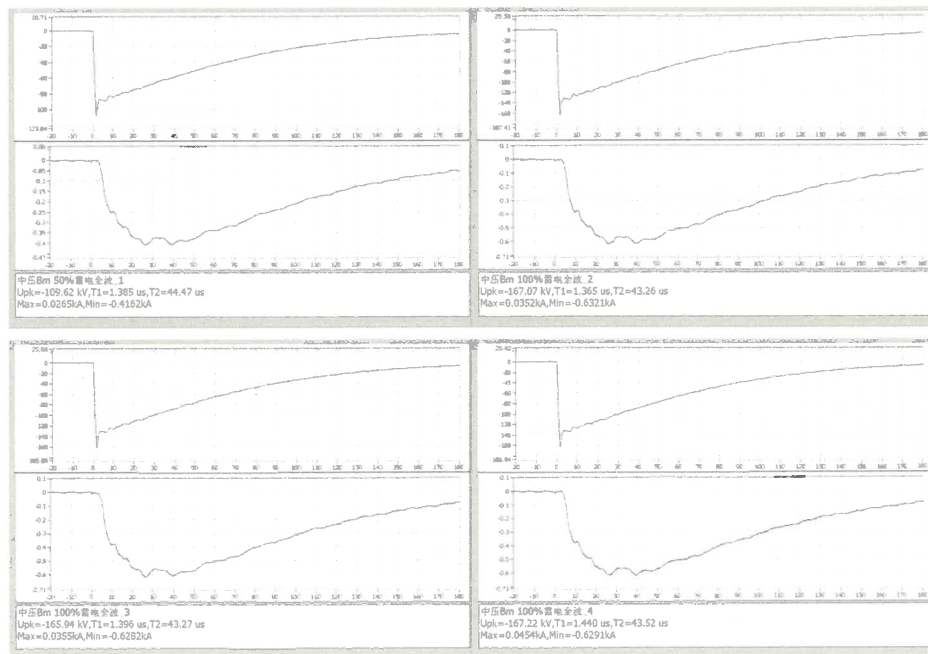


h.v. phase N

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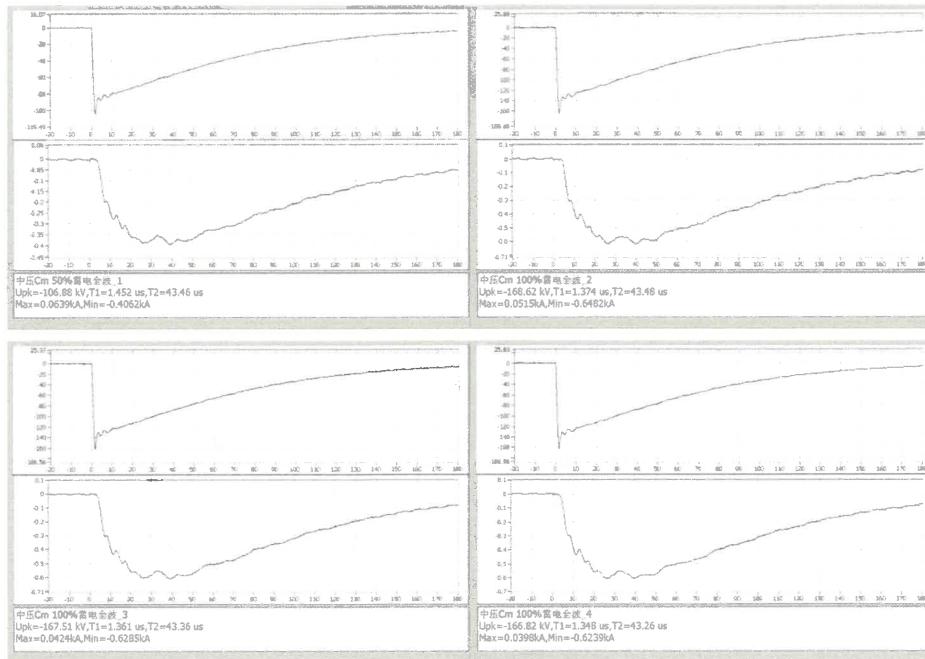


m.v. phase Am

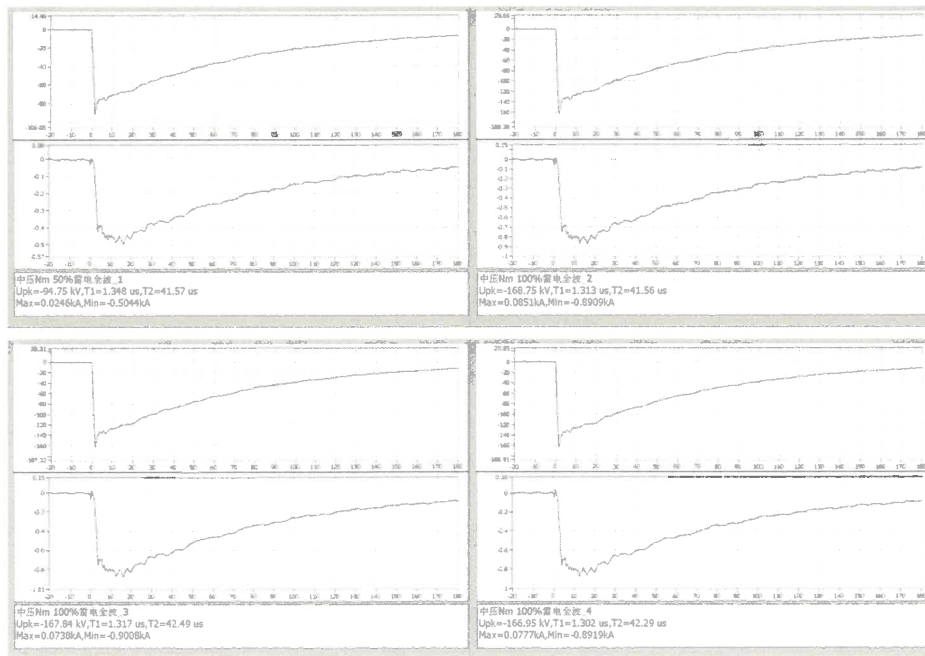


m.v. phase Bm

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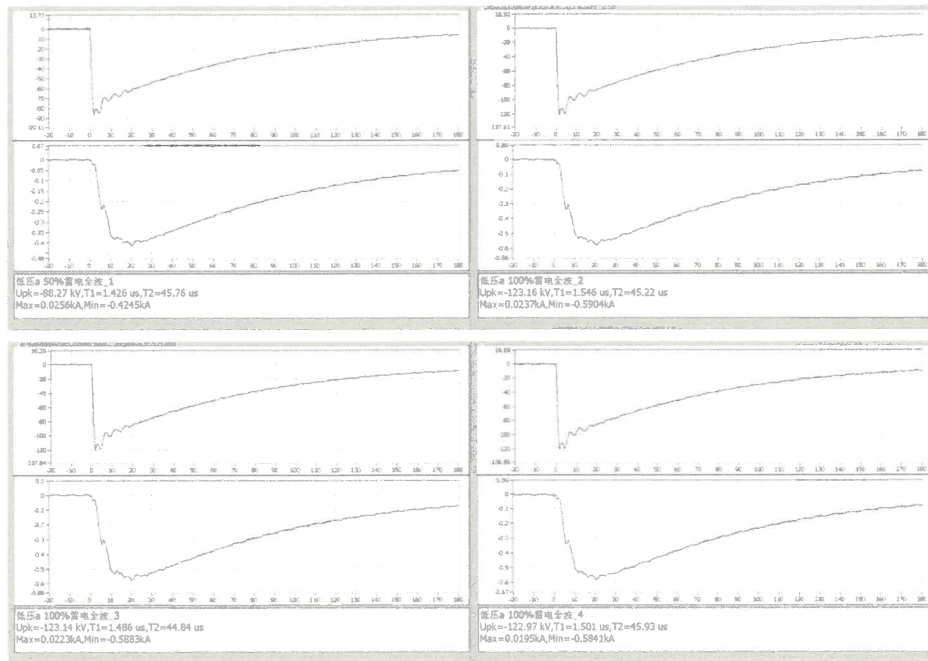
m.v. phase Cm



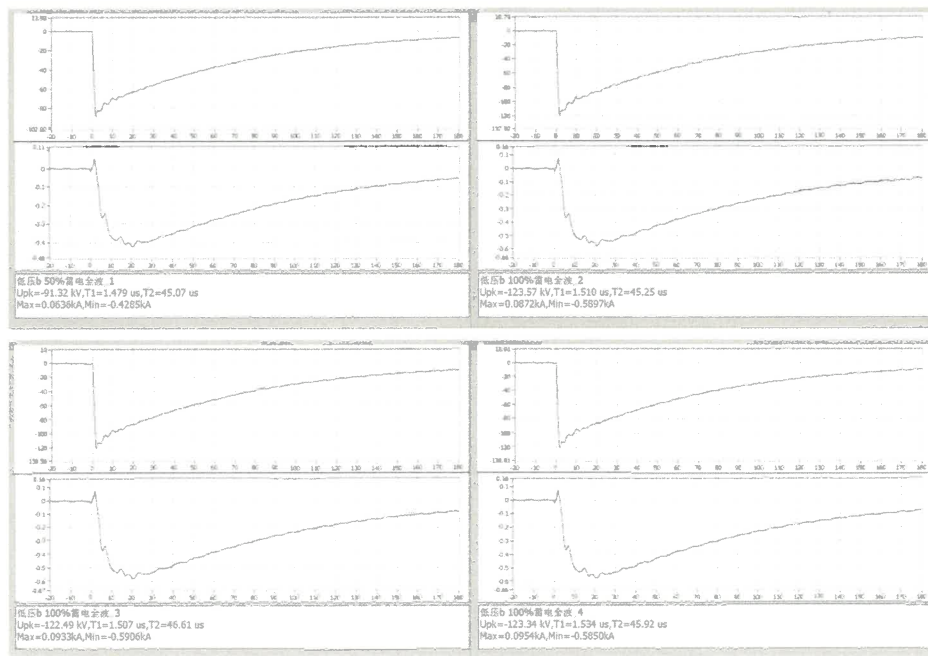
m.v. phase Nm

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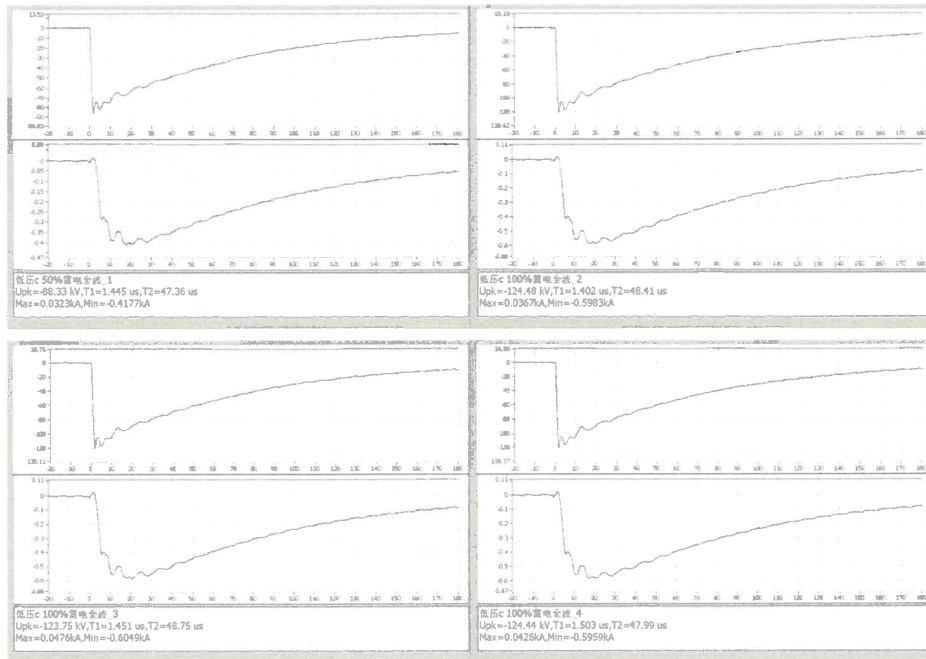
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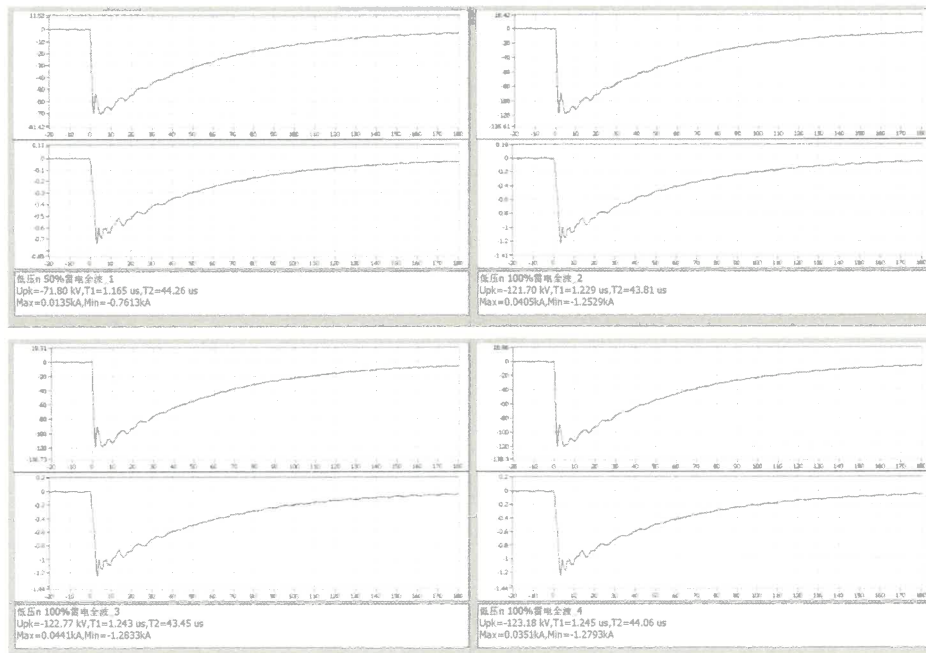
l.v. phase a



l.v. phase b



l.v. phase c



l.v. phase n

3.18 Sound level test

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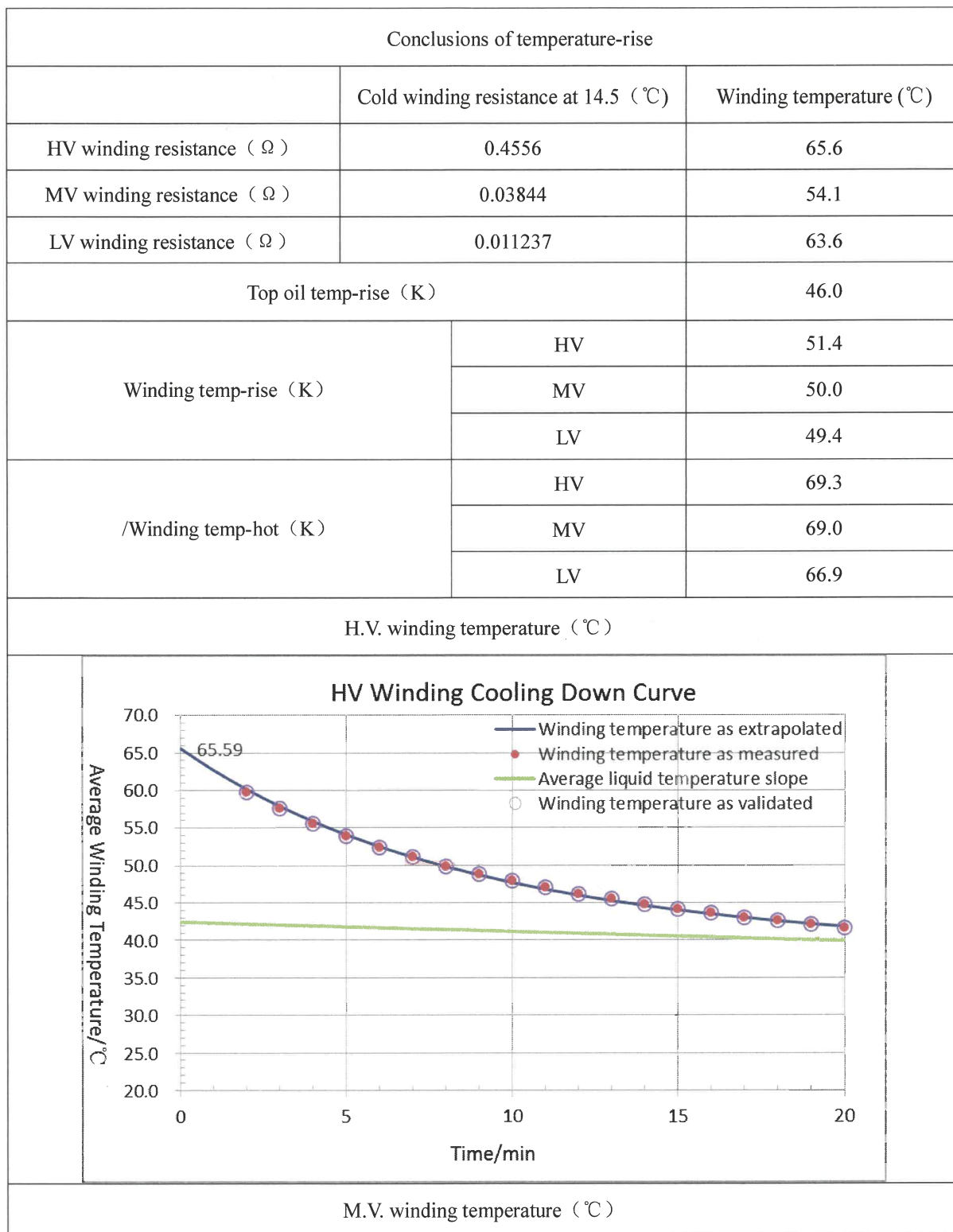
Total surface area of test room Sv (m ²)	Average acoustic absorption coefficient α	Sound absorption area of the test room A (m ²)	Distance to the principal radiating surface (m)	Area of the measurement surface S (m ²)	Environmental correction K (dB)
4746	0.15	711.9	3.0	255.4	3.86
4746	0.15	711.9	2.0	166.6	2.87

A-weighted background noise pressure level											
Measured points	1	2	3	4	5	6	7	8	9	10	Average (dB)
Before test	51.4	51.2	51.8	51.1	51.6	51.6	49.2	49	49.1	49.2	50.5
After test	51.2	52.0	51.6	51.0	51.1	47.2	49.1	47.7	48.1	47.2	49.6
State of Cooling Equipment: OFF Excite Rate: 100% ONAN (3m)											
Measured points	1/3 H	2/3H	Measured points	1/3 H	2/3H	Measured points	1/3 H	2/3H			
1	54.5	54.3	15	53.5	53.3	29	55.2	54.7			
2	54.0	54.3	16	54.1	54.0	30	54.3	54.3			
3	54.9	55.0	17	54.0	53.8	31	53.3	53.7			
4	53.2	53.7	18	54.4	54.7	32	53.7	53.9			
5	54.1	54.2	19	53.9	54.1	33	54.7	54.5			
6	54.8	54.4	20	54.4	54.6	34	54.9	54.7			
7	54.1	53.7	21	53.9	54.0	35	53.7	53.8			
8	54.3	55.0	22	54.8	54.7	36	54.9	54.7			
9	54.9	54.1	23	55.1	55.0	37	55.0	53.2			
10	55.1	54.2	24	53.3	53.7	38	53.7	54.1			
11	54.5	54.0	25	54.4	55.0	39	55.0	54.0			
12	55.0	54.3	26	54.6	53.2	40	53.2	53.8			
13	53.1	53.9	27	54.5	53.8	41	53.7	54.0			
14	54.7	54.9	28	54.6	53.3	42	53.9	54.0			

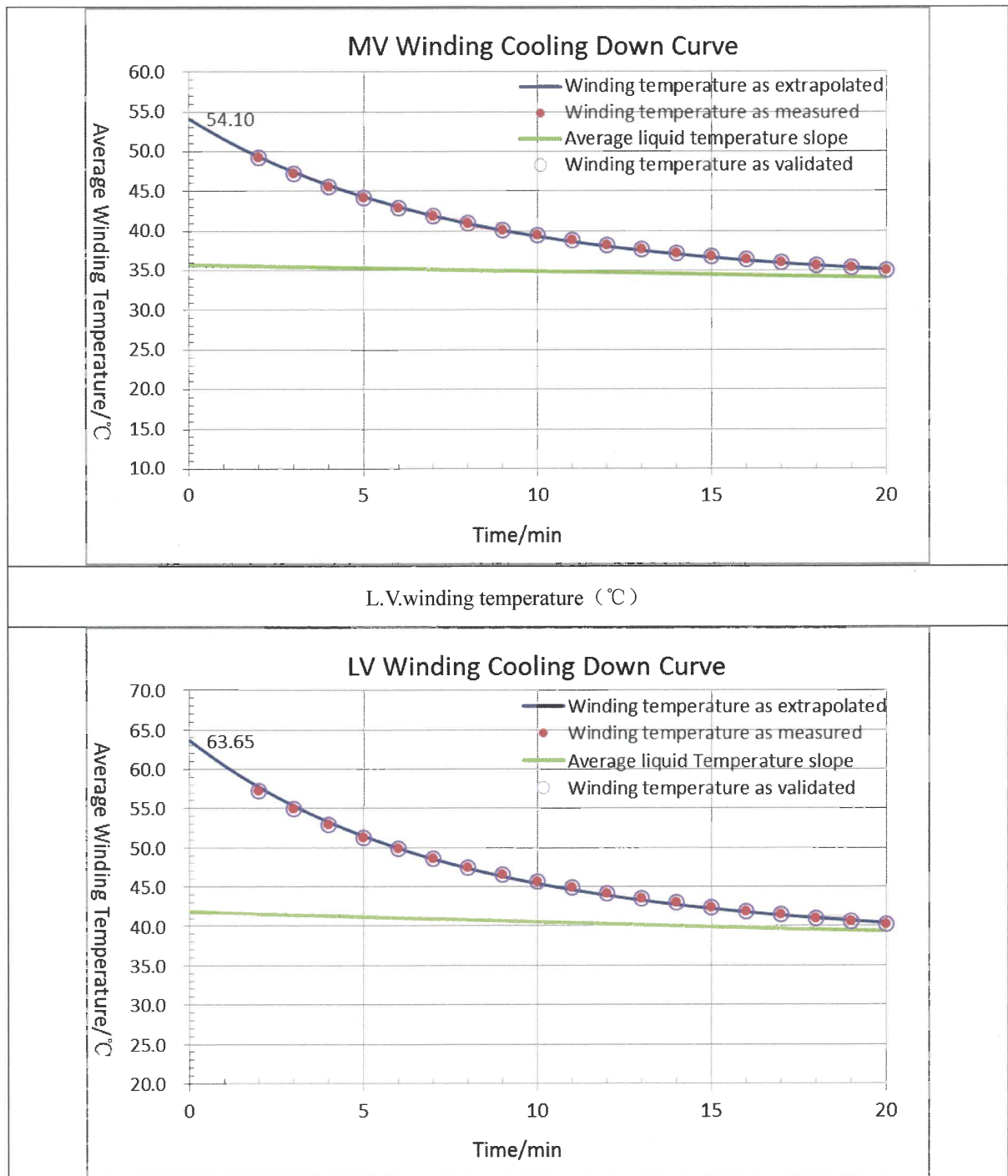
State of Cooling Equipment: ON Excite Rate: 100% ONAF (2 m)								
Measured points	1/3 H	2/3H	Measured points	1/3 H	2/3H	Measured points	1/3 H	2/3H
1	59.9	59.9	12	60.6	59.8	23	63.4	64.1
2	59.9	59.7	13	60.4	60.4	24	62.1	62.2
3	58.5	58.6	14	61.3	61.3	25	60.8	60.4
4	59.1	59.1	15	63.1	61.2	26	60.6	60.7
5	59.1	58.7	16	63.3	63.0	27	61.2	61.5
6	58.6	58.7	17	62.0	63.6	28	62.5	61.9
7	60.4	60.1	18	62.9	63.7	29	63.1	61.6
8	58.4	58.7	19	62.8	63.4	30	62.6	60.9
9	58.8	58.4	20	62.4	63.3	31	61.8	60.5
10	59.0	58.3	21	63.1	61.8	32	61.7	61.1
11	59.8	59.7	22	63.0	62.4	33	61.9	62.3
The test result								
Uncorrected average sound pressure level (dB) $\overline{L}_{PA0}$			Corrected average sound pressure level (dB) $\overline{L}_{PA}$		Guaranteed sound pressure level (dB) $\overline{L}_{PA}$		Calculated average sound power level (dB) $\overline{L}_{WA}$	
54.3			49.7		55.0		73.7	
61.4			58.7		65.0		80.9	

3.19 Temperature rise test

1) H.V.-L.V.: The test is conducted by means of a short-circuit method. The HV side is Tap17. specified total loss is 298.159 kW, injected total loss is298.159 kW. specified tap current is 285.3 A, injected current is 285.3 A. 2) H.V.-M.V.: The test is conducted by means of a short-circuit method. The HV side is Tap17. specified total loss is284.164 kW, injected total loss is284.164 kW. specified tap current is 285.3 A, injected current is 285.3 A.										
Measured values										
	Top oil temperature(°C)		HVside temperature(°C)		LVside temperature(°C)		Ambient temperature(°C)			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Total losses	61.7	62.0	54.7	58.1	33.4	34.0	14.9	15.2	16.0	16.7
Tap current	59.4	59.8	52.5	55.7	31.9	33.5	15.0	15.2	16.1	16.7
Tap current	54.2	54.6	47.7	51.3	28.4	29.6	15.1	15.0	16.0	16.3



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3.20 Measurement of Power consumption by the cooling fan

Applied Voltage (V)	Measured Current (A)	Measured Power (W)
380	1.227	390(for 1Fan)

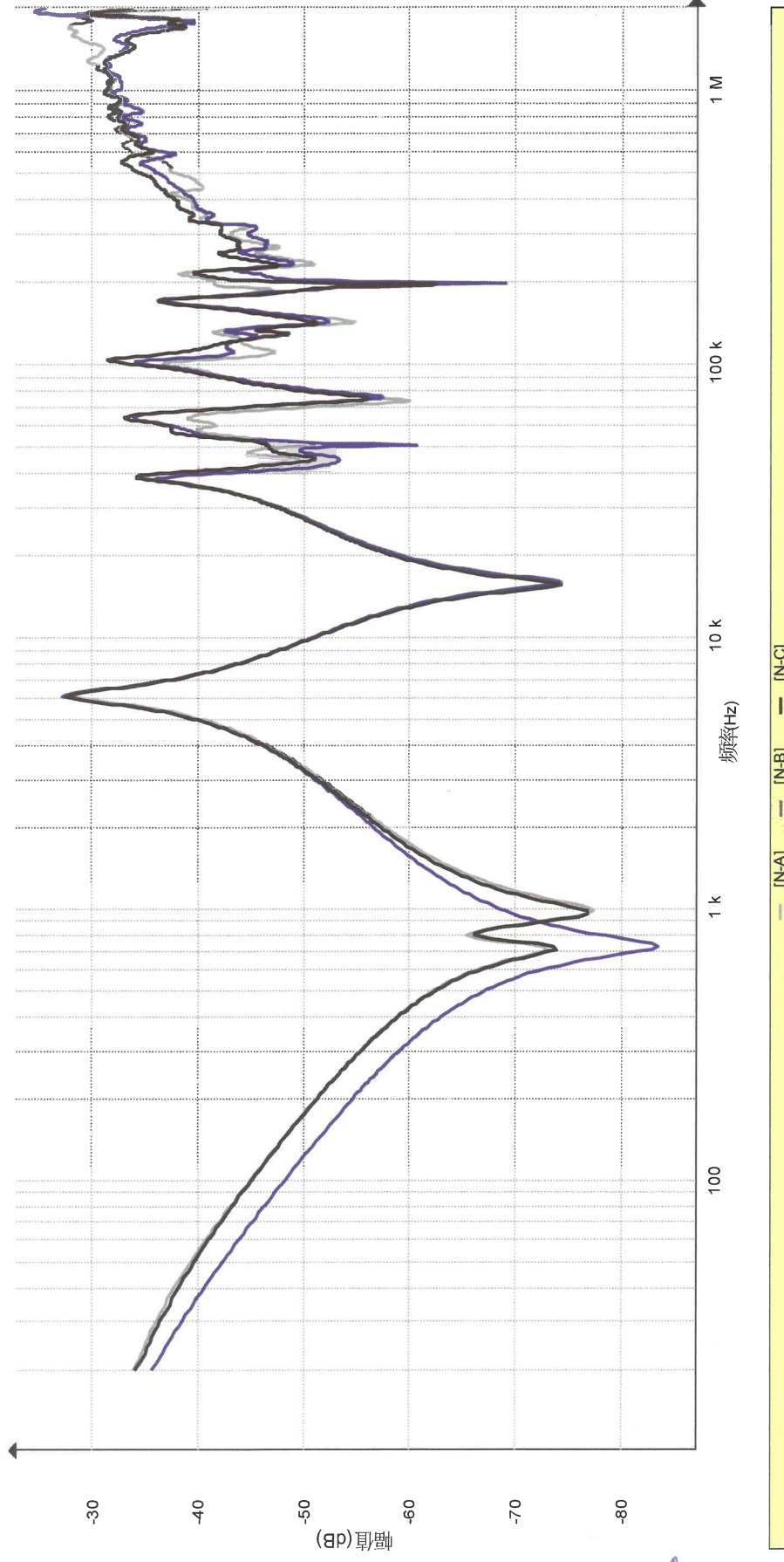
3.21Sweep Frequency Response Analysis test

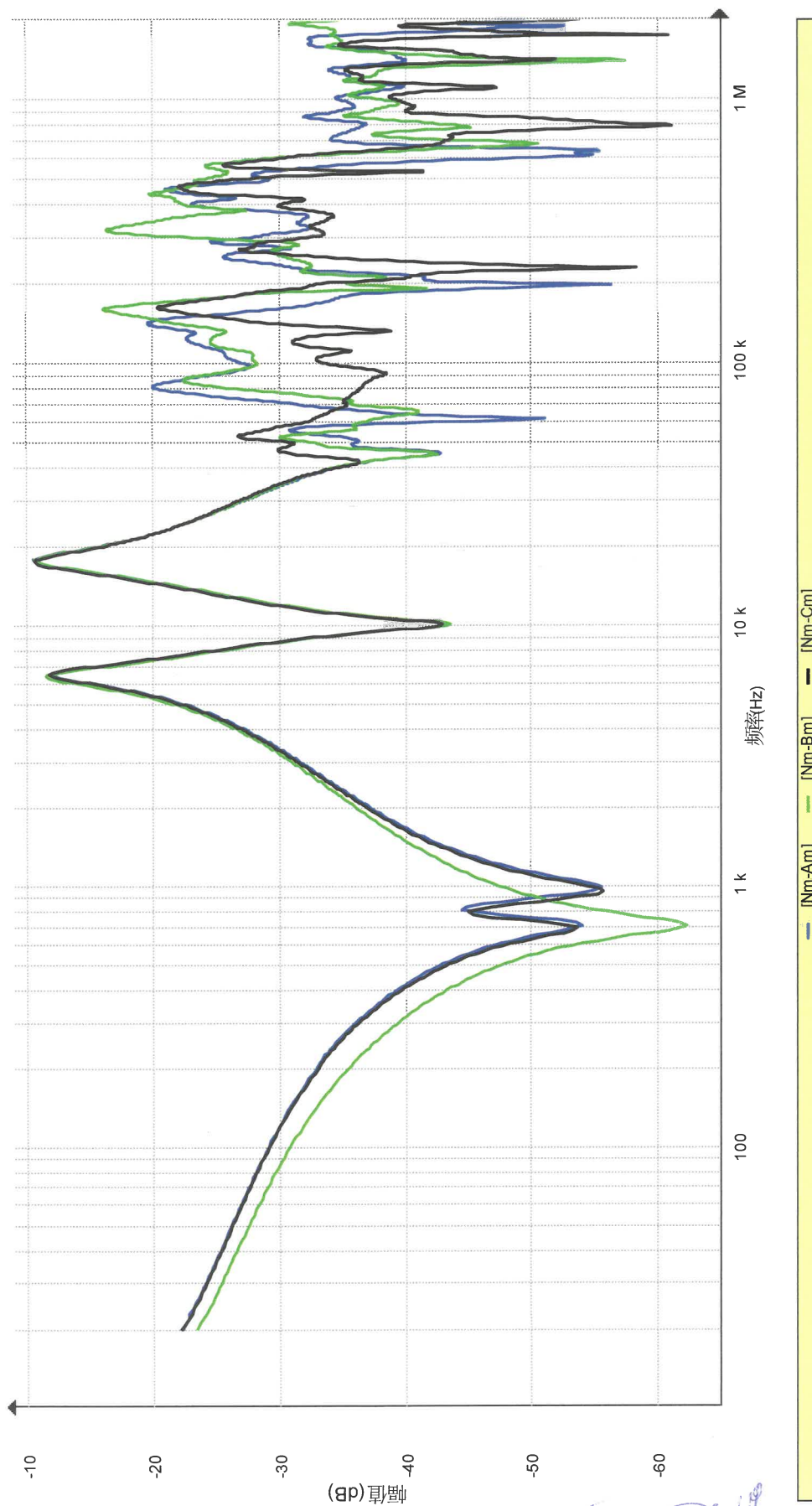
SFRA Test Results	
Report date: 2021-02-07	
Date of Test: 2021-2-4	Time of Test: 18:02:16
Company Name: JSB	Location:
Test Object: SFSZ-50000/115	Manufacturer:
Serial Number: 233512011001	Built Year: 2021-01
Phase Design: 3	Winding Configuration: YNyn0yn0+d11
KV Rating: 115-37.5-20.8-6.3	KVA Rating: 50000-50000-50000-16670
NLTC Position:	LTC Position:
Temperature: 13.9	Reason For Test:
Tested By:	
Notes:	

Transformer: "SFSZ-50000/115" at ¹¹⁵
Serial Number: 233512011001
Tested 2021-2-4 at 18:02:16

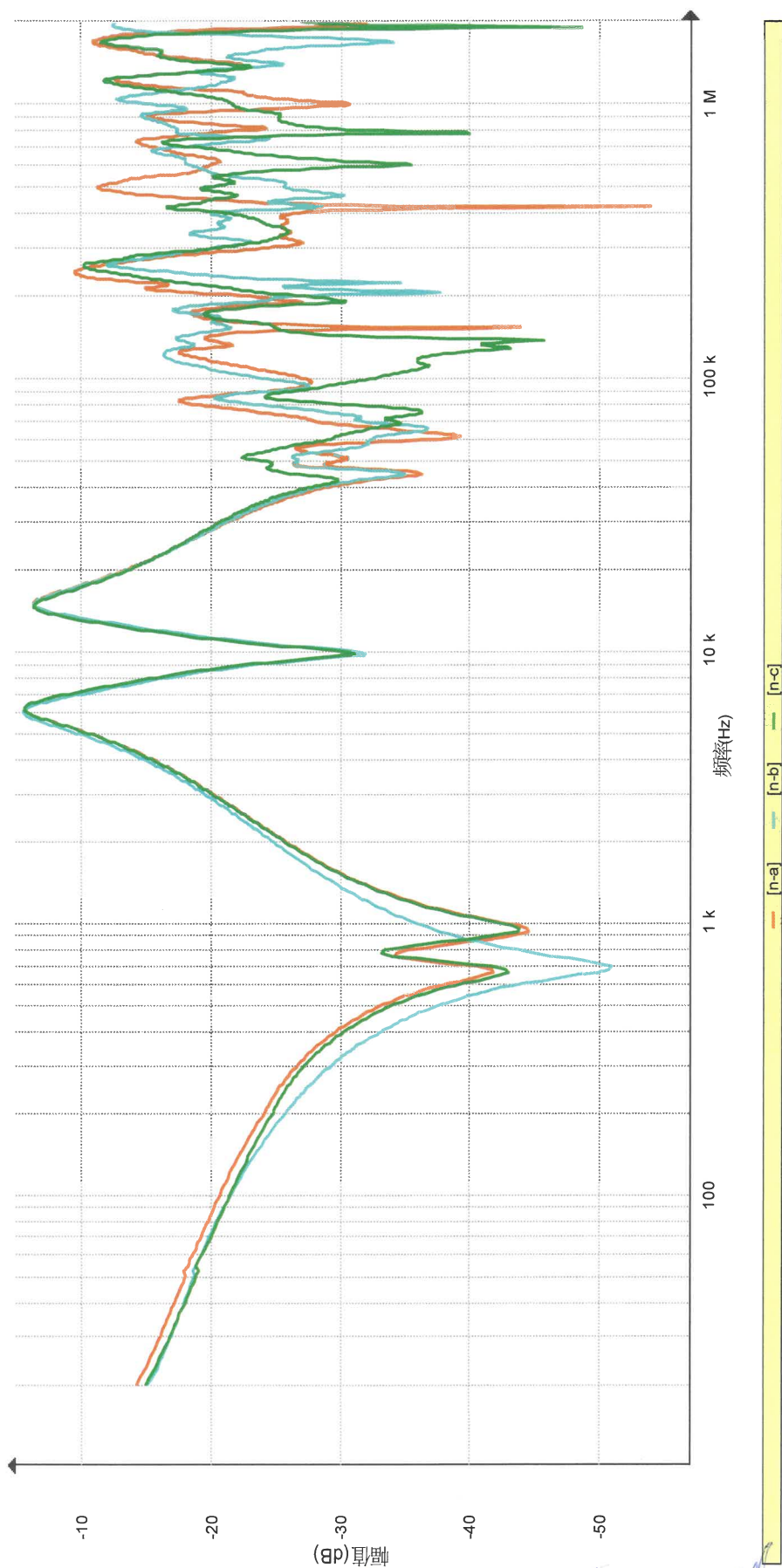
Manufacturer:
Tested by:

Magnitude:





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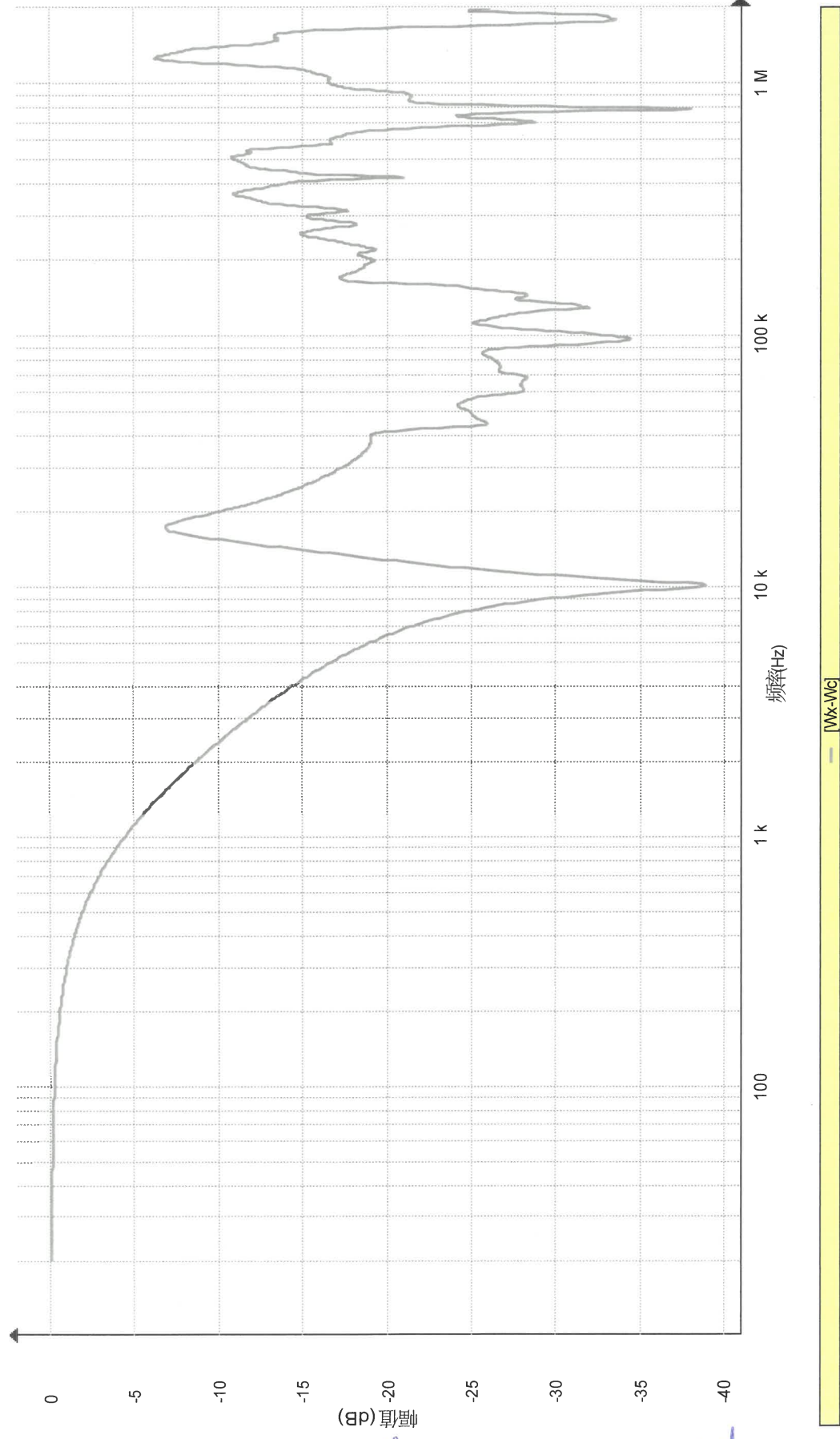


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4. Test conclusion:

The test results for power transformer SFSZ-50000/115 met the requirements of IEC 60076-1 2011, IEC 60076-2 2011, IEC 60076-3 2013, IEC 60076-10 2016 and Technical Guarantee File of Sales Contract. The product passed the test.

Tested by:
JSB

Mao Zhihua 毛志华
Zhou Xialei 周夏磊
Guan Jianfei 管建飞

Online participants:
OSHEE sh.a

Dritan Xhokaxhi
Juljan Sinani
Arben Xheleku

Online participants:
ENBI POWER sh.p.k

Seljano Nuredini
Erald Cela

Zhejiang Jiangshan Transformer Co., Ltd

