Power Industry Quality Inspection and Testing Center for Electric Equipment and Instruments

EETC2017HG509J

CMA 150008250711

CNAS 中国认可 国际互认 检测 TESTING CNAS L0699

Test Report

Address: NO. 143,Luoyu Road,Hongshan District,Wuhan, Hubei Province.

Postcode: 430074

Tel: 400-656-5689

Fax: 86-27-5937-8488

Website: http://www.epri.sgcc.com.cn

NOTICE

1 This test report will enter into effect with exclusive test seals, a steel seal and anti-fake labels of EETC.

2 This report is legally made available accompany with tested, checked, verified and approved signatures.

3 Any objections in the report should be posed within 30 days once the report is received.

4 This report only takes responsibility to the test sample.

5 Report's authenticity can be confirmed via website or tel on the cover.

Power Industry Quality Inspection and Testing Center for Electric Equipment and Instruments

Test Report

EETC2017HG509J

1 Client

Guangdong SiHui Instrument Transformer Works Co.,Ltd

2 Sample Description

Name: Inductive voltage transformer
Type: JSQXF-126
Manufacturer: Guangdong SiHui Instrument Transformer Works Co.,Ltd
Manufacture Date: Nov, 2016
Sample No./Details: V1609110012

3 Standards/Specifications

GB20840.1-2010 Instrument transformers-Part 1: General requirements
GB20840.3-2013 Instrument transformers-Part 3: Additional requirements for inductive voltage transformers
IEC61869-1:2007 Instrument transformers-Part 1: General requirements
IEC61869-3:2011 Instrument transformers-Part 3: Additional requirements for inductive voltage transformers

4 Test Category

Routine Test /Type Test

5 Test Date

03 Jan. 2017 to 04 Mar. 2017

6 Conclusion

The inductive voltage transformer with the type of JSQXF-126 offered by Guangdong SiHui Instrument Transformer Works Co.,Ltd meets the requirements of the corresponding items of the standards GB20840.1-2010,GB20840.3-2013,IEC61869-1:2007,IEC61869-3:2011

Note 1: In the event of any difference in meanings of the text, the Chinese report shall take priority over the English version.

Note 2: (Period of validity: 5 years.)

Tested by:

Checked by:

Verified by:

Approved by:

Date of issue: 2017-03-15

7 Inspection Items and Results

No.	Item	Requirements	Results	Evaluation
1	Verification of markings	The nameplate, sign, earthing terminal, terminal marking shall meet the requirements. The valve and the bursting plate shall be in good condition.	Meet the requirements	Pass
2	Power-frequency voltage withstand tests on secondary terminals	Applied voltage on winding-to-winding and winding-to-earth shall be 3kV/50Hz/60s.	Test voltage: 3kV/50Hz/60s No flashover and breakdown occurred.	Pass
3	Power-frequency voltage withstand tests on primary terminals	Induced voltage between primary winding and earth shall be 230kV /150Hz /40s. Applied voltage between earthed terminal of primary winding and earth shall be 5kV/50Hz/60s.	Test voltage: 230kV/150Hz /40s No flashover and breakdown occurred. GIS products do not need atmospheric correction Test voltage: 5kV/50Hz/60s No flashover and breakdown occurred.	Pass
4	Partial discharge measurement	Test frequency: 150 Hz Pre-stress voltage : 230 kV Test voltage : 126 kV Maximum permissible PD level : 10 pC Test voltage: 87.3 kV Maximum permissible PD level : 5 pC	Test frequency : 150 Hz Pre-stress voltage : 230 kV Test voltage: 126 kV PD level Phase A: 5 pC Phase B: 5 pC Phase C: 6 pC Test voltage: 87.5 kV PD level Phase A: 3 pC Phase B: 3 pC Phase C: 3 pC	Pass
5	Measurement of excitation characteristic	Exciting current shall be measured at 0.2, 0.5, 0.8, 1.0, 1.2 and 1.5 times of rated secondary voltage respectively.	Details are shown in item 2.5	---
6	Tests for accuracy	The errors of the secondary windings shall meet the requirements of accuracy classes 0.2/0.5/3P.	Meet the requirements	Pass
7	Temperature-rise test	The voltage of $1.0U_{pr}$ is applied on primary winding with the secondary windings loaded with the thermal limiting burden. The temperature-rise of windings shall not exceed 75K.	ANA: 23 K 2a2n: 26 K BNB: 23 K 2a2n: 26 K CNC: 25 K 2a2n: 25 K	Pass
		The voltage of $1.2U_{pr}$ is applied on primary winding with the secondary windings loaded with the maximum rated burden. The temperature -rise of windings shall not exceed 75K.	ANA: 11 K 1a1n: 12 K 2a2n: 12 K BNB: 12 K 1a1n: 12 K 2a2n: 13 K CNC: 12 K 1a1n: 12 K 2a2n: 14 K	Pass

No.	Item	Requirements	Results	Evaluation
7	Temperature-rise test	The voltage of $1.5U_{pr}$ is applied on primary winding for 30s beginning from the cold condition with the secondary windings loaded with the rated burden. The temperature-rise of windings shall not exceed 10K.	ANA: 0.6 K 1a1n: 0.5 K 2a2n: 0.7 K dadn: 0.4 K BNB: 0.5 K 1a1n: 0.7 K 2a2n: 0.4 K dadn: 0.4 K CNC: 0.3 K 1a1n: 0.4 K 2a2n: 0.4 K dadn: 0.3 K	Pass
8	Impulse voltage test on primary terminals(Lightning and chopped impulse voltage test on primary terminals)	Standard LI: 550kV/ ±15 Waveform : 1.2/50μs Standard LI-chopped : 632.5kV/-2 Waveform : (2~5) μs	Phase A: 548kV~556kV ±15 636kV, 638kV -2 Phase B: 539kV~556kV ±15 639 kV -2 Phase C: 549kV~553kV ±15 637kV, 638 kV -2 No flashover and breakdown occurred.	Pass
9	Short-circuit withstand capability test	The rated voltage 57.7V is applied on secondary winding for 1.0s with primary winding connected to earth. There shall be no electrical and mechanical damage.	1a1n (Phase A) Test voltage: 57.9 V Test current: 1273 A Duration: 1.01 s 1a1n (Phase B) Test voltage: 58.3 V Test current: 1202 A Duration: 1.01 s 1a1n (Phase C) Test voltage: 57.7 V Test current: 1285 A Duration: 1.01 s	Pass
10	Power-frequency voltage withstand tests on secondary terminals (retrial)	Applied voltage on winding-to-winding and winding-to-earth shall be 2.7kV/50Hz/60s.	Test voltage: 2.7kV/50Hz/60s No flashover and breakdown occurred.	Pass
11	Power-frequency voltage withstand tests on primary terminals (retrial)	Induced voltage between primary winding and earth shall be 207 kV /150Hz /40s. Applied voltage between earthed terminal of primary winding and earth shall be 4.5kV/50Hz/60s.	Test voltage: 207kV/150Hz /40s No flashover and breakdown occurred. Test voltage: 4.5kV/50Hz/60s No flashover and breakdown occurred.	Pass

No.	Item	Requirements	Results	Evaluation
12	Partial discharge measurement (retrial)	Test frequency: 150 Hz Pre-stress voltage : 207 kV Test voltage: 126 kV Maximum permissible PD level : 10 pC Test voltage : 87.3 kV Maximum permissible PD level : 5 pC	Test frequency : 150 Hz Pre-stress voltage : 207 kV Test voltage: 126 kV PD level: Phase A: 6 pC Phase B: 6 pC Phase C: 6 pC Test voltage: 87.5 kV PD level: Phase A: 3 pC Phase B: 3 pC Phase C: 3 pC	Pass
13	Measurement of excitation characteristic (retrial)	Exciting current shall be measured at rated secondary voltage.	Phase A Ialn: 3.19 A Phase B Ialn: 3.12 A Phase C Ialn : 3.06 A	---
14	Tests for accuracy (retrial)	The errors of the secondary winding shall meet the requirements of accuracy class 0.2.	Meet the requirements	Pass
15	Enclosure tightness test at ambient temperature	The relative leakage rate (F_{rel}) shall not exceed 0.5% per year at rated filling pressure.	F_{rel} <0.1%	Pass
16	Gas dew point test	The dew-point is not higher than -38.6℃ for a measurement at 20℃. The water content of gas shall be less than 150μL/L.	The dew-point : -49.1℃ The water content of gas :43μL/L	Pass
17	Verification of the degree of protection by enclosures	The degree of protection of low-voltage control and/or auxiliary enclosures for outdoor instrument transformers is IP54. The level of protection against effects of mechanical impacts is impact level IK07.	Meet the requirements. Note: The test was performed on another secondary terminal box of the same type offered by the client.	Pass
18	Pressure test for the enclosure	Welded aluminum enclosure shall withstand (2.3 or) $\times\sigma_t/\sigma_a\times$ "design pressure" for 1 min, no broken or permanent deformation.	Welded aluminum enclosure: Test Pressure:1.84MPa Duration:1min No broken or no permanent deformation Note: 1: The design pressure is 0.60MPa. 2: The test was performed on another welded aluminum enclosure of the same type offered by the client.	Pass

Note: 1. The tests of 1～8, 10～14 items were performed in the minimum functional pressure of 0.40MPa. The tests of 9, 15, 16 items were performed in the rated filling pressure of 0.45MPa

2. According to the client's request , The test voltage of 95kV (50Hz) was applied between primary winding and the earth for 5min in the pressure of 0 MPa. No flashover and breakdown occurred.

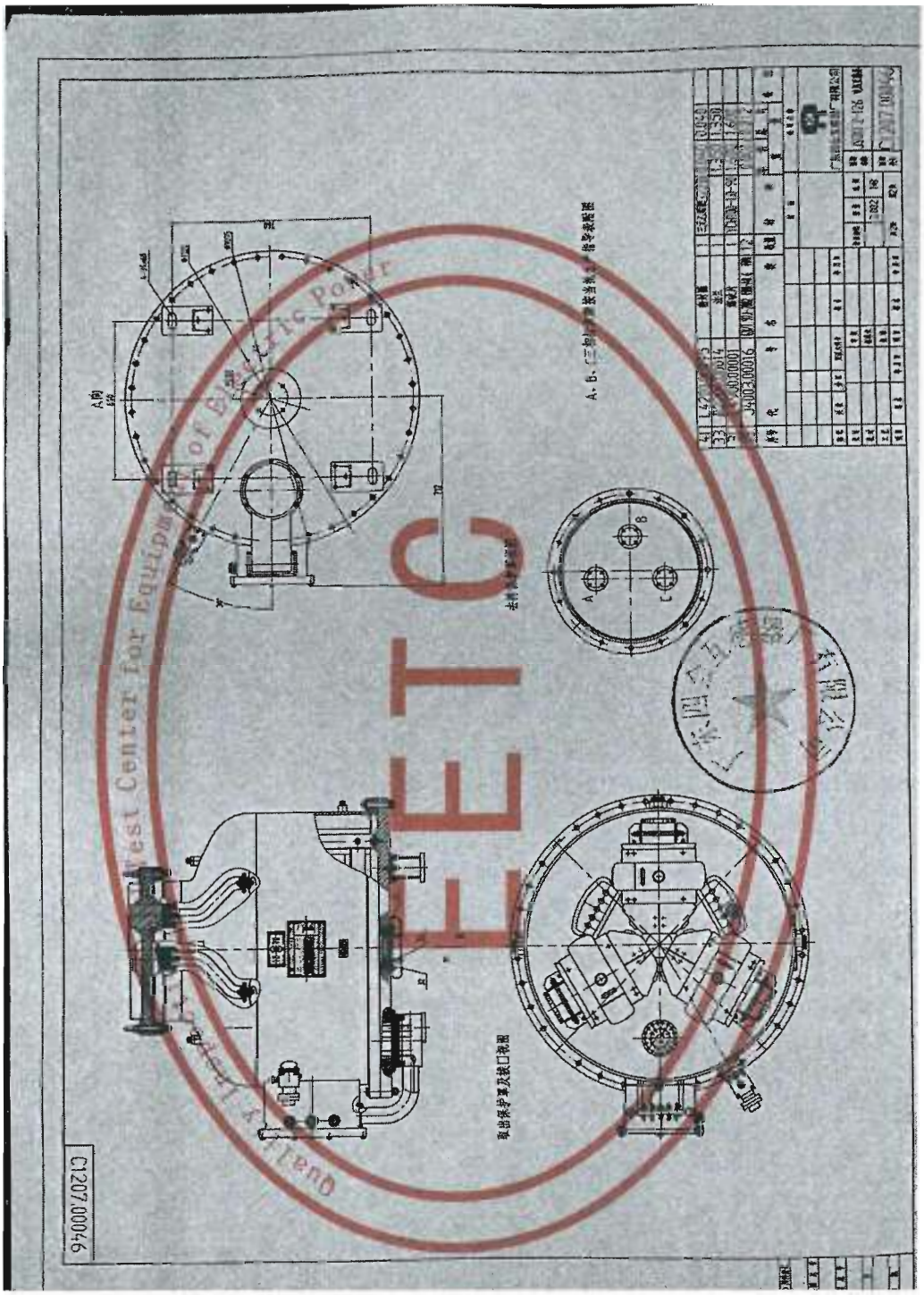
1 Identification of the tested object

1.1 Parameters

Name: Inductive voltage transformer
Type: JSQXF-126
Sample No.: V1609110012
Manufacturer: Guangdong SiHui Instrument Transformer Works Co.,Ltd
Sampling way: Offer by client
Date of Manufacture: Nov, 2016
Main parameters provided by the manufacturer:

Highest voltage for equipment(U_m)	126 kV	Rated primary voltage(U_{pr})	$110/\sqrt{3}$ kV
Equipment category	Indoor	Rated frequency	50Hz
Rated filling pressure	0.45MPa	Minimum functional pressure	0.40MPa
Temperature categories	-25 ℃/+40℃	Altitude	≤1000m
Rated transformation ratio	$110/\sqrt{3}/0.1/\sqrt{3}/0.1/\sqrt{3}/0.1$ kV		
Rated insulation level	126/230/550 kV		
Insulating class	E		
Rated voltage factor , rated time	1.2Upr, Continuous; 1.5U_{pr}, 30s		
Secondary winding(Phase A)/ Accuracy class	1a1n/0.2	2a2n/0.5	dadn/3P
Rated burden（VA）/Power factor	100/0.8	150/0.8	150/0.8
Rated thermal limiting output(VA)	/	2000	/
Secondary winding(Phase B)/ Accuracy class	1a1n/0.2	2a2n/0.5	dadn/3P
Rated burden(VA)/Power factor	100/0.8	150/0.8	150/0.8
Rated thermal limiting output(VA)	/	2000	/
Secondary winding(Phase C)/ Accuracy class	1a1n/0.2	2a2n/0.5	dadn/3P
Rated burden(VA)/Power factor	100/0.8	150/0.8	150/0.8
Rated thermal limiting output(VA)	/	2000	/

1.2 Drawings



1.3 Statement

图样和资料目录真实代表所送试品的声明

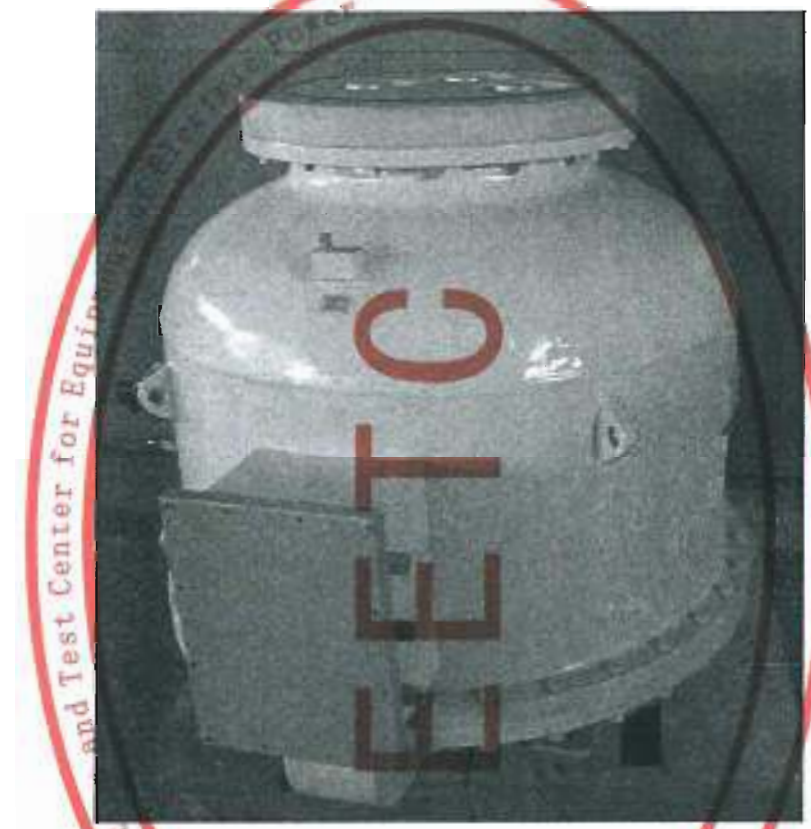
本公司向电力工业电气设备质量检验测试中心提交的型号为（JSQXF-126）互感器的图样、资料目录与所送试样机一致，能真实代表所送试验样机。

序号	目录	名称	编号/代码
1	总装图	JSQXF-126 电压互感器	C1207.00046
2	绝缘子详图	/	/
3	一、二次端子详图	盘式绝缘子/接线板	C9207.00001 B0100.00238
4	产品铭牌图	铭牌	E0000.01172
5	使用说明书	使用说明书	C1207.00046SM
6	产品技术条件/企标	技术条件	C1207.00046J
7	工厂明示的关键材料/部件清单	JDQXF-220 关键材料部件清单	/
8	制作工艺文件及设计文件目录	高压电磁式电压互感器各工序的生产作业指导书目录	C1207.00046ML
8.1	一、二次绕组绝缘包扎工艺文件	高压电磁式电压互感器高压绕组绝缘作业指导书 高压电磁式电压互感器低压绕组绝缘作业指导书	GY-005-2013 GY-004-2013
8.2	主绝缘制作	VT 高压线圈固化作业指导书	GY-001-2013
8.3	退磁干燥工艺文件	高压电磁式电压互感器器身装配作业指导书	GY-001-2014
8.4	产品密封工艺文件	成体试漏作业指导书	GY-002-2013
8.5	产品装配工艺文件	高压电磁式电压互感器总装配作业指导书	GY-011-2014

（单位公章）

1.3.1 The testing laboratory has checked that the drawings and other data submitted by the manufacturer can adequately represent the essential details and parts of the equipment to be tested, but isn't responsible for the accuracy of the detailed information.
1.3.2 Before all the tests, the test object offered by the client is a new, clean inductive voltage transformer, including frame and all the other parts as in normal operation.
1.3.3 The test object is a three-phase inductive voltage transformer for GIS.
1.3.4 Confirmed date of test object: 03 Jan. 2017
1.3.5 Client representative: Lu jianyi

1.4 Photographs of test object



2 Test items and results

2.1 Verification of markings

2.1.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Transformer calibrator	HEF-H	#KI020 (YQ320)	2	2018.02.25

2.1.2 Reference standard requirement

The nameplate and the mark of terminals shall meet the requirements. The valve and the bursting plate shall be in good condition.

2.1.3 Data

The nameplate, sign, earthing terminal, terminal marking meet the requirements. The valve and the bursting plate are in good condition.

2.1.4 Test result

The test object passed the tests.

2.2 Power-frequency voltage withstand tests on secondary terminals

2.2.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Equipment for secondary voltage withstand tests	HZSY-S	#6120611 (SB210)	3	2018.10.07

2.2.2 Reference standard requirement

The test voltage of 3kV(50Hz) shall be applied for 60s between the short-circuited terminals of each winding and earth in turn. No flashover and breakdown occur.

2.2.3 Data

The test voltage of 3kV(50Hz) was applied for 60s between the short-circuited terminals of each winding and earth in turn. No flashover and breakdown occurred.

2.2.4 Test result

The test object passed the tests.

2.3 Power-frequency voltage withstand tests on primary terminals

2.3.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Series resonance measuring system	TRF1200-0.002	#111030 (YQ220)	3	2017.12.17
2	Series resonance testing device	YDGK-1200/3×400	#111023 (SB220)	/	2018.01.25
3	Equipment for secondary voltage withstand tests	HZSY-S	#6120611 (SB218)	3	2018.10.07

2.3.2 Reference standard requirement

The induced voltage of 230kV (150Hz) shall be applied between primary winding and earth for 40s. No flashover and breakdown occur.

The test voltage of 5kV(50Hz) shall be applied between earthed terminal of primary winding and earth for 60s. No flashover and breakdown occur.

2.3.3 Data

Ambient temperature: 8 ℃ Relative humidity:60% Ambient air pressure: 102.6kPa

The induced voltage of 230kV (150Hz) was applied between primary winding and earth for 40s. No flashover and breakdown occurred.

The test voltage of 5kV(50Hz) was applied between earthed terminal of primary winding and earth for 60s. No flashover and breakdown occurred.

2.3.4 Test result

The test object passed the tests.

2.4 Partial discharge measurement

2.4.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Partial discharge detector	JFD-251	N1002 (YQ380)	10	2017.11.15
2	Series resonance measuring system	TRF1200-0.002	#111030 (YQ220)	3	2017.12.17
3	Series resonance testing device	YDGK-1200/3×400	#111023 (SB220)	/	2018.01.25

2.4.2 Reference standard requirement

Pre-stress voltage: 230 kV, Test frequency: 150Hz

Test voltage: 126 kV, Maximum permissible PD level: 10 pC

Test voltage: 87.3 kV, Maximum permissible PD level: 5 pC

2.4.3 Data

Ambient temperature:8℃ Relative humidity:60%

Test frequency (Hz)	150	Pre-stress voltage (kV)	230	
Test voltage (kV)	126	PD level (pC)	Phase A	5
			Phase B	5
			Phase C	6
Test voltage (kV)	87.5	PD level (pC)	Phase A	3
			Phase B	3
			Phase C	3

2.4.4 Test result

The test object passed the tests.

2.5 Measurement of excitation characteristic

2.5.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	V-A characteristic tester	ZZFA-IV	#10088 (YQ408)	0.2	2018.01.03

2.5.2 Reference standard requirement

Exciting current was measured at 0.2, 0.5, 0.8, 1.0, 1.2 and 1.5 times of rated secondary voltage respectively.

2.5.3 Data

Ambient temperature:8 ℃ Relative humidity: 69 %

Percentage of rated secondary voltage(%)		20	50	80	100	120	150
Test voltage（V）		12.0	28.8	48.1	58.0	69.0	86.7
(Phase A) 1a1n	No-load current (A)	0.62	1.58	2.71	3.02	3.01	5.00
	No-load loss(W)	/	/	/	39.1	/	/
Test voltage（V）		12.1	28.7	48.2	58.0	69.0	87.0
(Phase B) 1a1n	No-load current (A)	0.61	1.56	2.68	3.11	2.96	5.08
	No-load loss (W)	/	/	/	39.2	/	/

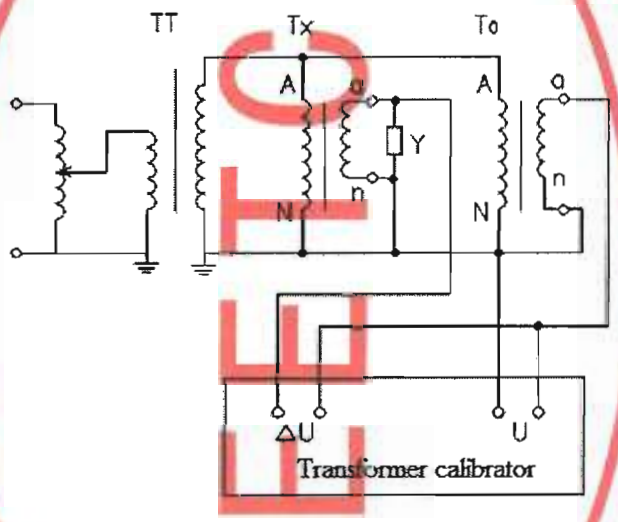
Test voltage（V）		12.1	28.2	48.0	57.8	69.1	87.0
(Phase C) 1a1n	No-load current (A)	0.62	1.61	2.60	3.05	2.90	6.40
	No-load loss (W)	/	/	/	39.0	/	/

2.5.4 Test result

The test object was both in good conditions before and after the tests.

2.6 Tests for accuracy

2.6.1 Test circuit diagram



TT: Test transformer Tx: Test object T_0: Standard voltage transformer Y:Burden

2.6.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Standard voltage transformer	HJ-220	#03002 (YQ369)	0.02	2018.10.26
2	Transformer calibrator	HEF-H	#KI020 (YQ320)	2	2018.02.25

2.6.3 Reference standard requirement

The errors of the secondary windings shall meet the requirements of accuracy classes 0.2/0.5/3P.

2.6.4 Data

Ambient temperature:8℃ Relative humidity: 60%

Phase A

Secondary windings	Accuracy class	U_{pr} %	Ratio error (%)	Phase displacement (')	Burden(VA) cosφ=0.8			Ratio error (%)	Phase displacement (')	Burden(VA) cosφ=0.8		
					1a 1n	2a 2n	da dn			1a 1n	2a 2n	da dn
1a1n	0.2	80	-0.08	0	100	150	/	+0.14	0	25	0	/
		100	-0.08	0				+0.14	0			
		120	-0.10	+1				+0.10	+1			
2a2n	0.5	80	-0.10	0	100	150	/	+0.10	0	0	37.5	/
		100	-0.15	+2				+0.10	0			
		120	-0.15	+2				+0.10	0			
dadn	3P	2	-0.05	-2	100	150	0	+0.10	0	0	0	0
		5	-0.05	-2				+0.10	0			
		100	-0.10	-2				+0.10	0			
		150	-0.40	0	100	150	150	-0.10	+2	0	0	37.5

Phase B

Secondary windings	Accuracy class	U_{pr} %	Ratio error (%)	Phase displacement (')	Burden(VA) cosφ=0.8			Ratio error (%)	Phase displacement (')	Burden(VA) cosφ=0.8		
					1a 1n	2a 2n	da dn			1a 1n	2a 2n	da dn
1a1n	0.2	80	-0.06	-1	100	150	/	+0.14	0	25	0	/
		100	-0.08	-1				+0.14	0			
		120	-0.10	0				+0.12	+1			
2a2n	0.5	80	-0.10	0	100	150	/	+0.10	0	0	37.5	/
		100	-0.15	+2				+0.10	0			
		120	-0.15	+2				+0.10	+2			
dadn	3P	2	-0.05	-2	100	150	0	-0.10	0	0	0	0
		5	-0.05	-2				+0.10	0			
		100	-0.10	-2				+0.10	0			
		150	-0.40	0	100	150	150	-0.10	+2	0	0	37.5

Phase C

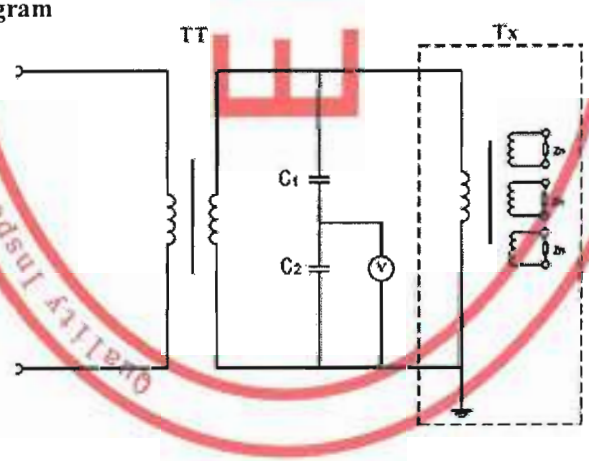
Secondary windings	Accuracy class	U_{pr} %	Ratio error (%)	Phase displacement (')	Burden(VA) cosφ=0.8			Ratio error (%)	Phase displacement (')	Burden(VA) cosφ=0.8		
					1a 1n	2a 2n	da dn			1a 1n	2a 2n	da dn
1a1n	0.2	80	-0.06	-1	100	150	/	+0.14	0	25	0	/
		100	-0.06	0				+0.14	+1			
		120	-0.10	0				+0.10	+1			
2a2n	0.5	80	-0.10	0	100	150	/	+0.10	0	0	37.5	/
		100	-0.15	+2				+0.10	0			
		120	-0.15	+2				+0.10	+2			
dadn	3P	2	-0.05	-2	100	150	0	+0.10	0	0	0	0
		5	-0.05	-2				+0.10	0			
		100	-0.10	-2				+0.10	0			
		150	-0.40	0	100	150	150	-0.10	-2	0	0	37.5

2.6.5 Test result

The test object passed the tests.

2.7 Temperature-rise test

2.7.1 Test circuit diagram



TT: Test transformer T_x: Test object C_1 ,C_2: High voltage divider Zn: Burden

2.7.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	DC bridge	JY44B	#01124972 (YQ210)	0.5	2018.01.18
2	Series resonance measuring system	TRF1200-0.002	#111030 (YQ220)	3	2017.12.17
3	Series resonance testing device	YDGK-1200/3×400	#111023 (SB220)	/	2018.01.25

2.7.3 Reference standard requirement

1) The voltage of $1.0U_{pr}$ is applied on primary windings(phase A, phase B, phase C) with the secondary winding (2a2n) loaded with the thermal limiting burden (2000VA). After every part reaching a steady state, the temperature-rise of windings shall not exceed 75K.

2) The voltage of $1.2U_{pr}$ is applied on primary windings(phase A, phase B, phase C) with the secondary windings loaded with the maximum rated burden .After every part reaching a steady state, the temperature-rise of windings shall not exceed 75K.

3) The voltage of $1.5U_{pr}$ for 30s is applied on primary windings(phase A, phase B, phase C) beginning from the cold condition with the secondary windings loaded with the maximum rated burden, the temperature-rise of windings shall not exceed 10K.

2.7.4 Data

Winding	ANA(kΩ)	1a1n(mΩ)	2a2n(mΩ)	dadn(mΩ)	Ambient temperature(℃)
Resistance at ambient temperature (Phase A)	10.569	34.23	33.45	90.14	9
Winding	BNB(kΩ)	1a1n(mΩ)	2a2n(mΩ)	dadn(mΩ)	
Resistance at ambient temperature (Phase B)	10.586	34.46	34.56	92.15	
Winding	CNC(kΩ)	1a1n(mΩ)	2a2n(mΩ)	dadn(mΩ)	
Resistance at ambient temperature(PhaseC)	10.564	32.95	32.73	88.01	

The temperature-rise are shown as follow:

Winding / Voltage	ANA(K)	1a1n(K)	2a2n(K)	dadn(K)	Ambient temperature(℃)
$1.0U_{pr}$	23	/	26	/	9
$1.2U_{pr}$	11	12	12	/	10
$1.5U_{pr}$	0.6	0.5	0.7	0.4	9
Winding / Voltage	BNB(K)	1a1n(K)	2a2n(K)	dadn(K)	Ambient temperature(℃)
$1.0U_{pr}$	23	/	26	/	9
$1.2U_{pr}$	12	12	13	/	10
$1.5U_{pr}$	0.5	0.7	0.4	0.4	9

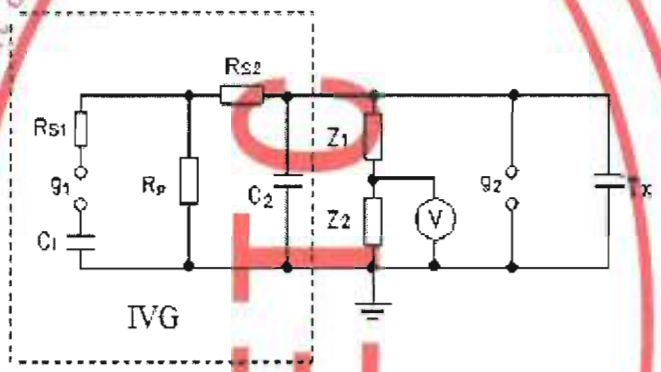
Winding / Voltage	CNC(K)	1a1n(K)	2a2n(K)	dadn(K)	Ambient temperature(℃)
$1.0U_{pr}$	25	/	25	/	9
$1.2U_{pr}$	12	12	14	/	10
$1.5U_{pr}$	0.3	0.4	0.4	0.3	9

2.7.5 Test result

The test object passed the tests.

2.8 Impulse voltage test on primary terminals (Lightning and chopped impulse voltage test on primary terminals)

2.8.1 Test circuit diagram



IVG: Impulse voltage generator Z_1,Z_2 :High voltage divider g_2:Chopped device Tx: Test object

2.8.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Impulse voltage generator	4000kV, 300kJ	#17020001003 (SB202)	/	2018.05.05
2	Impulse voltage measuring system	3000kV	#550264 (YQ212)	3	2017.08.05

2.8.3 Reference standard requirement

The test object shall be subjected to 15 full lighting impulses of positive and negative polarity at 550kV(peak value),2 chopped lighting impulses of negative polarity at 632.5kV(peak value).

No disruptive discharge on non-self restoring insulation shall occur and the number of disruptive discharge shall not exceed two for each series. No evidence of insulation failure shall be detected.

2.8.4 Date

Ambient temperature:10℃ Relative humidity: 59%

Phase A

No.	Voltage polarity	Test voltage (peak)(kV)	Chopped time (μs)	Waveform No.	Result
1	Pos.LI	282	/	1	Pass
2	Pos.LI	550	/	2	Pass

No.	Voltage polarity	Test voltage (peak)(kV)	Chopped time (μs)	Waveform No.	Result
3	Pos.LI	548	/	3	Pass
4	Pos.LI	549	/	4	Pass
5	Pos.LI	550	/	5	Pass
6	Pos.LI	550	/	6	Pass
7	Pos.LI	550	/	7	Pass
8	Pos.LI	550	/	8	Pass
9	Pos.LI	549	/	9	Pass
10	Pos.LI	550	/	10	Pass
11	Pos.LI	549	/	11	Pass
12	Pos.LI	549	/	12	Pass
13	Pos.LI	552	/	13	Pass
14	Pos.LI	549	/	14	Pass
15	Pos.LI	549	/	15	Pass
16	Pos.LI	550	/	16	Pass
17	Neg.LI	281	/	17	Pass
18	Neg.LI	551	/	18	Pass
19	Neg.LI-chopped	432	3.8	19	Pass
20	Neg.LI-chopped	638	3.8	20	Pass
21	Neg.LI-chopped	636	4.1	21	Pass
22	Neg.LI	556	/	22	Pass
23	Neg.LI	553	/	23	Pass
24	Neg.LI	553	/	24	Pass
25	Neg.LI	554	/	25	Pass
26	Neg.LI	553	/	26	Pass
27	Neg.LI	554	/	27	Pass
28	Neg.LI	555	/	28	Pass
29	Neg.LI	553	/	29	Pass
30	Neg.LI	554	/	30	Pass
31	Neg.LI	554	/	31	Pass
32	Neg.LI	554	/	32	Pass
33	Neg.LI	553	/	33	Pass
34	Neg.LI	554	/	34	Pass
35	Neg.LI	554	/	35	Pass

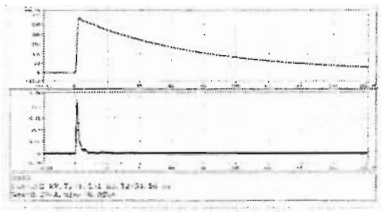
Phase B

No.	Voltage polarity	Test voltage (peak)(kV)	Chopped time (μs)	Waveform No.	Result
1	Pos.LI	284	/	1	Pass
2	Pos.LI	553	/	2	Pass
3	Pos.LI	554	/	3	Pass
4	Pos.LI	552	/	4	Pass
5	Pos.LI	552	/	5	Pass
6	Pos.LI	553	/	6	Pass
7	Pos.LI	553	/	7	Pass
8	Pos.LI	552	/	8	Pass
9	Pos.LI	554	/	9	Pass
10	Pos.LI	552	/	10	Pass
11	Pos.LI	553	/	11	Pass
12	Pos.LI	552	/	12	Pass
13	Pos.LI	553	/	13	Pass
14	Pos.LI	553	/	14	Pass
15	Pos.LI	553	/	15	Pass
16	Pos.LI	553	/	16	Pass
17	Neg.LI	284	/	17	Pass
18	Neg.LI	553	/	18	Pass
19	Neg.LI-chopped	384	4.2	19	Pass
20	Neg.LI-chopped	639	3.7	20	Pass
21	Neg.LI-chopped	639	3.8	21	Pass
22	Neg.LI	555	/	22	Pass
23	Neg.LI	556	/	23	Pass
24	Neg.LI	555	/	24	Pass
25	Neg.LI	548	/	25	Pass
26	Neg.LI	556	/	26	Pass
27	Neg.LI	555	/	27	Pass
28	Neg.LI	555	/	28	Pass
29	Neg.LI	539	/	29	Pass
30	Neg.LI	554	/	30	Pass
31	Neg.LI	554	/	31	Pass
32	Neg.LI	554	/	32	Pass
33	Neg.LI	553	/	33	Pass
34	Neg.LI	553	/	34	Pass
35	Neg.LI	553	/	35	Pass

Phase C

No.	Voltage polarity	Test voltage (peak)(kV)	Chopped time (μs)	Waveform No.	Result
1	Pos.LI	284	/	1	Pass
2	Pos.LI	552	/	2	Pass
3	Pos.LI	551	/	3	Pass
4	Pos.LI	552	/	4	Pass
5	Pos.LI	551	/	5	Pass
6	Pos.LI	550	/	6	Pass
7	Pos.LI	550	/	7	Pass
8	Pos.LI	550	/	8	Pass
9	Pos.LI	550	/	9	Pass
10	Pos.LI	549	/	10	Pass
11	Pos.LI	551	/	11	Pass
12	Pos.LI	550	/	12	Pass
13	Pos.LI	549	/	13	Pass
14	Pos.LI	550	/	14	Pass
15	Pos.LI	550	/	15	Pass
16	Pos.LI	551	/	16	Pass
17	Neg.LI	282	/	17	Pass
18	Neg.LI	552	/	18	Pass
19	Neg.LI-chopped	382	3.7	19	Pass
20	Neg.LI-chopped	637	3.8	20	Pass
21	Neg.LI-chopped	638	3.8	21	Pass
22	Neg.LI	551	/	22	Pass
23	Neg.LI	551	/	23	Pass
24	Neg.LI	551	/	24	Pass
25	Neg.LI	551	/	25	Pass
26	Neg.LI	552	/	26	Pass
27	Neg.LI	551	/	27	Pass
28	Neg.LI	552	/	28	Pass
29	Neg.LI	551	/	29	Pass
30	Neg.LI	553	/	30	Pass
31	Neg.LI	550	/	31	Pass
32	Neg.LI	550	/	32	Pass
33	Neg.LI	552	/	33	Pass
34	Neg.LI	552	/	34	Pass
35	Neg.LI	550	/	35	Pass

Waveform
Phase A



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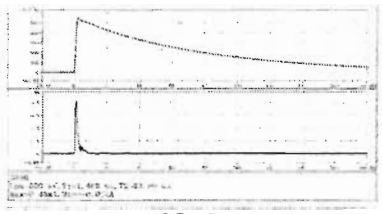

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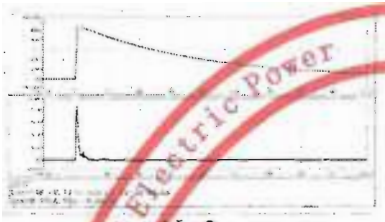

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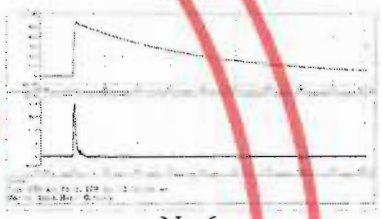

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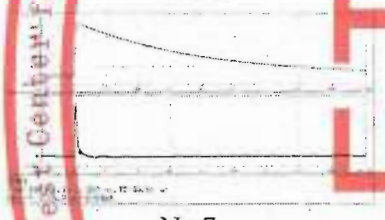

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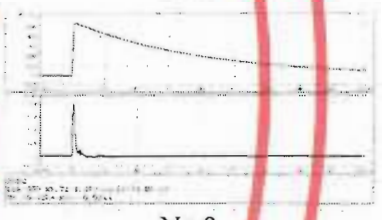

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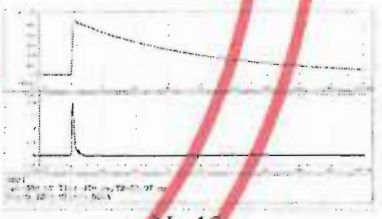

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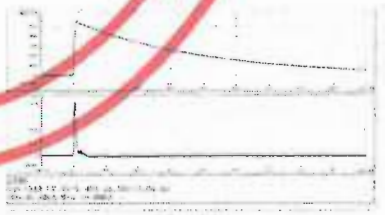

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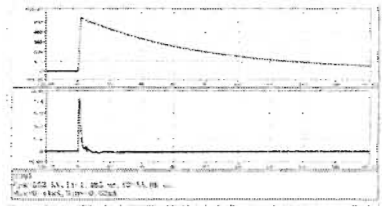

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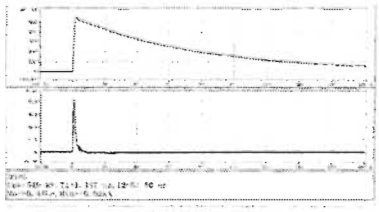

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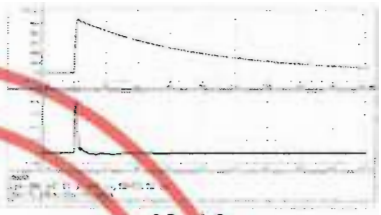

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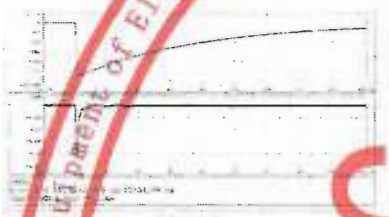

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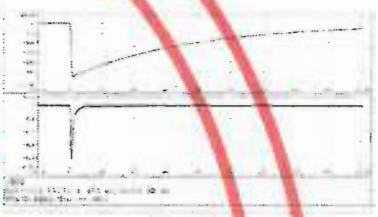

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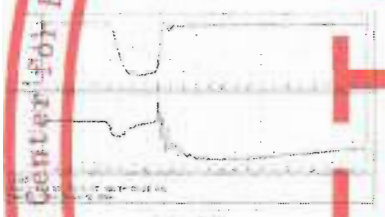

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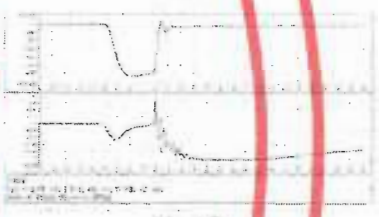

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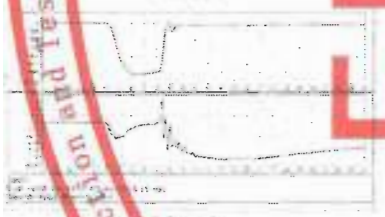

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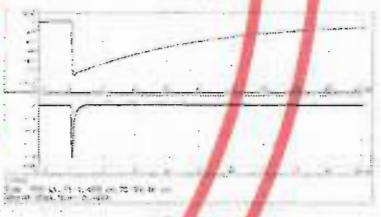

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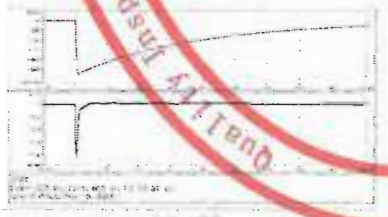

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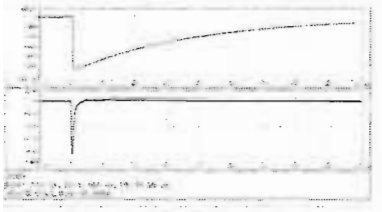

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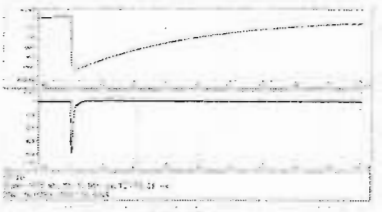

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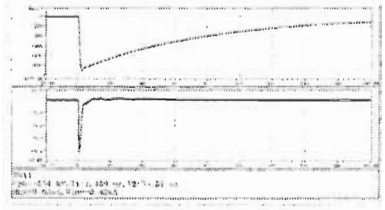

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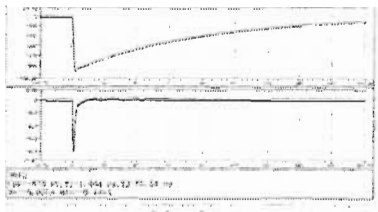

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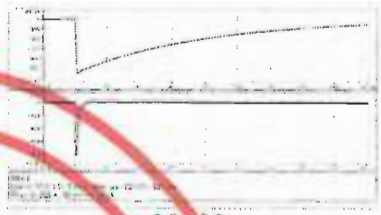

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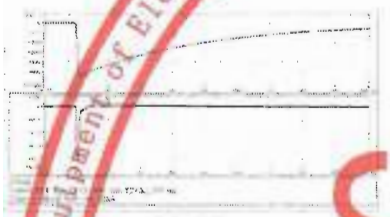

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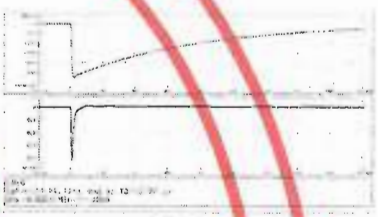

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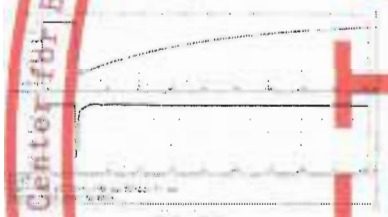

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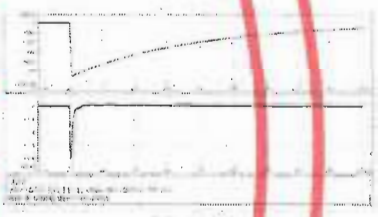

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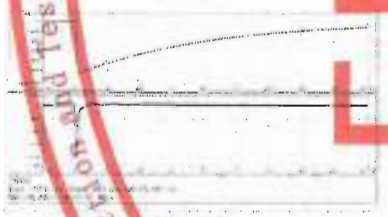

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Phase B

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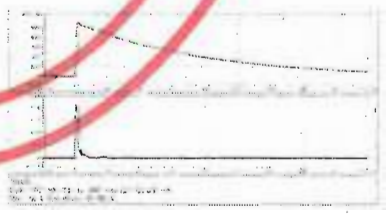

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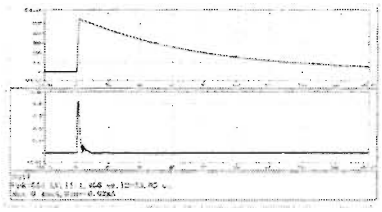

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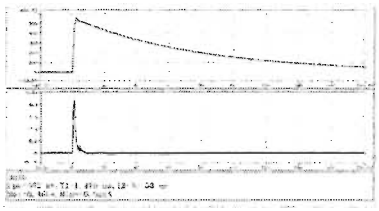

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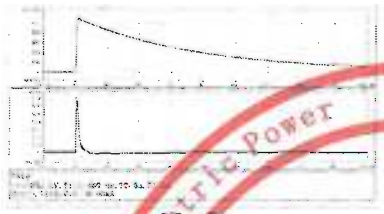

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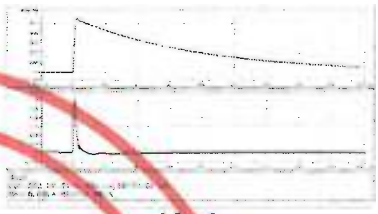

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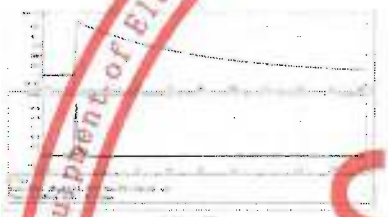

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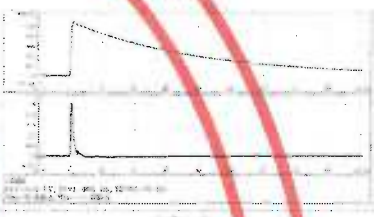

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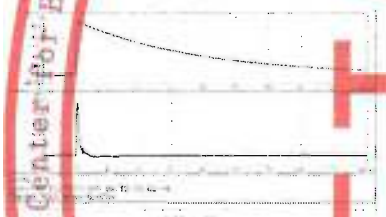

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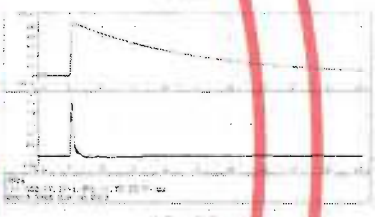

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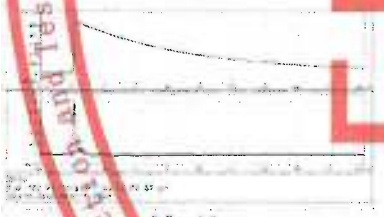

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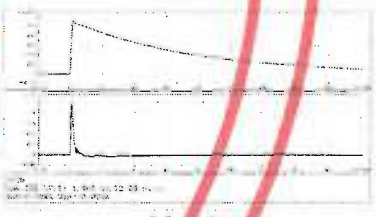

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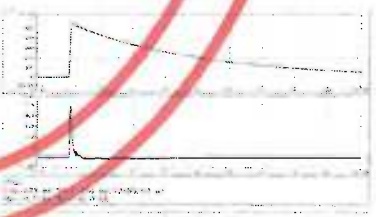

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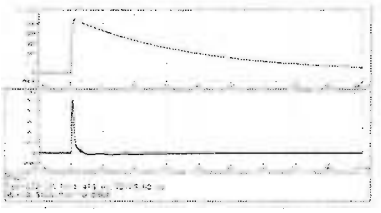

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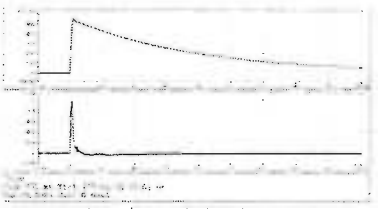

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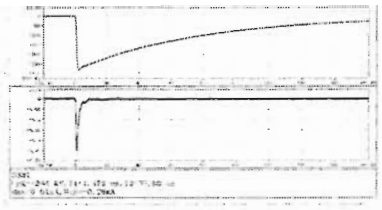

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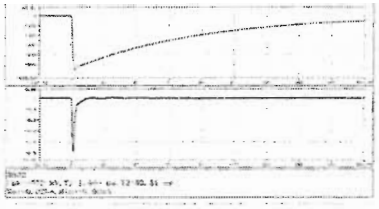

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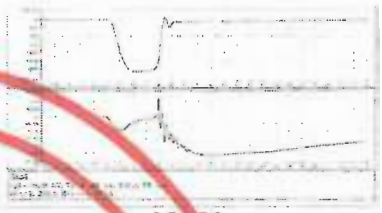

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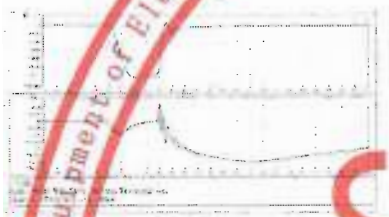

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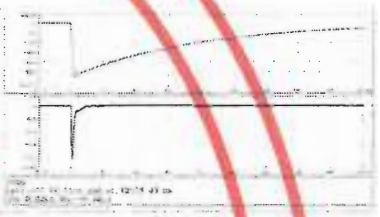

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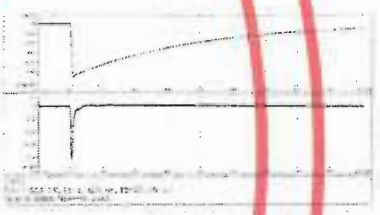

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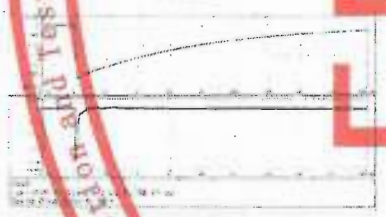

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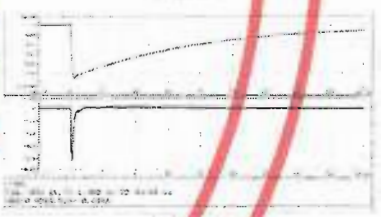

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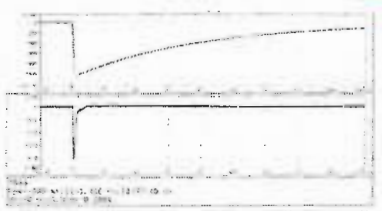

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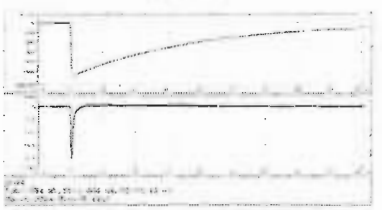

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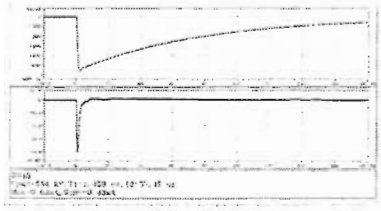

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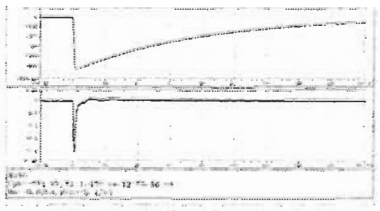

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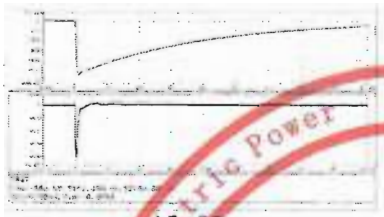

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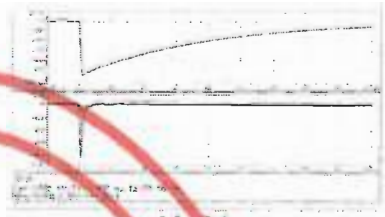

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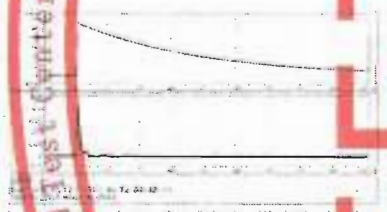
Phase C



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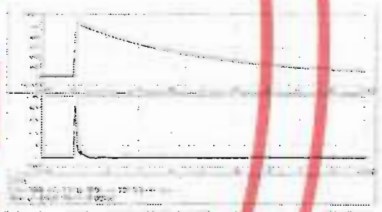

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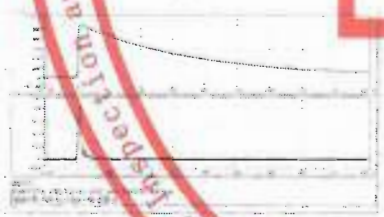

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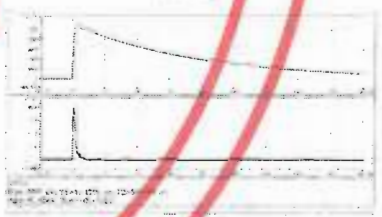

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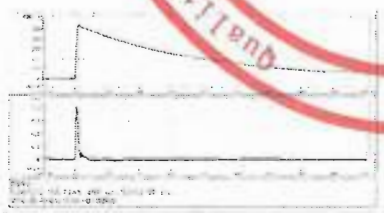

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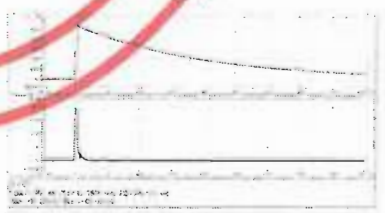

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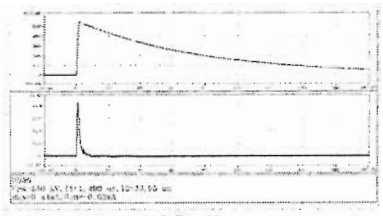

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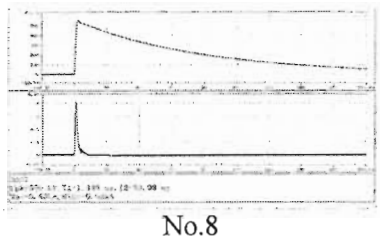

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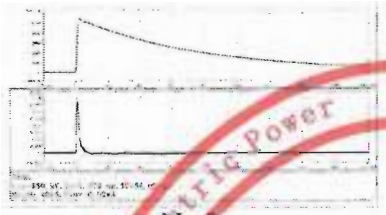

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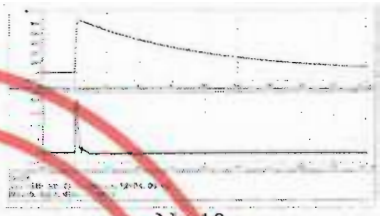

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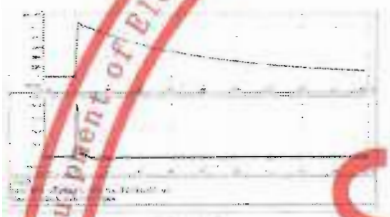

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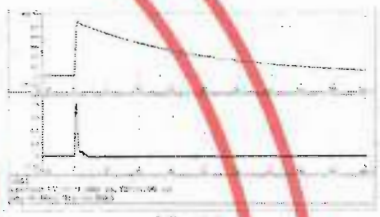

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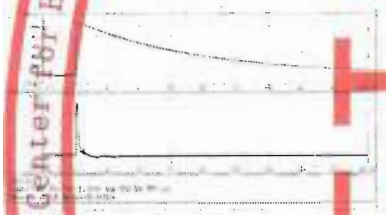

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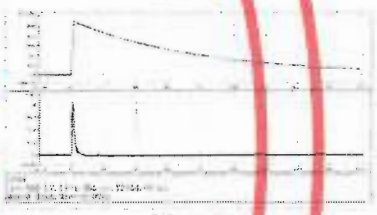

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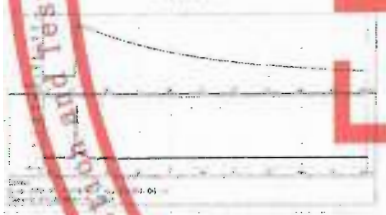

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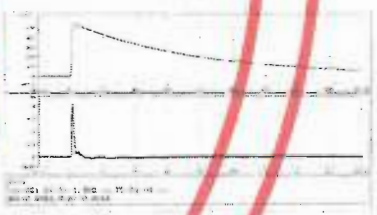

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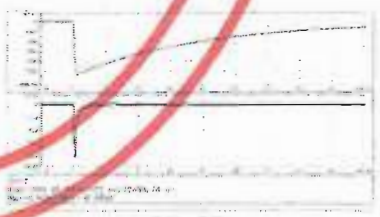

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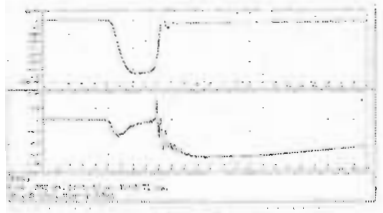

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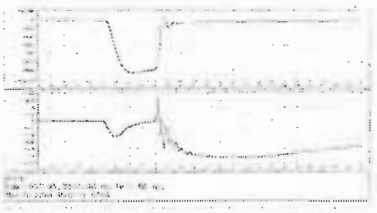

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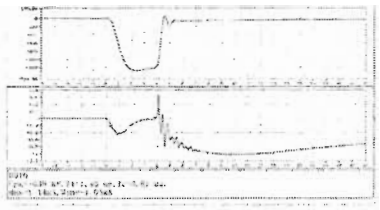

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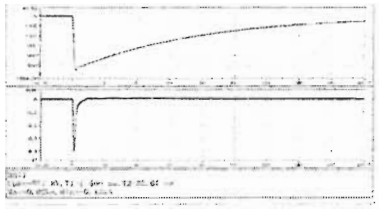

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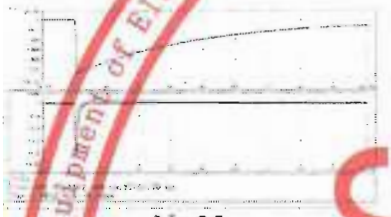

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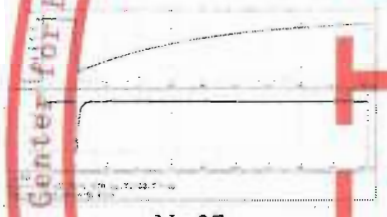

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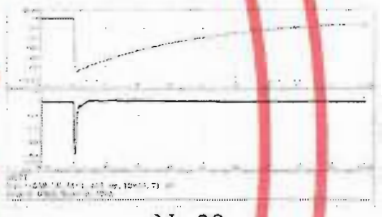

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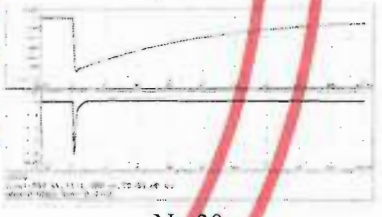

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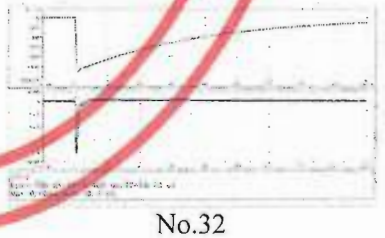

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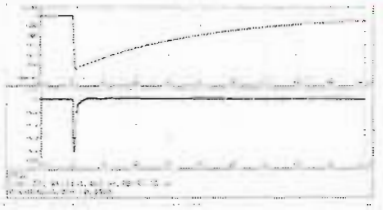

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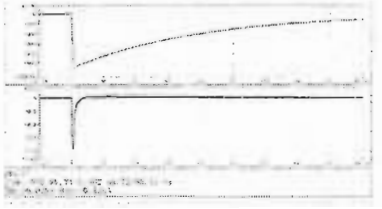

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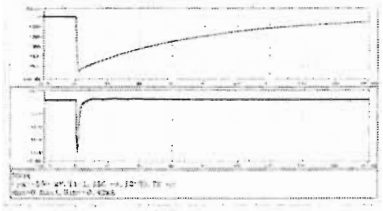


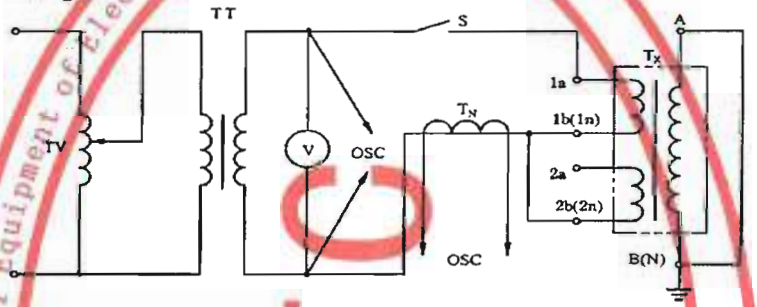
No.35

2.8.5 Test result

The test object passed the tests.

2.9 Short circuit withstand capability test

2.9.1 Test circuit diagram



TV: Voltage regulator TT: Test transformer OSC:Oscillograph TA: Measuring current transformer Tx:Test object

2.9.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Measuring current transformer	HL-43A	#16006 (YQ422)	0.2	2018.02.21
2	Test transformer	SYG-1050/0.4	#99012078 (SB345)	/	2018.05.05
3	Oscilloscope	DPO3014B	#C012465 (YQ405)	±3%	2017.03.24

2.9.3 Reference standard requirement

The rated voltage 57.7V is applied on secondary winding for 1.0s with primary winding connected to earth. There shall be no electrical and mechanical damage.

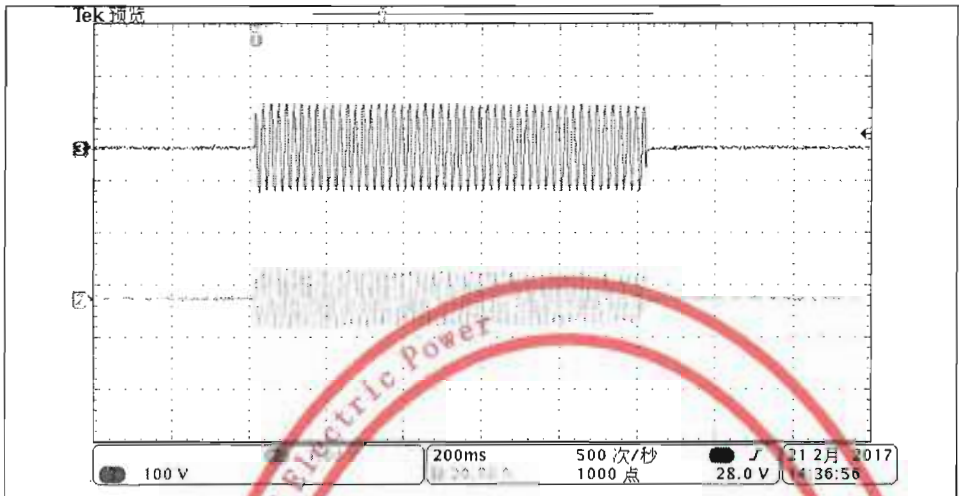
2.9.4 Data

Ambient temperature: 9℃ Relative humidity: 63%

Secondary winding	Secondary voltage (V)	Secondary short-circuit current (A)	Duration (s)
PhaseA 1a1n	57.9	1273	1.01
PhaseB 1a1n	58.3	1202	1.01
PhaseC 1a1n	57.7	1285	1.01

Note: The primary winding is of copper , and the calculated current density is47A/mm^2. The secondary winding is of copper, and the calculated current density is 135A/mm^2.

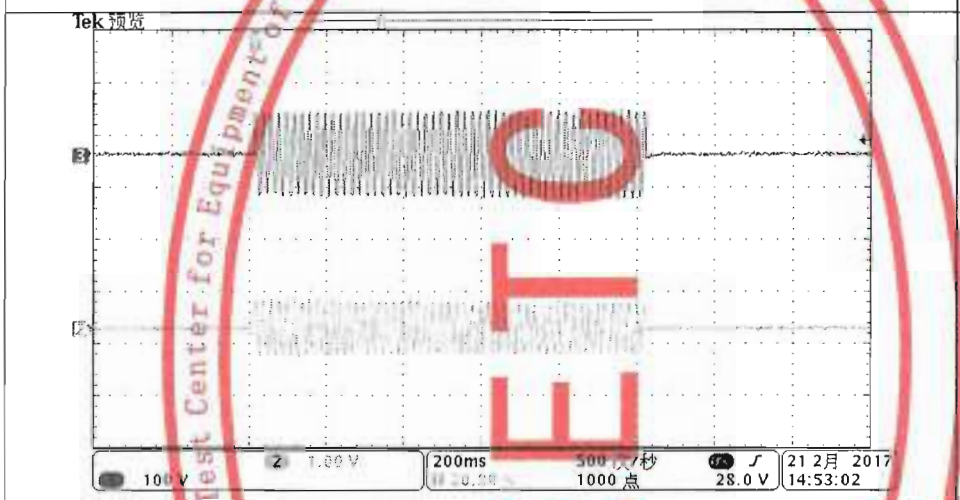
Waveform of short-circuit test



U

$I(R_0=0.12\Omega)$

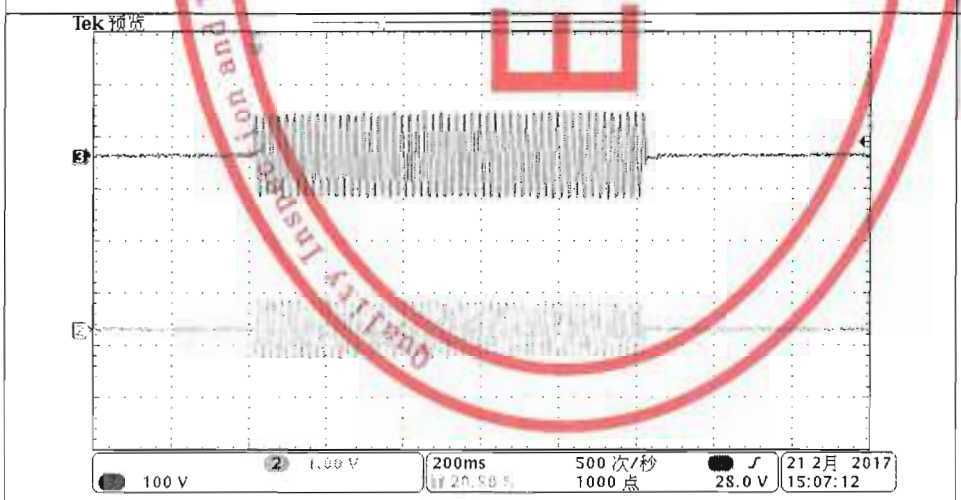
Phase A



U

$I(R_0=0.12\Omega)$

Phase B



U

$I(R_0=0.12\Omega)$

Phase C

U: Secondary voltage I: Secondary current

2.9.5 Test result

The test object was in good conditions before and after this test, no electrical and mechanical damage. The test object passed the tests.

2.10 Power-frequency voltage withstand tests on secondary terminals (retrial)

2.10.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Equipment for secondary voltage withstand tests	HZSY-S	#6120611 (SB210)	3	2018.10.07

2.10.2 Reference standard requirement

The test voltage of 2.7kV(50Hz) shall be applied for 60s between the short-circuited terminals of each winding and earth in turn. No flashover and breakdown occur.

2.10.3 Data

The test voltage of 2.7kV(50Hz) was applied for 60s between the short-circuited terminals of each winding and earth in turn. No flashover and breakdown occurred.

2.10.4 Test result

The test object passed the tests.

2.11 Power-frequency voltage withstand tests on primary terminals (retrial)

2.11.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Series resonance measuring system	TRF1200-0.002	#111030 (YQ220)	3	2017.12.17
2	Series resonance testing device	YDGK-120/3×400	#111023 (SB220)	/	2018.01.25
3	Equipment for secondary voltage withstand tests	HZSY-S	#6120611 (SB210)	3	2018.10.07

2.11.2 Reference standard requirement

The induced voltage of 207kV (150Hz) shall be applied between primary winding and earth for 40s. No flashover and breakdown occur.

The test voltage of 4.5kV(50Hz) shall be applied between earthed terminal of primary winding and earth for 60s. No flashover and breakdown occur.

2.11.3 Data

Ambient temperature:19 ℃ Relative humidity:54%

The induced voltage of 207kV (150Hz) was applied between primary winding and earth for 40s. No flashover and breakdown occurred.

The test voltage of 4.5kV(50Hz) was applied between earthed terminal of primary winding and earth for 60s. No flashover and breakdown occurred.

2.11.4 Test result

The test object passed the tests.

2.12 Partial discharge measurement (retrial)

2.12.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Partial discharge detector	JFD-251	#N1002 (YQ380)	10	2017.11.15
2	Series resonance measuring system	TRF1200-0.002	#111030 (YQ220)	3	2017.12.17
3	Series resonance testing device	YDGK-1200/3×400	#111023 (SB220)	/	2018.01.25

2.12.2 Reference standard requirement

Pre-stress voltage: 207kV, Test frequency: 150Hz
Test voltage: 126kV, Maximum permissible PD level: 10pC
Test voltage: 87.3kV, Maximum permissible PD level: 5pC

2.12.3 Data

Ambient temperature:19℃ Relative humidity:54%

Test frequency (Hz)	150	Pre-stress voltage (kV)	207	
Test voltage (kV)	126	PD level (pC)	Phase A	6
			Phase B	6
			Phase C	6
Test voltage (kV)	87.5	PD level (pC)	Phase A	3
			Phase B	3
			Phase C	3

2.12.4 Test result

The test object passed the tests.

2.13 Measurement of excitation characteristic (retrial)

2.13.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	V-A characteristic tester	ZZFA-IV	#10088 (YQ408)	0.2	2018.01.03

2.13.2 Reference standard requirement

Exciting current shall be measured at rated secondary voltage.

2.13.3 Data

Ambient temperature:19℃ Relative humidity:54%

Percentage of rated secondary voltage(%)		100
Test voltage（V）		57.9
Phase A 1a1n	No-load current (A)	3.19
	No-load loss (W)	39.0

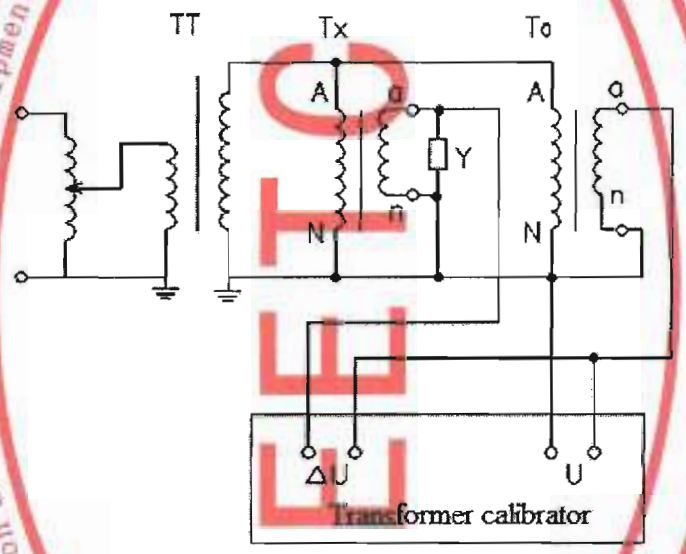
Test voltage（V）		58.0
Phase B 1a1n	No-load current (A)	3.12
	No-load loss (W)	39.2
Test voltage（V）		57.9
Phase C 1a1n	No-load current (A)	3.06
	No-load loss (W)	39.0

2.13.4 Test result

The test object was in good conditions before and after this test.

2.14 Tests for accuracy (retrial)

2.14.1 Test circuit diagram



TT: Test transformer Tx: Test object T_0: Standard voltage transformer Y:Burden

2.14.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Standard voltage transformer	HJ-220	#03002 (YQ369)	0.02	2018.10.26
2	Transformer calibrator	HEF-H	#KI020 (YQ320)	2	2018.02.25

2.14.3 Reference standard requirement

The errors of secondary winding (1a1n) shall meet the requirements of the accuracy class 0.2.

2.16.3 Data

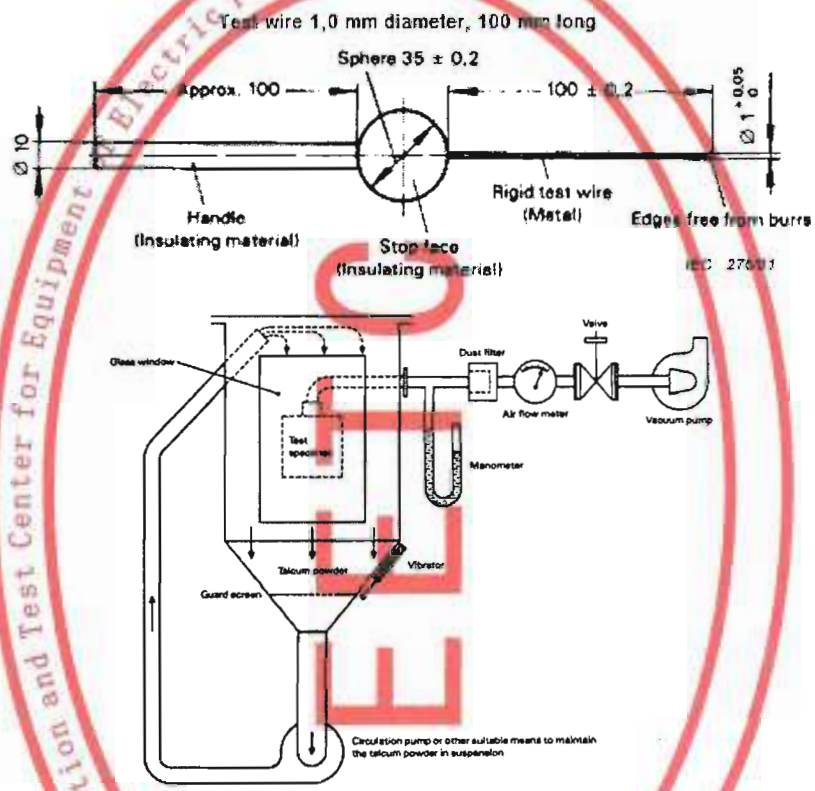
Dew-point at ambient temperature (℃)	Dew-point at 20℃ (℃)	The water content of SF_6 (20℃) μL/L
-50.4	-49.1	43

2.16.4 Test result

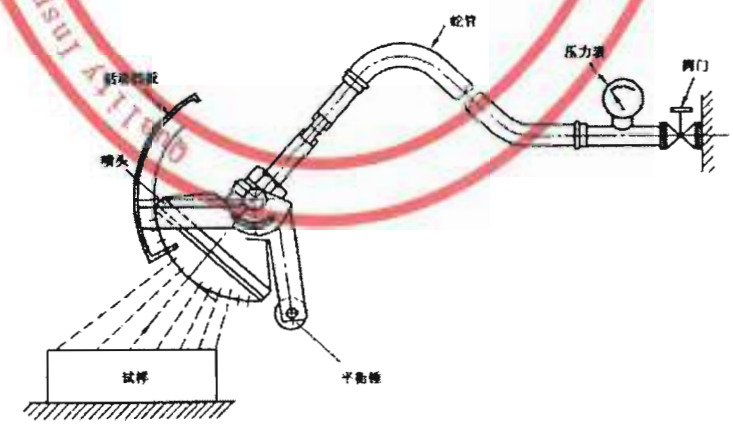
The test object passed the tests.

2.17 Verification of the degree of protection by enclosures

2.17.1 Test circuit diagram



Schematic diagram of IP5X



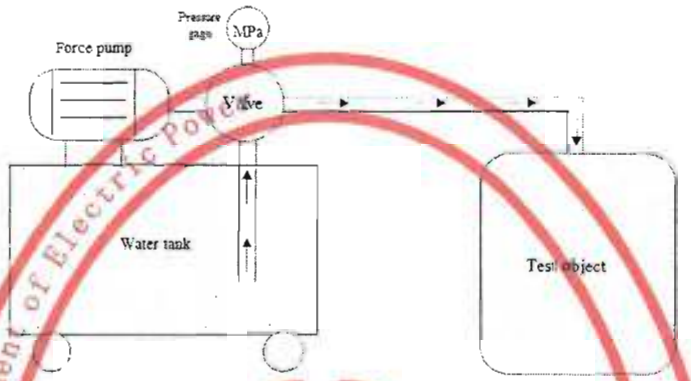
Schematic diagram of IPX4

2.17.5 Test result

The test object passed the tests.

2.18 Pressure test for the enclosure

2.18.1 Test circuit diagram



2.18.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Water pump for the test	4DSY-100/10	#201505012 (SB388)	/	2017.05.25
2	Pressure gage	YB-150A	#YA05038794 (BJ353	0.4	2017.07.13

2.18.3 Reference standard requirement

Welded aluminum enclosure shall withstand （2.3/v ）×σ_t/σ_a× “design pressure” for 1 min, no broken or permanent deformation.

2.18.4 Data

Ambient temperature:27℃ Relative humidity :63%

Welding coefficient v	Permissible design stress at test temperature σ_t （MPa）	Permissible design stress at design temperature σ_a （MPa）	Design pressure （MPa）
0.75	65	65	0.60

Texture	Test pressure （MPa）	Duration （min）
Welded aluminum enclosure	1.84	1

2.18.5 Test result

The test object passed the tests.