电力工业电气设备质量检验测试中心

Quality Inspection and Test Center
for Equipment of Electric Power

CMA 2011000711D　ilac-MRA　CNAS 检 测 CNAS L1026

（2013）检字　　JHG545 号

检 测 报 告

Inspection Report

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Quality Inspection and Test Center for Equipment of Electric Power
Inspection Report

2013JH6545

1.Client

Guangdong Sihui Instrument Transformer Works Co Ltd.

2.Description of Sample

Name of test sample: Voltage transformer
Type : JSQXF-252
Sample NO.: V1308220001
Manufacturer: Guangdong Sihui Instrument Transformer Works Co Ltd.
Date of Manufacture: July-2013
Sampling way: offer by client

3.Inspection Standards/References

GB 1207—2006 Voltage transformers
DL/T 726—2000 Specification of voltage transformer for electrical power for order
IEC 60044—2: 2003 Instrument transformers-Part 2: Voltage transformers

4.Category of Inspection

Routine Test /Type Test

5.Inspection Dates:

2013－08－13～2013－08－22

6.Conclusion:

Voltage transformer with the type of JSQXF-252 offered by Guangdong Sihui Instrument Transformer Works Co Ltd. meets the requirements of the corresponding items of the standards GB1207-2006, etc.

7.Valid time : 5 years

Note: This English report is written at request of the client. In the event of any difference in meanings of the text, the Chinese report shall take precedence over the English version.

Inspected by:

Checked by:

Examined and verified by:

Approved by:

Date: 2013-09-22

8.Testing Item and Conclusion

No.	Item	Reference standard	Test result	Conclusion
1	Inspection semblance and verification of terminal markings	The nameplate, sign, earthing terminal, terminal marking shall meet the requirements.	OK	Pass
2	Power-frequency withstand test on secondary windings	Applied voltage on winding-to-winding and winding-to-earth shall be 3kV/50Hz/1min	Test voltage 3kV/50Hz/1min No puncture occurs.	Pass
3	Power frequency withstand test on earthed terminal of primary winding	Applied voltage between earthed terminal of primary winding and earth shall be 5kV/50Hz /1min	Test voltage 5kV/50Hz/1min No puncture occurs.	Pass
4	Power-frequency withstand test on primary windings	Applied voltage on every primary winding to secondary windings and earth shall be 460kV/150Hz/40 s	Test voltage: 460kV/150Hz/40s No puncture occurs. Note: The object is a voltage transformer for GIS. No atmosphere correction needed. Ambient temperature: 29℃ Relative humidity : 50% Atmosphere pressure : 101.2kPa	Pass
5	Partial discharge measurement	Testing frequency 150 Hz Pre-stress voltage 460 kV Test voltage 302 kV PD ≤ 5 pC	Testing frequency 150 Hz Pre-stress voltage 460 kV Test voltage 302 kV PD Phase A 4 pC Phase B 4 pC Phase C 4 pC Background PD 1.8 pC Ambient temperature 29℃ Relative humidity 50 %	Pass
6	Measurement of Excitation	Providing the test data	Details in appendix No. C	Pass
7	Determination of errors	The errors of the second windings should meet the requirement of classes0.2/3P/3P.	The errors of secondary winding are measured at rated frequency and rated power factor within rated burden. Details in appendix No. D	Pass
8	Measurement of DC resistances of secondary windings	Providing the test data	Phase A AN: 36.53 kΩ 1a1n: 36.45 mΩ 2a2n: 35.20 mΩ dadn: 76.67 mΩ Phase B AN: 35.81 kΩ 1a1n: 36.39 mΩ 2a2n: 35.58 mΩ dadn: 77.44 mΩ Phase C AN: 36.10 kΩ 1a1n: 37.60 mΩ 2a2n: 36.82 mΩ dadn: 78.00 mΩ Ambient temperature 27 ℃	——

No.	Item	Reference standard	Test result	Conclusion
9	Temperature rise test	The temperature rise of windings cannot exceed 75K under the voltage of 1.0Un.	Rated primary voltage on phase A,B,C, the transformer should be tested with 1a1n connect to a burden corresponding to the thermal limiting output (1000VA) at a unity power factor without loading the residual voltage winding, the values of temperature rise are shown as follows. Phase A AN: 17 K 1a1n: 29 K 2a2n: 29 K Phase B AN: 17 K 1a1n: 29 K 2a2n: 29 K Phase C AN: 17 K 1a1n: 30 K 2a2n: 29 K Ambient temperature 27 ℃	
		The temperature rise of windings cannot exceed 75K under the voltage of 1.2Un.	Under the voltage of 1.2Un and rated burden on phase A,B,C, the values of temperature rise are shown as follows. Phase A AN: 4 K 1a1n: 5 K 2a2n: 6 K Phase B AN: 4 K 1a1n: 5 K 2a2n: 5 K Phase C AN: 4 K 1a1n: 5 K 2a2n: 5 K Ambient temperature 27℃	Pass
		The temperature rise of windings cannot exceed 10K under the voltage of 1.5Un 30s (beginning from the normality).	The voltage of 1.5Un is applied to primary winding on phase A,B,C for 30s beginning from the normality when the secondary windings load rated burden. After every part reaching a steady state, the values of temperature rise are shown as follows. Phase A AN: 0.4 K 1a1n: 0.5 K 2a2n: 0.5 K dadn: 0.6 K Phase B AN: 0.4 K 1a1n: 0.5 K 2a2n: 0.5 K dadn: 0.6 K Phase C AN: 0.4 K 1a1n: 0.5 K 2a2n: 0.5 K dadn: 0.6 K Ambient temperature 27 ℃ Details in appendix No.E.	

No.	Item	Reference standard	Test result	Conclusion
10	Lightning impulse test and chopped lighting impulse test	Applied voltage on primary winding to secondary windings and earth shall be Standard LI: 1050kV waveform : 1.2/50μs positive impulses : 15 times negative impulses : 15 times Standard LI-chopped: 220kV waveform: (2~5)μs negative impulses: 2 times	Fifteen consecutive LI in positive and negative polarities and two LI-chopped in negative polarity were applied at primary terminal. Details in appendix No.F. No puncture occurs.	Pass
11	Short-circuit withstand capability test	The rated voltage 57.7V is applied to secondary windings for 1.0s when primary winding is connected with the ground. There shall be no electrical and mechanical damage	Phase A 1a1n Secondary voltage: 57.8 V Secondary current: 1082 A Phase B 1a1n Secondary voltage: 57.7 V Secondary current: 1082 A Phase C 1a1n Secondary voltage: 57.7 V Secondary current: 1061 A Durative time: 1.05 s Waveform in appendix No. G There is no electrical and mechanical damage. Note The windings are copper and the current density in the windings is 18.2A/mm^2. The second windings are copper and the current density in the windings is 120A/mm^2.	Pass
12	Power-frequency withstand test on secondary windings(retrial)	Applied voltage on winding-to-winding and winding-to-earth shall be 3kV/50Hz/1min.	Winding-to-winding and winding-to-earth Test voltage: 3kV/50Hz/1min No puncture occurs.	Pass
13	Power frequency withstand test on earthed terminal of primary winding(retrial)	Applied voltage between earthed terminal of primary winding and earth shall be 5kV/50Hz /1min	Test voltage 5kV/50Hz/1min No puncture occurs.	Pass
14	Power-frequency withstand test on primary windings (retrial)	Applied voltage on primary winding to secondary windings and earth shall be 414kV/150Hz/40s	Test voltage: 414kV/150Hz/40s No puncture occurs.	Pass
15	Partial discharge measurement (retrial)	Testing frequency 150 Hz Pre-stress voltage 414 kV Test voltage 302 kV PD ≤ 5 pC	Testing frequency 150 Hz Pre-stress voltage 414 kV Test voltage 302 kV PD Phase A 4 pC Phase B 4 pC Phase C 4 pC Background PD 1.9 pC Ambient temperature 32 ℃ Relative humidity 60 %	Pass

No.	Item	Reference standard	Test result	Conclusion
16	Measurement of Excitation (retrial)	Providing the test data	Magnetizing current at rated voltage Phase A 9.01 A Phase B 8.99 A Phase C 8.81 A	——
17	Determination of errors (retrial)	The errors of the second windings shall meet the requirement of class 0.2	Details in appendix No.H	Pass
18	Transmitted overvoltage measurement	A low-voltage impulse（T1=10ns ±20%，T2≥100ns） shall be apllied between one of the primary terminals and earth，the value of the transmitted overvoltage does not exceed 1.6kV.	the value of the transmitted overvoltage 1196V~1397V， Details in appendix No. I	Pass
19	The gas seal test	The relative ratio of gas giving off in one year should not exceed 0.5% at the rated pressure of 0.55MPa.	The relative ratio of gas giving off in one year doesn't exceed 0.1%	Pass
20	Measurement of the water contained in gas	The water contained in gas shall be less than 150μL/L	The water contained in gas is 62μL/L	Pass
21	Short time power frequency withstand test on primary winding in the case of no displayed pressure	In the case of no displayed pressure, The test voltage (190kV) shall be applied between the terminal of the primary wind and earth for 5min.The terminals of the secondary windings shall be connected to earth..	In the case of no displayed pressure Test voltage 190kV/5min No disruptive discharge occurs	Pass
22	Inspection of core	Clear, no displacement, no distortion. The sizes should accord with the requirements of design.	OK Photographs in appendix No.K	Pass

Note 1. Main test circuits，Details in appendix No. J.

2. The tests of 1～18items were performed in the pressure of 0.5MPa . The tests of 19, 20 items were performed in the rated pressure of 0.55MPa.

3. The object is a three-phase community voltage transformer for GIS, the photograph of semblance in appendix No. K.

Appendix No.A Main characteristic Parameters of the Sample

Description: Voltage transformer
Sample No.: V1308220001
Type: JSQXF-252
Highest voltage for equipment: 252kV
Rated voltage: $220/\sqrt{3}$ kV
Rated frequency: 50 Hz
Rated transformation ratio: $220/\sqrt{3}$ / $0.1/\sqrt{3}$ / $0.1/\sqrt{3}$ / 0.1kV
Rated insulation level : 252/460/1050kV
Thermal limiting output: 3×2×1000VA（Phase A,B,C in 1a1n ,2a2n with 1000 VA burden）
Date of Manufacture: July-2013

Secondary windings(A) / Accuracy class		1a1n / 0.2	2a2n / 3P	dadn / 3P
Rated burden(VA) / Power factor=0.8	1a1n	2.5～100	100	100
	2a2n	150	150	150
	dadn	/	300	300

Secondary windings(B) / Accuracy class		1a1n / 0.2	2a2n / 3P	dadn / 3P
Rated burden(VA) / Power factor=0.8	1a1n	2.5～100	100	100
	2a2n	150	150	150
	dadn	/	/	300

Secondary windings(C) / Accuracy class		1a1n / 0.2	2a2n / 3P	dadn / 3P
Rated burden(VA) / Power factor=0.8	1a1n	2.5～100	100	100
	2a2n	150	150	150
	dadn	/	300	300

Appendix No.B Parameters of the main equipment

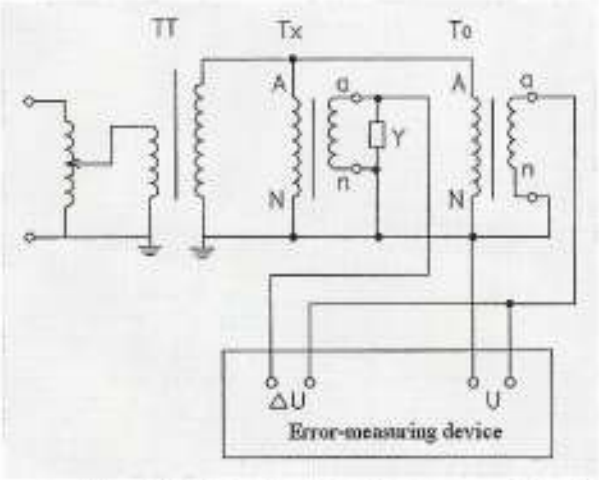
No.	Description/Type	Serial No.	Technical parameter	Accuracy class or uncertainty	Calibration institution	Valid date
1	Voltage transformer for measuring service HJ-220	#12006 (YQ367)	(110/$\sqrt{3}$ -220/$\sqrt{3}$)kV	0.02	National center for high voltage measurement	2014.10.29
2	Instrument transformer test set HEF-H	#KI020 (YQ320)	100、100/$\sqrt{3}$ V	2	National center for high voltage measurement	2013.12.04
3	Current transformer for measuring service HL-61C	#3089 （YQ608）	(5~5000)/5、1A	0.01	National center for high voltage measurement	2014.07.04
4	Partial discharge detector JFD-251	#20051112 (YQ381)	(0.5~2000)pC	10	N National center for high voltage measurement	2014.08.29
5	Impulse voltage generator	#17020001003 (SB202)	4000kV,300kJ	/	Quality inspection and testing station for instrument transformers	2014.05.08

Appendix No.C Measurement of Excitation

Percentage of rated secondary voltage(%)		20	50	80	100	120	150
No-load secondary current (A)	A laln	1.85	4.55	7.20	9.00	10.60	10.41
No-load loss （W）		/	/	/	50	/	/
No-load secondary current (A)	B laln	1.85	4.56	7.20	9.00	10.61	10.40
No-load loss （W）		/	/	/	50	/	/
No-load secondary current (A)	C laln	1.85	4.55	7.21	8.80	1061	10.60
No-load loss （W）		/	/	/	48	/	/
Ambient temperature		29℃		Relative humidity		50%	

Appendix No.D Determination of errors

1. Test circuits



TT: Testing transformer Tx: Object voltage transformer T_0: standard voltage transformer

2. Test result

Secondary windings	Accuracy class	Error	Percentage of rated current(phase A)			Burden (VA/cos φ)	
			80	100	120	1a1n	2a2n
1a1n	0.2	Ratio error (%)	-0.12	-0.12	-0.14	100 / 0.8	150 / 0.8
		Phase displacement(')	-3	-3	-3		
		Ratio error (%)	+0.16	+0.16	+0.14	2.5 / 0.8	0
		Phase displacement(')	0	0	0		

Secondary windings	Accuracy class	Error	Percentage of rated current(phase A)			Burden (VA/cos φ)		
			2	5	100	1a1n	2a2n	dadn
2a2n	3P	Ratio error (%)	-0.14	-0.14	-0.16	100 / 0.8	150 / 0.8	0
		Phase displacement(')	-2	-2	-2			
		Ratio error (%)	+0.14	+0.14	+0.14	0	37.5 / 0.8	0
		Phase displacement(')	+1	+1	+1			

Secondary windings	Accuracy class	Error	Percentage of rated current(phase A)	Burden (VA/cos φ)		
			150	1a1n	2a2n	dadn
2a2n	3P	Ratio error (%)	-0.26	100 / 0.8	150 / 0.8	300 / 0.8
		Phase displacement(')	-1			
		Ratio error (%)	+0.04	0	37.5 / 0.8	0
		Phase displacement(')	+1			

Secondary windings	Accuracy class	Error	Percentage of rated current(phase A)			Burden (VA/cos φ)		
			2	5	100	1a1n	2a2n	dadn
dadn	3P	Ratio error (%)	-0.44	-0.44	-0.46	100 / 0.8	150 / 0.8	0
		Phase displacement(')	-5	-5	-5			
		Ratio error (%)	-0.24	-0.24	-0.26	0	0	0
		Phase displacement(')	+1	+1	+1			

Secondary windings	Accuracy class	Error	Percentage of rated current(phase A)	Burden (VA/cos φ)		
			150	1a1n	2a2n	dadn
dadn	3P	Ratio error (%)	-1.00	100 / 0.8	150 / 0.8	300 / 0.8
		Phase displacement(')	-6			
		Ratio error (%)	-0.46	0	0	75 / 0.8
		Phase displacement(')	+1			

Secondary windings	Accuracy class	Error	Percentage of rated current(phase B)			Burden (VA/cos φ)	
			80	100	120	1a1n	2a2n
1a1n	0.2	Ratio error (%)	-0.12	-0.12	-0.14	100 / 0.8	150 / 0.8
		Phase displacement(')	-3	-3	-3		
		Ratio error (%)	+0.16	+0.16	+0.14	2.5 / 0.8	0
		Phase displacement(')	0	0	0		

Secondary windings	Accuracy class	Error	Percentage of rated current(phase B)			Burden (VA/cos φ)		
			2	5	100	1a1n	2a2n	dadn
2a2n	3P	Ratio error (%)	-0.14	-0.14	-0.16	100 / 0.8	150 / 0.8	0
		Phase displacement(')	-2	-3	-3			
		Ratio error (%)	+0.14	+0.14	+0.14	0	37.5 / 0.8	0
		Phase displacement(')	+2	+2	+2			

Secondary windings	Accuracy class	Error	Percentage of rated current(phase B)	Burden (VA/cos φ)		
			150	1a1n	2a2n	dadn
2a2n	3P	Ratio error (%)	-0.24	100 / 0.8	150 / 0.8	300 / 0.8
		Phase displacement(')	-1			
		Ratio error (%)	+0.04	0	37.5 / 0.8	0
		Phase displacement(')	+2			

Secondary windings	Accuracy class	Error	Percentage of rated current(phase B)			Burden (VA/cos φ)		
			2	5	100	1a1n	2a2n	dadn
dadn	3P	Ratio error (%)	-0.44	-0.44	-0.48	100 / 0.8	150 / 0.8	0
		Phase displacement(')	-5	-5	-5			
		Ratio error (%)	-0.26	-0.26	-0.26	0	0	0
		Phase displacement(')	+1	+1	+1			

Secondary windings	Accuracy class	Error	Percentage of rated current(phase B)	Burden (VA/cos φ)		
			150	1a1n	2a2n	dadn
dadn	3P	Ratio error (%)	-1.00	100 / 0.8	150 / 0.8	300 / 0.8
		Phase displacement(')	-7			
		Ratio error (%)	-0.48	0	0	75 / 0.8
		Phase displacement(')	+1			

Secondary windings	Accuracy class	Error	Percentage of rated current(phase C)			Burden (VA/cos φ)	
			80	100	120	1a1n	2a2n
1a1n	0.2	Ratio error (%)	-0.12	-0.12	-0.14	100 / 0.8	150 / 0.8
		Phase displacement(')	-3	-3	-2		
		Ratio error (%)	+0.16	+0.16	+0.16	2.5 / 0.8	0
		Phase displacement(')	0	0	0		

Secondary windings	Accuracy class	Error	Percentage of rated current(phase C)			Burden (VA/cos φ)		
			2	5	100	1a1n	2a2n	dadn
2a2n	3P	Ratio error (%)	-0.14	-0.14	-0.16	100 / 0.8	150 / 0.8	0
		Phase displacement(')	-2	-2	-2			
		Ratio error (%)	+0.14	+0.14	+0.12	0	37.5 / 0.8	0
		Phase displacement(')	+1	+1	+1			

Secondary windings	Accuracy class	Error	Percentage of rated current(phase C)	Burden (VA/cos φ)		
			150	1a1n	2a2n	dadn
2a2n	3P	Ratio error (%)	-0.26	100 / 0.8	150 / 0.8	300 / 0.8
		Phase displacement(')	-1			
		Ratio error (%)	+0.04	0	37.5 / 0.8	0
		Phase displacement(')	+1			

Secondary windings	Accuracy class	Error	Percentage of rated current(phase C)			Burden (VA/cos φ)		
			2	5	100	1a1n	2a2n	dadn
dadn	3P	Ratio error (%)	-0.46	-0.46	-0.46	100 / 0.8	150 / 0.8	0
		Phase displacement(')	-6	-5	-5			
		Ratio error (%)	-0.26	-0.26	-0.26	0	0	0
		Phase displacement(')	0	+1	+1			

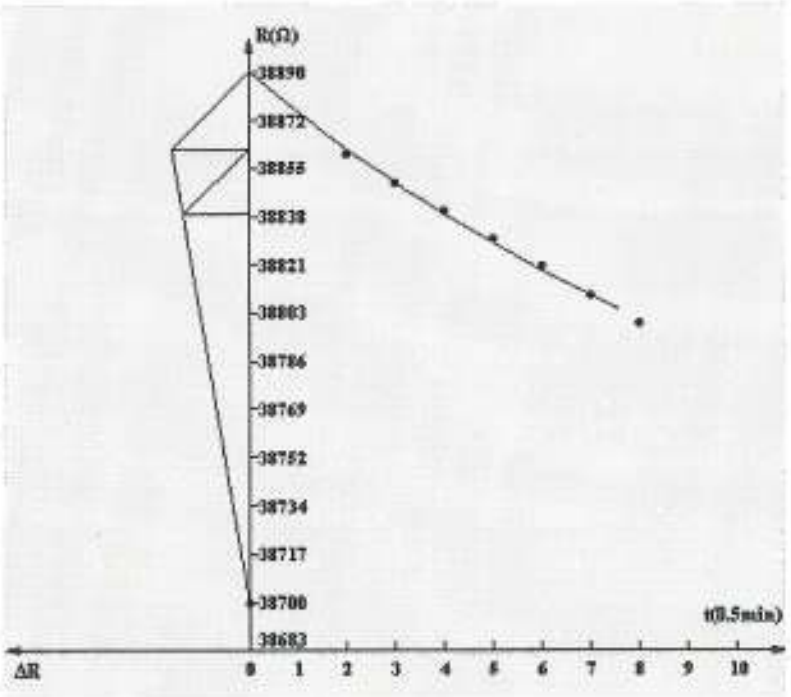
Secondary windings	Accuracy class	Error	Percentage of rated current(phase C)	Burden (VA/cos φ)		
			150	1a1n	2a2n	dadn
dadn	3P	Ratio error (%)	-0.98	100 / 0.8	150 / 0.8	300 / 0.8
		Phase displacement(')	-6			
		Ratio error (%)	-0.48	0	0	75 / 0.8
		Phase displacement(')	+1			

Ambient temperature	30 ℃	Relative humidity	60 %

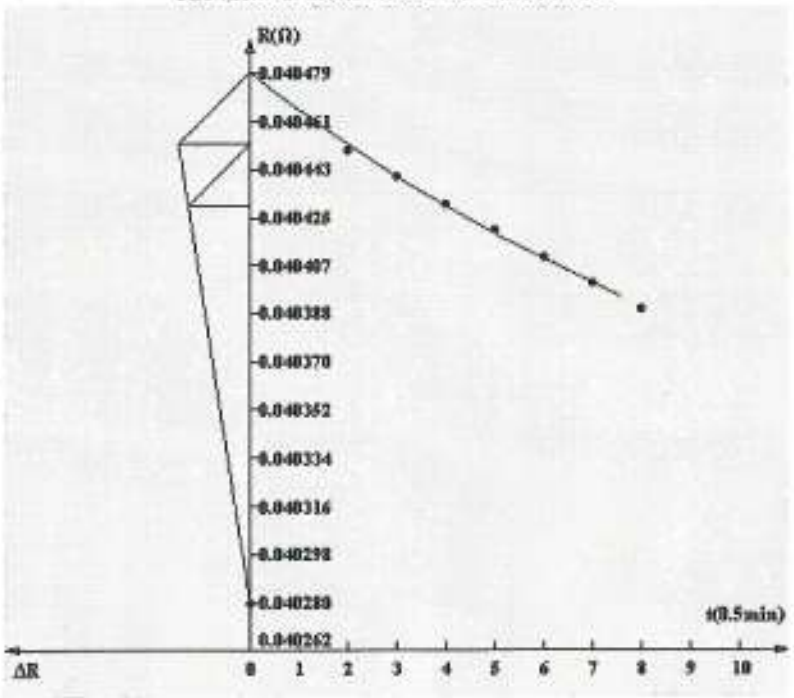
Appendix No. E Temperature rise test

Phase A 1.0Un

Temperature-rising curve of AN
The thermal resistance of R2=38890 Ω

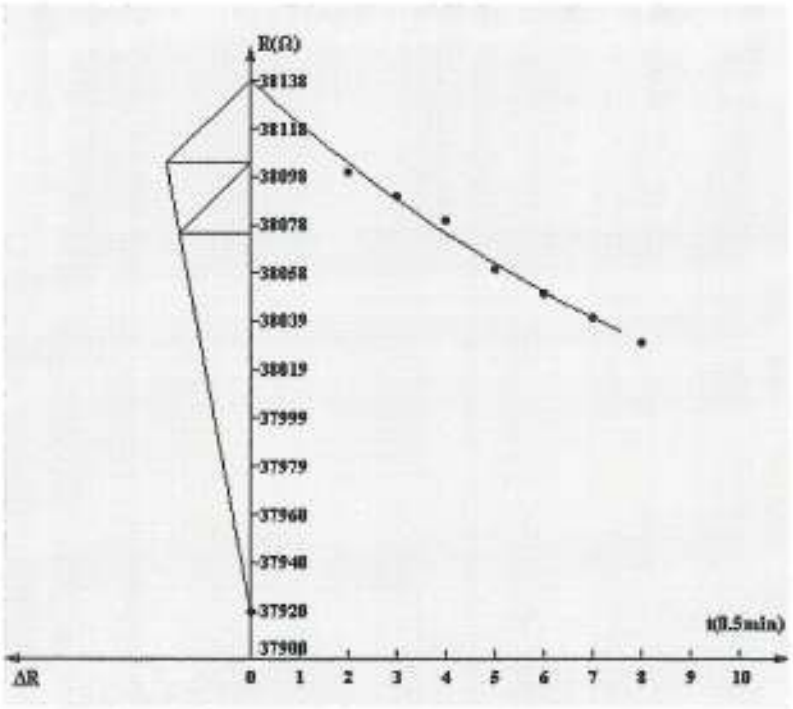


Temperature-rising curve of 1a1n
The thermal resistance of R2=0.040479 Ω

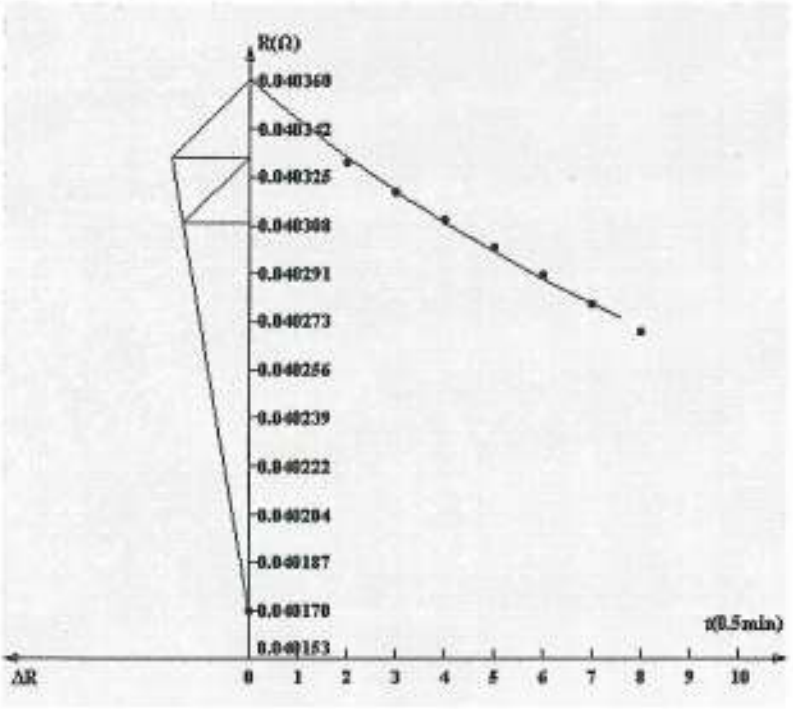


Phase B 1.0Un

Temperature-rising curve of AN
The thermal resistance of R2=38138 Ω

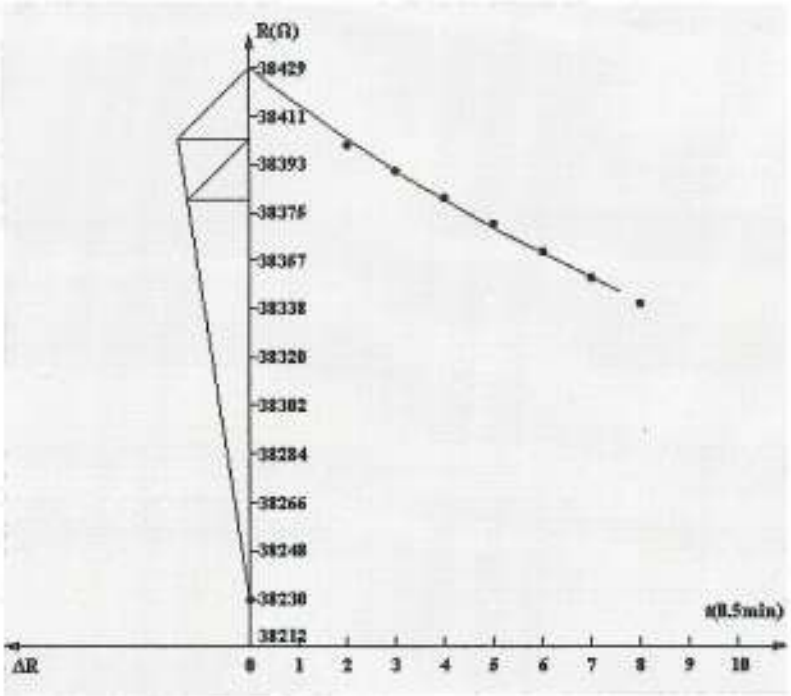


Temperature-rising curve of 1a1n The thermal resistance of R2=0.040360 Ω

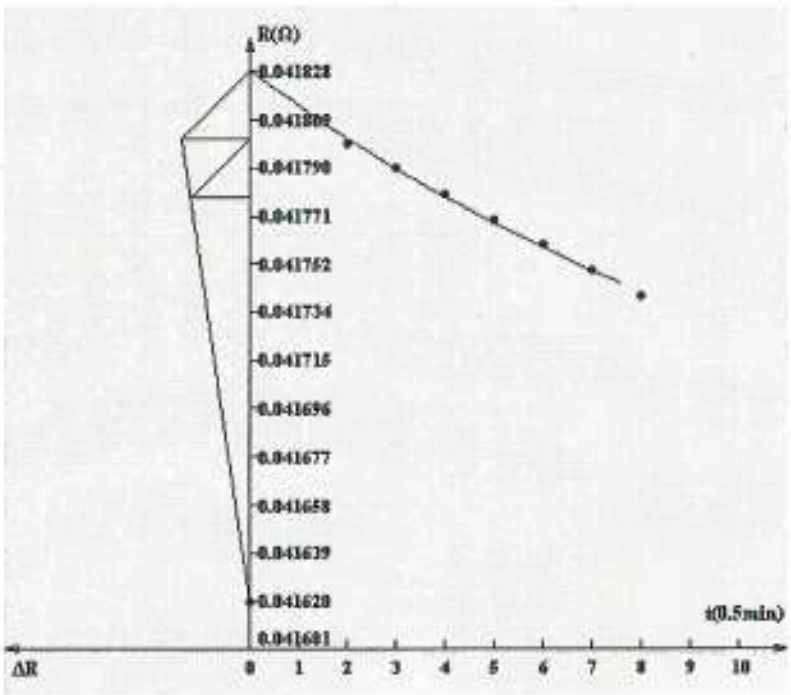


Phase C 1.0Un

Temperature-rising curve of AN The thermal resistance of R2=38429 Ω



Temperature-rising curve of 1a1n The thermal resistance of R2=0.041828 Ω

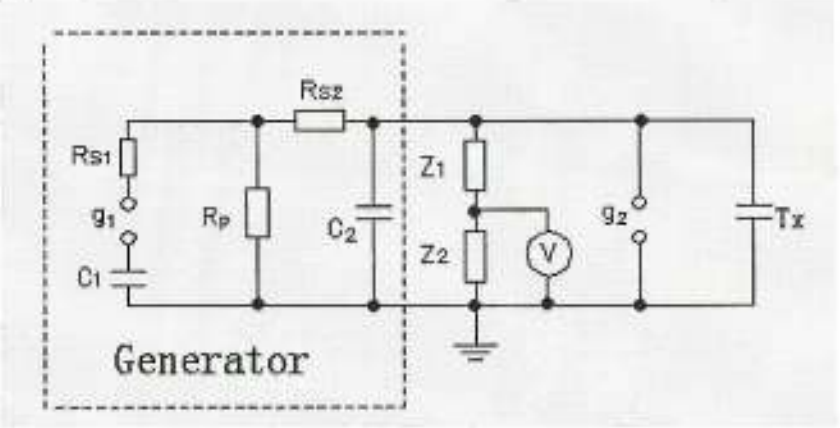


Appendix No.F Lightning impulse test and chopped lighting impulse test

1、Atmosphere conditions

Ambient temperature 29℃ Relative humidity 70 %

2、Test circuits



R_{S2}: front resistance R_P: tail resistance g_1: discharging sphere gap
g_2: chopping sphere gap C_1: front capacitor C_2: tail capacitor
Z_1、Z_2: divider T_x: object V: voltage meter

3、Test results

Phase A

No.	The standard voltage (peak) (kV)	Waveform of voltage	The test voltage (peak) (kV)	The chopped time(μs)	Wave-form No.	Result	Remarks
1	525	Pos.LI	512	/	1	OK	/
2	1050	Pos.LI	1041	/	2	OK	/
3	1050	Pos.LI	1047	/	3	OK	/
4	1050	Pos.LI	1053	/	4	OK	/
5	1050	Pos.LI	1053	/	5	OK	/
6	1050	Pos.LI	1055	/	6	OK	/
7	1050	Pos.LI	1055	/	7	OK	/
8	1050	Pos.LI	1056	/	8	OK	/
9	1050	Pos.LI	1054	/	9	OK	/
10	1050	Pos.LI	1054	/	10	OK	/
11	1050	Pos.LI	1056	/	11	OK	/
12	1050	Pos.LI	1056	/	12	OK	/
13	1050	Pos.LI	1060	/	13	OK	/
14	1050	Pos.LI	1060	/	14	OK	/

No.	The standard voltage (peak) (kV)	Waveform of voltage	The test voltage (peak) (kV)	The chopped time(μs)	Wave-form No.	Result	Remarks
15	1050	Pos.LI	1062	/	15	OK	/
16	1050	Pos.LI	1062	/	16	OK	/
17	525	Neg.LI	540	/	17	OK	/
18	1050	Neg.LI	1056	/	18	OK	/
19	604	Neg.LI-chopped	611	4.04	19	OK	/
20	1208	Neg.LI-chopped	1200	4.08	20	OK	/
21	1208	Neg.LI-chopped	1209	3.82	21	OK	/
22	1050	Neg.LI	1063	/	22	OK	/
23	1050	Neg.LI	1058	/	23	OK	/
24	1050	Neg.LI	1058	/	24	OK	/
25	1050	Neg.LI	1058	/	25	OK	/
26	1050	Neg.LI	1058	/	26	OK	/
27	1050	Neg.LI	1059	/	27	OK	/
28	1050	Neg.LI	1059	/	28	OK	/
29	1050	Neg.LI	1059	/	29	OK	/
30	1050	Neg.LI	1059	/	30	OK	/
31	1050	Neg.LI	1059	/	31	OK	/
32	1050	Neg.LI	1058	/	32	OK	/
33	1050	Neg.LI	1060	/	33	OK	/
34	1050	Neg.LI	1060	/	34	OK	/
35	1050	Neg.LI	1061	/	35	OK	/

Phase B

No.	The standard voltage (peak) (kV)	Waveform of voltage	The test voltage (peak) (kV)	The chopped time(μs)	Wave-form No.	Result	Remarks
1	525	Pos.LI	545	/	1	OK	/
2	1050	Pos.LI	1038	/	2	OK	/
3	1050	Pos.LI	1051	/	3	OK	/
4	1050	Pos.LI	1051	/	4	OK	/
5	1050	Pos.LI	1052	/	5	OK	/
6	1050	Pos.LI	1052	/	6	OK	/

No.	The standard voltage (peak) (kV)	Waveform of voltage	The test voltage (peak) (kV)	The chopped time(μs)	Wave-form No.	Result	Remarks
7	1050	Pos.LI	1052	/	7	OK	/
8	1050	Pos.LI	1052	/	8	OK	/
9	1050	Pos.LI	1053	/	9	OK	/
10	1050	Pos.LI	1052	/	10	OK	/
11	1050	Pos.LI	1053	/	11	OK	/
12	1050	Pos.LI	1054	/	12	OK	/
13	1050	Pos.LI	1053	/	13	OK	/
14	1050	Pos.LI	1053	/	14	OK	/
15	1050	Pos.LI	1053	/	15	OK	/
16	1050	Pos.LI	1054	/	16	OK	/
17	525	Neg.LI	545	/	17	OK	/
18	1050	Neg.LI	1043	/	18	OK	/
19	604	Neg.LI-chopped	615	3.81	19	OK	/
20	1208	Neg.LI-chopped	1203	3.57	20	OK	/
21	1208	Neg.LI-chopped	1203	3.20	21	OK	/
22	1050	Neg.LI	1060	/	22	OK	/
23	1050	Neg.LI	1060	/	23	OK	/
24	1050	Neg.LI	1059	/	24	OK	/
25	1050	Neg.LI	1059	/	25	OK	/
26	1050	Neg.LI	1060	/	26	OK	/
27	1050	Neg.LI	1060	/	27	OK	/
28	1050	Neg.LI	1060	/	28	OK	/
29	1050	Neg.LI	1062	/	29	OK	/
30	1050	Neg.LI	1062	/	30	OK	/
31	1050	Neg.LI	1061	/	31	OK	/
32	1050	Neg.LI	1060	/	32	OK	/
33	1050	Neg.LI	1061	/	33	OK	/
34	1050	Neg.LI	1061	/	34	OK	/
35	1050	Neg.LI	1060	/	35	OK	/

Phase C

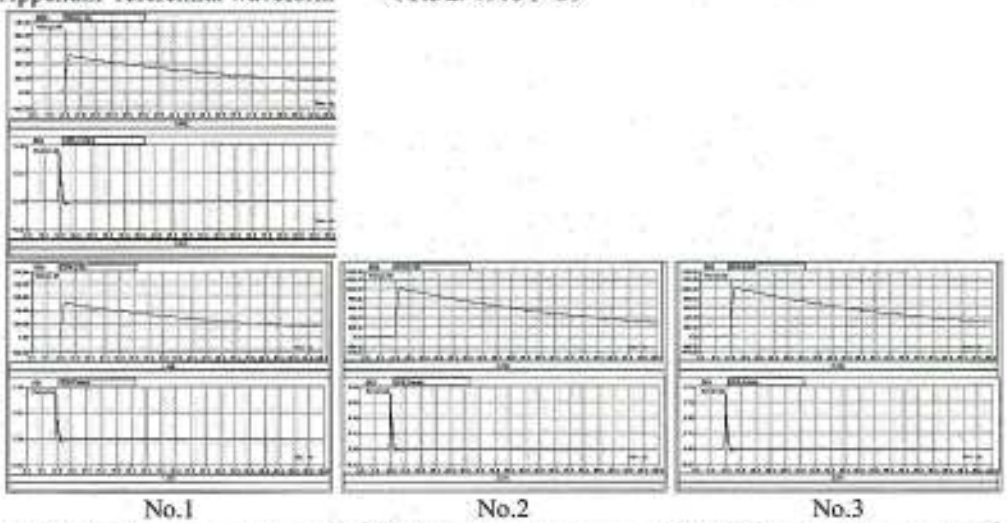
No.	The standard voltage (peak) (kV)	Waveform of voltage	The test voltage (peak) (kV)	The chopped time(μs)	Wave-form No.	Result	Remarks
1	525	Pos.LI	530	/	1	OK	/
2	1050	Pos.LI	1043	/	2	OK	/
3	1050	Pos.LI	1045	/	3	OK	/
4	1050	Pos.LI	1044	/	4	OK	/
5	1050	Pos.LI	1045	/	5	OK	/
6	1050	Pos.LI	1046	/	6	OK	/
7	1050	Pos.LI	1045	/	7	OK	/
8	1050	Pos.LI	1044	/	8	OK	/
9	1050	Pos.LI	1046	/	9	OK	/
10	1050	Pos.LI	1045	/	10	OK	/
11	1050	Pos.LI	1046	/	11	OK	/
12	1050	Pos.LI	1045	/	12	OK	/
13	1050	Pos.LI	1045	/	13	OK	/
14	1050	Pos.LI	1046	/	14	OK	/
15	1050	Pos.LI	1046	/	15	OK	/
16	1050	Pos.LI	1046	/	16	OK	/
17	525	Neg.LI	528	/	17	OK	/
18	1050	Neg.LI	1054	/	18	OK	/
19	604	Neg.LI-chopped	612	3.76	19	OK	/
20	1208	Neg.LI-chopped	1200	3.40	20	OK	/
21	1208	Neg.LI-chopped	1209	3.42	21	OK	/
22	1050	Neg.LI	1053	/	22	OK	/
23	1050	Neg.LI	1043	/	23	OK	/
24	1050	Neg.LI	1055	/	24	OK	/
25	1050	Neg.LI	1050	/	25	OK	/
26	1050	Neg.LI	1051	/	26	OK	/
27	1050	Neg.LI	1048	/	27	OK	/
28	1050	Neg.LI	1053	/	28	OK	/
29	1050	Neg.LI	1055	/	29	OK	/
30	1050	Neg.LI	1054	/	30	OK	/
31	1050	Neg.LI	1056	/	31	OK	/
32	1050	Neg.LI	1054	/	32	OK	/

No.	The standard voltage (peak) (kV)	Waveform of voltage	The test voltage (peak) (kV)	The chopped time(μs)	Wave-form No.	Result	Remarks
33	1050	Neg.LI	1054	/	33	OK	/
34	1050	Neg.LI	1056	/	34	OK	/
35	1050	Neg.LI	1056	/	35	OK	/

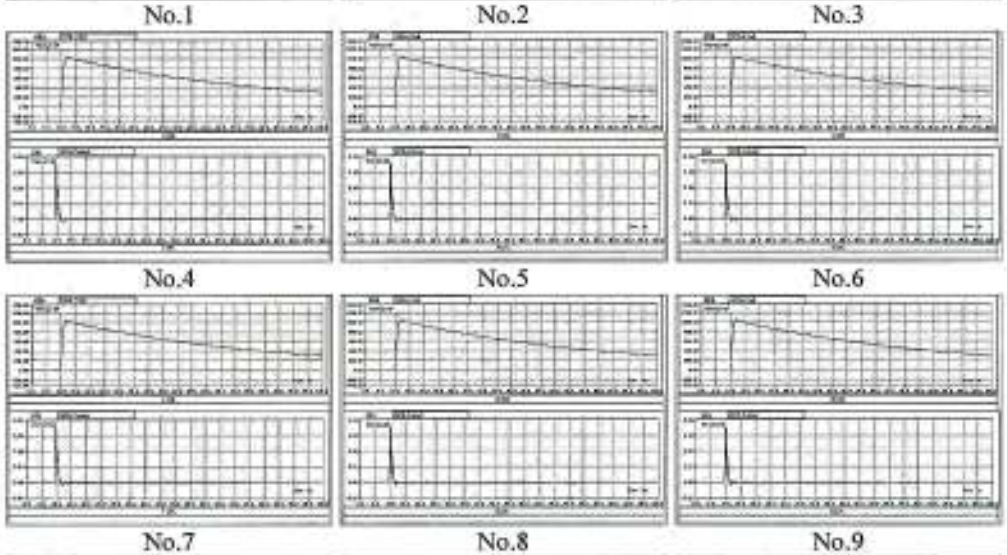
4、Conclusion Pass

Phase A

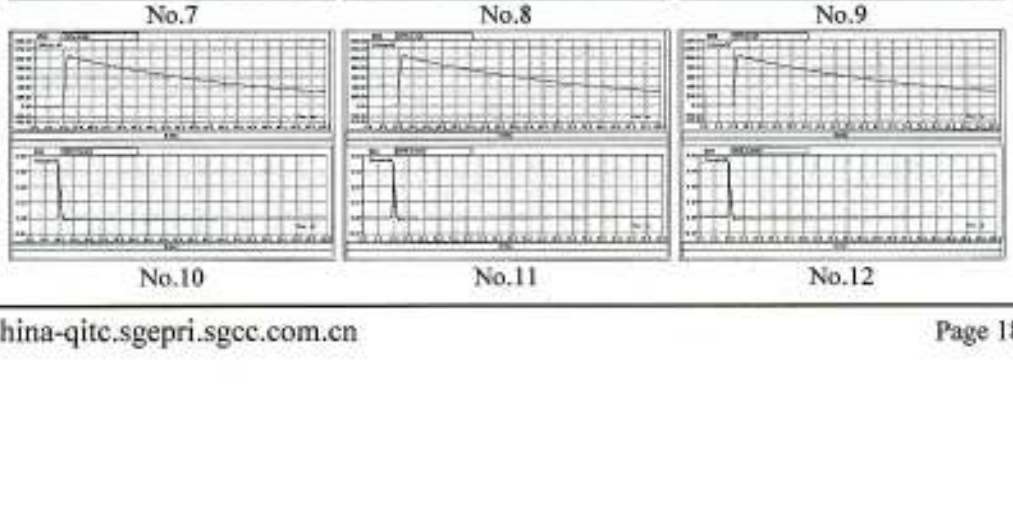
Appendix referential waveform (1.52/49.0μs)



No.1 No.2 No.3

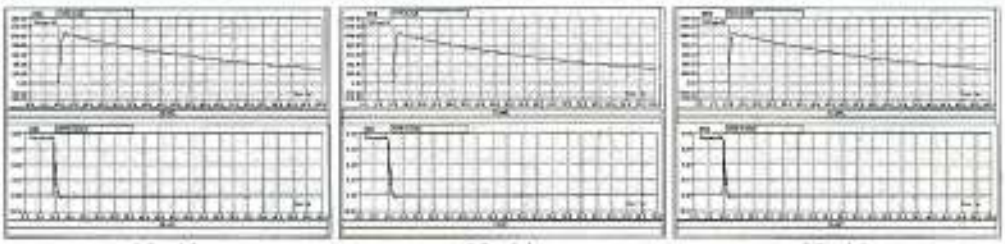


No.4 No.5 No.6

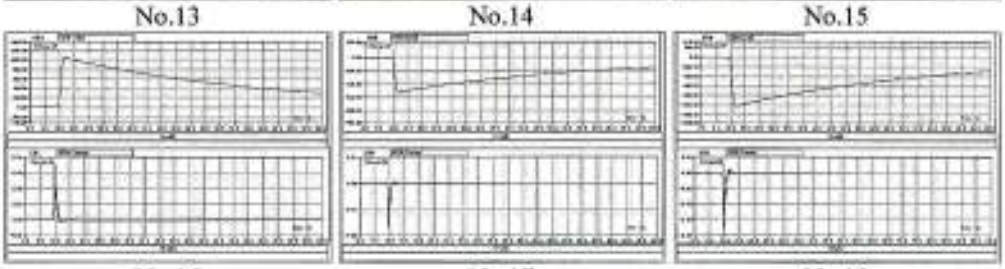


No.7 No.8 No.9

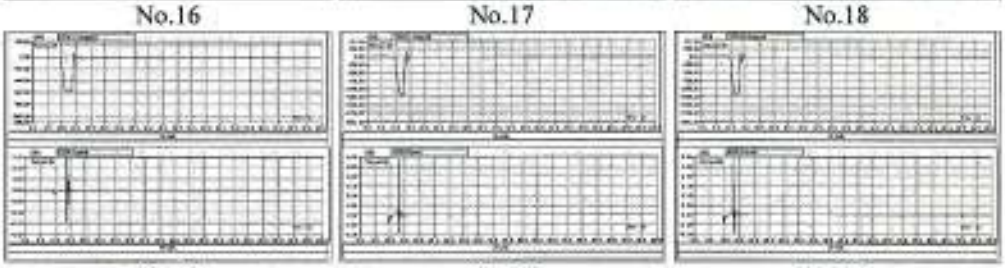
No.10 No.11 No.12



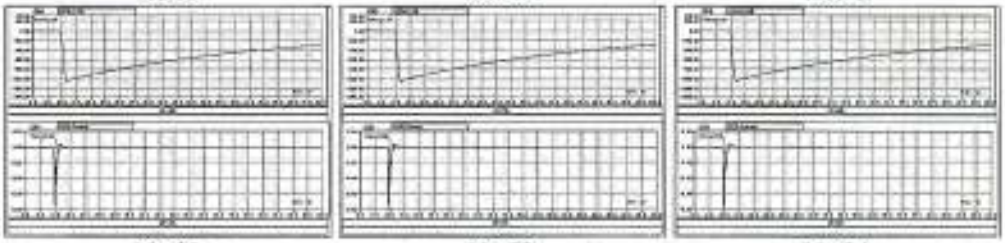
No.13 No.14 No.15



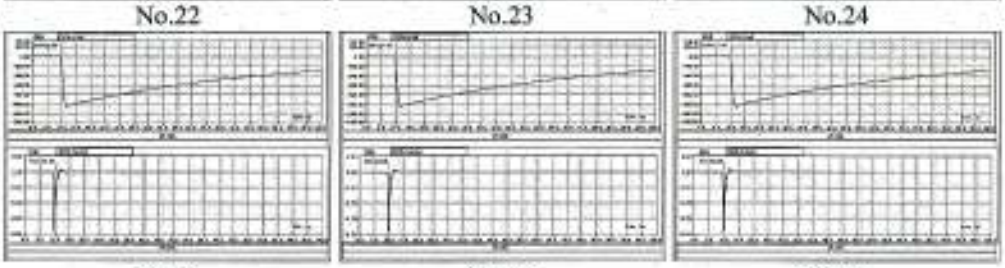
No.16 No.17 No.18



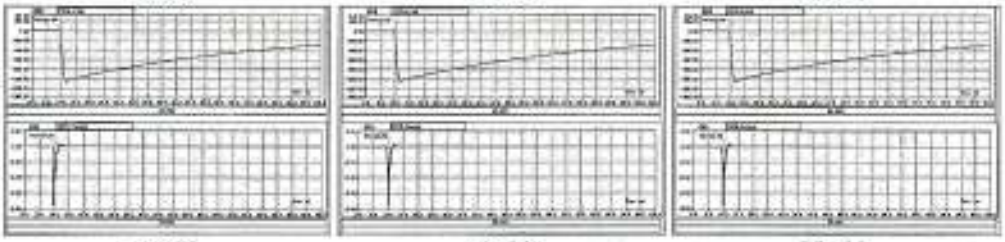
No.19 No.20 No.21



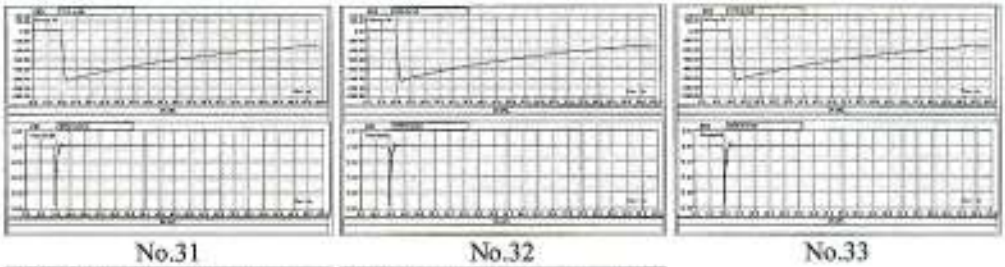
No.22 No.23 No.24



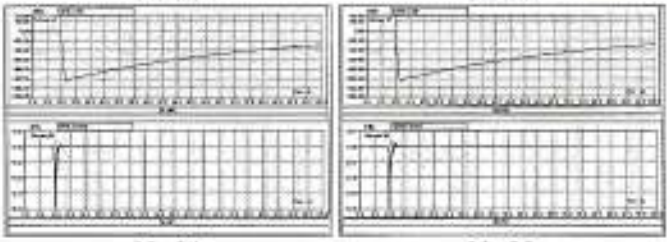
No.25 No.26 No.27



No.28 No.29 No.30



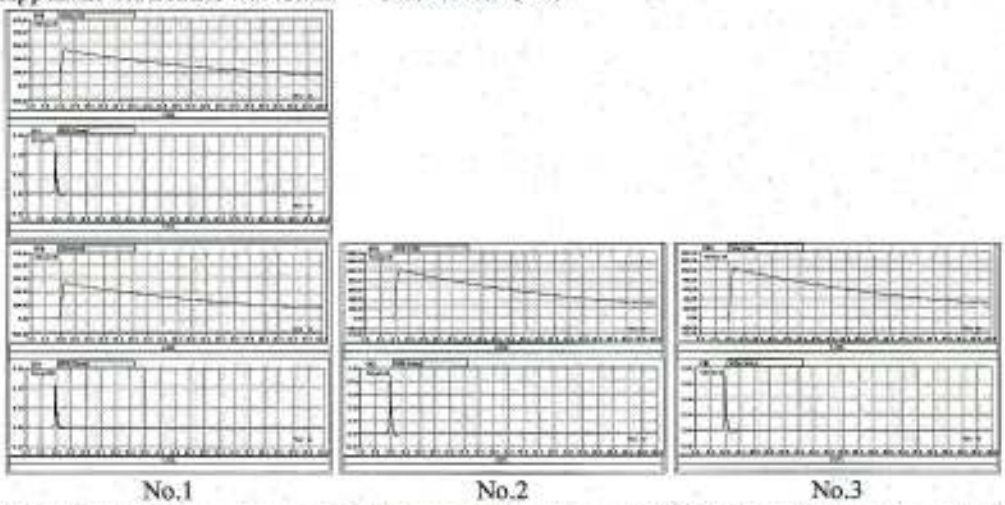
No.31 No.32 No.33



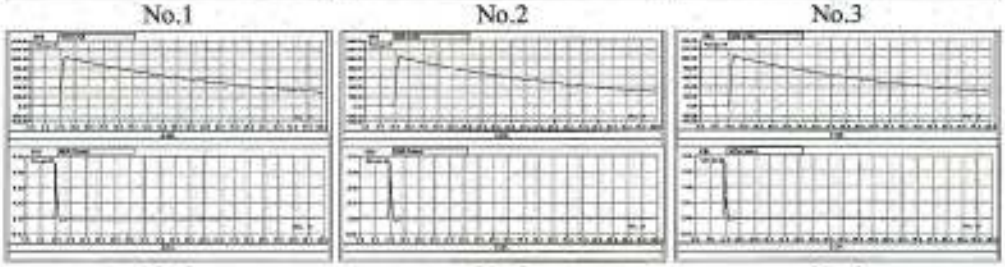
No.34 No.35

Phase B

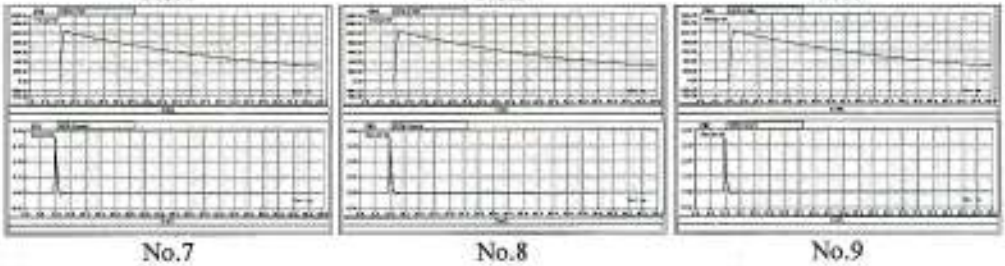
Appendix referential waveform (1.52/48.9 μ s)



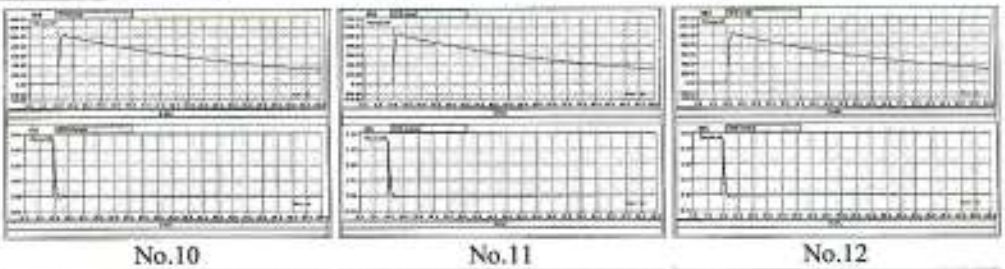
No.1 No.2 No.3



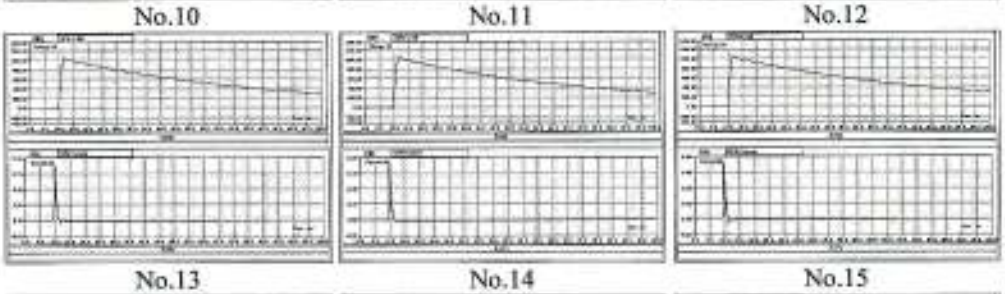
No.4 No.5 No.6



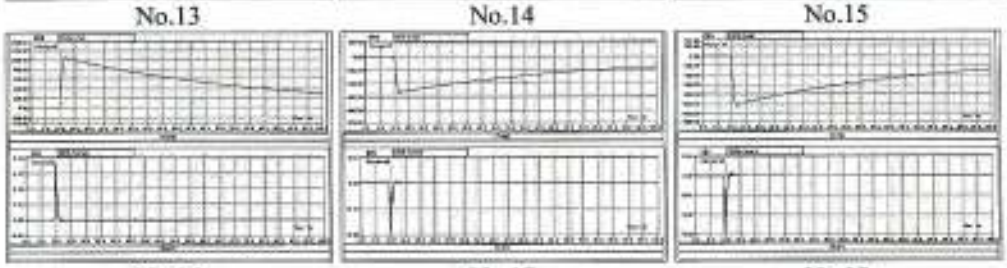
No.7 No.8 No.9



No.10 No.11 No.12

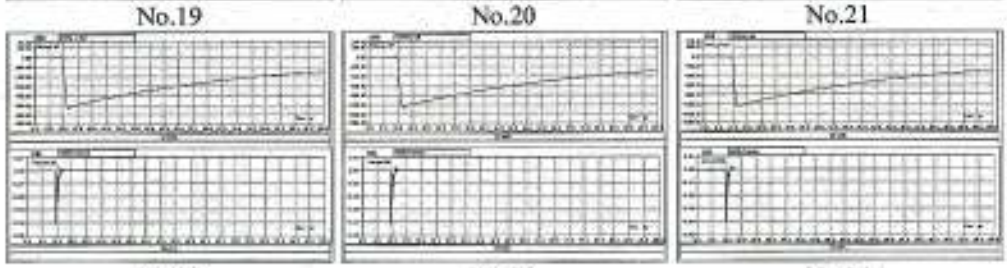


No.13 No.14 No.15

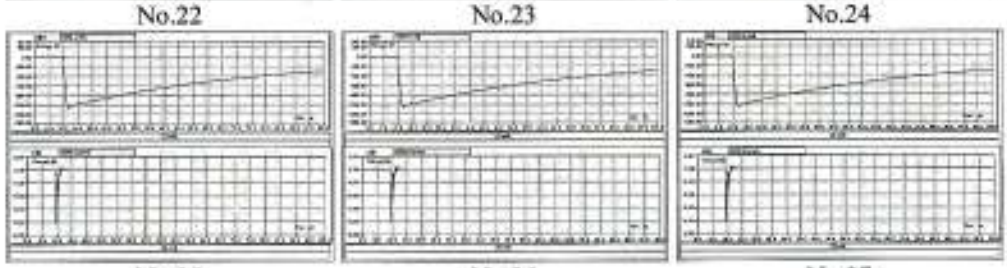


No.16 No.17 No.18

No.19 No.20 No.21



No.22 No.23 No.24



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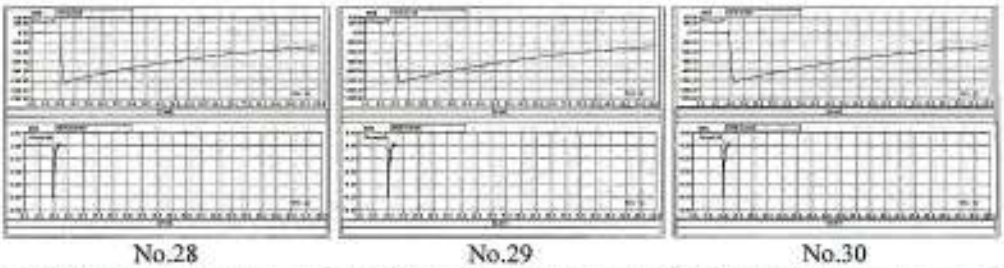
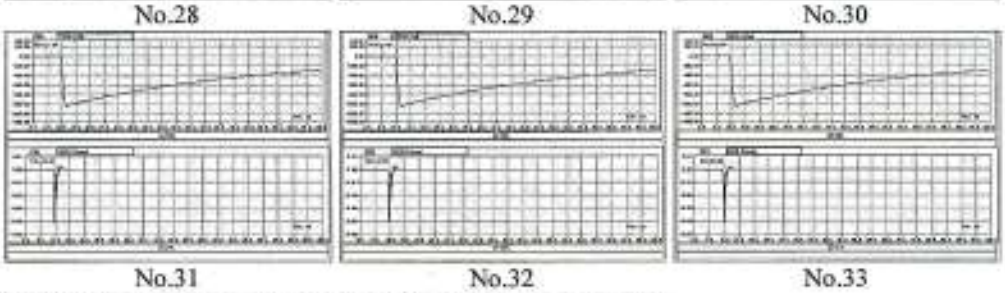


No.28 No.29 No.30

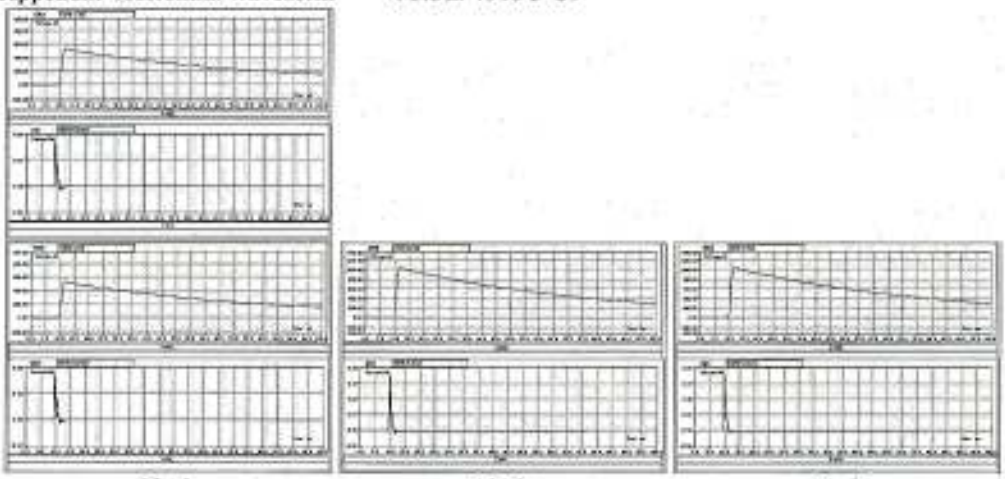


No.31 No.32 No.33

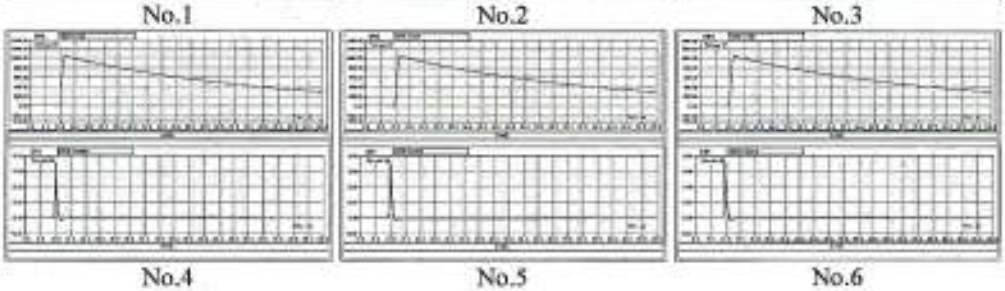
No.34 No.35

Phase C

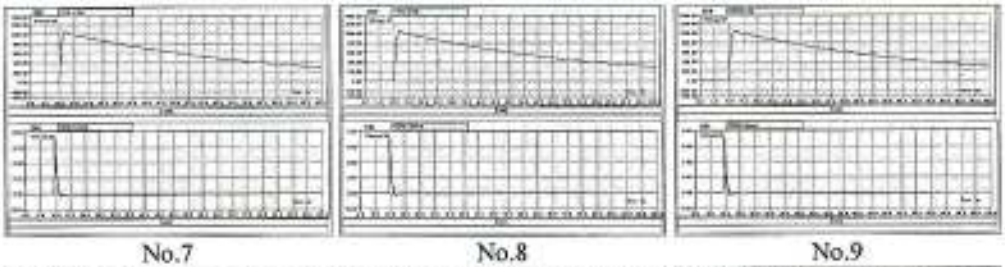
Appendix referential waveform (1.52/49.0μs)



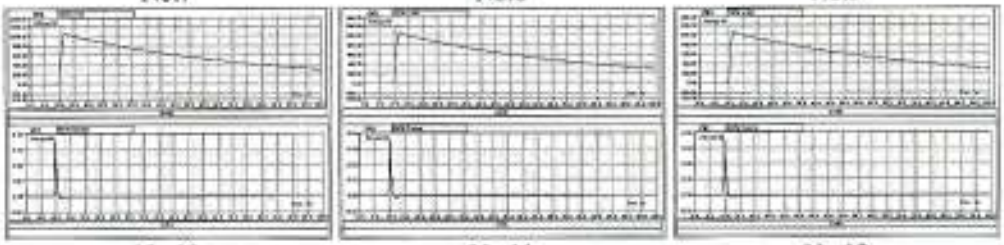
No.1 No.2 No.3



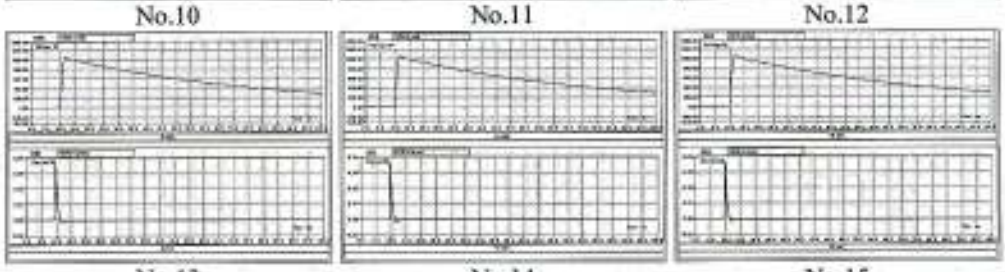
No.4 No.5 No.6



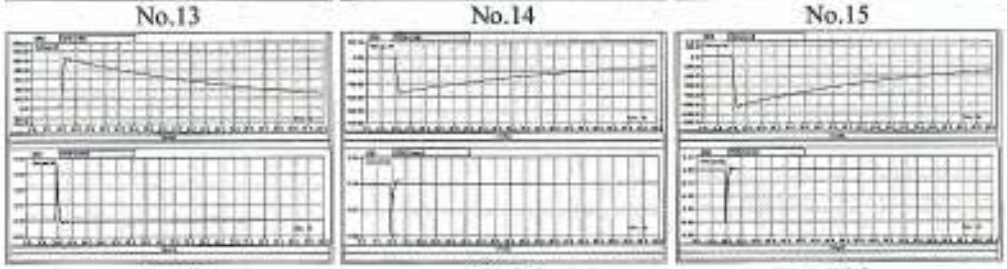
No.7 No.8 No.9



No.10 No.11 No.12



No.13 No.14 No.15



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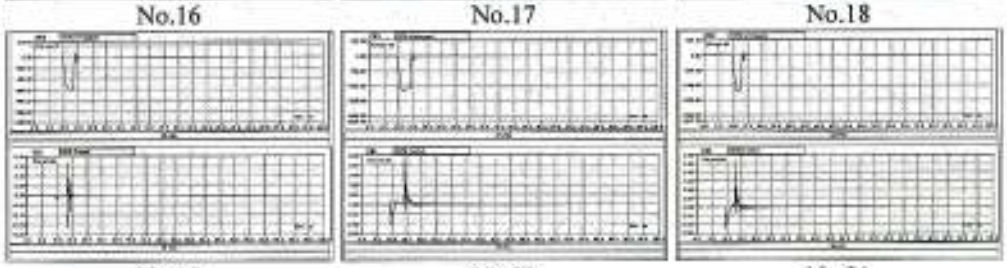
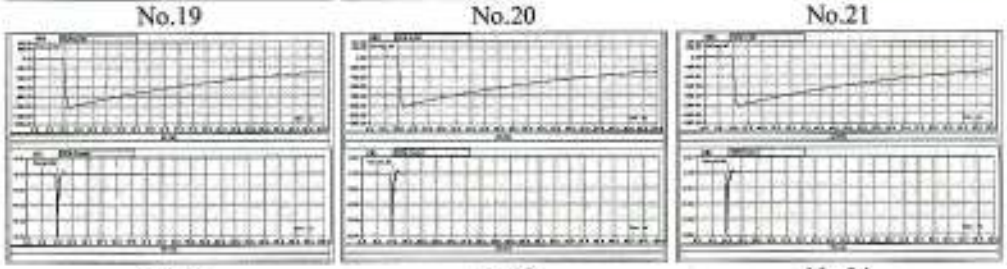
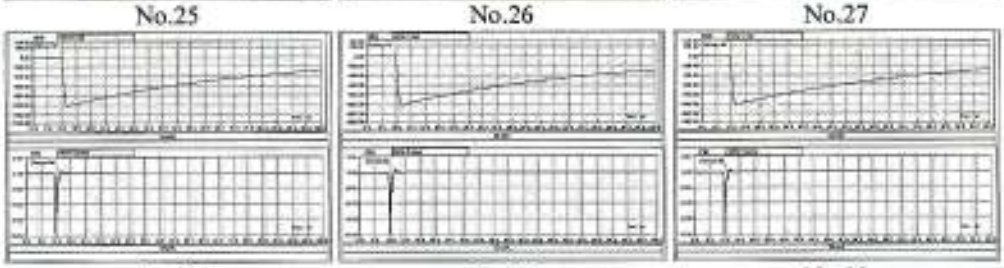


No.19 No.20 No.21

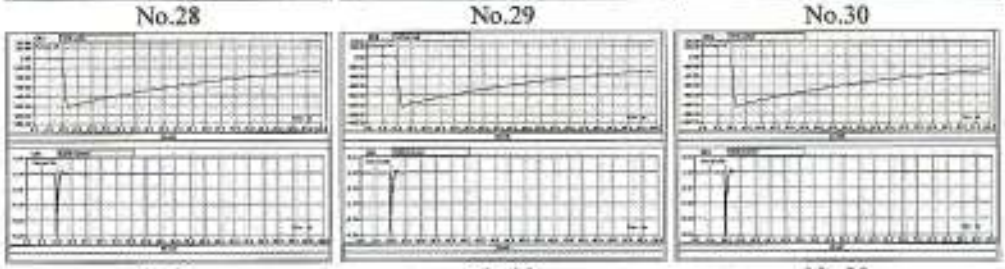


No.22 No.23 No.24

No.25 No.26 No.27



No.28 No.29 No.30

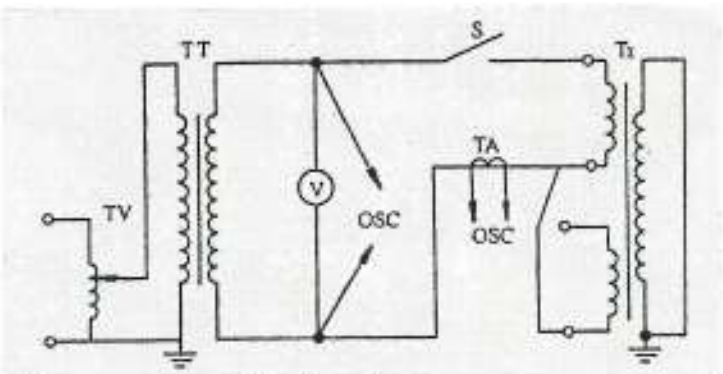


No.31 No.32 No.33

No.34 No.35

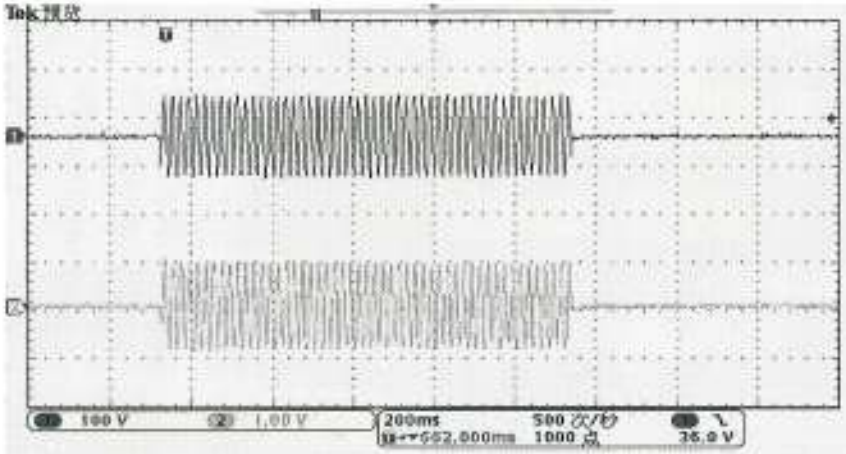
Appendix No.G Endurance of short circuit

1. Test circuits



TV: AC voltage regulator TT: Transformer S: Switch
TA: Measuring current transformer OSC: Recording oscillograph V: Voltage meter
Tx: Object voltage transformer

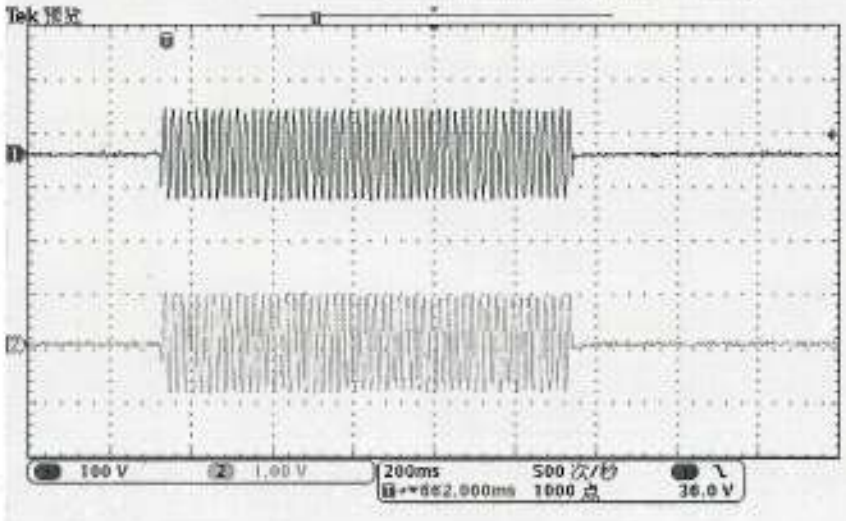
2. Test Waveform



U

$I(R_0=0.12\,\Omega)$

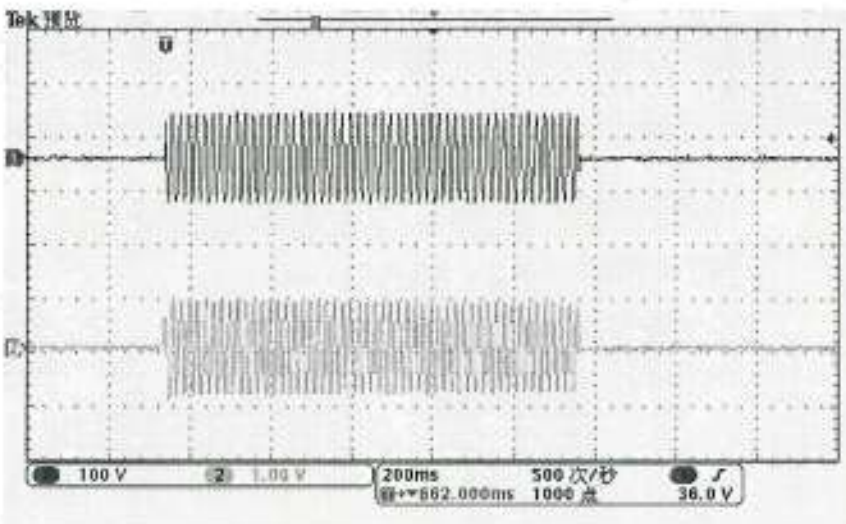
Phase A



U

$I(R_0=0.12\,\Omega)$

Phase B



U

$I(R_0=0.12\,\Omega)$

Phase C

Appendix No.H Determination of errors(retrial)

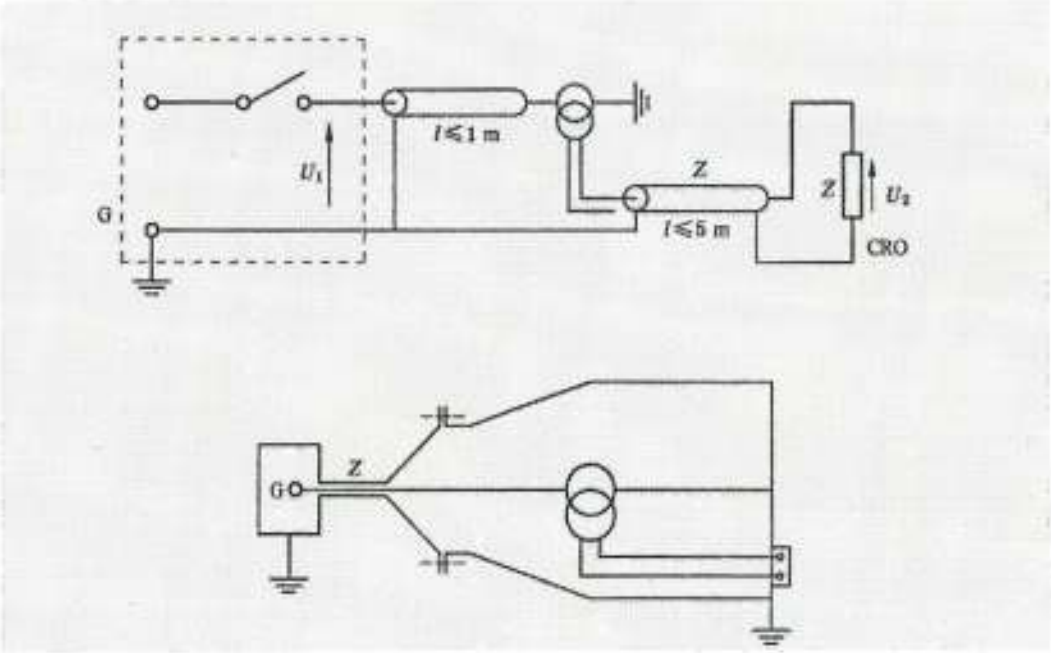
Secondary windings	Accuracy class	Error	Percentage of rated current (A)			Burden (VA/cos φ)	
			80	100	120	1a1n	2a2n
1a1n	0.2	Ratio error (%)	-0.12	-0.12	-0.14	100	150
		Phase displacement(')	-3	-3	-3	0.8	0.8
		Ratio error (%)	+0.16	+0.16	+0.14	2.5	0
		Phase displacement(')	0	0	0	0.8	
Secondary windings	Accuracy class	Error	Percentage of rated current (B)			Burden (VA/cos φ)	
			80	100	120	1a1n	2a2n
1a1n	0.2	Ratio error (%)	-0.12	-0.12	-0.14	100	150
		Phase displacement(')	-3	-3	-2	0.8	0.8
		Ratio error (%)	+0.16	+0.16	+0.14	2.5	0
		Phase displacement(')	0	0	0	0.8	
Secondary windings	Accuracy class	Error	Percentage of rated current (C)			Burden (VA/cos φ)	
			80	100	120	1a1n	2a2n
1a1n	0.2	Ratio error (%)	-0.12	-0.12	-0.14	100	150
		Phase displacement(')	-2	-2	-2	0.8	0.8
		Ratio error (%)	+0.16	+0.16	+0.14	2.5	0
		Phase displacement(')	0	+1	+1	0.8	
Ambient temperature		32 ℃		Relative humidity		60 %	

Appendix No. 1 Transmitted overvoltage measurement

1、Atmosphere conditions

Room temperature 29 ℃ Relative humidity 70 %

2、Test circuits



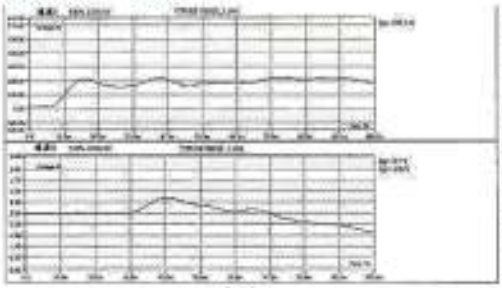
G: Generator CRO: OSC

3、Test results

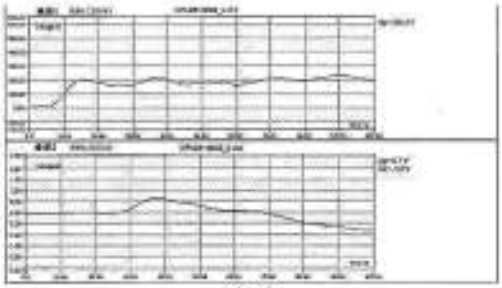
Secondary windings		Waveform T_1 μs T_2 μs	Applying impulse-voltage on primary winding(U_1) (kV)	The peak-voltage of secondary windings (U_2) (V)	The peak-voltage of transmission over-voltage (U_s) (V)	Waveform No.
1a1n	A	T_1 10.1 T_2 >100	213	0.8	1236	1
2a2n		T_1 10.1 T_2 >100	220	0.8	1196	2
dadn		T_1 10.1 T_2 >100	216	0.9	1371	3
1a1n	B	T_1 10.1 T_2 >100	214	0.9	1384	4
2a2n		T_1 10.1 T_2 >100	214	0.9	1384	5
dadn		T_1 10.1 T_2 >100	214	0.8	1230	6
1a1n	C	T_1 10.0 T_2 >100	216	0.9	1371	7
2a2n		T_1 10.0 T_2 >100	212	0.9	1397	8
dadn		T_1 10.0 T_2 >100	220	0.8	1196	9

Note $U_s=\frac{U_2}{U_1}\times U_P \quad U_P=1.6\frac{\sqrt{2}U_m}{\sqrt{3}}$

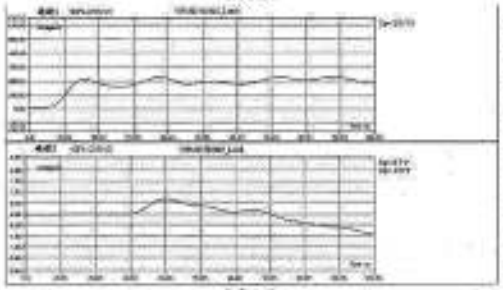
4、Conclusion Pass



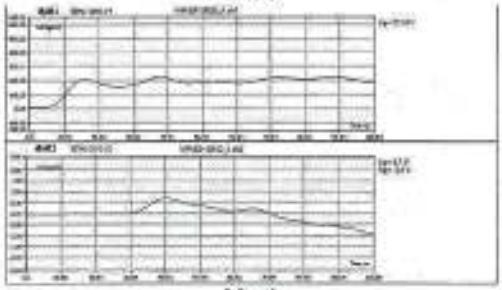
No.1



No.2



No.3



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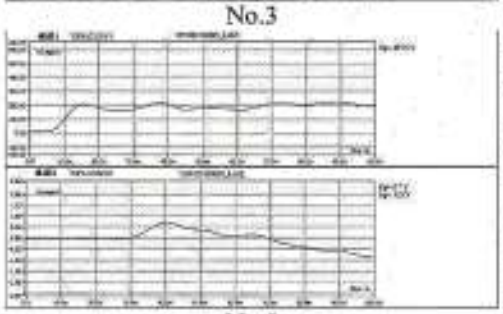

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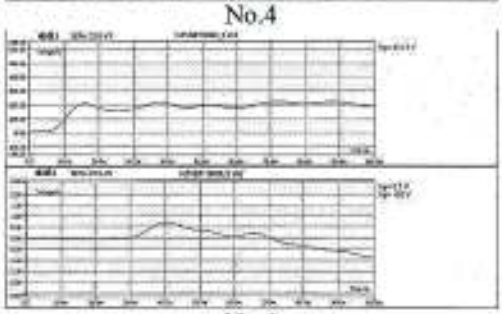

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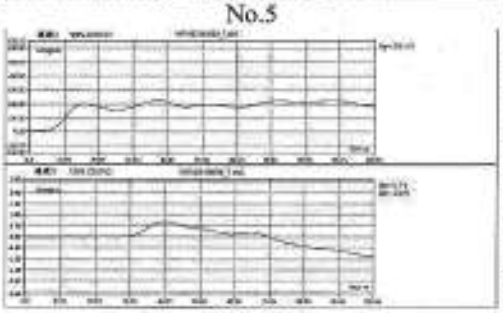

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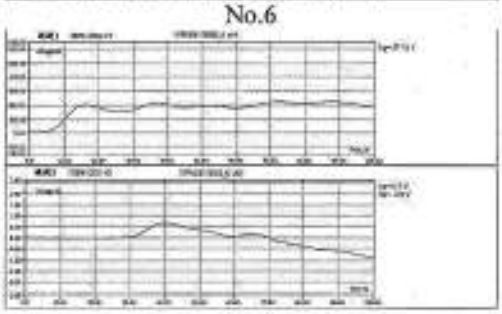

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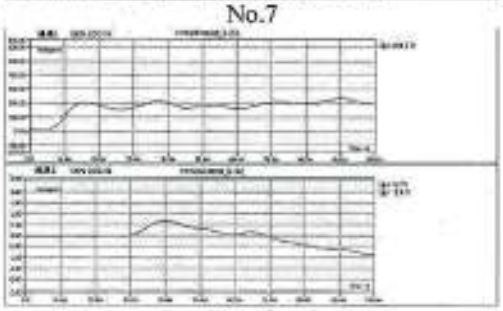
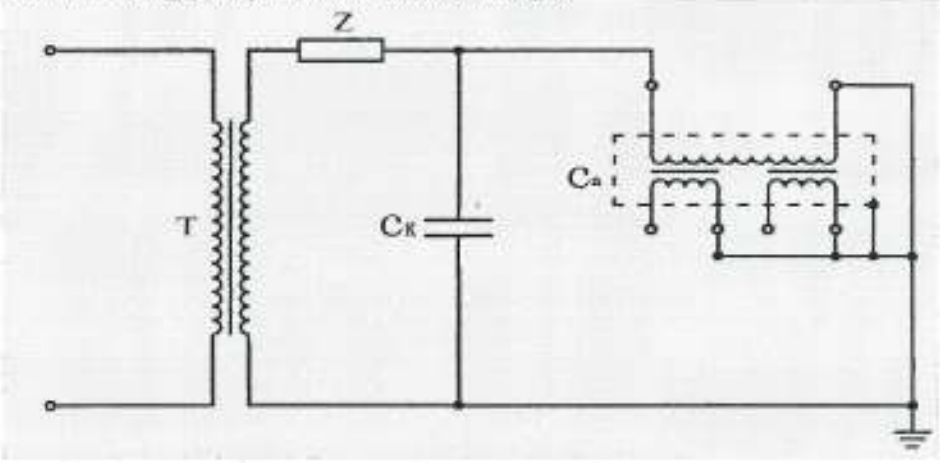


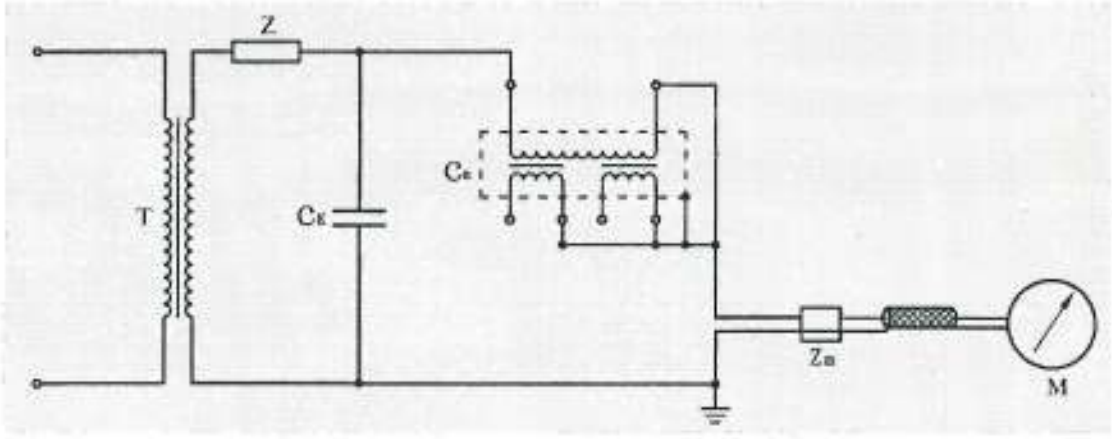
No.9

Appendix No. J Main test circuits

Figure 1——Power-frequency withstand test on primary windings



C_a——Object
C_k——Coupling capacitor
Z——filter（there is no need if C_k is capacitance of testing transformer）



T——testing transformer
Ca——Object
Ck——Coupling capacitor
M——measurement of partial discharge
Zm——testing impedance
Z——filter（there is no need if Ck is capacitance of testing transformer）

Appendix No. K Photograph of semblance