

# CTQC



**CNACL**

No.0299



国质监认字 080 号



(2000)量认(国)字(A0394)号



机检电(2000)07号

## TEST REPORT

No.: CTQC/B-03.277

Apparatus: POWER TRANSFORMER

Manufacturer: HANGZHOU QIANJIANG ELECTRIC  
GROUP CO., LTD.

Kind of testing: TRUST TESTING

CHINA NATIONAL TRANSFORMER QUALITY  
SUPERVISION TESTING CENTER





# CTQC

国家变压器质量监督检验中心  
CHINA NATIONAL TRANSFORMER QUALITY  
SUPERVISION TESTING CENTER

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China National Transformer Quality Supervision Testing Center


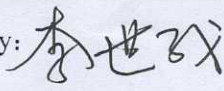

Test Report

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Test object name	Power Transformer	Test object type	SZ9-20000 / 35
		Brand	/
Entrusted by	HANGZHOU QIANGJIANG ELECTRIC GROUP CO., LTD.	Kind of testing	Trust testing
Manufacturer	HANGZHOU QIANGJIANG ELECTRIC GROUP CO., LTD.	Sampling date	Aug.26,2003
Address	QIANJIANG INDUSTRIAL ZONE, KANSHAN, XIAOSHAN, HANGZHOU, ZHEJIANG PROVINCE	Serial No	004332002
Standards	GB1094.1-1996 GB1094.3-1985 GB1094.5-1985 Contract requirements	Test items	Short-circuit withstand test.
Results	<p>The test results of short-circuit withstand test of SZ9-20000 / 35 are in accordance with GB1094.1-1996, GB1094.3-1985, GB1094.5-1985 standards and contract requirements. The sample passed short-circuit withstand test.</p> <p style="text-align: right;">Signing and issuing date: Sep. 15, 2003</p>		
Note			



Approved by:  Checked by:  Compiled by: 



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Test results					
No	Test items	Specified values	Measured values		Conclu- sions
		Standards (Contract requirements)	Before S.C.T.	After S.C.T.	
1	Measurement of insulation resistance and tan $\delta$ (Routine test)	Providing Insulation resistance ( $G\Omega$ ), Providing absorption ratio( $R_{60}/R_{15}$ ) and tan $\delta$	$R_{60}$ $R_{60}/R_{15}$ tan $\delta$	$R_{60}$ $R_{60}/R_{15}$ tan $\delta$	Passed
			H-L-E 12.6 1.58 0.0037	H-L-E 12.4 1.65 0.0038	
			L-H-E 9.8 1.18 0.0058	L-H-E 9.7 1.17 0.0053	
			H.L-E 12.9 1.74 0.0081	H.L-E 12.8 1.75 0.0082	
2	Measurement of voltage ratio and check of phase displacement (Routine test)	The tolerances of voltage ratio: $\pm 0.5\%$ Connection symbol: YNd11	0.00%~0.04%	0.00%~0.05%	Passed
			YNd11	YNd11	
3	Measurement of winding resistances (Routine test)	Maximum unbalancedness Line: $\leq 1\%$ Phase: $\leq 2\%$	H.V.( phase): 2.33% L.V.( line ): 0.27%	H.V.( phase): 2.48% L.V.( line ): 0.75%	Passed
4	Separate-source voltage withstand test (Routine test)	H.V. neutral : 85kV; 60s L.V.: 35kV; 60s (After S.C.T. $\times 85\%$ )	85kV; 60s 35kV; 60s	72.25kV; 60s 29.75kV; 60s	Passed
5	Induced overvoltage withstand test (Routine test)	Applied voltage (kV): $2U_r$ Induced voltage (kV): 70 Duration (s): 40 Frequency (Hz) (After S.C.T. $\times 85\%$ )	21 70 40 150	17.85 59.5 40 150	Passed
6	Measurement of no-load loss and current (Routine test)	$I_0\%$ : 0.55      +30% $P_0$ (kW): 18.00    +15%	0.15 16.28	0.15 16.74	Passed
7	Measurement of short-circuit impedance and load loss (Routine test)	t: 75°C $Z\%$ : 11.5 $\pm 10\%$ $P_k$ (kW): 87.00    +15% $P_0+P_k$ (kW): 105.00 +10%	11.49 94.12 110.40	11.49 94.73 111.47	Passed





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**Test results**

No	Test items	Specified values	Measured values		Conclusions
		Standards (Technical contract)	Before S.C.T.	After S.C.T.	
8	Test on transformer oil (Routine test)	Breakdown voltage (kV): $\geq 40$ $\tan \delta (90^\circ\text{C}): \leq 0.01$	52.68 0.0010	52.57 0.0011	Passed
9	Test on on-load tap-changers (Routine test)	According to Clause 10.8 of GB1094.1-1996	See 4.9	See 4.11.4.9	Passed
10	Leakage test (Routine test)	Applied pressure (kPa): 50 Duration (h): 24 No leakage or damage	50 24 No leakage or damage		Passed
11	Short-circuit withstand test (Special test)	Three times each phase Duration (s): $0.20 \pm 10\%$ Test waveshapes have no distortion Deviation of reactance before and after S.C.T. $\leq 2\%$ The untanking inspection shows no apparent defects Successfully repeat routine test	3 0.20 No distortion 0.49% No apparent defects Passed		Passed

- Annex 1: Rating plates and outline phone (Total pages 1)
- Annex 2: Test circuit (Total pages 5)
- Annex 3: Transformer drawing (Total pages 2)



## 1. Test object parameters

Rated power: 20000 kVA

Rated voltage: 35/10.5 kV

Rated current: 329.92/1099.7 A

Rated frequency: 50 Hz

Number of phases: 3

Tap range:  $(35 \pm 3 \times 2.5\%) / 10.5$  kV

Connection symbol: YNd11

Cooling method: ONAF

Temperature class of insulation: A

Insulation levels: LI200AC85/LI75AC35

## 2. Sample condition description

(1) Sample exterior construction and major dimensions( length, width, height) are compliance with drawing. Measured value: length:5220mm; width:3980mm, height:3700mm.

(2) The form, performance date, specifications of sample rating plate are compliance with drawing.

(3) The mark of the phase sequence on high voltage and low voltage side of the sample is clear and right.

(4)The surface of the sample has no collision and damage.

## 3. Standards

GB1094.1-1996 《Power transformers Part1: General》

GB1094.3-1985 《Power transformers Part3: Insulation levels and dielectric tests》

GB1094.5-1985 《Power transformers Part5: Ability to withstand short-circuit》

Contract requirements



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4. Test items and conclusions:

4.1 Measurement of insulation resistances and  $\tan \delta$  (Routine test) Test date: Aug.27,2003  
Humidity: 55% Oil temperature: 27°C

Measurement position	R <sub>60</sub> (GΩ)	R <sub>15</sub> (GΩ)	R <sub>60</sub> /R <sub>15</sub>	Tan δ
H.V.—L.V.&E	12.6	8.0	1.58	0.0037
L.V.—H.V. &E	9.8	8.3	1.18	0.0058
H.V.&L.V.—E	12.9	7.4	1.74	0.0081
Core-E	6100(MΩ)			

4.2 Measurement of voltage ratio and check of phase displacement (Routine test)

Test date: Aug.27,2003

H.V.		L.V.		Ratio	Measured deviation (%)			Conne- tion symbol
Tap position	Voltage (kV)	Tap position	Voltage (kV)		AB/ab	BC/bc	CA/ca	
1	37.63	/	10.5	3.58	0.06	0.08	0.10	YNd11
2	36.75			3.50	-0.07	-0.04	-0.03	
3	35.88			3.42	-0.19	-0.18	-0.17	
4	35.00			3.33	0.00	0.02	0.04	
5	34.13			3.25	-0.14	-0.12	-0.11	
6	33.25			3.17	-0.28	-0.26	-0.25	
7	32.38			3.08	-0.08	-0.06	-0.05	





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**4.3 Measurement of winding resistances (Routine test)**

Test date: Aug.27,2003

Oil temperature: 25°C

Winding	Tap position	Measured values (Ω)			Unbalancedness (%)
		A~O a~b	B~O b~c	C~O c~a	
H.V.	1	0.2292	0.2282	0.2282	0.44
	2	0.2206	0.2194	0.2195	0.55
	3	0.2113	0.2110	0.2110	0.14
	4	0.2007	0.1997	0.2001	0.50
	5	0.2145	0.2120	0.2136	1.17
	6	0.2230	0.2208	0.2222	0.99
	7	0.2340	0.2286	0.2331	2.33
L.V.	/	0.01469	0.01470	0.01473	0.27

Note: The unbalancedness of H.V. winding resistance is larger than the value specified in the standard because of lead construction according to manufacturer.

**4.4 Separate-source voltage withstand test (Routine test)**

Test date: Aug.27,2003

Test diagram is given in Annex 2-a

Humidity: 60%; Oil temperature: 25.0°C; Atmospheric press: 100.5kPa

Position	Applied voltage (kV)	Duration (s)	Results
H.V. neutral—L.V.&E	85	60	Passed
L.V.—H.V.&E	35	60	

**4.5 Induced overvoltage withstand test (Routine test)**

Test date: Aug.27, 2003

Test diagram is given in Annex 2-b

Humidity: 60%; Oil temperature: 25.0°C; Atmospheric press: 100.5kPa

Tap position	Applied voltage (kV)	Induced voltage (kV)	Induced multiple	Frequency (Hz)	Duration (s)	Results
	L.V.	H.V.				
4	21	70	2	150	40	Passed





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4.6 Measurement of no-load loss and current (Routine test)      Test date: Aug.27, 2003  
Test diagram is given in Annex 2-c

R.M.S. value voltage (kV)		No-load current		No-load loss (kW)	
Reading of mean value voltmeter	Reading of R.M.S. value voltmeter	(A)	(%)	Measured value	Corrected value
10.5	10.5	1.6	0.16	16.28	16.28

Note: The reading tolerance between R.M.S value voltmeter and mean value voltmeter is less than 3%.

4.7 Measurement of short-circuit impedance and load loss (Routine test)      Test date: Aug.27, 2003  
Test diagram is given in Annex 2-d

Oil temperature: 27°C

Winding	Tap position	Applied current I		Measured voltage (kV)	Short-circuit impedance (Each phase)		Load loss (kW)	Total loss (kW)
		(A)	I/Ir (%)		H.V. impedance (Ω)	(%)	Corrected value	Corrected value
					t=75°C I=Ir	t=75°C I=Ir	t=75°C I=Ir	t=75°C I=Ir
H.V.   L.V.	1	198	64.5	2.931	8.54	12.07	98.11	114.39
	4	234	70.9	2.853	7.04	11.49	94.12	110.40
	7	270	75.7	2.730	5.84	11.14	105.44	121.72

4.8 Test on transformer oil (Routine test)      Test date: Aug.27, 2003

tan δ (90°C)	Breakdown voltage (kV)
0.0010	52.68

4.9 Test on on-load tap-changers (Routine test)      Test date: Aug.27, 2003

Operation test:

- a. 8 complete operating cycles with the transformer un-energized;
- b. 1 complete operate cycle with the transformer is un-energized, with 85% of the rated operation voltage;
- c. 1 complete operating cycle with the transformer energized at rated voltage and frequency at no-load;
- d. 10 tap-change operations with ±2 steps on either side of the principal tap under on load test of transformer.

Auxiliary circuits dielectric test:

2kV (R.M.S.) 1 min separate-source voltage withstand test, passed.



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4.10 Leakage test (Routine test)      Test date: Aug.27, 2003

Test method	Applied pressure (kPa)	Duration (h)	Result
Atmospheric pressure	50	24	No leakage or damage

4.11 Short-circuit withstand test (Special test)      Test date: Sep.01, 2003

4.11.1 Calculated short-circuit current

Calculated short-circuit current (Reference temperature 75°C)

Tap position	Peak value(A)	Symmetrical value(A)	Multiple (K√2)
1	5919	2321	2.550
4	6561	2573	2550
7	7163	2809	2.550

4.11.2 Measurement of short-circuit current

Perform single-phase test, the single-phase supply is provided between one line terminal and the other two line terminals connected together, Test waveshapes have no distortion, Test oscillograms are shown in Page 13-15.

The percentage of peak value and symmetrical value is the ratio of applied current to calculated current.

Tap position	Applied current terminal	No.	Current measurement					
			Peak value		Symmetrical value		Duration (s)	Serial No.
			(A)	(%)	(A)	(%)		
1	A-BC	1	5272	89.1	2194	94.5	0.20	B03277-S01-1
		2	5873	99.2	2194	94.5	0.20	B03277-S01-2
		3	5229	88.3	2194	94.5	0.20	B03277-S01-3
		No.	Reactance measured					
			Measured reactance value (mH)			Deviation (%)		
			A	B	C	A	B	C
		before	26.43	26.82	26.53	/	/	/
		1	26.38	26.82	26.51	-0.19	<0.1	<0.1
		2	26.37	26.83	26.51	-0.23	<0.1	<0.1
		3	26.37	26.82	26.51	-0.23	<0.1	<0.1





Tap position	Applied current terminal	No.	Current measurement					Duration (s)	Serial No.
			Peak value		Symmetrical value				
			(A)	(%)	(A)	(%)			
4	B-AC	1	5805	88.5	2528	98.3	0.20	B03277-S02-1	
		2	6665	101.6	2528	98.3	0.20	B03277-S02-2	
		3	5365	81.8	2528	98.3	0.20	B03277-S02-3	
		No.	Reactance measured						
			Measured reactance value (mH)			Deviation (%)			
			A	B	C	A	B	C	
		before	22.04	22.26	22.13	/	/	/	
		1	21.95	22.29	22.09	-0.41	0.13	-0.18	
		2	21.95	22.30	22.09	-0.41	0.18	-0.18	
		3	21.95	22.30	22.09	-0.41	0.18	-0.18	

Tap position	Applied current terminal	No.	Current measurement					Duration (s)	Serial No.
			Peak value		Symmetrical value				
			(A)	(%)	(A)	(%)			
7	C-AB	1	5625	78.5	2704	96.3	0.20	B03277-S03-1	
		2	7105	99.2	2704	96.3	0.20	B03277-S03-2	
		3	5672	79.2	2704	96.3	0.20	B03277-S03-3	
		No.	Reactance measured						
			Measured reactance value (mH)			Deviation (%)			
			A	B	C	A	B	C	
		before	18.37	18.49	18.47	/	/	/	
		1	18.28	18.52	18.40	-0.49	0.16	-0.43	
		2	18.28	18.52	18.39	-0.49	0.16	-0.43	
		3	18.29	18.52	18.39	-0.44	0.16	-0.43	

The maximum deviation of short-circuit reactance is 0.49%.

#### 4.11.3 The out of tank inspection

There is no deformation of winding, connection or supporting structures, no traces of electrical discharge was found after S.C.T. The active part photos taken before and after S.C.T. are shown in Page 16 and Page 17.





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4.11.4 Repeat routine tests

4.11.4.1 Measurement of insulation resistances and  $\tan \delta$       Test date: Sep.02,2003  
Humidity: 60%      Oil temperature: 25.0°C

Measurement position	R <sub>60</sub> (GΩ)	R <sub>15</sub> (GΩ)	R <sub>60</sub> /R <sub>15</sub>	Tan δ
H.V.—L.V.&E	12.4	7.5	1.65	0.0038
L.V.—H.V. &E	9.70	8.3	1.17	0.0053
H.V.&L.V.—E	12.8	7.3	1.75	0.0082
Core-E	6000(MΩ)			

4.11.4.2 Measurement of voltage ratio and check of phase displacement

Test date: Sep.02,2003

H.V.		L.V.		Ratio	Measured deviation (%)			Conne- tion symbol
Tap position	Voltage (kV)	Tap position	Voltage (kV)		AB/ab	BC/bc	CA/ca	
1	37.63	/	10.5	3.58	0.06	0.07	0.10	YNd11
2	36.75			3.50	-0.06	-0.05	-0.04	
3	35.88			3.42	-0.18	-0.16	-0.17	
4	35.00			3.33	0.00	0.03	0.05	
5	34.13			3.25	-0.14	-0.13	-0.11	
6	33.25			3.17	-0.29	-0.27	-0.26	
7	32.38			3.08	-0.09	-0.07	-0.06	



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4.11.4.3 Measurement of winding resistances      Test date: Sep.02,2003

Oil temperature: 25°C

Winding	Tap position	Measured values (Ω)			Unbalancedness (%)
		A~O a~b	B~O b~c	C~O c~a	
H.V.	1	0.2275	0.2269	0.2272	0.26
	2	0.2190	0.2182	0.2185	0.37
	3	0.2107	0.2102	0.2101	0.29
	4	0.1999	0.1991	0.1994	0.40
	5	0.2146	0.2109	0.2119	1.74
	6	0.2218	0.2193	0.2208	1.13
	7	0.2322	0.2302	0.2265	2.48
L.V.	/	0.01460	0.01462	0.01471	0.75

Note: The unbalancedness of H.V. winding resistance is larger than the value specified in the standard because of lead construction according to manufacturer.

4.11.4.4 Separate-source voltage withstand test      Test date: Sep.02,2003

Humidity: 60%; Oil temperature: 25.0°C; Atmospheric press: 100.5kPa

Position	Applied voltage (kV)	Duration (s)	Results
H.V. neutral—L.V.&E	72.25	60	Passed
L.V.—H.V.&E	29.75	60	

4.11.4.5 Induced overvoltage withstand test      Test date: Sep.02,2003

Humidity: 60%; Oil temperature: 25.0°C; Atmospheric press: 100.5kPa

Tap position	Applied voltage (kV)	Induced voltage (kV)	Induced multiple	Frequency (Hz)	Duration (s)	Results
	L.V.	H.V.				
4	17.85	59.5	1.7	150	40	Passed





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4.11.4.6 Measurement of no-load loss and current      Test date: Sep.02,2003

R.M.S. value voltage (kV)		No-load current		No-load loss (kW)	
Reading of mean value voltmeter	Reading of R.M.S. value voltmeter	(A)	(%)	Measured value	Corrected value
10.5	10.5	1.6	0.15	16.74	16.74

Note: The reading tolerance between R.M.S value voltmeter and mean value voltmeter is less than 3%.

4.11.4.7 Measurement of short-circuit impedance and load loss      Test date: Sep.02,2003

Oil temperature: 25°C

Winding	Tap position	Applied current I		Measured voltage (kV)	Short-circuit impedance (Each phase)		Load loss (kW)	Total loss (kW)
		(A)	I/Ir (%)		H.V. impedance (Ω)	(%)	Corrected value	Corrected value
					t=75°C I=Ir	t=75°C I=Ir	t=75°C I=Ir	t=75°C I=Ir
H.V.   L.V.	4	234	70.9	2.853	7.04	11.49	94.73	111.47

4.11.4.8 Test on transformer oil      Test date: Sep.02,2003

tan δ (90°C)	Breakdown voltage (kV)
0.0011	52.57

4.11.4.9 Test on on-load tap-changers      Test date : Sep.02,2003

Operation test:

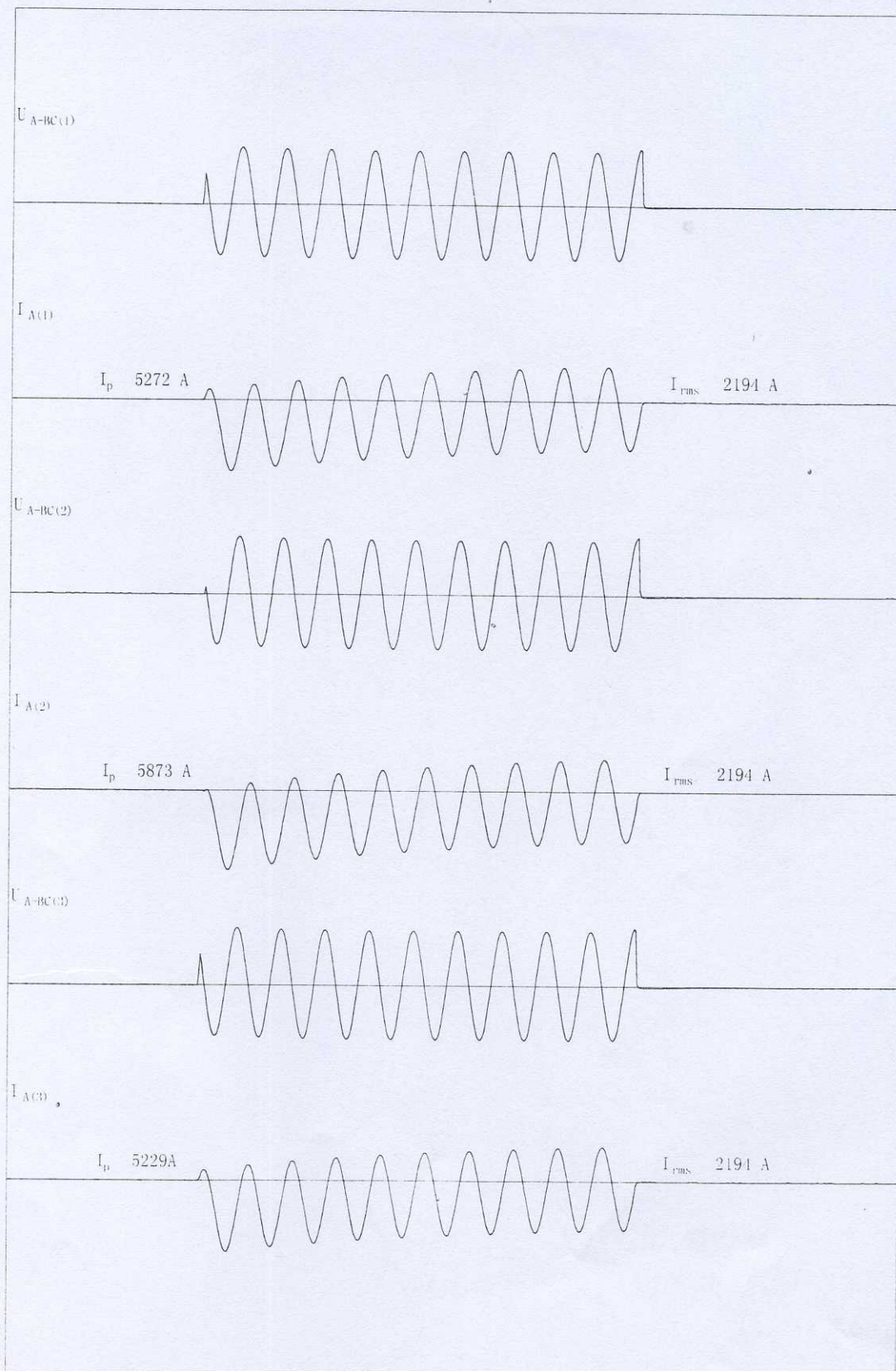
- a. 8 complete operating cycles with the transformer un-energized;
- b. 1 complete operate cycle with the transformer is un-energized, with 85% of the rated operation voltage;
- c. 1 complete operating cycle with the transformer energized at rated voltage and frequency at no-load;
- d. 10 tap-change operations with ±2 steps on either side of the principal tap under on load test of transformer.

Auxiliary circuits dielectric test:

2kV (R.M.S.) 1 min separate-source voltage withstand test, passed.

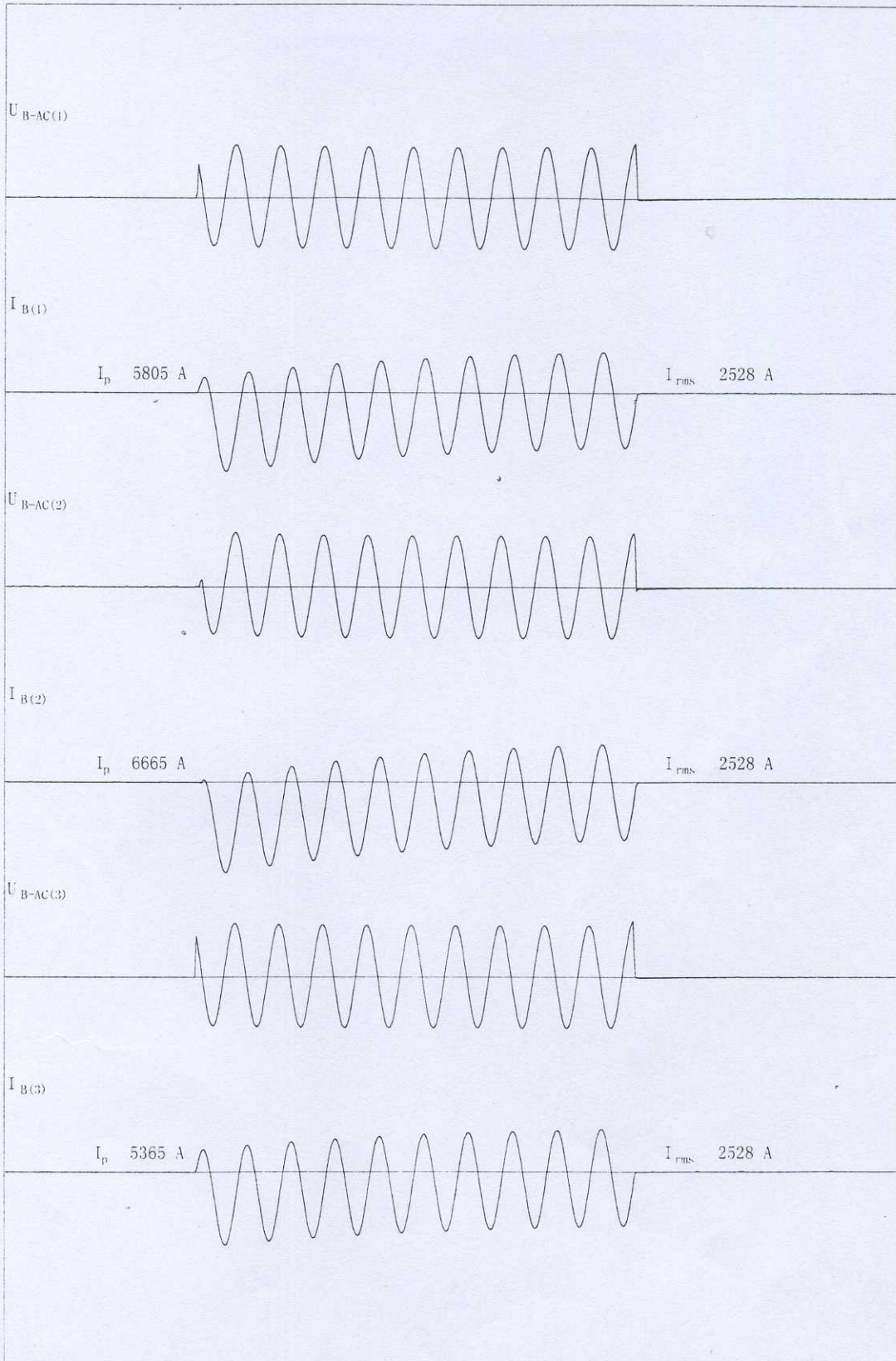






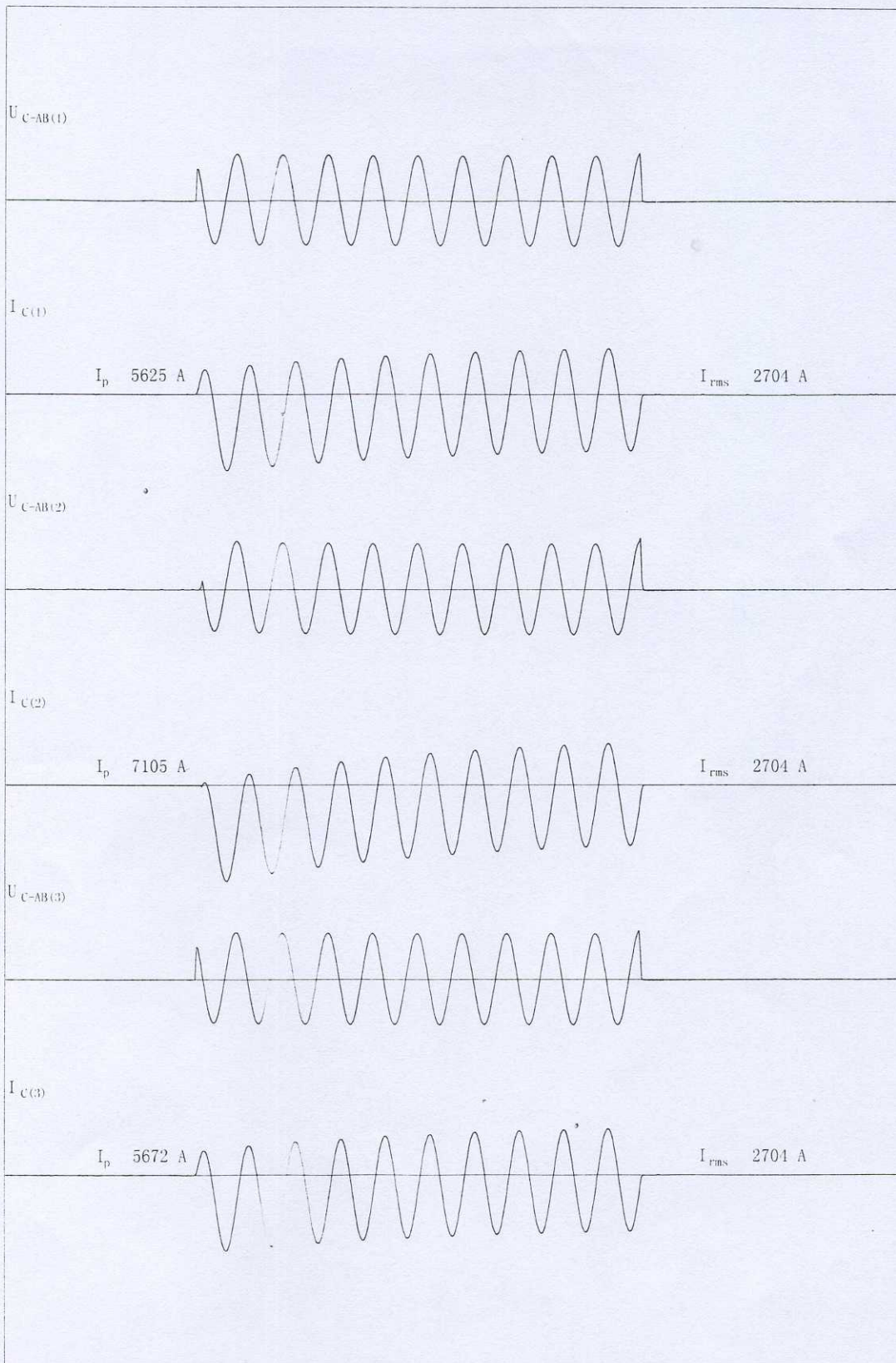
B03277-S01





B03277-S02





B03277-S03





Test Report

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High voltage side before S.C.T.:



Low voltage side before S.C.T.:



**CTQC**  
国家变压器质量监督检验中心



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High voltage side after S.C.T.:



Low voltage side after S.C.T.:





RATING PLATES AND OUTLINE PHONE



Rating plate:



Outline:

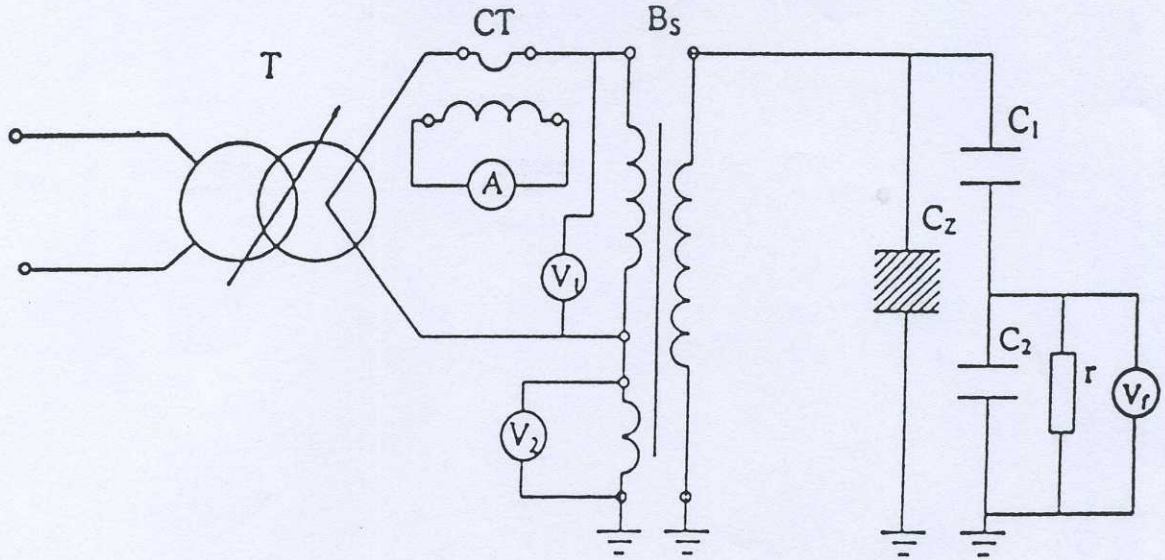


**CTQC**  
国家变压器质量监督检验中心



TEST CIRCUIT





外施耐压试验原理图

Separate-source voltage withstand test diagram

T—调压器 Regulator      A—电流表 Ampremeter

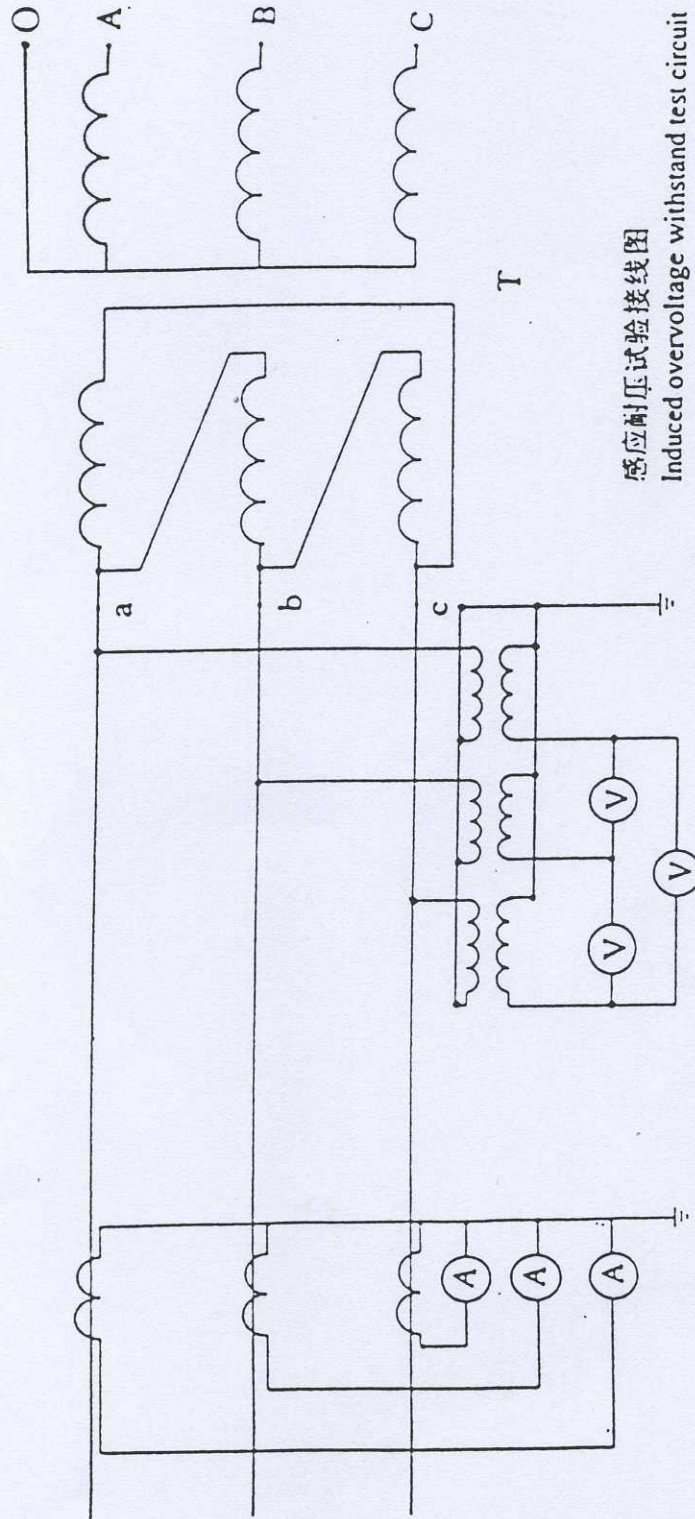
B<sub>S</sub>—试验变压器 Testing transformer      CT—电流互感器 Current transformer

V<sub>1</sub>、V<sub>2</sub>—电压表 Voltmeter      C<sub>1</sub>、C<sub>2</sub>—分压电容 Capacitor divider

C<sub>Z</sub>—试品 Sample      r—放电电阻 Discharge resistance

V<sub>f</sub>—峰值电压表 Peak value voltmeter





感应耐压试验接线图

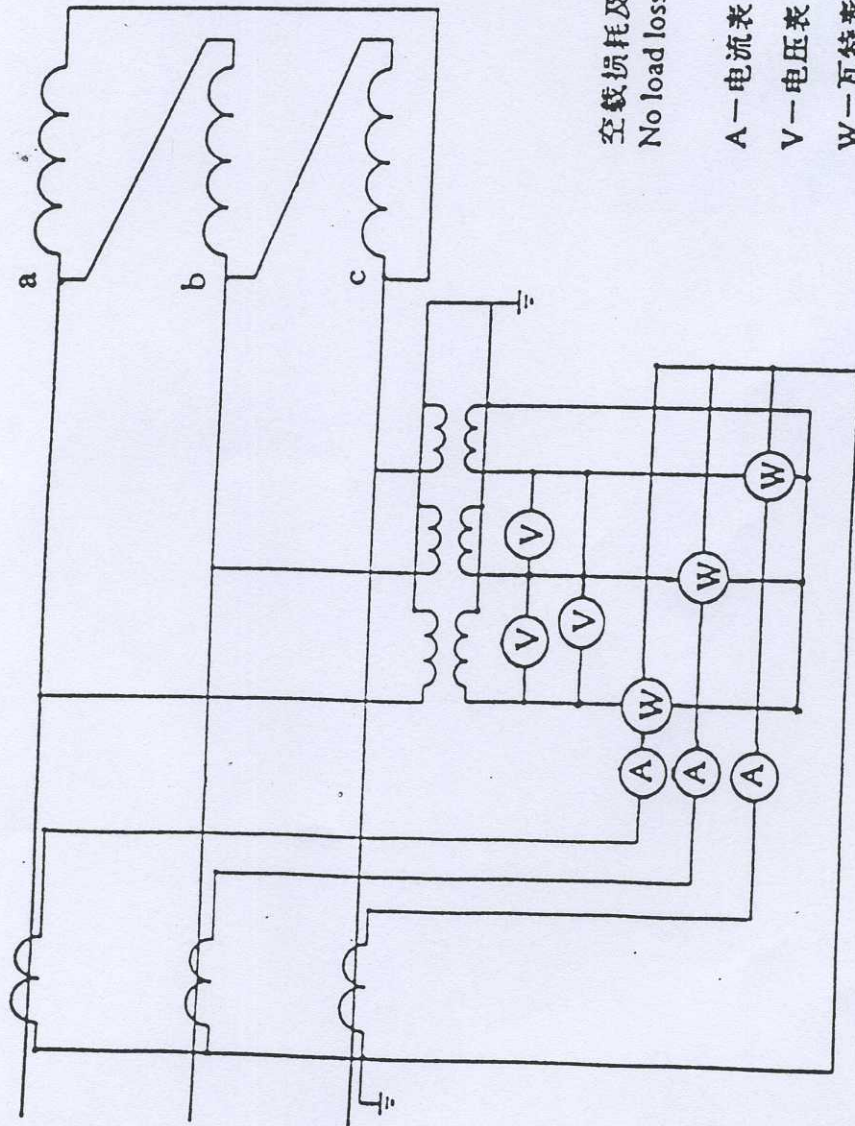
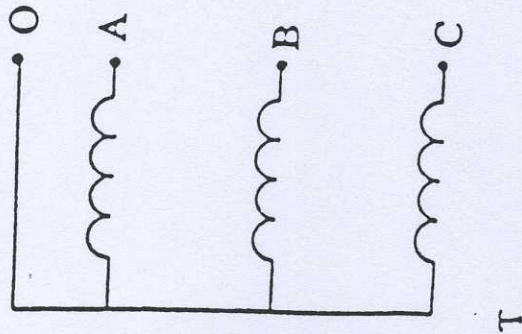
Induced overvoltage withstand test circuit

T- 被试变压器 Sample

A- 电流表 Amperemeter

V- 电压表 Voltmeter





空载损耗及空载电流测量线路图

No load loss and current measurement circuit

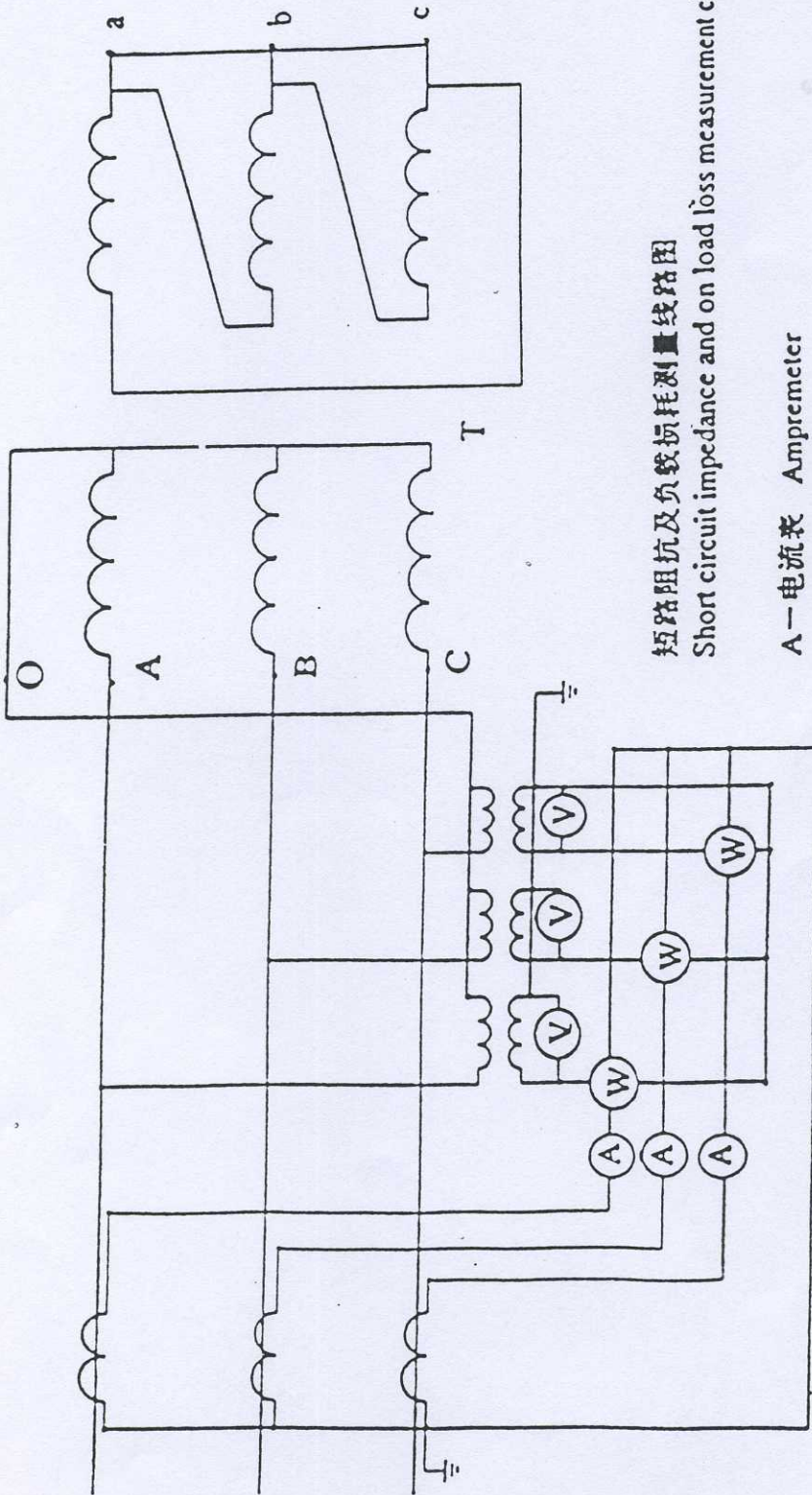
A—电流表 Ampmeter

V—电压表 Voltmeter

W—瓦特表 Wattmeter

T—被试变压器 Sample

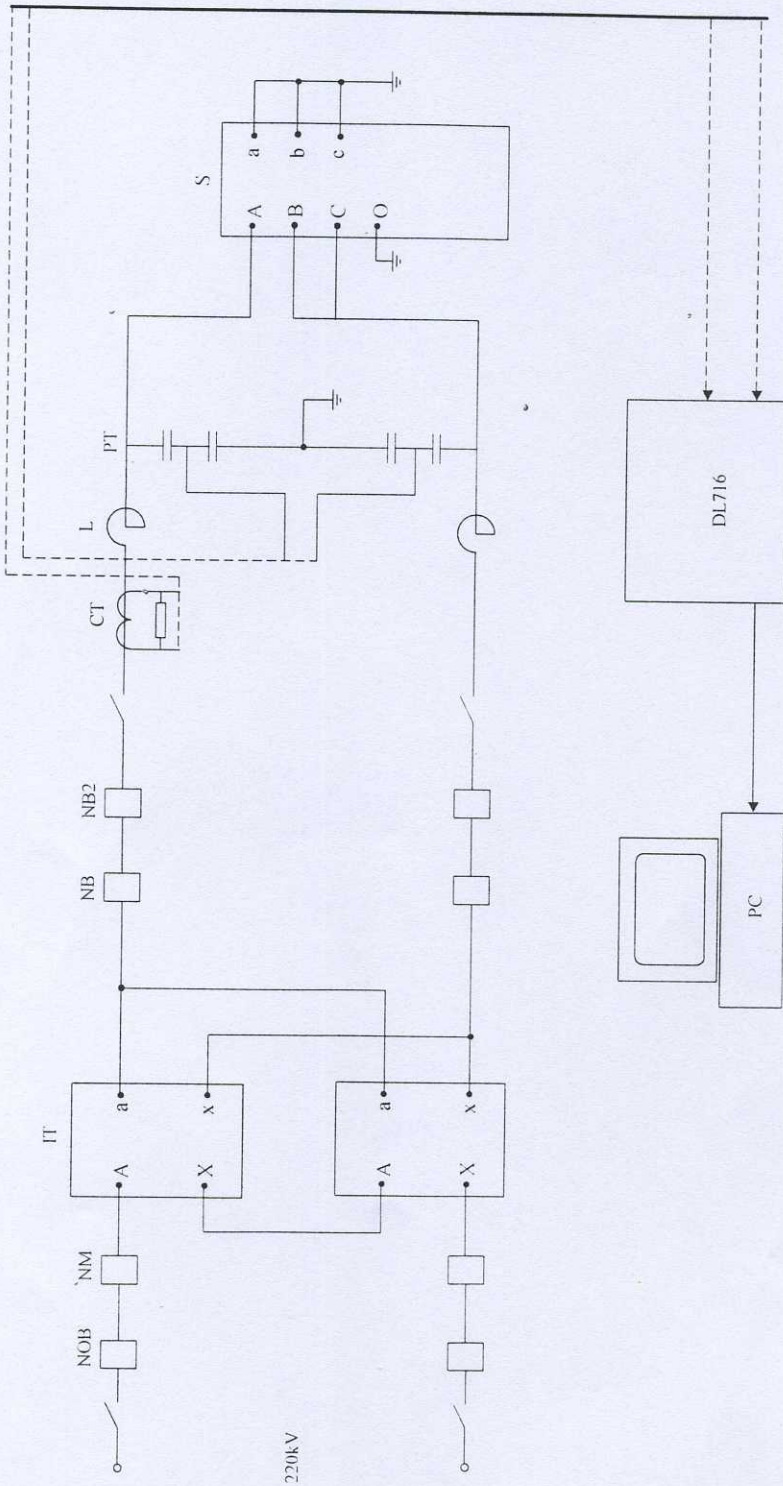




短路阻抗及负载损耗测量线路图  
Short circuit impedance and on load loss measurement circuit

- A—电流表 Ampere meter
- V—电压表 Voltmeter
- W—瓦特表 Wattmeter
- T—被试变压器 Sample





Short-time current tests of transformer:

IT: Intermediate transformer

CT: Standard current transformer

PT: Voltage divider

L: Reactors

NOB, NM, NB, NB2: SF6 switchgear

S: Sample

DL716: 16 channels analyzer

PC: Computer