KEMA

TYPE – APPROVAL

Based on tests witnessed

KEMA Nederland B.V. operating as an independent inspection body accredited according to the International standard EN 45004 hereby declares that the manufacturer

Wenzhou Yikun Electric Co., Ltd

at Wenzhou, China

has successfully type tested the product as mentioned below:

Metal-oxide surge arrester without gaps

Of type: YH 10W-24/75

The type test programme comprised all relevant type tests of the international standard

IEC 60099-4 Edition 1.2 (2001-12)

The tests were carried out strictly in accordance with the standard.
The tests were carried out in the laboratories of the manufacturer and were witnessed by KEMA inspectors.
This approval with number

02-31131TA

is issued based on the results of witnessed tests as stated in the inspection report 70240117-TDT 02-31131A issued by KEMA Nederland B.V.

The tests have been carried out on one single test object submitted by the manufacturer. The approval does not include an assessment of the manufacturer's production. Conformity of the production with the object tested is the responsibility of the manufacturer.

The approval is issued on

4-12-2002

The validity of this document expires five years after the date of issue of the inspection report or at the moment that modifications are introduced that might affect the performance of the equipment tested.

On behalf of KEMA Nederland B.V.

Managing Director KEMA T&D Testing Services

Ir. P.G.A. Bus

Product manager Inspection Services

Ing. F.F.P. van den Broek

STERIN

The tests were carried out in the laboratory of the manufacturer who is therefore jointly responsible for the correctness of the results obtained. This approval applies only to the specific object tested from the particular place of manufacture. The responsibility for conformity of any object having the same designation with that tested rests with the manufacturer.

STERIN

KEMA

70240117-TDT 02-31131A 02-12-03

Type testing on metal-oxide surge arrester without gaps, type YH10W-24/75, manufacturer Wenzhou Yikun Electric Co., Ltd., Wenzhou, China

KEMA T&D TESTING SERVICES

INSPECTION REPORT

Report no.	70240117-TDT 02-31131A
Client	Wenzhou Yikun Electric Co., Ltd. 6F, West-South Side Chezhan Avenue Wenzhou, China
Reference	agreement with ref. TDT 02-23735C
Concerning	type testing
Date	September 2 to October 23, 2002
Place	Xi'an, China
Object	metal-oxide surge arrester without gaps
Type	YH10W-24/75
Manufacturer	Wenzhou Yikun Electric Co., Ltd. Wenzhou, China

REQUIREMENTS
As per IEC 60099-4 Edition 1.2 (2001-12).

INSPECTION PROGRAMME
The programme was specified by KEMA.
For the programme we refer to page 3.

SUMMARY AND CONCLUSION
The results obtained relate only to the work ordered and to the material inspected.
The arrester withstood all type tests as per inspection program of page 3.

Author A.W. van Boetzelaer

KEMA Nederland B.V.

A.J.G. Klomp
KEMA T&D Testing Services

This B-report consists of:
12 pages
2 annexes (24 pages)

Arnhem, 3 December 2002

MATERIAL DATA metal-oxide surge arrester without gaps

Type		YH10W-24/75
Manufacturer		Wenzhou Yikun Electric Co., Ltd., Wenzhou, China
Housing material		polymer
Rated voltage Ur	kV	24
Reference voltage (1 mA)	kV	≥ 24
Rated frequency	Hz	50
Nominal discharge current	kA	10
Continuous operating voltage Ucov	kV	19,5
Residual voltage at		
- nominal discharge current 8/20 μs	kV	≤ 75
- switching current 30/60 μs	kV	≤ 58
- steep current 1/10 μs	kV	≤ 81
Line discharge class		1
Power frequency versus time		1,15 Ur / 0,1 s 1,1 Ur / 30 s 0,9 Ur / 1200 s
Housing insulation level		
- lightning impulse	kV	125
- power frequency	kV	55
Arrester mechanical load		
- torsional	Nm	60
- cantilever	N	147
Block dimensions		
- diameter	mm	40
- height	mm	20
Number of metal-oxide blocks		8
Rated short-circuit withstand current	kA	-
Drawing		6805.0

For the construction drawing of the transformer reference is made to annex A.

INSPECTION PROGRAM

The inspection program was specified by KEMA. All measurements and tests are in accordance with IEC 60099-4 (2001-12).

	Kind of test	Standard	Clause
1	COMPLETE ARRESTER		
1.1	Reference voltage measurement	IEC 60099-4	8.1 a
1.2	Internal partial discharge test	IEC 60099-4	8.1 c
1.3	Mechanical tests	IEC 60099-4	
1.3.1	Moisture ingress test	IEC 60099-4	9.7.9
1.3.2	Weather ageing test	IEC 60099-4	9.7.10
2	ARRESTER HOUSING		
2.1	Lightning impulse voltage test	IEC 60099-4	7.2.6
2.2	Power frequency voltage test, wet	IEC 60099-4	7.2.8
3	ARRESTER SECTION		
3.1	Residual voltage test	IEC 60099-4	
3.1.1	Lightning impulse	IEC 60099-4	7.3.2
3.1.2	Switching impulse	IEC 60099-4	7.3.3
3.1.3	Steep current	IEC 60099-4	7.3.1
3.2	Long duration current impulse withstand test	IEC 60099-4	7.4.3
3.3	Operating duty test	IEC 60099-4	
3.3.1	Accelerated ageing test	IEC 60099-4	7.5.2
3.3.2	Conditioning	IEC 60099-4	7.5.4.1
3.3.3	Operating duty test, application of impulses	IEC 60099-4	7.5.4.2

PERSONS ATTENDING THE INSPECTION

Mr Dick Yu	Wenzhou Yikun Electric Co., Ltd.
Mr Wang Tu-qiu	Wenzhou Yikun Electric Co., Ltd.

THE INSPECTION WAS CARRIED OUT BY

Mr André W. van Boetzelaer	KEMA Nederland B.V.

PURPOSE OF THE INSPECTION

Purpose of the inspection was to verify whether the arrester complies with the specified requirements.

DESCRIPTION AND RESULTS OF THE TEST

0 INSPECTION OF THE TEST SET-UP

The tests were carried out in the laboratory of China National Centre for Quality Supervision and Test of Insulators and Surge Arresters in Xi'an, China, who is therefore jointly responsible for the correctness of the results obtained. The measuring devices and the test set-up were checked by KEMA and where necessary calibrated.

Result

The inspection results did not give rise to remarks

1 COMPLETE ARRESTER

1.1 Reference voltage measurement

The reference voltage of the arrester is defined as the power frequency voltage applied to the arrester when the resistive component of the current flowing through the arrester is 1 mApeak. The reference voltage should be greater than the value as stated in the material data.
The reference voltage measurement was carried out on three complete arresters.
The results of this measurement are summarised in annex B.

Result

The test results fulfilled the requirements.

1.2 INTERNAL PARTIAL DISCHARGE TEST

The internal partial discharges were measured when applying a power frequency voltage to the arrester.

The voltage was first raised to the rated voltage, held for 10 s and then decreased to 1,05 times the continuous operating voltage at which level the partial discharges were measured.
The partial discharge level should be below 10 pC.
The partial discharge measurement was carried out on three complete arresters.
The results of this measurement are summarised in annex B.

Result

The test results fulfilled the requirements.

1.3 Mechanical tests

1.3.1 MOISTURE INGRESS TEST

One sample of a complete arrester was submitted to the following test sequence:
- initial measurements: partial discharge - watt losses - and residual voltage measurement
- terminal torque test at rated torque
- thermo mechanical test in four directions with rated cantilever load at temperatures of respectively +60 °C, -25 °C, +45 °C and -40 °C
- water immersion test in boiling water with NaCl for 42 hours
- visual inspection of the sample
- verification tests: partial discharge - watt losses - and residual voltage measurement.

The results of this test are summarised in annex B.

The acceptance criteria are:
- no mechanical change
- increase of watt losses should be less than 20%
- partial discharges < 10 pC at 1,05 Ucov
- change of residual voltage should be less than 5%.

Result

The test results fulfilled the requirements.

1.3.2 WEATHER AGEING TEST

One ratio arrester with an Ucov of 13,6 kV and an equivalent creep age distance was specially prepared for this test. This sample was submitted to the following test sequence:

- initial measurements: reference voltage - and partial discharge measurement
- test series A: 1000 hours at a constant power frequency voltage of Ucov (13,6 kV) in a climate room sprayed with salt water and a flow rate of 0,4 ± 0,1 l/h/m^3
- verification tests: reference voltage - and partial discharge measurement.

The results of this test are summarised in annex B.

The acceptance criteria are:

- change of reference voltage should be less than 5%
- partial discharges < 10 pC at 1,05 Ucov.

Result

The test results fulfilled the requirements

2 ARRESTER HOUSING

2.1 Lightning impulse voltage test

One empty housing was subjected to a standard lightning impulse voltage dry test with 15 impulses of positive polarity and 15 impulses of negative polarity and a crest value of 135 kV.
The results of this test are summarised in annex B.

The acceptance criteria is:
- not more than two external disruptive discharges per 15 impulses.

Result

The test results fulfilled the requirements.

2.2.1 POWER FREQUENCY VOLTAGE TEST, WET

One empty housing was tested with a power frequency of 70 kV, 50 Hz during 1 minute under artificial rain in accordance with IEC 60060-1 (1989).
The results of this test are summarised in annex B.
The acceptance criteria is:
- no external disruptive discharge during the test.

Result

The test results fulfilled the requirements.

3 ARRESTER SECTION

3.1 Residual voltage test

All residual voltage tests were carried out on the same three arrester sections. The rated voltage of one section is 3 kV and consisted of one metal-oxide block. By multiplying the measured residual voltage by the number of sections per arrester the equivalent residual voltage of the arrester was calculated.

3.1.1 LIGHTNING IMPULSE

Three lightning current impulses with a waveform of 8/20 μs with a peak value of respectively 5, 10 and 20 kA, this is respectively 0,5, 1 and 2 times the nominal discharge current, were applied to each of the three sections. The maximum value of the residual voltage was recorded.
The results of this test are summarised in annex B.
The acceptance criteria is:

the equivalent residual voltage of the arrester at nominal discharge current (10 kA) should be below 75 kV.

Result

The test results fulfilled the requirements.

3.1.2 SWITCHING IMPULSE

One switching impulse with a waveform of 30/60 μs and a peak value of 500 A was applied to each of the three sections. The maximum value of the residual voltage was recorded.
The results of this test are summarised in annex B.
The acceptance criteria is:

- the equivalent residual voltage of the arrester at nominal discharge current should be below 58 kV.

Result

The test results fulfilled the requirements.

3.1.3 STEEP CURRENT

One steep current impulse with a waveform of 1/10 μs and a peak value of 10 kA was applied to each of the three sections. The maximum value of the residual voltage was recorded.

The results of this test are summarised in annex B.
The acceptance criteria is:

- the equivalent residual voltage of the arrester at nominal discharge current should be below 81 kV.

Result

The test results fulfilled the requirements.

3.2 Long duration current impulse withstand test

The long duration current impulse withstand test was carried out on three arrester sections. The rated voltage of one section is 3 kV and consisted of one metal-oxide block. The line discharge class is 1.
Before this test the lightning impulse residual voltage at nominal discharge current and the switching impulse residual voltage at 125 A was measured. The latter was used for calculating the energy, which should be injected into the sample during every long duration impulse. This energy was determined as 3,33 kJ. The duration of the impulse is 2000 μs.
Each sample was tested with 18 long duration impulses divided in 6 groups. Between each impulse there is a pause of 50 to 60 s and between each group the samples are cooled down to ambient.
Following the test and after the samples are cooled down to ambient the lightning impulse residual voltage at nominal discharge current was measured.
The results of this test are summarised in annex B.
The acceptance criteria is:

- no evidence of puncture, flashover or other significant damage
- change of residual voltage should be less than 5%.

Result

The test results fulfilled the requirements.

3.3 Operating duty test

The operating duty test was carried out on three arrester sections. The rated voltage of one section is 3 kV and consisted of one metal-oxide block. Successively the following three tests were carried out.

3.3.1 ACCELERATED AGEING TEST

This test is designed to determine the elevated test voltages and to decide whether new or aged samples shall be used in the operating duty test.
The three samples were subjected to a long duration test with a corrected Ucov of 2,91 kV during 1000 hours. During the whole test duration the resistor power losses are measured. Taken into account the results of these loss measurements and using the calculation method described in the IEC standard the choice between aged and new samples for the following tests has to be made.

3.3.2 CONDITIONING

The conditioning test was made on three new same samples. Before the conditioning test the lightning impulse residual voltage at nominal discharge current was determined. Following this the three samples were exposed to 20 lightning current impulses of 8/20 μs with nominal discharge current. The impulses were applied while the sample was energized at 1,2 x Ucov. The 20 impulses are applied in four groups of 5 impulses. The interval between each impulse was 50-60 s and between each group 25-30 min.

3.3.3 OPERATING DUTY TEST, APPLICATION OF IMPULSES

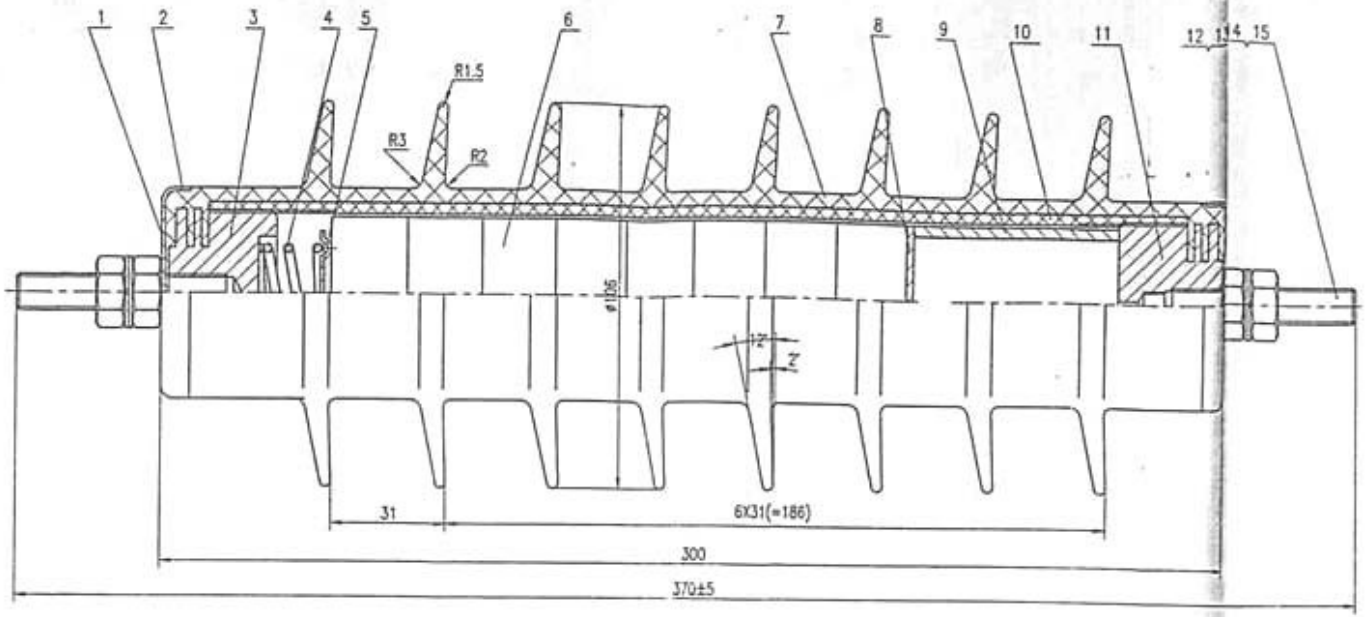
The operating duty test is made on the same samples as during conditioning, above. The samples were placed in a housing, which is thermal equivalent to the housing of a complete arrester.
All three samples were tested with two high current impulses of 100 kA, 4/10 μs. Before the application of the second impulse the samples were pre heated to a temperature of 60 °C.

Immediately after the second application of the high current impulse, a power frequency of Ur during 10 s and Ucov during 30 min. was applied. During these 30 min. the power dissipation of the sample was measured.
Following this and after the samples are cooled down to ambient the lightning impulse residual voltage at nominal discharge current was measured.
The results of this test are summarised in annex B.
The acceptance criteria is:

- the measurement of the losses during the voltage application did not show thermal instability
- change of residual voltage should be less than 5%
- no evidence of puncture, flashover or other significant damage.

Result

The test results fulfilled the requirements



ANNEX A , page 1

序号	代号	名称	数量	材料	单重	总重	备注
					单重(kg)		
15	GB93-87	弹垫 12	2	1Cr18Ni9Ti	0.003	0.006	
14	GB97.1-85	垫圈 12	4	1Cr18Ni9Ti	0.0033	0.0132	
13	GB6170-84	螺母 M12	4	1Cr18Ni9Ti	0.014	0.056	
12	GB73-85	圆柱螺栓M12X60	2	1Cr18Ni9Ti	0.0375	0.075	
11	6805.1.1-6	下电极	1	LY12CZ挤圆A级		0.115	
10	6805.1.1-5	绝缘筒	1	环氧玻璃纤维棒		0.122	
9	6805.1.1-3	垫筒	1	LY12CZ挤圆A级		0.044	
8	6805.1.1-4	垫片	1	LY12CZ挤圆A级		0.045	
7		中部	1	硅橡胶		0.7	
6	6805.1.1-2	电阻片φ40X(20±1)	8	ZnO	0.152	1.216	
5	6301.1.1-3	垫片	1	Q235		0.013	镀月
4	6301.1.1-2	弹簧	1	60Si2MnA		0.011	镀月
3	6805.1.1-1	上电极	1	LY12CZ挤圆A级		0.136	
2	6805-2	上下盖	2	1Cr18Ni9Ti	0.03	0.06	
1	6805-1	铭牌	1	铝板 L3M0.5		0.0027	

总装图	温州益坤电气有限公司
	24kV 10kA 避雷器
S A B	2.62 1:1
共 11 页 第 1 页	6805.0

CNACL
No.0224

(99)量认(国)字(A0196)号　国质监认字(059)号

No. WB-091-2002

国家绝缘子避雷器质量监督检验中心

CHINA NATIONAL CENTRE FOR QUALITY SUPERVISION AND TEST OF INSULATORS AND SURGE ARRESTERS

检 验 报 告

TEST REPORT

Object
产 品 名 称 YH10W—24/75 Polymeric Housed Metal Oxide Surge Arrester Without Gaps

Client
客 户 名 称 Wenzhou Yikun Electric Co.,Ltd.

Classification
检 验 类 别 Type Test

中 国 西 安
XIAN CHINA

2002 年 10 月 28 日

国家绝缘子避雷器质量监督检验中心
检验报告专用章

CHINA NATIONAL CENTRE FOR QUALITY SUPERVISION AND TEST OF INSULATORS AND SURGE ARRESTERS

TEST REPORT

NO.WB—091—2002

Name	Polymeric Housed Metal Oxide Surge Arrester Without Gaps	Type	YH10W—24/75
		Trade Mark	YI KUN
Consignor	Wenzhou Yikun Electric Co.,Ltd.	Manufacturer	Wenzhou Yikun Electric Co.,Ltd.
Representative	Wang Tu-qiu	Classification	Type Test
Address And Post Code	Hexiang road, Aojiang, Pingyang , Wenzhou Zhejiang ,China 325401	Telephone	86—0577—63654819
		Fax.	86—0577—63639100
Quantity of Samples	Arrester:3,Ratio arrester:1, section:25,Housing:1.	Samples Received Date	2002.08.30
		Test Date	2002.09.02~2002.10.22
Serial Number	Arrester:001~003; section:1~25, Ratio arrester:007, Housing :4.		
Test Judge	IEC 60099-4:2001-12 Metal-oxide surge arresters without gaps for a.c. systems		
Test Items	All test items see page 2 of this report.		
Test Conclusion	This surge arresters pass all 8 items of type test and is deemed satisfactory to meet standards specifications. (Offical Stamp) Confirmed on 2002.10.28		
Remarks	1. The arrester height is: 304 mm,Housing is scarlet,its diameter is 58 mm; diameter of sheds is 105 mm. 2. The size of resistors is Φ40 ×20mm. 3. The arrester has 8 piecese of resistors.		

CNACL No. 0224

Approved: 李凡 **Checked:** **Editor:** **Test-leader:**

CHINA NATIONAL CENTRE FOR QUALITY SUPERVISION AND TEST OF INSULATORS AND SURGE ARRESTERS TEST REPORT

Type Test Items

No.	Test Items	Req.	Test Data	Result
1	Power frequency reference voltage test	Voltage at1mA≥24 kV (peak/$\sqrt{2}$)	28 kV	passed
2	Partial discharge test	≤10pC	2.3~3.4 pC	passed
3	Residual voltage test	8/20μ s U_{10kA}≤75 kV 1/10μ s U_{10kA}≤81 kV 30/60μ s U_{500A}≤58 kV	72.6 kV 77.4 kV 55.4 kV	passed
4	Long duration current impulse withstand test	Class 1 line discharge	passed	passed
5	Operating duty test	4/10μ s, 100 kA	passed	passed
6	Insulation with--stand test	Lightning impulse withstand 170kV, 15 times positive and negative; Power frequence voltage (wet) withstand70kV, 1 min	passed	passed
7	Moisture ingress test	Withstand 60±5℃ ~ -40±5℃ heat-cool 2 times,boiling 42h in boiled 0.1%Nacl water;immering 50℃ water, test within 8 h after take out	passed	passed
8	Weather ageing test	Applied Uc 1000 hours in salt fog	passed	passed

Test Conclusion: Satisfied.

CNACL
No. 0224

CHINA NATIONAL CENTRE FOR QUALITY SUPERVISION AND TEST OF INSULATORS AND SURGE ARRESTERS TEST REPORT

1 Power Frequency Reference Voltage Test

No.	001	002	003	Req.
A.C. Reference voltage at 1mA (kV, peak/$\sqrt{2}$)	28	28	28	⩾24

Test Conclusion: Satisfied.

2 Partial Discharge Test

No.	Applied voltage kV(r.m.s)	P.D. Value pC
001	20.5	2.3
002	20.5	3.4
003	20.5	2.5
Req.	20.5	⩽10

Test Conclusion: Satisfied.

3 Residual Voltage Test

3.1 8/20μ s lightning impulse current residual voltage (see Fig1~Fig3)

No.	Residual voltage of sections kV			Equivalent residual voltage of arresters at 10 kA kV	Req. kV
	5 kA	10 kA	20 kA		
1	8.40	9.07	10.1	72.6	⩽ 75
8	8.34	9.04	10.17		
16	8.33	8.99	10.11		

3.2 30/60μ s switching impulse current residual voltage (see Fig4~Fig6)

No.	Residual voltage of sections at 500A kV	Equivalent residual voltage of arresters at 500A kV	Req. kV
1	6.93	55.4	⩽ 58
8	6.84		
16	6.86		

3.3 1/10μ s steep impulse current residual voltage (see Fig7~Fig9)

No.	Residual voltage of sections at 10kA kV	Residual voltage of arresters at 10kA kV	Req. kV
1	9.67	77.4	⩽ 81
8	9.57		
16	9.56		

Test Conclusion: Satisfied.

CHINA NATIONAL CENTRE FOR QUALITY SUPERVISION AND TEST OF INSULATORS AND SURGE ARRESTERS TEST REPORT

4 Long Duration Current Impulse Withstand Test (see Fig10~Fig12)

No.			7	17	25	Req.
U_{10kA} ,before		kV	9.04	9.03	9.14	/
U_{125A}		kV	6.44	6.46	6.53	/
Time		μs	2020	2020	2020	2000
1st.	Current	A	248	252	250	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.40	3.46	3.43	3.33
2nd.	Current	A	250	257	257	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.43	3.52	3.52	3.33
3th.	Current	A	252	255	248	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.46	3.50	3.40	3.33
4th.	Current	A	250	262	244	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.43	3.59	3.35	3.33
5th.	Current	A	253	257	251	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.47	3.52	3.44	3.33
6th.	Current	A	262	253	248	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.59	3.47	3.41	3.33
7th.	Current	A	248	250	252	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.40	3.42	3.46	3.33
8th.	Current	A	250	249	248	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.43	3.42	3.4	3.33
9th.	Current	A	255	260	246	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.50	3.56	3.37	3.33
10th.	Current	A	252	248	253	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.46	3.41	3.47	3.33
11th.	Current	A	248	253	245	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.41	3.47	3.36	3.33

No.			7	17	25	Req.
12th.	Current	A	250	249	247	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.43	3.42	3.39	3.33
13th.	Current	A	248	257	252	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.40	3.52	3.46	3.33
14th.	Current	A	252	250	246	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.46	3.42	3.37	3.33
15th.	Current	A	253	255	250	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.47	3.50	3.42	3.33
16th.	Current	A	250	257	251	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.43	3.52	3.44	3.33
17th.	Current	A	253	249	250	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.47	3.42	3.43	3.33
18th.	Current	A	255	250	245	/
	Voltage	kV	6.79	6.79	6.79	/
	Energy	kJ	3.50	3.43	3.36	3.33
Checking samples			all right	all right	all right	all right
U_{10kA}, after		kV	8.97	8.97	9.13	/
Varity of U_{10kA}		%	-0.8	-0.7	-0.1	≤5

Test Conclusion: Satisfied.。

5 Operating duty Test

5.1 Accelerated ageing test

5.1.1 The parameters of arrester

Ur=24 kV(r.m.s) ; Uc=19.5 kV(r.m.s) ; U_{10kA}≤75 kV。

5.1.2 The parameters of test

No.		11	12	13	Req.
U_{ct}	kV(r.m.s)	2.91	2.91	2.91	2.62
Time	h	1000	1000	1000	1000

CHINA NATIONAL CENTRE FOR QUALITY SUPERVISION AND TEST OF INSULATORS AND SURGE ARRESTERS TEST REPORT

5.1.3 The data of test

Power losses w / Time	No. 11	12	13	Temperature ℃
2002.09.03 18:00	1.164	1.100	1.106	116
2002.09.04 08:56	1.105	1.054	1.096	115
2002.09.04 12:00	1.030	0.987	1.032	116
2002.09.05 10:01	1.093	1.031	1.116	115
2002.09.06 08:10	1.155	1.072	1.194	116
2002.09.06 15:30	1.020	0.946	1.042	115
2002.09.07 10:10	1.030	0.948	1.047	115
2002.09.08 10:30	1.025	0.952	1.055	115
2002.09.09 09:30	1.020	0.957	1.062	115
2002.09.10 08:15	1.021	0.973	1.068	115
2002.09.11 11:10	1.040	0.951	1.072	115
2002.09.12 08:10	1.017	0.945	1.068	115
2002.09.13 08:25	1.021	0.951	1.059	115
2002.09.14 08:30	1.027	0.934	1.069	115
2002.09.15 10:00	0.989	0.927	1.050	116
2002.09.16 08:00	1.000	0.922	1.056	116
2002.09.17 09:30	0.982	0.914	1.060	115
2002.09.18 08:15	0.962	0.905	1.045	115
2002.09.19 08:05	0.961	0.893	1.039	115
2002.09.20 09:00	0.981	0.905	1.042	115
2002.09.21 09:00	0.962	0.896	1.029	116
2002.09.22 09:00	0.951	0.883	1.023	115
2002.09.23 08:00	0.942	0.877	1.018	115
2002.09.24 08:15	0.955	0.899	1.040	115
2002.09.25 08:10	0.922	0.855	1.002	115
2002.09.26 08:30	0.935	0.869	1.005	116
2002.09.27 08:00	0.925	0.865	1.000	115
2002.09.28 08:20	0.965	0.897	1.044	115
2002.09.29 08:10	0.960	0.904	1.043	115
2002.09.30 11:00	0.962	0.866	1.020	115
2002.10.01 10:10	0.915	0.856	1.009	116
2002.10.02 08:00	0.920	0.861	1.012	116
2002.10.03 09:05	0.950	0.870	1.020	115
2002.10.04 09:00	0.930	0.868	1.030	115
2002.10.05 08:10	0.938	0.870	1.034	116
2002.10.06 08:30	0.936	0.986	1.030	115
2002.10.07 08:05	0.935	0.965	1.028	115
2002.10.08 08:05	0.930	0.961	1.025	115
2002.10.09 08:30	0.928	0.952	1.010	116

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Power losses w / No. / Time	11	12	13	Temperature ℃
2002.10.10 08:05	0.920	0.842	1.008	116
2002.10.11 09:05	0.940	0.860	1.028	115
2002.10.12 08:30	0.941	0.866	1.033	115
2002.10.13 08:30	0.941	0.868	1.037	115
2002.10.14 08:30	0.944	0.872	1.040	115
2002.10.15 09:00	0.944	0.872	1.041	115
2002.10.15 09:05	stop test			
P_{1ct}	1.164	0.000	1.100	$P_{2ct}<1.1\times P_{3ct}$ $P_{2ct}<P_{1ct}$
P_{2ct}	0.944	0.872	1.041	
P_{3ct}	0.915	0.842	0.987	

5.2 High current impulse operating duty test (wave shape see Fig13~Fig21)

No.		4	14	21
8/20μ s,U_{10kA},before kV		9.01	9.06	9.07
Ur kV		3.0	3.0	3.0
Uc kV		2.71	2.71	2.71
Condition test	Applied1.2Uc=3.25kV, 8/20μ s, In =10 kA , 50 ° before peak			
	Times	20	20	20
4/10μ s high current impulse	1st. current kA	92.8	92.8	92.8
	Heated to 60 ℃			
	2nd. Current kA	94.4	96.0	96.0
Applied power frenquency voltage within 70 ms				
Ur kV		3.3	3.3	3.3
Power losses (max) at Ur W		56.0	66.0	55.0
Applied Uc kV		2.71	2.71	2.71
Power losses at Uc W	1 min	12.2	20.3	6.60
	15 min	1.130	1.402	0.773
	30 min	0.867	1.110	0.620
Checking samples		all right	all right	all right
8/20μ s,U_{10kA},after kV		9.20	9.15	9.18
Varity of U_{10kA} %		2.1	1.0	1.2

Test Conclusion: Satisfied.

6 Housing Insulation Withstand Test(wave shape see Fig22~Fig23)

6.1 Lightning impulse voltage withstand test

P=966×10^2 Pa, t_{dry}=17 ℃, t_{wet}=14 ℃, K=0.968 ;

No.	Req. kV		Adj. kV	Test Value kV	Withstand Times	Result
4	(+)	170	164.6	150.3~193.5	15	passed
	(−)	170	164.6	159.4~175.2	15	passed

6.2 Power frequency voltage insulation withstand test

P=966×10^2 Pa, t_{dry}=16.5℃, t_{wet}=13.5℃; t_{water}=14℃.

specific resistance of rain ρ_{20}=91.3 Ω·m.

rainfall: horizon=1.2 mm/min , verticality=1.3 mm/min.

$K_{(wet)}$=0.993

No.	Req. kV		Adj. kV	Test Value kV	Keeping time min	Result
4	wet	70	69.5	70	1	passed

Test Conclusion: Satisfied.

7 Moisture ingress test

7.1 Terminal torque test

M=60 N·m, withstand 30 s

7.2 Thermomechanical test

F1=147 N, F2 =8 N, F =(F1+F2) =155 N

No.	Test time	Temprature ℃	Applied angle degrees °	Times h	Bend load N
003	4th.Sep 11:15~11:30	58~62	0	8	155
	5th.Sep 08:00~13:10	-23~-27	180	8	
	6th.Sep 08:00~08:45	43~47	270	8	
	7th.Sep 08:00~14:15	-38~-42	90	8	
Req.	24h×4	(60±5) (-40±5)	0~360	≥8	155

7.3 Water immersion test(wave shape see Fig24~Fig25)

No.	Boiling time h	Partial discharge value pC			Power losses W			Residual voltage at 6kA kV		
		before	after	var.	before	after	var. %	before	after	var. %
003	42	2.3	1.0	-1.3	1.04	1.00	-3.8	71.3	69.2	-2.9
Req.	42	≤10		≤10	/		≤20	/		≤5

Test Conclusion: Satisfied.

8 Weather ageing test

fog room: 4 m^3 temperature of fog room : 22℃~24℃

water speed: 2.2~2.4 $L/m^3 \cdot h$ NaCl in water : 5 kg/m^3

date of test:2002.09.03~2002.10.15

No.	Uc kV	Creep distance mm	Time h	Power frenquency voltage kV			Partial discharge pC		
				before	after	var. %	before	after	var.
007	13.6	420	1008	20.0	20.0	0	3.5	3.2	-0.3
Req.	13.6	/	≥1000	/		≤5	≤10		≤10

Test Conclusion: Satisfied.

Testor: Zhang Ji-ning, Zhang Yi-ming, Zhu Jia-xi, Shi Rong

Sang Jian-ping, Hu Wen-qi , Zhong Yan-dong ,

Su Miao, Meng Fan-sheng, Hou Yu-jun, Jin Qi-xue

CNACL

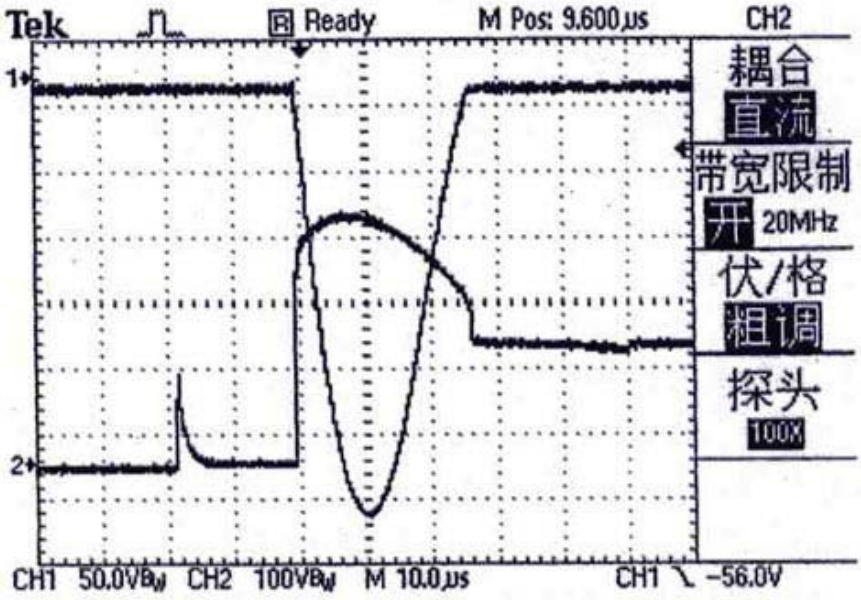


Fig1 1# 8/20μs , U_{10kA}

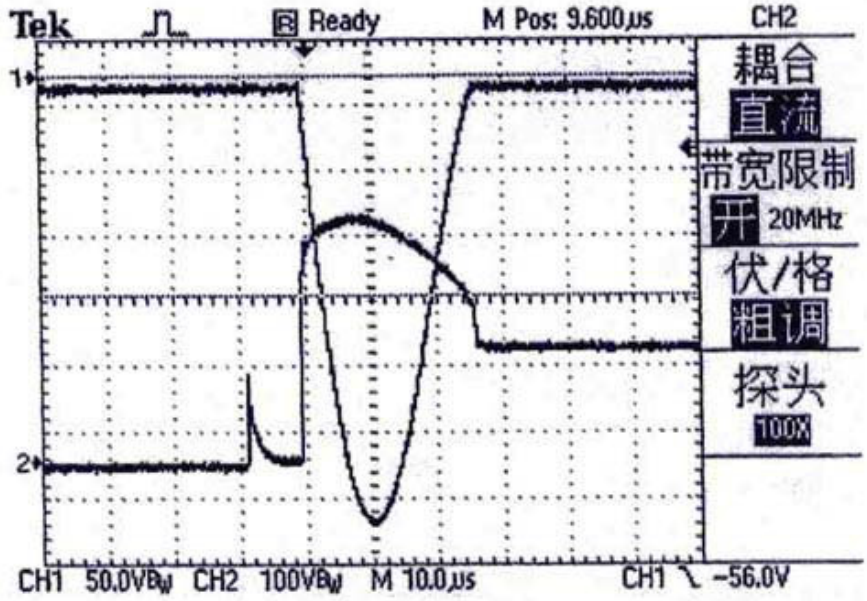


Fig2 8# 8/20μs , U_{10kA}

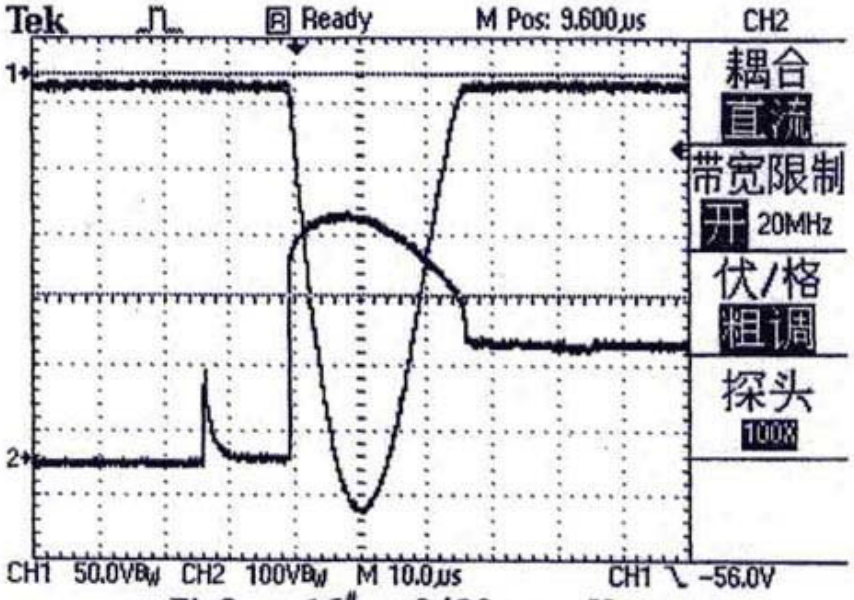


Fig3 16# 8/20µ s , U_{10kA}

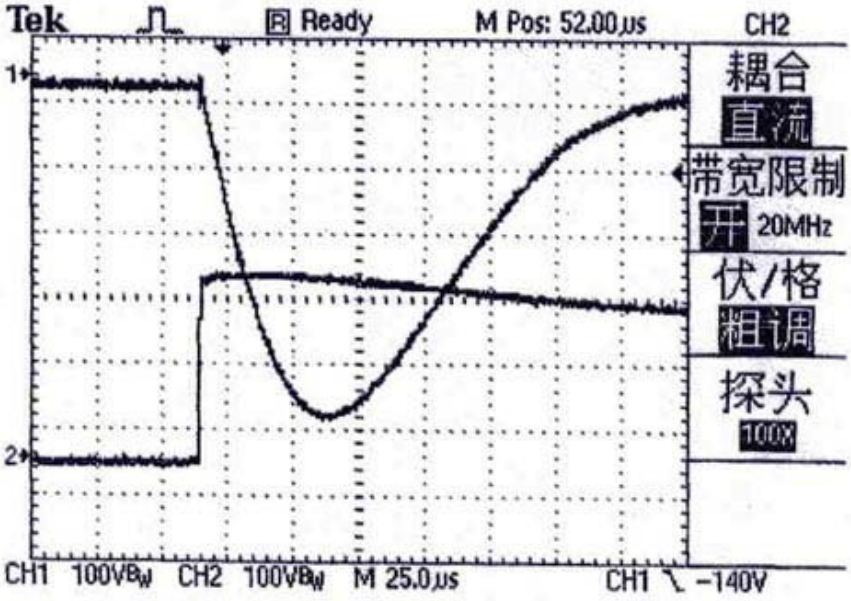


Fig4 1# 30/60µ s , U_{500A}

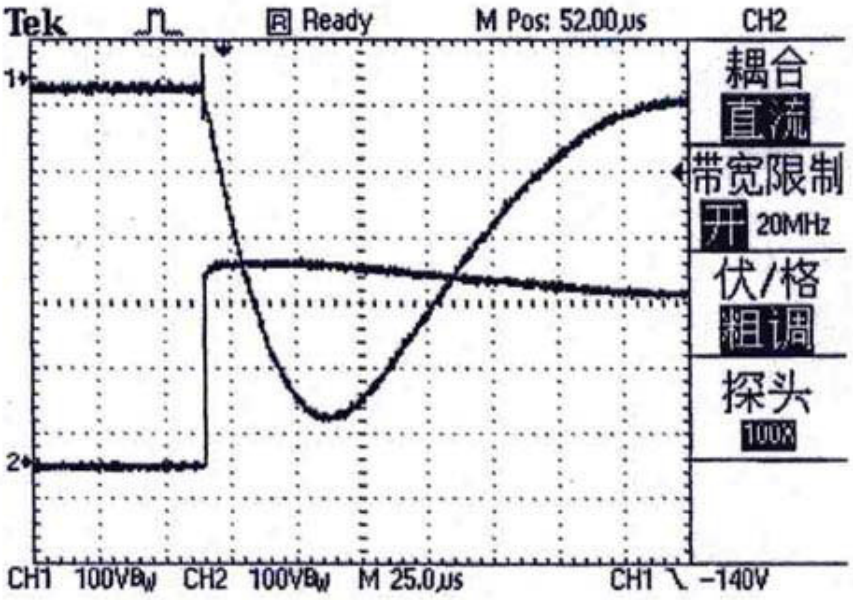


Fig5 8# 30/60μs , U_{500A}

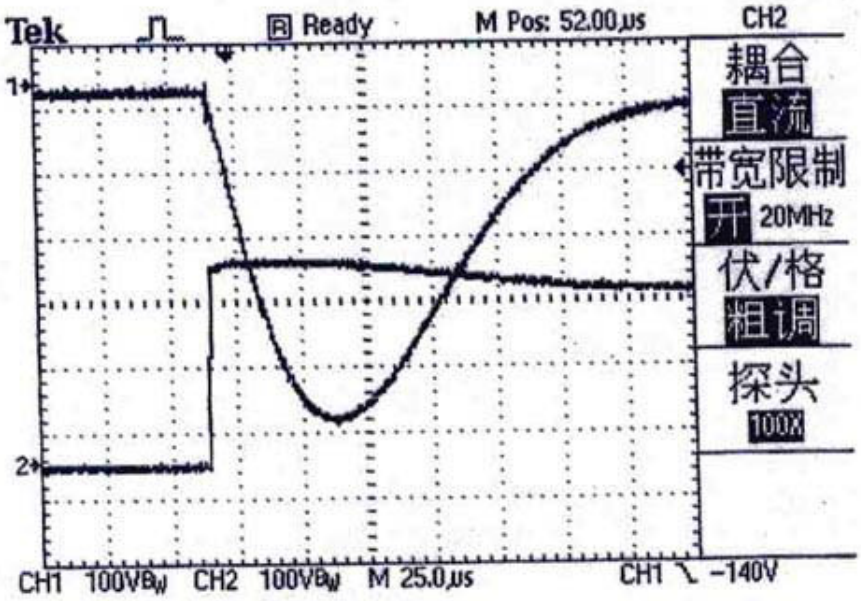


Fig6 16# 30/60μs , U_{500A}

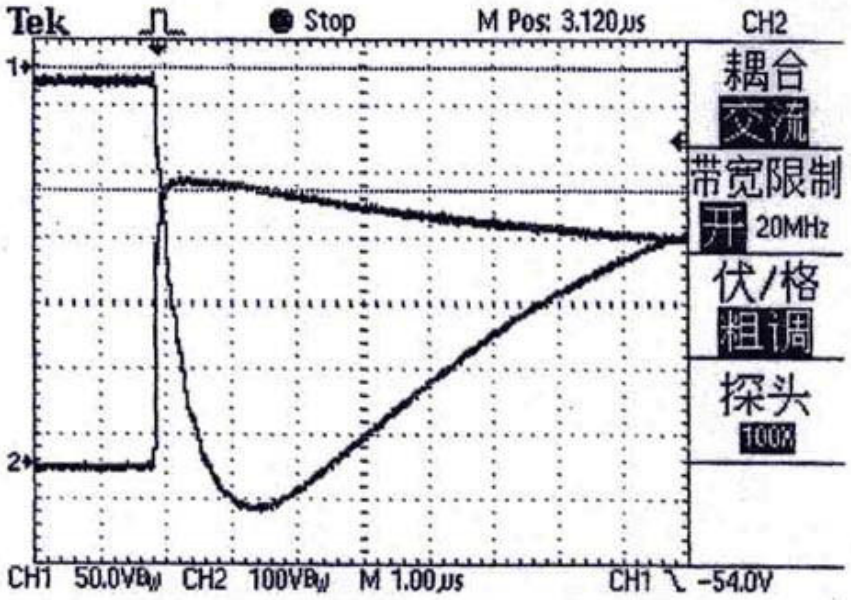


Fig7 1# 1/10μ s , U_{10kA}

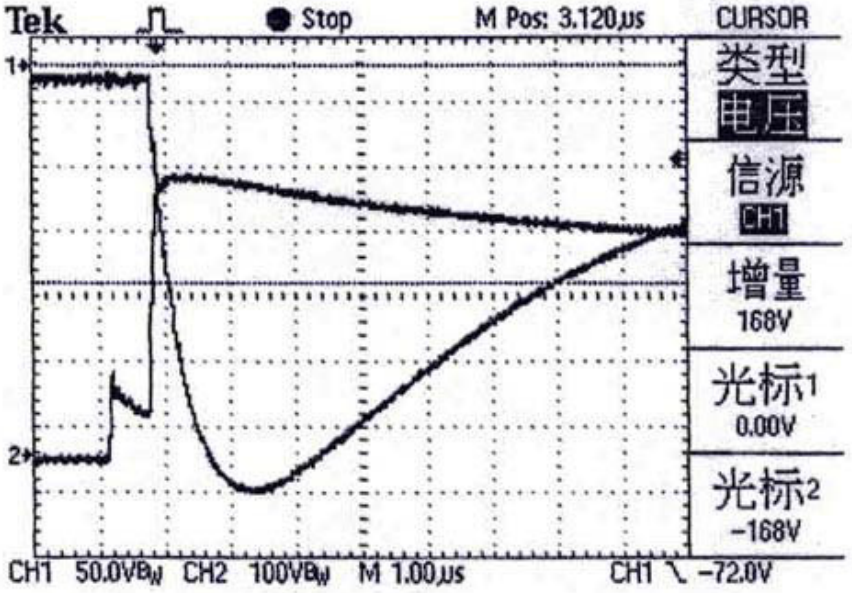


Fig8 8# 1/10μ s , U_{10kA}

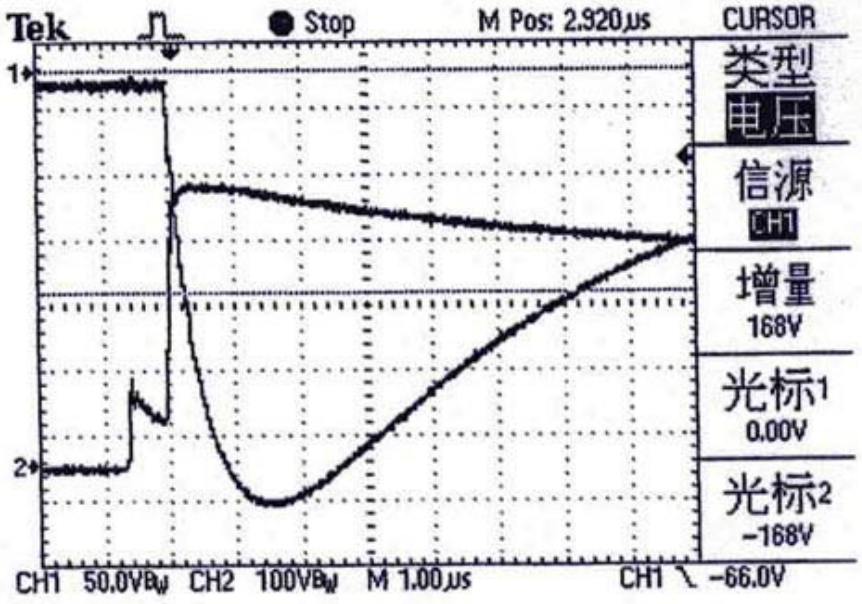


Fig9 16# 1/10µs , U_{10kA}

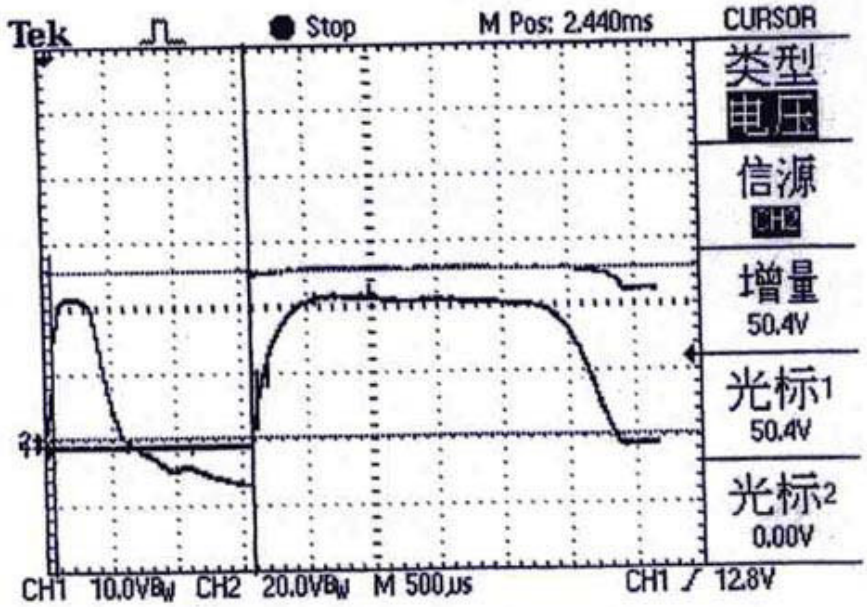


Fig10 7# Long Duration Current 1st.

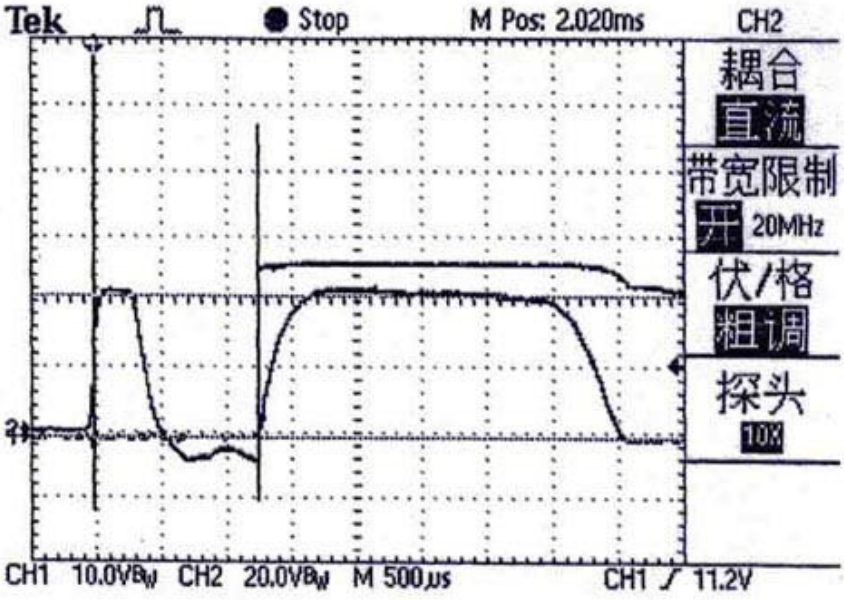


Fig11 17# Long Duration Current 1st.

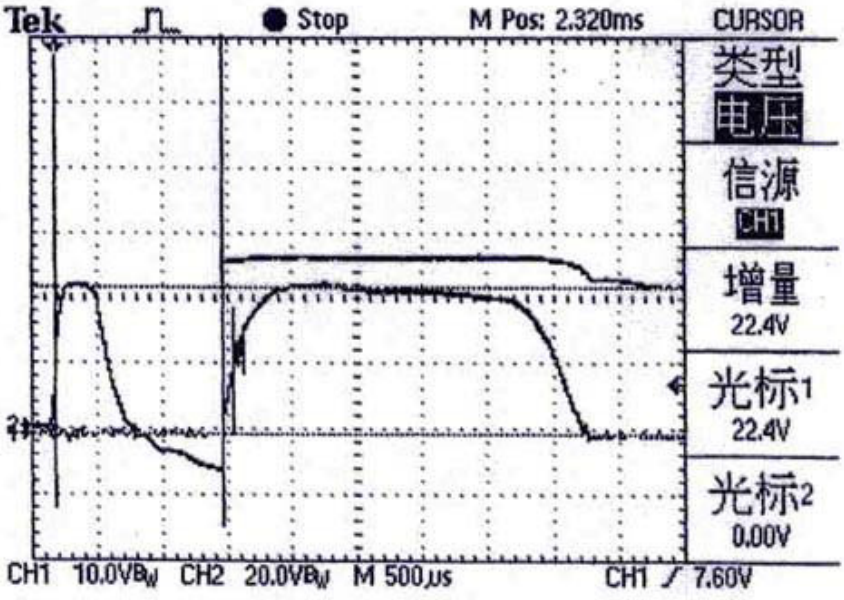


Fig12 25# Long Duration Current 1st.

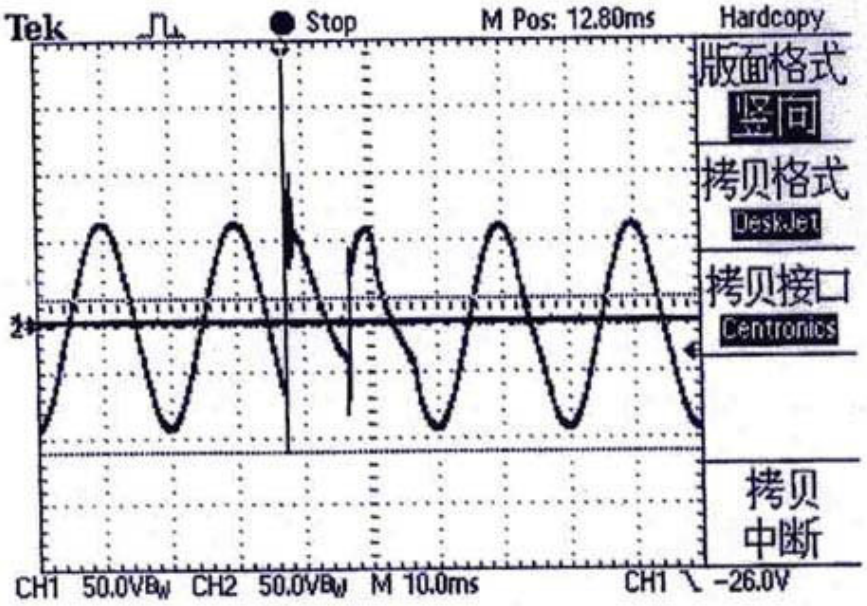


Fig13 4# conditioning test 10kA

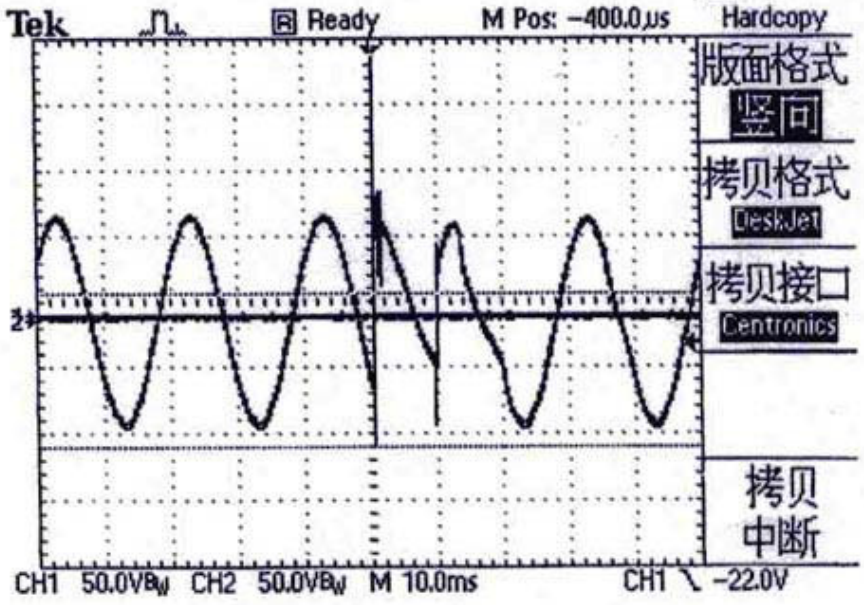


Fig14 14# conditioning test 10kA

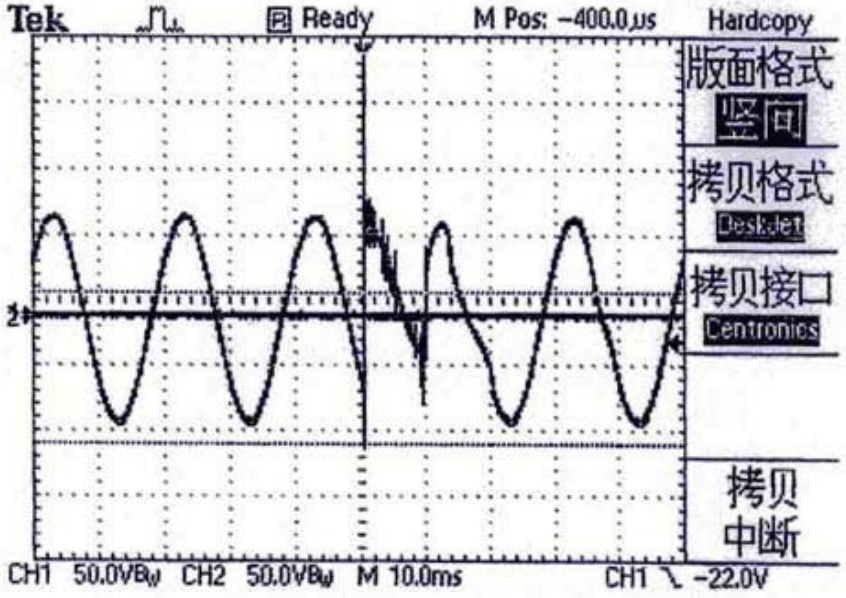


Fig15 21# conditioning test 10kA

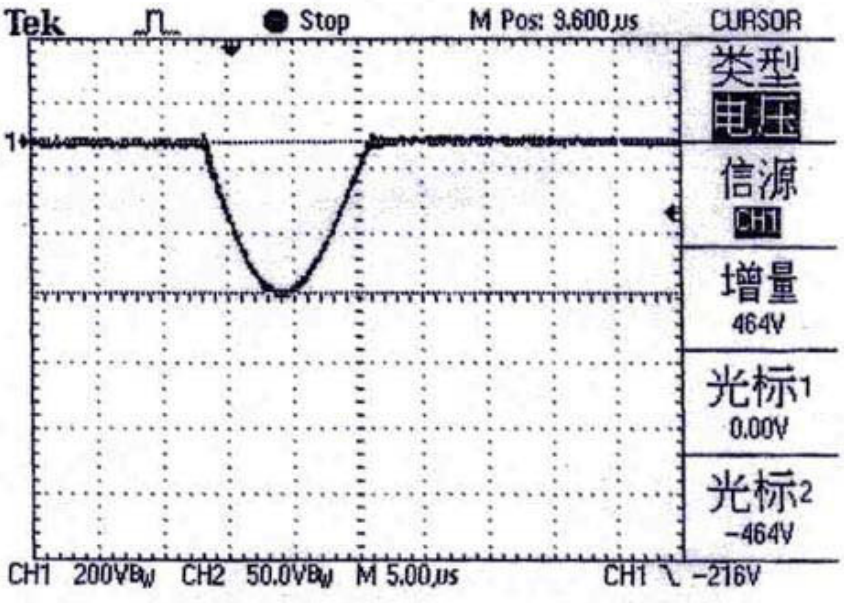


Fig16 4# 4/10μ s, 92.8kA,1st.

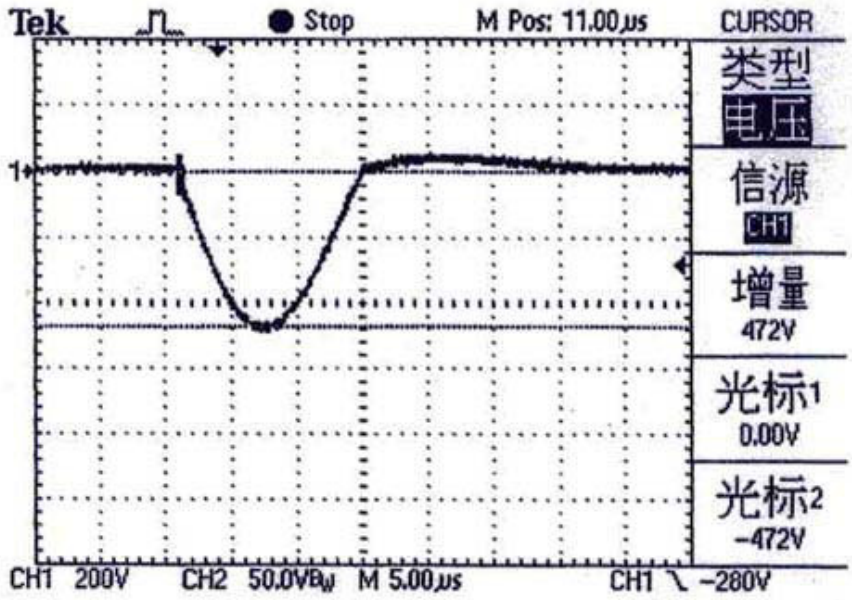


Fig17 4# 4/10µs ,94.4kA,2nd.

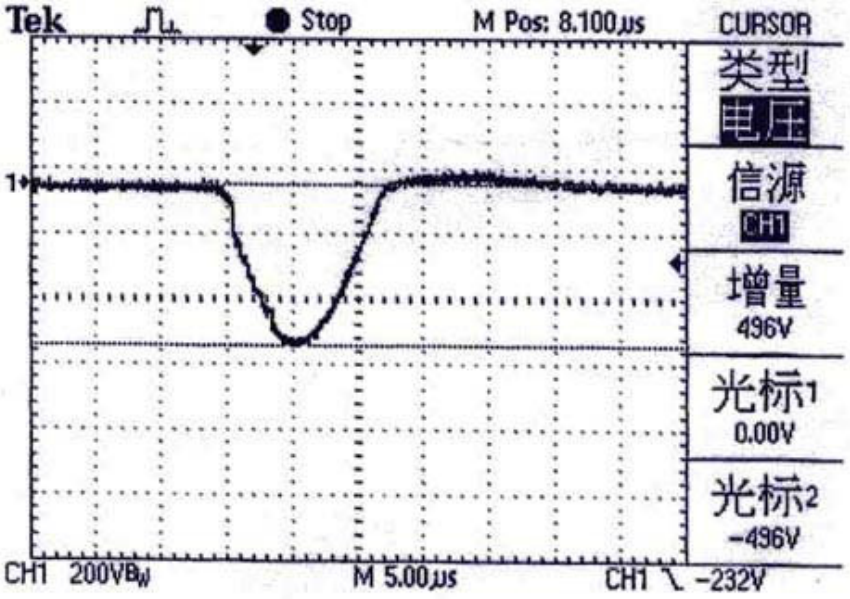


Fig18 14# 4/10µs,92.8kA,1st.

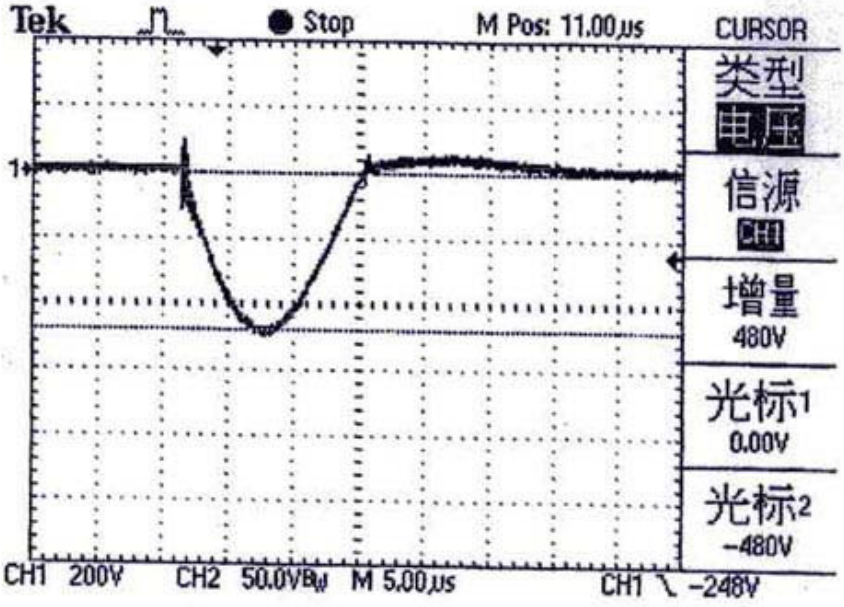


Fig19 14# 4/10μ s,96.0kA,2nd.

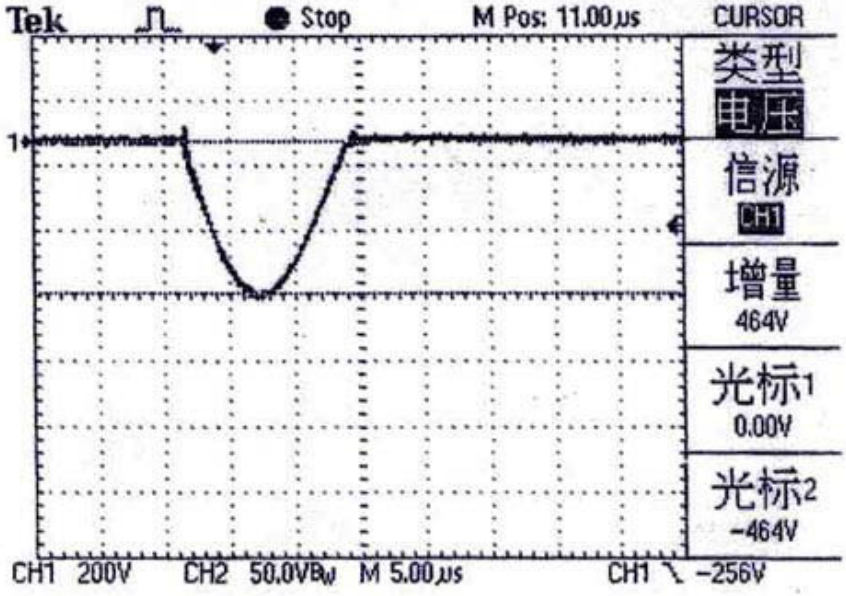


Fig20 21# 4/10μ s , 92.8kA,1st.

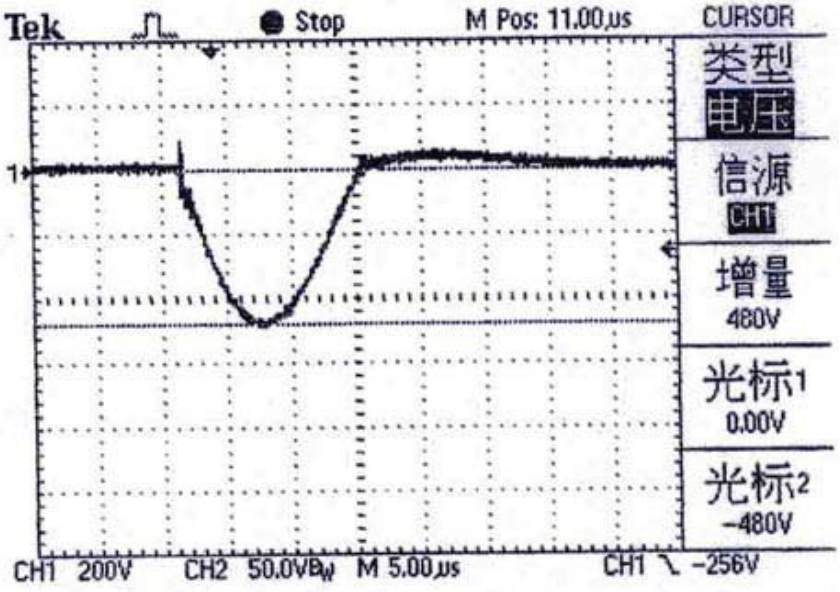


Fig21 21# 4/10μ s ,96.0kA,2nd.

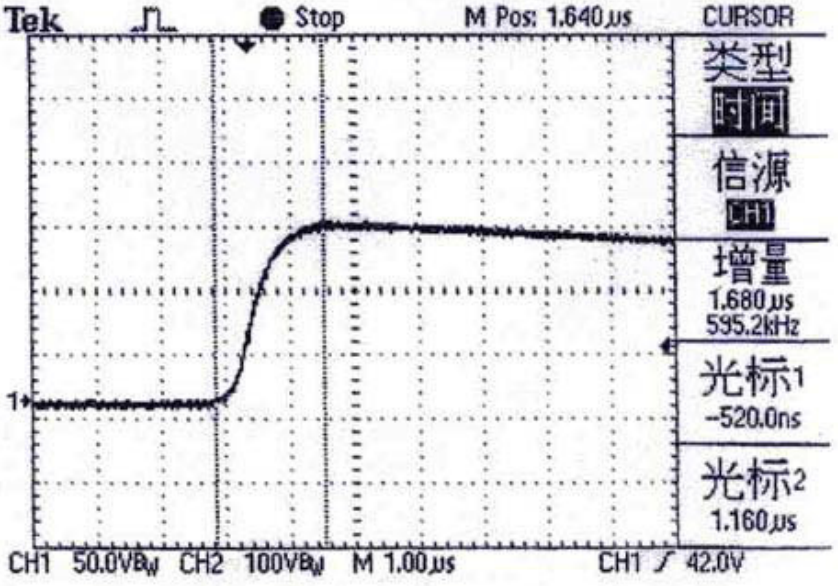


Fig22 4# front wave of 1.2/50μ s Impulse voltage

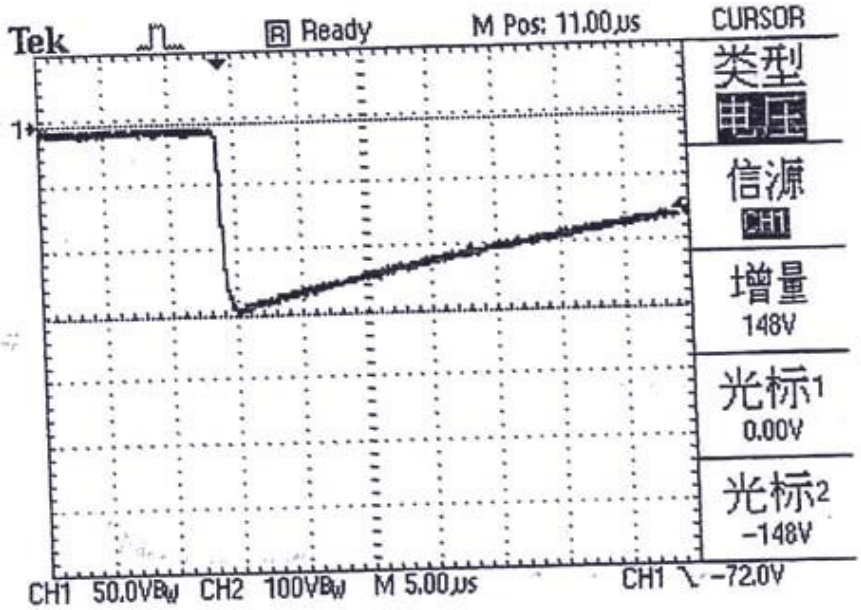


Fig23 4# full wave of 1.2/50μ s Impulse voltage

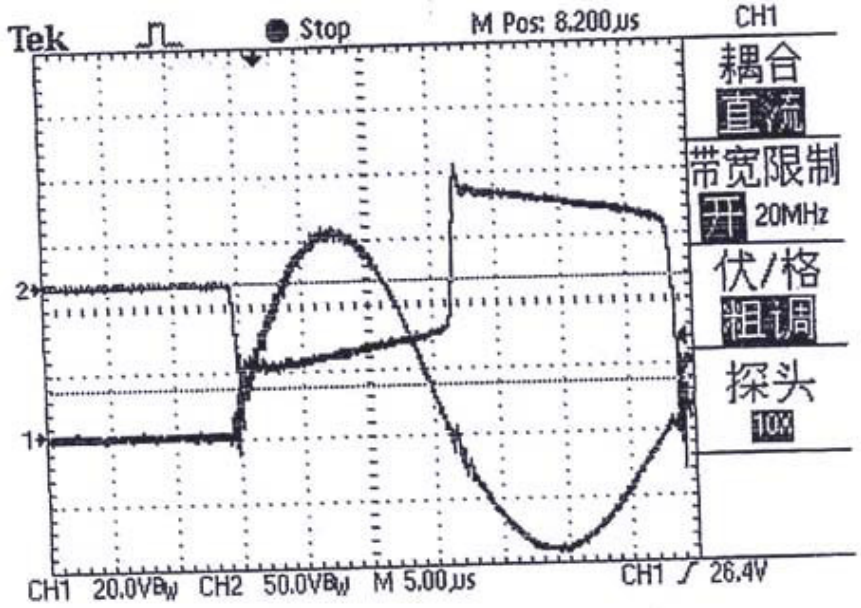


Fig.24 003# $U_{6.09kA}$ before moisture ingress test

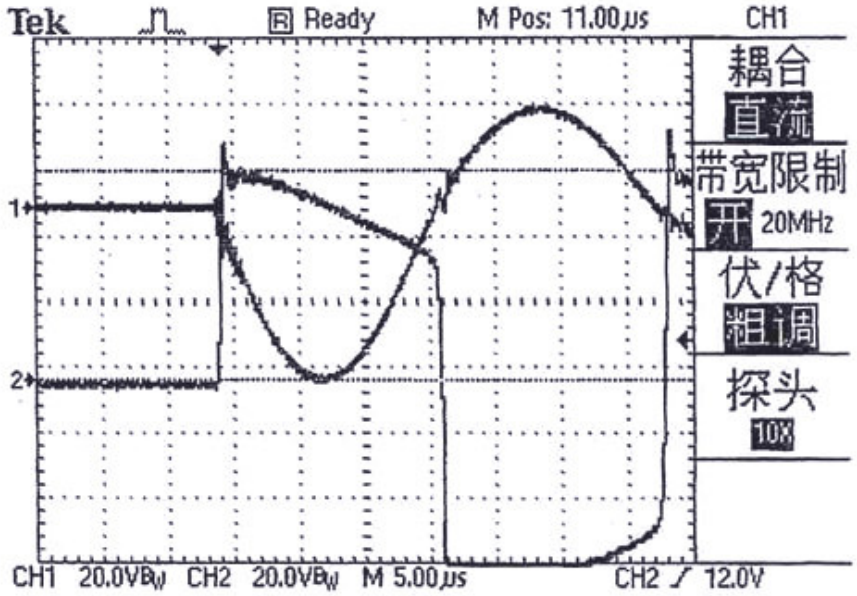
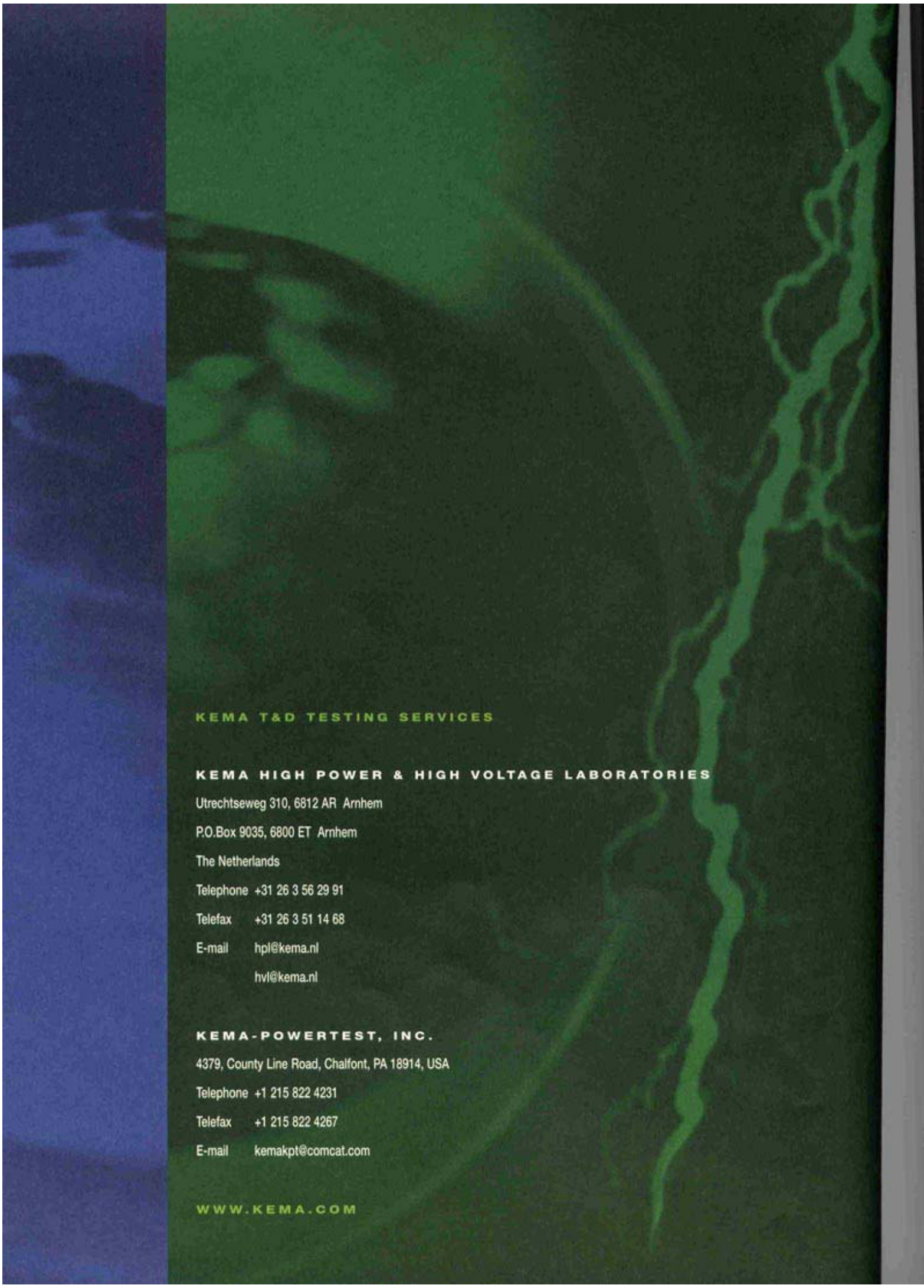


Fig.25 003# $U_{5.44kA}$ after moisture ingress test

End



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