



中国认可
国际互认
检测
TESTING
CNAS L0699



TEST REPORT

CEPRI-EET02-2023-0060 (E)

Client: Xi 'an Tiangong Electric Co.,Ltd

Object: Metal Oxide Varistor

Type: $\Phi 78\text{mm} \times 23\text{mm}$

Test Category: Characteristics test

**POWER INDUSTRY QUALITY INSPECTION AND TEST
CENTER FOR ELECTRIC EQUIPMENT**



NOTICE

1. This report will enter into effect with seals of test center.
2. This report is legally made available accompany with compiled, checked, verified and approved signatures.
3. Alter the report is invalid.
4. This report only takes responsibility to the test object.
5. Part of copy is invalid.
6. Any objections in the report should be posed within 15 days once the report is received.
7. The inspection and testing management system of China Electric Power Research Institute includes the following institutes:

National Wind Power Integration Research and Test Center

☆ **Power Industry Quality Inspection and Test Center for Electric Equipment**

Power Industry Quality Inspection & Test Center for Electric Power Equipment and Instruments

Power Industry Quality Inspection & Test Center for Electrical Material and Components

Power Industry Quality Inspection & Test Center for Automation Equipment

Power Industry Quality Inspection & Test Center for Communication Equipment

Power Industry Quality Inspection & Test Center for Concrete Power and Communication Poles

Power System Electromagnetic Compatibility and Electromagnetic Environmental Research and Monitoring Center

Address: NO.143, Luoyu Road, Hongshan District, Wuhan, Hubei Province, 430074.

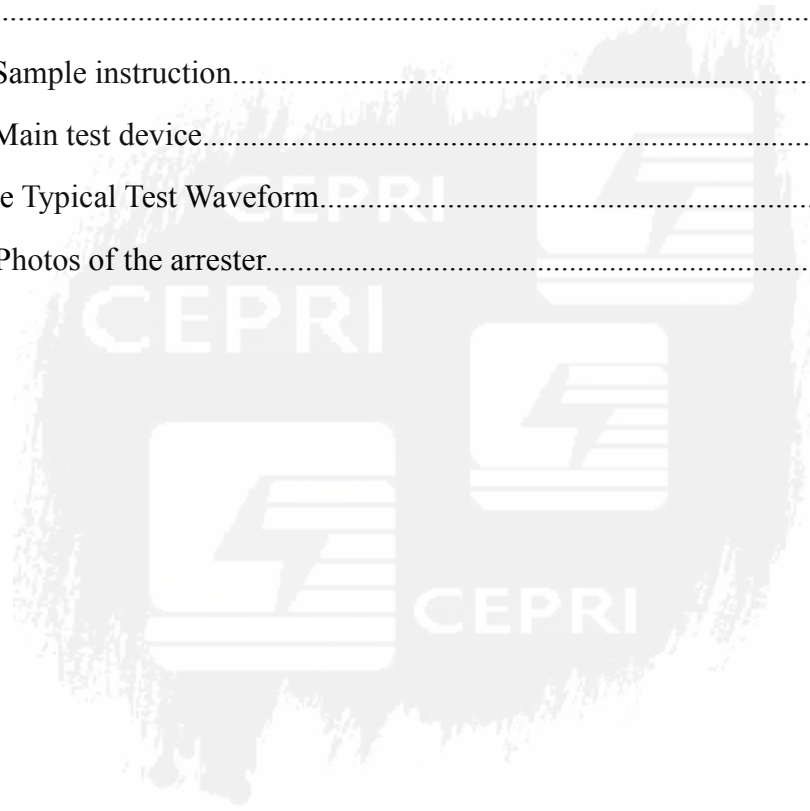
Fax: 86-27-5937-8488 Service line:86-27-59258069 Supervision hotline: 86-10-82813498

E-mail: eetc@epri.sgcc.com.cn




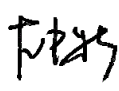
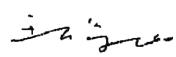
Website: <http://www.epri.sgcc.com.cn>

Catalogue

1.Catalogue.....	1
2.Signature Page.....	2
3.Test Results.....	3
4.Content.....	5
5.Appendix A Sample instruction.....	9
6.Appendix B Main test device.....	9
7.Appendix Che Typical Test Waveform.....	10
8.Appendix D Photos of the arrester.....	12





Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment 检测报告 专用章		CEPRI-EETC02-2023-0060(E) Total 12 Page 2
Client	Xi 'an Tiangong Electric Co.,Ltd	Manufacturer	Xi 'an Tiangong Electric Co.,Ltd
Object	Metal Oxide Varistor	Type	Φ78mm×23mm
Sampling procedure	By the client delivery	Serial No.	19 resistors (301~319)
Test Category	Characteristics test	Date	2023.02.13~2023.03.31
Requirements	1. GB/T 11032-2020 Metal-oxide surge arresters without gaps for a.c. systems 2. IEC 60099-4 Edition 3.0 (2014-06) Metal-oxide surge arresters without gaps for a.c. systems		
Conclusion	The metal oxide Varistor(Φ78mm×23mm) has passed the type test specified in GB/T 11032-2020 and IEC 60099-4 Edition 3.0 (2014-06).		
Note	Note :See appendix A for sample instruction.		
Tested by: 梁菊霞  陈立 			
Checked by: 王陆璐  Verified by: 左中秋 			
Approved by: 王保山  Date of issue: 2023-04-12			



Test Results

No.	Item	Requirements	Results	Evaluation	
1	Residual voltage test	Lightning impulse	$\leq 8.21 \pm 0.5 kV_p$	$7.90 kV_p \sim 7.94 kV_p$	Data only
		Switching impulse	Data only	See the text for details	
		Steep current impulse	Data only	See the text for details	
2	High current impulse withstand test	4/10 μ s、 100 kA 、 2times	101.6kA~112.8kA	Pass	
3	Repetitive charge transfer rating withstand test	$Q_{rs} = 4C$ by 2ms rectangular current for 20 times.	4.447C ~4.612C	Pass	
4	Test to verify long term stability under continuous operating voltage	Charge ability 85%, 115 $^{\circ}$ C, 1000h.	$P_{max} \leq 1.3P_{min}$ $P_{all.max} \leq 1.1P_{start}$	Pass	

(No content in this page below)



Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC02-2023-0060(E) Total 12 Page 4
--------------------	---	--

Content:

1 Residual voltage test

1.1 Lightning impulse residual voltage test

Samples				301	302	303
Resistor	U_{5mAAC}	Measured value	kV	3.37	3.38	3.36
		Specified value	kV _p	≥ 3.26		
	8/20 μ s, 10kA		kV _p	7.32	7.33	7.28
	8/20 μ s, 20kA		kV _p	7.94	7.92	7.90
	8/20 μ s, 40kA		kV _p	8.67	8.68	8.66
	Specified value		kV _p	$\leq 8.21 \pm 0.5$		

Note 1: Shunt 0.025 V/A, divider $K_d=206.8$

Note 2: According to the determined residual pressure, draw the residual voltage and current curve, in the curve corresponding to the nominal discharge current read residual voltage, defined as the lightning protection lightning protection level.

1.2 Switching impulse residual voltage test

Samples				301	302	303
Resistor	U_{5mAAC}		kV	3.37	3.38	3.36
	Residual voltage at 500A		kV _p	6.08	6.08	6.05
	Residual voltage at 1000A		kV _p	6.29	6.32	6.25
	Residual voltage at 2000A		kV _p	6.41	6.45	6.40

Note: Shunt 0.025 V/A, divider $K_d=206.8$

1.3 Steep current impulse residual voltage test

Samples				301	302	303
Resistor	U_{5mAAC}		kV	3.37	3.38	3.36
	8/20 μ s, 20kA		kV _p	8.79	8.75	8.73

Note1: Shunt 0.0267 V/A, divider $K_d=59.8$.

Note 2: If U_{res2}/U_{res1} is less than 2%, there is no need to correct Inductive effect.

Data only. Test waveform is shown in figure C.1~ figure C.3.

(No content in this page below)



质量
报
章

Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC02-2023-0060(E) Total 12 Page 5
--------------------	---	--

2 High current impulse withstand test

Environment temperature: 17.0°C humidity: 53%

Samples		304	305	306	Specified value
U _{1mADC} (Positive +)	kV	4.50	4.46	4.48	/
U _{1mADC} (Negative -)	kV	4.52	4.47	4.49	/
8/20μs U _{10kAp} before	kV _p	7.58	7.55	7.53	/
1 st impulse	kA	112.8	108.0	108.0	100kA, The interval should allow the samples to cool to ambient temperature
2 nd impulse		101.6	108.0	107.6	
U _{1mADC} (Positive +)	kV	4.51	4.50	4.47	/
Change rate (Positive +)	%	+0.22	+0.90	-0.22	/
U _{1mADC} (Negative -)	kV	4.47	4.37	4.42	/
Change rate (Negative -)	%	-1.11	-2.24	-1.56	/
Visual inspection	No puncture, flashover or cracking.				No puncture, flashover or cracking.

Note: Shunt 0.001V/A.

Fulfilled the requirements. Test waveform is shown in figure C.4.

(No content in this page below)



Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC02-2023-0060(E) Total 12 Page 6
--------------------	---	--

3 Repetitive charge transfer rating withstand test

Environment temperature: 14.5°C humidity:60%

Samples		310	311	312	313	314	315	316	317	318	319
Before test	U _{5mAAC} , kV	3.33	3.29	3.30	3.33	3.33	3.32	3.33	3.30	3.31	3.32
	8/20μsU _{10kA} , kV	7.49	7.47	7.42	7.43	7.48	7.40	7.44	7.45	7.43	7.44
Q _{rs} , C		Q _{rs} (Claimed repetitive charge transfer rating) × 1.1=4.4									
1 st	Q _{rs} , C	4.498	4.598	4.513	4.458	4.482	4.463	4.501	4.449	4.451	4.448
2 nd	Q _{rs} , C	4.454	4.457	4.529	4.537	4.449	4.521	4.537	4.449	4.521	4.537
3 rd	Q _{rs} , C	4.448	4.569	4.517	4.521	4.475	4.487	4.521	4.475	4.487	4.521
4 th	Q _{rs} , C	4.580	4.535	4.487	4.537	4.449	4.521	4.537	4.449	4.521	4.537
5 th	Q _{rs} , C	4.471	4.525	4.462	4.577	4.455	4.460	4.577	4.455	4.460	4.577
6 th	Q _{rs} , C	4.457	4.482	4.467	4.566	4.493	4.447	4.566	4.493	4.447	4.566
7 th	Q _{rs} , C	4.462	4.457	4.550	4.566	4.493	4.447	4.471	4.525	4.462	4.471
8 th	Q _{rs} , C	4.537	4.449	4.521	4.535	4.476	4.495	4.457	4.482	4.467	4.457
9 th	Q _{rs} , C	4.521	4.475	4.487	4.503	4.456	4.501	4.462	4.457	4.550	4.462
10 th	Q _{rs} , C	4.496	4.468	4.472	4.490	4.448	4.483	4.454	4.473	4.529	4.454
11 th	Q _{rs} , C	4.487	4.453	4.463	4.566	4.493	4.447	4.471	4.525	4.462	4.471
12 th	Q _{rs} , C	4.496	4.467	4.458	4.577	4.455	4.460	4.577	4.455	4.460	4.577
13 th	Q _{rs} , C	4.487	4.459	4.517	4.566	4.493	4.447	4.566	4.493	4.447	4.566
14 th	Q _{rs} , C	4.524	4.462	4.485	4.454	4.483	4.529	4.454	4.457	4.529	4.454
15 th	Q _{rs} , C	4.612	4.517	4.474	4.448	4.569	4.517	4.448	4.569	4.517	4.448
16 th	Q _{rs} , C	4.577	4.455	4.460	4.580	4.535	4.487	4.580	4.535	4.487	4.580
17 th	Q _{rs} , C	4.566	4.493	4.447	4.471	4.525	4.462	4.471	4.525	4.462	4.471
18 th	Q _{rs} , C	4.535	4.476	4.495	4.457	4.482	4.467	4.457	4.482	4.467	4.457
19 th	Q _{rs} , C	4.503	4.456	4.501	4.462	4.457	4.550	4.462	4.457	4.550	4.462
20 th	Q _{rs} , C	4.490	4.448	4.483	4.454	4.457	4.539	4.454	4.447	4.529	4.456
Test evaluation	U _{5mAAC} , kV	3.40	3.34	3.34	3.38	3.34	3.37	3.38	3.34	3.35	3.34
	Change rate, %	+3.34	+1.52	+1.21	+1.51	+0.30	+1.51	+1.50	+1.21	+1.21	+0.60
	8/20μs U _{10kA} , kV	7.42	7.27	7.25	7.22	7.26	7.25	7.24	7.26	7.27	7.24
	Change rate, %	-0.93	-2.68	-2.29	-2.83	-2.94	-2.03	-2.69	-2.55	-2.15	-2.69
	One 8/20 current impulse, kA	23.88kA (0.5kA/cm ² =0.5×3.14×(7.8/2) ² =23.88kA which is lower than 2 times I _n)									
	Visual inspection	All the samples have no puncture, flashover or cracking.									

Note: Shunt 0.01V/A.

Fulfilled the requirements, the test waveforms were shown in fig C.5.



Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC02-2023-0060(E) Total 12 Page 7	
--------------------	---	--	--

4 Test to verify long term stability under continuous operating voltage

Samples	307	308	309
U_{1mADC} , kV	4.38	4.39	4.39
U_{ct} , kV _{rms}	2.79	2.79	2.79
Charge rate,%	90.1	89.9	89.9
U_{5mAAC} , before test	3.32	3.30	3.33
U_{5mAAC} ,after test	3.40	3.35	3.41
Change rate, %	+2.41	+1.52	+2.41
Power losses P_{start} , 3h, W	1.146	1.138	1.090
Power losses P_{100h} , W	1.185	1.102	0.985
Power losses P_{200h} , W	1.210	0.990	0.971
Power losses P_{300h} , W	1.202	0.968	0.945
Power losses P_{400h} , W	1.194	0.951	0.933
Power losses P_{500h} , W	1.201	0.947	0.928
Power losses P_{600h} , W	1.201	0.947	0.928
Power losses P_{700h} , W	1.195	0.956	0.935
Power losses P_{800h} , W	1.201	0.949	0.926
Power losses P_{900h} , W	1.186	0.962	0.942
Power losses P_{end} , 1000+8h,W	1.195	0.984	0.963
P_{min} , W	1.146	0.947	0.926
Any increase of power losses from P_{min} during the remaining test period, P_{max}	1.210	0.984	0.963
$P_{all,max}$, W	1.210	1.138	1.090
$P_{max} / 1.3P_{min}$	0.813	0.799	0.800
$P_{all,max} / 1.1 P_{start}$	0.909	0.909	0.909

Because $P_{max} \leq 1.3P_{min}$, $P_{all,max} \leq 1.1P_{start}$, the samples fulfilled the requirements.

Note: The temperature of blocks: $115 \pm 4^\circ C$.

Fulfilled the requirements, the accelerated ageing curves were shown in fig 1.



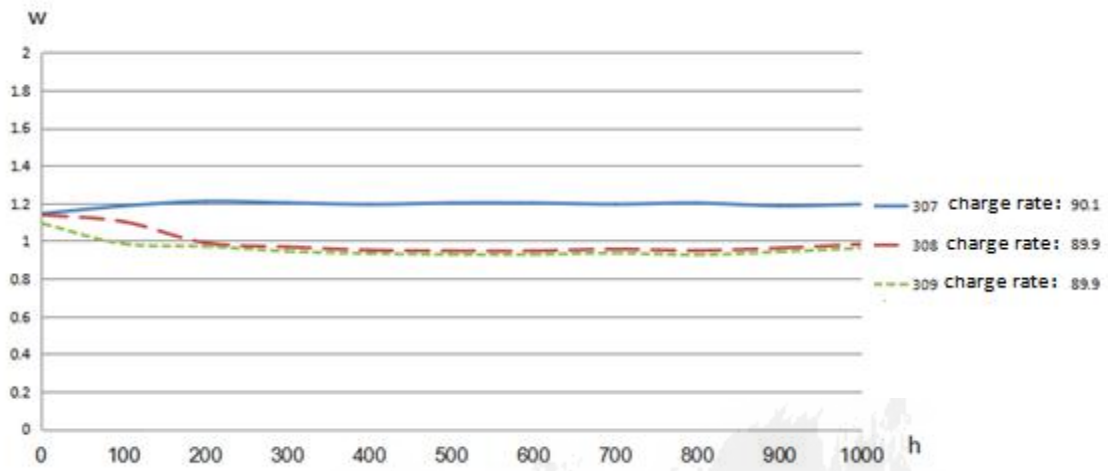


Fig 1 The Accelerated ageing curve of samples

(No content in this page below)



Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC02-2023-0060(E) Total 12 Page 9
--------------------	---	--

Appendix A: Sample instruction

Sample instruction:

- 1) 19 resistors, number EETC02-23/01/20-0060-301~ EETC02-23/01/20-0060-319, short for 301~319 in report.

Appendix B: Main test device

NO.	Device name	Device NO.	Measurement	Uncertainty /Accuracy	Calibration institution	Expiration date
1	impulse current generator	EETC02-0003	8/20 μ s 40 kA 4/10 μ s 130 kA	$U_{rel}=0.015 k=2$	National center for high voltage measurement	2023-06-23
2	impulse current generator	EETC02-0005	8/20 μ s 40 kA 30 kV 4/10 μ s 2 kA 30 kV	$U_{rel}=0.015 k=2$ $U_{rel}=0.018 k=2$	National center for high voltage measurement	2023-06-29
3	Steep current impulse generator	EETC02-0004	8/20 μ s 40 kA 30 kV 30/80 μ s 2 kA 30 kV	$U_{rel}=0.015 k=2$ $U_{rel}=0.018 k=2$	National center for high voltage measurement	2023-06-29
4	DC reference voltage tester	EETC02-0049	DC 0~9 kV	$U_{rel}=0.008 k=2$	Hubei province meteorological metrological verification station	2023-07-12
5	Accelerated aging device for MO resistor	EETC02-0036	115 $^{\circ}$ C	$U_{rel}=0.3^{\circ}$ Ck=2	Hubei province meteorological metrological verification station	2023-08-03
			0~10kV	$U_{rel}=0.013 k=2$	National center for high voltage measurement	2024-03-08

(No content in this page below)



Appendix C The typical test waveform

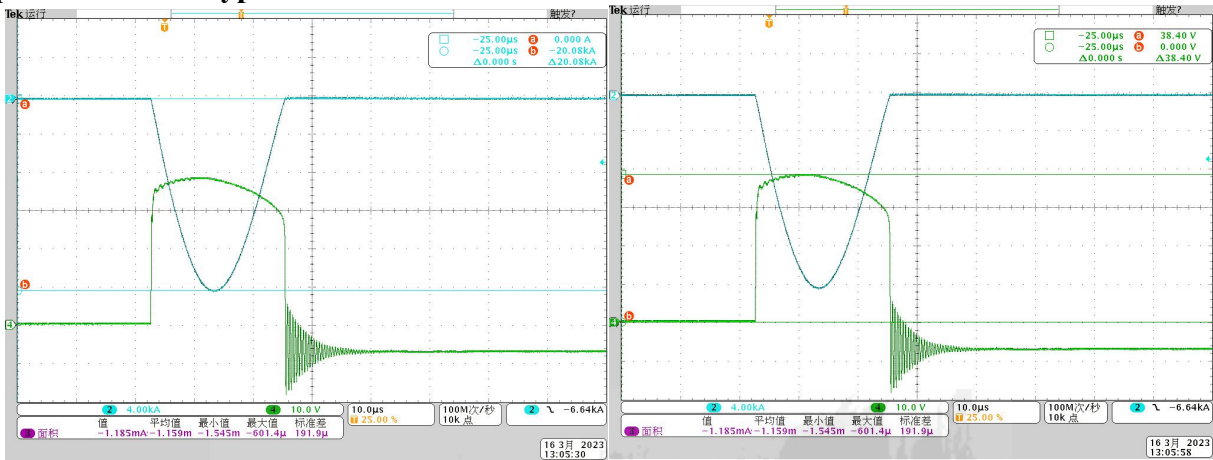


Fig C.1 Lightning impulse current and residual voltage waveform (sample 301, shunt 0.025V/A, divider $K_d=206.8$)

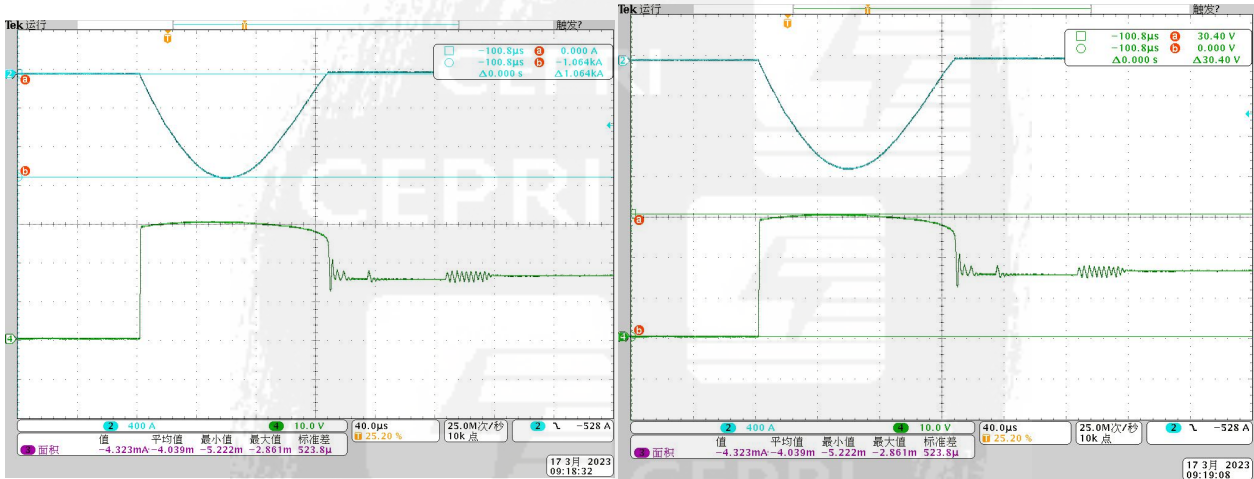


Fig C.2 Switching impulse current and residual voltage waveform (sample 301, shunt 0.025V/A, divider $K_d=206.8$)

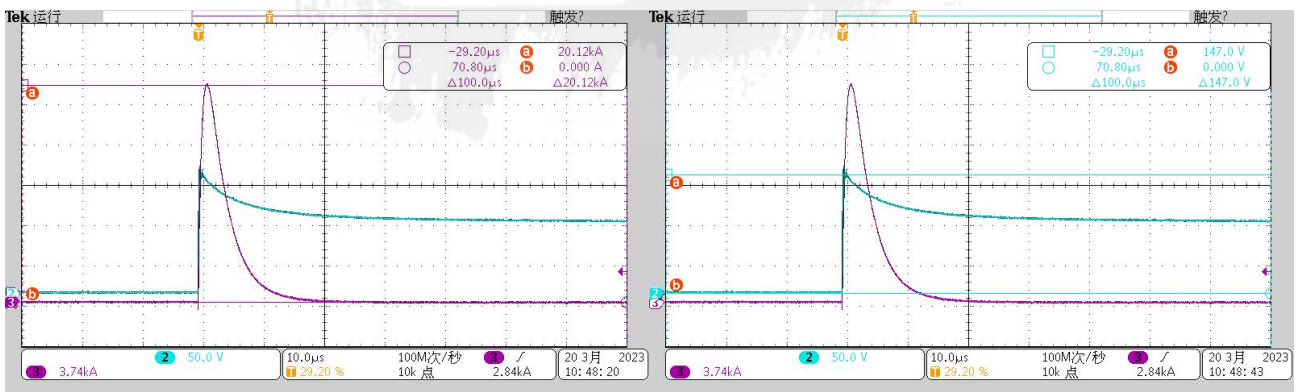


Fig C.3 Steep impulse current and residual voltage waveform (sample 301, shunt 0.0267V/A, divider $K_d=59.8$)

质量
报
章



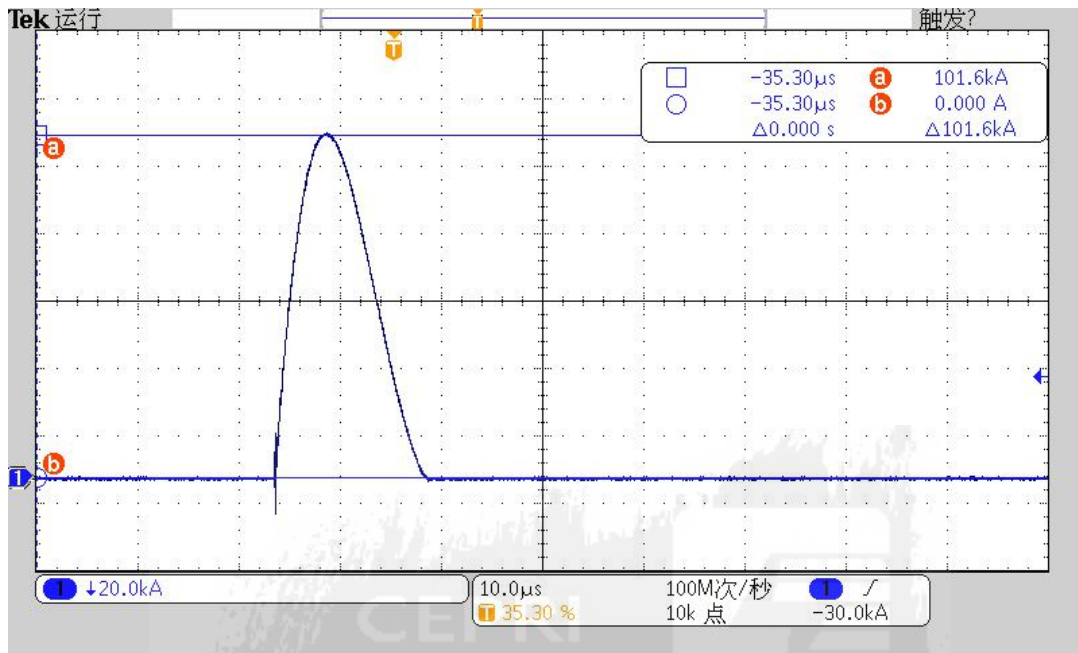


Fig C.4 Waveform of 304 conditioning test (first impulse)

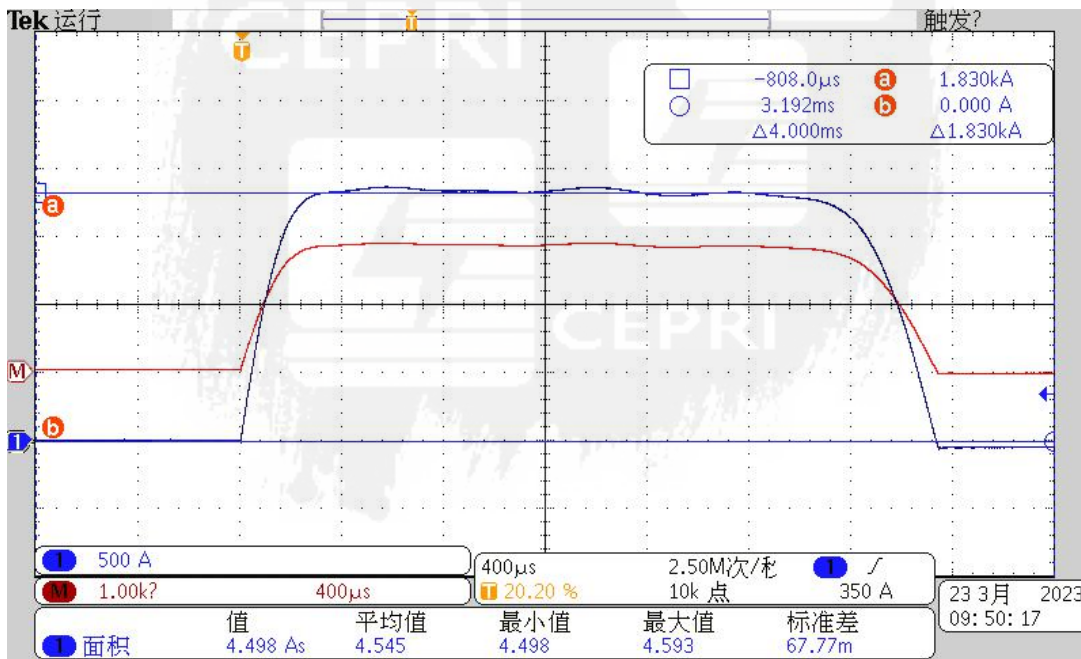


Fig C.5 The 1st time of sample 310, Repetitive charge transfer withstand, 0.01V/A

告



Appendix D: Photos of the arrester

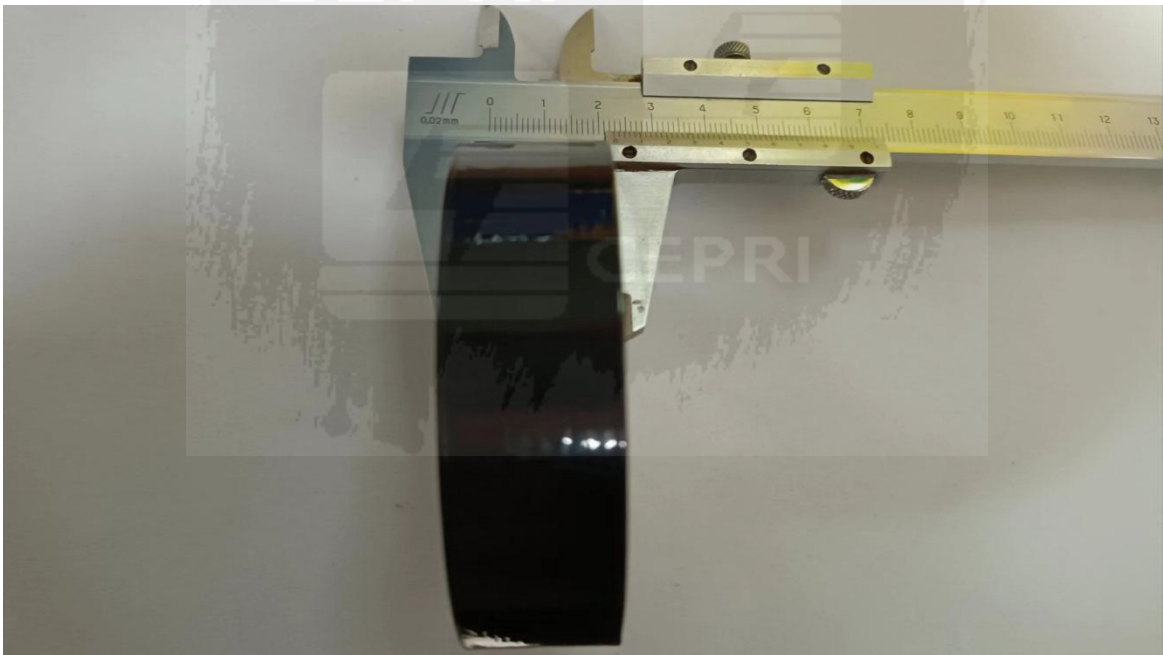


Fig D1: Outside view of MO resistor ($\Phi 78\text{mm} \times 23\text{mm}$)

