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TESTING
CNAS L0699



TEST REPORT

CEPRI-EET02-2023-0057 (E)

Client: Xi 'an Tiangong Electric Co.,Ltd

Object: Metal Oxide Varistor

Type: $\Phi 50\text{mm} \times 24\text{mm}$

Test Category: Characteristics test

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



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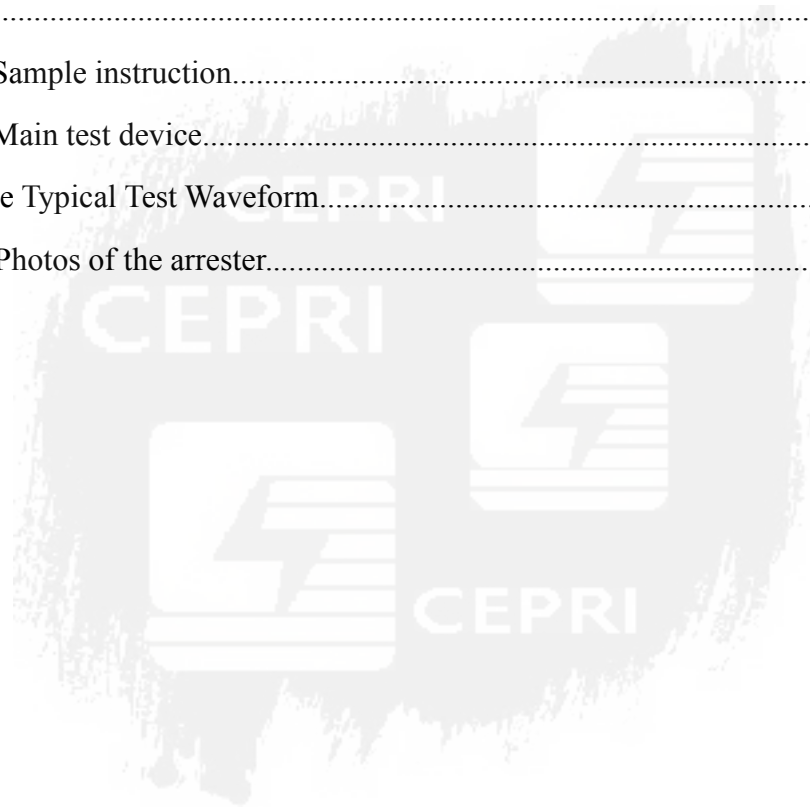
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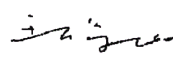
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Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment 检测报告 专用章		CEPRI-EETC02-2023-0057(E) Total 12 Page 2
Client	Xi 'an Tiangong Electric Co.,Ltd	Manufacturer	Xi 'an Tiangong Electric Co.,Ltd
Object	Metal Oxide Varistor	Type	Φ50mm×24mm
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(Φ50mm×24mm) 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	$\leq 10.19 \pm 0.5 kV_p$	10.21kV _p ~10.26kV _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	100.0kA~100.4kA	Pass	
3	Repetitive charge transfer rating withstand test	Q _{rs} =1.4C by 2ms rectangular current for 20 times.	1.545C ~1.613C	Pass	
4	Test to verify long term stability under continuous operating voltage	Charge ability 85%, 115°C, 1000h.	$P_{max} \leq 1.3P_{min}$ $P_{all.max} \leq 1.1P_{start}$	Pass	

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Content:

1 Residual voltage test

1.1 Lightning impulse residual voltage test

Samples				301	302	303
Resistor	U_{2mAAC}	Measured value	kV	4.40	4.38	4.36
		Specified value	kV _p	≥ 4.19		
	8/20 μ s, 5kA		kV _p	9.72	9.65	9.68
	8/20 μ s, 10kA		kV _p	10.26	10.26	10.21
	8/20 μ s, 20kA		kV _p	11.13	11.09	11.08
	Specified value		kV _p	$\leq 10.19 \pm 0.5$		

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_{2mAAC}		kV	4.40	4.38	4.36
	Residual voltage at 250A		kV _p	8.15	8.07	8.03
	Residual voltage at 500A		kV _p	8.48	8.44	8.40
	Residual voltage at 1000A		kV _p	8.85	8.87	8.81

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_{2mAAC}		kV	4.40	4.38	4.36
	8/20 μ s, 10kA		kV _p	11.12	11.02	11.02

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.

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2 High current impulse withstand test

Environment temperature: 17.0°C humidity: 53%

Samples		304	305	306	Specified value
U _{1mADC} (Positive +)	kV	5.99	5.98	6.00	/
U _{1mADC} (Negative -)	kV	6.00	5.98	6.03	/
8/20μs U _{10kAp} before	kV _p	10.25	10.18	10.23	/
1 st impulse	kA	100.4	100.4	100.4	100kA, The interval should allow the samples to cool to ambient temperature
2 nd impulse		100.0	100.0	100.4	
U _{1mADC} (Positive +)	kV	6.02	6.00	5.98	/
Change rate (Positive +)	%	+0.50	+0.33	-0.33	/
U _{1mADC} (Negative -)	kV	5.74	5.76	5.79	/
Change rate (Negative -)	%	-4.33	-3.68	-3.98	/
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.

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3 Repetitive charge transfer rating withstand test

Environment temperature: 8.5°C humidity:82%

Samples		310	311	312	313	314	315	316	317	318	319
Before test	U _{2mAAC} , kV	4.33	4.35	4.37	4.38	4.33	4.33	4.33	4.37	4.35	4.36
	8/20μsU _{10kA} , kV	10.13	10.11	10.14	10.15	10.13	10.11	10.13	10.14	10.15	10.13
Q _{rs} , C		Q _{rs} (Claimed repetitive charge transfer rating) ×1.1=1.54									
1 st	Q _{rs} , C	1.559	1.589	1.592	1.602	1.556	1.589	1.613	1.561	1.561	1.596
2 nd	Q _{rs} , C	1.591	1.569	1.556	1.574	1.596	1.569	1.573	1.593	1.583	1.562
3 rd	Q _{rs} , C	1.555	1.594	1.596	1.591	1.562	1.591	1.603	1.568	1.551	1.582
4 th	Q _{rs} , C	1.595	1.569	1.562	1.566	1.582	1.561	1.576	1.586	1.583	1.551
5 th	Q _{rs} , C	1.566	1.586	1.582	1.557	1.551	1.593	1.592	1.559	1.545	1.579
6 th	Q _{rs} , C	1.599	1.561	1.551	1.583	1.579	1.568	1.568	1.588	1.587	1.546
7 th	Q _{rs} , C	1.557	1.583	1.579	1.581	1.546	1.586	1.591	1.567	1.556	1.582
8 th	Q _{rs} , C	1.559	1.551	1.546	1.575	1.582	1.559	1.559	1.561	1.561	1.552
9 th	Q _{rs} , C	1.555	1.583	1.592	1.557	1.552	1.588	1.603	1.593	1.583	1.596
10 th	Q _{rs} , C	1.594	1.545	1.556	1.577	1.568	1.569	1.563	1.568	1.551	1.562
11 th	Q _{rs} , C	1.556	1.587	1.596	1.581	1.556	1.589	1.613	1.586	1.583	1.582
12 th	Q _{rs} , C	1.591	1.556	1.562	1.602	1.558	1.569	1.573	1.559	1.545	1.551
13 th	Q _{rs} , C	1.566	1.602	1.613	1.574	1.560	1.591	1.603	1.588	1.587	1.589
14 th	Q _{rs} , C	1.599	1.574	1.573	1.591	1.554	1.561	1.591	1.565	1.556	1.569
15 th	Q _{rs} , C	1.557	1.581	1.603	1.566	1.559	1.593	1.555	1.561	1.556	1.591
16 th	Q _{rs} , C	1.590	1.576	1.576	1.547	1.563	1.568	1.595	1.593	1.596	1.561
17 th	Q _{rs} , C	1.555	1.567	1.592	1.587	1.568	1.586	1.566	1.568	1.562	1.593
18 th	Q _{rs} , C	1.594	1.585	1.568	1.581	1.552	1.610	1.599	1.586	1.582	1.568
19 th	Q _{rs} , C	1.556	1.581	1.591	1.568	1.558	1.571	1.557	1.559	1.551	1.586
20 th	Q _{rs} , C	1.566	1.572	1.559	1.549	1.552	1.601	1.590	1.588	1.579	1.559
Test evaluation	U _{2mAAC} , kV	4.38	4.42	4.44	4.45	4.42	4.42	4.38	4.45	4.43	4.44
	Change rate, %	+1.15	+1.61	+1.60	+1.60	+2.08	+2.08	+1.15	+1.83	+1.84	+1.83
	8/20μs U _{10kA} , kV	10.22	10.21	10.25	10.26	10.21	10.22	10.21	10.24	10.25	10.23
	Change rate, %	+0.89	+0.99	+1.07	+1.08	+0.79	+1.09	+0.79	+0.99	+0.99	+0.99
	One 8/20 current impulse, kA	9.81kA (0.5kA/cm ² =0.5×3.14×(5.0/2) ² =9.81kA 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.



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4 Test to verify long term stability under continuous operating voltage			
Samples	307	308	309
U _{1mADC} , kV	5.92	5.91	5.88
U _{ct} , kV _{rms}	3.77	3.77	3.77
Charge rate,%	90.1	90.0	90.7
U _{2mAAC} , before test	4.33	4.32	4.31
U _{2mAAC} ,after test	4.44	4.43	4.43
Change rate, %	+2.54	+2.55	+2.78
Power losses P _{start} , 3h, W	0.687	0.648	0.556
Power losses P _{100h} , W	0.641	0.603	0.584
Power losses P _{200h} , W	0.605	0.616	0.592
Power losses P _{300h} , W	0.614	0.644	0.588
Power losses P _{400h} , W	0.665	0.636	0.582
Power losses P _{500h} , W	0.640	0.645	0.591
Power losses P _{600h} , W	0.624	0.643	0.592
Power losses P _{700h} , W	0.675	0.638	0.584
Power losses P _{800h} , W	0.642	0.632	0.604
Power losses P _{900h} , W	0.638	0.629	0.591
Power losses P _{end} , 1000+8h,W	0.647	0.637	0.583
P _{min} , W	0.605	0.603	0.556
Any increase of power losses from P _{min} during the remaining test period, P _{max}	0.675	0.645	0.604
P _{all.max} , W	0.687	0.648	0.604
P _{max} / 1.3P _{min}	0.858	0.823	0.835
P _{all.max} /1.1 P _{start}	0.909	0.909	0.987
Because P _{max} ≤ 1.3P _{min} , P _{all.max} ≤ 1.1P _{start} , the samples fulfilled the requirements.			
Note: The temperature of blocks: 115±4°C.			
Fulfilled the requirements, the accelerated ageing curves were shown in fig 1.			



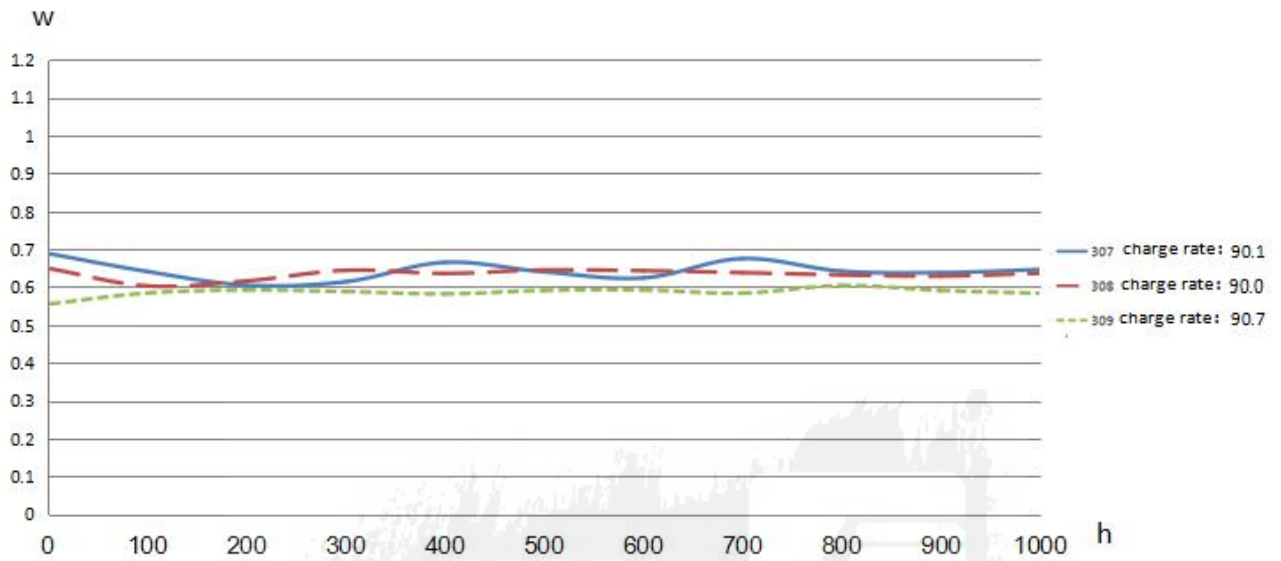


Fig 1 The Accelerated ageing curve of samples

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Appendix A: Sample instruction

Sample instruction:

- 1) 19 resistors, number EETC02-23/01/20-0057-301~ EETC02-23/01/20-0057-319, 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

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Appendix C The typical test waveform

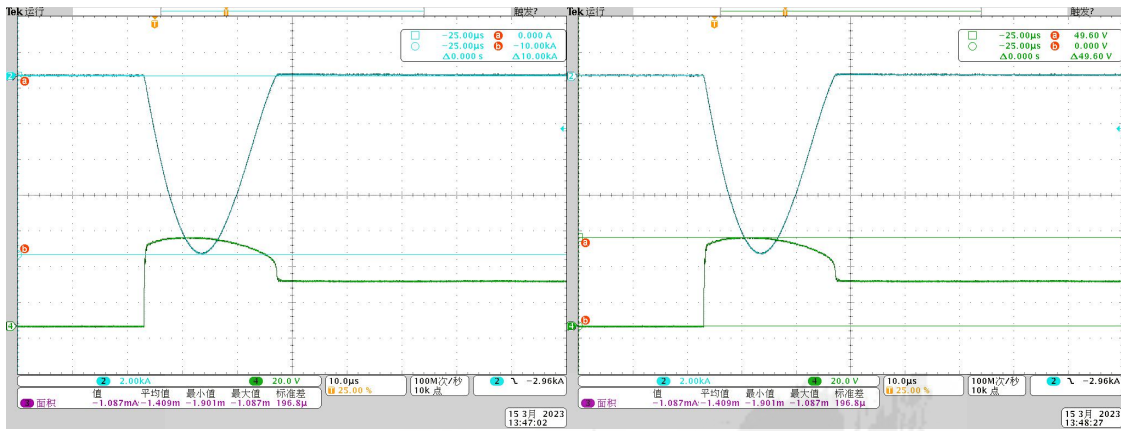


Fig C.1 Lightning impulse current and residual voltage waveform (sample 301, shunt 0.025V/A, divider $K_d=206.8$)

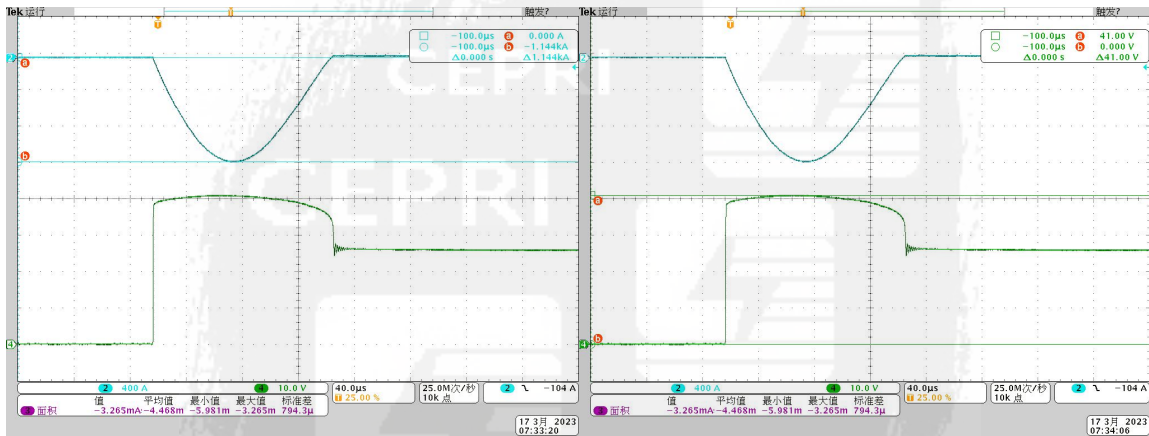


Fig C.2 Switching impulse current and residual voltage waveform (sample 301, shunt 0.025V/A, divider $K_d=206.8$)

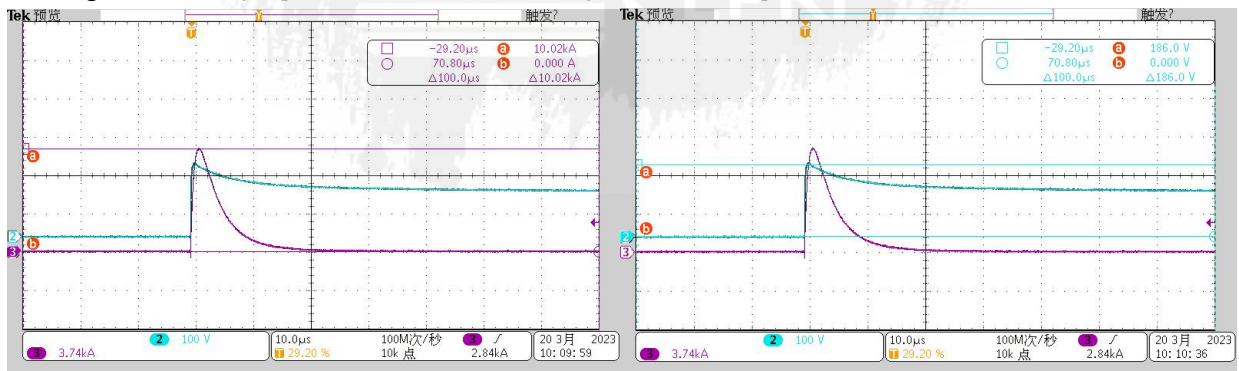


Fig C.3 Steep impulse current and residual voltage waveform (sample 301, shunt 0.0267V/A, divider $K_d=59.8$)

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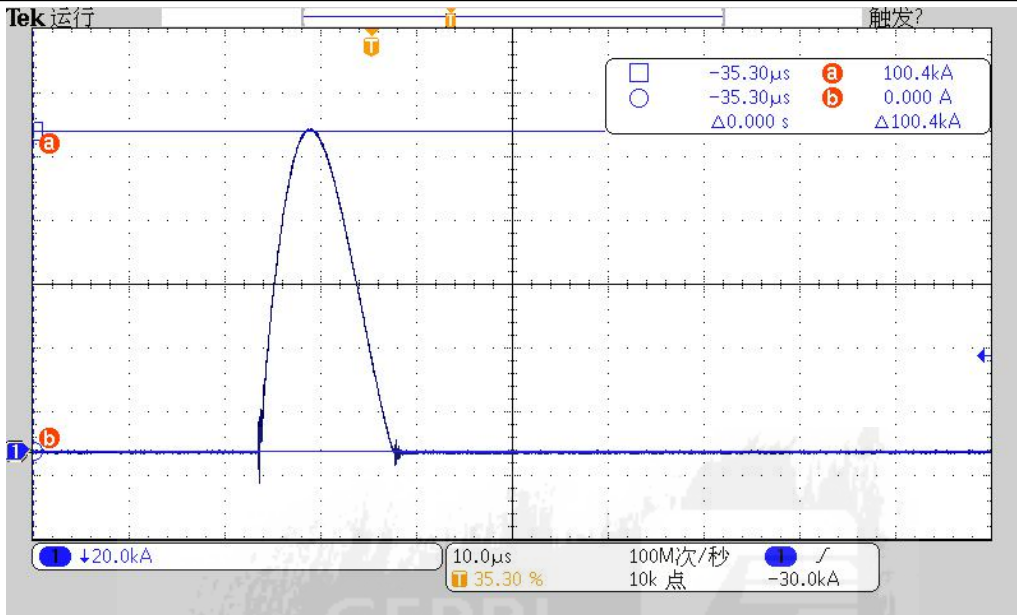


Fig C.4 Waveform of 304 conditioning test (first impulse)

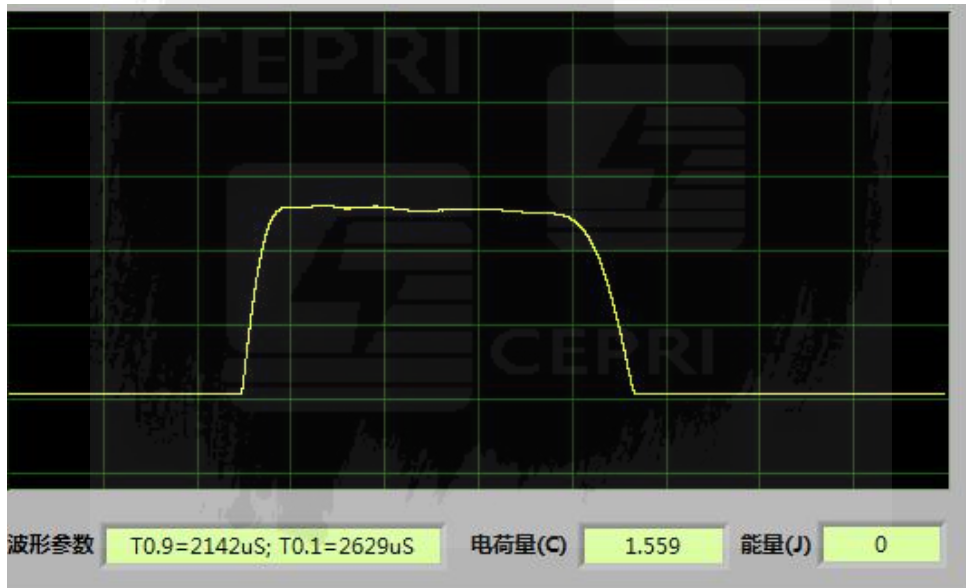


Fig C.5 The 1st time of sample 310, Repetitive charge transfer withstand, 0.01V/A

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Appendix D: Photos of the arrester



Fig D1: Outside view of MO resistor ($\Phi 50\text{mm} \times 24\text{mm}$)

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