

ASTA TYPE CERTIFICATE

VERIFICATION OF TEST

Project No: G104343209 **Certificate No:** ASTA-TYPE-00385

Applicant: SONG HONG VIET CO., LTD., Lot CN5 Quat Dong Expanded Industrial Zone,
Nguyen Trai Commune, Thuong Tin District, Ha Noi City, VIETNAM.

Apparatus: 400 kVA, ONAN, (35 kV $\pm$ 2 x 2.5%) / 0.4 kV, 50 Hz, three-phase, two winding
category 1, YynO, oil-type transformer with HV winding having 5 tap settings
and principal tap being on tap 3.

Manufactured By: SONG HONG VIET CO., LTD., Lot CN5 Quat Dong Expanded Industrial Zone,
Nguyen Trai Commune, Thuong Tin District, Ha Noi City, VIETNAM.

Test Report No: B20136

Designation: BAND

The apparatus which is representative of the designation, supplied drawings and photographs has been evaluated in accordance with:

IEC 60076-1: Edition 3.0, 2011-04, Clauses 11.1.2.1, 11.1.3, 11.1.4 f) & h), 11.2 to 11.6 & 11.8
IEC 60076-2: Edition 3.0, 2011-02, Clauses 6 & 7
IEC 60076-3: Edition 3.0, 2013-07, Clauses 10, 11 & 13
IEC 60076-5: Edition 3.0, 2006-02, Clause 4.2
IEC 60076-10: Edition 2.0, 2016-03, Clauses 11 & 12
and STL Guide to IEC 60076 issue 6.0, 1 June 2019, where applicable

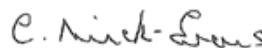
The results are shown in the record of tests attached hereto. The values obtained and the general performance is considered to comply with the above Standard(s) and to justify the ratings assigned by the manufacturer as stated on the ratings page(s) of this Certificate. This Certificate applies only to the apparatus tested. Responsibility for conformity of any apparatus having the same or other designations rests with the Manufacturer.



010



Certification Engineer



Certification Officer

25 July 2020

Date

Project No. G104343209

Certificate No. ASTA-TYPE-00385

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Project No. G104343209
Certificate No. ASTA-TYPE-00385
Limitations of use:

Verification of 3ph 400kVA/35kV/400V oil-type transformer

CHARACTERISTIC VERIFIED	CLAUSE/ SUBCLAUSE	VERIFIED TESTS AND RATINGS
Rated voltage, U_r	IEC 60076-1 clause 5.4.1	$U_r = 35\text{kV} / 0.4\text{kV}$
No-load loss and no-load current	IEC 60076-1 clause 11.1.3 e)	341.4W at 90% rated voltage
		427.0W at 100% rated voltage
		526.3W at 110% rated voltage
		0.12% at 90% rated voltage
		0.12% at 100% rated voltage
		0.14% at 110% rated voltage
Rated power, S_r	IEC 60076-2 clause 7.0	400kVA, ONAN
Short-circuit withstand test	IEC 60076-5 clause 4.2	Verified
Rated insulation level	IEC 60076-3 clauses 10, 11, 13.3	HV $U_m = 40.5\text{kV}$: LI = -200kV ac = 80kV LV $U_m < 1.1\text{kV}$: ac = 3kV
Sound pressure level for the transformer at 0.3 m under no-load current and rated voltage, ONAN	IEC 60076-10 clause 11	37dB(A), guaranteed 48dB(A)
Sound pressure level for the transformer at 0.3 m under no-load current and rated voltage, ONAN	IEC 60076-10 clause 12	49dB(A), guaranteed 59dB(A)
Measurement of winding resistance	IEC 60076-1 clause 11.2	Verified
Measurement of voltage ratio and check of phase displacement	IEC 60076-1 clause 11.3	Verified
Measurement of short-circuit impedance and load loss	IEC 60076-1 clause 11.4	Verified
Leak test with pressure for liquid-immersed transformer (tightness test)	IEC 60076-1 clause 11.8	Verified
Measurement of zero-sequence impedance(s) on three-phase transformer	IEC 60076-1 clause 11.1.4 f)	Verified
Measurement of d.c. insulation resistance between each winding to earth and between windings	IEC 60076-1 clause 11.1.4 h)	Verified

Project No. G104343209**Certificate No. ASTA-TYPE-00385****Certificate contents:**

The following documents are attached to and form part of this certificate:

Documents:	Number of pages:
Test Report (B20136, dated 6/07/2020)	53
Drawings	10

Certificate Revision Amendment Table:

Certificate Number	Issue date	Amendment
ASTA-TYPE-00385	25 July 2020	Initial Issue

APPARATUS TESTED: Three-phase, 400 kVA, $(35000 \pm 2 \times 2.5\%)$ / 400V (Ur), 50 Hz, ONAN, Category I, Yyn0, oil type transformer. The high voltage winding has 5 taps and the principal tap is tap 3.

STANDARD:

IEC 60076-1: Edition 3.0 2011-04	Clauses 11.1.2.1, 11.1.3, 11.1.4 f), 11.1.4 h), 11.2 to 11.6 and 11.8
IEC 60076-2: Edition 3.0 2011-02	Clauses 6 and 7
IEC 60076-3: Edition 3.0 2013-07	Clauses 10, 11 and 13
IEC 60076-5: Edition 3.0 2006-02	Clause 4.2
IEC 60076-10: Edition 2.0 2016-03	Clauses 11 and 12

and the STL Guide to IEC 60076 Issue 6.0, 1 June 2019, where applicable

MANUFACTURER: SONG HONG VIET CO., LTD.
Lot CN5 Quat Dong Expanded Industrial Zone, Nguyen Trai Commune, Thuong Tin district, Ha Noi city, VIETNAM

TESTING LABORATORY: Shenyang Transformer Institute Co., Ltd. Transformer Laboratory (STRI-CTQC)
No. 18, Hushitai South Street, Shenbei New Area, Shenyang, Liaoning, China



APPROVED BY: Stephen Yu, ASTA Observer, Intertek China

Date: 6 July 2020

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
CONTENTS

Record of proving tests:	Pages 1 to 33
Diagram numbers:	Pages 34 and 35 (Figures 1 & 2)
Oscillogram numbers:	Pages 36 to 46 Impulse oscillograms: B20136-L01 to B20136-L12 Short-circuit oscillograms: B20136-S01-1 to 3, B20136-S02-1 to 3 and B20136-S03-1 to 3
Photographs:	Pages 47 to 53
Drawings:	10 drawings

Photographs: The following photographs are included in this document.

Photograph No:	Description
P001	Measurement of winding resistance after the short-circuit withstand tests
P002	Measurement of voltage ratio and check of phase displacement after the short-circuit withstand tests
P003	Measurement of short-circuit impedance and load loss after the short-circuit withstand tests
P004	Measurement of no-load loss and current after the short-circuit withstand tests
P005	Full wave lightning impulse test (LI) on HV line terminal
P006	Applied voltage test (AV) after the short-circuit withstand tests on HV windings
P007	Induced voltage withstand test (IVW) after the short-circuit withstand tests
P008	Temperature rise test arrangement
P009	Short-circuit withstand tests arrangement view 1
P010	Short-circuit withstand tests arrangement view 2
P011	Transformer HV terminals side before the short-circuit withstand tests
P012	Transformer LV terminals side before the short-circuit withstand tests
P013	Transformer HV terminals side after the short-circuit withstand tests
P014	Transformer LV terminals side after the short-circuit withstand tests

Schedule of drawings: The following drawings were supplied by the client / manufacturer.

Drawing number	Issue Status		Description
	Revision	Date	
1ZT.710.5052.1	-	10/02/2020	SB-400/35 General Assembly
1ZT.001.5052	-	10/02/2020	Nameplate
5ZT.384.5052.1	-	10/02/2020	SB-400/35 OIL TANK
6ZT.602.5052	-	10/02/2020	SB-400/35 LV Coil
5ZT.517.5052	-	10/02/2020	SB-400/35 LV Leads
6ZT.602.5052.1	-	10/02/2020	SB-400/35 HV Coil
5ZT.516.5052.1	-	10/02/2020	SB-400/35 HVLeads
5ZT.700.5052	-	10/02/2020	SB-400/35
5ZT.641.5052.1	-	10/02/2020	SB-400/35 Iron Core Assembly
5ZT.640.5052.1	-	10/02/2020	SB-400/35 Iron core

The above drawings were supplied by the client and verified by the ASTA Observer as adequately representing the apparatus tested.

RECORD OF PROVING TESTS

Laboratory Ref. No: B20136

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APPARATUS TESTED

Three-phase, 400 kVA, $(35000 \pm 2 \times 2.5\%) / 400V (U_r)$, 50 Hz, ONAN, Category I, Yyn0, oil type transformer. The high voltage winding has 5 taps and the principal tap is tap 3.

TRANSFORMER DETAILS

Manufacturer : SONG HONG VIET CO., LTD.

Rating : 400 kVA, ONAN

Rated voltage ratio : 35000 / 400 V

Manufacturer's serial No. : 1203030288

Product type : Three-phase power transformer

Tapping : $\pm 5\%$ steps of 2.5 %, (5 tap positions)

Connection symbol : Yyn0

Rating plate impedance (75°C) : 4.64% for Tap 3

Cooling : ONAN

Dielectric properties : HV : U_m 40.5 / LI 200/ AC 80 kV
LV : $U_m < 1.1$ / AC 3 kV

Oil mass : 380 kg

Total mass : 1800 kg

Date of manufacture : March 2020

Windings : Circular

HV Winding material : Wire (Copper)

LV Winding material : Foil (Copper)

Material of the core : Silicon Core

Insulation system : Nynas Nytro Gemini X Oil

Nominal tapping ratios are detailed below. Tap 3 is the principal tap.

Tap Number	Rated HV Voltage V	Rated HV Current A	Rated LV Voltage V	Rated LV Current A
1	36750	6.28	400	577.4
2	35875	6.44		
3	35000	6.60		
4	34125	6.77		
5	33250	6.95		

RECORD OF PROVING TESTS**Laboratory Ref. No: B20136****CLIENT**

SONG HONG VIET CO., LTD.

Lot CN5 Quat Dong Expanded Industrial Zone, Nguyen Trai Commune,
Thuong Tin district, Ha Noi city, VIETNAM**ASTA****Page 5 of 53****DATE OF RECEIPT OF APPARATUS**

5 June 2020

ORDER NUMBER

QNS200423003

MANUFACTURER

SONG HONG VIET CO., LTD.

Lot CN5 Quat Dong Expanded Industrial Zone, Nguyen Trai Commune,
Thuong Tin district, Ha Noi city, VIETNAM**WITNESSES OF THE TESTS:****Name****Organisation**

Mr. Stephen Yu

– ASTA Observer, Intertek Guangzhou

LABORATORY

The apparatus was tested at:

Shenyang Transformer Research Institute Co., Ltd. (STRI-CTQC)

Hushitai South Avenue 18#, Shenbei New District, Shenyang, Liaoning Province, China

The laboratory accreditation details are:

**IECEE CB
Scheme**

This Laboratory is a CB Testing Laboratory (CBTL) under the IECEE CB Scheme with TUV Rheinland InterCert Kft., MEEI Division as the National Certification Body.

CNAS

This Laboratory is accredited by China National Accreditation Service for Conformity Assessment against the requirements of ISO / IEC 17025:2017, Accredited No. CNAS L0681

SCHEDULE OF TESTS

The transformer was tested in accordance with the following standards:

IEC 60076-1: Edition 3.0 2011-04 Clauses 11.1.2.1, 11.1.3, 11.1.4 f), 11.1.4 h), 11.2 to 11.6 and 11.8

IEC 60076-2: Edition 3.0 2011-02 Clauses 6 and 7

IEC 60076-3: Edition 3.0 2018-03 Clauses 10, 11 and 13

IEC 60076-5: Edition 3.0 2006-02 Clause 4.2

IEC 60076-10: Edition 2.0 2016-03 Clauses 11 and 12

and the STL Guide to IEC 60076 Issue 6.0, 1 June 2019, where applicable.

Test	Standard	Clause No.	Page No.
Routine tests			
Measurement of winding resistance	IEC 60076-1	Clause 11.2	12
Measurement of voltage ratio and check of phase displacement	IEC 60076-1	Clause 11.3	13
Measurement of short-circuit impedance and load loss	IEC 60076-1	Clause 11.4	14 and 15
Measurement of no-load loss and current at 100 % and 90 % and 110 % of rated voltage	IEC 60076-1	Clauses 11.5 and 11.1.3 e)	16 to 18
Applied voltage test (AV)	IEC 60076-3	Clause 10	19
Induced voltage withstand test (IVW)	IEC 60076-3	Clause 11	19
Leak testing with pressure for liquid-immersed transformers (tightness test)	IEC 60076-1	Clause 11.8	20
Type tests			
Temperature rise test	IEC 60076-2	Clauses 6 and 7	21 to 23
Determination of sound level	IEC 60076-10	Clauses 11 and 12	24 to 26
Measurement of no-load loss and current at 90 % and 110 % of rated voltage	IEC 60076-1	Clause 11.1.3 e)	17 and 18
Full wave lightning impulse test (LI)	IEC 60076-3	Clause 13	27
Special tests			
Short-circuit withstand test	IEC 60076-5	Clause 4.2	29 to 33
Measurement of zero-sequence impedance(s) on three-phase transformers	IEC 60076-1	Clause 11.6	28
Measurement of d.c. insulation resistance between each winding to earth and between windings	IEC 60076-1	Clause 11.1.4 h)	20

General

1. All the tests were performed on transformer serial no. 1203030288.
See Schedule of Tests, Page 7.

Routine tests

2. For all routine tests except the dielectric tests the transformer was supplied from a sinusoidal three-phase 50 Hz supply.
For the applied voltage test, the transformer was supplied from a sinusoidal 50 Hz single-phase supply before and after the short-circuit withstand tests.
For the induced voltage withstand test, the transformer was supplied from a sinusoidal 150 Hz supply before and after the short-circuit withstand tests.

3. The HV winding resistances were measured using a KRI winding analyser d.c. bridge model JYR(40E) at 0.1 A before and after the short-circuit withstand tests.

The LV winding resistances were measured using a KRI winding analyser d.c. bridge model JYR(40E) at 10.0 A before and after the short-circuit withstand tests.

4. The voltage ratio and check of phase displacement were measured using a Baoding SIRUIE electrical turns ratio meter model SR2000B before and after the short-circuit withstand tests.
5. For the load loss tests, the power, voltages and currents were measured using a YOKOGAWA power analyser model number WT 500 before and after the short-circuit withstand tests.

For the load loss test the transformer's HV winding was energised with the LV winding short-circuited such that at least 50 % of the rated current flowed in the HV winding.

The short circuit impedance and the load loss were calculated for the reference temperature of 75°C.

6. For the no-load loss tests, the power, voltages and currents were measured using a YOKOGAWA power analyser model number WT 3000 before and after the short-circuit withstand tests.

For the no-load loss test the transformer's LV winding was energised at rated voltage with the HV windings open circuit, in accordance with clause 11.5 of IEC 60076-1:2011.

7. The transformer oil temperatures were measured via PT resistance temperature detector.
8. All the PT resistance temperature detectors temperature measurements were made using KRI Data Logger Model No. DT1000.
9. In accordance with clauses 7.1, 7.2 and 7.3 of IEC 60076-3:2018 and clause 4.2.7.4 of IEC 60076-5:2006 the dielectric tests were performed in the following sequences before and after the short-circuit withstand tests:

Test Order	Before short-circuit tests	After short-circuit tests
1)	Applied voltage test (AV)	Full wave lightning impulse test (LI)
2)	Induced voltage withstand test (IVW)	Applied voltage test (AV)
3)	-	Induced voltage withstand test (IVW)

Temperature rise test

10. The temperature rise test was performed after the short-circuit withstand tests.
11. Load loss, no-load loss and dc resistance measurements were used to calculate the total power required for the temperature rise test. The temperature rise results have been calculated at the 75°C reference temperature.
12. The transformer was tested in accordance with clause 7.3 of IEC 60076-2:2011 using the short-circuit method.

The test was performed in ONAN condition:

The test was performed in two parts as follows:

- a) Total loss injection-
The transformer HV winding was subjected to a test voltage sufficient to supply total losses with the LV winding short-circuited. The test power was maintained until the increase in top oil was below 1 K per hour for a period of 3 hours.
The corrections of clause 7.13 of IEC 60076-2:2011 were used in determining the top oil and average oil temperature rises
 - b) Rated current injection for the HV and LV windings-
At the completion of part a), the test current was reduced to rated current for 1 hour followed by rapid disconnection of the test supply and the d.c. resistances of the windings were measured to determine their maximum temperatures using the change of resistance method for the HV and LV windings.
The corrections of clause 7.13 of IEC 60076-2:2011 were used in determining the top oil, average oil and winding temperature rises.
13. A YOKOGAWA power analyser model number WT 3000 was used to measure the current, voltages and power.
 14. The HV (B-C), and LV (b-c) winding resistances were measured using a d.c. resistance bridge before and during the hot resistance shutdown.
 15. One PT resistance temperature detector was placed in the top oil pocket of the transformer.
 16. The bottom radiators outlets temperatures were measured with PT resistance temperature detectors placed in 2 outlet points of the radiator banks.
 17. The ambient temperature was the average of 4 PT resistance temperature detectors placed in oil pots each with approximately a 2 hours' time constant.
The oil pots were positioned round the transformer located at about half the transformer's height and about 2 m from the transformer in ONAN condition.
 18. All the thermocouple temperature measurements were made using KRI Data Logger Model No. DT1000.
 19. The top oil temperature (θ_o) was determined from the average of the top oil pocket temperatures as per clause 7.4.1.
 20. The bottom oil temperature (θ_b) was determined from the average of the bottom oil outlet temperatures of the radiator banks as per clause 7.4.2.
 21. The average oil temperature was determined using clause 7.4.2: $\theta_{om} = (\theta_o + \theta_b)/2$

Determination of sound level

22. The sound pressure level was measured in accordance with clause 11 of IEC 60076-10:2016.
23. The sound pressure level tests were performed with the transformer in a room dimensioned 36.0 m wide, 8.0 m deep and 9.4 m high, rectangular shaped. The room had some equipment as shown in Figure 2.
24. The sound pressure level tests were performed before the temperature rise test.
25. Measurements were made using a Type 1 calibrated sound level meter complying with IEC 61672 and calibrated in accordance with clause 5.2 of ISO 3746 as follows:

A B & K sound level meter Type 2270, Serial No. 2746614 and 4380 factory Jiaxing branch Calibrator model type HS6020, Serial No. 27008618 were used for the testing.

The sound level calibrator meter was used before and after the test.
26. The sound level meter was mechanically held for all sound level measurements. The operator stood to the side of the meter for each measurement.
27. Before and after the sound pressure level tests, the A-weighted sound level pressure level of the background noise was measured at 15 measuring positions at half the height of the transformer.
28. The transformer sound pressure level was measured under no-load conditions with the LV winding supplied at rated volts from a sinusoidal 50 Hz three-phase supply with the HV windings open circuit, in accordance with clause 4.2 of IEC 60076-10:2016.
29. The sound pressure level was measured around the prescribed contour at a distance of 0.3m in ONAN condition from the transformer's principal radiating surface at half height of the transformer, as shown in Figure 2.
30. The average sound pressure level and power level were calculated from the measured sound pressure levels in accordance with clauses 11 and 12 of IEC 60076-10:2016.

Induced voltage withstand test (IVW)

31. The induced voltage withstand test (IVW) was performed in accordance with clauses 11.1 and 11.2 of IEC 60076-3:2018-03.
32. The induced voltage withstand test (IVW) was performed before and after the short-circuit withstand tests.
33. The low voltage windings of the transformer were energised from a three-phase 150 Hz supply.

Short-circuit withstand tests

34. Interpretation of IEC 60076-5:2006 was taken from the STL Guide to IEC 60076 issue 6.0, 1 June 2019.
35. A YOKOGAWA power analyser model number WT3000 was used in a three-phase circuit before the short-circuit withstand tests to determine short-circuit impedance and X/R ratio. These values were used in the calculation of short-circuit currents.

Short-circuit withstand tests(continued)

36. In accordance with clause 4.1.2 of IEC 60076-5:2006, the short-circuit impedance of the transformer was calculated at the reference temperature of 75°C.
37. The theoretical short-circuit currents were calculated based on the impedance of the transformer only. As the system impedance calculated for a short-circuit apparent power in accordance with Table 2 of IEC 60076-5:2006, 1000 MVA at U_{sys} 35 kV (U_{sys} 35 kV required by client, 1000 MVA refer to Table 2 of IEC 60075-5:2006) was less than 5% of the short-circuit impedance of the transformer.
38. For the short circuit test, single-phase tests were performed. The transformer's HV winding was energised from a two-phase 50 Hz test supply. The pre-short-circuit method was used with the LV winding short-circuited. Nine consecutive short-circuit tests of nominal 0.5 s duration were performed in accordance with clause 4.2.5 of IEC 60076-5:2006. See Figure 1 for the test circuit arrangement.
39. The reactance of the transformer was measured using a precision LCR analyser model XC2819 before the start of testing and after each short-circuit test.
40. For the short-circuit withstand tests, an earth fault detection device consisting of a current shunt between the tank of the transformer and the test station earth was used. The earth current was also monitored oscillographically.

Full wave lightning impulse tests (LI)

41. The full wave lightning impulse test (LI) was conducted after the short-circuit withstand tests on the HV winding on tap 3 in accordance with clause 13 of IEC 60076-3:2013.
42. The HV line terminals of the transformer were tested at LI 200 kV.
43. For all tests the transformer frame and core were solidly earthed.
44. A full sequence of tests in accordance with clause 13.2.2 as appropriate of IEC 60076-3:2013 was conducted on each phase in turn of the transformer under test.
45. The full wave lightning impulse test (LI) was applied to one HV line terminal at a time with the other HV terminals connected together and earthed via a current shunt, and the other winding terminals connected together to earth.
46. Fault detection was by comparison of oscillographic voltage and current traces between the reference reduced level test and the full level tests.

Inspection

47. The transformer was detanked and the windings and core inspected after the repeat routine tests.

Measurement of winding resistance

HV winding	Phase	Before short-circuit tests	After short-circuit tests
Tap 1	A-B	27.95 Ω	28.20 Ω
	B-C	27.96 Ω	28.20 Ω
	C-A	28.03 Ω	28.27 Ω
	Average	27.98 Ω	28.22 Ω
Tap 2	A-B	27.21 Ω	27.45 Ω
	B-C	27.22 Ω	27.45 Ω
	C-A	27.28 Ω	27.52 Ω
	Average	27.24 Ω	27.47 Ω
Tap 3	A-B	26.49 Ω	26.71 Ω
	B-C	26.48 Ω	26.71 Ω
	C-A	26.55 Ω	26.77 Ω
	Average	26.51 Ω	26.73 Ω
Tap 4	A-B	25.74 Ω	25.97 Ω
	B-C	25.74 Ω	25.96 Ω
	C-A	25.80 Ω	26.02 Ω
	Average	25.76 Ω	25.98 Ω
Tap 5	A-B	25.01 Ω	25.23 Ω
	B-C	25.00 Ω	25.22 Ω
	C-A	25.06 Ω	25.27 Ω
	Average	25.02 Ω	25.24 Ω

LV winding	Phase	Before short-circuit tests	After short-circuit tests
	a-b	2.365 m Ω	2.387 m Ω
	b-c	2.361 m Ω	2.386 m Ω
	c-a	2.399 m Ω	2.423 m Ω
	Average	2.375 m Ω	2.399 m Ω
Temperature-	Average oil	26.3 $^{\circ}\text{C}$	28.5 $^{\circ}\text{C}$
Date of Tests:		16 June 2020	18 June 2020

Photograph no.: P001

RECORD OF PROVING TESTS

Laboratory Ref. No: B20136

TEST RESULTS**ASTA**

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Transformer Serial No. 1203030288

Measurement of HV to LV voltage ratio and check of phase displacement

Tap No.	Rated Primary Voltage	Nominal Ratio*	Difference from nominal ratio before short-circuit tests (%)			Difference from nominal ratio after short-circuit tests (%)		
			AB-ab	BC-bc	CA-ca	AB-ab	BC-bc	CA-ca
1	36750	91.875	0.05	0.08	0.08	0.07	0.02	0.06
2	35875	89.688	0.05	0.02	0.03	0.05	0.03	0.04
3	35000	87.500	0.05	0.06	0.03	0.07	0.04	0.06
4	34125	85.312	0.00	0.03	0.02	0.03	0.03	0.03
5	33250	83.125	0.02	0.04	0.03	0.06	0.02	0.04

*The rated voltage of the LV winding was 400 V

The HV-LV phase displacement was verified to confirm to Yyn0 connection.

Photograph no.: P002

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

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Transformer Serial No. 1203030288

Measurement of short-circuit impedance and load loss Tap 1, HV to LV windings

Tap 1	Before short-circuit tests	After short-circuit tests
Average line voltage	1163.0 V	1158.0 V
Average line current	4.66 A	4.23 A
Total power	1420.0 W	1430.0 W
Average oil temperature	26.9 °C	28.5 °C
Reference temperature	75 °C	75 °C
Load loss at reference temperature	3600.0 W	3610.0 W
Impedance at reference temperature	159.03 Ω	159.03 Ω
Percent impedance at reference temperature	4.71 %	4.71 %
X/R ratio at reference temperature	5.13	5.09
Date of Tests:	16 June 2020	18 June 2020

Measurement of short-circuit impedance and load loss Tap 3, HV to LV windings

Tap 3	Before short-circuit tests	After short-circuit tests
Average line voltage	1092.0 V	1116.0 V
Average line current	4.46 A	4.55 A
Total power	1460.0 W	1540.0 W
Average oil temperature	26.9 °C	28.5 °C
Reference temperature	75 °C	75 °C
Load loss at reference temperature	3700.0 W	3710.0 W
Impedance at reference temperature	142.10 Ω	142.71 Ω
Percent impedance at reference temperature	4.64 %	4.66 %
X/R ratio at reference temperature	4.93	4.90
Date of Tests:	16 June 2020	18 June 2020

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

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Transformer Serial No. 1203030288

Measurement of short-circuit impedance and load loss Tap 5, HV to LV windings

Tap 5	Before short-circuit tests	After short-circuit tests
Average line voltage	1012.0 V	1012.0 V
Average line current	4.66 A	4.66 A
Total power	1470.0 W	1490.0 W
Average oil temperature	26.9 °C	28.5 °C
Reference temperature	75 °C	75 °C
Load loss at reference temperature	3780.0 W	3810.0 W
Impedance at reference temperature	126.03 Ω	126.31 Ω
Percent impedance at reference Temperature	4.56 %	4.57 %
X/R ratio at reference temperature	4.72	4.67
<i>Date of Tests:</i>	16 June 2020	18 June 2020

Photograph no.: P003

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Measurement of no-load loss and current at 100% rated voltage

		Before short-circuit tests		After short-circuit tests	
		U' mean scaled rms	U rms	U' mean scaled rms	U rms
Phase voltage	a-b	230.3 V	230.3 V	230.0 V	230.1 V
	b-c	232.2 V	231.8 V	232.1 V	231.6 V
	c-a	230.8 V	230.8 V	230.8 V	230.8 V
Average		231.1 V	231.0 V	231.0 V	230.8 V
Phase current	a	0.58 A		0.59 A	
	b	0.65 A		0.65 A	
	c	0.90 A		0.90 A	
Average		0.71 A = 0.12% of rated I _r		0.71 A = 0.12 % of rated I _r	
Total power	P _m	426.8 W		425.0 W	
Total power	P _o	427.0 W		425.4 W	
Ambient conditions					
Ambient air temperature		26.5 °C		28.4 °C	
Oil average temperature		26.9°C		28.5 °C	
Relative humidity		51 %		43 %	
Date of Tests:		16 June 2020		18 June 2020	

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Measurement of no-load loss and current at 90% rated voltage

		Before short-circuit tests		After short-circuit tests	
		U' mean scaled rms	U rms	U' mean scaled rms	U rms
Phase voltage	a-b	207.2 V	207.2 V	207.2 V	207.4 V
	b-c	208.7 V	208.4 V	208.8 V	208.6 V
	c-a	207.5 V	207.5 V	207.6 V	207.6 V
Average		207.8 V	207.7 V	207.9 V	207.9 V
Phase current	a	0.54 A		0.54 A	
	b	0.66 A		0.65 A	
	c	0.84 A		0.84 A	
Average		0.68 A = 0.12% of rated I _r		0.68 A = 0.12 % of rated I _r	
Total power	P _m	341.2 W		340.4 W	
Total power	P _o	341.4 W		340.4 W	
Ambient conditions					
Ambient air temperature		26.5 °C		28.4 °C	
Oil average temperature		26.9°C		28.5 °C	
Relative humidity		51 %		43 %	
Date of Tests:		16 June 2020		18 June 2020	

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Measurement of no-load loss and current at 110% rated voltage

		Before short-circuit tests		After short-circuit tests	
		U' mean scaled rms	U rms	U' mean scaled rms	U rms
Phase voltage	a-b	253.1 V	253.3 V	252.8 V	252.9 V
	b-c	255.1 V	255.1 V	255.5 V	255.1 V
	c-a	253.5 V	253.5 V	253.8 V	254.0 V
Average		253.9 V	254.0 V	254.0 V	254.0 V
Phase current	a	0.71 A		0.72 A	
	b	0.64 A		0.64 A	
	c	1.00 A		1.00 A	
Average		0.78 A = 0.14 % of rated I _r		0.78 A = 0.14 % of rated I _r	
Total power	P _m	526.5 W		525.0 W	
Total power	P _o	526.3 W		525.0 W	
Ambient conditions					
Ambient air temperature		26.5 °C		28.4 °C	
Oil average temperature		26.9°C		28.5 °C	
Relative humidity		51 %		43 %	
Date of Tests:		16 June 2020		18 June 2020	

Photograph no.: P004

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Applied voltage test (AV)

The HV winding satisfactorily withstood 80 kV (PK $\sqrt{2}$) before and after the short-circuit withstand tests, applied for 60 s between the HV terminals and the LV terminals connected together with the tank and connected to earth.

The LV winding satisfactorily withstood 3 kV (PK $\sqrt{2}$) before and after the short-circuit withstand tests, applied for 60 s between the LV terminals and the HV terminals connected together with the tank and connected to earth.

Ambient conditions during the applied voltage test (AV) were:

Ambient conditions	Before short-circuit tests	After short-circuit tests
Ambient air temperature	26.3 °C	28.5 °C
Relative humidity	51 %	43 %
Atmospheric pressure	998 hPa	996 hPa
Date of Tests:	16 June 2020	18 June 2020

Photograph no.: P006

Induced voltage withstand test (IVW)

Satisfactorily withstood 800 V before and after the short-circuit withstand tests at 150 Hz applied phase to phase for 40 s to the LV winding with the HV winding open-circuited and the neutral earthed.

Ambient conditions during the induced voltage withstand test were:

Ambient conditions	Before short-circuit tests	After short-circuit tests
Ambient air temperature	26.3 °C	28.5 °C
Relative humidity	51 %	43 %
Atmospheric pressure	998 hPa	996 hPa
Date of Tests:	16 June 2020	18 June 2020

Photograph no.: P007

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Leak testing with pressure for liquid immersed transformers (tightness test)

A pressure of 30 kPa over the normal liquid pressure was applied from the top oil bank with the transformer equipped with all bushings and radiator banks and maintained for a period of 8 hours. After the test, there was no evidence of oil leakage.

Date of Tests: 19 June 2020

Measurement of d.c. insulation resistance each winding to earth and between windings

The d.c. insulation resistance of the transformer were measured before and after the short-circuit withstand tests at 5000 V d.c. applied from the HV side and 2500 V d.c. applied from the LV side.

The results were:

Condition	Before short-circuit test	After short-circuit test
	60 s	60 s
HV to LV and Earth	7510 MΩ	6490 MΩ
LV to HV and Earth	5170 MΩ	4340 MΩ
HV and LV to Earth	4070 MΩ	3830 MΩ
HV to LV	8880 MΩ	7650 MΩ
Environment conditions		
Ambient air temperature	26.5 °C	28.4 °C
Average oil temperature	26.3 °C	28.5 °C
Relative humidity	51 %	43 %
Atmospheric pressure	998 hPa	996 hPa
Date of Tests:	16 June 2020	18 June 2020

HV : High voltage winding
LV : Low voltage winding

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Temperature rise test – in ONAN condition

Total rated losses of the transformer for temperature rise test at a reference temperature 75°C

Supply to the HV winding and short-circuit of the LV winding.

The total losses were equal to the sum of the load loss at reference temperature on tap 3 plus the no-load loss at rated voltage after short-circuit test in ONAN condition.

Test	Measured value
Load loss @ 75°C	3710.0 W
No load loss	425.4 W
Total loss @ 75°C	4135.4 W
Rated current on Tap 3	6.6 A

a) Top oil temperature rise

Average injected power during last hour of the test = 4136.6 W

Total rated losses = 4135.4 W

Average ambient temperature during last hour of total rated losses = 27.3 °C

Top oil temperature during last hour of total rated losses, θ_o = 57.1 °C

Top oil temperature rise during last hour of total rated losses = 29.8 K

Average bottom oil temperature during last hour of total rated losses, θ_b = 45.1 °C

Average oil temperature during last hour of total rated losses, θ_{om} = 51.1 °C

Average oil temperature rise during last hour of total rated losses = 23.8 K

Corrected top oil temperature rise

$$\Delta\theta_o = 29.8 \times (4136.6 / 4135.4)^{0.8} = 29.8 \text{ K}$$

Corrected average oil temperature rise

$$\Delta\theta_{om} = 23.8 \times (4136.6 / 4135.4)^{0.8} = 23.8 \text{ K}$$

Top oil temperature rise: 29.8 K

Guaranteed limit for top oil rise: 50 K*

* Note: Lower guaranteed limit as specified by the manufacturer. According to Table 1 of standard IEC 60076-2 the limit is 60 K

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Temperature rise test – in ONAN condition (Continued)

b) Winding temperature rise for the HV windings

Average HV current during last hour of the test	= 6.6 A
Rated HV current	= 6.6 A
Temperatures extrapolated back to time of switch off,	
HV winding temperature	= 64.1 °C
LV winding temperature	= 61.0 °C
Ambient temperature at switch off	= 27.4 °C
Average oil temperature at switch off	= 50.9 °C
Average oil temperature rise at switch off	= 23.5 °C

Winding temperature rises above average oil temperature at switch off

HV winding	= 64.0 – 50.9	= 13.1 K
LV winding	= 61.0 – 50.9	= 10.1 K

Corrected winding temperature rise above average oil temperature:

$\Delta\theta_w$ HV	= 13.1 x (6.6 / 6.6) ^{1.6}	= 13.1 K
$\Delta\theta_w$ LV	= 10.1 x (6.6 / 6.6) ^{1.6}	= 10.1 K

Corrected average oil temperature rise during last hour of the test to Part a) = 23.8 K

HV winding temperature rise = 13.1 + 23.8 = 36.9 K

LV winding temperature rise = 10.1 + 23.8 = 33.9 K

Guaranteed limit: 55 K*

* Note: Lower guaranteed limit as specified by the manufacturer. According to Table 1 of standard IEC 60076-2 the limit is 65 K

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Temperature rise test – in ONAN condition (Continued)

Summary of temperature rise test:

Top oil temperature rise:	29.8 K	Limit 50 K*
HV winding temperature rise:	36.9 K	Limit 55 K*
LV winding temperature rise:	33.9 K	Limit 55 K*

* Note: Lower guaranteed limit as specified by the manufacturer. According to Table 1 of standard IEC 60076-2 the limit is 60 K for top oil temperature rise and 65 K for winding temperature rise.

Result: The transformer satisfied the requirements of the standard in ONAN condition.

Photograph no.: P008

Date of Tests: 18 and 19 June 2020

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Determination of sound level - @ 0.3 m in ONAN condition

Test set up conditions

Height of transformer tank	1.45 m
Sound level measurements made at 1/2 height	0.73 m
Transformer length	1.45 m
Transformer width	1.01 m
Prescribed contour perimeter, l_m	7.32 m
Measuring distance from prescribed contour	0.3 m
Distance between measuring points	0.49 m
Number of measurement points	15
Measurement point no. 1	HV A phase bushing, numbered anticlockwise
Environmental conditions	
Temperature	28.3 °C
Relative humidity	45 %
Atmospheric pressure	998 hPa
Date of Tests:	19 June 2020

Note: * Measurements are made at 0.49m, equally spaced intervals.

Evaluation of sound level under rated current and short-circuit voltage conditions	
Transformer rated power, S_r	0.4 MVA
Reference power, S_p	1 MVA
$L_{WA,lr} = 39 + 18\log(S_r/S_p)$	32dB
Guaranteed sound power level	59dB
Guaranteed $-L_{WA,lr}$	= 27dB(A), > 10dB(A)

As $L_{WA,lr}$ is more than 10dB(A) below the guaranteed sound power level then load current sound level measurements were not required.

Sound level measurements were performed under no-load conditions before the temperature rise test.

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

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Transformer Serial No. 1203030288

Determination of sound level @ 0.3 m in ONAN condition (Continued)

Test No.	Background Pressure Level- (L_{bgAi}) dB(A)	
	Before the sound level test	After the sound level test
	1/2 Height	1/2 Height
1	37.8	37.9
2	37.8	38.0
3	38.8	38.4
4	38.9	38.8
5	38.6	38.7
6	38.4	38.5
7	37.8	37.7
8	37.0	37.8
9	38.2	38.1
10	37.9	37.9
Average	38.2 ($\overline{L_{bgA}}$)	38.2 ($\overline{L_{bgA}}$)

Position No.	Sound Pressure Level (L_{pAi}) dB(A)	Position No.	Sound Pressure Level (L_{pAi}) dB(A)
	1/2 Height		1/2 Height
1	39.5	9	41.0
2	40.2	10	41.4
3	40.1	11	41.8
4	40.8	12	40.2
5	40.7	13	40.8
6	40.4	14	40.4
7	42.3	15	41.5
8	42.5		
Average	41.0($\overline{L_{pA0}}$)		

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS (Continued)

Transformer Serial No. 1203030288

Determination of sound level @ 0.3 m in ONAN condition (Continued)

Calculation of sound pressure level and sound power level

Sound pressure level ($\overline{L_{pA0}}$)	41.0dB(A)
Background ($\overline{L_{bgA}}$) before test	38.2dB(A)
Background ($\overline{L_{bgA}}$) after test	38.2dB(A)
Test acceptance	Results are valid as per Table 1 of IEC 60076-10
Prescribed contour perimeter	$l_m = 7.32 \text{ m}$
Measurement surface	$S = 12.8 \text{ m}^2$
Test chamber	$\alpha = 0.20$
	$S_v = 2300 \text{ m}^2$
	$A = \alpha S_v = 460.0 \text{ m}^2$
	$A/S = 35.91 (>1)$
	$K = 10 \log (1 + 4/10.87) = 0.5 \text{ dB(A)}$

Sound pressure level at 0.3 m:

Guaranteed sound pressure limit under no load conditions: 48dB(A)

$$\overline{L_{pA}} = 10 \lg (10^{0.1 \overline{L_{pA0}}} - 10^{0.1 \overline{L_{bgA}}}) - K = 37 \text{ dB(A)}$$

Sound power level:

Guaranteed sound power limit under no load conditions: 59B(A)

$$L_{WA} = \overline{L_{pA}} + 10 \lg \frac{S}{S_0} = 49 \text{ dB(A)}$$

Date of Tests: 19 June 2020

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Full wave lightning impulse test (LI) on the HV Winding

Full wave lightning Impulse at LI 200 kV on the HV winding.
Standard lightning impulse wave shape: $1.2 \pm 30\%$ / $50 \pm 20\%$ μ s negative impulses

Terminal tested	Test No. B20136-	Type of Impulse	Test Voltage kV	Wave shape (μ s)		Result
				Tf	Tt	
A	L01	1 reduced level full wave	-119.9	1.41	50.6	Passed
	L02	1 full level full wave	-201.8	1.41	50.9	
	L03	1 full level full wave	-201.8	1.41	51.0	
	L04	1 full level full wave	-201.7	1.42	51.0	
B	L05	1 reduced level full wave	-120.2	1.39	50.5	Passed
	L06	1 full level full wave	-202.2	1.43	50.9	
	L07	1 full level full wave	-201.5	1.42	51.1	
	L08	1 full level full wave	-201.6	1.43	51.1	
C	L09	1 reduced level full wave	-120.1	1.44	50.6	Passed
	L10	1 full level full wave	-201.5	1.44	51.1	
	L11	1 full level full wave	-201.3	1.45	51.2	
	L12	1 full level full wave	-202.0	1.45	51.2	

Ambient conditions during the full wave lightning impulse test (LI) were:

Ambient conditions	
Temperature	29.9 °C
Relative humidity	34 %
Atmospheric pressure	992 hPa
Date of Tests:	17 June 2020

There were no flashovers, punctures or voltage collapses, and there was satisfactory agreement between the reference impulse and those recorded at the full test voltage.

Photograph no.: P005

Result: The HV winding of the transformer passed the full wave lightning impulse test (LI) on the HV winding and complied with the requirements of Clauses 13.2.2.2 of the IEC 60076-3:2013.

Date of tests: 16 to 19 June 2020

Stephen Yu, ASTA Observer

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Measurement of zero-sequence impedance(s) on three-phase transformers

Test supply terminals	abc-n	abc-n	abc-n	abc-n	abc-n
Short-circuit terminals	-	-	-	-	-
Open-circuit terminals	ABC	ABC	ABC	ABC	ABC
Test Voltage, U	11.575 V	21.796 V	31.381 V	40.097 V	48.288 V
Test Current, I	121.75 A	234.01 A	351.83 A	466.27 A	578.03 A
Tap	3	3	3	3	3
Test Current / phase	40.58 A	78.03 A	117.28 A	155.42 A	192.68 A
$Z_0 = 3 U/I$	0.2852 Ω	0.2852 Ω	0.2852 Ω	0.2852 Ω	0.2852 Ω
Oil average temperature	35.9 °C	35.9 °C	35.9 °C	35.9 °C	35.9 °C
Dates of Tests:	19 June 2020				

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Short-circuit withstand tests HV to LV windings, supply A-BC single-phase tests

Tapping voltage	-V	36750 / 400		
Tap		1		
Transformer HV impedance at 75°C	-Ω/phase	159.03		
X/R ratio at 75 °C		5.13		
Peak factor – Category I transformer		2.201		
Theoretical short-circuit phase currents:				
Asymmetrical peak - HV winding	-A	293.0		
Average symmetrical - HV winding	-A	133.0		
Asymmetrical peak - LV winding	-A	26890.0		
Average symmetrical - LV winding	-A	12220.0		
Test No.	B20136-	S01-1	S01-2	S01-3
Single-phase test supply connection		A-BC	A-BC	A-BC
Applied 2 phase HV line voltage during short-circuit tests	-kV	830.29	30.41	30.39
Duration	-s	0.501	0.501	0.501
Asymmetrical peak HV winding current	-A	288.0	291.0	292.0
Symmetrical HV winding current	-A	127.0	127.0	127.0
Asymmetrical peak LV winding phase current	-A	26180.0	27120.0	27120.0
Symmetrical LV winding phase current	-A	11710.0	11710.0	11740.0
Percent change in reactance	- A phase	0.03	0.01	0.02
	- B phase	0.04	0.04	0.03
	- C phase	0.02	0.03	0.02
Date of Tests: 17 June 2020				

TEST RESULTS

Transformer Serial No. 1203030288

Short-circuit withstand tests HV to LV windings, supply B-CA single-phase tests

Tapping voltage	-V	35000 / 400		
Tap		3		
Transformer HV impedance at 75°C	-Ω/phase	142.10		
X/R ratio at 75 °C		4.93		
Peak factor – Category I transformer		2.182		
Theoretical short-circuit phase currents:				
Asymmetrical peak - HV winding	-A	310.0		
Average symmetrical - HV winding	-A	142.0		
Asymmetrical peak - LV winding	-A	27110.0		
Average symmetrical - LV winding	-A	12430.0		
Test No.	B20136-	S02-1	S02-2	S02-3
Single-phase test supply connection		B-CA	B-CA	B-CA
Applied 2 phase HV line voltage during short-circuit tests	-kV	29.44	29.44	29.44
Duration	-s	0.502	0.502	0.502
Asymmetrical peak HV winding current	-A	315	315	312
Symmetrical HV winding current	-A	139	139	139
Asymmetrical peak LV winding phase current	-A	27560.0	27560.0	27440.0
Symmetrical LV winding phase current	-A	12260.0	12250.0	12250.0
Percent change in reactance	- A phase	0.03	0.02	0.03
	- B phase	0.10	0.03	0.02
	- C phase	0.12	0.10	0.02
Date of Tests: 17 June 2020				

TEST RESULTS

Transformer Serial No. 1203030288

Short-circuit withstand tests HV to LV windings, supply C-AB single-phase tests

Tapping voltage	-V	33250 / 400		
Tap		5		
Transformer HV impedance at 75°C	-Ω/phase	126.03		
X/R ratio at 75 °C		4.72		
Peak factor – Category I transformer		2.162		
Theoretical short-circuit phase currents:				
Asymmetrical peak - HV winding	-A	329.0		
Average symmetrical - HV winding	-A	152.0		
Asymmetrical peak - LV winding	-A	27320.0		
Average symmetrical - LV winding	-A	12640.0		
Test No.	B20136	S03-1	S03-2	S03-3
Single-phase test supply connection		C-AB	C-AB	C-AB
Applied 2 phase HV line voltage during short-circuit tests	-kV	28.81	28.55	29.06
Duration	-s	0.501	0.501	0.501
Asymmetrical peak HV winding current	-A	336.0	338.0	337.0
Symmetrical HV winding current	-A	148.0	148.0	149.0
Asymmetrical peak LV winding phase current	-A	28180.0	28080.0	27930.0
Symmetrical LV winding phase current	-A	12370.0	12320.0	12310.0
Percent change in reactance	- A phase	0.02	0.10	0.02
	- B phase	0.03	0.02	0.02
	- C phase	0.03	0.22	0.02
Date of Tests: 17 June 2020				

RECORD OF PROVING TESTS
Laboratory Ref. No: B20136
TEST RESULTS

Transformer Serial No. 1203030288

Short-circuit withstand tests (continued)

After test B20136-S03-3 the reactance was re-measured on the relevant taps, as indicated below:

Tap	Phase	Change in reactance %	Note: The maximum allowable percentage change in reactance for transformers with circular concentric coils and with metal foil as a conductor in the low-voltage wingding and with rated power up to 10000 kVA in accordance with clause 4.2.7.4 a) 5) of IEC 60076-5 is 4.0%. At the completion of the tests the maximum change of the reactance measured was 0.24 %.
1	A	0.19	
	B	0.24	
	C	0.03	
3	A	0.04	
	B	0.11	
	C	0.19	
5	A	0.02	
	B	0.22	
	C	0.04	

Photograph nos.: P009 to P014

Transformer Serial No. 1203030288

Inspection

Following the completion of all tests the transformer was de-tanked and examined.

There was no other visible damage to the structural integrity, the windings or the core.

Therefore, the transformer complied with the requirements of IEC 60076-5 clause 4.2.7.4.a) 3).

Date of final Inspection: 19 June 2020

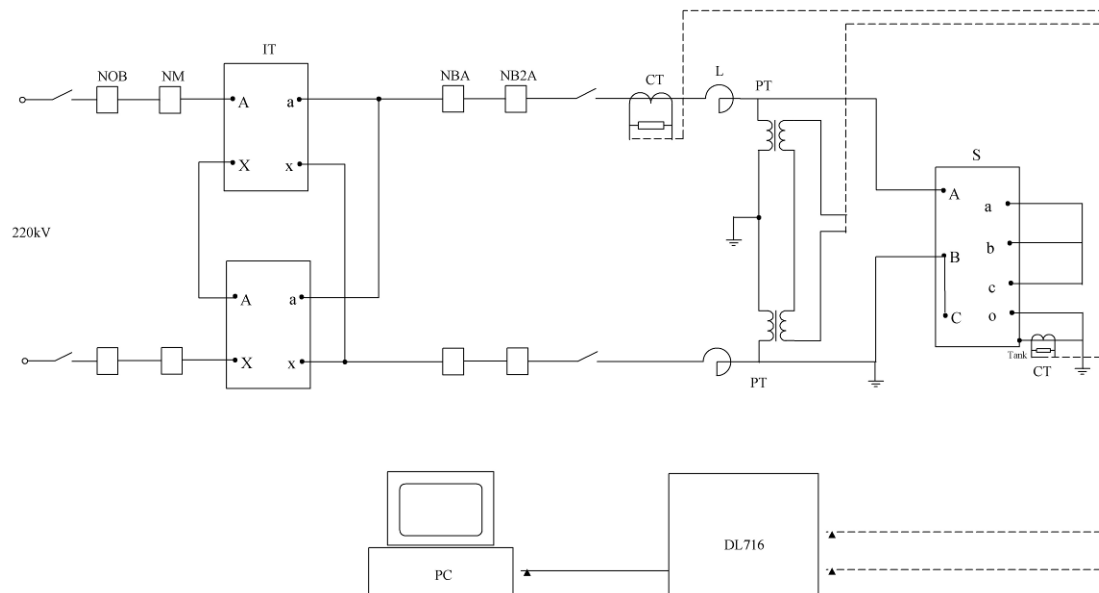
Summary Clause 4.2.7.4.a) of IEC 60076-5

Transformer Category I

1. The results of the short-circuit withstand tests and the measurements and other checks during the tests did not reveal any faults.
2. The dielectric tests and the other routine tests were successfully repeated.
3. The inspection was satisfactory.
4. There were no traces of any electrical discharge.
5. The maximum change in reactance as a result of the short-circuit withstand tests did not exceed the specified limit.

Result: The transformer passed the short-circuit withstand tests.

Figure 1



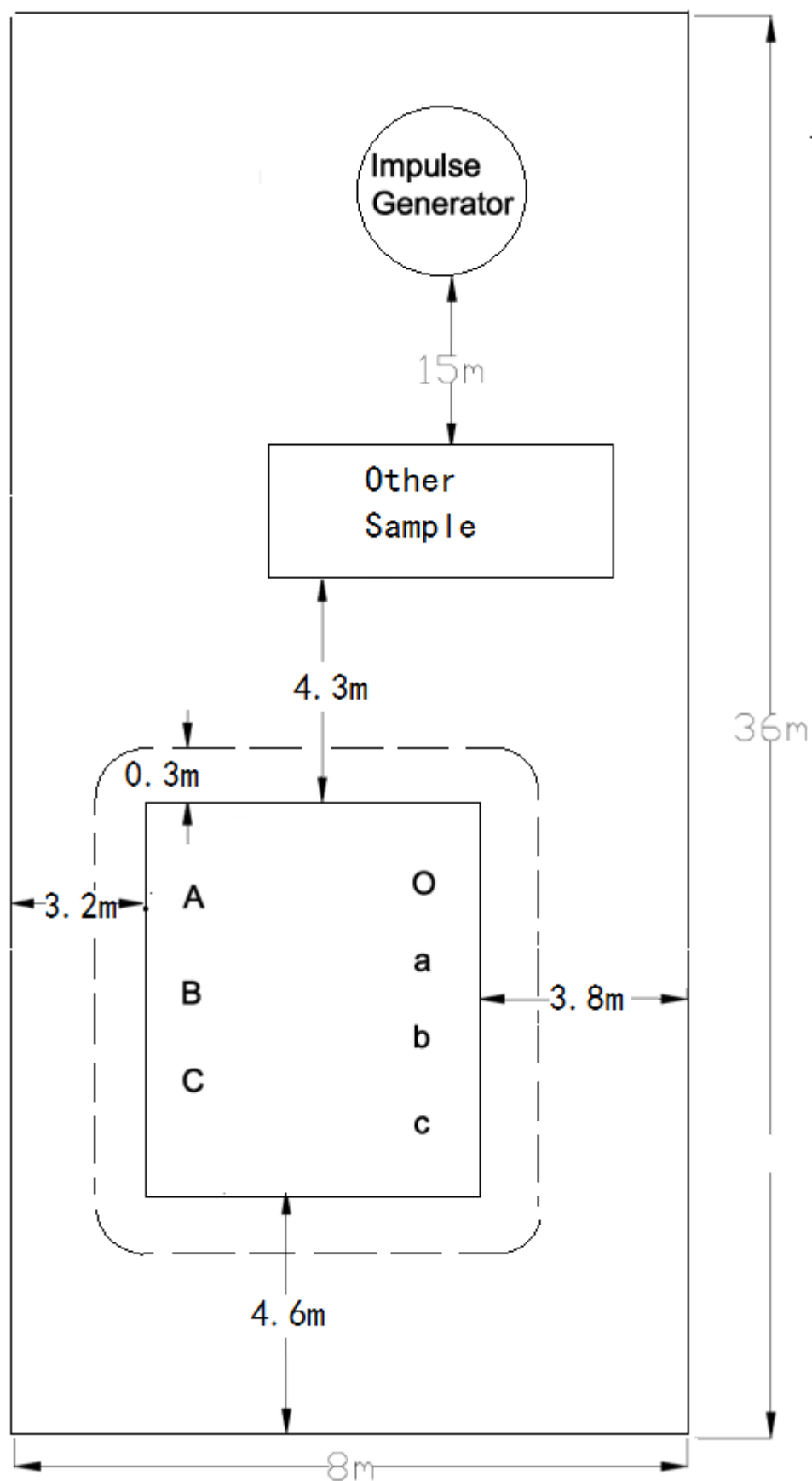
Short circuit tests of transformer:

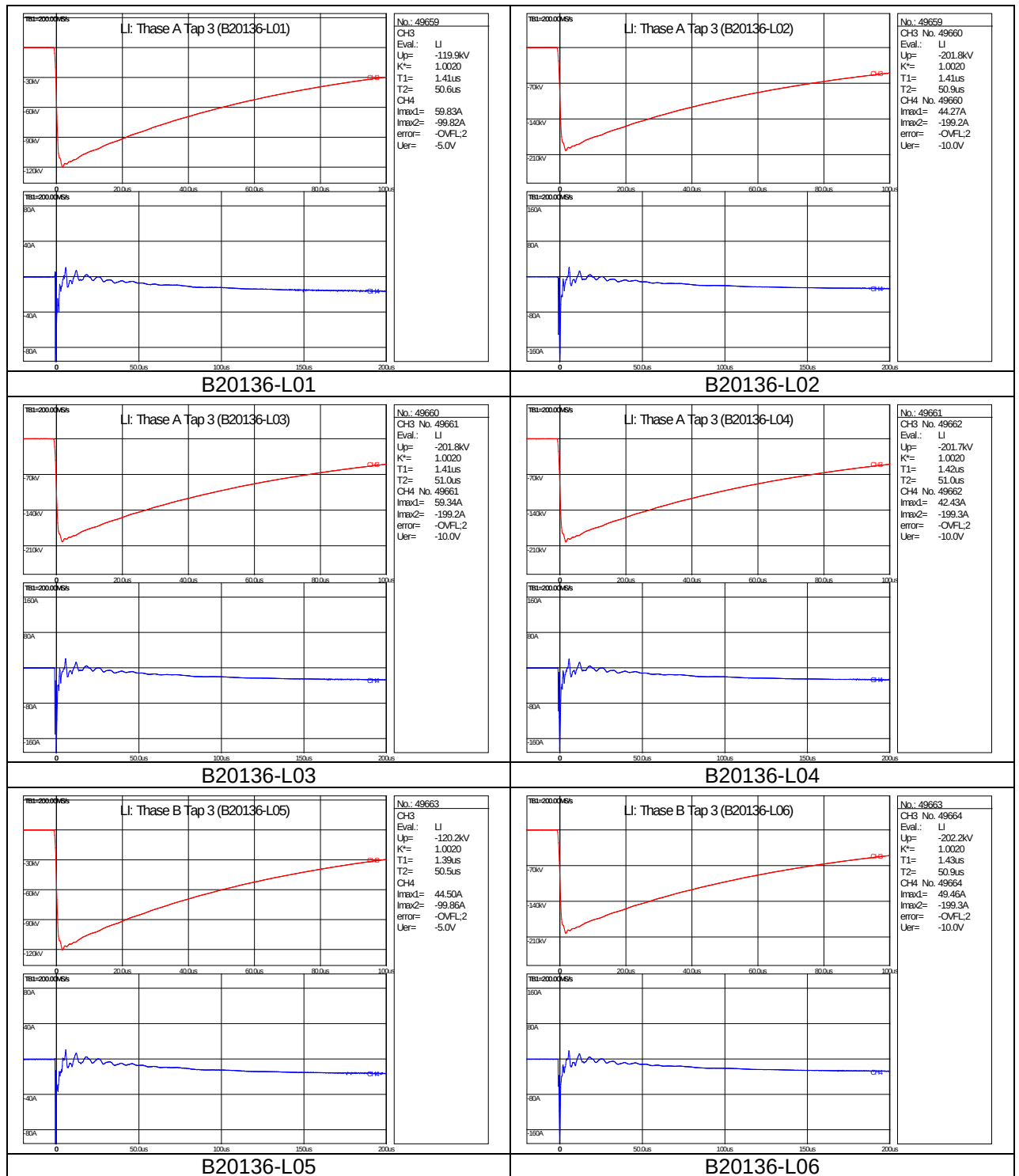
IT: Intermediate transformer
L: Reactors
S: Sample

CT: Standard current transformer
PT: Voltage transformer
NOB, NM, NB, NB2: SF6 switchgear

PC: Computer
DL716: 16 channels analyzer

Figure 2



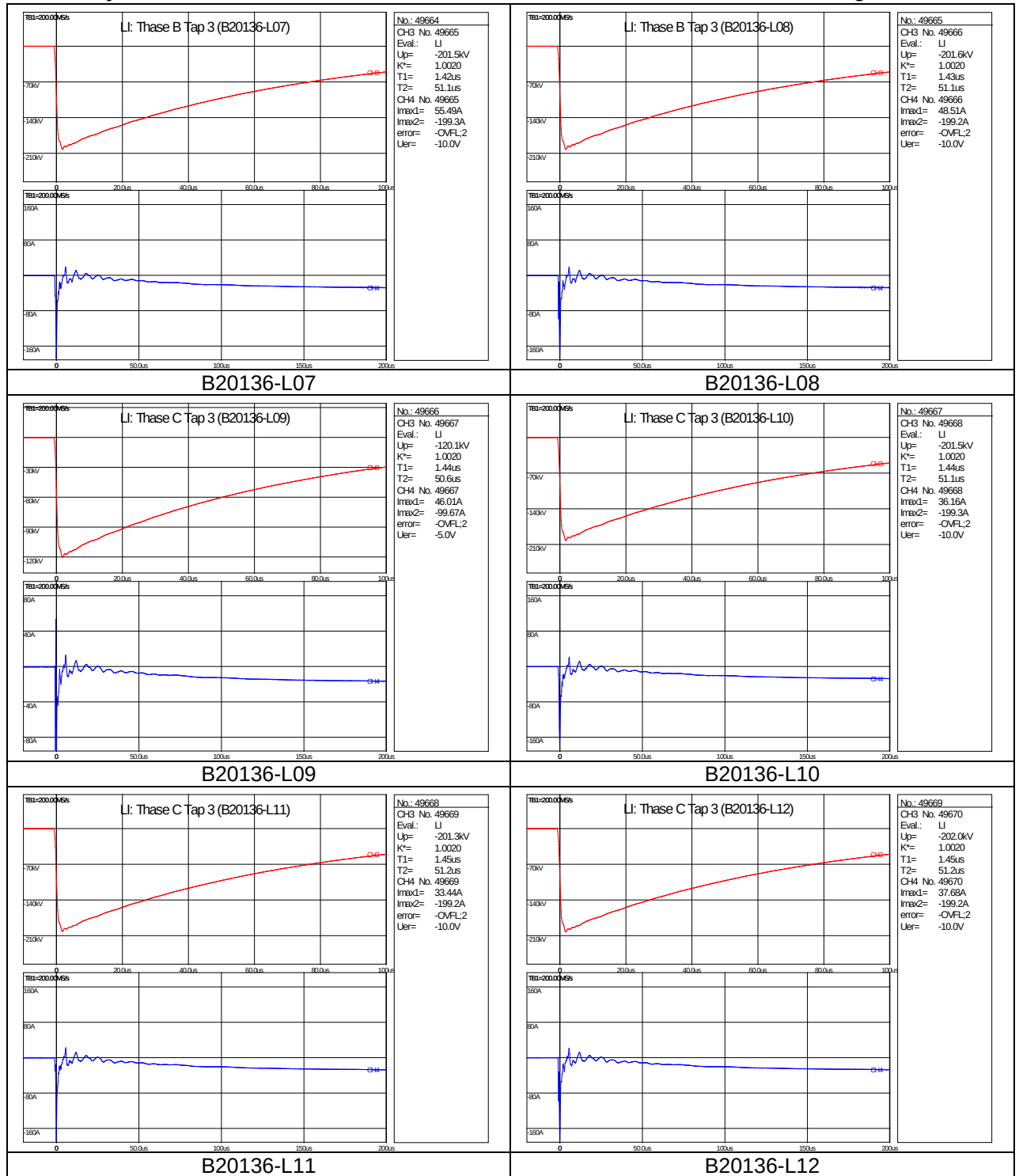


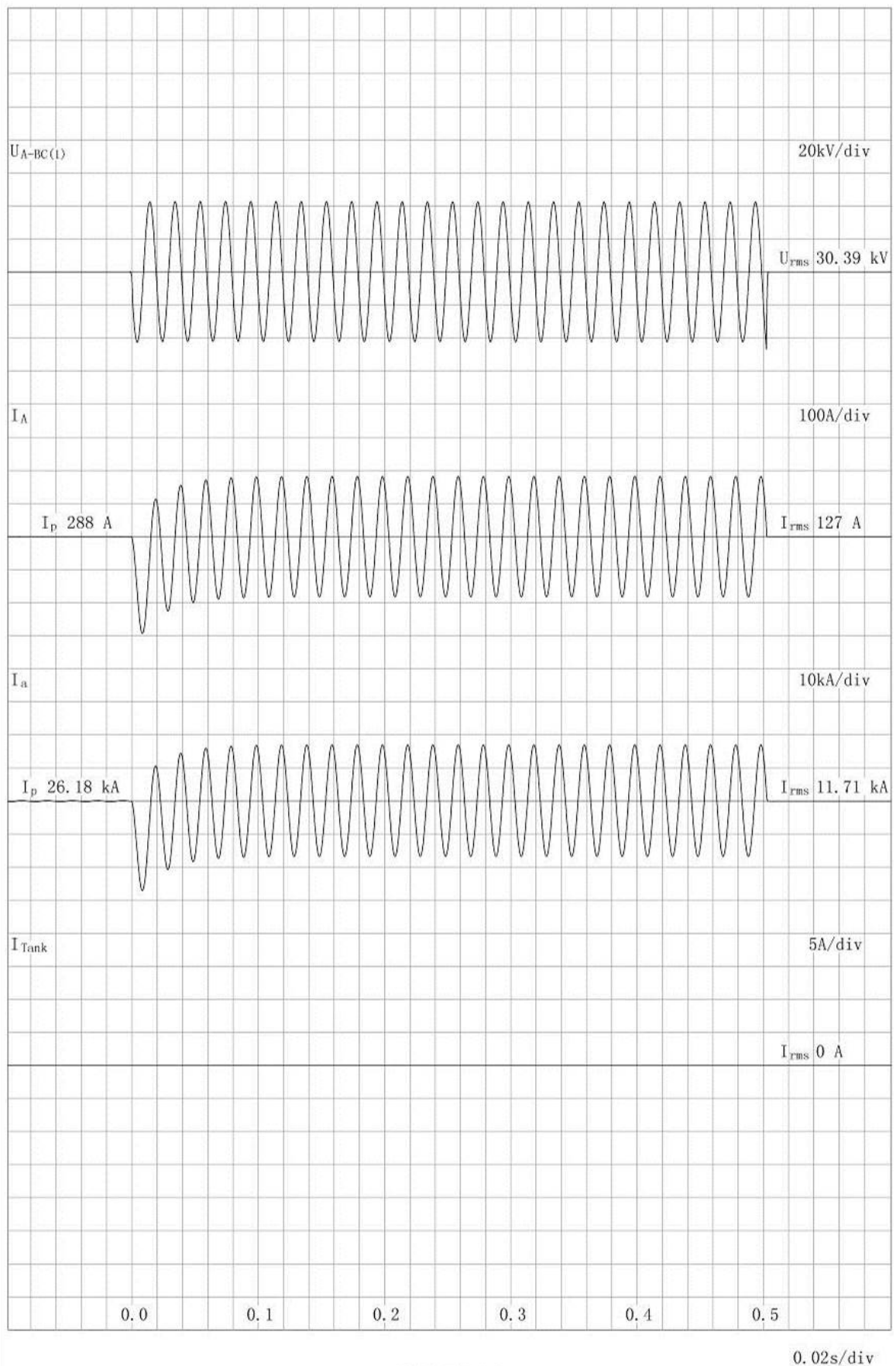
RECORD OF PROVING TESTS

Laboratory Ref. No: B20136

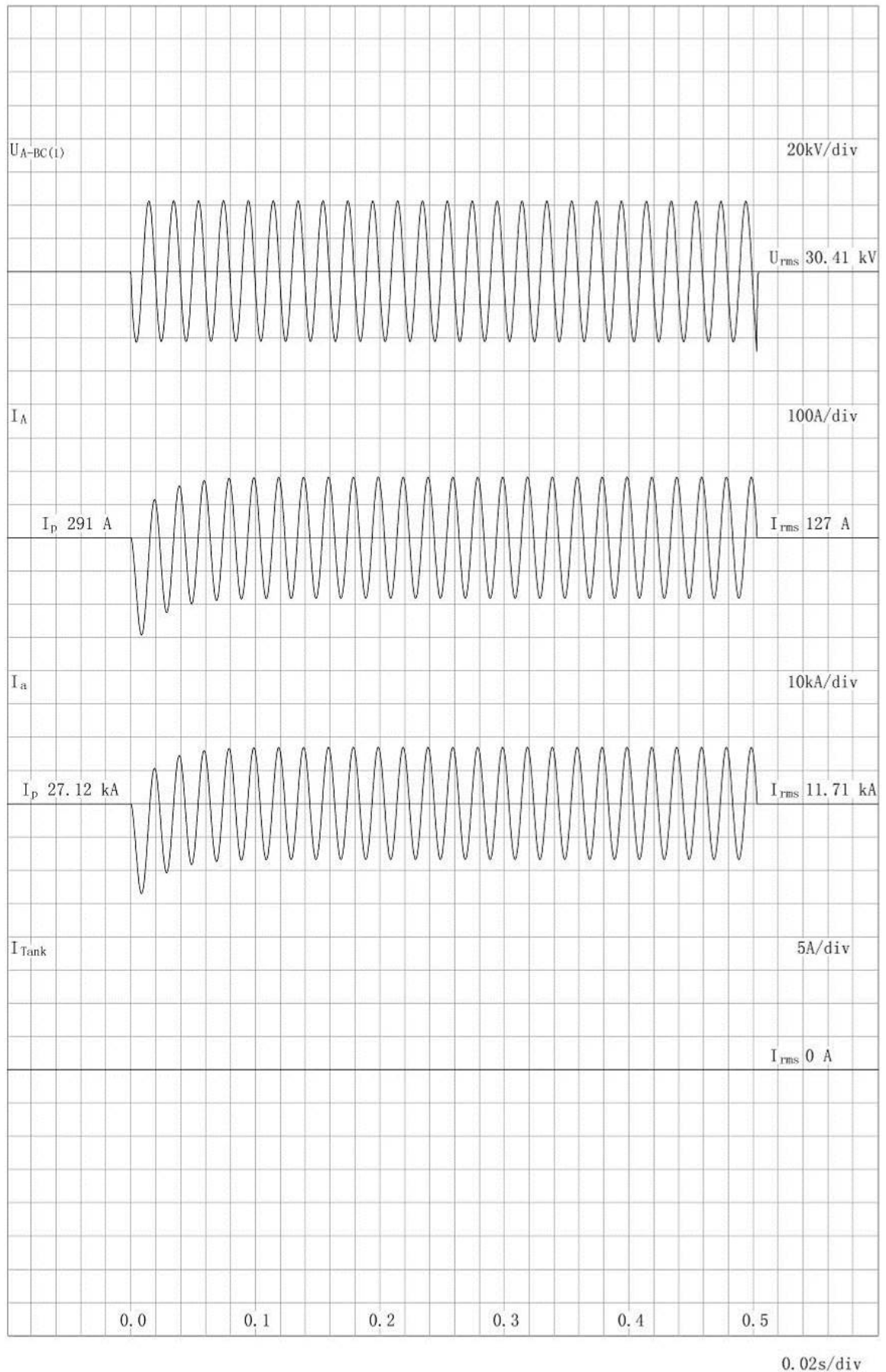
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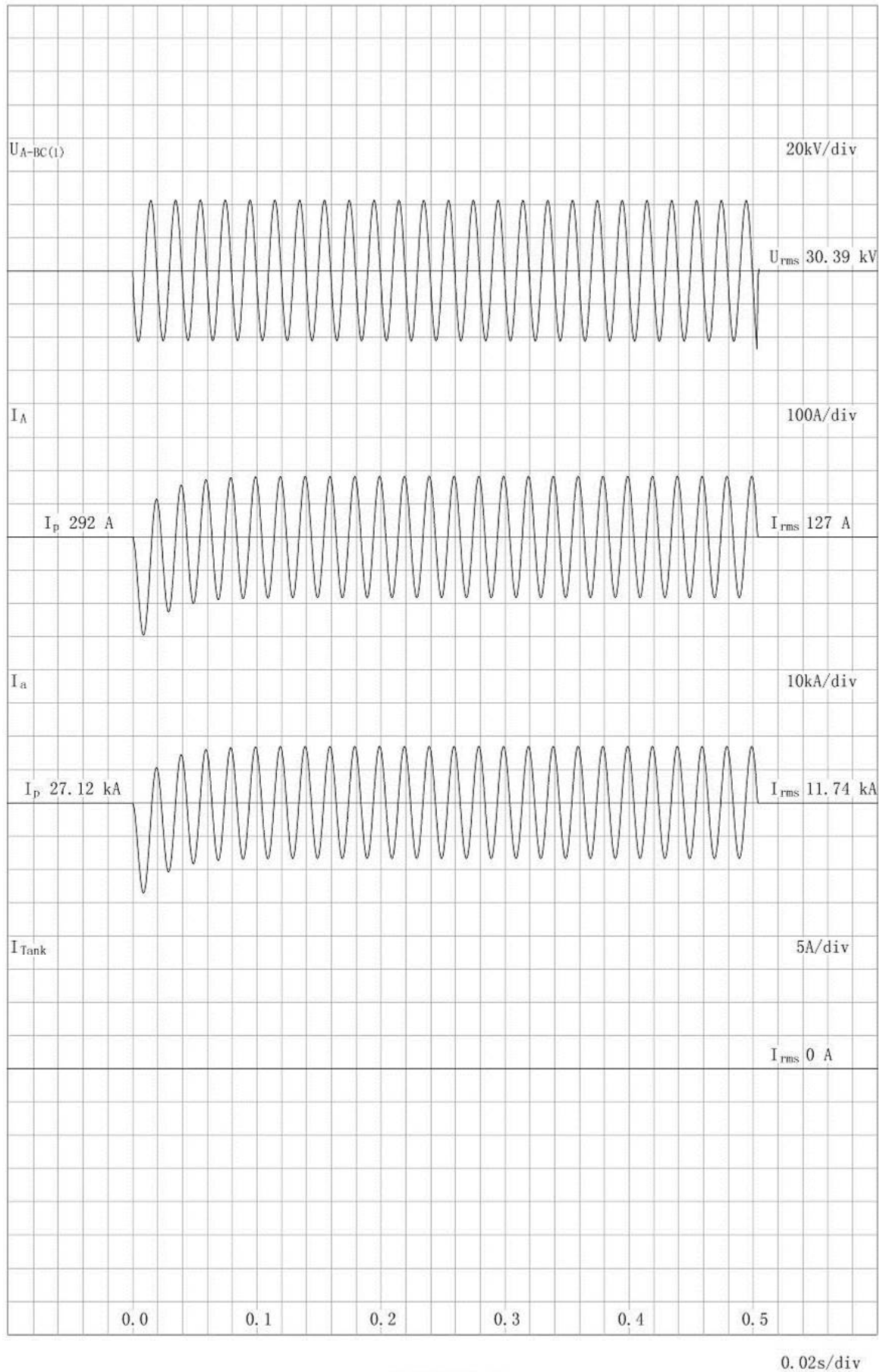




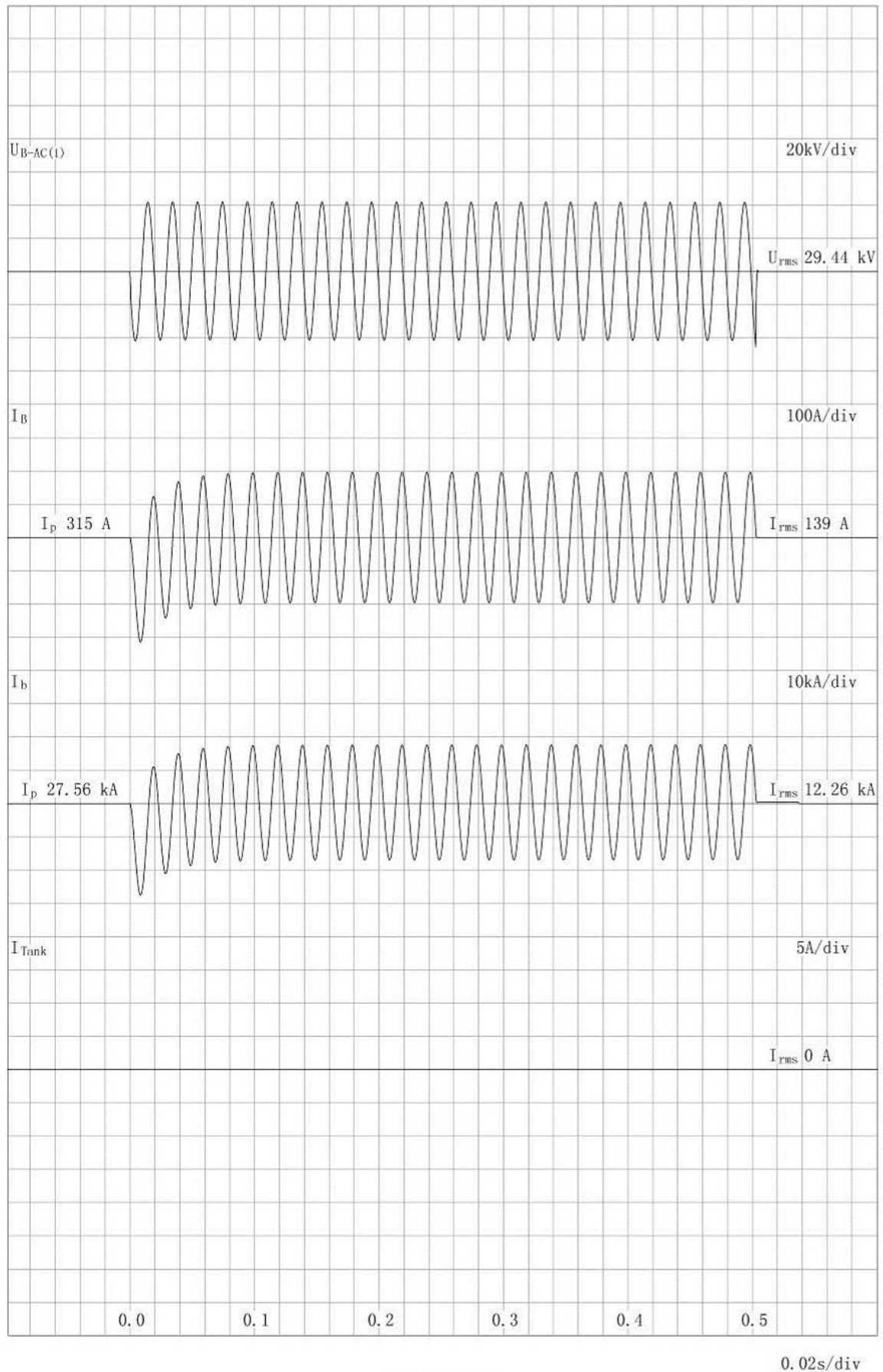
B20136-S01-1
B20136-S01-1



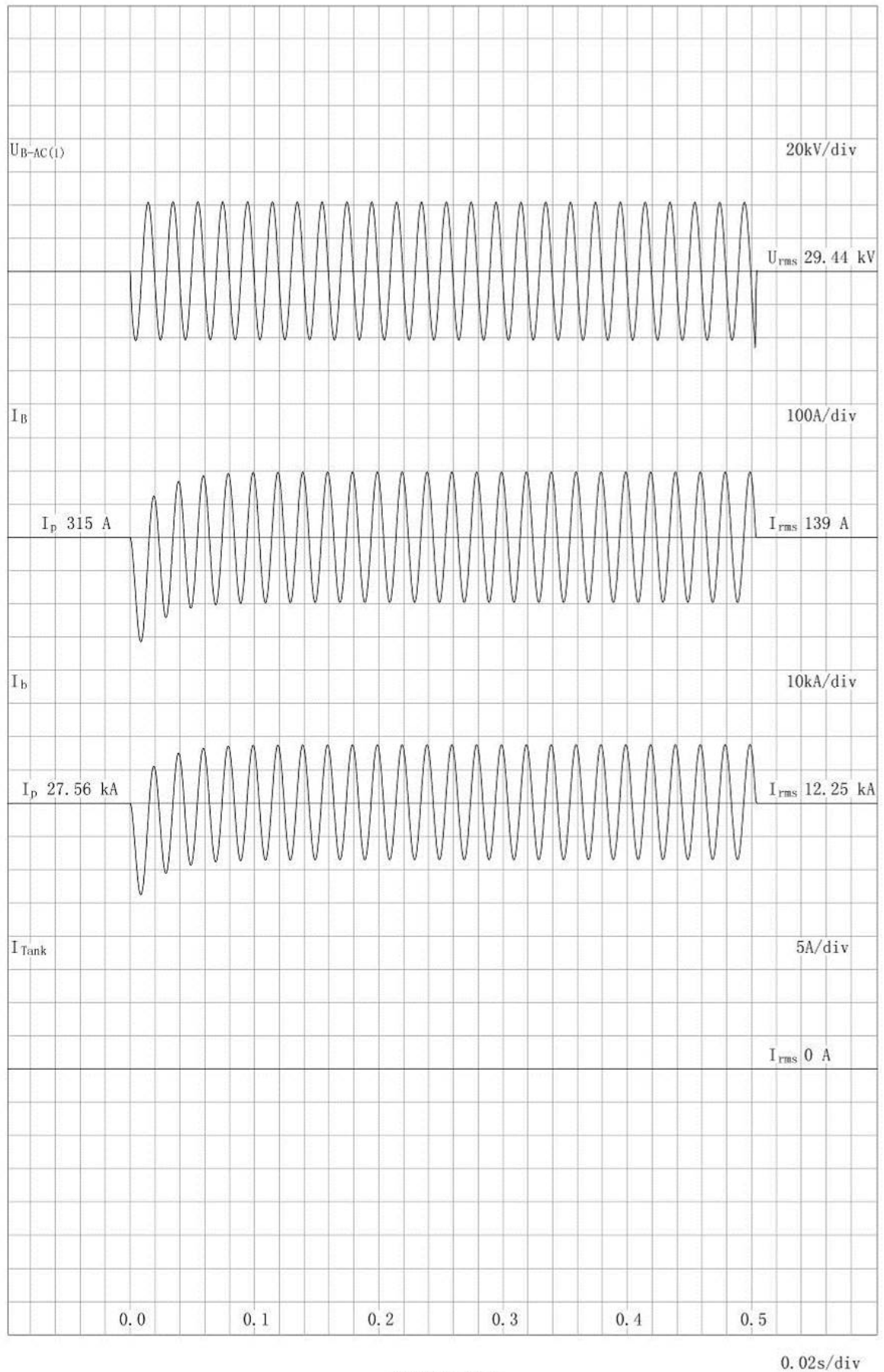
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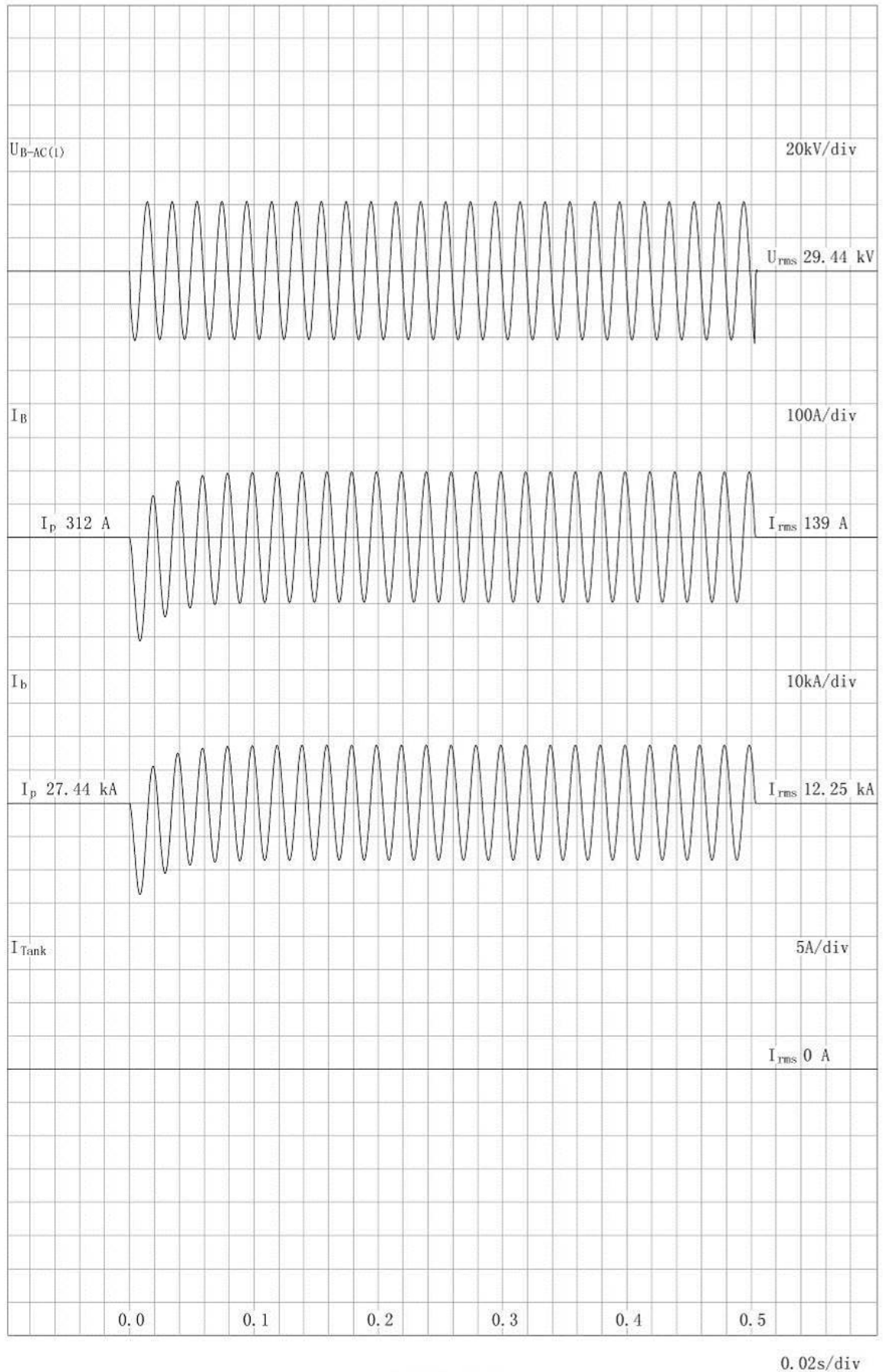
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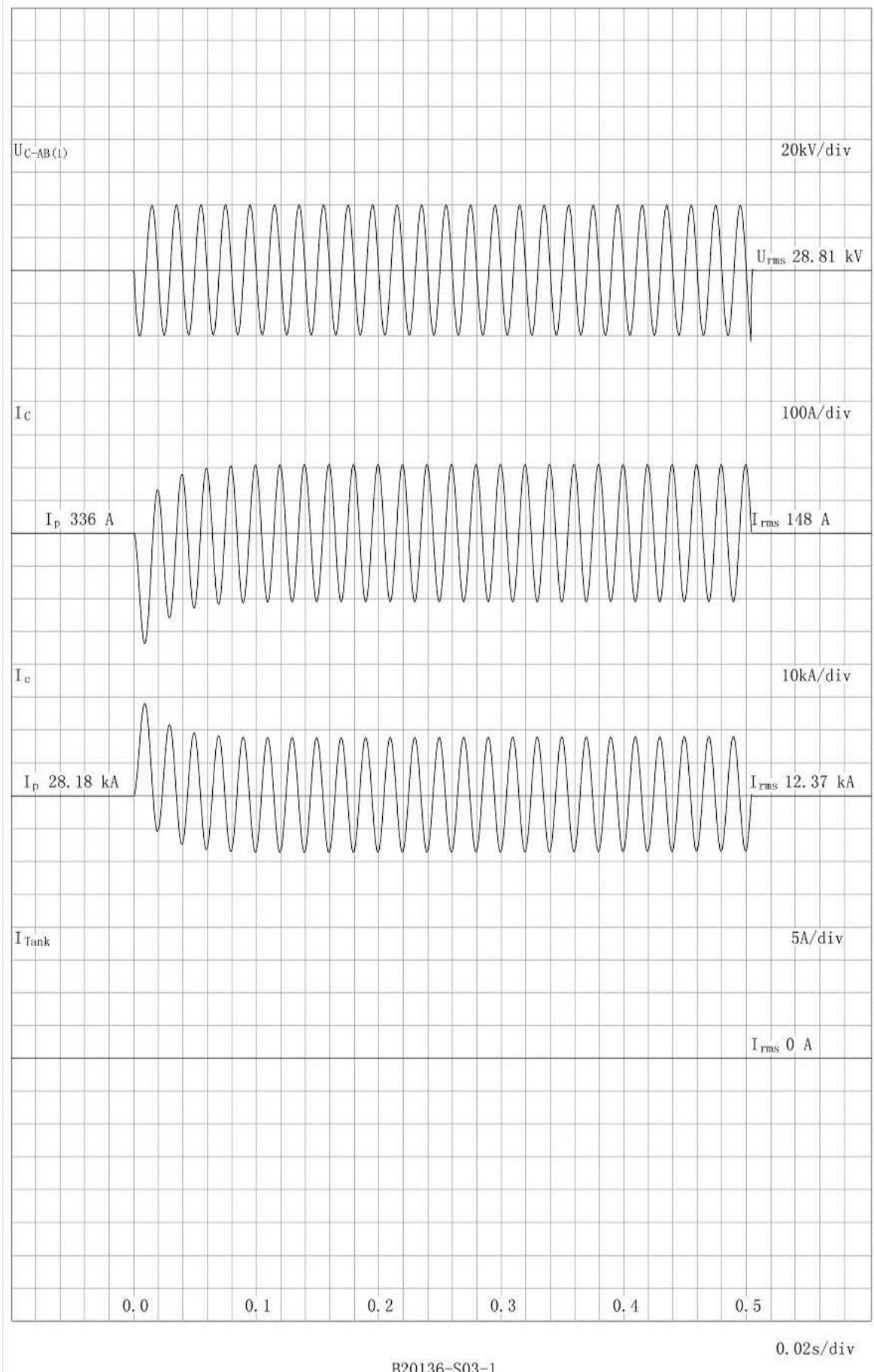
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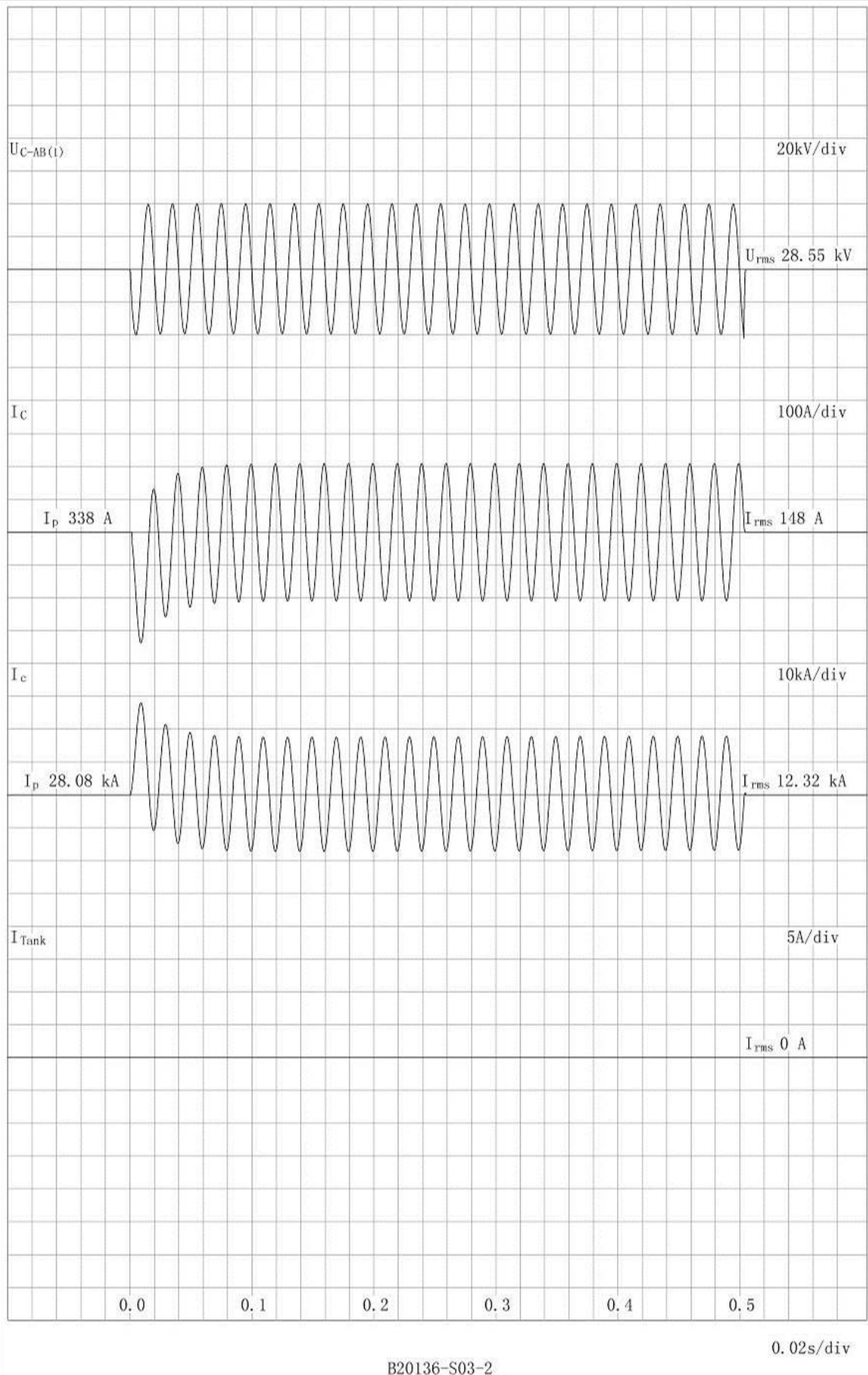
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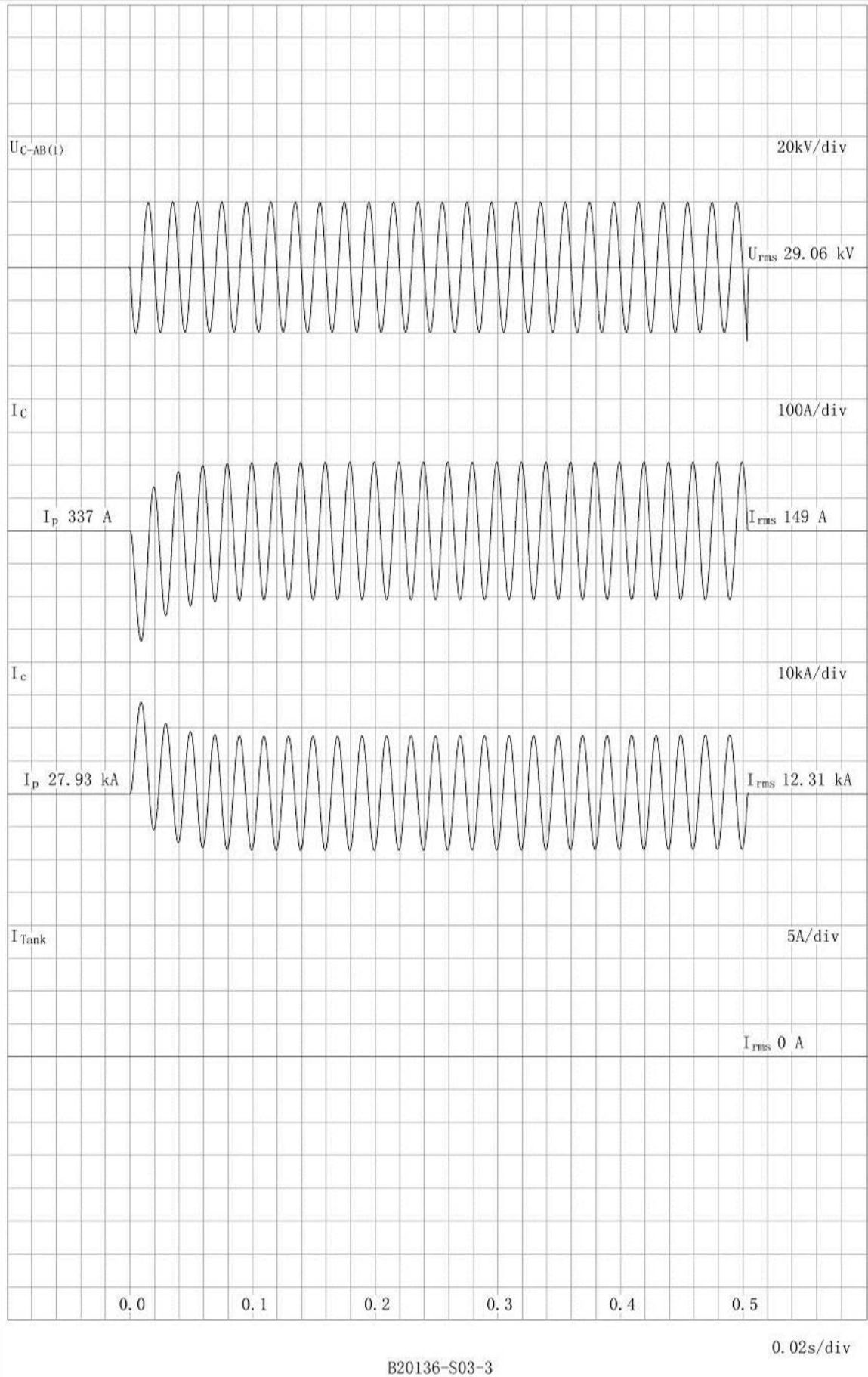


B20136-S02-3
B20136-S02-3



B20136-S03-1
B20136-S03-1





B20136-S03-3
B20136-S03-3



Photo No.: P001



Photo No.: P002



Photo No.: P003



Photo No.: P004

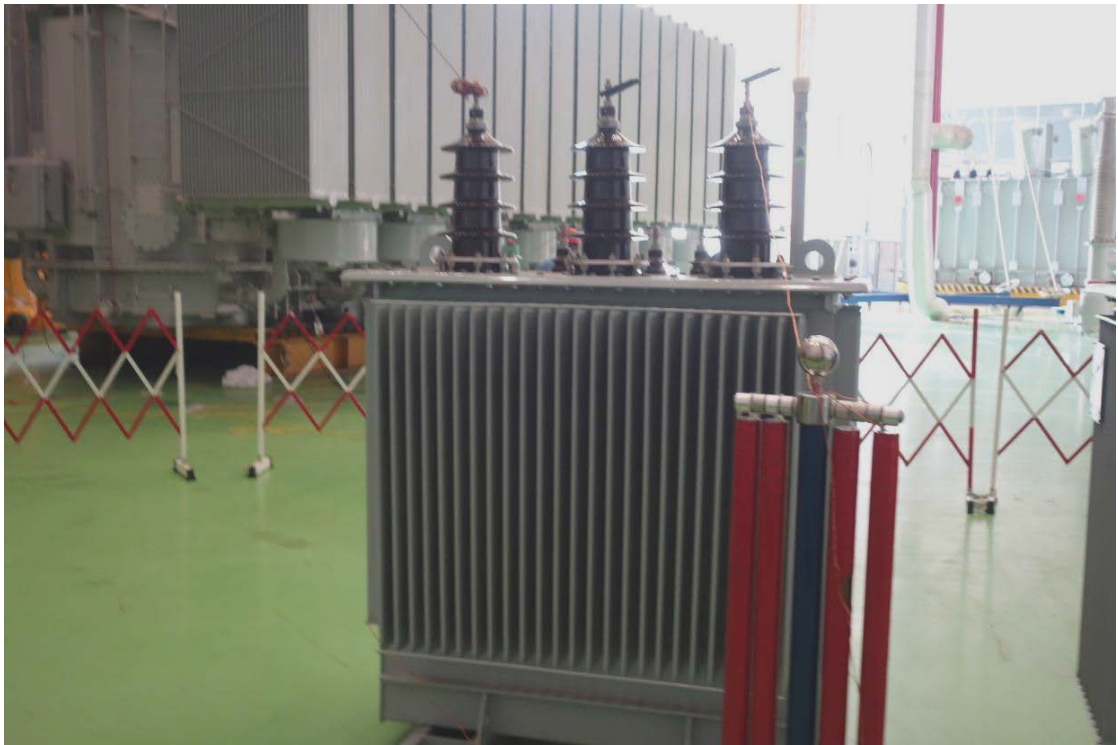


Photo No.: P005



Photo No.: P006



Photo No.: P007



Photo No.: P008



Photo No.: P009



Photo No.: P010



Photo No.: P011



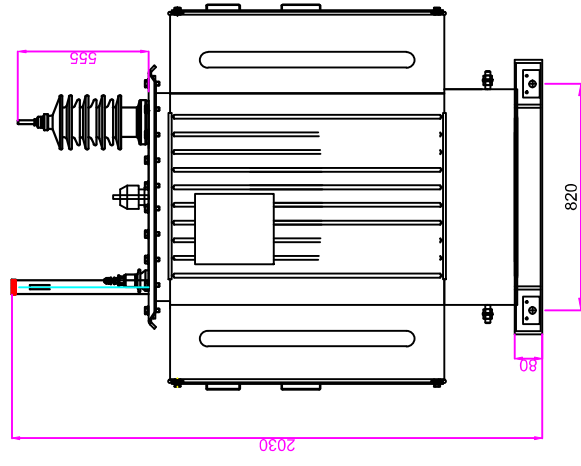
Photo No.: P012



Photo No.: P013



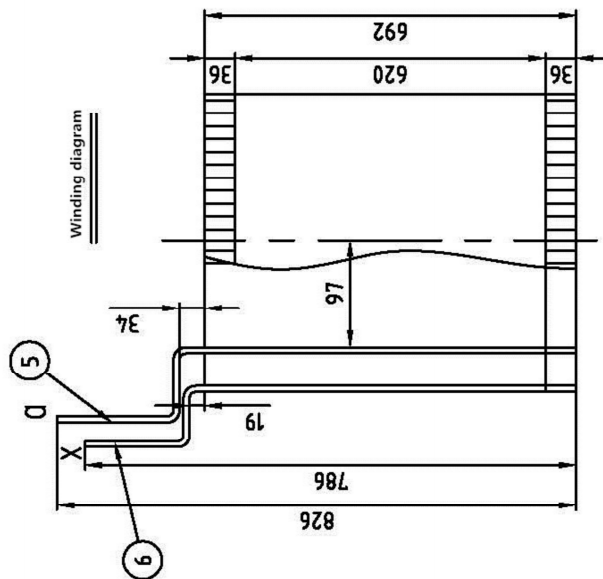
Photo No.: P014



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[illegible]

Technical requirement

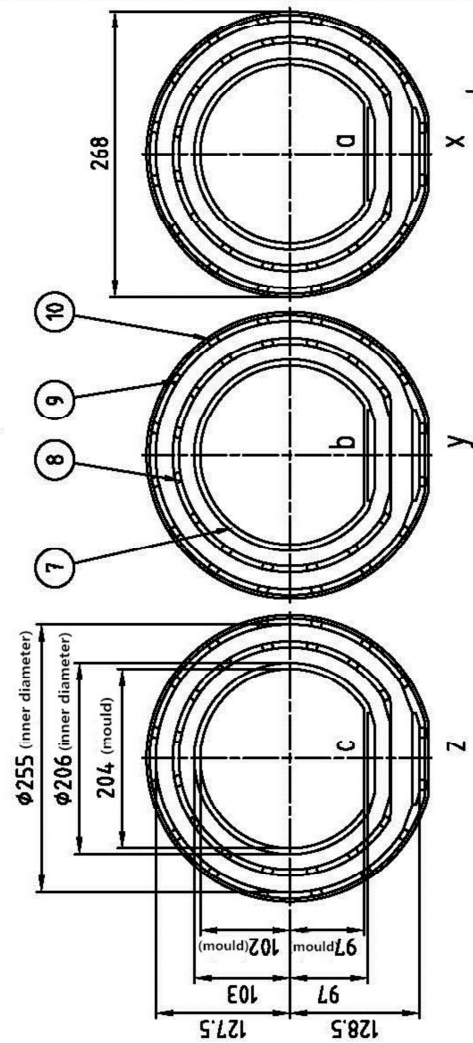


I DO VAN BAN, of SONG HONG VIET certify that the drawing is true representation of the apparatus tested.

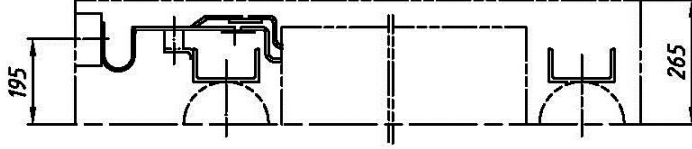
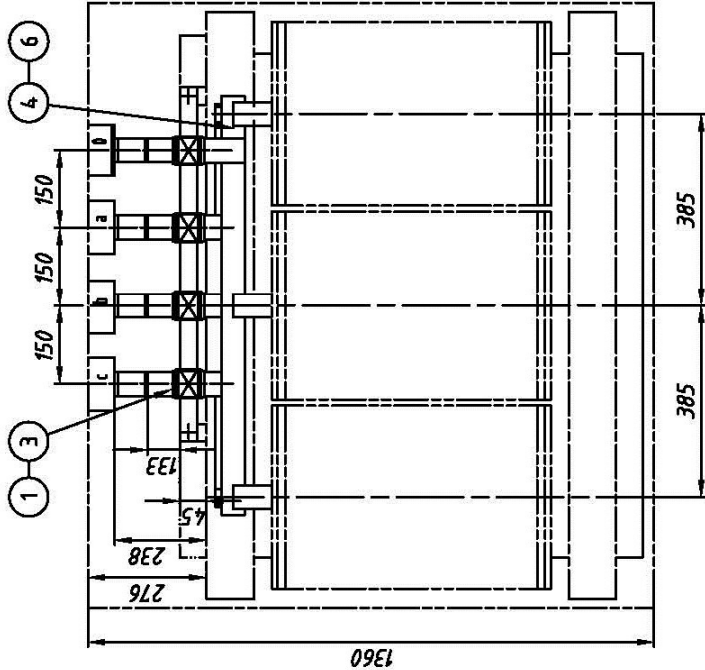
nominal voltage 400V		number of layer			R (75°D) =0.001322Ω				400kVA	
number of turns per layer	number of parallel winding	electromagnetic wire specification	weight of the wire KG	winding size			between layers insulation	oil clearance		
				axial direction	radial direction	inner wall			outer wall	
29	1	0.55×620 3×21.5m=64.5m	198	692	24.5	Ø206	Ø255	1x0.15	3.0 oil passage	

10	885×688×1.0	paperboard	2×3	1.0 insulated paperboard 100/00		
9	distance between stays 34mm	stay 4.0×8×688	24×3	insulated paperboard 100/00		
8	distance between stays 30mm	stay 3.0×8×688	24×3	insulated paperboard 100/00		
7	700×688×1.0	paperboard	3	1.0 insulated paperboard 100/00		
6	827.511.5052.2	copper bar	3	5×50 copper bar TMY		
5	827.511.5052.1	copper bar	3	5×50 copper bar TMY		
4	26000×688×0.15	between layer insulation	3	0.15AMA DIAMOND DOTTED PAPER		
3	50×35×5.0	stepping bar	3	insulated paperboard 100/00		
2	22000×36×0.5	end insulation	2×3	insulated paperboard 100/00		
1	0.55×620×21500	copper foil	3	0.55 copper foil	198kg	198kg
NO	Code	Name	Numbe	Material	Wight	Total weight

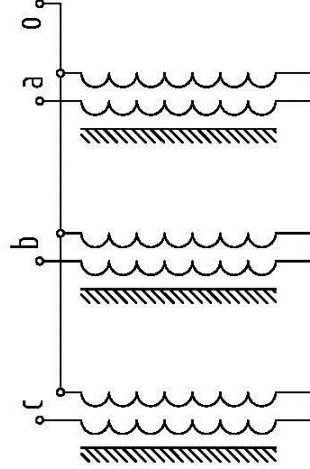
		VINH	Date: 10/02/2020	SB-400/35 LV Coil	6ZT.602.5052	0.4 KV
		BANI	Date: 10/02/2020			
		CUONG	Date: 10/02/2020			
		BANI	Date: 10/02/2020			

[illegible]

5ZT.517.5052



Winding diagram



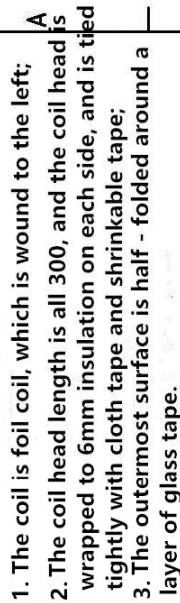
Technical requirement

1. The coil ends are enforced with item 7 cross;

I DO VAN BAN, of SONG HONG VIET certify that the drawing is true representation of the apparatus tested.

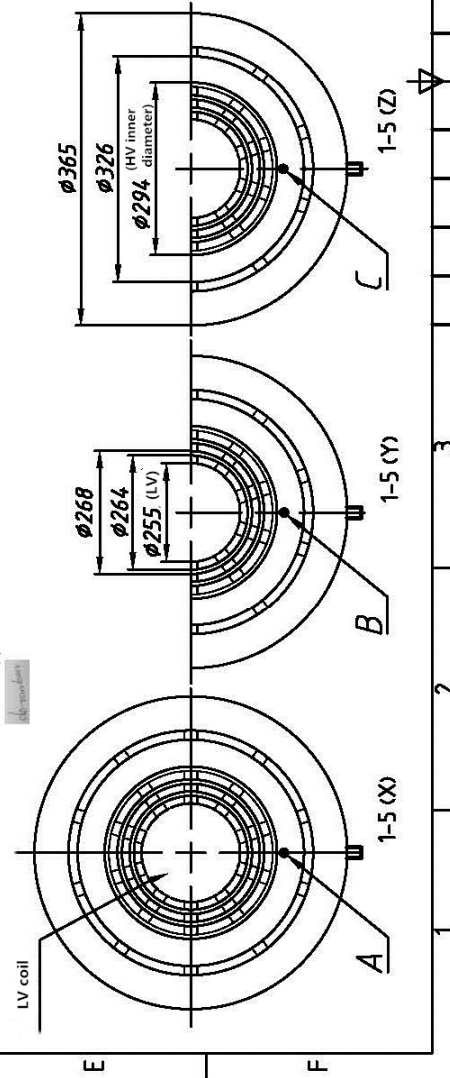
NO.	Code	NumberName	Number	Material
11		attached insulation		0.5 paperboard 100/00
10		shrinkable tape		shrinkable tape 0.2x20
9		LV bushing	(4)	
8	8ZT.110.5052	wooden clamp	1	
7	JB/ZQ4.351-86	locknut M10	12	galvanize
6	GB5782-86	bolt M10x30	12	galvanize
5	8ZT.516.0025	lug plate phase a and b plates fold in half, phase c & d plates fold in half	4	40x0.3 mild steel belt T2M
4	5ZT.511.5052.3	sealing O copper bar	1	5x50 copper busbar T2M
3	5ZT.511.5052.2	item C copper bar L=285	1	6x50 copper busbar T2M
2	5ZT.511.5052.1	item B copper bar L=285	1	5x50 copper busbar T2M
1	5ZT.511.5052.1	item A copper bar L=285	1	5x50 copper busbar T2M
NO.	Code	NumberName	Number	Material
	Draw by: VINH	Date: 10/02/2020		
	Designed by: BAN	Date: 10/02/2020		
	Check by: CUONG	Date: 10/02/2020		
	Approved by: BAN	Date: 10/02/2020		
		SB-400/35	5ZT.517.5052	
		LV Leads		
			yn Joint	
			SONG HONG VIET CO., LTD	
			8	

Technical requirement



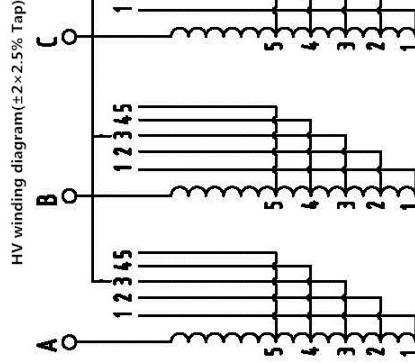
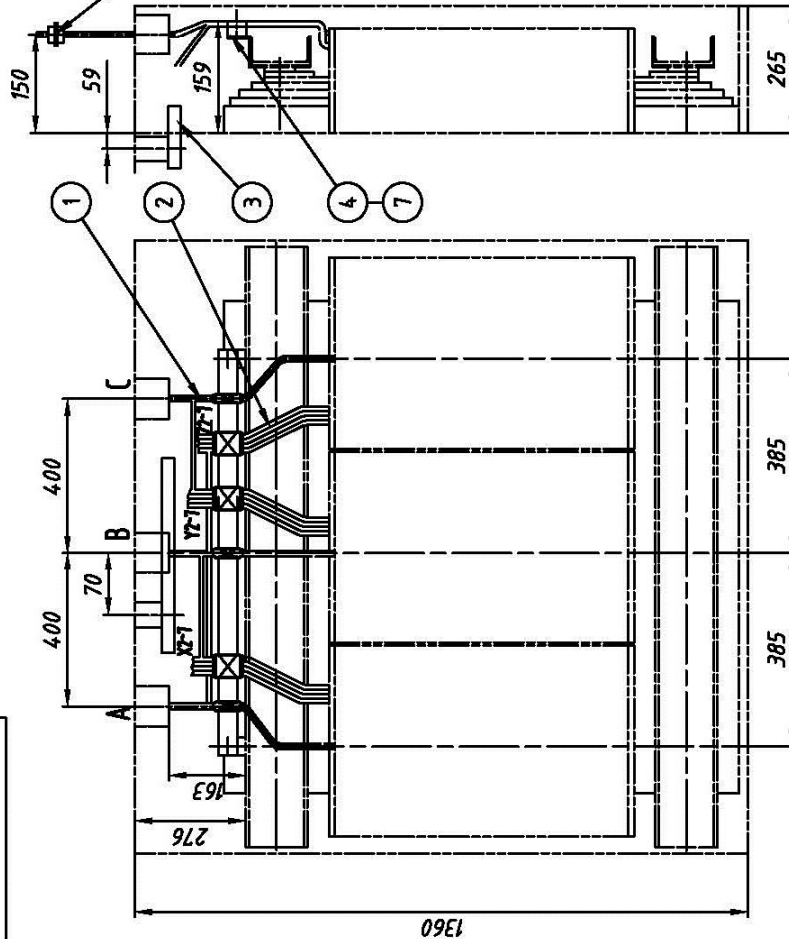
nominal voltage 35000V		phase current 6.60A		phase resistance $R_{ph}=15.4908\Omega$		3 phase		Y joint		rated capacity 400kVA	
number of layer	number of turns per layer	total number of turns	number of parallel winding	electromagnetic specification		conductor length in mm $3\times 1\times 2755$	conductor arrangement 	winding size		oil clearance	
				00-2				radial direction	inner wall		
10	270	2665	1	$\phi 2.12/\phi 2.23$				35.5	$\phi 294$	3.08	
layer No.	1	2		3	4	5	6	7	8	9	10
turns per layer	260	260	270	270	270	270	270	270	270	263	262
total	260	520	790	1060	1330	1600	1870	2140	2403	2665	2665

NO.	Code	Name	number	Material	Weight
11		shrinkable tape	Enough	150D gauze	
10		crepe paper	Enough		
9		cloth belt	Enough	straight grain cloth belt	
8	62T.123.5052.2	stay	16x3	paperboard 100/00	uniform distribution
7		insulated paperboard 1.5×655×930	3	paperboard 100/00	
6		stay 3.0×8×655	24x3	paperboard 100/00	
5	5ZT.790.5052	electrostatic shield	3	0.3 copper foil	
4		stay 3.0(0.24)×8×646	24x3	paperboard 100/00	uniform distribution
3	62T.750.5052.1	end insulation	1		
2	62T.751.5052.1	between layer insulation	1	0.08 cable point tape	
1		conductor (oxygen-free copper	1	Q0-2 φ2.12/φ2.23	270kg

[illegible]

I DO VAN BAN, of SONG HONG VIET certify that the drawing is true representation of the apparatus tested.

1.2505.915.1Z5



Technical requirement

- 1.Ensure that the insulation distance between the lead and the box wall is 20mm;
- 2.The wiring clip is covered with insulation;
- 3.When the lead goes through the wood, it is locked with a "8" shape tightening belt.

NO.	Code	Name	Number	Material
11		cloth belt		straight grain cloth belt 20
10		crepe paper		0.05×40 crepe paper
9		attached insulation		0.13×50 cable paper
8		35KV conducting rod	3	M12
7	GB97.1-85	gasket 10	2	
6	JB/ZQ4351-86	locknut M10	2	
5	GB5782-86	bolt M10×45	2	
4	82T.110.5052.1	conductor grip	1	laminated wood
3	WSTIII-63/35-5X5	tap switch	1	
2		leads long configuration	1	4.0 round copper wire 2.5.8
1		leads long configuration	1	4.0 round copper wire 2.5.8

5ZT.516.5052.1

SB-400/35

HVLeads

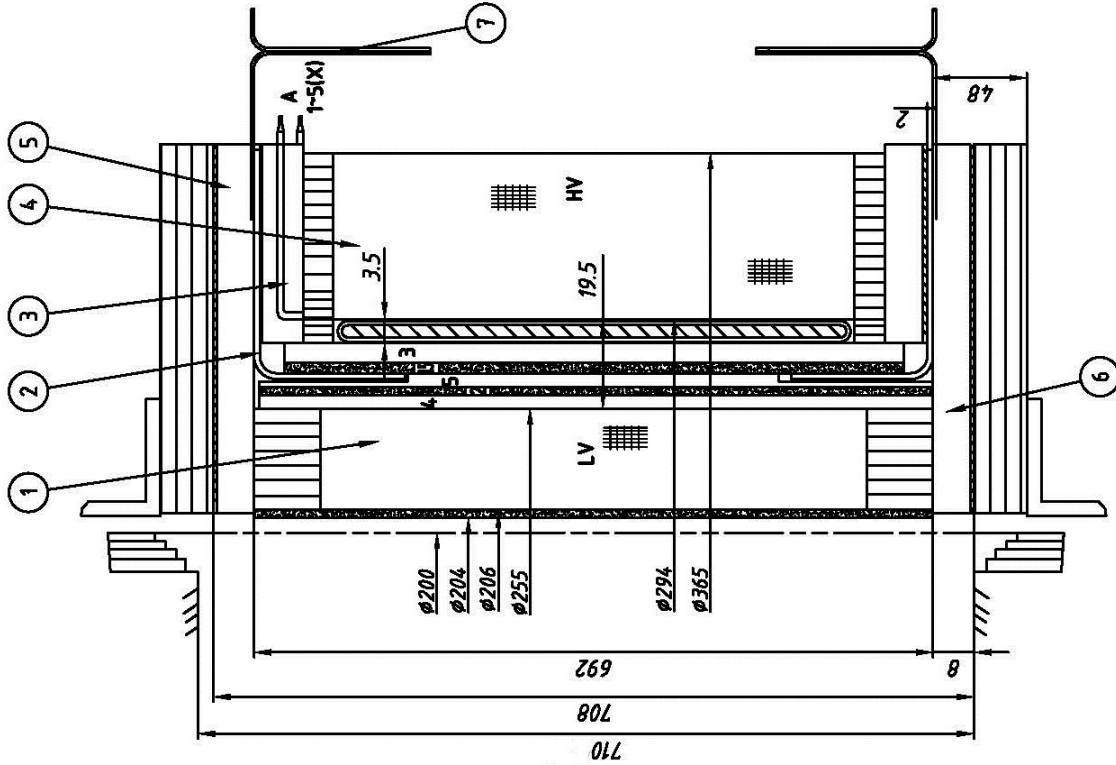
±2×2.5% (Y)



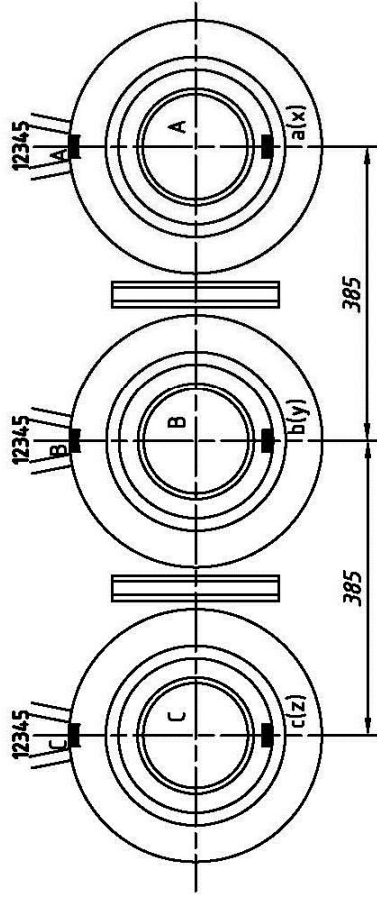
SONG HONG VIET CO.,LTD

I DO VAN BAN, of SONG HONG VIET certify that the drawing is true representation of the apparatus tested.

5ZT.700.5052



Head position and partition placement



NO.	Code	Name	Number	Material
9	8ZT.123.5052.1	round stay $\phi 6 \times 687$	3x26	
8		iron core stay	3x2	
7		phase partition	8x2	1.0 paperboard 100/00
6	5ZT.712.5052.2	lower iron yoke insulation	1	
5	5ZT.712.5052.1	upper iron yoke insulation	1	
4	6ZT.602.5052.1	lv coil	3	
3	5ZT.711.5052.1	end pad	3x2	
2	8ZT.759.5052.1	angle ring	3x2	
1	6ZT.602.5052	lv coil	3	

Draw by:	VINH	Date:	10/02/2020
Designed by:	BAN	Date:	10/02/2020
Check by:	CUONG	Date:	10/02/2020
Approved by:	BAN	Date:	10/02/2020

SB-400/35		5ZT.700.5052	
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SONG HONG VIET CO., LTD		8	
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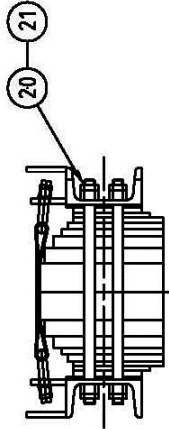
I DO VAN BAN, of SONG HONG VIET certify that the drawing is true representation of the apparatus tested.

(Signature)

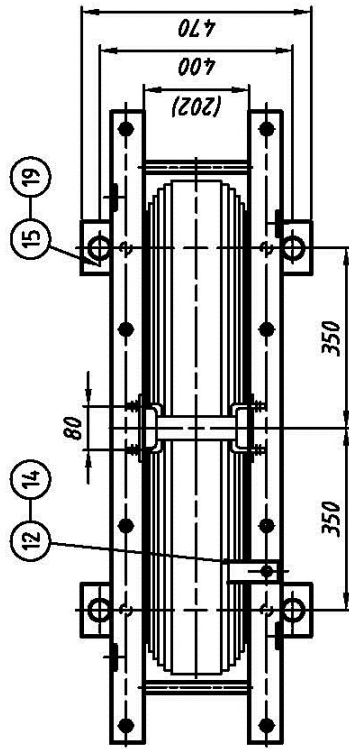


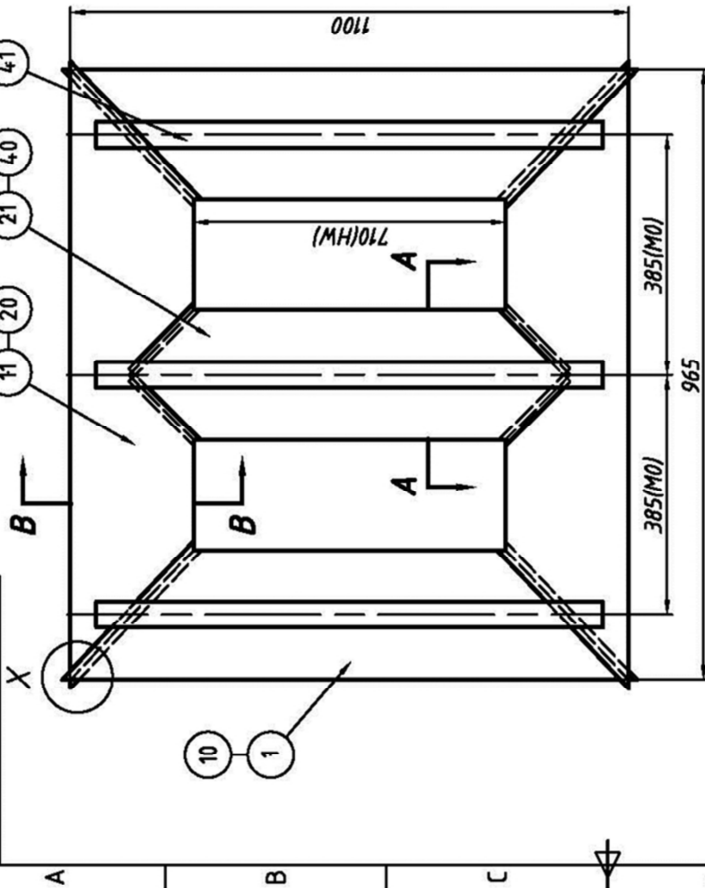
I DO VAN BAN, of SONG HONG VET certify that the drawing is true representation of the apparatus tested.

A-A



22			phenolic paper tube L= 780	8						
21			phenolic paper tube L=180	8						
20			side screw M12×270/50	8						galvanize
19	8ZT.786.5052.1		side screw	3						
18	8ZT.193.5052.1		foot pad	6						
17	5ZT.022.5052.2		assistant foot pad	1						galvanize
16	5ZT.022.5052.1		foot-pad	2						
15	GB/T853-1988		bevel washer 12	4						galvanize
14	GB5783-86		bolt M10×12	1						galvanize
13	GB97.1-85		gasket 10	1						galvanize
12			earthing plate 0.3×40×220	1				copper sheet		
11	JB/ZQ4.351-86		locknut M12	32						galvanize
10			tensile rod M12×1090/50	8						galvanize
9	5ZT.137.0002		U shape screw drawstring L=190	1						
8	GB853-85		bevel washer 10	4						galvanize
7	JB/ZQ4.351-86		locknut M10	4						galvanize
6			insulated paperboard 60×220	1				1.0 paperboard 100/100		
5	5ZT.750.5052.1-2		clamp insulation	2 each						
4	5ZT.071.5052.3		HV/LV lower clamp	2						
3	5ZT.071.5052.2		LV upper clamp	1						
2	5ZT.071.5052.1		HV upper clamp	1						
1	5ZT.640.5052.1		iron core	1						
NO.		Code	Name	Number				Material		

[illegible]



Technical requirements:

Grade 1.3 joint, 2 pieces in one stack;

2. In addition to the upper yoke, the end face of the iron core shall be coated with A polyurethane paint 7110;

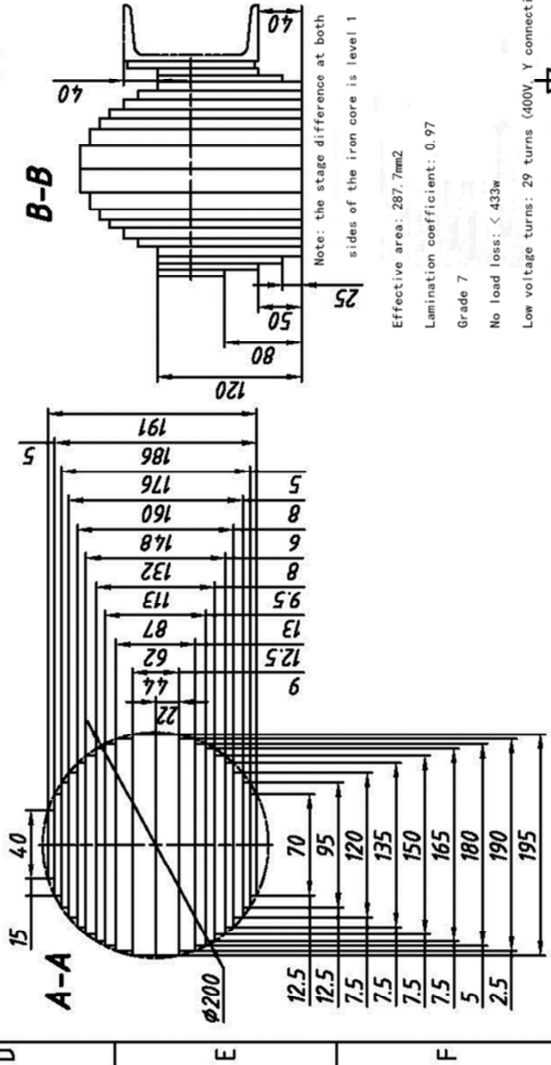
3. The splint can be temporarily fixed on the core column with self whitening cloth belt;

4. Total stack thickness error + 0;



Grade No.	B	L	Thickness	Sheet shape	Grade No.	B	L1	L2	L	Thickness	Sheet shape
20	10	40	810	2x5	40	10	40			910	1.7
19	9	70	840	2x10	39	9	70			880	3.3
18	8	95	865	2x16	38	8	95			855	5.3
17	7	120	890	2x12	37	7	120			830	4
16	6	135	905	2x16	36	6	135			845	5.3
15	5	150	920	2x19	35	5	150			860	6.3
14	4	165	935	2x26	34	4	165			875	8.7
13	3	180	950	2x25	33	3	180			890	8.3
12	2	190	960	2x18	32	2	190			900	6
11	1	195	965	2x44	31	1	195			905	14.7
10	10	40	950	2x5	30	10	40	15	25	910	3.3
9	9	70	950	2x10	29	9	70	30	40	880	6.7
8	8	95	950	2x16	28	8	95	42.5	52.5	855	10.7
7	7	120	950	2x12	27	7	120	55	65	830	8
6	6	135	980	2x16	26	6	135	62.5	72.5	845	10.7
5	5	150	1010	2x19	25	5	150	70	80	860	12.7
4	4	165	1040	2x26	24	4	165	77.5	87.5	875	17.3
3	3	180	1070	2x25	23	3	180	85	95	890	16.7
2	2	190	1090	2x18	22	2	190	90	100	900	12
1	1	195	1100	2x44	21	1	195	92.5	102.5	905	29.3

DO VAN BAN, of SONG HONG MET certify that the drawing is true representation of the apparatus tested.



Effective area: 287.7mm²
Examination coefficient: 0.97
Grade 7
No load loss: < 433w
Low voltage turns: 29 turns

[illegible]