Test Certificate

No. **L08057** Duly signed copy 0e

Reference: 141-08/290-298 and HV-U-0826

Apparatus: 3-Phase oil-immersed-type transformer with conservator

Type:	DOTL 630/22	Serial-no.:	AR/08/9632/1
Rated power:	630 kVA	Year of manufacture:	2008
Rated voltage:	22±5%/0,40 kV	Rated frequency:	50 Hz
Vector group:	Dyn 11	LI // AC:	125/- kV // 50/3 kV
Max. duration of short-circuit:	2 s	Rated impedance voltage:	4,1 %

Manufacturer: Ardan Electrical Industries
Soltam Industrial Zone, 20692 Yokneam
Israel

Customer: Ardan Electrical Industries
Soltam Industrial Zone, 20692 Yokneam
Israel

Place and Date of Tests: FGH - HPF and - LPF Mannheim, 2 to 8. July 2008

Test Specification: IEC publications 60076-5: 2006-02 Chapter 4.2 and 60076-1:2000-04 with 60076-3:2000-03

Test Performed:

a) Execution of Routine tests.

b) Nine three-phase short-circuit tests with a duration of 0.5 s each with the maximum peak current three times on each limb, to verify the ability to withstand short-circuits.

c) Lightning impulse voltage withstand test with -125 kV peak value for the full wave.

d) Dielectric Routine tests.

e) Visual inspection of the active part of transformer.

Test Results:

a, c) and d) The Routine tests before and the Lightning impulse voltage withstand test respectively Routine tests after the short-circuit tests did not detect any faults.

b and e) The oscillograms and the results of the short-circuit reactance measurements before and after each test and the visual inspection after all tests did not show any defect, which might endanger the safe operation of transformer.

The maximum increment of the short-circuit reactance was less than 0,3 %, the admissible value for this transformer with circular concentric coils having metal foil as a conductor in the low-voltage winding is 4 %.

The above mentioned test object has passed the tests performed in accordance with the applied test specifications.

FGH Engineering & Test GmbH FGH

Jürgen Faber	Karl Haitz	Andre Röhner
FGH Engineering & Test GmbH	Test Engineer	Test Engineer

Mannheim, 21. July 2008 Number of sheets: 30

This document may only be used complete and unabridged.

FGH Engineering & Test GmbH is a laboratory of the CESI Group

Deutscher Akkreditierungs Rat DAR DAT-P-103/00

Independent test laboratory accredited acc. to DIN EN ISO/IEC 17025 by Deutsche Akkreditierungsstelle Technik (DATech) e.V. in the fields of high-voltage equipment and components, power cables and their accessories, electro-magnetic compatibility (EMC) - quality of voltage and flicker.

Member Laboratory of the Short-Circuit Testing Liaison (STL)

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Test documents issued by the FGH Engineering & Test GmbH

A **Type Test Certificate**
is issued for complete type tests according to valid standards taking into account valid STL guides.
Equipment to be tested must be clearly identifiable:
- Apparatus by a nameplate according to the relevant standard and by suitable drawings;
- Equipment for which the relevant standard does not require a nameplate, by suitable drawings and descriptions where necessary. In certain cases, a specification of details may be required.

The Type Test Certificate confirms that during all tests of the equipment according to the standard the specified pass criteria for its behaviour during the tests and its conditions after the tests have been fully met.

A **Test Certificate**
is issued for equipment having passed parts of the type tests specified in the relevant standards or fulfilling accepted specifications or recommendations.

Equipment to be tested must be clearly identifiable:
- Apparatus by a nameplate according to the relevant standard and by suitable drawings;
- Equipment for which the relevant standard does not require a nameplate, by suitable drawings and descriptions where necessary. In certain cases, a specification of details may be required.

The Test Certificate confirms that during the test of the equipment according to the standard the specified pass criteria for its behaviour during the tests and its conditions after the tests have been fully met.

A **Test Report**
is issued for all tests which do not meet the requirements of a Type Test Certificate or a Test certificate and have been performed according to specifications, standards and/or clients‘ instructions. Similarly, this test report contains all test results, details of the conditions under which the tests were performed, also details relating to the behaviour of the test object, and its condition after the tests.

An **Investigation Report**
is issued for investigations which have not the character of proving tests.

A **Test Confirmation**
is issued immediately after the tests. It confirms that the tests have been conducted and is valid only until publishing the detailed results in an entire document.

Photographs and identification documents
Inserted photographs and identification documents (e. g. drawings, parts lists) must bear the FGH-stamp.
In case of electronic photographs the stamp can be omitted.

The customer confirmed by his signature that the test object corresponds to the submitted identification documents. FGH checked the accordance for essential details.

The original identification documents were stamped and signed by FGH. If this document contains electronic identification documents without FGH-stamp, the conformance with the checked, stamped and signed original documents has been verified by FGH.

With reference to ISO/IEC 17025 the FGH Engineering & Test GmbH states:

- The FGH Engineering & Test GmbH apply the PEHLA Procedure No. 12 for determining the uncertainties of measurement. As long as no explicit statements are made, the uncertainties required by the relevant standards have been complied with.
- The accreditation of the FGH Engineering & Test GmbH or its test documents by themselves in no way constitute or imply product approval by DATech or any other body.
- If a client refers to the accreditation of the FGH Engineering & Test GmbH, the reference shall include the accreditation body DATech, the relevant scope of the accreditation and the appropriate registration number.
- The test results included in the test documents as well as their evaluation relate exclusively to items tested.
- The test documents may not be reproduced, except in full contents, without written approval by the FGH Engineering & Test GmbH.

1 Contents

2 Participants

Name	Date	Company
Mr. Benjamin Vainshtein	2.-8.07.08	Israel Electric Company
Mr. Eugeni Farberon	2.-4.07.08	ARDAN
Mr. Eyal Sayar-Nitsan	2.-4.07.08	ARDAN
Mr. Paul Khait	7.-8.07.08	ARDAN
Mr. Haim Nudelman	7.-8.07.08	ARDAN
Mr. Robert Deutsch	2.-8.07.08	FGH Engineering & Test GmbH
Mr. Andre Röhner	2.-8.07.08	FGH Engineering & Test GmbH
Dr. Stephan Finke	2.-7.07.08	FGH Engineering & Test GmbH
Mr. Karl Haitz	7.-8.07.08	FGH Engineering & Test GmbH

3 Transformer under Test

Apparatus:	3-Phase oil-immersed-type transformer with conservator
Manufacturer:	Ardan Electrical Industries

Type:	DOTL 630/22	**Serial-no.:**	AR/08/9632/1
Rated power:	630 kVA	**Year of manufacture:**	2008
Rated voltage:	22±5%/0,40 kV	**Rated frequency:**	50 Hz
Vector group:	Dyn 11	**LI // AC:**	125/- kV // 50/3 kV
Max. duration of short-circuit:	2 s	**Rated impedance voltage:**	4,1 %
		Type of cooling:	ONAN

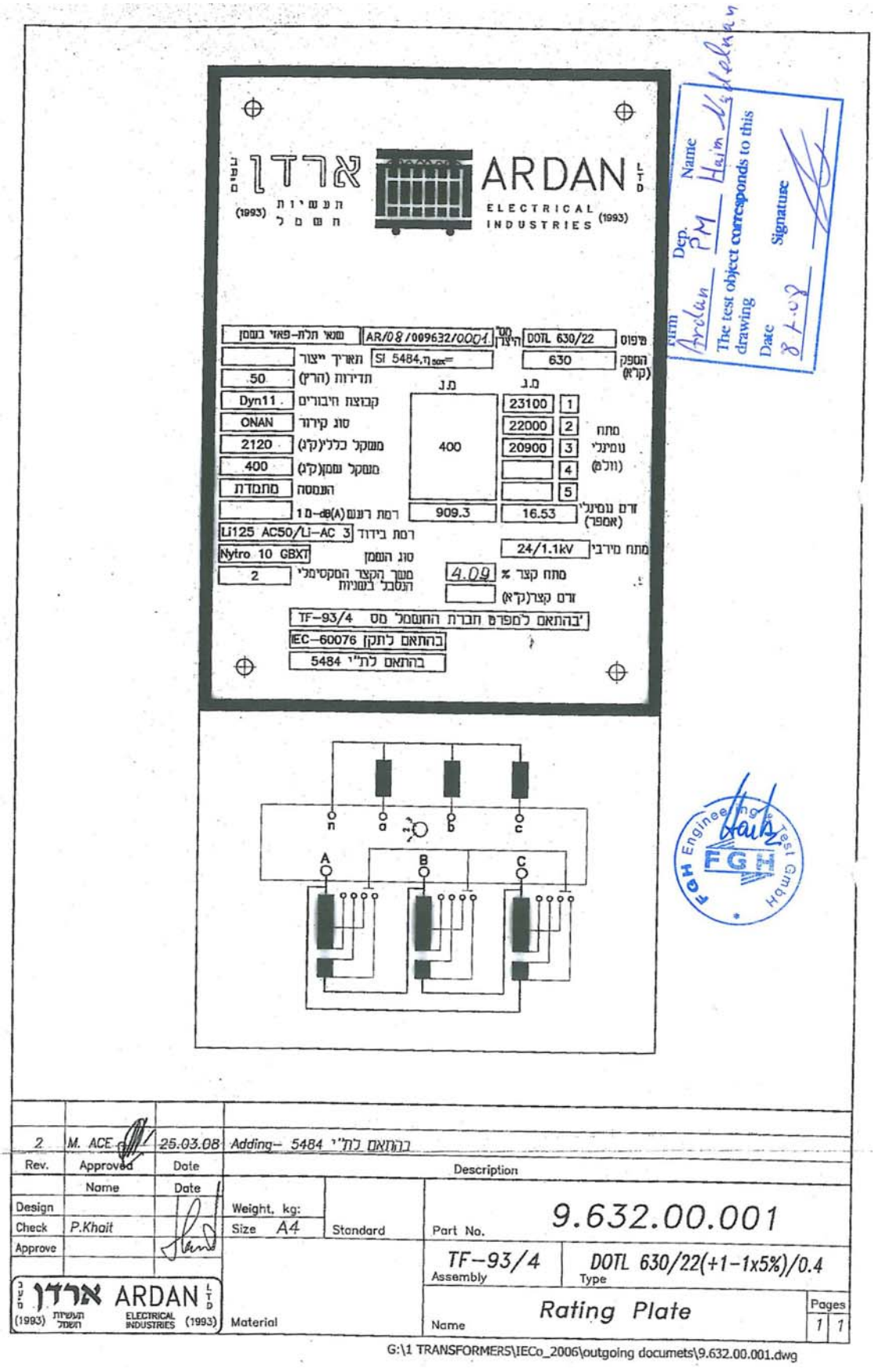
List of drawings submitted for identification:

Title	Drawing-no.	Date / Rev.	Sheet
Rating plate at transformer	AR/08/9632/1		5
Rating plate of transformer	9.632.00.001	25.03.08 / 2	6
Outline drawing of transformer	9.632.00.000 page 1/2	04.06.08 / 4	7
Content and Part list of outline drawing	9.632.00.000 page 2/2	04.06.08 / 4	8
Test report of Ardan Electrical Industries	AR/08/9632/1	21.05.08	9

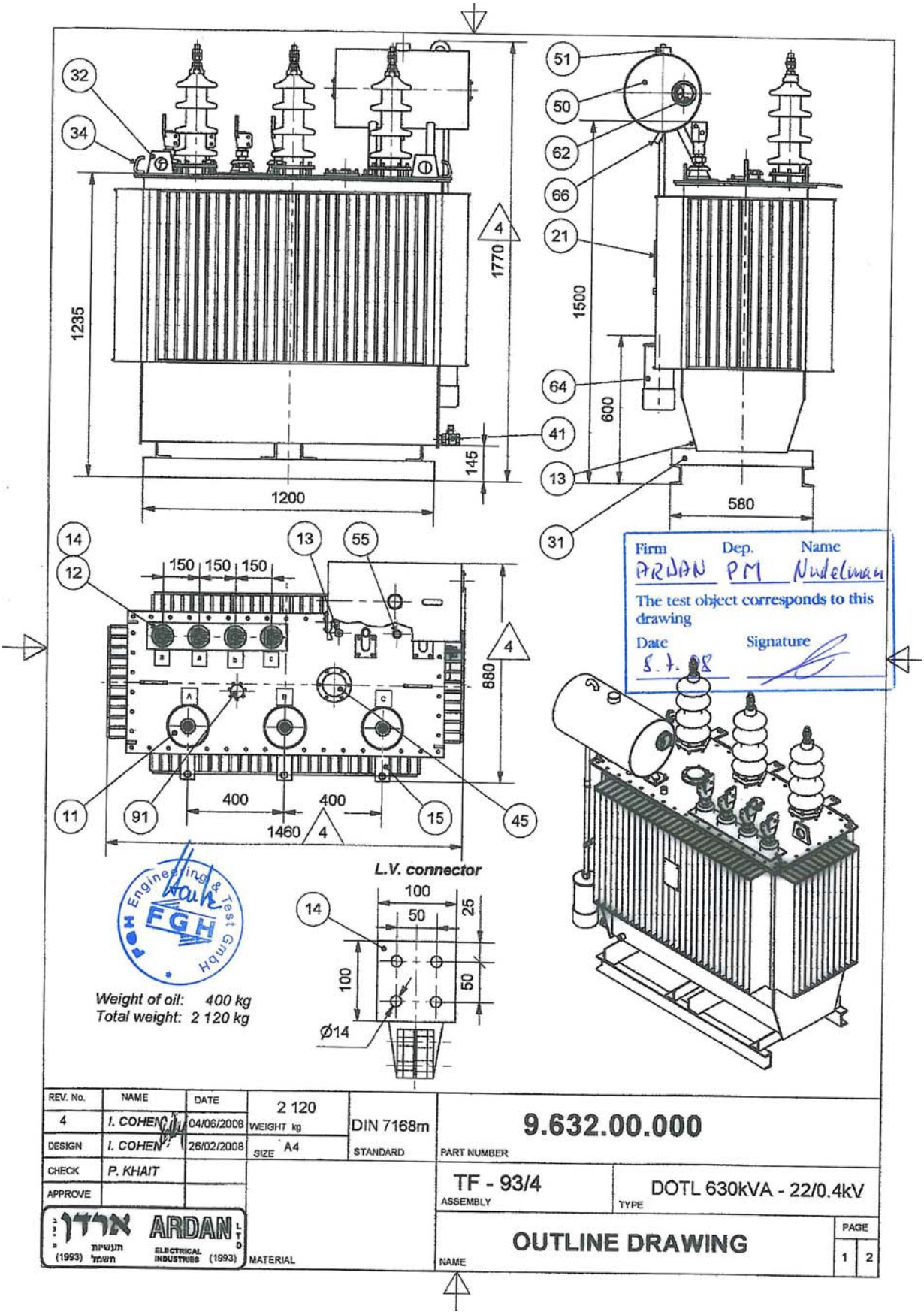
Identification documents not enclosed in this document are kept in the *manufacturers* files.

Rating Plate at transformer

3.1 Rating Plate of transformer



3.2 Outline drawing of transformer



3.3 Part list

Content and Part list of outline drawing 9.632.00.000

Position	Part Name	Type	Manufacturer	שרטוט או חומר סכני נלווה לסכמת הגשה
11	HV Bushing	DT 30nf630	Porcelain –Zapel Metal Part - Comem	דף קטלוג יצרן
12	LV Bushing	DT 1000	Porcelain –Zapel Metal Part - Comem	שרטוט יצרן 1.4
13	Earthing Terminal M12			שרטוט ארדן 257.85.700
14	LV connection clamp	NI-1024-01	Comem	שרטוט יצרן NI-1024-01
15	Fuse Base			שרטוט ארדן 9.102.70.018
21	Rating Plate			שרטוט ארדן 9.632.00.001
31	Base for transformer			
32	Lifting Lugs			שרטוט ארדן 25770005
34	Tie Downs			שרטוט ארדן 550038
41	Oil Drain Tank	1" – SN200	Sagiv	דף קטלוג יצרן
50	Conservator tank			
51	Filling Plug	G 2" A		
45	Overpressure relief device	ST-68	Shalev	שרטוט יצרן ST 00-000-0
55	Thermometer pocket	G 3/4 "		שרטוט ארדן 128.70.600
62	Magnetic oil level gauge	KSS-G 535	Elmek	דף קטלוג יצרן
64	Dehydrating Breather	NAK 1,0kg Form C 321 C	Elmek	דף קטלוג יצרן
66	Oil Drain Expansion Tank	1/2" –SN100	Sagiv	דף קטלוג יצרן
91	Off load tap changer	HR 7A1233	ASP	דף קטלוג יצרן
	מידע אודות צלעות מיכל			M.80.300 כולל דף מידות
	מידע אודות סלילי מ.נ זמ.ג			טבלה מרכזת של נתוני הסלילים
	פרמטרים גאומטריים לגרעין שנאי			דף נתונים ארדן
	Marking			שרטוט ארדן 9.632.00.002
	סיליקה ג'ל	Silica Gel White	CIC	
	צבע			לפי מפרט 02-16-10 לפי מפרט 02-16-09
	שמן	Nitro 10GBXT	Nynas	

Firm ARDAN Dep. PM Name Nudelman
The test object corresponds to this drawing
Date 8.7.08 Signature

Rev. No.	Revision doc	Date
2	NT-89/08 19/3/08	24.3.2008
3	Change LV connection	1.4.2008
4	**Change of dimensions**	**4.6.2008**

Design			Size A4	Standard
Check				
Approve				

9.632.00.000

Part No.

TF - 93/4 Assembly

DOTL 630-22/0.4 KV Type

ARDAN LTD (1993) ELECTRICAL INDUSTRIES (1993) ארדן בע"מ (1993) התעשיות החשמל

Material

Outline Drawing Name

Pages 2 2

3.4 Test Report of manufacturer

ARDAN ELECTRICAL INDUSTRIES (1993) LTD

NISKO ARDAN GROUP

3 PHASE OIL TRANSFORMER TEST REPORT

Purchaser	Israel Electric Co
Specification	TF - 93/4
Order no	1136189/02

Serial no:	AR/08/009632/0001
Type:	DOTL 630/22

TECHNICAL DATA:

Rat.Power[kVA]	630	Ins Level	24/1.1
Tap.volt1[V]	23100		
Rat.volt HV [V]	22000	RatVolt LV [V]	400.00
Tap.volt3[V]	20900		

Vector group	Dyn 11
Service:	Cont.
Frequ.[Hz]	50
Kind:	L
Class of temp	A
Cont.short.cir cur [kA]	0.375
Max.dur of short circ [s]	2

GUARANTEE VALUES

Po [W]	800.00
Pl [W]	5150.00
ez [%]	4.40
Io [%]	0.48
Lpa dB(A)/1m	50.00

Rat.Cur HV [A]	16.53	Rat cur LV [A]	909.30
Protection:	IP 54		
Cooling:	ONAN		
Tot weight[T]	2.120	Oil weight[T]	0.40

MEASUREMENT AT NO LOAD feeded LV 400 Volts at 50 [Hz]

Phase	Volts	c	Volts avg.	Amps.	c	Ampers avg	Io [%]	c	Watts
a-b	400.10	1	400.1	1.73	1	1.45	0.16	1	764
b-c	401.00			1.05					
c-a	399.20			1.58					

MEASUREMENT AT SHORT CIRCUIT feeded HV at 50 [Hz] : short circuted LV

Phase	Volts	c	Volts avg.	Ampers	c	Ampers avg	Watts	c	Position
A-B	883.00	1	883.7	16.16	1	16.30	4254.8	1	2
B-C	886.30			16.35					
C-A	881.80			16.38					

Pl in Watts	Losses in Watts at 75 C			Short circuit Impedance % at 75 C			Position
at 28.4 C	Pz	Pr	Pl	ez	er	ex	
4378	251.0	4804.3	5055.3	4.09	0.76	4.02	2

RESISTANCE MEASUREMENT at 28.4 C [Ohms]

Position	A-B	B-C	C-A	a-b	b-c	c-a
2	5.268	5.268	5.274	0.001535	0.001546	0.001568

RATIO MEASUREMENT

Conection to		Ratio (% Deviation) Pos 1	Pos 2	Pos 3
A-B	a-n	0.040	0.070	0.080
B-C	b-n	0.040	0.070	0.080
C-A	c-n	0.040	0.070	0.080
Rated Value		100.00	95.26	90.50

FGH Engineering & Test GmbH

Dyn 11 OK

INSULATION TESTS	Kv	Hz	min	Tests	NOTES
Separate-source test HV	50	50	1	OK	
Separate-source test LV	3	50	1	OK	
Induced overvoltage test	0.8	125	0.8	OK	
Insulating value of Oil kV/2.5 mm:		Oil quality NYTRO 10GBXT			

Date of test 21/05/2008 Tester Name: Gennady Approved 05 QA ARDAN

ARDAN IND. Ltd P.O.Box 615 Yokneam 20692 ארדן תעשיות חשמל בע"מ, ת.ד. 615 יקנעם 20692
E-mail: eyal.sayar@ardanelectric.co.il Tel:972-4-632 8888, Fax: 972-4-9892736

4 Routine Tests

(before short-circuit test)

- **Measurement of voltage ratio and check of voltage vector relationship**

Tap position	Rated value	measured values (deviation to rated value) A - B / a - n	B - C / b - n	C - A / c - n	Connection symbol
1	100,03	100,02 (- 0,01%)	100,02 (- 0,01%)	100,02 (- 0,01%)	**Dyn11 verified**
2	**95,26**	**95,34 (+ 0,08%)**	**95,34 (+ 0,08%)**	**95,34 (+ 0,08%)**	
3	90,50	90,59 (+ 0,10%)	90,59 (+ 0,10%)	90,59 (+ 0,10%)	

- **Measurement of winding resistance** **Temperature 29,4 °C**

Tap position	measured values on terminals A - B	B - C	C - A	Average
1 (23,1 kV)	5,612 Ω	5,605 Ω	5,608 Ω	5,61 Ω
2 (22 kV)	**5,310 Ω**	**5,311 Ω**	**5,314 Ω**	**5,31 Ω**
3 (20,9 kV)	5,020 Ω	5,018 Ω	5,022 Ω	5,02 Ω
	a - b	**b - c**	**c - a**	
	1,537 mΩ	**1,559 mΩ**	**1,575 mΩ**	**1,557 mΩ**

- **Measurement of no-load loss and current at 50 Hz**

U / Ur	| U | V	U_{rms} V	I_a A	I_b A	I_c A	I_0 A	I_0 / I_r	P_0 W	P_{0corr} W
100,0%	**399,9**	400,1	1,5722	1,0939	1,7354	1,467	**0,16%**	770,2	**770**

- **Measurement of impedance voltage, short-circuit impedance and load losses** **Temperature 28,8 °C**

Tap position	short ciruit	I_{mess} A	I_m / I_r	U_m V	P_m W	U_{kr} V	u_{kr}	P_{kr} W	P_{cur} W	P_{addr} W
1	a-b-c	15,666	99,5%	945,4	4418,0	950,22	4,11%	4463,2	4007,8	455,4
2		15,782	95,5%	858,3	4168,0	899,15	4,09%	4574,2	4099,7	474,5
3		15,680	90,1%	748,70	3767,5	830,99	3,98%	4641,2	4202,3	438,9

Correction to the reference temperature of 75°C°

Tap position	short ciruit	$P_{cur\ 75}$ W	$P_{addr\ 75}$ W	$P_{kr\ 75}$ **W**	$u_{kr\ 75}$	$u_{Rr\ 75}$	$u_{Xr\ 75}$	$Z_{kr\ 75}$ Ω	$\varphi_{kr\ 75}$
1	a-b-c	4720,4	387,5	**5108**	**4,13%**	0,81%	4,05%	**35,00**	**78,7°**
2		4828,7	403,8	**5232**	**4,11%**	0,83%	4,02%	**31,55**	**78,3°**
3		4949,5	373,5	**5323**	**4,00%**	0,84%	3,91%	**27,72**	**77,8°**

- **Separate-source voltage withstand test (50 Hz, 1~)**

Voltage at	earthed	U_{rv} (û/√2) *)	U_{tv} (û/√2) **)	U_{rv} / U_{tv}	Test duration	Result
HV	**LV, Vessel**	**50,0 kV**	**50,0 kV**	**100%**	**60 s**	**passed**
LV	**HV, Vessel**	**3,0 kV**	**3,0 kV**		**60 s**	**passed**

*) U_{rv} = Rated withstand voltage **) U_{tv} = Applied test voltage

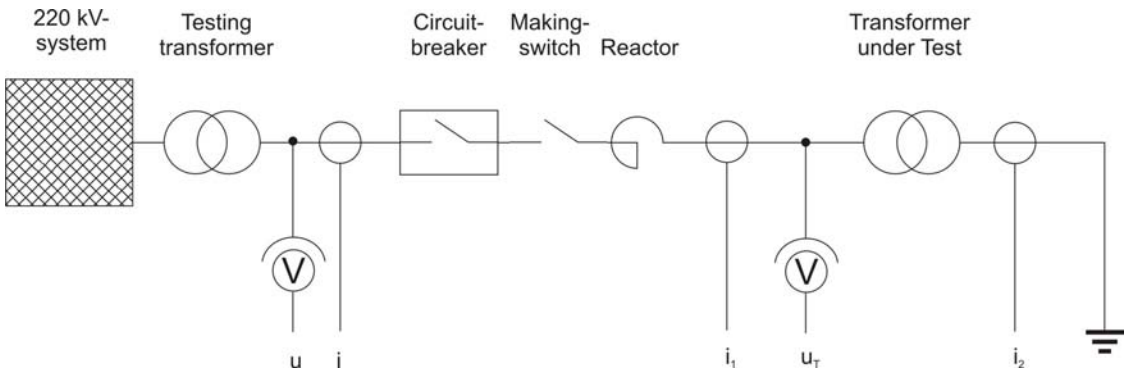
- **Induced overvoltage withstand test (150 Hz, 3~,)**

Voltage at	earthed	U_{2rv} (û/√2) *)	U_{tv} (û/√2) **)	U_{rv} / U_{tv}	Test duration	Result
a-b-c	**Vessel**	**800 V**	**800 V**	**100%**	**40 s**	**passed**

*) U_{2rv} = 2 x Rated voltage **) U_{tv} = Applied test voltage

5 Test of Short-circuit strength

5.1 Test Circuit and Measurement



Test-No.		141-08/	290 - 298
Phases/Poles		**Test circuit**	3-phases
		Transformer under test	3-phases
Power frequency		**Hz**	50
Testing transformer		**Connection symbol**	Yd1
		Secondary neutral	-
Short-circuit point			a-b-c-n-grounding terminal / frame short-circuited and earthed
Short-circuit apparent power		**MVA**	500
Current	**i_1:**	**Current transformer**	200A / 1A
	i_2:	**Rogowski-coil**	5,3 kA / s
Voltage	**u_T:**	**Voltage transformer**	35 kV / 0,1 kV

5.2 Test Results

Test-no.		141-08/	290	291	292	293	294	295	296	297	298
Tap-Position			2	2	2	1	1	1	3	3	3
Corresp. Voltage	kV		22,00	22,00	22,00	23,10	23,10	23,10	20,90	20,90	20,90
Circuit closed at zero voltage			B-C	B-C	B-C	A-B	A-B	A-B	C-A	C-A	C-A
No-load voltage	kV		22,0	22,0	22,0	22,8	22,8	22,5	20,9	21,2	21,4
Terminal voltage	kV	A-B	21,3	21,3	21,2	22,2	22,2	21,9	20,1	20,4	20,7
		B-C	21,2	21,2	21,2	22,2	22,2	21,9	20,1	20,3	20,6
		C-A	21,3	21,3	21,3	22,2	22,2	21,9	20,2	20,4	20,7
Mean value	kV		21,3	21,3	21,3	22,2	22,2	21,9	20,1	20,4	20,6
Peak current in winding	A	A-B	415	415	418	**492**	**505**	**486**	438	445	450
		B-C	**520**	**520**	**517**	406	407	399	437	444	450
		C-A	419	419	415	390	396	380	**534**	**544**	**554**
Short-circuit current (r.m.s.) on terminal	A	A	390	390	390	367	368	364	419	424	430
		B	391	391	391	367	367	365	421	426	431
		C	390	390	390	368	368	362	421	426	431
Mean value	A		390	390	390	367	368	364	420	425	431
Current duration	ms		506	506	506	531	531	531	529	531	531
Peak current (secondary)	kA	a	40,10	40,10	39,89	**49,57**	**50,57**	**47,53**	40,19	39,89	42,02
		b	**49,61**	**49,61**	**49,58**	41,10	40,11	38,29	40,19	41,44	40,63
		c	39,85	39,85	39,52	37,25	39,25	37,92	**48,59**	**48,93**	**49,69**
Short-circuit current (r.m.s.) (secondary)	kA	a	21,76	21,76	21,69	21,35	21,30	20,85	22,16	22,40	22,74
		b	21,55	21,55	21,47	21,27	21,24	20,91	22,08	22,39	22,59
		c	21,36	21,36	21,28	20,94	21,00	20,77	21,80	22,06	22,27
Mean value	kA		21,56	21,56	21,48	21,19	21,18	20,84	22,01	22,28	22,53

Remarks:

For transformers with delta connected primary windings the primary winding currents were computed from the primary line currents.
This method depends on symmetry of short-circuit impedance of the transformer under test.

The transformer was able to carry the short-circuit currents without any sign of deterioration.

The corresponding oscillograms are plotted in this report.

The pictures of the inspection of active part of transformer after all tests are integrated, too.

6 Lightning Impulse Voltage Withstand Test

(after short-circuit test)

6.1 Test procedure

The tests were carried out in accordance with IEC 60076-3: 2000-03, Clauses 13 and 14 and customers instructions.

The lightning impulse voltage of negative polarity was applied to each terminal of the high-voltage windings in turn, while the other two terminals and the vessel were connected to earth. The terminals of the low-voltage windings were short-circuited and connected to earth by means a measuring-resistor R_m = 0.08748 Ω.

A test sequence of 4 impulses was applied to each terminal in the following order:

1 calibration impulse	full lightning voltage	62.5 kV
3 test impulses		125 kV

6.2 Technical data of the impulse generator:

Surge capacitance :	300 nF
Load capacitance without transformer:	5,2 nF
Front resistance:	48 Ω
Discharge resistance:	210 Ω

With high-voltage terminals connected to the generator the lightning impulse voltage had a virtual front time T_1 = 1.18 µs and a time to half value T_2 = 44.2 µs. The values were inside the tolerances given in IEC 60060-1: 1994-06, i.e. T_1 = 1,2 µs ± 30%, T_2 = 50 µs ± 20%.
For measuring the peak value of the impulse voltage an approved Impulse Measuring System connected to an resistive divider (ratio 400) was used.

By means of the dual-trace transient recorder the following signals were recorded simultaneously:

- the shape of the lightning impulse voltage
- the voltage drop of the current across the measuring resistor R_m

6.3 Test results

In table 1 the impulse voltages of the test series and the relevant oscillograms are presented. There were no significant differences between the voltage and current transients recorded during the tests with full test voltages and those recorded during the test with half test voltage.

The transformer has passed the tests

Table 1: Lightning impulse withstand voltage test with full wave according to IEC 60076-3:2000-03, Clauses 13 and 14
(Tapping connector: principal tapping - pos. 2)

Terminal under test	Impulse No.	Type of impulse *)		Test voltage û/kV	Oscillogram no. **)
A	1	C	FW	-62.8	19962
	2	T	FW	-124.1	19963
	3	T	FW	-124.8	19964
	4	T	FW	-125.0	19965
B	5	C	FW	-61.8	19966
	6	T	FW	-127.5	19967
	7	T	FW	-126.3	19968
	8	T	FW	-122.3	19969
C	9	C	FW	-62.7	19970
	10	T	FW	-123.7	19971
	11	T	FW	-124.8	19972
	12	T	FW	-124.8	19973

*) Kind of impulse: FW ... 100% full wave lightning impulse
C ... calibration impulse
T ... test impulse

**) see pages 29 to 30

7 Results of Routine tests

(after short-circuit test)

- **Separate-source voltage withstand test (50 Hz - single phase)**

Voltage at	earthed	U_{rv} ($\hat{U}/\sqrt{2}$) *)	U_t ($\hat{U}/\sqrt{2}$) **)	U_t/U_{rv}	Test duration	Result
HV	LV, Vessel	50 kV	50 kV	100 %	60 s	passed
LV	HV, Vessel	3 kV	3 kV	100 %	60 s	passed

*) U_{rv} = rated withstand voltage **) U_t = test voltage (applied)

- **Induced overvoltage withstand test (150 Hz - three phase)**

Tap changer	Voltage at	earthed	U_{2rv} ($\hat{U}/\sqrt{2}$) *)	U_t ($\hat{U}/\sqrt{2}$) **)	U_t/U_{2rv}	Test duration	Result
22 kV / 2	a-b-c	Vessel	800 V	800 V	100 %	40 s	passed

*) U_{2rv} = 2 * rated voltage **) U_t = test voltage (applied)

8 Inspection of Active part

The inspection of the active part of transformer after all tests did not show any defect, which might endanger the safe operation of transformer.
Nonetheless small wooden distance sticks of stray channel between HV- and LV-winding fell down (2 in phase A, 1 in phase B) on LV-terminal side and the glue of one lower wooden support block was loosened, but block still in position.

The transformer passed the Short-circuit test.

Condition of transformer see following figures:

Fig. 1 Tested transformer (HV terminal side) after short-circuit test

Fig. 2 Tested transformer (LV terminal side) after short-circuit test

Fig. 3 Active part of tested transformer (HV-terminal side) after all tests

Fig. 4 Active part of tested transformer (LV-terminal side) after all tests

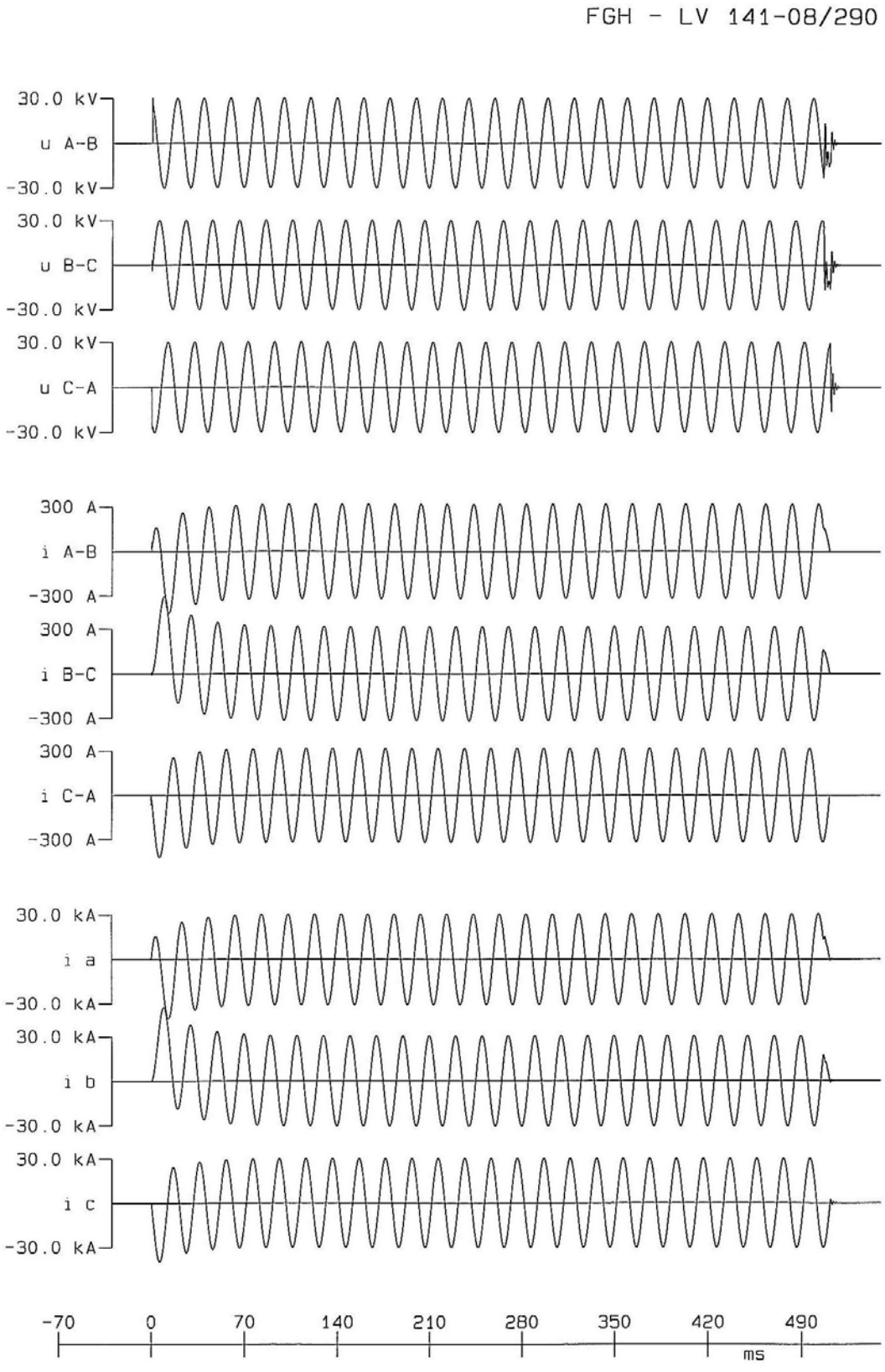
Fig. 5 Side view (phase A) of active part after all tests

Fig. 6 Side view (phase C) of active part after all tests

Fig. 7 Exemplary photograph (phase C) of small distance sticks of stray channel between HV- and LV-winding

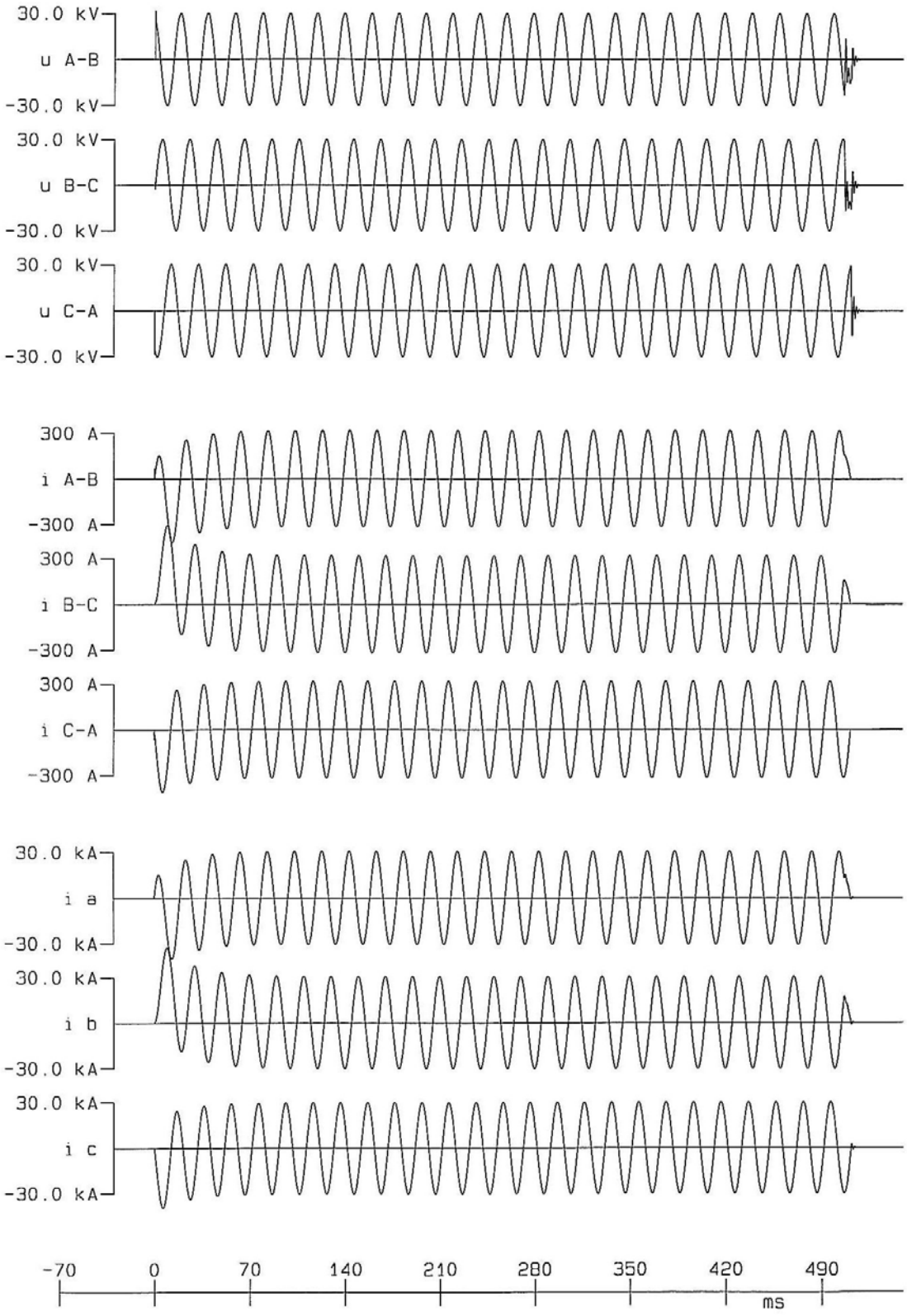
9 Oscillograms

9.1 Test of Short-circuit strength - Oscillograms



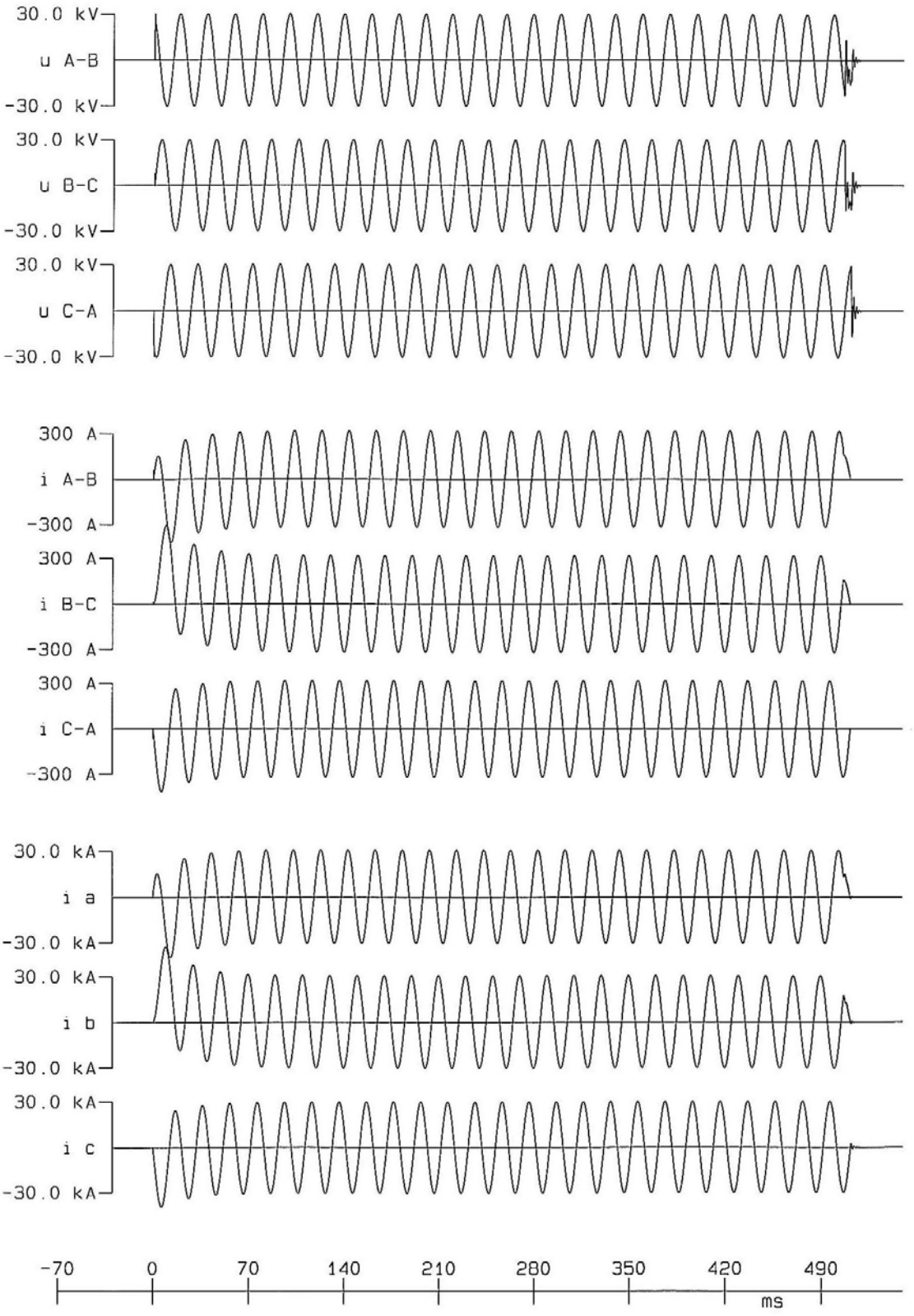
No. L08057 **Sheet** 21

FGH - LV 141-08/291



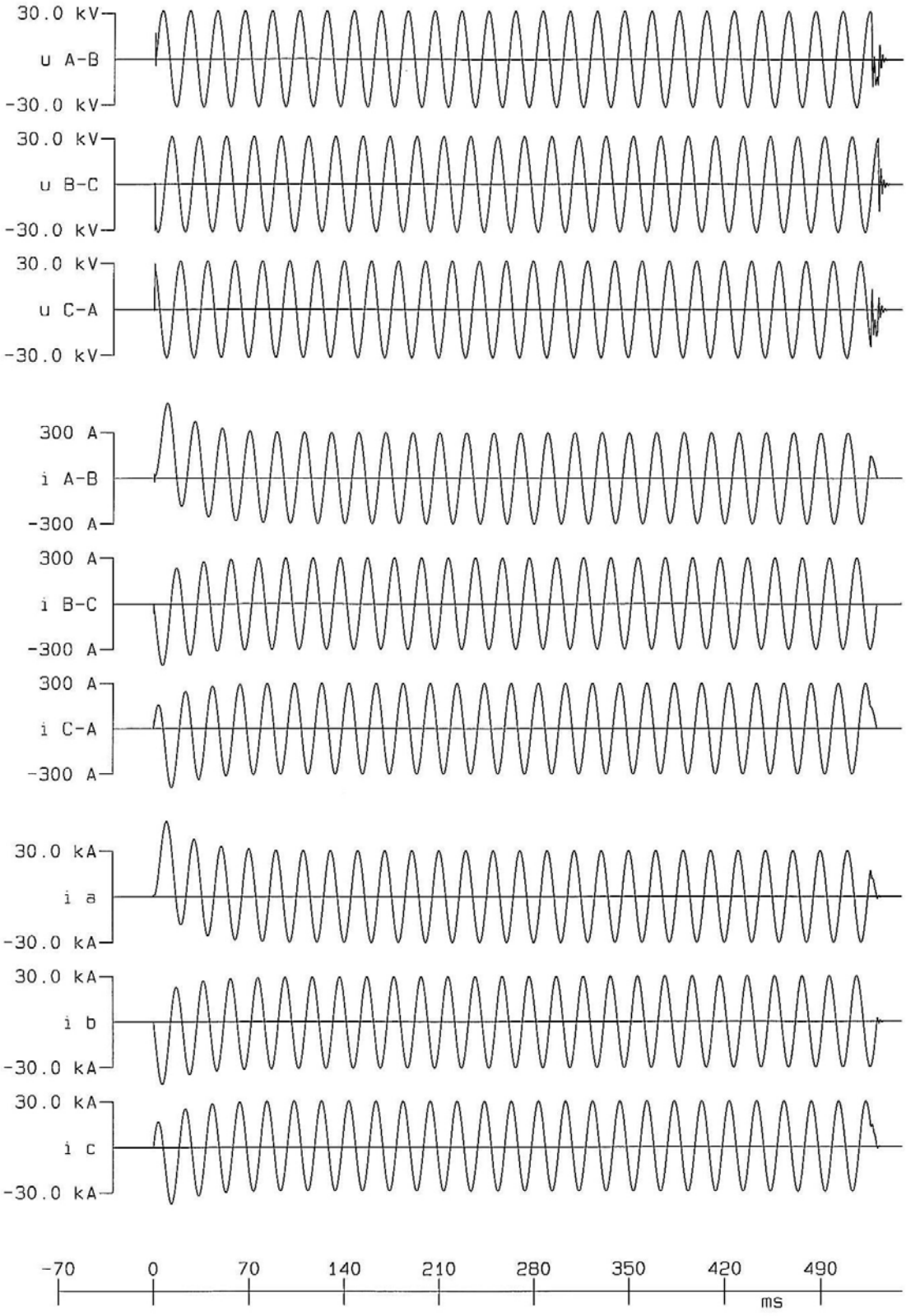
No. L08057 **Sheet** 22

FGH - LV 141-08/292



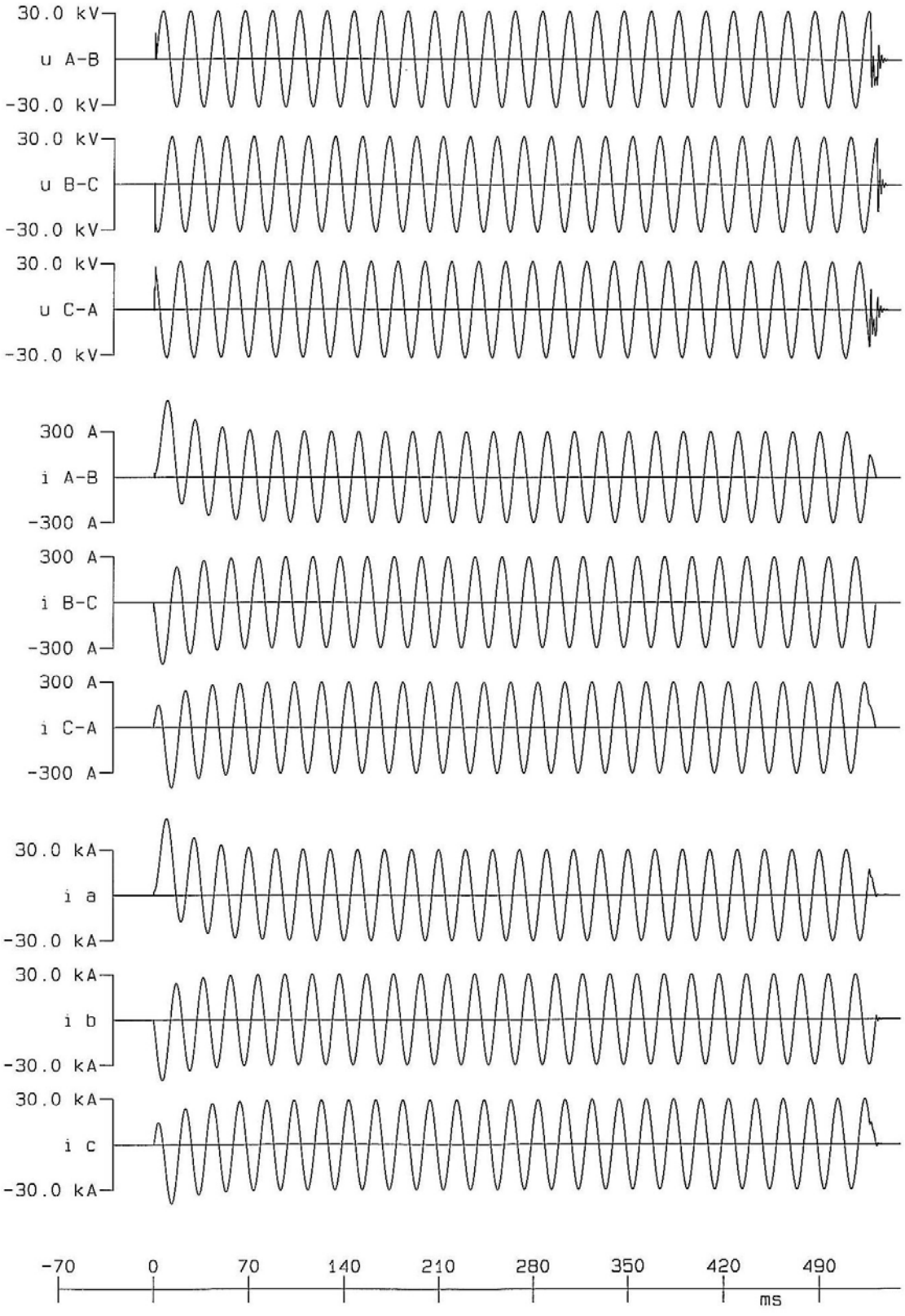
No. L08057 **Sheet** 23

FGH - LV 141-08/293



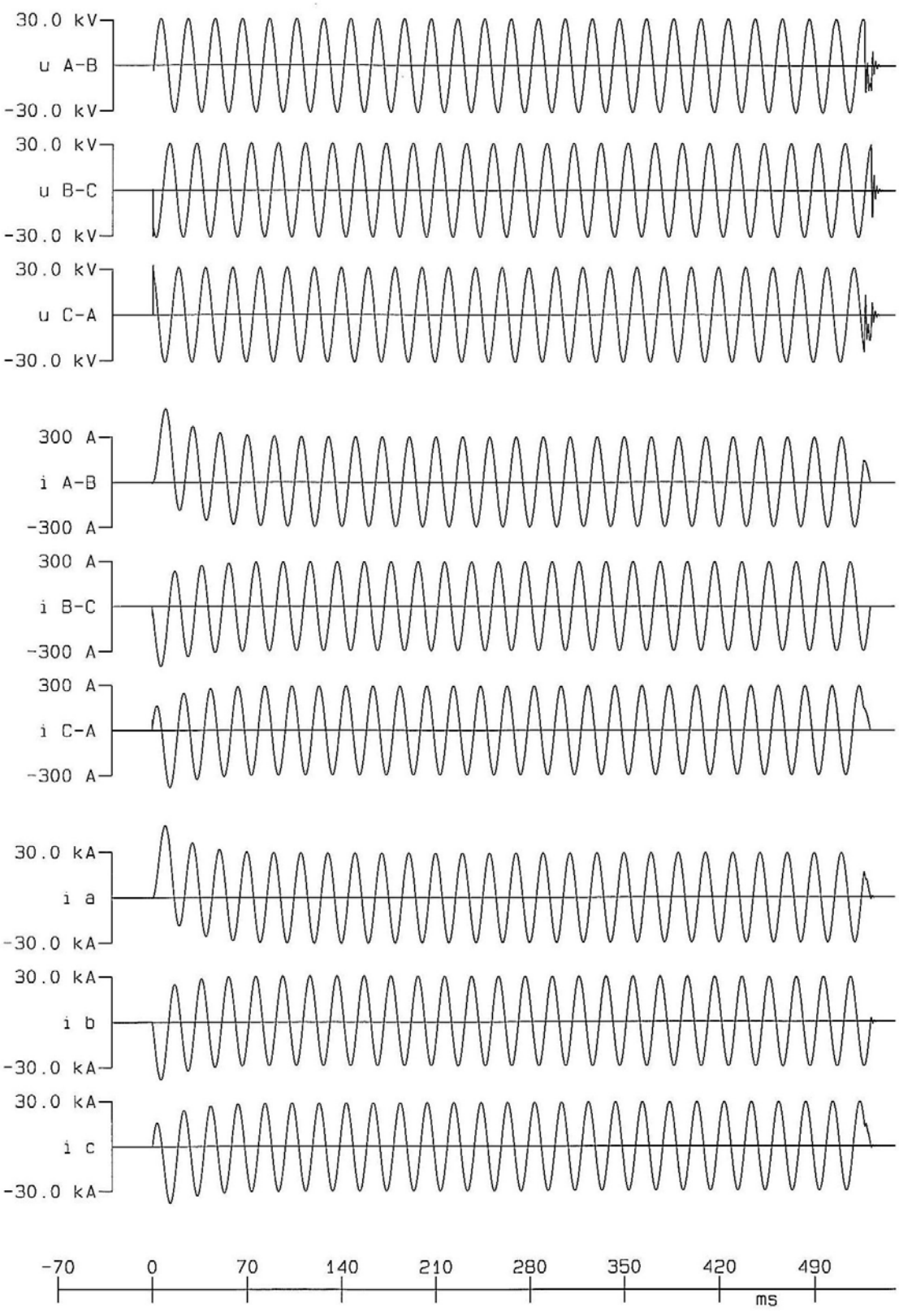
No. L08057 **Sheet** 24

FGH - LV 141-08/294



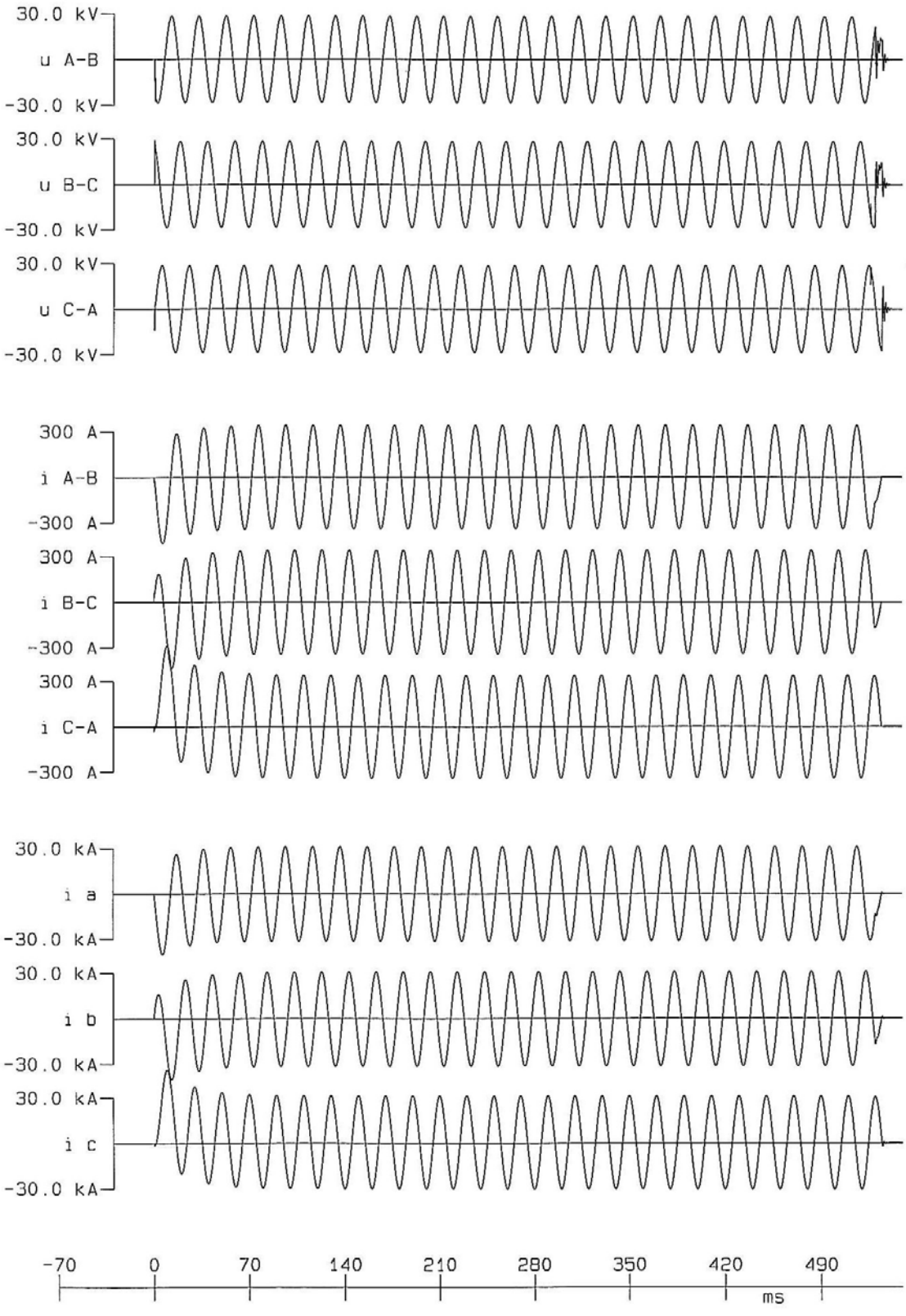
No. L08057 **Sheet** 25

FGH - LV 141-08/295

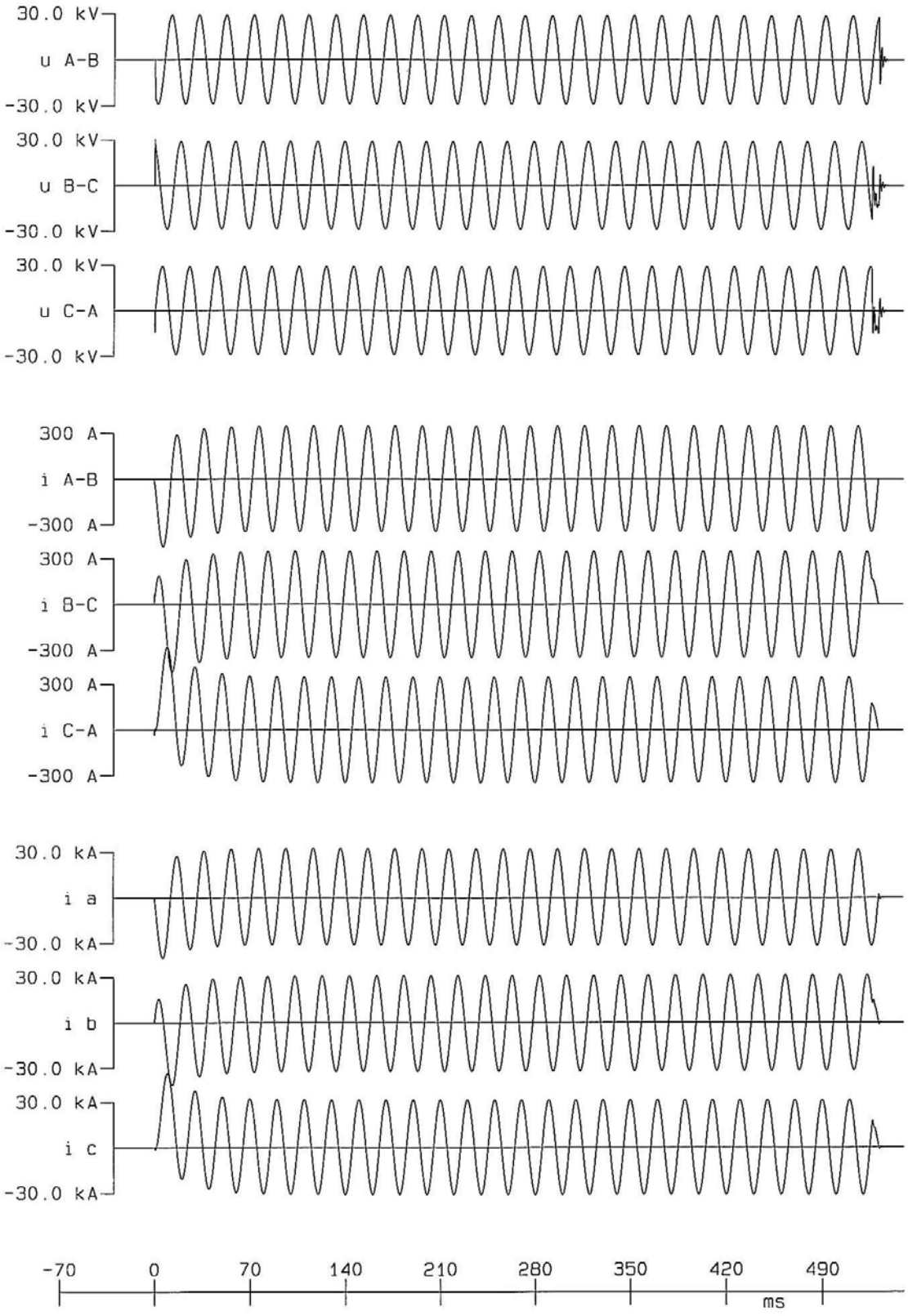


No. L08057 **Sheet** 26

FGH - LV 141-08/296

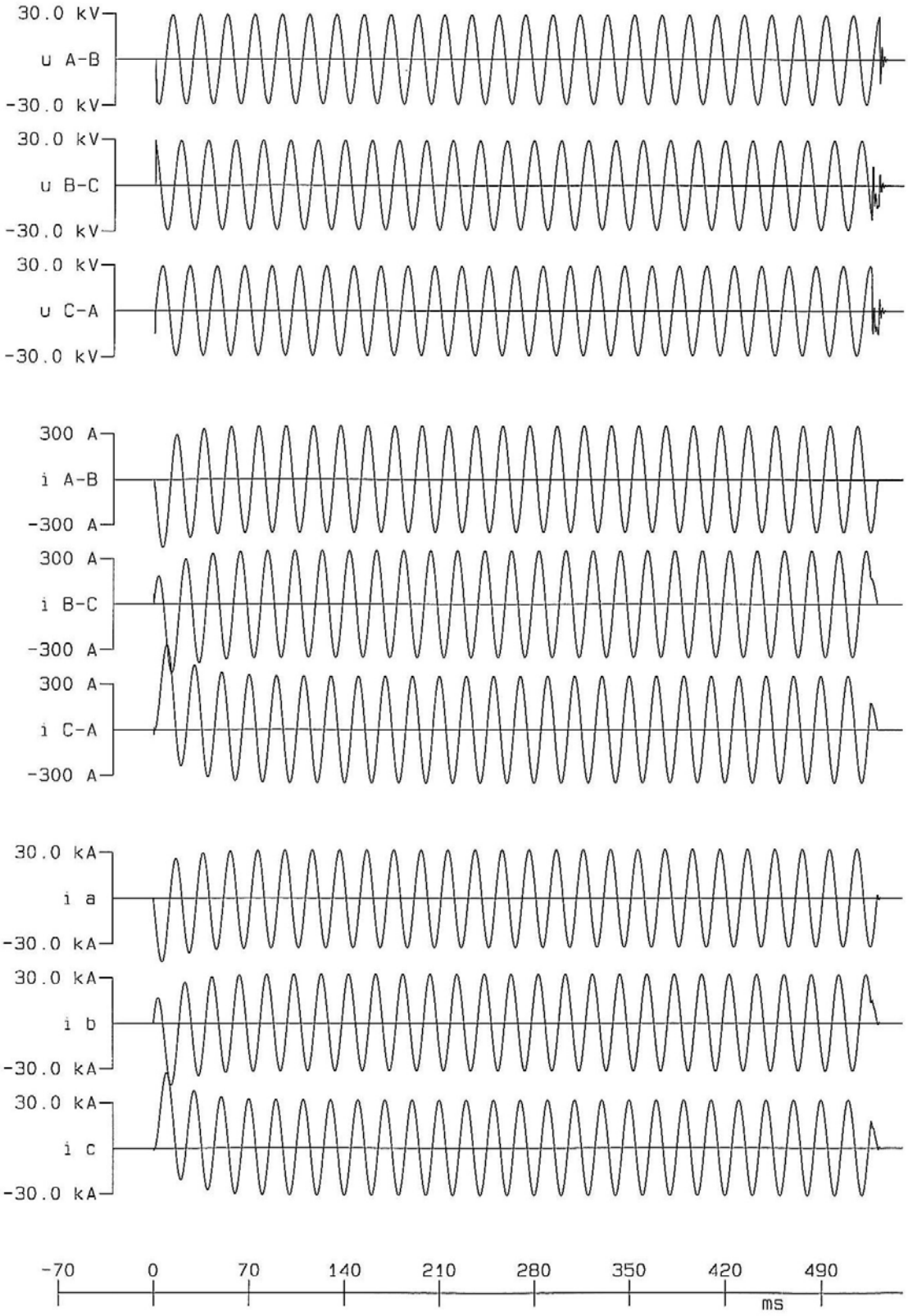


FGH - LV 141-08/297

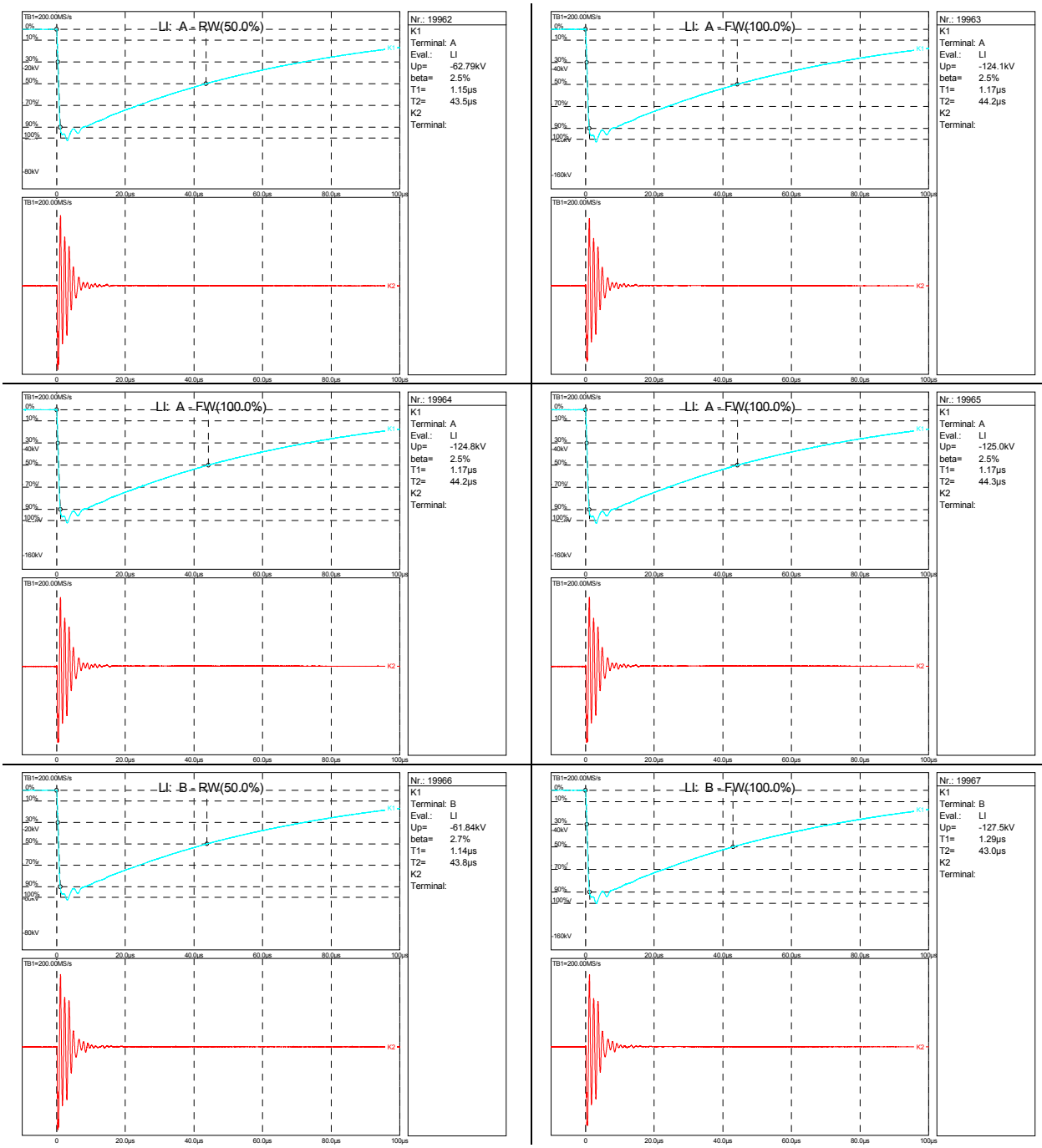


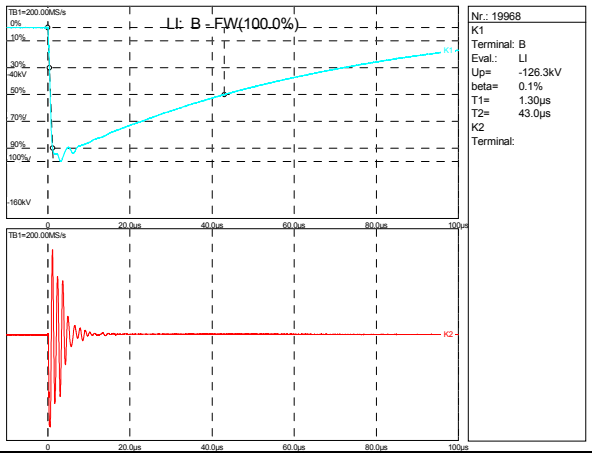
No. L08057 **Sheet** 28

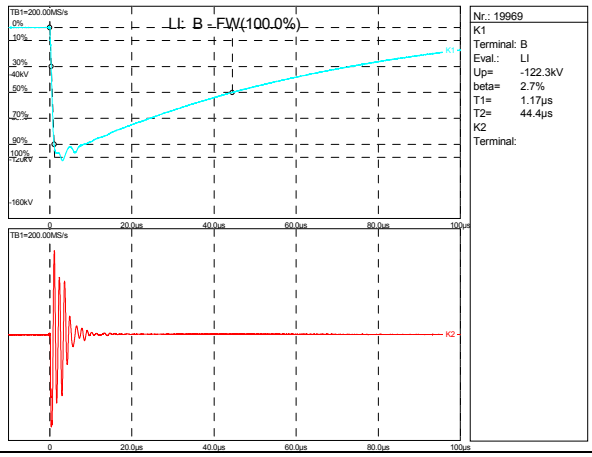
FGH - LV 141-08/298

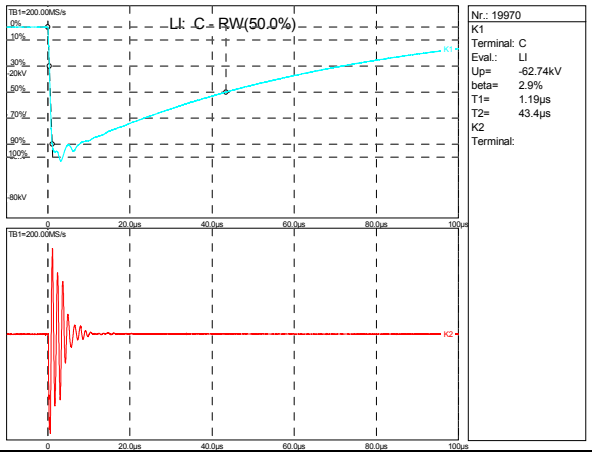


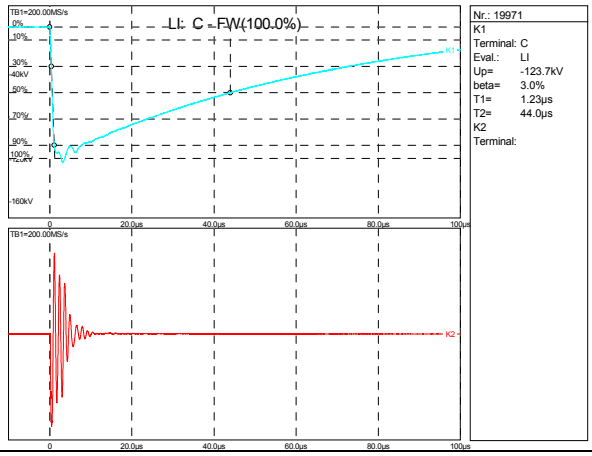
9.2 Lightning Impulse Voltage Withstand Test - Oscillograms

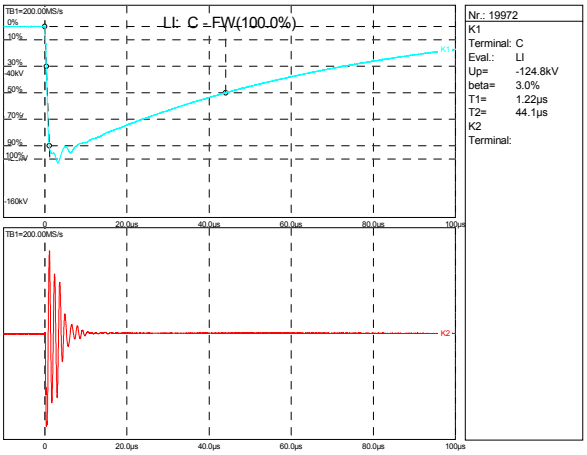


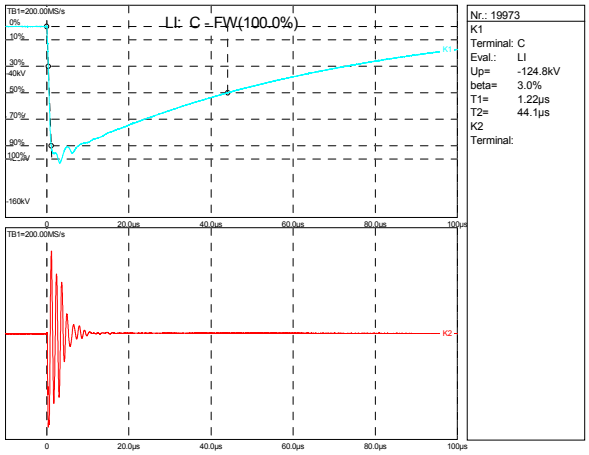

LI: B - FW(100.0%)
Nr.: 19968
K1
Terminal: B
Eval.: LI
Up= -126.3kV
beta= 0.1%
T1= 1.30µs
T2= 43.0µs
K2
Terminal:


LI: B - FW(100.0%)
Nr.: 19969
K1
Terminal: B
Eval.: LI
Up= -122.3kV
beta= 2.7%
T1= 1.17µs
T2= 44.4µs
K2
Terminal:


LI: C - FW(50.0%)
Nr.: 19970
K1
Terminal: C
Eval.: LI
Up= -62.74kV
beta= 2.9%
T1= 1.19µs
T2= 43.4µs
K2
Terminal:


LI: C - FW(100.0%)
Nr.: 19971
K1
Terminal: C
Eval.: LI
Up= -123.7kV
beta= 3.0%
T1= 1.23µs
T2= 44.0µs
K2
Terminal:


LI: C - FW(100.0%)
Nr.: 19972
K1
Terminal: C
Eval.: LI
Up= -124.8kV
beta= 3.0%
T1= 1.22µs
T2= 44.1µs
K2
Terminal:


LI: C - FW(100.0%)
Nr.: 19973
K1
Terminal: C
Eval.: LI
Up= -124.8kV
beta= 3.0%
T1= 1.22µs
T2= 44.1µs
K2
Terminal: