Intertek

Certificate No. 17545

ASTA Certificate

of Verification Tests

Laboratory Ref. No: 3345.2091256.0968

APPARATUS: 730 A / 415 V / 1000 V / 4 kV ($I_{nA}/U_n/U_i/U_{imp}$), 50 Hz Low-voltage power switchgear and controlgear assembly consisting of:
- a three-phase and neutral main busbar system,
- a protective busbar,
- an incoming MCCB-feeder unit,
- five outgoing units with MCCB

DESIGNATION: ELSTEEL TECHNO MODULE Panel Board Form 4b construction
800 A test assembly

MANUFACTURER: Bloudan Control Systems Industry L.L.C. (BCS)
P.O. Box 37691
Dubai, UAE

TESTED BY: Institut „Prüffeld für elektrische Hochleistungstechnik" GmbH
Landsberger Allee 378 A
12681 Berlin, Germany

DATE(S) OF TESTS: 21 December 2009 to 23 August 2010

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this certificate has been subjected to the series of proving tests in accordance with

IEC 61439-2: Edition 1.0 2009-01
Verifications with reference to the tests listed in Annex D:

1:	**strength of material and parts**	**9:**	**temperature-rise**
2:	**degree of protection**	**10:**	**short-circuit withstand strength**
3:	**clearances and creepage distances**	**11:**	**electromagnetic compatibility (EMC)**
4:	**protection against electric shock**	**12:**	**mechanical operation**
8:	**dielectric properties**		

Refer to pages 1, 2 and 3 for ratings

The results are shown in the record of Proving 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). This certificate applies only to the apparatus tested. Responsibility for conformity of any apparatus having the same or other designations rests with the Manufacturer.

This Certificate comprises this front sheet, 3 rating pages plus 84 other pages as detailed on pages 5 to 7.

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UKAS PRODUCT CERTIFICATION
010

ASTA Observer
R. Borchert

Certification Manager

Date 22nd September 2010

Ratings assigned and proven by test

No.	Characteristic verified	Clause/ Sub-clause	Verified Tests and Ratings
1	**Strength of material and parts**	10.2	See below for details of Sub-clauses
	Resistance to corrosion	10.2.2	Severity test A for metallic indoor enclosure: verified
	Properties of insulating materials	10.2.3	Verified
	Thermal stability	10.2.3.1	Not applicable to metallic enclosure
	Resistance of insulating materials to normal heat	10.2.3.2	Verified
	Resistance to abnormal heat and fire due to internal electric effects	10.2.3.3	Verified
	Resistance to ultra-violet (UV) radiation	10.2.4	Not applicable to metallic enclosure
	Lifting	10.2.5	Verified
	Mechanical impact	10.2.6	IK – 01 Verified
	Marking	10.2.7	Verified
2	**Degree of protection of enclosures**	10.3	IP44
3	**Clearances and creepage distances**	10.4	
	Min. clearances ≥ 8 mm (overvoltage category IV)	10.4	Verified
	Min. creepage distance ≥ 16 mm (material group IIIa, pollution degree 3)	10.4	Verified
4	**Protection against electric shock and integrity of protective circuits**	10.5	
	Effective earth continuity, R_{PE} < 0.1 Ω	10.5.2	Verified
	PE busbar, tinned copper 2 x 15 mm x 10 mm	10.5.3	1-phase 30 kA for 1 second, 63 kA peak
8	**Dielectric properties**	10.9	
	Rated insulation voltage Main circuits Auxiliary circuits	10.9.2	 1000 V 300 V
	Rated impulse withstand voltage Main/distribution busbar MCCB-feeder without RCD MCCB-feeder with RCD	10.9.3	 8 kV 8 kV 4 kV

R. Borchert
ASTA Observer

Date(s) of Test: 21 December 2009 to 23 August 2010

Ratings assigned and proven by test

No.	Characteristic verified	Clause/ Sub-clause	Verified Tests and Ratings
9	**Temperature-rise limits**	10.10.2	
	Main busbar 2 x 20 mm x 10 mm tinned copper per phase	10.10.2.3.6	730 A, 3-phase, 50 Hz
	MCCB-incomer, 1 x 50 mm x 10 mm tinned copper per phase with MCCB ABB TMAX T6S 800	10.10.2.3.6	730 A, 3-phase, 50 Hz
	Distribution busbar, 2 x 20 mm x 10 mm tinned copper per phase	10.10.2.3.6	730 A, 3-phase, 50 Hz
	3B-MCCB-feeder with insulated branch busbar 20 mm x 10 mm tinned copper, MCCB ABB TMAX T3S 250	10.10.2.3.6	250 A, 3-phase, 50 Hz
	3C-MCCB-feeder with insulated branch busbar 20 mm x 10 mm tinned copper, MCCB ABB TMAX T3S 200	10.10.2.3.6	200 A, 3-phase, 50 Hz
	3D-MCCB-feeder with insulated branch busbar 15 mm x 5 mm tinned copper, MCCB ABB TMAX T2S 160	10.10.2.3.6	100 A, 3-phase, 50 Hz
	3A-MCCB-feeder with insulated branch busbar 15 mm x 5 mm tinned copper, MCCB ABB TMAX T2S 160	10.10.2.3.6	70 A, 3-phase, 50 Hz
	4A-MCCB-feeder with insulated branch busbar 15 mm x 5 mm tinned copper, MCCB ABB TMAX T2S 160	10.10.2.3.6	10 A, 3-phase, 50 Hz
	Rated diversity factor		0.8

Ratings assigned and proven by test

10	**Short-circuit withstand strength**	10.11	
	Main busbar 2 x 20 mm x 10 mm tinned copper per phase	10.11.5.3.3	3-phase 50 kA for 1 second, 105 kA peak
	Distribution busbar 2 x 20 mm x 10 mm tinned copper per phase	10.11.5.3.3	3-phase 50 kA for 1 second, 105 kA peak
	MCCB-incomer 50 mm x 10 mm tinned copper per phase with MCCB ABB TMAX T6S-800	10.11.5.3.3	3-phase 50 kA, 415 V, power factor 0.25
	3B-MCCB-feeder with insulated branch busbar 20 mm x 10 mm tinned copper, MCCB ABB TMAX T3S 250	10.11.5.3.2	3-phase 50 kA, 415 V, power factor 0.25
	3C-MCCB-feeder with insulated branch busbar 20 mm x 10 mm tinned copper, MCCB ABB TMAX T3S 200	10.11.5.3.2	3-phase 50 kA, 415 V, power factor 0.25
	3D-MCCB-feeder with insulated branch busbar 15 mm x 5 mm tinned copper, MCCB ABB TMAX T2S 160	10.11.5.3.2	3-phase 50 kA, 415 V, power factor 0.25
	3A-MCCB-feeder with insulated branch busbar 15 mm x 5 mm tinned copper, MCCB ABB TMAX T2S 160	10.11.5.3.2	3-phase 50 kA, 415 V, power factor 0.25
	4A-MCCB-feeder with insulated branch busbar 15 mm x 5 mm tinned copper, MCCB ABB TMAX T2S 160	10.11.5.3.2	3-phase 50 kA, 415 V, power factor 0.25
	Main Neutral 2 x 20 mm x 10 mm tinned copper per phase	10.11.5.3.5	3-phase 30 kA for 1 second, 63 kA peak
	Distribution neutral 2 x 20 mm x 10 mm tinned copper per phase	10.11.5.3.5	3-phase 30 kA for 1 second, 63 kA peak
	Outgoing neutral of 3B-MCCB-feeder with insulated branch busbar 20 mm x 10 mm tinned copper, MCCB ABB TMAX T3S 250	10.11.5.3.5	Single-phase 30 kA, 253 V, power factor 0.25
	Outgoing neutral of 3C-MCCB-feeder with insulated branch busbar 20 mm x 10 mm tinned copper, MCCB ABB TMAX T3S 200	10.11.5.3.5	Single-phase 30 kA, 253 V, power factor 0.25
	Outgoing neutral of 3D-MCCB-feeder with insulated branch busbar 15 mm x 5 mm tinned copper, MCCB ABB TMAX T2S 160	10.11.5.3.5	Single-phase 30 kA, 253 V, power factor 0.25
	Outgoing neutral of 3A-MCCB-feeder with insulated branch busbar 15 mm x 5 mm tinned copper, MCCB ABB TMAX T2S 160	10.11.5.3.5	Single-phase 30 kA, 253 V, power factor 0.25
	Outgoing neutral of 4A-MCCB-feeder with insulated branch busbar 15 mm x 5 mm tinned copper, MCCB ABB TMAX T2S 160	10.11.5.3.5	Single-phase 30 kA, 253 V, power factor 0.25
11	**Electromagnetic compatibility (EMC)**	10.12	Conditions for no testing required (J.10.12): verified
12	**Mechanical operation**	10.13	
	200 operating cycles	10.13	Verified

R. Borchert
ASTA Observer

Date(s) of Test: 21 December 2009 to 23 August 2010

THE TEST EXPERTS · SERVICES FOR THE WORLD OF ENERGY

IPH BERLIN

The testing was carried out by IPH.

The accreditation details of IPH are:

Deutscher Akkreditierungs Rat DAR	IPH is accredited to DIN EN ISO/IEC 17025 by the German Accreditation Body Technology (DATech)
INTERTEK ASTA RECOGNIZED LABORATORY	IPH is accredited to BS EN ISO/IEC 17025 and ASTA Publication No. 31 by ASTA Intertek
IEC IECEE	IPH is entitled to operate as German CBTL within the IECEE CB Scheme
ALPHA	IPH is listed in the ALPHA and LOVAG register of approved test laboratories
PEHLA	IPH is a member of PEHLA (Association for Electrical High-Power Testing) and an associated member of STL

IPH is Service Provider for:
All partners of electric power industry – Manufacturers, Users, Certifiers
IPH is active in the fields of:
Testing, Measurement, Witnessing, Diagnosis, Monitoring, Calibration, Pre-qualification, Expert advice, Training

IPH „Institut Prüffeld für elektrische Hochleistungstechnik“ GmbH, Germany
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1. Present at the test

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2. Identity of the test object

2.1 Technical data and characteristics

The technical data and characteristics of the test object are defined by the following parameters and specified by the client.

Client's order:	0505				
Test object:	Low-voltage power switchgear and controlgear assembly				
Type:	ELSTEEL TECHNO MODULE Panel Board Form 4b construction 800 A test assembly				
Original manufacturer:	Bloudan Control Systems Industry L.L.C. (BCS)				
Serial No.:	Test sample				
Year of manufacture:	2009				
Rated characteristics:	Rated voltage		U_n	415	V
	Rated insulation voltage		U_i	1000	V
	Rated impulse withstand voltage		U_{imp}	4	kV
	Rated current of the assembly		I_{nA}	730	A
	Rated current of MCCB-incomer		I_{nc}	730	A
	Rated current of distribution busbars		I_{nc}	730	A
	Rated peak withstand current		I_{pk}	105	kA
	Rated short-time withstand current		I_{cw}	50	kA, 1s
	Rated conditional short-circuit current		I_{cc}	50	kA
	Rated frequency		f_n	50	Hz
	Degree of protection			IP44	
Service condition:	Installation			Indoor	
	Max. ambient temperature			50	°C
Dimensions:	Width			2200	mm
	Height			2000	mm
	Depth			600	mm
Busbars:	Main busbar	L1/L2/L3/N		Tinned copper 2 x 20 mm x 10	mm
	PE busbar			Tinned copper 2 x 15 mm x 10	mm
Section 1					
Characteristics:				Incoming unit	
	Distribution busbar	L1/L2/L3/N		Tinned copper, 50 mm x 10	mm
	Switching device			MCCB	
	Type			TMAX T6S 800, 4-pole Fixed installation	
	Manufacturer			ABB	
	Rated current			800	A
	Trip level setting			Max	
Section 2					
Characteristics:				Outgoing cable terminal unit	
				Not equipped	

Technical data and characteristics (continued)

Section 3

Characteristics:					
				Outgoing feeder unit	
	Distribution busbar	L1/L2/L3/N		Tinned copper, 2 x 20 mm x 10	mm
3B-MCCB-feeder	Rated current		I_{nc}	250	A
	Branch busbar	L1/L2/L3/N		Tinned copper, 20 mm x 10	mm
	Switching device			MCCB	
	Type			TMAX T3S 250, 3-pole	
				Fixed installation	
	Manufacturer			ABB	
	Rated current			250	A
	Trip level setting			Max	
3C-MCCB-feeder	Rated current		I_{nc}	200	A
	Branch busbar	L1/L2/L3/N		Tinned copper, 20 mm x 10	mm
	Switching device			MCCB	
	Type			TMAX T3S 200, 3-pole	
				Fixed installation	
	Manufacturer			ABB	
	Rated current			200	A
	Trip level setting			Max	
3D-MCCB-feeder	Rated current		I_{nc}	100	A
	Branch busbar	L1/L2/L3/N		Tinned copper, 15 mm x 5	mm
	Switching device			MCCB	
	Type			TMAX T2S 160, 3-pole	
				Fixed installation	
	Manufacturer			ABB	
	Rated current			100	A
	Trip level setting			Max	
3A-MCCB-feeder	Rated current		I_{nc}	70	A
	Branch busbar	L1/L2/L3/N		Tinned copper, 15 mm x 5	mm
	Switching device			MCCB	
	Type			TMAX T2S 160, 3-pole	
				Fixed installation	
	Manufacturer			ABB	
	Rated current			80	A
	Trip level setting			Max	
	Switching device			2 x Contactors	
	Type			A63-30, 3-pole	
	Manufacturer			ABB	
	Switching device			RCD	
	Type			F204, 80 A, 0.1 A, 4-pole	
	Manufacturer			ABB	
	Switching device			Fuses	
	Type			P51R06, Size 000, 690 V, 100 A	
	Manufacturer			OEZ	
	Wiring			Flexible copper cable 35 mm^2	

Technical data and characteristics (continued)

Section 4

Characteristics:				Outgoing feeder unit	
4A-MCCB-feeder	Rated current		I_{nc}	10	A
	Branch busbar	L1/L2/L3/N		Tinned copper, 15 mm x 5	mm
	Switching device			MCCB	
	Type			TMAX T2S 160, 3-pole Fixed installation	
	Manufacturer			ABB	
	Rated current			16	A
	Trip level setting			Max	
	Switching device			Contactor	
	Type			A16-30-10, 3-pole	
	Manufacturer			ABB	
	Switching device			RCD	
	Type			F204, 25 A, 0.1A, 4-pole	
	Manufacturer			ABB	
	Switching device			Fuses	
	Type			P51R06, Size 000, 690 V, 16 A	
	Manufacturer			OEZ	
	Wiring			Flexible copper cable 4 mm^2	

2.2 Identity documents

The manufacturer confirms that the test object has been manufactured in compliance with the drawings given in this document. IPH have verified that the drawings submitted by the client and detailed in this test report represent the apparatus tested in all essential details with respect of the characteristics to be proven by the tests.
The identity of the test object is fixed by the following drawings and data submitted by the client.

Name of drawing/list	Drawing No.	Date of drawing	Author	Notes
GENERAL ARRANGEMENT OF 800 A TEST ASSEMBLY	TTA/09/BCS/800-G1 SHEET NO 1 OF 6	04.01.2010	BCS	Page 81
GENERAL ARRANGEMENT OF 800 A TEST ASSEMBLY	TTA/09/BCS/800-G2 SHEET NO 2 OF 6	04.01.2010	BCS	Page 82
GENERAL ARRANGEMENT OF BUSBAR SYSTEM	TTA/09/BCS/800-G3 SHEET NO 3 OF 6	04.01.2010	BCS	Page 83
BUSBAR ARRANGEMENT FIELD-1	TTA/09/BCS/800-F1 Sheet NO 4 OF 6	04.01.2010	BCS	Page 84
BUSBAR ARRANGEMENT FIELD-3	TTA/09/BCS/800-F3 SHEET NO 5 OF 6	04.01.2010	BCS	Page 85
SLD OF THE 800 A TEST ASSEMBLY	TTA/09/BCS/800-SLD SHEET NO 6 OF 6	04.01.2010	BCS	Page 86
LIFTING INSTRUCTIONS	-	18.09.2008	ELSTEEL	Page 87
BILL OF QUANTITY	-	13.01.2010	BCS	*)

*) These drawings/lists were submitted for the identification of the test object. They are not part of this test document and are retained in the IPH archive.

Test objects received by IPH on: 17 December 2009

3. Verification of the resistance to corrosion

3.1 Test laboratory

RST Rail System Testing GmbH, Environmental Lab, 16761 Hennigsdorf, Germany

3.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.2.2.2, severity level A

3.3 Required test parameters

3.3.1 Test Db: Damp heat, cyclic (12 + 12 hour cycle)

Lower temperature:	(25 ±3) °C	relative humidity:	95 % … 100 %
Higher temperature:	(40 ±2) °C	relative humidity:	9 % … 96 %
Number of cycles:	6		

3.3.2 Test Ka: Salt mist

Temperature:	(35 ±2) °C
Salt solution:	5 % sodium chloride (NaCl) solution
pH value:	6.5 ... 7.2
duration of test:	two days

Acceptance conditions:
- no more than 1% rust covered area for a rust degree Ri 1 allowed
- doors, hinges, locks and fastenings elements must be able to be operated without extreme expenditure of energy.

3.4 Test arrangement

IEC 61439-1: 2009-01, Sub-clause 10.2.2; severity A

The test was carried out on a representative sample the same constructional details as the enclosure itself.

3.5 Test and measuring circuits

Climate test chamber type HC 7057 (Vötsch)
Salt mist test chamber type HSK 1000 (Vötsch)

3.6 Test results

Date of test: 21 December to 28 January 2010

The enclosure was tested according to the relevant specification. Changes at the specimens were detected in comparison with the initial state of the specimens with normal eyes at the inspections after the tests.
The determined corrosion phenomena lie - referred to the total area of the specimens - in the limit of the demands for the rust degree Ri1.

4. Verification of resistance of insulating materials to normal heat

4.1 Test laboratory

Low-voltage test laboratory, test room 9

4.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.2.3.2

4.3 Required test parameters

The test temperature was:

(125 ±2) °C for parts necessary to retain current carrying parts in position

4.4 Test arrangement

IEC 61439-1: 2009-01, Sub-clause 10.2.3.2

4.5 Technical data and characteristics

The technical data and characteristics of the test specimen are defined by the following parameters and specified by the client.

Test specimen	Material	Name / Part	Test temperature	Notes
1	BH	BH6	125 °C	-
2	UBH	UBH2	125 °C	-

4.6 Test results

Date of test: 07 January 2010

Test specimen	Test temperature [°C]	Duration of test t_a Minutes	Diameter of the imprint mm	Evaluation
1	125	60	No imprint of the sphere	Passed
2	125	60	No imprint of the sphere	Passed

Notes:
t_a: Duration of stay in a heating cabinet

In the case of all test specimen no imprint of the sphere present.

5. Verification of the resistance of insulating materials to abnormal heat and fire due to internal electric effects

5.1 Test laboratory

Low-voltage test laboratory, test room 3

5.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.2.3.3

5.3 Required test parameters

The test temperature was:

960 °C for parts necessary to retain current carrying parts in position

5.4 Test arrangement

IEC 61439-1: 2009-01, Sub-clause 10.2.3.3

5.5 Technical data and characteristics

The technical data and characteristics of the test specimen are defined by the following parameters and specified by the client.

Test specimen	Material	Name / Part	Test temperature	Notes
1	BH	BH6	960 °C	-
2	UBH	UBH2	960 °C	-

5.6 Test results

Date of test: 11 January 2010

Test specimen	Test temperature [°C]	Duration of test t_a s	t_i s	t_e s	Height of the flame mm	Soft tissue inflamed	Evaluation
1	960	30	27	30	5	No	Passed
2	960	30	0	33	60	No	Passed

Notes:

t_a: Duration of action of glow-wire

t_i: Duration from start of glow-wire application until the moment, when the test specimen ignites.

t_e: Duration from start of glow-wire application until the moment, when the flames go out during test or after completion of test.

In the case of all test specimen no flame present.

6. Lifting

6.1 Test laboratory

Low-voltage test laboratory, test room 10

6.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.2.5

6.3 Required test parameters

The test object was equipped with weights to achieve a weight of 1.25 times its maximum shipping weight.

Shipping weight [kg]	Additional weight [kg]
750	188

6.4 Test arrangement

The test was carried out on the test object according to the lifting instruction of the manufacturer (see page 87) by using a forklift. The test object stood on a palette.

Dimensions of the test object:	Width	2200 mm
	Height	2000 mm
	Depth	600 mm
Dimensions of the pallet:	Width	2600 mm
	Depth	1000 mm
Distance between the forks:	Width	1100 mm

6.5 Test results

Date of test: 23 August 2010

No deflections during the test and no cracks or permanent distortions which could impair any of its characteristics, present.

7. Verification of mechanical impact

7.1 Test laboratory

Low-voltage test laboratory, test room 10

7.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.2.6
IEC 62262: 2002-02

7.3 Required test parameters

The degree of protection against impact is defined by the code IK 01
The impact energy is 0.14 Joule.

7.4 Test arrangement

The test was carried out on a five selected points of enclosure (doors, walls).
The number of impacts was one per selected point.

7.5 Test and measuring devices

Pendulum hammer according to IEC 60068-2-75 Annex D

7.6 Test results

Date of test: 11 January 2010

No visible damages to the surface of the enclosure.
The safety and the reliability of the equipment are not reduced in comparison with the initial state.

8. Marking

8.1 Test laboratory

Low-voltage test laboratory, test room 3

8.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.2.7

8.3 Required test parameters

Rubbing the markings by hand for 15 s with

- a piece of cloth soaked in water
- a piece of cloth soaked with petroleum spirit

After test the marking shall be legible to normal or corrected vision without additional magnification.

8.4 Test arrangement

Front marking of incomer was chosen as representative test sample.

8.5 Test and measuring circuits

- Cotton cloth
- water
- petroleum ether 60 - 70 (aromatics < 0.01 %, density 0.68 g/cm^3, boiling point 60 - 70°C)

8.6 Test results

Date of test: 11 January 2010

After test, there was no change in the marking. Font and symbols remained clearly visible.

9. Degree of protection of enclosures

9.1 Degree of protection against access to hazardous parts and against solid foreign objects - IP4X

9.1.1 Test laboratory

Low-voltage test laboratory, test room 3

9.1.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.3
IEC 60529: 2001-02

9.1.3 Required test parameters

Test probe	Rigid test wire of 1 mm diameter, 100 mm length
Test force	1 N ± 10 %

The test probe shall not penetrate the enclosure of the test object anywhere.

9.1.4 Test arrangement

Using the above-mentioned test probe and the respective pressure force it was tried to penetrate into the enclosure at appropriate points (e.g. ventilation openings).

9.1.5 Test and measuring circuits

IP4X test probe: Rigid steel wire of 1 mm diameter (IEC 60529: 2001-02, Table 7), with integrated spring energy meter

9.1.6 Test results

Date of test: 05 January 2010

The test object was as tight on all tested sides that the object probe, 1-mm wire, was not able to penetrate into the enclosure at a test force of 1 N.

9.2 Degree of protection against ingress of water – IPX4

9.2.1 Test laboratory

High-voltage test laboratory, wet test room

9.2.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.3
IEC 60529: 2001-02

9.2.3 Required test parameters

Protection against splashing water

Test device	Spray nozzle
Water flow rate	(10 ± 0.5) l/min + 180° from the vertical
Water pressure	(100 ± 50) kPa
Duration of test	5 minutes
Distance between spray nozzle and the test object	300 – 500 mm
Ambient air temperature	24°C

9.2.4 Test arrangement

The test object was placed in its normal position of use.

9.2.5 Test results

Date of test: 24 June 2010

After opening of the test sample, no water was found inside.

10. Verification of clearances and creepage distances

10.1 Test laboratory

Low-voltage test laboratory, test room 3

10.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.4

10.3 Required test parameters

Minimum clearances and creepage distances (at ≤ 2000 m above SL, degree of pollution 3 and material group IIIa, inhomogeneous field):

	Main circuits	Auxiliary circuits
Clearances	≥ 8 mm	≥ 3 mm
Creepage distances	≥ 16 mm	≥ 5 mm

10.4 Test arrangement

All doors were open. Side covers and all modules removed for visual inspection.

10.5 Test and measuring circuits

The creepage distances and clearances were checked by inspection gauges.

10.6 Test results

Date of test: 20 January 2010

Main circuits
Minimum clearances measured: 8 mm (RCD in unit 3, between wire end ferrules)
Minimum creepage distance measured: 16 mm (Contactor A63-30 terminals in unit 3)

Auxiliary circuits
Minimum clearances measured: 6 mm (Relay terminals in unit 3 and 4)
Minimum creepage distance measured: 8 mm (Relay terminals in unit 3 and 4)

11. Verification of protection against electric shock and integrity of the protective circuit

11.1 Test laboratory

Low-voltage test laboratory, test room 10

11.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.5.1

11.3 Required test parameters

- Verification of the effective earth continuity between the exposed conductive parts of the assembly and the protective circuit

Resistance shall not exceed 0.1 Ω.

- Verification of the short-circuit withstand strength of the PE busbar

Peak current	63	kA	
Short-circuit current	30	kA	(0.6 x 50 kA)
Duration of short-circuit	1	s	

11.4 Test arrangement

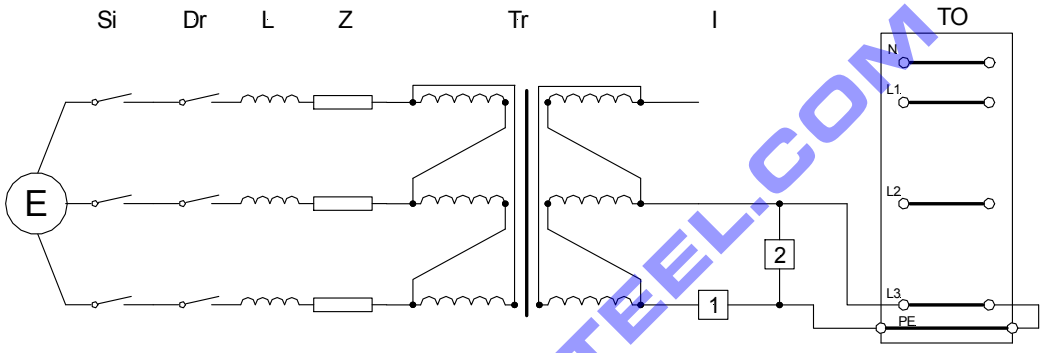
According to IEC 61439-1, Sub-clause 10.11.5.6.1

11.5 Test and measuring circuits

Technical data of test equipment for verification of effective earth continuity

Resistance measuring bridge Microohmmeter Theta R_{max} = 20 mΩ
I_{max} = 90 A

Technical data of test circuits for test of short-circuit withstand strength



E	Power supply (grid)	Tr	Short-circuit transformer
Si	Master breaker	TO	Test object
Dr	Making switch	I	Current measurement
Z	Test current impedance	U	Voltage measurement
		1, 2	Measuring points

Diagram 1: Test circuit for test of short-circuit withstand strength

Technical data of measuring circuits for test of short-circuit withstand strength

Measuring point	Measured quantity	Measuring sensor/device
1	Short-circuit current	Rogowski measuring device
2	Voltage	RC divider

11.6 Test results

- Verification of the effective earth continuity

Date of test: 05 January 2010

The resistance measured between the incoming protective conductor and different exposed conductive parts did not exceed 2.9 mΩ.

- Verification of short-circuit withstand strength of the protective circuit

Date of test:	15 January 2010
Connection of the test object:	By copper bar of 100 mm x 10 mm to the main busbar L1 and PE
Short-circuit point:	By copper bar of 50 mm x 10 mm at the incoming feeder between L1 and PE
Ambient temperature:	18 °C

Test No.			**1010 0073**
Test duty			**I_{pk} , I_{cw}**
Peak current		kA	**63.5**
Short-circuit current		kA	**30.3**
Duration of short-circuit		ms	**1014**
I^2t	10^6	A^2s	**932**
Equivalent 1-s current		kA	**30.5**
R_{PE} before/after test		µΩ	**205 / 195**
Notes			**-**
Evaluation			**OK**

Notes:
--

Condition of test object after test:

OK - Conductors and busbars did not show any undue deformation.
The supporting insulating parts did not show any significant signs of deterioration.
There was no loosening of parts used for the connection of conductors and conductors did not separate from the outgoing terminals.

12. Verification of the dielectric properties

12.1 Test laboratory

Low-voltage test laboratory, test room 3

12.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.9

12.3 Required test parameters

Power-frequency withstand voltage

Test AC voltage		
Main circuits	2200	V
Auxiliary circuits	1500	V
Frequency	50	Hz
Duration of test	5	s each

Impulse withstand voltage

Impulse voltage (1.2/50 µs)	
Main/distribution busbars	9.8 kV
MCCB-feeder without RCD	9.8 kV
MCCB-feeder with RCD	4.8 kV
Polarity	Positive and negative
Number of impulses	5 each

12.4 Test arrangement

For test 1, all MCCBs and RCDs were switched on. The test voltage was supplied to the main busbar in unit 1.

The contactor contacts were bridged with copper wires.

For test 2, the RCDs were switched off.

12.5 Test and measuring circuits

Technical data of test device:

AC voltage test device HA2000 E	u_{max} =	5	kV, 50 Hz
	I_{max} =	200	mA
Modular impulse generator MIG 0603	u_{max} =	12	kV
	i_{max} =	6	kA

12.6 Test results

Date of test: 12 January 2010

Power-frequency withstand voltage

Main busbars, distribution busbars, MCCB-feeder

Voltage for 5 s to	Earthed	Rated insulation voltage V	Test voltage kV	Result [1] Number of punctures or flash-overs
L1, L2, L3, N	PE, U	1000	2.2	0
L1	L2, L3, N, PE, U	1000	2.2	0
L2	L1, L3, N, PE, U	1000	2.2	0
L3	L1, L2, N, PE, U	1000	2.2	0
N	L1, L2, L3, PE, U	1000	2.2	0

Auxiliary circuits

Voltage for 5 s to	Earthed	Rated insulation voltage V	Test voltage kV	Result [1] Number of punctures or flash-overs
L, N	PE, U	300	1.5	0

Notes:

U Enclosure of the unit tested

1) No puncture or flash-over is permitted.

Impulse withstand voltage Test 1

Main busbars, distribution busbars, MCCB-feeder (RCD switched on)

Voltage applied to	Earthed	Rated impulse voltage withstand strength kV	Test voltage [1] kV	Result [3] No. of impulses/disruptive discharges
L1, L2, L3, N	PE, U	4	+ 4.8 - 4.8	5/0 5/0
L1	L2, L3, N, PE, U	4	+ 4.8 - 4.8	5/0 5/0
L2	L1, L3, N, PE, U	4	+ 4.8 - 4.8	5/0 5/0
L3	L1, L2, N, PE, U	4	+ 4.8 - 4.8	5/0 5/0
N	L1, L2, L3, PE, U	4	+ 4.8 - 4.8	5/0 5/0

Test results (continued)

Impulse withstand voltage Test 2

Main busbars, distribution busbars, MCCB-feeder (RCD switched off)

Voltage applied to	Earthed	Rated impulse voltage withstand strength kV	Test voltage [1] kV	Result [2] No. of impulses/disruptive discharges
L1, L2, L3, N	PE, U	8	+ 9.8 - 9.8	5/0 5/0
L1	L2, L3, N, PE, U	8	+ 9.8 - 9.8	5/0 5/0
L2	L1, L3, N, PE, U	8	+ 9.8 - 9.8	5/0 5/0
L3	L1, L2, N, PE, U	8	+ 9.8 - 9.8	5/0 5/0
N	L1, L2, L3, PE, U	8	+ 9.8 - 9.8	5/0 5/0

Notes:

U Enclosure of the unit tested

1) Required test parameter according to IEC 61439-1: 2009-01
2) According to IEC 61439-1: 2009-01, no disruptive discharge is permitted.

13. Verification of temperature rise by testing with current

13.1 Test laboratory

Low-voltage test laboratory, test room 3

13.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.10.2.3.6

13.3 Required test parameters

Test currents: 3-phase, 50 Hz

Main busbar:	730 A
MCCB-incomer:	730 A
Distribution busbar:	730 A

Verification of individual function units:

3A-MCCB-feeder:	70 A
3B-MCCB-feeder:	250 A
3C-MCCB-feeder:	200 A
3D-MCCB-feeder:	100 A
4A-MCCB-feeder:	10 A

Verification of the assembly:

Rated diversity factor:	0.8	
3A-MCCB-feeder:	56 A	(0.8 x 70 A)
3B-MCCB-feeder:	200 A	(0.8 x 250 A)
3C-MCCB-feeder:	160 A	(0.8 x 200 A)
3D-MCCB-feeder:	80 A	(0.8 x 100 A)

13.4 Test arrangement

The test object was tested three-phase, in free-standing arrangement. It was standing on its original transport pallet.

The right and left side walls were insulated with expanded polystyrene board.

The assembly was connected by flexible insulated copper cables of 4 m length and cross-section according to the table below.

Circuit	Test cable cross-section
MCCB-incomer	According Table 11, IEC 61439-1
3A-MCCB-feeder	
3B-MCCB-feeder	
3C-MCCB-feeder	
3D-MCCB-feeder	
4A-MCCB-feeder	

Test arrangement (continued)

All unused openings for cable connections in the bottom cable gland plates were sealed to have airflow only through the installed ventilation louvers.

The auxiliary voltage of 230V AC was permanently connected.

In unit 3 heating resistors were installed in the 4 feeder compartments to simulated power losses of outgoings for test of unit 4.

13.5 Test and measuring circuits

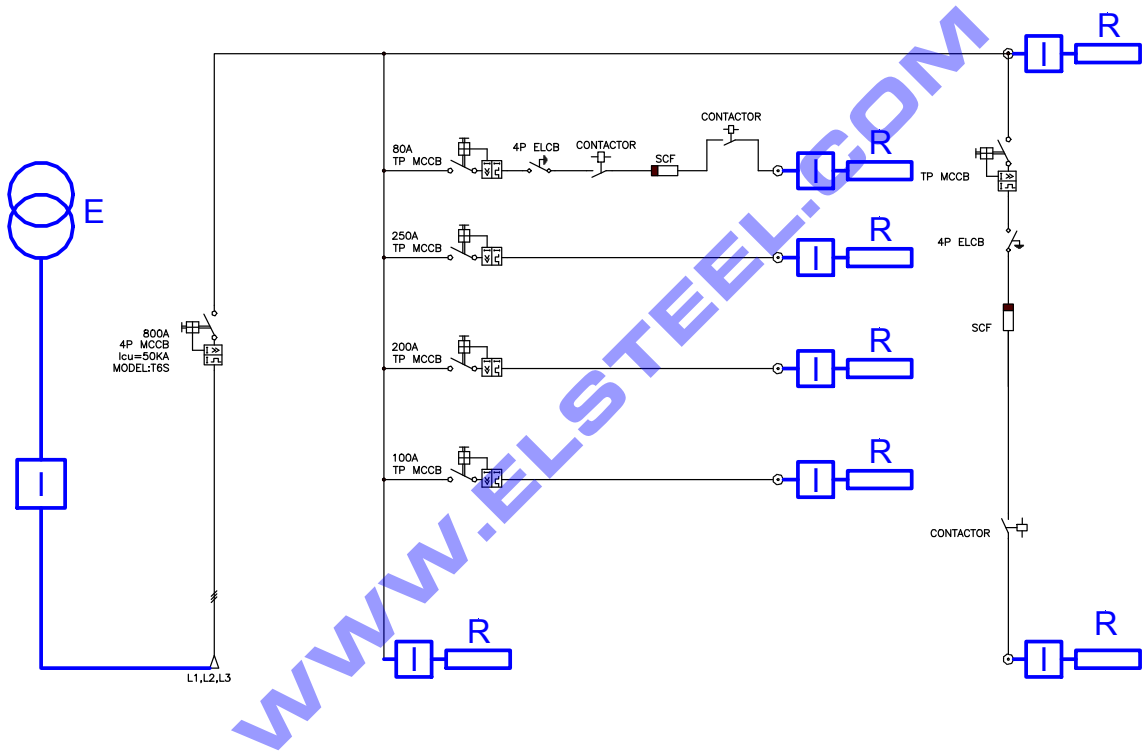


Diagram 2: Circuit for temperature-rise tests, single line diagram

E Supply transformer
R Load resistors
I Current measurement

Test and measuring circuits (continued)

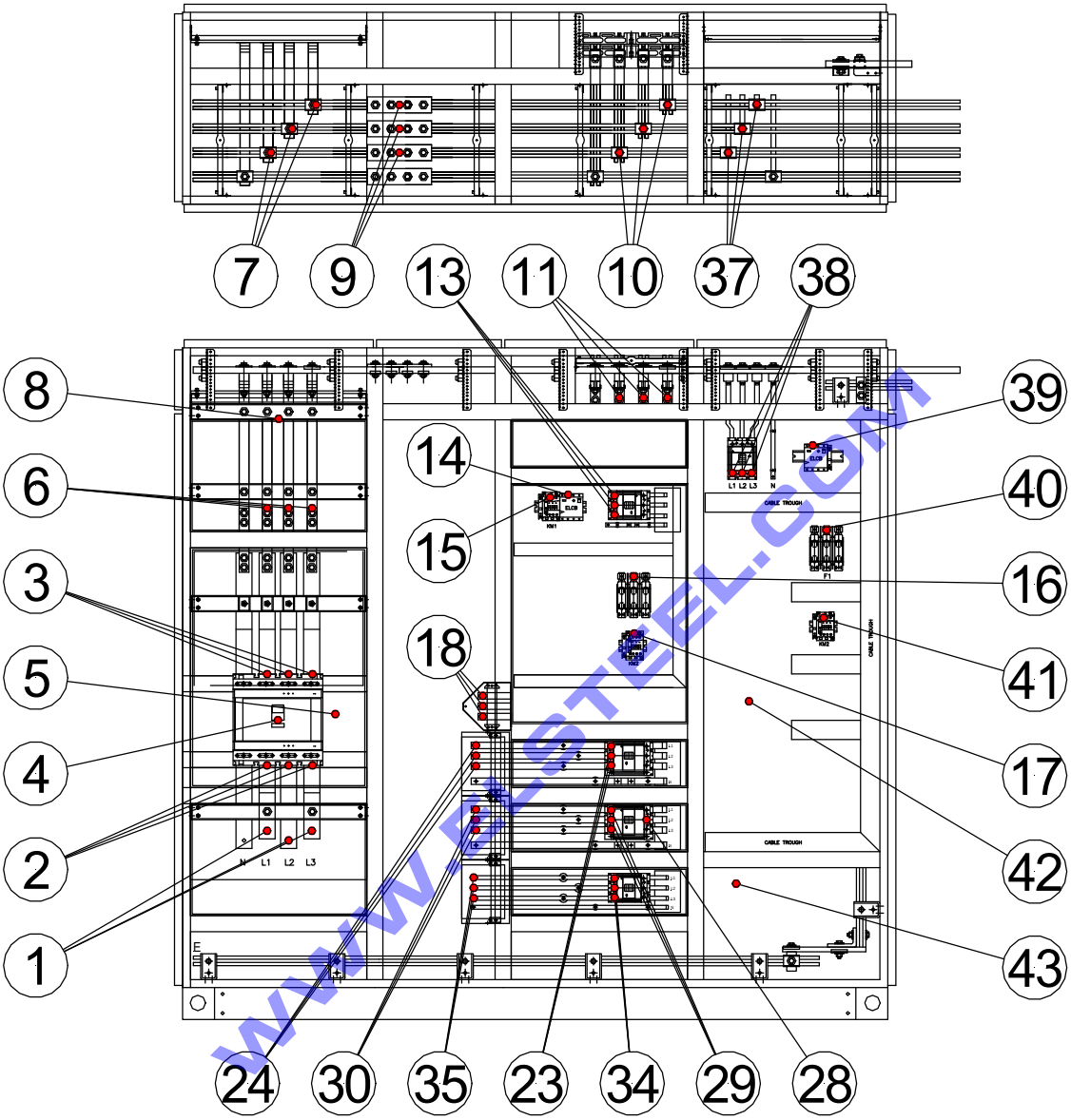


Diagram 3: Arrangement of selected temperature-measuring points

Test and measuring circuits (continued)

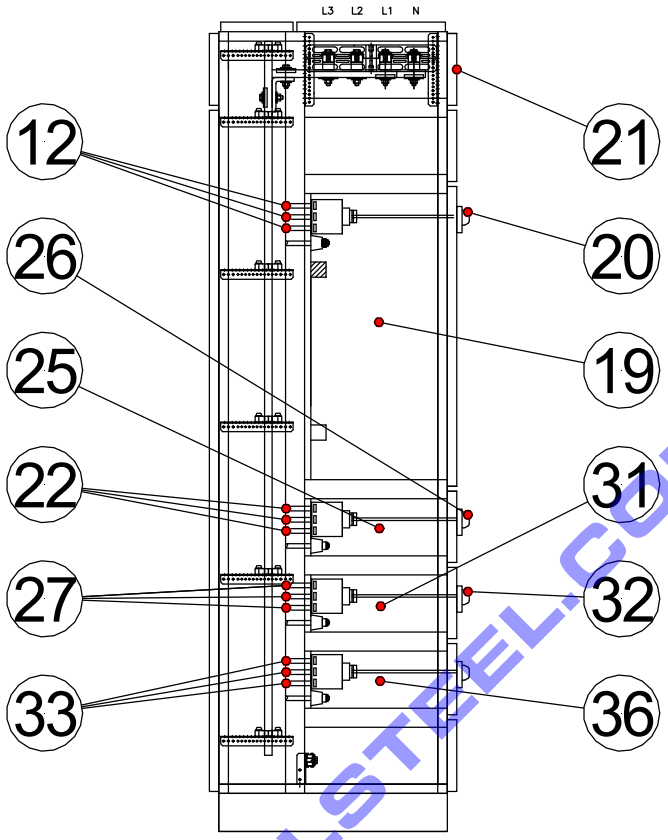


Diagram 4: Arrangement of selected temperature-measuring points in unit 3

Measuring point	Measured quantity	Measuring sensor/device
I	Current	Current transformers / digital displays
1 - 45	Temperature	Cu/constantan thermocouples Therm 5500-3

13.6 Test results

Date of test: 06 January 2010
Test requirement: Verification of individual function units
3B-MCCB-feeder
Test current main/distribution busbar: 730 A
Test current 3A-MCCB-feeder: 250 A
Ambient air temperature: 17.9 °C [1)]

Measuring points		Classification / Designation	Material	Temperature-rise limit permitted at a max. ambient air temp. of 50 °C in K	Final temperature in °C	Final temperature rise in K
1	L1	Incoming cable terminal	Tinned copper	55	60.8	42.9
	L2				67.1	49.2
	L3				61.9	44.0
2	L1	Lower MCCB terminals	Silver-plated copper	70 [2)]	80.7	62.8
	L2				87.0	69.1
	L3				81.9	64.0
3	L1	Upper MCCB terminals	Silver-plated copper	70 [2)]	81.9	64.0
	L2				87.3	69.4
	L3				85.6	67.7
4	-	Operating handle of incoming MCCB	Plastics	10	19.6	1.7
5	-	Air near MCCB	-	-	31.5	-
6	L1	Vertical busbar connection	Tinned copper	70 [2)]	58.5	40.6
	L2				62.3	44.4
	L3				59.6	41.7
7	L1	Connection Main/vertical busbar	Tinned copper	70 [2)]	57.5	39.6
	L2				58.8	40.9
	L3				56.2	38.3
8	-	Max. front temperature incomer	Metal	15	27.7	9.8
9	L1	Main busbar joint	Tinned copper	70 [2)]	59.6	41.7
	L2				61.4	43.5
	L3				58.3	40.4
10	L1	Connection Main/distribution busbar main busbar side	Tinned copper	70 [2)]	55.3	37.4
	L2				56.2	38.3
	L3				53.6	35.7
11	L1	Connection Main/distribution busbar distribution busbar side	Tinned copper	70 [2)]	55.7	37.8
	L2				58.8	40.9
	L3				54.2	36.3
22	L1	Connection distribution/feeder busbar	Tinned copper	70 [2)]	52.8	34.9
	L2				56.0	38.1
	L3				52.9	35.0
23	L1	Outgoing terminals of MCCB	Silver-plated copper	70 [2)]	75.4	57.5
	L2				78.3	60.4
	L3				54.8	36.9
24	L1	Outgoing cable terminal	Tinned copper	55	60.1	42.2
	L2				62.3	44.4
	L3				57.0	39.1
25	-	Air inside compartment	-	-	37.8	-
26	-	Operating handle of feeder MCCB	Plastics	10	20.3	2.4

Notes:
1) Average of 3 measuring points
2) Value specified by the manufacturer

Test results (continued)

Date of test: 06 January 2010

Test requirement: Verification of individual function units
3C-MCCB-feeder

Test current main/distribution busbar: 730 A

Test current 3C-MCCB-feeder: 200 A

Ambient air temperature: 19.1 °C [1)]

Measuring points		Classification / Designation	Material	Temperature-rise limit permitted at a max. ambient air temp. of 50 °C in K	Final temperature in °C	Final temperature rise in K
1	L1	Incoming cable terminal	Tinned copper	55	61.8	42.7
	L2				68.0	48.9
	L3				62.7	43.6
2	L1	Lower MCCB terminals	Silver-plated copper	70 [2)]	81.9	62.8
	L2				88.0	68.9
	L3				82.6	63.5
3	L1	Upper MCCB terminals	Silver-plated copper	70 [2)]	82.8	63.7
	L2				88.2	69.1
	L3				86.6	67.5
4	-	Operating handle of incoming MCCB	Plastics	10	20.0	0.9
5	-	Air near MCCB	-	-	31.8	-
6	L1	Vertical busbar connection	Tinned copper	70 [2)]	59.4	40.3
	L2				62.9	43.8
	L3				60.5	41.4
7	L1	Connection Main/vertical busbar	Tinned copper	70 [2)]	58.5	39.4
	L2				59.7	40.6
	L3				57.0	37.9
8	-	Max. front temperature incomer	Metal	15	27.7	8.6
9	L1	Main busbar joint	Tinned copper	70 [2)]	60.7	41.6
	L2				62.3	43.2
	L3				59.2	40.1
10	L1	Connection Main/distribution busbar main busbar side	Tinned copper	70 [2)]	56.0	36.9
	L2				57.0	37.9
	L3				54.2	35.1
11	L1	Connection Main/distribution busbar distribution busbar side	Tinned copper	70 [2)]	56.2	37.1
	L2				59.5	40.4
	L3				54.7	35.6
27	L1	Connection distribution/feeder busbar	Tinned copper	70 [2)]	47.4	28.3
	L2				51.0	31.9
	L3				47.5	28.4
28	L2	Incoming terminals of MCCB	Silver-plated copper	70 [2)]	57.5	38.4
29	L1	Outgoing terminals of MCCB	Silver-plated copper	70 [2)]	60.8	41.7
	L2				63.7	44.6
	L3				52.9	33.8
30	L1	Outgoing cable terminal	Tinned copper	55	51.3	32.2
	L2				50.8	31.7
	L3				47.0	27.9
31	-	Air inside compartment	-	-	31.0	-
32	-	Operating handle of feeder MCCB	Plastics	10	20.4	1.3

Notes:

1) Average of 3 measuring points
2) Value specified by the manufacturer

Test results (continued)

Date of test: 06 January 2010

Test requirement: Verification of individual function units
3D-MCCB-feeder

Test current main/distribution busbar: 730 A

Test current 3D-MCCB-feeder: 100 A

Ambient air temperature: 18.7 °C [1)]

Measuring points		Classification / Designation	Material	Temperature-rise limit permitted at a max. ambient air temp. of 50 °C in K	Final temperature in °C	Final temperature rise in K
1	L1	Incoming cable terminal	Tinned copper	55	61.6	42.9
	L2				67.9	49.2
	L3				62.7	44.0
2	L1	Lower MCCB terminals	Silver-plated copper	70 [2)]	81.5	62.8
	L2				87.6	68.9
	L3				82.4	63.7
3	L1	Upper MCCB terminals	Silver-plated copper	70 [2)]	82.2	63.5
	L2				87.5	68.8
	L3				86.1	67.4
4	-	Operating handle of incoming MCCB	Plastics	10	20.0	1.3
5	-	Air near MCCB	-	-	31.8	-
6	L1	Vertical busbar connection	Tinned copper	70 [2)]	59.3	40.6
	L2				62.6	43.9
	L3				60.7	42.0
7	L1	Connection Main/vertical busbar	Tinned copper	70 [2)]	58.6	39.9
	L2				59.6	40.9
	L3				57.2	38.5
8	-	Max. front temperature incomer	Metal	15	27.8	9.1
9	L1	Main busbar joint	Tinned copper	70 [2)]	62.3	43.6
	L2				60.6	41.9
	L3				59.1	40.4
10	L1	Connection Main/distribution busbar main busbar side	Tinned copper	70 [2)]	56.0	37.3
	L2				56.8	38.1
	L3				54.2	35.5
11	L1	Connection Main/distribution busbar distribution busbar side	Tinned copper	70 [2)]	55.8	37.1
	L2				59.1	40.4
	L3				54.5	35.8
33	L1	Connection distribution/feeder busbar	Tinned copper	70 [2)]	46.6	27.9
	L2				51.2	32.5
	L3				49.1	30.4
34	L1	Outgoing terminals of MCCB	Silver-plated copper	70 [2)]	51.0	32.3
	L2				51.1	32.4
	L3				43.0	24.3
35	L1	Outgoing cable terminal	Tinned copper	55	42.7	24.0
	L2				45.6	26.9
	L3				37.2	18.5
36	-	Air inside compartment	-	-	30.0	-

Notes:

1) Average of 3 measuring points
2) Value specified by the manufacturer

Test results (continued)

Date of test: 07 January 2010

Test requirement: Verification of individual function units
3A-MCCB-feeder

Test current main/distribution busbar: 730 A

Test current 3A-MCCB-feeder: 70 A

Ambient air temperature: 19.3 °C [1)]

Measuring points		Classification / Designation	Material	Temperature-rise limit permitted at a max. ambient air temp. of 50 °C in K	Final temperature in °C	Final temperature rise in K
1	L1	Incoming cable terminal	Tinned copper	55	62.6	43.3
	L2				68.3	49.0
	L3				63.1	43.8
2	L1	Lower MCCB terminals	Silver-plated copper	70 [2)]	82.5	63.2
	L2				87.9	68.6
	L3				81.6	62.3
3	L1	Upper MCCB terminals	Silver-plated copper	70 [2)]	87.0	67.7
	L2				83.8	64.5
	L3				88.2	68.9
4	-	Operating handle of incoming MCCB	Plastics	10	20.8	1.5
5	-	Air near MCCB	-	-	33.0	-
6	L1	Vertical busbar connection	Tinned copper	70 [2)]	61.3	42.0
	L2				64.3	45.0
	L3				62.2	42.9
7	L1	Connection Main/vertical busbar	Tinned copper	70 [2)]	60.4	41.1
	L2				61.4	42.1
	L3				59.1	39.8
8	-	Max. front temperature incomer	Metal	15	27.8	8.5
9	L1	Main busbar joint	Tinned copper	70 [2)]	62.6	43.3
	L2				64.3	45.0
	L3				61.1	41.8
10	L1	Connection Main/distribution busbar main busbar side	Tinned copper	70 [2)]	58.8	39.5
	L2				59.2	39.9
	L3				56.5	37.2
11	L1	Connection Main/distribution busbar distribution busbar side	Tinned copper	70 [2)]	59.1	39.8
	L2				61.9	42.6
	L3				57.6	38.3
12	L1	Connection distribution/feeder busbar	Tinned copper	70 [2)]	58.7	39.4
	L2				62.0	42.7
	L3				58.7	39.4
13	L1	Outgoing terminals of MCCB	Silver-plated copper	70 [2)]	83.8	64.5
	L2				84.0	64.7
	L3				73.1	53.8
14	L2	Terminal RCD	Silver-plated copper	70 [2)]	78.4	59.1
15	L2	Terminal contactor 1	Silver-plated copper	70 [2)]	81.1	61.8
16	L2	Terminal fuse base	Silver-plated copper	70 [2)]	85.5	66.2
17	L2	Terminal contactor 2	Silver-plated copper	70 [2)]	64.6	45.3
18	L1	Outgoing cable terminal	Tinned copper	55	46.0	26.7
	L2				46.8	27.5
	L3				45.1	25.8
19	-	Air inside compartment	-	-	39.3	-
20	-	Operating handle of incoming MCCB	Plastics	10	23.3	4.0
21		Max. front temperature unit 3	Metal	15	30.3	11.0

Notes:

1) Average of 3 measuring points
2) Value specified by the manufacturer

Test results (continued)

Date of test: 07 January 2010

Test requirement: Verification of individual function units
4A-MCCB-feeder

Test current main busbar: 730 A

Test current 4A-MCCB-feeder: 10 A

Heat resistors in unit 3: 50 W / 50 W / 30 W / 30 W

Ambient air temperature: 20.3 °C [1)]

Measuring points		Classification / Designation	Material	Temperature-rise limit permitted at a max. ambient air temp. of 50 °C in K	Final temperature in °C	Final temperature rise in K
1	L1	Incoming cable terminal	Tinned copper	55	59.4	39.1
	L2				66.1	45.8
	L3				61.4	41.1
2	L1	Lower MCCB terminals	Silver-plated copper	70 [2)]	78.5	58.2
	L2				85.4	65.1
	L3				80.9	60.6
3	L1	Upper MCCB terminals	Silver-plated copper	70 [2)]	80.6	60.3
	L2				85.4	65.1
	L3				84	63.7
5	-	Air near MCCB	-	-	31.7	-
6	L1	Vertical busbar connection	Tinned copper	70 [2)]	57.8	37.5
	L2				61.4	41.1
	L3				58.3	38.0
7	L1	Connection Main/vertical busbar	Tinned copper	70 [2)]	56.7	36.4
	L2				58.1	37.8
	L3				55.1	34.8
9	L1	Main busbar joint	Tinned copper	70 [2)]	58.8	38.5
	L2				60.9	40.6
	L3				57.3	37.0
10	L1	Connection Main/distribution busbar main busbar side	Tinned copper	70 [2)]	52.3	32.0
	L2				52.9	32.6
	L3				50.3	30.0
37	L1	Connection Main/feeder busbar	Tinned copper	70 [2)]	52.9	32.6
	L2				55.3	35.0
	L3				51.8	31.5
38	L2	Outgoing terminals of MCCB	Silver-plated copper	70 [2)]	40.8	20.5
39	L2	Terminal RCD	Silver-plated copper	70 [2)]	36.9	16.6
40	L2	Terminal fuse base	Silver-plated copper	70 [2)]	43.2	22.9
41	L2	Terminal contactor	Silver-plated copper	70 [2)]	36.5	16.2
42	-	Air inside compartment	-	-	26.9	-
43	L1	Outgoing cable terminal	Tinned copper	55	28.2	7.9
	L2				28.2	7.9
	L3				27.5	7.2
44	-	Operating handle of incoming MCCB	Plastics	10	21.6	1.3
45	-	Max. front temperature unit 4	Metal	15	27.1	6.8

Notes:

1) Average of 3 measuring points

2) Value specified by the manufacturer

Test results (continued)

Date of test: 08 January 2010

Test requirement: Verification of the assembly, RDF: 0.8

Test current main/distribution busbar: 730 A

Test current 3A-MCCB-feeder: 56 A (0.8 x 70 A)

Test current 3B-MCCB-feeder: 200 A (0.8 x 250 A)

Test current 3C-MCCB-feeder: 160 A (0.8 x 200 A)

Test current 3D-MCCB-feeder: 80 A (0.8 x 100 A)

Spill current taken at the end of the distribution busbar: 234 A

Ambient air temperature: 20.8 °C [1)]

Measuring points		Classification / Designation	Material	Temperature-rise limit permitted at a max. ambient air temp. of 50 °C in K	Final temperature in °C	Final temperature rise in K
1	L1	Incoming cable terminal	Tinned copper	55	63.5	42.7
	L2				69.7	48.9
	L3				64.3	43.5
2	L1	Lower MCCB terminals	Silver-plated copper	70 [2)]	83.6	62.8
	L2				89.3	68.5
	L3				84.1	63.3
3	L1	Upper MCCB terminals	Silver-plated copper	70 [2)]	84.5	63.7
	L2				89.7	68.9
	L3				87.3	66.5
4	-	Operating handle of incoming MCCB	Plastics	10	20.9	0.1
5	-	Air near MCCB	-	-	34.1	-
6	L1	Vertical busbar connection	Tinned copper	70 [2)]	61.8	41.0
	L2				65.8	45.0
	L3				62.9	42.1
7	L1	Connection Main/vertical busbar	Tinned copper	70 [2)]	60.7	39.9
	L2				62.1	41.3
	L3				59.6	38.8
8	-	Max. front temperature incomer	Metal	15	29.8	9.0
9	L1	Main busbar joint	Tinned copper	70 [2)]	62.9	42.1
	L2				64.9	44.1
	L3				61.7	40.9
10	L1	Connection Main/distribution busbar main busbar side	Tinned copper	70 [2)]	58.9	38.1
	L2				59.7	38.9
	L3				57.0	36.2
11	L1	Connection Main/distribution busbar distribution busbar side	Tinned copper	70 [2)]	59.5	38.7
	L2				62.5	41.7
	L3				58.0	37.2
12	L1	Connection distribution/feeder busbar	Tinned copper	70 [2)]	59.3	38.5
	L2				62.5	41.7
	L3				59.4	38.6
13	L1	Outgoing terminals of MCCB	Silver-plated copper	70 [2)]	65.8	45.0
	L2				66.6	45.8
	L3				58.7	37.9
14	L2	Terminal RCD	Silver-plated copper	70 [2)]	63.7	42.9
15	L2	Terminal contactor 1	Silver-plated copper	70 [2)]	71.7	50.9
16	L2	Terminal fuse base	Silver-plated copper	70 [2)]	67.1	46.3
17	L2	Terminal contactor 2	Silver-plated copper	70 [2)]	56.2	35.4
18	L1	Outgoing cable terminal	Tinned copper	55	43.2	22.4
	L2				43.8	23.0
	L3				42.5	21.7

Notes:

1) Average of 3 measuring points
2) Value specified by the manufacturer

Test results (continued)

Date of test: 08 January 2010
Test requirement: Verification of the assembly, RDF: 0.8
Test current main/distribution busbar: 730 A
Test current 3A-MCCB-feeder: 56 A (0.8 x 70 A)
Test current 3B-MCCB-feeder: 200 A (0.8 x 250 A)
Test current 3C-MCCB-feeder: 160 A (0.8 x 200 A)
Test current 3D-MCCB-feeder: 80 A (0.8 x 100 A)
Ambient air temperature: 20.8 °C [1)]

Measuring points		Classification / Designation	Material	Temperature-rise limit permitted at a max. ambient air temp. of 50 °C in K	Final temperature in °C	Final temperature rise in K
19	-	Air inside compartment	-	-	37.2	-
20	-	Operating handle of incoming MCCB	Plastics	10	22.9	2.1
21		Max. front temperature unit 3	Metal	15	30.1	9.3
22	L1	Connection distribution/feeder busbar	Tinned copper	70 [2)]	52.0	31.2
	L2				54.8	34.0
	L3				52.1	31.3
23	L1	Outgoing terminals of MCCB	Silver-plated copper	70 [2)]	62.0	41.2
	L2				63.6	42.8
	L3				49.3	28.5
24	L1	Outgoing cable terminal	Tinned copper	55	52.2	31.4
	L2				53.7	32.9
	L3				50.9	30.1
25	-	Air inside compartment	-	-	35.7	-
26	-	Operating handle of feeder MCCB	Plastics	10	22.1	1.3
27	L1	Connection distribution/feeder busbar	Tinned copper	70 [2)]	45.4	24.6
	L2				47.7	26.9
	L3				44.9	24.1
28	L2	Incoming terminals of MCCB	Silver-plated copper	70 [2)]	51.2	30.4
29	L1	Outgoing terminals of MCCB	Silver-plated copper	70 [2)]	52.2	31.4
	L2				54.2	33.4
	L3				47.2	26.4
30	L1	Outgoing cable terminal	Tinned copper	55	46.2	25.4
	L2				45.7	24.9
	L3				43.5	22.7
31	-	Air inside compartment	-	-	32.5	-
32	-	Operating handle of feeder MCCB	Plastics	10	21.3	0.5
33	L1	Connection distribution/feeder busbar	Tinned copper	70 [2)]	39.0	18.2
	L2				41.8	21.0
	L3				40.3	19.5
34	L1	Outgoing terminals of MCCB	Silver-plated copper	70 [2)]	44.3	23.5
	L2				43.9	23.1
	L3				38.3	17.5
35	L1	Outgoing cable terminal	Tinned copper	55	39.2	18.4
	L2				40.9	20.1
	L3				35.0	14.2
36	-	Air inside compartment	-	-	29.9	-

Notes:

1) Average of 3 measuring points
2) Value specified by the manufacturer

14. Verification of short-circuit withstand strength

14.1 Test laboratory

Low-voltage test laboratory, test room 1 and 10

14.2 Normative document

IEC 61439-2: 2009-01
IEC 61439-1: 2009-01, Sub-clause 10.11.5

14.3 Required test parameters

- Verification of short-circuit withstand strength of the main/distribution busbar

Peak current	105	kA
Short-circuit current	50	kA
Duration of short-circuit	1	s

- Verification of conditional short-circuit current of the outgoing MCCB-feeder

Test voltage	436	V
Peak short-circuit current	105	kA
Symmetrical short-circuit current	50	kA
Power factor	0.25	

- Verification of short-circuit withstand strength of the neutral busbar

Peak current	63	kA
Short-circuit current	30	kA
Duration of short-circuit	1	s

- Verification of conditional short-circuit current of the neutral of outgoing MCCB-feeder

Test voltage	253	V
Peak short-circuit current	63	kA
Symmetrical short-circuit current	30	kA
Power factor	0.25	

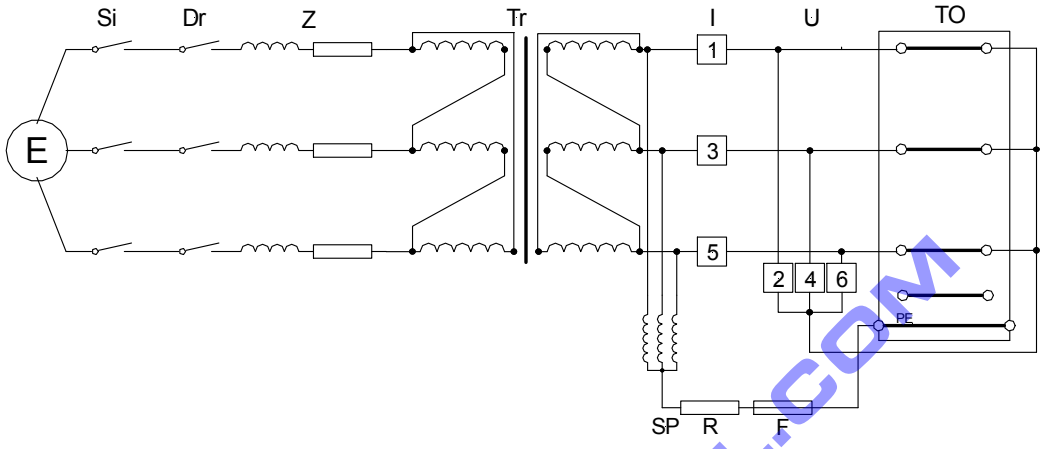
14.4 Test arrangement

According to IEC 61439-1: 2009-01, Sub-clause 10.11.5.1

14.5 Test and measuring circuits

Verification of short-circuit withstand strength

Technical data of test circuits



E	Power supply (grid)	TO	Test object
Si	Master breaker	I	Current measurement
Dr	Making switch	U	Voltage measurement
Z	Test current impedance	1 - 6	Measuring points
Tr	Short-circuit transformer	R	Fault current limiting resistance
SP	Artificial star point	F	Fault current detecting device

Diagram 5: Test circuit (3-phase tests)

Technical data of measuring circuits

Measuring point	Measured quantity	Measuring sensor/device
1	Short-circuit current L1	Rogowski measuring device
3	Short-circuit current L2	Rogowski measuring device
5	Short-circuit current L3	Rogowski measuring device
2	Voltage L1	RC divider
4	Voltage L2	RC divider
6	Voltage L3	RC divider

14.6 Test results

Test requirement:	Verification of conditional short-circuit current of outgoing MCCB-feeder
Date of test:	15 January 2010
Connection of the test object:	By bar of 100 mm x 10 mm to the main busbar
Short-circuit point:	At the outgoing cable terminal of the MCCB feeder with copper cable 0.75 m
Condition of test object before test:	As after previous tests

Test No.			1010 0068	1010 0062	1010 0063	1010 0064
Test duty			Setting	I_{cc}	I_{cc}	I_{cc}
Test voltage	V		440	440	440	440
Prospective peak current	kA	L1	110	110	110	110
		L2	84.1	84.1	84.1	84.1
		L3	93.7	93.7	93.7	93.7
Prospective symmetrical short-circuit current, r.m.s value	kA	L1	50.9	50.9	50.9	50.9
		L2	50.4	50.4	50.4	50.4
		L3	50.2	50.2	50.2	50.2
		Average	50.5	50.5	50.5	50.5
Power factor cos φ			0.21	0.21	0.21	0.21
Breaking current	kA	L1	-	8.83	22.4	23.3
		L2	-	15.7	28.9	29.1
		L3	-	8.37	12.4	12.7
Joule integral	10^6 A^2s	L1	-	0.106	1.15	1.29
		L2	-	0.313	2.03	2.18
		L3	-	0.075	0.238	0.246
Breaking time	ms		-	3.68	5.72	5.86
Notes			-	3D-MCCB-feeder	3C-MCCB-feeder	3B-MCCB-feeder
Evaluation			-	OK	OK	OK

Notes:

--

Condition of test object after test:

OK - Conductors and busbars did not show any undue deformation.

The supporting insulating parts did not show any significant signs of deterioration.

There was no loosening of parts used for the connection of conductors and conductors did not separate from the outgoing terminals.

The fault current detecting device did not respond.

The switching devices are able to operate mechanically properly.

The insulation test with AC 1.0 kV, 1 min. was OK.

Test results (continued)

Test requirement:	Verification of conditional short-circuit current of outgoing MCCB-feeder and incomer
Date of test:	15 January 2010
Connection of the test object:	By bar of 100 mm x 10 mm to the main busbar
Short-circuit point:	At the outgoing cable terminal of the MCCB feeder and incomer with copper cable 0.75 m
Condition of test object before test:	As after previous tests

Test No.			1010 0065	1010 0066	1010 0067
Test duty			Icc	Icc	Icc
Test voltage	V		440	440	440
Prospective peak current	kA	L1	110	110	110
		L2	84.1	84.1	84.1
		L3	93.7	93.7	93.7
Prospective symmetrical short-circuit current, r.m.s value	kA	L1	50.9	50.9	50.9
		L2	50.4	50.4	50.4
		L3	50.2	50.2	50.2
		Average	50.5	50.5	50.5
Power factor cos φ			0.21	0.21	0.21
Breaking current	kA	L1	1.09	43.8	0.351
		L2	>1.65	49.1	0.596
		L3	1.89	27.4	0.476
Joule integral	10^6 A^2s	L1	-	7.69	-
		L2	-	6.98	-
		L3	-	3.10	-
Breaking time	ms		0.39	10.0	1.93
Notes			3A-MCCB-feeder	Incomer	4A-MCCB-feeder
Evaluation			OK	OK	OK

Notes:

--

Condition of test object after test:

OK - Conductors and busbars did not show any undue deformation.

The supporting insulating parts did not show any significant signs of deterioration.

There was no loosening of parts used for the connection of conductors and conductors did not separate from the outgoing terminals.

The fault current detecting device did not respond.

The switching devices are able to operate mechanically properly.

The insulation test with AC 1.0 kV, 1 min. was OK.

Test results (continued)

Test requirement:	Verification of short-circuit withstand strength of the main busbar
Date of test:	15 January 2010
Connection of the test object:	By bar of 100 mm x 10 mm to the main busbar
Short-circuit point:	Above incoming MCCB in unit 1 with tinned copper bar of 2 x 30 mm x 10 mm
Condition of test object before test:	As after previous tests

Test No.			**1010 0069**
Test duty			**I_{pk}, I_{cw}**
Peak current	kA	L1	**109**
		L2	**76.3**
		L3	**98.9**
Short-time current	kA	L1	**51.7**
		L2	**51.7**
		L3	**50.9**
	Average		**51.4**
Duration of short-circuit	ms		**980**
I^2t	10^6 A^2s	L1	**2673**
		L2	**2632**
		L3	**2578**
Equivalent 1-s current	kA		**50.9**
Notes			**main busbar slightly bent**
Evaluation			**OK**

Notes:
--

Condition of test object after test:

OK - Conductors and busbars did show deformation, but the creepage and clearance distances described in sub-clause 10 were still complied with.

The supporting insulating parts did not show any significant signs of deterioration.

There was no loosening of parts used for the connection of conductors and conductors did not separate from the outgoing terminals.

The fault current detecting device did not respond.

Test results (continued)

Test requirement:	Verification of short-circuit withstand strength of the distribution busbar
Date of test:	15 January 2010
Connection of the test object:	By bar of 100 mm x 10 mm to the main busbar
Short-circuit point:	At the end of the distribution busbar in unit 3 with tinned copper bar of 2 x 30 mm x 10 mm
Condition of test object before test:	As after previous tests

Test No.			**1010 0070**
Test duty			**I_{pk}, I_{cw}**
Peak current	kA	L1	**107**
		L2	**73.8**
		L3	**98.9**
Short-time current	kA	L1	**51.2**
		L2	**51.2**
		L3	**50.5**
	Average		**51.0**
Duration of short-circuit	ms		**980**
I^2t	10^6 A^2s	L1	**2625**
		L2	**2580**
		L3	**2540**
Equivalent 1-s current	kA		**50.5**
Notes			**Distribution busbar slightly bent**
Evaluation			**OK**

Notes:
--

Condition of test object after test:

OK - Conductors and busbars did show deformation, but the creepage and clearance distances described in sub-clause 10 were still complied with.

The supporting insulating parts did not show any significant signs of deterioration.

There was no loosening of parts used for the connection of conductors and conductors did not separate from the outgoing terminals.

The fault current detecting device did not respond.

Test results (continued)

Test requirement:	Verification of short-circuit withstand strength of the neutral of the vertical distribution busbar
Date of test:	15 January 2010
Connection of the test object:	By bar of 100 mm x 10 mm to the main busbar
Short-circuit point:	At the end of the distribution busbar in unit 3 with tinned copper bar of 2 x 30 mm x 10 mm between phase L1 and N
Condition of test object before test:	As after previous tests

Test No.		**1010 0071**
Test duty		**I_{pk}, I_{cw}**
Peak current	kA	**64.1**
Short-time current	kA	**30.7**
Duration of short-circuit	ms	**1013**
I^2t	10^6 A^2s	**965**
Equivalent 1-s current	kA	**30.8**
Notes		**-**
Evaluation		**OK**

Notes:
--

Condition of test object after test:

OK - Conductors and busbars did not show any undue deformation.

The supporting insulating parts did not show any significant signs of deterioration.

There was no loosening of parts used for the connection of conductors and conductors did not separate from the outgoing terminals.

The fault current detecting device did not respond.

Test results (continued)

Test requirement:	Verification of short-circuit withstand strength of the neutral of the main busbar
Date of test:	15 January 2010
Connection of the test object:	By bar of 100 mm x 10 mm to the main busbar
Short-circuit point:	Above incoming MCCB in unit 1 with tinned copper bar of 2 x 30 mm x 10 mm
Condition of test object before test:	As after previous tests

Test No.			**1010 0072**
Test duty			**I_{pk}, I_{cw}**
Peak current		kA	**64.4**
Short-time current		kA	**30.8**
Duration of short-circuit		ms	**1014**
I^2t	10^6	A^2s	**959**
Equivalent 1-s current		kA	**30.8**
Notes			**-**
Evaluation			**OK**

Notes:
--

Condition of test object after test:

OK - Conductors and busbars did not show any undue deformation.
The supporting insulating parts did not show any significant signs of deterioration.
There was no loosening of parts used for the connection of conductors and conductors did not separate from the outgoing terminals.
The fault current detecting device did not respond.

Test results (continued)

Test requirement:	Verification of conditional short-circuit current of the neutral of outgoing MCCB-feeder
Date of test:	20 January 2010
Connection of the test object:	By copper cable of 240 mm² to the cable terminal L3 and N below the in coming MCCB in unit 1
Short-circuit point:	At the outgoing cable terminal of the MCCB feeder with copper cable 0.75 m
Condition of test object before test:	As after previous tests

Test No.			209 5322	210 0351	210 0352
Test duty			Icc	Icc	Icc
Test voltage		V	253	253	253
Prospective peak current		kA	65.0	65.0	65.0
Prospective symmetrical short-circuit current, r.m.s value		kA	30.1	30.1	30.1
Power factor cos φ			0.22	0.22	0.22
Breaking current		kA	-	13.8	13.7
Joule integral	10^3	A^2s	-	461	440
Breaking time		ms	-	5.0	5.0
Notes			Setting	3B-MCCB-feeder	3C-MCCB-feeder
Evaluation			OK	OK	OK

Notes:

--

Condition of test object after test:

OK - Conductors and busbars did not show any undue deformation.

The supporting insulating parts did not show any significant signs of deterioration.

There was no loosening of parts used for the connection of conductors and conductors did not separate from the outgoing terminals.

The fault current detecting device did not respond.

The switching devices are able to operate mechanically properly.

The insulation test with AC 1.0 kV, 1 min. was OK.

Test results (continued)

Test requirement:	Verification of conditional short-circuit current of the neutral of outgoing MCCB-feeder
Date of test:	20 January 2010
Connection of the test object:	By copper cable of 240 mm² to the cable terminal L3 and N below the in coming MCCB in unit 1
Short-circuit point:	At the outgoing cable terminal of the MCCB feeder with copper cable 0.75 m
Condition of test object before test:	As after previous tests

Test No.			210 0353	210 0351	210 0352
Test duty			Icc	Icc	Icc
Test voltage		V	253	253	253
Prospective peak current		kA	65.0	65.0	65.0
Prospective symmetrical short-circuit current, r.m.s value		kA	30.1	30.1	30.1
Power factor cos φ			0.22	0.22	0.22
Breaking current		kA	9.7	9.06	7.29
Joule integral	10^3	A^2s	154	125	88
Breaking time		ms	3.8	3.7	3.5
Notes			3D-MCCB-feeder	3A-MCCB-feeder	4A-MCCB-feeder
Evaluation			OK	OK	OK

Notes:

--

Condition of test object after test:

OK - Conductors and busbars did not show any undue deformation.

The supporting insulating parts did not show any significant signs of deterioration.

There was no loosening of parts used for the connection of conductors and conductors did not separate from the outgoing terminals.

The fault current detecting device did not respond.

The switching devices are able to operate mechanically properly.

The insulation test with AC 1.0 kV, 1 min. was OK.

15. Electromagnetic compatibility (EMC)

Immunity Tests
The assembly contains only passive elements except for the electronic over-current relays fitted in the moulded case circuit-breakers.

These products are covered by separate EMC disturbance test certificates supplied by the original manufacturer verifying compliance for Environment A conditions. No further immunity tests were applied. (Ref. ETL Semko test report E39009S2904G3_53/01)

Emission Tests
The assembly contains only passive elements except for the electronic over-current relays fitted in the moulded case circuit-breakers.

These products are covered by separate EMC disturbance test certificates supplied by the original manufacturer verifying compliance for Environment A conditions. No further emission tests were applied. (Ref. ETL Semko test report E39009S2904G3_53/01)

The assembly is a simple system comprising a mixture of passive components and EMC compliant components installed in accordance with the devices and components manufactures instructions. In accordance with clause J.10.12 no immunity or emission tests are required.

Date of check: 11 January 2010

16. Mechanical operation

16.1 Test laboratory

Low-voltage test laboratory, test room 3

16.2 Normative document

IEC 61439-2: 2009-01 and
IEC 61439-1: 2009-01, Sub-clause 10.13

16.3 Required test parameters

200 operating cycles for the MCCBs.

16.4 Test arrangement

None

16.5 Test and measuring circuits

An electronic register was installed for counting of operation cycles.

16.6 Test results

Date of test: 11 January 2010

All MCCBs installed were manually operated 200 times

After the tests, no signs of abnormal wear, damage or change of operating force was found on the switching devices.

17. Photographs

Photograph 1: Rear view of ventilation louver with wire mesh

Photograph 2: Front view of test object in the temperature-rise test room

Photograph 3: Rear view of test object in the temperature-rise test room

Photograph 4: Connection of the MCCB-feeder for the verification of the conditional short-circuit current

Photograph 5: Test object after short-circuit test 1010 0067

Photograph 6: Test object after test of short-circuit withstand strength of the main busbar (with covers removed)

Photograph 7: Test object after test of short-circuit withstand strength of the distribution busbar

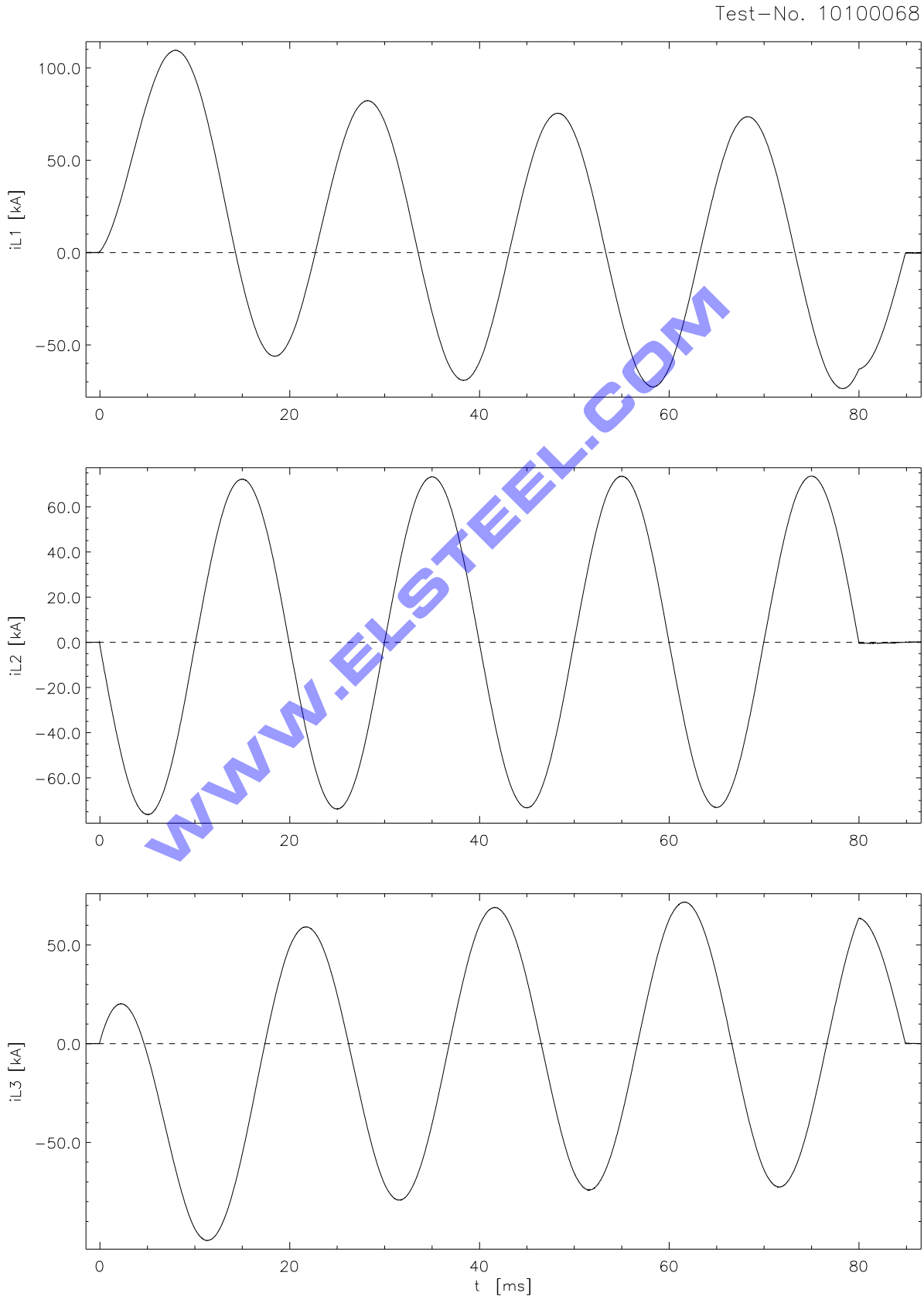
Photograph 8: Test object after test of short-circuit withstand strength of the neutral of the distribution busbar

Photograph 9: Test object after test of short-circuit withstand strength of the PE busbar

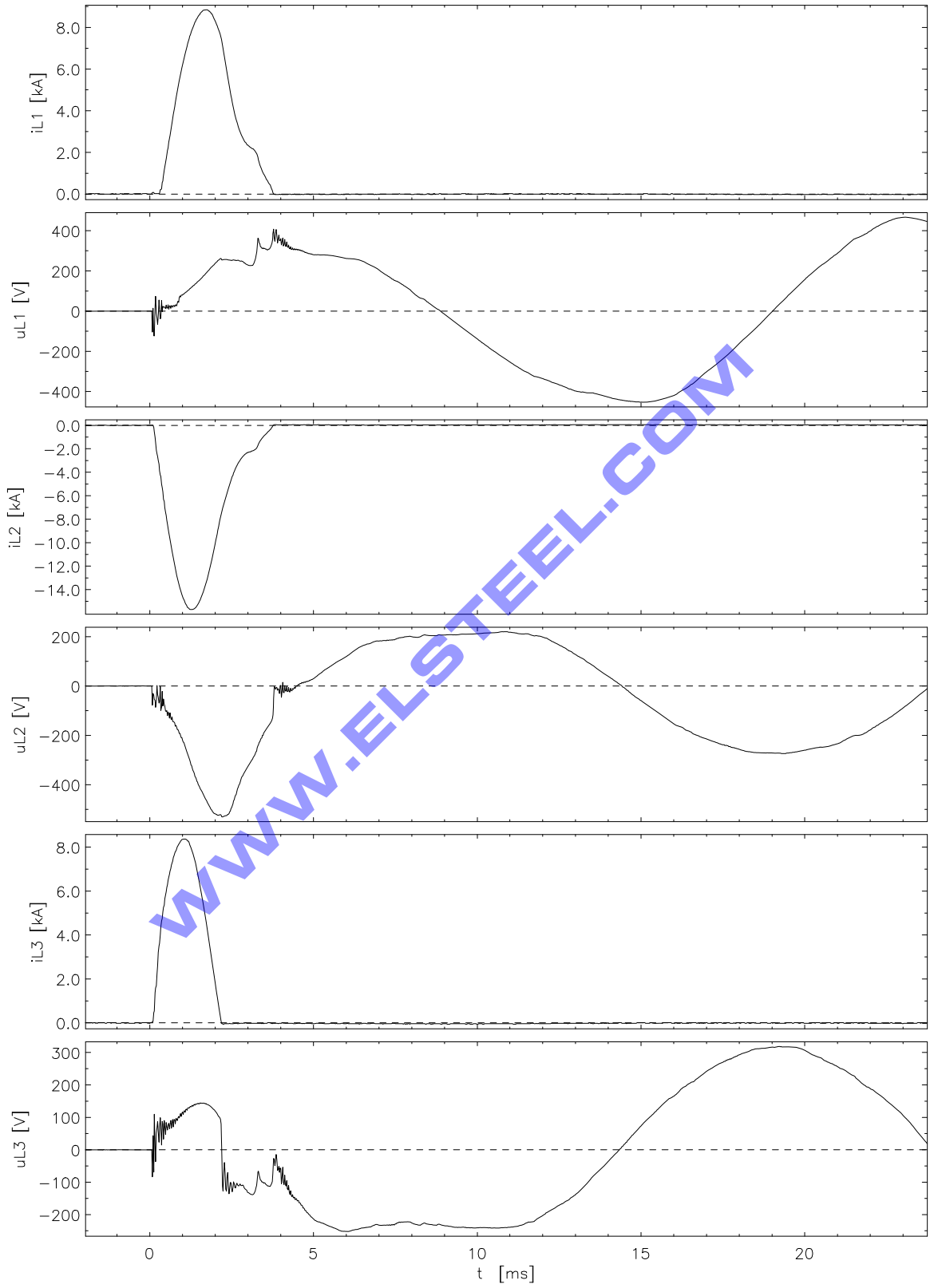
Photograph 10: Connection to the test object for test of the neutral of outgoing MCCB-feeder

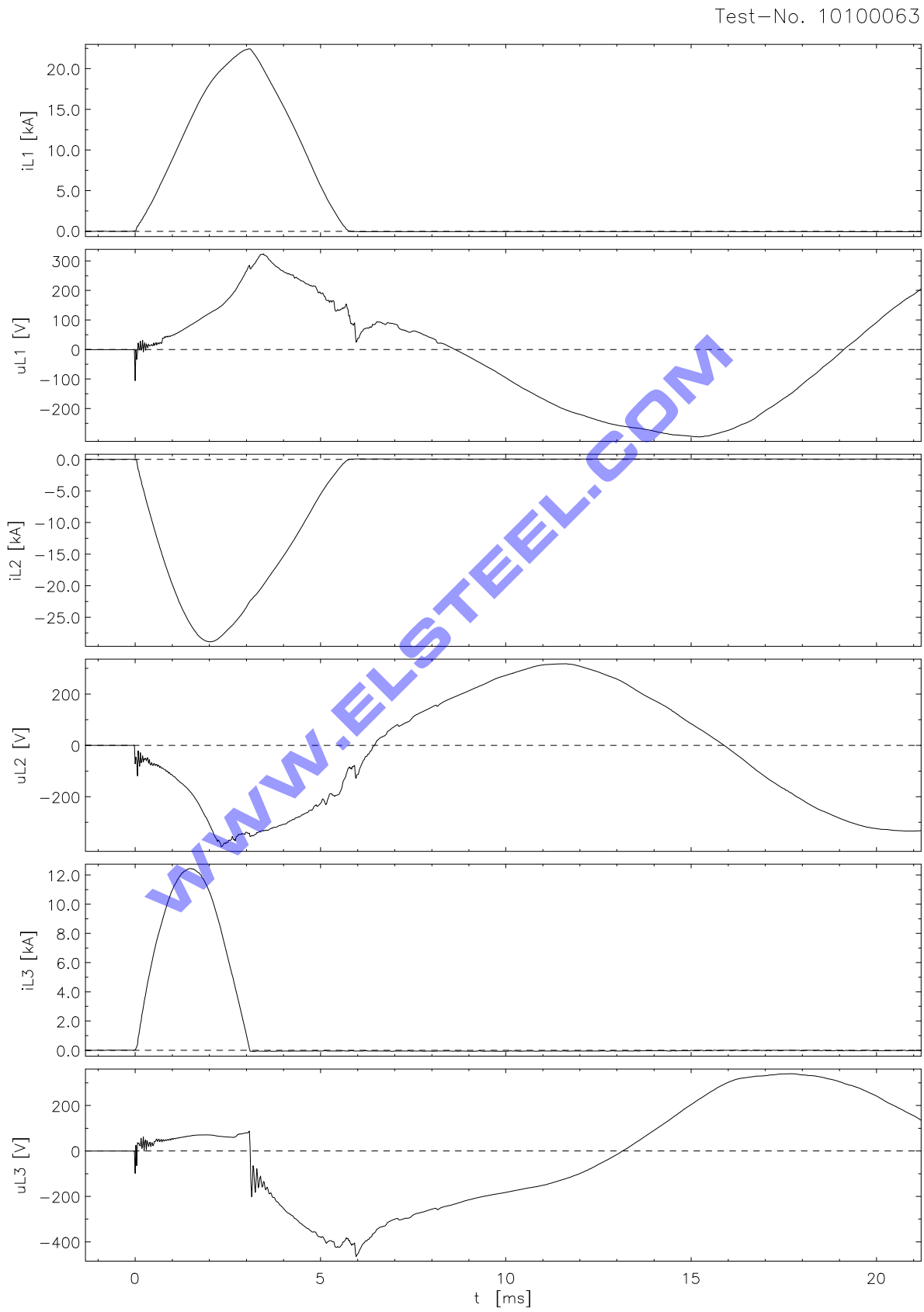
Photograph 11: Short-circuit connections for test of the neutral of outgoing MCCB-feeder

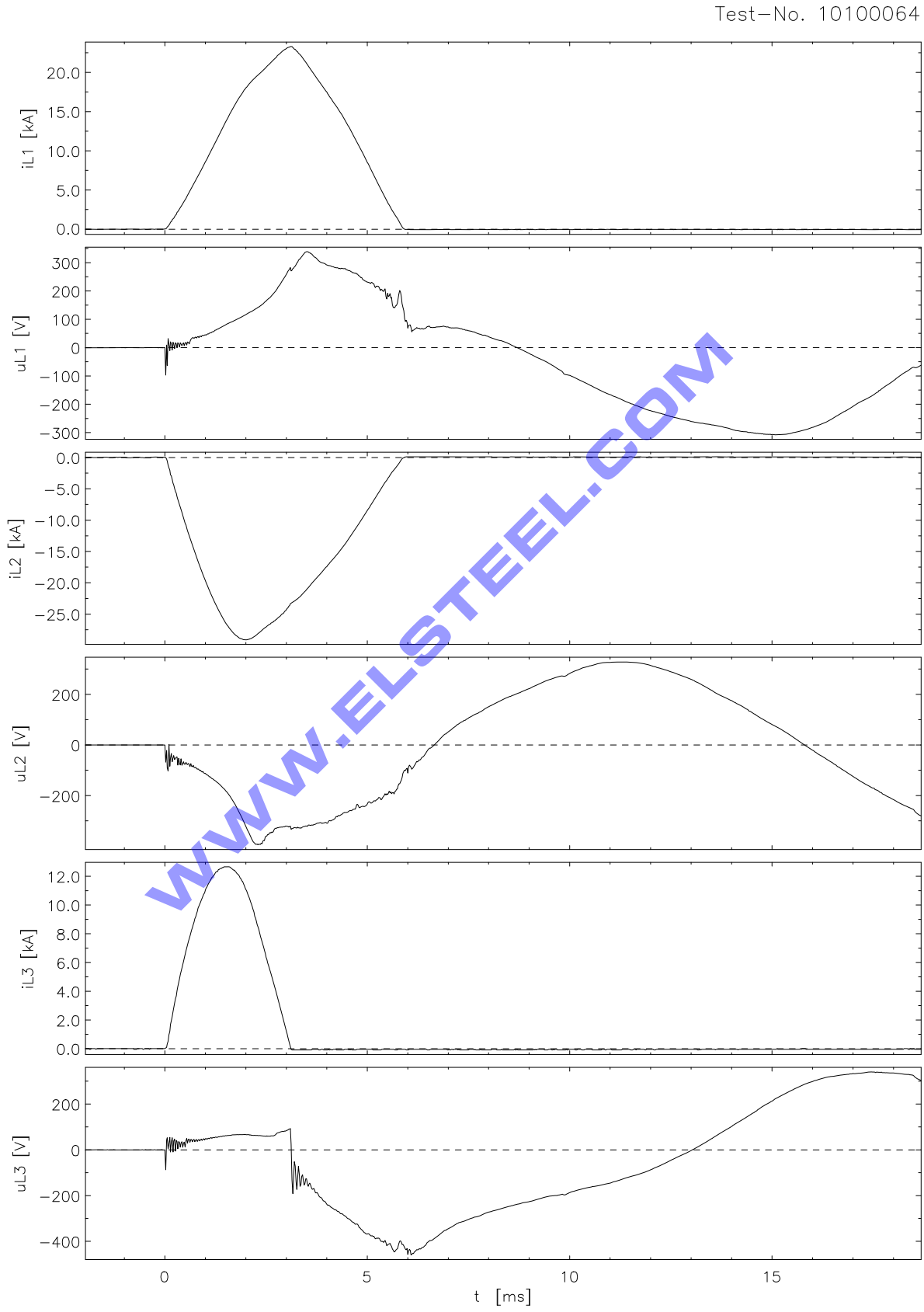
18. Oscillograms

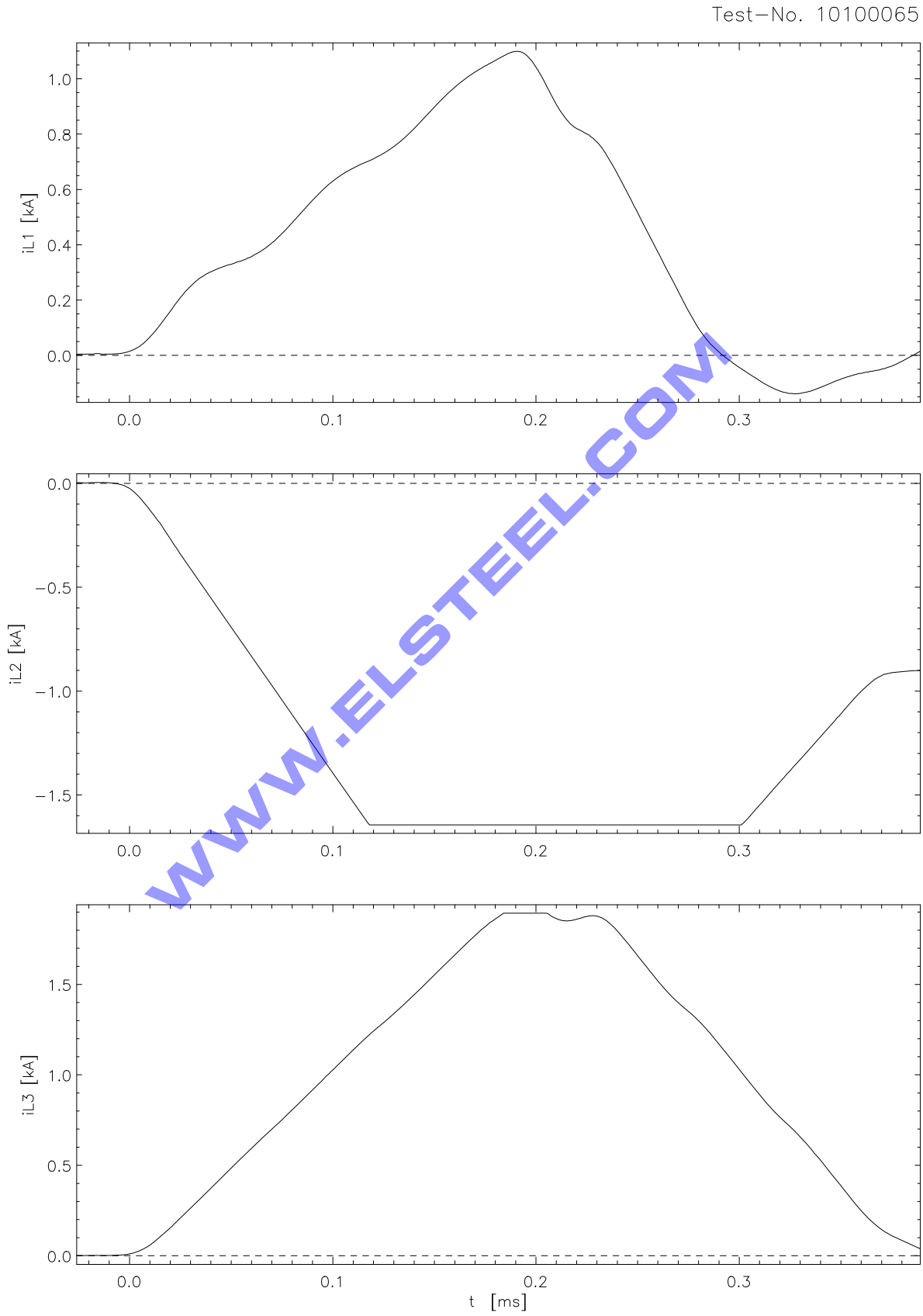


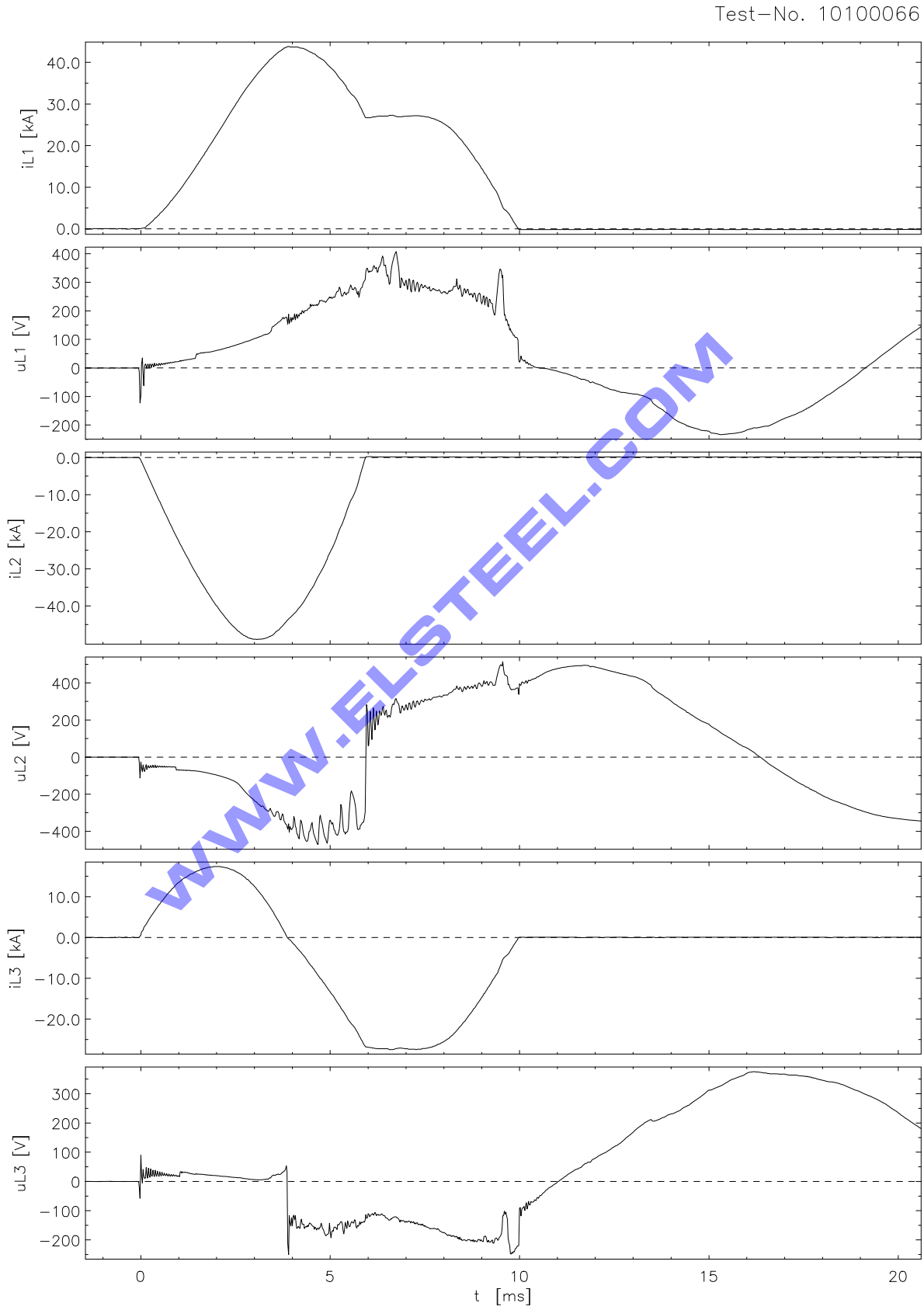
Test-No. 10100062











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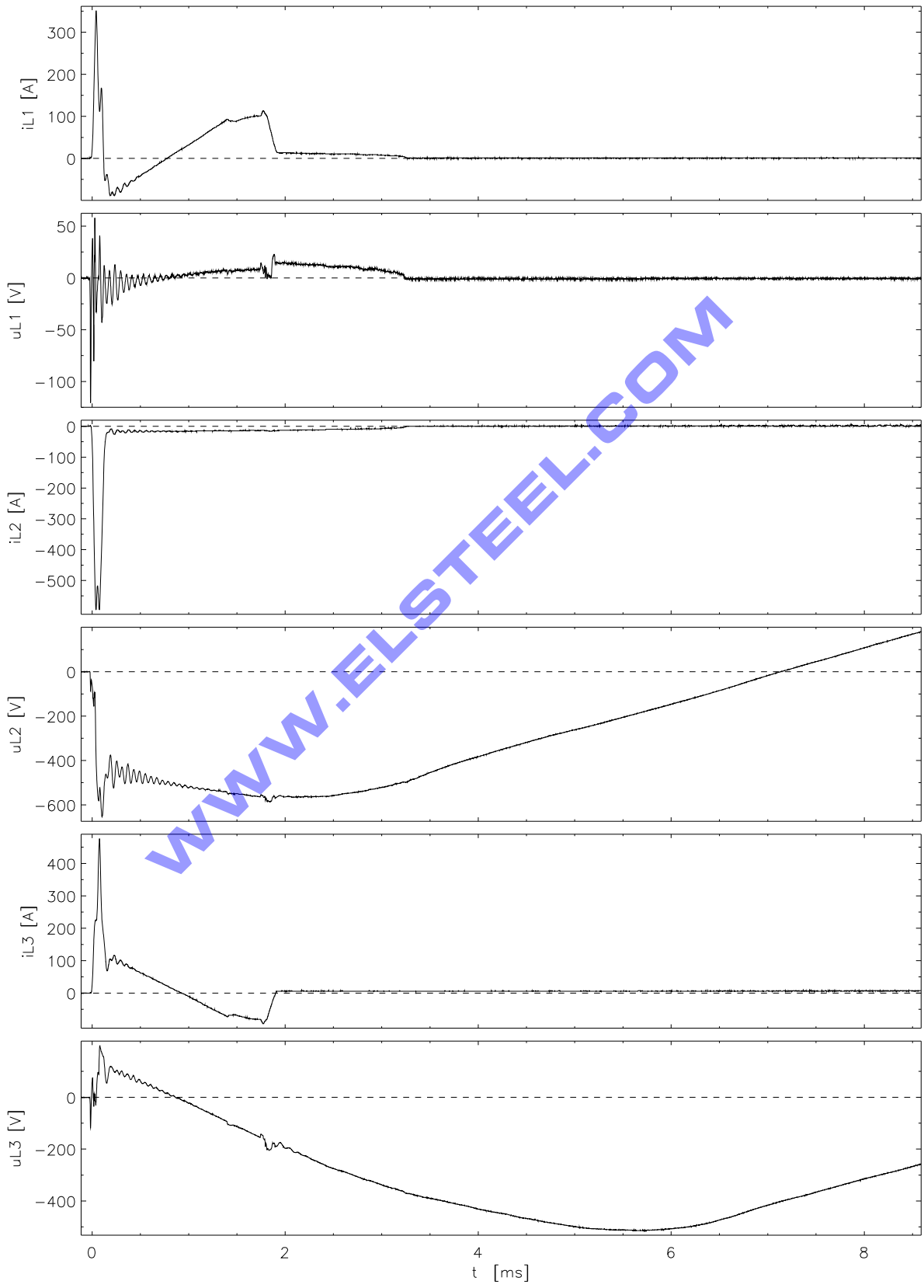
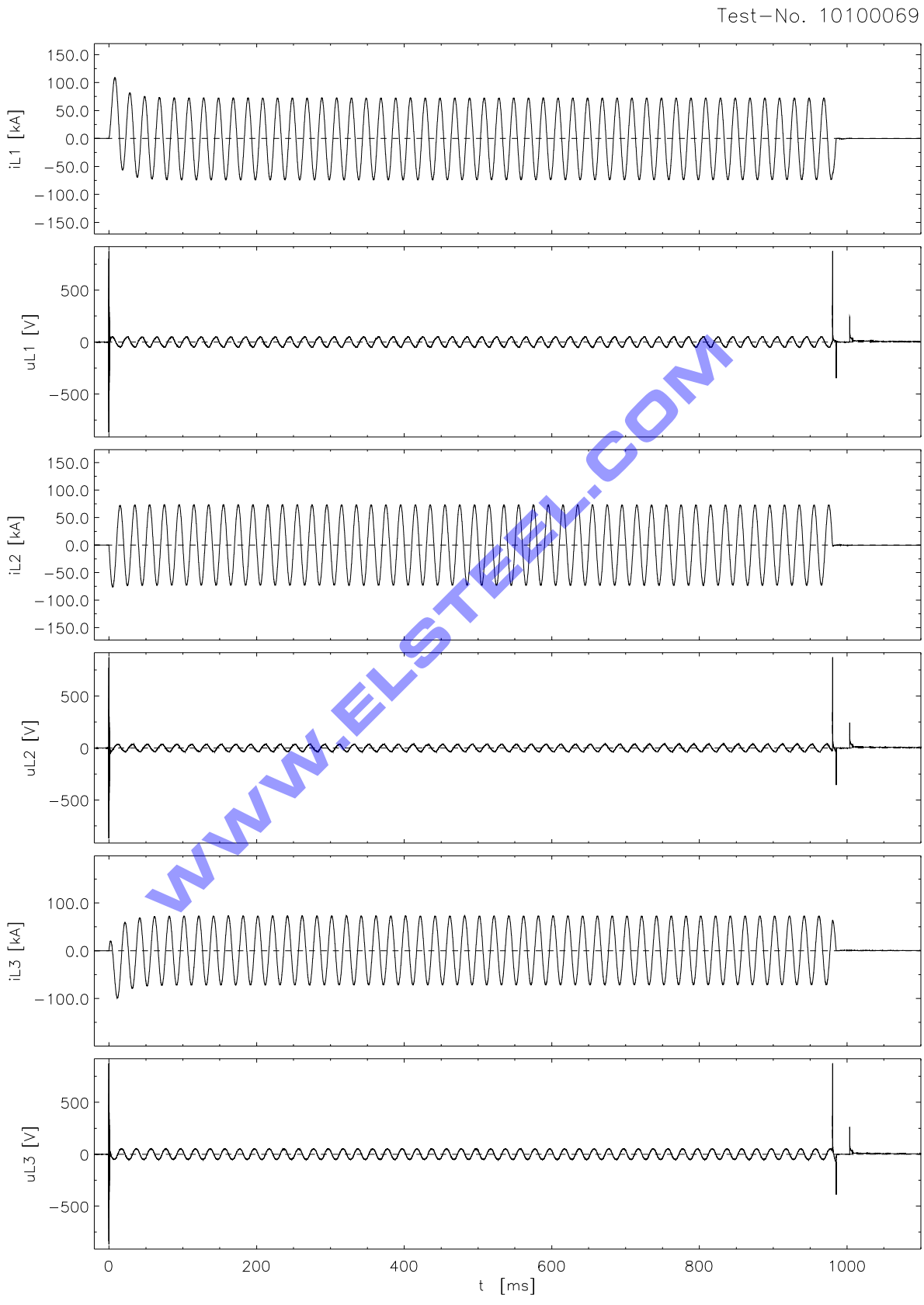
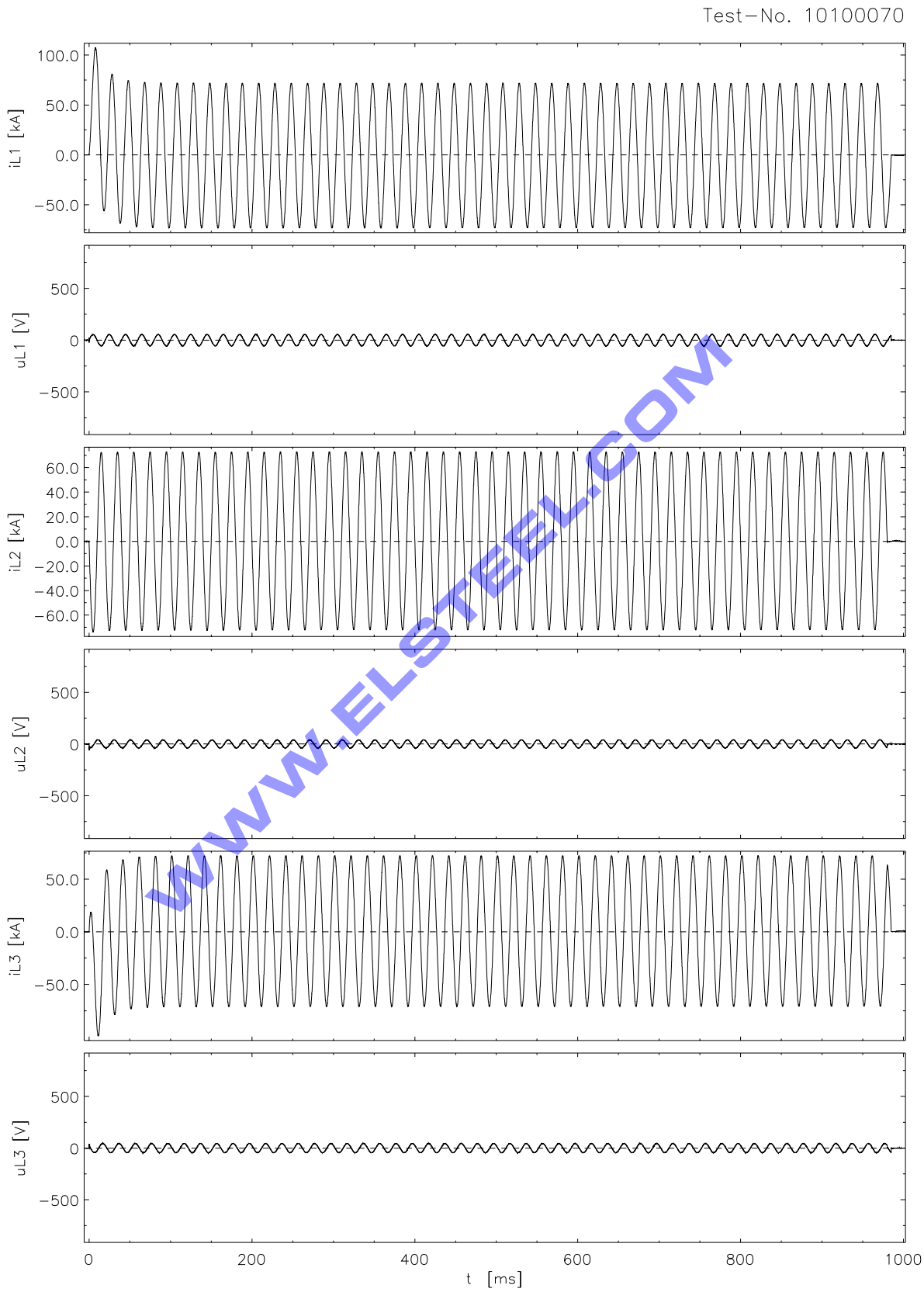
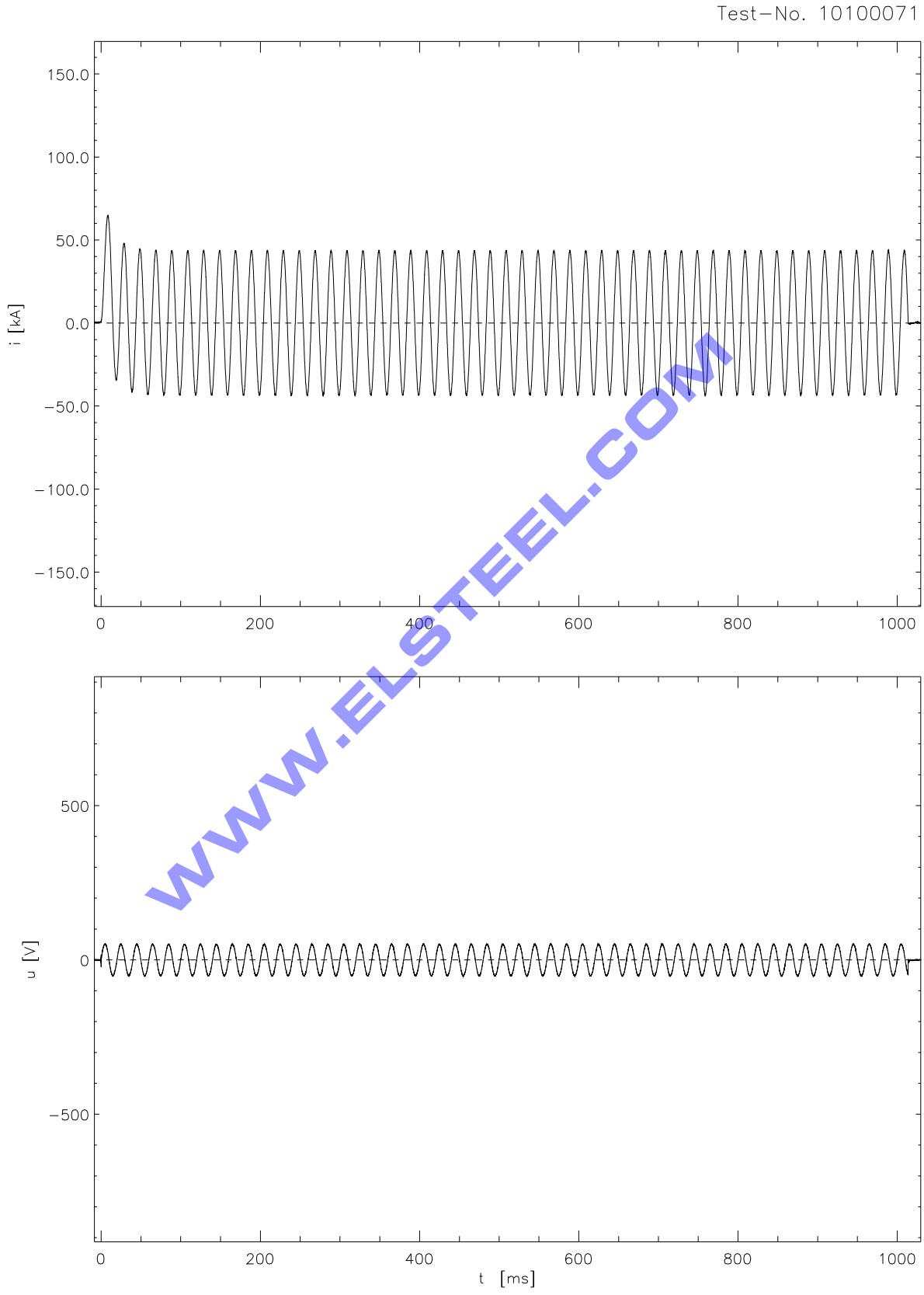
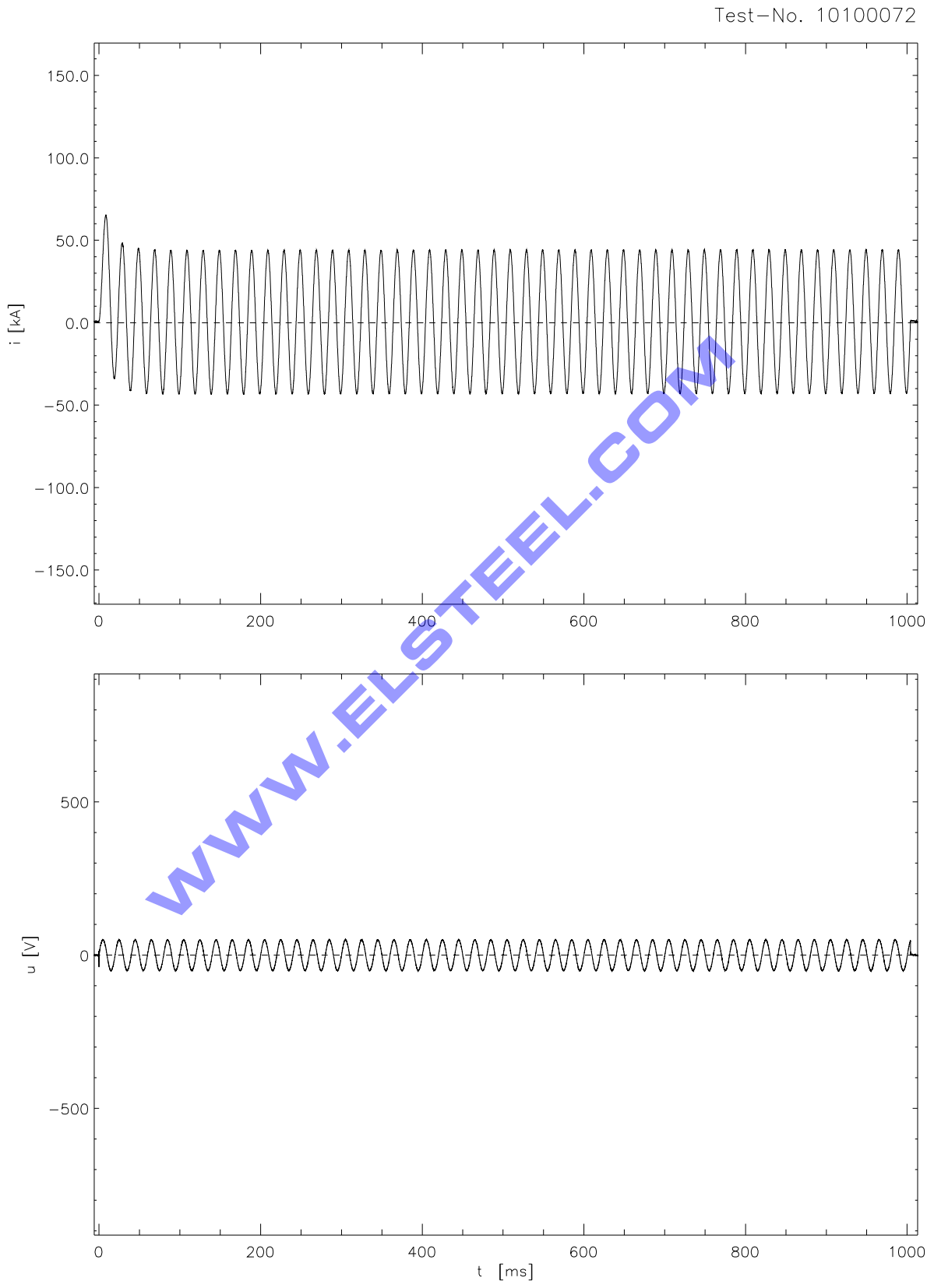
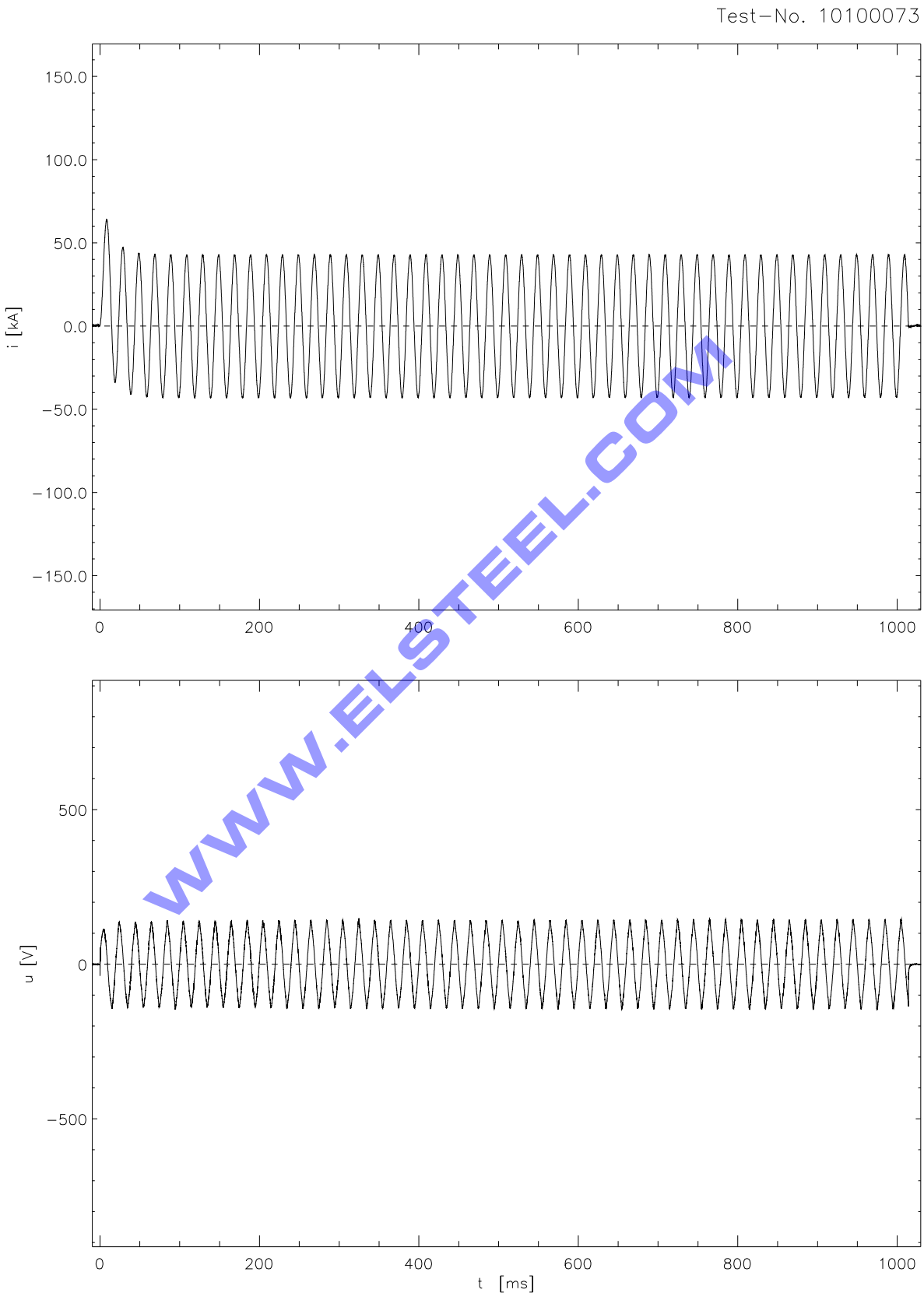


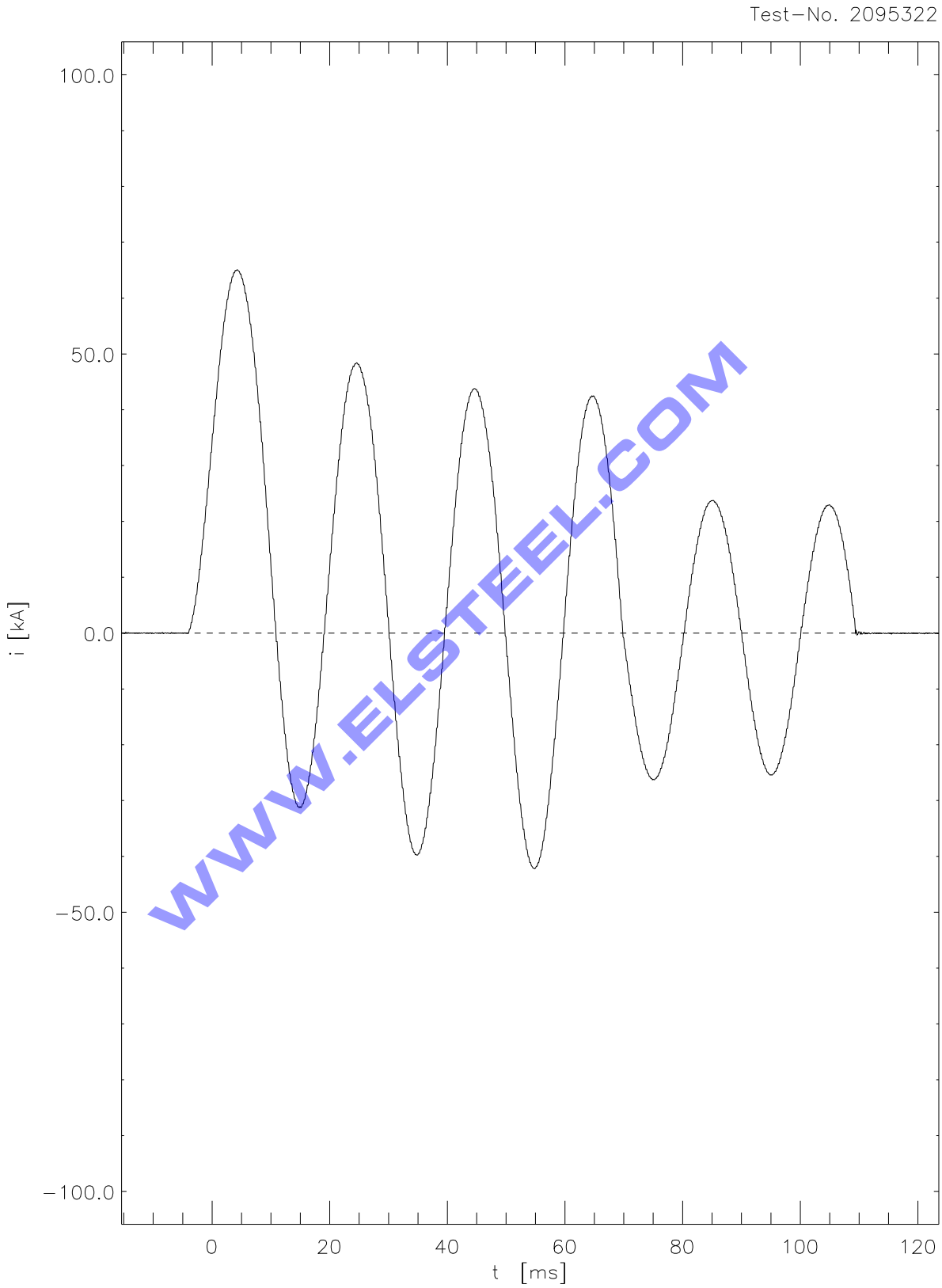


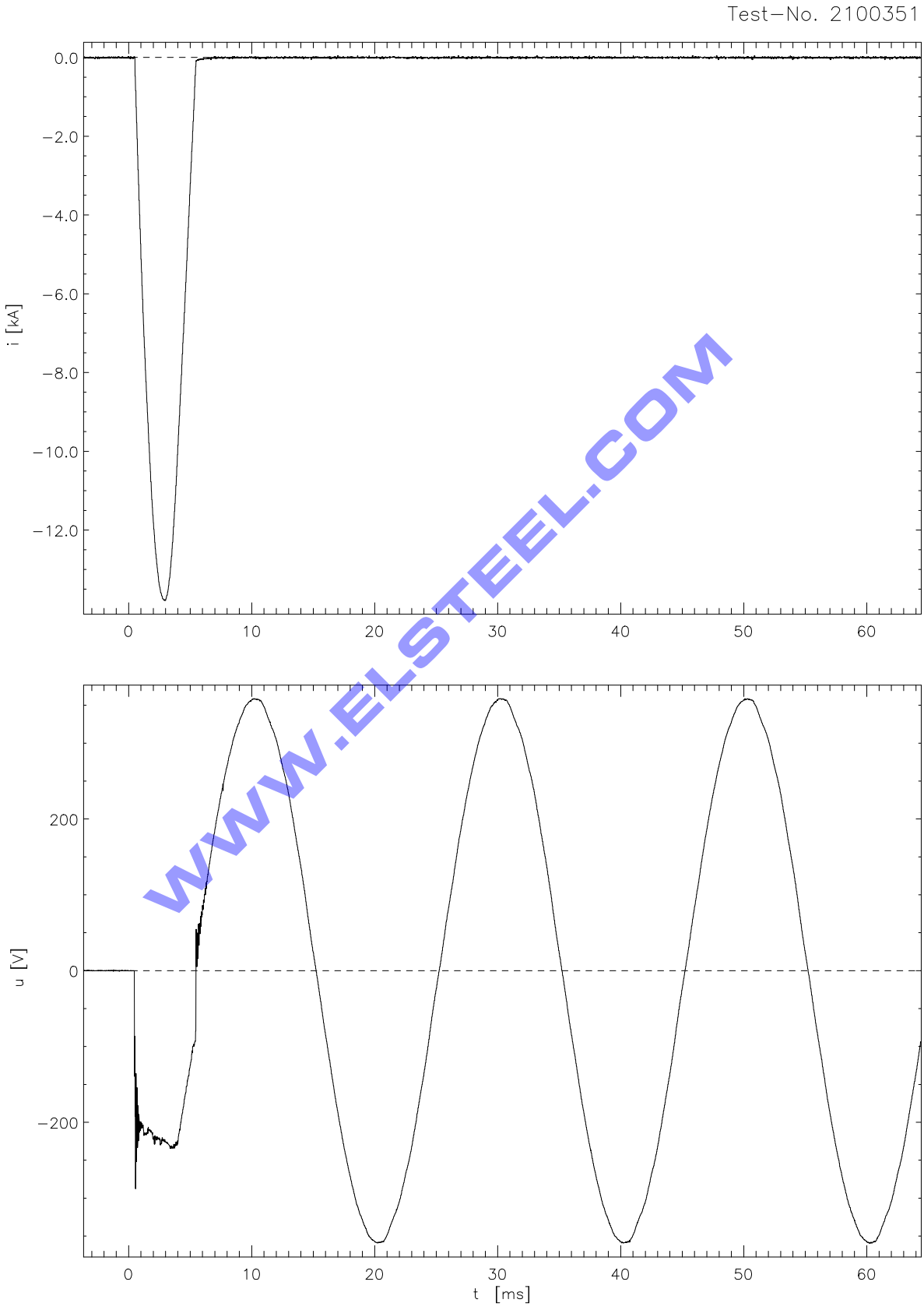


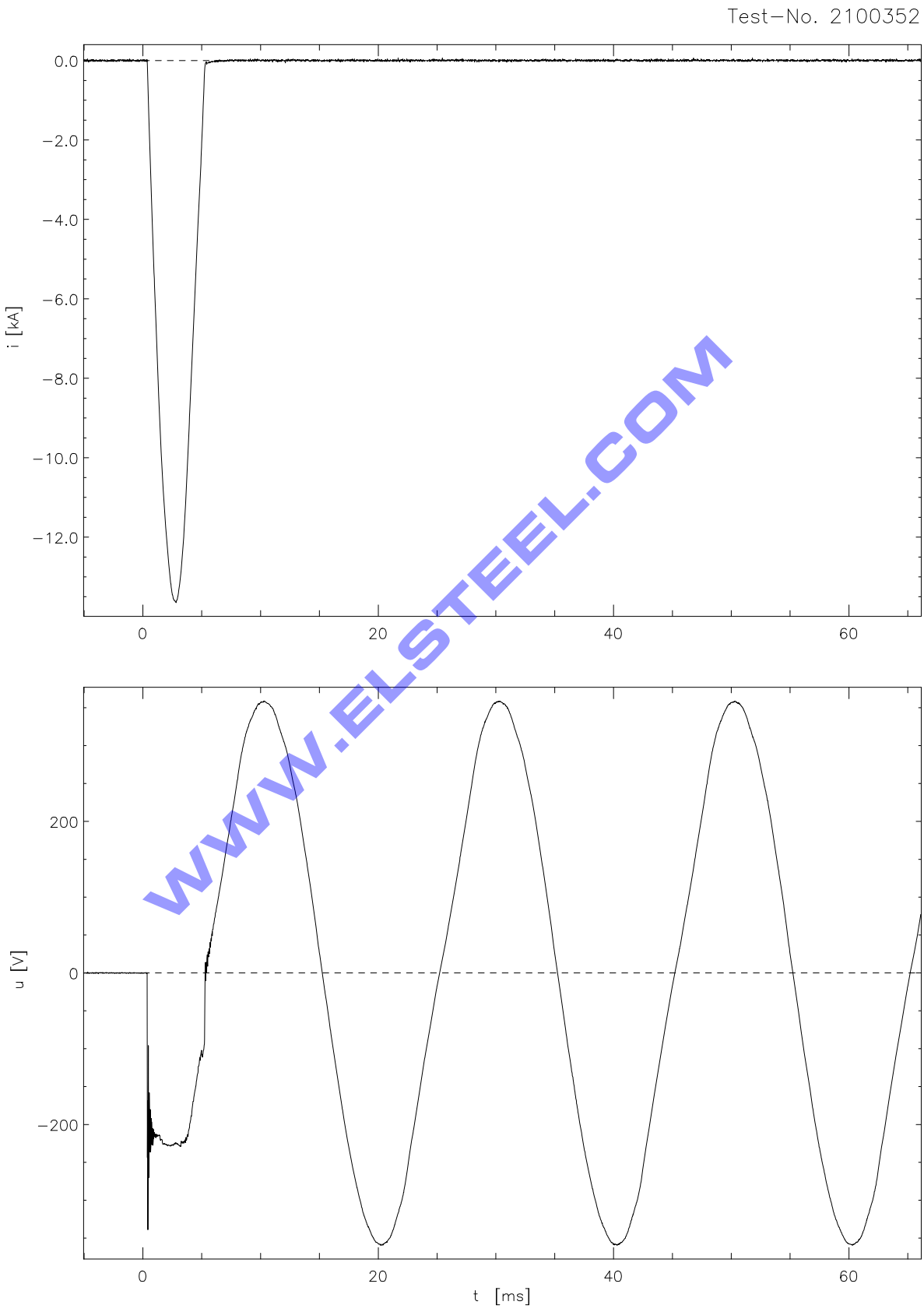


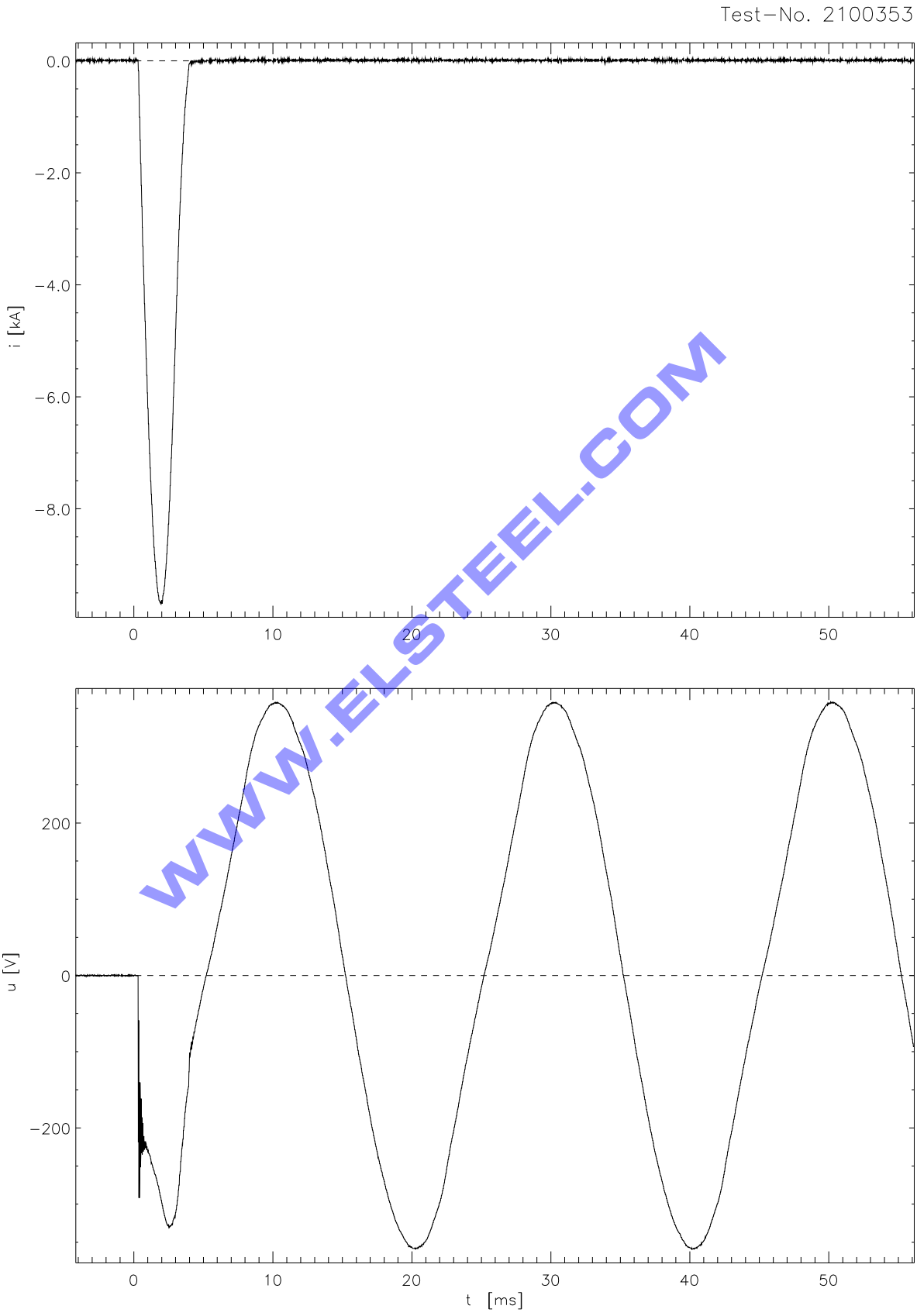


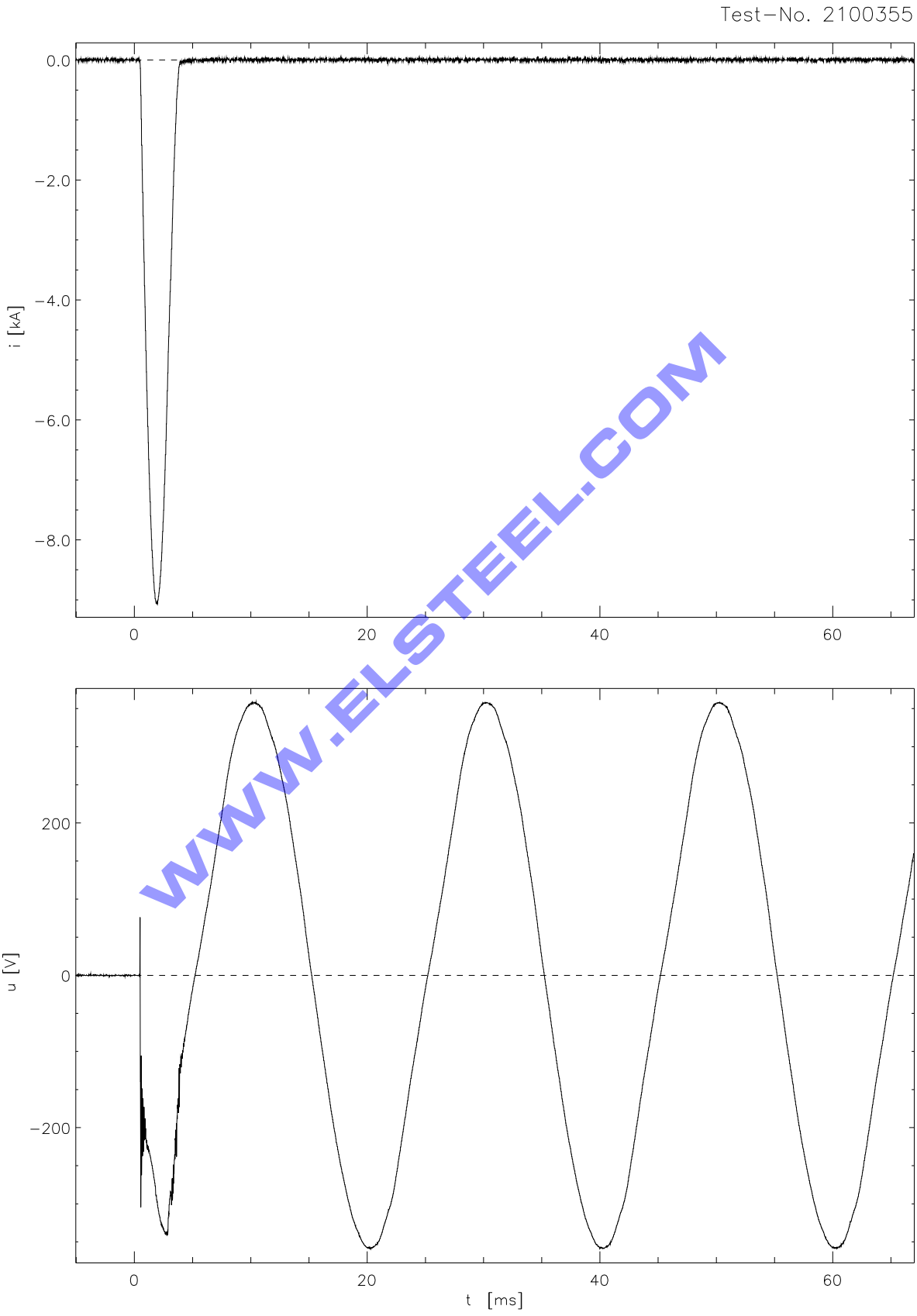


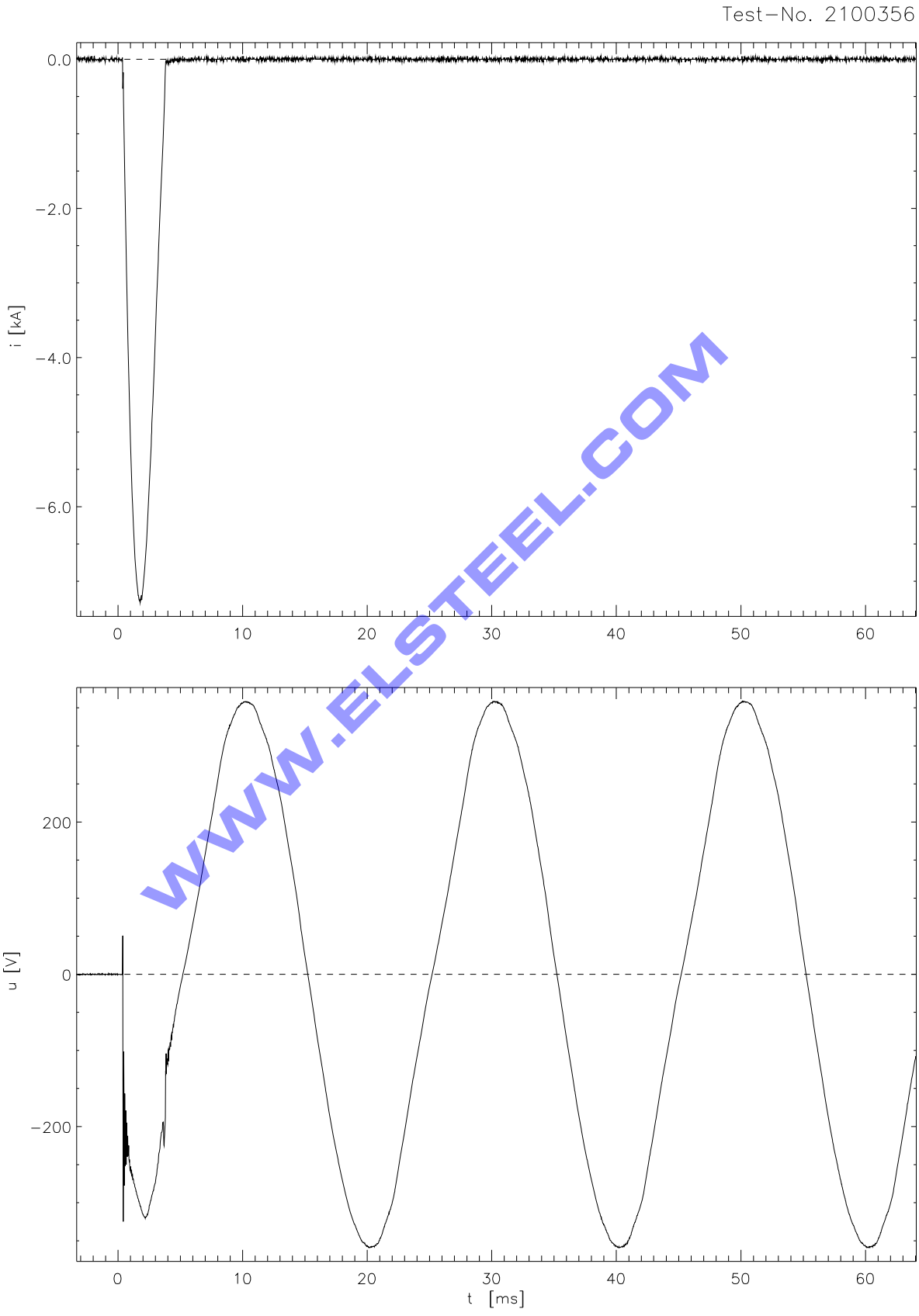




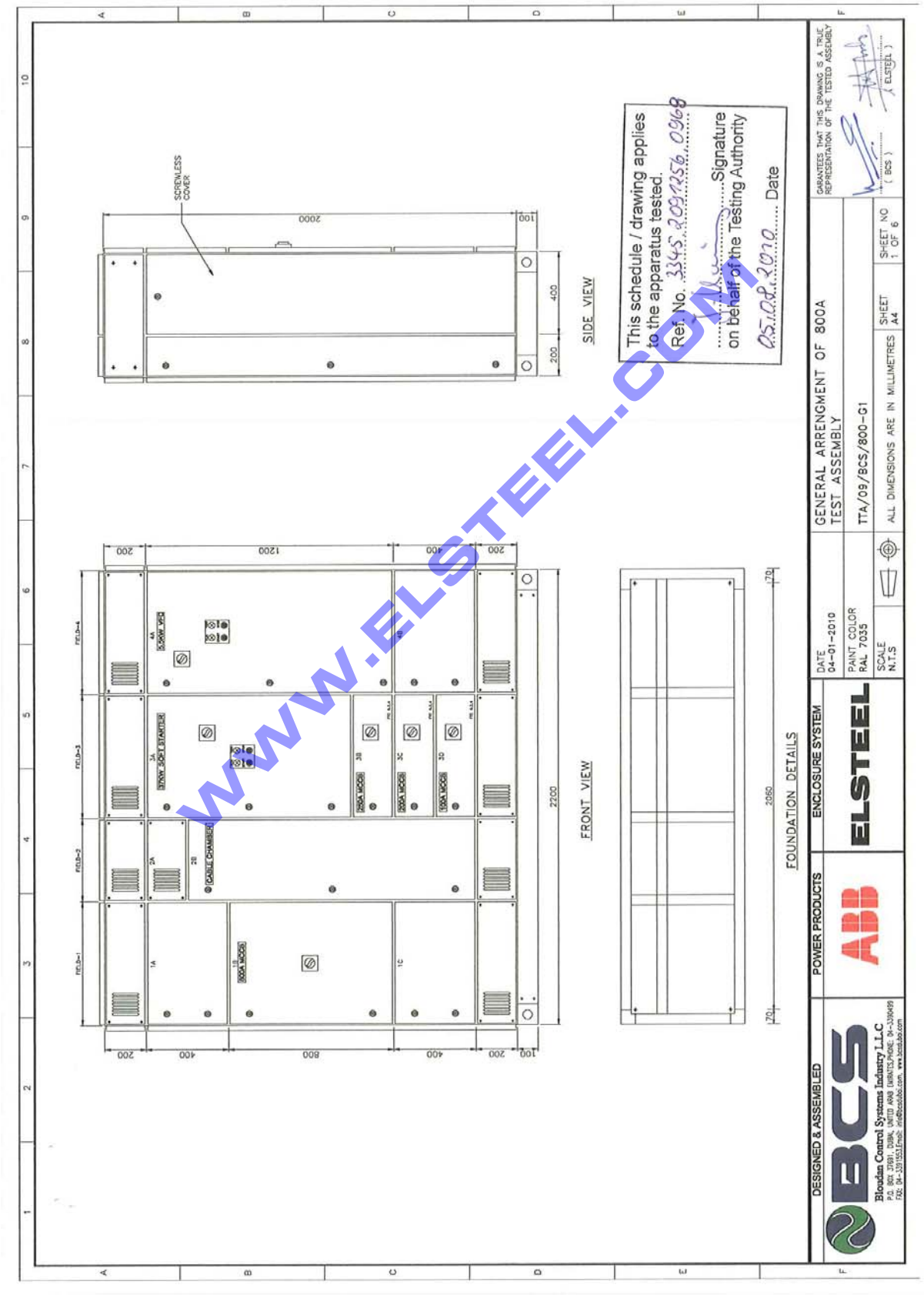


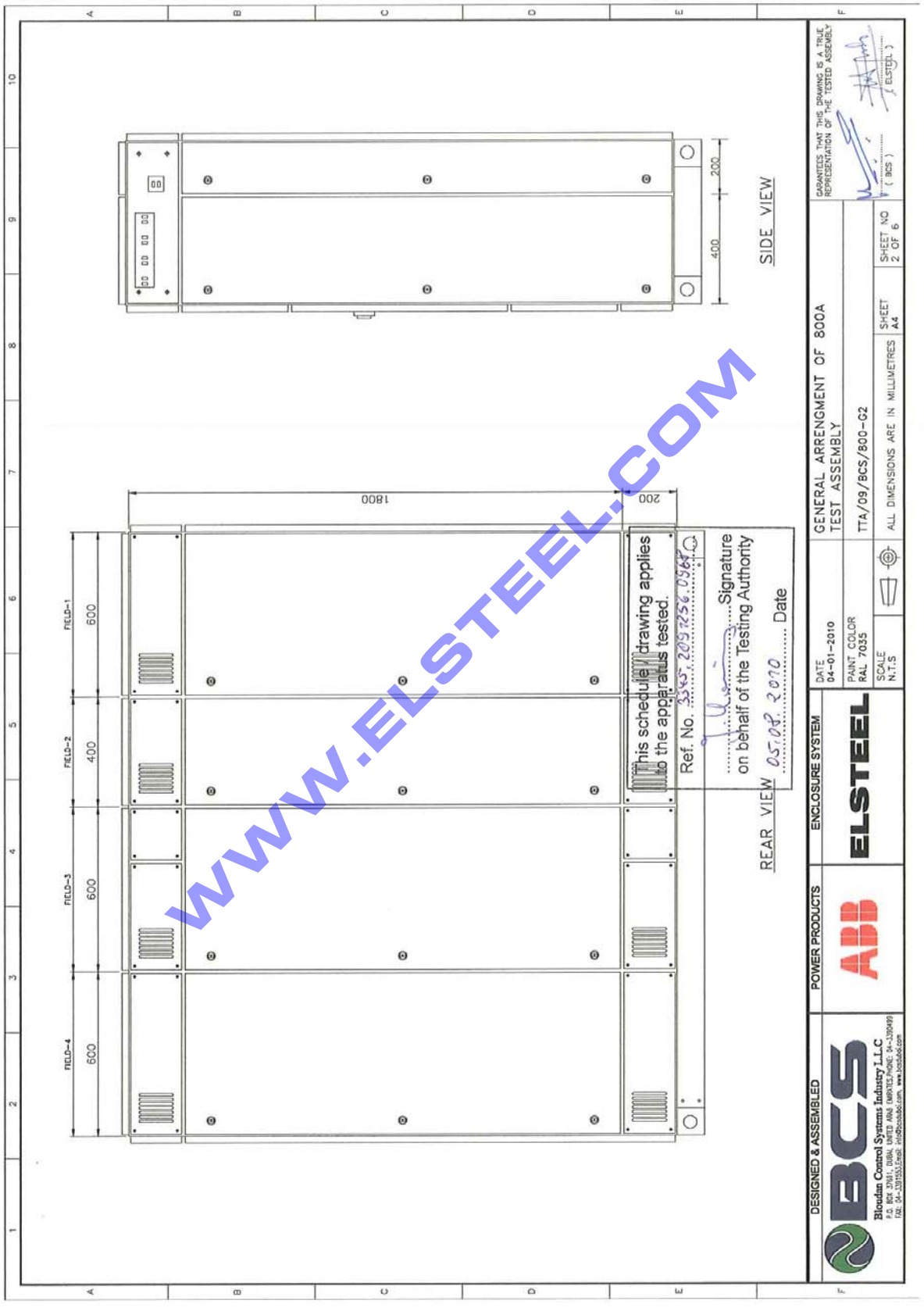


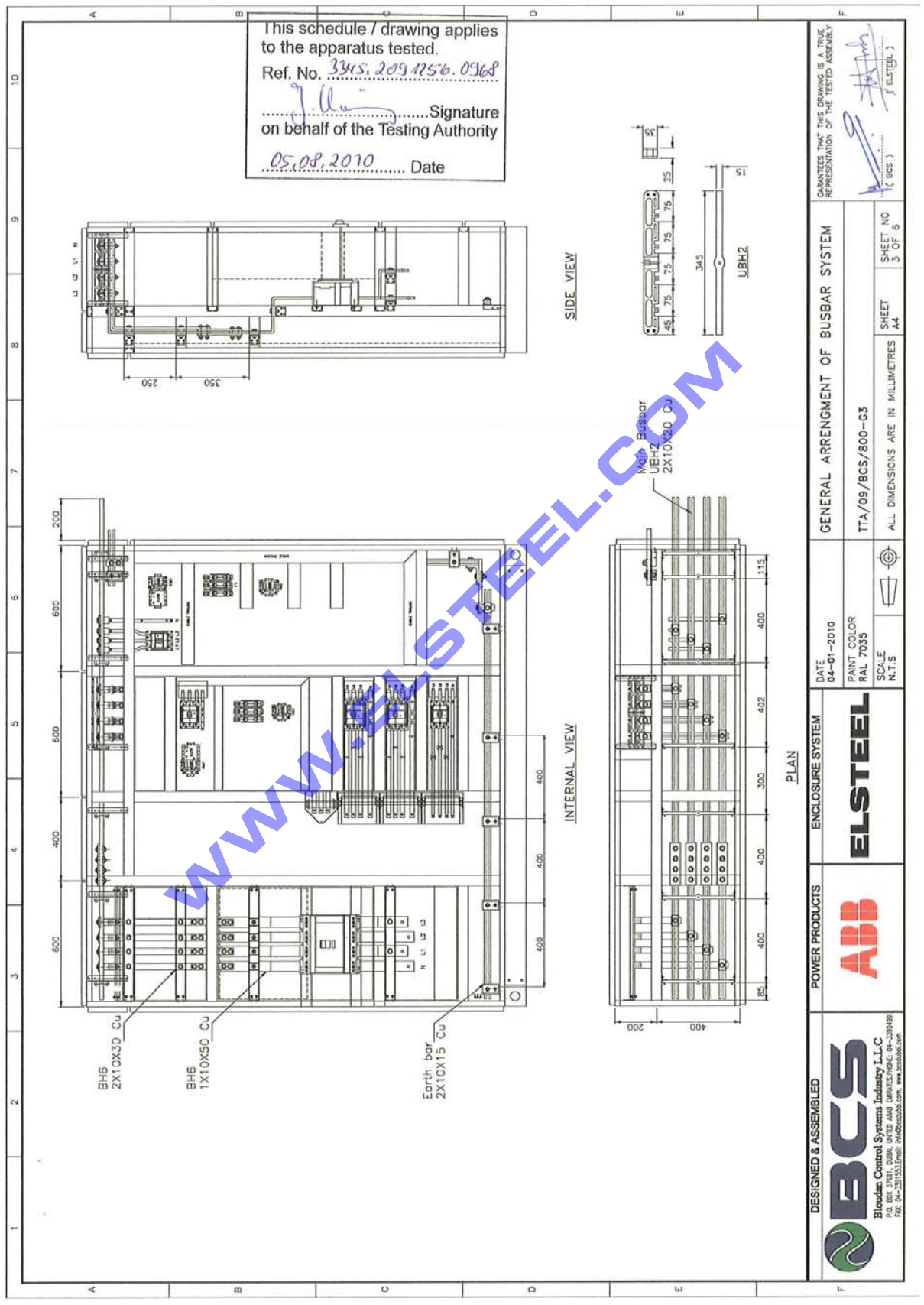


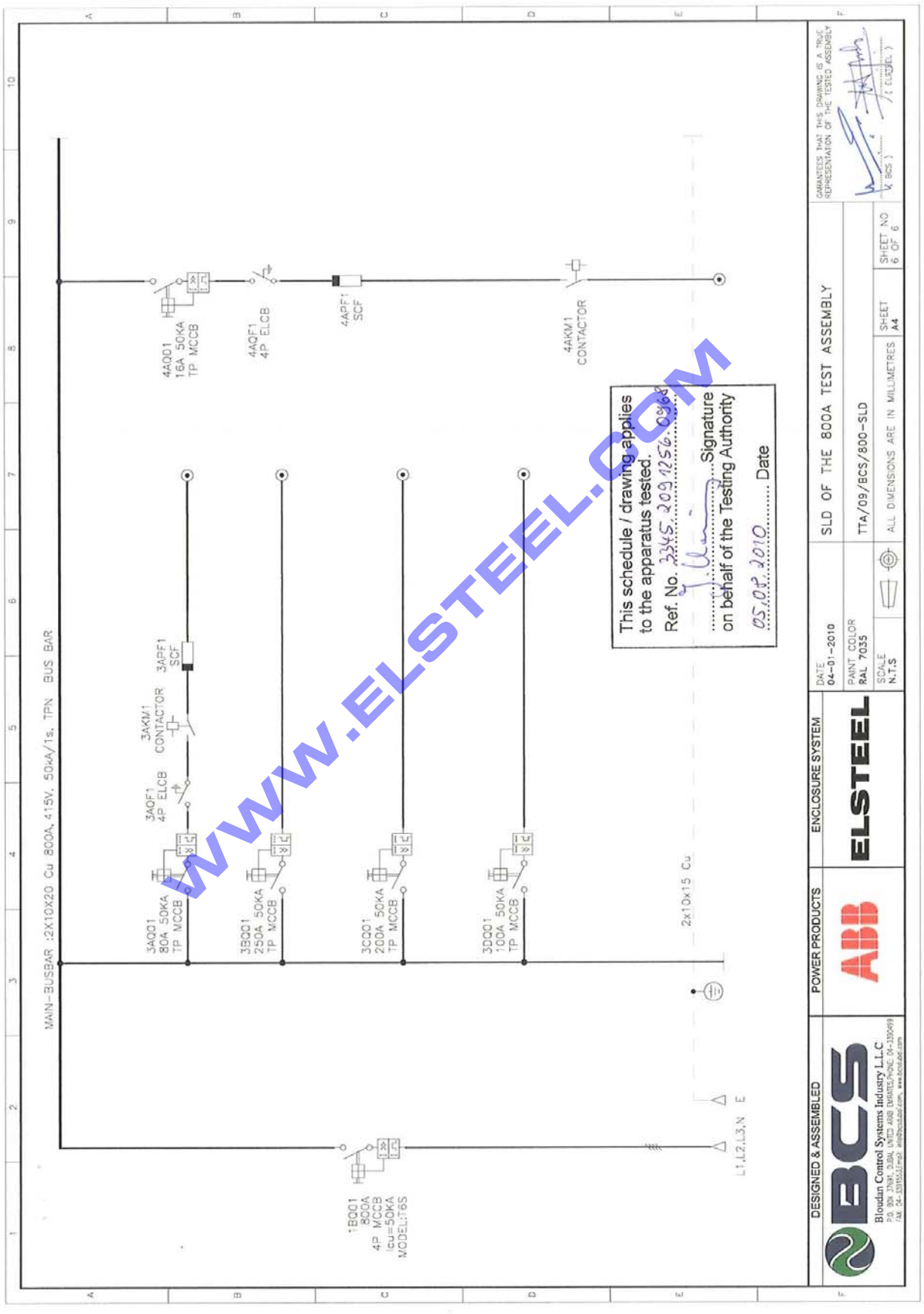


19. Drawings



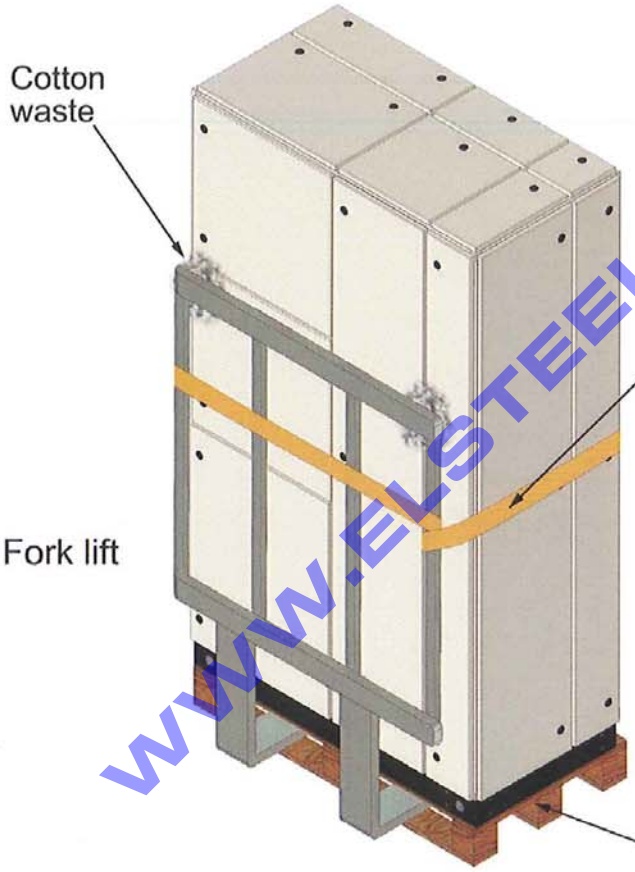






TRANSPORT AND INSTALLATION INSTRUCTIONS

LIFTING OF AN ENCLOSURE



This schedule / drawing applies to the apparatus tested.
Ref. No. 3345.2091256.0968
.....Signature
on behalf of the Testing Authority
23.08.2010 Date

ELSTEEL

Approved by : N. F	Drawn by : U. K	Date : 18.09.2008	Revision : 1