Title:
Short-circuit test.

Costumer:
Transformadores e Serviços de Energia das Américas S.A.
Rodovia Fernão Dias, 3045 – Amazonas
32240-090 – Contagem –MG – Brasil
Phone: +55 (31) 3329-6563
leonardo.jose@tseaenergia.com.br
At.: Leonardo José Siqueira Pinto

Test Proposal:
DLA – 19208/2018-AP2

Manufacturer:
The same

Area/Project:
E100/3002

Item under test:
Single phase voltage regulator.

Characteristics of the item under test:
Rated power: 500 kVA.
Rated voltage: 7970 V.
Other characteristics on the page 2.

Test performed:
Type test, listed on page 3, based on the standards ANSI C57.15:2009.

Observations:
The manufacturer's drawings for the item under test are on the pages 13 and 14.

Key-words:
Voltage regulator, short-circuit.

Approval:

Authorized Signatory
Claudio Cerqueira Siqueira
High Power – AP-2

Head of the Adrianópolis Laboratories Department - DLA
Alberto Junqueira
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Date of issue: 24/4/2019

This report is not a certificate of compliance. The results presented refer only to the tested items.

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rated characteristics of the tested item assigned by the manufacturer

Power:		500 kVA
Pass power:		5000 kVA
Voltage:		7970 V
Current:		627 A
Frequency:		60 Hz
Number of phases:		1
Voltage class:		15 kV
Regulation rate:		±10% in 32 degrees of 0,625%
Power frequency withstand voltage:		34 kV
Lightning impulse withstand voltage (NBI):		110 kV
Short-circuit impedance:		
Position +16:	Máx. 0,23 %	
Position -16:	Máx. 0,23 %	
Specification standard:		IEEE Std C57.15:2009
Conductor Material:		Series: Al – Excitation: Al
Equipment Status:		New
Cooling type:		ONAN
Limit of the temperature rise:		
Oil (top):	55 / 65 °C	
Windings:	55 / 65 °C	
Total mass:		5029 lbs
Active part mass w/ cover:		2685 lbs
Tank and accessories mass:		899,5 lbs
Volume of oil:		194 gal
Oil type:		Naphthenic
Serial number of the voltage regulator:		F18411
Model:		HCMR
Date of manufacture:		February/2019
Drawing:		
Characteristics nameplate:		Z3-0232467 – REV. 1
Constructive:		Z4-4613031 – REV. 1

Obs: CEPEL is not responsible for the information assigned by the manufacturer.

equipment on CEPEL:	02/21/2019
equipment conditions before the test:	new.
dimensional identification of the tested:	according to the drawings provided by the manufacturer.

ROGÉRIO PEIXE
Representante Legal
ELECTROMAN S.A.

table of the carried out tests

type of test: short circuit	**page**
1 application of symmetrical current at the position +16	5
1 application of symmetrical current at the position +16	6
1 application of asymmetrical current at the position +16	7
1 application of symmetrical current at the position -16	8
1 application of symmetrical current at the position -16	9
1 application of asymmetrical current at the position -16	10

test executers:

Cláudio Cerqueira Siqueira - CEPEL
Cristiano sobreira Xavier - CEPEL
Marcelo Guimarães Rodrigues - CEPEL
Mario Gonçalves - CEPEL
Robson Bianchi - CEPEL

witnesses to the tests:

Daniela Franciely Santos do Céu - TSEA

test assembler:

Adilson Jacinto Teixeira - SM21

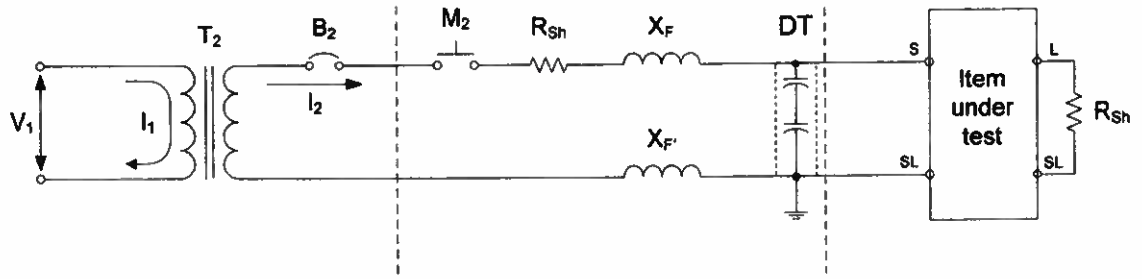
RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

short-circuit test

test circuit conditions: **power factor** < 0,1 **frequency** 60 Hz

source: to the terminals S - SL with the terminals L – SC short-circuited through a shunt of 0.1mΩ (photo 1 – page 12).

Test circuit



legenda:

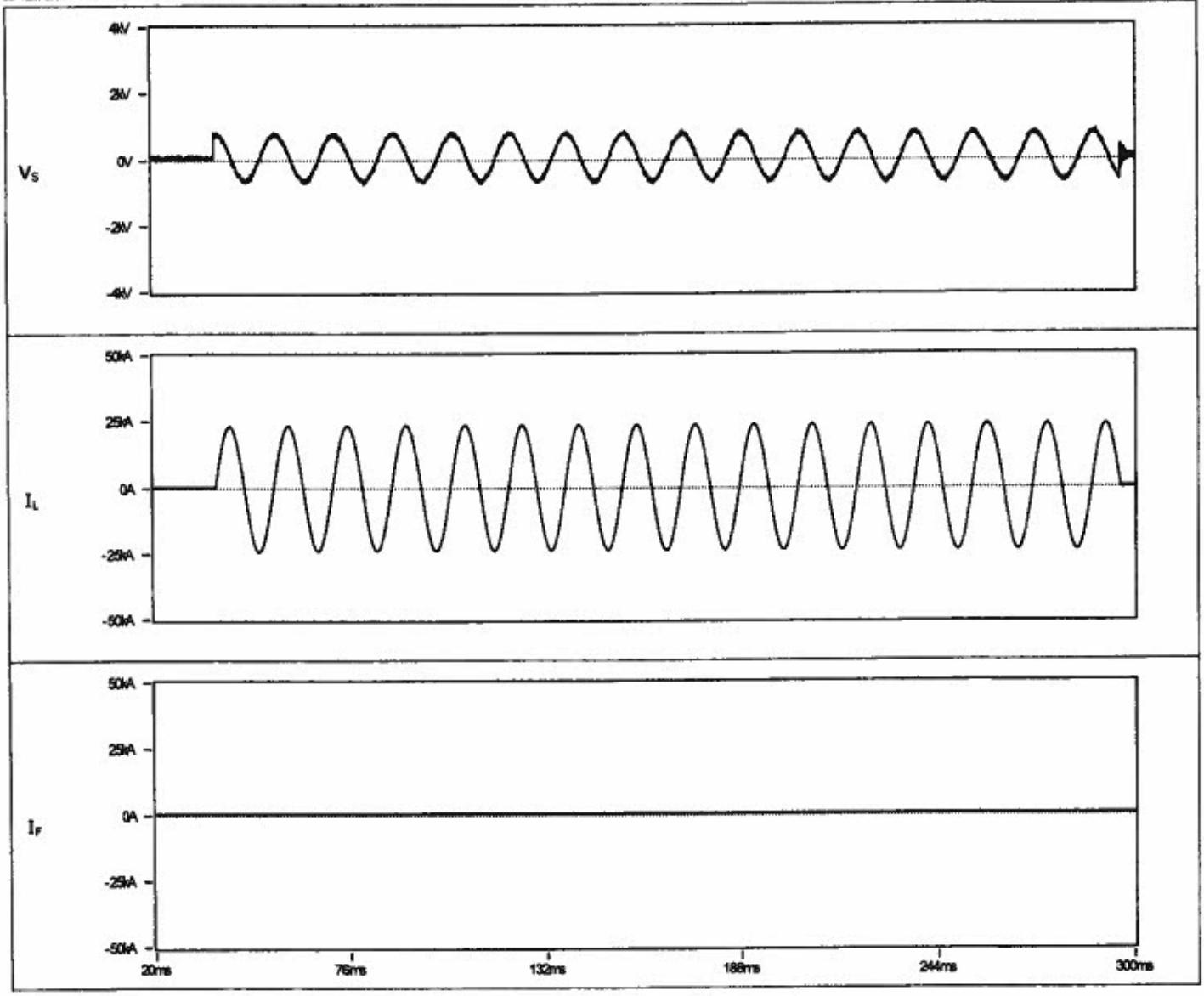
T_2	-	short-circuit transformer;
B_2	-	circuit-breaker;
M_2	-	making switch;
X_F e $X_{F'}$	-	current limiting reactor;
DT	-	voltage divider;
R_{Sh}	-	shunt for currents measurement;
V_1	-	input voltage of the short-circuit transformer;
I_1	-	short-circuit transformer input current;
V_S	-	voltage regulator voltage source side tested;
I_S	-	current source side of the voltage regulator tested;
I_L	-	load side current of the tested voltage regulator;
I_F	-	regulator fault current.

Obs.:

The maximum global uncertainty values of the source side current measurement systems, load side current and source side voltage are, respectively, 0,78% (k = 2,00), 0,58% (k = 2,00) and 0,42% (k = 2,00).

The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA-4/02.

ROBERTO PEREZ
Representante Legal
ELECTROPAR S.A.

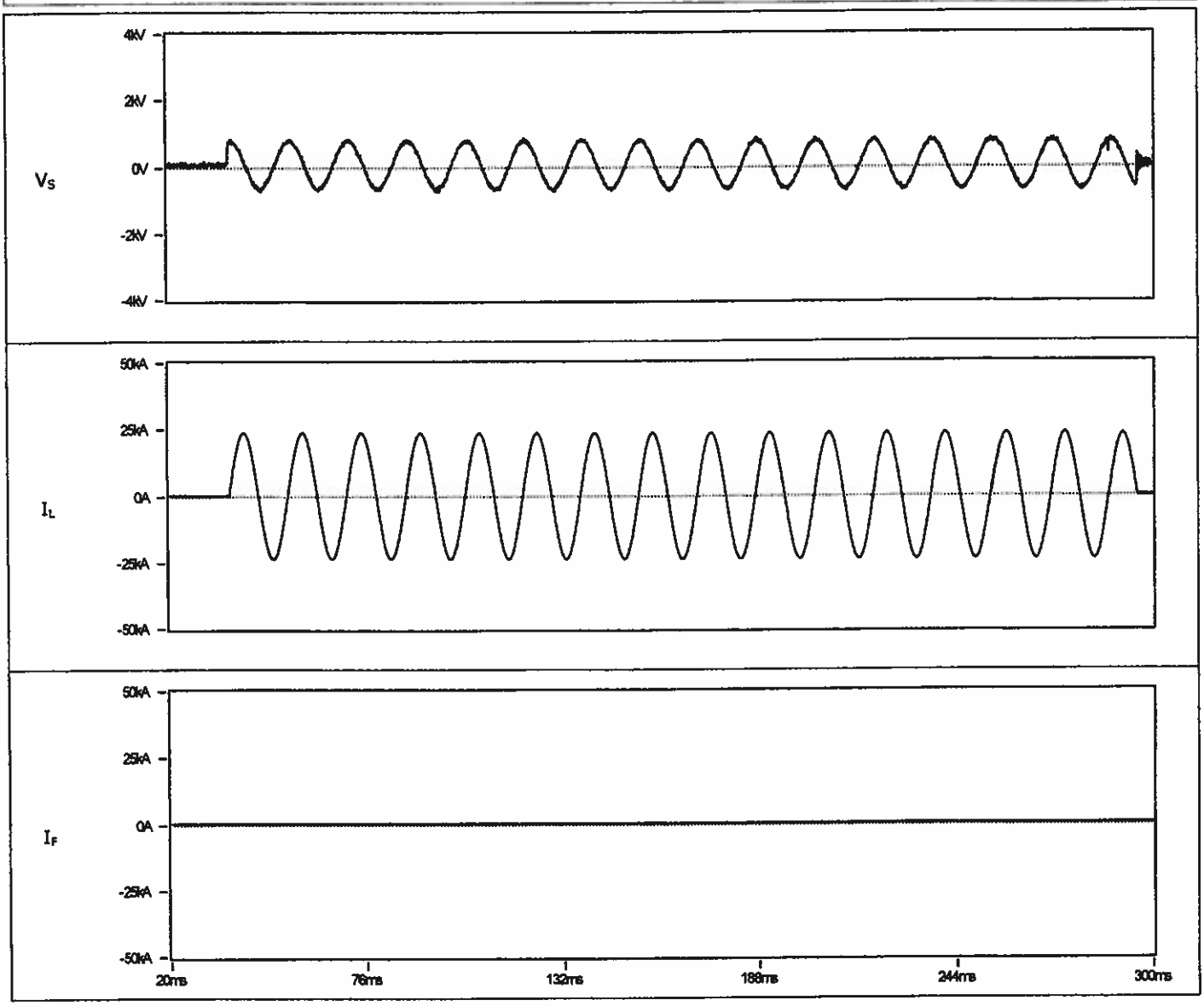


Application 1		RMS	Peak			RMS	Peak
Source side voltage	V_S	598,5 V	-	Load side current	I_L	15,05 kA	21,62 kA
Switch position	+16			Current Duration	250 ms		

Api161 (580x160)

Date - Application timing: 02/28/2019 - 08:48:21

Representante Legal
ELECTROPAR S.A.

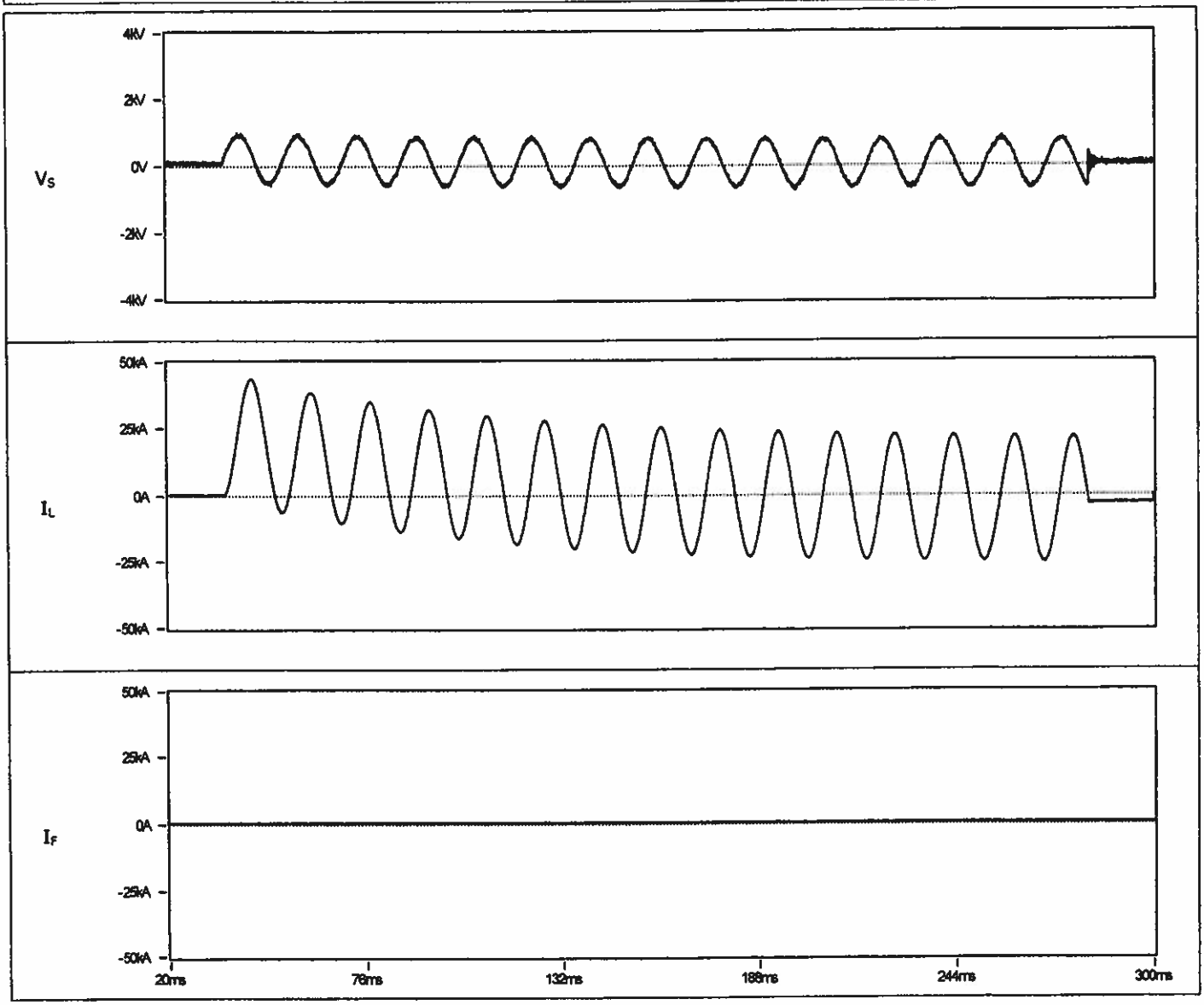


Application 2		RMS	Peak			RMS	Peak
Source side voltage	V_S	596,7V	-	Load side current	I_L	15,13 kA	21,59 kA
Switch position	+16			Current Duration	250 ms		

Apl162 (580x160)

Date - Application timing: 02/28/2019 - 09:05:09

Representante Legal
ELECTROPAR S.A.



Application 3		RMS	Peak			RMS	Peak
Source side voltage	V_S	595,5V	-	Load side current	I_L	15,11 kA	39,29 kA
Switch position	+16			Current Duration	250 ms		

Apl163 (580x160)

Date - Application timing: 02/28/2019 - 09:18:51

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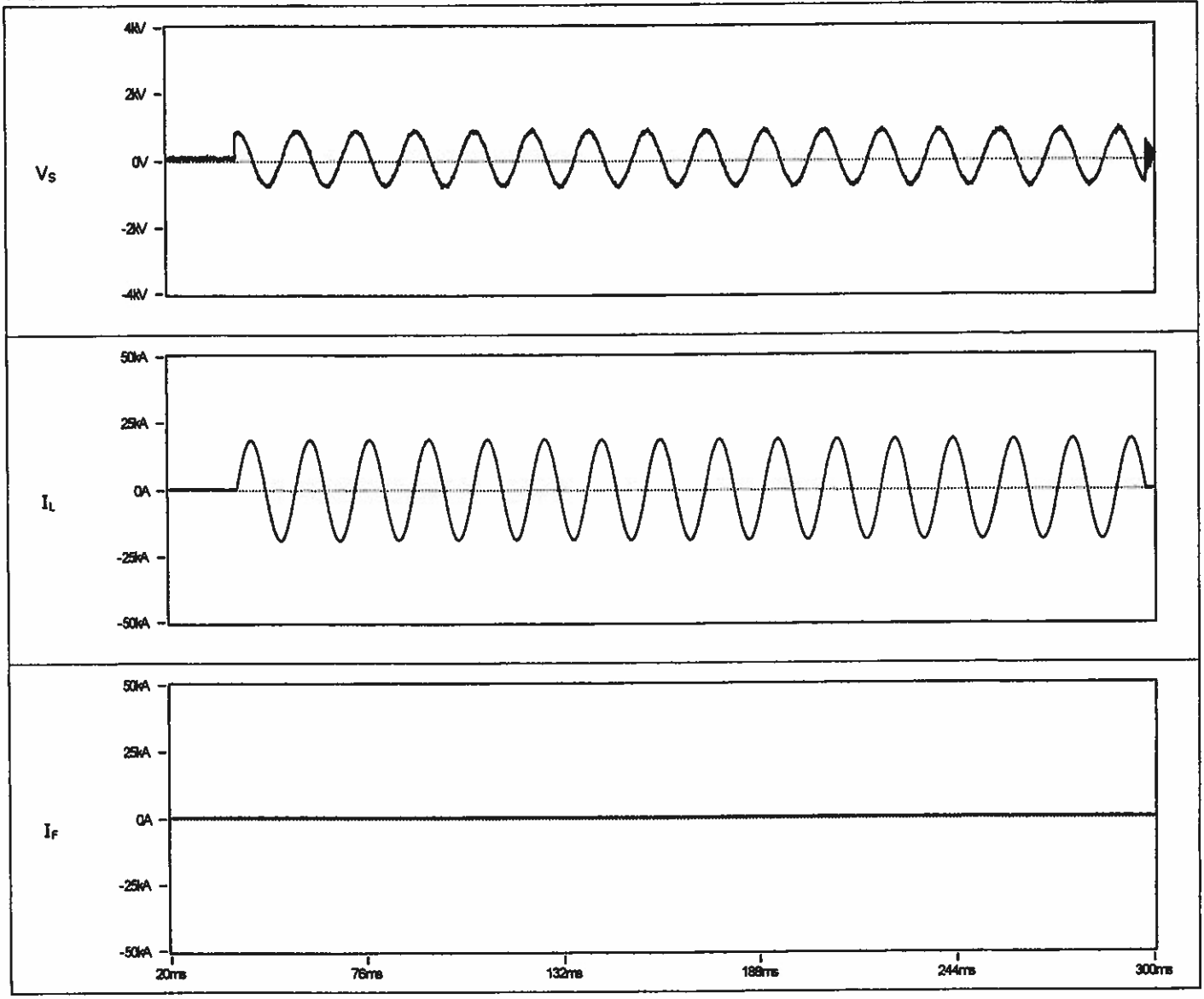
ELECTROPAR S.A.



Application 4		RMS	Peak			RMS	Peak
Source side voltage	V_S	596,2 V	-	Load side current	I_L	14,91 kA	21,09 kA
Switch position	-16			Current Duration	250 ms		

Api166 (580x160)

Date - Application timing: 02/28/2019 - 09:29:43

RODOLFO PEREZ
Representante Legal
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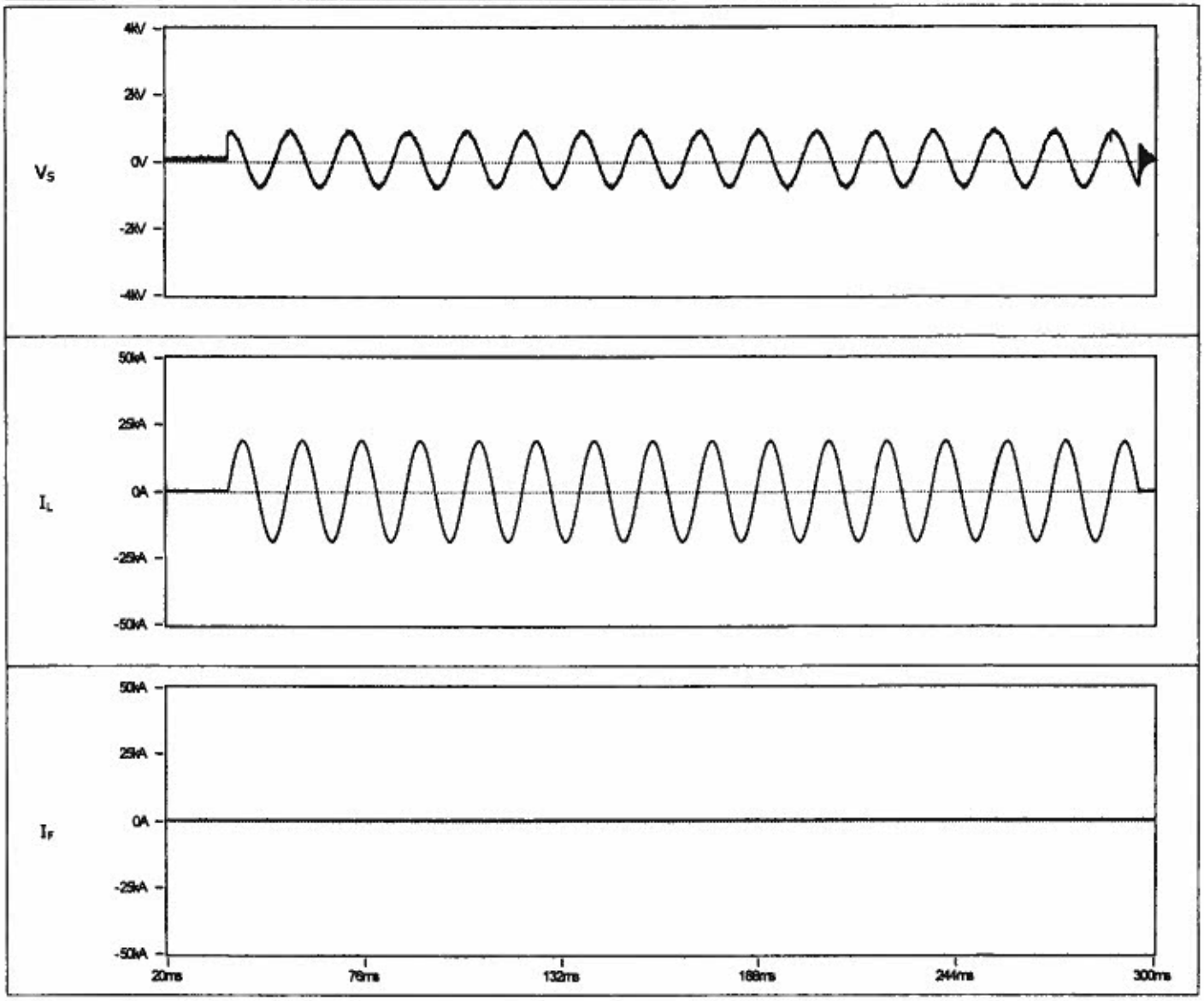
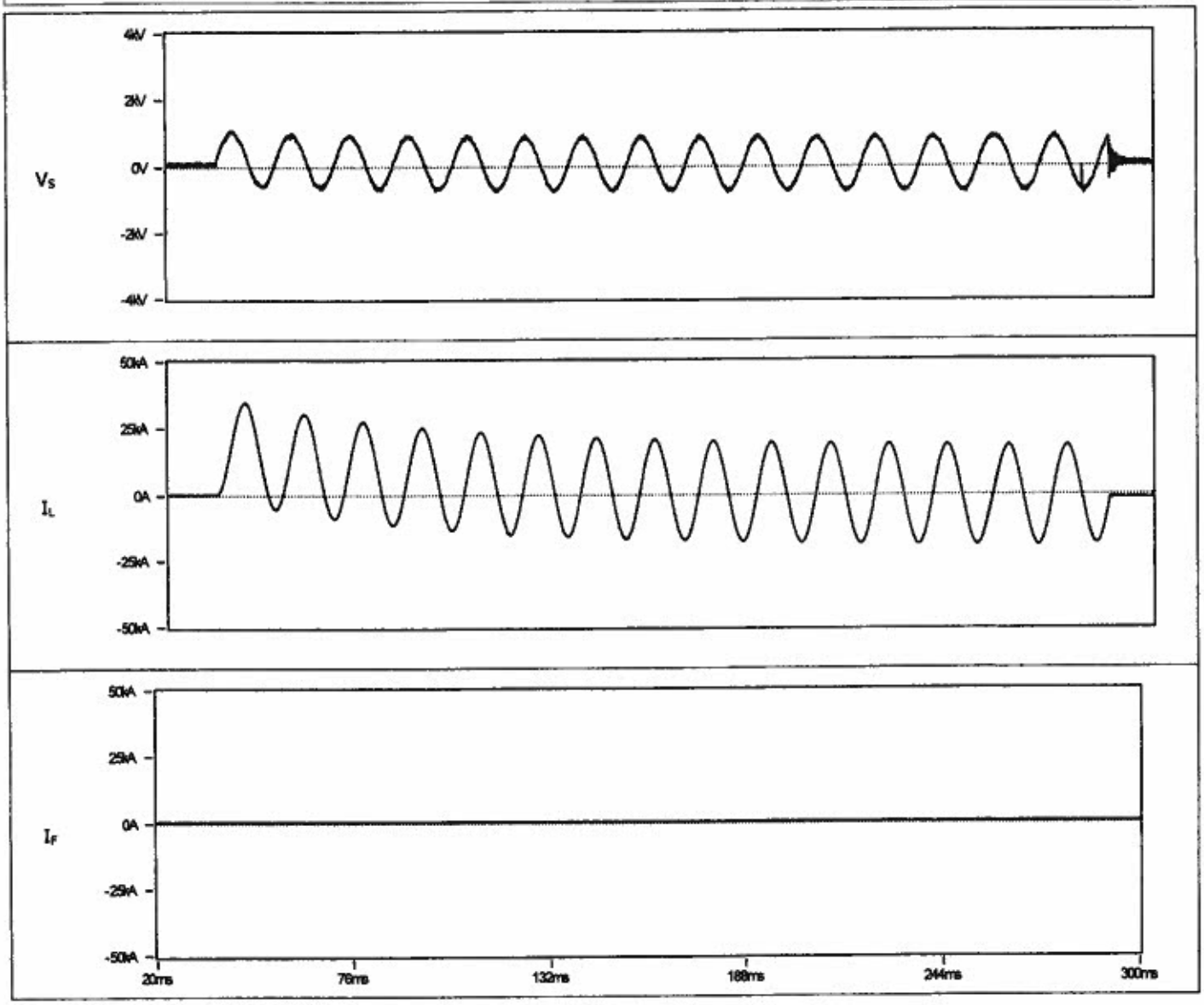


Application 5		RMS	Peak			RMS	Peak
Source side voltage	V_S	595,8 V	-	Load side current	I_L	14,93 kA	21,12 kA
Switch position	-16			Current Duration	250 ms		

Apl167 (580x160)

Date - Application timing: 02/28/2019 - 10:06:08

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.



Application 6		RMS	Peak			RMS	Peak
Source side voltage	V_S	596,1 V	-	Load side current	I_L	14,98 kA	38,79 kA
Switch position	-16			Current Duration	250 ms		

Apl168 (580x160)

Date - Application timing: 02/28/2019 - 10:18:35

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Representante Legal
ELECTROBAR S.A.

Inductance measurements

Instrument	Hameg programable LCR
calibration certificate	CA1-141/2016
next calibration	July/ 2019

position	terminals	before (µH)	after (µH)	variation (%)
+16	SL – L	54,81	57,64	5,2
-16	SL – L	58,63	61,79	5,4

environment temperature	26,2 °C	36,9 °C
environment humidity	68,2%	54,2%
date	02/28/19	02/28/19

The maximum overall uncertainty value of the inductance measurement system is 2,33 (k = 2,00).

The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA-4/02.

final remarks

a) The picture 1 (page 12) shows the tested voltage regulator.
b) There was no meaningful variation between current rms values in the beginning and in the end of each one of the six current applications performed.
c) The routine tests before and after the short-circuit test were not carried out by CEPEL.
d) The inspection of the active part, after the test, was not effectuated by CEPEL.

ROBERTO PEREZ
Representante Legal
ELECTROPAR S.A.

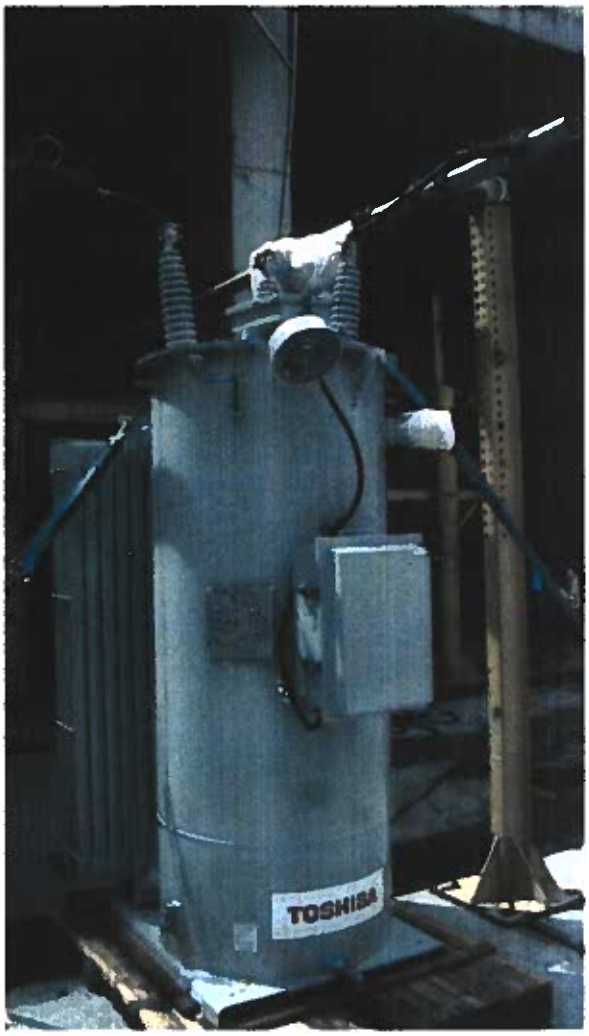
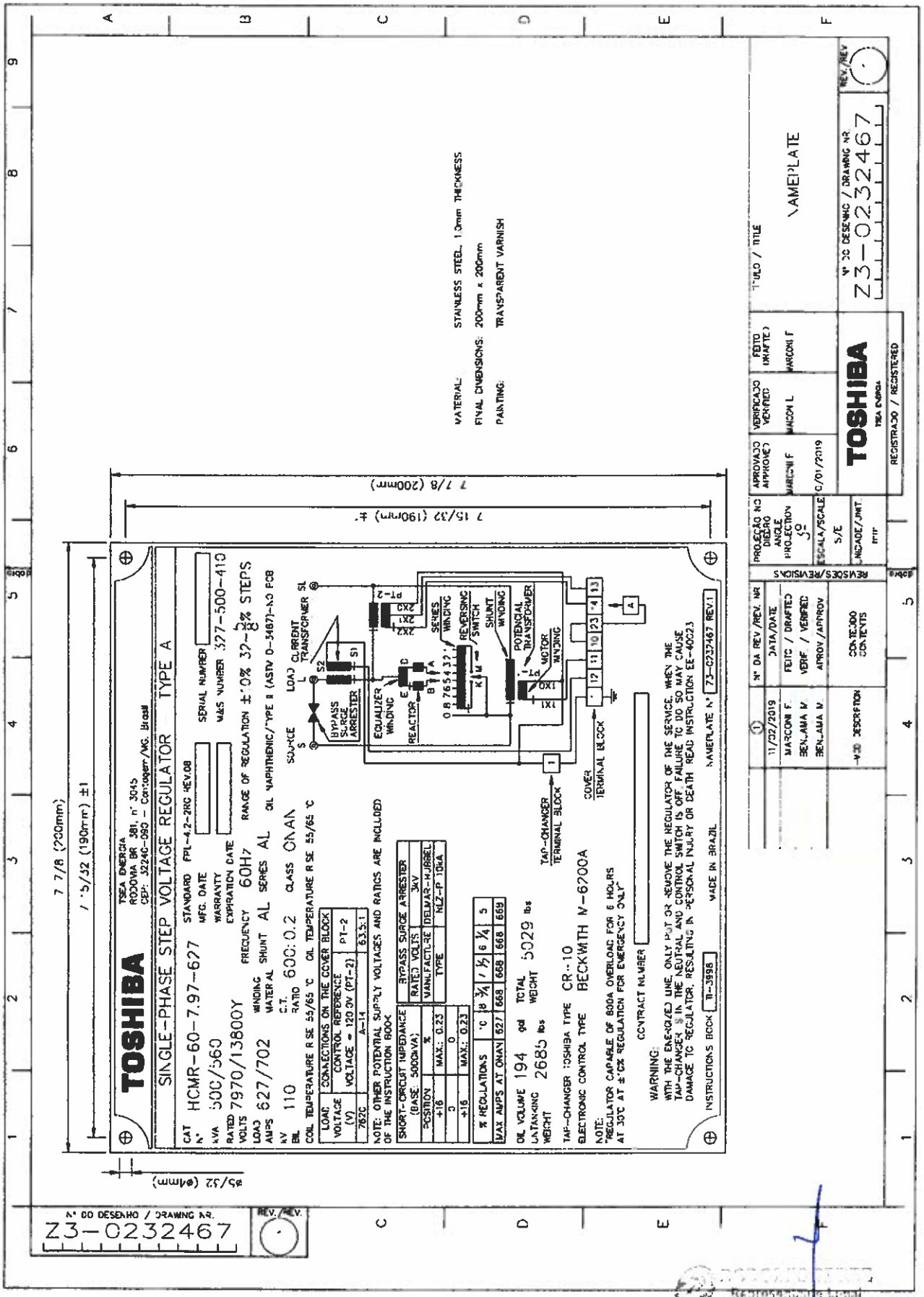
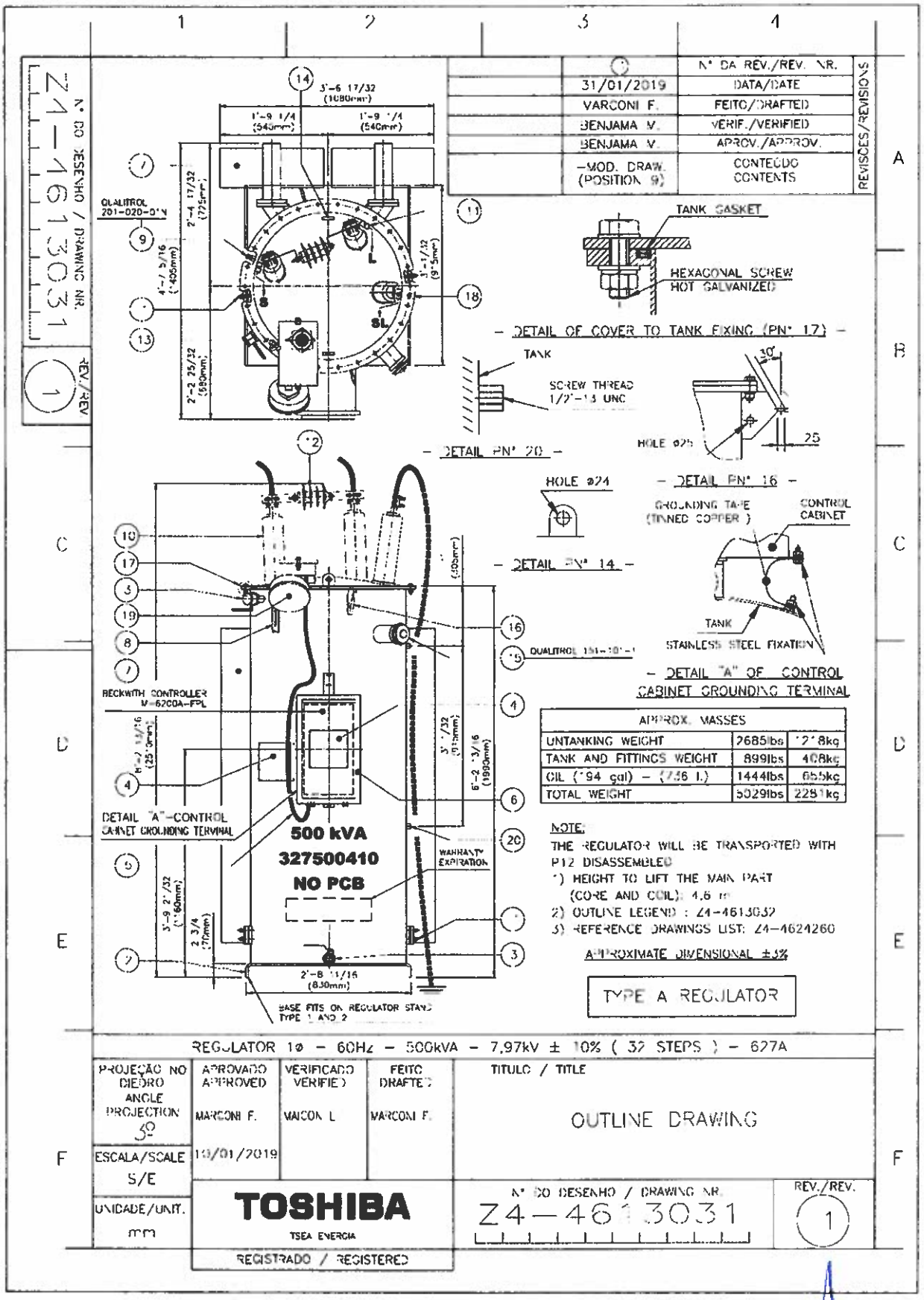


Photo 1 – test arrangement.

Representante Legal
ELECTROPAR S.A.



Representante Legal
ELECTROPAR S.A.



Representante Legal
ELECTROPAR S.A.

Title:
Short-circuit test.

Costumer:
Transformadores e Serviços de Energia das Américas S.A.
Rodovia Fernão Dias, 3045 – Amazonas
32240-090 – Contagem –MG – Brasil
Phone: +55 (31) 3329-6563
leonardo.jose@tseaenergia.com.br
At.: Leonardo José Siqueira Pinto

Test Proposal:
DLA – 19210/2018-AP2

Manufacturer:
The same

Area/Project:
E100/3002

Item under test:
Single phase voltage regulator.

Characteristics of the item under test:
Rated power: 667 kVA.
Rated voltage: 14400 V.
Other characteristics on the page 2.

Test performed:
Type test, listed on page 3, based on the standards ANSI C57.15:2009.

Observations:
The manufacturer's drawings for the item under test are on the pages 13 and 14.

Key-words:
Voltage regulator, short-circuit.

Approval:

Authorized Signatory
Claudio Cerqueira Siqueira
High Power – AP-2

Head of the Adrianópolis Laboratories Department - DLA
Alberto Junqueira
ajsl@cepel.br
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Date of issue: 24/4/2019

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Representante Legal
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rated characteristics of the tested item assigned by the manufacturer

Power:		677 kVA
Pass power:		6770 kVA
Voltage:		14400 V
Current:		470 A
Frequency:		60 Hz
Number of phases:		1
Voltage class:		24,2 kV
Regulation rate:		±10% in 32 degrees of 0,625%
Power frequency withstand voltage:		50 kV
Lightning impulse withstand voltage (NBI):		150 kV
Short-circuit impedance:		
Position +16:	Máx. 0,30 %	
Position -16:	Máx. 0,30 %	
Specification standard:		IEEE Std C57.15:2009
Conductor Material:		Series: Al – Excitation: Al
Equipment Status:		New
Cooling type:		ONAN
Limit of the temperature rise:		
Oil (top):	55 / 65 °C	
Windings:	55 / 65 °C	
Total mass:		6799 lbs
Active part mass w/ cover:		3710 lbs
Tank and accessories mass:		1362 lbs
Volume of oil:		232 gal
Oil type:		Naphthenic
Serial number of the voltage regulator:		F18417
Model:		HCMR
Date of manufacture:		February/2019
Drawing:		
Characteristics nameplate:		Z3-0232468 – REV. 1
Constructive:		Z4-4613033 – REV. 1

Obs: CEPEL is not responsible for the information assigned by the manufacturer.

equipment on CEPEL:	02/21/2019
equipment conditions before the test:	new.
dimensional identification of the tested:	according to the drawings provided by the manufacturer.

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

table of the carried out tests

type of test: short circuit	**page**
1 application of symmetrical current at the position +16	5
1 application of symmetrical current at the position +16	6
1 application of asymmetrical current at the position +16	7
1 application of symmetrical current at the position -16	8
1 application of symmetrical current at the position -16	9
1 application of asymmetrical current at the position -16	10

test executers:

Cláudio Cerqueira Siqueira - CEPEL
Cristiano sobreira Xavier - CEPEL
Marcelo Guimarães Rodrigues - CEPEL
Mario Gonçalves - CEPEL
Robson Bianchi - CEPEL

witnesses to the tests:

Daniela Franciely Santos do Céu - TSEA

test assembler:

Adilson Jacinto Teixeira - SM21

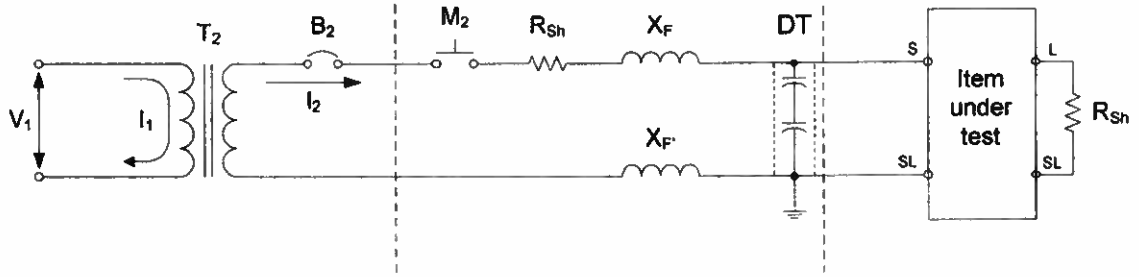
RODOLFO PEREZ
Representante Legal
ELECTROPAR S/A

short-circuit test

test circuit conditions: **power factor** < 0,1 **frequency** 60 Hz

source: to the terminals S - SL with the terminals L – SC short-circuited through a shunt of 0.1mΩ (photo 1 – page 12).

Test circuit



legenda:

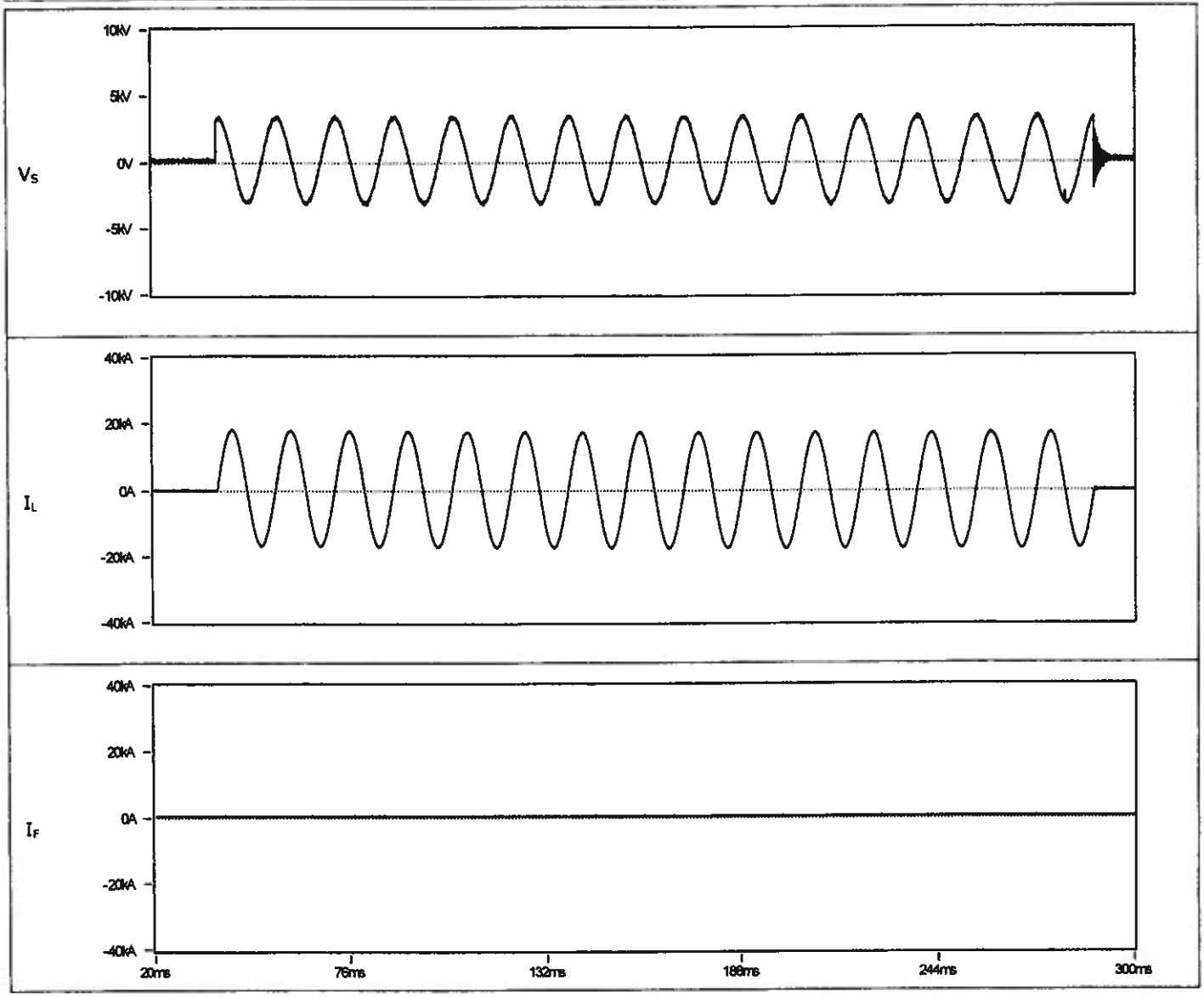
T_2	-	short-circuit transformer;
B_2	-	circuit-breaker;
M_2	-	making switch;
X_F e $X_{F'}$	-	current limiting reactor;
DT	-	voltage divider;
R_{Sh}	-	shunt for currents measurement;
V_1	-	input voltage of the short-circuit transformer;
I_1	-	short-circuit transformer input current;
V_S	-	voltage regulator voltage source side tested;
I_S	-	current source side of the voltage regulator tested;
I_L	-	load side current of the tested voltage regulator;
I_F	-	regulator fault current.

Obs.:

The maximum global uncertainty values of the source side current measurement systems, load side current and source side voltage are, respectively, 0,78% (k = 2,00), 0,58% (k = 2,00) and 0,42% (k = 2,00).

The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA-4/02.

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

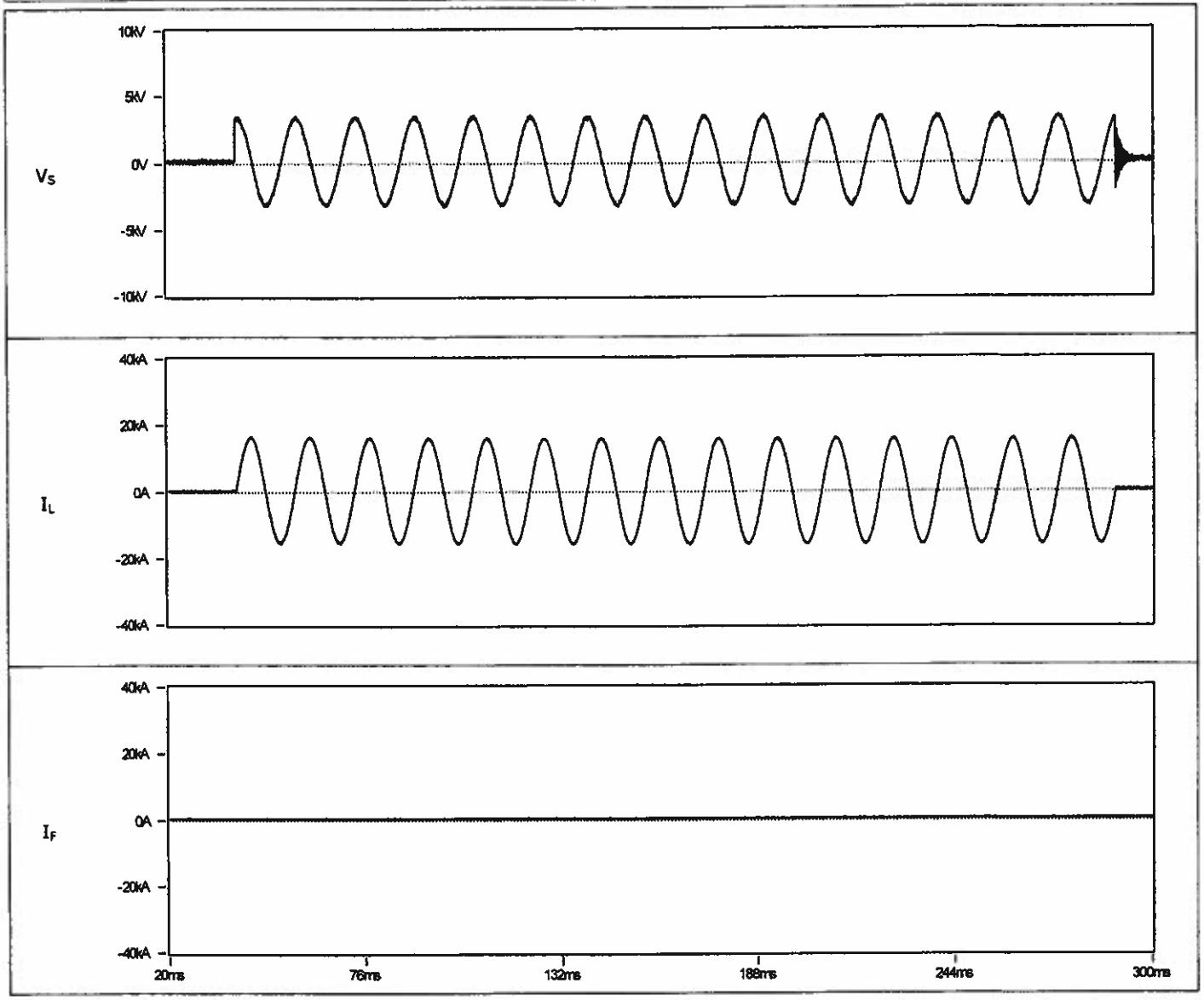


Application 1		RMS	Peak			RMS	Peak
Source side voltage	V_S	2,34 kV	-	Load side current	I_L	11,82 kA	16,93 kA
Switch position	-16			Current Duration	250 ms		

Api152 (580x160)

Date - Application timing: 02/27/2019 - 09:42:31

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

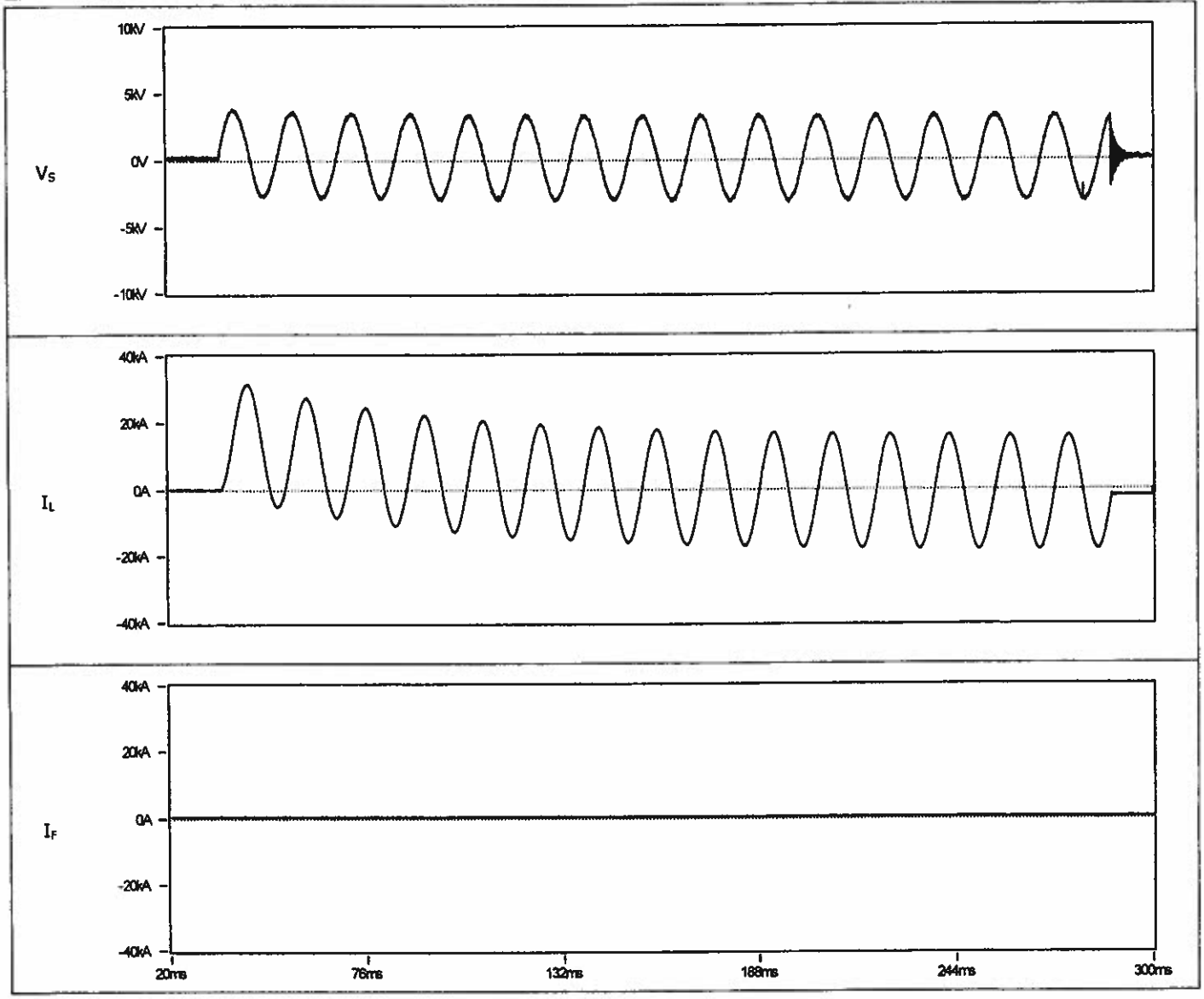


Application 2		RMS	Peak			RMS	Peak
Source side voltage	V_S	2,43 kV	-	Load side current	I_L	11,32 kA	16,52 kA
Switch position	-16			Current Duration	250 ms		

Apl153 (580x160)

Date - Application timing: 02/27/2019 - 09:56:18

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

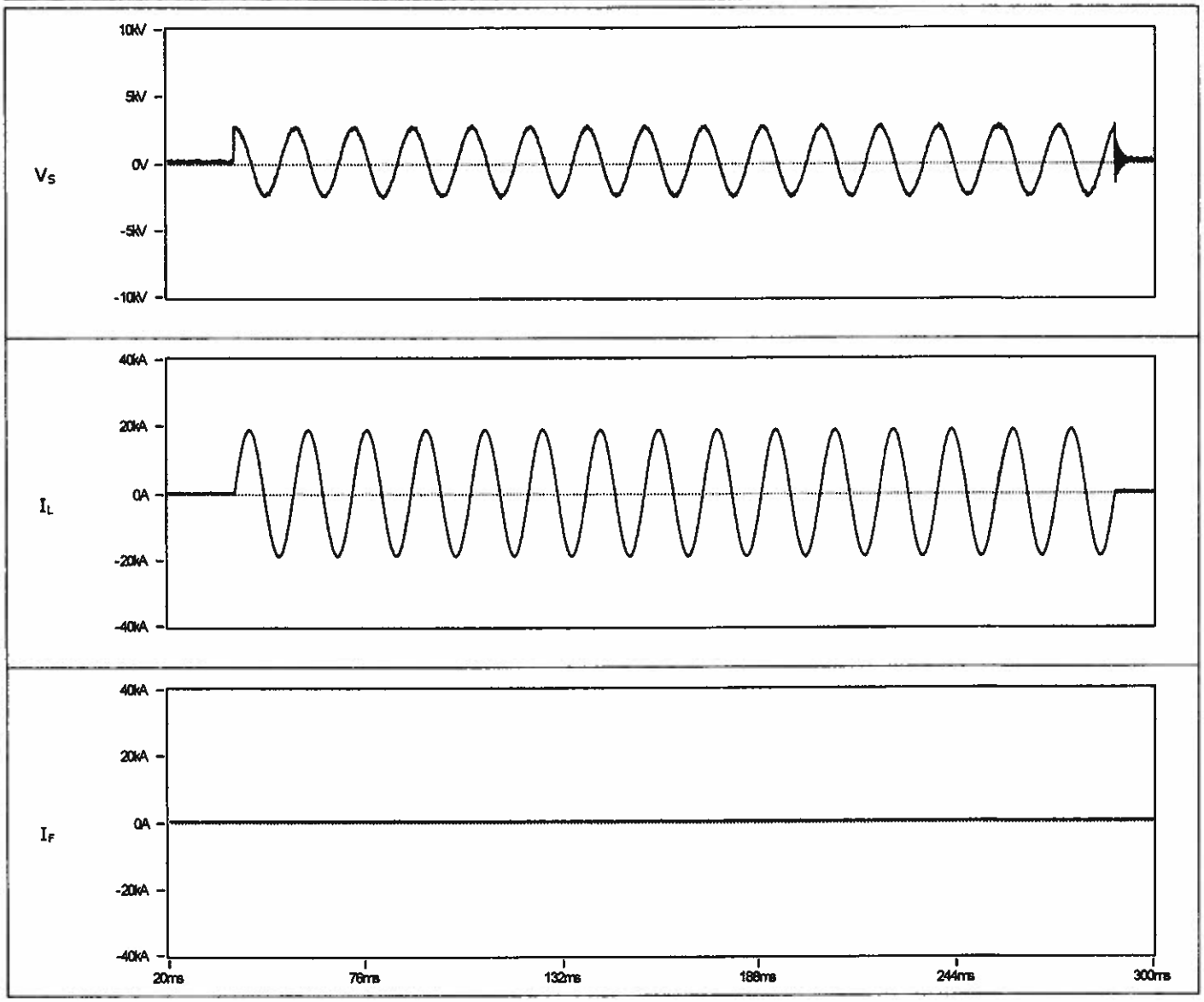


Application 3		RMS	Peak			RMS	Peak
Source side voltage	V_S	2,27 kV	-	Load side current	I_L	11,29 kA	29,35 kA
Switch position	-16			Current Duration	250 ms		

Apl154 (580x160)

Date - Application timing: 02/27/2019 - 10:01:09

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

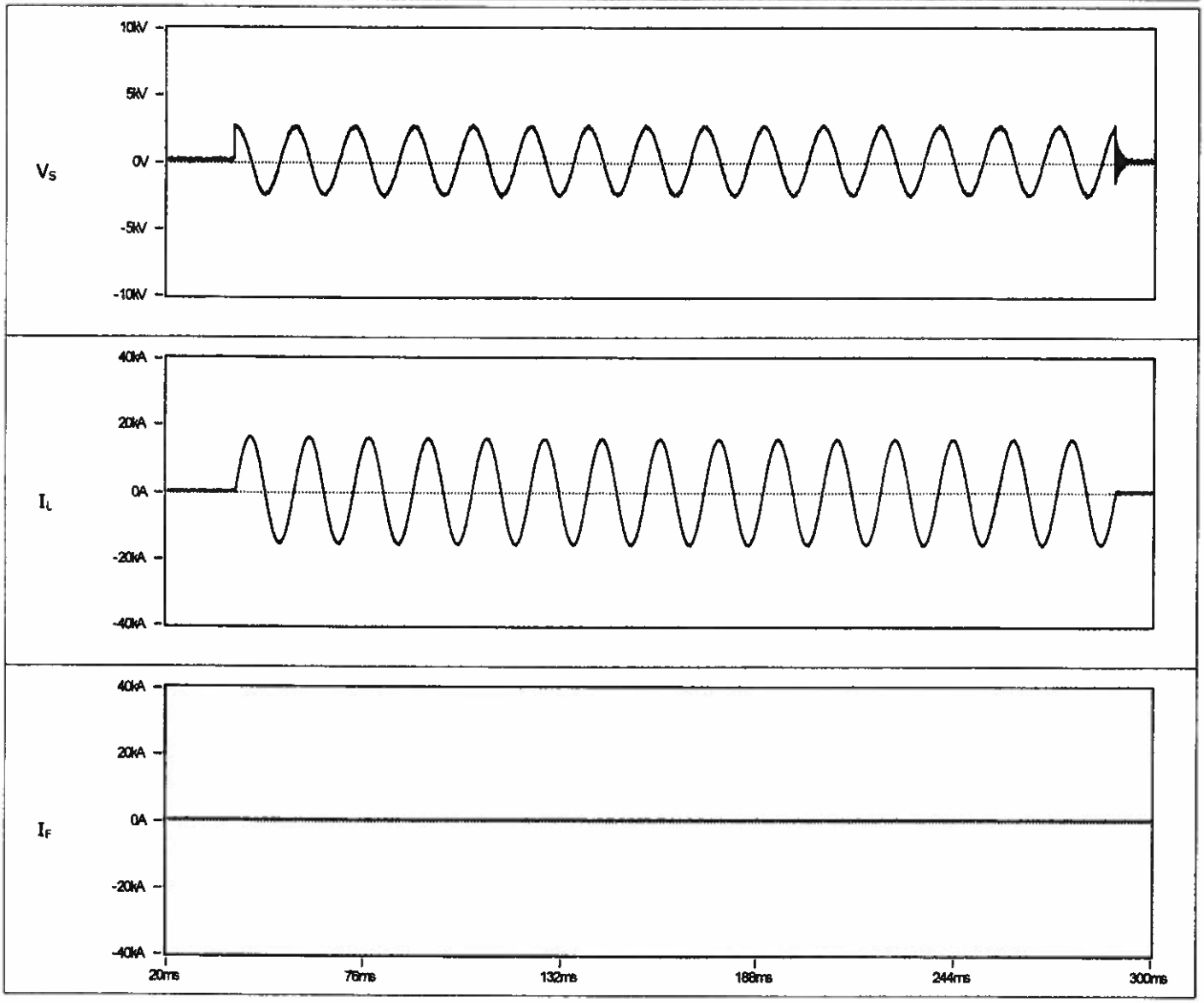


Application 4		RMS	Peak			RMS	Peak
Source side voltage	V_S	1,88 kV	-	Load side current	I_L	11,91 kA	17,05 kA
Switch position	+16			Current Duration	250 ms		

Apl156 (580x160)

Date - Application timing: 02/27/2019 - 10:38:31

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

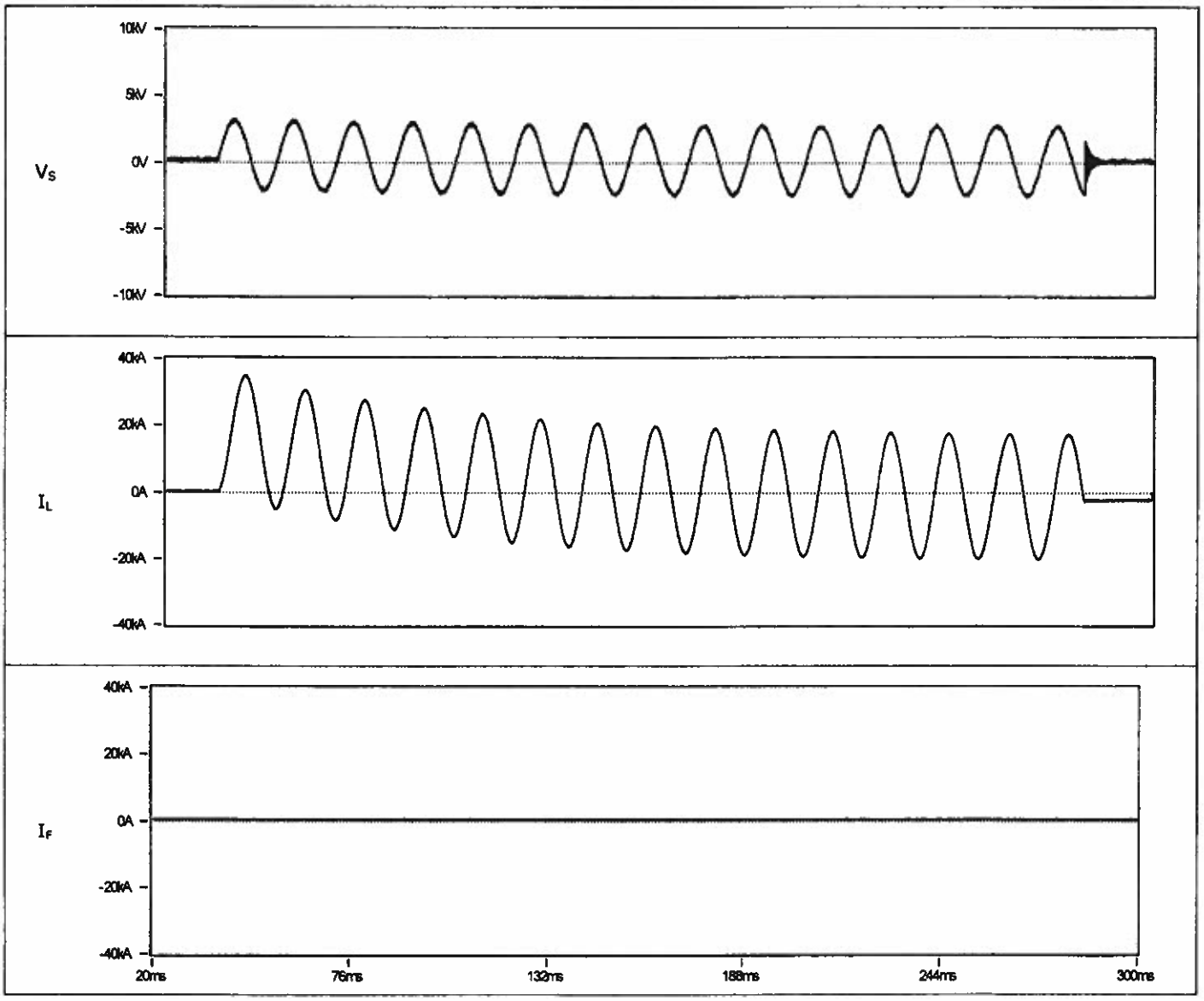


Application 5		RMS	Peak			RMS	Peak
Source side voltage	V_S	1,88 kV	-	Load side current	I_L	12,02 kA	17,00 kA
Switch position	+16			Current Duration	250 ms		

Apl157 (580x160)

Date - Application timing: 02/27/2019 - 10:57:12

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.



Application 6		RMS	Peak			RMS	Peak
Source side voltage	V_S	1,87 kV	-	Load side current	I_L	12,08 kA	31,08 kA
Switch position	+16			Current Duration	250 ms		

Apl158 (580x160)

Date - Application timing: 02/27/2019 - 11:09:34

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

inductance measurements

Instrument	Hameg programable LCR
calibration certificate	CA1-141/2016
next calibration	July/ 2019

position	terminals	before (µH)	after (µH)	variation (%)
+16	SL - L	166,99	170,62	2,17
-16	SL - L	184,46	187,94	1,89

environment temperature	28 °C	31 °C
environment humidity	68%	70%
date	02/27/2019	02/27/2019

The maximum overall uncertainty value of the inductance measurement system is 2,33 (k = 2,00).

The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA-4/02.

final remarks

a) The picture 1 (page 12) shows the tested voltage regulator.
b) There was no meaningful variation between current rms values in the beginning and in the end of each one of the six current applications performed.
c) The routine tests before and after the short-circuit test were not carried out by CEPEL.
d) The inspection of the active part, after the test, was not effectuated by CEPEL.

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

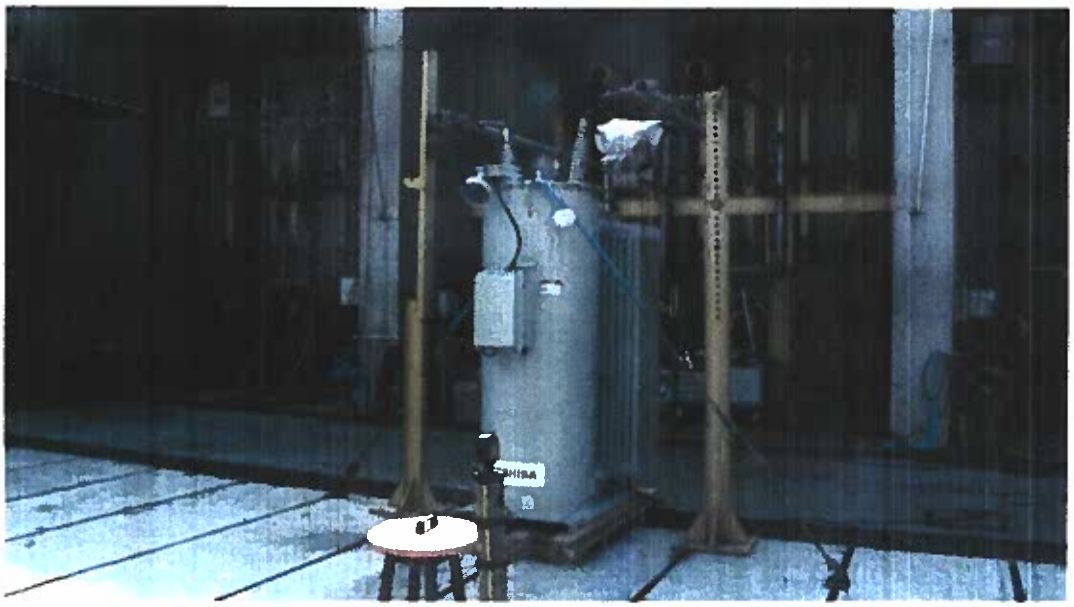
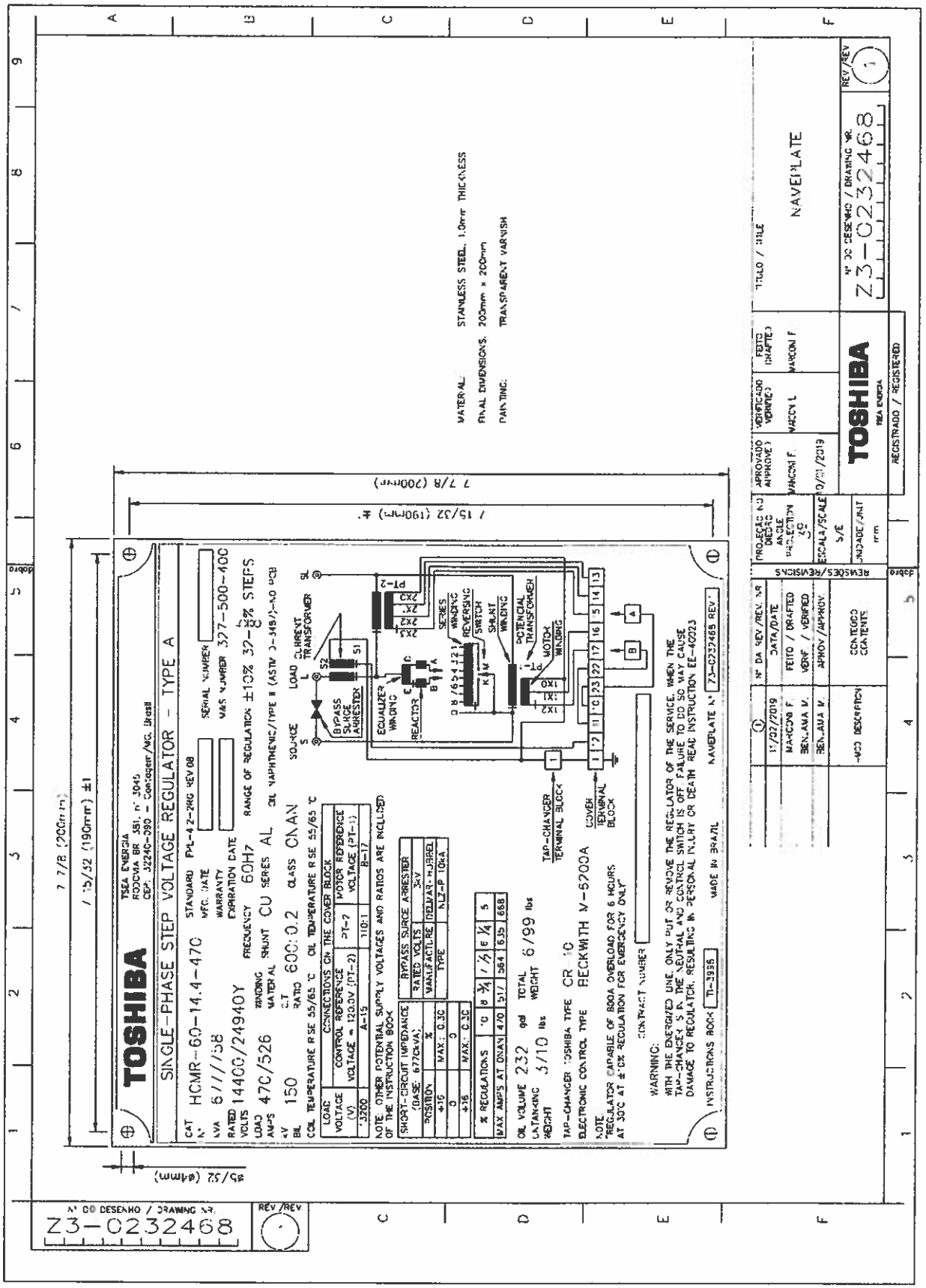
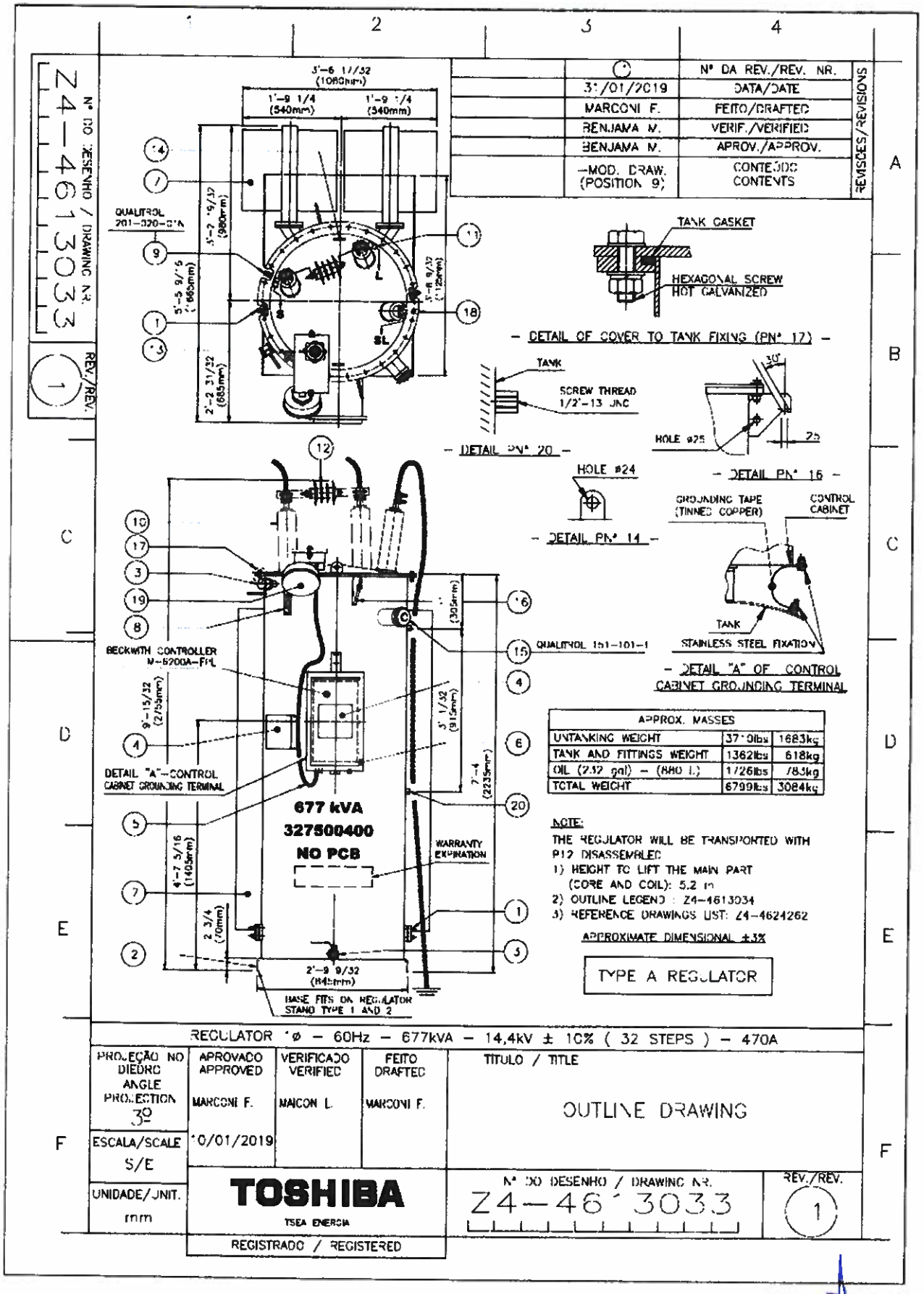


Photo 1 – test arrangement.

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.



RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.



RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

TSEA energia

Fabricando Transformadores marca Toshiba

Transformadores e Serviços de Energia das Américas
Rodovia BR-381, nº 3045 – Bairro Amazonas
CEP: 32240-090 - Contagem/MG, Brasil
Tel.: (31) 3329-6340 – Fax.: (31)3329-6699

Fecha: 17 de mayo de 2021
Cliente: ELECTROPAR S.A.
Ref.: Convocatoria de la Licitación 396223 - LPI1627-21 Adquisición de Equipos de Líneas de Distribución - LOTE 3
Propuesta: PF-E – 033/21

LISTA DE PLANOS, ENSAYOS Y CATALOGOS

ITEM Reguladores de tensión monofásicos 23kV – 300A – 690kVA

1) LISTA DE PLANOS

MATERIAL	PLANO
Terminal de Puesta a Tierra	Z4-4624404R0
Gabinete de Control TVC-MP	Z4-4624102R1
Indicador de Posición	Z4-4623797R2
Base del regulador	Z4-4624388R0
Descargador Serie 6kV	Z4-4623774R3
Descargador shunt 21Kv	Z4-4622438R3
Tapa de Inspección	Z4-4622963R3
Plano de referencia	Z4-4624403R0
Termómetro del aceite	Z4-4622443R3
Indicador de Nivel de Aceite	Z4-4622372R2
Bloque de Terminales	Z4-4622164R4
Válvula de Alivio de Presión	Z4-4622172R3
Boquilla	Z4-4621560R4
Válvula Esférica	Z4-4620382R6
Lista de Croquis de Regulador	Z4-4613142R0
Croquis de Regulador	Z4-4613141R0
Placa de características	Z3-0232592R0
Instrucciones para especificación de pintura para reguladores de tensión	ES-46991R0
Guia de remessa	GR-1919231R0
Diagrama del control	Z3-4731417R0

2) LISTA DE CATALOGOS

MATERIAL	PLANO
Manual del Regulador	ES-40023R3
Manual del TVC-MP control	ES-55259

3) LISTA DE ENSAYOS

MATERIAL	PLANO
Ensayos del control TVC-MP	Ensayos del control TVC-MP
Ensayos del regulador	Ensayos del regulador

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

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Para descargar los documentos arriba, por favor acceda el enlace abajo:

https://framcapital-my.sharepoint.com/:f:/g/personal/jonathan_silva_tseaenergia_com_br/EgWIAs0nZR1EpLpgurtUQZoBDWIcA-yX40VXPzQg0PGk0g?e=gCfopn

RODOLFO PEREZ
Representante Legal
ELECTROPAR S.A.

TOSHIBA
Leading Innovation

Manual de Instrucciones para

REGULADORES DE TENSIÓN MONOFÁSICOS

TOSHIBA eco style

ES-40023 Revisión 3 - Abril/2015

TOSHIBA AMÉRICA DO SUL LTDA.

RODOLFO PEREZ
Representante Legal
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