DNV·GL

KEMA TYPE TEST CERTIFICATE OF COMPLETE TYPE TESTS

Object	Bay control unit		**1522-19**
Type	DS Agile C264	**Serial No.**	See chapter 2.2

Rated input voltage	110-250 Vdc 110-250 Vac	Ethernet ports	4 (Up to 6)
		Optical ports	4 (Up to 6)
Mechanical class	1	EMC emission class	A
Device reliability class	1	EMC immunity location	G, H, P

Manufacturer	GE Renewable Energy, Grid Solutions, Stafford, United Kingdom, Pallavaram, India *) The manufacturer assembles the products at the sites listed here.
Client	GE Renewable Energy, Grid Solutions, Montpellier, France
Tested by	KEMA.V., Arnhem, the Netherlands
Date of tests	19 July 2016 to 28 April 2017 and 6 November 2018 to 1 April 2019

The object, 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 the complete type test requirements of

IEC 61850-3:2013

The results are shown in the record of proving tests and the oscillograms attached hereto. The values obtained and the general performance are considered to comply with the above standard(s) and to justify the ratings assigned by the manufacturer as listed on page 7.

This Certificate applies only to the object tested. The responsibility for conformity of any object having the same type references as that tested rests with the Manufacturer.
*) as declared by the manufacturer

This Certificate consists of 229 pages in total.

KEMA B.V.

Bas Verhoeven
Director, High-Voltage Laboratory

KEMA Laboratories

Arnhem, 29 December 2019

INFORMATION SHEET

1 KEMA Type Test Certificate

A KEMA Type Test Certificate contains a record of a series of (type) tests carried out in accordance with a recognized standard. The object tested has fulfilled the requirements of this standard and the relevant ratings assigned by the manufacturer are endorsed by DNV GL. In addition, the object's technical drawings have been verified and the condition of the object after the tests is assessed and recorded. The Certificate contains the essential drawings and a description of the object tested. A KEMA Type Test Certificate signifies that the object meets all the requirements of the named subclauses of the standard. It can be identified by gold-embossed lettering on the cover and a gold seal on its front sheet.
The Certificate is applicable to the object tested only. DNV GL is responsible for the validity and the contents of the Certificate. The responsibility for conformity of any object having the same type references as the one tested rests with the manufacturer.
Detailed rules on types of certification are given in DNV GL's Certification procedure applicable to KEMA Laboratories.

2 KEMA Report of Performance

A KEMA Report of Performance is issued when an object has successfully completed and passed a subset (but not all) of test programmes in accordance with a recognized standard. In addition, the object's technical drawings have been verified and the condition of the object after the tests is assessed and recorded. The report is applicable to the object tested only. A KEMA Report of Performance signifies that the object meets the requirements of the named subclauses of the standard. It can be identified by silver-embossed lettering on the cover and a silver seal on its front sheet.
The sentence on the front sheet of a KEMA Report of Performance will state that the tests have been carried out in accordance with …… The object has complied with the relevant requirements.

3 KEMA Test Report

A KEMA Test Report is issued in all other cases. Reasons for issuing a KEMA Test Report could be:

- Tests were performed according to the client's instructions.
- Tests were performed only partially according to the standard.
- No technical drawings were submitted for verification and/or no assessment of the condition of the object after the tests was performed.
- The object failed one or more of the performed tests.

The KEMA Test Report can be identified by the grey-embossed lettering on the cover and grey seal on its front sheet.
In case the number of tests, the test procedure and the test parameters are based on a recognized standard and related to the ratings assigned by the manufacturer, the following sentence will appear on the front sheet. The tests have been carried out in accordance with the client's instructions. Test procedure and test parameters were based on ..... If the object does not pass the tests such behaviour will be mentioned on the front sheet. Verification of the drawings (if submitted) and assessment of the condition after the tests is only done on client's request.
When the tests, test procedure and/or test parameters are not in accordance with a recognized standard, the front sheet will state the tests have been carried out in accordance with client's instructions.

4 Official and uncontrolled test documents

The official test documents of DNV GL are issued in bound form. Uncontrolled copies may be provided as a digital file for convenience of reproduction by the client. The copyright has to be respected at all times.

TABLE OF CONTENTS

1 SUMMARY

By order of the client type tests according to IEC 61850-3 have been performed on the test object.

Test / Measurement	Test result
Dimensions of structure and visual inspection	Passed
Functional requirements	Passed
Product safety	Passed
Electromagnetic compatibility (EMC)	Passed
Burden tests	Passed
Climatic environmental conditions	Passed
Mechanical environmental conditions	Passed
Enclosure protection	Passed

This report encloses the additional test results for the modified C264. The modified C264 encloses one TMU220 module and one of the three variants of the TMU210 (with sensible Ie current transformers 0,01 A/ 0,05 A/ 0,5 A) and a variant of the DIU module the DIU221.

The original report lists the type test results on a HW66 enclosing one TMU220 module and HW67 enclosing two TMU220 modules. The modified C264 is thus one variant of the model C264 product range.

The modification consists of;

1. Modified PSU BIU261D
2. Modified HBU200, piggy back board carrying the MOV's. protective sheet applied on the top side of the HBU200
3. Addition of a new DIU221 module
4. Addition of a new TMU 210 module.

The PSU modification consists of;

1. Main board:

- Replacement of R76 and R135: VB3000001 replaced with A01004717 (Higher power current sense resistors 50 mOhm)
- Addition of A01004658 TVS
- Changing of L3 (from A01001106 to A01005066)
- Changing of the PCB; PCB Blank updated for TVS footprint

2. Daughter board:

- Addition of F1 (A01004709) 5A fuse – Schematics and BOM updated,
- Changing of the PCB; PCB Blank up issued for inclusion of Fuse
- Changing of the power rating to avoid the resistors R49-R52 burning on a continuous power on/off cycle, R49-R52 with 1W power rating have been changed to R49-R52 with 3W power rating.

The manufacturer declares the C264 assembly is done at Stafford UK or at Pavalavaram India depending on the order placed.
The board manufacturing is done by external suppliers, the same suppliers are used by Stafford UK and Palavaram India assembly sites.
The C264 used for the type test originates from Stafford UK.

2 IDENTIFICATION OF THE OBJECT TESTED

2.1 Ratings/characteristics of the object tested

Rated auxiliary voltage	110-250 Vdc +/- 20% 110-250 Vac +/- 20 %
Rated frequency	50/60 Hz
Output contact continuous current (watchdog, alarm)	2 A
Output contact continuous current (DOU201, CCU)	5 A
Output contact continuous current (HBU200)	10 A
Output contact continuous current (AOU200)	2,5 A
CT nominal input current	1/5 A
VT nominal input voltage	57,73- 500,0 V
Maximum operating temperature (version with LCD display)	55 °C
Minimum operating temperature (version with LCD display)	-25 °C
Maximum operating temperature (version without LCD display)	65 °C
Minimum operating temperature (version without LCD display)	-40 °C
Maximum storage temperature	70 °C
Minimum storage temperature	-40 °C

Classification

IP-class	IP 2X
IP-class TMU220 connector	IP 1X
Mechanical class	1
EMC emission class	A
Reliability class	1
EMC immunity location	G, H, P
Signal connections	Local connections/ Field connections/ Telecommunication/ Connections within a protected area
Overvoltage category	III
Pollution degree	2
Insulation type	Basic/double/reinforced

2.2 Description of the object tested

Manufacturer (as stated by the client)	GE Renewable energy, Grid Solutions Stafford, United Kingdom, Pallavaram, India
Type	C264 (HW66/HW67) and C264 (HW66, HW67, TMU 210 and DIU221 with CPU4)
Object	DS Agile C264 control unit

IED 1, Sample HW66

Slot	Module	Hardware	Software
A	BIU261_D	ZP0028001_G6	-
B	CPU4		-
C	SRP-v2 Switch Board	ZP0015003_A2	-
D	AIU211	2071652_A11	-
E	DOU201	2071730A1_C4	-
F	CCU211	2071732_B6	-
G	AOU200	2071441_E1	IC27_MSP430_PWM_20
H, I, J, K, L, M, N, O	DIU211	2071669_C2	-
P	HBU200	ZP0026001_H2	-
Q	TMU220	2071613A01_G7	-

IED 2, Sample HW67

Slot	Module	Hardware	Software
A	BIU261_D	ZP0028001_G6	-
B	CPU4		-
C	SRP-v2 Switch Board	ZP0015003_A2	-
D	AIU211	2071652_A11	-
E	DOU201	2071730A1_C4	-
F	CCU211	2071732_B6	-
G	AOU200	2071441_E1	IC27_MSP430_PWM_20
H, I, J, K, L	DIU211	2071669_C2	-
M	HBU200	ZP0026001_H2	-
N, O	TMU220	2071613A02_A8	-

IED 3, Sample HW67

Slot	Module	Hardware	Software
A	BIU261_D	ZP0028001_G6	-
B	CPU4		-
C	SRP-v2 Switch Board	ZP0015003_A2	-
D	AIU211	2071652_A11	-
E	DOU201	2071730A1_C4	-
F	CCU211	2071732_B6	-
G	AOU200	2071441_E1	IC27_MSP430_PWM_20
H, I, J, K, L	DIU211	2071669_C2	-
M	HBU200	ZP0026001_H2	-
N, O	TMU220	2071613A02_A8	-

Test object HW 66 board positions

Slot A: Power Supply (BIU261D)
Slot B: CPU4
Slot C: Switch Board (SRPv2)
Slot D: Analogue Input Board (AIU211)
Slot E: Digital Output Board (DOU201)
Slot F: Control Unit (CCU211)
Slot G: Analogue Output (AOU200)
Slot H: Digital Input (DIU211)
Slot I: Digital Input (DIU211)
Slot J: Digital Input (DIU211)
Slot K: Digital Input (DIU211)
Slot L: Digital Input (DIU211)
Slot M: Digital Input (DIU211)
Slot N: Digital Input (DIU211)
Slot O: Digital Input (DIU211)
Slot P: High Break / High Speed Board (HBU200)
Slot Q: Analogue Input Board (TMU220)

Test object HW 67 board positions

Slot A: Power Supply (BIU261D)
Slot B: CPU4
Slot C: Switch Board (SRPv2)
Slot D: Analogue Input Board (AIU211)
Slot E: Digital Output Board (DOU201)
Slot F: Control Unit (CCU211)
Slot G: Analogue Output (AOU200)
Slot H: Digital Input (DIU211)
Slot I: Digital Input (DIU211)
Slot J: Digital Input (DIU211)
Slot K: Digital Input (DIU211)
Slot L: Digital Input (DIU211)
Slot M: High Break / High Speed Board (HBU200)
Slot N: Analogue Input Board (TMU220)
Slot O: Analogue Input Board (TMU220)

IED 4, 5 and 6 Samples C264 with TMU210 (0,5 A respectively, 0,05 A and 0,01 A versions) and DIU221

Slot	Module	Hardware	Software
A	BIU261_D	GP0021001_B ZP0027001_G ZP0028001_I	ZP0027_IC2_R316 BIU261-FR-DB_SEC_DC_V2.5.0
B	CPU4	ZP0016001_J9 ZP0063001_B4	H49-2.0.0.2 image_sd_prod_cpu4_1010-b01
C	SRPv2	ZP0015001_R1 ZP0020001_L1	srp282-2.1.1.0-build03_failSafe U2_Power_Supply_Firmware
D	AIU211	2071652_C	AIU211_IC34_V2Z AIU211_IC35_V2Z
E	DOU201	2071730A01_D1	2071730_IC1_V1A
F	CCU211	2071732_C1	2071732IC25_C6
G	AOU200	2071441_F	IC1_MSP430_PPC_30.d43_V1A IC2_CPLD_V1B IC27_MSP430_PWM_20_V1A
H	DIU221	ZP0062001_A8	ZP0062001_FPGA V0.5 ZP0062_SW_IC9-IC16_DIU221_ADC.V1.08.production
I, J, K, L	DIU211	ZP0011001_C	2071669IC55_applicatif_V1F
M	HBU200	ZP0026001_H6 ZP0072001_A3 GP0103001_A	ZP0026_FW_IC1_CONTROL_V1.1 ZP0026_SW_IC2x_HBU_CHANNEL_CONTROL.SVN404.V_2_0
N	TMU220	2071613A01_G9	2071613D1_V1Z
O	TMU210 case Ax X=[3:1]	2071370A0x_C 2071469A0x_F	Master 2071370 IC9 V1D

Test object C264 board descriptions

Slot A : Power Supply (BIU261D)
Slot B : CPU Board (CPU4)
Slot C : Switch Board (SRPv2)
Slot D : Analog Input Board (AIU211)
Slot E : Digital Output Board (DOU201)
Slot F : Control Unit (CCU211)
Slot G : Analog Output (AOU200)
Slot H : Digital Input (DIU221)
Slot I : Digital Input (DIU211)
Slot J : Digital Input (DIU211)
Slot K : Digital Input (DIU211)
Slot L : Digital Input (DIU211)
Slot M : High Break / High Speed Board (HBU200)
Slot N : CT/VT Board (TMU220)
Slot O : CT/VT Board (TMU210)

2.3 List of drawings

According to the client the following drawings and/or documents number(s) refer(s).
KEMA Laboratories has not verified these drawings and/or documents.

Drawings HW66/HW67

Drawing no./document no.	Revision
2071441_E1 AOU200	-
2071441IssueStatus	E1
2071613A01_G7 TMU220	-
2071613A01_G7IssueStatus	G7
2071613A02_A8 TMU220	-
2071613A02_A8 IssueStatus	A8
2071652_A11 AIU211	-
2071652_A10IssueStatus	A10
2071669_C2 DIU211	-
20712071669IssueStatus	C2
2071730A1_C4 DOU201	-
2071730A01_C4IssueStatus	C4
2071732_B6 CCU211	-
2071732_B6IssueStatus	B6
ZP0027001_F3	-
ZP0027_IssueStatus_F3	F3
LVDR0054I_C264_BIU261_ZP0027_ZP0028	A
ZP0015003_A2	-
ZP0015003_IssueStatus	A2
ZP0015003-A2 SRP V2	-
ZP0015003_IssueStatus	A2
ZP0026001_H.2 HBU CPLD	-
ZP0026_H.2 IssueStatus	H2
ZP0028001_G6 BIU261 daughter board	G6
ZP0028_G6.IssueStatus	G6
020_C26x_enSA_C60 safety manual	-
2071441IssueStatus	E1
C264.309006-001 High Speed High Break Specification	A7
C264-0005-002 A7 Universal Input Power Supply Specification	A7
C264H-492-001 C264 Final Instrument Flash Test Specification	A7
LVDR0054L	I
LVDR0054Z	F
PACIS47x-MiCOMComputers-090816-1504-12	-
Pxxx-SG-4LM-2	-

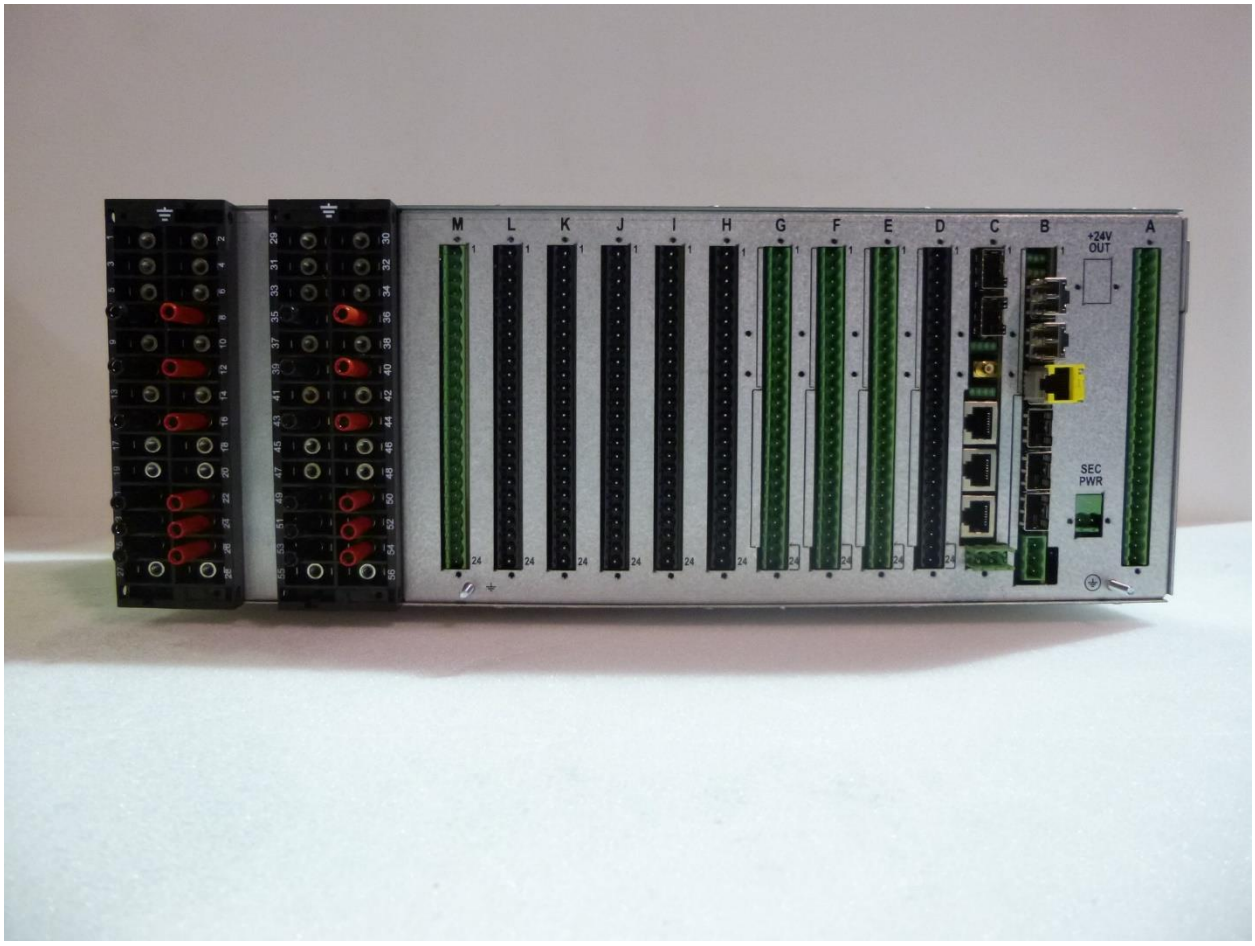
Drawings C264

Drawing no./document no.	Revision
2071441_F AOU200	F
2071441_F_IssueStatus	F
TMU210A01_2071370A01_C TMU210 version A01	C
2071370A01_C_IssueStatus	C
TMU210A01_2071469A01_F TMU210 version A01	F
2071469A01_F_IssueStatus	F
TMU210A02_2071370A02_C TMU210 version A02	C
2071370A02_C_IssueStatus	C
TMU210A02_2071469A02_F TMU210 version A02	F
2071469A02_F_IssueStatus	F
TMU210A03_2071370A03_C TMU210 version A03	C
2071370A03_C_IssueStatus	C
TMU210A03_2071469A03_F TMU210 version A03	F
2071469A03_F_IssueStatus	F
2071613A01_G9 TMU220	G9
2071613A01_G9IssueStatus	G9
AIU211_2071652_C AIU211	C
2071652_C_IssueStatus	C
DIU211_ZP0011001_C DIU211	C
ZP0011001_C_IssueStatus	C
DIU221_ZP0062001_A8 DIU221	A8
ZP0062001_A8_IssueStatus	A8
DOU201_2071730A1_D1 DOU201	D1
2071730A01_D1IssueStatus	D1
CCU211_2071732_C1 CCU211	C1
2071732_C1_IssueStatus	C1
BIU261_MB_ZP0027001_G BIU261_MB	G
ZP0027_IssueStatus_G	G
BIU261_DB_ZP0028001_I BIU216_DB	I
ZP0028_I.IssueStatus	I
BIU261D_GP0027001_B	B
GP0027001_B_IssueStatus	B
CPU4_GlobalA_ZP0063001_B4	B4
ZP0063001_IssueStatus_B4	B4
CPU4_ZP0016001_J9	J9
ZP0016001_IssueStatus_J9	J9
HBU200_MB_ZP0026001_H6 HBU-MB	H6
ZP0026_H.6 IssueStatus	H6
HBU200_DB_ZP0072001_A3 HBU-DB	A3
ZP0072001_IssueStatus_A.3	A3
HBU200_GlobalA_GP0103001_A	A
GP0103001_A_IssueStatus	A
SRPv2_GlobalA_ZP0020001_L01 SRPV2 board	L01
ZP0020001_IssueStatus	L01
DS agile C26x System Technical Manual	7.0.3.
TMU210 C26x/EN FT/HW/CO Functional HW description TMU210	-

2.4 Photograph of test object

HW66

HW67



HW67

HW67

HW67

C264 with TMU210 (0,5 A / 0,05 A / 0,01 A version) and DIU221 modules

Label C264 with TMU210-A03 0,01 A module version

Label C264 with TMU210-A02 0,05 A module version

Label C264 with TMU210-A01 0,5 A module version

3 GENERAL INFORMATION

3.1 The tests were witnessed by

The tests were carried out without a representative of the client present.

3.2 The tests were carried out by

Name	Company
Peter Hildering	KEMA B.V.
Gert van Wee	Arnhem, the Netherlands

3.3 Reference to other reports

Report No	Tests report id
16-2452	Test report of the PRP functional performance test in GE Grid Solutions ….
16-2453	Test report of the functional PTP test of GE Grid Solutions …
16-2454	Test report of the HSR functional performance test in GE Grid Solutions…

3.4 Subcontracting

The following tests were subcontracted to DEKRA, Arnhem, the Netherlands:

- measurement of radiated emission in accordance with IEC 61850-3 and CISPR22
- measurement of conducted emission in accordance with IEC 61850-3 and CISPR22.
- test of radiated EM field immunity in accordance with IEC 61850-3 and IEC 61000-4-3.

The following test was subcontracted to Thales, Hengelo, the Netherlands (the additional test results for the modified C264):

- test of radiated EM field immunity in accordance with IEC 61850-3 and IEC 61000-4-3.

The following tests were subcontracted to Sebert Trillingstechniek, Bergschenhoek, the Netherlands:

- test of vibration response and endurance in accordance with IEC 60255-21-1
- test of shock response and withstand in accordance with IEC 60255-21-2
- bump test in accordance with IEC 60255-21-2
- seismic test in accordance with IEC 60255-21-3.

3.5 Purpose of the tests

Purpose of the tests was to verify whether the material complies with the specified requirements.

3.6 Measurement uncertainty

A table with measurement uncertainties is enclosed in this Certificate. Unless otherwise stated, the measurement uncertainties of the results presented in this Certificate are as indicated in that table.

3.7 Laboratory environmental conditions

Tests have been performed in a controlled laboratory environment, where the environmental conditions are maintained within the applicable ranges.

Ambient temperature	15 °C – 25 °C
Relative Humidity	45% - 75%
Atmospheric pressure	86 kPa (860 mbar) to 106 kPa (1060 mbar)

When a condition has direct influence on a test, the value of the condition will be presented explicitly.

3.8 Measurement uncertainty

A table with measurement uncertainties is enclosed in this Certificate. Unless otherwise stated, the measurement uncertainties of the results presented in this Certificate are as indicated in that table.

3.9 Instruments used

A detailed list with instruments used is enclosed in this Certificate.

3.10 Standards

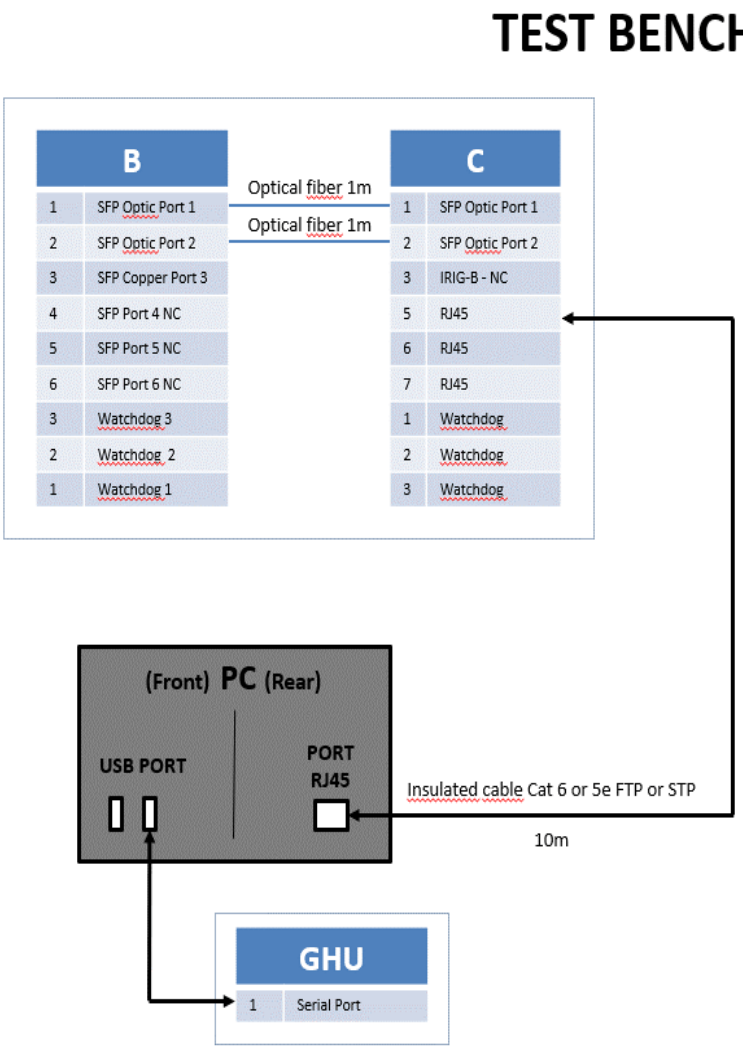
The product standard IEC 61850-3 (2013-12) refers to documents, in whole or in part, these documents are normatively referenced to in this product standard and these documents are indispensable for its application. For dated references, only the edition cited applies. For undated references the latest edition of the referenced document (including any amendments) applies. KEMA Laboratories will use the latest edition of the referenced documents (including any amendments) in all cases, also in the cases reference is made to dated editions.

4 TEST ARRANGEMENT

A general test set-up is made by connecting the DUT to a traffic generator (PC with dedicated software provided by the customer). The data stream through the equipment is 90% of the rated traffic speed.
The DUT has been configured to operate as in normal use.
The DUT has been configured (wired) with 50% binary input energized and 50% binary outputs energized as well (including HBU unit).
The DUT is powered with 110 Vdc power supply voltage (other supply voltage are mentioned when required for a test). The CT and VT inputs were energized with 1 A and 110 V respectively.

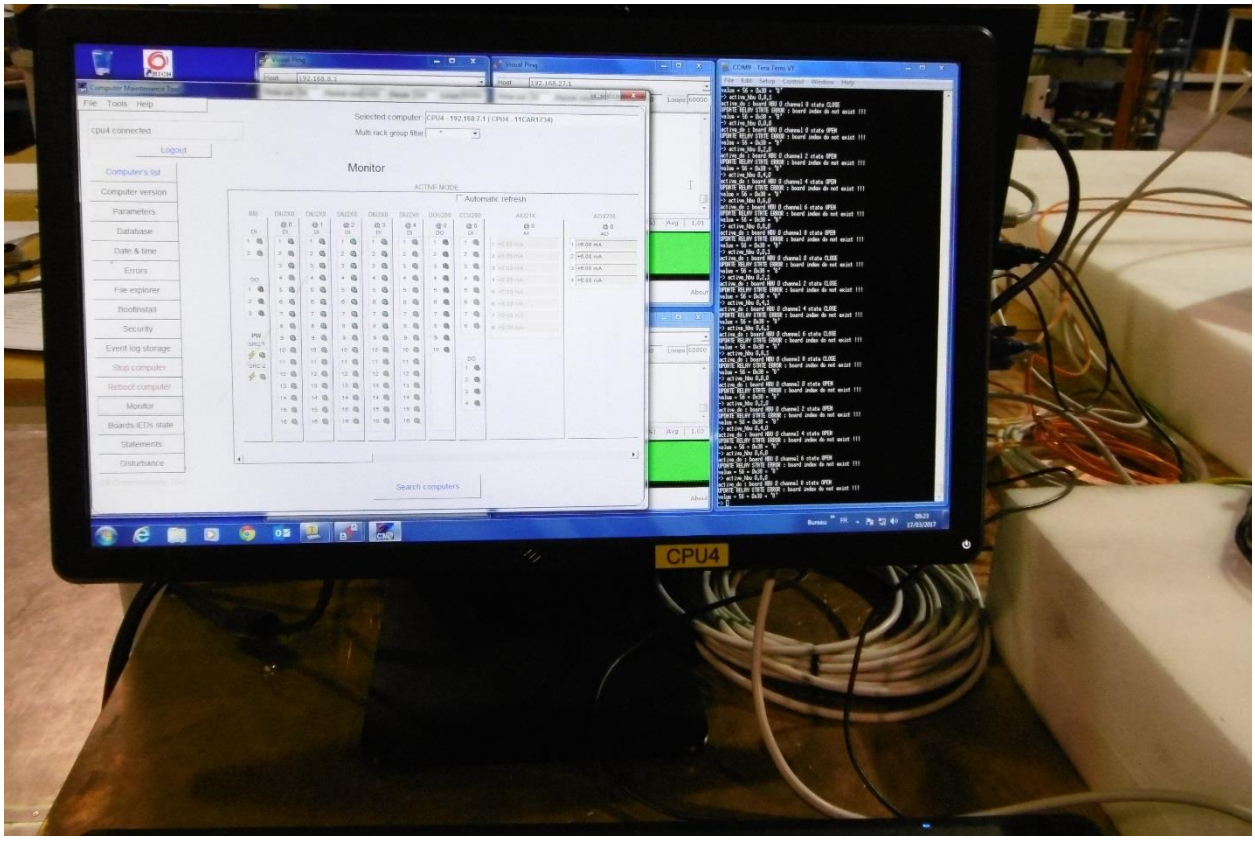
During the testing, the state of the DUT was monitored by observing:

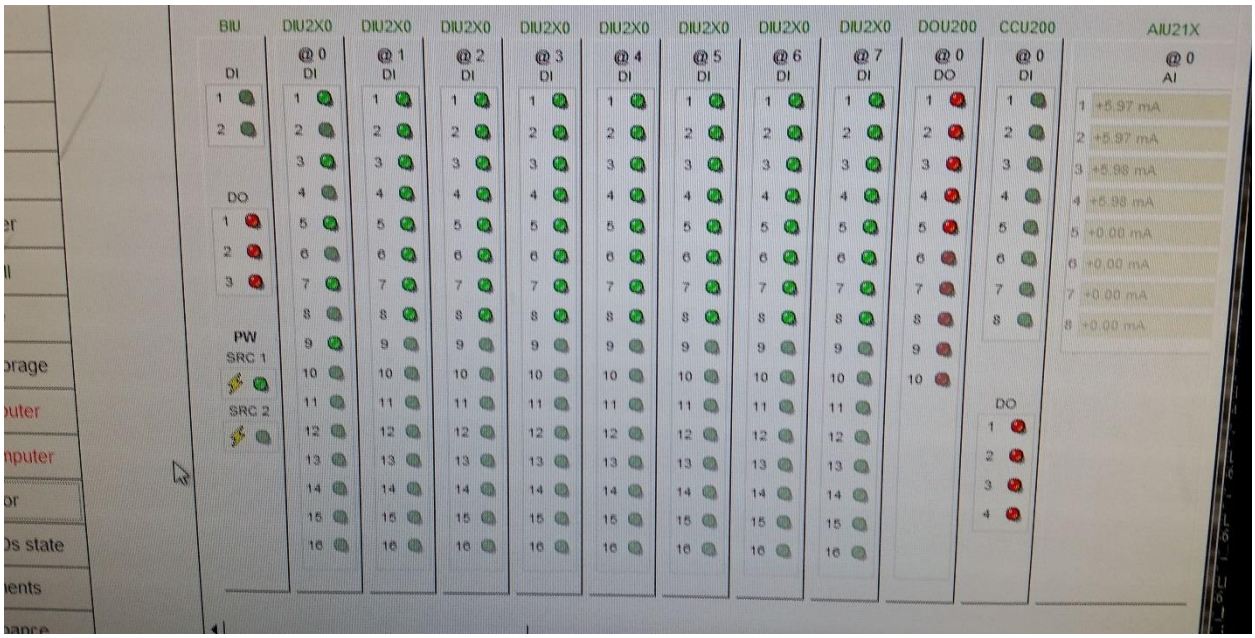
1. the display and LED's of the DUT
2. the display of the PC with dedicated software (showing the status of I/O and the data communication performance).



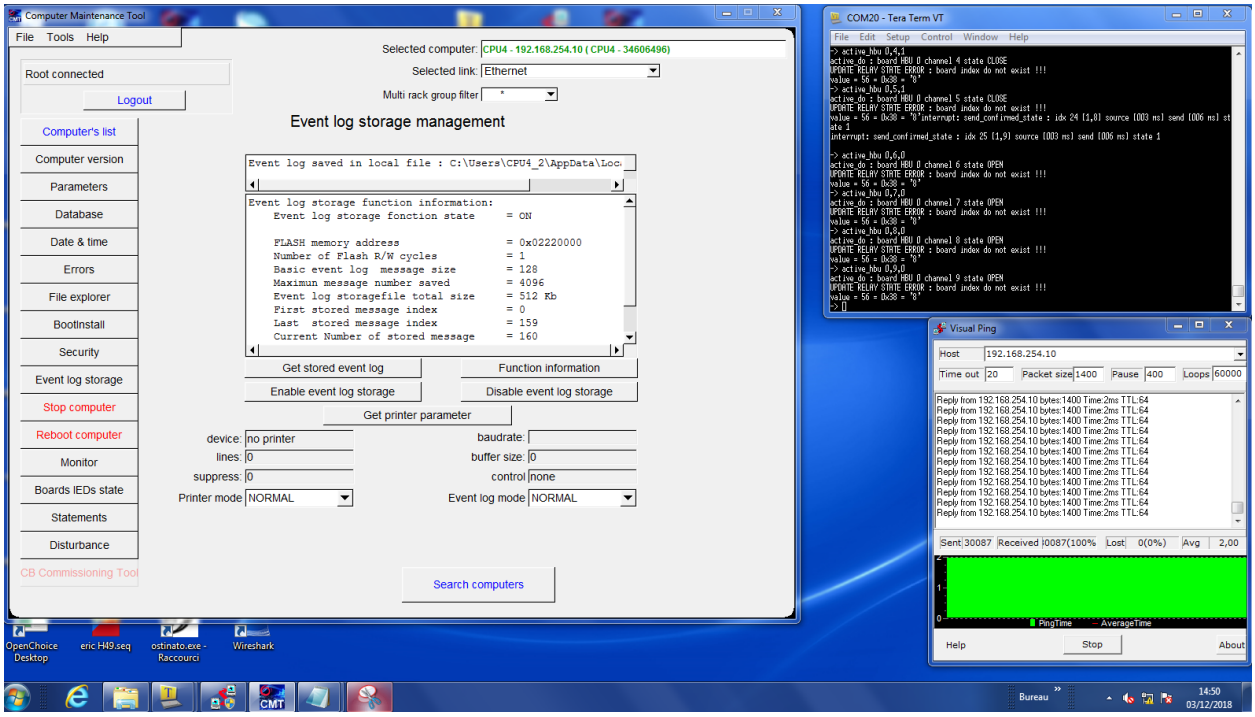
Connections of the PC (auxiliary equipment) to the test object (test bench)

Performance observation of C264 (HW66/HW67); data communication

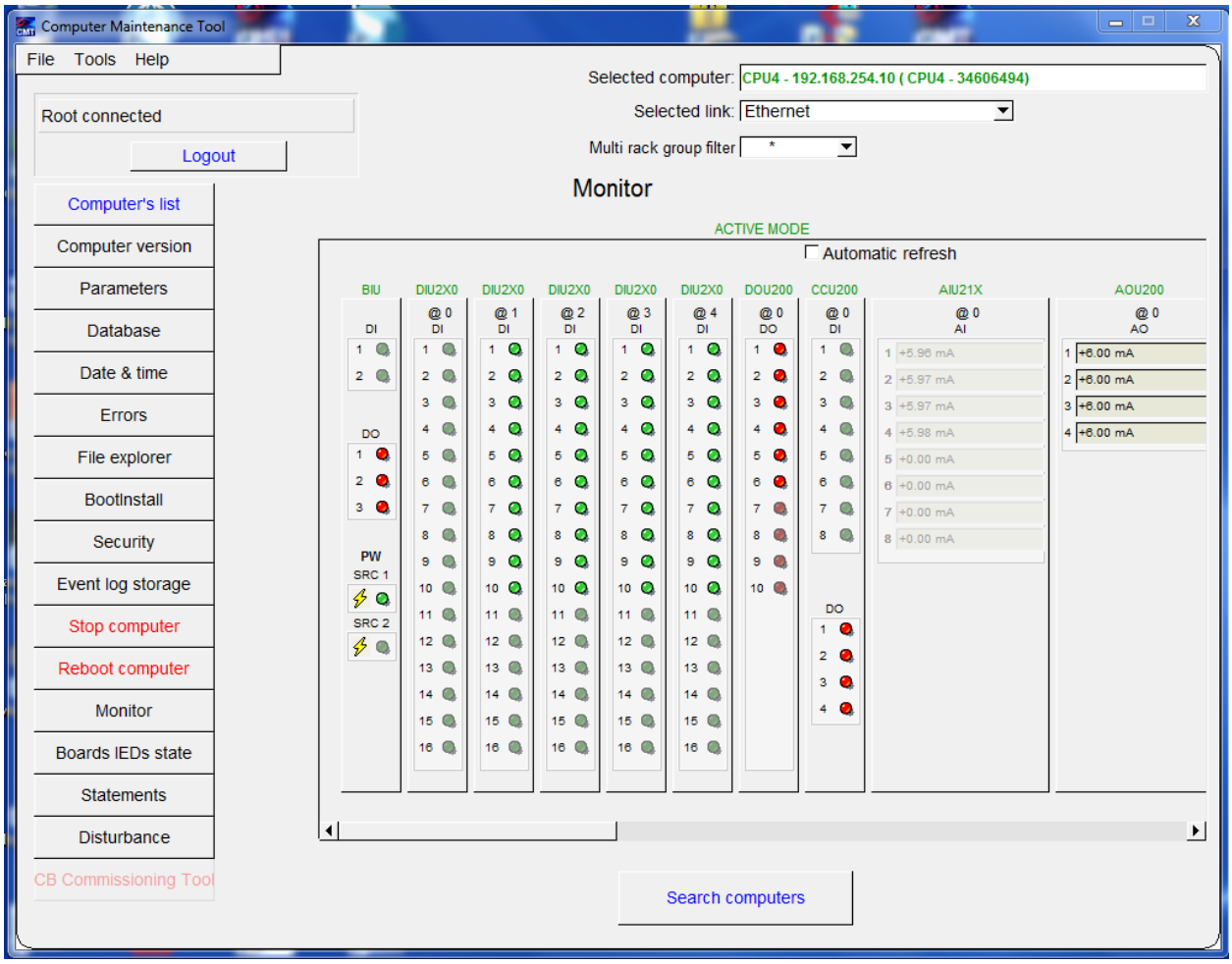




Performance observation C264 (HW66/67); status of the inputs/outputs

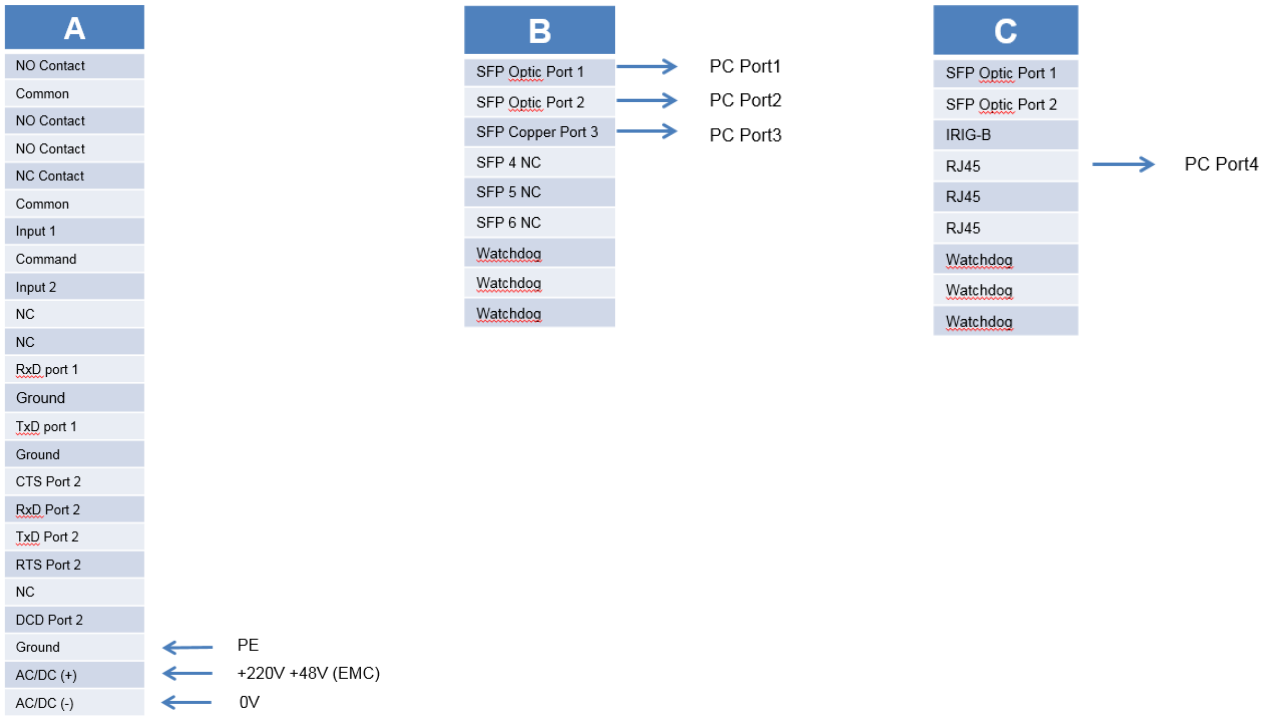


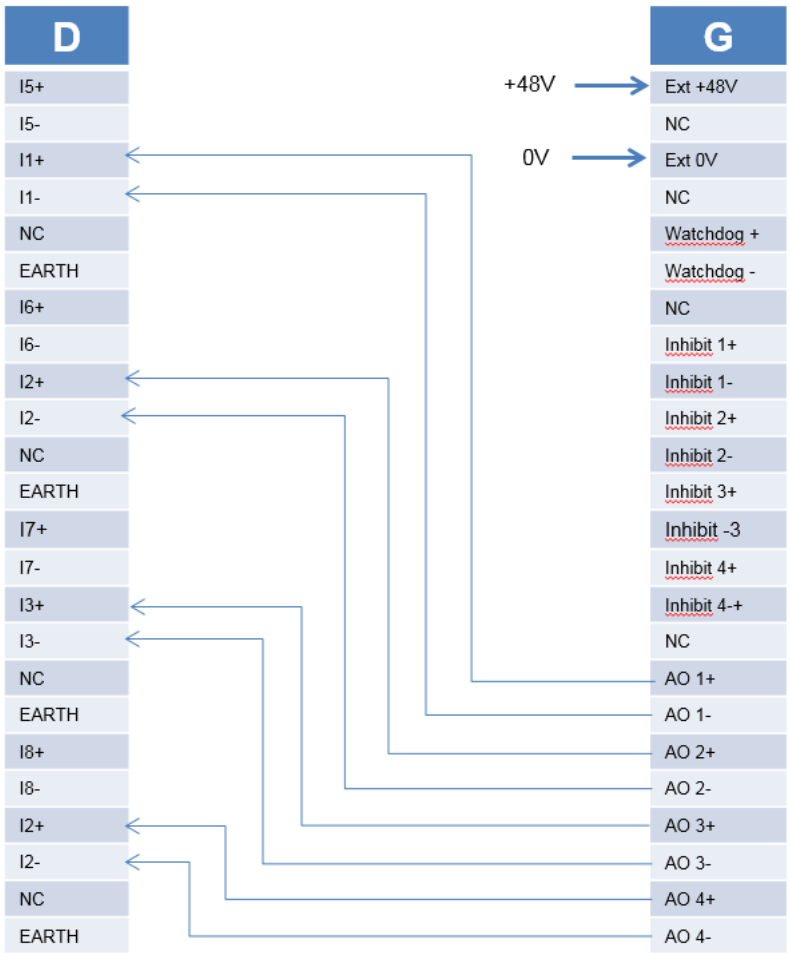
Screen capture of performance observation on the PC for C264; system logs, data communication, I/O control and I/O status.

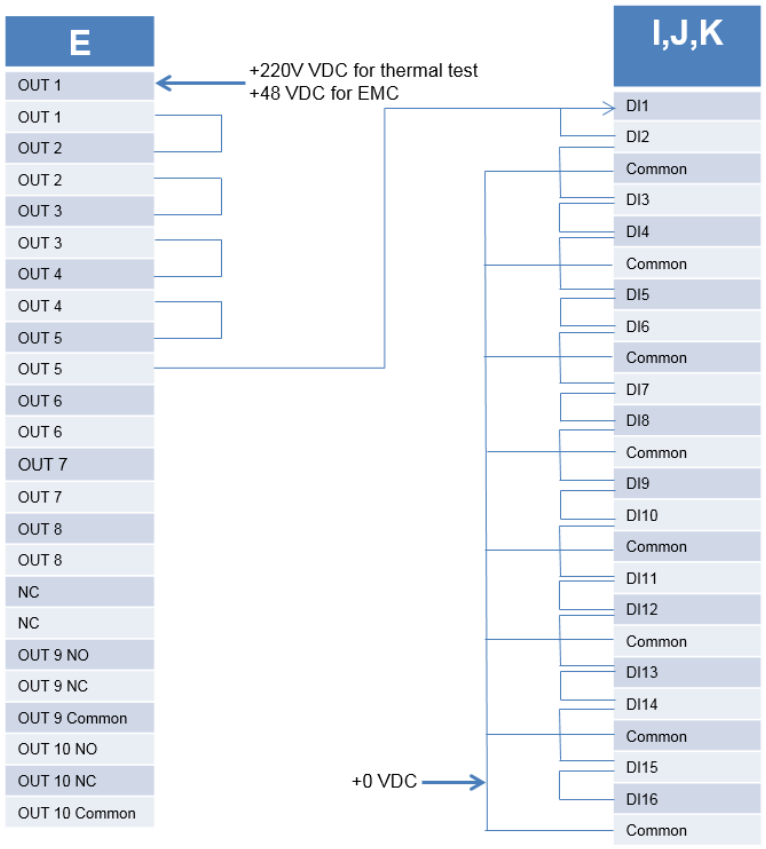


Screen capture of performance observation in the PC for C264; status of the inputs/outputs

4.1 DUT I/O connections C264 (HW66/67 models)






E
OUT 1
OUT 1
OUT 2
OUT 2
OUT 3
OUT 3
OUT 4
OUT 4
OUT 5
OUT 5
OUT 6
OUT 6
OUT 7
OUT 7
OUT 8
OUT 8
NC
NC
OUT 9 NO
OUT 9 NC
OUT 9 Common
OUT 10 NO
OUT 10 NC
OUT 10 Common
+220V VDC for thermal test
+48 VDC for EMC
+0 VDC
I,J,K
DI1
DI2
Common
DI3
DI4
Common
DI5
DI6
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DI7
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DI10
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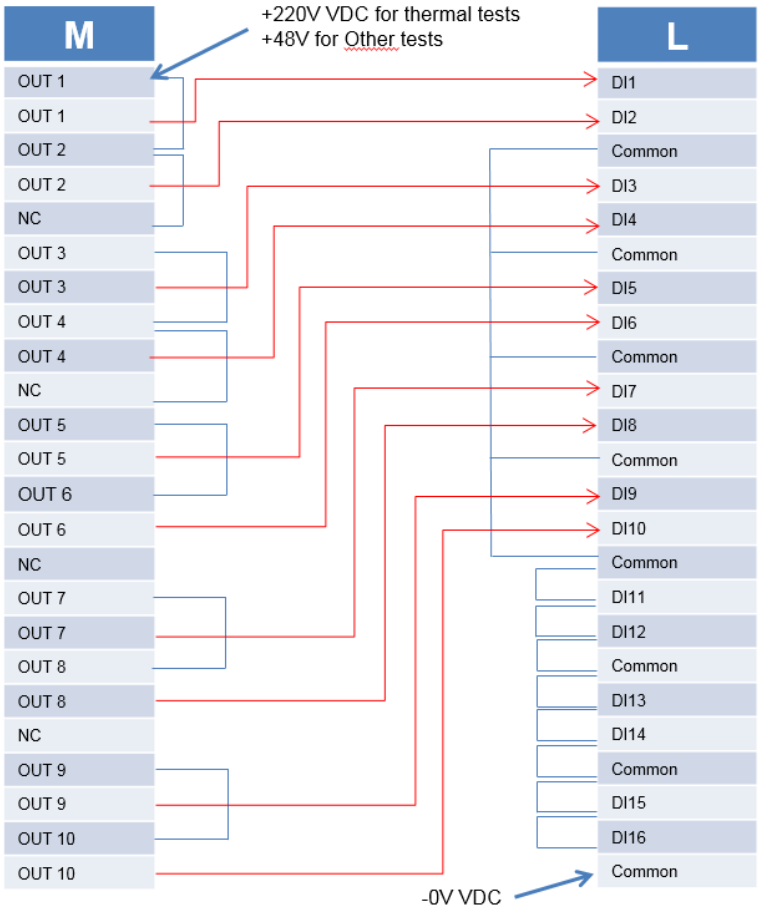
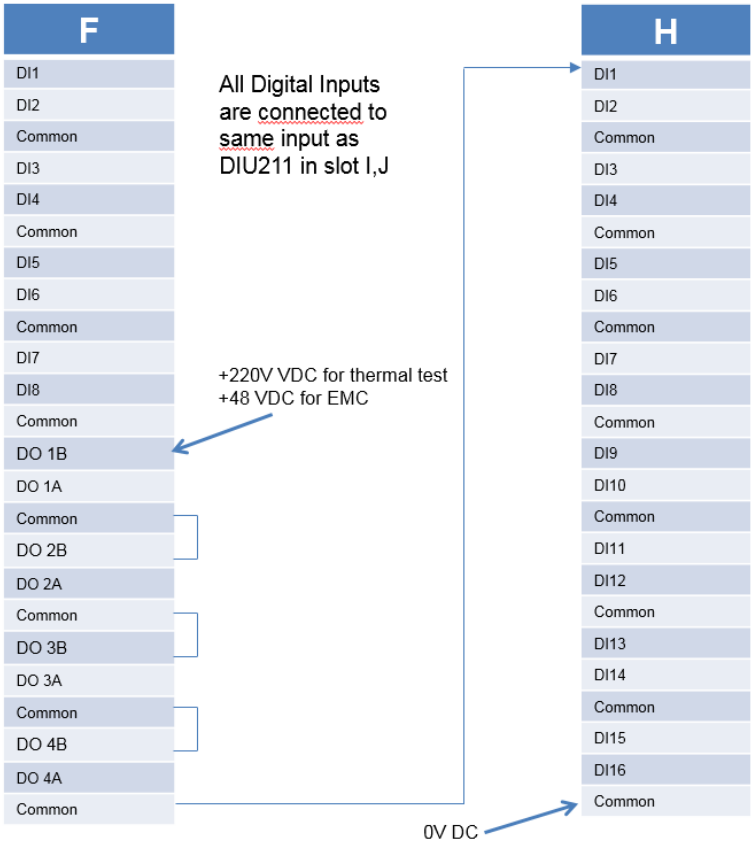
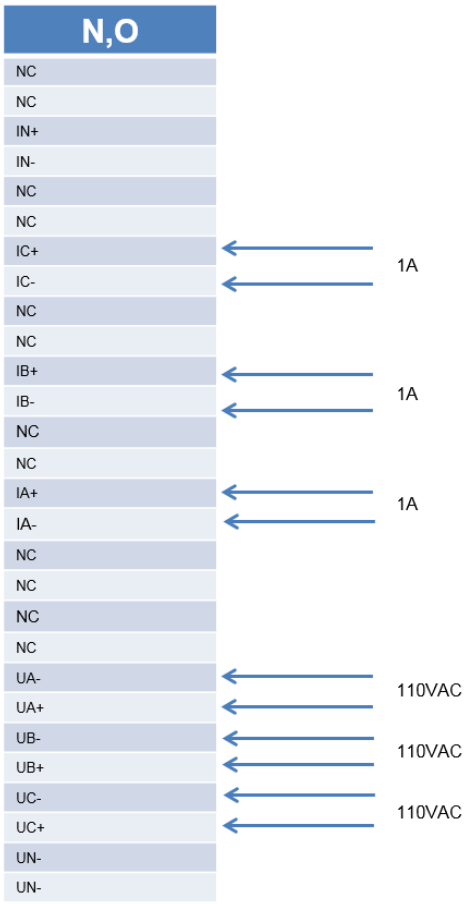
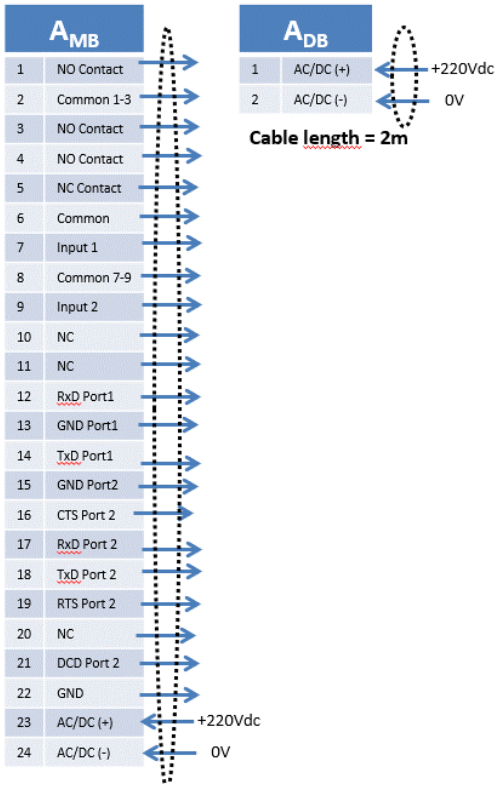
DI12
Common
DI13
DI14
Common
DI15
DI16
Common

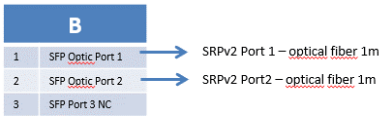

M
OUT 1
OUT 1
OUT 2
OUT 2
NC
OUT 3
OUT 3
OUT 4
OUT 4
NC
OUT 5
OUT 5
OUT 6
OUT 6
NC
OUT 7
OUT 7
OUT 8
OUT 8
NC
OUT 9
OUT 9
OUT 10
OUT 10
+220V VDC for thermal tests
+48V for Other tests
-0V VDC
L
DI1
DI2
Common
DI3
DI4
Common
DI5
DI6
Common
DI7
DI8
Common
DI9
DI10
Common
DI11
DI12
Common
DI13
DI14
Common
DI15
DI16
Common

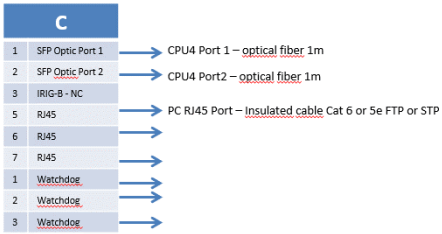

F
DI1
DI2
Common
DI3
DI4
Common
DI5
DI6
Common
DI7
DI8
Common
DO 1B
DO 1A
Common
DO 2B
DO 2A
Common
DO 3B
DO 3A
Common
DO 4B
DO 4A
Common
All Digital Inputs are connected to same input as DIU211 in slot I,J
+220V VDC for thermal test
+48 VDC for EMC
0V DC
H
DI1
DI2
Common
DI3
DI4
Common
DI5
DI6
Common
DI7
DI8
Common
DI9
DI10
Common
DI11
DI12
Common
DI13
DI14
Common
DI15
DI16
Common


N,O
NC
NC
IN+
IN-
NC
NC
IC+
IC-
NC
NC
IB+
IB-
NC
NC
IA+
IA-
NC
NC
NC
NC
UA-
UA+
UB-
UB+
UC-
UC+
UN-
UN-
1A
1A
1A
110VAC
110VAC
110VAC

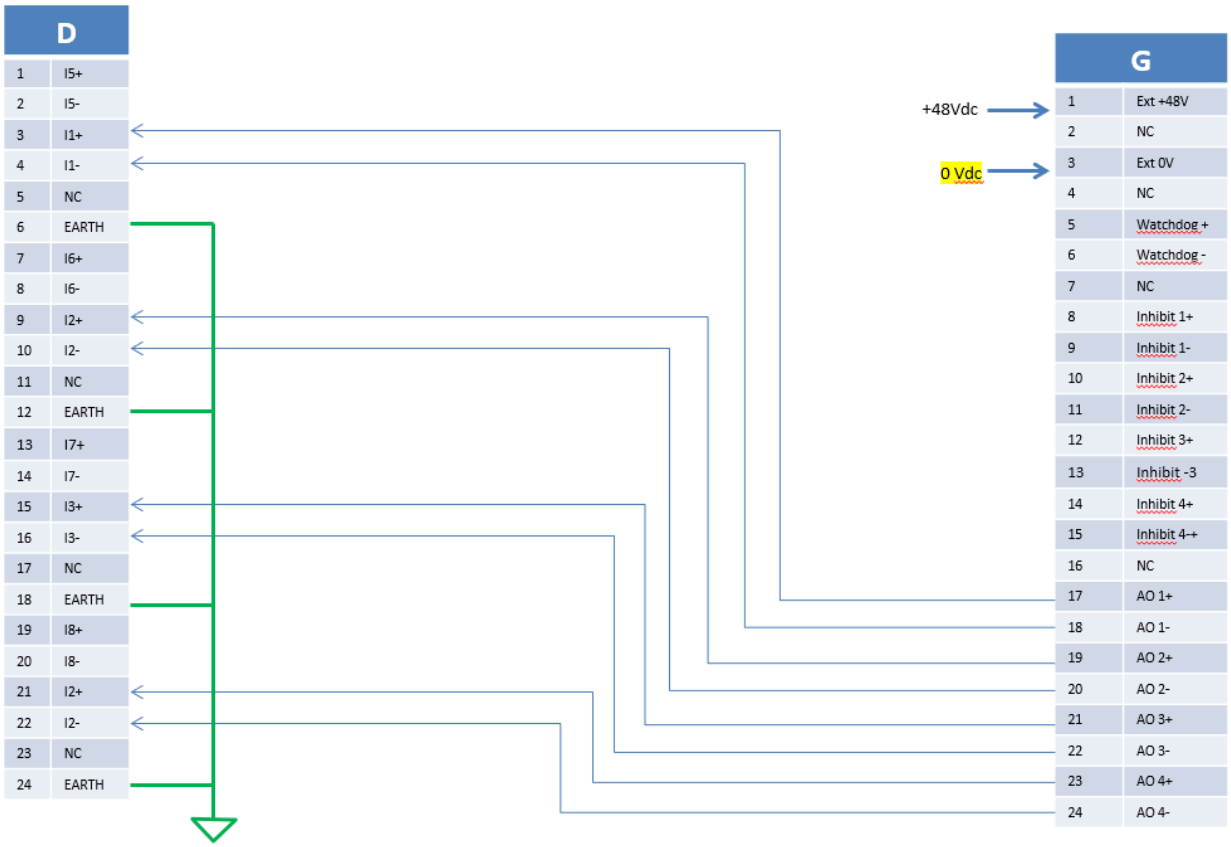
4.3 DUT I/O connections C264 with TMU210 and DIU221



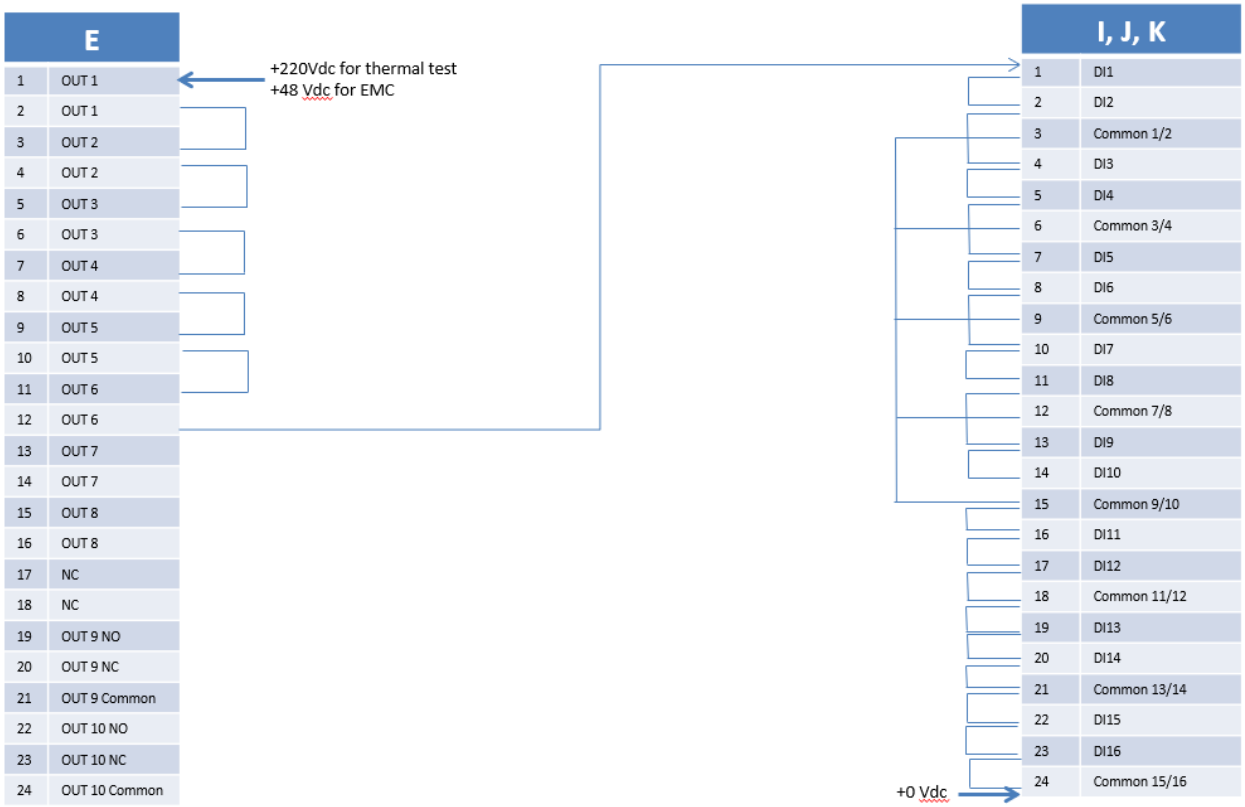




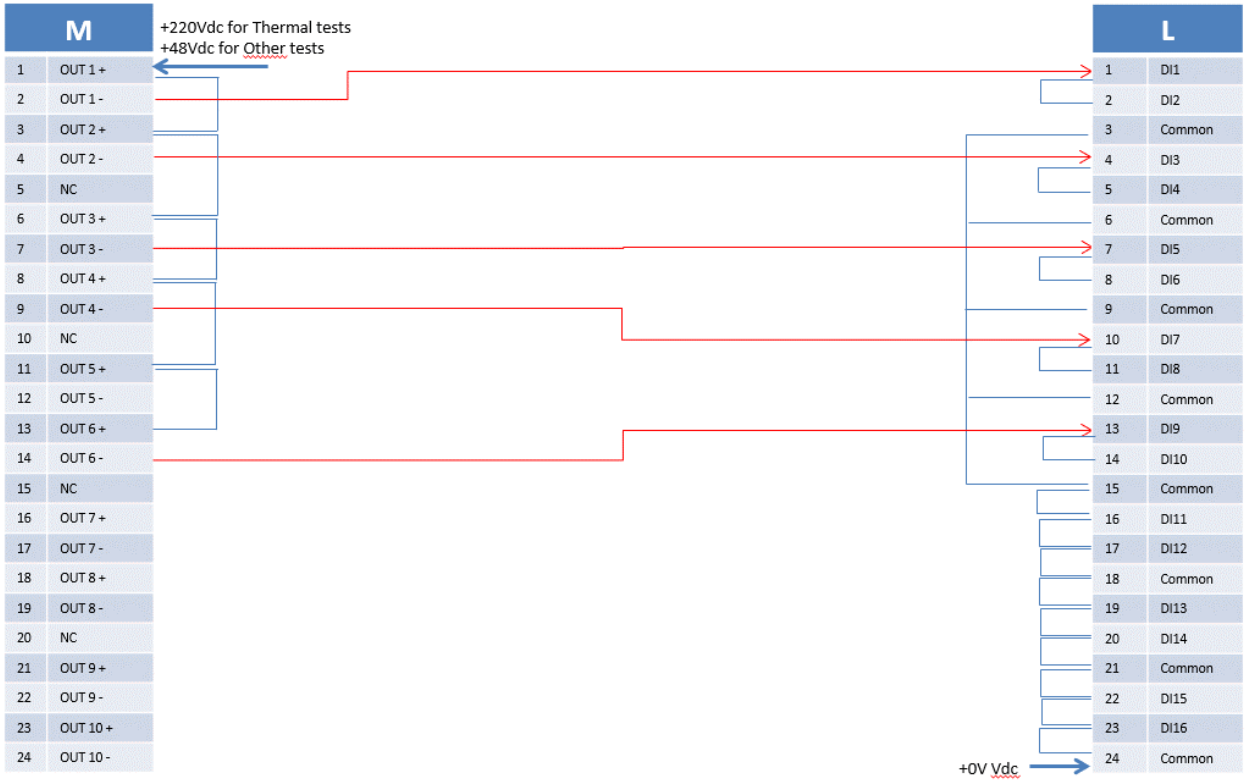
AIU211-AOU200



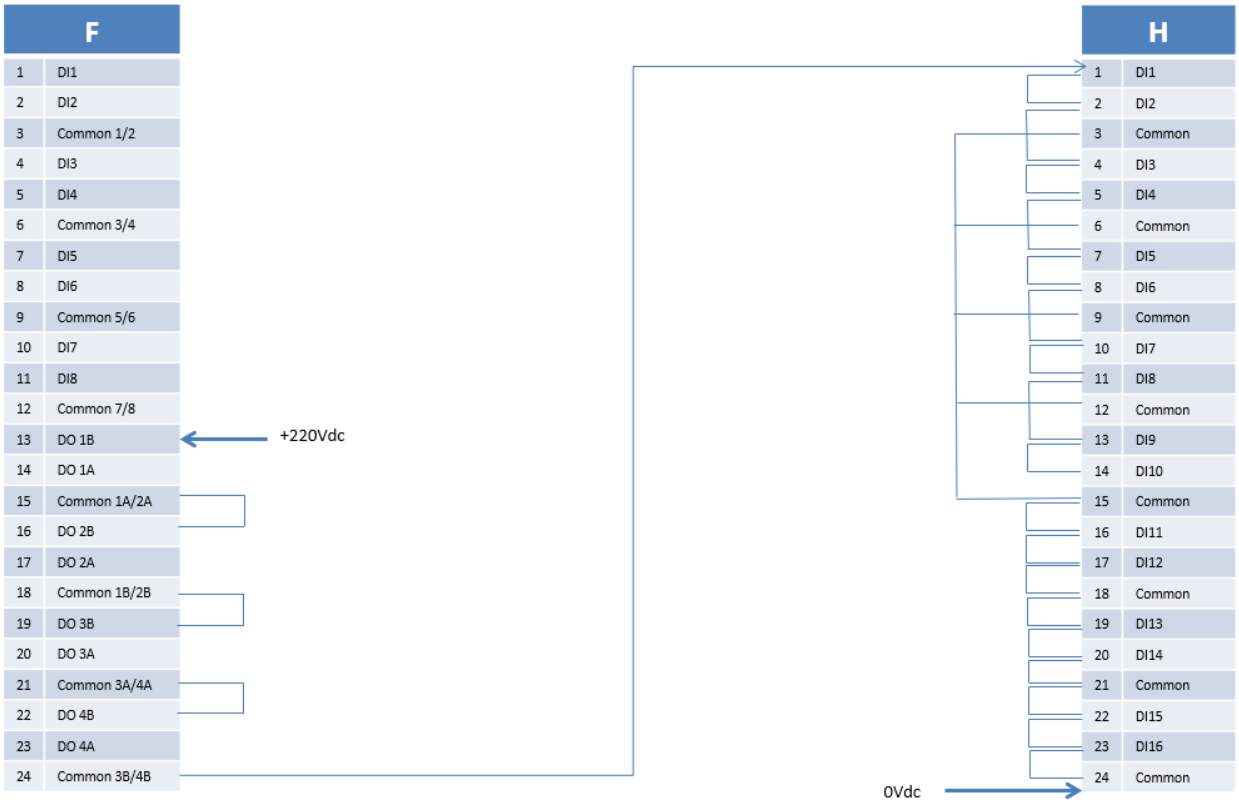
DOU201-DIU211



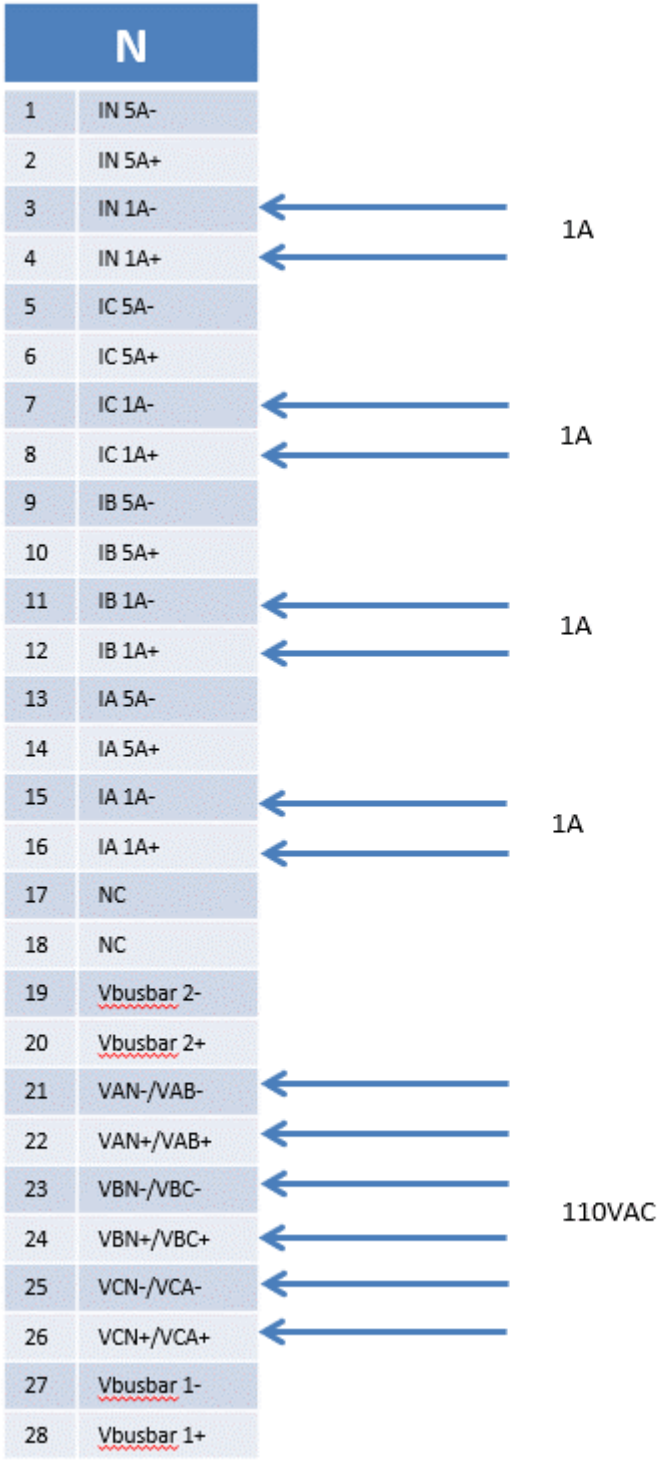
HBU200 - DIU211



CCU211 - DIU221

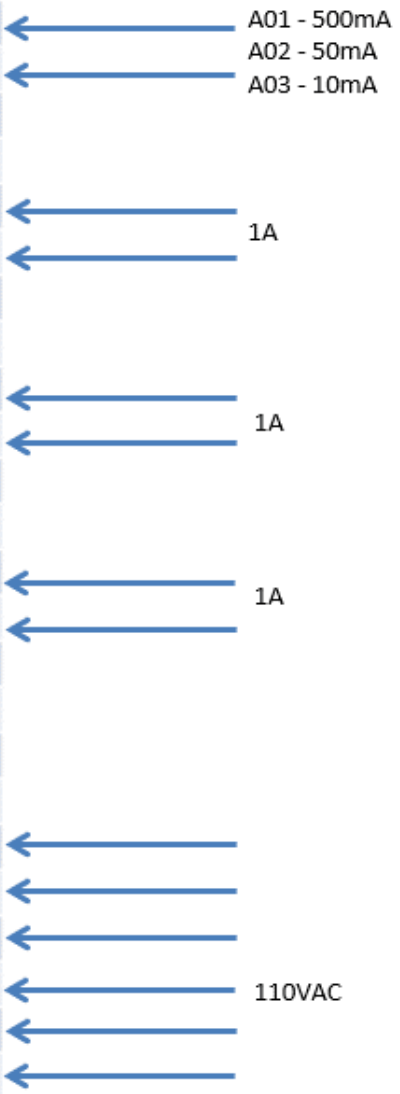


TMU220


N
1 IN 5A-
2 IN 5A+
3 IN 1A-
4 IN 1A+
5 IC 5A-
6 IC 5A+
7 IC 1A-
8 IC 1A+
9 IB 5A-
10 IB 5A+
11 IB 1A-
12 IB 1A+
13 IA 5A-
14 IA 5A+
15 IA 1A-
16 IA 1A+
17 NC
18 NC
19 Vbusbar 2-
20 Vbusbar 2+
21 VAN-/VAB-
22 VAN+/VAB+
23 VBN-/VBC-
24 VBN+/VBC+
25 VCN-/VCA-
26 VCN+/VCA+
27 Vbusbar 1-
28 Vbusbar 1+
1A
1A
1A
110VAC

TMU210-A01/A02/A03

O	
1	
2	
3	IE 1/5A -
4	IE 1/5A +
5	
6	
7	IC 1/5A -
8	IC 1/5A +
9	
10	
11	IB 1/5A -
12	IB 1/5A +
13	
14	
15	IA 1/5A -
16	IA 1/5A +
17	NC
18	NC
19	
20	
21	UA -
22	UA +
23	UB -
24	UB +
25	UC -
26	UC +
27	NC
28	NC



4.4 DUT I/O power supply

The DUT input /output (I/O) has been powered by external 48 /220 Vdc power supplies.
The total current to the input/output circuits was between 158 mA and 172 mA (C264, HW67 variant).

5 MARKING AND DOCUMENTATION

Standard and date

Standard	IEC 61850-3, subclause 6.1 and 6.2
Test date	25 to 28 April 2017 and 1 April 2019

Characteristic test data

Serial number	A160009583
Documentation	Technical manual DS Agile C26x system version: 7.0.3, Technical Manual, publication reference: C26x/EN M/E03

Requirement

- the markings on the test object shall comply with the requirements of IEC 61850-3, subclause 6.1
- the documentation of the test object shall comply with the requirements of IEC 61850-3, subclause 6.2.

Result

The object passed the test.

6 PACKAGING

Standard and date

Standard	IEC 61850-3, subclause 6.3
Test date	19 July 2016 and 6 November 2018

Requirement

The manufacturer shall ensure that the equipment is suitably packaged to withstand, without damage, reasonable handling and environmental conditions appropriate to the method(s) of transportation to the user's delivery address.

A visual inspection should be made by the user to check that the equipment has not been damaged during transportation.

Note

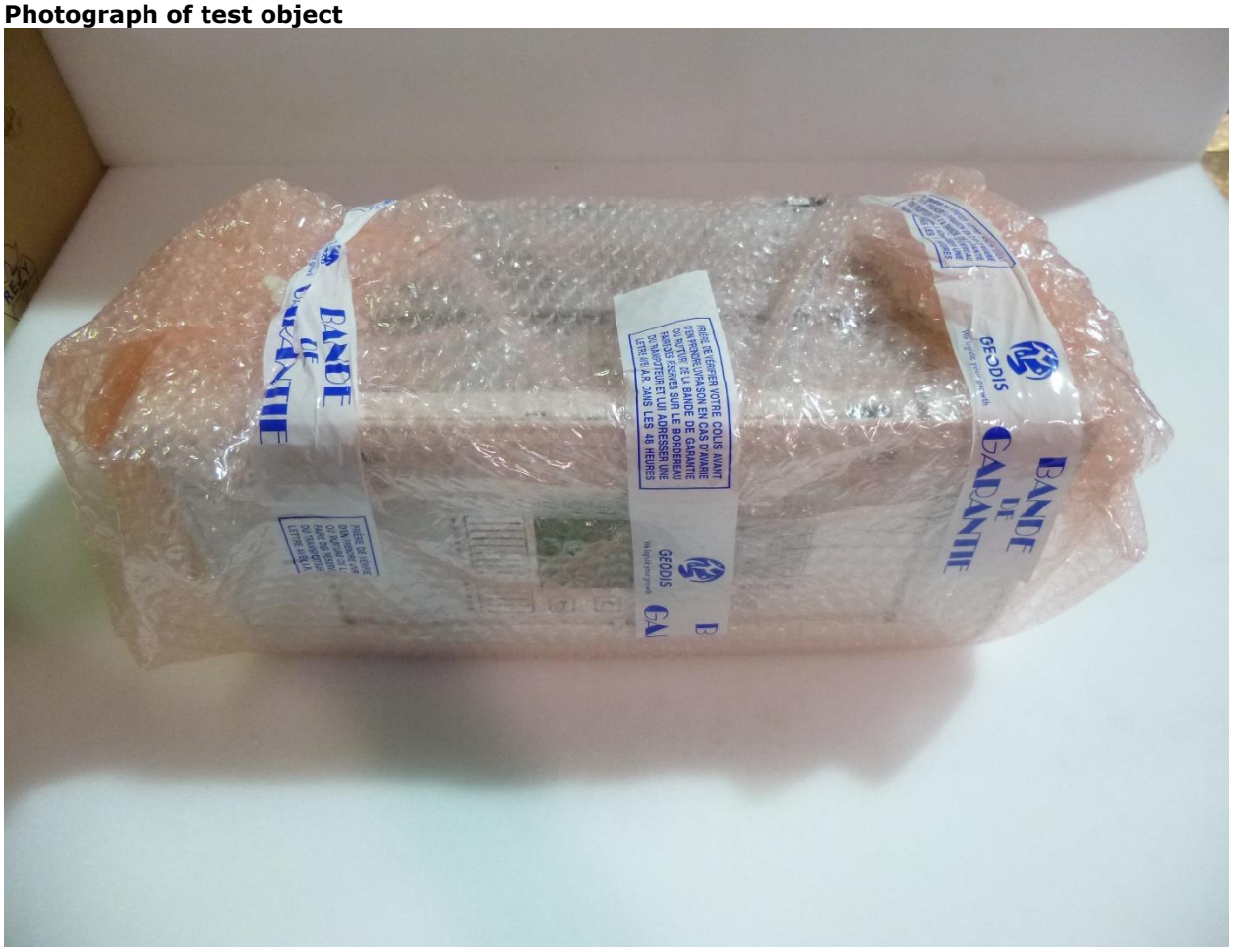
Equipment has been provided with alternative packing. This packing has been inspected.

Result

- The packaging meets the packaging requirements.
- No visual damage to the packaging and the equipment has been observed.

Photograph of test object HW66/HW67

Photograph of test object



Photograph of test object C264 with TMU210 and DIU221


ALSTOM
TMU210-A01

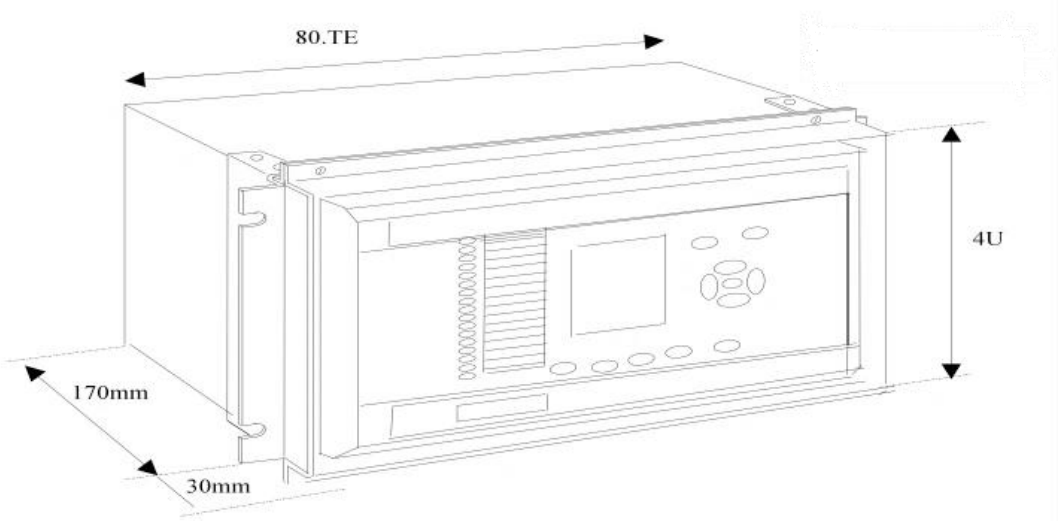

DS Agile
C284
MICOM ALSTOM
L/R

7 DIMENSIONS OF STRUCTURE

Standard and date

Standard IEC 61850-3, subclause 6.4

Test date 21 July 2016 and 1 April 2019



1U = 44,45 mm.

The rack is a 4U rack.

Item	Unit	Required	Measured (21 July 2016)	Measured (1 April 2019)
Height (H1)	mm	177,00 ± 0,4	177,0	177,35
Width (object without mounting kit)	mm	< 426,72	407,5	408,8
Width (object including mounting kit)	mm	482,60 ± 0,4	483,8	483,7
Depth	mm	170,0	170,5	170,3
Depth front panel	mm	30,00	30,50	30,40
H2	mm	101,60	-	101,80
H3	mm	37,70	-	37,65
Mounting hole size	mm	10,3 +/- 0,4	-	10,41
Mounting hole position	mm	13,5 +/- 0,4	-	14,20

Result

The object without mounting kit meets the dimension requirements.

8 FUNCTIONAL PERFORMANCE REQUIREMENTS

Standard and date

Standard	IEC 61850-3, subclause 6.5
Reference	IEC 61850-90-4
Date of report issue	24 October 2016

The equipment shall meet the applicable functional performance requirements (GOOSE testing) of the applicable standard. See Chapter 3.3 for reference to the relevant test reports.

Result

The object passed the test.

The test results can be found in Appendix A, B and C.

9 PRODUCT SAFETY

9.1 Inspection

9.1.1 Pre-inspection

The pre-inspection is performed to verify that the test object is in operating state. The pre-inspection is carried out previous to the test procedure.

The communication with the maintenance computer is verified. Signals are simulated to verify the functioning and operation with the specified performance specification for the following inputs and outputs:

- digital inputs
- contact outputs
- analogue inputs
- data communication.

9.1.2 Visual and functional inspection

After each test a visual and functional inspection is carried out as described in this chapter.

The visual inspection is carried out to verify that there is no visual mechanical damage.
There shall be no:

- burning of any components
- paint blisters on any components
- discolouration on components
- deformation of modules or components
- interruptions or damage on interconnecting cables, wires and connectors.

Functional inspection is carried out to verify the correct operation of the test object.
There shall be no:

- alarm indications on display and LED's
- error messages reported in the maintenance computer
- unintentional change of contact outputs
  there shall be no degradation of performance below the claimed performance according reliability class (1 or 2).

Unless otherwise stated the visual and functional inspection was carried out successfully after each test.

9.2 Clearances and creepage distances

Standard and date

Standard	IEC 61850-3, subclause 6.6.1
Test date	5 to 28 April 2017 and 5 February 2019

Characteristic test data

Serial number	A160009583
PCB Coating	No
Pollution degree	2
Over-voltage category	III

Requirements

Nominal rated insulation voltage or working voltage: 300 Vac / 300 Vdc.

Requirement IEC 61850-3; Category; OVC-III, PD2. IEC 61850-3 refers to IEC 60255-27 Annex C. for creepage and clearance requirements.

Creepage requirement for functional, basic or supplementary insulation.

1. Non-coated PCB; creepage distance = 3 mm (table C.6)
2. For double or reinforced insulation; creepage distance = 5,5 mm (table C.10).

Clearance requirement for basic functional or supplementary insulation

1. Clearance; 3 mm (table C.6)
2. For double or reinforced insulation; clearance distance = 5,5 mm (table C.10).

Nominal rated insulation voltage or working voltage: 150 Vac / 150 Vdc.

Requirement IEC 61850-3; Category; OVC-III, PD2. IEC 61850-3 refers to IEC 60255-27 Annex C. for creepage and clearance requirements.

Creepage requirement for functional, basic or supplementary insulation.

3. Non-coated PCB; creepage distance =1,5 mm (table C.6)
4. For double or reinforced insulation; creepage distance = 3,0 mm (table C.10).

Clearance requirement for basic functional or supplementary insulation

5. Clearance; 1,5 mm (table C.6)

For double or reinforced insulation; clearance distance = 3,0 mm (table C.10).

Nominal rated insulation voltage or working voltage: 50 Vac / 50 Vdc.

Requirement IEC 61850-3; Category; OVC-III, PD2. IEC 61850-3 refers to IEC 60255-27 Annex C. for creepage and clearance requirements.

Creepage requirement for functional, basic or supplementary insulation.

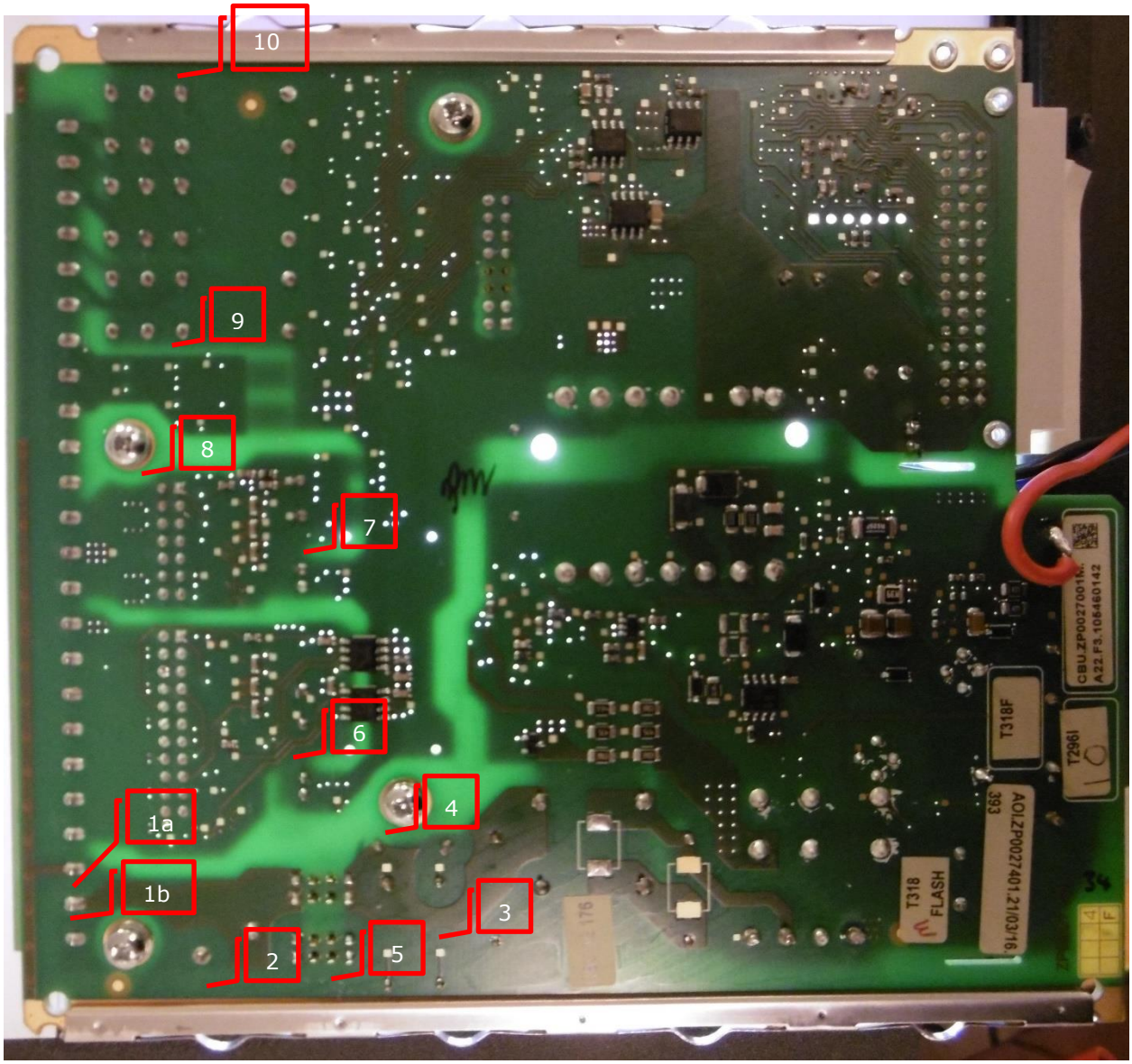
6. Non-coated PCB; creepage distance =0,15 mm (table C.6)
7. For double or reinforced insulation; creepage distance = 0,5 mm (table C.10).

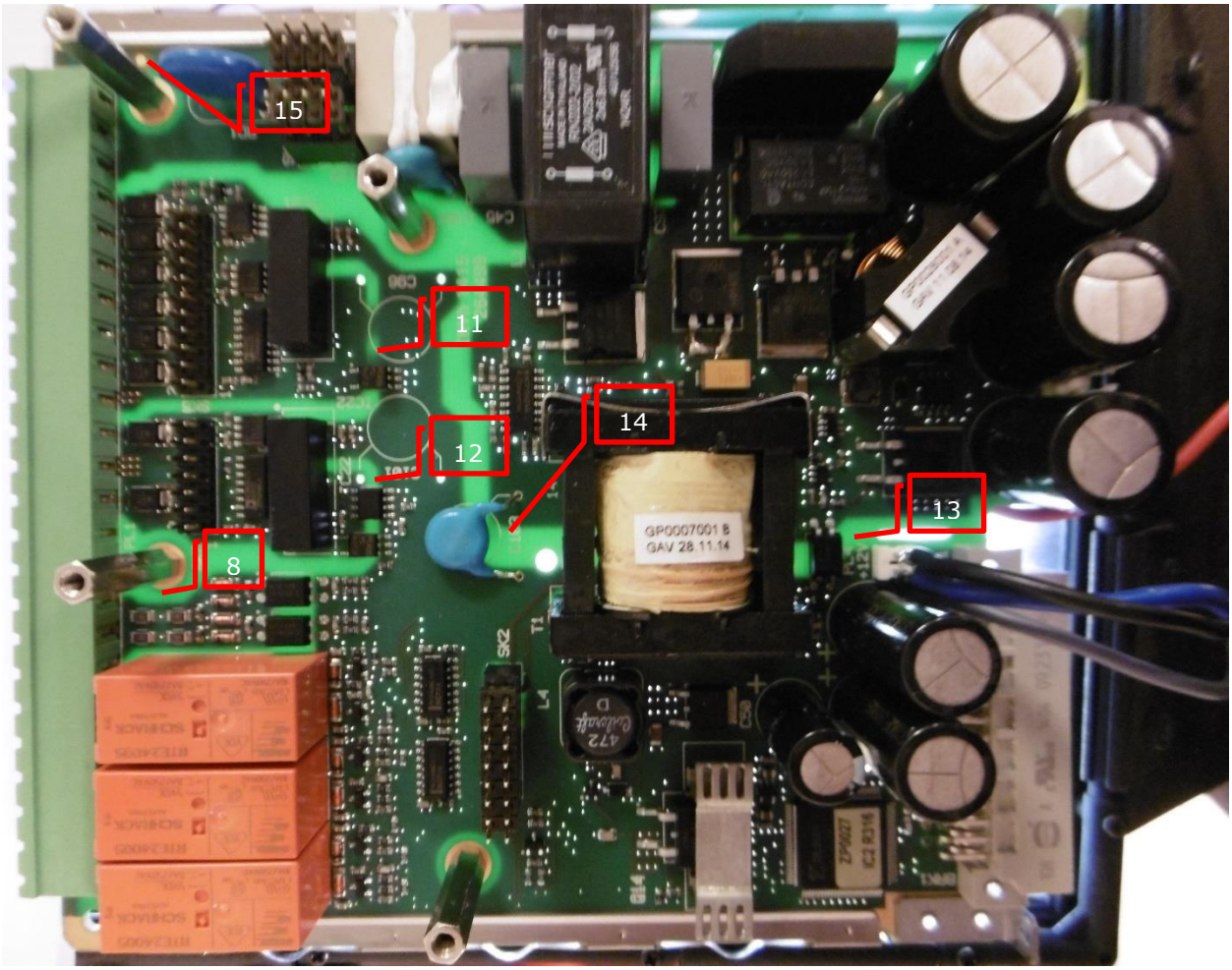
Clearance requirement for basic functional or supplementary insulation

8. Clearance; 0,15 mm (table C.6)
9. For double or reinforced insulation; clearance distance = 0,5 mm (table C.10).

Measurements

BIU261M (Motherboard - ZP0027001)



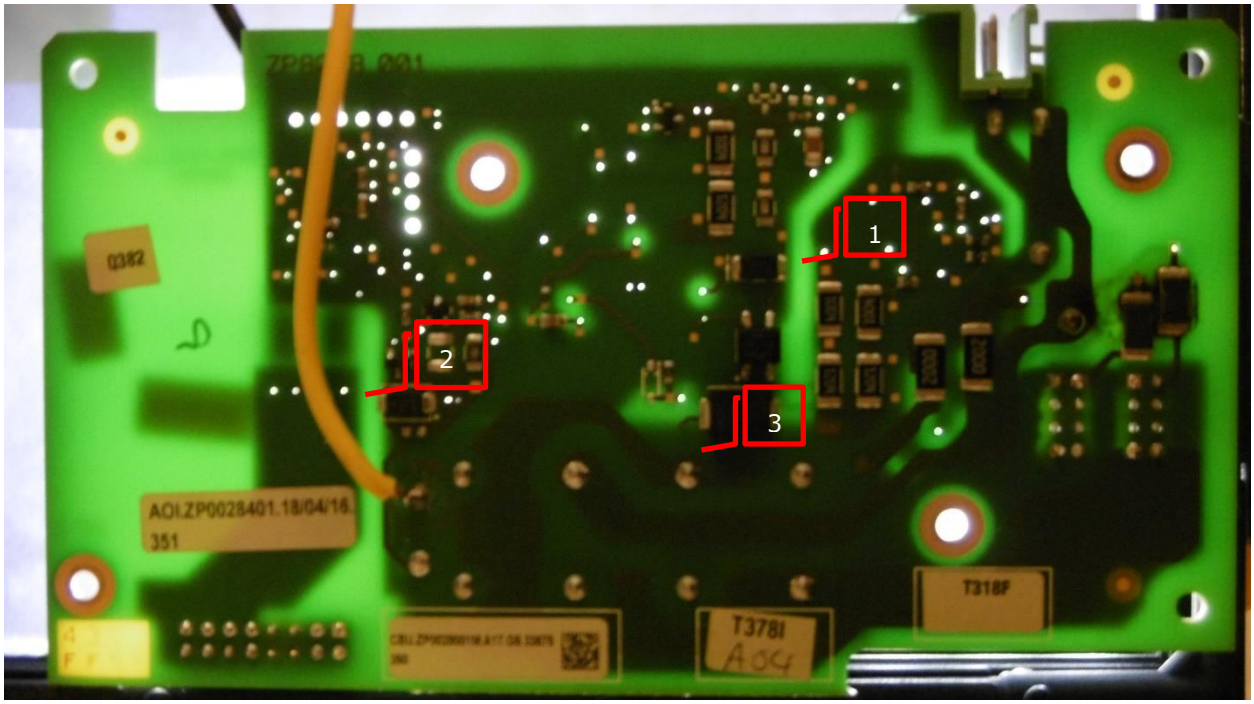


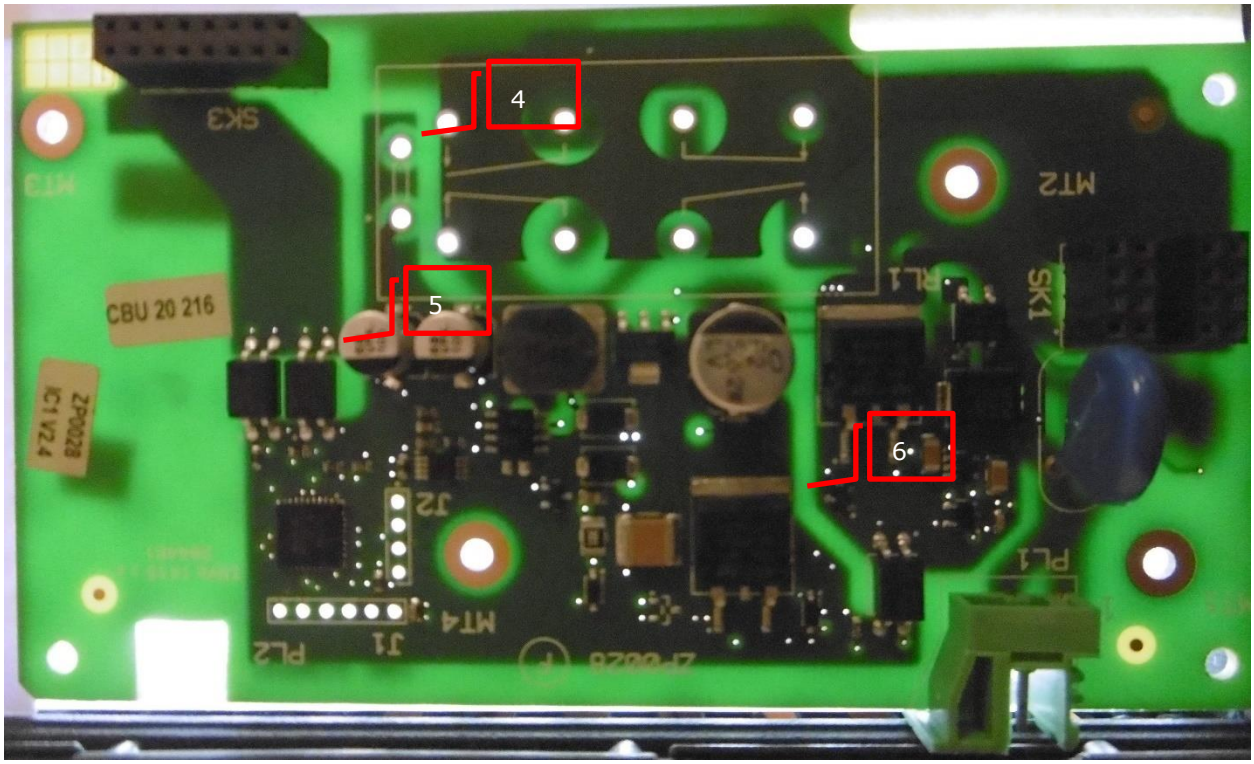
Creepage

Measurement point	Required mm	Measured mm	Result
1a; connector PL1 power input to PE	3,0	3,0	Passed
1a; connector PL1 power input, line to neutral	3,0	3,0	Passed
2; RD1 to conductive PCB card guide	3,0	3,0	Passed
3; Y capacitor C46A/C47A to PE	3,0	3,0	Passed
4; HLV to mounting stud	3,0	3,0	Passed
5; SK4 header to conductive PCB card guide	3,0	> 4,5	Passed
6; IC 21 isol. DC/DC converter comm I/F 1	0,15	3,0	Passed
7; IC 22 isol. DC/DC converter comm I/F 2	0,15	3,0	Passed
8; isolated serial interface and isolated input to HLV	3,0	3,0	Passed
9; isolated input to output relay RL1	3,0	3,0	Passed
10; relay RL4 to conductive PCB card guide	3,0	3,0	Passed
11; optocoupler comm I/F1	0,15	> 3,5	Passed

Measurement point	Required mm	Measured mm	Result
12; opto coupler comm I/F 2	0,15	> 3,5	Passed
13; HLV-ELV (opto coupler PSU)	3,0	> 6,0	Passed
14; HLV-ELV (Y-cap C103)	3,0	> 10,0	Passed
15; RD1 to PE (conductive PCB card guide)	3,0	> 4,0	Passed

BIU261D (Daughterboard - ZP0028001)

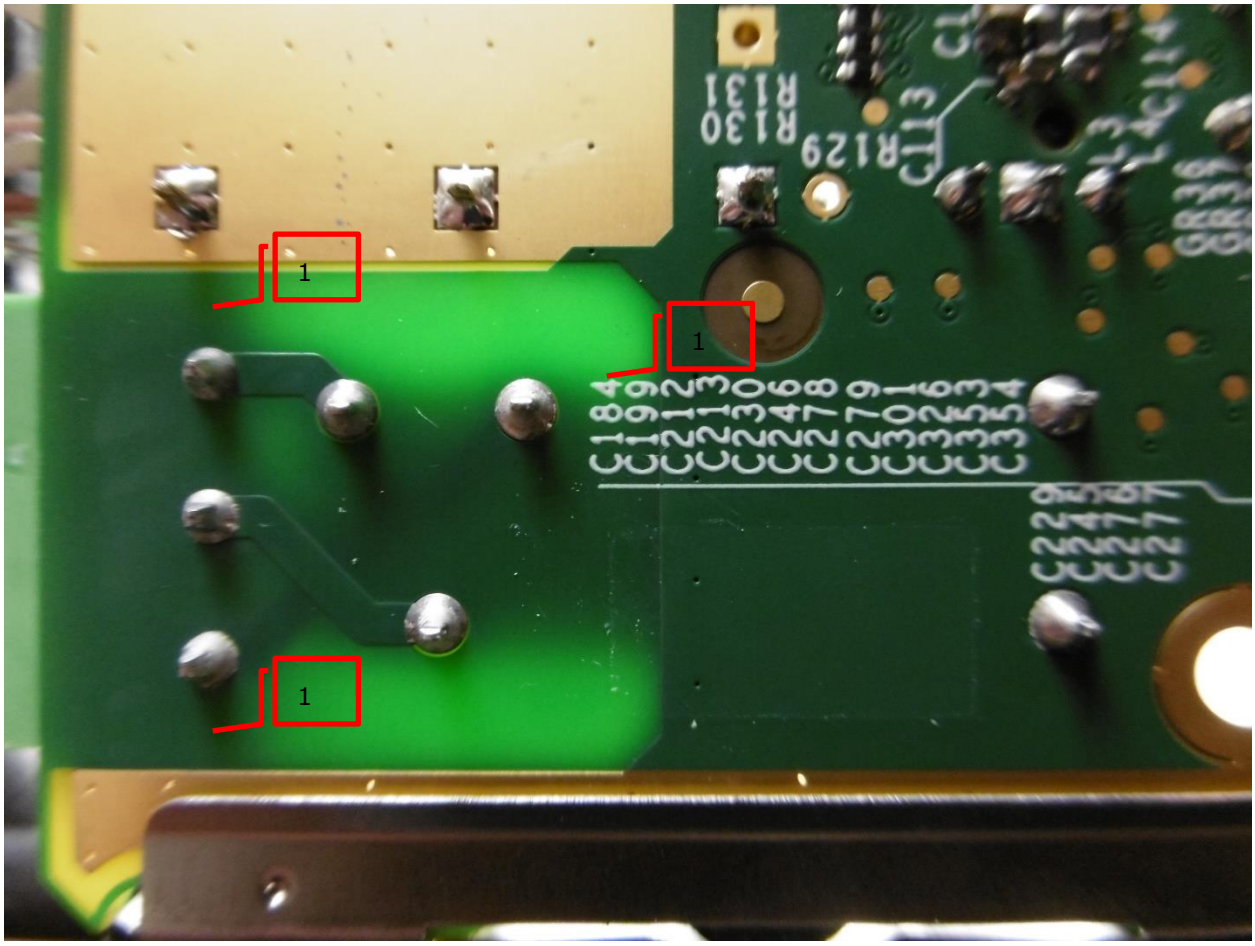




Creepage

	Required mm	Measured mm	Result
1; 24 V power supply to secondary power supply input	3,0	3,0	Passed
2; HLV to ELV	3,0	3,0	Passed
3; 24 V power supply to RL1	3,0	3,0	Passed
4; RL1, coil to contacts	3,0	3,0	Passed
5; HLV to ELV (between capacitor and optocoupler)	3,0	3,0	Passed
6; 24 V power supply to secondary power supply input	3,0	3,0	Passed

Measurements on the SRPv2 (CPU) board (watchdog output relay)



Creepage

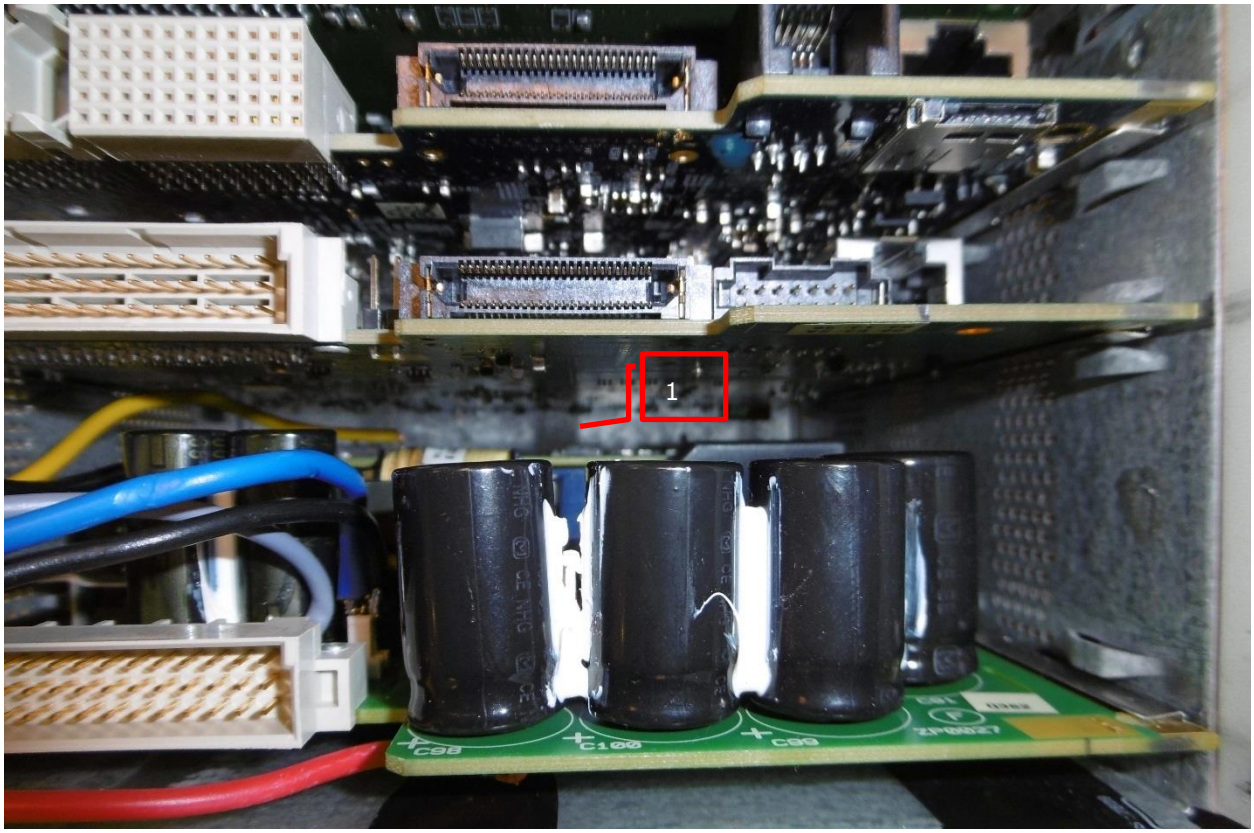
	Required mm	Measured mm	Result
1; relay contact to ELV (GND)	3,0	3,0	Passed

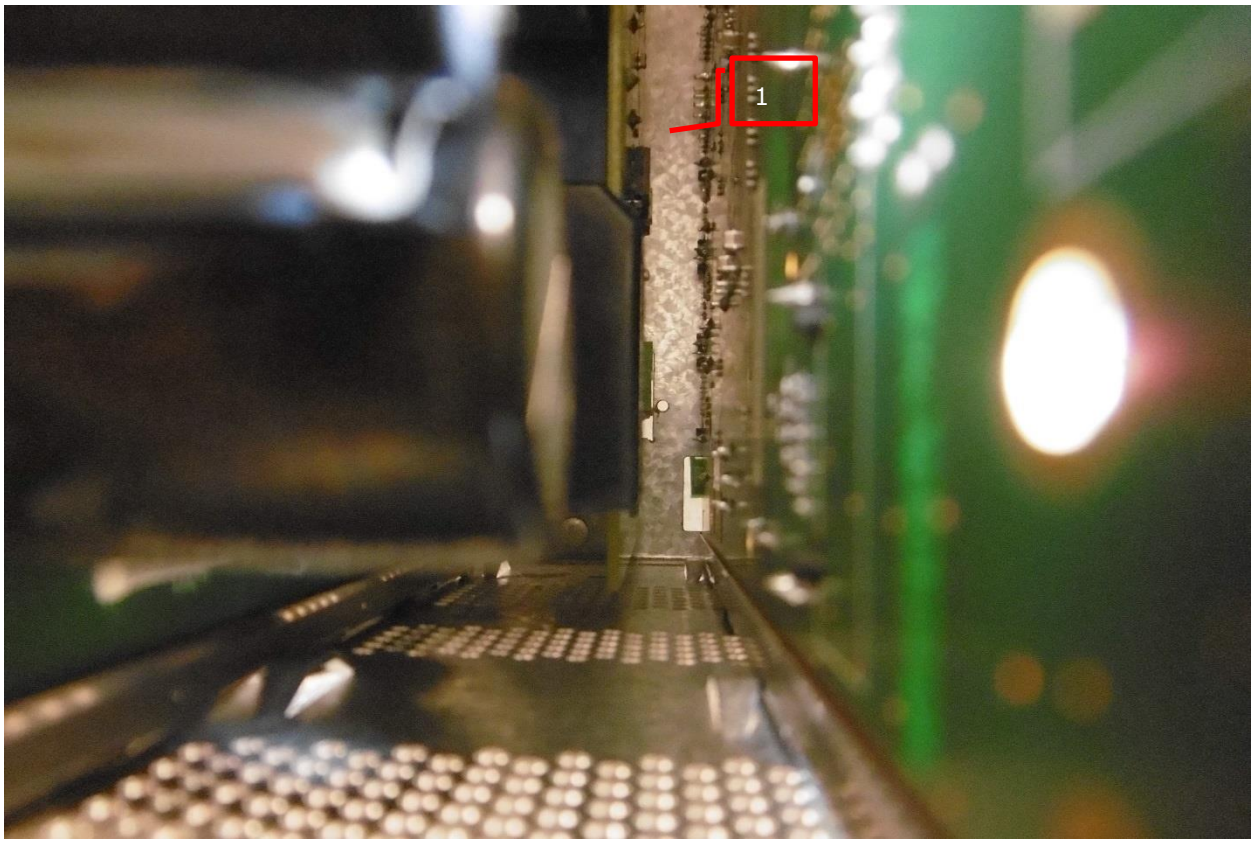
Clearance

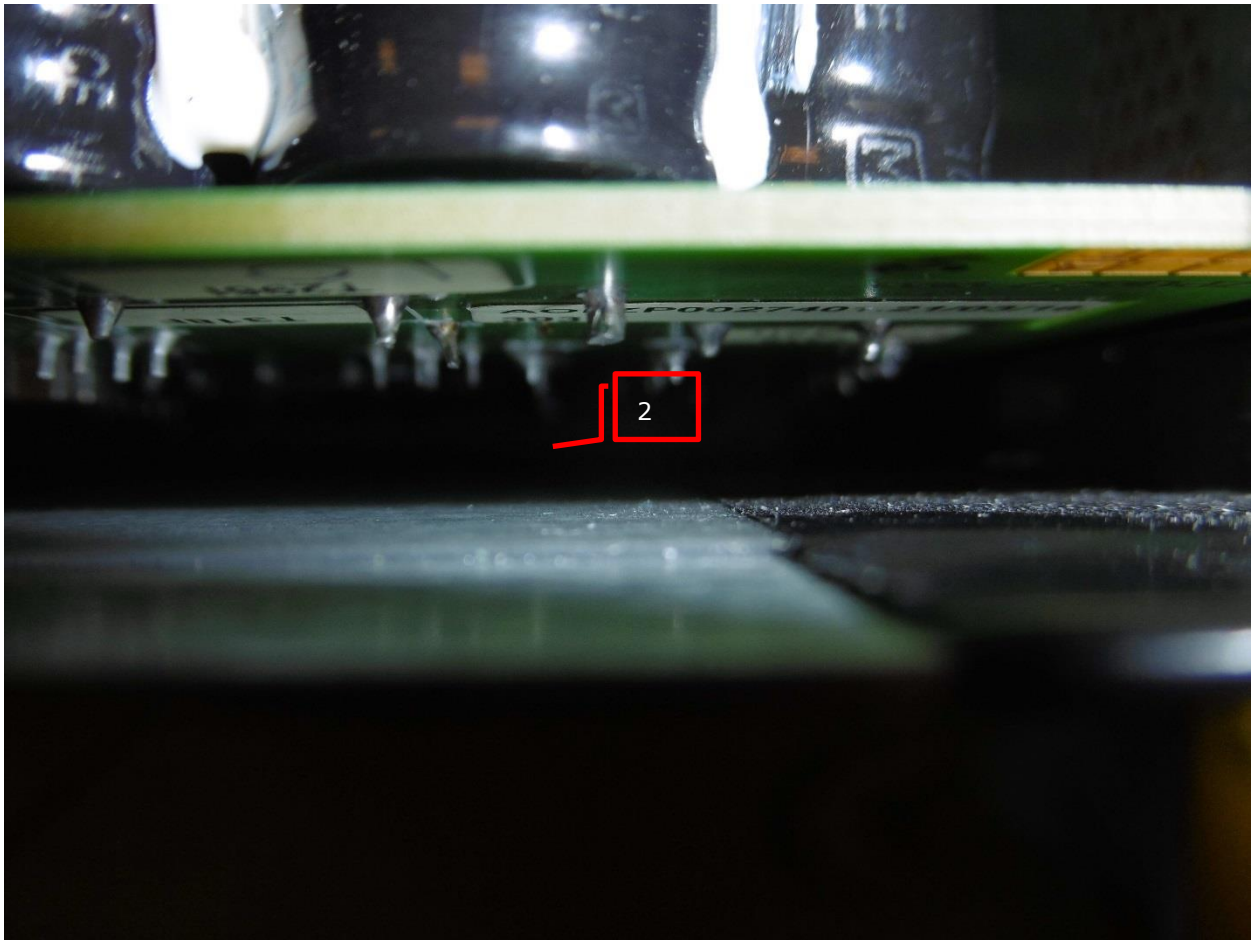
The observed clearance is well above the required clearance distance. No measurements required.

"IEC 61850-3 clause 6.6.1.1 General
Where there is any doubt that the required clearance and creepage distances are compliant with the values in the appropriate table from Annex C of IEC 60255-27:2013, measurements shall be made".

BU261D (Global Assembly - GP0027)







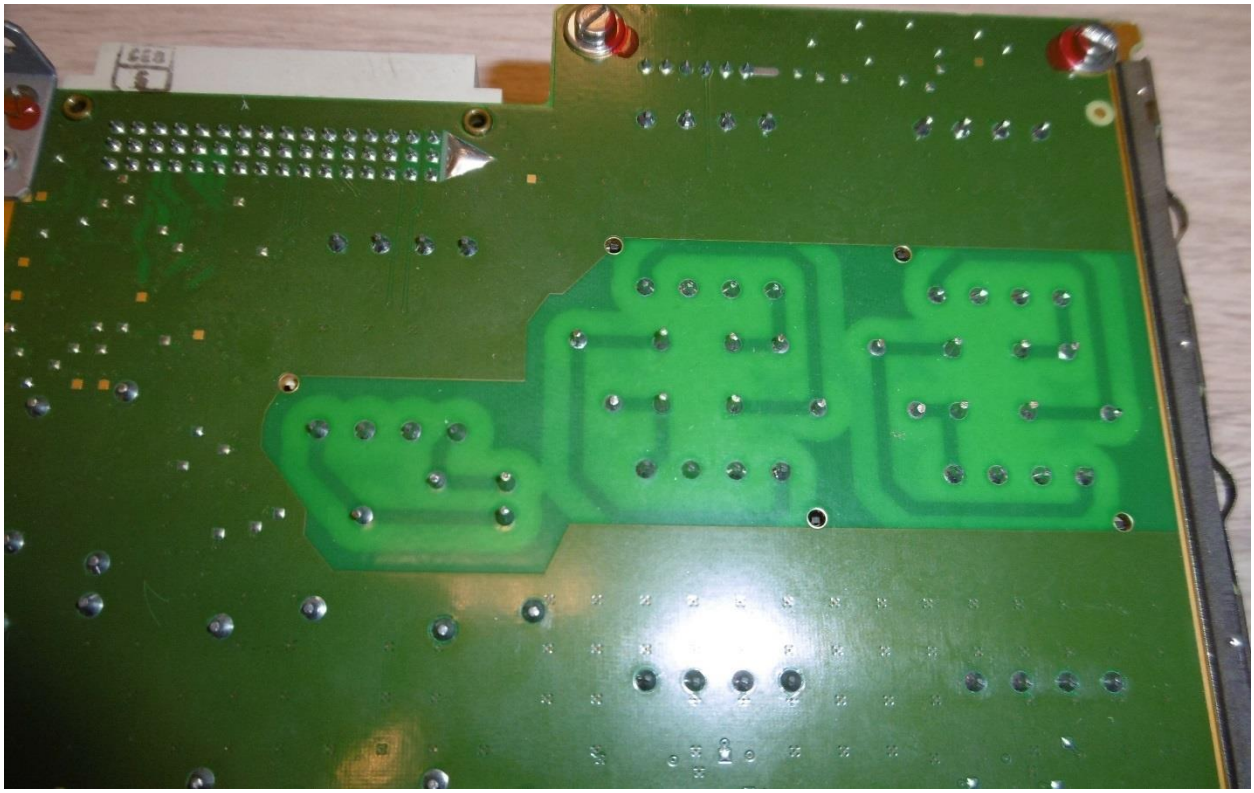
Clearance

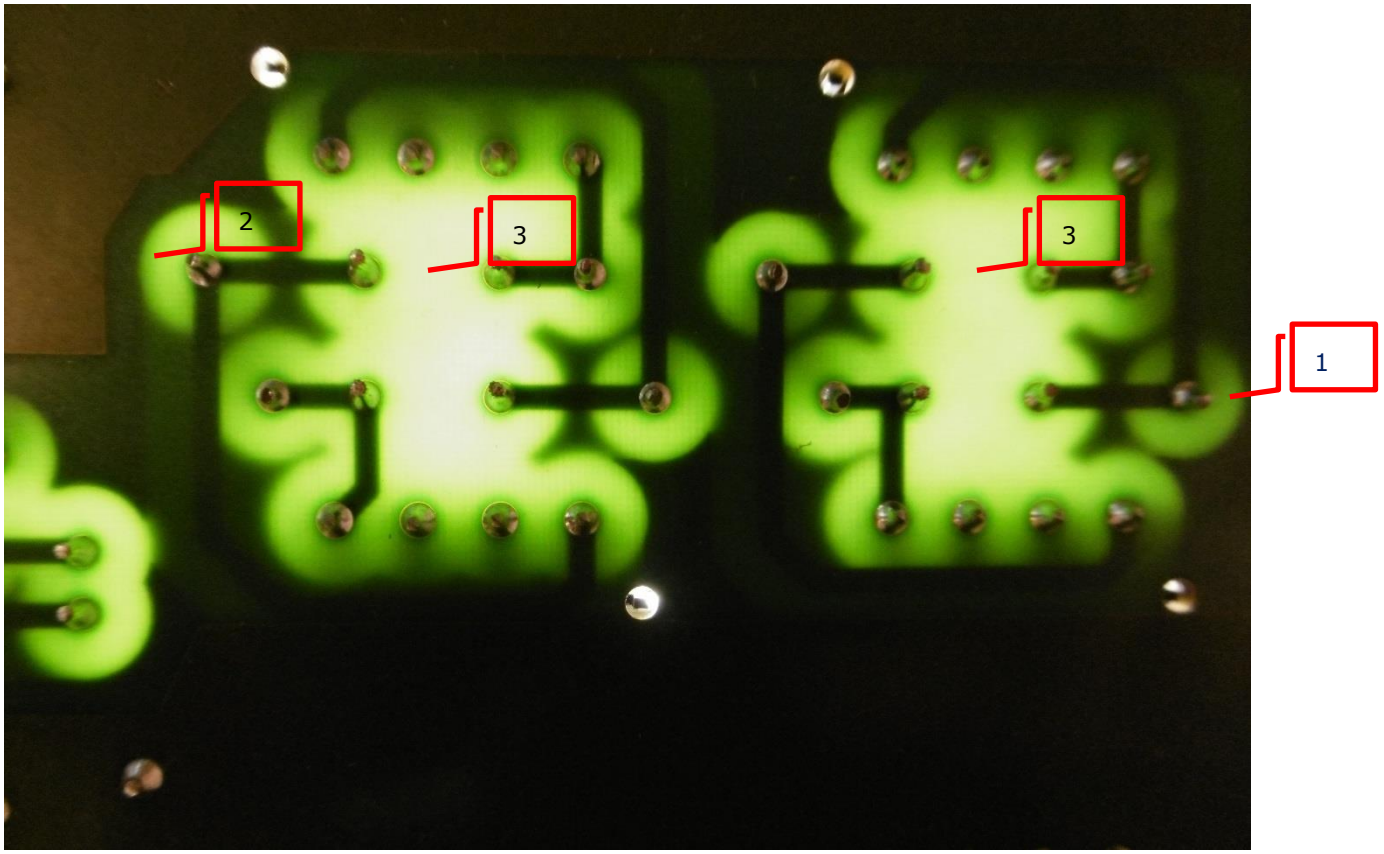
Measurement point	Required mm	Measured mm	Result
1: between BIU261D and CPU4 board	3,0	> 8,0	Passed
2: between BIU261 motherboard and rack	3,0	> 5,0	Passed

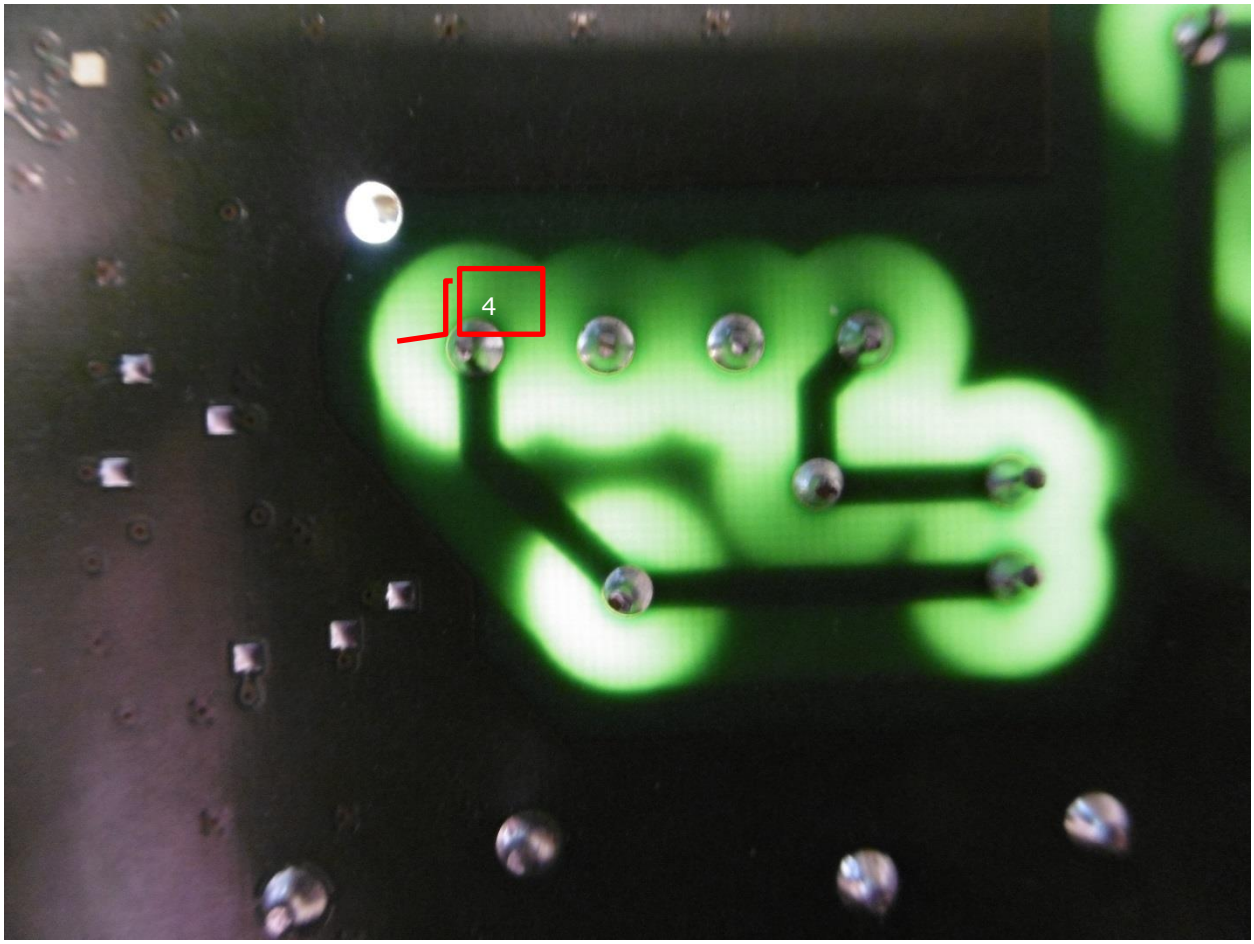
Note

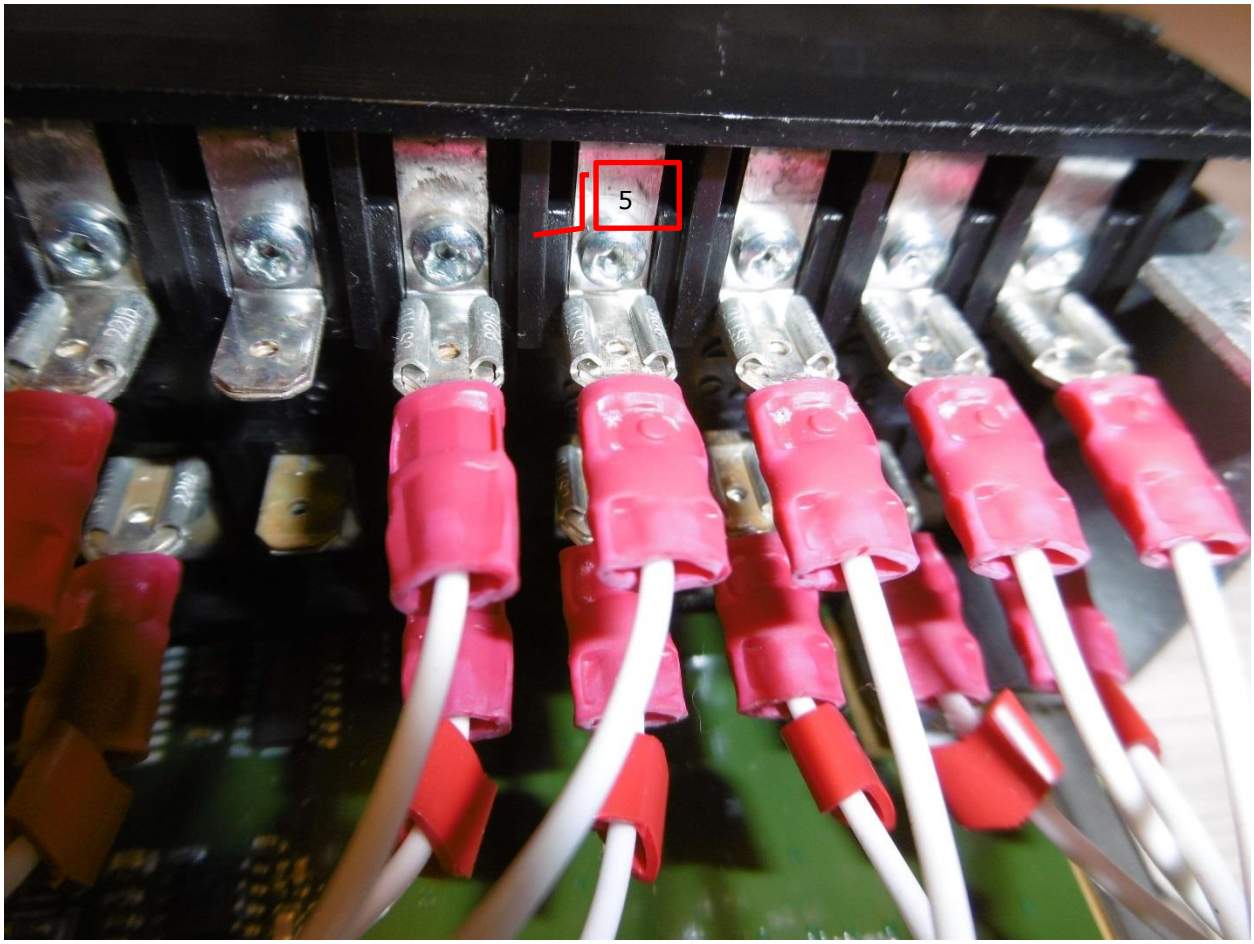
In model C264 an insulation foil has been applied to improve clearance.

TMU220



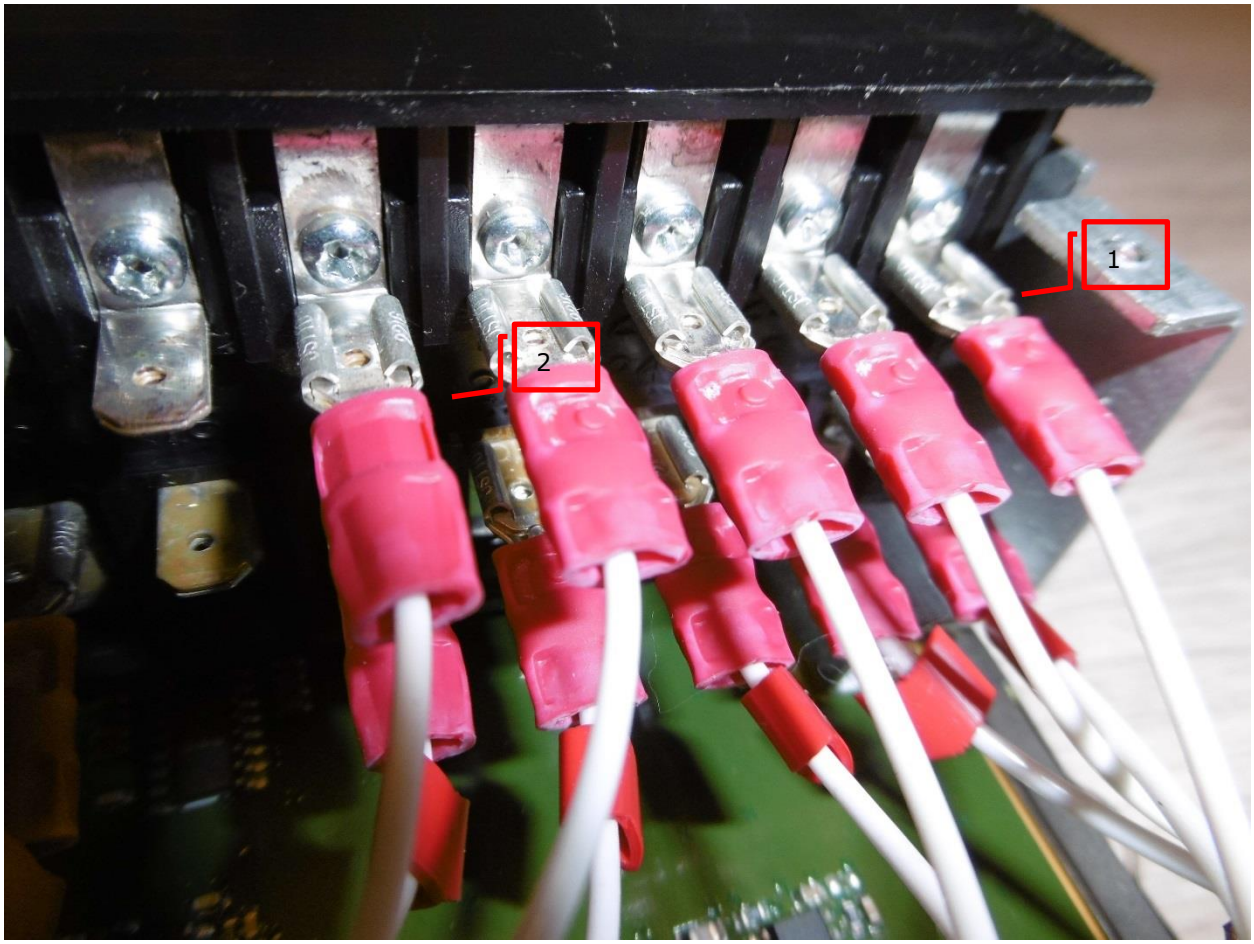


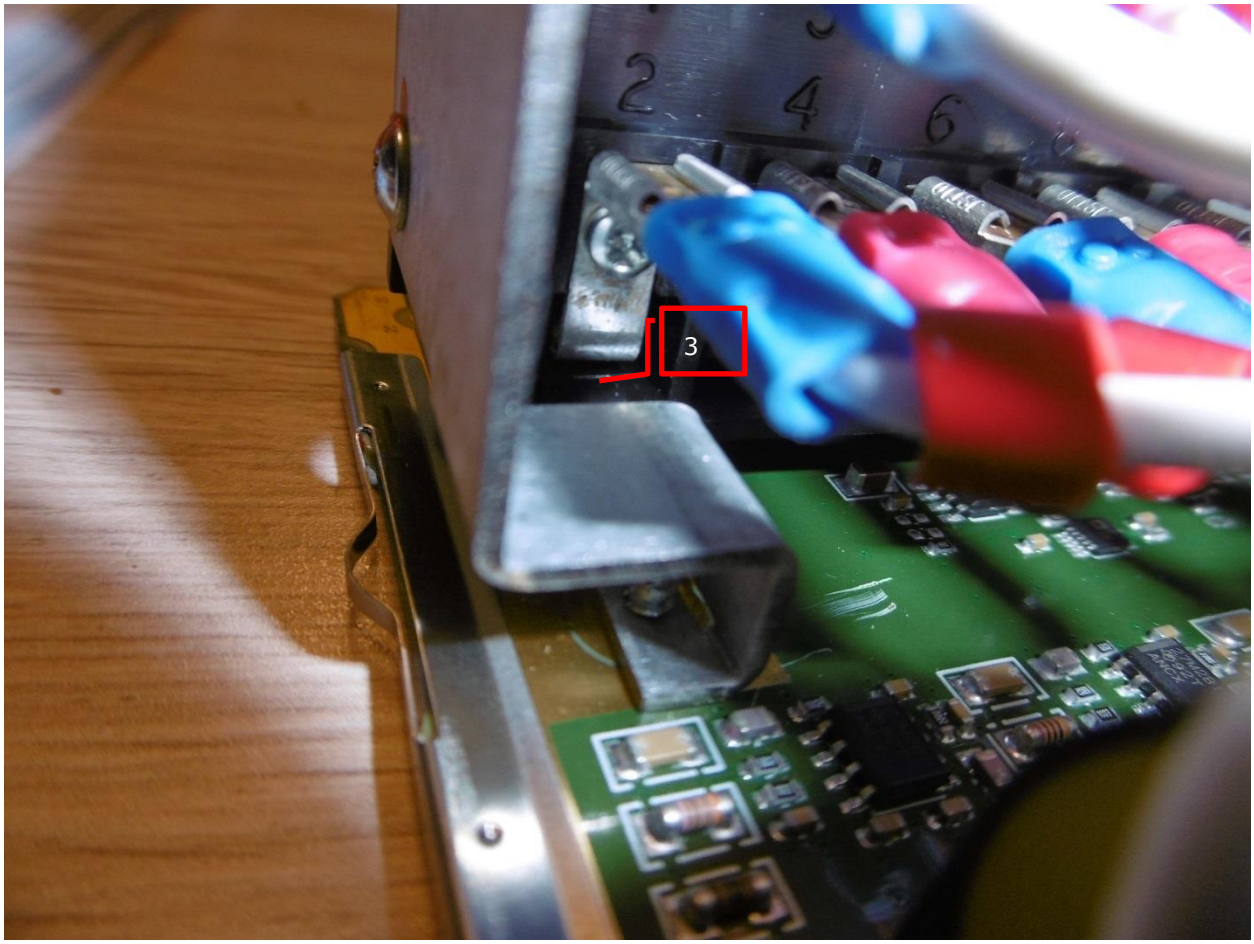

4



Creepage

Measurement point	Required mm	Measured mm	Result
1: MOV to conductive card guide (PE)	3,0	> 4,5	Passed
2: MOV to PE	3,0	> 4,5	Passed
3: between analogue voltage input circuits	3,0	> 4,5	Passed
4: analogue voltage input circuit to PE	3,0	> 4,5	Passed
5: CT/VT input connector between terminals	3,0	> 4,5	Passed

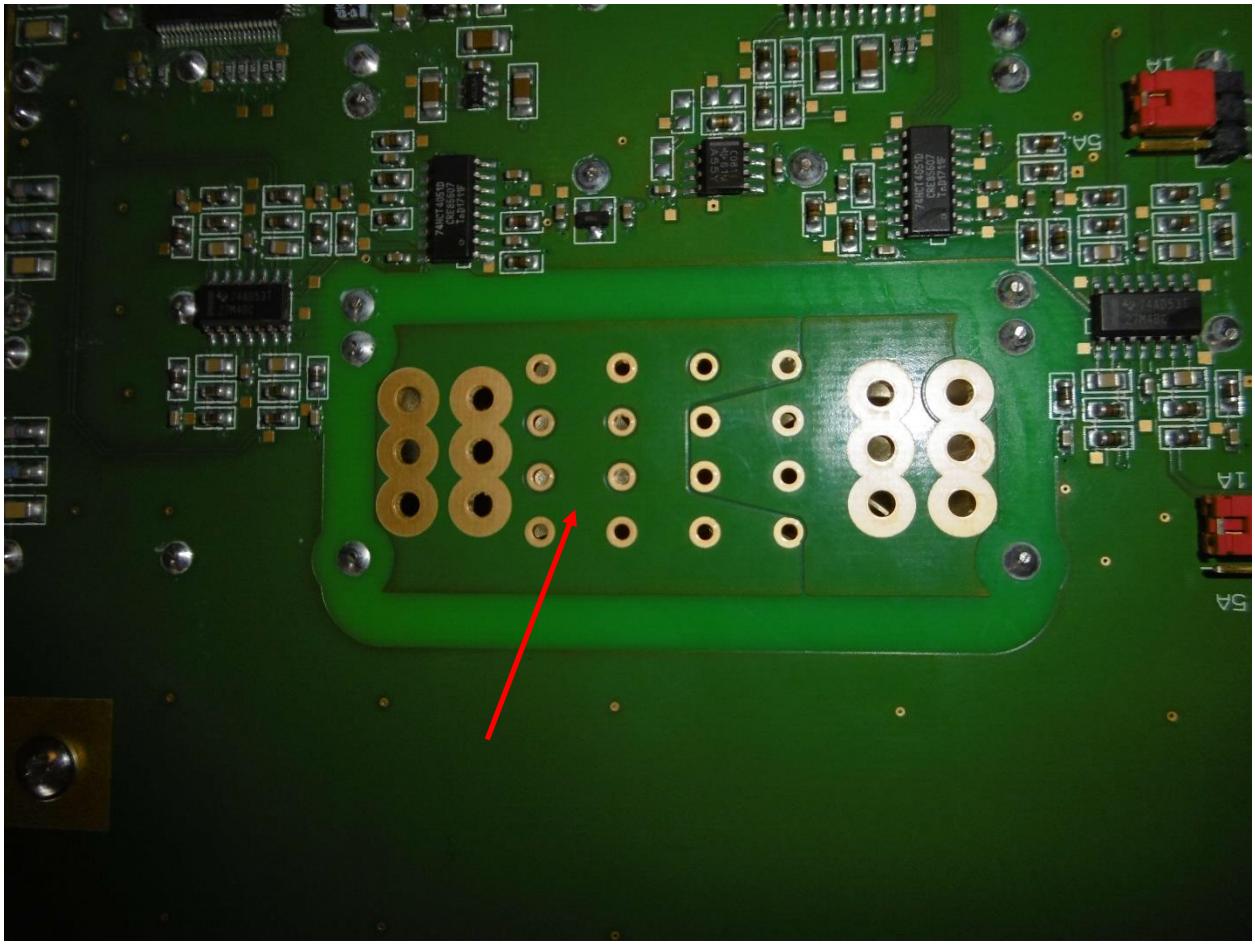

1
2



Clearance

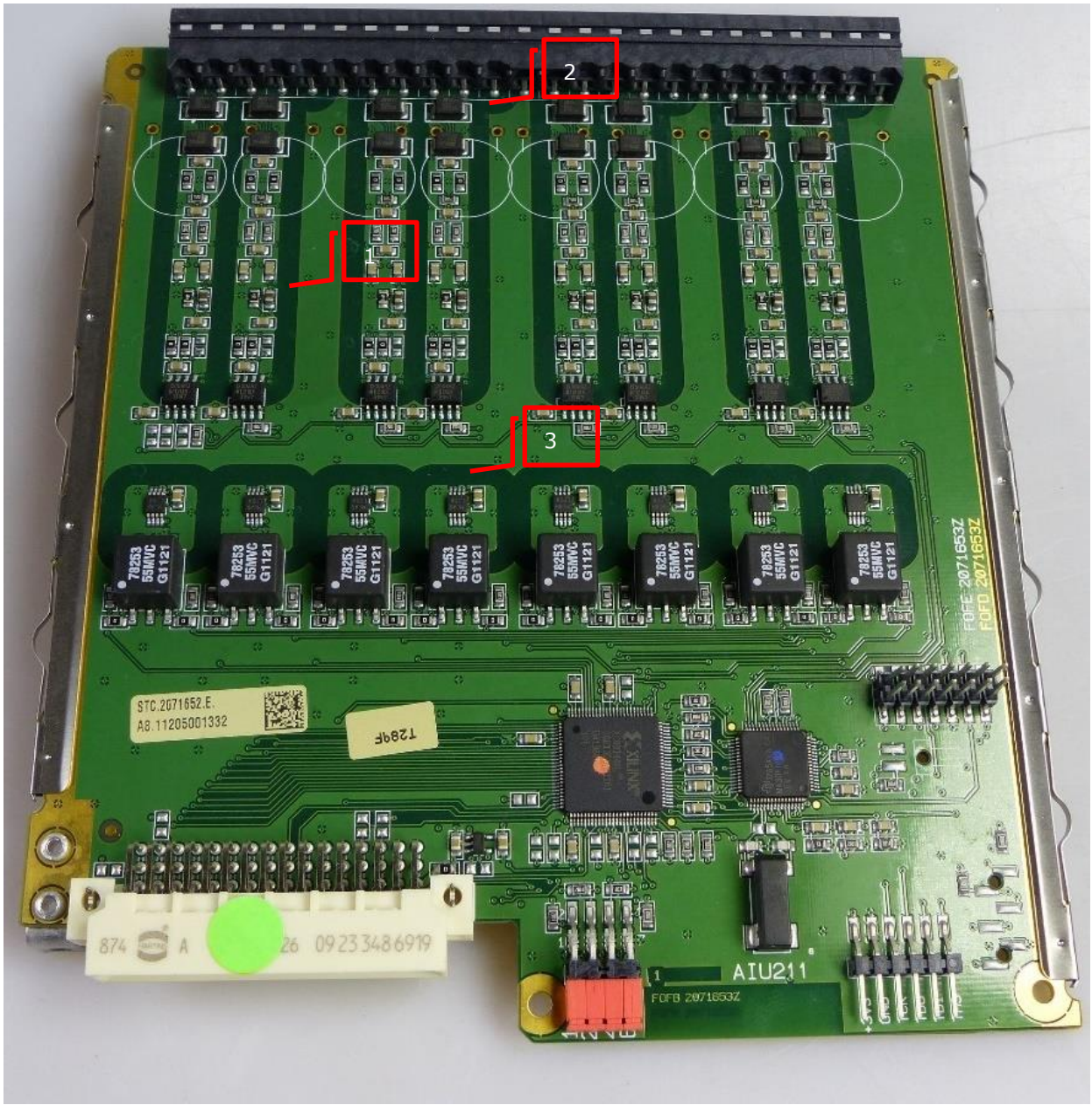
Measurement point	Required mm	Measured mm	Result
1: CT/VT input terminals to mounting bracket	3,0	3,0	Passed
2: between CT/VT input terminals	3,0	3,0	Passed
3: CT/VT input terminals to mounting bracket	3,0	3,0	Passed

TMU210



The isolated part on the pcb is unused. It is indicated by the arrow in the photo. The insulation has been implemented in the CT/VT's and TMU CT/VT input connector. Therefore no creepage/clearance measurements on the pcb required. For the measurements on the CT/VT connector, refer to the results for TMU220.

AIU211



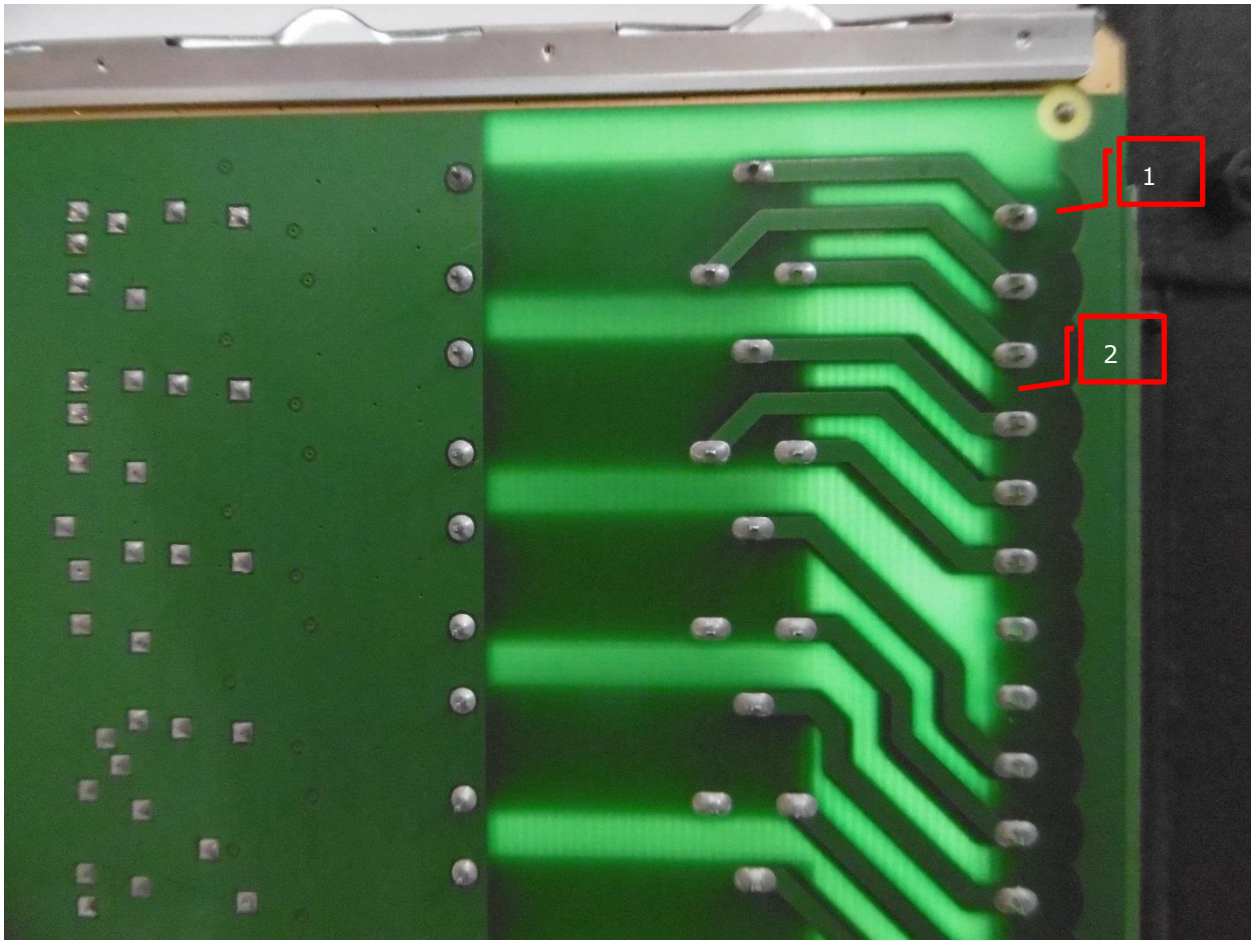
Creepage

Measurement point	Required mm	Measured mm	Result
1: between voltage input and PE	3,0	3,0	Passed
2: between connector terminals	3,0	3,0	Passed
3: between current input and PE	3,0	3,0	Passed

Clearance
The observed clearance is well above the required clearance distance. No measurements required.

"IEC 61850-3 clause 6.6.1.1 General
Where there is any doubt that the required clearance and creepage distances are compliant with the values in the appropriate table from Annex C of IEC 60255-27:2013, measurements shall be made".

DOU201



Creepage

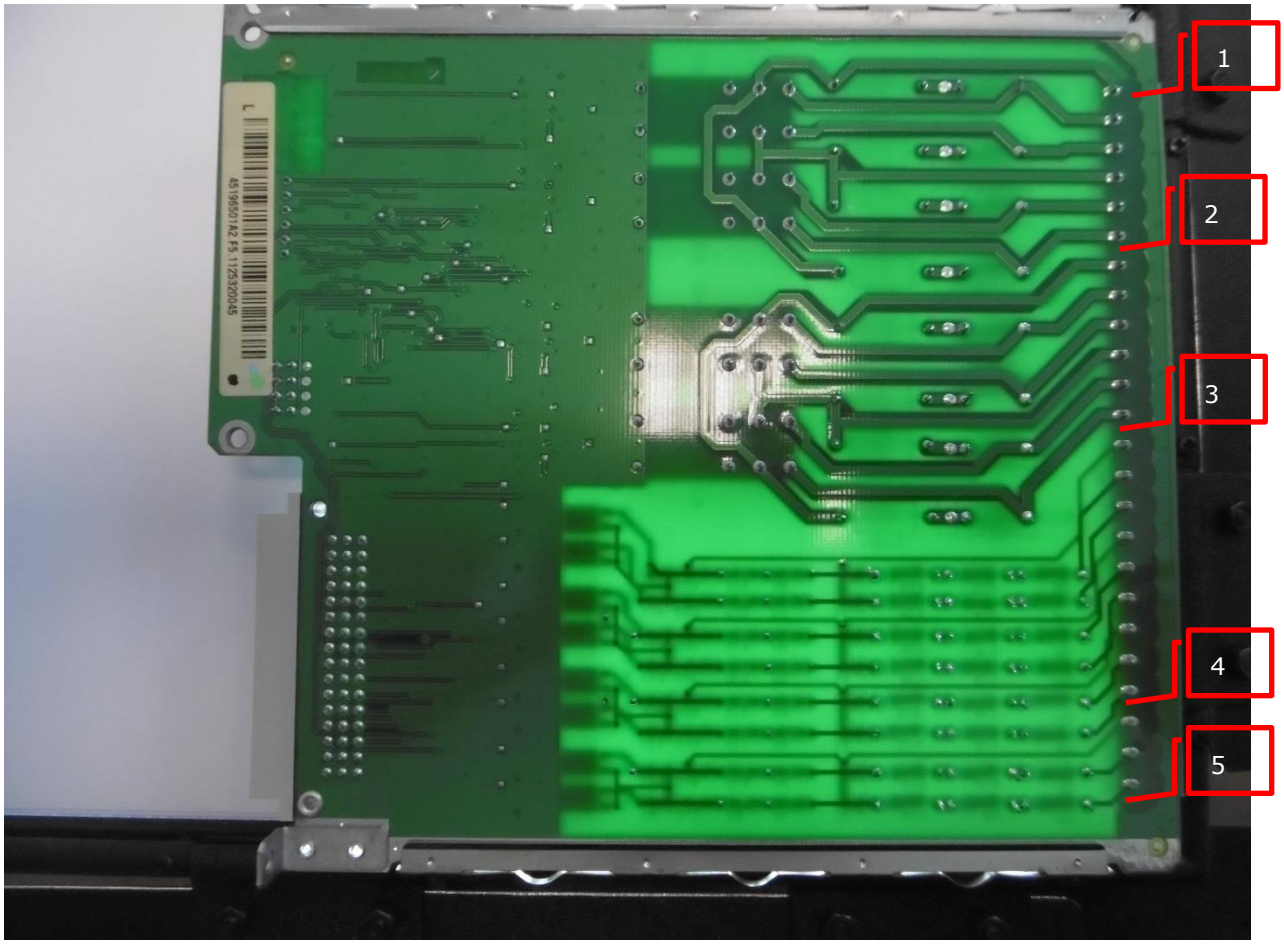
Measurement point	Required mm	Measured mm	Result
1: between relay output and PE	3,0	3,0	Passed
2: between adjacent relay outputs	3,0	3,0	Passed

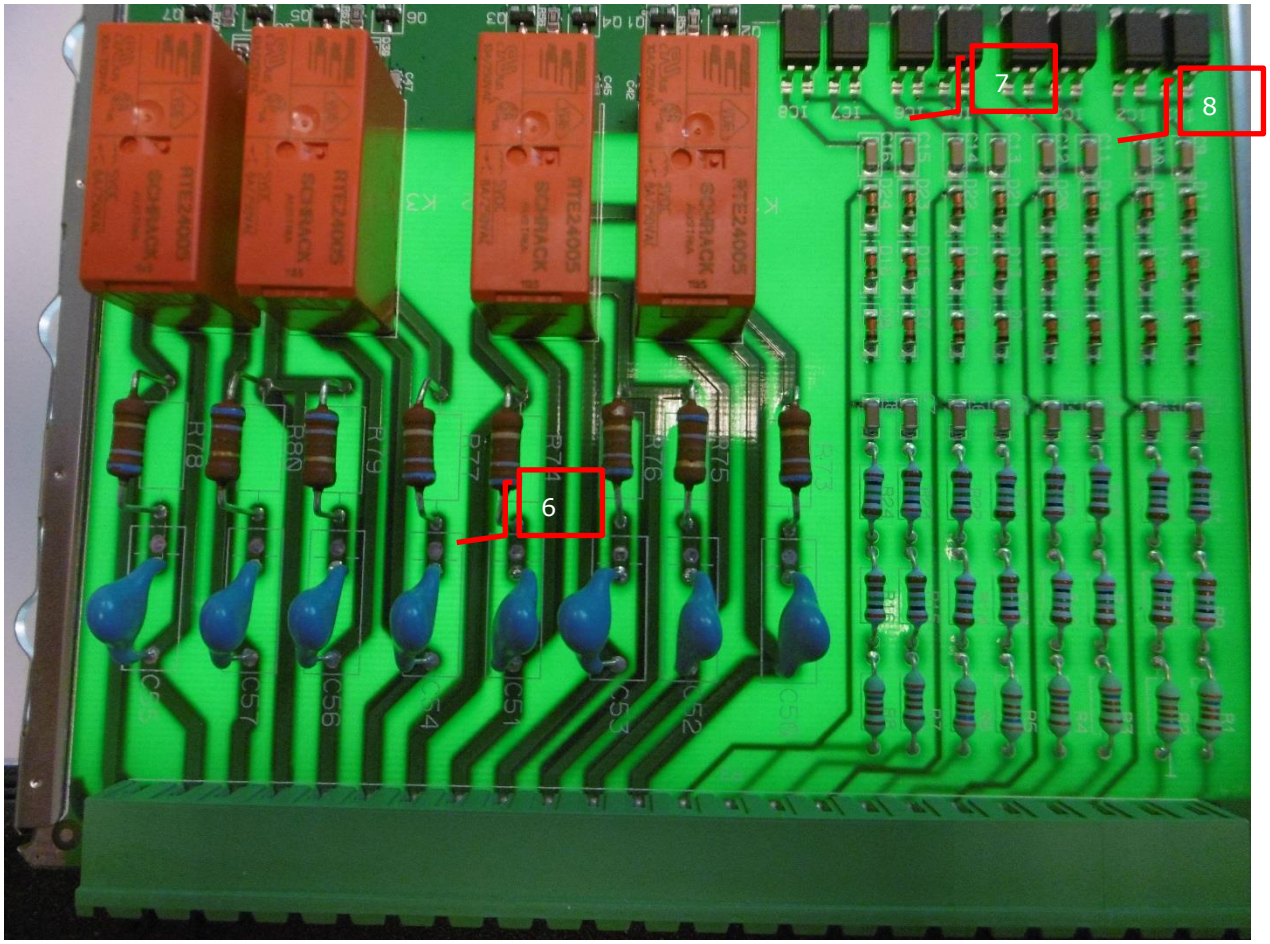
Clearance

The observed clearance is well above the required clearance distance. No measurements required.

"IEC 61850-3 clause 6.6.1.1 General
Where there is any doubt that the required clearance and creepage distances are compliant with the values in the appropriate table from Annex C of IEC 60255-27:2013, measurements shall be made".

CCU211





Creepage

Measurement point	Required mm	Measured mm	Result
1: between connector pin of P3 and PE	3,0	3,0	Passed
2: between adjacent relay outputs	3,0	3,0	Passed
3: between relay output and optocoupler input	3,0	3,0	Passed
4: between 2 opto coupler inputs	3,0	3,0	Passed
5; between optocoupler input :nd PE	3,0	3,0	Passed
6: between K2 and K3 relay sections	3,0	3,0	Passed
7: between optocoupler IC 7 and IC6	1,5[1]	2,0	Passed
8: between 2 opto coupler input circuits (IC2 and IC3)	1,5[1]	3,0	Passed

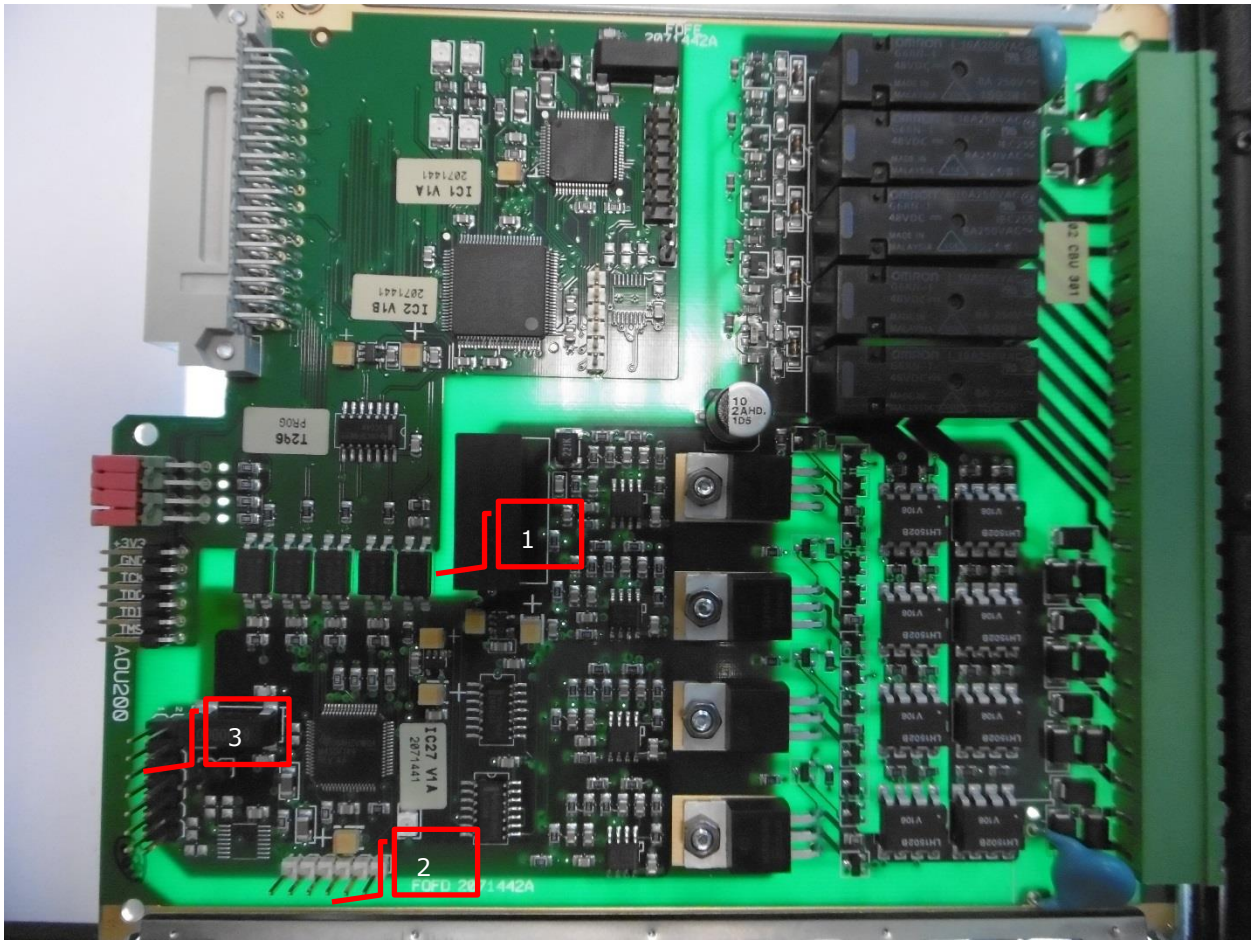
Note

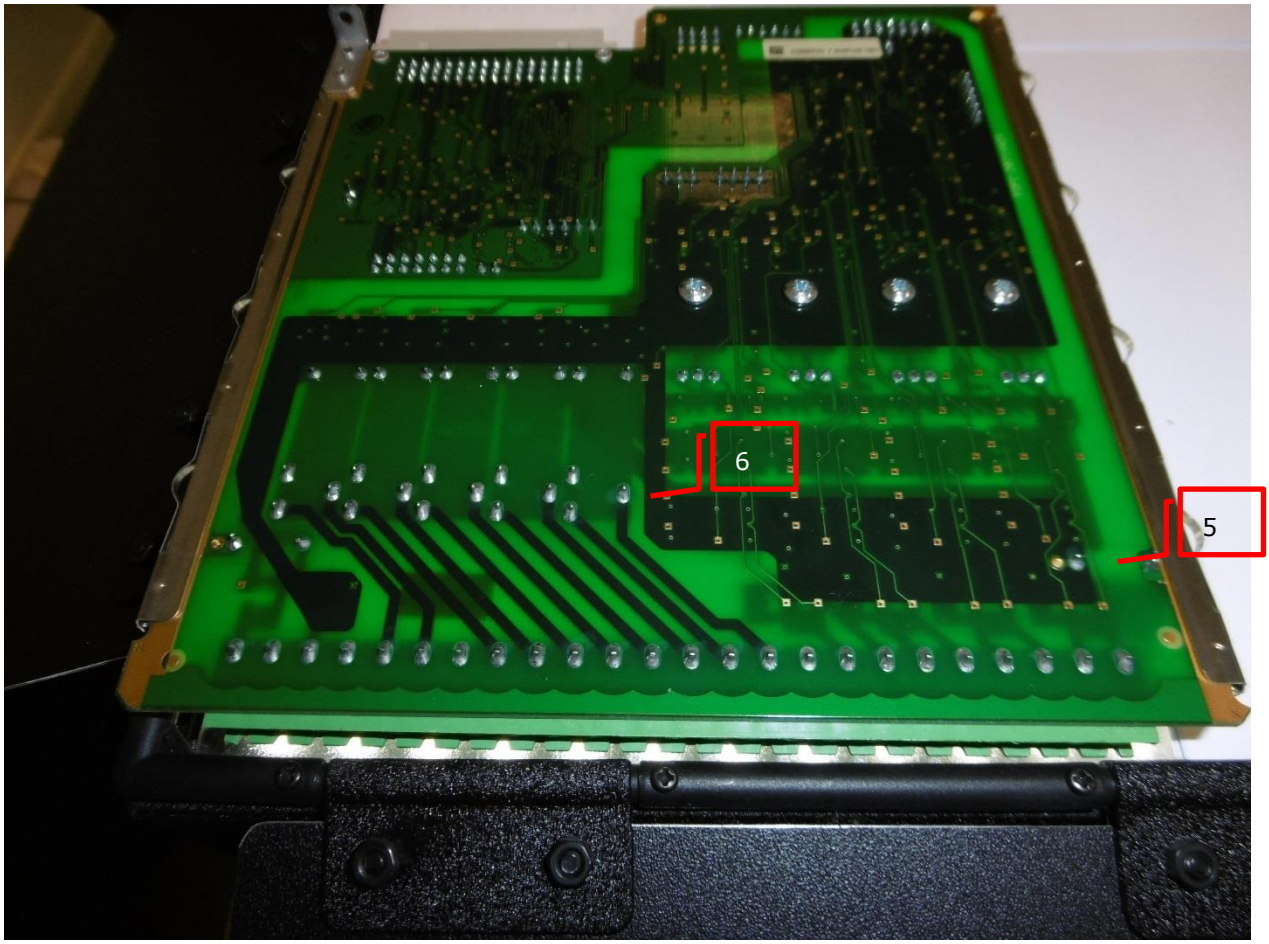
[1]The customer derated the working voltage specification for the optocoupler inputs to 125 Vdc. The required creepage distance is 1,5 mm.

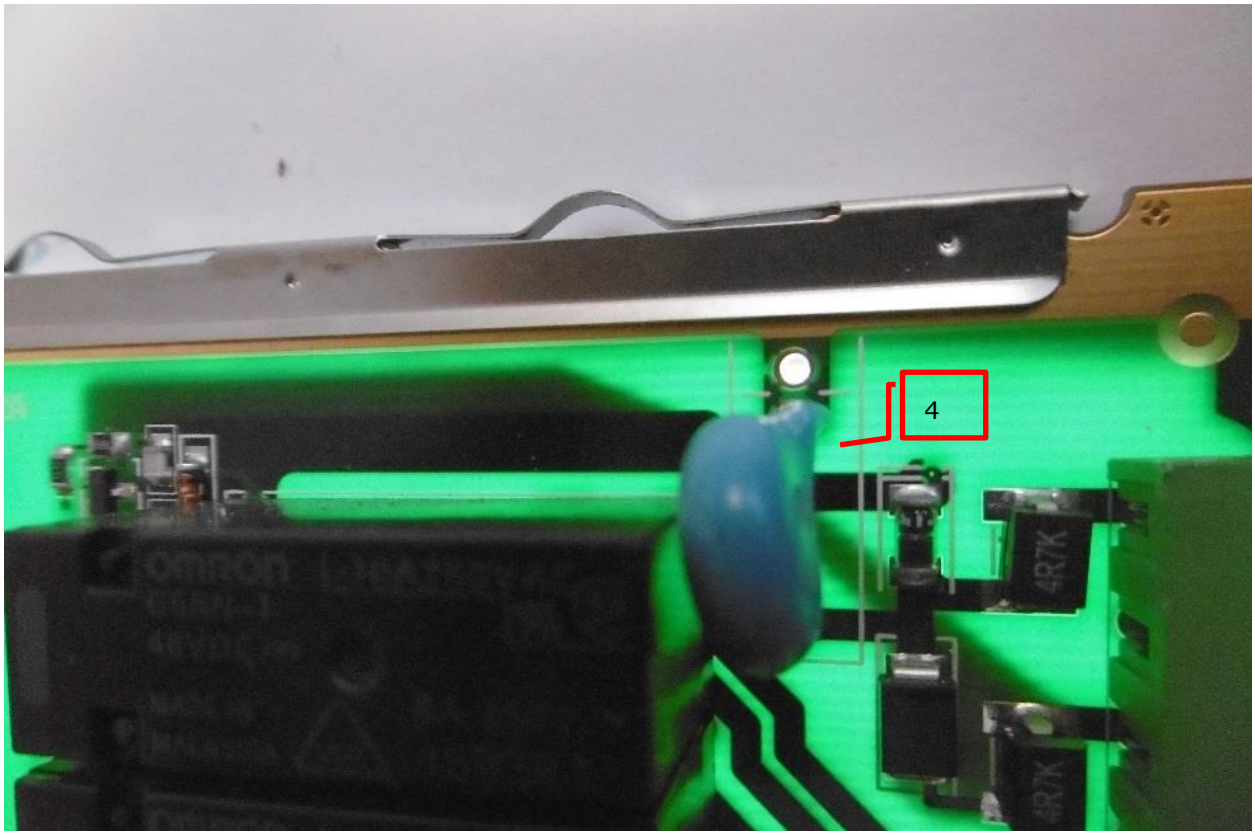
Clearance
The observed clearance is well above the required clearance distance. No measurements required.

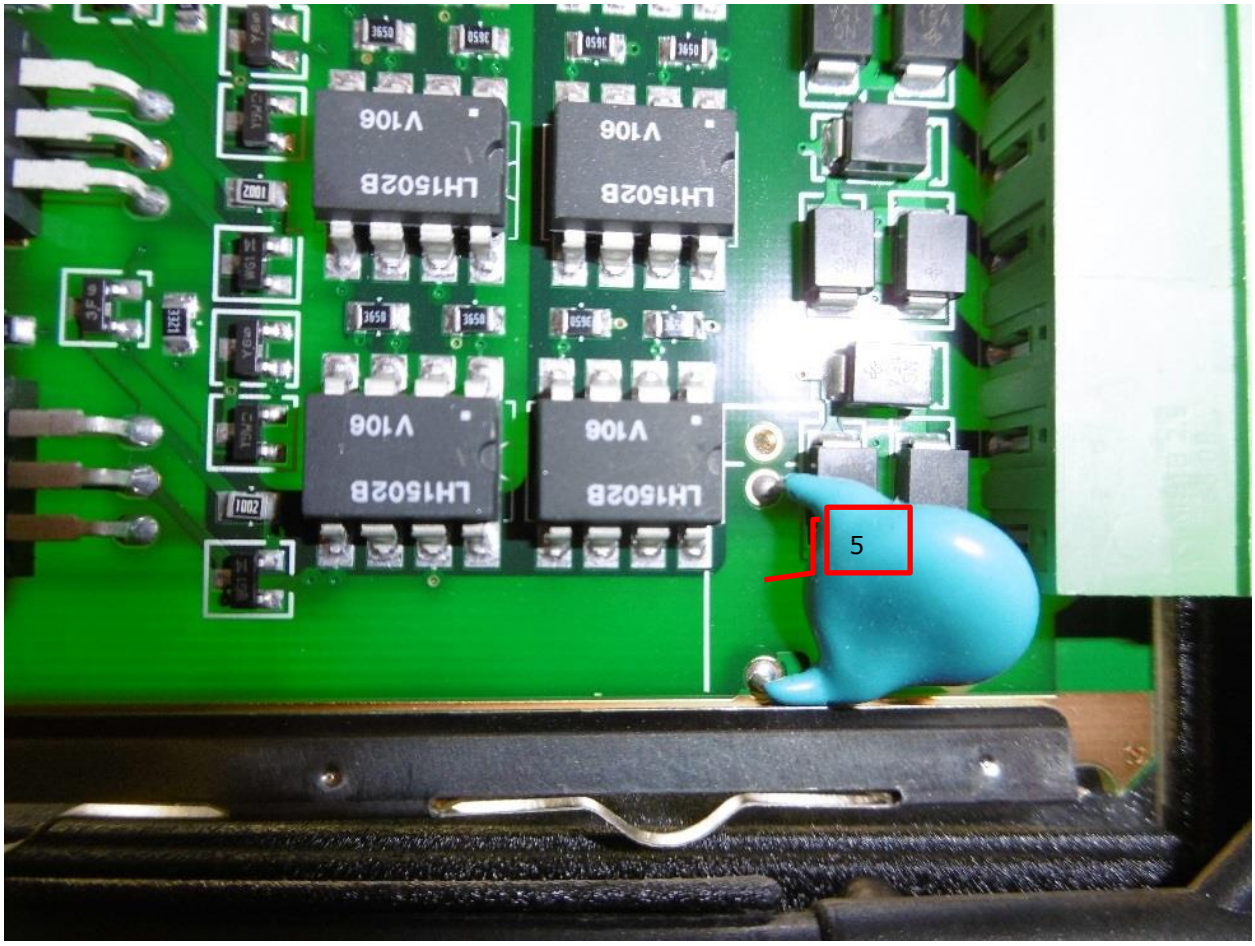
"IEC 61850-3 clause 6.6.1.1 General
Where there is any doubt that the required clearance and creepage distances are compliant with the values in the appropriate table from Annex C of IEC 60255-27:2013, measurements shall be made".

AOU200




6
5


4
4R7K
4R7K



Creepage

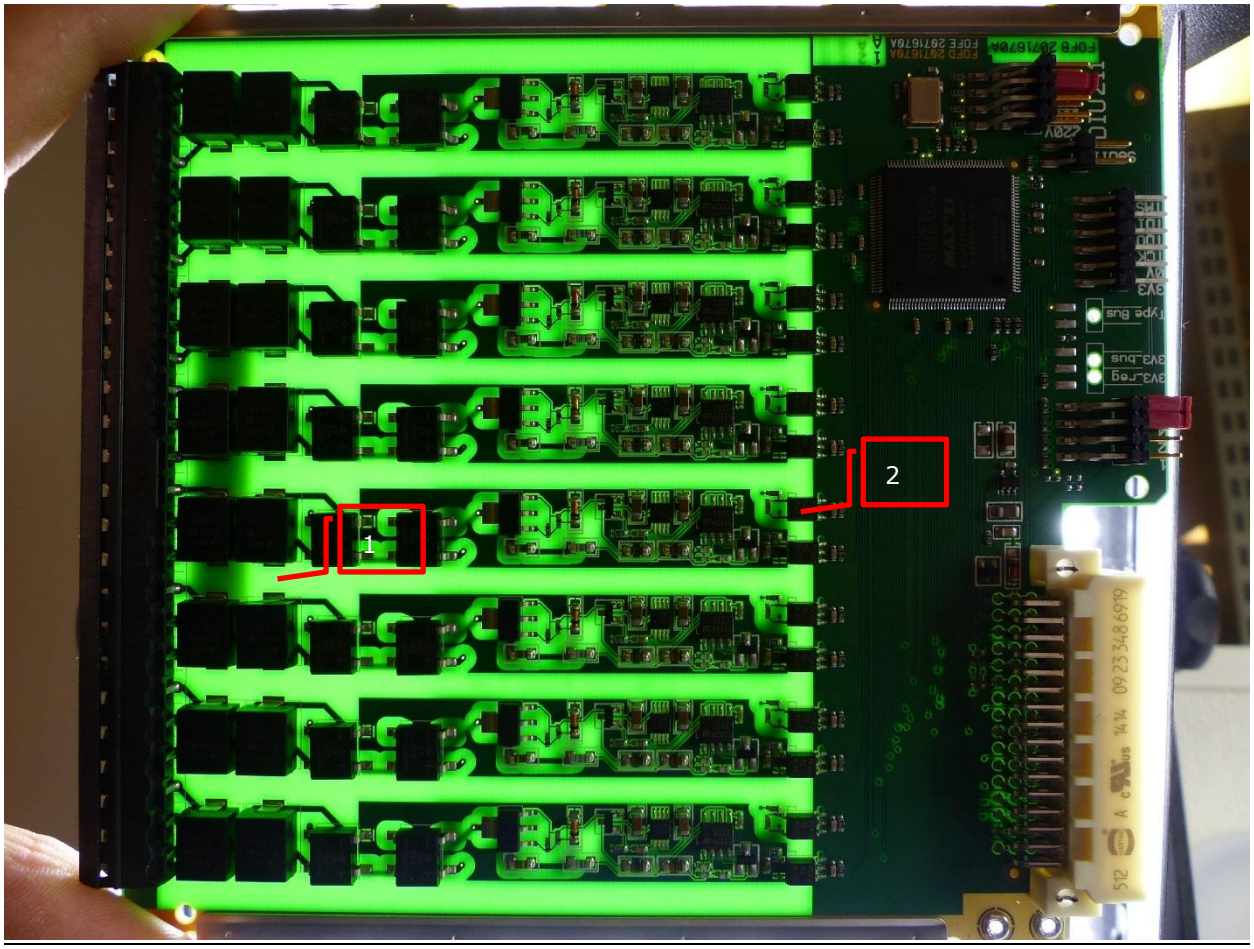
Measurement point	Required mm	Measured mm	Result
1: optocouplers	3,0	> 6,0	Passed
2: between header and PE	3,0	5,0	Passed
3: between header and PE	3,0	3,0	Passed
4: between Y-capacitor and diode	3,0	4,0	Passed
5: over the Y-capacitor	3,0	> 6,0	Passed
6: between relay and LM1502 circuit	3,0	3,0	Passed

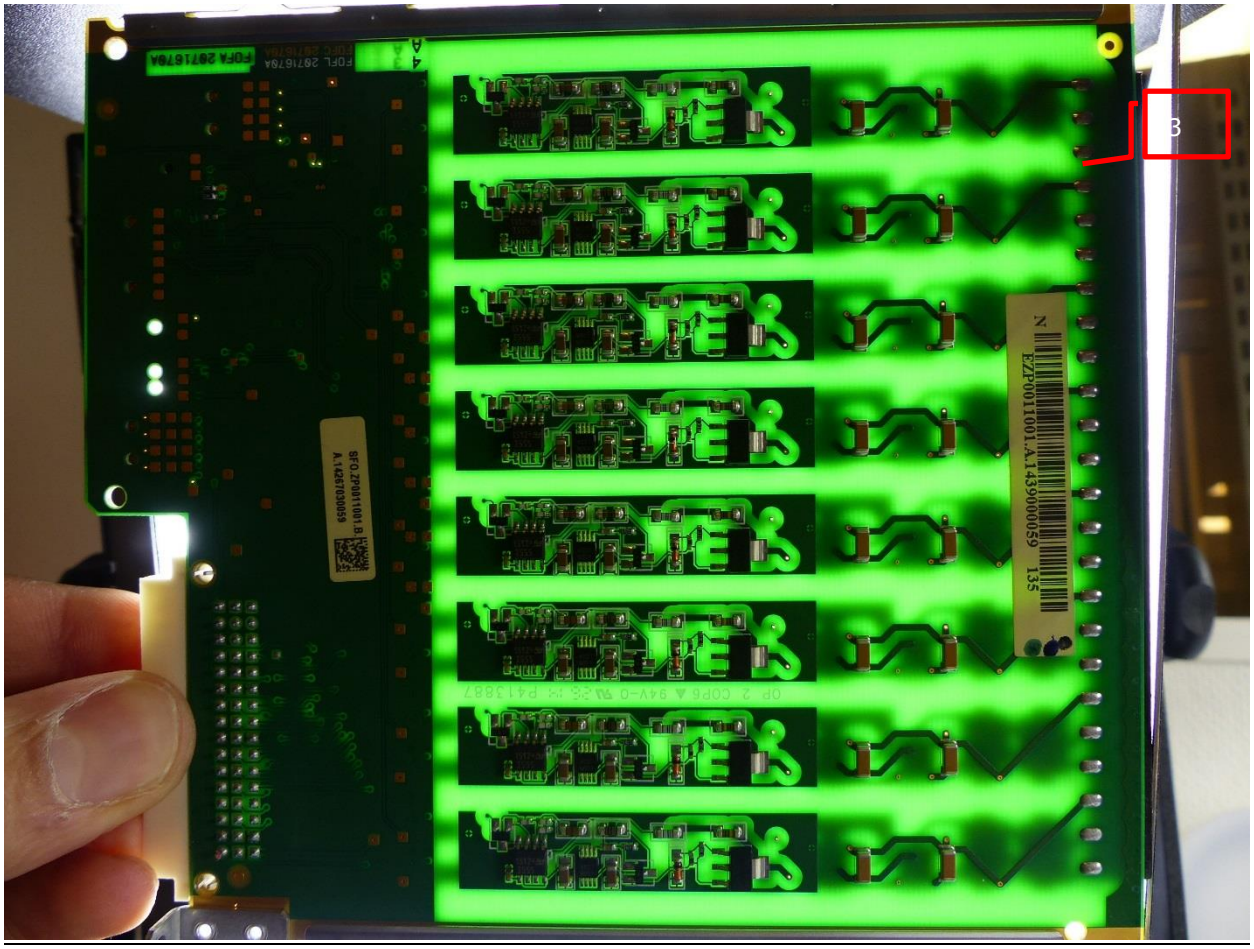
Clearance

The observed clearance is well above the required clearance distance. No measurements required.

"IEC 61850-3 clause 6.6.1.1 General
Where there is any doubt that the required clearance and creepage distances are compliant with the values in the appropriate table from Annex C of IEC 60255-27:2013, measurements shall be made".

DIU211





Creepage

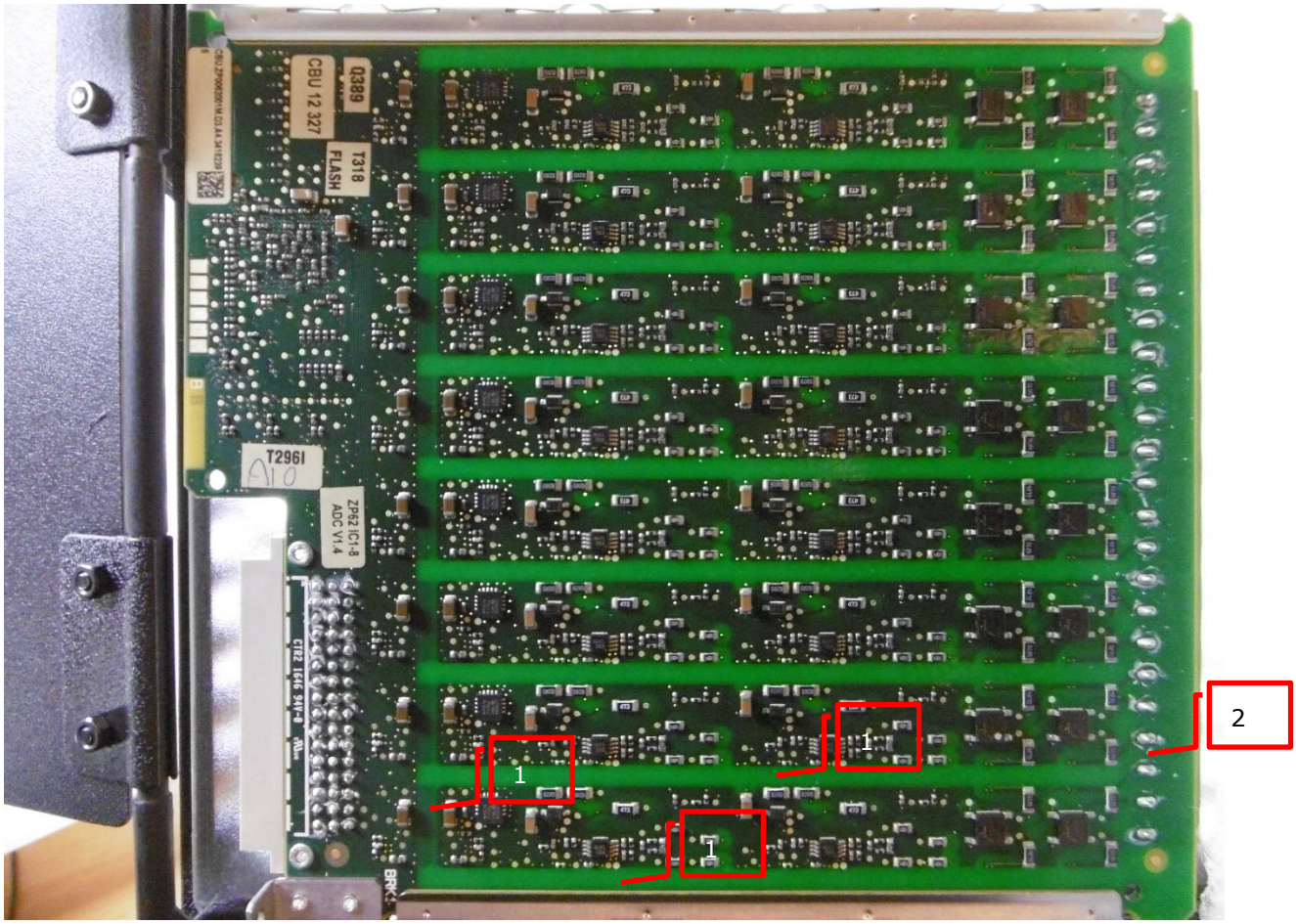
Measurement point	Required mm	Measured mm	Result
1: between transient suppressors of adjacent input circuits	3,0	3,5	Passed
2: over the optocouplers	3,0	> 4,0	Passed
3: between connector pins of adjacent circuits	3,0	3,0	Passed

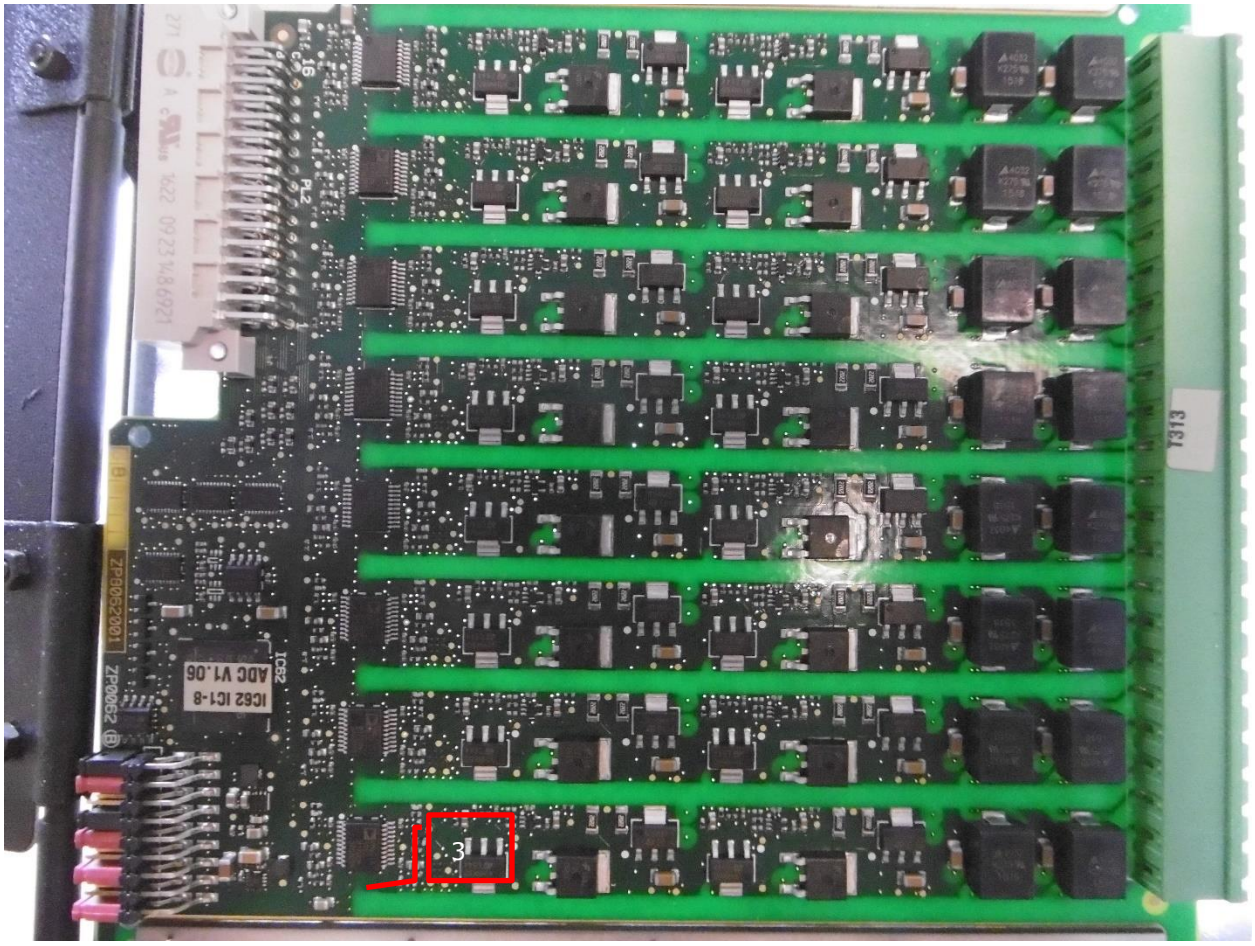
Clearance

The observed clearance is well above the required clearance distance. No measurements required.

"IEC 61850-3 clause 6.6.1.1 General
Where there is any doubt that the required clearance and creepage distances are compliant with the values in the appropriate table from Annex C of IEC 60255-27:2013, measurements shall be made".

DIU221





Creepage

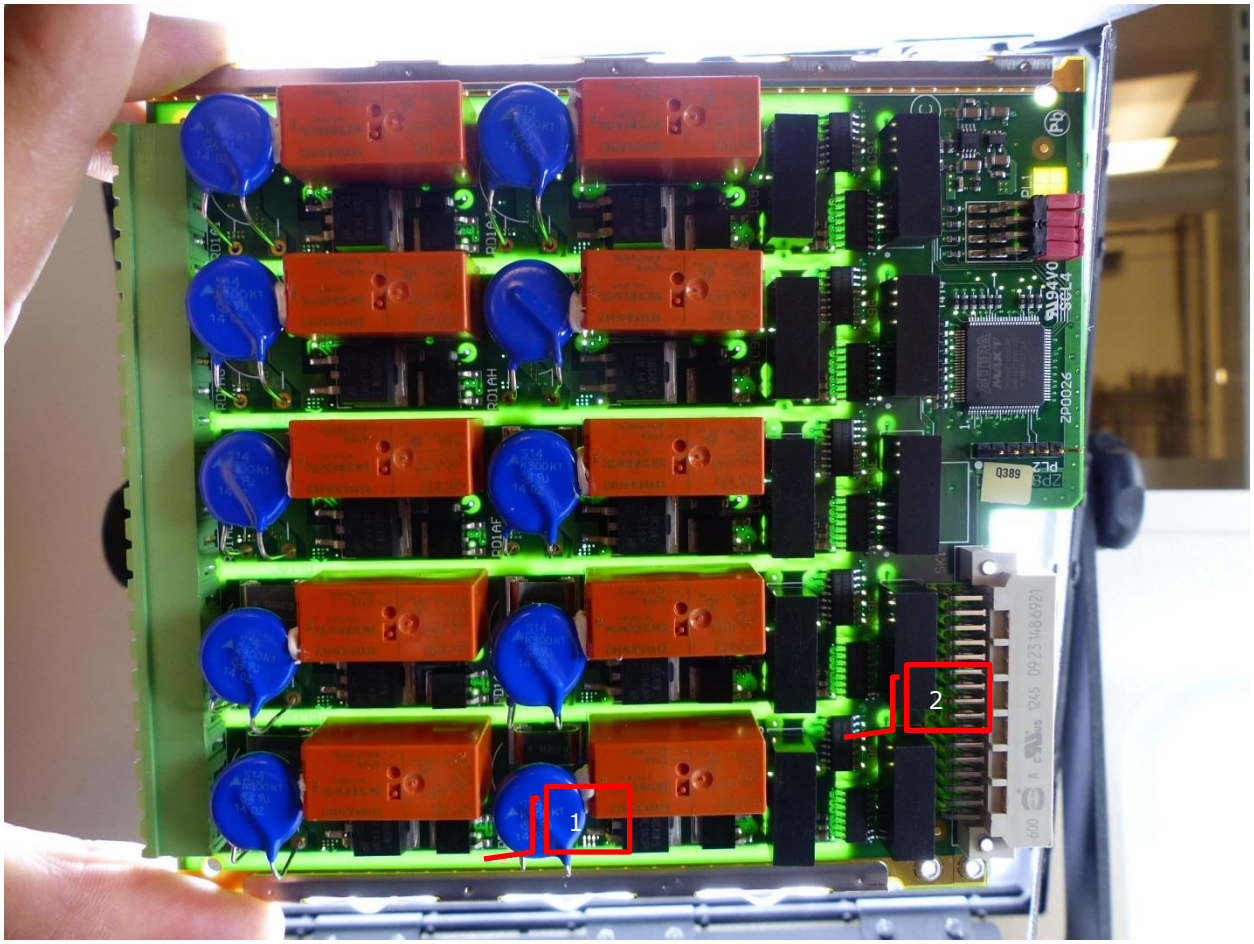
Measurement point	Required mm	Measured mm	Result
1: between adjacent input circuits and between ELV and input circuits	3,0	3,5	Passed
2: between connector pins of adjacent circuits	3,0	> 4,0	Passed
3: between ELV and input circuits at the isolation IC	3,0	3,0	Passed

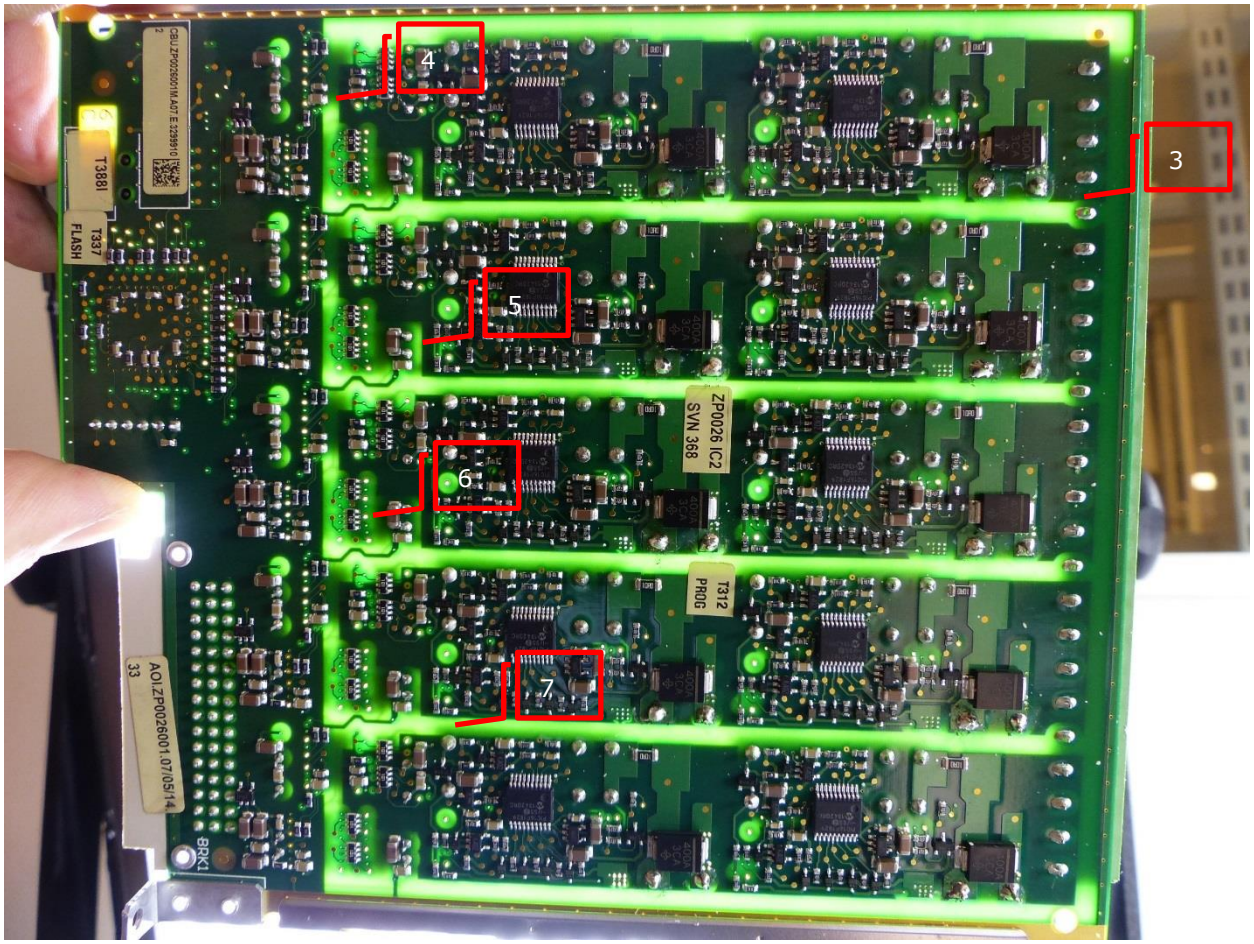
Clearance

The observed clearance is well above the required clearance distance. No measurements required.

"IEC 61850-3 clause 6.6.1.1 General
Where there is any doubt that the required clearance and creepage distances are compliant with the values in the appropriate table from Annex C of IEC 60255-27:2013, measurements shall be made".

HBU200





Creepage

Measurement point	Required mm	Measured mm	Result
1: between RD1AB and conductive card guide (PE)	3,0	3,0	Passed
2: over IC Si8462BB	3,0	> 4,0	Passed
3: between connector pins of adjacent circuits	3,0	3,0	Passed
4: between ELV and output circuits	3,0	3,0	Passed
5: between ELV and output circuits	3,0	3,0	Passed
6: between ELV and output circuits	3,0	3,0	Passed
7: between adjacent circuits	3,0	3,0	Passed

Clearance
The observed clearance is well above the required clearance distance. No measurements required.

"IEC 61850-3 clause 6.6.1.1 General
Where there is any doubt that the required clearance and creepage distances are compliant with the values in the appropriate table from Annex C of IEC 60255-27:2013, measurements shall be made".

Requirement
The DUT shall comply with the applicable creepage and clearance requirements of IEC 60255-27 annex C.

Result
The object passed the test.

9.3 IP rating test

Standard and date

Standard IEC 61850-3, subclause 6.6.2
Test date 1 November 2016

Environmental conditions

Ambient temperature 21,5 °C Relative humidity 50,4 %
Ambient air pressure 1014 hPa

Characteristic test data

Serial number A160009583

Terminal side	Degree of protection	
	Specification by the manufacturer	Observation
Front	IP 2x	IP 2x
Top	IP 2x	IP 2x
Bottom	IP 2x	IP 2x
Back	IP 2x	IP 2x
Back (TMU210/TMU 220)	IP 1x[1)]	IP 1x
Left	IP 2x	IP 2x
Right	IP 2x	IP 2x

[1)]according IEC 60255-27, subclause 5.1.5.2.6 Wiring terminals.

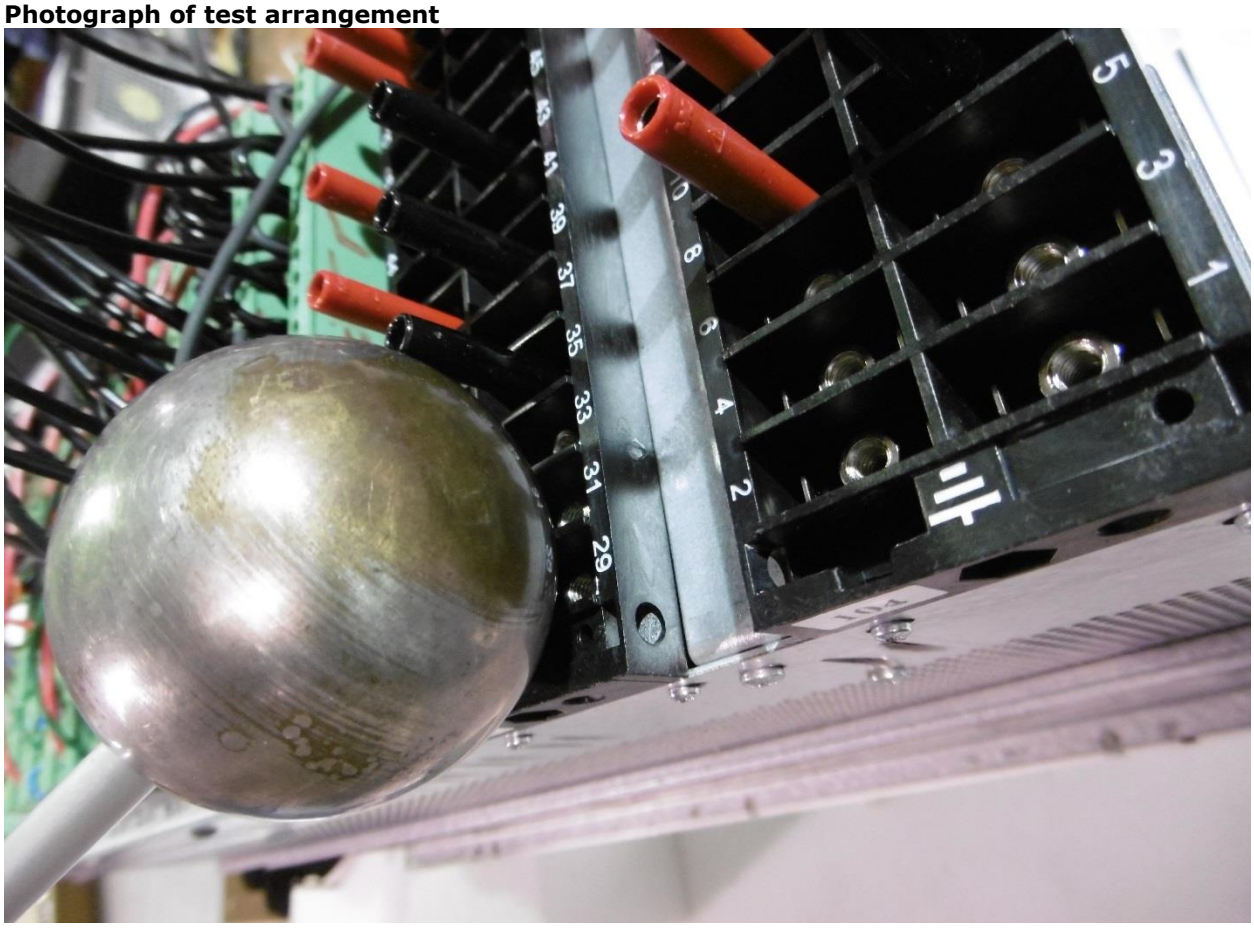
Requirement

- the test finger shall not touch hazardous live parts
- the test finger voltage or energy shall not exceed the safe limits for normal operational use
- no visual or functional inspection required.

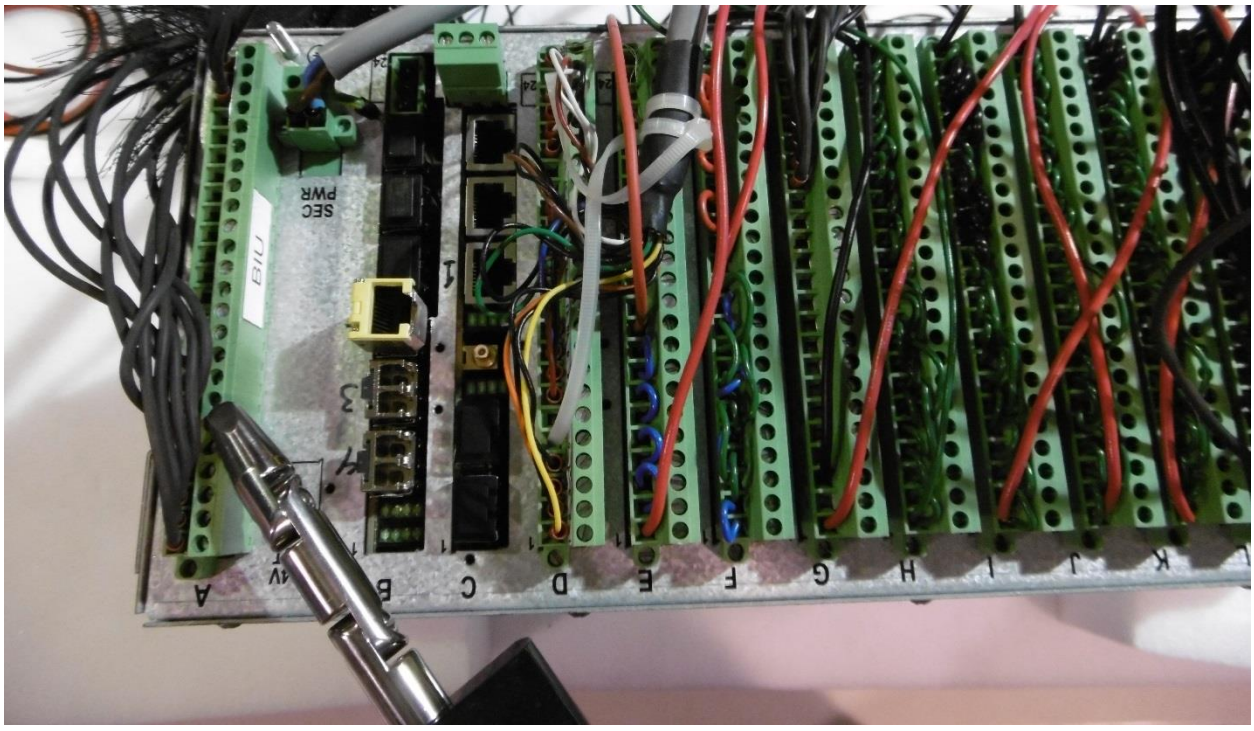
Result

The object passed the test.

Photograph of test arrangement



IP1x-test at the TMU 220 connector



IP2x-test

9.4 Impulse voltage test

Standard and date

Standard IEC 61850-3, subclause 6.6.3
Test date 3 November 2016 and 3 January 2019

Environmental conditions

Ambient temperature 19,5 °C Relative humidity 55,4 %
Ambient air pressure 1004 hPa

Characteristic test data

Serial number A160009583
Time to rise-value 1,2 µs (± 30%)
Time to half-value 50 µs (± 20%)
Source impedance 500 Ω (± 10%)
Insulation resistance > 0,55 GΩ
Output energy 0,5 J (± 10%)
Pulse interval ≥ 1 s

Test arrangement		Voltage applied	No. of impulses	Polarity	Observations
Voltage applied to	Tested between	kV			
Power (BIU261 Primary) (slot A)	Earth and all others	5	5	Positive and negative	No discharge No flashover
Power (BIU261 Secondary) (slot A)	Earth and all others	5	5	Positive and negative	No discharge No flashover
Binary output (BIU216) (slot A)	Earth and all others	5	5	Positive and negative	No discharge No flashover
LAN port (CPU4) (Slot B)	Earth and all others	1	5	Positive and negative	No discharge No flashover
LAN port (SRPv2) (Slot C)	Earth and all others	1	5	Positive and negative	No discharge No flashover
Analogue input (AIU211) (slot D)	Earth and all others	5	5	Positive and negative	No discharge No flashover
Digital output (DOU201) (slot E)	Earth and all others	5	5	Positive and negative	No discharge No flashover
Digital output/control unit (CCU211) (slot F)	Earth and all others	5	5	Positive and negative	No discharge No flashover
Analogue output (AOU200) (slot G)	Earth and all others	5	5	Positive and negative	No discharge No flashover
Digital input (DIU211) (slot H)	Earth and all others	5	5	Positive and negative	No discharge No flashover

Test arrangement		Voltage applied	No. of impulses	Polarity	Observations
Voltage applied to	Tested between	kV			
Digital output (HBU200) (slot M)	Earth and all others	5	5	Positive and negative	No discharge No flashover
Analogue input (TMU220) (slot N)	Earth and all others	5	5	Positive and negative	No discharge No flashover
Analogue input (TMU220) (slot O)	Earth and all others	5	5	Positive and negative	No discharge No flashover
Analogue input (TMU210) (slot O)	Earth and all others	5	5	Positive and negative	No discharge No flashover
Digital input (DIU221) (slot H)	Earth and all others	5	5	Positive and negative	No discharge No flashover

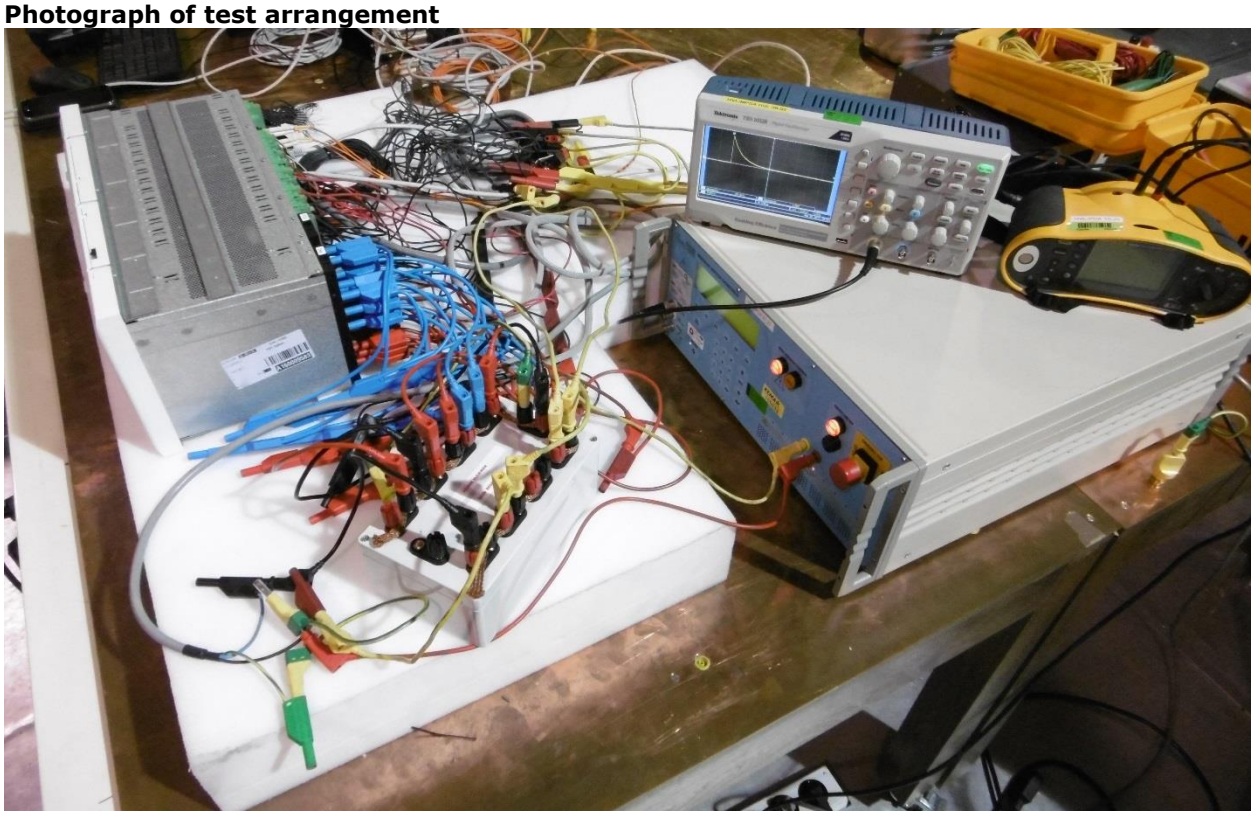
Requirement

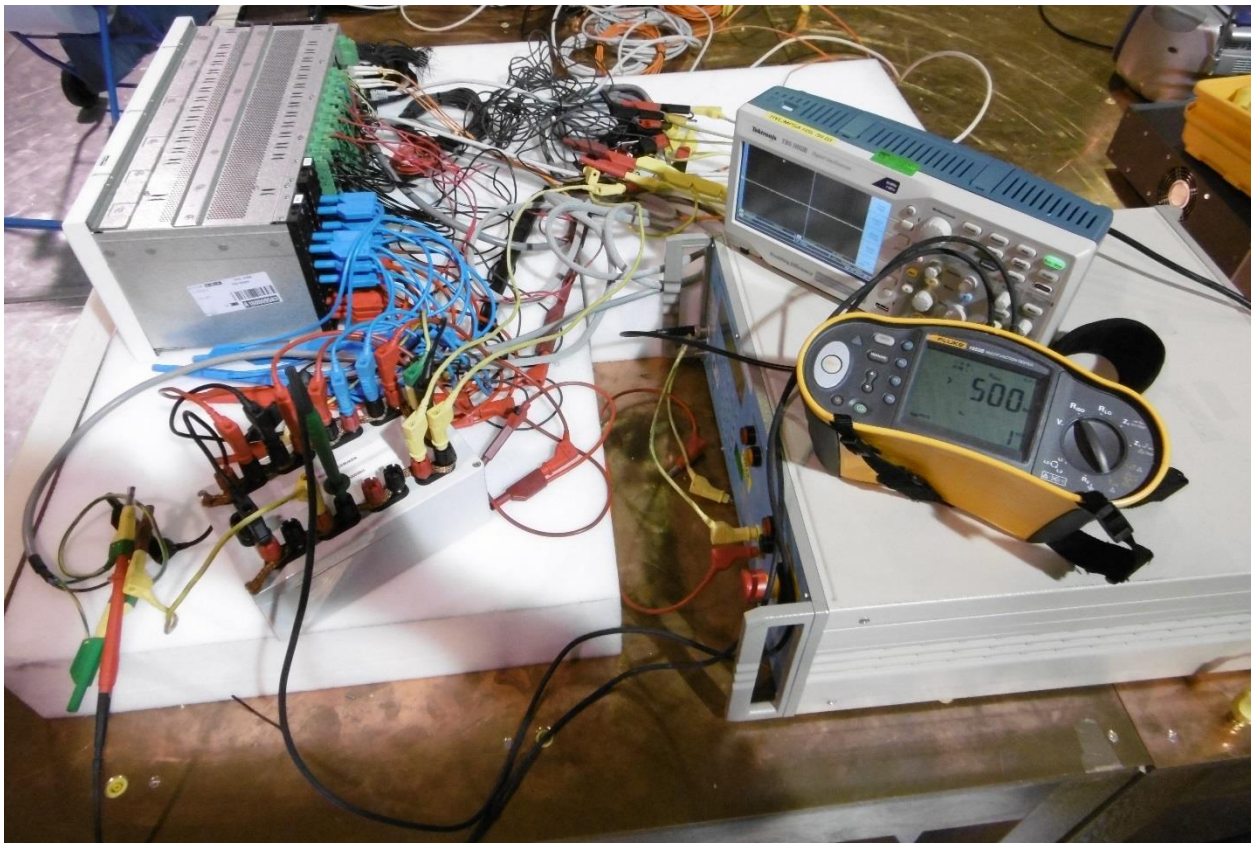
- no disruptive discharges or flashovers shall occur
- the visual and functional inspection shall not reveal any defects or malfunctions.

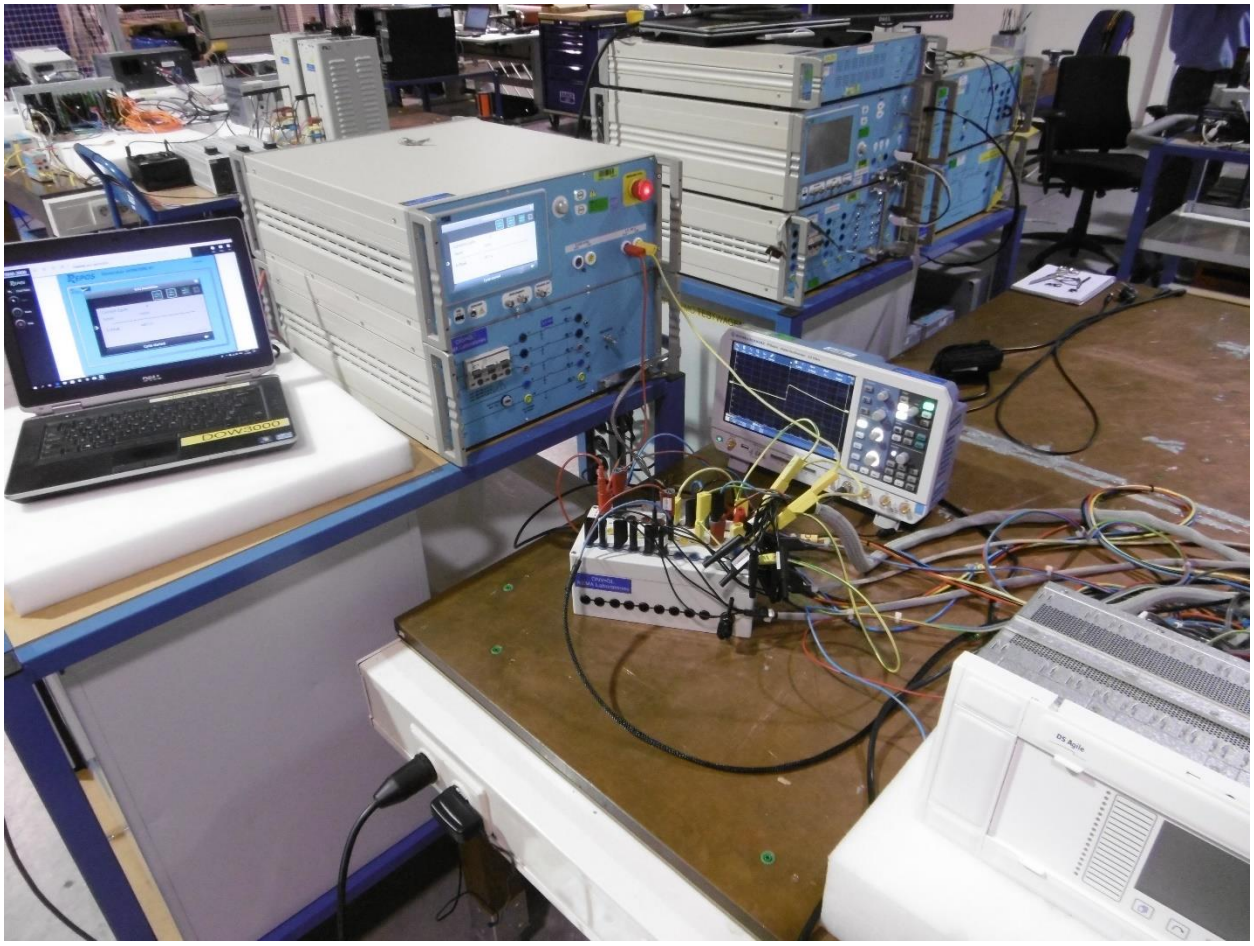
Result

The object passed the test.

Photograph of test arrangement







9.5 Dielectric voltage test

Standard and date

Standard IEC 61850-3, subclause 6.6.4
Test date 4 November 2016 and 2 November 2018

Environmental conditions

Ambient temperature 19,5 °C Relative humidity 55,4 %
Ambient air pressure 1004 hPa

Characteristic test data

Serial number A160009583
Frequency 50 Hz
Test duration 1 min

Voltage applied to Circuit/terminals	Insulation resistance at 500 Vdc (before the test) MΩ	Voltage applied kVac	Insulation resistance at 500 Vdc (after the test) MΩ	Observations
Power (BIU261 Primary) (slot A)	> 550	2	> 550	No breakdown No flashover
Power (BIU261 Secondary) (slot A)	> 550	2	> 550	No breakdown No flashover
Binary output (BIU216) (slot A)	> 550	2	> 550	No breakdown No flashover
LAN port (CPU4) (slot B)	> 550	0,5	> 550	No breakdown No flashover
LAN port (SRPv2 (slot C)	> 550	0,5	> 550	No breakdown No flashover
Analogue input (AIU211) (slot D)	> 550	2	> 550	No breakdown No flashover
Digital output (DOU201) (slot E)	> 550	2	> 550	No breakdown No flashover
Digital output/control unit (CCU211) (slot F)	> 550	2	> 550	No breakdown No flashover
Analogue output (AOU200) (slot G)	> 550	2	> 550	No breakdown No flashover
Digital input (DIU211) (slot H)	> 550	2	> 550	No breakdown No flashover
Digital output (HBU200) (slot M)	> 550	2	> 550	No breakdown No flashover
Analogue input (TMU220) (slot N)	> 550	2	> 550	No breakdown No flashover
Analogue input (TMU220) (slot O)	> 550	2	> 550	No breakdown No flashover

Voltage applied to Circuit/terminals	Insulation resistance at 500 Vdc (before the test) MΩ	Voltage applied kVac	Insulation resistance at 500 Vdc (after the test) MΩ	Observations
Analogue input (TMU210) (slot O)	> 550	2	> 550	No breakdown No flashover
Digital input (DIU221) (slot H)	> 550	2	> 550	No breakdown No flashover

Note

Each circuit has been tested against all other circuits and earth connected together

The test has been performed after completion of the climatic tests.

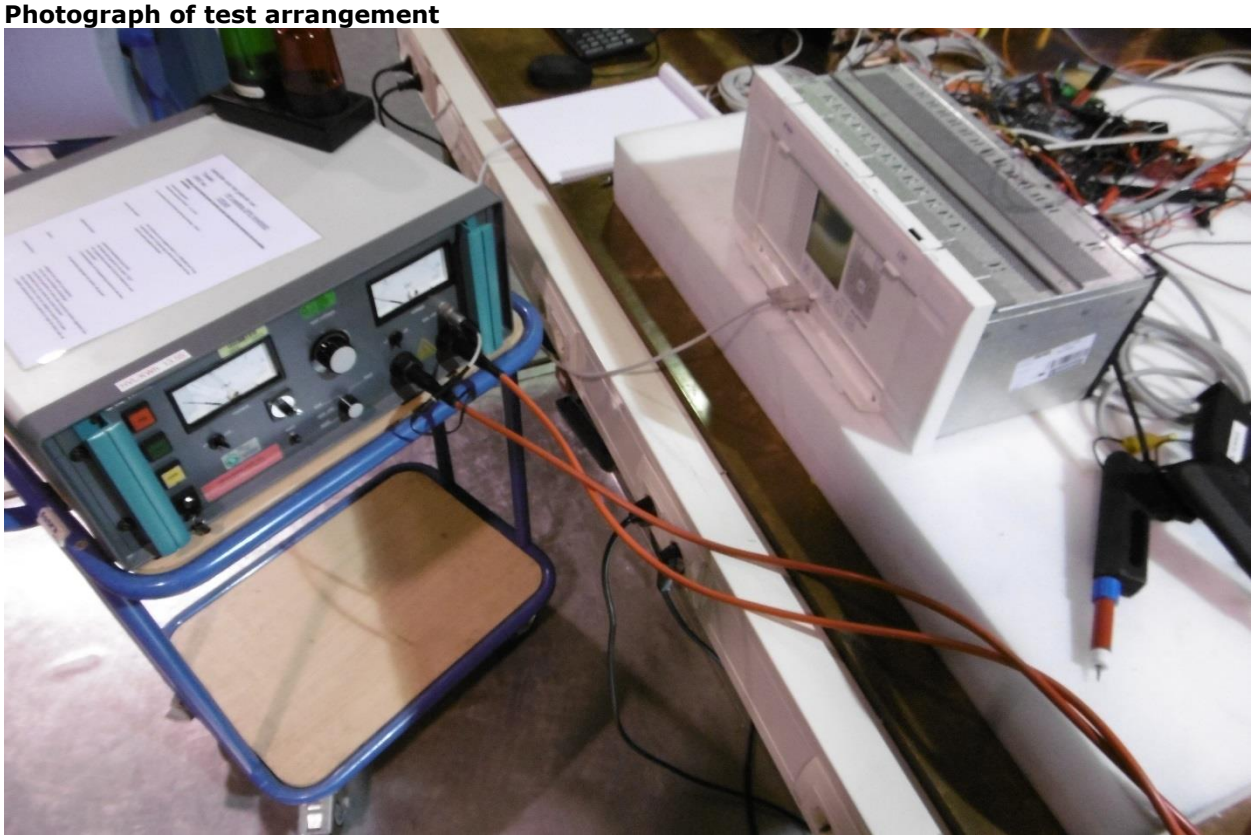
Requirement

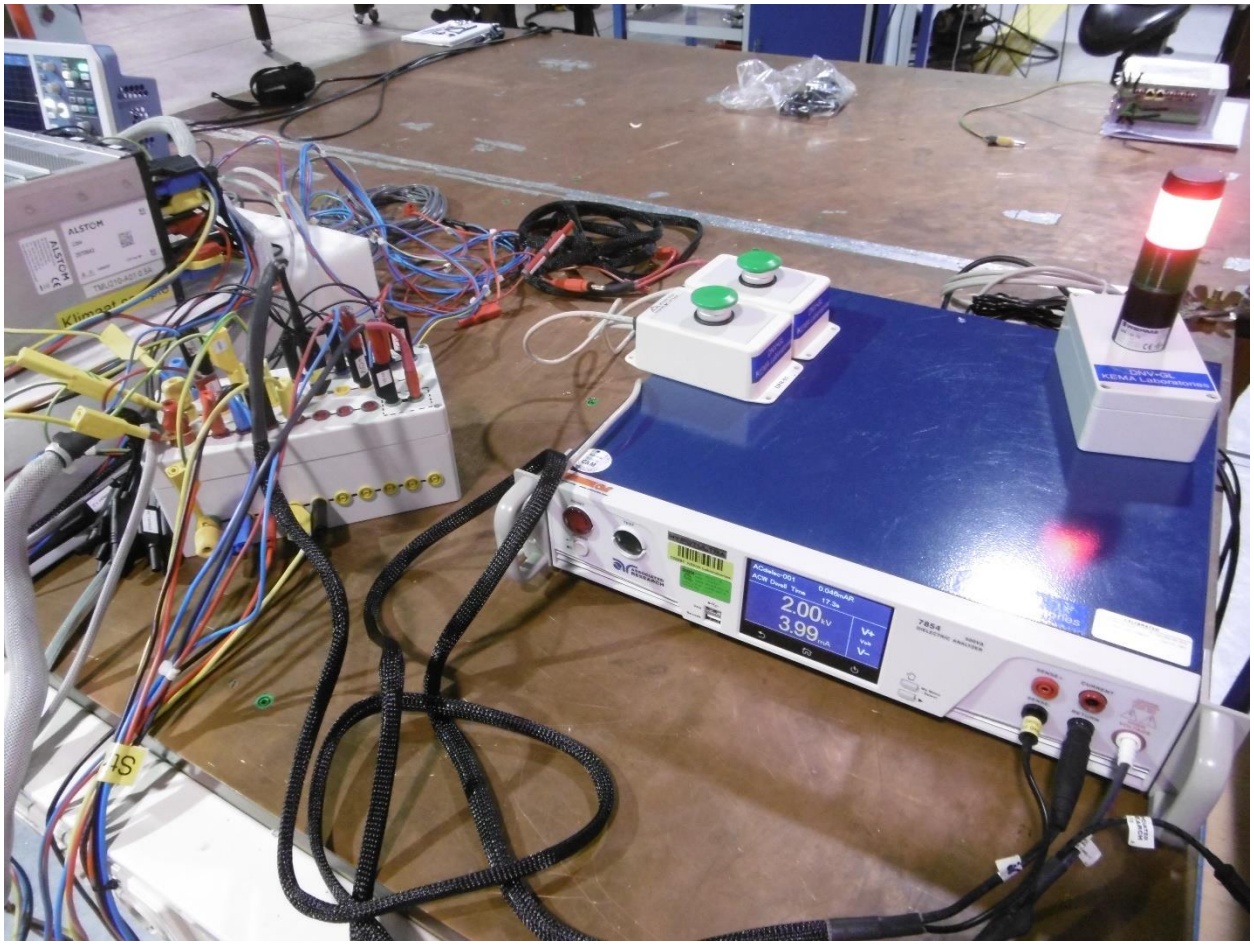
- no breakdown or flashover shall occur
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement





9.6 Protective bonding resistance

Standard and date

Standard	IEC 61850-3, subclause 6.6.5
Test date	4 November 2016

Environmental conditions

Ambient temperature	20,1 °C	Relative humidity	55,4 %
Ambient air pressure	1006 hPa		

Characteristic test data

Serial number	A160009583
Test voltage	< 12 Vdc
Test current	10 A
Test duration	60 s

Test point	Terminal	Resistance Ω
Upper mounting flag screw on most right side	Earth	0,022
Right under PE fixing screw close to slot A	Earth	0,0075
Right front, middle screw	Earth	0,0024
Rear, top of rack	Earth	0,031

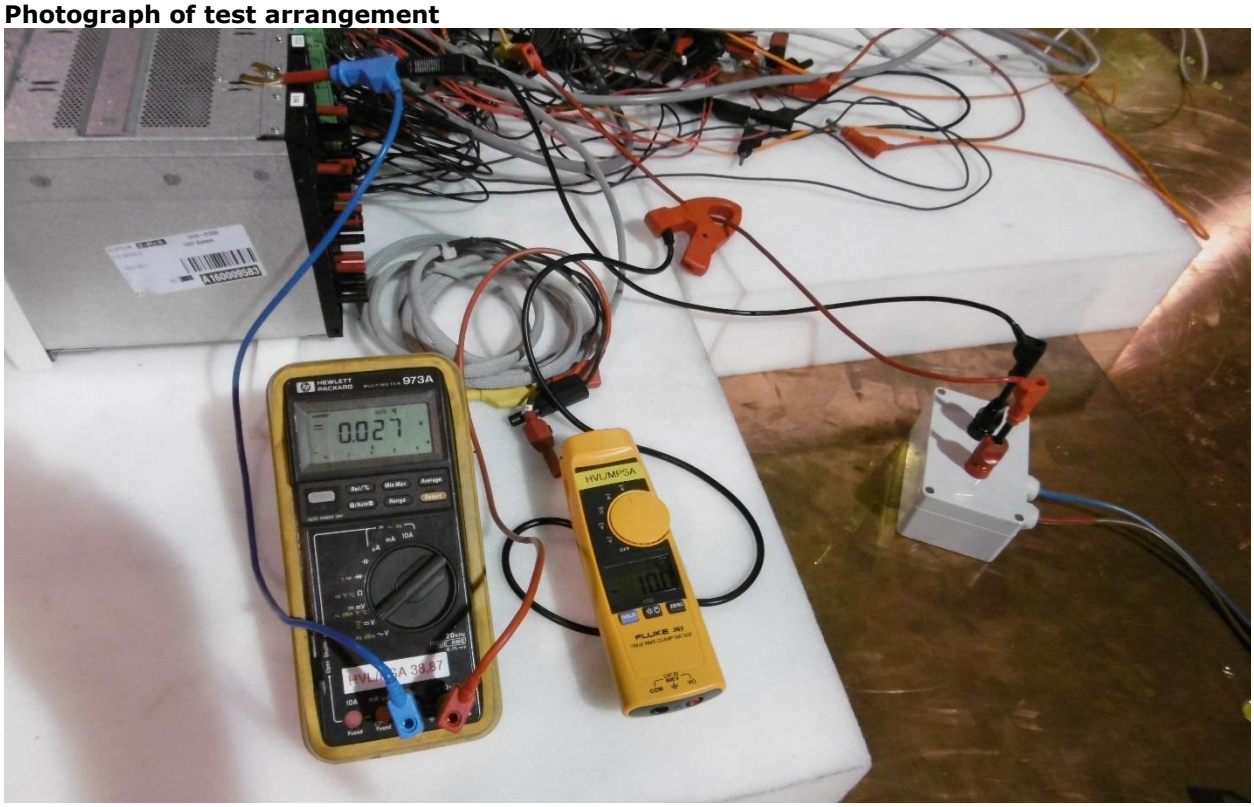
Requirement

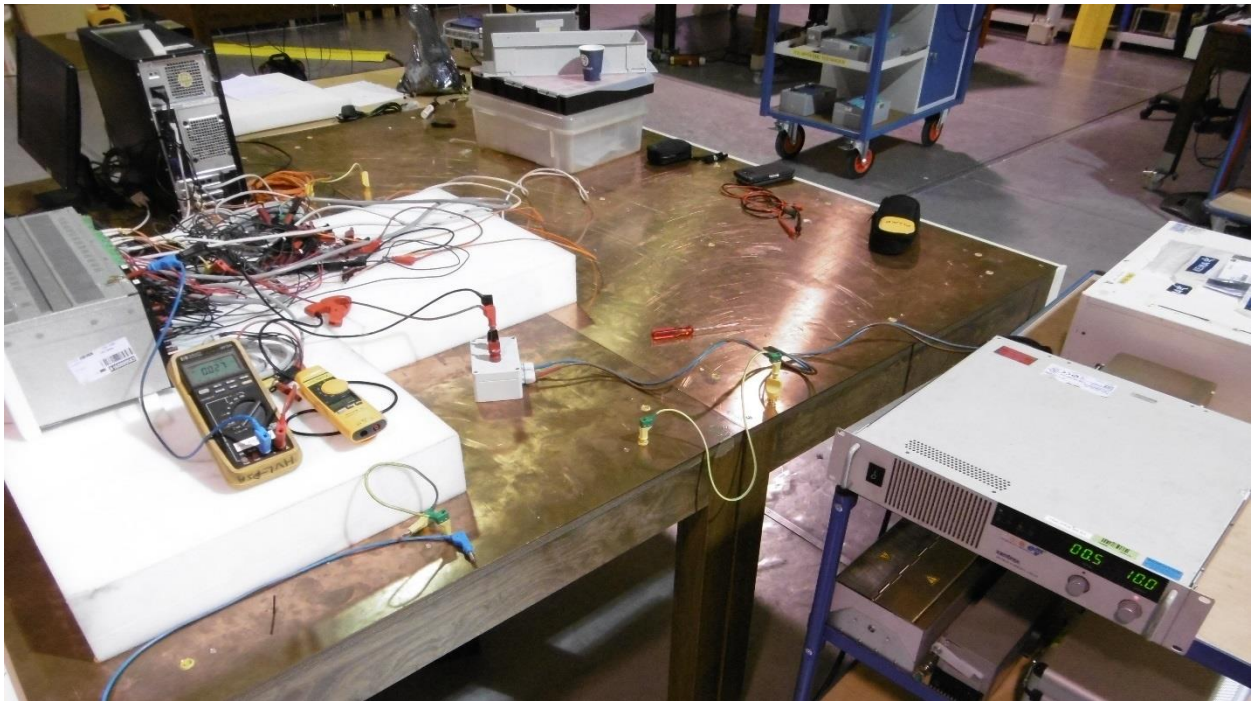
- the resistance between the test point and the protective conductor terminal shall not exceed 0,1 Ω
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement





9.7 Flammability of insulating materials, components and fire enclosures

Standard and date

Standard IEC 61850-3, subclause 6.6.6
Test date 20 April 2017

Environmental conditions

Ambient temperature 19,5 °C

Characteristic test data

Serial number A160009583

The DUT housing is a fire enclosure made of metal. The housing top and bottom plates are provided with cooling openings which meet the requirements of IEC 60255-27 clause 7.10.
Plate thickness; 1 mm steel. Hole; 2 mm. Hole spacing; 3 mm.
Side plates; no openings.
Front plate/front cover; metal. The front plate has been provided with openings for signal cables to the keypad/display. Front plate is covered by the plastic front cover. No connectors stick out the plastic front cover.

Module	Part	Rating	Result
Enclosure	Metal enclosure. Ventilation holes in top and bottom of metal case are 1.9mm diameter with a center to center spacing of 3.4mm. Material thickness is 1mm.	Equipment enclosure is a fire enclosure	P
Plastic front cover	Front panel moulding part; GN6022-001	94-V-0	P
Plastic foil over display (membrane)	Front panel membrane material: PET Autotex F200	94-HB	P
CPU4	Connector J3; TH HEADER - 3 WAY - MALE - 12-15A / 250-300V - HORIZONTAL - GREEN - PCC 5.08mm Part; 1515 LED array D1/D11; 2x3mm QUAD-LEVEL LED INDICATOR	94-V-0 94-V-0	P
Switch board SRPv2	Connector J10; Base strip - MSTBO 2,5/ 3-GL-5,08 - 1850440 Connector J3/J4/J5; Ethernet Connectors r/a 8 pos t/h black TH 90° Right angle RJ45 connector SFP Cage (metal) SFP cover TH HEADER - 3 WAY - MALE - 12-15A / 250-300V - HORIZONTAL - GREEN - PCC 5.08mm	94-V-0 94-V-0 94-V-0 - 94-V-0 94-V-0	P
BIU216D	Main board connector PL1, TH HEADER 24 WAY MALE - RIGHT-ANGLED - PCC 5.08mm Part; VB9501580 Daughter board PL1; HEADER - 2 WAY - VERTICAL - PCC 5.08mm - 12A - 320V – MSTBO Part; A01000567	94-V-0 94-V-0	P
AIU211	Connector J2	94-V-0	P

Module	Part	Rating	Result
DOU201	Connector PL2	94-V-0	P
CCU211	Connector P3, TH HEADER 24 WAY MALE - RIGHT-ANGLED - PCC 5.08mm Part; VB9501580	94-V-0	P
AOU200	Connector X2, TH HEADER 24 WAY MALE - RIGHT-ANGLED - PCC 5.08mm Part; VB9501580	94-V-0	P
DIU211 DIU221	Connector P2, TH HEADER 24 WAY MALE - RIGHT-ANGLED - PCC 5.08mm Part; VB9501580	94-V-0	P
HBU200	Connector PL3	94-V-0	P
TMU210 and TMU220	External field wiring terminal/internal cradle mounted connector, UL file QMFZ2.E41938	94-V-0	P

PCB's: flammability rating UL94-V-0.

Requirements

- insulated wires shall have a flammability class equivalent to V-1 or better
- connectors and insulating material on which components are mounted shall have a flammability class equivalent to V-1 or better
- no visual or functional inspection required.

Result

The object passed the test.

9.8 Single-fault condition

Standard and date

Standard IEC 61850-3, subclause 6.6.7
Test date 30 March 2017 and 11 April 2019

Environmental conditions

Ambient temperature 20 °C Relative humidity 55,4 %
Ambient air pressure 1005 hPa

Characteristic test data

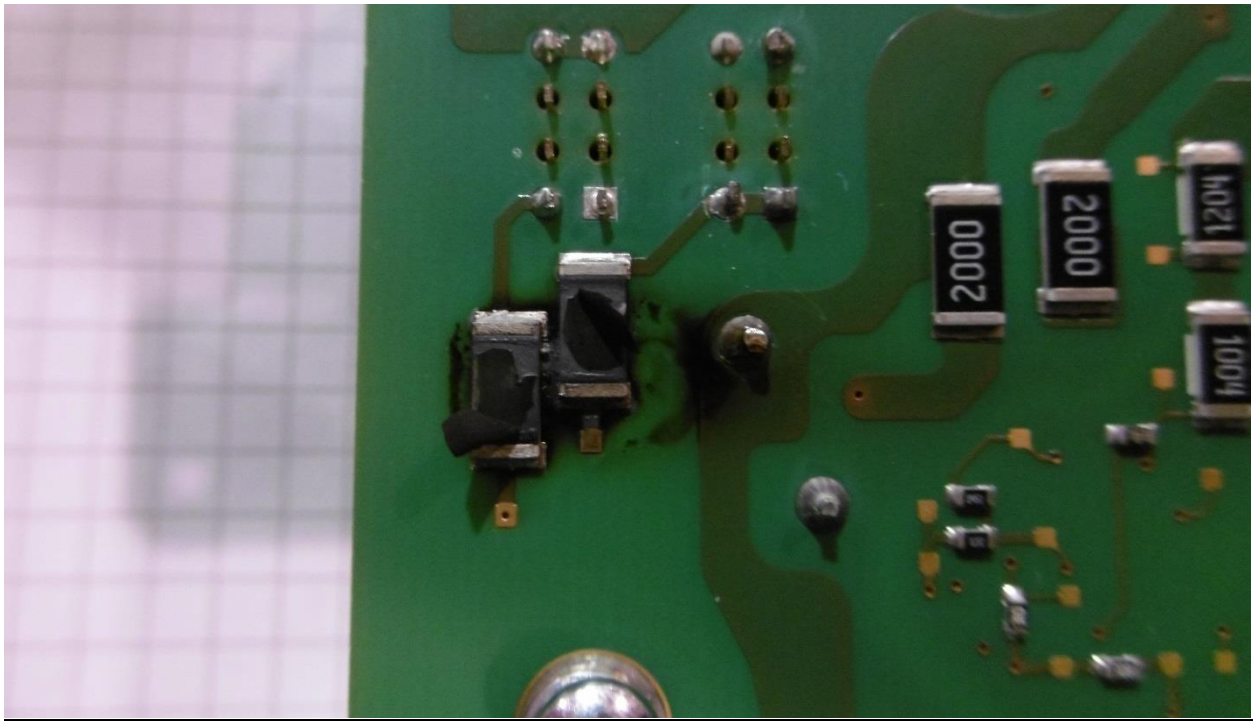
Serial number A16000958
Power supply 110 Vdc

Abnormal condition

Circuit under test	Test	Observation
+ 5 V power supply	Loaded with 5 A for 4 hours	Remains operational
+ 12 V power supply	Loaded with 3 A for 4 hours	Remains operational
+ 24 V power supply on daughter board	Loaded with 0,25 A for 4 hours	Resistors R49 and R50 started to smoke. After some time the +24 volt disappeared
+ 55 V power supply	Loaded with 1,1 A for 4 hours	Remains operational

Short circuit

Circuit under test	Test	Observation
+ 5 V power supply	Increase the load until the output voltage decreases. Finally a short circuit is created.	Current folds back and voltage goes to zero. Current > 10 A Power of required for a restart.
+ 12 V power supply	Increase the load until the output voltage decreases. Finally a short circuit is created.	The 12 V supply went defective
+ 24 V supply on daughter board	Increase the load until the output voltage decreases. Finally a short circuit is created.	2 resistors (R49 and R50) burned (see picture). No fire hazard arises during the test. No burned particles were found.
+ 55 power supply	Increase the load until the output voltage decreases. Finally a short circuit is created.	Current folds back and voltage drops. Current > 2,7A



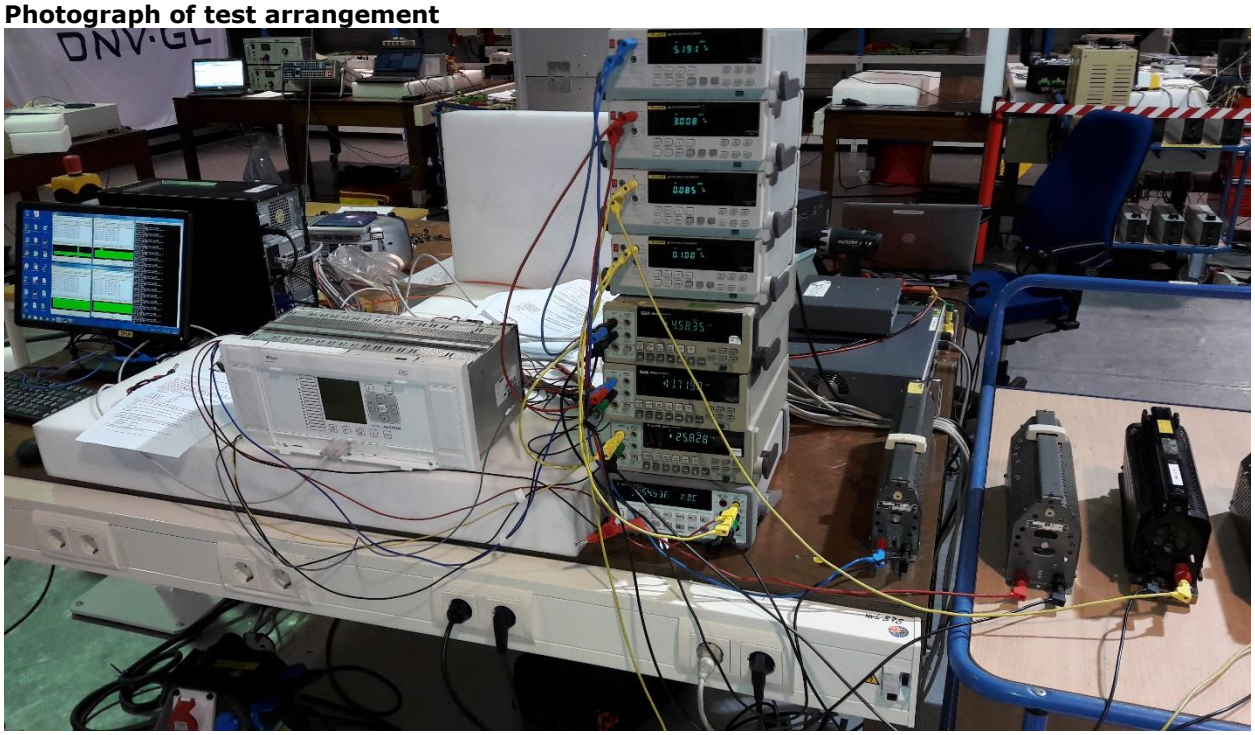
Requirements

- the test shall not result in a fire or electric shock risk/hazard
- the test object does not have to be functional after the test
- no visual or functional inspection required.

Result

The object passed the test.

Photograph of test arrangement



Enclosure temperature during the overload test.

10 ELECTROMAGNETIC COMPATIBILITY

10.1 Inspection

10.1.1 Pre-inspection

The pre-inspection is performed to verify that the test object is in operational state. The pre-inspection is carried out prior to the test procedure.

The communication with the maintenance computer is verified. Signals are simulated to verify the functioning and operation with the specified performance specification for the following inputs and outputs:

- digital inputs
- digital outputs
- analogue inputs
- contact outputs
- data communication.

10.1.2 Visual and functional inspection

After each test a visual and functional inspection is carried out as described in this chapter.

The visual inspection is carried out to verify that there is no visual mechanical damage.
There shall be no burning of any components.

Functional inspection is carried out to verify the correct operation of the test object.
The measurements of analogue input data shall not exceed twice the class index for the measurement.
There shall be no:

- alarm indications on display and LED's
- error messages reported in the maintenance computer
- unintentional change of contact outputs
- there shall be no degradation of performance below the claimed performance according reliability class (1 or 2).

Unless otherwise stated the visual and functional inspection was carried out successfully after each test.

10.2 Radiated emission

Standard and date

Standard	IEC 61850-3, subclause 6.7.4
Test date	9 November 2016 and 3 to 4 December 2018

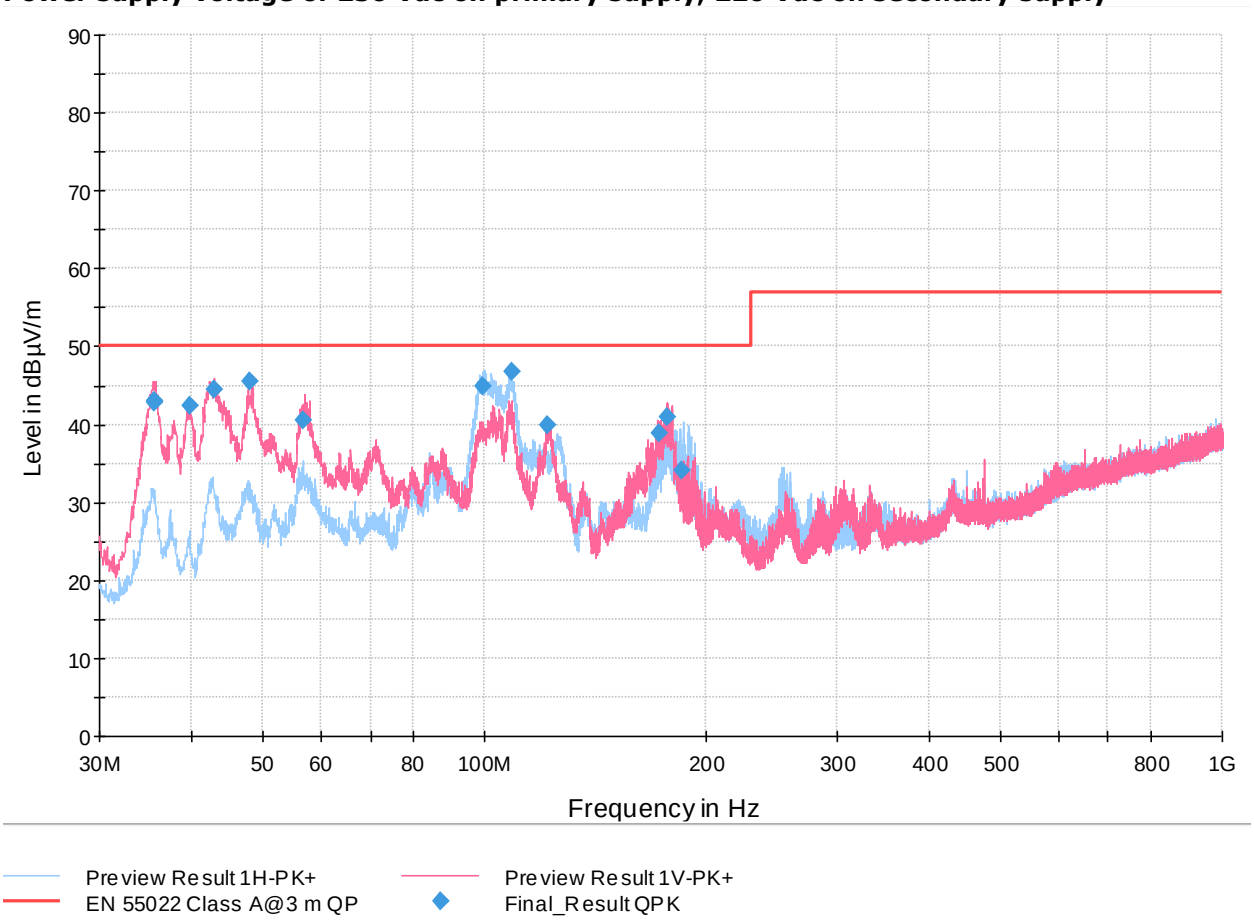
Environmental conditions

Ambient temperature	22 °C

Characteristic test data

Serial number	A160009584 C264 (HW66)
Power supply	230 Vac /220 Vdc

Power supply voltage of 230 Vac on primary supply, 220 Vdc on secondary supply



Final results (80 – 1000 MHz)

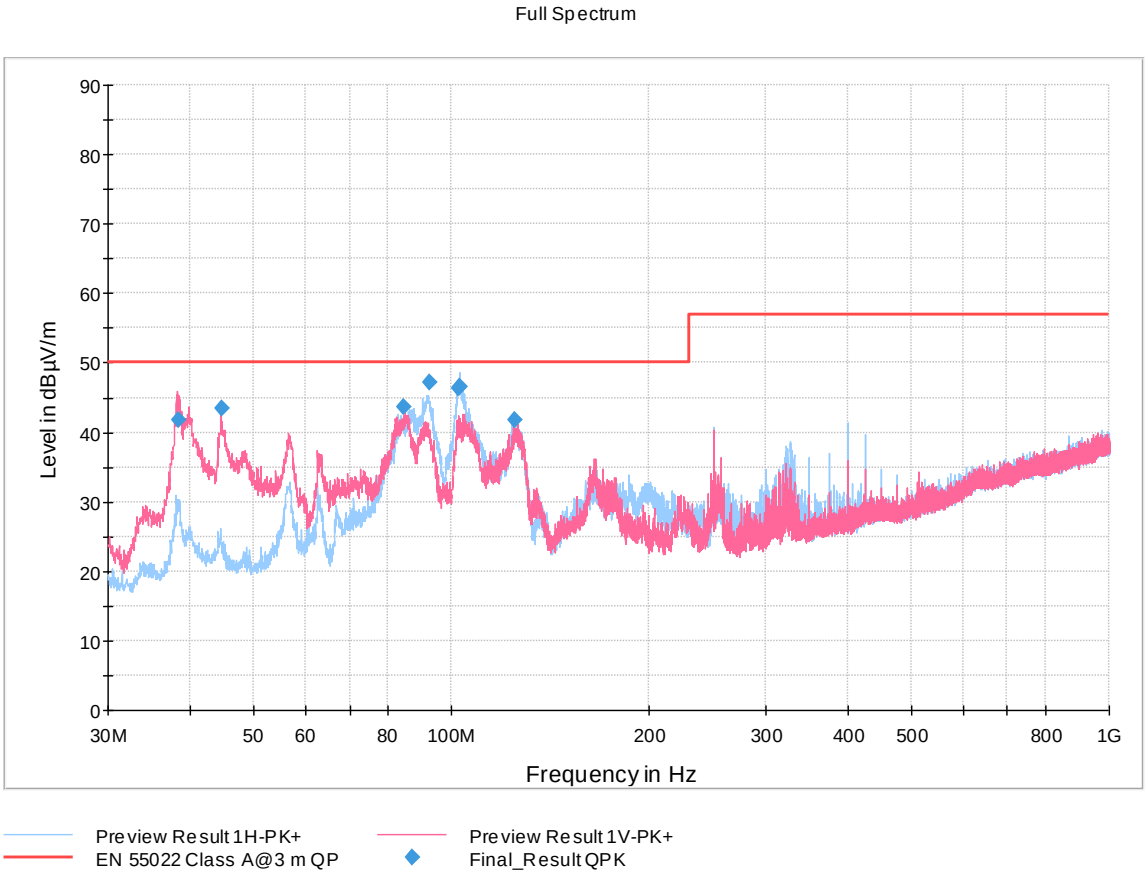
Frequency MHz	QuasiPeak dBµV/m	Limit dBµV/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg
35,576667	42,79	50,00	7,21	1000,0	120,000	125,0	V	143,0
35,619583	42,97	50,00	7,03	1000,0	120,000	137,0	V	105,0
39,781250	42,41	50,00	7,59	1000,0	120,000	118,0	V	34,0
42,933333	44,48	50,00	5,52	1000,0	120,000	110,0	V	157,0
47,989167	45,50	50,00	4,50	1000,0	120,000	118,0	V	121,0
56,838750	40,49	50,00	9,51	1000,0	120,000	150,0	V	128,0
99,399167	44,92	50,00	5,08	1000,0	120,000	254,0	H	149,0
108,603750	46,71	50,00	3,29	1000,0	120,000	251,0	H	154,0
121,665417	39,93	50,00	10,07	1000,0	120,000	131,0	V	94,0
172,539583	38,93	50,00	11,07	1000,0	120,000	110,0	V	235,0
176,952917	40,96	50,00	9,04	1000,0	120,000	110,0	V	242,0
185,169167	34,19	50,00	15,81	1000,0	120,000	186,0	H	-3,0

Characteristic test data

Serial number A160009584 C264 (HW67)

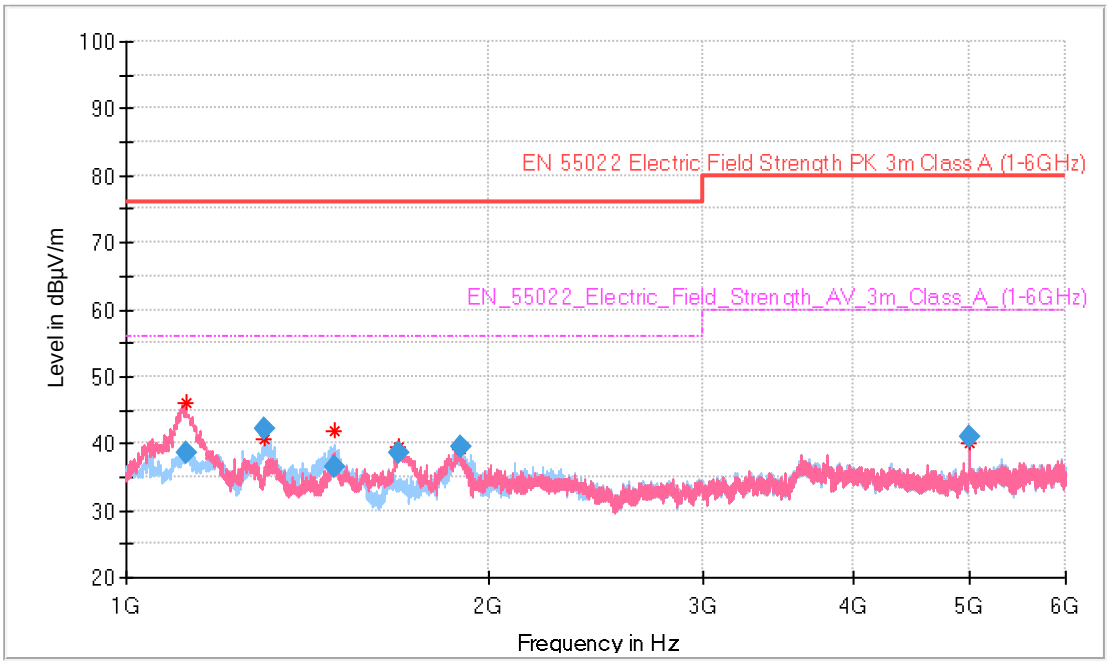
Power supply 230 Vac/105 Vdc

Power supply voltage of 230 Vac on primary supply, 105 Vdc on secondary supply



Final results (80 – 1000 MHz)

Frequency MHz	QuasiPeak dBµV/m	Limit dBµV/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg
38,365833	41,87	50,00	8,13	1000,0	120,000	110,0	V	91,0
44,710417	43,35	50,00	6,65	1000,0	120,000	110,0	V	135,0
84,647083	43,65	50,00	6,35	1000,0	120,000	146,0	V	-9,0
92,437500	47,15	50,00	2,85	1000,0	120,000	400,0	H	129,0
102,542500	46,37	50,00	3,63	1000,0	120,000	400,0	H	120,0
102,749583	46,56	50,00	3,44	1000,0	120,000	262,0	H	108,0
124,495417	41,70	50,00	8,30	1000,0	120,000	344,0	H	156,0



Final results (1 – 6 GHz)

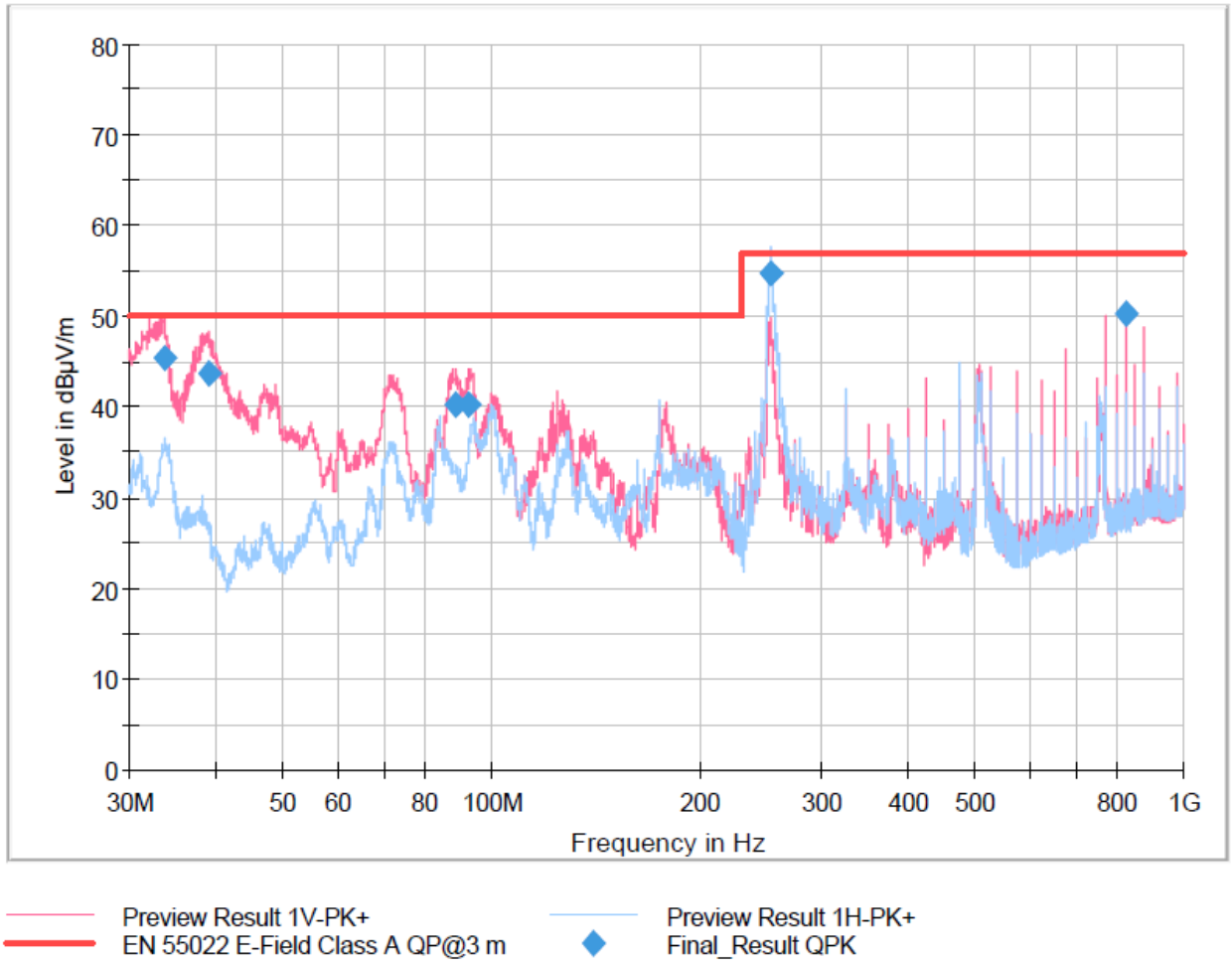
Frequency MHz	MaxPeak dBµV/m	Limit dBµV/m	Margin dB	Meas. Time ms	Height cm	Pol	Azimuth deg
1120,1500	38,64	76,00	37,36	1000,0	101,0	V	-70,0
1302,9000	42,12	76,00	33,88	1000,0	101,0	H	284,0
1485,6000	36,41	76,00	39,59	1000,0	101,0	H	163,0
1683,7500	38,57	76,00	37,43	1000,0	101,0	V	22,0
1889,8500	39,40	76,00	36,60	1000,0	101,0	V	201,0
5000,0000	41,05	80,00	38,95	1000,0	101,0	V	195,0

Characteristic test data

Serial number 34606495 C264 (with TMU210 and DIU221)

Power supply 220 Vdc

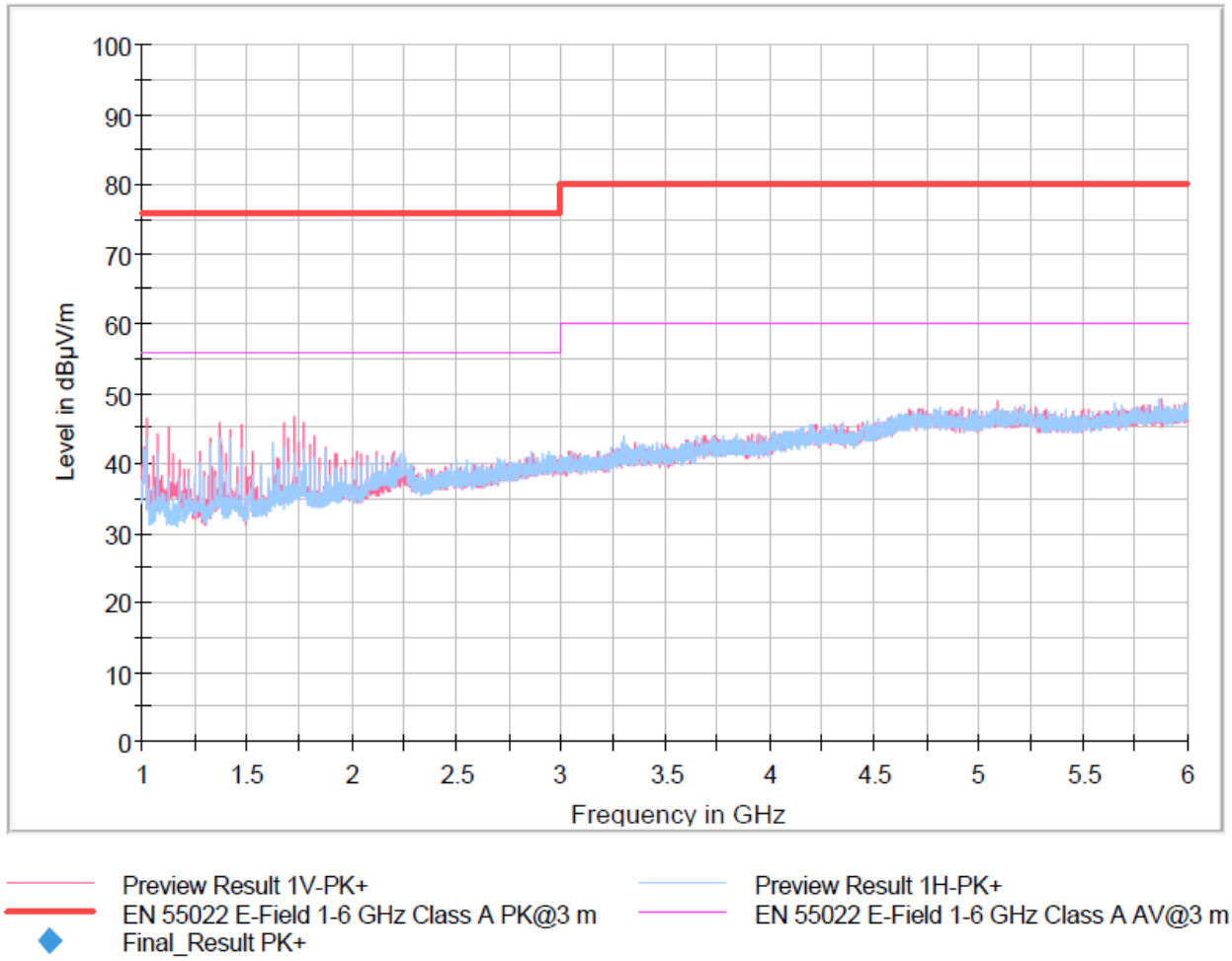
Power supply voltage of 220 Vdc on primary supply, 220 Vdc on secondary supply



Final results (30 – 1000 MHz)

Frequency MHz	QuasiPeak dBµV/m	Limit dBµV/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg
33,75000	45,45	50,00	4,55	1000,0	120,000	116,0	V	303,0
39,12000	43,61	50,00	6,39	1000,0	120,000	100,0	V	65,0
88,68000	40,15	50,00	9,85	1000,0	120,000	110,0	V	357,0
93,12000	40,28	50,00	9,72	1000,0	120,000	117,0	V	183,0
252,9300	54,75	50,00	2,25	1000,0	120,000	128,0	H	122,0
824,9700	50,36	50,00	6,64	1000,0	120,000	134,0	V	16,0

Power supply voltage of 220 Vdc on primary supply, 220 Vdc on secondary supply



Note; The power supply input voltage level has no influence on the radiated emission results.

Final results (1 – 6 GHz)

No significant emission has been measured in the frequency range 1 - 6 GHz.

Requirement

The radiated emission shall not exceed the limit specified in the basic standard CISPR22 class A.

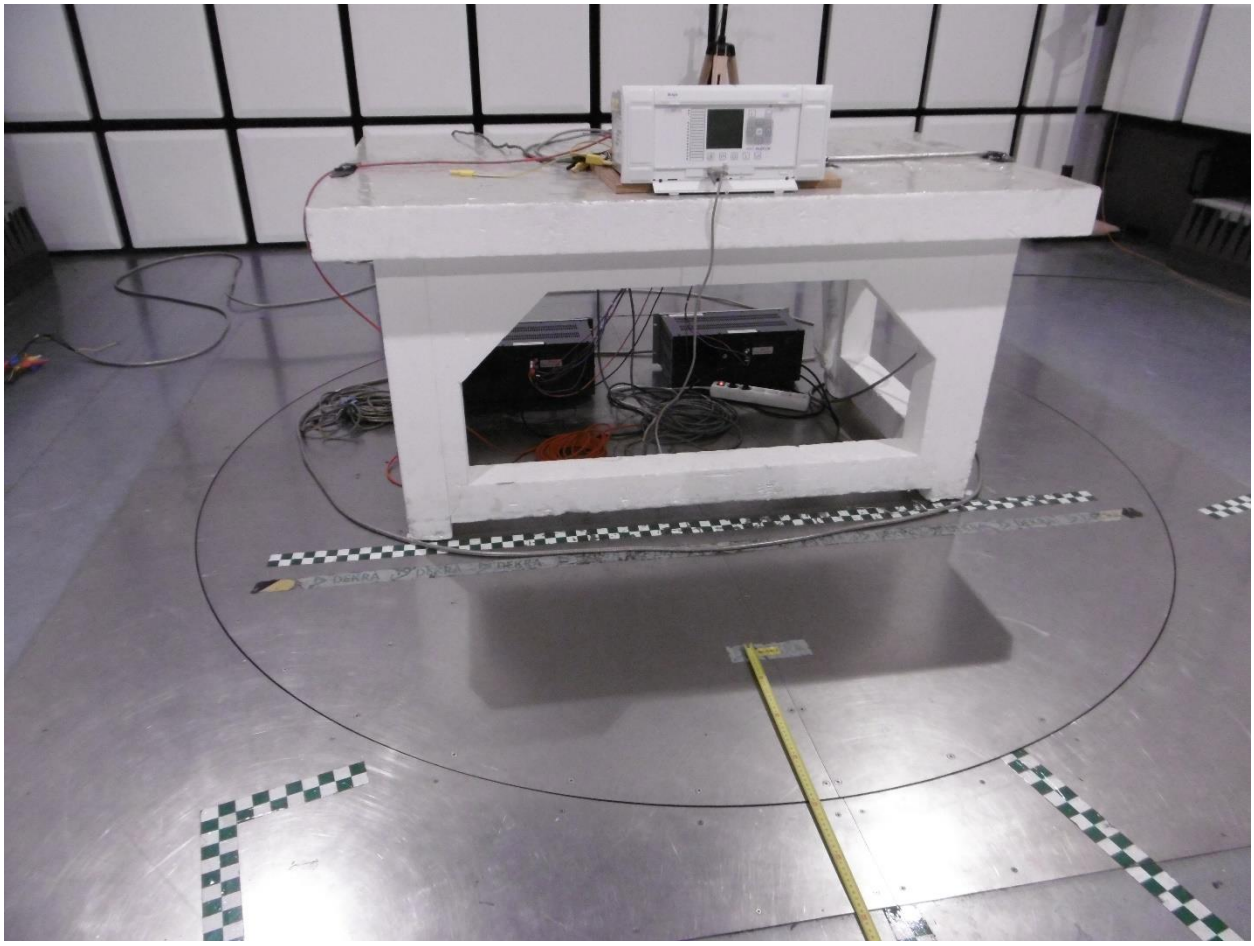
Result

The object passed the test.

Photograph of test arrangement

C264 (HW67)

C264 (HW66)



C264 (with TMU210 and DIU221, serial no 34606495)

10.3 Conducted emission

Standard and date

Standard IEC 61850-3, subclause 6.7.4
Test date 10 November 2016 and 4 December 2018

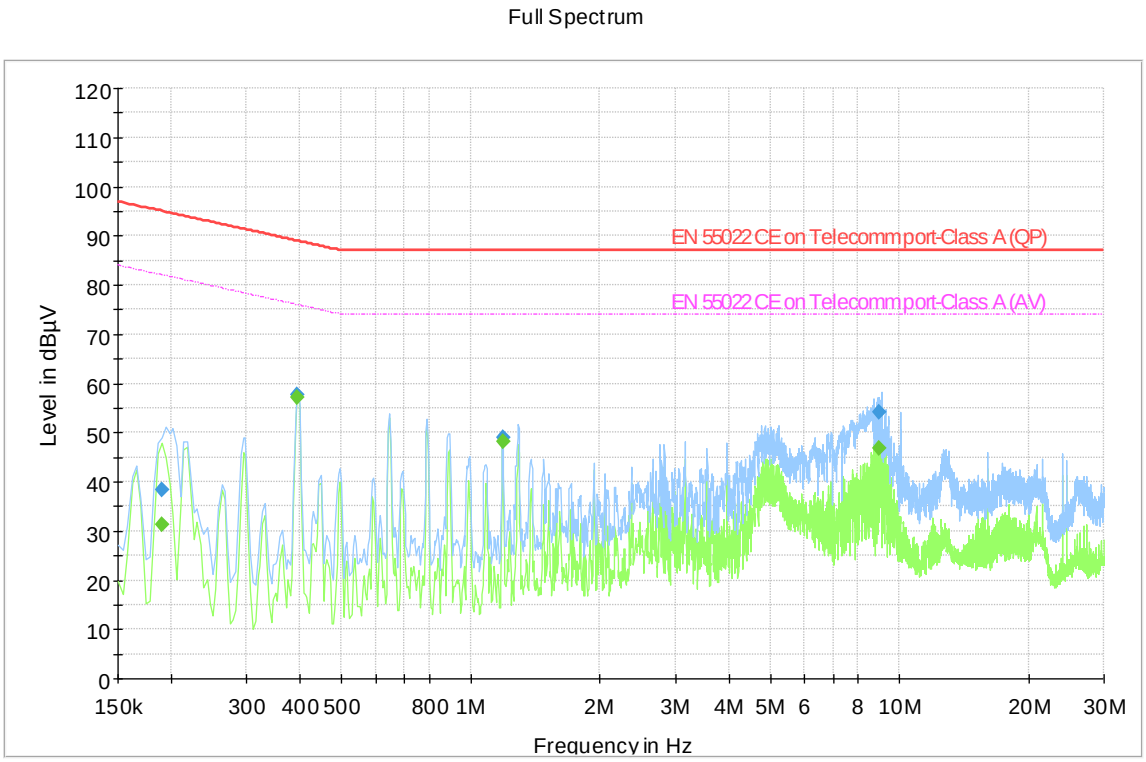
Environmental conditions

Ambient temperature 22 °C

Characteristic test data

Serial number A16000958 (HW67) /34606494
Power supply 200 Vdc

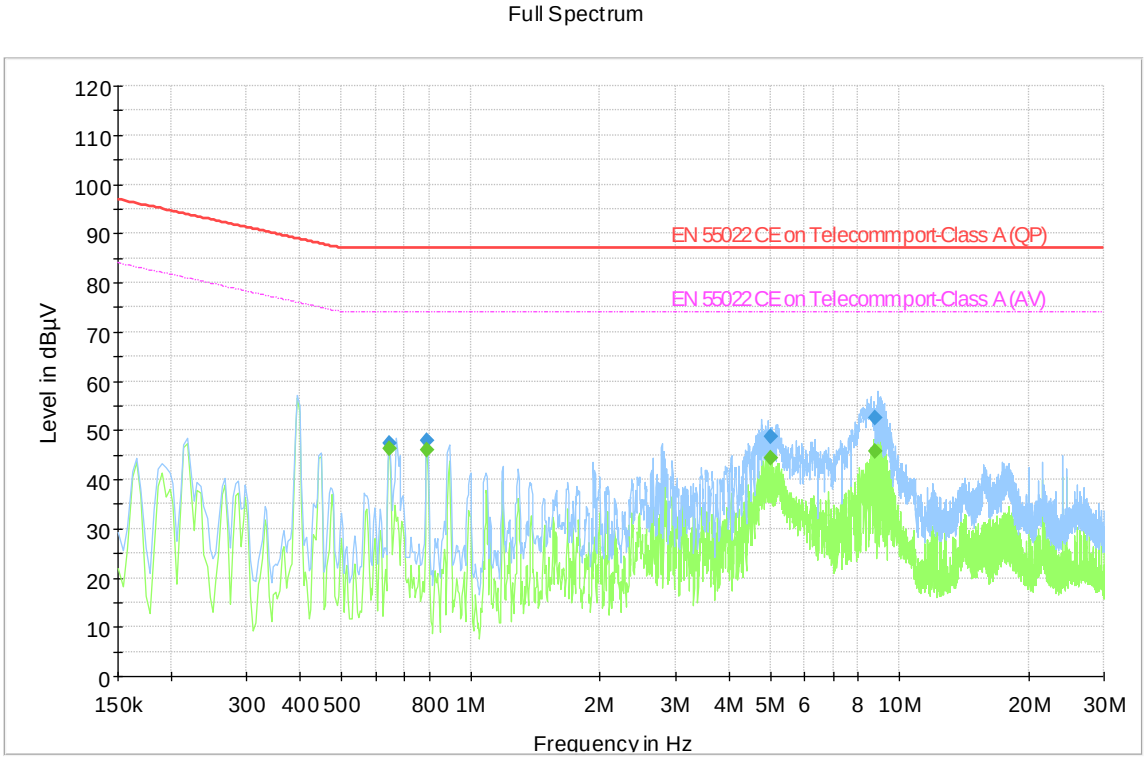
CPU4 LAN port



Final results

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line
0,190000	-	31,32	82,04	50,72	1000,0	10,000	Single line
0,190000	38,38	-	95,04	56,66	1000,0	10,000	Single line
0,394000	-	57,09	75,98	18,89	1000,0	10,000	Single line
0,394000	57,67	-	88,98	31,31	1000,0	10,000	Single line
1,186000	-	48,07	74,00	25,93	1000,0	10,000	Single line
1,186000	49,10	-	87,00	37,90	1000,0	10,000	Single line
8,998000	-	46,93	74,00	27,07	1000,0	10,000	Single line
8,998000	54,09	-	87,00	32,91	1000,0	10,000	Single line

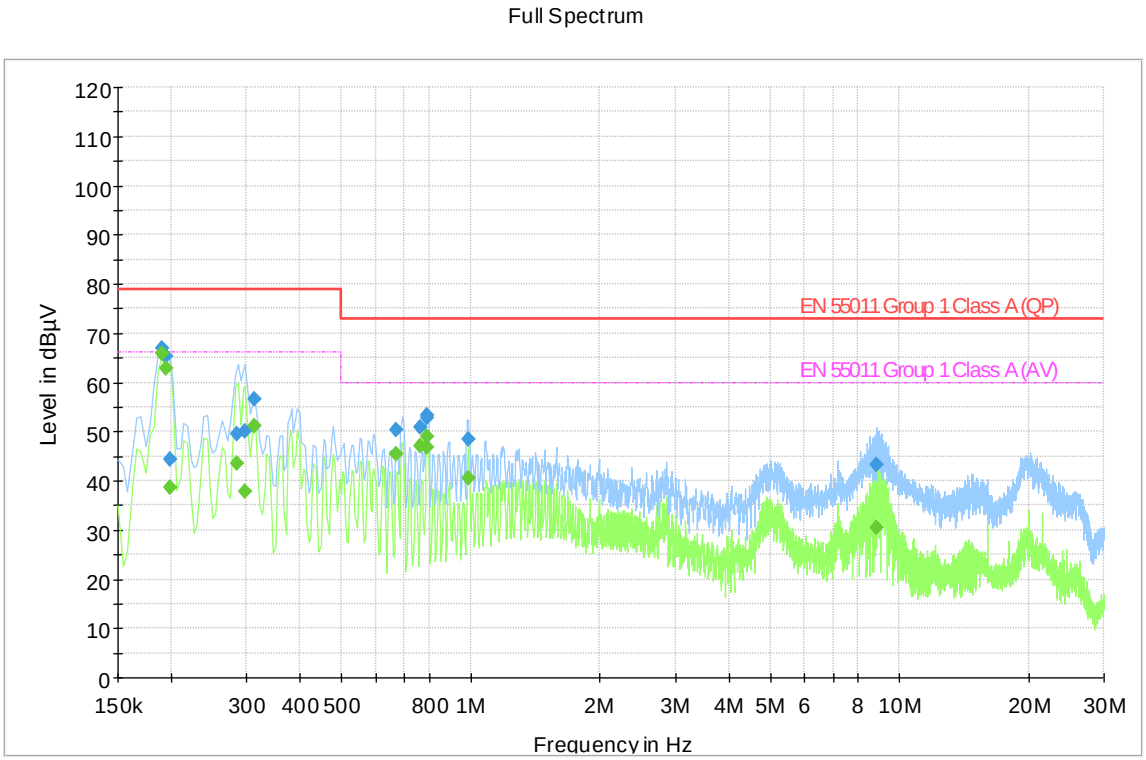
SRPv2 LAN port



Final results

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line
0,646000	-	46,30	74,00	27,70	1000,0	10,000	Single Line
0,646000	47,22	-	87,00	39,78	1000,0	10,000	Single Line
0,790000	-	46,02	74,00	27,98	1000,0	10,000	Single Line
0,790000	47,85	-	87,00	39,15	1000,0	10,000	Single Line
4,998000	-	44,27	74,00	29,73	1000,0	10,000	Single Line
4,998000	48,84	-	87,00	38,16	1000,0	10,000	Single Line
8,748000	-	45,62	74,00	28,38	1000,0	10,000	Single Line
8,748000	52,54	---	87,00	34,46	1000,0	10,000	Single Line

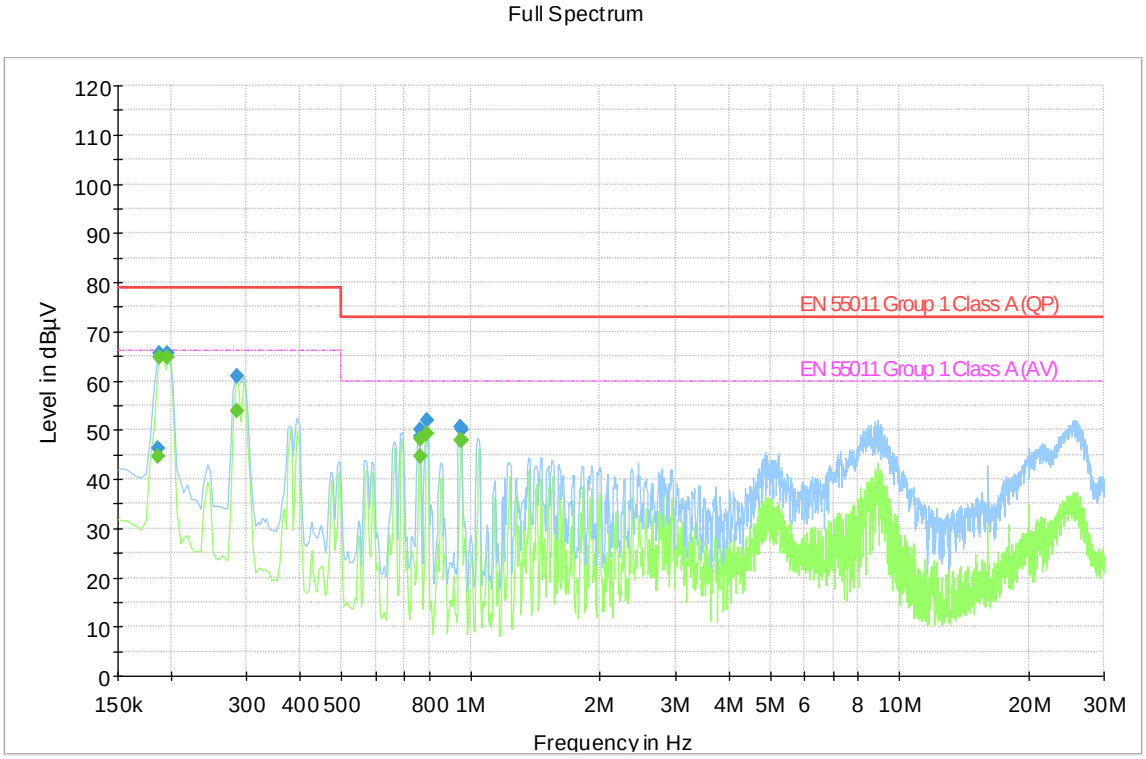
Power supply voltage of 200 Vdc on primary supply input, 0V on secondary power supply input



Final results

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line
0,190000	-	65,82	66,00	0,18	1000,0	10,000	N
0,190000	66,95	-	79,00	12,05	1000,0	10,000	N
0,194000	-	62,90	66,00	3,10	1000,0	10,000	N
0,194000	65,18	-	79,00	13,82	1000,0	10,000	N
0,198000	-	38,75	66,00	27,25	1000,0	10,000	L1
0,198000	44,36	-	79,00	34,64	1000,0	10,000	L1
0,284000	-	43,48	66,00	22,52	1000,0	10,000	L1
0,284000	49,60	-	79,00	29,40	1000,0	10,000	L1
0,296000	-	37,90	66,00	28,10	1000,0	10,000	N
0,296000	50,11	-	79,00	28,89	1000,0	10,000	N
0,312000	-	51,21	66,00	14,79	1000,0	10,000	L1
0,312000	56,50	-	79,00	22,50	1000,0	10,000	L1
0,668000	50,32	-	73,00	22,68	1000,0	10,000	N
0,668000	-	45,50	60,00	14,50	1000,0	10,000	N
0,762000	-	47,03	60,00	12,97	1000,0	10,000	N
0,762000	50,87	-	73,00	22,13	1000,0	10,000	N
0,788000	-	46,89	60,00	13,11	1000,0	10,000	N
0,788000	52,74	-	73,00	20,26	1000,0	10,000	N
0,792000	53,38	-	73,00	19,62	1000,0	10,000	N
0,792000	-	48,99	60,00	11,01	1000,0	10,000	N
0,986000	-	40,47	60,00	19,53	1000,0	10,000	N
0,986000	48,52	-	73,00	24,48	1000,0	10,000	N
8,858000	-	30,42	60,00	29,58	1000,0	10,000	L1
8,858000	43,18	-	73,00	29,82	1000,0	10,000	L1

Power supply voltage of 200 Vdc on secondary supply input, 0 V on the primary power supply input



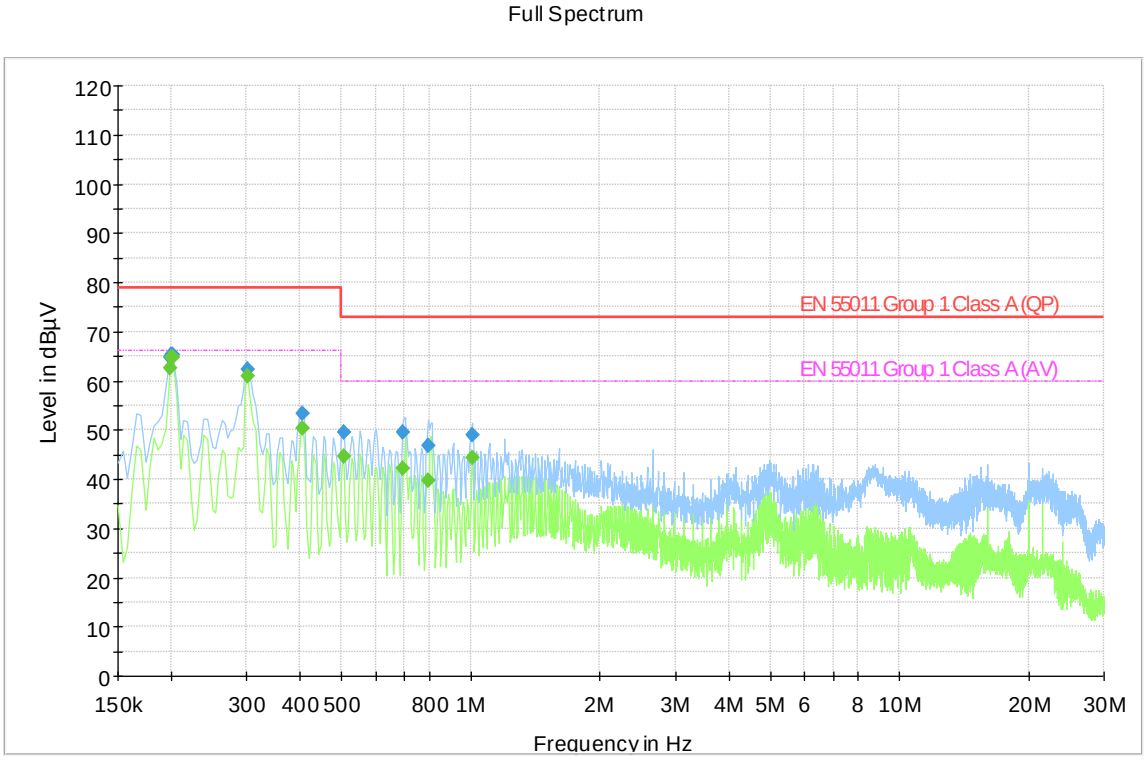
Final results

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line
0,186000	-	44,65	66,00	21,35	1000,0	10,000	L1
0,186000	46,27	-	79,00	32,73	1000,0	10,000	L1
0,188000	65,60	-	79,00	13,40	1000,0	10,000	N
0,188000	-	64,86	66,00	1,14	1000,0	10,000	N
0,196000	65,54	-	79,00	13,46	1000,0	10,000	L1
0,196000	-	64,86	66,00	1,14	1000,0	10,000	L1
0,284000	-	53,80	66,00	12,20	1000,0	10,000	L1
0,284000	61,07	-	79,00	17,93	1000,0	10,000	L1
0,760000	50,07	-	73,00	22,93	1000,0	10,000	N
0,760000	-	48,04	60,00	11,96	1000,0	10,000	N
0,762000	48,81	-	73,00	24,19	1000,0	10,000	L1
0,762000	-	44,59	60,00	15,41	1000,0	10,000	L1
0,790000	-	49,25	60,00	10,75	1000,0	10,000	N
0,790000	51,88	-	73,00	21,12	1000,0	10,000	N
0,946000	-	47,88	60,00	12,12	1000,0	10,000	L1
0,946000	50,59	-	73,00	22,41	1000,0	10,000	L1
0,950000	-	47,88	60,00	12,12	1000,0	10,000	N
0,950000	50,09	-	73,00	22,91	1000,0	10,000	N

Characteristic test data

Serial number	A160009584 C264 (HW66)
Power supply	200 Vdc

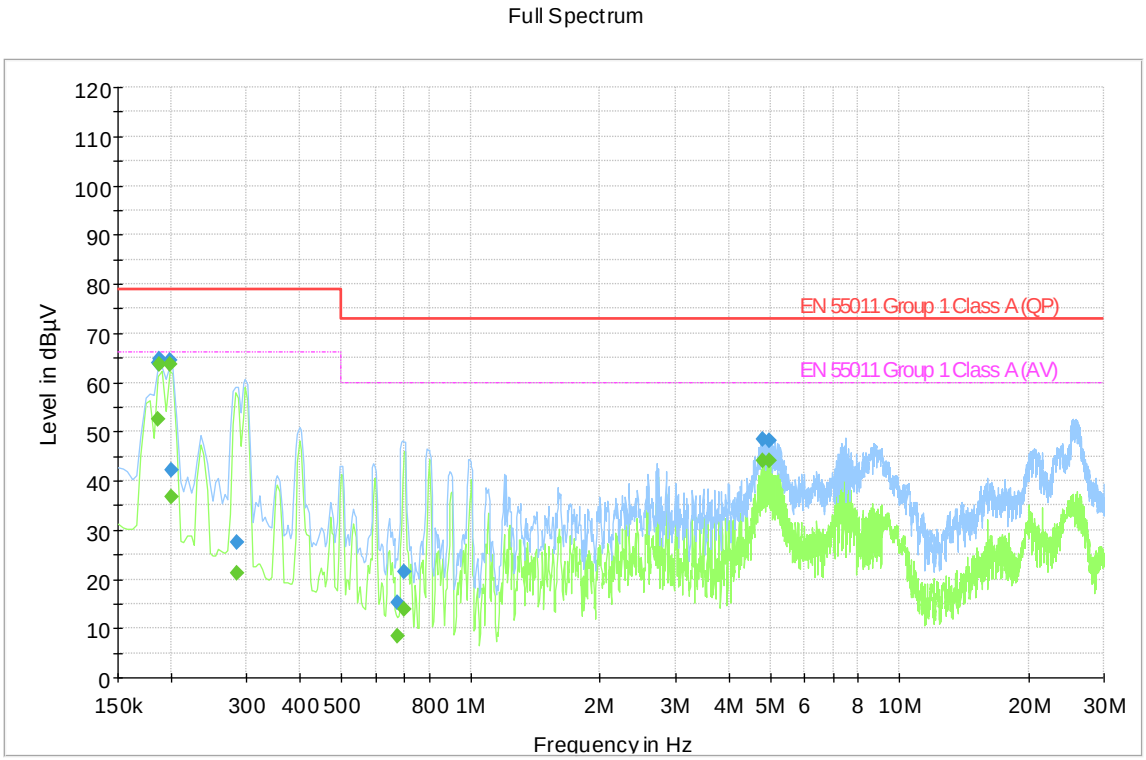
Power supply voltage of 200 Vdc on primary supply input, 0 V on the secondary power supply input



Final results

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line
0,198000	64,84	-	79,00	14,16	1000,0	10,000	N
0,198000	-	62,60	66,00	3,40	1000,0	10,000	N
0,200000	-	64,66	66,00	1,34	1000,0	10,000	N
0,200000	65,38	-	79,00	13,62	1000,0	10,000	N
0,202000	65,42	-	79,00	13,58	1000,0	10,000	N
0,202000	-	64,73	66,00	1,27	1000,0	10,000	N
0,302000	-	60,96	66,00	5,04	1000,0	10,000	N
0,302000	62,34	-	79,00	16,66	1000,0	10,000	N
0,404000	-	50,27	66,00	15,73	1000,0	10,000	N
0,404000	53,40	-	79,00	25,60	1000,0	10,000	N
0,504000	-	44,69	60,00	15,31	1000,0	10,000	N
0,504000	49,56	-	73,00	23,44	1000,0	10,000	N
0,696000	-	42,28	60,00	17,72	1000,0	10,000	N
0,696000	49,44	-	73,00	23,56	1000,0	10,000	N
0,794000	-	39,77	60,00	20,23	1000,0	10,000	N
0,794000	46,80	-	73,00	26,20	1000,0	10,000	N
1,008000	-	44,32	60,00	15,68	1000,0	10,000	N
1,008000	48,87	-	73,00	24,13	1000,0	10,000	N

Power supply voltage of 200 Vdc on secondary power supply input, 0 Vdc on primary supply input



Final results

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line
0,186000	63,86	-	79,00	15,14	1000,0	10,000	N
0,186000	-	52,42	66,00	13,58	1000,0	10,000	N
0,188000	64,66	-	79,00	14,34	1000,0	10,000	N
0,188000	-	63,70	66,00	2,30	1000,0	10,000	N
0,198000	-	63,63	66,00	2,37	1000,0	10,000	N
0,198000	64,38	-	79,00	14,62	1000,0	10,000	N
0,200000	-	36,83	66,00	29,17	1000,0	10,000	L1
0,200000	42,20	-	79,00	36,80	1000,0	10,000	L1
0,284000	-	21,13	66,00	44,87	1000,0	10,000	L1
0,284000	27,43	-	79,00	51,57	1000,0	10,000	L1
0,672000	-	8,34	60,00	51,66	1000,0	10,000	L1
0,672000	15,22	-	73,00	57,78	1000,0	10,000	L1
0,700000	-	13,93	60,00	46,07	1000,0	10,000	L1
0,700000	21,44	-	73,00	51,56	1000,0	10,000	L1
4,790000	-	44,11	60,00	15,89	1000,0	10,000	L1
4,790000	48,31	-	73,00	24,69	1000,0	10,000	L1
4,978000	-	44,16	60,00	15,84	1000,0	10,000	N
4,978000	48,15	-	73,00	24,85	1000,0	10,000	N

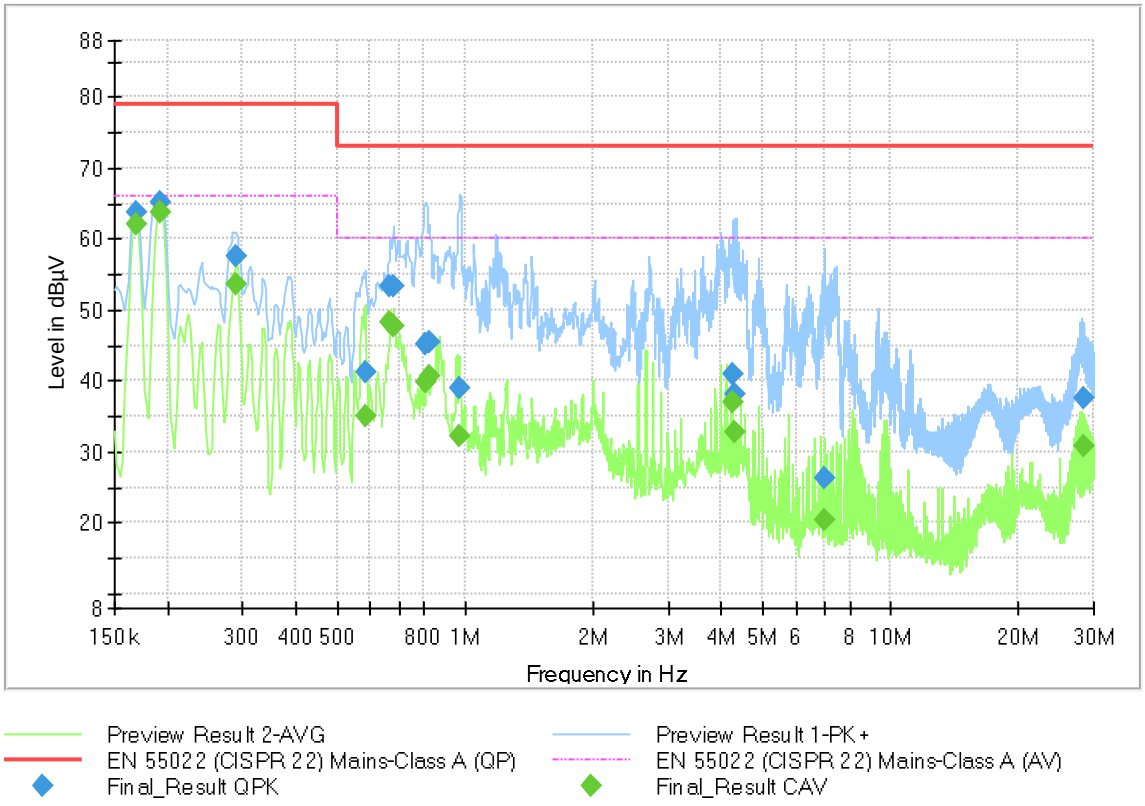
Characteristic test data

Serial number 34606495 C264 (with TMU201 and DIU221)

Power supply 250 Vdc

The measurement at 250 Vdc input power supply voltage shows the maximum emissions (with the lowest margin to the limit).

Power supply voltage of 0 Vdc on secondary power supply input, 250 Vdc on primary supply input

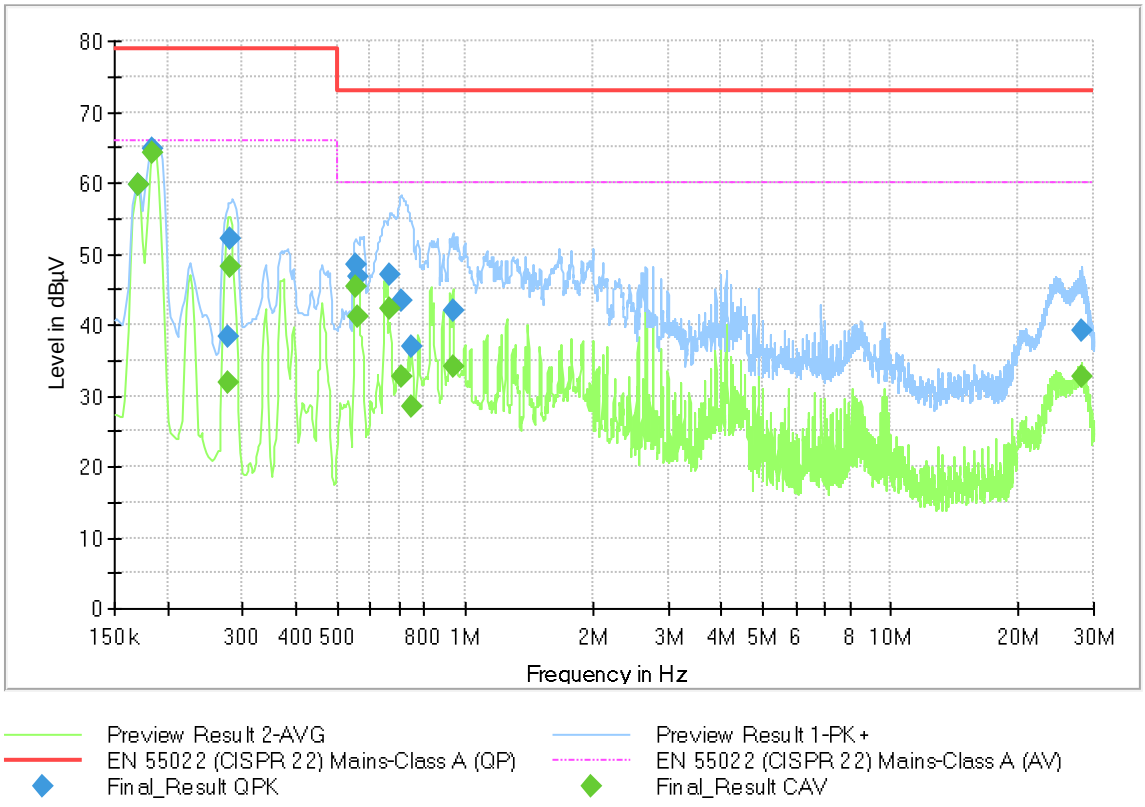


Final results

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line
0,168000	-	62,10	66,00	3,90	1000	9,000	N
0,168000	63,84	-	79,00	15,16	1000	9,000	N
0,192750	-	63,80	66,00	2,20	1000	9,000	N
0,192750	65,18	-	79,00	13,82	1000	9,000	N
0,289500	-	53,73	66,00	12,27	1000	9,000	N
0,289500	57,65	-	79,00	21,35	1000	9,000	N
0,582000	-	35,04	60,00	24,96	1000	9,000	N
0,582000	41,21	-	73,00	31,79	1000	9,000	N
0,667500	-	48,21	60,00	11,79	1000	9,000	L1
0,667500	53,38	-	73,00	19,62	1000	9,000	L1
0,678750	-	47,66	60,00	12,34	1000	9,000	N
0,678750	53,47	-	73,00	19,53	1000	9,000	N
0,809250	-	39,75	60,00	20,25	1000	9,000	L1
0,809250	45,16	-	73,00	27,84	1000	9,000	L1
0,822750	-	40,66	60,00	19,34	1000	9,000	L1

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line
0,822750	45,46	-	73,00	27,54	1000	9,000	L1
0,973500	-	32,31	60,00	27,69	1000	9,000	N
0,973500	38,91	-	73,00	34,09	1000	9,000	N
4,254000	-	36,90	60,00	23,10	1000	9,000	L1
4,254000	41,06	-	73,00	31,94	1000	9,000	L1
4,323750	-	32,91	60,00	27,09	1000	9,000	L1
4,323750	38,08	-	73,00	34,92	1000	9,000	L1
7,005750	-	20,34	60,00	39,66	1000	9,000	L1
7,005750	26,43	-	73,00	46,57	1000	9,000	L1
28,353750	-	30,92	60,00	29,09	1000	9,000	L1
28,353750	37,66	-	73,00	35,34	1000	9,000	L1

Power supply voltage of 250 Vdc on secondary power supply input, 0 Vdc on primary supply input

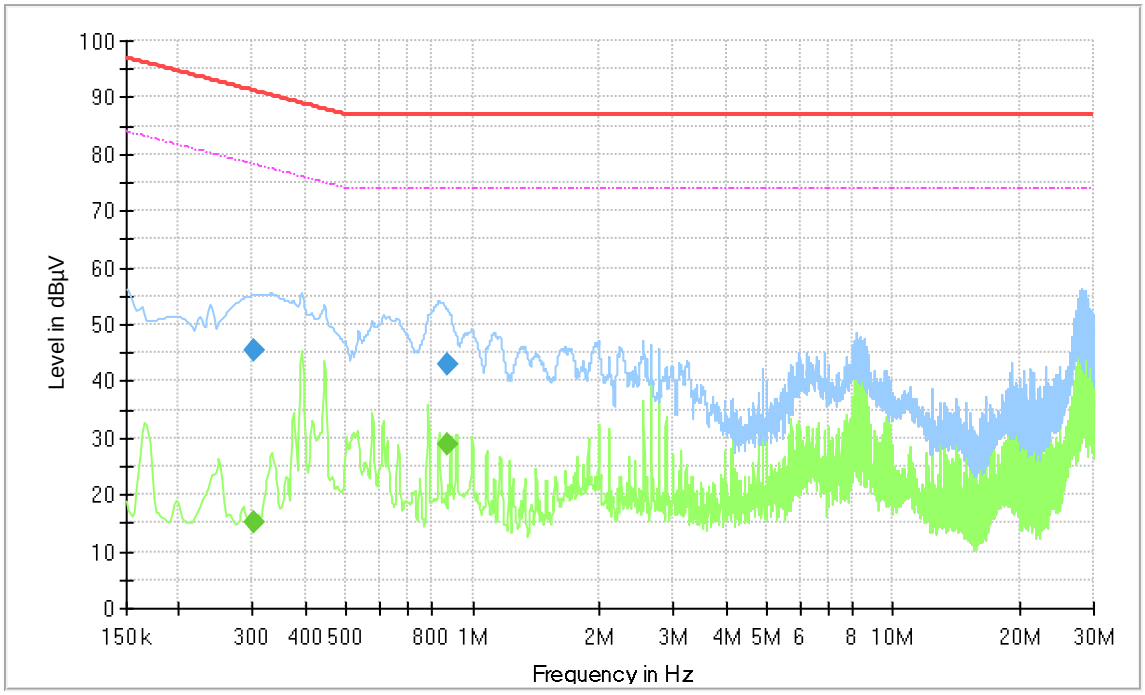


Final results

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line
0,170250	-	59,62	66,00	6,38	1000	9,000	N
0,170250	59,68	-	79,00	19,32	1000	9,000	N
0,183750	-	64,34	66,00	1,66	1000	9,000	N
0,183750	64,78	-	79,00	14,22	1000	9,000	N
0,276000	-	31,72	66,00	34,28	1000	9,000	N
0,276000	38,19	-	79,00	40,81	1000	9,000	N
0,280500	-	48,13	66,00	17,87	1000	9,000	L1

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line
0,280500	52,09	-	79,00	26,91	1000	9,000	L1
0,555000	-	45,30	60,00	14,70	1000	9,000	N
0,555000	48,53	-	73,00	24,47	1000	9,000	N
0,561750	-	41,16	60,00	18,84	1000	9,000	L1
0,561750	46,85	-	73,00	26,15	1000	9,000	L1
0,667500	-	42,19	60,00	17,81	1000	9,000	L1
0,667500	47,08	-	73,00	25,92	1000	9,000	L1
0,708000	-	32,65	60,00	27,35	1000	9,000	L1
0,708000	43,51	-	73,00	29,49	1000	9,000	L1
0,748500	-	28,44	60,00	31,56	1000	9,000	L1
0,748500	36,95	-	73,00	36,05	1000	9,000	L1
0,935250	-	34,10	60,00	25,90	1000	9,000	L1
0,935250	41,98	-	73,00	31,02	1000	9,000	L1
28,005000	-	32,76	60,00	27,24	1000	9,000	N
28,005000	39,12	-	73,00	33,88	1000	9,000	N

LAN port CPU4



Final results

Frequency MHz	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz
0,300750	-	15,25	78,22	62,97	1000	9,000
0,300750	45,53	-	91,22	45,69	1000	9,000
0,874500	-	28,77	74,00	45,23	1000	9,000
0,874500	43,02	-	87,00	43,98	1000	9,000

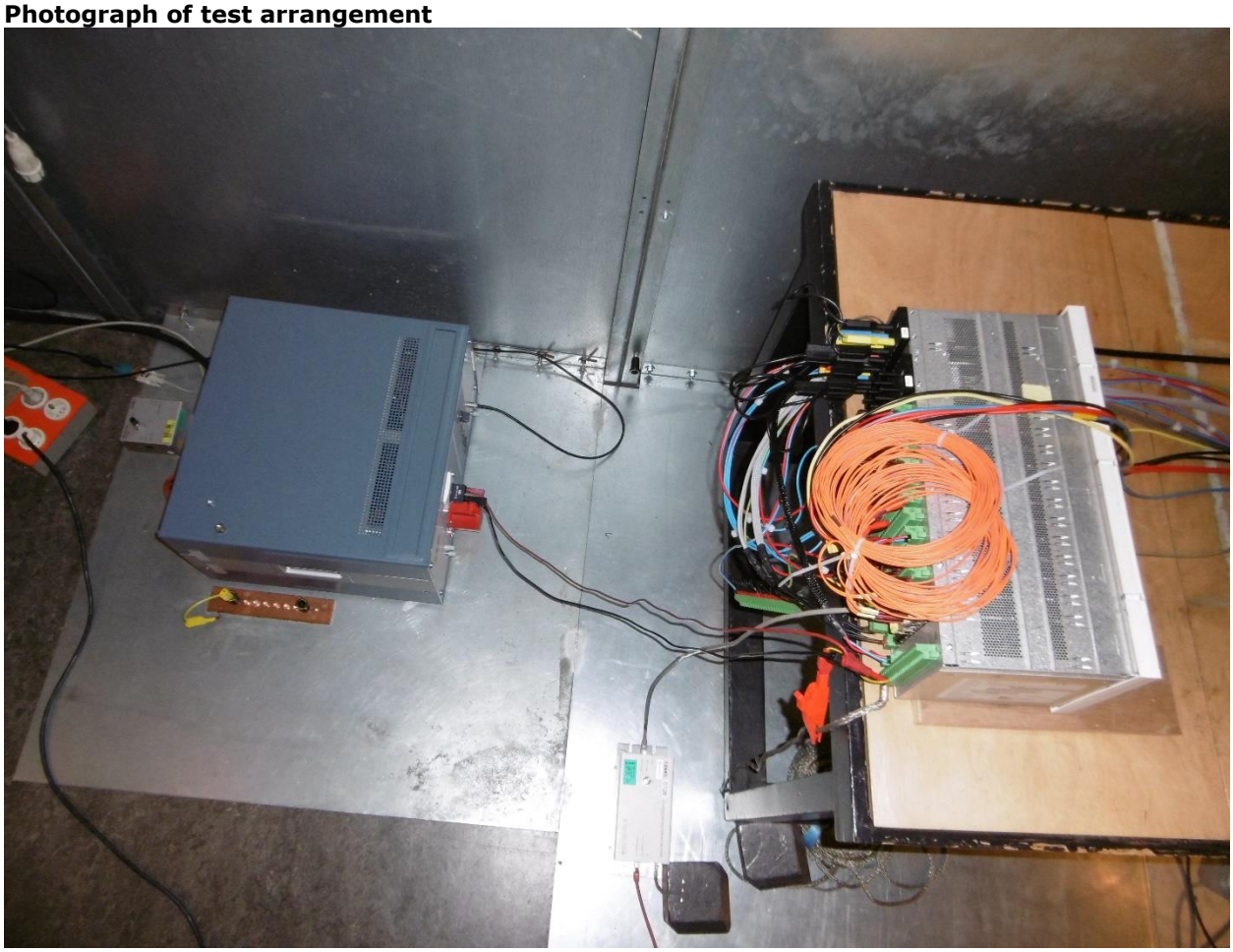
Requirement

The conducted emission shall not exceed the limits specified in the basic standard CISPR22 for class A equipment.

Result

The object passed the test.

Photograph of test arrangement



Conducted emission measurement on the power supply input port

Conducted emission measurement on the LAN (RJ45) port

10.4 Electrostatic discharge

Standard and date

Standard IEC 61850-3, subclause 6.7.3
Test date 18 October 2016

Environmental conditions

Ambient temperature 20,7 °C Relative humidity 54,3 %
Ambient air pressure 1011 hPa

Characteristic test data

Serial number A160009583
Power supply 110 Vdc

Discharge type	Test level kV	Test points	Coupling (direct/CP)	Polarity	Observation
Air	2-4-8	1	-	+ and -	-
Air	2-4-8	2	-	+ and -	-
Air	2-4-8	3	-	+ and -	-
Air	2-4-8	4	-	+ and -	-
Air	2-4-8	5	-	+ and -	-
Air	2-4-8	6	-	+ and -	-
Air	2-4-8	7	-	+ and -	-
Contact	6	1	Direct	+ and -	-
Contact	6	2	Direct	+ and -	-
Contact	6	3	Direct	+ and -	-
Contact	6	4	Direct	+ and -	-
Contact	6	5	Direct	+ and -	-
Contact	6	6	Direct	+ and -	-
Contact	6	7	Direct	+ and -	-
Contact	6	8	Direct	+ and -	-
Contact	6	9	Direct	+ and -	-

Note

Contact discharges have been applied to the screws and other metal parts hidden under the cover lids.

Observations

No degradation of performance observed during and after the test.

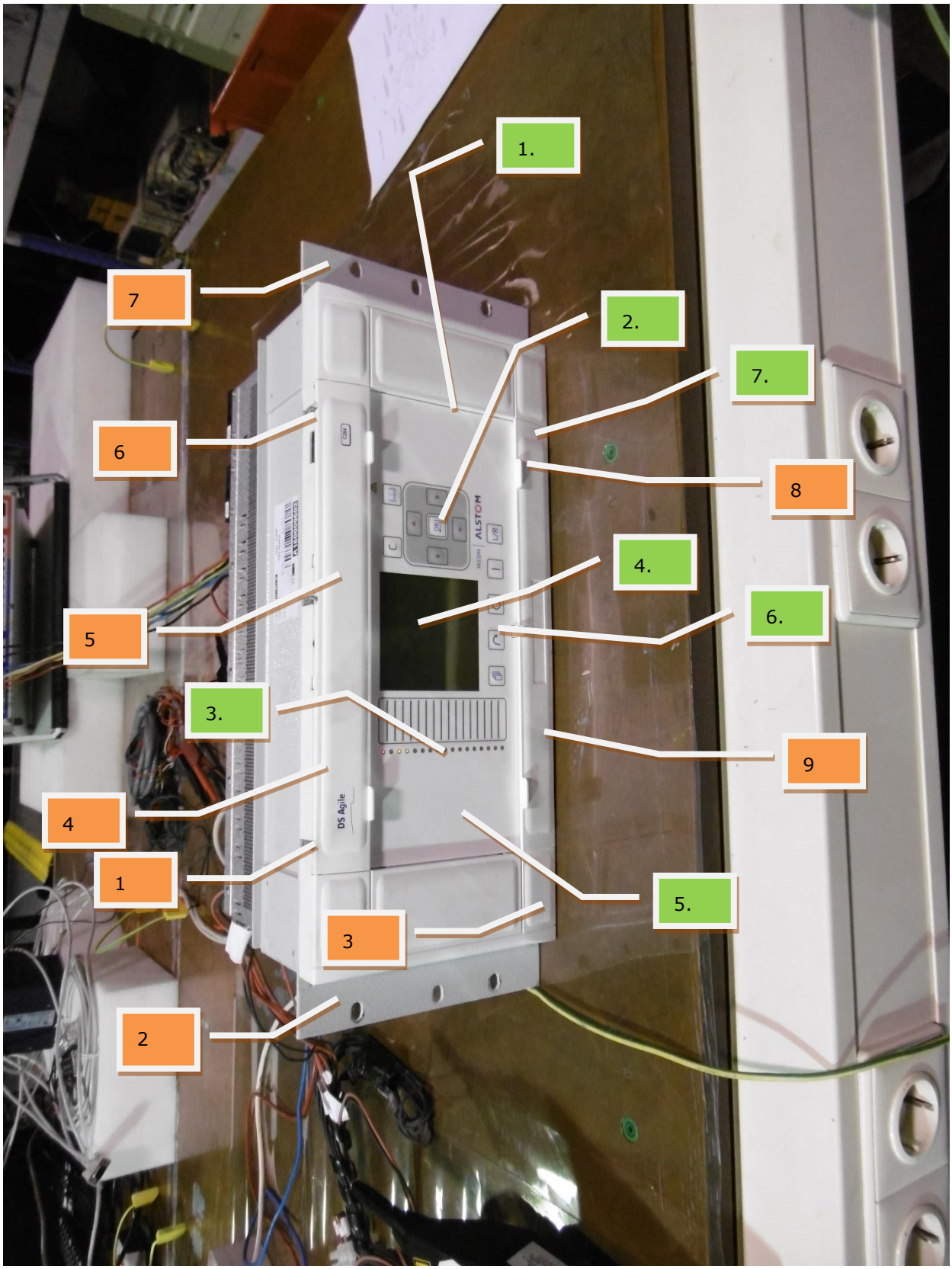
Requirements

- the object shall comply with reliability class 2 of chapter 7.5
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photographs of test points



Green=Air discharge
Orange=Contact discharge

Radiated interference

Standard and date

Standard IEC 61850-3, subclause 6.7.3
Test date 16 January 2019

Characteristic test data

Serial number A160009583 /34606494
Amplitude modulated 80 % AM (1 kHz)
Dwell time 2 s

Frequency sweep

Direction	Test level V/m	Sweep rate	Frequency sweep MHz	Observations
x side of EUT (horizontal & vertical polarization)	10	≤ 1%	80 – 3000	-
y side of EUT (horizontal & vertical polarization)	10	≤ 1%	80 – 3000	-
z side of EUT (horizontal & vertical polarization)	10	≤ 1%	80 – 3000	-

X, Y, Z to be defined, being front, side, back of the test object.

Additional spot frequencies (for information only)

Direction	Test level V/m	Sweep rate	Frequency sweep MHz	Observations
x side of EUT (horizontal & vertical polarization)	10	≤ 1%	80 MHz ± 0,5 % 160 MHz ± 0,5 % 380 MHz± 0,5 % 450 MHz ± 0,5 % 900 ± 5 MHz 1850 ± 5 MHz 2150 ± 5 MHz	-
y side of EUT (horizontal & vertical polarization)	10	≤ 1%	80 MHz ± 0,5 % 160 MHz ± 0,5 % 380 MHz± 0,5 % 450 MHz ± 0,5 % 900 ± 5 MHz 1850 ± 5 MHz 2150 ± 5 MHz	-
z side of EUT (horizontal & vertical polarization)	10	≤ 1%	80 MHz ± 0,5 % 160 MHz ± 0,5 % 380 MHz± 0,5 % 450 MHz ± 0,5 % 900 ± 5 MHz 1850 ± 5 MHz 2150 ± 5 MHz	-

Observations

No degradation of performance observed during and after the test.

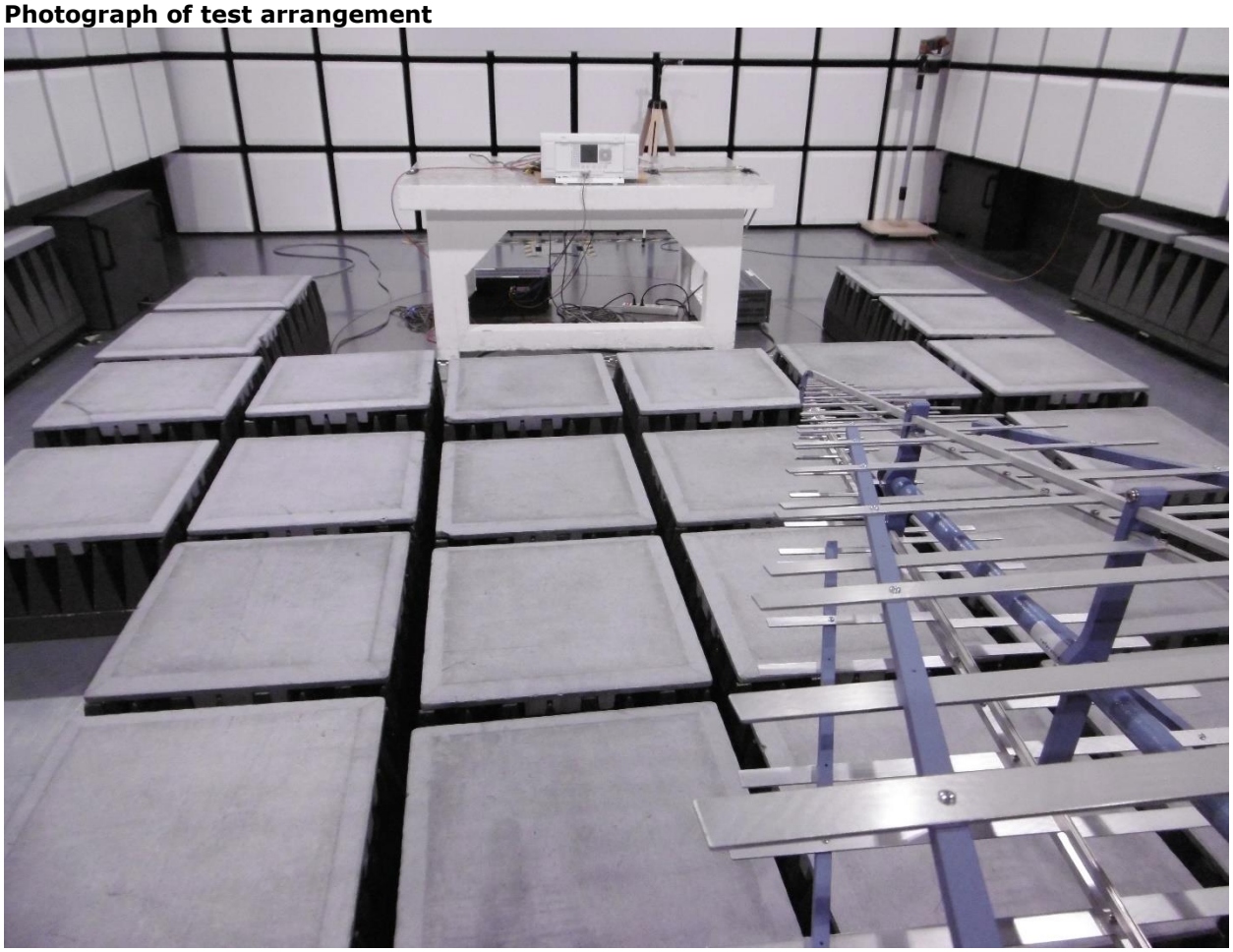
Requirements

- the object shall comply with reliability class 2 of chapter 7.5 of the standard.
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement



10.5 Electrical fast transient

Standard and date

Standard IEC 61850-3, subclause 6.7.3
Test date 14 October 2016 and 29 November 2018

Environmental conditions

Ambient temperature 23 °C Relative humidity 42 %
Ambient air pressure 1008 hPa

Characteristic test data

Serial number A160009583/34606494
Rise time (t_r) 5 ns
Pulse width (t_w) 50 ns
Power supply voltage 220 Vdc
110 Vdc

Circuit	Terminals	Coupling[1), 2)]	Test voltage kV	Repetition frequency kHz	Observations
Primary power supply input BIU216 (slot A)	Power 1 + PE	CDN	4	5	-
				100	-
Secondary power supply input BIU261 (slot A)	Power 2	CDN	4	5	-
				100	-
Binary output BIU261 (slot A)	-	CDN	4	5	-
				100	-
LAN port CPU4 (Slot B)	-	Clamp	2	5	-
				100	-
LAN port SRPv2 (slot C)	-	Clamp	2	5	-
				100	-
Analogue input AIU211 (slot D)	-	CDN	4	5	-
				100	-
Digital output (DOU201) (slot E)	-	CDN	4	5	-
				100	-
Digital output/control unit CCU211 (slot F)	-	CDN	4	5	-
				100	-
Analogue output AOU200 (slot G)	-	CDN	4	5	-
				100	-

Circuit	Terminals	Coupling[1), 2)]	Test voltage kV	Repetition frequency kHz	Observations
Digital input (DIU211) (slot H)	-	CDN	4	5	-
				100	-
Digital output (HBU200) (slot M)	-	CDN	4	5	-
				100	-
Analogue input (TMU220) (slot N)	-	CDN	4	5	-
				100	-
Analogue input (TMU220) (slot O)	-	CDN	4	5	-
				100	-
GROUND	GND	CDN	4	5	-
				100	-
Analogue input (TMU210) (slot O)	-	CDN	4	5	-
				100	-
Digital input (DIU221) (slot H)	-	CDN	4	5	-
				100	-

Note

[1)]CDN = Coupling Decoupling Network

[2)]Clamp = Capacitive coupling clamp

Observations

No degradation of performance observed during and after the test.

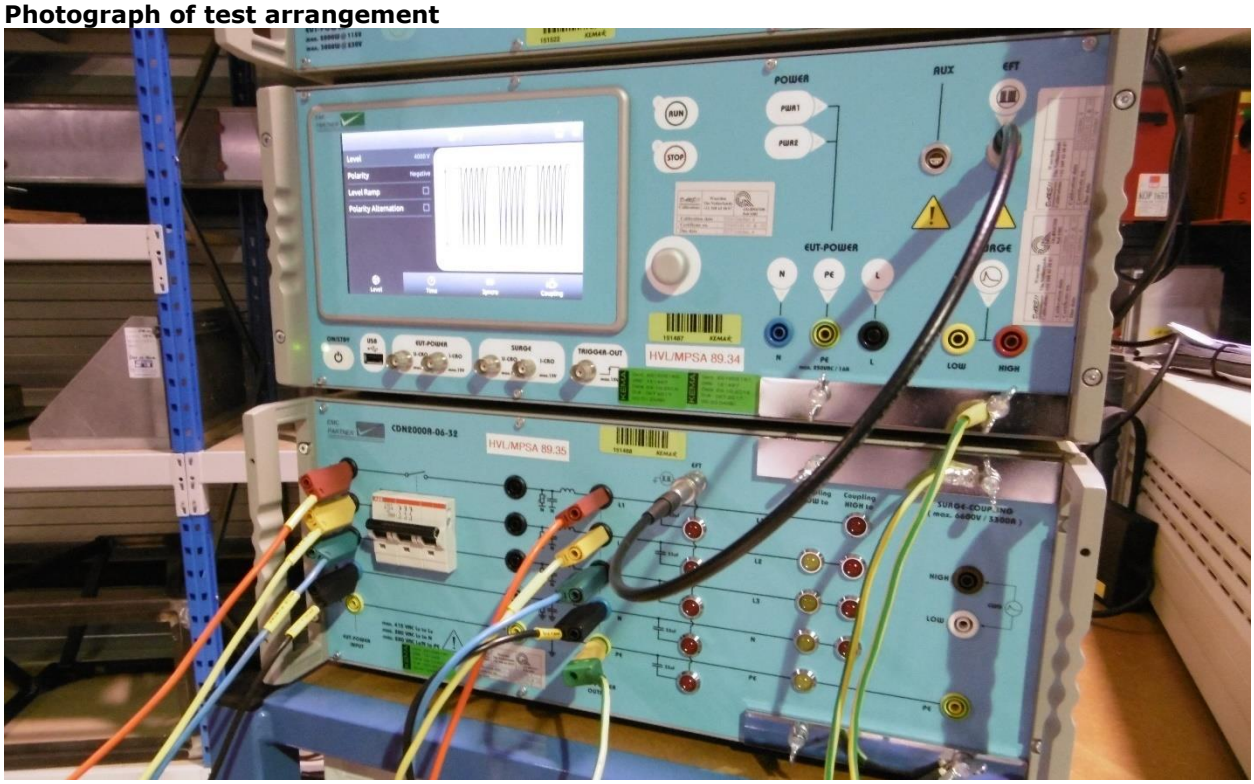
Requirements

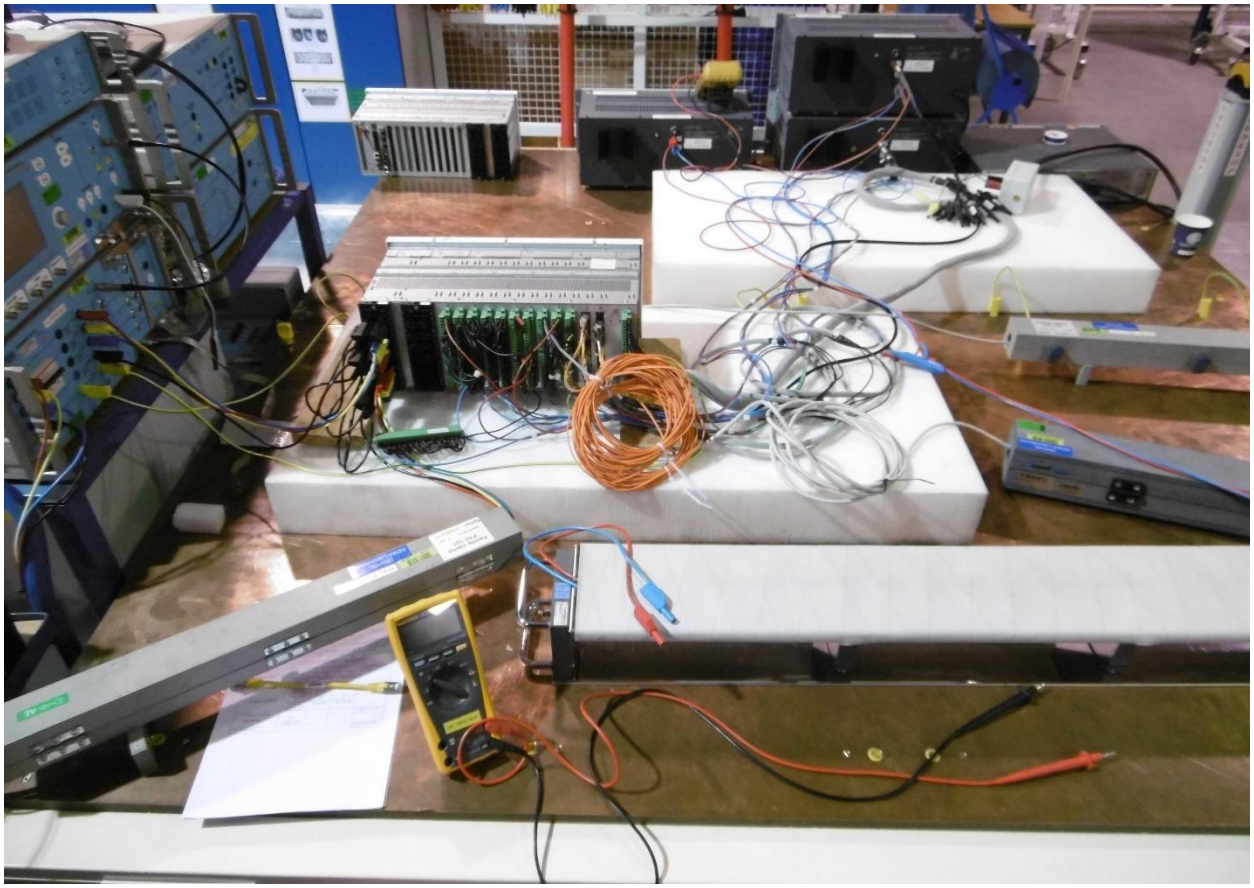
- the object shall comply with reliability class 2 of chapter 7.5
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement





10.6 Slow damped oscillatory wave

Standard and date

Standard IEC 61850-3, subclause 6.7.3
Test date 8 November 2016 and 29 November 2018

Environmental conditions

Ambient temperature 21 °C Relative humidity 45 %
Ambient air pressure 1022 hPa

Characteristic test data

Serial number A160009583 /34606494
Power supply voltage 220 Vdc
110 Vdc
Voltage oscillation frequency 1 MHz
Voltage rise time 75 ns
Repetition frequency 400 Hz
Output impedance 200 Ω

Circuit	Terminals	Coupling	Test voltage kV	Observations
Primary power supply input BIU261 (slot A)	Power 1 + PE	CM	2,5	-
		DM	1,0	-
Secondary power supply input BIU261 (slot A)	Power 2	CM	2,5	-
		DM	1,0	-
Binary output BIU261 (slot A)	-	CM	2,5	-
		DM	1,0	-
LAN port CPU4 (slot B)	-	CM	2,5	-
		DM	[1]	-
LAN port SRPv2 (slot C)	-	CM	2,5	-
		DM	[1]	-
Analogue input AIU211 (slot D)	-	CM	2,5	-
		DM	1,0	-
Digital output DOU201 (slot E)	-	CM	2,5	-
		DM	1,0	-
Digital output/control unit CCU211 (slot F)	-	CM	2,5	-
		DM	1,0	-
Analogue output AOU200 (slot G)	-	CM	2,5	-
		DM	1,0	-

[1]Not applicable: shielded cable

Circuit	Terminals	Coupling	Test voltage	Observations
			kV	
Digital input DIU211 (slot H)	-	CM	2,5	-
		DM	1,0	-
Digital output HBU200 (slot M)	-	CM	2,5	-
		DM	1,0	-
Analogue input TMU220 (slot N)	-	CM	2,5	-
		DM	1,0	-
Analogue input TMU220 (slot O)	-	CM	2,5	-
		DM	1,0	-
Analogue input TMU210 (slot O)	-	CM	2,5	-
		DM	1,0	-
Digital input DIU221 (slot H)	-	CM	2,5	-
		DM	1,0	-

Observations

No degradation of performance observed during and after the test.

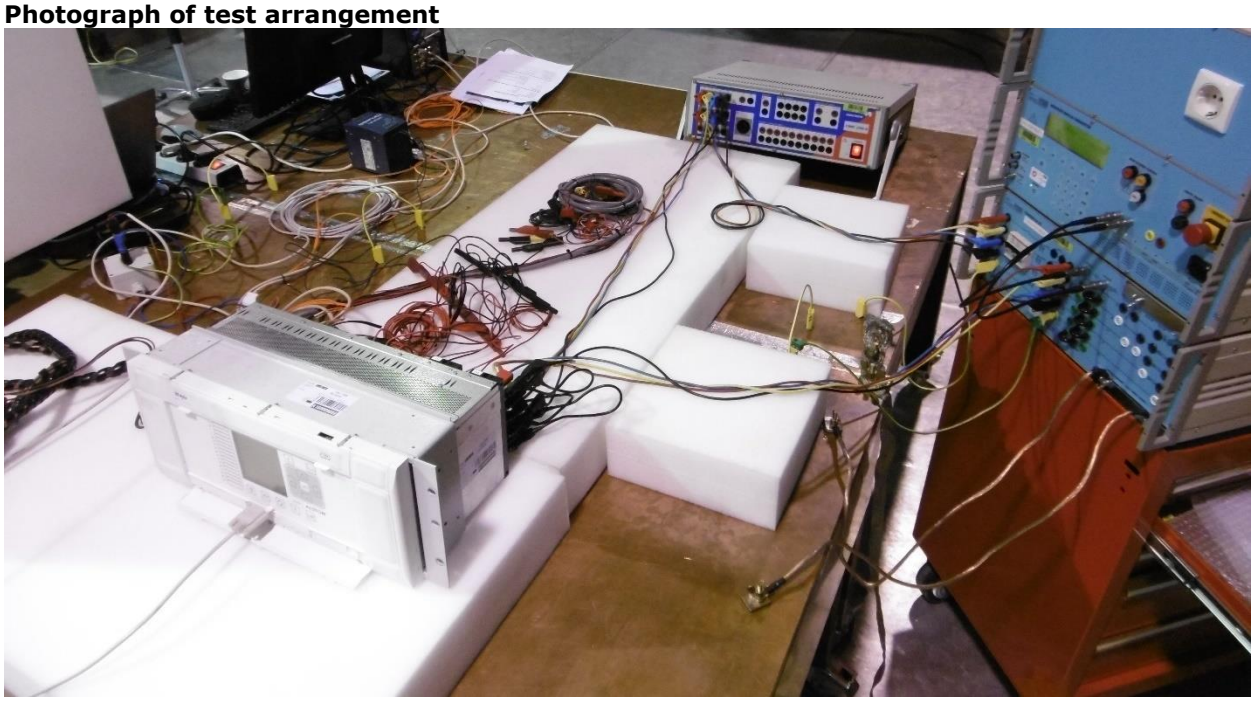
Requirements

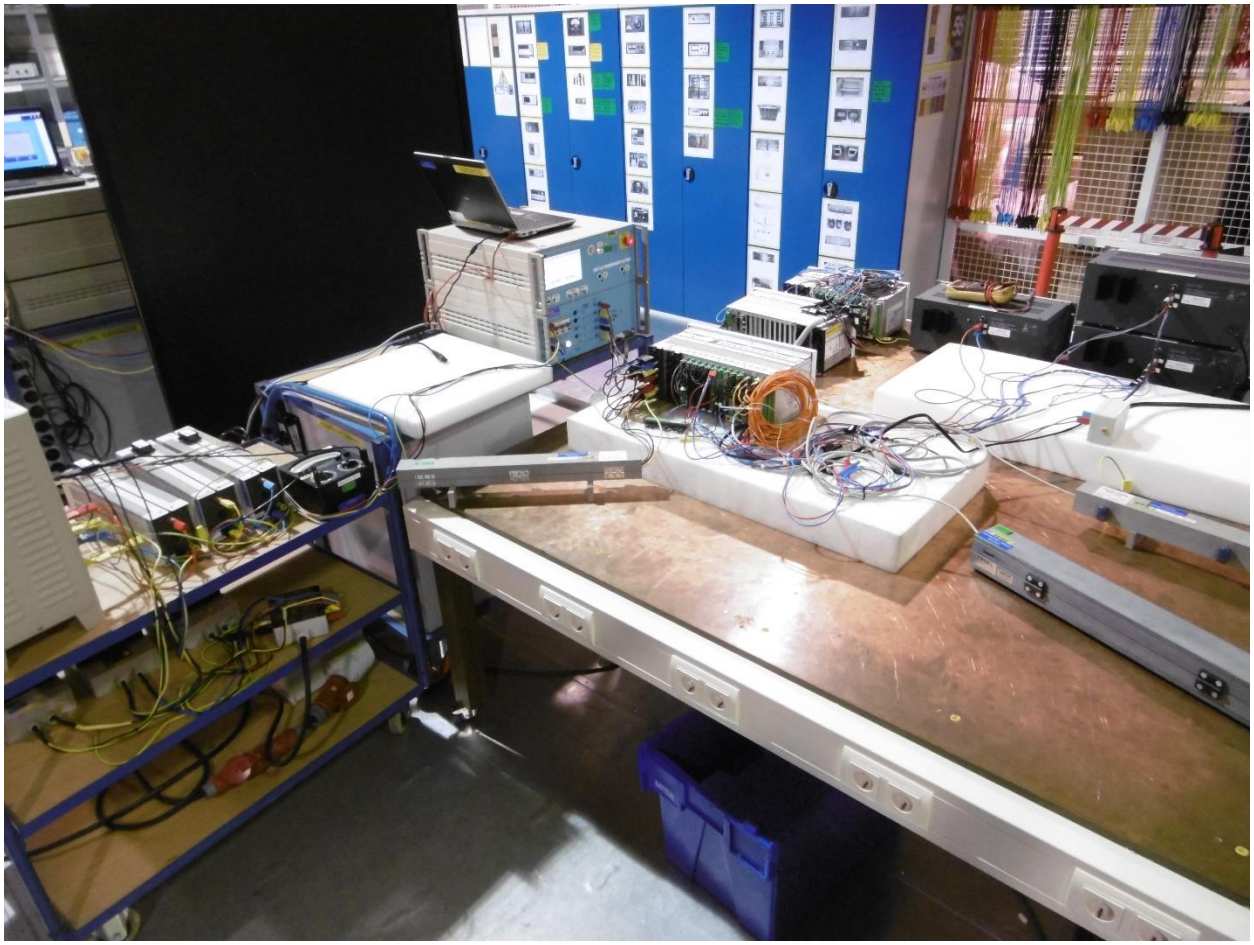
- the object shall comply with reliability class 2 of chapter 7.5
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement





10.7 Surge

Standard and date

Standard IEC 61850-3, subclause 6.7.3
Test date 5 December 2016 and 21 December 2018

Environmental conditions

Ambient temperature 22 °C Relative humidity 42 %
Ambient air pressure 1023 hPa

Characteristic test data

Serial number A160009583 /34606494
Power supply voltage 110 Vdc
110 Vdc
Source impedance 2 Ω
Front time (voltage) 1,2 µs
Time to half value (voltage) 50 µs
Front time (current) 8 µs
Time to half value (current) 20 µs
Auxiliary power supply port
Line-to-Line (LL)
Coupling capacitor 18 µF
Line-to-Earth (LE)
Coupling resistor 10 Ω
Coupling capacitor 9 µF

Input and output ports
Coupling resistor 40 Ω
Coupling capacitor 0,5 µF

Circuit	Terminals	Coupling	Test voltage kV	Observations
Primary power supply input BIU261 (slot A)	Power 1 + PE	LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Secondary power supply input BIU261 (slot A)	Power 2	LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Binary output BIU261 (slot A)	-	LL	0,5/1/2	-
		LE	0,5/1/2/4	-
LAN port CPU4 (slot B)	-	Direct injection on shield	0,5/1/2/4	-
LAN port SRPv2 (slot C)	-	Direct injection on shield	0,5/1/2/4	-
Analogue input AIU211 (slot D)	-	LL	0,5/1/2	-
		LE	0,5/1/2/4	-

Circuit	Terminals	Coupling	Test voltage kV	Observations
Digital output DOU201 (slot E)	-	LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Digital output/control unit CCU211 (slot F)	-	LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Analogue output AOU200 (slot G)	-	LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Digital input DIU211 (slot H)	-	LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Digital output HBU200 (slot M)		LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Analogue input TMU220 (slot N)		LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Analogue input TMU220 (slot O)		LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Analogue input TMU210 (slot O)		LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Digital input DIU221 (slot H)	-	LL	0,5/1/2	-
		LE	0,5/1/2/4	-

Tests performed with an angle of 0, 90, 180, 270 degrees.

Observations

No degradation of performance observed during and after the test.

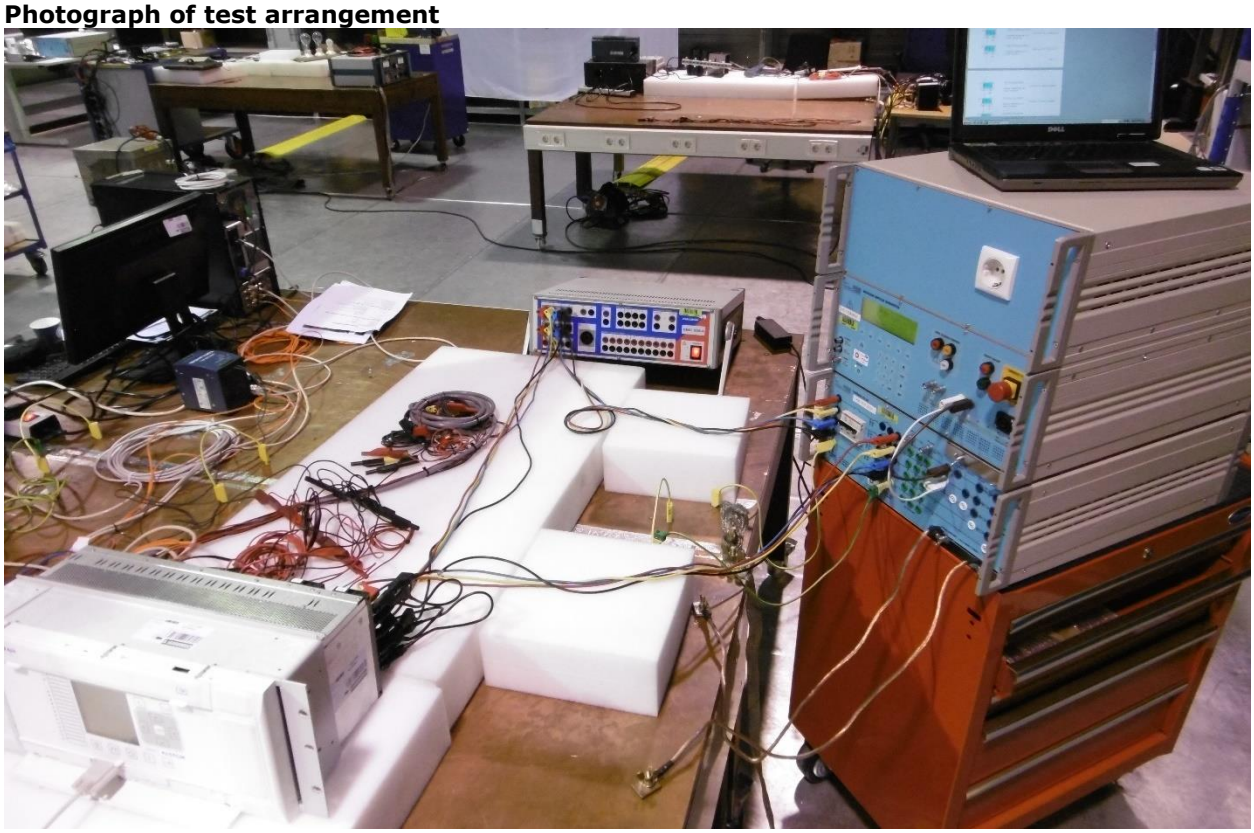
Requirements

- the object shall comply with acceptance criteria class 2 of chapter 7.5
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement



10.8 Conducted disturbance induced by radio-frequency fields

Standard and date

Standard IEC 61850-3, subclause 6.7.3
Test date 19 December 2016 and 9 November 2018

Characteristic test data

Serial number A160009583 /34606494
Power supply voltage 110 Vac
110 Vdc
Source impedance 150 Ω
Amplitude modulated 80 % AM (1 kHz)
Sweep rate 1 %
Dwell time (frequency sweep) 1 s
Test duration (spot frequency) 10 s

Frequency sweep

Circuit	Test level V	CDN	Frequency sweep MHz	Observations
Primary power supply input BIU261 (slot A)	10	M3	0,15 - 80	-
Secondary power supply input BIU261 (slot A)	10	M2	0,15 - 80	-
Binary output BIU261 (slot A)	10	AF2	0,15 - 80	-
LAN port CPU4 (slot B)	10	S8	0,15 - 80	-
LAN port SRPv2 (slot C)	10	S8	0,15 - 80	-
Analogue input AIU211 (slot D)	10	M4	0,15 - 80	-
Digital output DOU201 (slot E)	10	AF2	0,15 - 80	-
Digital output/control unit CCU211 (slot F)	10	EM101	0,15 - 80	-

Circuit	Test level V	CDN	Frequency sweep MHz	Observations
Analogue output AOU200 (slot G)	10	AF2	0,15 - 80	-
Digital input DIU211 (slot H)	10	AF2	0,15 - 80	-
Digital output HBU200 (slot M)	10	AF2	0,15 - 80	-
Analogue input TMU220 (slot N)	10	M4	0,15 - 80	-
Analogue input TMU220 (slot O)	10	M4	0,15 - 80	-
GROUND Earth port	10	M1	0,15 - 80	-
Analogue input TMU210 (slot O)	10	M4	0,15 - 80	-
Digital input DIU221 (slot H)	10	AF2	0,15 - 80	-

Spot frequencies

Circuit	Test level V	CDN	Duty cycle	Spot frequencies MHz	Observations
Primary power supply input BIU261 (slot A)	10	M3	100%	27, 68	-
Secondary power supply input BIU261 (slot A)	10	M2	100%	27, 68	-
Binary output BIU261 (slot A)	10	AF2	100%	27, 68	-
LAN port CPU4 (slot B)	10	S8	100%	27, 68	-
LAN port SRPv2 (slot C)	10	S8	100%	27, 68	-
Analogue input AIU211 (slot D)	10	M4	100%	27, 68	-
Digital output DOU201 (slot E)	10	AF2	100%	27, 68	-

Circuit	Test level V	CDN	Duty cycle	Spot frequencies MHz	Observations
Digital output/control unit CCU211 (slot F)	10	EM101	100%	27, 68	-
Analogue output AOU200 (slot G)	10	AF2	100%	27, 68	-
Digital input DIU211 (slot H)	10	AF2	100%	27, 68	-
Digital output HBU200 (slot M)	10	AF2	100%	27, 68	-
Analogue input TMU220 (slot N)	10	M4	100%	27, 68	-
Analogue input TMU220 (slot O)	10	M4	100%	27, 68	-
GROUND Earth port	10	M1	100%	27, 68	-
Analogue input TMU210 (slot O)	10	M4	100%	27, 68	-
Digital input DIU221 (slot H)	10	AF2	100%	27, 68	-

Observations

No degradation of performance observed during and after the test.

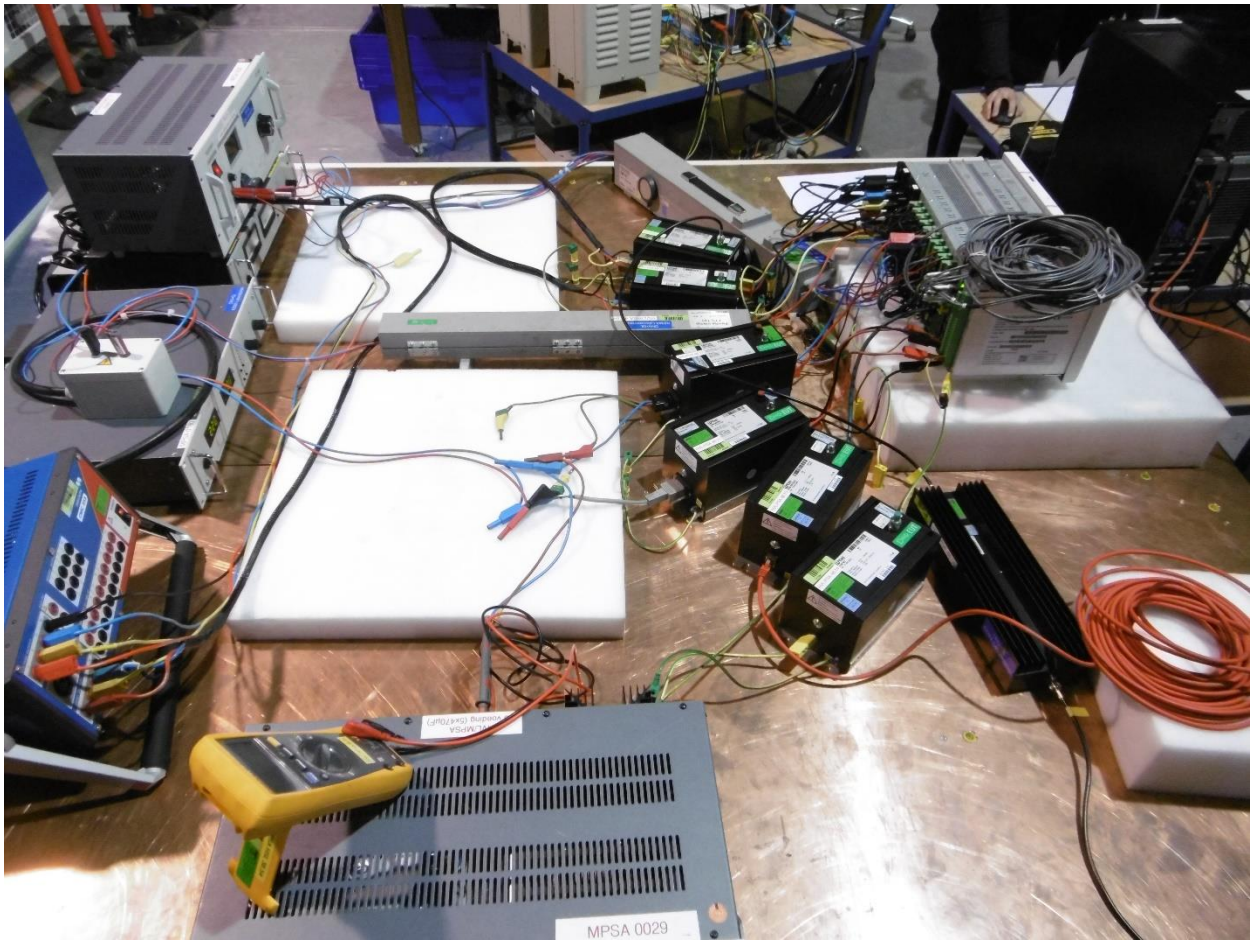
Requirements

- the object shall comply with reliability class 2 of chapter 7.5
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement



10.9 Power frequency magnetic field

Standard and date

Standard IEC 61850-3, subclause 6.7.3
Test date 3 December 2016

Characteristic test data

Serial number A160009583
Power supply 110 Vdc
Frequency 50 Hz

Direction	Test level A/m	Duration s	Observations
Horizontal longitudinal (x)	100	Continuous	-
	1000	1 s	-
Horizontal transversal (y)	100	Continuous	-
	1000	1 s	-
Vertical (z)	100	Continuous	-
	1000	1 s	-

Observations

No degradation of performance observed during and after the test.

Requirements

- the object shall comply with reliability class 2 of chapter 7.5
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement

10.10 Mains frequency voltage immunity

Standard and date

Standard IEC 61850-3, subclause 6.7.3
Test date 19 December 2016 and 14 December 2018

Characteristic test data

Serial number A160009583 /34606494
Frequency 50 Hz
60 Hz
Test duration continuous 60 s
Test duration short time 3 s

Frequency sweep

Zone B Level 4 30-3-30 V

Mains frequency continuous disturbance

Zone B Level 4 30 V

Mains frequency short time disturbance

Zone B Level 4 300 V

Frequency sweep (informative)

Circuit	Terminals	Coupling	Test level	Coupling resistor Ω	Coupling capacitor µF	Observations
Digital input BIU261 (slot A)	-	CDN	4	200	1	-
Digital input DIU211 (slot H)	-	CDN	4	200	1	-
Digital input DIU221 (slot H)	-	CDN	4	200	1	-

Mains frequency continuous disturbance

Circuit	Terminals	Coupling	Test level	Coupling resistor Ω	Coupling capacitor µF	Observations
Digital input BIU261 (slot A)	-	CDN	4	200	1	-
Digital input DIU211 (slot H)	-	CDN	4	200	1	-
Digital input DIU221 (slot H)	-	CDN	4	200	1	-

Mains frequency short duration disturbance

Circuit	Terminals	Coupling	Test level	Coupling resistor Ω	Coupling capacitor µF	Observations
Digital input BIU261 (slot A)	-	CDN	4	200	1	-
igital input (DIU211 (slot H)	-	CDN	4	200	1	-
Digital input DIU221 (slot H)	-	CDN	4	200	1	-

Observations

No degradation of performance observed during and after the test.

Requirements

- the object shall comply with reliability class 2 of chapter 7.5
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

10.11 Mains frequency voltage immunity (additional test acc. IEC 60255-26)

Standard and date

Standard IEC 60255-26, subclause 6.4
Test date 14 December 2018

Characteristic test data

Serial number A160009583 /34606494
Frequency 50 Hz
60 Hz

Zone A;

Circuit	Terminals	Coupling	Test voltage V	Coupling resistor Ω	Coupling capacitor µF	Observations
Digital input BIU261 (slot A)	-	DM	150	100	0,1	-
		CM	300	220	0,47	-
Digital input DIU211 (slot H)	-	DM	150	100	0,1	-
		CM	300	220	0,47	-
Digital input DIU221 (slot H)	-	DM	150	100	0,1	-
		CM	300	220	0,47	-

Observations

No degradation of performance observed during and after the test.

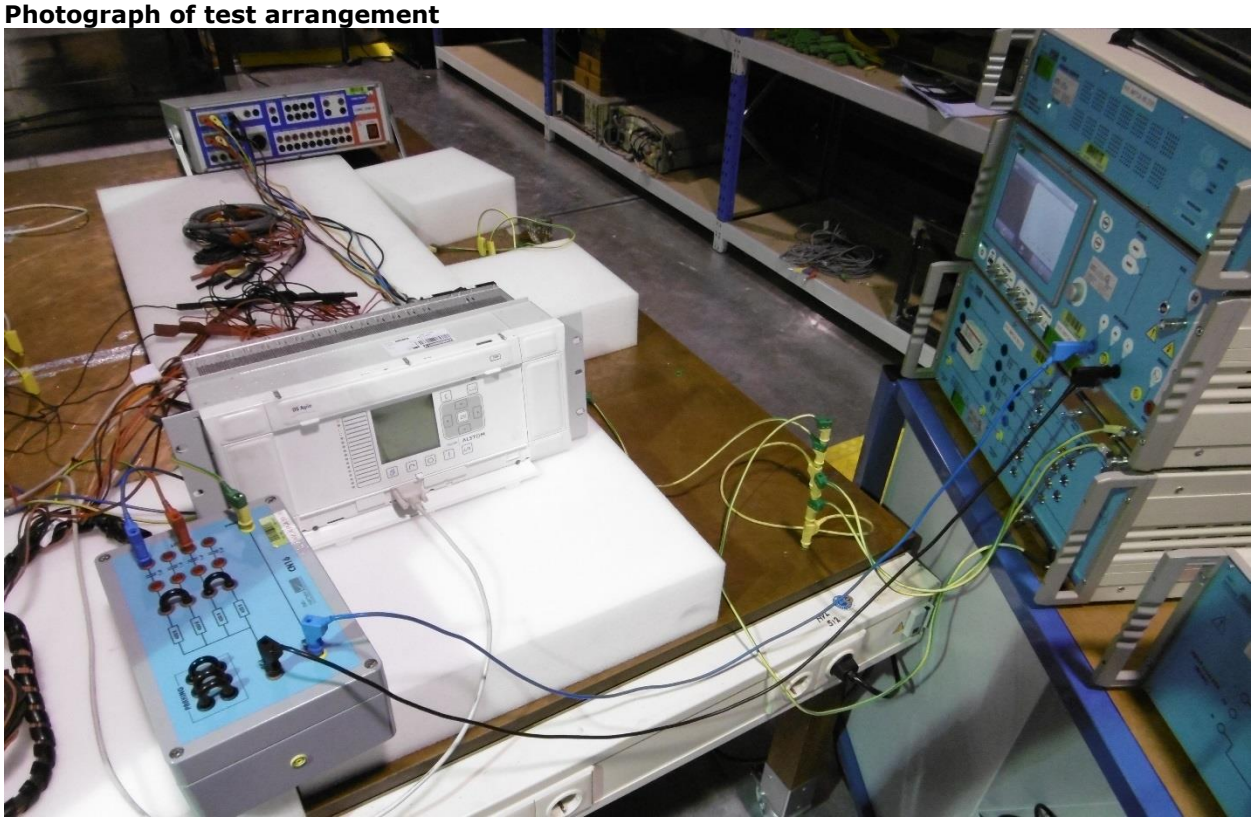
Requirements

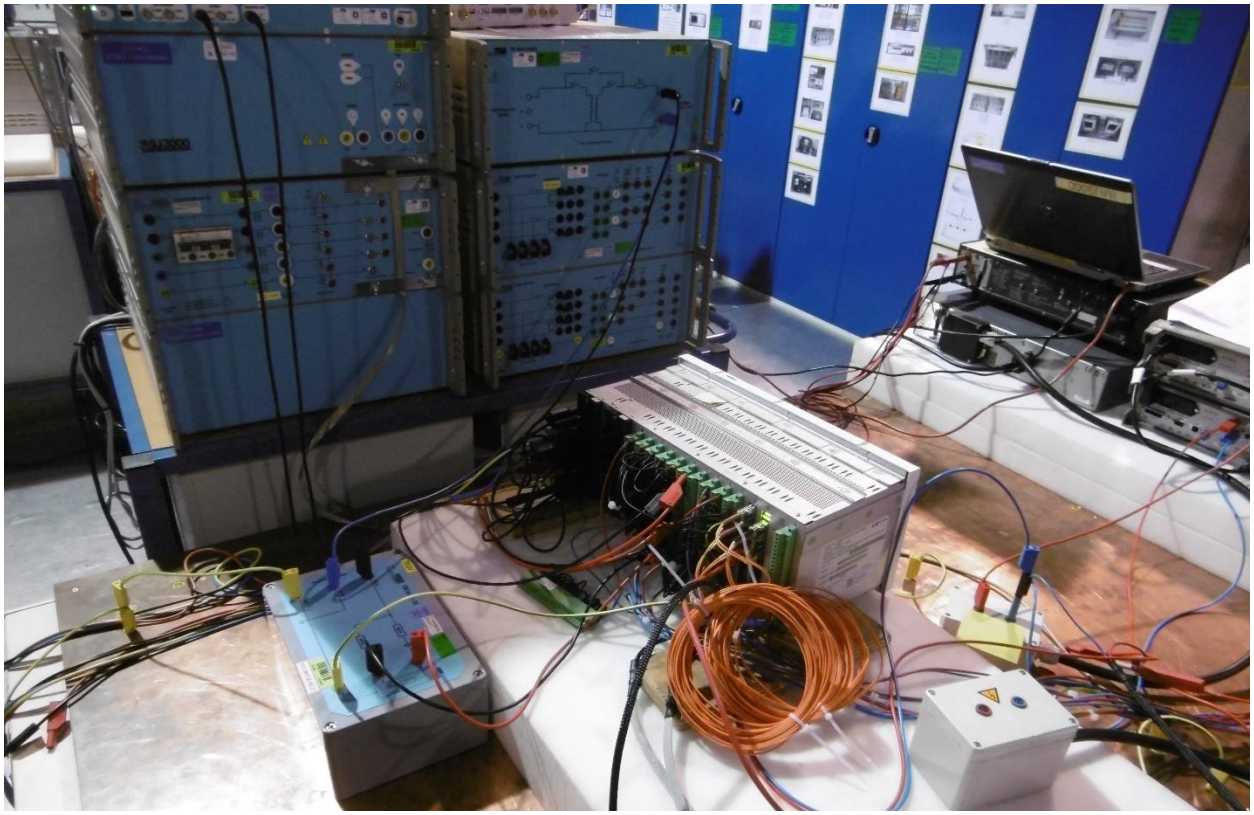
- the object shall comply with acceptance criteria A of IEC 60255-26, Table 23.
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement





10.12 Voltage dips and voltage interruptions on power supply voltage

Standard and date

Standard IEC 61850-3, subclause 6.7.3
Test date 16 December 2016 and 18 December 2018

Characteristic test data

Serial number A160009583
interruption 50 ms
Power supply 1 0 Vdc
Power supply 2 See table Vdc

Voltage interruption

Power supply voltage Vdc	Supply interruption %	Impedance	Observations
85	100	High	-
250	100	High	-
85	100	Low	-
250	100	Low	-

Characteristic test data

Serial number A160009583
interruption 50 ms
Power supply 1 See table Vdc
Power supply 2 0 Vdc

Voltage interruption

Power supply voltage Vdc	Supply interruption %	Impedance	Observations
85	100	High	-
250	100	High	-
85	100	Low	-
250	100	Low	-

Observations

No degradation of performance observed during and after the test.

Characteristic test data

Serial number	A160009583
interruption	50 ms
Power supply 1	85 Vdc
Power supply 2	See table Vdc

Voltage interruption

Power supply voltage Vdc	Supply interruption %	Impedance	Observations
85	100	High	-
250	100	High	-
85	100	Low	-
250	100	Low	-

Observations

No degradation of performance observed during and after the test.

Characteristic test data

Serial number	A160009583
Power supply 1	0 Vdc
Power supply 2	See table Vdc
Interruption	0,1 s

Voltage dips

Power supply voltage Vdc	Dip %	Residual voltage V	Observations
85	60	34	-
85	30	59,5	-
250	60	100	-
250	30	175	-

Observations

No degradation of performance observed during and after the test.

Characteristic test data

Serial number	A160009583
Power supply 1	See table Vdc
Power supply 2	0 Vdc
Interruption	0,1 s

Voltage dips

Power supply voltage Vdc	Dip %	Residual voltage V	Observations
85	60	34	-
85	30	59,5	-
250	60	100	-
250	30	175	-

Observations

No degradation of performance observed during and after the test.

Characteristic test data

Serial number	34606495
interruption	50 ms
Power supply 1	0 Vdc
Power supply 2	See table Vdc

AC voltage dips

Primary power supply input

PSU Vdc	Dips duration ms	Dips %	Residual voltage Vdc	Observations
88	100	30	61,6	-
88	100	60	35,2	-

Secundary power supply input

PSU Vdc	Dips duration ms	Dips %	Residual voltage Vdc	Observations
88	100	30	61,6	-
88	100	60	35,2	-

Redundant configuration

Primary PSU Vdc	Dips duration ms	Dips %	Residual voltage Vdc	Observations
88	100	30	61,6	-
88	100	60	35,2	-

Secondary voltage is set to 110 V – 20 % = 88 V

Redundant configuration

secondary PSU Vdc	Dips duration ms	Dips %	Residual voltage Vdc	Observations
88	100	30	61,6	-
88	100	60	35,2	-

Primary voltage is set to 110 V – 20 % = 88 V

Observations

No degradation of performance observed during and after the test.

DC voltage interruptions

Primary power supply input

PSU Vdc	Interruption duration ms	Observations
88	50 /Low impedance	-
88	50 /High impedance	-

Secondary power supply input

PSU Vdc	Interruption duration ms	Observations
88	50 /Low impedance	-
88	50 /High impedance	-

Redundant configuration

Primary PSU Vdc	Interruption duration ms	Observations
88	50 /Low impedance	-
88	50 /High impedance	-

Secondary voltage is set to 110 V – 20 % = 88 V

Redundant configuration

Secondary PSU Vdc	Interruption duration ms	Observations
88	50 /Low impedance	-
88	50 /High impedance	-

Primary voltage is set to 110 V – 20% = 88 V

Observations

No degradation of performance observed during and after the test.

Requirements

- the object shall comply with the reliability class 2 of chapter 7.5
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement

10.13 Voltage ripple on DC power supply voltage

Standard and date

Standard IEC 61850-3, subclause 6.7.3

Test date 10 February 2017 and 19 December 2018

Power supply voltage Vdc	Test frequency Hz	Ripple V/%	See oscillogram on next pages	Observations
110 (primary power supply)	100	11/10	1	-
110 (secondary power supply)	100	11/10	2	-
220 (primary power supply)	100	22/10	3	-
220 (secondary power supply)	100	22/10	4	-

Power supply voltage Pri. Vdc 20%	Test frequency Hz / uF	Ripple V/%	See oscillogram on next pages	Observations
88	120 / 78	16,5/15	6	-
300	120 / 0.33	37,5/15	7	-

Ripple (110V 15% 16.5V) (250V 15% 37,5 V)

Power supply voltage Sec. Vdc 20%	Test frequency Hz / uF	Ripple V/%	See oscillogram on next pages	Observations
88	120 / 78	16,5/15	5	-
300	120 / 0,33	37,5/15	8	-

Ripple (110 V 15% 16,5 V) (250 V 15% 37,5 V)

Observations

No degradation of performance observed during and after the test.

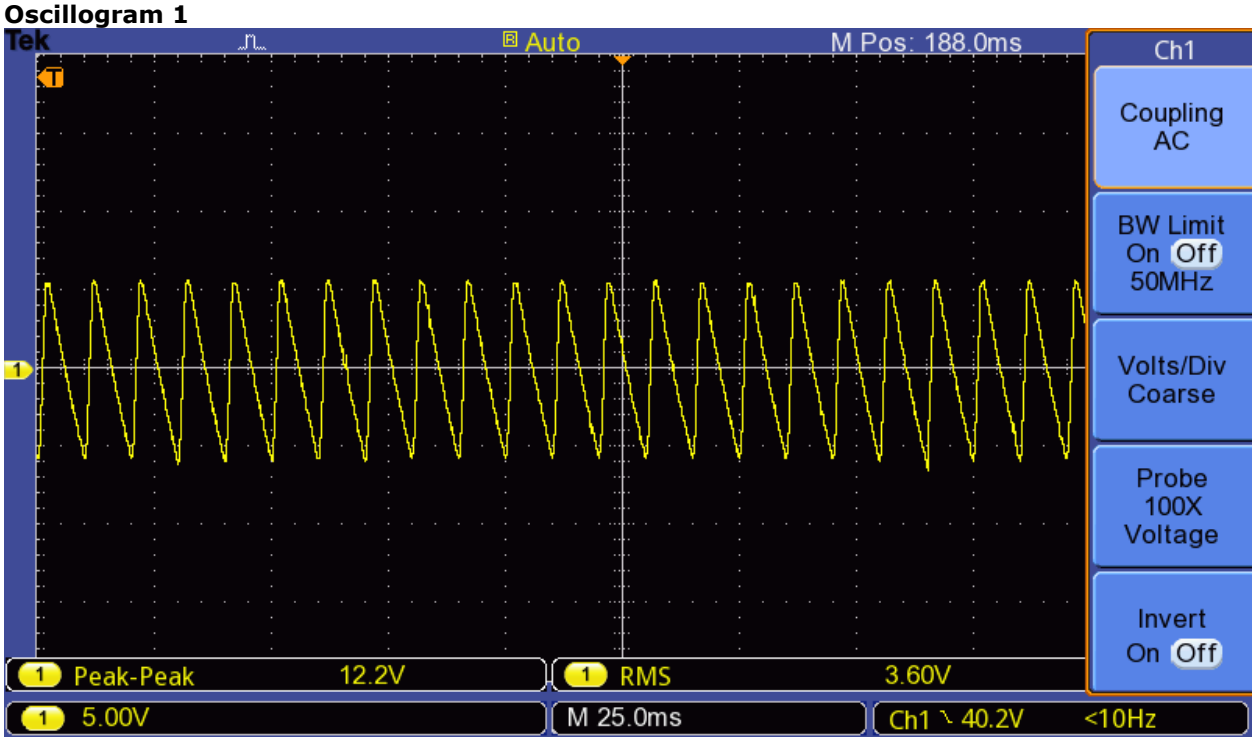
Requirements

- the object shall comply with the required reliability class 2 of chapter 7.5.
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

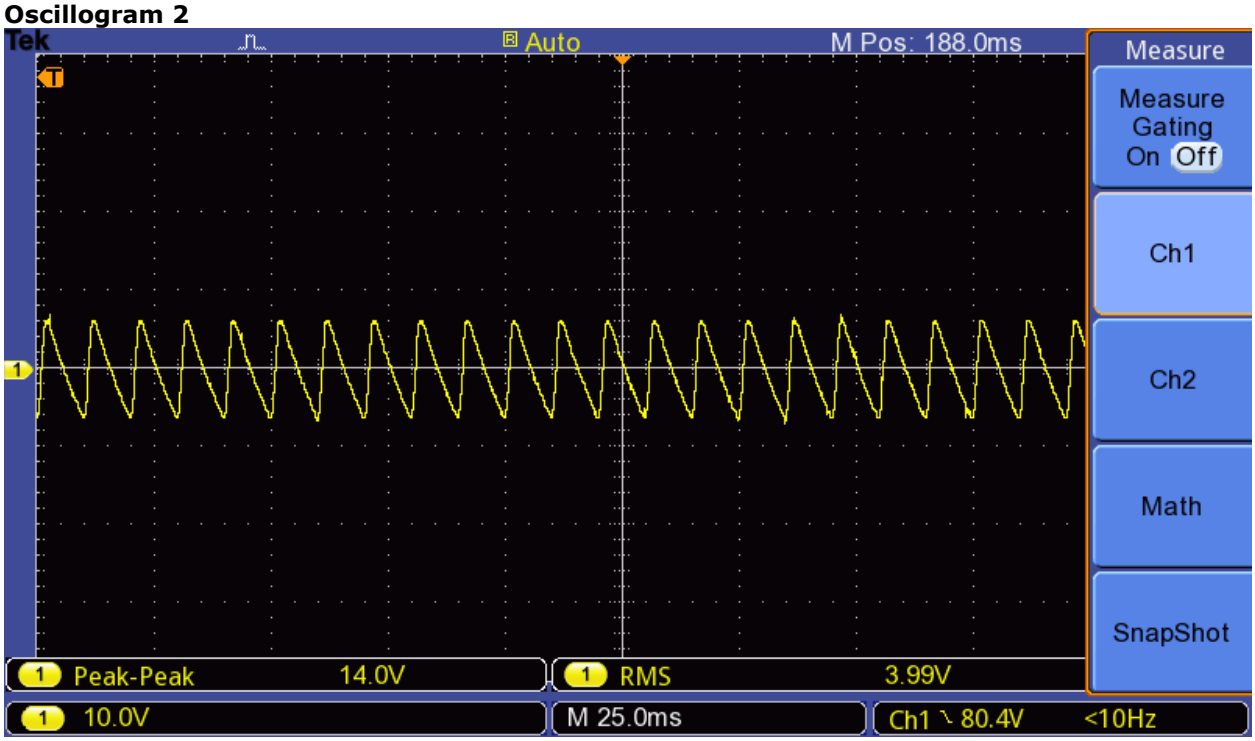
The object passed the test.

Oscillogram 1



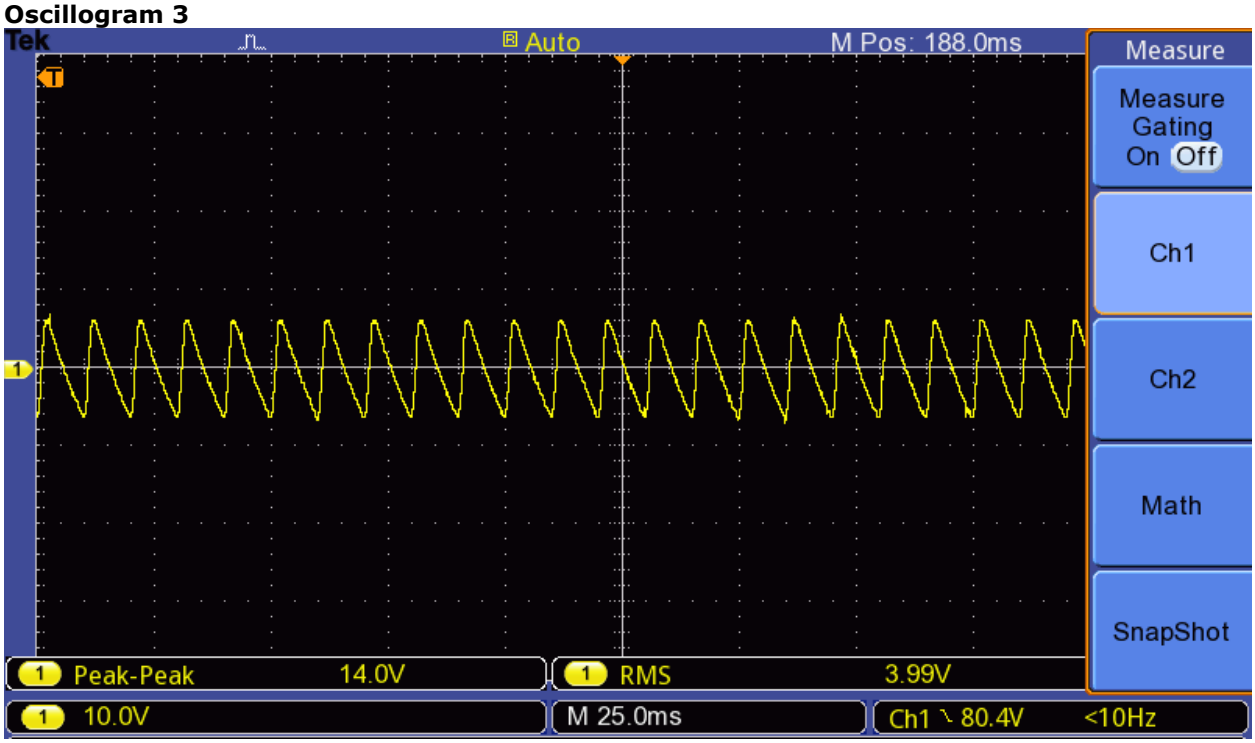
110 Vdc, 12,2 Vpp on the secondary power supply

Oscillogram 2



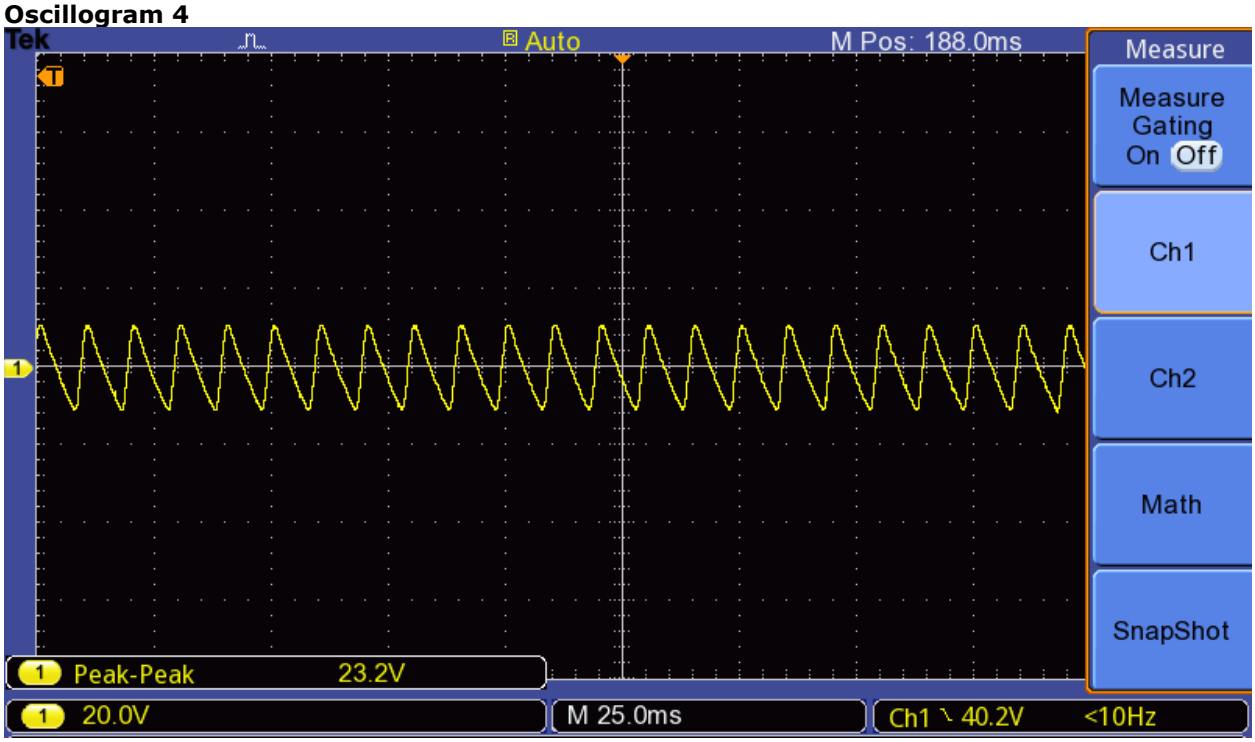
110 Vdc, 14,0 Vpp on the primary power supply

Oscillogram 3



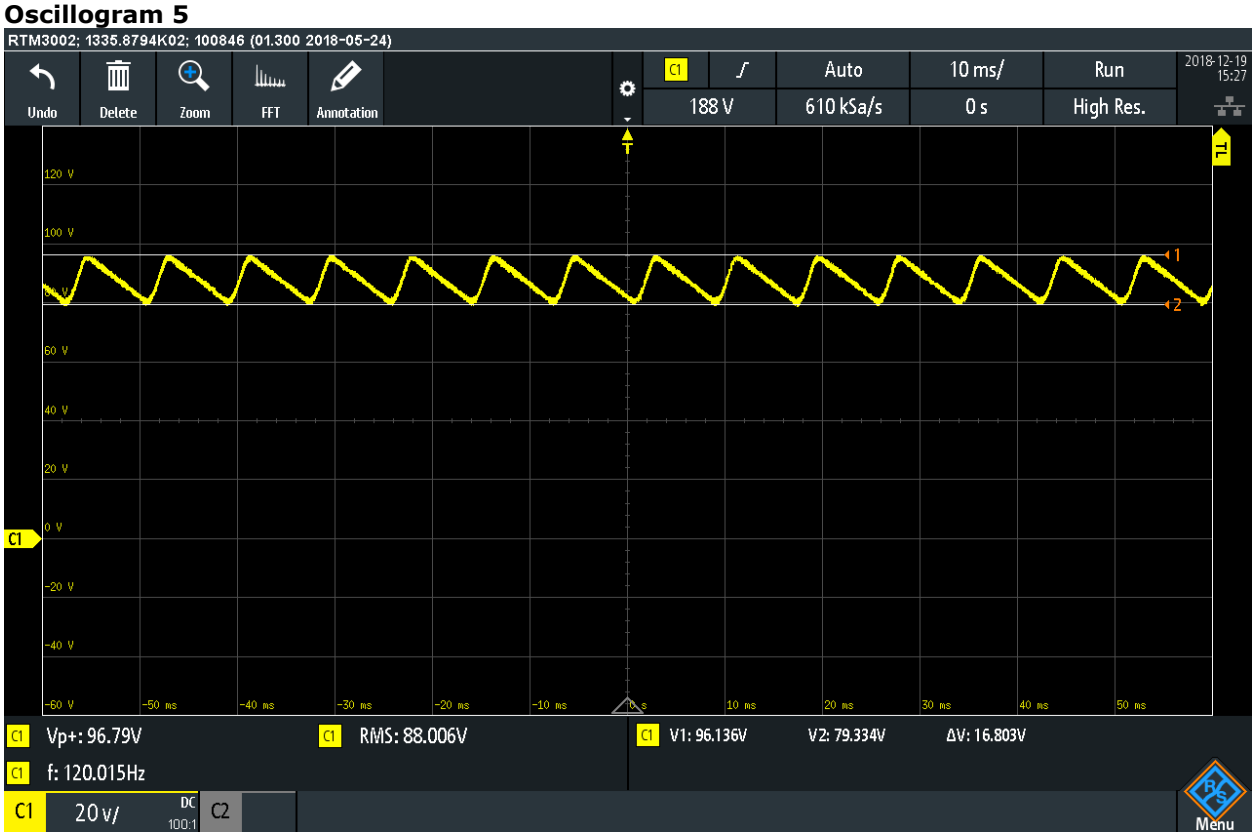
220 Vdc, 24,0 Vpp on the primary power supply

Oscillogram 4



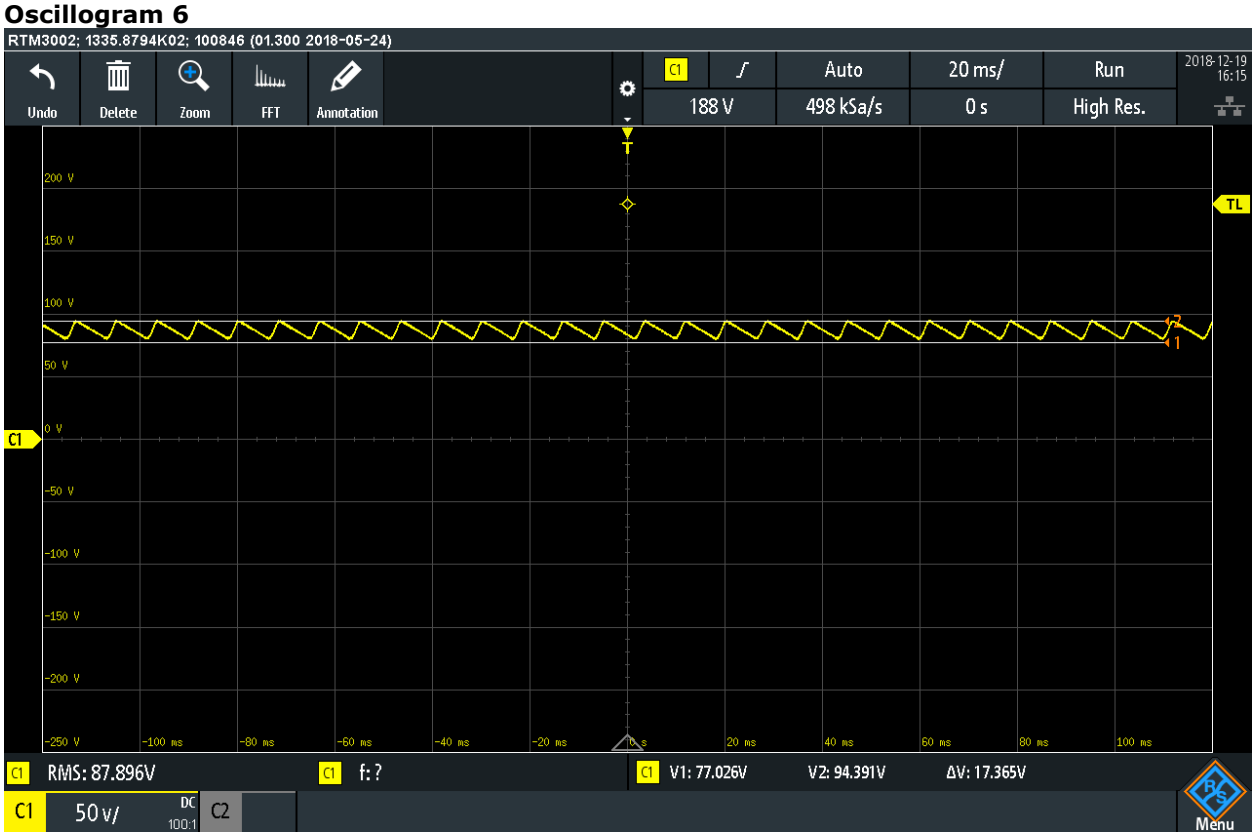
220 Vdc, 23,2 Vpp on the primary power supply

Oscillogram 5



88 Vdc, 16,8 Vpp on the secondary power supply

Oscillogram 6



88 Vdc, 17,36 Vpp on the primary power supply

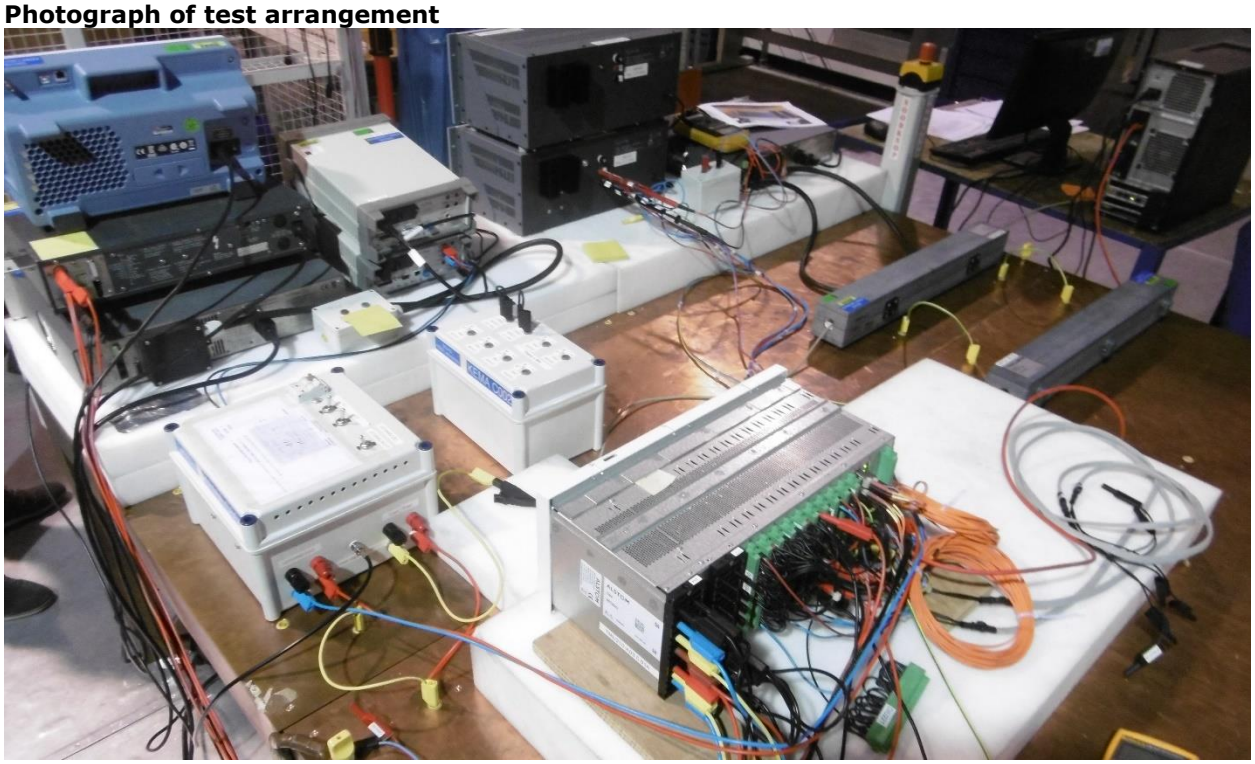
Oscillogram 7

300 Vdc, 37,59 Vpp on the primary power supply

Oscillogram 8

300 Vdc, 37,59 Vpp on the primary power supply

Photograph of test arrangement



11 ENERGIZING QUANTITIES

11.1 Burden for AC power supply

Standard and date

Standard IEC 61850-3, subclause 6.8.1

Test date 10 January 2019

Characteristic test data

Serial number 34606494

Number of measurements 5 (issue maximum value)

Power input voltage Vdc / load[1]	Specified maximum burden VA	Measured maximum burden VA	Note
PSU pri : 110 Vac	-	61,55	1
PSU sec : 110 Vac	-	9,11	2
PSU Sec : 110 (Pri OFF)	-	72,16	2
PSU pri : 220 Vac	-	84,26	1
PSU sec : 220 Vac	-	16,94	2
PSU Sec: 220 (Pri OFF)	-	86,90	2

[1]The equipment has been wired according to the graphs presented in section 4.1.

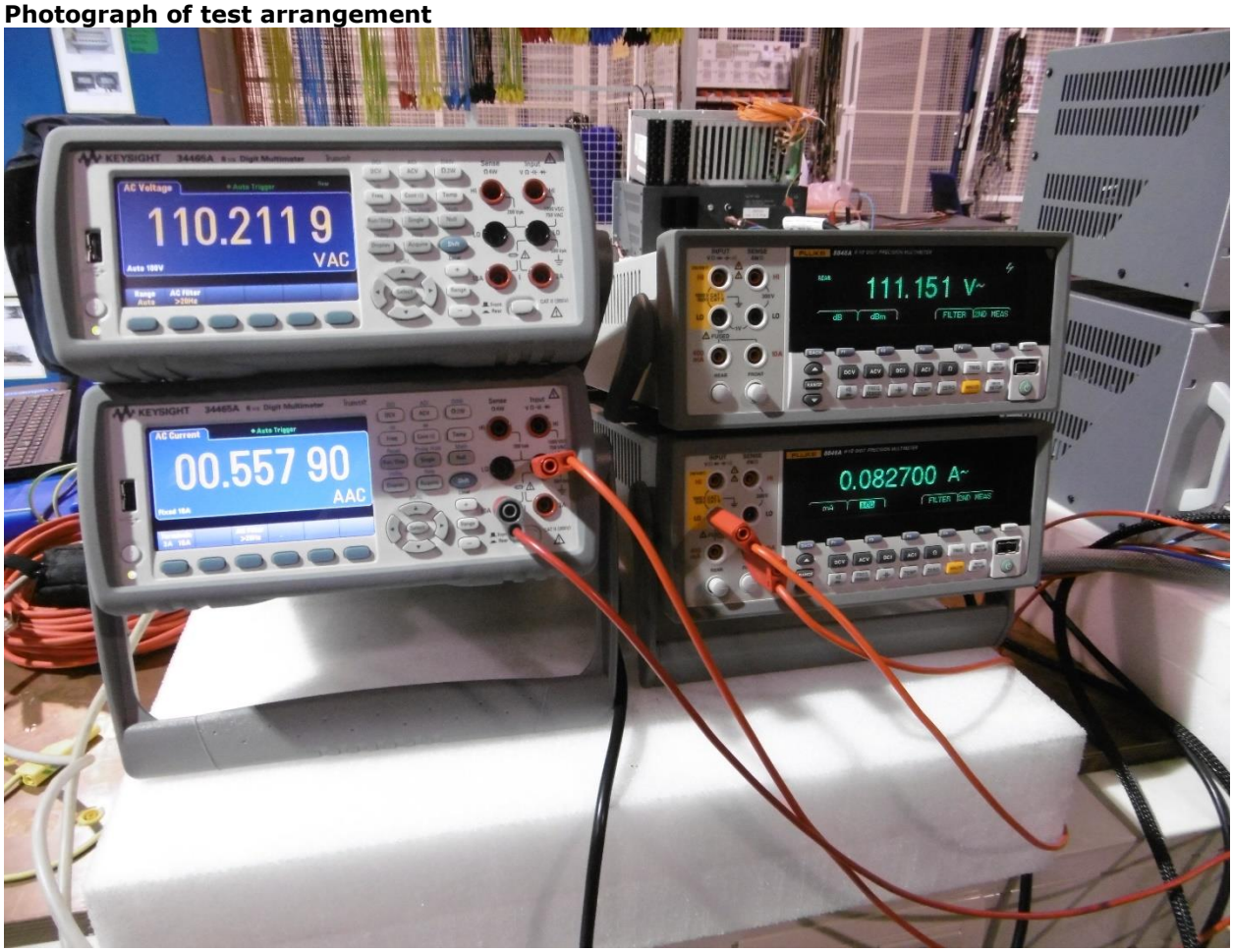
Note

1. Measured on the power supply input of the main board (BIU261M).
2. Measured on the power supply input of the daughterboard (BIU261D).

Result

The measurement results are for information only.

Photograph of test arrangement



11.2 Burden for DC power supply

Standard and date

Standard IEC 61850-3, subclause 6.8.2

Test date 13 February 2017 and 10 January 2019

Characteristic test data

Serial number A160009583/34606494

Number of measurements 5 (issue maximum value)

Power input voltage Vdc / load[1]	Specified maximum burden VA	Measured maximum burden (ser. No. A160009583) VA	Measured maximum burden (ser. No. 34606494) VA	Note
PSU: 220 Vdc/	-	38,7	38,7	1
PSU: 110 Vdc/	-	38,5	38,5	1
PSU: 220 Vdc/	-	38,7	38,7	2
PSU: 110 Vdc/	-	38,5	38,5	2

[1]The equipment has been wired according to the graphs presented in section 4.1.

Note

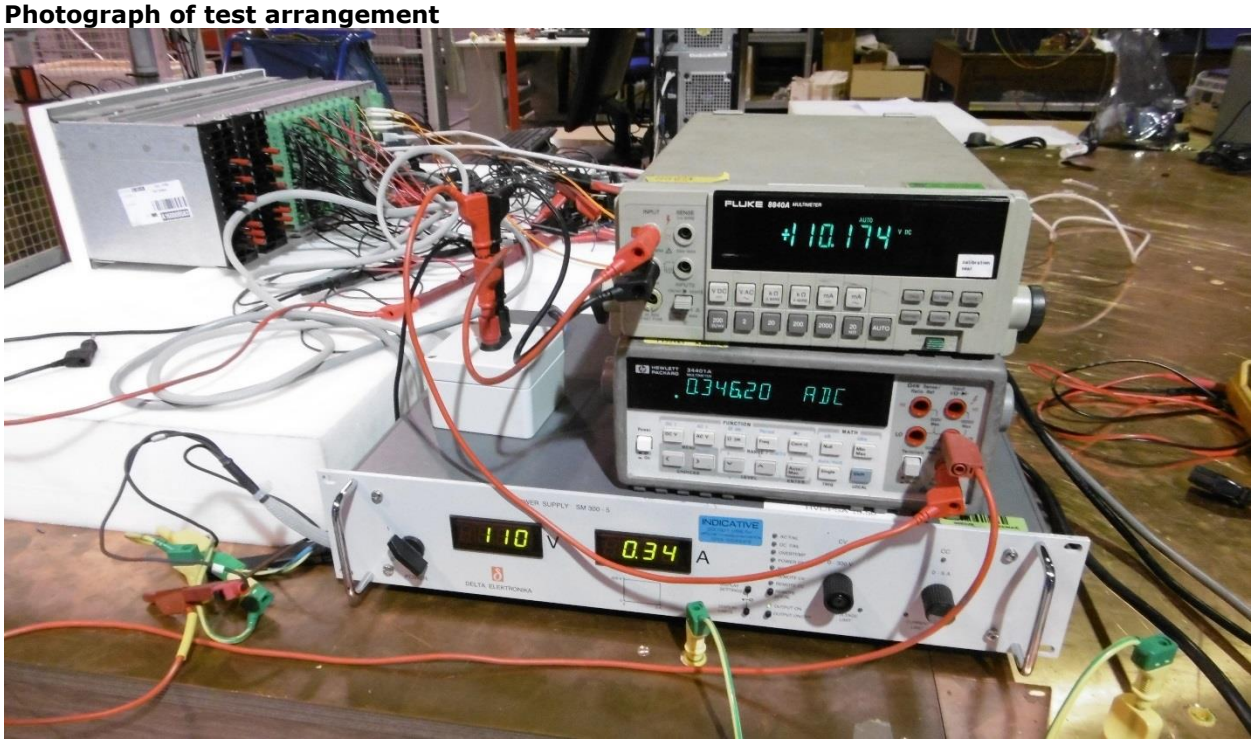
Measured on the power supply input of the main board (BIU261M).

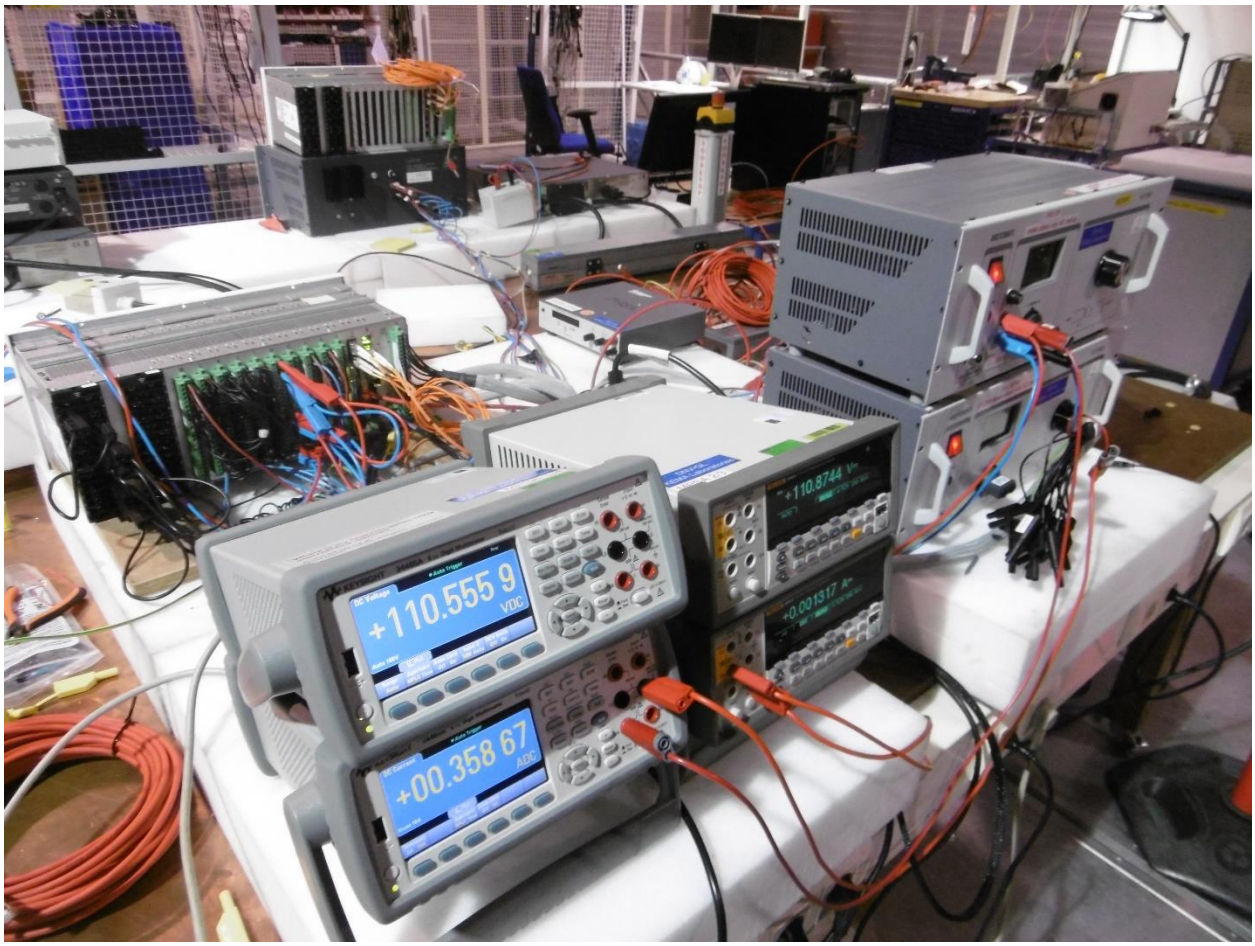
Measured on the power supply input of the daughterboard (BIU261D).

Result

The measurement results are for information only.

Photograph of test arrangement





11.3 Inrush current

Standard and date

Standard IEC 61850-3, subclause 6.8.1.2 and 6.8.2.2
Test date 13 February 2017

Characteristic test data

Serial number A160009583
Number of measurements 5 (issue maximum value)

Power input voltage	Specified		Measured		Observations
	Peak current	Power up duration	Peak current	Power up duration	
Vdc	A	ms	A	ms	
110	-	-	19,4	110	-
220	-	-	43,8	92	-

Result

The measurement results are for information only.

11.4 Burden for binary input

Standard and date

Standard IEC 61850-3, subclause 6.8.3
Test date 15 March 2017

Characteristic test data

Serial number A160009583
Number of measurements 5 (issue maximum value)

Slot A

Power input voltage Vdc	Specified maximum value W	Measured maximum value W	Observation
110	1	0,16	-
220	1	0,69	-

Slot F

Power input voltage Vdc	Specified maximum value W	Measured maximum value W	Observation
48	0,66	0,27	-
60	0,66	0,33	-

Slot I

Power input voltage Vdc	Specified maximum value W	Measured maximum value W	Observation
48	0,64	0,27	-
60	0,64	0,33	-

Result

The object passed the test.

12 CLIMATIC ENVIRONMENT

12.1 Inspection

12.1.1 Pre-inspection

The pre-inspection is performed to verify that the test object is in operational state. The pre-inspection is carried out prior to the test procedure.

The communication with the maintenance computer is verified. Signals are simulated to verify the functioning and operation with the specified performance specification for the following inputs and outputs:

- digital inputs
- analogue inputs
- contact outputs
- data communication.

12.1.2 Visual and functional inspection

After each test a visual and functional inspection is carried out as described in this chapter.

The visual inspection is carried out to verify that there is no visual mechanical damage.
There shall be no:

- burning of any components
- paint blisters on any components
- discolouration on components
- deformation of modules or components
- interruptions or damage on interconnecting cables, wires and connectors.

Functional inspection is carried out to verify the correct operation of the test object.
There shall be no:

- alarm indications on display and LED's
- error messages reported in the maintenance computer
- unintentional change of contact outputs
- there shall be no degradation of performance below the claimed performance according reliability class (1 or 2).

Unless otherwise stated the visual and functional inspection was carried out successfully after each test.

12.2 Measurement of insulation resistance before and after the climate tests

Standard and date

Standard IEC 61850-3, subclause 6.9.2.2
Test date 4 February 2016 and 6 November 2018

Characteristic test data

Serial number A160009583
Supply voltage 500 Vdc

Test arrangement		Measurement of resistance (before the test)	Measurement of resistance (after the test)	Observation
Voltage applied to	Tested between	MΩ		
Power (Primary) (slot A)	Earth and all others	> 550	> 550	-
Power (Secondary) (slot A)	Earth and all others	> 550	> 550	-
Binary output (slot A)	Earth and all others	> 550	> 550	-
LAN port (slot B)	Earth and all others	> 550	> 550	-
LAN port (slot C)	Earth and all others	> 550	> 550	-
Analogue input AIU211 (slot D)	Earth and all others	> 550	> 550	-
Digital output (DOU201) (slot E)	Earth and all others	> 550	> 550	-
Digital output/control unit (CCU) (slot F)	Earth and all others	> 550	> 550	-
Analogue output (AOU200) (slot G)	Earth and all others	> 550	> 550	-
Digital input (DIU211) (slot H)	Earth and all others	> 550	> 550	-
Digital output (HBU200) (slot M)	Earth and all others	> 550	> 550	-
Analogue input (TMU220) (slot N)	Earth and all others	> 550	> 550	-
Analogue input (TMU220) (slot O)	Earth and all others	> 550	> 550	-
Analogue input (TMU210) (slot O)	Earth and all others	> 550	> 550	-

Test arrangement		Measurement of resistance (before the test)	Measurement of resistance (after the test)	Observation
Voltage applied to	Tested between	MΩ		
Analogue input (DIU221) (slot H)	Earth and all others	> 550	> 550	-

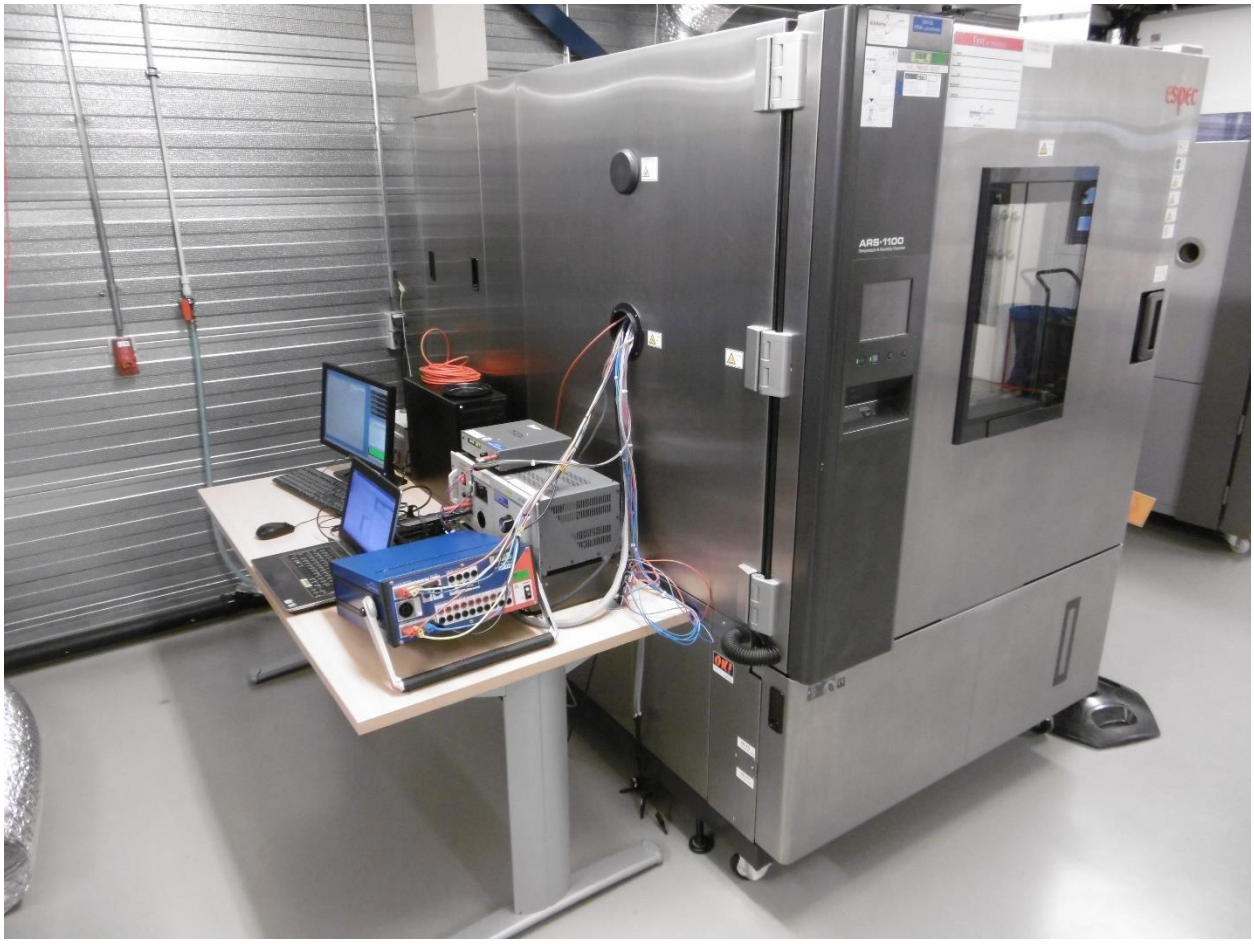
Requirement

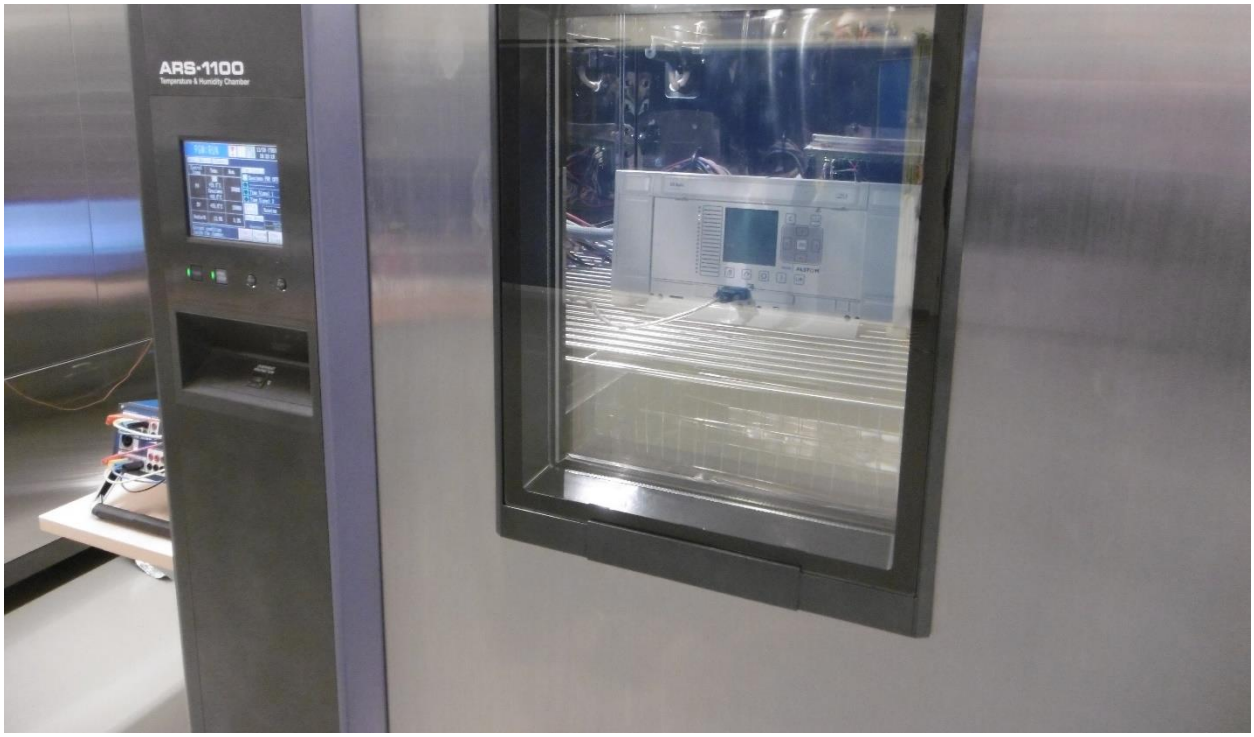
- the insulation resistance shall not be less than 100 MΩ
- no visual or functional inspection required.

Result

The object passed the test.

12.3 Photograph of test arrangement





12.4 Climatic environmental tests

12.4.1 Dry-heat test - operational

Standard and date

Standard	IEC 61850-3, subclause 6.9.3.1
Basic standard	IEC 60068-2-2
Test date	26 November 2018

Characteristic test data

Serial number	34606497
Type of test	Bd
Operating conditions	energized
Power supply	110 V
Relative humidity	<50 %
Maximum rate of change	1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Operating temperature °C	Observation
Powering up after	1	55	-
Correct function at rated load/current	96		-

Characteristic test data

Serial number	34606497 Front panel without LCD display
Type of test	Bd
Operating conditions	energized
Power supply	110 V
Relative humidity	<50 %
Maximum rate of change	1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Operating temperature °C	Observation
Powering up after	1	65	-
Correct function at rated load/current	96		-

Observations

No degradation of performance observed during and after the test.

Requirement

- a dielectric voltage test shall be performed
- measurement of insulation resistance should be performed before and after climatic tests and before and after dielectric tests
- the visual and functional inspection shall not reveal any defects or malfunctions.
- the object shall comply with the required reliability class 2 of chapter 7.5.

Result

The object passed the test.

12.4.2 Cold test - operational

Standard and date

Standard	IEC 61850-3, subclause 6.9.3.2
Basic standard	IEC 60068-2-1
Test date	21 November 2018

Characteristic test data

Serial number	34606497
Type of test	Ad
Operating conditions	energized
Power supply	110 V
Relative humidity	<50 %
Maximum rate of change	1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Operating temperature °C	Observation
Powering up after	1	-25	-
Correct function at rated load/current	96		-

Characteristic test data

Serial number	34606497 Front panel without LCD display
Type of test	Ad
Operating conditions	energized
Power supply	110 V
Relative humidity	<50 %
Maximum rate of change	1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Operating temperature °C	Observation
Powering up after	1	-40	-
Correct function at rated load/current	96		-

Observations

No degradation of performance observed during and after the test.

Requirement

- a dielectric voltage test shall be performed
- measurement of insulation resistance should be performed before and after climatic tests and before and after dielectric tests
- the visual and functional inspection shall not reveal any defects or malfunctions.
- the object shall comply with the required reliability class 2 of chapter 7.5.

Result

The object passed the test.

12.4.3 Dry-heat test at maximum storage temperature

Standard and date

Standard	IEC 61850-3, subclause 6.9.3.3
Basic standard	IEC 60068-2-2
Test date	12 November 2018

Characteristic test data

Serial number	34606497
Type of test	Bb
Operating conditions	non-energized
Power supply	0 V
Relative humidity	<50 %
Maximum rate of change	1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Operating temperature °C	Observation
Storage	96	70	--

Characteristic test data

Serial number	34606497 Front panel without LCD display
Type of test	Bb
Operating conditions	non-energized
Power supply	0 V
Relative humidity	<50 %
Maximum rate of change	1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Operating temperature °C	Observation
Storage	96	85	

Observations

No degradation of performance observed after the test.

Requirement

- a dielectric voltage test shall be performed
- measurement of insulation resistance should be performed before and after climatic tests and before and after dielectric tests
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

12.4.4 Cold test at minimum storage temperature

Standard and date

Standard	IEC 61850-3, subclause 6.9.3.4
Basic standard	IEC 60068-2-1
Test date	6 November 2018

Characteristic test data

Serial number	34606497
Type of test	Ab
Operating conditions	non-energized
Power supply	0 V
Relative humidity	<50 %
Maximum rate of change	1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Operating temperature °C	Observations
Storage	96	-40	

Observations

No degradation of performance observed after the test.

Requirement

- a dielectric voltage test shall be performed
- measurement of insulation resistance should be performed before and after climatic tests and before and after dielectric tests
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

12.4.5 Change of temperature test

Standard and date

Standard	IEC 61850-3, subclause 6.9.3.5
Basic standard	IEC 60068-2-14
Test date	30 November 2018

Characteristic test data

Serial number	34606497
Type of test	Nb
Operating conditions	energized
Power supply	110 V
Relative humidity	<50 %
Maximum rate of change	1 °C/min
Exposure time t_1	3 h
Duration of exposure	5 cycles

Test procedure	Exposure time h	Duration of exposure	Operating temperature °C	Observations
Pre-conditioning	1	-	+22	
Correct function	3	5	Min. -25	
			Max. 55	

Characteristic test data

Serial number	34606497 Front panel without LCD display
Type of test	Nb
Operating conditions	energized
Power supply	110 V
Relative humidity	<50 %
Maximum rate of change	1 °C/min
Exposure time t_1	3 h
Duration of exposure	5 cycles

Test procedure	Exposure time h	Duration of exposure	Operating temperature °C	Observations
Pre-conditioning	1	-	+22	-
Correct function	3	5	Min. -40 Max. 65	-

Observations

No degradation of performance observed during and after the test.

Requirement

- a dielectric voltage test shall be performed
- measurement of insulation resistance should be performed before and after climatic tests and before and after dielectric tests
- the visual and functional inspection shall not reveal any defects or malfunctions.
- the object shall comply with the required reliability class 2 of chapter 7.5.

Result

The object passed the test.

12.4.6 Damp-heat steady-state test

Standard and date

Standard	IEC 61850-3, subclause 6.9.3.6
Basic standard	IEC 60068-2-78
Test date	5 December 2018

Characteristic test data

Serial number	34606497
Type of test	Cab
Operating conditions	energized
Power supply	110 V
Relative humidity	93 %

Test procedure	Duration of exposure	Operating temperature °C	Humidity %	Observations
Powering up after	1 h	+40	93	-
Correct function	10 days	+40	93	-

Observations

No degradation of performance observed during and after the test.

Requirement

- a dielectric voltage test shall be performed
- measurement of insulation resistance should be performed before and after climatic tests and before and after dielectric tests
- a protective bonding resistance test shall be performed
- the visual and functional inspection shall not reveal any defects or malfunctions.
- the object shall comply with the required reliability class 2 of chapter 7.5.

Result

The object passed the test.

12.4.7 Damp heat cyclic (12 h + 12 h) test

Standard and date

Standard	IEC 61850-3, subclause 6.9.3.7
Basic standard	IEC 60068-2-30
Test date	3 January 2019

Characteristic test data

Serial number	34606497
Type of test	Db
Operating conditions	energized
Power supply	110 V

Test procedure	Duration of exposure h	Operating temperature °C	Humidity %	Observations
Pre-conditioning	1	25	93	-
Correct function	96	55 25	93 97	-

Observations

No degradation of performance observed during and after the test.

Requirement

- a dielectric voltage test shall be performed
- measurement of insulation resistance should be performed before and after climatic tests and before and after dielectric tests
- the visual and functional inspection shall not reveal any defects or malfunctions.
- the object shall comply with the required reliability class 2 of chapter 7.5.

Result

The object passed the test.

12.5 Dielectric voltage test after climate tests

Standard and date

Standard IEC 61850-3, subclause 6.6.4
Test date 1 December 2016 and 3 Jan 2019

Environmental conditions

Ambient temperature 20,1 °C Relative humidity 55 %
Ambient air pressure 1004 hPa

Characteristic test data

Serial number A160009583/34606497
Duration of test 1 min

Test arrangement		Insulation resistance at 500 Vdc (before the test)	Voltage applied	Insulation resistance at 500 Vdc (after the test)	Observations
Voltage applied to	Tested between	MΩ	kVac	MΩ	
Primary power supply BIU261 (slot A)	Earth and all others	> 550	2	> 550	No discharge No flashover
Secondary power supply BIU261 (slot A)	Earth and all others	> 550	2	> 550	No discharge No flashover
Binary output BIU261 (slot A)	Earth and all others	> 550	2	> 550	No discharge No flashover
LAN port CPU4 (slot B)	Earth and all others	> 550	0,5	> 550	No discharge No flashover
LAN port SRPv2 (slot C)	Earth and all others	> 550	0,5	> 550	No discharge No flashover
Analogue input AIU211 (slot D)	Earth and all others	> 550	2	> 550	No discharge No flashover
Digital output DOU201 (slot E)	Earth and all others	> 550	2	> 550	No discharge No flashover
Digital output/control unit CCU211 (slot F)	Earth and all others	> 550	2	> 550	No discharge No flashover
Analogue output AOU200 (slot G)	Earth and all others	> 550	2	> 550	No discharge No flashover
Digital input DIU211 (slot H)	Earth and all others	> 550	2	> 550	No discharge No flashover

Test arrangement		Insulation resistance at 500 Vdc	Voltage applied	Insulation resistance at 500 Vdc	Observations
Voltage applied to	Tested between	(before the test) MΩ	kVac	(after the test) MΩ	
Digital output HBU200 (slot M)	Earth and all others	> 550	2	> 550	No discharge No flashover
Analogue input TMU220 (slot N)	Earth and all others	> 550	2	> 550	No discharge No flashover
Analogue input TMU220 (slot O)	Earth and all others	> 550	2	> 550	No discharge No flashover
Analogue input TMU210 (slot O)	Earth and all others	> 550	2	> 550	No discharge No flashover
Digital input DIU221 (slot H)	Earth and all others	> 550	2	> 550	No discharge No flashover

Requirement

The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

12.6 Protective bonding resistance test after damp-heat environmental test

Standard and date

Standard IEC 61850-3, subclause 6.9.2.4
Test date 1 December 2016

Characteristic test data

Serial number A160009583
Test current 10 A
Test voltage ≤ 12 Vdc
Duration of test 60 S

Test point	Terminal	Resistance Ω
Upper mounting flag screw on most right side	Earth	0,022
Right under PE fixing screw close to slot A	Earth	0,0075
Right front, middle screw	Earth	0,0024
Rear, top of rack	Earth	0,031

Requirement

- the resistance between the protective conductor terminal and the part under test shall not exceed 0,1 Ω
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

13 MECHANICAL ENVIRONMENTAL CONDITION TESTS

13.1 Inspection

13.1.1 Pre-inspection

The pre-inspection is performed to verify that the test object is in operational state. The pre-inspection is carried out prior to the test procedure.

The communication with the maintenance computer is verified. Signals are simulated to verify the functioning and operation with the specified performance specification for the following inputs and outputs:

- analogue inputs
- digital inputs
- analogue inputs
- contact outputs
- data communication.

13.1.2 Visual and functional inspection

After each test a visual and functional inspection is carried out as described in this chapter.

The visual inspection is carried out to verify that there is no visual mechanical damage.
There shall be no:

- burning of any components
- paint blisters on any components
- discolouration on components
- deformation of modules or components
- interruptions or damage on interconnecting cables, wires and connectors.

Functional inspection is carried out to verify the correct operation of the test object.
There shall be no:

- alarm indications on display and LED’s
- error messages reported in the maintenance computer
- unintentional change of contact outputs
- there shall be no degradation of performance below the claimed performance according reliability class (1 or 2).

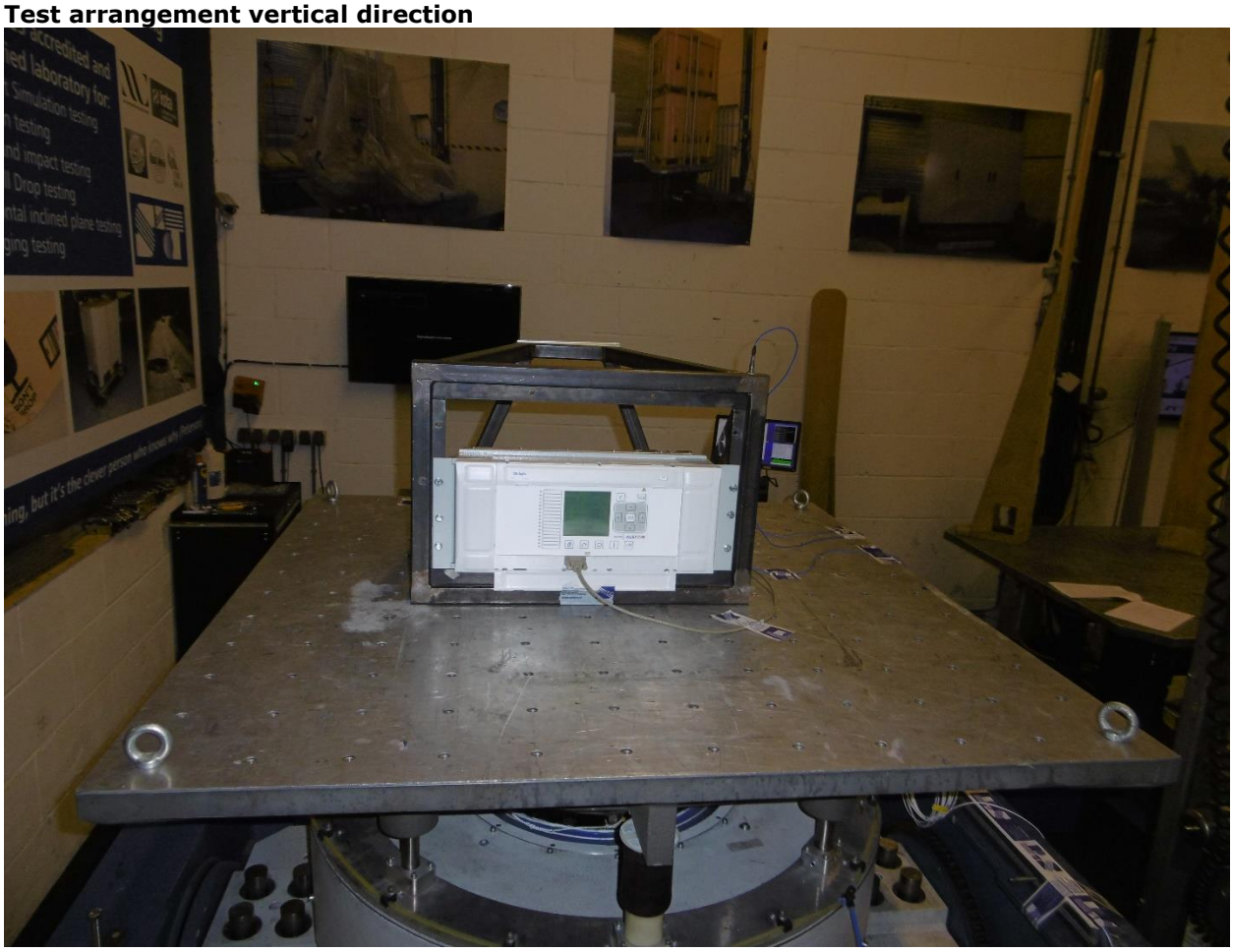
Unless otherwise stated the visual and functional inspection was carried out successfully after each test.

13.2 Photographs of test arrangement

Test arrangement horizontal longitudinal direction

Test arrangement horizontal transversal direction

Test arrangement vertical direction



13.3 Vibration response test

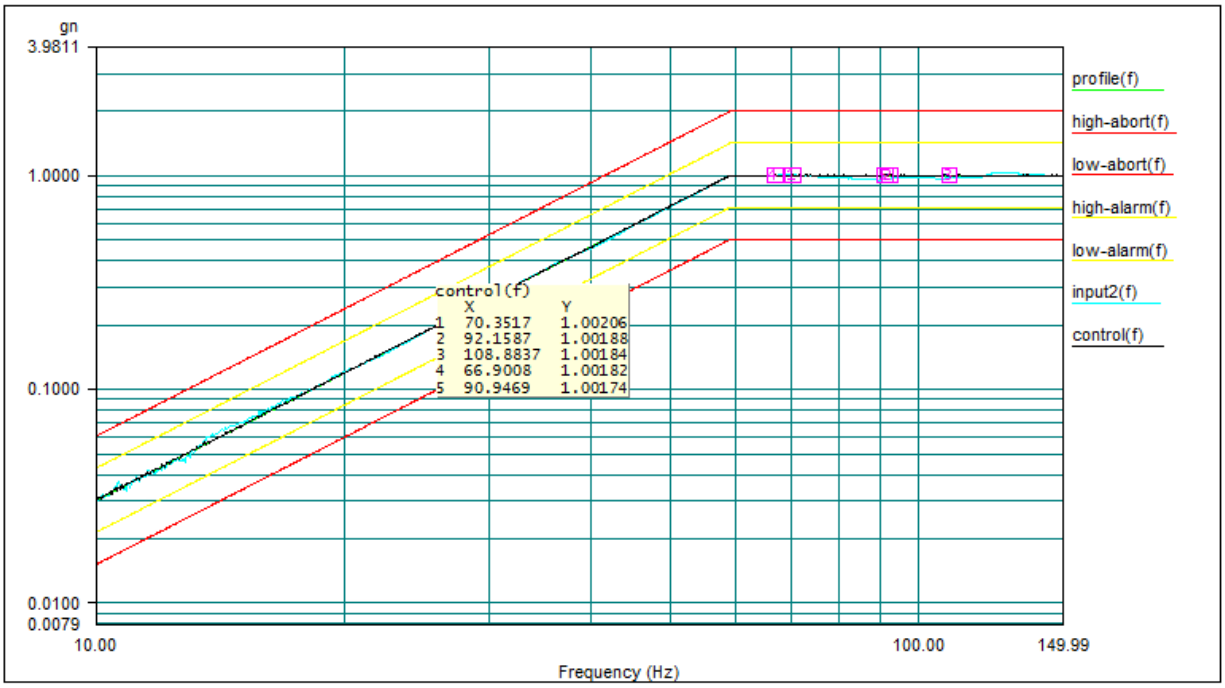
Standard and date

Standard	IEC 61850-3, subclause 6.10.1
Basic standard	IEC 60255-21-1
Test date	17 January 2019

Characteristic test data

Serial number	2070643 With TMU210-A02 0.05A
Test object	energized
Auxiliary power supply input	110 Vdc
Frequency range	10 to 150 Hz
Displacement	0,075 mm
Acceleration	1,0 g
Number of sweep cycles in each axis	1
Number of axis	3

Vibration response test



Observations

- during and after the test, the test object was functional.
- no visual damage or functional errors have been found on the test object.

Requirement

- The object shall be subjected to the class 1 or class 2 vibration response test parameters (Table 1) of IEC 60255-21-1
- the visual and functional inspection shall not reveal any defects or malfunctions.
- the object shall comply with the required reliability class 2 of chapter 7.5.

Result

The object passed the test.

13.4 Vibration endurance test

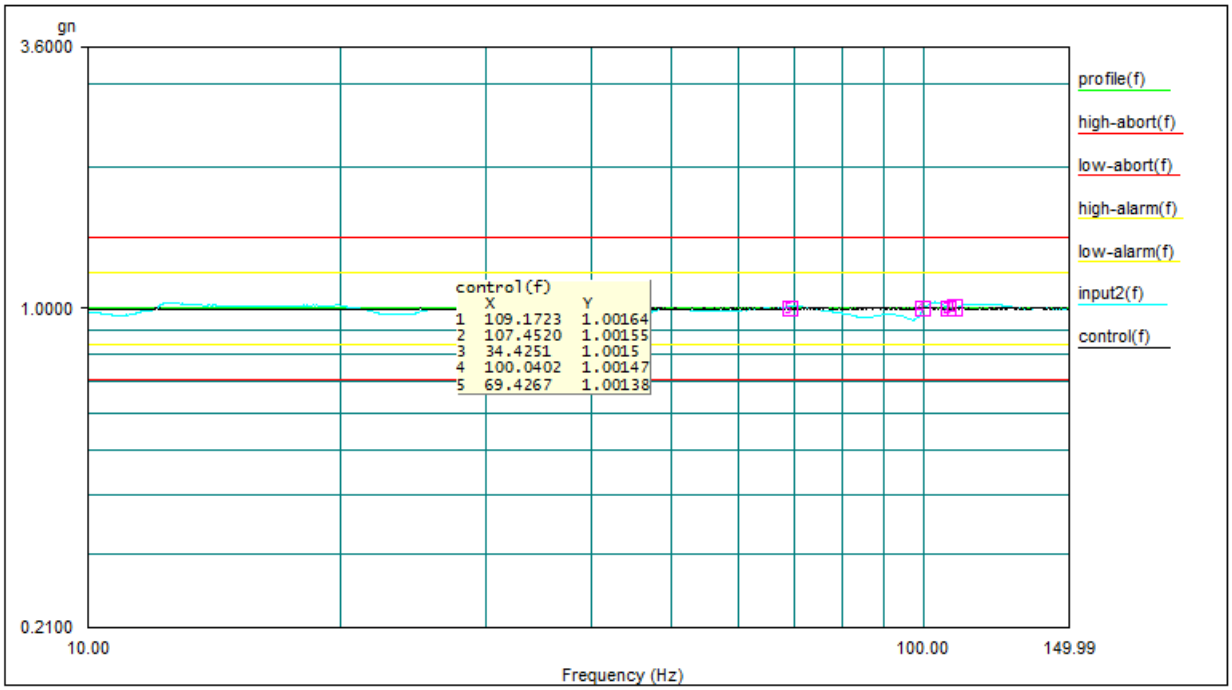
Standard and date

Standard	IEC 61850-3, subclause 6.10.1
Basic standard	IEC 60255-21-1
Test date	17 January 2019

Characteristic test data

Serial number	2070643 With TMU210-A02 0.05A
Test object	non-energized
Frequency range	10 to 150 Hz
Acceleration	1 g
Number of sweep cycles in each axis	20
Number of axis	3

Vibration endurance test



Observation

No visual damage or functional errors have been found on the test object.

Requirement

- The object shall be subjected to the class 1 or 2 of the vibration endurance test parameters (Table 2) of IEC 60255-21-1
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

13.5 Shock response test

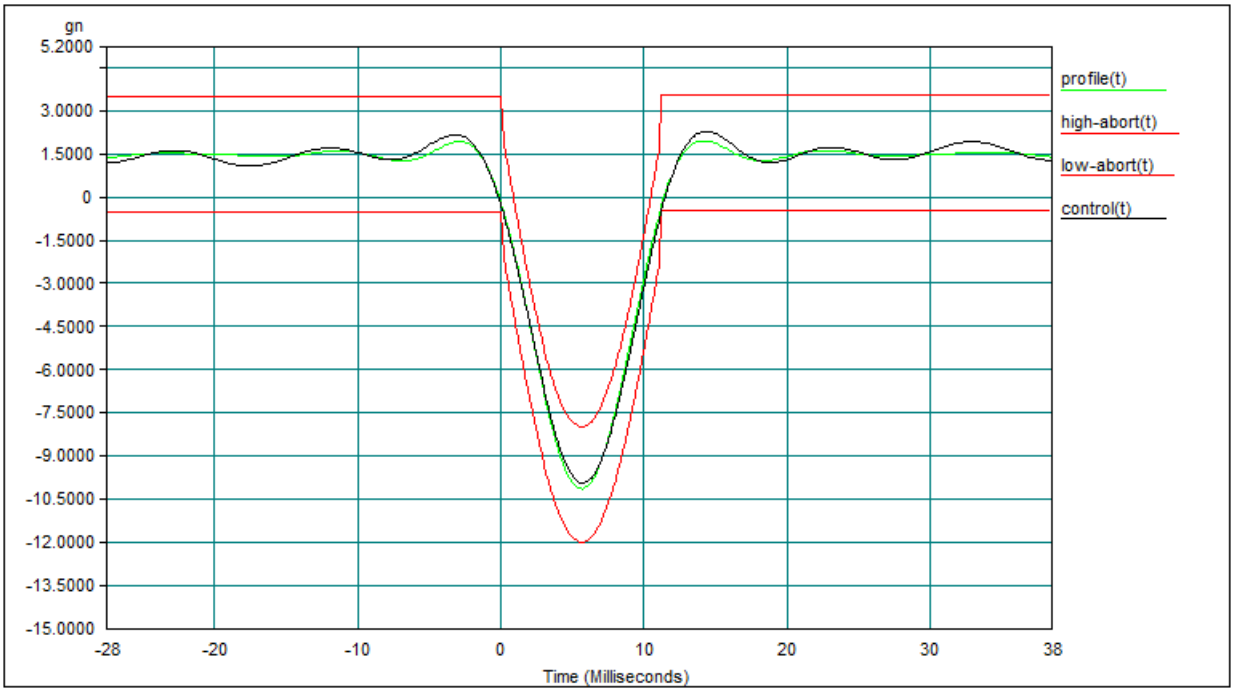
Standard and date

Standard	IEC 61850-3, subclause 6.10.2
Basic standard	IEC 60255-21-2
Test date	17 January 2019

Characteristic test data

Serial number	2070643 With TMU210-A02 0.05A
Test object	energized
Power supply	110 Vdc
Acceleration	10 g
Duration of pulses	11 ms
Number of pulses in each axis	6
Number of axis	3

Shock response test



Observations

- during and after the test, the test object was functional.
- no visual damage or functional errors have been found on the test object.

Requirement

- the object shall be subjected to the class 1 or 2 of the shock response test parameters (Table I) of IEC 60255-21-2
- the visual and functional inspection shall not reveal any defects or malfunctions.
- the object shall comply with the required reliability class 2 of chapter 7.5.

Result

The object passed the test.

13.6 Shock withstand test

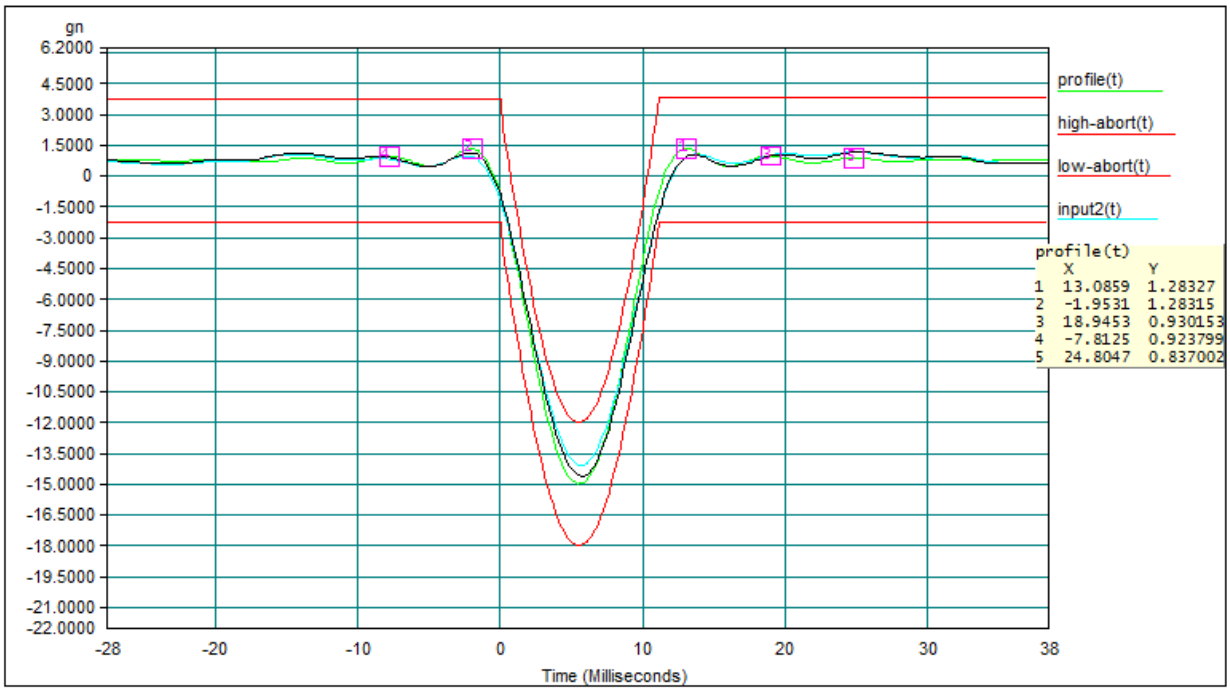
Standard and date

Standard	IEC 61850-3, subclause 6.10.2
Basic standard	IEC 60255-21-2
Test date	17 January 2019

Characteristic test data

Serial number	2070643 With TMU210-A02 0.05A
Test object	non-energized
Acceleration	15 g
Duration of pulses	11 ms
Number of pulses in each axis	6
Number of axis	3

Shock withstand test



Observation

No visual damage or functional errors have been found on the test object.

Requirement

- The object shall be subjected to the class 1 or 2 of the shock withstand test parameters (Table II) of IEC 60255-21-2
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

13.7 Bump test

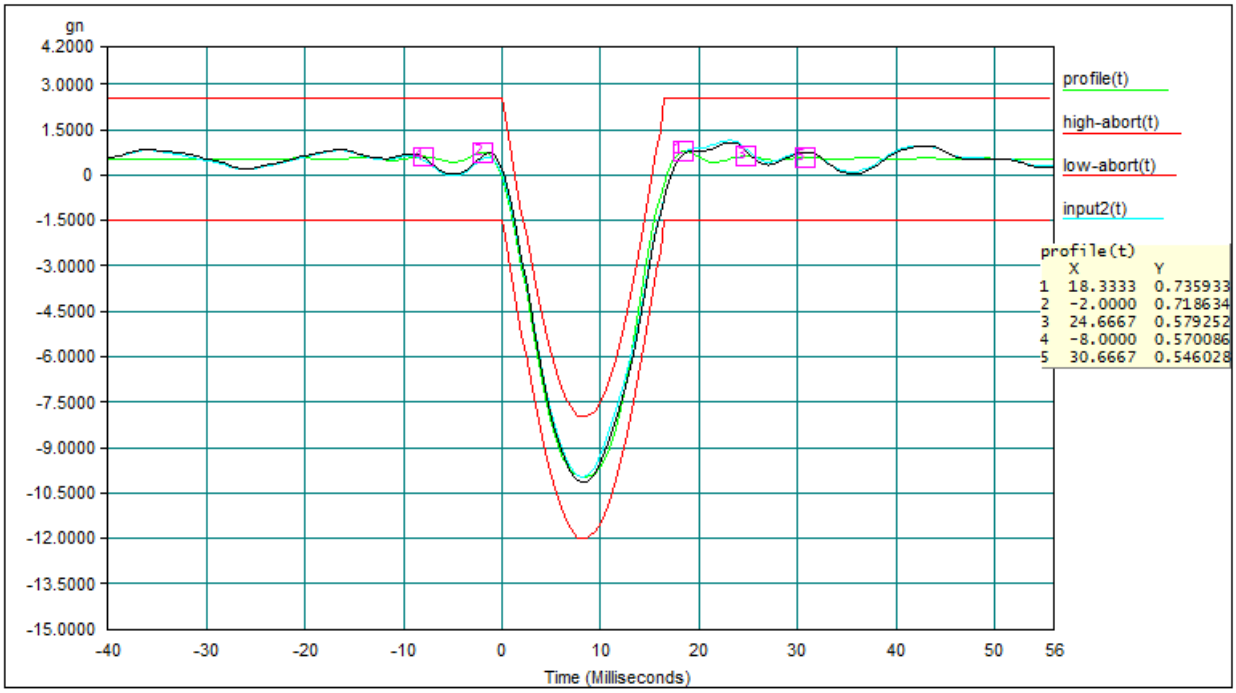
Standard and date

Standard	IEC 61850-3, subclause 6.10.2
Basic standard	IEC 60255-21-2
Test date	17 January 2019

Characteristic test data

Serial number	2070643 With TMU210-A02 0.05A
Test object	non-energized
Acceleration	10 g
Duration of pulses	16 ms
Number of pulses in each axis	2000
Number of axis	3

Bump test



Observation

No visual damage or functional errors have been found on the test object.

Requirement

- The object shall be subjected to the class 1 or 2 of the bump test parameters (Table III) of IEC 60255-21-2
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

13.8 Single axis sine sweep seismic test

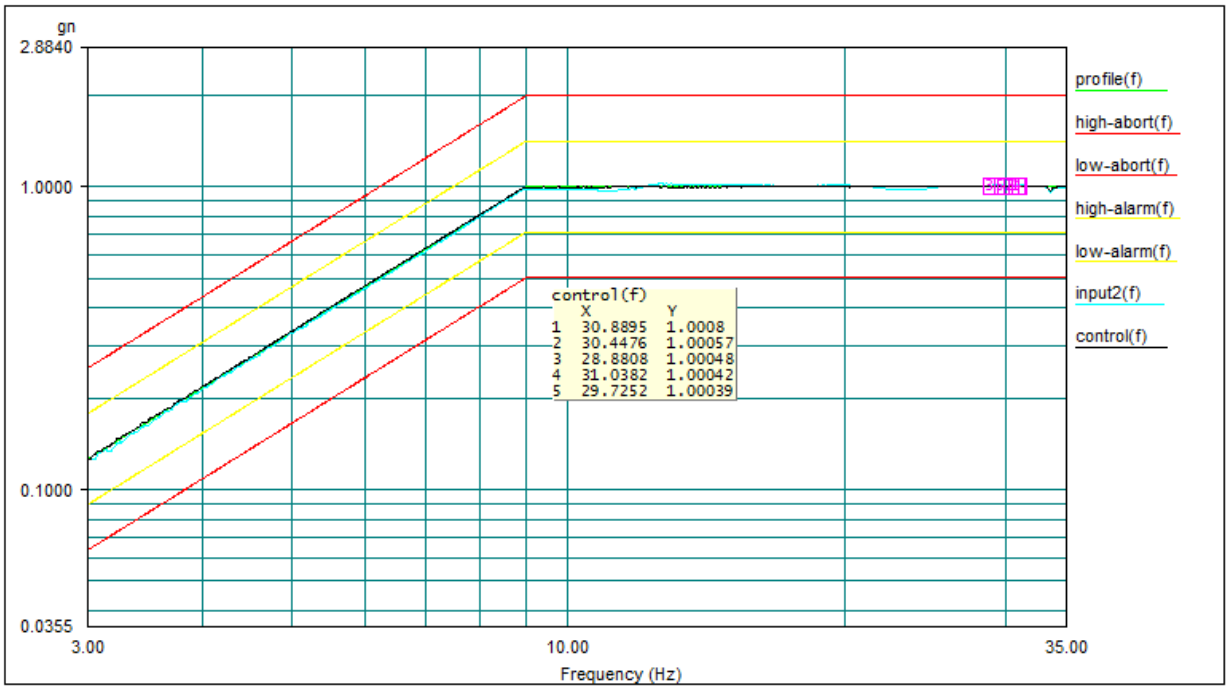
Standard and date

Standard	IEC 61850-3, subclause 6.10.3
Basic standard	IEC 60255-21-2
Test date	17 January 2019

Characteristic test data

Serial number	2070643 With TMU210-A02 0.05A
Test object	energized
Power supply input	110 Vac/Vdc
Frequency range	1 to 35 Hz
Cross-over frequency	8 to 9 Hz
Displacement horizontal axis (x)	7,5 mm
Displacement vertical axis (y)	3,5 mm
Acceleration horizontal axis (x)	2,0 g
Acceleration vertical axis (y)	1,0 g
Number of sweep cycles in each axis	1
Number of axis	3

Single axis sine sweep seismic test (vertical)



Observation

No visual damage or functional errors have been found on the test object.

Requirement

- the object shall be subjected to the class 1 or 2 of the seismic vibration test parameters (Table I) of IEC 60255-21-3
- the visual and functional inspection shall not reveal any defects or malfunctions.
- the object shall comply with the required reliability class 2 of chapter 7.5.

Result

The object passed the test.

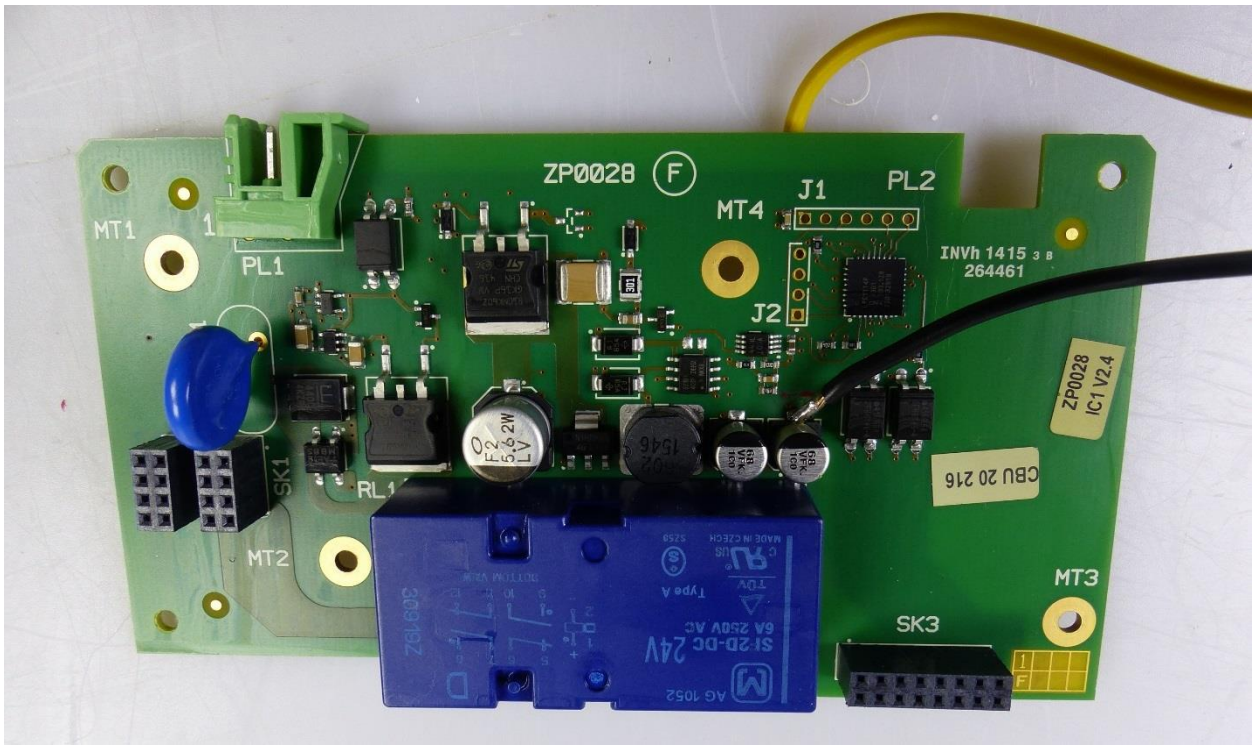
14 ENCLOSURE PROTECTION

Standard and date

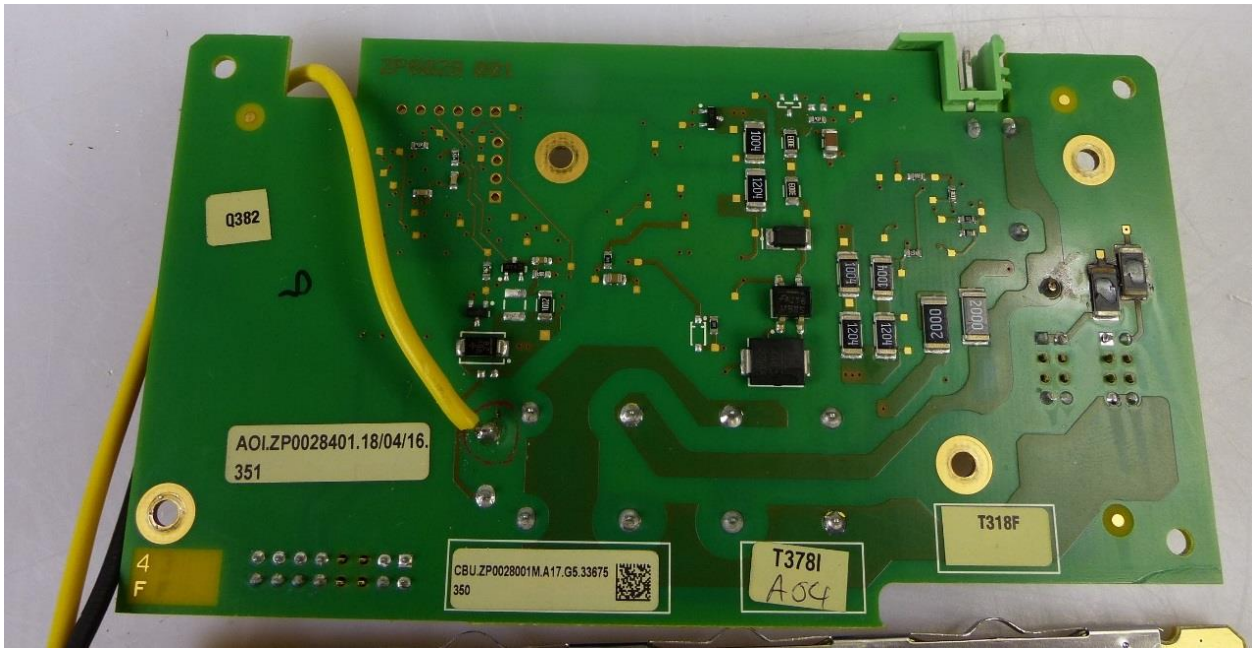
Standard IEC 61850, subclause 6.11
Basic standard IEC 60529
Test date 1 November 2016

Terminal side	Degree of protection	
	Specification by the manufacturer	Observation
Front	IP 2x	IP 2x
Top	IP 2x	IP 2x
Bottom	IP 2x	IP 2x
Back	IP 2x	IP 2x
Back (TMU220)	IP 1x	IP 1x
Left	IP 2x	IP 2x
Right	IP 2x	IP 2x

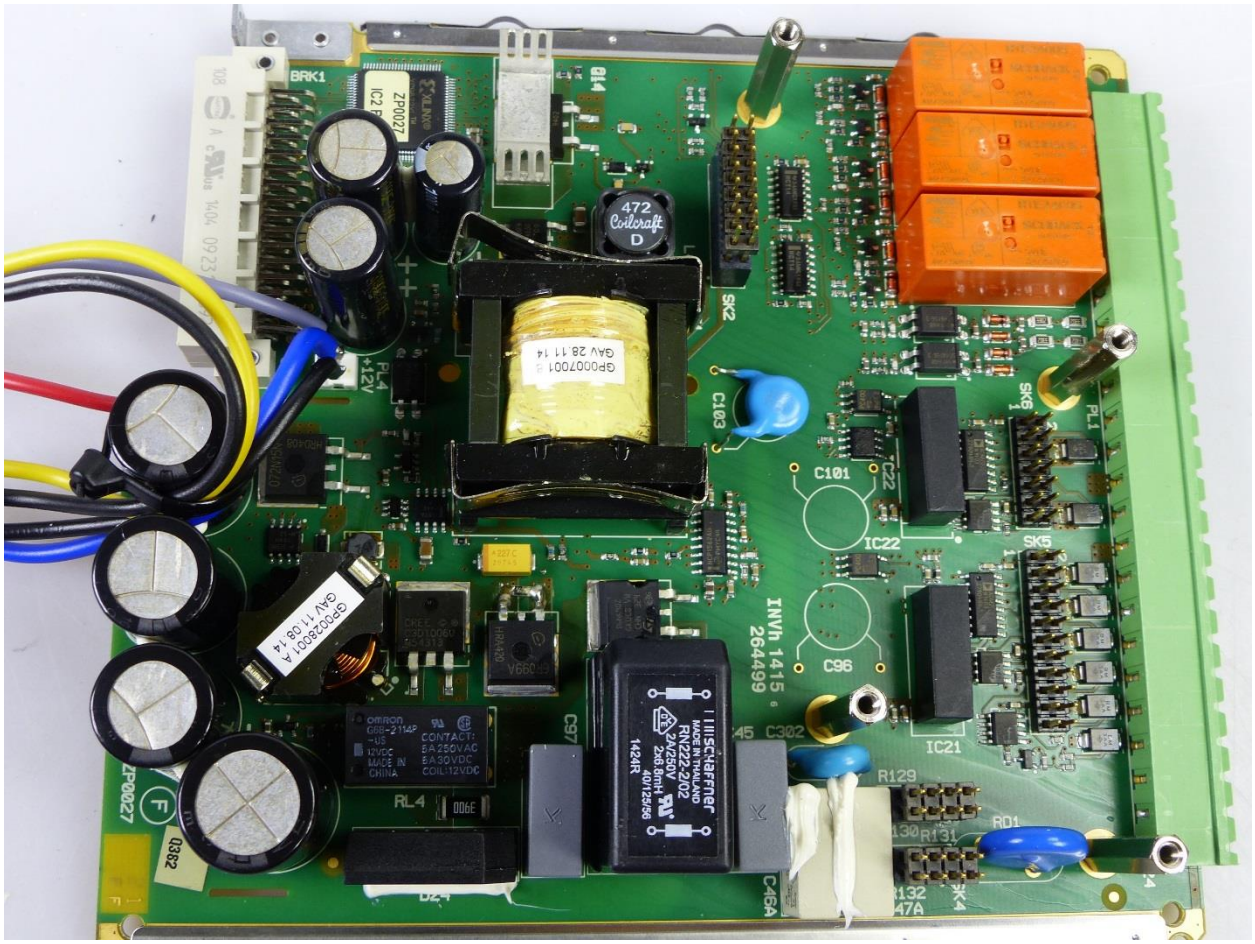
15 PHOTOGRAPHS OF PRINTBOARDS



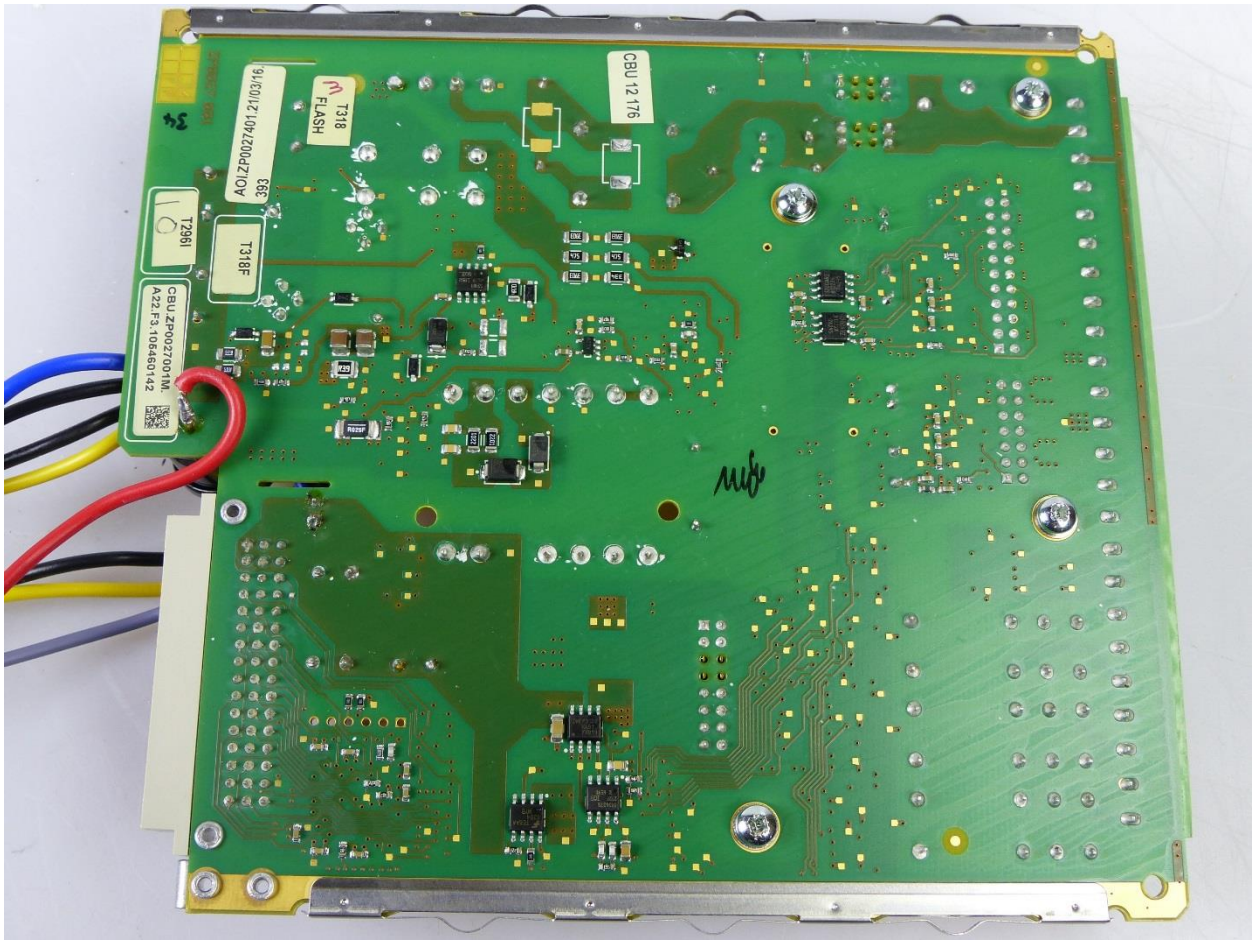
BIU 261D daughter board (top view). Secondary power supply input, power redundancy relay, 24 Vdc power supply



BIU 261D daughter board (bottom view). Secondary power supply input, power redundancy relay, 24 Vdc power supply

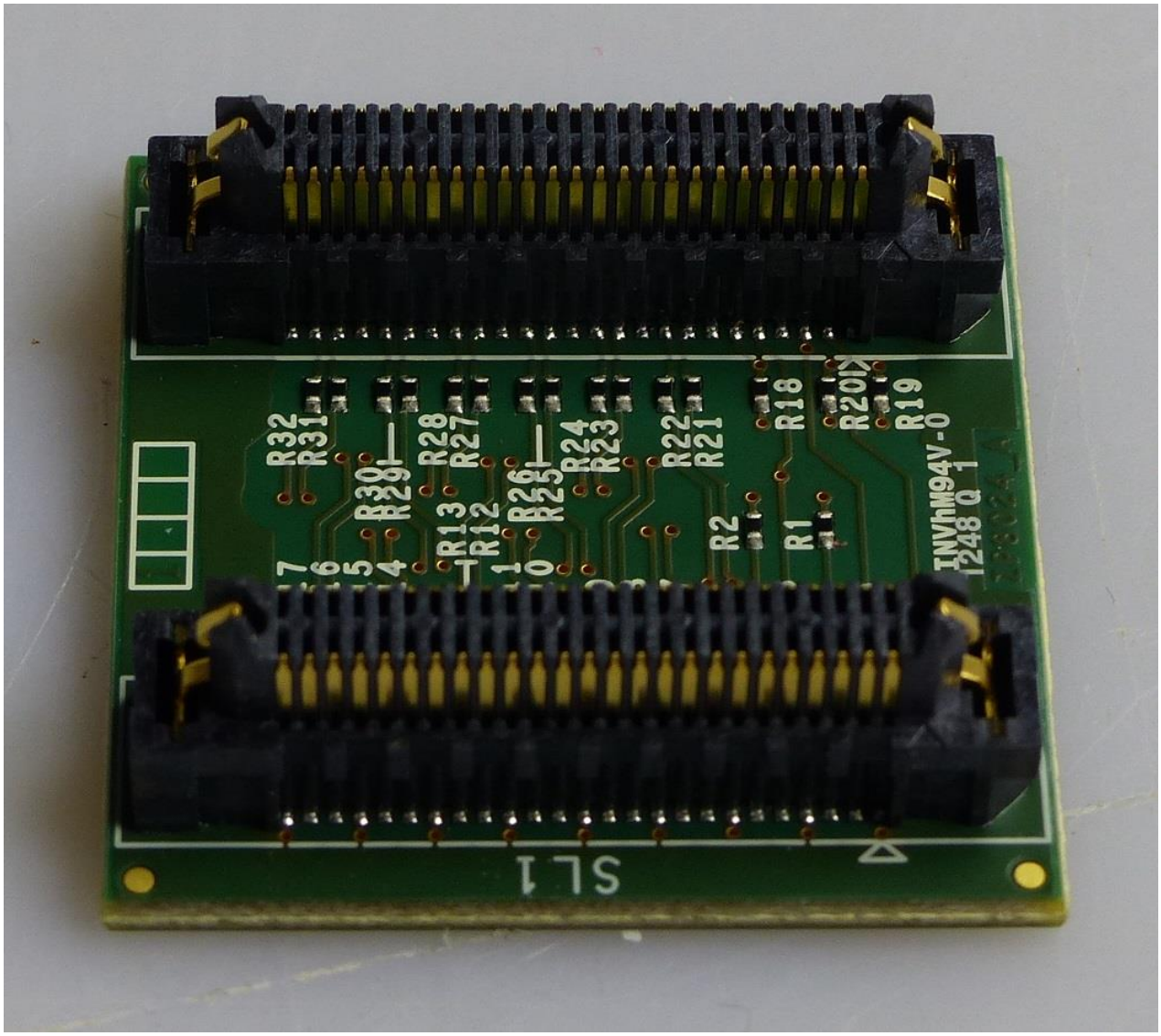


Slot A (top view)
BIU261D primary power supply, 55 Vdc, 12 Vdc, 5 Vdc
Watchdog relay
2 outputs, NO and 2 inputs for redundancy
2 isolated interfaces (port 1: RS232 or RS485, port 2: RS232, RS422 or RS485)



Slot A (bottom view)
BIU261D primary power supply, 55 Vdc, 12 Vdc, 5 Vdc
Watchdog relay
2 outputs, NO and 2 inputs for redundancy
2 isolated interfaces (port 1: RS232 or RS485, port 2: RS232, RS422 or RS485)

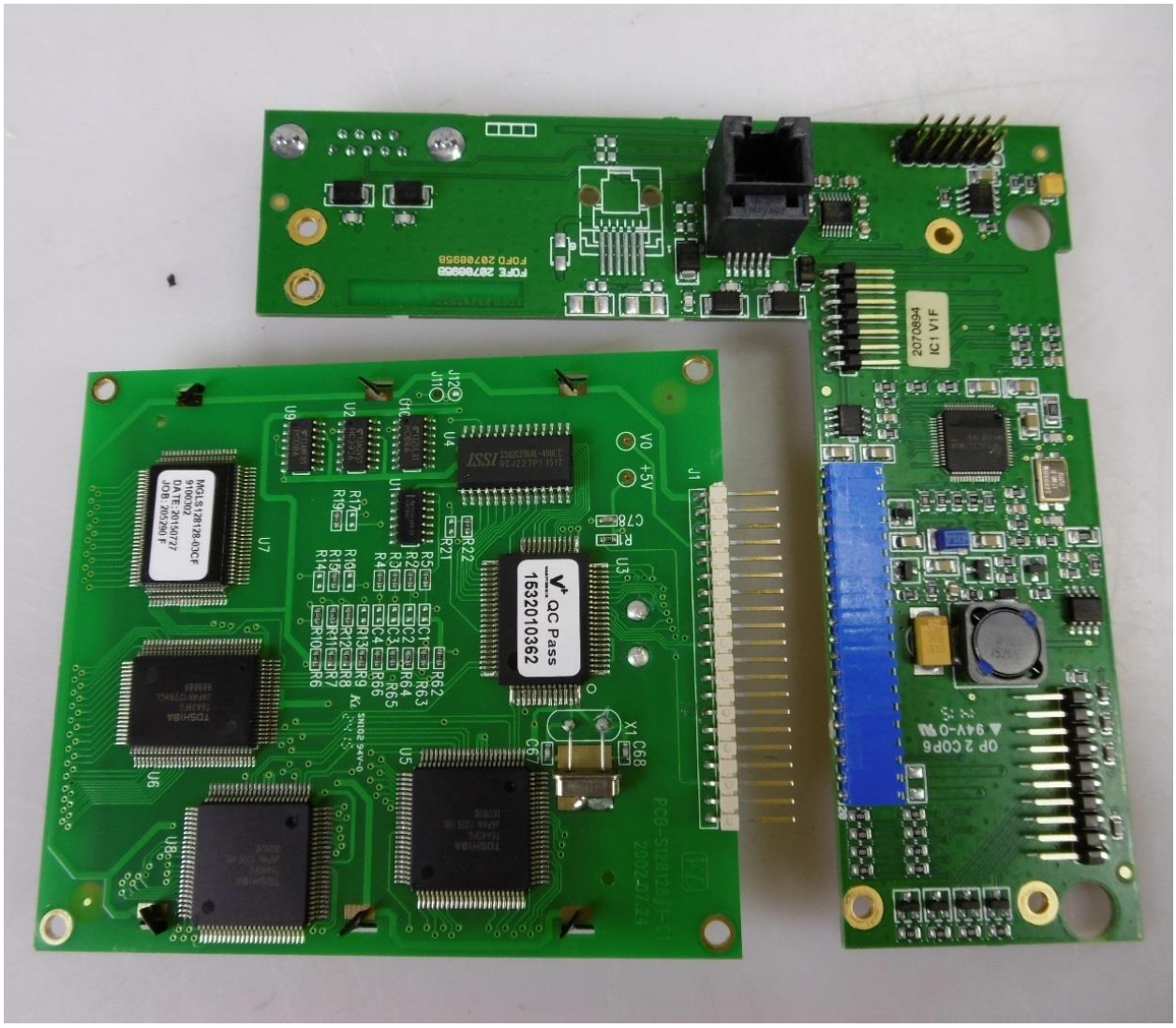
Connector board (bottom view)



Connector board (top view)

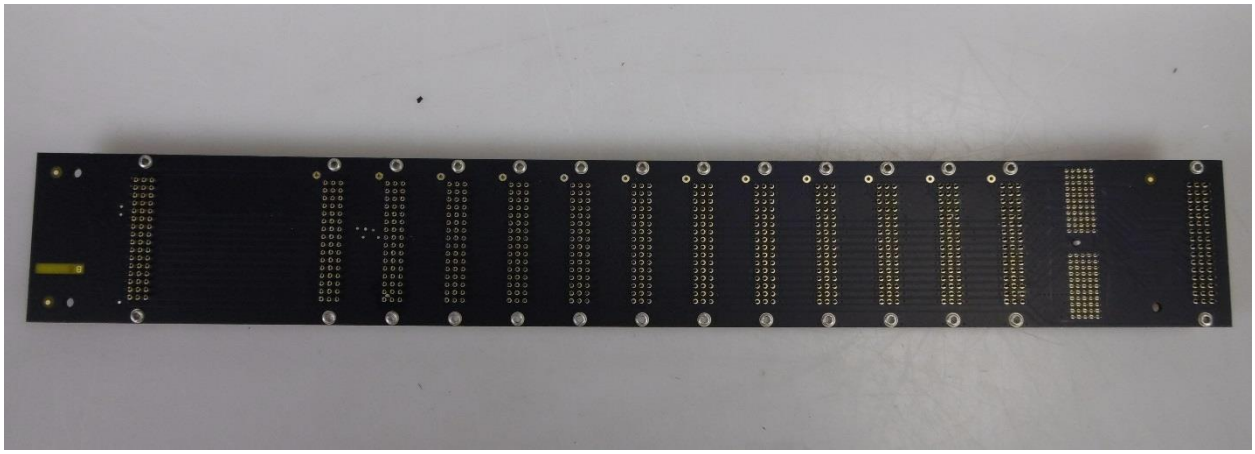
Slot B (bottom view)
Processor board CPU4, ZP0016001.B0.J.161113

Slot B (top view)
Processor board CPU4, ZP0016001.B0.J.161113

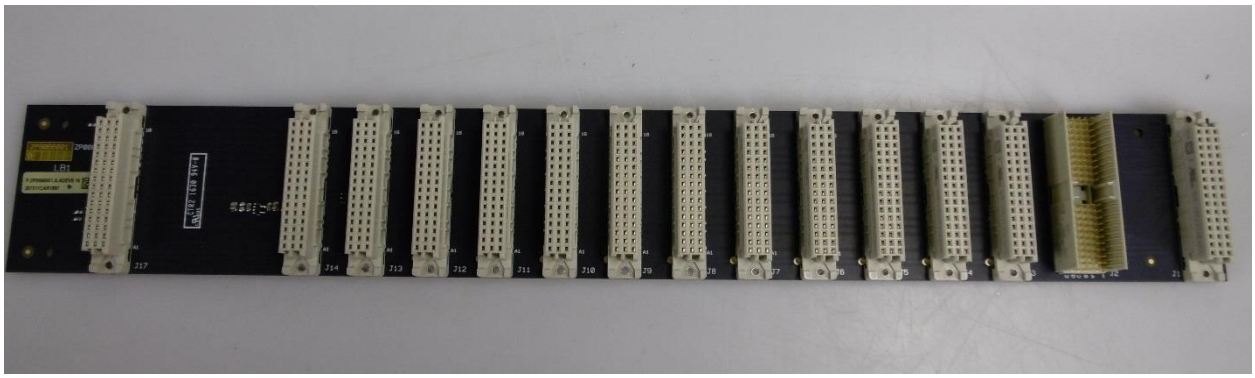


Display board and display/keyboard interface board (bottom view)

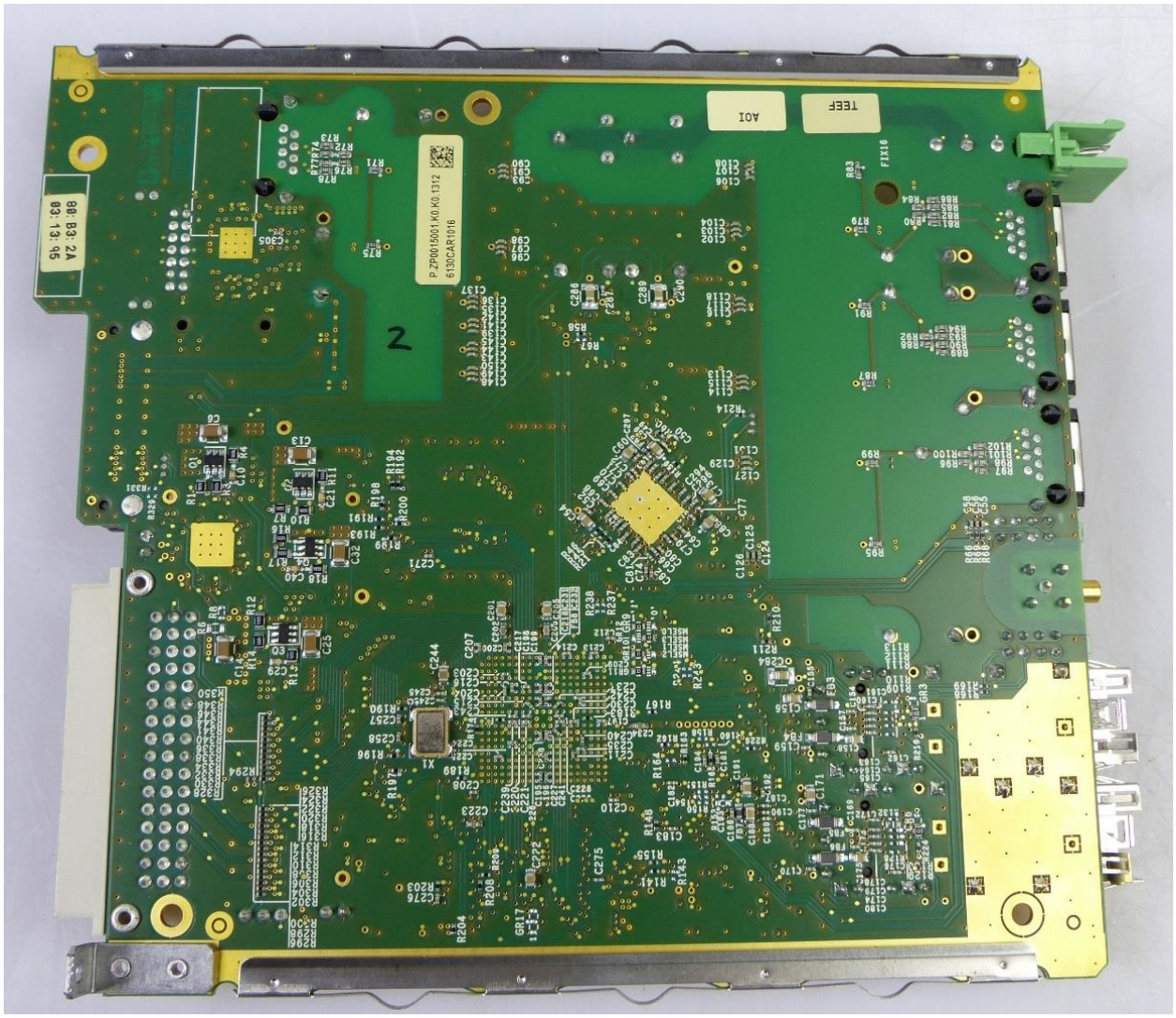
Display board and display/keyboard interface board (top view)



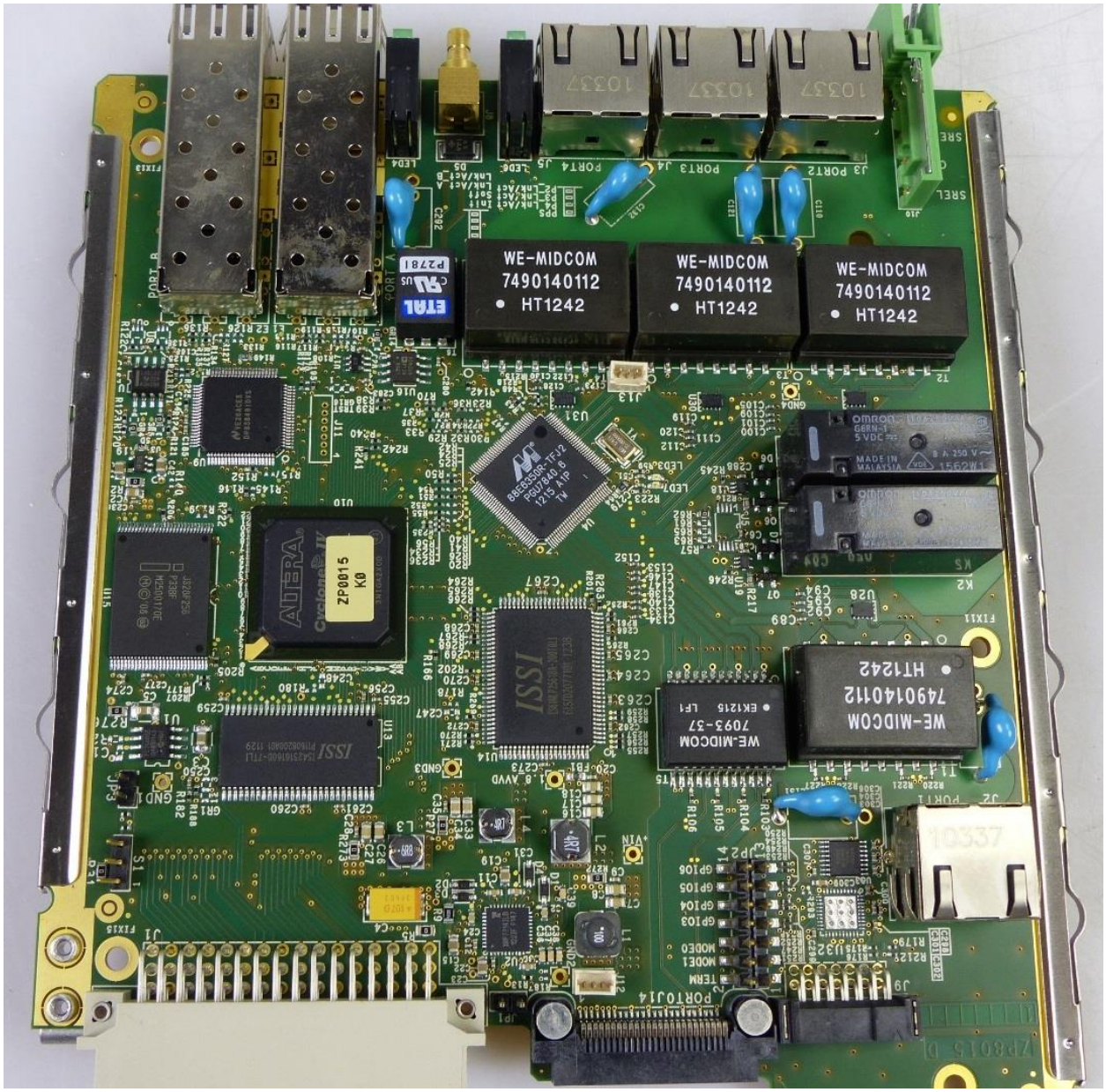
Interconnection backplane (bottom view)



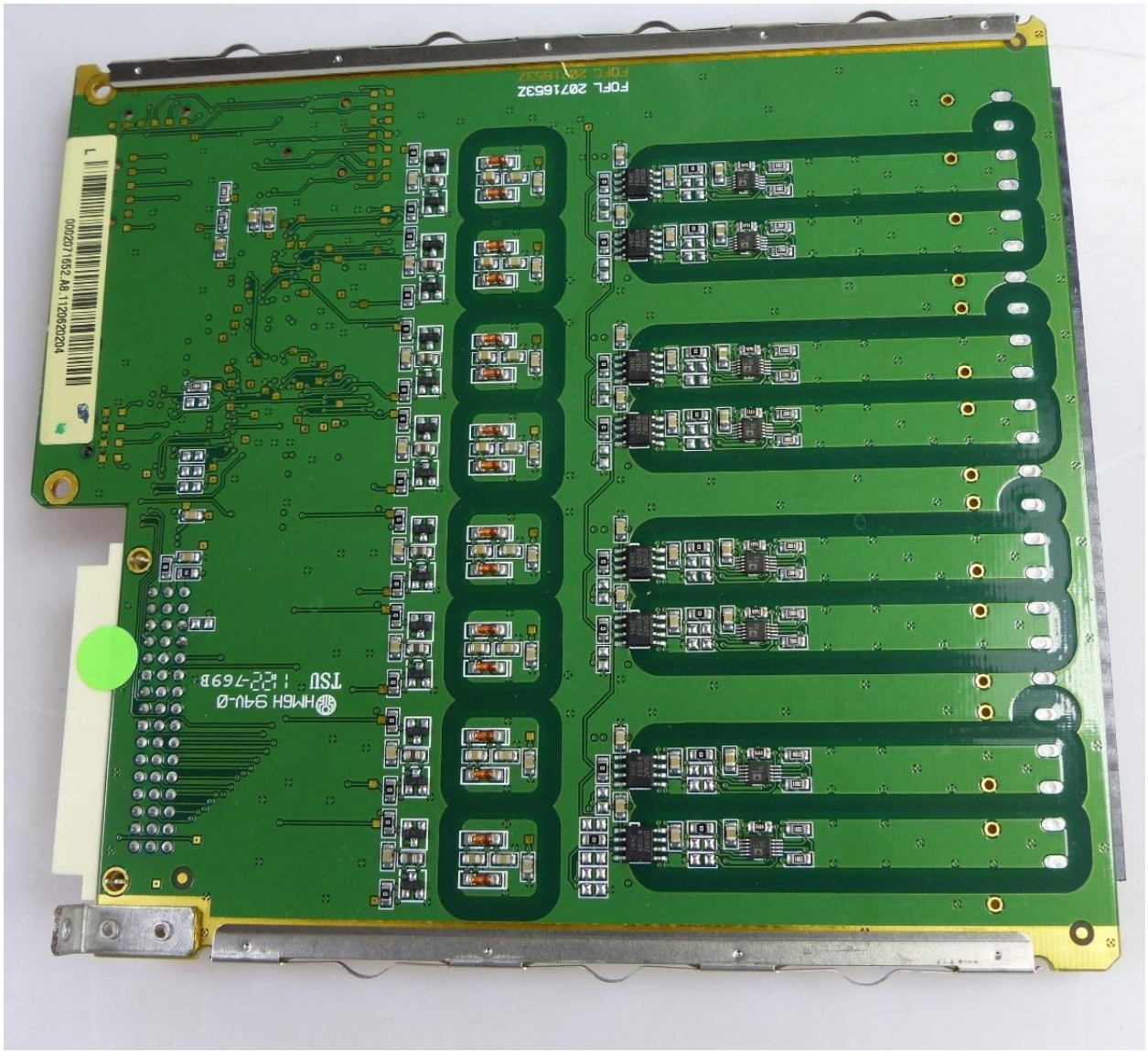
Interconnection backplane (top view)



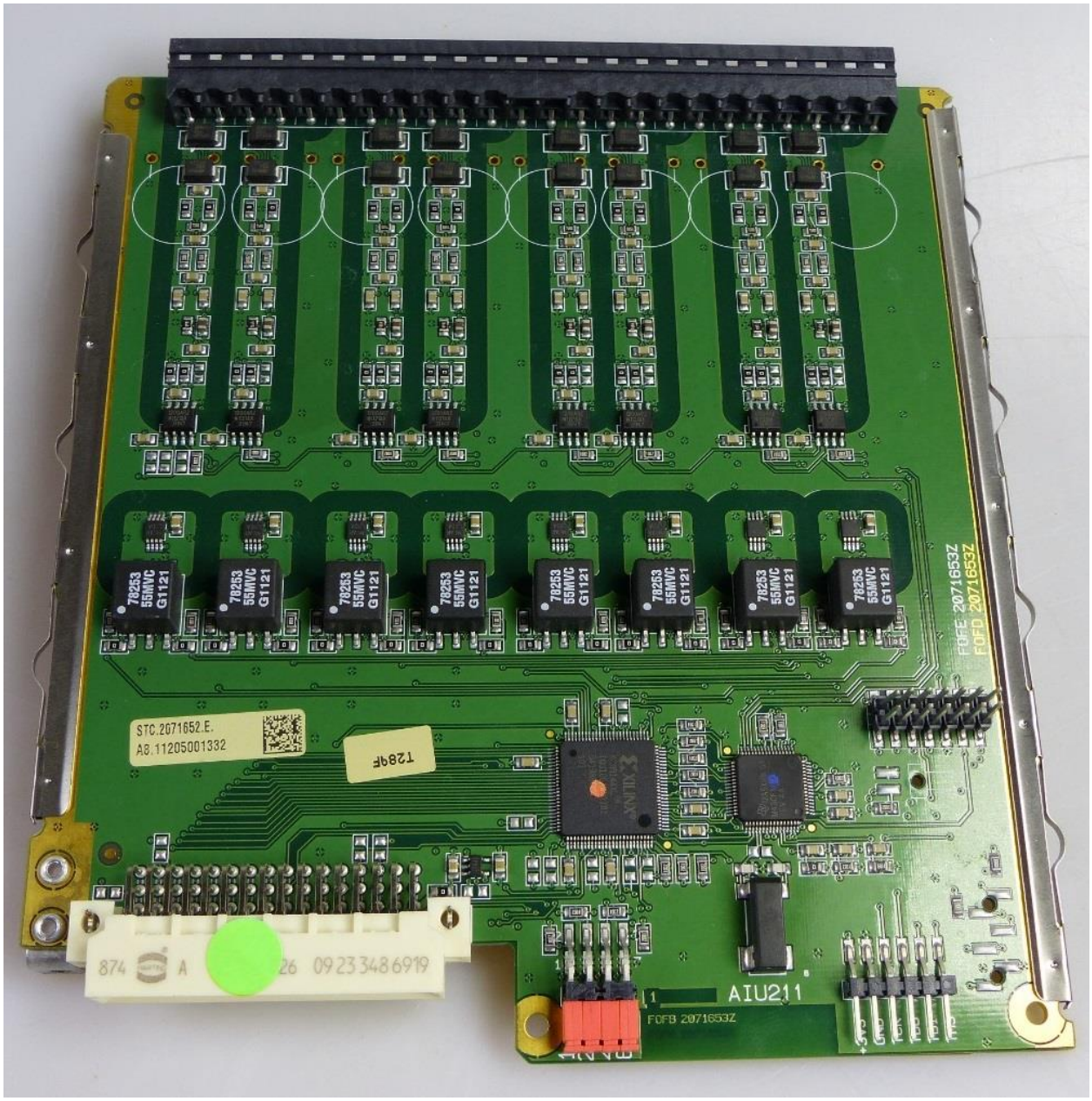
Slot C (bottom view)
Switch board ZP0016001.B0.J.161113



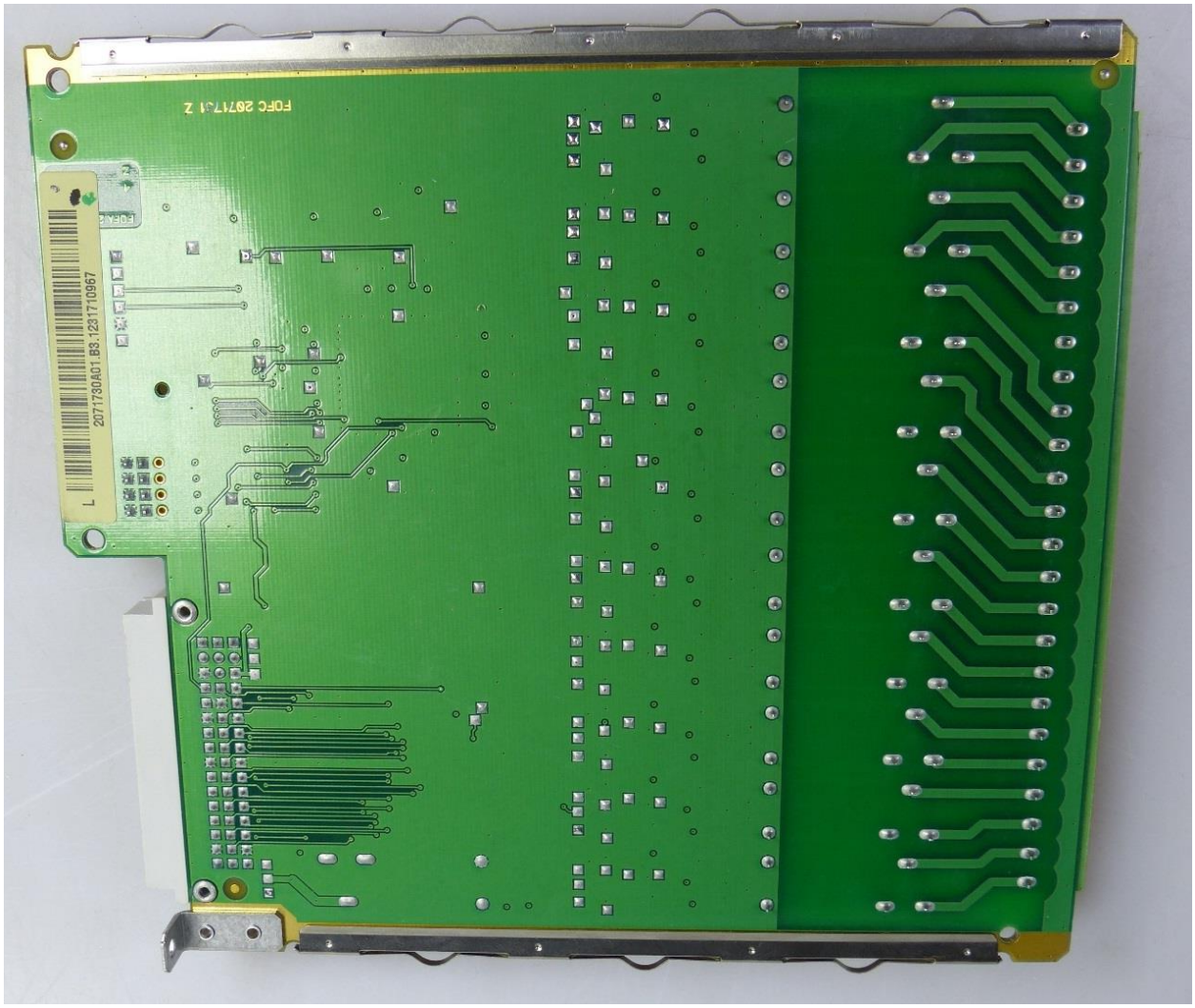
Slot C (top view)
Switch board ZP0016001.B0.J.161113



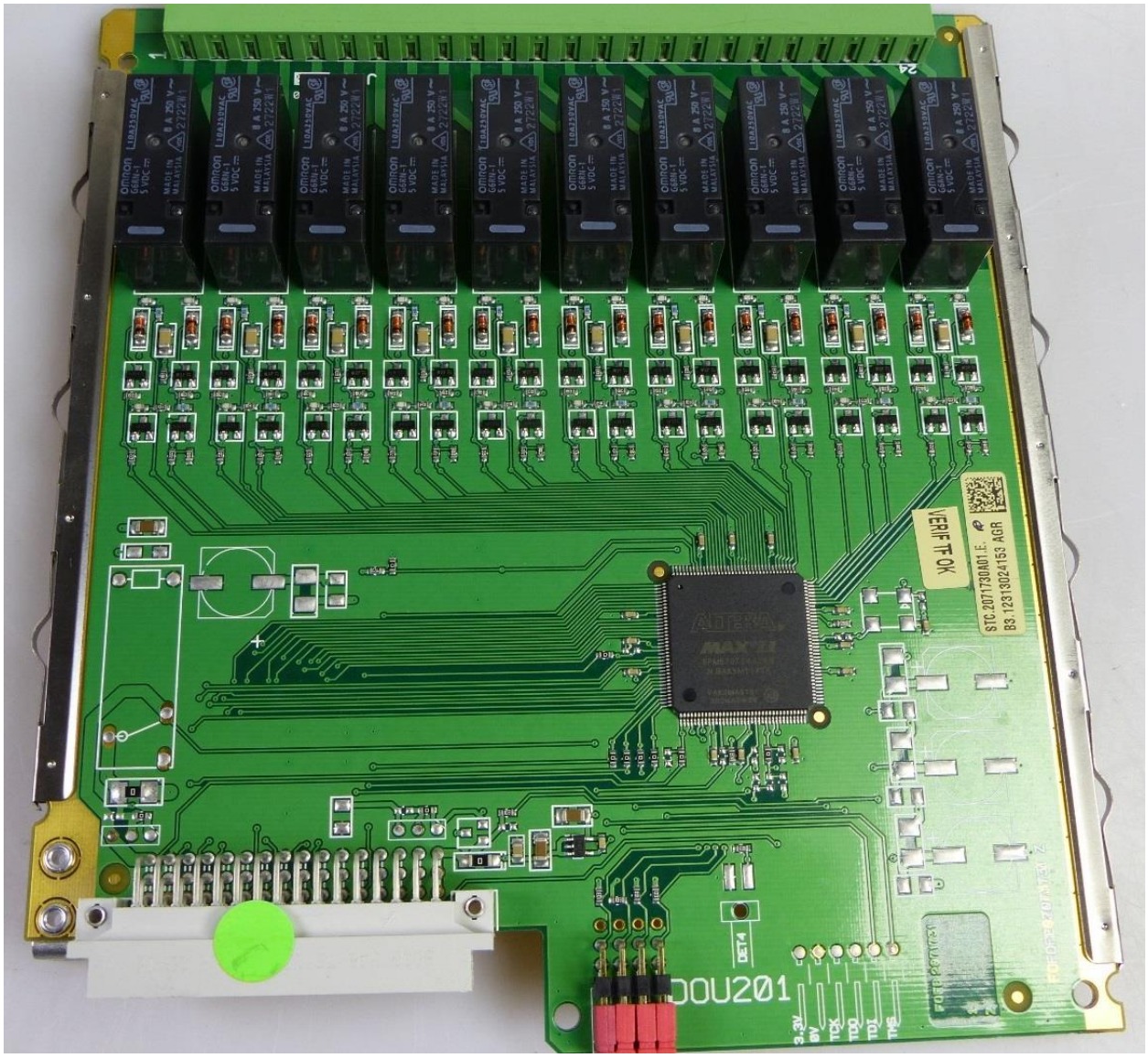
Slot D (bottom view)
(DIU211) 16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



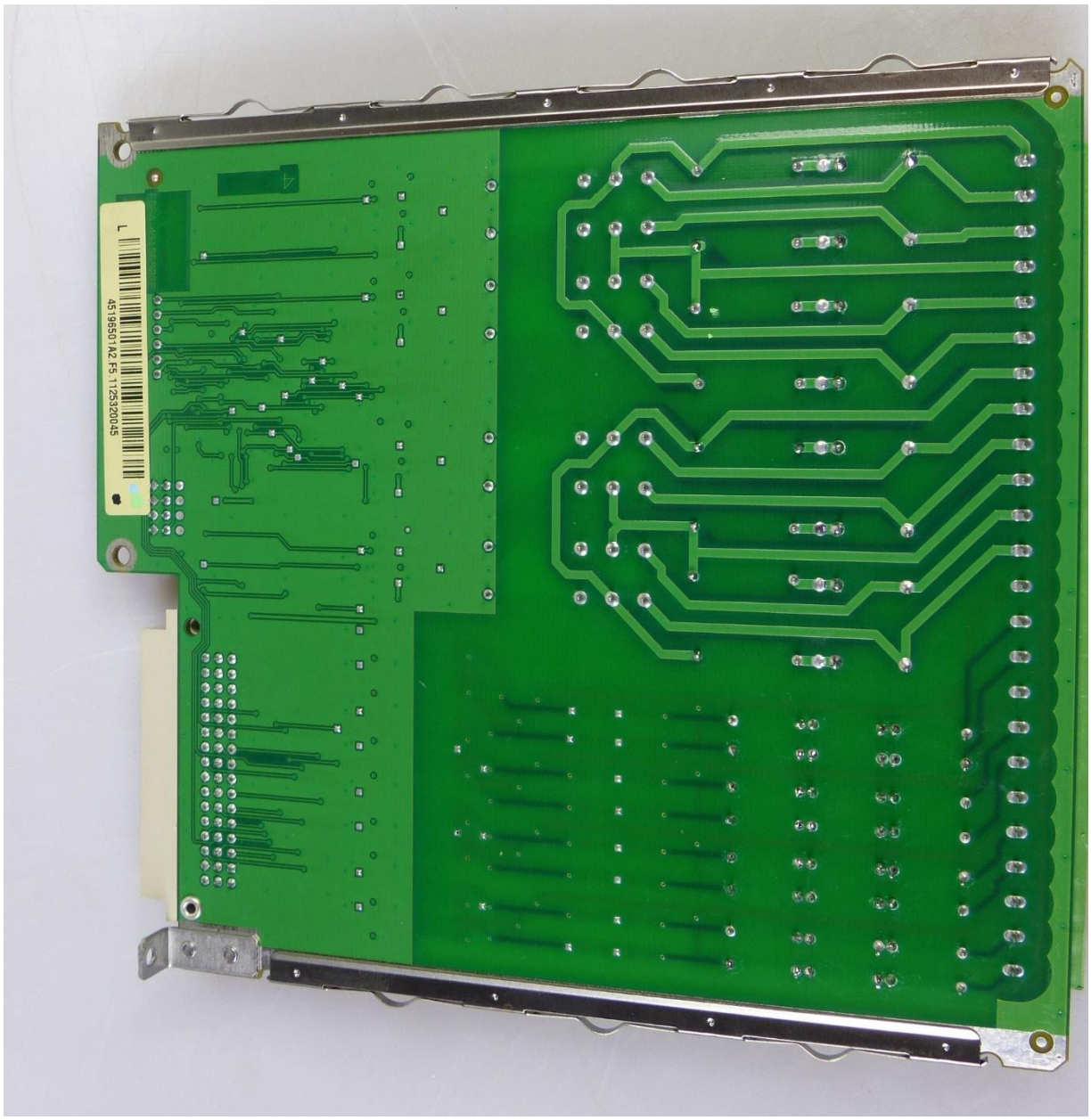
Slot D (top view)
(DIU211) 16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



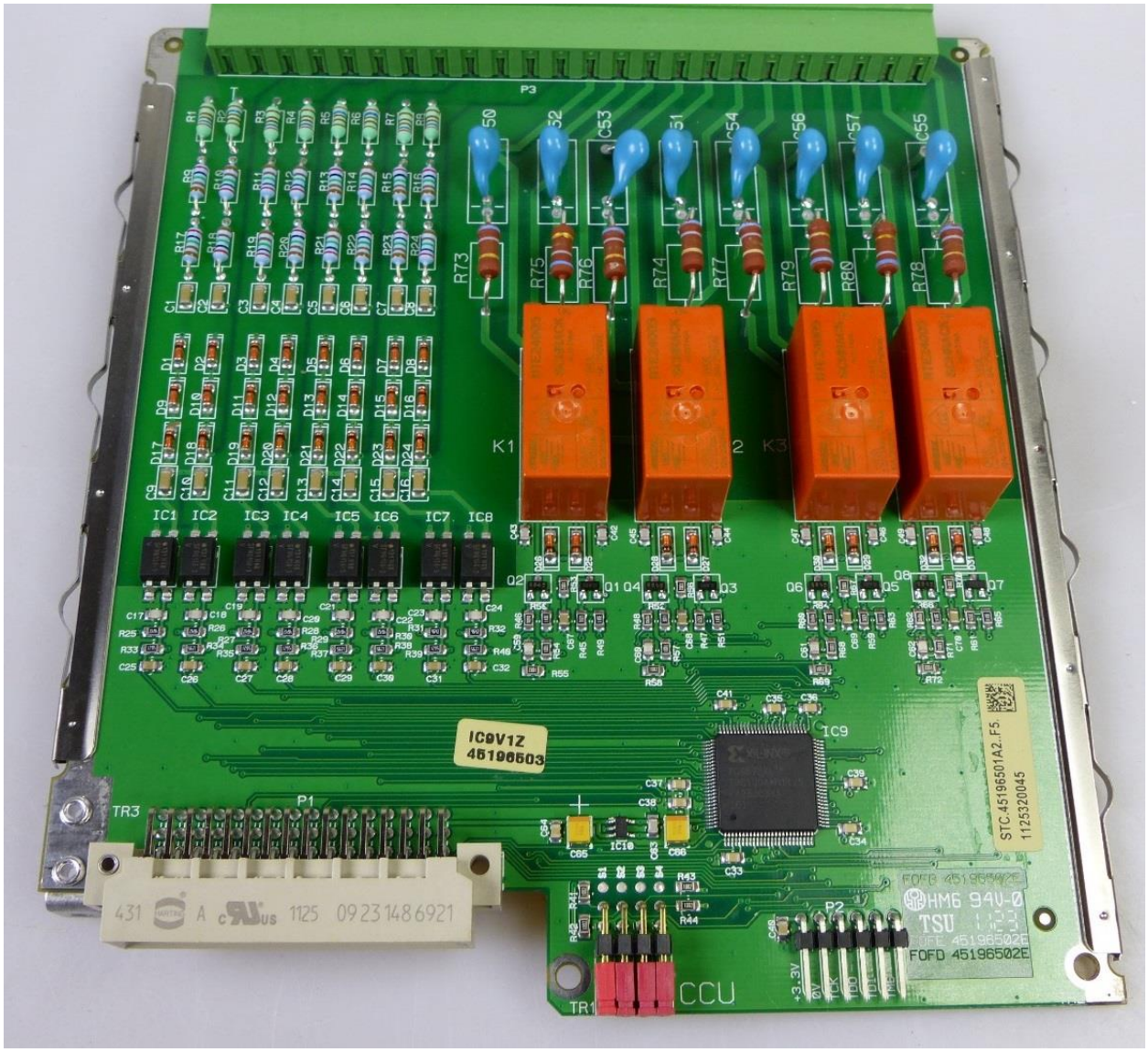
Slot E (bottom view)
(DOU201) Digital outputs unit
8 SP relays with one NO contact
2 DP relays with one NO/NC contact
Nominal voltage range; 24 Vdc to 250 Vdc / 230 Vac



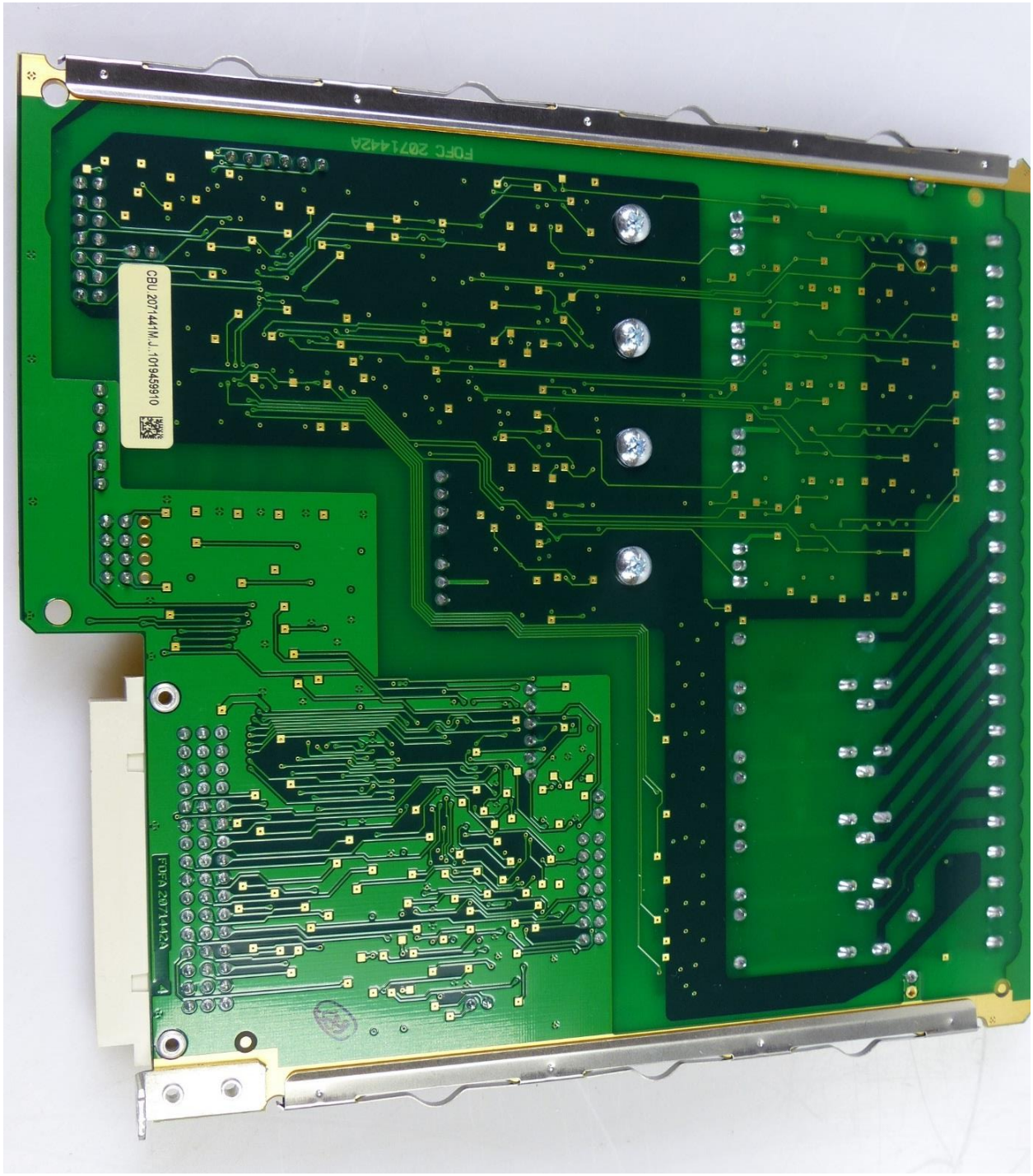
Slot E (top view)
(DOU201) Digital outputs unit
8 SP relays with one NO contact
2 DP relays with one NO/NC contact
Nominal voltage range; 24 Vdc to 250 Vdc / 230 Vac



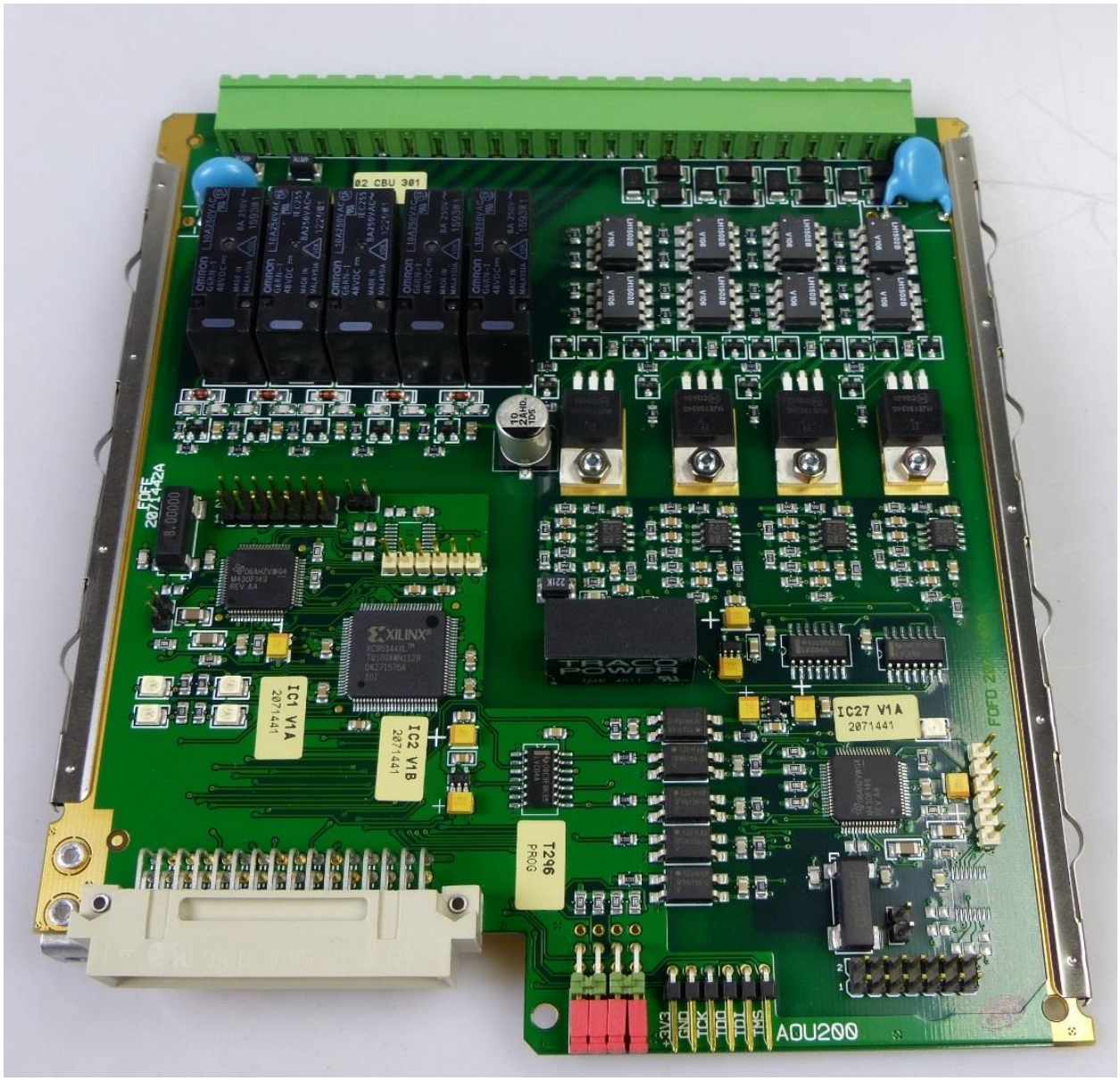
Slot F (bottom view)
(CCU200) Circuit breaker control unit
In- and output board for circuit breaker control. 8DI and 4 DO. Input voltages; 24 Vdc, 48/60 Vdc, 110/125 Vdc, 220 Vdc.



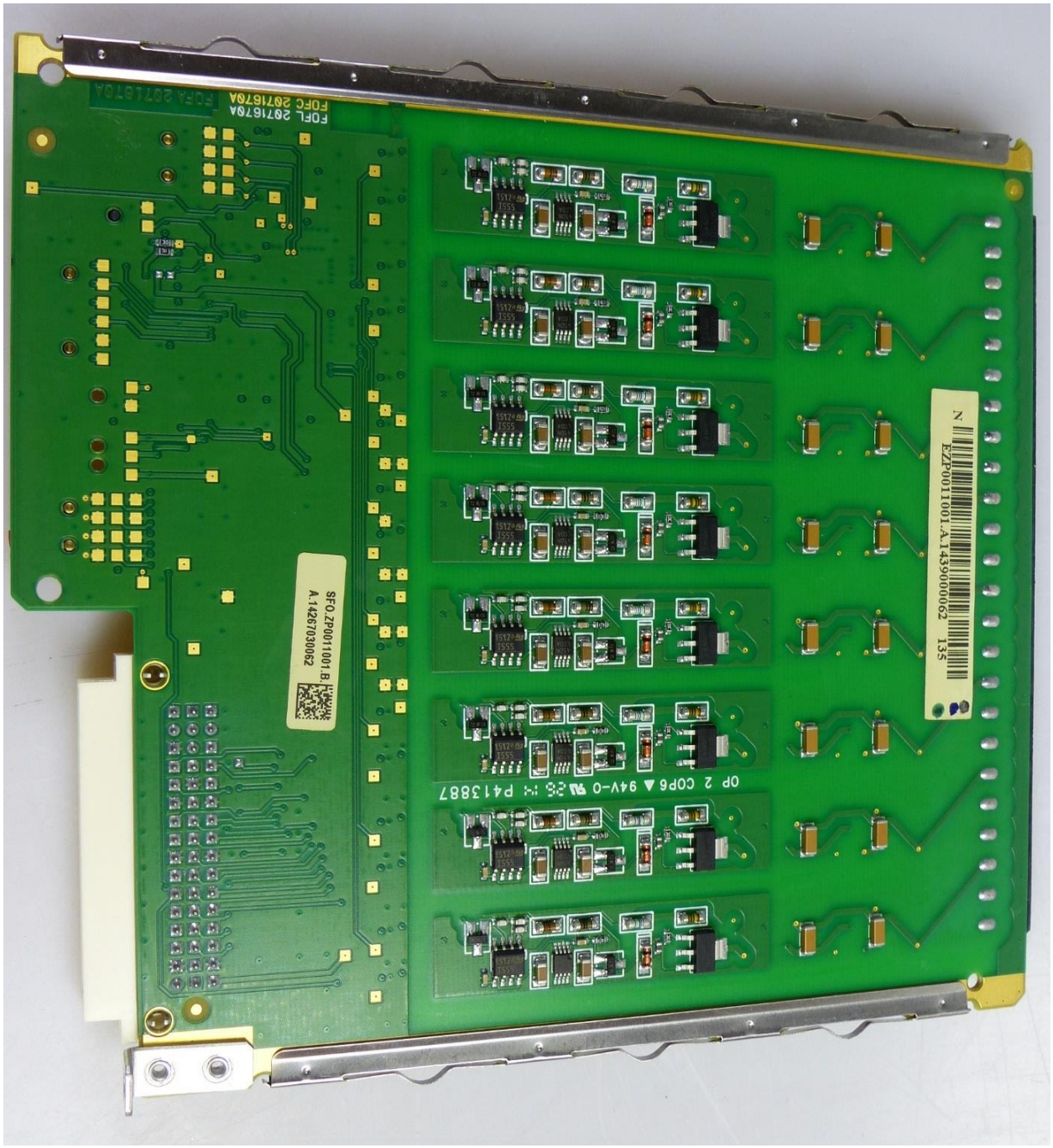
Slot F (top view)
(CCU200) Circuit breaker control unit
In- and output board for circuit breaker control. 8DI and 4 DO. Input voltages; 24 Vdc, 48/60 Vdc, 110/125 Vdc, 220 Vdc.



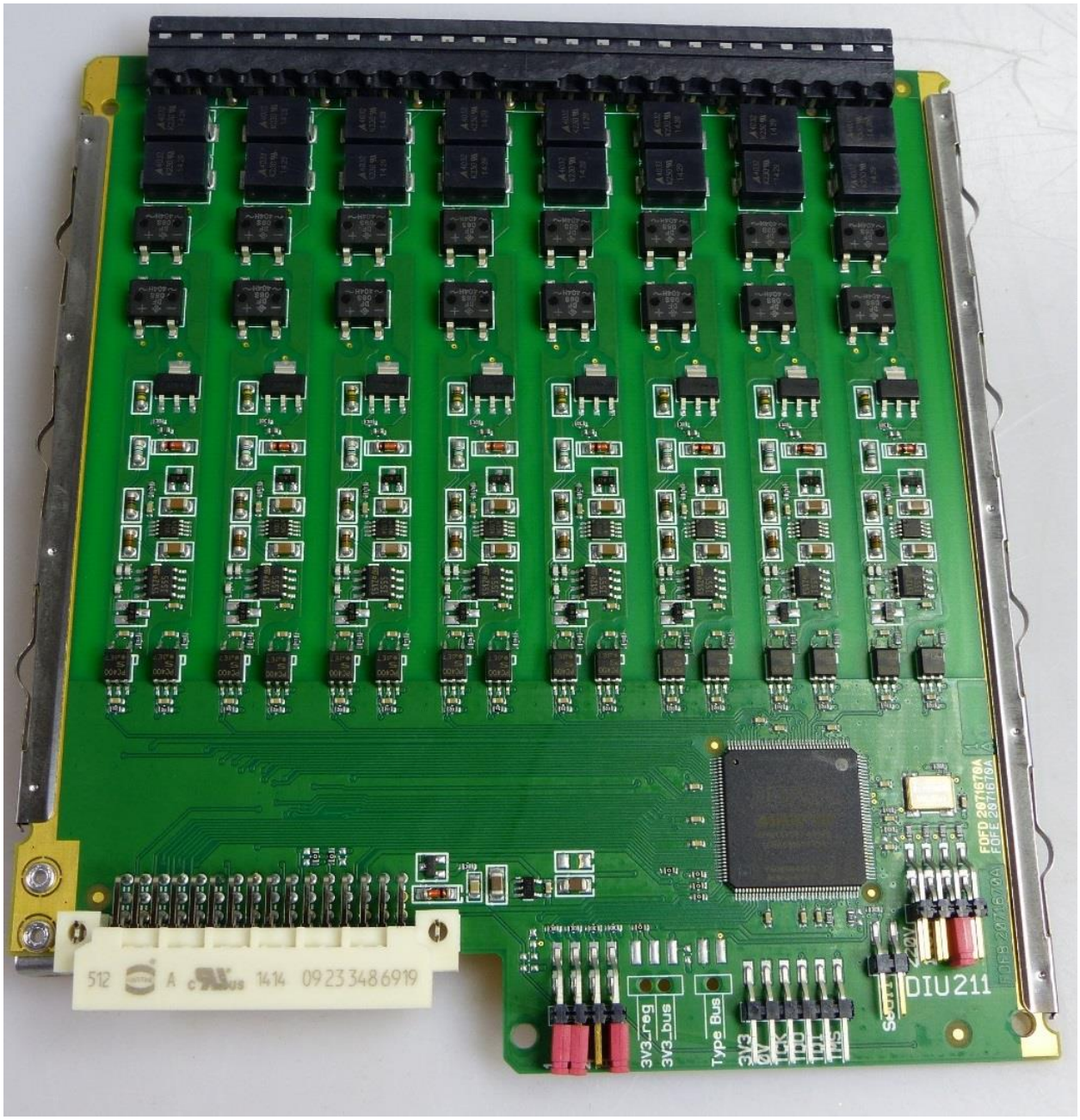
Slot G (bottom view)
(AOU200) Analogue output unit
4 current outputs. Needs external power supply of 48 Vdc



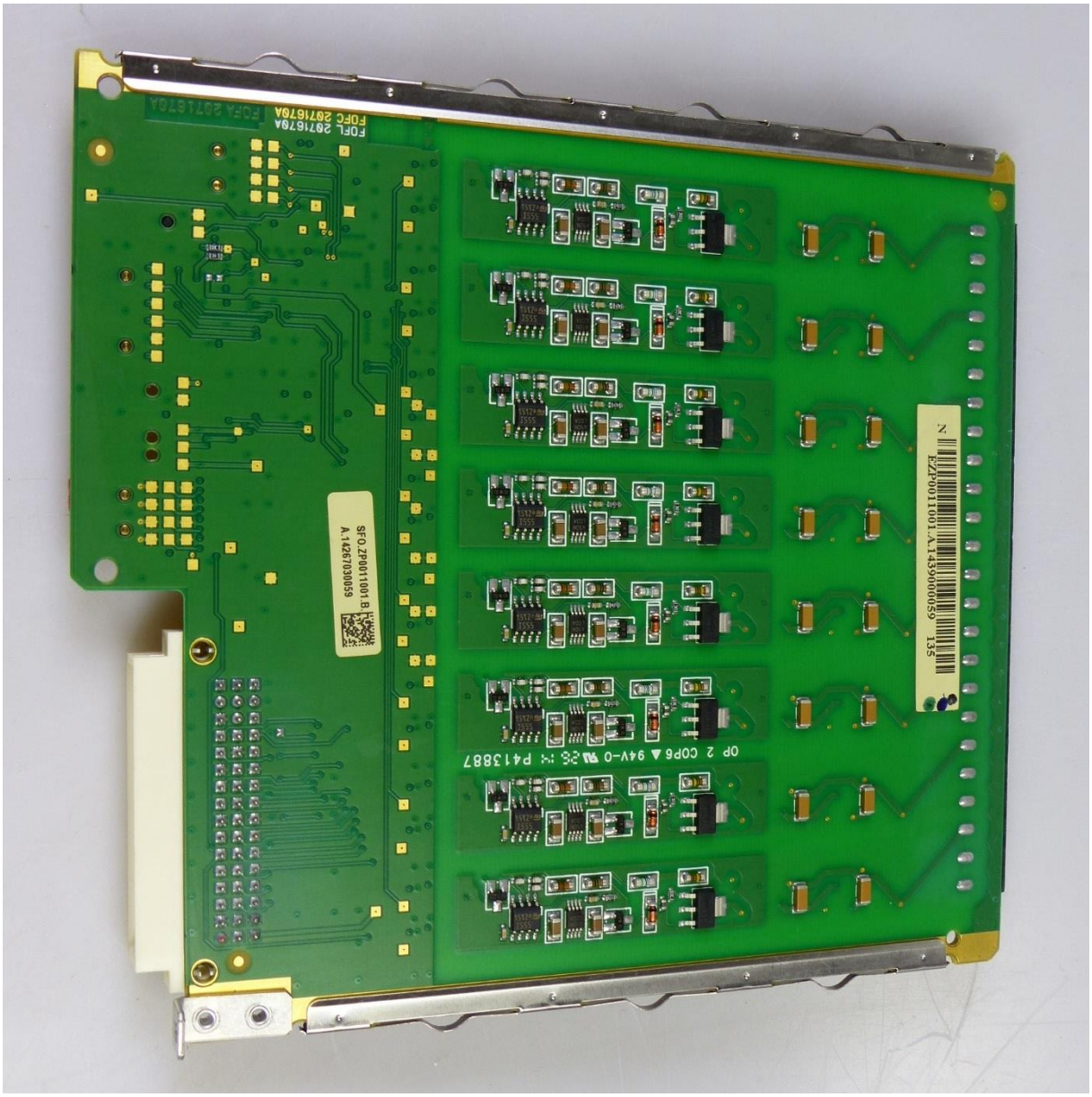
Slot G (top view)
(AOU200) Analogue output unit
4 current outputs. Needs external power supply of 48 Vdc



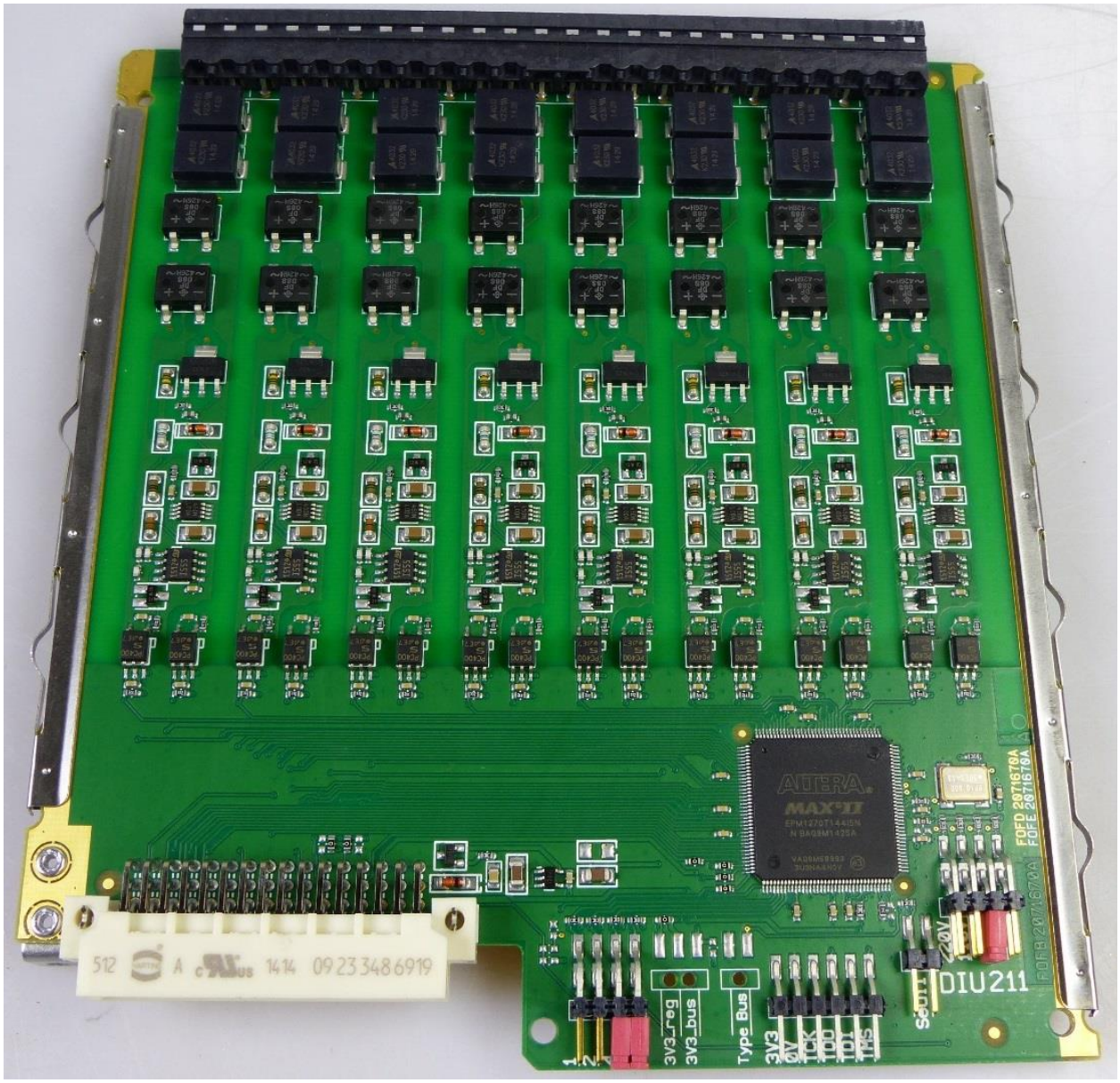
Slot H (bottom view)
(DIU211) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



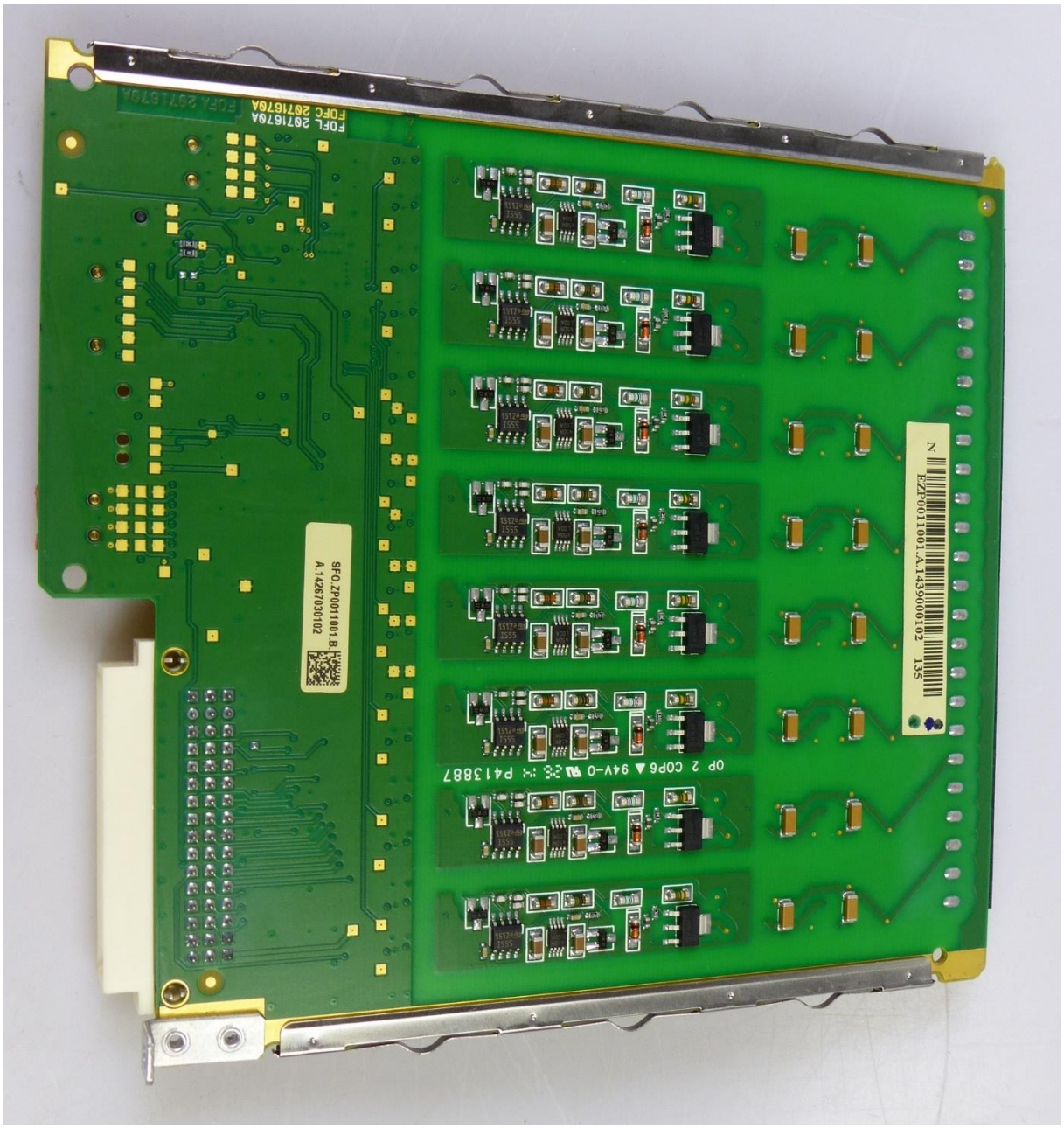
Slot H (top view)
(DIU211) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



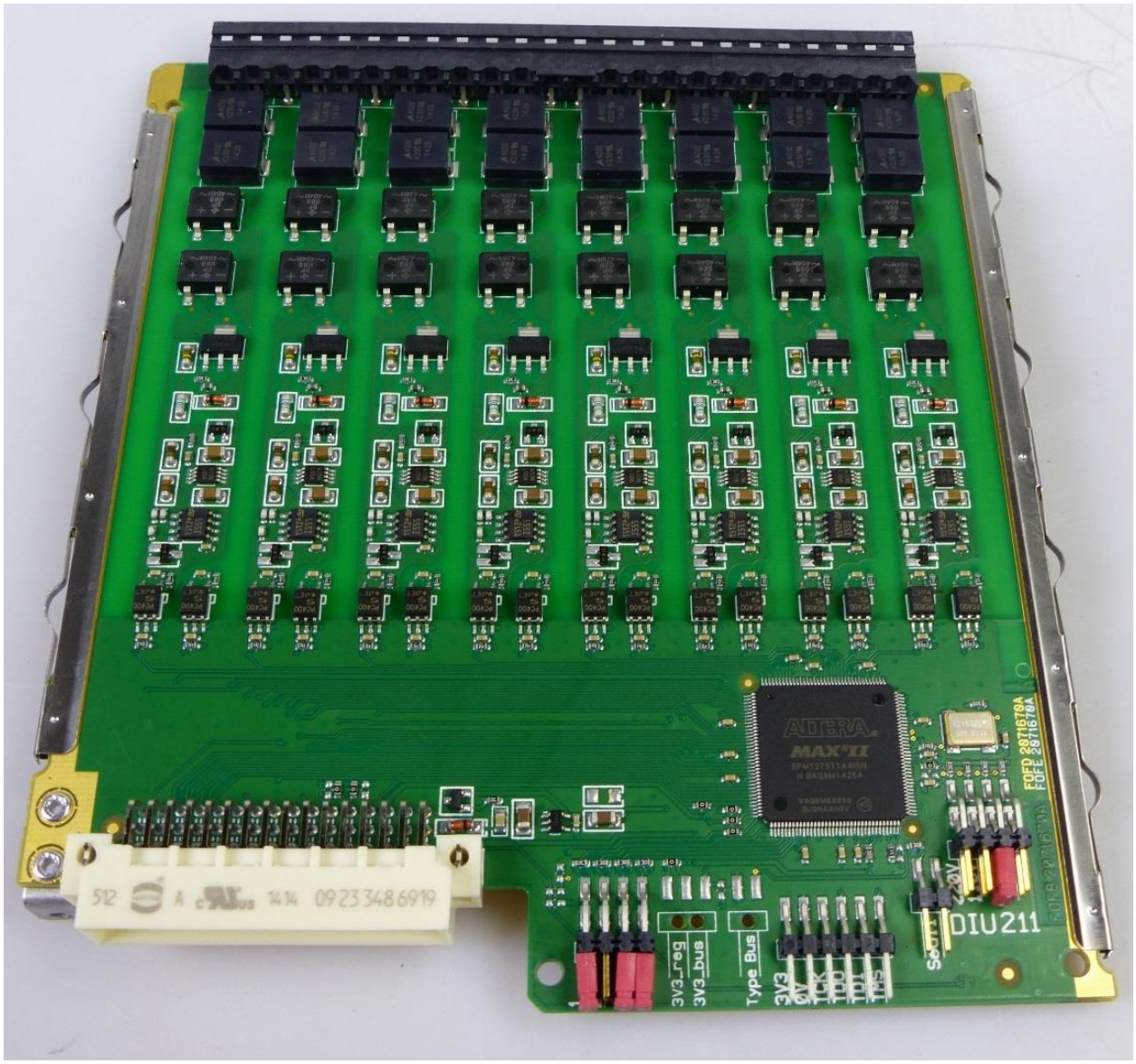
Slot I (bottom view)
(DIU211) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



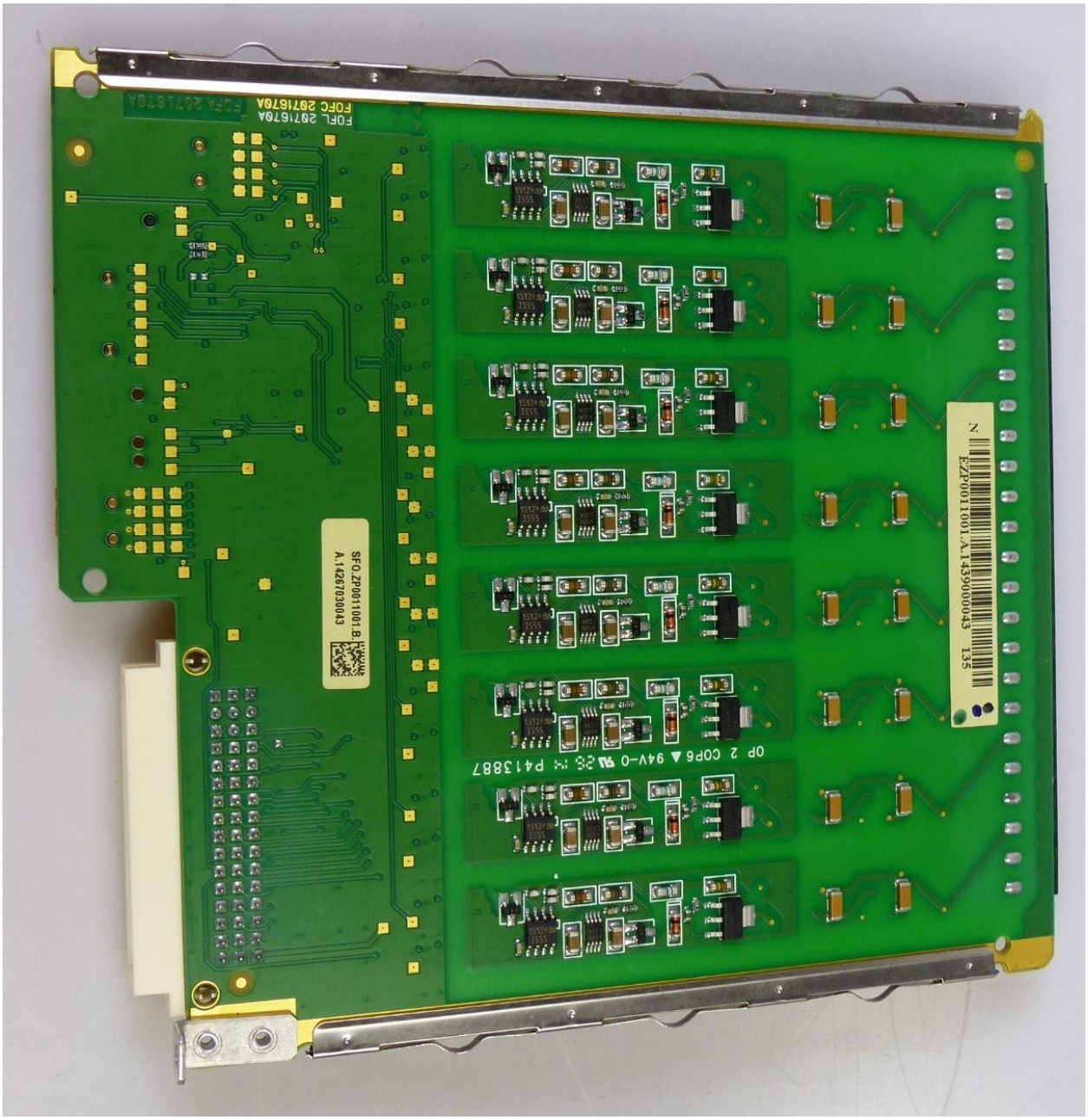
Slot I (top view)
(DIU211) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



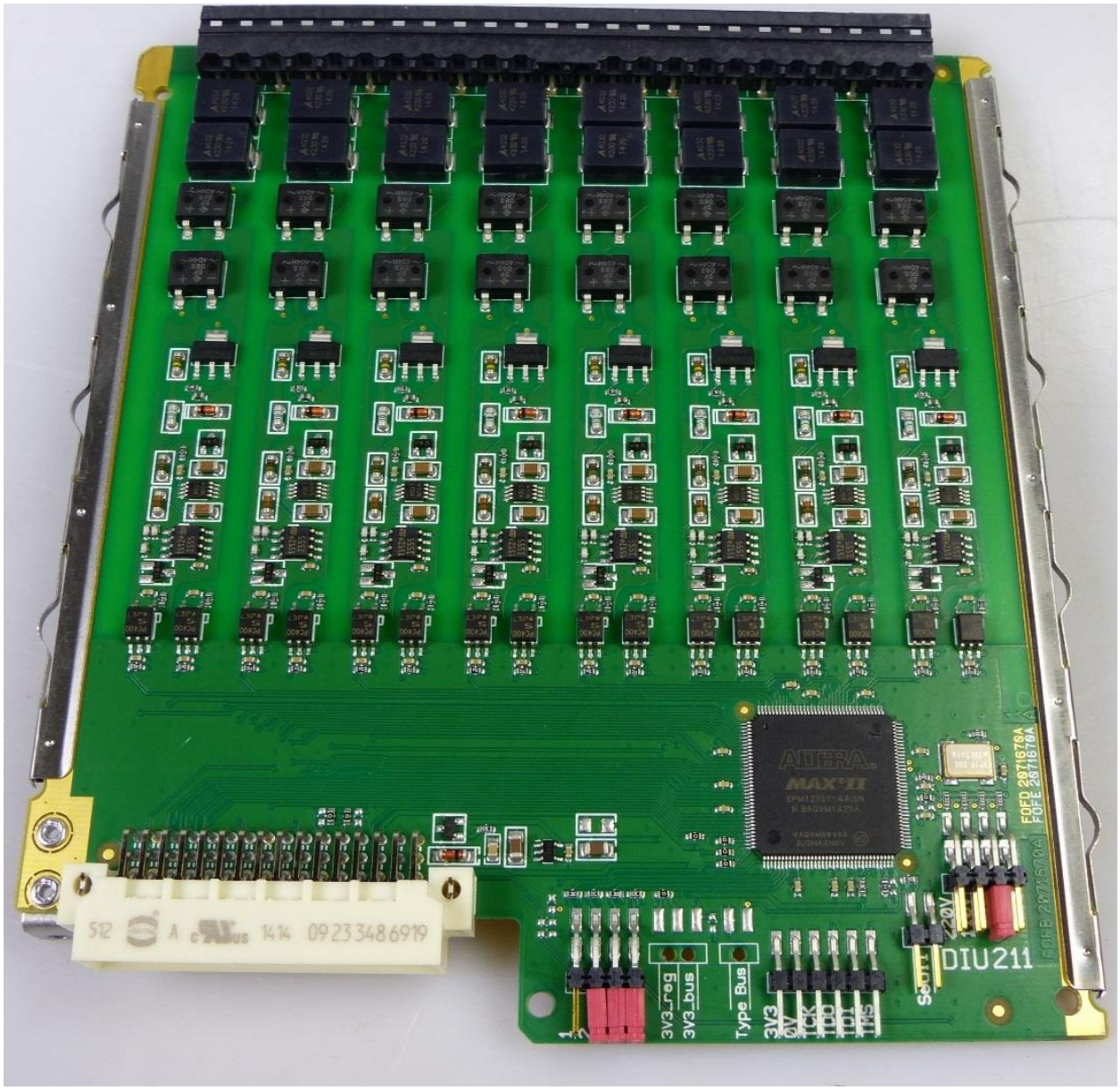
Slot J (bottom view)
(DIU211) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



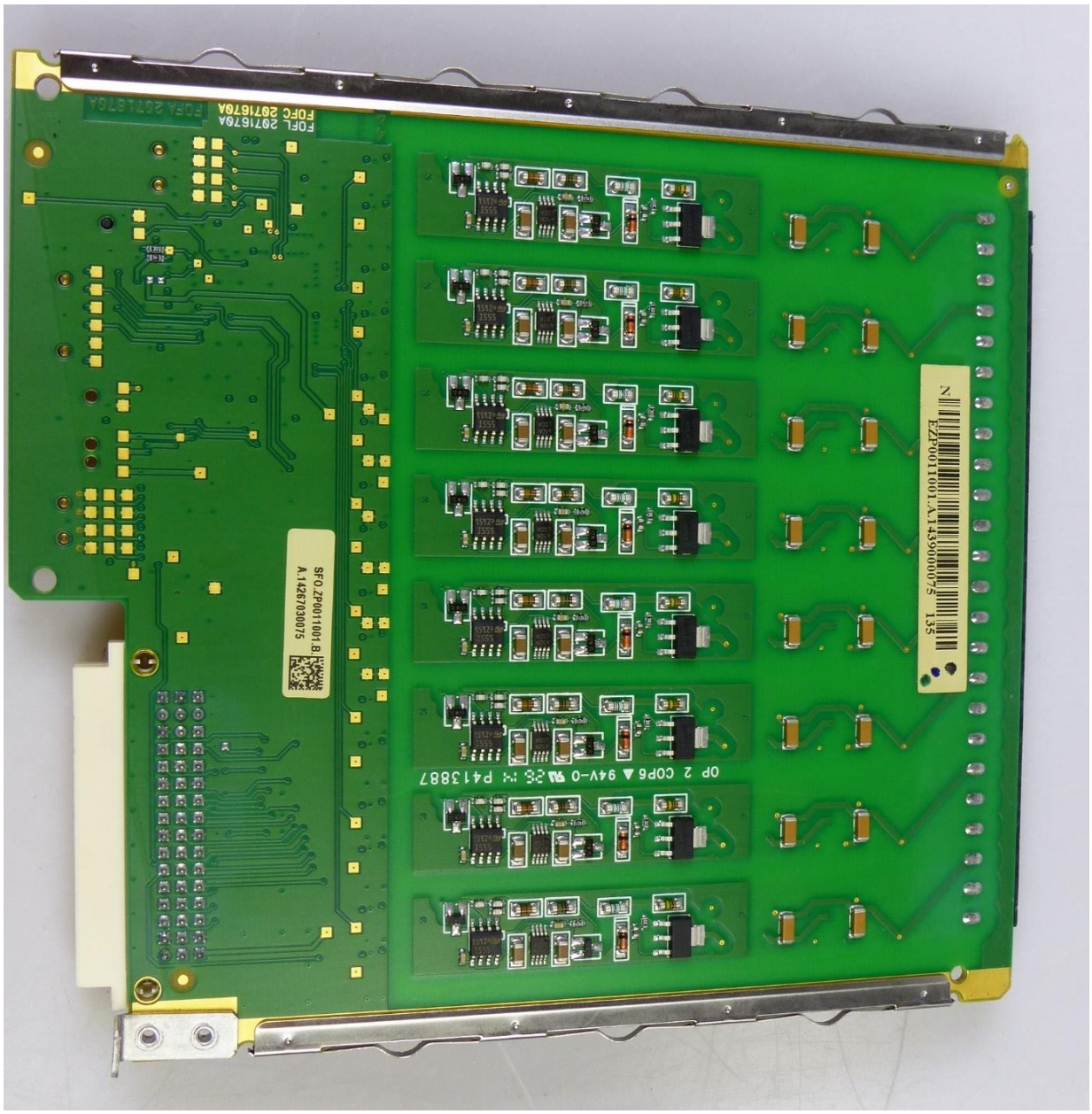
Slot J (top view)
(DIU211) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



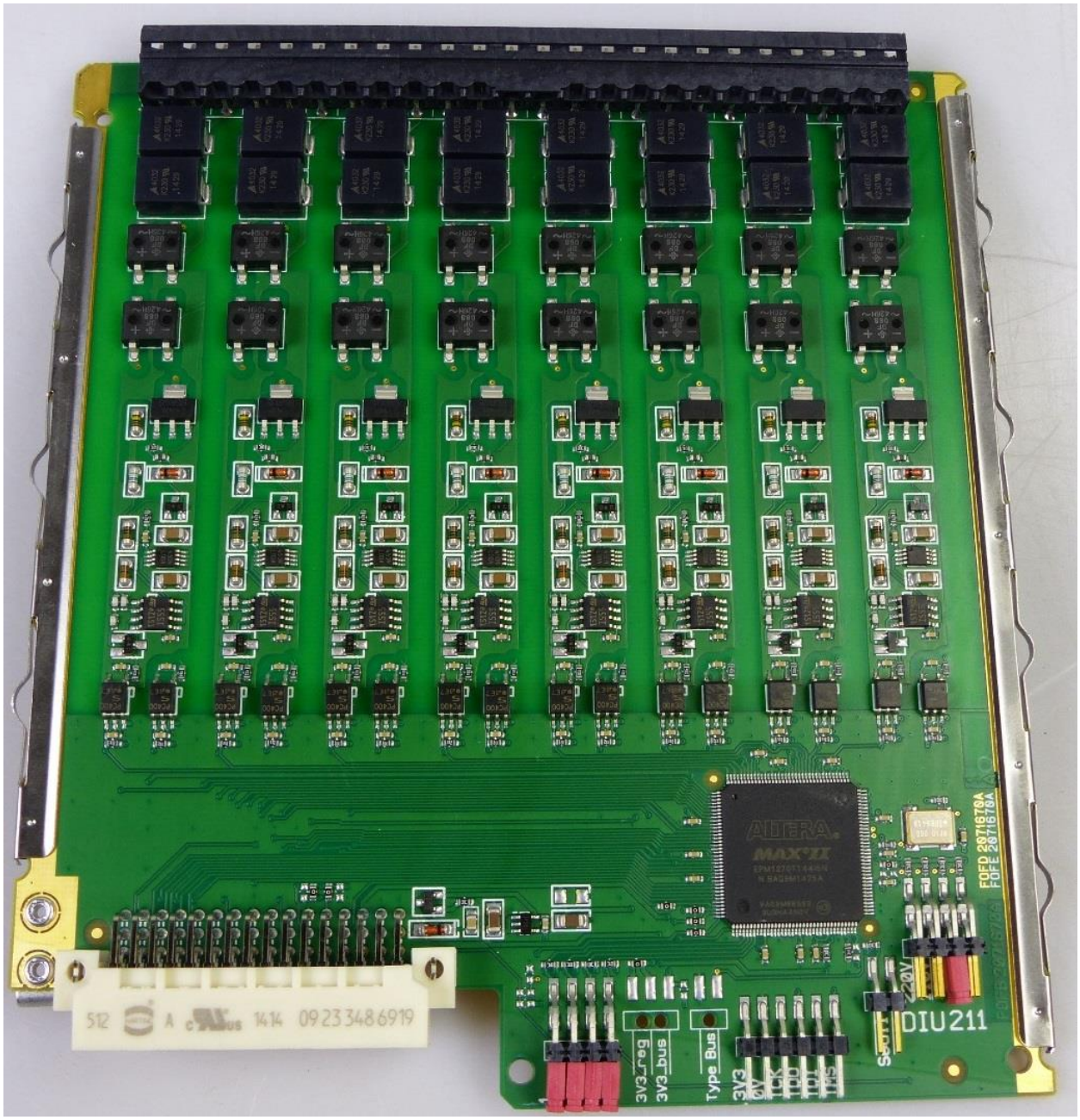
Slot K (bottom view)
(DIU211) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



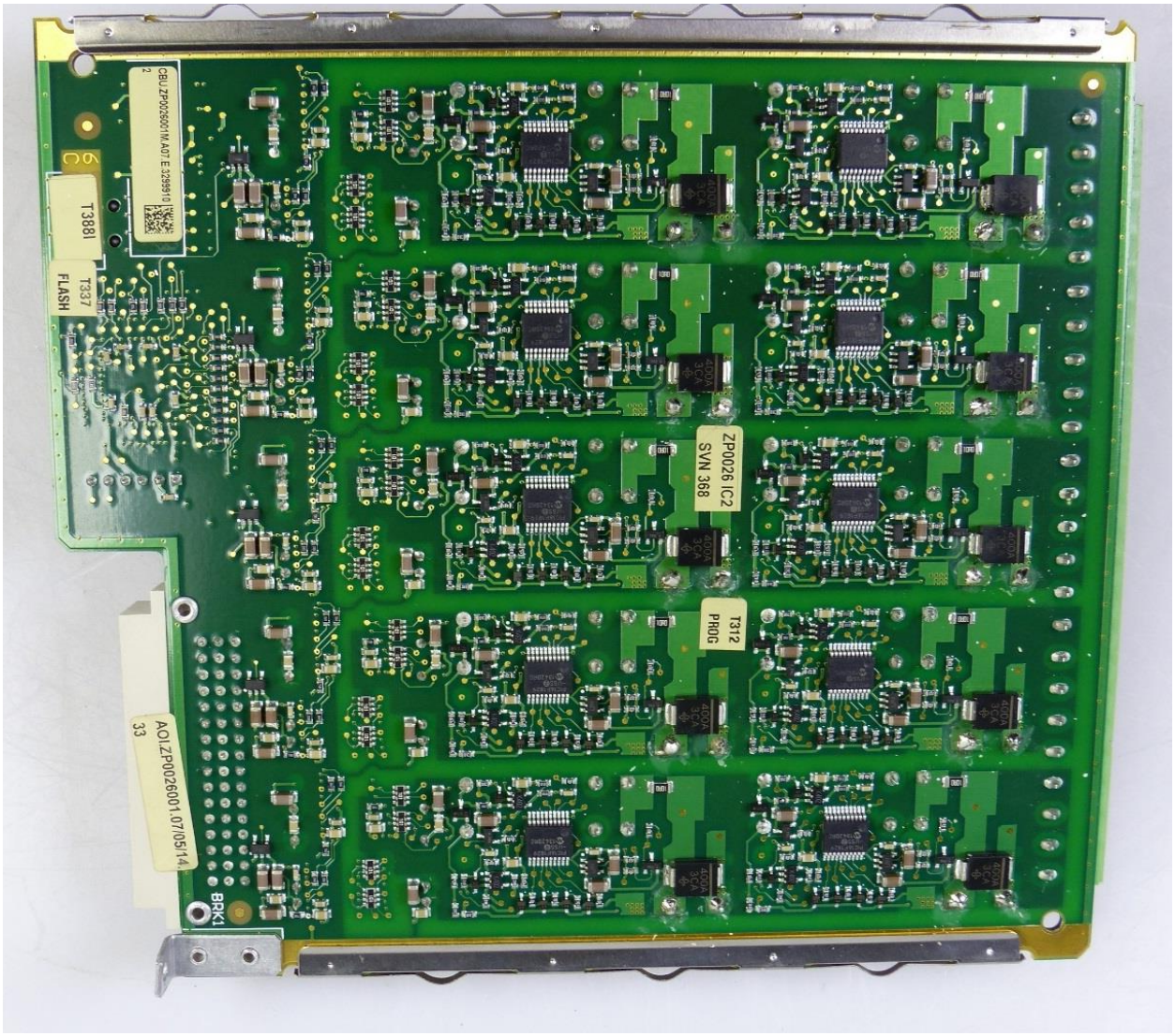
Slot K (top view)
(DIU211) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



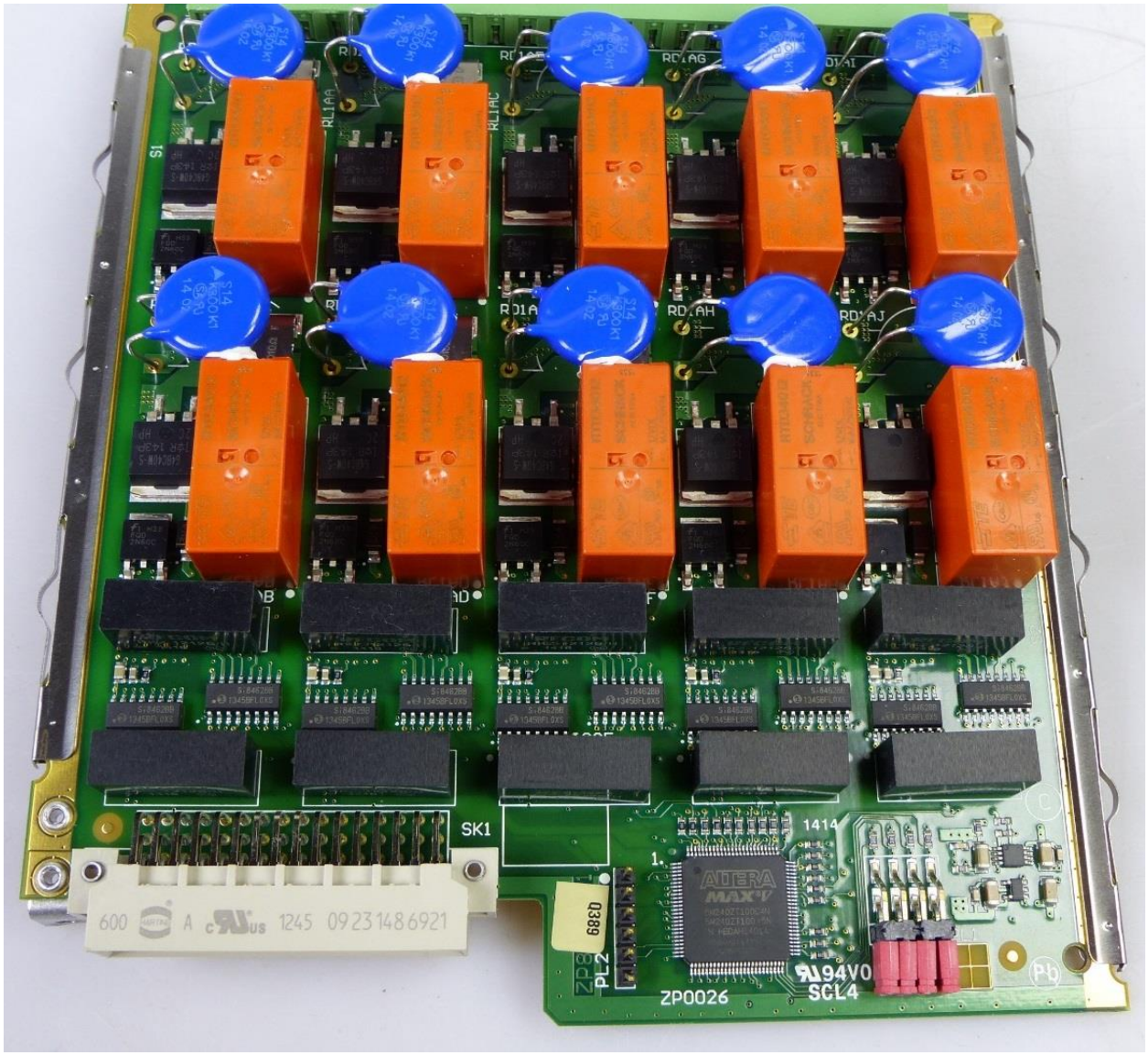
Slot L (bottom view)
(DIU211) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



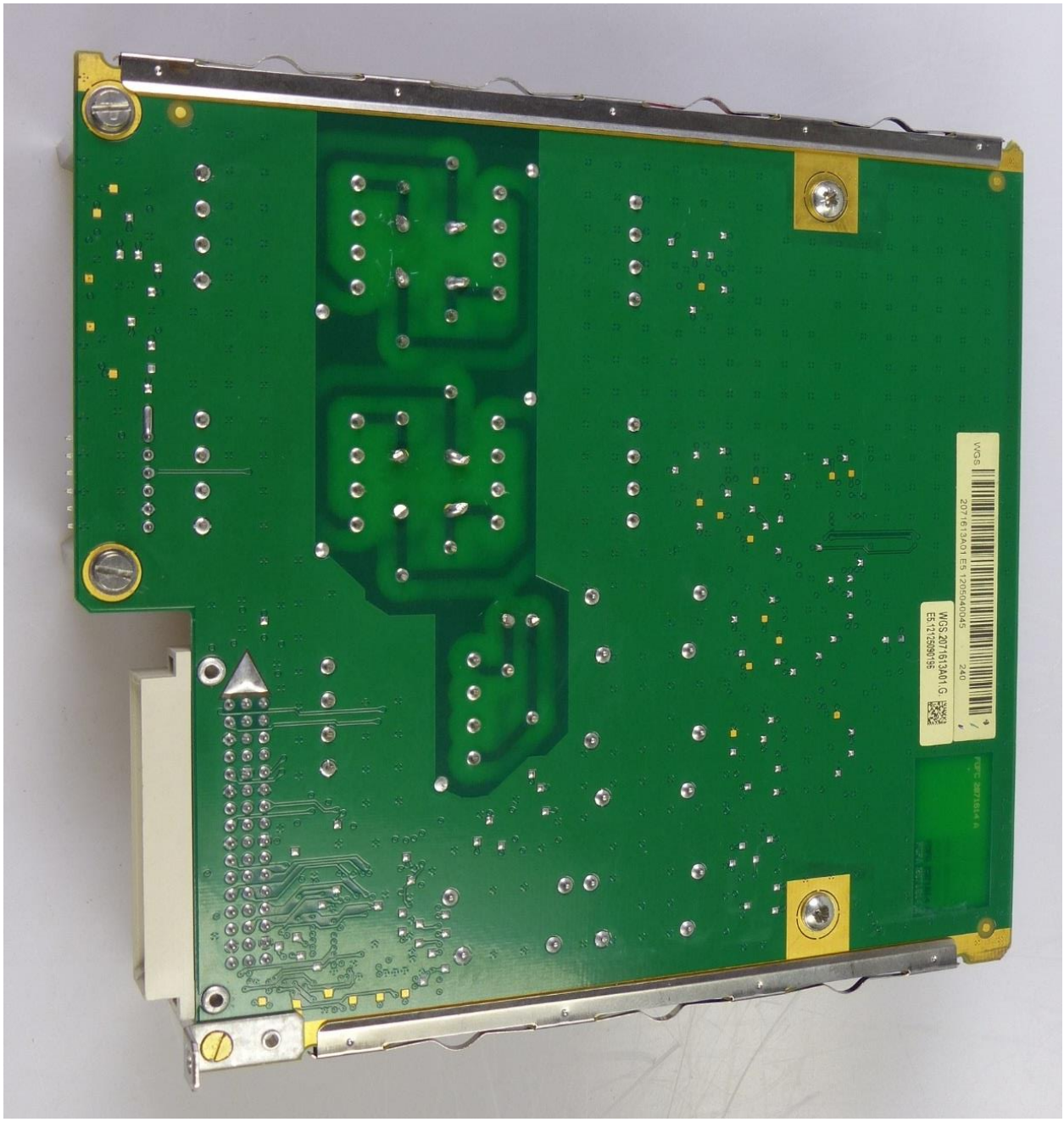
Slot L (top view)
(DIU211) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24 Vdc and 220 Vdc.
(in the DUT set to 48 - 60 Vdc)



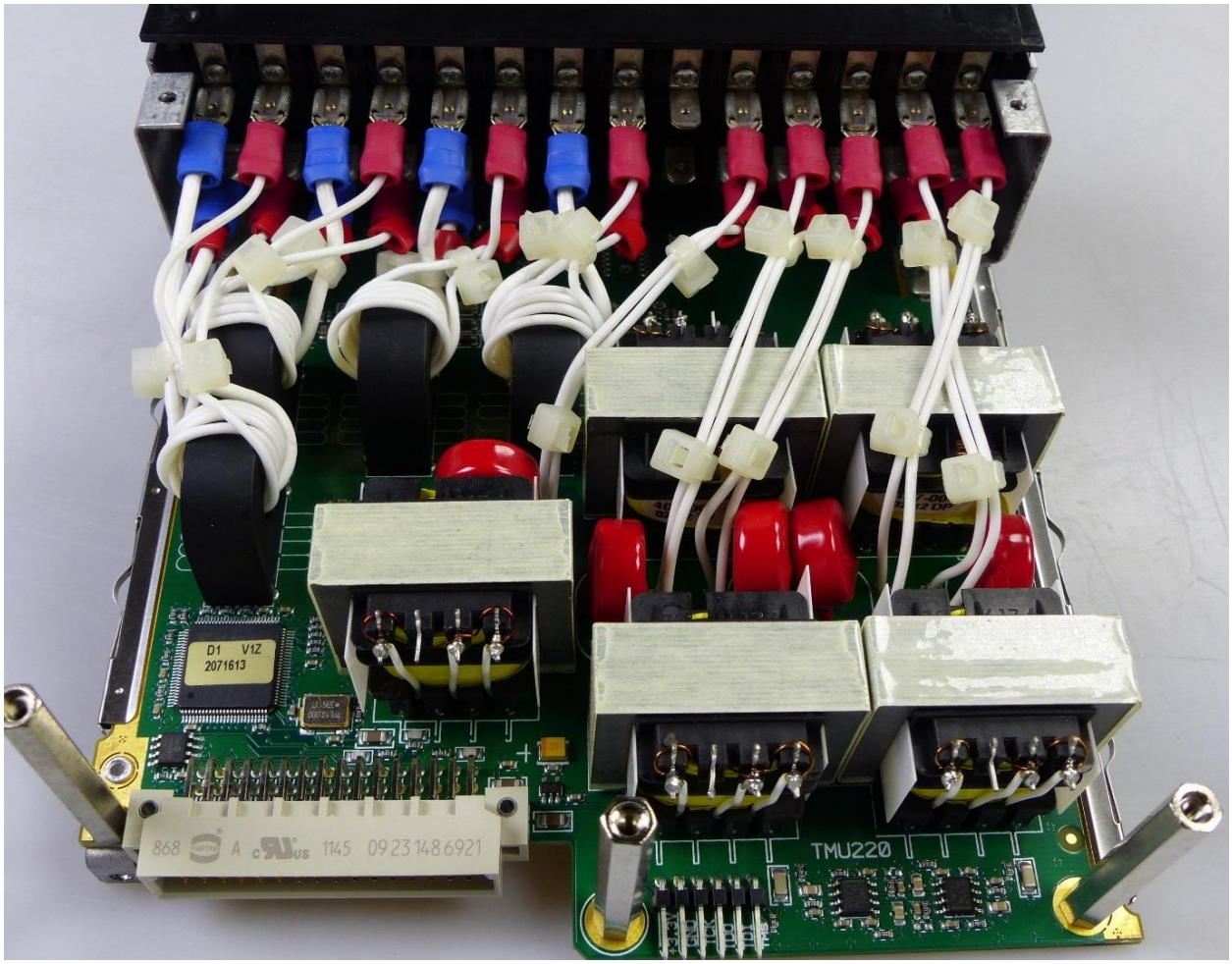
Slot M (bottom view)
(HBU200) High break unit
10 SP relays with NO contact.
Nominal operating voltage range of 24 Vdc to 250 Vdc / 250 Vac +20%



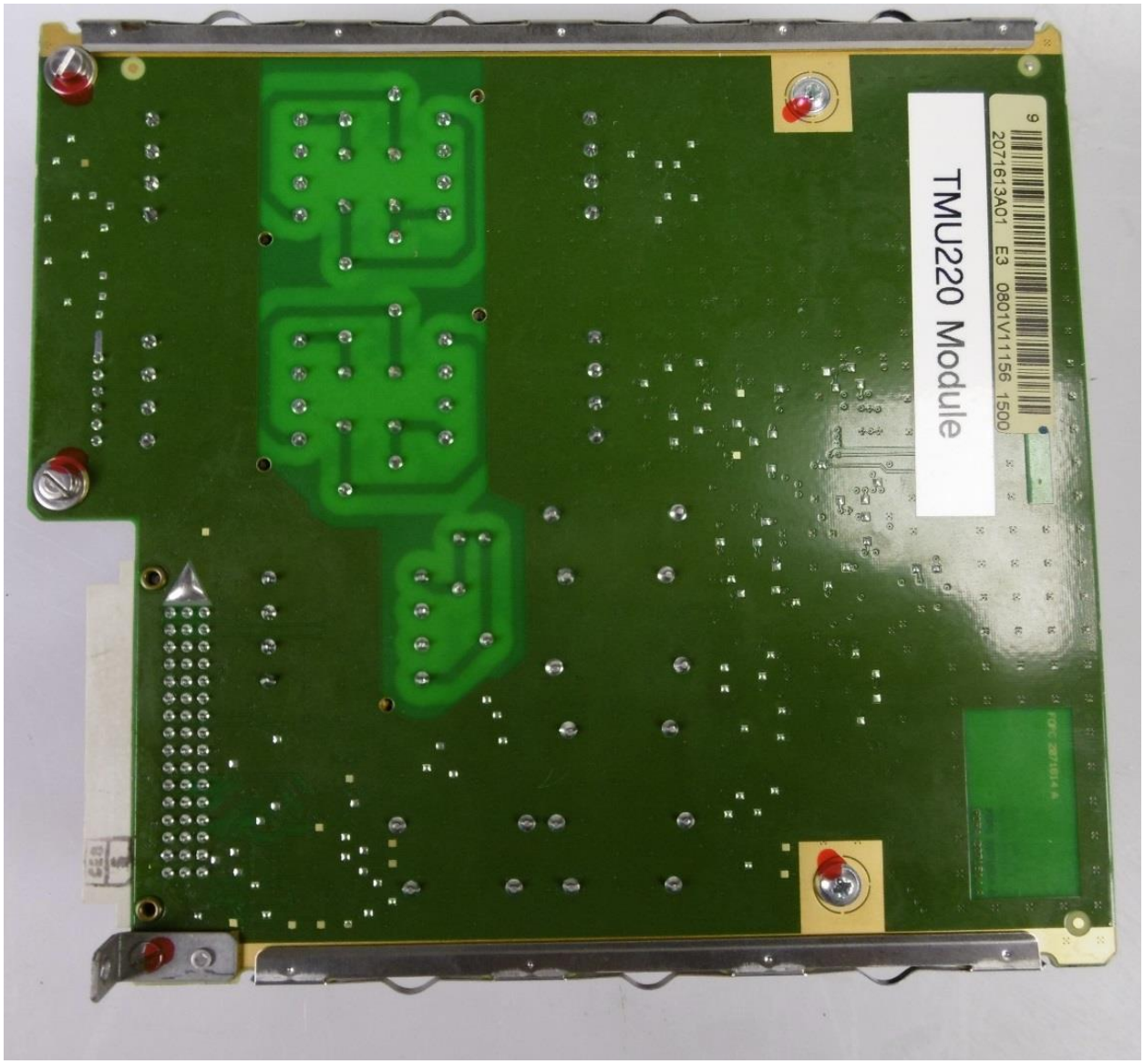
Slot M (top view)
(HBU200) High break unit
10 SP relays with NO contact.
Nominal operating voltage range of 24 Vdc to 250 Vdc / 250 Vac +20%



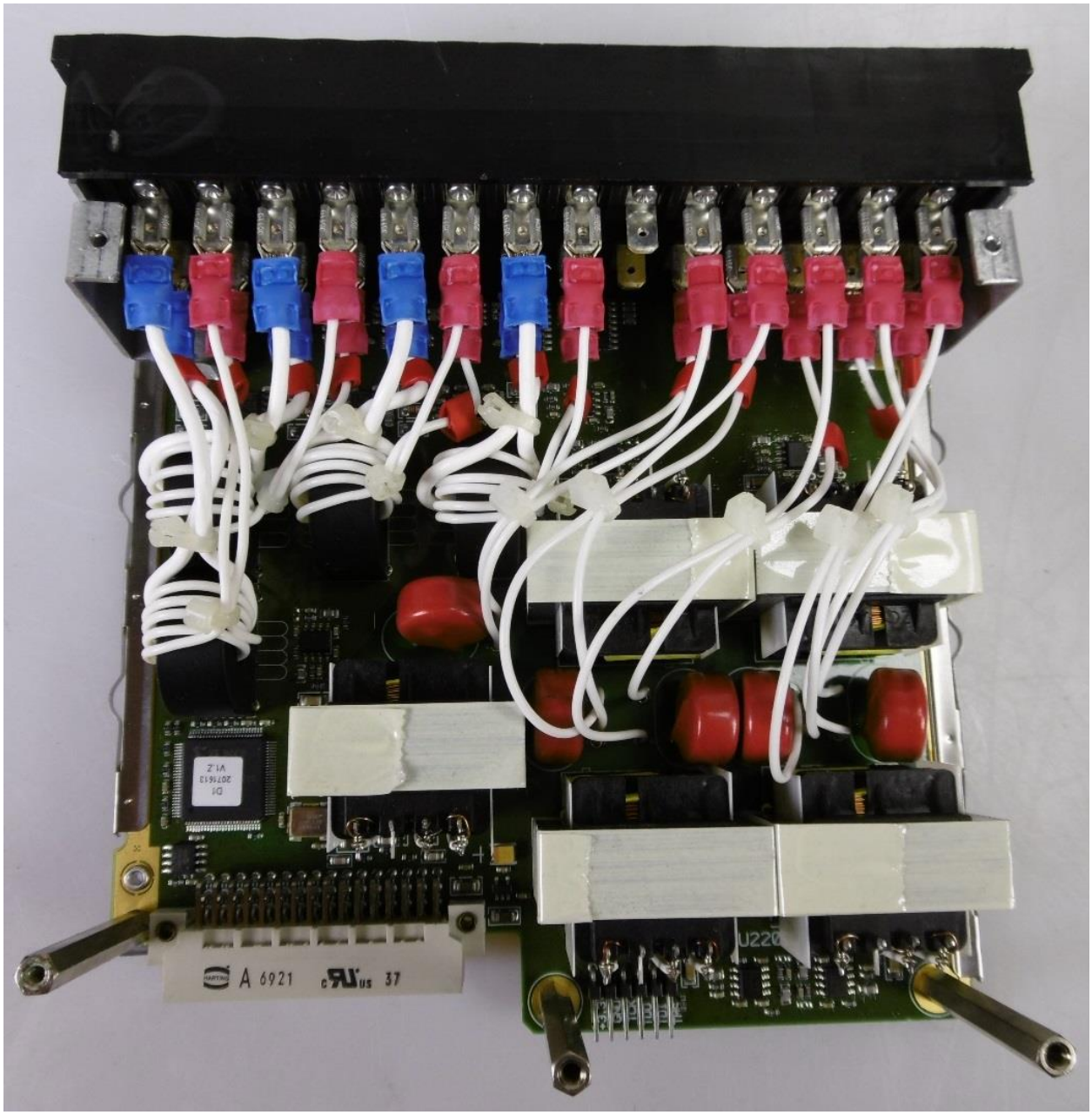
Slot N (bottom view)
(TMU220)
4 CT inputs, two ranges 1 A and 5 A.
5 VT inputs, 57,73 Vrms to 500 Vrms, 50 or 60 Hz



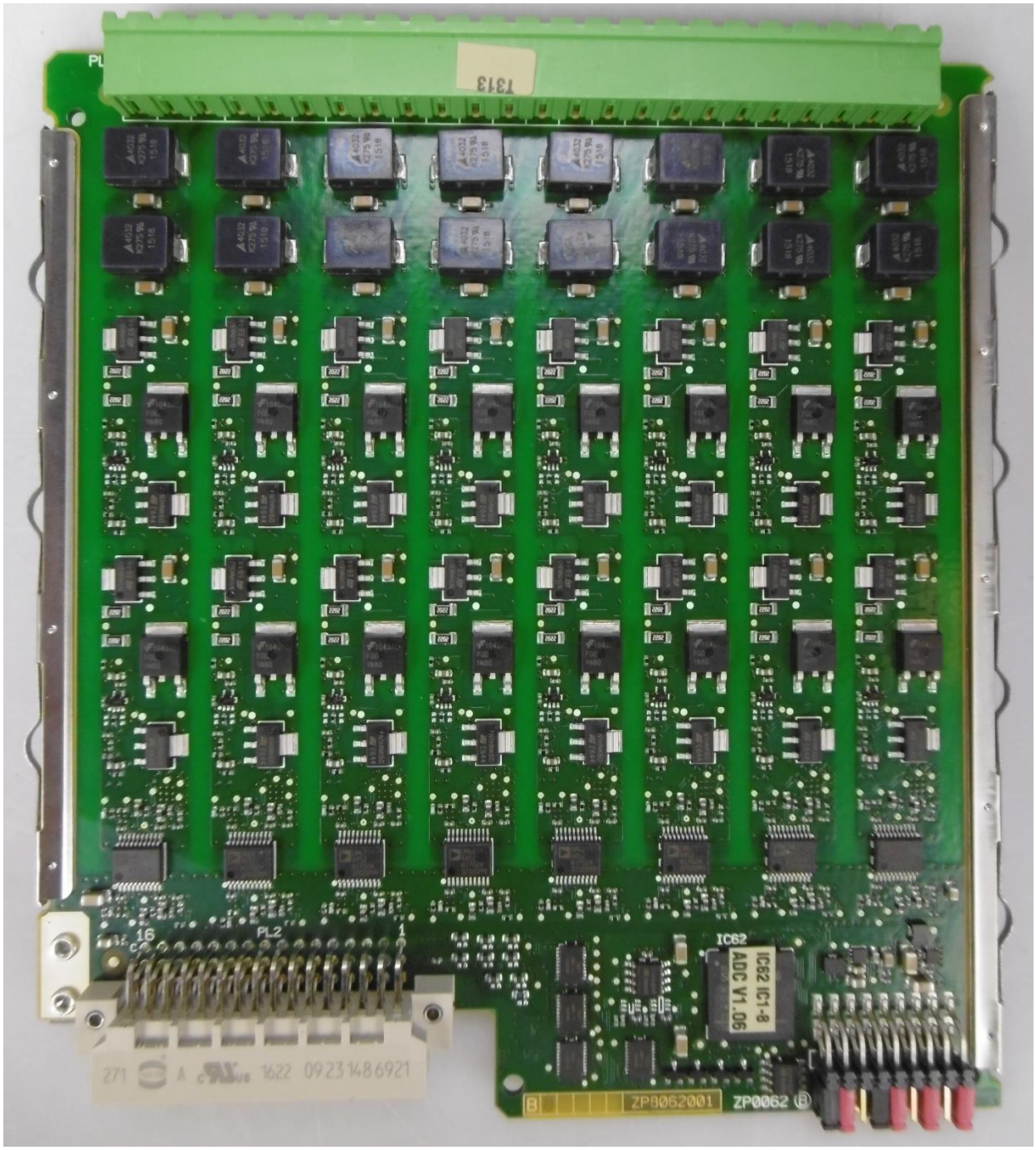
Slot N (top view)
(TMU220)
4 CT inputs, two ranges 1 A and 5 A.
5 VT inputs, 57.73 Vrms to 500 Vrms, 50 or 60 Hz



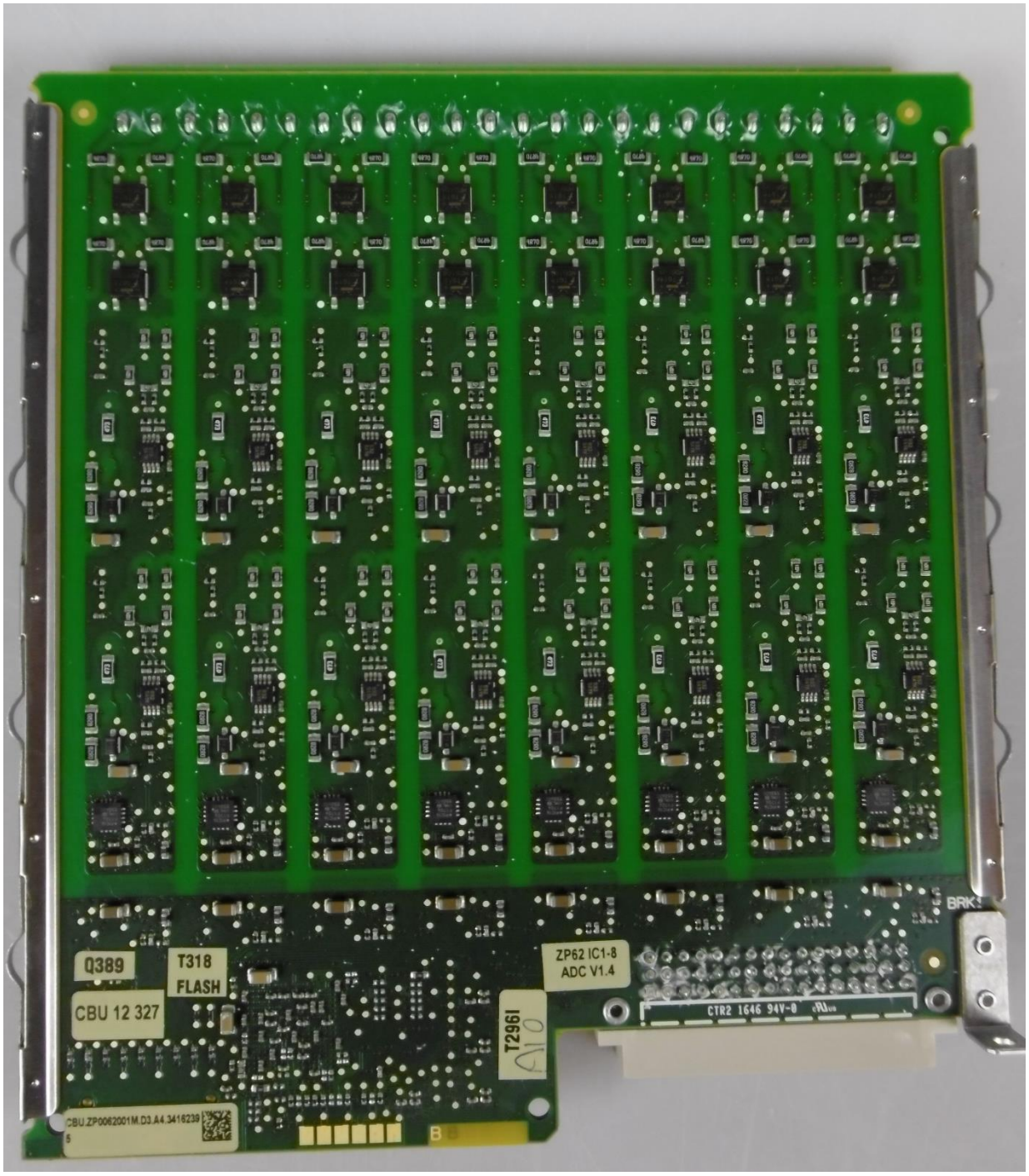
Slot N (bottom view)
(TMU220)
4 CT inputs, two ranges 1 A and 5 A.
5 VT inputs, 57,73 Vrms to 500 Vrms, 50 or 60 Hz



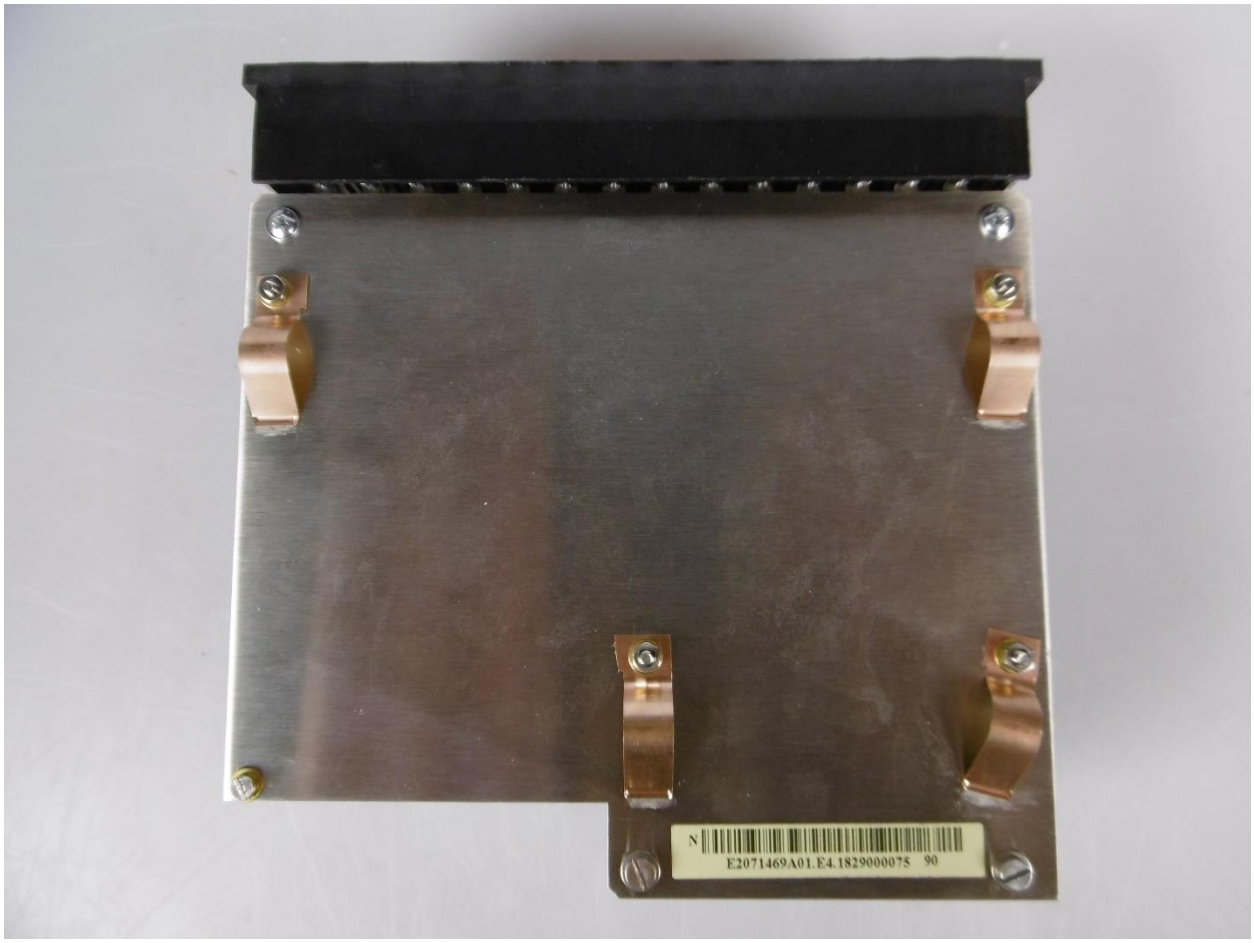
Slot N (top view)
(TMU220)
4 CT inputs, two ranges 1 A and 5 A.
5 VT inputs, 57.73 Vrms to 500 Vrms, 50 or 60 Hz



Slot H (top view)
(DIU221) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24/170 Vdc and 220 Vdc.
(in the DUT set to 170 Vdc)



Slot H (bottom view)
(DIU221) Digital input unit
16 optical isolated inputs, 1 common contact for 2 inputs
Input voltage configurable with jumper between 24/170 Vdc and 220 Vdc.
(in the DUT set to 170 Vdc)



Slot O (bottom view)
(TMU210)
3 variants available :
TMU210 variant A01 (default):

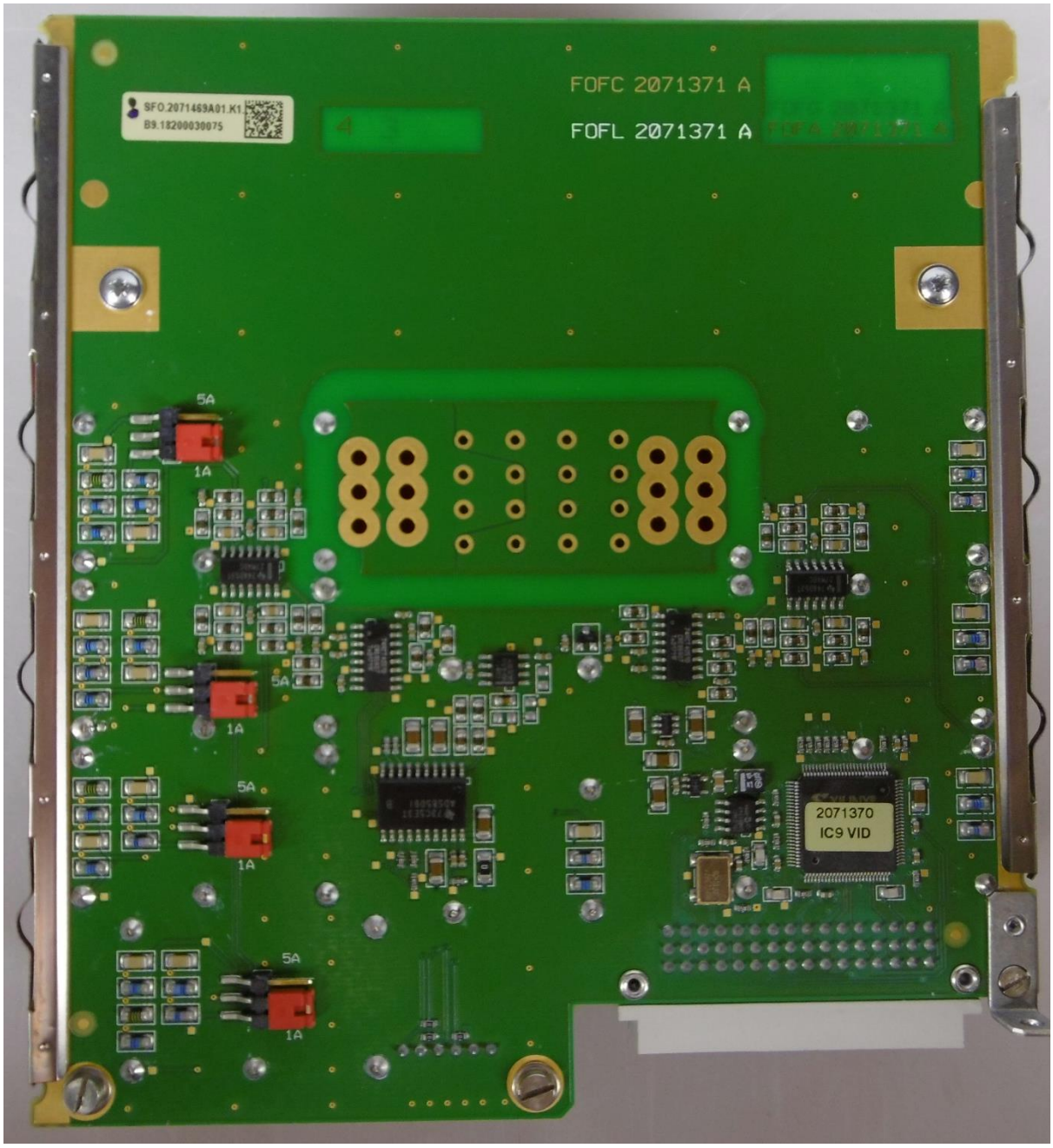
- 4 voltage channels (57 V-130 V)
- 4 current channels (1 A or 5 A)

TMU210 variant A02 :

- 4 voltage channels (57 V-130 V).
- 3 current channels (1 A or 5 A)
- 1 current channel (1 A sensible or 5 A sensible)

TMU210 variant A03 :

- 4 voltage channels (57 V-130 V).
- 3 current channels (1 A or 5 A)
- 1 current channel (1 A very sensible or 5 A very sensible)



Slot O (bottom view)
(TMU210)
3 variants available :
TMU210 variant A01 (default):

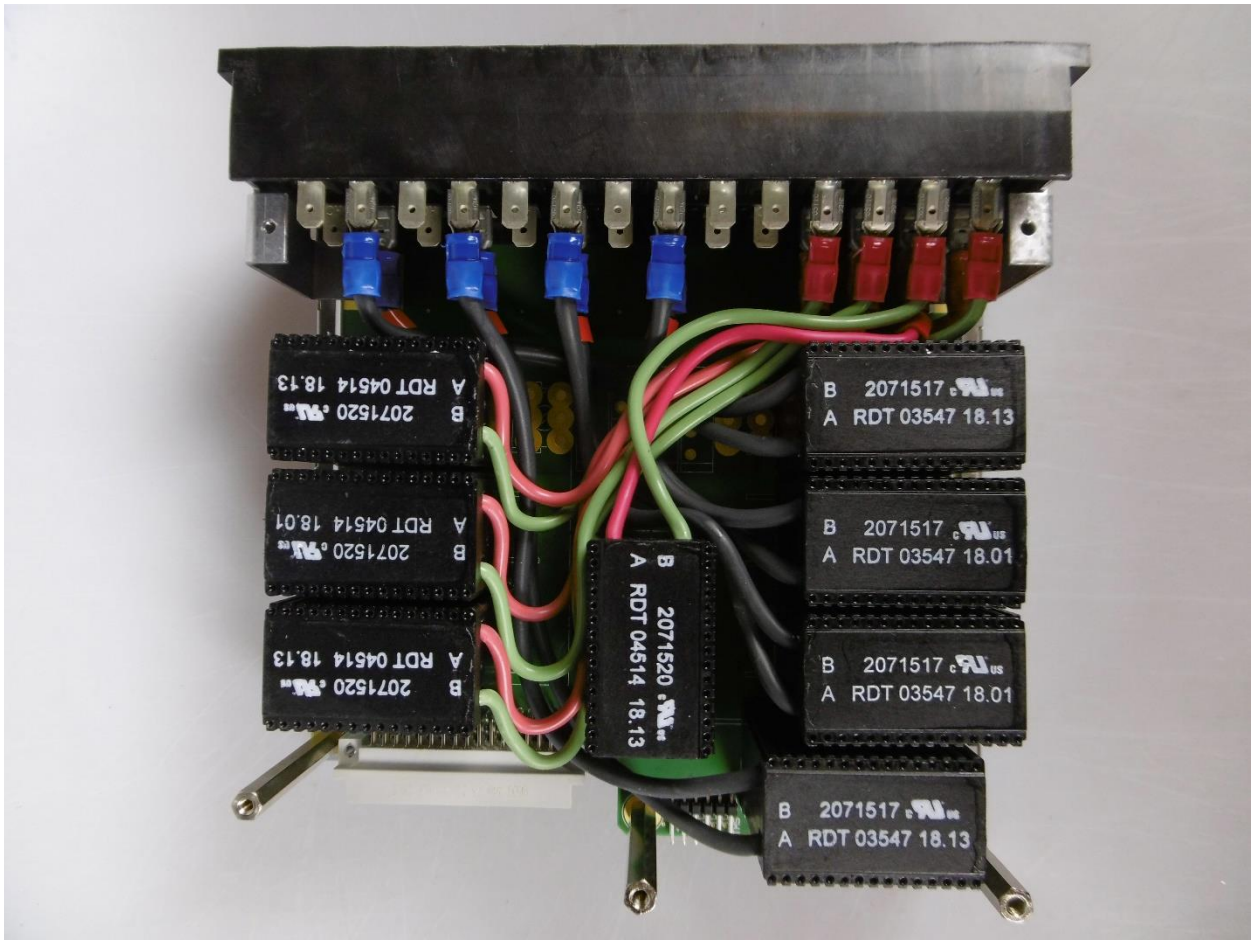
- 4 voltage channels (57 V-130 V)
- 4 current channels (1 A or 5 A)

TMU210 variant A02 :

- 4 voltage channels (57 V-130 V).
- 3 current channels (1 A or 5 A)
- 1 current channel (1 A sensible or 5 A sensible)

TMU210 variant A03 :

- 4 voltage channels (57 V-130 V).
- 3 current channels (1 A or 5 A)
- 1 current channel (1 A very sensible or 5 A very sensible)



Slot O (internal view)
(TMU210)
3 variants available :
TMU210 variant A01 (default):

- 4 voltage channels (57 V-130 V)
- 4 current channels (1 A or 5 A)

TMU210 variant A02 :

- 4 voltage channels (57 V-130 V).
- 3 current channels (1 A or 5 A)
- 1 current channel (1 A sensible or 5 A sensible)

TMU210 variant A03 :

- 4 voltage channels (57 V-130 V).
- 3 current channels (1 A or 5 A)
- 1 current channel (1 A very sensible or 5 A very sensible)

16 MEASUREMENT UNCERTAINTY

The used climate rooms and EMC test and measurement equipment are calibrated on an annual base. All the parameters are within the tolerances required by the basic (test/measurement) standards, taking into account the measurement uncertainty reported in the calibration certificates.

17 LIST OF INSTRUMENTS USED

17.1 EMC equipment

EMC test equipment			
Description	**Manufacturer**	**Type**	**ORS number**
Fast transient burst tester	EM Test	EFT500	105169
Capacitive coupling clamp			106168
Electrostatic discharge tester	**EM Test**	**NX30**	**152004**
Air discharge	EM Test	Air	152012
Contact discharge	EM Test	Contact	152011
Bleeding resistors ESD	EM Test	Weerstandskabel ESD	152013
Bleeding resistors ESD	EM Test	Weerstandskabel ESD	122014
Insulation tester	**EMC partner**	**MIG0603OS2**	**105333**
Oscillatory wave test system	**EMC partner**	**MIG0603OMI**	**150022**
CDN	EMC partner	CDN2000-06-25	150023
CDN-KIT1000	EMC partner	CN-U / DN-HF DN-LF1 / DN-LF2	89.02
H-field antenna	EMC partner	MF1000-1	151494
H-field antenna	EMC partner	MF1000-3	151495
Continuous wave simulator including	**EM Test**	**CWS500N1.1**	**151165**
50 ohm attenuator	EM Test	ATT 6/75	151158
CDN M1	EM Test	CDN M1	151180
CDN M2/M3	EM Test	CDN M2/M3	151164
CDN M2/M3	EM Test	CDN M2/M3	151179
CDN M4 N	EM Test	CDN M4 N	151160
CDN M4 N	EM Test	CDN M4 N	151178
CDN S8 RJ45	EM Test	CDN S8 RJ45	151181
CDN AF2	EM Test	CDN AF2	151162
Injection clamp	EM Test	EM101	151159
HF absorbing clamp	EM Test	FTC101	151168
HF absorbing clamp	EM Test	FTC101	151156
HF absorbing clamp	EM Test	FTC101	151157
Immunity tester, including	**EMC partner**	**IMU4000 F-S-D-V-C-1500**	**151487**
HF absorbing clamp	EM Test	FTC101	151168
HF ATTENUATION CLAMP	TESEQ	KEMA 801A	152042
HF ATTENUATION CLAMP	AMETEK CTS	KEMA 801A	152275
HF ATTENUATION CLAMP	AMETEK CTS	KEMA 801A	152276
Transformer	EMC-Partner	EXT-TRA3000 C-SHORT-1506	151486
Power supply	EMC-Partner	PS3-0204	151522
CDN	EMC-Partner	CN16-1514	151489
CDN	EMC-Partner	CN16T-1507	151491
CDN	EMC-Partner	CN16-22-7C-1503	151490
CDN	EMC-Partner	CN16-22-7D-1503	151492
Capacitive coupling clamp	EMC-Partner	CN-EFT1000-1568	151497
CDN	EMC-Partner	CN-BALUN-1505	151493
Insulation tester	FLUKE	1503	150150
Dielectric 50Hz AC Voltage test	SQS Electronic	HA3300D	105156
Dielectric 50Hz AC Voltage test	SQS Electronic	HA4000D	125345
Multi EMC generator	**EMC-Partner**	**IMU3000 F6SRTDVC**	**152084**

EMC test equipment			
Description	**Manufacturer**	**Type**	**ORS number**
CDN	EMC-Partner	CDN3000A-08-32 690V	152089
Power supply	EMC-Partner	PS3 Pwr1	152087
Power supply	EMC-Partner	PS3 Pwr2	152088
IEC 61000-4-16 extension	EMC-Partner	EXT-TRA3000 C-SHORT	152086
IEC 61000-4-29 extension	EMC-Partner	EXT-TRA3000 D-29D	152084
IEC 61000-4-16 CDN	EMC-Partner	CN16	152208
DOW generator	**EMC-Partner**	**DOW3000 S-F-I**	**152090**
Generator	EMC-Partner	MIG1803	152367
CDN	EMC-Partner	NW-IEC61036C218-1502	152368
CDN	EMC-Partner	NW-NMI-M6C3C4-1502	152369
IEC 61000-4-5 CDN kit	EMC-Partner	1000ED3	152146
HYPOTULTRA	AR	7854	152281

Radiated EM-equipment DEKRA			
Description	Manufacturer	Type	Number
Measurement receiver	Rohde & Schwarz	ESU26	126351
Antenna	ARA	Horn DRG 118/a	118369
Anechoic chamber	COMTEST	1712-000	129683
Pre Amplifier	Kuhne	BB-0180-C-N	128919
Coax cable	Suhner	RG214	129994
Pulse Limiter	Rohde&Schwarz	ESH3-Z2	116979
Bilog Antenna	Schwarzbeck	Vulbane-9161-4010	116983
Controller	Maturo	NCD/194/17340915	-
Turntable	Maturo	TT 2.5-2t	-
Antenna mast	Maturo	BAM 4.0-P	-
Test software	Rohde&Schwarz	EMC32 V10.20.01	-
Conducted RF-equipment DEKRA			
EMI Test Receiver	Rohde&Schwarz	ESR 7	132186
Artificial Mains Network	Rohde&Schwarz	ESH2-Z5	128201
ISN / CDN/RJ45	Teseq	ST08	127031
Test Software	Rohde & Schwarz	EMC32 V.10.20.01	-
Immunity test equipment DEKRA			
Radiated Immunity test rack	Dekra Certification	TS 080	127190
BiconiLog Antenna	Teseq	CBL 6144	129745
Horn Antenna	ARA	DRG 118/a	116667
Anechoic Chamber	Siemens – Matsushita	EAC 52772	118125
Test Software	Rohde & Schwarz	EMC32 V.10.20.01	-

17.2 Environmental Measurement equipment

Environmental instrumentation S2T			
Description	**Manufacturer**	**Type**	**Serial number**
ICP Accelerometer (reference point)	PCB Piezotronics	353B34	203417
Shaker control system	Dactron	Laser	4816833
ICP Accelerometer (reference point)	PCB Piezotronics	353B18	175664
ICP Accelerometer (check point)	PCB Piezotronics	353B18	6419
Monitoring of the enviromental conditions	Novasina	ClimaLog 30	1206059
Signal Conditioner	PCB Piezotronics	482C16	440
Position Drop Table	Lansmont Corporation	PDT-56^{E}	PT-56E-0216
Electric-dynamic shaker	Tira	TV59355/AIT-440 TGT Model 48XXL	036/07

Environmental instrumentation			
Description	**Manufacturer**	**Type**	**ORS number**
Climate chamber	ESPEC	ARS-1100	151485
Test finger	PL Contactvingers	Test vinger 12,5mm	150691
Test finger 2.5mm	PL Contactvingers	Test vinger 2,5mm	150692
Test finger 1mm	PL Contactvingers	Test vinger 1mm	150693

17.3 Measurement equipment

Measurement equipment			
Description	**Manufacturer**	**Type**	**ORS number**
Oscilloscope	Rohde & Schwarz	RTB2002	152140
Oscilloscope	Rohde & Schwarz	RTB2002	152287
Oscilloscope	Rohde & Schwarz	RTB2004	152142
Oscilloscope	Rohde & Schwarz	RTM3002	152229
Current probe	Tektronix	TCP A300&303	151982 151983
Current probe	Tektronix	TCP A300&303	151942 151937
Oscilloscope	Tektronix	TBS 1052B	151943
Oscilloscope	Tektronix	TBS 1052B	151500
Oscilloscope	Tektronix	TBS 1052B	151519
Oscilloscope	Tektronix	TBS 1064	152001
Differentiaal probe	Testec	TT-SI 9010A	151822
Differentiaal probe	Testec	TT-SI 9010	152277
EFT Veri1K	EMC Partner	Veri1K EFT	152157
EFT Veri50	EMC Partner	Veri50 EFT	152158
Multimeter	Fluke	8840A	069145
Analogue multimeter	avometer	MK.6	067424
Multimeter	Fluke	8846A	152266
Multimeter	Fluke	8846A	152265
Multimeter	Fluke	8846A	152264
Multimeter	Keysight	34465A	152269
Multimeter	Keysight	34465A	152268
Multimeter	Keysight	34465A	152267
Multimeter clamp meter	Fluke	365	152024
Multimeter clamp meter	Fluke	365	152025
Current clamp meter			77395
Multimeter clamp meter	Fluke	337	104632
Multimeter 179	Fluke	179	152027
Multimeter 179	Fluke	179	152028

17.4 Test set

Test set			
Description	**Manufacturer**	**Type**	**ORS number**
Relay test set	Omicron	CMC353	152044
Relay test set	Omicron	CMC356	152036