



REPORT OF PERFORMANCE

08-1441

OBJECT	Ethernet Switch		
TYPE	SICOM3024P	SERIAL No.	See chapter 1
	Uaux : 220 VAC; 220 VDC		
MANUFACTURER	Kyland Technology Co. Ltd. Beijing, China		
CLIENT	Kyland Technology Co. Ltd. Beijing, China		
TESTED BY	KEMA HIGH-VOLTAGE LABORATORY Arnhem, the Netherlands		
DATES OF TESTS	27 October until 26 November 2008		
TEST PROGRAMME	Selected tests in accordance with IEC 61850-3 (2002-01) and IEEE 1613 (2003) (see page 2).		
SUMMARY AND CONCLUSION	The tests were passed.		

This Report of Performance applies only to the object tested. The responsibility for conformity of any object having the same designations with that tested rests with the Manufacturer.

This report consists of 50 pages in total.

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KEMA Nederland B.V.


P.G.A. Bus
KEMA T&D Testing Services
Managing Director

Arnhem, 3 February 2009

TABLE OF CONTENTS

TABLE OF CONTENTS	2
SUMMARY	5
1 Identification of the test object.....	10
1.1 Description of the test object.....	10
1.2 List of electronic diagrams, PCB lay-outs, component lists	11
2 General information.....	12
2.1 The tests were witnessed by.....	12
2.2 The tests were carried out by.....	12
2.3 Reference to other reports	12
2.4 Purpose of the test	12
2.5 Measurement uncertainty.....	12
2.6 Applicable standards	12
3 Test Procedure.....	13
3.1 Test set-up	13
3.2 Performance criteria	14
4 1 MHz oscillatory wave immunity test	15
5 100 kHz oscillatory wave immunity test	16
6 100 kHz damped oscillatory magnetic field.....	17
7 1 MHz damped oscillatory magnetic field	18
8 Electrostatic discharge immunity test.....	19
9 Radiated, radio-frequency, electromagnetic field immunity test	20
10 Fast transient/burst immunity test	21
11 Surge immunity test.....	22
12 Immunity to conducted disturbances, induced by radio- frequency fields	23
13 Power frequency immunity.....	24

14	Power frequency magnetic field immunity test.....	25
15	Variations and interruptions to DC power supply	26
16	Earthing condition DC supply and polarity reversal	27
17	Alternating component (ripple) in DC power supply.....	28
18	Variations and interruptions to AC power supply	29
19	Conducted emission CISPR22.....	30
20	Conducted emission FCC part 15.....	31
21	Radiated emission CISPR22.....	32
22	Radiated emission FCC part 15	33
23	Vibration test	34
24	Shock test.....	35
25	Free fall test.....	36
26	Static load test.....	37
27	Cold operation test	38
28	Cold storage test	39
29	Dry heat operation test.....	40
30	Dry heat storage test.....	41
31	Damp-heat test.....	42
32	Impulse voltage test	43
33	Dielectric voltage test	44



APPENDIX A	MEASUREMENT UNCERTAINTIES.....	45
APPENDIX B	MANUFACTURER'S DRAWINGS/DATA SHEET.....	46
APPENDIX C	PHOTOGRAPHS OF THE TEST OBJECT.....	47
APPENDIX D	LIST OF INSTRUMENTS USED.....	49

SUMMARY

By the order of Kyland Technology Co. Ltd., located in Beijing, China, EMC, climatic and mechanical tests were performed on Ethernet Switch type SICOM3024P for use in substation and industrial environments.

Manufacturer Kyland Technology Co. Ltd.
 Type SICOM3024P Ethernet Switch
 Firmware version 1.2.10
 Hardware version 1.4

The SICOM3024P Ethernet Switch tested for use in HV substations and connections to HV equipment according IEC 61850 and IEEE 1613 class.

The following tests are performed with positive test results on the Ethernet Switch, SICOM3024P.

Test program according to IEC 61850-3

Communication networks and systems in substations – Part 3: General requirements (2002-01)

Climatic environmental conditions					
test description	IEC 61850-3 reference	test reference	requirement	test standard	ports
cold operation test	5.2	IEC 60870-2-2 table 1	class C3 (3K7), -40 °C	IEC 60068-2-1-Ad IEC 60721-3-3	F
dry heat operation test	5.2	IEC 60870-2-2	Class Dx, +85 °C	IEC 60068-2-2-Bb IEC 60721-3-3	F
cold storage test	5.2	IEC 60870-2-2 table 1	class C3 (1K5), -40 °C	IEC 60068-2-1-Ab IEC 60721-3-3	F
dry heat storage test	5.2	IEC 60870-2-2 table 1	class Dx, +85 °C	IEC 60068-2-2-Bb IEC 60721-3-3	F
damp heat test	5.3	IEC 60870-2-2 table 1	class C1 (3K5), 95%, 55 °C during 96 hours	IEC 60870-2-2 IEC 60068-2-78 IEC 60721-3-3	F

Mechanical environmental conditions					
test description	IEC 61850-3 reference	test reference	requirement	test standard	ports
stationary vibration	5.5	IEC 60870-2-2 table 3	class B _m (3M4, 4M4)	IEC 60068-2-6 IEC 60721-3-3	F
shock	5.5	IEC 60870-2-2 table 3	class B _m (3M4, 4M4)	IEC 60068-2-27 IEC 60721-3-3	F
free fall	5.5	IEC 60870-2-2 table 3	class C _m (3M6, 4M6)	IEC 60721-3-3 IEC 60068-2-32	F
static load	5.5	IEC 60870-2-2 table 3	class C _m	IEC 60721-3-3	F

Electromagnetic compatibility (EMC)					
test description	IEC 61850-3 reference	test reference	requirement	test standard	ports
immunity to conducted disturbances, induced by radio-frequency field	5.7.1.1	-	0,15 – 80 MHz AM 80% 1 kHz 10 V (un-modulated)	IEC 61000-4-6	A, B, C, E
surge immunity test	5.7.1.2	-	4 kV CM 2 kV DM	IEC/TS 61000-6-5 IEC 61000-4-5	A, B, C, E
100 kHz oscillatory waves	5.7.1.3	-	2,5 kV CM 1 kV DM	IEC 61000-4-12 IEC 61000-4-18	A, B, C, E
1 MHz oscillatory waves	5.7.1.3	-	2,5 kV CM 1 kV DM	IEC 61000-4-12 IEC 61000-4-18	A, B, C, E
fast transient	5.7.1.4	-	4 kV CM 4 kV DM not performed	IEC 61000-4-4 IEC/TS 61000-6-5	A, B, C, E
radiated, radio-frequency, electromagnetic field immunity test	5.7.2	-	0,08 – 2 GHz AM 80% 1 kHz 10 V/m (un-modulated)	IEC 61000-4-3	F
power frequency immunity	5.7.3	-	level 4 30 V cont., 300 V 1 s	IEC 61000-4-16	A, B, C, E
1 MHz damped oscillatory magnetic field	5.7.3	-	30 A/m	IEC 61000-4-10	F
100 kHz damped oscillatory magnetic field	5.7.3	-	30 A/m	IEC 61000-4-10	F

test description	IEC 61850-3 reference	test reference	requirement	test standard	ports
PF magnetic field	5.7.3	-	100 A/m continuous 1000 A/m 1 s to 3 s	IEC 61000-4-8	F
radiated emission	5.8	-	class A & B	CISPR22 FCC part 15	F
conducted emission		-	class A & B	CISPR22 FCC part 15	F
power supply variations, dips and interruptions	6	IEC 60870-2-1 IEC 610004-11 IEC 61000-4-29	AC: 220 V DC: 220V tolerances AC supply, class ACX (+20% to -60%) tolerances DC supply, class DCX (+60% to -40%) interruptions: 100 ms for DC & AC supply dips AC supply class ACX 40% any cycles 70 % any cycles 80 % any cycles dips DC supply class DCX 40% 100 ms 70 % any period 80 % any period		A
polarity reversal	6.3	IEC 60870-2-1 4.3.2	polarity reversal		
earthing condition DC supply	6.5		E+		

Ports

- A Main power supply input
- B 10/100Base Tx electrical Ethernet port
- C Digital input & output ports
- D RS232 console port
- E Functional earth port
- F Housing

Test program according to IEEE 1613

IEEE Standard Environmental and Testing Requirements for Communications Networking Devices in Electric Power Substations (2003)

Climatic environmental conditions					
test description	IEEE 1613 reference	test reference	requirement	test standard	ports
cold operation test	4.1.1	IEEE 1613 clause 4.1.1	-40°C	IEEE 1613 clause 4.1.1	A, B, C, E, F
dry heat operation test	4.1.1	IEEE 1613 clause 4.1.1	+85°C	IEEE 1613 clause 4.1.1	A, B, C, E, F
cold storage test	4.1.2	IEEE 1613 clause 4.1.2	-40°C	IEEE 1613 clause 4.1.2	F
dry heat storage test	4.1.2	IEEE 1613 clause 4.1.2	+85°C	IEEE 1613 clause 4.1.2	F
damp heat test	4.1.3	IEEE 1613 clause 4.1.3	+55°C, 95% during 96 hours	IEEE 1613 clause 4.1.3	A, B, C, E, F

Power inputs					
test description	IEEE 1613 reference	test reference	requirement	test standard	ports
power supply variations	5	IEEE 1613 clause 5.1	1)	IEEE 1613 clause 5.1	A
Alternating component (ripple) in DC power supply	5	IEEE 1613 clause 5.2	ripple 5%	IEEE 1613 clause 5.2	A
1) tolerances DC supply ripple on DC supply tolerances AC supply 24 V; 0,8 Ur - Umax = 28V 5% in range 0,8 Un – Umax 120 V; 85% = 102 V 48 V; 0,8 Ur - Umax = 56V 250 V; 0,8 Ur - Umax = 280V 240 V; 110% = 264 V					

Insulation					
test description	IEEE 1613 reference	test reference	requirement	test standard	ports
dielectric power frequency test	6.2	IEEE 1613 clause 6.2	2,0 kVrms if Ur > 50 V to 250 V 0,5 kV, RJ45	IEEE 1613 clause 6.2 IEEE C 37.90	A, B, C, E
impulse voltage test	6.3	IEEE 1613 clause 6.3	5,0 kV 0,5 kV, RJ45	IEEE 1613 clause 6.3 IEEE C 37.90	A, B, C, E

Electromagnetic compatibility (EMC)					
test description	IEEE 1613 reference	test reference	requirement	test standard	ports
1 MHz oscillatory waves	7	IEEE 1613 clause 7	2,5 kV CM 1 kV DM	IEEE C37.90.1	A, B, C, E
fast transient	7	IEEE 1613 clause 7	4 kV CM	IEEE C37.90.1	A, B, C, E
RF susceptibility	8	IEEE 1613 clause 8	0,08 – 2 GHz AM 80% 1 kHz 20 V/m (un-modulated) 35 V/m (modulated)	IEEE C37.90.2	F
electrostatic discharges	9	IEEE 1613 clause 9	8 kV contact, 15 kV air	IEEE C37.90.3 IEC 61000-4-2	F

Mechanical environmental conditions					
test description	IEEE 1613 reference	test reference	requirement	test standard	ports
stationary vibration	10	IEEE 1613 10, table 14	V.S.2, < 10 mm/s	IEEE C37.1 / IEEE 1613 10, table 14	F
free fall	10	IEEE 1613 10, table 15	height of fall 250 mm	IEEE 1613 10, table 15	F

Ports

- A Main power supply input
- B 10/100Base Tx electrical Ethernet port
- C Digital input & output ports
- D RS232 console port
- E Functional earth port
- F Housing

1 IDENTIFICATION OF THE TEST OBJECT

1.1 Description of the test object

Manufacturer	Kyland Technology Co. Ltd.		
Object description	Ethernet Switch		
Type	SICOM3024P Ethernet Switch		
Sample data			
Variant	Serial number	Firmware version	Hardware version
	S3CGT081238	1.2.10	1.4
	S3CGT081239		

The test samples are selected such that they represent the complete product type since testing all possible hardware and software variants will be impossible. The Report of Performance applies only to the objects tested. The responsibility for conformity of any object having the same designations with that tested rests with the manufacturer.



1.2 List of electronic diagrams, PCB lay-outs, component lists

The manufacturer has guaranteed that the object submitted for tests has been manufactured in accordance with the following electronic diagrams, PCB lay-outs, component lists. KEMA has verified that these electronic diagrams, PCB lay-outs and component lists adequately represents the objects tested.

The following drawings are kept in KEMA's files and are listed for reference only.

document name	reference no.	description
sicom3024P-BOM	KT/PD-0406-16	component lists of all modules included in the SICOM3024P
sicom3024P-fe-sch-v1.1	KT/RD-2426(.0003)-15	schematics of sicom3024P FE board
sicom3024P-FE-PCB-v1.1	KT/RD-2426(.0003)-17	PCB of sicom3024P FE board
sicom3024P-main board-sch-v1.4	KT/RD-2426(.0004)-15	schematics of sicom3024P main board
sicom3024P-main board-PCB-v1.4	KT/RD-2426(.0004)-17	PCB of sicom3024P main board

2 GENERAL INFORMATION

2.1 The tests were witnessed by

Name

Mr. Zhang Guogang

Company

Kyland Technology Co. Ltd.
Beijing, China

2.2 The tests were carried out by

Name

Mr. D.M. van Aartrijk
Mr. H.C. Koerts

Company

KEMA Nederland B.V.,
Arnhem, the Netherlands

2.3 Reference to other reports

Report no.

30820226-Consulting –8-2380

Tests described

Test report of the functional IEC 61850 tests in
Kyland Technology Co. Ltd., SICOM3024P

2.4 Purpose of the test

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

2.5 Measurement uncertainty

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

2.6 Applicable standards

When reference is made to a standard and the date of issue is not stated, this applies to the latest issue, including amendments, which have been officially published prior to the date of the tests.

3 TEST PROCEDURE

The tests are carried out in the following reference conditions unless otherwise mentioned.

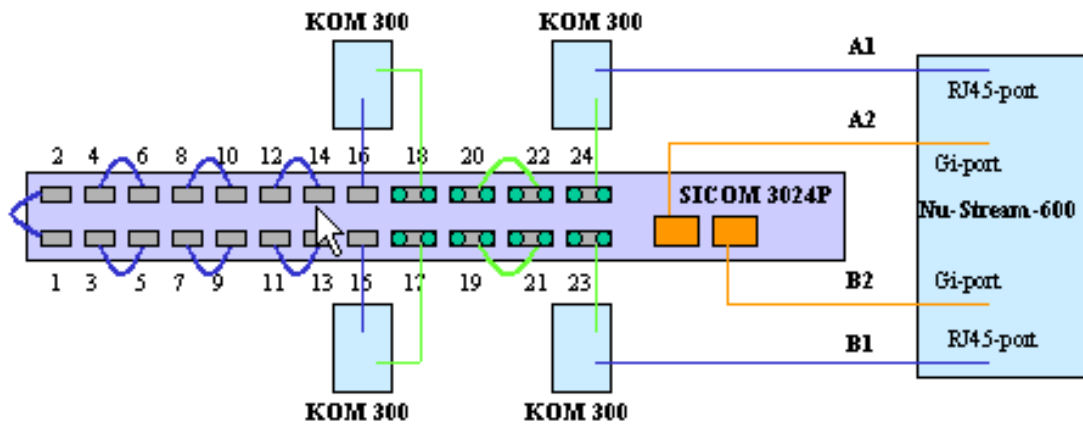
Environmental conditions

Ambient temperature	15 °C to 35 °C
Ambient air pressure	86 kPa to 106 kPa
Relative humidity	30% to 60%

The tests are carried out with auxiliary energizing quantities applied to the appropriate circuits equal to rated values.

3.1 Test set-up

The EUT is connected to a pattern generator in order to monitor correct functioning during tests. Messages are applied with 100% traffic rate. The back ports are looped and VLAN's are configured such that there will be no broadcast storm. RSTP is disabled for this configuration. Traffic entering on link A 1 and A2 flows counter clockwise through the other ports. Traffic entering from link B1 and B2 flows in the opposite direction.



3.2 Performance criteria

According to IEC 61850-3 the equipment shall be considered to have passed the tests if - during or as a result of the tests - all of the following conditions are met for the equipment and the connected devices:

- No hardware damage may occur.
- No change in calibration beyond normal tolerance may be caused by the test.
- No loss or corruption of stored memory or data may occur, including active or stored settings.
- System resets do not occur, and manual resetting is not required.
- Established communications are not permanently lost.
- If disrupted, established communications automatically recover within an acceptable time period.
- Communication errors, if they occur, do not jeopardize the protective or control functions.
- No changes in the states of the electrical, mechanical, or communication signal outputs occur. This includes alarms and status outputs.
- No erroneous, permanent change of state of the visual, audible, or message outputs may occur. Momentary changes in these outputs during the tests are permitted.
- No error outside the normal tolerances for data communication signals (SCADA analogues) may occur.

IEEE 1613 defines two performance classes:

Class 1

This performance class is for communications devices used for general-purpose substation communications where temporary loss of communications and/or communications errors can be. All devices shall meet class 1 requirements unless the user or manufacturer specifies class 2.

Class 2

This performance class is for communications devices used in substation communications where it is desired to have error-free, uninterrupted communications.

According to IEEE 1613 during and after the tests, the equipment and the connected devices shall be completely and accurately functional as designed, unless otherwise stated by the manufacturer.

The following conditions are to be met by both Class 1 and Class 2 devices:

- No hardware damage may occur.
- No loss or corruption of stored memory or data, including active or stored settings, may occur.
- Device resets may not occur, and manual resetting is not required.
- No changes in the states of the electrical, mechanical, or communication status outputs may occur. These outputs include alarms, status outputs, or targets.
- There may be no erroneous, permanent change of state of the visual, audio, or message outputs results. Momentary changes of these outputs during the tests are permitted.
- No error outside normal tolerances of the data communication signals (e.g., SCADA analogs) may occur.

4 1 MHZ OSCILLATORY WAVE IMMUNITY TEST

Standard and date

Generic standards IEC 61850-3, IEEE 1613
 Test standards IEC 61000-4-12; IEC 61000-4-18, ANSI IEEE C37.90.1
 Test dates 30 October 2008

Characteristic test data

Sample S3CGT081238
 Trise 75 ns \pm 20%, between 10% and 90% of Up
 Thalf between 3rd and 6th period of main frequency
 Oscillation frequency 1 MHz \pm 10%
 Repetition frequency 400 Hz
 Generator impedance 200 Ω \pm 20% resistive at 1 MHz
 Test time 2 s
 Coupling From each terminal of a circuit to earth, other terminal floating, common mode (CM1).
 Between the terminals of a circuit, generator common grounded, differential mode (DM1).

circuit	terminals	coupling	test voltage (kV)	remark
PSU	230 VAC/VDC	CM1	2,5	passed
	230 VAC/VDC	DM1	1,0	passed
RJ-45 ports	16	CM1	2,5	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies to class 2 of IEEE 1613.

5 100 KHZ OSCILLATORY WAVE IMMUNITY TEST

Standard and date

Generic standards IEC 61850-3
 Test standards IEC 61000-4-12; IEC 61000-4-18
 Test dates 30 October 2008

Characteristic test data

Sample S3CGT081238
 Trise 75 ns \pm 20%, between 10% and 90% of Up
 Thalf between 3rd and 6th period of main frequency
 Oscillation frequency 100 kHz \pm 10%
 Repetition frequency 400 Hz
 Generator impedance 150 Ω \pm 20% resistive at 100 kHz
 Test time 2 s
 Coupling From each terminal of a circuit to earth, other terminal floating, common mode (CM1)
 Between the terminals of a circuit, generator common grounded, differential mode (DM1)

circuit	terminals	coupling	test voltage (kV)	remark
PSU	230 VAC/VDC	CM1	2,5	passed
	230 VAC/VDC	DM1	1,0	passed
RJ-45 ports	16	CM1	2,5	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed.

6 100 KHZ DAMPED OSCILLATORY MAGNETIC FIELD

Standard and date

Generic standards IEC 61850-3
Test standards IEC 61000-4-10
Test dates 29 October 2008

Characteristic test data

Sample S3CGT081238
Frequency 100 kHz
Decay rate 50% of the peak value after 3 to 6 cycles
Repetition rate 40 transients
Output current range 0,1 A to 1 A (coil factor 100)
Test time 2 s

circuit	test level (A/m)	duration (s)	remark
transversal	30	2	passed
longitudinal	30	2	passed
vertical	30	2	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies to level 4 of IEC 61000-4-10.

7 1 MHZ DAMPED OSCILLATORY MAGNETIC FIELD

Standard and date

Generic standards	IEC 61850-3
Test standards	IEC 61000-4-10
Test dates	29 October 2008

Characteristic test data

Sample	S3CGT081238
Frequency	1 MHz
Decay rate	50% of the peak value after 3 to 6 cycles
Repetition rate	400 transients
Output current range	0,1 A to 1 A (coil factor 100)
Test time	2 s

circuit	test level (A/m)	duration (s)	remark
transversal	30	2	passed
longitudinal	30	2	passed
vertical	30	2	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies with level 4 of IEC 61000-4-10.

8 ELECTROSTATIC DISCHARGE IMMUNITY TEST

Standard and date

Generic standards IEC 61850-3, IEEE 1613
 Test standards IEC 61000-4-2, ANSI IEEE C37.90.3
 Test dates 28 October 2008

Characteristic test data

Sample S3CGT081238
 Trise 0,7 – 1,05 ns
 Thalf 60 ns
 Number of discharges 10 positive and negative
 Repetition rate at least 1 s between discharges
 Coupling Air discharges on insulated points
 Contact discharges on metal point
 Indirect discharges

Overview test points

test point	method	test voltage (kV)	remarks
on all accessible points of the equipment	contact	8	passed
on all accessible points of the equipment	air	15	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies with class 2 of IEEE 1613.

9 RADIATED, RADIO-FREQUENCY, ELECTROMAGNETIC FIELD IMMUNITY TEST

Standard and date

Generic standards IEC 61850-3
 Test standards IEC 61000-4-3
 Test dates 6 November 2008

Characteristic test data

Sample S3CGT081238
 Frequency range 80 MHz – 2,0 GHz
 Modulation AM, 1 kHz (sine wave) 80%
 Sweep time $1,5 * 10^{-3}$ decade/s
 Test points 200 per octave (logarithmic distribution)
 Dwell time frequency sweep 2 s

direction	frequency (kHz)	test level (V/m)	remarks
transversal	80 – 1000	10	passed
	1000 - 2000	10	passed
longitudinal	80 – 1000	10	passed
	1000 - 2000	10	passed
vertical	80 – 1000	10	passed
	1000 - 2000	10	passed

Requirements

Normal performance within the specification limits (see clause 3.2 “Performance criteria”).

Result

The test is passed.

10 FAST TRANSIENT/BURST IMMUNITY TEST

Standard and date

Generic standards IEC 61850-3, IEEE 1613
 Test standards IEC 61000-4-4, ANSI IEEE C37.90.1
 Test dates 28 October 2008

Characteristic test data

Sample S3CGT081238
 Trise 5 ns ± 30%
 Thalf 50 ns ± 30%
 Burst duration 15 ms ± 20%
 Period time 300 ms ± 20%
 Repetition rate 2,5 kHz ± 20%
 Polarity positive and negative
 Test duration 1 minute
 Maximum energy 4 mJ / pulse at 2 kV into 50 Ω
 Coupling Common mode direct coupling (CM1)
 Common mode capacitive coupling with a clamp (CM2)
 Common mode capacitive coupling with aluminum foil (CM3)
 Transversal mode (TM1)

circuit	terminals	coupling	test voltage (kV)	remark
PSU	230 VAC/VDC	CM1	4,0	passed
	230 VAC/VDC	TM1	4,0	passed
RJ45-ports	port 1-2, 7-9, 12-14	CM2	2,0	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies to class 2 of IEEE 1613.

11 SURGE IMMUNITY TEST

Standard and date

Generic standards IEC 61850-3
 Test standards IEC 61000-4-5
 Test dates 28 October 2008

Characteristic test data

Sample S3CGT081239
 $T_{rise_voltage}$ 1,2 μ s
 $T_{half_voltage}$ 50 μ s
 $T_{rise_current}$ 8 μ s
 $T_{half_current}$ 20 μ s
 Source impedance 2 Ω
 Number of pulses 5 positive and 5 negative
 Delay time between pulses 1 minute delay between the impulses
 Coupling Power supply terminals
 From the terminals of a circuit to earth (L-E.1 via 10 Ω in series with 9 μ F)
 Between the terminals of a circuit (L-L.1 via 18 μ F)
I/O terminals
 From the terminals of a circuit to earth (L-E.2 via 40 Ω in series with 0,5 μ F)
 Between the terminals of a circuit (L-L.2 via 40 Ω in series with 0,5 μ F)
Shielded interconnection lines at both ends
 Surge injection on the shield (L-E.3)

circuit	terminals	coupling	phase position (°)	test voltage (kV)	remark
PSU	230 VAC/VDC	L-E.1	0, 90, 180, 270	4,0	passed
	230 VAC/VDC	L-L.1	0, 90, 180, 270	2,0	passed
RJ45-ports	port 1-2	L-E.2	n.a.	4,0	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed.

12 IMMUNITY TO CONDUCTED DISTURBANCES, INDUCED BY RADIO-FREQUENCY FIELDS

Standard and date

Generic standards IEC 61850-3
 Test standards IEC 61000-4-6
 Test dates 6 November 2008

Characteristic test data

Sample S3CGT081238
 Frequency range 150 kHz – 80 GHz
 Spot frequencies 27 MHz, 68 MHz
 Modulation AM, 1 kHz (sine wave) 80%
 Sweep time $1,5 * 10^{-3}$ decade/s
 Test points 200 per octave (logarithmic distribution)
 Dwell time frequency sweep 1 s
 Testing time spot frequencies 10 s
 Output impedance 50 Ω
 Output class flatness ± 1 dB (un)controlled
 Harmonic and distortion ≤ -20 dB below carrier class

circuit	terminals	CDN	frequency (MHz)	test voltage (V)	remark
PSU	230 VAC/VDC	CDN	0,15 – 80	10	passed
RJ45-ports	port 16	clamp	0,15 – 80	10	passed

Requirements

Normal performance within the specification limits (see clause 3.2 “Performance criteria”).

Result

The test is passed.

13 POWER FREQUENCY IMMUNITY

Standard and date

Generic standards IEC 61850-3
 Test standards IEC 61000-4-16
 Test dates 4 November 2008

Characteristic test data

Sample S3CGT081238
 Mode continuous
 Duration 30 s
 Frequency 50 Hz
 Output impedance generator < 150 Ω
 On/off mode slowly increase and decrease
 Coupling R = 200 Ω, C = 1 μF (CM1)
 R = 50 Ω (CM2)

circuit	terminals	coupling	test voltage (V)	duration (s)	remark
PSU	230 VAC/VDC	CM1	30	continuous	passed
			300	1	passed
RJ45-ports	port 16	CM1	30	continuous	passed
			300	1	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed.

14 POWER FREQUENCY MAGNETIC FIELD IMMUNITY TEST

Standard and date

Generic standards TS IEC 61000-6-5
Test standards IEC 61000-4-8
Test dates 4 November 2008

Characteristic test data

Sample S3CGT081238
Output current test generator 1 to 10 A
Frequency 50 Hz
Coil factor 100
Maximum distortion current 8%

direction	test level (A/m)	duration	remarks
transversal	100	continuous	passed
	1000	3 seconds	passed
longitudinal	100	continuous	passed
	1000	3 seconds	passed
vertical	100	continuous	passed
	1000	3 seconds	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed.

15 VARIATIONS AND INTERRUPTIONS TO DC POWER SUPPLY

Standard and date

Generic standards IEC 61850-3
Test standards IEC 60870-2-1, IEC 61000-4-29
Test dates 30 October 2008

Characteristic test data

Sample S3CGT081239

power supply voltage	observation	result
230 VDC + 60%, 352 VDC	correct functioning	passed
230 VDC - 40%, 132 VDC	correct functioning	passed

power supply voltage (VDC)	interruption (ms)	dip (%)	observation	result
220 VDC	165	0, 40, 70, 80	correct functioning	passed
110 VDC	150	0, 40, 70, 80	correct functioning	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed.

16 EARTHING CONDITION DC SUPPLY AND POLARITY REVERSAL

Standard and date

Generic standards IEC 61850-3
Test standards IEC 60870-2-1- 4.3.2
Test dates 30 October 2008

Characteristic test data

Sample S3CGT081239

power supply voltage	observation reversed voltage / polarity reversal	result
130 VDC	earthing condition DC supply E+	passed
130 VDC	polarity reversal	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed.

17 ALTERNATING COMPONENT (RIPPLE) IN DC POWER SUPPLY

Standard and date

Generic standards	IEEE 1613
Test standards	IEC 61000-4-17
Test dates	30 October 2008

Characteristic test data

Sample	S3CGT081239
Ripple	5% of rated DC voltage

A ripple of 5% of rated DC Voltage will not exceed the maximum tested and allowed voltage of 352 VDC. For this reason the test is not performed.

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies with class 2 of IEEE 1613.

18 VARIATIONS AND INTERRUPTIONS TO AC POWER SUPPLY

Standard and date

Generic standards IEC 61850-3
 Test standards IEC 60870-2-1, IEC 61000-4-11
 Test dates 30 October 2008

Characteristic test data

Sample S3CGT081239

power supply voltage	observation	result
AC 220 V (+20 % to -60%) class ACX	correct functioning	passed

power supply voltage (VAC)	interruption (ms)	dip (%)	observation	result
230 VAC	10	0	correct functioning	passed
	200	40	correct functioning	passed
	500	70	correct functioning	passed
	5000	80	correct functioning	passed
	< 165	0	correct functioning	passed
110 VAC	< 145	0	correct functioning	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed.

19 CONDUCTED EMISSION CISPR22

Standard and date

Generic standards IEC 61850-3
 Test standards CISPR22
 Test dates 26 November 2008

Characteristic test data

Sample S3CGT081238
 Class A and B
 Auxiliary power supply 230 VAC
 Test frequency band 150 kHz to 30 MHz

frequency (MHz)	quasi peak (dB(μV))			average (dB(μV))		
	level	phase	limit	level	phase	limit
0,2475	47,9	L1	61,9	35	N	51,8
0,495	38,5	N	56,1	-	-	-
2,0175	42,5	L1	56	34,6	L1	46

Requirements

CISPR22 Class B.

frequency (MHz)	limit quasi peak (dB(μV))	limit average (dB(μV))
0,15 – 0,5	66 - 56	56 - 46
0,5 – 5	56	46
5 – 30	60	50

Result

The test is passed. The SICOM3024P complies with class A and B of EN 55022.

20 CONDUCTED EMISSION FCC PART 15

Standard and date

Generic standards IEC 61850-3
 Test standards FCC part 15
 Test dates 26 November 2008

Characteristic test data

Sample S3CGT081238
 Class A and B
 Auxiliary power supply 115 VAC
 Test frequency band 150 kHz to 30 MHz

frequency (MHz)	quasi peak (dB(μV))			average (dB(μV))		
	level	phase	limit	level	phase	limit
0,165	48,5	L1	65,2	40,8	N	55,1
2,0775	42,2	L1	56	35,9	L1	46
1,13750	41,3	L1	56	37,8	L1	46

Requirements

FCC part 15 class B.

frequency (MHz)	limit quasi peak (dB(μV))	limit average (dB(μV))
0,15 – 0,5	66 - 56	56 - 46
0,5 – 5	56	46
5 – 30	60	50

Result

The test is passed. The SICOM3024P complies with class A and B of FCC part 15.

21 RADIATED EMISSION CISPR22

Standard and date

Generic standards IEC 61850-3
 Test standards CISPR22
 Test dates 3 November 2008

Characteristic test data

Sample S3CGT081238
 Class A and B
 Auxiliary power supply 230 VAC
 Test frequency band 30 MHz to 1000 MHz

frequency (MHz)	antenna position	measured level 10 m (dB(μV/m))	limit value 10 m (dB(μV/m))	remarks
500	vertical	29,6	36,4	passed
179,7	vertical	28,6	33,5	passed
437,49	horizontal	28,0	36,4	passed

Requirements

CISPR22 Class B.

frequency (MHz)	limit quasi peak (dB(μV))
30 - 230	30,0
230 - 1000	37,0

Result

The test is passed. The SICOM3024P complies to class A and B of CISPR22.

22 RADIATED EMISSION FCC PART 15

Standard and date

Generic standards IEC 61850-3
 Test standards FCC part 15B
 Test dates 3 November 2008

Characteristic test data

Sample S3CGT081238
 Class A and B
 Auxiliary power supply 230 VAC
 Test frequency band 30 MHz to 1000 MHz

frequency (MHz)	antenna position	measured level 10 m (dB(μV/m))	limit value 10 m (dB(μV/m))	remarks
500	vertical	29,6	36,4	passed
179,7	vertical	28,6	33,5	passed
437,49	horizontal	28,0	36,4	passed

Requirements

FCC part 15B class B.

frequency (MHz)	limit quasi peak (dB(μV))
30 – 88	29,1
88 – 216	33,5
216 – 960	36,4
960 – 1000	39,5

Result

The test is passed. The SICOM3024P complies to class A and B of FCC part 15B.

23 VIBRATION TEST

Standard and date

Generic standards IEC 61850-3, IEEE 1613
Test standards IEC 60870-2-2; IEC 60721-3-3, IEC 60721-4-3
Test dates 24 till 25 November 2008

Characteristic test data

Sample S3CGT081239
Class Bm (3M4, 4M4)
Test object energized
Frequency range / displacement / acceleration 2-9 Hz 3 mm / 9-200 Hz 1g / 200-500 Hz 1,5 g
Number of sweeps per axis 20

axis	observation	remarks
transversal	correct functioning	passed
longitudinal	correct functioning	passed
vertical	correct functioning	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies to class Bm (3M4, 4M4) of IEC 60721-3-3.

24 SHOCK TEST

Standard and date

Generic standards IEC 61850-3, IEEE 1613
 Test standards IEC 60870-2-2; IEC 60721-3-3, IEC 60721-4-3
 Test dates 24 till 25 November 2008

Characteristic test data

Sample S3CGT081239
 Class Bm (3M4, 4M4)
 Test object energized
 Peak acceleration 10 gn
 Pulse duration 11 ms
 Directions positive and negative
 Number of pulses per direction 3

axis	shock	observation	remarks
transversal	positive	correct functioning	passed
	negative	correct functioning	passed
longitudinal	positive	correct functioning	passed
	negative	correct functioning	passed
vertical	positive	correct functioning	passed
	negative	correct functioning	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies to class Bm (3M4,4M4) of IEC 60721-3-3.

25 FREE FALL TEST

Standard and date

Generic standards IEC 61850-3, IEEE 1613
Test standards IEC 60870-2-2; IEC 60721-3-3, IEC 60721-4-3
Test dates 24 till 25 November 2008

Characteristic test data

Sample S3CGT081239
Class Cm (3M6, 4M6)
Test object non-energized
Position bottom side down
Fall distance 25 cm
Number of tests 1

test	observation	remarks
free fall	correct functioning before test and after test	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria") after the test.

Result

The test is passed. The SICOM3024P complies to class Cm (3M6, 4M6) of IEC 60721-3-3.

26 STATIC LOAD TEST

Standard and date

Generic standards IEC 61850-3
Test standards IEC 60870-2-2; IEC 60721-3-3, IEC 60721-4-3
Test dates 24 till 25 November 2008

Characteristic test data

Sample S3CGT081239
Test object non-energized
Load 5 kPa, 51 gr/cm²
Direction vertical
Duration 1 minute

test	observation	remarks
static load	correct functioning before test and after test	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria") after the test.

Result

The test is passed. The SICOM3024P complies to class Cm (3M6, 4M6) of IEC 60721-3-3.

27 COLD OPERATION TEST

Standard and date

Generic standards IEC 61850-3, IEEE 1613
Test standards IEC 60870-2-2; IEC 60068-2-1, IEC 60721-3-3
Test dates 29 October 2008

Characteristic test data

Sample S3CGT081238
Class C3(3K7)
Test object energized
Test Ad
Temperature -40 °C
Test time 16 hours
Max. rate of change 1 °C/min over a 5 min period

After 16 hours at -40 °C a functional test is performed. At the end of the climatic environmental tests the high voltage-withstand test, insulation resistance test and impulse test are performed (see clause 31 and 32 of this report).

test	observation	remarks
cold operation	correct functioning	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies to class C3(3K7) of IEC 60721-3-3, IEEE 1613 clause 4.1.1 and IEC 60068-2-1.

28 COLD STORAGE TEST

Standard and date

Generic standards IEC 61850-3, IEEE 1613
Test standards IEC 60870-2-2; IEC 60068-2-1, IEC 60721-3-3, IEC 60721-4-3
Test dates 29 October 2008

Characteristic test data

Sample S3CGT081238
Class C3 (1k5)
Test object non-energized
Test Ab
Temperature -40,0 °C
Test time 16 hours
Max. rate of change 1 °C/min over a 5 min period

After the cold storage test a functional test is performed at ambient temperature. At the end of the climatic environmental tests the high voltage-withstand test, insulation resistance test and impulse test are performed (see clause 31 and 32 of this report).

test	observation	remarks
cold storage	correct functioning	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria") after the test.

Result

The test is passed. The SICOM3024P complies to class C3 (1K5) of IEC 60721-3-3, IEEE 1613 clause 4.1.2 and IEC 60068-2-1.

29 DRY HEAT OPERATION TEST

Standard and date

Generic standards	IEC 61850-3, IEEE 1613
Test standards	IEC 60870-2-2; IEC 60068-2-2, IEC 60721-3-3, IEC 60721-4-3
Test dates	31 October 2008

Characteristic test data

Sample	S3CGT081238
Class	Dx
Test object	energized
Test	Bb
Temperature	+85 °C
Test time	16 hours
Max. rate of change	1 °C/min over a 5 min period

After 16 hours at +85 °C accuracy tests are performed. At the end of the climatic environmental tests the high voltage withstand test, insulation resistance test and impulse test are performed (see clause [31](#) and [32](#) of this report).

test	observation	remarks
dry heat operation	correct functioning	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies to class Dx of IEC 60721-3-3, IEEE 1613 clause 4.1.1 and IEC 60068-2-2.

30 DRY HEAT STORAGE TEST

Standard and date

Generic standards IEC 61850-3, IEEE 1613
Test standards IEC 60870-2-2; IEC 60721-3-3, IEC 60721-4-3, IEC 60068-2-2;
Test dates 31 October 2008

Characteristic test data

Sample S3CGT081238
Class Dx
Test object non-energized
Test Bb
Temperature +85 °C
Test time 16 hours
Max. rate of change 1 °C/min over a 5 min period

After the dry heat storage test an accuracy test is performed at ambient temperature. At the end of the climatic environmental tests the high voltage-withstand test, insulation resistance test and impulse test are performed (see clause [31](#) and [32](#) of this report).

test	observation	remarks
dry heat storage	correct functioning	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria") after the test.

Result

The test is passed. The SICOM3024P complies to class Dx of IEC 60721-3-3, IEEE 1613 clause 4.1.2 and IEC 60068-2-2.

31 DAMP-HEAT TEST

Standard and date

Generic standards IEC 61850-3, IEEE 1613
Test standards IEC 60870-2-2; IEC 60721-3-3, IEC 60721-4-3, IEC 60068-2-78
Test dates 30 October 2008

Characteristic test data

Sample S3CGT081238
Class C1(3K5)
Test object energized
Test Cab
Temperature +55°C / +25°C
Humidity 95%
Test time 4 days

After 2 days at +55 °C / +25 °C / 95% a functional test is performed. At the end of the climatic environmental tests the high voltage-withstand test, insulation resistance test and impulse test are performed (see clause [31](#) and [32](#) of this report).

test	observation	remarks
damp heat	correct functioning	passed

Requirements

Normal performance within the specification limits (see clause 3.2 "Performance criteria").

Result

The test is passed. The SICOM3024P complies to class C1 (3K5) of IEC 60721-3-3, IEEE 1613 clause 4.1.3 and IEC 60068-2-30.

32 IMPULSE VOLTAGE TEST

Standard and date

Generic standards IEEE 1613, IEEE C37.90
 Test standards IEC 60255-5
 Test dates 4 November 2008

Characteristic test data

Sample S3CGT081238
 Trise $1,2 \mu\text{s} \pm 30\%$
 Thalf $50 \mu\text{s} \pm 20\%$
 Output impedance 500Ω
 Output energy $0,5 \text{ J} \pm 10\%$
 Number of pulses 3 positive and 3 negative
 Pulse interval $\geq 1 \text{ s}$
 Test leads $\leq 2 \text{ m}$
 Method

- between each circuit (or each group of circuits) specified for the same impulse voltage and the exposed conductive parts at the impulse voltage specified for this circuit (or this group of circuits);
- between independent circuits, the terminals of each independent circuit being connected together.

circuit	terminals	insulation resistance (GΩ)	test voltage (kV)	insulation resistance (GΩ)	remarks
PSU	230 VAC/VDC	> 2	5	> 2	passed
RJ45 port	port 9-10, 11-12, 13-14, 15-16	> 2	0,5	> 2	passed

Requirements

No disruptive discharges or flashovers shall occur and normal performance within the specification limits (see clause 3.2 "Performance criteria") after the test.

Result

The test is passed. The SICOM3024P complies with IEC 60255-5.

33 DIELECTRIC VOLTAGE TEST

Standard and date

Generic standards IEEE 1613, IEEE C37.90
 Test standards IEC 60255-5
 Test dates 4 November 2008

Characteristic test data

Sample S3CGT081238
 Frequency 50 Hz
 Duration 1 minute
 Method

- between each circuit (or each group of circuits) specified for the same impulse voltage and the exposed conductive parts at the impulse voltage specified for this circuit (or this group of circuits);
- between independent circuits, the terminals of each independent circuit being connected together.

circuit	terminals	insulation resistance (GΩ)	test voltage (kV)	insulation resistance (GΩ)	remarks
PSU	230 VAC/VDC	> 2	2	> 2	passed
RJ45 port	port 11, 14	> 2	0,5	> 2	passed

Requirements

No breakdown or flashover shall occur.

Result

The test is passed. The SICOM3024P complies with IEC 60255-5.

APPENDIX A MEASUREMENT UNCERTAINTIES

The measurement uncertainties in the results presented are as specified below unless otherwise indicated.

measurement	measurement uncertainty
dielectric tests and impulse current tests	peak value: $\leq 3\%$ time parameters: $\leq 10\%$
measurement of insulation resistance	$\leq 10\%$
measurement of temperature	-50 °C - -40 °C : 3 K -40 °C - 125 °C : 2 K 125 °C - 150 °C : 3 K
Humidity (climatic test)	2%

APPENDIX B MANUFACTURER'S DRAWINGS/DATA SHEET

Reference Model : SICOM3024P
P/N : 0000000000
S/N : S3CGT081198
Hardware version : 1.4
Software version : 1.2.10

The following documents describe the tested SICOM3024P.

description/title	date	rev.
Overview of the sicom3024P for KEMA sn KT/RD-2426-36	11-10-2008	0.1
SICOM3024P Series Industrial Ethernet Switches User's Manual No. KT/PD-0406-SM-v1.0	01-01-2007	V1
Component list of sicom3024P sn KT/RD-0406-16	01-11-2008	V1.4
Sicom3024P FE board's PCB sn KT/RD-2426(.0003)-17	11-11-2008	V1.1
Sicom3024P FE board's Schematic sn KT/RD-2426(.0003)-15	11-11-2008	V1.1
Sicom3024P mainboard's PCB sn KT/RD-2426(.0004)-17	11-11-2008	V1.4
Sicom3024P mainboard's Schematic sn KT/RD-2426(.0004)-15	11-11-2008	V1.4

APPENDIX C PHOTOGRAPHS OF THE TEST OBJECT



Electrostatic discharge



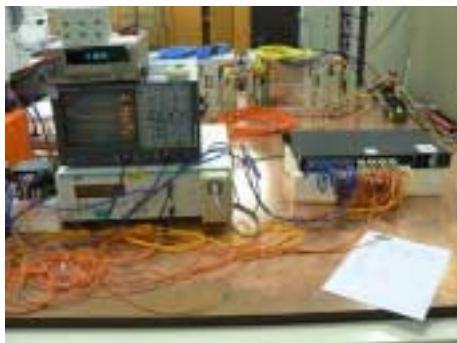
Fast transient



100 kHz / 1 MHz burst immunity



Surge test



Interruption in power supply



Conducted emission



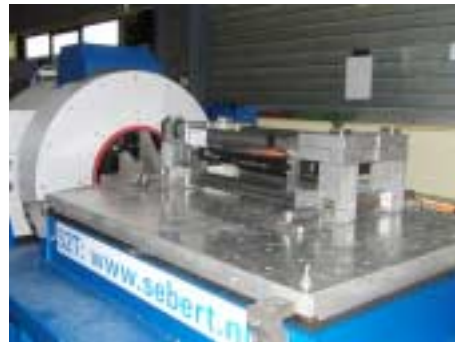
Conducted emission CISPR22



Conducted RF interference



Radiated emission



Vibration test horizontal



Vibration test vertical



Free fall test

APPENDIX D LIST OF INSTRUMENTS USED

No.	Description	Manufacturer	Type	Company code
1	Pattern generator	Nu_streams	NuStream-600	04NS06C00032
2	Signal generator	Rhode & Schwarz	SMT-03	116893
3	Amplifier	Bonn Electronic	BSA 0122-20	116519
4	Sensor	Rhode & Schwarz	URV5-Z4	116892
5	Power meter	Rhode & Schwarz	NRV5	116684
6	Attenuator	JFE IND	50FH-006-100	117828
7	CDN 801	Luthi	M3	116635
8	CDN 801	Luthi	M2	116636
9	CDN 801	Luthi	S1	77964
10	GTEM	EMCO	5317	116529
11	Anechoic room	-	-	118125
12	EMC test generator	EM-Test	ESD30	105167
13	EMC test generator	EM-Test	EFT500	105169
14	Capacitive coupling clamp	EM-Test	HFK	105168
15	Surge test generator	EM-Test	UCS-500	
16	Power fail simulator	EM-Test	PFS500	105166
17	Autotransformer	KEMA	0-230V	6285
18	H-field coil	KEMA	100 turns	116513
19	Relay tester	Haefely	P3	78261
20	CDN	Haefely	FP 10/3-2	78262
21	Climate test chamber	CTS GMBH	C-40/350	87055
22	Antenna	Swarzbeck	VULB 9161	116982
23	Powermeter	Rhode & Schwarz	NVRS	-
24	Digital multimeter	Hewlett Packard	973A	105164
25	Oscilloscope	Yokogawa	DL 1640	105217
26	Line imped. stab netw	Rhode & Schwarz	ESH3-Z5	77959
27	Impulse test generator	EM-Test	MIG0603OS2	105333
28	Receiver	ESHS 10	840046/08	117863
29	Receiver	ESU	126351	
30	Zweileiter	ESH3-Z5	893540/009	117864
31	Signal generator	Rhode & Schwarz	SMT03	118565
32	Amplifier	AR	150W1000	117929
33	Amplifier	AR	60S1G3	118859
34	Receiver	Rhode & Schwarz	ESU26	126351

35	CDN	Luthi	M3	116635
36	Inject clamp	Luthi	EM101	117251
37	Current probe amp.	Tektronix	AM503	-
38	Current probe	Tektronix	A6303	-
39	Digital multimeter	Hewlett Packard	973A	105163
40	Receiver	Rhode & Schwarz	ESVS10	78086
41	Shaker	Dactron Dual DSP		-