REPORT OF PERFORMANCE TIC 1509-12

OBJECT	Bay Computer		
TYPE	Alstom C264	**SERIAL Nos.**	32214625

U_{aux} : 110 to 125 VDC

MANUFACTURER	Alstom Grid, Stafford, United Kingdom
CLIENT	Alstom Grid, Stafford, United Kingdom
TESTED BY	KEMA HIGH-VOLTAGE LABORATORY Arnhem, the Netherlands
DATE OF TESTS	23 August to 29 October 2012
TEST PROGRAMME	Selected tests in accordance with IEC 60255-1 (2009), TS IEC 61000-6-5 (2001) see page 9 and 10.
SUMMARY AND CONCLUSION	The test object passed the test. See page 4 for a detailed summary.

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 48 pages in total.

KEMA Nederland B.V.

S.A.M. Verhoeven
Director Testing, Inspections & Certification The Netherlands

Arnhem, 18 February 2013

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SUMMARY

By the order of Alstom Grid, located in Stafford, United Kingdom, EMC tests and dielectric tests were performed on a bay computer, type Alstom C264 for use in power plant and substation environments.

Manufacturer	Alstom Grid, Stafford, United Kingdom
Type	Bay computer Alstom C264
Software version	Software Version B6.56K1

The test object is tested for use in high voltage substations and connections to high voltage equipment according to IEC 60255-1.

Test standard	**Tests**	**Class**
IEC 60255-1	EMC immunity	Performance class A
	EMC emission	Class A
IEC 60721-3-3	Environmental condition	Normal class 1

The tests described in chapter 3.1 are performed on the test object with positive test results.

1 IDENTIFICATION OF THE TEST OBJECT

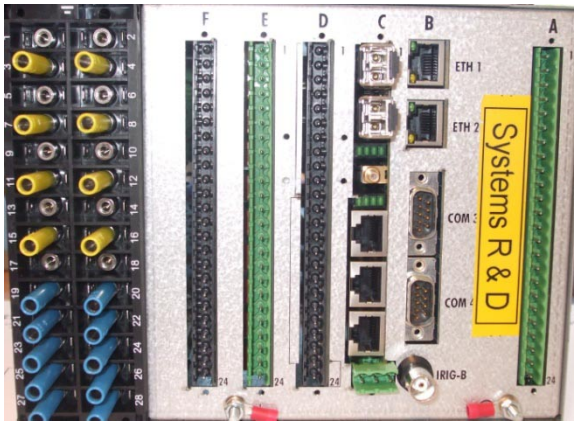
1.1 Description of the test object

Manufacturer	Alstom Grid
Object description	Bay Computer
Type	Alstom C264
Software version	The tests are performed on DS Agile 5.0.x software version B6.56K1 includes: IEC61850 agency version: 5.13F_13 ISaGraf software version: 5.12 MiCOM Alstom S1 version: M4.2I Triangle software version: 3.00.0025 BSP version: / B0.21I Date: sep 2012
Modules	An overview of the modules included in each sample is given in appendix B of this report.

The test samples are selected so that they represent the complete product type since testing of all possible hardware and software variants will be impossible.

The responsibility for conformity of any object having the same designations with that tested rests with the Manufacturer.

Test object



C264

1.2 List of documents

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

The following documents are only listed for reference and are kept in KEMA's files:

Board	Reference number	title
AIU211	2071652	AIU211 2071652_A8_layer1.pdf
		FDFC2071652 C p1.pdf
BIU241	2070879A03	BIU241 2070879A03_E2_Layer 1.pdf
		FDFC2070879E_P1.pdf
BUS 8 slots	2071600A01	BUS 8 Slots 2071600A01_A1_Layer 1.pdf
		fdfc2071600a01ap1.pdf
DIU211	2071669	DIU211 2071669_C1_Layer 1.pdf
		fdfc2071669dp1.pdf
DOU201	2071730A01	DOU201 2071730A01_B3_Layer 1.pdf
		fdfc2071730a01ap1.pdf
DSP260	2070871	DSP260 2070871_C1_Layer 1.pdf
		FDFC2070871H.pdf
GHU240	2070894	GHU240 2070894_H2_Layer 1.pdf
		FDFC2070894K.pdf
TMU220	2071613A01	TMU220 2071613A01_E5.pdf
		fdfc2071613_E.pdf
CPU270	ZP0001003	PCB ASSY CPU 270 board 21/08/2012
		ZP0001_1.pdf
		BOM 30/04/2012
		ZP0001003_A.pdf
SRP	ZP0015001	BOM latest change 27/07/2012
		ZP0015001_Issue_C0_dev.pdf
		SRP Board 26/06/2012
		FDFC_ZP0015_BO_collage.pdf

1.3 Ratings and tolerances

The ratings and tolerances are declared by the manufacturer in the following technical specifications:

type	document	title	issue/ date
DS Agile 5.0.0	PS01	Product specifications	26/09/2012
DS Agile 5.0.0	PS02	System Devices and functional arrangements	26/09/2012

2 GENERAL INFORMATION

2.1 The tests were witnessed by

The tests were not witnessed.

2.2 The tests were carried out by

Name	Company
Mr D. van Aartrijk	KEMA Nederland B.V., Arnhem, the Netherlands

2.3 Subcontracting

The following tests were subcontracted to DEKRA.:
- Conducted emission.
- Radiated emission.

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	12 to 35	°C
Air pressure	86 to 106	kPa
Relative humidity	10 to 75	%

The tests are carried out with auxiliary energizing quantities applied to the appropriate circuits equal to rated values.
All tests are executed with traceable calibrated test equipment. Before each test a confidence check is performed of the test setup.

3.1 Test program

3.1.1 Test program according to client specification

no.	description	standard	level	ports
1	dc voltage variations	-	110 V – 20% 125 V + 20%	A (DC)
2	dc voltage interruption	IEC 60255-11 IEC 61000-4-29	10 .. 5000 ms	A (DC)
3	dc voltage dip	IEC 60255-11 IEC 61000-4-29	40%, 200 ms 70%, 500 ms	A (DC)
4	ripple on dc voltage	IEC 60255-11 IEC 61000-4-17	15% on Umin and Umax	A (DC)
5	gradual shut down / start up	IEC 60255-11	-	A (DC)
6	reverse polarity	IEC 60255-11	-	A (DC)
7	damped oscillatory wave immunity	IEC 60255-22-1 IEC 61000-4-18	2,5 kV CM 1,0 kV DM	ABCDEFG ABCDEFG
8	fast transient immunity	IEC 60255-22-4 IEC 61000-4-4	4 kV 5&100 kHz 2 kV 5&100 kHz	AH BCDEFG
9	conducted emission	CISPR 22 IEC 60255-22-25	class A	A
10	radiated emission	CISPR 22	class A	I
11	conducted RF immunity	IEC 60255-22-6 IEC 61000-4-6	10 V	ABCDEFG

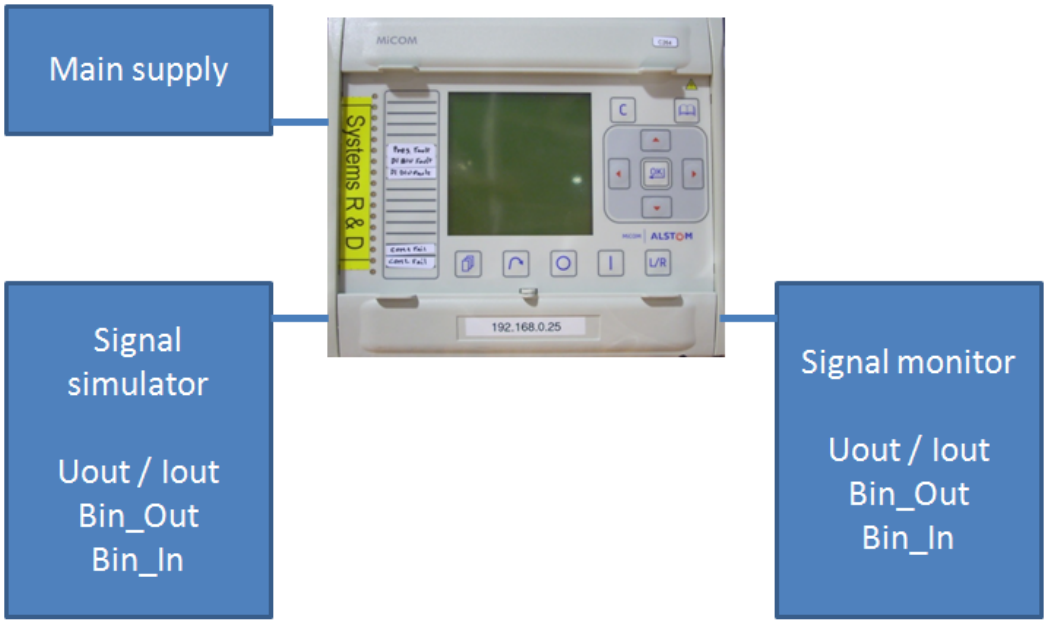
no.	description	standard	level	ports
12	radiated RF immunity	IEC 60255-22-3 IEC 61000-4-3 C37.90.2	80 MHz – 2,7 GHz	I
13	electrostatic discharge immunity	IEC 60255-22-2 IEC 61000-4-2 C37.90.3	15 kV air 8 kV contact 15 kV indirect	I (front with and without cover)
14	surge immunity	IEC 60255-22-5 IEC 61000-4-5	4 kV LE 2 kV LL	ABCDEFG ABCDEFG
15	power frequency magnetic field immunity	IEC 61000-4-8	100 A/m cont. 1000 A/m 3 s	I I
16	pulsed magnetic field immunity	IEC 61000-4-9	1000 A/m	I
17	damped oscillatory magnetic field immunity	IEC 61000-4-10	100 A/m 2 s both 1 MHz and 100 kHz	I
18	cold operation and storage	EN 60068-2-1	-25 °C / 96 h storage -25 °C / 96 h operation	I
19	dry heat operation and storage	EN 60068-2-2	+55 °C / 96 h operation +70 °C / 96 h operation	I
20	cyclic change of temperature, operation	EN 60068-2-14	5 cycles +55 °C / 3 h -25 °C / 3 h	I
21	cyclic temperature with humidity, operation	EN 60068-2-30	5 cycles +55 °C 93 % rh / 12 h +25 °C 93 % rh / 12 h	I

Port identification

Port A	Power supply
Port B	CT inputs
Port C	VT inputs
Port D	Binary (opto) inputs
Port E	Binary (relay) outputs
Port F	TIme sync (IRIG-B)
Port G	Process communication ports
Port H	Functional earth port
Port I	Housing

3.2 Test set-up

The test object is connected to signal simulation set that simulates the different input signals. A PC-monitor system and signal monitor is connected the test object for correct functioning during tests.



3.3 Performance criteria

<table>
<tr><td rowspan="2">functions [1]</td><td colspan="3">functional requirements versus electromagnetic phenomena</td></tr>
<tr><td>continuous phenomena</td><td>transient phenomena with high occurrence</td><td>transient phenomena with low occurrence</td></tr>
<tr><td>protection and teleprotection [2]</td><td colspan="3" rowspan="3">normal performance within the specification limits</td></tr>
<tr><td>on-line processing and regulation</td></tr>
<tr><td>metering</td></tr>
<tr><td>command and control</td><td rowspan="4"></td><td></td><td>short delay [4]</td></tr>
<tr><td>supervision</td><td></td><td>temporary loss self recovered [5]</td></tr>
<tr><td>man-machine interface</td><td></td><td>stop and reset [6]</td></tr>
<tr><td>alarm</td><td colspan="2">short delay [7], temporary wrong indication</td></tr>
<tr><td>data transmission and telecommunication [3]</td><td rowspan="5">normal performance within the specification limits</td><td>no loss, possible bit error rate degradation [8]</td><td>temporary loss [8]</td></tr>
<tr><td>data acquisition and storage</td><td colspan="2">temporary degradation [5], [9]</td></tr>
<tr><td>measurement</td><td colspan="2">temporary degradation, self recovered [10]</td></tr>
<tr><td>off-line processing</td><td>temporary degradation [10]</td><td>temporary loss and reset [10]</td></tr>
<tr><td>passive monitoring</td><td>temporary degradation</td><td>temporary loss</td></tr>
<tr><td>self-diagnosis</td><td colspan="2">temporary loss, self recovered [11]</td></tr>
</table>

1) For the application of the performance criteria to apparatus with multiple functions, as well as for concurrent functions (e.g. supervision and monitoring), the performance related to the most critical function applies.
2) For teleprotection using power line carrier, the "normal performance" during the switching of HV isolators may need an appropriate validation procedure.
3) Used in automation and control systems as auxiliary function to other ones, e.g. to implement co-ordination.
4) A delay of a duration, which is insignificant compared to the time constant of the controlled process, is acceptable.
5) Temporary loss of data acquisition and deviation in event scheduling time is accepted, but correct events sequence shall be maintained.
6) Manual restoration by operators is allowed.
7) With respect to the degree of urgency (not to the process).
8) Temporary bit error rate degradation can affect the communication efficiency; automatic restoration of any stoppage of the communication is mandatory.
9) No effect on stored data or processing accuracy.
10) Without affecting the measurement accuracy of analogue or digital indication.
11) Within the system diagnostic cycle.

4 ELECTROMAGNETIC COMPATIBILITY (EMC) TESTS

4.1 Damped oscillatory wave immunity test (1 MHz)

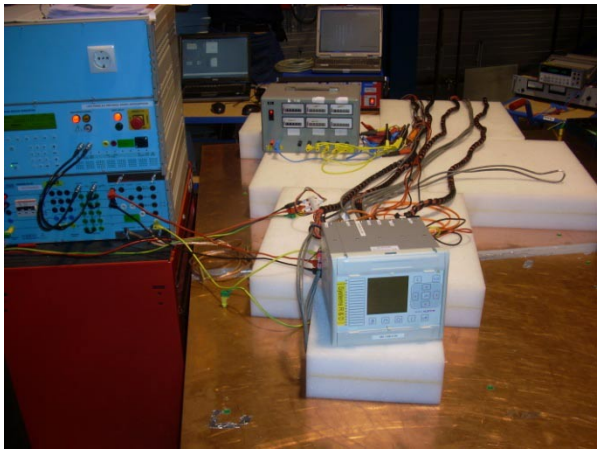
Standard and date

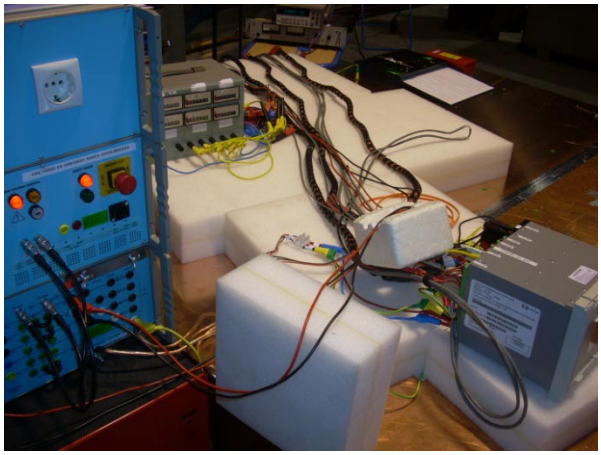
Generic standards	IEC 60255-1, IEC 60255-26, TS IEC 61000-6-5
Test standards	IEC 60255-22-1, IEC 61000-4-18
Test date	5 September 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Trise	75 ns ± 20%, between 10% and 90% of Up
Thalf	between 3rd and 6th period of main frequency
Oscillation frequency	1 MHz ± 10%
Repetition frequency	400 Hz
Generator impedance	200 Ω ± 20% resistive at 1 MHz
Burst time	10 s
Number of bursts	3 positive and 3 negative
Pause time	10 s
Coupling	From each terminal of a circuit to earth, other terminal floating, common mode (CM1). Between the cable connections of communication ports and earth (CM2). On the screening of a screened cable (CM3). Between the terminals of a circuit, generator common floating, differential mode (DM1).

Test set-up





Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Results C264

circuit	terminals	coupling	test voltage (kV)	result
BIU241-PSU	BIU241-23/24/22	CM1	2,5	passed
BIU241-PSU	BIU241-23-24	DM1	1,0	passed
TMU220-CT IA 1A	TMU220 15-16/case	CM1	2,5	passed
TMU220-CT IA 1A	TMU220 15-16	DM1	1,0	passed
TMU220-CT IB 1A	TMU220 11-12/case	CM1	2,5	passed
TMU220-CT IB 1A	TMU220 11-12	DM1	1,0	passed
TMU220-CT IC 1A	TMU220 7-8/case	CM1	2,5	passed
TMU220-CT IC 1A	TMU220 7-8	DM1	1,0	passed
TMU220-U busbar 2	TMU220 19-20/case	CM1	2,5	passed
TMU220-U busbar 2	TMU220 19-20/	DM1	1,0	passed
TMU220-VT input UN	TMU220 27-28/case	CM1	2,5	passed
TMU220-VT input UN	TMU220 27-28	DM1	1,0	passed
BIU241 watchdog	BIU241 5-6/case	CM1	2,5	passed
BIU241 watchdog	BIU241 5-6	DM1	1,0	passed
DOU201 OUT 1	DOU 1-2/case	CM1	2,5	passed
DOU201 OUT 1	DOU 1-2	DM1	1,0	passed
DOU201 OUT 4	DOU 7-8/case	CM1	2,5	passed
DOU201 OUT 4	DOU 7-8	DM1	1,0	passed
DOU201 OUT 9	DOU 21-19/case	CM1	2,5	passed
DOU201 OUT 9	DOU 21-19	DM1	1,0	passed
AIU211 I1, I5	AIU cable 1	CM3	2,5	passed
AIU211 I2, I6	AIU cable 2	CM3	2,5	passed
AIU211 I3, I7	AIU cable 3	CM3	2,5	passed
AIU211 I4, I8	AIU cable 4	CM3	2,5	passed
DIU211 IN1..16	DIU cable	CM3	2,5	passed

The Alstom C264 passed the test.

4.2 Electrostatic discharge immunity test

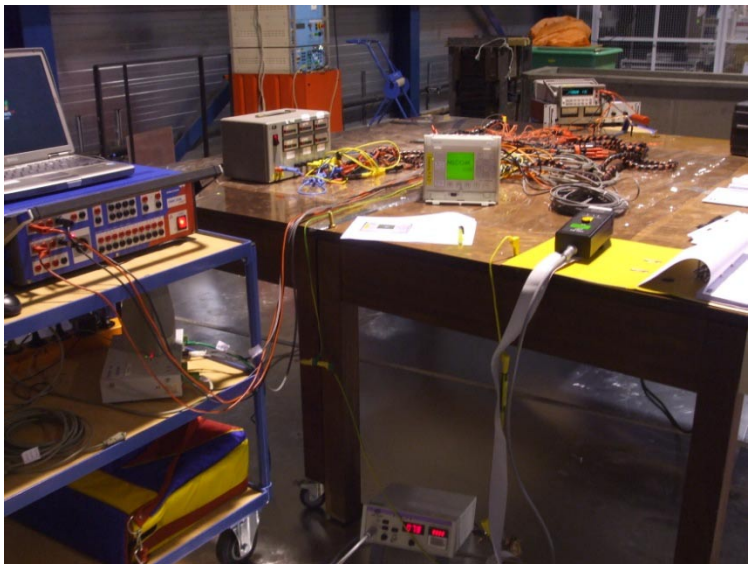
Standard and date

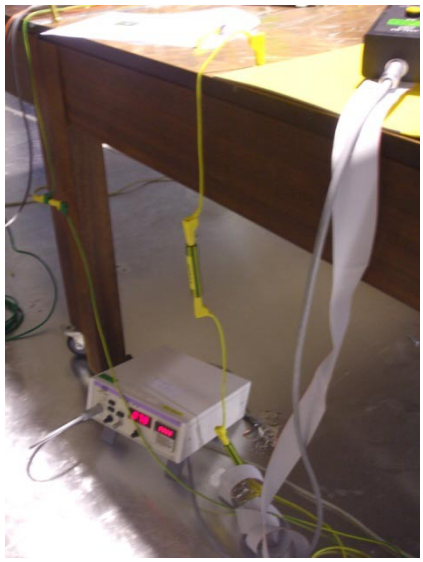
Generic standards	IEC 60255-1, TS IEC 61000-6-5
Test standards	IEC 60255-22-2, IEC 61000-4-2, IEEE C37.90.3
Test date	3 September and 29 October 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Class	4
Contact discharges	8 kV
Air discharges	15 kV
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.

Test set-up





Overview test points

Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Results C264

method	test point see picture	test voltage (kV)	result
air discharges	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	+15 -15	passed passed

The communication port located on the front panel is also tested. According to IEC 61000-4-2:2009 clause 8.3.2 it might be disputable testing this communication port.
The outcome of this test is that positive contact discharges on the chassis (point A in figure above) of the communication port may lead to a restart of the C264.

The Alstom C264 passed the test.

4.3 Radiated, radio-frequency, electromagnetic field immunity test

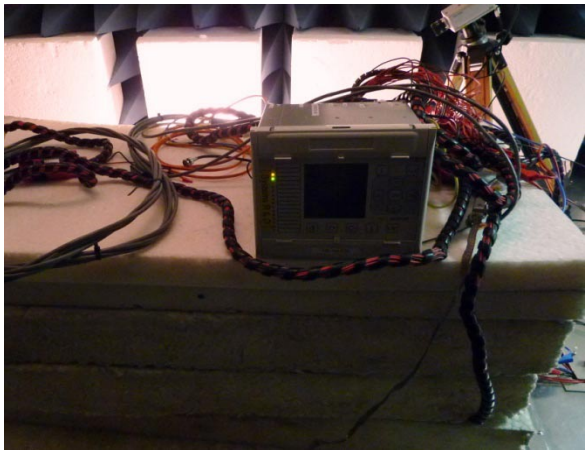
Standard and date

Generic standards	IEC 60255-1, TS IEC 61000-6-5
Test standards	IEC 60255-22-3, IEC 61000-4-3, IEEE 37.90.2
Test date	25 September 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Sweep test	
Frequency range	80 MHz – 2,7 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	1,0 s
Keying test	
Frequency range	80 MHz – 1,0 GHz
Modulation	PM, 100%
ON/OFF time	0,5 s ON and 0,5 s OFF
Spot frequencies	
Frequencies	80 MHz; 160 MHz; 380 MHz; 450 MHz; 900 MHz ; 1,85 GHz ; 2,15 GHz
Modulation	AM, 1 kHz (sine wave) 80%
Frequencies	900 MHz
Modulation	PM, 200 Hz 50% duty cycle
Dwell time	10 s

Test set-up



Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Results C264

direction	frequency (MHz)	test level (before modulation) (V/m)	result
x both sides of EUT (horizontal & vertical polarization)	80 – 1000	20	passed
	1000 - 2700	10	passed
	80; 160; 450; 900 (AM) 1850; 2150 (AM)	20 10	passed
	80 – 1000 (PM)	20	passed
y both sides of EUT (horizontal & vertical polarization)	80 – 1000	20	passed
	1000 - 2700	10	passed
	80; 160; 450; 900 (AM) 1850; 2150 (AM)	20 10	passed
	80 – 1000 (PM)	20	passed
z both sides of EUT (horizontal & vertical polarization)	80 – 1000	20	passed
	1000 - 2700	10	passed
	80; 160; 450; 900 (AM) 1850; 2150 (AM)	20 10	passed
	80 – 1000 (PM)	20	passed

The Alstom C264 passed the test.

4.4 Fast transient/burst immunity test

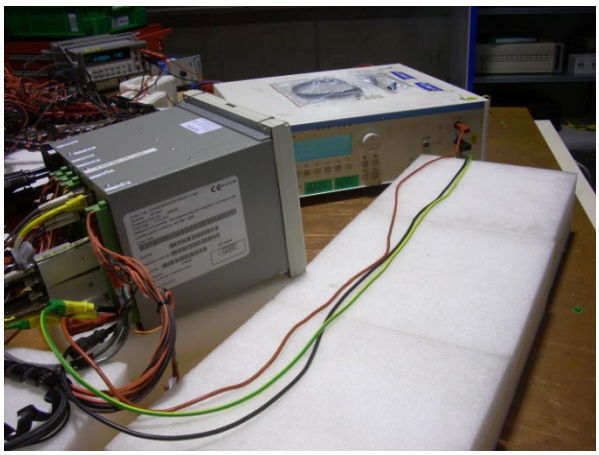
Standard and date

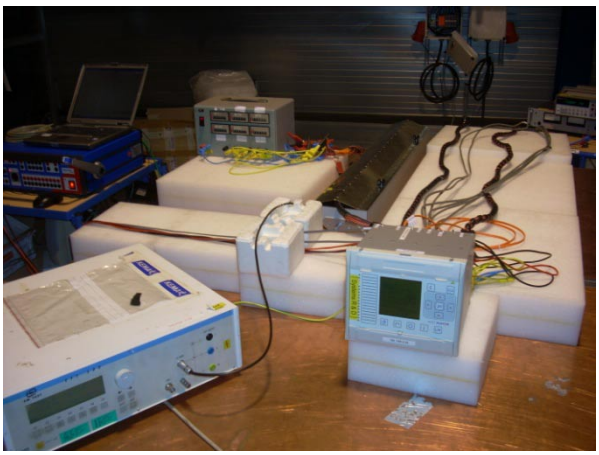
Generic standards	IEC 60255-1, TS IEC 61000-6-5
Test standards	IEC 60255-22-4, IEC 61000-4-4
Test date	4 September

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Level	3 / 4
Trise	5 ns ± 30%
Thalf	50 ns ± 30%
Burst duration	15 ms ± 20% (rep. rate 5,0 kHz) 0,75 ms ± 20% (rep. rate 100,0 kHz),
Period time	300 ms ± 20%
Repetition rate	5,0 kHz ± 20% and 100,0 kHz according to IEC 61000-4-4
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) Transversal mode (T1)

Test set-up





Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Results C264

circuit	terminals	coupling	repetition frequency (kHz)	test voltage (kV)	result
BIU241-PSU	BIU241-23/24/22	CM1	5 & 100	+ 4,0	passed
BIU241-PSU	BIU241-23/24	CM1	5 & 100	- 4,0	passed
BIU241-PSU	BIU241-23/24	CM1	5 & 100	+ 4,0	passed
BIU241-PSU	BIU241-23/24/22	CM1	5 & 100	- 4,0	passed
BIU241-PSU	BIU241-22	CM1	5 & 100	+ 4,0	passed
BIU241-PSU	BIU241-22	CM1	5 & 100	- 4,0	passed
BIU241 DI&DO cable	unscreened cable	clamp	5 & 100	+ 2,0	passed
BIU241 DI&DO cable	unscreened cable	clamp	5 & 100	- 2,0	passed
BIU241 COM2	screened cable	clamp	5 & 100	+ 2,0	passed
BIU241 COM2	screened cable	clamp	5 & 100	- 2,0	passed
AIU211 IN1..8	unscreened cable	clamp	5 & 100	+ 2,0	passed
AIU211 IN1..8	unscreened cable	clamp	5 & 100	- 2,0	passed
DOU201 OUT1..10	unscreened cable	clamp	5 & 100	+ 2,0	passed
DOU201 OUT1..10	unscreened cable	clamp	5 & 100	- 2,0	passed
DIU211 IN1..16	unscreened cable	clamp	5 & 100	+ 2,0	passed
DIU211 IN1..16	unscreened cable	clamp	5 & 100	- 2,0	passed
TMU220 CT & VT IN	unscreened cable	clamp	5 & 100	+ 2,0	passed
TMU220 CT & VT IN	unscreened cable	clamp	5 & 100	- 2,0	passed

The Alstom C264 passed the test.

4.5 Surge immunity test

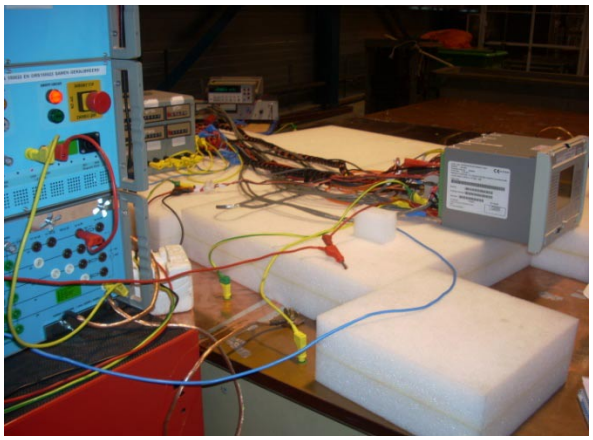
Standard and date

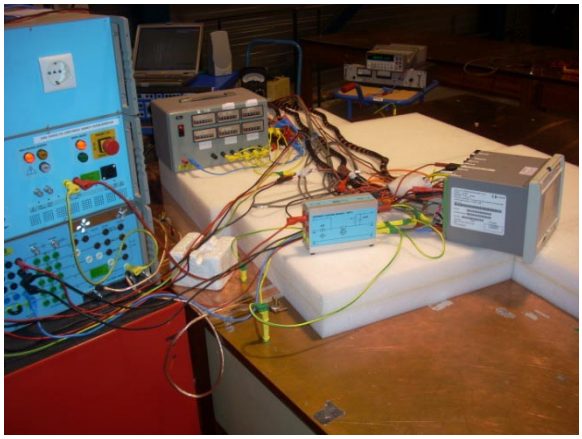
Generic standards	IEC 60255-1, TS IEC 61000-6-5
Test standards	IEC 60255-22-5 and IEC 61000-4-5
Test date	11, 12 and 13 September 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Trise_voltage	1,2 µs for PSU and alarm port
Thalf_voltage	50 µs for PSU and alarm port
Trise_current	8 µs
Thalf_current	20 µs
Source impedance	2 Ω for PSU and alarm port / 25 Ω for telecom lines
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 10Ω in series with 9 µF). Between the terminals of a circuit (L-L.1 via 18 µF). I/O terminals: From the terminals of a circuit to earth (L-E.2 via 40Ω in series with 0,5 µF). Between the terminals of a circuit (L-L.2 via 40Ω in series with 0,5 µF). Shielded interconnection lines at both ends: Surge injection on the shield (L-E.3).

Test set





Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Results C264

circuit	terminals	coupling	phase position (°)	test voltage (kV)	result
BIU241-PSU	BIU241-22/23/24	L-E.1	n.a.	+4	passed
BIU241-PSU	BIU241-22/23/24	L-E.1	n.a.	-4	passed
BIU241-PSU	BIU241-23-24	L-L.1	n.a.	+2	passed
BIU241-PSU	BIU241-23-24	L-L.1	n.a.	-2	passed
TMU220-CT IC 1A	TMU220 7-8	L-E.2	n.a.	+4	passed
TMU220-CT IC 1A	TMU220 7-8	L-E.2	n.a.	-4	passed
TMU220-CT IB 5A	TMU220 9-10	L-E.2	n.a.	+4	passed
TMU220-CT IB 5A	TMU220 9-10	L-E.2	n.a.	-4	passed
TMU220-VT input Ua	TMU220 21-22	L-E.2	n.a.	+4	passed
TMU220-VT input Ua	TMU220 21-22	L-E.2	n.a.	-4	passed
TMU220-VT input Ua	TMU220 21-22	L-L.2	n.a.	+2	passed
TMU220-VT input Ua	TMU220 21-22	L-L.2	n.a.	-2	passed
TMU220-VT input Uc	TMU220 25-26	L-E.2	n.a.	+4	passed
TMU220-VT input Uc	TMU220 25-26	L-E.2	n.a.	-4	passed
TMU220-VT input Uc	TMU220 25-26	L-L.2	n.a.	+2	passed
TMU220-VT input Uc	TMU220 25-26	L-L.2	n.a.	-2	passed
BIU241 Red. inp. 2	BIU 8-9	L-E.2	n.a.	+4	passed
BIU241 Red. inp. 2	BIU 8-9	L-E.2	n.a.	-4	passed
BIU241 Red. inp. 2	BIU 8-9	L-L.2	n.a.	+2	passed
BIU241 Red. inp. 2	BIU 8-9	L-L.2	n.a.	-2	passed
BIU241 Red. inp. 1	BIU 7-8	L-E.2	n.a.	+4	passed
BIU241 Red. inp. 1	BIU 7-8	L-E.2	n.a.	-4	passed
BIU241 Red. inp. 1	BIU 7-8	L-L.2	n.a.	+2	passed
BIU241 Red. inp. 1	BIU 7-8	L-L.2	n.a.	-2	passed
DIU211 IN 8	DIU 11-12	L-E.2	n.a.	+4	passed
DIU211 IN 8	DIU 11-12	L-E.2	n.a.	-4	passed
DIU211 IN 8	DIU 11-12	L-L.2	n.a.	+2	passed
DIU211 IN 8	DIU 11-12	L-L.2	n.a.	-2	passed
BIU241 watchdog	BIU 4-6	L-E.2	n.a.	+4	passed
BIU241 watchdog	BIU 4-6	L-E.2	n.a.	-4	passed
DOU201 OUT 5	DOU 9-10	L-E.2	n.a.	+4	passed
DOU201 OUT 5	DOU 9-10	L-E.2	n.a.	-4	passed
AIU211 I1..8	screened cable	L-E.3	n.a.	+4	passed

circuit	terminals	coupling	phase position (°)	test voltage (kV)	result
AIU211 I1..8	screened cable	L-E.3	n.a.	-4	passed
BIU241 COM1	screened cable	L-E.3	n.a.	+4	passed
BIU241 COM1	screened cable	L-E.3	n.a.	-4	passed
CPU270-ETH1-2	screened cable	L-E.3	n.a.	+4	passed
CPU270-ETH1-2	screened cable	L-E.3	n.a.	-4	passed

The Alstom C264 passed the test.

4.6 Immunity to conducted disturbances, induced by radio-frequency fields

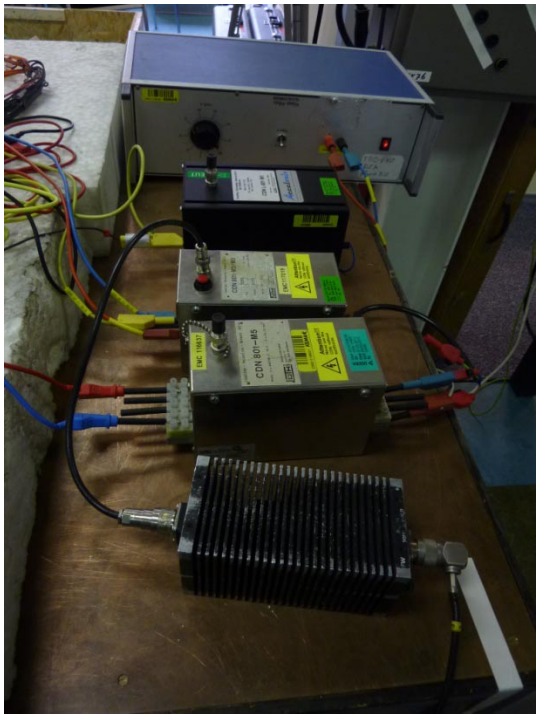
Standard and date

Generic standards	IEC 60255-1, TS IEC 61000-6-5
Test standards	IEC 60255-22-6, IEC 61000-4-6
Test date	24 September 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Frequency range	150 kHz – 80 MHz
Modulation	AM, 1 kHz (sine wave) 80%
Step size	1%
Dwell time	1 s
Spot frequencies	Clock frequencies 27 MHz and 68 MHz
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

Test set-up



Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Results C264

circuit	terminals	coupling	frequency (MHz)	test voltage (V)	result
BIU241 PSU	BIU241-23/24/22	CDN801-M3	0,15 – 80	10	passed
			27	10	
			68	10	
BIU241 COM1..2	BIU241-12-21/22	Clamp	0,15 – 80	10	passed
			27	10	
			68	10	
BIU241 Red. inp. 1..2	BIU241-7-8-9	Clamp	0,15 – 80	10	passed
			27	10	
			68	10	
BIU241 Red.outp. 1..2	BIU241-1-2-3	Clamp	0,15 – 80	10	passed
			27	10	
			68	10	
BIU241 watchdog	BIU241-4-5	Clamp	0,15 – 80	10	passed
			27	10	
			68	10	
CPU270 ETH1-2	CPU270-ETH1..2	Clamp	0,15 – 80	10	passed
			27	10	
			68	10	
CPU270 COM3..4	CPU270 COM2..4	Clamp	0,15 – 80	10	passed
			27	10	
			68	10	
CPU 270 IRIG-B	CPU270 IRIG-B	Clamp	0,15 – 80	10	passed
			27	10	
			68	10	
TMU220 CT 5 A inputs	TMU220-1, 2, 5, 6, 9 ,10, 13, 14	CDN801-M5	0,15 – 80	10	passed
			27	10	
			68	10	
TMU220 VT inputs	TMU220-19-28	CDN801-M5	0,15 – 80	10	passed
			27	10	
			68	10	
DIU211 IN1..16	DIU211-1-24	Clamp	0,15 – 80	10	passed
			27	10	
			68	10	
DOU201 OUT1..10	DOU201-1-24	Clamp	0,15 – 80	10	passed
			27	10	
			68	10	

circuit	terminals	coupling	phase position (°)	test voltage (V)	result
AIU211 I1..8	AIU211-1..24	Clamp	0,15 – 80	10	passed
			27	10	
			68	10	

The Alstom C264 passed the test.

4.7 Power frequency magnetic field immunity test

Standard and date

Generic standards	IEC 60255-1, TS IEC 61000-6-5
Test standards	IEC 61000-4-8
Test date	30 October 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Frequency	50 Hz
Maximum distorsion	8%

Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Test setup

Results C264

circuit	test level (A/m)	duration (s)	result
transversal (x)	100	10	passed
	1000	3	passed
longitudinal (y)	100	10	passed
	1000	3	passed
vertical (z)	100	10	passed
	1000	3	passed

The Alstom C264 passed the test.

4.8 Pulsed magnetic field immunity test

Standard and date

Generic standard	-
Test standard	IEC 61000-4-9
Test date	1 November 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Rise time	6,4 µs ± 30%
Duration	16 µs ± 30%

Test setup

Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Results C264c 80TE

circuit	test level (A/m)	result
transversal (x)	1000	passed
longitudinal (y)	1000	passed
vertical (z)	1000	passed

The Alstom C264 passed the test.

4.9 Damped oscillatory magnetic field immunity test

Standard and date

Generic standard	-
Test standard	IEC 61000-4-10
Test date	31 October 2012

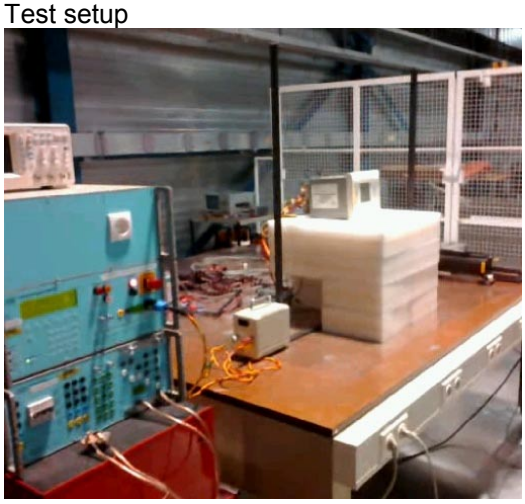
Characteristic test data

Sample	C264
Mains power supply	110 VDC
Oscillation frequency	0,1 MHz and 1 MHz ± 10%
Decay rate	50% of the peak value after 3 to 6 cycles
Repetition rate	continuous
Duration	5 s

Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Test setup



Results C264

circuit	test level (A/m)	oscillation frequency (MHz)	result
transversal (x)	100	0,1	passed
	100	1,0	passed
longitudinal (y)	100	0,1	passed
	1000	1,0	passed
vertical (z)	100	0,1	passed
	100	1,0	passed

The Alstom C264 passed the test.

4.10 Voltage dips, short interruptions, variations and ripple on auxiliary power supply port

Standard and date

Generic standards	IEC 60255-1, TS IEC 61000-6-5
Test standards	IEC 60255-11, IEC 61000-4-17, IEC 61000-4-29
Test date	30 August 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC to 125 VDC

Test set-up

Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

criterion	function	criterion for acceptance
A	protection	normal performance within the specification limits, during and after the test
	command and control	normal performance within the specification limits, during and after the test
	measurement	temporary degradation during test, with self-recovery at the end of the test. No loss of stored data
	integral human-machine interface and visual alarms	temporary degradation during test, with self-recovery at the end of the test. No loss of stored data
	data communication	possible bit error rate increase but no loss of transmitted data
C	protection	normal performance within the specification limits, or a predefined behavior, e.g. temporary loss of function or switch-off, which is clearly specified by the manufacturer until normal operation is automatically resumed. There shall be no unwanted operation.
	command and control	normal performance within the specification limits, or a predefined behavior, e.g. temporary loss of function or switch-off, which is clearly specified by the manufacturer until normal operation is automatically resumed. There shall be no unwanted operation.
	measurement	temporary degradation during test, or a predefined behavior, e.g. temporary loss of function, which is clearly specified by the manufacturer until normal operation is automatically resumed.
	integral human-machine interface and visual alarms	temporary degradation during test, or a predefined behavior, e.g. temporary loss of function or switch-off, which is clearly specified by the manufacturer until normal operation is automatically resumed.

Results C264

Voltage variation

power supply voltage (VDC)	variation (%) / (VDC)	duration	criterion	results
110	-20 / 88,0	continuous	A	passed
125	+20 / 150,0	continuous	A	passed

Voltage dips

power supply voltage (VDC)	residual voltage (%) / (VDC)	duration (ms)	criterion	results
110	0 / 0	10, 20, 50, 100, 300	A normal operation	passed
110	0 / 0	300, 500, 1000	C restart	passed
110	40 / 44	200	C normal operation	passed
110	70 / 77	500	C normal operation	passed

Voltage interruptions

power supply voltage (VDC)	residual voltage (%) / (VDC)	duration (ms)	condition	criterion	results
110	0 / 0	50	high impedance	C restart	passed
125	0 / 0	50	high impedance	C restart	passed

Alternating component

power supply voltage (VDC)	residual voltage (%) / (Vpp)	ripple frequency (Hz)	duration (min)	criterion	results
110	15 / 16,5	100	2	C normal operation	passed
125	15 / 18,75	100	2	C normal operation	passed

Gradual shut-down/start-up

power supply voltage (VDC)	test	duration (s)	criterion	results
110	shut-down	60	C	passed
110	shut-off duration	300	C	passed
110	start-up	60	C	passed
110	operation	-	A	passed

Reversal of DC power supply polarity

power supply voltage (VDC)	test	duration (s)	criterion	results
110	reverse polarity	60	C	passed

The Alstom C264 passed the test.

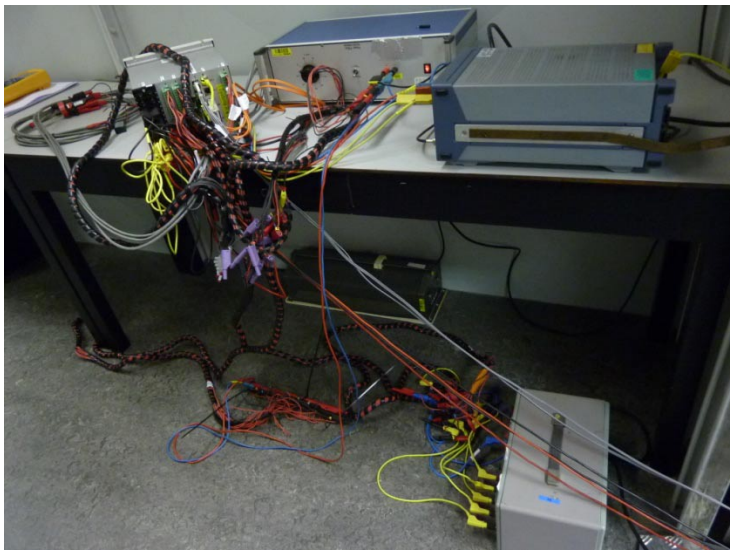
4.11 Conducted emission

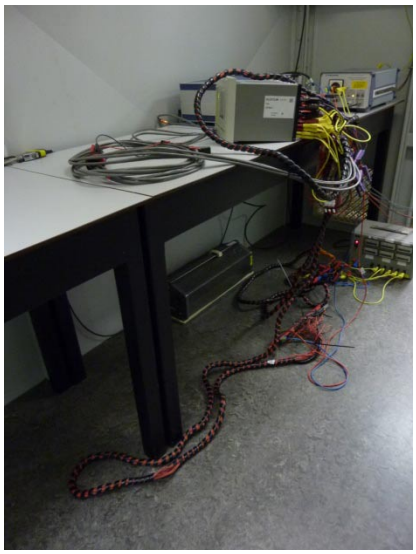
Standard and date

Generic standard	IEC 60255-1
Test standards	IEC 60255-25, CISPR22
Test dates	25 September 2012

Characteristic test data

Sample	C264
Class	A
Mains power supply	110 VDC to 125 VDC
Test frequency band	150 kHz to 30 MHz





Requirements

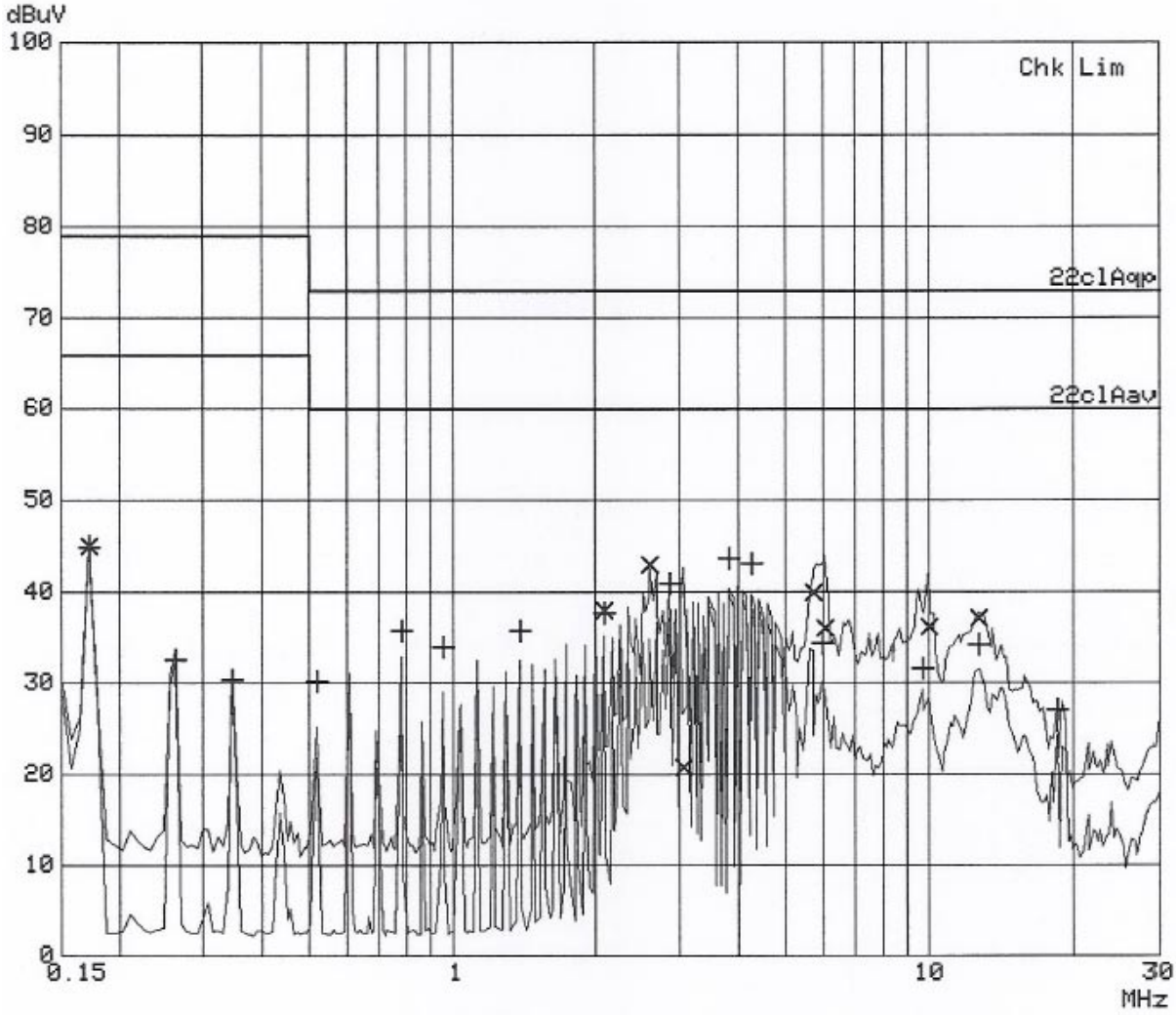
Mains CISPR 22 Class A

frequency (MHz)	limit quasi peak (dB(µV))	limit average (dB(µV))
0,15 – 0,5	79	66
0,5 – 30,0	73	60

Telecommunication ports CISPR 22 Class A

frequency (MHz)	limit quasi peak (dB(µV))	limit average (dB(µV))
0,15 – 0,5	97 to 87	87
0,5 – 30,0	84 to 74	74

Results C264



Conducted emission 110 VDC power supply voltage.

Conducted emission was also performed on Com port 1 and Com port 2
Highest levels were measured on Com port 1 (BUI241 pin 14) with a level of 73 dB(µV) at 5,63 MHz

The Alstom C264 passed the test.

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4.12 Radiated emission

Standard and date

Generic standard	IEC 60255-1
Test standards	IEC 60255-25, CISPR22
Test dates	26 September 2012

Characteristic test data

Sample	C264
Class	A
Mains power supply	110 VDC to 125 VDC
Test frequency band	30 MHz to 1000 MHz

Test set-up

Requirements

CISPR22 Class A

frequency (MHz)	limit of radiated emission at 10 m quasi peak dB(µV)
30 - 230	40
230 - 1000	47

Results C264

Pre-scan measurements were done in an anechoic chamber (distance between EUT and antenna 3 meters).

The graphs below give the measured emission at 110 VDC (indication only) and the corresponding limits related to 3 m distance between EUT and antenna.

No additional tests were performed on OATS because the measured levels at 3 m are more than 10 dB(µV) below the limit.

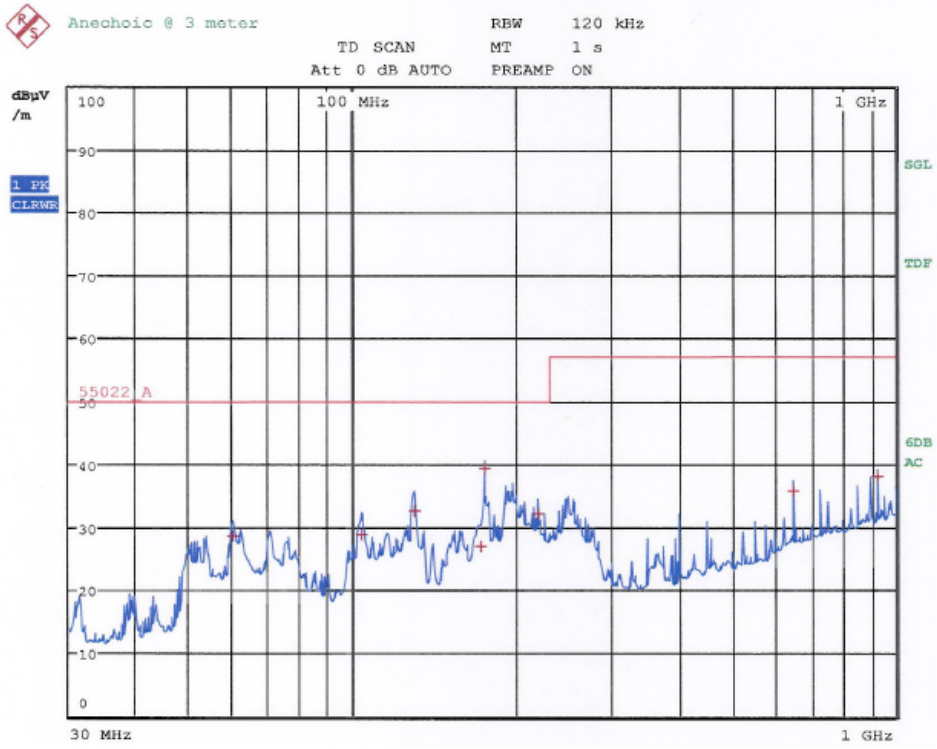
Test Spec

EN 55022 A Horz. @ 3 m H = 1.70m

Time Domain Scan (1 Range)

Scan Start: 30 MHz
Scan Stop: 1 GHz
Detector: Trace 1: MAX PEAK
Transducer: VULBANE

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
30.000000 MHz	1.000000 GHz	30.00 kHz	120.00 kHz	50 ms	Auto	20 dB	INPUT1

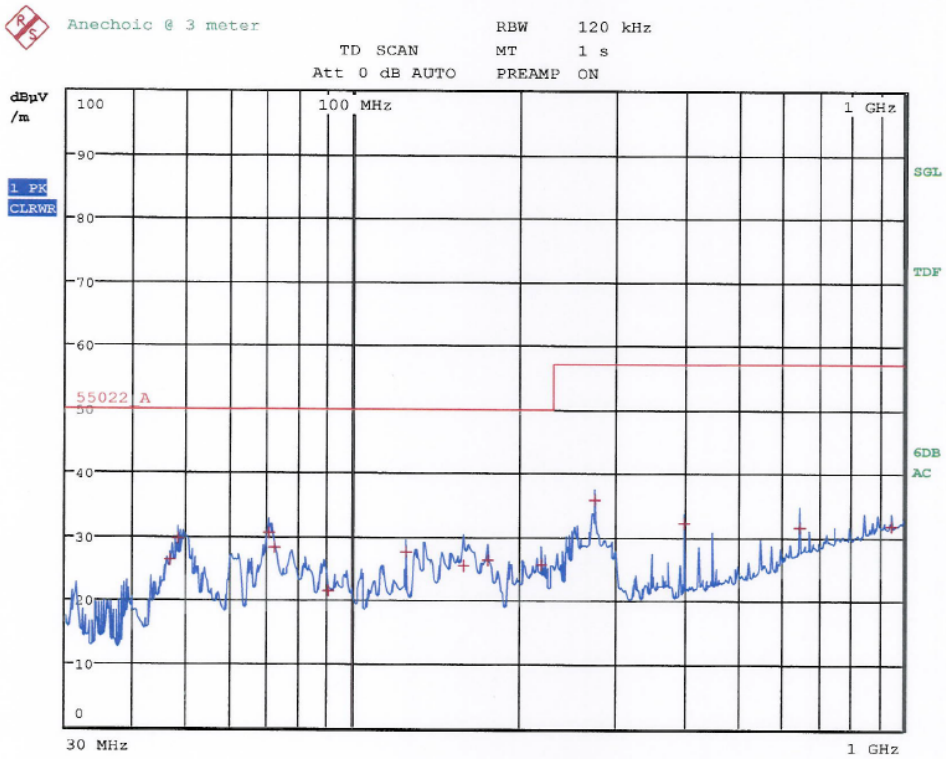


Test Spec
EN 55022 A Vert. @ 3 m H = 1.70m

Time Domain Scan (1 Range)

Scan Start: 30 MHz
Scan Stop: 1 GHz
Detector: Trace 1: MAX PEAK
Transducer: VULBANE

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
30.000000 MHz	1.000000 GHz	30.00 kHz	120.00 kHz	50 ms	Auto	20 dB	INPUT1



The Alstom C264 passed the test.

5 CLIMATE TESTS

5.1 Change of temperature

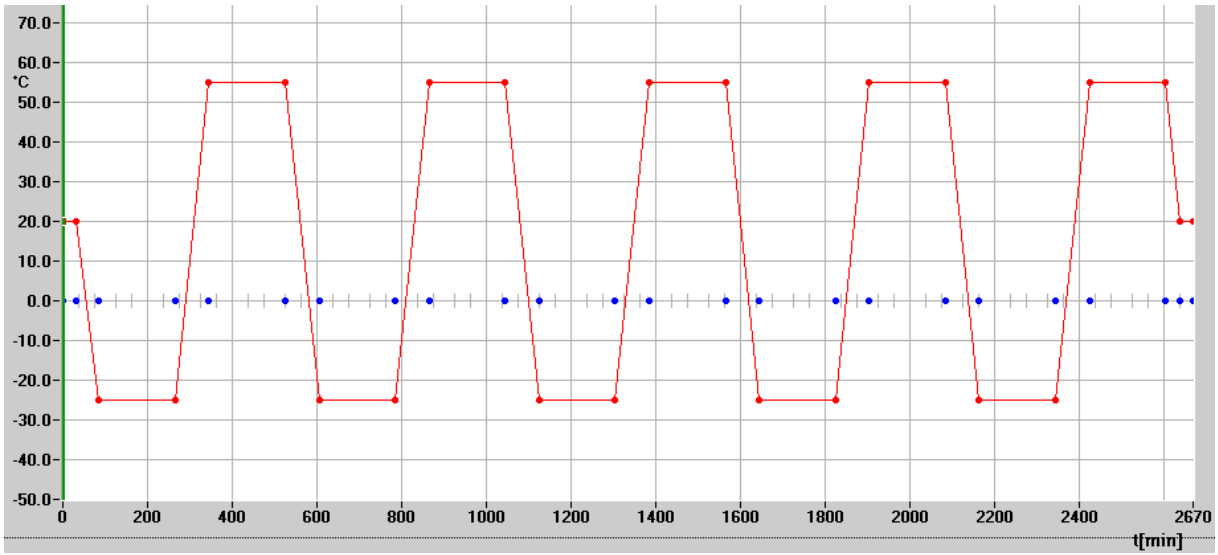
Standard and date

Generic standard	IEC 60255-1
Test standard	IEC 60068-2-14
Test date	17 September upto 19 September 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Temperature	see profile below
Test time	see profile below
Max. rate of change	1 °C/min over a 1 min period

The following profile is used.



Testsetup

Results

The Alstom C264 passed the test.

5.2 Cold operation and storage test

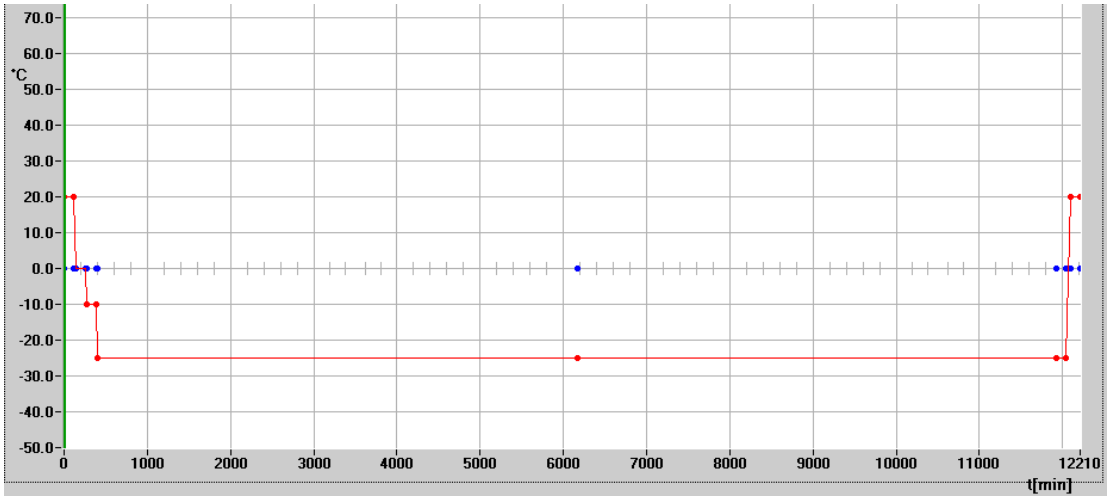
Standard and date

Generic standard(s)	IEC 60255-1 sub clause 6.12.3.2 and sub clause 6.12.3.4
Test standard(s)	IEC 60068-2-1
Test date(s)	18 October to 29 October 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Test	Ad and Ab
Temperature	see profile below
Test time	see profile below
Max. rate of change	1 °C/min over a 5 min period

The following profile is used



The following conditions and profile is used. The cold operation test is followed by the cold storage and transportation test.

condition	temp (°C)	type of test	duration (h)	EUT energized
Start-up	+20	functional verification test	2	yes
Intermediate	0	functional verification test	2	yes
Intermediate	-10	functional verification test	2	yes
Low temp. claim	-25	functional verification test	96	yes
Low temp. claim	-25	storage	96	no
Cold start	-25	operate	2	yes
Last test	+20	functional verification test	2	yes

Test set-up

Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Results

condition	temp (°C)	type of test	duration (h)	EUT energized	observation
Start-up	+20	functional verification test	2	yes	passed
Intermediate	0	functional verification test	2	yes	passed
Intermediate	-10	functional verification test	2	yes	passed
Low temp. claim	-25	functional verification test	96	yes	passed
Low temp. claim	-25	storage	96	no	passed
Cold start	-25	operate	2	yes	passed
Last test	+20	functional verification test	2	yes	passed

Result

The Alstom C264 passed the test.

5.3 Dry heat operating and storage test

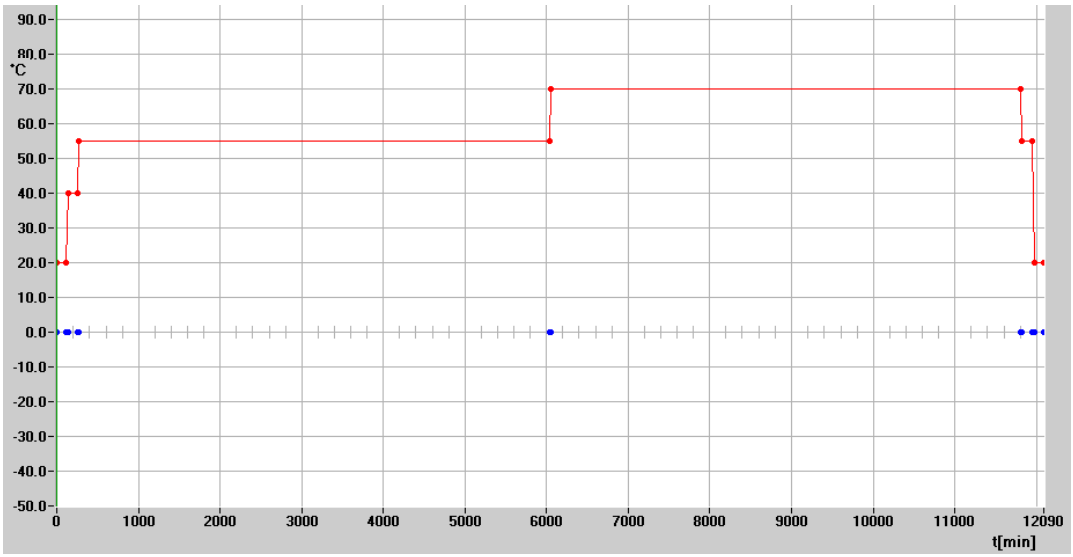
Standard and date

Generic standard(s)	IEC 60255-1 sub clause 6.12.3.1 and sub clause 6.12.3.3
Test standard(s)	IEC 60068-2-2
Test date(s)	8 October to 17 October 2012

Characteristic test data

Sample	C264
Mains power supply	110 VDC
Test	Bd and Bb
Temperature	see profile below
Test time	see profile below
Max. rate of change	1 °C/min over a 5 min period

The following profile is used



The following conditions and profile is used. The high temperature operation test is followed by the high temperature storage and transportation test.

condition	temp (°C)	type of test	duration (h)	EUT energized
Start-up	+20	functional verification test	2	yes
Intermediate	+40	functional verification test	2	yes
High temp. claim	+55	operate	96	yes
High temp. claim	+70	storage	96	no
Hot start	+55	operate	2	yes
Last test	+20	functional verification test	2	yes

Test set-up

Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Results

condition	temp (°C)	type of test	duration (h)	EUT energized	observation
Start-up	+20	functional verification test	2	yes	passed
Intermediate	+40	functional verification test	2	yes	passed
High temp. claim	+55	operate	96	yes	passed
High temp. claim	+70	storage	96	no	passed
Hot start	+55	operate	2	yes	passed
Last test	+20	functional verification test	2	yes	passed

Result

The Alstom C264 passed the test.

5.4 Damp-heat cyclic test

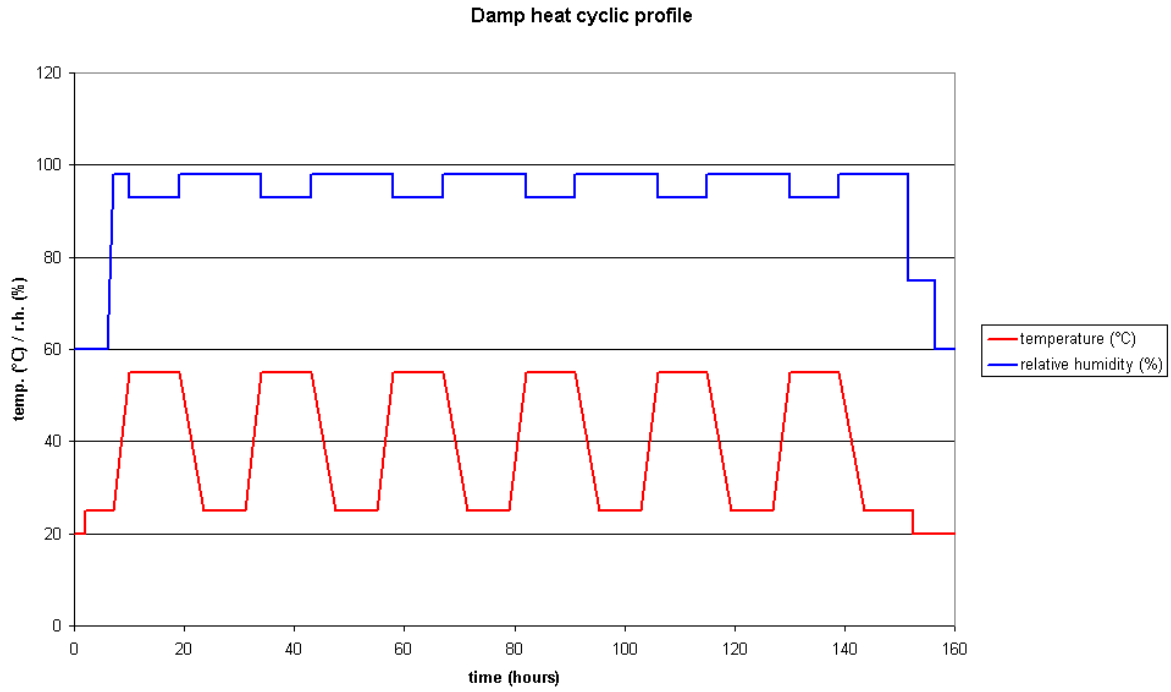
Standard and date

Generic standard(s)	IEC 60255-1 sub clause 6.12.3.7
Test standard(s)	IEC 60068-2-30
Test date(s)	26 September to 1 October 2012

Characteristic test data

Sample	C264
Mains power supply	110VDC
Test object	see profile below
Temperature	+25 °C / +55 °C
Relative humidity	93% + / 93%
Test time	6 cycles (12h+12h)

The following damp heat profile is used.



During the damp heat the correct operation of the C264 is monitored.

Test set-up

Requirement

Normal performance within the specification limits (see clause 3.3 “Performance criteria”).

Result

test	observation	result
damp heat cyclic	functional verification during damp heat cyclic profile	passed

Result

The Alstom C264 passed the test.

APPENDIX A MEASUREMENT UNCERTAINTIES

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

measurement	**measurement uncertainty**
dielectric tests	peak value: ≤ 3% time parameters: ≤ 10%
measurement of insulation resistance	≤ 10%
measurement of temperature	-50 °C - -40 °C : 3 K -40 °C - 125 °C : 2 K 125 °C - 150 °C : 3 K
current	0,05 – 100 A
	0,01 – 0,05 A
voltage	0,5 – 150 V
	0,1 – 0,5 V
time	0,5 ms
phase angle voltage / current	0 – 360 degrees

measurement	**measurement uncertainty**
current static: 0,01 – 0,05 A 0,05 – 20 A	 5,0% 0,5%
current dynamic: 0,01 – 0,05 A 0,05 – 20 A 20 – 100 A	 5,0% 0,5% 0,5%
voltage static: 0,1 – 0,5 V 0,5 V – 150 V	 2,0% 0,5%
voltage dynamic: 0,1 – 0,5 V 0,5 V – 150 V	 2,0% 0,5%
frequency: 40 – 70 Hz	 0,1%
harmonics: n = 2 .. 9	 1,0%
phase angle voltage/current: 0..360°	 0,1°
timing	0,5ms

APPENDIX B SAMPLE CONFIGURATION

Sample data

type: C264			
sample	serial number	software version	hardware version
ALSTOM C264	32214625	DS Agile 5.0.x B6.56K1	n.a.

Modules included

module	Material	barcode	revision
C264 PCB assembly – CPU 3 board	ZP0001001	B1202244CAR595	n.a.
Extended board CPU	2070872A	2070871.C1.1205421706	n.a.
C264 PCB assembly – bus board 40TE	E2071600A01	STC.2071600A01.ZA1.11263003114	n.a.
C264 (TMU220)	E2071613A01	WGS.2071613A01.G.E5.12125090196	n.a.
SRP212 multimode PRP board	ZP0015001	ZP0015001 B0 1048 120018 0026	n.a.
AIU211 Analogue input board	FOFL2071653Z	STC.2071652.E.A8.11204001036	n.a.
DOU201 board	E2071731 Z	STC.2071730A01.E.B3.12123011507	n.a.
40TE pre-fitted front panel (GHU240)	EGN0583001	STC.GN0583001.A01.A.1132820777	n.a.
110/125 VDC BIU241 board	EZP0010003	STC.ZP0010003.A01.A0.1204821712	n.a.
DIU211 digital input board	OZP0011001	STC.ZP0011001.A01.A0.1202320115	n.a.