



**TEST REPORT CONCERNING THE COMPLIANCE
OF AN INDUCTIVE PROXIMITY CARD READER,
BRAND NEDAP, MODEL COMBI-BOOSTER2 WITH 47
CFR PART 15 (2003-12-08).**

FCC listed : 90828
Industry Canada : IC3501
VCCI registered : R-1518, C-1598

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Test specification(s): 47 CFR Part 15 (2003-07-22)
Description of EUT: Inductive proximity card reader
Manufacturer: NEDAP N.V.
Brand mark: NEDAP
Model: COMBI-BOOSTER2
FCC ID: CGDCOMBI-BOOSTER2

MEASUREMENT/TECHNICAL REPORT

Integrated Engineering B.V.

Model : COMBI-BOOSTER2

FCC ID:CGDCOMBI-BOOSTER2

September 14, 2004

This report concerns:	Original grant/certification	Class 2 change	Verification
Equipment type:	Inductive proximity card reader operating on 121 kHz		
Deferred grant requested per 47 CFR 0.457(d)(1)(ii) ?	Yes	No	n.a.
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The data taken for this test and report herein was done in accordance with 47 CFR Part 15 and the measurement procedures of ANSI C63.4-2001. TNO Electronic Products & Services (EPS) B.V. at Niekerk, The Netherlands, certifies that the data is accurate and contains a true representation of the emission profile of the Equipment Under Test (EUT) on the date of the test as noted in the test report. I have reviewed the test report and find it to be an accurate description of the test(s) performed and the EUT so tested.

Date: September 20, 2004

Signature:

P. de Beer, location manager
TNO Electronic Products & Services (EPS) B.V.



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Description of test item

Test item : Inductive proximity card reader operating on 121 kHz
Manufacturer : NEDAP N.V.
Brand : NEDAP
Model : COMBI-BOOSTER2
Serial number : 9888888
Revision : n.a.
Receipt number :
Receipt date : August 27, 2004

Applicant information

Applicant's representative : Mr. W. Vrugteveen
Company : N.V. Nederlandsche Apparatenfabriek NEDAP short name NEDAP
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PO-box : 6
Postal code : 7140 AA
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Telephone number : +31 544 47 11 11
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Test(s) performed

Location : Niekerk
Test(s) started : September 13, 2004
Test(s) completed : September 14, 2004
Purpose of test(s) : Type approval / certification
Test specification(s) : 47 CFR Part 15 (2003-12-08)

Test engineer : J. Schuurmans

Report written by : J. Schuurmans

Project leader: : J. Schuurmans

This report is in conformity with NEN-EN-ISO/IEC 17025: 2000.

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The test results relate only to the item(s) tested.



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1 General information.

1.1 Product description.

1.1.1 Introduction.

The inductive proximity reader, brand NEDAP, model COMBI-BOOSTER2, is intended to add the detection of 121 kHz inductive tags to their TRANS IT reader system.

1.1.2 Choice of operating frequency.

The operating frequency of the Inductive proximity card reader brand NEDAP, model COMBI-BOOSTER2, is 121 kHz.

1.1.3 Operating principles.

The Inductive proximity card reader is a DC powered system with an integral antenna. The Inductive proximity card reader generates a magnetic field of 121 kHz. Upon the detection, the card sends information to the reader, using energy from the incident magnetic field. The COMBI-BOOSTER2 receives the information and deploys backscatter modulation to make the information detectable for their TRANS IT system.

1.2 Related submittal(s) and/or Grant(s).

Not applicable.

1.3 Tested system details.

Details and an overview of the system and all of its components, as it has been tested, may be found in table 1 below. FCC ID's are stated in this overview where applicable. The EUT is listed in the first row of table 1. The EUT is battery powered using a 3.6 V Lithium battery.

Description	Manufacturer	Model number	Serial number	FCC ID	Cable descriptions
Inductive cardreader	NEDAP N.V.	9888888	n.a.	CGDCOMBI-BOOOSTER2	none

Table 1 - Tested system details overview.



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1.4 Test methodology.

The test methodology used is based on the requirements of 47 CFR Part 15 (2003-12-08), sections 15.207, 15.205, 15.209.

The test methods, which have been used, are based on ANSI C63.4: 2001

Radiated emission tests above 30 MHz were performed at a measurement distance of 3 meters. Below 30 MHz the radiated emission tests were carried out at measurement distances of 1, 3 and 10 meters. The test results regarding the radiated emission tests on frequencies below 30 MHz have been extrapolated in order to determine the field strength of the measured values at measurement distances of 30 and 300 meters (as required by 47 CFR Part 15).

The receivers are switching automatically to the right bandwidth in accordance with CISPR 16. This is implemented in the receiver. The antenna factors are programmed in the test receiver. The receiver automatically calculates the appropriate correction factor for the utilized antenna and also the appropriate antenna factor for the cable loss. The total correction is automatically added to the measured value.

1.5 Test facility.

The Federal Communications Commission has reviewed the technical characteristics of the test facilities at TNO Electronic Products & Services (EPS) B.V., located in Niekerk, 9822 TL Smidshornerweg 18, The Netherlands, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 2, section 2.948, per October 23, 2000.

The description of the test facilities has been filed at the Office of the Federal Communications Commission under registration number 90828. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

The list of all public test facilities is available on the Internet at <http://www.fcc.gov>.

1.6 Product labeling.

In accordance with 47 CFR Part 15.19 (a)(3) the following text shall be placed on a label, which is attached to the EUT:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

In accordance with 47 CFR Part 2.925 (a)(1), the FCC ID shall be placed on a label, which is attached to the EUT.

For further details about the labeling requirements (size, legibility, etc.) as set by the Federal Communications Commission see 47 CFR Part 15.19 (a)(3), 47 CFR Part 15.19 (b)(2), 47 CFR Part 15.19 (b)(4), 47 CFR Part 2.925 and 47 CFR Part 2.926.



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2 System test configuration.

2.1 Justification.

The system was configured for testing in a typical fashion (as a customer would normally use it). During all tests the EUT was set up to function in accordance with the manufacturer's instructions.

The justification and manipulation of cables and equipment in order to simulate a worst-case behaviour of the test setup has been carried out as prescribed in ANSI C63.4: 2001

2.2 EUT mode of operation.

Radiated and conducted emission measurements were carried out when the system was active and was generating a continuous transmitting signal.

2.3 Special accessories.

No special accessories are used and/or needed to achieve compliance with the appropriate sections of 47 CFR Part 15.

2.4 Equipment modifications.

No modifications have been made to the equipment in order to achieve compliance with the appropriate sections of 47 CFR Part 15.

2.5 Configuration of the tested system.

Unit title	:	Inductive proximity card reader
Model number	:	COMBI-BOOSTER2
Part number	:	9888888
FCC ID	:	CGD-COMBIBOOSTER2
Frequency range	:	121 kHz
Description/details	:	see section 1.1 of this test report
Power supply	:	3.6 V Lithium Battery
Clock Oscillator(s)	:	60 kHz
Cabinet & Screening	:	Plastic
Interface Cable(s)	:	not applicable
Method of screening	:	not applicable
Method of grounding	:	not applicable
Operating configuration	:	See section 1.3 of this test report



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2.6 Block diagram of the EUT.

The block diagram is available in the technical documentation package.

2.7 Schematics of the EUT.

The schematics are available in the technical documentation package.

2.8 Part list of the EUT.

The part list is available in the technical documentation package.



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3 Radiated emission data.

3.1 Radiated field strength measurements (frequency range of 30-1000 MHz, E-field).

Frequency (MHz)	Measurement results dB(μ V)/m @ 3 metres Quasi-peak		Limits dB(μ V)/m @ 3 metres Quasi-peak	Margin (dB) Quasi-peak		Result
	Vertical	Horizontal		Vertical	Horizontal	
178.12	< 20.0	21.9	43.5	-21.3	-21.6	PASS
189.75	< 20.0	27.7	43.5	-21.6	-15.8	PASS
193.61	< 20.0	27.2	43.5	-21.5	-16.3	PASS
197.49	< 20.0	29.5	43.5	-21.4	-14.0	PASS
210.35	< 20.0	29.5	43.5	-20.9	-14.0	PASS
205.23	< 20.0	29.4	43.5	-21.1	-14.1	PASS
209.10	< 20.0	30.5	43.5	-20.9	-13.0	PASS
212.98	< 20.0	28.3	43.5	-20.8	-15.2	PASS
216.85	< 20.0	31.3	46.0	-23.1	-14.7	PASS
224.60	< 20.0	31.6	46.0	-22.8	-14.4	PASS
232.34	< 20.0	31.2	46.0	-21.9	-14.8	PASS
240.09	< 20.0	30.9	46.0	-20.8	-15.1	PASS

Table 2

The results of the radiated emission tests, carried out in accordance with 47 CFR Part 15, sections 15.205 and 15.209, with the EUT operating in continuous transmit mode on 121 kHz, are depicted in table 2.

Note: - Field strength values of radiated emissions at frequencies not listed in table 2 are more than 20 dB below the applicable limit.

Test engineer

Signature : 

Name : J. Schuurmans

Date : September 13, 2004



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3.2 Radiated field strength measurements (frequency range of 0.009-30 MHz, H-field).

Frequency (MHz)	Measurement results dB μ V Quasi-peak			Antenna factor dB	Cable loss dB	Measurement results dB(μ V)/m Quasi-peak (calculated) 30 meters	Limits Part 15.209 & 225 dB(μ V)/m
	1 meters	3 meters	10 meters				
0.009 – 0.121	<10.0	n.a.	n.a.	20.5	1	-	28.5 – 13.8 (300 m)
0.121	41.4	17.5	n.a.	19.5	1	-12.1	25.9 (300 m)
0.242	<10.0	n.a.	n.a.	19.5	1	-	19.9 (300 m)
0.363	29.4	<5.0	n.a.	19.5	1	-	16.4 (300 m)
0.484	20.1	n.a.	n.a.	19.5	1	-	13.9 (300 m)

Table 3

The results of the radiated emission tests, carried out in accordance with 47 CFR Part 15, sections 15.205 and 15.209, with the EUT operating in continuous transmit mode on 13.56 kHz, are depicted in table 3.

- Notes:**
- A total work out of the calculated measurement result can be found in the Appendix 1.
 - Frequency range: 9-90 kHz Average detector used during measurements
110-490 kHz Average detector used during measurements
 - The radiated field strengths were measured at a distance of 3 and 10 meters. Measured field strengths at a distance of 10 meters were already below the limit of 30/300 meters
 - n.a. indicates that no field strength values could be measured on the listed frequencies or in the listed frequency range
 - Field strength values of radiated emissions at frequencies not listed in table 3 are more than 20 dB below the applicable limit

The EUT was varied in two positions (flat on table and standing on its side, the loop antenna was varied in two orientations (directed towards the EUT and 90 degrees rotated.. The reported value is the worst case found at the reported frequency.

Test engineer

Signature

Name : J. Schuurmans

Date : September 13 , 2004



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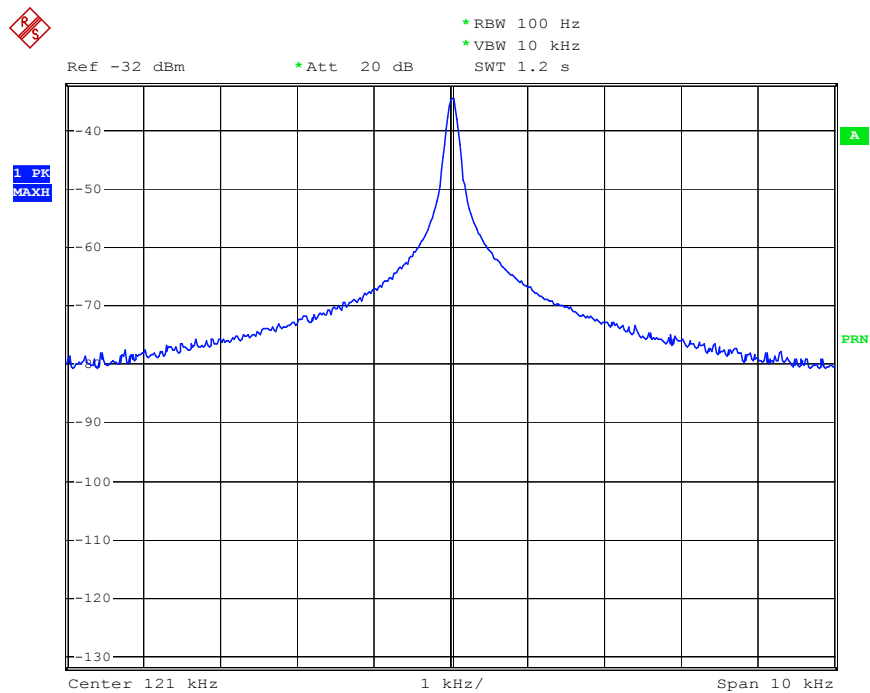
4 Conducted emission data.

No conducted emission measurement was performed. The EUT is battery powered only.



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5 Plot of the carrier signal.



Date: 14.SEP.2004 11:16:29

Test engineer

Signature :

Name : J. Schuurmans

Date : September 14, 2004



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6 List of utilized test equipment.

Inventory number	Description	Brand	Type
12471	Biconical antenna 20MHz-200MHz	EATON	94455-1
12473	Log-per antenna 200-1000MHz	EATON	96005
12476	Antenna mast	EMCO	TR3
12477	Antenna mast 1-4 mtr	Poelstra	--
12482	Loop antenna	EMCO	6507
12483	Guidehorn	EMCO	3115
12484	Guidehorn	EMCO	3115
12488	Guidehorn 18 - 26.5 GHz	EMCO	RA42-K-F-4B-C
12533	Signalgenerator	MARCONI	2032
12559	Digital storage oscilloscope	Le Croy	9310M
12561	DC Power Supply 20A/70V	DELTA	SM7020D
12567	Plotter	HP	7440A
12605	calibrated dipole 28MHz-1GHz	Emco	3121c
12608	HF milliwattmeter	Hewlett Packard	HP435a
12609	Power sensor 10MHz-18GHz	Hewlett Packard	HP8481A
12636	Polyester chamber	Polyforce	--
12640	Temperature chamber	Heraeus	VEM03/500
13664	Spectrum analyzer	HP	HP8593E
13078	Preamplifier 0.1 GHz - 12 GHz	Miteq	AMF-3D-001120-35-14p
13452	Digital multi meter	HP	34401A
13526	Signalgenerator 20 GHz	Hewlett & Packard	83620A
13594	Preamplifier 10 GHz - 25 GHz	Miteq	AMF-6D-100250-10p
13886	Open Area testsite	Comtest	--
14051	Anechoic room	Comtest	--
14450	2.4 GHz bandrejectfilter	BSC	XN-1783
15633	Biconilog Testantenna	Chase	CBL 6111B
15667	Measuring receiver	R&S	ESCS 30
99045	DC Power Supply 3A/30V	DELTA	E030/3
99055	Non-conducting support	NMi	--
99061	Non-conducting support 150cm	NMi	--
99068	Detector N-F/BNC-F	Radiall	R451576000
99069	Cable 5m RG214	NMi	--
99071	Cable 10m RG214	NMi	--
99076	Bandpassfilter 4 - 10 GHz	Reactel	7AS-7G-6G-511
99077	Regulating trafo	RFT	LTS006
99112	Tripod	Chase	--
99136	Bandpassfilter 10 - 26.5 GHz	Reactel	9HS-10G/26.5G-S11



Appendix 1

Calculated measurements results radiated field strength, H-Field

Calculated measurements results radiated field strength, H-Field

General Formula:

d_s = short distance; H_s is field strength at short distance

d_l = long distance; H_l is field strength at long distance

$$(d_s/d_l)^n = H_l/H_s \dots\dots\dots[\text{eq1}]$$

$$n \log(d_s/d_l) = \log(H_l/H_s) \text{ or } n = \log(H_l/H_s) / \log(d_s/d_l)$$

Calculation of n, for measured field strengths

$$H_s = 61.9 \text{ dB}\mu\text{V/m} = 1244.5 \mu\text{V/m}$$

$$H_l = 38.0 \text{ dB}\mu\text{V/m} = 79.4 \mu\text{V/m}$$

$$n = \log(79.4/1244.5) / \log(1/3)$$

$$n = 2.50$$

Calculated field strength at new distance, from the 3 meter value:

H_s now becomes $H_s = 79.4 \mu\text{V/m}$ and $d_s=3$

Assume $d_l=30$

Now from [eq1] H_l becomes:

$$H_l = H_s * (d_l/d_s)^{-n}$$

$$\text{So } H_l = 79.4 * (30/3)^{-2.50} = 0.249 \mu\text{V/m or } -12.1 \text{ dB}\mu\text{V/m}$$