# 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

**TNO Electronic Products & Services (EPS) B.V.**
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# 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. |


| Report prepared by: | | |
|---|---|---|
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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.

## 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 |
| Address | : | Parallelweg 2 |
| postal code | : | NL-7141 DC |
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| PO-box | : | 6 |
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| Country | : | Netherlands |
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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.**
**This report shall not be reproduced, except in full, without the written permission of TNO Electronic Products & Services (EPS) B.V.**
**The test results relate only to the item(s) tested.**

# Table of contents

# 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 filed of 121 kHz. Upon the detection, tha 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.

## 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.

# 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 |

## 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.

# 3 Radiated emission data.

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

| Frequency (MHz) | Measurement results dB(µV)/m @ 3 metres Quasi-peak | | Limits dB(µV)/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

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

| Frequency (MHz) | Measurement results dBµV Quasi-peak | | | Antenna factor | Cable loss | Measurement results dB(µV)/m Quasi-peak (calculated) | Limits Part 15.209 & 225 dB(µV)/m |
|---|---|---|---|---|---|---|---|
| | 1 meters | 3 meters | 10 meters | dB | dB | 30 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 

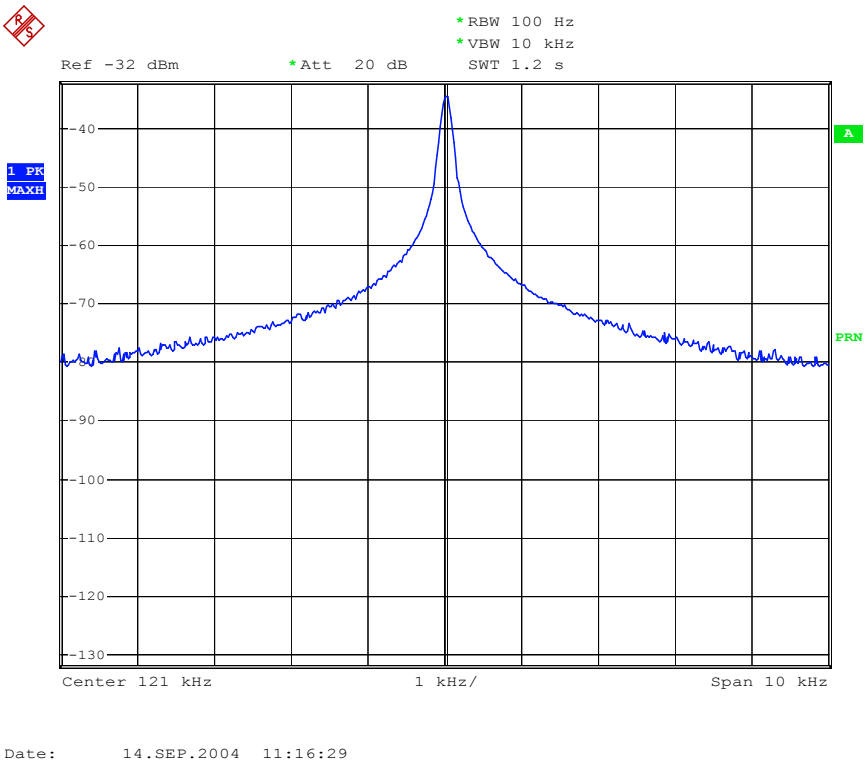
Name : J. Schuurmans

Date : September 13 , 2004

# 4 Conducted emission data.

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

# 5 Plot of the carrier signal.




Test engineer

Signature : 

Name : J. Schuurmans

Date September 14, 2004

# 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

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

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

**Calculation of n, for measured field strengths**

$H_s$ = 61.9 dBµV/m = 1244.5 µV/m

$H_l$ = 38.0 dBµV/m = 79.4 µV/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 µV/m and $d_s$=3

Assume $d_l$ =30

Now from [eq1] $H_l$ becomes:

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

So $H_l = 79.4 * (30/3)^{-2.50}$ = 0.249 uV/m or -12.1 dBuV/m