

**TEST REPORT OF A 2.4 GHz. low power RLAN PCMCIA Card,  
BRAND APPLE, TYPE 630-37XX (built-in in P21 Tower),  
IN CONFORMITY WITH FCC PART 15, ED. MAY 24, 2001.**

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FCC ID: IMRAPPC2411R  
Description of EUT: 2.4 GHz. low power RLAN PCMCIA Card  
Manufacturer: Apple Computer, Inc.  
Brand mark: Apple  
Built-in in type: P21 Tower

## MEASUREMENT/TECHNICAL REPORT

**Apple Computers, Inc.**

**2.4 GHz. low power RLAN PCMCIA Card**

**FCC ID EUT: IMRAPPC2411R**

December 3, 2001

|                                                                      |                        |                                            |                           |
|----------------------------------------------------------------------|------------------------|--------------------------------------------|---------------------------|
| This report concerns (check one):                                    |                        | Original grant                             | <del>Class 1 change</del> |
| Equipment type: Direct Sequence Spread Spectrum Transceiver          |                        |                                            |                           |
| Deferred grant requested per 47 CFR 0.457(d)(1)(ii)?                 |                        | Yes                                        | <del>No</del>             |
| If yes defer until:                                                  |                        | <u>January 15, 2001</u>                    |                           |
| Apple Computer, Inc. USA, 1 Infinite Loop, Cupertino CA 95014 , USA. |                        |                                            |                           |
| Report prepared by:                                                  | Name                   | : D. H. Kruiter, B.Sc. E.E. and B.Sc. T.M. |                           |
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|                                                                      | Postal code/city       | : 9822 ZG Niekerk                          |                           |
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*The data taken for this test and report herein was done in accordance with FCC Part 15 and measurement procedures of ANSI C63.4-1992. TNO Certification EPS 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 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: December 3, 2001

Signature:  
P. de Beer



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## 1 General information.

### 1.1 Product description.

The 2.4 GHz low power RLAN PCMCIA card, brand Apple, type 630-37XX, is designed to operate in the 2.4 GHz ISM frequency band, Channels 1 to 11 (2412 MHz to 2462 MHz), as specified by the Federal Communications Commission in the USA.

The 2.4 GHz low power RLAN PCMCIA card, brand Apple, type 630-37XX, utilises Direct Sequence Spread Spectrum (DSSS) technology.

The 2.4 GHz low power RLAN PCMCIA card, brand Apple, type 630-37XX, is intended for use in notebooks and personal computers, which incorporate an integrated antenna. Only antennas which have been certified by the Federal Communications Commission for use with this specific 2.4 GHz low power RLAN PCMCIA card may be connected to the antenna of this device.

### 1.2 Related submittal(s)/grant(s).

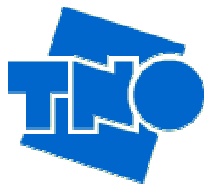
Not applicable.

### 1.3 Tested system details.

The FCC ID's for all equipment, plus descriptions of all cables used in the tested system (included inserted cards, which have grants) are:

| Model                  | Serial/model number | FCC ID        | Description                       | Cable Descriptions                                  |
|------------------------|---------------------|---------------|-----------------------------------|-----------------------------------------------------|
| Apple PCMCIA card      | -01UT41300015       | -IMRAPPC2411R | -Wireless LAN                     | -                                                   |
| P21 Tower              | -SSSPVT 12/12       | -n.a.         | -Desktop PC                       | -Unshielded power cord to AC Mains                  |
| USB Keyboard           | -M2452              | -n.a. (DoC)   | -For input in Tower. 5V DC, 200mA | -USB cord to Tower                                  |
| USB Mouse              | -M4848              | -n.a. (DoC)   | -For input in Tower               | -USB cord to USB keyboard                           |
| Hewlett Packard screen | -D2806B             | -n.a.         | -Display                          | -Unshielded power cord to AC Mains<br>-Monitor cord |
| HP Deskjet 895CXI      | -C6410A             | -n.a. (DoC)   | -Printer                          | -USB cord to Tower<br>-Power cord to AC-mains       |

Table 1.1: tested system details.



FCC ID: IMRAPPC2411R  
Description of EUT: 2.4 GHz. low power RLAN PCMCIA Card  
Manufacturer: Apple Computer, Inc.  
Brand mark: Apple  
Built-in in type: P21 Tower

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## 1.4 Test methodology.

The test methodology used has been based on the requirements of FCC Part 15, issue May 24, 2001, relevant clauses 15.107, 15.109, 15.205, 15.207, 15.209 and 15.247. The used measuring methods are based on the ANSI C63.4 - 1992 document.

Radiated tests above 30 MHz were performed at a distance of 3 meter. Below 30 MHz the measurement was carried out at a distance of 10 meter. The eventual found results will be calculated to values for the required measuring distance of 30/300 meter.

Fieldstrength measurements on frequencies above 1 GHz were measured with appropriate pre-amplifiers, antennas and a spectrum analyser. At found frequencies the actual level at the input of the pre-amplifier was generated with aid of a signal generator. The output level of the signal generator was increased with the antenna-factor to obtain the fieldstrength.

## 1.5 Test facility

The FCC has per Public Notice declared that the measurement facilities located at the TNO Certification EPS. Located in Nieuwerkerk, Smidshornerweg 18, The Netherlands, has been reviewed and found to be in compliance with the requirements of section 2.948 of the FCC rules per October 23, 2000.

The description of the measuring facilities have been filed at the FCC's Offices. The facility has been added to the list of those who perform these measurement services for the public on a fee basis. An up-to-date list of such public test facilities is available on the Internet on the FCC Website at <http://www.fcc.gov>, E-Filing and OET Equipment Authorisation Electronic Filing.



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## 2 Product labelling.

### 2.1 FCC ID Label.

The following label shall be attached to the device under test.

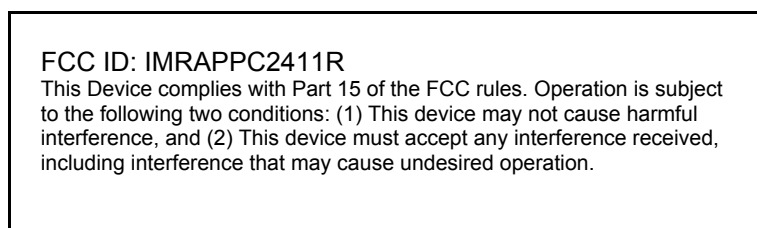


Figure 2.1: FCC ID.



Figure 2.2: FCC ID, label.

### 2.2 Location of the FCC ID Label on the EUT.

The FCC ID Label will be placed on the frontside of the 2.4 GHz RLAN PCMCIA Card.

See attached documentation-sheet for more detailed information.



### 3 System test configuration.

#### 3.1 Justification.

The system was configured for testing in a typical fashion (as a customer would normally use it).

The justification of cables and equipment has been carried out as prescribed in the ANSI C63.4-1992 document.

The measurements were performed at the lowest operating frequency (channel 1: 2412 MHz), the operating frequency in the middle of the specified frequency band (channel 6: 2437 MHz) and the highest operating frequency (channel 11: 2462 MHz).

| Channel | operating frequencies (MHz) | Rated output power (dBm) | test performed |
|---------|-----------------------------|--------------------------|----------------|
| 1       | 2412                        | 20                       | Yes            |
| 2       | 2417                        | 20                       | No             |
| 3       | 2422                        | 20                       | No             |
| 4       | 2427                        | 20                       | No             |
| 5       | 2432                        | 20                       | No             |
| 6       | 2437                        | 20                       | Yes            |
| 7       | 2442                        | 20                       | No             |
| 8       | 2447                        | 20                       | No             |
| 9       | 2452                        | 20                       | No             |
| 10      | 2457                        | 20                       | No             |
| 11      | 2462                        | 20                       | Yes            |

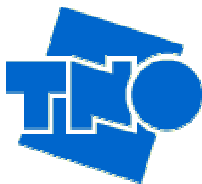
Table 3.1: operating frequencies and rated output power levels.

To complete the configuration required by the FCC, the transmitter was tested in the P21 Tower with the antenna connected to the antenna port.

The transmitter antenna connector is unique and is non-interchangeable.

#### 3.2 EUT exercise software.

The EUT was enabled to transmit or receive continuously.



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Built-in in type: P21 Tower

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**3.3 Special accessories.**

No special accessories are used to achieve FCC compliance.

**3.4 Equipment modifications.**

No modifications have been made to the equipment to achieve compliance.

|                     |        |          |        |
|---------------------|--------|----------|--------|
| Applicant Signature | : n.a. | Date     | : n.a. |
| Typed/Printed Name  | : n.a. | Position | : n.a. |

### 3.5 Configuration of the tested system.

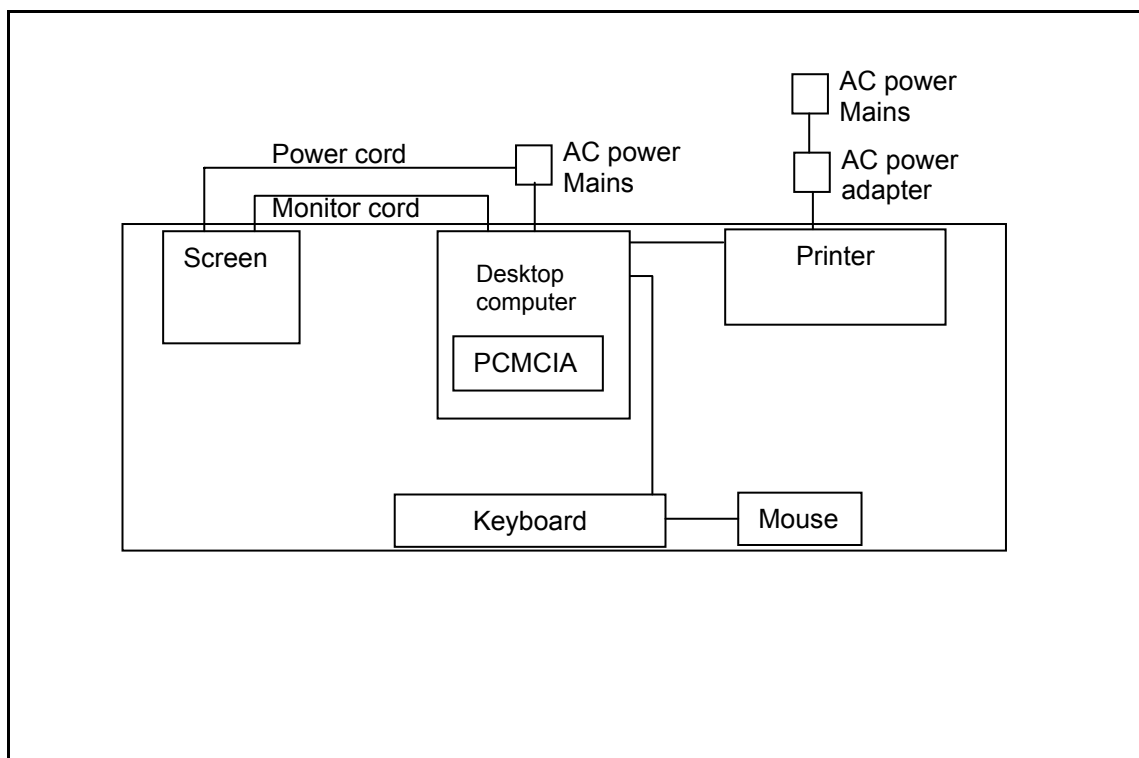


Figure 3.1: configuration of the tested system.

## 4 Block diagram(s) of the tested model.

Information is annexed in the technical documentation supplied by the applicant.

## 5 Conducted and radiated measurement photos.

### 5.1 Conducted emission configuration.



Figure 5.1: front picture of testconfiguration.



Figure 5.2: back picture of testconfiguration.

## 5.2 Radiated emission configuration.



Figure 5.3: front picture of testconfiguration.



Figure 5.4: back picture of testconfiguration.



## 6 Radiated emission data

### 6.1 Radiated emission data in accordance with FCC 15.109 and FCC 15.209, receive mode.

Reception on channel 1, 2412 MHz.

| Frequency<br>(MHz) | Results for horizontal and vertical<br>polarisation of measurement<br>antenna<br>(dB $\mu$ V/m) |            | Detector type:<br>QP=Quasi peak<br>AV=Average<br>PK=Peak | Resolution<br>Bandwidth of<br>field strength<br>meter<br>(kHz) | Limits<br>(dB $\mu$ V/m) |
|--------------------|-------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------|----------------------------------------------------------------|--------------------------|
|                    | Vertical                                                                                        | Horizontal |                                                          |                                                                |                          |
| 69.87              | 19.8                                                                                            | <20.0      | QP                                                       | 120                                                            | 40.0                     |
| 71.00              | 23.9                                                                                            | <20.0      | QP                                                       | 120                                                            | 40.0                     |
| 216.0              | <20.0                                                                                           | 25.6       | QP                                                       | 120                                                            | 46.0                     |
| 240.0              | 27.2                                                                                            | 28.0       | QP                                                       | 120                                                            | 46.0                     |
| 391.0              | 26.0                                                                                            | <20.0      | QP                                                       | 120                                                            | 46.0                     |
| other freq.        | <41.0                                                                                           | <41.0      | PK                                                       | 1000                                                           | 74.0                     |

Table 6.1: radiated emission data on channel 1.

Note: Above 1 GHz, the peak values are below the limits for measurement with the average detector. Therefore, not all spurious emissions are measured with the average detector.

Test personnel:

Tester signature:

Date: December 3, 2001

Name : D.H. Kruiter



FCC ID: IMRAPP2411R  
 Description of EUT: 2.4 GHz. low power RLAN PCMCIA Card  
 Manufacturer: Apple Computer, Inc.  
 Brand mark: Apple  
 Built-in in type: P21 Tower

Reception on channel 6: 2437 MHz.

| Frequency<br>(MHz) | Results for horizontal and vertical<br>polarisation of measurement<br>antenna<br>(dB $\mu$ V/m) |            | Detector type:<br>QP=Quasi peak<br>AV=Average<br>PK=Peak | Resolution<br>Bandwidth of<br>field strength<br>meter<br>(kHz) | Limits<br>(dB $\mu$ V/m) |
|--------------------|-------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------|----------------------------------------------------------------|--------------------------|
|                    | Vertical                                                                                        | Horizontal |                                                          |                                                                |                          |
| 30 - 1000          | <30.0                                                                                           | <30.0      | QP                                                       | 120                                                            | 40.0 - 54                |
| 1062               | <35.0                                                                                           | 40.06      | PK                                                       | 1000                                                           | 74.0                     |
| 1195               | <35.0                                                                                           | 47.23      | PK                                                       | 1000                                                           | 74.0                     |
| 1200               | 41.46                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 1333               | 38.27                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 1603               | 42.97                                                                                           | 47.21      | PK                                                       | 1000                                                           | 74.0                     |
| 1727               | 36.01                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 1860               | <35.0                                                                                           | 41.02      | PK                                                       | 1000                                                           | 74.0                     |
| 1998               | 37.82                                                                                           | 40.35      | PK                                                       | 1000                                                           | 74.0                     |
| 2131               | <35.0                                                                                           | 42.97      | PK                                                       | 1000                                                           | 74.0                     |
| 2135               | 40.35                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2406               | <35.0                                                                                           | 41.89      | PK                                                       | 1000                                                           | 74.0                     |
| 2677               | <35.0                                                                                           | 39.31      | PK                                                       | 1000                                                           | 74.0                     |
| 2800               | <35.0                                                                                           | 37.33      | PK                                                       | 1000                                                           | 74.0                     |
| 2925               | 40.53                                                                                           | 46.06      | PK                                                       | 1000                                                           | 74.0                     |
| 3442               | 39.23                                                                                           | 44.55      | PK                                                       | 1000                                                           | 74.0                     |
| 3836               | 43.21                                                                                           | 42.35      | PK                                                       | 1000                                                           | 74.0                     |
| 5042               | <35.0                                                                                           | 39.48      | PK                                                       | 1000                                                           | 74.0                     |
| other freq.        | <35.0                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |

Table 6.2: radiated emission data on channel 6.

Note: Above 1 GHz, the peak values are below the limits for measurement with the average detector.  
 Therefore, not all spurious emissions are measured with the average detector.

Test personnel:

Tester signature:

Date: December 3, 2001

Name : D.H. Kruiter



Reception on channel 11: 2462 MHz.

| Frequency<br>(MHz) | Results for horizontal and vertical<br>polarisation of measurement<br>antenna<br>(dB $\mu$ V/m) |            | Detector type:<br>QP=Quasi peak<br>AV=Average<br>PK=Peak | Resolution<br>Bandwidth of<br>field strength<br>meter<br>(kHz) | Limits<br>(dB $\mu$ V/m) |
|--------------------|-------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------|----------------------------------------------------------------|--------------------------|
|                    | Vertical                                                                                        | Horizontal |                                                          |                                                                |                          |
| 30 -1000           | <30.0                                                                                           | <30.0      | QK                                                       | 120                                                            | 40.0 - 54.0              |
| 1062               | 34.28                                                                                           | 40.77      | PK                                                       | 1000                                                           | 74.0                     |
| 1195               | <35.0                                                                                           | 46.26      | PK                                                       | 1000                                                           | 74.0                     |
| 1200               | 40.49                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 1328               | 38.49                                                                                           | 45.24      | PK                                                       | 1000                                                           | 74.0                     |
| 1599               | 43.37                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 1603               | <35.0                                                                                           | 46.50      | PK                                                       | 1000                                                           | 74.0                     |
| 1727               | 36.01                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2002               | 38.16                                                                                           | 40.24      | PK                                                       | 1000                                                           | 74.0                     |
| 2131               | <35.0                                                                                           | 42.75      | PK                                                       | 1000                                                           | 74.0                     |
| 2135               | 40.82                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2397               | <35.0                                                                                           | 43.23      | PK                                                       | 1000                                                           | 74.0                     |
| 2401               | 39.18                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2667               | 34.98                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2925               | 40.56                                                                                           | 46.85      | PK                                                       | 1000                                                           | 74.0                     |
| 3442               | 39.67                                                                                           | 43.78      | PK                                                       | 1000                                                           | 74.0                     |
| 3836               | 44.39                                                                                           | 40.89      | PK                                                       | 1000                                                           | 74.0                     |
| 3984               | 41.03                                                                                           | 39.18      | PK                                                       | 1000                                                           | 74.0                     |
| 5042               | <35.0                                                                                           | 37.72      | PK                                                       | 1000                                                           | 74.0                     |
| other freq.        | <35.0                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |

Table 6.3: radiated emission data on channel 11.

Note: Above 1 GHz, the peak values are below the limits for measurement with the average detector. Therefore, not all spurious emissions are measured with the average detector.

Test personnel:

Tester signature:

Date: December 3, 2001

Name : D.H. Kruiter



## 6.2 Radiated emission data in restricted bands in accordance with FCC 15.205, transmit mode.

The following data lists the significant emission frequencies, measured levels in accordance with FCC 15.205.

Transmitting on channel 1, 2412 MHz

| Frequency<br>(MHz) | Results for horizontal and vertical<br>polarisation of measurement<br>antenna<br>(dB $\mu$ V/m) |            | Detector type:<br>QP=Quasi peak<br>AV=Average<br>PK=Peak | Resolution<br>Bandwidth of<br>field strength<br>meter<br>(kHz) | Limits<br>(dB $\mu$ V/m) |
|--------------------|-------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------|----------------------------------------------------------------|--------------------------|
|                    | Vertical                                                                                        | Horizontal |                                                          |                                                                |                          |
| 44.8               | 20.30                                                                                           | <20.0      | QP                                                       | 120                                                            | 40.0                     |
| 108.0              | 20.20                                                                                           | 21.50      | QP                                                       | 120                                                            | 43.5                     |
| 156.0              | 28.20                                                                                           | 33.00      | QP                                                       | 120                                                            | 43.5                     |
| 162.0              | 23.40                                                                                           | 27.00      | QP                                                       | 120                                                            | 43.5                     |
| 304.0              | 23.80                                                                                           | <20.0      | QP                                                       | 120                                                            | 46.0                     |
| 306.0              | 35.90                                                                                           | 41.40      | QP                                                       | 120                                                            | 46.0                     |
| 1057               | 42.91                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 1195               | 39.54                                                                                           | 42.51      | PK                                                       | 1000                                                           | 74.0                     |
| 1200               | 44.22                                                                                           | 42.62      | PK                                                       | 1000                                                           | 74.0                     |
| 1328               | <35.0                                                                                           | 44.46      | PK                                                       | 1000                                                           | 74.0                     |
| 1333               | 46.81                                                                                           | 44.98      | PK                                                       | 1000                                                           | 74.0                     |
| 1599               | 41.37                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 1603               | 41.30                                                                                           | 45.09      | PK                                                       | 1000                                                           | 74.0                     |
| 1860               | 42.35                                                                                           | 43.41      | PK                                                       | 1000                                                           | 74.0                     |
| 2558               | 46.34                                                                                           | 45.70      | PK                                                       | 1000                                                           | 74.0                     |
| 2922               | <35.0                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2928               | 43.49                                                                                           | 43.47      | PK                                                       | 1000                                                           | 74.0                     |
| 3456               | <35.0                                                                                           | 41.90      | PK                                                       | 1000                                                           | 74.0                     |
| 3461               | 42.18                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 5035               | 37.88                                                                                           | 39.37      | PK                                                       | 1000                                                           | 74.0                     |
| other freq.        | <30.0                                                                                           | <30.0      | PK                                                       | 1000                                                           | 74.0                     |

Table 6.4: radiated emission data on channel 1.

Note: Radiated emission tests are performed with all bitrates. The highest values are given here. Above 1 GHz, the peak values are below the limits for measurement with the average detector. Therefore, not all spurious emissions are measured with the average detector.

Test personnel:

Tester signature:

Date: December 3, 2001

Name : D.H. Kruiter



Transmitting on channel 6: 2437 MHz.

| Frequency<br>(MHz) | Results for horizontal and vertical<br>polarisation of measurement<br>antenna<br>(dB $\mu$ V/m) |            | Detector type:<br>QP=Quasi peak<br>AV=Average<br>PK=Peak | Resolution<br>Bandwidth of<br>field strength<br>meter<br>(kHz) | Limits<br>(dB $\mu$ V/m) |
|--------------------|-------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------|----------------------------------------------------------------|--------------------------|
|                    | Vertical                                                                                        | Horizontal |                                                          |                                                                |                          |
| 306.0              | 35.90                                                                                           | 41.40      | QP                                                       | 120                                                            | 46.0                     |
| 1062               | <35.0                                                                                           | 41.20      | PK                                                       | 1000                                                           | 74.0                     |
| 1195               | 39.28                                                                                           | 43.58      | PK                                                       | 1000                                                           | 74.0                     |
| 1200               | 39.34                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 1328               | <35.0                                                                                           | 44.88      | PK                                                       | 1000                                                           | 74.0                     |
| 1333               | 44.82                                                                                           | 46.83      | PK                                                       | 1000                                                           | 74.0                     |
| 1599               | 41.71                                                                                           | 45.31      | PK                                                       | 1000                                                           | 74.0                     |
| 1603               | 41.82                                                                                           | 45.15      | PK                                                       | 1000                                                           | 74.0                     |
| 1860               | <35.0                                                                                           | 42.17      | PK                                                       | 1000                                                           | 74.0                     |
| 2577               | 44.69                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2582               | 45.55                                                                                           | 44.21      | PK                                                       | 1000                                                           | 74.0                     |
| 2925               | 41.75                                                                                           | 43.07      | PK                                                       | 1000                                                           | 74.0                     |
| 2928               | 42.02                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2933               | <35.0                                                                                           | 44.51      | PK                                                       | 1000                                                           | 74.0                     |
| 3464               | <35.0                                                                                           | 42.41      | PK                                                       | 1000                                                           | 74.0                     |
| 5050               | 37.29                                                                                           | 39.69      | PK                                                       | 1000                                                           | 74.0                     |
| 5065               | <35.0                                                                                           | 38.32      | PK                                                       | 1000                                                           | 74.0                     |
| other freq.        | <30.0                                                                                           | <30.0      | PK                                                       | 1000                                                           | 74.0                     |

Table 6.5: radiated emission data on channel 6.

Note: Radiated emission tests are performed with all bitrates. The highest values are given here. Above 1 GHz, the peak values are below the limits for measurement with the average detector. Therefore, not all spurious emissions are measured with the average detector.

Test personnel:

Tester signature:

Date: December 3, 2001

Name

: D.H. Kruiter



FCC ID: IMRAPP2411R  
 Description of EUT: 2.4 GHz. low power RLAN PCMCIA Card  
 Manufacturer: Apple Computer, Inc.  
 Brand mark: Apple  
 Built-in in type: P21 Tower

Transmitting on channel 11: 2462 MHz.

| Frequency<br>(MHz) | Results for horizontal and vertical<br>polarisation of measurement<br>antenna<br>(dB $\mu$ V/m) |            | Detector type:<br>QP=Quasi peak<br>AV=Average<br>PK=Peak | Resolution<br>Bandwidth of<br>field strength<br>meter<br>(kHz) | Limits<br>(dB $\mu$ V/m) |
|--------------------|-------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------|----------------------------------------------------------------|--------------------------|
|                    | Vertical                                                                                        | Horizontal |                                                          |                                                                |                          |
| 30 -1000           | <30.0                                                                                           | <30.0      | QK                                                       | 120                                                            | 40.0 - 54.0              |
| 1062               | 41.18                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 1195               | 39.56                                                                                           | 43.41      | PK                                                       | 1000                                                           | 74.0                     |
| 1328               | <35.0                                                                                           | 44.60      | PK                                                       | 1000                                                           | 74.0                     |
| 1333               | 45.58                                                                                           | 45.72      | PK                                                       | 1000                                                           | 74.0                     |
| 1599               | 41.44                                                                                           | 44.98      | PK                                                       | 1000                                                           | 74.0                     |
| 1603               | 43.32                                                                                           | 45.44      | PK                                                       | 1000                                                           | 74.0                     |
| 1860               | <35.0                                                                                           | 42.30      | PK                                                       | 1000                                                           | 74.0                     |
| 2606               | 47.38                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2610               | 45.96                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2620               | <35.0                                                                                           | 43.82      | PK                                                       | 1000                                                           | 74.0                     |
| 2925               | <35.0                                                                                           | 44.08      | PK                                                       | 1000                                                           | 74.0                     |
| 2928               | 40.98                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 2930               | 41.70                                                                                           | 43.04      | PK                                                       | 1000                                                           | 74.0                     |
| 4525               | 37.47                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |
| 5050               | <35.0                                                                                           | 39.27      | PK                                                       | 1000                                                           | 74.0                     |
| other freq.        | <35.0                                                                                           | <35.0      | PK                                                       | 1000                                                           | 74.0                     |

Table 6.6: radiated emission data on channel 11.

Note: Radiated emission tests are performed with all bitrates. The highest values are given here. Above 1 GHz, the peak values are below the limits for measurement with the average detector. Therefore, not all spurious emissions are measured with the average detector.

Test personnel:

Tester signature:

Date: December 3, 2001

Name : D.H. Kruiter



## 7 Conducted emission data at the AC power line terminals in accordance with FCC 15.107 and FCC 15.207.

The following table lists worst case conducted emission data from transmissions / receptions with various bitrates on various channels in accordance with FCC 15.207 and FCC 15.207. The conducted test was performed with the EUT exercise program loaded.

| Frequency<br>(MHz) | Measurement results<br>dB(μV)<br>Neutral |      | Measurement results<br>dB(μV)<br>Line |      | Limits<br>dB(μV) | Margin<br>(dB)<br>Neutral | Margin<br>(dB)<br>Line | Result |
|--------------------|------------------------------------------|------|---------------------------------------|------|------------------|---------------------------|------------------------|--------|
|                    | QP                                       | AV   | QP                                    | AV   | QP               | QP                        | QP                     |        |
| 0.450              | 23.9                                     | 23.8 | 24.2                                  | 24.2 | 48.0             | 24.1                      | 23.8                   | PASS   |
| 0.840              | 30.2                                     | 29.9 | 26.0                                  | 25.6 | 48.0             | 17.8                      | 22.0                   | PASS   |
| 0.955              | 27.9                                     | 27.6 | 24.5                                  | 24.0 | 48.0             | 20.1                      | 23.5                   | PASS   |
| 3.599              | 30.3                                     | 30.1 | 24.9                                  | 22.2 | 48.0             | 17.7                      | 23.1                   | PASS   |
| 3.951              |                                          |      | 23.7                                  | 21.9 | 48.0             |                           | 24.3                   | PASS   |
| 5.280              | 29.0                                     | 27.2 | 24.3                                  | 21.3 | 48.0             | 19.0                      | 23.7                   | PASS   |
| 10.000             | 23.5                                     | 21.5 | 14.1                                  | 8.7  | 48.0             | 24.5                      | 33.9                   | PASS   |
| 18.200             |                                          |      | 27.8                                  | 27.3 | 48.0             |                           | 20.2                   | PASS   |
| 20.000             | 17.9                                     | 13.2 | 16.3                                  | 11.3 | 48.0             | 30.1                      | 31.7                   | PASS   |
| 25.000             | 17.0                                     | 12.4 | 16.5                                  | 11.5 | 48.0             | 31.0                      | 31.5                   | PASS   |
| 30.000             | 16.2                                     | 11.1 | 16.9                                  | 11.7 | 48.0             | 31.8                      | 31.1                   | PASS   |

Table 7.1: worst case disturbance voltage levels.

Measurement results are average and quasi peak results. The conducted emission measurement has been carried with AC supply voltage of 120 V.

Test personnel:

Tester signature:

Date: December 3, 2001

Name:

P. Hamstra



## 8 Testresults of measurements in accordance with FCC 15.247.

### 8.1 Minimum 6 dB bandwidth.

| Bitrate    | Minimum 6 dB bandwidth (kHz) |                       |                        | Limit (kHz) |
|------------|------------------------------|-----------------------|------------------------|-------------|
|            | Channel 1<br>2412 MHz        | Channel 6<br>2437 MHz | Channel 11<br>2462 MHz |             |
| 1 Mbit/s   | 10280                        | 10200                 | 10280                  | >500        |
| 2 Mbit/s   | 10050                        | 10050                 | 10050                  | >500        |
| 5.5 Mbit/s | 10280                        | 10200                 | 10280                  | >500        |
| 11 Mbit/s  | 11480                        | 11480                 | 11180                  | >500        |

Table 8.1: data concerning minimum 6 dB bandwidth.

Test personnel:

Tester signature:

Date: December 3, 2001

Name:

O. H. Hoekstra

### 8.2 Maximum peak output power of the intentional radiator.

| Bitrate    | Maximum peak output power (dBm) |                       |                        | Limit (dBm)    |
|------------|---------------------------------|-----------------------|------------------------|----------------|
|            | Channel 1<br>2412 MHz           | Channel 6<br>2437 MHz | Channel 11<br>2462 MHz | Gain<br><6 dBi |
| 1 Mbit/s   | 18.8                            | 18.8                  | 18.8                   | 30.0           |
| 2 Mbit/s   | 18.8                            | 18.8                  | 18.8                   | 30.0           |
| 5.5 Mbit/s | 18.3                            | 18.3                  | 18.3                   | 30.0           |
| 11 Mbit/s  | 18.7                            | 18.7                  | 18.7                   | 30.0           |

Table 8.2: data concerning maximum peak output power of the intentional radiator.

Maximum values from measurements with supply voltages varied between 85% and 115% are noted down here. There are no differences in measurement results due to voltage variations between 85% and 115%. As the antenna gain does not exceed 6 dBi, no reduction of the maximum peak output power is required.

Test personnel:

Tester signature:

Date: December 3, 2001

Name:

O. H. Hoekstra



FCC ID: IMRAPP2411R  
Description of EUT: 2.4 GHz. low power RLAN PCMCIA Card  
Manufacturer: Apple Computer, Inc.  
Brand mark: Apple  
Built-in in type: P21 Tower

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**8.3 Radiated emission data outside restricted bands in a 100 kHz bandwidth shall be at least 20 dB below the highest level in a 100 kHz bandwidth within the band.**

| Frequency<br>(MHz) | dB below working<br>channel<br>(based on field<br>strength) | Limits<br>(dB) |
|--------------------|-------------------------------------------------------------|----------------|
| 2398.1             | -34.4                                                       | <-20.0         |
| 2400               | -37.1                                                       | <-20.0         |
| Other frequencies  | <-40.0                                                      | <-20.0         |

Table 8.3: data concerning radiated emission outside restricted bands in a 100 kHz bandwidth.

Note: Worst case situations for transmissions with all bitrate / channel 1, channel 6, and channel 11 combinations.

Test personnel:

Tester signature:

Date: December 3, 2001

Name:

O.H. Hoekstra



**8.4 Conducted emission data outside restricted bands in a 100 kHz bandwidth shall be at least 20 dB below the highest level in a 100 kHz bandwidth within the band.**

| Frequency<br>(MHz) | dB below<br>working channel | Limits<br>(dB) |
|--------------------|-----------------------------|----------------|
| 2398.1             | -34.4                       | -20.0          |
| 2400               | -37.1                       | -20.0          |

Table 8.4: data concerning conducted emission outside restricted bands in a 100 kHz bandwidth.

Note: Summary for transmissions with all bitrate / channel 1, channel 6, channel 11 combinations.

Test personnel:

Tester signature:

Date: December 3, 2001

Name : O. H. Hoekstra

**8.5 Peak power spectral density conducted from the intentional radiator in any 3 kHz band.**

| Bitrate    | Peak power spectral density in any 3 kHz band (dBm) |                       |                        | Limit (dBm) |
|------------|-----------------------------------------------------|-----------------------|------------------------|-------------|
|            | Channel 1<br>2412 MHz                               | Channel 6<br>2437 MHz | Channel 11<br>2462 MHz |             |
| 1 Mbit/s   | -9.0                                                | -8.9                  | -9.0                   | <8.0        |
| 2 Mbit/s   | -8.9                                                | -8.6                  | -8.7                   | <8.0        |
| 5.5 Mbit/s | -9.0                                                | -8.8                  | -8.8                   | <8.0        |
| 11 Mbit/s  | -6.5                                                | -6.2                  | -6.2                   | <8.0        |

Table 8.5: data concerning peak power spectral density.

Test personnel:

Tester signature:

Date: December 3, 2001

Name: O. H. Hoekstra



FCC ID: IMRAPP2411R  
Description of EUT: 2.4 GHz. low power RLAN PCMCIA Card  
Manufacturer: Apple Computer, Inc.  
Brand mark: Apple  
Built-in in type: P21 Tower

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## 8.6 Processing gain of a direct sequence system.

The results are available in a separate test report.

Test personnel:

Tester signature:

A handwritten signature in blue ink, appearing to read 'O. H. Hoekstra'.

Date: December 3, 2001

Name:

O. H. Hoekstra



FCC ID: IMRAPP2411R  
Description of EUT: 2.4 GHz. low power RLAN PCMCIA Card  
Manufacturer: Apple Computer, Inc.  
Brand mark: Apple  
Built-in in type: P21 Tower

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## 9 Plots of measurement data.

For reference purposes and spectrum analyzer settings during the measurements, a selection of plots of measurement data is presented here.

Test personnel:

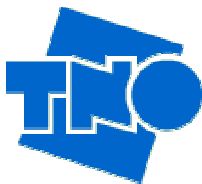
Tester signature:

A handwritten signature in blue ink, appearing to read 'O. H. Hoekstra'.

Date: December 3, 2001

Name:

O. H. Hoekstra



9.1 Emission in restricted bands nearest to the band 2400 - 2483.5 MHz.

9.1.1 Average values in restricted band 2310 - 2390 MHz.

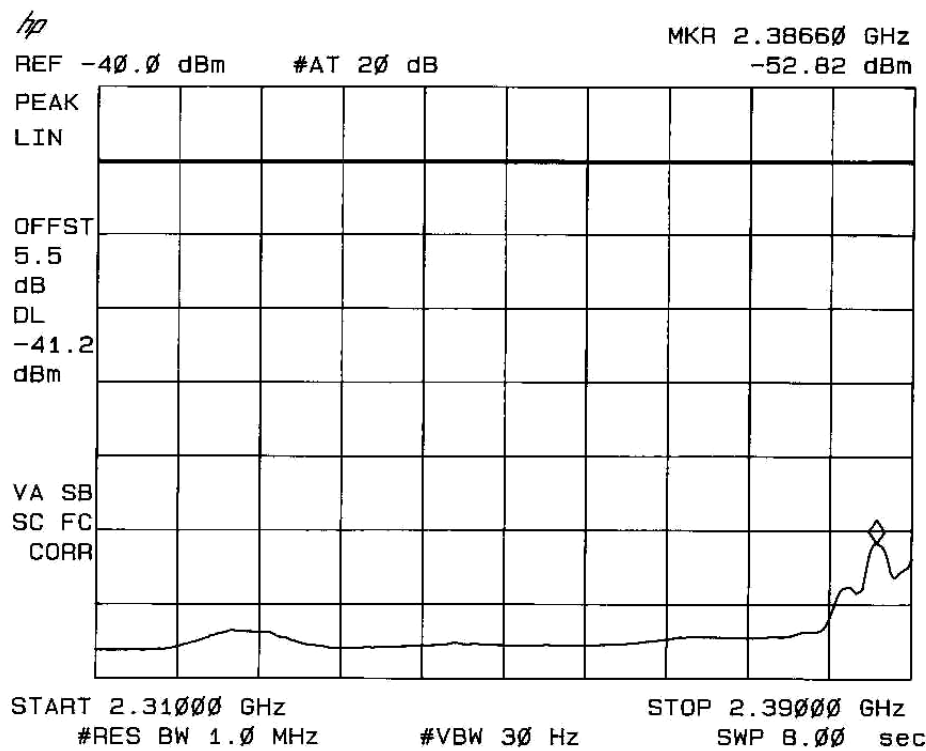
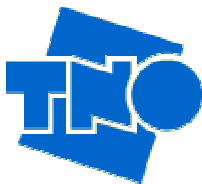


Figure 9.1: average values in restricted band, All bitrate settings, conducted measurement, corrected for 2 dBi antenna gain and 2.6 dB cable losses. 54 dBµV/m :: -41.2 dBm display line setting.



9.1.2 Peak values in restricted band 2310 - 2390 MHz.

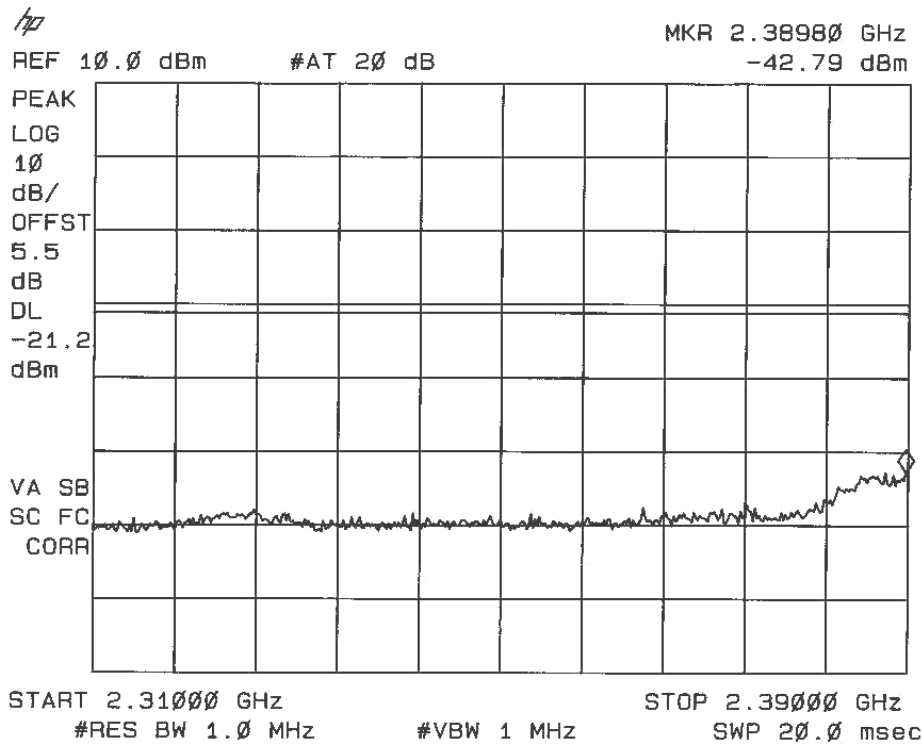


Figure 9.2: peak values in restricted band, All bitrate settings, conducted measurement, corrected for 2 dBi antenna gain and 2.6 dB cable losses. 74 dBμV/m :: -21.2 dBm display line setting.



9.1.3 Average values in restricted band 2483.5 - 2500 MHz.

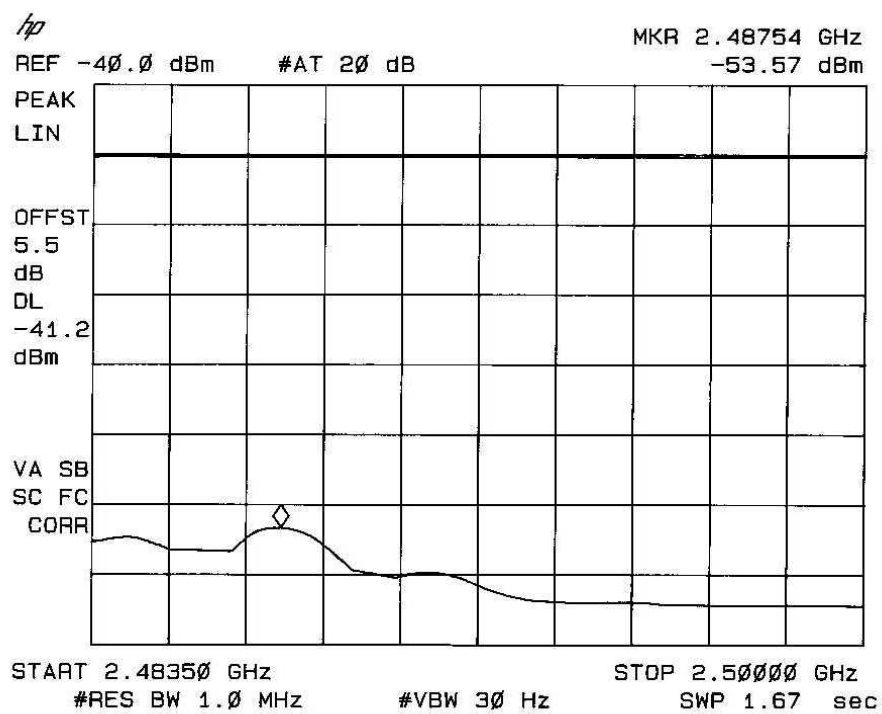
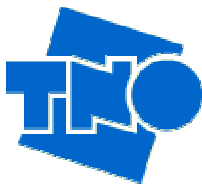


Figure 9.3: average values in restricted band, All bitrate settings, conducted measurement, corrected for 2 dBi antenna gain and 2.6 dB cable losses. 54 dBμV/m :: -41.2 dBm display line setting.



9.1.4 Peak values in restricted band 2483.5 - 2500 MHz.

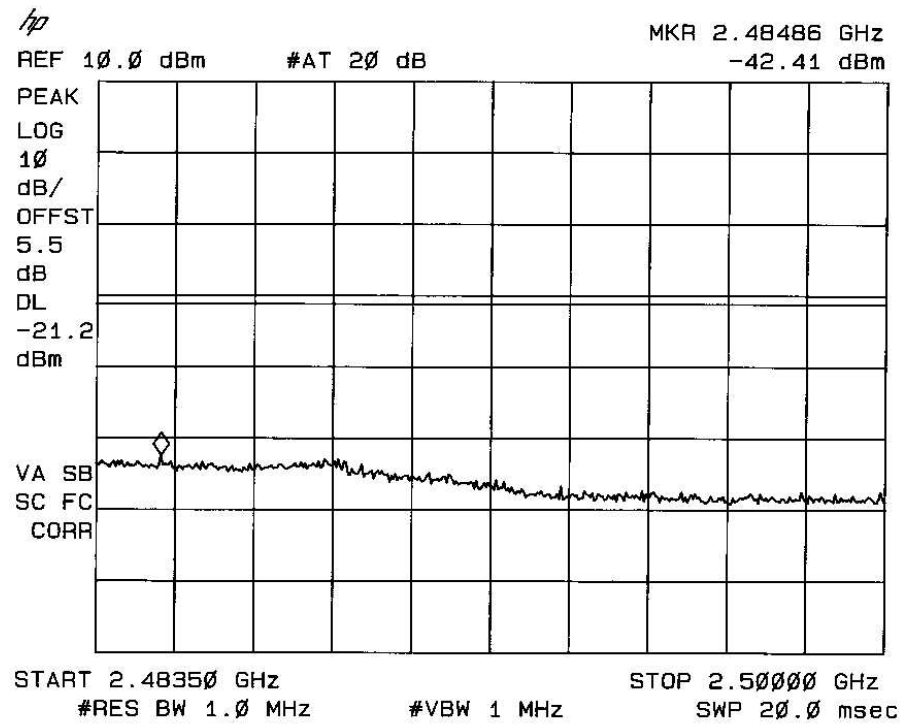
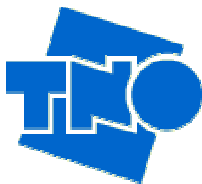


Figure 9.4: peak values in restricted band, All bitrate settings, conducted measurement, corrected for 2 dBi antenna gain and 2.6 dB cable losses. 74 dBµV/m :: -21.2 dBm display line setting.



9.2 Minimum 6 dB bandwidth.

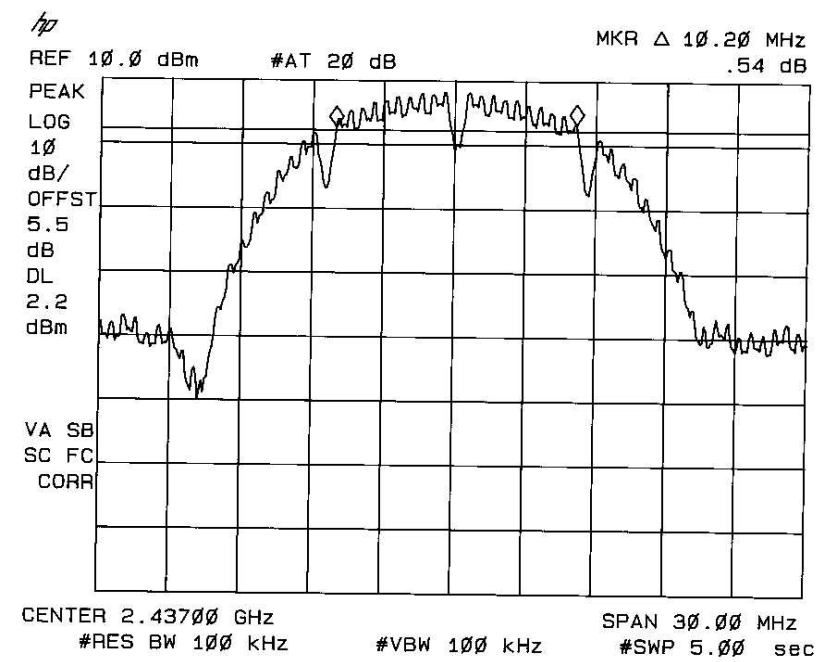


Figure 9.5: minimum 6 dB bandwidth at 1 Mbit/s.

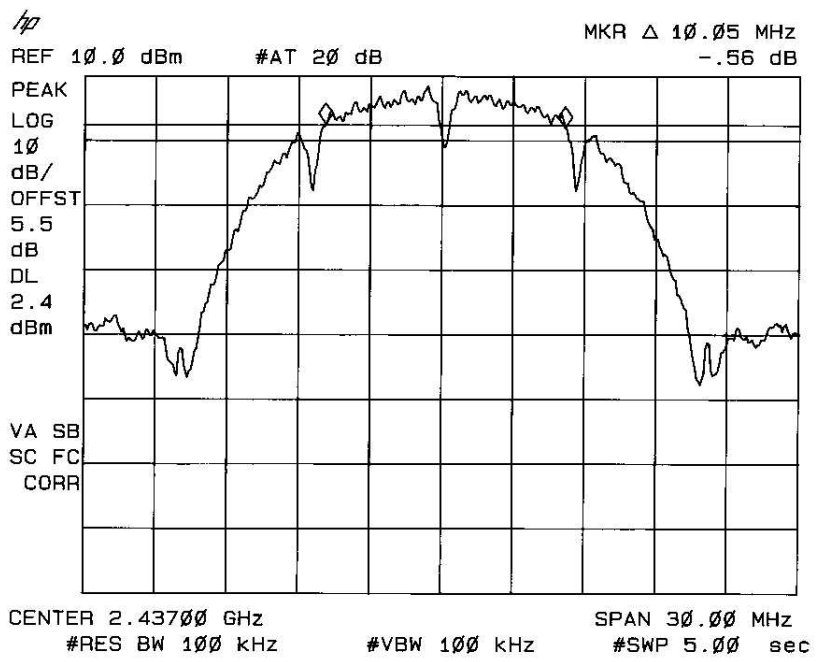


Figure 9.6: minimum 6 dB bandwidth at 2 Mbit/s.

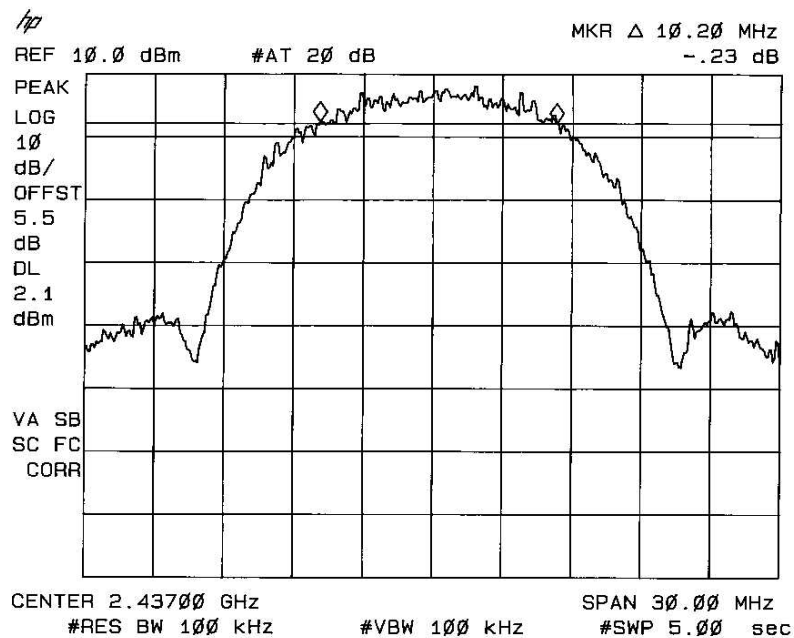
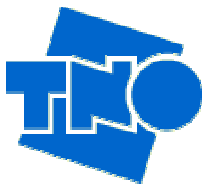


Figure 9.7: minimum 6 dB bandwidth at 5.5 Mbit/s.

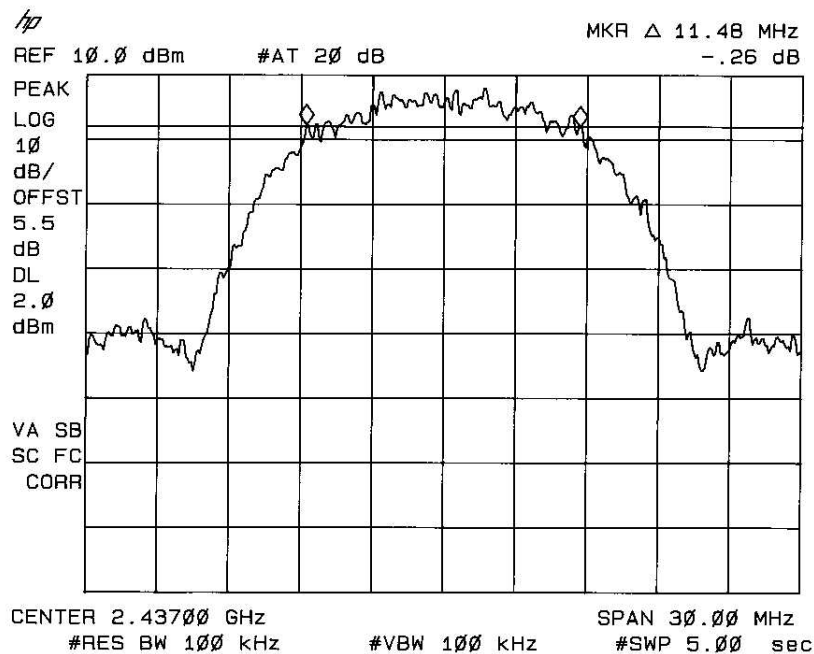
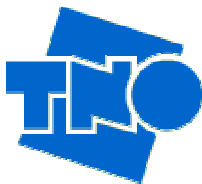


Figure 9.8: minimum 6 dB bandwidth at 11 Mbit/s.



9.3 Conducted emission data outside restricted bands in a 100 kHz bandwidth shall be at least 20 dB below the highest level in a 100 kHz bandwidth within the band.

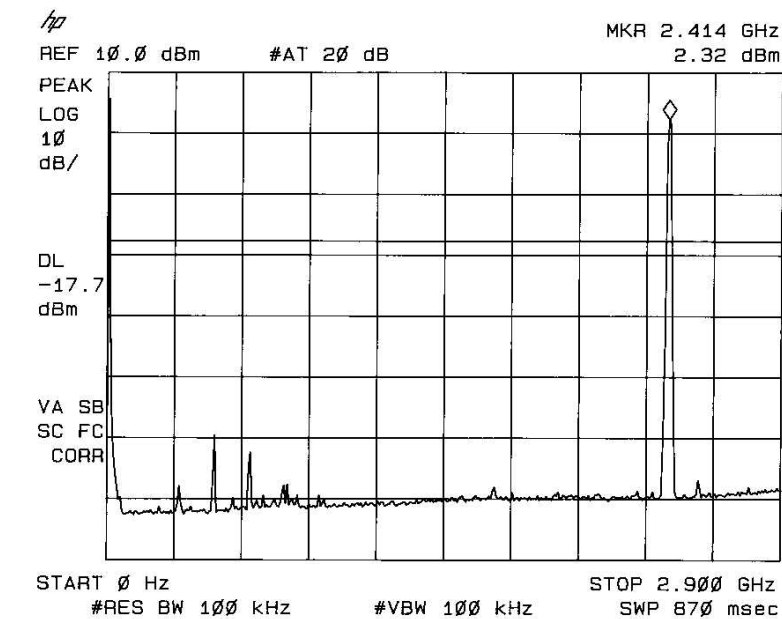


Figure 9.9: conducted emission outside restricted band. Display line :: -20 dB limit line. Corrected (offset) for cable losses.

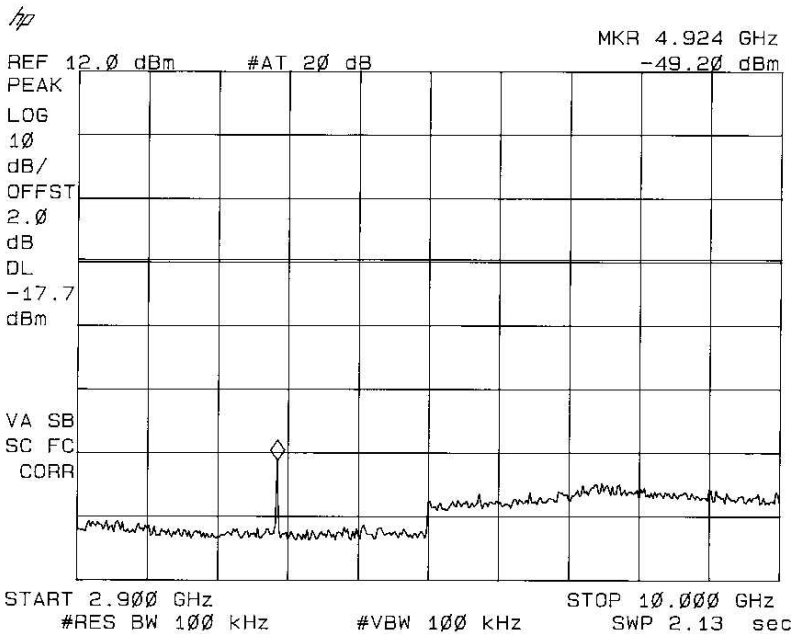


Figure 9.10: conducted emission outside restricted band. Display line :: -20 dB limit line. Corrected (offset) for cable losses.

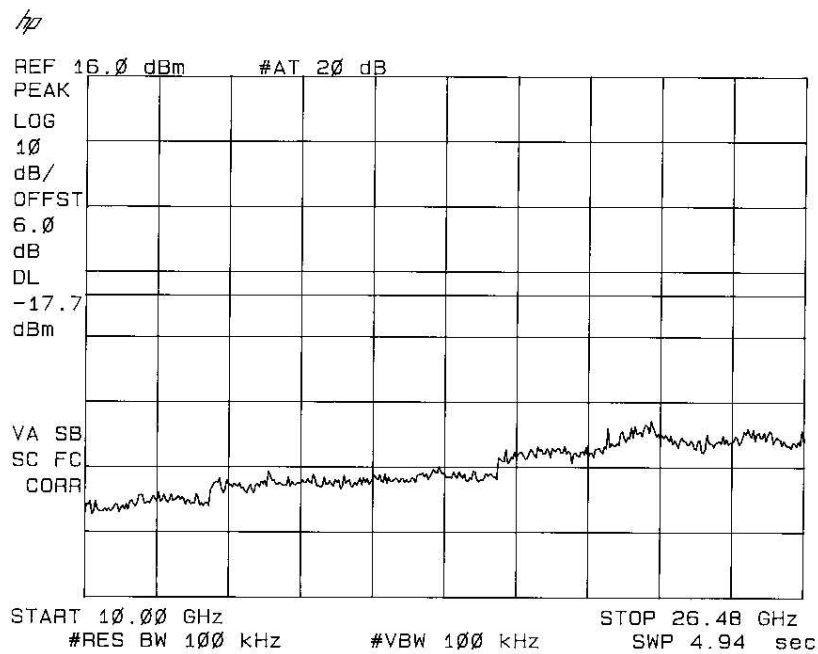
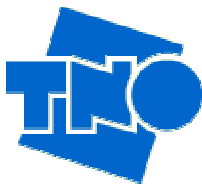
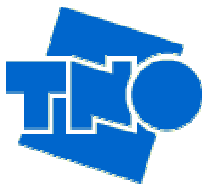


Figure 9.11: conducted emission outside restricted band. Display line :: -20 dB limit line. Corrected (offset) for cable losses.



9.4 Peak power spectral density conducted from the intentional radiator in any 3 kHz band.

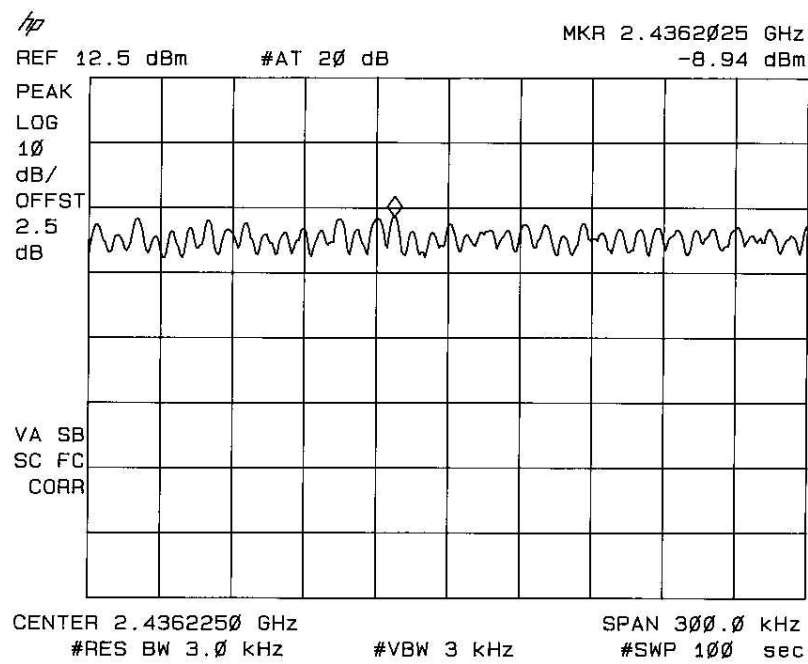


Figure 9.12: peak power density in a 3 kHz bandwidth at 1 Mbit/s. Corrected (offset) for cable losses.

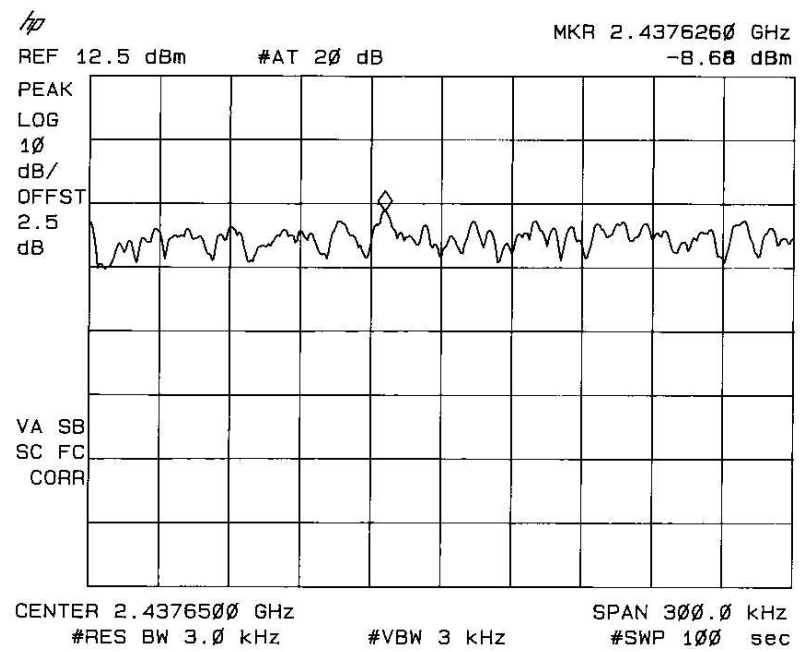


Figure 9.13: peak power density in a 3 kHz bandwidth at 2 Mbit/s. Corrected (offset) for cable losses.

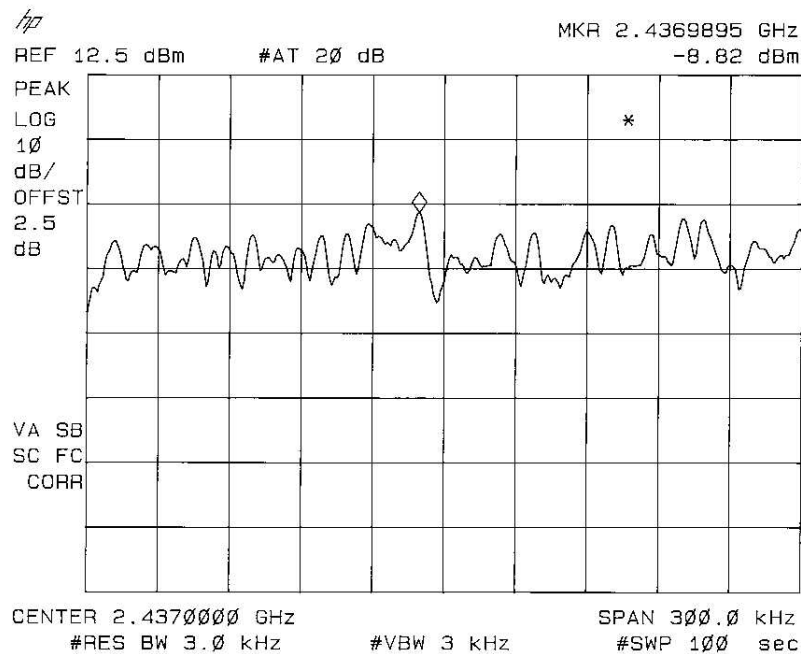
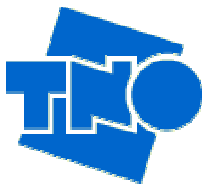


Figure 9.14: peak power density in a 3 kHz bandwidth at 5.5 Mbit/s. Corrected (offset) for cable losses.

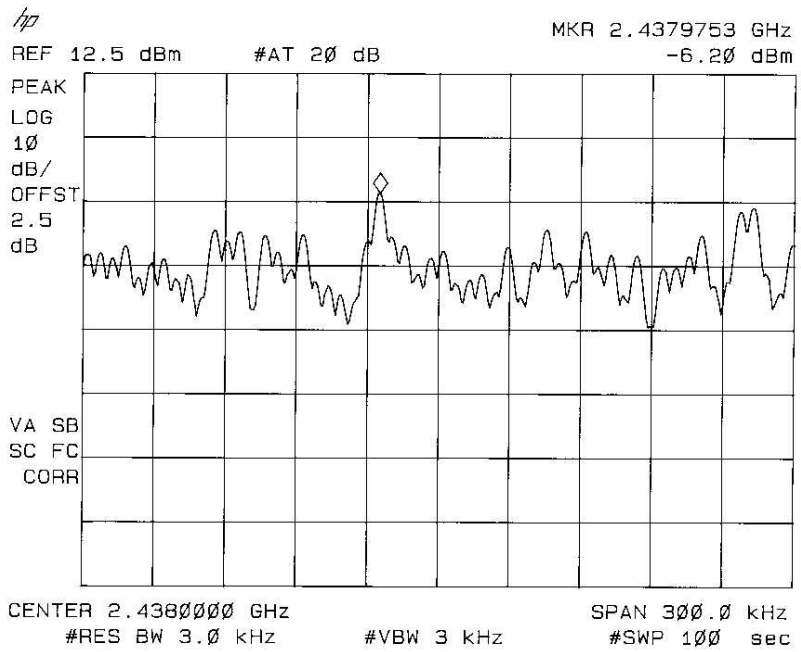


Figure 9.15: peak power density in a 3 kHz bandwidth at 11 Mbit/s. Corrected (offset) for cable losses.



## 10 List of used measuring equipment.

| TNO number | Description                        | Brand           | Type                 |
|------------|------------------------------------|-----------------|----------------------|
| 12471      | Biconical antenna 20 MHz - 200 MHz | EATON           | 94455-1              |
| 12473      | Log-per antenna 200 - 1000 MHz     | 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                            | Hewlett Packard | 7440A                |
| 12605      | calibrated dipole 28 MHz - 1 GHz   | EMCO            | 3121c                |
| 12608      | HF milliwattmeter                  | Hewlett Packard | HP435a               |
| 12609      | Power sensor 10 MHz - 18 GHz       | Hewlett Packard | HP8481A              |
| 12636      | Polyester chamber                  | Polyforce       | --                   |
| 12640      | Temperature chamber                | Heraeus         | VEM03/500            |
| 13664      | Spectrum analyzer                  | Hewlett Packard | HP8593E              |
| 13078      | Preamplifier 0.1 GHz - 12 GHz      | Miteq           | AMF-3D-001120-35-14p |
| 13452      | Digital multi meter                | Hewlett Packard | 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             | ESCS30               |
| 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    |
| 99220      | Regulating trafo                   | RFT             | LTS020               |

Table 10.1: list of used measuring equipment.