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Compliance test report ID **199523-1TRFWL**

Date of issue
March 6, 2012

# FCC 47 CFR Part 15, Subpart C, Chapter 15.231

Periodic operation in the band 40.66–40.70 MHz and above 70 MHz

Applicant **Tecnoplus srl**
Product **TX device for central vacuum cleaners**
Model **Flisy**
FCC ID **DGO-FLISY**

Test location

Nemko Spa
Via del Carroccio, 4
20853 Biassono (MB)
Italy
Test site FCC ID: 481407 (10 m semi anechoic chamber)

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| | | |
|---|---|---|
| **Tested by** | | March 6, 2012 |
| | P. Barbieri | **Date** |
| **Reviewed by** | | March 6, 2012 |
| | G. Curioni | **Date** |

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Spa ISO/IEC 17025 accreditation.

Copyright notification

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# Section 1 Report summary

## 1.1 Applicant

*Tecnoplus srl*
*Via Cilavegna n.53*
*27020 Gravellona Lomellina (PV)*
*Italy*

## 1.2 Manufacturer

*Tecnoplus srl*
*Via Cilavegna n.53*
*27020 Gravellona Lomellina (PV)*
*Italy*

## 1.3 Test specifications

FCC 47 CFR Part 15, Subpart C, Chapter 15.231

Periodic operation in the band 40.66–40.70 MHz and above 70 MHz

## 1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

## 1.5 Exclusions

None

## 1.6 Test report revision history

| Revision # | Details of changes made to test report |
|---|---|
| 199523-1TRFWL | Original report issued |

# Section 2 Summary of test results

## 2.1 FCC Part 15 Subpart C – Intentional Radiators, test results

| Part | Test description | Verdict |
|---|---|---|
| §15.207(a) | Conducted limits | Not applicable |
| §15.231(a) | Conditions for intentional radiators to comply with periodic operation | Pass |
| §15.231(b) | Field strength of emissions | Pass |
| §15.231(c) | Emission bandwidth | Pass |
| §15.231(d) | Requirements for devices operating within 40.66–40.70 MHz band | Not applicable |
| §15.231(e) | Conditions for intentional radiators to comply with periodic operation | Not applicable |
| Notes: None | | |

# Section 3 Equipment under test (EUT) details

## 3.1 Sample information

| | |
|---|---|
| **Receipt date** | February 24, 2012 |
| **Nemko sample ID number** | 199523 |

## 3.2 EUT information

| | |
|---|---|
| **Product name** | TX device for central vacuum cleaners |
| **Model** | Flisy |
| **Serial number** | Not provided |
| **Part number** | Not provided |

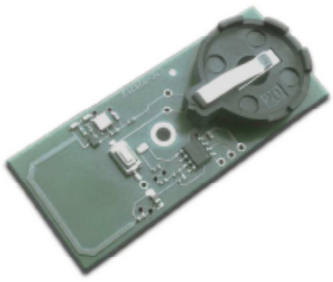
## 3.3 Technical information

| | |
|---|---|
| **Operating band** | 433.05 to 434.79 MHz |
| **Operating frequency** | 433.925 MHz |
| **Modulation type** | AM (OOK) |
| **Occupied bandwidth** | - |
| **Emission designator** | P1D |
| **Power requirements** | 80.8 dBµV/m (All tests were performed with new battery.) |
| **Antenna information** | Antenna type and gain<br>The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator. |

## 3.4 Product description and theory of operation

The EUT is a radio controller for central vacuum cleaners with the following performance data

| TABLE 2 - PERFORMANCE DATA TRANSMITTER CT72 | | |
|---|---|---|
| Frequency | | 433.925 MHz ± 150KHz |
| Modulation | | AM (OOK) |
| Output RF power | @3V DC | -27 dBm ERP |
| Data rate | Default | 1 kbps |
| | Max | 5 kbps |
| System setup time | | 25 µs |
| Supply current | Active | 10 mA |
| | Sleep | 0 mA |
| Supply Voltage | Min | 2.6V DC |
| | Max | 3.3V DC |
| Operating temperature range | | +5°C ÷ +35°C - CAT III |
| Antenna | | Loop integrated |
| Dimensions | | 60 x 20 x 10 mm |



CT72 - TRANSMITTER

## 3.5 EUT exercise details

The EUT has been tested pushing the button when discontinuous working is needed and it has been tested in continuous transmission mode forced with an electrical bridge.

# Section 4 Engineering considerations

## 4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

## 4.2 Technical judgment

None

## 4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

# Section 5 Test conditions

## 5.1 Atmospheric conditions

Temperature: 15–30 °C
Relative humidity: 20–75 %
Air pressure: 86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

## 5.2 Power supply range

The EUT has been tested with its dedicated 3 Vdc battery (new).

# Section 6 Measurement uncertainty

## 6.1 Uncertainty of measurement

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Nemko Spa Technical Procedure WML1002. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.
Hereafter the best measurement capability for Nemko Spa laboratory is reported:

| Test | Range | Measurement Uncertainty | Notes |
|---|---|---|---|
| Radiated Disturbance | Antenna distance 3m, 10m (30÷200) MHz | 5.0 dB | (1) |
| | Antenna distance 3m (0.2÷6) GHz | 5.2 dB | (1) |
| | Antenna distance 1m, 3m (6÷18) GHz | 5.8 dB | (1) |
| | Antenna distance 1m, 3m (18÷40) GHz | 7.2 dB | (1) |
| Conducted Disturbance | 9 kHz ÷ 150 kHz with AMN | 3.8 dB | (1) |
| | 150 kHz ÷ 30 MHz with AMN | 3.4 dB | (1) |
| | 150 kHz ÷ 30 MHz with AAN | 4.6 dB | (1) |
| | 9 kHz ÷ 30 MHz with voltage probe | 2.9 dB | (1) |
| | 9 kHz ÷ 30 MHz with current probe | 2.9 dB | (1) |

NOTES:
(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor *k* = 2 which has been derived from the assumed normal probability distribution with infinite degrees of freedom and for a coverage probability of 95 %

# Section 7 Test equipment

## 7.1 Test equipment list

| Equipment | Manufacturer | Model no. | Asset no. | Cal date | Next cal. |
|---|---|---|---|---|---|
| Trilog Broad Band Antenna | Schwarzbeck | VULB 9168 | VULB 9168-242 | 2012/02 | 2015/02 |
| Bilog antenna 1 ÷ 18 GHz | Schwarzbeck | STLP 9148-123 | 123 | 2012/02 | 2015/02 |
| Broadband preamplifier | Schwarzbeck | BBV 9718 | 9718-137 | 2010/07 | 2013/07 |
| EMI receiver 20 Hz ÷ 8 GHz | R&S | ESU8 | 100202 | 2012/02 | 2013/02 |
| Turning-table | R&S | HCT | 835 803/03 | NCR | NCR |
| Antenna mast | R&S | HCM | 836 529/05 | NCR | NCR |
| Controller | R&S | HCC | 836 620/7 | NCR | NCR |
| Semi-anechoic chamber | Nemko | 10m semi-anechoic chamber | 530 | 2010/08 | 2012/08 |
| Shielded room | Siemens | 10m control room | 1947 | NCR | NCR |
| Note: NCR - no calibration required | | | | | |

# Section 8 Testing data

## 8.1 Clause 15.231(a) Conditions for intentional radiators to comply with periodic operation

### 8.1.1 Definitions and limits

The provisions of this section are restricted to periodic operation within the band 40.66–40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition

5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

### 8.1.2 Test summary

| | | | | | |
|---|---|---|---|---|---|
| **Test date** | March 5, 2012 | **Test engineer** | P. Barbieri | **Verdict** | Pass |
| **Temperature** | 20 °C | **Air pressure** | 1000 mbar | **Relative humidity** | 45 % |

### 8.1.3 Observations/special notes

None

### 8.1.4 Test data

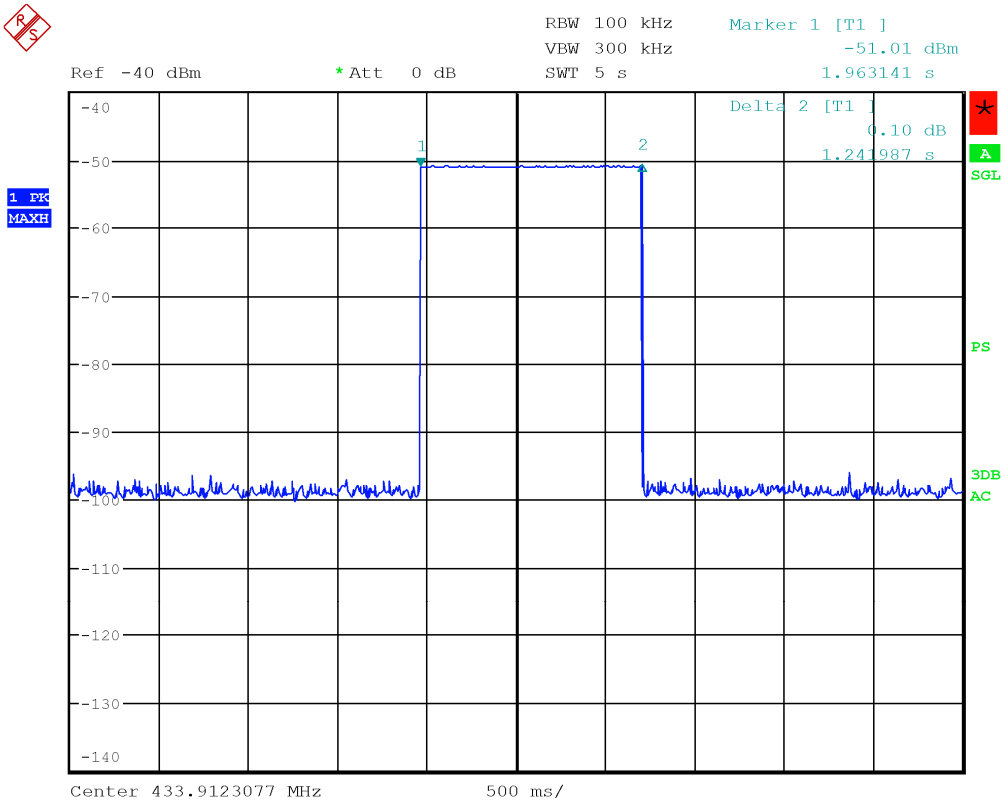
1) The EUT is manually triggered.
   See attached plot for the timing of a manually trigger event.

2) The EUT is not activated automatically.

3) The EUT is not a periodic transmitter.

4) The EUT usage is not for radio control purposes during emergencies.

5) The EUT does not transmit set-up information




**Plot: Timing measurement**

## 8.2 Clause 15.231(b) Field strength of emissions

### 8.2.1 Definitions and limits

In addition to the provisions of §15.205 the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

**Table 8.2-1:** Field strength limits

| Fundamental frequency (MHz) | Field strength of fundamental (µV/m) | (dBµV/m) | Field strength of spurious emissions (µV/m) | (dBµV/m) |
|---|---|---|---|---|
| 40.66–40.70 | 2,250 | 67 | 225 | 47 |
| 70–130 | 1,250 | 61.9 | 125 | 41.9 |
| 130–174 | 1,250 to 3,750* | 61.9 to 71.5* | 125 to 375* | 41.9 to 51.5* |
| 174–260 | 3,750 | 71.5 | 375 | 51.5 |
| 260–470 | 3,750 to 12,500* | 71.5 to 81.9* | 375 to 1,250* | 51.5 to 61.9* |
| Above 470 | 12,500 | 81.9 | 1,250 | 61.9 |
| * Linear interpolations | | | | |

1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.
2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.
3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

### 8.2.2 Test summary

| | | | | | |
|---|---|---|---|---|---|
| **Test date** | March 2, 2012 | **Test engineer** | P. Barbieri | **Verdict** | Pass |
| **Temperature** | 20 °C | **Air pressure** | 1000 mbar | **Relative humidity** | 45 % |

### 8.2.3 Observations/special notes

**Table 8.2-2:** §15.209 – Radiated emission limits

| Frequency (MHz) | Field strength (µV/m) | Measurement distance (dBµV/m) | (m) |
|---|---|---|---|
| 0.009–0.490 | 2400/F | 67.6−20log(F) | 300 |
| 0.490–1.705 | 24000/F | 87.6−20log(F) | 30 |
| 1.705–30.0 | 30 | 29.5 | 30 |
| 30–88 | 100 | 40.0 | 3 |
| 88–216 | 150 | 43.5 | 3 |
| 216–960 | 200 | 46.0 | 3 |
| above 960 | 500 | 54.0 | 3 |

– F = fundamental frequency in kHz
– In the emission table above, the tighter limit applies at the band edges.
– For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

## 8.2.3 Observations/special notes, continued

**Table 8.2-3:** §15.205 – Restricted bands of operation

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090–0.110 | 16.42–16.423 | 399.9–410 | 4.5–5.15 |
| 0.495–0.505 | 16.69475–16.69525 | 608–614 | 5.35–5.46 |
| 2.1735–2.1905 | 16.80425–16.80475 | 960–1240 | 7.25–7.75 |
| 4.125–4.128 | 25.5–25.67 | 1300–1427 | 8.025–8.5 |
| 4.17725–4.17775 | 37.5–38.25 | 1435–1626.5 | 9.0–9.2 |
| 4.20725–4.20775 | 73–74.6 | 1645.5–1646.5 | 9.3–9.5 |
| 6.215–6.218 | 74.8–75.2 | 1660–1710 | 10.6–12.7 |
| 6.26775–6.26825 | 108–121.94 | 1718.8–1722.2 | 13.25–13.4 |
| 6.31175–6.31225 | 123–138 | 2200–2300 | 14.47–14.5 |
| 8.291–8.294 | 149.9–150.05 | 2310–2390 | 15.35–16.2 |
| 8.362–8.366 | 156.52475–156.52525 | 2483.5–2500 | 17.7–21.4 |
| 8.37625–8.38675 | 156.7–156.9 | 2690–2900 | 22.01–23.12 |
| 8.41425–8.41475 | 162.0125–167.17 | 3260–3267 | 23.6–24.0 |
| 12.29–12.293 | 167.72–173.2 | 3332–3339 | 31.2–31.8 |
| 12.51975–12.52025 | 240–285 | 3345.8–3358 | 36.43–36.5 |
| 12.57675–12.57725 | 322–335.4 | 3600–4400 | Above 38.6 |
| 13.36–13.41 | | | |

- The spectrum was searched from 30 MHz to the 10th harmonic.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
- within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
- above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
- and using average detector with 1 MHz/3 MHz RBW/VBW for average results.

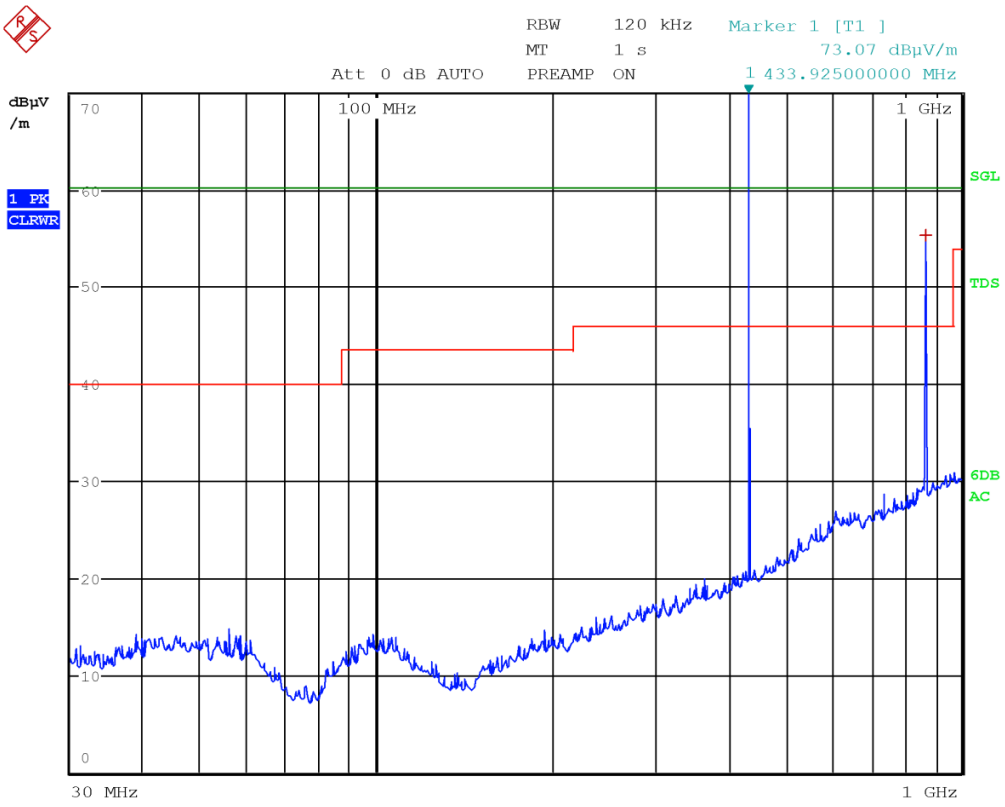
## 8.2.4 Test data

Duty cycle/average factor calculations

§15.35(c) When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed; the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

$$Duty\,cycle\,/\,average\ factor = 20\times\log_{10}\left(\frac{Tx_{100\,ms}}{100\,ms}\right)$$

8.2.5 Test data, continued




**Plot:** Antenna in horizontal polarization

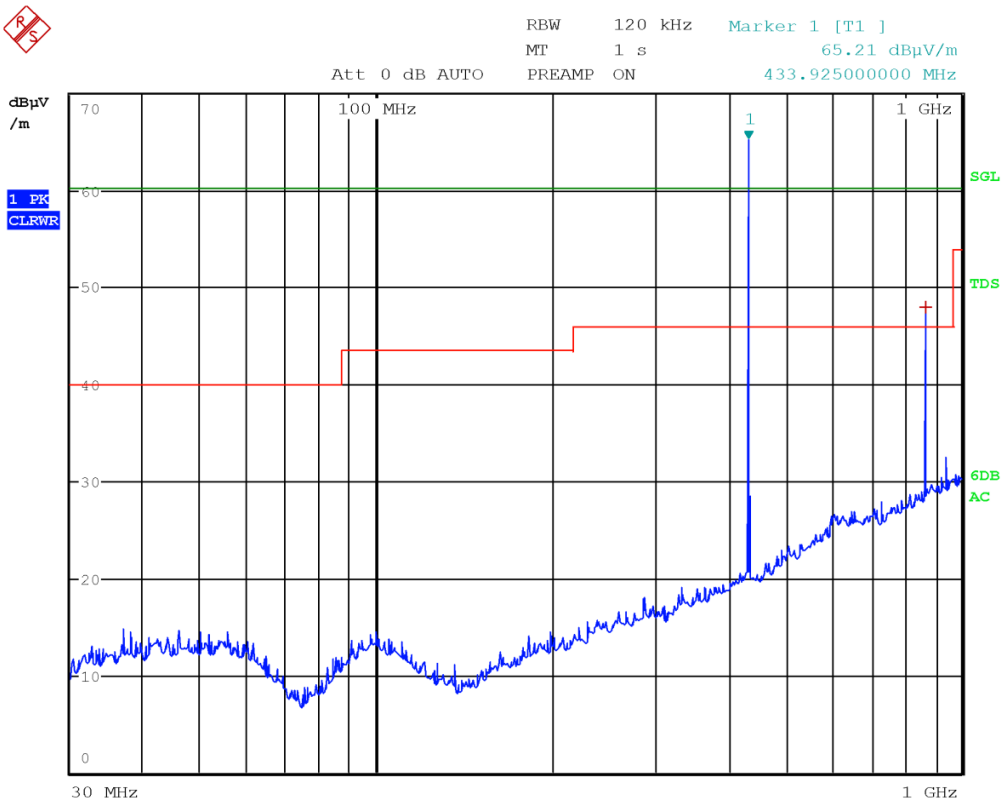
The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators) for determination of compliance. Limits have been adjusted to reflect 3 m requirements.

A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated and antenna adjusted to maximize radiated emission. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

**Table:** Field strength measurement results

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|
| 433.9250 | 73.1 | 80.8 | -7.7 | PK |
| 867.8250 | 55.4 | 60.8 | -5.4 | PK |

8.2.4 Test data, continued




**Plot:** Antenna in vertical polarization

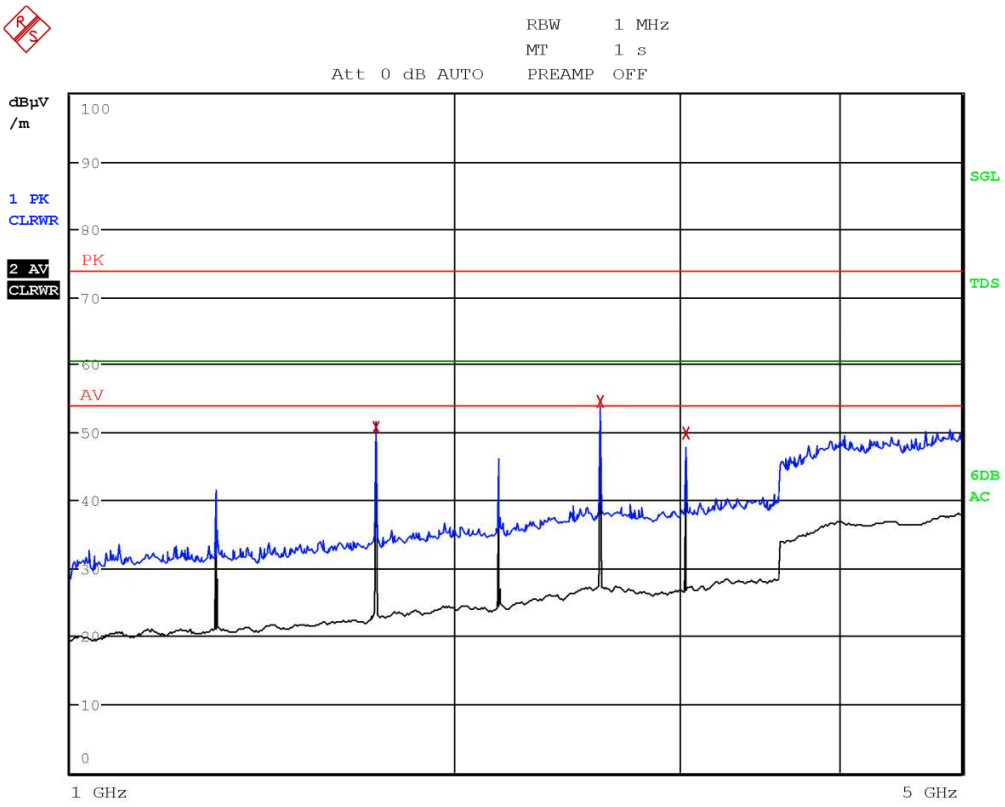
The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators) for determination of compliance. Limits have been adjusted to reflect 3 m requirements.

A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated and antenna adjusted to maximize radiated emission. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

**Table:** Field strength measurement results

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|
| 433.9250 | 65.2 | 80.8 | -15.6 | PK |
| 867.8250 | 48.0 | 60.8 | -12.8 | PK |

8.2.4 Test data, continued




**Plot:** Antenna in horizontal polarization

The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators) for determination of compliance. Limits have been adjusted to reflect 3 m requirements.

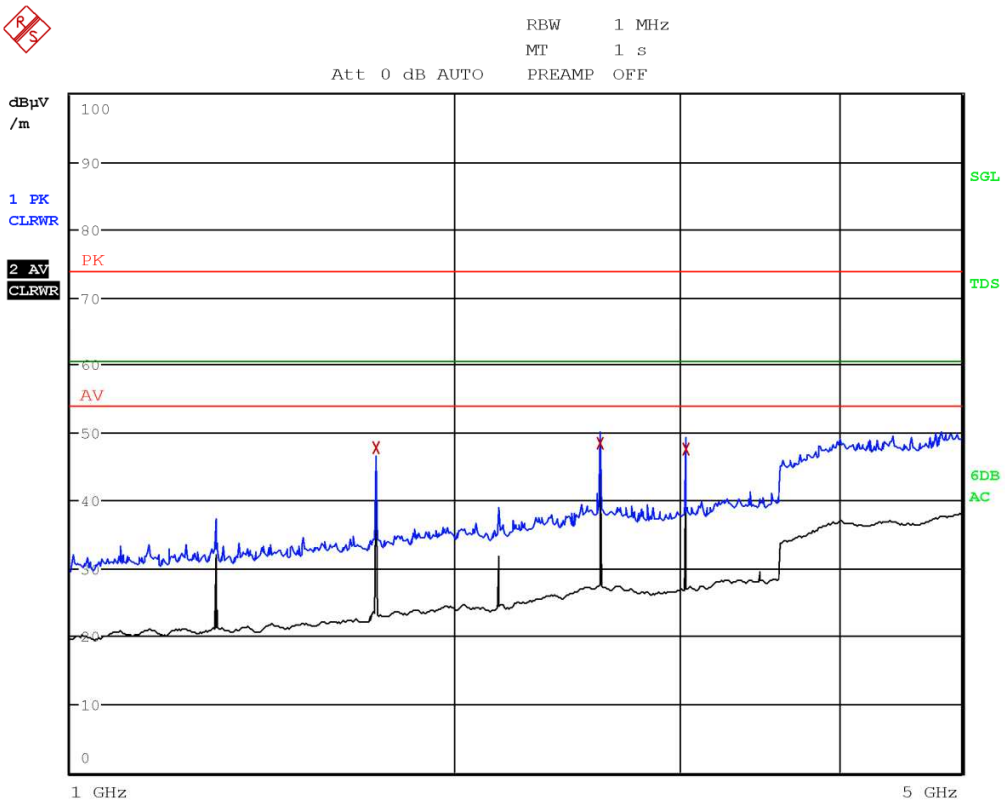
A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated and antenna adjusted to maximize radiated emission. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

**Table:** Field strength measurement results

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|
| 1735.5000 | 50.8 | 60.8 | -10.0 | PK |
| 2603.5000 | 54.4 | 60.8 | -6.4 | PK |
| 3037.5000 | 50.0 | 60.8 | -10.8 | PK |

Average calculation not required since the PK value is under the limits

8.2.4 Test data, continued




**Plot:** Antenna in vertical polarization

The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators) for determination of compliance. Limits have been adjusted to reflect 3 m requirements.

A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated and antenna adjusted to maximize radiated emission. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

**Table:** Field strength measurement results

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|
| 1735.5000 | 47.9 | 60.8 | -12.9 | PK |
| 2603.5000 | 48.5 | 60.8 | -15.3 | PK |
| 3037.5000 | 47.6 | 60.8 | -13.2 | PK |

Average calculation not required since the PK value is under the limits

## 8.3 Clause 15.231(c) Emission bandwidth

### 8.3.1 Definitions and limits

The bandwidth of the emission shall be no wider than 0.25 % of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5 % of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

### 8.3.2 Test summary

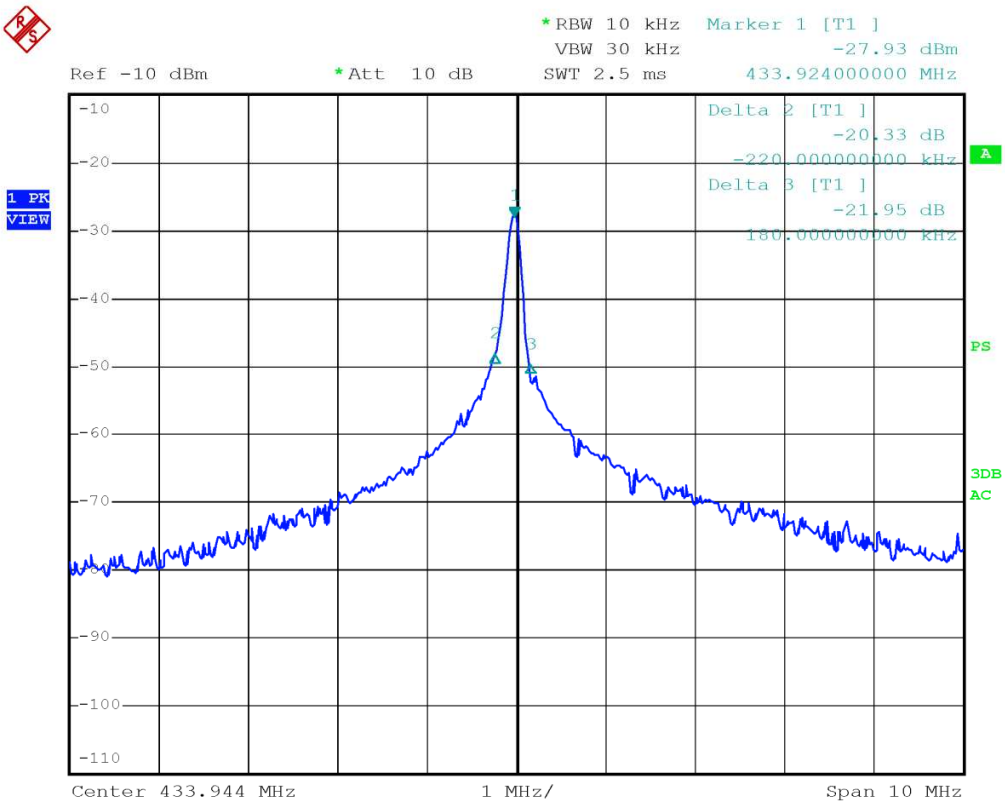
| | | | | | |
|---|---|---|---|---|---|
| **Test date** | March 5, 2012 | **Test engineer** | P. Barbieri | **Verdict** | Pass |
| **Temperature** | 20 °C | **Air pressure** | 1000 mbar | **Relative humidity** | 45 % |

### 8.3.3 Observations/special notes

The test was performed using peak detector of the spectrum analyzer with RBW no narrower than 1 % of the emission bandwidth.

### 8.3.4 Test data

Limit: 0.25 % of 433.925 MHz is 1084.8125 kHz



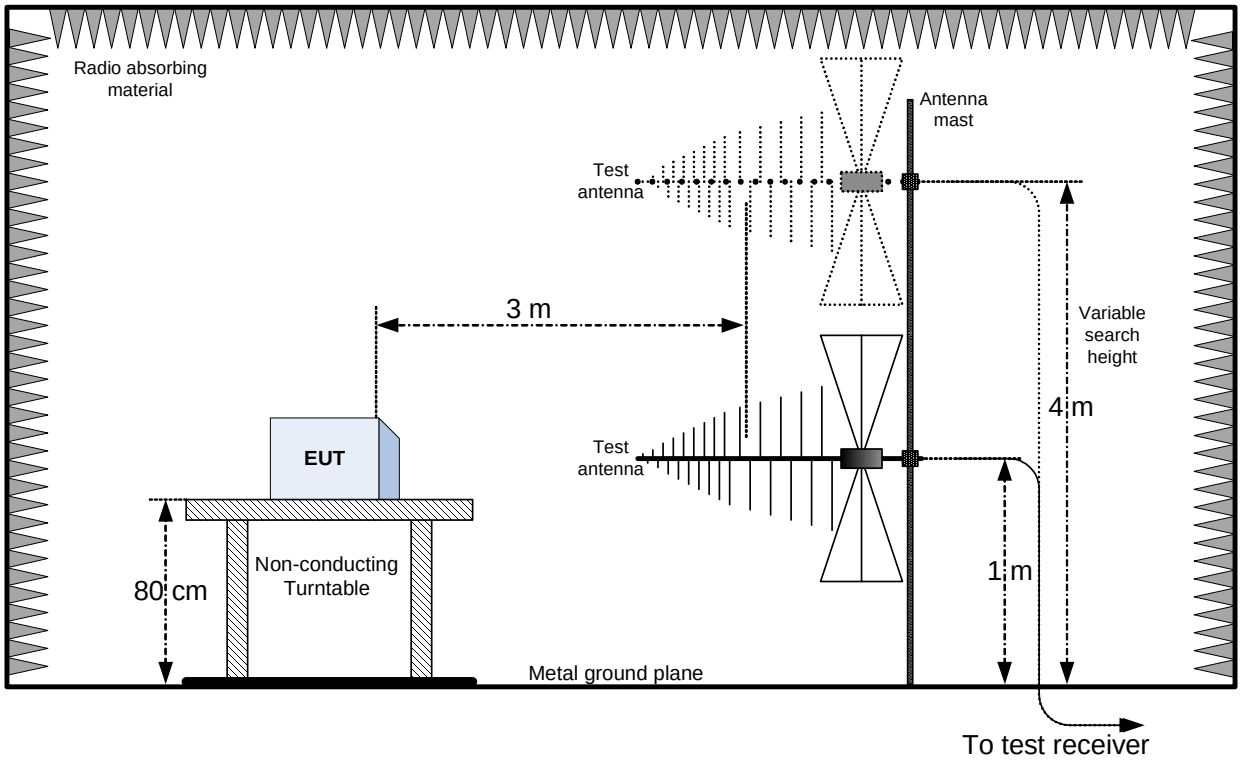

**Plot:** 20 dB bandwidth

**Table:** 20 dB bandwidth

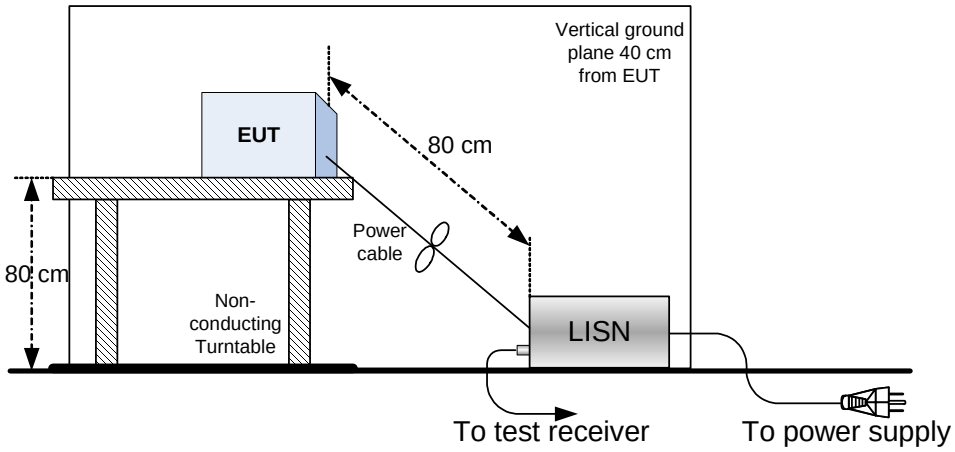
| 20 dB bandwidth (kHz) | Limit (kHz) | Margin (kHz) |
|---|---|---|
| 400 | 1084.8125 | -684.8125 |

# Section 9 Block diagrams of test set-ups

## 9.1 Radiated emissions set-up




## 9.2 Conducted emissions set-up



# Section 10 EUT photos

## 10.1 External photos

### 10.1.1 EUT side view

### 10.1.2 EUT top view

### 10.1.3 EUT internal view

### 10.1.4 EUT bottom view