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# DELTA Test Report

TEST Reg. no. 19

## Test of flowIQ2100 according to FCC requirements

## Performed for Kamstrup A/S

DANAK-19/12504 Rev. A
Project no.:T203210-1


30 October 2012

**DELTA**
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| | |
|---|---|
| **Title** | Test of flowIQ2100 according to FCC requirements |
| **Test object** | flowIQ2100 |
| **Report no.** | DANAK-19/12504 Rev. A |
| **Project no.** | T203210-1 |
| **Test period** | 24 September to 02 October 2012 |
| **Client** | Kamstrup A/S<br>Industrivej 28, Stilling<br>8660 Skanderborg<br>Denmark<br>Tel.: +45 89 93 10 00 |
| **Contact person** | Bjarne Lund Jensen<br>E-mail: blj@kamstrup.dk |
| **Manufacturer** | Kamstrup A/S |
| **Specifications** | 47 CFR Part 15, Subpart C (Specific rule part §15.247) |
| **Results** | The test objects were found to be in compliance with the specifications, as listed in Section 1 |
| **Test personnel** | Claus Momme Thomsen |
| **Test site(s)** | DELTA, Venlighedsvej 4, 2970 Hørsholm, Denmark |
| **Date** | 20 October 2012 |

**Project Manager**

Jakob Steensen, Consultant
Centre of Compliance Engineering, DELTA

**Responsible**

Claus Rømer Andersen, Business Manager
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This test report replaces previously issued test report DANAK-19/12504 dated 22 October 2012. The changes in this report are:

Section 6: Information about calibration has been added.

## Table of contents

# 1. Summary of tests

The authorization procedure for the flowIQ2100 is:

Certification by FCC Part 15 C.

| Test case ID | Description | Specification | Test methods | Results |
|---|---|---|---|---|
| 2.3 | 6 dB Bandwidth | 47 CFR Part 15C Subpart 15.247(a)(2) | ANSI C63.10-2009 | Passed |
| 2.5 | Radiated limits; general requirements | 47 CFR Part 15C Subpart 15.209 | ANSI C63.10-2009 | Passed |
| 2.6 | Antenna Conducted Emission | 47 CFR Part 15C Subpart 15.247(b)(3) | ANSI C63.10-2009 | Passed |
| 2.7 | Occupied Bandwidth & Band Edge Compliance | 47 CFR Part 15C Subpart 15.247(c) | ANSI C63.10-2009 | Passed |
| 2.8 | Power Spectral Density | 47 CFR Part 15C Subpart 15.247(e) | ANSI C63.10-2009 | Passed |

The given result is based on a shared risk principle with respect to the measurement uncertainty.

**Conclusion**

The test objects mentioned in this report meet the requirements of the rule part stated below.

- 47 CFR Part 15, Subpart C (Specific rule part §15.247).

The test results relate only to the objects tested.

# 2. Test objects


Photo 2.1.1 Test object.

## 2.1 Test objects

**Test object 2.1.1**

| | |
|---|---|
| Name of test object | flowIQ2100 |
| Model / type | flowIQ2100 |
| Part no. | - |
| Serial no. | SN:001 |
| FCC ID | OUY-FLOW2100 |
| Manufacturer | Kamstrup A/S |
| Supply voltage | 3.7 VDC |
| Software version | Test software ver 001 |
| Hardware version | - |
| Cycle time | 0.1 msec |
| Highest frequency generated or used | 915.0 MHz |
| Comment | Used for radiated measurements |

**Test object 2.1.2**

| | |
|---|---|
| Name of test object | flowIQ2100 |
| Model / type | flowIQ2100 |
| Part no. | - |
| Serial no. | SN:002 |
| FCC ID | OUY-FLOW2100 |
| Manufacturer | Kamstrup A/S |
| Supply voltage | 3.7 VDC |
| Software version | Test software ver 001 |
| Hardware version | - |
| Cycle time | 0.1 msec |
| Highest frequency generated or used | 915.0 MHz |
| Comment | Used for conducted measurements |

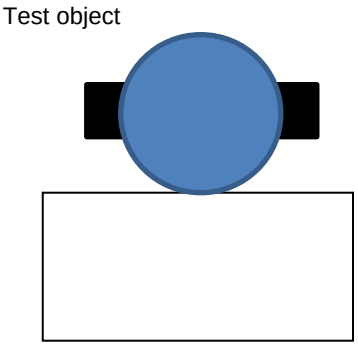
## 2.2 Auxiliary equipment

**Auxiliary equipment 2.2.1**

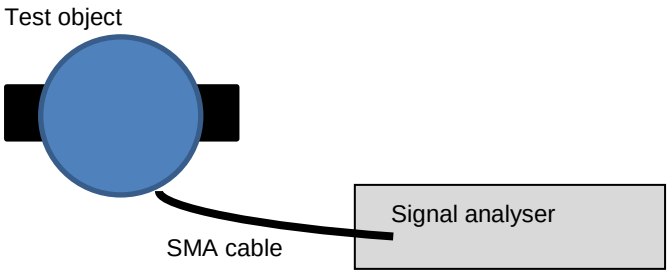
| | |
|---|---|
| Name of auxiliary equipment | Optical Readout head with USB |
| Model / type | 6699-099 |
| Part no. | - |
| Serial no. | Batch:123456.1 |
| FCC ID | - |
| Manufacturer | Kamstrup A/S |
| Supply voltage | USB 5.0 VDC |
| Highest frequency generated or used | - |
| Comment | The aux equipment is supplied by the client, who also has the responsibility for its correct function and set up. The aux equipment is only used for test object configuration prior to testing. Not present during testing. |

# 3. General test conditions

## 3.1 Test setup during test




For radiated measurements, the test object is placed on a table in a stand-alone configuration (no aux equipment, powered only by internal battery).




For conducted measurements, the test object's integrated antenna is cut off, and the test object is retrofitted with a coax cable, connected through an extension coax cable to a signal analyser.

Figure 3.1 Block diagram of test objects with cables and auxiliary equipment.

The flowIQ2100 is powered by battery and put into continuous Tx mode. The test object is measured completely stand alone.

A separate device with the internal antenna replaced with a SMA connector is supplied for conducted tests.

### 3.1.1 Description and intended use of test object

The flowIQ2100 is used for measurement of cold water consumption in households as well as in industrial and commercial buildings.

Ultrasonic flow measurement is utilized for exact measuring accuracy and longevity.

The flowIQ2100 is power supplied by battery. Battery lifetime is up to 16 years.

All measurements, references, readings, events and calculations are stored in a data logger for billing and analysis.

The water meter has a readable display.

Remote meter reading is possible by handheld devices and by integration in smart metering networks.

The remote data communication is handled in either of two ways:

- By broadband wireless communication in the 902-928 MHz band, with output power of approximately 10 mW.
- By low power, very low proximity infrared communication.

For the purpose of testing, only option 1 is used.

### 3.1.2 Test modes during emission tests

All test objects were running special test software.

Tests were performed at the following fundamental frequency of the radio transmitter:

915.0 MHz.

For all the emission tests, all relevant functions are activated in order to maximize emissions and to monitor that the radio is active. The presence of an active radio is checked both prior to and after each test.

The test object is put into constant, modulated Tx operating mode with a modulation cycle no higher than 0.1 msec, so that each measurement sample completely covers a cycle.

## 3.2 Radio specification

| | |
|---|---|
| Radio | Proprietary 915 MHz radio |
| Fundamental operating frequency (f_center) | 915.0 MHz |
| Maximum measured field strength @ 3m | 98.3 dBuV/m |
| Antenna type | Integral antenna |
| Equipment Type | I: Transfer of messages (digital or analogue signals) |
| Equipment intended for fixed use? | Yes |
| Equipment intended for vehicular or mobile use? | No |
| Equipment intended for portable use? (<20cm from user) | No |
| Transmit mode available | Yes |
| Receive mode available | Yes |
| Environment | General population |
| User proximity by FCC definition | Fixed use (more than 20 cm from user during normal operation) |
| Frequency band | 902-928 MHz |
| Maximum permissible output power in the band | 1 W from ant connector (127.38 dBuV/m @ 3m) |
| Number of power levels | 1 |
| Number of channels | 1 |
| Modulation forms | FSK (digital modulation) |
| Maximum Data Rate [kbps] | 250 |
| Manufacturer stated band width (20 dB) [kHz] | 1000 |
| Manufacturer stated band width (6 dB) [kHz] | 520 |
| Channel spacing | One channel only |
| Maximum Duty Cycle during normal use | 1 % |

# 4. Test results

## 4.1 Test ID 2.5: Radiated limits below 1 GHz

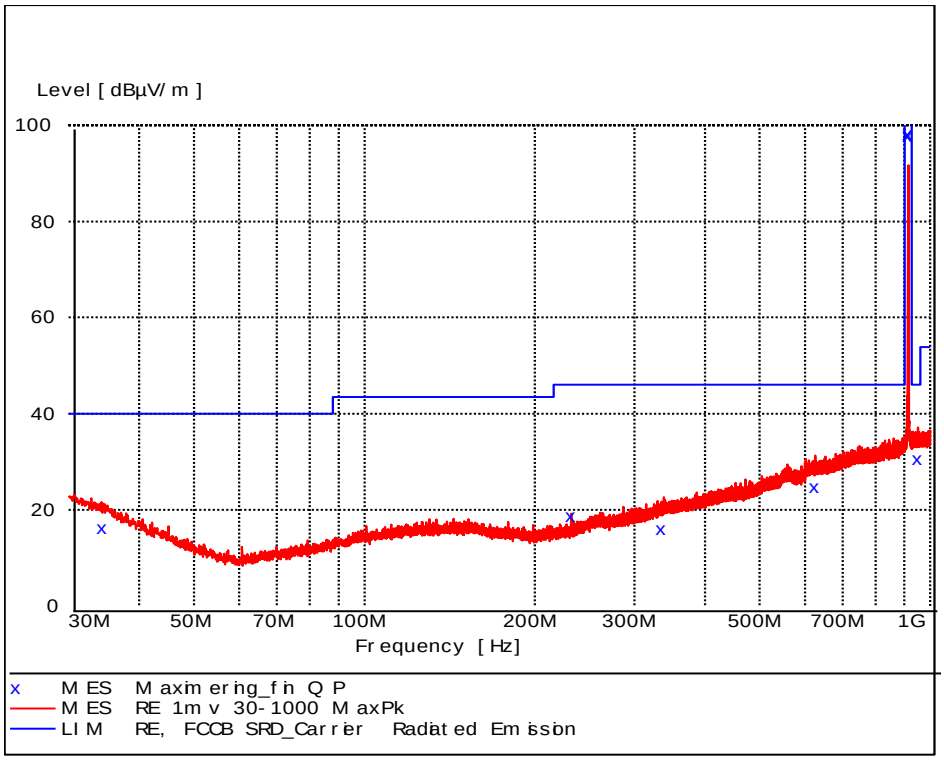
| | | | |
|---|---|---|---|
| Test object | flowIQ2100 | Sheet | RE_Spur-1 |
| Type | flowIQ2100 | Project no. | T203210-1 |
| Serial no. | SN:001 | Date | 24 Sep 2012 |
| Client | Kamstrup A/S | Initials | CMT |
| Specification | See Section 1, Summary of tests | Frequency | 30-1000 MHz |

| | | | |
|---|---|---|---|
| Test method<br>Characteristics | ANSI C63.10:2009<br>Peak search ant. at 3 m, height: 1-4 m, v/h pol. | Temperature<br>Humidity | 23 °C<br>41 % RH |
| Detector | Peak and Quasi peak | Bandwidth | 120 kHz |
| Test equipm. | EMI room Hørsholm 49600 29861 29727 29301 49421 | Uncertainty | 4.9 dB |

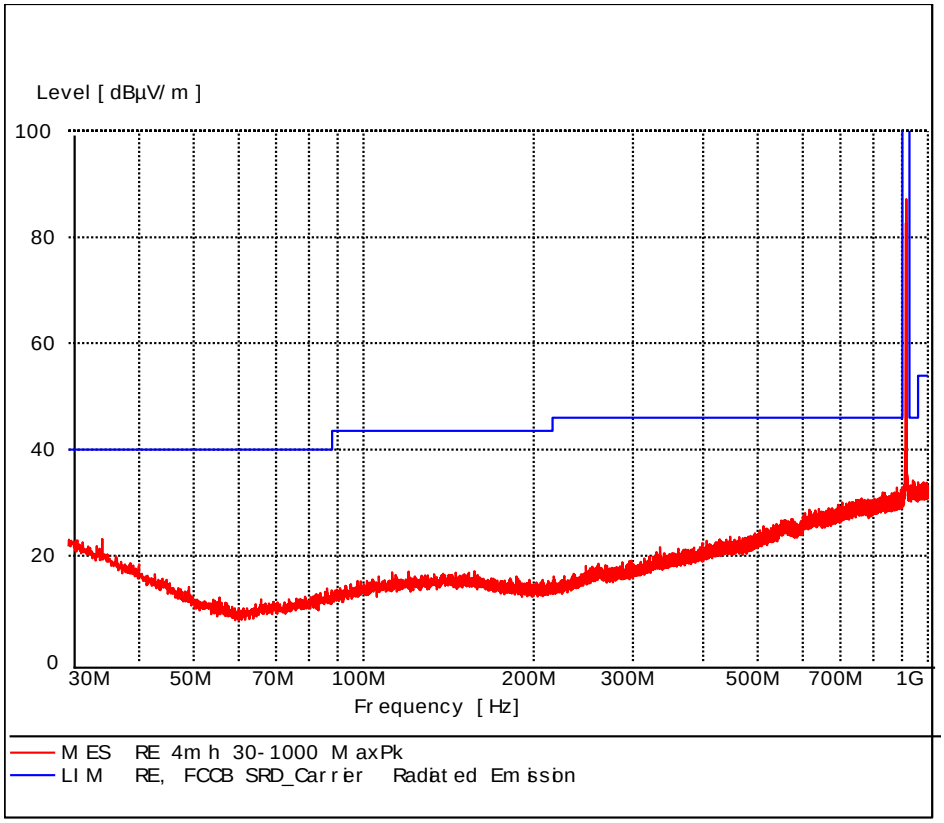
Final max (Quasi peak):

| Frequency MHz | Level dBµV/m | Transd dB | Limit dBµV/m | Margin dB | Height cm | Azimuth deg | Polarisation |
|---|---|---|---|---|---|---|---|
| 34.440000 | 16.30 | 18.5 | 40.0 | 23.7 | 131.0 | 45.00 | VERTICAL |
| 232.110000 | 18.70 | 13.8 | 46.0 | 27.3 | 101.0 | 358.00 | HORIZONTAL |
| 335.220000 | 16.10 | 17.8 | 46.0 | 29.9 | 132.0 | 147.00 | VERTICAL |
| 625.860000 | 24.70 | 24.5 | 46.0 | 21.3 | 271.0 | 48.00 | HORIZONTAL |
| 914.770000 | 97.80 | 29.3 | 127.4 | 29.6 | 142.0 | 25.00 | HORIZONTAL |
| 915.220000 | 98.30 | 29.3 | 127.4 | 29.1 | 142.0 | 26.00 | HORIZONTAL |
| 951.960000 | 30.70 | 30.1 | 46.0 | 15.3 | 128.0 | 59.00 | HORIZONTAL |

| | |
|---|---|
| Test result | The measured field strengths were below the limit |
| Polarization | Vertical and horizontal |
| Test Port | Enclosure |
| Test frequency | Tx @ 915 MHz |
| Test mode | Continuous Tx - normal modulation |
| Condition | Normal |
| Compliant | Yes |
| Comments | Prescan and final maximal measurements by variation of turntable azimuth, antenna height, and antenna polarisation |




Pre-scan, Antenna at 3 m, 1 m height, vert. pol. Peak detector.




Pre-scan, Antenna at 3 m, 4 m height, hor. pol. Peak detector.

Photo 4.1.1 Test setup regarding measurement Radiated limits below 1 GHz.

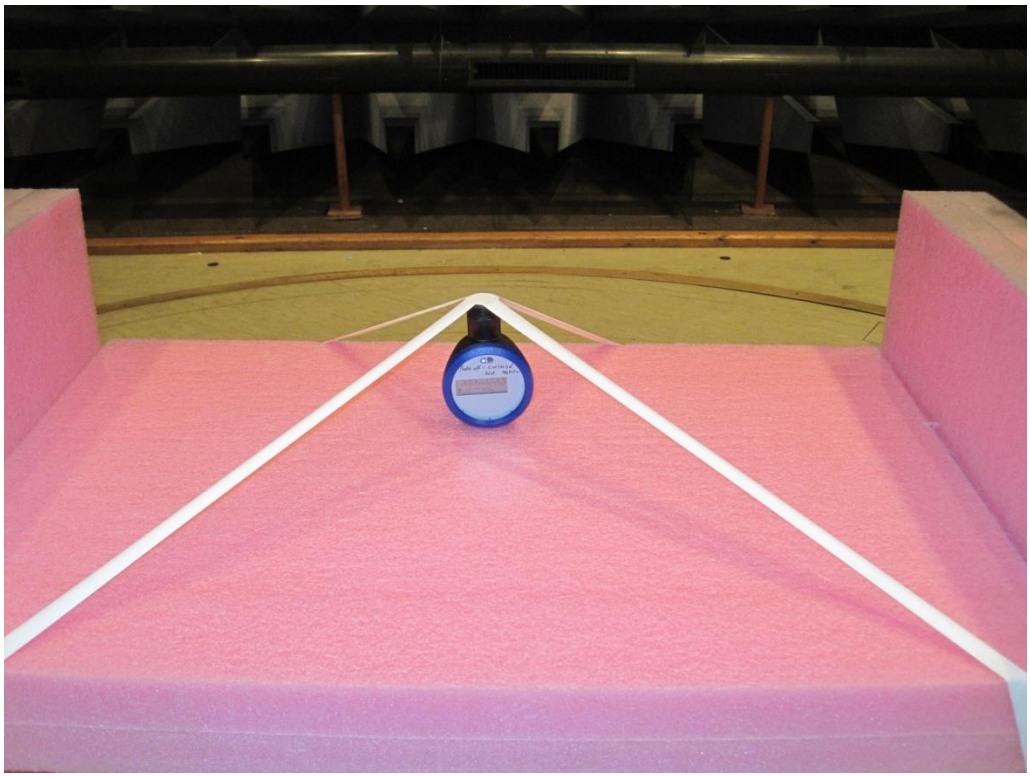


Photo 4.1.2 Test setup regarding measurement Radiated limits below 1 GHz.

## 4.2 Test ID 2.5: Radiated limits above 1 GHz

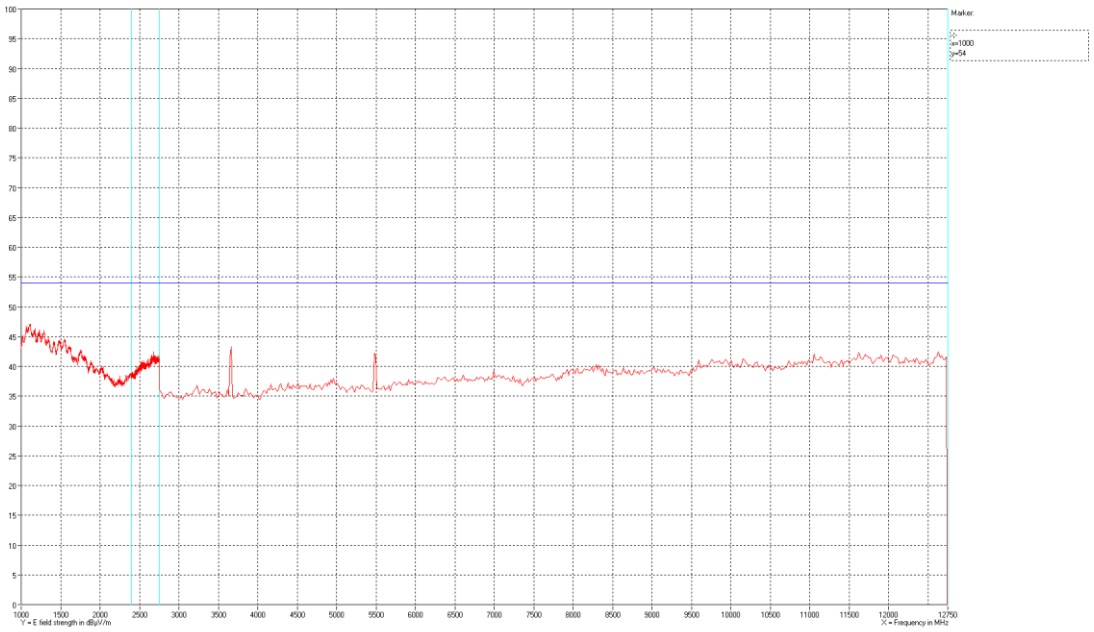
| | | | |
|---|---|---|---|
| Test object | flowIQ2100 | Sheet | RE_Spur-2 |
| Type | flowIQ2100 | Project no. | T203210 |
| Serial no. | SN:001 | Date | 24 Sep 2012 |
| Client | Kamstrup A/S | Initials | CMT |
| Specification | See Section 1, Summary of tests | Frequency | 1-12.75 GHz |

| | | | |
|---|---|---|---|
| Test method<br>Characteristics | ANSI C63.10:2009<br>Complete search, antenna distance 3 m | Temperature<br>Humidity | 23 °C<br>41 % RH |
| Detector | Peak | Bandwidth | 1 MHz |
| Test equipm. | EMI room Hørsholm 49600 49712 49625 | Uncertainty | 4.9 dB |

Final max (Peak):

| Frequency MHz | Level dBµV/m | Peak Limit dBµV/m | AV Limit dBµV/m | Margin to AV dB | Polarisation |
|---|---|---|---|---|---|
| 3665.20000 | 43.3 | 74.0 | 54.0 | 10.7 | Complete search |
| 5479.20000 | 42.3 | 74.0 | 54.0 | 11.7 | Complete search |

| | |
|---|---|
| Test result | The measured field strengths were below the limit |
| Test Port | Enclosure |
| Test frequency | Tx @ 915 MHz |
| Test mode | Continuous Tx - normal modulation |
| Condition | Normal |
| Compliant | Yes |
| Comments | Prescan and final maximal measurements by variation of turntable azimuth, antenna height and antenna polarization |




| | |
|---|---|
| Polarization | Vertical and horizontal peak measurements |
| Comments | All measurements are performed with a peak detector.<br>All peak measurements were below average limit. |

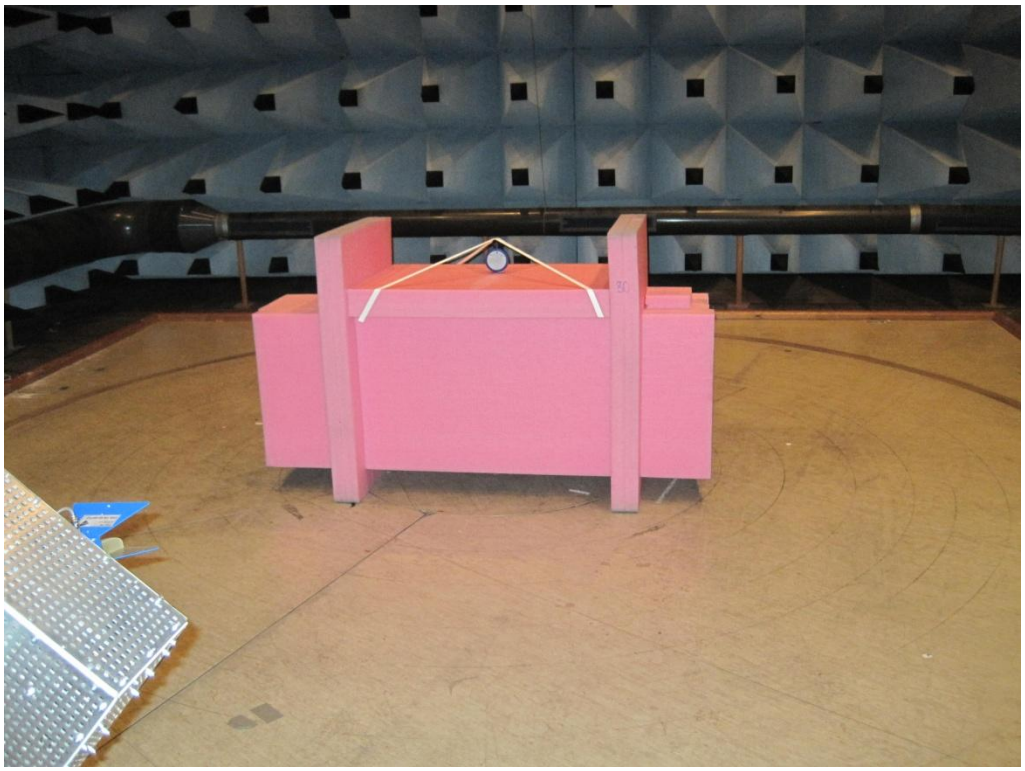


Photo 4.2.1 Test setup regarding measurement Radiated limits above 1 GHz.

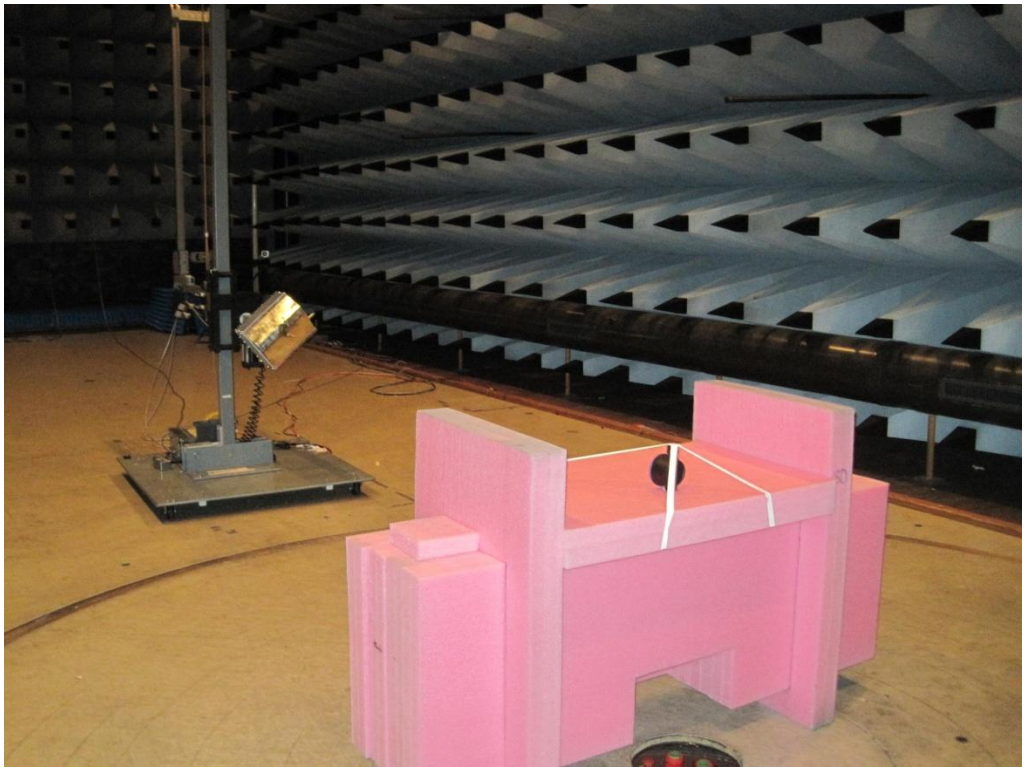


Photo 4.2.2 Test setup regarding measurement Radiated limits above 1 GHz.

## 4.3 Test ID 2.6: Antenna conducted emission

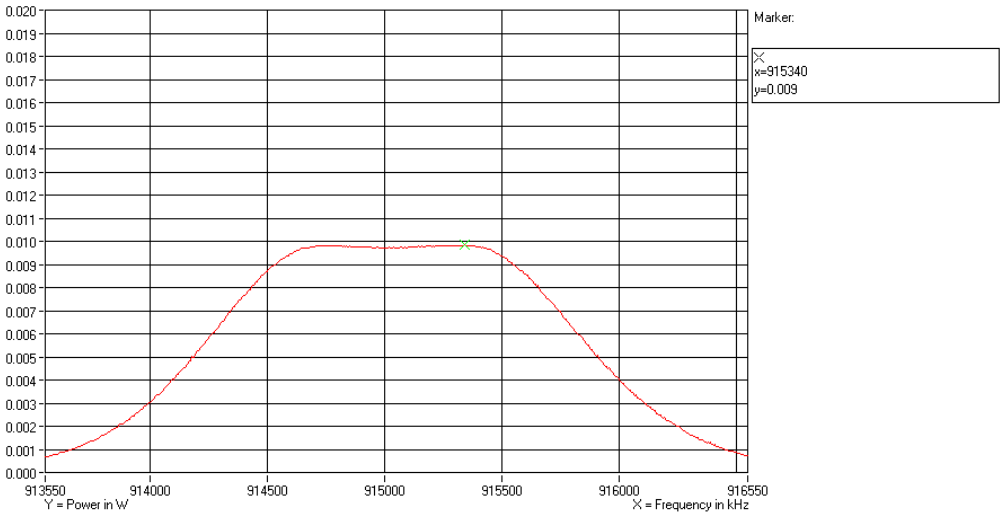
| | | | |
|---|---|---|---|
| Test object | flowIQ2100 | Sheet | RE_Con-1 |
| Type | flowIQ2100 | Project no. | T203210 |
| Serial no. | SN:002 | Date | 02 Oct 2012 |
| Client | Kamstrup A/S | Initials | CMT |
| Specification | See Section 1, Summary of tests | Frequency | 915 MHz |

| | | | |
|---|---|---|---|
| Test method<br>Characteristics | ANSI C63.10:2009<br>Conducted measurement @ antenna port | Temperature<br>Humidity | 21 °C<br>42 % RH |
| Span | 3 MHz | RBW | 1 MHz |
| Sweep | Auto | VBW | 3 MHz |
| Detector | Peak | Trace | Max hold |
| Test equipm. | Outside EMC room Hørsholm 49184 49550 49299 | Uncertainty | 1.1 dB |

Final max (Peak):

| Frequency MHz | Level dBm | Level mW | Limit dBm @ 3m | Limit mW | Margin dB | (Max ant gain) ( dB ) |
|---|---|---|---|---|---|---|
| 915.34000 | 9.93 | 9.84 | 30.00 | 1000.0 | 20.07 | (-8.29) |

| | |
|---|---|
| Test result | The measured power was below the limit |
| Test Port | Antenna connector |
| Test frequency | 915.34 MHz |
| Test mode | Continuous Tx - normal modulation |
| Condition | Normal |
| Compliant | Yes |
| Comments | The limit of 1000.0 mW applies to transmitters with antenna gain up to 6 dBi. The test object incorporates an integrated PCB antenna with a maximum gain of -8.29 dBi.<br>Measurements are corrected for cable losses. |




| | |
|---|---|
| Polarization | Not applicable |
| Comments | Conducted measurement of antenna emission |

## 4.4 Test ID 2.3: 6 dB bandwidth

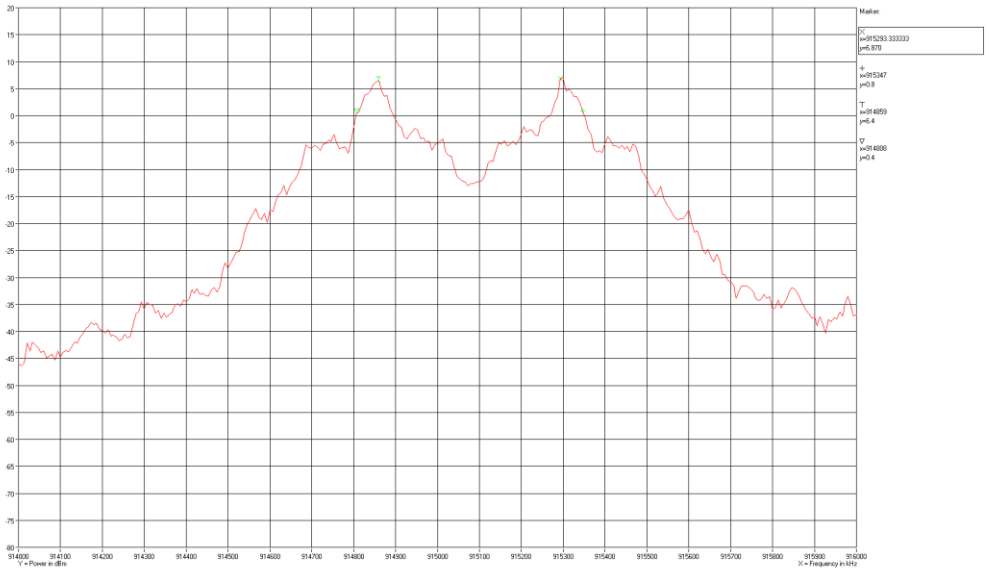
| | | | |
|---|---|---|---|
| Test object | flowIQ2100 | Sheet | RE_Con-2 |
| Type | flowIQ2100 | Project no. | T203210 |
| Serial no. | SN:002 | Date | 02 Oct 2012 |
| Client | Kamstrup A/S | Initials | CMT |
| Specification | See Section 1, Summary of tests | Frequency | 915 MHz |

| | | | |
|---|---|---|---|
| Test method<br>Characteristics | ANSI C63.10:2009<br>Conducted measurement @ antenna port | Temperature<br>Humidity | 21 °C<br>42 % RH |
| Span | 2 MHz | RBW | 10 kHz |
| Sweep | Auto | VBW | 30 kHz |
| Detector | Peak | Trace | Max hold |
| Test equipm. | Outside EMC room Hørsholm 49184 49550 49299 | Uncertainty | 1.1 dB |

Final max (Peak):

| Frequency Peak 1 MHz | Frequency 6 dB Delta 1 MHz | Frequency Peak 2 MHz | Frequency 6 dB Delta 2 MHz | 6 dB BW Delta 2 – Delta 1 MHz |
|---|---|---|---|---|
| 914.859 | 914.808 | 915.293 | 915.347 | 000.539 |

| | |
|---|---|
| Test result | The measured bandwidth was within the limit |
| Test Port | Antenna connector |
| Test frequency | Fundamental frequency is set at 915 MHz |
| Test mode | Continuous Tx - normal modulation |
| Condition | Normal |
| Compliant | Yes |
| Comments | The 6 dB BW lower limit is 500 kHz.<br>The test object has a 6 dB BW of 539 kHz.<br>Measurements are corrected for cable losses. |



| | |
|---|---|
| Polarization | Not applicable |
| Comments | Conducted measurement of 6 dB BW |

## 4.5 Test ID 2.7: Occupied bandwidth & band edge compliance

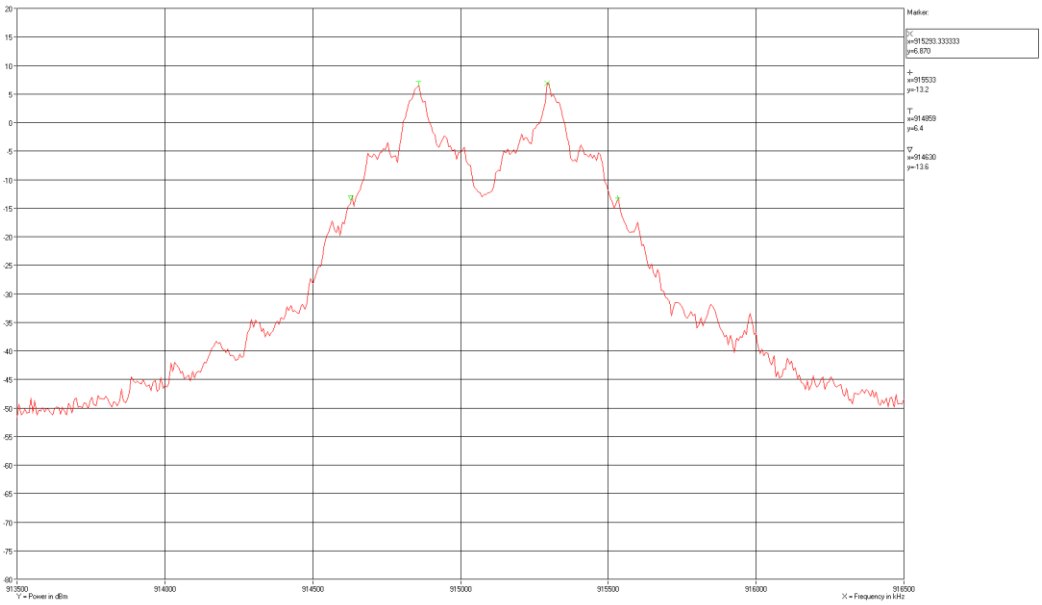
| | | | |
|---|---|---|---|
| Test object | flowIQ2100 | Sheet | RE_Con-3 |
| Type | flowIQ2100 | Project no. | T203210 |
| Serial no. | SN:002 | Date | 02 Oct 2012 |
| Client | Kamstrup A/S | Initials | CMT |
| Specification | See Section 1, Summary of tests | Frequency | 915 MHz |

| | | | |
|---|---|---|---|
| Test method<br>Characteristics | ANSI C63.10:2009<br>Conducted measurement @ antenna port | Temperature<br>Humidity | 21 °C<br>42 % RH |
| Span | 3 MHz | RBW | 10 kHz |
| Sweep | Auto | VBW | 30 kHz |
| Detector | Peak | Trace | Max hold |
| Test equipm. | Outside EMC room Hørsholm 49184 49550 49299 | Uncertainty | 1.1 dB |

```
Final max (Peak):
   Frequency      Frequency      Frequency      Frequency         20 dB OBW
     Peak 1    20 dB Delta 1      Peak 2    20 dB Delta 2    Delta 2 - Delta 1
       MHz            MHz           MHz            MHz              MHz
    914.859        914.630       915.293        915.533          000.903

   Band Edge      20 dB OBW frequency      Margin
      MHz               MHz                MHz
    902.000           914.630            12.630
    928.000           915.533            12.467
```

| | |
|---|---|
| Test result | The measured occupied bandwidth was within the limit.<br>Band edges are respected. |
| Test Port | Antenna connector |
| Test frequency | Fundamental frequency is set at 915 MHz |
| Test mode | Continuous Tx - normal modulation |
| Condition | Normal |
| Compliant | Yes |
| Comments | The measured 20 dB OBW is 903 kHz.<br>The 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated (15.247). |




| | |
|---|---|
| Polarization | Not applicable |
| Comments | Conducted measurement of 20 dB Occupied BW |

## 4.6 Test ID 2.8: Power Spectral Density

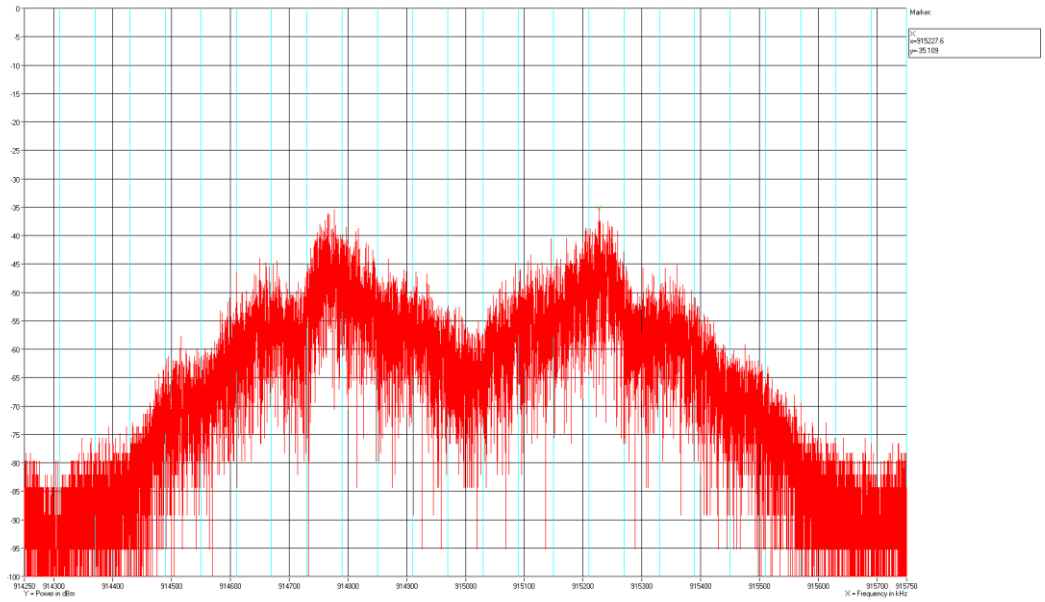
| | | | |
|---|---|---|---|
| Test object | flowIQ2100 | Sheet | RE_Con-4 |
| Type | flowIQ2100 | Project no. | T203210 |
| Serial no. | SN:002 | Date | 02 Oct 2012 |
| Client | Kamstrup A/S | Initials | CMT |
| Specification | See Section 1, Summary of tests | Frequency | 915 MHz |

| | | | |
|---|---|---|---|
| Test method<br>Characteristics | ANSI C63.10:2009<br>Conducted measurement @ antenna port | Temperature<br>Humidity | 21 °C<br>42 % RH |
| Span | 1.5 MHz | RBW | 3 kHz |
| Sweep | Auto | VBW | 10 kHz |
| Detector | Peak | Trace | Max hold |
| Test equipm. | Outside EMC room Hørsholm 49184 49550 49299 | Uncertainty | 1.1 dB |

```
Final max (Peak):
Max peak value in any 3 kHz band

   Frequency      Level      Limit      Margin
      MHz          dBm        dBm         dB
    915.228      -35.11      8.00        43.11
```

| | |
|---|---|
| Test result | The measured power spectral density was within the limit. |
| Test Port | Antenna connector |
| Test frequency | Fundamental frequency is set at 915 MHz |
| Test mode | Continuous Tx - normal modulation |
| Condition | Normal |
| Compliant | Yes |
| Comments | The maximum output power is -35.11 dBm within any 3 kHz band.<br>Measurements are corrected for cable losses. |




| | |
|---|---|
| Polarization | Not applicable |
| Comments | Conducted measurement of power spectral density |

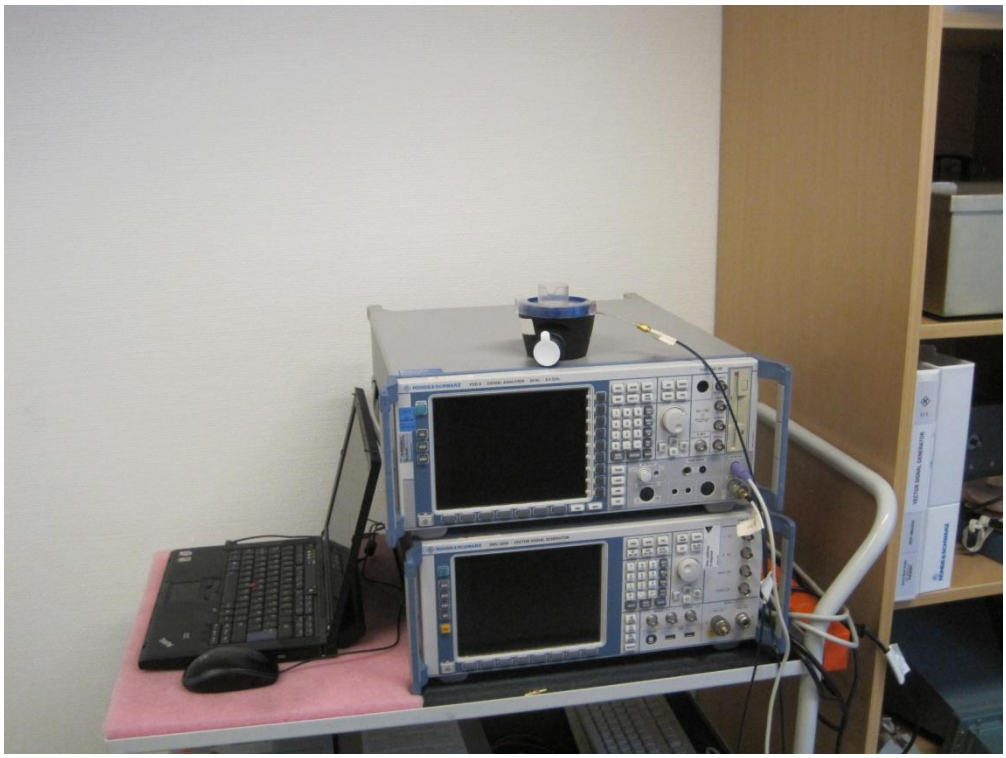


Photo 4.6.1 Test setup for all conducted measurements:
Antenna conducted emission
6 dB bandwidth
Occupied bandwidth & band edge compliance
Power spectral density

# 5. National registrations and accreditations

## 5.1 DANAK Accreditation

**Organization:** Danish Accreditation and Metrology Fund - DANAK, see www.danak.dk and www.ilac.org

**Registration Number:** 19

**Area Number:** C

DANAK is part of ILAC (International Laboratory Accreditation Cooperation) including its MRA (Mutual Recognition Arrangement). The MRA includes the Australian NATA and Canadian SCC.

CISPR 22 is equivalent to AS/NZS CISPR 22, and therefore this report can be used for applying the **Australian C-Tick mark** for IT equipment, when this test has been passed.

CISPR 22:2002 is equivalent to ICES-003:2004, and therefore this report can be used for approval in Canada for IT equipment, when this test has been passed.

## 5.2 FCC Registrations

**Organization:** Federal Communications Commission, USA

**Registration Number:** 90529

**Facilities:** EMC room 2 Hørsholm (EMC-2)
EMC room 3 Hørsholm (EMC-3)
EMC room 4 Hørsholm (EMC-4)
EMI room Hørsholm (EMC-5)

## 5.3 VCCI Registrations

**Organization:** Voluntary Control Council for Interference by Information Technology, Japan

**Member Number:** 910

**Facilities:**

| | |
|---|---|
| EMC room 2 Hørsholm (EMC-2): | C-707, T-246 and T-1547 |
| EMC room 3 Hørsholm (EMC-3): | C-2532, T-247 and T-1548 |
| EMC room 4 Hørsholm (EMC-4): | C-2533, T-248 and T1549 |
| EMI room Hørsholm (EMC-5): | R-1180, C-706 and T-1550, G-470 |

## 5.4 IC Registrations

**Organization:** Industry Canada, Certification and Engineering Bureau

**Registration Number:** IC4187A-5

**Facilities:** EMI room Hørsholm (EMC-5)

# 6. List of instruments

| No. | Description | Manufacturer | Type No. | Cal date | Cal exp |
|---|---|---|---|---|---|
| 29301 | ARTIFICIAL MAINS NETWORK | ROHDE & SCHWARZ | ESH2-Z5 | 2011-12-21 | 2012-12-21 |
| 29861 | EMI-SOFTWARE VER. 1.60 | ROHDE & SCHWARZ | ES-K1, PART: 1026.6790.02 | - | - |
| 49086 | REMI EMISSION SOFTWARE PACKAGE v. 2.133, ROOM 5 | NeWeTec | REMI | - | - |
| 49421 | IMPULSE VOLTAGE LIMITER (BNC) | ROHDE & SCHWARZ | ESH3/Z2 | 2012-06-21 | 2013-06-21 |
| 49550 | SIGNAL ANLYZER | ROHDE & SCHWARZ | FSQ8 | 2012-02-28 | 2013-02-28 |
| 49600 | SPECTRUM ANALYZER / MEASUREMENT RECEIVER | ROHDE & SCHWARZ | ESU40 | 2011-12-16 | 2012-12-16 |
| 49624 | DUAL RIDGE HORN ANTENNA – 1 GHz – 26 GHz (2 GHz – 32 GHz) | SATIMO | SH2000 | 2011-09-19 | 2014-09-19 |
| 49625 | SRD COAX SWITCH MATRIX USED IN 1GHZ TO 26 GHz SRD ANTENNASYSTEM | DELTA | COAX SWITCH MATRIX | 2012-05-11 | 2013-05-11 |