

| <b>RADIO REPORT</b><br><b>FCC 47 CFR Part 90I</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Report Reference No</b>                        | G0M-2002-8859-TFC090PMR-V02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Testing Laboratory</b>                         | Eurofins Product Service GmbH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Address</b>                                    | Storkower Str. 38c<br>15526 Reichenwalde<br>Germany                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Accreditation</b>                              |    <br>DAKKS - Registration number : D-PL-12092-01-03 (ISED)<br>ISED Testing Laboratory site: 3470A-2<br>DAKKS - Registration number : D-PL-12092-01-04 (FCC)<br>FCC Filed Test Laboratory, Reg.-No.: 96970 |
| <b>Applicant</b>                                  | Kamstrup A/S                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Address</b>                                    | Industrivej 28<br>8660 Skanderborg<br>DENMARK                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Test Specification</b>                         | 47 CFR Part 90I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Non-Standard Test Method</b>                   | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Equipment under Test (EUT):</b>                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Product Description</b>                        | Ultrasonic water meter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Model(s)</b>                                   | KWM2220                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Additional Model(s)</b>                        | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Brand Name(s)</b>                              | Kamstrup                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hardware Version(s)</b>                        | Unit: 6201-210-04, rev. 00; RF PCB BOM: 55501823, rev. C1; Flow PCB BOM: 55501813, rev. B3                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Software Version(s)</b>                        | RF: 50981336, rev. N1; Meter: 50981595, rev. 00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>FCC-ID</b>                                     | OUY-KWMX220                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>IC</b>                                         | n/a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Test Result</b>                                | <b>PASSED</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------|
| <b>Possible test case verdicts:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |                                                                                                |
| Required by standard but not tested                                                                                                                                                                                                                                                                                                                                                                                                                                            | N/T             |                                                                                                |
| Not required by standard                                                                                                                                                                                                                                                                                                                                                                                                                                                       | N/R             |                                                                                                |
| Not applicable to EUT                                                                                                                                                                                                                                                                                                                                                                                                                                                          | N/A             |                                                                                                |
| Test object does meet the requirement                                                                                                                                                                                                                                                                                                                                                                                                                                          | P(PASS)         |                                                                                                |
| Test object does not meet the requirement                                                                                                                                                                                                                                                                                                                                                                                                                                      | F(FAIL)         |                                                                                                |
| <b>Testing:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                                                                                |
| Test Lab Temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 20 °C – 23 °C   |                                                                                                |
| Test Lab Humidity                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 32 % – 38 %     |                                                                                                |
| Date of receipt of test item                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2020-05-28      |                                                                                                |
| <b>Report:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |                                                                                                |
| Compiled by                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Toralf Jahn     |                                                                                                |
| Tested by (+ signature)<br>(Responsible for Test)                                                                                                                                                                                                                                                                                                                                                                                                                              | Toralf Jahn     | <br>.....  |
| Approved by (+ signature)<br>(Head of Lab)                                                                                                                                                                                                                                                                                                                                                                                                                                     | Christian Weber | <br>..... |
| Date of Issue                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2020-07-28      |                                                                                                |
| Total number of pages                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 50              |                                                                                                |
| <b>General Remarks:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                                                                                                |
| <p>The test results presented in this report relate only to the object tested.</p> <p>The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.</p> <p>This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.</p> |                 |                                                                                                |
| <b>Additional Comments:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |                                                                                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                                                                                |

## ADDITIONAL VARIANTS

| Additional Variants<br>(not tested and not evaluated variants) |                          |                                                                                                |
|----------------------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------|
| Not-tested Variant                                             | Description              |                                                                                                |
| 1                                                              | Product Type Description | Ultrasonic water meter                                                                         |
|                                                                | Model name               | KWM2220                                                                                        |
|                                                                | Brand name               | Kamstrup                                                                                       |
|                                                                | Hardware Version         | Unit: 6201-210-01, rev. 00<br>RF PCB BOM: 55501823, rev. C1<br>Flow PCB BOM: 55501813, rev. B3 |
|                                                                | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                              |
| 2                                                              | Product Type Description | Ultrasonic water meter                                                                         |
|                                                                | Model name               | KWM2220                                                                                        |
|                                                                | Brand name               | Kamstrup                                                                                       |
|                                                                | Hardware Version         | Unit: 6201-210-02, rev. 00<br>RF PCB BOM: 55501823, rev. C1<br>Flow PCB BOM: 55501813, rev. B3 |
|                                                                | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                              |
| 3                                                              | Product Type Description | Ultrasonic water meter                                                                         |
|                                                                | Model name               | KWM2220                                                                                        |
|                                                                | Brand name               | Kamstrup                                                                                       |
|                                                                | Hardware Version         | Unit: 6201-210-03, rev. 00<br>RF PCB BOM: 55501823, rev. C1<br>Flow PCB BOM: 55501813, rev. B3 |
|                                                                | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                              |
| 4                                                              | Product Type Description | Ultrasonic water meter                                                                         |
|                                                                | Model name               | KWM3220                                                                                        |
|                                                                | Brand name               | Kamstrup                                                                                       |
|                                                                | Hardware Version         | Unit: 6202-205-01, rev. 00<br>RF PCB BOM: 55501823, rev.C1<br>Flow PCB BOM: 55501523, rev B1   |
|                                                                | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                              |
| 5                                                              | Product Type Description | Ultrasonic water meter                                                                         |
|                                                                | Model name               | KWM3220                                                                                        |
|                                                                | Brand name               | Kamstrup                                                                                       |
|                                                                | Hardware Version         | Unit: 6202-103-02, rev. 00<br>RF PCB BOM: 55501823, rev.C1<br>Flow PCB BOM: 55501523, rev B1   |
|                                                                | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                              |
| 6                                                              | Product Type Description | Ultrasonic water meter                                                                         |
|                                                                | Model name               | KWM3220                                                                                        |
|                                                                | Brand name               | Kamstrup                                                                                       |
|                                                                | Hardware Version         | Unit: 6202-103-03, rev. 00<br>RF PCB BOM: 55501823, rev.C1<br>Flow PCB BOM: 55501523, rev B1   |
|                                                                | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                              |

Test Report No.: G0M-2002-8859-TFC090PMR-V02

|                                                                                                                                                                                                                                                            |                          |                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------------------------------------------------------------------------------|
| 7                                                                                                                                                                                                                                                          | Product Type Description | Ultrasonic water meter                                                                       |
|                                                                                                                                                                                                                                                            | Model name               | KWM3220                                                                                      |
|                                                                                                                                                                                                                                                            | Brand name               | Kamstrup                                                                                     |
|                                                                                                                                                                                                                                                            | Hardware Version         | Unit: 6202-103-04, rev. 00<br>RF PCB BOM: 55501823, rev.C1<br>Flow PCB BOM: 55501523, rev B1 |
|                                                                                                                                                                                                                                                            | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                            |
| 8                                                                                                                                                                                                                                                          | Product Type Description | Ultrasonic water meter                                                                       |
|                                                                                                                                                                                                                                                            | Model name               | KWM3220                                                                                      |
|                                                                                                                                                                                                                                                            | Brand name               | Kamstrup                                                                                     |
|                                                                                                                                                                                                                                                            | Hardware Version         | Unit: 6202-103-06, rev. 00<br>RF PCB BOM: 55501823, rev.C1<br>Flow PCB BOM: 55501523, rev B1 |
|                                                                                                                                                                                                                                                            | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                            |
| 9                                                                                                                                                                                                                                                          | Product Type Description | Ultrasonic water meter                                                                       |
|                                                                                                                                                                                                                                                            | Model name               | KWM3220                                                                                      |
|                                                                                                                                                                                                                                                            | Brand name               | Kamstrup                                                                                     |
|                                                                                                                                                                                                                                                            | Hardware Version         | Unit: 6202-103-07, rev. 00<br>RF PCB BOM: 55501823, rev.C1<br>Flow PCB BOM: 55501523, rev B1 |
|                                                                                                                                                                                                                                                            | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                            |
| 10                                                                                                                                                                                                                                                         | Product Type Description | Ultrasonic water meter                                                                       |
|                                                                                                                                                                                                                                                            | Model name               | KWM3220                                                                                      |
|                                                                                                                                                                                                                                                            | Brand name               | Kamstrup                                                                                     |
|                                                                                                                                                                                                                                                            | Hardware Version         | Unit: 6202-103-05, rev.<br>RF PCB BOM: 55501823, rev.C1<br>Flow PCB BOM: 55501523, rev B1    |
|                                                                                                                                                                                                                                                            | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                            |
| 11                                                                                                                                                                                                                                                         | Product Type Description | Ultrasonic water meter                                                                       |
|                                                                                                                                                                                                                                                            | Model name               | KWM3220                                                                                      |
|                                                                                                                                                                                                                                                            | Brand name               | Kamstrup                                                                                     |
|                                                                                                                                                                                                                                                            | Hardware Version         | Unit: 6202-103-08, rev.<br>RF PCB BOM: 55501823, rev.C1<br>Flow PCB BOM: 55501523, rev B1    |
|                                                                                                                                                                                                                                                            | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                            |
| 12                                                                                                                                                                                                                                                         | Product Type Description | Ultrasonic water meter                                                                       |
|                                                                                                                                                                                                                                                            | Model name               | KWM3220                                                                                      |
|                                                                                                                                                                                                                                                            | Brand name               | Kamstrup                                                                                     |
|                                                                                                                                                                                                                                                            | Hardware Version         | Unit: 6201-204-01, rev. 00<br>RF PCB BOM: 55501823, rev.C1<br>Flow PCB BOM: 55501523, rev B1 |
|                                                                                                                                                                                                                                                            | Software Version         | RF: 50981336, rev. N1<br>Meter: 50981595, rev. 00                                            |
| Comment: Those named additional variants above have not been tested. Those additional variants of the series have been declared by the manufacturer. The test report explicitly states that those variants were neither tested nor assessed nor evaluated. |                          |                                                                                              |

## VERSION HISTORY

| Version History |            |                                                                                                                                                                    |            |
|-----------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Version         | Issue Date | Remarks                                                                                                                                                            | Revised By |
| 01              | 2020-06-30 | Initial Release                                                                                                                                                    |            |
| 02              | 2020-07-28 | Replaced document: G0M-2002-8859-TFC090PMR-V01<br>Replaced by: G0M-2002-8859-TFC090PMR-V02<br><br>Reason:<br>Antenna 1 model changed<br>Additional antenna 5 added | T.Jahn     |

## ABBREVIATIONS AND ACRONYMS

| Acronyms         |                                                     |
|------------------|-----------------------------------------------------|
| Acronym          | Description                                         |
| EUT              | Equipment Under Test                                |
| FCC              | Federal Communications Commission                   |
| ISED             | Innovation, Science and Economic Development Canada |
| RBW              | Resolution bandwidth                                |
| RMS              | Root mean square                                    |
| VBW              | Video bandwidth                                     |
| V <sub>NOM</sub> | Nominal supply voltage                              |
| V <sub>MIN</sub> | Miminal supply voltage                              |
| V <sub>MAX</sub> | Maximal supply voltage                              |
| T <sub>NOM</sub> | Nominal temperature                                 |
| T <sub>MIN</sub> | Miminal temperature                                 |
| T <sub>MAX</sub> | Maximal temperature                                 |
| N/A              | Not Applicable                                      |

## REPORT INDEX

|          |                                                                            |           |
|----------|----------------------------------------------------------------------------|-----------|
| <b>1</b> | <b>Equipment (Test Item) Under Test.....</b>                               | <b>8</b>  |
| 1.1      | Photos – Equipment External .....                                          | 10        |
| 1.2      | Photos – Equipment Internal .....                                          | 14        |
| 1.3      | Photos – Test Setup.....                                                   | 16        |
| 1.4      | Support Equipment.....                                                     | 17        |
| 1.5      | Test Modes .....                                                           | 18        |
| 1.6      | Test Frequencies.....                                                      | 19        |
| 1.7      | Sample emission level calculation.....                                     | 20        |
| <b>2</b> | <b>Result Summary.....</b>                                                 | <b>21</b> |
| <b>3</b> | <b>Test Conditions and Results.....</b>                                    | <b>22</b> |
| 3.1      | Test Conditions and Results - Power .....                                  | 22        |
| 3.2      | Test Conditions and Results - Emission mask and authorized bandwidth ..... | 24        |
| 3.3      | Test Conditions and Results - Spurious emissions at antenna terminal.....  | 29        |
| 3.4      | Test Conditions and Results - Transmitter radiated emissions .....         | 31        |
| 3.5      | Test Conditions and Results - Frequency stability.....                     | 34        |
| 3.6      | Test Conditions and Results - Transient frequency behavior .....           | 37        |
| ANNEX A  | Transmitter conducted emissions.....                                       | 45        |

## 1 Equipment (Test Item) Under Test

|                           |                                                                                                 |                                                       |
|---------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Description               | Ultrasonic water meter                                                                          |                                                       |
| Model                     | KWM2220                                                                                         |                                                       |
| Additional Model(s)       | None                                                                                            |                                                       |
| Brand Name(s)             | Kamstrup                                                                                        |                                                       |
| Serial Number(s)          | KAM21142842/20 (sample ID 29577)                                                                |                                                       |
| Hardware Version(s)       | Unit: 6201-210-04, rev. 00; RF PCB BOM: 55501823, rev. C1; Flow PCB BOM: 55501813, rev. B3      |                                                       |
| Software Version(s)       | RF: 50981336, rev. N1; Meter: 50981595, rev. 00                                                 |                                                       |
| PMN                       | n/a                                                                                             |                                                       |
| HVIN                      | n/a                                                                                             |                                                       |
| FVIN                      | n/a                                                                                             |                                                       |
| HMN                       | n/a                                                                                             |                                                       |
| IC                        | n/a                                                                                             |                                                       |
| FCC-ID                    | OUY-KWMX220                                                                                     |                                                       |
| Equipment type            | End Product                                                                                     |                                                       |
| Radio type                | Transceiver                                                                                     |                                                       |
| Radio technologies        | PMR                                                                                             |                                                       |
| Assigned frequency band   | 421 - 512 MHz                                                                                   |                                                       |
| Operating frequency range | 450.25 - 469.9875 MHz                                                                           |                                                       |
| Channels                  | Low: : Frequency 450.25 MHz<br>Mid: : Frequency 460.11875 MHz<br>High: : Frequency 469.9875 MHz |                                                       |
| Modulation(s)             | 4-GFSK, 4.8 kbps                                                                                |                                                       |
| Emission designator       | F1D                                                                                             |                                                       |
| Channel bandwidth         | 12.5 kHz                                                                                        |                                                       |
| Authorized bandwidth      | 11.25 kHz                                                                                       |                                                       |
| Channel spacing           | 11.25 kHz                                                                                       |                                                       |
| Number of modules         | 0                                                                                               |                                                       |
| Radio Module              | Type                                                                                            | N/A                                                   |
|                           | Model                                                                                           | N/A                                                   |
|                           | Manufacturer                                                                                    | N/A                                                   |
|                           | HW Version                                                                                      | N/A                                                   |
|                           | SW Version                                                                                      | N/A                                                   |
|                           | FCC-ID                                                                                          | N/A                                                   |
|                           | IC                                                                                              | N/A                                                   |
| Number of antennas        | 5                                                                                               |                                                       |
| Antenna 1                 | Type                                                                                            | external, helix antenna                               |
|                           | Model                                                                                           | 30261216 A1                                           |
|                           | Manufacturer                                                                                    | Kamstrup A/S                                          |
|                           | Gain                                                                                            | -0.6 dBi                                              |
| Antenna 2                 | Type                                                                                            | external, wall antenna 2 meters cable length          |
|                           | Model                                                                                           | 6699490                                               |
|                           | Manufacturer                                                                                    | Kamstrup A/S                                          |
|                           | Gain                                                                                            | 0.5 dBi                                               |
| Antenna 3                 | Type                                                                                            | external, pit antenna (small) 0.6 meters cable length |
|                           | Model                                                                                           | 6697916                                               |
|                           | Manufacturer                                                                                    | Kamstrup A/S                                          |
|                           | Gain                                                                                            | -5.3 dBi                                              |

|                       |                                                               |                                             |
|-----------------------|---------------------------------------------------------------|---------------------------------------------|
| Antenna 4             | Type                                                          | external, pit antenna 2 meters cable length |
|                       | Model                                                         | 6697902                                     |
|                       | Manufacturer                                                  | Kamstrup A/S                                |
|                       | Gain                                                          | 0.0 dBi                                     |
| Antenna 5             | Type                                                          | external, helix antenna                     |
|                       | Model                                                         | 30261216 B1                                 |
|                       | Manufacturer                                                  | Kamstrup A/S                                |
|                       | Gain                                                          | -2.9 dBi                                    |
| Supply Voltage        | V <sub>NOM</sub>                                              | 3.66 V                                      |
|                       | V <sub>MIN</sub>                                              | 3.0 V                                       |
|                       | V <sub>MAX</sub>                                              | 3.66 V                                      |
| Operating Temperature | T <sub>NOM</sub>                                              | 25 °C                                       |
|                       | T <sub>MIN</sub>                                              | -30 °C                                      |
|                       | T <sub>MAX</sub>                                              | 65 °C                                       |
| Battery supply        | Yes                                                           |                                             |
| AC/DC-Adaptor         | Model                                                         | N/A                                         |
|                       | Vendor                                                        | N/A                                         |
|                       | Input                                                         | N/A                                         |
|                       | Output                                                        | N/A                                         |
| Manufacturer          | Kamstrup A/S<br>Industrivej 28<br>8660 Skanderborg<br>DENMARK |                                             |

## 1.1 Photos – Equipment External







## 1.2 Photos – Equipment Internal



|  |
|--|
|  |
|--|

|  |
|--|
|  |
|--|

### 1.3 Photos – Test Setup



#### 1.4 Support Equipment

| Product Type | Device                  | Manufacturer | Model     | Comment                                                                                               |
|--------------|-------------------------|--------------|-----------|-------------------------------------------------------------------------------------------------------|
| AE           | Optical readout head    | Kamstrup     | 14071     | Programming interface                                                                                 |
| AE           | Laboratory power supply | KORAD        | KD6005P   | The EUT battery does not last to perform the tests. Therefore an external power supply was necessary. |
| CBL          | Auxillary cable         |              |           | To connect EUT and power supply.                                                                      |
| SFT          | Device Control Tool     | Kamstrup     | ver. 0.05 | Tool for controlling RF modules and meters                                                            |
| Description: |                         |              |           |                                                                                                       |
| AE           | Auxiliary Equipment     |              |           |                                                                                                       |
| SIM          | Simulator               |              |           |                                                                                                       |
| CBL          | Connecting Cable        |              |           |                                                                                                       |
| SFT          | Software                |              |           |                                                                                                       |
| Comment:     |                         |              |           |                                                                                                       |

## 1.5 Test Modes

| Mode        | Description                                                            |
|-------------|------------------------------------------------------------------------|
| Unmodulated | Mode = Transmit<br>Modulation = None                                   |
| Transmit    | Mode = Transmit<br>Modulation = 4-GFSK, 4.8 kbps<br>Duty cycle = 100 % |

## 1.6 Test Frequencies

| Designator | Mode    | Frequency [MHz] |
|------------|---------|-----------------|
| F1         | Tx / Rx | 450.25          |
| F2         | Tx / Rx | 460.11875       |
| F3         | Tx / Rx | 469.9875        |

## 1.7 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dBμV. Any external preamplifiers used are taken into account through internal analyzer settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

$$\text{Reading on Analyzer (dB}\mu\text{V)} + \text{A.F. (dB)} = \text{Net field strength (dB}\mu\text{V/m)}$$

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBμV/m). The FCC limits are given in units of μV/m. The following formula is used to convert the units of μV/m to dBμV/m:

$$\text{Limit (dB}\mu\text{V/m)} = 20 \cdot \log (\mu\text{V/m})$$

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

|              |                       |   |             |               |           |
|--------------|-----------------------|---|-------------|---------------|-----------|
| Reading + AF | = Net Reading         | : | Net reading | - FCC limit   | = Margin  |
| +21.5 dBμV   | + 26 dB = 47.5 dBμV/m | : | 47.5 dBμV/m | - 57.0 dBμV/m | = -9.5 dB |

## 2 Result Summary

| Test Summary                                                    |                                                              |                                       |        |         |
|-----------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------|--------|---------|
| Product Standard Reference                                      | Requirement                                                  | Reference Method                      | Result | Remarks |
| FCC 90.205<br>FCC 2.1046<br>RSS-119 5.4                         | Power                                                        | ANSI C63.26:2015<br>5.2               | PASS   |         |
| FCC 90.209<br>FCC 90.210<br>FCC 2.1049<br>RSS-119 4.2,5,5.5,5.8 | Authorized bandwidth<br>Emission masks<br>Occupied bandwidth | FCC 90.210<br>ANSI C63.26:2015<br>5.4 | PASS   |         |
| FCC 90.210<br>FCC 2.1051<br>RSS-119 4.2,6.13                    | Spurious emissions at antenna terminal                       | FCC 90.210<br>ANSI C63.26:2015<br>5.7 | PASS   |         |
| FCC 90.210<br>FCC 2.1053<br>RSS-119 4.2,6.13                    | Spurious emissions radiated                                  | FCC 90.210<br>ANSI C63.26:2015<br>5.7 | PASS   |         |
| RSS-Gen 7.1                                                     | Receiver spurious emissions                                  | ANSI C63.26:2015<br>5.7               | N/T    |         |
| FCC 90.213<br>FCC 2.1055<br>RSS-119 5.3                         | Frequency Stability                                          | ANSI C63.26:2015<br>5.6               | PASS   |         |
| FCC 90.214<br>RSS-119 5.9                                       | Transient Frequency behavior                                 | ANSI C63.26:2015<br>6.5               | PASS   |         |
| Comment:                                                        |                                                              |                                       |        |         |

| Possible Test Case Verdicts |                                              |
|-----------------------------|----------------------------------------------|
| PASS                        | Test object does meet the requirements       |
| FAIL                        | Test object does not meet the requirements   |
| N/T                         | Required by standard but not tested          |
| N/R                         | Not required by standard for the test object |

### 3 Test Conditions and Results

#### 3.1 Test Conditions and Results - Power

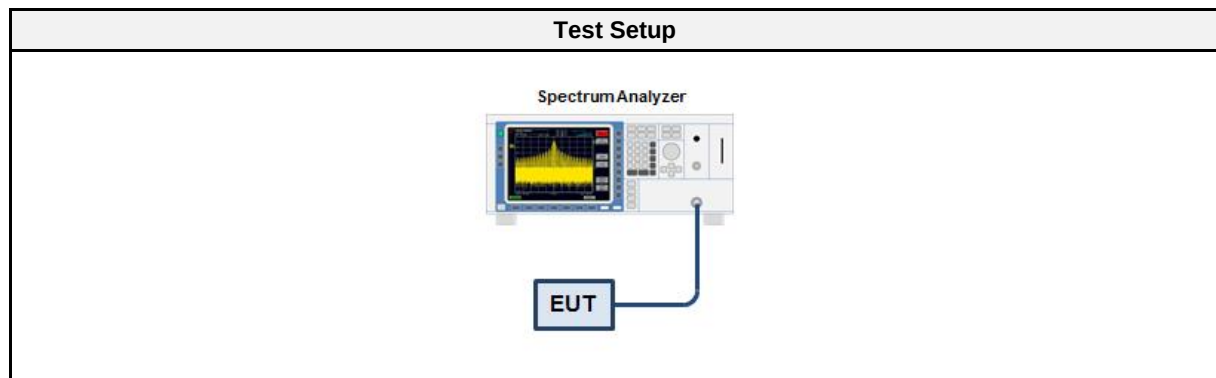
##### 3.1.1 Information

| Test Information     |                                                                   |
|----------------------|-------------------------------------------------------------------|
| Reference            | FCC 90.205, FCC 90.2.1046<br>ISED RSS-119, Issue 12 (Section 5.4) |
| Measurement Method   | ANSI C63.26:2015 5.2                                              |
| Test Method          | Conducted                                                         |
| Test Mode            | Unmodulated                                                       |
| Maximum antenna gain | 0.5 dBi (-1.65 dBd)                                               |
| Operator             | Toralf Jahn                                                       |
| Date                 | 2020-06-03                                                        |

##### 3.1.2 Limits

| Limits       |                 |
|--------------|-----------------|
| Device       | Power [W ERP]   |
| Base / Fixed | 110 (50.41 dBm) |
| Mobile       | 60 (47.78 dBm)  |

##### 3.1.3 Setup



##### 3.1.4 Equipment

| Test Equipment    |              |       |            |           |          |
|-------------------|--------------|-------|------------|-----------|----------|
| Description       | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
| Spectrum analyzer | R&S          | FSU43 | EF01631    | 2019-12   | 2020-12  |

### 3.1.5 Procedure

| Test Procedure |                                                                                                         |
|----------------|---------------------------------------------------------------------------------------------------------|
| 1.             | EUT transmitter is activated in test mode under normal conditions                                       |
| 2.             | The spectrum analyzer is set to peak detection and maximum hold with a span twice the emission spectrum |
| 3.             | The resolution bandwidth is set to 3 MHz                                                                |
| 4.             | Peak power is determined from peak of spectrum envelope                                                 |
| 5.             | EIRP power is calculated by adding the antenna gain in dBi                                              |
| 6.             | ERP power is calculated by subtracting 2.15 from EIRP power                                             |

### 3.1.6 Results

| Test Results  |                       |                      |                    |                       |             |
|---------------|-----------------------|----------------------|--------------------|-----------------------|-------------|
| Channel [MHz] | Conducted Power [dBm] | ERP Peak Power [dBm] | ERP Peak Power [W] | ERP Power Limit [dBm] | Margin [dB] |
| 450.25        | 30.41                 | 28.76                | 0.75               | 47.78                 | -19.02      |
| 460.11875     | 30.28                 | 28.63                | 0.73               | 47.78                 | -19.15      |
| 469.9875      | 30.14                 | 28.49                | 0.71               | 47.78                 | -19.29      |

### 3.2 Test Conditions and Results - Emission mask and authorized bandwidth

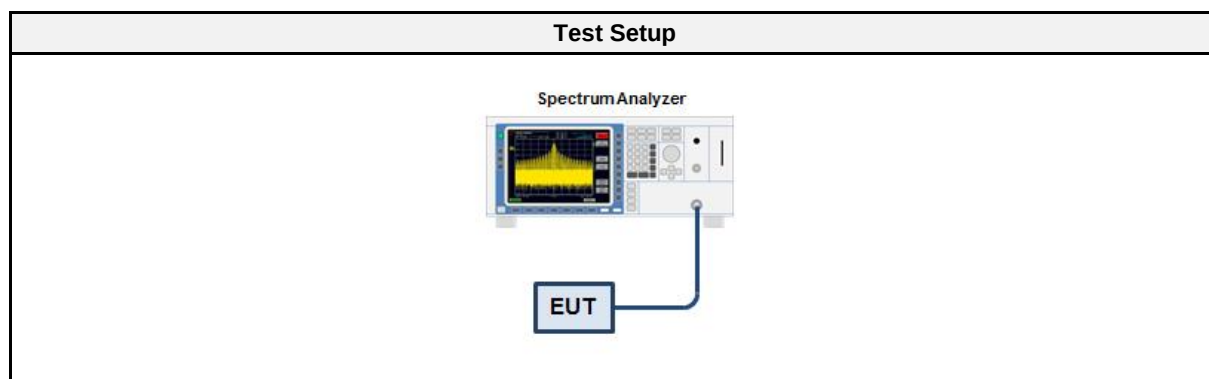
#### 3.2.1 Information

| Test Information   |                                                                                     |
|--------------------|-------------------------------------------------------------------------------------|
| Reference          | FCC 90.209, FCC 90.210, FCC 2.1049<br>ISED RSS-119, Issue 12 (Sections 4.2,5.5,5.8) |
| Measurement Method | FCC 90.210, ANSI C63.26:2015 5.4                                                    |
| Test Method        | Conducted                                                                           |
| Test Mode          | Modulated                                                                           |
| Operator           | Toralf Jahn                                                                         |
| Date               | 2020-06-03                                                                          |

#### 3.2.2 Limits

| Limits                                                                      |
|-----------------------------------------------------------------------------|
| Emission Mask D                                                             |
| Necessary bandwidth (Occupied bandwidth) < 11.25 kHz (Authorized bandwidth) |

#### 3.2.3 Setup



#### 3.2.4 Equipment

| Test Equipment    |              |       |            |           |          |
|-------------------|--------------|-------|------------|-----------|----------|
| Description       | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
| Spectrum analyzer | R&S          | FSU43 | EF01631    | 2019-12   | 2020-12  |

#### 3.2.5 Procedure

| Test Procedure                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. EUT set to test mode</li> <li>2. Span set in order to cover the emission spectrum and emission mask</li> <li>3. Resolution bandwidth set to 100 Hz and VBW to 300 Hz</li> <li>4. Detector is set to peak max hold</li> </ol> |

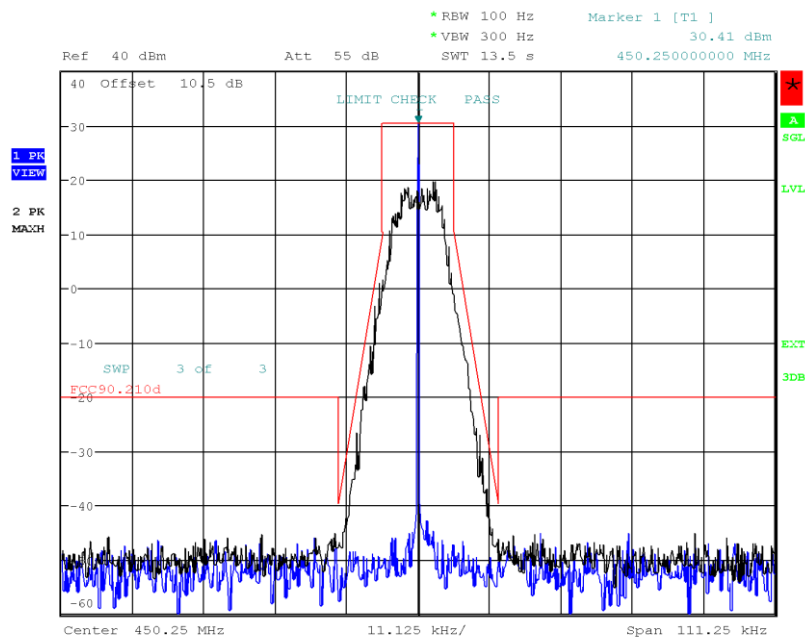
### 3.2.6 Results

| Test Results - Emission Mask |         |
|------------------------------|---------|
| Channel [MHz]                | Verdict |
| 450.25                       | PASS    |
| 460.11875                    | PASS    |
| 469.9875                     | PASS    |

| Test Results - Authorized bandwidth |                 |             |         |
|-------------------------------------|-----------------|-------------|---------|
| Channel [MHz]                       | Bandwidth [kHz] | Limit [kHz] | Verdict |
| 450.25                              | 9.660           | 11.25       | PASS    |
| 460.11875                           | 9.610           | 11.25       | PASS    |
| 469.9875                            | 9.710           | 11.25       | PASS    |

## Emission mask

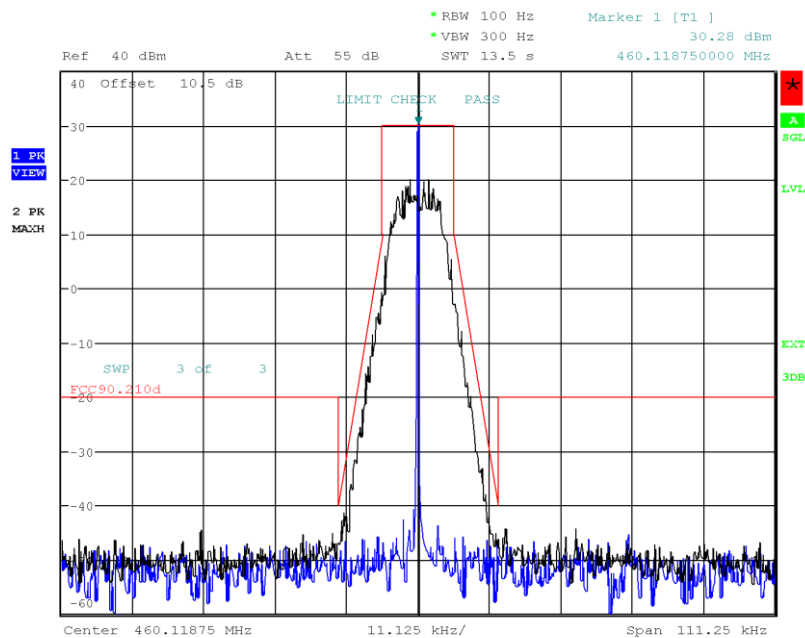
Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-03  
 Operating Conditions: Tnom/Vnom  
 Mode: 450.25 MHz



Date: 3.JUN.2020 12:43:13

## Emission mask

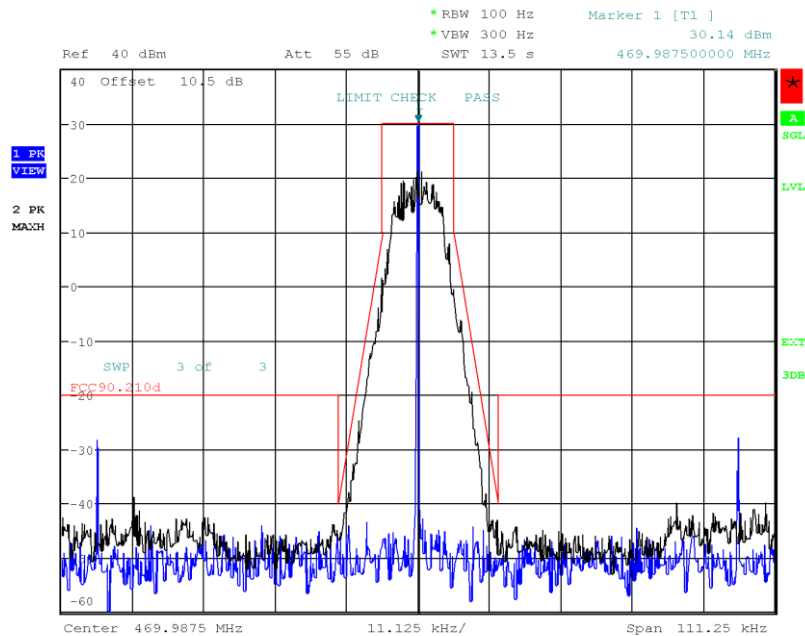
Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-03  
 Operating Conditions: Tnom/Vnom  
 Mode: 460.11875 MHz



Date: 3.JUN.2020 12:47:15

## Emission mask

Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-03  
 Operating Conditions: Tnom/Vnom  
 Mode: 469.9875 MHz



Date: 3.JUN.2020 12:52:53

### 3.3 Test Conditions and Results - Spurious emissions at antenna terminal

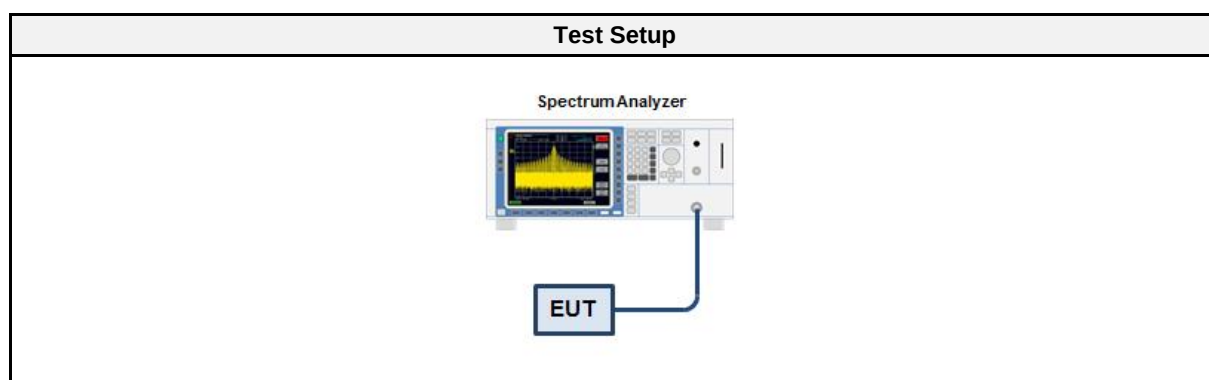
#### 3.3.1 Information

| Test Information   |                                                                      |
|--------------------|----------------------------------------------------------------------|
| Reference          | FCC 90.210, FCC 2.1051<br>ISED RSS-119, Issue 12 (Sections 4.2,6.13) |
| Measurement Method | FCC 90.210<br>ANSI C63.26:2015 5.7                                   |
| Test Method        | Conducted                                                            |
| Test Mode          | Unmodulated                                                          |
| Test Range         | 10 MHz to 10th Harmonic                                              |
| Operator           | Toralf Jahn                                                          |
| Date               | 2020-06-03                                                           |

#### 3.3.2 Limits

| Limits  |
|---------|
| -20 dBm |

#### 3.3.3 Setup



#### 3.3.4 Equipment

| Test Equipment    |              |       |            |           |          |
|-------------------|--------------|-------|------------|-----------|----------|
| Description       | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
| Spectrum analyzer | R&S          | FSU43 | EF01631    | 2019-12   | 2020-12  |

#### 3.3.5 Procedure

| Test Procedure                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. EUT set to test mode</li> <li>2. Span is set according to measurement range</li> <li>3. Resolution bandwidth is set to 100 kHz below 1 GHz and 1 MHz above 1 GHz</li> <li>4. Detector is set to peak and trace mode to max hold</li> </ol> |

## 3.3.6 Results

| Test Results     |         |
|------------------|---------|
| Channel<br>[MHz] | Verdict |
| 450.25           | PASS    |
| 460.11875        | PASS    |
| 469.9875         | PASS    |

### 3.4 Test Conditions and Results - Transmitter radiated emissions

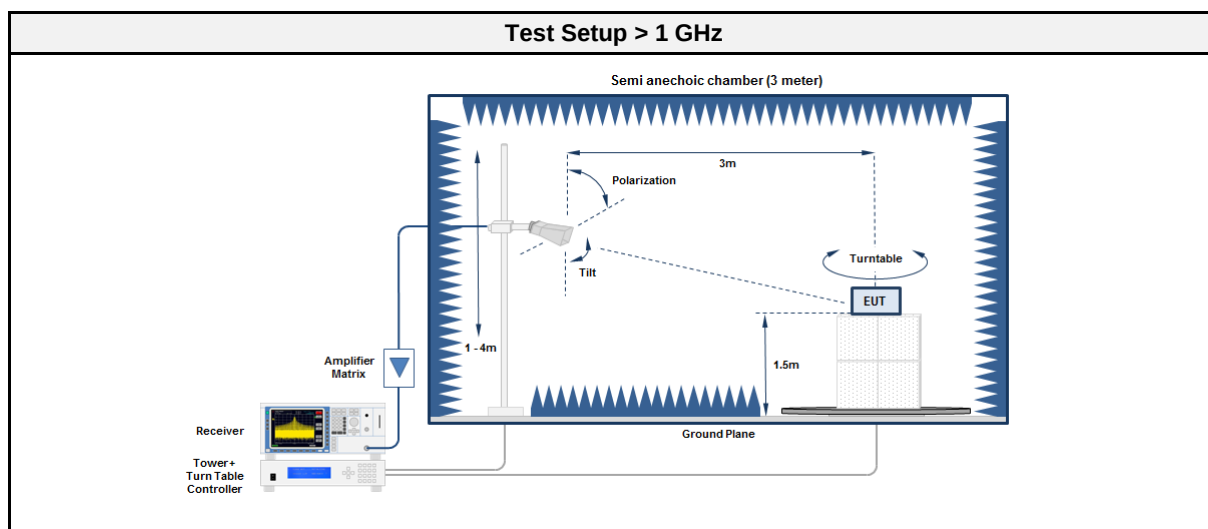
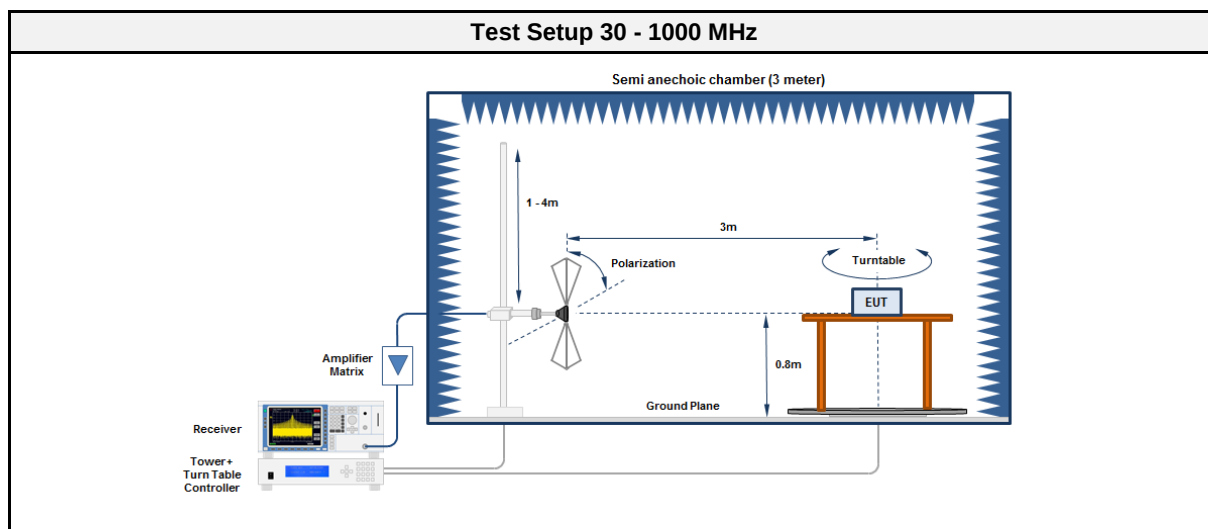
#### 3.4.1 Information

| Test Information   |                                                                        |
|--------------------|------------------------------------------------------------------------|
| Reference          | FCC 90.210<br>FCC 2.1053<br>ISED RSS-119, Issue 12 (Sections 4.2,6.13) |
| Measurement Method | FCC 90.210<br>ANSI C63.26:2015 5.7                                     |
| Test Method        | Radiated                                                               |
| Test Mode          | Unmodulated                                                            |
| Test Range         | 30 MHz to 10th Harmonic                                                |
| Operator           | Toralf Jahn                                                            |
| Date               | 2020-06-02                                                             |

#### 3.4.2 Limits

| Limits  |
|---------|
| -20 dBm |

#### 3.4.3 Setup



Test Report No.: G0M-2002-8859-TFC090PMR-V02

Eurofins Product Service GmbH  
Storkower Str. 38c, D-15526 Reichenwalde, Germany

### 3.4.4 Equipment

| Test Software |                  |            |          |
|---------------|------------------|------------|----------|
| Description   | Manufacturer     | Name       | Version  |
| EMC Software  | DARE Instruments | RadiMation | 2016.1.1 |

| Test Equipment 30 - 1000 MHz |              |        |            |           |          |
|------------------------------|--------------|--------|------------|-----------|----------|
| Description                  | Manufacturer | Model  | Identifier | Cal. Date | Cal. Due |
| Anechoic Chamber             | Frankonia    | AC1    | EF00062    | 2018-07   | 2021-07  |
| EMI Test Receiver            | R&S          | ESR7   | EF00943    | 2019-10   | 2020-10  |
| Antenna                      | R&S          | HK 116 | EF00030    | 2019-04   | 2022-04  |
| Antenna                      | R&S          | HL 223 | EF00187    | 2019-05   | 2022-05  |

| Test Equipment > 1 GHz |              |            |            |           |          |
|------------------------|--------------|------------|------------|-----------|----------|
| Description            | Manufacturer | Model      | Identifier | Cal. Date | Cal. Due |
| Anechoic Chamber       | Frankonia    | AC1        | EF00062    | 2018-07   | 2021-07  |
| Spectrum analyzer      | R&S          | FSU26      | EF01003    | 2019-07   | 2020-07  |
| Antenna                | Schwarzbeck  | BBHA 9120D | EF00018    | 2019-10   | 2022-10  |

### 3.4.5 Procedure

| Test Procedure 30 - 1000 MHz                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ol style="list-style-type: none"> <li>1. EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground</li> <li>2. EUT set to test mode</li> <li>3. The receiver is set to peak detection with max hold</li> <li>4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m</li> <li>5. All significant emissions are measured again using the corresponding final detector</li> </ol> |  |

| Test Procedure > 1 GHz                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ol style="list-style-type: none"> <li>1. EUT is placed on a non conducting support at the center of a turn table 1.5 m above the ground</li> <li>2. EUT set to test mode</li> <li>3. The receiver is set to peak detection with max hold</li> <li>4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m</li> <li>5. All significant emissions are measured again using the corresponding final detector</li> </ol> |  |

## 3.4.6 Results

| Test Results  |                |             |      |      |             |             |
|---------------|----------------|-------------|------|------|-------------|-------------|
| Channel [MHz] | Emission [MHz] | Level [dBm] | Det. | Pol. | Limit [dBm] | Margin [dB] |
| 450.25        | 900.5          | -61.00      | pk   | hor  | -20.00      | -41.00      |
| 450.25        | 900.5          | -61.00      | pk   | ver  | -20.00      | -41.00      |
| 450.25        | 1350.75        | -64.50      | pk   | hor  | -20.00      | -44.52      |
| 450.25        | 1350.75        | -62.20      | pk   | ver  | -20.00      | -42.22      |
| 450.25        | 1801           | -61.40      | pk   | hor  | -20.00      | -41.43      |
| 450.25        | 1801           | -58.30      | pk   | ver  | -20.00      | -38.27      |
| 450.25        | 2251.25        | -49.40      | pk   | hor  | -20.00      | -29.36      |
| 450.25        | 2251.25        | -49.30      | pk   | ver  | -20.00      | -29.29      |
| 460.11875     | 920.2375       | -61.00      | pk   | hor  | -20.00      | -41.00      |
| 460.11875     | 920.2375       | -61.00      | pk   | ver  | -20.00      | -41.00      |
| 460.11875     | 1380.35625     | -64.50      | pk   | hor  | -20.00      | -44.55      |
| 460.11875     | 1380.35625     | -62.70      | pk   | ver  | -20.00      | -42.73      |
| 460.11875     | 1840.475       | -58.00      | pk   | hor  | -20.00      | -37.98      |
| 460.11875     | 1840.475       | -59.00      | pk   | ver  | -20.00      | -39.02      |
| 460.11875     | 2300.59375     | -47.60      | pk   | hor  | -20.00      | -27.64      |
| 460.11875     | 2300.59375     | -51.50      | pk   | ver  | -20.00      | -31.48      |
| 469.9875      | 939.975        | -61.00      | pk   | hor  | -20.00      | -41.00      |
| 469.9875      | 939.975        | -61.00      | pk   | ver  | -20.00      | -41.00      |
| 469.9875      | 1409.9625      | -65.00      | pk   | hor  | -20.00      | -45.02      |
| 469.9875      | 1409.9625      | -62.30      | pk   | ver  | -20.00      | -42.25      |
| 469.9875      | 1879.95        | -54.20      | pk   | hor  | -20.00      | -34.15      |
| 469.9875      | 1879.95        | -53.80      | pk   | ver  | -20.00      | -33.82      |
| 469.9875      | 2349.9375      | -52.80      | pk   | hor  | -20.00      | -32.84      |
| 469.9875      | 2349.9375      | -54.10      | pk   | ver  | -20.00      | -34.05      |

### 3.5 Test Conditions and Results - Frequency stability

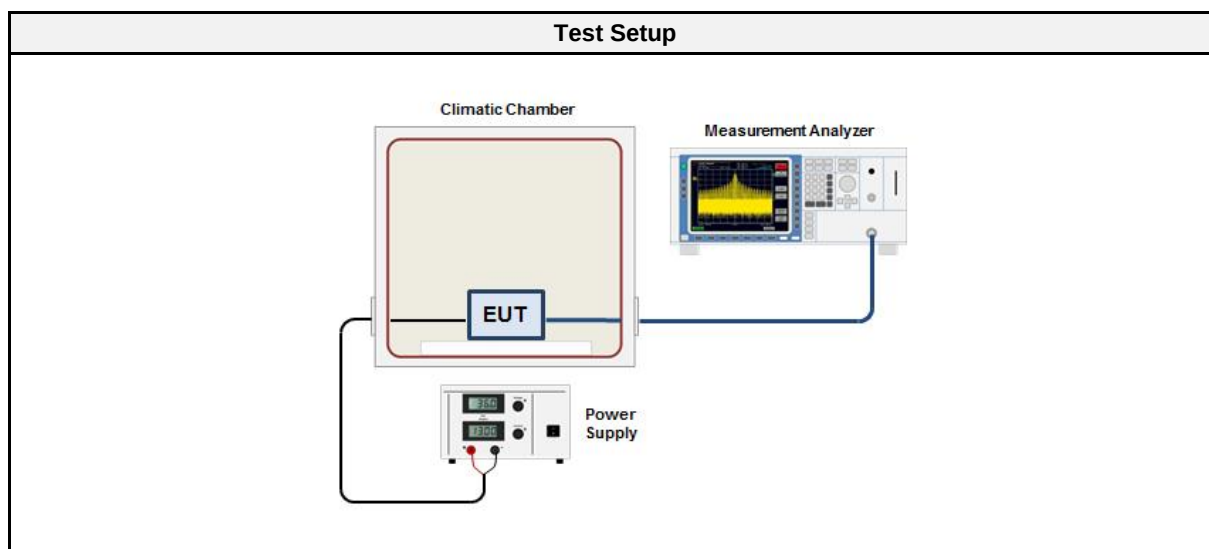
#### 3.5.1 Information

| Test Information   |                                                                 |
|--------------------|-----------------------------------------------------------------|
| Reference          | FCC 90.213, FCC 2.1055<br>ISED RSS-119, Issue 12 (Sections 5.3) |
| Measurement Method | ANSI C63.26:2015 5.6                                            |
| Test Method        | Conducted                                                       |
| Test Mode          | Unmodulated                                                     |
| Operator           | Toralf Jahn                                                     |
| Date               | 2020-06-09                                                      |

#### 3.5.2 Limits

| Limits       |                   |         |
|--------------|-------------------|---------|
| Device Type  | Channel bandwidth | Limit   |
| Base / Fixed | 12.5              | 1.5 ppm |
| Base / Fixed | 6.25              | 0.5 ppm |
| Mobile       | 12.5              | 2.5 ppm |
| Mobile       | 6.25              | 1.0 ppm |

#### 3.5.3 Setup



#### 3.5.4 Equipment

| Test Equipment    |              |         |            |           |          |
|-------------------|--------------|---------|------------|-----------|----------|
| Description       | Manufacturer | Model   | Identifier | Cal. Date | Cal. Due |
| Spectrum analyzer | R&S          | FSU43   | EF01631    | 2019-12   | 2020-12  |
| Climatic chamber  | Vötsch       | VT 4010 | EF00134    | 2019-08   | 2020-08  |

### 3.5.5 Procedure

| Test Procedure with respect to ambient temperature |                                                                                                                                                                |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.                                                 | The EUT is turned off and placed inside the temperature chamber                                                                                                |
| 2.                                                 | The temperature chamber is set to the highest operating temperature                                                                                            |
| 3.                                                 | The EUT is turned on at nominal supply voltage and the carrier frequency is measured at startup, at 2 minutes, 5 minutes and 10 minutes after EUT is energized |
| 4.                                                 | The EUT is turned off again                                                                                                                                    |
| 5.                                                 | The temperature of the chamber is lowered by 10 °C                                                                                                             |
| 6.                                                 | The carrier frequency measurement is repeated after temperature has stabilized                                                                                 |
| 7.                                                 | The procedure is repeated until the lowest operating frequency is reached                                                                                      |

| Test Procedure when varying supply voltage |                                                                                                                                     |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 1.                                         | The EUT is supplied with nominal supply voltage or a fully charged battery at room temperature (15 to 25 °C)                        |
| 2.                                         | The carrier frequency is measured                                                                                                   |
| 3.                                         | The procedure is repeated at 85 % and 115 % of the nominal supply voltage or at the battery endpoint for battery operated equipment |

| Test Procedure of carrier frequency measurement |                                                                                                                 |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| 1.                                              | The emission spectrum is measured using a resolution band width of 100 kHz with peak detection and maximum hold |
| 2.                                              | The peak of the emission spectrum is determined                                                                 |
| 3.                                              | The left most frequency $f_1$ 10 dB below the peak emission is searched                                         |
| 4.                                              | The right most frequency $f_2$ 10 dB below the peak emission is searched                                        |
| 5.                                              | The center frequency is calculated from $f_c = (f_1 + f_2) / 2$                                                 |
| 6.                                              | The center frequency and the deviation from the nominal center frequency are recorded                           |

## 3.5.6 Results

| Test Results - Variation of temperature                                           |             |                  |                       |                 |                 |                 |
|-----------------------------------------------------------------------------------|-------------|------------------|-----------------------|-----------------|-----------------|-----------------|
| Channel [MHz]                                                                     | Voltage [V] | Temperature [°C] | Time after activation | Frequency [MHz] | Deviation [kHz] | Deviation [ppm] |
| 460.11875                                                                         | 3.66        | 65               | 0                     | 460.118737      | 0.136           | 0.30            |
| 460.11875                                                                         | 3.66        | 60               | 0                     | 460.118715      | 0.114           | 0.25            |
| 460.11875                                                                         | 3.66        | 50               | 0                     | 460.118673      | 0.072           | 0.16            |
| 460.11875                                                                         | 3.66        | 40               | 0                     | 460.118614      | 0.013           | 0.03            |
| 460.11875                                                                         | 3.66        | 30               | 0                     | 460.118565      | -0.036          | -0.08           |
| 460.11875                                                                         | 3.66        | 20               | 0                     | 460.118601      | reference       | reference       |
| 460.11875                                                                         | 3.66        | 10               | 0                     | 460.118690      | 0.098           | 0.21            |
| 460.11875                                                                         | 3.66        | 0                | 0                     | 460.118813      | 0.212           | 0.46            |
| 460.11875                                                                         | 3.66        | -10              | 0                     | 460.118797      | 0.196           | 0.43            |
| 460.11875                                                                         | 3.66        | -20              | 0                     | 460.118785      | 0.184           | 0.40            |
| 460.11875                                                                         | 3.66        | -30              | 0                     | 460.118790      | 0.189           | 0.41            |
| Comment: The EUT transmits in normal operation mode only for a few milli seconds. |             |                  |                       |                 |                 |                 |

| Test Results - Variation of supply voltage |             |                  |                 |                 |                 |
|--------------------------------------------|-------------|------------------|-----------------|-----------------|-----------------|
| Channel [MHz]                              | Voltage [V] | Temperature [°C] | Frequency [MHz] | Deviation [kHz] | Deviation [ppm] |
| 460.11875                                  | 3.66        | 20               | 460.118601      | reference       | reference       |
| 460.11875                                  | 3.0         | 20               | 460.118582      | -0.019          | -0.04           |

### 3.6 Test Conditions and Results - Transient frequency behavior

#### 3.6.1 Information

| Test Information   |                                                     |
|--------------------|-----------------------------------------------------|
| Reference          | FCC 90.214<br>ISED RSS-119, Issue 12 (Sections 5.9) |
| Measurement Method | ANSI C63.26:2015 6.5                                |
| Test Method        | Conducted                                           |
| Test Mode          | Unmodulated                                         |
| Operator           | Toralf Jahn                                         |
| Date               | 2020-06-09                                          |

#### 3.6.2 Limits

**Limits**

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

| Time intervals <sup>1 2</sup>                                                       | Maximum frequency difference <sup>3</sup> | All equipment  |                |
|-------------------------------------------------------------------------------------|-------------------------------------------|----------------|----------------|
|                                                                                     |                                           | 150 to 174 MHz | 421 to 512 MHz |
| Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels   |                                           |                |                |
| $t_1$ <sup>4</sup>                                                                  | ±25.0 kHz                                 | 5.0 ms         | 10.0 ms        |
| $t_2$                                                                               | ±12.5 kHz                                 | 20.0 ms        | 25.0 ms        |
| $t_3$ <sup>4</sup>                                                                  | ±25.0 kHz                                 | 5.0 ms         | 10.0 ms        |
| Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels |                                           |                |                |
| $t_1$ <sup>4</sup>                                                                  | ±12.5 kHz                                 | 5.0 ms         | 10.0 ms        |
| $t_2$                                                                               | ±6.25 kHz                                 | 20.0 ms        | 25.0 ms        |
| $t_3$ <sup>4</sup>                                                                  | ±12.5 kHz                                 | 5.0 ms         | 10.0 ms        |
| Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels |                                           |                |                |
| $t_1$ <sup>4</sup>                                                                  | ±6.25 kHz                                 | 5.0 ms         | 10.0 ms        |
| $t_2$                                                                               | ±3.125 kHz                                | 20.0 ms        | 25.0 ms        |
| $t_3$ <sup>4</sup>                                                                  | ±6.25 kHz                                 | 5.0 ms         | 10.0 ms        |

<sup>1</sup>  $t_{on}$  is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

$t_1$  is the time period immediately following  $t_{on}$ .

$t_2$  is the time period immediately following  $t_1$ .

$t_3$  is the time period from the instant when the transmitter is turned off until  $t_{off}$ .

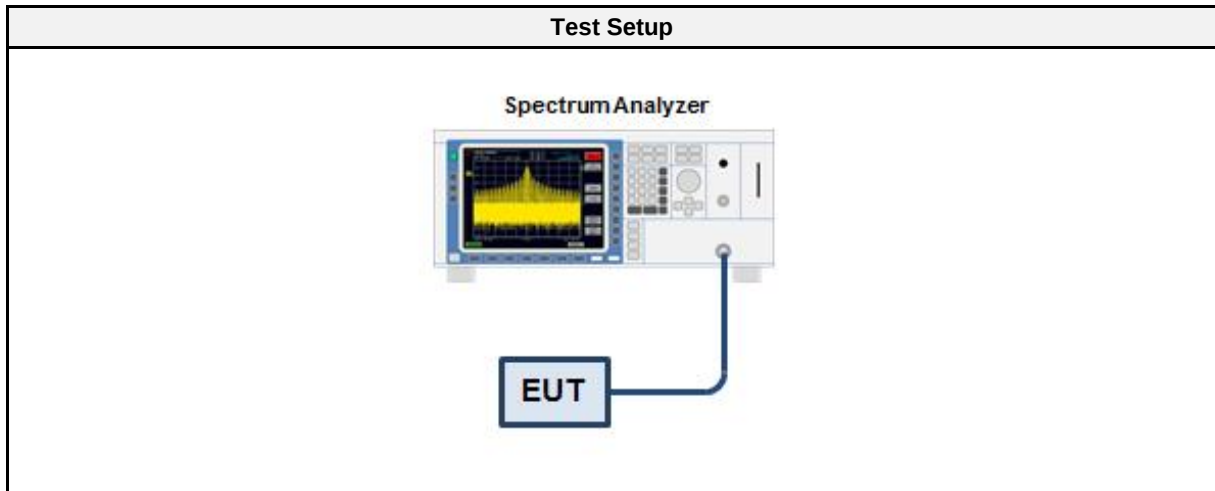
$t_{off}$  is the instant when the 1 kHz test signal starts to rise.

<sup>2</sup> During the time from the end of  $t_2$  to the beginning of  $t_3$ , the frequency difference must not exceed the limits specified in §90.213.

<sup>3</sup> Difference between the actual transmitter frequency and the assigned transmitter frequency.

<sup>4</sup> If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

### 3.6.3 Setup



### 3.6.4 Equipment

| Test Equipment    |              |        |            |           |          |
|-------------------|--------------|--------|------------|-----------|----------|
| Description       | Manufacturer | Model  | Identifier | Cal. Date | Cal. Due |
| Spectrum Analyzer | R&S          | FSW 43 | EF00896    | 2019-07   | 2020-07  |

### 3.6.5 Procedure

| Test Procedure                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. The EUT is set to test frequency</li> <li>2. The EUT is connected to modulation analyzer</li> <li>3. The EUT is switched on and off in order to determine the transient switching behavior</li> </ol> |

### 3.6.6 Results

| Test Results  |        |         |
|---------------|--------|---------|
| Channel [MHz] | State  | Verdict |
| 450.25        | Tx Off | PASS    |
| 460.11875     | Tx Off | PASS    |
| 469.9875      | Tx Off | PASS    |
| 450.25        | Tx On  | PASS    |
| 460.11875     | Tx On  | PASS    |
| 469.9875      | Tx On  | PASS    |

## Transient frequency behavior

Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-09  
 Operating Conditions: Tnom/Vnom  
 Mode: Ton 450.25 MHz



10:48:27 09.06.2020

## Transient frequency behavior

Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-09  
 Operating Conditions: Tnom/Vnom  
 Mode: Ton 460.11875 MHz



10:52:55 09.06.2020

## Transient frequency behavior

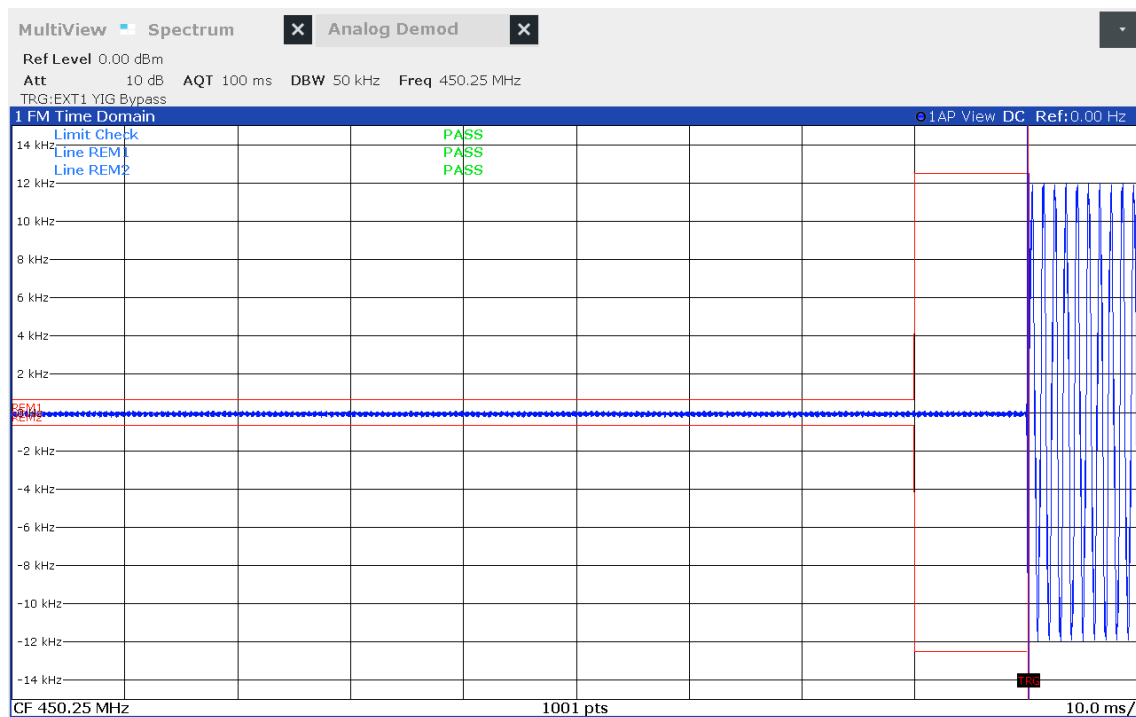
Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-09  
 Operating Conditions: Tnom/Vnom  
 Mode: Ton 469.9875 MHz



10:55:26 09.06.2020

## Transient frequency behavior

Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-09  
 Operating Conditions: Tnom/Vnom  
 Mode: Toff 450.25 MHz



11:23:42 09.06.2020

## Transient frequency behavior

Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-09  
 Operating Conditions: Tnom/Vnom  
 Mode: Toff 460.11875 MHz



11:26:18 09.06.2020

## Transient frequency behavior

Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-09  
 Operating Conditions: Tnom/Vnom  
 Mode: Toff 469.9875 MHz

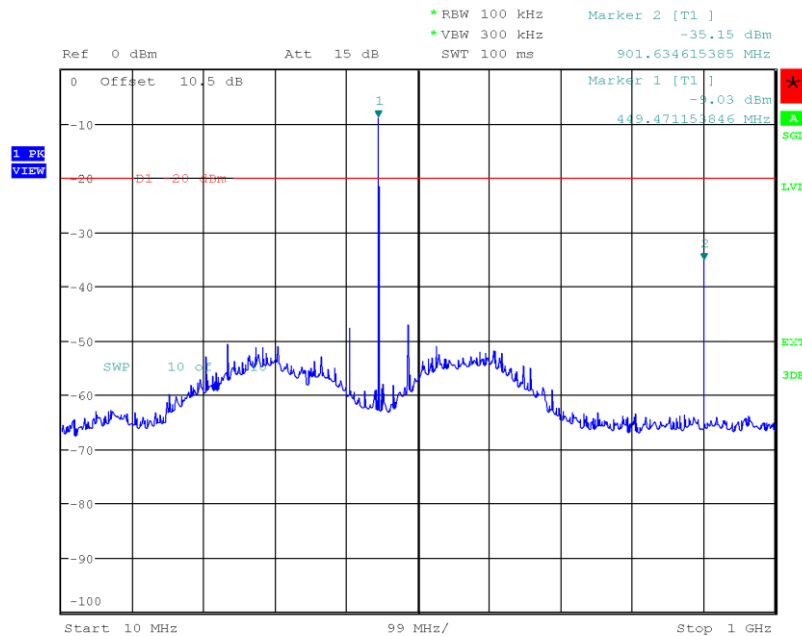


11:31:02 09.06.2020

## ANNEX A Transmitter conducted emissions

### Spurious emissions at antenna terminal

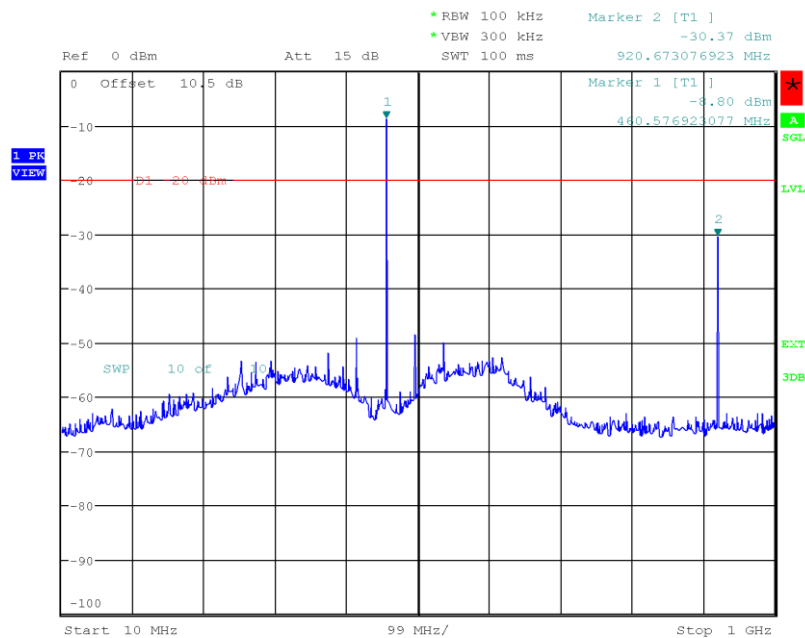
Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-03  
 Operating Conditions: Tnom/Vnom  
 Mode: 450.25 MHz



Date: 3.JUN.2020 13:24:39

## Spurious emissions at antenna terminal

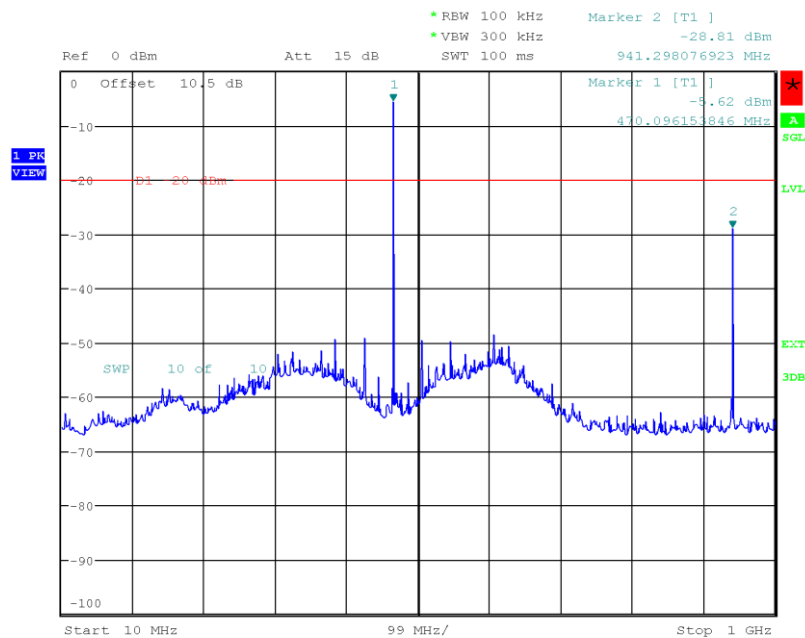
Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-03  
 Operating Conditions: Tnom/Vnom  
 Mode: 460.11875 MHz



Date: 3.JUN.2020 13:26:50

## Spurious emissions at antenna terminal

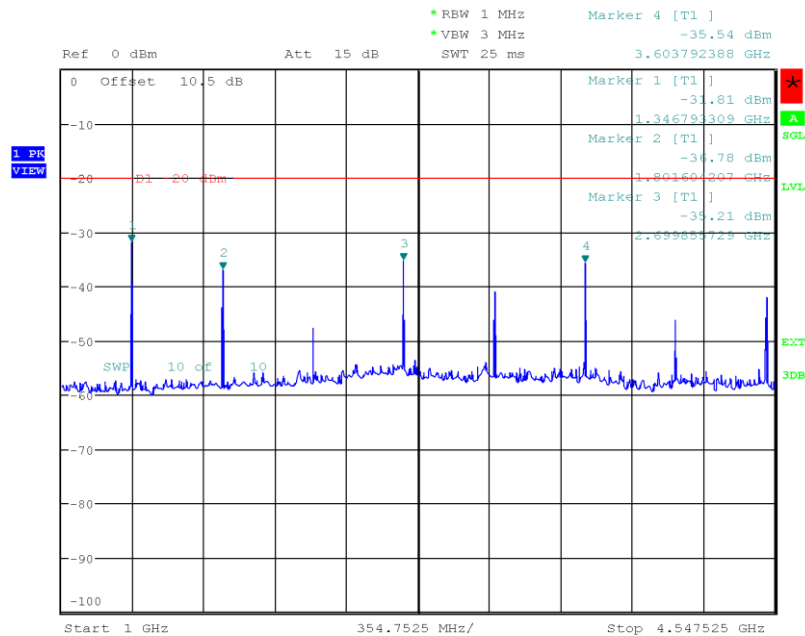
Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-03  
 Operating Conditions: Tnom/Vnom  
 Mode: 469.9875 MHz



Date: 3.JUN.2020 13:29:09

## Spurious emissions at antenna terminal

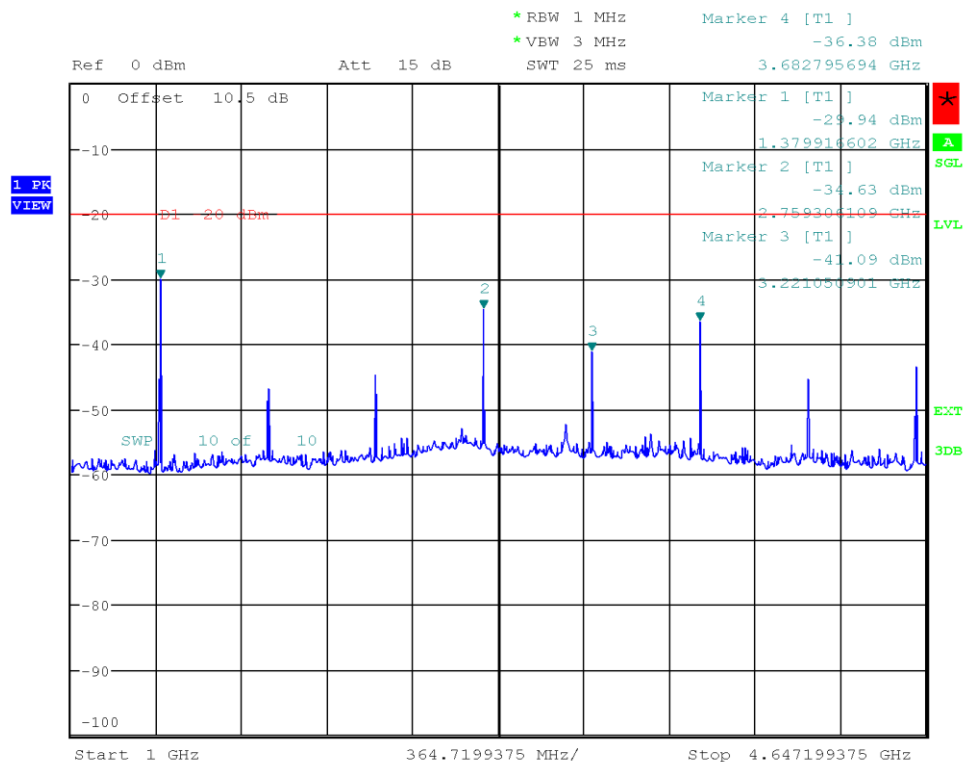
Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-03  
 Operating Conditions: Tnom/Vnom  
 Mode: 450.25 MHz



Date: 3.JUN.2020 13:34:08

## Spurious emissions at antenna terminal

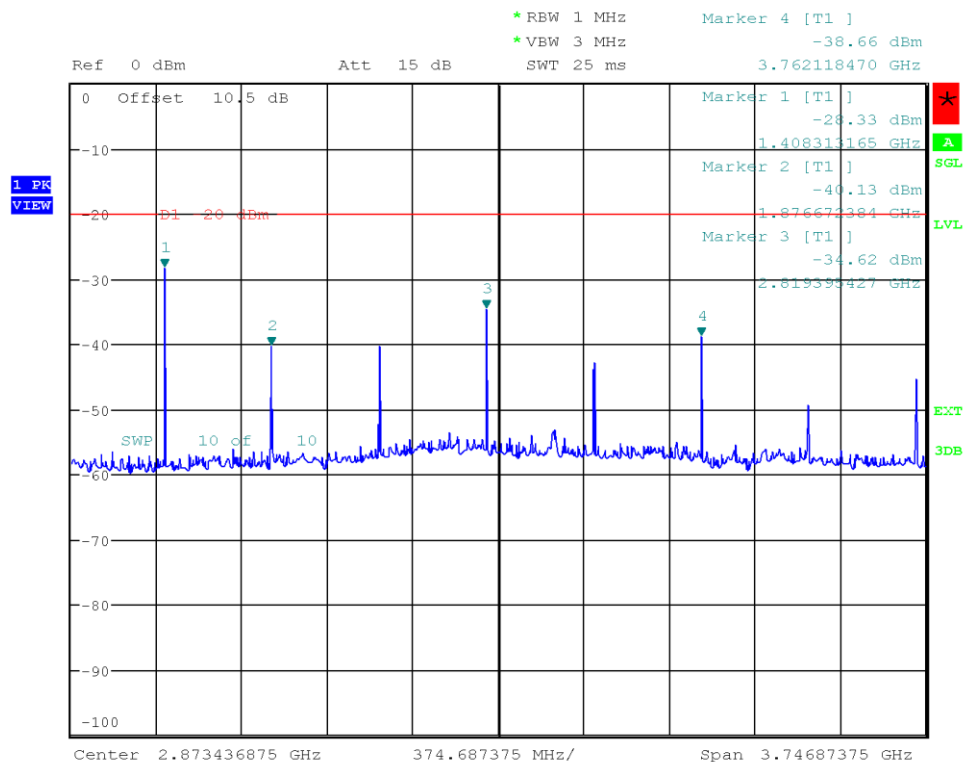
Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-03  
 Operating Conditions: Tnom/Vnom  
 Mode: 460.11875 MHz



Date: 3.JUN.2020 13:36:37

## Spurious emissions at antenna terminal

Project Number: G0M-2002-8859  
 Applicant: Kamstrup A/S  
 Model Description: Ultrasonic water meter  
 Model: KWM2220  
 Test Sample ID: 29577  
 Operator: Toralf Jahn  
 Test Site: Eurofins Product Service GmbH  
 Test Date: 2020-06-03  
 Operating Conditions: Tnom/Vnom  
 Mode: 469.9875 MHz



Date: 3.JUN.2020 13:38:49