



Registration No. DAT-P-207/05

## EMI -- TEST REPORT

- FCC Part 15.249 -

|                          |                       |                               |
|--------------------------|-----------------------|-------------------------------|
| <b>Test Report No. :</b> | <b>T34021-00-03KJ</b> | 18. May 2010<br>Date of issue |
|--------------------------|-----------------------|-------------------------------|

Type / Model Name : VarioTel 2

Product Description : Multi-channel transmitter for controlling roller shutters, veneation blinds and sun protection systems

**Applicant** : elero GmbH Antriebstechnik

Address : Linsenhofer Str. 59-63  
72660 BEUREN, GERMANY

**Manufacturer** : elero GmbH Antriebstechnik

Address : Linsenhofer Str. 59-63  
72660 BEUREN, GERMANY

**Licence holder** : elero GmbH Antriebstechnik

Address : Linsenhofer Str. 59-63  
72660 BEUREN, GERMANY

|  |                 |
|--|-----------------|
| <b>Test Result</b> according to the standards listed in clause 1 test standards: | <b>POSITIVE</b> |
|--|-----------------|



DAT-P-207/05-00

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

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## **1 TEST STANDARDS**

The tests were performed according to following standards:

### **FCC Rules and Regulations Part 15, Subpart A - General (October, 2009)**

|                                   |   |
|-----------------------------------|---|
| Part 15, Subpart A, Section 15.31 | Measurement standards                         |
| Part 15, Subpart A, Section 15.33 | Frequency range of radiated measurements      |
| Part 15, Subpart A, Section 15.35 | Measurement detector functions and bandwidths |

### **FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (October, 2009)**

|                                    |  |
|------------------------------------|--|
| Part 15, Subpart C, Section 15.203 | Antenna requirement  |
| Part 15, Subpart C, Section 15.204 | External radio frequency power amplifiers and antenna modifications                                |
| Part 15, Subpart C, Section 15.205 | Restricted bands of operation  |
| Part 15, Subpart C, Section 15.209 | Radiated emission limits, general requirements   |
| Part 15, Subpart C, Section 15.249 | Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz |

ANSI C63.4: 2003

Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

## 2 SUMMARY

### GENERAL REMARKS:

The EuT is working in transmit mode at 915.3 MHz and 918.3 MHz.  
The frequency range was scanned from 9 kHz to 10000 MHz.  
All emissions not reported in this test report were more than 10 dB below the specified limit.

### FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 02. March 2010

Testing concluded on : 12. April 2010

Checked by:

Tested by:

\_\_\_\_\_  
Klaus Gegenfurtner  
Dipl.-Ing.(FH)  
Manager: Radio Group

\_\_\_\_\_  
Josef Knab

### 3 EQUIPMENT UNDER TEST

#### 3.1 Photo documentation of the EUT – External Photos

VarioTel 2

Front view



Rear view



FCC ID: YBU282XX0901

VarioTel 2  
Bottom view



VarioTel 2  
Top view



FCC ID: YBU282XX0901

VarioTel 2  
Open battery case



VarioTel 2  
Label view



**VarioTel 2**

**elero**

FCC ID: YBU282XX0901 / IC: 8929A-282XX0901

28 247.0901 0410 915 MHz Band

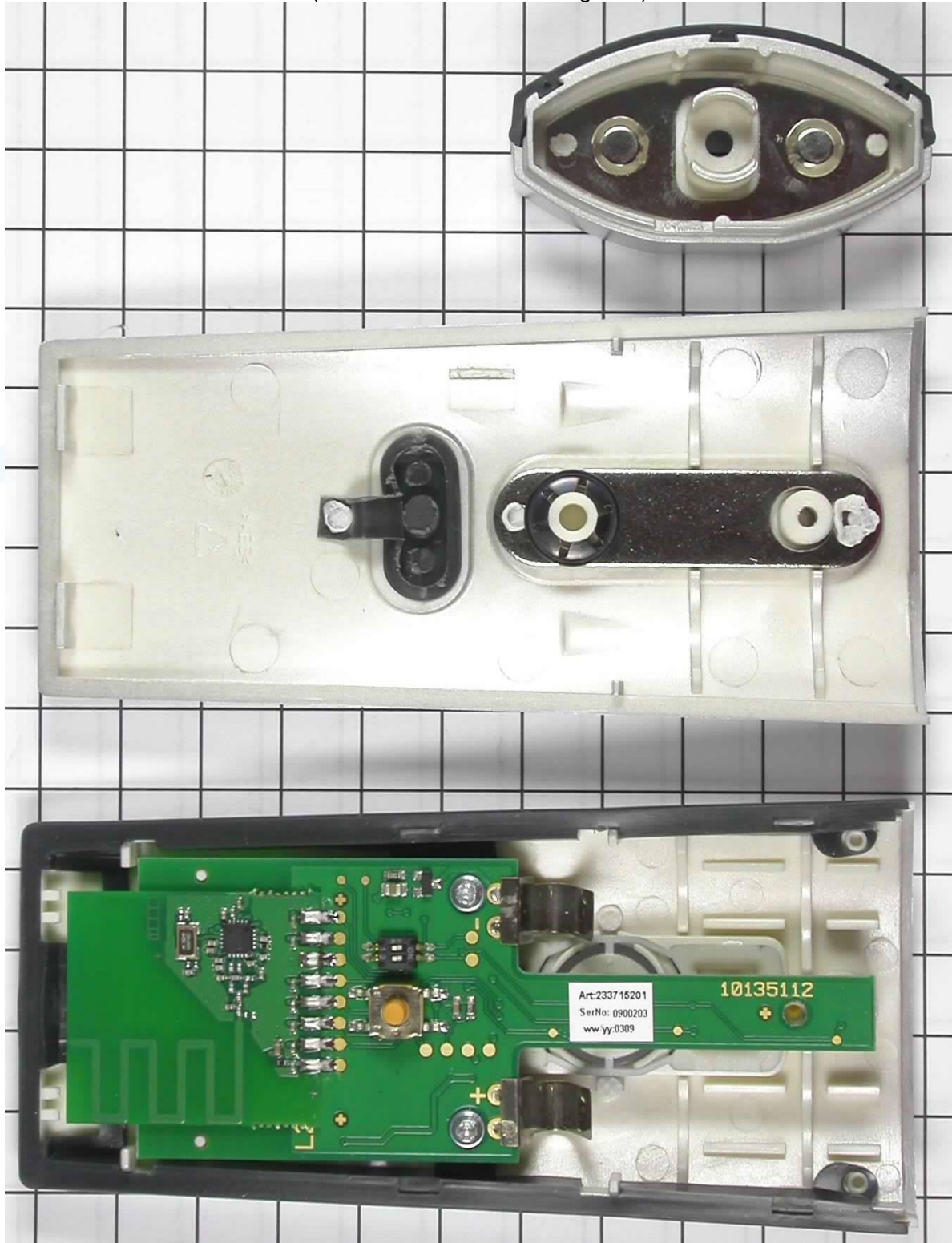
No. 90001 00429 .57 3VDC





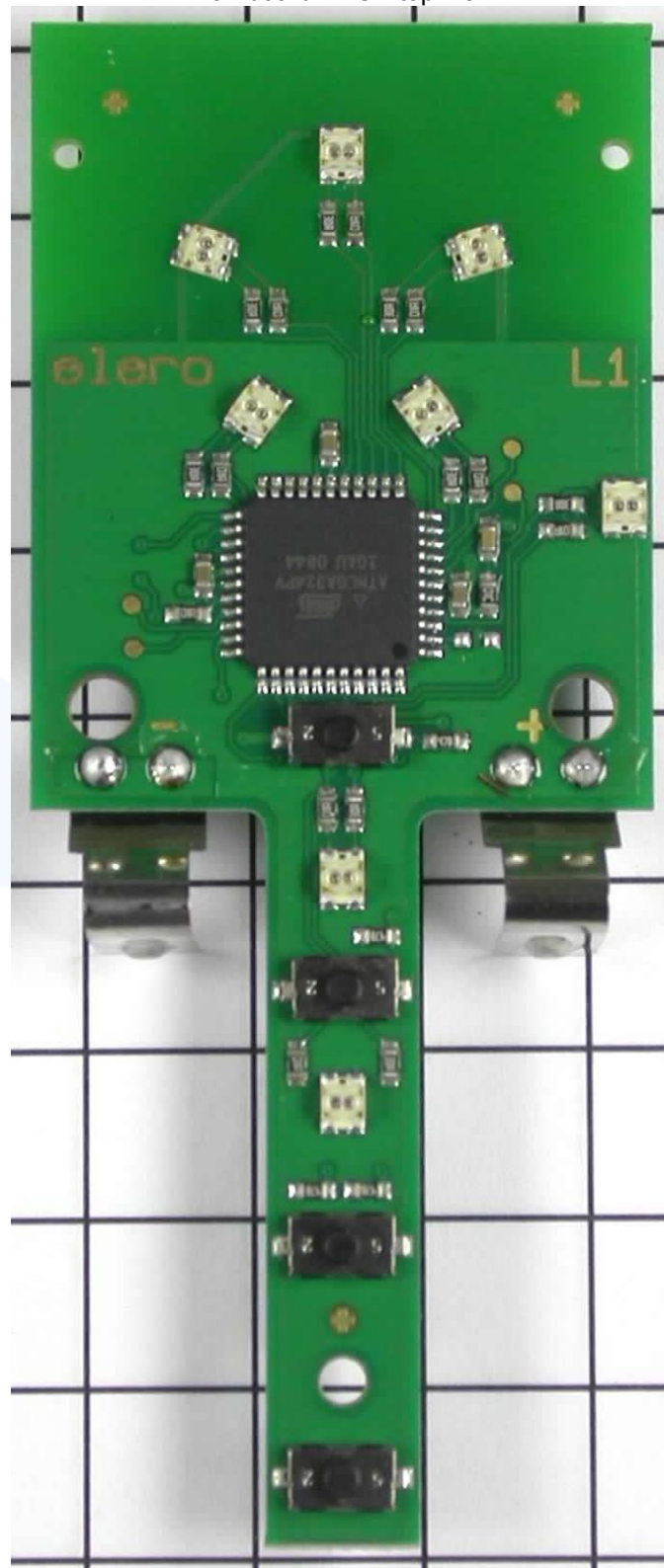
### 3.2 Photo documentation of the EUT – Internal Photos

VarioTel 2  
Internal view / open case  
(mainboard and RF board together)



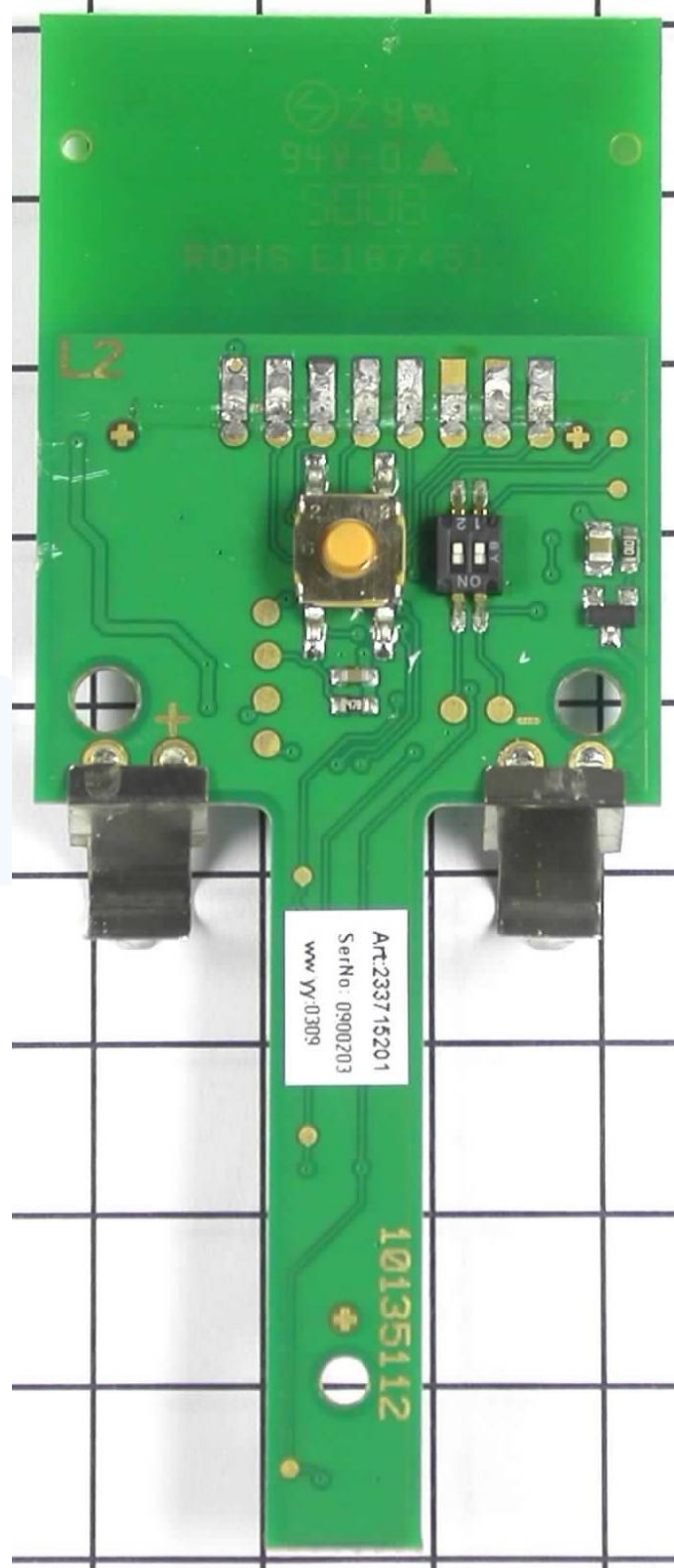


VarioTel 2  
Mainboard - PCB top view



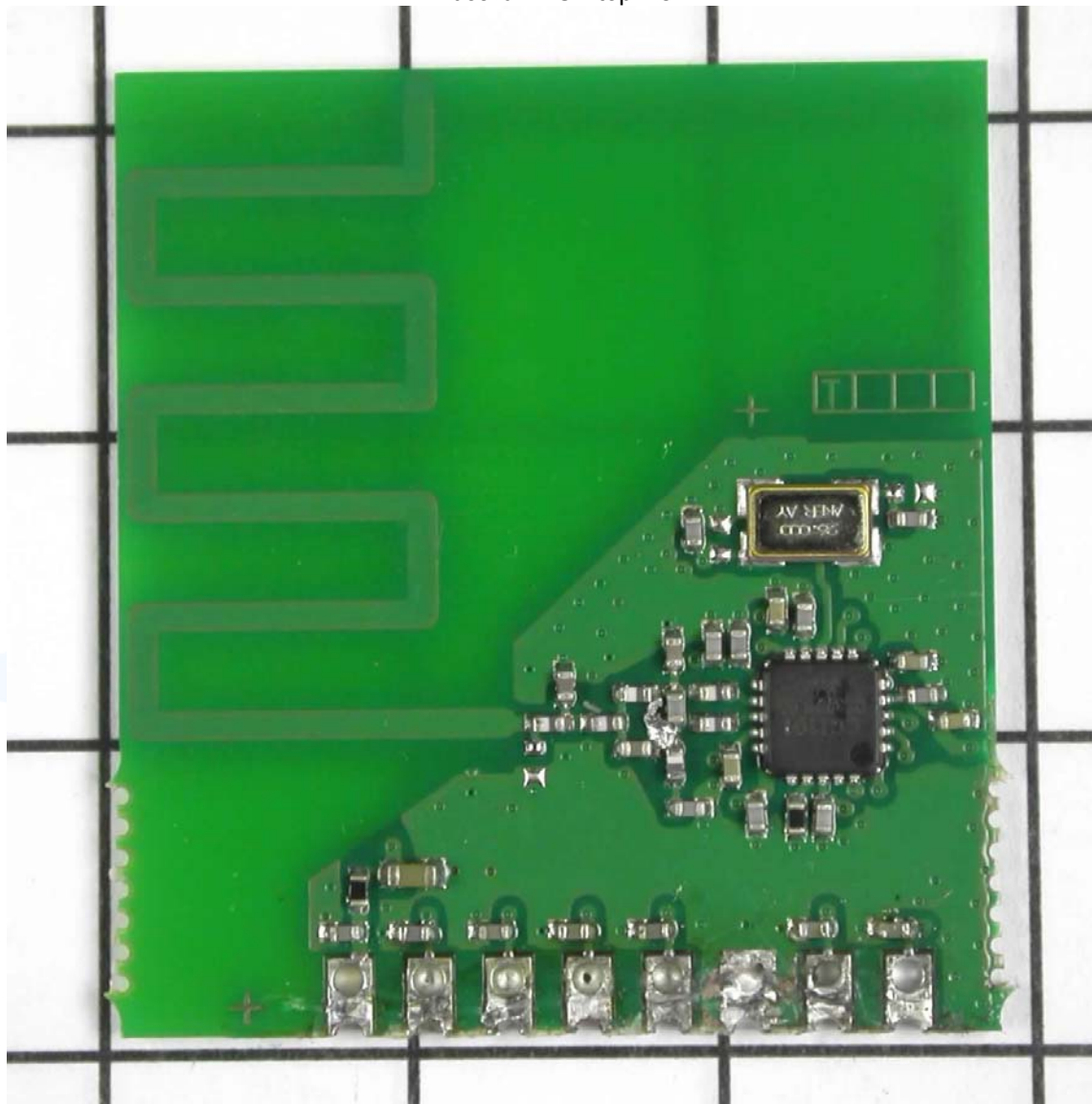
FCC ID: YBU282XX0901

VarioTel 2  
Mainboard - PCB rear view



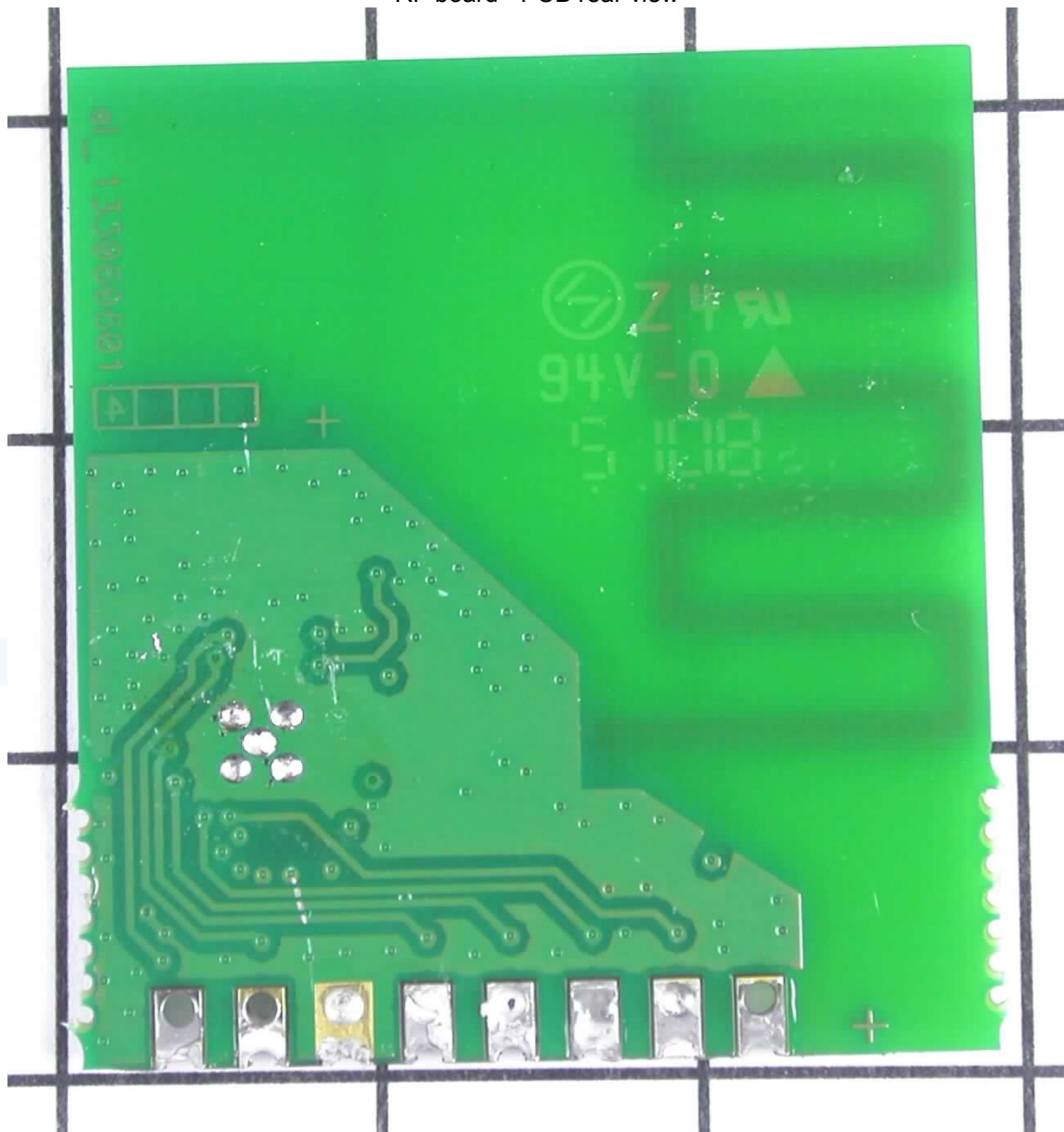
FCC ID: YBU282XX0901

VarioTel 2  
RF board - PCB top view



FCC ID: YBU282XX0901

VarioTel 2  
RF board - PCB rear view



### 3.3 Power supply system utilised

Power supply voltage : 3.0 V / DC

### 3.4 Short description of the equipment under test (EUT)

The EuT is a multi-channel transmitter. Each channel can be used unidirectionally or bidirectionally. The handheld transmitter may only be used for controlling roller shutters, venetian blinds and sun protection systems that are fitted with elero radio receivers.

Number of tested samples: 1  
Serial number: 00006.40

#### EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- continuous TX at 915.300 MHz and 918.300 MHz

- standby

-

#### EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

#### The following peripheral devices and interface cables were connected during the measurements:

- \_\_\_\_\_ Model : \_\_\_\_\_
- \_\_\_\_\_ Model : \_\_\_\_\_
- \_\_\_\_\_ Model : \_\_\_\_\_
- \_\_\_\_\_ Model : \_\_\_\_\_
- \_\_\_\_\_ Model : \_\_\_\_\_
- \_\_\_\_\_ Model : \_\_\_\_\_



## **4 TEST ENVIRONMENT**

### **4.1 Address of the test laboratory**

**mikes-testingpartners gmbh**  
**Ohmstrasse 2-4**  
**94342 STRASSKIRCHEN**  
**GERMANY**

### **4.2 Environmental conditions**

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

### **4.3 Statement of the measurement uncertainty**

The data and results referenced in this document are true and accurate. The reader may notice that tolerances within the calibration of the equipment and facilities may cause additional uncertainty. The measurement uncertainty is calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurement“ and documented in the mikes-testingpartners gmbh quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, mikes-testingpartners gmbh, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component diversity and modifications in production processes may result in additional deviation. If necessary, refer to the test lab for the actual measurement uncertainty for specific tests. The manufacturer has the sole responsibility of continued compliance of the EUT.

### **4.4 Measurement protocol for FCC, VCCI and AUSTEL**

#### **4.4.1 GENERAL INFORMATION**

##### **4.4.1.1 Test methodology**

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

##### **4.4.1.2 Justification**



The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

#### 4.4.2 DETAILS OF TEST PROCEDURES

##### General Standard information

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

#### 4.4.3 Conducted emission

##### Description of measurement

The final level, expressed in dB $\mu$ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit or to the CISPR limit.

To convert between dB $\mu$ V and  $\mu$ V, the following conversions apply:

$$\begin{aligned} \text{dB}\mu\text{V} &= 20 \cdot \log(\mu\text{V}); \\ \mu\text{V} &= 10^{(\text{dB}\mu\text{V}/20)}; \end{aligned}$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50 $\Omega$ /50  $\mu$ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin of a peak mode measurement appears to be less than 20 dB, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

#### 4.4.4 Radiated emission (electrical field 30 MHz - 1 GHz)

##### Description of measurement

Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 meters horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters and the EUT is rotated 360 degrees.

The final level in dB $\mu$ V/m is calculated by taking the reading from the EMI receiver (Level dB $\mu$ V) and adding the correction factors and cable loss factor (dB). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:

30 MHz – 1000 MHz: RBW: 120 kHz

Example:

| Frequency<br>(MHz) | Level<br>(dBμV) | + | Factor<br>(dB) | = | Level<br>(dBμV/m) | - | CISPR Limit<br>(dBμV/m) | = | Delta<br>(dB) |
|--------------------|-----------------|---|----------------|---|-------------------|---|-------------------------|---|---------------|
| 719.0              | 75.0            | + | 32.6           | = | 107.6             | - | 110.0                   | = | -2.4          |

#### 4.4.5 Radiated emission (electrical field 1 GHz - 40 GHz)

##### Description of measurement

Radiated emissions from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

#### 4.5 Discovery of worst case measurement conditions

The tested model is a handheld transmitter and consists of 3 different versions.

|             |                      |
|-------------|----------------------|
| VarioTel 2  | art.-no. 28.205.0901 |
| LumeroTel 2 | art.-no. 28.225.0901 |
| MonoTel 2   | art.-no. 28.245.0901 |

All the versions are technically identical except the following items:

- the boards are similar with differences only in the values of some LED and pushbutton
- different component placement of the PCB in accordance to the schematics / part list
- firmware versions of the microcontrollers

The complete measurement was performed with VarioTel 2, this sample is full equipped and has all options.

## **5 TEST CONDITIONS AND RESULTS**

### **5.1 Conducted emissions**

For test instruments and accessories used see section 6 Part A 4.

#### **5.1.1 Description of the test location**

Test location:               None

**Remarks:**           The measurement is not applicable.

The EuT has no AC mains connections.

mikes

## 5.2 Radiated emission of the fundamental wave

For test instruments and accessories used see section 6 Part CPR 2.

### 5.2.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

### 5.2.2 Photo documentation of the test set-up



**5.2.1 Applicable standard**

According to FCC Part 15C, Section 15.249(a):

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the effective limits.

**5.2.2 Description of Measurement**

The radiated emission of the fundamental wave from the EUT is measured using a tuned receiver and appropriate linear polarized antennas.

Receiver settings:

RBW: 120 kHz

Detector: Quasi peak

**5.2.3 Test result**

Channel 1

| Frequency (MHz) | Level QP (dB $\mu$ V) | Correct. factor (dB) | Corrected level dB( $\mu$ V/m) | Limit dB( $\mu$ V/m) | Delta (dB) |
|-----------------|-----------------------|----------------------|--------------------------------|----------------------|------------|
| 915.30          | 62.8                  | 28.5                 | 91.6                           | 94.0                 | 2.4        |

Channel 2

| Frequency (MHz) | Level QP (dB $\mu$ V) | Correct. factor (dB) | Corrected level dB( $\mu$ V/m) | Limit dB( $\mu$ V/m) | Delta (dB) |
|-----------------|-----------------------|----------------------|--------------------------------|----------------------|------------|
| 918.30          | 63.9                  | 28.8                 | 92.7                           | 94.0                 | 1.3        |

Limit according to FCC Section 15.249(a) for fundamental

| Frequency (MHz) | Field strength of fundamental |                |
|-----------------|-------------------------------|----------------|
|                 | (mV/m)                        | dB( $\mu$ V/m) |
| 902 - 928       | 50                            | 94             |

The requirements are **FULFILLED**.

Remarks:

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### 5.3 Spurious emissions radiated

For test instruments and accessories used see section 6 Part SER 1, SER 2, SER 3.

#### 5.3.1 Description of the test location

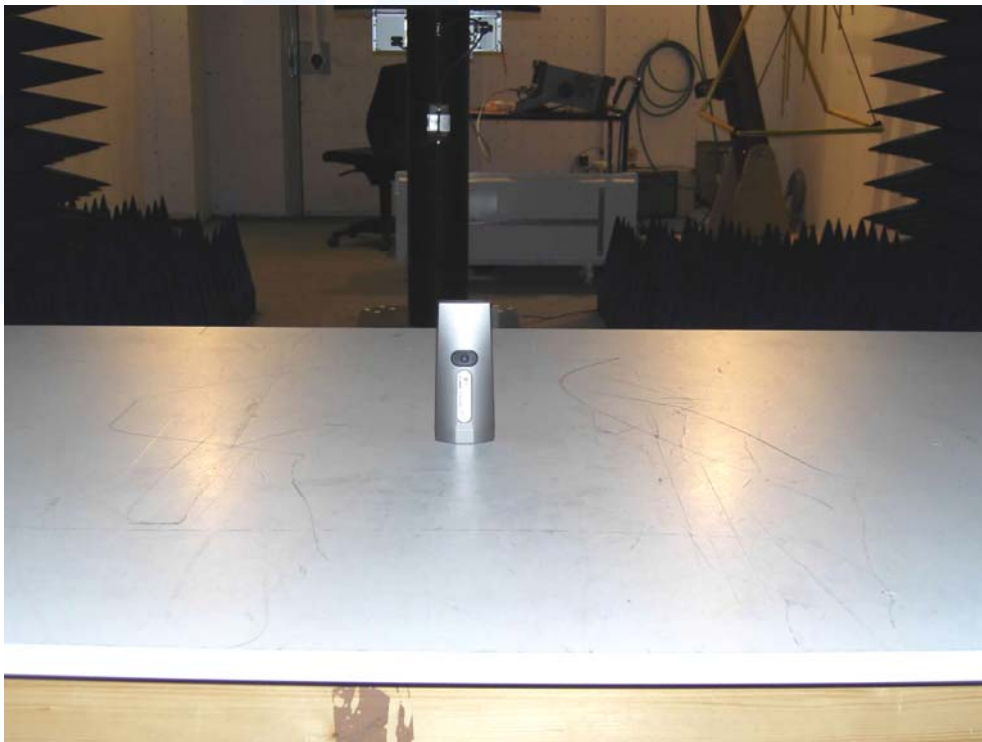
Test location: OATS1  
Test location: Anechoic Chamber A2  
Test distance: 3 metres

#### 5.3.2 Photo documentation of the test set-up





FCC ID: YBU282XX0901



**5.3.3 Applicable standard**

According to FCC Part 15C, Section 15.249(d):

Emission radiated outside of the specified frequency bands, except harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limit in §15.209, whichever is the lesser attenuation.

**5.3.4 Description of Measurement**

The radiated emissions from the EUT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The set up of the EUT will be in accordance to ANSI C63.4. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. If the emission level in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported. During the test, the EUT was set into continuous transmitting mode modulated.

Instrument settings:

|                    |            |         |
|--------------------|------------|---------|
| 9 kHz – 150 kHz    | RBW:       | 200 Hz  |
| 150 kHz - 30 MHz   | RBW:       | 9 kHz   |
| 30 MHz – 1000 MHz: | RBW:       | 120 kHz |
| 1000 MHz – 40 GHz  | RBW = VBW: | 1 MHz   |

**5.3.5 Test result f < 1 GHz**

Channel 1

| Frequency (MHz) | Reading level QP (dBµV) | Reading level AV (dBµV) | Bandwidth (kHz) | Correction factor (dB) | Corrected level QP dB(µV/m) | Corrected level AV dB(µV/m) | Limit dB(µV/m) | Delta (dB) |
|-----------------|-------------------------|-------------------------|-----------------|------------------------|-----------------------------|-----------------------------|----------------|------------|
| 0.009 – 0.15    |                         |                         |                 |                        | < 30                        |                             |                |            |
| 0.15 – 30       |                         |                         |                 |                        | < 30                        |                             |                |            |
| 30 – 1000       |                         |                         |                 |                        | < 30                        |                             |                |            |

Channel 2

| Frequency (MHz) | Reading level QP (dBµV) | Reading level AV (dBµV) | Bandwidth (kHz) | Correction factor (dB) | Corrected level QP dB(µV/m) | Corrected level AV dB(µV/m) | Limit dB(µV/m) | Delta (dB) |
|-----------------|-------------------------|-------------------------|-----------------|------------------------|-----------------------------|-----------------------------|----------------|------------|
| 0.009 – 0.15    |                         |                         |                 |                        | < 30                        |                             |                |            |
| 0.15 – 30       |                         |                         |                 |                        | < 30                        |                             |                |            |
| 30 – 1000       |                         |                         |                 |                        | < 30                        |                             |                |            |

5.3.6 Test result f > 1 GHz

Channel 1

| Frequency (MHz) | Level PK (dBµV) | Duty Cycle Correction (dB) | Level AV (dBµV)* | Correct. Factor (dB) | Corrected Level PK dB(µV/m) | Corrected Level AV dB(µV/m) | Limit PK dB(µV/m) | Limit AV dB(µV/m) | Delta (dB) |
|-----------------|-----------------|----------------------------|------------------|----------------------|-----------------------------|-----------------------------|-------------------|-------------------|------------|
| 1828            | 64.3            | 0                          | 64.3             | -11.4                | 52.9                        | 52.9                        | 74                | 54                | 1.1        |
| 5494            | 44.4            | 0                          | 44.4             | 5.0                  | 39.4                        | 39.4                        | 74                | 54                | 14.6       |

Channel 2

| Frequency (MHz) | Level PK (dBµV) | Duty Cycle Correction (dB) | Level AV (dBµV)* | Correct. Factor (dB) | Corrected Level PK dB(µV/m) | Corrected Level AV dB(µV/m) | Limit PK dB(µV/m) | Limit AV dB(µV/m) | Delta (dB) |
|-----------------|-----------------|----------------------------|------------------|----------------------|-----------------------------|-----------------------------|-------------------|-------------------|------------|
| 1834            | 65.0            | -20                        | -46.3            | -11.2                | 53.8                        | 33.8                        | 74                | 54                | 20.2       |
| 3574            | 52.1            | -20                        | -32.1            | -8.0                 | 44.1                        | 24.1                        | 74                | 54                | 29.9       |
| 5512            | 46.1            | -20                        | -26.1            | 4.9                  | 51.0                        | 31.0                        | 74                | 54                | 23.0       |

\*) Average values were calculated from the subtraction of peak values minus correction duty cycle factor.

Limit according to FCC Part 15C, Section 15.209:

| Frequency (MHz) | 15.209 Limits dB(µV/m) | Measurement distance (m) |
|-----------------|------------------------|--------------------------|
| 0.009 - -0.49   | 2400/f(kHz)            | 300                      |
| 0.49 - 1.705    | 24000/f(kHz)           | 30                       |
| 1.705 - 30.0    | 30                     | 30                       |
| 30-88           | 40                     | 3                        |
| 88-216          | 43,5                   | 3                        |
| 216-960         | 46                     | 3                        |
| Above 960       | 54                     | 3                        |

The requirements are **FULFILLED**.

Remarks: The measurement was performed up to the 10<sup>th</sup> harmonic (10000 MHz).

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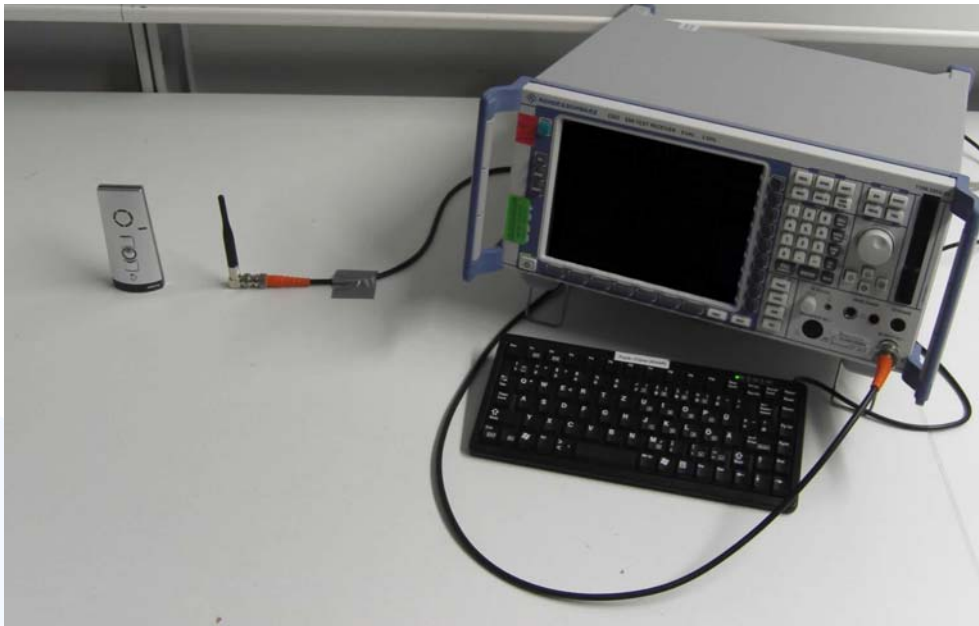
## 5.4 Emission Bandwidth

For test instruments and accessories used see section 6 Part MB.

### 5.4.1 Description of the test location

Test location:                   Shielded Room S4

### 5.4.2 Photo documentation of the test set-up



### 5.4.3 Applicable standard

According to FCC Part 15, Section 15.215(c):

Intentional radiators operating under the provisions to the general emission limits, as contained in Section 15.217 through Section 15.257, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated.

### 5.4.4 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -20 dB. The reference level is the level of the highest signal amplitude observed from the transmitter at the fundamental frequency. Alternative is the x-dB-down function of the analyser used. The EBW is then directly shown in the marker display. The measurement is performed with normal modulation and a transfer rate means the worst case.

Spectrum analyser settings:

|             |        |           |        |       |         |
|-------------|--------|-----------|--------|-------|---------|
| RBW:        | 10 kHz | VBW:      | 30 kHz | Span: | 500 kHz |
| Sweep time: | 5 ms   | Detector: | Peak   |       |         |

**5.4.5 Test result**

| Operating frequency band (MHz) | Channel no. | 20 dB Bandwidth (MHz) |
|--------------------------------|-------------|-----------------------|
| $f_{low} > 902$                | 1           | $f_{low} = 915.240$   |
| $f_{high} < 928$               | 2           | $f_{high} = 918.366$  |

80% bandwidth of the permitted band:

912.4 MHz to 917.6 MHz

Limit according to FCC Part 15C, Section 15.215(c):

The EUT must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band is designated in the rule section under which the equipment is operated. The requirement includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well the frequency stability. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

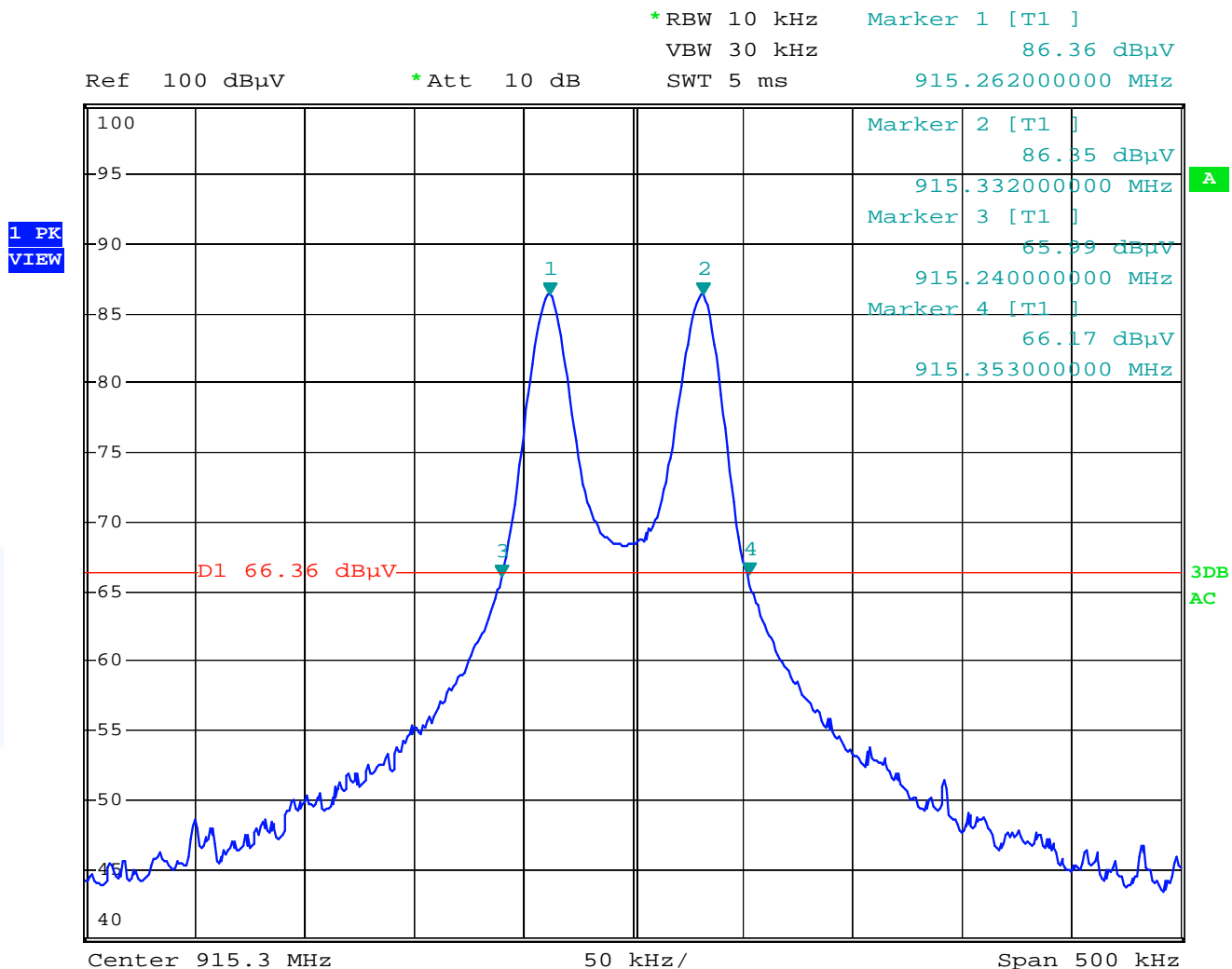
The requirements are **FULFILLED**.

**Remarks:** For detailed results, please see the test protocol below.

For the bandwidth there is no limit defined in Part 15.249. This measurement is informative only.

5.4.6 Test protocol - Channel 1

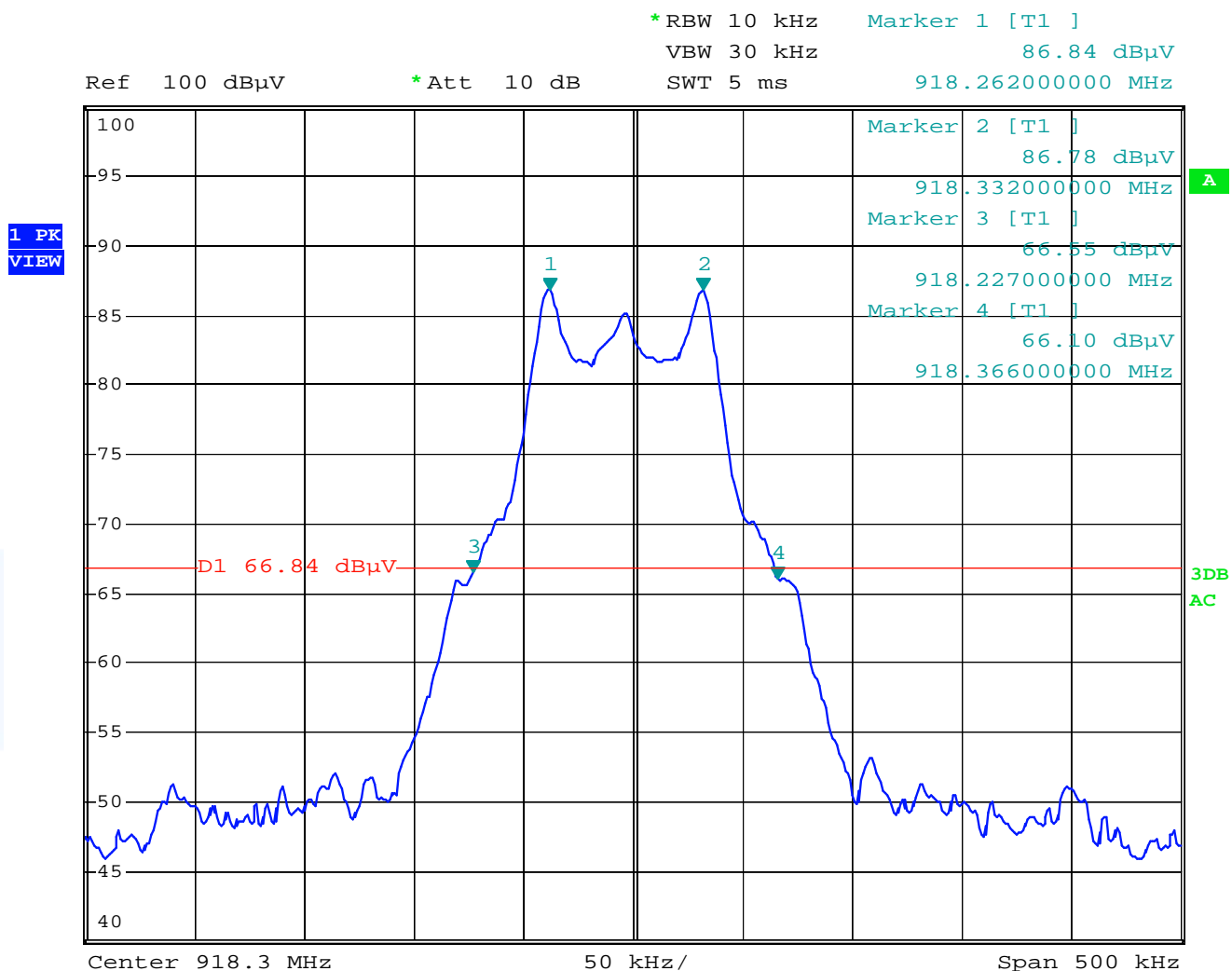
Center frequency: 915.300 MHz





5.4.7 Test protocol - Channel 2

Center frequency: 918.300 MHz



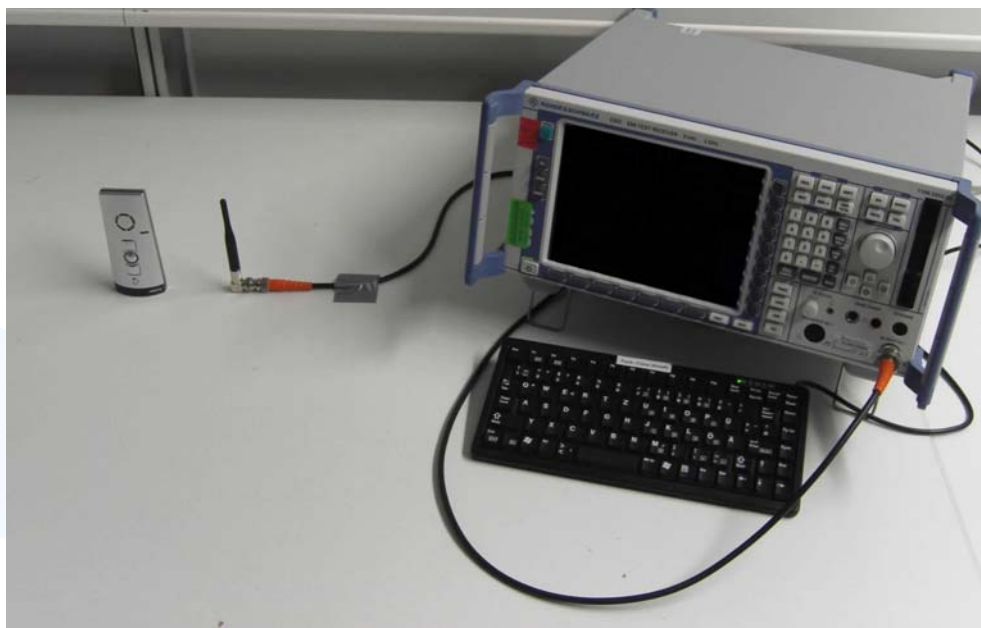
## 5.5 Band edge test

For test instruments and accessories used see section 6 Part MB.

### 5.5.1 Description of the test location

Test location:               Shielded Room S4

### 5.5.2 Photo documentation of the test set-up



### 5.5.3 Description of Measurement

The EuT was connected to the spectrum analyzer with a suitable attenuator. The span of the spectrum analyzer was set wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation. The highest amplitude appearing on spectral display was measured and it was set as the reference level for the emission mask.

It was allowed the trace to stabilize and after then it was set the emission mask on the reference level to show the compliance with the bandedge requirements.

Further settings on the spectrum analyzer:

|                    |                        |
|--------------------|------------------------|
| RBW:               | $\geq 1\%$ of the span |
| VBW:               | $\geq$ RBW             |
| Sweep:             | Auto                   |
| Detector function: | Peak                   |

**5.5.4 Test result**

Channel 1

| Frequency [MHz] | Peak Power Output [dBμV] | Spurious emission read value [dBμV] | Result of Band edge [dBc] | Band edge LIMIT [dBc] |
|-----------------|--------------------------|-------------------------------------|---------------------------|-----------------------|
| < 902,0         | 111.6                    | 52.1                                | 59.5                      | >50                   |
| > 928,0         | 111.7                    | 54.3                                | 57.4                      | >50                   |

Channel 2

| Frequency [MHz] | Peak Power Output [dBμV] | Spurious emission read value [dBμV] | Result of Band edge [dBc] | Band edge LIMIT [dBc] |
|-----------------|--------------------------|-------------------------------------|---------------------------|-----------------------|
| < 902,0         | 111.3                    | 53.1                                | 58.2                      | >50                   |
| > 928,0         | 112.0                    | 51.9                                | 60.1                      | >50                   |

Peak-Limit according to FCC Subpart 15.249(d)

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

The requirements are **FULFILLED**.

**Remarks:** For detailed test result please refer to following test protocol.

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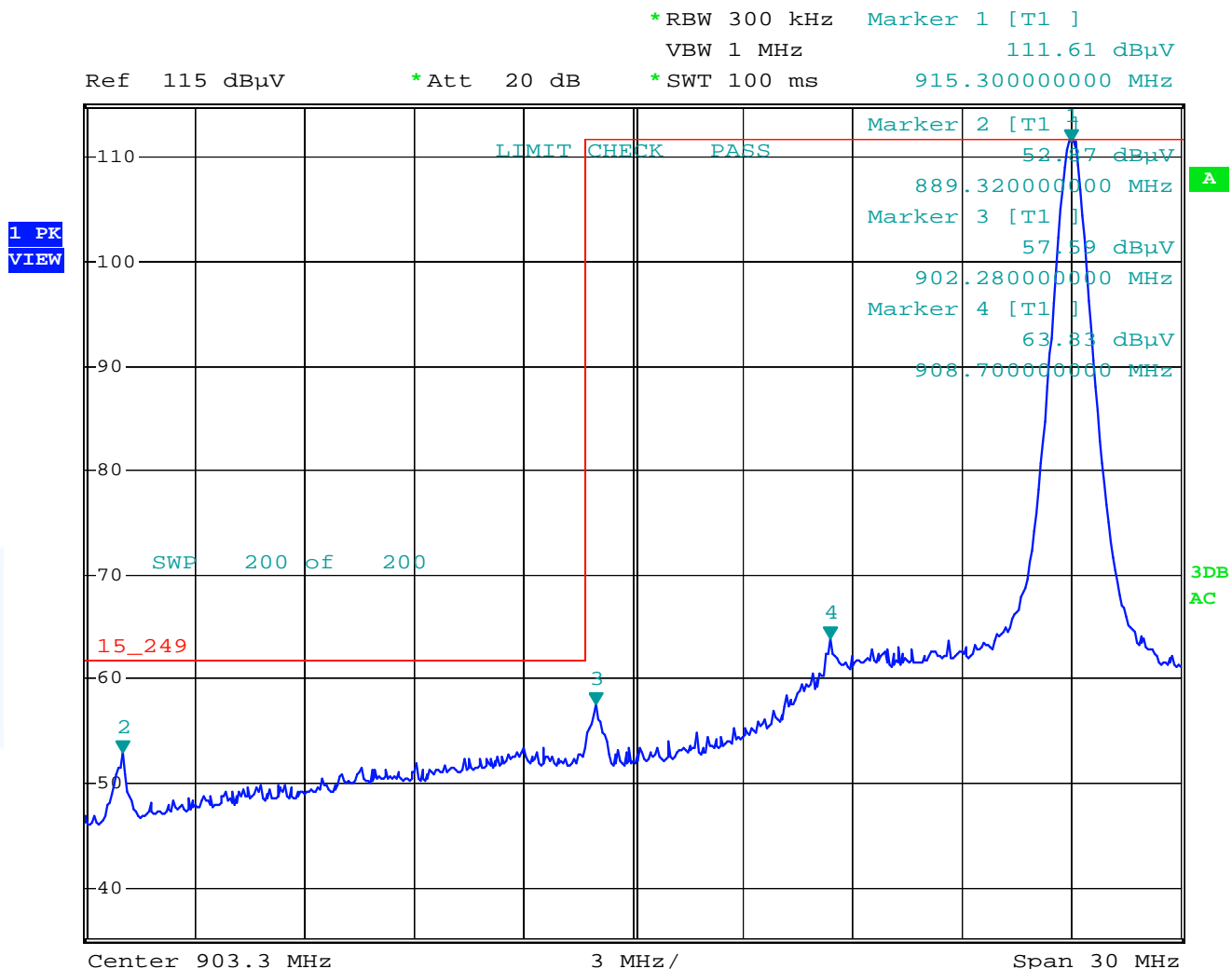
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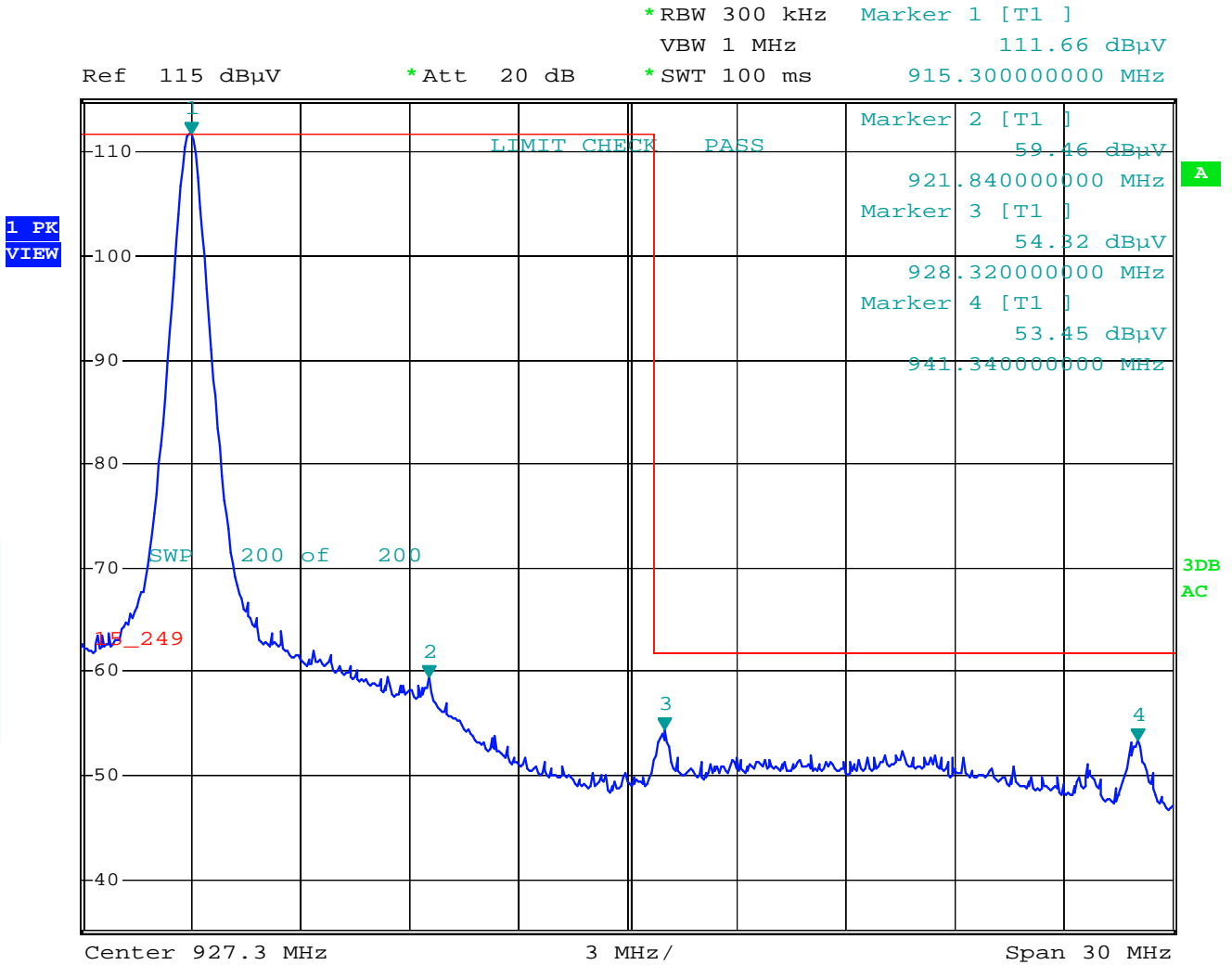
---

5.5.5 Test protocol - Channel 1

Lower band edge – 902 MHz

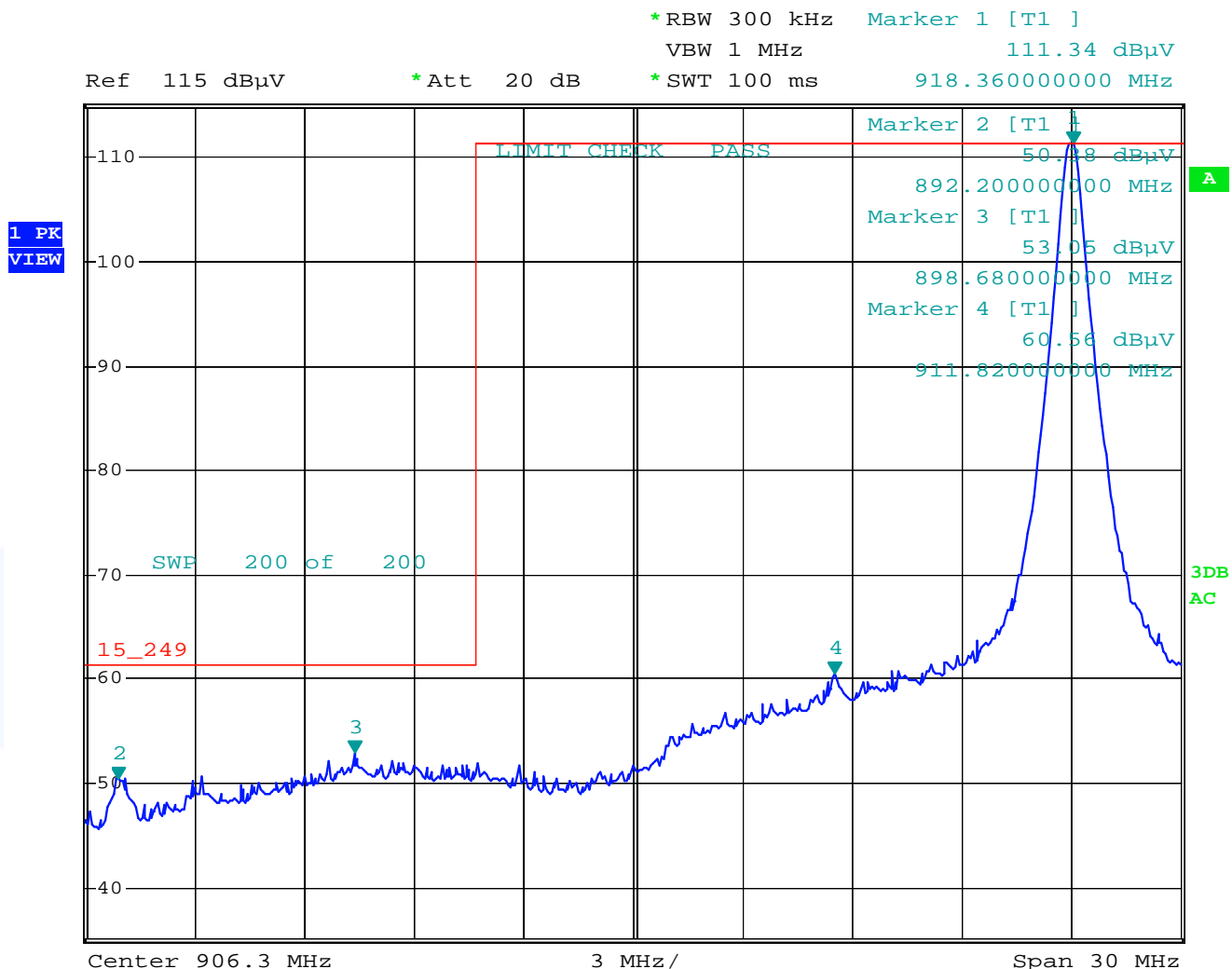


Higher band edge – 928 MHz



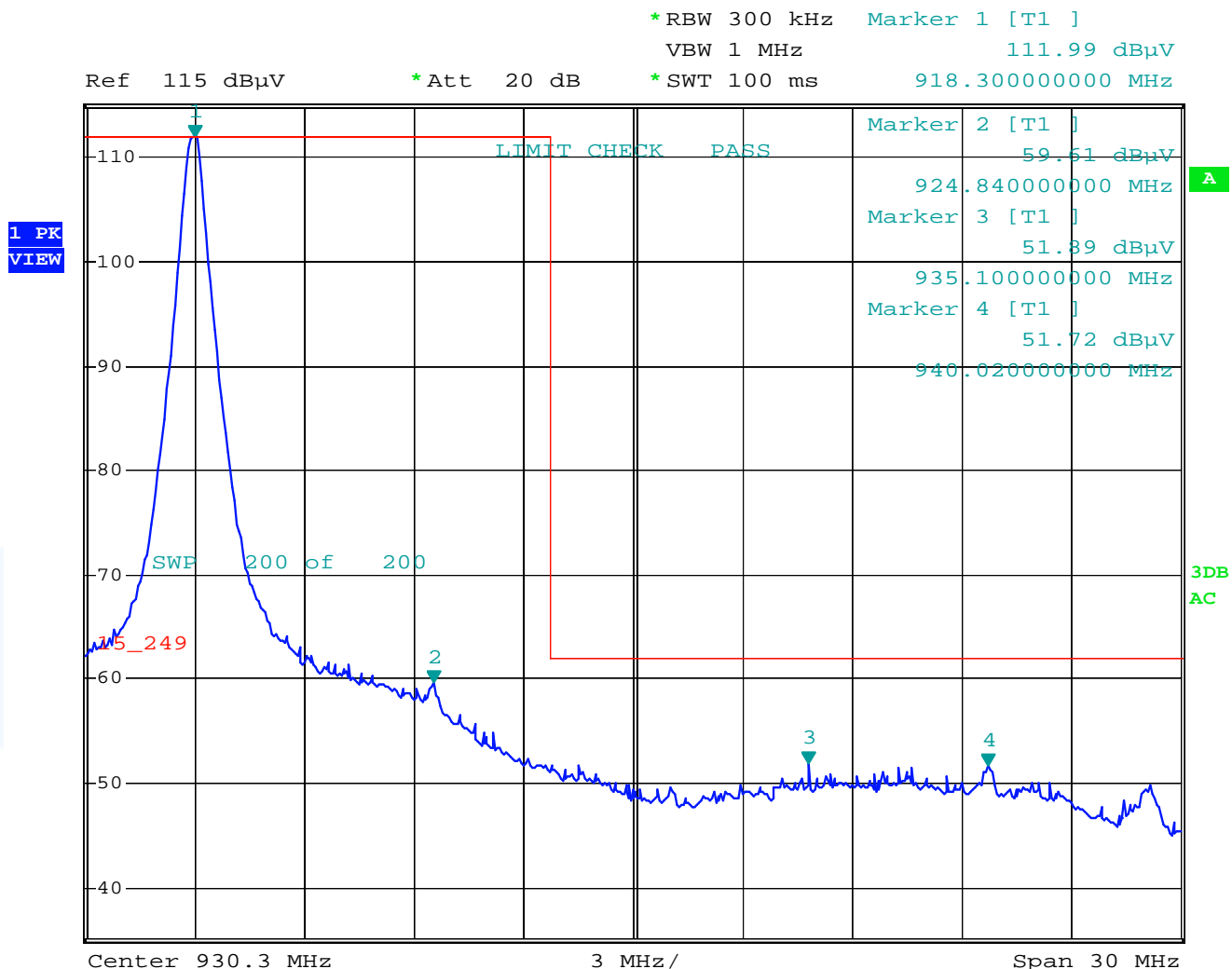
5.5.6 Test protocol - Channel 2

Lower band edge – 902 MHz





Higher band edge – 928 MHz



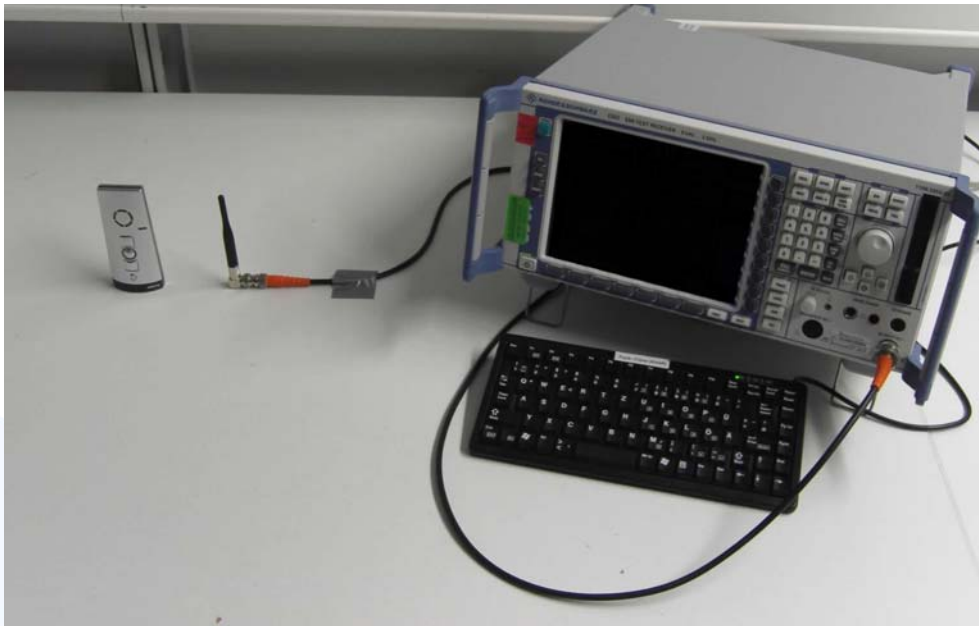
## 5.6 Correction for pulse operation (duty cycle)

For test instruments and accessories used see section 6 Part DC.

### 5.6.1 Description of the test location

Test location:                   Shielded Room S4

### 5.6.2 Photo documentation of the test set-up



### 5.6.3 Applicable standard

According to FCC Part 15A, Section 15.35(c):

When the radiated emission limits are expressed in terms of average value and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete puls train, including blanking intervals, as long as the pulse train does not exceed 0.1s. in cases where the puls train exceeds 0.1s, the measured field strength shall be determined from the average absolute voltage during a 0.1s interval during which the field strength is at its maximum. The exact method of calculating the average field strength shall be submitted.

### 5.6.4 Description of Measurement

The duty cycle factor (dB) is calculated applying the following formula:

$$KE = 20 \log (t_B/T_B)$$

|                        |                                   |      |
|------------------------|-----------------------------------|------|
| <i>KE</i> :            | pulse operation correction factor | (dB) |
| <i>t<sub>B</sub></i> : | pulse duration for one pulse      | (µs) |
| <i>T<sub>B</sub></i> : | a period of one pulse             | (ms) |

**5.6.5 Test result**

Channel 1

| $t_B$<br>(ms) | $T_B$<br>(ms) | $KE$<br>(dB/%) |
|---------------|---------------|----------------|
| 100           | 100           | 0.0            |

Channel 2

| $t_B$<br>(ms) | $T_B$<br>(ms) | $KE$<br>(dB/%) |
|---------------|---------------|----------------|
| 100           | 4.4           | 27.1           |

**Remarks:** The pulse train ( $T_w$ ) exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulse widths over the 100 ms width with the highest average value.

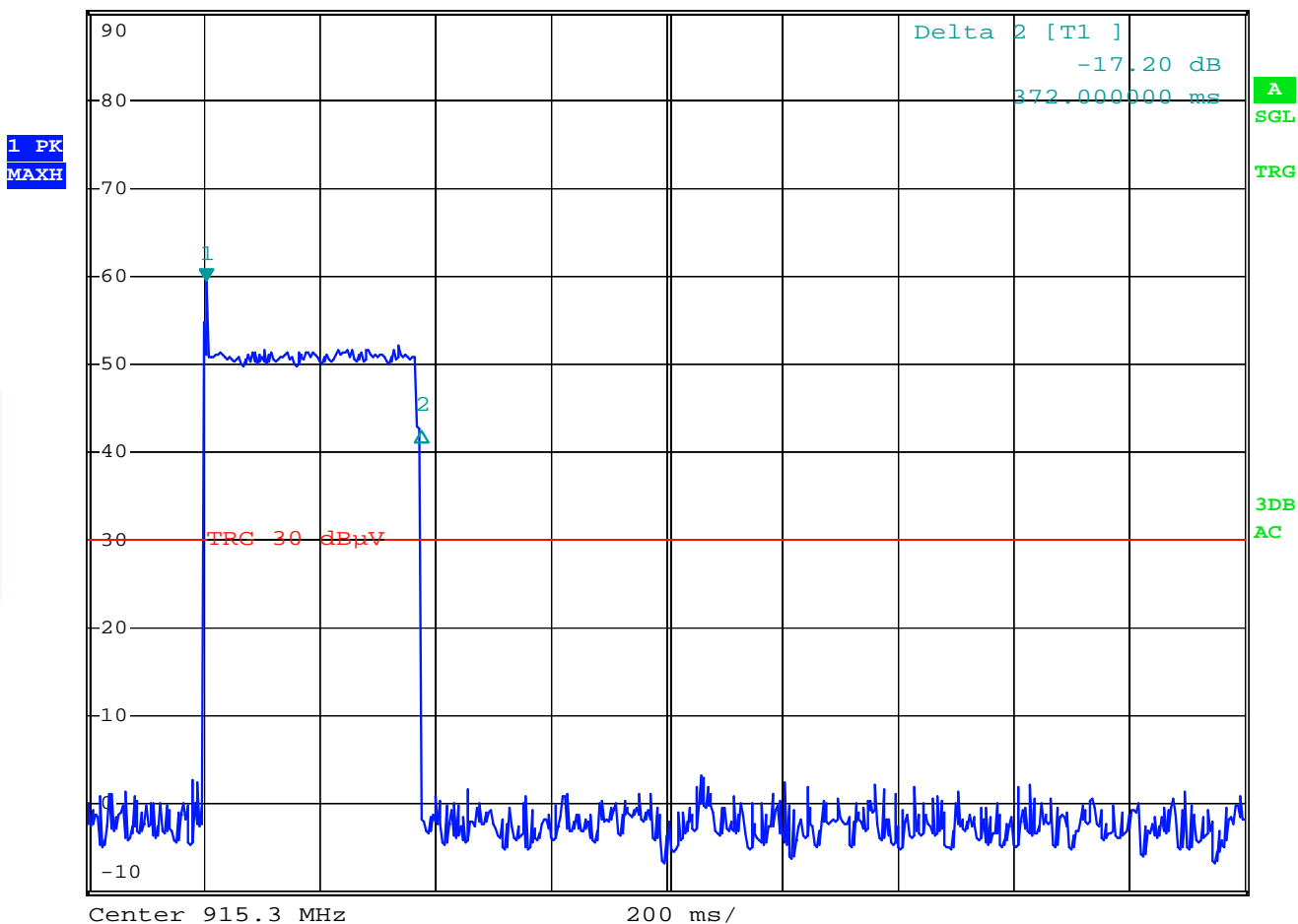
For detailed results, please see the test protocol below.

The maximal duty cycle correction for channel 2 is 20 dB.

5.6.6 Test protocol

**Correction for pulse operation**  
FCC Part 15C, Section 15.35(c)  
Channel 1  
(one transmission)

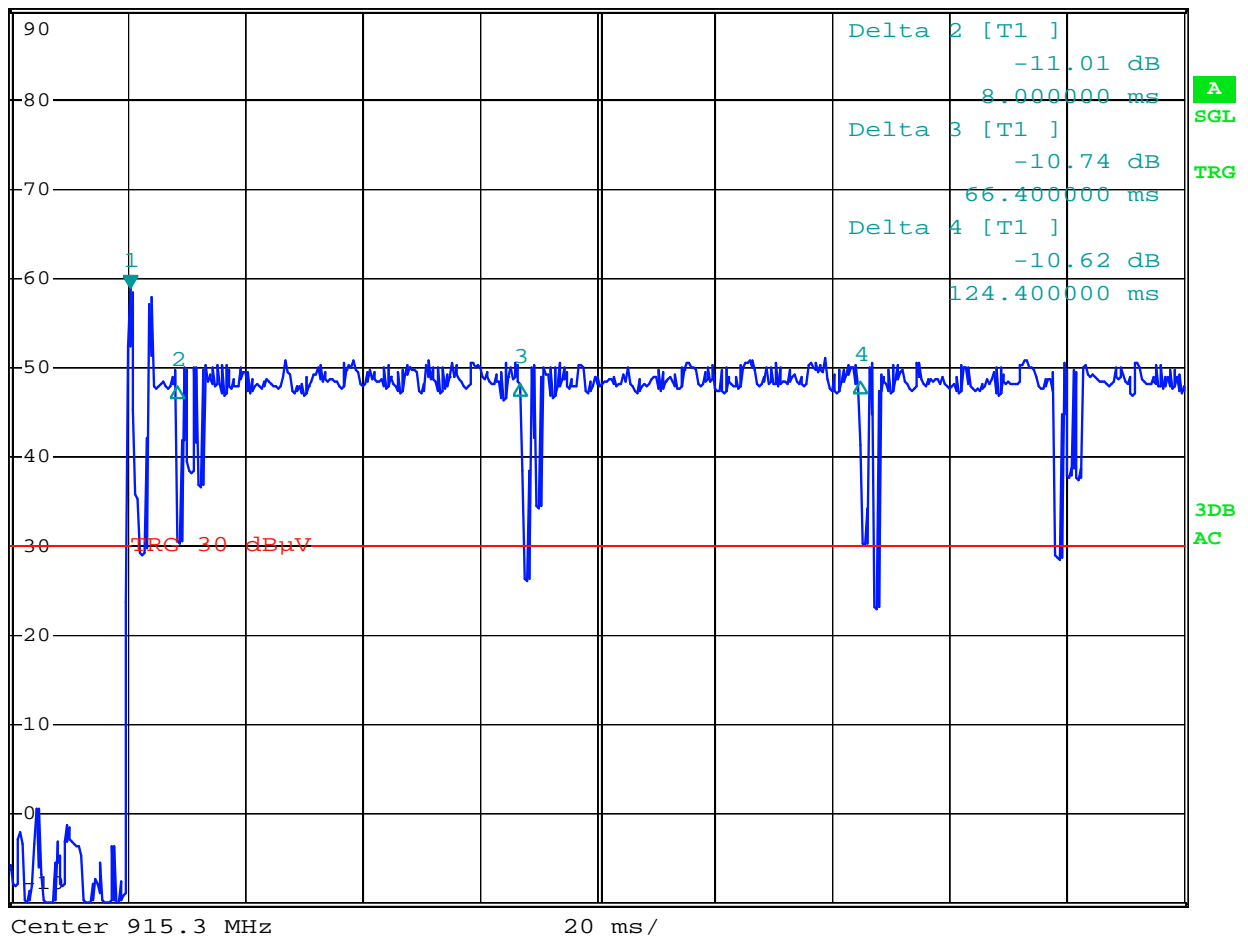
Ref 90 dB $\mu$ V      \*Att 10 dB      RBW 1 kHz      Marker 1 [T1]      59.52 dB $\mu$ V  
SWT 2 s      4.000000 ms



**Correction for pulse operation**  
FCC Part 15C, Section 15.35(c)  
Channel 1  
(zoom in)

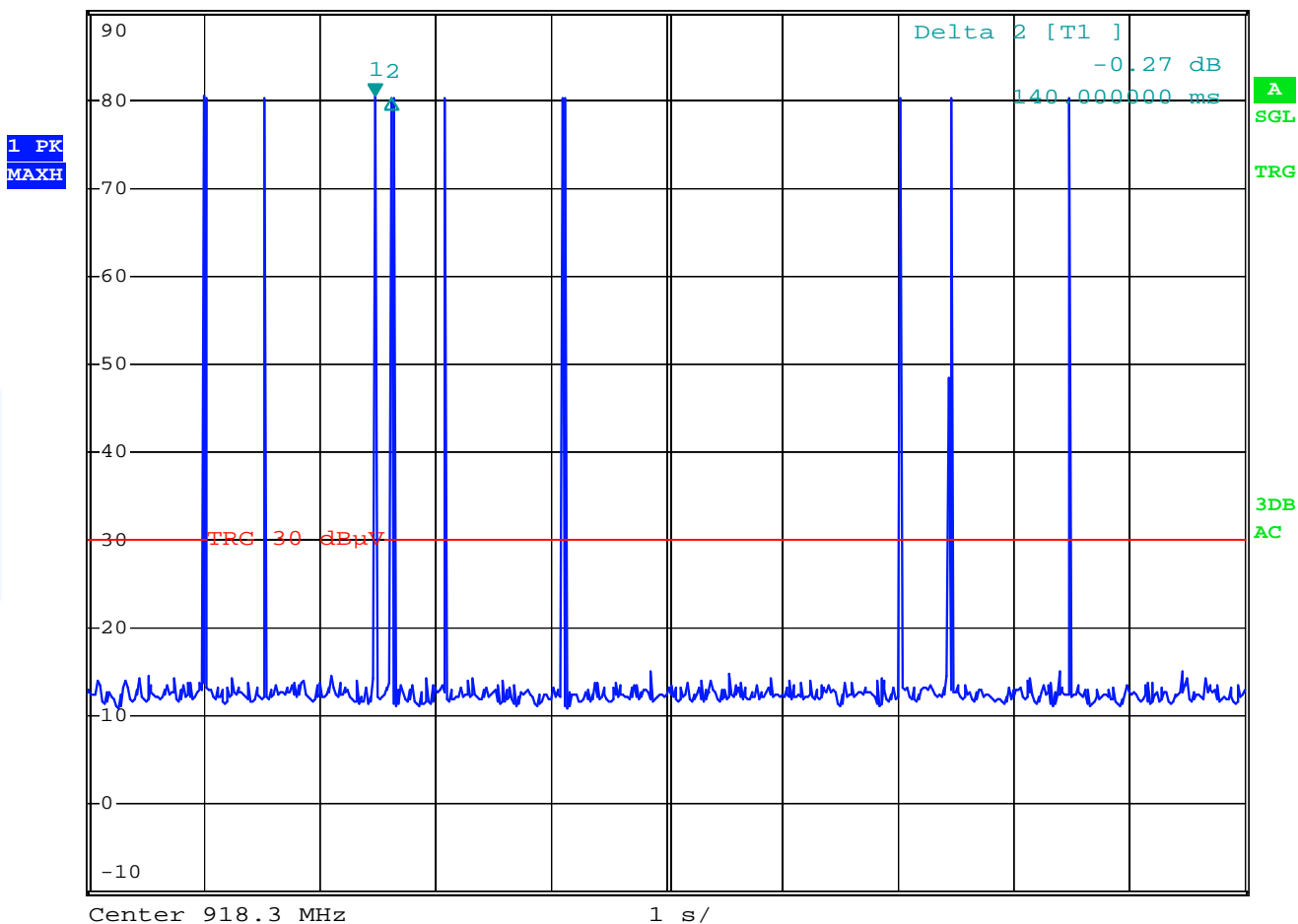
Ref 90 dB $\mu$ V      \*Att 10 dB      RBW 1 kHz      Marker 1 [T1 ]  
 VBW 3 kHz      59.00 dB $\mu$ V  
 SWT 200 ms      400.000000  $\mu$ s

1 PK  
MAXH



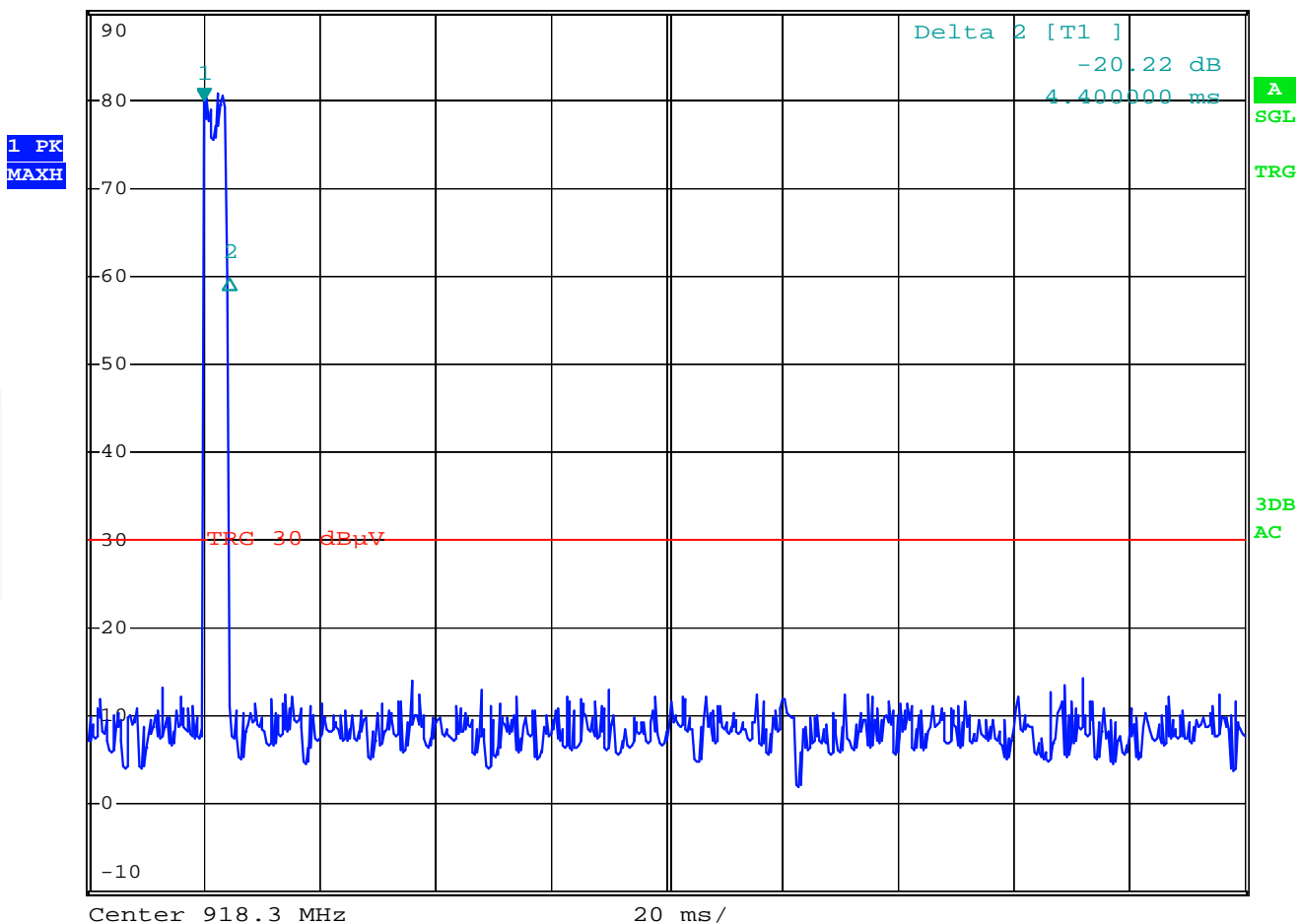
**Correction for pulse operation**  
FCC Part 15C, Section 15.35(c)  
Channel 2  
(minimum repetition rate between two peaks)

Ref 90 dB $\mu$ V      \*Att 10 dB      RBW 10 kHz      Marker 1 [T1 ]  
 VBW 30 kHz      80.30 dB $\mu$ V  
 SWT 10 s      1.480000 s



**Correction for pulse operation**  
FCC Part 15C, Section 15.35(c)  
Channel 2  
(peak zoom)

Ref 90 dB $\mu$ V      \*Att 10 dB      RBW 10 kHz      Marker 1 [T1 ]  
 VBW 30 kHz      79.92 dB $\mu$ V  
 SWT 200 ms      760.635587  $\mu$ s





## 5.7 Antenna application

### 5.7.1 Applicable standard

According to FCC Part 15C, Section 15.203(a):

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

The EUT's antenna meets the requirement of FCC Part 15 C, Section 15.203 and 15.204.

### 5.7.2 Result

The EUT used a dipole antenna and is printed on the PCB and no other antenna than that furnished by the responsible party are be used with the device.

mikes

## 5.8 Receiver radiated emissions

For test instruments and accessories used see section 6 Part SER1, SER2 and SER3.

### 5.8.1 Description of the test location

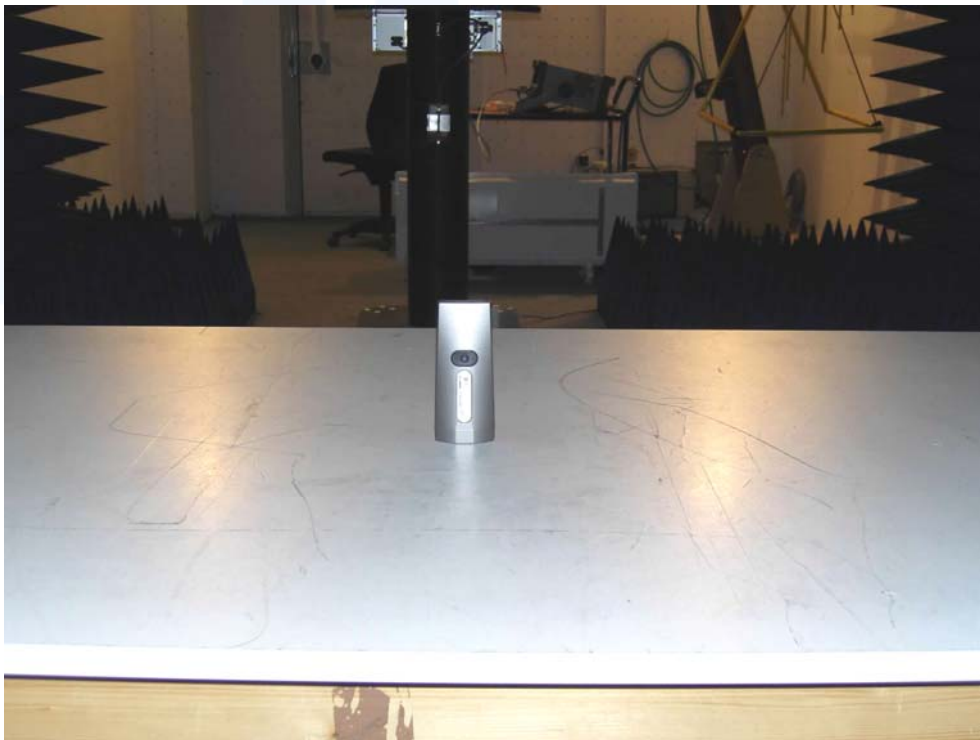
Test location: OATS1  
Test location: Anechoic Chamber A2

Test distance: 3 metres

### 5.8.2 Photo documentation of the test set-up



FCC ID: YBU282XX0901



### 5.8.3 Applicable standard

According to FCC Part 15C, Section 15.209(a):

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 m shall not exceed the given limit.

**5.8.4 Description of Measurement**

The radiated emissions from the EUT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. The set up of the EUT will be in accordance to ANSI C63.4. If the emission level in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported. During the test, the EUT was set into continuous transmitting mode modulated.

Instrument settings:

|                    |            |         |
|--------------------|------------|---------|
| 9 kHz – 150 kHz    | RBW:       | 200 Hz  |
| 150 kHz - 30 MHz   | RBW:       | 9 kHz   |
| 30 MHz – 1000 MHz: | RBW:       | 120 kHz |
| 1000 MHz – 40 GHz  | RBW = VBW: | 1 MHz   |

**5.8.5 Test result f < 1 GHz**

Channel 1 / Channel 2

| Frequency (MHz) | Reading level QP (dBµV) | Reading level AV (dBµV) | Bandwidth (kHz) | Correction factor (dB) | Corrected level QP dB(µV/m) | Corrected level AV dB(µV/m) | Limit dB(µV/m) | Delta (dB) |
|-----------------|-------------------------|-------------------------|-----------------|------------------------|-----------------------------|-----------------------------|----------------|------------|
| 0.009 – 0.15    |                         |                         |                 |                        | < 30                        |                             |                |            |
| 0.15 – 30       |                         |                         |                 |                        | < 30                        |                             |                |            |
| 30 – 1000       |                         |                         |                 |                        | < 30                        |                             |                |            |

**5.8.6 Test result f >1 GHz**

Channel 1 / Channel 2

| Frequency (MHz) | Level PK (dBµV) | Duty Cycle Correction (dB) | Level AV (dBµV)* | Correct. Factor (dB) | Corrected Level PK dB(µV/m) | Corrected Level AV dB(µV/m) | Limit PK dB(µV/m) | Limit AV dB(µV/m) | Delta (dB) |
|-----------------|-----------------|----------------------------|------------------|----------------------|-----------------------------|-----------------------------|-------------------|-------------------|------------|
| 1000 – 5000     |                 |                            |                  |                      |                             | < 40                        |                   |                   |            |

Limit according to FCC Part 15C, Section 15.209:

| Frequency (MHz) | 15.209 Limits dB(µV/m) | Measurement distance (m) |
|-----------------|------------------------|--------------------------|
| 0.009 - -0.49   | 2400/f(kHz)            | 300                      |
| 0.49 – 1.705    | 24000/f(kHz)           | 30                       |
| 1.705 – 30.0    | 30                     | 30                       |
| 30-88           | 40                     | 3                        |
| 88-216          | 43,5                   | 3                        |
| 216-960         | 46                     | 3                        |
| Above 960       | 54                     | 3                        |

The requirements are **FULFILLED**.

**Remarks:** During the test, the EUT was set into continuous receiving mode.

The measurement was performed up to the 5<sup>th</sup> harmonic (5000 MHz).

## 6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

| Test ID | Model Type             | Equipment No.   | Next Calib. | Last Calib. | Next Verif. | Last Verif. |
|---------|------------------------|-----------------|-------------|-------------|-------------|-------------|
| CPR 2   | ESVS 30                | 02-02/03-05-006 | 08/05/2010  | 08/05/2009  |             |             |
|         | VULB 9168              | 02-02/24-05-005 | 05/06/2011  | 05/06/2008  | 10/01/2010  | 04/01/2010  |
|         | S10162-B               | 02-02/50-05-031 |             |             |             |             |
|         | KK-EF393-21N-16        | 02-02/50-05-033 |             |             |             |             |
|         | NW-2000-NB             | 02-02/50-05-113 |             |             |             |             |
| DC      | ESCI                   | 02-02/03-05-005 | 11/10/2010  | 11/10/2009  |             |             |
|         | RF Antenna             | 02-02/24-05-032 |             |             |             |             |
| MB      | ESCI                   | 02-02/03-05-005 | 11/10/2010  | 11/10/2009  |             |             |
|         | RF Antenna             | 02-02/24-05-032 |             |             |             |             |
| SER 1   | FMZB 1516              | 01-02/24-01-018 |             |             | 02/15/2011  | 02/15/2010  |
|         | ESCI                   | 02-02/03-05-005 | 11/10/2010  | 11/10/2009  |             |             |
|         | S10162-B               | 02-02/50-05-031 |             |             |             |             |
|         | KK-EF393-21N-16        | 02-02/50-05-033 |             |             |             |             |
|         | NW-2000-NB             | 02-02/50-05-113 |             |             |             |             |
| SER 2   | ESVS 30                | 02-02/03-05-006 | 08/05/2010  | 08/05/2009  |             |             |
|         | VULB 9168              | 02-02/24-05-005 | 05/06/2011  | 05/06/2008  | 10/01/2010  | 04/01/2010  |
|         | S10162-B               | 02-02/50-05-031 |             |             |             |             |
|         | KK-EF393-21N-16        | 02-02/50-05-033 |             |             |             |             |
|         | NW-2000-NB             | 02-02/50-05-113 |             |             |             |             |
| SER 3   | FSP 30                 | 02-02/11-05-001 | 04/20/2010  | 04/20/2009  |             |             |
|         | AFS4-01000400-10-10P-4 | 02-02/17-05-003 |             |             |             |             |
|         | AMF-4F-04001200-15-10P | 02-02/17-05-004 |             |             |             |             |
|         | AFS5-12001800-18-10P-6 | 02-02/17-06-002 |             |             |             |             |
|         | 3117                   | 02-02/24-05-009 | 02/10/2011  | 02/10/2010  |             |             |
|         | Sucoflex N-1600-SMA    | 02-02/50-05-073 |             |             |             |             |
|         | Sucoflex N-2000-SMA    | 02-02/50-05-075 |             |             |             |             |