


# Poročilo o preskusu / Test Report

Št. / No.:

T251-0047/14

Datum / Date:

2014-01-21

<b>Proizvod / Product</b> Ventilation system Type: MIKrovent Model: MIKRO 100 SEE PAGE 3	<b>Listov / Pages</b> 59
<b>Naročnik / Applicant</b> EMSISO d.o.o. Zagrebška 20, SI-2000 Maribor, Slovenia	<b>Vrsta preskusa / Test procedure</b> EMC
<b>Proizvajalec / Manufacturer</b> MIK d.o.o. Celjska cesta 55, 3212 Vojnik, Slovenia	<b>Št. merjencev / No. of items tested</b> 1
<b>Blagovna znamka / Trade Mark</b> 	<b>Mapa predmeta št. / Subject file No.</b> C20140088
<b>Standardi - predpisi / Standards - regulations</b> EN 55014-1:2006+A1:2009+A2:2011, EN 55014-2:1997+A1:2001+A2:2008, EN 61000-3-2:2006+A1:2009+A2:2009, EN 61000-3-3:2008	<b>Kraj preskusa / Place of test</b> SIQ, EMC lab., Trpinčeva ul.39, 1000 Ljubljana, SLOVENIA
	<b>Opomba / Remark</b> /

## Zaključek / Conclusion

Preskušani proizvod ustreza zahtevam navedenih standardov. / Tested product complies with the requirements of stated standards.

Rezultati preskusov se nanašajo samo na preskušani vzorec. / The test results relate only to the item tested.

Datum prispetja vzorca / Date of receipt of test item: 2014-01-16

Datum izvedbe preskusov / Date of performance of tests: 2014-01-16

Testni laboratorij je akreditiran pri Slovenski Akreditaciji, Reg. Št.:LP-009 /  
Testing laboratory is accredited by Slovenian Accreditation, Reg. No.LP-009

Odgovoren za preskušanje / Responsible for the test

Damjan Repar  


Vodja področja / Department Manager

Marjan Mak  


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Tržaška cesta 2, SI-1000 Ljubljana, Slovenia • t: +386 01 4778 100 • f: +386 01 4778 444 • e: info@siq.si • http://www.siq.si  
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<b>CONTENTS</b>	<b>page</b>
<b><u>1. GENERAL</u></b>	<b><u>3</u></b>
1.1 EQUIPMENT UNDER TEST	3
<b><u>2. TEST SUMMARY</u></b>	<b><u>4</u></b>
2.1 PURPOSE OF THE TEST	4
2.2 PERFORMANCE CRITERIA	4
<b><u>3. EMISSION TESTS</u></b>	<b><u>5</u></b>
3.1 CONDUCTED EMISSION MEASUREMENT	5
3.2 RADIATED EMISSION MEASUREMENT	24
3.3 HARMONIC CURRENT TEST	35
3.4 VOLTAGE FLUCTUATION MEASUREMENT	35
<b><u>4. IMMUNITY</u></b>	<b><u>36</u></b>
4.1 GENERAL DESCRIPTION	36
4.2 IMMUNITY TO ELECTROSTATIC DISCHARGE	37
4.3 RADIATED ELECTROMAGNETIC FIELD IMMUNITY TEST (RS)	46
4.4 ELECTRICAL FAST TRANSIENT/BURST IMMUNITY TEST	50
4.5 SURGE IMMUNITY TEST	53
4.6 IMMUNITY TO CONDUCTED DISTURBANCES INDUCED BY RF FIELDS (CS)	55
4.7 VOLTAGE DIPS AND SHORT INTERRUPTIONS IMMUNITY TEST (DIP)	58

## 1. GENERAL

Equipment under test was tested according to EMC standards for household appliances.  
Test results are valid only for the tested device.

### 1.1 Equipment under test

#### Ventilation system

**Type:** MIKrovent

**Model:** MIKRO 100

**NOTE:** MIKrovent models MIKRO 100, MIKRO 123, MIKRO 148, MIKRO 300 are local ventilation systems. Difference between these stated models is only in length of recuperator and outer length of product. All models use same electronic and same power supply.

Power supply: 230V, 50Hz, 180mA

Power supply used for testing: 230V  $\pm$  10 %, 50Hz

Protective class: I.

Highest internal clock frequency: 16 MHz

**Critical component:** Ferrite, type: WE 742 7113



Picture of label

## 2. TEST SUMMARY

STANDARDS	Tested		Samples	
	yes	no	pass	not pass
<b>EN 55014-1</b> Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>EN 55014-2</b> Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 2: Immunity - Product family standard	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>EN 61000-3-2</b> Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for current emissions (equipment input current up to and including 16A per phase)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>EN 61000-3-3</b> Electromagnetic compatibility (EMC) – Part 3-3: Limits – limitation of voltage fluctuations and flicker in public low-voltage supply systems for equipment with rated current up to 16A	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### 2.1 Purpose of the test

To determine whether the equipment under test fulfils the EMC requirements of the standards stated above.

### 2.2 Performance criteria

The performance criteria are based on the general criteria of the standard and specified by the manufacturer.

Criterion A: No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer when the equipment is used as intended.

Criterion B: The EUT shall continue to operate as intended after the test. During the test, degradation of performance is allowed however.

Criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by power on/off.

### 3. EMISSION TESTS

#### 3.1 Conducted emission measurement

##### 3.1.1 Limits of conducted emission measurement

Frequency (MHz)	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 – 0.5	66 – 56	59 – 46
0.50 – 5.0	56	46
5.0 – 30.0	60	50

**NOTE:** • The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

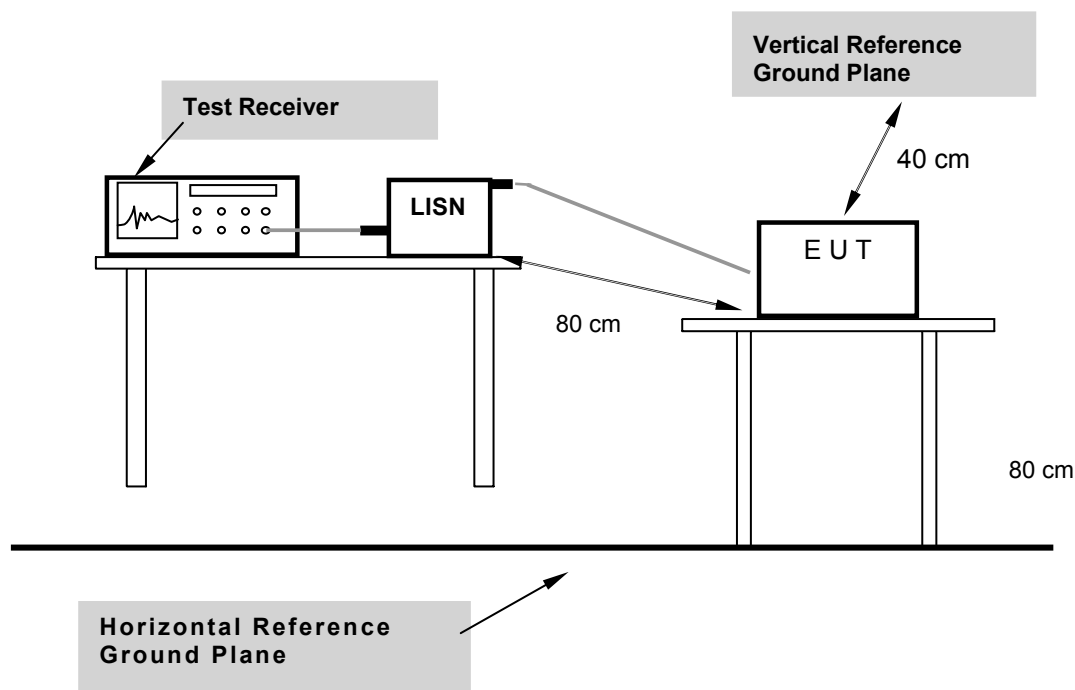
##### 3.1.2 Test instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SIQ NO.	USED	CALIBRATED UNTIL
Rohde & Schwarz, RFI test receiver	ESU8	105187	X	2015-04
Rohde & Schwarz, Artificial main network	ESH 2-Z5	106899	X	2014-12

##### 3.1.3 Test procedure

- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 Ohm/ 50 $\mu$ H of coupling impedance for the measuring instrument.
- Both lines of the AC connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.

### 3.1.4 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

### 3.1.5 Test results

<b>EUT:</b>	MIKrovent	<b>Model:</b>	MIKRO 100
<b>Mode:</b>	BLOW IN, BLOW OUT		
<b>Input voltage:</b>	207V, 50Hz; 230V, 50Hz; 253V, 50Hz	<b>Date:</b>	2014-01-16
<b>Environmental conditions:</b>	22±5°C, 55±30% RH	<b>Tested by: Damjan Repar</b>	

**NOTE: PASS**

#### MEASUREMENT UNCERTAINTY:

- The measurement uncertainty is calculated in document EN122E

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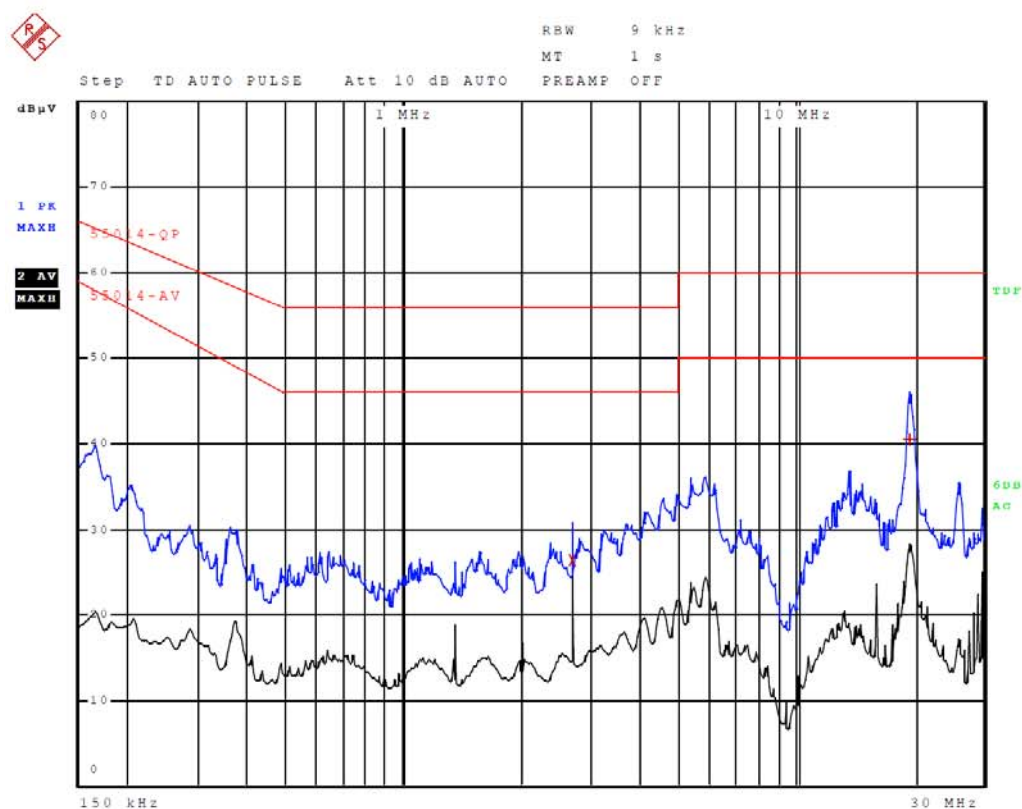
16.Jan 14 09:46

**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 207V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 LINE L

**Time Domain Scan (1 Range)**

Scan Start: 150 kHz  
 Scan Stop: 30 MHz  
 Detector: Trace 1: MAX PEAK Trace 2: Average  
 Transducer: ESH2-Z5

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2



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**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 207V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
LINE L

**Final Measurement**

**Meas Time:** 1 s  
**Margin:** 20 dB  
**Subranges:** 2

Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
1	19.461750000 MHz	40.50	Quasi Peak	-19.50
2	2.692500000 MHz	26.34	Average	-19.66



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16.Jan 14 09:45

**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 207V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 LINE N

**Time Domain Scan (1 Range)**

Scan Start: 150 kHz  
 Scan Stop: 30 MHz  
 Detector: Trace 1: MAX PEAK Trace 2: Average  
 Transducer: ESH2-Z5

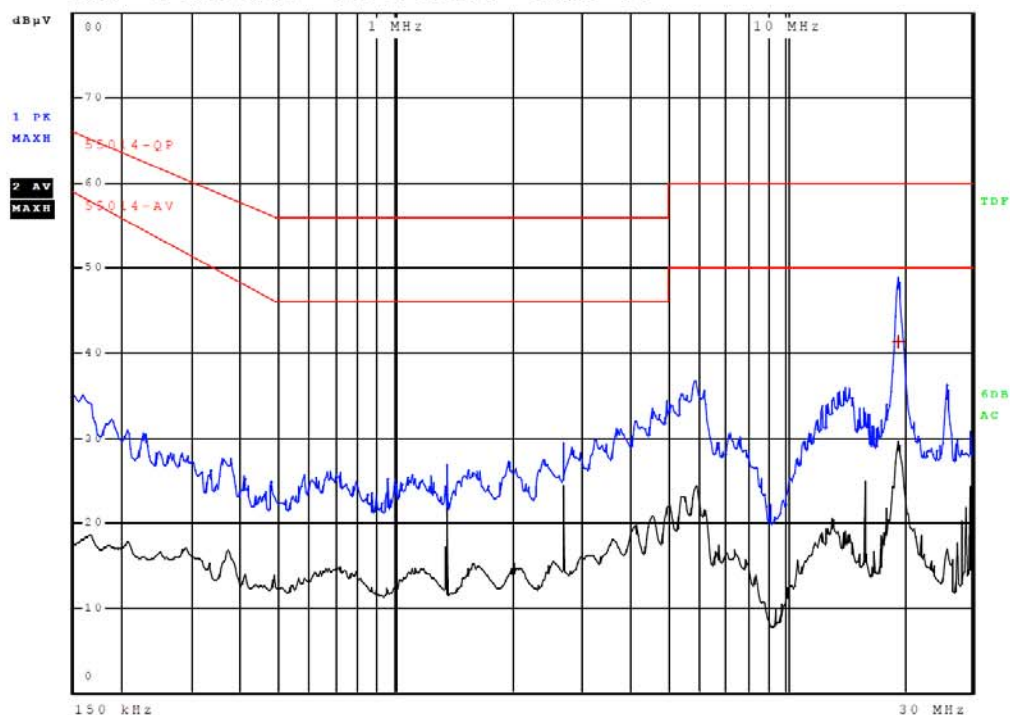
Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2



RBW 9 kHz

MT 1 s

Step TD AUTO PULSE Att 10 dB AUTO PREAMP OFF





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**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 207V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
LINE N

**Final Measurement**

Meas Time: 1 s  
Margin: 20 dB  
Subranges: 1

Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
1	19.468500000 MHz	41.33	Quasi Peak	-18.67



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**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 230V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 LINE L

**Time Domain Scan (1 Range)**

Scan Start: 150 kHz  
 Scan Stop: 30 MHz  
 Detector: Trace 1: MAX PEAK Trace 2: Average  
 Transducer: ESH2-Z5

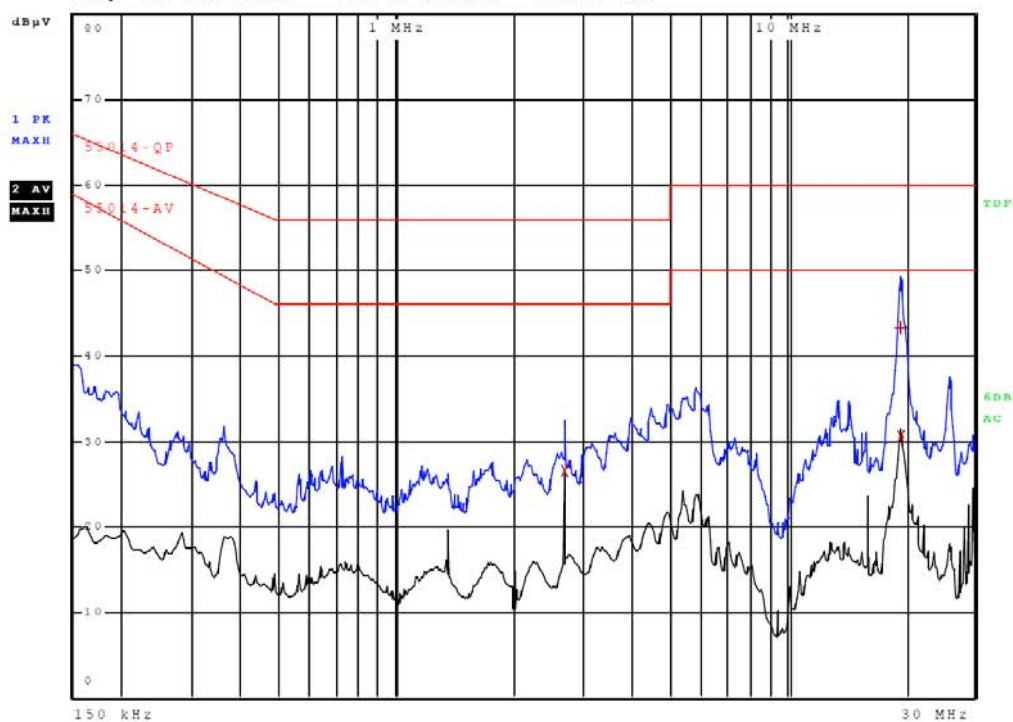
Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2



RBW 9 kHz

MT 1 s

Step TD AUTO PULSE Att 10 dB AUTO PREAMP OFF



**C20140088**

16.Jan 14 09:44

**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 230V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
LINE L

**Final Measurement**

Meas Time: 1 s  
Margin: 20 dB  
Subranges: 3

Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
1	19.491000000 MHz	43.27	Quasi Peak	-16.73
2	19.529250000 MHz	30.53	Average	-19.47
2	2.692500000 MHz	26.41	Average	-19.59

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16.Jan 14 09:41

**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 230V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 LINE N

**Time Domain Scan (1 Range)**

Scan Start: 150 kHz  
 Scan Stop: 30 MHz  
 Detector: Trace 1: MAX PEAK Trace 2: Average  
 Transducer: ESH2-Z5

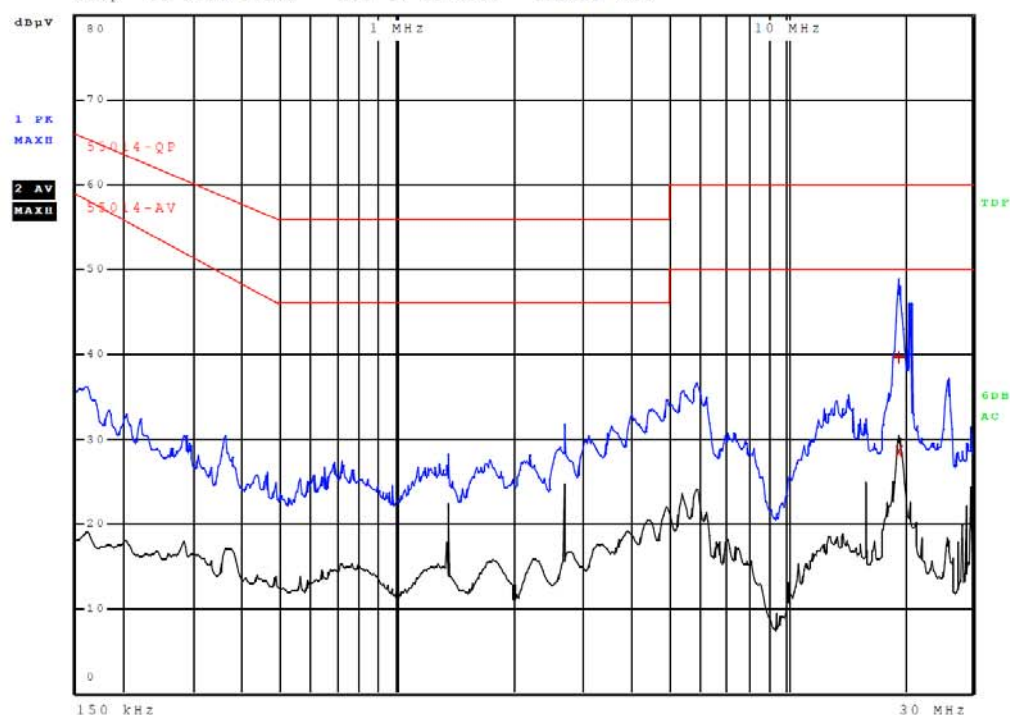
Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2



RBW 9 kHz

MT 1 s

Step TD AUTO PULSE Att 10 dB AUTO PREAMP OFF





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**C20140088**

16.Jan 14 09:41

**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 230V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
LINE N

**Final Measurement**

Meas Time: 1 s  
Margin: 20 dB  
Subranges: 2

Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
1	19.486500000 MHz	39.56	Quasi Peak	-20.44
2	19.529250000 MHz	28.41	Average	-21.59

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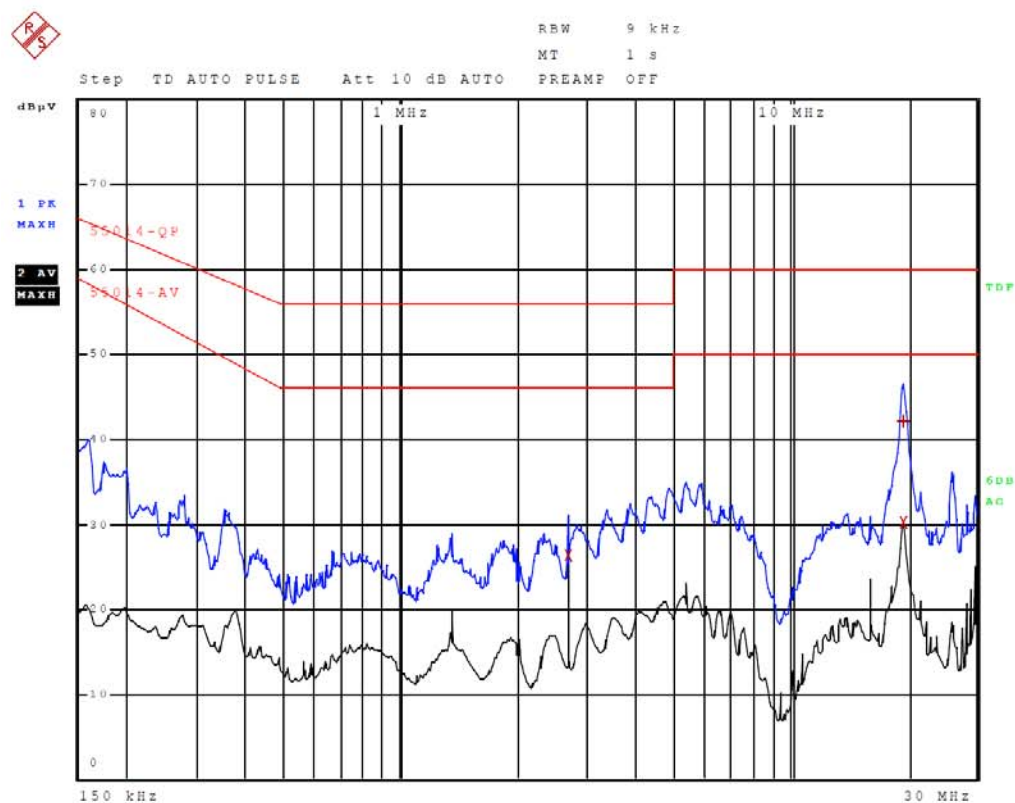
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**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 LINE L

**Time Domain Scan (1 Range)**

Scan Start: 150 kHz  
 Scan Stop: 30 MHz  
 Detector: Trace 1: MAX PEAK Trace 2: Average  
 Transducer: ESH2-Z5

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2





**C20140088**

16.Jan 14 09:44

**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
LINE L

**Final Measurement**

Meas Time: 1 s  
Margin: 20 dB  
Subranges: 3

Trace	Frequency	Level (dB $\mu$ V)	Detector	Delta Limit/dB
1	19.441500000 MHz	42.04	Quasi Peak	-17.96
2	2.692500000 MHz	26.29	Average	-19.71
2	19.509000000 MHz	30.21	Average	-19.79



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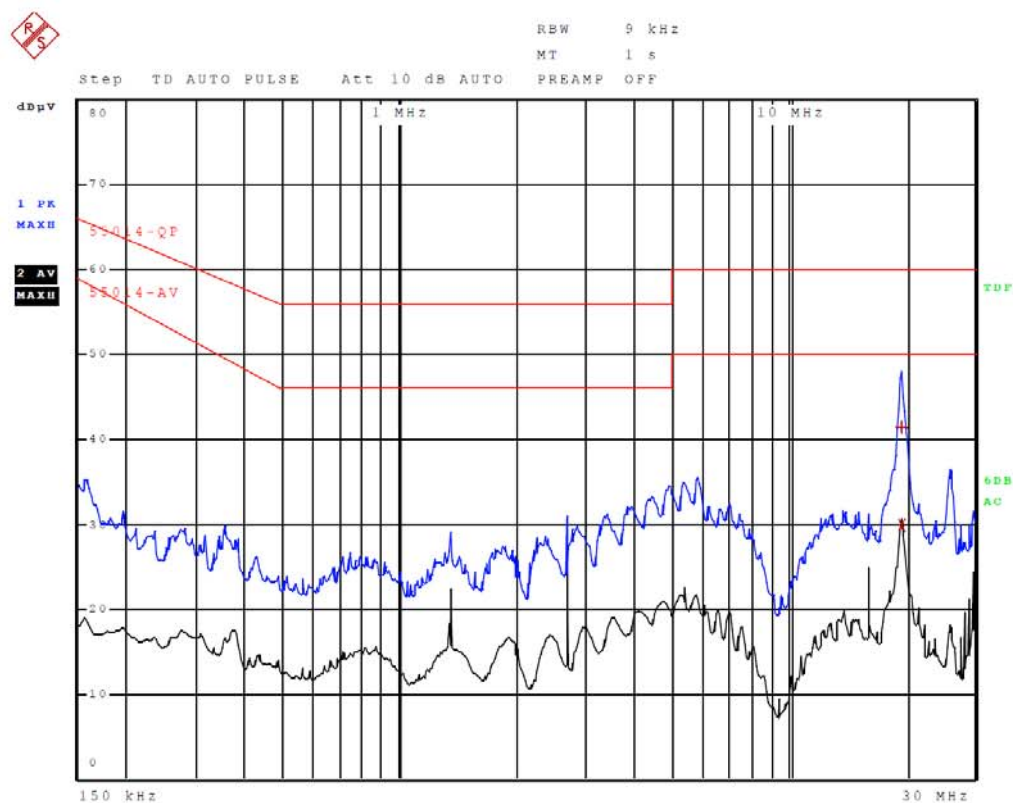
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**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 LINE N

**Time Domain Scan (1 Range)**

Scan Start: 150 kHz  
 Scan Stop: 30 MHz  
 Detector: Trace 1: MAX PEAK Trace 2: Average  
 Transducer: ESH2-Z5

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2



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16.Jan 14 09:45

**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
LINE N

**Final Measurement**

Meas Time: 1 s  
Margin: 20 dB  
Subranges: 2

Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
1	19.441500000 MHz	41.48	Quasi Peak	-18.52
2	19.529250000 MHz	29.80	Average	-20.20

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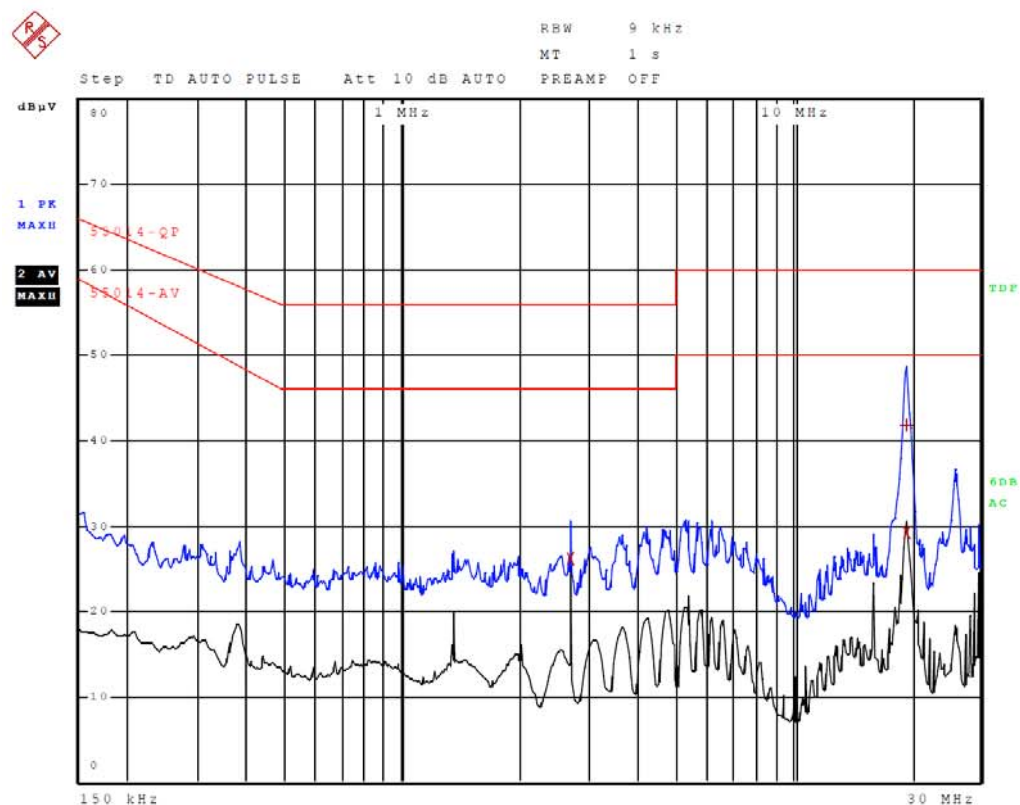
16.Jan 14 09:55

**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, IZSESAVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 LINE L

**Time Domain Scan (1 Range)**

Scan Start: 150 kHz  
 Scan Stop: 30 MHz  
 Detector: Trace 1: MAX PEAK Trace 2: Average  
 Transducer: ESH2-Z5

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2



**C20140088**

16.Jan 14 09:55

**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, IZSESAVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
LINE L

**Final Measurement**

Meas Time: 1 s  
Margin: 25 dB  
Subranges: 3

Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
1	19.443750000 MHz	41.79	Quasi Peak	-18.21
2	2.694750000 MHz	26.22	Average	-19.78
2	19.529250000 MHz	29.23	Average	-20.77

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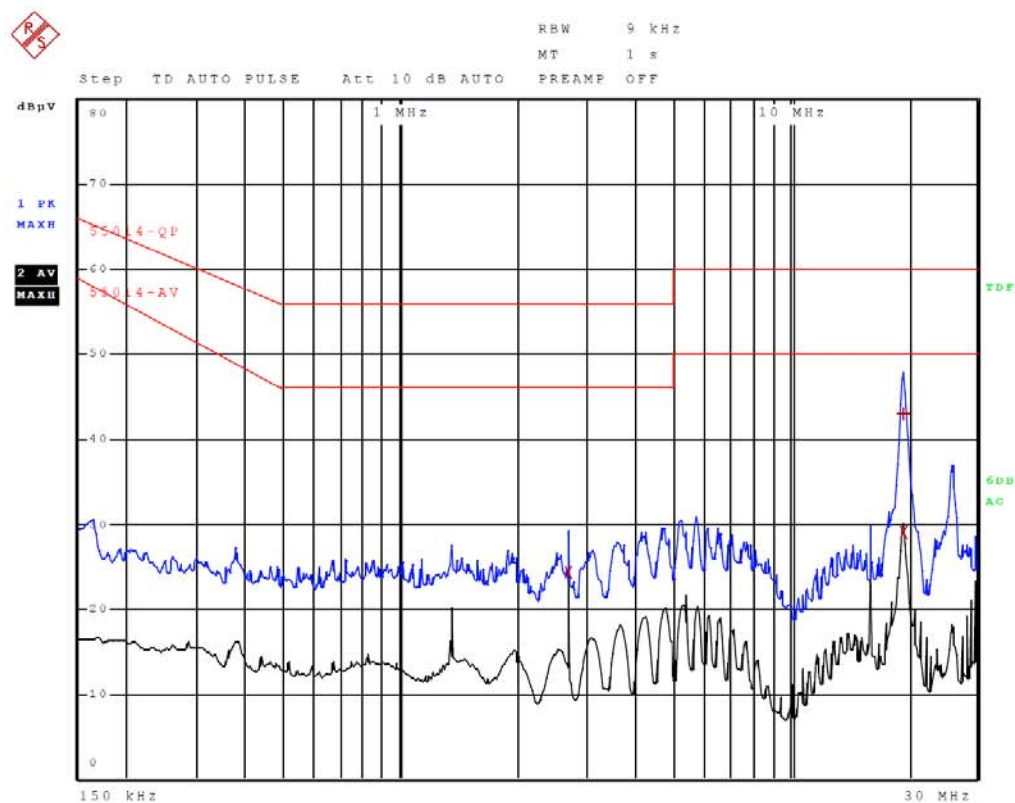
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**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, IZSESAVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 LINE N

**Time Domain Scan (1 Range)**

Scan Start: 150 kHz  
 Scan Stop: 30 MHz  
 Detector: Trace 1: MAX PEAK Trace 2: Average  
 Transducer: ESH2-Z5

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2





T251-0047/14

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**Meas Type** CONDUCTED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, IZSESAVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
LINE N

**Final Measurement**

Meas Time: 1 s  
Margin: 25 dB  
Subranges: 3

Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
1	19.506750000 MHz	43.00	Quasi Peak	-17.00
2	19.527000000 MHz	29.05	Average	-20.95
2	2.694750000 MHz	24.33	Average	-21.67



**Figure 1: Conducted emission test**



### 3.2 Radiated emission measurement

#### 3.2.1 Limits of radiated emission measurement

FREQUENCY (MHz)	Limit (at 3 m) (dB $\mu$ V/m)
30 - 230	40
230 - 1000	47

**NOTE:**

- The lower limit shall apply at the transition frequencies.
- Emission level (dB $\mu$ V/m) = 20 log Emission level ( $\mu$ V/m).

#### 3.2.2 Test instruments

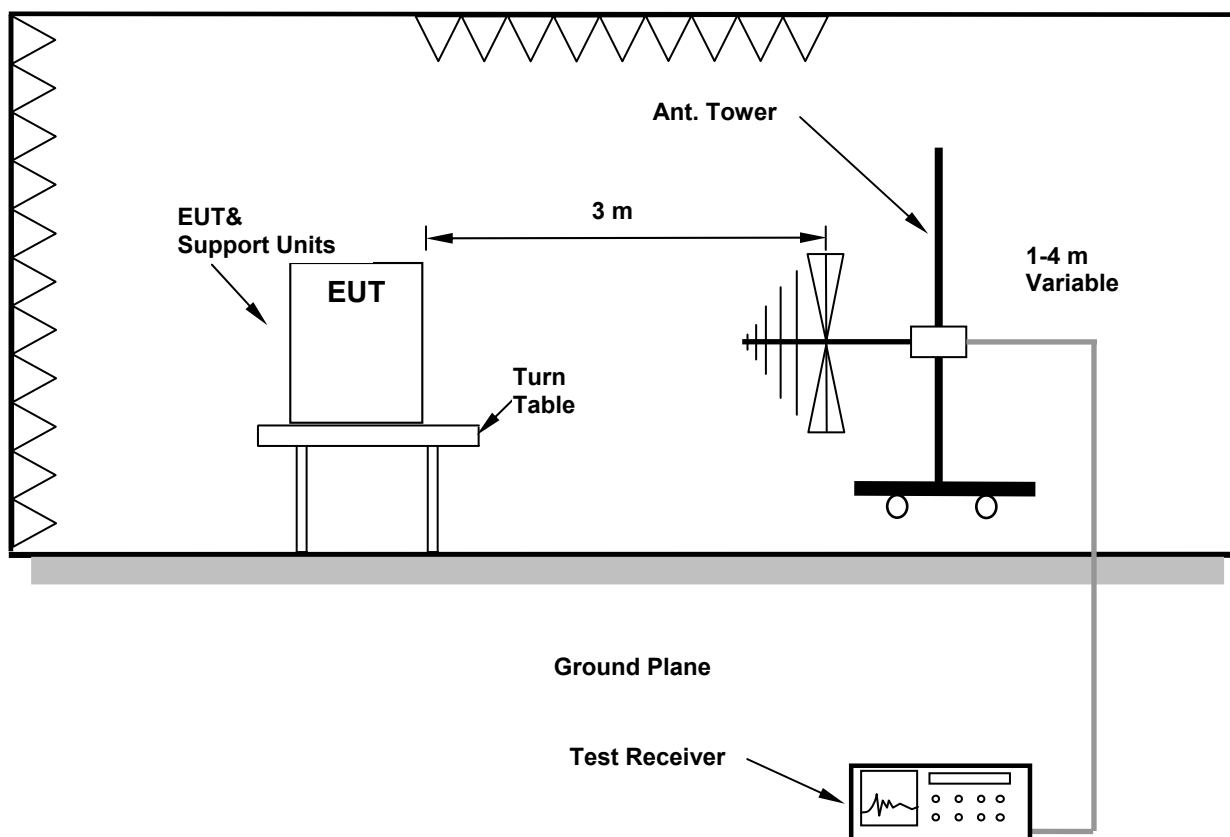
Description & Manufacturer	Model No.	SIQ No.	Used	Calibrated until
ETS, Anechoic chamber	3m	103949	X	2014-12
Rohde & Schwarz, RFI test receiver	ESU8	105187	X	2015-04
EMCO, Antenna	model 3142	104351	X	2015-09
EMCO, Antenna	model 3115	103002		2015-09
Heinrich Deisel, Turn table	DS 420.00	103337	X	NA
ETS, Antenna tower			X	NA

#### 3.2.3 Test procedure

1. The EUT was set 3 m away from the interference-receiving antenna, which was mounted on the top of variable-height antenna tower.
2. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the turn table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
5. The highest points would be re-tested one by one using the quasi-peak method.



### 3.2.4 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

### 3.2.5 Test result

<b>EUT:</b>	MIKrovent	<b>Model:</b>	MIKRO 100
<b>Operating mode:</b>	BLOW IN, BLOW OUT		
<b>Input voltage:</b>	253 V, 50 Hz	<b>Date:</b>	2014-01-16
<b>Environmental conditions:</b>	22±5°C, 55±30% RH	<b>Tested by: Damjan Repar</b>	

**NOTE: PASS**

#### MEASUREMENT UNCERTAINTY:

- The measurement uncertainty is calculated in document EN122E

**C20140088**

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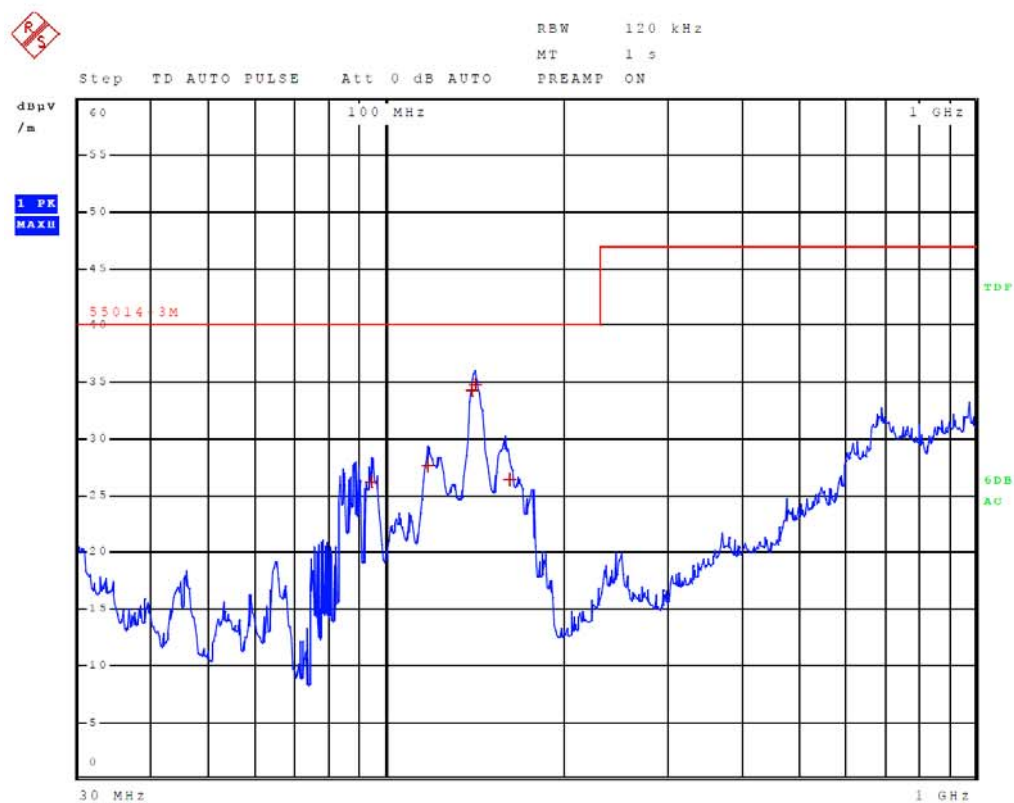
**Meas Type** RADIATED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, IZSESAVANJE  
**Operator** DAMJAN REPAR

**Test Spec**  
 VERTICAL 245 CM 90 DEG

**Time Domain Scan (1 Range)**

Scan Start: 30 MHz  
 Scan Stop: 1 GHz  
 Detector: Trace 1: MAX PEAK  
 Transducer: 3142B3m

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
30.000000 MHz	1.000000 GHz	30.00 kHz	120.00 kHz	10 ms	Auto	20 dB	INPUT2



**C20140088**

16.Jan 14 10:23

**Meas Type** RADIATED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, IZSESAVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
VERTICAL 245 CM 90 DEG

**Final Measurement**

**Meas Time:** 1 s  
**Margin:** 12 dB  
**Subranges:** 5

Trace	Frequency	Level (dB $\mu$ V/m)	Detector	Delta Limit/dB
1	141.360000000 MHz	34.79	Quasi Peak	-5.21
1	140.010000000 MHz	34.19	Quasi Peak	-5.81
1	117.810000000 MHz	27.49	Quasi Peak	-12.51
1	161.550000000 MHz	26.35	Quasi Peak	-13.65
1	94.260000000 MHz	26.22	Quasi Peak	-13.78

**C20140088**

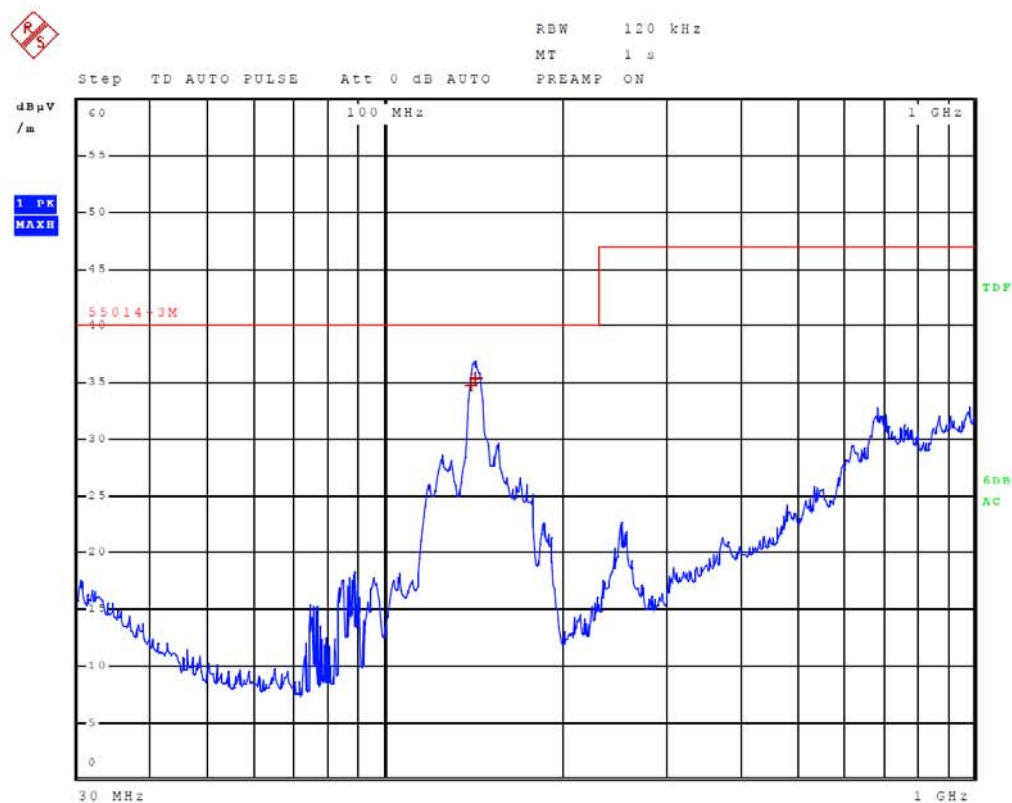
16.Jan 14 10:25

**Meas Type** RADIATED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, IZSESAVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 HORIZONTAL 270 CM 90 DEG

**Time Domain Scan (1 Range)**

Scan Start: 30 MHz  
 Scan Stop: 1 GHz  
 Detector: Trace 1: MAX PEAK  
 Transducer: 3142B3m

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
30.000000 MHz	1.000000 GHz	30.00 kHz	120.00 kHz	10 ms	Auto	20 dB	INPUT2



**C20140088**

16.Jan 14 10:25

**Meas Type** RADIATED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, IZSESAVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
HORIZONTAL 270 CM 90 DEG

**Final Measurement**

Meas Time: 1 s  
Margin: 12 dB  
Subranges: 2

Trace	Frequency	Level (dB $\mu$ V/m)	Detector	Delta Limit/dB
1	142.020000000 MHz	35.39	Quasi Peak	-4.61
1	140.010000000 MHz	34.77	Quasi Peak	-5.23

**C20140088**

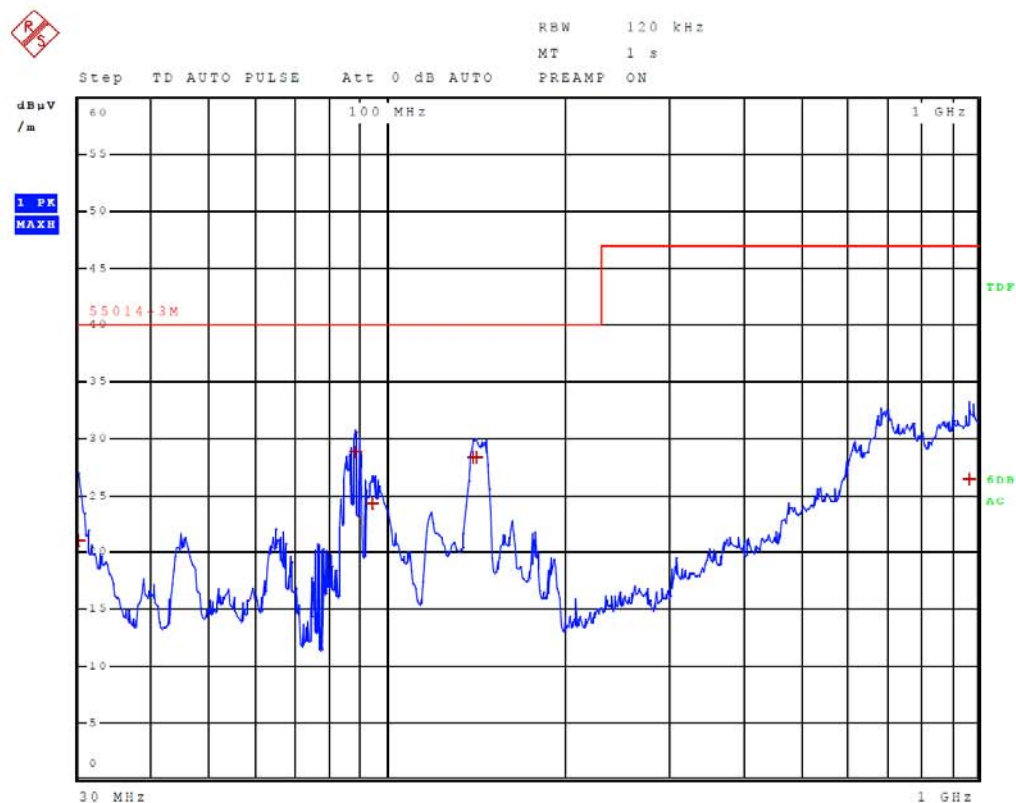
16.Jan 14 10:48

**Meas Type** RADIATED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 VERTICAL 100 CM 180 DEG

**Time Domain Scan (1 Range)**

**Scan Start:** 30 MHz  
**Scan Stop:** 1 GHz  
**Detector:** Trace 1: MAX PEAK  
**Transducer:** 3142B3m

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
30.000000 MHz	1.000000 GHz	30.00 kHz	120.00 kHz	10 ms	Auto	20 dB	INPUT2



**C20140088**

16.Jan 14 10:48

**Meas Type** RADIATED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
 VERTICAL 100 CM 180 DEG

**Final Measurement**

Meas Time: 1 s  
 Margin: 14 dB  
 Subranges: 6

Trace	Frequency	Level (dB $\mu$ V/m)	Detector	Delta Limit/dB
1	88.200000000 MHz	28.85	Quasi Peak	-11.15
1	141.420000000 MHz	28.32	Quasi Peak	-11.68
1	140.070000000 MHz	28.24	Quasi Peak	-11.76
1	94.290000000 MHz	24.21	Quasi Peak	-15.79
1	30.030000000 MHz	20.96	Quasi Peak	-19.04
1	967.410000000 MHz	26.46	Quasi Peak	-20.54





ROHDE &amp; SCHWARZ

**C20140088**

16.Jan 14 10:46

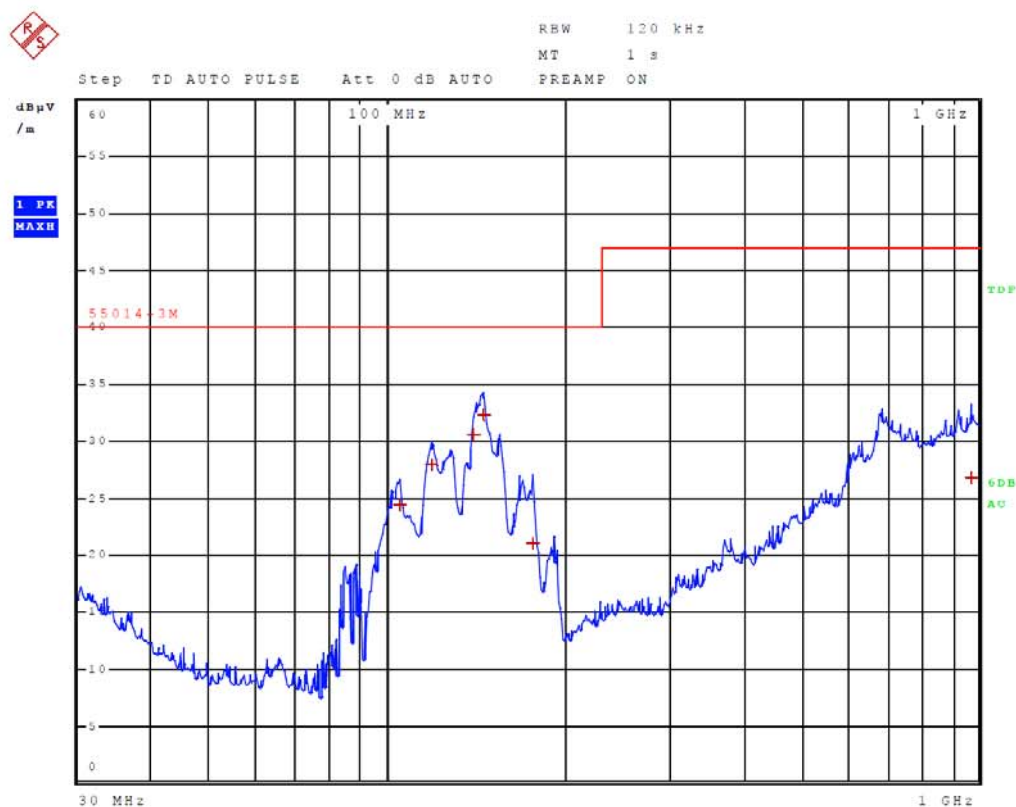
**Meas Type** RADIATED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR

**Test Spec**  
 HORIZONTAL 156 CM 180 DEG

**Time Domain Scan (1 Range)**

Scan Start: 30 MHz  
 Scan Stop: 1 GHz  
 Detector: Trace 1: MAX PEAK  
 Transducer: 3142B3m

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
30.000000 MHz	1.000000 GHz	30.00 kHz	120.00 kHz	10 ms	Auto	20 dB	INPUT2







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33 (59)

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**C20140088**

16.Jan 14 10:46

**Meas Type** RADIATED EMISSION  
**Equipment under Test** MIKrovent, Type MIKRO 100  
**Manufacturer** MIK D.O.O.  
**OP Condition** Uin 253V/50Hz, VPIHOVANJE  
**Operator** DAMJAN REPAR  
**Test Spec**  
HORIZONTAL 156 CM 180 DEG

**Final Measurement**

Meas Time: 1 s  
Margin: 14 dB  
Subranges: 6

Trace	Frequency	Level (dB $\mu$ V/m)	Detector	Delta Limit/dB
1	145.470000000 MHz	32.32	Quasi Peak	-7.68
1	140.070000000 MHz	30.58	Quasi Peak	-9.42
1	118.530000000 MHz	27.97	Quasi Peak	-12.03
1	105.060000000 MHz	24.38	Quasi Peak	-15.62
1	175.770000000 MHz	20.99	Quasi Peak	-19.01
1	971.310000000 MHz	26.73	Quasi Peak	-20.27



**Figure 2: Radiated emission measurement**



### **3.3 Harmonic current test**

Not applicable. EUT consumes less than 75 W.

### **3.4 Voltage fluctuation measurement**

Not applicable. EUT is unlikely to produce significant voltage fluctuations or flicker.

## 4. Immunity

### 4.1 General description

<b>Basic Standard, Specification, and Performance Criteria:</b>	EN 61000-4-2	Electrostatic Discharge – ESD: 8 kV air discharge, 4 kV Contact discharge, Performance criterion B
	EN 61000-4-4	Electrical Fast Transient/Burst – EFT, AC Power line: 1 kV, Performance criterion B
	EN 61000-4-3	Radiated electromagnetic field immunity test (RS) 80 – 1000 MHz, 3 V/m, 80 % AM, 1kHz Performance criterion A
	EN 61000-4-5	Surge Immunity Test: 1.2/50 us Open Circuit Voltage, 8 /20 us Short Circuit Current, Power line 1 kV L-N, 2kV L-PE, N-PE Performance criterion B
	EN 61000-4-6	Conducted Radio Frequency Disturbances 0.15-80 MHz, 3 V, 80% AM (1kHz), Performance criterion A
	EN 61000-4-11	Electromagnetic compatibility-Voltage dips, short interruptions and voltage variations immunity test: Performance criterion C

## 4.2 Immunity to electrostatic discharge

### 4.2.1 Test specification

<b>Basic Standard:</b>	IEC 61000-4-2
<b>Discharge Impedance:</b>	330 $\Omega$ / 150 pF
<b>Discharge Voltage:</b>	Air Discharge- 8 kV Contact Discharge- 4 kV (direct and indirect)
<b>Polarity:</b>	Positive / Negative
<b>Number of Discharge:</b>	Minimum 10 times at each test point
<b>Discharge Mode:</b>	Single Discharge
<b>Discharge Period:</b>	1-second minimum

### 4.2.2 Test instruments

Description& Manufacturer	Model No.	SIQ No.	Used	Calibrated until
EM TEST, Simulator ESD	P30N	105296	X	2014-02

### 4.2.3 Test procedure

The discharges shall be applied in two ways:

1. Contact discharges to the conductive surfaces and coupling planes:

The EUT shall be exposed to at least 10 discharges, 5 each at negative and positive polarity, at a minimum of four test points. One of the test points shall be subjected to at least 10 indirect discharges to the center of the front edge of the horizontal coupling plane. If no direct contact test points are available, than at least 20 indirect discharges shall be applied in the indirect mode. Test shall be performed at a maximum repetition rate of one discharge per second.

On each discharge point the test shall start with 2 kV and continue with value increased for 2 kV.

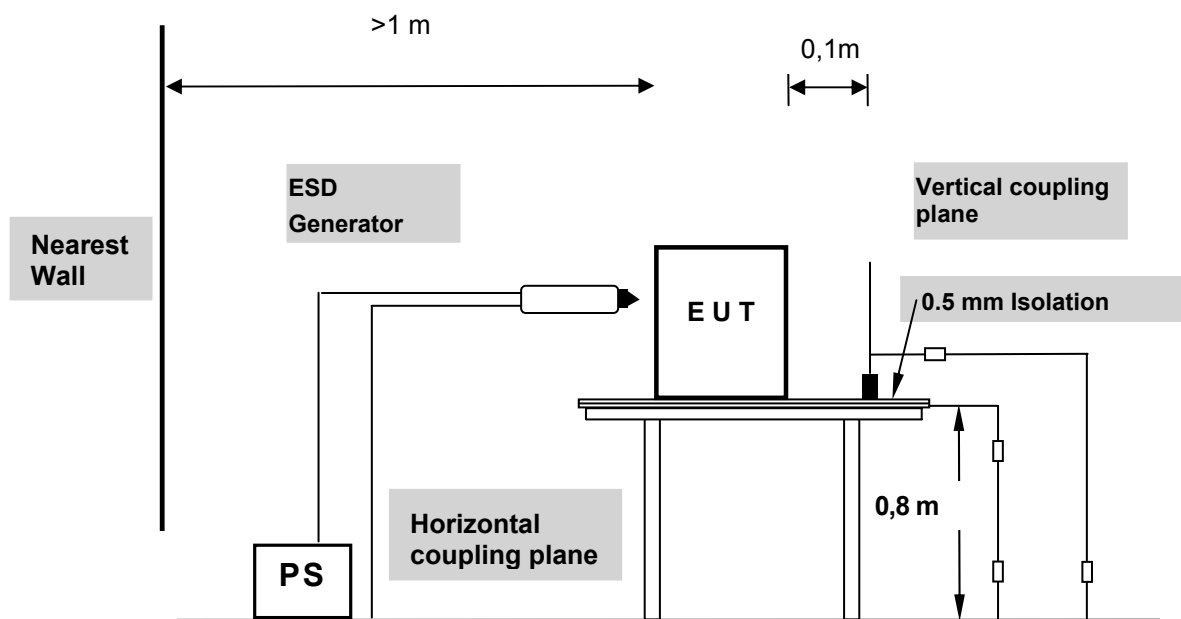
2. Air discharges at slots and apertures and insulating surfaces:

On those parts of the EUT where it is not possible to perform contact discharge testing, the equipment should be investigated to identify user accessible points where breakdown may occur. Such points are tested using the air discharge method. This investigation should be restricted to those area normally handled by the user. A minimum of 10 single air discharges shall be applied to the selected test point for each such area.

The basic test procedure was in according with IEC 61000-4-2:

1. Electrostatic discharges were applied only to those points and surfaces of the EUT that are accessible to users during normal operation.
2. The test was performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.
3. The time interval between two successive single discharges was at least 1 second.
4. The ESD generator was held perpendicularly to the surface to which the discharge was applied and the return cable was at least 0.2 meters from the EUT.
5. Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.
6. Air discharges were applied with the round discharge tip of the discharge electrode approaching the EUT as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator was removed from the EUT and re-triggered for a new single discharge. The test was repeated until all discharges were complete.
7. At least ten single discharges (in the most sensitive polarity) were applied to the Horizontal Coupling Plane at points on each side of the EUT. The ESD generator was positioned vertically at a distance of 0.1 meters from the EUT with the discharge electrode touching the Horizontal Coupling Plane.
8. At least ten single discharges (in the most sensitive polarity) were applied to the center of one vertical edge of the Vertical Coupling Plane in sufficiently different positions that the four faces of the EUT were completely illuminated. The Vertical Coupling Plane (dimensions 0.5m x 0.5m) was placed vertically to and 0.1 meters from the EUT.

#### 4.2.4 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

The configuration consisted of a wooden table 0.8 meters high standing on the **Ground Reference Plane**. The **GRP** consisted of a sheet of aluminum at least 0.25 mm thick, and 2.5 meters square connected to the protective grounding system. A **Horizontal Coupling Plane** (1.6m x 0.8m) was placed on the table and attached to the **GRP** by means of a cable with 940 kΩ total impedance. The equipment under test, was installed in a representative system as described in section 7 of EN 61000-4-2, and its cables were placed on the **HCP** and isolated by an insulating support of 0.5 mm thickness. A distance of 1-meter minimum was provided between the EUT and the walls of the laboratory and any other metallic structure.

#### 4.2.5 Test results

<b>EUT:</b>	MIKrovent	<b>Model:</b>	MIKRO 100
<b>Mode:</b>	Normal		
<b>Input voltage:</b>	230 V, 50 Hz	<b>Date:</b>	2014-01-16
<b>Environmental conditions:</b>	25±10°C, 45±15% RH	<b>Tested by: Damjan Repar</b>	

Test results of direct application					
Discharge Level (kV)	Polarity	Test Point	Contact Discharge	Air Discharge	Achieved performance criterion
4	+ / -		X		B
8	+ / -			X	B

**Legend:**

- Contact discharge points (including HCP and VCP)
- Air discharge points

**NOTE: PASS**



**Figure 3: Electrostatic discharge test**





**Figure 4: Electrostatic discharge test**



**Figure 5: Electrostatic discharge test**

**Figure 6: Electrostatic discharge test****Figure 7: Electrostatic discharge test**

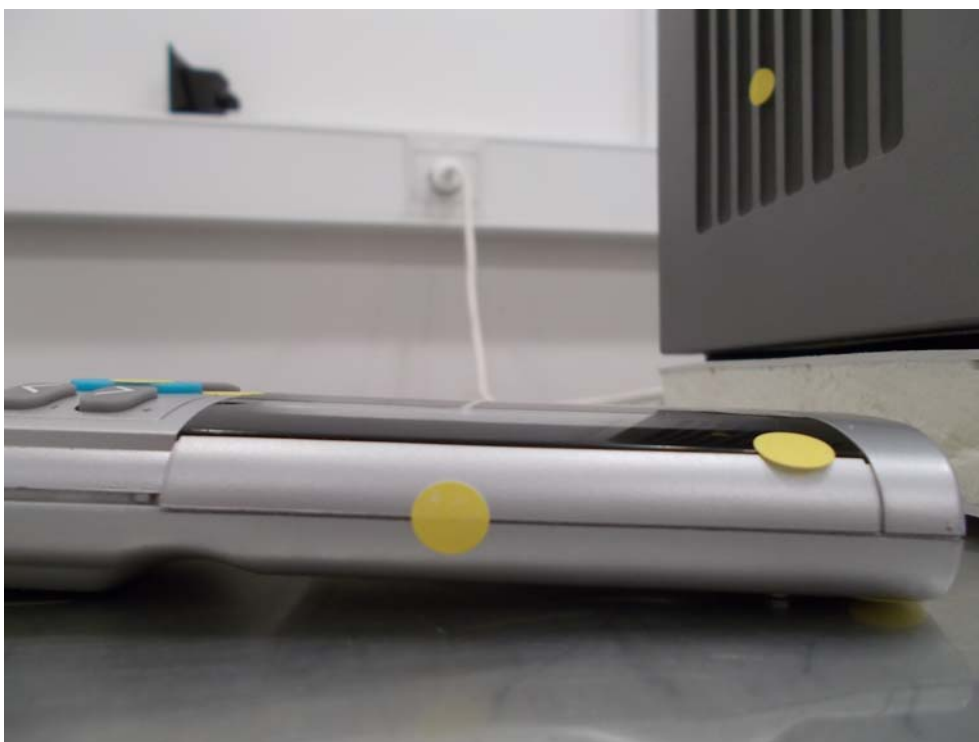
**Figure 8: Electrostatic discharge test****Figure 9: Electrostatic discharge test**



Figure 10: Electrostatic discharge test



Figure 11: Electrostatic discharge test



**Figure 12: Electrostatic discharge test**



**Figure 13: Electrostatic discharge test**

### 4.3 Radiated electromagnetic field immunity test (RS)

#### 4.3.1 Test specification

<b>Basic Standard:</b>	IEC 61000-4-3
<b>Frequency Range:</b>	80 – 1000 MHz
<b>Field Strength:</b>	3 V/m
<b>Modulation:</b>	1 kHz Sine Wave, 80 %, AM Modulation
<b>Frequency Step:</b>	1 % of fundamental
<b>Polarity of Antenna:</b>	Horizontal and Vertical
<b>Test Distance:</b>	3 m
<b>Antenna Height:</b>	1.5 m

#### 4.3.2 Test instruments

Description & Manufacturer	Model No.	SIQ No.	Used	Calibrated until
EMCO, Antenna	model 3142	104351	X	2015-09
ETS, Anechoic chamber	3m	103949	X	2014-12
HP, signal generator	8648C	105045	X	2015-11
WARLATONE, Directional coupler	C5100	104257	X	2015-11
WARLATONE, Directional coupler	C3910	104258	X	2015-11
KALMUS, RFAMPLIFIER	827FC	104256	X	2014-12

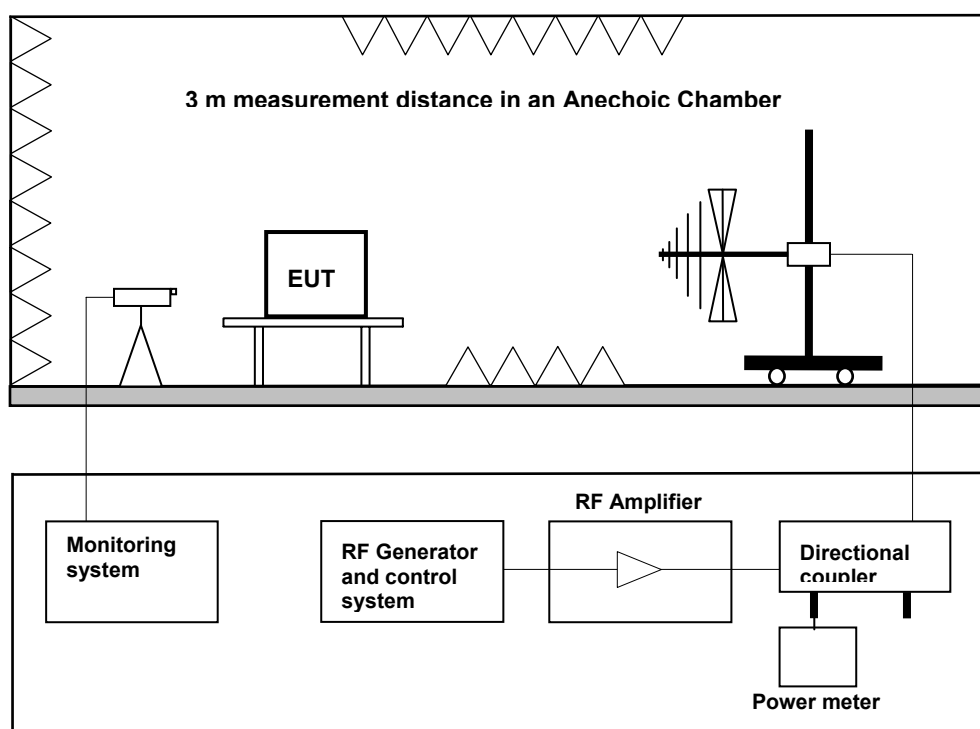


### 4.3.3 Test procedure

The test procedure was in accordance with IEC 61000-4-3

1. The testing was performed in an anechoic chamber. The transmit antenna was located at a distance of 3 meters from the EUT.
2. The frequency range is swept from 80 MHz to 1000 MHz with the signal 80 % amplitude modulated with 1 kHz sine-wave. The rate of sweep did not exceed  $1.5 \times 10^{-3}$  decade/s. Where the frequency range is swept incrementally, the step size was 1% of fundamental.
3. The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.
4. The field strength level was 3 V/m.
5. The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.

### 4.3.4 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

The EUT installed in a representative system as described in section 7 EN 61000-4-3. The system under test was connected to the power and signal wire according to relevant installation instructions.

### 4.3.5 Test results

<b>EUT:</b>	MIKrovent	<b>Model:</b>	MIKRO 100
<b>Mode:</b>	Normal		
<b>Input voltage:</b>	230 V, 50 Hz	<b>Date:</b>	2014-01-16
<b>Environmental conditions:</b>	22±5°C, 55±30% RH	<b>Tested by: Damjan Repar</b>	

Frequency	Level	Modulation	Observed function	Performance criterion
80MHz - 1000MHz	3 V/m	80%	Working operation	A

**NOTE: PASS**



**Figure 14: Radiated electromagnetic field immunity**





**Figure 15: Radiated electromagnetic field immunity**

## 4.4 Electrical fast transient/burst immunity test

### 4.4.1 Test specification

<b>Basic Standard:</b>	IEC 61000-4-4
<b>Test Voltage:</b>	Power Lines – 1 kV
<b>Polarity:</b>	Positive/Negative
<b>Impulse Frequency:</b>	5 kHz
<b>Impulse Waveshape:</b>	5/50 ns
<b>Burst Duration:</b>	15 ms
<b>Burst Period:</b>	300 ms
<b>Test Duration:</b>	2 min

### 4.4.2 Test instruments

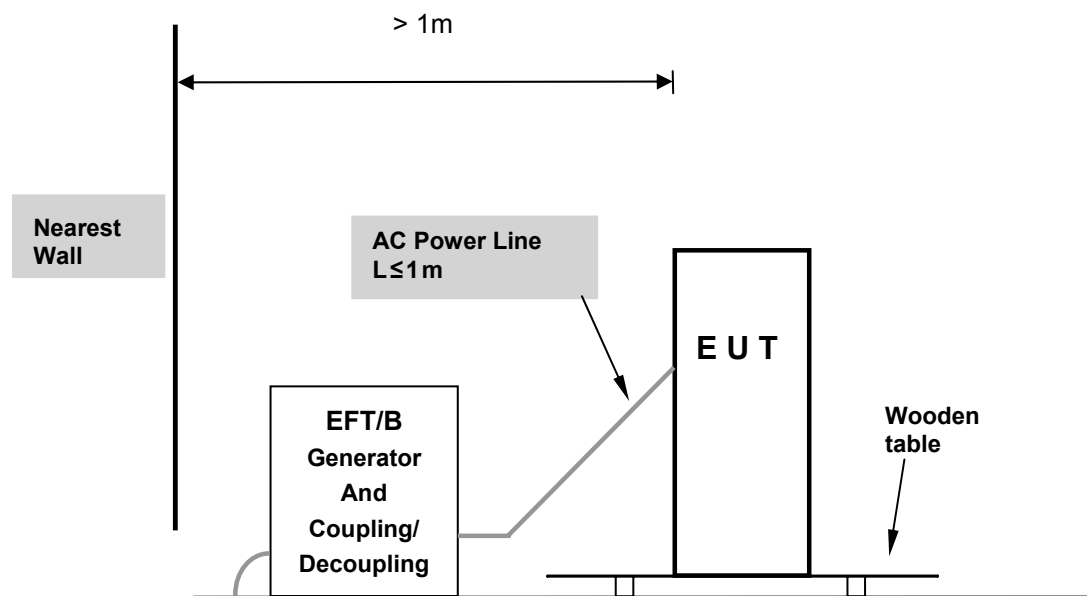
Description& Manufacturer	Model No.	SIQ No.	Used	Calibrated until
EM TEST, Universal immunity simulator	UCS 500 N5	105294	X	2015-05
EM TEST, Capacitance coupling clamp	HFK	103431		NA

### 4.4.3 Test procedure

1. The EUT was tested with 1000 volt discharges to power lines.
2. Both positive and negative polarity discharges were applied.
3. The length of the "hot wire" from the coaxial output of the EFT generator to the terminals on the EUT should not exceed 1 meter.
4. The duration time of each test sequential was 2 minute.
5. The transient/burst waveform was in accordance with IEC 61000-4-4, 5/50 ns.

#### 4.4.4 Test setup

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.



The EUT installed in a representative system as described in section 7 of EN 61000-4-4 and its cables, were isolated from the Ground Reference Plane by an insulating support that is 0.1-meter thick. The GRP consisted of a sheet of aluminum (at least 0.25mm thick and 2.5 m square) connected to the protective grounding system.

#### 4.4.5 Test results

<b>EUT:</b>	MIKrovent	<b>Model:</b>	MIKRO 100
<b>Mode:</b>	Normal		
<b>Input voltage:</b>	230 V, 50 Hz	<b>Date:</b>	2014-01-16
<b>Environmental conditions:</b>	25±10°C, 50±25% RH	<b>Tested by: Damjan Repar</b>	

Test Point	Polarity	Test Level (kV)	Observation	Achieved performance criterion
Line	+/-	1	Working operation	A
Neutral	+/-	1	Working operation	A
PE	+/-	1	Working operation	A

**NOTE: PASS**



**Figure 16: Electrical fast transient/burst and surge immunity test**

## 4.5 Surge immunity test

### 4.5.1 Test specification

<b>Basic Standard:</b>	IEC 61000-4-5
<b>Wave-Shape:</b>	Combination Wave
<b>Test Voltage:</b>	±1 kV symmetrical, ±2 kV unsymmetrical 1.2/50 us Open Circuit Voltage
<b>Generator Source:</b>	2 ohm between networks (symmetrical) 12 ohm between networks (unsymmetrical)
<b>Polarity:</b>	Positive/Negative
<b>Phase Angle:</b>	90 ° / 270 °
<b>Pulse Repetition rate:</b>	1 time / min. (maximum)
<b>Number of Tests:</b>	5 positive and 5 negative at selected points

### 4.5.2 Test instruments

Description& Manufacturer	Model No.	SIQ No.	Used	Calibrated until
EM TEST, Universal immunity simulator	UCS 500 N5	105294	X	2015-05
EM TEST, 3-phase network matrix	CNI 503 A	105295		2015-11

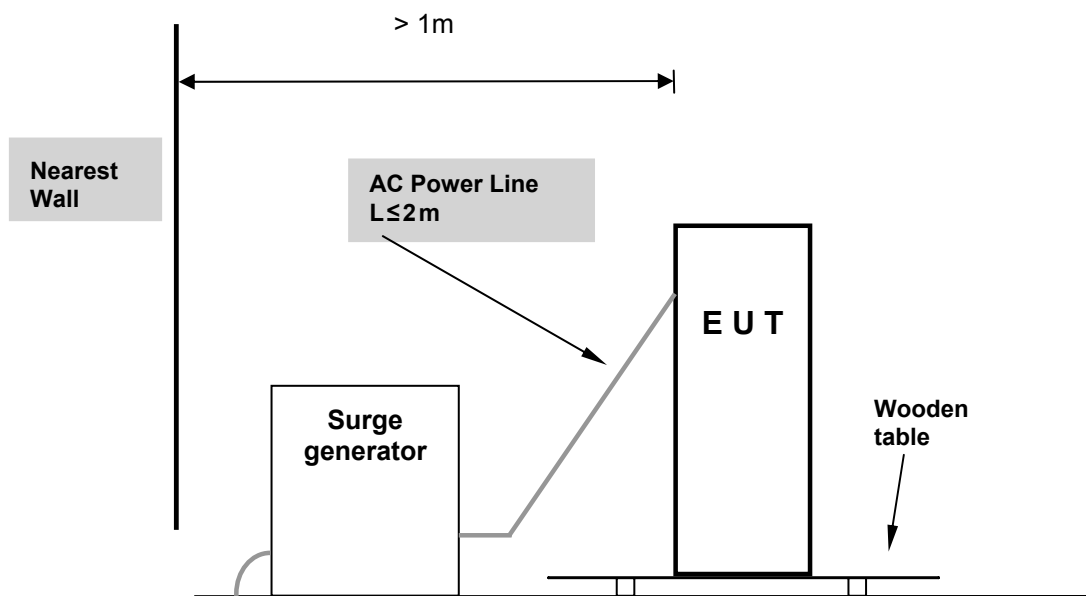
### 4.5.3 Test procedure

1. For EUT power supply:

The surge is to be applied to the EUT power supply terminals via the capacitive coupling network. Decoupling networks are required in order to avoid possible adverse effects on equipment not under test that may be powered by the same lines, and to provide sufficient decoupling impedance to the surge wave. The power cord between the EUT and the coupling/decoupling networks shall be 2 meters in length (or shorter).

#### 4.5.4 Test setup

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.



#### 4.5.5 Test results

<b>EUT:</b>	MIKrovent	<b>Model:</b>	MIKRO 100
<b>Mode:</b>	Normal		
<b>Input voltage:</b>	230 V, 50 Hz	<b>Date:</b>	2014-01-16
<b>Environmental conditions:</b>	$25 \pm 10^\circ\text{C}$ , 10-75% RH	<b>Tested by:</b> Damjan Repar	

Test Point	Polarity	Angle ( $^\circ$ )	Test Level (kV)	Observation	Achieved performance criterion
L -N	+	90	1	Working operation	A
L -N	-	270	1	Working operation	A
L -PE	+	90	2	Working operation	A
L -PE	-	270	2	Working operation	A
N -PE	+	90	2	Working operation	A
N -PE	-	270	2	Working operation	A

**NOTE: PASS**

## 4.6 Immunity to conducted disturbances induced by RF fields (CS)

### 4.6.1 Test specification

<b>Basic Standard:</b>	IEC 61000-4-6
<b>Frequency Range:</b>	0.15 MHz – 80 MHz
<b>Field Strength:</b>	3 V
<b>Modulation:</b>	1 kHz Sine Wave, 80 %, AM Modulation
<b>Frequency Step:</b>	1 % of fundamental
<b>Coupled Cable:</b>	Power Mains, Unshielded

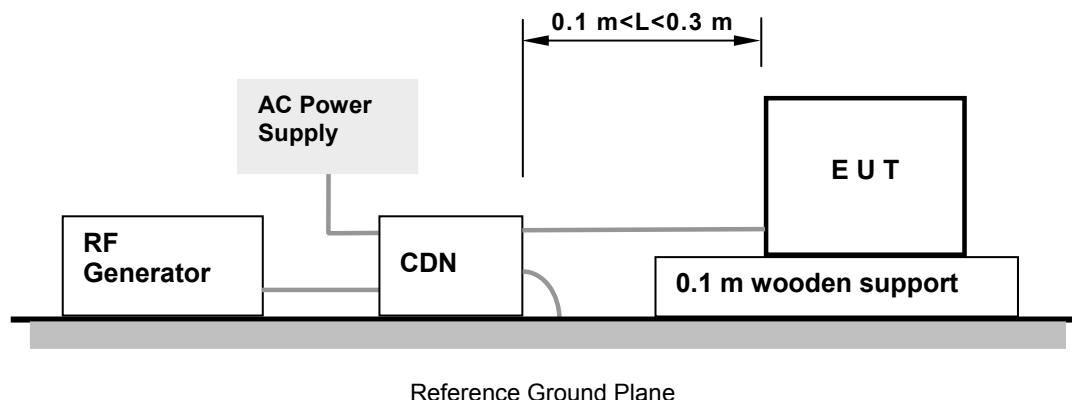
### 4.6.2 Test instruments

Description& Manufacturer	Model No.	SIQ No.	Used	Calibrated until
Robert Luthi, EM clamp	EM 101	/		With instrument
EM TEST, Conductive CW immunity system	CWS 500 N2	/	X	2014-09
EM TEST, Coupling/decoupling device	CDN-M3N/32A	/	X	With instrument
EM TEST, Coupling/decoupling device	CDN-M2/32A	/		With instrument
EM TEST, Coupling/decoupling device	CDN-M5/16A	/		With instrument
EM TEST, Coupling/decoupling device	CDN-T8-RJ45	/		With instrument
EM TEST, Coupling/decoupling device	CDN-S8-RJ45	/		With instrument
EM TEST, Coupling/decoupling device	CDN-S4-USB	/		With instrument
EM TEST, Attenuator	ATT3/100	/	X	With instrument

### 4.6.3 Test procedure

1. The EUT shall be tested within its intended operating and climatic conditions.
2. The test shall be performed with the test generator connected to each of the coupling and decoupling devices in turn, while the other non-excited RF input ports of the coupling devices are terminated by a 50  $\Omega$  load resistor.
3. The frequency range is swept from 150 kHz to 80 MHz, using the signal level established during the setting process and with a disturbance signal of 80 % amplitude. The signal is modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or the switch coupling devices as necessary. The sweep rate shall not exceed  $1.5 \times 10^{-3}$  decades/s. The step size shall not exceed 1 % of the start and thereafter 1 % of the preceding frequency value where the frequency is swept incrementally.
4. The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies such as clock frequency(ies) and harmonics or frequencies of dominant interest, shall be analyzed separately.
5. Attempts should be made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.

#### 4.6.4 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

The equipment to be tested is placed on an insulating support of 0.1 meters height above a ground reference plane. All relevant cables shall be provided with the appropriate coupling and decoupling devices at a distance between 0.1 meters and 0.3 meters from the projected geometry of the EUT on the ground reference plane.

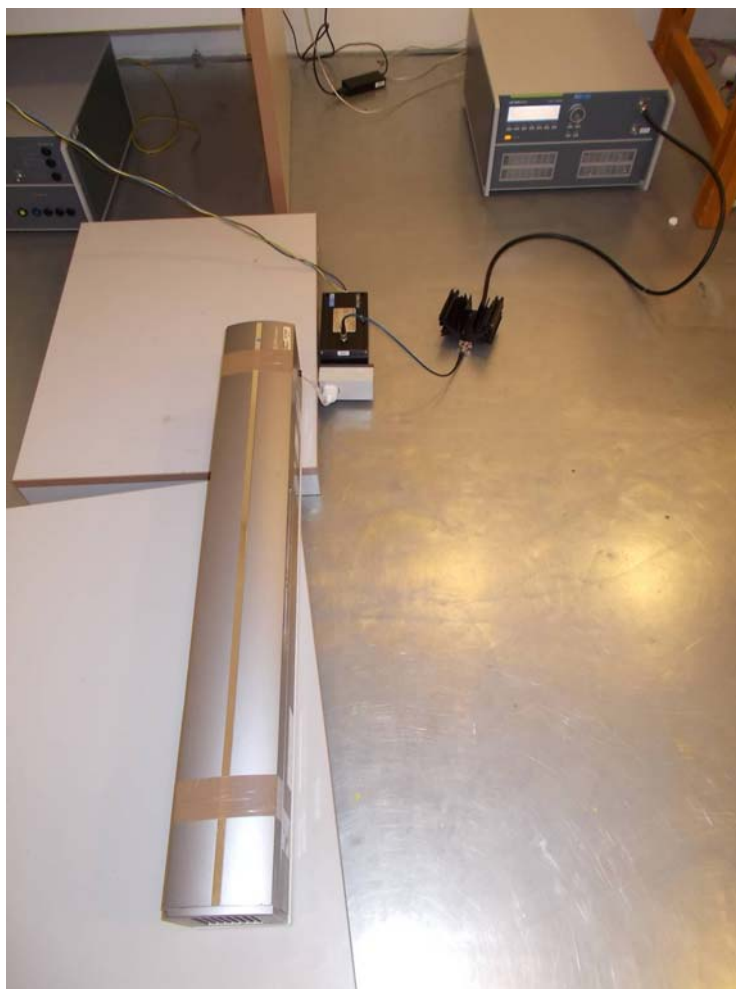
#### 4.6.5 Test results

<b>EUT:</b>	MIKrovent	<b>Model:</b>	MIKRO 100
<b>Mode:</b>	Normal		
<b>Input voltage:</b>	230 V, 50 Hz	<b>Date:</b>	2014-01-16
<b>Environmental conditions:</b>	22±5°C, 55±30% RH	<b>Tested by:</b> Damjan Repar	

Frequency	Level	Modulation	Observed function	Performance criterion	Degradation (Yes/No)
150kHz - 80MHz	3 V	80%	Working mode	A	No

**NOTE: PASS**





**Figure 17: Immunity to conducted disturbances induced by RF fields (CS)**

## 4.7 Voltage dips and short interruptions immunity test (DIP)

### 4.7.1 Test specification

<b>Basic Standard:</b>	IEC 61000-4-11
<b>Test Duration Time:</b>	Minimum three test events in sequence
<b>Interval between Event:</b>	Minimum ten seconds
<b>Phase Angle:</b>	0 °, 180°
<b>Test Cycle:</b>	3 times

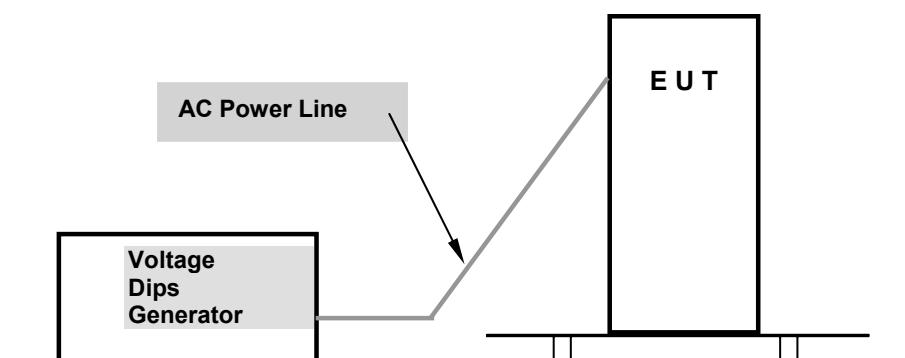
### 4.7.2 Test instruments

Description& Manufacturer	Model No.	SIQ No.	Used	Calibrated until
EM TEST, Ultra compact Simulator	UCS 500 N5	106887	X	2015-05
EM TEST, Motorized variac	MV2616	106891	X	2015-05

### 4.7.3 Test procedure

The EUT shall be tested for each selected combination of test levels and duration with a sequence of three dips/interruptions with intervals of 10s minimum (between each test event). Each representative mode of operation shall be tested. Abrupt changes in supply voltage shall occur at zero crossings of the voltage waveform.

### 4.7.4 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

#### 4.7.5 Test result

<b>EUT:</b>	MIKrovent	<b>Model:</b>	MIKRO 100
<b>Mode:</b>	Normal		
<b>Input voltage:</b>	230 V, 50 Hz	<b>Date:</b>	2014-01-16
<b>Environmental conditions:</b>	22±5°C, 55±30% RH	<b>Tested by: Damjan Repar</b>	

Phenomena	Test level (dip)	Duration (in periods)	Achieved performance criterion	Pass / Fail
Voltage dips	>95%	0,5	A	Pass
Voltage dips	30%	25	A	Pass
Voltage dips	60%	10	A	Pass

**NOTE: PASS**



**Figure 18: Immunity to voltage dips and short interruptions**