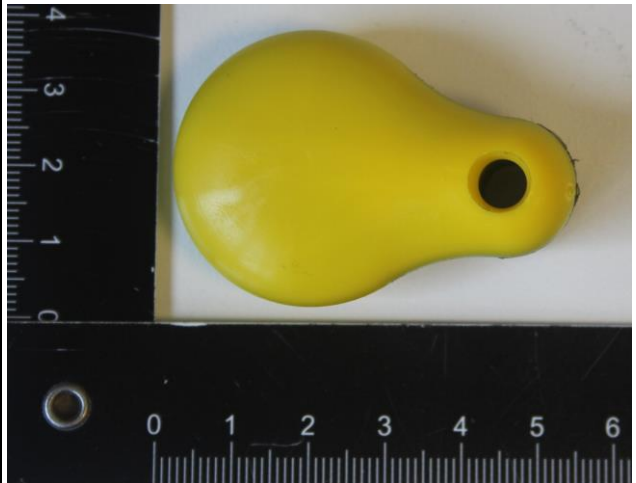


Prüfbericht-Nr.: Test Report No.:	19121802.r02	Auftrags-Nr.: Order No.:	89003559	Seite 1 von 25 Page 1 of 25
Kunden-Referenz-Nr.: Client Reference No.:	1541649	Auftragsdatum: Order date:	10.02.2020	
Auftraggeber: Client:	Nedap N.V. Parallelweg 2 7141 DC Groenlo, Netherlands			
Prüfgegenstand: Test item:	433.3 - 434.5 MHz active RFID Tag			
Bezeichnung / Typ-Nr.: Identification / Type No.:	SMARTTAG EAR FERPH4			
Auftrags-Inhalt: Order content:	Compliance with regulatory requirements			
Prüfgrundlage: Test specification:	FCC 47 CFR Part 15, Subpart C, Section 15.247 (10-1-19 Edition) RSS-Gen (Issue 5, April 2018) and RSS-210 (Issue 9, August 2016) ANSI C63.10-2013			

Wareneingangsdatum: Date of receipt:	2020-09-29	
Prüfmuster-Nr.: Test sample No.:	433.3 & 434.5	
Prüfzeitraum: Testing period:	2020-10-06 - 2020-11-16	
Ort der Prüfung: Place of testing:	Leek	
Prüflaboratorium: Testing laboratory:	TÜV Rheinland Nederland B.V. Leek Laboratory	
Prüfergebnis*: Test result*:	Pass	

geprüft von / tested by: 			Genehmigt von / Approved by:		
2020-11-16	R. van der Meer/Test Eng.		2020-11-16	T. Koning/Senior Eng.	
Datum Date	Name / Stellung Name / Position	Unterschrift Signature	Datum Date	Name / Stellung Name / Position	Unterschrift Signature
Sonstiges / Other: Firmware version: VT2223b69 Hardwareversion: A.08.					
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery: 2			Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. Test specification(s) F(ail) a.m. test specification(s) N/A = not applicable N/T = not tested					
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the above mentioned testsample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This report does not entitle to carry any test mark					

V04

Liste der verwendeten Prüfmittel
List of used test equipment

Prüfmittel Kind of Equipment	Hersteller / Manufacturer	Bezeichnung / Model Name	Prüfmittel-Nr. / ID-Nr. Equipment No. / ID-No.	Kalibrierung Calibration (mm/yyyy)	Nächste Kalibrierung Next calibration (mm/yyyy)
For Radiated Emissions					
Measurement Receiver	Rohde & Schwarz	ESR7	2790499	09/2020	09/2021
RF Cable S-AR	Gigalink	APG0500	2789217	03/2020	03/2021
Controller Turntable	Maturo	SCU/088/ 8090811	2789220	N/A	N/A
Controller Mast	Innco Systems	CO3000	9002463	N/A	N/A
Test facility	Comtest	FCC listed: 786213 IC: 2932G-2	2789206/ 2789082	03/2019	03/2022
Spectrum Analyzer	Rohde & Schwarz	FSV	2789106	09/2020	09/2021
Antenna mast, boresight	Innco Systems	MA4640-XP-ET- 0800-com	9002463	N/A	N/A
Temperature- Humiditymeter	Extech	SD500	2789214	07/2020	07/2021
Gain Horn antenna 1-18 GHz	EMCO	3115	2787776	12/2017	12/2020
Cable RF > 1G	H&S	Sucotest 18/ Sucoflex 102	2789108&109	06-2020	06-2021
Biconilog Testantenna	Teseq	CBL 6111D	2789237	08/2020	08/2021

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025 has been confirmed before testing. NA= Not Applicable

Accreditation

The reported tests were performed under ISO17025 accreditation, unless otherwise specified as 'not under Accreditation'

An overview of all TÜV Rheinland Nederland B.V. accreditations, notifications and designations, please visit our website www.tuv.com/nl. You can find the relevant declarations under the download link.

Notes:

For the influence of the measuring uncertainties on the results, reference is made to the validation of the respective methods.

Unless otherwise stated in this report, all tests were performed under accreditation.

The test results exclusively relate to the tested sample.

This report is only to be read as a whole, no sections from this report may be copied.

No opinions or interpretations are included in this report.

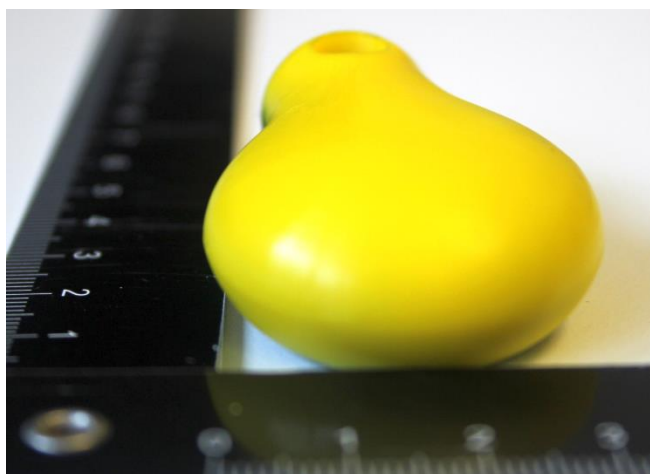
TÜV Rheinland Nederland B.V. is solely responsible for the content.

Prufbericht-Nr: 19121802.r02
Test report No:

Seite 3 von 25
Page 3 of 25

Produktbeschreibung
Product description / Disclaimer
(info as provided by the client)

1	Produktdetails <i>Product details</i>	The SMARTTAG EAR is an active Radio Frequency Identification (RFID) tag for individual tracing, cow activity monitoring, heat detecting and/or health indicating.
2	Maße / Gewicht <i>Dimensions / Weight</i>	H x W x D = 36.3x52.7x21.2 mm / 23g
3	Bedienelemente <i>Operating elements</i>	None
4	Ausstattung / Zubehör <i>Equipment / Accessories</i>	None
5	Verwendete Materialien <i>Used materials</i>	micoA @ 3Vdc non-replacable coin cel
6	Sonstiges <i>Other</i>	Firmware revision: VT2223b69 Hardware revision: A.08



Revisions <i>Revisions</i>			
Revision Revision	Datum Date	Anmerkung Remark	Verfasser Author
-	16-11-2020	First release	R. van der Meer
Note: Latest revision report will replace all previous reports			

Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Radiated Emission	30MHz – 4.5GHz	±5.22 dB

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Annex A Similarity Declaration by the client

1 General information.

1.1 Tested system details.

Details and an overview of the system and all of its components, as it has been tested, may be found below.

Antenna : Internal, gain -15 dBi
Operating frequency : 433.30 – 434.50 MHz
Sample: 433.3 MHz
Sample: 434.5 MHz
Modulation : FSK
Power setting : as is

1.1.1 Description of input and output ports.

The EUT is battery operated only and there are no actual input and output ports present.

1.2 Test summary

The EUT was tested in accordance with the specifications given in the table below.

Test Standard		Description	Page	Pass / Fail / Not Applicable
47 CFR Part 15 (10-1-18 Edition)	RSS-210 Issue 9, August 2016			
15.207(a)	RSS-Gen(8.8)	AC power line Conducted emissions	17	Not Applicable
15.209, 15.231(e)*	RSS-Gen(8.9) and RSS-210(A.1.4)	Radiated emissions	9 – 16	Pass
15.215(c)	RSS-Gen(6.7)	Bandwidth of the emission	18 - 21	Pass
15.231(e)*	RSS-210 (A.1.4)	RF on/off time	22 - 24	Pass

Table: Test specifications

1.3 Test methodology.

The test methodology used is based on the requirements of 47 CFR Part 15 (10-1-19), sections 15.31, 15.35, 15.205, 15.209, 15.231(e) and RSS-GEN (ISSUE 5, APRIL 2018) RSS-210 (ISSUE 9, AUGUST 2016).

The test methods, which have been used, are based on ANSI C63.10: 2013.

Radiated emission tests above 30 MHz were performed at a measurement distance of 3 meters.

Radiated emission tests below 30 MHz were performed at a measurement distance of 3 meters.

To calculate the field strength level from these results to the appropriate distance at which the limit is specified, the appropriate extrapolation factor is used.

The receivers are switching automatically to the right bandwidth in accordance with CISPR 16. This is implemented in the receiver. The antenna factors are programmed in the test receiver. The receiver automatically calculates the appropriate correction factor for the utilized antenna and also the appropriate antenna factor for the cable loss. The total correction is automatically added to the measured value.

1.4 Test facility.

The Semi-Anechoic chamber used to collect the radiated data has been constructed in accordance with ANSI C63.7. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meters. The site is listed with the FCC and ISED and accredited by RvA (Cert #L484). The 3 meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meter

The Federal Communications Commission and Industry Canada has reviewed the technical characteristics of the test facilities at TÜV Rheinland Nederland B.V., located in Leek, 9351VT Eiberkamp 10, The Netherlands, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948.

The description of the test facilities has been filed at the Office of the Federal Communications Commission under Designation Number NL0005 (test site registration number: 786213). The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

The description of the test facilities has been filed to Industry Canada under CABID number NL0002 (test site registration number: 2932G-2). The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

1.5 Test conditions.

Normal test conditions:

Temperature (*)	: +15°C to +35°C
Relative humidity(*)	: 20 % to 75 %
Supply voltage	: 3 V _{DC} battery powered (new battery used during testing)
Air pressure	: 950 – 1050 hPa

**When it was impracticable to carry out the tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests are stated separately.*

2 System test configuration.

2.1 Justification.

Dedicated samples were provided for each test frequency.

All tests were done with a new fully loaded battery.

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10- 2013.

2.2 EUT mode of operation.

The EUT has been tested in modulated transmit mode, i.e. the EUT is transmitting while continuously transmitting data.

Testing was performed at the lowest operating frequency (433.3 MHz) and at the highest operating frequency (434.5 MHz) of the specified frequency band.

All test set ups have been documented in pictures in the documentation package which will be submitted to the Commission.

2.3 Special accessories.

No special accessories are used and/or needed to achieve compliance.

2.4 Equipment modifications.

No modifications have been made to the equipment in order to achieve compliance.

3 Radiated emission data.

RESULT: Pass

Date of testing: 2020-10-06 & 07

Frequency range: 30MHz - 4.35GHz

Requirements:

FCC 15.205, FCC 15.209, FCC 15.231(e) and IC RSS-Gen(4.9, 7.2.2 and 7.2.5) and RSS-210(2.5)

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a), must comply with the radiated emission limits specified in FCC 15.209(a).

Radiated emissions which fall outside the operation frequency band and outside restricted bands shall either meet the limit specified in FCC 15.209(a)/ RSS-Gen (8.9) or be attenuated at least 20dB below the power level in the 100kHz bandwidth within the band that contains the highest level of the desired power (the less severe limit applies).

Test procedure:

ANSI C63.10-2013.

The EUT was placed on a nonconductive turntable 0.8m above the ground plane up to 1GHz and at 1.5m above ground plane above 1 GHz. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 30MHz to the 10th harmonic of the highest fundamental transmitter frequency. Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit. For final testing the EUT was tested only in vertical position, the worst case position from pre-tests.

3.1 Radiated field strength measurements (30 MHz – 4.35 GHz, E-field)

Frequency (MHz)	Detector	Polarization	Results (dBµV/m)	Limits @3m (dBµV/m)	Pass/Fail
30.7	Qp	Vertical	24.2	40.0	Pass
157.3	Qp	Vertical	22.2	43.5	Pass
165.5	Qp	Vertical	21.7	43.5	Pass
Fundamentals:					
433.30	Pk	Vertical	84.2	92.86	Pass
434.50	Pk	Vertical	84.4	92.88	Pass
866.6 *H	Qp	Vertical	39.5	52.9	Pass
869.0 *H	Qp	Vertical	39.5	52.9	Pass
2433.5	Pk	Vertical	42.4	74 Pk / 54 Av	Pass
3613.9	Pk	Vertical	44.3	74 Pk / 54 Av	Pass
4305.3	Pk	Vertical	45.5	74 Pk / 54 Av	Pass
4335.7 *H	Pk	Vertical	47.2	74 Pk / 54 Av	Pass
4342 *H	Pk	Vertical	48.8	74 Pk / 54 Av	Pass

Table 1 Radiated emissions of the EUT.

The results of the radiated emission tests, carried out in accordance with 47 CFR Part 15 section 15.205, 15.209, 15.231(e), RSS-210 (Annex 1) and RSS-Gen (8.9, 8.10) are depicted in Table 1.

Notes:

1. Field strength values of radiated emissions at frequencies not listed in the Table 1 above are more than 20 dB below the applicable limit.
2. Measurements were performed up to the 10th harmonic of the transmit frequency of 434.5 MHz.
3. A resolution bandwidth of 120 kHz was used below 1000 MHz.
4. Above 1000 MHz a Peak detector was used with a bandwidth of 1 MHz.
5. *^H denotes a harmonic of the fundamental, *^R denotes an emission in a restricted band
6. A selection of plots are provided on the next pages.

Used test equipment and ancillaries:

2790499	2789217	2789220	9002463	2789206/2789082	2789106	9002463	2789214	

3.2 Radiated field strength measurements of the fundamental, Average values

The table below show calculated average values from the pulsed emissions measurement data, corrected with the worst case duty cycle factor over 100 msec. The average values noted are calculated through the application of a duty cycle correction, according to part 15.35c. see section 5.2 for duty cycle details.

Duty cycle calculation:

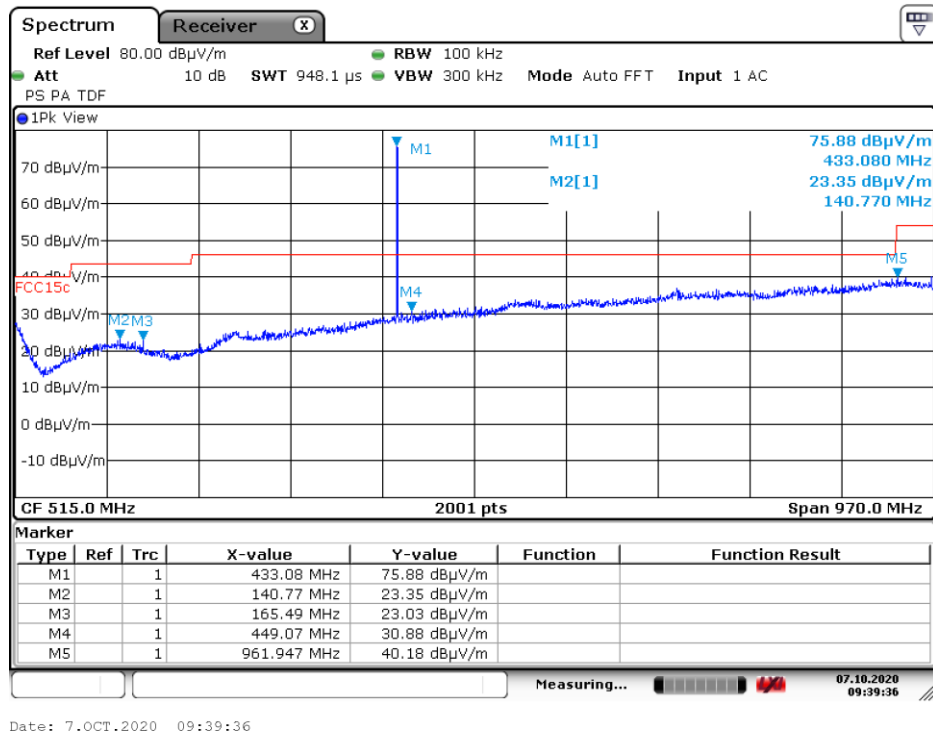
Duty cycle correction (dB) = $20 \log (10.10 \text{ msec} / 100 \text{ msec}) = -19.9 \text{ dB}$

Frequency (MHz)	Measurement results Pk @3m (dBµV)	Duty Cycle correction (dB)	Calculated results Pk @3m (dBµV)	Limits @3m (dBµV/m)	Pass/ Fail
Fundamentals:					
433.30	84.2	-19.9	64.3	72.85	Pass
434.50	84.4	-19.9	64.5	72.89	Pass

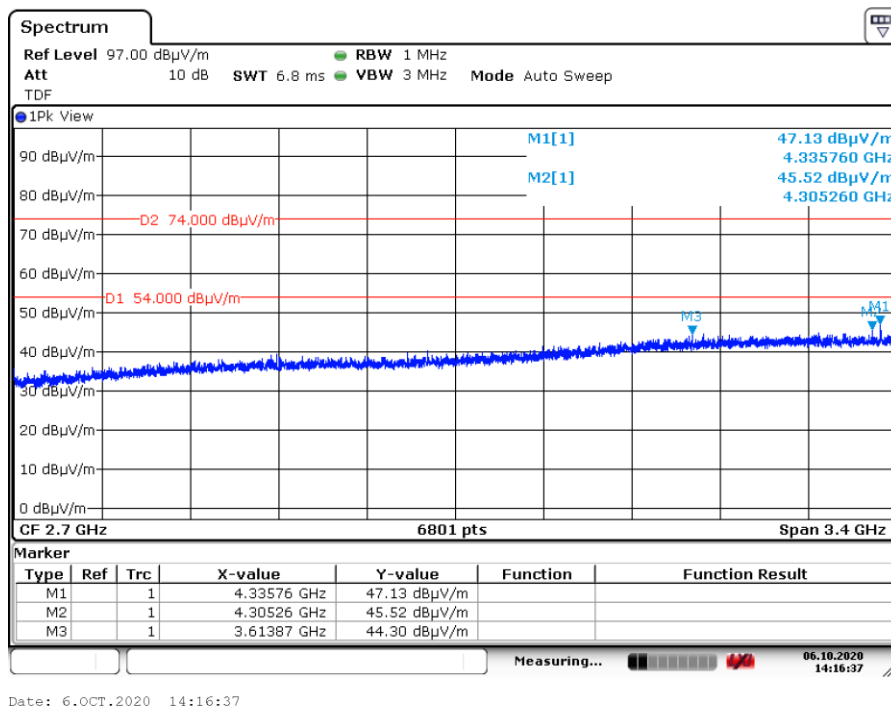
Table 2 Radiated emissions of the EUT, Average values.

The results of the radiated emission tests, carried out in accordance with 47 CFR Part 15 section 15.35, 15.205, 15.209, 15.231(e), RSS-210 and RSS-Gen are depicted in Table 2.

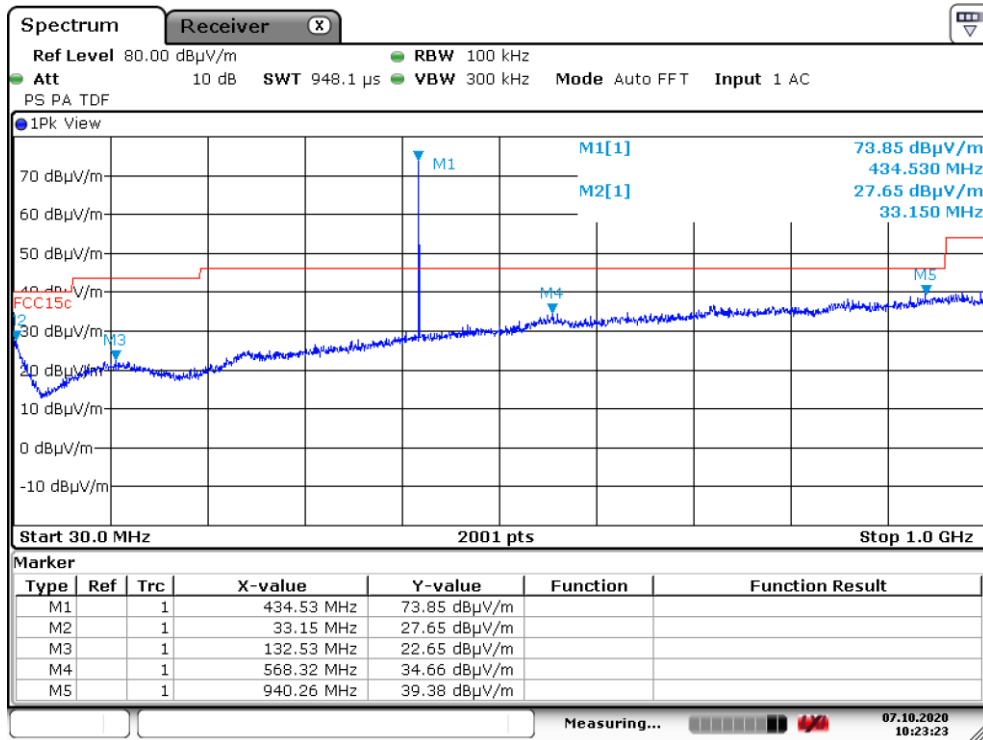
3.3 Plots of the emissions



Pre-scan Plot of the emissions in the range 30 – 1000 MHz, Antenna Vertical, EUT @ 433.3 MHz

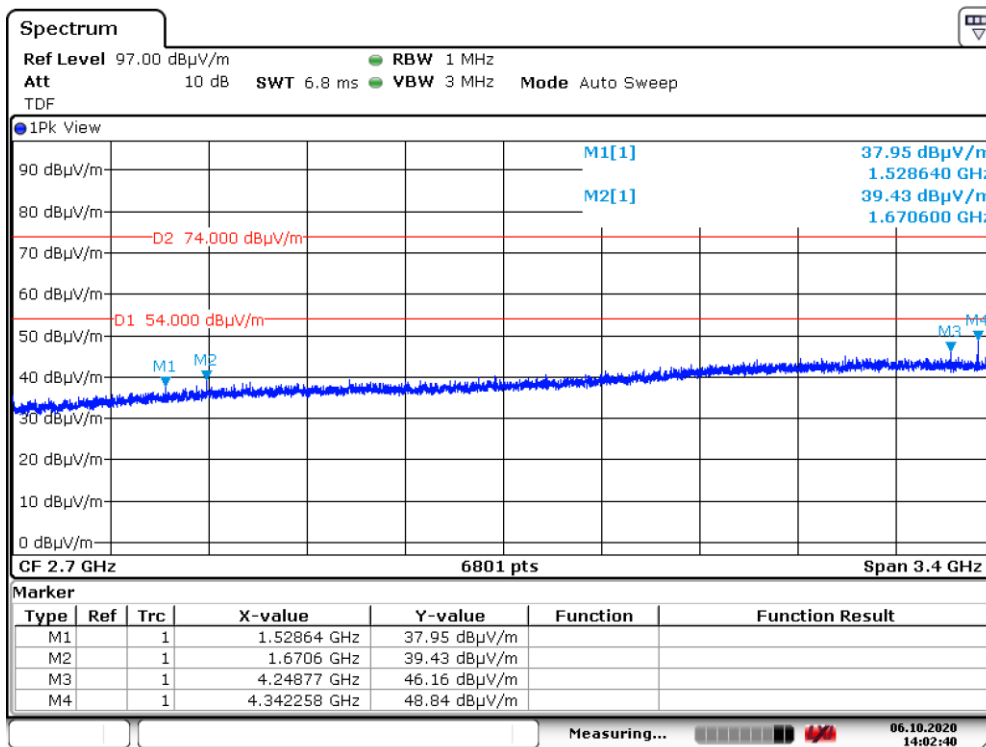


Plot of the emissions in the range 1G – 4.5 GHz, Antenna Vertical, EUT @ 433.3 MHz



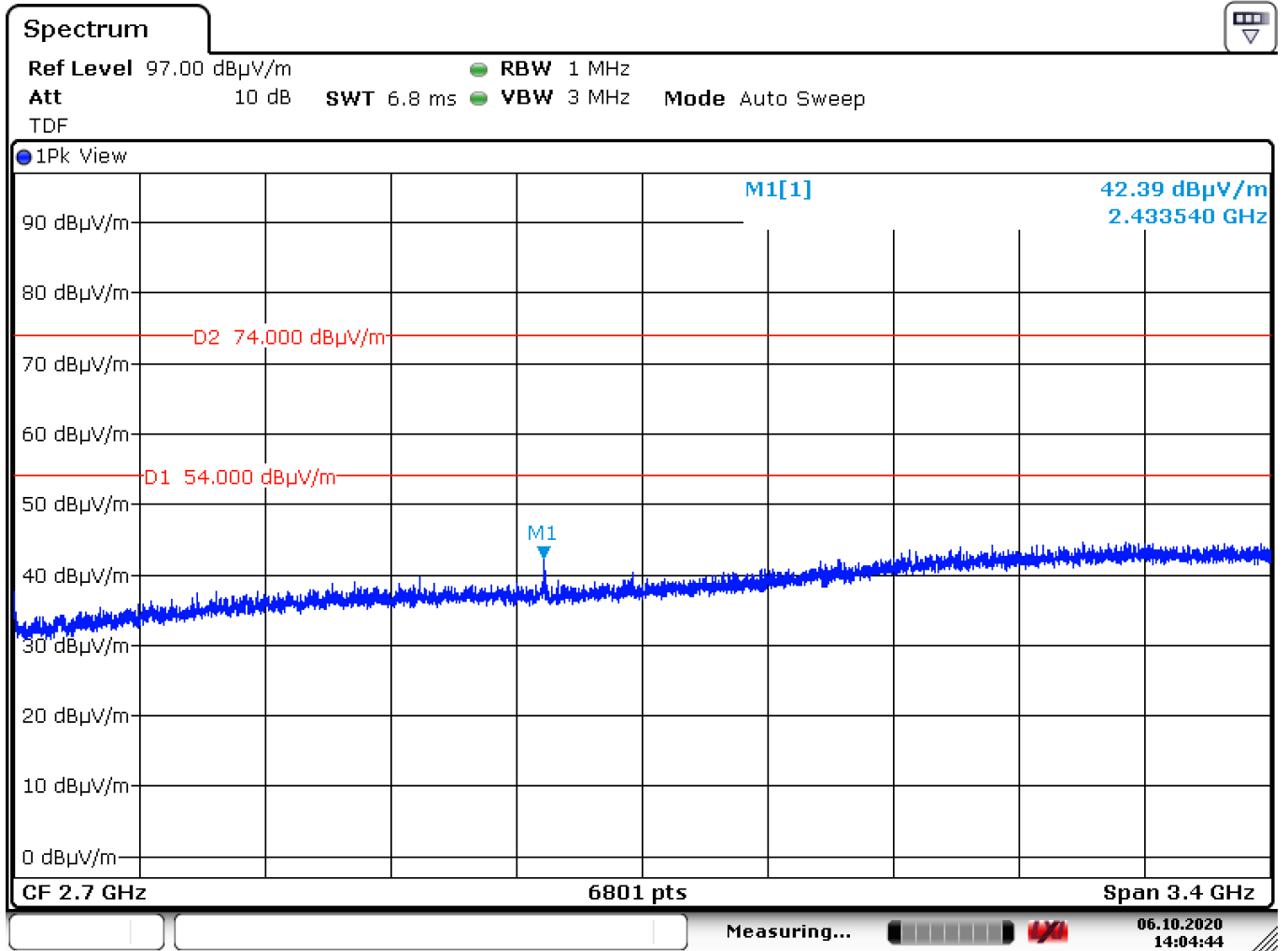
Date: 7.OCT.2020 10:23:23

Pre-scan Plot of the emissions in the range 30 – 1000 MHz, Antenna Vertical, EUT @ 434.5 MHz



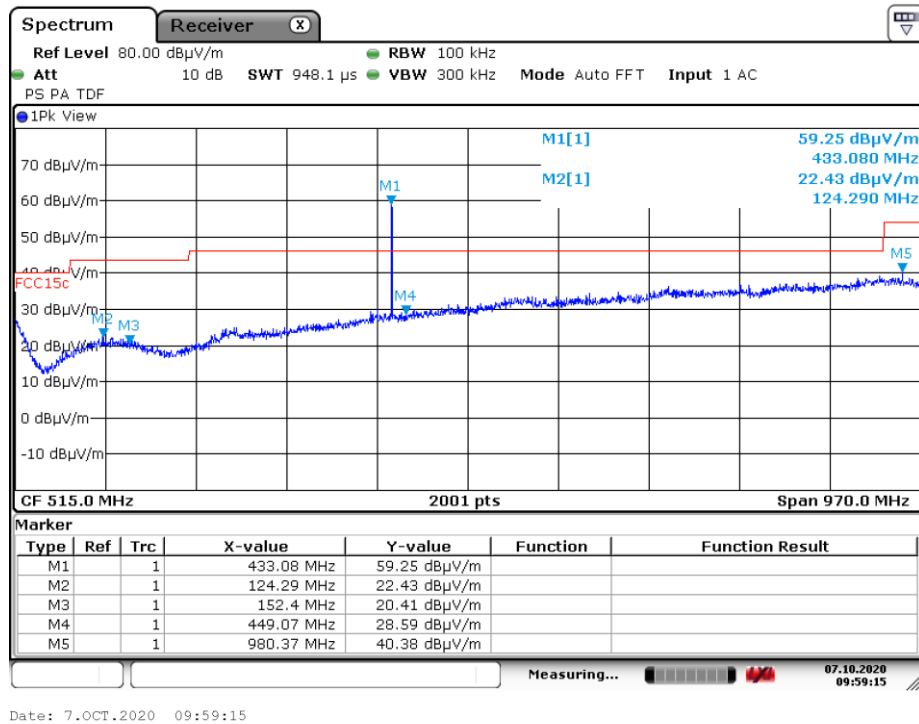
Date: 6.OCT.2020 14:02:40

Plot of the emissions in the range 1G – 4.5 GHz, Antenna Vertical, EUT @ 434.5 MHz

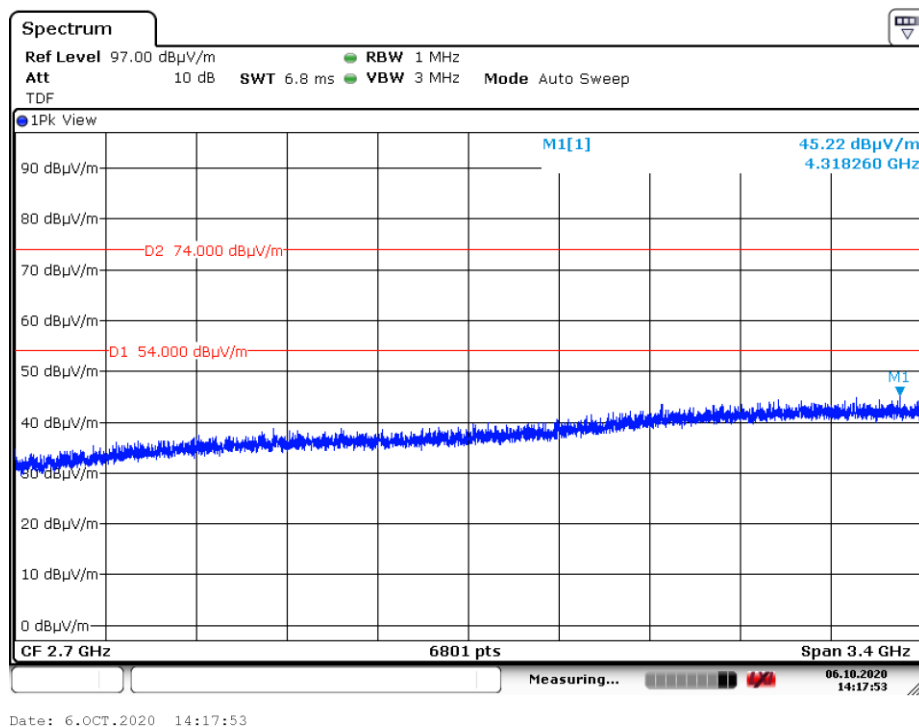


Date: 6.OCT.2020 14:04:44

Plot of the emissions in the range 1G – 4.5 GHz, Antenna Vertical, EUT horizontal @ 434.5 MHz



Pre-scan Plot of the emissions in the range 30 – 1000 MHz, Antenna Vertical, EUT Z pos @ 434.0 MHz



Plot of the emissions in the range 1G – 4.5 GHz, Antenna Vertical, EUT Z pos @ 433.3 MHz

4 AC Power line Conducted emission data.

4.1 AC Power Line Conducted Emission data of the EUT.

RESULT: Not applicable, the EUT is battery operated only.

Date of testing: Not applicable

5 Plots of measurement data

5.1 Bandwidth of the emission

RESULT: PASS

Date of testing: 2020-10-07

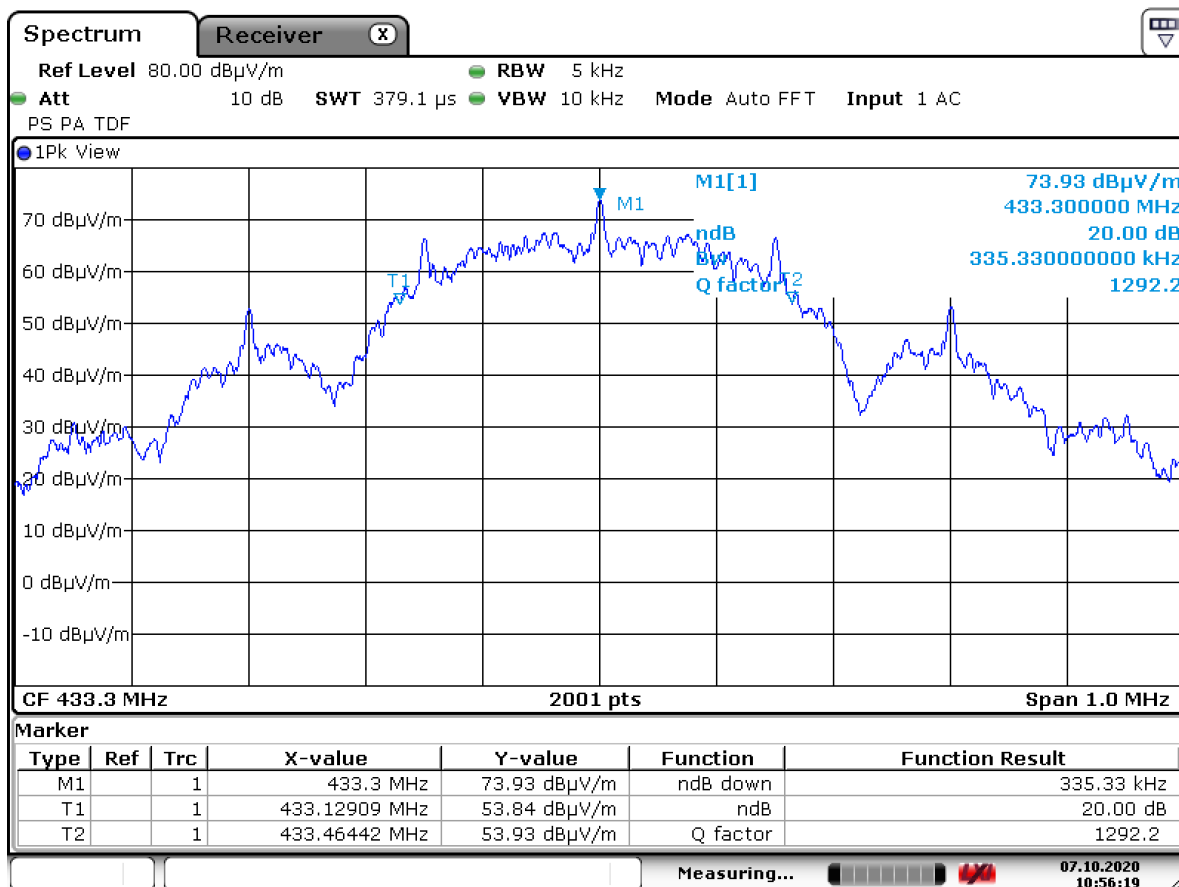
Requirement:

The bandwidth of emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier. For this EUT operating at the lowest operating frequency of 433.30 MHz (Channel 1) the allowable bandwidth of emissions would be:

$$0.25\% * 433.30 \text{ MHz} = 1083.25 \text{ kHz.}$$

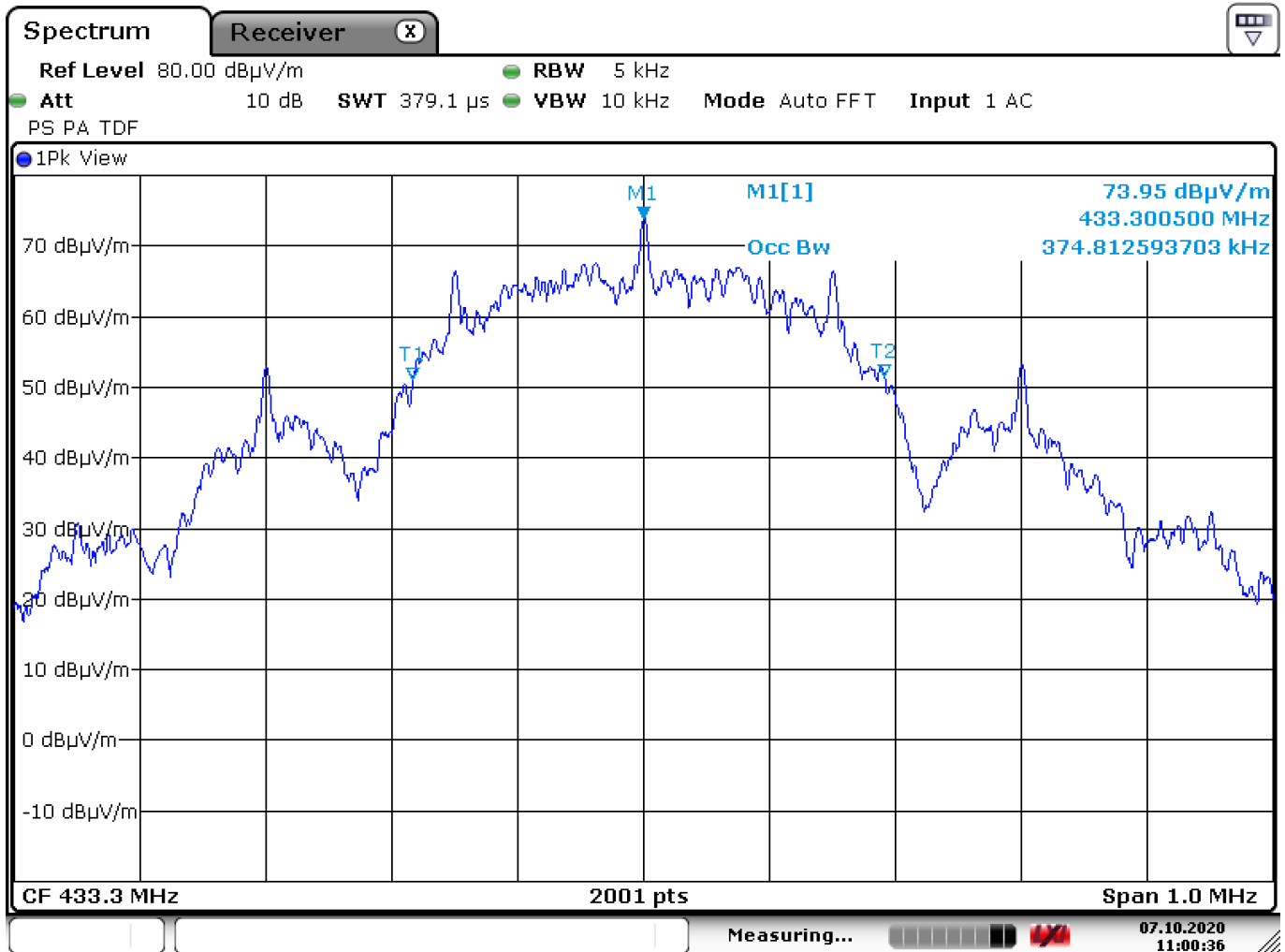
Test result:

The measured bandwidth of the emissions as measured with a spectrum analyzer was: **335.3 kHz** (see Plot 1a).



Date: 7.OCT.2020 10:56:19

Plot1a: plot of the emission at Channel 1.



Date: 7.OCT.2020 11:00:37

Plot 1b: plot of the 99% emission bandwidth Channel 1. Measured value is 374.8 kHz as measured on a spectrum analyzer.

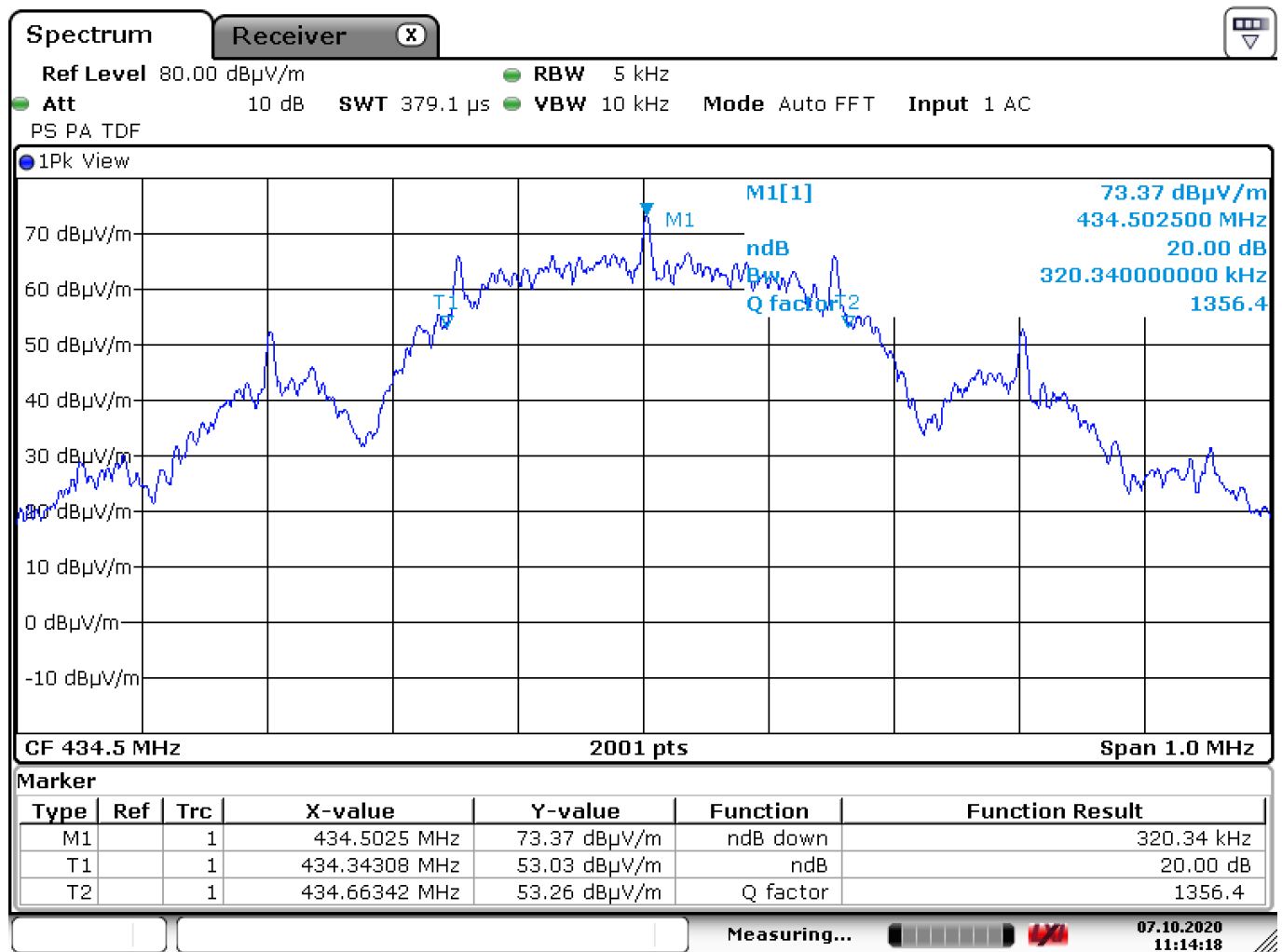
Requirement:

For this EUT operating at the highest operating frequency of 434.50 MHz the allowable bandwidth of emissions would be:

$$0.25\% * 434.50 \text{ MHz} = 1086.25 \text{ kHz.}$$

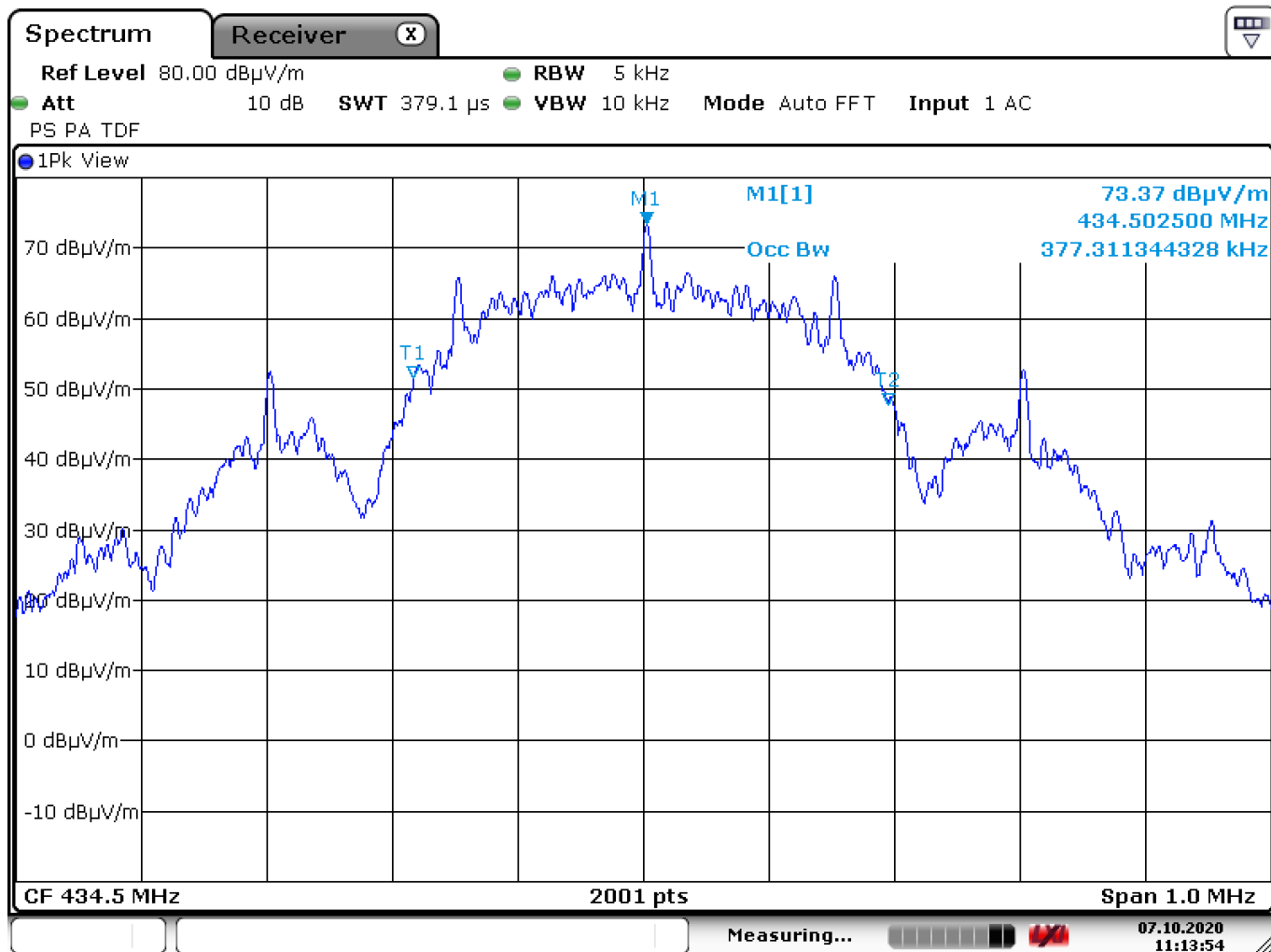
Test result:

The measured bandwidth of the emissions as measured with a spectrum analyzer was: **320.3 kHz** (see Plot2a).



Date: 7.OCT.2020 11:14:19

Plot2a: plot of the emission at 434.5 MHz



Date: 7.OCT.2020 11:13:54

Plot 2b: plot of the 99% emission bandwidth at 434.5MHz. Measured value is 377.3 kHz as measured on a spectrum analyzer.

5.2 RF On time

RESULT: PASS

Date of testing: 2020-10-07 & 2020-11-16

Requirement:

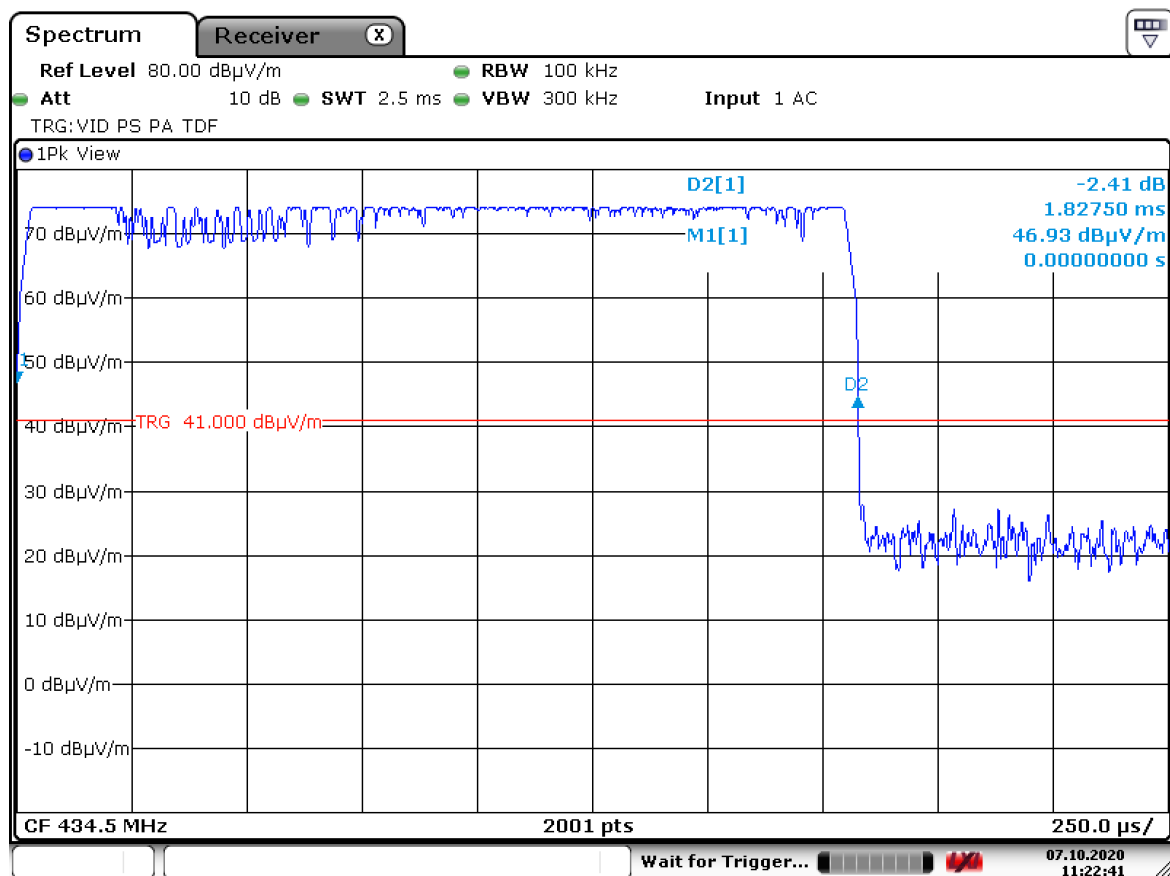
The duration of each transmission is confined within 1 second, and the required silent period is at least 10 seconds or 30 times the duration of transmissions according to 15.231(e) and RSS-210 (Annex A1.1.5)

Test result:

Plot 3 and plot 4 below shows the EUT's RF On Time.

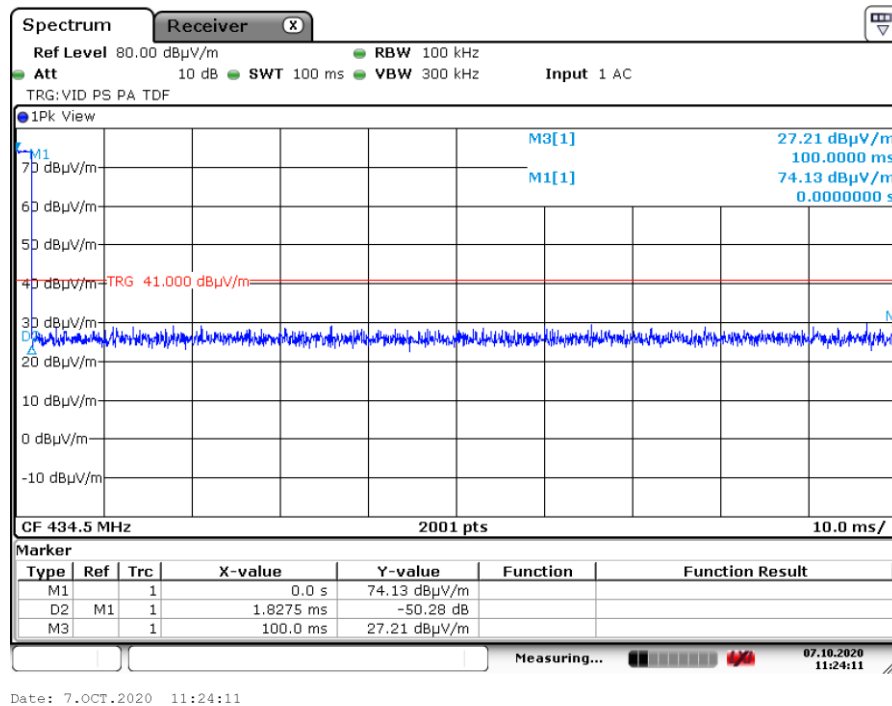
The RF On time for data transfer (position info) in 100 ms is: 1.87 ms.

The RF On time for data transfer (activity info) in 100 ms is: 10.10 ms.

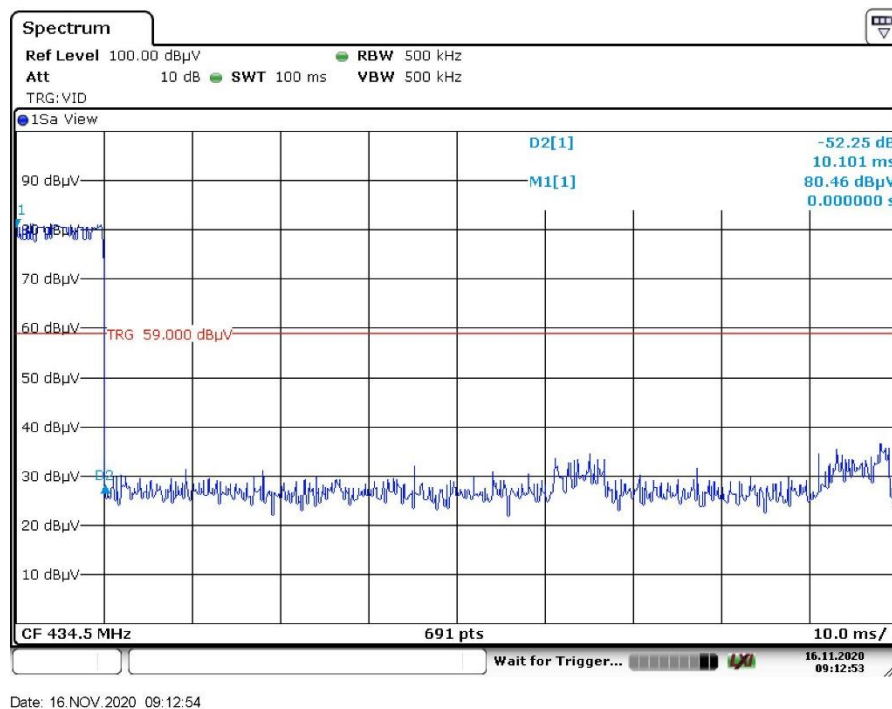


Date: 7.OCT.2020 11:22:41

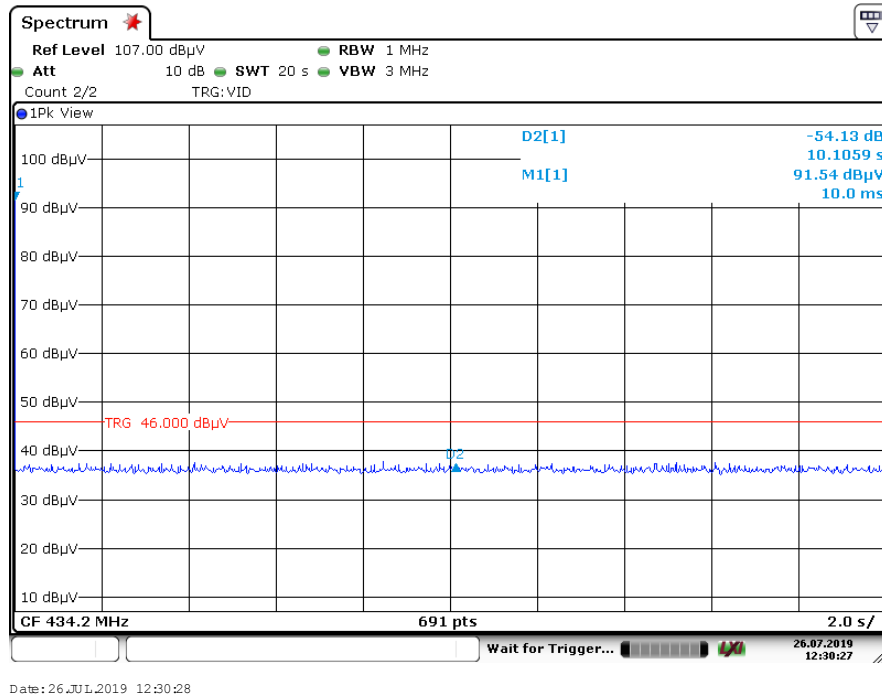
Plot 3: the duration of each data transmission (position info) is less than 1 sec.
as measured on a spectrum analyzer.



Plot 4: RF On Time for data transfer (position info) in a 100ms period, as measured on a spectrum analyzer.



Plot 5: RF On Time for Activity communication in a 100ms period, as measured on a spectrum analyzer.



Plot 6: RF Off Time as measured on a spectrum analyzer

The RF Off time is more than 10 seconds as required by section 15.231(e) as shown in plot 6 above where the RF On is indicated with marker 1. Marker D2 indicates the 10 seconds period, while the whole plot covers 20 seconds.

<< End of report >>

Annex A Similarity Declaration by the client


technology that matters

TÜV Rheinland Nederland B.V.
Eiberkamp 10
9351 VT Leek
The Netherlands

Groenlo, August 31, 2020

Subject: Similarity Declaration Nedap Smarttag Ear FER4 and FERP4

To whom it may concern

We
Nedap N.V.
Parallelweg 2
7141 DC GROENLO
The Netherlands

Declare that the engineering differences between the models are driven by an additional 3D coil and crystal for model Smarttag Ear FERP to support the feature "Cow Position". These differences are considered minor and do not impact regulatory compliance.

Model Smarttag Ear FERP4 has been tested as representative for models Smarttag Ear FER4 and Smarttag Ear FERP4 since it the max. configuration of the products and is considered to be the worst case situation regarding EMC- and radio testing.

Best Regards,

Nedap N.V.



Anne Pieter Haytema
Quality Manager Nedap Livestock management

N.V. Nederlandsche Apparatenfabriek "Nedap"
Parallelweg 2
NL-7141 DC Groenlo
P.O. Box 6
NL-7140 AC Groenlo

T +31 (0)544 471 111
F +31 (0) 544 463 475
E info@nedap.com
www.nedap.com

Traderegister 08013836
ABN-AMRO 59.16.32.330
IBAN NL83ABNA0591632330
BIC ABNANL2A
VAT NL006456285B01

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