

Prüfbericht-Nr.: <i>Test Report No.:</i>	18052801.r02	Auftrags-Nr.: <i>Order No.:</i>	89213872	Seite 1 von 25 Page 1 of 25
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	205334	Auftragsdatum: <i>Order date:</i>	17.07.2018	
Auftraggeber: <i>Client:</i>	PPA-Electronics b.v.b.a FAID'HERBESTRAAT 3A 2800 MECHELEN BELGIUM			
Prüfgegenstand: <i>Test item:</i>	Receiver for Dockmate System			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	DOCKMATE (receiver)			
Auftrags-Inhalt: <i>Order content:</i>	Compliance with regulatory requirements			
Prüfgrundlage: <i>Test specification:</i>	47 CFR Part 15 (10-1-17 edition), Subpart C			
	-			
	-			

Wareneingangsdatum: <i>Date of receipt:</i>	14.08.2018	
Prüfmuster-Nr.: <i>Test sample No.:</i>	Rx.1 (unidentified sample)	
Prüfzeitraum: <i>Testing period:</i>	12.09.2018 – 13.09.2018	
Ort der Prüfung: <i>Place of testing:</i>	Leek	
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland Nederland B.V. Leek Laboratory	
Prüfergebnis*: <i>Test result*:</i>	Pass	

geprüft von / tested by: <i>R.v.d.Meer</i>			Kontrolliert von / reviewed by: <i>E.v.d.Wal</i>		
27.09.2018	R.van der Meer/Test Eng.		27.09.2018	E. van der Wal/Senior Eng.	
Datum <i>Date</i>	Name / Stellung <i>Name / Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name / Stellung <i>Name / Position</i>	Unterschrift <i>Signature</i>
Sonstiges / Other: -					
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>			Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
<p>* 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</p> <p>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</p>					
<p>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. <i>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</i></p>					

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Liste der verwendeten Prüfmittel
List of used test equipment

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing.
NA= Not Applicable

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	ESCI	A00314	03/2018	03/2019
RF Cable S-AR	Gigalink	APG0500	A00447	01/2018	01/2019
Controller	Maturo	SCU/088/ 8090811	A00450	NA	NA
Controller	EMCS	DOC202	A00257	NA	NA
Test facility	Comtest	FCC listed: 786213 IC: 2932G-2	A00235	10/2017	10/2020
Spectrum Analyzer	Rohde & Schwarz	FSV	A00337	07/2018	07/2019
Antenna mast	EMCS	AP-4702C	A00258	NA	NA
Temperature- Humiditymeter	Extech	SD500	A00445	06/2018	06/2019
Horn antenna 1-18 GHz	EMCO	3115	A00008	12/2017	12/2020
Filterbox	EMCS	RFS06S	A00255	03/2018	03/2019
RF cables >1G setup	H&S	Sucoflex	A00339 / A00343	07/2018	07/2019
Biconilog Testantenna	Teseq	CBL 6111D	A00466	10/2017	10/2018

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.

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Produktbeschreibung
Product description

1	Produktdetails <i>Product details</i>	Receiver (Rx/Tx) for a wireless system for a boat.
2	Maße / Gewicht <i>Dimensions / Weight</i>	See product documentation
3	Bedienelemente <i>Operating elements</i>	See product documentation
4	Ausstattung / Zubehör <i>Equipment / Accessories</i>	--
5	Verwendete Materialien <i>Used materials</i>	--
6	Sonstiges <i>Other</i>	--



Absatz			
Clause	Anforderungen – Prüfungen / Requirements - Tests		
1	15.207(a)	AC Power Line Conducted Emissions <i>Note: Not applicable, does not connect to the public network</i>	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/T <input type="checkbox"/>
2	15.209, 15.231(b) 15.215(c) 15.231(b)	Radiated unwanted emissions Bandwidth of the emission RF on/off time	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>

Testmethods: ANSI C63.10-2013.

Revisions <i>Revisions</i>			
Revision Revision	Datum Date	Anmerkung Remark	Verfasser Author
-	27.09.2018	First release	R. van der Meer
Note: Latest revision report will replace all previous reports			

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1 General information.

1.1 Product description.

EUT is part of a remote control system for moto yachts, to allow easy docking. It controls Engines, Thrusters, Anchor winch and the Horn of the boat. System comprises of Transmitter (Hand held) and receiver (built into the dash board of a boat). System operates on 433MHz band. Receiver is supplied from on board 12/24V installation. Receiver has simple non-powered relay outputs - so for example relay is connected in parallel with horn switch on the dash board, to allow user to operate it remotely. Cable length of all the connections doesn't exceed 3m. Radio communication is 2-way. This report concerns the Receiver part of the system.

Details:

Voltage input rating	:	12 / 24Vdc
Antenna	:	External
Operating frequency	:	433.1 – 433.6 MHz
Modulation	:	FSK
Power setting	:	3 (max is 12)
Firmware version	:	2.11c
Remarks	:	2 way communication system.

1.2 Test methodology.

The test methodology used is based on the requirements of 47 CFR Part 15 (10-1-17), sections 15.31, 15.35, 15.205, 15.209, 15.231. The test methods, which have been used, are based on ANSI C63.10-2013.

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

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.

1.3 Test facility.

The Federal Communications Commission and Industry Canada has reviewed the technical characteristics of the test facilities at TÜV Rheinland, 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 registration number 786213. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

1.4 Test conditions.

Normal test conditions:

Temperature (*)	:	+15°C to +35°C
Relative humidity(*)	:	20 % to 75 %
Supply voltage	:	12 / 24 Vdc

**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.

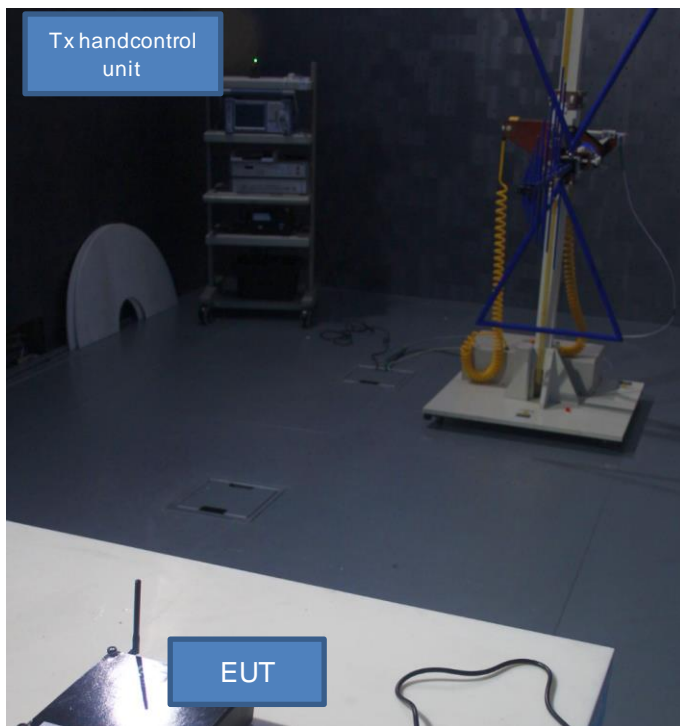
2.1 Justification.

This report covers the EUT as a stand-alone transmitter.

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.

An EUT was supplied which enabled a constant transmit mode for testing purposes. The EUT was tested while continuously communicating with the transmitter handcontrol unit. The transmitter handcontrol unit was placed on the other side of the Semi-anechoic Room far as possible away from the measurement antenna so not to influence the measurement results. It was pre-programmed for 433.2 MHz and although that is not in the middle of the frequency band it operates on (as required per ANSI C63.10-2013 section 5.6 Table 4), for practical reasons it was used for the testing. Tested on power level : 3.



2.3 Special accessories.

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

2.4 Equipment modifications.

No modifications are used and/or needed to achieve compliance.

3 Radiated emission data.

RESULT: PASS

Date of testing: 2018-09-12

Frequency range: 30MHz - 4500MHz

Requirements:

For the EUT the general radiated emissions limits are applicable according FCC 'Code of Federal Regulations Title 47' Part 15, Subpart C, Section 15.209 and limits for the transmitter per FCC 15.231(b).

The field strength of radiated emissions shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (µV/meter)	Field strength (dBµV/m)	Measurement distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0 (Av), 74 (Pk)	3

Table of applicable general radiated emissions limits per 15.209

Funda-mental fre-quency (MHz)	Field strength of funda-mental (microvolts/ meter)	Field strength of spurious emissions (microvolts/meter)
40.66–40.70.	2,250	225
70–130	1,250	125
130–174	¹ 1,250 to 3,750	¹ 125 to 375
174–260	3,750	375
260–470	¹ 3,750 to 12,500	¹ 375 to 1,250
Above 470	12,500	1,250

¹ Linear interpolations.

Table of applicable radiated emissions limits per 15.231(b), specified at a distance of 3 meters.

For the fundamental frequency the EUT operates on this would mean the Field strength level as mentioned in table below.

Frequency (MHz)	Field strength (µV/meter)	Field strength (dBµV/m)	Measurement distance (meters)
433.1 – 433.6	4385.0 – 4401.5*	80.8 (Av) – 100.8 (Pk)	3

Table of applicable radiated emissions limits per 15.231(b) for the EUT

* linear interpolation

In addition, emissions appearing in the Restricted bands of Operation listed in paragraph 15.205(a) shall not exceed the general requirements shown in paragraph 15.209.

Test procedure:

The EUT was placed on a nonconductive turntable 0.8m (<1 GHz) or 1.5m (>1GHz) above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile.

The spectrum was examined from 30MHz to 4.5 GHz (up to the 10th harmonic of the fundamental frequency the EUT operates on). Final radiated emission measurements were made at 3m distance.

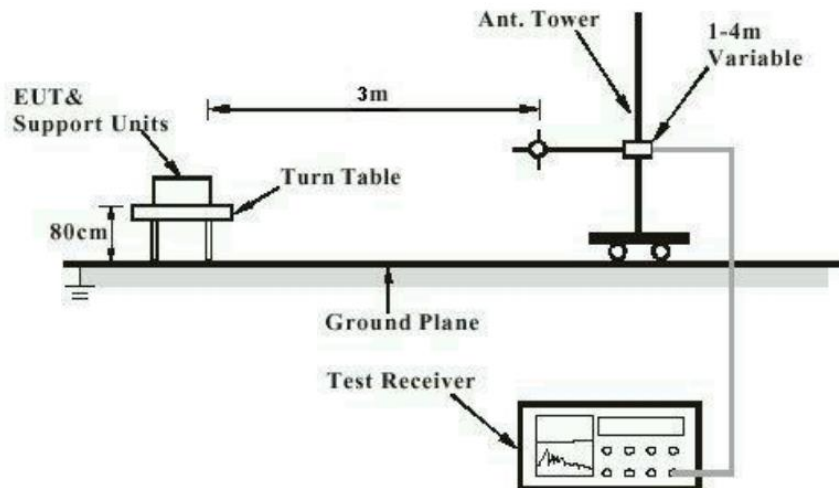
At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. The EUT was tested in horizontal and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

The six 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. Where Peak (Pk) values were at least 6 dB under the Average (Av) limits, Av value was not tested. Where Average values were tested, Average values were measured using a reduced Video Bandwidth.

Measuring instrument and setting

Radiated emissions test settings	
Frequency range	30 MHz – 4500 MHz
Test distance	3 m
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical / Horizontal
Test instrument detector and bandwidth <1GHz	Quasi-peak (Qp) 120 kHz *unless otherwise noted
Test instrument detector and bandwidth >1GHz and 15.231(b)	Peak (Pk) RBW=1MHz VBW=3MHz and Average (Avg) RBW=1MHz VBW=<3MHz >10 kHz

Test setup diagram



Note: Measurements above 1 GHz are done with a table height of 1.5m

3.1 Radiated field strength measurements (30 MHz – 1 GHz, E-field)

Frequency [MHz]	EUT Orientation	Antenna Orientation	Level Qp [dBµV/m]	Limit QP [dBµV/m]	Margin [dB]	Result Pass/Fail
31.45 noise	Horizontal	Vertical	28.0	40.0	12.0	Pass
120.00	Side	Horizontal	38.9	43.5	4.6	Pass
180.00	Horizontal	Horizontal	34.4	46.0	11.6	Pass
240.00	Horizontal	Vertical	43.9	46.0	2.1	Pass
300.00	Horizontal	Horizontal	45.1	46.0	0.9	Pass
433.2 fundamental	Vertical	Vertical	96.7 Pk 69.7 Av	100.8 Pk 80.8 Av	4.1 Pk 11.1 Av	Pass
866.4 ^{*H}	Vertical	Horizontal	45.7	46.0	0.3	Pass
894 noise	Horizontal	Horizontal	26.0	46.0	20.0	Pass

Table 2 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(b) are depicted in Table 2.

Notes:

1. Field strength values of radiated emissions at frequencies not listed in the table above are more than 20 dB below the applicable limit. The reported value is the worst case found at the reported frequency.
2. Measurement uncertainty is 5.1 dB.
3. Detector: Quasi Peak, bandwidth: 120 kHz unless otherwise stated.
4. ^{*R} refers to a frequency in a restricted band, ^{*H} refers to a harmonic of the fundamental frequency of the EUT.
5. a selection of plots is provided on the next pages.

3.1.1 Test equipment used (for reference see test equipment listing).

A00257	A00258	A00314	A00450	A00447	A00235	A00466	A00444	

3.1.2 Radiated field strength measurements (1 GHz – 4.5 GHz, E-field)

Frequency [GHz]	EUT Orientation	EUT's Antenna orientation	Antenna Orientation	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Result
1.08 ^{*R}	Vertical	Vertical	Vertical	42.3 Pk	54 (Av) 74 (Pk)	10.7	Pass
1.44 ^{*R}	Horizontal	Vertical	Horizontal	44.4 Pk	54 (Av) 74 (Pk)	9.6	Pass
2.28 ^{*HR}	Vertical	Horizontal	Horizontal	42.9 Pk	54 (Av) 74 (Pk)	11.1	Pass
3.47 ^{*H}	Horizontal	Horizontal	Vertical	47.5 Pk	54 (Av) 74 (Pk)	6.5	Pass
4.33 ^{*HR}	Horizontal	Vertical	Vertical	57.3 Pk 53.2 Av	54 (Av) 74 (Pk)	0.7	Pass

Table 3 Radiated emissions of the EUT in the frequency range 1 – 4.5 GHz

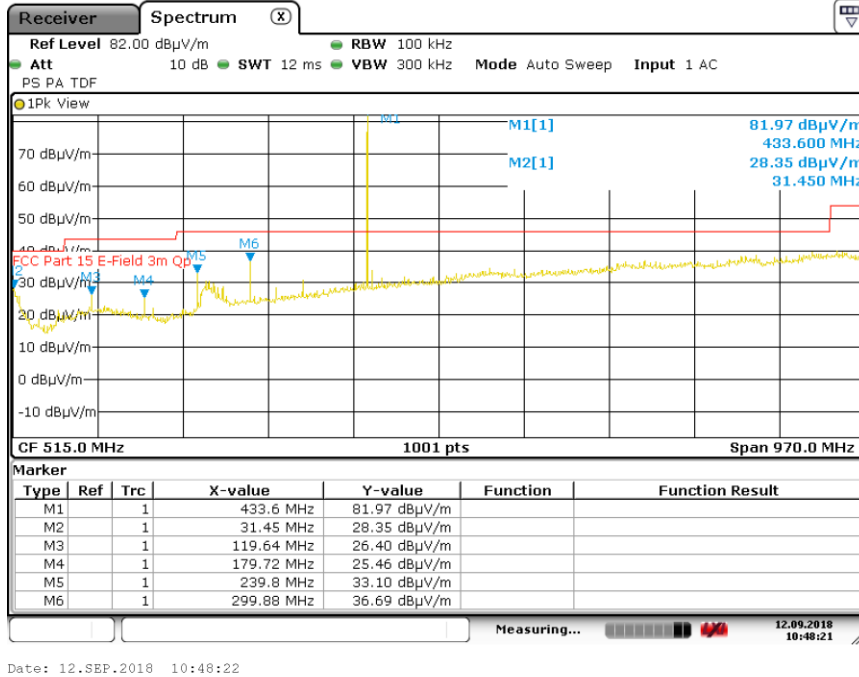
Notes:

- ^{*R} refers to a frequency in a restricted band,
- ^{*H} refers to a frequency which is a harmonic of the fundamental.
- Field strength values of radiated emissions not listed in the tables above are more than 20 dB below the applicable limit.
- Where Peak (Pk) values were within a 6 dB margin of Average (Av) limits, Av not tested.
- Measurement uncertainty is +/- 5.1 dB.
- a selection of plots is provided on the next pages.

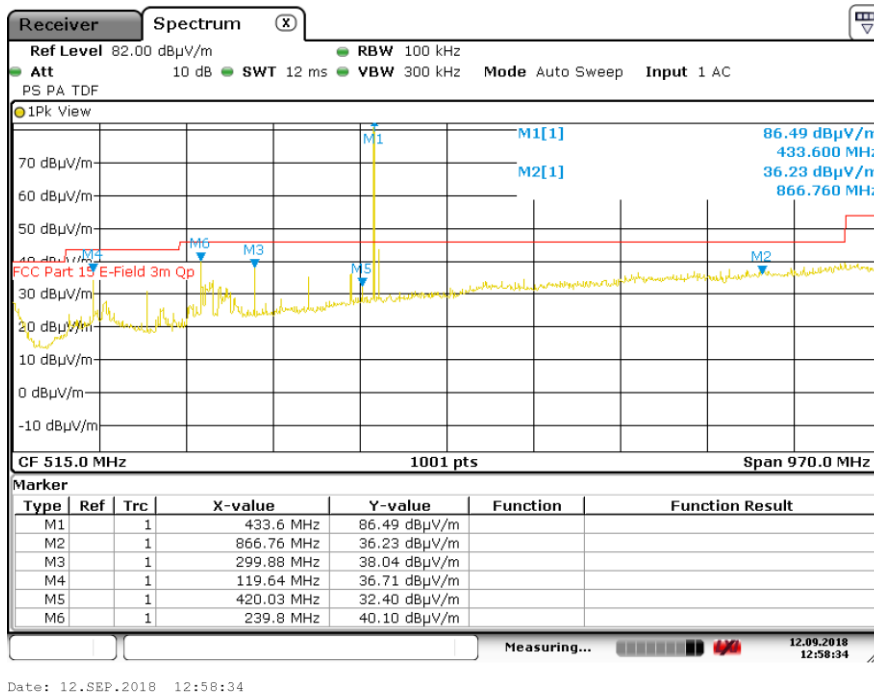
Used test equipment and ancillaries:

A00450	A00257	A00235	A00337	A00258	A00444	A00008	A00247	A00255

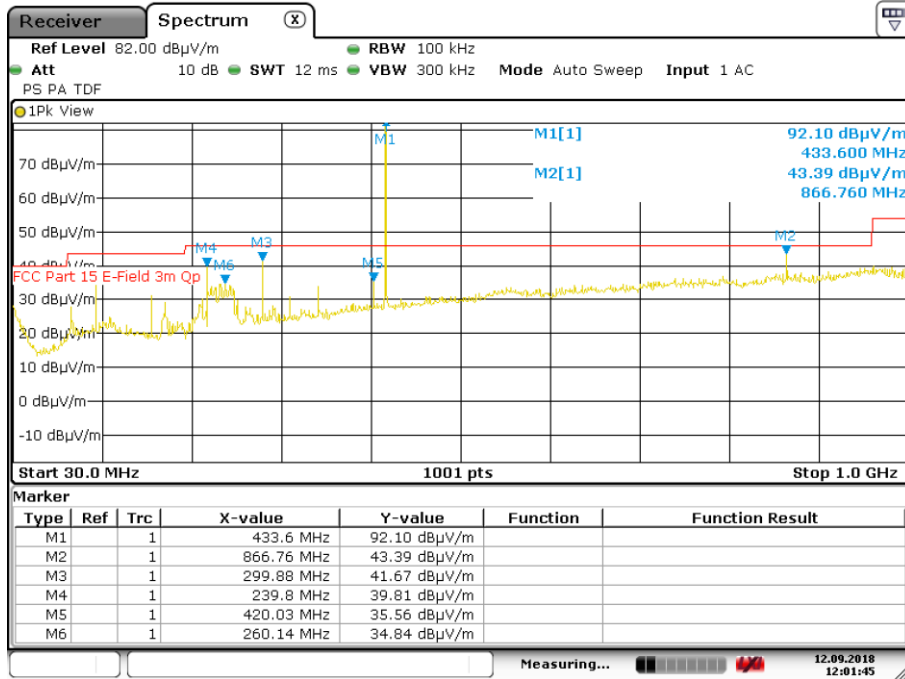
3.1.3 Plot of the emissions below 1 GHz



Plot 1: the emissions , EUT Horizontal, Antenna Vertical polarization, Peak values shown

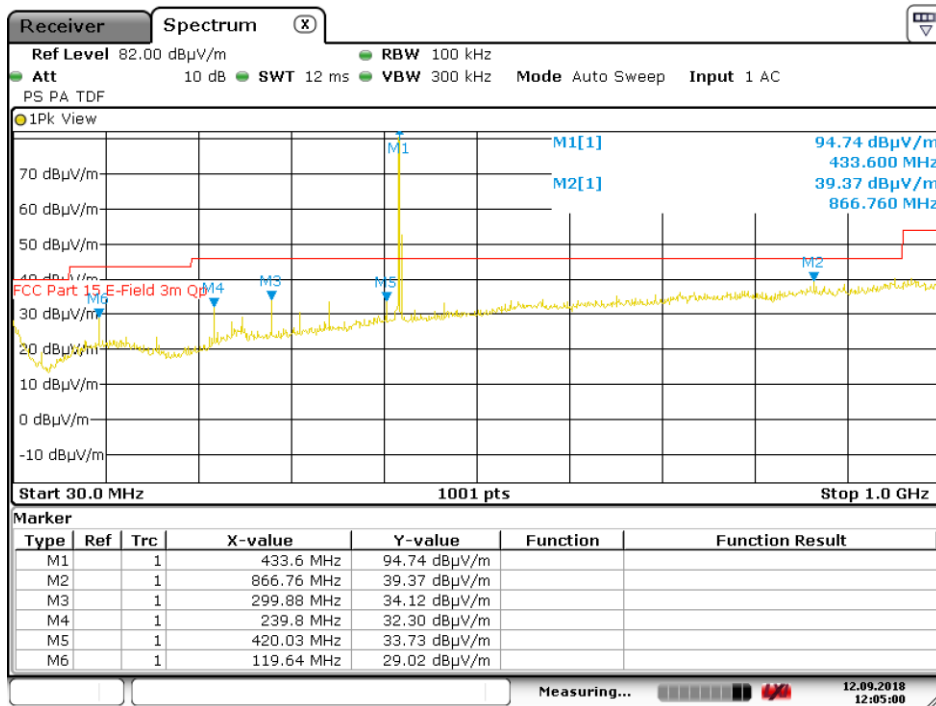


Plot 2: of the emissions, EUT Side-Antenna Horizontal, Antenna Horizontal polarization, Peak values shown



Date: 12.SEP.2018 12:01:45

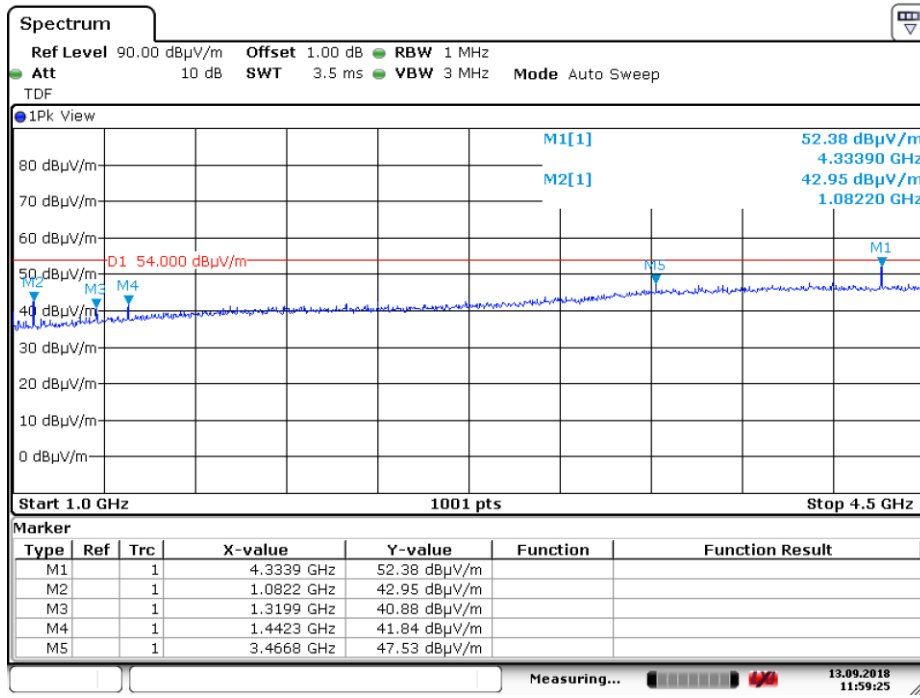
Plot 3: the emissions, EUT Side, Antenna Horizontal polarization, Peak values shown



Date: 12.SEP.2018 12:05:00

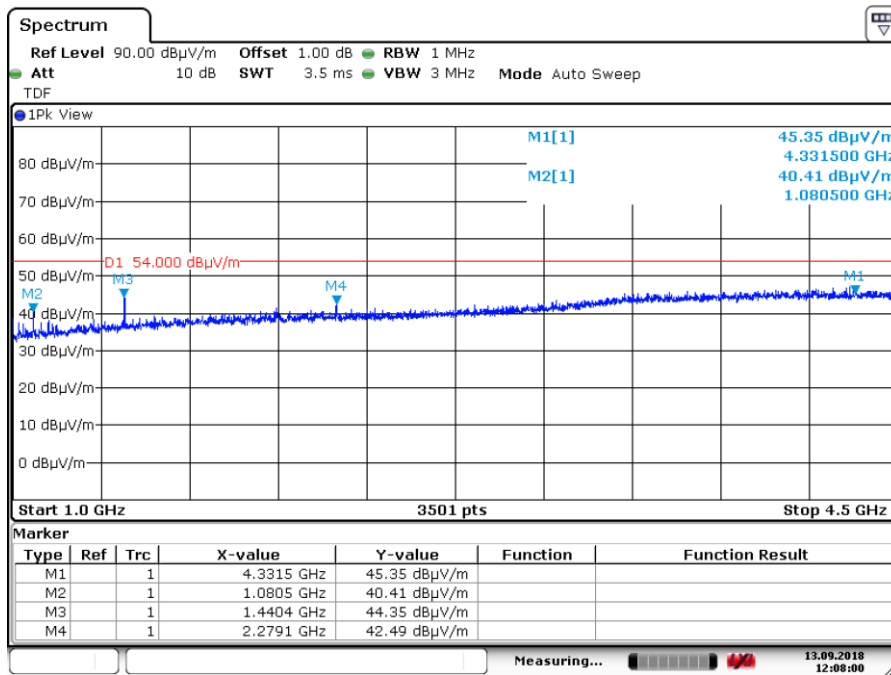
Plot 4: the emissions, EUT Side, Antenna Vertical, Peak values shown

3.1.4 Plots of the emissions above 1 GHz



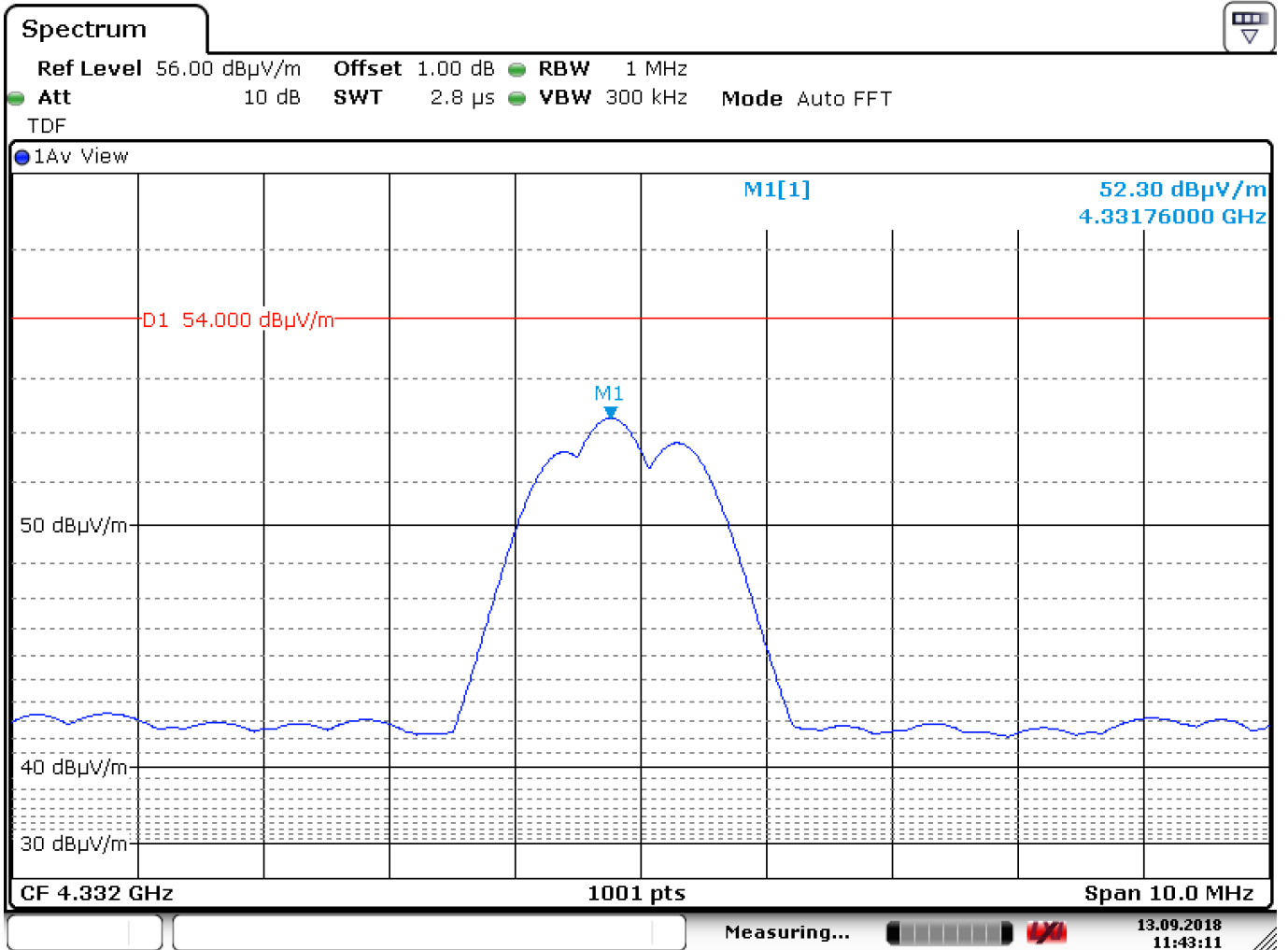
Date: 13.SEP.2018 11:59:24

Plot 5: radiated emissions of the EUT, in the range 1 – 4.5 GHz (peak values shown), EUT horizontal, Antenna vertical



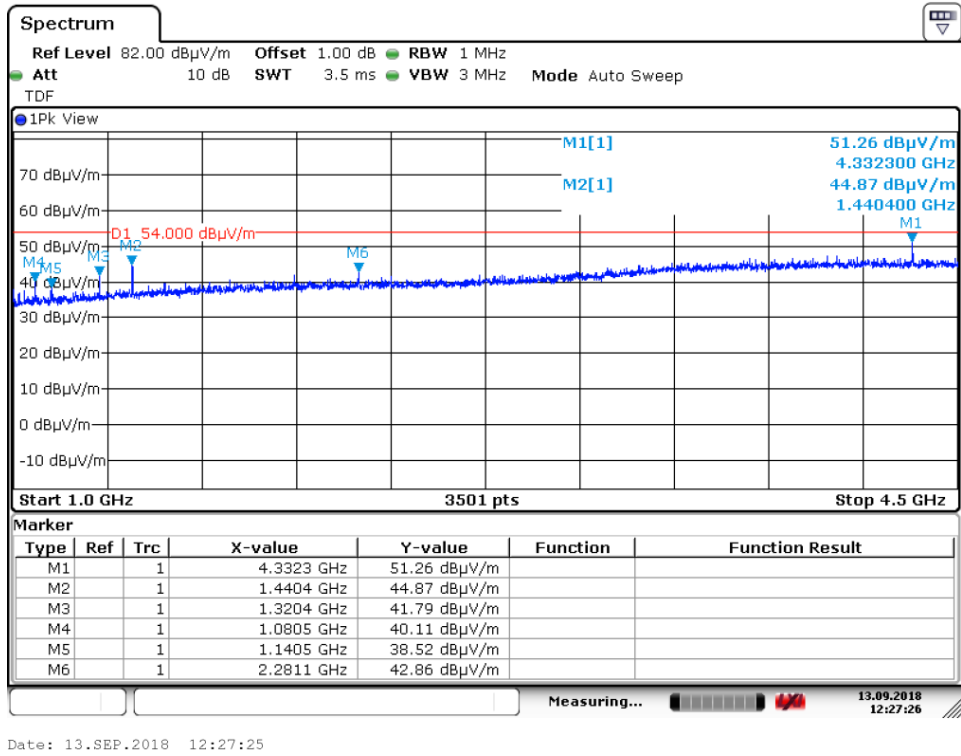
Date: 13.SEP.2018 12:08:00

Plot 6: radiated emissions of the EUT, in the range 1 – 4.5 GHz (peak values shown), EUT Horizontal, Antenna vertical

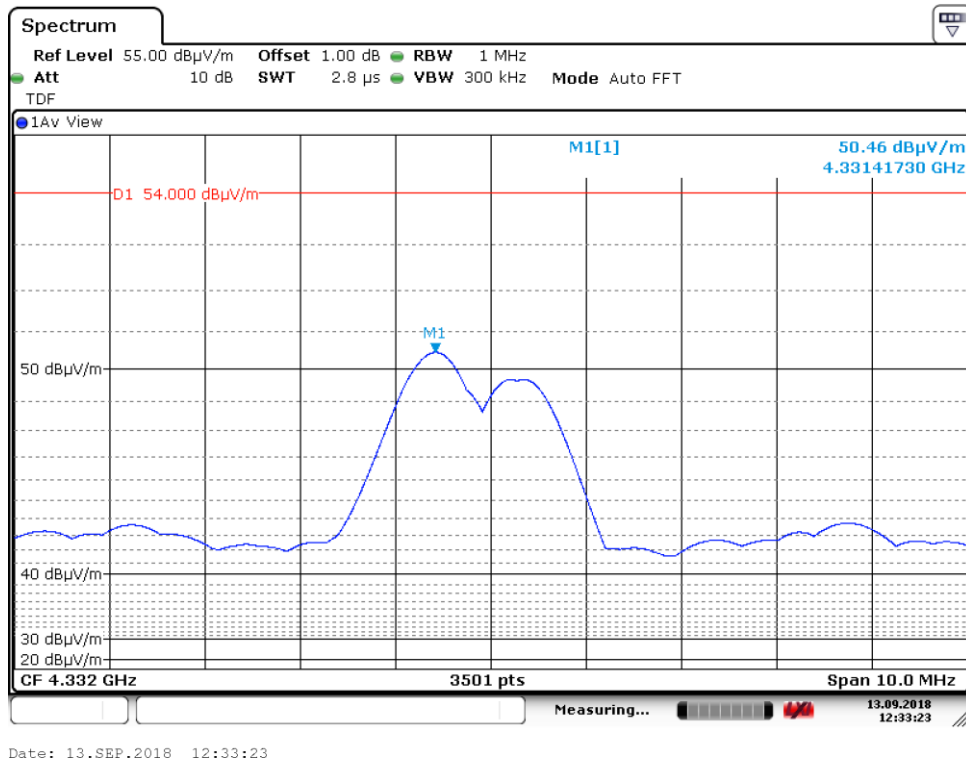


Date: 13.SEP.2018 11:43:10

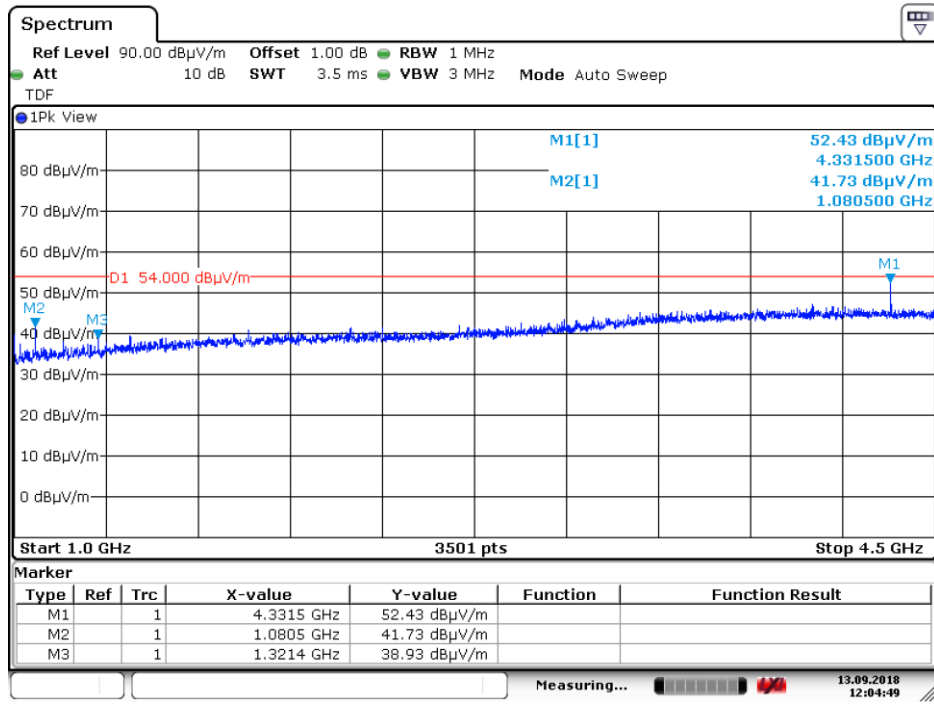
Plot 6b: radiated emissions of the EUT, in the range 1 – 4.5 GHz (average value shown),
EUT Horizontal, Antenna vertical



Plot 7a: radiated emissions of the EUT, in the range 1 – 4.5 GHz (peak values shown), EUT vertical, Antenna horizontal

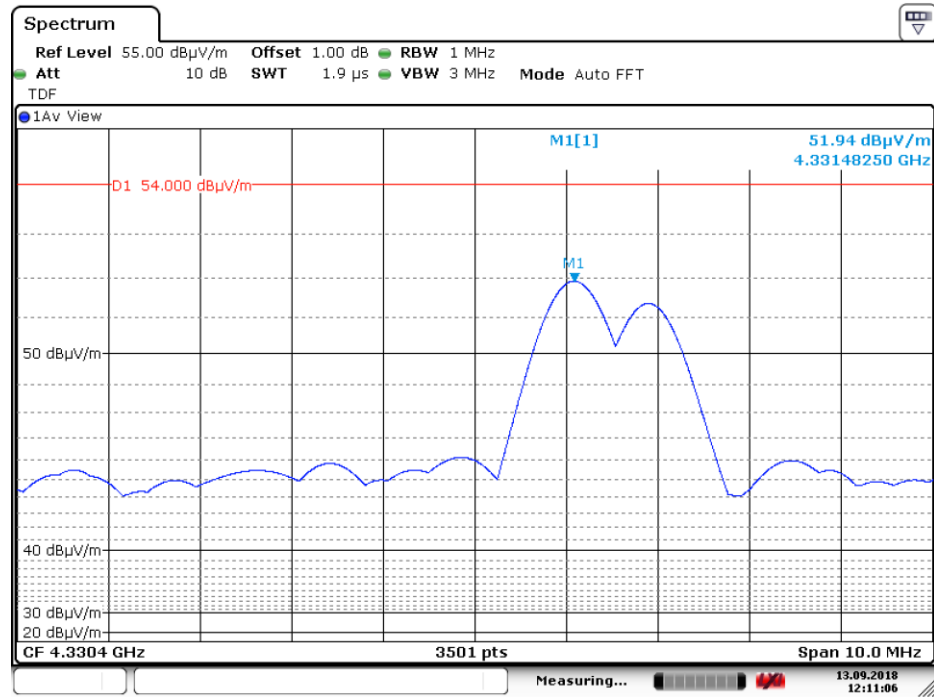


Plot 7b: radiated emissions of the EUT, in the range 1 – 4.5 GHz (4.33 GHz average value shown), EUT vertical, Antenna horizontal



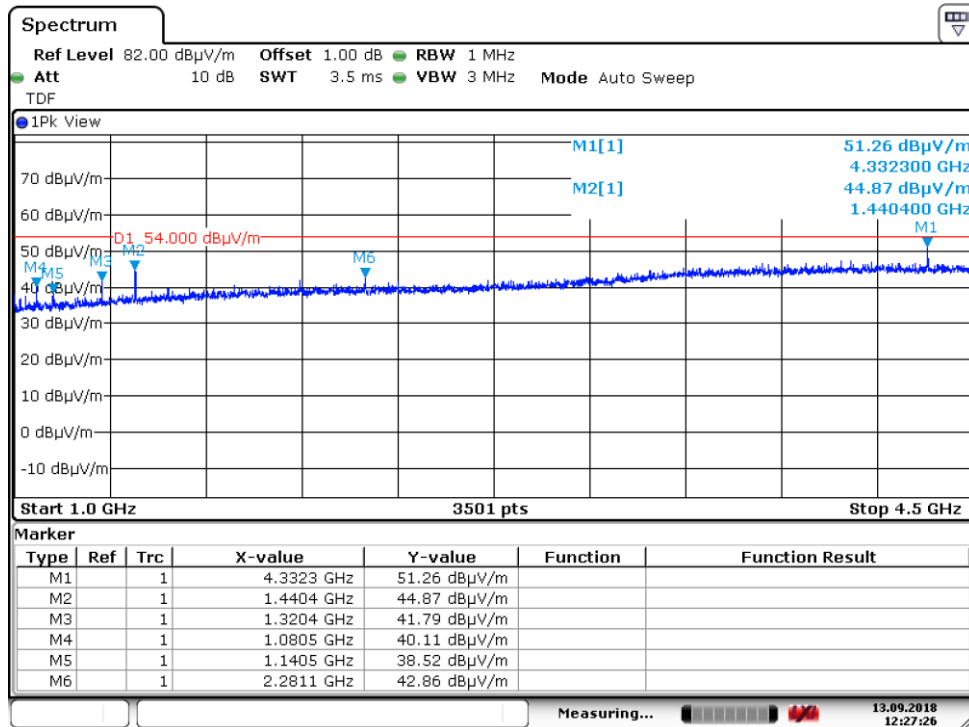
Date: 13.SEP.2018 12:04:49

Plot 8a: radiated emissions of the EUT, in the range 1 – 4.5 GHz (peak values shown), EUT vertical, Antenna vertical



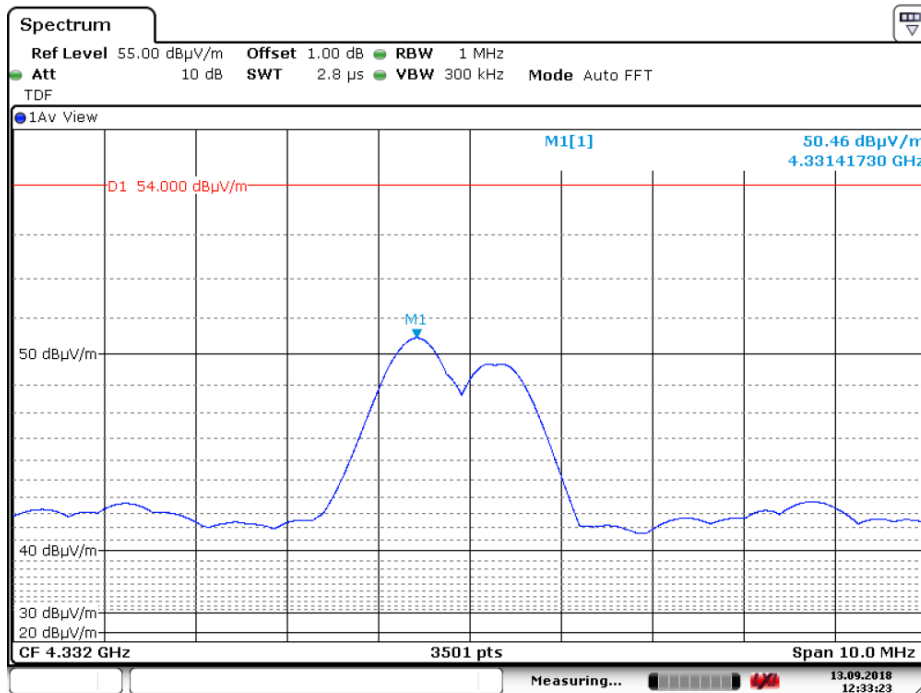
Date: 13.SEP.2018 12:11:06

Plot 8b: radiated emissions of the EUT, in the range 1 – 4.5 GHz (4.33 GHz average value shown), EUT vertical, Antenna vertical



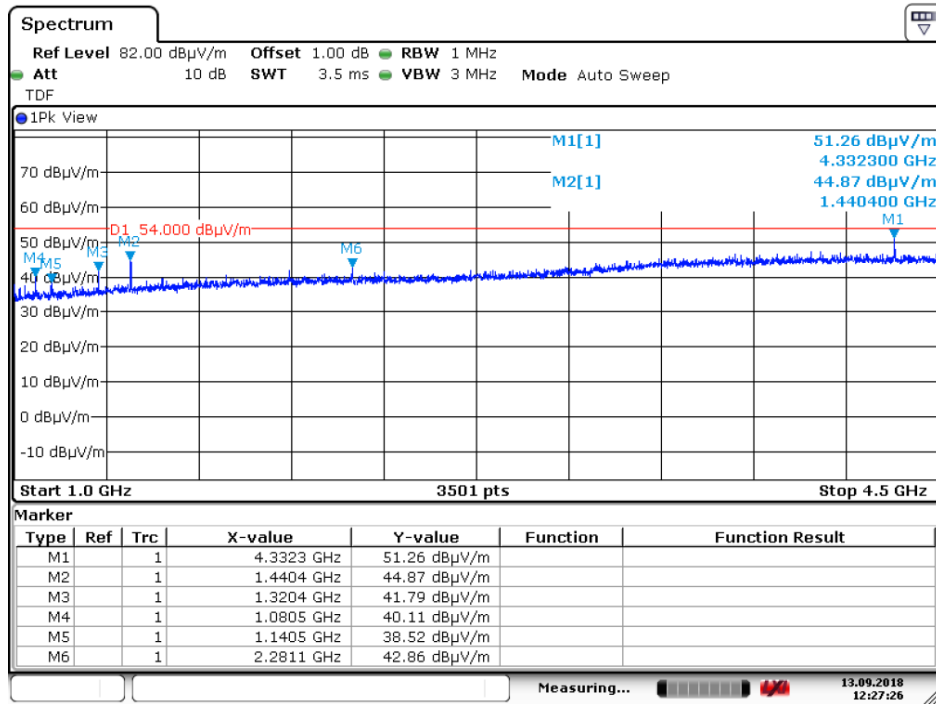
Date: 13.SEP.2018 12:27:25

Plot 9a: radiated emissions of the EUT, in the range 1 – 4.5 GHz (peak values shown), EUT horizontal, EUT Ant vertical, Antenna vertical



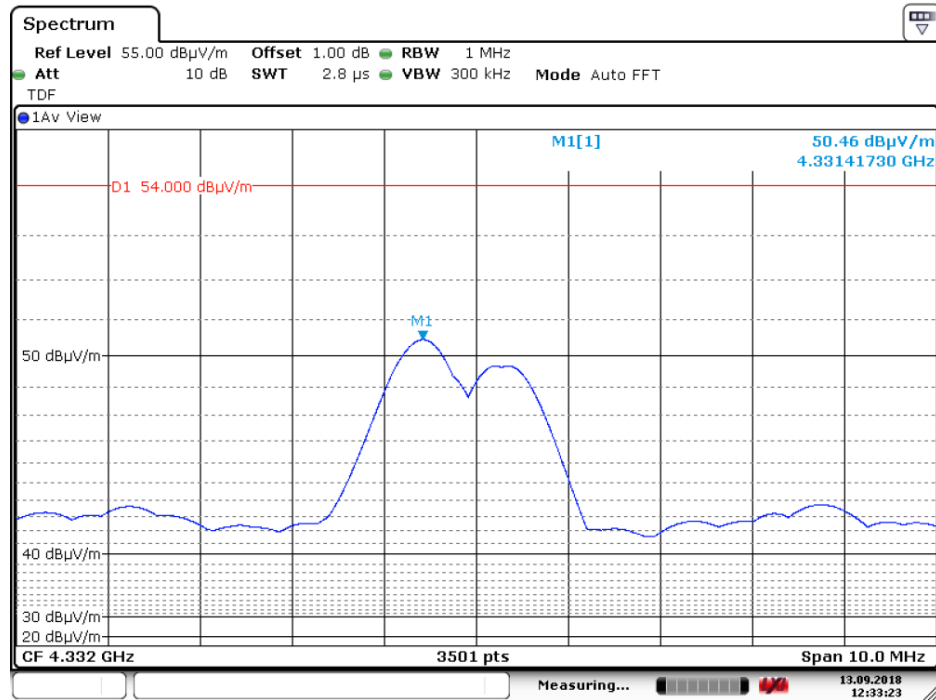
Date: 13.SEP.2018 12:33:23

Plot 9b: radiated emissions of the EUT, in the range 1 – 4.5 GHz (4.33 GHz average value shown), EUT horizontal, EUT Ant vertical, Antenna vertical



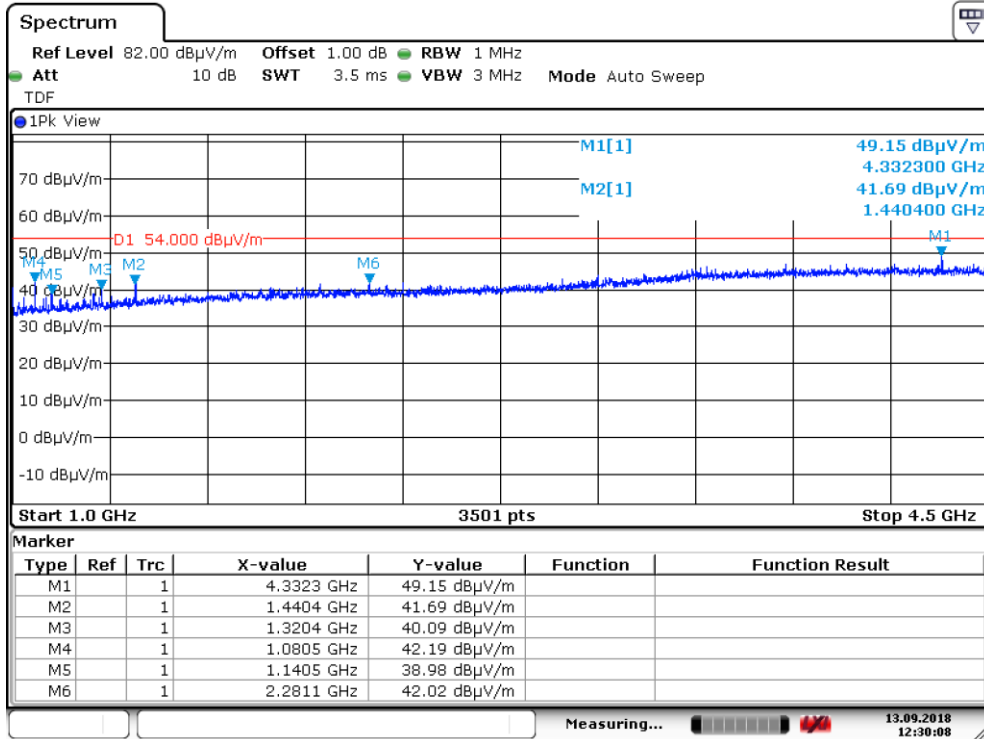
Date: 13.SEP.2018 12:27:25

Plot 10a: radiated emissions of the EUT, in the range 1 – 4.5 GHz (peak values shown), EUT vertical, EUT Ant horizontal, Antenna horizontal



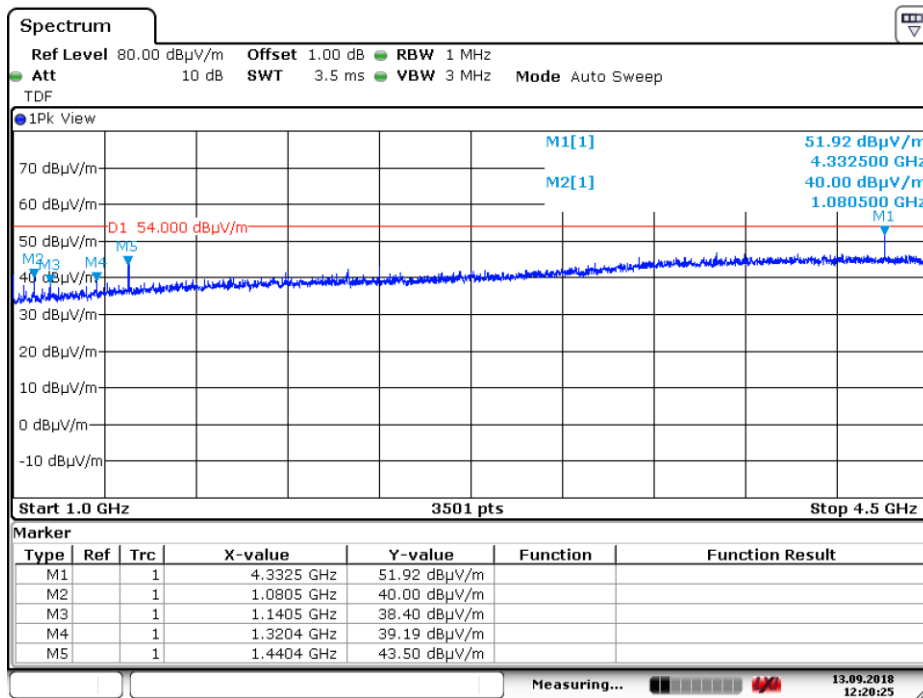
Date: 13.SEP.2018 12:33:23

Plot 10b: radiated emissions of the EUT, in the range 1 – 4.5 GHz (4.33 GHz average value shown), EUT vertical, EUT Ant horizontal, Antenna horizontal



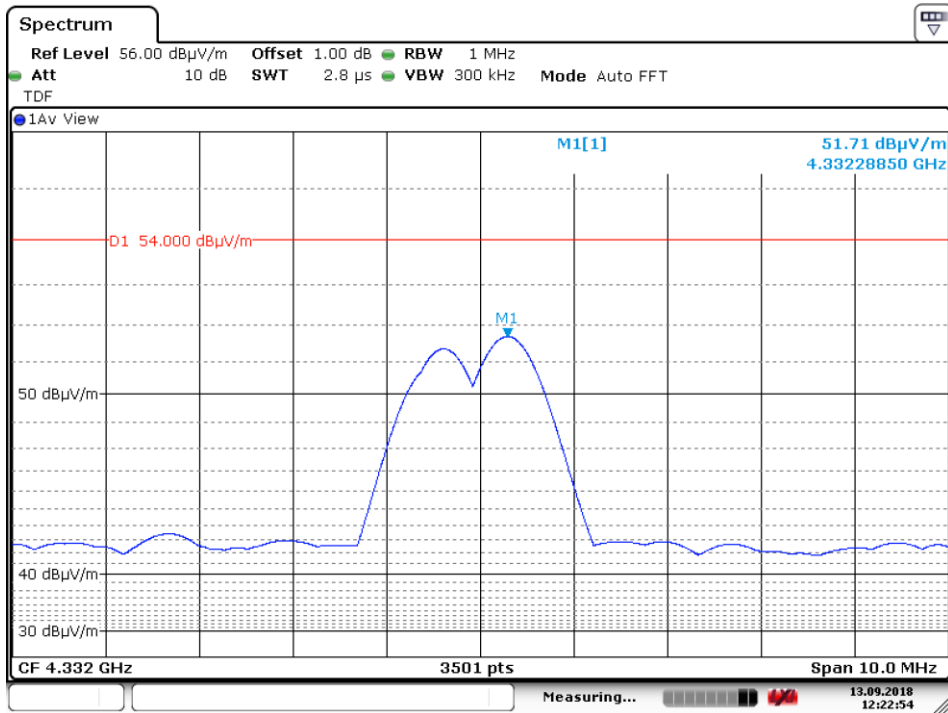
Date: 13.SEP.2018 12:30:08

Plot 11: radiated emissions of the EUT, in the range 1 – 4.5 GHz (peak values shown), EUT vertical, EUT Ant horizontal, Antenna vertical



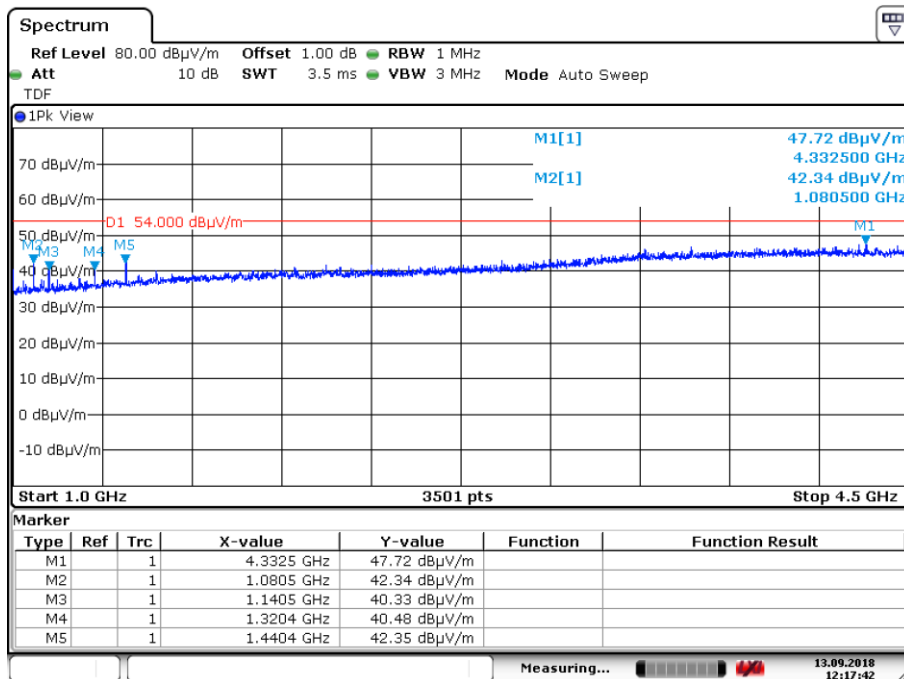
Date: 13.SEP.2018 12:20:24

Plot 12a: radiated emissions of the EUT, in the range 1 – 4.5 GHz (peak values shown), EUT vertical, EUT Ant vertical, Antenna horizontal



Date: 13.SEP.2018 12:22:53

Plot 12b: radiated emissions of the EUT, in the range 1 – 4.5 GHz (4.33 GHz average value shown), EUT vertical, EUT Ant vertical, Antenna horizontal



Date: 13.SEP.2018 12:17:42

Plot 13: radiated emissions of the EUT, in the range 1 – 4.5 GHz (peak values shown), EUT vertical, EUT Ant vertical, Antenna vertical

4 Plot of the carrier bandwidth

4.1 Bandwidth of the emission

RESULT: PASS

Date of testing: 2018-09-12

Requirements:

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 operating frequency of 433.2 MHz the allowable bandwidth of emissions would be: $0.25\% * 433.2 \text{ MHz} = 1083 \text{ kHz}$.

Testprocedure: ANSI C63.10-2013

Testresults:

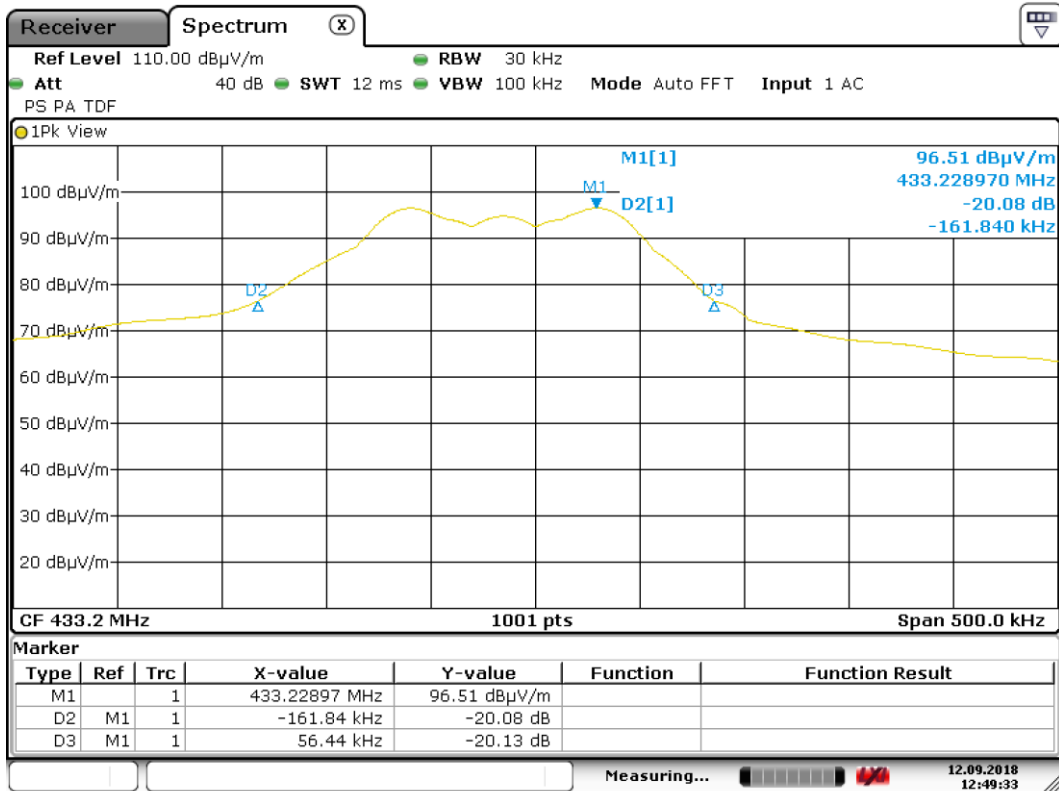
Measurement uncertainty is +/- 26kHz.

The measured bandwidth of the emissions as measured with a spectrum analyzer was: 218.3 kHz (see Plot 14). The test was performed on a modified EUT, where constant transmission was enabled. See next page for the plot.

Used test equipment and ancillaries:

A00266	A01744	A00444	A01634				
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The complete list of used equipment can be found in section 1 of this testreport.



Date: 12.SEP.2018 12:49:33

Plot 14: plot of the emission.

Note: the measurement was taken at an output power level of 12, hence the high level at M1.

4.2 RF On time

RESULT: PASS

Date of testing: 2018-09-12

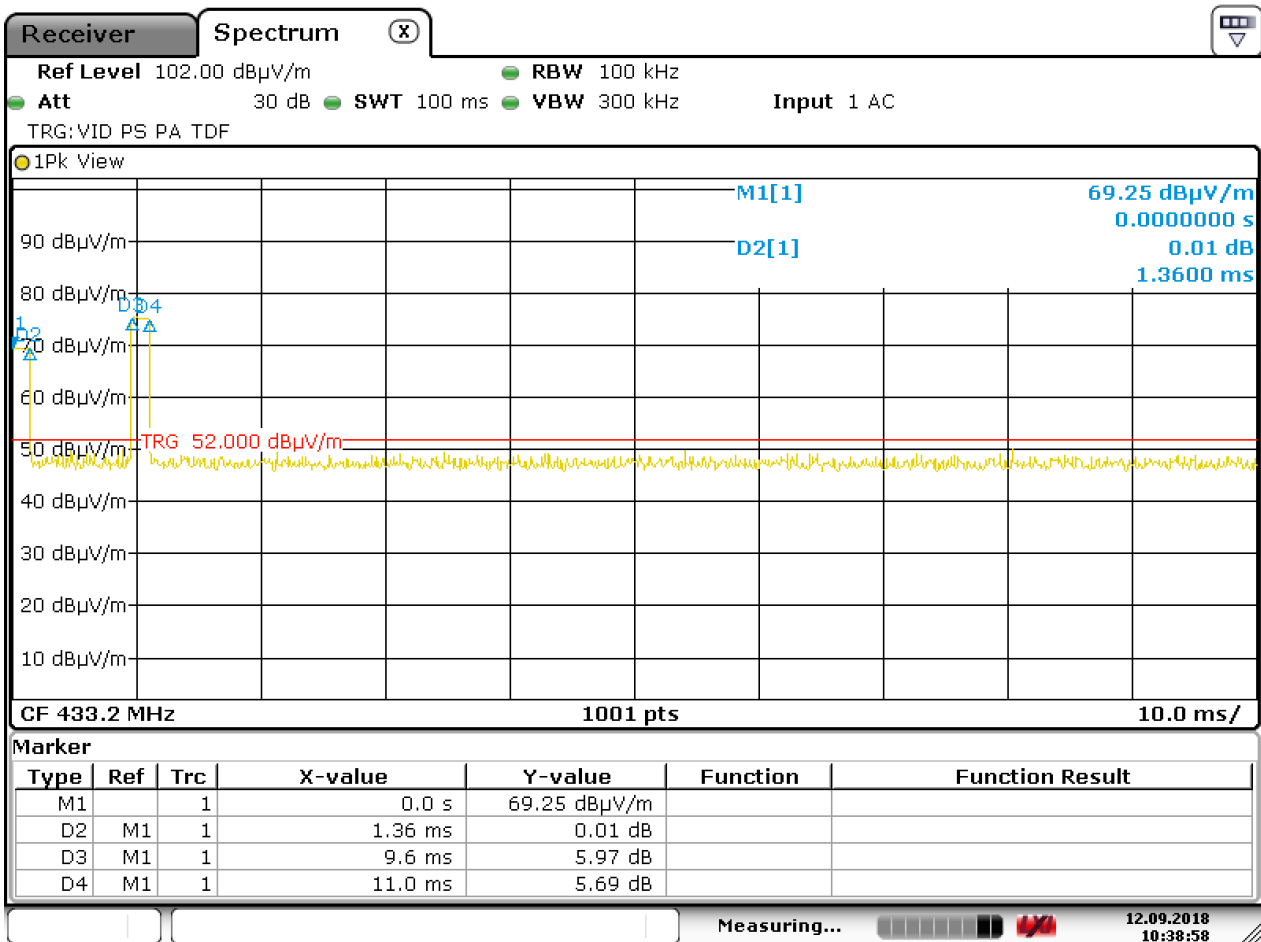
Requirement:

15.231(a)(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

Testresult:

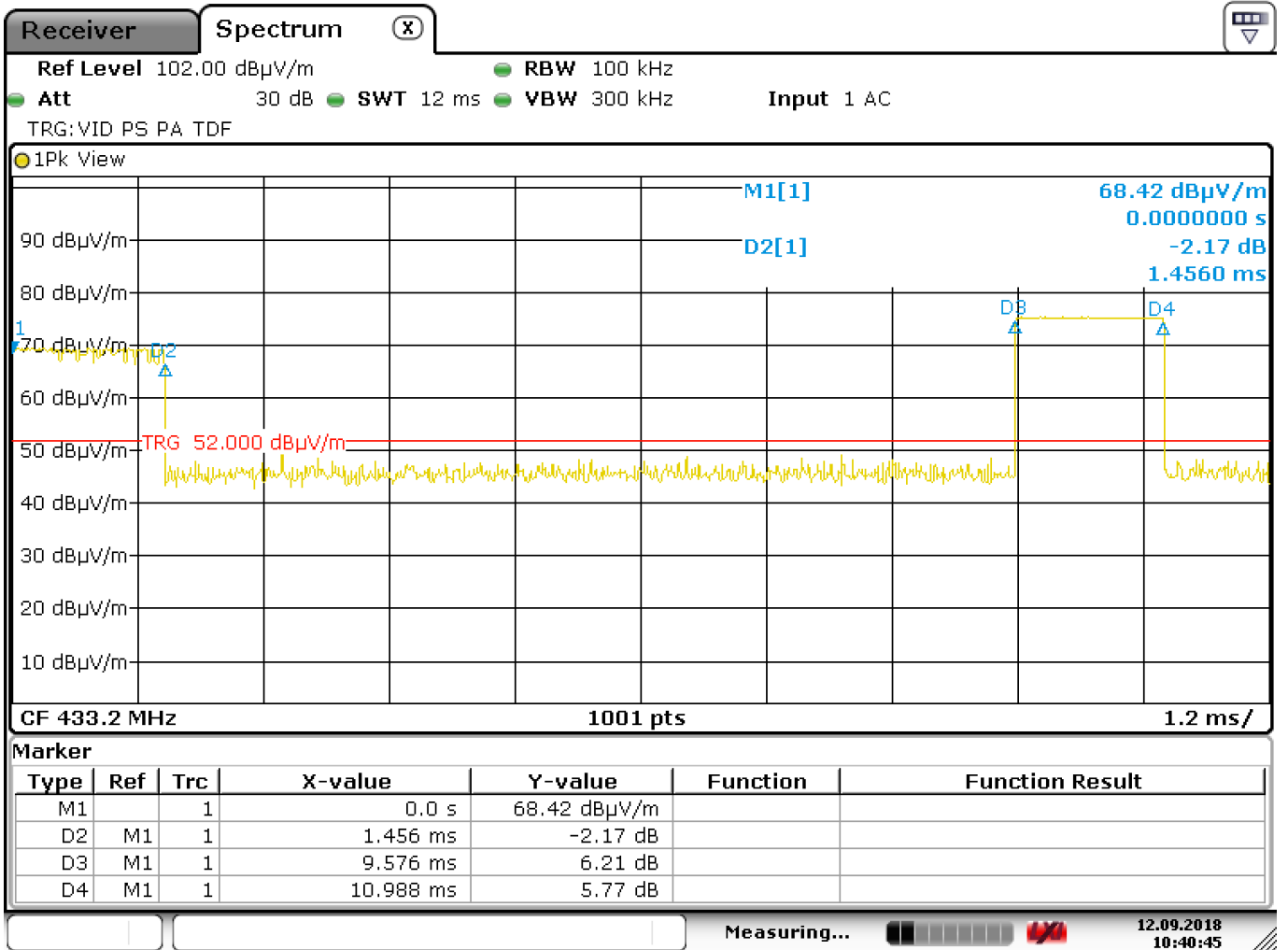
Plot below shows the EUT's RF On Time in a 100ms period.

The RF On time in 100 ms is the sum of the two pulse widths: (1.36 – 0) ms + (11.0-9.6) ms = 2.76 ms.



Date: 12.SEP.2018 10:38:59

Plot 15a : RF On Time of the transmitter as measured on a spectrum analyzer.



Date: 12.SEP.2018 10:40:46

Plot 15b: RF On Time, zoomed in for more accurate measurement, as measured on a spectrum analyzer.

<< End of report >>