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FCC Test Firm Registration	409640
Date	14th Jun 2019
EUT Description	MIFARE card and pin reader
FCC ID	2AHDLMULL
Authorised by	Paul Reilly
Authorised Signature:	

TEST SUMMARY

Emissions were assessed to the following standards:

FCC CFR 47 Part 15

Federal Communications Commission: Part 15 Radio Frequency Devices

The equipment complies with the requirements according to the following standards.

FCC Part Section(s)	TEST PARAMETERS	Test Result
15.203	Antenna Requirement	Pass
15.225	Spectrum Mask	Pass
15.225(d), 15.209	Limit outside band 13.11-14.01MHz	Pass
15.225e	Frequency Stability	Pass
15.207	Conducted Emissions	Pass
	Occupied Bandwidth	Pass

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF COMPLIANCE ENGINEERING IRELAND LTD

Exhibit A – Technical Report

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1.0 EUT Description

Model:	See model list below*
Type:	MIFARE card and pin reader
FCC ID:	2AHDLMULL
Test Standards:	47 CFR, Part 15.225
Type of radio:	Stand-alone
Transmitter Type:	AM 13.56MHz
Operating Frequency Range(s):	13.56MHz
Number of Channels:	1
Antenna:	Integral
Power configuration:	12 v dc
Oper. Temp Range:	5° C to +35° C
Classification:	DXX
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10-2013

*Models covered

(1) VR50M-MF MIFARE	Card Reader and Keypad
(2) VR20M-MF MIFARE	Card Reader Only
(3) AR50M-MF MIFARE	Card Reader and Keypad
(4) AR20M-MF MIFARE	Card Reader Only

Notes

a) The VR20M-MF MIFARE is a sub-populated version of the VR50M-MF MIFARE with the keypad removed

b) VR* and AR* have branding differences only
where the VR* are branded "Vanderbilt" and the AR* are branded "Siemens"

c) A pre-test comparison between the VR50M-MF MIFARE and the VR20M-MF MIFARE for spurious emissions gave worst case results for the VR50M-MF MIFARE.

The full range of tests were carried out on model VR50M-MF MIFARE.

1.1 EUT Operation

Operating Conditions during Test:

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

The EUT was operated in normal modulated mode for all tests (i.e. transmitter always operational)

The EUT was powered from a power Supply set at 12V dc
Farnell Stabilised Power Supply Type TSV 70 MK2

Note for Conducted Emissions on the mains the EUT was powered from a 12v DC adapter Manufacturer Kings Model KSS12_120_1000B

Environmental conditions

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

Temperature: +15 to +35 ° C

Humidity: 20-75 %

1.2 Modifications

No modifications were required in order to pass the test specifications.

1.3 Date of Test

The tests were carried out on one sample of the EUT on dates 29th March and 1st Apr and 14th Jun 2019.

1.4 Description of Test Methods

Tests were performed manually, and no special software was used

1.4 Electromagnetic Emissions Testing

The guidelines of CISPR 16-4 were used for all uncertainty calculations, estimates and expressions thereof for EMC testing. A copy of Compliance Engineering Ireland Ltd.'s policy for EMC Measurement Uncertainty is available on request.

RF Requirements: Spurious emissions in accordance with FCC CFR 15.107, 15.109 and 15.209. Tests were carried out to the requirements of CISPR 16-4 and ANSI C63.4-2014.

1.4.1 Measurement Uncertainty

The measurement uncertainty (with a 95% confidence level) for the conducted emissions test was ± 3.5 dB.

The measurement uncertainty (with a 95% confidence level) for the radiated emissions test was ± 5.3 dB (from 30 to 100 MHz), ± 4.7 dB (from 100 to 300 MHz), ± 3.9 dB (from 300 to 1000 MHz) and ± 3.8 dB (from 1 GHz to 40 GHz).

2 Emissions Measurements

2.1 Conducted Emissions Measurements

The EUT was connected to connected to a 12v DC adapter Manufacturer Kings Model KSS12_120_1000B, which was connected to the mains through a LISN and measurements were carried out using a Receiver over the frequency range 150KHz to 30MHz.

2.2 Radiated Emissions Measurements

Radiated Power measurements were made at the Compliance Engineering Ireland Ltd anechoic chamber located in Dunshaughlin, Co. Meath, Ireland to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

The EUT was centred on a motorized turntable, which allows 360 degree rotation. A measurement antenna was positioned at a distance of 3 metres as measured from the closest point of the EUT. The radiated emissions were maximised by configuring the EUT, by rotating the EUT and by raising and lowering the antenna from 1 to 4 meters.

Emissions below 30MHz were measured using a loop antenna. In this case the resolution bandwidth was 200Hz for frequencies below 150KHz and RBW was 9KHz for frequencies above 150KHz.

Emissions between 30MHz and 300MHz were measured using a bi-conical antenna. Emissions between 300MHz and 1GHz were measured using a bi-log antenna. In both cases the resolution bandwidth was 120KHz.

Antenna Requirements

According to FCC 47 CFR 15.203:

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

* The antennas of this E.U.T are internal to the unit and are permanently attached.

*The E.U.T Complies with the requirement of 15.203

3.0 Results for Conducted emissions

Ambient Temp 21deg C RH =57.3%

Mains Conducted Emissions results

Detector	Frequency	Reading	Margin	Phase
QP/ Ave	MHz	dBuV	dB	L/N
Average	0.2333	36.01	-17.61	Live
Quasi-Peak	0.2355	47.94	-15.62	Live
Quasi-Peak	0.2558	43.11	-19.87	Live
Quasi-Peak	0.6990	39.37	-16.63	Live
Quasi-Peak	0.751	39.13	-16.87	Live
Average	0.767	26.16	-19.84	Live
Quasi-Peak	1.271	37.51	-18.49	Live
Quasi-Peak	2.213	35.10	-20.9	Live
Quasi-Peak	13.560	38.98	-21.02	Live
Average	13.560	34.00	-16	Live
Quasi-Peak	27.119	39.82	-20.18	Live
Average	27.119	33.71	-16.29	Live

Detector	Frequency	Reading	Margin	Phase
QP/ Ave	MHz	dBuV	dB	L/N
Quasi-Peak	0.2333	41.81	-21.81	Neutral
Quasi-Peak	0.4695	31.50	-25.37	Neutral
Quasi-Peak	0.7530	34.60	-21.4	Neutral
Quasi-Peak	1.6260	31.41	-24.59	Neutral
Quasi-Peak	2.2920	28.50	-27.5	Neutral
Quasi-Peak	27.1185	40.21	-19.79	Neutral
Average	27.1185	32.28	-17.72	Neutral

Ref Appendix B for scans

Result: Pass

4.0 Results for Radiated emissions

Ambient Temp 20deg C RH =42%

4.1 Carrier Power

4.1.1 Carrier Power 13.56 MHz

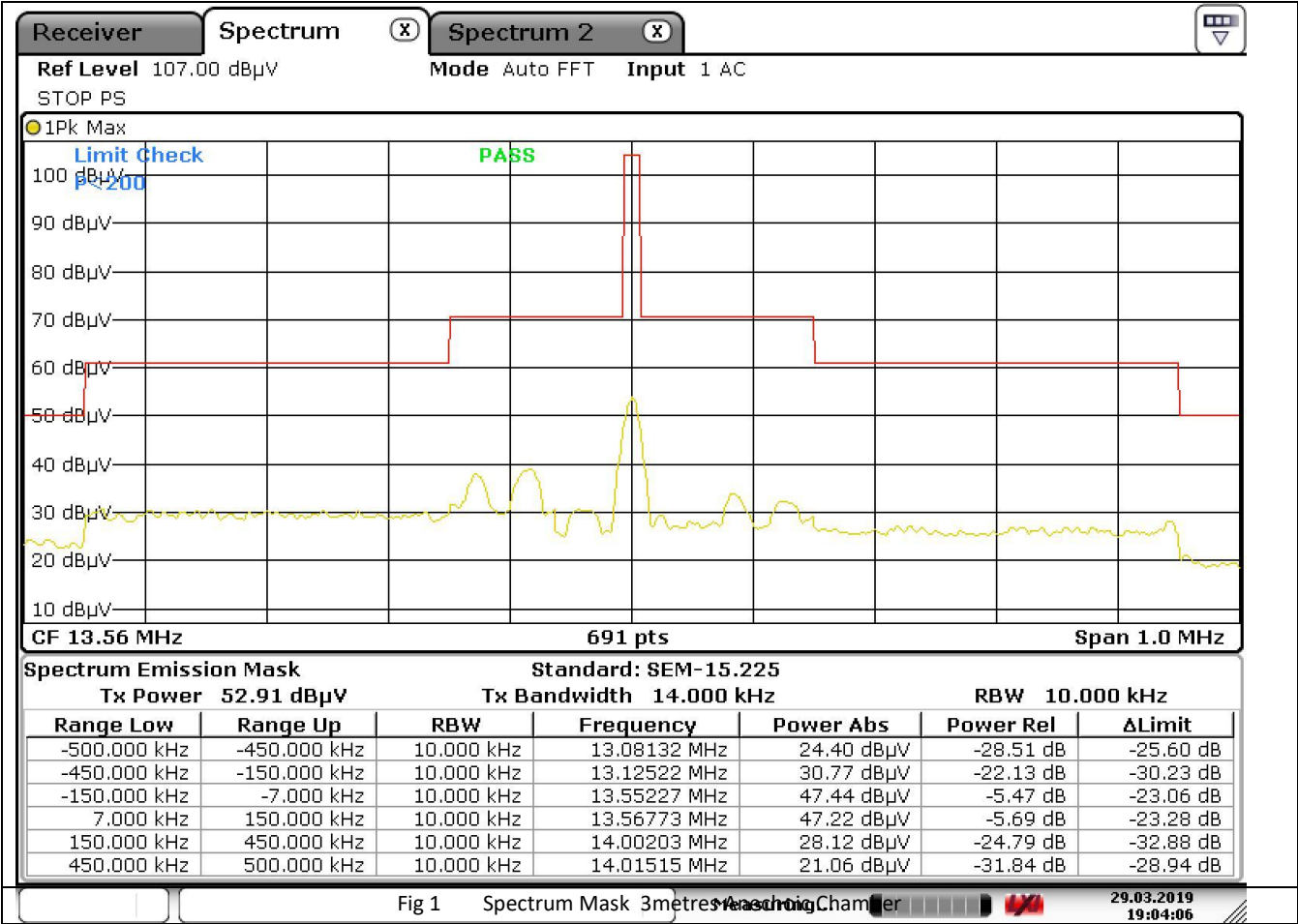
Limit as per 15.225

Frequency	Level	Antenna Factor	Cable Loss	Final Field Strength	Detector	Emission Limit	Margin	Pass / Fail
MHz	dBuV/m	dB	dB	dBuV/m		dBuV/m	dB	P/F
13.56	48.48	8.25	0.1	56.83	Peak	124	67.17	Pass

Note as the pulse rate (1/period) is less than 20Hz, a peak detector measurement as per 15.35a was used

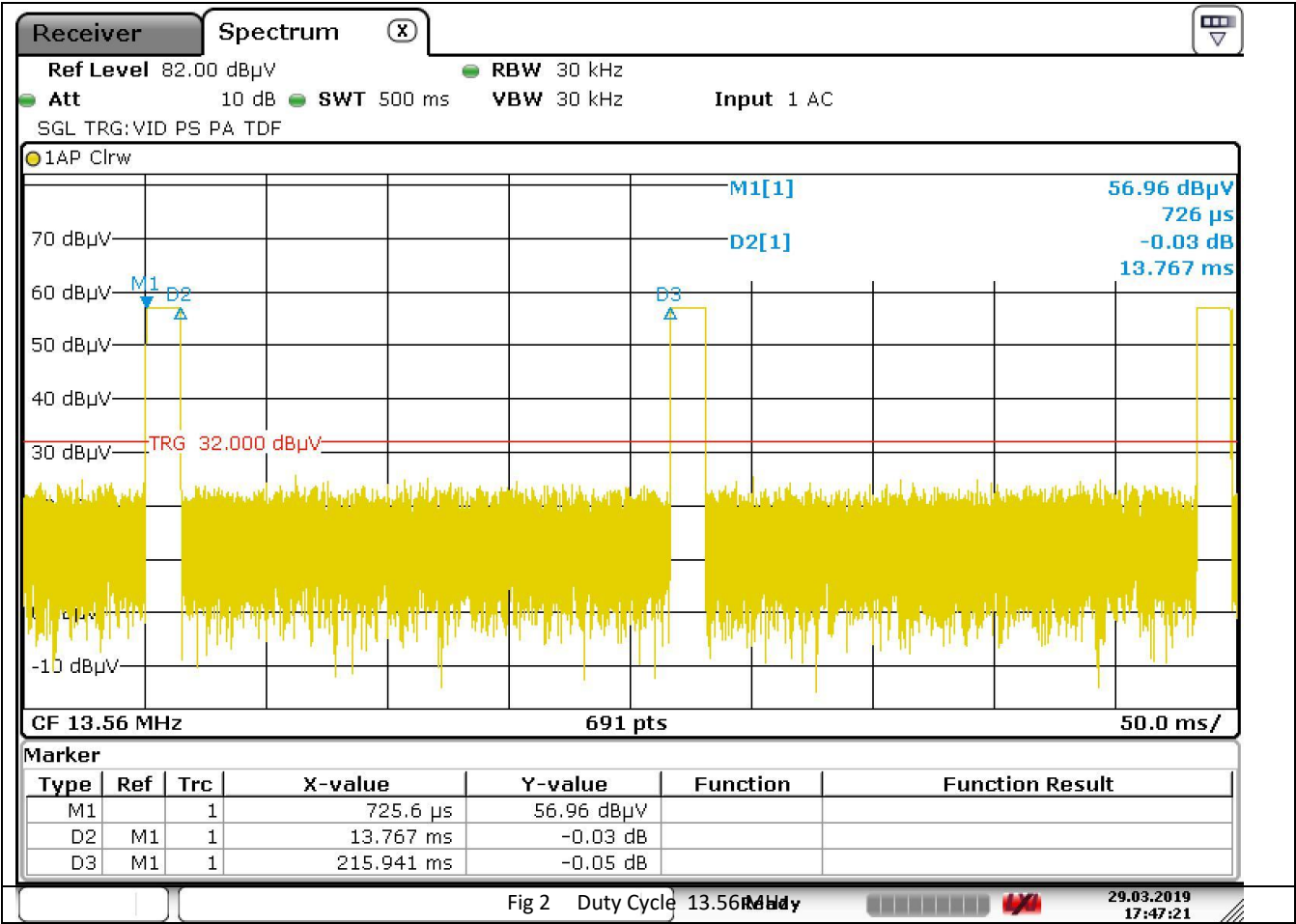
Result: Pass

4.2 Mask



Test result Pass

4.3 Duty Cycle



Pulse repetition rate = $1/216\text{ms}$ = 4.6Hz

4.4 Spurious Emissions Measurements 9kHz -30MHz

4.4.1

Frequency	Level	Antenna Factor	Cable Loss	Final Field Strength	Detector	Spurious Emission Limit	Margin	Pass / Fail
MHz	dBuV	dB	dB	dBuV/m		dBuV/m	dB	P/F
0.01125	38.19	13.6	0.1	51.89	Average	126.58	74.69	Pass
0.01965	34.12	11.78	0.1	45.9	Average	121.74	75.84	Pass
0.19799	36.02	9.58	0.1	45.6	Average	101.67	56.07	Pass
*0.252	71.41	9.49	0.1	80.9	Average	99.58	18.68	Pass

* background due to local radio transmitter at 252 KHz

4.4.2 Spurious Emissions which are harmonics of the fundamental at 13.56MHz

Frequency	Level	Antenna Factor	Cable Loss	Final Field Strength Peak	Detector	Limit	Margin	Pass / Fail
MHz	dBuV	dB	dB	dBuV/m		dBuV/m	dB	P/F
27.12	12.48	6.32	0.1	18.9	Peak	69.54	50.64	Pass

Note as the pulse rate (1/period) is less than 20Hz, a peak detector measurement as per 15.35a was used

Appendix A shows the results of the scans in the anechoic chamber.

Result: Pass

4.5 Measurements 30MHz to 1GHz

4.5.1 Spurious Emissions which are not harmonics of the fundamental

Frequency MHz	Quasi Peak Level dBuV/m	Antenna Polarity	Antenna Factor dB	Cable loss dB	Final Field Strength Quasi Peak dBuV/m	Quasi Peak Limit dBuV/m	Margin dB
97.26	11.9	Vertical	10.3	0.2	22.4	43.5	21.1
144.72	10.9	Vertical	11.6	0.2	22.7	43.5	20.8
239.1	21.83	Vertical	10	0.2	32.03	46.0	14.0
146.07	3.2	Horizontal	11.6	0.2	15	43.5	28.5
230.52	14.7	Horizontal	9.8	0.2	24.7	46.0	21.3

Appendix A shows the results of the scans in the anechoic chamber.

Result: Pass

4.5.2 Spurious Emissions which are harmonics of the fundamental at 13.56MHz

Frequency MHz	Peak Level dBuV/m	Antenna Polarity	Antenna Factor dB	Cable loss dB	Final Field Strength Peak dBuV/m	Limit	Margin dB
40.68	6.6	Vertical	14.2	0.2	21	40.0	19.0
54.24	24.6	Vertical	7.2	0.2	32	40.0	8.0
67.8	7.7	Vertical	6.1	0.2	14	40.0	26.0
81.36	13	Vertical	8.4	0.2	21.6	40.0	18.4

Note as the pulse rate (1/period) is less than 20Hz , a peak detector measurement as per 15.35a is used

Appendix A shows the results of the scans in the anechoic chamber.

Result: Pass

4.6 Frequency Stability Temperature Testing

Ambient Temp 18deg C RH =38%

(e) The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery

Temp	Supply	Frequency	Variation	Limit
Deg C	V dc	MHz	%	%
20	12	13.559747	0	0.01

The EUT was capable of operating over a voltage range of 9v -28v dc with a nominal of 12V dc.

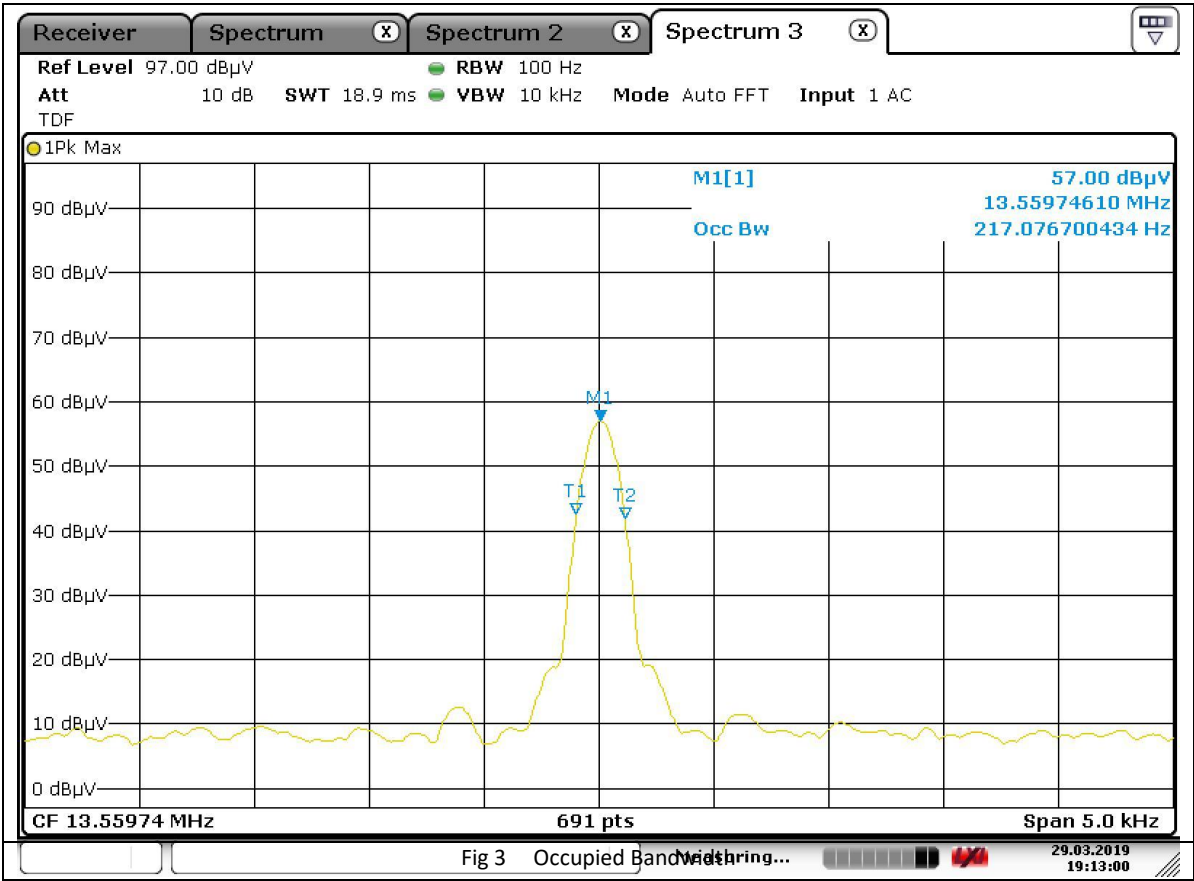
Temp	Supply	Frequency	Variation	Limit	Result
Deg C	V dc	MHz	%	%	
50	9	13.559705	-0.0003	0.01	Pass
40	9	13.559722	-0.0002	0.01	Pass
30	9	13.559763	0.0001	0.01	Pass
20	9	13.559747	0	0.01	Pass
10	9	13.559789	0.0003	0.01	Pass
0	9	13.559848	0.0007	0.01	Pass
-10	9	13.559852	0.0008	0.01	Pass
-20	9	13.559837	0.0007	0.01	Pass

Temp	Supply	Frequency	Variation	Limit	Result
Deg C	V dc	MHz	%	%	
50	28	13.559705	-0.0003	0.01	Pass
40	28	13.559719	-0.0002	0.01	Pass
30	28	13.559766	0.0001	0.01	Pass
20	28	13.559747	0	0.01	Pass
10	28	13.559789	0.0003	0.01	Pass
0	28	13.559848	0.0007	0.01	Pass
-10	28	13.559852	0.0008	0.01	Pass
-20	28	13.559837	0.0007	0.01	Pass

Result: Pass

4.7 99% Occupied Bandwidth

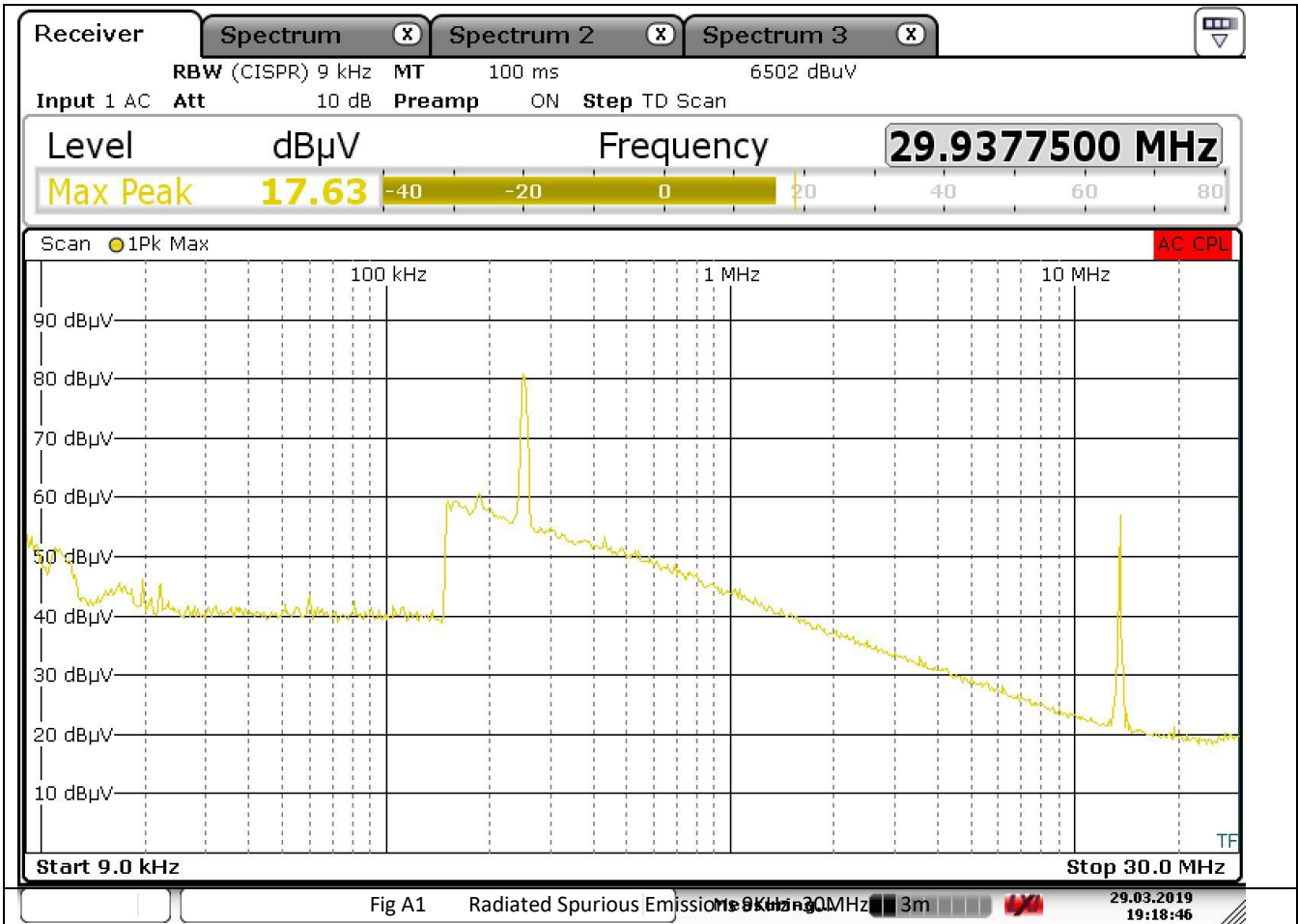
Ambient Temp 20deg C RH =42%

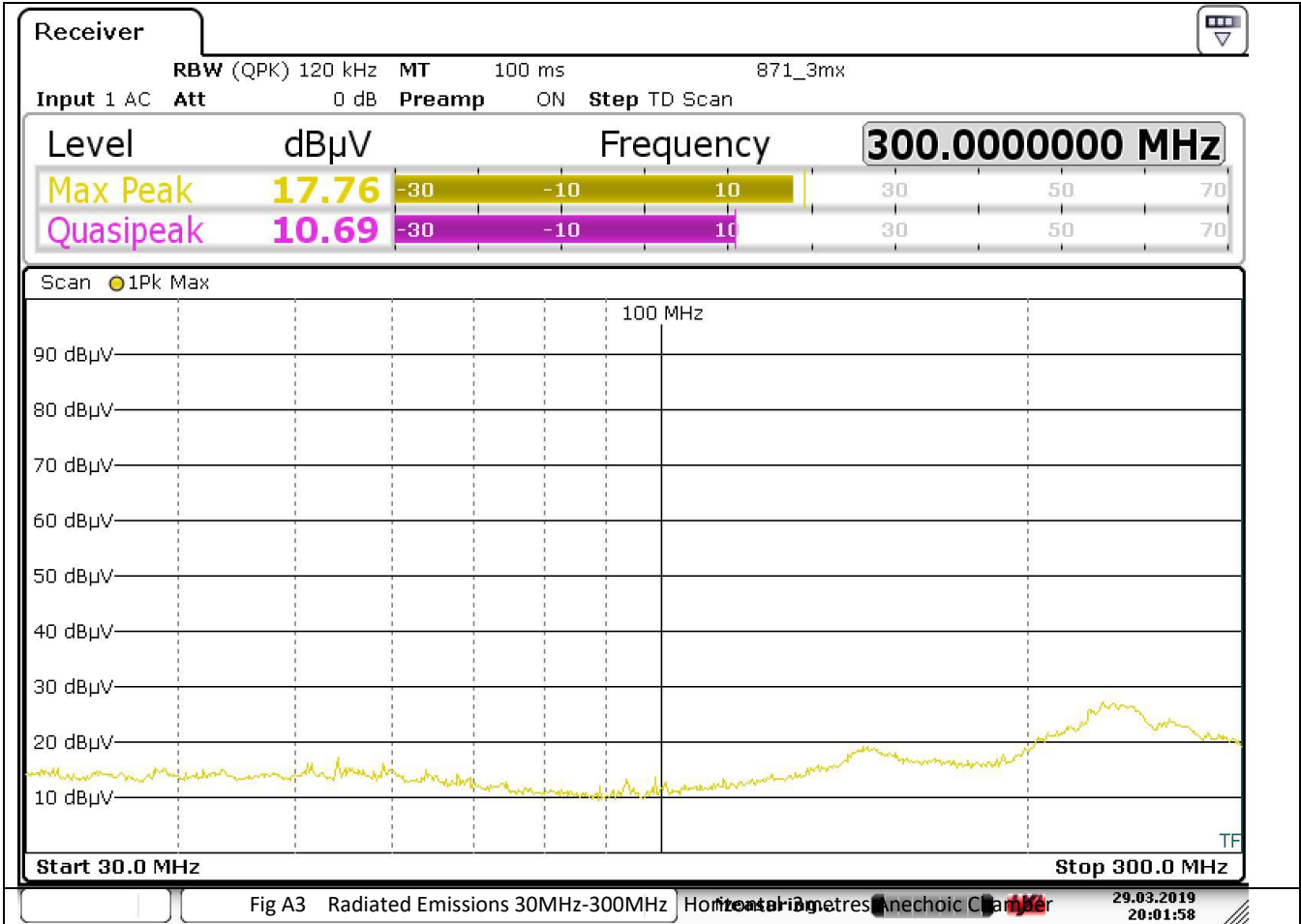
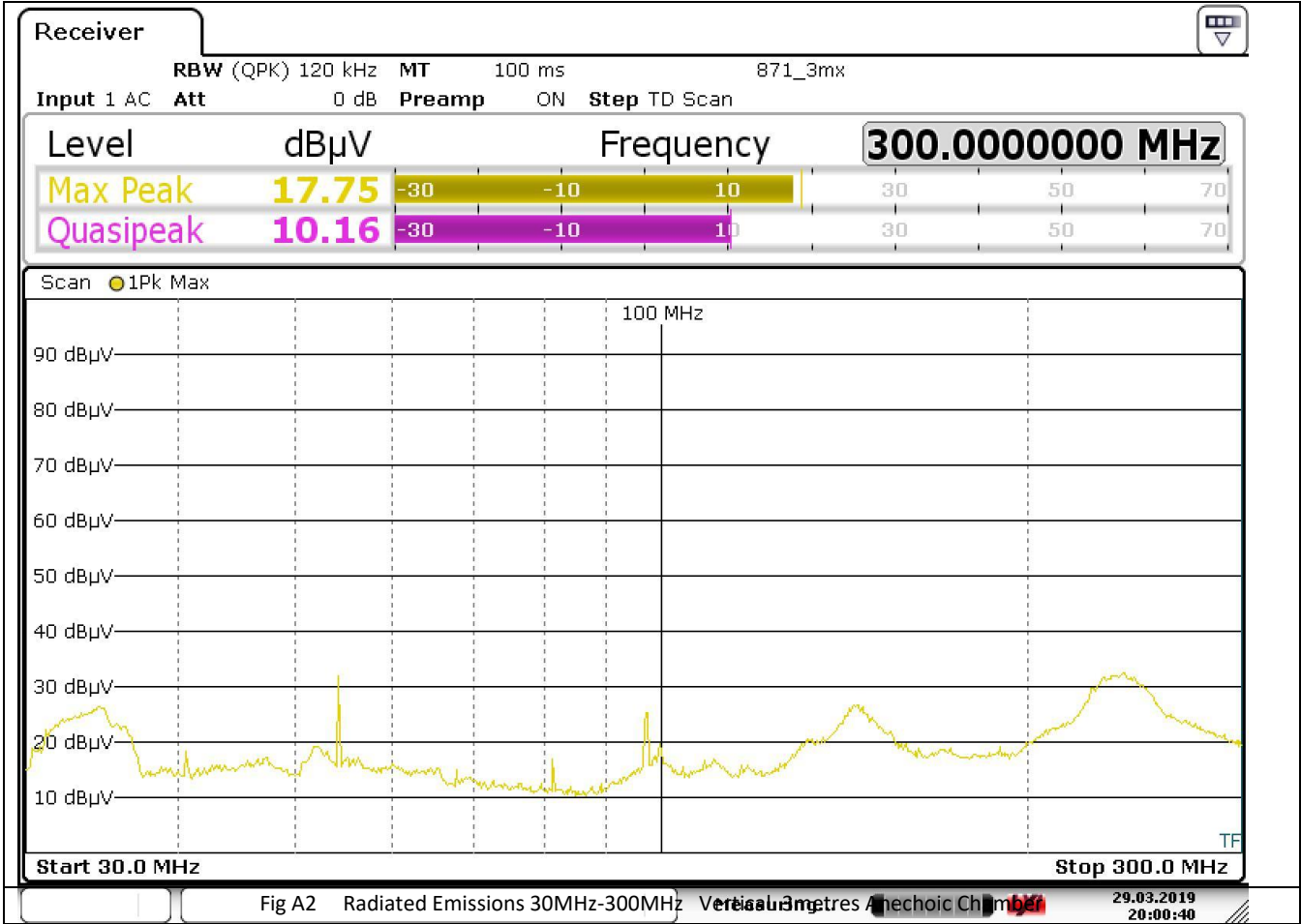


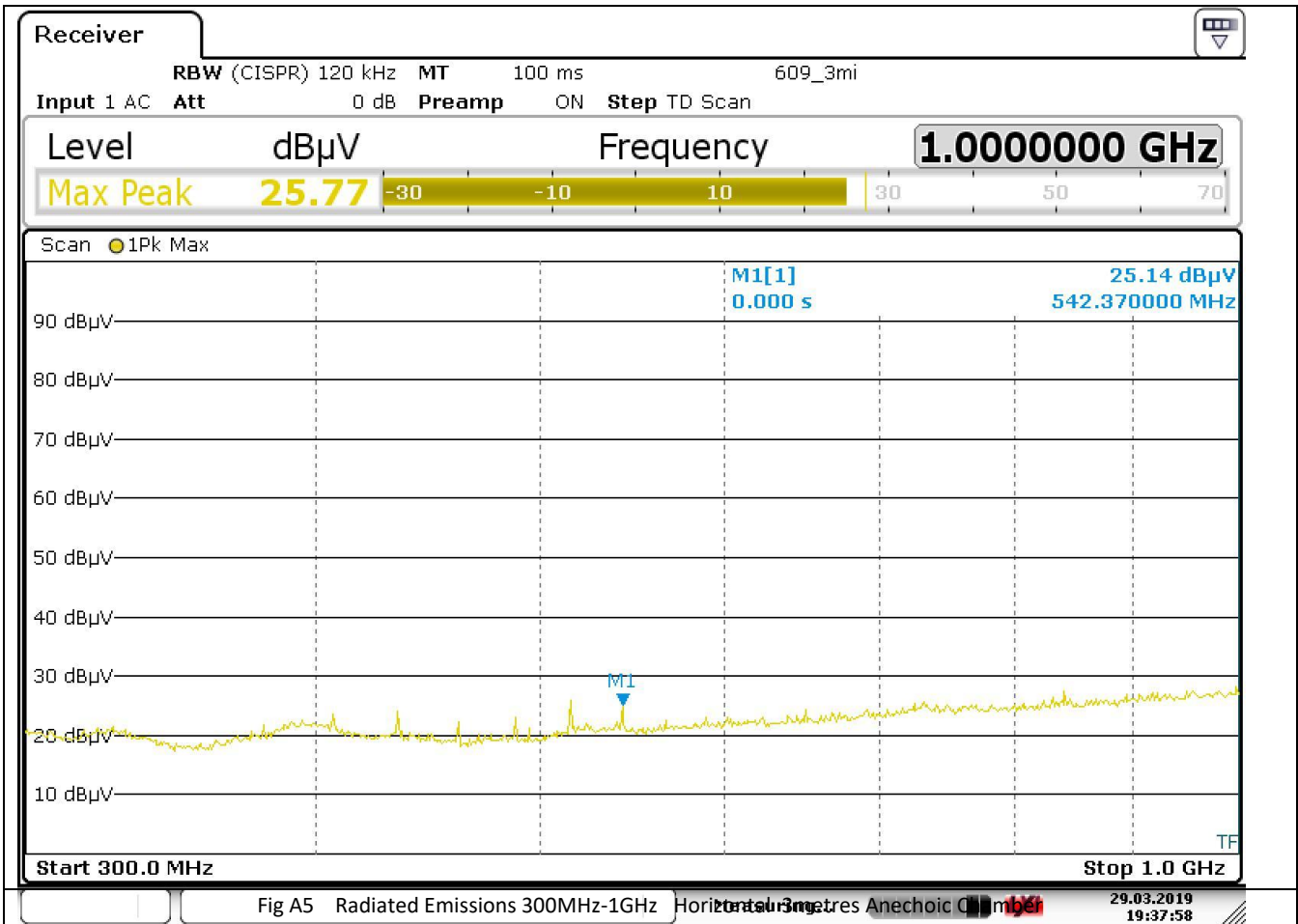
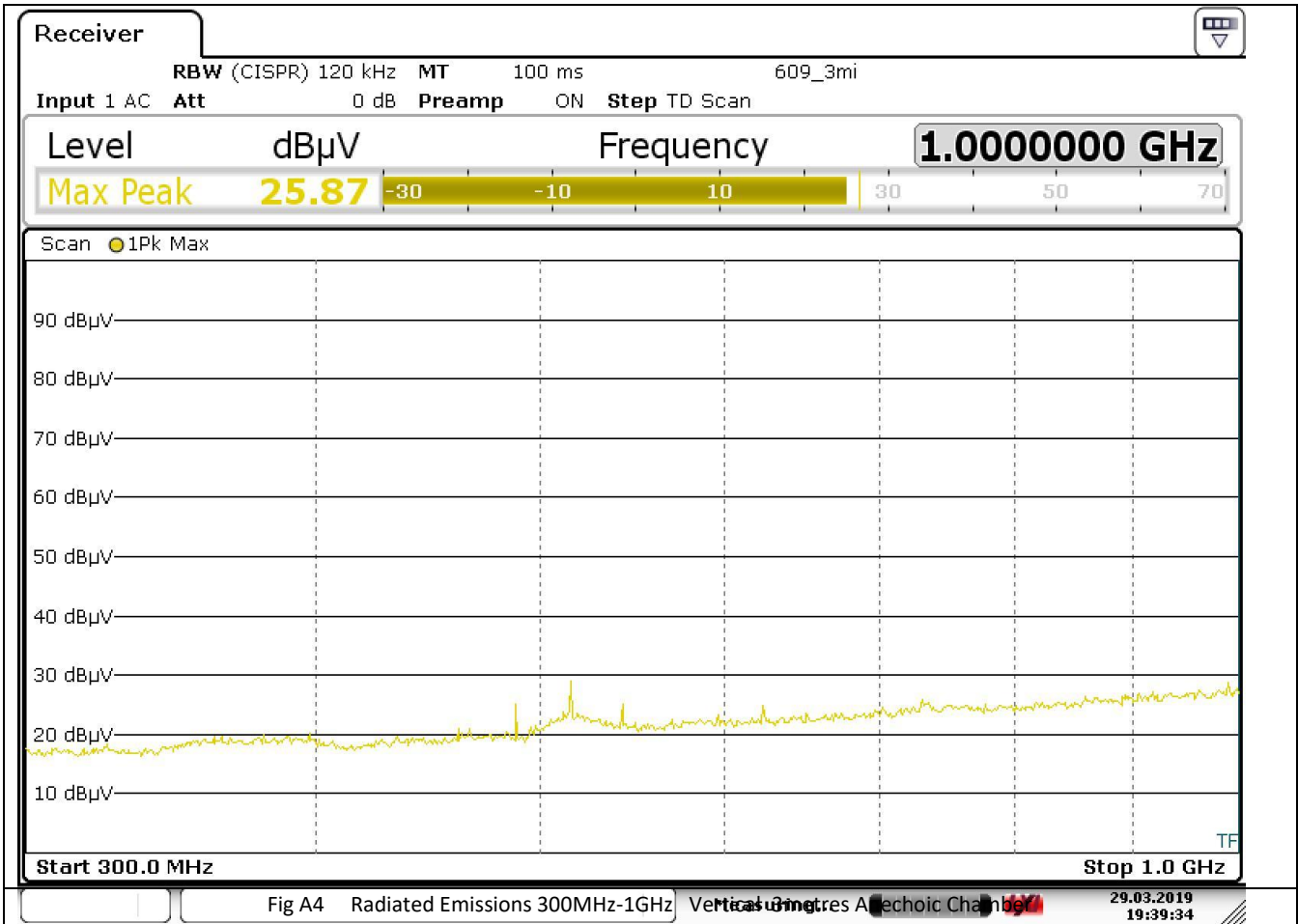
13.56MHz Occupied Bandwidth = 217 Hz

Appendix A:

Test Results

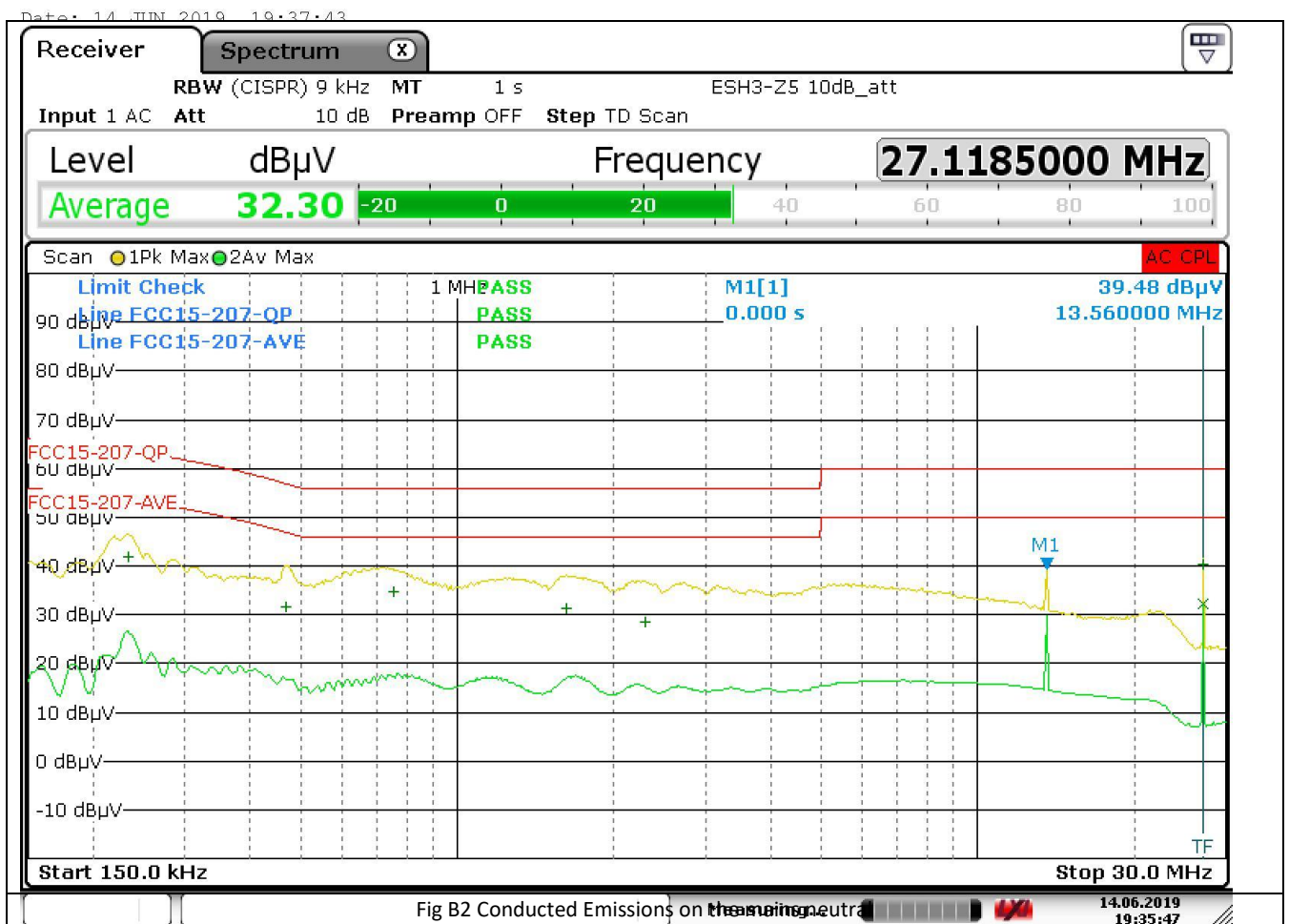
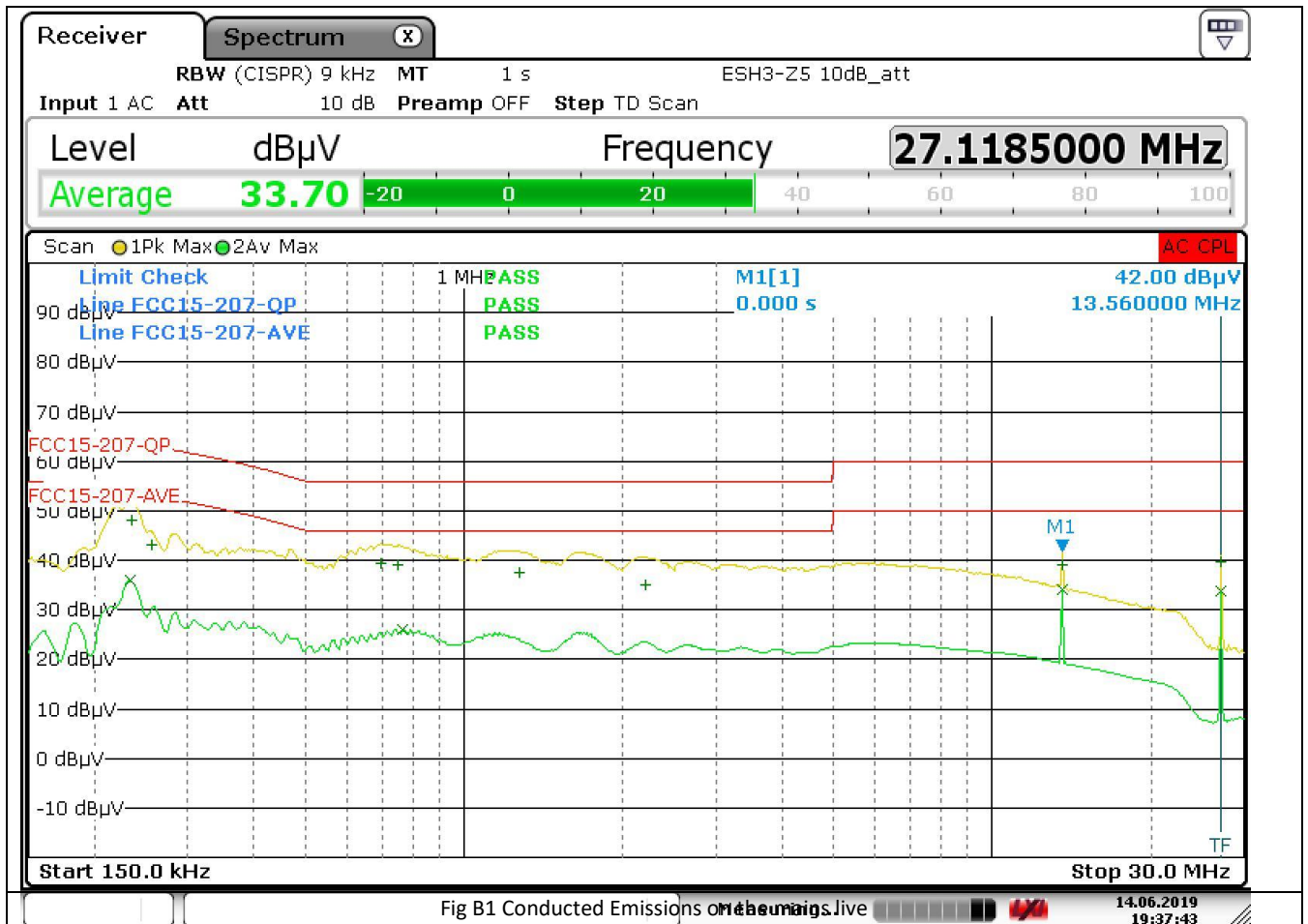






Appendix B

Conducted Emissions on the mains



Appendix C

List of Test Equipment

Instrument	Manufacturer	Model	Serial Num	CEI Ref	Cal Due Date	Cal Interval Months
Test Receiver 3.6GHz	Rohde& Schwarz	ESR	1316.3003k03-101625-s	869	07-Jun-20	36
Anechoic Chamber	CEI	SAR 10M	845	845	16-Mar-22	36
Antenna Log Periodic	Chase	UPA6108	1072	609	03-Sep-21	36
Loop Antenna	EMCO	6502	9609-3099	821	07-Nov-20	36
Antenna Biconical	Schwarzbeck	VHBB 9124	9124 667	871	15-Sep-19	12

End of Report