

FCC CERTIFICATION TEST REPORT

FOR

Applicant	:	Lorenz High Definition LLC
Address	:	230 Rt 206 STE 401, Flanders, New Jersey, United States
Equipment under Test	:	DC Motor Controller
Model No.	:	ZEN53 LR
Trade Mark	:	zooZ TM
FCC ID	:	2AZ2V-080822ZEN53
Manufacturer	:	Shenzhen ZVIDAR Technologies CO.,Ltd.
Address	:	Room 468, Building F1, TCL Technologies Park, 1001, Zhongshanyuan Road, Shuguang Community, Xili Street Office, Nanshan District, Shenzhen City

Issued By: Dongguan Dongdian Testing Service Co., Ltd.

Add.: No. 17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park,
Dongguan City, Guangdong Province, China, 523808

Tel.: +86-0769-38826678, **E-mail:** ddt@dgddt.com, <http://www.dgddt.com>

REPORT

Table of Contents

	Test report declares.....	3
1.	Summary of Test Results.....	5
2.	General Test Information	6
2.1.	Description of EUT	6
2.2.	Accessories of EUT.....	6
2.3.	Assistant equipment used for test.....	6
2.4.	Block diagram of EUT configuration for test.....	6
2.5.	Test environment conditions	7
2.6.	Deviations of test standard.....	7
2.7.	Test laboratory	7
2.8.	Measurement uncertainty.....	8
3.	Equipment Used During Test.....	9
4.	20 dB Bandwidth	10
4.1.	Block diagram of test setup.....	10
4.2.	Limits	10
4.3.	Test procedure	10
4.4.	Test result.....	10
4.5.	Original test data	11
5.	Radiated Emission	12
5.1.	Block diagram of test setup.....	12
5.2.	Limit.....	13
5.3.	Test procedure	14
5.4.	Test result.....	15
6.	Power Line Conducted Emission.....	25
6.1.	Block diagram of test setup.....	25
6.2.	Power line conducted emission limits	25
6.3.	Test procedure	25
6.4.	Test result.....	26
7.	Antenna Requirements	27
7.1.	Limit.....	27
7.2.	Result	27
8.	Test Setup Photograph	28
9.	Photos of the EUT	29

Test Report Declare

Applicant	:	Lorenz High Definition LLC
Address	:	230 Rt 206 STE 401, Flanders, New Jersey, United States
Equipment under Test	:	DC Motor Controller
Model No.	:	ZEN53 LR
Trade mark	:	ZOOZ TM
Manufacturer	:	Shenzhen ZVIDAR Technologies CO.,Ltd.
Address	:	Room 468, Building F1, TCL Technologies Park, 1001, Zhongshanyuan Road, Shuguang Community, Xili Street Office, Nanshan District, Shenzhen City

Test Standard Used:

FCC Rules and Regulations Part 15 Subpart C.

Test procedure used:

ANSI C63.10:2013.

We Declare:

The equipment described above is tested by Dongguan Dongdian Testing Service Co., Ltd. and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and Dongguan Dongdian Testing Service Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above FCC standards.

Report No:	DDT-R22063004-1E01		
Date of Receipt:	Jul. 11, 2022	Date of Test:	Jul. 11, 2022 ~ Aug. 02, 2022

Prepared By:

Sanvin Zheng

Sanvin Zheng/Engineer

Approved By:



Damon Hu/EMC Manager

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Dongguan Dongdian Testing Service Co., Ltd.

Revision History

Rev.	Revisions	Issue Date	Revised By
---	Initial issue	Aug. 02, 2022	

1. Summary of Test Results

The EUT have been tested according to the applicable standards as referenced below.		
Description of Test Item	Standard	Results
20 dB Bandwidth	FCC Part 15: 15.215 ANSI C63.10:2013	Pass
Radiated Emission	FCC Part 15: 15.205 FCC Part 15: 15.209 FCC Part 15: 15.249 ANSI C63.10:2013	Pass
Power Line Conducted Emission	FCC Part 15: 15.207 ANSI C63.10:2013	N/A
Antenna requirement	FCC Part 15: 15.203	Pass
Note: N/A is an abbreviation for Not Applicable, and means this item is not applicable for this device or no need to test according to standard.		

2. General Test Information

2.1. Description of EUT

EUT* Name	: DC Motor Controller
Model Number	: ZEN53 LR
EUT function description	: Please reference user manual of this device
Power supply	: DC 6-32V
Operation frequency	: 908.40 - 916.00 MHz
Modulation	: FSK
Antenna Gain	: -2.80 dBi
Serial Number	: S22063004-01

Note: EUT is the abbreviation of equipment under test.

Data rate (kbps)	Frequency (MHz)
9.6	908.42
40	908.40
100	916.00

2.2. Accessories of EUT

Description of Accessories	Manufacturer	Model number	Serial No.	Other
N/A	N/A	N/A	N/A	N/A

2.3. Assistant equipment used for test

Assistant equipment	Manufacturer	Model number	Serial No.	Other
N/A	N/A	N/A	N/A	N/A

2.4. Block diagram of EUT configuration for test

Tx Mode:



Test software: Uart Assistant

The test software was used to control EUT work in Continuous Tx mode, and select test channel, wireless mode as below table.

Tested mode, channel, information			
Mode	Setting Tx Power Level	Data rate (kbps)	Frequency (MHz)
FSK Tx mode	4	40	908.40
	4	100	916.00

2.5. Test environment conditions

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

Temperature range:	21-25 °C
Humidity range:	40-75%
Pressure range:	86-106 kPa

2.6. Deviations of test standard

No deviation.

2.7. Test laboratory

Dongguan Dongdian Testing Service Co., Ltd.

Add.: No. 17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City, Guangdong Province, China, 523808.

Tel.: +86-0769-38826678, <http://www.dgddt.com>, Email: ddt@dgddt.com.

CNAS Accreditation No. L6451; A2LA Accreditation Number: 3870.01

FCC Designation Number: CN1182, Test Firm Registration Number: 540522

Innovation, Science and Economic Development Canada Site Registration Number: 10288A

Conformity Assessment Body identifier: CN0048

VCCI facility registration number: C-20087, T-20088, R-20123, R-20155, G-20118

2.8. Measurement uncertainty

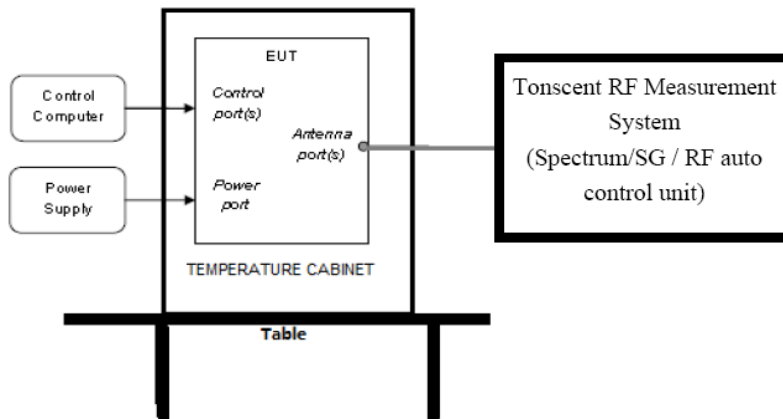
Test Item	Uncertainty
Bandwidth	1.1%
Peak Output Power (Conducted) (Spectrum Analyzer)	0.86 dB ($10\text{ MHz} \leq f < 3.6\text{ GHz}$);
	1.38 dB ($3.6\text{ GHz} \leq f < 8\text{ GHz}$)
Peak Output Power (Conducted) (Power Sensor)	0.74 dB
Power Spectral Density	0.74 dB ($10\text{ MHz} \leq f < 3.6\text{ GHz}$);
	1.38 dB ($3.6\text{ GHz} \leq f < 8\text{ GHz}$)
Frequencies Stability	6.7×10^{-8} (Antenna couple method)
	5.5×10^{-8} (Conducted method)
Conducted Spurious Emissions	0.86 dB ($10\text{ MHz} \leq f < 3.6\text{ GHz}$);
	1.40 dB ($3.6\text{ GHz} \leq f < 8\text{ GHz}$)
	1.66 dB ($8\text{ GHz} \leq f < 26.5\text{ GHz}$)
Uncertainty for Radio Frequency (RBW < 20 kHz)	3×10^{-8}
Temperature	0.4 °C
Humidity	2 %
Uncertainty for Radiation Emission Test (9 kHz – 30 MHz)	3.44 dB
Uncertainty for Radiation Emission Test (30 MHz - 1 GHz)	4.70 dB (Antenna Polarize: V)
	4.84 dB (Antenna Polarize: H)
Uncertainty for Radiation Emission Test (1 GHz - 40 GHz)	4.10 dB (1 - 6 GHz)
	4.40 dB (6 GHz - 18 GHz)
	3.54 dB (18 GHz - 26 GHz)
	4.30 dB (26 GHz - 40 GHz)
Uncertainty for Power Line Conduction Emission Test	3.32 dB (150 kHz - 30 MHz)
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	

3. Equipment Used During Test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
☒ RF Connected Test (Tonscend RF Measurement System 1#)					
SIGNAL ANALYZER	R&S	FSQ26	101272	May 18, 2022	1 Year
Wideband Radio Communication tester	R&S	CMW500	120259	Sep. 02, 2021	1 Year
Vector Signal Generator	Agilent	E8267D	US49060192	Oct. 15, 2021	1 Year
Vector Signal Generator	Agilent	N5182A	MY48180737	May 18, 2022	1 Year
RF Control Unit	Tonsend	JS0806-2	158060010	May 18, 2022	1 Year
Temp&Humi Programmable	ZHIXIANG	ZXGDJS-150L	ZX170110-A	May 26, 2022	1 Year
Test Software	JS Tonscend	JS1120-3	Ver.2.6.77.0518	N/A	N/A
☒ Radiation 3#chamber					
EMI Test Receiver	R&S	ESU	100472	May 18, 2022	1 Year
Spectrum analyzer	Agilent	E4447A	MY50180031	May 18, 2022	1 Year
Active Loop antenna	Schwarzbeck	FMZB-1519	1519-038	Sep. 19, 2021	1 Year
Trilog Broadband Antenna	Schwarzbeck	VULB 9163	01429	Aug. 07, 2021	1 Year
Double Ridged Horn Antenna	Schwarzbeck	BBHA9120	02468	Nov. 17, 2021	1 Year
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	790	May 06, 2022	1 Year
Pre-amplifier	COM-POWER	PAM-118A	18040084	Sep. 02, 2021	1 Year
Pre-amplifier	COM-POWER	PAM-840A	461369	Apr. 11, 2022	1 Year
Test software	Audix	E3	V 6.1.1.1	N/A	N/A

4. 20 dB Bandwidth

4.1. Block diagram of test setup



4.2. Limits

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

4.3. Test procedure

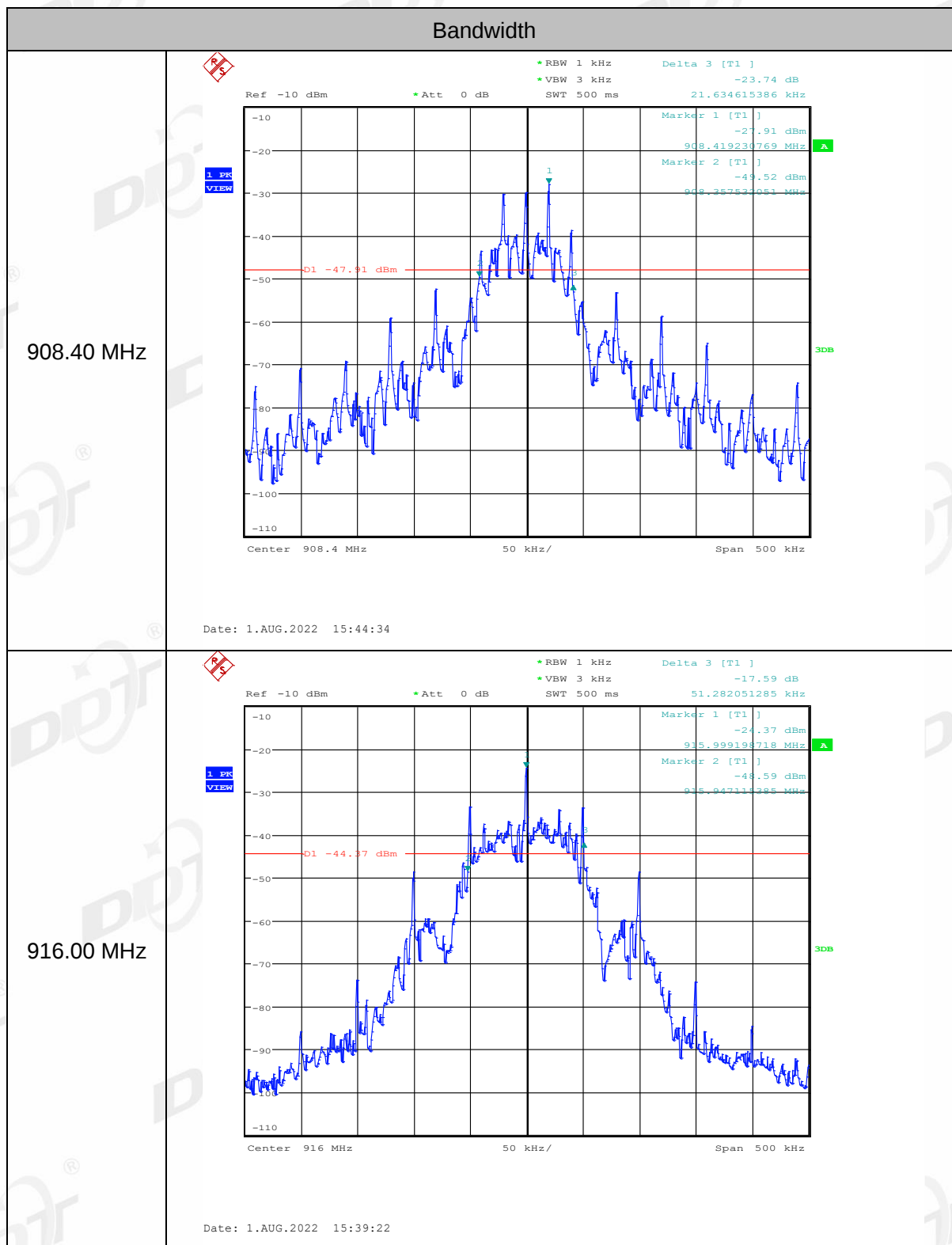
- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) Set the spectrum analyzer as follows:

RBW:	1 kHz
VBW:	3 kHz
Detector Mode:	Peak
Sweep time:	auto
Trace mode	Max hold
- (3) Allow the trace to stabilize, measure the 20 dB bandwidth of signal.

4.4. Test result

Mode	Freq (MHz)	20 dB bandwidth Result (kHz)	Limit (kHz)	Conclusion
FSK	908.40	21.63	/	Pass
FSK	916.00	51.28	/	Pass

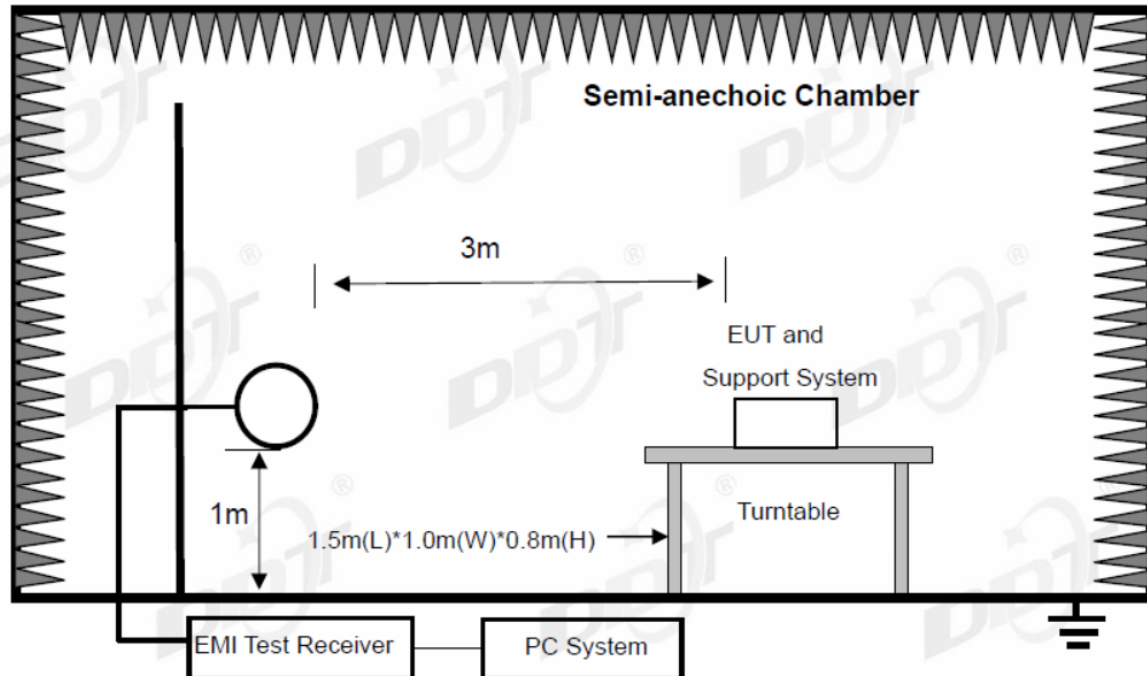
4.5. Original test data



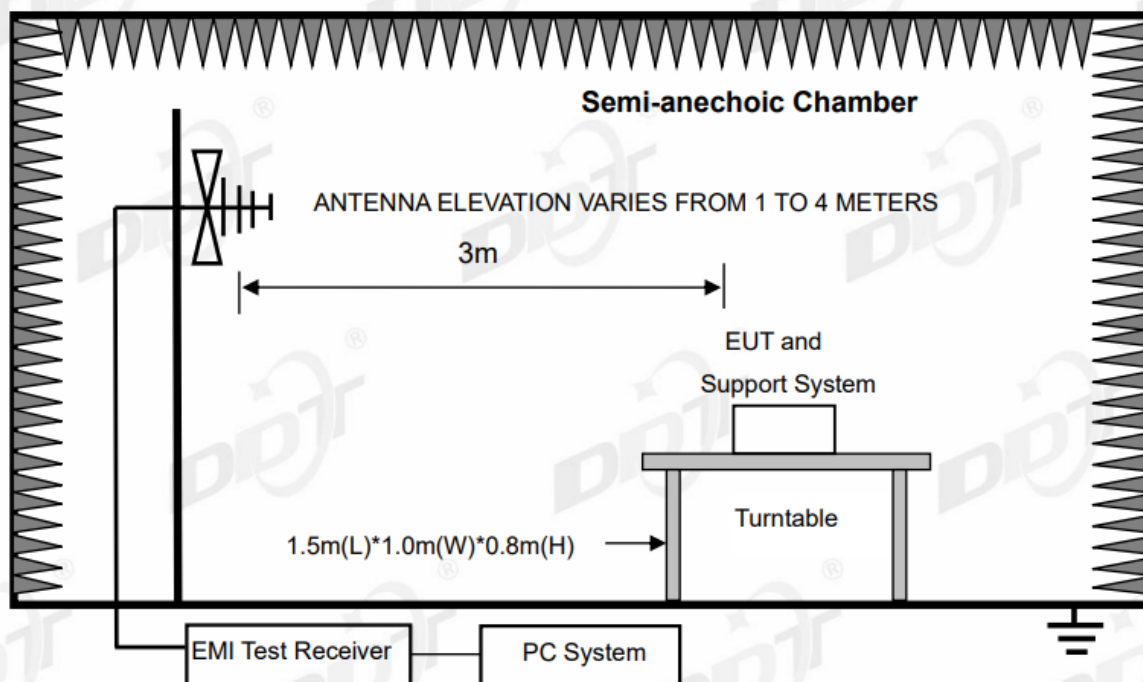
5. Radiated Emission

5.1. Block diagram of test setup

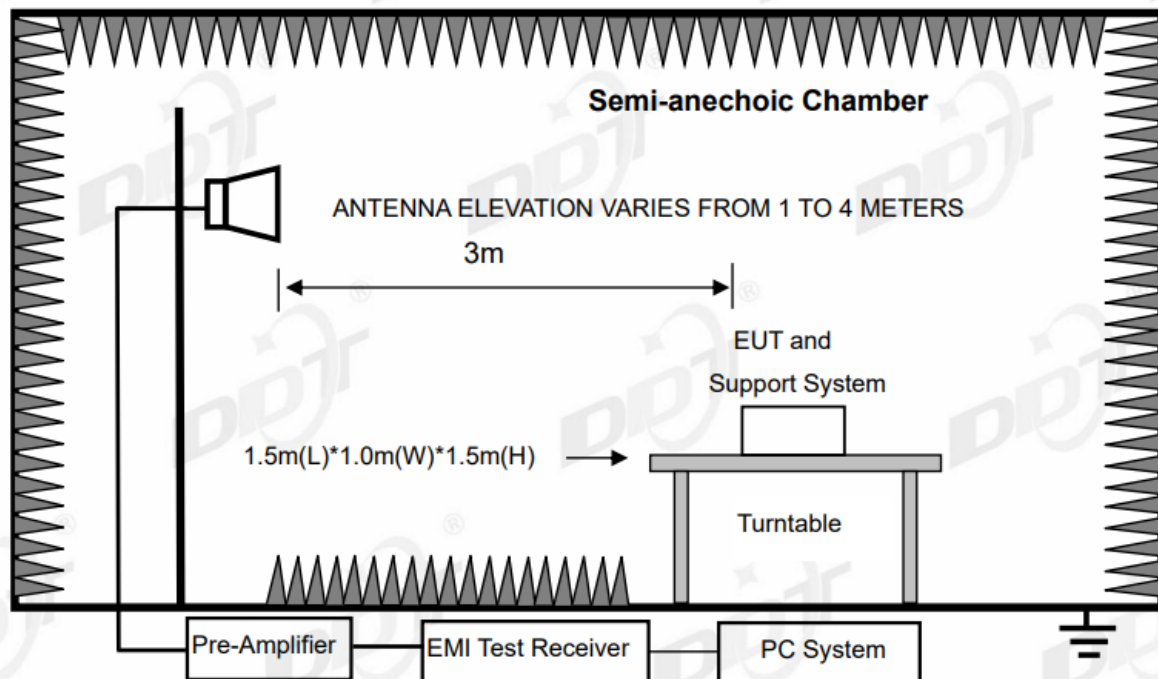
In 3 m Anechoic Chamber, test setup diagram for 9 kHz - 30 MHz:



In 3 m Anechoic Chamber, test setup diagram for 30 MHz - 1 GHz:



In 3 m Anechoic Chamber, test setup diagram for frequency above 1 GHz:



Note: For harmonic emissions test an appropriate high pass filter was inserted in the input port of AMP.

5.2. Limit

(1) FCC 15.205 Restricted frequency band

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.1772&4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.2072&4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(²)
13.36-13.41			

¹Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

²Above 38.6

(2) FCC 15.209 Limit.

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		$\mu\text{V}/\text{m}$	$\text{dB}(\mu\text{V})/\text{m}$
0.009 ~ 0.490	300	2400/F(kHz)	67.6-20log(F)
0.490 ~ 1.705	30	24000/F(kHz)	87.6-20log(F)
1.705 ~ 30.0	30	30	29.54
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000 MHz	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	
Field Strength of Fundamental emission for 902 MHz - 928 MHz	3	94.0 dB(μV)/m (QP)	
Field Strength of Harmonics	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	

Remark:

- (1) Emission level $\text{dB}\mu\text{V} = 20 \log \text{Emission level } \mu\text{V}/\text{m}$
- (2) The smaller limit shall apply at the cross point between two frequency bands.
- (3) Distance is the distance in meters between the measuring instrument, antenna and the closest point of any part of the device or system.
- (4) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz, radiated emission limits in these three bands are based on measurements employing an average detector.

5.3. Test procedure

- (1) EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber for below 1 G and 150 cm above the ground plane inside a semi-anechoic chamber for above 1 G.
- (2) Setup EUT and assistant system according clause 2.4
- (3) Test antenna was located 3 m from the EUT on an adjustable mast. Below pre-scan procedure was first performed in order to find prominent radiated emissions.
 - (a) Change work frequency or channel of device if practicable.
 - (b) Change modulation type of device if practicable.
 - (c) Change power supply range from 85% to 115% of the rated supply voltage
 - (d) Rotated EUT though three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions
- (4) Spectrum frequency from 9 kHz to 10 GHz (tenth harmonic of fundamental frequency) was investigated, and no any obvious emission were detected from 9 kHz to 30 MHz, so below

final test was performed with frequency range from 30 MHz to 10 GHz.

- (5) For final emissions measurements at each frequency of interest, the EUT were rotated and the antenna height was varied between 1m and 4m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipment and all of the interface cables were changed according to ANSI C63.10:2013 on Radiated Emission test.
- (6) For emissions from 30 MHz to 1 GHz, Quasi-Peak values were measured with EMI Receiver and the bandwidth of Receiver is 120 kHz.
- (7) For emissions above 1 GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1 MHz, VBW is set at 3 MHz for Peak measure; according ANSI C63.10:2013 clause 4.1.4.2 procedure for average measure.
- (8) For fundamental frequency test, set spectrum analyzer's RBW = 100 kHz, VBW = 300 kHz. Peak detector for pre-test, then read the QP Level in spectrum analyzer and record.

5.4. Test result

Pass. (See below detailed test result)

All the emissions except fundamental emission from 9 kHz to 10 GHz were comply with 15.209 limit.

Note1: According exploratory test, the emission levels are 20 dB below the limit detected from 9 kHz to 30 MHz, so the final test was performed with frequency range from 30 MHz to 10 GHz and recorded in below.

Note2: For emissions above 1 GHz. If peak results comply with AV limit, AV Result is deemed to comply with AV limit.

Field Strength of the Fundamental Signal

Freq. (MHz)	Read level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
908.40	52.10	22.67	6.50	81.27	94.00	-12.73	QP	HORIZONTAL
908.40	44.29	22.66	6.50	73.45	94.00	-20.55	QP	VERTICAL
916.00	59.48	22.90	6.51	88.89	94.00	-5.11	QP	HORIZONTAL
916.00	52.36	22.90	6.51	81.77	94.00	-12.23	QP	VERTICAL
Result: Pass								

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

Radiated Emission test (below 1 GHz)

TR-4-E-009 Radiated Emission Test Result

Test Site : DDT 3m Chamber 3#

D:\E3 6.111\2022 Report Data\Q22063004-1E ZEN53 916\FCC
BELOW 1G.EM6

Test Date : 2022-08-02

Tested By : James Gan

EUT : DC Motor Controller

Model Number : ZEN53 LR

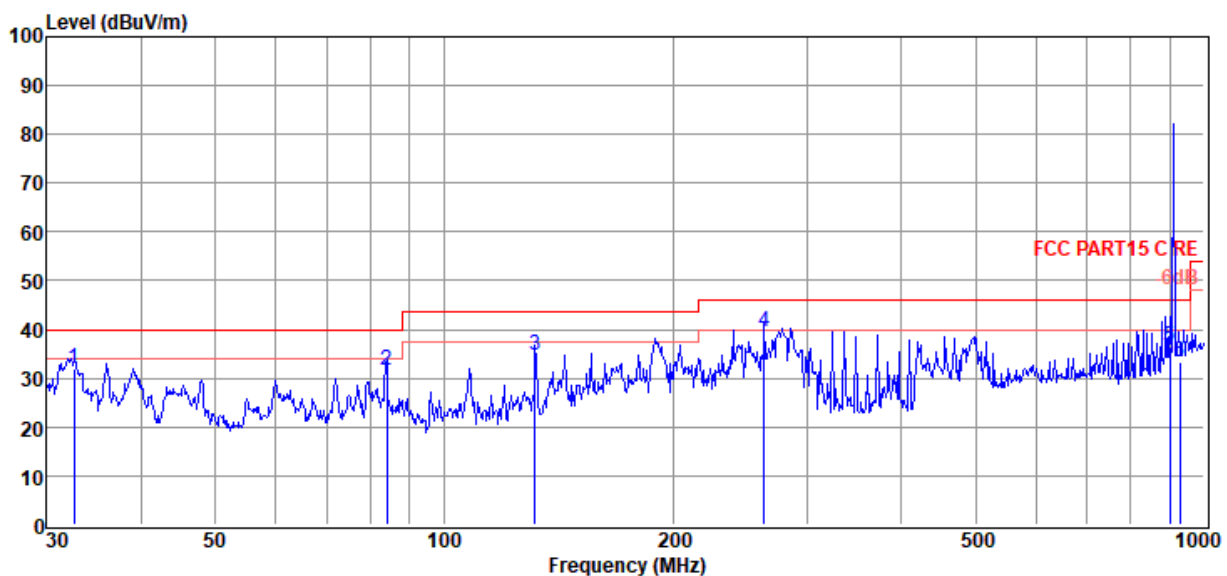
Power Supply : DC 12V

Test Mode : Tx Mode

Condition : Temp:23°C,Humi:62%,Press:100.1kPa

Antenna/Distance : 2022 9161 #3/3m/HORIZONTAL

Memo : 908.4MHz



Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	32.63	17.21	11.23	3.57	32.01	40.00	-7.99	QP	HORIZONTAL
2	84.11	17.49	10.12	3.90	31.51	40.00	-8.49	QP	HORIZONTAL
3	131.76	16.21	14.23	4.17	34.61	43.50	-8.89	QP	HORIZONTAL
4	263.82	22.88	12.08	4.70	39.66	46.00	-6.34	QP	HORIZONTAL
5	902.00	7.35	22.74	6.48	36.57	46.00	-9.43	QP	HORIZONTAL
6	928.00	3.85	22.96	6.53	33.34	46.00	-12.66	QP	HORIZONTAL

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

TR-4-E-009 Radiated Emission Test Result

Test Site : DDT 3m Chamber 3#

D:\E3 6.111\2022 Report Data\Q22063004-1E ZEN53 916\FCC
BELOW 1G.EM6

Test Date : 2022-08-02

Tested By : James Gan

EUT : DC Motor Controller

Model Number : ZEN53 LR

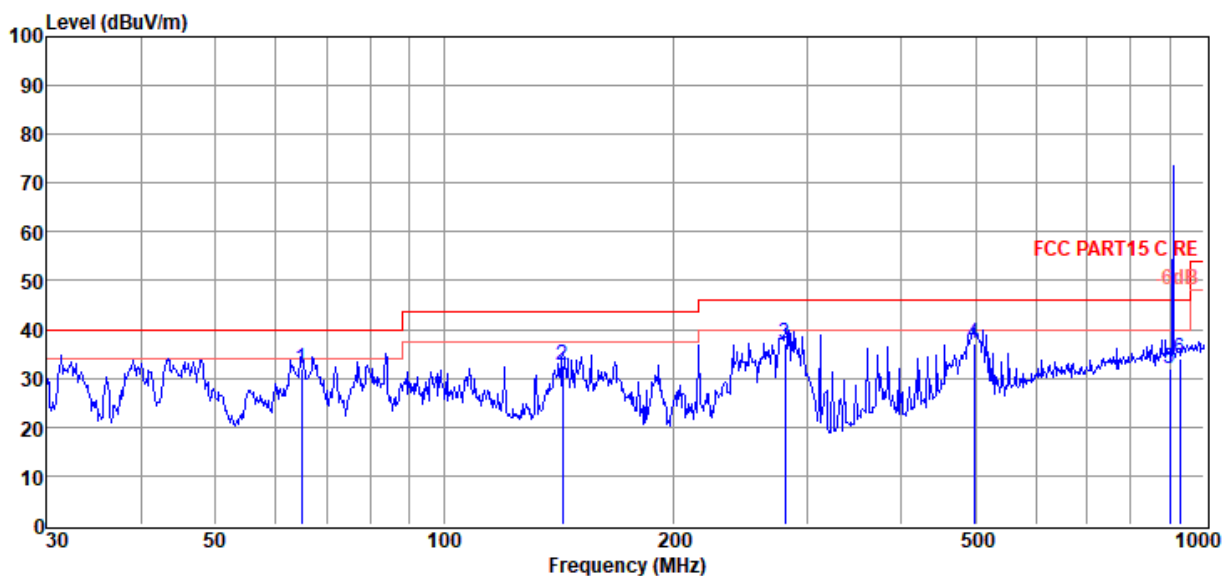
Power Supply : DC 12V

Test Mode : Tx Mode

Condition : Temp:23°C,Humi:62%,Press:100.1kPa

Antenna/Distance : 2022 9161 #3/3m/VERTICAL

Memo : 908.4MHz



Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	64.89	17.86	10.26	3.79	31.91	40.00	-8.09	QP	VERTICAL
2	143.33	11.53	16.77	4.22	32.52	43.50	-10.98	QP	VERTICAL
3	281.01	19.58	12.72	4.76	37.06	46.00	-8.94	QP	VERTICAL
4	497.68	14.44	17.35	5.47	37.26	46.00	-8.74	QP	VERTICAL
5	902.00	2.60	22.74	6.48	31.82	46.00	-14.18	QP	VERTICAL
6	928.00	4.60	22.96	6.53	34.09	46.00	-11.91	QP	VERTICAL

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

TR-4-E-009 Radiated Emission Test Result

Test Site : DDT 3m Chamber 3#

D:\E3 6.111\2022 Report Data\Q22063004-1E ZEN53 916\FCC
BELOW 1G.EM6

Test Date : 2022-08-02

Tested By : James Gan

EUT : DC Motor Controller

Model Number : ZEN53 LR

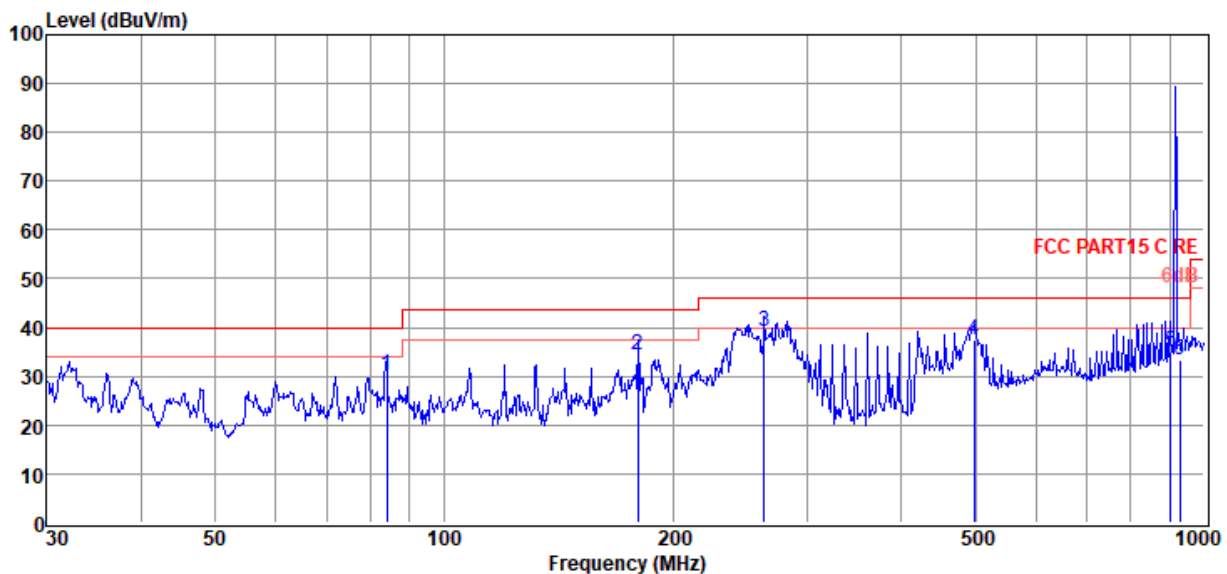
Power Supply : DC 12V

Test Mode : Tx Mode

Condition : Temp:23°C,Humi:62%,Press:100.1kPa

Antenna/Distance : 2022 9161 #3/3m/HORIZONTAL

Memo : 916MHz



Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	84.11	16.36	10.12	3.90	30.38	40.00	-9.62	QP	HORIZONTAL
2	180.02	15.82	14.10	4.38	34.30	43.50	-9.20	QP	HORIZONTAL
3	263.82	22.42	12.08	4.70	39.20	46.00	-6.80	QP	HORIZONTAL
4	497.68	14.56	17.35	5.47	37.38	46.00	-8.62	QP	HORIZONTAL
5	902.00	5.86	22.77	6.49	35.12	46.00	-10.88	QP	HORIZONTAL
6	928.00	3.87	22.98	6.53	33.38	46.00	-12.62	QP	HORIZONTAL

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

TR-4-E-009 Radiated Emission Test Result

Test Site : DDT 3m Chamber 3#

D:\E3 6.111\2022 Report Data\Q22063004-1E ZEN53 916\FCC
BELOW 1G.EM6

Test Date : 2022-08-02

Tested By : James Gan

EUT : DC Motor Controller

Model Number : ZEN53 LR

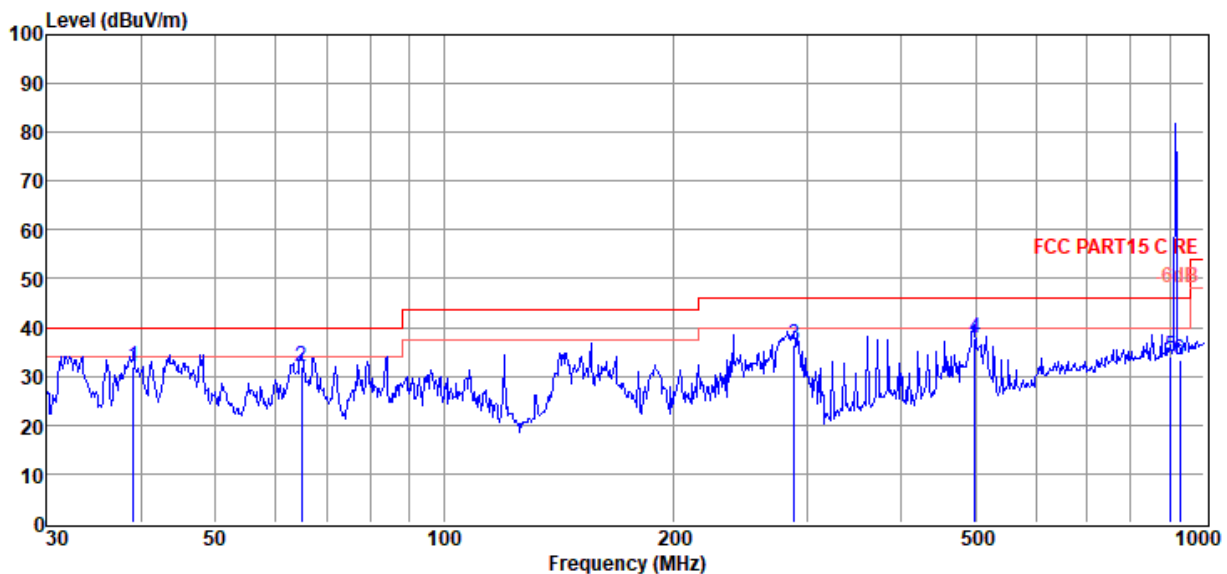
Power Supply : DC 12V

Test Mode : Tx Mode

Condition : Temp:23°C,Humi:62%,Press:100.1kPa

Antenna/Distance : 2022 9161 #3/3m/VERTICAL

Memo : 916MHz



Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	39.02	16.29	12.20	3.61	32.10	40.00	-7.90	QP	VERTICAL
2	64.89	17.75	10.26	3.79	31.80	40.00	-8.20	QP	VERTICAL
3	289.00	18.65	12.88	4.79	36.32	46.00	-9.68	QP	VERTICAL
4	499.43	14.78	17.39	5.48	37.65	46.00	-8.35	QP	VERTICAL
5	902.00	4.65	22.77	6.49	33.91	46.00	-12.09	QP	VERTICAL
6	928.00	3.73	22.98	6.53	33.24	46.00	-12.76	QP	VERTICAL

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

Radiated Emission test (above 1 GHz)

TR-4-E-009 Radiated Emission Test Result

Test Site : DDT 3m Chamber 3#

D:\E3 6.111\2022 Report Data\Q22063004-1E ZEN53
916\FCC ABOVE 1G .EM6

Test Date : 2022-08-01

Tested By : James Gan

EUT : DC Motor Controller

Model Number : ZEN53 LR

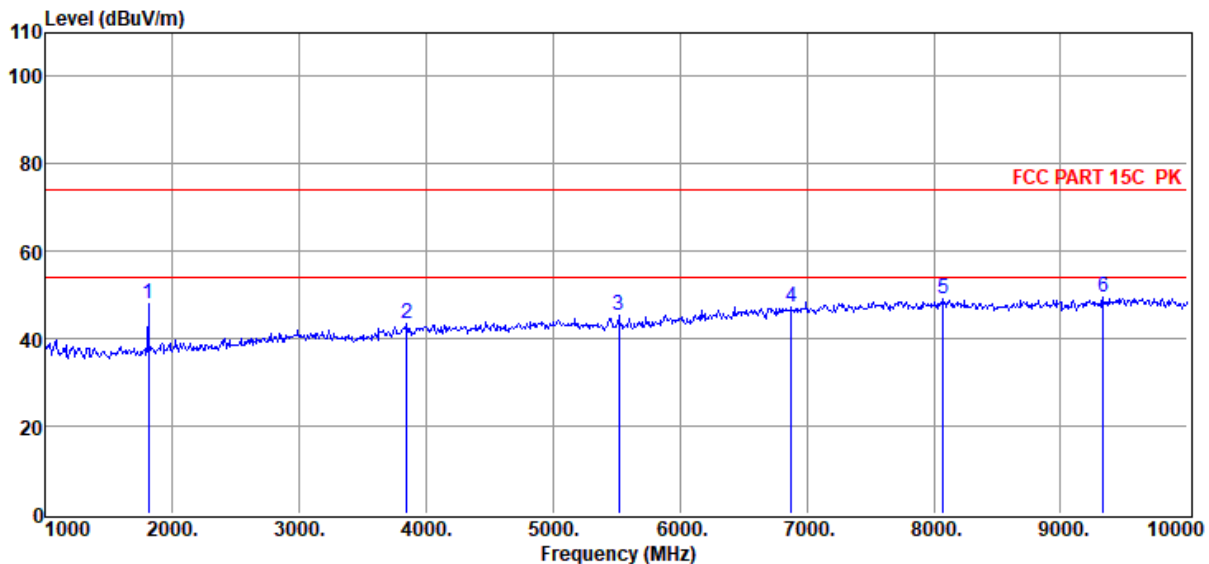
Power Supply : DC 12V

Test Mode : Tx Mode

Condition : Temp:23.9°C,Humi:52%,Press:100.3kPa

Antenna/Distance : 2021 BBHA 9120D
3#/3m/HORIZONTAL

Memo : 908.4MHz



Item (Mark)	Freq. (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Filter Factor dB	Result Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Detector	Polarization
1	1816.80	58.85	26.21	39.12	1.52	0.65	48.11	74.00	-25.89	Peak	HORIZONTAL
2	3844.00	50.05	30.57	40.15	1.98	0.85	43.30	74.00	-30.70	Peak	HORIZONTAL
3	5518.00	49.21	32.84	40.45	2.59	1.03	45.22	74.00	-28.78	Peak	HORIZONTAL
4	6877.00	47.25	35.80	39.80	3.08	0.96	47.29	74.00	-26.71	Peak	HORIZONTAL
5	8074.00	47.34	37.12	39.81	3.19	1.18	49.02	74.00	-24.98	Peak	HORIZONTAL
6	9334.00	46.25	38.57	40.13	3.52	1.24	49.45	74.00	-24.55	Peak	HORIZONTAL

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss + Filter Factor - PRM Factor.

2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.

3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

TR-4-E-009 Radiated Emission Test Result

Test Site : DDT 3m Chamber 3#

D:\E3 6.111\2022 Report Data\Q22063004-1E ZEN53
916\FCC ABOVE 1G .EM6

Test Date : 2022-08-01

Tested By : James Gan

EUT : DC Motor Controller

Model Number : ZEN53 LR

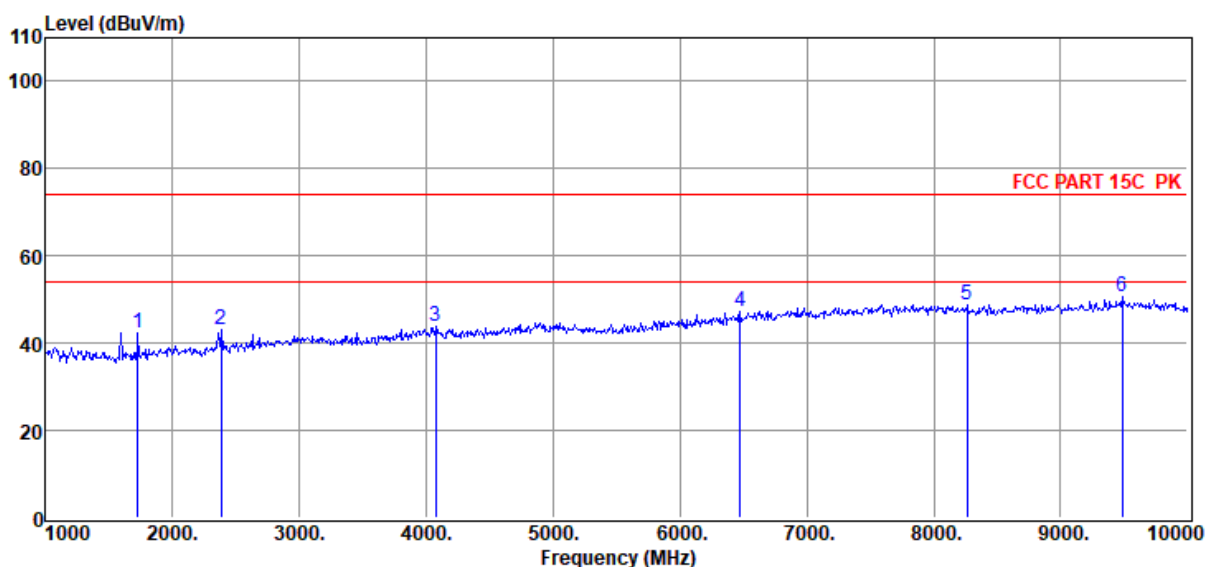
Power Supply : DC 12V

Test Mode : Tx Mode

Condition : Temp:23.9°C,Humi:52%,Press:100.3kPa

Antenna/Distance : 2021 BBHA 9120D 3#/3m/VERTICAL

Memo : 908.4MHz



Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Filter Factor dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	1729.00	53.36	26.00	38.99	1.48	0.63	42.48	74.00	-31.52	Peak	VERTICAL
2	2386.00	52.95	27.39	39.59	1.71	0.72	43.18	74.00	-30.82	Peak	VERTICAL
3	4078.00	49.75	31.16	40.22	2.15	0.86	43.70	74.00	-30.30	Peak	VERTICAL
4	6472.00	47.78	35.13	40.12	3.26	1.04	47.09	74.00	-26.91	Peak	VERTICAL
5	8263.00	46.84	37.42	39.83	3.21	1.18	48.82	74.00	-25.18	Peak	VERTICAL
6	9487.00	47.16	38.69	40.24	3.61	1.27	50.49	74.00	-23.51	Peak	VERTICAL

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss + Filter Factor - PRM Factor.

2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.

3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

TR-4-E-009 Radiated Emission Test Result

Test Site : DDT 3m Chamber 3#

D:\E3 6.111\2022 Report Data\Q22063004-1E ZEN53
916\FCC ABOVE 1G .EM6

Test Date : 2022-08-01

Tested By : James Gan

EUT : DC Motor Controller

Model Number : ZEN53 LR

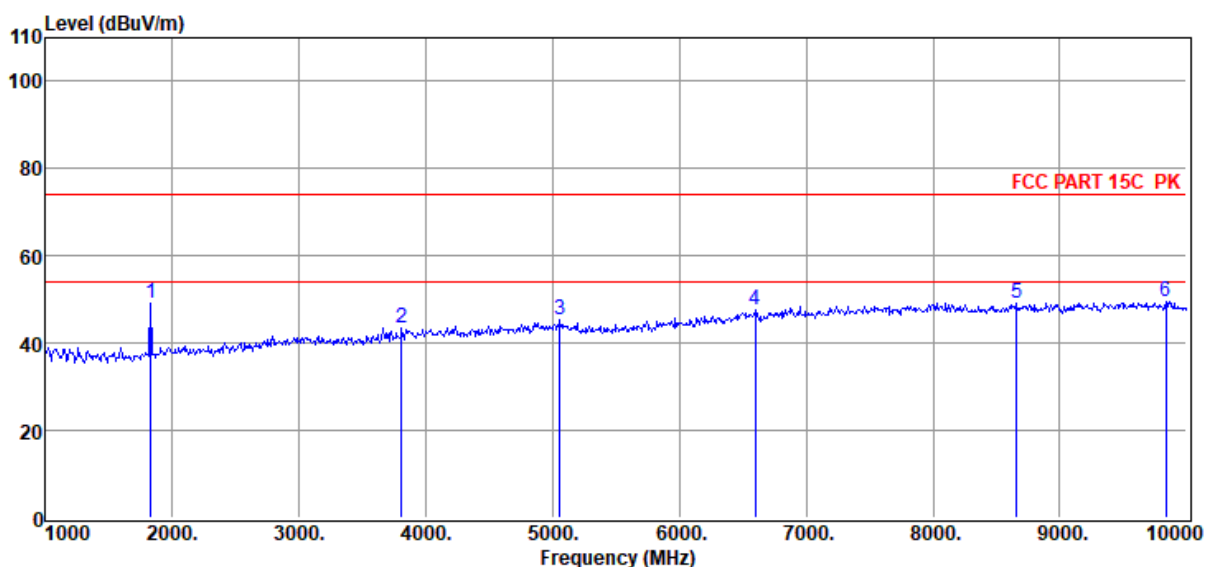
Power Supply : DC 12V

Test Mode : Tx Mode

Condition : Temp:23.9°C,Humi:52%,Press:100.3kPa

Antenna/Distance : 2021 BBHA 9120D
3#/3m/HORIZONTAL

Memo : 916MHz



Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Filter Factor dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	1832.00	60.03	26.25	39.14	1.52	0.65	49.31	74.00	-24.69	Peak	HORIZONTAL
2	3808.00	50.20	30.45	40.14	1.95	0.85	43.31	74.00	-30.69	Peak	HORIZONTAL
3	5059.00	49.18	33.06	40.41	2.54	0.92	45.29	74.00	-28.71	Peak	HORIZONTAL
4	6598.00	48.19	35.36	40.02	3.22	1.01	47.76	74.00	-26.24	Peak	HORIZONTAL
5	8659.00	46.68	37.96	39.87	3.25	1.18	49.20	74.00	-24.80	Peak	HORIZONTAL
6	9838.00	46.48	38.50	40.49	3.65	1.34	49.48	74.00	-24.52	Peak	HORIZONTAL

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss + Filter Factor - PRM Factor.

2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.

3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

TR-4-E-009 Radiated Emission Test Result

Test Site : DDT 3m Chamber 3#

D:\E3 6.111\2022 Report Data\Q22063004-1E ZEN53
916\FCC ABOVE 1G .EM6

Test Date : 2022-08-01

Tested By : James Gan

EUT : DC Motor Controller

Model Number : ZEN53 LR

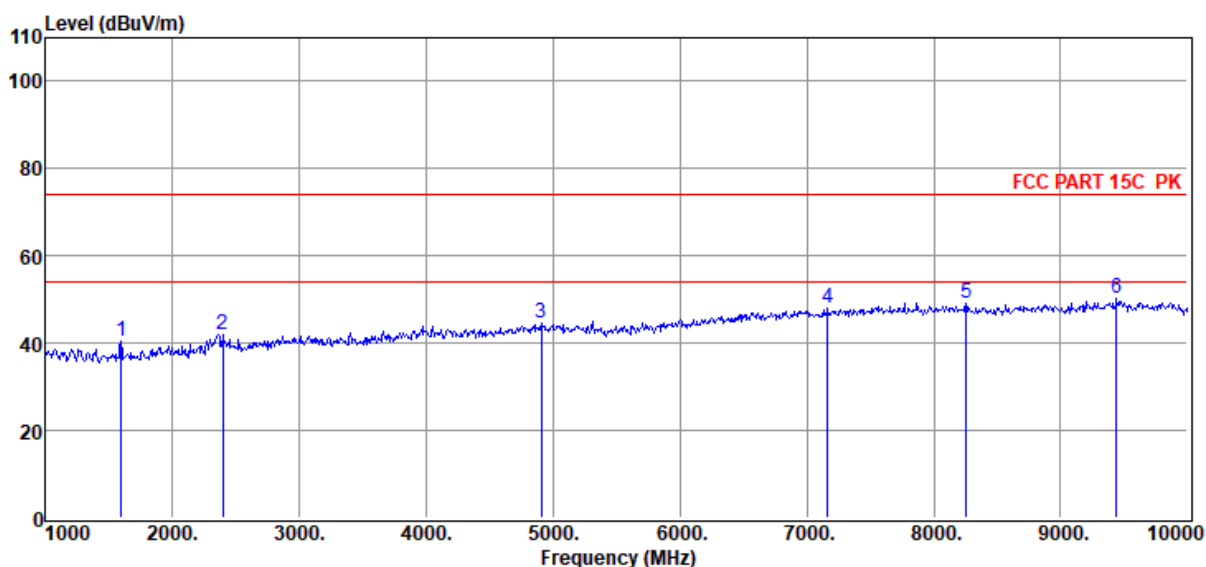
Power Supply : DC 12V

Test Mode : Tx Mode

Condition : Temp:23.9°C,Humi:52%,Press:100.3kPa

Antenna/Distance : 2021 BBHA 9120D 3#/3m/VERTICAL

Memo : 916MHz



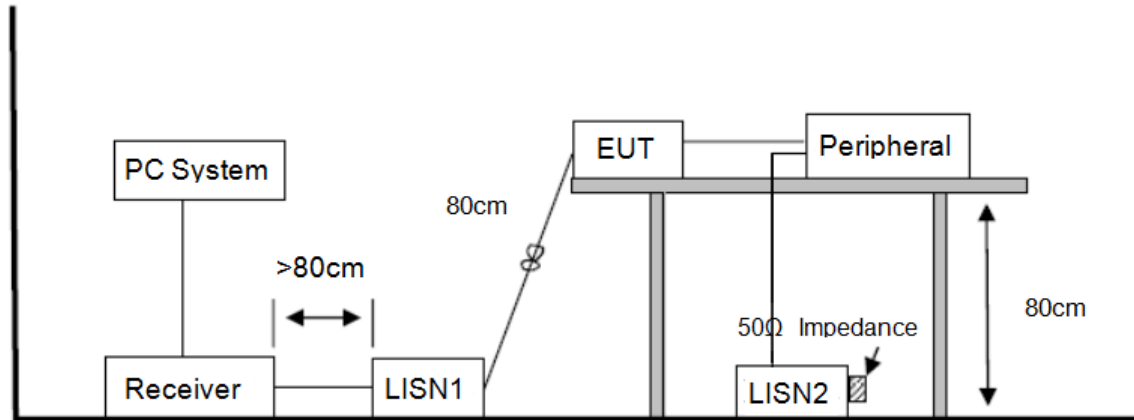
Note: 1. Result Level = Read Level + Antenna Factor + Cable loss + Filter Factor - PRM Factor.

2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.

3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

6. Power Line Conducted Emission

6.1. Block diagram of test setup



6.2. Power line conducted emission limits

Frequency	Quasi-Peak Level dB(μ V)	Average Level dB(μ V)
150 kHz ~ 500 kHz	66 ~ 56*	56 ~ 46*
500 kHz ~ 5 MHz	56	46
5 MHz ~ 30 MHz	60	50

Note 1: * Decreasing linearly with logarithm of frequency.

Note 2: The lower limit shall apply at the transition frequencies.

6.3. Test procedure

The EUT and Support equipment, if needed, were put placed on a non-metallic table, 80cm above the ground plane.

Configuration EUT to simulate typical usage as described in clause 2.4 and test equipment as described in clause 6.1 of this report.

All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.

All support equipment power received from a second LISN.

Emissions were measured on each current carrying line of the EUT using an EMI Test Receiver connected to the LISN powering the EUT.

The Receiver scanned from 150 kHz to 30 MHz for emissions in each of the test modes.

During the above scans, the emissions were maximized by cable manipulation.

The test mode(s) described in clause 2.4 were scanned during the preliminary test.

After the preliminary scan, we found the test mode producing the highest emission level.

The EUT configuration and worse cable configuration of the above highest emission levels were recorded for reference of the final test.

EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test.

A scan was taken on both power lines, Neutral and Line, recording at least the six highest emissions.

Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit.

The test data of the worst-case condition(s) was recorded.

The bandwidth of test receiver is set at 9 kHz.

6.4. Test result

Not applicable, EUT is powered by DC input.

7. Antenna Requirements

7.1. Limit

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

7.2. Result

The antenna used for this product and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain is -2.80 dBi.