

FCC CERTIFICATION TEST REPORT

FOR

Applicant	:	Lorenz High Definition LLC
Address	:	230 Rt 206 STE 401, Flanders, New Jersey, United States
Equipment under Test	:	Dry Contact Relay
Model No.	:	ZEN51
Trade Mark	:	/
FCC ID	:	2AZ2V-091821ZEN51
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

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REPORT

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Test Report Declare

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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-R21081127-1E01		
Date of Receipt:	Aug. 23, 2021	Date of Test:	Aug. 23, 2021 ~ Sep. 17, 2021

Prepared By:

Sam Li

Sam Li/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	Nov. 03, 2021	

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	Pass
Antenna requirement	FCC Part 15: 15.203	Pass

2. General Test Information

2.1. Description of EUT

EUT* Name	: Dry Contact Relay
Model Number	: ZEN51
EUT function description	: Please reference user manual of this device
Power supply	: AC 100-240V, 50/60Hz
Operation frequency	: 908.40 - 916.00 MHz
Modulation	: FSK
Antenna Gain	: 1 dBi
Sample Type	: Series production
Serial Number	: N/A

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	Data rate (kbps)	Frequency (MHz)
FSK Tx mode	/	40	908.40
	/	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, 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 ($8 \text{ GHz} \leq f < 22 \text{ GHz}$)
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.	

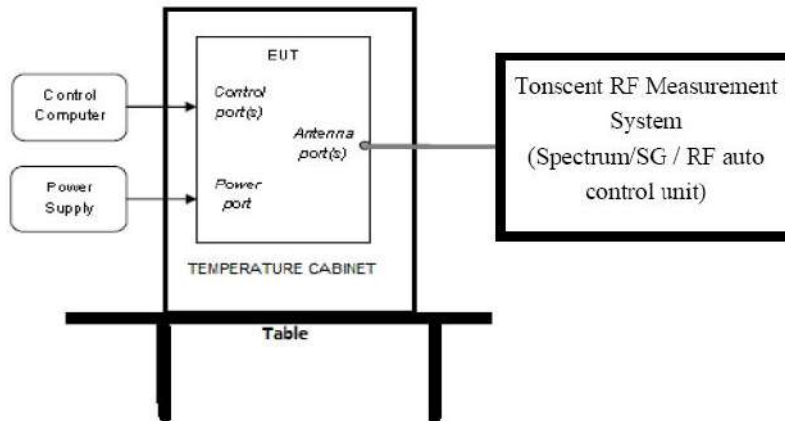
3. Equipment Used During Test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
☐ RF Connected Test (Tonscend RF Measurement System 1#)					
Spectrum analyzer	R&S	FSU26	200071	Sep. 25, 2020	1 Year
Wideband Radio Communication tester	R&S	CMW500	117491	Jun. 01, 2021	1 Year
Vector Signal Generator	Agilent	E8267D	US49060192	Sep. 24, 2020	1 Year
Vector Signal Generator	Agilent	N5182A	MY48180737	Jun. 01, 2021	1 Year
RF Control Unit	Tonsend	JS0806-2	DDT-ZC0290	Jun. 01, 2021	1 Year
Temp&Humi Programmable	ZHIXIANG	ZXGDJS-150L	ZX170110-A	Jun. 01, 2021	1 Year
Test Software	JS Tonscend	JS1120-3	Ver.2.7	N/A	N/A
☒ RF Connected Test (Tonscend RF Measurement System 2#)					
Spectrum analyzer	R&S	FSU26	101472	Jun. 01, 2021	1 Year
Wideband Radio Communication tester	R&S	CMW500	120259	Jan. 19, 2021	1 Year
Vector Signal Generator	Agilent	N5182A	MY19060405	Jun. 01, 2021	1 Year
Vector Signal Generator	Agilent	N5182A	MY48180912	Jun. 01, 2021	1 Year
RF Control Unit	Tonsend	JS0806-2	DDT-ZC01449	Jun. 01, 2021	1 Year
Temp&Humi Programmable	ZHIXIANG	ZXGDJS-150L	ZX170110-A	Jun. 01, 2021	1 Year
Test Software	JS Tonscend	JS1120-3	Ver.2.7	N/A	N/A
☐ Radiation 1#chamber					
EMI Test Receiver	R&S	ESU8	100316	Sep. 24, 2020	1 Year
Spectrum analyzer	Agilent	E4447A	MY50180031	Jun. 01, 2021	1 Year
Trilog Broadband Antenna	Schwarzbeck	VULB9163	9163-462	Nov. 13, 2020	1 Year
Active Loop antenna	Schwarzbeck	FMZB-1519	1519-038	Nov. 18, 2020	1 Year
Double Ridged Horn Antenna	R&S	HF907	100276	Nov. 13, 2020	1 Year
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	790	May 07, 2021	1 Year
Pre-amplifier	A.H.	PAM-0118	360	Sep. 28, 2020	1 Year
RF Cable	HUBSER	CP-X2+ CP-X1	W11.03+ W12.02	Sep. 24, 2020	1 Year
RF Cable	N/A	5m+6m+1m	06270619	Sep. 30, 2020	1 Year
MI Cable	HUBSER	C10-01-01-1M	1091629	Sep. 30, 2020	1 Year
Test software	Audix	E3	V 6.11111b	N/A	N/A
☐ Radiation 2#chamber					
EMI Test Receiver	R&S	ESCI	101364	Sep. 28, 2020	1 Year
Spectrum analyzer	Agilent	E4447A	MY50180031	Jun. 01, 2021	1 Year

Trilog Broadband Antenna	Schwarzbeck	VULB 9163	9163-994	Nov. 13, 2020	1 Year
Active Loop antenna	Schwarzbeck	FMZB-1519	1519-038	Nov. 18, 2020	1 Year
Double Ridged Horn Antenna	Schwarzbeck	BBHA9120	02108	Jul. 17, 2021	1 Year
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	790	May 07, 2021	1 Year
Pre-amplifier	TERA-MW	TRLA-0040 G35	1013 03	Sep. 28, 2020	1 Year
RF Cable	N/A	14+1.5m	06270619	Sep. 28, 2020	1 Year
Test software	Audix	E3	V 6.11111b	N/A	N/A
☒ Radiation 3#chamber					
EMI Test Receiver	R&S	ESU	100472	Jun. 01, 2021	1 Year
Trilog Broadband Antenna	Schwarzbeck	VULB 9163	01429	Aug. 07, 2021	1 Year
Double Ridged Horn Antenna	Schwarzbeck	BBHA9120	02108	Jul. 17, 2021	1 Year
Pre-amplifier	COM-POWER	PAM-118A	18040084	Sep. 28, 2020	1 Year
RF Cable	N/A	14+1.5m	06270619	Sep. 28, 2020	1 Year
Test software	Audix	E3	V 9	N/A	N/A
☐ Power Line Conducted Emissions Test 1#					
EMI Test Receiver	R&S	ESU8	100316	Sep. 24, 2020	1 Year
LISN 1	R&S	ENV216	101109	Sep. 28, 2020	1 Year
LISN 2	R&S	ESH2-Z5	100309	Sep. 28, 2020	1 Year
Pulse Limiter	R&S	ESH3-Z2	101242	Sep. 24, 2020	1 Year
CE Cable 1	HUBSER	N/A	W10.01	Sep. 24, 2020	1 Year
Test software	Audix	E3	V 6.11111b	N/A	N/A
☒ Power Line Conducted Emissions Test 2#					
Test Receiver	R&S	ESPI	101761	Sep. 24, 2020	1 Year
LISN 1	R&S	ENV216	101170	Sep. 28, 2020	1 Year
LISN 2	R&S	ESH2-Z5	100309	Sep. 28, 2020	1 Year
Pulse Limiter	R&S	KH43101	43101180156 8-12#	Jun. 01, 2021	1 Year
CE Cable 2	HUBSER	N/A	W11.02	Sep. 24, 2020	1 Year
Test software	Audix	E3	V 6.11111b	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

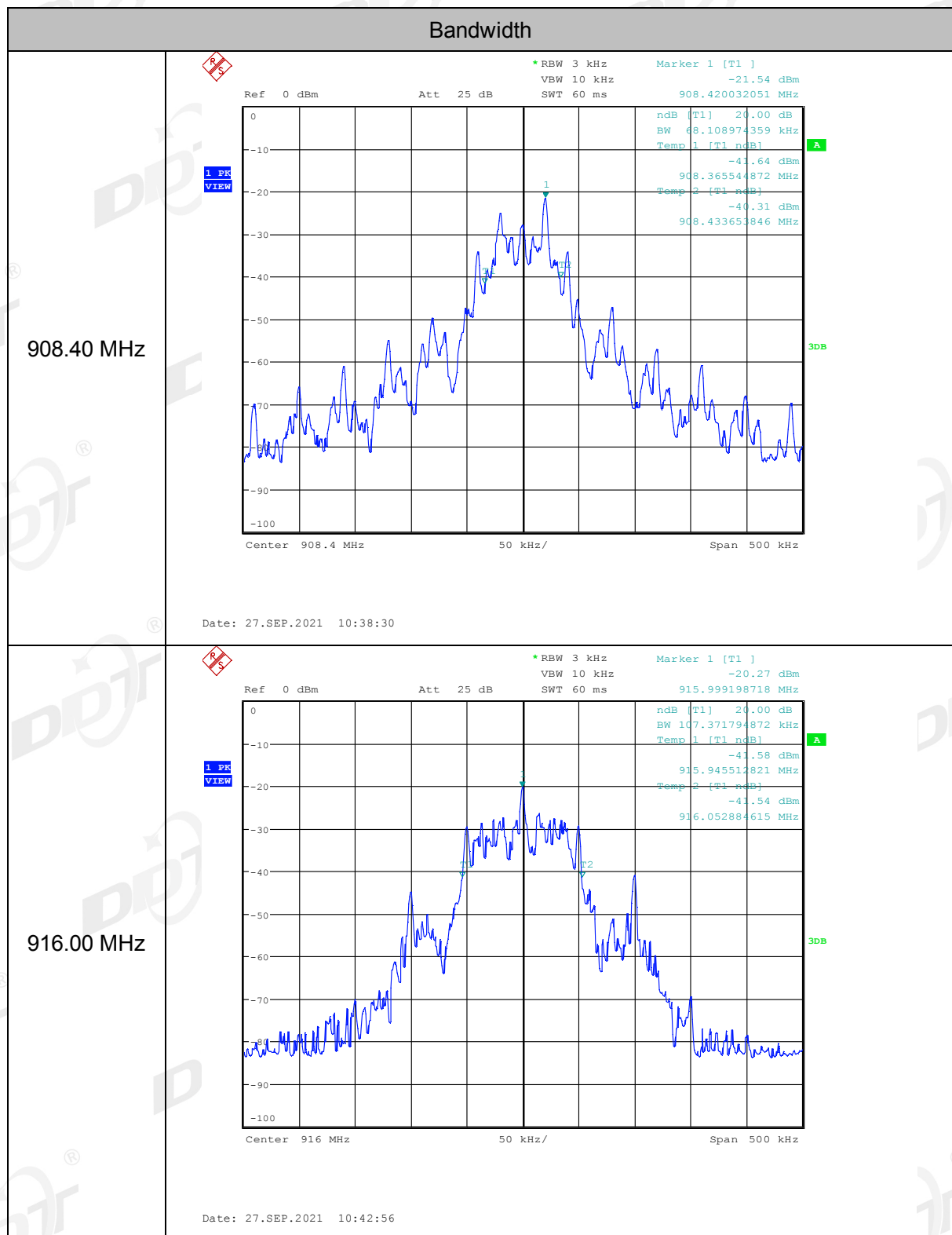
- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) Set the spectrum analyzer as follows:

RBW:	3 kHz
VBW:	10 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	68.11	/	Pass
FSK	916.00	107.37	/	Pass

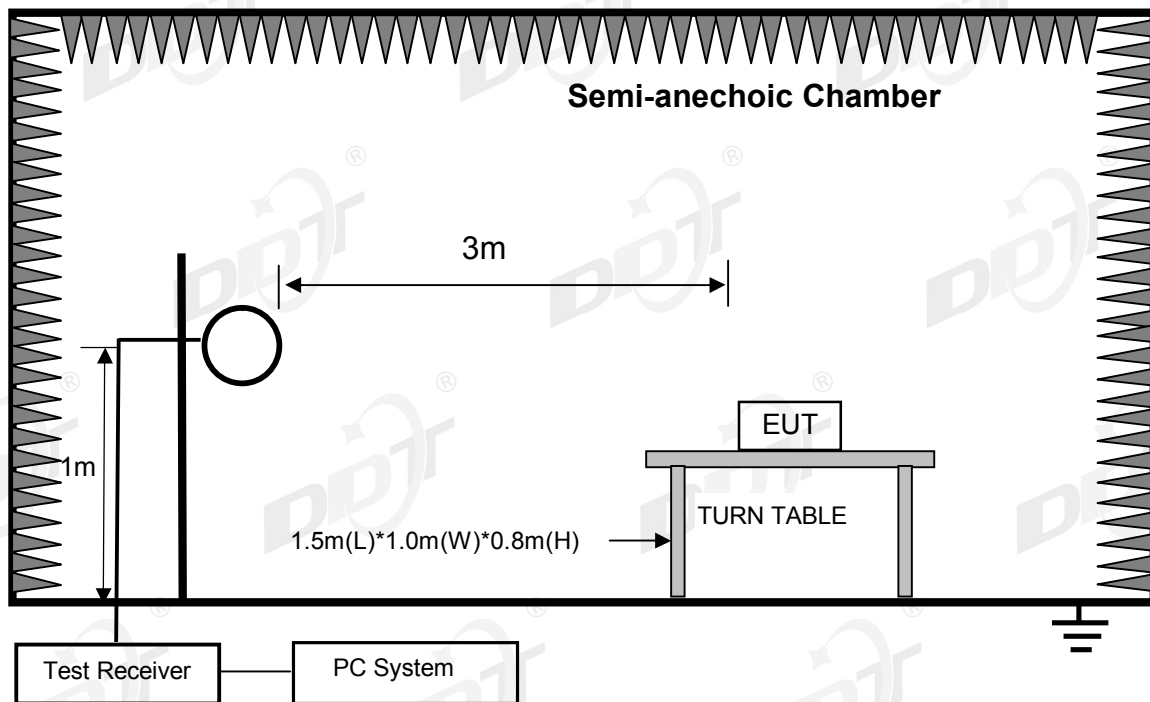
4.5. Original test data



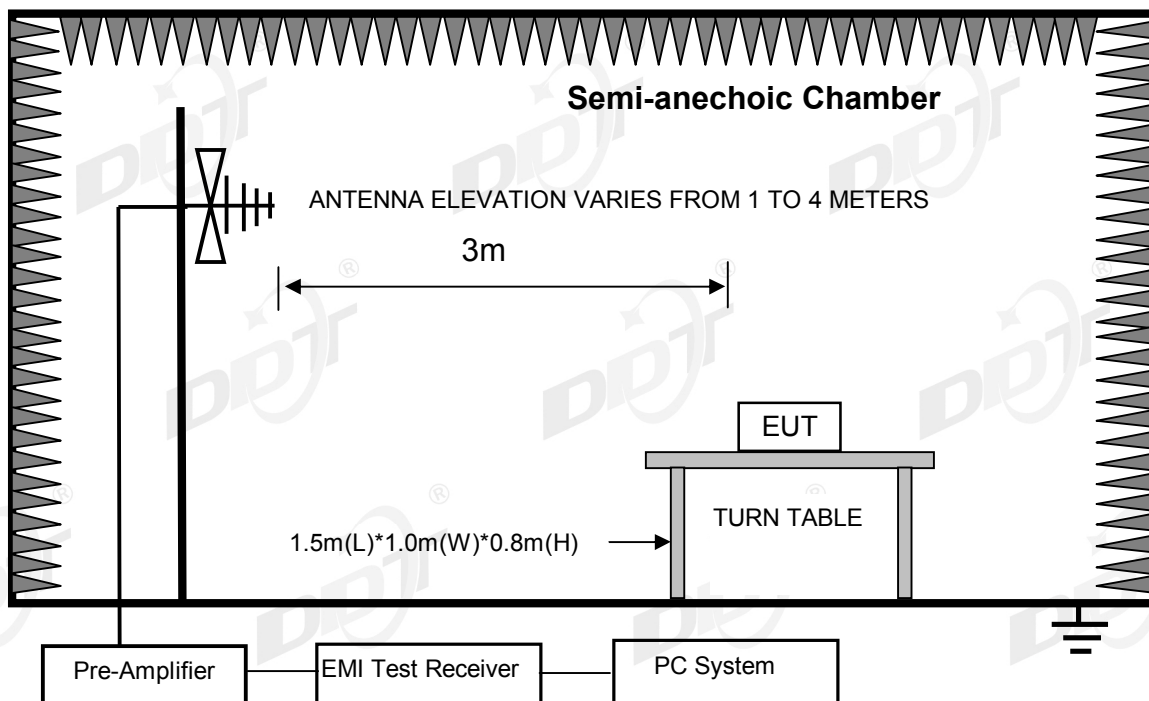
5. Radiated Emission

5.1. Block diagram of test setup

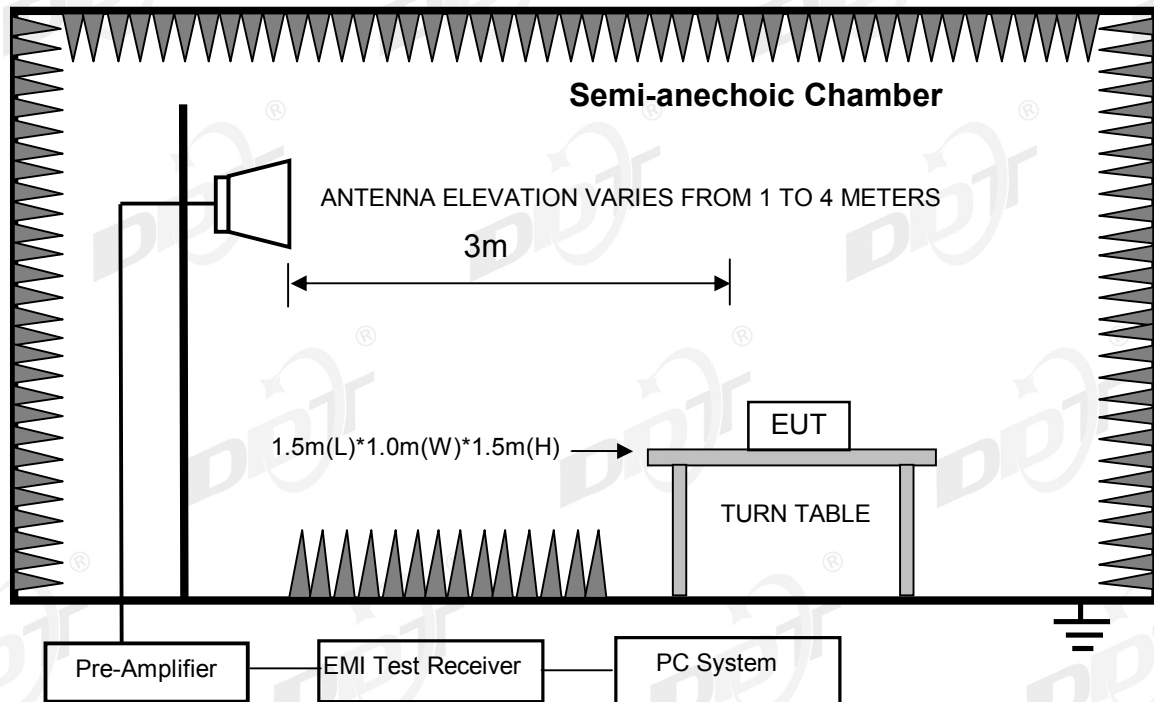
In 3 m Anechoic Chamber, test setup diagram for 9 kHz - 30 MHz:



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	$2400/F(\text{kHz})$	$67.6-20\log(F)$
0.490 ~ 1.705	30	$24000/F(\text{kHz})$	$87.6-20\log(F)$
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 $\text{dB}(\mu\text{V})/\text{m}$ (Peak) 54.0 $\text{dB}(\mu\text{V})/\text{m}$ (Average)	
Field Strength of Fundamental emission for 902 MHz - 928 MHz	3	94.0 $\text{dB}(\mu\text{V})/\text{m}$ (QP)	
Field Strength of Harmonics	3	74.0 $\text{dB}(\mu\text{V})/\text{m}$ (Peak) 54.0 $\text{dB}(\mu\text{V})/\text{m}$ (Average)	

Remark:

- (1) Emission level $\text{dB}\mu\text{V} = 20 \log$ 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.
- (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	45.33	22.27	6.39	73.99	94.00	-20.01	QP	HORIZONTAL
908.40	38.43	22.27	6.39	67.09	94.00	-26.91	QP	VERTICAL
916.00	46.40	22.40	6.41	73.21	94.00	-20.79	QP	HORIZONTAL
916.00	40.62	22.40	6.41	66.43	94.00	-27.57	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:\2021 report data\Q21081127-2E ZEN51\FCC BELOW
1G\FCC BELOW 1G_00003.EMI

Test Date : 2021-09-08

Tested By : Sanvin Zheng

EUT : Dry Contact Relay

Model Number : ZEN51

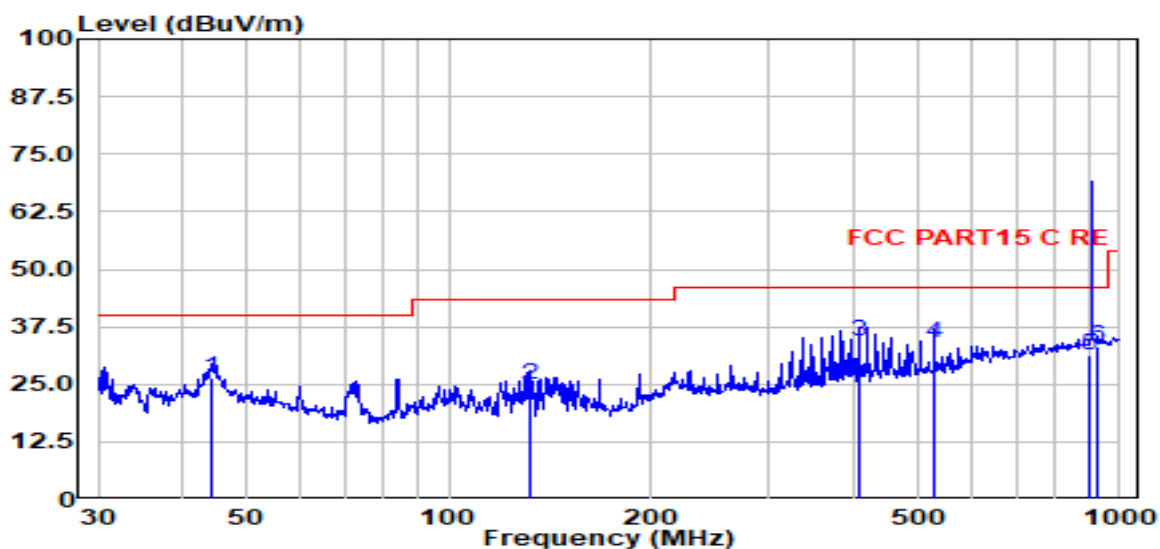
Power Supply : AC 120V/60Hz

Test Mode : Tx mode

Condition : Temp:24.3°, Humi:54%,
Press:100.1kPa

Antenna/Distance : VLUB 9163 3#/3m/VERTICAL

Memo : 908.4 MHz



Item (Mark)	Freq. (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Detector	Polarization
1	44.28	7.57	15.03	3.66	26.26	40.00	-13.74	QP	VERTICAL
2	131.76	12.09	8.92	4.00	25.01	43.50	-18.49	QP	VERTICAL
3	408.95	13.62	15.76	5.08	34.46	46.00	-11.54	QP	VERTICAL
4	528.25	11.19	17.30	5.42	33.91	46.00	-12.09	QP	VERTICAL
5	902.00	2.98	22.14	6.38	31.50	46.00	-14.50	QP	VERTICAL
6	928.00	4.25	22.40	6.45	33.10	46.00	-12.90	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:\2021 report data\Q21081127-2E ZEN51\FCC BELOW
1G\FCC BELOW 1G_00004.EMI

Test Date : 2021-09-08

Tested By : Sanvin Zheng

EUT : Dry Contact Relay

Model Number : ZEN51

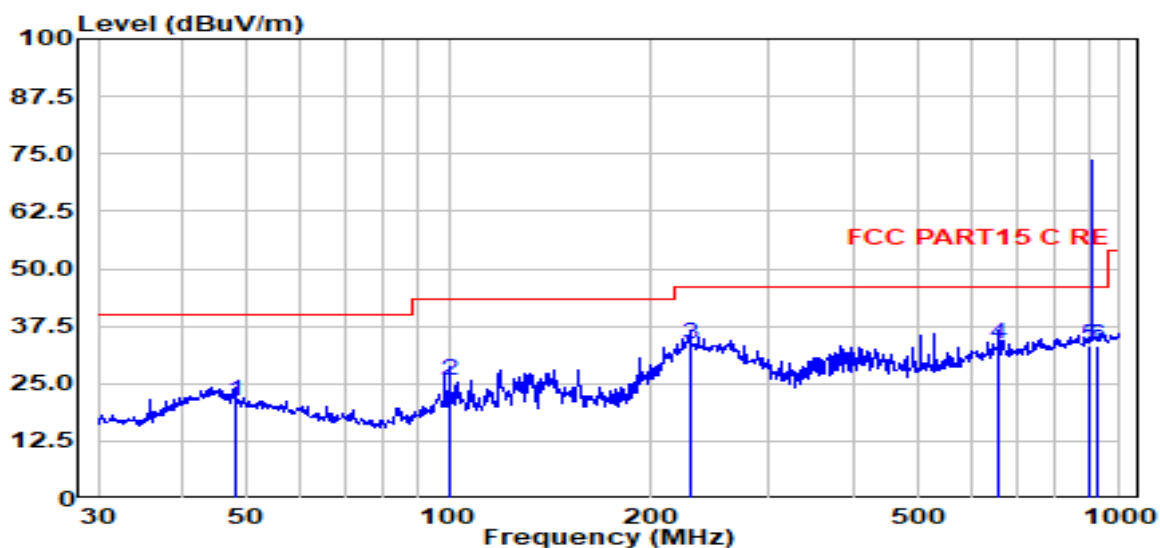
Power Supply : AC 120V/60Hz

Test Mode : Tx mode

Condition : Temp:24.3°, Humi:54%,
Press:100.1kPa

Antenna/Distance : VLUB 9163 3#/3m/HORIZONTAL

Memo : 908.4 MHz



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	47.99	4.12	13.40	3.69	21.21	40.00	-18.79	QP	HORIZONTAL
2	100.23	10.27	11.52	3.89	25.68	43.50	-17.82	QP	HORIZONTAL
3	228.49	17.36	11.94	4.45	33.74	46.00	-12.26	QP	HORIZONTAL
4	661.15	8.71	19.02	5.79	33.52	46.00	-12.48	QP	HORIZONTAL
5	902.00	4.66	22.14	6.38	33.18	46.00	-12.82	QP	HORIZONTAL
6	928.00	4.38	22.40	6.45	33.23	46.00	-12.77	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:\2021 report data\Q21081127-2E ZEN51\FCC BELOW
1G\FCC BELOW 1G_00001.EMI

Test Date : 2021-09-08

Tested By : Sanvin Zheng

EUT : Dry Contact Relay

Model Number : ZEN51

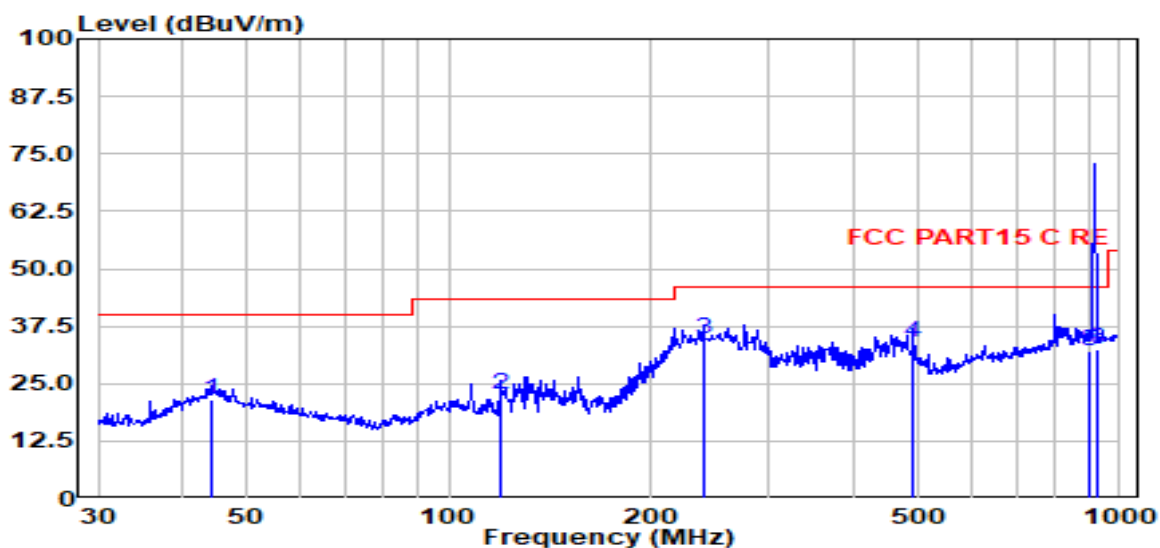
Power Supply : AC 120V/60Hz

Test Mode : Tx mode

Condition : Temp:24.3°,Humi:54%,Press:100.1kPa

Antenna/Distance : VLUB 9163 3#/3m/HORIZONTAL

Memo : 916.00 MHz



Item (Mark)	Freq. (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Detector	Polarization
1	44.12	2.68	15.01	3.66	21.35	40.00	-18.65	QP	HORIZONTAL
2	119.44	9.66	9.16	3.96	22.77	43.50	-20.73	QP	HORIZONTAL
3	239.99	17.75	12.50	4.49	34.73	46.00	-11.27	QP	HORIZONTAL
4	492.47	11.72	16.75	5.33	33.79	46.00	-12.21	QP	HORIZONTAL
5	902.00	3.71	22.14	6.38	32.23	46.00	-13.77	QP	HORIZONTAL
6	928.00	3.60	22.40	6.45	32.44	46.00	-13.56	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:\2021 report data\Q21081127-2E ZEN51\FCC BELOW
1G\FCC BELOW 1G_00002.EMI

Test Date : 2021-09-08

Tested By : Sanvin Zheng

EUT : Dry Contact Relay

Model Number : ZEN51

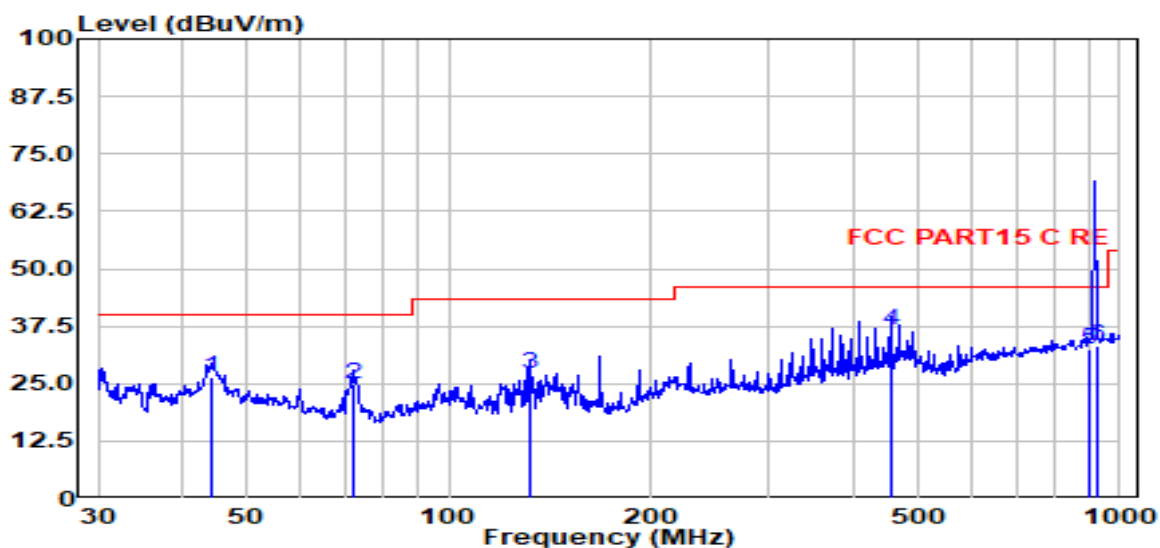
Power Supply : AC 120V/60Hz

Test Mode : Tx mode

Condition : Temp:24.3°,Humi:54%,Press:100.1kPa

Antenna/Distance : VLU8 9163 3#/3m/VERTICAL

Memo : 916.00 MHz



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	44.28	7.86	15.03	3.66	26.55	40.00	-13.45	QP	VERTICAL
2	72.34	12.19	8.87	3.73	24.78	40.00	-15.22	QP	VERTICAL
3	131.76	14.39	8.92	4.00	27.31	43.50	-16.19	QP	VERTICAL
4	455.91	15.56	15.82	5.23	36.61	46.00	-9.39	QP	VERTICAL
5	902.00	3.92	22.14	6.38	32.43	46.00	-13.57	QP	VERTICAL
6	928.00	4.43	22.40	6.45	33.27	46.00	-12.73	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)

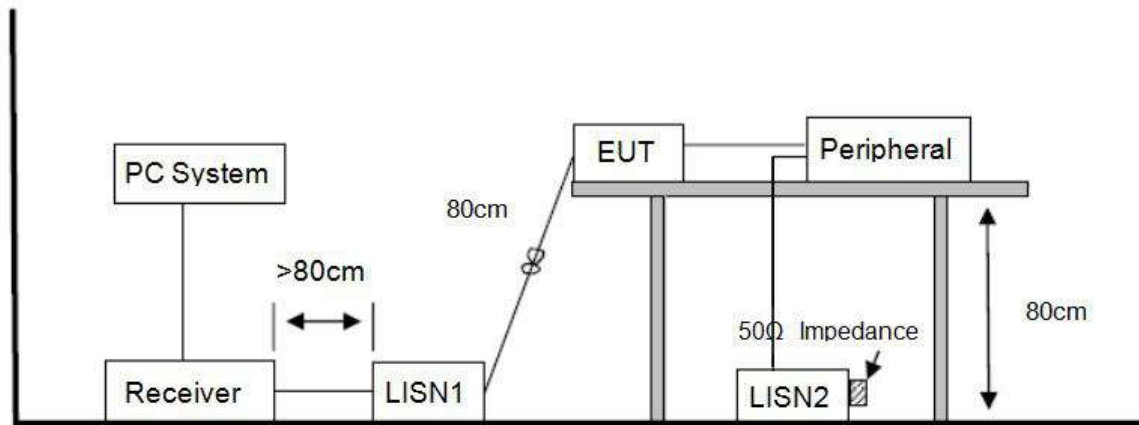
Freq. (MHz)	Read level (dBμV)	Antenn a Factor (dB/m)	PRM Facto r (dB)	Cable Loss (dB)	Result Level (dBμV/ m)	Limit (dBμV/ m)	Margin (dB)	Detector type	Polarization
Tx mode: 908.40 MHz									
3633.60	53.81	29.09	5.76	43.89	44.77	74.00	-29.23	Peak	HORIZONTAL
4987.00	45.67	31.77	7.02	43.21	41.25	74.00	-32.75	Peak	HORIZONTAL
6364.00	43.73	33.66	7.70	43.32	41.77	74.00	-32.23	Peak	HORIZONTAL
7489.00	44.07	36.87	8.82	42.66	47.10	74.00	-26.90	Peak	HORIZONTAL
8866.00	42.22	37.56	9.33	41.87	47.24	74.00	-26.76	Peak	HORIZONTAL
9532.00	42.55	38.71	9.70	42.01	48.94	74.00	-25.06	Peak	HORIZONTAL
2395.00	55.38	27.59	4.80	43.10	44.68	74.00	-29.32	Peak	VERTICAL
3628.00	49.48	29.08	5.76	43.89	40.43	74.00	-33.57	Peak	VERTICAL
5455.00	46.02	31.80	7.11	43.34	41.60	74.00	-32.40	Peak	VERTICAL
7183.00	44.10	36.01	8.29	42.87	45.53	74.00	-28.47	Peak	VERTICAL
8677.00	42.45	37.22	9.05	41.96	46.76	74.00	-27.24	Peak	VERTICAL
9433.00	42.82	38.58	9.64	41.97	49.06	74.00	-24.94	Peak	VERTICAL
Tx mode: 916.00 MHz									
2386.00	51.40	27.56	4.79	43.09	40.67	74.00	-33.33	Peak	HORIZONTAL
3664.00	52.42	29.13	5.78	43.90	43.43	74.00	-30.57	Peak	HORIZONTAL
5041.00	45.35	31.80	7.05	43.21	40.99	74.00	-33.01	Peak	HORIZONTAL
6517.00	43.93	34.15	7.82	43.24	42.66	74.00	-31.34	Peak	HORIZONTAL
7633.00	43.84	36.98	8.78	42.56	47.04	74.00	-26.96	Peak	HORIZONTAL
9424.00	42.39	38.56	9.64	41.97	48.62	74.00	-25.38	Peak	HORIZONTAL
2395.00	57.05	27.59	4.80	43.10	46.34	74.00	-27.66	Peak	VERTICAL
3187.00	50.20	28.96	5.34	43.76	40.74	74.00	-33.26	Peak	VERTICAL
4582.00	47.61	30.80	6.50	43.53	41.37	74.00	-32.63	Peak	VERTICAL
6211.00	43.90	33.18	7.57	43.39	41.25	74.00	-32.75	Peak	VERTICAL
7849.00	43.40	37.11	8.69	42.41	46.80	74.00	-27.20	Peak	VERTICAL
9856.00	43.51	38.77	10.10	42.14	50.24	74.00	-23.76	Peak	VERTICAL

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

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

6. Power Line Conducted Emission

6.1. Block diagram of test setup



6.2. Power line conducted emission limits

Frequency	Quasi-Peak Level dB(μV)	Average Level dB(μV)
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 10.2 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

Pass. (See below detailed test result)

Note1: All emissions not reported below are too low against the prescribed limits.

Note2: “---” means Peak detection; “---” means Average detection.

Note3: Pre-test AC conducted emission at both voltage AC 120V/60Hz and AC 240V/50Hz, recorded worse case.

TR-4-E-010 Conducted Emission Test Result

Test Site : DDT 5# Shield Room

D:\2021 report data\Q21081127-2E ZEN51\0926 CE.EM6

Test Date : 2021-09-26

Tested By : Sanvin Zheng

EUT : Dry Contact Relay

Model Number : ZEN51

Power Supply : AC 120V/60Hz

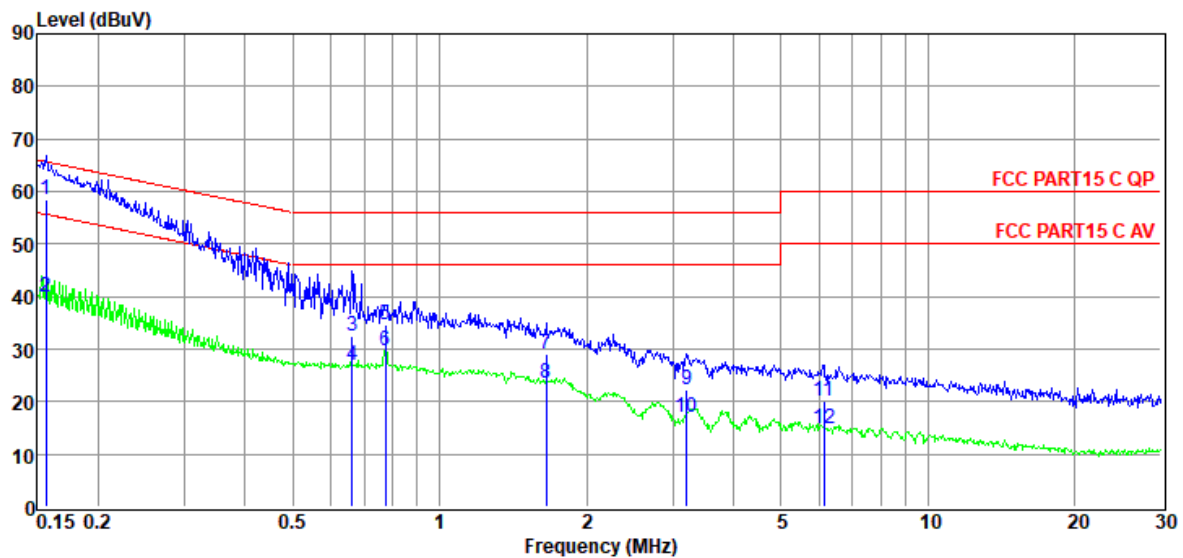
Test Mode : Tx mode

Condition : Temp:24.5°C,Humi:55.5%,Press:101.4kPa

LISN : 2020 ENV 216 2#/LINE

Memo :

Data: 6



Item (Mark)	Freq. (MHz)	Read Level (dBμV)	LISN Factor (dB)	Cable Loss (dB)	Pulse Limiter Factor (dB)	Result Level (dBμV)	Limit Line (dBμV)	Over Limit (dB)	Detector	Phase
1	0.16	39.08	9.41	0.02	10.01	58.52	65.65	-7.13	QP	LINE
2	0.16	20.59	9.41	0.02	10.01	40.03	55.65	-15.62	Average	LINE
3	0.66	12.99	9.45	0.03	10.01	32.48	56.00	-23.52	QP	LINE
4	0.66	7.28	9.45	0.03	10.01	26.77	46.00	-19.23	Average	LINE
5	0.78	15.12	9.44	0.03	10.01	34.60	56.00	-21.40	QP	LINE
6	0.78	10.21	9.44	0.03	10.01	29.69	46.00	-16.31	Average	LINE
7	1.65	9.47	9.43	0.04	10.01	28.95	56.00	-27.05	QP	LINE
8	1.65	3.98	9.43	0.04	10.01	23.46	46.00	-22.54	Average	LINE
9	3.21	2.79	9.45	0.07	10.01	22.32	56.00	-33.68	QP	LINE
10	3.21	-2.45	9.45	0.07	10.01	17.08	46.00	-28.92	Average	LINE
11	6.12	0.45	9.52	0.09	10.01	20.07	60.00	-39.93	QP	LINE
12	6.12	-4.63	9.52	0.09	10.01	14.99	50.00	-35.01	Average	LINE

Note: 1. Result Level = Read Level + LISN Factor + Pulse Limiter Factor + Cable loss.

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

3. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz).

4. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.

TR-4-E-010 Conducted Emission Test Result

Test Site : DDT 5# Shield Room

D:\2021 report data\Q21081127-2E ZEN51\0926 CE.EM6

Test Date : 2021-09-26

Tested By : Sanvin Zheng

EUT : Dry Contact Relay

Model Number : ZEN51

Power Supply : AC 120V/60Hz

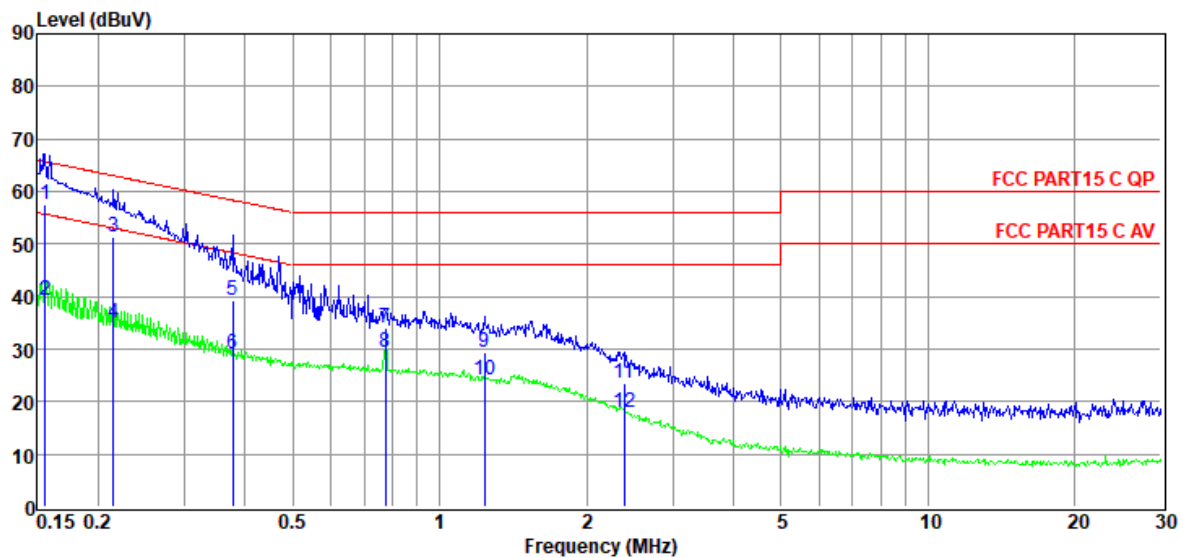
Test Mode : Tx mode

Condition : Temp:24.5°C,Humi:55.5%,Press:101.4kPa

LISN : 2020 ENV 216 2#/NEUTRAL

Memo :

Data: 8



Item (Mark)	Freq. (MHz)	Read Level (dBμV)	LISN Factor (dB)	Cable Loss (dB)	Pulse Limiter Factor (dB)	Result Level (dBμV)	Limit Line (dBμV)	Over Limit (dB)	Detector	Phase
1	0.16	38.03	9.38	0.02	10.01	57.44	65.69	-8.25	QP	NEUTRAL
2	0.16	19.72	9.38	0.02	10.01	39.13	55.69	-16.56	Average	NEUTRAL
3	0.22	32.02	9.39	0.02	10.01	51.44	63.01	-11.57	QP	NEUTRAL
4	0.22	15.48	9.39	0.02	10.01	34.90	53.01	-18.11	Average	NEUTRAL
5	0.38	19.91	9.39	0.02	10.01	39.33	58.34	-19.01	QP	NEUTRAL
6	0.38	9.60	9.39	0.02	10.01	29.02	48.34	-19.32	Average	NEUTRAL
7	0.78	14.58	9.40	0.03	10.01	34.02	56.00	-21.98	QP	NEUTRAL
8	0.78	9.97	9.40	0.03	10.01	29.41	46.00	-16.59	Average	NEUTRAL
9	1.24	9.85	9.41	0.04	10.01	29.31	56.00	-26.69	QP	NEUTRAL
10	1.24	4.61	9.41	0.04	10.01	24.07	46.00	-21.93	Average	NEUTRAL
11	2.38	3.94	9.42	0.06	10.01	23.43	56.00	-32.57	QP	NEUTRAL
12	2.38	-1.41	9.42	0.06	10.01	18.08	46.00	-27.92	Average	NEUTRAL

Note: 1. Result Level = Read Level + LISN Factor + Pulse Limiter Factor + Cable loss.

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

3. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz).

4. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.

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. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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 1 dBi.

END OF REPORT