



EMC Test Report

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Applicant Name: PHOTONWARES CORPORATION
Address: 15 Presidential Way, Woburn, MA 01801
USA

Product Description: MEMS 1xN($2 \leq N \leq 64$)Optical Switch Module
Brand Name: Agiltron
Tested Model: MSWH-A1251131
Electrical Rating: DC 5-12V
Report No.: DNT230874E1017-1399
Received Date: 2023-11-29
Tested Date: 2023-11-29 ~ 2023-11-30
Issued Date: 2023-12-4
Test Standards: EN 55032:2015+A11:2020
EN 55035:2017+A11:2020
EN IEC 61000-3-2:2019+A1:2021
EN 61000-3-3:2013+A1:2019+A2:2021

Test Result: PASS

Prepared By: Leo Lu (Testing Engineer)
Reviewed By: mark wu (Project Engineer)
Approved By: Heise Chen (Manager)



Note: If there is any objection to the results in this report, please submit a written inquiry to the company within 15 days from the date of receiving the report. The test report is effective only with both signature and specialized stamp, and is issued by the company in accordance with the requirements of the "Conditions of Issuance of Test Reports" printed in the attached page. Unless otherwise stated, the results presented in this report only apply to the samples tested this time. Partial reproduction of this report is not allowed unless approved by the company in writing.

Dongguan DN Testing Co., Ltd.

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V2.0	/	2023-12-4	Original Report	/

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information	
Applicant:	SHEN ZHEN OE PHOTONICS CO.,LTD
Address of applicant:	501,Building 1.Dexingchang Smart Park, NO.23, Heping Road. Longhua Street, Longhua District, Shenzhen, Guangdong Province P.R.China
Manufacturer:	SHEN ZHEN OE PHOTONICS CO.,LTD
Address of manufacturer:	501,Building 1.Dexingchang Smart Park, NO.23, Heping Road. Longhua Street, Longhua District, Shenzhen, Guangdong Province P.R.China

General Description of EUT	
Product Name:	MEMS 1xN(2≤N≤64)Optical Switch Module
Model No.:	OE-MS-1×N-M-TTL
Additional Model(s):	01.08.0830,01.08.1609,01.08.0816,01.08.3215,01.08.1602
Difference description:	All the additional models 01.08.0830,01.08.1609,01.08.0816,01.08.3215,01.08.1602 are identical with the test model OE-MS-1×N-M-TTL except the Bit Per Second and model. only full test was performed on the OE-MS-1×N-M-TTL.
Rated Voltage:	DC 5-12V
Protection:	/
Adapter Information:	/
Equipment Category:	/
Highest Internal Frequency:	Above 108MHz

1.2 EUT Operation Mode and test details

Test Mode List		
Test Mode	Description	Remark
1	Normal working	N/A

Remark: Prescan all test mode, and performed the final measure on the mode of maximum emission and recorded the test data.
“ * ” means it's the worst mode.

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/



Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

1.3 Measurement Uncertainty

Parameter	Frequency	Measurement uncertainty
Conducted Emission (with AMN)	150kHz~30MHz	U= 2.7dB K=2
Conducted Emission (with ANN)	150kHz~30MHz	U= 2.8dB K=2
Radiated Emission	30MHz-1000MHz	U= 5.0dB K=2
Radiated Emission	Above 1000MHz	U= 5.4dB K=2

1.4 Test Facility

Test Site	Dongguan DN Testing Co., Ltd.
Test Location	No. 1, West Fourth Street, South Xinfu Road, Wusha Liwu, Chang 'an Town, Dongguan City, Guangdong P.R.China

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1.5 Test Equipment List and Details

Test Equipment for Conducted Emission					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Receiver	R&S	ESCI3	101152	2023-10-31	2024-10-30
LISN	R&S	ENV216	102874	2023-10-31	2024-10-30
ISN	R&S	ENY81-CA 6	0295	2023-10-31	2024-10-30
Test Equipment for Radiated Emission					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Receiver	R&S	ESR7	102497	2023-10-31	2024-10-30
RF Cable	ETS-LINDGREN	RFC-NMS- 100-NMS-3 50-IN	/	2023-10-31	2024-10-30
Log periodic antenna	ETS-LINDGREN	VULB 9168	01475	2023-10-31	2024-10-30
Horn Antenna	ETS-LINDGREN	3117	00252566	2023-10-31	2024-10-30
Preamplifier	Schwarzbeck	BBV9743B	00423	2023-10-31	2024-10-30
Preamplifier	ETS-LINDGREN	3117-PA	00252566	2023-10-31	2024-10-30
Preamplifier	ETS-LINDGREN	3116C-PA	00251779	2023-10-31	2024-10-30
Test Equipment for ESD					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
ESD Gun	TESEQ	NSG437	1240	2023-10-31	2024-10-30
Test Equipment for RS					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Stack log-periodic antennas	S&B	STLP-9129	00225	2023-10-31	2024-10-30
Transmit antenna	Keysight	N9010A	MY52221458	2023-10-31	2024-10-30
Power amplifier	ETS-LINDGREN	8000-002	00163152	2023-10-31	2024-10-30
Power amplifier	ETS-LINDGREN	8100-045	00163616	2023-10-31	2024-10-30
Generator	Keysight	N5182B	MY57300617	2023-10-31	2024-10-30
Test Equipment for Harmonic/Flicker					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Harmonic&Flicker Module	APS	LFZ-1-16	20006	2023-04-03	2024-04-02
PACIFIC POWER SOURCE	APS	140AMX-U PC12/S	1792	2023-04-03	2024-04-02



1.6 Performance Criteria for EMS

According to Clause 8 of EN 55035:2017+A11:2020:

- General performance criteria are defined in the following. These criteria shall be used during the testing of primary functions where no relevant annex is applicable.

When assessing the impact of a disturbance on a function, the assessment should take into consideration the impact of a disturbance on a function, the assessment should take into consideration the function's performance prior to the application of the disturbance and only identify as failures those changes in performance that are a result of the disturbance.

- Performance criterion A

The equipment shall continue to operate as intended without operator intervention. No degradation of performance, loss of function or change of operation state is allowed below a performance level specified by the manufacturer when the equipment is use as intended.

The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

- Performance criterion B

During the application of the disturbance, degradation of performance is allowed. However, no unintended change of actual operating state or stored data is allowed to persist after the test.

After the test, the equipment shall continue to operate as intended without operator intervention; no degradation of performance or loss of function is allowed, below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance.

If the minimum performance level (or the permissible performance loss), or recovery time, is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

- Performance criterion C

Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. A reboot or re-start operation is allowed.

Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.



2. SUMMARY OF TEST RESULTS

Emissions		
Test Standards	Description of Test Item	Result
EN 55032: 2015+A11:2020	Conducted Emissions	/
	Radiated Emissions	PASS

Immunity		
Test Standards	Description of Test Item	Result
EN 55035:2017+A11:2020	Electrostatic Discharge	PASS
	Continuous radiated disturbances	PASS
	Electrical Fast Transients	N/A
	Surges	N/A
	Continuous conducted disturbances	N/A
	Power Frequency Magnetic Field	N/A
	Voltage Dips and Interruptions	N/A

EN IEC 61000-3-2:2019+A1:2021		
Rule	Description of Test Item	Result
EN IEC 61000-3-2:2019+A1:2021	Harmonic Current Emissions	N/A

EN 61000-3-3:2013+A1:2019+A2:2021		
Rule	Description of Test Item	Result
EN 61000-3-3:2013+A1:2019+A2:2021	Voltage fluctuations & flicker	N/A

*Note1: N/A means not applicable.



3. GENERAL REMARKS

When applying the basic standard in this test report, the latest amendment is always included.

3.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix 1: Test Result

3.2 Result Level & Over Limit Calculation

The Measurement (Result Level) is calculated by Reading Level adding the Correct Factor(maybe including LISN Factor and the Cable Factor etc.), The basic equation is as follows:

Measurement = Reading Level + Correct Factor(including LISN Factor ,Cable Factor etc.)

The “Over Limit” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a “Over Limit” of -6dB means the emission is 6dB below the maximum limit for device. The equation for “over limit” calculation is as follows:

Over Limit = Measurement(Result Level) –Limit

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a “Margin” of 6dB means the emission is 6dB below the maximum limit for device. The equation for “over limit” calculation is as follows:

Margin = Limit–value&Level



4. Radiated Emissions

4.1 Radiated Emission Limit

Requirements for radiated emissions at frequencies up to 1GHz for Class B equipment

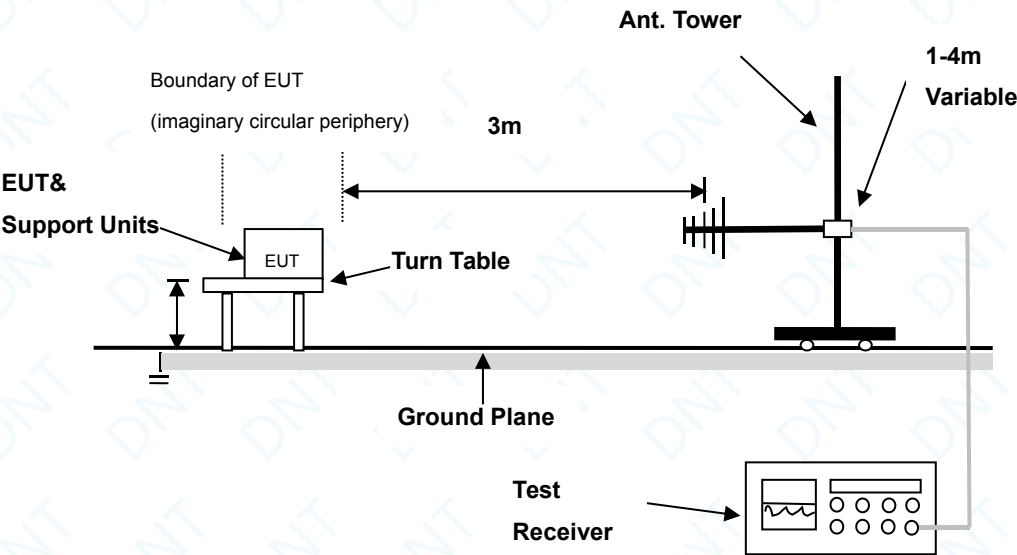
Frequency range (MHz)	Measurement		Class B limits dB(μV/m)
	Distance (m)	Detector type/bandwidth	
30 ~ 230	3	Quasi Peak/120kHz	40
230 ~ 1000			47

Requirements for radiated emissions at frequencies above 1GHz for Class B equipment

Frequency range (MHz)	Measurement		Class B limits dB(μV/m)
	Distance (m)	Detector type/bandwidth	
1000 ~ 3000	3	Average/1MHz	50
3000 ~ 6000			54
1000 ~ 3000	3	Peak/1MHz	70
3000 ~ 6000			74

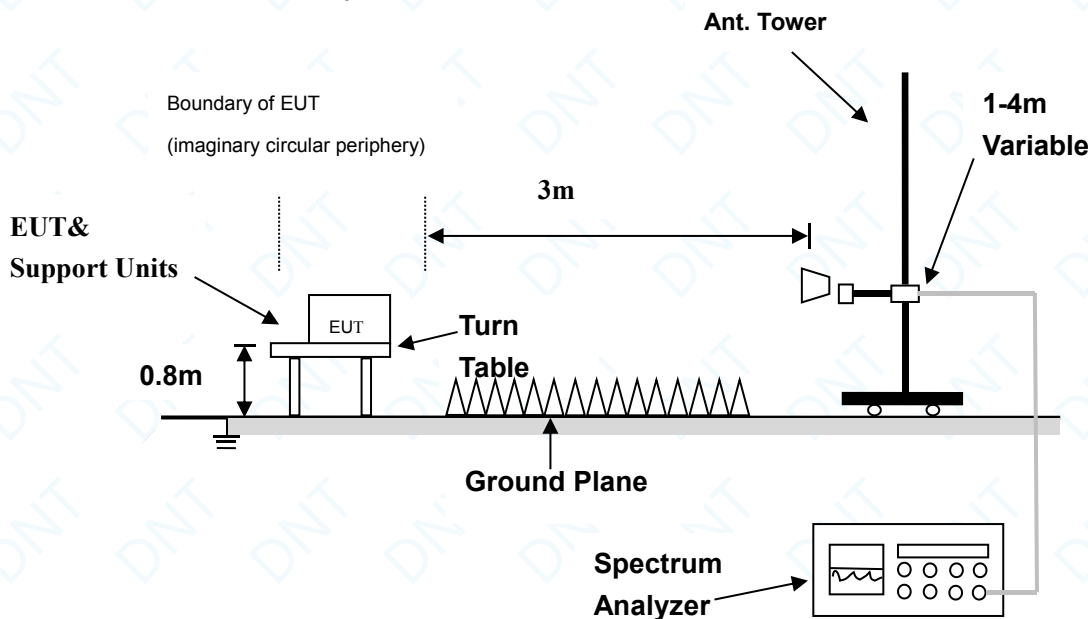
4.2 Block Diagram of Test Setup

Radiated Emissions Frequency:30MHz to 1000MHz:





Radiated Emissions Frequency:1000MHz to 6000MHz:



4.3 Test Procedure

- (1) The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual.
- (2) Support equipment, if needed, was placed as per EN 55032.All I/O cables were positioned to simulate typical actual usage as per EN 55032
- (3) The EUT is placed on a turntable, which is 0.8 meter high above the ground. The turntable can rotate 360 degrees to determine the position of the maximum emission level. The EUT is set 3 meters away from the receiving antenna, which is mounted on a antenna tower. Emissions were scanned and measured rotating the EUT to 360 degrees and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.
- (4) Recorded at least the six highest emissions.

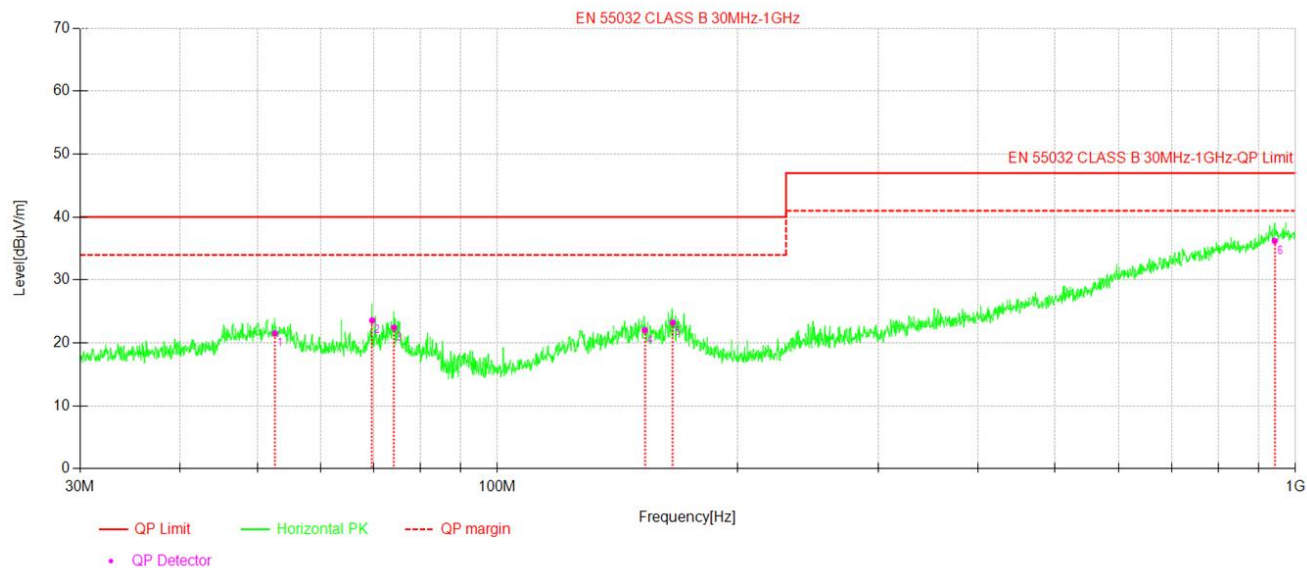
4.4 Environmental Conditions

Temperature:	25℃
Relative Humidity:	60%
Atmospheric Pressure:	101.3 kPa
Test Voltage:	DC 12V
Test Date:	2023-12-1
Tested By:	Leo Lu



4.5 Test Data and Result

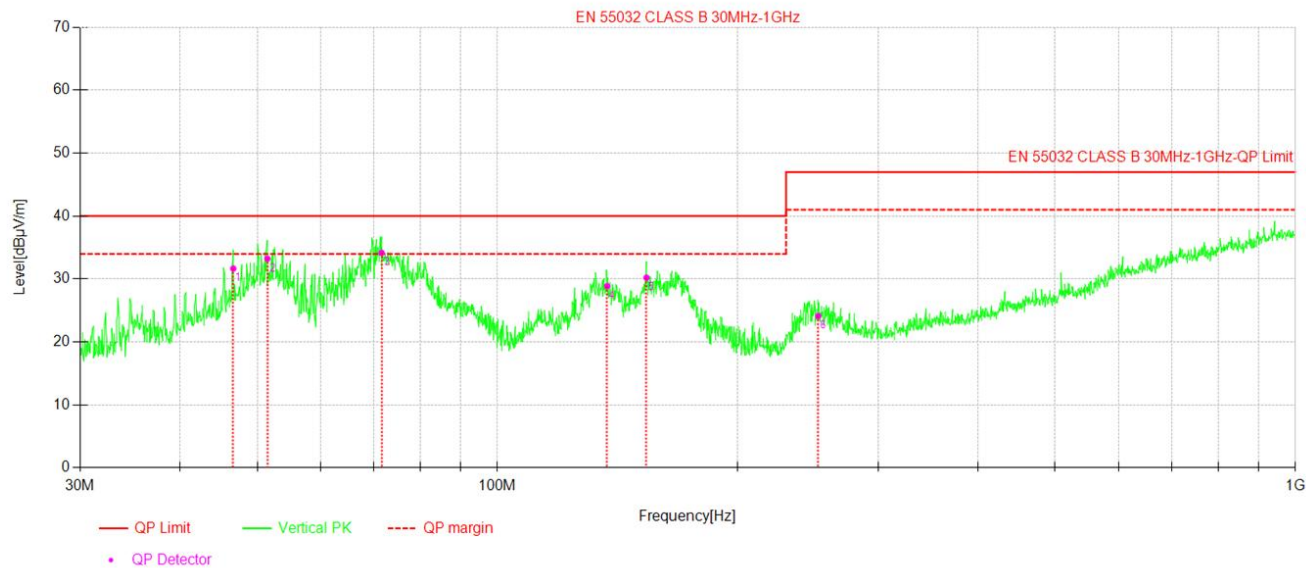
Below 1GHz:
Horizontal



Final Data List									
NO	Freq. [MHz]	Factor[dB]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1	52.6368	-6.64	21.53	40.00	18.47	100	212	Horizontal	PASS
2	69.6819	-10.02	23.59	40.00	16.41	100	0	Horizontal	PASS
3	74.2218	-11.01	22.45	40.00	17.55	100	7	Horizontal	PASS
4	153.0214	-7.88	22.03	40.00	17.97	100	0	Horizontal	PASS
5	165.8741	-8.10	23.22	40.00	16.78	100	224	Horizontal	PASS
6	942.1305	6.19	36.21	47.00	10.79	100	4	Horizontal	PASS



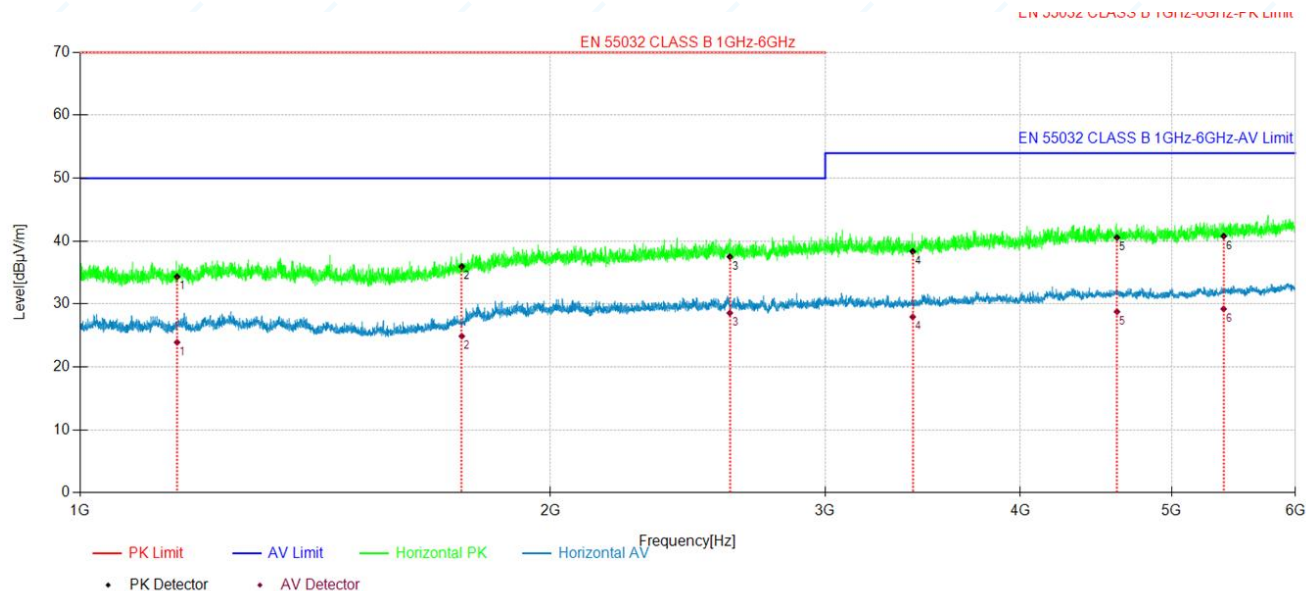
Vertical



Final Data List									
NO	Freq. [MHz]	Factor[dB]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1	46.6664	-6.65	31.68	40.00	8.32	200	290	Vertical	PASS
2	51.4807	-6.68	33.24	40.00	6.76	100	360	Vertical	PASS
3	71.5806	-10.37	34.17	40.00	5.83	100	54	Vertical	PASS
4	137.2597	-8.92	28.88	40.00	11.12	200	0	Vertical	PASS
5	153.7385	-7.88	30.22	40.00	9.78	200	63	Vertical	PASS
6	252.3575	-8.99	24.12	47.00	22.88	200	10	Vertical	PASS



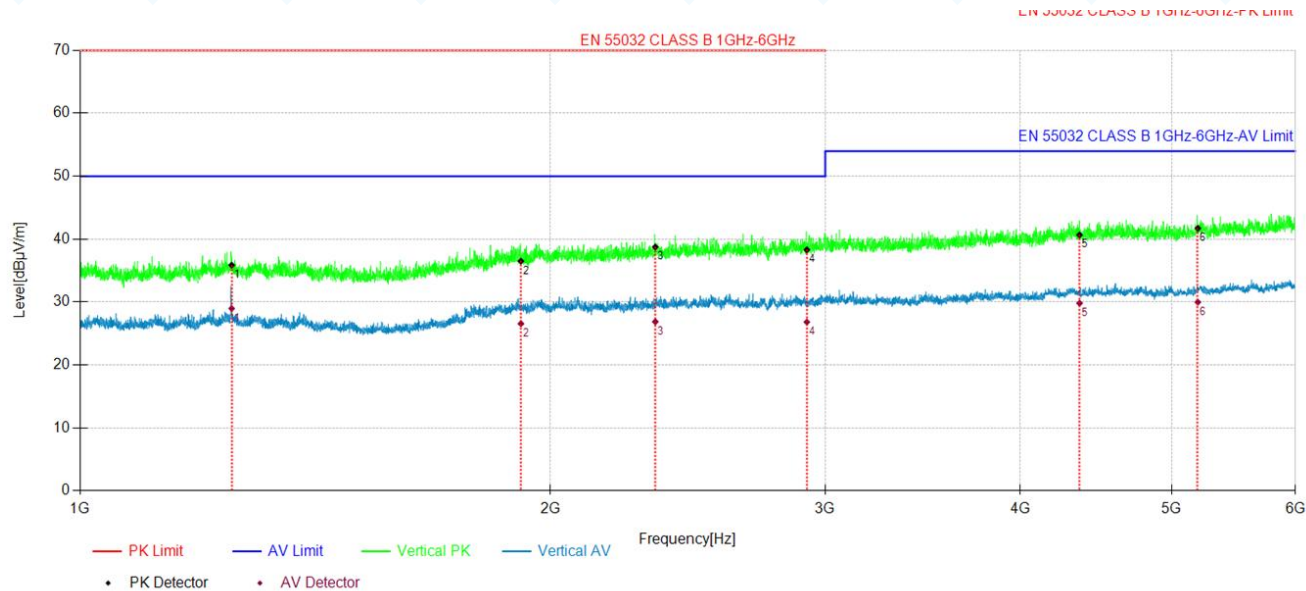
Above 1GHz:
Horizontal



PK Final Data List											
NO	Freq. [MHz]	Factor [dB]	PK Value [dBμV/m]	PK Limit [dBμV/m]	PK Margin [dB]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1153.70	-14.48	34.36	70.00	35.64	23.92	50.00	26.08	100	230	Horizontal
2	1755.56	-11.93	35.97	70.00	34.03	24.89	50.00	25.11	100	298	Horizontal
3	2606.15	-7.17	37.53	70.00	32.47	28.58	50.00	21.42	100	223	Horizontal
4	3412.80	-5.20	38.37	74.00	35.63	27.96	54.00	26.04	100	328	Horizontal
5	4612.31	-1.46	40.57	74.00	33.43	28.78	54.00	25.22	100	343	Horizontal
6	5398.09	-0.91	40.80	74.00	33.20	29.23	54.00	24.77	100	360	Horizontal



Vertical



PK Final Data List											
NO	Freq. [MHz]	Factor [dB]	PK Value [dBμV/m]	PK Limit [dBμV/m]	PK Margin [dB]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1250.36	-13.45	35.86	70.00	34.14	28.98	50.00	21.02	100	1	Vertical
2	1915.29	-10.07	36.51	70.00	33.49	26.56	50.00	23.44	100	179	Vertical
3	2335.06	-8.36	38.76	70.00	31.24	26.87	50.00	23.13	100	360	Vertical
4	2919.67	-6.24	38.31	70.00	31.69	26.83	50.00	23.17	100	70	Vertical
5	4364.67	-2.30	40.67	74.00	33.33	29.82	54.00	24.18	100	12	Vertical
6	5195.95	-0.99	41.72	74.00	32.28	29.99	54.00	24.01	100	183	Vertical

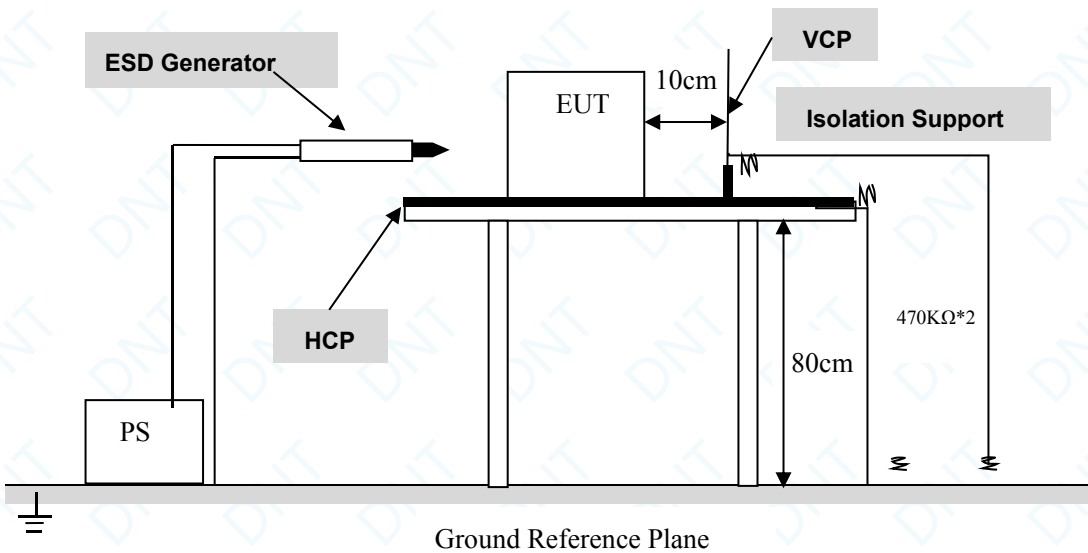


5. Electrostatic Discharge

5.1 ESD Immunity Requirements

Environmental Phenomenon	Port	Test Specification	Basic Standard	Performance criterion
Electrostatic discharge	Enclosure port	$\pm 4\text{kV}$ (Contact Discharge)	EN 61000-4-2	B
		$\pm 8\text{kV}$ (Air Discharge)		

5.2 Block Diagram of Test Setup



5.3 Test Procedure

Air Discharges:

This test is done on a non-conductive surface. The round Discharges tip of the Discharges electrode shall be approached as fast as possible to touch the EUT. After each Discharge, the Discharges electrode shall be removed from the EUT. The generator is then re-triggered for a new single Discharge and repeated 10 times for each pre-selected test point. This procedure shall be repeated until all the air Discharges completed.

Contact Discharges:

All the procedure shall be same as Section 8.3.1 of EN 61000-4-2, except that the tip of the Discharges electrode shall touch the EUT before the Discharges switch is operated.

Indirect Discharges for HCP

At least 20 single Discharges shall be applied to the horizontal coupling plane, at points on each side of the EUT. The Discharges electrode positions vertically at a distance of 0.1 m from the EUT and with the Discharges electrode touching the coupling plane.

Indirect Discharges for VCP

At least 20 single Discharges shall be applied to the center of one vertical edge of the coupling plane. The coupling plane, of dimensions 0.5m X 0.5m, is placed parallel to, and positioned at a distance of 0.1m from the EUT. Discharges shall be applied to the coupling plane, with this plane in sufficient different positions that the four faces of the EUT are completely illuminated



5.4 Environmental Conditions

Temperature:	25℃
Relative Humidity:	50%
Atmospheric Pressure:	101.3 kPa
Test Voltage:	DC 12V
Test Date:	2023-12-1
Tested By:	Eric Huang

5.5 Test Data and Result

EN 61000-4-2 Test Points	Test Levels (kV)			
	-2	+2	-4	+4
Contact Discharge				
metallic	/	/	A	A

EN 61000-4-2 Test Points	Test Levels (kV)			
	-4	+4	-8	+8
Air Discharge				
Shell non-metallic gaps	/	/	A	A

EN 61000-4-2 Test Points	Test Levels (kV)			
	Indirect Contact Discharge (HCP)		Indirect Contact Discharge (VCP)	
	-4	+4	-4	+4
Front Side	A	A	A	A
Back Side	A	A	A	A
Left Side	A	A	A	A
Right Side	A	A	A	A

Remark:

A:No degradation was found.

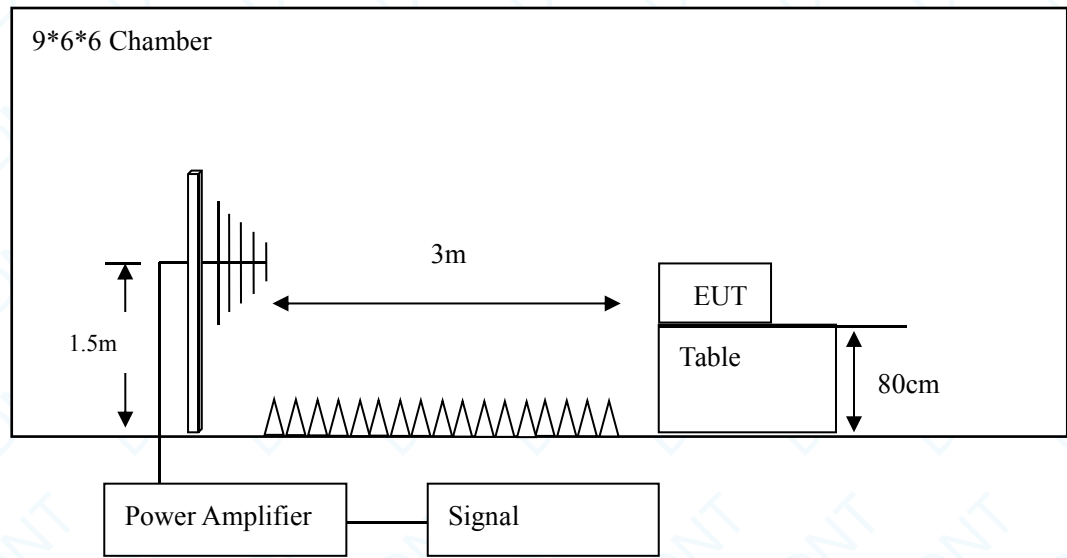


6. Radio Frequency Electromagnetic Field

6.1 RS Immunity Requirements

Environmental Phenomenon	Port	Test Specification	Basic Standard	Performance criterion
Radio-frequency electromagnetic field Amplitude modulated	Enclosure port	80-1000MHz,1800MHz, 2600MHz,3500MHz,500 0MHz 3V/m(unmodulated, r.m.s) 80% AM(1kHz)	EN 61000-4-3	A

6.2 Block Diagram of Test Setup



6.3 Test Procedure

- a) Test is conducting under the description of EN 61000-4-3.
- (1)The EUT was switched on and allowed to warm up to its normal operating condition.
 - (2)The EUT was exercised and monitored in the manner specified by the customer.
 - (3)All test instruments were PC controlled, via their IEEE 488.2 bus interfaces, and the test conducted in the following manner:
The testing frequencies were swept over the required frequency range, with a step frequency equal to 1% of fundamental. The sweep rate was 1.0×10^{-3} decades/s.For each frequency tested, the signal generator output level was adjusted automatically until the unmodulated field strength registered by the field monitor reached the desired level. This level was held constant for the specified dwell time.
 - (4)The EUT was continuously monitored during the test in accordance with the Pass / Fail criteria declared by the customer.
 - (5)The test was done in both horizontal and vertical antenna polarizations, and for all necessary sides of the EUT.



6.4 Environmental Conditions

Temperature:	23.5℃
Relative Humidity:	50%
Atmospheric Pressure:	101.3 kPa
Test Voltage:	DC 12V
Test Date:	2023-12-1
Tested By:	Eric Huang

6.5 Test Data and Result

Field Strength: 3V/m
Frequency step: 1% of fundamental
Dwell time: 1 second
Modulation: AM by 1kHz sine wave with 80% modulation depth

Frequency Range(MHz)	Field (V/m)	Front		Rear		Left Side		Right Side	
		VERT	HORI	VERT	HORI	VERT	HORI	VERT	HORI
80-1000	3	A	A	A	A	A	A	A	A
1800,2600, 3500,5000	3	A	A	A	A	A	A	A	A

Remark:
A: No degradation was found.



EXHIBIT A – PHOTOGRAPHS OF TEST SETUP

Radiated Emission Test View(Below 1GHz)



Radiated Emission Test View(Above 1GHz)



Dongguan DN Testing Co., Ltd.

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ESD Immunity Test View



RS Immunity Test View



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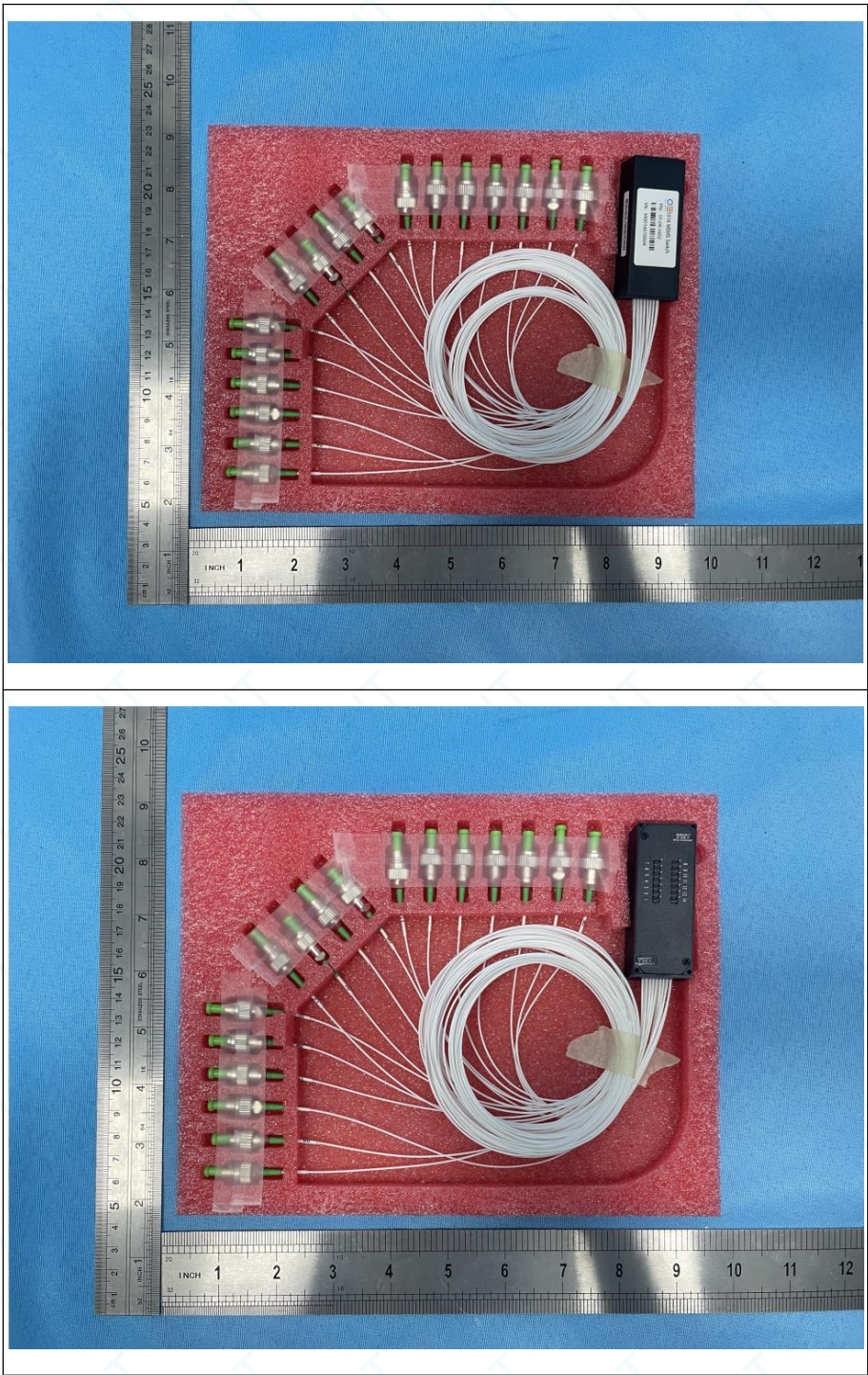
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EXHIBIT B – PHOTOGRAPHS OF EUT



***** END OF REPORT *****

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