

# Test Report

Report No.: XAG-M22-E0656-01

EUT Name: Defibrillator monitor

EUT Type : BeneHeart DX、 BeneHeart DM

Applicant : Shenzhen Mindray Bio-Medical Electronics Co., Ltd.

Test Type : Entrusted Test



Xi'an Sushi Guangbo Environmental Reliability Laboratory Co., Ltd.

# CAUTIONS

1. This test report is not allowed to be copied partly without written authorization.
2. This test report is only based on the test result of the sample unit.
3. This test report will not be valid without "test report stamp" or the stamp of the test institution on the report.
4. This test report will not be valid without the signature of those who generate, checked and approved and edited the report.
5. This test report will not be valid if changed.
6. Statement
  - ① When the applicant knows that the test item deviates from the specified conditions and still requires testing, the laboratory makes a statement and indicates the possible impact due to deviation.
  - ② The laboratory is responsible for all information in the report, except for information provided by the applicant. The use of data provided by the applicant in the report should be clearly identified. In addition, a statement is hereby made when the information provided by the applicant may affect the validity of the results.
7. The test item must be collected within one month after the completion of the test. The laboratory will destroy it by itself after the deadline.
8. This report shall be used solely for the purposes of scientific research, teaching and internal quality control; any disagreement with the test report shall be submitted to the laboratory within the 15 days of the date of receipt of the report.

Test institution: Xi'an Sushi Guangbo Environmental Reliability Laboratory Co., Ltd

Address: No.29, Shang Lin Yuan Third Road, High-tech District, Xi'an City, Shaanxi Province

Tel: +86-029-81021408


Test institution: Shenzhen Mindray Bio-Medical Electronics Co., Ltd.

Address: Mindray Building, Keji 12th Road South, High-tech Industrial Park, Nanshan, Shenzhen,

P.R. China

Tel: 13410893192

## EUT Testing Information

EUT name	Defibrillator monitor	EUT type	BeneHeart DX、BeneHeart DM
Applicant	Shenzhen Mindray Bio-Medical Electronics Co., Ltd.	Brand	/
EUT number (inner)	M22-E0656-01	EUT number (client)	/
EUT arrived date	2022.10.09	EUT quantity	1
Sender	Yang Wenshan	Acceptor	Gao Qing
Manufacturer	Shenzhen Mindray Bio-Medical Electronics Co., Ltd.		
Test items	Radiation Emission of Radio Frequency Energy Conduction Emission of Radio Frequency Energy Conduction Susceptibility of Radio Frequency Energy Radiation Susceptibility of Radio Frequency Energy		
Test Standards	RTCA DO-160G Environmental Conditions and Test Procedures for Airborne Equipment		
Customer or client requirements	/		
Test conclusion	<p>On commission of Shenzhen Mindray Bio-Medical Electronics Co., Ltd. We conduct the test: Radiation Emission of Radio Frequency Energy, Conduction Emission of Radio Frequency Energy, Conduction Susceptibility of Radio Frequency Energy, Radiation Susceptibility of Radio Frequency Energy, Conduction Emission-Voltage Method, Conductive Emission-Current Method, Radiation emission.</p> <p>Summary of test result is in page 3. Description of test environment is in page 4. The description of the EUT are in pages 5~6. Test result are in pages 7~23. Test photos are in pages 24~31.</p> <p>Created: <i>Li Xinyang</i></p> <p>Edited: <i>Wang Diao Bo</i></p> <p>Reviewed: <i>Gao Fengjuan</i></p> <p>Approved: <i>HuShen</i></p> <div style="text-align: right;">             Date: 2023.02.10            (Only valid with Xi'an Sushi Guangbo's Seal for Inspection)         </div>		
Note	/		

## Summary of Test Result

No.	Test items	Test standards	Test conclusion	Note
1	Conduction Emission of Radio Frequency Energy	RTCA DO-160G	Compliance	See test results table for details
2	Radiation Emission of Radio Frequency Energy	RTCA DO-160G	Compliance	See test results table for details
3	Conduction Susceptibility of Radio Frequency Energy	RTCA DO-160G	Compliance	See test results table for details
4	Radiation Susceptibility of Radio Frequency Energy	RTCA DO-160G	Compliance	See test results table for details

## Description of Test Environment

No.	Test items	Test date	Test location	Environmental conditions		
				temperature(°C)	humidity(%RH)	Atmospheric pressure(kPa)
1	Conduction Emission of Radio Frequency Energy	2023.01.06	Electromagnetic shielding room 3	15.9	44.6	97.01
2	Radiation Emission of Radio Frequency Energy	2022.10.11	3m Semi-anechoic chamber 2	16.4	51.9	96.97
3	Conduction Susceptibility of Radio Frequency Energy	2022.10.12	Electromagnetic shielding room	18.4	49.2	96.66
4	Radiation Susceptibility of Radio Frequency Energy	2022.10.19	3m Semi-anechoic chamber 1	20.5	52.2	96.83

## Description of the EUT

EUT description	EUT is Defibrillator monitor which produced by Shenzhen Mindray Bio-Medical Electronics Co., Ltd. EUT type are BeneHeart DX, BeneHeart DM. EUT is powered by DC 12V through unshielded cable. EUT is not connected to the ground. Working voltage: DC 12V Working current: / Power: /
Auxiliary equipment connected to the EUT	EUT is connected to the simulator through all parameter cables.
EUT status and working conditions before testing	Working mode 1: EUT is not turned off, no mode switching, no unexpected alarm, no automatic charging and discharging, parameter waveform is normal, 60, 90, 0, no offset, cursor does not run automatically, normal screen display.
EUT status and working conditions during testing	EUT is not turned off, no mode switching, no unexpected alarm, no automatic charging and discharging, parameter waveform is normal, 60, 90, 0, no offset, cursor does not run automatically, normal screen display.
EUT status after testing	In accordance with EUT status before testing.

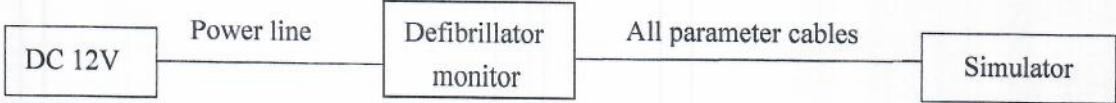

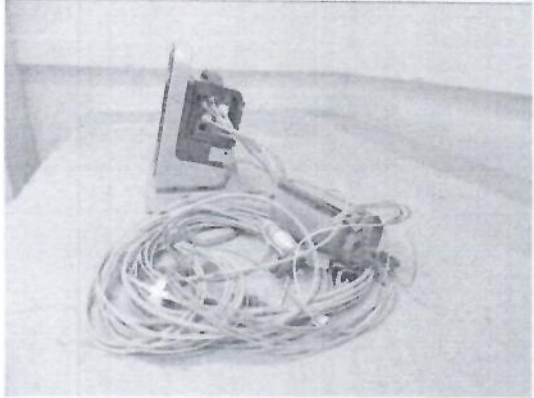
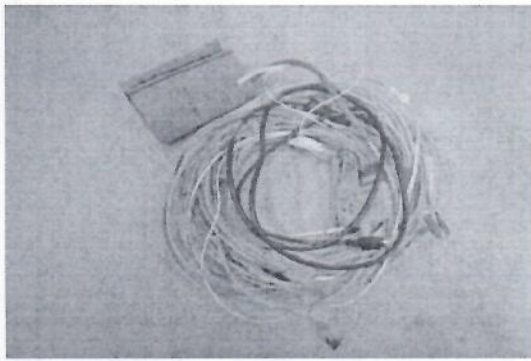
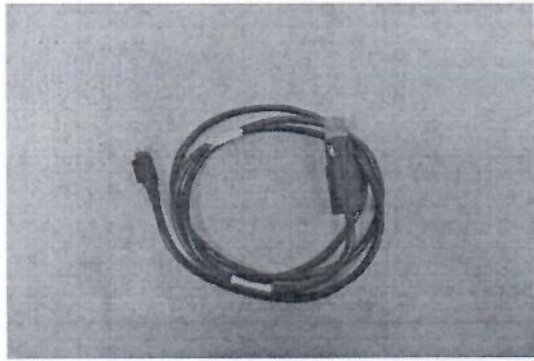
### Requirements for evaluation of the test results

Target	Content	Method	Result Criterion
1	ECG	Monitor the EUT screen	60±1 indicates compliance; otherwise, it indicates non-compliance.
3	RESP	Monitor the EUT screen	20±1 indicates compliance; otherwise, it indicates non-compliance.
4	SPO2	Monitor the EUT screen	98±2 indicates compliance; otherwise, it indicates non-compliance.
5	CO2	Monitor the EUT screen	0±2 indicates compliance; otherwise, it indicates non-compliance.
6	NIBP	Monitor the EUT screen	±5 indicates compliance; otherwise, it indicates non-compliance.
7	IBP	Monitor the EUT screen	0±1 indicates compliance; otherwise, it indicates non-compliance.
8	TEMP	Monitor the EUT screen	37±0.1 indicates compliance; otherwise, it indicates non-compliance.

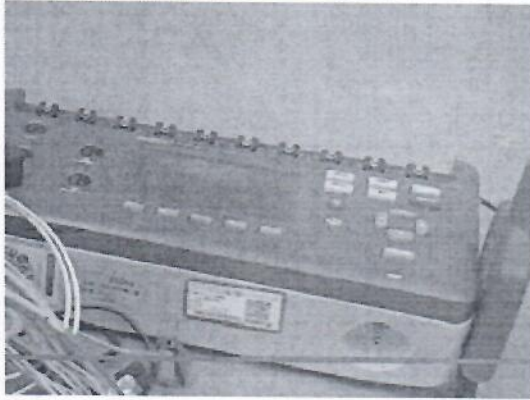
9	EUT status	Monitor the EUT screen	No malfunction, no non-operation when operation is required, no inadvertent discharge or other unintentional change of state during this test; indicates compliance, otherwise, it indicates non-compliance.
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### Description of the EUT

<p>Connection diagram of the EUT</p>	 <pre> graph LR     DC12V[DC 12V] --- PowerLine[Power line] --- DefibrillatorMonitor[Defibrillator monitor]     DefibrillatorMonitor --- AllParameterCables[All parameter cables] --- Simulator[Simulator]             </pre>	
<p>EUT Photos</p>	 <p>Back side</p>	 <p>Right side</p>
<p>Cable photos</p>	 <p>All parameter cables</p>	 <p>Power line</p>

Auxiliary  
equipment  
photos



Simulator

/

Note

Overwrite model difference table

	Typical Model	Overwrite model
Model	BeneHeart DX、 BeneHeart DM	BeneHeart DM
Appearance color	Grey	Blue

The BeneHeart DX/BeneHeart DM has the same electrical design and main system Software, their main difference are the appearance color, The difference does not affect EMC test results. So BeneHeart DX was selected as a typical Model for testing.

## Test Result

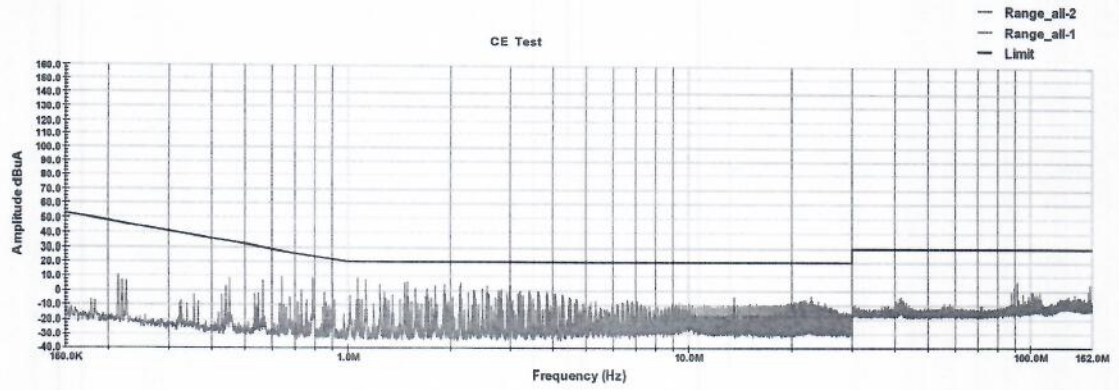
Test item	Conduction Emission of Radio Frequency Energy	Test standards	RTCA DO-160G	
<b>Test layout</b>				
EUT status	Reference working mode 1. EUT is powered by DC 12V through unshielded cable. EUT is not connected to the ground.			
<b>Main test equipment</b>				
No.	Instrument	Type	S/N	Calibration Due
1	Receiver	ESW44	101755	2023.12.03
2	LISN	NNBM DO160-1500	00002	2023.03.19
3	LISN	NNBM DO160-1500	00003	2023.03.19
4	Current probe	4688	82703	2023.07.07
<b>Test equipment</b>				
Frequency	Detector	Bandwidth	Dwell time	
150kHz~30MHz	Peak	1kHz	0.015s	
30MHz~100MHz	Peak	10kHz	0.015s	
100MHz~152MHz	Peak	10kHz	0.015s	

The limits

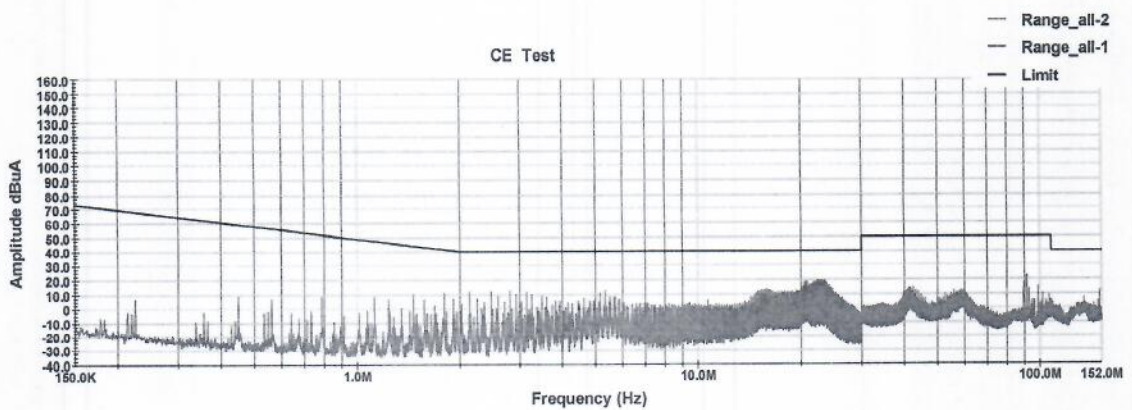
Maximum Level of Conducted RF Interference -Power lines-Category M

Maximum Level of Conducted RF Interference -Interconnecting Bundles-Category M

Test result



150kHz~152MHz Power lines Test curve



150kHz~152MHz All parameter cables Test curve

Test conclusion	The test result comply with the Maximum Level of Conducted RF Interference –Power lines-Category M & Maximum Level of Conducted RF Interference -Interconnecting Bundles-Category M of RTCA DO-160G
Note	/
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## Test Result

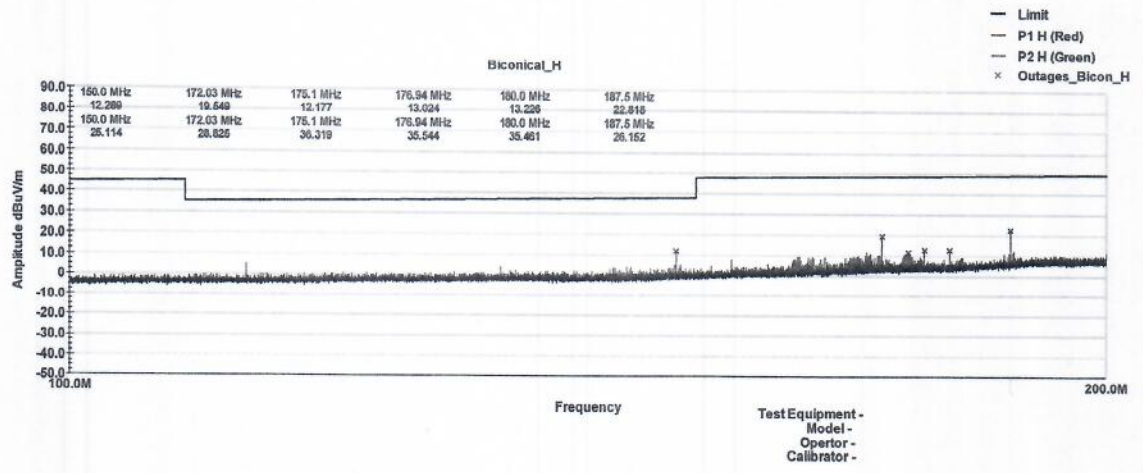
Test item	Radiation Emission of Radio Frequency Energy	Test standards	RTCA DO-160G	
<b>Test layout</b>				
<p>The diagram illustrates the test setup within a shielded room. The EUT (Under Test Unit) is connected to a power source (电源) and a LISN (Line Impedance Stabilization Network) with a 10 μF capacitor. The EUT is positioned at a distance of 0.9m from the LISN. The antenna is placed at a distance of 1m from the EUT. The antenna is a rod antenna, with its center at a height of 0.3m above the ground plane. The antenna is connected to a receiver (ESW44) and a spectrum analyzer (频谱分析仪) with an interference measurement device (干扰测量设备). The receiver is connected to a data recorder (数据记录仪). The antenna is also connected to a shielded room (屏蔽室) and a measurement equipment interface (测试设备接口: 模拟的、数字的或混合的飞机模拟负载). The diagram also shows a 10cm distance between the EUT and the antenna, and a 10cm distance between the antenna and the receiver. The antenna is labeled as '天线' and the receiver as 'ESW44'. The spectrum analyzer is labeled as '频谱分析仪' and the data recorder as '数据记录仪'. The shielded room is labeled as '屏蔽室'.</p>				
EUT status	Reference working mode 1. EUT is powered by DC 12V through unshielded cable. EUT is not connected to the ground.			
<b>Main test equipment</b>				
No.	Instrument	Type	S/N	Calibration Due
1	Receiver	ESW44	101755	2022.12.03
2	LISN	NNBM DO160-1500	00002	2023.03.19
3	LISN	NNBM DO160-1500	00003	2023.03.19
4	Rod antenna	3301C	00218779	2023.07.12
5	Biconical antenna	3110C	00224162	2023.06.28
6	Double-Ridged Horn antenna	3106B	00225256	2023.07.12
7	Double-Ridged Horn antenna	3117-PA	00225258	2023.06.28
<b>Receiver parameter</b>				
Frequency	Detector	Bandwidth	Dwell time (s)	
100MHz~400MHz	Peak	10kHz	0.015s	

400MHz ~960MHz	Peak	100kHz	0.015s
960MHz ~6GHz	Peak	1MHz	0.015s

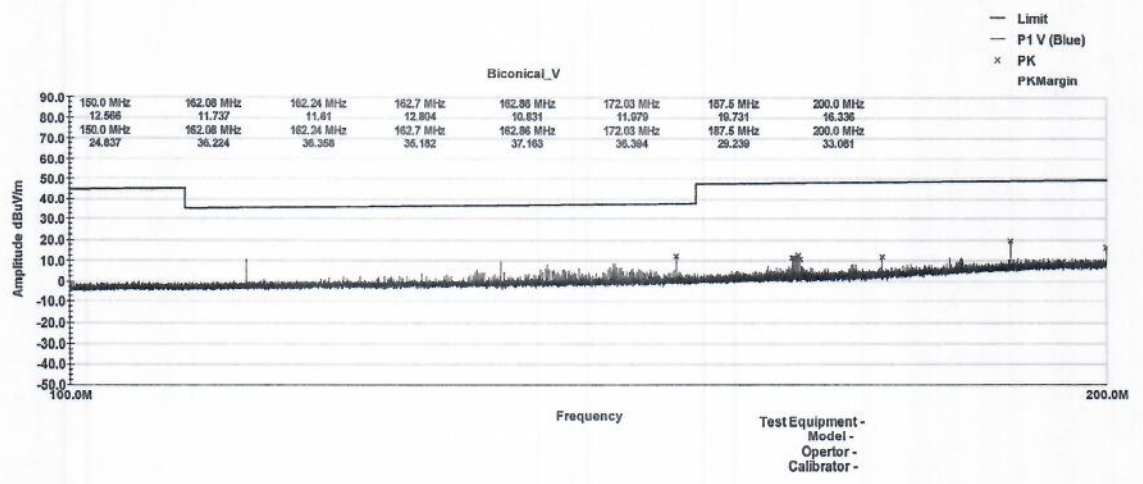
**Test parameter**

Frequency range	100MHz ~6GHz
The limit line	Maximum Level of Radiated RF Interference – Category M
Test position	Front side

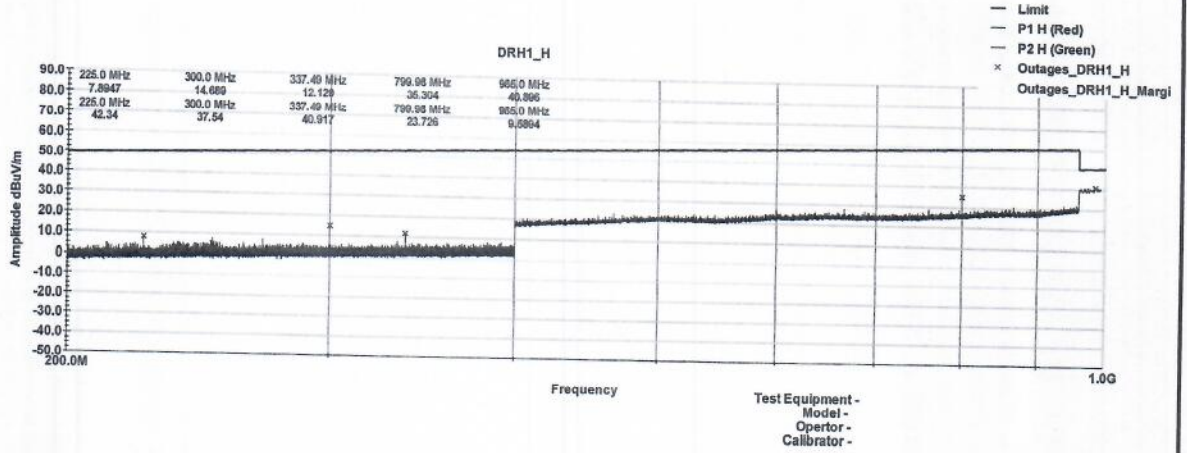
**Test result**



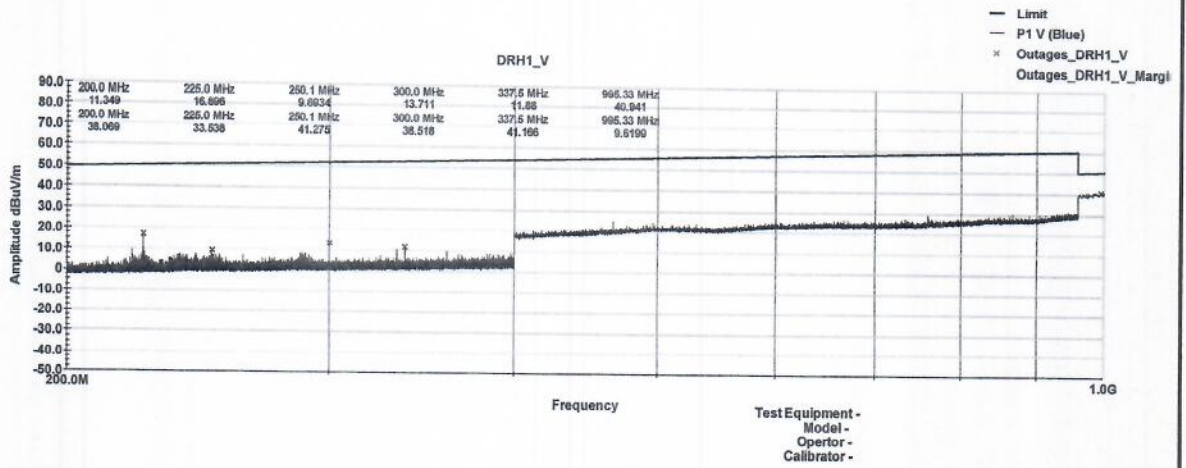
100MHz ~200MHz Horizontal polarization direction of antenna



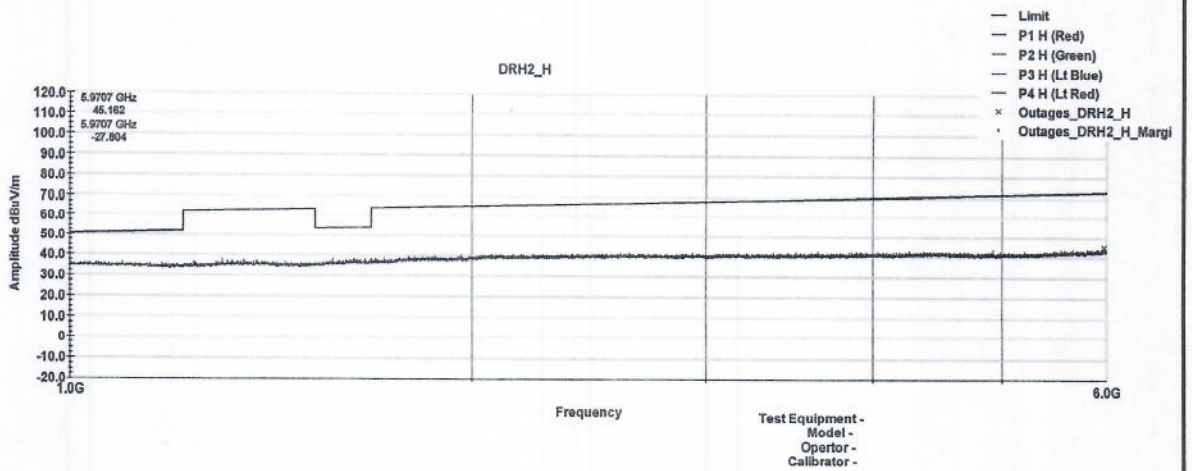
100MHz ~200MHz Vertical polarization direction of antenna



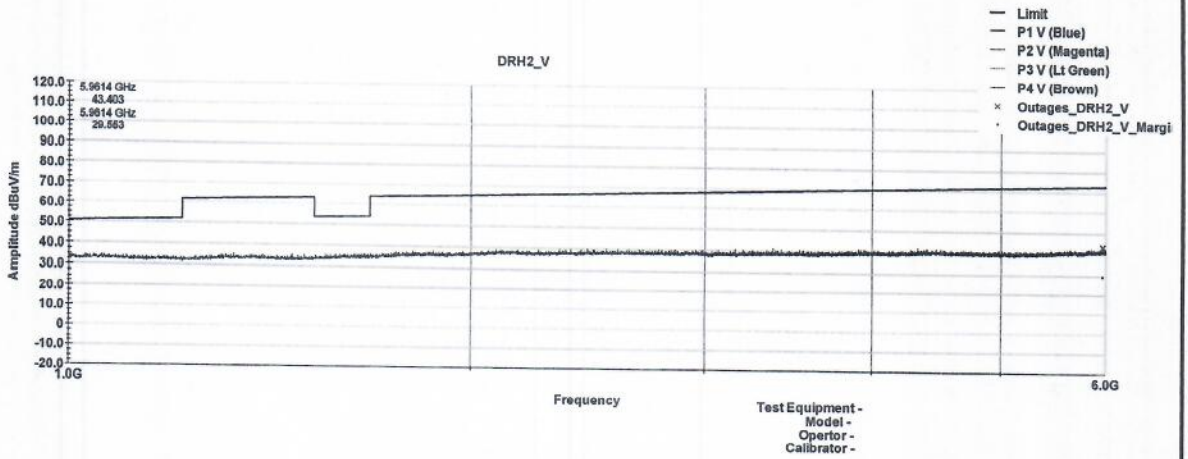
200MHz~1GHz Horizontal polarization direction of antenna



200MHz~1GHz Vertical polarization direction of antenna



1GHz~6GHz Horizontal polarization direction of antenna



1GHz ~6GHz Vertical polarization direction of antenna

Test conclusion	The test result comply with the Maximum Level of Radiated RF Interference – Category M of RTCA-DO-160G.
Note	/

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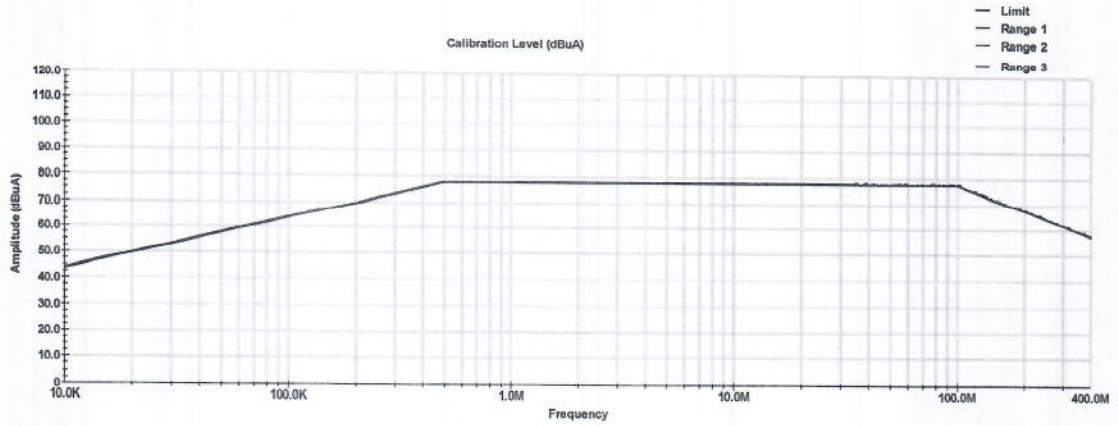
### Test Result

Test items	Conduction Susceptibility of Radio Frequency Energy	Test standards	RTCA DO-160G	
Test layout:				
<p>Calibration layout</p>		<p>Test layout</p>		
EUT status	Reference working mode 1. EUT is powered by DC 12V through unshielded cable. EUT is not connected to the ground.			
<b>Main test equipment</b>				
No.	Instrument	Type	S/N	Calibration Due
1	LISN	NNBM DO160-1500	00002	2023.03.19
2	LISN	NNBM DO160-1500	00003	2023.03.19
3	Signal generator	N5171B	MY57281051	2023.07.04
4	Power amplifier	BSA0040-150	1811849	2023.07.08
5	Current injection probe	F-120-8-HV	190691	2023.07.07
6	Current monitoring probe	CLCE-400	30020042	2023.07.07
<b>Test parameter</b>				
Frequency range	10kHz~400MHz			
The limit line	Conducted Susceptibility Test Levels –Category T			
Frequency step	10kHz~100MHz	$f_{n+1} = f_n * 10^{(1/10)}$		
	100MHz~400MHz	$f_{n+1} = f_n * 10^{(1/100)}$		
Modulation method	CW& 1 kHz square wave with a modulation depth of 90%			
Dwell time	2s			
Test cables	Complete power lines & All parameter cables			

Injection position

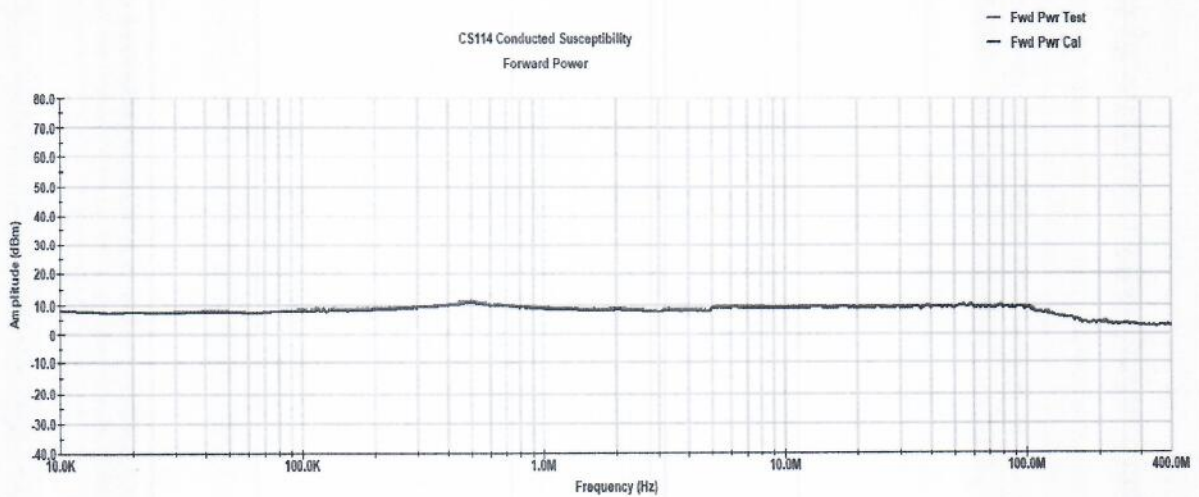
The distance between the Current injection probe and the Current monitoring probe is 5cm. The distance between the Current injection probe and EUT is 5cm.

Test calibration

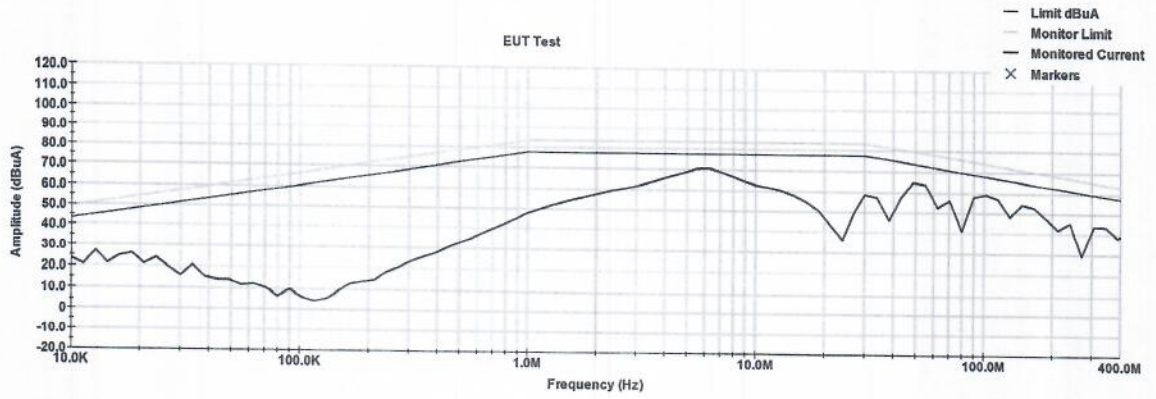


Calibration current curve

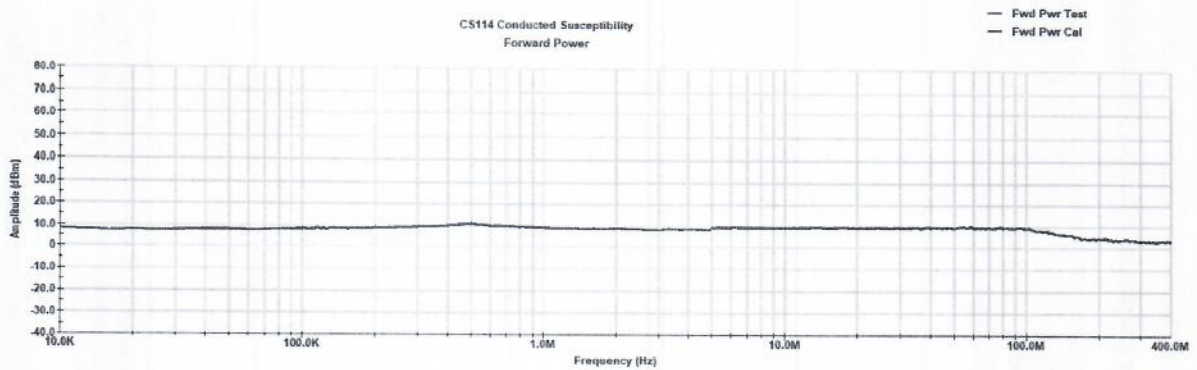
Test result



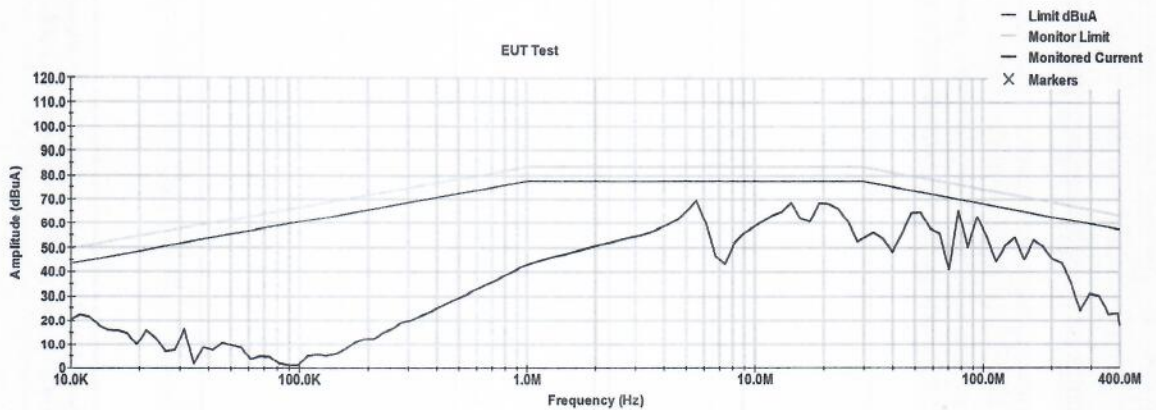
Forward power/Testing monitoring curve (Complete power lines & All parameter cables) (CW modulation)



Monitoring current curve (Complete power lines & All parameter cables) (CW modulation)



Forward power/Testing monitoring curve (Complete power lines & All parameter cables) (1 kHz square wave with a modulation depth of 90%)



Monitoring current curve (Complete power lines & All parameter cables) (1 kHz square wave with a modulation depth of 90%)

Test conclusion

During this test, no malfunction, no non-operation when operation is required, no inadvertent discharge or other unintentional change of state during this test.

Monitor the EUT screen: ECG( $60 \pm 1$ ), RESP( $20 \pm 1$ ), SPO2( $98 \pm 2$ ), CO2( $0 \pm 2$ ), NIBP( $\pm 5$ ), IBP( $0 \pm 1$ ), TEMP ( $37 \pm 0.1$ ).

The test result comply with requirements for evaluation of the test results .

Note

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### Test Result

Test item	Radiation Susceptibility of Radio Frequency Energy	Test standards	RTCA DO-160G	
Test layout:				
EUT status	Reference working mode 1. EUT is powered by DC 12V through unshielded cable and EUT is not connected to the ground.			
<b>Main test equipment</b>				
No.	Instrument	Type	S/N	Calibration Due
1	LISN	NNBM DO160-1500	00002	2023.03.19
2	LISN	NNBM DO160-1500	00003	2023.03.19
3	Signal generator	N5173B	MY57280542	2022.12.03
4	Signal generator	N5173B	MY57280567	2022.12.03
5	Power amplifier	NTWPAS-0081020001000E	18083171	2023.01.15
6	Power amplifier	NTWPAS-1025250	18043067	2022.11.22
7	Power amplifier	NTWPAS-2560200	18023031	2022.11.22
8	Power amplifier	NTWPAS-60180200	18119080	2022.11.22
9	Power meter	N1914A	MY58170013	2022.12.03
10	Field Probe	HI-6023	00225503	2022.09.27
11	Field Probe	HI-6053	00225409	2022.09.27

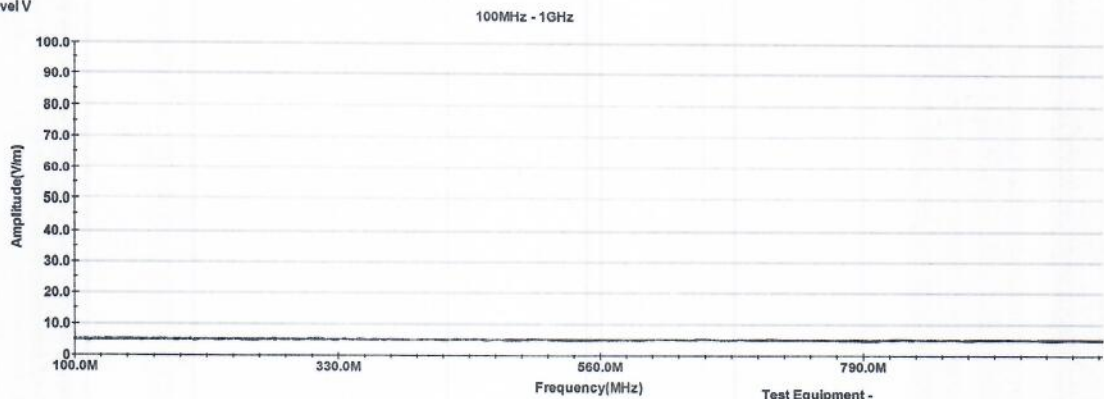
12	Stacked log periodic antenna	STLP9128ES	#3065	2022.12.09
13	Horn antenna	ATH800M6GMI	0351883	2022.12.09
14	Horn antenna	ATH6G18	0351208	2022.12.09

**Test parameter**

Frequency range	100MHz ~8GHz		
The limit line	Radiation Susceptibility Test Levels -Category T		
Test field strength(V/m)	100MHz ~8GHz	5V/m	
Modulation method	CW& 1 kHz square wave with a modulation depth of 90%		
扫描速率	100MHz~18GHz	$f_{n+1} = f_n * 10^{(1/100)}$	
Dwell time(s)	2s		
Test position	Front side		

**Test Result**

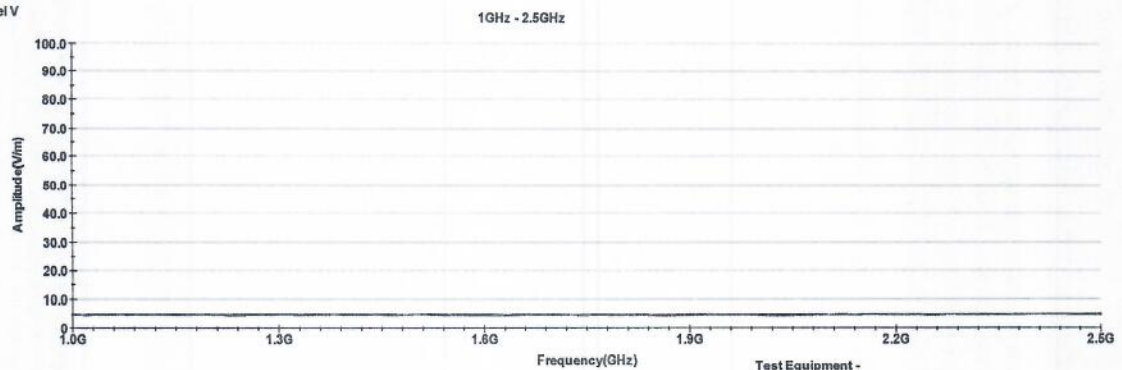
- Target
- Test Level H
- Test Level V



Test Equipment -  
Model -  
Operator -  
Calibrator -

100MHz~1GHz (CW)

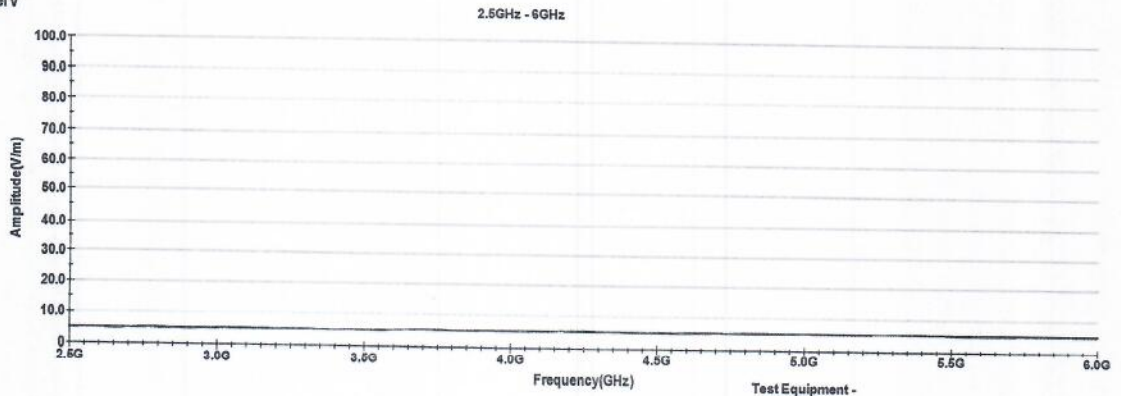
- Target
- Test Level H
- Test Level V



Test Equipment -  
Model -  
Operator -  
Calibrator -

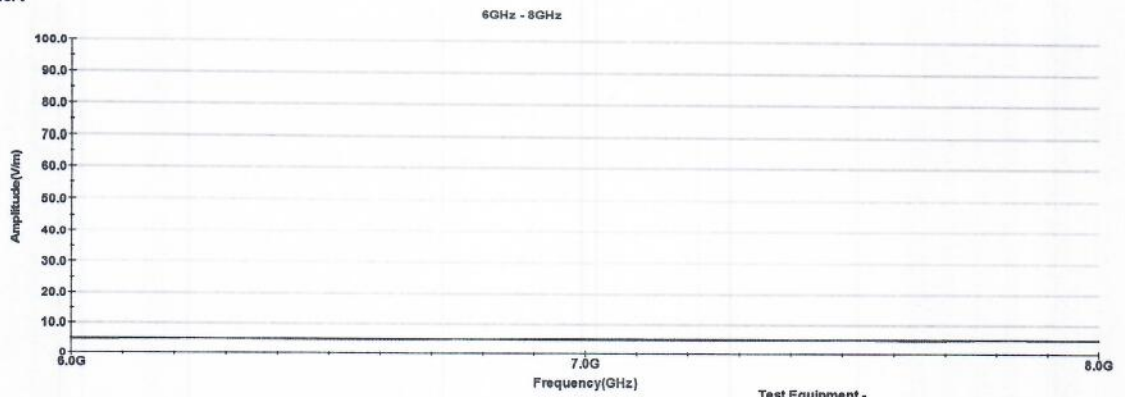
1GHz~2.5GHz (CW) Test curve

— Target  
— Test Level H  
— Test Level V



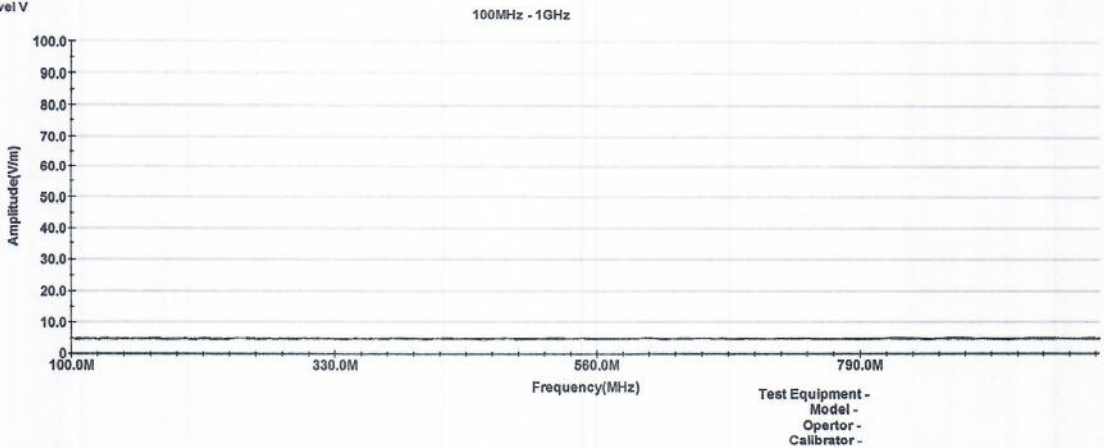
2.5GHz~6GHz (CW) Test curve

— Target  
— Test Level H  
— Test Level V



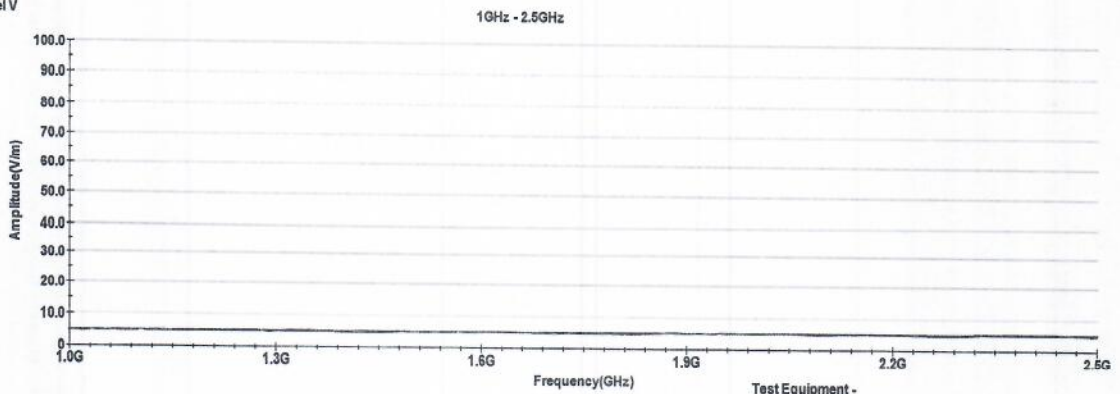
6GHz~8GHz (CW) Test curve

— Target  
— Test Level H  
— Test Level V



100MHz~1GHz (SW) Test curve

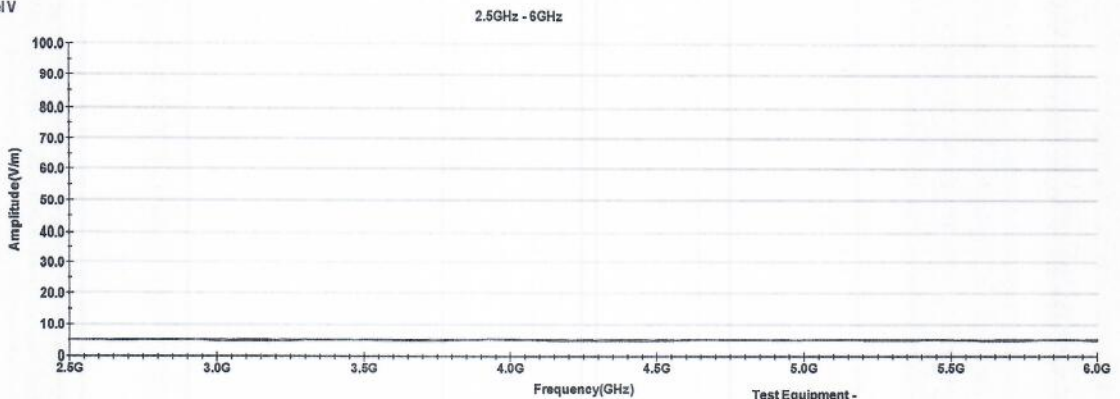
— Target  
— Test Level H  
— Test Level V



Test Equipment -  
Model -  
Operator -  
Calibrator -

1GHz~2.5GHz (SW) Test curve

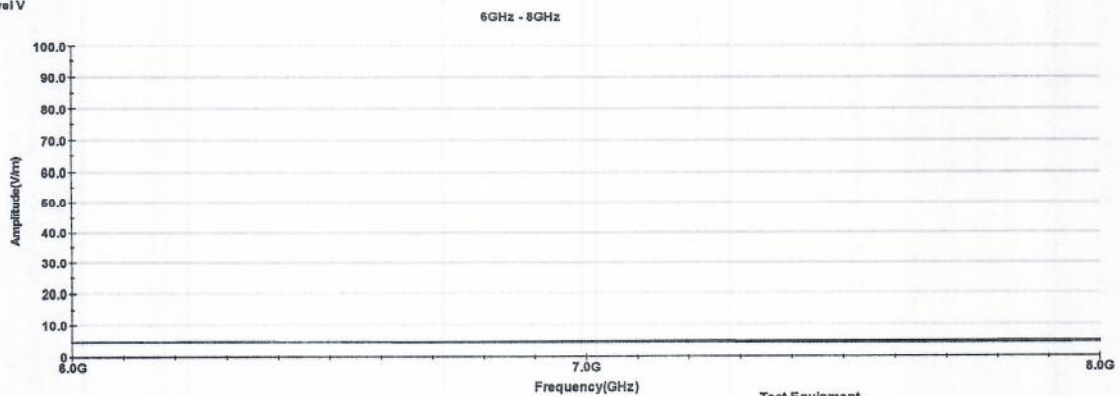
— Target  
— Test Level H  
— Test Level V



Test Equipment -  
Model -  
Operator -  
Calibrator -

2.5GHz~6GHz (SW) Test curve

— Target  
— Test Level H  
— Test Level V

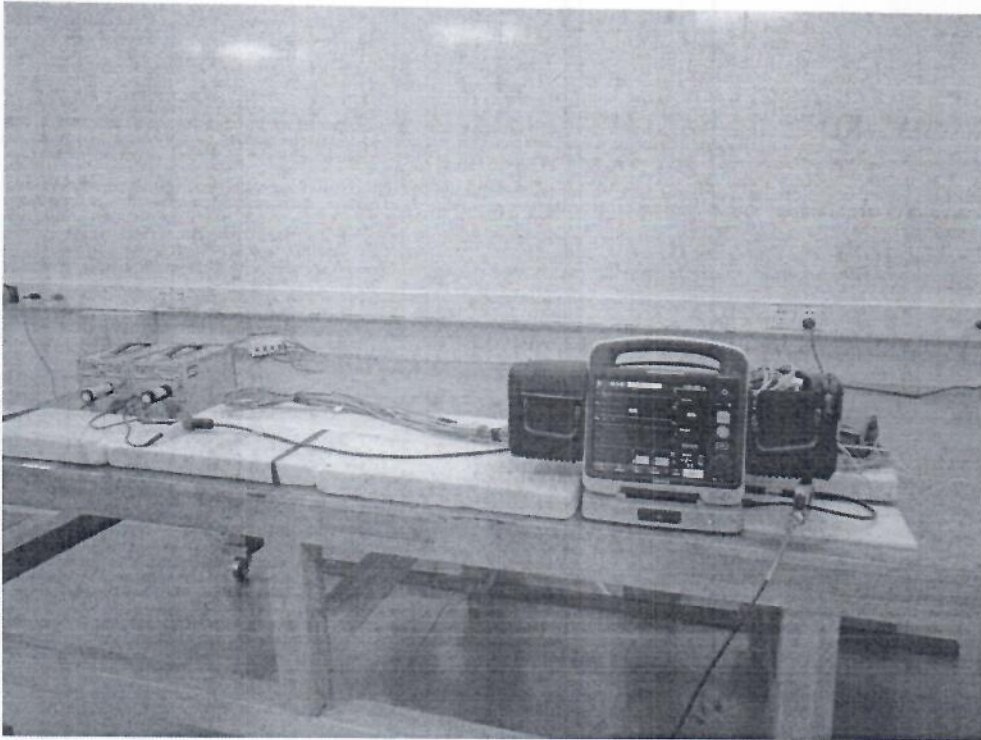


Test Equipment -  
Model -  
Operator -  
Calibrator -

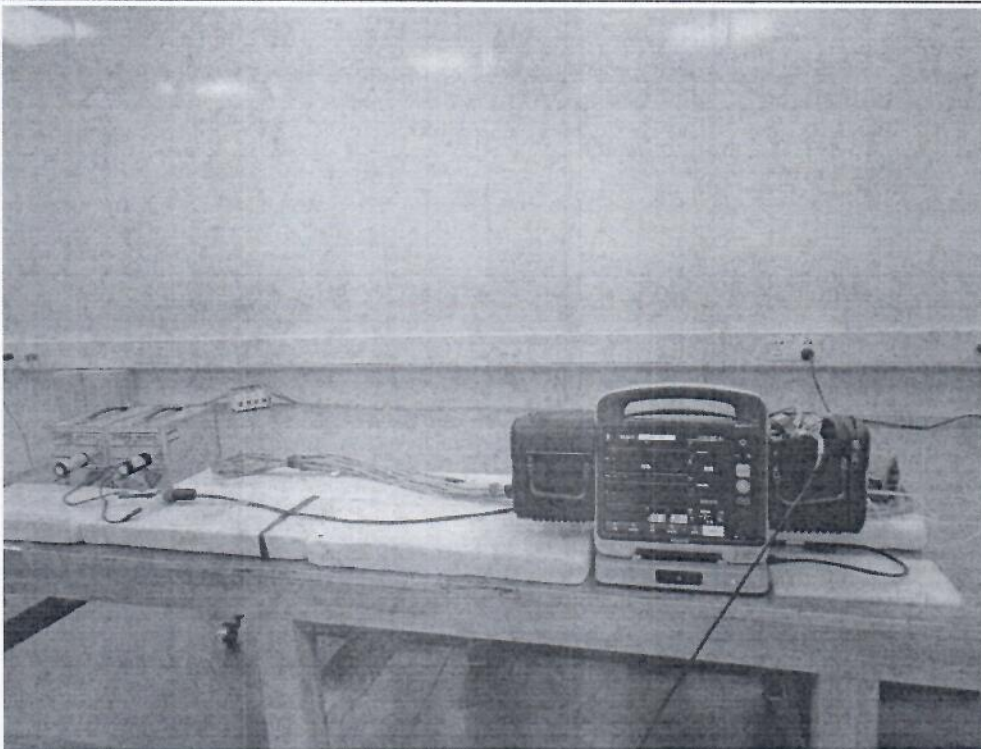
6GHz~8GHz (SW) Test curve

Test conclusion	During this test, no malfunction, no non-operation when operation is required, no inadvertent discharge or other unintentional change of state during this test. Monitor the EUT screen: ECG( $60 \pm 1$ ), RESP( $20 \pm 1$ ), SPO2( $98 \pm 2$ ), CO2( $0 \pm 2$ ), NIBP( $\pm 5$ ), IBP( $0 \pm 1$ ), TEMP ( $37 \pm 0.1$ ). The test result comply with requirements for evaluation of the test results .
Note	/
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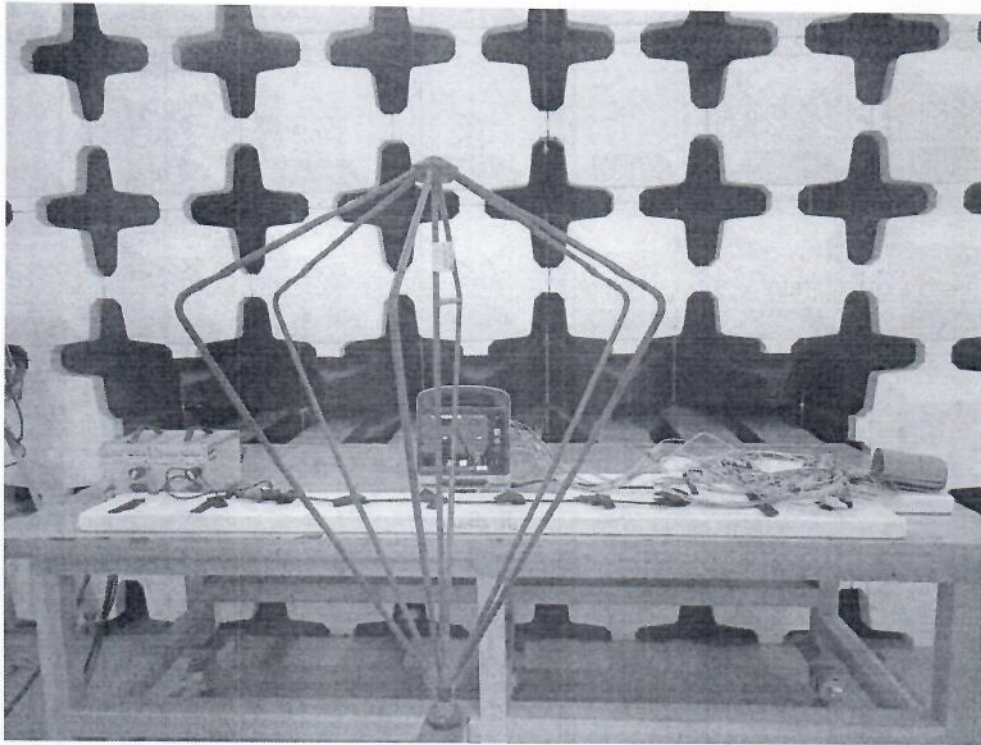
## Test Photos



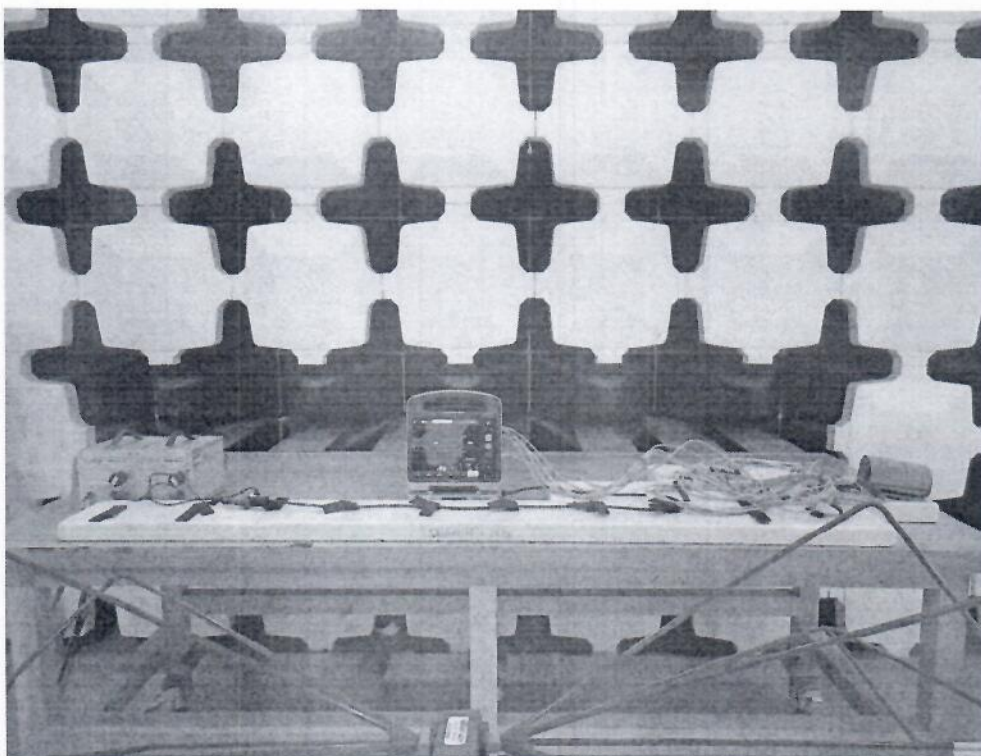
Conduction Emission of Radio Frequency Energy Complete power lines 150kHz~152MHz



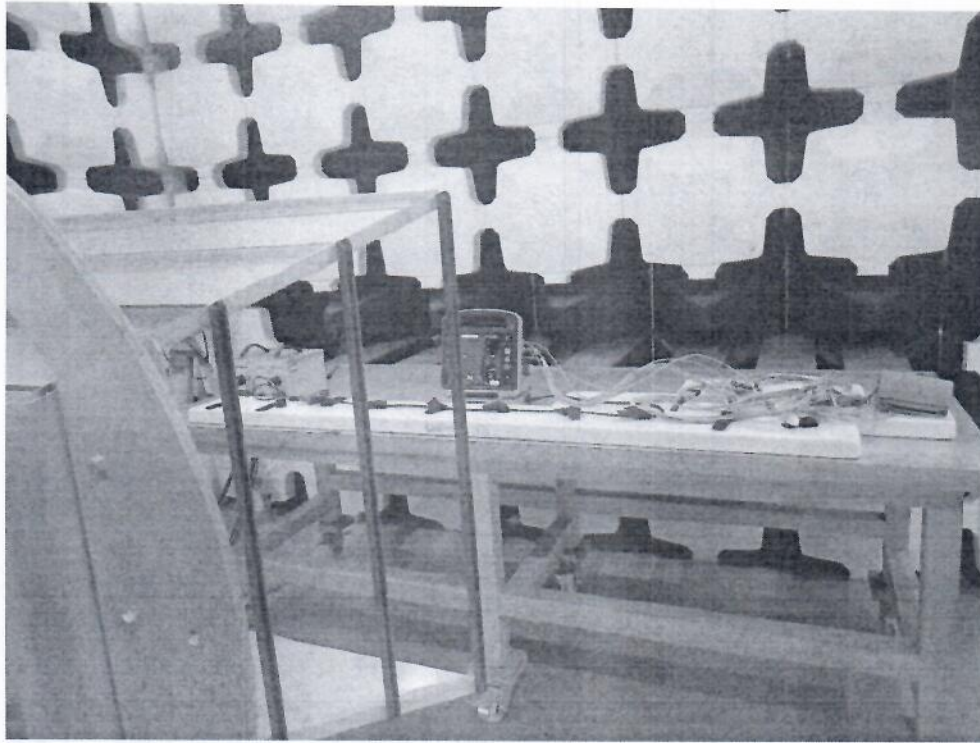
Conduction Emission of Radio Frequency Energy All parameter cables 150kHz~152MHz



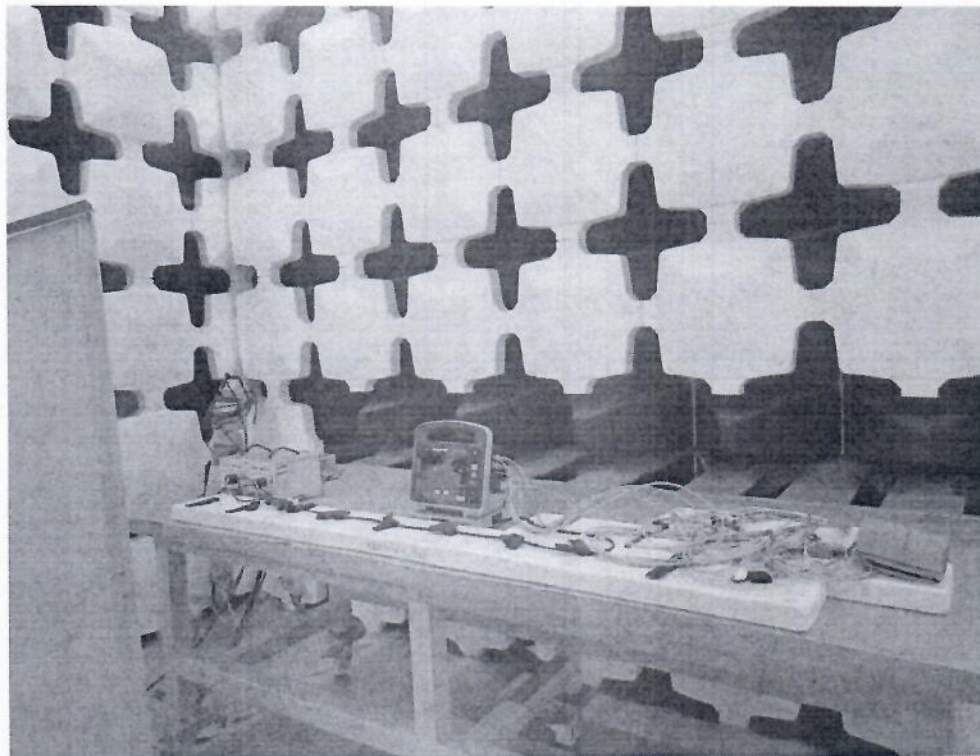
Radiation Emission of Radio Frequency Energy 100MHz~200MHz Vertical polarization direction of antenna



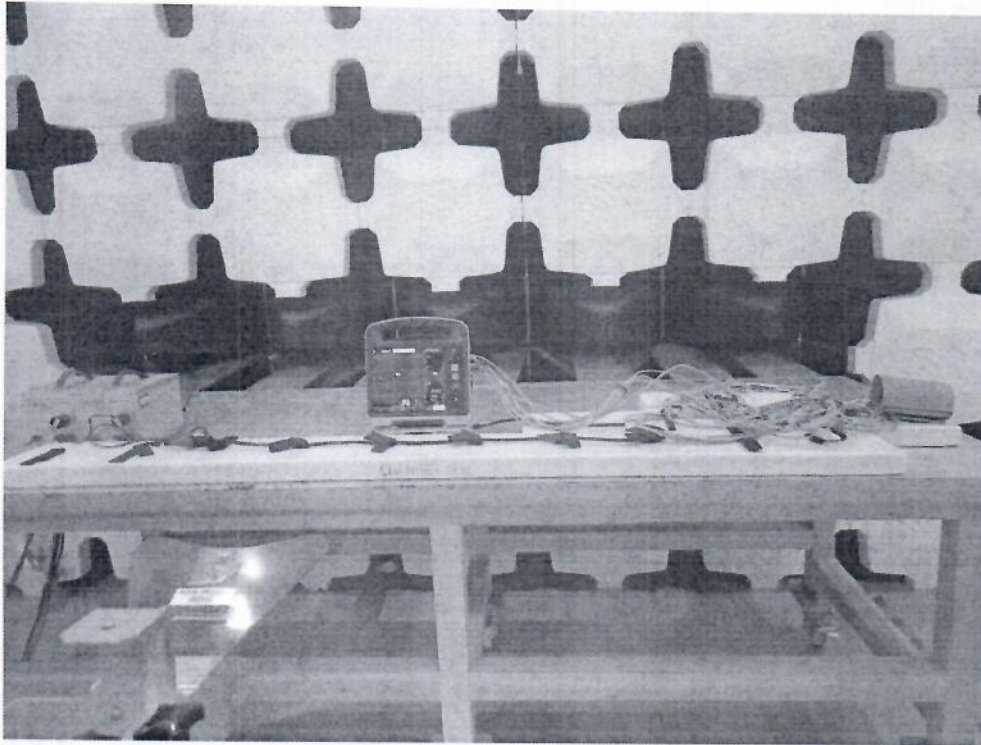
Radiation Emission of Radio Frequency Energy 100MHz~200MHz Horizontal polarization direction of antenna



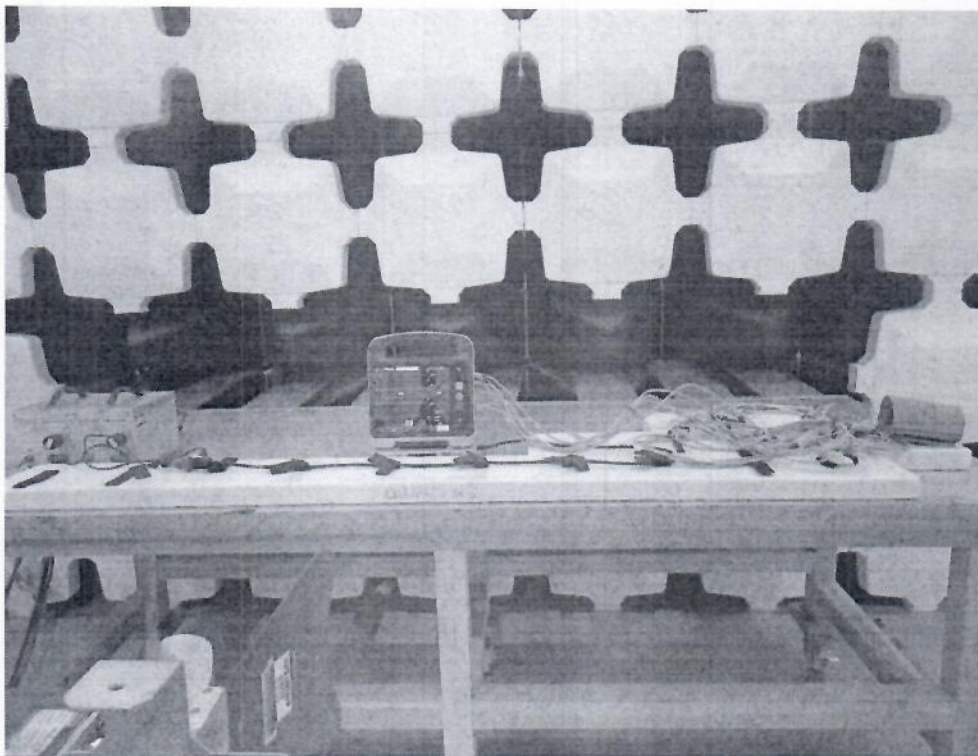
Radiation Emission of Radio Frequency Energy 200MHz~1GHz Vertical polarization direction of antenna



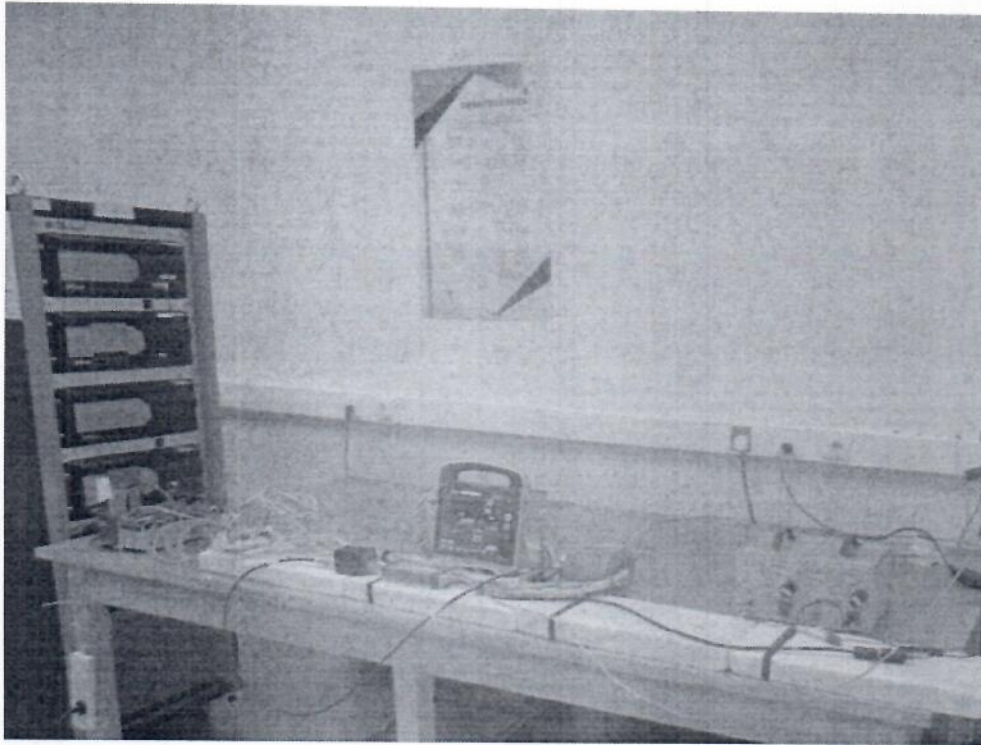
Radiation Emission of Radio Frequency Energy 200MHz~1GHz Horizontal polarization direction of antenna



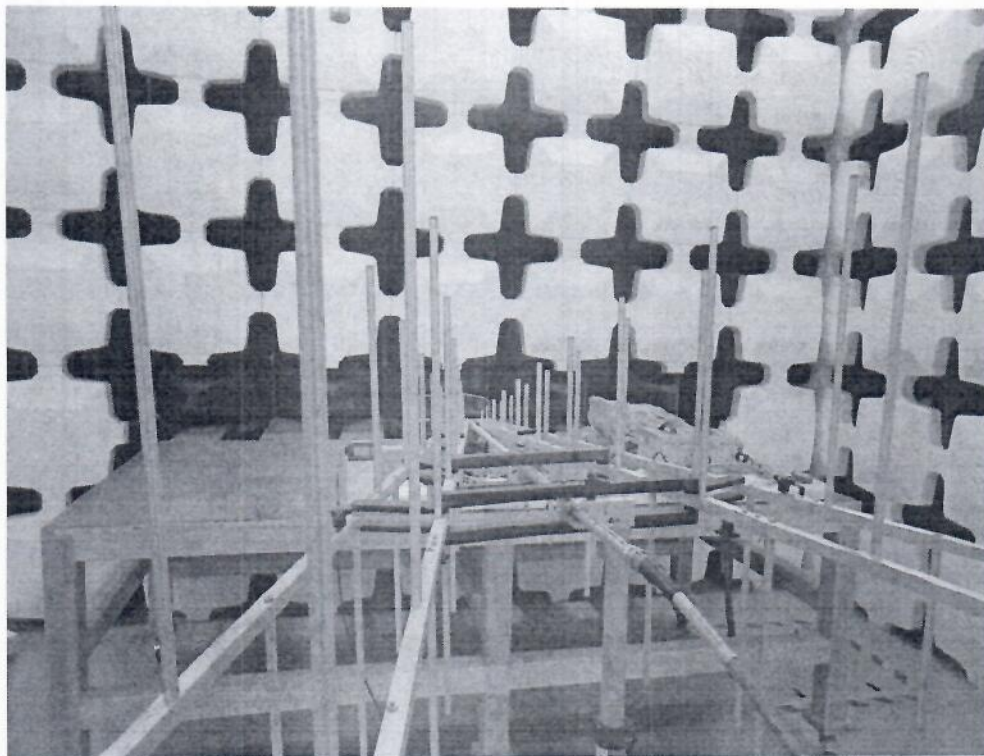
Radiation Emission of Radio Frequency Energy 1GHz~6GHz Vertical polarization direction of antenna



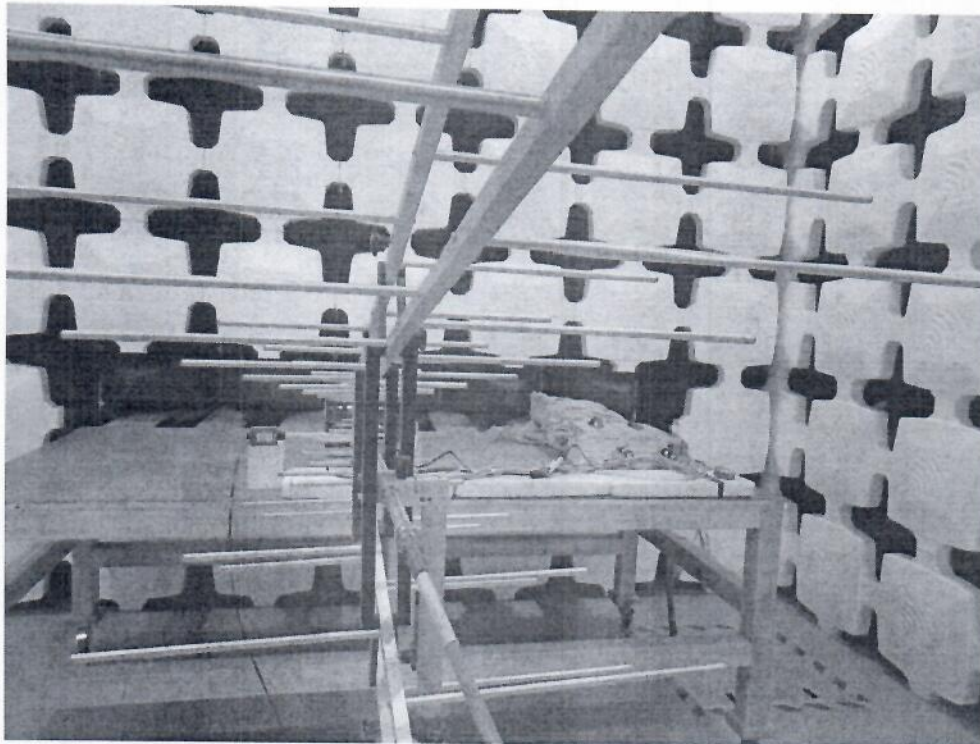
Radiation Emission of Radio Frequency Energy 1GHz~6GHz Horizontal polarization direction of antenna



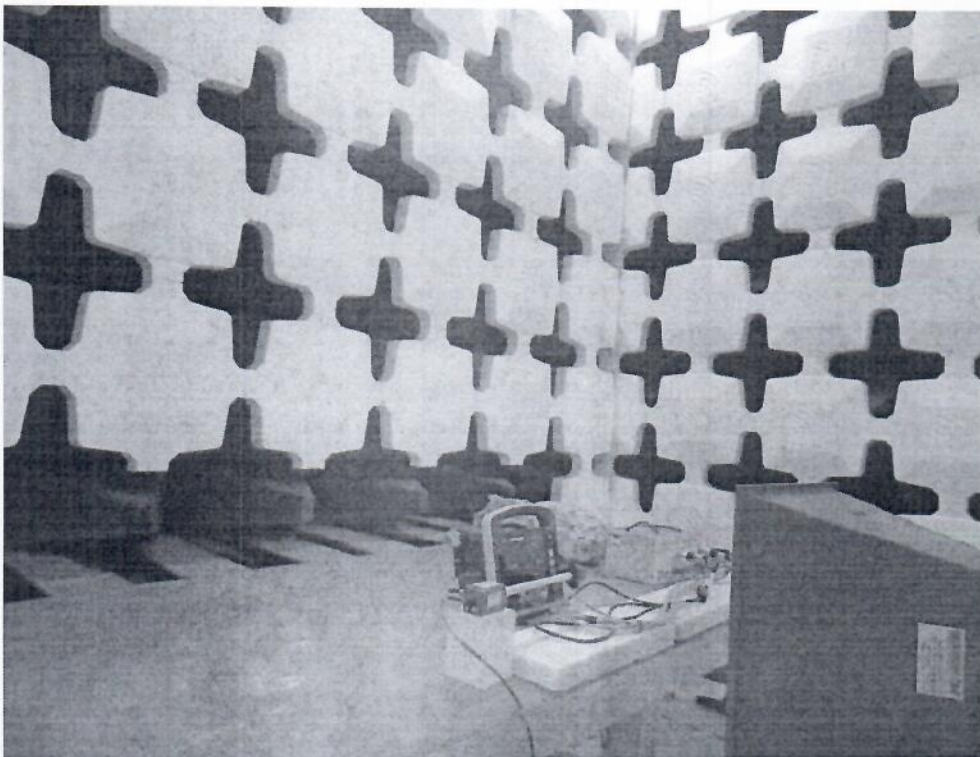
Conduction Susceptibility of Radio Frequency Energy 10kHz~400MHz



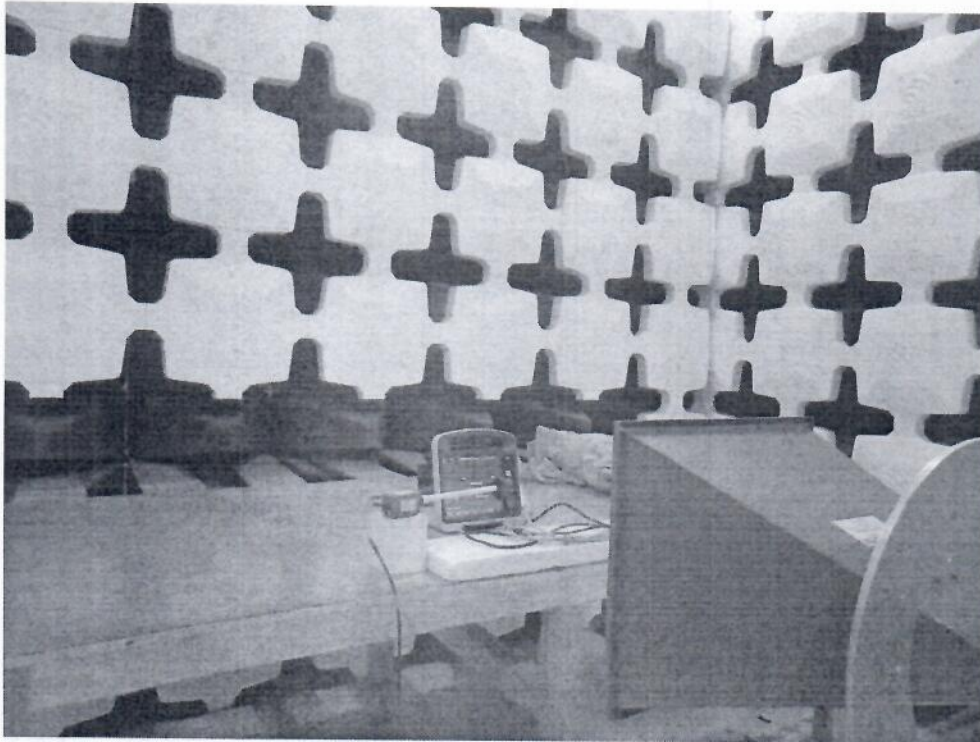
Radiation Susceptibility of Radio Frequency Energy 100MHz~1GHz Vertical polarization direction of antenna



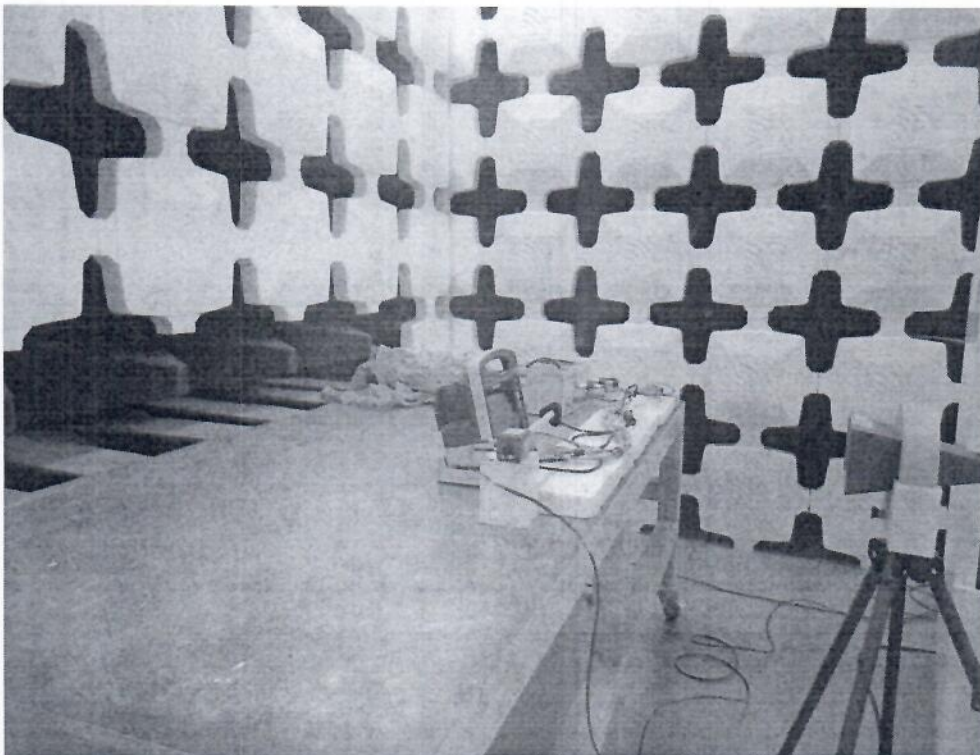
Radiation Susceptibility of Radio Frequency Energy 100MHz~1GHz Horizontal polarization direction of antenna



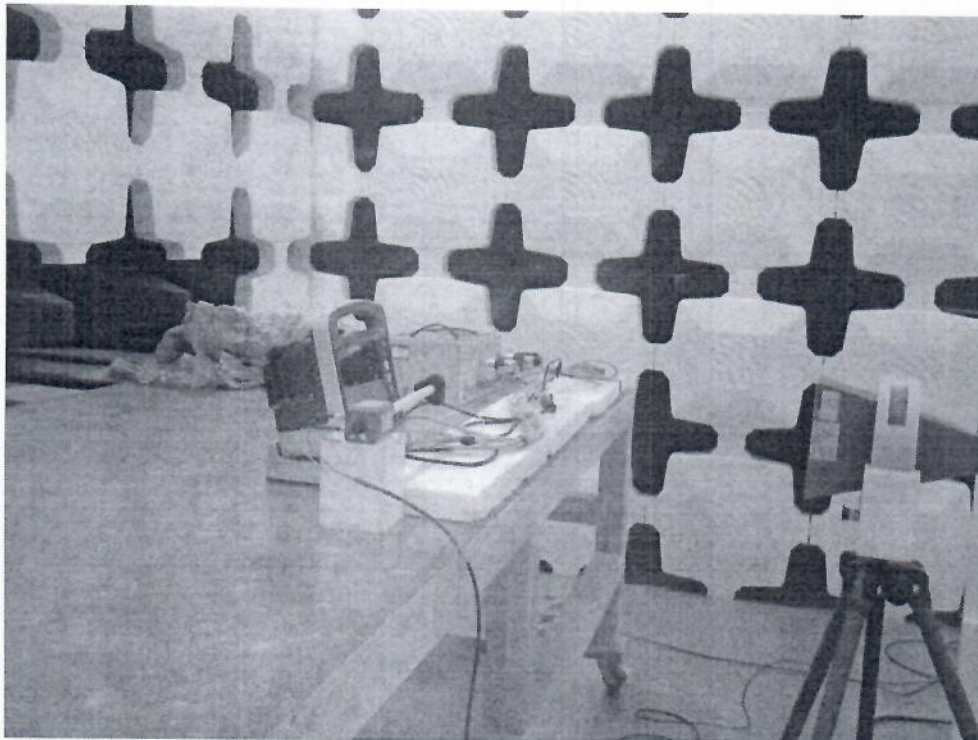
Radiation Susceptibility of Radio Frequency Energy 1GHz~6GHz Vertical polarization direction of antenna



Radiation Susceptibility of Radio Frequency Energy 1GHz~6GHz Horizontal polarization direction of antenna



Radiation Susceptibility of Radio Frequency Energy 6GHz~8GHz Vertical polarization direction of antenna



Radiation Susceptibility of Radio Frequency Energy 6GHz~8GHz Horizontal polarization direction of antenna

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