



WHA YU INDUSTRIAL CO., LTD.(HEAD OFFICE)

DONGGUAN AEON TECH CO.,LTD.(CHINA)

SPECIFICATION FOR APPROVAL

CUSTOMER: 鴻海科技股份有限公司

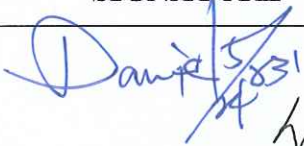
PART NAME: PIFA Antenna

PART NO.: 361.01671.005

REVISION:

W. Y. P/NO.: C107-512024-A(SRF2023799)

REV.: X4

	MANUFACTURER	CUSTOMER
	SIGNATURE	
APPROVED BY :	 5/24/23	
DATE :	 5/24/23	

WHA YU GROUP

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PIFA Antenna

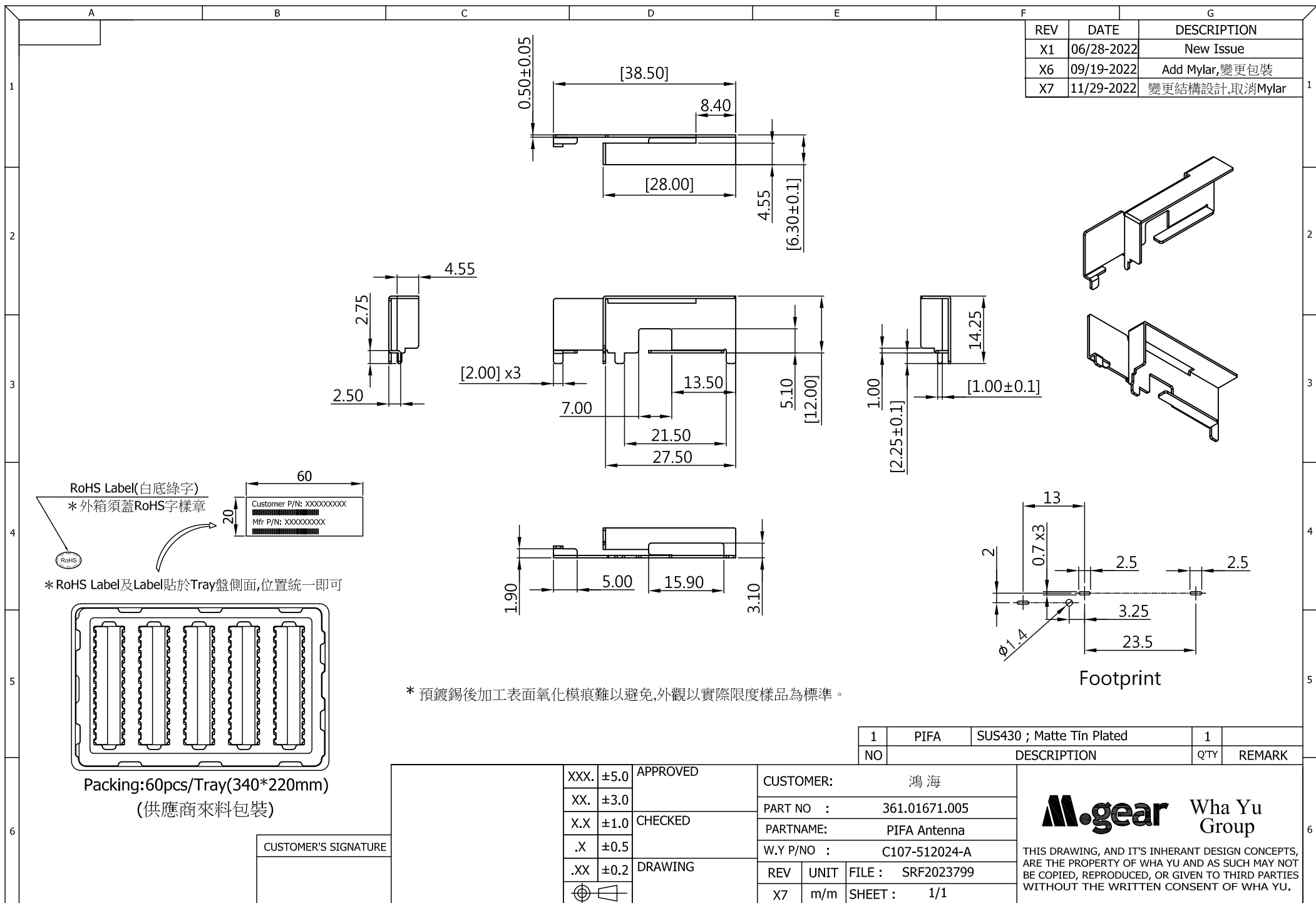
Specification

1. Electrical Properties : (With housing)

- 1.1 Frequency Range..... 865~928 MHz
- 1.2 Impedance 50Ω Nominal
- 1.3 VSWR 1.92 : 1 Max.
- 1.4 Return Loss..... 10 dB Min.
- 1.5 Radiation Omni-directional
- 1.6 Peak Gain..... -0.16 dBi Max. (With Battery)
0.28 dBi Max. (Without Battery)
- 1.7 Polarization..... Linear

2. Physical Properties :

- 2.1 Operating Temp. -10°C ~ +60°C
- 2.2 Storage Temp. -10°C ~ +70°C



Antenna Test Report (Sub-G)

Document Number: NA

Version: V 1.20

Released Date: 2023/03/22

Prepared By: Tim Cheng

Reviewed By: Rick

Contents

- Revised History
- Specification
- Antenna Placement & Solution
- Test Setup for S-parameter Measurement
- Return Loss Results
- Test Setup for Radiation Pattern Measurement
(Device Orientation in the chamber)
- 2D Radiation Pattern Results
- Results Summary (return loss, peak gain, efficiency)

Revision History

Released Date	Version	Record
2022/04/27	1.00	Antenna evaluation report
2022/05/13	1.01	Modify antenna for test (With housing)
2022/05/27	1.02	Modify antenna for test (With new housing)
2022/05/30	1.03	V1.02-Remove battery for test
2022/06/02	1.04	Modify antenna for test
2022/06/10	1.05	Modify antenna for test
2022/06/15	1.06	Modify antenna for test
2022/06/20	1.07	Modify antenna for test
2022/06/23	1.08	Modify pi matching for test
2022/06/29	1.09	Modify pi matching for test
2022/07/19	1.10	Modify antenna and pi matching for test
2022/07/21	1.11	Modify antenna and pi matching for test

Revision History

Released Date	Version	Record
2022/10/25	1.12	DV2.01 (Antenna test report)
2022/10/27	1.13	Modify footprint for test (DV2.01)
2022/11/01	1.14	Change the test plan (DV2.01)
2022/11/08	1.15	Change of the new antenna pin position (DV2.01)
2022/11/11	1.16	Modify antenna for test (DV2.01) –CASE2
2022/11/15	1.17	1. To optimize antenna & values of matching circuit. 2. Pin design as following DV2 request. 3. Device revision: DV2.01 – #02
2023/01/19	1.18	1. Device revision: DV2.01 – #01 2. PCBA revision: U12I465T50 GP REV.0
2023/03/20	1.19	1. Device revision: DV3.01 2. PCBA revision: U12I465T50
2023/03/22	1.20	1. To optimize pi values of matching circuit. 2. Device revision: DV3.01 3. PCBA revision: U12I465T50

Specification

Requirements of Antenna Design

RF Function	Number of ANT	Frequency Band	Remark
Sub-G	1	865-928 MHz	

Requirements of Measurement

Test Item	Specification	Remark
Return Loss	> 6 dB	
Isolation	NA	
Peak gain	NA	
Efficiency	>= 40%	
Radiation pattern	Scale:+10~-40dBi, Angle step size: 2 degree	

Antenna Placement & Solution

With Battery-Antenna (865-928MHz)



Antenna	ANT Type	Size (L * W * H* T)	Cable Length (mm)	Cable Type
Sub-G	Metal PIFA	NA	72mm for test (Total)	Semi-rigid cable

Antenna Placement & Solution

Without Battery-Antenna (865-928MHz)

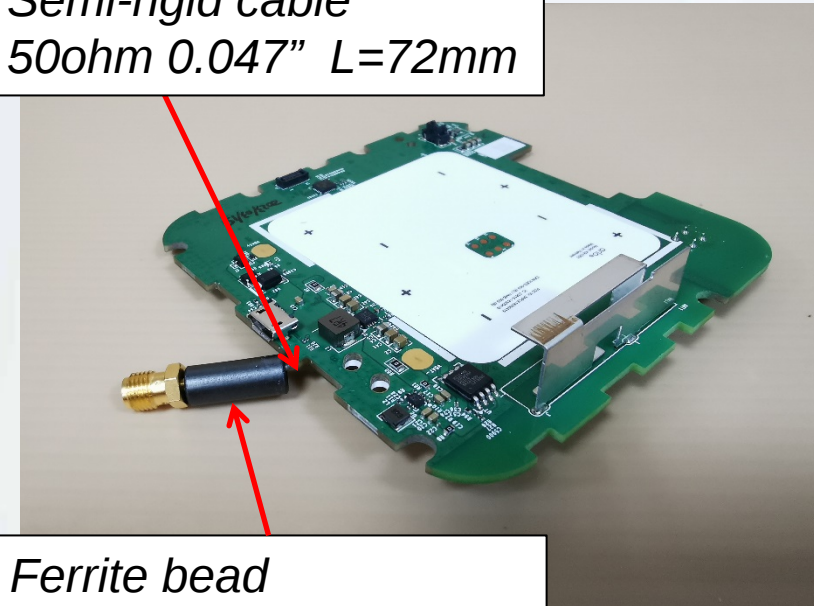


Antenna	ANT Type	Size (L * W * H* T)	Cable Length (mm)	Cable Type
Sub-G	Metal PIFA	NA	72mm for test (Total)	Semi-rigid cable

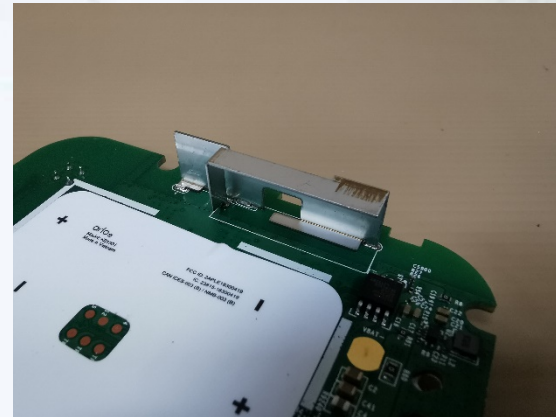
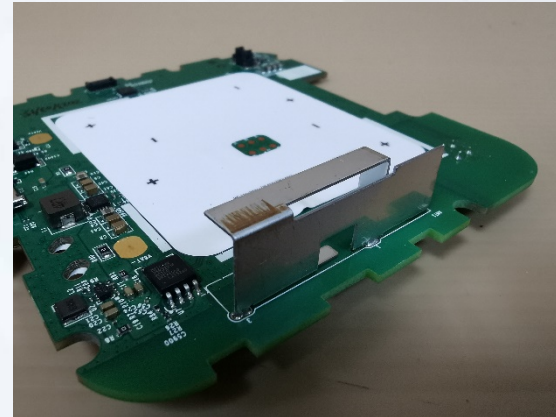
Antenna Placement & Solution

The antenna photos after optimized

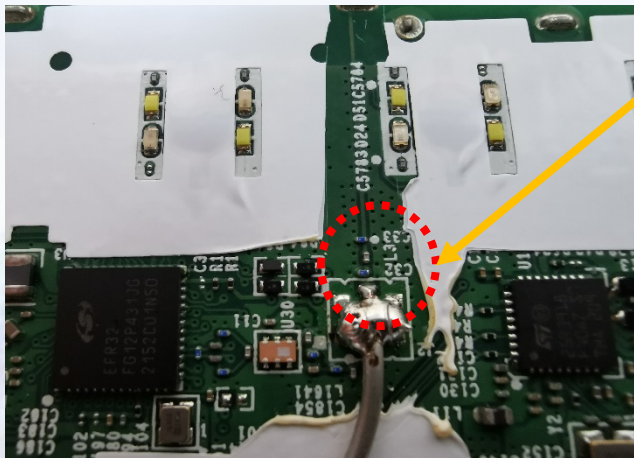
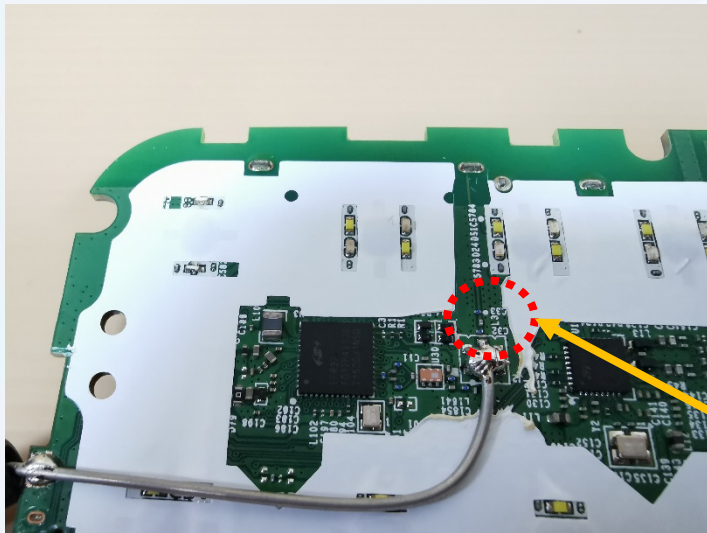
Semi-rigid cable
50ohm 0.047" L=72mm



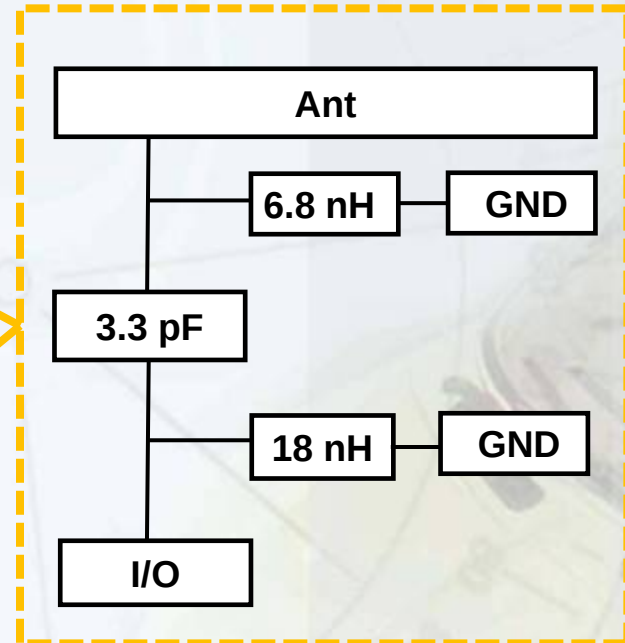
Ferrite bead
K5B RH6.35x15.8x3.3



Antenna Matching



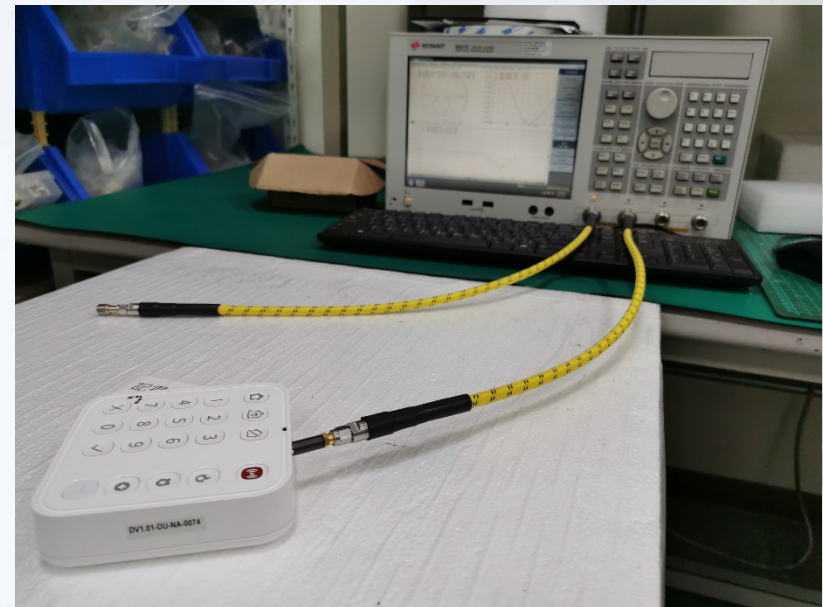
Matching values



Test Setup for S-parameter Measurement

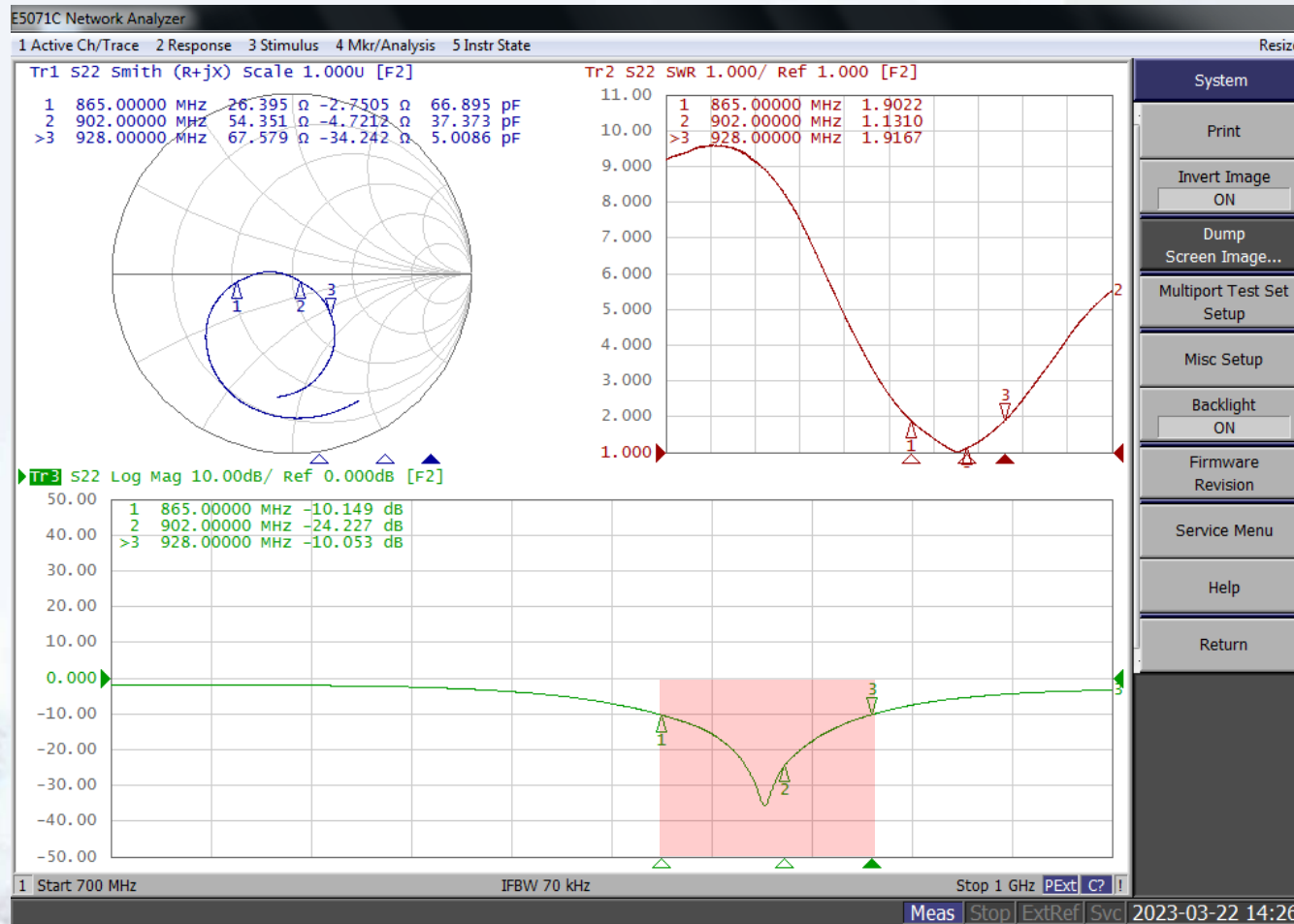


Equipment	Brand	Model	S/N
Network Analyzer	Keysight	E5071C	MY46522259



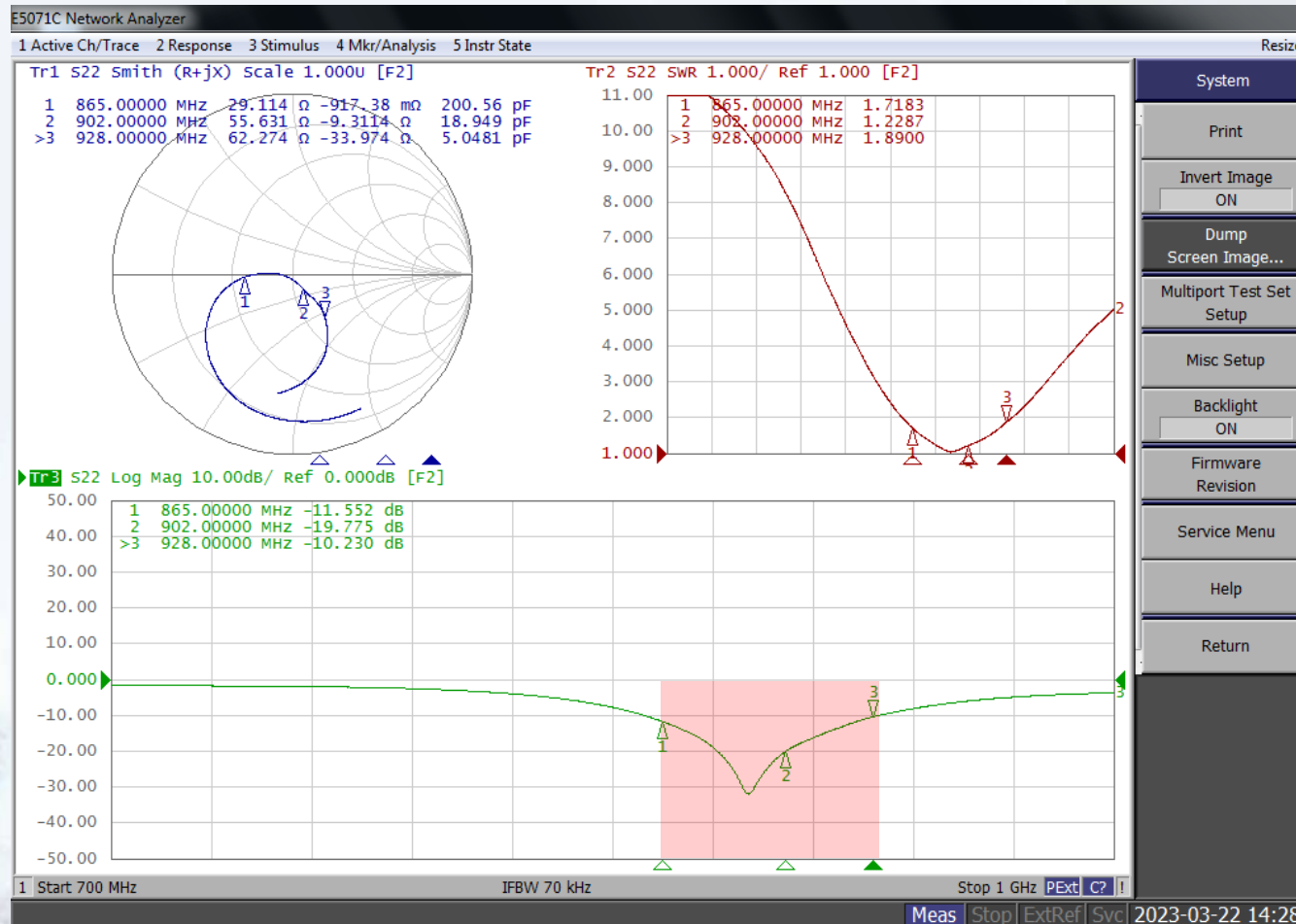
Return Loss Results

With Battery-Antenna (865-928MHz)



Return Loss Results

Without Battery-Antenna (865-928MHz)



Test Setup for Radiation Pattern Measurement

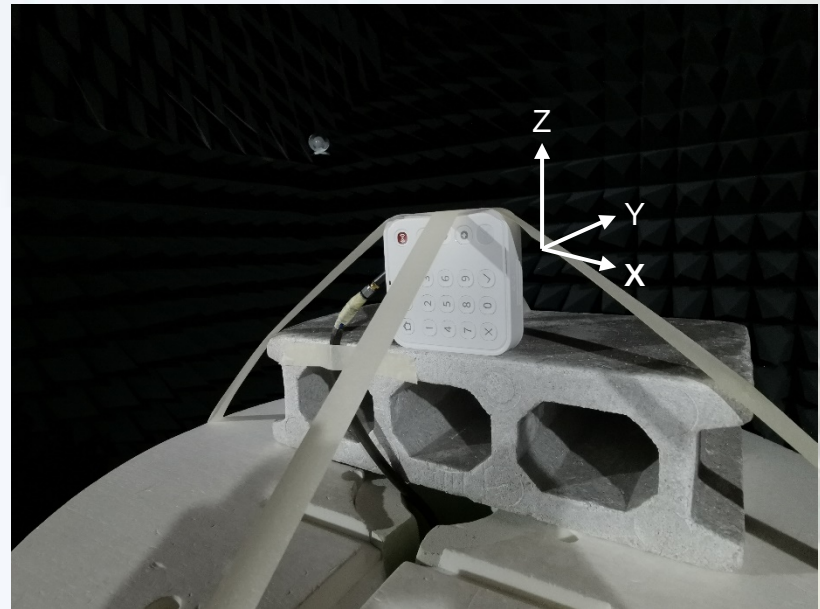
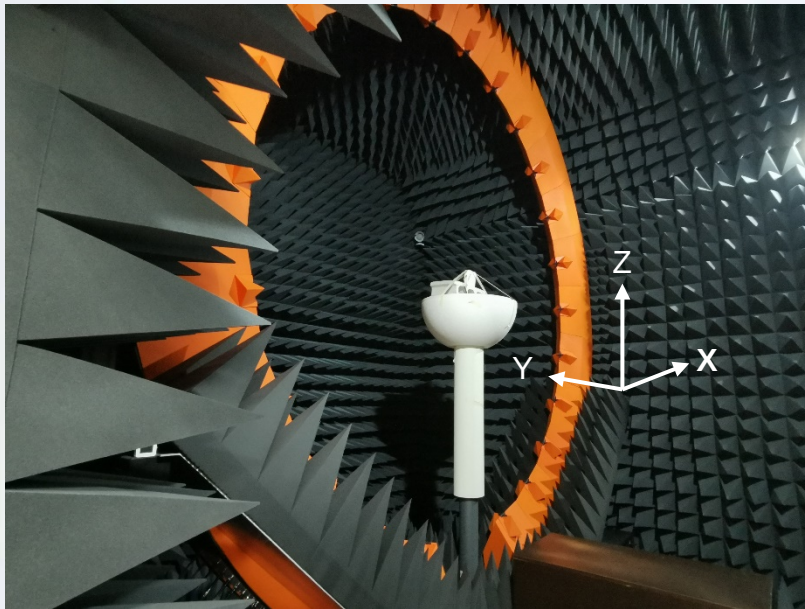


- **SATIMO SG-24L Multi-Probe Antenna Measurement System**
 - Frequency range: 400 MHz – 9 GHz
 - Chamber Room Size: 5m L x 5m W x 5m H

Chamber	Brand	Model	Location
SATIMO	SATIMO	SG-24	Taiwan HsinChu

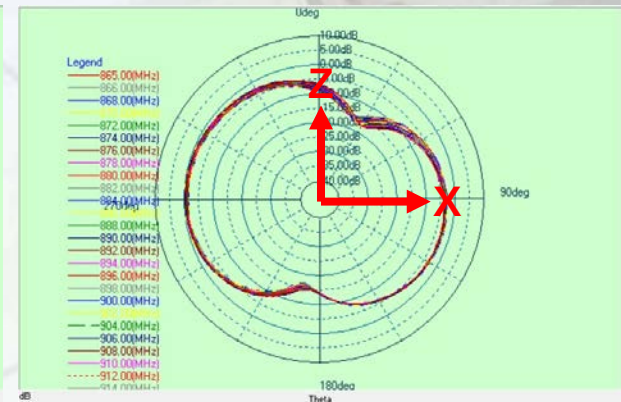
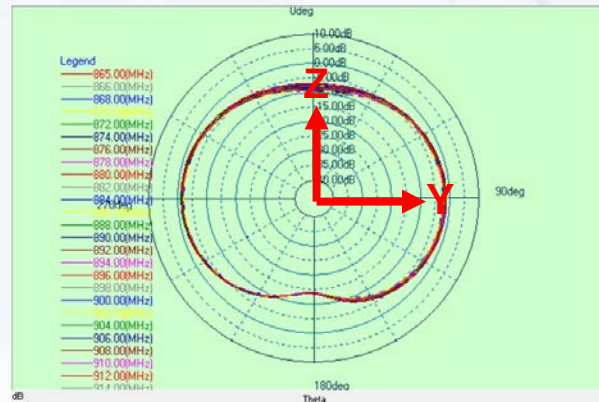
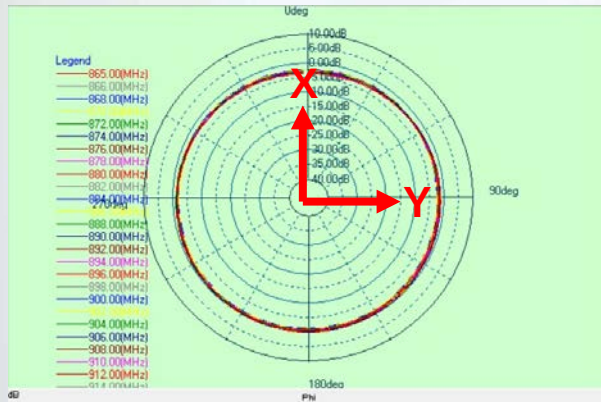
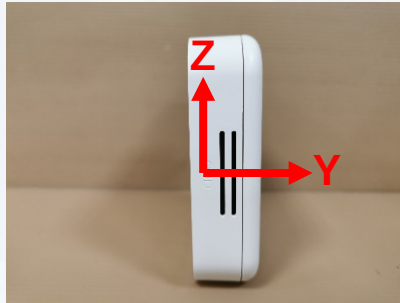
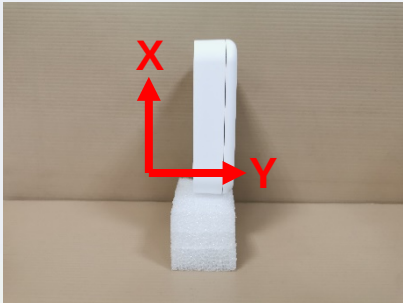
Test Setup for Radiation Pattern Measurement

Device orientation & measurement setup in the chamber



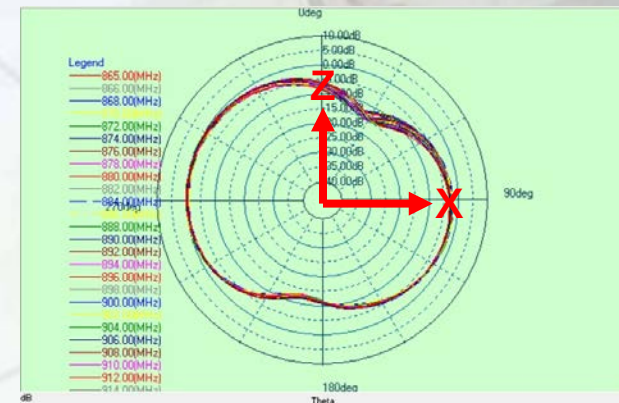
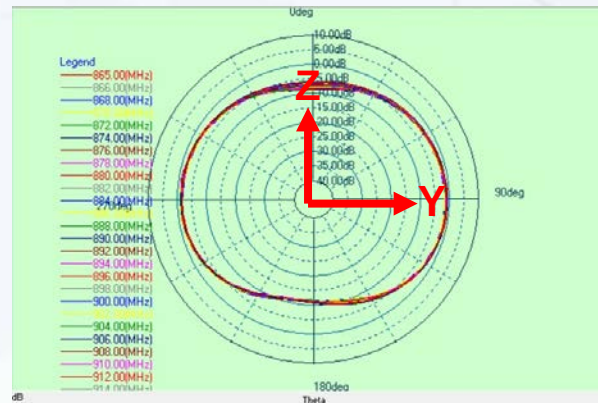
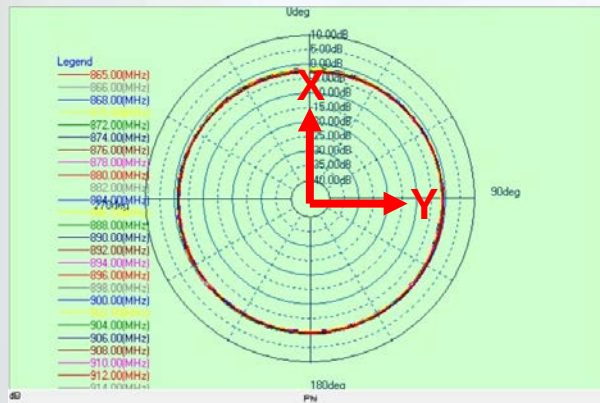
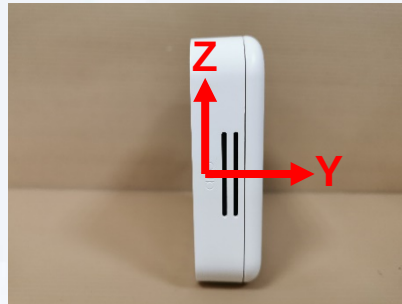
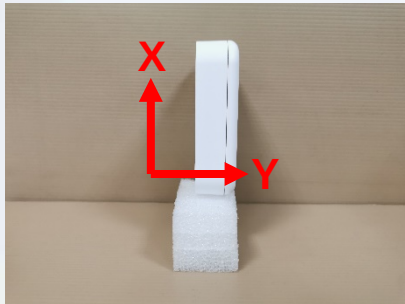
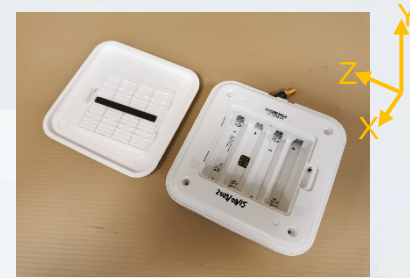
2D Radiation Pattern Results

With Battery-Antenna



2D Radiation Pattern Results

Without Battery-Antenna



Results Summary

Return Loss

Frequency (MHz)	With Battery -Antenna (dB)	Without Battery -Antenna (dB)
865	10.1	11.5
902	24.2	19.7
928	10.0	10.2

Results Summary

Frequency (MHz)	Peak Gain (dBi)	
	With Battery	Without Battery
865	-1.38	-0.87
866	-1.36	-0.86
868	-1.37	-0.88
870	-1.29	-0.81
872	-1.09	-0.61
874	-0.93	-0.43
876	-0.90	-0.40
878	-0.91	-0.40
880	-0.77	-0.27
882	-0.51	0.06
884	-0.34	0.22
886	-0.40	0.09
888	-0.52	0.06
890	-0.44	0.10
892	-0.29	0.21
894	-0.29	0.20
896	-0.45	0.04

Frequency (MHz)	Peak Gain (dBi)	
	With Battery	Without Battery
898	-0.51	-0.02
900	-0.36	0.11
902	-0.16	0.28
904	-0.23	0.21
906	-0.43	0.00
908	-0.51	-0.08
910	-0.38	0.04
912	-0.29	0.12
914	-0.38	0.02
916	-0.54	-0.16
918	-0.57	-0.20
920	-0.45	-0.08
922	-0.38	-0.03
924	-0.55	-0.20
926	-0.78	-0.43
928	-0.81	-0.47

Results Summary

Frequency (MHz)	Efficiency (%)	
	With Battery	Without Battery
865	41	48
866	41	48
868	40	48
870	41	48
872	43	50
874	44	52
876	44	51
878	44	51
880	45	52
882	48	55
884	50	57
886	49	56
888	48	54
890	49	55
892	50	56
894	50	56
896	48	54

Frequency (MHz)	Efficiency (%)	
	With Battery	Without Battery
898	48	53
900	50	55
902	52	57
904	51	57
906	49	54
908	48	53
910	50	55
912	50	56
914	49	54
916	47	52
918	47	52
920	48	53
922	49	54
924	47	52
926	45	49
928	45	49

Conclusion

- The report exhibits the antenna performance:
 - Return Loss: $> 6\text{dB}$ @ 865MHz – 928MHz, both with & without battery conditions.
 - Realized efficiency: $\geq 40\%$ @ 865MHz – 928MHz , both with & without battery conditions.
 - Peak Realized Gain is about -1.4dBi to 0.3dBi @ 865MHz – 928MHz , both with & without battery conditions.