

Junior Antenna Design Engineer Exam




Exam 2. Hands-on Antenna Design

Section 1: Exam equipment and rules

Section 2: Exam grading information

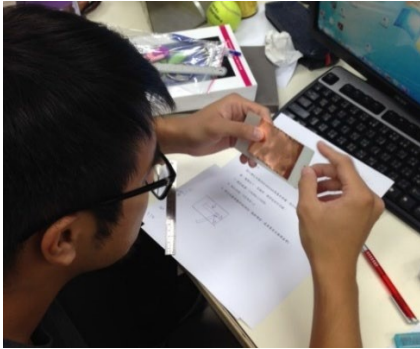
Section 1. Exam equipment and rules

1. Exam site layout and equipment required

Exam site layout	VNA	Antenna design component package
	 <p>The individual exam sites should have SMA connectors and Polystyrene ready</p>	 <p>Provided by exam host organization</p>

*Antenna design component package include: utility knife, steel ruler, soldering iron, soldering station, tweezers, SMA female connector, copper tape, solder, dielectric board (FR4 board, 50x70x1.6mm, dielectric constant 4.3)

1. Exam procedure



a. Tape copper to the board



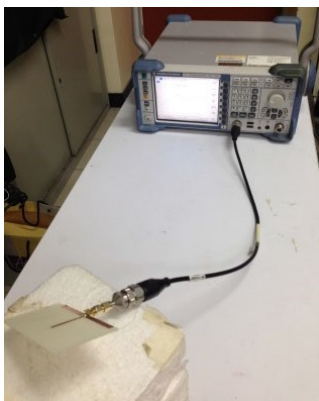
b. tailor the copper to desired dimensions



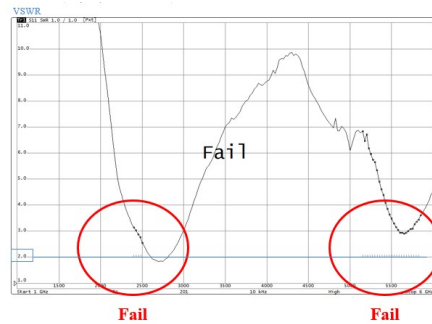
c. solder



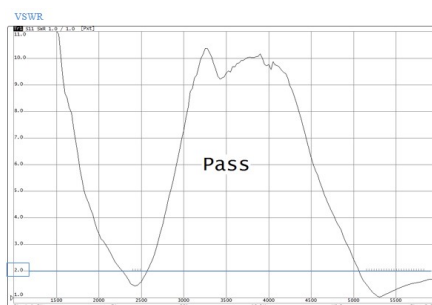
d. design antenna



e. test antenna





Pass



Fail

1. Exam rules

1. The correct way to test antenna:

Correct way to test antenna	What's not allowed
<p>If during the antenna test, the result is oscillating between pass and fail, the supervisor should make sure the examinee's hands are not close to the antenna so that they don't affect antenna measurements. Also, it is acceptable to adjust the pass threshold based on the environment.</p> 	<p>It is not allowed for the examinee to adjust antenna design while the antenna is under test.</p> 

Section 2: Exam grading information

1. Example exam procedure recording:

<https://youtu.be/sXztL2A6bM0>

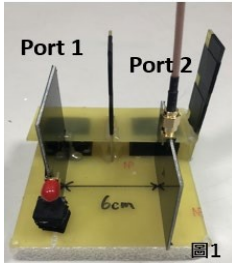
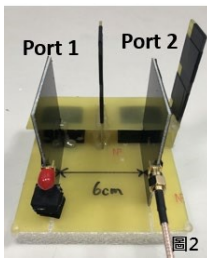
【Hands-on exam information】

The grade consists of two parts :

- The first part is hands-on antenna design (VSWR and S21, this is 50% of the total grade)

Examinee should use the component package to design an antenna for WIFI.

Please note that the copper cannot go out of the boundary of the dielectric board, or the grade will be zero.

Tests	explanation	
VSWR (40 points)	rules	<ul style="list-style-type: none"> ● The examinee can only test the VSWR three times with the VNA. ● The last VSWR measurement will be used for grading
	Grading information	<ul style="list-style-type: none"> ● VSWR grading information is under (Appendix P6 - P8). There are three possible grades for this: 0, 20 or 40 points.
<p>For the ones who get 40 points on VSWR, please test S21 directly without adjustments in the antenna design</p>		
(10 points)	Testing instructions	<ul style="list-style-type: none"> ● This testing is only for the ones who get 40 points on VSWR. ● Every exam site should prepare the setup for S21 as shown in the pictures before the exam ● The examinee should connect designed antenna to port 2 without changing the setup for antenna standard which is on port1. The examinee can either put the antenna parallel to ground or perpendicular to <div style="display: flex; justify-content: space-around; align-items: center;">   </div>

		<p>ground. The antenna has to be at least 6 cm from the Port 1 antenna.</p> <ul style="list-style-type: none"> ● This test passes if the antenna S21 is within tolerance either being parallel to ground or perpendicular to ground
	Grading information	<ul style="list-style-type: none"> ● If the test result S21 is at most 4 dB lower than threshold for 2.4-2.5GHz range and is at most 5 dB lower than threshold for 5.15-5.85GHz range, the antenna passes this test. ● S21 grading information is detailed in <Appendix P.9 - P.10>. The grade would be 10 points for a pass and 0 for a fail.

Please note : Please bring the exam paper with the antenna to do the testing. During the testing, the examinee's hands should be away from the antenna to avoid affecting antenna performance. The examinee is not allowed to write down the test result. If the antenna design needs to be adjusted, the examinee must go back to his seat to do so. It is not allowed to adjust antenna design at the test station

- Section 2 is written exam, please write the answer on this exam paper.

2. Written exam grading example :

Example question : Please explain in detail the design theory, building process and expected performance of XX type antenna. The requirements are : Frequency ranges : 2.4GHz-2.5GHz, 5.15GHz-5.85GHz; impedance match : $VSWR \leq 2$

The board material dimensions: FR4 board, 50mm*70mm*1.6mm, dielectric constant 4.3.

※Important: 1: Every examinee can only test VSWR three times, if one gets 40 points for VSWR, then he can test

S21. He gets 10 points for S21 if the antenna passes performance test being either parallel to ground or perpendicular to ground.

※Important: 2: The final grade is the grade from the LAST TEST.

【Situation 1】 : Steve’s antenna got 20 points for VSWR in his test number ○1. Because he did not get 40 points for VSWR, he cannot do the S21 test. Steve then adjusted his antenna design and in his test number ○2 he got 40 points for VSWR but he did not pass S21. After some work, he decided to test it again. However, in his test number ○3 he got 20 points for VSWR again. In this situation, Steve’s final grade would be 20 points for VSWR and 0 point for S21.

	○1	○2	○3
Test number			
VSWR grade (40 points)	20	40	20
S21 grade (10 points)	x	0	x

【Situation 2】 : If in the above situation, after Steve’s test number ○2 , he decided not to do test number 3, then Steve’s final grade would be 40points for VSWR and 0 point for S21.

	○1	○2	○3
Test number			
VSWR grade (40 points)	20	40	-

S21 grade (10 points)	x	0	-
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✘ Expected answer for the written exam :

1. This exam requires a design of xx type antenna, so theoretically the antenna length has to be xx mm. The math for this calculation is xx, ...
2. The actual antenna length is xx mm, and the reason why this length is different from theoretical is because ...
3. In the process of building this antenna, xx problem exists. The reason for this problem is probably xx, so in the process, xx method is used to overcome this problem, ...
4. The test result of the antenna is expected (or unexpected), the reason is ...
5. The test result shows the antenna's center frequency is xx, bandwidth is xx. It is expected (or unexpected), the reason is ...
6. The antenna's radiation properties are expected to be xx, ...
7. Explains the antenna theory, the building process or any other relevant topics.
8. It is allowed to attach the antenna's layout, dimensions and tested VSWR curve.

9. Describe why S21 is an important measure for antenna design.
10. Other observations.

<Appendix: Grading information>

Section 1 : Antenna Design(VSWR)

Required frequency ranges : 2.4GHz-2.5GHz 、 5.15GHz-5.85GHz
Grading information

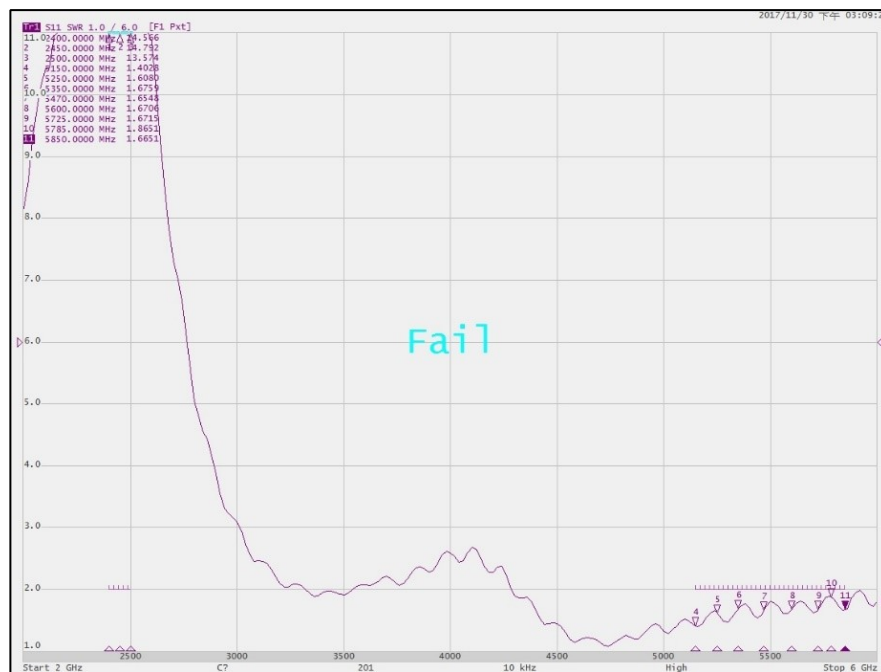
「0 point」

1. The VSWR is worse than 2 among both frequency ranges
2. Only achieves impedance match within a narrow band
3. Within the two frequency ranges, antenna only achieves impedance match partially (dual band but each band is too narrow)

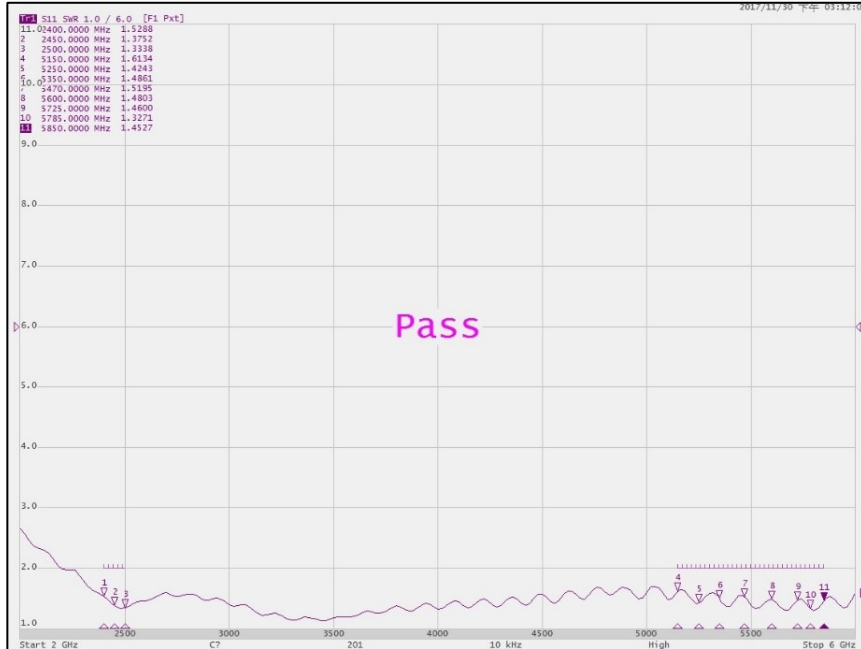


20 points

1. Only achieves broad band within one of the two frequency ranges

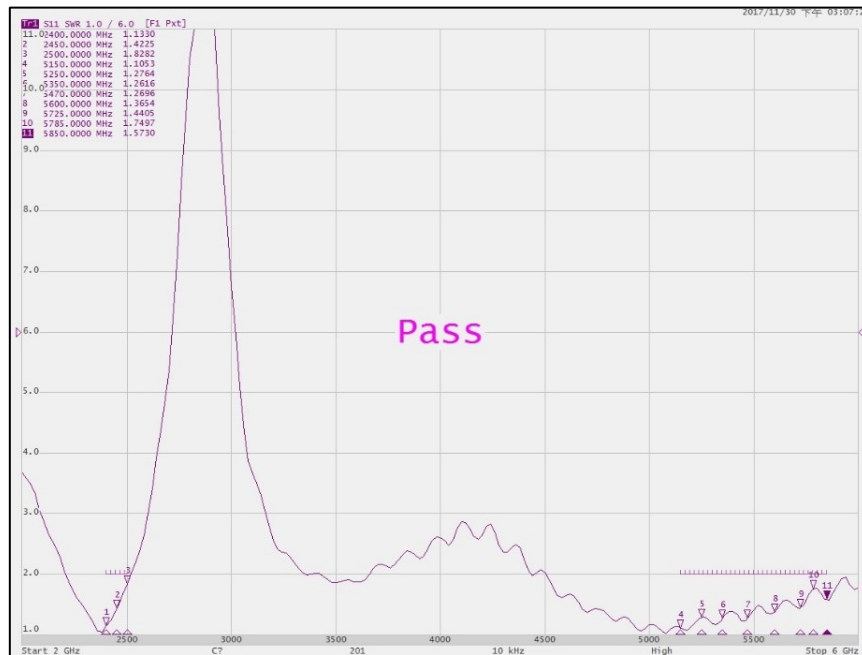


3. Among the two frequency ranges shown above, the VSWR is less than 2 and also the antenna shows broad band characteristics.



「40 points」

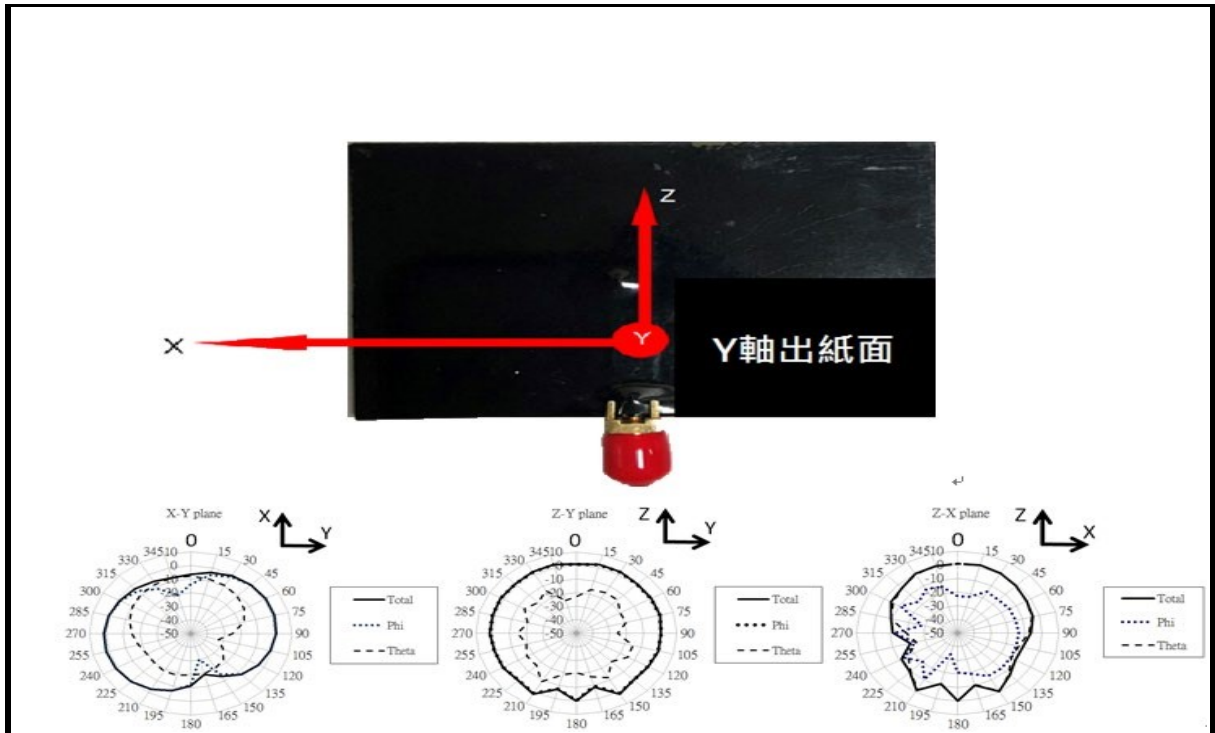
Among the two frequency ranges shown above, the antenna achieves impedance match and shows dual band characteristics.



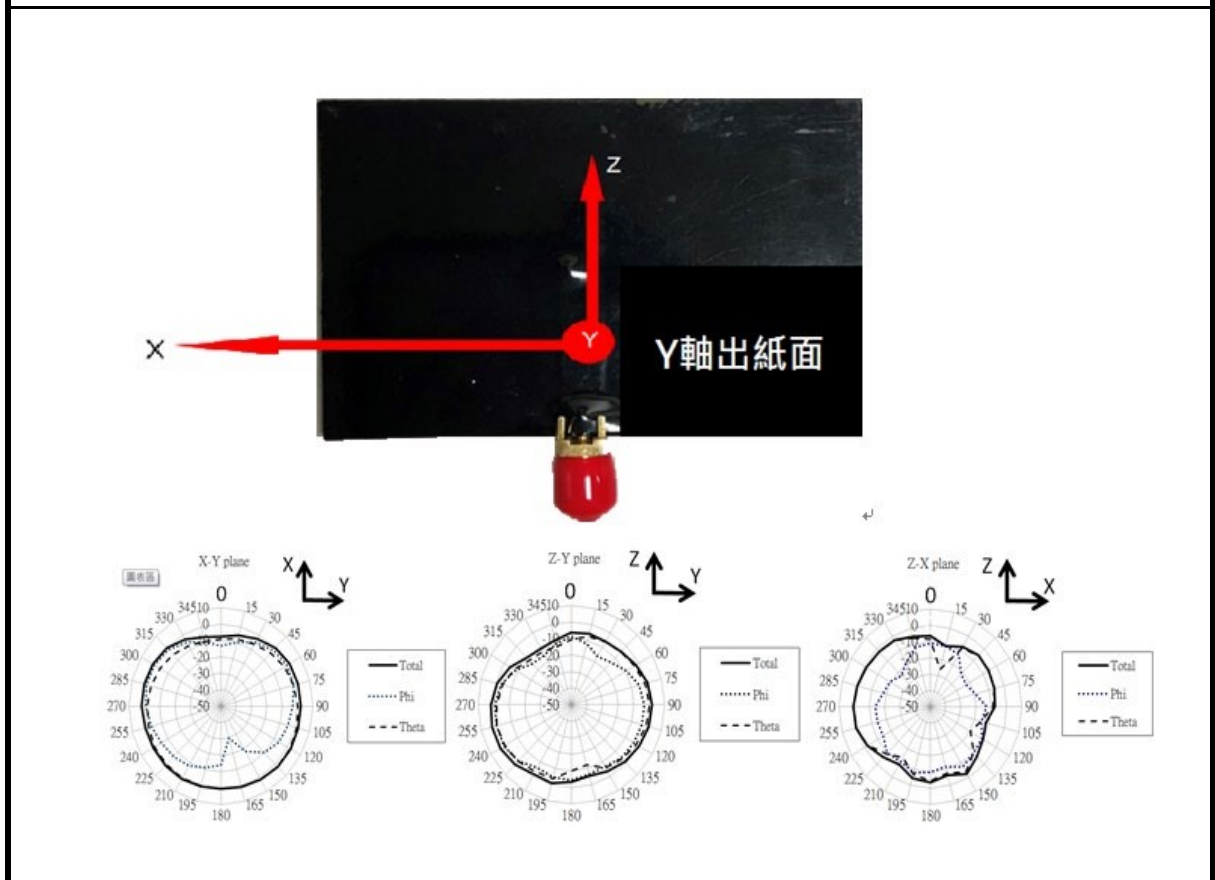
Section 1: antenna design (S_{21})

Standard radiation pattern at 2.45GHz (2450MHz)

(y axis goes out of page)



The standard radiation pattern at 5.5GHz (5500MHz)
(y axis goes out of page)

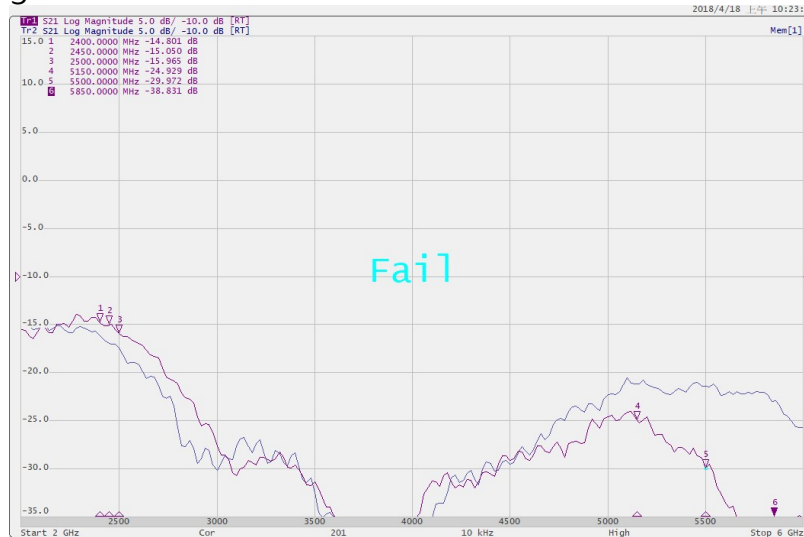


requirements : 2.4GHz-2.5GHz、5.15GHz-5.85GHz

Grading information

「0 point」

1. Within the two frequency ranges shown above, the impedance is always matched and can show dual band characteristics.
2. The examinee gets 0 point if either the antenna performance goes 4 dB lower than standard in 2.4 -2.5 GHz range, or the antenna performance goes 5 dB lower than the standard in 5.15 – 5.85GHz range.



「10 points」

1. Within the two frequency ranges shown above, the impedance is always matched and can show dual band characteristics.
2. If in 2.4 -2.5 GHz range, the antenna performance does not go 4 dB lower than the standard and in 5.15 – 5.85GHz the performance does not go 5 dB lower than the standard, it is considered pass and the examinee gets 10 points.

