# LYNwave Technology

Antenna & Thermal solution provider

# **Antenna Test Report**

| Project Name: | <b>EW-7822UNX</b> |
|---------------|-------------------|
| Model Name:   |                   |
| Feature:      | Wifi Dual Band    |
| Application:  | Dongle            |

| Date  | Owner | Revision   |
|-------|-------|--|
| 01/17 | Alex  | 1. Antenna passive measurement with V1 mockup                    |
| 02/07 | Zino  | 1. Antenna passive measurement with V1 mockup (new thermal sol.) |
| 05/04 | Zino  | 1. Antenna passive measurement with V2 mockup (without heatsink) |
| 06/23 | Zino  | 1. Antenna passive measurement with T2 mockup                    |
| 07/06 | Zino  | 1. Add USB GND   |
| 07/18 | Zino  | 1. Antenna passive measurement with T3 mockup (Grounding USB)    |
|       |       |  |
|       |       |  |
|       |       |  |
|       |       |  |
|       |       |  |
|       |       |  |
|       |       |  |
|       |       |  |
|       |       |  |
|       |       |  |

#### **Table of Contents**

- A. Antenna RF Characteristics
  - 1. Antenna Placement
  - 2. Equipment List
  - 3. Test architecture
  - 4. Conversion from S21 to antenna gain dBi performed step
  - 5. S-Parameters
  - 6. Gain Table
  - 7. 2D/ 3D Radiation Pattern
  - 8. Summary

#### **Antenna Placement**

| Antenna | Description | Frequency                                 |
|---------|-------------|---|
| Ant.1   | 2.4/5G      | 2400 MHz ~ 2500 MHz / 5150 MHz ~ 5825 MHz |
| Ant.2   | 2.4/5G      | 2400 MHz ~ 2500 MHz / 5150 MHz ~ 5825 MHz |
|         |             |   |
|         |             |   |
|         |             |   |
|         |             |   |
|         |             |   |
|         |             |   |



# S-parameter Measurement Equipment



| Equipment        | Brand    | Model  | Calibration Date |
|------------------|----------|--------|------------------|
| Network analyzer | Keysight | M9010A | 2022/07/04       |

# Passive Equipment List :

| Antenna Chamber  | MFC-2531(1.4x1.4x2.8m) |
|------------------|------------------------|
| Test software    | Passive 2D/3D川升        |
| Network analyzer | Agilent E5071B         |
| Controller       | MF7802                 |
| Calibration time | 2022/07/04             |

# Antenna Chamber



# Network analyzer and Controller :



#### **Test architecture :**



#### **Test System Calibration**



We will use a standard antenna which have bean verified and whose accurate gain table is available to carry out the chamber calibration.

The standard antenna will be re-measured by the chamber. The difference between the measured gain values and its verified gain table will be compensated to the measurement system.

# Conversion from S21 to antenna gain dBi performed step



Path Loss 1

Step :

1.Calculate Total Loss: Total Loss= Path Loss 1 + Path Loss 2 + Space Loss + Horn Gain 2.Measurement Value S21 By Chamber

3.Measurement Value S21- Standard Antenna Gain = Total Loss =

Compensation (Path Loss)

4. Measurement Value S21 = Standard Antenna Gain + Total Loss

# Confirmation before calibration list and step

| Check | List   |
|-------|--|
|       | Remove the 3dB attenuator from the DUT's cable           |
|       | No other metal substances in the measurement environment |
|       | No extension cable taped on Phi axis                     |
|       | Align the DUT to the laser line center                   |
|       | Prepare ETS or Bwant Dipole Fixture                      |
|       | Crossline laser  |
|       | VNA, Turn Table, Switch on and confirm in NIMAX          |
|       | Passive Software   |

The measured value of the same test object might be changed before and after calibration, so it is not recommended to calibrate frequently.





- 1. Set-up the dipole start from low frequency (SD650).
- 2. Rotate 90 degree on Theta axis.

| Antenna Pattern Measur<br>File Prompt   |  |
|---|--|
| Measure Mode<br>Frequency Range<br>Correction<br>Instrument<br>VNA<br>Switch<br>Rotator | Rotator Address            ¥ COM34          Rotator Move Test         Theta         Phi         Speed         12         Speed         Angle         Move         Move         Home         Current Location         Theta         Phi |
|   | ▲ Apply ③ RUN  |

- Choose "Calibration Vertical Polarization".
- Or choose "Calibration Horizontal Polarization" if you need a horizontal one.

| File | Prompt  |  |
|------|---|--|
| Ð    | Measure Mode<br>Frequency Range<br>Correction<br>Instrument<br>VNA<br>Switch<br>Rotator | <ul> <li>Two Axis Double Polarization</li> <li>Two Axis Horizontal Polarization</li> <li>Two Axis Vertical Polarization</li> <li>Single Theta Axis Double Polarization</li> <li>Single Theta Axis Horizontal Polarization</li> <li>Single Theta Axis Vertical Polarization</li> <li>Single Phi Axis Double Polarization</li> <li>Single Phi Axis Horizontal Polarization</li> <li>Single Phi Axis Horizontal Polarization</li> </ul> |
|      | WARNI CO., LO   | Calibration Horizontal Polarization Calibration Vertical Polarization  |

• Cancel all the selection as follow picture.

| A i  | ntenna Pattern Measu            | ure                 |   |
|------|---------------------------------|---------------------|---|
| File | Prompt                          |                     |   |
|      | Measure Mode<br>Frequency Range | -Manual Correction- | Horizontal Polarization Correction File         |
| -    | Correction                      | Horizontal          | Range Loss 1                                    |
| 2    | VNA                             | Freq. (MHz) dB      | C:\Users\user\Desktop\gain\CALH.calh            |
|      | Switch                          |                     | Range Loss 2                                    |
|      | Rotator                         |                     | D:\BWant's Passive\Cal\20190119cal\H\Horizontal |
|      |                                 | T                   | Vert cal Polarization Correction File           |
|      |                                 | Vertical            | Range Loss 1                                    |
|      |                                 | Freq. (MHz) dB      | C:\Users\user\Desktop\gain\CALV.calv            |
|      |                                 |                     | Range Loss 2                                    |
|      |                                 |                     | D:\BWant's Passive\Cal\20190119cal\V\Vertical   |
|      |                                 | 1                   |   |
|      |                                 | Total               | Total Polarzation Correction File               |
|      |                                 | Freq. (MHz) dB      | Range Loss 1                                    |
|      |                                 |                     |   |
|      |                                 |                     | Range Loss 2                                    |
|      |                                 |                     | C:\Calibration Data\dipole 2-6GHz KKK           |
|      |                                 |                     | HISHITA   |
|      |                                 |                     | HX/PJ1/4J                                       |
| 7    | BREAT CO., LT                   | Apply RUN           | Result Pattern Demo                             |
|      |                                 |                     | 2019/1/24 上午 09:10:2                            |

• Set the IF Bandwidth to 100Hz.



- Select the calibration dipole type from Standard KIT.
  - The frequency band is labeled on the dipole (the start & cutoff frequencies and the test points number would be set automatically after selection).

| Antenna Pattern Measur          | 5                                       |         |     | -        |          | ×    |
|---------------------------------|---|---------|-----|----------|----------|------|
| Measure Mode<br>Frequency Range | Frequency List                          |         |     |          |          |      |
| Instrument                      | 4900 MHz  User define                   |         |     |          |          |      |
| - VNA<br>Switch                 | 4910 MHz Frequency Span to List         |         |     |          |          |      |
| Rotator                         | 4920 MHz Start Frequency Stop Frequency |         |     |          |          |      |
|                                 | 4930 MHz 100 MHz 0 6000 MHz 0           |         |     |          |          |      |
|                                 | 4940 MHz Span Freq.                     |         |     |          |          |      |
|                                 | 4950 MHz 5 MHz 🗢 🍱 🍏 🛅                  |         |     |          |          |      |
|                                 | 4960 MHz                                |         |     |          |          |      |
|                                 | 4970 MHz Calibration Function           |         |     |          |          |      |
|                                 | 4980 MHz Standard KIT                   |         |     |          |          |      |
|                                 | 4990 MHz BWant SD5400_#F10 💌            |         |     |          |          |      |
|                                 | 5000 MHz Start Frequency Stop Frequency |         |     |          |          |      |
|                                 | 5010 MHz 4900 MHz 🗘 5900 MHz 🕏          |         |     |          |          |      |
|                                 | 5020 MHz Points                         |         |     |          |          |      |
|                                 | 5030 MHz U 1001 😌 🗹 Calibration         |         |     |          |          |      |
|                                 |   |         |     |          |          |      |
|                                 |   |         |     |          |          |      |
| BWant Co., Ltd                  |   |         |     | Measure  | Time: 00 | 26:3 |
| - Manr                          | Z Apply 🛃 RUN 🚪 📕 🚺 Result 💐 F          | Pattern | emo | 2019/5/2 | 9下午05    | 39.  |

- 1. Click on "Apply".
- 2. Click on "Run" and start the testing.

| A 👘  | ntenna Pattern Measur           |   |              | -         |          | ×      |
|------|---------------------------------|---|--------------|-----------|----------|--------|
| File | Prompt                          |   |              |           |          |        |
| F    | Measure Mode<br>Frequency Range | - Frequency List Select Frequency List  |              |           |          |        |
| 8    | Instrument                      | 4900 MHz 🔿 User define 💌                |              |           |          |        |
|      | VNA                             | 4910 MHz Frequency Span to List         |              |           |          |        |
|      | Rotator                         | 4920 MHz Start Frequency Stop Frequency |              |           |          |        |
|      |                                 | 4930 MHz 100 MHz 0 6000 MHz 0           |              |           |          |        |
|      |                                 | 4940 MHz Span Freq.                     |              |           |          |        |
|      |                                 | 4950 MHz 5 MHz 🗘 🏣 🏅 🛅                  |              |           |          |        |
|      |                                 | 4960 MHz                                |              |           |          |        |
|      |                                 | 4970 MHz Calibration Function           |              |           |          |        |
|      |                                 | 4980 MHz                                |              |           |          |        |
|      |                                 | 4990 MHz BWant SD5400_#F10 •            |              |           |          |        |
|      |                                 | 5000 MHz Start Frequency Stop Frequency |              |           |          |        |
|      |                                 | 5010 MHz 4900 MHz 🖨 5900 MHz 🖨          |              |           |          |        |
|      |                                 | 5020 MHz Points                         |              |           |          |        |
|      |                                 | 5030 MHz U 1001 Calibration             |              |           |          |        |
|      |                                 |   |              |           |          |        |
|      |                                 | 2                                       |              |           |          |        |
|      | BWant Co., Ltd                  |   |              | Measure   | Time: 00 | 26:3   |
| -    | Manr                            | Apply RUN F Result                      | Pattern Demo | 2019/5/29 | 9下午05    | 5:39:0 |

- 1. Confirm there is testing value in "Meas Data" field.
- 2. Click on "Offset Calculate".
- 3. Click on "Save CSV".

| Freq. (MHz) | Calls I dp |           |    |              |         |         |   |   |
|-------------|------------|-----------|----|--------------|---------|---------|---|---|
|             | Gain [dB   | Efficienc |    | Horizonta    |         |         | ^ |   |
| 600.000     | 1.610      | -0.570    |    | Freq.(MH:    | Gain    | phas    |   |   |
| 601.000     | 1.580      | -0.600    |    | 600.000      | -27.507 | -27.507 | 8 |   |
| 602.000     | 1.570      | -0.630    | 21 | 601.000      | -27.483 | -27.483 |   |   |
| 603.000     | 1.550      | -0.655    |    | 602.000      | -27.514 | -27.514 |   |   |
| 604.000     | 1.540      | -0.685    |    | 603.000      | -27.643 | -27.643 |   |   |
| 605.000     | 1.520      | -0.716    |    | 604.000      | -27.426 | -27.426 |   |   |
| 606.000     | 1.500      | -0.742    |    | 605.000      | -27.644 | -27.644 |   |   |
| 607.000     | 1.480      | -0.768    |    | 606.000      | -27.400 | -27.400 |   |   |
| 608.000     | 1.470      | -0.794    |    | 607.000      | -27.528 | -27.528 |   |   |
| 609.000     | 1.440      | -0.825    |    | 608.000      | -27.626 | -27.626 |   |   |
| 610.000     | 1.420      | -0.867    |    | 609.000      | -27.627 | -27.627 |   |   |
| 611.000     | 1.400      | -0.894    |    | 610.000      | -27.701 | -27.701 |   |   |
| 612.000     | 1.370      | -0.926    |    | 611.000      | -27.688 | -27.688 |   |   |
| 613.000     | 1.350      | -0.953    |    | 612.000      | -27.449 | -27.449 |   |   |
| 614.000     | 1.310      | -0.996    |    | 613.000      | -27.709 | -27.709 |   |   |
| 615.000     | 1.280      | -1.024    |    | 614.000      | -27.608 | -27.608 |   |   |
| s16.000     | 1 240      | -1.062    | *  | 615.000<br>< | -27.647 | -27.647 |   | 4 |

- Save the testing file according by each dipole test band and polarization.
  - Ex Vertical Polarization SD650
  - Place the Cal->V Folder and named it as "SD650\_V"

| · → • ↑ | 📙 > 本機 > Data | (D:) > BWant's Passive > Ca | al .  | 5 v     | 搜尋 Cal |   |   | ۶ |
|---------|---------------|-----------------------------|-------|---------|--------|---|---|---|
|         |               |                             |       | 1 🗳 - 🔏 | n ť    | X | ~ |   |
| 马稱      | ^             | 修改日期                        | 類型    | 大小      |        |   |   |   |
| н       |               | 2019/5/29下午 0               | 檔案資料夾 |         |        |   |   |   |
| V       |               | 2019/5/29下午 0               | 檔案資料夾 |         | 1      |   |   |   |

- Repeat all the 11pcs antenna as right table to complete the full band frequency according the steps from Page 5~12.
- Click on "Files Combine", select the "Folder V" and all frequency band file would be generated.
  - Ex. Vertical Polarization 600-5900 MHzPath Loss.csv

|  | Vertical<br>Confirmatio<br>n | Dipole<br>Name |
|--|------------------------------|----------------|
|  |                              | SD650          |
|  |                              | SD740          |
|  |                              | SD900          |
| Source Table Meas Data Result Data   |                              | SD1150         |
| Freq. (MHz)         Gain [dB]         Efficient         A         Honzonta         A           600.000         1.610         -0.570         Freq. (MH: Gain phas         Freq. (MH: Gain phas <td< td=""><td></td><td>SD1575</td></td<> |                              | SD1575         |
| 602.000         1.570         -0.630         601.000         -27.463         -27.463         601.000         -29.083         -27.483           603.000         1.550         -0.655         602.000         -27.514         602.000         -29.084         -27.514           604.000         1.540         -0.685         603.000         -27.643         603.000         -29.193         -27.643           604.000         -29.064         -27.214         -27.264         -27.242         603.000         -29.193         -27.643   |                              | SD1800         |
| 605.000         1.520         -0.716         604.000         -27.420         604.000         -28.900         -27.420           606.000         1.500         -0.742         605.000         -27.644         605.000         -29.164         -27.644           607.000         1.480         -0.768         606.000         -27.400         606.000         -28.900         -27.400           607.000         -0.768         607.000         -27.328         -27.528         607.000         -28.900         -27.400  |                              | SD2140         |
| 608.000         1.470         -0./94         607.000         -27.526         27.526         607.000         -29.096         -27.626           609.000         1.440         -0.825         608.000         -27.626         608.000         -29.096         -27.626           610.000         1.420         -0.867         609.000         -27.627         609.000         -29.067         -27.627           610.000         1.420         -0.867         609.000         -27.627         610.000         -29.067         -27.627           610.000         -29.027         -27.701         -27.701         -27.21         -27.701  |                              | SD2450         |
| 611.000         1.400         -0.894         610.000         -27.701         610.000         -29.101         27.701           612.000         1.370         -0.926         611.000         -27.688         611.000         -29.088         -27.688           613.000         1.350         -0.953         612.000         -27.449         612.000         -28.819         -27.449  |                              | SD3200         |
| 614.000         1.310         -0.996         613.000         -27.709         613.000         -29.099         -27.709           615.000         1.280         -1.024         614.000         -27.608         -27.608         614.000         -28.918         -27.608           616.000         1.240         -1.062         T         615.000         -27.647         *         615.000         -28.927         -27.647         *   |                              | SD3600         |
| BWant Dead Toffset By Coffset By Coffset I Save Clear Make   |                              | SD5400         |
| SD0650.csv Meas Gain Gain Cabulate Cabulate Cal File Cal File  |                              |                |

1. Align the dipole feeding point to laser line.





- Repeat all the 11pcs antenna as right table to complete the full band frequency according the steps from Page 5~12.
- Click on "Files Combine", select the "Folder H" and all frequency band file would be generated.
  - Ex. Horizontal Polarization 600-5900 MHzPath Loss.csv

|   |                             |   | Hor<br>Conf | izontal Dipole<br>irmatio Name<br>n |
|---|-----------------------------|---|-------------|-------------------------------------|
|   |                             |   |             | SD650                               |
|   |                             |   |             | SD740                               |
| a Create Calibration File                                   |                             |   | ×           | SD900                               |
| Source Table  | as Data                     | Result Data                               |             |                                     |
| Freq. (MHz) Gain [dB Efficient<br>600.000 1.610 -0.570 Free | rizonta<br>q.(MH: Gain phas | Horizonta<br>Freq.(MH: Gain Phas          |             | SD1150                              |
| 601.000 1.580 -0.600 600                                    | .000 -27.507 -27.507 =      | 600.000 -29.117 -27.507                   | e           |                                     |
| 602.000 1.570 -0.630 - 601                                  | .000 -27.483 -27.483        | 601.000 -29.063 -27.483                   |             | SD1575                              |
| 603.000 1.550 -0.655 602                                    | .000 -27.514 -27.514        | 602.000 -29.084 -27.514                   |             | 515                                 |
| 604.000 1.540 -0.685 603                                    | .000 -27.643 -27.643        | 603.000 -29.193 -27.643                   |             |                                     |
| 605.000 1.520 -0.716 604                                    | .000 -27.426 -27.426        | 604.000 -28.966 -27.426                   |             | SD1800                              |
| 606.000 1.500 -0.742 605                                    | .000 -27.644 -27.644        | 605.000 -29.164 -27.644                   |             |                                     |
| 607.000 1.480 -0.768 606                                    | 000 -27.400 -27.400         | 606.000 -28.900 -27.400                   |             | SD2140                              |
| 608.000 1.470 -0.794 607                                    | .000 -27.528 -27.528        | 602.000 -29.008 -27.528                   |             | 3D2140                              |
| 609.000 1.440 -0.825 606                                    | 000 -27.627 -27.620         | 609.000 -29.090 -27.020                   |             |                                     |
| 610.000 1.420 -0.867 610                                    | 000 -27.701 -27.701         | 610,000 -29,121 -27,701                   |             | SD2450                              |
| 611,000 1.400 -0.894 611                                    | 000 -27 688 -27 688         | 611 000 -29 088 -27 688                   |             | 5524750                             |
| 612,000 1.370 -0.926 612                                    | 000 -27.449 -27.449         | 612,000 -28,819 -27,449                   |             |                                     |
| 614,000 1,210 0,006 613                                     | 000 -27.709 -27.709         | 613.000 -29.059 -27.709                   |             | SD3200                              |
| 615,000 1,280 -1,024 614                                    | .000 -27.608 -27.608        | 614.000 -28.918 -27.608                   |             | 2                                   |
|   | .000 -27.647 -27.647 +      | 615.000 -28.927 -27.647<br><              |             | SD3600                              |
| BWant SD0650.csv Control Meas Gain                          | y Offset Save Save          | Clear Make Files<br>able Cal File Combine | -1          | SD5400                              |

• Change the "IF Bandwidth" value back to 500Hz.



#### 1. Set-up the dipole start from low frequency (SD650) as Page 14.



- Select "Two Axis Double Polarization " on Measure Mode Page.
- Set the angle of Theta and Phi to 30 degree.



- Delete "Frequency List".
- Insert the current dipole "start & cutoff frequencies".
- Insert Span Freq.
  - SD650 

     SD740: 1MHz
  - SD900 \land SD1575 \land SD5400: 5MHz
    - Other Dipole : 10MHz
- Add "Frequency List".
- Apply.
- Run.



- Select and check the calibration files that generated on Page 13 & Page 15.
- 2. Click on "ReCorrect".
- Apply .calh file in "Range Loss1"
- Apply .csv file in "Range Loss2"



- If any efficiency value >100%, please refer to the next page to correct.
- Efficiency value <100%, then calibration is done.

|   | Prompt                          |            |           |            |             |            |            |          |         |          |         |     |
|---|---------------------------------|------------|-----------|------------|-------------|------------|------------|----------|---------|----------|---------|-----|
|   | Measure Mode<br>Frequency Range | Power      | Phase 0   | Coordinate | 1           |            |            |          |         |          |         |     |
| 3 | Correction<br>Instrument        | 5900.000   | -26.599   | -18.255    | 8.344       | -26.599    | 0.219      | -18.255  | -55.637 | 225.000  | 165.000 | 3.4 |
|   | VNA                             | Total Pole |           |            |             |            |            |          |         |          |         |     |
|   | Rotator                         | Frequenc   | Tot. Rad. | Peak EIRF  | Directivity | Efficiency | Efficiency | Gain (dE | Min EIR | Peak Phi | Peak Th | 4   |
|   |                                 | 4900.000   | -0.220    | 1.443      | 1.663       | -0.220     | 95.054     | 1.443    | -22.750 | 15,000   | 60.000  | C   |
|   |                                 | 4905.000   | -0.109    | 1.543      | 1.652       | -0.109     | 97.512     | 1.543    | -22.559 | 15.000   | 60.000  | C   |
|   |                                 | 4910.000   | -0.023    | 1.659      | 1.682       | -0.023     | 99.482     | 1.659    | -23.848 | 15.000   | 60.000  | C   |
|   |                                 | 4915.000   | -0.115    | 1.630      | 1.745       | -0.115     | 97.386     | 1.630    | -23,359 | 15.000   | 60.000  | С   |
|   | 4920.000                        | -0.062     | 1.701     | 1.763      | -0.062      | 98.580     | 1.701      | -23.550  | 45.000  | 60.000   | C       |     |
|   | 4925.000                        | -0.301     | 1.459     | 1.761      | -0.301      | 93.297     | 1.459      | -23.590  | 15.000  | 60.000   | C       |     |
|   | 4930.000                        | -0.335     | 1.397     | 1.732      | -0.335      | 92.571     | 1.397      | -22.497  | 15.000  | 60.000   | C       |     |
|   |                                 | 4935.000   | -0.133    | 1.577      | 1.710       | -0.133     | 96.989     | 1.577    | -21.297 | 15.000   | 60.000  | C   |
|   |                                 | 4940.000   | -0.165    | 1.603      | 1.768       | -0.165     | 96.272     | 1.603    | -21.298 | 15.000   | 60.000  | C   |
|   |                                 | 4945.000   | -0.218    | 1.591      | 1.809       | -0.218     | 95.104     | 1.591    | -20.277 | 330.000  | 60.000  | C   |
|   |                                 | 4950.000   | -0.205    | 1.663      | 1.868       | -0.205     | 95.384     | 1.663    | -19.716 | 15.000   | 60.000  | C   |
|   |                                 | 4955.000   | -0.132    | 1.805      | 1.937       | -0.132     | 97.009     | 1.805    | -18.919 | 15.000   | 60.000  | C   |
|   |                                 | 4960.000   | -0.131    | 1.815      | 1.946       | -0.131     | 97.033     | 1.815    | -18.275 | 15.000   | 60.000  | C   |
|   |                                 | 4965.000   | -0.119    | 1.888      | 2.007       | -0.119     | 97.299     | 1.888    | -19.220 | 15.000   | 60.000  | c   |
|   |                                 | 4970.000   | 0.016     | 2.045      | 2.029       | 0.016      | 100.369    | 2.045    | -18.712 | 45.000   | 60.000  | C   |
|   |                                 | 4975.000   | 0.023     | 2.065      | 2.042       | 0.023      | 100.531    | 2.065    | -19.120 | 15.000   | 60.000  | C   |
|   |                                 | 4980.000   | 0.105     | 2.113      | 2.008       | 0.105      | 102.453    | 2.113    | -18.912 | 15.000   | 60.000  | Cv  |
|   |                                 | <          |           |            | -           |            |            |          |         |          |         | >   |

- If any efficiency value >100%, please refer to the following steps to correct:
  - 1. Backup the Horizontal & Vertical combined files
  - 2. Find the maximum efficiency value, Ex. 0.105

| Measure Mode    | . 1        |           |           |             |            |            |          |         |          |         |     |
|-----------------|------------|-----------|-----------|-------------|------------|------------|----------|---------|----------|---------|-----|
| Frequency Range | Power      | Phase C   | oordinate |             |            |            |          |         |          |         |     |
| Correction      | 5900.000   | -26.599   | -18.255   | 8.344       | -26.599    | 0.219      | -18.255  | -55.637 | 225.000  | 165.000 | 3 . |
| VNA             |            |           |           |             |            |            |          |         |          |         |     |
| Switch          | Total Poli |           |           |             |            |            |          |         |          |         |     |
| Rotator         | Frequenc   | Tot. Rad. | Peak EIRF | Directivity | Efficiency | Efficiency | Gain (dł | Min EIR | Peak Phi | Peak Th | 4   |
|                 | 4900.000   | -0.220    | 1.443     | 1.663       | -0.220     | 95.054     | 1.443    | -22.750 | 15.000   | 60.000  | C   |
|                 | 4905.000   | -0.109    | 1.543     | 1.652       | -0.109     | 97.512     | 1.543    | -22.559 | 15.000   | 60.000  | C   |
|                 | 4910.000   | -0.023    | 1.659     | 1.682       | -0.023     | 99,482     | 1.659    | -23.848 | 15.000   | 60.000  | C   |
|                 | 4915.000   | -0.115    | 1.630     | 1.745       | -0.115     | 97.386     | 1.630    | -23.359 | 15.000   | 60.000  | C   |
|                 | 4920.000   | -0.062    | 1,701     | 1.763       | -0.062     | 98.580     | 1.701    | -23.550 | 45.000   | 60.000  | C   |
|                 | 4925.000   | -0.301    | 1.459     | 1.761       | -0.301     | 93.297     | 1.459    | -23.590 | 15.000   | 60.000  | C   |
|                 | 4930.000   | -0.335    | 1,397     | 1.732       | -0.335     | 92.571     | 1.397    | -22.497 | 15.000   | 60.000  | C   |
|                 | 4935.000   | -0.133    | 1.577     | 1.710       | -0.133     | 96.989     | 1.577    | -21.297 | 15.000   | 60.000  | C   |
|                 | 4940.000   | -0.165    | 1,603     | 1.768       | -0.165     | 96.272     | 1.603    | -21.298 | 15.000   | 60.000  | c   |
|                 | 4945.000   | -0.218    | 1.591     | 1.809       | -0.218     | 95.104     | 1.591    | -20.277 | 330.000  | 60.000  | c   |
|                 | 4950.000   | -0.205    | 1.663     | 1.868       | -0.205     | 95.384     | 1.663    | -19.716 | 15.000   | 60,000  | c L |
|                 | 4955,000   | -0.132    | 1.805     | 1.937       | -0.132     | 97.009     | 1.805    | -18.919 | 15.000   | 60.000  | c P |
|                 | 4960.000   | -0.131    | 1.815     | 1.946       | -0.131     | 97.033     | 1.815    | -18.275 | 15.000   | 60.000  | c   |
|                 | 4965.000   | -0.119    | 1.888     | 2.007       | 0.110      | 97.299     | 1.888    | -19.220 | 15.000   | 60.000  | c   |
|                 | 4970.000   | 0.016     | 2.045     | 2.029       | 0.016      | 100.369    | 2.045    | -18.712 | 45,000   | 60.000  | C   |
|                 | 4975,000   | 0.023     | 2.065     | 2.042       | 0.023      | 100.531    | 2.065    | -19,120 | 15,000   | 60.000  | c   |
|                 | 4980.000   | 0.105     | 2.113     | 2.008       | 0.105      | 102.453    | 2.113    | -18.912 | 15.000   | 60.000  | Cv  |
|                 | <          |           |           |             |            |            |          |         |          |         | >   |
|                 | 1.51       |           |           |             |            |            |          |         |          |         |     |

- 3. Correct the H & V calibration data.
  - Ex. Max: 0.105
  - New Gain=Red Frame + Max + 0.1

| <b>□</b> 5 · ⊂ |           | 5 · c      |             |
|----------------|-----------|------------|-------------|
| 檔案 常用          | 插入 頁面配置   | 檔案 常用      | 插入頁面配置      |
| <sup>™</sup> × | 新細明體 - 12 | <b>*</b> * | 新細明體        |
| 貼上             |           | 贴上 **      | в I Ц - 🖽 - |

|                | 5.0         |              |                               |        | +2 - c*    |            |               | Fx. Of | rigina    | I Fre   | a 600               | G  | ain= -    | 53.38   | 2              |
|----------------|-------------|--------------|-------------------------------|--------|------------|------------|---------------|--------|-----------|---------|---------------------|----|-----------|---------|----------------|
| 横梁             | *用          | 插入<br>新細明體   | 頁面配置 公式 第                     | 2 1813 | 6 常用<br>×  | 插入         | 夏南配置 公式 資料    |        |           | :0 000  |                     | 05 |           | - 52    | 177            |
|                | 10 -        | BIU          | - A A =                       |        | 0 -        | 新細明體       | - 12 -        | new G  | amo       | 03.302  | 2 <del>T</del> U. I | 00 | τ U. I    | 55      | . 177          |
| *<br>*         | *           | 🖽 • 🔑        | - <u>A</u> - #2 - 📧           | - PO.  | *          | BIU        | - E - Q - A - | 2      | Freq.(MH: | Gain    | Phas                | 2  | Freq.(MH: | Gain    | Phas           |
| 剪贴现            | <b>1</b> 15 | 5            | P型 6                          | 1 mi   | RETAIL IS  |            | 字型            | 3      | 600       | -53.177 | 81.172              | 3  | 600       | -53,842 | 82,573         |
| B <sup>3</sup> |             | • 1 ×        | <ul> <li>✓ fx -53.</li> </ul> | A t    | 7          | 1.8        | 🗸 🎜 Vertic    | 4      | б01       | -53.227 | 39.542              | 4  | 601       | -53.92  | 40 992         |
| Н              | A           | В            | C D                           | 1      | A          | B          | C D           | 5      | 602       | -53.282 | -2.081              | 5  | 602       | -53 998 | -0.537         |
| 1 Ho           | rizontal    | Polarization | n                             | 1      | Vertical P | larization |               | 6      | 603       | -53.339 | -43.572             | 6  | 603       | -54 070 | 42.083         |
| 2 Fre          | q.(MH       | Gain 1       | Phas                          | 2 1    | Freq.(MH:  | Gain       | Phas          | 7      | 604       | -53,399 | -84,996             | 7  | 604       | 54.075  | -42.000        |
| 3              | 600         | -53.382      | 81.172                        | 3      | 600        | -54.047    | 82.573        | 8      | 605       | -53 47  | -126 298            | ,  | 004       | -54,105 | -05,303        |
| 4              | 601         | -53,432      | 2.081                         | 4 5    | 602        | -54.125    | 40.992        | 9      | 606       | -53 533 | -167 518            | 8  | 605       | -54.200 | -125.11        |
| 6              | 603         | -53.544      | -43,572                       | 6      | 603        | -54.284    | -42.083       | 10     | 607       | 52 507  | 151 211             | 9  | 606       | -54.357 | -166.611       |
| 7              | 6(4         | -53,604      | -84.996                       | 7      | 604        | -54.368    | -83.585       | -Q     | 607       | -33.397 | 151.511             | 10 | 607       | -54.461 | 151.965        |
| 8              | 605         | -53,675      | -126.298                      | 8      | 605        | -54.471    | -125.11       |        | 608       | -53.649 | 110.324             | 11 | 608       | -54.563 | 110.56         |
| 9              | 606         | -53,738      | -167.518                      | 9      | 606        | -54,562    | -166.611      |        | 609       | -53.691 | 69.311              | 12 | 609       | -54.663 | 69.218         |
| 10             | 607         | -53.802      | 151.311                       | 10     | 607        | -54.666    | 151.965       |        | 610       | -53.724 | 28.323              | 13 | 610       | -54 772 | 27 897         |
| 11             | 000         | -53.654      | 110.324                       | 11     | 608        | -54,768    | 110,56        |        | 611       | -53.735 | -12.64              | 14 | 611       | 54 882  | 13 //0         |
| 12             | 60          | -53,690      | 28 323                        | 12     | 610        | -34.000    | 27.807        | 15     | 612       | -53,742 | -53,618             | 15 | 612       | -04.00Z | -13.449        |
| 14             | 61          | -53.94       | -12.64                        | 14     | 611        | -55.087    | -13.449       | 16     | 613       | -53 743 | -94 539             | 15 | 012       | -54.967 | -54.710        |
| 15             | 62          | -53,947      | -53.618                       | 15     | 612        | -55.192    | -54.716       | 17     | 614       | 53 733  | 135 581             | 16 | 613       | -55.098 | -95.987        |
| 16             | 6.3         | -53,948      | -94.539                       | 16     | 613        | -55.303    | -95.987       | 17     | 615       | -55.755 | -135.501            | 17 | 614       | -55.212 | -137.092       |
| 17             | 6.4         | -53,938      | -135.581                      | 17     | 614        | -55.417    | -137.092      | 18     | 615       | -53.719 | -1/6.539            | 18 | 615       | -55.316 | -178.256       |
| 18             | 6.5         | -53,924      | -176.539                      | 18     | 615        | -55.521    | -178.256      | 19     | 616       | -53.706 | 142.475             | 19 | 616       | -55,443 | 140.706        |
| 19             | 6.6         | -53.911      | 142.475                       | 19     | 616        | -55.648    | 140.705       | 20     | 617       | -53.667 | 101.449             | 20 | 617       | -55 538 | 99 694         |
| 20             | 0./         | -53.872      | 101.449                       | 20     | 619        | -35,743    | 59.004        | 21     | 618       | -53.631 | 60,392              | 21 | 619       | 55 625  | 59 774         |
| 22             | 60          | -33,030      | 10.392                        | 22     | 610        | -55 025    | 17.852        | 22     | 619       | -53,58  | 19.342              | 21 | 010       | -55.055 | 30.774         |
| 23             | 60          | -53,728      | -21 844                       | 23     | 630        | -55,998    | -23.117       | 23     | 620       | 53 523  | -21 844             | 22 | 619       | -55.72  | 17.852         |
| 24             | 61          | -53,658      | -63.059                       | 24     | 621        | -56.062    | -64.064       | 20     | 621       | 52 452  | 63.050              | 23 | 620       | -55.793 | -23.117        |
| 25             | 622         | 53.602       | -104.368                      | 25     | 622        | -56.129    | -105.069      | 24     | 621       | -50.455 | -03.039             | 24 | 621       | -55.857 | -64.064        |
|                | -           | SD650_H      | ÷                             |        | 5          | D650_V     | ۲             | 25     | 622       | -55.597 | -104.368            | 25 | 622       | -55.924 | -105.069<br>23 |

 According to the Page 17~24, keep confirm all the antennas' efficiency value.

| Efficiency Value<br>Confirmation | Dipole<br>Name |
|----------------------------------|----------------|
|                                  | SD650          |
|                                  | SD740          |
|                                  | SD900          |
|                                  | SD1150         |
|                                  | SD1575         |
|                                  | SD1800         |
|                                  | SD2140         |
|                                  | SD2450         |
|                                  | SD3200         |
|                                  | SD3600         |
|                                  | SD5400         |

24

#### **S-Parameters**



#### Equipment : ETS Chamber



#### **Gain Table**

| Ant.1           |       |      |      |      |      |      |  |  |  |  |
|-----------------|-------|------|------|------|------|------|--|--|--|--|
| Frequency (MHz) | 2400  | 2450 | 2500 | 5150 | 5550 | 5825 |  |  |  |  |
| Efficiency(%)   | 31    | 32   | 33   | 42   | 43   | 42   |  |  |  |  |
| Peak Gain(dBi)  | -1.4  | -0.9 | -0.6 | 0.4  | 1.8  | 2.6  |  |  |  |  |
|                 | Ant.2 |      |      |      |      |      |  |  |  |  |
| Frequency (MHz) | 2400  | 2450 | 2500 | 5150 | 5550 | 5825 |  |  |  |  |
| Efficiency(%)   | 33    | 33   | 34   | 41   | 43   | 43   |  |  |  |  |
| Peak Gain(dBi)  | -1.7  | -1.1 | -0.9 | 0.5  | 2.8  | 3.0  |  |  |  |  |

#### The antenna characteristics

- Return loss < -8dB in operating band
- Isolation
  - All Band > 10 dB
- Efficiency
  - WIFI 2.4GHz Band  $\geq$  30%
  - WIFI 5GHz Band  $\geq$  40%
- Gain
  - WIFI 2.4GHz Band -1.7 ~ -0.6dBi
  - WIFI 5GHz Band 0.4 ~ 3.0dBi

#### Ant.1\_ 2D.3D Radiation Pattern Frequency(MHz) : 2D. 2400~2500 3D. 2450

#### Radiation Pattern :



#### Setup :



#### Ant.1\_ 2D.3D Radiation Pattern Frequency(MHz) : 2D. 5150~5825 3D. 5550

#### Radiation Pattern :



#### Setup :



#### Ant.2\_ 2D.3D Radiation Pattern Frequency(MHz) : 2D. 2400~2500 3D. 2450

#### Radiation Pattern :



#### Setup :



#### Ant.2\_ 2D.3D Radiation Pattern Frequency(MHz) : 2D. 5150~5825 3D. 5550

#### Radiation Pattern :

| Azimuth Plane | Elevation Plane<br>phi = 0 | Elevation Plane<br>phi = 90 |
|---------------|----------------------------|-----------------------------|
|               |                            |                             |
|               |                            |                             |

Setup :



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