# REVERSE ENGINEERING CHALLENGE

VRC MIDDLE SCHOOL 2023/2024

# D-Link DIR-605L

## Team 96944X


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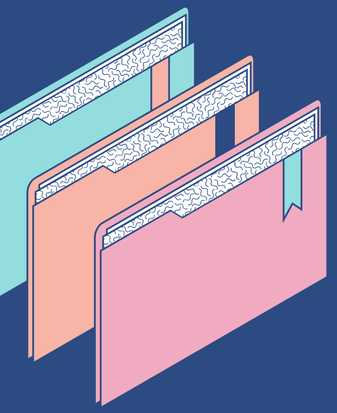
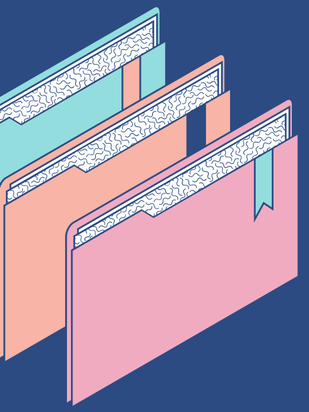






# Why the D-Link DIR-605L ?

In the process of making VEX robots, we constantly need to discuss with team members and consult relevant information, such as competition rules and mechanical structures, all of which are closely related to the internet.

During this process, we began to ponder how a router can provide us with wireless network connectivity through a single network cable, and what its internal structure is. Does the direction and size of the antenna really affect the network signal?

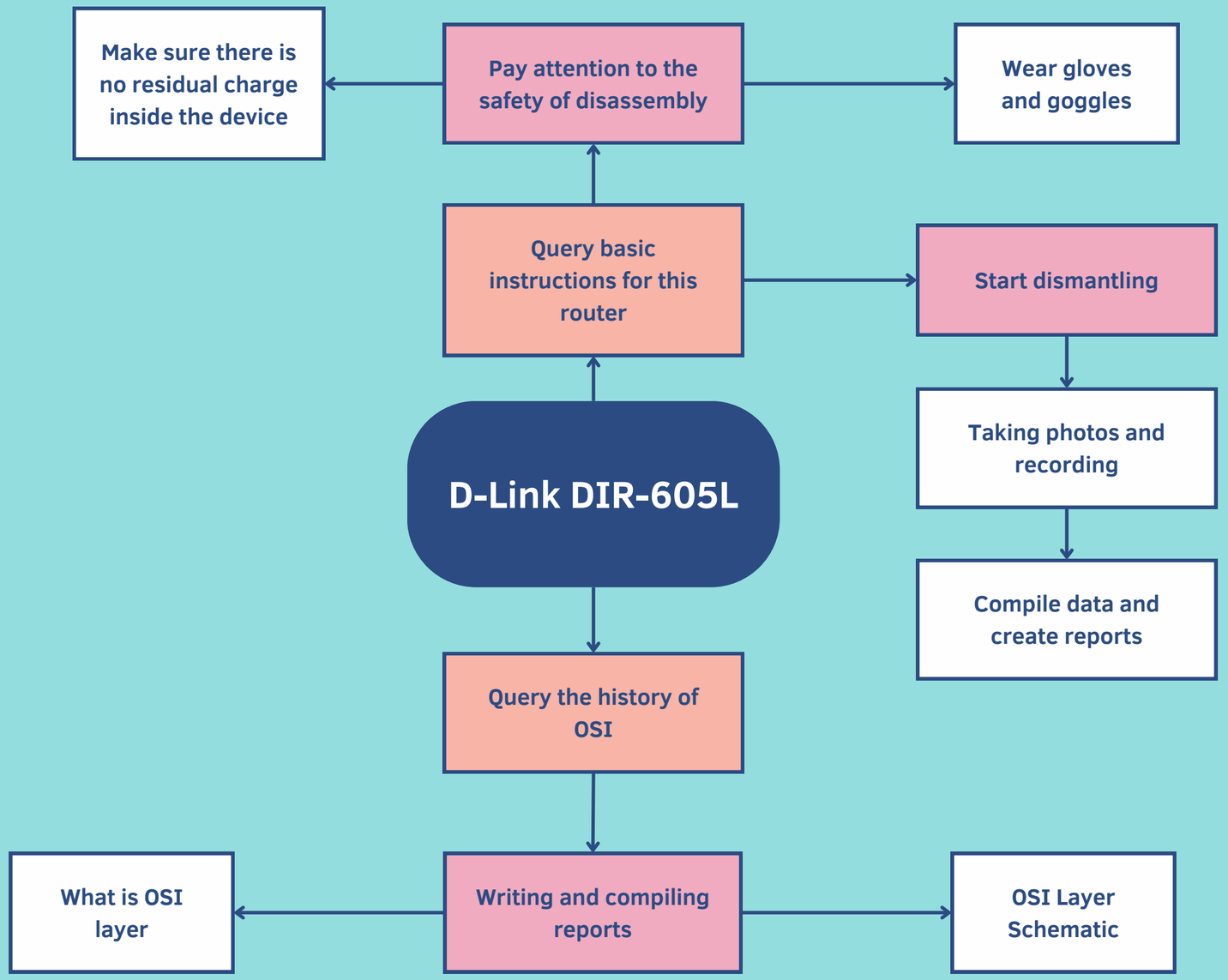
Considering the above questions, we decided to use the D-Link DIR-650L as our research project. We disassemble it and try to understand its principles and architecture, so that we not only know how to use the network, but also learn to understand the knowledge and principles behind it.


D-Link DIR-605L
Front view

D-Link DIR-605L
Rear view

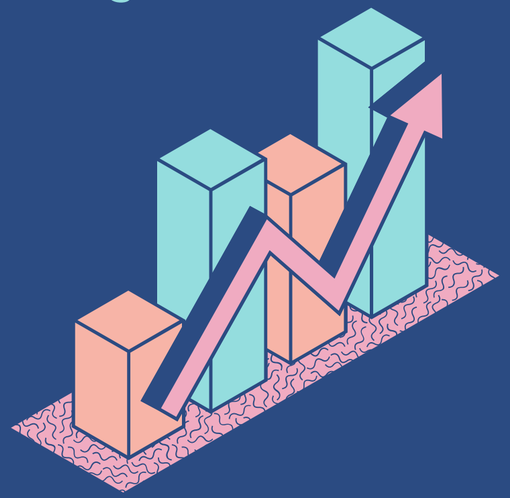
# Flow diagram

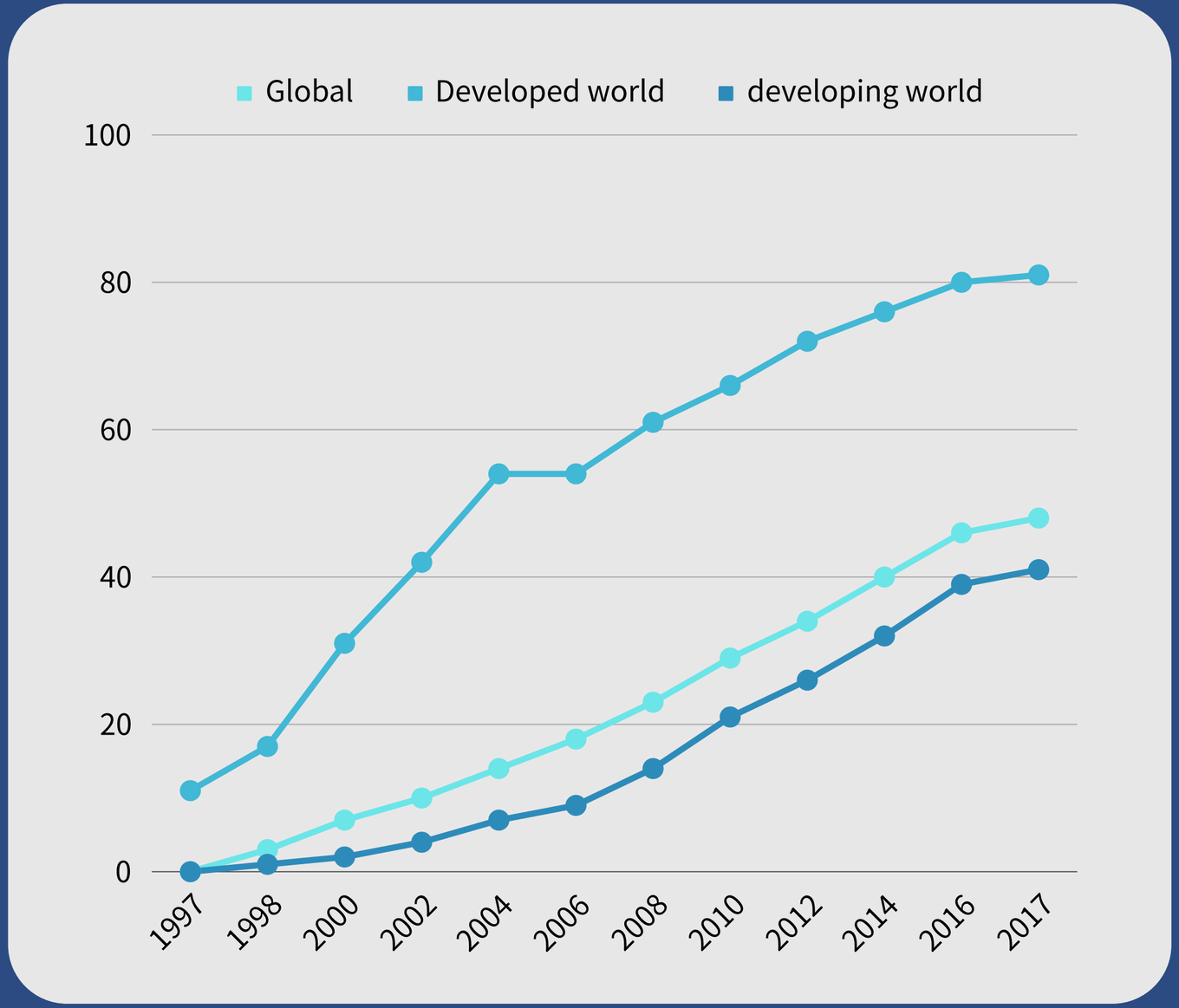
Through thorough pre-planning of the disassembly process and division of tasks, we can avoid situations where recording is forgotten during actual operations. This approach also enhances teamwork and efficiency.



# Internet users per 100 inhabitants

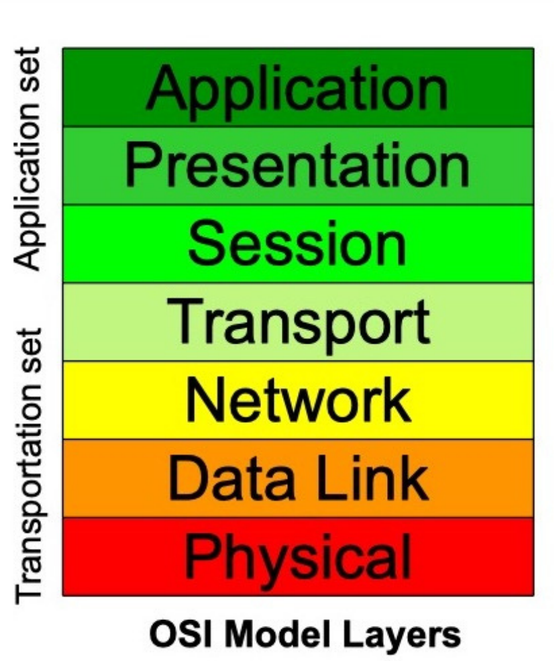
We can know from the data that people’s demand for the Internet is gradually increasing





# What is OSI layer ?

**The OSI model is a conceptual framework that is referenced in the development of network standards.The OSI model is divided into seven different levels.**



OSI Model Layers

## Top layer

**7.Application Layer**
**The main function of the application layer is to process applications.**

**6.Presentation Layer**
**Convertible presentation through display layer.**

**5.Session Layer**
**This level is responsible for establishing network connections.**

**4.Transport Layer**
**The transmission layer is mainly responsible for the overall data transmission and control of the computer.**

**3.Network Layer**
**Definition Network Routing and Addressing Functions.**

**2.Data Link Layer**
**The main purpose is to create logical links between networks.**

**1.Physical Layer**
**Used to define the transfer of bit data between networked devices.**

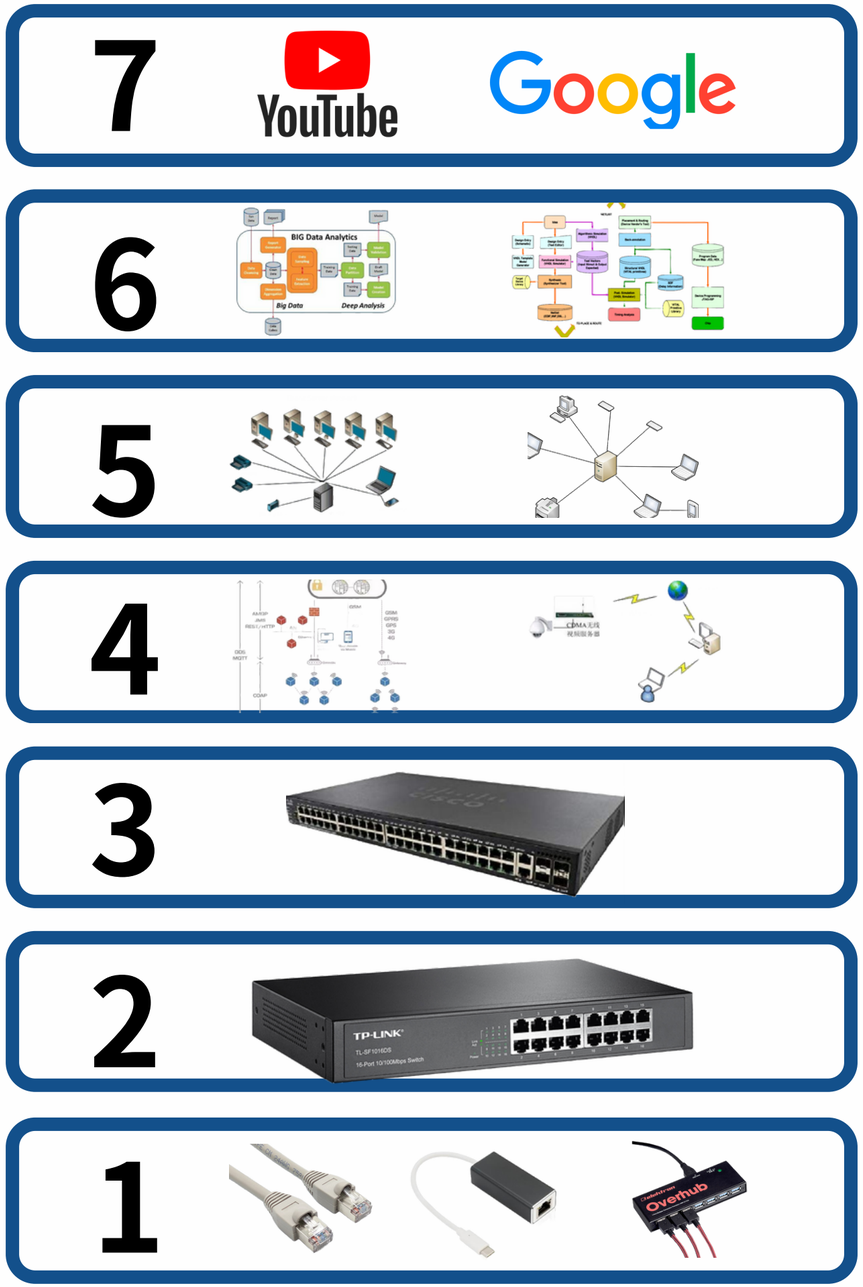
## Bottom Layer

# OSI Layer Schematic

**Each layer in the OSI model performs specific functions, and communication between layers is achieved through standardized protocols and interfaces. This modular approach to networking allows for interoperability between different systems and technologies.**

**OSI model**

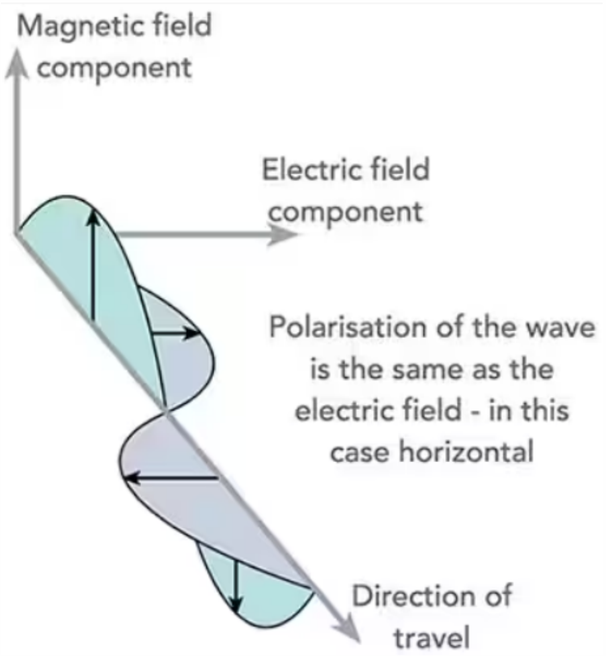
| Layer | Name | Example protocols |
|---|---|---|
| 7 | Application Layer | HTTP, FTP, DNS, SNMP, Telnet |
| 6 | Presentation Layer | SSL, TLS |
| 5 | Session Layer | NetBIOS, PPTP |
| 4 | Transport Layer | TCP, UDP |
| 3 | Network Layer | IP, ARP, ICMP, IPSec |
| 2 | Data Link Layer | PPP, ATM, Ethernet |
| 1 | Physical Layer | Ethernet, USB, Bluetooth, IEEE802.11 |

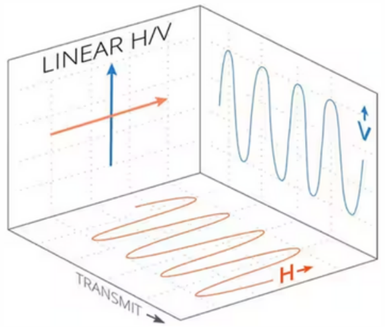


# Antenna polarization

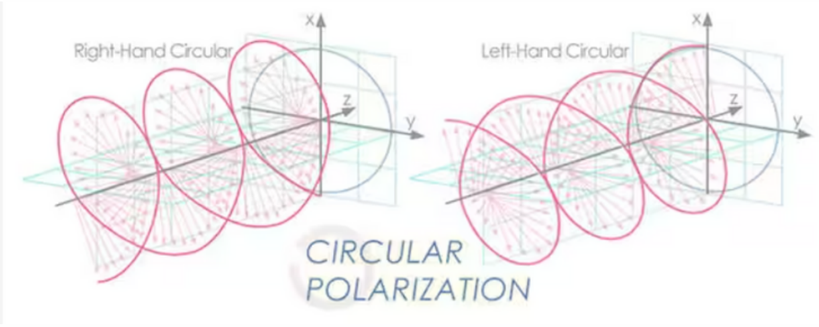
**These waves consist of electric and magnetic fields traveling in a single direction. The electric and magnetic fields are perpendicular to each other, as well as perpendicular to the direction of propagation of the plane wave.**

**Polarization refers to the plane of the electric field as viewed from the signal transmitter: in horizontal polarization, the electric field oscillates horizontally, whereas in vertical polarization, the electric field oscillates vertically.**




**Linear polarization provides two orthogonal polarization options.**




**In circular polarization, the electric field vector of the electromagnetic wave rotates; this rotation can be either right-handed or left-handed.**

# Disassembly process


D-Link DIR-605L
Front view

D-Link DIR-605L
Rear view

## Precautions

1、Disassemble the equipment while ensuring that it is powered off.

2、Confirm that there are no residual charges inside the capacitors.

3、Wear safety goggles and gloves when disassembling the casing.

# 1


**The manufacturer hides the screws under the cushion for aesthetic reasons.**

# 2


**So we're going to remove the pads and then find the screws and remove them.**

# 3


**Separate host and cover.**

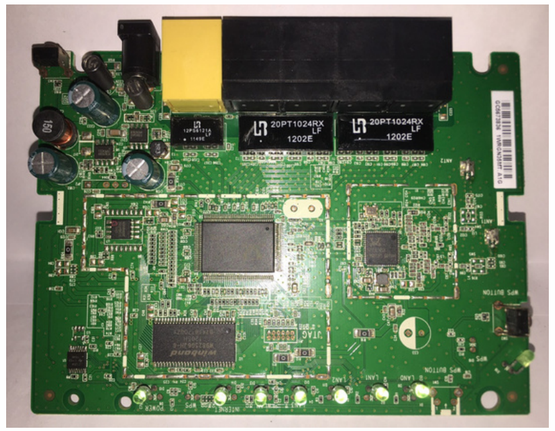
## 4


we  remove the cushion first, then we will find the screws and remove them.

## 5


After removing the screws, we separate the cover from the main body of the host.

## 6




Internal host circuit board

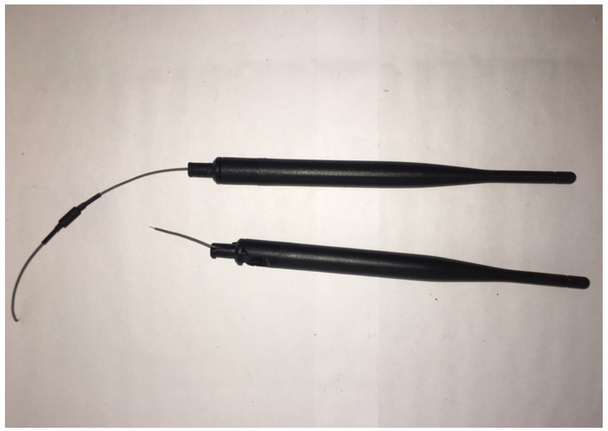
## 7

Enclosure after removing the Internal host circuit.

## 8

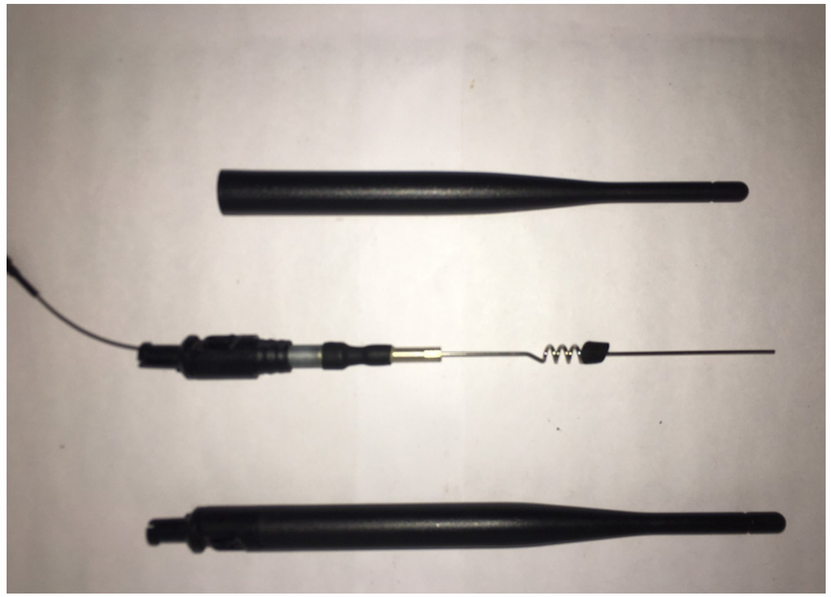

After removing the cover and iInternal host circuit board, you can clearly see the antenna inside.

## 9



We removed the antenna from the chassis.

# 10

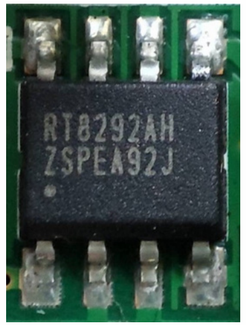


Then remove the housing from the antenna.

# 11


All dismantled parts.

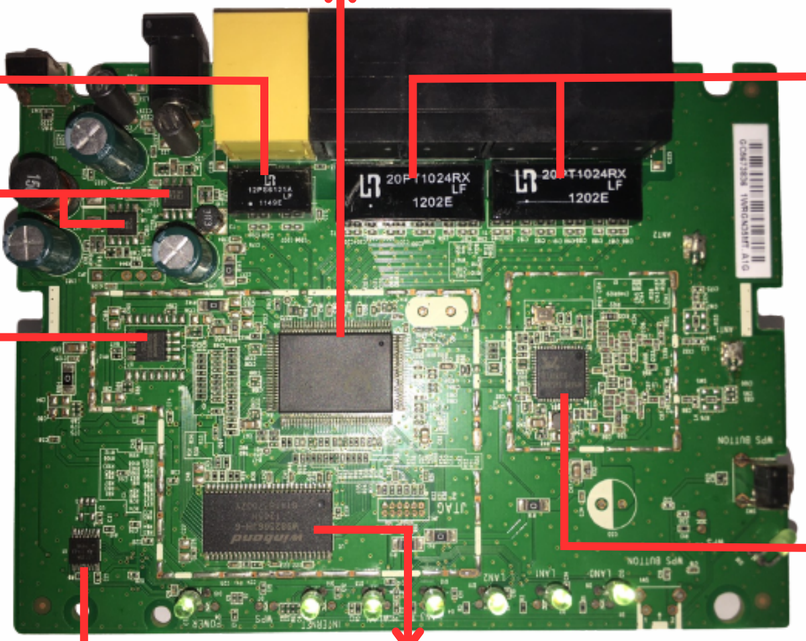
**RT8292AHZSP**
**High-efficiency current mode synchronous step-down regulator that can deliver up to 2A output current from a wide input voltage range of 4.5V to 23V**




**12PS6121A**
**Designed to meet IEEE 802.3u requirement, including 350uH OCL with 8mA bias.**


**RTL8196C**
**Realtek provides the turnkey solution for 11n Router/AP in hardware and software.**

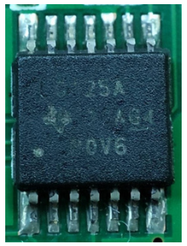

**20PT1024RX-LF**
**Compliant with IEEE 802.3u and ANSI X3.263 standards including 350uH OCL with 8mA Bias. l Symmetrical TX and RX channels for Auto MDI/MDIX capability.**


**RTL8192CE**
**SINGLE-CHIP IEEE 802.11b/g/n 2T2R WLAN**
**CONTROLLER w/PCI EXPRESS INTERFACE**

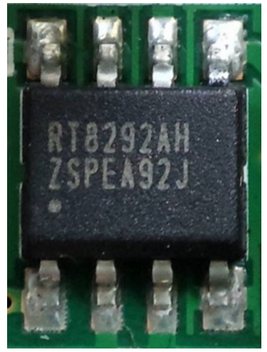
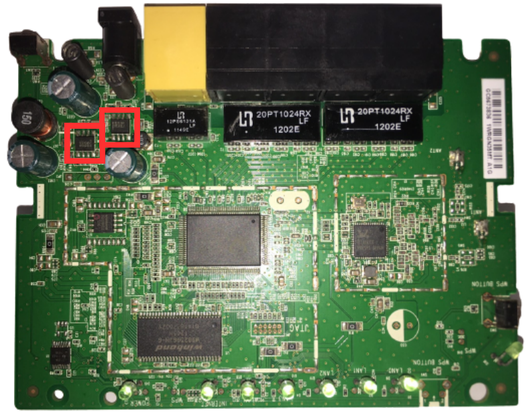
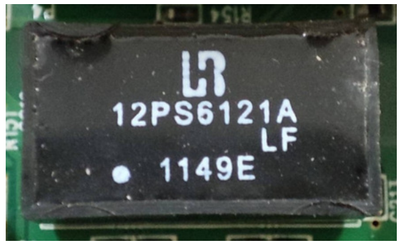
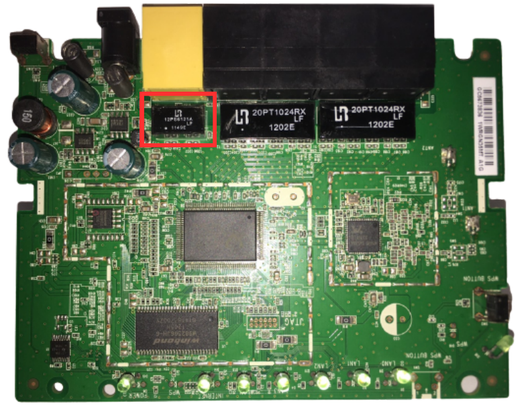

**W25Q32BV**
**3V 32M-BIT**
**SERIAL FLASH MEMORY WITH DUAL AND QUAD SPI**

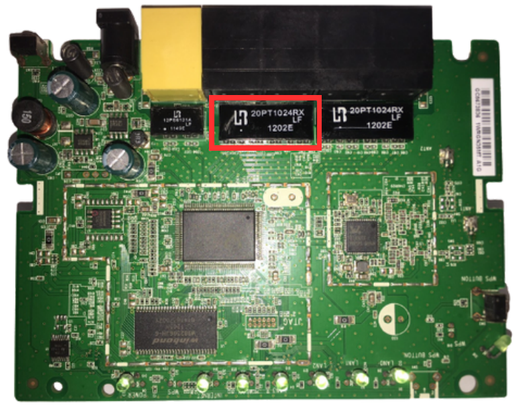
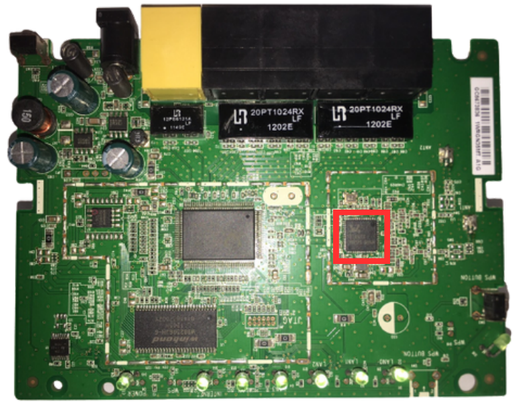

**lc125a**

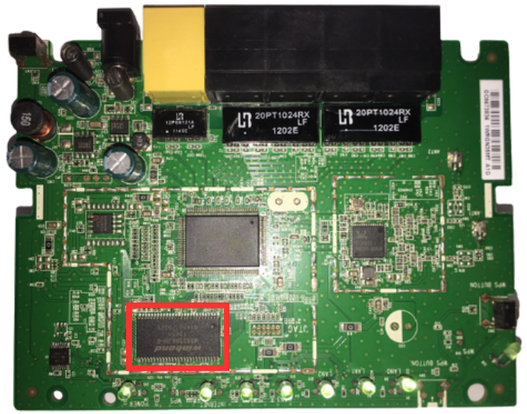
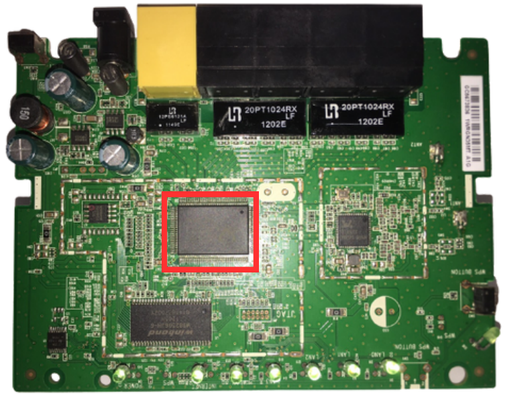


**W9825G6JH**
**4M X 4 BANKS X 16 BITS SDRAM**

# Part Name and Function

| | | | |
|---|---|---|---|
| RT8292AHZSP | High-efficiency current mode synchronous step-down regulator that can deliver up to 2A output current from a wide input voltage range of 4.5V to 23V |  |  |
| 12PS6121A | Designed to meet IEEE 802.3u requirement, including 350uH OCL with 8mA bias. |  |  |

| | | | |
|---|---|---|---|
| **20PT1024RX-LF** | **Realtek provides the turnkey solution for 11n Router/AP in hardware and software.** |  |  |
| **RTL8192CE** | SINGLE-CHIP IEEE 802.11b/g/n 2T2R WLAN |  |  |

| | | | |
|---|---|---|---|
| **W9825G6JH** | **4M X 4 BANKS X 16 BITS SDRAM** |  |  |
| **RTL8196C** | **Realtek provides the turnkey solution for 11n Router/AP in hardware and software.** |  |  |

# Datasheet

## RT8292AHZSP

### *Power-up & Measurement Procedure*

1. Apply a 12V nominal input power supply (4.5V < $V_{IN}$ < 23V) to the VIN and GND terminals.
2. The EN voltage is pulled to logic high by R4 (100kΩ to VIN) to enable operation. Drive EN high (>2.7V) to enable operation or low (<0.4V) to disable operation.
3. Verify the output voltage (approximately 3.3V) between VOUT and GND.
4. Connect an external load up to 2A to the VOUT and GND terminals and verify the output voltage and current.

### *Output Voltage Setting*

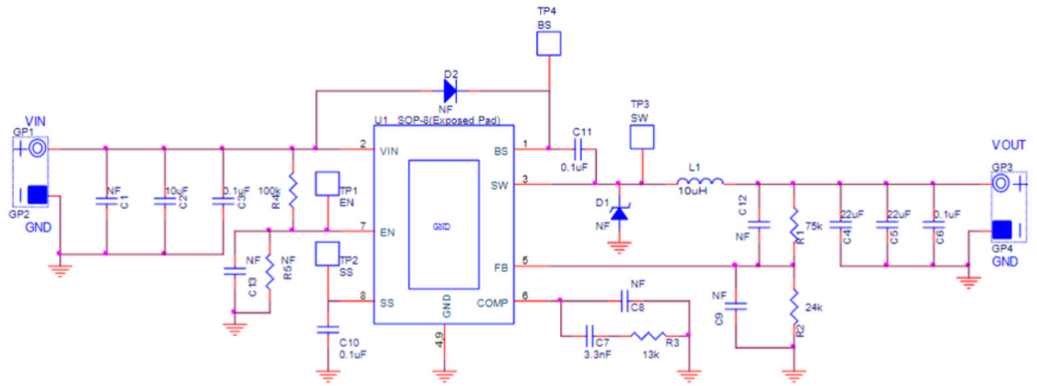
Set the output voltage with the resistive divider (R1, R2) between VOUT and GND with the midpoint connected to FB. The output is set by the following formula:

$$V_{OUT} = 0.8 \times (1 + \frac{R1}{R2})$$

The installed VOUT capacitors (C4, C5) are 22μF, 16V X5R ceramic types. Do not exceed their operating voltage range and consider their voltage coefficient (capacitance vs. bias voltage) and ensure that the capacitance is sufficient to maintain stability and provide sufficient transient response for your application. This can be verified by checking the output transient response as described in the RT8292 IC datasheet.

| Key features | Evaluation board number: PCB004_V1 |
|---|---|
| Default Input Voltage | 12V |
| Max Output Current | 2A |
| Default Output Voltage | 3.3V |
| Default Marking & Package Type | RT8292AHZSP, PSOP-8 (Exposed Pad) |
| Operation Frequency | Steady 340kHz at all load currents |
| Other Key Features | 4.5V to 23V Input Voltage Range<br>Programmable Soft-Start |
| Protection | Output Under-Voltage Protection (hiccup mode):<br>Cycle-by-cycle Current Limit<br>Thermal Shutdown |

### *EVB Schematic Diagram*

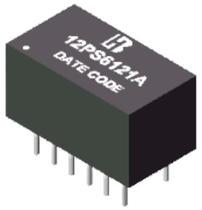



C2: 10μF/50V/X5R, 1206, TDK C3216X5R1H106K

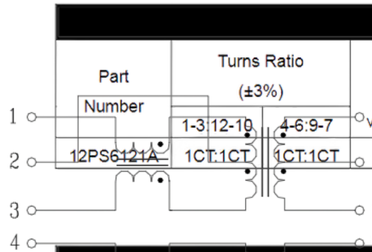
C4, C5: 22μF/16V/X5R, 1210, Murata GRM32ER61C226K

L1: 10μH TAIYO YUDEN NR8040T100M, DCR=34mΩ

# 12PS6121A




- Designed to meet IEEE 802.3u requirement, including 350uH OCL with 8mA bias.
- Operating temperature range: 0℃ to +70℃.
- Storage temperature range: -25℃ to +125℃.

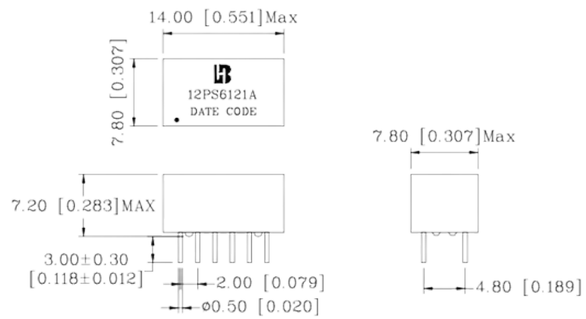



**Electrical Specifications @ 25°C**

| Part Number | Turns Ratio (±3%) 1-3:12-10 | Turns Ratio (±3%) 4-6:9-7 | OCL (uH Min) @ 100KHz/0.1V with 8mA DC Bias | $C_{W/W}$ (pF Max) | L.L (uH Max) | DCR (Ω Max) 1-3/4-6 | DCR (Ω Max) 12-10/9-7 | HI-POT (Vrms) |
|---|---|---|---|---|---|---|---|---|
| 12PS6121A | 1CT:1CT | 1CT:1CT | 350 | 28 | 0.5 | 1.1 | 0.9 | 1500 |

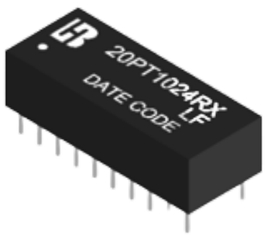
**Continue**

| Part Number | Insertion Loss (dB Max) 0.3-100MHz | Return Loss (dB Min) 0.3-30MHz | Return Loss (dB Min) 40MHz | Return Loss (dB Min) 50MHz | Return Loss (dB Min) 60-80MHz | Cross talk (dB Min) 0.3-60MHz | Cross talk (dB Min) 60-100MHz | DCMR (dB Min) 30MHz | DCMR (dB Min) 60MHz | DCMR (dB Min) 100MHz |
|---|---|---|---|---|---|---|---|---|---|---|
| 12PS6121A | -1.1 | -18 | -15.5 | -13 | -12 | -45 | -35 | -40 | -35 | -30 |




Units: mm[Inches] Tolerances: xx.x0±0.25[0.010]
0.xx±0.05[0.002]

# 20PT1024RX-LF



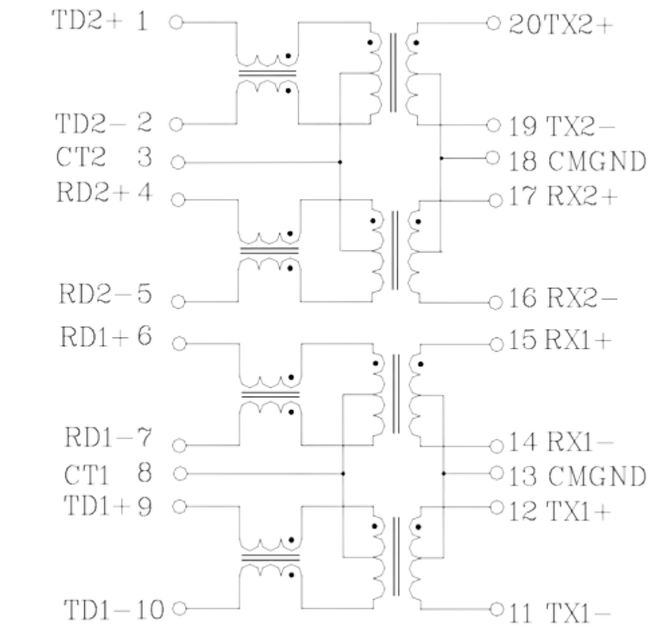

- Compliant with IEEE 802.3u and ANSI X3.263 standards including 350uH OCL with 8mA Bias.
- Symmetrical TX and RX channels for Auto MDI/MDIX capability.
- Compliance with ROHS requirements.
- Operating temperature range : 0℃ to +70℃.
- Storage temperature range: -25℃ to +85℃.

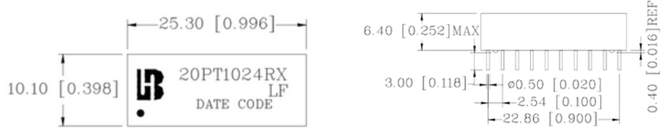
**Electrical Specifications @ 25°C**

| Part Number | Turns Ratio (±5%) | | OCL(μH Min) @100KHz/0.1Vrms with 8mA DC/Bias | $C_{WW}$ (pF Max) | DCR (Ω Max) | HI-POT (Vrms) |
|---|---|---|---|---|---|---|
| | TX | RX | | | | |
| 20PT1024RX LF | 1CT:1CT | 1CT:1CT | 350 | 56 | 0.9 | 1500 |

**Continue**

| Part | Insertion Loss (dB Max) | Return Loss (dB Min) | | | Cross talk (dB Min) | DCMR (dB Min) |
|---|---|---|---|---|---|---|
| | 0.3-100MHz | 0.3-30MHz | 30-60MHz | 60-80MHz | 0.3-100MHz | 0.3-100MHz |
| 20PT1024RX LF | -1.1 | -18 | -14 | -12 | -35 | -30 |

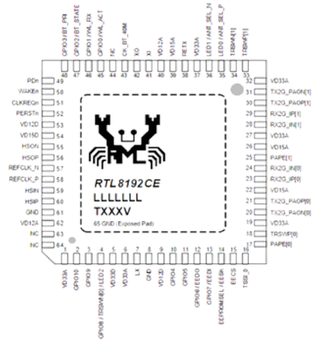


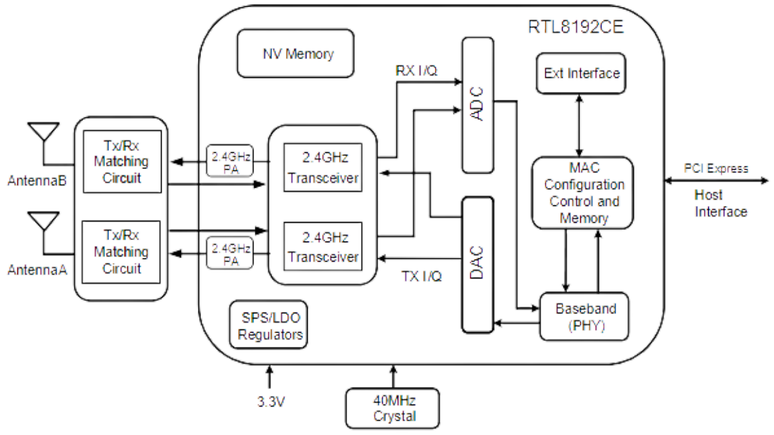
# RTL8192CE

**Description:**
**Realtek provides the turnkey solution for 11n Router/AP in hardware and software. The firmware could be adopted in Realtek EV (evaluation) board, or platforms designed according to Realtek reference circuit. The current release firmware has only supported for router package. Will add AP package support in the future. The release firmware image has been included in the package of CMK (Customization Kit). This kit will allow customers to modify the web pages and configuration settings to the target system as their need. The following sections will describe the hardware requirements, firmware features, to-do list, and the release history.**

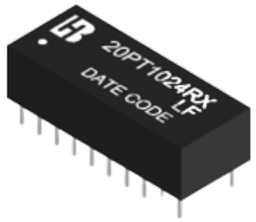
## Pin Assignments




## Application Daigrams



# W9825G6JH



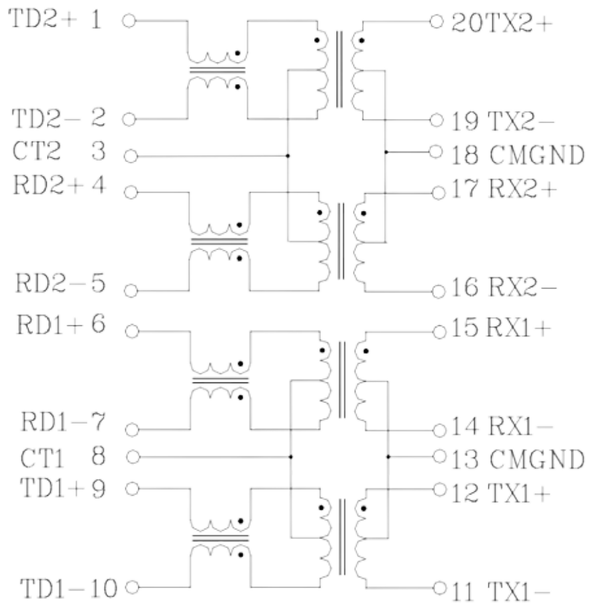

- Compliant with IEEE 802.3u and ANSI X3.263 standards including 350uH OCL with 8mA Bias.
- Symmetrical TX and RX channels for Auto MDI/MDIX capability.
- Compliance with ROHS requirements.
- Operating temperature range : 0℃ to +70℃.
- Storage temperature range: -25℃ to +85℃.

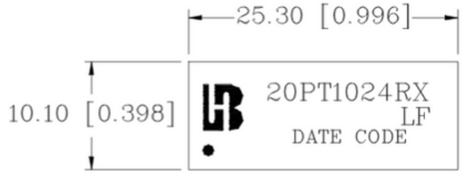
**Continue**

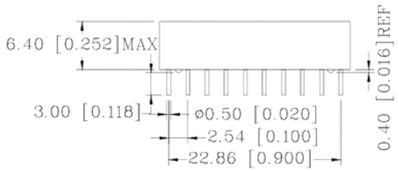
| Part | Insertion Loss (dB Max) | Return Loss (dB Min) | | | Cross talk (dB Min) | DCMR (dB Min) |
|---|---|---|---|---|---|---|
| | 0.3-100MHz | 0.3-30MHz | 30-60MHz | 60-80MHz | 0.3-100MHz | 0.3-100MHz |
| 20PT1024RX LF | -1.1 | -18 | -14 | -12 | -35 | -30 |

**Continue**

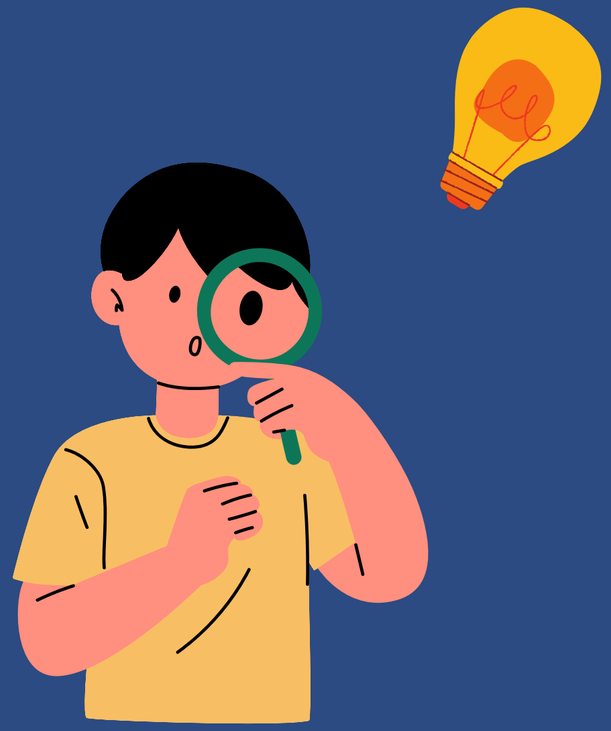
| Part | Insertion Loss (dB Max) | Return Loss (dB Min) | | | Cross talk (dB Min) | DCMR (dB Min) |
|---|---|---|---|---|---|---|
| | 0.3-100MHz | 0.3-30MHz | 30-60MHz | 60-80MHz | 0.3-100MHz | 0.3-100MHz |
| 20PT1024RX LF | -1.1 | -18 | -14 | -12 | -35 | -30 |



# Experience & Lessons



## Ensure safety during disassembly

Follow safe disassembly procedures to avoid the danger of retained charge in internal capacitors.

## Observing circuit board knowledge

We observed that the traces on the circuit board do not follow right angles, which is different from what we imagined. However, upon investigation, we learned that this is to ensure impedance matching and to avoid the accumulation of heat at right angles. Therefore, most of the traces are designed using curves or 45° angles.

## We utilized datasheets to understand component information.

The components on the circuit board are diverse, but through this disassembly, we learned to look up information about parts, including basic operating voltage and power consumption. The datasheet also provides detailed information about the names and functions of each pin.

# Literature Reference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