



RCB-W24B-LVDS

User Guide



RCB-W24B-LVDS User Guide V1.2



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SAFETY WARNINGS

DSPW products use Lithium Ion batteries.

Be careful and take precautions.



⚠ DANGER

Failure to observe instructions / warnings could result in death or serious injuries.

Rechargeable Li-ion Battery

- Do not charge, use, or leave the battery in high temperature (above 30°C (85°F)) locations.
- Only use the included or specified Battery Charger or USB cable to charge.
- Do not allow the battery to come into contact with liquids.
- Use the battery only for its intended purpose.
- Keep the battery away from heat and fire.
- Do not connect the + and - terminals with metal objects such as wire.
- Do not carry or store the battery with metal objects.
- Do not throw, hit or damage the battery in any way.
- Do not solder any connections to the battery.
- Do not disassemble or modify the battery.
- Do not dispose of the battery with household waste. Must be recycled.

⚠ WARNING

Failure to observe instructions / warnings could result in death or serious injuries.

Rechargeable Li-ion Battery safety

- Keep the battery away from infants or children.
- If the battery is ingested by human or animal, seek immediate medical advice.
- If liquid from battery gets in eyes, wash eyes with clean water. See doctor immediately.
- Use the included Battery charger or cable to prevent any damage.
- Charge the battery in environments between 50°F and 85°F / 10°C and 30°C.
- Stop using the battery if there are noticeable abnormalities such as smell, heat, deformities, swelling, or discoloration.

⚠ WARNING

Failure to observe instructions / warnings could result in death or serious injuries.

RCB-W24x-LVDS Battery Charger and Charging Environment

- Use the specified or included Battery charger or cable to prevent any damage.
- Charge the battery in environments between 50°F and 85°F / 10°C and 30°C.
- When not in use keep battery out of sunlight or other UV source of light.
- Do not damage the battery charger enclosure.
- Do not place heavy objects on any DSPW devices.
- Do not forcibly bend or pull on wires or connectors.
- Do not disassemble or modify. Do not drop or hit.
- Do not allow battery charger to come into contact with liquids.
- **IMPORTANT** - If you notice abnormalities such as smell, heat, deformities, swelling, or discoloration while in use or storage, stop using the RCB-W24x-LVDS, disconnect any cables, and remove the battery if it is a removable model.



OVERVIEW

The DSPW RCB-W24B-LVDS is a Wi-Fi interface for the Intan Technologies LLC RHD2000 series of Bio Sensing Amplifier boards (headstages). RCB-W24B-LVDS provides wireless connectivity, enabling data streaming and device configuration using off-the-shelf Wi-Fi routers. Streaming data display and recording is achieved using an Open Ephys GUI Plugin.

Throughout this document reference is made to either the “RCB-W24B-LVDS” specifically or to “RCB” devices in general. Much of this information is appropriate for all RCB devices.

Intended Use

DSP Wireless, Inc. (DSPW) products are designed and sold for use in research and education applications in lab environments using various animal models.

DSPW RCB Wi-Fi products are not intended for use on Humans.

DSPW products are **not intended for use as medical devices** or in medical environments. No product supplied by DSPW is intended to be used for diagnosis, treatment, or monitoring of a subject. Furthermore, no DSPW product is intended for the prevention, curing or alleviation of disease, injury or disability.

Features:

- **Wi-Fi Interface:** Supports 2.4GHz 802.11 b/g/n wireless networks.
- **Continuous Streaming Data:**
 - Up to 32 RHD2132 channels at 20ksps with 16-bit resolution.
 - Up to 28 RHD2132 channels at 30ksps with 16-bit resolution.
 - Up to 16 RHD2216 channels at 30ksps with 16-bit resolution.
- **Connectivity:** LVDS-SPI differential SPI interface via a 12-pin Omnetics connector.
- **Power Supply:** User replaceable, rechargeable NB-11L lithium-ion battery.
- **Compact Design:** Module dimensions are 2.1” x 1.55” x 0.63”.
- **Free User-Friendly Interfaces for setup and control:**
 - Open Ephys GUI plugin for Windows and macOS.
 - HTML web server with browser access for easy network provisioning.

DESCRIPTION

Each RCB-W24B-LVDS device connects to one (1) Intan Technologies RHD2132 or RHD2216 amplifier board (headstage). For ex. Intan RHD2132 Amplifier Board part number C3314. The RCB-W24B-LVDS device does not work with Intan RHD2164 IC based headstages.

Intan RHD2000 headstage is not included, purchase from Intan Technologies.

The RCB-W24B-LVDS module interfaces to a headstage via LVDS SPI signals on a 12-Pin Omnetics connector. RCB-W24B-LVDS is connected to the Intan headstage via an SPI cable purchased from Intan Technologies. RCB-W24-LVDS has been tested to work with Intan blue and purple SPI cables of various lengths.

The RCB-W24B-LVDS device uses rechargeable lithium protected NB-11L batteries with nominal voltage of 3.7v. Do not connect a battery with voltage above 4.25v or you will damage the RCB module. See Battery section for more information.

Depending on the RCB-W24B-LVDS device type the Wi-Fi antenna is either a PCB trace inside the module or an external antenna connected via an SMA connector. See Wi-Fi



Antenna for more information. Antenna should not be obscured behind metal or other RF limiting material. For larger animal models (dog) external antenna version might be better.

RCB-W24B-LVDS is configured (provisioned) to connect to the Wi-Fi network using web pages that are accessed with a browser. See Wi-Fi Provisioning for more information.

Once provisioned, the RCB-W24B-LVDS is controlled via the Open Ephys GUI. DSPW provides an Open Ephys GUI Plugin for Win10/11, MacOS, and Linux. See User Interface for details.

The RCB-W24B-LVDS transmits continuous streaming data. 2.4G 802.11n Wi-Fi router dedicated to the RCB system is recommended. See Wi-Fi Router for more information.

RCB-W24B-LVDS is not waterproof. Protect the RCB-W24B-LVDS from water or other liquids.

RCB-W24B-LVDS HW OVERVIEW

RCB-W24B-LVDS Top View



Wi-Fi Antenna

- **Internal Antenna** - Wi-Fi Antenna is a PCB trace antenna located inside the RCB-W24B-LVDS enclosure. Antenna is located under the DSPW logo shown above. Available today.
- **External Antenna** - External Wi-Fi Antenna is connected to an SMA connector located at the top of the RCB device. Contact DSPW support for availability.

LED Indicator

Blue LED, located near the center of the enclosure at the bottom edge, indicates RCB-W24B-LVDS operating mode through various blink patterns.

- **Slow Blink (1.25Hz)**: AP (Access Point) mode.
- **Fast Blink (10Hz)**: STA (Station) mode searching for a router.
- **Twinkle (~1Hz)**: Connected and waiting for commands.
- **Steady ON**: Actively streaming data.
- **OFF**: Device is powered down.

12-Pin Omnetics Connector

Intan format LVDS SPI connection for Intan 12-pin SPI cable.

RCB-W24B-LVDS connects to the Intan RHD headstage through this LVDS SPI interface.



RCB-W24B-LVDS Left Side View

Power Enable/Disable Switch

Switch located on Left side of RCB-W24B-LVDS.

Power OFF – Switch toward Top ↑

Power ON – Switch toward Bottom ↓
Blue LED will blink.



RCB-W24B-LVDS Bottom View



Battery Cover

Slide Battery Cover to remove. Cover does not need to be installed for RCB-W24B-LVDS to operate. Battery cover is not waterproof. Protect the RCB-W24B-LVDS from water.

Battery Connector

Located under Battery Cover. Insert the battery carefully, check polarity to avoid damage.

Change Battery Procedure

1. **Remove Battery Cover and Battery:** Slide cover to remove. Lift Battery from the side opposite the battery connector.
2. **Insert charged Battery:** Insert the battery carefully, ensuring correct polarity to avoid damage. Replace cover.

AP Mode Switch.

Located to next to the battery connector, under the battery cover.

RCB-W24B-LVDS will operate in AP Mode if no Wi-Fi Profiles are entered on the Profiles tab of the RCB configuration web page. Please see Profiles Configuration Page located below.

Force AP mode: only used for Wi-Fi provisioning and initial setup

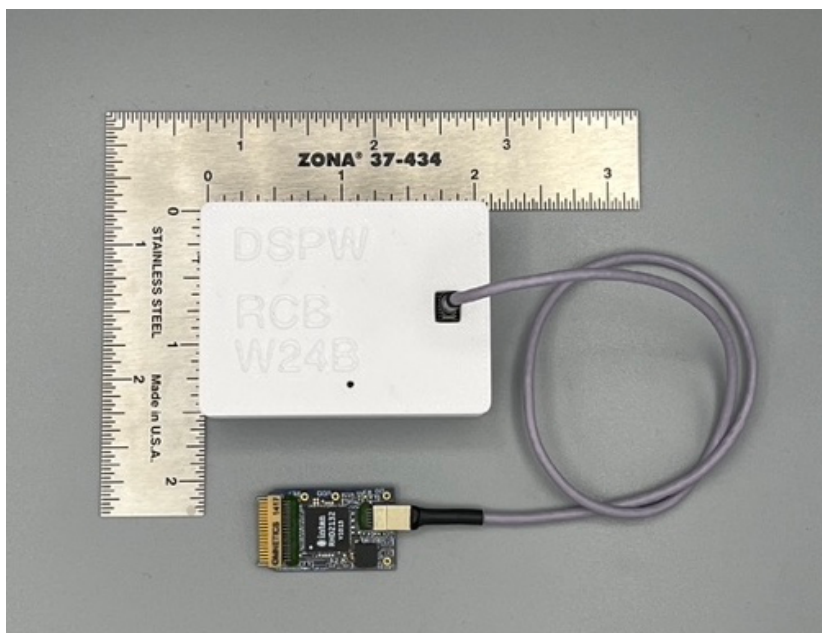
1. Slide the switch toward the battery connector.
2. Power cycle the RCB-W24B-LVDS device.
 - The Blue LED will change to a Slow Blink, indicating AP mode.
 - RCB-W24B-LVDS will broadcast a Wi-Fi SSID that is a combination of "dspwlink-abcdef" where "abcdef" is the last 6 digits of your RCB-W24B-LVDS Wi-Fi MAC address.

**Force STA mode: Normal Operation**

1. Slide the switch (S1) away from the battery connector.
2. Power cycle the device.
 - The Blue LED will change to a Fast Blink while searching for a router.
 - Once Router is connected Blue LED will change to a twinkle at 1Hz indicating the RCB-W24B-LVDS is Connected to the Wi-Fi Router waiting for commands from the DSPW RCB Wi-Fi Open Ephys GUI Plugin.

RCB-W24B-LVDS to Intan RHD Headstage Connection

RCB-W24B-LVDS connected to Intan amplifier board via Intan 1ft ultra-thin purple SPI cable.

**RCB SYSTEM MATERIALS****Intan Headstage and SPI Cable Selection**

DSPW RCB-W24B-LVDS devices work with these Intan SPI cables:

- C3211- 1ft ultra-thin purple cable
- C3213 - 3ft ultra-thin purple cable
- C3216 - 6ft ultra-thin purple cable
- C3203 - 3ft standard blue cable
- C3206 - 6ft standard blue cable

DSPW RCB-W24B-LVDS works with these Intan RHD2000 Headstages (Amplifier Boards):

- C3314, C3324 - 32 channel single ended RHD2132 IC
- C3334, C3335 - 16 channel single ended RHD2132 IC
- C3313, C3323 - 16 channel differential RHD2216 IC

DSPW RCB-W24B-LVDS does NOT work with Intan Headstages that use the RHD2164 IC:

- C3315, C3325 - 64 channel single ended RHD2164 IC
- C3316 - 128 channel single ended RHD2164 IC



Wi-Fi Router

RCB-W24B-LVDS requires a Wi-Fi router capable of 2.4GHz 802.11n performance.

There are many, many, Wi-Fi routers for sale. Wi-Fi 4, Wi-Fi 5, Wi-Fi 6, gaming, mesh, ...

RCB -W24B-LVDS is using an older modulation type. 2.4GHz 802.11n is a mature Wi-Fi 4 standard that is used with millions of Internet of Things (IoT) devices. To achieve excellent performance, it is not necessary to use the newest Wi-Fi router. In fact, newer high end routers often have poor 2.4G 802.11n performance. We have found that it is necessary to disable some Wi-Fi 6 features available on the new routers. Sometimes simple is better.

For example, an older, discontinued, Apple Airport Express router will deliver 2.4G 802.11n performance as good or better than many of today's routers. DSPW often uses these in testing and demos.

We have tested with various vendors routers. We have not tested all vendors routers. This is an ever evolving area, new routers are available every day. Today, we recommend TP-Link as they have better 2.4G performance than others we have tested. For example, the TL-WR841N is a solid performer.

Check with DSPW support for latest list of recommended Wi-Fi routers and for pre-configured factory supplied Wi-Fi router options.

In all configurations the RCB-W24B-LVDS connects to the Wi-Fi router using 2.4GHz SSID.

- RCB-W24B-LVDS and GUI PC should be on their own private local network. Do not connect to the Internet. Doing so will likely increase sample data dropouts (misses).
- Do not connect GUI PC to the 2.4G SSID unless your sample rate or channel count is very low. Contact DSPW support for help.

GUI PC/Mac can connect to the Wi-Fi Router using wired Ethernet (preferred) or on 5GHz SSID if you have a dual band router.

1. PC/Mac connects using Wired Ethernet-
 - a. Connect Ethernet cable between router Lan port and the GUI PC/Mac.
 - b. Check network settings for the IP Address assigned to the PC/Mac.
 - c. Use this IP Address in the GUI Host IP ADDR: box.
2. PC/Mac connects using 5GHz SSID
 - a. Ensure your router supports setting up both 2.4GHz and 5GHz SSIDs.
 - b. RCB-W24B-LVDS and GUI PC should be on their own private network.
 - c. RCB-W24B-LVDS connects to router 2.4G SSID, GUI PC connects to 5G SSID.
 - d. Check network settings for the IP Address assigned to the PC/Mac.
 - e. Use this IP Address in the GUI Host IP ADDR: box.

Wi-Fi Tips

- If connecting GUI PC to router with Ethernet cable, then do not need 5G SSID.
- The RCB-W24B-LVDS data stream is UDP based with no retransmits.
- If there is network congestion on the Wi-Fi channel you will lose RHD2000 ADC data.
- Do Not use the lab microwave oven if is near the experiment. Microwave oven will interfere with the RCB-W24B-LVDS 2.4GHz connection.



RCB-W24B-LVDS Battery Selection

Battery for the RCB-W24B-LVDS is an NB-11L Canon Camera battery.

Canon brand NB11L are expensive and hard to find. However, there are many inexpensive aftermarket NB-11L batteries available at Amazon or similar outlets.

DSPW tests with NB-11L batteries from - Powerextra, Wasabi Power, and Kastar. These are available on Amazon for approximately \$10 or less. Other brand NB-11L may work as well.

These batteries typically come with a battery charger.

- Ensure a nominal voltage of 3.6V or 3.7V.
- Fully charge the battery before use
- Battery capacity markings for NB-11L batteries range from 680mAh to 1050mAh. It is unclear that they have different actual real world capacities. Tests show minimum 4 hours of continuous 32 channel 20ksps streaming data with any of them.

Battery Storage

To ensure the highest performance and longest life from the rechargeable Li-ion Battery, when storing the Battery for a long period of time:

- Charge once every six months.
- Store in a cool dry place out of direct sunlight, between 50°F - 85°F / 10°C - 30°C.

Battery Tips

- Avoid discharging below 3.5V for optimal performance.
- Inserting the battery incorrectly can damage the device and void the warranty.
- Battery is designed turn off to protect itself if over-discharged.
- Battery will age and reduce capacity over time, more so if deeply discharged.
- Power usage will depend on number of channels, sample rate and PA power setting.
- For 32 channels @ 20ksps, PA Attn set to 4, RCB-W24B-LVDS will draw approximately 150mA average current from battery when streaming, 6mA when not streaming (standby).

Battery and charger we test with. Other NB-11L batteries are likely to work.





WI-FI SETUP

Wi-Fi Provisioning

Configuration of RCB-W24B-LVDS Wi-Fi network parameters is done using the on-board RCB HTTP webserver and webpages. RCB-W24B-LVDS must be set up (Provisioned) with correct settings for 2.4G SSID and WPA2 Password so it can connect to your Wi-Fi Router. Provisioning is accomplished by setting up Wi-Fi network **Profiles**.

Profiles

The RCB-W24B-LVDS can store up to 4 Wi-Fi "Profiles". These Profiles numbered 1-4 are associated with a certain Wi-Fi network SSID, Password and Priority. Profiles are either set up by the user or configured at the DSPW factory. Most users will only have one profile. If you wish to have a backup profile, consider setting it to a lower priority.

When setting up a Profile, be sure that the Wi-Fi Router 2.4G SSID that matches the Profile SSID and WPA2 Password that you will be entering into the webpage is powered up and working correctly.

When you add the Profile, RCB-W24B-LVDS will check for valid 2.4G SSID and WPA2 Password. If either is incorrect, or the Wi-Fi router is not powered up, the Profile you entered will be deleted and you will have to enter again. This is only true for the first time you enter the Profile and power cycle to save and initialize the Profile. Once successfully saved your network Profile will be remembered by the RCB-W24B-LVDS device.

The RCB-W24B-LVDS device will operate in AP (Access Point) Mode until provisioned with a valid Profile including SSID and WPA2 password, and then power cycled.

Wi-Fi Profiles are set up using the RCB-W24B-LVDS Profiles webpage. See [Profiles Configuration Page](#) (below) for details.

Wi-Fi Mode

Wi-Fi Provisioning Procedure depends on if your RCB-W24B-LVDS device is:

1. RCB-W24B-LVDS set up at factory to work with factory supplied Wi-Fi Router.
 - a. To add additional Profiles, see **Sta Mode (Station Mode)** below.
2. RCB-W24B-LVDS is not provisioned by factory. Initial setup done by user (you).
 - a. RCB-W24B-LVDS will be set up using **AP Mode (Access Point Mode)**
3. RCB-W24B-LVDS requires AP Mode Recovery procedure.
 - a. Go to **AP Mode Recovery** below

AP Mode (Access Point Mode)

The RCB-W24B-LVDS device will operate in AP (Access Point) Mode until provisioned with a valid Profile including SSID and WPA2 password, and then power cycled.

AP Mode is only used to set up Profiles or change IP number. RCB-W24B-LVDS will not connect with the GUI or stream data while in AP mode.



AP Mode SSID

In AP mode the RCB-W24B-LVDS module will broadcast a Wi-Fi SSID that is a combination of "dspwlink-abcdef" where "abcdef" is the last 6 digits of your module Wi-Fi MAC address.

The RCB-W24B-LVDS Wi-Fi MAC address is located on the RCB-W24B-LVDS device label. If label was lost it is likely that the RCB unit is the only device broadcasting a dspwlink SSID.

For example, if your module label indicates a MAC number of 12:34:56:78:9A your AP mode SSID would be: **dspwlink-56789A**. You should see **dspwlink-56789A** SSID in the list of available Wi-Fi connections.

There are two (2) scenarios when AP Mode is used. These are Uninitialized and Recovery.

Uninitialized RCB-W24B-LVDS

AP mode is the default mode for a factory supplied non-provisioned RCB-W24B-LVDS device. When an uninitialized RCB-W24B-LVDS device, one that has no Profiles stored, is powered up it will default to AP mode.

AP Mode is used in this scenario so that you can connect to the RCB-LVDS internal configuration webpages to set up the Wi-Fi SSID and WPA2 Password Profile to match those of your network.

See [AP Mode Uninitialized RCB-W24B-LVDS Setup Procedure](#) for details.

AP Mode Recovery

This is used if the Wi-Fi router, that was originally set up in the Profile, failed or was lost or if the SSID was changed possibly due to a router reset.

AP mode can be forced by setting the AP Mode Switch described in AP Mode Switch section below. Also described in the below section - AP Mode Recovery Procedure.

See [AP Mode Recovery Procedure](#) for details.

STA Mode (Station)

The RCB-W24B-LVDS must be in STA Mode to connect to the GUI and to stream data.

Once configured with a Profile and connected to that network, normal RCB-LVDS operation is done using STA mode.

STA mode can be distinguished from AP mode by the RCB-W24B-LVDS BLUE LED blink rate. Continuous slow blink is AP mode. Continuous fast blink is STA mode looking for the Wi-Fi router that corresponds to the SSID in the Profile.

Once RCB-W24B-LVDS has connected to the Wi-Fi router and is waiting for commands from the GUI, the LED blink rate be more of a twinkle.

STA mode can also be verified by connecting to the RCB-W24B-LVDS configuration web page at 192.168.0.93 (default IP address).



AP MODE UNINITIALIZED RCB-W24B-LVDS SETUP PROCEDURE

If RCB-W24B-LVDS unit has not been factory configured, follow these steps for initial setup.

Whenever setting up (provisioning) the RCB-W24B-LVDS device use a fully charged battery. During the setup process, data is written to the RCB-W24B-LVDS Flash memory. Maintaining a stable power supply is crucial to prevent attempts to write to Flash memory with a low battery, which could result in data corruption.

Steps.

1. **Prepare the Wi-Fi Router:** Ensure your Wi-Fi router is powered on and broadcasting the correct SSID.
2. **Insert the RCB-W24B-LVDS Battery:** Carefully insert the NB-11L battery into the RCB-W24B-LVDS device. Ensure the battery polarity matches to avoid damage.
3. **Power On the RCB-W24B-LVDS Device:** Slide the Power Enable Switch located on the left side of the device to the ON position.
4. **Verify RCB-W24B-LVDS LED Status:** After powering on, the Blue LED should blink slowly. This indicates the RCB-W24B-LVDS device has booted and is in AP mode.
5. **Scan for Wi-Fi Networks:** On your PC, scan for available Wi-Fi networks.
6. **Locate RCB-W24B-LVDS AP Mode SSID:** Scan for a network dspwlink-abcdef, where abcdef corresponds to the last six digits of the MAC address found on the RCB-W24B-LVDS box label.
7. **Connect to the RCB-W24B-LVDS AP Mode Network:** Connect your PC to the dspwlink-abcdef Wi-Fi network. This is an open network with no password.
8. **Access the Configuration Page:** Open a web browser and navigate to 192.168.1.1. This will open the RCB-W24B-LVDS Status webpage.
9. Set Up the Wi-Fi Profile:
 - a. Navigate to the **Profiles** tab on the webpage.
 - b. **Enter network settings:** Enter your router's SSID, WPA2 password, and set the priority (use "7" for highest priority). WPA2 is required.
 - c. **Save to the profiles list.** After pressing the "Add" button the profile should be listed in the Profiles list.
10. **Power Cycle the Device:** Turn the device OFF, then ON again to apply changes. Note that two power cycles may be necessary. The dspwlink-abcdef network should no longer appear as an available Wi-Fi network.
11. **Reconnect Your PC:** Connect your PC to your Wi-Fi router, preferably using a wired Ethernet connection or the 5GHz Wi-Fi channel to reduce interference.
12. **Verify Connection:** After Power Cycle and reboot, the RCB-W24B-LVDS should connect to your Wi-Fi router. The Blue LED will twinkle slowly, indicating a successful connection.
13. **Access the RCB-W24B-LVDS Device:** Open a browser, navigate to 192.168.0.93 to confirm connectivity. If you have changed the RCB IP Address, use the new IP Address to confirm that RCB-W24B-LVDS is connected OK.

Once setup is successful the RCB-W24B-LVDS module can be controlled using the DSPW Plugin for Open Ephys GUI. See User Interface section for more information.



AP MODE RECOVERY PROCEDURE

Use these instructions to perform AP Mode recovery. See above AP Mode Switch settings for correct AP Mode Switch setting.

Whenever setting up (provisioning) the RCB-W24B-LVDS unit use a fully charged battery. During the setup process, data is written to the RCB-W24B-LVDS Flash memory. Maintaining a stable power supply is crucial to prevent attempts to write to Flash memory with a low battery, which could result in data corruption.

Steps.

1. **Remove Battery Cover and Battery:** Slide cover to remove. Lift Battery from the side opposite the battery connector.
2. **AP Mode Switch Setting:** Slide AP selection switch to the side nearest to the Battery connector to turn On AP Mode.
3. **Insert the RCB-W24B-LVDS Battery:** Carefully insert the NB-11L battery into the RCB-W24B-LVDS device. Ensure the battery polarity matches to avoid damage.
4. **Power On the RCB-W24B-LVDS Device:** Slide the Power Enable Switch located on the left side of the device to the ON position.
5. **Verify RCB-W24B-LVDS LED Status:** After powering on, the Blue LED should blink slowly. This indicates the RCB-W24B-LVDS device has booted and is now in AP mode.
6. **Scan for Wi-Fi Networks:** On your PC, scan for available Wi-Fi networks.
7. **Locate the RCB-W24B-LVDS AP Mode SSID:** Look for a network named dspwlink-abcdef, where abcdef corresponds to the last six digits of the MAC address found on the RCB-W24B-LVDS box label.
8. **Connect to the RCB-W24B-LVDS AP Mode Network:** Connect your PC to the dspwlink-abcdef Wi-Fi network. This is an open network with no password.
9. **Access the Configuration Page:** Open a web browser and navigate to 192.168.1.1. This will open the RCB-W24B-LVDS Status webpage.
10. **Set Up the Wi-Fi Profile:** Navigate to the **Profiles** tab on the webpage.
11. **Enter network settings:** Enter your router's SSID, WPA2 password, and set the priority (use "7" for highest priority). WPA2 is required.
12. **Save to the profiles list.** After pressing the "Add" button the profile should be listed in the Profiles list.
13. **AP Mode Setting:** Slide AP selection switch to the side away from the Battery connector to turn Off AP Mode.
14. **Power Cycle the Device:** Turn RCB-W24B-LVDS OFF, then ON to apply changes. Note that two power cycles may be necessary.
15. The **dspwlink-abcdef** network should no longer appear as an available Wi-Fi network.
16. **Reconnect Your PC:** Connect your PC to your Wi-Fi router, preferably using a wired Ethernet connection or the 5GHz Wi-Fi channel to reduce interference.
17. **Verify Connection:** After Power Cycle and reboot, RCB-W24B-LVDS should connect to your Wi-Fi router. The Blue LED will blink a few times and then twinkle slowly, indicating a successful connection.
18. **Access the RCB-W24B-LVDS:** Open a browser to 192.168.0.93 to confirm connectivity. If you have changed the RCB IP Addr use new IP Addr to confirm.

Once setup is successful the RCB-W24B-LVDS module can be controlled using the DSPW Plugin for Open Ephys GUI. See User Interface section for more information.



RCB-W24B-LVDS WEB BROWSER PROVISIONING SETUP

Status page

Set browser URL to 192.168.0.93. Status is the Default page or press "Status" button to display this page.

RCB-W24B-LVDS	Status	Device Config	IP Config	Profiles
DSPW Status				
Device				
Device Name:		RCB-W24B-LVDS		
Device Mode:		Station		
MAC Address:		D8:B0:4C:D2:7E:3E		
Station				
DHCP State:		Disabled		
IP Address:		192.168.0.93		
Subnet Mask:		255.255.255.0		
Default Gateway:		192.168.0.1		
DNS server:		192.168.0.1		
Access Point				
Channel No:		6		
SSID:		dspwlink-d27e3e		
Security Type:		Open		
Domain Name:		dspwlink.net		
IP Address:		192.168.1.1		
DHCP Server:				
Start Address:		192.168.1.2		
Last Address:		192.168.1.254		
Lease Time:		86400		
Version				
2.9.0.000 _ 31.1.4.0.1 _ 1.0.3.25 _ 0x4000010				

**Device Configuration page.**

Press "Device Config" button.

Used to set RCB-W24B-LVDS Device Name and Connection policy.

Device name should be seen on your Wi-Fi routers list of connected devices.

Device Name can be set to a friendly name to help identify a particular RCB-W24B-LVDS. Most helpful if you have multiple RCB-W24B-LVDS devices.

Please do not change Connection Policy unless instructed to do so by DSPW support.

The screenshot shows a web browser window with the address bar displaying 192.168.0.93. The page has a navigation bar with tabs: RCB-W24B-LVDS, Status, Device Config, IP Config, and Profiles. The 'Device Config' tab is active, showing the 'DSPW Device Configuration' page. The page is divided into two main sections: 'Device' and 'Connection Policy'. The 'Device' section has a 'Device Name' field with the value 'RCB-W24B-LVDS' and an 'Apply' button. The 'Connection Policy' section has two radio buttons: 'Auto Start' (selected) and 'Fast Connect'. Below the radio buttons is a 'Set Connection Policy' button and a warning message: 'Do not change setting unless instructed to do so by DSPW support. Mode will take effect after RCB-LVDS module power cycle.'



IP Configuration Page.

Press "IP Config" button.

This page is used to set RCB-W24B-LVDS Fixed IP number that is used in STA mode.

The default factory setting is:

IP Address: 192.168.0.93

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.0.1

DNS Server: 192.168.0.1

We assume that your Wi-Fi router is set for a local network of 192.168.0.xxx. if this is not how your network is configured, please adjust either your network settings or change the RCB-W24B-LVDS network IP setting to match your router settings.

If the network settings are changed to a wrong setting, ex. Wrong IP address, and the RCB-W24B-LVDS device cannot connect to the router in STA mode. Use AP mode recovery as described above. Or contact DSPW support for help.



Profiles Configuration Page

Press "Profiles" button.

This page is used to associate your Wi-Fi network SSID with the RCB-W24B-LVDS. Four profiles can be saved. For most users only one profile will be used.

Enter your Wi-Fi network SSID, Security Type - WPA2, and WPA2 Security Key (password).

Also enter a priority. 7 is highest priority, 0 is lowest priority.

After pressing "Add" button the profile should be listed in the Profiles list. If you enter incorrect information or the router is not turned on, and the module cannot connect the profile may be deleted. Try again.

Power cycle RCB-W24B-LVDS using the Power Switch on left side of the RCB-W24B-LVDS.

After the RCB-W24B-LVDS reboots (power cycle) it will attempt to connect to the SSID in the profile with highest Priority 7, then Priority 6, SSID Priority 0 will be tried last.

If successful, RCB-W24B-LVDS will connect to the Wi-Fi network associated with the SSID and will be in STA mode. In STA mode LED will twinkle. You should now connect your PC to the same network as RCB-W24-LVDS and open browser to 192.168.0.93 (default IP) to verify Profile is working OK and that you can communicate with your RCB-W24B-LVDS.



OPEN EPHYS GUI PLUGIN USER INTERFACE

The RCB-W24B-LVDS user interface is an Open Ephys GUI Plugin – DSPW RCB Wi-Fi.

DSPW RCB Wi-Fi Plugin is designed and tested to work with Open Ephys GUI v0.6.7.

Plugin is available for x86 Windows and x86 MacOS and Linux. Tested on Win10/11, MacOS Monterey and Ubuntu 22.04.02. Other OS versions may work as well.



DSPW assumes that users are familiar with the Open Ephys GUI. Open Ephys GUI is a free download from the Open Ephys website - open-ephys.org. Please refer to the Open Ephys GUI docs and wiki for support and help with OE GUI behaviors.

The DSPW RCB Wi-Fi Plugin has a few controls that are similar to the Plugin used with the Intan USB board. Such as Upper/Lower bandpass filter settings and sample rate. For details on Intan RHD2000 product behaviors check on the Intan Technologies website.

Most DSPW Plugin controls and status are specific to the DSPW RCB Wi-Fi Plugin (below).

How to Install the Plugin

DSPW RCB Wi-Fi Plugin is currently available on the DSPW website downloads area. Plugin files are different for each OS. Contact DSPW support for help with plugin installation.

Instructions for installation depends on if Win10/11 vs MacOS vs Linux.

- **Win10/11:** Copy RCB-WiFi.dll to - C:\Program Files\Open Ephys\plugins
- **MacOS:** Copy RCB-WiFi.bundle to - Home/Library/Application Support/open-ephys/plugins-api8. Directory is hidden. Command/shift/period to show in Finder.
- **Linux:** Copy RCB-WiFi.so to - your open-ephys-gui-v0.6.7.deb. extraction dir - /usr/local/bin/open-ephys-gui/plugins/plugins

Contact DSPW support for help with installation.

At a future date DSPW RCB Wi-Fi Plugin will be available using the OE GUI Plugin Installer.



Before You launch the Open Ephys GUI

- Connect your computer to the same network as the RCB-W24B-LVDS device.
- Turn on the RCB-W24B-LVDS and verify that it has connected to the Wi-Fi Router.
 - Blue LED will flash a few times and then twinkle at a low duty cycle.
 - RCB-W24B-LVDS should be available on the network. Open browser or ping 192.168.0.93 (default IP) to verify connectivity if needed.

Plugin First time use vs after Modification

- First time use – When plugin is first dragged into the Signal Chain area, plugin will have default values. Ex. Default RCB IP Addr is 192.168.0.93 as is shown above.
- Once Plugin has been saved it will reopen with last used values for Ip Number etc.
- For example, if modified RCB IP Addr is 192.168.0.94, then that number will be used upon restarting the GUI. Below graphic shows plugin with modified IP Addr:

The screenshot shows the DSPW RCB WI-FI plugin interface with the following settings:

DSPW RCB WI-FI				v0.1.8	
RCB IP Addr:	DSP	HPF	Fs (Hz)	AUX CH	Packet PDR: 99.999%
192.168.0.93	DSP: 0.8	0.8	20000	Enable	SQ N-1507864
Host IP Addr:	Upper	Channels	Event #		Good-1507846
192.168.0.149	5.0 kHz	32 1	Set 0		Miss-18
Port	Initialize	Lower	PA Attn	Time ms	RHD2132 Bat Poll
51233	Ready	1.0 Hz	4	1000	32Ch Uni Rate (m)
					Bat 3.93V OK OFF

DSPW RCB Wi-Fi Plugin Setup

1. Launch the Open Ephys GUI v0.6.7.
2. Drag the **DSPW RCB Wi-Fi** Plugin to the Signal Chain area.
3. Plugin will try to find the correct IP address of the Host PC.
 - a. If Host IP Address is not correct, edit the Host IP Addr: in the space provided.
4. On the DSPW Plugin enter correct configuration information for your system:
 - a. **RCB IP Address:** Default is 192.168.0.93. Update if changed during setup.
 - b. **GUI Host IP Address:** Verify the correct IP Address for your Host computer.
 - c. **Port:** Default is 51234. Change only if a conflict occurs.
 - d. **DSP HPF** - Filter On/Off and cutoff value.
 - e. RHD2000 **Upper** filter – default is 7.5 kHz - **Lower** filter – default is 1.0 Hz
 - f. Sample rate **Fs** – default 20000 Hz nominal. Actual Fs will be different.
 - g. **Channels** – Number of data channels, starting channel – Default 32,1
 - h. **PA Attn** - Reduces max Wi-Fi Power Amp Tx Power. Default is 4.
 - i. **AUX CH** Button - Enable/Disable Intan RHD headstage AUX channels.
 - j. **Event #** Button – Set Event # TTL Events. If 0 then Broadcast Sync.
 - k. **Samples/ Time** – Enter samples for Event toggle/ Sync Time msec.
 - l. **Bat Poll Rate** - Poll rate (min) of network message to query Battery voltage.
5. Once Plugin has been saved it will reopen with last used values for IP Address etc.
 - a. See Open Ephys GUI docs and wiki for information regarding GUI behaviors.



View RHD2000 Data

- Click the **Configure (Init)** button in the lower-left corner of the plugin.
- If Init is successful,
 - the Configure button will indicate "Ready",
 - the DSPW RCB Wi-Fi plugin border will turn Orange.
 - the Open Ephys GUI "**Start/Stop Acquisition**" button will be enabled.
- Press **Start/Stop Acquisition** button to Start continuous UDP streaming data from RCB-W24B-LVDS to PC.
- Press **Start/Stop Acquisition** button again to Stop continuous UDP streaming data from RCB-W24B-LVDS to PC.

Monitoring Status

- **Packet Delivery Ratio (PDR%)**:
 - Should exceed 95% for reliable performance.
 - SQ N: - Each UDP Packet contains an incrementing Packet Sequence Number
 - Good: - number of good packets received from RCB-W24B-LVDS.
 - Miss: - number of missed or lost packets. This data cannot be recovered.
 - PDR% is updated as UDP packets are received.
- **Battery Voltage**:
 - Displays in real-time when streaming, on request when standby.
 - If RCB-W24B-LVDS is streaming data, voltage is reported in each UDP packet.
 - When not sending UDP packets the voltage is updated when the Configure (Init) button is pressed or at the Bat Poll Rate.
- **RHD Status**:
 - Detects headstage type and SPI connection issues.
 - Shows type of RHD headstage that is connected via SPI cable.
 - Shows Error if no Intan headstage is connected.
 - Updated when the Configure (Init) button is pressed.

Multiple RCB devices using Multiple OE GUI Signal Chains

- Multiple RCB devices can be used with Open Ephys GUI.
- Add an instance of the DSPW Plugin to each GUI Signal Chain.
- Each RCB device must have a unique IP Address.
- PC Host IP Address must be the same for Each signal Chain.
- PC Host Port number must be unique for Each signal Chain.
- Contact DSPW Support for help with setting up multiple RCB devices.
 - Not all combinations of Sample Rate and Number of Channels are supported.
 - For information on various Broadcast Synchronization methods please see the Synchronization Docs and App note. Contact DSPW Support for help.

Unsupported RHD2000 features

The DSPW RCB Wi-Fi Plugin currently does not support these RHD2000 features:

- **Impedance Testing**: Impedance measurements are unavailable in this version.
- **Fast Settle**: The fast-settle function is not supported.

Note: These features may be added in future release. Check for updates at DSPW Support.



TROUBLESHOOTING

Wi-Fi Connection Issues

- **Initial setup** (provisioning)
 - Device not broadcasting AP mode SSID:
 - Verify the AP Mode switch is in the correct position.
 - Ensure the device is powered on (Blue LED blinking slowly).
- **After provisioning is successful**
 - Device not connecting to router in STA mode:
 - Double-check the SSID and password entered during provision setup.
 - Verify the router supports 2.4GHz Wi-Fi.
 - Check that Wi-Fi router is turned on.
 - Verify that router subnet is the same as RCB-W24B-LVDS subnet.

RCB Wi-Fi Plugin Issues

- Installation:
 - Download from website - tbd
 - Install with Plugin Installer - tbd
- Configuration:
 - Plugin is Grey, no Orange border.
 - Check IP address, Host address and port settings in the DSPW plugin matches your RCB-W24B-LVDS configuration
 - Check that battery is charged.

Data Streaming Issues

- Packet Delivery Ratio (PDR%):
 - Low Reduce network congestion by using a private network.
 - Ensure the RCB-W24B-LVDS device is within range of the router.
 - Consider changing PA ATTN to 0 (will use more battery).
 - Don't turn on the lab microwave oven!
- No data displayed in Open Ephys GUI:
 - Confirm the IP address, Host address and port settings in the DSPW plugin matches your RCB-W24B-LVDS configuration.
 - If there are multiple signal chains, all must be ready to transmit.
 - Restart the GUI and reinitialize the plugin.

Battery-Related Issues

- Device not powering on:
 - Check the battery for correct insertion and polarity.
 - Recharge the battery if the voltage is below 3.5V.
- Short battery life:
 - Avoid deep discharges below 3.3V.
 - Replace aging batteries as their capacity diminishes over time.
 - Aging effect increases if battery is continually deeply discharged.
- Inserting the battery incorrectly can damage the device and void the warranty.
- Power usage will depend on number of channels, sample rate and PA power setting.
- For 32 channels @ 20ksps, PA Attn set to 4, RCB will draw approximately 150mA average current from battery when streaming, 6mA when not streaming (standby).



WARRANTY

Summary of Terms

DSP Wireless, Inc. (DSPW) offers a limited hardware warranty for the RCB-W24B-LVDS device. Below is a summary for your convenience.

This summary is provided for your convenience only and is not an official statement. For the official warranty statement, please see "**Official Warranty Terms**" below.

- **Intended use:** *For use with and on animals only. Not intended for use on Humans.*
- **Warranty Coverage:** *The product is warranted to be free from material defects for 90 days under normal use and within specification.*
- **Approval Requirement:** *Obtain approval from DSPW Support before sending a product for repair. Contact support at www.dspwi.com/support. Additional information regarding your issue may be requested.*
- **Documentation:** *Include a written note describing the issue when shipping the product for repair.*
- **Disassembly:** *Disassembling the product for any reason is prohibited and will void the warranty unconditionally.*
- **Exclusions:** *The warranty does not cover obvious misuse, such as incorrect power supply voltage or usage outside the specifications outlined in the product manual.*
- **Shipping:** *Customers are responsible for shipping costs to DSPW's facility in New Hampshire. DSPW will cover the return shipping for repaired or replaced goods."*

Official Warranty Terms

Intended Use.

DSP Wireless, Inc. (DSPW) products are designed and sold for use in teaching and research applications in lab environments with animal models. DSPW products are not intended for use as medical devices or in medical environments. No product supplied by DSPW is intended to be used for diagnosis, treatment, or monitoring of a subject. Furthermore, no DSPW product is intended for the prevention, curing or alleviation of disease, injury or disability. **DSPW products are not intended for use on Humans.**

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DSP Wireless, Inc. (DSPW) products are manufactured and designed to perform as specified in the supplied documentation. Each device undergoes individual testing and a burn-in process before leaving our manufacturing facility to ensure reliability and quality and technical support is provided for all products. Nevertheless, since DSPW products could be affected by external factors, such as the computer system on which the product operates, Wi-Fi network environment in which the product is used, absolute performance and reliability cannot be guaranteed.

The Purchaser therefore assumes all risks as to the performance and reliability of the products and the results gained using them.

DSPW is not responsible for any problems or issues with the user computer system or Wi-Fi router not directly related to DSPW products.



Official Warranty Terms cont.

Furthermore, DSPW does not assume, nor authorize any individual or institution to assume on its behalf, liability in connection with the sale, installation, service or use of its products.

DSPW shall not be held liable for any special, consequential or punitive damages arising from the sale, installation, service, or use of its products.

If you suspect that your DSPW product is malfunctioning, please contact our Technical Support Team (www.dspw.io/support). If DSPW Support agrees that your device might be defective, the following terms will apply based on your specific product:

Hardware Warranty

We guarantee our products to be free of material defects for 90 days of normal use and within specified operating conditions. Since our products are used in conjunction with customer hardware, each warranty claim will be evaluated on a case-by-case basis.

This warranty does not apply to products that have been modified in design or function, subjected to abuse, misuse, mishandling, or unauthorized repair. However, within the 90-day use period, if the failure is found to be solely due to defects in our product during normal use within specification, we will, at our discretion, repair or replace the product, provided it is returned in its original condition. Please contact us for return instructions prior to returning any products. Note that shipping costs are non-refundable."

During this 90 day period, if a customer is unable to resolve a product issue, and DSPW determines that the product is defective, a Return Material Authorization (RMA) will be issued. Upon receiving an RMA, the customer must return the product to DSPW in NH at customer's expense. Returned product must include a written description of the defect for evaluation.

Upon receiving the defective product, DSPW will conduct warranty verification. This process includes a visual inspection and testing to assess normal wear and tear, unauthorized alteration, and functional compliance of the returned product. Any product production label must be present and intact.

Once the warranty is verified, DSPW will repair or replace the product and ship it back to the Customer within 30 business days or best effort. Repaired (or replacement) product is shipped back to the Customer at DSPW's expense.

If the product is not covered under warranty, the customer may opt to have DSPW repair the unit for a fee or have the product returned without repair. Repairs are conducted at DSPW facility in New Hampshire, USA. This warranty does not cover repair at the Customer's site.

This warranty becomes void under the following conditions:

- DSPW determines that product was used in an unauthorized or improper manner.
- Product was deployed in an environment not designed for its use, as outlined in the specifications and product documentation.
- Product was disassembled or tampered with by the customer.

Customers will not be charged for repairs if the product is under warranty. However, if the returned product fails warranty verification, additional fees for testing, repairs, and/or shipping may apply.



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