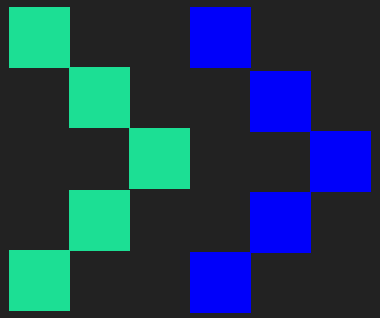
Revolve User Manual

For the Discover ECHO App



Questions? Contact ECHO Support
Support Chat: discover-echo.com/contact
General Email: info@discover-echo.com
Service Email: support@discover-echo.com

ECHO’s Mission Statement

ECHO is built on two foundations:

1. We build the best microscopes in the industry. With progressive design, we empower our users to change the way they view science.

2. We commercialize our products by providing unmatched value to our customers and distributors. Our brand changes outdated perceptions and defines the future of microscopy.

For more information about your Revolve, or for any assistance with Setup and Operation, please contact us on our website at discover-echo.com/support.

2. Operating Instructions

2.1 Restrictions

Both the Revolve Microscope and the Discover ECHO App (the “App”, “ECHO App”) are intended for research, investigational, and educational usage only. The Revolve Microscope and Discover ECHO App are not intended to be used for diagnostic purposes, testing, or treatment in humans.

2.2 Maintenance

The Revolve requires no regularly scheduled maintenance. In case of an error or problem with your system, the iPad and Revolve are both covered by a One-Year (1) Manufacturer Warranty, starting 14 days after shipment from ECHO. Additional Warranty coverage may be purchased at a later date. Contact ECHO Support via email with your scope Serial Number (SN) for details.

Your Revolve can be cleaned with up to a 70% Ethanol solution in the event that it needs to be decontaminated for experiments. Avoid spraying the solution directly onto the system to reduce the risk of seepage into internal electronics.

The Revolve only requires a single cable for power. This power cable will come with an adapter for your country’s or municipality’s standard power type. The iPad charges utilizing the USB-C cable extending from the rear panel of your Revolve.

2.3 Safety Instructions

This symbol means that there is a risk of an electric shock. An electric shock could cause death or personal injury.

The Revolve has been certified by international, CA, EU, UK, and US safety standards and is safe to use when operated in accordance with this manual. Proper usage of the Revolve will limit the chance of an electric shock to the user.

Do not look directly into the LED illuminated light source. High strength LED light, particularly that from the UV and IR portions of the spectrum, can be damaging to your eyes. Max LED strength at source for the BF LED is 10W. FL LEDs have a max source strength of 2W.

To reduce the risk of injury, please use this system with care and take the following precautions:

• All maintenance should only be completed by ECHO-authorized parties. Unauthorized third-party maintenance will void your warranty.

• Only use Revolve once you have read this manual, been trained on use of the scope by ECHO or your company, and/or have watched our YouTube Series.

• Do not utilize any power bricks or cables that have not been supplied by Discover ECHO.

• Plug the system into a surge protector. Ensure the cable is easily accessible to remove the system from power.

• Do not insert foreign objects into the user access panel or microscope ports.

• Do not insert foreign objects into the rotation or locking mechanisms.

• Do not open the microscope while the LEDs are still on.

• Do not expose the microscope stand to fluids.

Discover Echo disclaims all warranties and shall in no event be liable for any kind of damages caused by or arising out of any kind of operation or use in violation with the above safety and handling procedures.

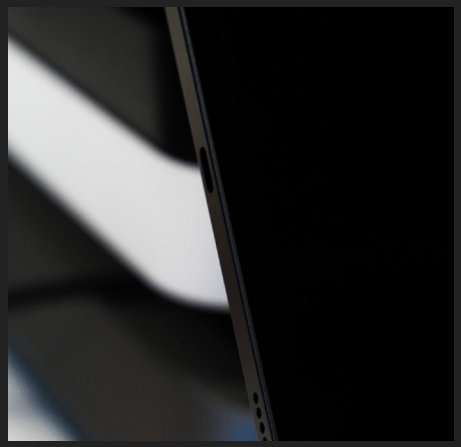


Image top: USB-C cable from the ECHO Revolve. Note that your cable may either be black or white.

Image bottom: USB-C input on the side of the iPad. USB-C cables can be plugged in either orientation and still provide charge and data connection to the iPad.

2.4 Revolve System Components

Depending on if you have purchased additional condensers or objectives, you may have fewer components than outlined in this list. Different models of the Revolve (B, G, D, M, RVL2-) may appear slightly different and utilize different internal electronics. Additionally, depending on if you have ordered an R3 (BF only) or R4 (FL capable) Revolve, some internals may be different. This manual will utilize the RVL2- generations of Revolve. Other Revolve generations may not have some features covered in this manual.

Model	Serial Number Contains
Beta	B-*****
Gamma	G-*****
Delta	D-*****
Omega	M-*****
Kappa	RVL2-K****
Kappa 2	RVL2-K2-*****
Kappa 3	RVL2-K3-*****
Kappa 4	RVL2-K4-*****

2.5 Installation

Your Revolve will be installed by your local ECHO Representative or a Representative of your ECHO-Approved Distributor. If this service is unavailable at your location, please contact Discover ECHO for detailed Microscope installation instructions.

Users can install or change accessories on their own.

A typical Revolve will include:

One Revolve Body, containing:

1. One 12MP Color Camera
2. One 5MP Mono Camera (R4 Only, required for FL capture)
3. Ethernet (RJ45) Port
4. USB-A Port – Data export
5. USB-C Port – Focus Puck

One or More Condensers (if purchased)

1. LWD Universal Condenser
2. LWUCD Universal Condenser
3. High-Resolution Universal Phase Turret Condenser
4. Swing-out Condenser

One Stage

Plate-inserts (if purchased)

Objective lenses (if purchased)

LED and Filter Cubes (if purchased)

One 12.9” iPad Tablet, pre-loaded with the ECHO Lite App.

One Remote Focus Puck

One power cable, brick, and local adapter.

Revolve Microscope Body with various available accessories. Not all accessories pictured may come with your microscope. Condensers, FL LEDs & Filter Cubes, Plate Inserts, and Objectives are all sold separately.

Rear panel of the Revolve Microscope. The sticker with the Serial Number and Wi-Fi Network (SSID and Password), along with the power, ethernet, and USB-C ports are highlighted.

2.5.1 Switching Objectives

The Revolve supports up to 6 objectives on the same nosepiece turret (INP). It is easier to swap objectives in the inverted configuration.

To change objectives:

1. Rotate to the desired slot.
2. If there is already an objective in this location, remove the objective by turning it counterclockwise.
3. Install your new objective by aligning the thread in the turret with that of your objective. Rotate clockwise until the objective base is seated firmly against the nosepiece.

To update your objective within the software:

1. Tap on the objective icon from the top bar of the Discover ECHO App.
2. Select your objective's magnification.
3. Select your objective's Numerical Aperture.

If you change the objective again at a later time, please ensure you re-program the objective within the software.

2.5.2 Switching Condensers

To install either the High-Resolution or Swing-Out Condenser, you will first need to remove any pre-installed condenser. If you ordered the ELWD Condenser as well, this will be pre-installed.

To install the High-Resolution Condenser or Darkfield Condensers:

1. Slide the Condenser latch all the way to the left.
2. Install the Condenser by slotting it into place. There will only be one orientation the condenser will fit.
3. Lock the Condenser latch to the right to lock the Condenser in place.
4. Raise the condenser into position and being Köhler Illumination Alignment

To install the Swing-Out Condenser:

1. Make sure the swing-our collimator is rotated into the down position before installing.
2. Install the Condenser by slotting it into place. There will only be one orientation the condenser will fit.
3. Lock the Condenser latch to the right to lock the Condenser in place.
4. Flip the swing-out collimator into position.
5. Raise the condenser into position and being Köhler Illumination Alignment

To install the LWUCD Condenser:

1. Slide the Condenser latch all the way to the left.
2. Install the Condenser by slotting it into place. There will only be one orientation the condenser will fit.
3. Lock the Condenser latch to the right to lock the Condenser in place.

To complete Kohler Illumination, which is not required on the ELWD or LWUCD condensers:

1. Using your lowest magnitude objective, find the focal plane of your sample.
2. Remove the sample.
3. Close down the aperture on the condenser.
4. Raise the condenser. You should see a sharp hexagon shape on the iPad screen.
5. Using the set screws on either side of the condenser, move the hexagon to the center of your screen.
6. Repeat for higher mag objectives.

On the Swing-Out Condenser, the lowest mag objective we recommend Köhlering with is 10x. Lower magnitude objectives may not exhibit a large enough hexagon for aligning lower magnitude objectives with the swing-out collimator in position.

2.5.3 Switching LEDs and Filter Cubes

The Revolve R4 supports up to 4 simultaneously-installed fluorescent channels. To install a new channel or swap out a channel:

1. Convert the Revolve into the inverted configuration.
2. Raise the nosepiece for clearance.
3. Remove the user access panel.
4. Identify an open position on the lightbox and filter turret. If there is not a position open, remove one FL LED and the corresponding Filter Cube.
5. Slot the FL LED into the desired channel. You may feel a magnetic attracting force which will guide the FL LED into position. Press the FL LED firmly into position to seat.
6. Slot the corresponding Filter Cube into the same channel on the automated FL turret. You may feel a magnetic attracting force which will guide the Filter Cube into position. Press firmly on the Filter Cube to seat.
7. Update the FL channel name in the Discover ECHO App by opening FL mode, then long-pressing on the name of a filter cube at the bottom. Select "Edit Channels". Rename your FL channel and update the color as desired. FL channel names cannot contain special characters.

2.6 Connecting to and Networking Revolve

The iPad must be connected Revolve to utilize core functions of the microscope. These include:

1. Adjusting LED Lighting Controls
2. Adjusting Image Exposure
3. Capturing Images
4. Sharing Images via the included USB-A port

Networking Revolve adds additional features:

1. Network Access
2. Exporting Images via Cloud Services
3. Exporting Images via Network Server (SMB)

2.6.1 Connecting to Revolve

To connect via Revolve's Built-in Wi-Fi hotspot:

1. Locate your Revolve's SSID. This is printed on the Rear Sticker of your Revolve Microscope.
2. Locate your Revolve's Wi-Fi password. This is also printed on the Rear Sticker of your Revolve Microscope. The Wi-Fi password cannot be changed.
3. Open iOS Settings > Wi-Fi
4. Select your Revolve's Wi-Fi network.
5. Enter your Revolve's Wi-Fi password.
6. Select the "I" icon and disable both "Private Wi-Fi Address" and "Limit IP Address Tracking".

To connect to Revolve's USB-C Ethernet network, which is only available on RVL2-systems, but provides a faster, more stable connection:

1. Plug your iPad into the USB-C charging cable extending from Revolve.
2. Open iOS Settings > Wi-Fi.
3. Turn off Wi-Fi.
4. Select iOS Settings > Ethernet > USB 10/100/1000 LAN.
5. Check the IP address is showing 10.0.0.XX.

After connecting to Revolve, open the Discover ECHO App and check the Microscope Status Connection Indicator at the top of the app.

2.6.2 Networking Revolve

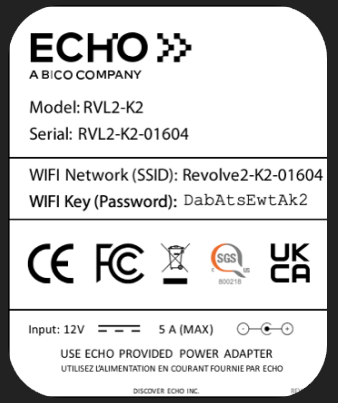
After connecting your iPad and Revolve, Revolve can be networked to a corporate or institutional network. These steps are completed through the Discover ECHO App.

Revolve is designed to be a "Plug and Play" device. Therefore, the Microscope's network configurations are not accessible. The Microscope is shipped as "open" from the factory. Network ports on the Microscope cannot be closed or reconfigured. The microscope's internal CPU cannot be accessed by the user. This CPU receives firmware and security updates when the App is updated.

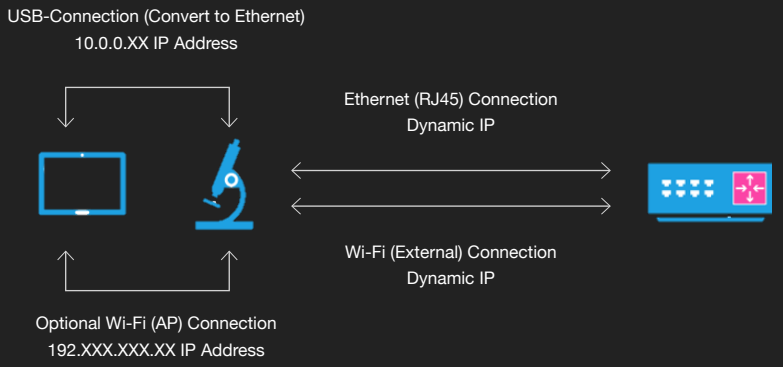
Networking Revolve will not expose the iPad's IP or MAC address to an external network. Rather, it will turn the Revolve Network into an Access Point for the connected iPad. Lastly, networking Revolve does not mean that any device on the network can control the Revolve Microscope.

The Revolve can either be networked via Ethernet (Wired) or Wi-Fi (Wireless). Whenever possible, ECHO recommends using a wired connection due to the increased speed and stability provided.

Top – Three potential Microscope Status Connection Indicator states. Green indicates a proper connection. Grey indicates the iPad and Microscope are not properly connected. Red is an error code, which can typically be resolved by power-cycling the microscope. If power-cycling does not resolve the error code, please contact ECHO Support.



The rear sticker on Revolve. This contains the Wi-Fi Network name (SSID) and the password.



ECHO Rebel Network Diagram, provided by the Discover ECHO Engineering Team.

2.6.2.1 Networking via Ethernet

Before networking Revolve via Ethernet, please confirm that the Wall Port is enabled and if the network is Whitelisted.

If your Wall Port is crossed-over, please purchase a cross-over adapter and place this in line between the Revolve and Wall Port.

1. Plug an Ethernet (CAT) cable into the RJ45 port on the rear panel of your Revolve.
2. Plug the other end of the CAT cable into the wall port.
3. Open the Discover ECHO App.
4. Click on the Microscope Status Connection Indicator > Internet > Ethernet.
5. Check that the Ethernet Status shows a cable is “Plugged In”.
6. Record the MAC Address listed here for Whitelisting.
7. Check the IP Address. If either an IPV6 address is listed, or no IP address is listed, contact your IT Department with the MAC Address and Wall Port number.
8. Exit the Discover ECHO App and open your browser. Visit captive.apple.com or 1.1.1.1 to check for any landing pages. You may need to enter user account information to register this device.
9. Visit discover-echo.com to verify your device can connect to the internet.

Note: Revolve only supports IPv4 addresses. A IPv6 address indicates a blocked connection. Contact your IT department.

2.6.2.2 Networking via Wi-Fi

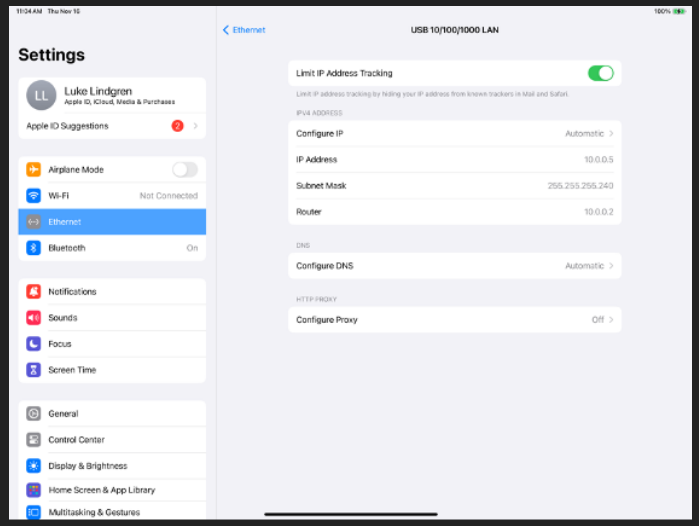
Revolve only supports the following network types:

1. Unsecure “Guest” Networks, which do not require any input for network access.
2. Password-only networks.
3. Landing Page “Airport” Networks. These redirect the user to a login page to enter a Username and Password.

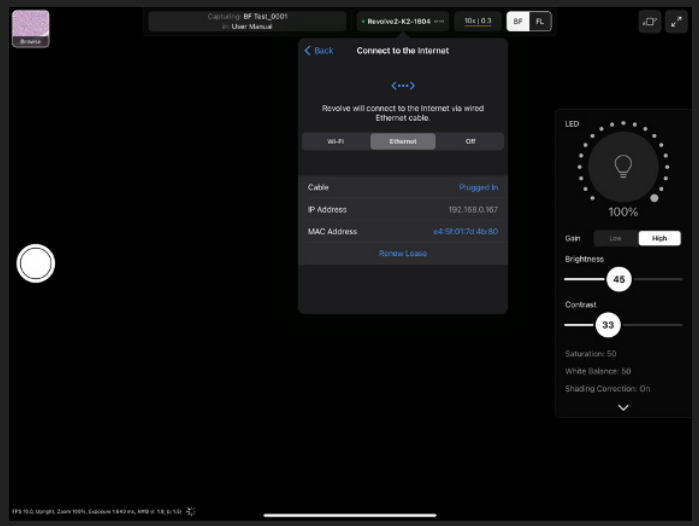
Once the network type is confirmed to be one of the 3 above network types:

1. Open the Discover ECHO App.
2. Click on the Microscope Status Connection Indicator > Internet > Wi-Fi.
3. Wait for the list of networks to load.
4. Locate and connect to your network. Follow any prompts on screen.
5. Once connected, close the Discover ECHO App and open your browser. Visit captive.apple.com or 1.1.1.1 to check for any landing pages. You may need to enter user account information to register this device.
6. Visit discover-echo.com to verify your device can connect to the internet.

Note: The Wi-Fi antenna inside your microscope may not be able to pick up your Wi-Fi network, even if the iPad can see it. Please try moving the microscope or connecting via Ethernet instead.



Screen capture of the iOS Settings App for an iPad which has been connected to Revolve’s USB-C Ethernet Network.



Screen capture of Discover ECHO App v. 7.1.0 network settings for a properly networked Revolve. Your MAC Address will be different than the one shown. Your IP Address may be different as these are randomly assigned by your Network.

3. First-Time Steps

When using Revolve for the first time, there are a few steps you will need to complete before performing microscopy with your Revolve.

These steps will require internet/network access. You can directly connect your iPad to your network to complete the following. After completion, please delete your internet credentials.

3.1 Create your Apple ID

To download apps from the App Store, and/or update iPadOS, you will need to have an Apple ID or have your iPad enrolled in an MDM plan.

To create an Apple ID, please follow the steps from Apple's Website https://support.apple.com/en-us/HT204316#ios) Note that a mobile phone number may be required for 2-Factor Authentication.

ECHO strongly recommends that more than one individual has access to the Apple ID login and password in case someone leaves or is on PTO. Additionally, the same Apple ID can be used for multiple iPads, so if your facility has multiple ECHO Microscopes, you will not need to create a unique Apple ID for each scope. ECHO does not manage user IDs and cannot help recover Apple IDs if the username or password are lost.

3.2 Update iPadOS

To prevent any potential glitches or incompatibilities, automatic updates are turned off by default on all iPads shipping from ECHO. Before updating, please contact your local ECHO Representative for additional information on the latest tested and supported iPadOS version.

In the event a security patch has been released, or if you'd like to update iPadOS:

1. Ensure you or another user has the Apple ID login information.
2. Open iOS Settings > General > Software Update.
3. Wait for the iPad to search for an update.
4. If an update is available, iPad will tell you which version it is. Please contact your local ECHO Representative or ECHO Support for the latest tested and approved iPadOS version.
5. If the update has been approved, please download and install the update.
6. If prompted, enter the Apple ID information.

3.3 Install Discover ECHO

Your iPad will come pre-loaded with ECHO Lite. This version of the app caps out at a maximum of 50 images. This app version is used by our team to build and QC your Revolve Microscope.

We strongly encourage upgrading to the Discover ECHO App, which is available for download from the Apple App Store.

1. Ensure you or another user has the Apple ID login information.
2. Open the App Store
3. Search for Discover ECHO
4. Click the "Get", "Download" or "Install" button.
5. If prompted, enter the Apple ID login information.
6. Close the App Store
7. Uninstall ECHO Lite by holding down the ECHO Lite icon until it vibrates.
8. Click the red "x" in the upper right-hand corner of the ECHO Lite icon.
9. Click on a blank portion of your iPad screen.
10. Open the Discover ECHO App when it has completed installing by quick-pressing the app icon.

4. Discover ECHO App Interface

The Discover ECHO App is designed to be intuitive, sharing a similar look to the iOS Camera and Files Apps. However, there are a few additional features that are unique to controlling a microscope – these include the Microscope Status Connection Indicator, the Capture Menu, Objective Indicator, Anti-Shake Indicator, and additional Image Controls.

4.1 Main Screen

4.1.1 Microscope Status Connection Indicator

The Microscope Status Connection Indicator has three potential LED colors to demonstrate connection status:

1. Green – Microscope is connected and healthy.
2. Grey – Microscope is not detected.
3. Red - Microscope Error.

If the indicator is grey or red:

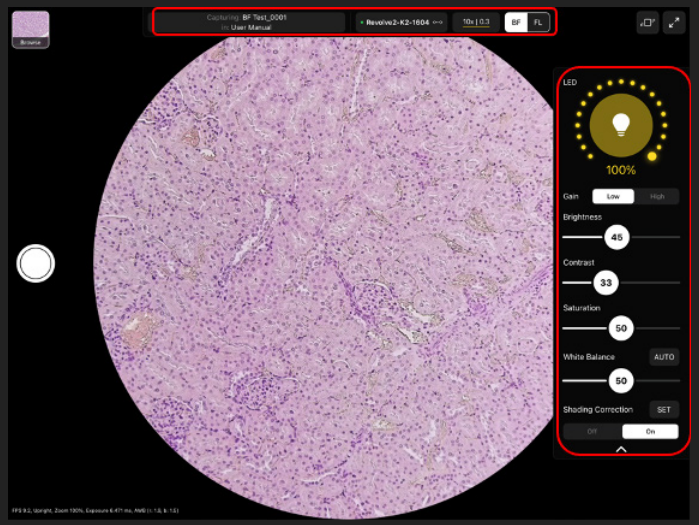
1. Force-quit the App by swiping up from the bottom of your screen to 1/3 up your screen.
2. Swipe up on the miniature app window. This will close the app.
3. Unplug your microscope from power.
4. Wait 30 seconds.
5. Plug power back in.
6. Wait 30 Seconds.
7. Open the Settings App on your iPad and ensure you are connected to your Revolve's Wi-Fi or Ethernet Network.
8. Open the Discover ECHO App.
9. If the issue has not resolved, please contact ECHO Customer Support.

4.1.2 Capture Menu

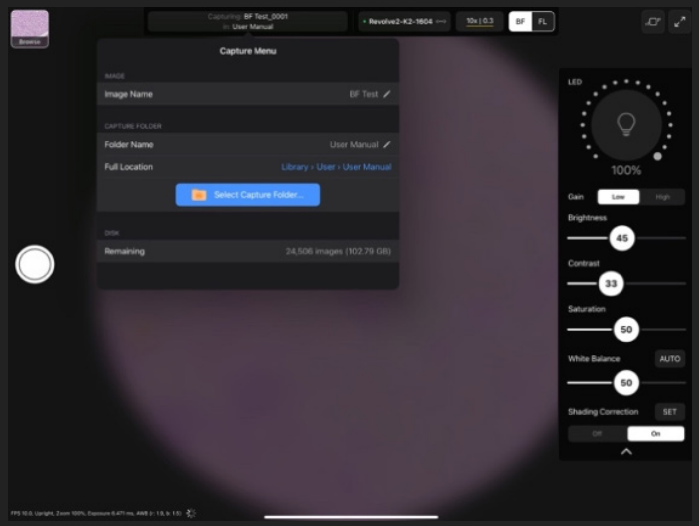
The Capture Menu is where folders and files can be named. Images are automatically indexed with a _XXXX.

If no other folders are created, images will default to saving in the main "Library" folder. You can change the capture folder by selecting the "Select Capture Folder…" icon. New folders can be created within this menu, up to 6 layers deep. Folder names cannot begin or end with a space, nor can they contain any reserved characters (? / \ : ; .)

The amount of disk space left on your iPad is also listed here. An estimate for how many image records this could be is printed next to the remaining space.



Screen capture of the Discover ECHO App, version 7.1.0, main screen. The covered controlled have been outlined in red boxes for easier viewing.



Cropped of the capture menu. In this example, image records are being saved to the location "Library\User\User Manual" (3 folders deep).

4.1.3 Capturing Images (BF)

Before capturing an image, it is important to ensure the camera is properly white balanced and that the shading correction does not have any burnt-in artifacts.

1. Remove your sample.
2. Tap the center of the iPad screen to re-expose the camera.
3. Select the downwards carrot to expose the extended camera controls.
4. Select “Auto” for White Balance.
5. If your Revolve has a shading correction toggle, select “SET”, then “On”.
6. Re-load your sample.

The right-hand menu of the Discover ECHO App contains most of the controls required to expose images.

1. LED Toggle and Intensity Dial: These can turn up and down the intensity of Revolve’s broad-spectrum LED.
2. Gain Toggle: Can be set to low or high.
3. Brightness Slider: This adjusts the post-capture brightness.
4. Contrast: This adjusts the post-capture contrast
5. Saturation: This adjusts the post-capture saturation.

Tapping the center of the iPad screen will auto-expose the image. There is no manual exposure in BF mode on Revolve.

Tapping the capture button on screen will take your image.

4.1.4 Capturing Images (FL)

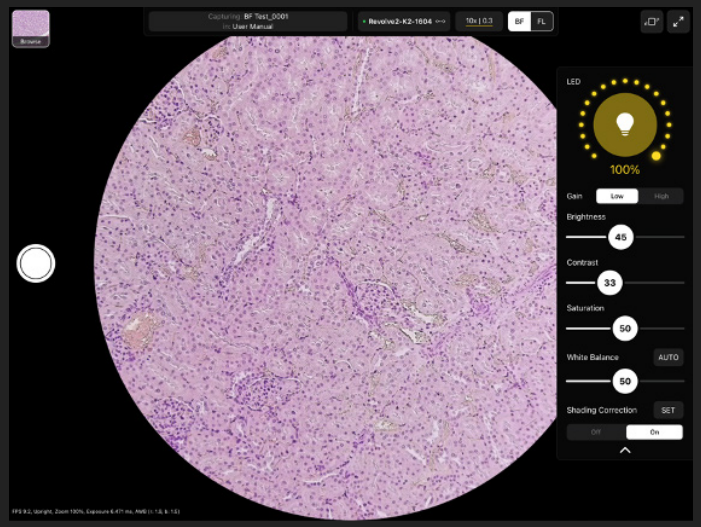
The FL capture mode will only be accessible on R4 Revolves. R3 Revolves do not have the monochrome camera required for FL imaging.

The right-hand menu of the Discover ECHO App contains most of the controls required to expose images.

1. DHR Control (if purchased) –toggle DHR on or up to 3 levels of DHR enhancement.
2. Channel Histogram: Adjust minimum and maximum displayed grey values manually or automatically.
3. Gain Toggle: Can be set to low or high.
4. Exposure controls: Increase or decrease the exposure in increments of 5msec or 50msec.
5. LED Toggle and Intensity Dial: These can turn up and down the intensity of the single-wavelength LED.
6. Capture Button: Short press captures just your current channel, a two finger long press toggles through all channels.

The controls listed at the bottom of the screen:

1. Capture Selection Toggle: Capture only single channel captures, channel overlays, or (if purchased) Z-Stack’s.
2. Pseudocolor Toggle
3. Channel Selector: Change which of the 4FL Channels (+Trans) you are currently capturing.



Screen capture of the Discover ECHO App, version 7.1.0, Revolve BF Mode Capture Screen.

Screen capture of the Discover ECHO App, version 7.1.0, Revolve FL Mode Capture Screen. The option to add different levels of DHR (Digital Haze Reduction) will require a DHR License. Likewise, the Z-Stack toggle will require a Z-Stack License.

4.2 Image Library

All captured records are saved directly to the Image Library within the Discover ECHO App.

Images can be moved between folders within the Image Library by selecting and dragging them into new folders. A group of images can be moved by using the Select Tool > Move.

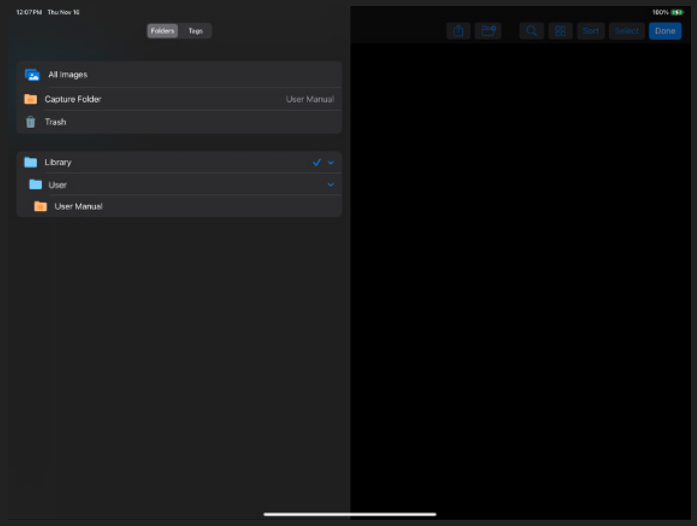
Folders or individual records can be exported using the Select Tool > Share.

Folders can be navigated through by clicking on them and using the “<” icon in the top left corner to go back, or by expanding the side menu for a high-level overview of file paths.

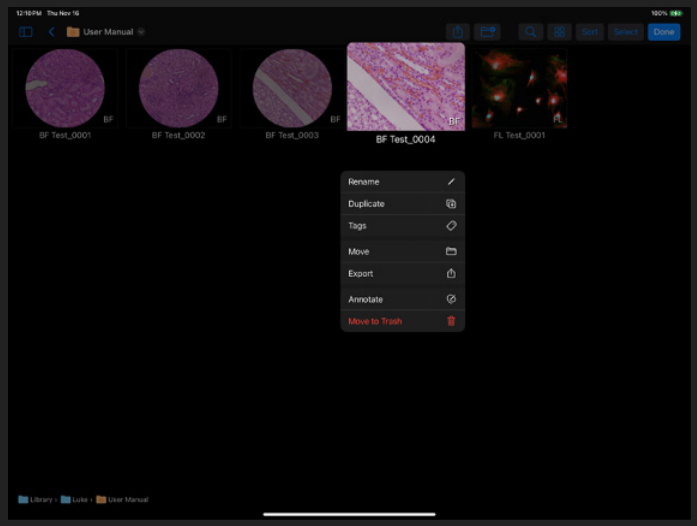
Records containing specific characters or phrases can be searched for by pressing the search icon, then entering a string of characters.

Tags can be added to a record by holding the record down > Tags. You can create as many tags as you would like, but there are only 8 color codes a tag may have.

The trash folder can only be selected by using the side menu. This folder is where deleted records will go. Trash must be manually emptied. If a record has been deleted from the Trash, it cannot be recovered.



Screen capture of the Discover ECHO App, v 7.1.0, Image Library root path screen. This is the highest-level folder that exists. The side menu has been selected, showing a high-level overview of all file paths.



Selected record. Selecting a single record displays a menu with all possible actions that can be completed to the record.

4.3 Images

Multichannel and Z-Stack images are saved as single records in the Discover ECHO App.

4.3.1 Annotations

Images can be annotated from within the Discover ECHO App. There are six different types of annotation tools available within the App:

1. Count
2. Arrow
3. Label
4. Length
5. Area
6. Scale Bar

The first 5 annotation tools can be color coded to blue, green, yellow, red, or white. These annotation tools can also be increased or decreased in size.

Area and length-based measurement tools will use the um/pixel measurements from the objective that was selected at time of capture. If this objective was incorrect, the magnification can be changed within the annotations menu.

Annotating an image retains an unannotated copy of the image.

4.3.2 Editing

Editing an image adjusts the post capture effects. BF, FL, and Z-Stack images can all be edited.

When editing a BF mode image, the following toggles can be adjusted.

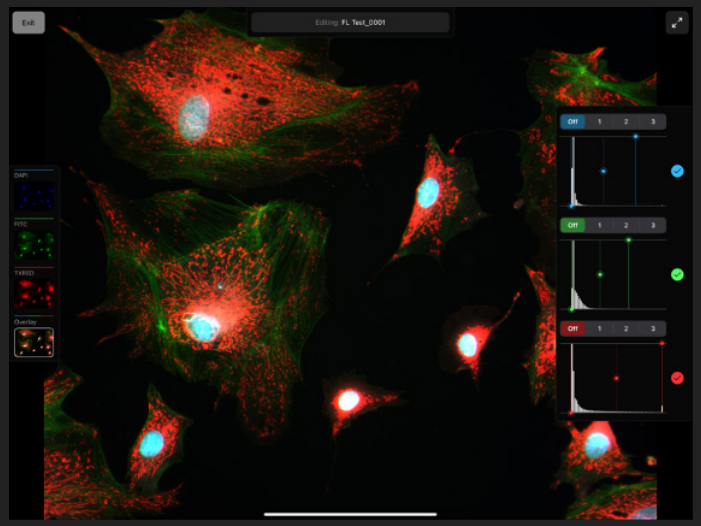
1. Brightness
2. Contrast
3. Saturation

When editing a FL mode image, the display curve (histogram) can be adjusted. If the iPad is connected to a scope with a DHR license, DHR levels can be adjusted. In FL overlay images, channels which were captured but later turned off can be reactivated.

When editing a Z-Stack image, the display curve (histogram) can be adjusted. If the iPad is connected to a scope with a DHR license, DHR levels can be adjusted. In Z-Stack images, deactivating a captured toggle will permanently remove it from the record.

Editing does not save an unannotated copy of the image. Edits are saved on top of the record, meaning they can be changed at any time.

Screen capture of the Discover ECHO App, v 7.1.0, Image Annotation Screen. Several annotations have already been placed on the image.



Screen capture of the Discover ECHO App, v.7.1.0, Image Edit Screen for an FL Mode Capture. DHR options will only show if the iPad is connected to a Revolve with a DHR license.

4.3.3 Exporting

Images can be exported from the Discover ECHO App as four different kinds of files:

1. **JPG** – Compressed, lossy image file type. 2-5MB in size.
2. **TIFF** – An uncompressed, lossless image file type. 20-50MB in size.
3. **CSV** – Metadata-only export in an excel-readable comma separated value file.
4. **Archive** – ECHO image archive file which allows for reimport back into the Discover ECHO App.

FL images also have the option of exporting individual channels or an overlay. Overlays will always be exported, in full color, as JPG. Single-channels captured in an overlay will be exported in color if exported as JPG, but will be exported in greyscale if exported as TIFF.

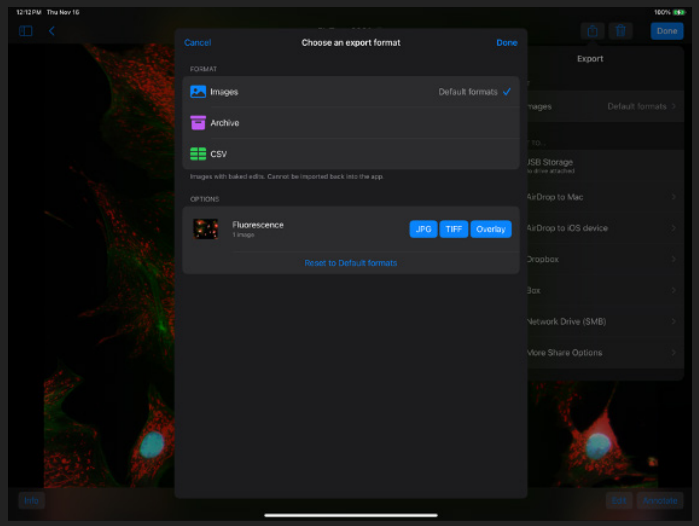
Z-Stack images can be exported as either individual z-slices, EDF, or MIP at the time of export.

The Discover ECHO App natively supports the following export methods:

1. **AirDrop** – Requires the use of other Apple products in lab.
2. **Box** – Requires networking of the scope.
3. **Dropbox** – Requires networking of the scope.
4. **Network Drive** (SMB) – Requires networking of the scope and a network server.
5. **USB Storage** – Revolves support unpowered drives under 2TB in storage size. Drive must be formatted to FAT32 (legacy Revolves) or exFAT/FAT32 (RVL2-) Revolves).

Natively supported export methods do not have a cap to the number of records that can be transferred in a single export.

Unsupported export methods, such as Google Drive or OneDrive, may appear within the export center if you have these Apps installed on your iPad. Unsupported export methods are subject to Apple's inter-app data transfer limitations, and therefore, may not export all selected records.



Screen capture of the Discover ECHO App, v 7.1.0, Export Menu. The default export type for any experiment is JPG.

5. Microscopy Modes

Your Revolve supports up to five different microscopy techniques in both the Upright and Inverted configurations. Sections 5.1-5.5 will cover how to perform each type of microscopy on the Revolve. Section 5.6 will explain how to convert your Revolve from Upright to Inverted.

5.1 Brightfield Microscopy

To take images in brightfield, first ensure that the selected phase ring on your condenser is set to “BF” and that the aperture is fully open.

1. Select “BF” mode.
2. Set the LED power in the Discover ECHO App to 100%.
3. Load your sample.
4. Rotate to your desired objective on the nosepiece.
5. Focus your objective.
6. Auto-expose the image by tapping the center of the screen or clicking Remote Focus Puck’s right button.
7. Lower the LED power as needed and re-expose.
8. Adjust your image brightness, contrast, saturation, and white balance.
9. Apply digital magnification (digital zoom) by pinching the image and opening the pinch to zoom in. The opposite motion will zoom out.
10. Click the circle button in the App to capture your image, or click the left button on your Remote Focus Puck.

5.2 Fluorescence Microscopy

5.2.1 Single/Overlay Captures

1. Select “FL” mode.
2. Select “Single” or “Overlay”. If choosing an overlay, repeat steps 4-10 for each channel.
3. Load your sample.
4. Set the LED power in the Discover ECHO App to 100%.
5. Rotate to your desired objective on the nosepiece.
6. Focus your objective.
7. Auto-expose your image by selecting the “Auto” button beneath the histogram, or manually set the exposure time by using the +/- buttons to adjust exposure in 5 or 50msec intervals.
8. Reduce LED power as needed.
9. Adjust your histogram bounds by selecting “Auto” or manually dragging the min and max displayed values, along with the gamma.
10. If you have DHR, select your desired amount of Digital Haze Reduction.
11. Apply digital magnification (digital zoom) by pinching the image and opening the pinch to zoom in. The opposite motion will zoom out.
12. Short press the capture button to capture a single channel, or capture all channels by long pressing the button with two fingers.

5.2.2 Z-Stack Captures

Requires a Z-Stack license on your Revolve.

1. Select the “FL” mode.
2. Select “Z-Stack”.
3. Load your sample.
4. Set the LED power in the Discover ECHO App to 100%.
5. Rotate to your desired objective on the nosepiece.
6. Focus your objective.
7. Select which channels you’d like to include in your Z-Stack using the left-side menu. If using multiple channels in your Z-Stack, repeat steps 8-10 for each channel.
8. Auto-expose your image by selecting the “Auto” button beneath the histogram, or manually set the exposure time by using the +/- buttons to adjust exposure in 5 or 50msec intervals.
9. Adjust your histogram bounds by selecting “Auto” or manually dragging the min and max displayed values, along with the gamma.
10. If you have DHR, select your desired amount of Digital Haze Reduction.
11. Set the bottom of your Z-Stack.
12. Set the top of your Z-Stack.
13. Select “Auto” or enter your own stack spacing. Note that the maximum thickness of a Z-Stack is 40 images/channel.
14. Press the start button.

5.3 Phase Contrast Microscopy

Phase-capable objectives will have magnification information printed in green, whereas brightfield-only objectives will have white text. Phase contrast can either be completed with BF or FL TRANS. The steps below assume imaging with BF Mode.

1. Fully open the condenser aperture.
2. Set the LED power in the Discover ECHO App to 100%.
3. Load your sample.
4. Rotate to your desired objective.
5. Select the corresponding phase ring on your condenser. Use of incompatible phase rings will cause a distorted image.
6. Apply the proper amount of oil to your objective as needed.
7. Auto-expose the image by tapping the center of the screen or clicking Remote Focus Puck’s right button.
8. Lower the LED power as needed and re-expose.
9. Adjust your image brightness, contrast, saturation, and white balance.
10. Apply digital magnification (digital zoom) by pinching the image and opening the pinch to zoom in. The opposite motion will zoom out.
11. Click the circle button in the App to capture your image, or click the left button on your Remote Focus Puck.

5.4 Darkfield Microscopy

Darkfield Microscopy can only be performed with two different condensers offered by ECHO. Other condensers may be able to simulate darkfield conditions. When working in Darkfield, your image background will be black.

5.4.1 Darkfield Condenser

If you are uncertain on how to utilize an oiled condenser or oil objectives, please contact the appropriate individual at your facility for instructions on how to utilize these pieces of equipment.

1. Fully open the condenser aperture.
2. Apply oil to the condenser lens.
3. Set the LED power in the Discover ECHO App to 100%.
4. Load your sample.
5. Raise your condenser slightly so it creates a firm seal between the condenser and slide.
6. Rotate to your desired objective.
7. Apply the proper amount of oil to your objective as needed.
8. Auto-expose the image by tapping the center of the screen or clicking Remote Focus Puck's right button.
9. Lower the LED power as needed and re-expose.
10. Adjust your image brightness, contrast, saturation, and white balance.
11. Apply digital magnification (digital zoom) by pinching the image and opening the pinch to zoom in. The opposite motion will zoom out.
12. Click the circle button in the App to capture your image, or click the left button on your Remote Focus Puck

5.4.2 High-Resolution Universal Phase Turret Condenser

The Darkfield stop on this condenser can create darkfield conditions for any objective with a numerical aperture below 0.55NA.

1. Fully open the condenser aperture.
2. Set the LED power in the Discover ECHO App to 100%.
3. Load your sample.
4. Rotate to your desired objective.
5. Select the DF stop on your condenser.
6. Auto-expose the image by tapping the center of the screen or clicking Remote Focus Puck's right button.
7. Lower the LED power as needed and re-expose.
8. Adjust your image brightness, contrast, saturation, and white balance.
9. Apply digital magnification (digital zoom) by pinching the image and opening the pinch to zoom in. The opposite motion will zoom out.
10. Click the circle button in the App to capture your image, or click the left button on your Remote Focus Puck.

5.5. Polarized Light Microscopy

ECHO offers two different polarizer options – a linear polarizer and a circular polarizer. Both polarizers are operated in the same way.

Only the circular polarizer can create a color image without use of third-party equipment. To create a color image with the linear polarizer, you would need to purchase a third-party quarter-wave plate. ECHO is not responsible for damages caused by this, or other, third-party add-ons.

To install and take an image with the polarizers:

1. Fully open the condenser aperture.
2. Set the phase ring to BF.
3. Place the polarizer over the condenser.
4. Place the analyzer into the light path.
5. Offset both by 90°. This should cause an extinction of light.
6. Load your sample.
7. Rotate to your desired objective on the nosepiece.
8. Focus your objective.
9. Auto-expose the image by tapping the center of the screen or clicking Remote Focus Puck's right button.
10. Lower the LED power as needed and re-expose.
11. Adjust your image brightness, contrast, saturation, and white balance.
12. Apply digital magnification (digital zoom) by pinching the image and opening the pinch to zoom in. The opposite motion will zoom out.
13. Click the circle button in the App to capture your image, or click the left button on your Remote Focus Puck.

5.6 Revolving your Revolve

The following steps are for converting from Upright to Inverted. If converting from Inverted to Upright, fully lower your objectives.

1. Raise your objectives.
2. Remove your sample.
3. Remove your stage by:
   a. Undoing the dovetail latch.
   b. Pulling the stage out slowly. You may first need to pull up slightly, then out.
4. Place your stage to the side.
5. Press the long, skinny button on the top of the microscope body. The button will have "ECHO Revolve" written on it.
6. Assist the Revolve with completing its rotation.
7. Reengage the locking mechanism by completing the rotation. You should feel, and potentially hear, a click.
8. Reinstall the stage.
9. Replace your sample.
10. Raise your objectives.

Failure to follow the above steps could result in damage to your microscope or objectives.

6. Technical Specifications

6.1 Power Requirements

Your Revolve will come with a power adapter suited for your country or municipality's standard outlet and power supply type.

This adapter can safely provide the Revolve with power in the following conditions:

Input Voltage: 110-240V (50/60Hz)
Output Voltage: 12V
Output Current: 5A (Max)
Output Power: 60W

Use of a third-party adapter is not recommended. ECHO is not responsible for any damage to the Revolve that comes from using third-party equipment with the Revolve Microscope.

The built-in USB-C iPad charger can trickle-charge the iPad at 7.5W (1.5A, 5V).

6.2 USB Storage

The Revolve RVL2- supports both FAT32 and exFAT formatted, unpowered drives less than 2TB in size. This is a departure from previous generation Revolves which only supported FAT32-formatted drivers.

If your thumb drive is not appearing, please ensure that you are using a high-quality drive and that the drive is correctly formatted.

USB drives can be reformatted on PC or Mac. Reformatting drives will irreversibly remove all data from the drive. ECHO is not responsible for data loss from reformatting drives.

To format drives on PC:

1. Insert your USB drive into a port on your PC.
2. Locate the drive in File Manager.
3. Right click on the drive and select "Format".
4. Select either FAT32 or exFAT.
5. Select "Start".

To format drives on Mac:

1. Insert your USB drive into a port on your PC.
2. Open Disk Utility and locate your drive.
3. Select "Erase".
4. Select either exFat or MS-DOS (FAT).
5. Select "Erase".

7. System Troubleshooting

7.1 Restarting the Discover ECHO App

If the Discover ECHO App needs to be restarted, the following steps can be utilized to force-close ("kill") the App. The same steps can be utilized for other apps on the included iPad:

1. Slowly swipe up from the bottom of the iPad screen. Stop approximately 1/3 of the distance up the screen.
2. Swipe up on the miniature Discover ECHO App tile to close the ECHO Application.
3. Touch a different location on the screen that is not within a tile to close the app switcher screen.
4. Open the Discover ECHO App to relaunch.

7.2 Rebooting the Microscope

If the microscope is unresponsive, you may need to power-cycle the microscope:

1. Unplug the power cord from your power strip.
2. Force-close the Discover ECHO App.
3. Plug the microscope back into power.
4. Open the iOS Settings App and confirm connection via Ethernet > USB 10/100/1000 LAN. If the iPad and scope are connected, a 10.0.0.XX IP address will be listed here.
5. Open the Discover ECHO App.

7.3 Grey Status Indicator

A grey status indicator dot, either blinking or solid, indicates that the iPad and microscope are not properly connected.

Please ensure that the iPad is not connected to, or remembers your, institutional or university Wi-Fi in the iOS Settings App. After confirmation, please try reconnecting the scope and iPad according to the steps outlined in Section 2.6.1

7.4 Red Status Indicator

A red status indicator dot will be paired with an error code. Error codes are typically 2-3 letters followed by a 5-digit number. This will indicate which service or set of services failed to check in on time during microscope initialization. This does not indicate something is wrong with the microscope.

To resolve the error code, please power cycle the scope according to the steps in Section 7.2. If this does not resolve your issue, please contact ECHO Support with your Revolve Serial Number and Error Code(s).

7.5 App Opens iPad Camera

If the Discover ECHO App opens the iPad camera instead of the Revolve's built-in camera, this may indicate a permissions error with the Discover ECHO App.

1. Force-close the ECHO Pro App according to the steps within Section 7.1 1-3. Do not re-open the app.
2. Open the iOS Settings App.
3. In the left-hand menu, select Discover ECHO. If you have lots of Apps on your iPad, you may need to scroll down this menu.
4. Ensure all permissions are enabled.
5. Close the iOS Settings App.
6. Open the Discover ECHO App.

7.6 Cannot See Image

If your LED is on but you are unable to see an image on your screen, there are a few potential causes.

7.6.1 Camera Exposure Time

If your screen is either completely white or completely black, it is likely that your camera needs to be re-exposed. To auto expose the Revolve's BF, tap the center of the iPad screen. To adjust the exposure for the FL camera, use the +/- buttons.

7.6.2 Image Out of Focus

If your image is out of focus, you may see color but not details of your sample. Please adjust the focus with the Remote Focus Puck.

7.6.3 Condenser Settings

Incompatible phase rings may cause poor image quality or prevent you from seeing your image. Ensure the correct phase ring is selected for your objective.

A closed-down aperture can limit the amount of light reaching your sample. Fully open the aperture of your condenser, then tap the center of the screen to adjust exposure time.

7.7 Poor Image Quality

If your image quality is poor (dark, pixelated, grainy, etc.), there may be several reasons.

7.7.1 Camera Exposure Time

If your screen is either completely white or completely black, it is likely that your camera needs to be re-exposed. To auto expose the Revolve's internal camera, tap the center of the iPad screen. Revolve does not have a manual exposure.

7.7.2 Image Out of Focus

If your image is out of focus, you may see color but not details of your sample. Please adjust the focus with the Remote Focus Puck.

7.7.3 Condenser Settings

Incompatible phase rings may cause poor image quality or prevent you from seeing your image. Ensure the correct phase ring is selected for your objective.

A closed-down aperture can limit the amount of light reaching your sample. Fully open the condenser aperture, then tap the center of the screen to adjust exposure time.

7.7.4 Incorrect Objective

Some objectives have smaller working distances than others. Other objectives may have correction collars which allow them to be used for imaging through multiple types of vessels from slides to multi-well plates.

Correction collar objectives will be labeled with CC and have a correction collar ring. Exact settings will depend on your sample vessel, but it is typically recommended to image through Number 1 Coverslips with the correction collar set to 0.17. For imaging through plastic-bottom dishes and plates, a value of 1.0 is typically recommended. To adjust the correction collar:

1. Place your sample on the microscope and attempt to get your image into as good as possible focus.
2. Rotate the correction collar continuously in one direction. If the image quality appears worse, turn the correction collar the other direction.
3. Adjust the fine focus on your microscope.

Long working distance objectives will be marked LWD and will be able to better through multi-well plates or dishes than coverslip-corrected objectives.

7.7.5 Post-Processing

Changing the post-processing options (brightness, contract, etc.) back to default values may help resolve pixelation or grainy images. To reset these sliders to ECHO defaults, double-tap the bar

7.8 Sample Not Appearing Flat

If your sample does not appear flat, it may be possible that you have a thick sample with lots of topographical variation. However, if your sample has a noticeable tilt, the effect could be reduced by:

1. Ensuring the stage insert is flush.
2. If you are utilizing a slide, check that the coverslip is in the proper orientation. If imaging in upright, the coverslip should be facing up.

7.9 Phantom Image

If you are seeing an image when your sample has been removed, it is likely that a shading correction was completed with a sample loaded on the Revolve. To resolve this:

1. Remove any sample or sample vessels from the microscope.
2. Select the downwards carrot to expose the extended camera controls.
3. Select “Auto” for White Balance.
4. If your Revolve has a shading correction toggle, select “SET”, then “On”.
5. Re-load your sample.

7.10 Delayed Image Capture

If your image takes a while to capture, it is possible that Anti-Shake has been enabled.

The best indication that Anti-Shake has been enabled would be the appearance of a blue bar at the top of your screen after clicking the capture button.

To turn off Anti-Shake, tap [icon] in the top-right corner of the Discover ECHO App.

7.11 FL Channel Disappeared

If one or more of your channels are not showing up in the Discover ECHO App, it is possible that they were deactivated for another user’s experiment.

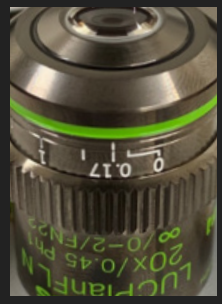
To restore your channels:

1. Long-press one of the FL channel names at the bottom of your screen.
2. Click “View All Channels”.
3. Select your channel that is missing.
4. Change the toggle to “Active”.

The channel will not be available for you to use in single-channel images. To use it in overlays, ensure it is selected from the “Edit” column on the left-hand side.

Gen 2 Focus Puck. These pucks can be used with E(2) series Rebels and. RVL2- series Revolves.

20x Phase Objective with a correction collar set to 1.0.



20x Phase Objective with a correction collar set to 0.17.

7.12 FL Channel Weak/Off

If one or more of your fluorescence channels does not display light despite being turned on, or appears much weaker than normal:

1. Adjust the exposure time of that channel. Some channels may require additional LED brightness and exposure time than others to show up.
2. Ensure the LED and Filter Cube are properly matched. For example, if your DAPI LED is in Channel 1, the corresponding DAPI Filter Cube must be in Channel 1 on the filter wheel.

If these do not resolve the issue, the following steps can be used as a diagnostic to assist ECHO Support with resolving the issue:

1. Convert your microscope to the inverted configuration.
2. Locate an empty position on your nosepiece there is no empty position, remove an objective.
3. Place a tissue, kimwipe, or sheet of white paper on this open position.
4. Repeat steps 4-6 for each channel.
5. Set the LED power in the Discover ECHO App to 100%.
6. Take a picture using your phone or another device of the pattern produced on the paper.
7. Attach this image to your email or chat.

7.13 System Won't Focus

If your Revolve's Focus Puck stops working, there are a few things to check:

1. Unplug the Focus Puck and rotate the USB-C connector 180°. Plug it back in to the Revolve.
2. Plug the Focus Puck at a slight angle. On occasion, the USB-C connector can get caught on the plastic backing of the microscope.
3. If you have more than 2 Revolves, try swapping Focus Puck's between systems, provided that the pucks are from the same generation.

If your puck still is unable to adjust focus, please contact ECHO Support with your Revolve Serial Number and a picture of your Focus Puck.

7.14 iPad Not Charging

The included iPad can be charged using a 20W fast charger, which is higher than the wattage supplied by the Revolve's built-in charger.

If your iPad's power is draining quickly:

1. Turn off auto-brightness in the iOS Settings.
2. Set the brightness between 80-90%.

If your iPad's battery is below 15% and will not increase, please utilize an external, 15W+, iPad charger for 30 minutes.

7.15 USB Not Recognized

If your USB drive is not recognized by Revolve, there are two likely causes:

1. Drive is too large (2TB+)
2. Drive is not properly formatted. RVL2- Revolves support FAT32 and exFAT formatted drives.

If after removing your USB Drive from Revolve, images on the drive appear corrupted, the USB drive was likely not ejected using the ejection option within the App. Please re-format the drive and try again.

7.16 SMB Server Not Recognized

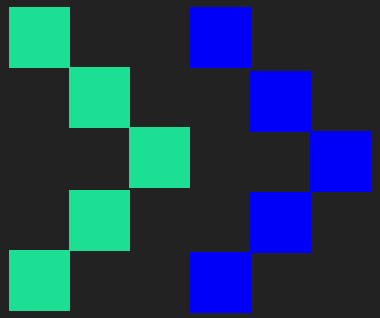
If you have networked your scope and are unable to connect to a network (SMB) drive, please confirm the following:

1. iPad has internet access. Please open your browser and visit discover-echo.com to ensure the scope has internet. If you are unable to connect to our website, please follow the networking steps in Section 2.6.2.
2. Microscope and SMB Drive are on the same network.
3. iPad Files App can locate and connect to the SMB Drive.
4. SMB Drive allows connection via IP-address registration (IPv4).
5. The "SMB://" is omitted from the IP address within the Discover ECHO App.
6. The domain field is left empty within the Discover ECHO App.

7.17 Cannot Re-Import Image into App

Only ECHO Archive Files can be reimported into the Discover ECHO App. The export types (JPGs, TIFFs, and CSV files) cannot be brought back into the App after the original file has been deleted.

If you modify ECHO Archive files (open, edit, delete) while they are outside of the Discover ECHO App, this may lead to file corruption. Corrupted archive files may not be recognized by the App's Archive Import feature. ECHO is not responsible for lost data or data corruption caused by improper handling of export files.



Questions? Contact ECHO Support
Support Chat: discover-echo.com/contact
General Email: info@discover-echo.com
Service Email: support@discover-echo.com