Zivid One+

User Guide

Zivid One+ S (ZVD1P-S)

Zivid One+ M (ZVD1P-M)

Zivid One+ L (ZVD1P-L)

Table of Contents

Start Guide

1.1 Zivid box contents

In the Zivid box you should find:

- Zivid 3D camera
- Power supply
- 5 m USB 3.0 Cable (Machine Vision Certified)

Optional: 10 / 25 m optical cable.

1.2 Target Applications

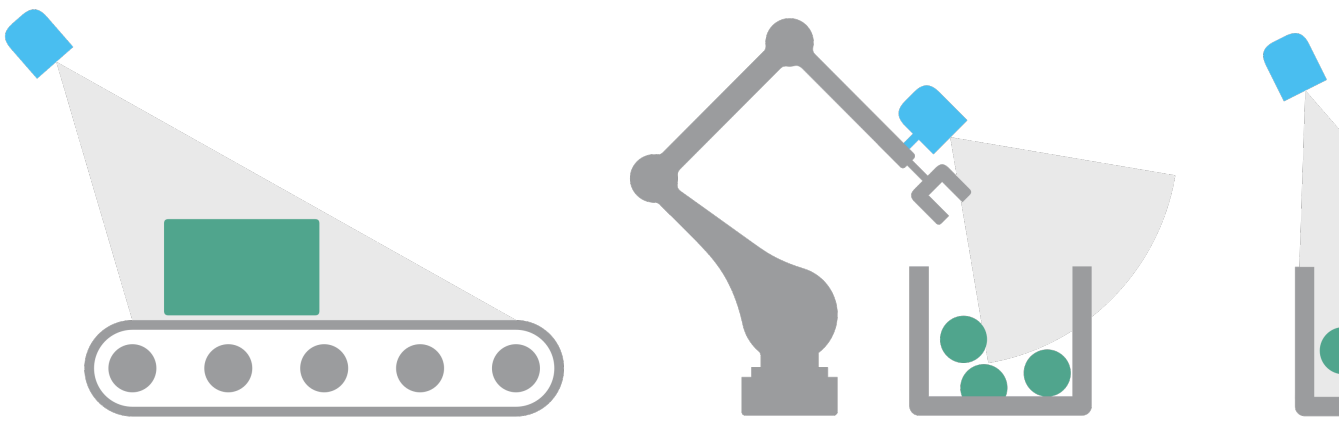
Zivid One+ 3D cameras are primarily targeted for industrial automation in the manufacturing, automotive, and logistic industries. Typical 3D machine vision applications for industrial and collaborative robots are:

- Pick and place
- Machine tending
- Assembly
- Palletization
- Inspection

The cameras are factory calibrated. There is a one-to-one correspondence between color and depth because Zivid cameras acquire XYZ point cloud data and RGB colors with the same sensor chip. Zivid technology provides high-quality images of objects made of materials with different optical properties, and of various shapes, dimensions, and colors. Due to the high dynamic range, Zivid One+ cameras are suitable for imaging dark absorptive parts and shiny metal parts. The following cases do not work well with Zivid cameras:

- Transparent objects (e.g., plastic bottles)
- Highly specular surfaces (e.g., mirrors)
- Imaging for precision less than 0.03 mm
- Moving objects

Mounting can be stationary or on a robot.



1.3 Robustness, Safety and IP rating

Robustness

Zivid One+ cameras have a robust aluminum casing. Cooling ribs are integrated into the design in a way that makes Zivid look and stay cool!

Safety

Zivid One+ cameras are compliant with EN60950, FCC class A, CE, and CB environmental standards.

Zivid One+ cameras use a white light source, which is tested against IEC62471 and is classified as Risk Group 2.

Connections, assembly, and settings must be performed by competent technicians.

Do not connect external I/O signals to the device while it is powered; this may damage the device.

IP rating

Zivid One+ cameras are water and dust resistant and are rated IP65. Zivid One+ cameras can handle vibrations and shocks without being damaged according to the following shock/vibration standards:

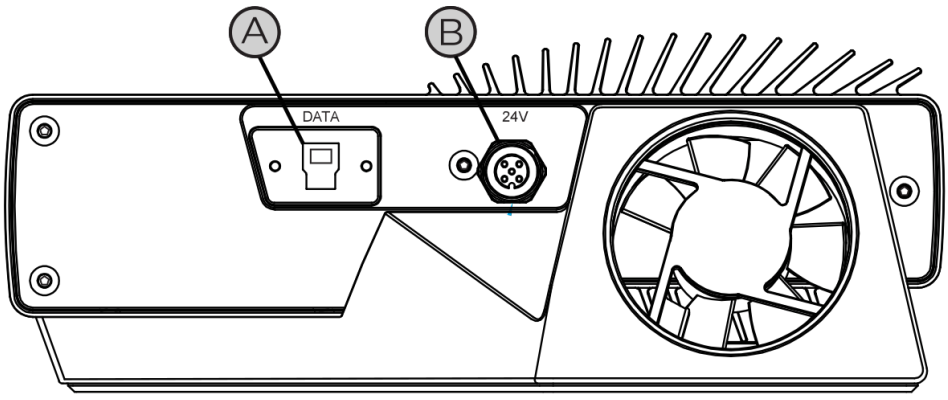
- 5 G Random
- 15 G Shock

1.4 Connectivity and Power Supply

Available ports

A) USB3: Data SuperSpeed USB3 type-B receptacle for PC connection. Note: PC must support USB 3.0 SuperSpeed. Cables need to be “USB3 Vision” compliant.

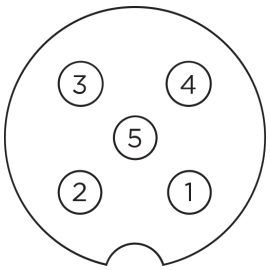
B) M12-5: Power Connector 24V, 5A DC



Power supply interface

Exceeding the limit values may cause permanent damage. Please note the power ratings if power is provided from other sources than the supplied AC/DC converter and ensure compliance to standards.

The Zivid unit is protected against reverse polarity and against overheating by a thermistor that physically removes the power.

Pinout	Pin	Purpose
	1	24V DC +/- 20% (Max 4A)
	2	24V DC +/- 20% (Max 4A)
	3	GND
	4	GND
	5	SENSE SIGNAL (optional)

Optional mating connector: TE Connectivity AMP 1838275-3 (Digikey: A97645-ND)

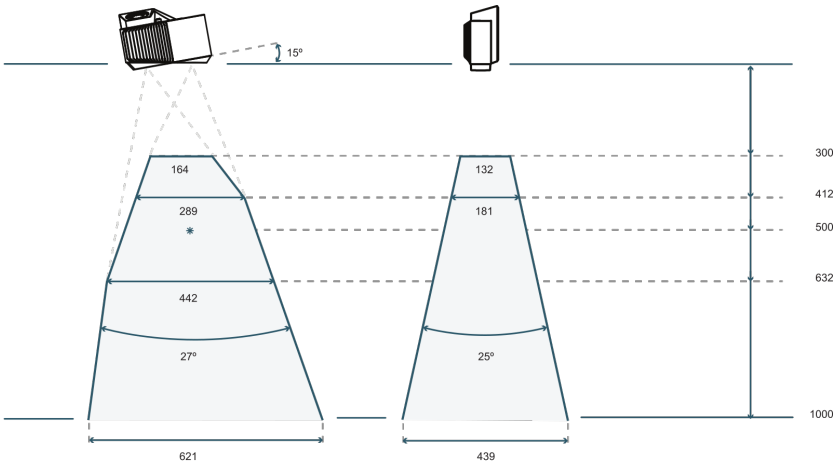
1.5 System Requirements

OS	Windows 7/8/10 or Linux Ubuntu 16.04/18.04
GPU	CPU with integrated GPU This is the most cost-efficient and preferred solution for Zivid. The benefit of an integrated GPU is that the copying of data from GPU to CPU is fast. A high-end integrated GPU with 3GB of memory available is required for optimal performance. Recommendations: • AMD Ryzen 5 2400G or better • Intel i7 with HD630 or better
GPU	Dedicated GPU This solution may be best if the GPU is planned to be used for more than Zivid computations. A medium to high-end AMD or NVIDIA GPU with 3GB of memory is required for optimal performance. Recommendations: • NVIDIA GeForce GTX 1060 or better • NVIDIA GeForce MX150 or better • AMD Radeon RX 550 or better
USB	SuperSpeed USB3 port

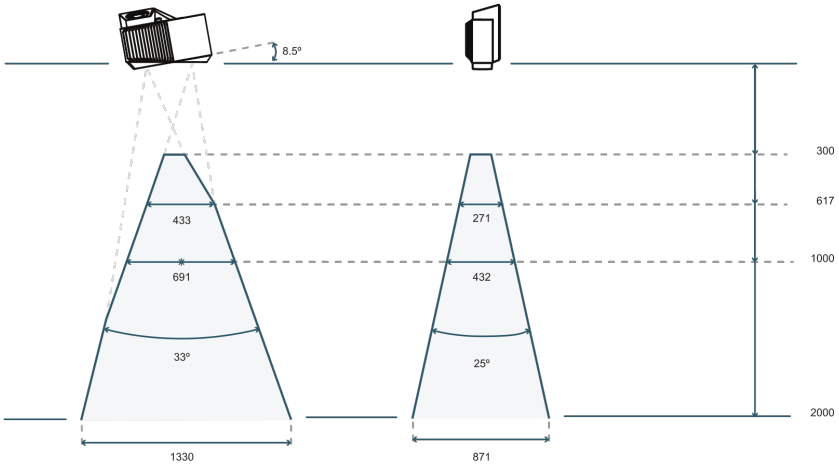
1.6 Mechanical and Electrical Installation

Working Distance and Field of View

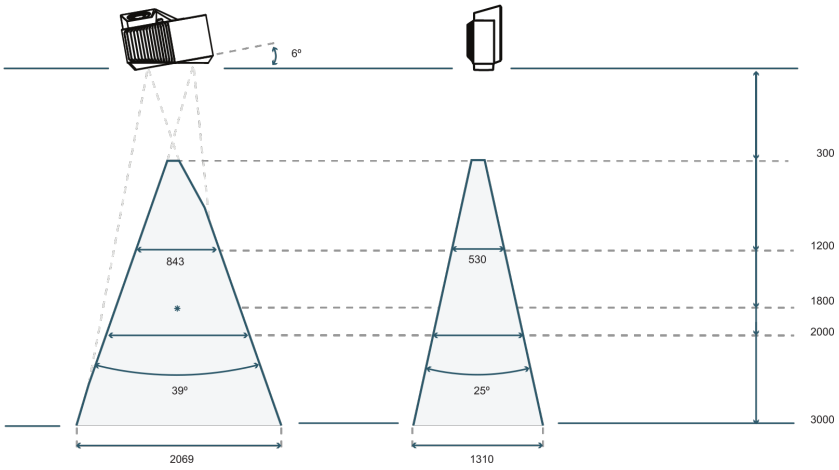
Zivid One+ S



Zivid One+ M

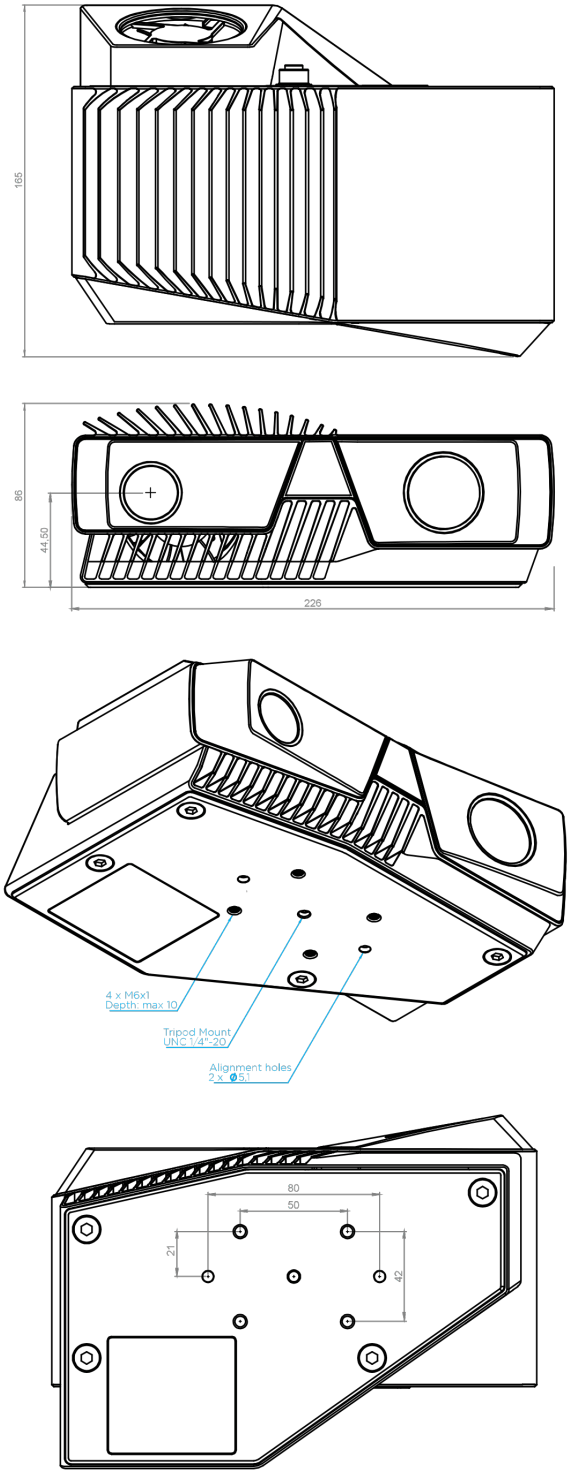


Zivid One+ L



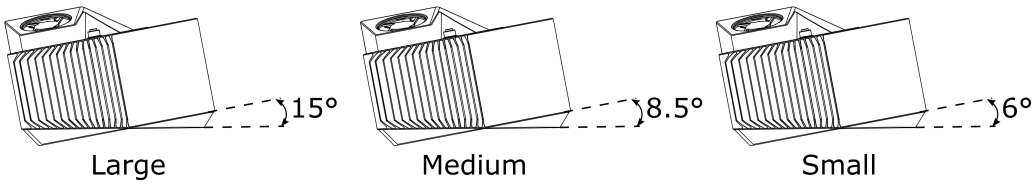
Mounting Specifications and Dimensions

Use the threaded holes on the bottom side of the device to mount it to a bracket. Zivid cameras can be fixed on most standard photography tripods.

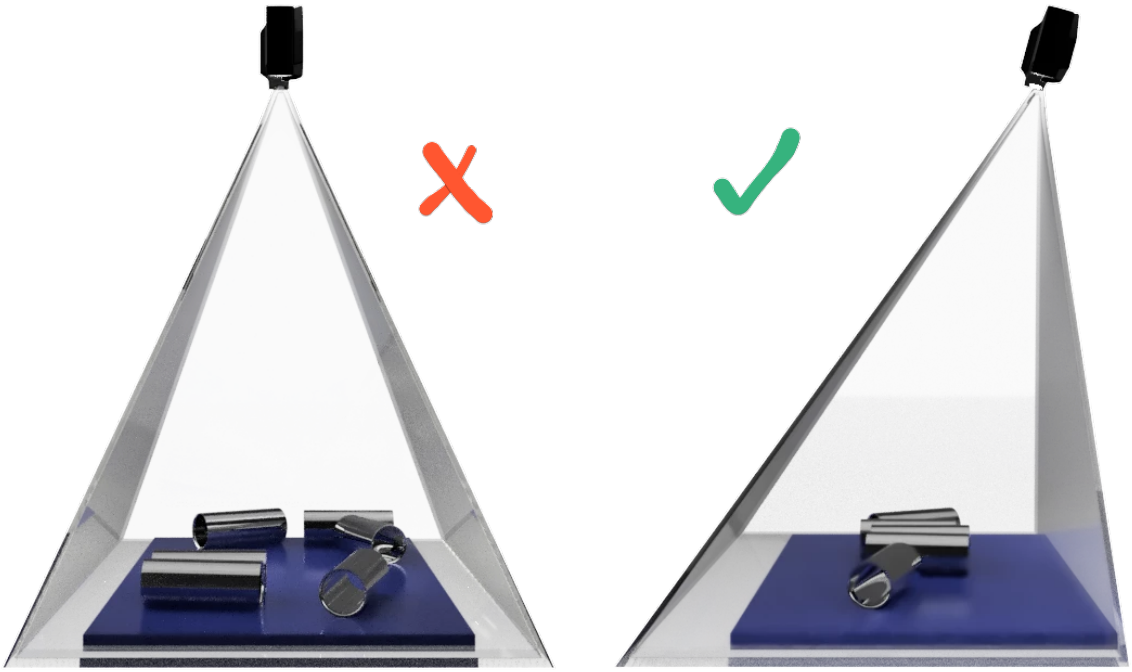


Angle the camera

The imaging sensor inside Zivid cameras is offset at a slight pan angle in the azimuth direction (y-axis). This should be considered if it is desired to have the camera perpendicular to the scene.



Although the most intuitive, this is not the best way to mount the camera. If possible, mount the camera at a slight tilt angle to avoid reflections from the background. This also frees up space above the scene for easier access for tools and robots.

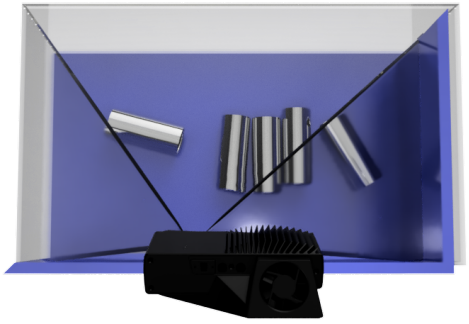


Note

Camera tilting is more important if the scene contains specular surfaces.

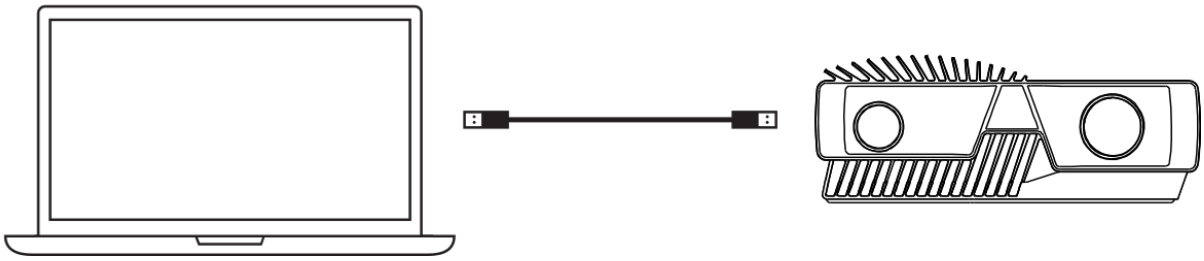
In bin-picking applications

For bin-picking applications, place the Zivid camera projector above the back edge or above the rear corner of the bin (see images below). Pan and tilt it so that the 2D camera is looking at the bin center. The projector rays should not fall on the inner surfaces of the two walls closest to the projector; they should almost be parallel to those two walls. Mounting the camera this way minimizes interreflections from the bin walls.



Connect the camera to a computer

1. Plug the power supply into the “24V” port and into a power outlet.
2. Plug the USB cable into the “DATA” port and into a USB 3.0 port on your PC.



Note

Ensure that all connections are screwed tightly in.

Using a direct cable from the PC to the Zivid camera works better than connecting the camera via a USB hub.

Use only Zivid approved cables and extenders.

1.7 Service and Maintenance

The device contains no user-serviceable parts inside. The product warranty will be void if opened.

Follow the below instructions to ensure that your Zivid camera is well maintained:

- Check screw connections and connectors at regular intervals.
- Do not block the air opening on the front and rear sides of the product.
- Use a small vacuum cleaner or a small canister of compressed air to remove dust or other accumulated particles from the glasses or in between the ribs of the heat sink.

1.8 Technical Specification Sheet

	Zivid One+ Small	Zivid One+ Medium	Zivid One+ Large
Key applications	Tiny and small objects, trays/boxes	Small and medium objects, totes/bins	Medium and large objects, standard EU/US pallets
Optimal working distance (mm)	300 - 800	600 - 1600	1200 - 2600
Max working distance (mm)	1000	2000	3000
Field of View (mm)	164 x 132 @ 0.3 m 650 x 480 @ 1.0 m	420 x 270 @ 0.6 m 1370 x 900 @ 2.0 m	850 x 530 @ 1.2 m 2110 x 1360 @ 3.0 m
Spatial resolution (mm)	0.12 @ 0.3 m 0.40 @ 1.0 m	0.23 @ 0.6 m 0.75 @ 2.0 m	0.45 @ 1.2 m 1.11 @ 3.0 m
Point precision (um)	0.03 @ 0.3 m <0.2 @ 1.0 m	0.07 @ 0.6 m <1.0 @ 2.0 m	0.3 @ 1.2 m <2.0 @ 3.0 m
3D technology	Structured light		
Imaging	1920 x 1200 (2.3 Mpixel) Native Color		
Point cloud output	3D (XYZ) + Color (RGB) + SNR for each pixel		
Aperture	f/1.4 to f/32		
Exposure Time (ET)	6 500 us to 100 000 us		
Gain	1x to 16x		
Projector Brightness	1/4x to 1.8x 1x = 400 lumens		
Exposures per 3D acquisition	12		
Min acquisition time	90 ms at ET = 6 500 us single acquisition capture		
Calibration	Factory calibrated		
Data interface	USB 3.0 SuperSpeed		
Power	24 V DC		

Software APIs	C++, C#, .NET, Python, ROS, GenICam/HALCON
OS	Windows 7 / 8 / 10 Ubuntu 16.04 / Ubuntu 18.04
Operating temperature	10 to 40°C
Storage temperature	-20 to 60°C
Safety and EMC	CE / CB / EN60950 / FCC class A
Size and weight	Aluminium body 226 mm x 86 mm x 165 mm 2 kg
Environmental	IP65 5 G Random 15 G Shock
Power connector	M12-5
USB data connector	USB type B Jack screw M2
External power adapter	24 V 5 A EU, US and UK power plug options

Zivid Studio

2.1 Introduction

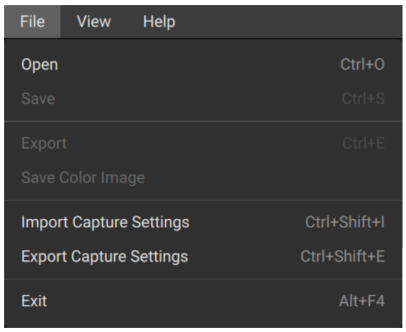
Zivid Studio is an application within the Zivid SDK which provides a graphical user interface (GUI) for exploring the functionality of Zivid One+ 3D cameras and capturing high-definition 3D point clouds.

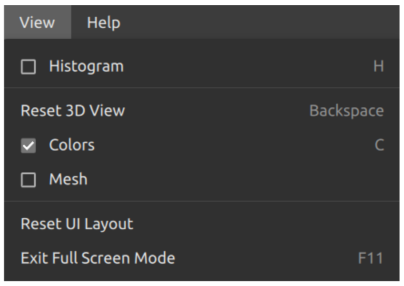
Use Zivid Studio to learn and understand how the majority of functions available in the Zivid SDK works. This is useful when developing your application. You can:

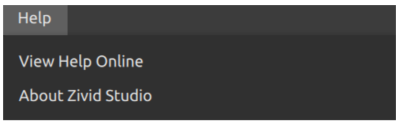
- Capture point clouds.
- Visualize point clouds, color images (2D), and depth maps (Z axis).
- Analyze and evaluate 3D data quality.
- Determine correct settings and filters for your target objects and scenes.
- Save point clouds and color images to disk.

2.2 Toolbar

The toolbar is located at the top of the Zivid Studio GUI. It consists of drop-down menus to handle files, control the GUI, and get information about the Zivid Software.



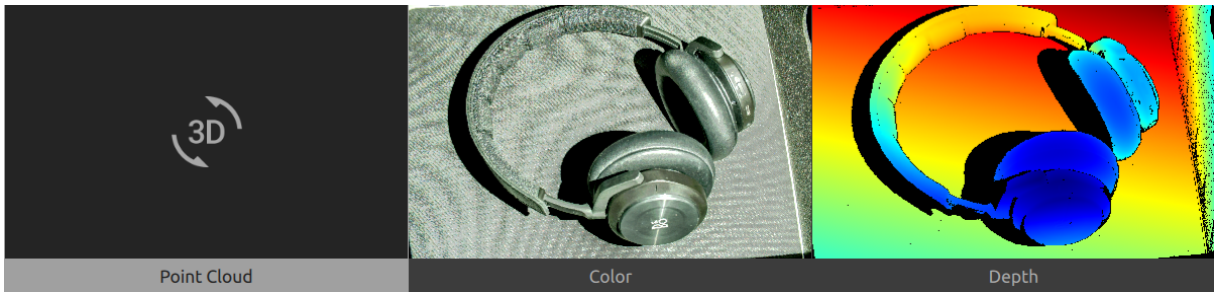




File	Shortcut	Function
Open	Ctrl+O	Load a ZDF file. .zdf is the native Zivid file format that includes point cloud, color image, and depth image data.
Save	Ctrl+S	Save a point cloud, color image, and depth image data to a ZDF file, the native Zivid file format.
Export	Ctrl+E	Export a point cloud data to a file in unordered or ordered Polygon (PLY), ASCII (XYZ), or Point Cloud Data (PCD) file format.
Save Color Image		Save a color image to a file in PNG, BMG, or JPG file format.
Import Capture Settings	Ctrl+Shift+I	Load saved capture settings from a file in YML into Zivid Studio.
Export Capture Settings	Ctrl+Shift+E	Save current capture settings from Zivid Studio into a file in YML.
Exit	Alt+F4	Exit Zivid Studio.
View	**Shortcut**	**Function**
Histogram	H	Open the Histogram, a tool for analyzing pixel intensity distribution on an image.
Reset 3D View		Reset the point cloud, color image, and depth image view back to the default view.
Color	C	Enable/disable point cloud colors.
Mesh		Generate surfaces in the point cloud. Creates a 3D mesh appearance.
Reset UI Layout		Reset the layout of the Zivid Studio window.
Enter / Exit Full Screen Mode	F11	Toggle between full and regular screen mode.
Help		**Function**
View help online		URL to the Zivid Knowledge Base.
Legal Notice		Detailed information on Zivid and third-party software licenses.
System Info		Information on the system used by the Zivid software.

2.3 Available Views

There are three available views to choose from at the bottom of the Zivid Studio GUI.

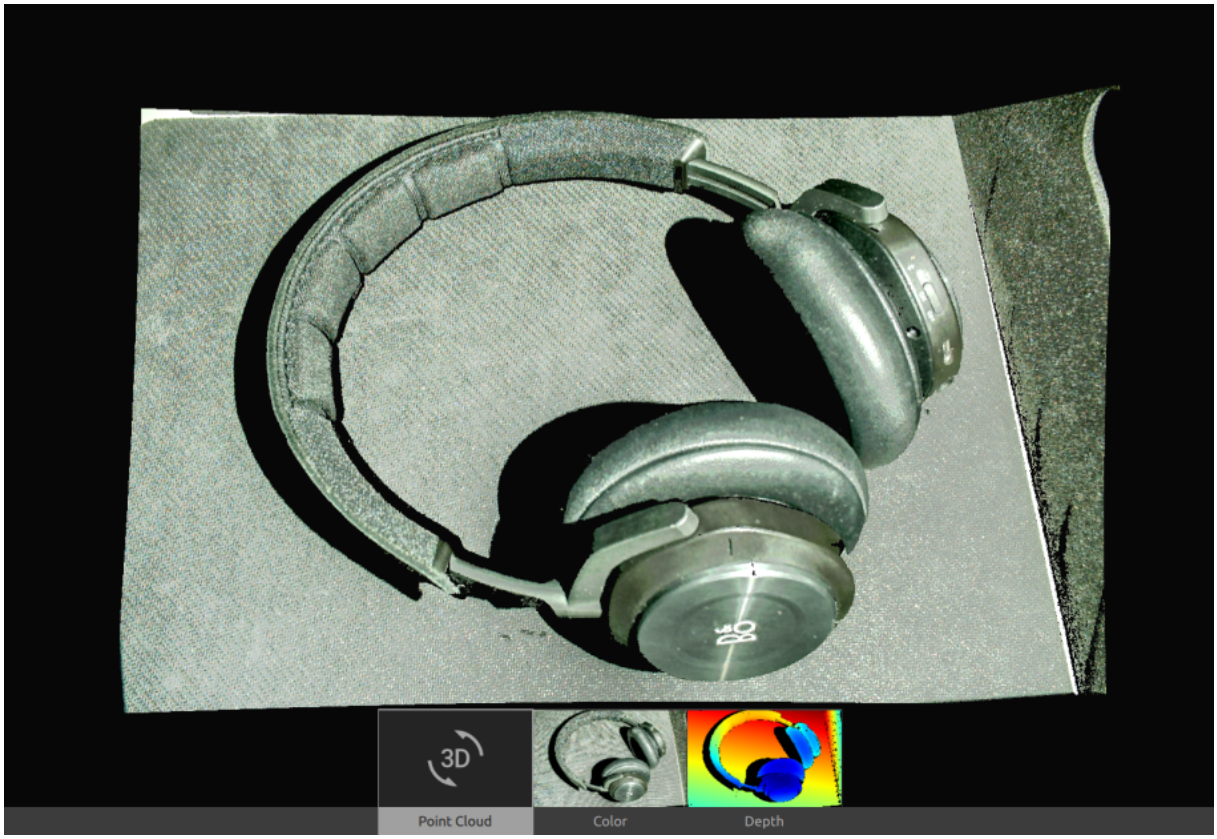


2.3.1 Point Cloud

This view displays the point cloud of the scene after a capture or after loading a ZDF file.

- Use the left mouse button to rotate the point cloud
- Use the right mouse button to pan.
- Zoom in or out by rolling the mouse wheel or, if available, by the middle mouse button followed by dragging the mouse.

Turning color and mesh on and off in this view helps evaluate the point cloud quality.



2.3.2 Color

This view displays the color image of the scene after a capture or after loading a ZDF file.

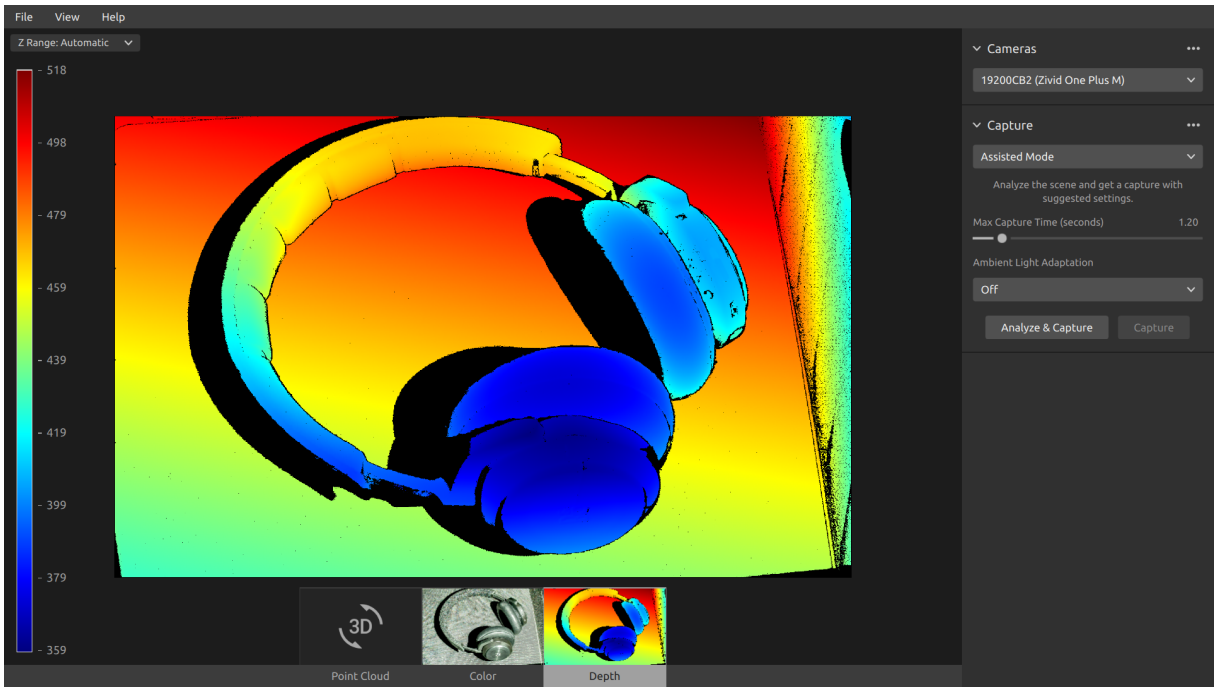
- Position the mouse pointer over a pixel in the image to get image coordinates, RGB, and SNR values. The pixel values are displayed in the status bar in the bottom left corner of the window.
- Zoom in or out by rolling the mouse wheel or, if available, by the middle mouse button followed by dragging the mouse.
- Use the right mouse button to pan the view.

2.3.3 Depth

This view displays the depth image of the scene after a capture or after loading a ZDF file.

- Position the mouse pointer over a pixel in the image to get image coordinates, XYZ, and SNR values. The pixel values are displayed in the status bar in the bottom left corner of the window.
- Use the drop-down menu located at the top left corner of the view to modify the Z range.

The color scale represents the distance variation along the z-axis from the camera to the surfaces of the imaged objects.



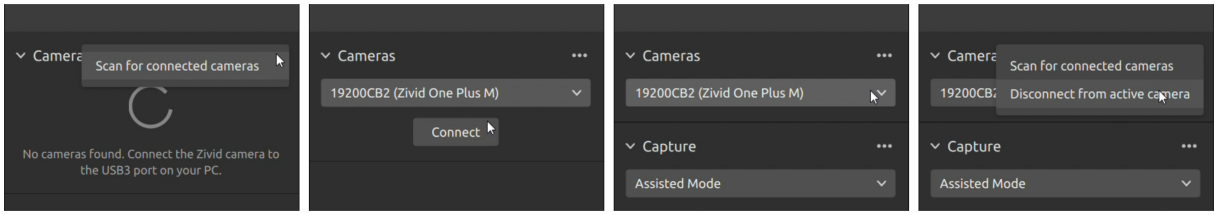
2.4 Control Panel

The control panel is located on the right side in the Zivid Studio GUI. It contains two sections:
This view displays the depth image of the scene after a capture or after loading a ZDF file.

- Camera
- Capture

2.4.1 Camera

This section is used to scan for, connect to, and disconnect from available cameras.



Camera	Function
Scan for connected cameras	Show all cameras plugged into the PC and list them by model and serial number.
Connect	Connect to the camera selected in the drop-down menu. Zivid Studio can connect to a single camera at a time.
Disconnect from active camera	Disconnect from the active camera.

2.4.2 Capture

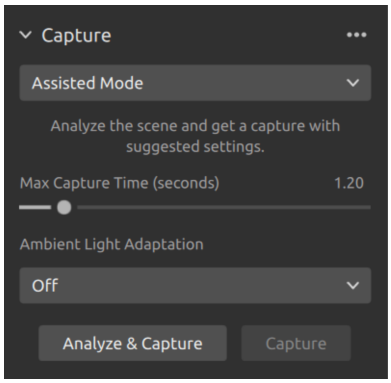
This section is used to capture 3D images. Here you can control and configure the camera settings. This section has two modes:

- Assisted Mode
- Manual Mode

Assisted Mode

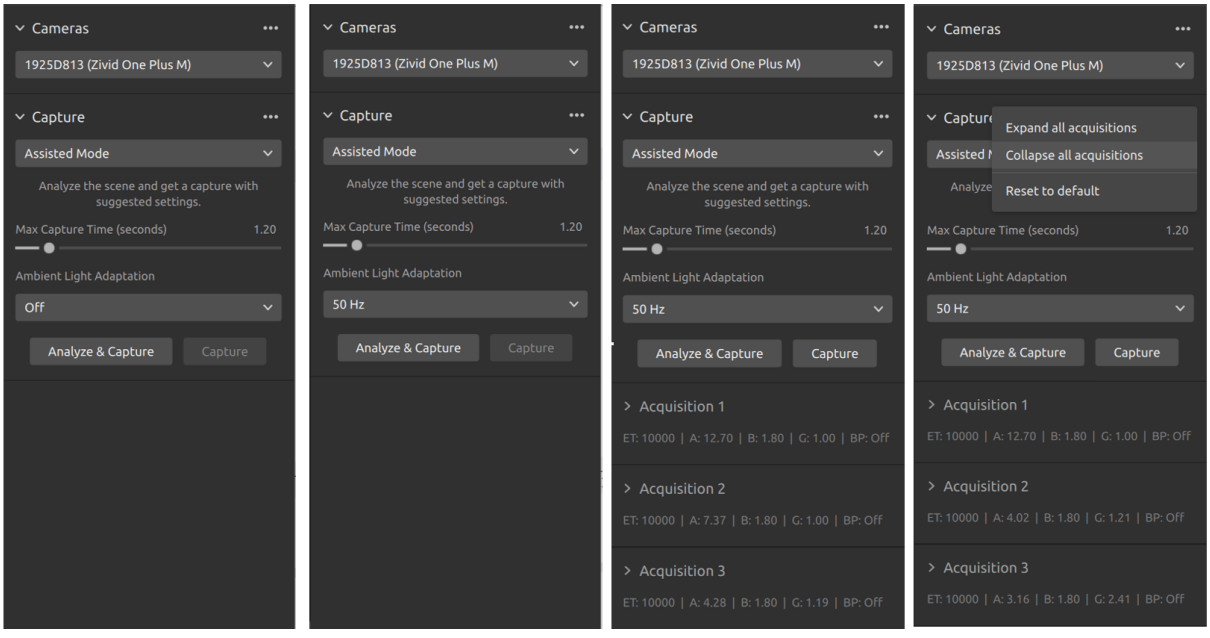
This mode is the easiest to use.

- Specify the maximum capture time
- Click “Analyze & Capture”



This triggers the camera to analyze the scene and output the camera settings required to cover as much of the dynamic range in the scene as possible. Immediately after this, the camera performs a second capture using these settings.

- The “Capture” button performs a capture with the settings suggested by the assisted capture, without additional scene analysis.

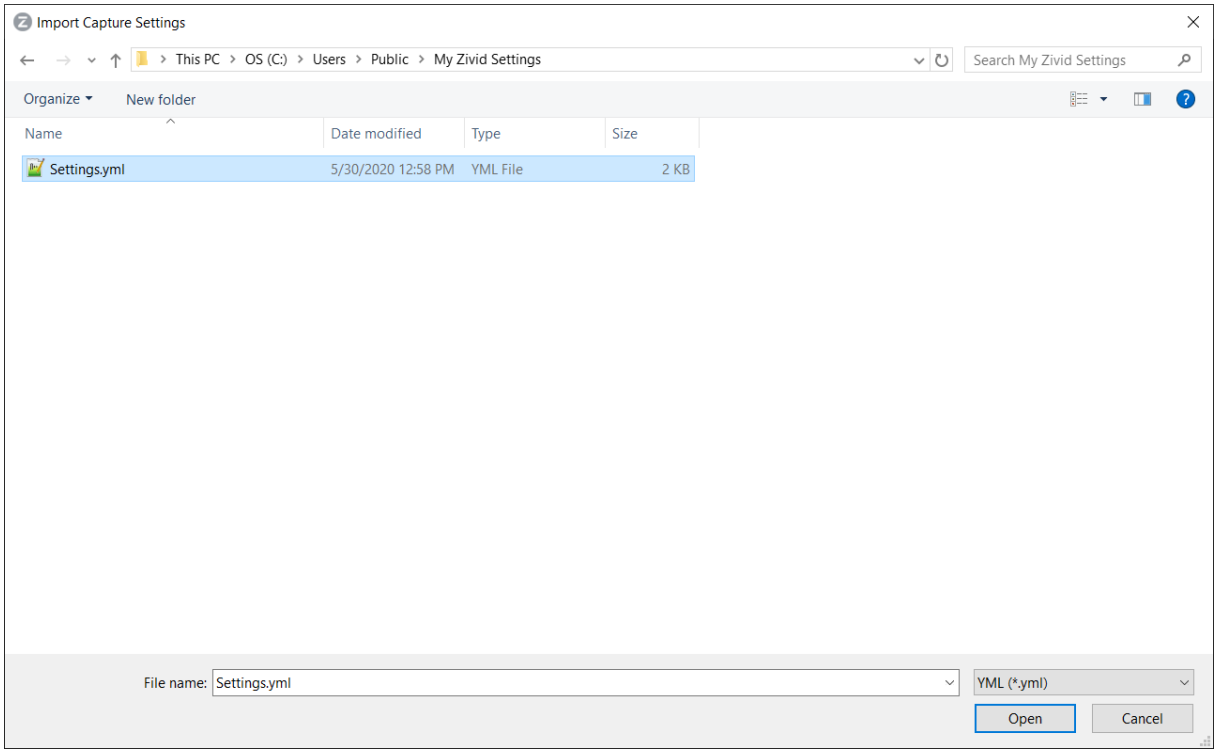


“Ambient Light Adaptation” is used when ambient light (AC powered) is mixed with the camera’s projector.

- Select your power grid frequency from the drop-down menu. 60 Hz is typically used in Japan, Americas, Taiwan, South Korea, and the Philippines. 50 Hz is the normal in the rest of the world.

Acquisition and processing (filters and color) settings appear at the bottom right corner of the “Capture” section after camera captures. It is possible to import/export all settings from/to disk.

- Click File, then click Import/Export Settings

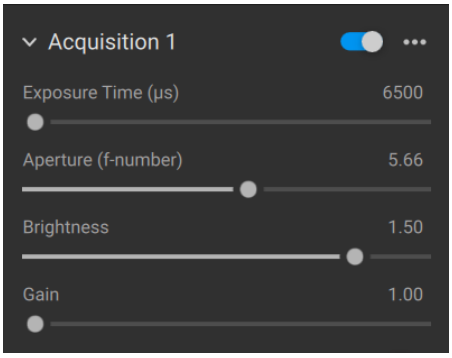


Manual Mode

In the manual mode, users must configure all settings and manually.

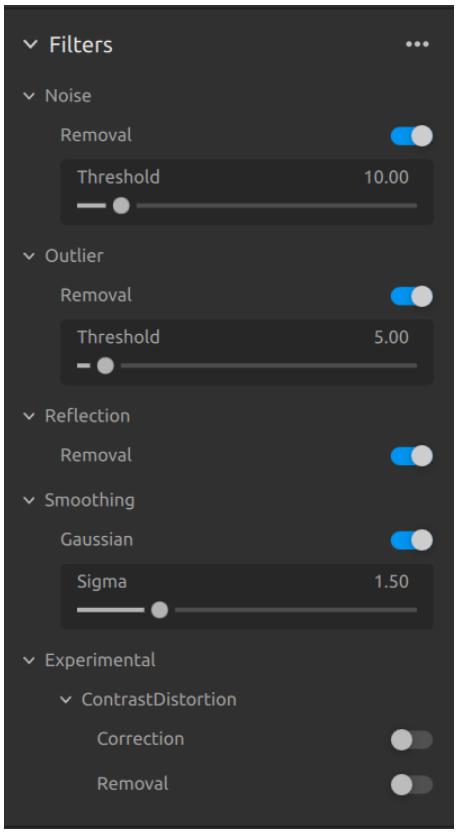
Acquisition

Setting	Function
Exposure Time	The duration a single camera image is exposed to light.
Aperture	The opening that controls the amount of light to the camera sensor through the lens.
Brightness	The output power (the amount of light) emitted by the LED projector.
Gain	The amplification of the signal from the camera sensor.



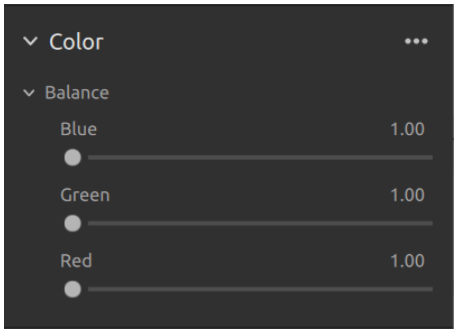
Filters

Setting	Function
Noise Filter	Remove points where the projected pattern signal-to-noise-ratio is below the specified threshold.
Outlier Filter	Remove points if the distance to their neighboring pixels within the small local region is larger than the threshold specified in mm.
Reflection Filter	Remove points impacted by reflections and thus erroneous.
Gaussian Smoothing	Perform Gaussian smoothing on the point cloud.
Contrast Distortion	Corrects and/ or removes points affected by blurring in the camera lens.



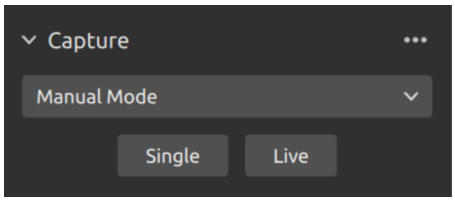
Color

The color temperature of ambient light affects the appearance of the color image. Set the white balance by adjusting blue, green and red color balance to make color images look natural.



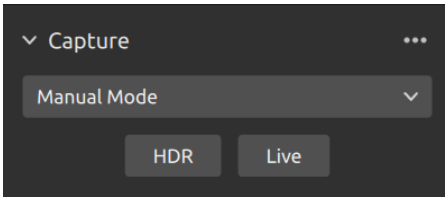
Single and Live captures

- The “Single” button captures a single acquisition with the specified settings, which is then displayed.
- The “Live” button triggers continuous captures, which enable you to view the scene in real-time.



HDR capture

For high dynamic range scenes, it is necessary to use multi-acquisition HDR. In this mode, the camera captures multiple acquisitions per 3D capture. Acquisition settings are configured per acquisition while the filters and color settings are configured per 3D capture.

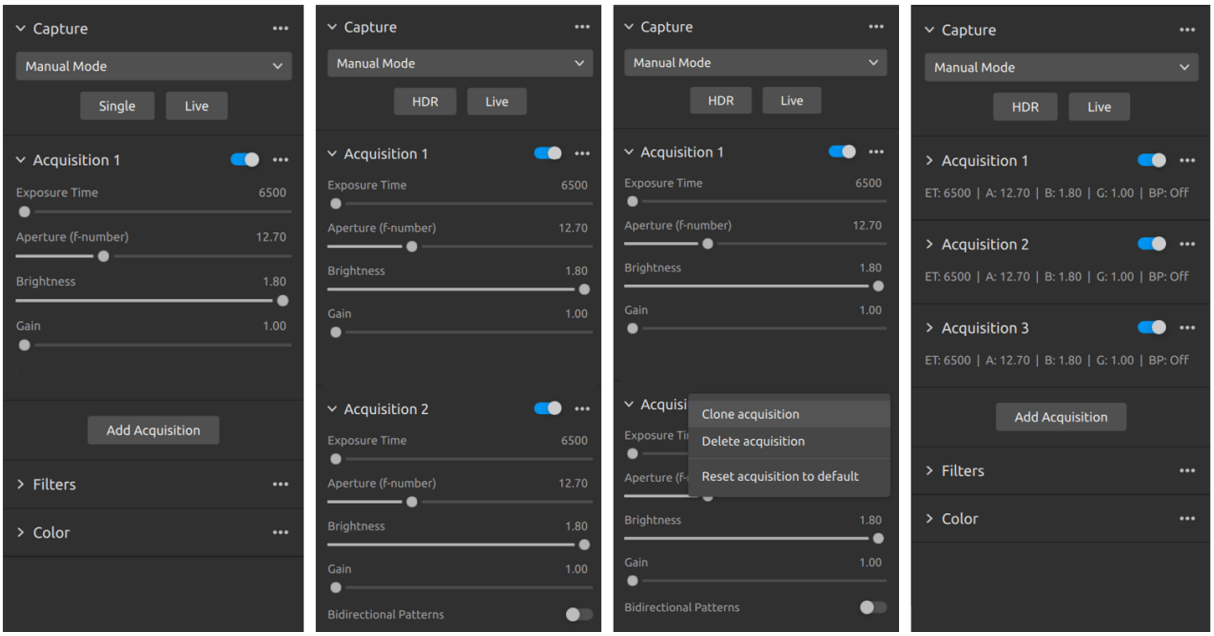


Once you select the manual mode, you can click the “Add Acquisition” button to add additional acquisitions. By default, each new acquisition added uses the settings of the previous acquisition.

You can clone a specific acquisition by clicking on the three dots next to that acquisition and then on the “Clone” acquisition option.

Use the same menu to reset acquisition settings or delete individual acquisitions. Disable or enable acquisitions with the checkbox.

Click the “HDR” button to capture an image with the acquisition settings specified; unchecked acquisitions are ignored by the capture.



2.5 Quick Reference Index

File	Shortcut	Function
Open	Ctrl+O	Load a ZDF file. .zdf is the native Zivid file format that includes point cloud, color image, and depth image data.
Save	Ctrl+S	Save a point cloud, color image, and depth image data to a ZDF file, the native Zivid file format.
Export	Ctrl+E	Export a point cloud data to a file in unordered or ordered Polygon (PLY), ASCII (XYZ), or Point Cloud Data (PCD) file format.
Save Color image		Save a color image to a file in PNG, BMG, or JPG file format.
Import Capture Settings	Crtl+Shift+I	Load saved capture settings from a file in YML into Zivid Studio.
Export Capture Settings	Crtl+Shift+E	Save current capture settings from Zivid Studio into a file in YML.
Exit	Alt+F4	Exit Zivid Studio.
View	Shortcut	Function
Histogram	H	Open the Histogram, a tool for analyzing pixel intensity distribution on an image.
Reset 3D View		Reset the point cloud, color image, and depth image view back to the default view.
Color	C	Enable/disable point cloud colors.
Mesh		Generate surfaces in the point cloud. Creates a 3D mesh appearance.
Reset UI Layout		Reset the layout of the Zivid Studio window.
Enter / Exit Full Screen Mode	F11	Toggle between full and regular screen mode.
Help		Function
View help online		URL to the Zivid Knowledge Base.
Legal Notice		Detailed information on Zivid and third-party software licenses.
System Info		Information on the system used by the Zivid software.
Camera		Function
Scan for connected cameras		Show all cameras plugged into the PC and list them by model and serial number.
Connect		Connect to the camera selected in the drop-down menu. Zivid Studio can connect to a single camera at a time.
Disconnect		Disconnect from the active camera.
Capture		Function
Assisted Mode		Switch to assisted capture mode.
Max Capture Time (seconds)		Maximum capture time in seconds for assisted capture.
Ambient Light Adaptation		Specify if and to what ambient light frequency the assisted capture is to adapt.

Analyze & Capture	Trigger assisted capture to analyze the scene, then another capture, with the settings suggested by assisted capture.
Capture	Trigger capture with the settings that have already been suggested by the assisted capture.
Manual Mode	Switch to manual capture mode.
Single	Trigger a single acquisition capture with the settings specified in the checked acquisition.
Live	Trigger a continuous capture that allows viewing the scene in real-time.
HDR	Trigger a multi-acquisition HDR capture with the settings specified in the checked acquisitions; unchecked acquisitions are ignored.
Expand all acquisitions	Expand the settings on all acquisitions.
Collapse all acquisitions	Collapse the settings on all acquisitions.
Reset to default	Reset the control panel to the default state.
Acquisition	Function
Exposure Time	The duration a single camera image is exposed to light. The exposure time ranges from 6 500 to 100 000 us.
Aperture	The opening that controls the amount of light to the camera sensor through the lens. The f-number values range from 31.9 to 1.4.
Brightness	The output power (the amount of light) emitted by the LED projector. The brightness ranges from 0 to 1.8.
Gain	The amplification of the signal from the camera sensor. The gain values range from 1 to 16.
Toggle switch	Enable/disable the selected acquisition.
Toggle switch	Add a new acquisition resembling the setting of the selected acquisition.
Delete acquisition	Delete the selected acquisition.
Add acquisition	Add a new acquisition resembling the setting of the last acquisition.
Reset acquisition to default	Reset the selected acquisition settings to default values.
Filters	Function
Noise Filter	Remove points where the projected pattern signal-to-noise-ratio is below the specified threshold.
Outlier Filter	Remove points if the distance to their neighboring pixels within the small local region is larger than the threshold specified in mm.
Reflection Filter	Remove points impacted by reflections and thus erroneous.
Gaussian Smoothing	Perform Gaussian smoothing on the point cloud.
Contrast Distortion	Corrects and/ or removes points affected by blurring in the camera lens.
Reset to default	Reset the filters to the default state.

Color	Function
Blue color balance	The color temperature of ambient light affects the appearance of the color image. Setting white balance by adjusting blue color balance makes the color image look natural. The blue color balance parameter ranges between 1.0 and 2.0.
Green color balance	The color temperature of ambient light affects the appearance of the color image. Setting white balance by adjusting green color balance makes the color image look natural. The green color balance parameter ranges between 1.0 and 2.0.
Red color balance	The color temperature of ambient light affects the appearance of the color image. Setting white balance by adjusting red color balance makes the color image look natural. The red color balance parameter ranges between 1.0 and 2.0.
Reset to default	Reset the blue, green, and red color balance to the default state.

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