codex

USER GUIDE

ACTION CAM

VERSION 2015.03.03

Safety Warnings

Please observe any warnings and follow all instructions.

- Do not use this equipment near water and clean only with a dry cloth.
- Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
- Do not install near any heat sources such as radiators, heat registers, stoves, or other equipment (including amplifiers) that produce heat.
- Do not expose to excessive vibration, or drop this product.
- Do not defeat the safety purpose of the polarised or grounding-type plug. A polarised plug has two blades with one wider than the other. A grounding-type plug has two blades and a third grounding prong. The wide blade, or the third prong, is provided for your safety.
- If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
- Protect the power cord from being walked on or pinched, particularly at plug ends, convenience receptacles, and the point where they exit from the equipment.
- Only use attachments/accessories specified by the manufacturer.
- Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the equipment.
- Unplug this equipment during lightning storms or when not in operation for long periods of time.
- Refer all servicing to qualified service personnel. Servicing is required when the equipment has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the equipment, has been exposed to rain or moisture, does not operate normally, or has been dropped.
- To reduce the risk of fire or electric shock, do not expose equipment to rain or moisture.
- To avoid electrical shock, do not attempt to open this equipment. Refer servicing to qualified personnel only.

WARNING: Remote Heads and Capture Drives may become hot during use.

Disclaimer

Codex products are continually developed to remain at the forefront of the industry, and as such the information in this guide is subject to change without notice. Whilst Codex endeavour to ensure that all documentation provided is correct at the time of writing, this document is not guaranteed to be error-free.

Codex does not assume responsibility for issues or losses due to misinterpretation of the information in this document, errors in this document, or incorrect configuration or installation of the equipment described herein.

Please report any errors found in this document to **support@codexdigital.com**

Support and Servicing

For assistance with your Action Cam please contact **support@codexdigital.com**

Warning Notes on bright lights, direct sunlight exposure, and laser beams

The following warnings and information are provided as guidance to yield the best possible results from the Action Cam CCD (Charge Coupled Device) image sensor.

Working with High Energy Light Sources

High energy light beams may damage the CCDs - even when the Action Cam system is not powered on! If you shoot a scene that includes a bright light beam, be careful not to let the beam be directed into the lens of the camera. If you take off the lens, be sure that the protection cap is immediately put back onto the lensmount.

Phenomena Specific to CCD Image Sensors

The following phenomena that may appear in images are specific to CCD image sensors. They do not indicate malfunctions.

Image phenomena	Information
White flecks	Although the CCD image sensors are produced with high-precision technologies, fine white flecks may be generated on the screen in rare cases, caused by cosmic rays. This is related to the principle of CCD image sensors and is not a malfunction. The white flecks especially tend to be seen: • when operating at a high environmental temperature • when you have raised the sensitivity
Smear	When an extremely bright object, such as a strong spotlight or flashlight, is being shot, vertical tails may be produced on the screen, or the image may be distorted.
Oversaturation dot	In extreme cases of light saturation, the centre of a bright element can appear black.
Oversaturation area	In extreme cases of light saturation on the edges of the sensor, the bright element can appear black or distorted.
Aliasing	When fine patterns, stripes, or lines are shot, they may appear jagged or flicker.

Contents

Appendix

1. Introduction

Welcome to this guide for Codex Action Cam - a complete shooting and capture solution for situations that require a compact form factor and low weight.

Codex Action Cam itself is a tiny remote head camera for shooting at up to 60fps. The output is 1920x1080 12-bit RAW for exceptional quality.

It comes packaged with the Codex Camera Control Recorder that delivers full remote control of the camera, plus the proven workflow of the industry-standard Codex recorder.

The Codex Action Cam is ideal for:

- Point Of View and Action Camera; the creative possibilities are endless.
- Witness Camera; trifocal rig with two Codex Action Cams capturing depth information that is invaluable for VFX compositing and stereoscopic conversion.
- Native S3D; with Action Cam, 3D shooting is easy. Connect two Camera heads to the Codex Camera Control Recorder, and the signals undergo exactly the same processing.

Action Cam makes back focus adjustment quick, easy and precise, thanks to a special mechanism consisting of a sturdy locking lever, firmly securing the adjustment, and an accurate back focus wheel that rotates independently of the lens mount.

The Action Cam is compatible with C-Mount lenses for professional production, giving you everything you expect from larger lenses in a small form factor. A PL mount adaptor is available to allow the use of Ultra 16 and 16mm lenses.

2. Product Diagrams

2.1 Remote Head

Feature	Description
Locking lever (A)	Locking/unlocking the adjustment ring
Flange back adjustment ring (B)	Rotates independently of C-mount and lens
Lens mount (C)	Standard C-mount thread
Lens mount lock (D)	Allows for lens scale position alignment in 30 degree steps
System LED (E)	Glows continuously when on, flashes during link detection and in case of malfunction.
CoaXPress interface (F)	For connection with Camera Control Recorder via 75 Ohm coaxial cable with BNC plug
Bottom mount (G)	1/4” thread for attaching tripod, handle, base-plate, etc.

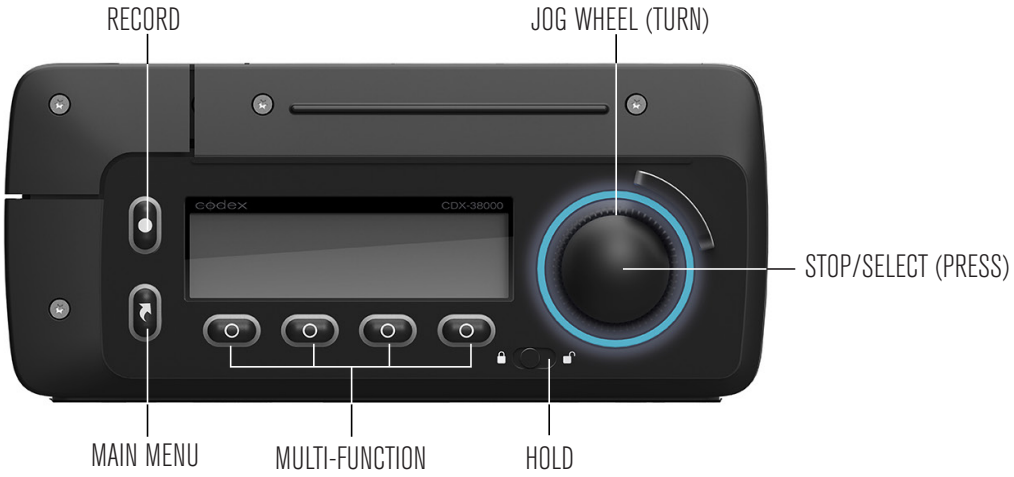
2.2 Camera Control Recorder

The Camera Control Recorder will be referred to as the CCR for the remainder of this user guide, for brevity.

Connector	Description
CXP 1	For connection to Remote Head 1
CXP 2	For connection to Remote Head 2
GPIO	For connection of external recorder trigger
LTC	For Timecode Input during record and Output during playback
GENLOCK	For connection of external Genlock sync source
OUT 1	For connection to HD video monitor for Remote Head 1 image
OUT 2	For connection to HD video monitor for Remote Head 1 or 2 image
DC IN	10-34V Power Input
RS422	For connection to Codex Control Panel (CDX-P065)
NETWORK	For connection to computer for remote control and software updates

The Action Cam CCR looks similar to the Codex Onboard S recorder but is functionally different. Action Cam Remote Heads cannot be used with an Onboard S recorder, and other cameras cannot be used with the Action Cam CCR.

2.3 Control Panel



Button	Description
RECORD	When on Monitor screen press to start recording. From other menu screens press as a shortcut to go to Monitor screen
MAIN MENU	Press to access the four Main Menu options under the display (Monitor, Play, Setup, Storage)
MULTI-FUNCTION	For access to contextual options for that menu
HOLD	Slide to lock all Control Panel buttons
JOG WHEEL	Rotate to navigate through menus, or jog during playback
STOP/SELECT	Press to stop recording. In other menus press to select the menu item

For further details please refer to the section ‘Menu System’.

3. Hardware Setup

3.1 Power

The Action Cam CCR requires an input voltage of 10-34V.

If powering from mains electricity use only the CDX-P099 power supply available from Codex.

The Action Cam CCR supplies power via the CoaXPress link to each of the Remote Heads. Therefore DO NOT connect from the CXP 1 or CXP 2 connections to a device other than an Action Cam Remote Head, as this may cause damage either to the CCR or to the connected equipment.

3.2 Cable Length

The maximum cable length between the Remote Head and Camera Control Recorder is limited by the signal attenuation and the conductor DC resistance of the cable.

Maximum cable length as limited by signal attenuation (rule of thumb):
Max. cable length = 25 dB / attenuation at 1.5 GHz

Maximum cable length as limited by conductor DC resistance (rule of thumb):
Max. cable length = 8 Ω / conductor DC resistance

Example calculation for Belden 1505F Flexible cable:
– Nom. attenuation at 1.5 GHz: 13.300 dB / 100 ft
– Nom. conductor DC resistance: 12.2 Ω / 1000 ft

Max. cable length = 25 dB / (13.300 dB / 100 ft) = ~188 ft (57 m)
Max. cable length = 8 Ω / (12.2 Ω / 1000 ft) = ~656 ft (200 m)

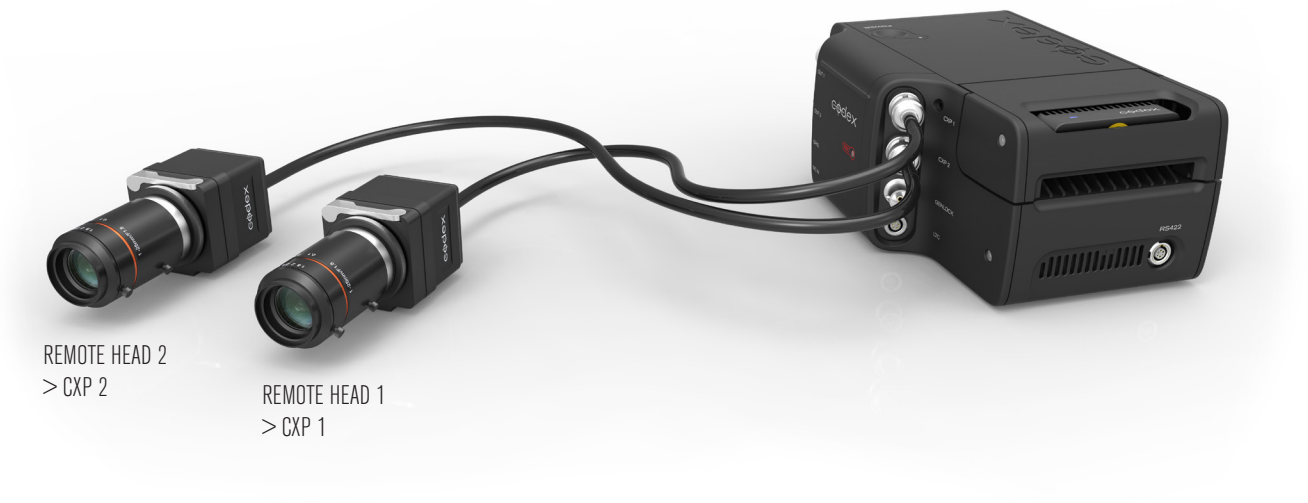
The lower of the two values determines the approximate maximum cable length, in this example 188 ft (57 m).

3.3 Connecting the Hardware

Follow these guidelines when connecting the Action Cam hardware:

- Before connecting the hardware ensure that all components are switched off.
- Connect the Remote Head(s) and other accessories to the CCR.
- Switch on all accessories and the CCR.

3.4 Remote Head to Camera Control Unit



Note: Only the Action Cam Remote Head is compatible with the CCR. No other camera signal will be accepted by the CCR.

3.5 Timecode Connection

An external LTC timecode source can be connected to Action Cam using the included cables.

The system will automatically sync to an LTC input. This can be jam sync'd and the timecode will continue to run, or the LTC source can be left connected.

For making a custom cable please refer to the section 'Connector Pin Outs'.

3.6 Shutter Synchronisation

There are two ways to achieve shutter synchronisation of the Action Cam with other camera systems.

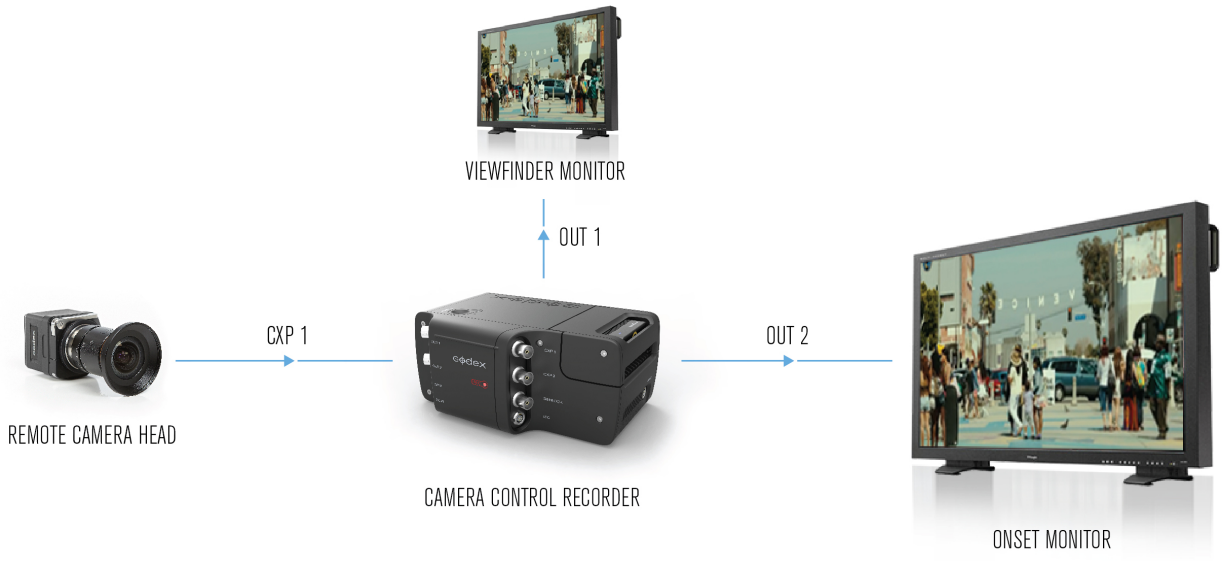
The general method of synchronising cameras is through the use of a Genlock signal connected to all systems. The SYNC input on the CCR accepts standard analog SD/HD video signals (NTSC, PAL, 480p, 576p, 720p, and 1080i/p/psF) with either bi-level (black bursts) or tri-level sync. In the Action Cam menu Setup->Video->Cam Sync should be set to Genlock for the Remote Heads to synchronize their shutters to the Genlock input signal.

If using an ARRI ALEXA the camera outputs a sync signal via the RS outputs during recording and this can be connected to the GPIO socket of the CCR. In the Action Cam menu Setup->Video->Cam Sync should be set to RS for the Remote Heads to synchronize their shutters with the ALEXA.

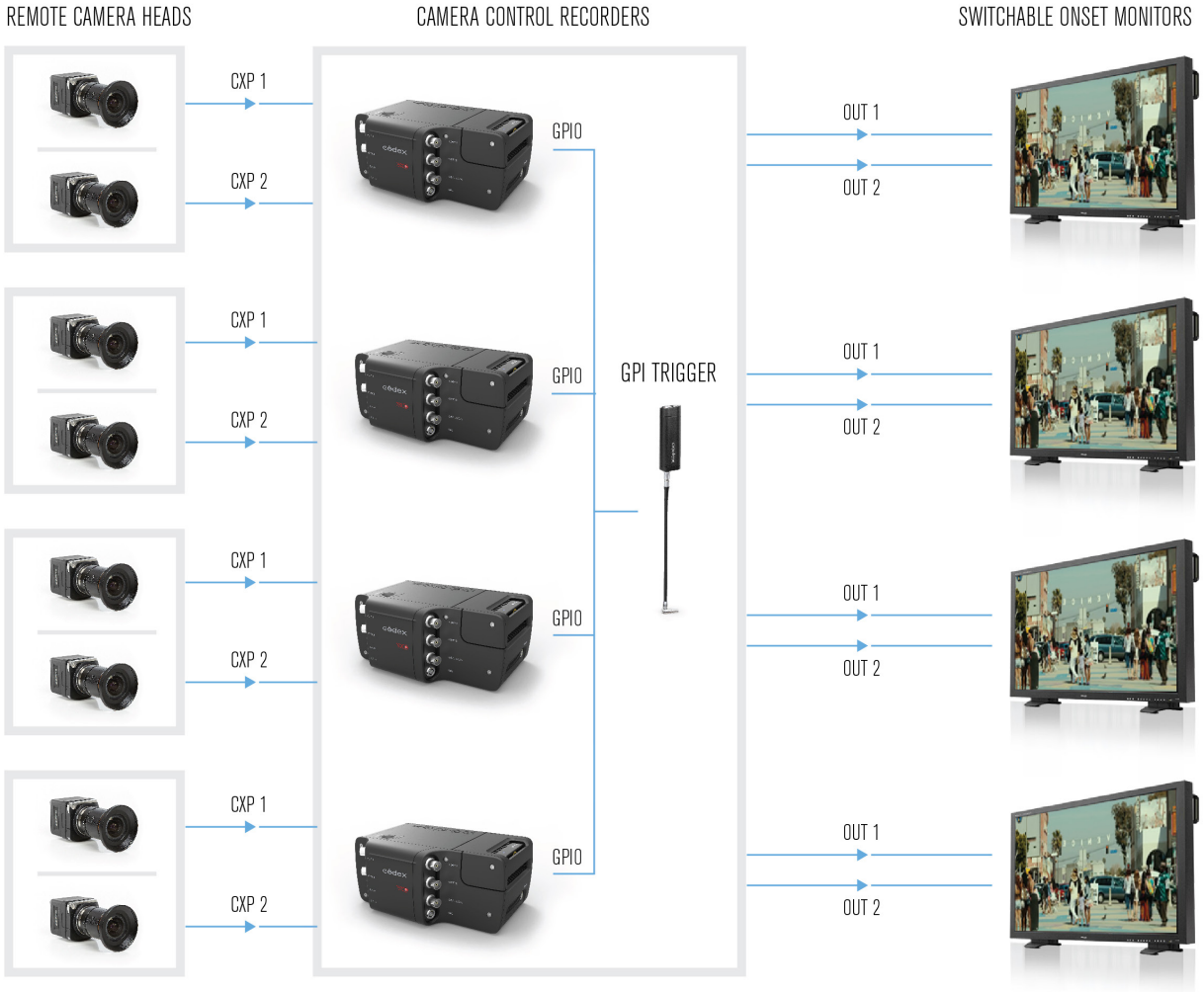
Note: if synchronising the Action Cam to the ALEXA RS output the exposure level for the Action Cam should be set during a test when the ALEXA is recording (the ALEXA only outputs the RS sync signal when it is recording).

3.7 Connection Examples

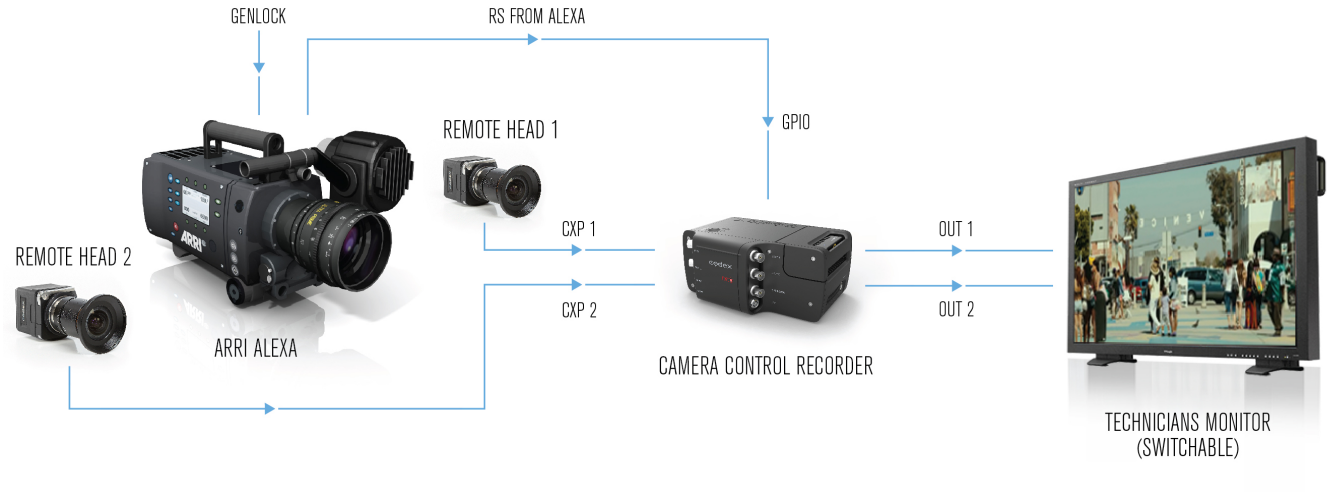
3.7.1 Point of View (POV) / Action Camera Setup



3.7.2 Multi-Camera Setup

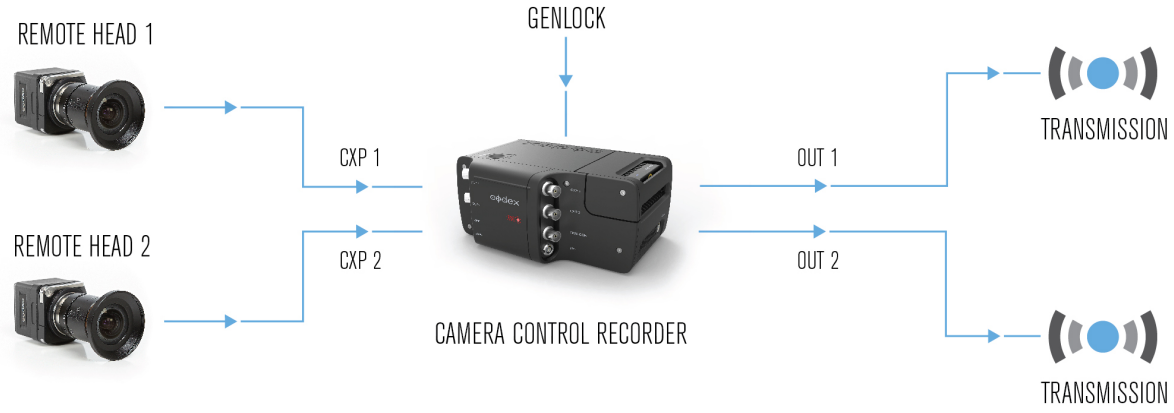


3.7.3 Witness Camera Setup



3.7.4 S3D Camera Setup

3.7.5 Broadcast Setup



3.8 Installing Lenses

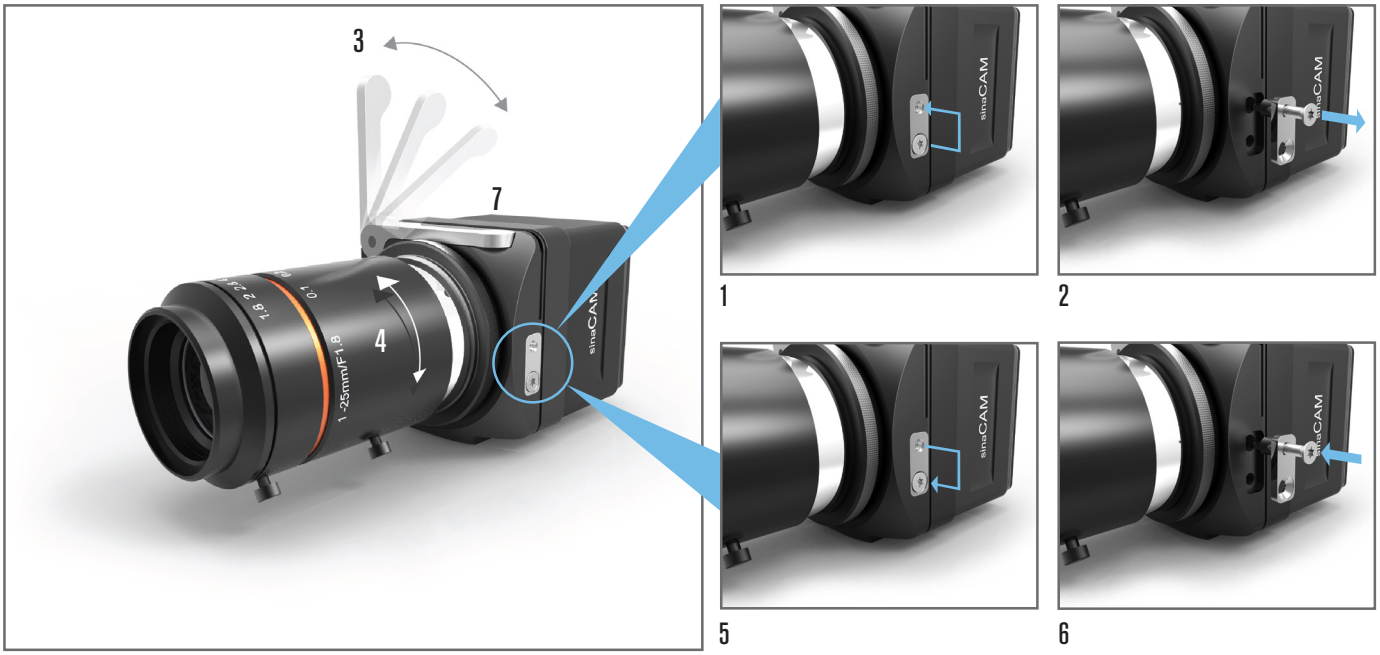
Action Cam can be used directly with C-mount lenses (suitable for 2/3" CCD Cameras), or with PL, B4 or EF mount lenses using the corresponding adaptor available from Codex.

To attach a C-mount lens gently screw it into the standard C-mount thread of the Remote Head.

For further details on PL, B4, and EF lens adaptors contact support@codexdigital.com.

3.9 Adjusting the Lens Scale Position

Depending on the camera positioning it may be necessary to for the lens to be fitted at a different angle than usual for the lens scale to remain readable. To provide flexibility Action Cam Remote Heads support 6 different positions for the lens mount, each 60° apart. The lens mount is held in the chosen position by the lens mount lock, with the lens scale on top by default.



To adjust the position of the lens scale follow these steps:

- Remove the screw from the lens mount lock's lower screw hole, then partially screw it into the upper one (1).
- Note: **The screw will not go all the way in.**
- Grip the screw head to pull out the lens mount lock (2).
- Make sure the locking lever is in the open position (3).
- You can now change the position of the lens (4).
- Note: Inside, the lens mount is equipped with 12 holes (each 30° apart) for the lens mount lock.
- Choose one of the valid positions, then reinsert the lens mount lock (5) to fix the lens mount in its place.
- Move the screw back into the lower screw hole of the lens mount lock and tighten it (6).
- Then move the locking lever back into the closed position (7).

NOTE: After adjusting the lens scale position, adjustment of the flange back distance is also necessary. See section 3.10 for further details on this procedure.

3.10 Adjusting the Flange Back Distance

If the focus is sharp when zoomed in, but soft when zoomed out, the back focus may need adjustment.

Action Cam Remote Heads allow for easy back focus adjustment by changing the flange back distance between the rear of the lens and the CCD. This can be done using typical back-focusing techniques, e.g. a test chart or a back focus collimator. See Appendix A1 and A2 for further details.

Note: Incorrect flange back distance adjustment can result in undesirable focusing issues. Flange back distance adjustment should only be performed by experts.

To adjust the flange back distance follow these steps:

- Lift up the locking lever (A).
- Turn the adjustment ring (B) until the flange back distance is accurately set (± 1 rotation = ±250 µm):
- To decrease the distance turn to the right (-).
- To increase the distance turn to the left (+).
- Push down the locking lever (A).
- Check the adjustment has been successful with a control measurement.

4. Power On and Off

Once all necessary equipment is connected press the Power button on the top surface of the CCR. When the CCR has started the Monitor screen will show either running timecode or a message if some settings need to be checked. The LED ring will light orange if the Capture Drive is formatted and ready for recording, or otherwise blue if it needs to be formatted.

After power up if the Capture Drive is not formatted, or no Capture Drive is inserted, the CCR cannot enter Monitor mode and the video hardware will not be fully initialised. At this stage the video output will not be processed according to the correct settings. Once a formatted Capture Drive is loaded the video hardware will initialise and the output will appear correctly.

To power off press the Power button on the top surface of the CCR, and then press the Shutdown button under the Control Panel display. The shutdown process is complete when the Control Panel display switches off.

5. Menu System

5.1 Overview

The Main Menu button provides access to the four main areas of the menu system via the buttons under the display:

Main Menu Option	Description
Monitor	Where recording is started and settings for recording can be adjusted.
Play	Where playback is controlled and where a shot can be selected for playback.
Setup	Where settings for video output, sync, timecode, and shot naming can be adjusted.
Storage	Where the Capture Drive can be formatted.

The general operation of the menu system is as follows:

- From any part of the menu system press Main Menu->Monitor to return to the monitor screen, where you must be to start recording. Then to start recording, if all settings and input signals are correct, press the RECORD button.
- During recording the only responsive button is STOP which finishes the recording.
- The colour of the LED ring on the Control Panel shows the current mode of the Camera Control Recorder. The different modes are: Monitor = Orange; Recording = Red; Playing = Green; Pause/Setup = Blue.
- When the Hold Switch is engaged there will be a padlock symbol at the top of the screen, and none of the other buttons will respond until the Hold Switch is set to be off. The image below shows the screen with the padlock symbol:

- In the menus turn the Jog Wheel to move up and down through a list and press the Jog Wheel (SELECT) to make a selection.
- If there are 3 or less settings (e.g. Monitor->Options->EI: 100, 200, 400) these can be selected from the buttons under the display. Otherwise press the Jog Wheel (SELECT) to open the list of settings (e.g. Monitor->Options->WB).
- Some menus allow text entry but also have presets available, indicated by < and > symbols (e.g. Setup->Slate). Press the Next button under the display to move through the presets. Then press Accept to use a preset, or otherwise Cancel.

- Pressing the Jog Wheel (SELECT) on a text field will open the text editor. Turning the Jog Wheel moves the cursor, and Backspace deletes a character. Press Insert to open a row of characters that can be scrolled by turning the Jog Wheel, and press the Jog Wheel to insert the highlighted character. The Shift button cycles through Shift, Caps, and Normal case modes. Leave Insert mode by pressing the Cursor button.
- The battery level is always shown in the top left corner of the display.
- The record time remaining is always shown in the top right corner of the display. If this symbol is flashing then it indicates either that there is less than 5 minutes of record time remaining, or that there is an issue with the Capture Drive which should be checked from the Storage screen.

5.2 Setup

Use this menu to access a range of sub-menus for system settings.

5.2.1 Presets

Use this menu to save the current settings as a preset, or to load a previously saved setup.

This makes it fast and easy to move between different setups - for example for different combinations of frame rate, exposure, and shutter angle. The following options are available:

Option	Notes
Load	Press to load a previously saved preset.
Save	Press to save the current settings as a preset. By default the presets are named ‘Preset 1’, ‘Preset 2’, etc. but the name of the preset can be customised when it is saved. The following settings are saved in the preset: • Slate settings (Shot and Roll naming) • Capture settings (EI, WB, Shutter Angle, FPS) • Video settings • Timecode settings
Delete	Press to delete a previously saved preset from the list.

5.2.2 Video

Use this menu to adjust capture and output settings.

The following settings are available:

Setting	Options	Notes
Fps	23.98 24.00 25.00 29.97 30.00 47.95 48.00 50.00 59.94 60.00	Sets the video output rate. This must be equal to or higher than the desired shutter rate. If 'Cam Sync' is set as 'Free Run' or 'Genlock' the Remote Head shutter rate is determined by the Monitor->Filecard->FPS setting. By default this is Locked to the video output rate. Alternative shutter rates (e.g. 12fps, 33.333fps) are set from Monitor->Filecard->FPS. Please refer to section 'Setting the Frame Rate' for further details. Remote Head shutter rate is controlled by 'RS' input signal if this option is selected for 'Cam Sync'. Note: Changing the shutter rate will alter the exposure level.
Channels	1 2	Sets the number of Remote Heads to be recorded.
Aspect	Square Anamorph x1.3	Sets the pixel aspect metadata for the recordings. This affects the desqueeze applied by the Codex software when producing deliverables such as ProRes or Avid MXF for editing and dailies.
Output	4:2:2 Default 3G Duplicated	Sets the video output mode. '4:2:2' provides a single link 1.5GHz output per Remote Head. 'Default' provides a 4:4:4 dual link 1.5GHz output for Remote Head 1. '3G' provides a single link 3GHz output per Remote Head. 'Duplicated' provides two single link 1.5GHz outputs for Remote Head 1.

Setting	Options	Notes
Cam Sync	Free Run Genlock RS	Sets the sync source for the Action Cam CCR. 'Free Run' uses the Action Cam internal clock and is not synchronised to other devices. 'Genlock' synchronizes the video output to the Genlock input signal. If no Genlock input is connected an error will be shown and recording is not possible. 'RS' synchronizes to the RS output from an ARRI ALEXA to achieve shutter sync with the camera.

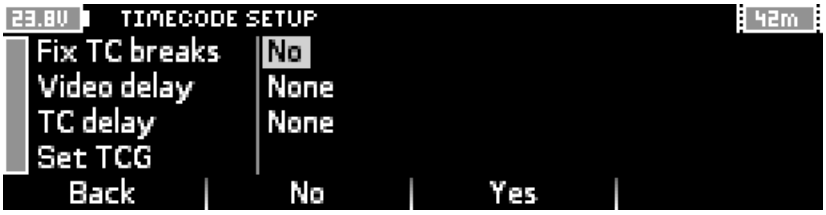
5.2.3 Source

Use this menu to set unique metadata for the Action Cam rig and Remote Heads:

- Source ID: this should be set as a unique ID for each Action Cam, the default is A.
- Channel ID V1: this should be set as a unique ID for Remote Head 1, the default is V1.
- Channel ID V2: this should be set as a unique ID for Remote Head 2, the default is V2.

5.2.4 Timecode

Use this menu to adjust timecode settings.



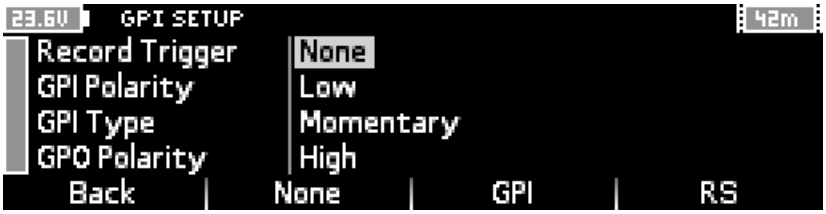
The Action Cam will automatically sync to an external LTC source, or you can set the internal timecode generator with the Set TCG option. The timecode mode is always continuous run (and not record run).

Setting	Options	Notes
Fix TC breaks	Yes No	Sets whether the Action Cam will automatically repair timecode if sync is lost between shutter and timecode input. Set to Yes if using an external timecode source.
Video delay	1 2 3 4	Set to correct for a video delay if a test with a timecode slate shows that video is delayed with respect to timecode.
TC delay	1 2 3 4	Set to correct for a timecode delay if a test with a timecode slate shows that timecode is delayed with respect to video.

Setting	Options	Notes
Set TCG	Set Time Of Day Change	Sets the internal timecode generator. Press 'Time Of Day' and then 'Set' to set the internal timecode generator to current time-of-day. To enter another value press 'Change' and set the required timecode followed by 'Set'.

5.2.5 GPI

Use this menu to adjust settings for record triggering.



This may be from an electrical GPI trigger switch or from an RS port on ARRI ALEXA which sends a trigger signal when the Camera is recording - both of these are connected via the GPIO port on the Action Cam.

Setting	Options	Notes
Record Trigger	None GPI RS	Sets whether an external source is used to trigger record start/stop. Set to 'None' to use the RECORD and STOP buttons on the Control Panel. Set to 'GPI' to use an electrical GPI trigger connected to the GPIO port. Set to 'RS' to take the trigger from an ALEXA RS port. Note: Setup->Video->Cam Sync should also be set to RS to use trigger from ALEXA RS port.
GPI Polarity	Low High	Set depending on the configuration of the GPI trigger being used.
GPI Type	Latching Momentary	Set to 'Latching' for push-and-release record/stop operation, or 'Momentary' for push-and-hold record/stop operation.
GPO Polarity	Low High	Set depending on the configuration of the GPI trigger being used.

5.2.6 Slate

Use this menu to set how the shot name and roll name metadata is applied to recordings.

There are a range of presets that can be cycled through using the Next button under the display.

Setting	Options	Notes
Shot naming rule	{Scene}-{Take}_{r} {Scene}-{Take} {Scene}-{Take}{SourceId}	Sets the structure of metadata used for shot names. Scene and Take values are set from Monitor->Filecard.
Roll naming rule	{SourceId}{Datapack} {Datapack} {Datapack} {SourceId}	Sets the structure of metadata used for roll names. SourceId is set in Setup->Source->Source ID and should be a unique ID per Action Cam rig. Datapack is set by the Roll name given on the Storage screen.

5.2.7 Project

Use this menu to set the following production metadata that will be applied to all recordings:

- Production
- Production Company
- Unit
- Director
- DP
- Location
- Codex Operator

5.2.8 System

Use this menu to check and adjust overall system settings. The top of the display indicates the installed software version on the Action Cam and the serial number.

The network port settings (IP, Mask, Gateway, DNS) can be configured to facilitate connection from another computer. This can be used to load LUT files onto the CCR and also to control the Action Cam from another computer via network.

The other settings available are:

Setting	Options	Notes
System control	Unlocked Locked	Sets whether the Action Cam can be controlled from a networked computer (Unlocked) or not (Locked).
Screen contrast	0 - 15	Sets the contrast of the screen. This can be useful in particularly bright or dark environments.
Control ring bright	0 - 15	Sets the brightness of the Control Panel LED ring. This can be useful in particularly bright or dark environments.
Rec tally bright	0 - 15	Sets the brightness of the REC light on the side of the CCR. This can be useful in particularly bright or dark environments.

Setting	Options	Notes
Shutdown volts	Disabled Default 11V - 24V	Sets the voltage at which the Action Cam will shutdown. 'Default' (recommended) is 10V, but this can be Disabled (minimum 8V) or increased to a higher setting.
Automatic power up	Disabled Enabled	Sets if the Action Cam powers up immediately when a power source is connected. Use of the 'Enabled' setting is recommended.
Switch controller	RS422	Assigns control of Action Cam from the inbuilt Control Panel to an external Control Panel connected via the RS422 port.
CDL server	<User Input>	Use this setting to specify the IP address for a connected CDL server.

5.2.9 Licence

This menu contains details of the licensed features on an Action Cam. By default these should be HD and Multi.

5.2.10 Date/Time

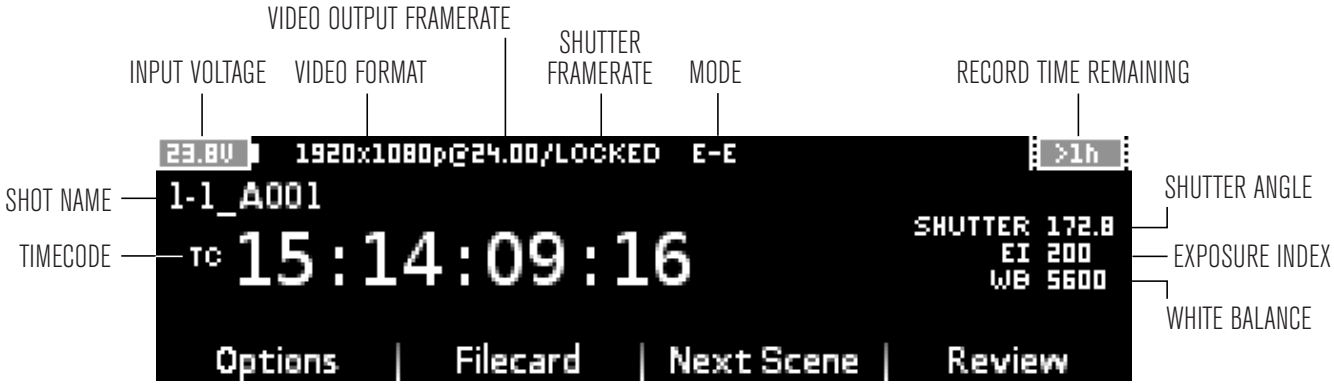
This menu contains system date and time settings that can be adjusted to be correct for the locale. These settings are used for the internal timecode generator and also to set the creation time metadata for recordings.

5.3 Monitor

The Action Cam must be on the Monitor screen to start a recording. The Monitor screen shows the current settings for recording, as well as timecode and any warning/error messages.

5.3.1 Monitor Screen Layout

This image shows the Monitor screen with the shutter rate LOCKED to the video output rate:



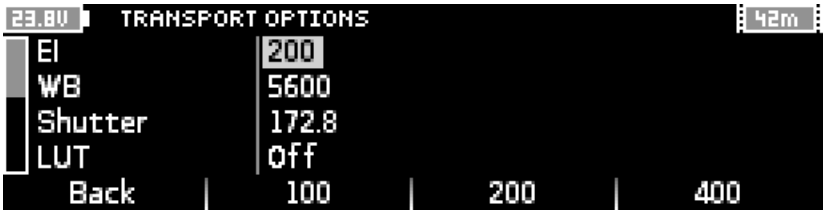
This image shows the Monitor screen when the shutter rate has been set to a custom rate in the Filecard:

If there is a warning or error message it will appear under the timecode display:

Error and warning messages are cleared from the display if their cause is resolved prior to starting a recording. If a warning or error occurs during recording it will remain on the display until the users moves away from the Monitor screen to a different menu.

5.3.2 Options

Use this menu to adjust Remote Head settings for capture and output settings for monitoring and playback.



Setting	Options	Notes
EI	100 200 400	Sets the Exposure Index for recordings. Changes to this setting affect the live video output. A setting of 200 does not adjust the gain of the signal. A setting of 100 reduces the gain, whilst a setting of 400 increases it. To set a value other than the presets available here use the Filecard. This sets metadata that does not affect the recorded data, and can be modified after recording/prior to generating files for post production if necessary.

Setting	Options	Notes
WB	3200 4300 5600 6500	Sets the White Balance for recordings. Changes to this setting affect the live video output. To set a value other than the presets available here use the Filecard. This sets metadata that does not affect the recorded data, and can be modified after recording/prior to generating files for post production if necessary.
Shutter	11.2 22.5 45.0 90.0 135.0 172.8 180.0 270.0 356.0	Sets the shutter angle which determines the exposure time. This can be converted to exposure time as follows: Exposure Time = Shutter Angle / (360 x FPS) Changes to this setting affect the live video output. To set a value other than the presets available here use the Filecard. Note: Changing the shutter angle will alter the exposure level.
LUT	Off On	Sets whether a 1D monitoring LUT is applied to the video outputs.
LUT Select	<User Select>	Sets the LUT to be applied to the video output.
TC rate	23.98 24.00 25.00 29.97 30.00 47.95 48.00 50.00 59.94 60.00	Sets the timecode rate for monitoring and the playback rate. This is typically set to the project editing rate.
TC source	TC AUX POS	Sets the timecode source that is displayed. ‘TC’ is standard timecode, ‘AUX’ is the auxiliary timecode track, and ‘POS’ is the timecode position in the current shot starting from 00:00:00:00.
TC type	Standard Frames	Sets how the timecode is displayed. ‘Standard’ is displayed as hh:mm:ss:ff, while ‘Frames’ is a 8-digit number showing the TC value since midnight or POS value since the start of the shot.
Marks*	Set In Set Out Clear All	Set In point and Set Out point for playback, or Clear All playback marks on current clip.
Play loop*	Stop Repeat Bounce	Sets the playback behaviour. ‘Stop’ will end playback at the last frame of the clip, ‘Repeat’ will play the clip over and over, and ‘Bounce’ will play the clip forwards and then backwards.

Setting	Options	Notes
Play range*	All Marks	Sets whether 'All' the clip is played, or only the range inside the 'Marks'. The start and end of the clip are the In and Out points by default.

*Available in Play mode only.

5.3.3 Filecard

Use the Filecard to input metadata for the next shot to be recorded, such as Scene and Take values.

It is also used to enter custom settings for FPS (shutter rate), EI (Exposure Index), WB (White Balance), and Shutter Angle, before recording.

When the FPS is Locked the camera shutter is running at the same rate as the video outputs. Provided that Setup->Video->Cam Sync is set to 'Free Run' then a different FPS can be set in the Filecard.

The full list of settings available in the Filecard is:

- Scene
- Take
- Circle
- Day
- Date
- Comments
- Name
- Roll
- Sound Roll
- Log Note (this information is added automatically when necessary)

Setting	Options	Notes
EI	<User Input> 100 200 400	Press the Jog Wheel to enter a custom setting. Press the Next button to move through the preset options. Changes to this setting affect the live video output. This sets metadata that does not affect the recorded data, and can be modified after recording/prior to generating files for post production if necessary.

Setting	Options	Notes
WB	<User Input> 3200 4300 5600 6500	Press the Jog Wheel to enter a custom setting. Press the Next button to move through the preset options. Changes to this setting affect the live video output. This sets metadata that does not affect the recorded data, and can be modified after recording/prior to generating files for post production if necessary.
Shutter Angle	<User Input> 11.2 22.5 45.0 90.0 135.0 172.8 180.0 270.0 356.0	Press the Jog Wheel to enter a custom setting. Press the Next button to move through the preset options. Note: Changing the shutter angle will alter the exposure level.
FPS	<User Input> Locked 23.98 24.00 25.00 29.97 30.00 47.95 48.00 50.00 59.94 60.00	Sets the Remote Head shutter rate. The 'Locked' setting means Remote Head shutter rate matches Setup->Video->Fps setting. Press the Jog Wheel to enter a custom setting. (If Setup->Video->Cam Sync is set to 'RS' then custom settings are not possible.) Press the Next button to move through the preset options. Note: Changing the shutter rate will alter the exposure level.

The Filecard is also accessible from the Play->Shots menu to edit metadata after recording.

5.3.4 Next Scene

Use the 'Next Scene' button on the Monitor screen to quickly and easily increment the Scene number for the next recording.

5.3.5 Review

Use the 'Review' button on the Monitor screen to play back the last 10 seconds of the previous recording. When playback finishes the system will return to the Monitor screen.

6. Loading and Unloading Media

To load a Capture Drive lift the door at the front of the CCR. Slide the Capture Drive into the port (with cooling ridges facing upwards) and push so that the connector is fully mated.

Close the door and the Capture Drive will be loaded. The LED on the Capture Drive will flash blue whilst it loads,

and turn off when it finishes loading.

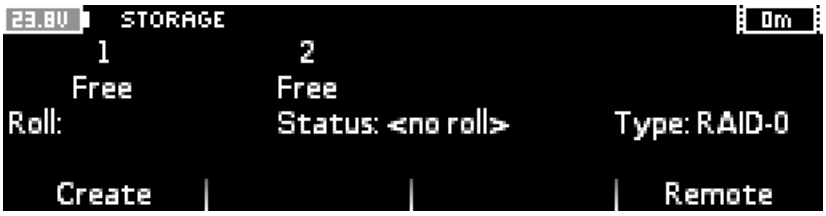
To unload a Capture Drive lift the door. The Capture Drive will be ejected and the LED will flash blue for a short time. When it becomes solid blue the Capture Drive can be safely removed.

7. Preparing for Recording

A Capture Drive must be formatted with a Roll before it can be used for recording.

Press Main Menu->Storage to check the status of the Capture Drive. If the Capture Drive is formatted there will be a Roll number shown and the status will be Ready.

If there is no Roll number press Create and the system will suggest the next Roll number (based on the previous Roll number that was loaded). Edit the Roll number if required, then press Create again to complete the formatting process.



8. Setting the Frame Rate

To set the frame rate for recording from the Monitor screen press the Filecard button. Here the FPS (Frames Per Second) rate of the camera shutter can be changed.

By default the FPS of the shutter is Locked, which means it is the same as the video output frame rate from OUT 1 / OUT 2.

To change the setting scroll down to FPS. Press the Next button to move through a list of standard frame rates. To enter a custom frame rate (e.g. 12fps or 33.333 fps) press the Jog Wheel and enter the desired rate.

Note: Setup->Video->Cam Sync must be 'Free Run' to allow custom frate rates. If Setup->Video->Cam Sync is set to 'RS' then the shutter rate is determined by the sync signal from the ALEXA and custom settings are not possible.

9. Recording

With the Capture Drive formatted and all settings correct, press Main Menu->Monitor. The LED ring should now be orange and the timecode display should be running.

Press RECORD to begin the recording - both the LED ring and the tally light on the other side of the CCR will turn red.

Press STOP (centre of Jog Wheel) to end the recording.

If the recording does not start check there is not a warning or error message shown under the timecode display. In this case please refer to the later section Warning and Error Messages for further information to resolve the problem.

Frame Rate	1 Camera Record Time	2 Camera Record Time
23.98	107 (minutes)	53
24.00	107	53
25.00	102	51
29.97	84	42
30.00	84	42
47.95	53	26
48.00	53	26
50.00	50	25
59.97	42	21
60.00	42	21

10. Playback

From the Monitor screen press Review to play back the last 10 seconds of the previous recording.

To choose a different shot for playback press Main Menu->Play. The previous recording will be loaded for playback.

Use the > button to play the shot forwards, and the < button to play the shot backwards. The Jog Wheel can be used to jog through the shot.

To load another shot press the Shots button, which will bring up the Shot List. Scroll through the list with the Jog Wheel and press it to select a shot for playback.

11. Remote Head LED Indicators

LED Colour and Behaviour	Notes
Off	No power
Solid orange	System booting
Fast flash green	Link detection in progress
Fast flash orange	Link detection in progress, resyncing
Solid red	Power supply for Remote Head is over current
Slow pulse green	Connected to CCR but no data being transferred
Solid green	Connected to CCR and data is being transferred
1/2 second pulse red	Error during data transfer
Fast flash red	System error

12. Recommended Settings

The table below covers the recommended input and output settings for a range of shooting setups the Action Cam can be used on:

Setting	Action Cam	Multi Cam	Witness Cam	S3D Cam	Broadcast Cam
Setup->Video->Fps	Your choice	Your choice	Your choice	Your choice	Your choice
Setup->Video->Channels	1	2	2	2	2
Setup->Video->Output	Duplicated	4:2:2	4:2:2	4:2:2	4:2:2
Setup->Video->Cam Sync	Free Run	Genlock	RS	Free Run	Genlock
Setup->GPI->Record Trigger	None	GPI	RS	None	None

For the Setup->Slate settings the following preset options are sensible defaults:

Shot Naming Rule: {Scene}-{Take}_{r}

Roll Naming Rule: {SourceId}{Datapack}

13. Mounting Options

The Action Cam CCR has an integrated quick release mounting system built into the base. This can be used with a mount plate in a range of configurations to provide flexible solutions for mounting on its own rig or in combination with other camera systems such as the ARRI ALEXA.

13.1 Cheeseplate Mount

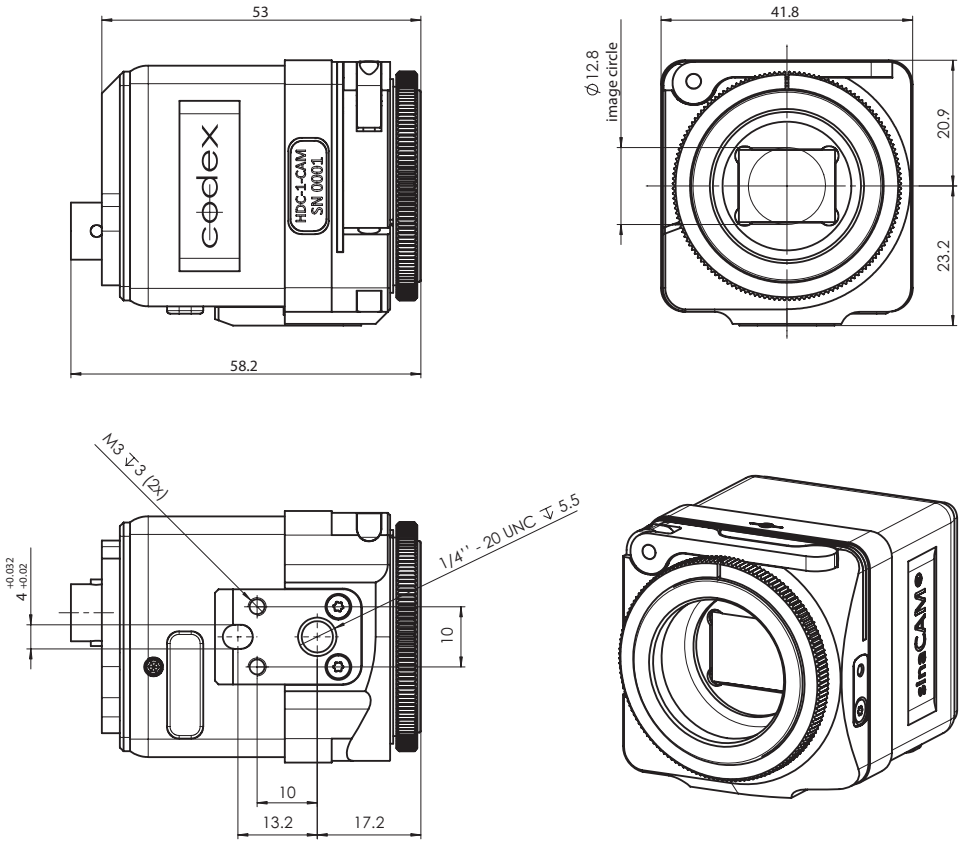
The cheeseplate mount provides a range of mounting options, including compatibility with Anton Bauer and IDX battery mounts. Standard mount threads allow for mounting in a range of custom configurations.

13.2 Vocas Mount

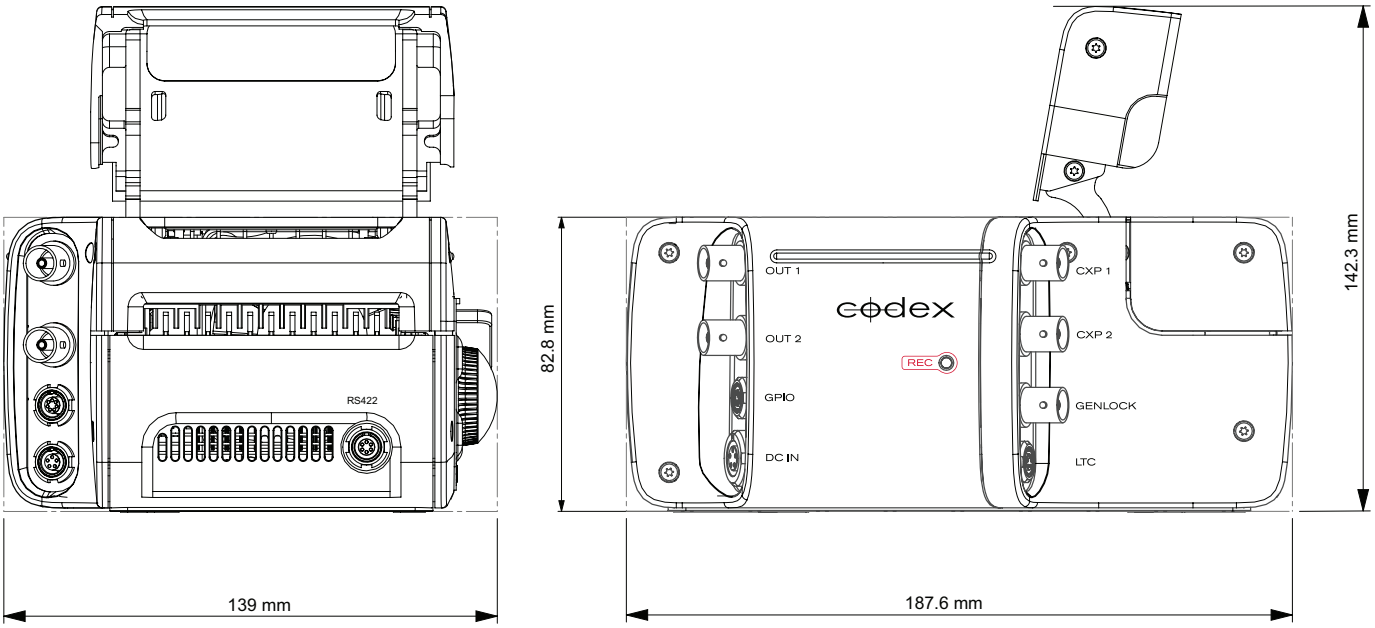
With the Vocas mount the CCR can be securely mounted to 15mm rails with quick and easy angle adjustment
.

14. Dimensions

14.1 Remote Head Dimensions



14.2 Camera Control Recorder Dimensions



15. Technical Specifications

15.1 Remote Head Specification

Image Sensor	2/3” Single Chip Kodak CCD Sensor (RGB) 2004×1144 Pixels, Progressive Scan
Electronic Shutter Type	Global
Sensitivity	2000Lux @ f8.0 / 0dB Gain (100% video out) 160Lux @ f2.2 / 0dB Gain (100% video out)
Resolution	1920×1080 Pixels (5.5 µm pixel size)
Active Image Area	10.56mm x 5.94mm (12.1mm diagonal, 2/3” optical format)
Dynamic Range	13.5 f-stops
Signal/Noise Ratio	64 dB @ 0 dB Gain
Interface	CoaXPress, 75 Ω BNC Cable
Max. Cable Lengths	80 m (260 ft) with Standard BNC Cable
Lens Mount	C-mount with Flange Back Distance adjustment
Power Consumption	4.6 W max.
Operating Temperature Range	0 to 45 °C (32 to 113 °F)

15.2 Camera Control Recorder Specification

White Balance Modes	3200 K, 4300 K, 5600 K, 6500 K, User Input
Exposure Control	100, 200, 400 ASA, User Input
Gamma	Action Cam Log
Electronic Shutter	11.2, 22.5, 45.0, 90.0, 135.0, 172.8, 180.0, 270.0, 356.0°
Remote Head Connections	CoaXPress (via 75 Ω BNC Cable)
HD-SDI Output Formats	Up to 2 x HD-SDI (SMPTE 292M, 372M), 1920x1080, 10-bit 4:2:2 or 4:4:4
Recording Formats	12-bit Bayer, 1920x1080, 23.98, 24, 25, 29.97, 30, 47.95, 48, 50, 59.94, 60
Synchronization	Internal, ALEXA RS, or GenLock to Tri-Level Sync or Black Burst
Network Ports	1Gb Ethernet
Power Consumption	30 W max (including 2 Remote Heads)
Operating Temperature Range	0 to 45 °C (32 to 113 °F)

16. Colour Management

16.1 Video Output Code Distribution Chart

The following table details how the Action Cam Log Curve distributes 10-bit SMPTE video code values across the available latitude in Stops from the camera.

Stop	10-bit SMPTE video code (v)	Codes / half stop
2.0 (800 ASA clip point)	1016 (MAX)	50
1.5	966	50
1.0 (400 ASA clip point)	916	50
0.5	866	50
0.0 (200 ASA clip point)	816	50
-0.5	766	50
-1.0	716	50
-1.5	666	49
-2.0	617	49
-2.5	568	48
-3.0	520	48
-3.5	472	46
-4.0	426	46
-4.5	380	43
-5.0	337	42
-5.5	295	38
-6.0	257	35
-6.5	222	32
-7.0	190	27
-7.5	163	23
-8.0	140	18
-8.5	122	15
-9.0	107	11
-9.5	96	9
-10.0	87	6
-10.5	81	5
-11.0	76	3
-11.5	73	3
-12.0	70	2
-12.5	68	1
-13.0	67	1

16.2 “Cineon” Equivalence

The Action Cam log encoding is based on classic Cineon, but with different parameters:

Parameter	Cineon Log Value	Action Cam Log Value
Black	95	64
White	685	560
FilmNegGamma	0.6	0.667443421

16.3 Special Values

The following values are provided as common reference points:

10-bit SMPTE code value	Linear value, t (to six decimal places)
4	-0.011437
64	0.000000
560	1.000000
940	14.192376
1016	24.000000

Linear value, t	10-bit SMPTE code value	Waveform %
0.00	64	0
0.18	332	31
0.90	545	55
1.00	560	57
6.00	816	86
12.00	916	97
24.00	1016	109

16.4 Use of Exposure Index

The native ASA of Action Cam is 200, with a clipping point at 600% video level. The Action Cam Log Curve can represent values up to 2400%.

The standard Exposure Index settings available in the camera are 100, 200, and 400.

For a 10-bit SMPTE video code value **x**, to convert to a normalised signal level **v**:

v = (x-64)/876

The normalised signal level must be multiplied by a constant to get a linear value **t**:

t = normalisedSignalLevel * 6 * (exposureIndex/200)

16.5 Log To Linear Conversion

The following

t = (pow(10, (v - a) / b) - c) / (1 - c)

16.6 Linear To Log Conversion

v = a + b * log10(c + t*(1 - c))

16.7 Conversion Variables

The following variables are used when processing the output of Action Cam:

Variable	Value
a	0.566210
b	0.380962
c	0.032639

17. Warning and Error Messages

Warning/Error	Notes	Action
No video input signal detected	No valid input signal detected on CXP1 by the CCR. The signal could be absent or too weak (or not from an Action Cam Remote Head).	Check cabling between the Remote Head and the CCR.
No video input signal 2 detected	No valid input signal detected on CXP2 by the CCR. The signal could be absent or too weak (or not from an Action Cam Remote Head).	Check cabling between the Remote Head and the CCR.
Video CRC error	An error has been detected on the input signal. This may result in visible errors on the recorded image.	Check cabling. It could be damaged, too long, or suffering interference from lighting etc.
Video frame dropped	There has been loss of input signal during recording, or a failure writing data to the Capture Drive.	Check cabling. If this happens from one Remote Head it may be a cable issue. If it happens from two Remote Heads it may be a Capture Drive issue.
Timecode break	The timecode and shutters have lost sync, which may result in duplicate/ missing timecode values in the shot.	Check video and timecode source genlock.
Roll is full	There is no more space on the Capture Drive.	Load a Capture Drive which has storage space remaining.

18. Connector Pin Outs

Connector	Pins
LTC - 5 pin 0B Lemo socket	1 Ground 2 LTC IN + 3 LTC IN — 4 LTC OUT — 5 LTC OUT + For unbalanced input, use ‘LTC IN +’ and connect ‘LTC IN -’ to ground (Pin 1).
GPIO - 7 pin 0B Lemo socket	1 Reserved for RS232 RX - DO NOT CONNECT 2 Reserved for RS232 TX - DO NOT CONNECT 3 Ground 4 GPI IN 5 GPI OUT 6 Reserved - DO NOT CONNECT 7 Reserved - DO NOT CONNECT
DC IN - 5 pin 1B Lemo socket	1 Battery V— (0V) 2 IDX SCL (IDX digital clock) 3 IDX SDA (IDX digital data) 4 AB DATA (Anton/Bauer coms) 5 Battery V+ (12-28V DC)
RS422 - 6 pin 0B Lemo socket	For connection to Codex Control Panel CDX-P065 only.

APPENDIX

A1. Flange Back Distance and Back Focus Adjustment

Flange Back Distance is the distance between the lens mount flange and the camera sensor (or film) plane. Back Focus Adjustment is a feature of the specific lens being used, and adjusts the distance between the rear element of the lens and the camera sensor (or film) plane. For accurate and consistent focus it is crucial to have both of these distances correctly aligned.

When they are calibrated properly, the distance markings on the lenses are exact but when they are misaligned, even by a few microns, the distance markings on the lens can be wildly off and completely unreliable, with the potential to cause major focus issues. This is equally essential when measuring by distance to pull focus.

With the Codex Action Cam, you can adjust flange back distance for any attached lens – the procedure is outlined in **Section 3.10** of this guide. Once a lens is mounted that has it's own back focus adjustment, it is critical to adjust this as well for optimum focus.

Note: The correct flange back distance for one lens may not be suitable for a different lens. Therefore after changing lenses it is possible for an image that is sharp when zoomed in to be soft when zoomed out. In this case the flange back distance (and lens back focus adjustment where available) should be checked and adjusted again as necessary.

As the flange back distance is critical to achieve the best shooting results it should be done -

- During camera prep when assembling the equipment at the start of the production.
- Before each shooting day.
- After every lens change.
- After significant temperature changes of the equipment, for example when moving from indoors to outdoors.

Before starting the adjustment, connect the Remote Head to the Camera Control Recorder (CCR) and connect a high resolution video display to the video output - see **Section 2.2** of this guide for connector details and **Section 5.2.2** for video settings.

Put the video display in a "high contrast" setting and mount the camera on a tripod.

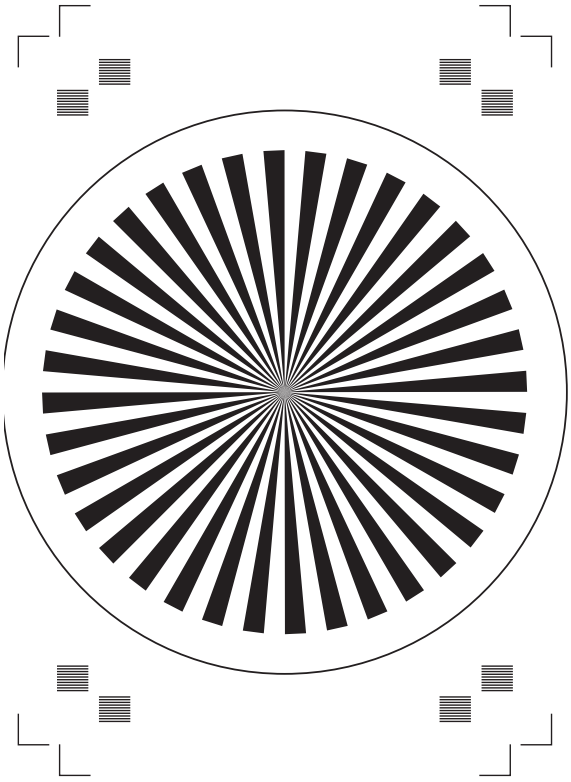
Position the recommended Test Chart (Appendix A2. Figure 1.) at least 2 to 3 metres (8 to 10 feet) from the camera. Alternatively follow the rule of thumb "lens focal length in mm x 25 = minimum distance in millimeters to the pattern". Otherwise, position the chart as far as possible with good pattern visibility. Follow the procedure below to set flange back distance:

1. Set the iris to manual.
2. Set the zoom control to manual.
3. Open the iris to its widest aperture. If the illumination on the test chart is too bright for the open iris, reduce the light, use ND filtering or move the chart to a darker area.
4. Set the Shutter to 356.0 (max open) as described in **Section 5.3.2**.
5. Switch off any macro feature in your lens.
6. Turn the zoom barrel to extreme telephoto.
7. Focus on the center of the chart.
8. Set the zoom to wide angle .
9. Loosen the back focus locking lever (A) on the Remote Head. (Appendix A2. Figure 2.)
10. Slowly adjust the flange back adjustment ring (B) on the Remote Head (Appendix A2. Figure 2.) for the sharpest focus, using the "pop-out or target cross" effect of the test chart.
11. Repeat steps 6 through 10 until focus is consistently sharp.
12. When satisfied, tighten the locking lever to secure the back focus ring.

Note: The hexscrew on the side of the Action Cam is not an adjustment for focus. It releases the "Lens mount lock" which can be used to alter / rotate the mounting position of the Lens relative to the camera body in 12 different positions so that the Lens scale remains readable. See **Section 3.9** for details.

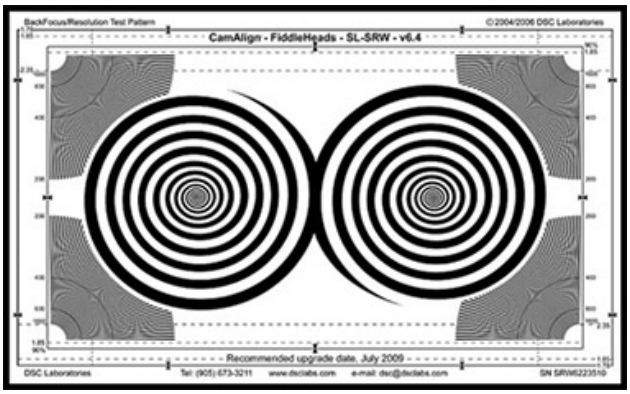
A2. Recommended Test Charts

Figure 1.



Siemens Star Chart

A printable eps file is available for download at http://www.codexdigital.com/products/action-cam



DSC FH SW FiddleHeads Test Chart

http://dsclabs.com/shop/resolution-focus/fiddleheads-with-resolution/

Note: a usable chart should be printed at least A3 size or larger

Figure 2.

Notes

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