



Harry's GPS LapTimer

Documentation v1.7



Harry's LapTimer

Scope

This paper is part of LapTimer's documentation. It covers all available editions LapTimer comes in – both for iOS and Android. In case functionality or wording differs, the document marks the respective sections using and Apple  or a Droid . For historical reasons, most snapshots are iOS pictures. However, as both apps converge over time and will show only minor differences, pictures are not doubled in general.

For further documentation <http://www.gps-laptimer.de/documentation> is the first address for everything.

Video Recording

Overview

One of the most frequently requested LapTimer features is video recording. Like many features, video recording has evolved over time: firstly to allow users to create videos including data overlay, LapTimer version 10.4 added support to allow recorded data to be exported to DashWare¹ and TrackVision² desktop software. Version 11 added support for video recording using the iPhone's internal cam – in sync with timed laps. Version 12 was the first version that allowed recorded data to be overlaid onto recorded video. Version 15 came with a fully reworked video recording module allowing video recordings across single laps with various overlaying options. Version 17.0 introduced picture in picture overlays and the ability to control multiply cams from within LapTimer (MultiCam). Besides iOS devices being remote controlled using the dedicated MultiCam app, version 17 included experimental support for wifi connected GoPro HERO³ cams. Version 18 introduced multi lap overlays, vehicle specific overlay gadgets, and Android 🟢 video recording and overlaying support. Version 19 added official support for both the full range of GoPro cams as well as a broad range of Sony cams and introduced an end-to-end integration (recording to overlay) for selected models. Finally, version 20 added real time display of overlaid videos and background video recording for Android.

LapTimer video overlay has now evolved into the extremely sophisticated and powerful tool it is today. Both video rendering and compression are hardware supported placing it above of many desktop systems. Due to the tight integration with LapTimer's knowledge of track setup and data recordings, video overlay in LapTimer is feature rich and unique when compared to other solutions: full synchronization between data and video without the need to adjust anything manually, augmentation of videos with track information like points of interest, and min / max speeds achieved on straights and corners amongst others.

Video features require a device equipped with a video cam (recommended: iPhone 4S and later, or compatible Android smartphones). The device defines the max resolution available too: SD, HD, FullHD, or 4K UHD. Please note that video features are not available in LapTimer's Rookie edition. Entry level for video recording is LapTimer's Petrolhead Edition, MultiCam features are available in LapTimer Grand Prix edition only.

Reading this Chapter



LapTimer is designed to support “out of the box” and easy to use video recording and overlaying. Most users will never need to dive into video timing, manual synchronization, distributed memory management and LapTimer's more advanced settings. This chapter is organized to give an intro into [Standard Operation](#) in the beginning, and refine topics step by step. As videos use up a lot of space, special thought needs to be taken on this topic. [Video Size and Some Thoughts on Video Recording](#) gives you some recommendations we found valuable when planning and performing video session. [Overlaying](#) is the ultimate goal of video recording in LapTimer. Overlaying data generates extremely high value in terms of understanding driving tactics making you faster. Besides this rational, LapTimer generates quite beautiful augmented footage you will find nice to keep and share with your friends. The next section, [Overlaying Options and Organization](#), introduces all the settings available when overlaying data. As several of these options require background understanding in the way LapTimer organizes laps in data recording and video, this section includes an introduction to the video timing concept and processing in LapTimer. We recommend you fully read this section in case you need to fix broken links between data recordings, footage and when optimizing synchronization between overlay and the raw video material. The last section we recommend you read is [Maintain](#)

¹ Dashware is a product by ChaseWerks, Inc.

² TrackVision is a trade mark of Apex Visualizations, LLC.

³ GoPro and HERO are trade marks by Woodman Labs, Inc.

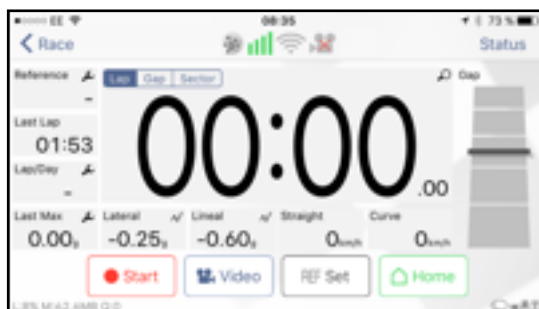
[Video Data](#). This section introduces video memory management on your smartphone and gives valuable hints on how to solve issues you may run into - especially in circumstances where you recorded too much, and used up all your space.

The iOS  section [Using iCloud to Have More Space Available](#) starts the more sophisticated items. We recommend to read this area once you have practiced regular video recording and want to get even more insights. Starting with version 17, LapTimer includes support for iCloud enabling you to transfer footage from one device to another. As a positive side effect, iCloud can be used to unload videos to the cloud you are not currently using. While all linking between laps and videos stays untouched, you can make local space available using this feature. For Android  devices, SD card handling is covered in section [Maintain Video Data](#). One of the really exciting new video features for advanced users is the support of picture in picture videos, which is outlined in the section, [Working with Multiple Videos](#). While this mode is typically used when recording with multiple cameras (MultiCam), it is a versatile feature of LapTimer's overlaying engine: you can add any number of videos to a lap and arrange them in any order you like. Even without handling videos individually, LapTimer has an extremely helpful feature by adding a reference video as picture in picture video to your overlay, which is aligned by sector. While Working with Multiple Videos is about arranging existing videos, the next section [MultiCam - Controlling Multiple Video Cams at a Time](#) introduces a unique feature in today's smartphone world: using MultiCam – a companion app for LapTimer – LapTimer takes control of several satellite cams installed inside and outside of your car. Using MultiCam, LapTimer will automate synchronized video recording across smartphone and external cams. In addition, an overview on LapTimer's integration of GoPro HERO and Sony cams is given. Like reference videos, this is a LapTimer GrandPrix feature.

Finally two special sections to finish this chapter: [Fighting Device Overheating](#) goes towards addressing the issue whilst video recording: video recording at high resolutions burns a lot of energy. Adding this to wifi operation, a bright screen, and the powerful LapTimer engine, generates probably one of the most demanding scenarios for an iPhone. We offer some useful tips to help solve this problem. [External Overlaying and Overlaying External Sources](#) ends this chapter: in early versions of LapTimer it was necessary to use 3rd party programs to overlay data recorded onto video with software like Dashware and TrackVision. However, current versions have evolved to enable you to do this directly on the smartphone using LapTimer. Nevertheless, in case you want to use an external overlayer, this section gives you a how-to. This section is good for the other direction too: LapTimer can be used to overlay footage recorded externally too!

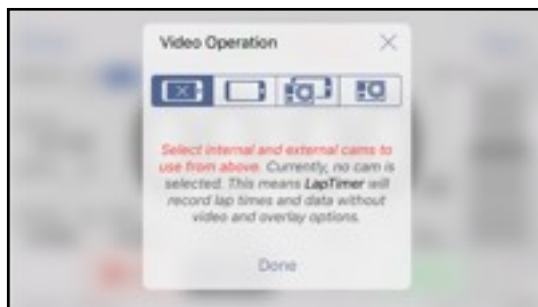
Standard Operation

Using LapTimer, recording videos is a simple task. While recording laps and data is the default, video recording can be added in any of the [Timer Views](#) by pressing the [Video](#) button (Petrolhead and above). The snapshot below shows LapTimer with video recording *disabled* (see cam symbol with red strikethrough in the top).



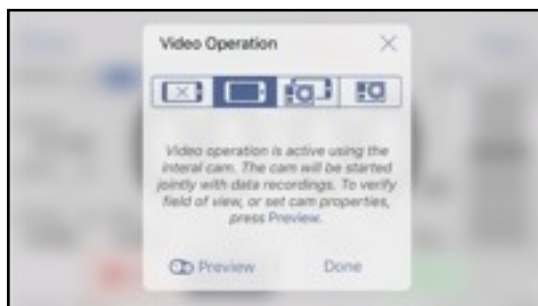
Default Situation with Video Recording Disabled

Once Video has been pressed, the central [Video Operation](#) control panel will appear. It allows you to select between no video operation, recording with the smartphone's cam, and various external cam options (GrandPrix).



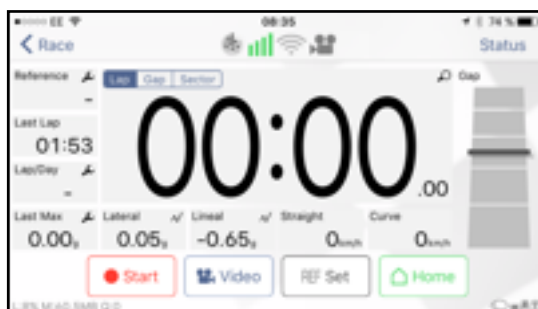
Video Operation Dialog with Video Recording Disabled

After selecting the internal cam as shown in the illustration below, LapTimer will trigger a video recording in sync with lap recordings. This allows overlay of data recordings at a later point in time. LapTimer memorizes the relationship between the video and the data recordings. We will see more details on this important relationship later.



Video Operation Set to Recording with Internal Cam

Leave [Video Operation](#) using the [Done](#) button to confirm your selection and you are done with preparation - everything else will work automatically. Once video recording is enabled, the cam icon in LapTimer's status gadget (top of [Timer View](#)) changes from a gray icon with a red cross to a solid colored cam. This allows you to check the current mode of operation at any time and without bringing up the [Video Operation](#) panel again.



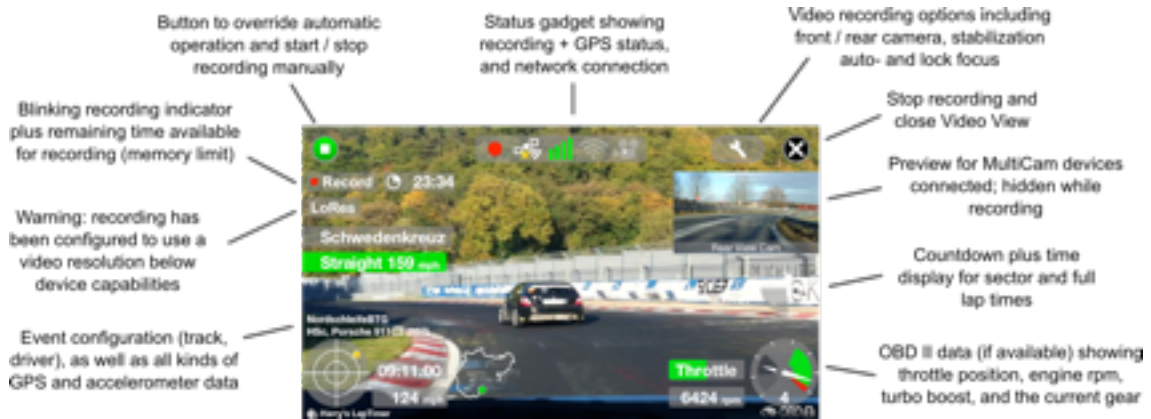
LapTimer Ready to Go with Video Recording Enabled

Video recording requires landscape orientation, so please mount the device in this position.



Video recording is controlled by LapTimer in sync with lap time and data recording. It needs to be enabled using the Video Operation panel. Video operation status can be monitored in LapTimer's status gadget.

But let us return to [Video Operation](#) to see another feature. With internal cam operation enabled, you will see a [Preview](#) button in the bottom of the panel. Pressing [Preview](#), will bring you to [Video View](#).

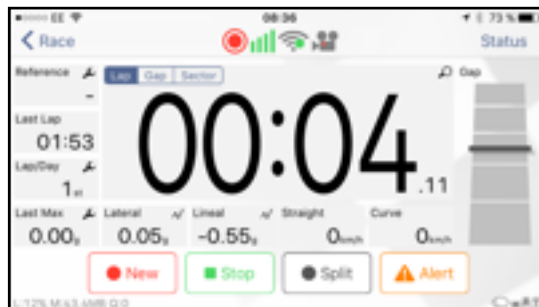


Video View

The picture above is an example of the [Video View](#) and includes overlaid data and several buttons which control the video recording functions. LapTimer has been designed so that the driver does not need to touch the screen at all while driving. LapTimer is fully automated and “hands free” when it is set to record and is waiting to be triggered.

Options when Recording Video

Most users will not want to see real-time video whilst driving - but it is fine to stay in [Video View](#) on track. The standard most users will want to use is the so called **background video operation**. This means you will watch the racing oriented [Timer View](#) on track and LapTimer will record video in background. To verify the cam is actually recording, please watch the status gadget's cam icon. It will come with a red LED while recording in background.



Recording Video in Background, Cam Symbol has a Red LED

Another option you have when recording video is adding some footage ahead and behind the actual lap recordings. Usually, lap / data recording and video recording will start once you pass the start / finish line the first time. As video startup requires

1 or 2 seconds, the video will actually even start later than that. The result is that video overlays for lap #1 of the session will start with the display at 1 or 2 seconds lap time already.

For the finish, things are not critical: when leaving the track you will come back from an incomplete cool down lap. Recording the cool down lap has been started when you passed the start / finish line the last time - with video still recording. So back in the pits, press [Cancel](#) or [Stop](#) to either purge the cool down data recording, or store it as an incomplete lap. In both cases, the video will simply be stopped but not purged.

To work around the incomplete beginning, LapTimer allows a so called **mixed mode operation**. This type of operation means you mix manual recordings and triggered recordings: start a manual recording before leaving the pits; with video operation selected, this will start data and video recording immediately. Once you cross start / finish the first time, LapTimer will stop the introduction lap and start a new lap #1. Video will still be recorded, so you will have continuous footage starting from the pits.

Video Size and Some Thoughts on Video Recording

Today's smartphones come with impressive memory sizes... Nonetheless, recording videos in FullHD or even 4K UHD quality will fill up any space very fast. Memory used for videos depends on the so called bit rate - the number of bits available per second to hold the visual representation of a video. For an HD video, the typical bit rate is 10.5 Mbit/s. Add some additional space for audio and we are at approximately 80MB/min. For FullHD videos – supported by all modern devices – a typical bit rate is 24 Mbit/s, summing up to approximately 190MB/min. Finally, 4K UHD videos use a bit rate of 50 Mbit/s and will use 375MB/min. Or the other way around: 1GB of free memory gives you 12 minutes of HD, 5 minutes of Full HD, and 3 minutes 4K UHD.

Not only because of this limitation but also factors mentioned earlier, therefore it is our recommendation that you do not record video all of the time. You miss a lot of fun and track focus when fiddling around with video. So my suggestion is to train the first half of a track day using standard data/time recording and then video record a trained session only. This gives you plenty of opportunity for a great video.



In case you video record using LapTimer, make sure you have an eye on available storage (check remaining minutes in shown in the Video Preview View). Adopt video resolution selection and sections recorded to the storage you have available!

Here is an overview on video sizes available (select in [LapTimer](#) ▶ [Administration](#) ▶ [Settings](#) ▶ [Internal Cam](#) ▶ [Resolution](#)) and some recommendation:

- **192x144 - Low, 3G:** included to cover special situations (e.g. long term recording); overlay not supported; can be used as picture in picture video in case the master video is SD only (see [Working with Multiple Videos](#))
- **480x360 - Medium, Wifi:** included to allow recording of picture in picture videos applied to HD (and Full HD) master videos; overlay not supported
- **640x480 - SD:** best resolution available on 3GS iPhones and very old Android devices (both are not supported any more); SD optimized overlay available; best choice for picture in picture videos applied to HD and FullHD master videos
- **1280x720 - HD:** available for all recent smartphones; best choice in terms of memory / quality balance; well suited as master video; HD optimized overlay available; requires 80 MB/minute

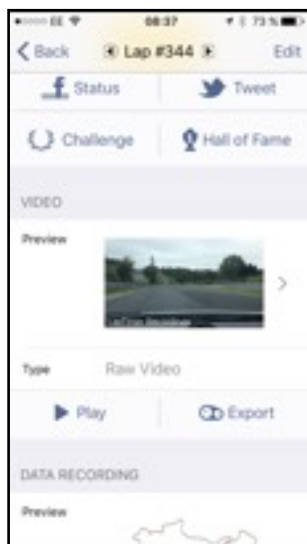
- **1920x1080 - FullHD:** highest resolution for many smartphones; Full HD optimized overlay available; this is probably the best choice for master videos in terms of quality, space required (190 MB/minute) and overlay processing time
- **3840x2160 - 4K UHD:** available for high end smartphones; UHD optimized overlays available; 4K UHD videos actually come with 4 times the pixels of a Full HD video - which is a lot; even if supported by your smartphone, processing and handling can get cumbersome

Overlaid Videos

Overlaying a video is the process of adding gauges displaying data recorded to a video recorded. While recording laps and video, there is an option to watch the overlaid video live: [Timer](#) ▶ [Video](#) ▶ [Video Operation](#) ▶ [Preview](#). This live view will allow you to check the field of view and get an impression how things will look like. However, using this preview is probably not the view you want to use while driving.

Real Time Overlay

When coming back into the pits with video recording enabled, you will find both data and the raw video on your device. The preferred and fastest way to watch the result is LapTimer's real time video overlay: select any lap from your session from [Lap List](#) and press [Play](#). This will bring up a special video viewer showing the full session overlaid instantly!



Play and Export Options for a Video Recorded

The viewer provided to display overlaid videos in real time will always show the full session of a lap selected. Use the scrubber view in the bottom to scroll forward and backwards as required. NB: picture in picture videos are not displayed when using the viewer.



Scrubber View in the Bottom

Touch the picture itself to see the full video, press the Play button to get a full playback of the video:



Overlaid Video Shown in Real Time

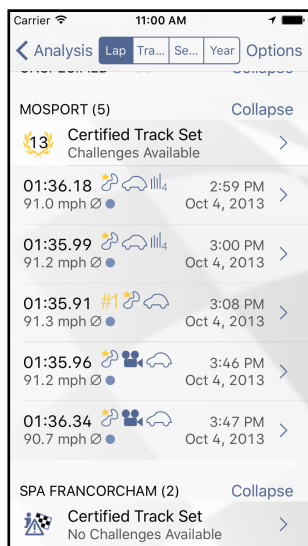
Creating Overlaid Video for Distribution

Only in case you want to distribute an overlaid video to your friends, the creation of a new video including the overlay is required. This video creation is a processing intensive task and will require some time to complete.

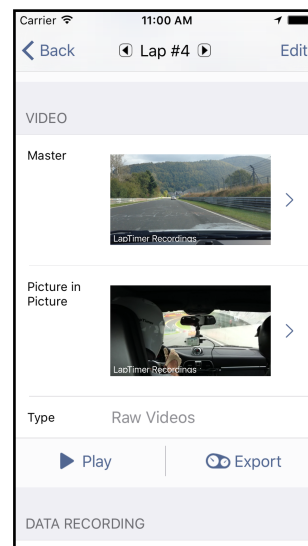
The time required depends a lot on your smartphone generation, the operation systems, and its version. While iOS uses hardware accelerated overlaying and video encoding by default, this feature is available for Android 5.1 and later only. For older Android versions, or in case your smartphone has problems handling the video, a slower software based encoding is supported.

The creation of an overlaid video is started in [Lap Details](#) again. Instead of pressing [Play](#), select [Export](#) to start video generation. For iOS, the result is stored in your iPhone's Photo Library (or LapTimer Recordings area in case access is not granted). For Android, it is stored on the phones external SD card (if available). They can be accessed from within LapTimer and from the other apps available on the device (Photo library, Gallery app).

But let's go through the overlaying process in full detail!

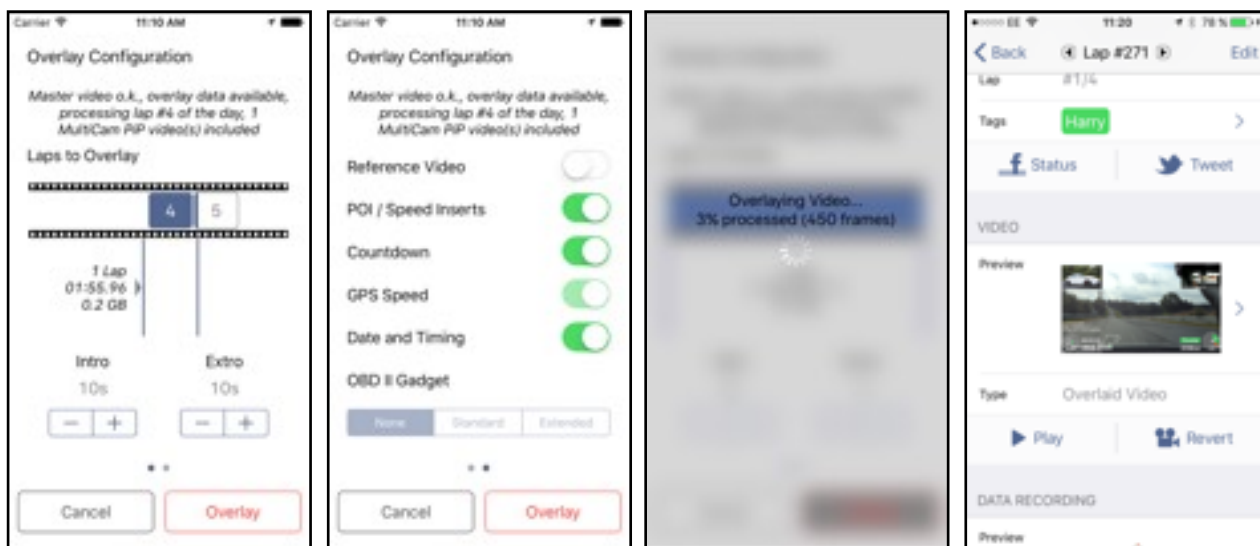


To the left, you see the [Lap List](#), representing all of LapTimer's data recording. Several of the laps recorded for track "Mosport" have a video associated with it. The laps timed at 01:35.96 and 01:36.34 have probably been recorded in one session. A small cam means there is some raw video associated with the lap. We select the first of the two laps and see the screen to the right.



The [Video](#) section shows the raw videos associated (in this case one master and a Picture in Picture videos – we come to this later). Buttons below this videos offer actions that can be applied to the videos, in this case [Play](#) or [Export](#) to create a new video with an overlay added to the raw videos.

To understand the complete workflow, we create a new overlaid video by pressing this [Export](#) button:



Full Process of Creating an Overlaid Video

In a first step, the scope of the overlay is selected. By default, LapTimer will overlay the lap selected to the video. In case you want to generate a **multi lap overlay**, extend the scope of laps to the left and right by tapping the left and rightmost lap you want to be part of the result. Laps offered for overlay need to be consecutive and need to be covered by a common session video. In our sample, we do not extend the scope to lap 5.

In a second step, you select various options for overlay creation. We will come back to this in a minute. Once you have selected your options and press the red [Overlay](#) button, overlaying starts. The time required for the overlaying process will

depend on your hardware, the master video's resolution, features added (picture in picture), and the the availability of hardware accelerated encoding. It can range from half the time of the video duration up to a factor of 20.

Functionality is the same for iOS 🍏 and Android 🌿 here. Scope selection and overlaying options are arranged in a long scrollable list for Android, and not the two screen shown above.

Once the overlay is created, the overlaid video is passed to the Photo library 📷 or SD card 🌿 – and associated with the lap. The original links to the raw videos are retained - as long you do not delete the raw video, you can revert to this raw state later. At this point you can see the buttons below the video have changed. As an overlay has been applied already, LapTimer offers [Revert](#) and [Play](#) now.

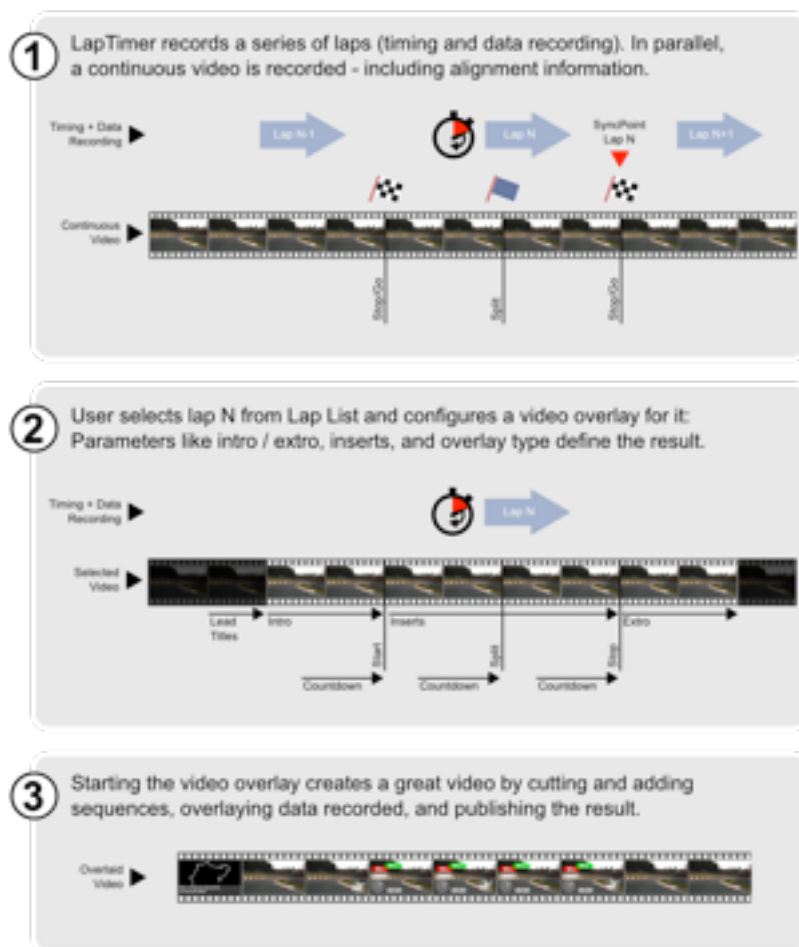


Overlaid Video Sample (www.youtube.com/watch?v=bviiV7SnU7k)

Overlaying Options and Organization

The process behind is a bit more complicated. Looking into the diagram below, we have actually 3 steps to create a video:

1. Recording a video covering one or more laps recorded in parallel
2. Configuring the overlay and the relationship between the data recording and the video
3. Extracting the relevant section from the video, adding data recording, and storing the result



Lap / Video Synchronization

Some notes on the various elements of configuration:

Without [Intro](#) and [Outro](#), the overlaid video will have the length of the lap recorded. You can expand the range shown by adding intro and outro time. This option is only available, if footage has been recorded ahead and behind the respective lap. The [Intro](#) and [Outro](#) sections will show some basic information on the lap, but no acceleration, time, and other data.

[Reference Video](#) will add a picture in picture video of the reference lap in case it is selected. Availability of this switch depends on the LapTimer Edition (GrandPrix required), a reference lap set, and the availability of the video for the reference lap. For more details on reference videos, please read [Working with Multiple Videos](#).

The [POI and Speed Inserts](#) are generated from existing information. POI information is usually received by downloading a track set. A minimal track set, with only one [Stop/Go](#) trigger, will have pretty poor inserts. A well prepared track set - including a [Stop/Go](#) trigger, several splits, and an Information POI for every corner generate great videos. Please read the Tracks chapter on track set creation and continuous improvement.

[Countdown](#) selects whether the overlaid video will show count downs ahead of splits and full laps, as well as the display of the final split and lap times.

GPS Speed overrides the speed source used for speed displays and corner and straight speeds calculated. By default, LapTimer will use OBD (wheel) speed if available and fall back to GPS speed otherwise. In case you have both speeds available but want to force LapTimer to use GPS speed, check this switch.

Date and Timing is to remove or add any timing information for the overlay. Date and time include both the display of the lap's date and time, and lap / split times. Usually you will have this selected, but there are situations you may prefer to not show how fast you have been and when!

In case your recordings include engine information, there is an option to customize the appearance of the engine gauges in the bottom right of the screen (**OBD II Gadget**). **None** will remove any engine data, **Standard** will show one gauge (rpm, throttle, gear) and **Extended** will add another gauge showing power, temperatures, and fuel level. The extended setting is part of the LapTimer GrandPrix feature set only.

Adding Intro / Outro Footage

LapTimer has a quite sophisticated mechanism to start / stop video recording automatically on the one side, and allow additional recording for intro and outro frames on the other:

In standard operation, LapTimer starts video recording when a **Go** trigger is passed. Passing a **Stop/Go** trigger later will stop current lap timing and start the next one. Video recording will simply be continued in this scenario. Assuming you leave the track after the second lap, you will have two laps recorded associating the same (long) video using two different sync points. Passing a **Stop** trigger will stop video recording too in this scenario.

In manual operation, you start a recording using the small red button located in the top left of the Video View. Triggers passed will add sync points as above. But take care: video recording needs to be stopped manually in this scenario. Even a **Stop** trigger will not change the video recording status! In the example above (Nordschleife video), manual operation has been used: we started video recording when leaving the pits, ran one lap (LapTimer started timing automatically at the Bridge), and manually stopped video recording a few seconds after LapTimer had stopped lap timing at the finishing gate.

Maintain Video Data

LapTimer features a flexible schema of places to store videos to and retrieve videos from. Places are defined by a physical location and availability differs a lot for the iOS and Android platforms. Nevertheless, they share some common characteristics we want to start with:

- **Physical location:** can be a directory on the smartphone, a SD card, a cloud, an external cam, or a repository of media; while the physical location is mostly visible on Android, it is usually replaced by a logic container (like [Camera Roll](#)) for iOS
- **Access from smartphone:** some places allow writing videos to, some allow moving videos, all allow reading videos, and some allow deletion of footage
- **Access from other devices:** a place can be accessible by LapTimer only, or it can be managed from other devices and apps in addition
- **Default location:** there is always a default location for videos recorded, and a default location for videos generated; for Android this places are the same while for iOS they are usually different

Before entering a platform specific discussion of places available and how to handle them, have a look into the Video List to the right. For both iOS 🍏 and Android 🌿, this list is made up from sections representing one place each. The section title is a short description followed by some core characteristics of the place. The rest of the section is made up from the list of videos available in this place—including some characteristics shown by icons.

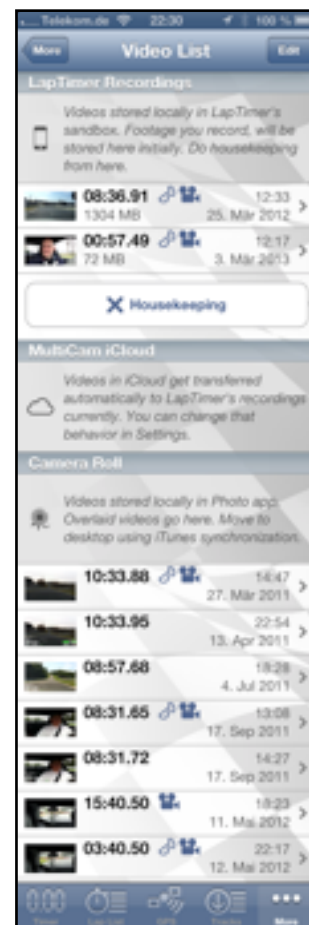
Icons shown are similar to those you will know from Lap List. The cam symbol 📷 means the video is a raw or original video (i.e. a video without overlay). The small dash icon ⏸ means the video is an overlaid video, a small track symbol 📊 means the video is linked by a lap from Lap List and either the result of an overlay, or the source for an overlay. In case a video is not linked by any lap and the place it is sitting in allows video deletion, a red exclamation mark ❗ is displayed to signal “this is a candidate for housekeeping”.

As videos require a lot of memory, you need to take care when using it. Videos overlaid can be removed from the mobile device once they are copied to the desktop. Pressing the [Housekeeping](#) button will purge all videos not associated with a lap at once. Other videos are deleted by applying the platform specific deletion gestures ([Edit](#) button + Delete for iOS 🍏, and long press + Trash for Android 🌿) line by line. Please take care with this function, a video deleted is lost and can no longer be recovered.

iOS Video Places 🍏

[LapTimer Recordings](#) is a media directory part of the LapTimer app's sandbox. Although this directory is considered private, it can be accessed from your desktop using iTunes File Sharing ([iTunes](#) ▶ [iPhone](#) ▶ [Apps](#) ▶ [File Sharing](#) ▶ [Apps/LapTimer](#) ▶ [Documents](#)). The directory may be used for other resources too, so please take care you access .mov and .mp4 files only. [LapTimer Recordings](#) is the default location for all video recordings. Videos included can be deleted and moved. The physical location is on the local device and part of the well known storage 16GB, 32GB, 64GB, 128GB common to all iOS devices.

[Camera Roll](#) is a synonym for iOS's [Photo Library](#). Videos stored here can be accessed both from within LapTimer and the Photo app. While videos stored in Camera Roll can be deleted and distributed from the Photo app, it is used by LapTimer as the default location for overlaid videos only. Once they are transferred to the library, LapTimer's access is limited to playing



the video. In case the user does not grant LapTimer permission to access Photo Library, the default location for overlaid videos is [LapTimer Recordings](#).

[MultiCam iCloud](#) is shared storage accessible by all LapTimer and MultiCam apps. Use and handling of this place is described in details in [Using iCloud to Have More Space Available](#).

[GoPro HERO4 \(and other cams\)](#) is a remote place sitting on your external cam's SD card. For some action cam models, videos can be accessed from LapTimer's Video List directly—e.g. to download them for overlay. Availability of a video list depends both in the cam type, and the current cam connection status. As long as you see a spinning indicator, LapTimer searches for a cam actively.

Android Video Places 🌱

[SD Card \(both emulated and real\)](#) is the most common place to store video on Android. There are usually a number of SD card places available to store videos on. Depending on the Android version both directories considered public (like `/Movies`) and considered private (like `.../com.harrys.laptimer/files/Movies`) will be available. For smartphones with an external SD card slot, you will see corresponding SD card directories on top of emulated ones. Emulated SD cards are just internal storage—with a strange name.

The default [SD Card](#) place is always the one shown in the top of [Video List](#). It is selected by checking memory available and selecting the one offering most. Important: the decision is made when LapTimer is started. So in case things change (SD card attached / detached, or files moved around), you may want to restart LapTimer to make a new decision.

[SD Card](#) places can be accessed from your desktop too. There are basically two options: either you mount your smartphone using a USB adapter, or you detach the SD card from the smartphone and plug it into a slot available on your computer. The later is usually faster and gives you full access to all files, while the former is probably more convenient (and model specific). When mounting your smartphone, the list of files accessible may be filtered. So if you are missing something—or have problems locating a directory, try the other approach. The physical address on the SD card can be derived from the directory name given in [Video List](#)'s section headers.

[GoPro HERO4 \(and other cams\)](#) is a remote place sitting on your external cam's SD card. For some action cam models, videos can be accessed from LapTimer's Video List directly—e.g. to download them for overlay. Availability of a video list depends both in the cam type, and the current cam connection status. As long as you see a spinning indicator, LapTimer searches for a cam actively.



Associations between laps and videos are stored using the filename of the video for Android, not the full path. This means LapTimer will find a video in any of the SD Card places, even after moving it around.

Using iCloud to Have More Space Available 🍏

LapTimer v17 added support for Apple's iCloud. iCloud both provides automatic synchronization between local copies of a video and a remote version, as well as providing additional storage to the user. While an initial 5 GB of space is available for free, contingents up to 50 GB are available on a paid basis.


Both services provided by iCloud are used by LapTimer – but in different scenarios. While synchronization is used to transfer footage from MultiCam devices to LapTimer devices (covered in [MultiCam - Controlling Multiple Video Cams at a Time](#)), this section covers the use of external storage to free up (on device) space.

Using iCloud, the place a video is stored becomes virtualized. This means LapTimer can hold a link to a video and does not need to differentiate if that video is stored locally, or remote. LapTimer utilizes this mechanism by allowing the user to decide if a local copy of the video is kept, or if we are fine with the cloud stored version as we do not access it currently.



The following step by step descriptions cover several scenarios:

- A. Storing a video in iCloud (instead of [LapTimer Recordings](#))
- B. Deciding whether a local copy of an iCloud stored video is kept or not
- C. Transferring an iCloud stored video back to local storage
- D. Deleting an iCloud stored video


To store a video in iCloud (A.), follow the steps below:

- 1. Navigate to [Video List](#), and scroll to the [LapTimer Recordings](#) section
- 2. Select the video you want to be stored in iCloud
- 3. Scroll down to the bottom of the [Video Details](#) view
- 4. Press the  [Move](#) button
- 5. Back in [Video List](#), the video will be listed in the [MultiCam iCloud](#) section

To decide to have a video stored remotely only (actually the memory saving scenario), or both locally and remote (B.):

- 1. Navigate to [Video List](#) and scroll to the [MultiCam iCloud](#) section
- 2. Select the video you want to be stored remotely only (or both locally and remotely)
- 3. Scroll down to the bottom of the [Video Details](#) view
- 4. Press the  [Unload](#) button (or  [Download](#))
- 5. Back in [Video List](#), the video will be shown as [OFFLINE](#)

To transfer a video back to our local recordings area (i. e. removing it from the cloud) (C.), follow these steps:

- 1. Navigate to [Video List](#) and scroll to the [MultiCam iCloud](#) section
- 2. Select the video you want to be stored locally only
- 3. Scroll down to the bottom of the [Video Details](#) view
- 4. Press the  [Move](#) button
- 5. Back in [Video List](#), the video will be listed in the [LapTimer Recordings](#) section

To delete a video stored in iCloud (D.) you perform the same step as for deleting any local video: just navigate to the video and press Delete. NB: other than deleting a local copy, this will delete the remote video representation too. In addition, if more than one LapTimer/MultiCam instances have used this video, these local videos are deleted too.



All iCloud operations take place asynchronously and while being connected to a wifi only. There is no guarantee the operation (like downloading a remote video locally) will be performed within a certain time frame. So please be patient...

Working with Multiple Videos

Starting with LapTimer version 17, picture in picture videos are supported for video overlay. The concept is simple: instead of linking one video to a lap, you add several videos. The user interface to accomplish this is straight forward: navigate from [Lap List](#) to the lap's details view first. For iOS, change to edit mode by pressing the [Edit](#) button. Now, you can add videos using the [+](#) button, you can remove videos using the [-](#) button, or you can reorder the videos using the reorder controls [≡](#). For Android, press [+](#) to add a video and long-press a video row to remove that item or move it up or down in the list of videos. But what does the order mean for videos? The first video in order is always the master video - the one everything else is overlaid to. All other videos are [Picture in Picture](#) videos, i.e. video that gets "slid" into the master video, displaying additional perspectives. The order of picture in picture videos is the preferred order they are "slid" in.

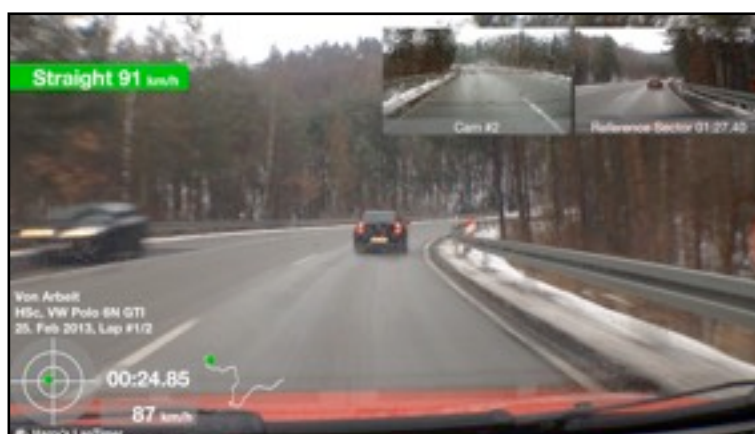
Picture in picture videos can come from several sources including external cams (see [External Overlaying and Overlaying External Sources](#)), videos recorded in sync using MultiCam (see [next section](#)), or reference videos:

Reference videos are a unique feature available in LapTimer Grand Prix edition. They allow a visual side by side comparison of the lap overlaid, and the video associated to the reference lap selected (reference laps are introduced in the [Racer's View description](#)). In case you have selected the [Best Lap](#) as the reference lap, you will see the best lap's video footage in your overlaid video – making it extremely convenient to understand were you had lost or gained time.

The reference video is inserted into the master video just like other picture in picture videos are. Besides similarities there are some differences too:

1. Selecting the reference video is done by selecting the reference lap (it certainly needs to have a video linked). So please do not add the reference laps video manually. In many cases, you will not need to do anything, as the reference lap is set automatically.
2. The reference video is not shown continuously, but is realigned to each sector's start: you will see a slide in / slide out during each sector count down. Aligning the reference video for each sector separately, gives you more positions on track you can start comparing the videos at the same position.
3. Inclusion of a reference video can be de-selected in [Overlay Options](#) (introduced above).

The snapshot below shows a video with both an additional cam to the rear, and a reference video. The reference video comes with a caption showing the sector time of the reference lap.



Video with Rear Cam (Cam #2), and Reference Video



Picture in picture videos come at the price of additional overlaying time (+50% per additions picture in picture video). We recommend to insert reference videos only for analysis, not for videos showing the drive to others.

Another picture in picture feature has been added in LapTimer v20. When selecting a video from [Video List](#) or by navigating from a lap's details screen, it is possible to set a [PiP Name](#). This name is used instead of the standard caption ("Cam #2" etc.). And there is a well hidden tweak available too: set "Rear View Mirror" as the [PiP Name](#) and the video will be shown top centered with some panoramic effect!



Rear View Mirror in Action

MultiCam - Controlling Multiple Cams at a Time

In the section [Working with Multiple Videos](#) we have seen how multiple videos can be combined to one rich overlaid video using picture in picture technology. For those having used desktop software to overlay and combine their footage in the past, this process is familiar - but not particularly convenient.

MultiCam is the technology LapTimer uses to prepare multiple video for this after the fact combination process – right from the beginning. Besides aligning master and satellite footage with data recordings automatically, it makes controlling complex cam scenarios very convenient too.



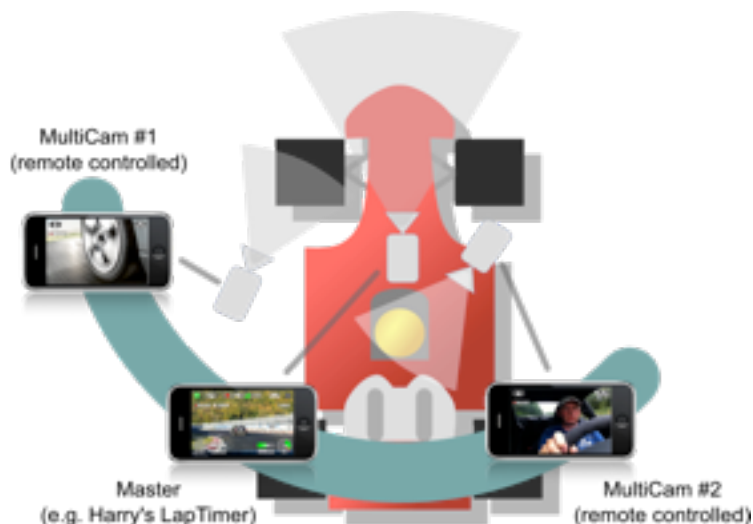
MultiCam satellites can be either external action cams, or iPhones running the free companion app "MultiCam". While the former are supported for both Android and iOS, the later is an iOS only feature.

MultiCam Sample Scenario

Let's have a look into the following scenario to understand how the recording process can look like: we want to run some timed laps using a racing car. In addition to automatic lap timing and data recording, we want to record footage showing several perspectives including the track ahead, the driver, and some front wheel dynamics. To accomplish this, we have three iOS devices available (for Android, please check [Using External Action Cams as MultiCams](#) below; keep reading here as this section outlines the idea of MultiCam). The so called master device – the device LapTimer is running on – is mounted to our windscreen and video records the track ahead. It is the device we use for data recording and lap timing too.

We have a second device mounted to the windscreen on the co-pilot's side – pointing to the driver including the steering wheel. Finally, we have mounted another iPhone to the pilot's door from the outside – focusing the left front wheel.

The picture below shows our scenario:




Typical MultiCam scenario

In addition to Harry's LapTimer Grand Prix on the master device, we have started a free companion app named Harry's MultiCam on both satellite devices. What else do we need to do to start our session? Actually you will follow the same steps you perform when using LapTimer stand alone: just switch to the video view and drive!

So what steps do we perform for a recording? Once you switch to the [Video View](#) in LapTimer, it will check if it finds MultiCam devices around. This connection is done using Bluetooth, so no configuration is necessary, it is plug & play – but without the need to plug. Once LapTimer detects any MultiCam device, it will send a command to it to switch to [Video View](#). It will ask it to select a video preset you can change from within LapTimer, and it will ask it to send a video live stream to check the field of view set. So in our scenario the driver sitting in his / her seat would see the Video View showing the master video, real time data recording using LapTimer's overlay preview, and two picture in picture videos named [Cam #2](#) and [Cam#3](#) as life previews.

Next, we leave the pits and enter the track. We perform the entry lap and approach the start / finish line the first time. Once LapTimer detects the line has been crossed, it starts timing, data recording, starts video recording for the master video, and video recording for the two satellites – no touch. It is just like standard operation.

 While recording data, LapTimer will turn off any live video stream to allow Bluetooth sensors to use the full bandwidth. To allow the driver to see the connection status, it will present picture in picture placeholders for each MultiCam connected.

So let's finish the session – we have returned to the pits and we stop the final, incomplete lap pressing the [Cancel](#) button in LapTimer's [Video View](#). Again, this will stop video recording on the master, and for both satellites. In addition, it will void the last incomplete lap like usual.

Now, we leave [Video View](#) and return to [Lap List](#). To save energy, LapTimer will close both Satellite [Video Views](#) too. In the event that connections are not used to MultiCam for a period of time, they will be closed for the same reason. In our scenario, we have some need to use the open connections: we have entered [Lap List](#) in LapTimer and navigate to one of the laps just recorded. Lap Details for this lap will show three videos: the master video marked [LapTimer Recordings](#), and two picture in picture videos marked with the MultiCam device's name (e.g. [Harry's iPhone6 Recordings](#)).



Picture in picture videos shown in Lap Details may reside in any of the supported storage areas – including a MultiCam device connected.

Preparing iOS MultiCam Devices for Recording

Every additional device integration added to LapTimer introduces potential pitfalls. This section outlines the conditions for successful MultiCam device connections using iOS devices.

1. You need to have [Harry's LapTimer Grand Prix Edition](#) installed on your "Master" iPhone; in case you run either the Rookie or the Petrolhead Editions, please upgrade from within LapTimer first
2. Install the free [Harry's MultiCam app](#) from AppStore to any iOS device you have available
3. Both devices - master and satellite(s) - need to have Bluetooth active: [iOS](#) ▶ [Settings](#) ▶ [Bluetooth](#) ▶ [ON](#)
4. In LapTimer, make sure you have MultiCam operation enabled in [Video Operation](#) (see [Standard Operation](#)): goto [Timer](#) ▶ [Video](#) ▶ [Video Operation](#); select either the external cam only, or the internal + external cam options
5. Start the MultiCam app on the satellite device (no need to change a view here)

To test the connection, switch to the [Video Preview View](#) within LapTimer - you should see the gray little cam in the status bar turning white; in addition, you should see communication going on between master and satellite shown by small green and blue indicators; the MultiCam app will change to [Video View](#) automatically – you are ready to record. You will see a small life stream view for the MultiCam device in LapTimer to check the field of view.

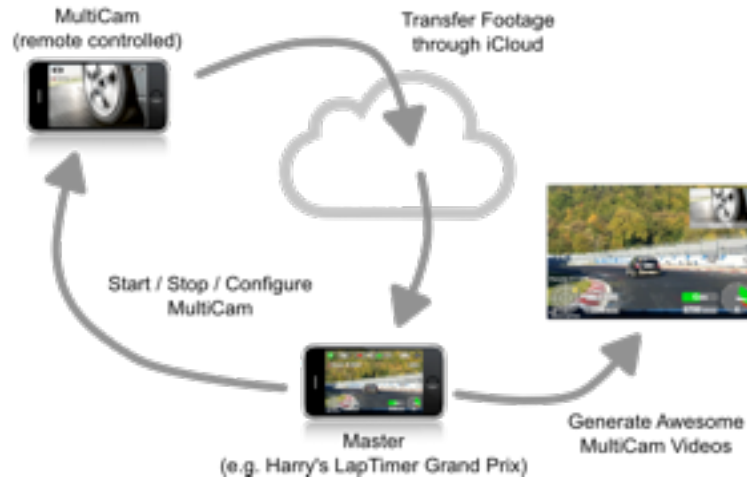


Starting with iOS8, MultiCam app integration has become flaky. We plan to replace the iOS specific mechanism used currently, by a cross platform solution for an upcoming version. Till then, please turn of WiFi for both the LapTimer and the MultiCam device in addition and let them join a common network. In case no network is available, turn on tethering for one phone and join the WiFi created with the other.

Transferring Video from MultiCam Devices

Although we see a preview of the picture in picture videos in [Lap Details](#), we cannot use the footage to overlay it yet.

LapTimer requires all videos being used in an overlay to be stored locally. So before we can enjoy the multi video result, we need to transfer the footage to the master device.



MultiCam Processing

LapTimer's current implementation uses iCloud to transfer footage from MultiCam to LapTimer. As outlined in section [Using iCloud to Have More Space Available](#), this process requires a wifi connection to work (Bluetooth is too slow, and mobile data will be too expensive) and will be performed asynchronously. The overall workflow is shown in the picture above.

The standard behavior of MultiCam is to move footage stored locally to the [MultiCam iCloud](#) ([MultiCam](#) ▶ [Settings](#) ▶ [Auto Send Videos](#)). Once the video is uploaded to the cloud, LapTimer will detect that a new video appeared in the cloud and will transfer it to its local storage area ([LapTimer](#) ▶ [Settings](#) ▶ [iCloud](#) ▶ [Auto Receive Videos](#)). This means as long as the settings are not changed, videos recorded in MultiCam will arrive in LapTimer for overlay – some time later...

Troubleshooting Video Transfer Through iCloud 🍏

In case MultiCam footage does not arrive in your LapTimer app, please check the following items:

1. Both the MultiCam and the LapTimer iPhones need to be logged in to iCloud ([iOS](#) ▶ [Settings](#) ▶ [iCloud](#))
2. Make sure you have enabled iCloud and auto transfer to iCloud in MultiCam (both [MultiCam](#) ▶ [Settings](#) ▶ [Use iCloud](#) and [MultiCam](#) ▶ [Settings](#) ▶ [Auto Send Videos](#) need to be in position ON)
3. Make sure you have enabled iCloud and auto receive videos in LapTimer (both [LapTimer](#) ▶ [Administration](#) ▶ [Settings](#) ▶ [Use iCloud](#) and [LapTimer](#) ▶ [Administration](#) ▶ [Settings](#) ▶ [iCloud](#) ▶ [Auto Receive Videos](#) need to be in position ON)
4. Verify iCloud access works ([LapTimer](#) ▶ [Analyze](#) ▶ [Video List](#) ▶ [MultiCam iCloud](#) shows positive status)
5. Make sure both devices are connected to the Internet using a wifi connection (iCloud does not replicate while in a cellular networks only - that's at least the default)

In case all of the above steps are o.k., you need to wait up to an hour for iCloud to transfer the videos in background.

MultiCam Video Preset

As mentioned in our MultiCam scenario, LapTimer can be used to control the video preset not only for its own video recordings ([LapTimer](#) ▶ [Administration](#) ▶ [Settings](#) ▶ [Video](#) ▶ [Resolution](#)), but for MultiCam too. The setting can be found in [LapTimer](#) ▶ [Administration](#) ▶ [Settings](#) ▶ [MultiCam Control](#) ▶ [MultiCam Preset](#). The reason we have added this setting is it allows the user to optimize memory and energy usage, and transfer size of footage recorded. As an example, if you know you will use the front wheel footage from our sample scenario as a picture in picture video only (i.e. not as a master video), it makes sense to record it in single density from the beginning. There are three settings available: [Picture in Picture](#) optimized video settings for later use as a picture in picture video, [Master](#) will set the video to allow a later use as a master video, and [None](#) does not change the video settings selected in MultiCam itself. Use the last setting value in case you want to set an individual video preset in MultiCam or the external cam itself.

Besides selecting the resolution, this settings defines the role of a video recorded too. So if you select [Picture in Picture](#) for the MultiCam device, it will be added as PiP to lap associations. Otherwise it will be the master video.

Using External Action Cams as MultiCams

At the time of writing, LapTimer supports GoPro's HERO3, 3+ and 4 (Black and Silver) cams as well as a variety of Sony cams. To check the latest status, please visit <http://www.gps-laptimer.de/compatibility/ios> or <http://www.gps-laptimer.de/compatibility/android>. Not all action cams come with the same set of integration features, this will be detailed below. Support is the same for iOS and Android. We got reports by users the HERO2 plus BacPac works too, but it is not a supported configuration. The HERO4 Session is not supported by GoPro's 3rd party interface currently.

Preparing External Cams for Recording

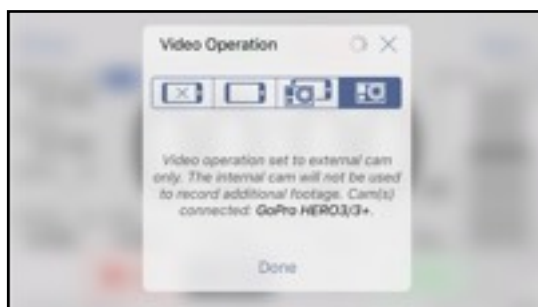
Before we go into the section on recording with an external cam, here are the steps you need to perform to connect your smartphone:

1. Make sure you have a compatible action cam available (see above).
2. Make sure you have the latest firmware for your action cam installed.
3. Make sure you have set the correct Wi-Fi mode for the action cam. Action cams often with two modes of control: some proprietary remote controls and a Wi-Fi based app communication. Select the later.
4. Turn on Wi-Fi operation for the action cam.
5. Connect your smartphone to the action cam Wi-Fi. This step is performed in iOS / Android Wi-Fi settings.
6. Select the correct external cam type from [LapTimer](#) ▶ [Administration](#) ▶ [Settings](#) ▶ [MultiCam Control](#) ▶ [External Cam](#).
7. In case you use a HERO3 or 3+, please enter your GoPro Wi-Fi password in [MultiCam Control](#) ▶ [HERO3/3+ Wifi Password](#); this is necessary as every command sent to the HERO3 series requires this password - no good practice from my point of view and obsolete for the HERO4.
8. While the HERO3 and 3+ can be woken up by Wi-Fi (so only Wi-Fi operation needs to be turned on), the HERO4 and Sony cams need to be turned on manually.
9. In case you want to use the action cam recorded video as the master video later, make sure you setup resolution to one of the presets supported by LapTimer: [640x480 \(SD\)](#), [1280x720 \(HD\)](#), [1920x1080 \(FullHD\)](#), or [3840x2160 \(4K UHD\)](#). It is possible to select other resolutions, but this may lead to cropped or misaligned overlays later.

Finally, you need to turn on MultiCam operation. This is done using the [Video Operation](#) panel introduced in [Standard Operation](#): bring up the dialog by selecting [LapTimer](#) ▶ [Race](#) ▶ [Timer](#) ▶ [Video](#).

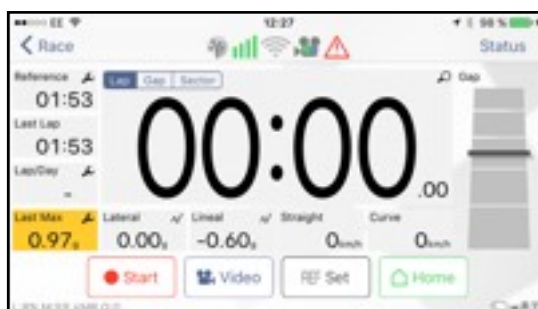


Select Option 3 to Record with Both Internal and External Cams



Select Option 4 to Record with External Cams Only

Besides the status text showing up in [Video Operation](#), you have two more reliable checks to verify the Action Cam is online. Going back to [Timer View](#), green and blue blinks shown in the cam icon indicate LapTimer is communicating with an external cam.



Green and Blue Blinks Mean Commands are Exchanged

In case you have selected option 3 (both internal and external cams used), you can go through the full recording cycle too. In [Video Operation](#), press [Preview](#). Wait a few seconds and a picture in picture placeholder for the cam connected will slide in from the side. NB: there is no live preview support available for external cams! Press the small red button (Record) to start a manual recording and press the green one to stop it again. You should see your action cam starting and stopping too, usually with some beeps issued. Return to [Timer View](#) and video recording is active in background.

To turn MultiCam operation off again, either return to [Video Operation](#) and select option 1, or power off the action cam.



In case this does not work, please try the action cam's manufacturer's app available for free on the net. They use the same mechanism. The most frequent issue seen for the HERO3 / 3+ series is a password mismatch between action cam configuration and LapTimer setting.



Connecting to HERO4 cams and keeping the connection can be tricky. Even if the HERO4 signals it has WiFi on, it may be in sleep mode to save power. To reconnect, please turn off WiFi for the cam and turn it on again. Do not forget to join your smartphone to the WiFi again afterwards!

Features Available by Action Cam

Actually we would like to provide the same service level for external action cams we have available for iOS devices (MultiCam app). For some cams this level of support has been achieved since LapTimer v19, for others we miss full support by the API provided by manufacturers and want to give advice how to substitute missing features by manual steps.

The table below shows all features desired (in order of video recording / overlaying process) and the current level of cam support provided:

Feature	HERO 3/3+	HERO 4	Sony Cams
Wake up on Wi-Fi	supported	turn on manually	n/a
Video presets applied	supported	supported	supported
Life Preview(*)	supported	not supported	supported
Automatic recording	supported	supported	supported
Automatic lap / video synch	supported	supported	supported
Browsing videos on cam	not supported(*)	supported	not yet supported
Automatic transfer to phone	not supported(*)	supported	not yet supported
Automatic lap association	use Re-Link	supported	use Re-Link
Overlaying	supported	supported	supported

Some comments on the above items: "Life Preview" is available in our Harry's Camper app only, it is not supported in LapTimer yet. "Browsing videos on cam" and "Automatic transfer to phone" are not yet implemented for Sony cams but may follow in a later version. Support for this features is disabled for HERO 3/3+ cams as we found the integration to be not reliable. You can enable this feature in LapTimer's [Expert Settings](#), but we cannot support issues you run into. "Automatic lap association" is the process to identify videos transferred from an action cam to be the ones recorded for a session of laps. For cams not supporting this feature, LapTimer provides an easy manual step as a workaround (see below).

Transfer Footage from Action Cam to Smartphone

In case your cam supports automatic transfer to the smartphone, and in case the video is comparably small, things can be easy. For most users, a manual transfer is recommended. It is faster and more reliable. Please skip to the next paragraph for the manual transfer. But back to automatic transfer:

- Connect the cam and the smartphone like discussed for MultiCam recording

- Switch to [LapTimer](#) ▶ [Analysis](#) ▶ [Video List](#) and scroll to the [External Cam](#) section (name depends on cam type, see above).
- Wait until the spinner has stopped and videos appear. This process will take some time depending on the cam processing power. Wait for the time necessary.
- Select the video you want to transfer. In case your cam supports “Automatic lap association”, you will see the list of laps referencing this video in the bottom of [Video Details](#).
- Press [Download](#) (button in the bottom of [Video Details](#) for iOS 🍏, image button in the top right for Android 🤖) to start the download from action cam to smartphone.

The download will be performed in background. You can return to Video Details and check the Location row to see the status of download. It will be either [Remote](#), [Downloading x%](#), or [Downloaded/Local](#). There are slight changes how background downloads work for iOS and Android: for iOS, the download will take place independent whether LapTimer is active, inactive, or not in memory at all. For Android, the app needs to run either in foreground or background. In case it is killed from some reason, the download needs to be restarted. Needless to say, the cam needs to stay turned on and connected until the video has arrived.

Once the video is downloaded, it is available for overlays from Lap List in case “Automatic lap association” is supported by your action cam. In case this feature is not supported, please continue with reading [Associate Video Transferred with Laps](#).


In case your cam does not support automatic transfer, you need to copy videos manually. **This is the recommended way to transfer video in general as it is a lot faster and more reliable too.**

- Start by either mounting the action cam to a desktop computer (so you can access the SD card from Finder / Explorer), or unplug the SD card from the cam and plug it into your desktop's SD card slot (if available).
- For iOS 🍏, start iTunes and connect your iPhone. Select the phone from the top and select [Apps](#) from the left list. Scroll down and find [File Sharing / Apps](#) and select [LapTimer](#). Now, you will see all files stored in [LapTimer Recordings](#) on the right—just drop the video you want to overlay into this folder.
- For Android 🤖, either mount your smartphone using a USB cable, or plug the smartphone's SD card into a second SD card slot of your desktop. In LapTimer, check [Video List](#) for the preferred directory (see [Android Video Places](#)). The directory shown on your desktop will slightly differ from the Android directory (different mounting points). It often helps to compare the files contained in the directory to identify it. Now, just drop the video you want to overlay into this directory.

After performing this steps, the video will be available in [Video List](#) in LapTimer, but it is not yet associated with laps. This step is described in the next section:

Associate Video Transferred with Laps

Once the video has arrived in one of the video places accessible by LapTimer, follow these steps:

1. Select any lap from [LapTimer](#) ▶ [Analysis](#) ▶ [Lap List](#) you recorded the video for. As LapTimer cannot recreate the link automatically, you will see an empty video placeholder stating the video cannot be found.
2. Select the video placeholder—which will bring you to a nearly empty [Video Details](#) dialog.
3. Scroll to the bottom of that view and press [Re-Link](#) for iOS 🍏, or select  from the top right for Android 🤖.
4. Now, select the video from the [Video List](#) shown. Although you can repeat that step, please take care you select the right video here.


5. Confirm all laps referencing this session video should be re-linked to the video selected. This operation will actually re-link all laps in the same session you recorded a single session video for. This in turn means, you need to go through this steps only once. Syncing between the external video and LapTimer laps will be preserved and will not require you to select sync points individually!


So, you are actually done. All videos (internal, external, MultiCam) are available and can be overlaid now. In case you need help on this item, please return to [Overlaying](#).

External Overlaying and Overlaying External Sources

In case you want to design your own dashboards for video overlays, you need to export both data recordings, and optionally the video to a 3rd party software available elsewhere. To transfer data recordings, please use the .CSV format available from LapTimer's [Export View](#). To copy videos, access depends on the place they are stored in. Please revisit [Maintain Video Data](#) to understand how to access videos from your desktop.


The opposite scenario is supported too: LapTimer can be used to overlay externally recorded videos following these steps:

1. Record your lap using any video cam, e.g. an action cam not supported by LapTimer's MultiCam.
2. Copy the video to one of the video places available in [Video List](#). Revisit [Maintain Video Data](#) for the options.
3. From within LapTimer / [Lap Details](#), associate the video with your lap (press [Edit](#) and [Add Video](#) on iOS, press  for Android).
4. Select the position in the video that matches the lap's end (finish line)
5. Start the overlaying process by pressing [Play](#) or [Export](#) – and enjoy the result

Quality of the output depends both on your device type, video resolutions available, and the video input quality. For Android , there are two tweaks available to adjust the bitrate used for new videos: [LapTimer](#) ▶ [Administration](#) ▶ [Settings](#) ▶ [Expert Settings](#) ▶ [Video Tweaks / Video Bitrate Multiplier](#).

On Android , for videos generated, the master video dimensions are used, while on iOS , one of these dimensions is used:

- SD: 640 x 480 (4:3)
- HD: 1280 x 720 (16:9)
- FullHD: 1920 x 1080 (16:9)
- 4K UHD: 3840 x 2160 (16:9)




This means, for iOS , you need to take care the input video can be mapped without getting stretched or squished. In case the processed video does not match one of the above, the resolution is selected based on height only:

- ≥ 2160 uses 3840 x 2160 (4K UHD)
- ≥ 1080 uses 1920 x 1080 (FullHD)
- ≥ 720 uses 1280 x 720 (HD)
- the rest goes to 640 x 480 (SD)

So for iOS, it is best to record external footage using one of the native resolutions, or a multiple keeping the aspect ratio.

Manually Aligning Laps with Videos



In [Overlaying Options and Organization](#) we have seen how laps and videos are related and linked. In [Lap Details](#), the main entry point for a lap including its videos, you either see a video (or videos) linked, or no video section at all. To add an existing video from any of the storage places supported, you press the [Edit](#) button to get the video section with its options to add, remove, synchronize, and reorder for iOS , or select the  or long press a video's row and select from the action menu for Android . Once the add operation is performed, any video in the supported storage areas can be selected and gets associated with your lap.

Once you have added a video, LapTimer will prompt you to set the synchronization point: as videos typically will not match a single lap exactly, video and data recordings need to be synchronized. You need to select the end of the lap—i.e. the finish line—to get a correct overlay later.

Please revisit the diagram [Lap / Video Synchronization](#) above to understand the meaning of this sync points.

To fine adjust synchronization, long press the filmstrip shown in the snapshot to the left. LapTimer will zoom in and allow synchronization on frame level. As an alternative and to fine adjust, use the stepper buttons to scroll through footage by frame.

Fighting Device Overheating

Smartphones devices in warm / hot environments while active, run into overheating problems from time to time. As videoing at high resolutions is the most energy intensive process you can perform on your phone, we want to give some hints how to work around this issue:

- Reduce energy consumption as this directly relates to heat developed
- Shade your smartphone from direct sun
- Place you device in a cool place

The first point is pretty obvious. Here are combinations for energy consumptions on your device – from strong, to low impact: video capturing, wifi operation, bright screen, mobile network operation, Bluetooth operation.

The video capturing process heats the smartphone quite a bit, just record a few minutes and touch the area around your lens – it is getting pretty hot. Besides reducing resolution, there is not too much you can do about this as long as you want a video recording. However, we want to repeat our recommendation made above: *"... it is our recommendation that you do not record video all of the time."*

Wifi operation should be turned off while using LapTimer. The only exception is when you use one of the wifi connected external accessories like OBD dongles etc.

Screen brightness can be reduced to approximately 80% without any impact on readability. I'm not sure how much difference the 20% make for power consumption, but it is worth a try. In case you do not watch LapTimer while driving, you may consider reducing brightness far below 80%.

Cellular operation is not significant as long as you do not use online access. However during normal operation, LapTimer does send position and lap time data while actively lapping. You can turn this feature off using LapTimer's setting [Online Racing ▶ Publish](#) by switching it to [Never](#). Turning it off will not allow your friends to view you on track, see yellow flags, or get your time into the Hall of Fame however.

Bluetooth operation is the least significant component. However it is good practice to treat it like wifi operation and turn it off as long as you do not have an external Bluetooth sensor connected, or use the MultiCam feature.

Next point is direct sun. You can overheat your smartphone by placing it into direct sun very quickly. A typical beach problem 🏖️. So please try to place your phone in a shadowed position, which will help significantly.

The last point is the most powerful approach. I personally never ever ran into any overheating problem with any of my devices—even with all features above turned on. Reason is I have my smartphone placed directly into one of my car's air fan streams with the fan set to cool/cold.



Place your smartphone into one of your car's air fan streams to work around overheating.



iPhone Placed into an Air Fan's Stream

Please check this option first, in case you have the opportunity to place your iPhone e.g. like in the picture.