Front and Rear Dashcam Installation in a Rav4 Hybrid (Gen5, 2019-20**)

Summary

This article: (1) describes how to install a dual dashcam taking the Viofo A129 plus duo into a Toyota rav4 hybrid as an example; (2) recommends against long use of dashcam parking mode from the small auxiliary battery usually installed in a hybrid car; (3) gives some limitations of power banks to run a dashcam; (4) describes a better way to achieve automatic activation of parking mode in a Viofo dashcam; (5) considers power use of the dashcam in relation to available battery capacity; and (6) concludes that for use of a dashcam in parking mode beyond a few days, there is no practical alternative to installation of a deep-cycle vehicle battery of suitable capacity.

Installing the Dashcam

Available instructions do not fully describe a safe and efficient method. Those below round things out. I used a Viofo A129 plus duo, but similar considerations apply to most dashcams. Check the cameras and wires by powering them up before installation, and check that they fit in the intended mounting locations without interfering with the driver's view of the road.

1. Watch these videos:

2017 Rav4 Right Pillar with Airbag Removal www.youtube.com/watch?v=vHRZcmA1A9U

And at least one of these (or search for 2019 Rav4 dashcam install dual)
www.youtube.com/watch?v=y4kfjH2lygE www.youtube.com/watch?v=JWO34NCTZeQ
www.youtube.com/watch?v=c7eYHrr2KlM www.youtube.com/watch?v=UE1ssakGlX0

Read opinions and experiences at www.rav4world.com/threads/.298861/ and /.299734/.

2. The Viofo A129 runs on 5v (usb) power. Because the hybrid's 12v battery is essential to start the car, but relatively small (45-60 Ah) and expensive, it is better not to use a hard-wire kit for power when parked. Use the power cable and cigarette lighter-usb adapter supplied with the dashcam, or an available usb outlet if it can provide 1A. These will switch off with the vehicle. If you want to continue recording (for a while) when parked, you could investigate a deep-cycle 12v battery. Some batteries are advertised to combine useful features for cranking and deep cycling. How successful each model is in this quest can be judged from the performance curves, if the manufacturer makes them public. Or you could use a suitable power bank with 12v (cigarette lighter) input and usb output.

3. It is necessary to remove the glove box tray (and later replace it, as in the videos).

4. If there is no hole in the plastic panel above the front switched power outlet (12v cigarette lighter socket), you can make one using a rotary tool (Dremel) with extension cable and grinding wheel attachment. There is space above this panel (and below the air-conditioner controls) to feed the power cable through. A flexible tool with remote claw (mechanical fingers) makes it easier to grab the power cable and pull it through to the space above the glove box. Or use a bent wire as a hook.

If your rav4 has a power outlet in the centre console box (Australian GX) it is even easier to run the power cable there for a completely hidden installation. The plastic trim in front of this box unclips easily, and can be lifted a little to see below. Make a hole with the Dremel at the desired height in the front corner of the console box, where there is no obstruction, and feed the cable along under the base of the console trim, to the front space above the glove box. Otherwise you can check the current rating of any usb outlet in the console box, or buy and swap in a 12v outlet.

5. Mechanical fingers or your bent wire are useful again to push the cable from the space above the glove box, up to the dash level near the front of the A pillar. Make sure you are happy with the cable path to avoid rattles. Later you can coil excess cable and secure it in the space above the glove box (or beside the centre console).

6. Some users have worked the dashcam cable under the A-pillar trim from the windscreen side, but at the top this may take the cable over the side-curtain airbag. To avoid this, it is best to remove the A-pillar trim above the glove box. Go gently. There are two 'teaser' clips designed to let the trim move some distance from the pillar if that airbag is activated. You do not need pliers or special tools to remove these clips without damage. Just pull the trim a short way from the pillar, then use your forefinger and thumb to push in the sliding rods at the base of each clip, turn the clip 90 degrees, and ease it from the mount hole in the pillar. First the top clip, then the lower one. Once the trim is removed, you can easily push the clips all the way back into the trim. When all the wiring is completed, you can then easily replace the trim, starting by locating the lower lugs in their dashboard slots, then pushing in the lower clip and finally pushing in the upper clip.

The advice for safety is to disconnect the 12v battery before working near the airbags. If you do this, be very careful to avoid sparks that can cause a battery explosion, especially near a recently-charged battery. Ventilate thoroughly around the battery first, and wait for hydrogen to dissipate. On reconnection it may be necessary to reset electronic features as described in the car owner's manual (nothing required a reset after battery disconnection in my base-model rav4 hybrid).

7. The front dashcam camera can mount onto the plastic cover between the rear-view mirror and the inbuilt front camera in the Rav4. The 3M glue-mount sticks firmly to this (cleaned) plastic cover, and the dashcam unit is almost completely behind the rear-view mirror for most drivers. This location is a key decision, so if in doubt, check it first. I am in Australia (RHD), but from checking on the other side I think it is at least as good with LHD.

The dashcam keeps cooler here than on the windscreen glass, it is accessible from all sides, the GPS is fine, and the dashcam cables route snugly through the cover (which is easy to slide down/off and up/on). It is not necessary to disassemble this 2-piece cover, or to remove the nearby lighting module from the headliner. Make sure you are happy with the cable lengths for attachment to the front dashcam unit, as you will work from here back to hide the cables.

8. The cable to the rear dashcam camera can be routed behind the airbag device at the A-pillar. It may be OK in front, as there seems to be a gap here between parts that inflate; but go behind to be sure that the cable will not interfere with airbag deployment.

9. Both cables fit easily into the headliner / door seal spaces as in the videos. It is not too hard to get the rear camera cable past the B- and C- pillars using a plastic trim tool. I have not pulled off all the trim to look at airbag operation in these areas, but the cable should not interfere here from what I can see in online advice and Rav4 schematic diagrams.

10. After removal of the rear headliner press-studs and the rear-window upper trim plastic (as in the videos), coax the cable for the rear camera through the larger rubber boot, using a cable-tie plus electrical tape plus lubricant (as in the videos). After selecting the rear camera location, use the Dremel again to make a passage for the cable in the rear-window inner-trim plastic. This allows the rear camera to be mounted high on the rear window without strain on the camera cable or usb port. Excess cable can be coiled in the rear headliner before replacing the press-studs.

11. Before removing the covers over the adhesive camera mounts, make sure that you have practiced how you will ensure that these cameras are in the desired positions (and at the required angle) when you press them into place. This adhesive is tenacious and it does not allow adjustments. Apparently heat (eg from a hair dryer) helps to remove it later if necessary.

About Power Banks

Many power banks today have a jump-start feature, so you have a back-up starter battery (at least when parking mode on the dashcam has not used all the available capacity of the power bank). Some power banks are small enough to sit inconspicuously in the front tray or centre console. They can be recharged from a 'cigarette-lighter socket' while driving. But there are several types of 'Lithium" battery chemistry (http://nordkyndesign.com/category/marine-engineering/electrical/lithium-battery-systems/). Unfortunately the cheaper power banks generally use Li-Co polymer chemistry, which is unsafe inside a car. More expensive $LiFePO_4$ (LFP) batteries are arguably as safe as lead-acid batteries in cars: both need careful use for safety.

Most inexpensive power banks do not have a pass-through capability. If the charger is plugged in, the usb output is cut off. Such power banks have to be turned on manually to commence usb output, which typically will continue as long as there is current draw, until any low-voltage self-protection kicks in. For the dashcam user, this means running usb power to the dashcam from the vehicle while the vehicle is running, and remembering for parking mode to (i) move the usb cable over to the power bank, and (ii) switch on the power bank output. Then it is necessary to plug the power bank in somewhere to recharge while driving. Some power banks have usb charging, but users warn that charging a power bank by usb is 'achingly slow'. They will recharge faster from a cigarette lighter socket, and faster still from a wall outlet at home. Either way, it is a bit of inconvenience. You might avoid the inconvenience if you pay more for a power bank with true long-term pass-through capability, especially one designed for use with dashcams.

In some power banks the EC-5 (jump starter) outlet is pass-through (and continuous), whereas the usb outlets are not. In that case, you can connect the power bank to charge through its cigarette-lighter charger, and use an EC-5 to cigarette-lighter socket adapter to power the dashcam. This is completely 'hands-off', but it may need hours of driving for a full recharge of the power bank. Caution: it is unclear in many such power banks whether the EC-5 outlet has all the protection features of the usb outlets. Some manufacturers warn that pass-through charging causes heating that shortens power bank life. Some users feel that charging is the most dangerous time for Lithium power banks.

About Parking Mode

It should be possible to set the dashcam to switch to a (lower-power) parking mode after the camera detects no movement for a period of time (a few minutes for the A129 plus). Most people who have tested power use report that it does not decrease much in parking mode (Viofo reported a drop from 5W to 4W for a 4K dashcam). Whether this reduction is useful depends on factors including your battery capacity, parking duration, amount of movement around the parked vehicle, and your parking mode settings. In general, parking mode can be used for a few hours, but even a large car battery will not power it for a week. There is more on dashcam models, power consumption, parking mode and buffering at Dashcam Talk; eg: https://dashcamtalk.com/forum/threads/.39569/, /.41079/, /.43812/, /.43551/.

If you go on a holiday and use parking mode with a Viofo hardwire kit, the dashcam reduces the vehicle 12v 'cranking' battery to between 11.8v (~35% remaining charge) and 12.4v (~78% remaining charge) depending where you set it. The dashcam stops after one or a few days, and at that moment your rav4 hybrid should start. But you have pushed the vehicle 12v battery down to a capacity where, through ongoing drain to the vehicle electronics, it is more likely to be damaged, or fail to start your hybrid when you return days or weeks later, after your holiday. Many factors can affect battery service life, and owners will generally not perceive the effect immediately; but most battery manufacturers caution that repeated discharge of a cranking battery to below 12.4v will have a substantial adverse effect. Whether that is an acceptable 'price' for parking mode use of a dashcam is an individual choice.

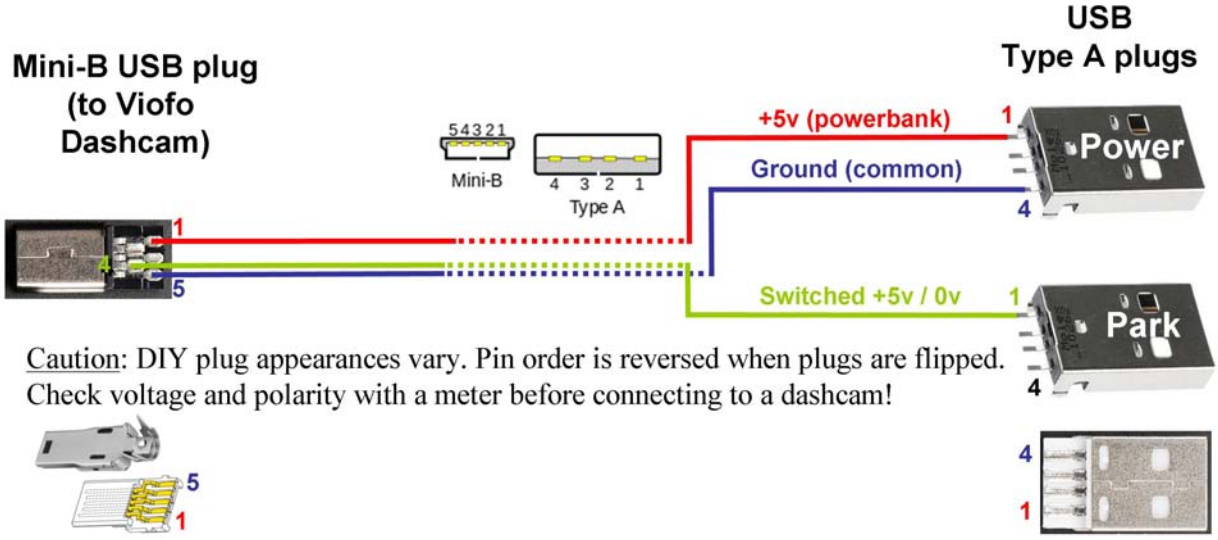
Time lapse recording at a low frame rate is probably the lowest power user when parked, especially if there is a lot of surrounding movement, but even this mode does not give a huge power-use saving. Unfortunately, it seems slow to auto-activate in the A129 plus when using a power bank; and in my experience it flips back to regular recording frequently unless parking mode G sensitivity is set to low. GPS data should switch the A129 plus out of parking mode, back to regular recording mode, when you drive again.

A Better '3-Wire' Option

Many dashcam users prefer a power bank or a deep-cycle battery, to avoid drain on a cranking battery while parked; but find the transition to parking mode slow or unreliable due to movement around the parked vehicle. Some expensive power banks incorporate '3-wire' capability to trigger parking mode when the vehicle is turned off (if wired with a kit like Viofo HK3). A trigger to parking mode can also be arranged without a HK3 kit. Thanks to 'Viofu' for key information and elegant (but complicated) method involving relays: https://dashcamtalk.com/forum/threads/.40370/page-2.

In summary, some Viofo dashcams use the presence or absence of a +3v to +5.5v signal on mini-B usb pin 4 (sometimes called pin x or ID), to switch between normal and parking mode. This is a non-standard use of mini-usb pin 4. A +5v wire from pin 1 of an in-vehicle switched usb port to pin 4 on the front dashcam mount achieves the same effect.

The easiest method for those with some DIY wiring skill (and a fine-tip soldering iron) is to make up a Y cable: with mini-usb pins 1 and 5 going to pins 1 and 4 of a type A usb plug (for +5v from the power bank or unswitched usb adapter wired to a deep cycle battery), and mini-usb pin 4 going to pin 1 of another type A usb plug (for the +5v / 0v switched usb signal). Only a 3-core cable is needed (no data wires). You can make it to the required length (shorter is better). Preferably use conductors of 0.3-0.2 mm^2 (22-24 AWG) for dashcam power; thicker for current above 1A or length above 3m. Cheap usb and stereo cables have thinner conductors, so voltage drop and overheating are concerns. You could use high-quality 28/1P+24/2C usb cable with the twisted pair (28/1P) joined to mini-usb pin 4, which does not draw much current. Some usb cables are labelled 22AWG or even 20AWG (for fast chargers), but those for charging may only have 2 cores. Belden 8443 (0.3mm^2 = 22 AWG) or Multicomp MP002326 (0.2 mm^2 ≈ 24 AWG) are suitable. Check that you are happy with overall cable diameter and flexibility. Thicker and less flexible cables are harder to route. Thicker wires are harder to attach without shorting at the mini-usb connector. Connectors with solder tabs on two layers (Adafruit) may be easier. Use a little hot-melt glue after soldering for improved insulation and cable attachment. Pre-wired (moulded) mini-B usb plugs typically have no wire to pin 4.



This method occupies a switched in-vehicle usb port, plus a power bank or unswitched usb adapter wired to a deep cycle battery with voltage cut-off. Remember that a power bank must be plugged into a vehicle cigarette lighter socket to provide a common ground. This way the power bank also charges while the vehicle is running, and the vehicle will be attended (on) while charging.

Splitters that provide multiple usb and 'cigarette lighter' outlets from a single cigarette lighter socket are widely available and inexpensive. Check that the usb outlets have suitable current limitation (1-2A is enough to power most dual dashcams, 0.5A is plenty for mini-usb pin 4). I have never seen a fuse on a usb output cable, so I guess the 5v and current limitation take care of safety there. The whole power and 'parking sensor' system is easily concealed in a rav4 console box. Then 3.3 m of cable allows concealed wiring to the front dashcam.

This method (with Belden 8443 cable and Adafruit connectors) works with a Viofo A129 plus duo. Viofo mini-usb pin 4 is OK with 5.55v, so no resistor is needed. The capacitor mentioned by 'Viofu' should only be required in a relay system.

Power Use *(Including Dashcam in Parking Mode)*

By my measurement (using a TENMA71-13540 USB tester), an A129 plus duo (with 2650*1440F, 1920*1080R, H.265 activated and medium bitrate selected) uses:

Condition	Voltage	Current (mA)	Power (W)	Power (W) at 90% efficiency from 12v-5v
Normal recording (30fps) screen on or off	5.11	730	3.73	4.14
Not recording, menu on	5.11	610	3.12	3.47
Parking 1fps	5.11	550	2.81	3.12 (223 / 260 mA)
Parking 2fps	5.11	570	2.91	3.23
Parking 3fps	5.11	590	3.01	3.34
Long-press power off after 30 sec*	5.11 --	40 ?	0.2 ?	0.23 0.27 (20 mA)
Power disconnected	0	0	0	0

* Although drain dropped below the resolution of the TENMA71-13540 USB device (supposedly 0.01A), the Toyota 'Auxiliary Battery Dark Current' PID reports that the unit (with the required voltage converter) continues to draw about ~20 mA (from a 13.3V LFP auxiliary battery). This PID confirms the expected ~220 mA drain in 1fps Parking Mode.

Current drawn the by the dashcam oscillates somewhat (possibly with GPS polling). More current is drawn in a spike to initially charge the capacitor. Low bitrate may use less power (for lower quality). No current measurable by the TENMA71-13540 USB device is drawn from the 'Park' usb socket, but it is essential to trigger parking mode when the vehicle is turned off.

In a secure location (like a home garage) you may not want parking dashcam (and associated power drain). After long press of the power button there is slight ongoing power use, and recording starts automatically with the next vehicle start. If you pull out the power converter (for assured zero power use), remember that the vehicle must be on before you reconnect the dashcam power, if you want to trigger parking mode when the vehicle is next turned off (the Viofo unit looks for voltage on mini-usb pin 4 when it powers up to enable automatic parking mode). The preferred parking mode must have been selected, and parking timer turned off in the Viofo menu.

No 12v-5v converter is perfectly efficient. As an example, the Viofo D3000 cigarette lighter-usb adaptor draws >20mA@12.0v for its ring light, with no usb cables attached. It draws 820mA @ 12.0v (9.84W) to deliver 1700mA @ 5.3v (9.01W); ie 91.6% efficiency (less at low current). The best converters that I have tested are 90-95% efficient. Hence the final column in the table above.

The lowest ‘standby’ drains that I have measured in cigarette lighter-usb adaptors are 1.75mA (22.4mW) without an LED light; and 2.8mA (35.8mW) with an LED light. This adds little to commensal drain by the car electronics in ‘sleep’ mode. As a ‘rule of thumb’ for a typical car 12v lead-acid cranking battery, a total drain of 2-3mA might be OK for several months, but 20-30mA could cause problems after a few weeks and 200-300mA would be a concern within a few days.

Vehicle in ‘Sleep’ Mode

I measured rav4 battery voltage (using a DIGITECH QM1517 multimeter) and current (using a UNI_T UT210E DC clamp ammeter) periodically while parked. With no cabin light or other car lights, there is high and variable current draw soon after any door is opened, then it quickly drops to ~300mA. After about 3-5 minutes, it drops to 100-125mA. After about 25-30 minutes it drops to 0-15mA (~ 0.12W). There is no difference whether the car is locked or unlocked.

This clamp-type DC current meter has a repeatability of about +/- 10mA (if the user is careful to press zero as close as possible to the final measurement angle and position) because it is sensing a magnetic field strength close to that of planet earth. It is also important to replicate, and to take readings immediately after zeroing, to avoid spurious readings and drift. With these precautions, a clamp meter can be good enough for our purpose, while avoiding the need to break into the measured circuit. An OBDlink device reports 3-7mA from the Toyota ‘Dark Current’ PID.

How Long Can a Dashcam Run in Parking Mode

So every hour of dashcam use from the vehicle battery (~3.1W at 1fps in time lapse, the lowest-drain parking mode) would reduce time to parked vehicle restart failure by slightly over one day. Whether this is a problem will depend on the time for which the vehicle is parked, availability of a charged jump starter, and personal sensitivity about permanent damage to your vehicle starter battery. For those who are concerned, the method above provides the convenience of automatic parking mode with zero dashcam drain on the starter battery, or the option to use a deep-cycle car battery with suitable voltage cut-off.

How long you get in dashcam parking mode will depend on your power bank or deep-cycle battery capacity. A reasonable approximation for 1-2 fps time lapse is: capacity in Wh ÷ 3 = hours recorded, provided you drive long enough to fully charge the ‘battery’ used.

Bear in mind that in-car recharge time goes up with capacity so you are effectively compelled to use a wall outlet to charge high-capacity power banks. It is all a compromise because vehicle cranking batteries, chargers and electrical circuits are not designed for long use of a dashcam (drawing 3-5W) while parked.

The gen5 rav4 hybrid has a 6.5Ah @ 245v = 1600Wh NiMh battery pack, but it is not designed for deep discharge and Toyota does not provide any way to use this capacity for accessories (other than in READY mode, which should not be used unattended).

Toyota sells an expensive (Fujitsu Ten Limited) front-only dashcam that uses post-impact-only recording when parked. While parked, this will be low power but not very effective for monitoring most relevant events. The (12v) Toyota dashcam has no screen. It uses cable splices and in-line fuses for hard wiring, and harness tape against abrasion and rattles where needed.

Conclusion

If your vehicle is going to be parked for more than a couple of days, forget about using a dashcam while you are away; unless it is connected through a suitable voltage cut-off unit to a deep-cycle battery of sufficient capacity. To recharge a lead-acid deep-cycle battery, you will still need a long drive (with DC-DC charger), a solar panel, or a wall outlet (with AC-DC charger). The possibility to use a $LiFePO_4$ vehicle battery is considered in the companion article.