

DSLRs – What you need to know!

This article describes how modern DSLR Cameras are now a practical consideration for shooting productions with excellent results on a low budget.

Other articles on 35mm adapters describes the effect of larger sensor sizes, longer focal lengths and larger iris has on narrowing the depth of field: <http://www.vmi.tv/training/learning-centre/film-look-on-a-budget/>.



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Acquisition

The implementation and use of SLR

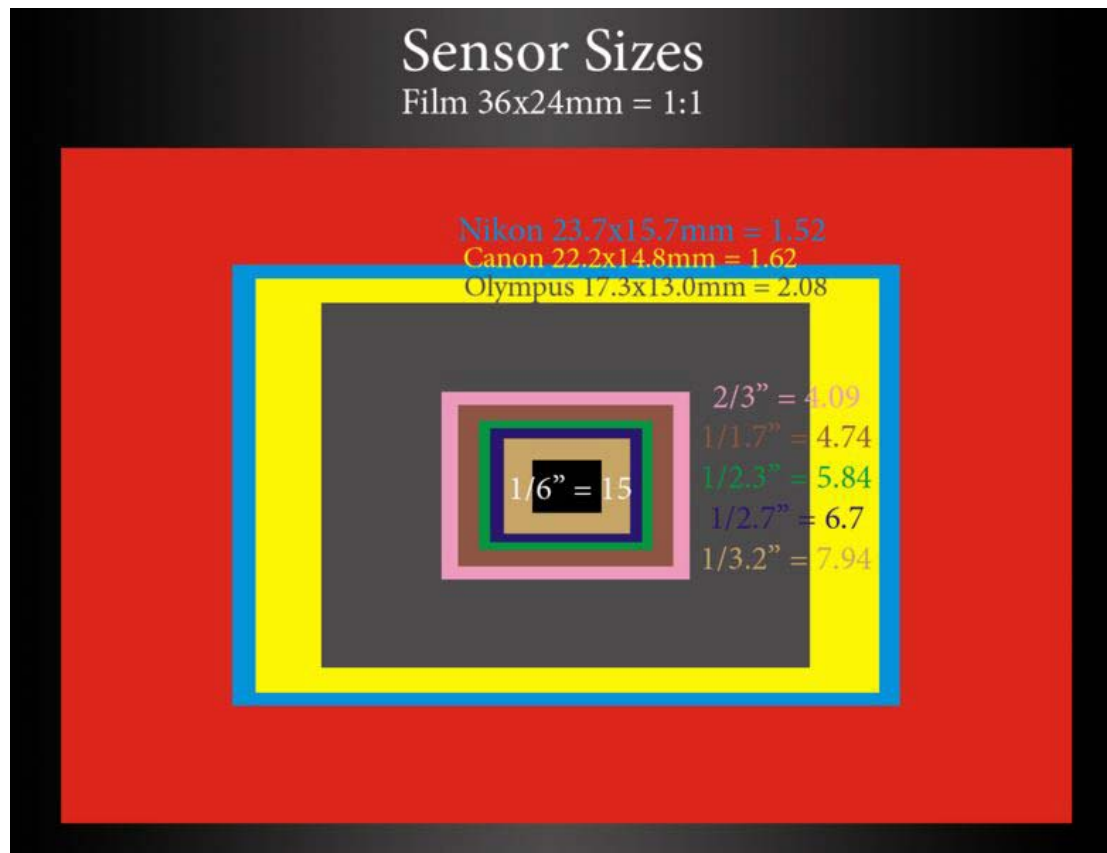


Fig 1.

The look of the camera is based on the highly successful implementation of digital cameras in the 35mm size SLR (single lens reflex) stills cameras.

There have been 2 types of cameras in this field due to hardware restrictions and functionality, which are The Full Frame 35mm Stills digital sensors and The APS Sensor Format.

Full Frame 35mm Stills Digital Sensors



The fact that these cameras were designed primarily for stills first with video has to be stressed and not as a video camera alone which results in some other restrictions.

Firstly there is the full size stills size sensor different from the motion picture size sensor seeing that stills cameras film travels horizontally and they did not need to record or print sound on the edge of the negative next to the picture. The result was a much wider angle of view with the same focal length or depth of field.

At this stage there is only one camera known shooting motion picture or video digitally in this format or chip size and that would be the Canon 5D mark2 depicted on the red area in fig 1.

Due to hardware restrictions as to camera size and processing power this camera films on a highly compressed H264 codec at about 38mbps and roughly scans about every third line on this highly developed 21.1 mega pixel camera resulting in some rolling shutter gello or image bending problems with the scanning rolling shutter that one finds on these cmos based chip cameras.

The size of the chip helps the camera with some very sharp pictures resulting in some advances in latitude and sensitivity but because it has a unique stills chip size, one will have to be very careful about vignette or cut off seeing the bulk of lenses designed for motion picture is more or less designed for motion picture size chip and film cameras. Lens choices at this point in time are very restricted to mainly still lenses, which covers the whole area, which also opens a whole bunch of problems on manual iris and focusing.

APS Sensor Format



Secondly there is the motion picture size chip, which is based primarily on the 35mm motion picture film camera where the film use to travel vertically through the film gate with enough room for printing sound next to the picture and then later with digital advancements in sound resulting in the super 35mm picture where the picture could be wider seeing they did not need so much or completely discarded the sound.

The image in fig.1 can now be seen as taking the red area punch a bunch of perforations on the left and right and some sound on the side and one would end up more or less in the blue yellow and grey areas.

Years ago professional photographers asked stills manufacturers to make a digital camera which is faster in stills frame burst, quick on auto focusing and a bunch of other advancements and the manufacturers decided to go with a smaller size chip about same size as the motion picture to get more stills performance out of them thus resulting in the APS size chips as in the Nikon (blue) and the Canon (yellow).

Other manufacturers thought of making cameras more compact and lightweight but still big enough to give you proper picture taking out the mirror reflex viewing system and replacing them with rangefinder and lately digital viewfinders directly of the chip with a almost vibration free shutter resulting in sharper pictures as in the gray area in fig.1 or more commonly known as the four thirds size image as adopted by the compact Leica and Olympus pen range and the very popular Panasonic GH1 to just name a few.

Recently manufacturers have figure out a way to give users a live view mode directly from the chip in order for them to use a LCD screen to frame up and also to lock up the SLR viewing mirror to give less vibration on stills and then decided to give it video capabilities thus resulting in the highly successful 5D mark 2 camera. However, as clients wanted more functions they decided to go the same route as their stills cameras thus resulting in the APS chip size like the Canon 7D camera. These cameras have a smaller chip but better shutter

and other capabilities thus resulting in a chip on the same size as motion picture 35mm cameras and later the same size as the Red one, Sony F35/Genesis, Arri D21 and this is shared by the latest ARRI Alexa range and most 35mm size chip HD cameras.

This camera can also shoot 50 frames per second in 1280x720 mode. The manufacturers stuck to this format, since motion picture (PL) lenses are optimized for this size sensor and will vignette, cut off or fall off resolution on the larger 5D size chip. These HD/SLR cameras have a reflex mirror, which also limits its functionality with 3rd party accessories. The other smaller size chips in the fig.1 depicts the conventional HD and video cameras

The effect on depth of field and the use of 35mm size stills lenses

There is a lot of confusion about larger sensor sizes but it is important to consider that the focal length and its depth of field depicted by the aperture controlled by exposure is a set norm it is a scientific fact and it does not change.

For the same lens focal length and iris, the depth of field in the larger full 35mm stills sensors is the same as that of the smaller APS sensors but the field of view is wider on the larger sensor image. A full 35mm stills sensor, which covers the whole spectrum, has an even more dramatic effect on the scene with a very dramatic effect on the picture.

Rolling shutter and the gello effect

Most digital cameras have either a 3 streamed CCD global shutter which scans all lines simultaneously but results in light bleeding in certain situations or a single stream CMOS rolling shutter that scans from top to bottom like the DSLR cameras with resulting in skew images by sudden moving images also known as gelloing effect.



The scanning can also have an effect on filming images with some flash photography involved.



Most of the post production tools have rectification tools to cope with this effect and the Foundry has a rolling shutter plug-in for their Nuke software and also for After Effects and Final Cut Pro. The smaller EOS-7D camera compared with the larger sensor 5DMkII apparently handles these situations much better and these problems also is less prominent in the 720 HD mode at 50fps seeing it has faster shutter actions and does not scan over a larger picture

30fps and problems with flicker etc.

As I am writing this piece Canon has just released a new firmware update allowing the 5D to film in 25 or 24 fps in Pal and 30 or 24 fps in NTSC mode in the 1080 HD format. It is also important to note that the 7D is also compatible with 25fps as the smaller chip can also shoot in 50fps (720) HD format and although most people will play it back at 50fps for a smoother image or better shutter performance in real time, there is also room to slow it down to 25fps for a slow motion effect.

The limitations on sound recording

The limitations in sound recording has also been improved in the firmware update and although it has a new manual recording feature it still does not show sound levels in the live view picture.

Using an external sound mixer like the beachtek DXA-5D box you can control sound much better. These cameras only possess a stereo mini-jack input which also doubles up as an output so monitoring sound directly of the camera is not an option when an external input provided which is a very risky situation to be in, so many DSLR shooters are now opting to record their sound externally.

The limitations on monitoring and viewing

The firmware update has also addressed the viewing capabilities of using the HDMI port but although there is no alteration in the 7D operation the larger chip 5D scales down the 1080 HDMI feed to 480 lines HDMI feed to monitor once the record button has been pressed.

This restricts you from using an HDMI to HD-SDI conversion box to be able to monitor HD signals on multiple monitors when using the 5D camera but it is possible with the 7D camera. Monitoring is also restricted using the higher resolution HDMI feed but works very well in the much lower resolution composite output. None of the Canon DSLR cameras allow for simultaneous external monitoring and on-camera viewing via the on board LCD simultaneously. Zacuto makes an optical viewfinder which turns the on board LCD into a professional video style viewfinder for help with focusing, exposure etc. but this needs to be stuck to the camera body using a Z-frame and it takes 24 hours for the glue to harden, so be aware of this if you immediately want to take it onto location!

The operating and solutions on working with a small camera.

These cameras are very small and one has to adapt all lensing to fit a follow-focus/mattebox configuration. There are also numerous shoulder kits available from Zacuto, Red rock micro and ARRI to name a few.

The camera is very light weight and there is a multitude of steadicam rigs on the market which don't require all kinds of harnesses and arms like the steadicam merlin or the Hague handheld steady rig. These cameras are much easier on mini jib arms and dollies but are very difficult to handheld alone without shoulder mount kits or steadicam rigs etc. These cameras tend to be very front heavy with shoulder kits and needs some counterbalancing weights or battery packs mounted behind the camera.

The importance of lighting and camera support (gripping) on large chip cameras

The use of a very good DOP or lighting cameraman is a very big necessity on the larger chip cameras, seeing that a lot of skill will be required on such sharp and sensitive format.

The camera is extremely light sensitive and a great skillful is required since needing less light means that it can be hard to light situations at a lower level. The larger sensor cameras see

more and the lenses angle of view is wider so much greater that larger areas have to be lit and dealt with.

Matte box, follow focus and monitoring solutions for camera assistants



DSLR cameras have a reflex mirror built into them, which limits this camera's functionality with other accessories and this means that compatibility is mostly limited to using stills lenses.

Canon stills lenses only have aperture control internally and they are electronically controlled, and they need special rings to adapt for follow focus and they do not have a proper start or stop point for focussing. Zeiss manufacture Nikon ZF-mounted Distagon and Planar prime lens sets which are compatible with Canon DSLR Cameras but like most other stills lenses they have to be modified in order to be optimised for follow focus and matte box use. Zeiss also produce Canon mounted versions of the same lenses but be aware that in common with all other Canon DSLR lenses, these have had the rear iris ring removed, so all iris adjustment needs to be done from the camera body – not how cinematographers like to work! Consequently, VMI use the fully manual Nikon ZF-mounted lenses and high quality adapters to convert to Canon EOS mounts for use with Canon DSLR camera bodies.

Some companies exist that modify the camera bodies by removing the internal mirror and fitting an external PI mount to the camera but this creates issues for insurance and voiding the manufacturer warranty.

ARRI has designed some superb follow focus system for them complete with a stop and start system and a reverse gear to compensate for the opposite direction of focus rotation of stills lenses compared with motion picture lenses which would otherwise be problematic even for a seasoned Focus-Puller.

ARRI, Red rock micro and others have now produced a range of matte box and other solutions complete with rotating trays accommodating both 4X4 and PV-size filters (5.65" x 4"). There are some external powering solutions available which can power both the camera and peripherals. VMI have customised these to a fine degree to power all peripherals from a central battery source, which also acts as a weight counter-balance as well! Hocus Focus has also designed a low-cost wireless focus system suitable for DSLR stills lenses. Stills lenses are primarily designed for one man operating with very tight calibration settings for one hand action and these focus systems can help assistants to calibrate them a bit wider for better focus control.

Post Production

Compression and camera frame rates.

The Canon and Nikon cameras use with the highly compressed H264 QuickTime codec at roughly 40mbps. Some cameras still allows for the movie JPEG at 30fps as an extra option, which is compatible with all computer systems and was initially the reason why the 5D was running 30fps as it was designed to show home movies on your domestic computer at home.

These codecs all being highly compressed, adopt the GOP (group of pictures) compression scheme which was very badly received on tape based cameras which has a limited window of performance where footage was squeezed through resulting in some jerk and pixilation in images. Solid state recording cameras are able to use this more effectively and they can alter their window when needed and has been greatly received in the market as can be seen in the performance in the XDCAM market.

30fps to 25fps conversions and plug ins

This problem has been addressed with the new firmware update but if you have footage that has been shot on 30fps there is a 5D to FCP free software program that deals with these types of situations.

5D TO FCP

<http://industrialrevolution.com/component/sobi2/?sobi2Task=sobi2Details&catid=2&sobi2Id=22>

Importing into FCP and ease of workflow with H264 and avchd

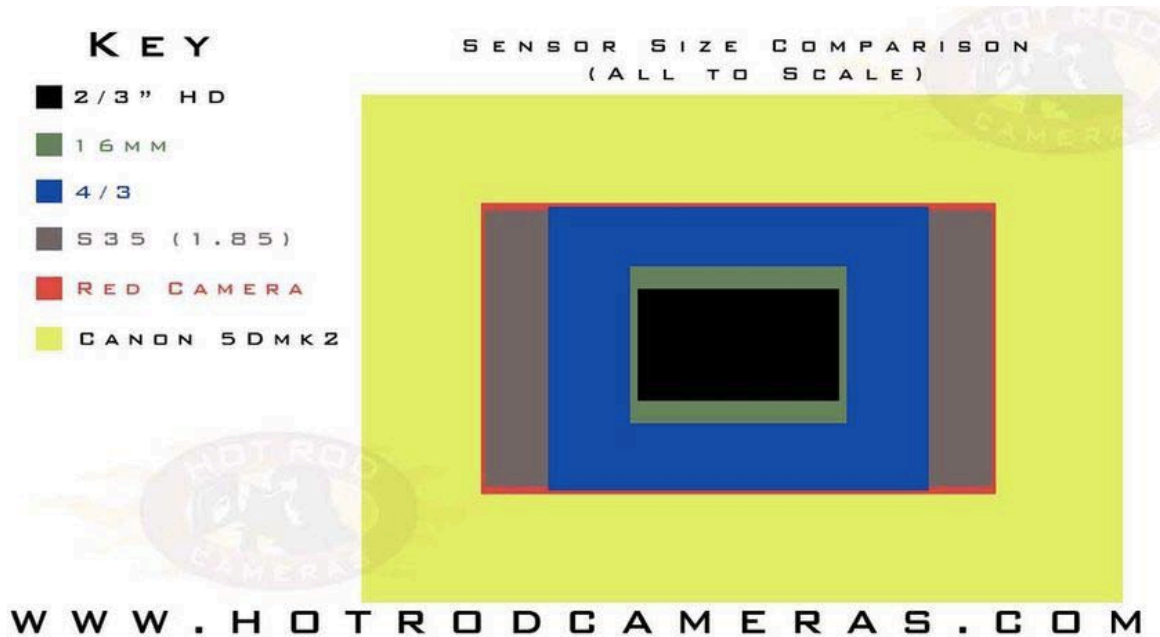
H264 is a quicktime .mov codec and imports directly into Final Cut Pro with no need of encoding or capturing material and can be dragged onto a timeline directly for editing.

AVCHD has to go through a log and capture process where the footage can be transcoded to a client's preferred codec like the ever-popular Apple Pro Res codec. It can be a little time consuming but nothing compared with processing film or working with redcode.

Footage can now be taking up a lot more disc space if a high performance codec is chosen for transcoding, so it could be a little bit more flexible. Canon has released a plug in for FCP so editors can transfer footage via log and capture with time code and also have the option to transcode to the popular Apple Pro Res family.

<http://www.usa.canon.com/dlc/controller?act=GetArticleAct&articleID=3249>

Another diagram of sensor sizes but for motion/video picture formats only.



Types of 35mm Lenses

DSLR Lenses – Canon vs. Nikon Mount

There are a huge range of DSLR lenses which offer excellent optics and variations on primes, zooms, mounts etc that the choice can be bewildering. However, some useful points about using DSLR lenses for cinematic productions:

Firstly, modern digital SLR cameras tend to be fully automatic and all of the lens controls are operable from the camera. Consequently, over time, the manual functions began to disappear from stills lenses, so that today many lenses available to buy do not have a manual iris ring, which makes them useless for the lens adapters above. Canon followed this lead and even their most expensive lenses don't have a manual iris ring, so the camera body always controls the iris adjustment.



This is counter to how cinematographers like to work, so VMI prefer to offer fully-manual Nikon-mounted Zeiss ZF Distagon and ZF planer lenses with high quality Nikon-Canon adapter rings. This means that you have the benefit of using a fully manual lens on a DSLR adapter.

Problems with using stills lenses for video applications

1. **Stills lenses aren't built to withstand the rigours of motion picture film production**, which means that they are built in much more lightweight lens housings. As a result of this, the screws holding a lens together are not designed to withstand the forces applied when using follow focus units etc. If you use a lens control system to control the focus, then the power of the servo units is sufficient to rip the screws of a stills lens apart!

2. ***There is no focus gear on stills lenses.*** This means that you can't drive the focus mechanism with a follow-focus unit. You can install an external focus gear using the Zacutto Zipgear system or custom modify lenses (like VMI do), which effectively straps a gear onto the outside of the lens to be driven by a follow focus unit. The downside to doing this is that the focus adjustment of small lenses means that you only have a small amount of adjustment of the focus ring over the entire range of the lens. In other words, your focus puller will complain if you use this combination!
3. ***The focus thread runs in the opposite direction*** to motion picture film lenses, so your focus puller either needs to learn to pull focus in the opposite direction, or alternatively use a follow focus unit with an idler gear, which reverses the motion of the follow focus correct for stills lenses. This correction gear is built in to the new ARRI MFF1 follow focus units.
4. ***Differing lens diameters meaning standard clip-on matte boxes won't fit –*** besides which the lens will not be strong enough to hold a clip-on matte box without putting undue pressure on the lens mount and housing.
5. ***Stills lenses have multiple non-compatible lens mounts*** to Motion Picture lenses, so you will need to fit suitable adapters to work with existing cameras and 35mm lens mounts. Nikon uses a ZF mount and there are many more standards including 2 alone for Canon. These mounts are also not as secure as PL motion picture lens mounts or B4 video lens mounts.
6. ***They are designed for portability, so some lenses 'breathe'*** and so when changing the focus of the lens, the image can noticeably resize, resulting in 'Focus Breathing'.

There are many fully-manual older prime lenses available second hand which are completely suitable but at VMI we chose the excellent Zeiss ZF series prime lenses which have fully manual operation and for which we have made some custom modifications to make them work better in video applications.

Even considering all of the above, if you have a low-budget short film and want to narrow the depth of field of your images and are using a low-cost camcorder, then it is still worth considering a set of stills primes to work with your system.

Be prepared for your crew to complain audibly about having to work with non-standard lenses or adapters and above all, be gentle with the equipment! You don't want them falling apart on you whilst in production (or indeed at any other time either!).

Solutions to using stills lenses for Video – Zeiss ZF Distagon/planar set

At VMI we have chosen the Zeiss ZF series lens sets for our Letus kits, as in our opinion they offer the best compromise for budget applications of performance and quality.



<http://www.vmi.tv/equipment/pro-duct-list/?catid=5&subcatid=59>

- The Zeiss Planar and Distagon design use the same lens arrangements which have been proven in the World-acclaimed Zeiss SuperSpeed, DigiPrime, UltraPrime and MasterPrime lenses.
- The ZF series lenses are the same high quality optics re-housed as used in the new ARRI lightweight 35mm lenses, except they cost ¼ of the price!
- VMI have modified the lenses to fit a custom follow focus ring which is a larger diameter than the lens, to give the focus-puller a greater range of adjustment.
- VMI have also custom-fitted lens fronts so that the entire set shares a common 80mm lens diameter and can be used with common matte-box donuts for ease of use.
- VMI supply the ARRI MFF1 follow-focus unit which includes a reversible gear, so that the direction of rotation is corrected during operation automatically.
- The lenses are very fast (T1.4 and T2) to allow the Cinematographer easier depth of field manipulation.
- These lenses include the commonly available Nikon ZF mount which allows them to be fitted either to Nikon stills lenses or threading adapters for other stills lenses or 35mm lens adapters such as Letus etc.

Solutions (2) to using stills lenses for Video – Zeiss Compact Primes set (CP.2)



A recent development from Zeiss is to re-house the Zeiss ZF DSLR Prime lenses into a new film lens housing, which corrects for the lack of focus rings, direction of focus adjustment and has superior mechanics.

Zeiss have even gone one stage further and produced multiple lens mounts for these lenses including PL mount for motion picture lenses including ARRI Alexa and RED, EOS mounts for Canon DSLR lenses plus also ZF mounts for Nikon cameras.

These lenses are more expensive than the ZF Distagon and ZF Planar lenses and don't offer any quality improvement, their improved mechanics aid focus pulling applications and the increase in cost reflects this.

The VMI DSLR 35mm package

VMI offer an elegant 35mm solution based on the Canon EOS-7D and 5D MkII with Zeiss Distagon lenses and ARRI Matte box and follow focus kits. Cheaper matte boxes and follow focus units are available but VMI like to think that there are some items that cinematographers should not have to compromise on during production!



The package includes the ARRI MFF1 follow focus with reversible focus gear, bridge plate and also ARRI MMB1 matte box.

The system is designed to work with VMI-modified Zeiss ZF Series lenses but external follow focus rings are available if using the kit with your own lenses.

Conclusion:

The HD SLR cameras are making a marked difference to low budget productions and bringing the larger format 35mm look within reach to clients with a very easy workflow.

The cameras are also very easy to move around when filming on locations and do not need any specialised vehicles for transportation. They are also very light sensitive and there is no light loss as opposed to using smaller sensors with 35mm adapters, so one does not need additional lighting which can also have a large cost implication.

On the downside, the monitoring on these cameras is very limiting and sound recording is not ideal, so alternative provision needs to be considered. The reflex mirror system also limits the cameras with other lenses and the larger 5D vignette.

The cameras are so small, that there is a significant hardware limitation to consider and they can be prone to overheating. Also, handheld operation can be difficult and handheld rigs can be fiddly and you need to consider counterbalance systems if you plan to have a lot of handheld operation.

The size also dictates the image processing and storage, resulting in a heavily compressed codec.

The cameras are ideally suited to stills so the ergonomics of the interface is more designed for stills as opposed to motion picture applications. There is definitely a difference in looks between the 7D and 5D and learning from others experience it is not advisable to combine the two cameras on a multi camera shoot.

Saying this, these cameras can produce excellent results in the right hands and providing you shoot within the limitations of the technology.

Gerard Botha, March 2010