

DSLR A900 as negative scanner

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Introduction

If you use an A900, you have pretty good opportunity to use a digital camera as slide/negative duplicator to "scan" b&w and color negatives and slides, saving a lot of time and money comparing to negative or flatbed scanning. A900 as FF camera allows 1:1 shooting typical 24x36 film frames, also for type 120 (6x6) negatives cropping is acceptable.

Shooting the negatives you can use the power of FF 24MP matrix (6048 pixels (horizontal) by 4032 pixels (vertical)) which is comparable with resolution of powerful film scanners. The work will be done very quickly, but without ICE function (which in fact does not work for b&w negatives).

Moreover, using proper custom white balance you can easy remove orange cast from negatives using camera only!

EQUIPMENT

Very important question is to properly place the negative in front of the camera (due to the very narrow depth of field!) on the light box, providing stable, reliable, and consistent illumination. Rather avoid mounting camera on the tripod, it is not stable enough.

Mounting of A900

Macro stand

The best effects you can get using reproduction column, which allows you to smooth distance regulation. Other option is using column from any type of enlarger with smooth height of head regulation.



It could be used the column from enlarger (eventually with macro rails) which provides stable mount for camera.

Other solution is to use macro rails, mounted on the stable, vertical surface.



For the most advanced users the DIY film copy macro stand is presented below.



Detailed description is presented here:
<http://www.digcaminfo.btinternet.co.uk/diyfilmcopying2.htm>

Light box

The basic requirement for light box is to provide stable, reliable, and consistent illumination. One of the possible solutions is to use ready-made light box (like presented below).

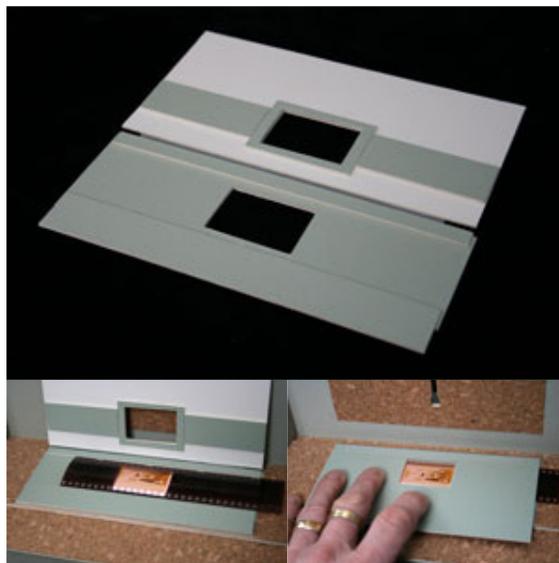


The screen is usually 7"x 5", not huge, but enough for most general purposes. If it uses daylight balanced fluorescent tubes it is an advantage, but not strong requirement. The light illumination used for copying is as vital to the final image quality as the lens optics or the image processing, as over-bright light produces higher contrast images with higher dynamic range, and so some consistent and reliable means of illumination is needed whatever particular form of equipment is used for copying.

Economic solution: other option is to use any box lamp with compact fluorescent lamp inside (like darkroom safelight lamp) covered with matte glass tile, take a lamp marked as "Photo" with 5400 K color temperature or "Day Light" with 6500K. Using lamp of 15 W power, you can use even ISO 100 for shooting

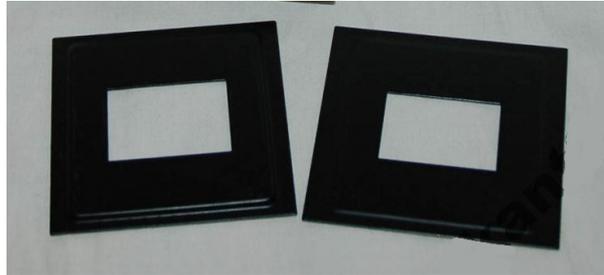
Negative holder

The DIY negative holder could be prepared as presented below:



Source and description: <http://www.digicaminfo.btinternet.co.uk/diyfilmcopying2.htm>

Other possibility is to use **enlarger negative holder frames** mounted directly on the light box.



Mounting of the camera and negative holder are very important for the comfort of work, stable construction allows very fast processing, even more than 400 frames per hour!

DIGITIZING PROCEDURES

Camera settings

The following settings for camera were worked out:

- Use lens 50 mm macro or 100 mm macro (1:1) for 24x36 mm negative.
- Turn on light box, wait for light stabilization.
- Set AF to manual.
- Set Aperture priority mode, select value of f/stop as f/8 for sharpest image.
- Turn off “Steady Shot Inside”
- Set Image Style to “Standard”.
- Set ISO to 100...400, in special cases set ISO 800.
- Set Dynamic Range Optimizer to DRO+ mode. In special cases use higher value.
- Set noise reduction to “Standard”.
- Set Color Space to sRGB.
- Set image size to L:24 and quality as X-Fine jpg, for special cases use RAW (if real highest quality of processing is required) or HDR mode.
- Use 50CC blue and 50CC cyan filters to minimize negative's orange mask (optional for color negatives only)
- Set “Custom White Balance” and store it in camera memory shooting:
 - empty transparent frame of b&w negative or color slide,
 - empty transparent frame of color negative. If you get a camera error add cyan or cyan and blue filters to balance the white. This works well for ca. 5500 K light box. If you failed, shoot empty frame (no negative) for color materials.

- Set metering mode to Multisegment metering.
- Optionally lock up mirror.
- Use remote controller for shooting.
- Thoroughly place negative in front of the camera.
- Shoot empty transparent frame of color negative, on the live view the picture should be neutral grey.
- Periodically check the image sharpness on the viewfinder.
- To obtain best results, repeat setting “Custom White Balance” for each new color negative.

To get the best results, the sensor plane of the camera must be parallel to the plane of the negative or transparency. Some copy stands will have adjustments to align the camera properly. The slide or negative must be held as flat as possible. The light box should be clean. Leave some distance (ca 10 mm) between the light box and negative, any small dust spots on the light box surface will be out of focus.

Presented procedure for setting custom white balance removes orange cast automatically (in case of successful empty frame shooting).

Image exposure - dynamic range issues with slide and negative [from Digicaminfo]

Photo film is capable of capturing a wide dynamic range. Black&White print film has the widest exposure latitude, color print film slightly less, and slide film the least of all. Negative film can capture up to 9-10EV stops of dynamic range against 5-6 EV stops for slides, and so there is less loss of shadow and highlight detail. This greater range is compressed to fit into the film emulsion due to the lower contrast of negative film. Slide film has higher contrast, with less shadow or highlight detail as a result, but although the dynamic range captured may well be less the density extremes of slide film can be greater, and thus contain a greater dynamic range. As a consequence negative film images actually exhibit a lower overall dynamic range than slides.

When copying film images this thus translates into a need for the widest possible DR capture range when slides are involved, with careful attention to exposure, with a much lower DR requirement for negatives and more latitude with exposure. The self same scenarios that exist with each film type as when taking shots with them. Copying images taken on negative film is thus much easier than those on slide film.

When using a digital camera to copy an image on film the main concern is to capture the widest range of tones possible, with particular attention being paid to the retention of highlight detail. Loss of shadow detail in high contrast scenes is not usually quite as offensive to the viewer of an image as loss of highlights, although loss of either is a situation that is best avoided wherever possible but which is sometimes inevitable. To this end the use of a source of light illumination that is not excessively high is of benefit, since contrast will be lower and thus the dynamic range less. This is the same basic principle that was used with the copying of film images using film, lowering contrast to capture the widest tonal range, and it's still holds good here with digital capture.

Reducing exposure doesn't have the same effect. It's useful for preserving highlights although this is at the expense of shadow detail, just as increasing exposure reveals shadow detail at the expense of highlights. Neither alters the basic contrast of an image, or the dynamic range that exists, should it be greater than can be coped with.

These are the same situations that are faced when using a digital camera for what could be termed 'normal' shots. In low contrast situations the camera's DR range will be able

to cope with the full tonal range, whilst where high contrast is encountered it probably won't, and either highlight or shadow detail, or perhaps both, will be lost.

It is for this reason that it is recommended to use a daylight balanced light box as source illumination, particularly as it was diffused. It provided more than enough light without being excessive, although we still had to make some exposure adjustments. Using a stronger light source would have produced results that wouldn't have been as good as those we obtained. The ideal solution would be an adjustable light level source, but in the absence of such this was the next best solution.

Image exposure - varying exposure to suit [from Digicaminfo]

When you have a situation where the lighting source for a series of images is at a fixed level then it often follows that the exposure needed should also be found to be at a consistent level.

One of the main principles behind the adjustment of exposure settings when taking a shot is to produce an exposure that is correct for the scene/subject involved. To allow for the wide difference in light levels that can be encountered and produce an image that is neither too light nor too dark and where the greatest tonal range is depicted. As slides are designed to be viewed and projected for large scale viewing using light illumination of a constant brightness level, it follows that those that are under or over exposed will look either too dark or too bright, both instances leading to unsatisfactory viewing pleasure due to a visible loss of image detail.

Negative images that suffer badly due to incorrect exposure can often be rescued at the printing stage by varying the exposure from that used for a normal correctly exposed negative due to the wide exposure latitude they have. These are the principles under which the 'dodging and burning' of prints also occurs, the selective exposure of a print negative to reveal highlight and shadow details that would be lost with a constant exposure across the whole negative.

Using auto-exposure when undertaking film copying thus seems to be okay if you're using a light source of a fixed level because the exposure will automatically adjust to suit those images that are under or over exposed. This assumption is correct to a degree, and works within a certain range, but there are however some images that are deliberately dark or light. Those taken at night will be of predominately darker tonal hues with just small areas of extreme brightness. Those taken in snow will generally be at the opposite extreme.

Whilst in our experience over-bright images tend in the main to be okay with auto-exposure, although they can often benefit from some slight increase in exposure because under-exposure can occur, the same cannot be said about darker and mainly night-time shots. Auto-exposure will end up badly over-exposing them. To prevent this they need on average the same exposure as an ordinary well exposed daytime slide shot. On average it was founded the application of -2 EV exposure compensation to be about right in these circumstances.

Copying slide images [from Digicaminfo]

Because of slide images high contrast/density they pose a challenge to any attempt to copy them due to the wide DR range that is needed. This is generally much greater than most digital cameras can cope with and it's all too easy to lose both highlight and shadow tones. It's particularly easy to over-expose them and gain shadow detail at the expense of highlights. This often occurs with camera auto-exposure readings and application of a minus exposure compensation value, 0.5 to 1 stop, is often needed to prevent this, although shadow detail then suffers. This is of course the self same problem that occurs with digital camera sensor capture

of any ordinary scene where high contrast occurs and is why DR optimization is appearing in the latest DSLR's. Should you use one of these for slide film capture then you might find that using this option could prove to be beneficial.

There is however a method of obtaining the maximum possible detail and tonal range out of a slide image with a digital camera, HDR (high dynamic range) imaging. HDR brings considerable benefit with most slide images although sometimes the effect is subtle and the advantage not as immediately apparent as with others.

DIGITIZING B&W NEGATIVES

Procedure: Invert (eventually using special curve) → Auto-levels → Convert to Greyscale → Gamma, Contrast and brightness semi-automatic or manual correction.

Reversing a b&w image to produce a positive is very easy. In Photoshop or any other similar editor all you do is to 'invert' the image, reversing the tones, using built-in function or specific reverse curve. Usually the result will lack contrast; the image will look 'flat' and "washed". It is easy to correct using the levels tool, than converting to black and white. Sometimes it is enough to use auto-levels only, to get best results gamma, contrast and brightness could be set up manually. Use daylight or a relatively cool light to illuminate the negatives, but there are no any restrictions to use other light sources (except avoiding overheating of negatives).

Reversed logarithmic curve for b&w negatives, prepared by **alcoss**, could be downloaded from: <http://varia.alkos.info/inv.zip>

DIGITIZING COLOR SLIDES

Procedure: Auto-levels → Gamma, Contrast and brightness semi-automatic or manual correction.

Sometimes it is enough to use auto-levels only, to get best results gamma, contrast and brightness could be set up manually.

DIGITIZING COLOR NEGATIVES

Reversing color negative images is not really different. There is an "orange mask syndrome" and the difficulties this creates are easy to manage in the few steps. Use daylight or a relatively cool light to illuminate the negatives, not tungsten, or your blue channel will be dark and noisy. Don't rely on the camera's auto-exposure or auto white balance.

Economic procedure

Procedure: Invert → Auto-levels → Gamma, Contrast and Brightness semi-automatic or manual correction.

Fully manual procedure

Procedure: Invert → Manual level Red → Manual level Green → Manual level Blue → Manual level RGB → Gamma, Contrast and Brightness semi-automatic or manual correction.

Fully manual procedure 2 (in case of error in custom white balance setting)



Procedure. Shoot one frame with clear orange mask → Pick color on an area of pure orange mask (blurred before) → Create a new layer → Select All → Overlay → Fill the selection with the blurred pure orange mask color → Invert the color of new layer → Merge visible layers → Invert merged image → Auto-levels (or Manual level).

Use Auto-Levels with white clip set at .1% and black clip at .01%. For the majority of images, this gives real close to good results.

“Manual level” means that sliders are moved exactly to the start of the graph on each end of histogram.

For first two methods just open the captured image and invert it, just as for a B&W image. This results in an image that is a color positive but with a blue/green cast caused by the orange mask. Strength of this effect depends on the film type. Application of auto-levels usually removes it, but sometimes leaves too high contrast for further adjustments.

The amount to move the slider should be obvious by examining the histogram. Some images look best when the sliders are moved exactly to the start of the graph on each end and some images look best when the sliders are moved close to the start of the histogram graph on each end.

Detailed procedure (more control - in case of error in custom white balance setting)

Procedure:



Procedure Step 1. Shoot one frame with half clear orange mask and half totally black
→ Create a curves layer → Click the white eyedropper on an area of pure orange mask (blurred before) → Click the black eyedropper on a maximum black section of frame (blurred before) → Invert the ends of the RGB curve → Save the curve.



Blurring: Shoot one frame with half clear orange mask and half totally black. Do this by setting the film leader up so that you get a half of black and a half of orange on the same picture or, if necessary, you can shoot two pictures. Create two separate files, one with the orange and one with the black. Using a Gaussian blur, heavily blur each file. This allows getting the required colors.

Procedure Step 2. Invert (using saved curve to invert images to a positive) → Auto-levels → Gamma, Contrast and Brightness semi-automatic or manual correction.

Use Auto-Levels with white clip set at .1% and black clip at .01%. This preset works with the majority of images. For fine tuning, in levels or curves, check each of the color channels individually as presented earlier. Setting the darkest areas of the image to digital 0 (actual black, by moving the left slider all the way to the start of the graph) will cause the darkest shadow areas in your image to lose some detail. The last part of the histogram adjustment is to move the middle slider to adjust the gamma or midtones of the image.

Automated procedure (with specialized software)

For reversing negatives you can use specialized software: VueScan from Hamrick Software or plug-in for Photoshop ColorNeg from C-F Systems.

Once you've shot the JPEG of your negative, you can simply use the software to convert the negative to a positive image. You can even set up a batch of negatives to convert during the night. The correction curves built into the software may not include your particular film, so you might end up having to do some correction work anyway.

RAW or JPG?

RAW conversion options being basically image editor options, tonal input/output and tonal hues etc, re-packaged to seem more like normal photo taking options - under-exposure/over-exposure, white balance, etc. There is no basic image editing options such as 'invert', well not in any of the RAW converters on the market. Inverting has to be done with negative images of TIFF or JPG files. If it is required by used editing method/software, use 16 bit TIFF files and **very precise** conversion for large prints and JPG – for normal prints and computer presentations. There is no simple answer, format results from the actual needs.

Some remarks I received from David Dunthorn,C F Systems, the Author of ColoNeg plug-in:

Hello M. Biliński,

If you intend to use ColorNeg I would recommend not using the procedure that you describe. Take an image of the color negative that looks like the color negative and let ColorNeg deal with the colored negative mask. You are unlikely to get any benefit from what you describe and with the white balance set that far off normal, many cameras will make added adjustments that are particularly disasterous for a negative. Try the straight method for a few negatives first and then try your method for a comparison. There are a few cameras in which it could work better, but usually the results will be inferior.

To work well at all the dslr must be set to produce a 16-bit/channel image. 14-bit per channel or even 12-bit per channel may be satisfactory if that is what your camera produces. Some dslr setups can be set to produce linear images and that is preferred if possible. If the dslr does not produce linear images then use Scantique with a gamma of 2.2 before using ColorNeg. ColorPerfect has a G/L button for gamma/linear and does not require Scantique. Do not at any point "convert" the image to a working profile, but you should "assign" a working profile either before or after ColorNeg/ColorPerfect if you use a working profile.

David Dunthorn

Summary

Presented procedures turning the background to white or close to white, then converting from negative to positive and also boosting contrast could be performed.

Every type of color negative film has a slightly different orange cast, and the orange cast will vary from scan to scan. Therefore, the presented in the “Detailed method” steps need to be taken individually for each film. The decision concerning the method and accuracy is in your hands.

The negative has a gamma of -0.6 with respect to the original scene, so your conversion needs a gamma of about -1.67 to restore the original scene contrast. This is pre-defined curve in Photoshop (as in “Detailed procedure”).

There is an additional complication. The data from the camera is probably gamma-corrected (unless you captured in RAW format and then converted to 16-bit linear). So you need to undo the gamma correction - then - perform the negative-to-positive operation, and then re-do gamma correction. If you want to do this as three separate steps, you really should do everything in 16 bits per channel to avoid losing information, but the three operations can be expressed as a single lookup table with 8-bit input and output. That could be performed by curves.

- Final three main points are:
- Negative should be shooting in the best way as possible for archiving and further detailed processing.
 - Setting proper custom white balance allows easy removal of orange cast from negatives. It could be used ca. 50CC blue and 50CC cyan filters to balance the light box or to minimize negative's orange mask (optional for color negatives only).
 - The best result could be achieved by overexposing a bit with negatives, for example from 2/3 to 1 stop. With overexposure, you will be able to retain as much highlight detail as possible, because dark areas of the negative are highlights on the positive.
 - In the batch mode (night mode ;-)) only the simplest operations are performed: reversing, auto balancing and saving results as copies. This allows preview of the pictures and further modifications.
 - If you have a special picture you can do a special treatment of the original if required, for example repeating shooting in HDR mode or processing RAW format.

In one point JPG has special advantage vs. RAW: for ca 5 kg (!) of negatives from last 40 years, RAW files are too big for rational storage on the Blue Ray/DVD disks.

THE END

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More information and theoretical background you can find, for example, here:

<http://www.digicaminfo.btinternet.co.uk/index.htm>
<http://www.c-f-systems.com/Plug-ins.html>
<http://www.c-f-systems.com/PhotoMathDocs.html>
<http://www.scantips.com/>
<http://www.hamrick.com>

Documents from C F Systems:

1. [CFS-242 Film Gamma Versus Video Gamma](#) PDF (175KB PDF).
2. [CFS-243 Maintaining Color Integrity in Digital Photography](#) (297KB PDF).
3. [CFS-244 Negative to Positive](#) (291KB PDF).
4. [CFS-276 Complete Color Integrity](#) (1.25 MB PDF).

Other methods (using actions and curves for Photoshop) are described by **alcoss**:

for color negatives:

<http://pentax.org.pl/viewtopic.php?t=24464&sid=4942fd426833c691ea17d6f29cc2350c>
<http://pentax.org.pl/viewtopic.php?t=21145&sid=4942fd426833c691ea17d6f29cc2350c>

with curves

<http://varia.alkos.info/Inv.atn>

http://varia.alkos.info/cs2_inv.amp

and for b&w negatives:

<http://pentax.org.pl/viewtopic.php?t=5316>

with curves:

<http://varia.alkos.info/inv.zip>