Photography I

Electronic Flash

Many people think that the electronic flash, or just “flash” as we will call it, must be used “when you are indoors”. As you have progressed through photography, you certainly know by now you do not need a flash indoors. Simply open up the aperture or go to a slower shutter speed and you may not need a flash at all! But what if you are trying to “freeze” the new bride throwing the bridal bouquet in mid-throw and we are in a banquet hall that has low light? We cannot slow down the shutter speed because the bouquet (and the bride for that matter) will come out as a big blur. We can only slow down the shutter speed or open the aperture so far, so therefore, we need extra light. This is where a flash is used, when we need more light and it is unavailable from another source.

We can also fulfill the need for more light by adding extra light fixtures or lights on stands. However if we want to move around at an event and capture it quickly, a light source with its own power supply is a necessity. This is where the flash really shines (what a great pun)!

How An Electronic Flash Works

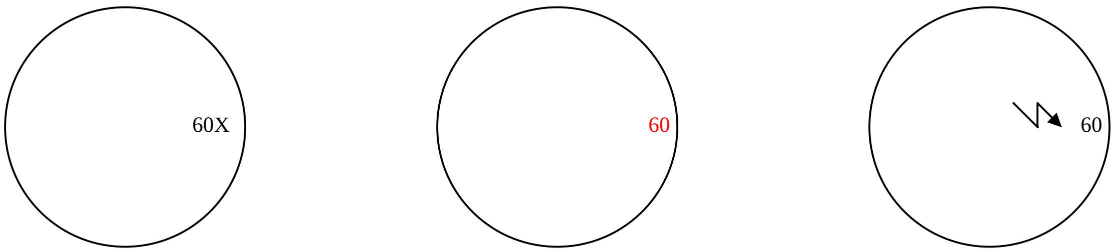
In its simplest sense, an electronic flash is nothing more than a controlled and repeatable spark. OK, it’s more like a lightening bolt but the concept is the same. All the flash unit does is store energy in a set of capacitors and then discharge that energy via the flash tube when the shutter is released or the “Open Flash” button is pushed. The capacitors receive from either batteries or line current. “So if we are getting energy from the batteries, why do we need these capacitors”? you may ask. The capacitor is like a bucket for electricity. It may take a while to fill a bucket, but once the water is in it, we can empty the bucket very quickly. This is just what the capacitor does, it “dumps” electricity very quickly.

Older style flash units (before 1970) have a simple capacitor dump system. Once the flash has been triggered, all of the electricity in the capacitors is dumped. In the 1970’s, new circuits were developed that allow some of the electricity that wasn’t needed for the exposure to be saved in the capacitor for later use. This technology gave longer battery life and allowed recycle time (the time it takes to fill the “bucket” we call a capacitor) to also be shortened.

Physics, Distance and the Speed of Light

TO understand exposures with electronic flash (or any man-made light source), we first need to understand some aspects of light. The first is the speed of light. Light travels at 186,000 miles per second. If we were moving in a car moving this fast, it would be the equivalent of 669,600,000 miles per hour (with head winds or traffic jams). It is also 982,080,000 feet per second! This is dern fast! But it will help us as you will see.

With the speed of light this fast, what does it care about a shutter speed of 1/1000th of a second? Even 1/2000th of a second is extremely slow compared to the speed of light. “Why then,” you may ask. “am I supposed to use a certain shutter speed on my camera when I use flash”? IF you were not aware you had to do this, look on your camera's shutter speed dial. The "sync" speed, or the speed at which you camera and flash will work together, is indicated by a little lightening bolt, a different color to the shutter speed or a small "x" as indicated below:

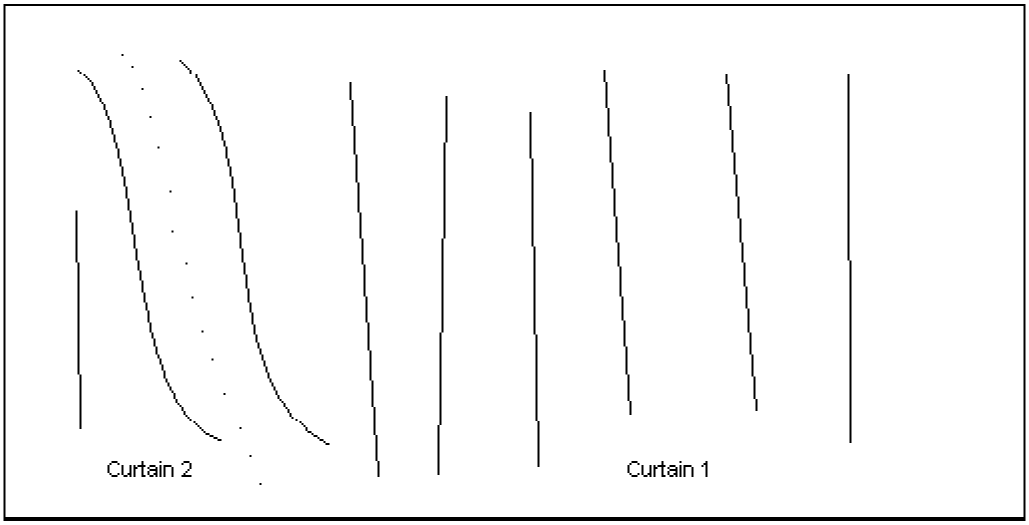


Not all cameras require sync speed, but most 35mm cameras will because of the shutter system used.

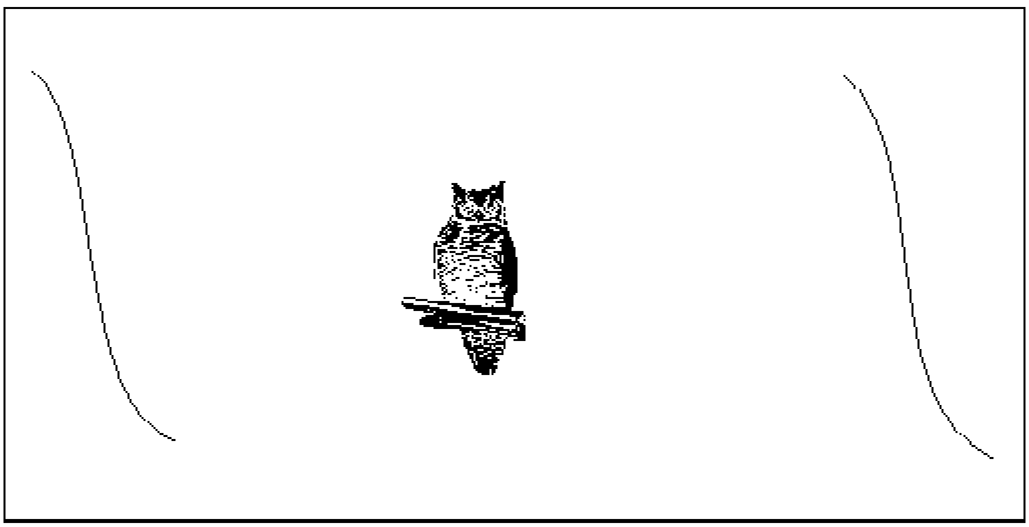
The Focal Plane Shutter

The words "focal plane" simply mean "at the plane of focus". So a focal plane shutter is a device that is placed just in front of the film and allows light to strike the film at the proper time and for a specified amount of time. We are not concerned with the amount of time with the electronic flash (the flash duration will take care of this), but we are concerned with the proper time. But we must also work around the mechanics of a focal plane shutter.

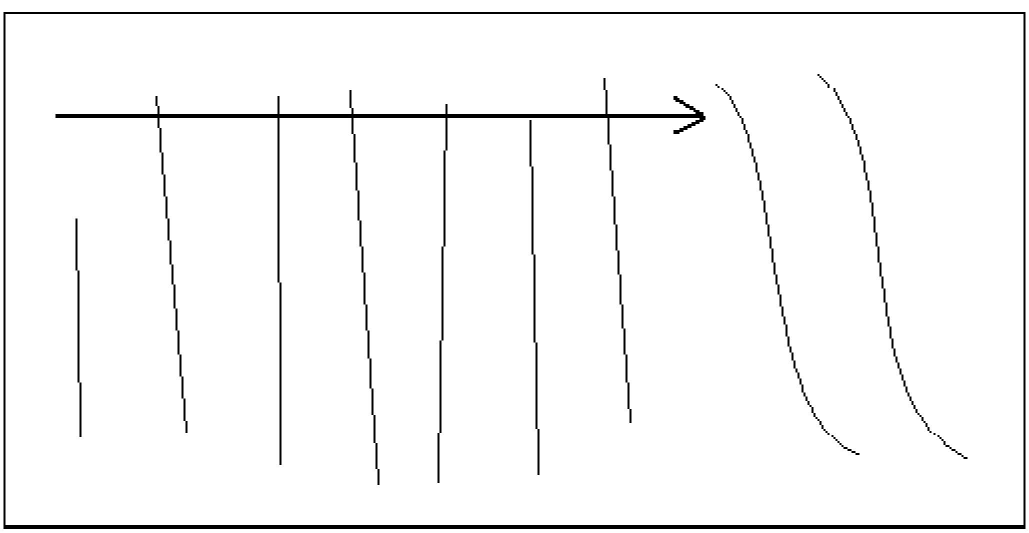
The focal plane shutter works very much like a two-paneled window curtain. Each panel can be opened and closed separately, but always from the same side of the room. One has the curtain material on the left side, the other on the right side. If one were to draw the first panel completely open and then draw the second panel completely closed, one would have the workings of a focal plane shutter. The diagrams on the next page help to illustrate this:



Curtain one closed, curtain 2 open



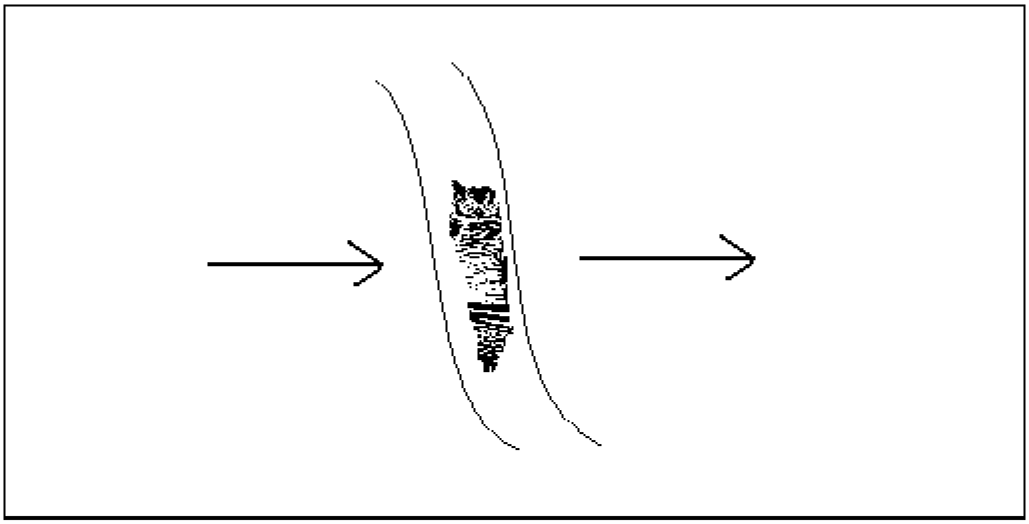
Curtain 1 open, curtain 2 open



Curtain 1 open, curtain 2 closed

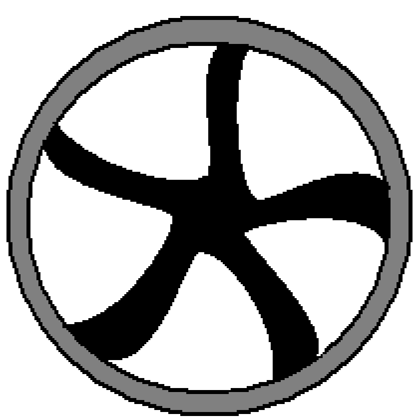
Both curtains are then drawn back together so no light can be seen where the two meet.

As we open and close the curtains faster and faster, there comes a point at which the curtains form a slit that passes in front of the window. The panel below illustrates what the film would see if the curtains were stopped in mid-draw:



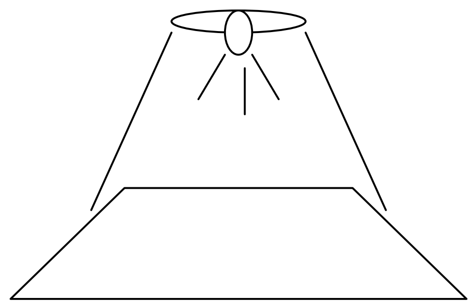
This is precisely how a focal plane shutter works. The curtains are controlled by separate timers that open and close the panels of the curtain to give the chosen shutter speed. With flash pictures, we have to make certain the first curtain is fully open AND the second curtain has not yet started to close. The shutter speed at which this happens is your camera's sync speed". If a shutter speed faster than the appropriate sync speed is used, the image will be underexposed in a portion of the film. This will be evident by and underexposed band on one side, the top or the bottom of the image, depending on how your camera operates.

Some camera systems incorporate a leaf shutter. In this type of shutter a set of overlapping leaves must open and close together. Because the leaves of the shutter can act just like the aperture if they do not open all the way, this type of shutter will be synchronized at all shutter speeds. This will be an advantage in fill flash, discussed later in this section. An example of a leaf shutter part-way open is illustrated here:

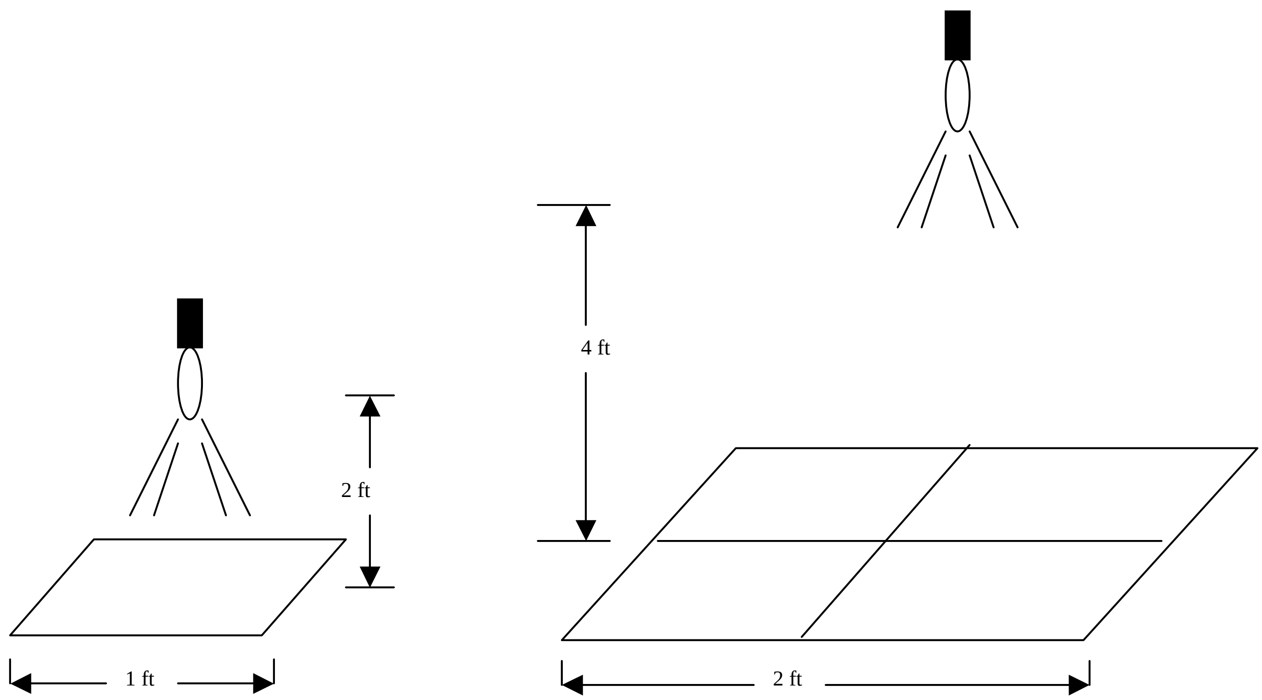


Light and Distance

Another aspect of light we need to understand is how it reacts when it must travel a distance. As light travels, it spreads or radiates. This is why we can see streetlight from many different angles. If there is a reflector on the light source, the light spreads out in a cone. As it spreads, it must cover an ever-enlarging area. Because of this, the amount of light or brightness diminishes with distance. Below is a diagram that illustrates this:



Happily, the light disperses in a very predictable manner. If the light source is two feet away from the surface and we then double the distance to four feet, assuming we started out with 1 unit of light to begin with, we will now have a light intensity of ¼. Why not half? Because the area the light will cover has doubled in *each direction, length and width*. This is a law of physics called the *Inverse Square Law of Light*. In photographic terms, if we started out at f11 at ten feet and then moved our subjects to 20 feet (or kept the subjects where they were but moved the lights so they were 20 feet from the subjects), we would need to open up two stops (f11 > f8 > f5.6) to obtain the same exposure we had at ten feet.



Likewise, if we started out at two feet again and reduced the distance to one foot, the amount of light has quadrupled. We must stop down two stops (f11 > f16 > f22) to achieve the same exposure we had at the two-foot distance.

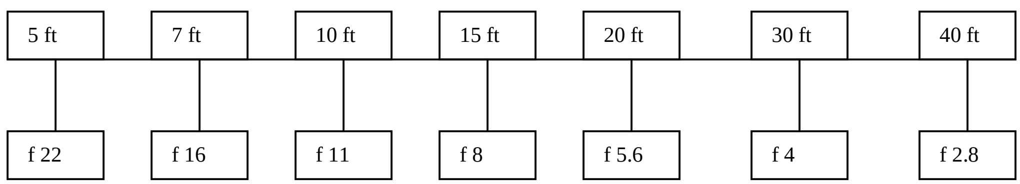
It is very easy to now see that light dissipates very quickly. Most electronic flashes have an effective range of only 10 to 60 feet, depending on the overall power of the unit.

Determining the Proper f-stop To Be Used

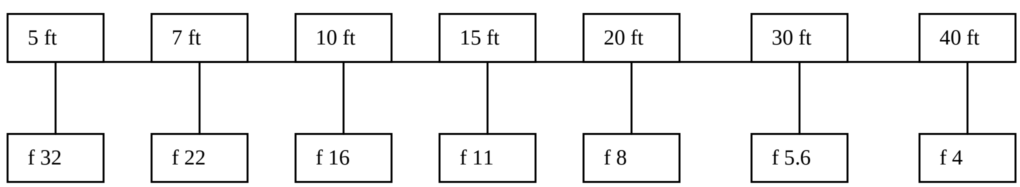
The Manual Method

Because light fall-off characteristics are so predictable, it is very easy to determine how much light there is available at any distance. IN the manual method of choosing the proper f-stop for a particular film, first focus the camera and determine the distance to the subject as indicated on the barrel of the lens. Next apply that distance to the exposure scale on your flash unit. It can be a circular or linear scale. Make certain the proper film speed is set on the scale first. Finally read off the f-stop to be used. An example scale is given below:

ISO 200 film



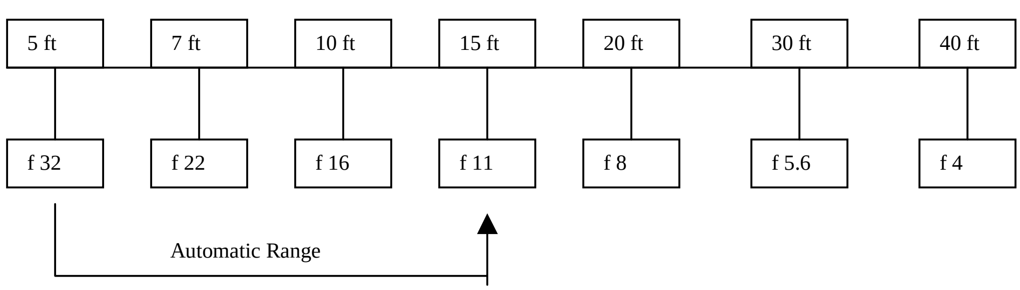
ISO 400 film



The Automatic Method

Since the early 1960's flash units have incorporated light sensing circuits that monitor the amount of light that is reflected off of the subject and then adjusts the flash duration to modify the exposure. How is this done? Since light is traveling so fast (186,000 mps), the light leaves the flash, bounces off the subject, comes back to the flash, the power circuits adjust the flash duration (which can be as short as 1/10,000th of a second but is closer to 1/5000th of a second) all in the amount of time the shutter is fully open (somewhere between 1/40th and 1/250th of a second, depending on the camera). All the user needs to do is pre-determine which f-stop to use with this automatic setting. Usually, the flash has a range of distances with which the automatic feature will work. An example is given below using a modification of the previous diagram:

ISO 400 film



In the example given on the previous page, the automatic setting on the flash can be used from 5 to 15 feet, always leaving the camera set at f 11 (for ISO 400 film).

There is a condition or “catch” when using this feature of the flash. The photographer MUST realize that the system is not smart, it does not know what your the subject is. All it does know is that light has come back to the light sensor. If there is an object (or objects) between the flash and the intended subject, the first object the light from the flash hits will be the object for which the flash will give the correct exposure. Your subject will be underexposed.

The Super Automatic Method

As electronics have become smaller, more and more of it can be placed I devices that previously did not have the room to fit them, while still remaining portable. Such is the case with in-camera sensors and flash controls. The first possibility would be for the camera having the ability to “talk” with the flash unit such that the camera “knows” when a flash unit is attached or is being used. In this case, there are extra contacts on both the flash unit and camera that link these electronic systems. Since no two camera manufacturers want to operate their equipment the same for market and technical reasons, such camera/flash combinations require “dedicated” flash units. This simply means that the flash MUST be designed to work with the particular camera if we expect or want the electronic link to be available. To make choosing the flash system easier, the flash manufacturers have developed dedicated “modules” that attach to the flash, and each of these different modules are designed for a particular camera model or manufacturer.

The advantages of the dedicated flash are a mixed blessing. On the positive side, as soon as the flash is attached to the camera, the proper shutter speed (sync speed) is also set. This is possible with cameras that employ an electronic rather than a mechanical shutter system. This will avoid the accidental “banding” effect caused by a shutter speed that is too fast. The negative draw back of this system is the possible inability to use shutter speeds *slower* than the proper sync speed. There are situations where this is desirable, which will be explained in the “Lighting Options” section. An additional drawback can be the flash unit s inability to work with other camera systems. If someone owns more than one type of camera, they would wither need special modules for each system or use a non-dedicated flash.

The second option of the “Super automatic” method is possible if the camera has a light sensor that can sense a short duration of light and meters the light at or near the film plane. Now, instead of relying on the light sensor in the flash itself, which can cause some exposure problems in particular situations, the light is controlled by the camera itself. The dedicated flash system is still necessary. Certainly, this type of camera employs the most expensive option.

Flash Accessories

When More Light Is Needed

There are times, for creative or technical reasons, in which more than one light source is needed. We may want a main light with a lower power auxiliary light to reduce the harsh shadows, commonly called a fill light. We could use wires to connect the various flash units, but given the circumstance of the wedding assignment and the need to move around easily, this solution would be impractical. There are two options that are much easier to work with and they have varied costs.

The first option is to use a light trigger or "slave". This system senses the light from the flash as it is triggered and then triggers the flash to which it is connected. Again, since light travels so fast, both flash units are triggered virtually simultaneously. With this device, we can have as many flash units as we wish, but each must be connected to a slave unit. Slave units are fairly inexpensive, costing between $10 and $30 each.

For shooting events, the light slave has a major and minor drawback. The minor drawback is simple, ambient light will influence its effectiveness. In high-light situations (using a slaved flash as a fill flash for instance) the light slave may not be useful. The slave unit can loose its sensitivity to the flash in higher light environments. The second drawback is more annoying. Just like the light sensor in the flash used in the automatic mode, the slave is dumb. All it knows is that a flash went off and it triggered the flash. This means that if Aunt Martha is at the event and shoots her 110 instamatic camera with a flash cube, our slave unit will also be triggered. Invariably, just as we get a shot set-up, someone beats us to the shot and "pops" one off for their own photo archive, making you wait for the flashes to recycle to full power.

A more expensive option is the use of a "radio" slave. With this option, a small, cigarette-pack-sized radio transmitter is connected to the camera. When the shutter is released, the radio transmitter sends out a signal in every direction. On each flash unit a radio slave receiver is attached. The receiver picks up the signal from the transmitter and trips the flash. Thankfully, radio signals are actually light from a different portion of the electromagnetic spectrum and therefore, also travel at the speed of light. Just as with the conventional slave unit, each flash would need to have its own receiver. Unlike the conventional light activated slave, the radio slave also has the advantage of not being effected by ambient light. Another very nice feature of the radio slave is, just as with conventional radio, we can have different channels. Now we can actually have a number of photographers shooting in the same room, each with their own fill light or lights, and no one is bothering the other's lights.

The radio slave is expensive with a transmitter costing about $200 and each receiver costing about $100. However, if your livelihood is based on photographing events, the expense is well worth the convenience, and besides, if its your business, the expense is tax deductible!

Softening the Shadows

When we shoot with flash, the source is generally very bright when compared to the ambient light. Add to this the characteristic of the short flash duration giving harsh shadows and we wind up with an image having a great deal of contrast, which is usually not appealing. We receive most of our visual impression of a subject from the shadows it causes. Its general shape, how round or textured it is we determine visually from its shadows. It would be nice if these shadows could be lightened, but would still be present to accentuate the subject.

One option is the use of the fill flash. Here, a second flash is used, coming in at an angle to the subject, to give light to shadows. SO as not to give an artificial look to the image, the fill light should have an exposure that is 1 ½ to 2 stops lower than the main or key light. As an example, if the camera flash needs to use f 11, the fill flash would be set at a distance or power setting showing we should use f 5.6, though we still set the camera to f 11. We effectively "underexpose" the shadows by 2 stops, but this is done intentionally, because we want them to appear as shadows!

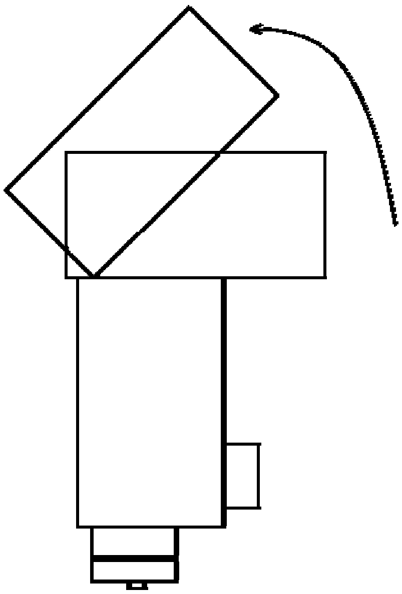
Another option is to take advantage of ambient light. Here we will have two options, use the flash as the main light source and allow the ambient light to soften the shadows, or use the ambient light as the main light and then use the flash to soften the shadows. In the first option, we would first determine the exposure for the ambient light. Next the f-stop needed for the subject when using the flash is determined. We would set the camera aperture to this f-stop. Finally we would set the camera's shutter speed so that the ambient light exposure indicates we need to use an f-stop that is two stops *wider* (an f-number two stops lower)than what the aperture is set. We are not concerned about the shutter speed as long as it is not faster than the sync speed nor so slow as to increase motion blur effects (less than 1/30th or 1/15th of a second). As an example, the camera tells us the ambient light exposure is 1/60th at f-2.8. The flash indicates we need to use an f-stop of f-11 for the subject distance (let's say 10 feet). With a maximum sync speed of 1/60th, we change the shutter speed so the ambient light exposure is f-5.6 (the shutter speed would have to be 1/30th). We then shoot the image at 1/30th of a second at f-11.

Why does this work? Remember, the duration of the light burst from the flash is less than 1/5000th of a second. The only reason we need to use a sync speed is to make certain the focal plane shutter is completely open so we do not experience exposure banding. We cannot use a shutter speed *faster* than the sync speed but we *can* use a shutter speed *slower* than the sync speed. A good way of thinking of the sync speed is it is the *fastest* shutter speed that we can use with the flash. In the example above, we are again underexposing the shadows by two f-stops, intentionally. In this way the shadows will appear to be shadows and the main subject will be properly exposed.

The second option would be to use the ambient light as the main light and use the flash as the fill light. In this situation, we would determine the exposure for our subject and choose an f-stop/shutter speed combination where the shutter speed is not faster than the flash sync speed. Now we set the flash so that it will give a proper exposure with the f-stop setting two stops wider than the f-stop chosen for the ambient exposure, though we leave the camera set at the f-stop for the ambient exposure. Again, the shadows are two stops underexposed and the main subject is exposed properly.

To give an example and help make this clearer, and using a similar example as we used before, the camera tells us the ambient light exposure is 1/60th at f-11. The flash indicates for the subject distance (we will say 10 feet) we need to use an f-stop of f-8. With a sync speed of 1/60th on the camera, we change the flash-to-subject distance or change the power setting on the flash (possible with some models of flash) so the flash exposure indicates we use f-5.6 (the distance from the flash to the subject would need to be 15 feet, or we would set the power setting to ½). We shoot the image at 1/60th of a second at f-11.

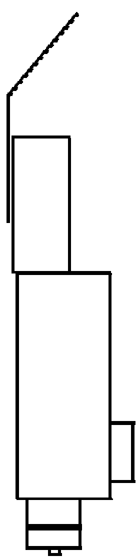
There is a third option we can use to soften the harsh shadows, and again it is made possible by the speed of light. If we are shooting indoors, we can take advantage of the ceilings and walls to soften the light. To do this, we need to hold the flash off the camera or have a flash with an articulated head (it can be adjusted up and down or side to side). The diagram on the next page illustrates this concept.



To take the shot, stand within 5 feet of a wall or ceiling and point the flash at the wall or ceiling. The camera will still be pointed toward the subject. Take the shot. The light reflecting from the wall will be softened and therefore the shadows will be much less harsh. Certainly this will not work on a wall or ceiling that has a color other than white, however luckily, especially for ceilings, most of them are white.

One point to be aware of, depending on the distance to the wall or ceiling, as much as four stops of light will be lost. It is best to use the automatic mode when working with bounce flash and if the flash has a safe exposure indicator (an "I have enough light to create a good exposure" type of monitor), test the set-up before taking the shot.

One way to avoid the variability of bouncing off walls or ceilings is to use a bounce attachment with the flash. These are inexpensive vinyl attachments that are adhered to the flash using hook/loop fasteners or double-stick tape. The hook and loop fasteners are the best option. With a little creativity, one can be made quite easily. To use this attachment, point the flash up and attach the bounce attachment to the flash. Using this attachment the harsh shadows can be remove and have very consistent exposures will be realized. It must be understood that light will be lost, as much as two stops.

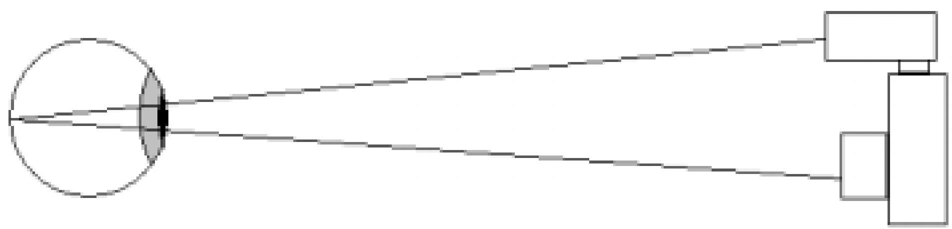


One more option to soften the shadows will also give a professional look to the image, the use of photographic umbrellas. These umbrellas have special material that is either reflective or translucent. The flash is always faced *into* the umbrella. With the reflective umbrellas, the flash is pointed into the umbrella and the open end is pointed toward the subject. When the flash is triggered, the light hits the reflective surface and bounces back out to the subject. The translucent umbrellas can be used in this way or can also be used as a sheer curtain diffuser. The flash is still used pointing into the umbrella but the top of the umbrella is pointed toward the subject (the open end is pointed away from the subject). This will give a higher level of light diffusion. In all cases umbrellas must be used with light stands and generally indoors, as wind will make them, and the flash attached to them, fly as easily as Mary Poppins! To determine exposures, the use of a flash meter is necessary, discussed later in this text

Flash Problems

The typical problem of using the wrong shutter speed with a flash unit has already been discussed. However, there are two common problems that need to be addressed so one can achieve better flash photography. One is easy to understand and the other can be avoided, if we know how.

The first problem is the dreaded "Red Eye." Although an interesting effect if we are trying to make people look "demonic", if we want people to appear more natural, this effect is very unappealing. Most people who have taken flash pictures have seen the effects of “red eye”. It is so named because the subject literally appears to have red eyes. The cause is very simple. Remember the speed of light? Here is an instance where it works against us. We usually use flash in low-light situations. Because of this, the iris in the subject’s eye is dilated open. As the light leaves the flash, it strikes the subject, travels to the back of the subject’s eye, reflects off of the back of the eye (the retina) and bounces back to the camera, where the image is captured. The eye is red because the back of the eye is covered with tiny blood vessels. The light picks up the color of the blood, hence “red eye”.

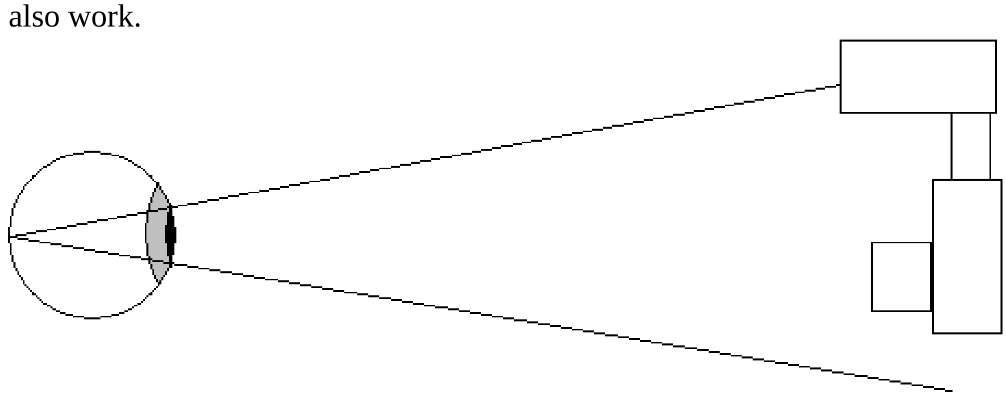


At first consideration, it may be concluded that the eye, being dilated open, causes the red eye. Actually, this only allows it to occur. It actually happens all the time, we just don’t see it. What actually causes it is the flash being too close to the axis of the lens. This is a very predictable characteristic of light, the angle of incidence equals the angle of reflectance. In other words, if a light strikes a reflective surface at a 45° angle, it will leave the subject at a 45° angle. But if the angle the light strikes the object (in this case the back of the eye) is only 2°, then it is reflected back at 2°. The diagram above illustrates this effect.

There are two ways to avoid red-eye. The first method, and it is the method professionals use in the studio, is to increase the light level in the area of the subject. This will cause the iris of the eye to close down. Studio flash units used by professionals include “modeling lights” or auxiliary tungsten lights to accomplish this. The lights are bright enough to close the iris, but the flash is much brighter so the modeling lights do not effect the exposure.

The second option, and the option that would be used in the field, is to move the flash away from the camera so the light from the eye, bouncing back toward the camera, is not seen by the lens. This is not hard as hard as it might seem and some flash units are already designed to accommodate this need. The diagram below illustrates the solution.

If your flash is not already designed to do this, there are brackets available to which the flash can be attached and the bracket in turn is attached to the camera via the tripod socket. Using bounce flash will also work.



On some flash units, there is a “red-eye control” system. This is usually found on the smaller “point-and-shoot” cameras that have integrated flash on the camera itself. Since the flash cannot be moved, they employ a different solution to the problem, they get the iris of the eye to close down. This is done with a series of short flash bursts, emitted by the flash before the shutter is released and before the main flash exposure is given. These short bursts are seen as bright light to the eye (which it is) and the iris closes down. This only takes about a second, but the iris reacts very quickly. The only problem with this system is that it can drain battery life. The short bursts will use some of the energy in the battery. Keep an extra set on hand when shooting.

The second flash problem is the case of “the perfectly exposed heads and stage”. As you watch sporting events or concerts, in person or on TV, you will invariably all of these flashes going off in the audience. People are trying to catch the moment, and because it is dark or they are indoors, they think they need to use the flash. As has been discussed earlier, light dissipates fairly quickly. It’s intensity drops considerably as the distance increases. The people are not aware of how *useless* the flash is in this situation. Most people have seen images taken at the circus, a concert or a sporting event, in a dark auditorium or outside at night. The stage is nicely lit so the conclusion is, the flash did its job. But look again at these images and you will see a series of rows where the back of the heads of the people are nicely exposed, and then blackness until you come to the stage. The flash did nothing for the events on the stage, it just exposed the backs of the heads! If the flash were actually helping expose the performers on stage, the entire auditorium would be lit up!

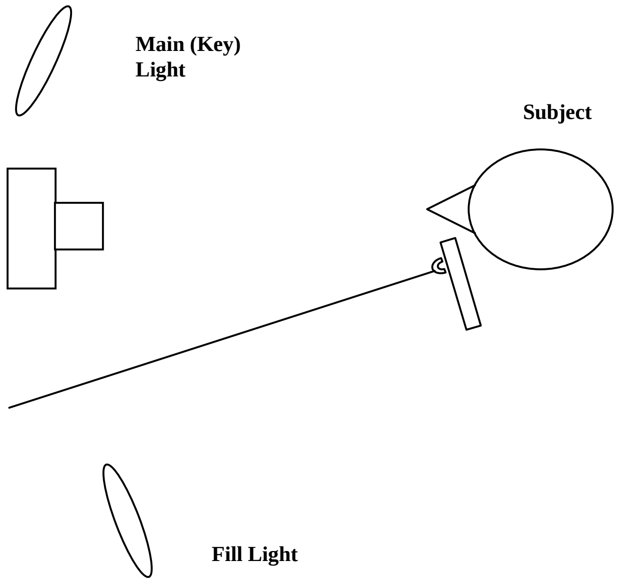
So why is the stage so nicely lit? If you have ever been on a stage with the lights on you know the answer. There are literally thousands of watts of light being poured onto the stage, more than enough light to give a good exposure with films of even moderate speed (ISO 200 to 400). Next time you are such an event, take your camera and leave your flash at home. It will be less annoying to the performers and you can laugh at all the other people photographing the heads of the people.

Determining Exposures With Electronic Flash

If we are using only one flash, we can determine exposures well enough. However, if we are using more than one flash, another method is needed to determine the proper exposure. For best results, a flash meter must be used.

A flash meter is not unlike the meter we find in most cameras, however it has been specifically designed to measure very short bursts of light. They come in varying prices, from about $100 to $600, but they all do the same thing, measure flash exposures. Some units, the more expensive ones, can also measure continuous light so are doubly useful. Most of them are hand-held meters, the most expensive ones are spot flash meters, capable of measuring very small areas within a scene.

A flash meter is used just like a conventional hand-held meter. If you are using a reflection meter (a small home in front of the detector), point the meter at the subject, preferably on a mid-tone (a gray tone or Caucasian skin are good examples). Perform the light measurement as described by the manufacturer of the meter. The measurement should be made close to the subject, such that, the light bouncing off the subject is coming from the main light. Try to make certain you are not creating a shadow on the subject that will block light to the meter. If the meter is an incident type (it has a small white globe over the sensor), while at the subject, point the white globe halfway between the main light and the fill light and take the measurement (see the illustration below). Set your camera's f-stop as indicated by the meter. The spot meters are all reflective type and allow measurements to be made at the camera position. Unfortunately, they are also expensive!



Understanding and using flash in photography is one of the most important aspects of the art form to understand. It provides the photographer with the ability to photograph their subjects in low-light situations that could not otherwise be captured. With the basic understanding here, one can go further and calculate exposures using flash guide numbers (the standardized method of rating the power of a portable flash unit), study lighting set-ups and so on. The information given here should provide more than enough to start and give a foundation for further study and discovery.