



VISATEC®
by bron

Electronic Flash Basics

1. What you should know

Flash has been used in photography since the middle of the nineteenth century. Then, magnesium powder was burned to produce the intense light necessary for photography, and it could be a dangerous process. Later, the magnesium was contained within a capsule or bulb, to be eventually replaced by aluminium and zirconium wire as the modern flash bulb evolved. Fox Talbot was the first to take a photograph using purely electrical means as early as 1851, using the light from an electrical spark. Even then he understood the potential of electronic flash for portraiture and action photography. It took the best part of a hundred years, however, before electronic flash equipment had developed into a practical photographic tool. Today, Fox Talbot's simple spark has been replaced by an electrical discharge within a tube containing xenon gas. It is fast, reliable, powerful and safe.

A modern electronic flash unit consists of two parts, a flash tube and reflector assembly, and a power supply to provide the electrical energy necessary. In monolights and portable units these two parts are combined in a single housing for portability and ease of use. The xenon filled flash tube itself is made of quartz or Pyrex glass, and is fitted with sealed electrodes at both ends. Power to fire the flash is taken from the mains (AC-line) supply, converted to direct current and stored in an electrical component called a capacitor. The size of capacitor determines how much power can be stored, and, ultimately, the final maximum

power of the flash unit. When the flash unit is switched on and the capacitor connected to the flash tube, it will not discharge immediately because the tube itself does not conduct electricity. Instead, a short high voltage "triggering" pulse is fed to a wire wound around the exterior of the tube. The gas inside the tube then "ionizes" and is able to conduct electricity. The capacitor then discharges its electric charge through the tube, producing a brief, but intense flash of light. The triggering pulse is commanded by a signal from the camera shutter, ensuring that the flash fires the instant the shutter is open, or is "synchronized" with it. The capacitor is then immediately recharged, ready for the next flash.

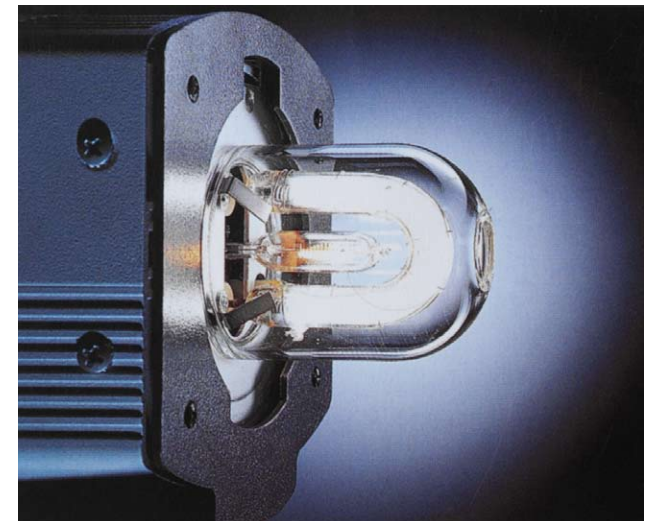
Flash Power

Originally, the power output of an electronic flash unit was measured in Watt seconds (Ws) or joules (J). This measurement indicates the ability of a flash power unit to supply a certain amount of power to the flash tube. It doesn't take into account, however, the efficiency of the flash tube and reflector unit to convert this power into light. For this reason, fewer and fewer flash manufacturers use this system, and prefer instead a measurement which indicates the amount of light the flash system produces.

Guide Numbers

One system used by manufacturers of small battery-operated flash units is the "guide number" of a flash unit. This is calculated by multiplying the f: number by the distance from the flash to the subject to obtain correct exposure for a particular

film speed. Thus a flash unit with a guide number of 44 metres (or 132 ft), for ISO 100 film means that it will expose film correctly at an aperture of f:11 at 4 metres or 12 feet distance. If the dimension of the light source is small compared to the distance the system gives a good guide for small amateur fixed reflector flash units, but the figures will vary when the beam angle is altered by changing the reflector. It is therefore less suitable for use with professional flash equipment with a large range of reflectors and lighting accessories.



Flash tube/modelling lamp/protecting glass

For this reason, most manufacturers use a system which defines the flash unit power simply as the aperture required to correctly expose film at a distance of 2 metres (or 6 ft) using a particular

general purpose reflector. This gives both a comparative measure to use from system to system, and also gives an idea of reflector efficiency, both of interest to the serious photographer. As an idea, a small to medium power monolight like the VISATEC SOLO 800 B will correctly expose ISO 100 film at a distance of two metres (or 6 ft) using a lens aperture of between f:32 and f:22, using a universal reflector. The Guide Number of this particular combination is about 55 metres resp. 154 ft.

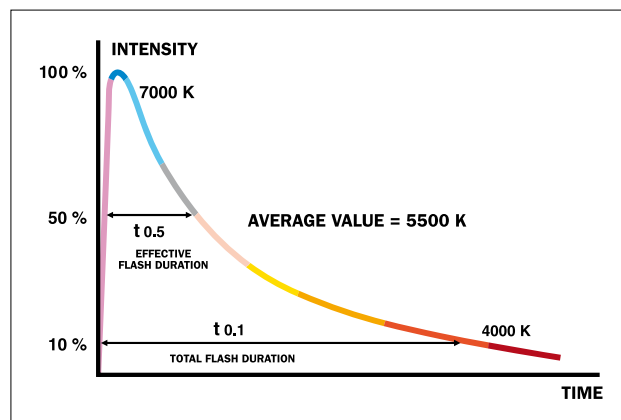
Colour Temperature

One of the advantages of using electronic flash is that the average colour temperature of the light produced closely resembles that of daylight. The colour temperature of the flash changes during the flash output. Initially, the colour temperature rises sharply to a peak of around 7,000 degrees Kelvin. It then decays slowly as the capacitor discharges and the colour temperature drops. The colour temperature averaged over the duration of the flash is about 6,000 degrees, and a coating on the tube brings this to the standard daylight value of about 5,500 degrees. This is generally a constant value, and doesn't tend to change as flash power is varied providing switched power output is used on the electronic flash unit. If continuously variable power controls are used, however, the colour temperature will drop as the power is reduced. This works out at a drop of approximately 120 degrees Kelvin per f-stop of power reduction. The photographer can normally ignore this for general work, but it can be a problem for still-life studio photography if the power settings of several identical flash

units vary widely and colour accuracy is important. Colour-stabilized flash units are available for these applications. With these, colour temperature is constant over a wide power variation.

Flash Duration

When the capacitors in an electronic flash unit discharge through the tube, the light output varies with time. At the beginning, the capacitors are fully charged, and the flash quickly reaches its peak. After this, the power decreases gradually as the capacitors are emptied, and the flash power dies away slowly, so much so that it is difficult to say exactly when the flash output stops completely. For this reason, manufacturers have decided to



Definition of flash duration

define the flash duration as the time during which the flash intensity exceeds 50% of the peak value. This is known as the t 0.5 value also called “effective flash duration”, and most flash units have

an effective flash duration of between 1/250 and 1/2000 second on this basis. This is a good way of comparing flash duration times of one unit against another.

Flash Duration t 0.1 versus t 0.5

When you want to freeze motion with a particular flash unit t 0.5 shouldn't be taken as a guide to do so. Even after the flash intensity has dropped to half the peak value, it is still producing light that can expose film, and blur rapid motion. For this reason the standards offer a second definition “total flash duration” as the time the flash output exceeds 10% of the peak value also known as t 0.1. This time tends to be about three times as long as the t 0.5 figure, and is a much more meaningful measure of a flash unit's ability to freeze motion. Thus, whilst a manufacturer quotes a t 0.5 flash duration of 1/1,500 second, the total flash duration is more like 1/500 second.

Modelling Lamps

Modelling lamps are tungsten lights used to preview the effect of the flash. Usually they are small halogen lamps fitted in the centre of the flash tube itself so they produce a lighting pattern that closely matches that of the flash. In most cases, the power of the modelling light can be made proportional to the power of the flash head. With most manufacturer's flash units, modelling light proportionality can be maintained not only for power changes on a particular head, but also where different lamps are used for multi-lamp sets. Generally, the intensity of the modelling light is low compared to the flash itself, and has little influence on the subject

exposure. Some cameras, however, with a slow synchronization speed, and a powerful modelling light can have a significant influence on the overall exposure. As the modelling light has a warmer colour temperature than the flash, it can affect the colour balance of the shot. If this happens, it is sometimes better to turn the modelling lamp power down, or even switch it off just before the flash exposure.

Lighting Accessories, Light Shapers

One of the major advantages of electronic flash over other forms of light is the great variety of lighting effects possible by the use of accessories. They can soften or harden the light, produce lighter or denser shadows, accentuate subject texture and increase or decrease colour saturation. Every photographer should have a good selection.

Reflectors

A general purpose “universal” reflector is usually shipped as standard equipment with a monolight. Reflectors are used for direct illumination, and the various sizes control the beam angle possible. The area illuminated depends on the beam angle and the distance from the flash to the subject. Generally, a wide angle reflector used at a short distance will give a similar lighting quality as a narrow angle reflector used farther away, although the light fall off with distance will be greater. Reflectors are useful when you need high colour saturation and you want to record surface textures and fine detail. Many reflector designs allow barn doors to be fitted to shape the light beam and control unwanted light “spill”.



VISATEC LOGOS 1600

Honeycomb Grids

Honeycomb grids can be used with reflectors or soft boxes. Honeycomb grids have little effect on the quality of light from the original source, but restrict the lateral light scatter. In this way they suggest spotlight illumination without producing the typical harshness.

Snoots

Snoots are cone-shaped accessories which narrow the beam angle down to a small diameter circle, but without sharply defined edges or shadows. They are useful for producing background patterns, and in adding small areas of light, hair lights for portraiture, for example.

Umbrellas

Generally, umbrellas are used for indirect illumination, where light is bounced off a white, silvered or golden interior. Transparent umbrellas can also be fitted with a diffusing material for use for direct diffused light. Umbrellas are most useful and flexible accessories, giving a wide variety of lighting qualities. Used at short distances they give soft shadows and medium colour saturation. Used further away, the light becomes harder and colours more saturated. Several umbrellas used at close distances can give a superb soft light for figure and fashion work difficult to obtain in any other way. A dedicated reflector is normally used with umbrellas.

Soft boxes

Soft boxes, or large area lights, are used mainly for still-life and table-top as well as increasingly in social photography. They consist of a directly lit diffusing panel housed within a rectangular silvered reflector. They are available in a wide variety of sizes, an useful size being 1 metre resp. 10 ft square. If the soft box diffuser area is larger than the area being photographed, the result will be almost shadow free illumination with good reproduction of detail and colour saturation. Soft boxes produce a smaller amount of uncontrolled stray light and

yield better saturated colours than umbrellas. Soft boxes can need a lot of power to drive them, so if much still-life photography is planned, make sure you have plenty of power.



Soloflex 60x90

Diffusers

The light pattern from a reflector can be substantially changed by the use of a diffuser, and most manufacturers supply a selection of them. They can dramatically soften shadows, and whilst a diffused reflector is not a substitute for a small soft box, it can give similar results. There are also many DIY (do-it-yourself) options using a variety of materials, from rigid sheets of matt Plexiglas held in front of a reflector, to rolls of tracing paper draped over a silver lined umbrella. The only caution is to make sure diffusing material is kept well away from hot modelling lamps to minimize the risk of fire.

2. A Matter of Exposure

There are many things which contribute to the technical success of a photograph, and surely the correct exposure is one of the most important. With modern 35 mm and some roll film cameras, the photographer has the advantage of quite sophisticated TTL metering systems. With these, most exposure decisions are handled automatically, even when small on camera flash units are used. With studio flash, however, the situation is not quite so simple. Not only is there the question of correct overall exposure, but the photographer also has to balance one flash head against another, and, on occasions, with ambient daylight or tungsten light.

The Flash Exposure Meter

Because of the nature of electronic flash, a dedicated flash exposure meter is an essential tool for even the simplest flash set-up. There have



VISATEC FM 2000 flashmeter

been other methods used, however. One works on a relationship between the modelling light intensity and the flash output, enabling standard ambient light exposure meters to be used. As a technique it isn't a great success, and requires a series of bracketed exposures to be sure of a correctly exposed photograph.

Another is the "guide number" concept where guide numbers are established for each flash head/reflector combination. The mathematics required with multiple flash arrangements are complicated, and the method doesn't work well at short distances or allow for different sized studios or wall colour. The guide number technique can work well with small battery-operated flash units, but has no place with studio electronic flash lighting.

Flash meters are not expensive today, and they basically consist of a sensitive photo transistor measuring circuit which will measure both the short burst of flash together with any ambient light over a pre-set time, known as the “gate” time. Depending on the meter, this can vary between 1/8 second and 1/500 second. On the cheaper meters this gate time is fixed, normally at around 1/60 second, on others it can be varied to suit the shutter speed used on the camera. This can be important when photographing moving subjects in bright ambient conditions. A camera shutter speed of 1/250 second will help to minimize subject movement by keeping the effect of ambient light down to a minimum. If the flash meter gate time is set to the same speed, then an accurate exposure reading will result. A simple flashmeter e.g. the VISATEC FM 1000 can be set for gate times from 1/60 second to 1/500 second, and will give the exposure needed for the combined flash + ambient light at these times. More efficient flashmeters, e.g. the broncolor FCM 2, might have an increased gate time range from 1/8 second to 1/500 second, and will not only indicate the combined flash + ambient exposure at these times, but can also give separate readings for each.

Incident Light Measurement

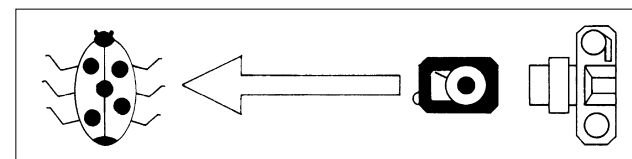
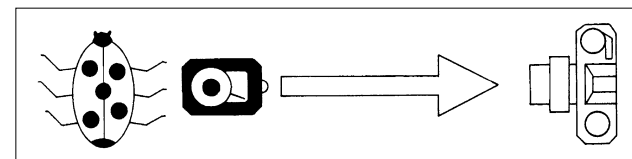
Hand-held flash exposure meters offer two ways of exposure measurement using either incident or reflected light readings. The incident light technique is the most popular for general photography, and depends on the theory that the majority of subjects contain even amounts of

light, medium and dark tones. These average to a mid-grey tone, and if the exposure is based on this, all lighter and darker tones will be exposed correctly. An incident light exposure meter therefore needs to measure the intensity of the light falling on the subject and give the exposure necessary to reproduce a mid-tone or 18% grey tone. It does this by measuring the light falling on the subject with the aid of a hemispherical translucent plastic diffuser which is placed over the meter’s measuring cell.

Reflected Light Measurement

Whilst incident light readings will satisfy the majority of picture taking situations, there are some subjects, particularly studio still-life sets, where reflected light measurements are more appropriate. Here, the flash meter reads the intensity of light reflected directly from the subject, and for this, the incident light diffuser is moved to one side revealing the meter’s measuring cell. A reflected light reading is an average or integrated reading of the full area of the subject captured by the measuring cell. Applying this method requires, however, some skill and experience. Firstly the photographer has to estimate the degree of reflectivity of the area measured: dark velvet will obviously give a lower reading than white foam (see next paragraph). Secondly the area measured must not include any specular highlights since these would blind the cell thus falsifying the result. To avoid these problems some flash meters do not offer reflected light measurement. Most meters have a field of view equal to that of a standard focal length camera

lens, so the field measured from the camera position is broadly the same as that seen in the viewfinder of the camera. If the meter is brought closer to the subject, there are some interesting alternatives. The first is to position a standard grey card, like the Kodak Neutral Test Card, in an area of the set that is receiving the full intensity of the flash source. If the exposure meter is brought close to this so that the measuring cell is only seeing the grey card, the result will be an average grey reading. This will be very similar to an incident light reading using a hemispherical diffuser, and the two techniques are, in fact, interchangeable.



Incident and reflected light

Spot Tone Techniques

The ability of a flash meter to read a single tone like this can be very important in still-life work. In many cases an average mid-tone reading will not give the correct exposure if the subject is predominantly light or dark, and in these cases the indicated exposure needs to be decreased or

increased by around one f-stop or EV (exposure value) to take account of the subject brightness. One way of dealing directly with this problem is to take an exposure reading from a highlight area (not specular highlights!) in the scene and use this to compute the actual exposure.

This is also a good technique to use when there is no natural mid-tone in the scene, and it isn't possible to introduce a grey card into the set. If a reading is taken from a highlight area, adding two and one third f-stops to the measured exposure will retain detail in the photograph from the highlights down to the shadows within the contrast range of the film used. This is an exposure technique favoured by professional photographers working with colour transparency materials. It is also possible to do the same thing taking a shadow area as the measurement point and reducing the measured exposure by two and two thirds of an f-stop. This is a less popular technique as it can result in burned-out highlights in the finished photograph if the subject brightness range is wide. Yet another way is to take both a highlight and shadow reading from the set and take the mean by averaging both readings. Some meters, the broncolor FCM 2 for example, will do this automatically if required.

Some meters allow the use of accessories to reduce the angle of acceptance of the measuring cell, making spot tone readings like this easier to make. The ultimate in this area is the 1 degree spot flashmeter, a specialized but expensive professional tool.

Shutter Speeds and Flash Duration

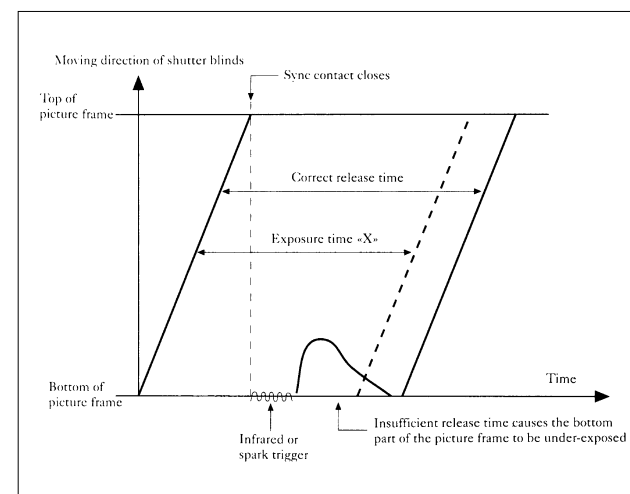
It is a common belief that because flash duration times are generally short, one can use the fastest shutter speed with electronic flash providing it is within the synchronization range of the camera shutter. Depending on the method the flash manufacturer uses to measure the flash duration of his units, the flash is emitting some light during a much longer period. If the camera shutter isn't open for the whole of this time, then the total output of the flash unit won't be available to expose film. Ideally, the camera shutter shouldn't close fully until the output of the flash has died down completely (for focal plane shutter this condition is a must to avoid uneven exposure over the film format), and this can mean a speed three times as long as the quoted effective flash duration. Happily, there are some guidelines. In the studio, the shutter speed should be no shorter than 1/60 second, with 1/125 second for shots taken on location if the full output of the flash unit is to be used.

Using between the lens shutters shorter shutter times may be selected, with a model, for example. All that happens is that a certain amount of the flash light will be wasted, but providing the flashmeter is set to the actual shutter speed used, it will still give the correct exposure for the photograph.

Fill-in Flash and Synchro-Sunlight

One of the more creative ways of using electronic flash is to mix it with ambient light, usually sunlight, to fill in shadows without removing the overall modelling of a scene. Generally, the technique

is used for interior shots, but it can also be used to advantage with full length fashion shots in attractive interior and exterior settings. Here, the secret is to balance the output of the flash units so that shadows are filled in without the flash light dominating the shot.



Focal plane shutter and studio flash

Here, an exposure meter that can individually read out the flash and ambient components like the broncolor FCM 2 is almost essential for good results. Generally, although many effects are possible, it is best to limit the flash exposure to at least one f-stop below the ambient reading, and many fashion photographers use a figure of between one and a half and two f-stops. The relative power outputs of ambient and flash can be altered in a number of ways. Varying the power of the flash lamp base is the obvious way, and a flash

unit with a continuously variable power output like the VISATEC SOLO 1600 B and 3200 B units is invaluable in these circumstances. Another way is to increase the shutter speed by one f-stop and decrease the camera aperture by the same. The ambient exposure will remain unchanged, but the flash exposure will be effectively halved, reducing the fill-in light. The light from a flash unit can also be reduced by increasing the distance between the flash head and the subject, or by using a Softlight reflector with various density diffusers.

If the camera will accept a Polaroid instant picture back, then this is a good way to learn to balance flash and daylight lighting to start with. A little experience with a good flashmeter, however, will give good consistent fill-in-flash photographs in the longer term.

Buying a Flashmeter

There is a tremendous choice of flashmeters on the market, with prices varying from under \$100 to well over a thousand. It isn't wise to buy the cheapest, however. A flashmeter with a variable gate time and remote triggering like the VISATEC FM 1000 is virtually essential, even for the simplest work. More advanced work in the studio or for fill-in and interior work will need a flashmeter with separate flash + ambient readings like the broncolor FCM 2.

A good flashmeter is a wise investment, and will give good returns in both time and money saved, as well as in superior quality photographic work. It's one expense that will never be regretted.

3. Working with Flash

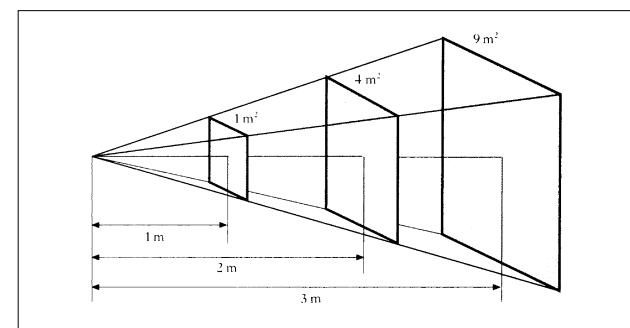
Electronic flash brings independence and a high degree of lighting control to the photographer. Possession of a flash outfit with a couple of heads and a selection of accessories means there are few subjects that can't be handled competently and creatively, whatever the weather or the ambient lighting conditions. To use flash well, however, does need an understanding of a few of the ways in which it works. There are a few simple rules.

The Inverse Square Law

Unlike the parallel rays of light from the sun, the intensity of light from a lamp base reduces as the distance from the lamp to the subject increases. This fall off of light is defined by the inverse square law, which simply states that the light reduces as the square of the distance from the source. Practically, this means that the level of light at a subject two metres away from the lamp is one quarter (the inverse of 2×2) of the level of light at one metre distance. Since half the light corresponds to 1 f-stop the following rule of thumb may help: double the light distance = open 2 f-stops.

If the distance between the lamp and subject increases to three metres, the level of light decreases to one ninth (the inverse of 3×3) of the level of light at one metre, and, perhaps more importantly, to around half of the amount of light present at the two metre distance. This means that if a photograph is being taken with subjects at 2 metres and 3 metres (or feet) away from the lamp base, the subject at 3 metres (or feet) will be underex-

posed by about 1 f-stop if the subject at 2 metres is correctly exposed, or the subject at 2 metres (or feet) will be 1 f-stop overexposed if the subject at 3 metres (or feet) is correctly exposed. This principle is fundamental to the use of flash, and examples can be seen in everyday photographs. If a picture is taken of a child cutting a birthday cake on a table, for instance, unless the cake and



Light fall off

the child are exactly at the same distance away from the lamp, either the cake or the child will be incorrectly exposed. Usually, especially with small computer-controlled battery flash units, the child's face is correctly exposed whilst the cake ends up as a burned-out white image. With portable electronic flash, there is much that can be done to minimize the effects of the inverse square law. The aim is to make the difference in distance between the front and the back of the subject group small compared to the flash to subject distance. For example, we have seen that if the flash distance is two and three metres respectively from two subjects, there will be a difference in exposure of one

f-stop. If the lamp base only is moved back by one metre, however, the flash-subject distance increases to three and four metres respectively. Applying the inverse square law shows that the lighting difference between the two subjects is now approximately half an f-stop instead of one f-stop (the difference between one ninth and one sixteenth). Bouncing the flash from a wall behind the camera will usually increase the flash subject distance even further. Another way of solving the problem is to use two lamp bases, positioned so that the flash-subject distance is the same for both.

Depth of Field

Photographing subjects at different distances from the camera can bring in depth of field problems. Whilst the illumination difference between two subjects at different distances from the camera can only be solved by changing the flash-subject distance, depth of field is determined by the lens aperture used on the camera. The easiest way to determine this is by using depth of field tables, or, more simply, the depth of field scale on the camera lens.

The power of the flash is then altered to ensure correct exposure. Doubling the output of the lamp base, for instance, will allow the lens aperture to be closed by one f-stop. For group photographs of people or subjects that are liable to move, this is the only way of ensuring sharpness, and the flash has to be powerful enough to allow the aperture required. For still-life subjects in the studio, it is easier in that multiple



Dept of Field

flashes can be given with the shutter held open until the subject is correctly exposed. Most good flashmeters have a multiple flash setting, so the procedure isn't difficult. Multiple flash exposures need to be taken in the dark, however, with the flash head modelling lamps switched off. Depth of field, and, as some define it "Depth of Light" problems are often inter-related. An understanding of what is going on helps to resolve them.

High-Key and Low-Key Set-ups

A low-key treatment of a subject usually involves high contrast lighting against a dark background, with high-key needing soft, low contrast lighting against a light background. The inverse square law can help creating low-key effects simply by positioning a dark background some distance behind the main subject. If the main subject is placed exactly halfway between the lamp and the background, the background illumination will be two f-stops below that of the main subject. Using a dark surface will guarantee a solid black low-key background.

For high-key work, the inverse is true. One way is to position the background as close as possible to the subject to minimize light fall off due to the inverse square law. A better way, however, is to light the background separately using an additional lamp. Providing the background itself is light, and the reflected light level measured by a flashmeter is at least between two and three f-stops higher than the main subject, the result will be a pure white high-key background.

Key and Fill-in Lighting

The human eye is used to seeing one principal light source, the sun. Shadow details are also accurately registered by the brain, and the eye/brain combination can see a tremendously wide range of brightness. Photographic film can't register the same brightness range, and shadow areas need to be filled in with light if they are to give a pleasing tone on a photographic print or transparency. The classic lighting arrangement for portraiture



Low-key



High-key

consists of a key light positioned 45 degrees to the side of the camera, and 45 degrees above it. This position gives a lighting effect not unlike the mid-afternoon sun, and gives pleasing modelling to both the male and female face. A soft light, produced by an umbrella or a large soft box are most suitable for female portraits, whilst the harder light and reflector combination is usually better for male studies.

The shadows produced by this key light need to be lightened by the use of a fill-in light, and this is best positioned as close as possible to the camera lens. A good lighting accessory for this is a small soft box. Or a reflector/diffuser combination. The ratio of the power of the key and fill-in light is important, especially with colour transparency materials. A good starting point is that the fill-in light should be half as powerful as the key, but this can be varied to personal taste. These two lights form the basis of traditional portrait lighting. An additional small lamp base fitted with a snoot behind the model can give a hair effect light, and a fourth lamp can introduce pattern into the background. This four light set-up is the standard used by many professional portrait photographers.