

LEDs:

the energy-efficient solution

by David Amphlett, founder and managing director of GTC sponsor company Gekko Technology

When the sun goes down each evening, most of us reach for the nearest light switch with little thought that, until just over a century ago, we would have lit an oil-lamp or a candle... or retired early to bed. The timeline of lighting development dates back to the taming of fire around 70,000 years ago. One of the earliest electric lights was a fluorescent tube demonstrated in 1867 by Alexandre-Edmond Becquerel. Thomas Alva Edison and Joseph Swan patented the carbon-filament incandescent lamp in 1879 and the rest is history.

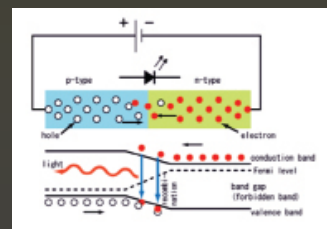
All of these forms of lighting, along with the arc-lamps that were used during the early days of studio lighting, had one detail in common: they were essentially an encapsulation of the original raw flame. An incandescent lamp has much in common with an electrical fuse in the brief moment before it melts, hence the difficulty Edison and his contemporaries experienced in developing filaments with usefully long life... and their high vulnerability to damage.

The light-emitting diode (LED) offered a completely different way of

converting electrical energy into light. LEDs are based on the phenomenon of electroluminescence, first observed by a Russian physicist, Oleg Vladimirovich Losev, in the diodes of radio receivers. Losev's studies were developed into a viable light source by Nick Holonyak (1962) while working as a consultant scientist at General Electric Company in New York. A year later, Holonyak predicted that LEDs would eventually replace incandescents. In a world increasingly concerned with electrical efficiency, that prediction is now becoming reality.

The early LEDs were red, amber and green. They quickly became popular as indicator lights in devices such as sound recorders and audio mixers. Blue LEDs followed in the mid 1990s and 'cold' (white with a hint of blue) LEDs later in that decade. Figure 1 shows how the movement of electrons within the diode results in actual emission of light.

In 2000, I was shooting a presenter-led television documentary in the Far East, and realised that LEDs offered a solution to several problems inherent in traditional luminaires. The potential benefits were considerable.



▲ Fig 1 - Principle of photon generation in a light-emitting diode

Flesh-friendly

Traditional point-source studio luminaires tend to create hard shadows which exaggerate the surface texture of a close-up human face. Although the sun itself is a strong light source, it is normally accompanied by reflected light which reduces the contrast of shadows. A ring, strip or large grid of multiple LEDs emits a gentler light than a small-source filament-based lamp. The contrast control ability of a ring light, for instance, is particularly applicable where HD capture resolution is higher and less forgiving than organic 35mm film.

Energy efficiency

The most immediately apparent

characteristic of an LED is its electrical efficiency; very little of its energy is wasted in heat, which is a significant concern for on-camera talent working in a hot climate or a confined studio. Power efficiency is of considerable importance when your electricity source is a battery. Ecological, financial and legislative pressures are increasing the relevance of this with studio solutions.

Reliability

The combination of inherently low operating temperature and the complete absence of a filament makes LED technology far more reliable than earlier forms of studio light. The hot filament in an incandescent lamp is extremely fragile, and the slightest movement or vibration can easily result in the bulb needing replacement; that in turn decreases operational efficiency as a consequence of the need to transport and store spares. More advanced LED luminaires incorporate an array of light sources, each LED having a life expectancy of typically several thousand hours. An additional advantage of LED lighting is that there



"before the introduction of LED studio luminaires, film and video lighting equipment was notoriously bulky"

is no 'warm-up' time to influence colour temperature.

Easier maintenance

LED lights are practically maintenance-free. They very rarely fail though there is a gradual reduction in light output and possible shift in colour temperature over the lifetime of a component. A typical LED will lose approximately 10% of its light output over 50,000 hours, equivalent to nearly six years of continuous use, with no operational penalty for repeated switching on and off. Operating at far lower temperatures than other lights, they are free from the familiar 'never-touch-the-bulb' constraint of tungsten-halogen lamps.

Size and weight

Before the introduction of LED studio

luminaires, film and video lighting equipment was notoriously bulky and had to be transported with all the care and attention required for glass components such as bulb heads and gas-discharge tubes. Being solid-state, LED lights contain no brittle glass and can be shipped without special precaution against shattering. Unlike HMI and fluorescent lights, LEDs contain no mercury; an important concern given current legislation on mercury in the domestic and industrial environment.

Colour temperature

Traditional tungsten lights tend towards red when dimmed. A properly designed LED studio luminaire is fully dimmable (locally or via DMX) with negligible colour variation and without need for bulky ballast.

Onset of Gekko

With no product on the market that suited my lighting needs, I started researching both the LED concept and the available components. In 2003, with the maturing of the core technology and availability of high brightness LEDs, our first luminaire – kisslite (Figure 2) – was conceived. Gekko Technology was formed shortly afterwards, with a highly talented design team to develop a range of lights meeting practically every requirement for studio-based or location-based production. This was in February 2004, just one month before completion of the kisslite prototype. By June we had sold our fourth kisslite, going on to demonstrate at IBC in September.

Gekko was assisted by the introduction of warm white LEDs in 2003 and by increasing LED efficiency, reaching 113 lumens per watt in 2006. Distribution agreements with France, Germany and India were signed and, in October 2005, we sold the first two kisslite spin-offs: lenslite and george. In March 2006, we began designing our first colour luminaires.



▲ Fig 2 - Gekko kisslite

At IBC2008, Gekko won an Innovation Award for the kloor-colour technology which formed the basis of our impending kedo variable-colour LED luminaire. The kedo itself was shown in prototype at NAB2009, where it won two awards for innovation.

Gekko's original ringlight systems, kisslite, george and lenslite, were produced as tools to supply solutions to a number of artistic and technical challenges that lighting cameramen face.

Below, we look at how these lights can provide the solution to ten challenges commonly faced by lighting cameramen.



▲ Gekko kisslite at work

CHALLENGE 1 The moody corridor shot

The shot involves tracking backwards down a long corridor in front of an artist who runs away from a pursuer or alternatively chases the camera. This may be a hand-held, dolly or Steadicam shot. The corridor is moodily low-key lit with bands of light emanating from doorways and shafts of light beaming down from the ceiling. We want to keep the low-key lighting intact, but this shot runs for a considerable time and we want a hint of the emotion on the face and in the eyes of the artist. It is a fast move,

operator, keeping overall weight to a minimum and requiring no extra cables or personnel.

The kisslite 3200K and 5600K white light source is a lightweight and portable LED ringlight system designed for commercial, drama and documentary shooting. When used with manually-supported stabilisers such as Steadicam, kisslite provides a lightweight beauty light source or fill. It can also be used for handheld, dolly and crane shots where a lightweight fill is required without compromising the quality of the dominant light source. A filter tray housing is included. The kisslite

individual switching of four-quarter-subsets (top, bottom, left and right) and dimming from 100% to 5% without altering colour temperature. The power supply features instant start at preset dim level and at full colour temperature. george features the unique and robust Gekko accessory mounting method for fast colour modification and diffusion.

CHALLENGE 2 Background lights

The shot involves a piece to camera with the programme presenter. The presenter has to look good, but the background scene is lit with neon, effects lighting and lasers, and the scene is dark. We want to maintain the ambient lighting effects and therefore need a wide aperture to capture this. The commonly used onboard camera light is harsh, unflattering and too bright. A sun gun is too bright and has no dimming facility. There is no experienced person to hold the light in place, even if its output is reduced with an ND filter or wires, and you are working against the clock.

Solution: kisslite or lenslite can be set at a level with the onboard dimmer low enough not to spoil the ambient lighting. The operator can look through the viewfinder and match the background and foreground light levels to eye whilst maintaining a flattering light source on the presenter. They are extremely quick to set up and do not involve a second person or assistant.

The correct level can be set on the dimmer, the batteries saved and the light is prepared for instant start as

soon as the presenter and sound crew are ready.

lenslite is a lightweight and portable white LED ringlight intended for serious operators of HDV and video cameras, providing a highly portable and easily controllable beauty source of fill. It comes with an integral filter tray housing. The lenslite clamps onto lightweight 15mm bars which are mounted on a camera base unit designed and balanced for the smaller HDV cameras. Alternative versions use a 'flying' ballast. Step-down rings are available for most lenses from 110mm down to 77mm.

CHALLENGE 3 The long interview

The shot involves a piece to camera on location on a bright day. The artist is backlit. A daylight balanced light source fill is required to last for an interview piece, which may be as long as 40 minutes (one digiBeta tape). There is no one available to hold the lamp and maintain constant position. There is no lighting stand in the kit. The HMI sun gun batteries won't last the length of the take and the settling-in time.

Solution: kisslite, lenslite – these can be used at full power with the diffusion frame in place for over two hours. The position and quality of the light will remain constant throughout the take. If the sun or backlight changes due to cloud cover, then the operator can adjust the level of subtlety in shot with the power regulator on their belt without taking their eye away from the eyepiece or having to stoop down to reach the HMI ballast sitting on the floor.

CHALLENGE 4 Weight-restricted travel

A small documentary unit travelling around the world needs to be light and self-contained. It needs to take one light to shoot interviews in interior and exterior locations, cars, planes and perhaps even a tent. The unit is taking numerous flights, stepping in and out of cars and vans, and has to keep kit weight to a minimum. The shoot will involve long hours working in countries with a variety of voltage supplies and frequencies. There will rarely be time to check into a hotel to charge batteries.

Solution: kisslite, lenslite – the full kisslite kit with tungsten and daylight

"LED based fixtures lend themselves particularly well to dynamic lighting"

and using an AC powered light would take a long time to set up and introduce a trip hazard. It would be difficult to maintain a constant distance between the camera light and the artist.

Solution: kisslite or george can be set with the onboard dimmer low enough to preserve the ambient lighting emanating from the doorways and skylights but high enough to catch glints in eyes and teeth. The light source does not create nasty nose shadows or 'badger eyes'. The light can be mounted on the camera lens, and the battery belt and power regulator unit strapped round the waist of the

ringlight unit clamps onto the barrel of most popular fixed-barrel lenses and also features an adapter clamp for standard ARRI 19mm and 15mm bars, lightweight 15mm bars and Panavision PV bars. Step-down rings are available for most lenses from 117mm down to 77mm.

george is a lens-mounted ringlight designed for use where an on-axis fill is required in conjunction with large-diameter zoom or prime optics. It is powered by a lightweight, dedicated power supply that runs from any 12 to 40V DC power source or mains adapter. The controller provides flicker-free power and allows

balanced lamp heads, fits into one small self-contained case. lenslite is lighter still, with one small daylight head, a colour correction filter and plenty of space for batteries in the specially formatted case. The two kisslite battery belts will last for a combined running time of nearly four hours before charging. The charger has an auto-sensing input and accepts 90–240V at 50/60Hz. It will also run off the cigar-lighter socket on a negative-earth vehicle. The kit contains IEC cables for UK, EU and US power outlets, and a cigar-lighter cable. There is a mains supply unit (also auto-sensing) running on worldwide power. The kisslite kit also contains reusable colour correction filters, eliminating the need to transport heavy rolls of gel.

CHALLENGE 5 The crane shot

The shot involves a huge jib up with a camera mounted on a remote control head, which in turn is mounted on the end of an 85ft camera crane. The maximum nose weight of the crane at the preferred operating length is 100lbs. The remote head alone weighs 68lbs, the film stock 2.5lbs, leaving next to nothing for the camera or light. There is no excess power available from the camera or remote head and the voltage drop over 100ft will be quite high.

Solution: kisslite, george – the lamp heads are the lightest combination of light and control box or ballast on the market, thus keeping the overall weight to a minimum. The kisslite and george power supply will run on any DC power from 12 to 40 volts. With 24 volts supplied at the crane base from a battery, the kisslite or george would be more than happy with 20 volts at the nose of the crane allowing a 16% voltage drop over distance, reducing the cable gauge requirement and thus the cable weight and ultimately the nose weight.

CHALLENGE 6 The car shot

The shot involves filming a talking head in a car from passenger seat to driver's seat. Exterior/ambient lighting is changing from minute to minute and, while the camera operator can ride the stop as normal, other available camera lights will not allow dimming to maintain a complementary relationship between ambient and fill light.

Solution: kisslite, lenslite – the daylight lamp heads can be used with a diffusion filter, softening and spreading the output. Output level can be adjusted with the dimmer on the power regulator to match ambient light. The camera operator remains in control and crew can be kept to a minimum.

CHALLENGE 7 Impromptu interview

The shot is an interview in the tunnel of an arena, a dressing room or motor-home. You have been granted an impromptu interview with the goal scorer/race winner, but his/her PA will

only give you a five-minute slot ten minutes from now. The local arena and broadcaster cannot guarantee you any power. You need to maximise interview time rather than waste your slot setting up equipment.

Solution: kisslite or lenslite can be totally operational in under five minutes. Either will run on its own battery power. Each is small and lightweight, so does not demand a lighting assistant to be cramped in a small space, and the light is flattering. The daylight lamp head can be used to match the ambient light coming through the window of the motor-home or the tungsten light of the dressing room. If someone changes

the direction of view at the last minute, the camera operator remains in control and crew can be kept to a minimum.

CHALLENGE 8 Keeping cool

The shot is inside the commentator's ringside cabin. You need a talking head shot of the commentator live in five minutes, but you get to him ten minutes late. The tiny black-draped room is like a sweat-box and even using a redhead causes the temperature to soar.

Solution: kisslite or lenslite. The kit can be preset with the correct

evolution through innovation

some of the movies that have benefited from Gekko's range of innovative LED lighting products:

CASINO ROYALE

STAR TREK

DEATH DEFYING ACTS

THE GOLDEN COMPASS

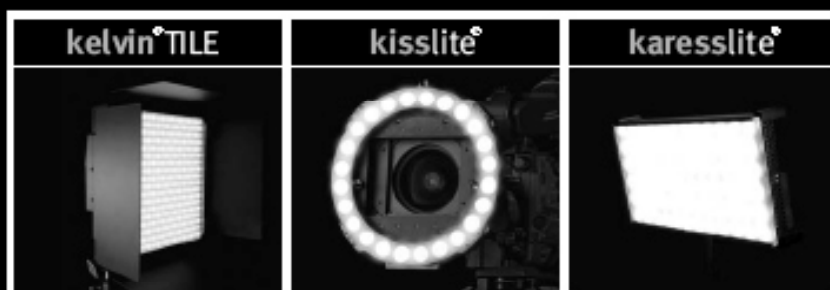
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▲ Fig 3 - Gekko kedo colour head (set to dark green)



▲ Fig 4 - Gekko karesslite

dimming level to produce the amount of light required. Five minutes before you go live, the lamp is turned on and it starts instantly at the pre-set dimmed level. The light is very cool and has a negligible effect on the ambient temperature. Even if it is left on for 20 minutes in a tiny room, it won't heat the room up, and the look is flattering.

CHALLENGE 9 Cable-free track

Steadicam track across a road. The shot involves tracking back over a pedestrian crossing. The cameraman wants a fill light around the lens axis, but Health and Safety will not allow him to run a cable.

Solution: kisslite or george. No trailing cables, no team of extra people to trip over. The cameraman is in control using a wireless dimmer 30 feet away. The Health and Safety department is happy.

CHALLENGE 10 Rollercoaster ride

The shot involves strapping a camera on a rig to shoot riders on a rollercoaster. The cameraman wants a fill light around the lens axis which will stay on axis without being affected by severe vibration.

Solution: kisslite and george are robust lights not affected by vibration. When securely mounted to the barrel of the lens and the support bars, they are guaranteed to stay on lens axis. LEDs are solid-state devices containing no moving parts or filaments, so they withstand rough environments, heavy vibration and impact. No glass, no mercury, no toxic gas and no filament. There is nothing to break, shatter, rupture, leak or contaminate. Bouncing around in the back of a van

or an aircraft or being wheeled around on top of a lighting stand presents no problem, let alone being strapped into a rollercoaster. How many other lamps would remain lit under such duress and still be in service months later?

Gekko luminaires

Kedo: LED-based lights now offer facilities which have hitherto been practically unobtainable. At NAB2009, we introduced kedo, the world's first focusable single-source multi-colour light formulated for image capture. Kedo (Figure 3) gives lighting directors and camera crews the freedom to obtain focusable high-strength light in millions of colours from a single source. Eliminating the need for inefficient colour filters, kedo uses the kleeer-colour light engine: a single array high-power light-emitting diode which can be tuned under software control to a wide range of different colour temperatures. A focusable spotlight, equivalent in output to a 1 kW Fresnel, kedo delivers precise colour rendering across a wide range of operating temperatures and illumination levels. As well as primary and intermediate colours, kedo can accurately emulate a high-quality tungsten reference source. It can be switched quickly and easily to produce 2900K, 3200K, 4300K, 5600K and 6500K, as well as a wide range of colours.

The Gekko range of lighting systems also includes:

k-lite: a robust three-LED dimmable ENG light providing a lightweight and controllable fill for operators of HDV and the generation of smaller film and video cameras. An on-board dimmer allows the operator to respond quickly as ambient lighting conditions change. The k-lite unit clamps on top of any

camera, and is lightweight and small enough to remain there even when not in use. An optional adjustable Noga arm allows the operator to adjust and change the look and direction of the light source, using an off-axis kicker, for instance. The k-lite is powered by a 12V input and can plug directly into a camera. A compact power adapter is available for smaller HD cameras without auxiliary outputs. A 12V power unit is included.

kicklite: a high-output six-LED inline white lighting block for use where space is tight. Powered from batteries, kicklite LED blocks are available in 3200K and 5600K colour temperature. The kicklite 106 version allows multiple units to be stacked using a unique magnetic mounting.

kuelite: a lightweight 6 x 3 LED block 3200K white light source for use in conjunction with a teleprompter or in the cramped and temperature-sensitive conditions of a commentary box where instant start, DMX control and low heat are paramount. The kuelite has integral DMX control using DMX512A protocol and the latest ESTA DMX standard. Fitting is via a standard 3/8" Whitworth tap and M5 thread.

karesslite: a 600 x 300mm soft panel (Figure 4) for studio or on-location applications, available in either daylight or tungsten colour temperatures. Consuming just 85W, it can be operated for a continuous 2h 50mins from two Hawk-Woods VL0175 batteries. An integral diffusion grating modifies the beam without restricting it, unlike the traditional egg-crate light diffuser.

The karesslite can be used as a single unit in portrait or landscape positions with three switchable sectors. It can also be combined with additional karesslites into a larger

multiple light source. Light output can be adjusted with an internal dimmer or via a DMX-interfaced remote lighting controller.

kelvin TILE: a soft panel employing a combination of red, green, blue, cyan, amber and white LEDs in a 16 x 15 matrix to generate high-quality broad-spectrum white light. A soft-light companion to the focusable Gekko kedo, the kelvin TILE provides total control over colour temperature from 2200K to 6500K with presets at 3000K and 5500K. Measuring 301 x 301 x 99mm (WHD), the kelvin TILE delivers up to 419 Lux at 5500K or 273 Lux at 3000K (both measured at 1 metre distance) with a power consumption of only 85W. Beam angle is 108° at 50% intensity. Lighting parameters can be saved, recalled and cloned when using the optional paintbox.

Looking ahead

LED-based fixtures lend themselves particularly well to dynamic lighting, allowing both intensity and colour to be controlled easily and efficiently over a very wide range. They have a considerable range of applications, not just in the world of film and television but in entertainment generally. Coupled with this, the green credentials of LEDs make them an increasingly viable solution.

Fact File

Gekko Technology Ltd
Units 3-4
Cotton Drive
Alehouse Lane
Kenilworth CV8 2UE
t: +44 (0)8448 005 326
f: +44 (0)1926 863 347
www.gekkotechnology.com