Vari-Lite VLX Wash

by Mike Wood

Fig. 1: Unit as tested.

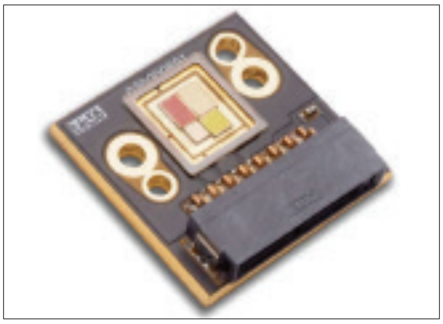

Fig. 2: Luminus Devices LED array.

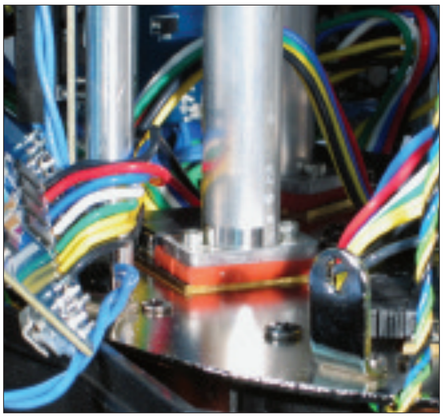

Fig. 3: LED and Light Pipe.

It's been a couple of years since we've looked at a product from Vari-Lite in these reviews. Now, of course, part of the Philips stable of companies, Vari-Lite remains one of the best known and respected manufacturers of automated lighting, with a history that goes back to the first days of moving lights. They've always been recognised for their innovation with colour systems and the VL5 wash light with its radial dichroic colour system and distinctive turbine appearance has become an iconic workhorse product. That tradition continued with the VL500 wash and now Vari-Lite makes its first move into using LEDs with the VLX Wash. How does it perform? Does it live up to the legacy of its illustrious forebears? Is the light output enough? I hope this review will help you determine that for yourself.

As always with these reviews, I reviewed a single unit supplied to me by Vari-Lite as typical of the product and try and take measurements of everything I can think of that's measurable, from light source to output. The VLX Wash is fitted with a universal power supply rated from 100-240V 50/60Hz and for these tests the luminaire was run from a nominal 115V 60Hz supply.

Light source and primary optics

In this review we're going to spend longer than usual discussing the light source as they are key to this product. The VLX uses seven LED arrays from Luminus Devices (Figure 2), each of which contains four emitters - red, green, blue and white. The arrays are nominally rated at 120W total power each although, as with all LEDs, the rating is more of a guide and can be pushed up and down depending on how good your cooling system is. Although LEDs do have a maximum current rating the usual limiting factor is temperature. Keep them cool and you should be OK. Luminus Devices specialises in the development of very high output LED arrays and they include a number of features that make them suitable for our industry. Two features in particular are important to us. Firstly, they mount the dies directly on to a heat conducting substrate (often copper) with as few intervening semiconductor or insulating layers as possible so as to maximise heat transfer. Secondly, each die is capped with layers of a photonic lattice structure in a secondary fabrication process. This lattice serves to act like a series of minuscule light pipes and controls the beam angle of the emitted light, reducing it from the normal 180° Lambertian output down to a much more manageable modified Lambertian with a lot more of the energy in the central 120° (it varies for each colour, with red and white being wider than blue and green). Vari-Lite claims a lifetime for the LEDs of in excess of 10,000 hours. The Luminus datasheet suggests this should be a conservative estimate and that a longer life, albeit with slowly reducing output, is likely.

Vari-Lite mounts those arrays onto individual heat spreader plates (of which more later) and then immediately couple the light outputs into long hexagonal glass integrating rods or light pipes encased in protective aluminum tubes (Figure 3). Here's where the narrower exit angle of the Luminus Devices LED comes into play as that reduced exit angle of the die is closer to that needed to get perfect coupling with the glass rod so that all beams inside the rod are within the TIR (Total Internal Reflection) angle and bounce back and forth inside the rod with almost no loss. These reflections within the rod help to homogenise the outputs of all four dies into a single uniformly coloured beam. At the other end of each of those integrating rods is a very deep compound parabolic concentrator (CPC) reflector (Figure 4) which collects and condenses that homogenised beam through a moulded plastic fresnel lens which caps the reflector and produces the VLX Wash's native field angle of around 22°. Figure 5 shows the final reflectors, each with their associated output lens.

Heat management

As we've discussed before in these reviews successful application of LEDs is all about good heat management. LEDs are very sensitive to temperature and operate best when you keep them below 80°C - the lower the better. In the VLX, Vari-Lite has over 1,000W of heat to get rid of from the LEDs and drivers - no easy task. To do so they've had to go to extreme lengths that will perhaps be more familiar to a PC manufacturer than an automated light company. The copper heat spreader mentioned earlier that the LED sits on is actually the heat collection block for a combination heat pipe and heat sink system. As you can see in Figure 6, each copper block has three heat pipes leading through it which transport the heat energy away from the LEDs and into the seven finned heat sinks. Six of these are mounted in a ring around the edge of the luminaire and the final, seventh, is mounted flat to the plate in the middle of the luminaire. Each of the six circumferential heat sinks has its own fan forcing air through the fins. But that's not all! As illustrated in Figure 7 there is a second, inner ring of more conventional aluminium finned heat sinks on the back side of the fans that connect to the main heat spreader plate that's common to all seven LED arrays. The fans pull air through one heat sink and then push it out through another.

With the covers back on the unit the heat management system is visible through the large air vents on the rear of the unit (Figure 8). Vari-Lite tells me it's just serendipitous that this shape echoes the asterisk in their logo and the vanes in a VL500.

Is this complex system effective? It appears so: I ran the unit for many hours in my workshop and the thermostatically controlled fans kept everything on an even keel. As you probably know the output of LEDs is temperature sensitive, with red LEDs the most affected. If a luminaire doesn't compensate for this then its red output will rise and fall disproportionately and the colour mix will shift as the LED temperatures change. Vari-Lite compensates for this by measuring the temperature and adjusting levels accordingly such that all colours track together and keep the colour mix constant. In my tests the drop in output from a cold start to equilibrium was only a few percent, showing that the VLX temperature management was working well.

Optics

We've talked about the primary optics which produce the native narrow beam. However, the VLX has a secondary variable optical system mounted after those lenses. Vari-Lite call this a beam spreader and it uses two adjacent lens plates that can be varied in separation by three small linear actuator stepper motors. One of the plates has an array of concave dimples while the other has a matching array of convex bumps. When the two plates are pushed together the dimples align with the bumps and mesh. This effectively cancels out the optical properties of both the concave and convex elements so the combination has no net effect on the beam. However, as you start to separate the two plates, an air gap opens up between the bumps and the dimples and they each act as lenses with the overall combination acting to widen the beam. The further apart the two plates are, the wider the beam. Figure 9 shows a side view with the two plates together (left) and separated (right). The movement isn't much but it's enough to take the measured field angle through a 2.5:1 range from 23° to 57° in my tests. Figure 10 shows the view in the front of the unit when the beam spreader is closed. Each of the small grid of squares you can see in that image is one pair of nested concave and convex elements.

Output

Of course, the user doesn't really care about how Vari-Lite does their heat management, all that really matters is that they've done it well enough that light continues to come out of the front. But how much light and what's the quality of that light like? I measured the output with all four LED channels at full at 13,120 lumens in a narrow field angle of 22.6° ramping down to around 11,700 lumens at the 57.2° wide field angle. This is certainly the highest output I've measured in an LED fixture so far. The mix with all channels at full is a slightly greenish hue, well off the black body line, so far in fact that my instruments couldn't calculate a sensible correlated colour temperature but it was clearly very high. However, by reducing the green and blue channels I also mixed a 5600K white as close to the black body line as I could. That dropped the output to a level about 90% of the previous figures, which is still very good.

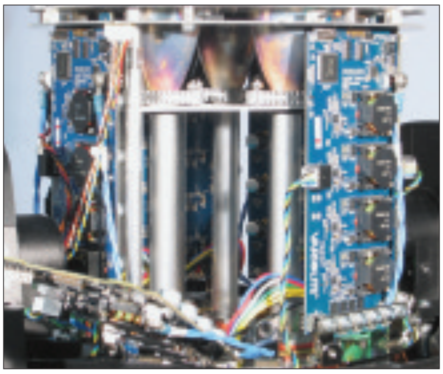

Fig. 4: Driver Boards and Light Pipes.

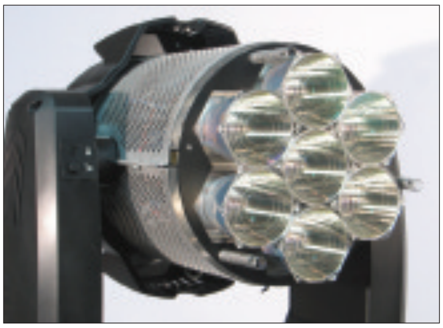

Fig. 5: Output lenses with beam spreader removed.

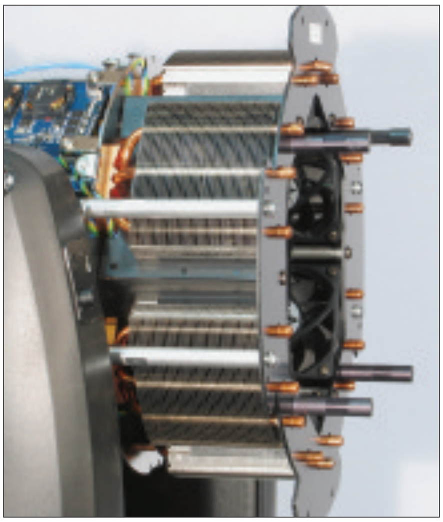

Fig. 6: Heat Pipes.

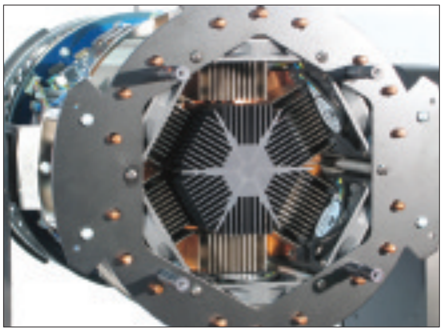

Fig. 7: Heat Sinks and Fans.

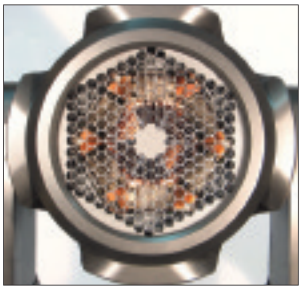

Fig. 8: Heat sink array.

Fig. 9: Beam Spreader.

Fig. 10: Front lens array.

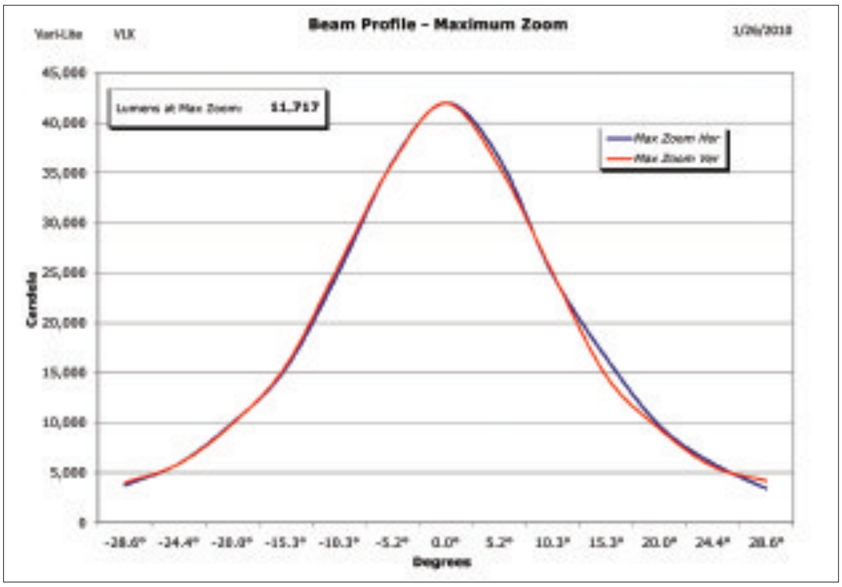

Fig. 11: Maximum zoom.

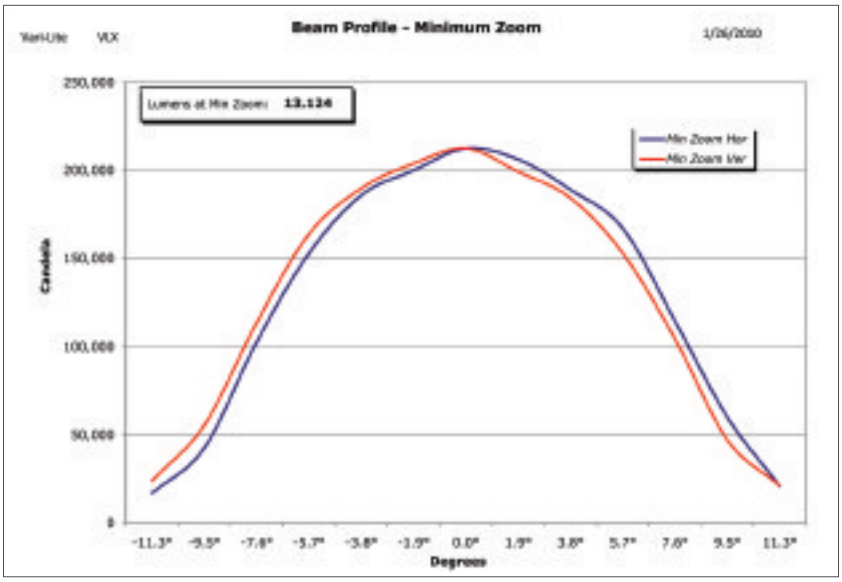

Fig. 12: Minimum zoom.

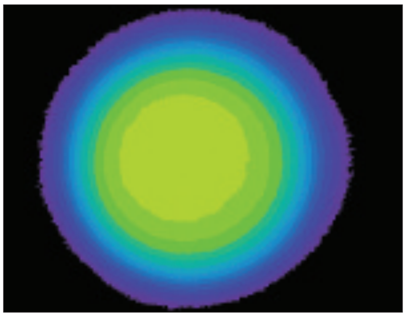

Fig. 13: Narrow angle.

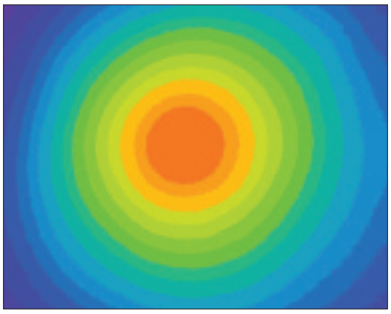

Fig. 14: Wide angle.

The beam profiles at wide and narrow are shown in Figures 11 and 12 and are both smooth and very usable. Interestingly, the narrow angle has a significantly flatter distribution than the wide - a function of the optics of the beam spreader. You can clearly see the beam profiles in the false colour shots shown in Figures 13 and 14 taken with the Special Labs webcam. Figure 13 is the narrow angle and shows a very flat central region while the wide angle shown in Figure 14 shows a more peaky distribution. The colour homogenisation was also very good - at short throws of less than 20ft it is possible to see some slight circular colour banding of the red in amongst the mix but this is minimal and I suspect it would not be visible in normal use. At longer throws it blends out and there are no coloured shadows at all.

As we've seen in a number of prior tests of LED luminaires from other manufacturers, Vari-Lite is doing some power balancing with the 4 channels. This allows them to maximise the output for every colour mix without exceeding the total heat handling capacity of the luminaire. As the blue channel has the lowest lumen efficiency I was actually able to increase the output from the 'all at full' level slightly by reducing the blue channel to 50%. At that point the power that was being consumed by the blue LEDs was being shared amongst the other, more efficient, colours and the total output went up by about 6%.

Dimming

Figure 13 shows the VLX Wash dimming curves for the 'all at full' mix and for a single colour. This was with the unit in square law mode. The curve is fine but, equally if not more importantly, the quality of the dimming is excellent. Vari-Lite has done a great job of providing smooth dimming while maintaining the colour mix. This is particularly difficult to do at the bottom end of the curve, with the final 10% to black out being really hard to get right. Using 16-bit dim mode I saw no steppiness anywhere on the curve, even when dimming at very slow speeds. The VLX Wash also offers a strobe mode and I measured this as ranging all the way up to 47Hz. I'm not sure what such a fast strobe would be used for - but it's there if you need it.

Colour System

The output measurements above are in white but what an LED RGBW unit is really about is colour. The VLX Wash mixes a good range of colours within its available RGB gamut. Although it doesn't help widen the gamut of available colours, the white channel helps a lot in mixing pastel colours as well as filling in the gaps in the overall spectrum. As I've said before in these reviews, I find the colour mixing range of RGB a little limiting, however the VLX Wash does an excellent job within those known and understood limitations.

Figure 14 shows the spectrum of the emitted light when all LEDs are at full and Figures 15 and 16 shows the RGB and white spectrums respectively.

The output in the main primary colours as a percentage of full output was as follows.

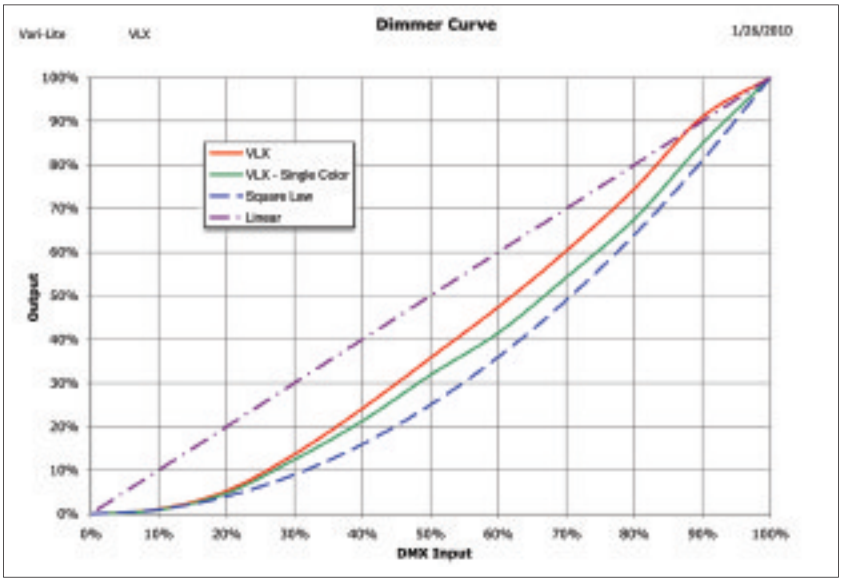

Fig. 15: Dimmer curve.

Colour Mixing

Colour	Cyan	Magenta	Yellow	Red	Green	Blue
Output	84%	26%	90%	20%	77%	11%

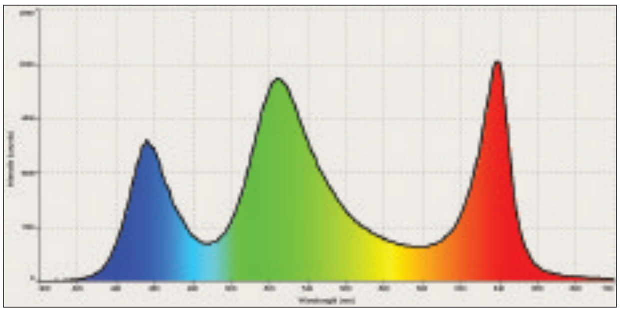

Fig. 16: All at full.

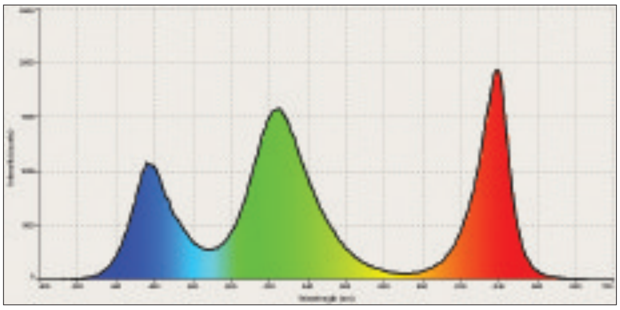

Fig. 17: RGB.

As mentioned earlier, Vari-Lite is using dynamic power balancing to always maximise the output of colours which explains why these figures don't appear to add up.

I usually report the PWM frequency of the drivers in LED fixtures, but this proved hard to measure with the VLX Wash as they are clearly using some fairly complex system to smooth out their dimming. However, the core frequency appears to be around 1500Hz which should be high enough to avoid any aliasing flicker with television systems. The webcam light profiling system had no problem with it and it can be quite sensitive to those issues.

Pan and tilt

The VLX has a pan range of 560° and tilt of 270°. A full range pan move took 5.72 seconds, while a more typical 180° move finished in 4 seconds. Tilt took 2.7 seconds for a full move and 2.4 seconds for 180°. Positional repeatability on both pan and tilt was around 0.8° - which is around 130mm of error at a 10m throw. Pan and tilt behaved slightly differently here. Pan had around a 1.2° overshoot but then came back to position over a period of 1 to 2 seconds, while tilt had almost no overshoot but slightly worse hysteresis. I imagine this is a function of the different dampening and balance issues on the two axes.

Pan and tilt both use three-phase motors with encoders and belt drives. Figure 19 shows a view of the tilt system in one of the yoke arms. The movement was smooth at most speeds but exhibited some minor 'hunting' at very slow speeds. This is nothing to be of any concern in a wash light.

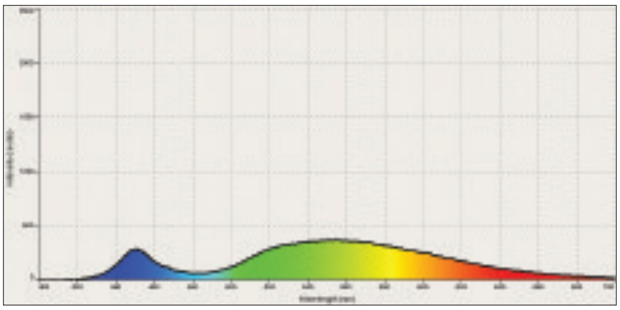

Fig. 18: White.

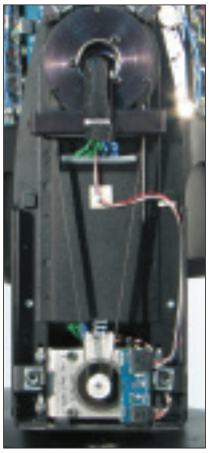

Fig. 19: Tilt Motor and Encoder Wheel.

Fig. 20: Motor Driver Board.

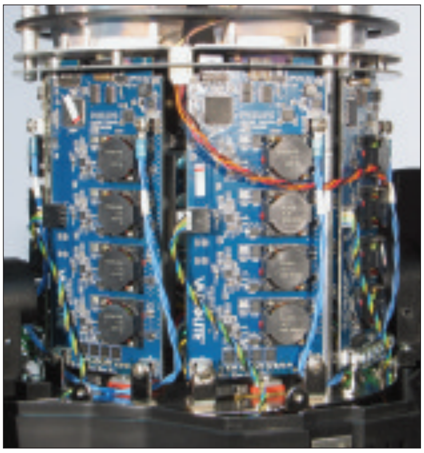

Fig. 21: LED Drivers.

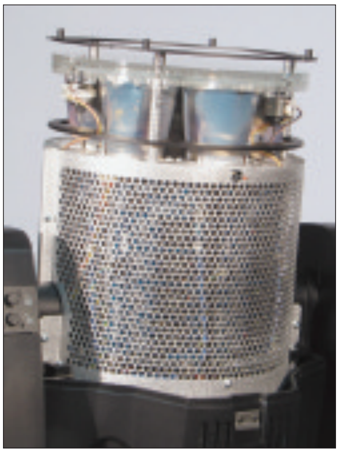

Fig. 22: EMI Screens.

Noise

The VLX Wash has eight fans in total - six in the head for the LEDs and two in the top box for the power supplies. Everything is temperature controlled so, in normal mode, the fans ramp up and down with the thermal load. I measured noise levels as follows with everything at full power:

Sound Levels

	Normal Mode
Ambient	<35 dBA at 1m
Stationary	48 dBA at 1m
Homing/Initialization	57 dBA at 1m
Pan	52 dBA at 1m
Tilt	51 dBA at 1m
Zoom	49 dBA at 1m

The fan noise when operating at full output in 'Normal' mode is fairly high but you also have the option of a 'Quiet' mode selectable through the configuration menu where the maximum power is restricted. In that mode I measured a 30% drop in maximum light output while the stationary noise level from the fans dropped by 8dB from 48 to 40 dBA. A quite significant reduction.

Electrical parameters

The VLX has a fully power -factor-corrected auto-ranging (100 – 240V 50/60Hz) power supply and consumed 11.2A, 1290W with a power factor of 0.99 when running with all four LED channels at full power in 'Normal' mode.

The initialisation time from power up or from sending a reset command through the DMX512 control channel was 45 seconds and the VLX is well-behaved during reset in that that it went to blackout before starting to move and didn't illuminate again until the reset was finished.

Electronics and control

Electronics is distributed in multiple spots in the luminaire. Power supplies are in the top box while drivers for the three motor systems - pan, tilt and beam spreader - are mounted in a yoke arm (Figure 20). Finally, the seven LED driver boards are mounted in a ring surrounding the LEDs and their light pipes (Figure 21). Each LED array has its own driver and they all appear to run asynchronously (which further confounded my attempts to measure the PWM frequency). Those LED drivers operate at high power and high frequencies so, in normal operation, they are surrounded by a screen to shield for EMI. Figure 22 shows the unit with EMI screens in place.

The VLX provides an LCD based display and menu system offering the usual range of functions and configuration options (Figure 23). Power and 5-pin XLR for DMX512 data come in to a connection panel on the opposite side of the top box (Figure 24).

Construction

The VLX Wash construction uses a combination of steel chassis, plastic injected molded covers and a large pair of aluminium die-castings for the top-box (partly for strength and partly as a heat sink for the power supplies). I had no problem removing covers and getting into the basic structure of the unit that the regular user would need to access for general maintenance and cleaning (although a magnetic screwdriver is essential for reassembly). My guess is that the narrow fins on the heat sink will need cleaning to keep them clear of fog fluid and dirt on a reasonably regular basis to avoid clogging up the cooling system, although Vari-Lite tell me that if that does happen the unit will just throttle back slightly to keep in safe operating conditions. Both pan and tilt are fitted with push button operated locking system for transport: you can see the tilt system in Figure 6 and the Pan system is shown in Figure 25.

Fig. 23: Display.

Fig. 24: Connections.

Fig. 25: Pan Lock.

Conclusions

Well, there you have it, the Vari*Lite VLX Wash - a very interesting entry into the professional LED lighting product catalogue. The VLX Wash offers output that is comparable with existing automated lighting units and can fairly be compared on a one-to-one basis. It's perhaps less efficacious than units using more traditional light sources in open white, but really comes into its own in colours, particularly the deeper shades where its efficacy, like all additive LED-based units, is significantly better. Is it for you? As always these reviews should only be a starting point for your own investigations and, if the Vari-Lite VLX interests you, I encourage you to try out the unit for yourself.

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