Fig. 1: Unit as tested.

JB-Lighting's JBLED A7

German company JB-lighting has been manufacturing automated lighting products for over 20 years - that's just about as long as anybody in what is still really a very new business. Although it is a well-known name in Europe, it is less familiar in the United States; however, last September, at the PLASA show in London, JB-lighting introduced an LED-based washlight with a feature that could help change that situation . . .

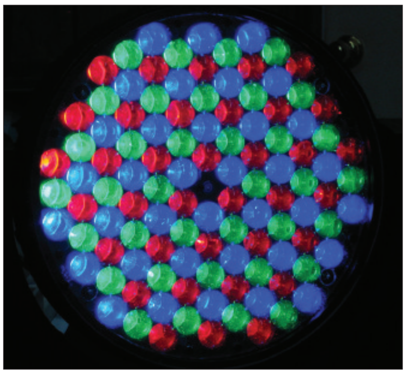

Fig. 2: Narrow angle.

Fig. 3: Cooling slots.

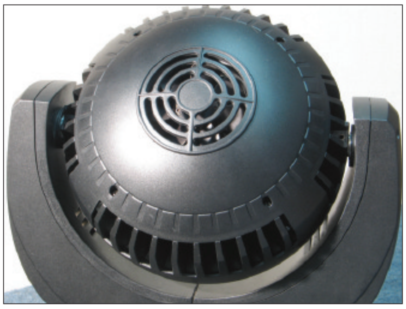

Fig. 4: Rear and fan.

The product is the JBLED A7 and the feature is beam angle control, or zoom. To my mind, beam angle control on an automated wash light is a critical parameter that could help take a purely decorative lighting product and turn it into a useful tool. Wash lights have had variable angle control since the earliest Fresnel luminaire, and just about every automated wash light has this feature in one form or another. Although LED-based units have real strength in colour control, beam angle control is a real help in gaining acceptance as a generic workhorse lighting instrument. JB-lighting is also taking a step towards getting better known outside of its home territories; its products, including the JBLED A7, will be exclusively distributed in North America through Creative Stage Lighting.

The progress with LED-based luminaires is dramatic. Although LEDs have really only been bright enough for illumination for a year or so, we are already seeing the third generation of units. Rapid changes in the emitters, and developments in optics and control, have made for very short product life cycles. How does the JBLED A7 compare with its recent antecedents and can it truly replace its incandescent or HID-based cousins?

As always with these reviews, I measured a unit supplied to me by the manufacturer as typical of the model for everything I can think of that's measurable - from light source to output - and present those results here for you to use in your own determination. The JBLED A7 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

The JBLED A7 uses 108 Luxeon emitters split evenly, with 36 each of red, green, and blue. The Luxeon emitters are very familiar, of course, being one of the commonest LEDs used by entertainment lighting manufacturers. In this case, they are arranged in regular RGB triads across the face of the circular fixture in what, at first glance, also looks to be a familiar and ubiquitous arrangement - but more of that in a moment (Figure 2).

One of the most important considerations with any LED fixture is heat management - LEDs are extremely heat-sensitive; a rise in temperature changes both the output of the LED die and its colour, so keeping everything at a constant temperature is important for a consistent output. The JBLED A7 mounts the LED dies and their drivers (another source of heat) fairly close together on two parallel boards, but with a distinct air space between them. If you take a look from the side of the head (Figure 3) you can see right through from the air slots on one side to the air slots on the other. In between those two boards is a large die-cast aluminum heat sink, visible in Figure 3, cooled by a single temperature-controlled external fan

Fig. 5: Lens support plate and LEDs.

Fig. 6: Lens.

Fig. 7: Lens support plate.

mounted on the rear of the head on an inset plastic injection molded cover (Figure 4). The unit ran in my tests for many hours continuously and, although I saw some temperature-related changes in output, they were kept to a very reasonable level, with a 7-10% drop in output as the unit warmed up to equilibrium. This is a very acceptable figure for LED luminaires.

Optics

Here's where things start to get interesting. Instead of the normal fixed focal length TIR-based lens system used by many manufacturers, each of the 108 LEDs in the JBLED A7 has its own individual two-element zoom lens system. The first element is a fixed lens right above the die itself, which can be seen in Figure 5 as the domed elements over each single colour chip array. The second lens elements are formed by a single plastic plate which has 108 concave/convex lenslets molded across its surface (Figure 6). This lens plate is attached to a punched aluminum support plate (Figure 7) which, in turn, is mounted on the shafts of four small stepper motor driven linear actuators (Figure 8). As the four motors turn in sync', an internal lead screw is driven backwards and forwards to give the lens plate about 10mm of movement back and forwards. This movement of the front lenslets gives a very respectable 3:1 zoom range in the output; when the lens plate is right back close to the emitters, the unit is in its widest angle and zooms to narrow as the lens plate moves forward, away from the LEDs. As with all simple zoom lenses, I'm sure that this system is less efficient than a single fixed lens would be, but that's a penalty you may be prepared to live with to get the zoom control. Figure 9 gives an overall view of the entire system.

Output

How do those zoom optics perform? I measured the unit in full output (red, green, and blue, all at full) as giving 3,418 lumens at a wide angle of 35.6° ramping down to a slightly lower 2,936 lumens at the narrow angle of 12.9°. (Note that I always report field angles - that is the point at which the light has dropped to 10% of the peak value.) The beam profiles were very smooth as can be seen in Figures 10 and 11. There was also good homogenisation of the three colours, particularly at throws greater than 3.5-4.5m with minimal coloured shadows. I suspect the optical system helps with this. As I mentioned above, nothing comes for free, and the addition of a second lens inevitably means these are slightly lower output figures than some competitive units, but you get beam angle control instead. Which one you choose will depend on your needs for a particular show.

Usually with RGB-based fixtures, the full output has a very pinkish tinge, as the green emitters are overpowered by the red and blue. With the JBLED A7 however, it appears that some tweaking has gone on, as the unit instead gives a bluish white colour. The colour coordinates of the white

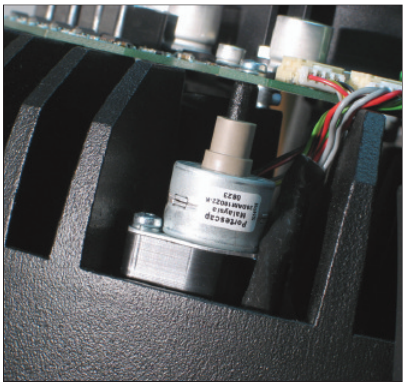

Fig. 8: Lens plate motor.

Fig. 9: Fixture and lens.

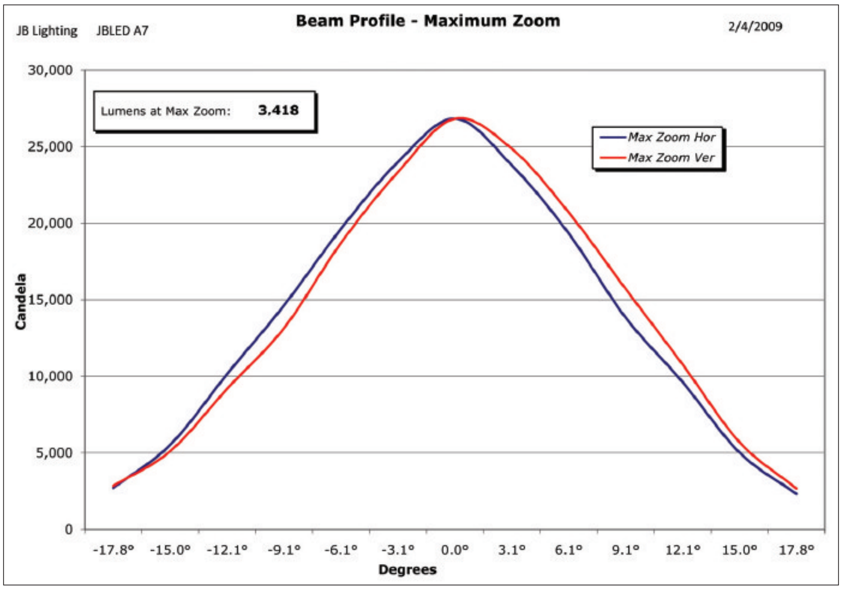

Fig. 10: Maximum zoom.

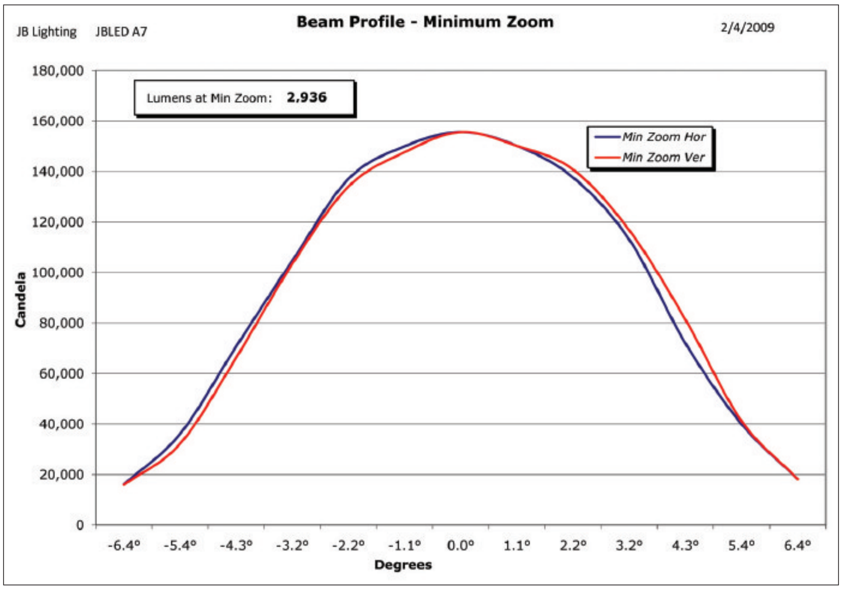

Fig. 11: Minimum zoom.

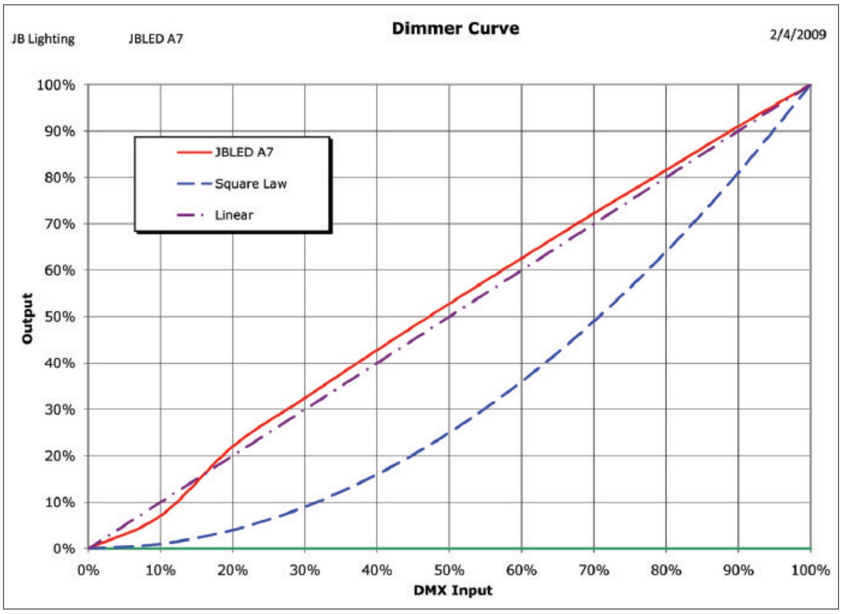

Fig. 12: Dimmer curve.

were too far from the black body line for my measuring instruments to be able to calculate a sensible correlated colour temperature result; however, using the colour temperature channel, I was able to bring it back closer to the line and get a range of measurable whites from 12,000K to 2,900K. Of course, as you lower the colour temperature, the light output drops as well, and I saw between 10% and 55% reduction as I went through the whites from the initial full level down to 2,900K.

The zoom function does a reasonable job of maintaining the homogenisation throughout its range; however, the three different LED dies have slightly different shapes and sizes, and have different output profiles as well as the obvious different wavelengths. All these small differences combine, and the net result is that the lens divergence differs from colour to colour, and so the beam mix varies as the beam angle changes. In mid-to-saturated colours, this wasn't visible in the beam; however, with pastel colours and shades of white, it was clear that the center of the beam and the very outside edge were redder than the rest. The red hotspot in particular was more apparent in some beam angles than others.

Dimming

Figure 12 shows the JBLED A7 dimming curve. This was very close to a linear response. JB-lighting has clearly added significant smoothing algorithms to the incoming DMX512 signal, as the dimming output in slow fades was very smooth, and no steppiness was visible, except over the last two or three steps before blackout. It looked to me as if they were interpolating internally to 12 or 16 bits from the eight bits of the DMX512 intensity channel. (The A7 offers the option of 16-bit control for the colour channels, which is how I was running it, but not for intensity). The interpolation and predictive algorithms weren't perfect, and I managed to fool them a couple of times, but the overall result was excellent - it's difficult to enforce a smoothing algorithm while still recognising and facilitating strobe effects and other rapid changes. This is a real issue with the use of LEDs, and JB-lighting has done a good job here. The strobe channel allowed a range of different strobe types at rates I measured from around 20Hz down to 1.9Hz at the slowest. The fixture also showed good colour stability while dimming. This is hard to do in the paler colours, and shows that JB-lighting has put a lot of work into this function.

Colour System

Of course, LED units are all about colour, and the JBLED A7 presented a good range of controllable colours within the RGB gamut. As well as the expected RGB DMX channels, the unit also offers a colour wheel channel, which allows rainbow and colour-changing effects using a range of pre-programmed colours. I felt that the amber in this pre-programmed range was particularly useful. As mentioned above, there was some slight unevenness in the beam in the palest colours, but no problems in mid tones or saturated colours. (Figure 13 shows the spectrum of the emitted light when all LEDs are at full and Figure 14 shows it adjusted for a 3,000K white.)

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

Colour Mixing

Colour	Cyan	Magenta	Yellow	Red	Green	Blue
Output	90%	21%	89%	10%	79%	11%

These figures confirm what was suspected: that JB-lighting is controlling the mix so as to ensure that there is enough green available to make a good white. Green is always the weak link in an RGB system, and usually there isn't enough, so you end up with a pinkish result.

As mentioned above, the JBLED A7 offers a CTC control for colour temperature. This adds a further layer of control to the same RGB LEDs.

I measured the PWM frequency of the JBLED A7 at a very low 120Hz (when set for 60Hz cameras) or 100Hz (when set for 50Hz cameras). I find that this low a frequency makes for visible flicker, either when the unit is moving fast or when an object moves past it. It might also cause problems with some cameras - for example, it confused my digital camera when taking the shots for this review. I'd also be concerned about aliasing with the 44Hz DMX512 signal, but saw no evidence of that in my testing. I suspect JB-lighting traded off the increase in resolution they needed for their excellent dimming with the PWM frequency. That's a hard decision to make.

Pan and tilt

The JBLED A7 has a pan range of 450° and tilt of 332°. A full range pan move took 3.2 seconds, while a more typical 180° move finished in 2.3 seconds. Tilt took 2.3 seconds for a full move and 1.8 seconds

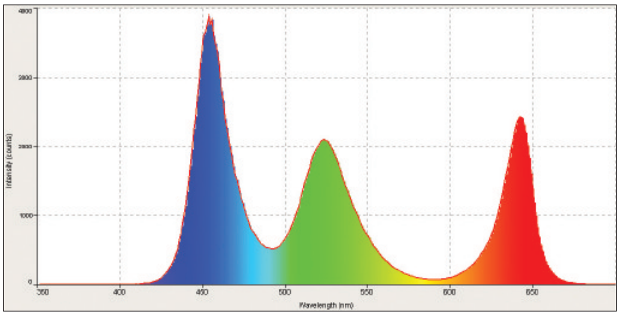

Fig. 13: All LEDs at full spectrum.

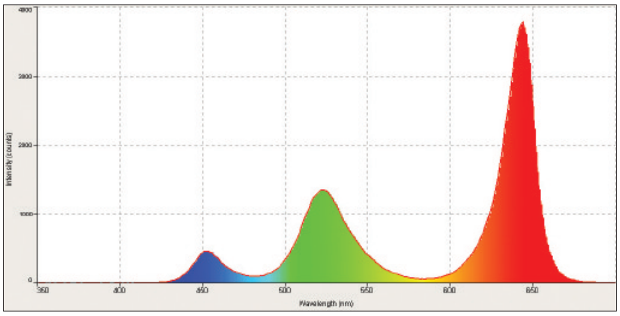

Fig. 14: 3000K white spectrum.

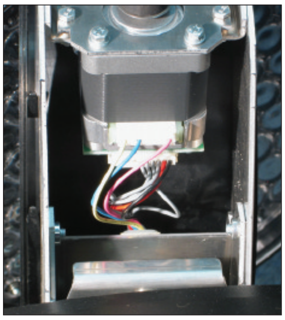

Fig. 16: Motor and encoder.

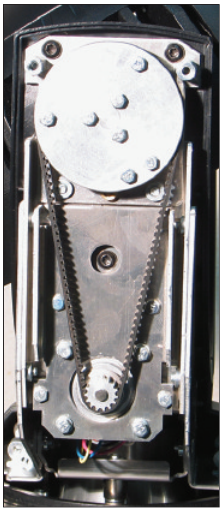

Fig. 15: Tilt drive.

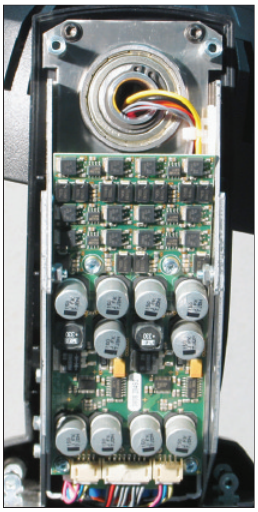

Fig. 17: Motor drivers.

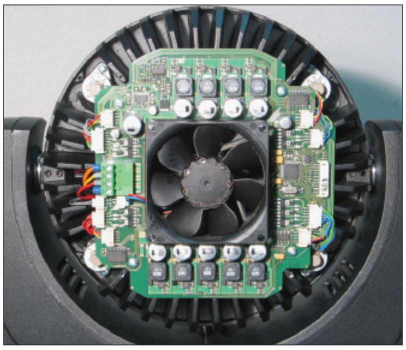

Fig. 18: Main LED driver board.

Fig. 19: Display.

Fig. 20: Connections.

for 180°. Positional repeatability on both pan and tilt was an excellent 0.09° - which is around 10mm of error at a 6m throw.

Both pan and tilt use motors in the yoke arm and use three-phase stepper motors, with a small positional encoder mounted to the back of the motor to reset the position if it is knocked or obstructed. Figure 15 shows the belt used for the tilt drive while figure 16 shows one of the motors with its associated encoder. Movement using these three-phase motors was very smooth with no noticeable steps or jerks at any speed.

As an aside, I have a new very handy tool for measuring pan and tilt angles on luminaires - my iPod Touch! A small inexpensive application for the iPod (or iPhone) uses the internal accelerometers to turn the device into a very accurate clinometer. This is much easier than the combination of protractors and squares I was using before.

Noise

There are six motors - pan, tilt and the four linear actuators for zoom. There is also a cooling fan in the head. Pan was the nosiest function but still relatively quiet.

Sound Levels

	Normal Mode
Ambient	<35 dBA at 1m
Stationary	38 dBA at 1m
Homing/Initialisation	40 dBA at 1m
Pan	45 dBA at 1m
Tilt	40 dBA at 1m
Zoom	41 dBA at 1m

Electrical parameters

The JBLED A7 has a fully power factor-corrected auto-ranging (100 - 24V 50/60Hz) power supply and consumed 2.75A, 330W with a power factor of 0.99 when running with all colours at full power.

The initialisation time from power up or from sending a reset command through the DMX512 control channel was 51 seconds. The unit was well-behaved: it went to blackout before starting to move in reset and didn't illuminate again until the reset was finished.

Electronics and control

All electronics are distributed throughout the unit. The top box contains the power supply, DMX512 input and the display and menu system. Motor control is in one yoke arm (Figure 17) and the main LED driver board is in the back of the head (Figure 18). The unit has a large, LCD-based display offering the usual range of set-up and diagnostic options (Figure 19). Interestingly, JB-lighting has fitted it with two sets of control buttons. The orientation of the display changes depending on which set you use - you always use the buttons that are below the display.

The JBLED A7 provides both five-pin and three-pin XLR connectors on the top box adjacent to the power cord for DMX512 in and out connections (Figure 20).

Construction

The unit is nicely constructed using a combination of sheet metal, aluminum die cast parts and moulded plastic. The unit will sit directly on the floor as shown in the photographs or, for suspension on truss, has two mounting points for omega clamps using quarter turn Camloc connectors. Access to the head and yoke arms is very easy for cleaning and maintenance; the top box is a little more involved. The overall shape with a disc-shaped head and small top box seems to be becoming a de-facto standard for LED-based wash units.

Conclusions

As I mentioned at the top of this article, this is the first LED wash light with beam angle control that I've measured, but I'm sure it won't be the last. The 3:1 zoom gives the JB-lighting JBLED A7 the potential to be a useful workhorse fixture. As always, I encourage you to try the unit in your own venue - LED fixtures are very difficult to measure accurately, and it's even more important that you try them out in the actual circumstances they will be used. As always, my intent with this review is to aid your decision but if my figures and your eyes disagree - then your eyes should win!

Mike Wood provides research and development, technical, and intellectual property consulting services to the entertainment technology industry. He can be contacted at mike@mikewoodconsulting.com

Next month in Technical Focus:

City Theatrical's ShowDMX