Martin MAC Aura

By: Mike Wood

Figure 1: Fixture as tested

Martin Professional is no stranger to these reviews; however, checking back, it seems that this is the first Martin automated LED wash light that I've tested. The market for small, LED-based moving head wash lights is booming; this is the most vibrant category within the automated lighting sector at the moment. The moving light market has been slow to recover from the industry tumble of 2009 and remains somewhat depressed, with users slow to replace their last-generation units. However, it's finally slowly climbing back, and automated LED wash lights are in the vanguard of that recovery. The move to LEDs has provided advantages that give users a reason to upgrade older luminaires; those advantages have been quickest to manifest themselves in wash lights. The MAC Aura, therefore, enters this busy sector at a good time—but how does it perform and compare with its many competitors? The important features of this new sector seem to be threefold: small and nimble units, well-homogenized color mixing, and beam control. How does the Mac Aura shape up in these areas? As usual, I'll try and help you make your mind up by presenting objective measurements of as many parameters as I can, taken from a sample of the unit supplied to me by Martin Professional (Figure 1).

Light source

As always, I'll start at the light source and work my way through the luminaire. The Martin Mac Aura uses 19 Osram Ostar-SMT LE ATB S2W emitters for the main light source; each package contains four dies—red, green, blue, and white—and is rated at around 10W total. (The Aura also has supplementary LEDs for its eponymous "aura" effect—but more on that later.) This LED package has no primary optic, just a glass window, so it behaves as a Lambertian emitter, with light shooting out in all directions. Martin captures as much of that light as it can with a square profile light pipe placed in contact with the top of that glass window. Figure 2 shows an emitter and its associated light pipe. The latter homogenizes the four colors and leads the light up to a fixed lens at the other end of the pipe. Light pipes need to be quite long in relation to their width to perform good homogenization—at least 3:1 in ratio—and it looks like the MAC Aura pipes are somewhat longer than that. The unit is constructed in layers, like a sandwich. All the LEDs are mounted on a single heat-conductive circuit board that, in turn, is attached to a die cast aluminum heat sink in the center of the unit. The other side of the heat sink has the main circuit board forming the rear layer in the sandwich. Figure 3 shows the construction and the array of large bulbous lenses, injection-molded as a single plastic plate mounted in front of the light pipes. This lens array, which can move backwards and forwards through three stepper motors hidden among the LEDs, provides the zoom function of the luminaire.

Cooling

Behind the main circuit board is a single large fan, which blows through a hole in the center of the board and across the heat sink. This fan is thermally regulated and, in my tests, ran very slowly just about all the time. Admittedly, it was quite cool in my workshop, and I'm sure the fan runs somewhat more quickly in higher ambient temperatures. Figure 4 shows the fan with the surrounding circuit board. Martin has done a good job with thermal regulation. Luminaire output dropped to 96% of its initial cold output after the unit had been running at full power for around 30 minutes. It then stabilized at that level and didn't drop any further.

Optics

As already mentioned, the Aura essentially uses a three-component optical system; fixed light pipe for homoge-

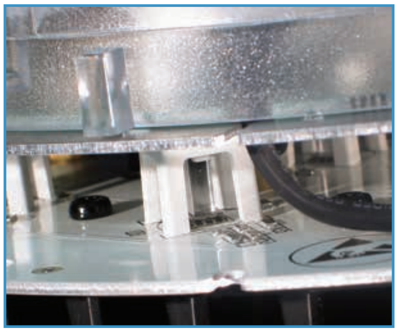

Figure 2: LEDs and light pipes

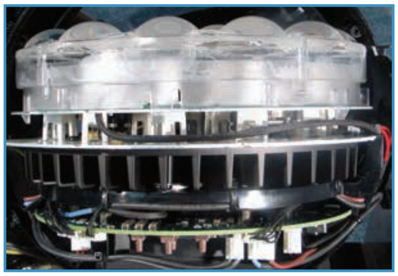

Figure 3: Optics and LEDs

Figure 4: Circuit board and cooling

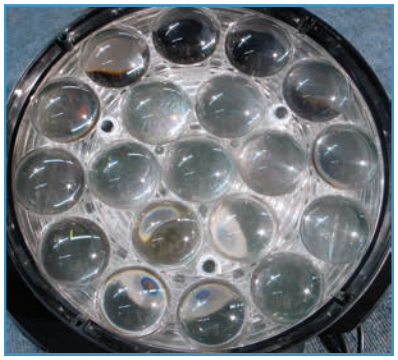

Figure 5: Main zoom lens

nization, a fixed first lens on top of the light pipe, and a moving second lens in the large array to provide beam angle control. Figure 5 shows a front view of that main lens array. You can see the 19 large lenses and three points where the stepper motors attach. Also visible in Figure 5 are the molded circular facets placed between the main lenses, reminiscent of those in a Fresnel lens. These serve to distribute the "aura" light from the secondary LEDs across the lens so as to evenly illuminate it.

Output

The Aura has a number of possible operational modes relating to how the RGBW emitters are controlled. For my measurements, I tested the unit in calibrated mode, where the user controls the values of RGB only and the unit provides the correct amount of light from the white emitter to complement the mixed color. In this mode, with the RGB control channels all at full, the unit's calibration produces a very acceptable mixed white at approximately 6,000K. (Running in raw, uncali-

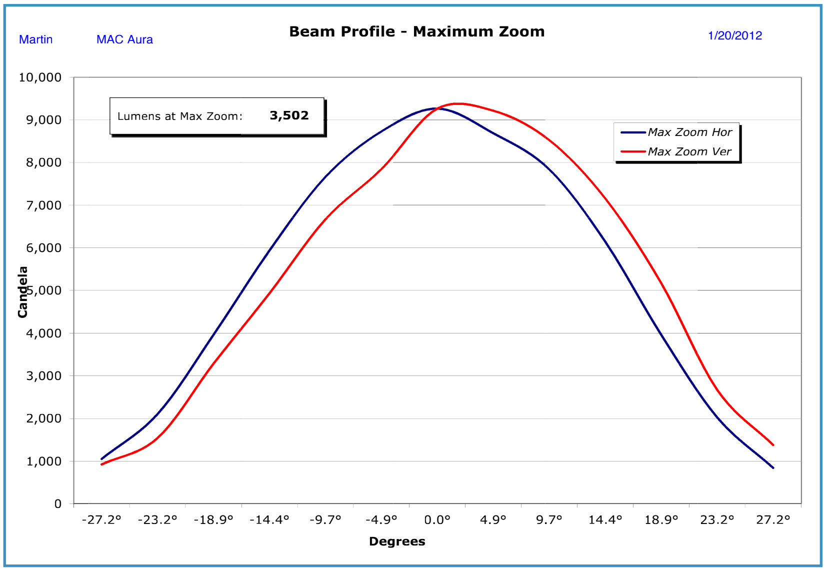

Figure 6: Maximum zoom

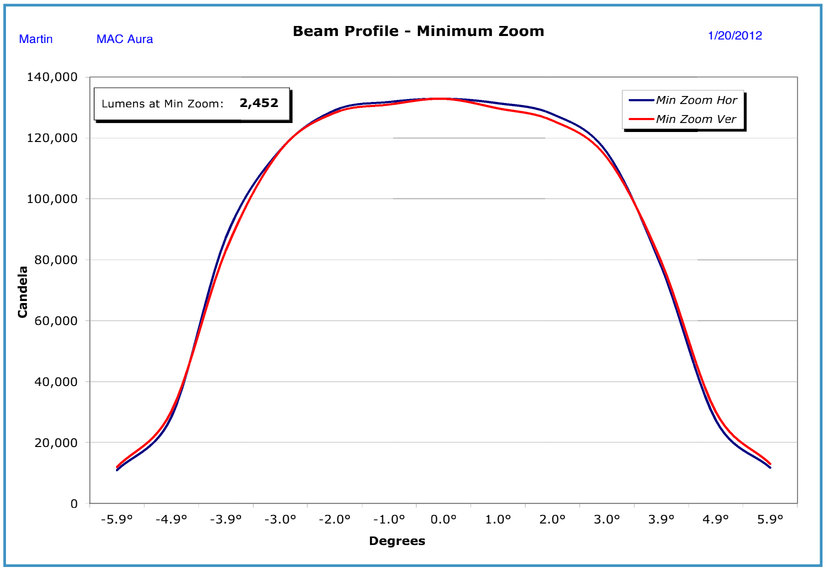

Figure 7: Minimum zoom

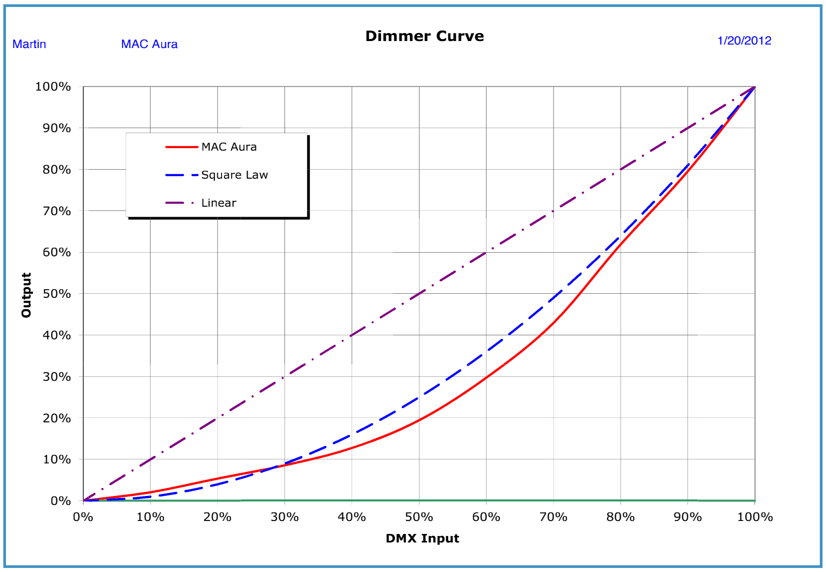

Figure 8: Dimmer curve

brated mode with all four RGBW emitters at full, the output is pinkish.) In calibrated mode, I measured an output of 3,502 field lumens at a wide angle of just under 55°, ramping down to 2,452 field lumens at the narrow angle of 11.8°. This is an excellent zoom ratio of 4.6:1 (Figures 6 and 7). As you can see from the charts, the beam profile varied quite a lot as the unit zoomed, from a flat-topped, steep-sided distribution at the narrow end moving to a peakier, blending distribution at the wide end. There is also some "blooming" at the extreme narrow positions within 10% of the top of the range, with spill light increasing as you get near the focal point of the lens. In raw mode, I was able to get about 7% more light, but, personally, I prefer the calibrated colors.

Color homogenization was good at all beam angles; I could see some colored patches at the widest angles, but nothing too significant. There were no real problems with colored shadows, either. The zoom mechanism, which is a little noisy, takes about 0.8 seconds to move from one end of the range to the other.

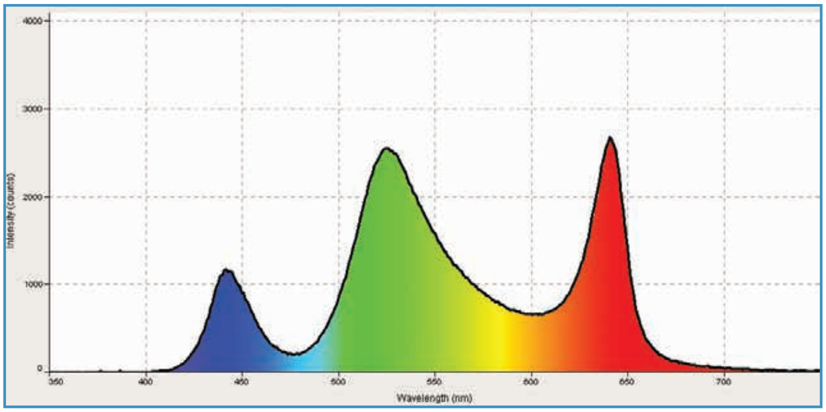

Figure 9: Spectrum - calibrated mode all channels full CTC 0

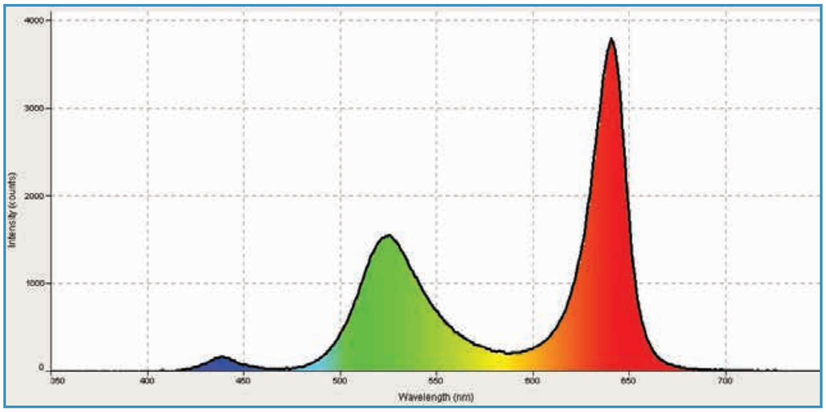

Figure 10: Spectrum - calibrated mode all channels full CTC 100

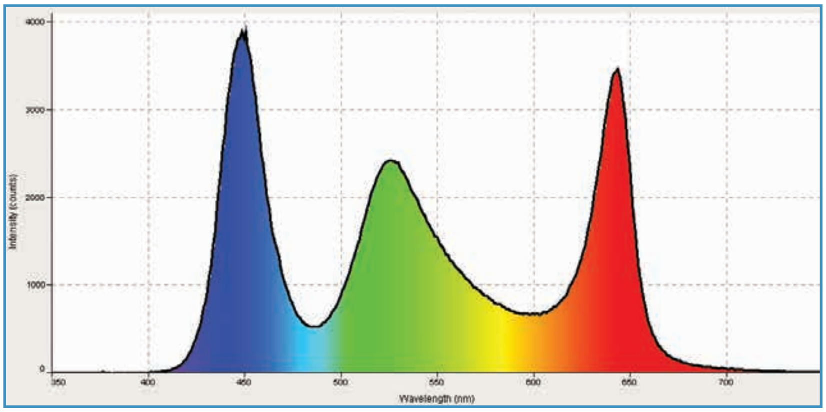

Figure 11: Spectrum - raw mode all channels full CTC 0

Dimming

The dimming curve is shown in Figure 8. The Aura has four user-selectable options for this curve: linear, square law, inverse square law, and S-curve. I used the default square law. It is always my preference, if available, because it matches the response of the human eye and gives natural-looking fades. The curve is smooth and, visually, the dimming performance is excellent. I set the dimming mode to "smooth;" all transitions were clean and step-free, even at the very bottom of the range. The smooth mode behaves a little differently with large and small transitions. For example, with any step intensity change of less than 20%, the unit smoothly fades from the current level to the new. If the change is 21% or higher, it does a snap change. This probably gives the transitions you want most of the time, but it's important to realize what is going on or you may be surprised by the results. You also have the option to set dimming in fast mode, which is, in fact, the default setting. In that mode, all changes are speedy, but you will see some steppiness with slow fades. For my taste, the smooth dimming mode is the one to use.

Color consistency is very good across the whole dimming range; I only saw very small variations in color as the unit was dimmed, and then only really in the very bottom 1-2% before black. That final transition to black is also very nice—one of the best I've seen to date with an LED-based unit. There must always be a last step between the LEDs being on, albeit at a very low level, and, being off, and it's hard to disguise that final jump. Martin deserves credit here for a job well done.

As we've come to expect with LED-based units, the Aura has a comprehensive range of strobes. I measured the basic strobe speeds as ranging from 1Hz (one flash every second) up to 20Hz.

The measured PWM frequency was 1.2kHz, fast enough that video use shouldn't be a problem. It also looks like Martin varied the PWM phase angle between the colors to further help with aliasing issues.

Color system

The color mixing is normal for an RGBW unit. Martin has also provided a color temperature (CTC) channel, which provides color temperature control when the unit is set to produce white light. (I found that it does slightly unpredictable things when the unit is producing colored light) Figure 9 shows the spectrum when the unit is in calibrated color mode, and is set to full white with the CTC channel at zero. In this mode, I measured the color temperature at 6,000K. Figure 10 shows the same output spectrum when the CTC channel is at full. I measured this at 3,040K. (Note: All color temperature readings should be taken with a large pinch of salt when the light source consists of narrow-band LED emitters. You are unlikely to get two meters that agree.). The system does a good job of mixing pleasant whites. Inevitably, you lose output as you lower the color temperature. Figure 11 shows the full output when in raw mode and all emitters are at full; I measured 58% of maximum output when set to a calibrated 3m040K and 60% at 3m200K.

Martin also provides an effects mode for the color channels, with which you can select pre-programmed gel colors from the Lee range, and also run it in color-chase or simulated-color-wheel modes.

The outputs in the main mixed colors of each emitter as a percentage of full output were as follows.

COLOR MIXING

Color	Red	Green	Blue	Cyan	Magenta	Yellow	White
Output	17%	40%	15%	44%	25%	49%	50%

You can see that these figures don't add up linearly; this is expected, and is a consequence of the color calibration and power-sharing algorithms tweaking levels behind the scenes.

Aura

The aura is the product's unique feature. In addition to the main LEDs, the unit also has a secondary set of RGB LEDs, mounted on the same circuit board, whose task is only to illuminate the front lens, not to provide output. This light is deliberately diffused and relatively low-level, so as not to provide any coloring of the actual output beam with the Fresnel-like facets on the lens helping the distribution. It's quite an interesting effect, as you can choose a contrasting color for the aura without affecting the main beam. For example, you can color the lens red while the unit is producing a blue beam. Figure 12 shows a couple of examples

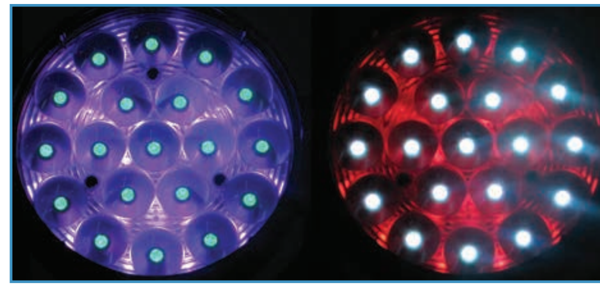

Figure 12 - Aura effects

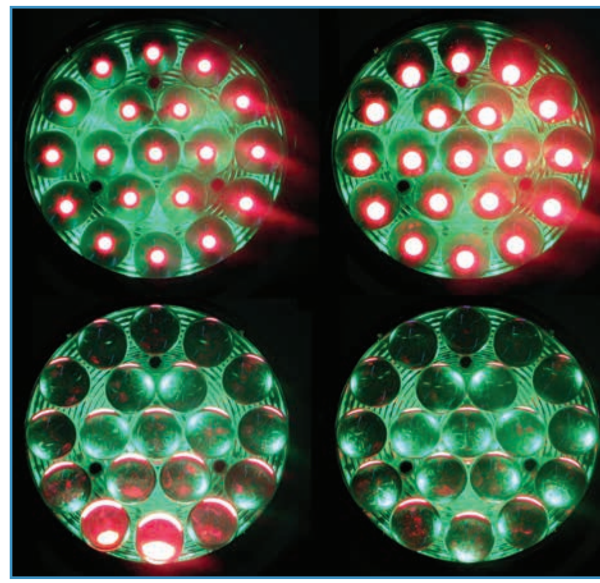

Figure 13 - Aura while zooming

of the possible effects. These are somewhat hard to photograph, and quite a bit of juggling with zoom levels and outputs is necessary to get the best out of this feature. The effect varies significantly as you change the beam angle of the unit. Figure 13 shows four stages as you zoom, with no changes to light levels, as the MAC Aura changes from minimum beam angle (top left) to maximum (bottom right). These pictures were taken with the camera slightly off-axis as the effect changes, depending on your position relative to the beam. The unit provides a second set of color DMX512 channels to control the aura LEDs, as well as options to synchronize them in some manner with the main output. You can have the aura automatically use a complimentary color, for example.

Pan and tilt

The Aura has a pan range of 540° and a tilt range of 230°. The full range pan move took 2.5 seconds, while a more typical 180° move finished in 1.1 seconds. Tilt took 1.1 seconds for a full move and 0.9 seconds for 180°. Positional repeatability on both pan and tilt was excellent, with an error of only 0.07° on pan and 0.03° on tilt. These equate to 0.3" and 0.1" of error at a 20' throw respectively. The mechanical system is a stiff one, so hysteresis is minimal, but there is some bounce on final positioning. With

Figure 14: Pan motor and encoder

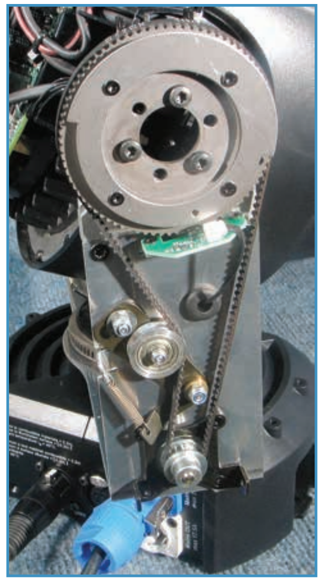

Figure 15: Tilt system

pan, the final bounce was up to ten times the hysteresis error, while with tilt it was around two times. Slow speed movement was very good, smooth and accurate. Both main movement motors are mounted in the yoke; Figure 14 shows the pan motor in one side, while Figure 15 shows tilt in the other.

Noise

The Aura is a very quiet unit most of the time. As I mentioned earlier, the thermally controlled fan always ran quite slowly for me. However, to test how it would behave in very high ambient temperatures, I switched the fan manually to full speed mode and measured that as well.

SOUND LEVELS

	Normal Mode
Ambient	<35 dBA at 1m
Stationary, output full.	35 dBA at 1m
Homing/Initialization	43 dBA at 1m
Pan	44 dBA at 1m
Tilt	40 dBA at 1m
Zoom	45 dBA at 1m
Stationary with Fans at full speed, output full.	51 dBA at 1m

The zoom system produced the most noise in normal operation. The gear systems in these linear actuator stepper motors are often quite noisy.

Electrical parameters

The Aura is rated for operation on a 100-240V AC 50/60Hz supply, auto switching. At the 120V I was using, I measured a static power consumption of 139W at full output when in calibrated color mode, and 196W in raw color mode. In both cases, the power factor was around 0.98. Quiescent power consumption with all LEDs off was 13W at a power factor of 0.73. This consumption equates to an efficacy in color calibrated mode of 25lm/W at wide angle and 17.6lm/W at narrow angle.

The initialization time, from power up or from sending a reset command through the DMX512 control channel, was around 20 seconds. The unit is very well-behaved when reset live; it does a nice slow fade to black before moving the motors and then a slow fade back in again after homing is finished. I always appreciate that attention to detail.

Electronics and control

The Aura has a traditional control menu with four-button navigation. Slightly unusually, these are mounted on the top and bottom of the head, above and below the fan grill. As soon as you press any of the buttons on the control pad, the unit disengages pan and tilt, so you don't have to chase it around. Pan and tilt re-engage a few seconds after you exit the menu system again. Figure 16

Figure 16: Rear of unit

Figure 17: Menu display

Figure 18: Connections

shows the positioning of the controls, while Figure 17 shows a close-up of the display.

As is the case with the controls and display, most of the electronics are located in the head. The main board and drivers are in its rear, while power supplies are in the base of the unit. Connections for power and DMX512 are also in the base with standard PowerCON and five-pin XLR connectors (Figure 18). The MAC Aura also supports RDM for remote configuration.

Construction

Construction is fairly standard for Martin; the Aura has a steel-and-aluminum chassis with injection-molded plastic covers. However, the plastic covers are important, as they also provide a significant part of the structural rigidity. The yokes are very springy until the covers are fitted, for example.

Disassembly is not that easy. It seems that the unit is not really designed to have many user-serviceable components. There are many screws, all of which have Torx heads, and it is not possible to remove and change the LEDs without disconnecting and removing the wiring harness, including cutting the cable ties (which I didn't really want to do on the test unit). If the LEDs really do last the rated 50,000 hours, then this isn't a problem. The top box is similarly tricky to get into. Overall, it's a very neat small unit with a lot crammed in. I enjoy testing luminaires I can pick up with one hand!

Conclusions

That's about it; the Martin Mac Aura, definitely a strong entrant in the busy field for small automated LED wash lights. Is it a winner, and what does the Aura feature bring to the mix? As usual, I've provided the data, but you get to decide.

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