Fig. 1: Fixture as tested

The Martin MAC TW1

by Mike Wood

A few issues ago, we tested the Vari*Lite VL500, which joined High End System's Studio Command H in the incandescent wash light sector—which, up until fairly recently, has been fairly quiet. This month, we look at another entry into this arena—the Martin MAC TW1 (Fig. 1).

Although they occupy the same broad category, a direct comparison between the MAC TW1 and the other units is not really correct. The High End and Vari-Lite units are based on parabolic reflectors and use full-field color-mixing systems, while the MAC TW1 uses ellipsoidal optics and a more conventional color-mix system. The characteristics of those optical systems are very different—the parabolic system is good for very tight, almost parallel, beams, while the ellipsoidal system offers a blending distribution with good zoom range. They're different fixtures for different jobs; however, some comparison is inevitable, so this review seeks to present a comprehensive set of measurements to allow you to decide which is right for you.

The review starts at the lamp and works through the fixture to the output lens, presenting the measurements in as objective a manner as possible. As always, these results are based on the testing of one specific unit supplied by the manufacturer as typical of the product.

The MAC TW1 supplied for the review was fitted with the multi-voltage IGBT lamp dimmer, which was used for all tests. The fixture was run off a nominal 115V, 60Hz supply, which actually measured 117V at the fixture input.

Lamp

The MAC TW1 is one of the first fixtures to use the new Philips FastFit incandescent lamps—in this case, a 1,200W, 115V version (Fig. 2). Each of these lamps uses a twist-and-lock base, which makes for a very easy lamp change and ensures accurate positioning of the filament. This lamp has a 3,200K color temperature and a nominal life of 300 hours when run at the full voltage. I measured the full output of the TW1's dimmer at around 111V when run from 117V. As with all incandescent lamps, a slight reduction of voltage makes a big difference to its life, so this small change would give an effective life increase of about 158%, to just under 500 hours. This may be deliberate on Martin's part, to get a significantly better lamp life at the expense of a reduction of about 11% in light output and around 50K in color temperature. If you run the lamp from an external dimmer, you might want to bear this in mind and do the same.

To repeat, the lamp change is very simple. Figure 3 shows the lamp replacement panel. Releasing the single captive screw allows this door to swing open, revealing the ceramic base. Twist this 45° anti-clockwise, and the lamp can be pulled out. Replacement is the opposite procedure, making sure that the lamp connector pins align with the slots, and turning it until it clicks into place. These pins are keyed—one is larger than the other—ensuring that the lamp goes back in the same way round it came out (Fig. 4: Lamp change).

The TW1 uses a large glass cold-mirror ellipsoidal reflector, followed by a hot mirror to keep as much heat as possible in the rear of the unit. In fact, the whole of the lamphouse is maintained as a sealed compartment, using ducted air from a blower mounted in the front of the head for cooling, coupled with large cooling fins around the reflector. Figure 5 gives a view of the fixture with the optics removed; you can see the lamp, reflector, and hot mirror very clearly. Figure 6 shows a close-up of the blower fan and twin pipes, which duct external air into the lamp-house assembly. (Note the elastic mounting for the fan for noise reduction.) The cooling system performed very well and very quietly—more about this later.

Dimmers and strobe

Immediately after the hot mirror is the single mechanical dimmer/strobe flag. It's a long way out of any focal planes, and produces very smooth, clean, full-field dimming with no evidence of beam artifacts or glitches over the majority of the dim range. You get a very slight, right-to-left curtain effect as the fixture finally blacks out, but it's a minor complaint. The engineers have clearly put some trouble into adjusting the movement of this flag, and the dimming curve from this mechanical dimmer was as close to matching the hypothetical linear light curve as I've seen. The strobe speed range of 2-5Hz was also pretty good for an incandescent unit with its large aperture.

As mentioned above, you have various options with dimming: the mechanical dimmer, the internal IGBT electronic dimmer, or an external dimmer through a connector on the control panel. (There is also a fourth option planned, which will use an internal 80V

Fig. 2: Lamp

Fig. 3: Lamp replacement panel

Fig. 4: Lamp change

Fig. 5

Fig. 6

dimmer for a low-voltage version of the lamp.) Each has its advantages and disadvantages. Using the mechanical dimmer gives much "snappier" strobes and blackouts than either electronic option, as the large 1,200W filament takes a few seconds to dim out. On the other hand, the dim curve and red-shift of the electronic dimmer will allow you to match the output and dimming of the TW1 to other conventional dimmer-driven fixtures in your rig. Each has their time and place.

All the measured dimmer curves are shown in Figure 7, along with hypothetical square law and linear light law curves for comparison. I found a minor issue with the software at this point. The manual states that there are three selectable dimmer curves available: linear, square law, and inverse square law. The unit tested did not have the inverse square law curve available, and Martin confirmed to me that this curve is not in the first release of software.

There is also significant confusion with the nomenclature "linear" when applied to a moving light. It's often used to describe a possible dimmer curve; however, different manufacturers mean different things by the term. It could potentially mean linear voltage, linear power, or linear light output, depending on who you are talking to, what continent you are on, and what kind of unit is using it. Conventional dimmer manufacturers in Europe often mean linear voltage or linear power, whereas U.S. dimmer manufacturers and all moving light manufacturers usually mean linear light output. With moving lights this makes sense, because they are usually referring to a mechanically dimmed discharge lamp where the voltage is irrelevant. The confusion here is in deciding what is meant in the TW1—this is a moving light, so linear should mean linear light output. Or should it? It's also an incandescent lamp running off a dimmer, so linear could mean linear voltage. Which is it? Well, in the TW1, with Martin being a European manufacturer, linear means linear voltage, which is far from linear in light output. This explains the steep "linear" curve in Figure 7.

To my mind, a linear voltage dim curve is pretty useless in practice, as it curves so steeply and gives you little control at the top end; I suggest you use the square law. There's no such confusion with this term; it's defined on light output by everyone and, as you can see, the TW1 does an excellent job of matching the theoretical curve.

Color mixing

Next in line are three CMY dichroic color-mixing wheels. These are fairly standard, with a conventional etched "finger" pattern. Figure 8 shows the edge of one of the wheels just starting to cover the aperture. As with the mechanical dimmer, the color mixing is a long way out of focus and consequently is very smooth, with excellent homogenization and no visible difference in color from one side of the beam to the other.

This is an incandescent unit, so color mixing always looks a bit different from the discharge lamps we are more familiar with in moving lights. The TW1 system gives a good range of colors, from the pastels to more saturated colors; its only weakness is in the deeper blues, where incandescent lamps have very little energy. There are very nice ambers and reds, as you would expect, but also a good range of the pale and mid-blues beloved by theatrical lighting designers (Fig. 9: Color mix).

Color Mixing

Color	Cyan	Magenta	Yellow	Red	Green	Blue
Transmission	7%	12%	89%	12%	3%	4%

Color change speed – worst case	1 sec

Lenses and output

The TW1 uses a slightly unconventional optical system for a wash light, with three lenses forming the zoom system.

Immediately after the color mixing is the first static lens, a large and very thick aspheric condenser (Fig 10). Next in line is a very unusual compound lens made up of hundreds of individual lenslets (Fig.11); this is the element that moves to provide the zoom function. I'm sure those lenslets also have a lot to do with homogenizing the beam. This element has a very long travel (as can be seen in Figure 12), which accounts for the relatively slow zoom time of eight seconds, end to end. The final lens is the front Fresnel lens, again static. Figure 13 shows another view of the system.

The measured field angle range was 21-41°, with total lumens in open white ranging from 7,790 in narrow angle to 9,295 in wide. (Fig. 14: Output at narrow angle; Fig. 15: Output at wide angle). These figures are about what you would expect from an incandescent unit with color mixing and compare well with rival units.

Pan and tilt

The MAC TW1 has the industry-standard pan-and-tilt ranges of 540° and 242°, respectively. In "normal" mode, a full range pan move took 7.6 seconds, while a more typical 180° move took 3.4 seconds. Tilt took 4.1 seconds for a full 242° move and 3.4 seconds for 180°.

Positional repeatability on both pan and tilt was 0.13°—which is around 0.5" of error with a 20' throw. Movements are generally very smooth, with just a little bounce when the unit comes to a halt—but this was only noticeable when fitted with my testing laser and won't normally be visible with a soft-edge wash light.

The pan and tilt mechanisms are familiar and share a lot with other Martin units (Fig. 16: Yoke arm tilt system). One noticeable change is the addition of a relay to both the pan and tilt motors (visible on the circuit board just above the motor in Figure 16), which shorts out the stepper motor windings when the unit is powered down. Shorting the windings makes the stepper motor very hard to turn; consequently, the motor acts as a brake, stopping the head flopping about when powered down—a neat touch.

Noise

Martin has clearly put a lot of work in on trying to make the TW1 quiet—I'm sure the company is aiming this product at the theatre market. Sound levels were consistently low, with the most noise coming from the zoom lens system. A couple of motors exhibited whines; again, the zoom system was the main culprit, but overall ,it is a quiet unit. The TW1 offers three modes of operation: "normal" and "studio" modes—where motors all run at normal speeds and the fan speed is regulated by the temperature of the unit—and "silent" mode, where the motor speeds are reduced slightly and the fans are set to an absolute minimum. (Note: The manual says that the fans are turned off in silent mode; this isn't correct. In particular, the lamp blower continues to run, albeit more slowly than usual.) These tests were carried out in an ambient temperature of 75°F (24°C).

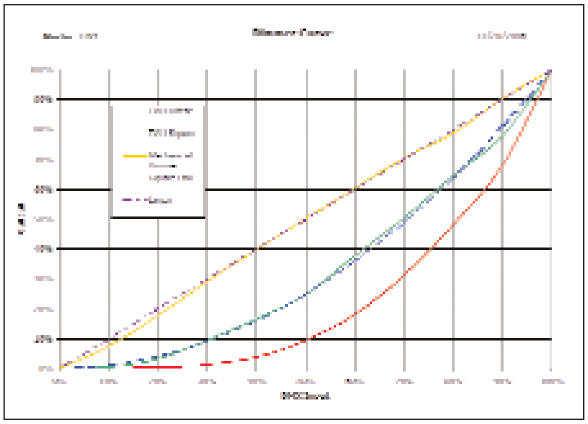
Fig. 7: Dimmer curves


Fig. 8: Color mix aperture


Fig. 9: Color mix

Sound Levels

	Normal Mode	Silent Mode
Ambient	<35dBA at 1m	<35dBA at 1m
Stationary	37.5dBA at 1m	35.2dBA at 1m
Homing/Initialization	42.3dBA at 1m	40.7dBA at 1m
Pan	41.3dBA at 1m	39.8dBA at 1m
Tilt	40.3dBA at 1m	38.4dBA at 1m
Color	43.5dBA at 1m	36.3dBA at 1m
Zoom	50.0dBA at 1m	48.1dBA at 1m
Strobe	38.1dBA at 1m	35.2dBA at 1m

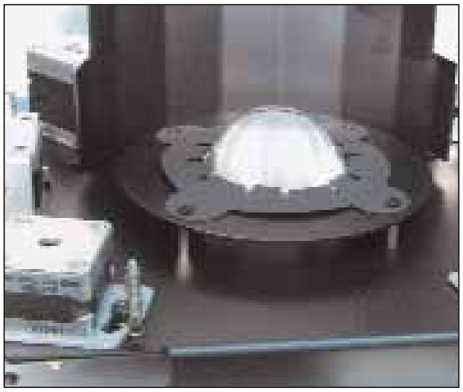
Fig. 10: Condenser lens

The strobe in "silent" mode is reduced slightly in amplitude, so that there is no danger of it hitting the end stops—it's almost completely silent, but the strobe contrast ratio is reduced.

Note the extra fans in the yoke arm in Figure 17—these are only used to cool the fixture when it's pointing straight down and the lamp house is within the yoke. At that angle, the cooling fins probably don't work as well and heat could get trapped inside the rear of the unit. In my tests, running in silent mode, these fans never came on.


Fig. 11: Compound lens

Electrical parameters

Power consumption at 119V, 60Hz

	Current, RMS	Power Factor
Max when initializing (no lamp)	0.5A	0.99
Normal running (with lamp)	10.5A	0.99

Homing/initialization time

Initialization took an average of 39 seconds from a cold start and a maximum of 45 seconds when the fixture is powered up and a "reset" command is sent. The time depends on where the zoom lens is positioned, as this is the slowest to move. The reset functions are well behaved and the unit doesn't reopen its shutter or power up its dimmer until the fixture has completed its position changes.

Construction

The MAC TW1 has a neat and tidy construction with easy access to all the major serviceable components. Removing the complete optical


Fig. 12: Optical module showing zoom travel

Fig. 13: Condenser and compound lenses

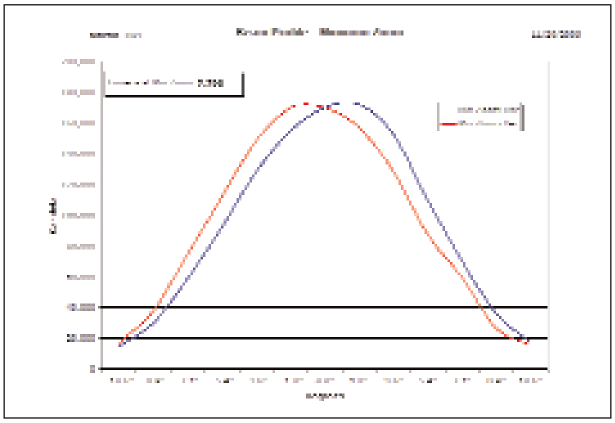

Fig. 14: Output at narrow angle

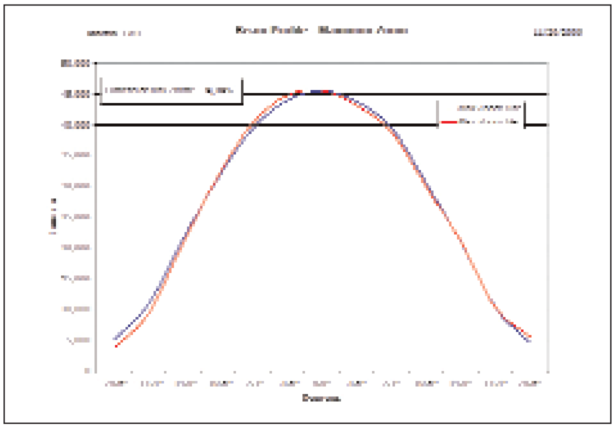

Fig. 15: Output at wide angle

module is a quick and easy task; just two screws hold the module in place, once the front and top covers are removed. With the optical module removed, the fixture chassis is as shown in Figure 5.

The covers themselves are worth mentioning. At first glance, this looks like the usual current-day fixture—a sheet metal chassis with injection-molded plastic covers. However, the covers on the TW1 are not plastic; instead, they are thin wall magnesium moldings. My guess is they were manufactured using the relatively new thixotropic molding technique which, with careful control of temperature and pressure, allows the use of magnesium in tooling very similar to plastic injection molding. You see this technique used extensively in laptop computers and PDAs, as it permits a design with very thin walls (down to 0.5mm) and high detail—but in magnesium rather than a plastic. The use of magnesium gives the designer a component which has both greater strength and much better heat transfer characteristics than a plastic, while still remaining attractive and lightweight. I've been expecting to see this manufacturing process show up in a light before too long and it was good to see it here—it's perfect for assisting heat transfer out of the unit. Take a look at Figure 18 to see the level of detail you can get using this process and how thin the walls are. A number of other TW1 parts are made using this technique.

One comment: the front and top covers are such a good fit and the safety bonds holding them to the fixture are just long enough (I'd have liked another 0.5" on each) that it takes some practice and fiddling to get them back in place again. Try this out in the shop before climbing the truss.

Access to the electronics in the head is also very simple; both side panels drop down with their associated electronics after removing four screws. One side of the top box has the fixture motor control electronics, while the other side has the dimmer (either standard IGBT or the 80V

Fig. 16: Yoke arm

Fig. 18: Thin wall covers

Fig. 17: Yoke fans

unit). The motor and electronics power supply is mounted in between the two panels. Figure 19 shows a view of the electronics side.

Electronics and Control

The TW1 has a good and comprehensive menu system in the usual Martin style, with many options and settings available in the firmware. In common with its sibling MAC units, the TW1 offers both standard five-pin XLR and the legacy three-pin XLR for DMX.

One addition to the control panel is the “external lamp supply” input socket and associated selection switch (Fig. 20). As mentioned earlier, you have the option of powering the lamp from an external dimmer rather than the internal one. Take great care if you use this option with the 80V lamp—it won’t last long on 115V or 230V!

Well, that’s it; the MAC TW1 enters the increasingly busy incandescent wash light market. How does it shape up? It’s clearly a physically larger unit than some of its competitors, but offers good light output and a wide zoom range in return. It’s also, as I said at the start, insidious to compare an elliptical-based unit with parabolic ones. It’s your choice and, ultimately, your decision as to which suits you and your application best. I hope that the information presented here helps you make that decision and, as usual, I leave you to draw your own conclusions.

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Fig 19 - Top Box

Fig 20 - Control Panel