Robe T1 Profile

By: Mike Wood

Figure 1: Fixture as tested.

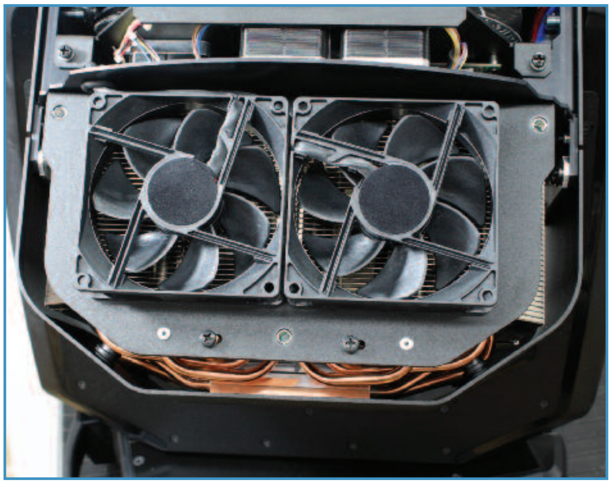

Figure 2: Cooling.

Robe is one of the few manufacturers producing automated profiles using additive color mixing. The main reason being that it's harder to get the output power in white light that you can with a subtractive white LED plus dichroic filters solution. However, what you lose in white output with additive mixing over subtractive, you gain in color control and color intensity. Personally, as you'll know if you read this column regularly, I'm a great believer in additive mixing and think that it will, eventually, come out on top for any applications where color is important. Maybe not yet, but it will! Robe has shown us four- and seven-color additive LED fixtures before, and our current subject, the T1 Profile, clearly comes from the same family. However, it has a different and somewhat reduced feature set making clear that it's aimed at a slightly different market.

As always, I've tried to test and measure everything I can, from power input to light output, and report the raw data so you have information to help you make your own mind up.

The results presented here are based on the testing—with the fixture operating on a nominal 120V 60Hz supply—of a single Robin T1 Profile unit supplied to me by Robe (Figure 1). The unit is self-adjusting for supply voltage and will run on any voltage from 100V – 240V, 50Hz/60Hz.

Light source

The T1 Profile uses a variant of the Atria light engine from Appotronics, fitted with five colors of LED rather than the usual single or dual white. In this case, the emitters are red, green, blue, amber, and lime. The lime emitters, like the mint used in other products, provide most of the lumens as their output closely matches the response curve of the human eye. They look green on their own but, mixed in with some red and blue, are capable of making good-quality mixed whites. The addition of amber to that mix improves the color quality and rendering at lower color temperatures. The difference between lime and mint is that lime has a single, very broad green spike from a number of opaque phosphors, with very little blue, while a mint emitter also has a blue spike from the pump LED similar to that seen in white phosphor LEDs.

The Appotronics engine assembly is cooled by the usual array of heat pipes, large finned heat sinks, and four fans, two on each side at top and bottom of the heat sink, as can be seen in Figure 2. The output from the light engine is

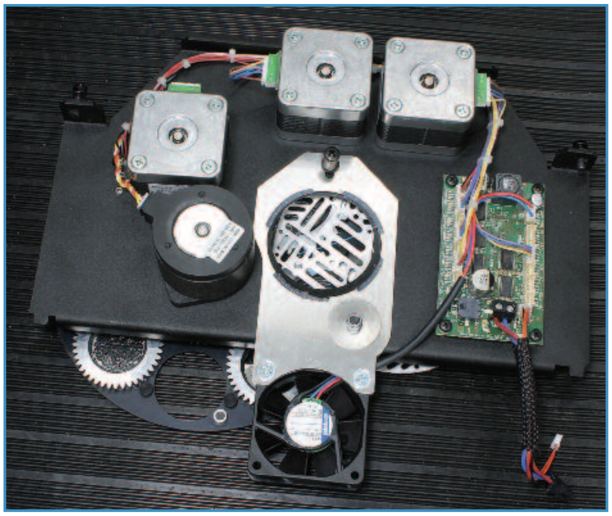

Figure 3: Relay lens.

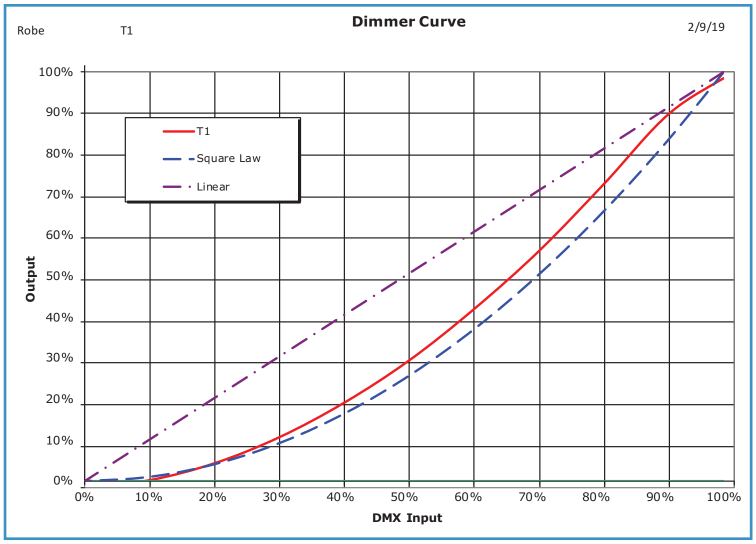

Figure 4: Dimmer curve.

directed through a final relay lens, which serves to further collimate it through the gate and optical systems. The relay lens can be seen glued across the aperture on the back of the gobo module in Figure 3.

Dimming and strobe

The T1 Profile offers a range of different selectable dimming curves; for this testing, I used my favorite, the square law. Figure 4 shows the resultant dimmer curve. Dimming was very smooth with no visible steps at low dim levels. The unit has options to run in tungsten emulation mode, where it adds simulated thermal delay of various sizes of incandescent lamps to the dimming. It also introduces red-shift to the dimming in this mode, so that the output warms as the lamp is dimmed. As with other Robe fixtures I've tested. The PWM waveform was interesting; it looks like Robe uses a couple of frequencies or phases of PWM, one superimposed on top of the other. The default is 600Hz, but there are higher-frequency components, on top of that, that are brought in as you dim down. It could be that this is just different strings of LEDs operated out of phase with each other, it's hard to tell. The base PWM rate is adjustable with four base frequencies, 300Hz, 600Hz, 1,200Hz, and 2,400Hz, tweakable in fine increments around those base frequencies through a DMX channel. With these controls, it should be possible to find a range and setting that produces minimum artifacts on camera. Strobe range is adjustable from 0.5Hz up to a measured 27Hz. The unit took about five minutes when running at full output to heat up to a stable operating temperature, during which time the output dropped by about 13%. All the results I provide in this report are taken after the unit has reached steady operating temperature so include the effects of the thermal droop.

Color systems

As with its other additive mixing products, Robe offers the option to control the color-mixing system through standard RGB or CMY controls in addition to providing direct access to each of the five LED channels. A virtual color wheel channel gives access to 66 preselected colors that are chosen to match popular gel colors. The user can also preprogram ten user colors, which are then accessible through this same channel.

Another feature we've seen on other Robe products is the range of calibrated whites. The T1 Profile provides a number of calibrated whites, with color temperatures ranging from 2,700K to 8,000K. I measured the color temperature, relative output, and color rendering using a Sekonic C800 meter as follows:

	COLOR TEMP., K	RELATIVE OUTPUT	TM-30 RF	TM-30 RG	CRI RA
8000K	7670	100%	82	111	80.7
6600K	6426	95%	83	112	79.8
5600K	5672	90%	84	112	79.6
4200K	4353	80%	86	110	81.3
3200K	3359	69%	87	109	81.1
2700K	2837	62%	86	109	78.5

Table 1: Output at calibrated whites.

These readings are taken when in the default low-color-rendering mode. Note that in all cases Rg is slightly over 100, which shows some oversaturation of colors. This likely isn't a bad thing; the human eye tends to prefer slight over saturation. This also explains why the TM-30 values are higher than the CRI. The latter incorrectly penalizes oversaturation more heavily than TM-30 does. I'd suggest that, if

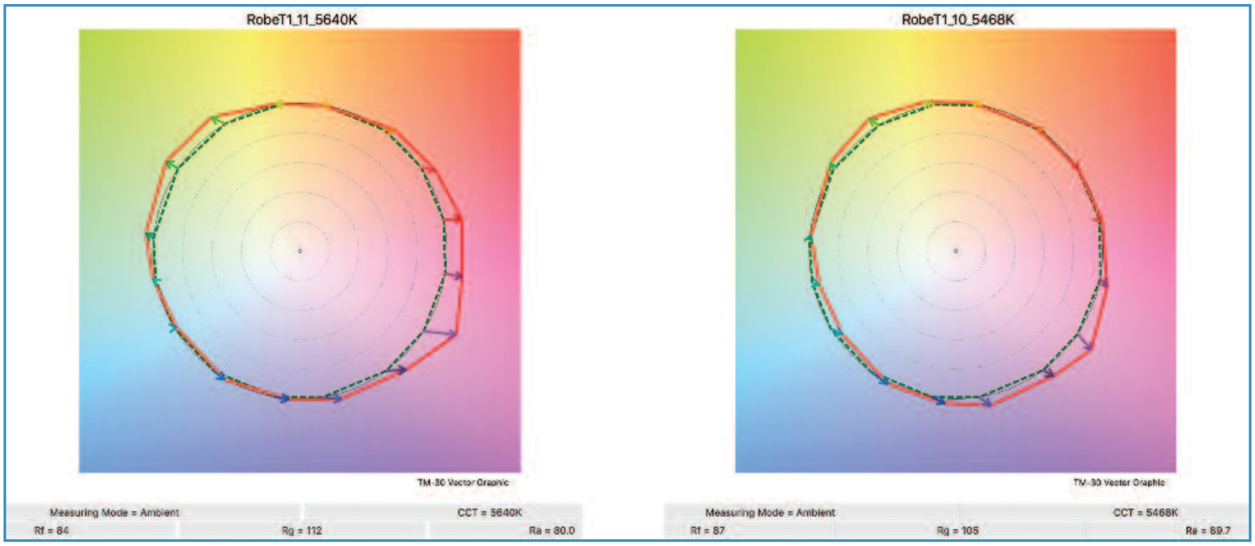

Figure 5: Color rendering.

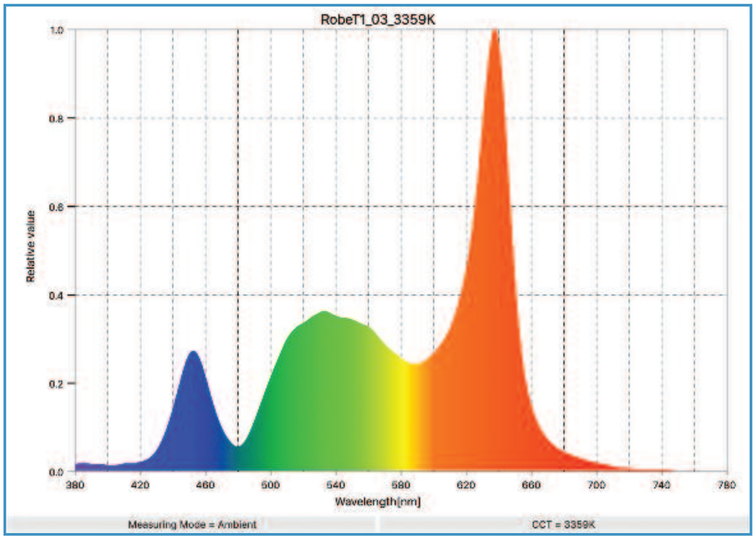

Figure 6: Spectral distribution - 3,200K low CRI

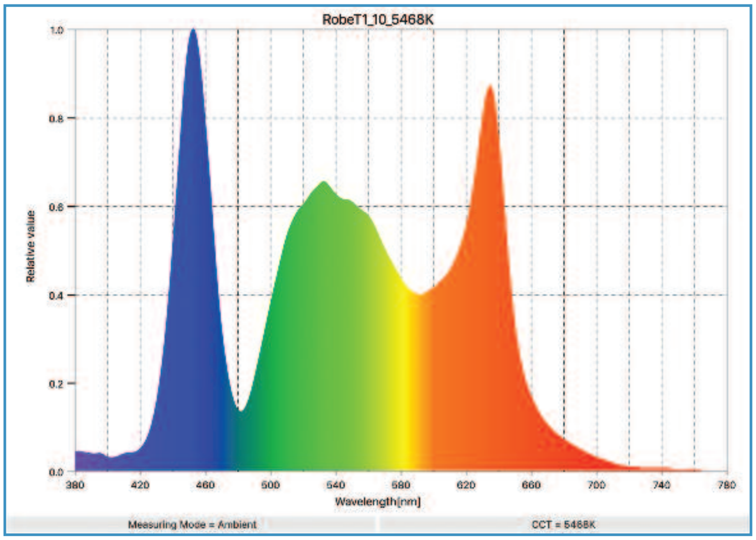

Figure 7: Spectral distribution - 5,600K high CRI

they used TM-30 rather than the outdated CRI, Robe would find that the color rendering is better than it thinks it is! You can also see from the TM-30 chart that any color-rendering issues are mostly in the green and magenta areas. When running at high color rendering, the outputs reduced slightly, and color rendering went up. Figure 5 shows an example, with the chart on the left showing the output at 5,600K in normal mode and the chart on the right the same but in high color rendering mode. In this case, the TM-30 Ra increased by three points and CRI Ra increased by ten points. In addition to these options, the unit also provides a CTO channel for whites between the calibrated values and a green correction channel for video users, which shifts the color point along the green/magenta axis.

COLOR TEMPERATURE	TM-30 RF MINIMUM	TM-30 RF MAXIMUM	CRI RA MINIMUM	CRI RA MAXIMUM
5600K	84	87	80	90
3200K	87	89	81	84

Table 2: Color rendering control.

Figures 6 and 7 show the measured spectra at the preset 3,200K and 5,600K settings. The broad green peak in the center is the lime emitter.

The table below shows the relative lumen output of the LED colors. As you would expect, the lime emitters provide most of the light. The light engine homogenizes the colors extremely well; there was an even color across the beam, with no objectionable colored shadows.

COLOR MIXING

Color	Red	Green	Blue	Amber	Lime
Output	10%	22%	4.4%	15%	62%

Now we move into the imaging portion of the optical train. The T1 Profile has two removable modules containing the majority of the optical effect components.

Gobo module

First in line is the gobo module. This has an animation wheel and a single rotating gobo wheel, along with the relay lens previously mentioned. Figure 8 shows the two wheels. The animation wheel is a large aluminum breakup pattern that can be swung across the beam. The distance you insert the wheel is adjustable, but not the angle of the axis of rotation. It takes 0.3 seconds to insert or remove the wheel and, once in place, it can be rotated at speeds varying from 0.08rpm up to 50rpm. The focus is quite a long way from the gobo wheel, but it is still possible to get overlaid effects from the two wheels.

Immediately after this is the rotating gobo wheel, which has seven replaceable glass gobos and an open slot. Figure 9 shows a gobo in its snap-and-lock carrier.

ROTATING GOBO SPEEDS

Gobo change speed – adjacent	0.2 sec
Gobo change speed – worst case	0.5 sec
Maximum gobo spin speed	0.48 sec/rev = 126 rpm
Minimum gobo spin speed	1440 sec/rev = 0.04 rpm
Maximum wheel spin speed	4.5 sec/rev = 13 rpm
Minimum wheel spin speed	260 sec/rev = 0.2 rpm

Rotation and indexing were very smooth, with a good range of rotation speeds. Movement was clean when changing direction, with very little hysteresis. I measured the accuracy at 0.03° of hysteresis error., which equates to 0.1" at a throw of 20' (5mm at 10m). The gobo wheel uses a quick-path algorithm to minimize change times.

Framing module

Figures 10 and 11 show both sides of the framing module, which also includes the iris. The shutter system mechanism is the same as on previous Robe units. Each shutter blade has approximately +/- 25° of rotation and can move in to

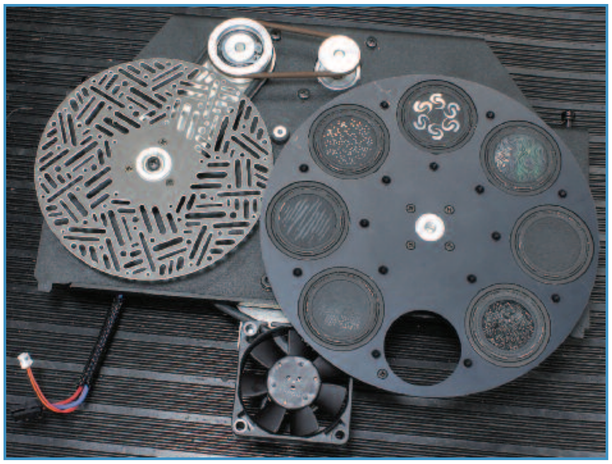

Figure 8: Gobo wheel.

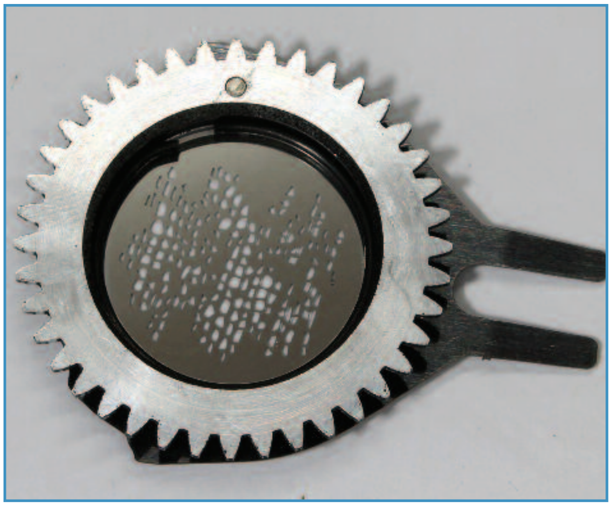

Figure 9: Gobo.

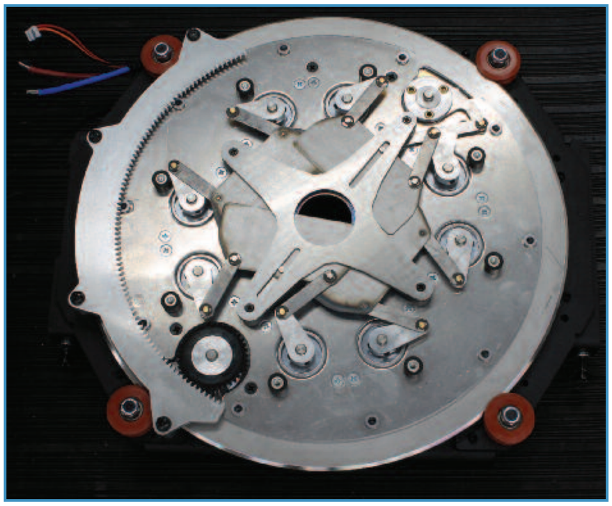

Figure 10: Framing shutters 1.

Figure 11: Framing shutters 2.

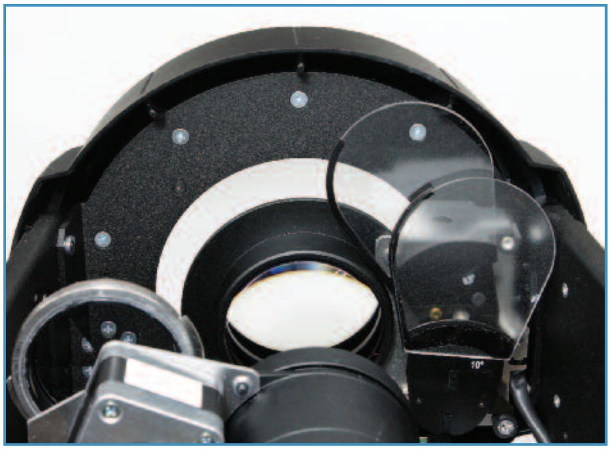

Figure 12: Prism and frost flags.

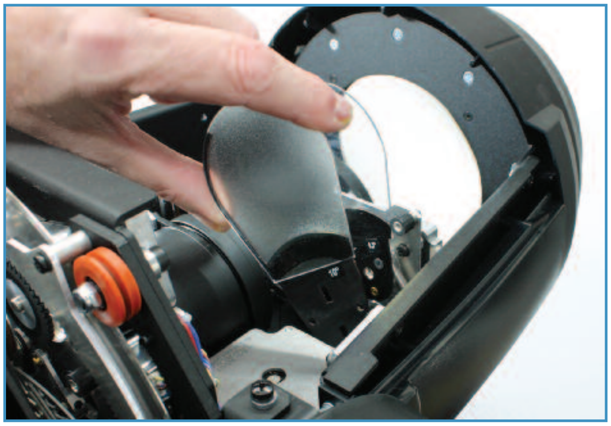

Figure 13: Frost change.

cover about 75% of the beam. The entire assembly can be rotated a further +/- 60°. The blades are small and can thus move fairly quickly, a maximum of about 0.4 seconds from fully open to fully closed. Rotation is much slower, at 2.3 seconds for a full 120°. Shutter cuts were straight with very little pincushion or barrel distortion. As with the animation wheel, the focus for the framing is quite a distance from that of the gobos. However, it is possible to get a reasonable soft-focus framing cut on top of a gobo.

Finally, for imaging effects, the T1 Profile has an iris. This reduces the aperture to 15% of its full size, which gives equivalent field angles of 1.1° at minimum zoom and 6.3° at maximum zoom. I measured the opening/closing time at around 0.25 seconds.

Prism and frost

The final optical effects in the T1 Profile are the prism and frost flags. There is a single, six-facet rotatable prism mounted to the output side of the rear lens group and two frost flags mounted to the input side of the front lens group. Both prism and frost travel with their associated lens groups. Figure 12 shows a view from the rear of the unit with the prism on the left, and frost flags on the right.

The prism can be inserted or removed in about 0.5 seconds and then rotated at speeds up to 120rpm in either direction. Image separation is about 50% at mid zoom angles.

Turning to frost, as already mentioned there are two flags. The rear flag is a heavy frost and is mounted on a magnetically attached arm for easy replacement. Figure 13 shows this flag being replaced. The frost supplied as standard is labeled 10°, and I assume Robe will make other frost types available. The second frost is a non-interchangeable light frost, labeled 0.5°.

In operation, I found the light frost was excellent; it gives a true frost (edge-softening) effect. The heavy frost, however, acts as a contrast reducer, not a frost. Figure 14 shows what I mean. Working from left to right, we have the unfrosted beam, 100% light frost, heavy frost at 80%, 100% light frost plus 80% heavy frost, and 100% heavy frost. You can see that the light frost on its own (second from left) softens the edges of the gobo pattern nicely, whereas the heavy frost on its own (center) leaves the edges sharp while reducing contrast over the entire beam, more like a wash light. However, I'm not complaining too much; it's good to have both types of frost available, a true frost and a contrast reducer/wash frost.

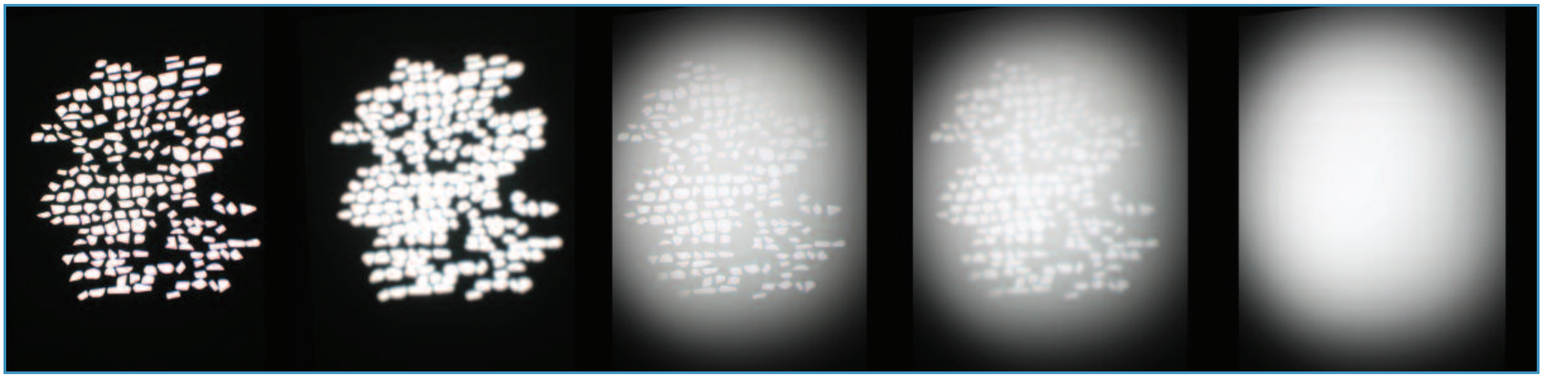

Figure 14: Frost effects.

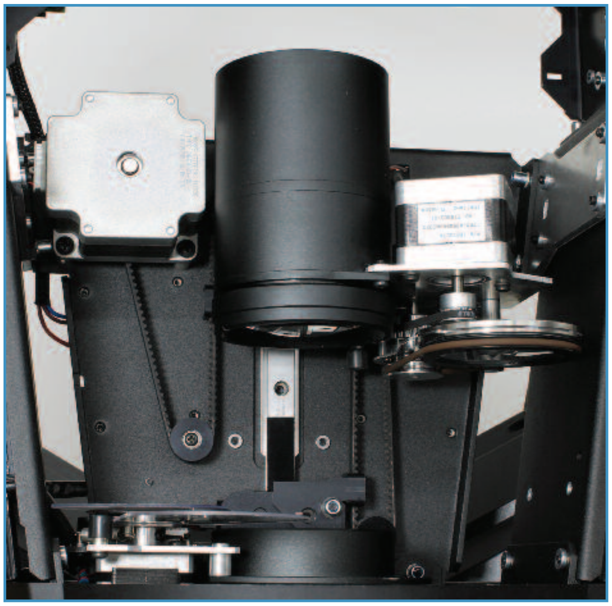

Figure 15: Lenses.

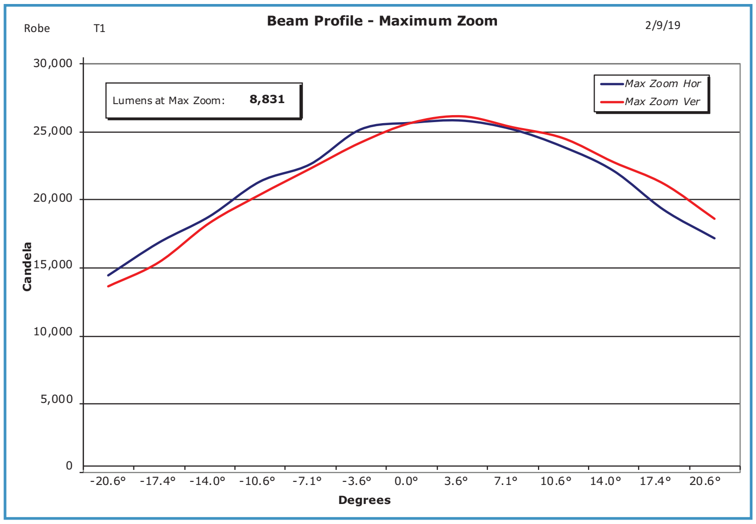

Figure 16: Maximum zoom.

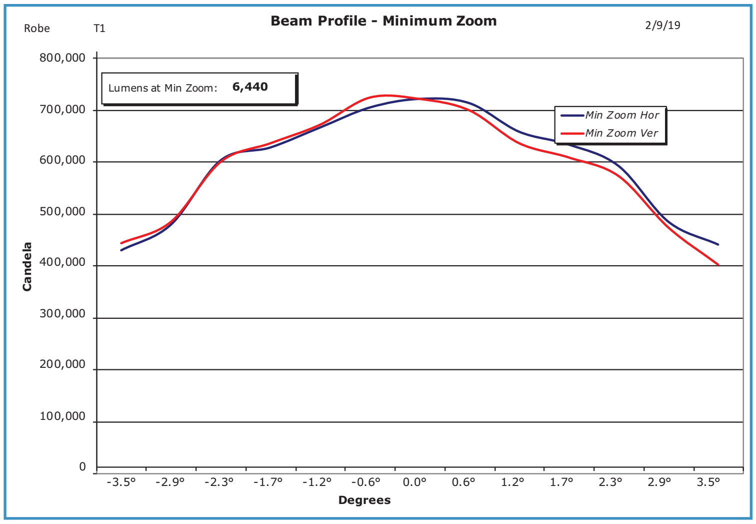

Figure 17: Minimum zoom.

Lenses and output

Figure 15 shows an overhead view of the two movable lens groups. The fixed output lens is out of shot at the top of the figure. These move to provide zoom and focus. I measured the zoom group as taking one second to travel from end to end, with the focus group taking 0.5 seconds. Robe produces its photometric data when the unit is producing the 8.000K low CRI white, so I measured at the same settings. I measured the output in wide angle at 8,830 lumens at a field angle of 41°, ramping down to 6,440 lumens at 7° field angle. As can be seen from figures 16 and 17, the beam distribution is extremely flat and smooth. You may need to reduce these figures to suit the color temperature you are using with the data in Table 1.

Pan and tilt

I measured the pan and tilt range of the T1 Profile at 540° and 280°, respectively. A full-range 540° pan move took 4.3 seconds to complete, while a more typical 180° move finished in 2.6 seconds. Tilt took 2.9 seconds for a full 280° move and 2.5 seconds for 180°. The pan and tilt systems use Robe's Electronic Motion Stabiliser system, which incorporates accelerometers in the head to detect external induced vibrations and cancel them out in the control system. This results in precise movement. I measured hysteresis on both pan and tilt at 0.06°, equivalent to 0.2" at 20' (10mm at 10m).

Noise

The four LED cooling fans provide the primary background noise in the T1 Profile. As usual, zoom and focus were the noisiest movement functions, followed by pan and tilt.

SOUND LEVELS

	Normal Mode
Ambient	<35 dBA at 1m
Stationary	37.4 dBA at 1m
Homing/Initialization	46.3 dBA at 1m
Pan	42.6 dBA at 1m
Tilt	42.0 dBA at 1m
Gobo	38.2 dBA at 1m
Gobo rotate	39.7 dBA at 1m
Zoom	45.1 dBA at 1m
Focus	45.4 dBA at 1m
Animation wheel	38.7 dBA at 1m
Iris	40.1 dBA at 1m
Frost	37.8 dBA at 1m
Prism	41.3 dBA at 1m
Framing Shutters	40.4 dBA at 1m

This was with the fans running in auto mode. The user can also take direct control of the fans if her or she wants to, with a subsequent reduction in light output if necessary.

Homing/initialization time

Full initialization took 65 seconds from either a cold start or a DMX512 reset command. Homing is well behaved in that the fixture fades out smoothly, resets, and keeps the LEDs off before fading up again after all reset movement is finished

Construction

The T1 Profile follows the standard Robe model; it is of modular construction, with the vast majority of the head components on the main modules. These modules are straightforward to remove with two captive screws and power and data connectors for each module.

Figure 18 shows the two yoke arms. One with the cabling and motor drive board for pan and tilt, and the other with the tilt belt and encoder.

The T1 Profile is also available with the connections and mechanical fittings to be fitted with the company's RoboSpot camera for use as a remote followspot.

Electronics and control

The T1 Profile uses the familiar color touch-screen system used in many of Robe's products. This provides access to a comprehensive array of setup and service functions (Figure 19). This includes RDM, Ethernet protocols, optional wireless DMX using the LumenRadio CRMX system, standalone operation, and self-test modes.

The connector panel on the opposite side of the top box contains Neutrik True-1 power input along with standard five-pin and three-pin DMX512 connections and an Ethernet port (Figure 20).

I measured power consumption when running at full output in 8,000K open white as 4.58A, 550W, 555VA, a power factor of 0.99. The quiescent load with all LEDs off was 0.65A, 78W, 79.4VA, power factor of 0.97.

That about covers it for the Robe Robin T1 Profile. It's an interesting, and brighter, variation on the company's previous DL4 and DL7 units, which also offered additive mixing from LEDs. Is the T1 for you? As ever, if you are interested, I urge you to try it out in your own space and decide for yourself.

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

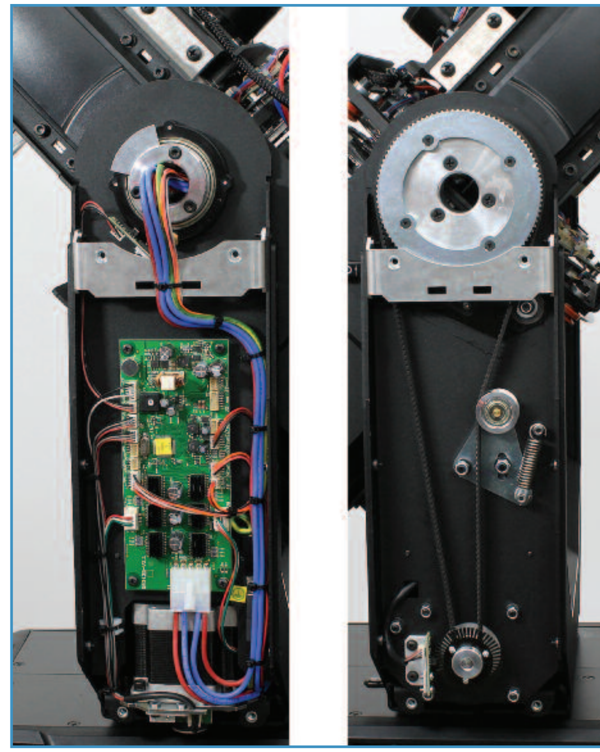

Figure 18: Yoke arms.

Figure 19: Controls and display.

Figure 20: Connections.