High End Systems trackspot Bolt

By Mike Wood

Figure 1: Fixture as tested

This review marks a first for me, which is strange, given that, over the course of eight years, I have reviewed nearly 50 products from many different manufacturers. In all that time, I've never reviewed a moving-mirror light. Now I right that wrong, as we look at the trackspot Bolt, from High End Systems. It marks a return to a well-loved product name for High End. The original trackspot represented the quintessential inexpensive moving-mirror light of the 1990s—small, quick and using a simple light source. Even though the trackspot Bolt is somewhat larger than the original, it's clear that it is designed for the same market niche. It's tempting to compare it with the Technobeam instead, but I don't think that's correct. The original trackspot was all about simplicity and speed, and High End seems to have followed that path with the trackspot Bolt, rather than the route taken by the more complex and sophisticated Technobeam. In many ways, the trackspot Bolt's white LED light source is more similar in concept to the incandescent lamp of the trackspot than the discharge lamp of the Technobeam; it offers instant on and off, no warm up or restrike time, and no concerns about the cost of changing lamps, making this a potentially good candidate for a club fixture. Of course, it costs more than the old trackspot, so I hope this review helps you decide if that extra is worthwhile.

Moving-mirror automated luminaires have been pushed into the background over the past few years by their moving-yoke siblings; is this an unjustified relegation? Whatever the reason for that, I'm delighted to check out the trackspot Bolt.

As you know by now, I always start at the light source and work my way through to the output lenses, reporting what I see and what I can measure as we go along. That was the route taken here, with all reported results based on the measurement of a single unit sent to me by High End Systems, seen here in Figure 1. (Logistically, I cannot measure many units and average them, although that would be a better technique to follow.) All tests were run with the fixture operating on a nominal 115V 60Hz supply. However, the trackspot Bolt can be run on supplies between 100-240 VAC, 50/60Hz, with automatic voltage selection through switched-mode power supplies.

Physically, the unit is sized somewhere between the original trackspot and Technobeam, but styled in the more recent "angular" High End Systems house style. For these tests, I ran the unit standing upright on its rear handles but, of course, you can hang it and run it at any angle.

Light source

The trackspot Bolt uses a single CBM-360 light engine from Luminus Devices, providing white light output from a small group of LED dies. Luminus Devices LEDs are well-known in our industry as being reliable and efficient engines, well-suited to the task of trying to get a lot of light through a small hole. It's difficult to say exactly what power it is being run at, but that package is typically run around at 90-100W. As with everything LED, the power you can push in, and thus the light you can get out, is controlled by the quality of your heat management system. The cooler the better; the cooler the brighter.

Figure 2 shows the LED package with a large primary optic mounted on top, just about in contact with the package. Luminus Devices LEDs have a slightly collimated output due to their coatings, but it's still quite a wide-angle output and needs collecting immediately, as close to the die as you can, and collimating into the desired beam. (Read my article on etendue in the Winter 2012 issue of *Protocol* for more information on the hows and whys of LED light collection). What you can also see in Figure 2 is the large block of copper on which the LEDs are mounted and the row of heat pipes coming out the right-hand side. Those heat pipes lead down and round into a large aluminum heat sink mounted on top of a large fan, pushing cool

Figure 2: LED and primary optics

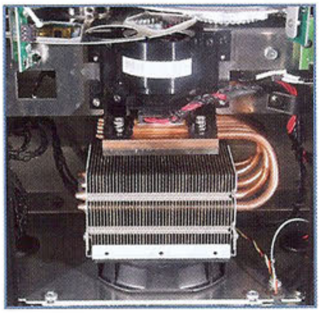

Figure 3: Heat pipes and cooling

air through the assembly. Figure 3 shows the entire assembly with LED, heat pipes, heat sink, and fan. This fan is thermostatically controlled, and ramps up and down as needed as you control the light output. The fan is a little whiny at some speeds—not always the fastest ones—but seemed to do a good job of keeping everything at the right operating point. I carried out all measurements after the unit had been running for at least 30 minutes, to make sure that thermal equilibrium was achieved.

Color systems

The trackspot Bolt LED source is white only; all colors come from a conventional dichroic color wheel, which is next in line in the optical train. This has its advantages and disadvantages; a color wheel can never be as quick as a color-mixing LED system and is more limited in its color palette. However, the colors you get from dichroics are crisper and more saturated than from RGB LEDs. There's no absolute right and wrong here; each has its place in your toolbox. The color wheel uses permanently attached, trapezoidal dichroic glass filters, which provide nice transitions from one color to the next. That transition is very clean, and provides good half colors, with no dark or light streaks between colors. Figure 5 shows two filters and how they are positioned next to each other on the wheel.

The output from each color is shown in the chart. The low red output is what you would expect from a white

Color Wheel

Color	Red	Yellow	Indigo	Dk. Magenta	Cyan	Green	Amber	Pink	Dk. Blue
Transmission	2.4%	92%	0.2%	5.4%	40%	36%	40%	35%	3.2%

Strobe and dimmer

As this is an LED unit, all dimming and strobing are done within the light source itself—no need for fancy mechanics, as it's all in the electronics and control circuitry. High End Systems has provided a 16-bit control option for the intensity channel, which I recommend you use. Figure 4 shows the dimming curve of the trackspot Bolt. It's a little like an inverse square law, but was smooth, and, with 16-bit resolution, offers no real evidence of steppiness or color change. Slow fades looked good. The separate strobe channel gave me measured strobe rates ranging from 0.35Hz all the way up to 33Hz, which is fast enough that it looks a little like an old-time movie! Dimming is achieved through PWM; I measured the PWM rate at 369Hz. That's a little slow these days, so care needs to be taken if you are using video.

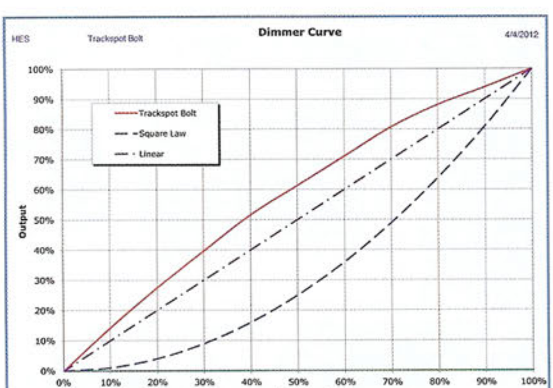

Figure 4: Dimmer curve

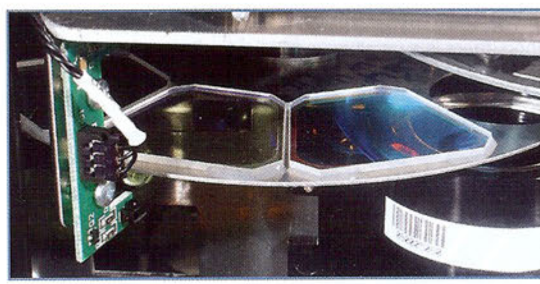

Figure 5: Color wheel

LED. However, the red you get through the dichroic is well-saturated. White LEDs using phosphors tend to have the most output in the yellow–green area and a good peak in the blue. As always, the indigo and dark blue readings look better to the eye than you might think; light meters severely underestimate the amount of blue light we can actually see.

Color change speed is very good, approximately 0.1 seconds between adjacent colors, and a maximum of 0.4 seconds between the most distant colors. The unit always takes the quickest path between colors to minimize this time. The color wheel can also be rotated continuously at the speeds I measured, varying from 1.7rpm up to 95rpm.

Gobo wheels

The trackspot Bolt has two gobo wheels, one rotating and one static. First in line is the rotating gobo wheel. This has seven replaceable patterns plus the open hole, and uses the familiar HES coiled spring system to exchange gobos. Access for changing them is a little tricky and cramped. All patterns in this wheel are glass.

Rotating Gobo Speeds

Gobo change speed – adjacent	1 sec
Gobo change speed – worst case	1 sec
Maximum gobo spin speed	1.45 sec/rev = 41 rpm
Minimum gobo spin speed	85 sec/rev = 0.7 rpm
Maximum wheel spin speed	1.475 sec/rev = 41 rpm
Minimum wheel spin speed	85 sec/rev = 0.7 rpm

The gobo change speed was a little strange; it seemed to always take one second, no matter whether the gobos were next to each other or on opposite sides of the wheel. Gobo rotation and indexing was very good and smooth; however, the wheel rotation was a little jerky at slow speeds. There are also some small light leaks around the gobo bearings, and a hole in the wheel at one point in the rotation that lets a shaft of light through. I measured the hysteresis in gobo indexing at 0.21°; that's about 0.9" at 20' throw.

The focus quality and sharpness of gobo projection is good; there is a small amount of spherical aberration (edge-to-center focus difference), but it is very acceptable. Figure 6 shows an example of a projected image.

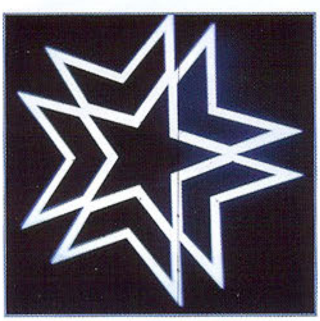

Figure 6: Focus quality

The static gobo wheel is mounted face-to-face with the rotating wheel, as close as possible to each other. This is an interesting wheel; it also has seven full-sized patterns plus open hole, but additionally has smaller, intermediate, patterns in between the main gobos. You can't easily stop the gobo wheel on these spots; however, when it is rotated you get the effect of a continuous wheel, somewhat like an animation or effects wheel. Using this in conjunction with the rotating gobo wheel gives some interesting effects and motion to the image. Figure 7 shows the layout and the intermediate patterns.

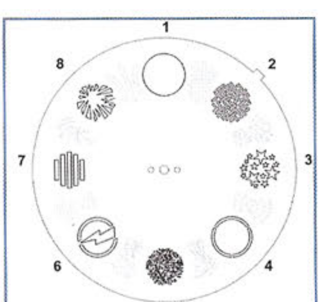

Figure 7: Static gobo wheel

Figure 8 shows one of the intermediate patterns in use as the wheel rotates. It is a single etched metal wheel, so it can only be replaced in its entirety.

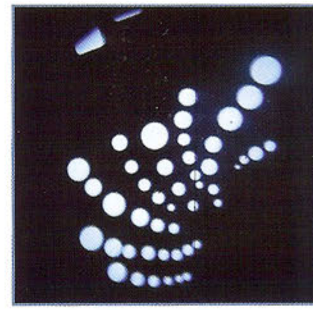

Figure 8: Intermediate patterns

Static Gobo Speeds

Gobo change speed – adjacent	0.2 sec
Gobo change speed – worst case	0.5 sec
Maximum wheel spin speed	0.6 sec/rev = 102 rpm
Minimum wheel spin speed	34 sec/rev = 1.8 rpm

As expected, gobo change speed was much better on the static wheel, and there is a good range of smooth rotation speeds.

Taken together, the two wheels offer some interesting options for morphing and overlay effects. Although they are physically close, the optical system is very fast, with a very short depth of focus; thus, hard focus is only possible on one wheel at a time.

Iris

The trackspot Bolt has an iris positioned immediately after the two gobo wheels. The fully closed iris reduces the aperture size to 13% of its full size, which gives an equivalent field angle of 1.9°. I measured the opening and closing time at around 0.2 seconds. As with the two gobo wheels, the focus difference between the gobos and the iris is such that it isn't possible to sharply iris in on a gobo—one or the other can be in focus, not both at the same time.

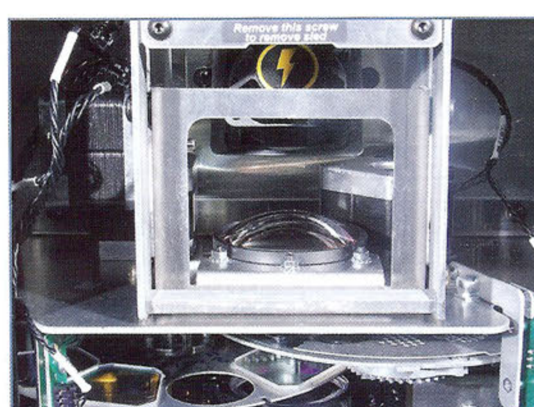

Figure 9: Gobo wheels and focus lens

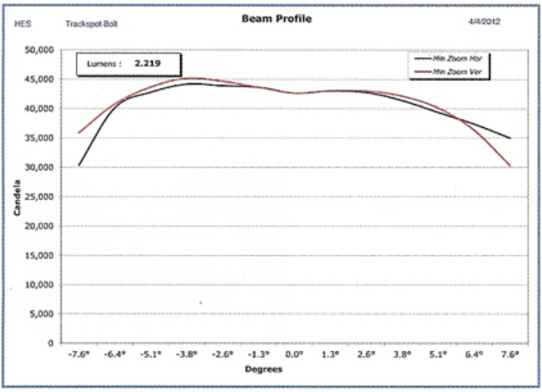

Figure 10: Light output

Lenses and output

The trackspot Bolt has a fixed focal length optical system with two groups. A single movable group provides variable focus (Figure 9) and there is a final fixed lens group just before the mirror. I measured the output from the complete system when running at full power at 2,219 field lumens at a field angle of 15°. The field was almost completely flat, which makes the trackspot Bolt well-suited for gobo projection and aerial effects. Figure 10 shows the output profile. The focus lens took 0.4 seconds to run from one end to the other.

The spectrum of the light is shown in Figure 11. This is typical for a white LED, and I calculated the color temperature as 8,200K with a Δuv of 0.001. This is very close to

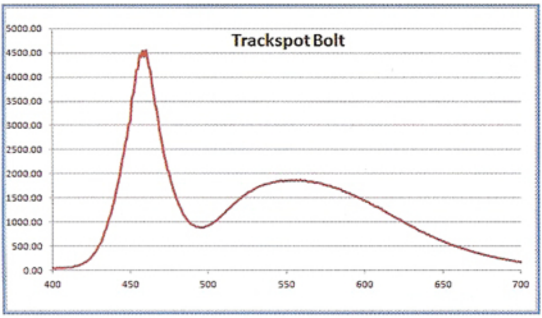

Figure 11: Spectrum

Figure 12: In operation

the black-body line, just very slightly on the green side. (I measure CCT and Δuv using a spectrometer and then calculate from that. Your tristimulus color meter is useless at measuring LEDs. Don't even try it; you are wasting your time.).

Figure 12 shows the gate area of the trackspot Bolt when in operation; it's not recommended to do this with a discharge lamp unit because of the UV—but it's pretty safe with LEDs!

Pan and tilt

The trackspot Bolt is a mirror unit (Figure 13) and, as expected, has very quick movement over its slightly limited range. It has a pan range of 150° and a tilt range of 110°; a full-range move of either axis took just 0.4 seconds to complete.

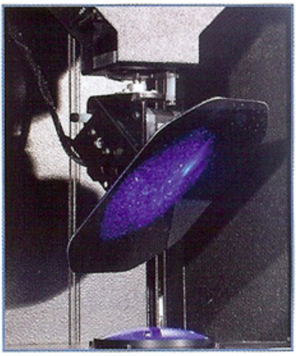

Figure 13: Mirror

The quality of the movement was excellent, with no steppiness visible, even on very slow moves. In fact, these motors were the smoothest of any in the unit. The accuracy of positioning had a measured hysteresis of 0.32° on both pan and tilt. That's equivalent to 1.3" at a 20' throw. Again, as this is a mirror with very little mass, the positioning is very precise, with no bounce or overshoot. This has always been a plus point for mirrors.

Noise

Sound Levels

	Normal Mode
Ambient	<35 dBA at 1m
Stationary	40.0 dBA at 1m
Homing/Initialization	58.2 dBA at 1m
Pan	54.6 dBA at 1m
Tilt	56.3 dBA at 1m
Gobo	41.2 dBA at 1m
Gobo rotate	56.9 dBA at 1m
Focus	55.8 dBA at 1m

As can be seen in the table, the rotating gobo wheel was the noisiest function, although pan, tilt, and focus were almost the same. The stationary noise figure reported is with the LEDs and their associated fan running after 30 minutes of use at full power.

Electrical parameters and homing/initialization time

Power Consumption at 115V, 60Hz

	Current, RMS	Power, W	VAR, VA	Power Factor
Quiescent (LEDs off)	0.38A	42W	47VA	0.88
LEDs at full	1.63A	196W	199VA	0.98

Initialization took around 38 seconds from a cold start and 33 seconds from a DMX512 reset command. Homing is badly behaved, in that the fixture dims up the LEDs before pan and tilt have finished moving to their final position, although, as the mirror moves so quickly, this is a very brief problem! Wall-plug efficacy with this power consumption is 11.3 lm/W.

Construction

The construction is similar to previous High End Systems moving-mirror units, with everything built on a sled that can be removed from the outer casing for servicing. Once you have done that, components are easy to access. However, even without sliding the sled out, the main circuit board and primary optical components are simple to access and clean under the main cover.

Electronics and control

Figure 14 shows the main circuit board controlling all functions of the trackspot Bolt. It also integrates the menu and control system, seen in Figure 15. The trackspot Bolt provides standard five-pin DMX512 in-and-out connectors and a fixed power cord. The menu is again typical of High End Systems, very reminiscent of the 250 and Technobeam series, and provides access to the usual fixture set-up and maintenance functions.

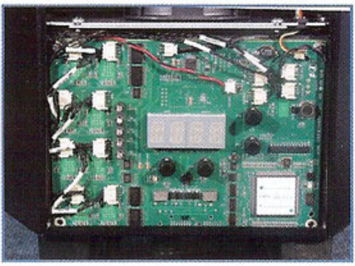

Figure 14: Circuit board

Figure 15: Control menu

That about covers it. I hope the measurements and comments provided here help you decide if it's a fixture you need to try out. Do you need the speed of a moving mirror fixture and could the trackspot Bolt be the one that meets those needs? As always, you get to decide.

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