The Chauvet Legend 412

By: Mike Wood

Figure 1: Fixture as tested

It's been a little while since we looked at something from Chauvet, an interesting manufacturer with a large range of lower-priced products primarily designed for the nightclub and similar markets. In recent times, Chauvet has introduced an increasing number of more sophisticated products, clearly aimed at transitioning the company towards loftier goals. The Legend 412 falls in that latter category; to my mind, it undoubtedly has applications across many different areas of our business, and it will be interesting to see how it competes with similar products. It joins the recent trend of manufacturers producing very small LED-based luminaires that, although possible to use as singletons, are really designed for arrays of larger numbers. In fact, the tiny size of the packaging fooled me when it arrived at my workshop. I saw UPS draw up, and opened the large doors, ready for them to wheel in a road case or dolly; instead, the driver stepped out of the truck and passed over this small package with one hand. That makes a change!

The Legend 412 is a compact RGBW LED wash light with some design features meant to facilitate its use in pixel-mapped applications as well as more conventional wash light situations. How does it stand up against a number of similar products on the market? I hope this review will help you make that decision. I will follow my normal procedure of following the luminaire from source to output measuring, reporting everything as objectively as possible. All results were based on measurements from a single unit sent to me by Chauvet as typical (Figure 1).

All tests were run with the fixture operating on a nominal 115V 60Hz supply. However, the Legend 412 allows operation on supplies rated between 100-240 VAC, 50/60Hz, with automatic voltage selection through a switched mode power supply.

Light source

The Legend 412 uses 12 Cree XLamp MC-E 4 LED packages. Each contains four dies, one each of red, green, blue, and white, mounted together closely under a single primary optic. Figure 2 shows one of the 12 packages, with the phosphor on the white LED clearly visible. The packages are mounted on a single circuit board, which, in turn, is attached to a finned aluminum heat sink. Figure 3 shows the complete circular array.

Each four-color LED package has an associated secondary optic, to collate the beam down from its native field angle of around 140°. The secondary optics are large TIR (total internal reflection) lenses, where the LED fits within a central base cavity at the bottom of the conical molded plastic lens. Figures 4 and 5 show the array of TIR optics and the detail of a single unit. Chauvet states that it runs the dies at 700mA each, thus taking the Cree specification sheet data for forward voltage; this equates to around 110W for the total array.

The spectrum produced by all emitters running at full power is shown in Figure 6. As expected, this is dominated by the three peaks from the red, green, and blue emitters, with the subsidiary blue and yellow peaks from the white emitters helping fill in the gaps in the cyan and amber areas. Figure 7 shows the white on its own, to the same scale, so you can see its contribution to the whole. Its output is very broad across a lot of the spectrum, so it appears much brighter to the eye than the low peak level might suggest. It's the area under the spectral curve that represents energy, and thus total brightness, not the height of the peaks. The addition of white really helps with the color rendering of such a system, particularly if the units are to be used on skin tones (although I suspect that won't be a normal application for the Legend 412). Those cyan and magenta regions are critical to the human eye's evaluation of flesh tones.

Good cooling is essential for LED longevity and consistency. As mentioned above, the LEDs in the Legend 412 are mounted in contact with a finned aluminum heat sink,

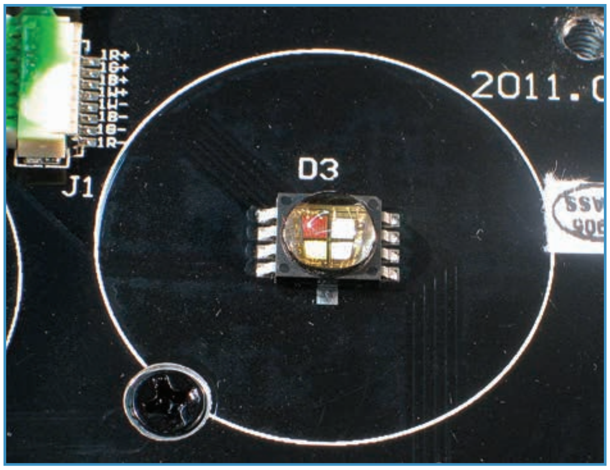

Figure 2: Cree LED package

Figure 4: TIR lens array

which, in turn, is cooled by a single axial fan. Figure 8 shows the arrangement, with the fan cooling both the heat sink and the driver electronics.

Optics and output

There's really not much else to say about the optics—the Legend 412 has a fixed focal length, with the primary and secondary TIR optics we've already discussed providing the

Figure 3: LED array

Figure 5: TIR lens detail

beam collimation. After that, a simple top-hat baffle array deals with some of the inevitable light spill and tidies up the beam. I measured the initial total output, with all LEDs at full, at 1,427 lumens with a field angle of 23°. The field is reasonably smooth and has a normal wash light, blending, distribution (Figure 9). Color homogenization was, on the whole,

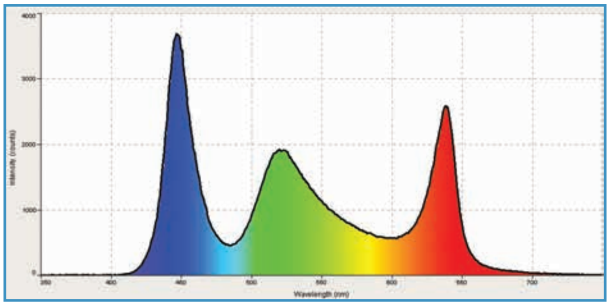

Figure 6: Spectrum - all channels full

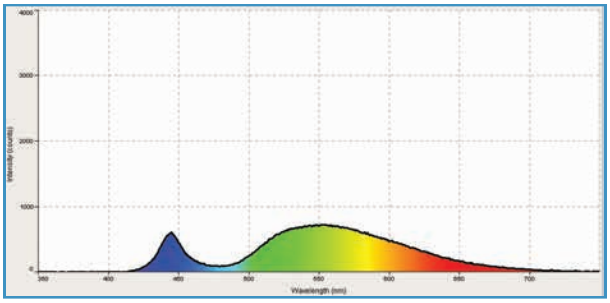

Figure 7: Spectrum - white

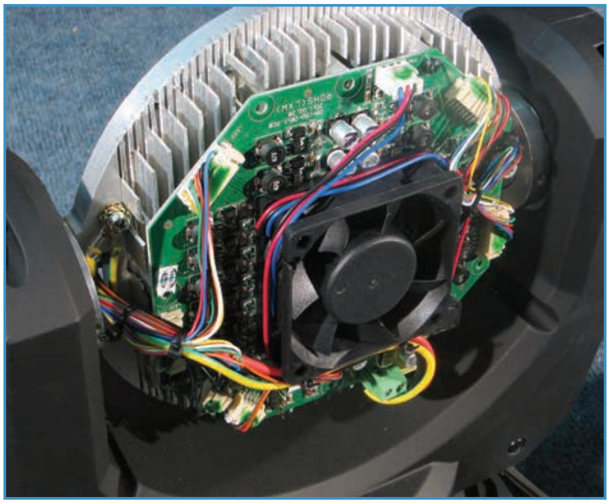

Figure 8: Heat sink and cooling

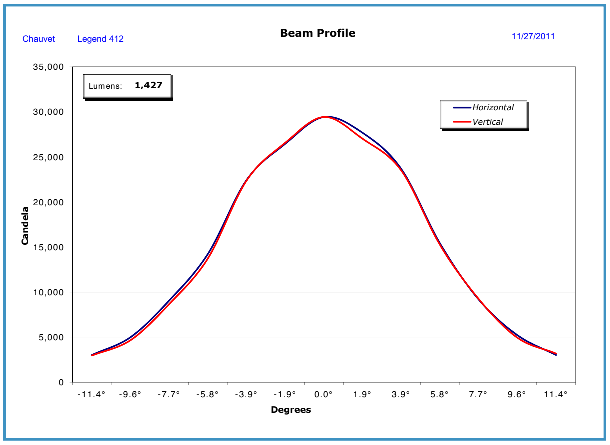

Figure 9: Beam profile

quite good. I found some issues when using red and green only: The mixed yellow output was somewhat uneven, with one side of the beam much redder and the opposite side much greener, than the central mixed area. At longer throws, there was little or no evidence of colored shadows.

The correlated color temperature with all four channels at full was too far off the black body line to measure. When I pulled it back to the line, by reducing the blue LED output, I was able to achieve a measured 5,600K at about 93% of the full output.

As the unit warmed up over 30 minutes of continuous full power running, the output dropped to 89% of its initial value, and then held steady.

Dimming

As we've seen in other Chauvet units, the dimming performance is excellent. It's very smooth, with good interpolation of the eight-bit DMX512 data to what looks like an internal 16-bit dimming curve. Chauvet has also done a good job of matching the dim curves for all four colors, so that the beam stays the same color as it dims. It's not unusual for some of the colors in LED luminaires to dim more quickly than the others, causing the beam to move in color as it

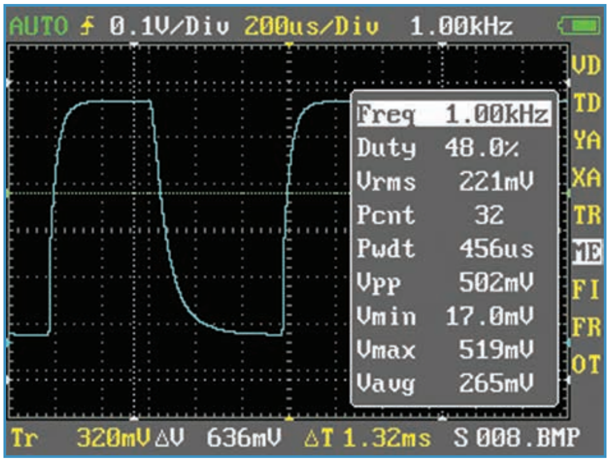

Figure 10: PWM measurement

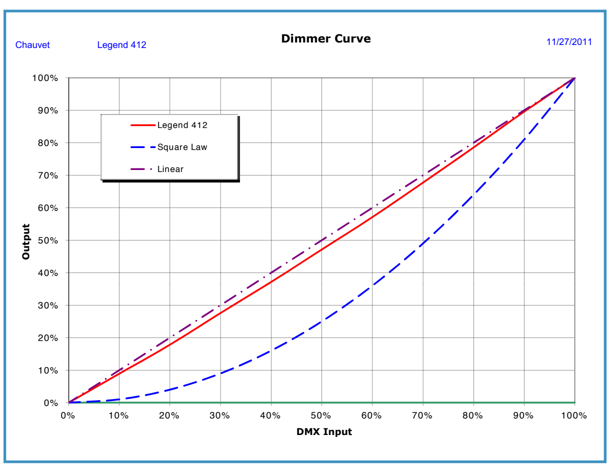

Figure 11: Dimmer curve

dims down—particularly at the bottom end—but Chauvet avoids that issue well in the Legend 412.

I measured the PWM frequency at 1kHz, which should be high enough to avoid flicker problems in most applications.

As a sidebar, I was asked recently how I measure the PWM frequency of LED luminaires. I try to make all my measurements as non-invasive as possible, and don't want to go poking around with voltage probes on unknown circuit boards. In this case, I use a small photovoltaic solar cell connected to an oscilloscope, which, when placed in the output beam, clearly shows the rapid fluctuations in light output from the PWM pulses. Figure 10 is the curve from the Legend 412 when it is dimmed down to about 50%; it shows a solid 1kHz PWM signal.

The dimmer curve itself is almost perfectly straight, and matches a linear dim curve very well (Figure 11). Overall, I feel that Chauvet has done an impressive job with both the dimming smoothness and control. Controlling it with a manual fader, the dimming felt natural and organic.

Finally, the unit has a dedicated strobe channel, with the normal varied strobe options, including ramp and snap strobes. I measured a possible strobe range (using the same solar cell and oscilloscope setup used for measuring PWM) of 0.78Hz to 13.3Hz. As an extra feature, as well as the regular strobes, the Legend 412 also offers some interesting colored chase strobes and individual quadrant strobing.

Color

The Legend 412 offers a number of options for color control. At its simplest, you can operate the unit in a mode where all the LEDs are controlled by a single set of RGBW channels. In this mode, I measured the output of individual emitters as shown.

COLOR MIXING, PERCENTAGE OF FULL RGBW OUTPUT

Color	Red	Green	Blue	Cyan	Magenta	Yellow	White
Output	15%	40%	2%	41%	17%	54%	44%

Figure 12: Quadrant control

Note that the blue output is nowhere near as low to the eye as these figures might suggest. As can be seen in the spectra earlier in this review, Chauvet has chosen a short wavelength blue at around 450nm. This is an area of the spectrum where light meters respond badly and don't correctly reflect what the human eye actually sees. In practice, the blue from this unit is bright and saturated.

The Legend 412 also allows you to put the unit into an extended control mode (using 28 DMX512 channels instead of 12), where you can access the RGBW values of each of four quadrants, each comprising three LED sets independently. Figure 12 shows how this breaks down. You can then treat the unit as if it were four pixels of a large array and program accordingly, or use a pixel-mapper.

Finally, the Legend 412 offers a number of preprogrammed color macros, which put the unit through its paces in both full-field and quadrant modes.

Pan and tilt

The Legend 412 has a pan range of 630° and a slightly restricted tilt range of 200°. Movements were quick, taking advantage of the unit's small size. A full-range 630° pan move took three seconds to complete, while a more typical 180° move finished in 1.5 seconds. Tilt took the same 1.5 seconds for both a full 200° and a 180° move. Both hysteresis and quality of movement were good—the low weight and a balanced head really help here. I measured hysteresis at less than 0.1° on both pan and tilt. That's equivalent to 0.3" at 20'. Both pan and tilt have optical encoders to reset position errors. There was also almost no bounce as the unit came to rest. Figure 13 shows the pan motor and an encoder disk, while Figure 14 shows the tilt.

Figure 13: Pan motor and encoder

Figure 14: Tilt

Noise

The three main noise-producers in the Legend 412 are the pan-and-tilt motors and the cooling fan in the head. I measured these as follows, after the unit had been running for 30 minutes at full power to reach thermal equilibrium:

SOUND LEVELS

	Normal Mode
Ambient	<35 dBA at 1m
Stationary	38.0 dBA at 1m
Homing/Initialization	51.2 dBA at 1m
Pan	50.0 dBA at 1m
Tilt	42.8 dBA at 1m

Electrical parameters and homing/initialization time

POWER CONSUMPTION AT 115V, 60HZ

	Current, RMS	Power, W	VAR, VA	Power Factor
Quiescent (LEDs off)	0.25A	15W	30VA	0.5
LEDs at full	1.89A	142W	230VA	0.6

The unit is clearly not power-factor-corrected and the resultant power factor at 0.6 is very poor; this means the unit takes considerably more power from the supply system than it consumes. Depending on how your facility is metered, you may or may not have to pay for this power; whichever it is, however, the utility company has to generate it, and your cables have to be sized to carry the full current.

Figure 15: Menu system

Initialization time varies, depending on where the head is physically positioned when you start; an average was around 40 seconds from either a cold start or 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.

Figure 16: Connectors

Electronics and control

Figure 15 shows the menu and control system, which contains all the usual options, including stand-alone operation and master-slave settings. Figure 16 shows the main connector block, with an IEC for power input and five-pin XLR connectors for DMX512 in and out. I worried slightly about using IEC connectors for this, as they can fall out too easily. However, I raised this concern with Chauvet, and the company says it has switched to a locking IEC for production units.

The top box contains the main electronics processing

Figure 17: Main electronics

Figure 18: Movement and chassis

board and motor control drivers, as well as the power supply and menu system. Getting into the unit was straightforward. The external covers come off the head, yoke, and top box, revealing a sheet metal chassis and all components and circuit boards. I found everything very simple to access, and I believe this should be an easy unit to maintain. Figures 17 and 18 show two views of the chassis construction.

Conclusions

The Chauvet Legend 412 is a neat unit, very small and nimble. The output is reasonable for a unit of its size, and, although the color mixing homogenization isn't the best I've seen, it should be adequate for the intended use of the unit. The pixel-mapping options are interesting, if you are able to use a large array of the units. With the deep blue LEDs that don't show up on light meters, it's definitely a unit you need to try out for yourself to evaluate. Is it the unit for you? As always, you get to decide.

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