



# 1 WITNESS

Katy Perry's *Witness: The Tour*  
has all the grand gestures any good diva expects

By: Sharon Stancavage



The illumination of the flying star is controlled via 12 RC4 Wireless RC4Magic S3 2.4 SX DMXio-HG transceivers.

**K**aty Perry's *Witness: The Tour* is the result of a long collaborative process. Perry takes a very active role, gathering inspiration from fashion shows, sculptures, theatre, opera, and other sources. "At the end of all of those discussions, we had Katy taking

pen to paper and saying, 'I want an eye on the screen, because we're about witnessing, and being a witness to something'," states Perry's producer/lighting designer Baz Halpin, of Silent House Productions. Once Perry determined the direction, scenic designer Es Devlin came back



Marchwinski and Gnagey used the XYZ positioning feature in the grandMA2 for special focus positions.

with sketches. Halpin adds: “Katy looked at it and said: ‘That’s what we want,’ and then we began the process of putting a show together.” Halpin asked longtime collaborators Ashley Evans and Antony Ginandjar, of the Squared Division, to come onboard as creative directors and choreographers, completing the creative team.

Like all of Perry’s previous tours, *Witness* is performed in acts. Halpin notes: “This show was more about creating different worlds. The concept is, we’re flying from planet to planet. Each planet has its own aesthetic, and that’s what drives each of the individual acts.” Act I, The Red Planet, includes the hits “Roulette” and “Dark Horse.” Act II is the ‘80s Planet, which features art and colors inspired by that decade. Third, fans visit the Flower Planet, where plants are colorfully super-sized. Next is the Space Planet, where she performs “Thinking of You,” “Save as Draft,” and “Power.” Act V features the Pixel Planet, which explores vintage ‘80s video games. “The whole show has sort of an ‘80s edge to it,” Halpin says.

The 70’-wide custom stage was fabricated by TAIT, located in Lititz, Pennsylvania; it includes a 90’ runway that

leads to a stylized B stage. Halpin adds: “There is an island stage that we call teardrop stage; it is a bit isolated, at stage right of center, about 30’ from the main stage. It’s used during the flying section.” It’s where Perry lands after her journey—via a Tait Navigator controller automation track—on a ringed planet that may or may not be Saturn. The stage also includes eight LED-clad performer lifts that ascend to 6’.

#### Video

The most attention-getting feature is the 130’-wide by 40’-high LED eye, consisting of ROE Visual MC-7H panels, provided by Real Deal Touring, based in Nashville, Tennessee. The panels are housed in Acass Systems touring frames (with additional custom frames supplied by Tait); content was supplied by Gabriel Coutu-Dumont and J.T. Rooney, of Silent Partners Studio, which has offices in Montréal and Los Angeles. “Gab and JT had a team of over 100 animators across multiple countries and cities and companies working on the project; it was a massive undertaking,” notes associate lighting designer and

video/lighting programmer Eric Marchwinski, of Earlybird Visual. “The video system [which handles both IMAG and content] isn’t enormous, but is fairly complex in comparison to systems we’ve done for past tours. We have two disguise [formerly d3 Technologies] gx2s, optimized for running Notch, which is a generative software, with JT Rooney building the Notch block.” IMAG is supplied via three Sony HSL 300 cameras in the pit, three more at the front of house, and three additional robo cams.

Real Deal, working for the first time with Perry, “has been very attentive to what needed to be addressed,” says lighting director and programmer Drew Gnagey. Eric Wade, of Real Deal Touring, adds, “Working with Baz and his team is great; this is our third tour with him. Katy was a challenge, since it’s such a large tour, but our shop really came through on this one.”

A major challenge from a video programming standpoint involved the LED doors located inside the eye. Marchwinski notes, “The big thing is the tracking of the video wall using UDP [User Datagram Protocol] sent by TAIT, so that we can know where the video wall is and reveal the content as the doors open and close. We had Chet Miller, from disguise, on-site for a week to help us get through the first little bit, working out some of the animation data.” Gnagey also worked on the video programming alongside Marchwinski.

The visuals also include special effects, provided by the Las Vegas office of Pyrotek Special Effects. They include pyro and confetti (in “Firework,” the finale) as well as 18 lasers [12 RGB Beam Bursts and six 20W scanning lasers] that appear during “Power” and “Hey, Hey, Hey.” Lasers were programmed by Gnagey and Marchwinski, using Pangolin’s Beyond software, on an MA Lighting grandMA2 console as part of the larger show programming. This allowed for greater continuity between special effects and other production elements. Atmosphere is created using four Reel-FX DF-50 haze machines and four High End Systems F-100 foggers, provided by Upstaging, of DeKalb, Illinois, the tour’s lighting vendor.

## Lighting

“This lighting rig was definitely a great challenge at first,” Marchwinski says. “The set design goes 25’ to 30’ into the seats on either side of the arena. Every statement has to be a grand statement. You can’t just take four lights and do something; it has to be all 38 lights on that truss; otherwise, it doesn’t mean anything.”

Three 140’ trusses are placed over the stage. “The upstage two trusses are all [Claypaky Scenius] Unicos, end to end, and the downstage truss is filled with Scenius Profiles. It’s lots and lots of the same thing next to each other; there are no cluttered trusses, it’s a very clean design,” Marchwinski adds. Halpin weighs in: “We didn’t want a multitude of fixtures; scale was what we wanted. For me, a traditional design has a lot of different places

that create the illusion of scale. This already has a massive amount of scale.”

The trusses have breaks in them to accommodate the curved fly track. “We have six trusses that go about 20’ into the audience on both sides of the stage, so hanging the system is a bit of a challenge on a day-to-day basis,” notes lighting crew chief Thomas Walls. However, it’s worth it from a design standpoint, Marchwinski says: “The ends of the truss curve down as they go offstage, so we ended up with this optimal position for high sidelight, way offstage. In a standard touring rig, you don’t normally have lights all the way out there, and you wouldn’t hang a truss in the seats just for that position. The design and the shape of the eye drove the reasoning to have the trusses that long; therefore, the end Unicos on all three trusses on either side—the end six lights—became the workhorse fixtures for our high dance light. It’s the perfect position to light dancers from.”

The Unicos, 77 in all, form the core of the lighting rig. Halpin explains: “When you’re going out for a large quantity of fixtures, you need to listen to the vendors in terms of what they have and what they want to invest in. Both Eric and I wanted to work with the Unico, and a lot of the vendors wanted to invest in it. It’s the first time I’ve worked with it, and it’s great.” Marchwinski adds, “When I saw the Scenius Profile, I thought this was the brightest profile that I had ever seen; they’re incredible units. We put them up next to the Unicos and it was no competition; it is unbelievable how much brighter the Unicos are.”

He adds, that with the Unicos, “you sacrifice a gobo wheel, but I think it’s completely worth it. The gobo load is perfect for what you need. You have framing shutters, you have an animation wheel, you have a color wheel that’s loaded in a really logical manner.” Gnagey says, “The Unicos have been absolutely fantastic. We are not having any major issues, and the minor issues we have are handled expertly by our Upstaging crew.”

As for the massive video eye, Marchwinski notes, “On the inside of the fascia in front of the video wall, there are 78 [Solaris] Flare [Q+] LRs. The Flare LR is the brightest LED I’ve ever seen in my life; it actually hurts to turn all of them on at full. The whole show was designed knowing that the LED wall would be this bright; the whole show is lit extremely brightly on purpose, because that’s what you have to do to pull the dancers away from the back wall.”

“Behind the screen, we have a big circular truss with [24 Claypaky] Mythos and [86] GLP [impression] x4 units,” Halpin notes. These appear when the door, controlled by a Tait Navigator system, opens and closes. Marchwinski explains, “We don’t see that often; the purpose of those units is to help fill the picture when the doors open and to light the props that come in and out. It does great work for us, but it’s a situational thing.” The stage itself is outlined by 43 Chroma-Q Color Force 72s and 13 Color Force 48s;

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the rig also includes six Philips Vari-Lite VL3500FX luminaries and 12 Philips Color Kinetics ColorBlast 12 TRX with 40-40 lenses.

Working with the lighting rig are six venue spotlights. Gnagey says, "One directive from Baz is to use a pair of spotlights at half house or even further upstage, to accent [Perry] as she leaves the stage. We try to do corner spotlight positions, as well as the front of house; we generally have two corner positions at front of house, [to ensure that] coverage is evenly spaced. When you have six spotlights on her from around the room, it looks that much more massive." The show features approximately 150 spot cues.

"It's not as heavily cued as [Perry's 2014 – 15] *Prismatic World Tour*; I would say we have about half the number of spot cues, mainly because of good lighting design on the

front end," the lighting director notes.

In addition, Marchwinski says, two truss spots feature Robe BMFL Blades on the Follow-Me remote follow spot control system. "The team at Upstaging and Follow-Me both worked closely with us to help revise the software to have a little bit more functionality just to create some more independent control over the attributes of the light." Gnagey says, "Having control, from the console, of attributes like color, zoom size, and iris size is a huge advantage for us, because we can program that in with everything else and keep it just as accurate and on point as the rest of the show." Walls adds, "When you isolate two lights for Follow-Me and create their own network, they seem to work fine. On other tours, they've used the entire system with any light at any time as part of the Follow-Me system, and it created a lot of problems. Out here, Follow-Me



The massive tracking doors located upstage posed a challenge in terms of video mapping.

works perfectly.”

“In addition,” Marchwinski says, “there are two trusses at the front of house that sit under the scoreboard on either side of the B stage. Each has nine Scenius Profiles; their original purpose was to light the B stage straight down. As soon as we started focusing them, we found that both trusses were the perfect front-of-house catwalk angle for onstage key light. The trusses, coupled with high sidelight on the ends of the three onstage trusses, made the key lighting and dancer area lighting really stand out.” These units have an impact on the spot cueing, Gnagey says: “We’re utilizing so much key light from the trusses at some moments that we don’t need to utilize house spotlights as much as we would previously, because we can cue in and deal with key light from our rig.”

The lighting system has a wireless component, because

of several illuminated props [see sidebar for details] and a hat created by Los Angeles-based Tom Talmon Studio. Walls says, “At the top of the show, we have a star with 12 separate receivers in it. The eyes in the lion [“Roar”] have several units, and we have a motorcycle [“Hey, Hey, Hey”] with a couple of transceivers. Then we have an LED hat Katy wears during the show that’s wirelessly controlled.”

Knowing that numerous individuals—including wardrobe, carpenters, and technicians—would be working with these props, the vendors needed a wireless system that was easy to use as well as reliable; they all independently chose RC4 Wireless 2.4GHz products. “The RC4 equipment has been working flawlessly; technically, there have been no issues at all,” Walls says. The units include RC4Magic S3 2.4SX DMXio-HGs [in the star and the lion head], RC4Magic S3 2.4SX DMXios [the motorcycle and



Upstage of the eye is a wall of Claypaky Mythos and GLP impression x4s.

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the hats], and RC4Magic 2.4SX DMX4dims [the lion head and the hat]. The DMXio-HG and the DMXio are transmitters; they can be used for both transmitting and receiving, while the DMX4dim is a compact four-channel dimmer. All the units on tour operate in the 2.4GHz bandwidth, which is optimized for worldwide usage. Additionally, “*Witness: The Tour* is using our new RC4Magic Series 3 SX software, which makes LEDs in props and costumes even more pleasing to the eye, thanks to our exclusive 19-bit-per-color wireless dimming,” notes James David Smith, president and chief developer at RC4 Wireless, headquartered in Raleigh, North Carolina.

A key RC4 feature is Private System ID, which gives each user a secure, private ID used solely for their particular wireless DMX universes and the RC4 devices assigned to them. “Control-wise, the RC4 equipment is great,” Walls says. “The guys really like the unique system IDs and were able to understand how to set the system up without any problems. The RC4 system really makes a lot of sense.”

### Programming

Marchwinski and Gnagey programmed the show together on an MA Lighting grandMA2 console; the show is time-coded. Marchwinski notes: “For this show, from a cueing perspective, simpler is better. We come from an era of programmers where we’re time-coding every last breath out of the music. It was a bit refreshing to be forced to make more focused decisions, boiling it down to just a couple of things. Basically, they had two paintbrushes; the Flare LRs and the Scenius Profiles overhead. It was a wonderful challenge to overcome.”

As it turns out, “fewer cues” does not equal “less complex.” At all. “In the past, we’ve taken automation data from Tait, and Tait is good about telling us where things are using PSN [PosiStageNet],” Marchwinski says. “This is a common thing we’ve done before, and not a lot of shows can afford the time to get into all of the nuances or have the resources. Then we decided to take it a step further.”

Marchwinski continues: “When you use PSN, the fixtures need to be in the correct XYZ position and rotation in the 3D environment

within the console. This allows the console to properly calculate a pan/tilt value needed to point a fixture at the PSN stage marker. In addition to having this ability, once all of the fixtures are arranged in 3D space, you are now able to store position data as XYZ values, instead of traditional pan/tilt values. These XYZ values are absolute points in the room, in relation to 0,0.

“In the past, we have used this feature as an easy way to create focuses when fixtures were hung in a complex manner. We knew the desk could store these XYZ values as positions and you could crossfade from an XYZ value to a pan/tilt value and so forth. We took a pretty big jump and decided to store any position that wasn’t a graphic focus as an XYZ position.”

The pair then turned to the grandMA2 calibration tool. Marchwinski says, “As the rig tours, and is hung day-to-day, the fixtures end up in slightly different 3D positions than the previous day. We needed a way to ensure all of our XYZ focuses updated every day, and we decided the next step was to utilize the grandMA2’s internal fixture calibration tool. Every day, we have the riggers mark out four points on the arena floor in a very large rectangle. Next, you point all the lights at each point, and you focus them as tight zoom, tight iris, right on the ‘X’ mark on the floor. You do that four times [for each point on the rectangle], store it in the desk, and tell the desk to run the calibration. The desk uses the pan-and-tilt values you entered for each light to get those four points, and interpolates exactly



Speaking of the disguise gx2, Marchwinski says, “We push the system pretty hard with such a large texture size: Eight outputs and 7K worth of texture would bring most any media server to its knees. But the gx2 stands strong for almost anything we ask it to do.”



Behind the inflatable, articulating lips, Perry is in a custom molding chair that is part of the Tait automation system.

where the light is and how it's rotated sitting in 3D space. It's some complex math under the hood, it's a really powerful tool, and, at the end of the day, it allowed us to update a ton of positions all at once."

Marchwinski adds, "We had a few hiccups along the way, as it comes with uncharted waters, so we turned to A.C.T Lighting for some support," the US supplier of MA Lighting. "A.C.T gave us a tremendous amount of support, and helped us create the workflow we are using every day on the road to update all of our XYZ focuses. The first time we did this and ran the calibration, we pointed all the lights at downstage center 000, then +1.8m, which is the top of the stage, and it was the most accurate positioning I have ever seen with these lights."

Marchwinski notes, "At Earlybird, we do lots of MA 3D files and we did an MA 3D file for this. We use everything based on the rigging plot and everything is super-exact, and when we get there, we try that. We point everything to 00, and it comes up pretty close, and would be passable for most everything." He adds, "This was so incredibly accurate, we were both astonished at how precise this

process actually became."

Gnagey continues: "We developed a workflow to use the XYZ calibration tool with the big square on the road daily, because the load-in time is shorter, and drives are longer. Everybody's back is against the wall to do 30 graphic focuses and 65 to 70 special positions that you just can't get to some days, and you just hope you're in the right spot. So we went all in."

On the road, he says, "We basically update 60 positions in a matter of 20 minutes. The update happens instantaneously when you do the calibration, but it takes 15 to 20 minutes to focus 200 lights at four points, which is a lot easier on a load-in day than having to go through each and every position." The project was a success, thanks in part to the support of A.C.T Lighting [specifically director of software support and development Will Murphy] and MA Lighting.

In terms of working with this protocol daily, Gnagey reports: "This tool has single-handedly changed the way we can do shows like this in such a short amount of time." A case in point: A 1:15 pm load-in with 7pm doors in





Perry uses a Sennheiser MD 5235 for her vocals.

Québec City earlier in the tour. “No one wants to show up at 1:15 and have the trucks dumped but when they do, a tool like this allows us to have the same consistent-looking show every night, and it’s brilliant. Nobody wants to go into a show at doors thinking, I wish I had time to focus the rig, and I hope that it’s right. This tool gives me the satisfaction of knowing that this will be right every night. The console does the math. It knows what it’s doing. This tool should be viable for everyone at any time. There is no other way to do a show in my opinion now. This is absolutely groundbreaking.”

### Sound

Handling the mix at the front of house is Toby Francis, who has worked with Perry intermittently over the course of several tours. One enticement to come along for this run was the opportunity to work with music director Kris Pooley. “Musically, this present tour sounds amazing. Sonically, it’s the full gamut. It’s just fun to mix,” Francis says. “Kris lets me, and [Super] Dave Rupsch, our monitor engineer, put our spin on things. He doesn’t dictate exactly

how to do it; he tells you what he wants, but also wants our input.”

Francis’ rig consists of Clair Global Cohesion CO-12 boxes. “This is the least EQ I’ve ever had on any PA I’ve used,” he says. “It’s very phrase-correct and responsive in all frequencies; most PAs, at certain sections, are more or less responsive. Every part of this PA is very efficient and very linear from top to bottom.”

The main hang is made up of 16 CO-12 cabinets per side. “There are three CP-218 subs in cardioid behind the main hang on each side, and six CP-218s in the center on the ground,” Francis says. “Then there is a sub on either side at the back of the stage that points out, covering a VIP area.” All subs are cardioid except the two individual subs at the corners of the stage. Francis adds: “One of the biggest comments I’m getting back is how good the low end sounds; people are shocked when they hear how few boxes we have.”

The rig also includes 16 I-3 cabinets per side. “For the front fill, we have the Clair FF2, which are their older front-fill boxes. They’re very small, and they’re built into the front

of the stage behind the soft goods. They are about every 6', so there are 12 of them," Francis notes.

Francis has been mixing on DiGiCo consoles for the past decade but was intrigued by the Solid State Live L200 and was ready to take it out on the road for Perry. But, he says, "Todd Hudson, the general manager at Clair, asked me to try the Yamaha [Rivage] PM10. It turned out to be the coolest console I've ever used."

Along with the PM10, Francis says, "I use a Rupert Neve [5059 Satellite] analog summing mixer, and I output stems from the digital console into the summing mixer. The show that you hear is created in the analog. I do a stereo drum stem, stereo bass stem, stereo guitar stem, stereo keyboards, stereo tracks, stereo vocals (which are the live background vocals), background tracks, all the effects, and a mono path for Katy and a mono path for guest vocals and/or the rap tracks for a few songs that she does with rappers. I have a mono path, vocal-wise, and stereo path."

The two vocal paths travel to another piece of outboard gear. Francis says, "Those two mixes go through a Rupert Neve [Portico II], their bus compressor, which widens the stereo and masters the low end." The Neve Master Bus process has a section called SFE, which Francis uses extensively. "There's a knob that you use to pick the width of the stereo; where the lead vocal is the only mono source, as you manipulate the stereo, the mono becomes more prevalent in the mix. I can have her voice in the mix more like on the record instead of out front, where you're

typically about a dB and a half louder in a live mix, because you're mixing in an ambient environment just to get the clarity you need. Doing it this way, you can put it where you would normally put it in a record, so you hear it clear as a bell." The result sounds incredibly similar to Perry's studio mix. "Friends of mine mix records, and we compared notes. Most of what I was doing was very similar to what they were doing, with this exception. I tried this, and was stunned at the difference," Francis says.

Also, Francis says, "The Yamaha console has a feature called SILK. All the Neve outboard devices have the real version of Silk, which is an extra transformer; you just tap into that and add how much you want. The PM10 has an emulation of Silk that Rupert worked and developed with them. BLUE Silk adds thickness [the Yamaha site says, "solidity and power"] and RED Silk adds air [Yamaha says, "sparkling energy"] on top of the mix. With Silk, you're adding the closest emulation to transformer saturation that anyone has done. I have that feature on every pre-amp, which I use extensively. The stems sound analog on their own."

Francis also uses a selection of outboard gear: "I have a Smart [Research] C2 compressor on the drums and, for the stereo vocals, a Tube-Tech SMC 2B [multi-band opto compressor]. These are all the best dynamic control devices that money can buy, inserted in the Neve mixer. On the bass guitar, inserted in the console is a Wes Audio LC-EQP [single-channel passive equalizer], which is a straight-up copy of a tube EQ and a [Wes Audio] Mimas



The motorcycle is on a mobilator with a 3D motion base.

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[analog compressor with digital recall], which is basically a [UREI/Universal] 1176. The guitar stems have a Rupert Neve 543 [mono compressor]; there are two of them: a left and a right." The entire band mix goes to an API 2500 compressor.

Perry's show includes flying and a 100' winding thrust that leads to the teardrop-shaped stage, which directly affects Francis. "Katy spends about 40% of the show in front of the PA," he says. "There are times when she's directly in front of the PA. But I make it work with the Yamaha; I'm not doing anything different. With the DiGiCo, I would create three vocal channels for the primary artist; I would have the normal channel, one that was for the first problem place, and so on for the problem spots. With the Yamaha, I'm doing it on one channel all night."

For his vocal mics, "I use the 5000 series from Sennheiser; I really like the MD 5235, which is a dynamic mic. That's the only vocal mic I ever use. You can cup it, you can throw it down on the ground, you can do anything you want with it; it always works and always sounds good." For the drum kit, there are mics from Telefunken and Sennheiser. "There are also AKG mics on the drums; Telefunken M81s on all three snare tops; Neumann 184s on all three bottom snares; an AKG C451 on the hat, ride and stacks; an AKG C414 for the overheads; and Sennheiser e 904 tom mics. Everything else is a DI. I haven't put a mic on a guitar in ten years," he admits.

Katy Perry's *Witness: The Tour* continues in the US through the beginning of February, and then moves to Europe. 📶

# PROPPING FOR PERRY

*Witness: The Tour* is loaded with props; the first time Perry is seen by the audience, she is high over the stage, flying in a 15' x 15' LED-lined star-shaped structure fabricated by ShowFX, based in Santa Fe Springs, California. "Due to the flying system's weight limitations and liability issues, the prop was completely modeled in Inventor [3D CAD software for product development] and drawn to every detail before the first piece of aluminum was cut," explains ShowFX CEO David Mendoza.

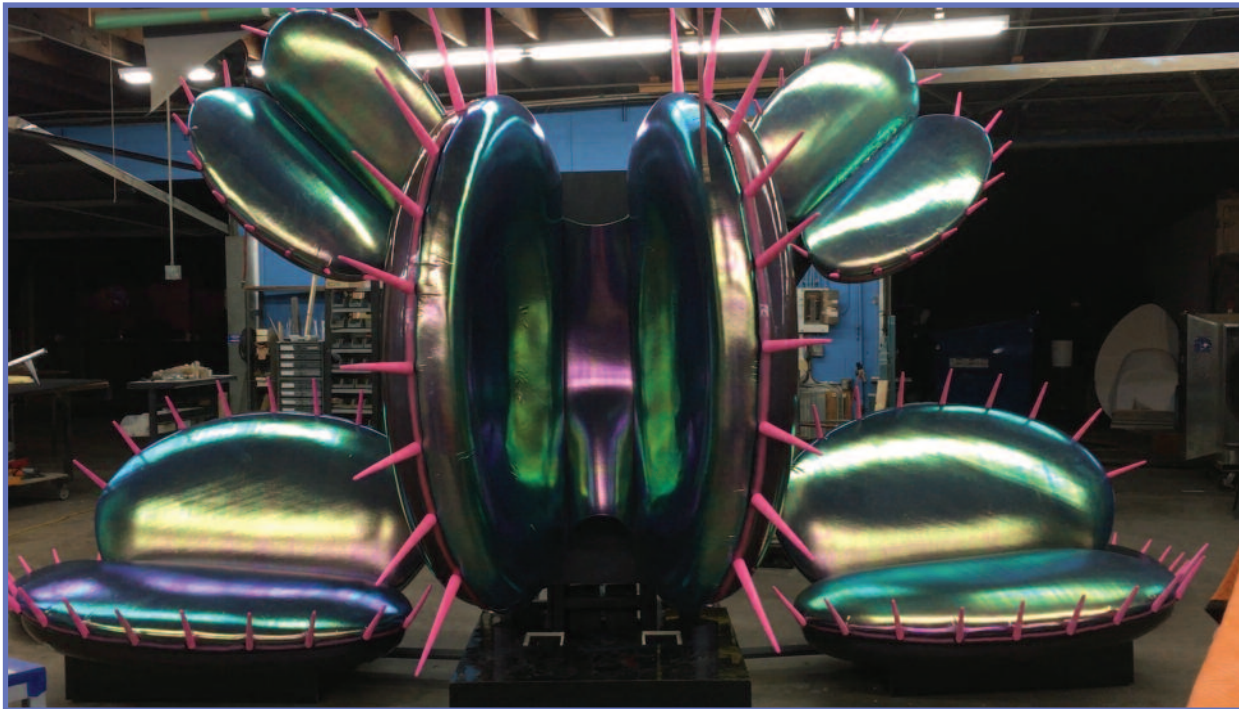
The star is comprised of illuminated spikes. "We used an RGB LED tape with a silicone diffusion, which protects the product and also gives it a true neon look," Mendoza says. The LED tape was sourced from Environmental Lights, based in San Diego. The star also includes a five-step Plexiglas stair unit that Perry uses to descend to the stage.

"One of the requirements of this prop was that it be quickly deployable and quickly dismantled, in very little light and within minutes, as it was too large to move on and off the stage fully assembled," notes Mendoza. Taking props apart in the dark is always a challenge, especially when electrical connections are involved. Mendoza and his team decided to go wireless, with 12 RC4 Wireless RC4 Magic S3 2.4SX DMXIO-HG transceivers. "To minimize the



Perry's show includes a variety of custom fabricated helmets for the dancers. Opposite: One of the Venus flytraps.

assembly/disassembly time, we designed each point of the star as a self-contained element, each with its own rechargeable battery, DMX receiver, and LED decoder built in," he says. "This way, there was only a mechanical con-



nection to contend with. Each point of the star fit into a custom set cart where the batteries could be charged while sitting backstage.”

Perry hits the metaphorical streets on a motorcycle, during “Hey, Hey, Hey.” It’s the most complex prop, fabricated by DAS Design Works, also based in Santa Fe Springs. “The motorcycle was hand-carved out of foam and then hard-coated. It has a very beautiful paint job done by Kev Elliot, who owns Kev’s Rod and Custom in Southern California,” reports Aaron Ford, a partner at DAS.

The motorcycle, surrounded by low fog, is revealed when the upstage LED screen doors open. “It has an electric motor in it, so it can rotate 360°, and then it’s mounted onto a 3D motion base so that it can tilt, lean, and move with the content,” Ford says. The motorcycle will wheelie up 22.5° back, and it will lean left and right up to 15°. It also rotates 720° in either direction.”

The motorcycle sits atop a 7’ by 7.5” mobilator. Ford notes: “The 3D motion base is integrated into the mobilator; the screen doors open, and the motorcycle drives out. It’s built to scale of an actual bike, although the seat is about 4’ 5” off the ground due to the heights of the mobilator and 3D motion base.”

Also, Ford says, “The wheels light up and there are headlights and tail lights.” They are controlled via RC4 Wireless RC4Magic S3 2.4SX DMXios. “We’ve done a lot of work with RC4 products; we had a lot of their gear on Katy’s last tour. They are absolutely the only wireless DMX that we’ll work with.”

DAS also fabricated Saturn, the planet Perry uses to travel over the audience during “Thinking of You.” Ford says: “It’s 4’ around for the globe, and the rings make it 9.6’. There’s a divot and a safety belt for her, and her microphone stand is mounted to it. It’s a really neat prop.”

Another DAS creation is essentially invisible, at least to the audience. Ford says, “In the scene with the large inflatable lips [“I Kissed a Girl”], Katy flies up through the lips, and they move like they’re chomping on her. We made the clear PETG seat that she sits on; the seat flies in, she fits into that, she flies up, and the big old lips chomp away.” The seat also includes a hand loop for safety.

Ford continues: “We did a mold off of a 3D scan of her and then drape-formed the plastic to that, so it fit her perfectly. That’s the first time we’ve done a mold off of a 3D scan. We got the scan, then did a foam carving on our CNC router, coated that, and had the plastic drape molded. It worked the first shot, which was exciting.” The team at DAS also created the yellow beam on which Perry and her dancers cavort on during “Teenage Dream,” in addition to a handful of custom microphones for Perry. The company also supplied the vinyl wrap for the guitars and drums.

The 32’-wide inflatable lips that dominate “I Kissed a Girl” were fabricated by Netherlands-based Airworks Inflatables. “The lips were a complex rig from a single point, with cables and pulleys to allow stagehands and dancers to operate the mouth,” explains Airworks creative director Matthew Whitehead.

Airworks is also responsible for the massive—and solid looking—articulating hand that appears in the finale, “Firework.” “The hand mechanism was a very complex build with a high-powered actuator moving a system of sleeved cables that could control each individual finger,” Whitehead adds. “The engineering in the hand was the greatest challenge; getting the printed texture of the hand took some time to get right as well.”

“Roar” features not just a lion, but an enormous, statement-making lion that dominates the stage. Perry’s team turned to Landmark Creations, located in Burnsville,

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Minnesota, for a 28'-high by 23'-wide by 17'-deep inflatable lion head with glowing eyes. "Creating a large, inflated, angular-faceted, geometrical shape that holds its flat edges was a challenge since inflatables naturally have rounded edges," explains Landmark Creations president Tom Meacham.

"The material needed to be color-matched, IFR [inherent flame-retardant], matte [so there wouldn't be glare in photos and video], and the nap needed to create contrast between pieces. Inflatable displays are required to hold up and look picture-perfect performance after performance through a worldwide tour in over 50 cities," he adds.

"The lion's eyes are equipped with custom-designed, waterproof, dimmable, wireless remote-controlled LED light boards manufactured to be durable, yet flexible, for use inside a soft shape," Meacham explains. The LED light boards are from Environmental Lights, while the illumination is controlled via RC4 Wireless RC4Magic S3 2.4SX DMX4dms, four-channel dimmers that feature 19-bit-per-color dimming.

When Perry ventures into space, she's flanked by two



The eyes in the roses are based on a scan of one of Perry's eyes.



One of the biggest challenges in terms of creating the "Roar" lion head was the angularity of the inflatable.

inflatable planets; one is 6' in diameter, while the other is 8'. They're from Landmark Creations as well. "We manufacture in Minneapolis, which is a particular point of pride in our industry, where so many inflatable companies have shifted their manufacturing to imports from India and China," Meacham adds.

Backline Fabrication, based in Austin, was tasked with several giant props, including the giant dice that appear in "Roulette." "The dice alone were a huge challenge to fabricate," says Ryan Newland, owner of Backline. "They had to be made to come apart in six pieces and be able to be put on a prop cart so that they could tour the world. Since they had to support the dancers and Katy and be extremely safe at all times so no one would get hurt, it took a lot of planning and some engineering."

Newland says, "We had to figure out how to add the lighting around the entire die and inside each number hole. On the inside of each hole, we had aluminum plate water jet with the interior circle being 1" smaller than the one cut in the face of the dice, so that we could securely mount the RGB LED neon lights. The dancers can physically go through and come out any of the holes on both dice, except the three on the flat-sitting dice, which is where we made round steps to be able to climb to the top from the exterior. We used roughly 245' per dice of RGB LED neon rope with two 600W power supplies and two 24-channel wired DMX controllers [specifically, the DMX Decoder-Studio] that we picked up from Environmental Lights out

of San Diego.” Working with Backline on the dice were Standard Scenery, located in North Hollywood; Utility Specialized Metals, of Sun Valley, California; and JP Design and Print, based in North Hollywood.

“Swish, Swish” features a basketball court, complete with a massive hoop and net assembly. “The basketball set is 16' 6" wide,” Newland says, “with an 8' tall backboard supporting a 6' aluminum hoop. The top of the backboard is roughly 16' from the floor. The court floor separates into five pieces and it also is 16' 6" wide and stands 14" from the ground. From upstage to downstage, the court is 12'.” To illuminate the basketball court, “We used roughly 150" of RGB LED neon rope with two 600W power supplies and another DMX Decoder-Studio.”

One of Backline’s biggest challenges had to do with the basketball set. “We were never able to fully put it together in the shop because the ceiling wasn’t tall enough,” Newland says. “For our test fits, we had to test everything in sections, then take it apart and move on to the next layer.” Backline, assisted by Utility Specialized Metals, also created a 42" diameter glowing sphere used in a musical interlude, as well as the pink cylinder that rolls onstage during “California Girls.”

North Hollywood-based FlixFX was tasked with populating the Flower Planet. When the act opens, the stage is filled with massive mutant roses. FlixFX CEO Damon Dunay notes, “Every petal of the roses was sculpted individually and then vacuformed; they are done in 1/8" plastic. Every one of them was hand-painted to give each individual rose its own specific unique look.” The roses are tall, and range from 4' to 5' tall; the stems range in size up to 12'.

There’s more to the roses than initially meets the eye. “When we saw the rendering in the designs, we saw the eyeball in the roses,” Dunay says. “It wasn’t until we got into the nitty-gritty that we realized we were using Katy’s eyes. There’s a photograph of her eye, we took that file and printed and VacuPrinted it.”

VacuPrinting is a unique service offered by FlixFX. Marc Pollack, the company’s president, says, “We have a way, on large format, to pre-print on plastic an image and then, by vacuforming, pull it over a form so that it registers onto a three-dimensional object. Essentially, we can make three-dimensional props that have graphic artwork registered to the actual prop itself. When you vacuform, you’re stretching the plastic and the printed image over a form to create a beautiful registered image.”

As “Déjà Vu” segues into “E.T.,” more surreal flowers appear on stage: six Venus flytraps that, Pollack says, “were constructed with fabric faces, vacuform plastic shells on the back with a foam interior, and a steel sub-structure.”

The largest Venus flytrap is 10' tall and 16' wide in the closed position; it’s manually operated via a lever from the

rear of the piece. Pollack notes: “By pulling a lever back, a dancer can make the leaves of the Venus flytrap open and close.” Dunay adds, “We did it that way, so a dancer could control the speed in which it opens and closes; that way, they can time out the reveal in relation to the rhythm of the song.”

No Venus flytrap is complete without spikes. Pollack confides: “To protect the dancers, the exteriors of the spikes are soft but are embedded with steel, so the dancers could actually climb up on flytraps.” Dunay adds: “The spikes were constructed from a urethane elastomer, cast over steel rod. We created them so that they are structurally sound and could support the weight of a heavy dancer climbing and or dangling from them throughout the entire tour. We ensured that the tips are soft, so if a dancer or crew member bumped into them, no one would be hurt.”



Perry’s flying star, complete with an almost invisible staircase.