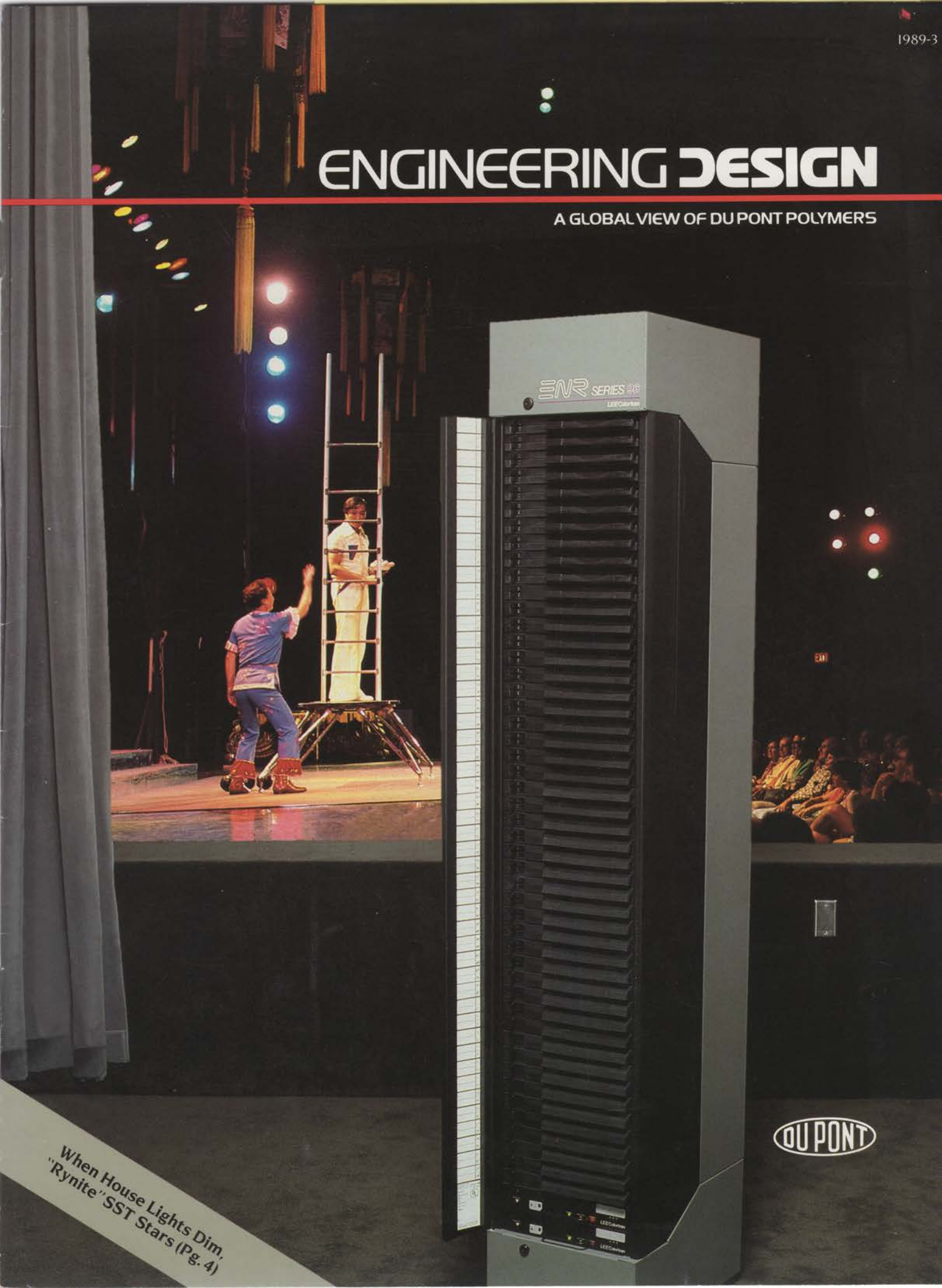
1989-3

ENGINEERING DESIGN

A GLOBAL VIEW OF DU PONT POLYMERS



When House Lights Dim, "Rynite" SST Stars (Pg. 4)

DU PONT

WHEN THE HOUSE LIGHTS DIM

"Rynite"SST;"Delrin"500T Star in Lighting Controls Developed By Entertec for Lee Colortran

By Jack Montgomery

WEST HOLLYWOOD, CALIFORNIA

Because of heat generated in the controls that fade lights up or down to establish "mood" in theaters, television studios, concert halls, convention centers, hotel lobbies, ballrooms, and churches, safety codes once called for light dimmers to be housed in metal. Now those awkward contrivances are being retired, joining the discarded resistance and auto transformer panels at which stagehands and electricians formerly stood ready to raise or lower lighting in synchronization with whatever drama was unfolding.

Lee Colortran, Inc. and its design partner, Entertec, designers and manufacturers of memory and computer-controlled systems for environmental and architectural lighting, as well as performing art enhancement, are responsible for this latest development.

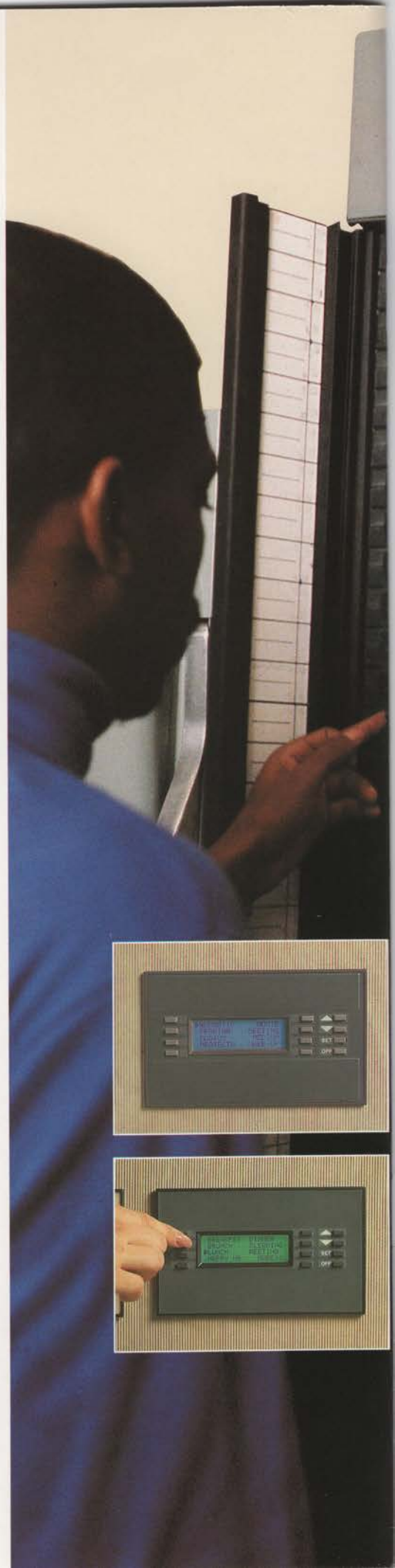
In a Lee Colortran ENR series dimming system, plug-in dimmer modules of "Rynite" SST35 thermoplastic polyester—molded with integral cooling channels, assembly snap-fits, and compartments for a solid state power device, noise filters, and circuit breakers—stack in either wall-mounted or free-standing racks. Cooling fans built into these dimmer racks draw ambient air through the modules (rated for dual 20 amp or single 50 amp loads) to keep heat levels at a minimum.

Lee Colortran's architectural control system is called "Viewpoint". Coupled with the ENR dimmer rack, it handles low voltage, incandescent, fluorescent, cold cathode, and neon, as well as non-dimming lights, with up to 48 dimmers (96 circuits) per wall rack. Standard "Viewpoint" systems are controlled by LED and LCD wall stations. An expanded "Viewpoint" system, using free standing racks, ties control stations and dimmers together via a personal computer, and contains as many as 512 dimmers. Complete installations, though, may include many more—the new Disney Dolphin hotel boasts a total of more than 2,000 dimmers. "Prestige" series 3000 consoles routinely employ 800 dimmers in Broadway-type or television studio productions.

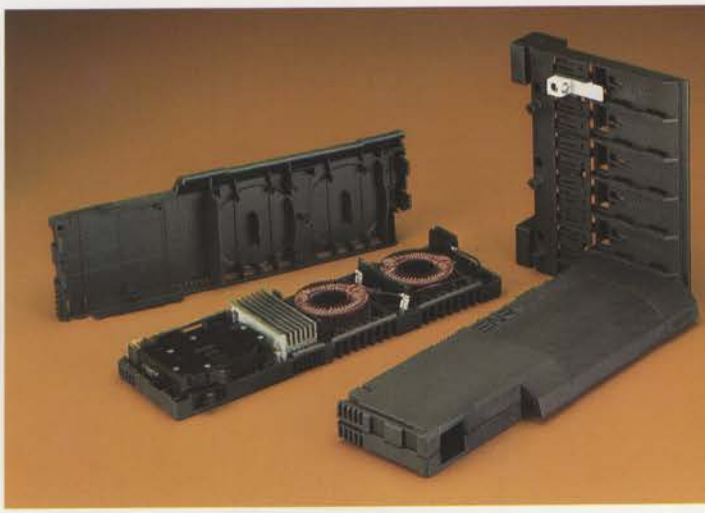
Eliminating Buzz, Static

"That's a lot of power to deal with," says Gregg Esakoff, a founder of Entertec. (He manages the team that designed the mechanics of the system, co-founder David Cunningham manages the electronics and software teams.) "With any thermoplastic other than 'Rynite' SST, we might still be working on the dimmer design."

As Esakoff recalls it, heat wasn't the problem initially. The real problem solved by Lee Colortran ENR dimmers—ENR stands for electronic noise reduction—was buzz and static. The Colortran goal as the project got underway in 1987 was



The LCD (left) and LED (right) control stations used with wall-mounted dimmer racks can also be tied into expanded lighting systems that employ computer controls and free standing dimmer racks.



Molded features of dimmer modules in "Rynite" SST include ribbed air vents and screw bosses in both halves; snap-fit prongs and a handle that forms part of the wall in the top half; and, in the bottom half, positioning posts for the chokes, the seating channel for power and load connectors, and wiring paths. The ramp or guide track (right rear) on which the modules slide is molded in "Delrin" 500T toughened acetal.

elimination of dimmer noise and the threat of filament 'sing'—harmonic vibrations capable of increasing decibel volume and interfering with sensitive equipment.

In the past, manufacturers coped—at least partially—with noise by increasing the size of toroidal filter chokes, donut-shaped copper windings that limit radiated radio frequencies, electromagnetic interference, and acoustical noise in lamp filaments. Entertec went in the opposite direction. It increased the number of filter wire turns to reduce choke size by two thirds, and employed a patented phase-firing technique to reduce the "chopping" of the sine wave from 120 to 60 times per each one second cycle, thus producing only one half of the noise generating "events."

"That reduced objectionable harmonics by 75 percent," says Esakoff. "It worked so well that the manager of the ABC television studio in New York where we tried out the prototype didn't want to part with the unit after the test."

But Entertec's job was only half finished. "Closer winding generated heat levels close to the 140°C (284°F) maximum and we wanted a higher safety margin," Esakoff explains.

"With control elements of the system ready for production, we had to finalize a design with optimized thermal features.

"The design changes were simple compared to selecting the right plastic," the designer notes. "Naturally, we wanted a high-heat resistant resin. We also needed one that molded easily in the complex configuration of both module halves. Dimensional stability was a must—the 300 mm (11.8 in) long module had to slide into a track of 'Delrin' 500T toughened acetal resin, meshing smoothly with power and load connectors. Both had to be tough to take such handling, while resiliency was essential in the snap fits."

Confidence in "Rynite"

Given the luxury of time, Entertec might have started at the beginning with new prototype molds and a reevaluation of material candidates. To meet its self-imposed deadline, the firm zeroed in on the three materials that had already proven their capabilities in preliminary studies—PET (polyethylene

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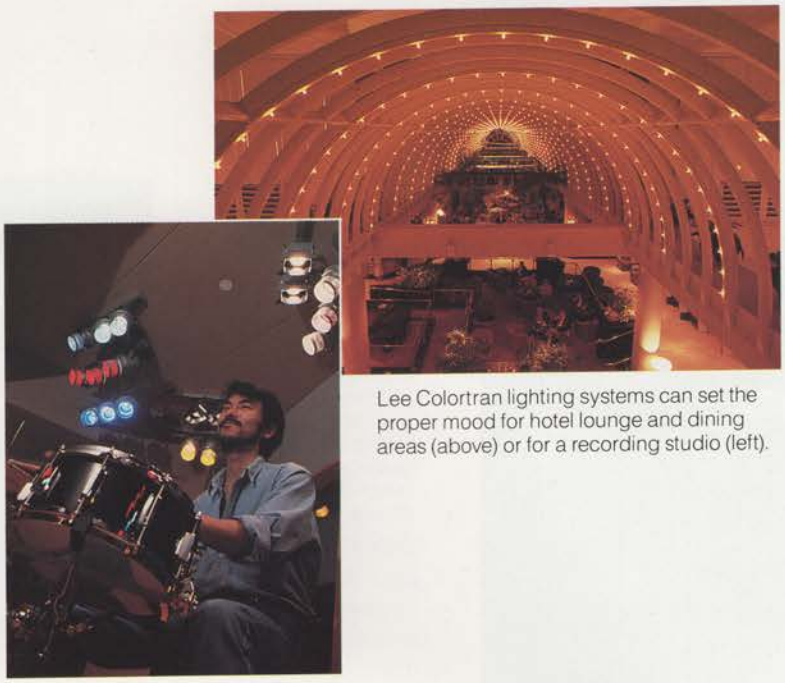

Lee Colortran lighting systems can set the proper mood for hotel lounge and dining areas (above) or for a recording studio (left).

terephthalate) and PBT (polybutylene terephthalate) thermoplastic polyester resins and polycarbonate—while starting on parallel tool-cutting.

"We would have lacked the confidence for such a step if it had not been for the range of options 'Rynite' polyester gave us," Esakoff admits. "Available grades and types, including both PET and PBT, promised the highest heat resistance, plus a choice of strength, stiffness and toughness properties. Moreover, 'Rynite' had demonstrated its ability to be molded in the long, flat configuration then taking shape in the tool steel.

"Because the final choice would be based on a balance of properties, however, competitive testing continued through mold tryouts."

In the final analysis, it was a balance of impact and heat resistance that won the assignment for "Rynite" SST35. A stiffened super tough PET polyester—it pairs the highest combined stiffness/toughness of any thermoplastic with a heat deflection temperature of 220°C (428°F). With the help of a team of Du Pont experts, its adaptability permitted fine tuning right up until the beginning of production.

Calling on CAD (computer aided design) support groups, Du Pont design engineer Doug Hicks recommended a near-doubling of height in four snap fit prongs at the ends of the module cover—from 9.0 mm to 15.2 mm (0.355 in to 0.6 in)—to increase resiliency. At his suggestion, walls were thinned and strengthening ribs added at vents.

To counteract warp, Du Pont molding technologist Tuan Dao recommended a new, evenly-spaced gate system in the two-cavity family mold to increase packing pressure. He then worked with the processor, Molding Corporation of America in Burbank, to redesign the entire sprue and runner system.

Molder's Contribution

MCA's own touches included increased venting along the parting line, and a post-molding clamp fixture to further guard against warpage via a five minute curing.

"Probably our biggest contribution," says MCA engineering vice president Terry Allen, "was mating hot oil technology with existing cooling channels to increase cavity heat. Oil heating and revamping the runner system helped us speed up the molding cycle by five percent to cut costs."

"That was an unexpected dividend," agrees Esakoff. "But the two main payoffs were the speed with which we got into production—half the time a conventional redesign approach would have taken—and the performance of the modules in 'Rynite' SST. They not only meet toughness, dielectric, and thermal performance requirements of UL 891 and 508 standards—plus Canadian CSA equivalents—they go beyond them in terms of safety."

In a "worst case scenario" described by Esakoff, the cooling fans and automatic shut-down circuits were intentionally disabled for 3.5 hours in a system running at 100 percent capacity without initiating any safety hazards such as fire or exposure of electrically "live" parts. This in spite of module temperatures exceeding 280°C (540°F)!

"Product reliability of that sort fits in well with 'the show must go on' spirit," suggests Bill Liento, Lee Colortran's senior vice president for sales and marketing. "The producers of any show—a stage spectacle, the romantic atmosphere in a restaurant, or a political drama climaxing in a convention hall—can count on the highlighting our equipment makes possible."