

Advanced optical films for mobile electronics and displays



Figure 1: Precision converting of optical films and optically clear adhesives for integrated displays. Source: Boyd Corporation

Advanced optical films provide a number of screen enhancements in today's mobile electronics and display systems. Inclusive of directional light-control films, anti-glare films, device-protective films and brightness-enhancement films, these materials are converted to form a custom product that extends screen life, increases its efficiency and enhances its optical properties.

3M Company (Display Materials and Systems Division) is a highly innovative company that has remained at the forefront of materials research and development. They offer a full suite of optical films that fulfill the needs of next-generation mobile electronics and display systems. Their portfolio consists of three functional groups: directional light control, protection and brightness enhancement. These films collectively manipulate the physical properties of light to fulfill the display requirements of today's mobile electronics, consumer electronics, automotive displays, wearable devices and medical display systems.

Brightness-enhancement films (BEFs)

BEFs serve a targeted application. Manufacturers integrate the films into a display backlight architecture to increase brightness, decrease weight, mitigate heat and extend battery life. 3M provides several BEFs with a structured surface to recycle and collimate light, increase the viewing angle of the display and improve backlight efficiency.

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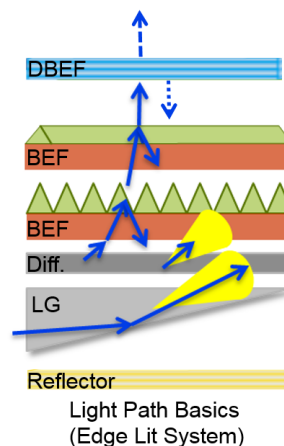


Figure 2: Precision converting and forming manufacturing technologies. Source: Boyd Corporation

In Partnership With:



3M BEF

3M BEF is a family of optical films with precision micro-replicated prisms that refract and collimate light toward the viewer. These films are available with a variety of prism angles and with various haze and matte finishes. A single BEF or two BEFs crossed at 90° collimate light and increase on-axis brightness of liquid crystal displays (LCDs). The films also increase backlight uniformity and hide defects.

3M dual brightness enhancement film (3M DBEF)

3M DBEF is a family of reflective polarizers. These multi-layered optical films recycle non-polarized light that would otherwise be absorbed by the rear polarizer. They increase backlight efficiency by 30% to 40%, while distributing polarized light over a wide viewing angle. They are also available with an optically clear adhesive (e.g., 3M DBEF-QV2).

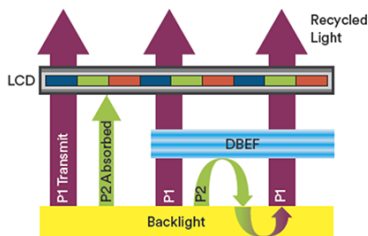


Figure 3: Recycling of non-polarized light with 3M DBEF. Source: 3M Display Materials and Systems Division

3M enhanced specular reflector films (3M ESR)

3M ESR is a family of non-metallic color-neutral reflectors that reflect 98% of all wavelengths across the visible spectrum. These films improve the recycling efficiency of LCD backlights and are paired with 3M DBEF reflective polarizers to maximize backlight efficiency. 3M ESR film thickness ranges from 65 to 82 microns, and halogen-free versions are also available.

Directional light control films

Directional light control films are a group of films that address data privacy needs, field of view requirements and interference concerns of consumer electronics, autonomous vehicles, commercial kiosks and medical displays. These films are integrated into a display to provide a narrow field-of-view, eliminate reflections and glare or provide precise positioning of automotive heads-up display systems. 3M’s portfolio of directional light control films is inclusive of gold privacy filters, high-clarity products, touchscreen products and other directional light control films.

Protective films

Protective films provide an optically transparent barrier. They improve a display’s scratch resistance, impact resistance, UV resistance and water resistance, while maintaining optical transmittance. These products may also provide additional functionality, including anti-glare treatments, contrast enhancements and an organic encapsulation or barrier.

3M Flexible Transparent Barrier film (FTB3-50)

3M FTB3-50 is a barrier film that is lighter, more flexible and more impact resistant than glass. The optically clear film consists of a multilayer polymer-oxide coating on a heat-stable, optical-grade polyester (PET) base. The non-conductive, protective film provides an oxygen and water vapor barrier for

sensitive electronics, display systems or even solar cells. They also feature:

- 88% transmittance (>85%)
- Thickness of 52 µm
- Low haze; less than 2.5%
- High clarity; greater than 95%

3M Barrier Protective Sheeting (BPS-55)

3M recently introduced an anti-glare, UV-blocking barrier film that is only 55 microns thick, which is approximately one-fifth the thickness of traditional anti-glare films. This new protective film, 3M BPS-55, complements next-generation consumer electronics, wearable devices, medical monitors and flexible electronics. It transmits less than 3% of all UV light, is thin, flexible and scratch resistant, with a pencil hardness greater than 3H.

Boyd Corporation — A preferred converter of optical films

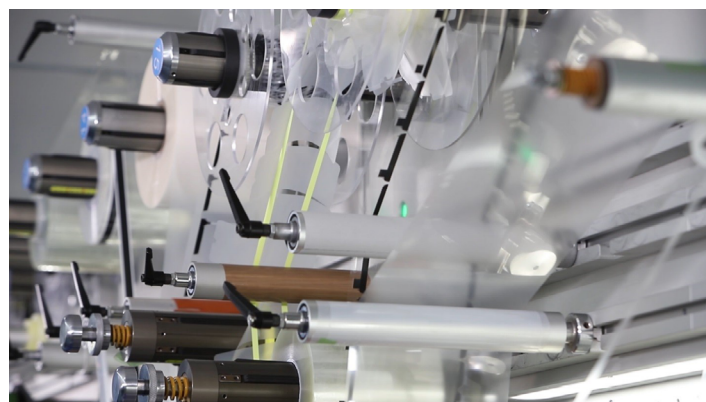


Figure 4: High-precision converting and advanced rotary die cutting technologies. Source: Boyd Corporation

To achieve desired characteristics and maintain a competitive price point, vendors require a supplier with a host of display film solutions that can be converted precisely and efficiently. As a 3M Preferred Converter, Boyd Corporation is uniquely positioned to address display film requirements of mobile electronics and display systems.

Boyd is able to leverage their fully integrated, in-house, precision converting capabilities to produce optical films that are optimized for unique automated assembly systems. Core competencies include producing die-cut components with zero-gap tolerances, in cleanroom manufacturing environments, with advanced, segmented-frame manufacturing technology. With decades of experience, a strategic partnership with an advanced materials manufacturer and production facilities and design centers across the globe, Boyd is a pioneer in integrated sealing, thermal management and protection solutions that meet or exceed design criteria for virtually any display system, while delivering a low total cost of ownership.

Ultra-tight tolerances

Advanced OLED and LED display technologies require deliverables that maintain ultra-tight tolerances. Multi-layered optical films for these advanced display systems are produced by converting a stack of high-tack materials.

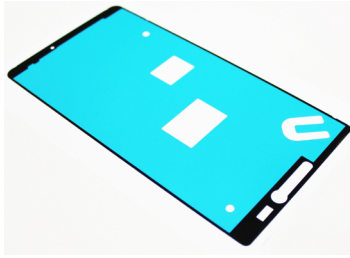


Figure 5: OLED and LED display components. Source: Boyd Corporation

However, to maintain product orientation and achieve required dimensional accuracies throughout the conversion process, precise registration and web control are paramount. Boyd maintains registration control by incorporating multi-station, servo-driven rotary presses with a proprietary MR-Module and programmable

logic controllers. They model and produce multi-layered optical film assemblies and achieve zero-gap tolerances, which provides their customers with the following benefits.

- Increased functionality and life expectancy of electronic display modules.
- Enhanced degree of protection against ingress and moisture.
- Ability to address challenges when handling and die-cutting optically clear adhesive (OCA).
- Inclusion of multi-station, servo driven rotary presses and proprietary technologies to maintain registration control and support ultra-tight tolerances.

Cleanroom capabilities

High-quality LED displays, OLED screens, touchscreens and other high-performance electronic components exhibit increased sensitivity to debris, particulates and contamination. Boyd’s regional manufacturing locations are inclusive of FDA-registered class 100 to class 100,000 cleanroom facilities, as defined by the United States federal standard concerning classification of cleanrooms, U.S. FED STD 209E. Boyd’s high-precision converting and advanced rotary die-cutting technologies are housed in a cleanroom environment that provides high yield rates and low reject rates in volume production, and maintains integrity of OCAs and protective, light-control or brightness properties.

Segmented-frame manufacturing technology

Opposed to traditional full window-frame designs, Boyd’s segmented-frame manufacturing technology allows them to eliminate material waste and drive down converted bill of material (BOM) costs. The yield-optimized technology allows them to convert multiple rolls of specialized high-performance films and produce a single, cohesive deliverable in a format optimized for assembly. They are able to incorporate sealing, thermal and protection solutions, while increasing material utilization and achieving zero-gap tolerances at the lowest possible total cost of ownership.

Global manufacturing

Boyd Corporation’s diversified sourcing capabilities allows them to address logistical challenges and supply chain requirements. They have over 30 manufacturing locations across the globe, which are strategically located to support regional manufacturing and address logistical challenges. Boyd’s qualifying supply chain partners are selected based on product quality, supplier leadership, financial stability and strength. Additionally, a cross-functional team aids in the management of new product introductions, volume production and delivery deadlines.

Conclusion

A backlight only transmits 8% of generated light through a display. With a demand for large, high-resolution displays and the need to meet Energy Star 8.0 regulations, manufacturers must rely on advanced optical film solutions to innovate electronics displays. Boyd Corporation provides high-quality, high-performance optical film solutions at the lowest total cost of ownership. Their fully integrated, in-house, precision converting capabilities and multiple facilities provide competitive solutions for complex manufacturing and assembly requirements globally. .

To receive more information regarding optical films, please visit www.boydcorp.com.

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ABOUT BOYD CORPORATION

Boyd Corporation has over 90 years of customer-focused performance success and is a global leader in advanced sealing, thermal management and protection solutions. From humble beginnings as an industrial fabricator in the Bay Area of California in 1928, Boyd has evolved into a dynamic global innovator. Empowering human curiosity through the safe exploration of space. Enhancing the safety and flexibility of medical care and transportation. Enabling faster, brighter, more functional technology with greater power density. From self-driving cars to brain surgery, space stations to smart farming, high powered computing devices to wearable medical technologies. As our customers redefine their markets and technology – unique solutions from Boyd empower them to be possible.