

BLULINE II

Enabling Fascination 3D



BLULINE II

The Platform for High Quality Blu-ray Discs

The success of 3D in the cinemas is encouraging, the Hollywood Studios are increasing the production of 3D movies, broadcasters are preparing to launch 3D channels, the consumer electronics industry is readying a whole range of 3D TVs and Blu-ray players. SINGULUS is supporting all that with the right replication equipment for the 3D Blu-ray Discs!

Hollywood Studios want to take advantage of the enormous storage capacity of a BD50 disc in order to deliver an unprecedented video and audio experience in Hi-def quality to the home consumer. For this reason, the availability of 50 GB Dual Layer Blu-ray Discs is a clear must for these formats.

The Blu-ray format has definitively established itself as the new standard in the market. High-definition television, HDTV (Full HD and 3D), combined with the Blu-ray video format, is the new technology of the media sector. The market introduction of the 50 GB Dual Layer Blu-ray Disc was a show-stopper for the entertainment industry.

The high storage capacity of the format enables optimum audio and video High-Definition quality and also offers the ability to store bonus material such as additional trailers, interviews with directors and stars as well as BD-Java-based applications, enabling viewers to enjoy an interactive movie experience never possible before. The Blu-ray Disc will initially be the only method of delivering Full HD (1080p) 3D content to the home.

SINGULUS' experience in the field of Blu-ray goes back to its early, exclusive partnership with the format developer Sony in 2005. SINGULUS has already a large number of production lines at over 30 replicators around the globe.

The SINGULUS Blu-ray Disc production system BLULINE II is designed for the economical production of Blu-ray Discs (BD ROM Single Layer and Dual Layer (BD ROM SL/DL), according to the specifications issued by the BDA.

All production steps from molding, cooling, metallizing, wet-embossing, lacquering and

UV-curing to quality inspection are incorporated in the BLULINE II. Its functionality, speed and design will again set a new benchmark for the industry. The BLULINE II operates with one molding machine and comprises all the advanced features required for production of high end Dual Layer Blu-ray Discs.

The most common technology for creating an additional information layer on a substrate surface is the the wet-embossing process. The benefit of the wet-embossing process is that it provides a very fine pit geometry and therefore generates a flawless electrical signal.

The dual layer process requires an excellent uniformity of the space layer between the two information layers (approx. 25 ± 1 micron). This space layer is created by our field proven spin coating process and uses resin heating and curing to achieve the required uniformity. Finally the BD50 disc requires a precise 75 micron cover layer.



The following features characterize the BLULINE II concept:

- _ Dedicated to production of BD ROM SL/DL
- _ Cycle time BD SL < 4.0 s / BD DL < 4.5 s
- _ Highly integrated design
- _ All production steps included
- _ Thickness Measurement Device (TMD) for metallized layers with close loop control for the cathode
- _ Spectrometer for spacer-layer and cover-layer measuring with close loop control for spin process
- _ High productivity, high uptime
- _ Clear structured disc flow
- _ Automated handling of BD through all production steps
- _ Minimum space required



Concept



Sputter Station for Layer 0 and Layer 1 Metallization

For metallization of the molded Blu-ray Discs substrates with Layer 0 full-reflective material, one high sputter rate SINGULUS V module with the patented SMART Cathode® is used. Silver Alloy is sputtered with a layer thickness of approx. 35 nm. For the second metallization of the wet-embossed disc with Layer 1 semi-reflective material, the same sputter station is used. A second sputter module is used for sputtering the label side of the disc with a moisture barrier.

Dual Layer Cover-Layer Unit

Lacquering for the cover layer takes place on a double track module for high throughput. Each track consists of one lacquer dispense system, two spin bowls and one IR lamp. One pulsed UV lamp is alternating used for both tracks. By using the second spin bowl, a mask and the influence of heat from the IR lamp, a homogeneous thickness of cover layer is achieved. The combination of the UV station and an additional spin bowl creates a uniform shape and outer edge on the disc.

Wet-Embossing Station

The Layer 1 wet-embossing station is the key unit of the dual-layer application. This unit is built with a 4-position turntable and one embossing head. The embossing head is designed for the Layer 1 wet-embossing process with a Nickel stamper in the uncured pit-transfer resin. The Layer 0 disc is loaded onto a quartz glass for embossing and is centered with a center pin. The Layer 1 stamper is mounted onto to the top side of the embossing head and is supported by vacuum and a mechanical stamper holder.

Main Components

1 Injection Molding

SINGULUS has qualified the MoldPro All-Electric molding machine for Blu-ray Disc production. Other qualified molding machines can be integrated on request.

2 Cooling Conveyor

A linear cooling conveyor transports the discs in a horizontal position through a separate conveyor belt to the downstream. This additional cooling of the substrates during transportation provides a uniform temperature distribution over the disc surface.

3 Layer 0 Metallization

A high-rate SINGULUS V sputter module with the patented SMART Cathode® is used for the metallization of the molded Blu ray Disc substrates with Layer 0 full-reflective material. Silver Alloy is sputtered with a layer thickness of approx. 35 nm.

4 Base Resin

Lacquering takes place on a double track module for high throughput. Both tracks are connected to one lacquer dispense system, two spin bowls and one IR lamp. One Xenon pulsed UV lamp is used for each track. The combination of a spin bowl and the UV station creates a uniform shape and outer edge on the disc.

5 Pit-Transfer-Resin

This unit consists of one lacquer dispense systems and two spin bowls. The discs are transported by one handling system. Once the metallized and resign-coated disc reaches the first position, a highly accurate circular ring of lacquering agent is applied onto the disc with 2 µm pit-transfer-resin.

6 Pre Curing

A one-position turntable to pre-cure the center of the lacquered Blu-ray Discs is positioned just prior the wet-embossing station.

7 Wet-Embossing Station

The Layer 1 wet-embossing station is the key unit of the dual-layer application. This unit is built with a 4-position turntable and one embossing head. The embossing head is designed for the Layer 1 wet-embossing process with a Nickel stamper in the uncured pit-transfer resin. The Layer 0 disc is loaded onto a quartz glass for embossing and is centered with a center pin. The Layer 1 stamper is mounted onto to the top side of the embossing head and is supported by vacuum and a mechanical stamper holder.

8 Layer 1 Metallization

For the second metallization of the wet-embossed disc with Layer 1 semi-reflective material, the same

sputter station is used as for Layer 0. Silver Alloy is sputtered with a thickness of approx. 30 nm.

9 Cover Layer

Lacquering for the cover layer takes place on a double track module for high throughput. After UV curing, the disc is positioned directly under a spectrometer to measure the cover layer thickness and uniformity. With these results, a closed loop cover layer control is generated to ensure constant thickness and uniformity.

10 Hard Coating

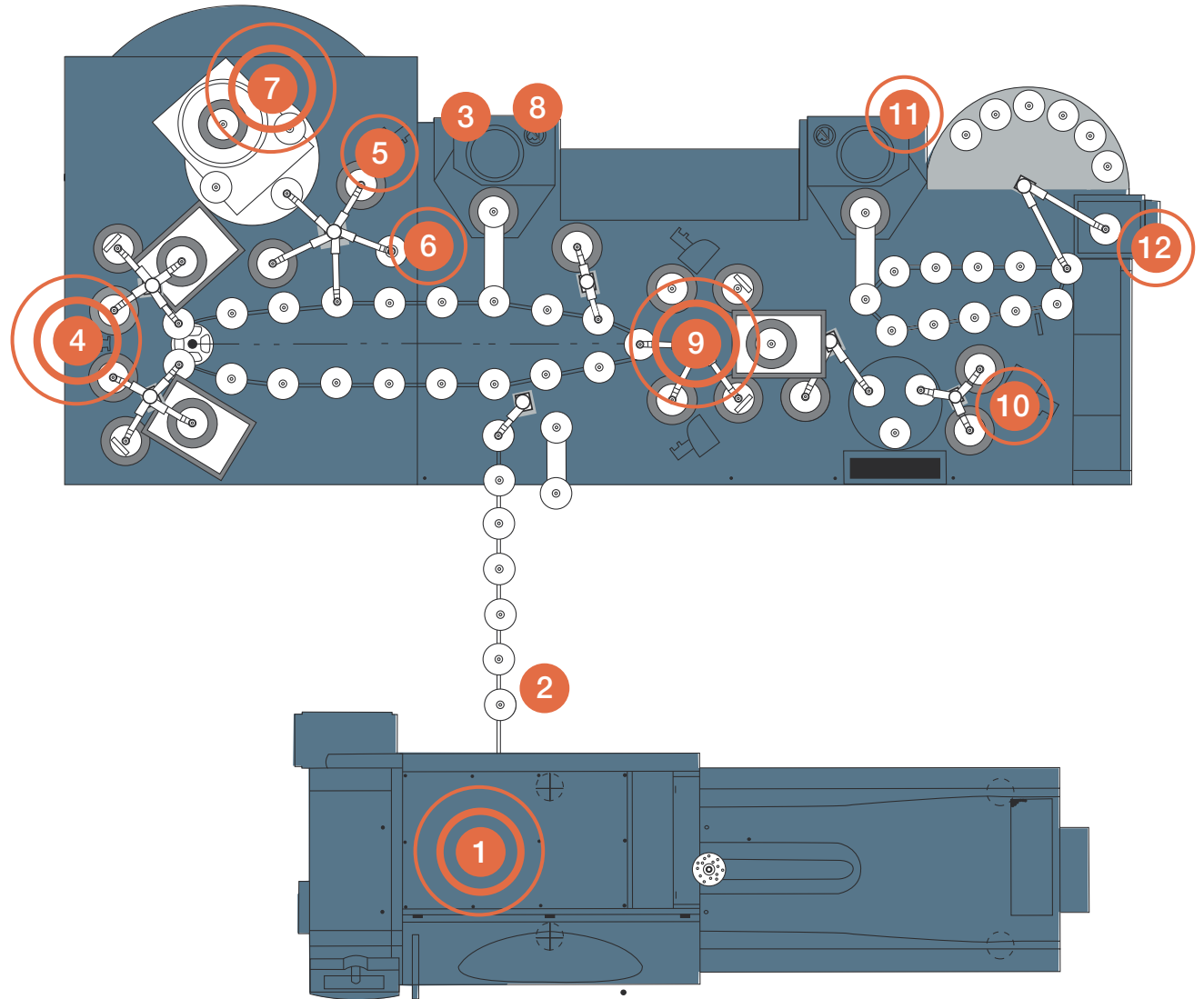
The hard coat is performed with a spin process, ensuring a very thin and uniform distribution of the hard coat material. Afterwards, the disc will be UV-cured and positioned on the conveyor. A flip-over handling arm brings the print side of the disc facing up.

11 Barrier Layer

A SINGULUS V module is used for sputtering the label side of the disc with a moisture barrier. SiN is sputtered with a layer thickness of approx. 10 nm.

12 Final Inspection

The unique layer thickness measuring system controls the layer thickness and layer uniformity of each metallized substrate automatically.



Main Features

Format	BD ROM
	Single Layer & Dual Layer
Cycle time	DL < 4.5 s
	SL < 4.0 s
Space layer	25 µm
Cover layer BD DL	75 µm
Cover layer BD SL	100 µm

Metallization

Fully reflective layer	Ag+ (approx. 35 nm)
Semi reflective layer	Ag+ (approx. 30 nm)
Barrier layer	SiN (approx. 10 nm)

Available Options

Adaption of BCA module

Dimensions BLULINE II

(with MoldPro Injection Molding Machine)

Length	4500 mm
Width	3700 mm
Height	2080 mm



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