

SINGULUS III



SINGULUS III *Smart metallizer with optical measuring unit TMD I and a 12 spindle turntable*

SINGULUS Metallizer for CD, CD-ROM, CD-R, DVD

Metallization, i.e., the application of a thin metal layer onto a still transparent polycarbonate disc by means of vacuum coating technology, is what enables the information (music/data/video) embedded in the disc during the molding process to be read. Consequently, it is one of the most important manufacturing steps in CD and DVD production.

Because of its key role, this coating technology is the most important core competence of our business. Singulus offers a metallizer family for all optical disc manufacturing applications. The patented cathode technology with integrated closed-loop control of the sputtering process in the SINGULUS III Smart metallizer is attractive not only for our own lines but especially for OEM customers. It meets all criteria set by the market for all gold, silicon and silver layers currently used for DVD applications and is distinguished by its high target utilization.

By the end of 2000, SINGULUS TECHNOLOGIES had built more than 2,500 machines for OEM customers or for use in its own lines.

The corporation is preparing an entirely new generation of metallizers for the year 2001 that will advance SINGULUS TECHNOLOGIES' technological lead even further.

SINGULUS metallizer family for all applications:

- SINGULUS III with 1.5 s or 2.7 s cycle time for **CD Audio/CD ROM**
- SINGULUS III Smart with 1.5 s or 3.0 s cycle time for **CD-R**
- SINGULUS III Smart with 1.5 s or 3.0 s cycle time for **DVD**
- SINGULUS III Twin metallizer for **DVD 9**

SKYLINE



Two SKYLINE replication lines at
MEMORY-Tech, Japan

Right picture: SKYLINE Duplex
during acceptance test

SKYLINE Replication lines for CD, CD-ROM and DVD 5

People shook their heads when the newcomer SINGULUS TECHNOLOGIES introduced a prototype of the SKYLINE CD replication line at the April 1996 European Replitech trade show in Utrecht. "Another supplier" was the general reaction. Although the II lines placed into operation in its first year on the market was an initial success and earned it the respect of the CD industry, a breakthrough had not yet been achieved.

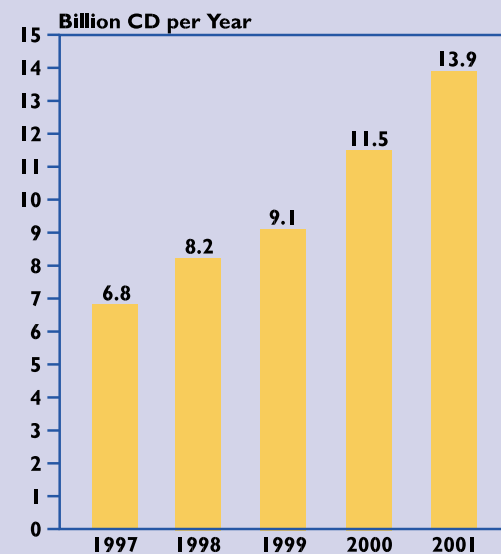
SKYLINE sales will soon cross the 1,000 mark. In the year 2000 alone, 405 lines were realized as sales.

With its basic design unchanged, many details in the system have since been improved. In 1999, the dual-use SKYLINE DUPLEX model provided an interesting alternative for entrants into the DVD market. The CD card version developed at the end of 1999 created additional interesting business for the year 2000.

The SKYLINE replication line for CD/CD ROM, DVD5, CD Card and all 80 mm applications has since



become the benchmark in the industry in terms of production reliability and productivity.



Source: Understanding & Solution and Internal

CD/CD-ROM Market world wide

The market for compact discs continues to evolve. New applications, especially in the realm of CD-ROM, e.g. for PC software, online applications and games, have contributed to positive growth. Video CD and Super Video CD are additional factors in Asia, supported in part by the region's large karaoke market.



SPACELINE



**Four SPACELINE replication lines at OEM,
Charlottesville, USA**

**Right picture top: One of 47 SPACELINEs
at INFODISC, Taiwan**

**Right picture bottom: Six of a total of
12 SPACELINEs at FUTURE MEDIA, USA**

SPACELINE Replication lines for DVD

When the SPACELINE DVD replication line was introduced in 1997, the company embarked upon a course viewed as utopian by industry experts: the inline production of prerecorded DVD, particularly DVD9, i.e., production in a line in which the substrate flow would be uninterrupted, from synthetic granulate to finished DVD.

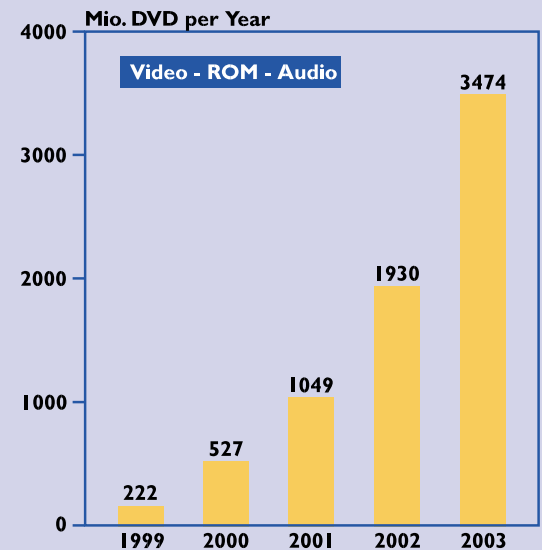
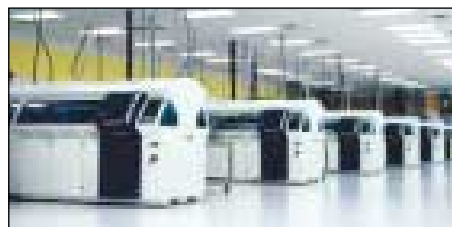
From the outset, SINGULUS TECHNOLOGIES has oriented its line development to the high standards of DVD 9. The first of two discs needed to produce a DVD disc is coated with reflective aluminum, the second with semi-transparent gold (or silicon). The subsequent adhesion of these two DVD disc halves is known as bonding.

The breakthrough of this inline concept was achieved through early, intense cooperation with key customers in 1998 and 1999. In the year 2000 alone, 100 lines were successfully placed into operation at customer facilities.

Numerous advances have been implemented in the SPACELINE DVD



replication line since its market introduction in 1997. The utilization of the SMART CATHODE was a first step that later permitted the successful transition from the use of a gold to a silicon layer. The development of an inline optical measuring device (TMD) with closed loop control of the sputtered layer not only significantly increased the SPACELINE's yield to its current level of 17,000 good discs per day, but for the first time provided 100% quality assurance for all reflective layers.



Source: Understanding & Solution

DVD Market world wide

The market for prerecorded DVD discs is progressing at a rapid pace. Annual growth rates of 100% have already become a reality for DVD video. High growth rates for DV-ROM applications are expected for 2001 and 2002 as a result of game applications for PlayStation 2 and XBOX and high-end audio aficionados will have DVD Audio.

STREAMLINE



Two upgraded STREAMLINEs with a daily capacity of 25,000 disc

Right picture: Two STREAMLINE at ACME, Hong Kong

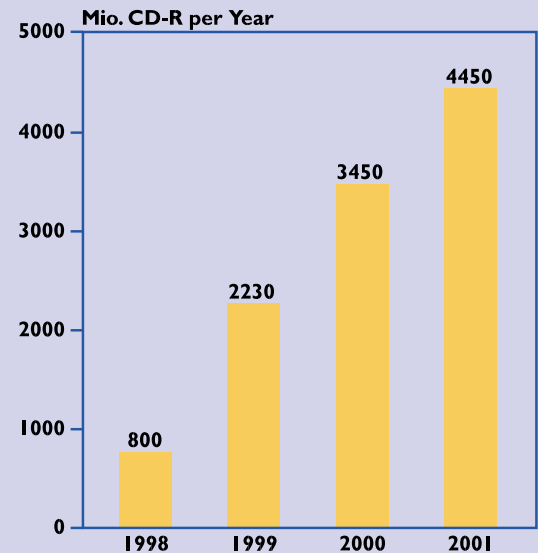
STREAMLINE Replication lines for CD-R, DVD-R

Our STREAMLINE CD-R replication system found recognition among Asia's leading manufacturers following its 1999 introduction. Its compact design and high degree of reliability guarantee replicators very low operating costs. The SINGULUS philosophy that promotes the proprietary development of all key components has been borne out here as well. In conjunction with a modified SKYLINE, the dye module in particular ensures stable production.



The hardware for the future DVD-R format has already been laid out. Here too, emphasis is placed upon the proprietary development of essential process know-how.

A STREAMLINE for production of the new once-recordable DVD-R with its 4.7 Gbyte storage capacity will be introduced during the course of 2001.



Source: IRMA

CD-R Market world wide

According to IRMA, expectations for 2001 include approximately 30% new growth in CD-R. The industry projects that the current overcapacity will be eliminated this year. The introduction of DVD-R will generate the need for additional systems.

MODULUS



¹³MODULUS with 13 process stations for the production of DVD-RAM

MODULUS Metallizer for CD-RW, DVD±RW and DVD-RAM

After a number of years in the development stage, SINGULUS TECHNOLOGIES introduced the new MODULUS metallizing system in July 2000 to mark the opening ceremonies of its new headquarters in Kahl/Main.

The new multicathode metallizer was developed for the production of CD-RW and especially for the new rewritable DVD. Operating according to the phase change principle, the composition of rewritable CD and DVD discs has a much higher level of complexity than other formats, consisting of layer stacks with up to 8 individual layers.

In 2000, PIONEER/Japan and SINGULUS TECHNOLOGIES entered into a cooperation agreement for the mass production of DVD-RW. The essence of this cooperation is the optimization of the process chain for all operating steps in the manu-

facture of rewritable DVD: particular emphasis is placed on the coating technology in vacuum as the most important production step.

At the end of December last year, the first MODULUS multilayer metallizer was successfully placed into production at the facilities of our Taiwanese customer ITRI (Industrial Technology Research Institute). Following delivery in early December, the full scope of DVD-RAM specifications set forth by ITRI were met in just under two weeks.



Like VHS cassettes, DVD±RW/RAM can be recorded repeatedly but, as a digital optical storage medium (VHS is analog), offers significantly better playback quality than the aging magnetic tape. Due to a unique layer configuration, however, the new rewritable DVD±RW places the utmost demands on manufacturing technology and consequently on the sputtering technology it employs.