

1 Introduction

Basler REFERENCE is a series of **high-resolution off-line testers** used to measure the physical parameters of 120 mm optical data storage media (**DVD, CD, Single Layer Blu-ray** discs).



Fig. 1: Basler REFERENCE Tester

Table 1 shows the types of measurement critical to the different steps of disc production depending on the type of disc format.

Type of Measurement	Critical to the Process of	CD-Audio CD-ROM	CD Recordable		DVD Prerecorded		DVD Recordable		Blu-ray SL
			CD-R	CD-RW	DVD-5 DVD-10	DVD-9 DVD-18	DVD-R	DVD-RAM DVD-RW	
Tilt	Bonding Molding	+	+	+	++	++	++	++	++
Birefringence	Molding	+	+	+	+	+	+	+	+
Reflectivity	Sputtering Molding	0	0	0	0	0	0	0	0
Transmission / Opt. Density	Dye Coating	-	++	-	-	+(semi-transp)	++	-	-
Groove Geometry	Molding	-	++	+	-	-	++	+	++*
Resin Thickness	Bonding Molding	-	-	-	-	++	+	-	-
Substrate Thickness	Molding	-	-	-	+	++	+	+	-
Cover Thickness	Spin Coating	-	-	-	-	-	-	-	++

Table 1: Which Type of Measurement for Which Format?

where: - not required, 0 of interest, + required, ++ critical

* This type of measurement is currently not available on the Basler REFERENCE.

For **molding** control, in-line measurements of birefringence directly observe the actual trend. But due to the discs still being warm, no absolute value can be obtained. Only an off-line test will show whether birefringence is within tolerance. Therefore, a combination of in-line and off-line testing is optimum. Off-line substrate thickness measurements allow that changes in the polycarbonate thickness can be controlled with high precision. **Groove Geometry** gives a clear indication of the replication capability of the injection molding machine.

For the **sputtering** process, precise off-line reflectivity measurements are required.

To control the quality of the **bonding** process, off-line tilt inspections are required. Furthermore, tilt inspections with independent measurements from both information layers are definitely required in-line and off-line for DVD-9 and DVD-18 discs. With the Basler REFERENCE, both information layers can be measured from the same side. Since the resin layer is part of the optical path in DVD-9 and DVD-18, it is essential to measure the layer's thickness and uniformity on the entire disc surface. This measurement should be carried out in-line for every disc. To get the most precise information, it should also be tested off-line.

Transmission/Optical density measurements are used to control the **dye coating** process when producing recordable CDs or DVDs.

If **spin coating** is used to apply the cover layer of Blu-ray discs, it is necessary to control its uniformity and thickness. Therefore, cover thickness measurements are offered on the Basler REFERENCE.

The Basler REFERENCE offers **more types of measurement** and a **higher measurement resolution** than in-line testers do. Due to its high resolution, measurements will be a reference for any in-line testing equipment. It will be the ideal tool for performing crosschecks with in-line testers.

With the invention of DVD, optical disc production has reached a new degree of production complexity. The Basler REFERENCE is the first off-line testing equipment that **precisely meets the complex requirements of DVD production**. It complies exactly with the testing specifications defined in the official standards for DVD production.

The Basler REFERENCE measures and evaluates at the same time. In addition to these two processes, representations of the measurements can be printed out simultaneously. Different useful types of graphical and alpha numerical result representation are available.

All **printers with drivers for Windows NT® 4.0** including Post Script printers are supported.

A **high-resolution TFT LCD touch display** is your user interface for parameterization, measurement and evaluation. A keyboard with integrated trackball is included for entering parameters, and for service purposes.

A standard 100 MBit/s Ethernet **network interface** allows to interface with your local computer network.

All the measured data can easily be **exported** to other data base applications such as Windows Excel® for further processing.

1.1 Variants of the Basler REFERENCE

Basler REFERENCE off-line testers are available in three different variants, the **Basler REF 100**, the **Basler REF 100 pre-recorded** and the **Basler REF 100 recordable**. The variants differ concerning the types of media that can be measured.

Throughout the manual, the tester will be called the Basler REFERENCE. Passages that are only valid for a specific variant will be so indicated.

BASLER REF100

The Basler REF100 measures all CD and DVD-related disc types. Optionally, it can be set up to measure Blu-ray cover layers.

It offers the following types of measurements:

- Reflectivity
- Transmission
- Diffraction Efficiency CD (R1/R2, T1/T2)
- Diffraction Efficiency DVD (R1, T1/T2)
- Birefringence (Absolute)
- Birefringence (Radial, In-plane)
- Birefringence (Orientation)
- Birefringence (Perpendicular)
- Radial/Tangential Deviation (Tilt)
- Axial Acceleration
- Axial Deviation
- Dual Layer Deviation (Tilt on Two Layers)
- Substrate Thickness
- Space Layer Thickness (Resin Layer Thickness)
- Optical Density of Recording Layer (CD-R/CD-RW)
- Optical Density of Recording Layer (DVD-R/DVD-RW)
- Optical Density of Sputtered Layers (CD/DVD)
- Groove Depth, Groove Width (CD-R/CD-RW*)
- Groove Depth, Groove Width (DVD-R/DVD-RW*)
- Single Cover Layer Thickness (Optional)
- Groove Filling

BASLER REF100^{PRE-RECORDED}

The Basler REF 100 pre-recorded is made for all pre-recorded CD and DVD-related disc types.

It offers the following types of measurement:

- Reflectivity
- Transmission
- Diffraction Efficiency CD (R1/R2, T1/T2)
- Diffraction Efficiency DVD (R1/ T1)
- Birefringence (Absolute)
- Birefringence (Radial, In-plane)
- Birefringence (Orientation)
- Birefringence (Perpendicular)
- Radial/Tangential Deviation (Tilt)
- Axial Acceleration
- Axial Deviation
- Dual Layer Deviation (Tilt on Two Layers)
- Substrate Thickness
- Space Layer Thickness (Resin Layer Thickness)
- Optical Density of Sputtered Layers (CD/DVD)

BASLER REF100^{RECORDABLE}

The Basler REF 100 recordable is made for recordable and rewritable CDs and DVDs.

It offers the following types of measurement:

- Reflectivity
- Transmission
- Diffraction Efficiency CD (R1/R2, T1/T2)
- Diffraction Efficiency DVD (R1, T1/T2)
- Birefringence (Absolute)
- Birefringence (Radial, In-plane)
- Birefringence (Orientation)
- Birefringence (Perpendicular)
- Radial/Tangential Deviation (Tilt)
- Axial Acceleration
- Axial Deviation
- Substrate Thickness
- Optical Density of Recording Layer (CD-R/CD-RW)
- Optical Density of Recording Layer (DVD-R/DVD-RW)
- Groove Depth, Groove Width (CD-R/CD-RW*)
- Groove Depth, Groove Width (DVD-R/DVD-RW*)
- Groove Filling



*** Note:**

Basler REFERENCE testers are calibrated for the groove geometry of CD-R and DVD-R. Consequently, absolute groove depth and groove width are measured for *R* media while a relative groove depth and groove width is given for *RW* media.