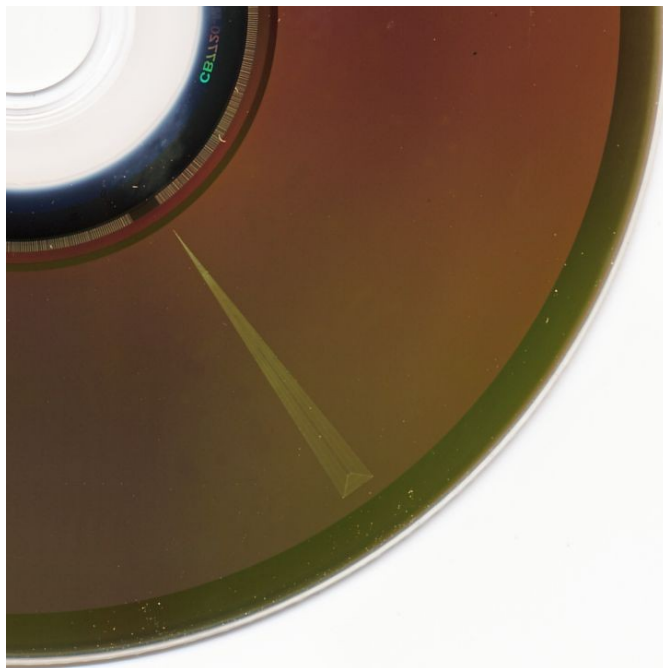




BUROSCH

Laser Test Blu-ray Disk

Technical Documentation



Laser Test BD Technical Documentation

The Laser Test BD Set consists of two burned BD-R discs. There is no HDCP copy protection on the BDs. The Laser Test BD Set is produced exclusively for evaluation of Blu-ray players. It includes controlled errors in the information layer, which may arise in practice due to improper treatment and resulting scratches in the Blu-ray disc. The wider the scratches, the more intensive the Blu-ray laser has to focus and the better the error correction of the tested Blu-ray player has to be. More or less severe scratches on Blu-ray disks are, unfortunately, quite common. Because of this, a relative statement about the technical quality of a Blu-ray player is possible by evaluating it with the Laser Test BD.

Our invention is based on the principle that the information layer of a Blu-ray disc is damaged deliberately by a precision laser. This simulated and linearly increasing error is called interference wedge. It simulates the aforementioned scratches on the BD.

The actual BD technology tries to interpolate by error correction this interruption of the data stream. The better the quality of the laser is in conjunction with data processing and interim storage in the Blu-ray player, the less artifacts are visible in actual movie playback. The better the interior error correction is working, the better even more severe simulated errors are compensated. The worse the error correction, the more distinct artifacts are visible in the footage even with a smaller width of the interference wedge. Even complete blockage of movie playback is possible.

If the Blu-ray player to be tested can reproduce the footage even with a relatively wide interference wedge, its quality in terms of laser and interpolation algorithms can be considered relatively good.

In practice, our invention of the simulated error has already been proved for the **Laser CD** and **Laser DVD**. Through our development of the interference wedge in the information layer it is possible for the engineer in industry or for a laboratory for comparative product tests to make a relative statement about the quality of a Blu-ray player. The Laser BD allows precise assessment of quality and relative comparison to other Blu-ray players.

The geometry of the simulated error

Through extensive testing with different devices the maximum width of the interference wedge was set to 3.5 mm for Disk 1, and 7.0 mm for Disk 2. In theory, the Blu-ray specification requires a maximum possible error correction of 7.0 mm, but an upper limit of 3.5 mm was set for Disk 1 because otherwise the laser incorrectly jumps between the radial tracks because of its arc radius. Because of the shape of the interference wedge, it is possible to assign each track a certain margin of error. Both disks contain 37 Tracks: For Disc 1, the first track is error free, the second track has an error of 0.1 mm, the third 0.2, ..., and the 36th 3.5 mm. The 37th Track serves as a safety margin to the edge of the disk. In Disk 2, the widths of the errors are doubled: 0.0, 0.2, 0.4, 0.6, ... 7.0 mm. In addition to the errors in the information layer, Disc 2 also contains errors in the surface with the same geometry. Due to the high precision control using our focal laser, we can ensure that the interference wedge has a homogeneous surface.

Footage used in the Laser Test BD

The footage used in the Laser Test BD was produced by BUROSCH-Audio-Video-Technik in the resolution of 1920 x 1080px. We are thus the owner of all copyrights. The footage is encoded with exactly 25P.

We deliberately use varying footage and vary between weak and strong contrast image content, less intense and more intense color, slower and faster footage.

We have also made sure that there is a slight blur everywhere in the footage. The technical reason is that, as a result of this, the decoding algorithm of the Blu-ray player to be tested has absolutely no chance to cache data this way.

Usage of the Laser Test BD

After loading of the BD you see the menu shown in the screenshot below.



Press the [Play] or [OK] button on the remote control to select the desired track directly. As shown in the two sample frames on the following page, each frame is overlaid by current track number and time code.

Timecode

The total duration of the Laser Test BD is 02:04:40. The timecode shows the playing time up to the currently displayed frame. It consists of the following five pieces of information:

1. Plus symbol
2. Current hours
3. Minutes since last full hour
4. Seconds since last full minute
5. Frames since last full second



The following instructions refer to Disk 1, for Disk 2 the widths of the errors are different and so are the typical results of the evaluations. In any case, when documenting the evaluation, make sure you write down which disk was used. The first track does not include a simulated error. Its purpose is to ensure that the BD player is able to start the Laser Test BD. According to state of the art in 2011, every Blu-ray player should be able to play at least up the track 11 (where the error is 1 mm wide) without adverse visual impact.

In accordance with the arithmetic curve, each individual track is proportionally longer in time than its respective predecessor.

Depending on the quality of the Blu-ray player to be tested, starting at track 17 there are more or less severe artifacts visible in the image. At the same time the acoustic test tone freezes. The test tone is therefore very useful for unattended documentation.

Please document the first time when the player freezes the current image for more than a second. Use the timecode overlay for this.

Document the second time when the picture freezes for more than three seconds, then continues again on it self.

The third measurement is documented when error correction has become impossible and the picture freezes completely

These three values assure comparable test results in the evaluation of the quality of the test Blu-ray player.

Due to manufacturing tolerances in Blu-ray players the measurements might scatter somewhat. Please repeat your measurements.

Case study:

Evaluation of the Panasonic BD-Player BD80 using Disk 1

1. Test:

Track 17, Timecode +00:45:37:17 Picture continues after 1 second

2. Test:

Track 17, Timecode +00:46:33:20 Picture continues after 3 seconds

3. Test:

Track 18, Timecode +00:48:14:05 Picture is frozen

Tracks and distances from the middle in meters, seconds, and radii

<u>Track</u>	<u>Inner Radius / m</u>	<u>Absolute Position / m</u>	<u>Length / m</u>	<u>Duration / s</u>	<u>Accumulated Duration / min</u>	<u>Remark(s) or width of error / mm</u>
0			---			Menu
1	23.00	0	409	120	2.00	0,0 (error free)
2	23.89	409	425	125	4.08	0.1
3	24.78	834	440	129	6.24	0.2
4	25.67	1274	456	134	8.47	0.3
5	26.56	1730	471	138	10.78	0.4
6	27.44	2201	487	143	13.16	0.5
7	28.33	2688	502	148	15.62	0.6
8	29.22	3190	518	152	18.16	0.7
9	30.11	3708	533	157	20.77	0.8
10	31.00	4241	549	161	23.46	0.9
11	31.89	4790	564	166	26.22	1.0
12	32.78	5354	580	170	29.06	1.1
13	33.67	5934	595	175	31.98	1.2
14	34.56	6529	611	179	34.97	1.3
15	35.44	7140	626	184	38.03	1.4
16	36.33	7767	642	189	41.18	1.5
17	37.22	8409	657	193	44.40	1.6
18	38.11	9066	673	198	47.69	1.7
19	39.00	9739	688	202	51.06	1.8
20	39.89	10427	704	207	54.51	1.9
21	40.78	11131	719	211	58.04	2.0
22	41.67	11851	735	216	61.63	2.1
23	42.56	12586	750	221	65.31	2.2
24	43.44	13336	766	225	69.06	2.3
25	44.33	14102	782	230	72.89	2.4
26	45.22	14884	797	234	76.79	2.5
27	46.11	15681	813	239	80.77	2.6
28	47.00	16493	828	243	84.83	2.7
29	47.89	17321	844	248	88.96	2.8
30	48.78	18165	859	252	93.16	2.9
31	49.67	19024	875	257	97.45	3.0
32	50.56	19899	890	262	101.81	3.1
33	51.44	20789	906	266	106.24	3.2
34	52.33	21694	921	271	110.75	3.3
35	53.22	22616	937	275	115.34	3.4
36	54.11	23552	952	280	120.00	3.5
37	55.00	24504	952	280	124.66	Safety Margin to the edge

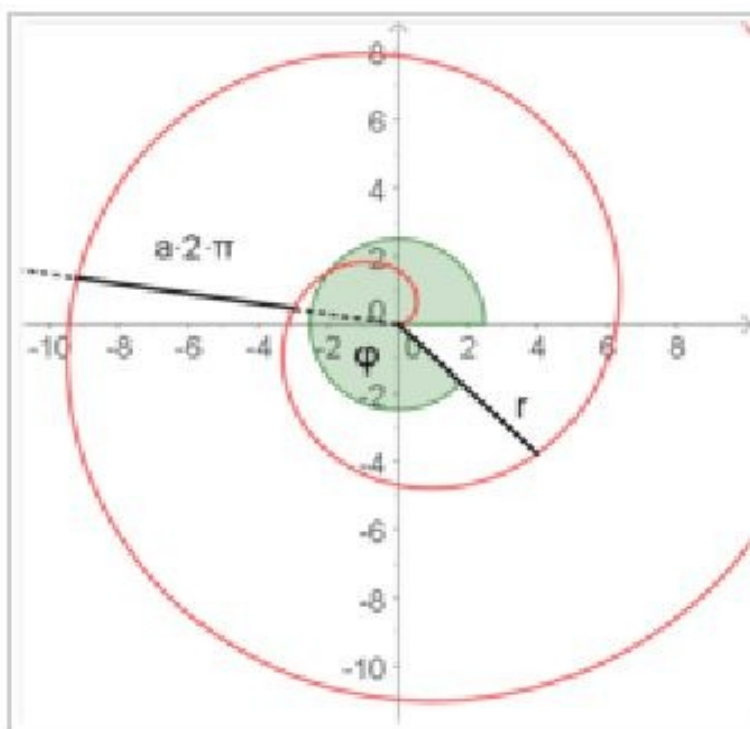
Calculation of the interference wedge

The positioning of the interference wedge in relation to both, the disks center and edge, assures that the BD is properly detected by the BD player. The arithmetic spiral was used to calculate the lengths of the tracks. The formula for calculating the exact length of the films at certain radii is as follows:

$$f : \varphi \mapsto (r \cdot \cos(\varphi), r \cdot \sin(\varphi)) = (a \cdot \varphi \cdot \cos(\varphi), a \cdot \varphi \cdot \sin(\varphi)).$$

The position of the error on the disk can be determined very precisely, so that mapping tracks to errors is possible.

By using the arithmetic spiral, we were able to trace the exact radial position of each track. Burning the tracks with the wrong error width can thus be easily avoided.



The Arithmetic Spiral

Our manufacturing process

Each Laser Test BD is produced individually and controlled carefully. To ensure absolutely precise reproduction of the interference wedge, a special mount for precise guidance of our laser was constructed. Errors caused by own motion of the mount are negligible. Our laser thus destroys the information layer of the disk with absolute precision only in the penetration depth of 0.1 mm. Our special laser technology also prevents that the corners of the wedge are circularly deformed. Since the laser destroys an area of exactly 0.1 mm, it starts at exactly 0.1 mm i.e. 0.2 mm error margin, and finishes at exactly 3.5 mm i.e. 7.0 mm error margin. The positioning and burning of the disc is done by high-precision equipment that we have specially designed for the manufacturing of the Laser Test BD. By using a special laser, it is possible to manipulate the disk surface with pre-defined optical performance. We don't resort to a pulse modulation, which would unnecessarily distort the triangle or unintentionally irradiate the surface with different intensities.

This technique is responsible for the selective destruction of sectors on the Blu-ray disc. Thanks to our experience gained from numerous tests, it was possible to generate a predefined data loss from minimal to illegible, which should be recognized by modern error correction but is not corrected in practice.

The manufacturing process of the Laser Test BD is subject to Privacy Policy and is therefore a trade secret of BUROSCH Audio-Video-Technik.

In contrast to the old CD or DVD technology (layer in 0.6 mm depth), a separate examination by simulated errors in the BD disc surface is not necessary for Blu-ray technology – the information layer of the BD disk is located exactly in a depth of 0.1 mm.

The corresponding patent is pending.
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Usage of the Laser Test Blu-ray

The laser test BD can be very easily navigated using the integrated menu. Any desired track can be selected directly. The following instructions refer to Disk 1 of the Laser Test BD Set.

Track 01 is error-free. During the second track, an error of 0.1 mm is included, for each additional track, 0.1 mm is added to the error. Track 36 thus has an error of 3.5 mm, track 37 has an error of 3.6 mm width.

The metadata at the beginning and end of the BD is not damaged, so the menu of the BD has to work on any device absolutely error free. If the menu can't be read on the device or the disc is not recognized, there is a fault in the device.

Visible defects are for example missing image segments, image segments with distorted color, an interruption of sound or picture or even a complete blockage of the device, f.e. when selecting one of the outer film segments from track 30.

Expected errors:

Depending on state of the art and quality of the tested player, short term sound and image freezing is expect during track 15 up to track 17. In certain cases, there also was erroneous decoding. In these cases, erroneous image segments or a stuttering picture with visible disturbed blocks were observed.

From track 18 to track 22, faulty segments and reading errors are expected. In this case, either the image is loaded only half, or square areas of false color (artifacts) are visible in the picture. Audio is temporarily interrupted. In some cases, the disk can not be read anymore at all or the BD player crashes.

From track 20 on (intensive testing) all listed errors are possible, from an interruption of the image to a faulty reading of the device or a crash of the device.

The further one advances in the disk, the more likely the occurrence of an error. The sooner read errors occur, the smaller is the dimension of the error which can not be corrected anymore.

Publishing information

Development and distribution of audio and video reference test sequences

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The user of this Laser Test BD Set acknowledges our general terms and conditions. Liability for direct or indirect damages that result from the application of our test BD is hereby explicitly excluded.

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