Audio Signals Disc 1

Introduction

This disc contains audio-signals useful in measuring the performance of a Compact Disc player. The quality is of the highest degree, all signals having been Computer generated, Computer assembled and digitally recorded.

Caution before start of Disc!

A number of the audio-signals have been recorded at maximum level (0dB). The volume-control should therefore be adjusted in order to prevent damage to e.g. loudspeakers, headphones or the human ear.

When listening to high-frequency sine waves it is also necessary to adjust the volume-control to a moderate level. Tweeters are not normally capable of withstanding prolonged exposure to a high-level signal.
The noise-signal and when not muted, the data-tracks also contain a lot of high-frequency power, so caution is advised.
At some places on this disc, where high-level program is preceded by low-level material or silence, a gradual fade-in of the (higher level) takes place. This is to avoid any discomfort which may otherwise arise when listening carefully to the silent passage.

Standardization

This disc is made according to the requirements of the Compact Disc Digital Audio System as described in IEC Publication 908 (1987).

Precise frequencies of the recorded sine waves

Correlation of the sampling-moments with the phase of the recorded sine waves will result in clustering of the spectral lines of the quantization-noise, due to the addition of rounding errors. This phenomenon would adversely affect the harmonic-distortion measurements. In order to prevent this occurring, the actual recorded frequencies of the sine waves are about 0.01 Hz higher than those listed.
The sine waves at tracks 74 and 75 are directly coupled to the sampling frequency and therefore should not be used for measurement of harmonic distortion.

Level definition

the reference-level of 0dB refers to a sine wave whose most positive value corresponds to +32767 quantization steps whose most negative value corresponds to -32767 quantization steps.

Description of the signal-tracks

Tracks 1, 2 and 3:
These tracks are used to indicate the 0dB reference-level of the signals.
Tracks 2 and 3 indicate the Left and the Right channel of the Audio-system.

Track 4:
To check whether the player is fully de-muted at the beginning of the track, a test signal with the following components is employed:
Pulses consisting of 10 samples at 0 dB, recurring every full second; pulses consisting of 10 samples at -20 dB, recurring every 1/100 second between the 0dB-pulses.

One should hear 5 clicks spaced at an interval of one second, and a hum-like sound in between the clicks. Program the player to repeat only track 4 and observe if all five clicks are heard at equal loudness. The humming will disappear while the player jumps back to the beginning of the track.

Track 5:
This track consists of a frequency-sweep which is compatible with e.g. Brüel & Kjær frequency measurement equipment operating at a writing-speed of 3mm/sec.
Duration: 50sec
Start-frequency: 20Hz
End-frequency: 20 KHz
Sweep-speed: 1 decade in 16.6 sec.
Level: 0dB

Track 6:
This track is a frequency-sweep with frequency-markers for use on X-T plotters:
Duration: 120 sec.
Start frequency: 20Hz
End-frequency: 20 KHz
Sweep-speed: 1 decade in 40 sec.
Level: 0dB
Specialties: markers and index-steps:
Markers at: 50Hz, 100Hz, 200Hz, 500Hz, 1KHz, 2KHz, 5KHz, 10KHz. When these marker-frequencies are reached the amplitude is smoothly attenuated to -6dB for 0.5 second.
Index-steps: the index, which is recorded in the sub code, will be 01 for the first 22 seconds. It then steps each second until it reaches 99, which occurs 1 sec. before the end of the track. This may be used to check the index-display of the CD-player.
This frequency sweep can also be use to plot the frequency-response of other audio equipment, using the CD-player as a signal-source. One should of course first verify that the frequency-response of the player is correct.

Tracks 7..48:
These tracks contain sine waves of differing frequencies and at different levels. They are intended for use in measuring the harmonic distortion of the player.
Due to the fact that there is no coupling between the recorded frequencies and the sampling-frequency, it is possible that the distortion measuring equipment will indicate the quantization noise when testing better players.

Tracks 7...23 contain sine waves of different frequencies recorded at a level of 0dB; measure the harmonic distortion of the player as a function of the recorded frequency.

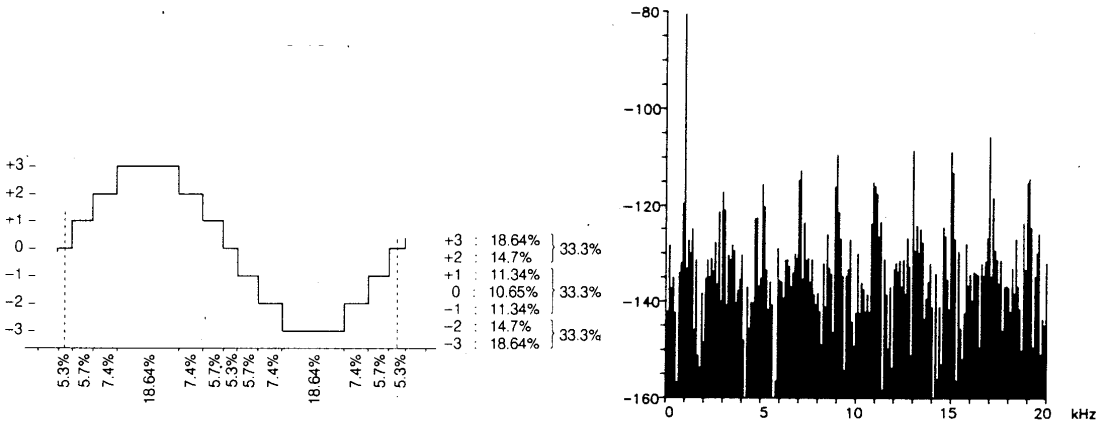
Tracks 24..31 contain various frequencies recorded at -24dB and at -60dB.
The degradation of the distortion both at low and high frequencies is measurable with these signals.

Tracks 32..46 contain a sine wave of 1 KHz recorded at successively decreasing levels. This may be used to measure the harmonic distortion of the player as a function of the recorded level. At the lowest levels the sine wave only reaches a few digital quantization levels, causing clearly audible distortion of the signal. Track 32 starts with a fade-in of about 4 seconds.

Tracks 43..46 contain a special waveform employing extremely low-level signals. The following tables indicate the waveform, the percentage-duration of the different digital levels, the calculated spectrum of the signal, the level of the 1 KHz component and the ratio of this component to the harmonics and sampling noise. This ratio is the theoretical optimal signal-to-noise ratio.

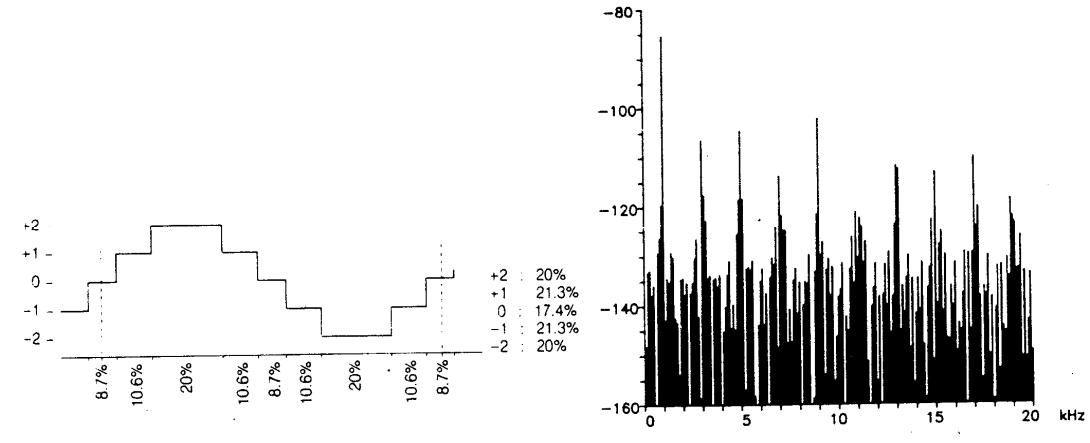
Track 43:
1 KHz component = 80.59dB

$$\frac{signal}{noise + harmonics} = 18.55dB$$



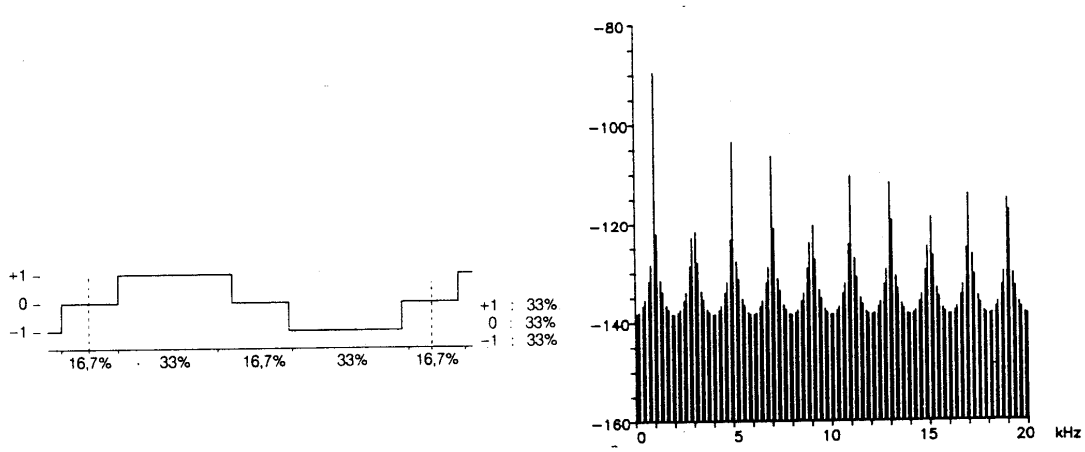
Track 44:
1 KHz component = -85.24dB

$$\frac{signal}{noise + harmonics} = 12.35dB$$



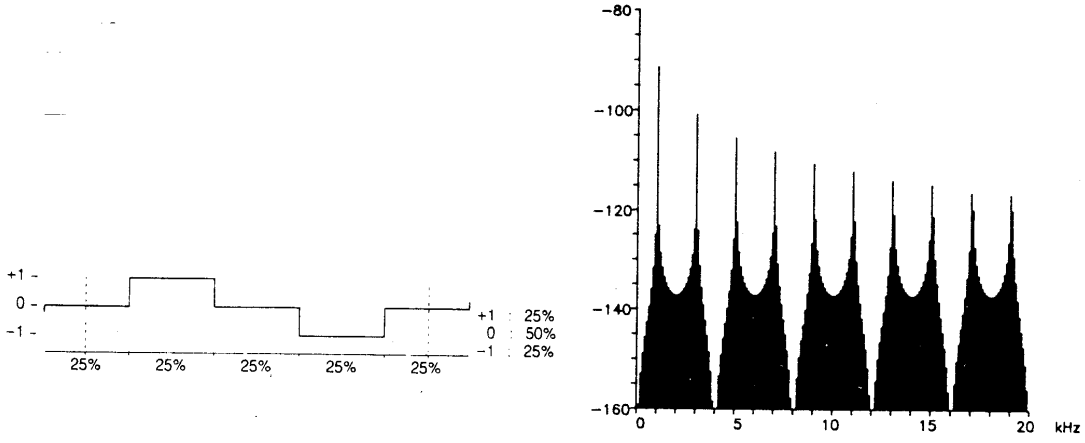
Track 45:
1 KHz component = -89.46dB

$$\frac{signal}{noise + harmonics} = 10.27dB$$



Track 46:
1 KHz component = -91.24dB

$$\frac{signal}{noise + harmonics} = 6.385dB$$



Tracks 47 and 48 are recorded with dither. The dither signal has a rectangular probability density function between + and -0.5 bit.
The sine wave recorded at track 47 has an amplitude of -80.7dB. This ensures that (including the dither signal) only the +3 to -3 output steps are used.
The recorded signal on track 48 has an amplitude of -90.31dB, ensuring that only the +1 and -1 output steps are used (again including the dither signal).
In using the CD-player as a signal-source for measuring the harmonic distortion of e.g. amplifiers, tracks 7..23 may be used as an extremely low-distortion sine wave generator. Do not use tracks 24..31 for this purpose. If a lower level is needed then an external attenuator should be used.

Using the CD-player as a signal-source, tracks 32..42 with 1KHz signals at decreasing levels of 0dB,-1dB,-3dB,-6dB,-10dB,-20dB,etc. may also be useful in calibrating or checking devices such as Peak Program Level Meters and A/D converters.

Tracks 49 and 50:
These tracks containing digital silence are intended for measuring the background noise of the CD-player. The noise may be dependent on the pre emphasis.

Track 51,52 and 53:
These tracks are intended to check the correct functioning of the de emphasis circuit. The frequencies are recorded with such an amplitude that the playback levels of the three tracks are -10dB if the de emphasis-circuitry is functioning correctly. Track 51 starts with a fade-in of about 4 seconds.
The left and right channel of these tracks are recorded 90° out of phase. By connecting the X- and Y-input of an oscilloscope to the left and right of the player, the screen of the oscilloscope will display a stable circle.
When the player is bumped it may lose tracking of the disc and the circle will collapse for a moment. In this way an impression can be got about the shock-sensitivity of the player. This applies especially to portable equipment.

Track54:
This track is included to measure inter modulation at low frequencies.
The signal is composed of 2 sine waves:
Frequency 1: 60Hz level -2dB
Frequency 2: 7000Hz level -14dB

At the peaks of both sine waves the level of the composed signal just reaches the value corresponding to the peak-value of a single sine wave at 0dB.

Track 55:
This track is included to measure inter modulation at high frequencies.
The signal is composed of 2 sine waves:
Frequency 1: 19000Hz level -6dB
Frequency 2: 20000Hz level -6dB

At peaks of both sine waves the level of the composed signal just reaches the value corresponding to the peak-value of a single sine wave at 0dB.

Track 56:
This track consists of a recorded square-wave pattern. Using an oscilloscope connected directly to the audio output, the step-response of the player's filtering-circuitry can be judged.
The frequency of the square-wave is coupled to the sampling-frequency and consists of 22 samples high, followed by 22 samples low. The precise frequency is 1002,27 Hz.
To avoid overload of the filtering-circuitry, this signal is not recorded at maximum level. The RMS-level is -12dB, so the power is equal to that of the sine wave on tracks 91..94 and 96..99.
Track 57:
This represents an impulse-train comprising 1 maximum-amplitude positive signal reoccurring every 70 samples. The precise frequency is 630Hz. Using an oscilloscope connected to the audio output, the impulse-response of the filtering-circuitry of the player can be monitored.

Track 58:
This also represents an impulse-train, which in this case contains 1 positive sample down 12db from maximum-amplitude recurring every 10 seconds. This signal is intended for monitoring the response of (digital) reverberation circuits.

Track 59:
This track is intended for testing the functions of compression and expansion circuits.
A 1 KHz -40dB sine wave is recorded on both the left and right channels. Every 2 seconds, the level of the left-channel is momentarily increased to 0dB for a duration of 0.1 second.

Track 60:
This comprises noise with a uniform frequency-distribution (white noise) and a Gaussian amplitude distribution. The RMS-level is -12dB, so the power is equivalent to that of the sine wave on e.g. track 99.

Track 61:
This represents noise containing equal power in each octave (pink noise) with a Gaussian amplitude distribution. The RMS-level is -12 dB, so the power is equivalent to the sine wave on e.g. track 99.

Track 62..65:
These four data-tracks may be used to observe the behavior of the player when a CD-ROM disc is played. Recent CD-players should mute or attenuate the loud and disturbing audio-signals which would otherwise be generated by such discs.
The behavior of the display can also be observed during these four data-tracks.

Track 66..73:
These tracks are useful in measuring the channel-separation. Sine waves of different frequencies are recorded on one channel only and with maximum amplitude.

Tracks 74 and 75:
A 1 KHz sine wave is recorded on one channel while the frequency on the other channel is 20 KHz. These sine waves are coherent, whereby both have zero-crossings the same moment. This can be monitored by displaying both signals simultaneously on the same oscilloscope-screen. If the player exhibits no phase-difference between the two channels, the up going as well as the down-going zero-crossing of the 1 KHz signal should coincide with an up-going zero-crossing of the 20 KHz signal.

Tracks 76 .. 89:
These tracks contain silence, alternately with and without pre emphasis. The resultant switching of the player's de emphasis-circuit should occur without any audible clicks. Starting with track 82 no pauses are inserted between the tracks, so in tracks 82 .. 89 switching of the de emphasis-circuit is done during active audio.

Tracks 90 .. 99:
These tracks are recorded in a direct sequence and without intermediate pauses. The signal is a 1 kHz sine wave, which fades in smoothly during track 90 to the constant level of -12 dB maintained
on tracks 91 .. 99; except for track 95.
This -12 dB level may be used as a kind of practical maximum level for music from CD's. This value is according to IEC Publication 268-15(1987) "Preferred matching values for the interconnection of sound system components" where "Rated output voltage" for a component is mentioned in e.g. Sub-clause 15.1.
To check the correct working of an RMS-calibrated level-meter, the reading at these tracks may be compared with the value of the square-wave at track 56 and the reading of the noise-signals at
tracks 60 and 61.
Most of these tracks have the minimum permitted length of 4 seconds. A player should be able to search for and find these tracks. Tracks 97, 98 and 99 are somewhat longer to allow checking of players which exhibit difficulty with the 4-second tracks.

Track 95
By selecting only track 95 in repeat mode, it is possible to check if the player is not prematurely de-muted at the end of the previous track. It is also possible to determine if the player is fast enough in muting the beginning of the next track. Normally some sound is heard from the previous track as well as the next track.
The disc ends at 72 minutes sharp. A player should be able to play to the end of track 99.

Tools for measurement

A 13th order low pass filter is necessary when measuring distortion and signal to noise ratio (low pass filter service code no. 4822 395 30204) or internal code no. 7104 087 04981.

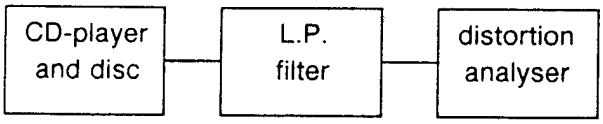
Specifications of the low pass filter:

Passband	:	0...20 KHz
Ripple	:	max. + and - 0.1 dB
Stop band	:	3 dB attenuation at 20.1 KHz Above 23 kHz attenuation > 110 dB
THD	:	< 100 dB

Block diagrams

- Block diagram for measuring harmonic distortion

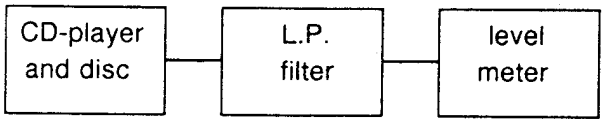
Recommended tracks:
tracks 7 .. 23,
24 .. 48 for low level



- Block diagram for measuring signal to noise ratio (with and without preempasis)
and checking of frequency response of deemphasis circuit

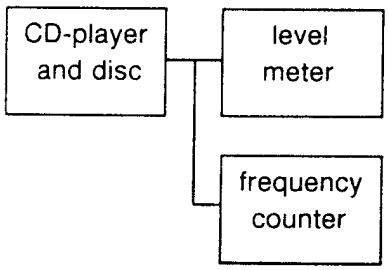
tracks 32, 49 and 50

tracks 51 .. 53

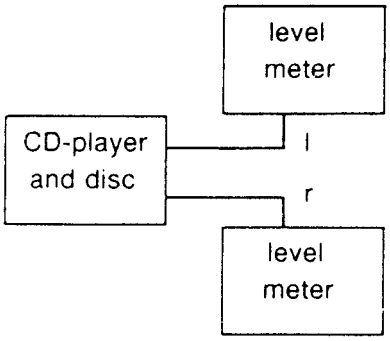


- Block diagram for measuring the frequency response

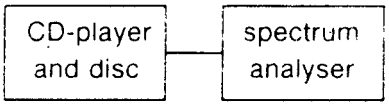
tracks: 5, 6 and 7 .. 23



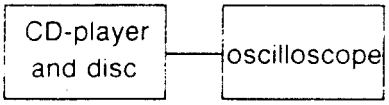
- Block diagram for measuring channel separation tracks: 66 .. 73



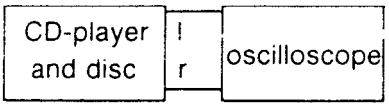
- Block diagram for measuring intermodulation distortion tracks 54 and 55



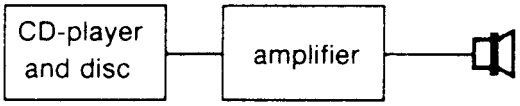
- Block diagram for checking time domain response tracks 56 .. 59
  Don't use the low pass filter!



- Block diagram for measuring the channel phase tracks 74 and 75



- Block diagram for click test of the deemphasis circuit tracks 76 .. 89



SURVEY OF TRACK-CONTENTS

General checks

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
1	00	00:00	2 sec	off	silence	--	L+R	Pause
1	01	00:02	28 sec	off	1 KHz	0 dB	L+R	ref.
2	00	00:30	2 sec	off	silence	--	L+R	Pause
2	01	00:32	13 sec	off	1 KHz	0 dB	L	L channel check
3	00	00:45	2 sec	off	silence	--	L+R	Pause
3	01	00:47	13 sec	off	1 KHz	0 dB	R	R channel check

Check correct demute on start of track

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
4	00	01:00	2 sec	off	silence	--	L+R	Pause
4	01	01:02	4 sec	off	pulses	0 dB	L+R	1 second ticks

Check of frequency response. check of index-functions

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
5	00	01:06	2 sec	off	silence	--	L+R	Pause
5	01	01:08	28 sec	off	1 KHz	0 dB	L+R	ref.
6	00	01:58	2 sec	off	silence	--	L+R	Pause
6	01	02:00	13 sec	off	1 KHz	0 dB	L	L channel check
6	00	02:22	2 sec	off	silence	--	L+R	Pause
6	00	02:23	2 sec	off	silence	--	L+R	Pause
6	..	...	.	...	...	...	.	..
6	Index incrementing each second ...							
6	..	...	.	...	...	...	.	..
6	98	03:58	1 sec	off	sweep	0 dB	L+R	
6	99	03:59	1 sec	off	sweep	0 dB	L+R	end of sweep

Measurement of harmonic distortion versus frequency at high level

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
7	00	04:00	2 sec	off	silence	--	L+R	Pause
7	01	04:02	58 sec	off	2 Hz	0 dB	L+R	
8	00	05:00	2 sec	off	silence	--	L+R	Pause
8	01	05:02	58 sec	off	8 Hz	0 dB	L+R	
9	00	06:00	2 sec	off	silence	--	L+R	Pause
9	01	06:02	58 sec	off	16 Hz	0 dB	L+R	
10	00	07:00	2 sec	off	silence	--	L+R	Pause
10	01	07:02	58 sec	off	31.5 Hz	0 dB	L+R	
11	00	08:00	2 sec	off	silence	--	L+R	Pause
11	01	08:02	58 sec	off	63 Hz	0 dB	L+R	
12	00	09:00	2 sec	off	silence	--	L+R	Pause
12	01	09:02	58 sec	off	125 Hz	0 dB	L+R	
13	00	10:00	2 sec	off	silence	--	L+R	Pause
13	01	10:02	58 sec	off	250 Hz	0 dB	L+R	
14	00	11:00	2 sec	off	silence	--	L+R	Pause
14	01	11:02	58 sec	off	500 Hz	0 dB	L+R	
15	00	12:00	2 sec	off	silence	--	L+R	Pause
15	01	12:02	58 sec	off	1 KHz	0 dB	L+R	
16	00	13:00	2 sec	off	silence	--	L+R	Pause
16	01	13:02	58 sec	off	2 KHz	0 dB	L+R	
17	00	14:00	2 sec	off	silence	--	L+R	Pause
17	01	14:02	58 sec	off	4 KHz	0 dB	L+R	
18	00	15:00	2 sec	off	silence	--	L+R	Pause
18	01	15:02	58 sec	off	6.4 KHz	0 dB	L+R	
19	00	16:00	2 sec	off	silence	--	L+R	Pause
19	01	16:02	58 sec	off	10 KHz	0 dB	L+R	
20	00	17:00	2 sec	off	silence	--	L+R	Pause
20	01	17:02	58 sec	off	16 KHz	0 dB	L+R	
21	00	18:00	2 sec	off	silence	--	L+R	Pause
21	01	18:02	58 sec	off	18.1 KHz	0 dB	L+R	
22	00	19:00	2 sec	off	silence	--	L+R	Pause
22	01	19:02	58 sec	off	19 KHz	0 dB	L+R	
23	00	20:00	2 sec	off	silence	--	L+R	Pause
23	01	20:02	58 sec	off	20 KHz	0 dB	L+R	

Measurement of harmonic distortion versus frequency at low level

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
24	00	21:00	2 sec	off	silence	--	L+R	Pause
24	01	21:02	58 sec	off	16 Hz	dB	L+R	
25	00	22:00	2 sec	off	silence	--	L+R	Pause
25	01	22:02	58 sec	off	1 KHz	0 dB	L+R	
26	00	23:00	2 sec	off	silence	--	L+R	Pause
26	01	23:02	58 sec	off	16 KHz	0 dB	L+R	
27	00	24:00	2 sec	off	silence	--	L+R	Pause
27	01	24:02	58 sec	off	20 KHz	0 dB	L+R	
28	00	25:00	2 sec	off	silence	--	L+R	Pause
28	01	25:02	58 sec	off	1 KHz	0 dB	L+R	
29	00	26:00	2 sec	off	silence	--	L+R	Pause
29	01	26:02	58 sec	off	1 KHz	0 dB	L+R	
30	00	27:00	2 sec	off	silence	--	L+R	Pause
30	01	27:02	58 sec	off	16 KHz	0 dB	L+R	
31	00	28:00	2 sec	off	silence	--	L+R	Pause
31	01	28:02	58 sec	off	20 KHz	0 dB	L+R	

Measurement of harmonic distortion versus level

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
32	00	29:00	2 sec	off	silence	--	L+R	Pause
32	01	29:02	58 sec	off	1 KHz	0 dB	L+R	Fade-in during about 4 seconds
33	00	30:00	2 sec	off	silence	--	L+R	Pause
33	01	30:02	58 sec	off	1 KHz	-1 dB	L+R	
34	00	31:00	2 sec	off	silence	--	L+R	Pause
34	01	31:02	58 sec	off	1 KHz	-3 dB	L+R	
35	00	32:00	2 sec	off	silence	--	L+R	Pause
35	01	32:02	58 sec	off	1 KHz	-6 dB	L+R	
36	00	33:00	2 sec	off	silence	--	L+R	Pause
36	01	33:02	58 sec	off	1 KHz	-10 dB	L+R	
37	00	34:00	2 sec	off	silence	--	L+R	Pause
37	01	34:02	58 sec	off	1 KHz	-20 dB	L+R	
38	00	35:00	2 sec	off	silence	--	L+R	Pause
38	01	35:02	58 sec	off	1 KHz	-30 dB	L+R	
39	00	36:00	2 sec	off	silence	--	L+R	Pause
39	01	36:02	58 sec	off	1 KHz	-40 dB	L+R	
40	00	37:00	2 sec	off	silence	--	L+R	Pause
40	01	37:02	58 sec	off	1 KHz	-50 dB	L+R	
41	00	38:00	2 sec	off	silence	--	L+R	Pause
41	01	38:02	58 sec	off	1 KHz	-60 dB	L+R	
42	00	39:00	2 sec	off	silence	--	L+R	Pause
42	01	39:02	58 sec	off	1 KHz	-70 dB	L+R	
43	00	40:00	2 sec	off	silence	--	L+R	Pause
43	01	40:02	58 sec	off	1 KHz	-80.59dB	L+R	
44	00	41:00	2 sec	off	silence	--	L+R	Pause
44	01	41:02	58 sec	off	1 KHz	-85.24dB	L+R	
45	00	42:00	2 sec	off	silence	--	L+R	Pause
45	01	42:02	58 sec	off	1 KHz	-89.46dB	L+R	
46	00	43:00	2 sec	off	silence	--	L+R	Pause
46	01	43:02	58 sec	off	1 KHz	-91.24dB	L+R	
47	00	44:00	2 sec	off	silence	--	L+R	Pause
47	01	44:02	58 sec	off	1 KHz	-80.70dB	L+R	with dither
48	00	45:00	2 sec	off	silence	--	L+R	Pause
48	01	45:02	58 sec	off	1 KHz	-90.31dB	L+R	with dither

Measurement of signal to noise ratio with and without pre emphasis

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
49	00	46:00	2 sec	off	silence	--	L+R	Pause
49	01	46:02	58 sec	off	silence	--	L+R	
50	00	47:00	2 sec	on	silence	--	L+R	Pause
50	01	47:02	58 sec	on	silence	--	L+R	

Checking of de emphasis circuitry and shock-sensitivity

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
51	00	48:00	2 sec	on	silence	--	L+R	Pause
51	01	48:02	58 sec	on	1 kHz	-10 dB	L,R	Fade-in (4seconds) Recorded at -9.63dB
52	00	49:00	2 sec	on	silence	--	L+R	Pause
52	01	49:02	58 sec	on	4 kHz	-10 dB	L,R	Recorded at -6.46dB
53	00	50:00	2 sec	on	silence	--	L+R	Pause
53	01	50:02	58 sec	on	16 kHz	-10 dB	L,R	Recorded at -0.96 dB

Measurement of inter modulation

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
54	00	51:00	2 sec	off	silence	--	L+R	Pause
54	01	51:02	58 sec	off	2 tone 60Hz+7K hz	0 dB	L+R	levels 4:1
55	00	52:00	2 sec	off	silence	--	L+R	Pause
55	01	52:02	58 sec	off	2 tone 60Hz+7K hz	0 dB	L+R	levels 1:1

Measurement and checking of time-domain responses

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
56	00	53:00	2 sec	off	silence	--	L+R	Pause
56	01	53:02	58 sec	off	square	-12 dB	L+R	Square-wave of 1KHz
57	00	54:00	2 sec	off	silence	--	L+R	Pause
57	01	54:02	58 sec	off	impulses	0 dB	L+R	width = 1 sample, 630 pulses/ sec.
58	00	55:00	2 sec	off	silence	--	L+R	Pause
58	01	55:02	58 sec	off	impulses	-12 dB	L+R	Reverber ation-test
59	00	56:00	2 sec	off	silence	--	L+R	Pause
59	01	56:02	58 sec	off	tone-burst	0 dB	L+R	Com-pression test

Measurement on noise-signals

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
60	00	57:00	2 sec	off	silence	--	L+R	Pause
60	01	57:02	58 sec	off	noise	-12 dB	L+R	White noise
61	00	58:00	2 sec	off	silence	--	L+R	Pause
61	01	58:02	58 sec	off	noise	-12 dB	L+R	Pink noise

Data-track mute test

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
62	00	59:00	3 sec	off	data	--	L+R	Pregap
62	01	59:03	29 sec	off	data	--	L+R	data-track A
63	01	59:32	13 sec	off	data	--	L+R	data-track B
64	01	59:45	11 sec	off	data	--	L+R	data-track C
65	01	59:56	2 sec	off	data	--	L+R	data-track D
65	02	59:58	2 sec	off	data	--	L+R	Postgap

Measurement of channel separation

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
66	00	60:00	2 sec	off	silence	--	L+R	Pause
66	01	60:02	58 sec	off	16 Hz	0 dB	L	
67	00	61:00	2 sec	off	silence	--	L+R	Pause
67	01	61:02	58 sec	off	1 KHz	-0 dB	L	
68	00	62:00	2 sec	off	silence	--	L+R	Pause
68	01	62:02	58 sec	off	16 KHz	-0 dB	L	
69	00	63:00	2 sec	off	silence	--	L+R	Pause
69	01	63:02	58 sec	off	20 KHz	-0 dB	L	
70	00	64:00	2 sec	off	silence	--	L+R	Pause
70	01	64:02	58 sec	off	16 Hz	-0 dB	L	
71	00	65:00	2 sec	off	silence	--	L+R	Pause
71	01	65:02	58 sec	off	1 KHz	-0 dB	L	
72	00	66:00	2 sec	off	silence	--	L+R	Pause
72	01	66:02	58 sec	off	16 Hz	-0 dB	L	
73	00	67:00	2 sec	off	silence	--	L+R	Pause
73	01	67:02	58 sec	off	20 KHz	-0 dB	L	

Measurement of channel phase

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
74	00	68:00	2 sec	off	silence	--	L+R	Pause
74	01	68:02	58 sec	off	1 KHz 20 KHz	-0 dB	L R	
75	00	69:00	2 sec	off	silence	--	L+R	Pause
75	01	69:02	58 sec	off	20 KHz 1 KHz	-0 dB	L R	

Click-test of de emphasis circuit

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
76	00	70:00	1 sec	off	silence	--	L+R	Pause
76	01	70:01	4 sec	off	silence	--	L+R	
77	00	70:05	1 sec	on	silence	--	L+R	Pause
77	01	70:06	4 sec	on	silence	--	L+R	
78	00	70:10	1 sec	off	silence	--	L+R	Pause
78	01	70:11	4 sec	off	silence	--	L+R	
79	00	70:15	1 sec	on	silence	--	L+R	Pause
79	01	70:16	4 sec	on	silence	--	L+R	
80	00	70:20	1 sec	off	silence	--	L+R	Pause
80	01	70:21	4 sec	off	silence	--	L+R	
81	00	70:25	1 sec	on	silence	--	L+R	Pause
81	01	70:26	4 sec	on	silence	--	L+R	
82	00	70:30	4 sec	off	silence	--	L+R	
83	00	70:34	4 sec	on	silence	--	L+R	
84	00	70:38	4 sec	off	silence	--	L+R	
85	00	70:42	4 sec	on	silence	--	L+R	
86	00	70:46	4 sec	off	silence	--	L+R	
87	00	70:50	4 sec	on	silence	--	L+R	
88	00	70:54	4 sec	off	silence	--	L+R	
89	00	70:59	4 sec	on	silence	--	L+R	

Track-access-test and playability test to end of disc

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
90	01	71:02	4 sec	off	1KHz	fade-in	L+R	
91	01	71:06	4 sec	off	1KHz	-12 dB	L+R	
92	01	71:10	4 sec	off	1KHz	-12 dB	L+R	
93	01	71:14	4 sec	off	1KHz	-12 dB	L+R	
94	01	71:18	4 sec	off	1KHz	-12 dB	L+R	
95	01	71:22	4 sec	off	silence	--	L+R	
96	01	71:26	4 sec	off	1KHz	-12 dB	L+R	
97	01	71:30	6 sec	off	1KHz	-12 dB	L+R	
98	01	71:36	8 sec	off	1KHz	-12 dB	L+R	
99	01	71:44	16 sec	off	1KHz	-12 dB	L+R	

End of disc

tr	ind	min:sec	length	emph.	signal	level	channel	remarks
AA	01	72:00	Start of Lead-out area					