SUPER AUDIO CD

Super Audio CD

Audio Signal Properties
(Including Annex D&E)

Version 1.3

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SONY PHILIPS

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1. General

1.1 Scope

This document contains audio signals definitions as specified in the Super Audio CD System Description Part 2 Version 1.3 in Annex D and Annex E.

1.2 Recommendations from Super Audio CD Part 2

Among others the following recommendations are given in the Super Audio CD specification:

- It is recommended that a multichannel disc contains the same content in both the 2-Channel Stereo Area and in the Multi Channel Area.
- It is recommended that a hybrid disc contains the same content in both the CD Layer and in the 2-Channel Stereo Area of the high density layer.

1.2.1 Player reference model

It is recommended that both the fade-in and the fade-out time of a Super Audio CD player are shorter than 50 mS. As a consequence it is recommended that the Track Start Markers in a DSDIFF file have an offset of minimally 50 mS to the actual start of the Track.

1.3 Definitions from Super Audio CD Part 2

Among others the following definitions are used in the Super Audio CD specification:

Audio Channel Number	The sequence number assigned to an Audio Channel.
DSD Polarity	A DSD bit equal to one means "plus". A DSD bit equal to zero means "minus".
Silence Pattern	A digitally generated DSD pattern with the following properties: • All Audio Bytes have the same value • Each Audio Byte must contain 4 bits equal to zero and 4 bits equal to one.
Tracks	A Super Audio CD contains maximum 255 audio Tracks in the 2-Channel Stereo Area and maximum 255 audio Tracks in the Multi Channel Area.

1.3.1 Bandwidth and levels

On the disc all Audio Channels, including LFE, are always full bandwidth and have equal audio gain.

1.3.2 Channel Numbers and Loudspeaker Position

The relation between the SACD Audio Channel Number and the Loudspeaker Position is defined in the Channel Mapping. Except for the LFE Channel, the Channel Mapping refers to the loudspeaker positions as defined in ITU-R BS.775-1.

1.3.2.1 Channel Mapping for a 2-Channel Stereo Area

For the 2-Channel Stereo Area, the Channel Mapping is defined in Figure 1.

Audio Channel Number	Channel Mapping
1	Left
2	Right

Figure 1 : Definition of Channel Mapping for the 2-Channel Stereo Area

1.3.2.2 Channel Mapping for a Multi Channel Area with 5 Audio Channels

For a Multi Channel Area with 5 Audio Channels, the Channel Mapping is defined in Figure 2.

Audio Channel Number	Channel Mapping
1	Left
2	Right
3	Center
4	Left Surround
5	Right Surround

Figure 2 : Definition of Channel Mapping for 5 Audio Channels

1.3.2.3 Channel Mapping for a Multi Channel Area with 6 Audio Channels

For a Multi Channel Area with 6 Audio Channels, the Channel Mapping is defined in Figure 3.

Audio Channel Number	Channel Mapping
1	Left
2	Right
3	Center
4	LFE
5	Left Surround
6	Right Surround

Figure 3 : Definition of Channel Mapping for 6 Audio Channels

Annex D: Audio Signal Requirements (Normative)

D.1 Super Audio CD Audio Level measuring condition

Super Audio CD Audio levels must be measured after a 50 kHz Butterworth 30 dB/Oct low pass filter.

D.2 Super Audio CD Zero dB Audio Reference Level

The Super Audio CD Zero dB Audio Reference Level, referred to as “0 dB SA-CD”, corresponds to a sine wave with a peak amplitude equal to 50% of the theoretical maximum DSD signal level.

D.3 Maximum Super Audio CD Audio Peak Level

The maximum Super Audio CD audio peak level is determined by the maximum allowable DSD modulation level. The DSD Modulation Level is equal to $\frac{|28-2N|}{28}$, where N is the number of bits set to one within any 28 consecutive bits of the DSD stream, and $4 \le N \le 24$. The maximum allowed value of the DSD Modulation Level is 20/28. A DSD Modulation Level of 20/28 corresponds to the maximum Super Audio CD Audio Peak Level of +3.10 dB SA-CD. Peak signal levels above +3.10 dB SA-CD are not allowed.

D.4 High Frequency DSD Signal + Noise Level

The accumulated RMS signal + noise level of the DSD signal, measured after a 40 kHz Butterworth 30 dB/Oct high pass filter and a 100 kHz Butterworth 30dB/Oct low pass filter, is maximally equal to the RMS level of an input sinewave with a peak amplitude of -20 dB SA-CD (see D.2).
The averaging filter used to calculate the RMS level must be a first order unity gain IIR filter with a coefficient of 1/524288 (2^{-19}), corresponding to an IIR filter with a cutoff frequency of about 0.85 Hz.

Annex E: Audio Signal Recommendations (Informative)

E.1 Analog Output Level

The recommended analog output level of a 1 kHz 0 dB SA-CD sine wave is 2 V RMS ±1 dB.
For a Super Audio CD player with CD-DA playback capability it is recommended that the analog CD-DA output of a fully modulated signal is equal to the analog Super Audio CD output for a 0 dB SA-CD signal.
Note: the maximum allowed peak signal level is +3.10 dB SA-CD, see D.3.

E.2 Analog Post-filter

To protect analog amplifiers and loudspeakers, it is recommended that a Super Audio CD player contain at its output an analog low pass filter with a cut-off frequency of maximum 50 kHz and a slope of minimum 30 dB/Oct. For use with wide-band audio equipment, filters with a cut-off frequency of over 50 kHz can be used.

E.3 DSD DC Offset

It is recommended that the DC Offset of the DSD signal on the disc is less than -50 dB SA-CD.

E.4 DSD polarity

It is recommended that a DSD bit equal to one translates into a rising output voltage at the output of a Super Audio CD player.