DaTARIUS

Quality control and process management systems

CD - Digital error signals

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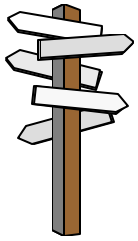
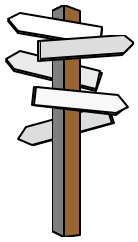
Research & Development

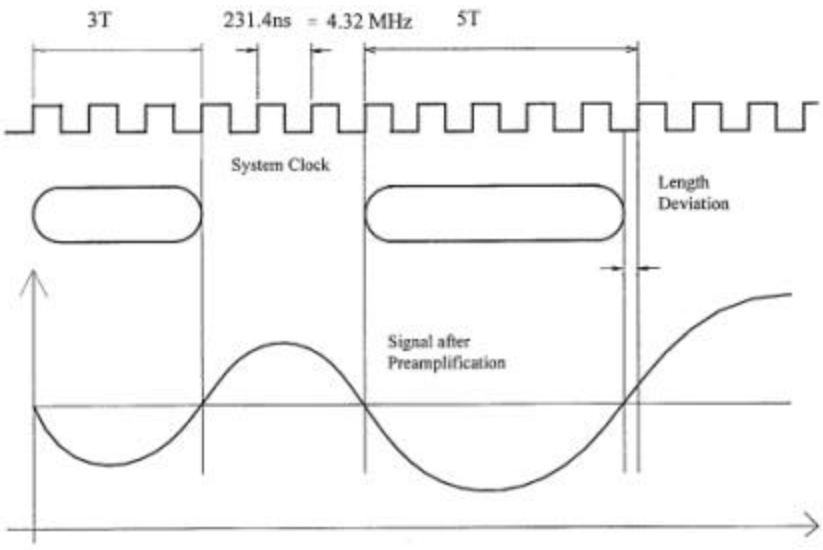
Contents



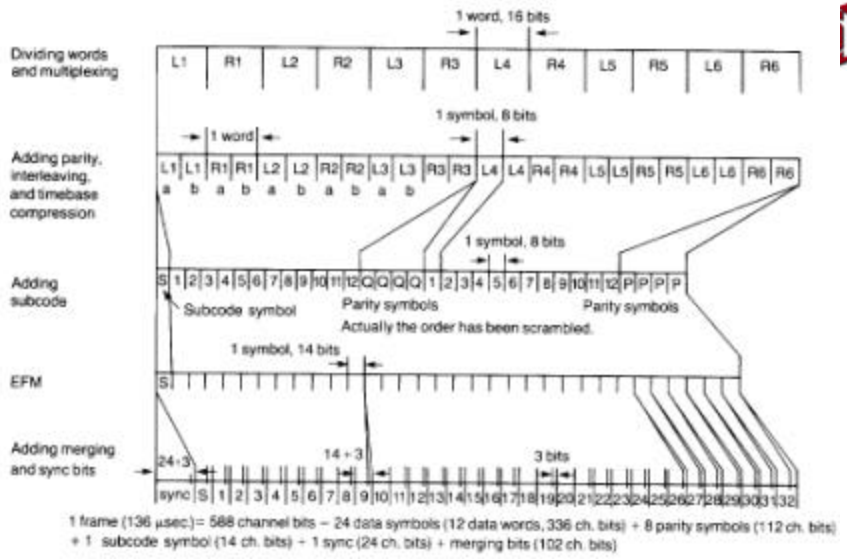
Contents

CD - Data format

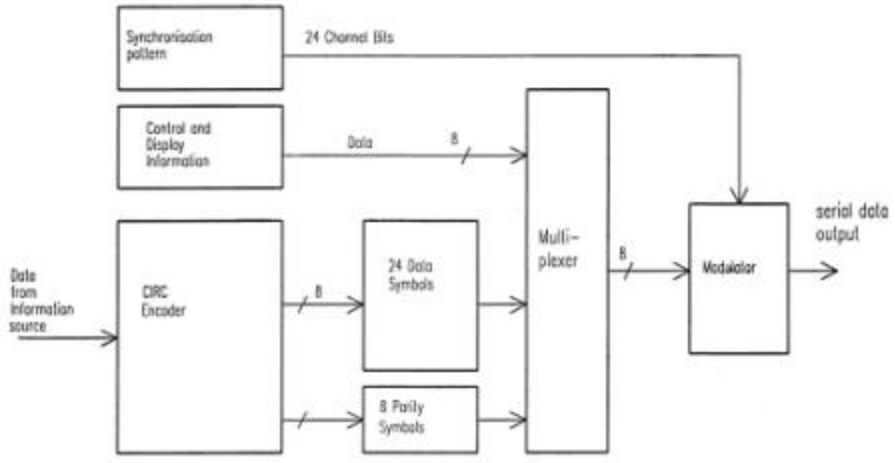




Data encoding



Frame format



Data modulation structure

Error correction system

How is it possible to protect data?

- by **adding redundant data** to the original data before it is written on the disc
- the added data can be used to reconstruct almost any loss of data because of media imperfections and transmission errors
- 8 parity bytes are added to the 24 bytes of audio information the data are **encoded** in **two stages (C1 & C2)**
- after the first stage the data are **interleaved**

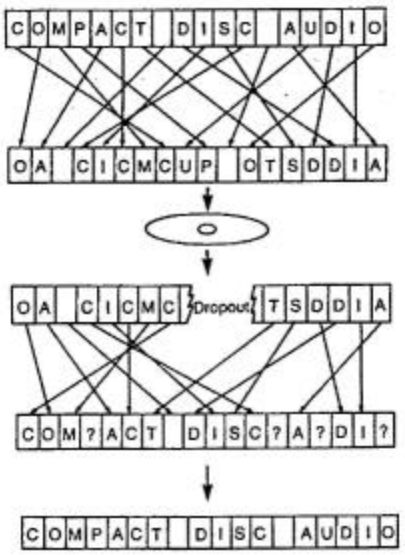
Data block	After transmission	
1 0 1 0	1 0 1 0	† error cannot be detected
0 1 1 1	0 1 **0** 1	
1 0 0 1	1 0 0 1	
1 0 1 1	1 0 1 1	

With **parity values** attached to **each row**

1 0 1 0 **0**	1 0 1 0 **0**	† error can be detected
0 1 1 1 **1**	0 1 **0** 1 **1**	† but not corrected
1 0 0 1 **0**	1 0 0 1 **0**	
1 0 1 1 **1**	1 0 1 1 **1**	

With **parity values** attached to **each row and column**

1 0 1 0 **0**	1 0 1 0 **0**	† row error
0 1 1 1 **1**	0 1 **0** 1 **1**	† column error
1 0 0 1 **0**	1 0 0 1 **0**	† parity may be used to correct the error
1 0 1 1 **1**	1 0 1 1 **1**	
1 1 1 1 0	**1 1 1 1 0**	



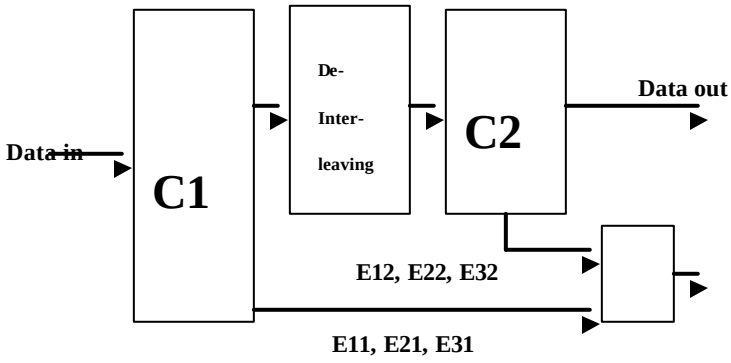
Data interleaving

First decoder stage C1

- From the four parity bytes of the first stage the C1 decoder is able to **correct random errors** and to **detect burst errors**
- The C1 decoder is able to **correct up to two bytes** in a frame
- If more than two bytes are defective the C1 decoder will flag the data of the corresponding frame as unreliable (E31)

First decoder stage C2

- **After** the first decoder stage the data are **deinterleaved**
- By means of the error flag from the first decoder stage and the remaining four parity symbols the C2 decoder is able to correct burst errors
- As for the first stage, in the second stage two defective frames can be corrected



Decoding

Error correction flags

- To accomplish the error correction of the retrieved data the decoder flags the unreliable data

- By evaluating these flags, we can draw some conclusions about the quality of the CD

First decoder stage C1

- **E11** - One symbol out of the frame is defect and has been corrected
- **E21** - Two symbols out of a frame are defect and have been corrected
- **E31** - Three or more symbols out of the frame are defect. This means the symbols of the frame can not be corrected. The whole frame is marked as erroneous

First decoder stage C2

- **E12** - One symbol out of the second decoder stage is defective and has been corrected
- **E22** - Two symbols out of the second decoder stage are defective and have been corrected
- **E32** - More than two symbols in the second decoder stage are defective. Uncorrectable error

Additional error signals

- **BLER** - Block (Frame) Error Rate

  measures the number of frames per second containing at least one defective symbol,

  is a summary of both correctable and uncorrectable errors in the first decoder stage: **E11 + E21 + E31**,

  only 3% of all frames within one second are allowed to be erroneous - this results in an error rate of 220 frames per second.

- **FBL** - Frame Burst Error Length

  the number of consecutive frames which are erroneous.