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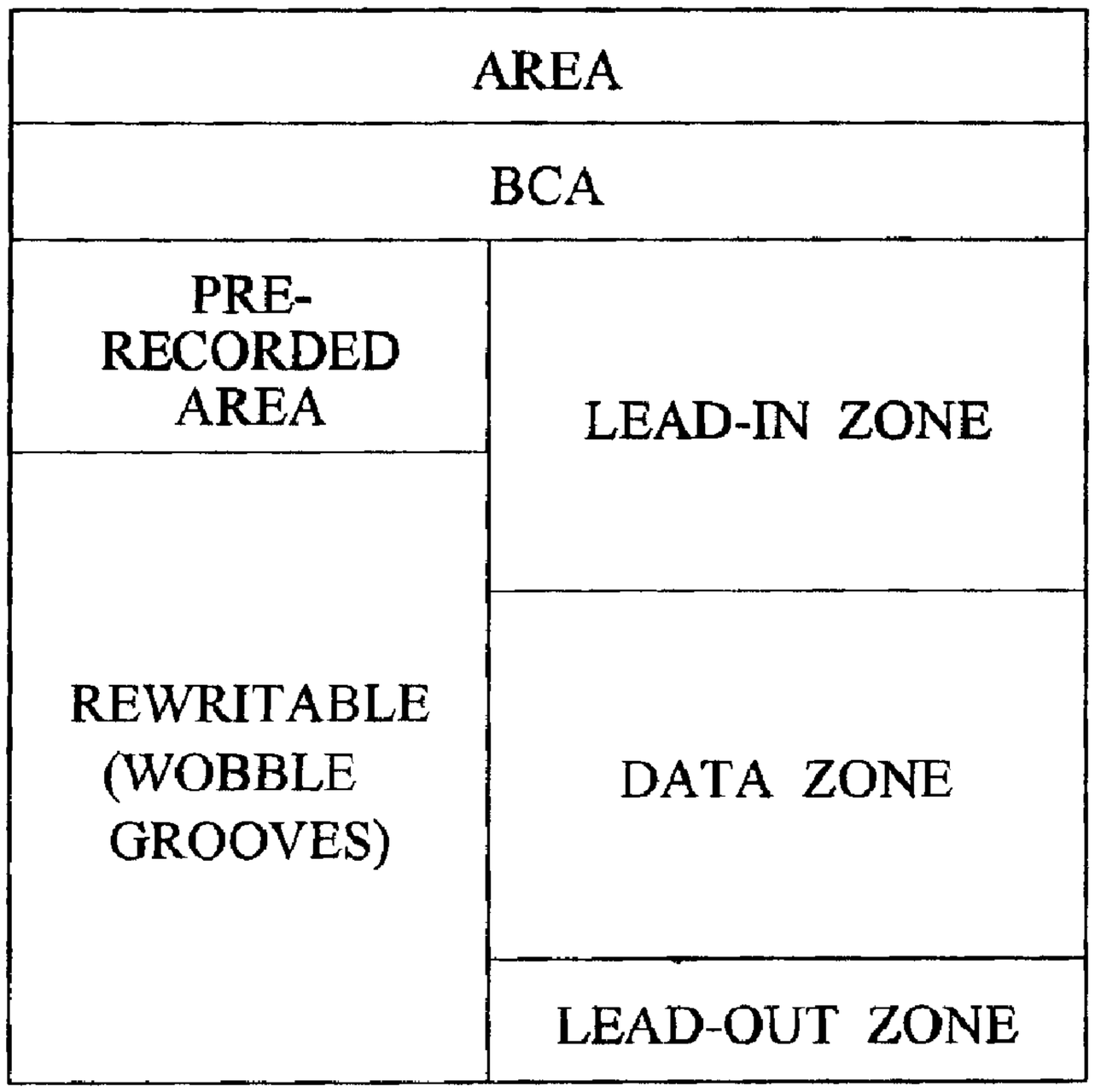
(54) Titre : SUPPORT D'ENREGISTREMENT OPTIQUE CONTENANT UN MODELE D'EFFACEMENT DE L'INFORMATION SUR LES NIVEAUX DE PUISSANCE

(54) Title: OPTICAL RECORDING MEDIUM ON WHICH POWER INFORMATION OF ERASE PATTERN IS RECORDED



(57) Abrégé/Abstract:
An optical recording medium storing information about powers of an erase pulse is provided. The optical recording medium allows data to be recorded on, erased from, and reproduced from. In the optical recording medium, erase pattern information including

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(57) Abrégé(suite)/Abstract(continued):
information about power levels of start and last pulses of an erase pattern for erasing data is recorded. The start and last pulses of the erase pattern that can be differently set depending on kinds of recording layers of disks, kinds of disks, or each layer of a multi-layered recording layer are recorded in a reproducible only area of the optical recording medium. Thus, the time required for selecting an optimal erase power for the optical recording medium in which the recording apparatus is inserted can be considerably reduced.

Abstract of the Disclosure

An optical recording medium storing information about powers of an erase pulse is provided. The optical recording medium allows data to be recorded on, erased from, and reproduced from. In the optical recording medium, erase pattern information including information about power levels of start and last pulses of an erase pattern for erasing data is recorded. The start and last pulses of the erase pattern that can be differently set depending on kinds of recording layers of disks, kinds of disks, or each layer of a multi-layered recording layer are recorded in a reproducible only area of the optical recording medium. Thus, the time required for selecting an optimal erase power for the optical recording medium in which the recording apparatus is inserted can be considerably reduced.

OPTICAL RECORDING MEDIUM ON WHICH POWER INFORMATION OF ERASE PATTERN IS RECORDED

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an optical recording medium, and more particularly, to an optical recording medium on which power information of an erase pattern is recorded.

2. Description of the Related Art

Recording data on an optical disk, a kind of optical recording media, means that a mark is made in a track formed on the optical disk. Currently recordable, erasable, and reproducible disks include RW-CDs of 650MB, DVDs-RAM/R/RW of 4.7GB, DVDs+RW of 4.7GB, HD-DVDs of 23GB still under development, and the like. In a rewritable disk, a recording layer is coated with a phase change layer which is changed from crystalline to amorphous according to the temperature level, and a mark is formed (according to the data required) through a phase change of the phase change layer. In such a rewritable medium, a writing strategy, according to the types of recording media, is adopted to optimize recording/reproducing characteristics. However, since recording conditions may vary from drive to drive, optical recording media may not be compatible with drives.

SUMMARY OF THE INVENTION

To solve the above-described problem, it is an object of the present invention to provide an optical recording medium storing information about power levels of start and last pulses of an erase pattern and capable of detecting a laser optimal power level necessary for erasing data when used with any type of drive.

Accordingly, to achieve the above object, there is provided an optical recording medium which allows data to be recorded on, erased from, and reproduced from. In the optical recording medium, erase pattern information including information about power levels of start and last pulses of an erase pattern for erasing data is recorded.

BRIEF DESCRIPTION OF THE DRAWINGS

The above object and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a view showing all areas of an optical recording medium;

FIG. 2 is a view showing waveforms of data and four types of erase patterns;

FIG. 3 is a view of an example of a recording waveform for recording data in a data zone of the optical recording medium shown in FIG. 1;

FIG. 4 is a view of an example of data recorded in a pre-recorded area shown in FIG. 1; and

FIG. 5 is a view of an example of data recorded in the pre-recorded area shown in FIG. 1 when the optical recording medium is a dual layer optical recording medium.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, a preferred embodiment of the present invention will be described in detail with reference to the attached drawings.

FIG. 1 is a view showing all areas of an optical recording medium including a burst cutting area (BCA), a pre-recorded area, and a rewritable area. Referring to FIG. 1, in the BCA, disk's own information, such as a disk number or the like, is recorded in a barcode type in a radial direction. In the pre-recorded area, reproducible only data is recorded as high frequency wobbles or pits. Data recorded in the pre-recorded area includes data types, disk sizes, channel bit lengths, disk structures, time required for forming recording and erase patterns, recording powers, and the like. In the optical recording medium according to the present invention, erase pattern information about power levels of start and last pulses of an erase pattern for erasing data is recorded in a reproducible only pre-recorded area or rewritable area in/from which data is rewritten/reproduced. Hereinafter, for convenience, it is described that the erase pattern information is stored in the pre-recorded area.

A combination of power levels of start and last pulses of an erase pattern for erasing data recorded in an optical disk can be classified into four types according to kinds of recording layers of disks or kinds of disks, as shown in FIG. 2.

Referring to FIG. 2, an erase pattern is classified into four types: (a) LH, (b) HH, (c) HL, and (d) LL. Each erase pattern is marked with a circle for easy identification of the differences. (a) LH represents that power of a start pulse constituting the erase pattern is equal to a low level P_{BE} of a subsequent erase multi-pulse, a last erase multi-pulse constituting the erase pattern is ended at the low level P_{BE}, and power level of a last pulse Tsfp of a subsequent erase pattern is equal to a high level P_{PE} of the erase multi-pulse. (b) HH represents that power of a start pulse constituting the erase pattern is equal to the high level P_{PE} of a subsequent erase multi-pulse, a last erase multi-pulse constituting the erase pattern is ended at the high level P_{PE}, and level of a last pulse Tsfp of a subsequent erase pattern is maintained at the high level P_{PE} of the erase multi-pulse. (c) HL represents that power of a start pulse constituting the erase pattern is equal to the high level P_{PE} of a subsequent erase multi-pulse, a last erase multi-pulse constituting the erase pattern is ended at the high level P_{PE}, and the level of a last pulse Tsfp of a subsequent erase pattern is equal to the low level P_{BE} of the erase multi-pulse. Finally, (d) LL represents that power of a start pulse constituting the erase pattern is equal to the low level P_{BE} of a subsequent erase multi-pulse, a last erase multi-pulse constituting the erase pattern is ended at the low level P_{BE}, and level of a last pulse Tsfp of a subsequent erase pattern is maintained at the low level P_{BE} of the erase multi-pulse.

When an optical recording medium where start and last pulses of an erase pattern that can be differently set depending on kinds of recording layers of disks, kinds of disks, or each layer of a multi-layered recording layer are recorded in a reproducible only area is inserted into a recording apparatus, the recording apparatus does not need to perform an additional test for selecting an optimal erase power. Thus, the time required for determining an erase power level can be considerably reduced.

FIG. 3 is a view of an example of a recording waveform for recording data in a data zone of the optical recording medium shown in FIG. 1. In FIG. 3, horizontal quantities represent times of recording and erasing patterns while vertical quantities represent recording powers.

FIG. 4 is a view of an example of data recorded in the pre-recorded area shown in FIG. 1. Referring to FIG. 4, in the pre-recorded area, besides the times required for forming recording and erase patterns of the waveform shown in FIG. 3, recording power, kinds of disks, sizes of disks, and the like can be recorded. Also,

the pre-recorded area includes reserved bytes that are not assigned for recording. Information about power levels of start and last pulses of the erase pattern can be recorded in one of the reserved bytes. In FIG. 4, byte number (BN) N was assigned for recording information about the power levels of the start and last pulses of the erase pattern. In detail, the power level of the start pulse of the erase pattern can be defined as high 4 bits, and the power level of the last pulse can be defined as low 4 bits. If the low level P_{BE} of an erase multi-pulse is defined as "0001" and the high level P_{PE} of the erase multi-pulse is defined as "0000", in the case of the erase pattern shown in FIG. 3, "00010000" is recorded in BN N. The recording apparatus reads "00010000" recorded in BN N of the optical disk that is inserted therein, and thus can identify that the power level of the start pulse of the erase pattern is P_{BE} and the power level of the last pulse is P_{PE} without an additional test procedure. In FIG. 4, M represents a last byte in an area storing disk information.

FIG. 5 is a view of an example of data recorded in the pre-recorded area shown in FIG. 1 when the optical recording medium is a dual layer optical recording medium. Referring to FIG. 5, BN N is assigned for recording erase pattern information about power levels of start and last pulses of an erase pattern for a first recording layer L0. BN N+1 is assigned for recording erase pattern information about power levels of start and last pulses of an erase pattern for a second recording layer L1. The power level of the start pulse of the erase pattern is defined as high 4 bits of each of BN N and N+1, and the power level of the last pulse is defined as low 4 bits.

In FIG. 5, even though erase pattern information of two recording layers are recorded in one recording layer, erase pattern information corresponding to each recording layer can be recorded in each of the two recording layers.

As described above, in the optical recording medium on which information about powers of an erase pattern is recorded, start and last pulses of the erase pattern that can be differently set depending on kinds of recording layers of disks, kinds of disks, or each layer of a multi-layered recording layer are recorded in a reproducible only area of the optical recording medium. Thus, the time required for selecting an optimal erase power for the optical recording medium in which the recording apparatus is inserted can be considerably reduced.

What is claimed is:

1. An optical recording medium on which data may be recorded, from which data may be erased, and from which data may be reproduced, wherein data is erased from the optical recording medium according to an erase pattern having a start pulse, a multi-pulse and a last pulse, the multi-pulse having a high level and a low level, and the optical recording medium having recorded thereon erase pattern information including information indicating whether power levels of the start and the last pulses of the erase pattern are of the high level or the low level of the multi-pulse, respectively.

2. The optical recording medium of claim 1 wherein the erase pattern information is recorded in a reproducible only area of a recording layer on which data is recorded.

3. The optical recording medium of claim 1, wherein the erase pattern information is recorded in a recordable area of the recording layer on which data is recorded.

4. The optical recording medium of claim 1, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the high level of the multi-pulse and the power level of a last pulse of the erase pattern is the high level of the multi-pulse.

5. The optical recording medium of claim 1, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the low level of the multi-pulse and the power level of a last pulse of the erase pattern is the low level of the multi-pulse.

6. The optical recording medium of claim 1, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the

high level of the multi-pulse and the power level of a last pulse of the erase pattern is the low level of the multi-pulse.

7. The optical recording medium of claim 1, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the low level of the multi-pulse and the power level of a last pulse of the erase pattern is the high level of the multi-pulse.

8. An optical recording medium on which data may be recorded, from which data may be erased, and from which data may be reproduced, wherein data is erased from the optical recording medium according to an erase pattern having a start pulse, a multi-pulse and a last pulse, the multi-pulse having a high level and a low level, the optical recording medium comprising:

a plurality of recording layers on which data including the erase pattern information is recorded, wherein the erase pattern information includes information indicating whether power levels of the start and the last pulses of the erase pattern are of the high level or the low level of the multi-pulse, respectively, for erasing data corresponding to each of the recording layers.

9. The optical recording medium of claim 8, wherein the erase pattern information about each of the plurality of recording layers is stored in one layer selected from the plurality of recording layers.

10. The optical recording medium of claim 9, wherein the erase pattern information is recorded in a reproducible only area of the selected recording layer.

11. The optical recording medium of claim 9, wherein the erase pattern information is recorded in a recordable are of the selected recording layer.

12. The optical recording medium of claim 9, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the

high level of the multi-pulse and the power level of a last pulse of the erase pattern is the high level of the multi-pulse.

13. The optical recording medium of claim 9, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the low level of the multi-pulse and the power level of a last pulse of the erase pattern is the low level of the multi-pulse.

14. The optical recording medium of claim 9, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the high level of the multi-pulse and the power level of a last pulse of the erase pattern is the low level of the multi-pulse.

15. The optical recording medium of claim 9, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the low level of the multi-pulse and the power level of a last pulse of the erase pattern is the high level of the multi-pulse.

16. The optical recording medium of claim 8, wherein the erase pattern information about each of the plurality of recording layers is respectively recorded on each corresponding recording layer.

17. The optical recording medium of claim 16, wherein the erase pattern information about the plurality of recording layers is respectively recorded in reproducible only areas of each of the recording layers.

18. The optical recording medium of claim 16, wherein the erase pattern information about the plurality of recording layers is respectively recorded in recordable areas of each of the recording layers.

19. The optical recording medium of claim 16, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the high level of the multi-pulse and the power level of a last pulse of the erase pattern is the high level of the multi-pulse.

20. The optical recording medium of claim 16, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the low level of the multi-pulse and the power level of a last pulse of the erase pattern is the low level of the multi-pulse.

21. The optical recording medium of claim 16, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the high level of the multi-pulse and the power level of a last pulse of the erase pattern is the low level of the multi-pulse.

22. The optical recording medium of claim 16, wherein the erase pattern information indicates that the power level of the start pulse of the erase pattern is the low level of the multi-pulse and the power level of a last pulse of the erase pattern is the high level of the multi-pulse.

23. A method of recording erase pattern information on an optical recording medium, wherein the optical recording medium is configured to have data recorded thereon, erased therefrom, and reproduced therefrom, and wherein data is erased from the optical recording medium according to an erase pattern having a start pulse, a multi-pulse and a last pulse, the multi-pulse having a high level and a low level, the method comprising:

recording the erase pattern information on the optical recording medium, wherein the erase pattern information includes information indicating whether the power levels of the start and last pulses of the erase pattern are of the high level or the low level of the multi-pulse, respectively.

24. The method of claim 23, further comprising recording the erase pattern information in a reproducible only area of a recording layer of the optical recording medium.

25. The method of claim 23, further comprising recording the erase pattern information in a recordable area of a recording layer of the optical recording medium.

26. A method of recording erase pattern information on an optical recording medium, the optical recording medium having a plurality of recording layers configured to have data recorded thereon, erased therefrom, and reproduced therefrom, and wherein data is erased from the optical recording medium according to an erase pattern having a start pulse, a multi-pulse and a last pulse, the multi-pulse having a high level and a low level, the method comprising:

recording the erase pattern information on the optical recording medium, wherein the erase pattern information includes information indicating whether the power levels of the start and last pulses of the erased pattern is one of the high level or the low level of the multi-pulse, respectively, for erasing data in each of the recording layers.

27. The method of claim 26, further comprising recording the erase pattern information for each of the plurality of recording layers in one layer selected from the plurality of recording layers.

28. The method of claim 27, further comprising recording the erase pattern information in a reproducible only area of the selected recording layer.

29. The method of claim 27, further comprising recording the erase pattern information in a recordable area of the selected recording layer.

30. The method of claim 26, further comprising recording erase pattern information for each of the plurality of recording layers in each corresponding recording layer.

31. The method of claim 30, further comprising recording the respective erase pattern information for each of the plurality of recording layers in a reproducible only area of each of the recording layers.

32. The method of claim 30, further comprising recording the respective erase pattern information for each of the plurality of recording layers in a recordable area of each of the recording layers.

33. A method of erasing data from an optical recording medium, wherein the optical recording medium is configured to have data recorded thereon, erased therefrom, and reproduced therefrom, and wherein data is erased from the optical recording medium according to an erase pattern having a start pulse, a multi-pulse and a last pulse, the multi-pulse having a high level and a low level, the method comprising:

erasing data from the optical recording medium based on the erase pattern information recorded on the optical recording medium, the erase pattern information including information indicating whether the power levels of the start and last pulses of the erase pattern are of the high level or low level multi-pulse, respectively.

34. The method of claim 33, wherein the erase pattern information is recorded in a producible only area of a recording layer of the optical recording medium.

35. The method of claim 33, wherein the erase pattern information is recorded in a recordable area of a recording layer of the optical recording medium.

36. A method of erasing data from an optical recording medium, the optical recording medium having a plurality of recording layers configured to have data

recorded thereon, erased therefrom, and reproduced therefrom, and wherein data is erased from the optical recording medium according to an erase pattern having a start pulse, a multi-pulse and a last pulse, the multi-pulse having a high level and a low level, the method comprising:

erasing data from the optical recording medium based on the erase pattern information recorded on the optical recording medium, the erase pattern information including information indicating whether the power levels of the start and last pulses of the erase pattern are of the high level or the low level of the multi-pulse, respectively, for erasing data in each of the recording layers.

37. The method of claim 36, wherein the erase pattern information for each of the plurality of recording layers is recorded in one layer selected from the plurality of recording layers.

38. The method of claim 37, wherein the erase pattern information is recorded in a reproducible only area of the selected recording layer.

39. The method of claim 37, wherein the erase pattern information is recorded in a recordable area of the selected recording layer.

40. The method of claim 36, wherein erase pattern information for each of the plurality of recording layers is recorded in each corresponding recording layer.

41. The method of claim 40, wherein the respective erase pattern information for each of the plurality of recording layers is recorded in a reproducible only area of each of the recording layers.

42. The method of claim 40, wherein the respective erase pattern information for each of the plurality of recording layers is recorded in a recordable area of each of the recording layers.

FIG. 1

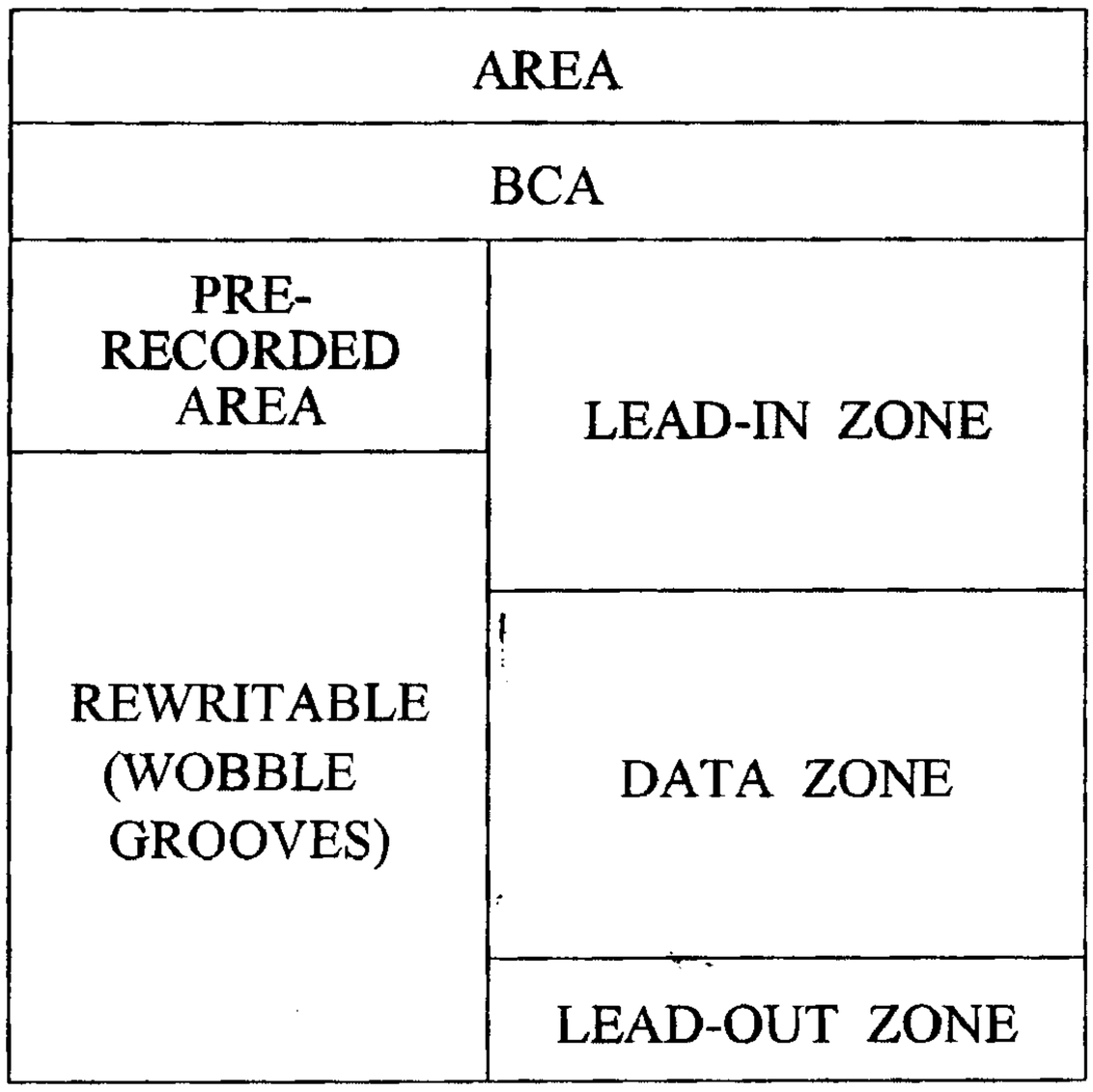

AREA
BCA
PRE-RECORDED AREA
LEAD-IN ZONE
REWRITABLE (WOBBLE GROOVES)
DATA ZONE
LEAD-OUT ZONE

FIG. 2

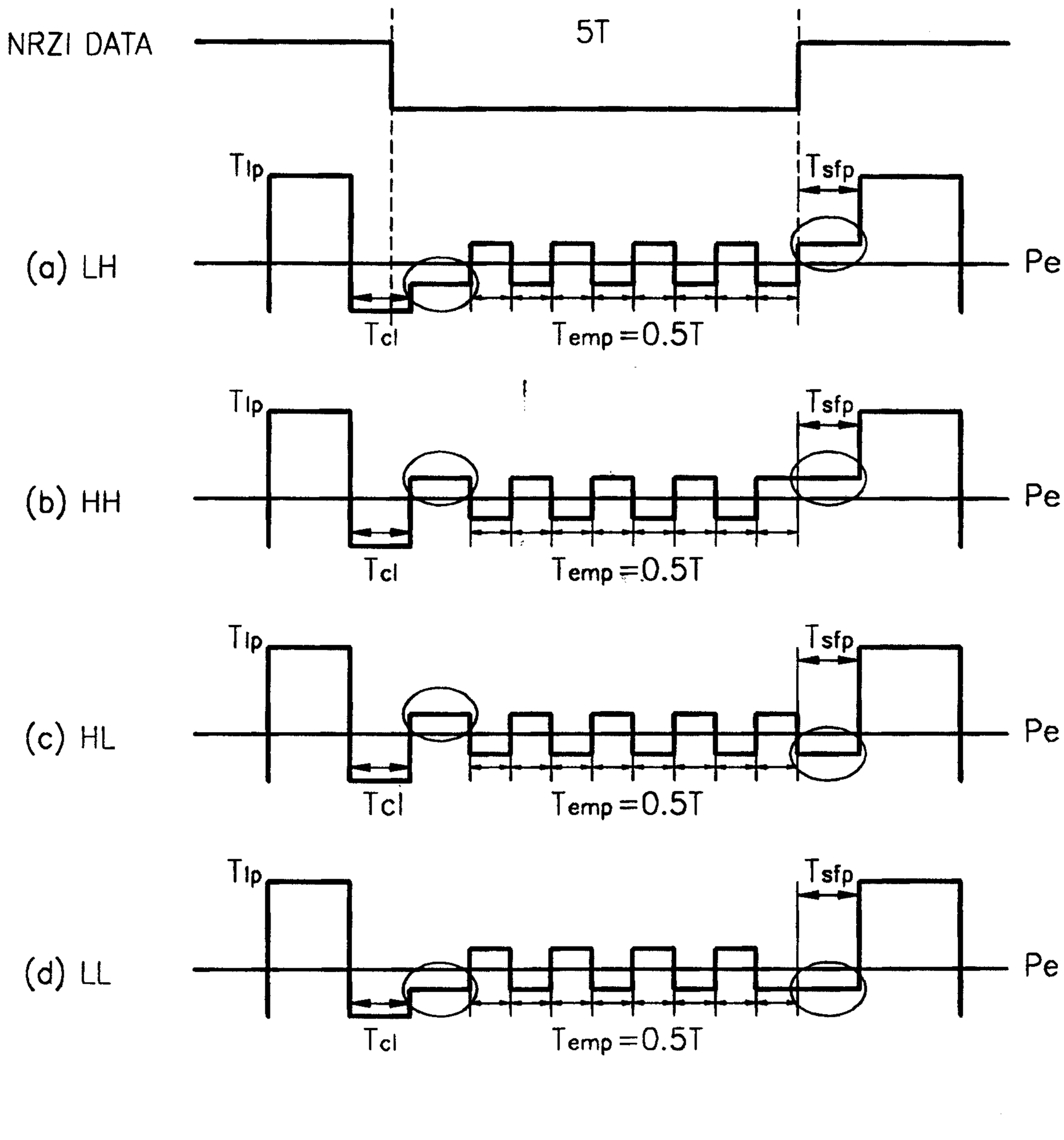

NRZI DATA
5T
(a) LH
Tlp
Tsfp
Pe
Tcl
Temp =0.5T
(b) HH
Tlp
Tsfp
Pe
Tcl
Temp =0.5T
(c) HL
Tlp
Tsfp
Pe
Tcl
Temp =0.5T
(d) LL
Tlp
Tsfp
Pe
Tcl
Temp =0.5T

FIG. 3

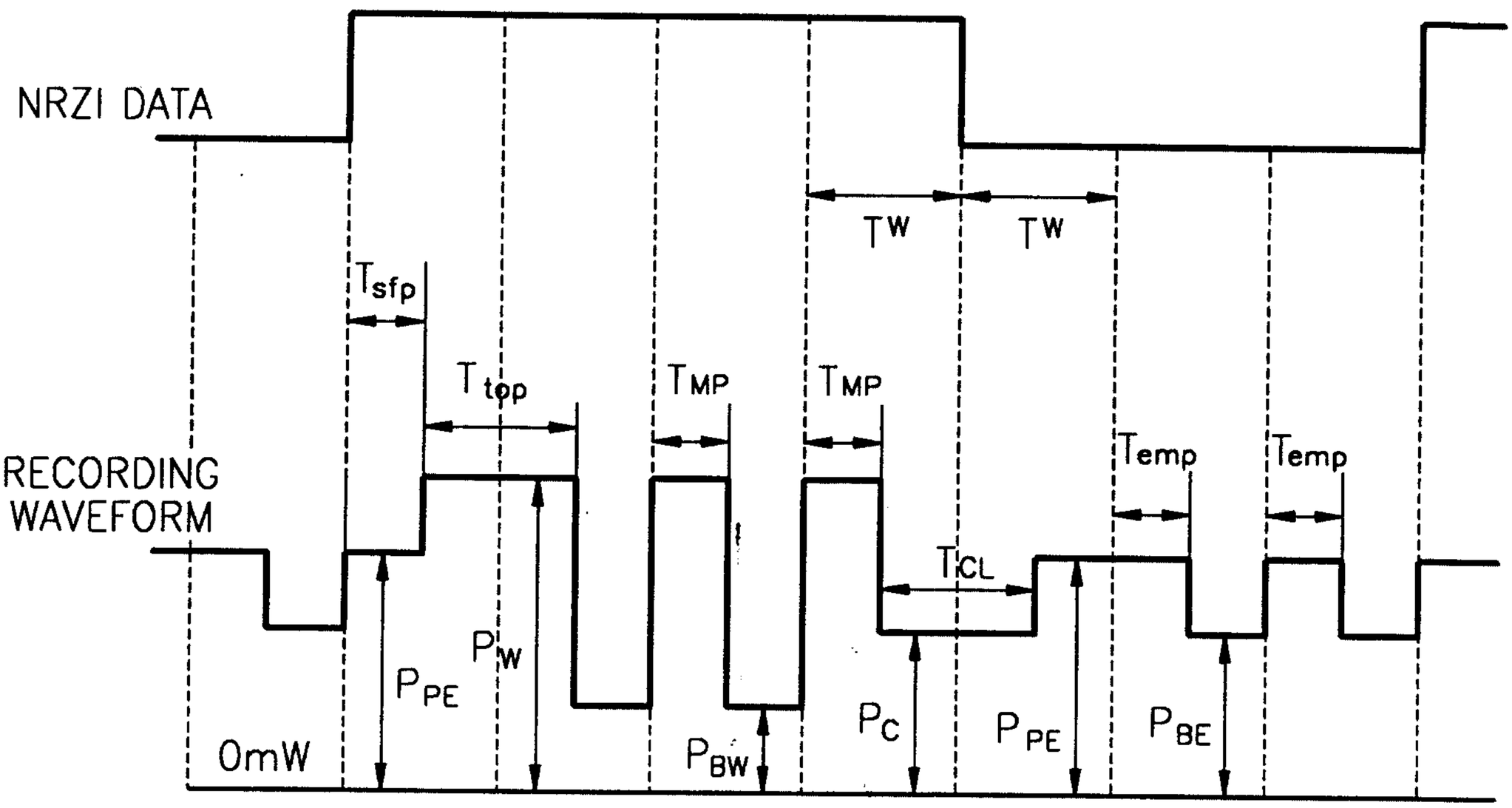
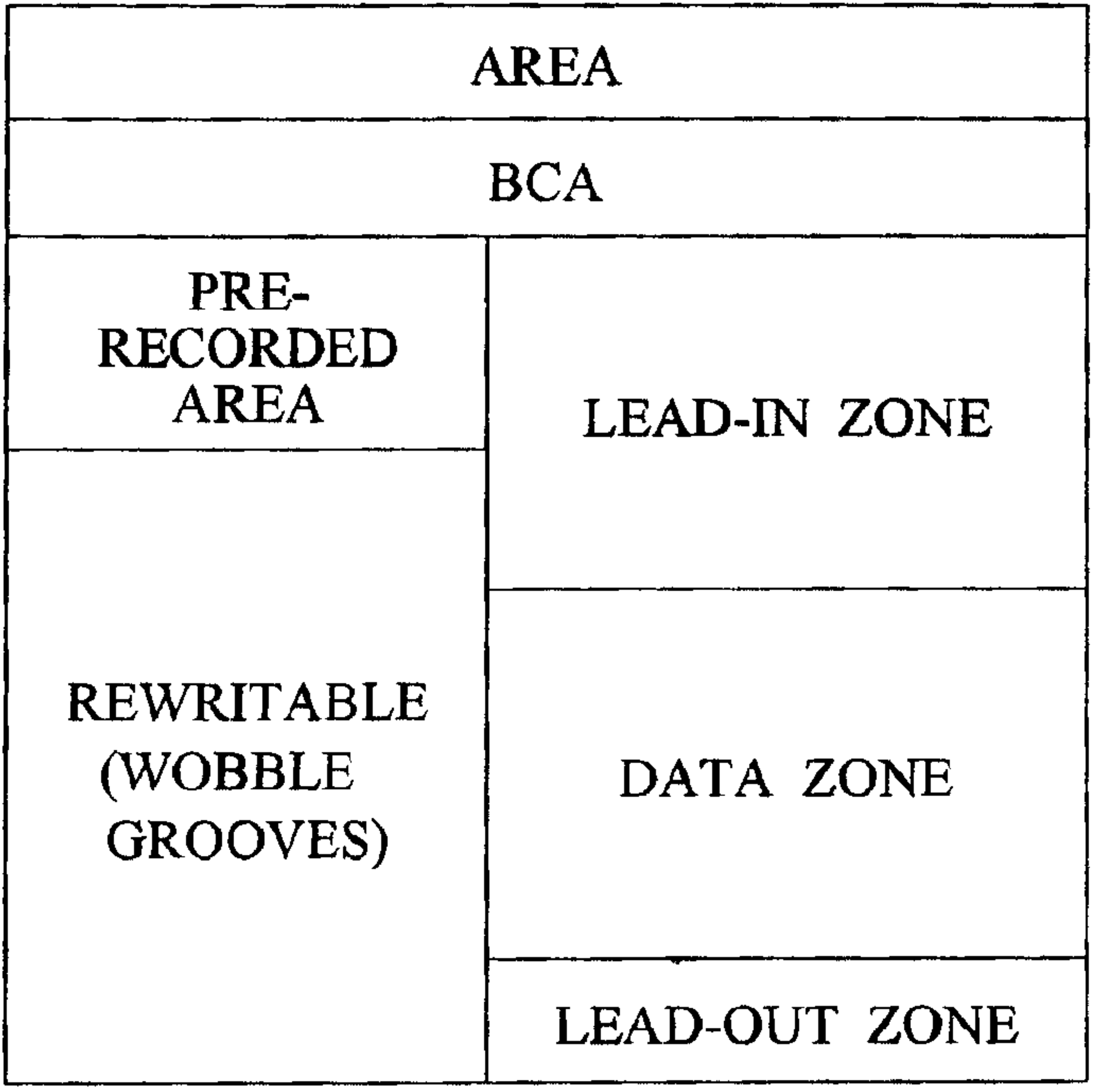

NRZI DATA
RECORDING WAVEFORM
0mW
Tsfp
Ttop
TMP
TMP
Tw
Tw
Temp
Temp
TCL
PPE
Pw
PBW
Pc
PPE
PBE

FIG. 4

BYTE NUMBER	CONTENTS	# OF BYTES
0 ~ N-1	...	-
N	POWER LEVELS OF THE START AND LAST PULSES IN ERASE PULSE TRAIN	1
N+1 to M	...	-

FIG. 5

BYTE NUMBER	CONTENTS	# OF BYTES
0 ~ N-1	...	-
N	POWER LEVELS OF THE START AND LAST PULSES IN ERASE PULSE TRAIN FOR L0	1
N+1	POWER LEVELS OF THE START AND LAST PULSES IN ERASE PULSE TRAIN FOR L1	1
...		


AREA
BCA
PRE-
RECORDED
AREA
LEAD-IN ZONE
REWRITABLE
(WOBBLE
GROOVES)
DATA ZONE
LEAD-OUT ZONE