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PCT/EP91/02375

Method for transmitting additional information in an AM radio signal

DESCRIPTION

- The invention relates to an additional information signal according to the preamble of Patent Claim 1. Such a signal is known from the research paper BBC RD 1982/2 from the British Broadcasting Corporation "L.F. Radio-Data: Specification of the BBC experimental transmissions 1982" dated August 1982.
- The aforesaid research paper discloses how digital, coded additional information is transmitted in an AM (amplitude modulation) radio signal by means of phase modulation and demodulation of the AM radio signal carrier. In order to prevent the station signal of the phase-modulated AM carrier from being disrupted, the British Broadcasting Corporation selected a value of $\pm 22.5^\circ$ as the maximum acceptable phase-angle deviation, which corresponded to a transmission capacity for the additional information of 25 bit/s. This extremely small channel capacity requires error protection which is matched as well as possible in terms of low redundancy to the properties of the AM radio transmission channel. For this purpose, the data stream is divided up into blocks with a length of 50 bits each, each block comprising a synchronous bit, an information word of 36 bits and a check word of 13 bits. For the block coding, use is made of an optimum error-correcting code with which an error burst up to a length of 6 bits can be corrected. The selected code is cyclical and is shortened to the block length of 50 bits. In order to be able to detect the start of blocks reliably, the synchronous bit is placed in front of the block at the transmitter end, as a result of which the cyclical character of the block code is destroyed. In order to identify the contents of the

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32-bit-long information word, a 4-bit-wide block use code is transmitted directly after the synchronous bit at the start of the information word. Within the information word, a specific information coding is provided, in conjunction with the block use code 0000, exclusively for the information relating to the time and calendar date.

In contrast to the above, the object of the invention consists in reducing the redundancy in the case of an additional information signal of the type mentioned at the beginning and in facilitating the assignment, and thus detection, of different items of information.

This object is achieved according to the invention by means of the characterizing features of Patent Claims 1 and 2.

Advantageous refinements and developments of the additional information signal according to the invention emerge from the Subclaims 3 to 10. A method for transmitting an additional information signal according to the invention is disclosed in the independent Claim 11, while a method for receiving an additional information signal according to the invention is disclosed in the independent Claim 14.

Advantageous refinements and developments of the methods according to Claims 11 and 14 emerge from the Subclaims 12, 13 and 15, 16.

The invention is explained in greater detail below with reference to the exemplary embodiments illustrated in the drawings. In the description of the drawings, the number of information blocks is, as disclosed in Claim 2, limited to the number two.



1. Baseband coding

1.1 Structure of the baseband coding

Figure 1 shows the structure of the baseband coding. The largest element within the structure is referred to as group. A group comprises 2 blocks with 47 bits each. Each block contains an information word (36 bits) and a check word (11 bits). In order to distinguish between the blocks of one group and in order to permit reliable block synchronization, an offset word (11 bits) is superimposed on each check word (modulo 2 addition).

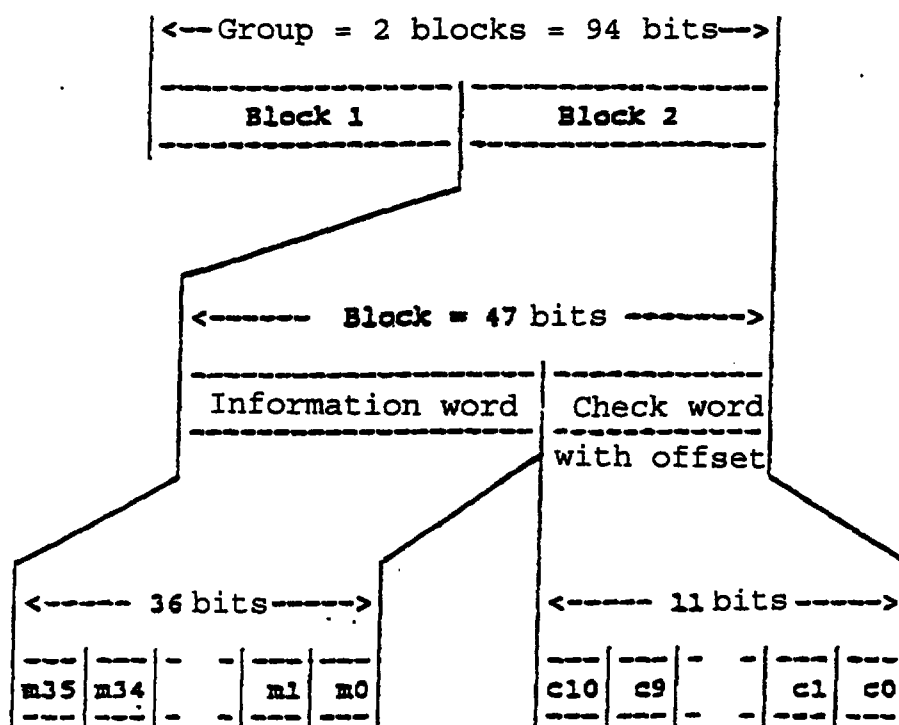


Figure 1 Structure of the baseband coding

1.2 Features of the data transmission

In the case of all information words, check words, binary numbers or addresses, the highest-order bit is transmitted first (Figure 2). The last bit of a binary number or address to be transmitted has the value 2^0 .

The data transmission is completely synchronous,

i.e. there are no gaps between groups or blocks.

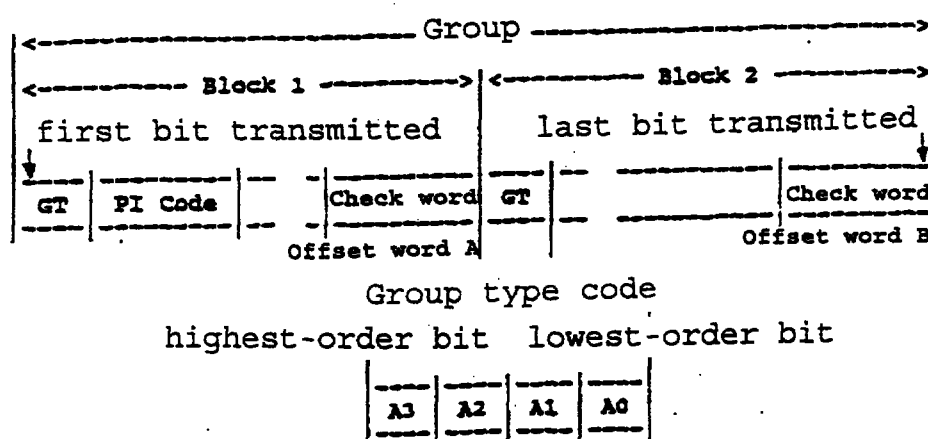


Figure 2 Data format and addressing

Explanations

	GT	Group type code	(4 bits) cf. 2.2
5	PI code	Station series identification	(16 bits) cf. 2.1
	Check word	for error protection, block synchronization and group synchronization	(11 bits) cf. 1.3
10	X	unused capacity	cf. 2.2.1-2.2.5
	Block 1 of each individual group is transmitted first.		

1.3 Error protection

- Each block has a check word (11 bits) for detecting and correcting transmission errors in the receiver/decoder. This check word ($c_{10}, c_9, \dots, c_0$ in Figure 1) is the sum (modulo 2) of:
- the remainder after multiplication of the 36-bit information word $m(x)$ by X^{11} and subsequent division (modulo 2) by the generator polynomial $g(x)$
 - an 11-bit binary sequence $d(x)$, referred to as offset word



$$\text{or check word } c(x) = d(x) + \frac{m(x) x^{11}}{g(x)} \bigg| \text{ mod } g(x)$$

the generator polynomial (degree 11) being described by the following equation:

$$g(x) = x^{11} + x^8 + x^6 + 1$$

- 5 and different offset words being used for each block within a group.

The 11-bit binary sequence for the offset words A and B is defined as follows:

	Offset	Offset word d(x)										
		d10	d9	d8	d7	d6	d5	d4	d3	d2	d1	d0
10	A	0	1	0	1	1	0	1	0	1	0	1
	B	1	0	1	1	0	1	0	1	0	1	1

The error protection code has the following properties:

- 15 - it detects all the individual errors and double errors in a block
- it detects each individual error burst up to 11 bits
- it detects approximately 99.90% of the error bursts with 11 bits and approximately 99.95% of all the longer bursts
- 20

The code is also an optimum error-correcting code for error bursts up to a length of 5 bits. Depending on the number of errors of a block or on the block contents, either the error detection or the error correction, or

25 else both, can be used at the reception end.

1.4 Block synchronization and group synchronization

By using the two offset words A and B, both the start and end of a block and the start and end of a group

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can be detected in the receiver. The offset words destroy the cyclical nature of the original code, so that cyclical displacements of code words of the modified code do not permit any other code words to be produced and thus make this type of block synchronization reliable.

2. Data format

2.1 Definitions for data transmission

There is no fixed repetition rhythm for the different group types (cf. 2.2), i.e. there is enough flexibility to connect the different types of information chronologically in such a way that they fulfil the requirements of the user.

The selected data format also has 10 free group types and is thus sufficiently adaptable to allow for future uses also.

In order to ensure effective utilization of the channel, the smallest possible number of different types of information is mixed in one group. As a result, the user is not forced to waste channel capacity as a result of transmitting unused information.

The first 4 bits in each block are assigned to the group type code (cf. 2.2) which specifies the use of the group. As a result, it is possible to decode each block of a group in the receiver/decoder without reference to another block. Thus, in the event of transmission faults, the access time to information which is divided up between a plurality of blocks is reduced.

In each case the first block of a group contains the station series identification PI.

30 PI code

The PI code (station series identification) comprises a code (16 bits) which permits the receiver to distinguish between nationality, station area/language area and station code. The PI code is not provided for direct display, it is individually assigned to each radio station and serves to detect transmitters which broadcast

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the same station. As a result, the receiver/decoder is enabled to search for an alternative frequency automatically in the event that the transmitter which has been set during mobile reception becomes too bad.

- 5 The coding below makes it possible to distinguish between 256 countries, 16 station areas and 16 stations.
- Bit 1 - 8 Nationality identification
- Bit 9 - 12 Station area identification/language areas
- Bit 13 - 16 Station code

- 10 The abbreviation for the respective country can be derived from the nationality identification of the PI code and can be presented on the display of the receiver.

2.2 Group types

- 15 The group type code - the first 4 bits of a block (Figure 2) - determines the use of the group. The previously defined group types can be found in the table below.

20	Group type code					Use
	Decimal value	Binary code				
		A3	A2	A1	A0	
25	0	0	0	0	0	PS Name of the station series
	1	0	0	0	1	RT Radio text
	2	0	0	1	0	AF Alternative frequencies
	3	0	0	1	1	TMC Traffic message channel
	4	0	1	0	0	IH Internal radio use
	.	.	.	.	.	Not defined
	15	1	1	1	1	

Table 1 Group types



2.2.1 Group type 0

Name of the station series

PS

Switching information

TMC, TP, TA

Figure 3 shows the data format of group type 0.

Block 1

4	16	1	1	7	7
GT	PI Code	T	T	PS	PS
		M	P	Drawing 1	Drawing 2
		C			

Block 2

4	1	3	7	7	7	7
GT	T	X	PS	PS	PS	PS
	A		Drawing 3	Drawing 4	Drawing 5	Drawing 6

5 Figure 3 - Data format of group type 0

PS

The name of the station series is transmitted as a 7-bit character (Table 2, columns 2-7) in accordance with the ISO 646 code tables for display in the receiver. 6 characters, including idle signals, are provided for the name. The position of the individual characters in the name corresponds to the appendant number. The transmission of the name begins with the character 1. The highest-order bit of each character is transmitted first.

10 Receivers with a display of more than 6 characters could additionally display the respective nationality abbreviations (cf. 2.1 PI code).

TMC

20 TMC (traffic message channel) is a switching signal which identifies transmitters which transmit intermittently coded traffic messages. The identification



can be evaluated for an automatic search run for TMC transmitters.

TP

TP (traffic radio identification) is a switching
5 signal which identifies transmitters which transmit
intermittently announced traffic messages. A lamp or a
corresponding device can be used to indicate on the
receiver that the station being received is transmitting
traffic messages at specific times. The identification
10 can be evaluated for an automatic search run for traffic
radio transmitters.

TA

TA (traffic announcement identification) is a
switching signal for identifying whether a traffic
15 announcement has been transmitted. The signal can be used
in the receiver in the following way:

- automatically switching on the traffic announcement
if the receiver is in the stand-by mode and is
switched to the mute setting;
- 20 - automatically switching over from cassette playback
to the traffic announcement;

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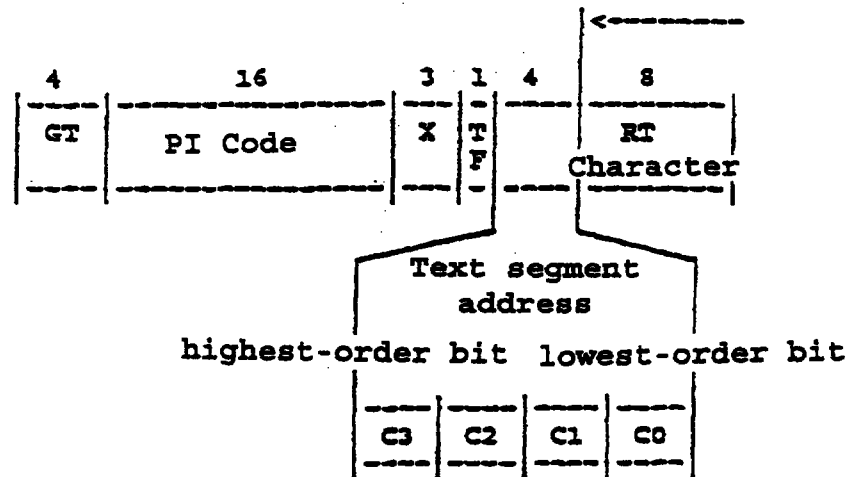


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2.2.2 Group type 1 Radio text RT

Figure 4 shows the data format of group type 1.

Block 1



Block 2

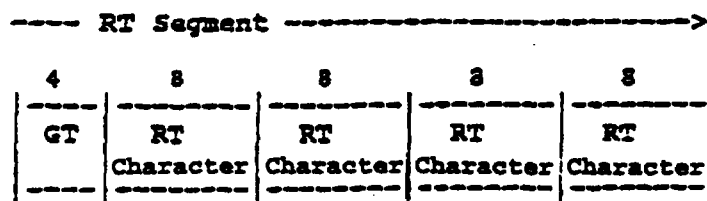


Figure 4 - Data format of group type 1

The radio text is transmitted with 8-bit characters in accordance with the ISO 646 code tables (cf. Table 2). The transmission starts with the highest-order bit of a character.

The text segment address in block 1 serves to arrange the text segment, comprising the characters from blocks 1 and 2, in a display or in a memory. By means of the area of the segment address (0-15) and the characters (5) contained in a group, radio texts up to a length of 80 characters can be transmitted.

If a display with less than 80 characters is used



for RT, a memory should be provided in the receiver/decoder, so that parts of the message can be displayed successively.

5 A change of the text flag (TF) in block 1 identifies the transmission of a new radio text. In the receiver/decoder, the text flag is used to clear the display or the memory.

10 RT is principally intended for home receivers with a suitable display and for car receivers, for example for controlling a voice generator.

2.2.3 Group type 2 Alternative frequencies AF

Figure 5 shows the data form of group type 2.

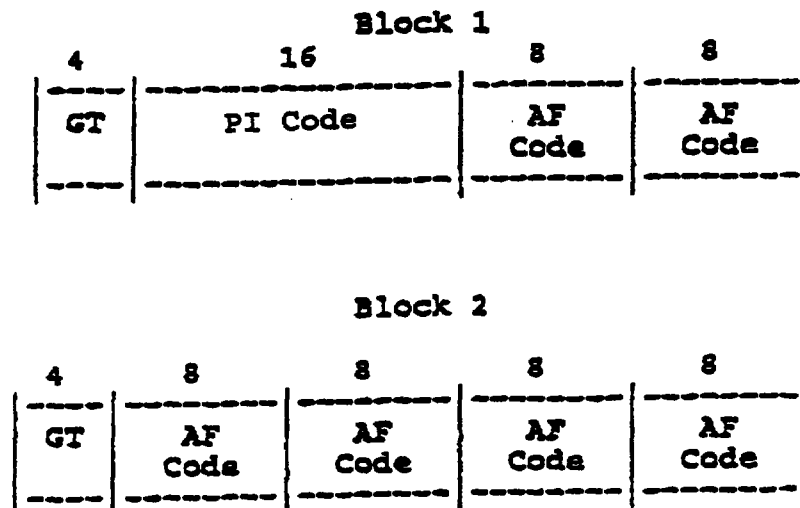


Figure 5 - data format of group type 2

2.2.4 Codes for alternative frequencies

15 Long wave and medium wave

Long wave and medium wave frequencies are represented with 9 kHz spacing by means of an 8-bit code.



	Number	Binary code	Carrier frequency
	1	0000 0001	153 kHz
	15	0000 1111	279 kHz
	16	0001 0000	531 kHz
5	135	1000 0111	1602 kHz

Shortwave

The short-wave frequencies are represented with 5 kHz spacing by means of two 8-bit codes. They are characterized by the fact that the first 8-bit code lies in the range of 140-157. In this case, the first code is to be evaluated in pairs with the following code. Pairs which go beyond a block are unacceptable.

	Number	Binary code	Number	Binary code	Carrier frequency
	140	1000 1100	0	0000 0000	3980 MHz
15	157	1001 1101	190	1011 1110	26100 MHz

VHF

The VHF channels are represented with 100 kHz spacing by means of two 8-bit codes. They are characterized by the fact that the first 8-bit code = 160. In this case, the code identifies, with the following code, a VHF channel. Pairings which go beyond a block are unacceptable.

	Number	Binary code	Number	Binary code	Carrier frequency
	160	1010 0000	0	0000 0000	87.5 MHz
25	160	1010 0000	204	1100 1101	107.9 MHz

Number and filler code

The number code indicates how many frequencies, filler codes excepted, are contained in an AF list. An AF list can contain up to 31 frequencies. The number code is



transmitted at the start of an AF list.

The filler code is used to occupy unused AF codes within the group.

	Number	Binary code	Use
5	136	1000 1000	Filler code
	224	1110 0000	No AF
	241	1110 0001	AF list with 1 frequency
	255	1111 1111	AF list with 31 frequencies

10 The list of alternative frequencies indicates which transmitters in the same reception areas, or in adjacent reception areas, broadcast the same station. Receivers/decoders with a memory for AF lists can thus shorten the switch-over time to another transmitter.

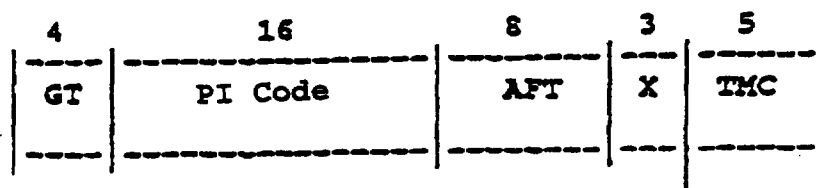
2.2.4 Group type 3

15 Traffic message channel TMC

Alternative frequencies for TMC AFT

Figure 6 shows the data format of group type 3.

Block 1



Block 2

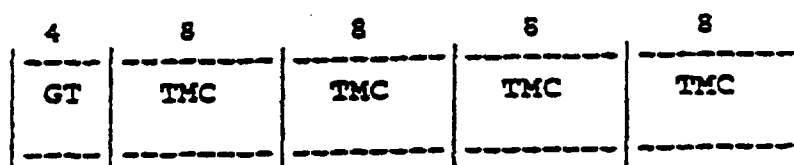


Figure 6 - Data format of group type 3

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The data format complies with the proposals from Blaupunkt and the EBU regarding the information length (37 bits).

5 The alternative frequencies for TMC (AFT) refer only to transmitters with identical, coded traffic messages. These transmitters do not broadcast the same sound program. The AFT is based on the same coding as the alternative frequencies (AF). The use of AFT is limited to LW and MW frequencies.

10 2.2.5 Group type 4 Internal radio information IH
Figure 7 shows the data format of group type 4.

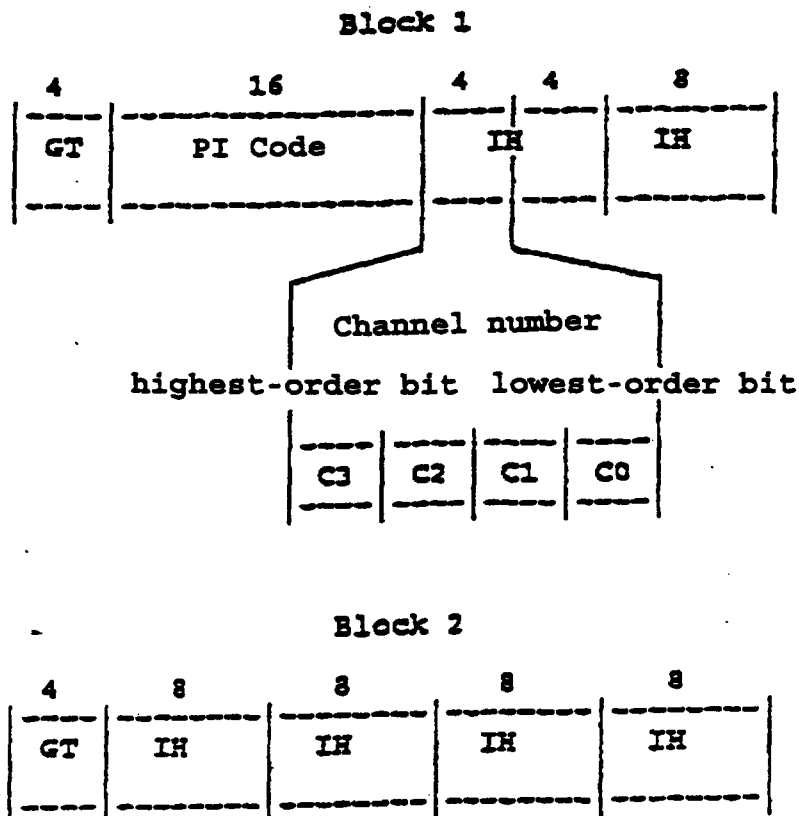


Figure 7 - Data format of group type 4

48 bits are available for IH, 16 bits in block 1 and 32 bits in block 2. The contents of the bits specified with IH may be determined by the radio organization

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itself. In this context, a data format similar to that of RDS seems expedient. The first 4 IH bits of block 1 are used as channel numbers 0 to 15. The remaining 44 bits are regarded as 11 HEX characters and are available for

5 a bit-transparent data transmission.

Examples of the use of IH:

Station source identification

Remote control of transmitter networks

Paging for company personnel





Patent Claims

1. Digital, coded additional information signal within an AM radio signal, characterized in that the additional information (PI, PS, AF, AFT, TP, TA, TMC, RT) of the additional information signal is divided up into a cyclically repeated number of groups with one information block or to form a plurality of information blocks, in that each information block has an information word and a check word comprising in each case a specific number of data bits, in that, in the case of groups with a plurality of information blocks, the check words of each group have different offset words superimposed on them, and in that the offset words are used at the reception end to synchronize the information blocks.
2. Digital, coded additional information signal within an AM radio signal, characterized in that the additional information (PI, PS, AF, AFT, TP, TA, TMC, RT) of the additional information signal is divided up into a cyclically repeated number of groups to form in each case two information blocks of identical length, in that each information block has an information word and a check word comprising in each case a specific number of data bits, in that the two check words of each group have different offset words superimposed on them, and in that the offset words are used at the reception end to synchronize the information blocks.
3. Additional information signal according to Claim 1 or 2, characterized in that the information words within each group contain, at the start of the word, a group type identification (GT) which identifies the respective group.
4. Additional information signal according to Claim 1, 2 or 3, characterized in that the station identification (PI) which identifies the station series of the respective AM radio signal is contained in each case in the first information block of each group.
5. Additional information signal according to one of Claims 1-4, characterized in that a station service (PS)

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identification which identifies the name of the station series of the respective AM radio signal is always contained in a first group of the cycle.

6. Additional information signal according to
5 Claim 5, characterized in that, in the same group of the cycle in which the PS identification is contained, further identifications are inserted for the identification of the transmitter of the respective AM radio signal as the transmitter for coded traffic messages
10 (TMC identification) and as the traffic radio transmitter (TP identification) and for the switching signal (TA identification) which accompanies an uncoded traffic message.

7. Additional information signal according to one
15 of Claims 1-6, characterized in that radio text information (RT identification) in the form of a sequence of addressed text segments is contained in a second group of the cycle, and in that a binary clear signal (TF) is inserted before each text segment, which clear signal
20 (TF) changes its binary state as soon as a previously transmitted and reproduced text is to be replaced by a new text.

8. Additional information signal according to one
of Claims 1-7, characterized in that information relating
25 to alternative frequencies (AF) of transmitters which broadcast the same station as the currently received AM radio signal transmitter is contained in a third group of the cycle, each item of AF information having an additional identification for the wave range (LW/SW,
30 MW/VHF) of the respective alternative frequency.

9. Additional information signal according to one of
Claims 1-8, characterized in that coded traffic messages (TMC) and information (AFT) relating to the frequencies
of alternative transmitters which broadcast the same
35 coded traffic messages are contained in a fourth group of the cycle, each item of AFT information having an additional identification for the wave range (LW, MW) of the respective frequency of the alternative transmitter.





10. Additional information signal according to one of Claims 1-9, characterized in that internal radio information (IH) is contained in a fifth group of the cycle.
11. Method for transmitting an additional information
5 signal according to one of Claims 1-10, characterized in that an AM radio signal carrier is modulated in its phase angle with the digital, coded additional information signal.
12. Method according to Claim 11, characterized in
10 that the AF information is transmitted as a continuous list, the number of items of AF information within the list being transmitted at the start of the list.
13. Method according to Claim 11, characterized in
15 that the AFT information is transmitted as a continuous list, the number of items of AFT information within the list being transmitted at the start of the list.
14. Method for receiving an additional information
20 signal according to one of Claims 1-10, the said additional information signal being transmitted in accordance with Claim 11, 12 or 13, characterized in that the received AM radio signal carrier is phase-modulated, the acquired additional information signal is decoded and the decoded additional information is used for tuning, switching and/or playback.
- 25 15. Method according to Claim 14, characterized in that the number of items of AF information which is transmitted at the start of the list of AF information is selected from the received list of AF information and is used to check for the complete reception of the list.
- 30 16. Method according to Claim 14, characterized in that the number of items of AFT information which is transmitted at the start of the list of AFT information is selected from the received list of AFT information and is used to check for the complete reception of the list.
- 35 17. Method according to one of Claims 14-16, characterized in that at least one brief range switch-over is performed if an item of AF information has an additional identification for the wave range (LW, SW, MW, VHF) of





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the respective alternative frequency.

18. Method according to one of Claims 14-17, characterized in that the respective VHF frequency is predominantly set if an AF identification has an additional
- 5 identification for the VHF wave range of the respective alternative frequency.

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1. Baseband coding

1.1 Structure of the baseband coding

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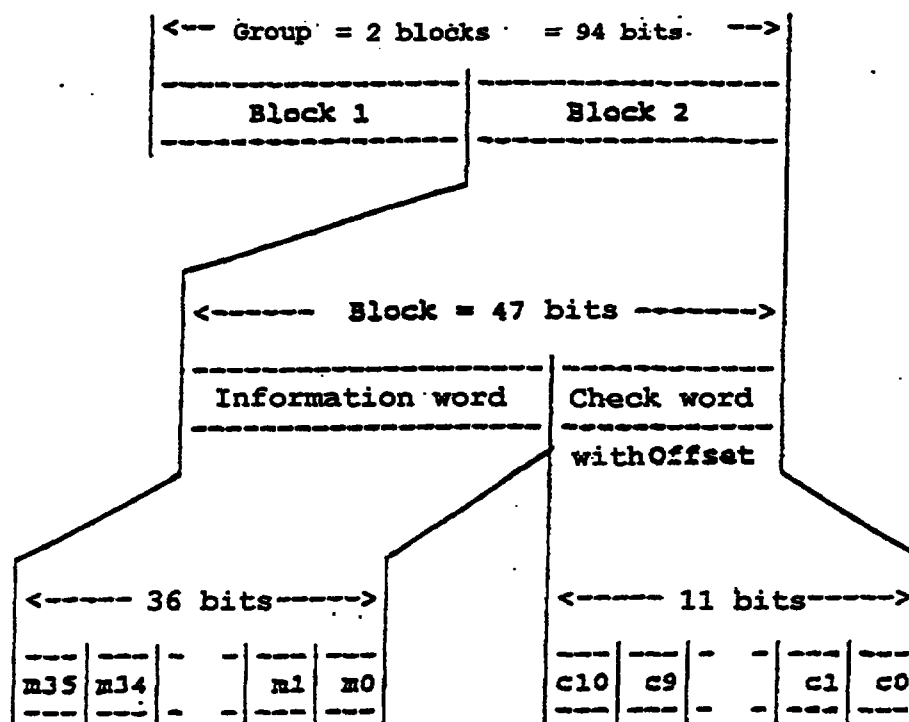


Figure 1 Structure of the baseband coding

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In the case of all information words, check words, binary numbers or addresses, the highest-order bit is transmitted first (Figure 2). The last bit of a binary number or address to be transmitted has the value 2^0 .

The data transmission is completely synchronous, i.e. there are no gaps between groups or blocks.

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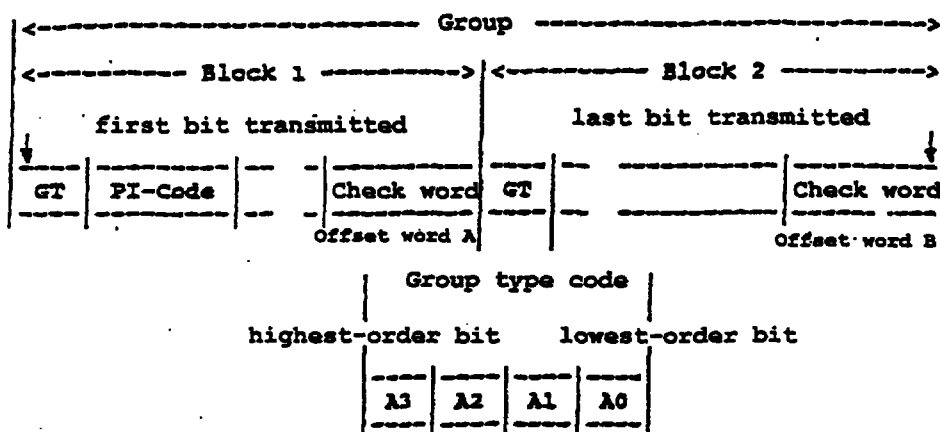


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Block 1 of each individual group is transmitted first.		

1.3 Error protection

Each block has a check word (11 bits) for detecting and correcting transmission errors in the receiver/decoder. This check word ($c_{10}, c_9, \dots, c_0$ in Figure 1) is the sum (modulo 2) of:

- the remainder after multiplication of the 36-bit information word $m(x)$ by X^{11} and subsequent division (modulo 2) by the generator polynomial $g(x)$ and
- an 11-bit binary sequence $d(x)$, referred to as offset word

$$\text{or check word } c(x) = d(x) + \frac{m(x) x^{11}}{g(x)} \mod g(x)$$

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the generator polynomial (degree 11) being described by the following equation:

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and different offset words being used for each block within a group.

The 11-bit binary sequence for the offset words A and B is defined as follows:

Offset	Offset word d(x)										
	d10	d9	d8	d7	d6	d5	d4	d3	d2	d1	d0
A	0	1	0	1	1	0	1	0	1	0	1
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The error protection code has the following properties:

- it detects all the individual errors and double errors in a block
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The code is also an optimum error-correcting code for error bursts up to a length of 5 bits. Depending on the number of errors of a block or on the block contents, either the error detection or the error correction, or else both, can be used at the reception end.

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The selected data format also has 10 free group types and is thus sufficiently adaptable to allow for future uses also.

In order to ensure effective utilization of the channel, the smallest possible number of different types of information is mixed in one group. As a result, the user is not forced to waste channel capacity as a result of transmitting unused information.

The first 4 bits in each block are assigned to the group type code (cf. 2.2) which specifies the use of the group. As a result, it is possible to decode each block of a group in the receiver/decoder without reference to another block. Thus, in the event of transmission faults, the access time to information which is divided up between a plurality of blocks is reduced.

In each case the first block of a group contains the station series identification PI.

PI code

The PI code (station series identification) comprises a code (16 bits) which permits the receiver to distinguish between nationality, station area/language area and station code. The PI code is not provided for direct display, it is individually assigned to each radio station and serves to detect transmitters which broadcast the same station. As a result, the receiver/decoder is enabled to search for an alternative frequency automatically in the event that the transmitter which has been set during mobile reception becomes too bad.

The coding below makes it possible to distinguish between 256 countries, 16 station areas and 16 stations.

Bit 1 - 8 Nationality identification

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Bit 9 - 12 Station area identification/language areas

Bit 13 - 16 Station code

The abbreviation for the respective country can be derived from the nationality identification of the PI code and can be presented on the display of the receiver.

2.2 Group types

The group type code - the first 4 bits of a block (Figure 2) - determines the use of the group. The previously defined group types can be found in the table below.

Group type code					Use
Decimal value	Binary code				
	A3	A2	A1	A0	
0	0	0	0	0	PS Name of the station series
1	0	0	0	1	RT Radio text
2	0	0	1	0	AF Alternative frequencies
3	0	0	1	1	TMC Traffic message channel
4	0	1	0	0	IH Internal radio use
.	.	.	.	.	Not defined
15	1	1	1	1	

Table 1 Group types



2.2.1 Group type 0

Name of the station series PS

Switching information TMC, TP, TA

Figure 3 shows the data format of group type 0.

Block 1

4	16	1	1	7	7
GT	PI-Code	T	T	PS	PS
		M	P	Drawing 1	Drawing 2
		C			

Block 2

4	1	3	7	7	7	7
GT	T	X	PS	PS	PS	PS
	A		Drawing 3	Drawing 4	Drawing 5	Drawing 6

Figure 3 - Data format of group type 0

PS

The name of the station series is transmitted as a 7-bit character (Table 2, columns 2-7) in accordance with the ISO 646 code tables for display in the receiver. 6 characters, including idle signals, are provided for the name. The position of the individual characters in the name corresponds to the appendant number. The transmission of the name begins with the character 1. The highest-order bit of each character is transmitted first. Receivers with a display of more than 6 characters could additionally display the respective nationality abbreviations (cf. 2.1 PI code).

TMC

TMC (traffic message channel) is a switching signal which identifies transmitters which transmit intermittently coded traffic messages. The identification can be evaluated for an automatic search run for TMC

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transmitters.

TP

TP (traffic radio identification) is a switching signal which identifies transmitters which transmit intermittently announced traffic messages. A lamp or a corresponding device can be used to indicate on the receiver that the station being received is transmitting traffic messages at specific times. The identification can be evaluated for an automatic search run for traffic radio transmitters.

TA

TA (traffic announcement identification) is a switching signal for identifying whether a traffic announcement has been transmitted. The signal can be used in the receiver in the following way:

- automatically switching on the traffic announcement if the receiver is in the stand-by mode and is switched to the mute setting;
- automatically switching over from cassette playback to the traffic announcement;

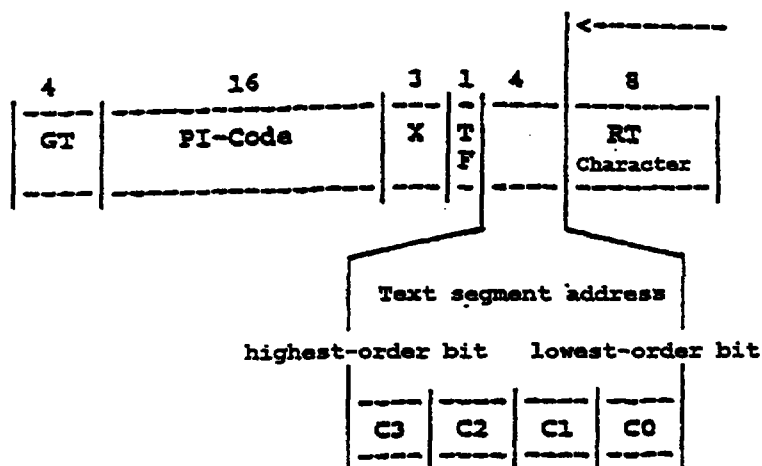


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2.2.2 Group type 1 Radio text RT

Figure 4 shows the data format of group type 1.

Block 1



Block 2

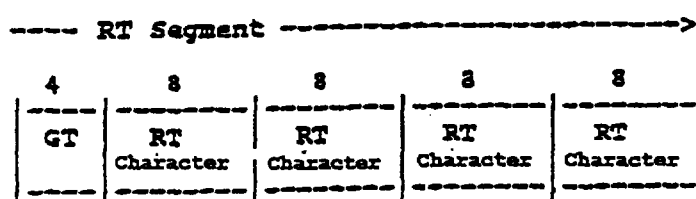


Figure 4 - Data format of group type 1

The radio text is transmitted with 8-bit characters in accordance with the ISO 646 code tables (cf. Table 2). The transmission starts with the highest-order bit of a character.

The text segment address in block 1 serves to arrange the text segment, comprising the characters from blocks 1 and 2, in a display or in a memory. By means of the area of the segment address (0-15) and the characters (5) contained in a group, radio texts up to a length of 80 characters can be transmitted.

If a display with less than 80 characters is used for RT, a memory should be provided in the receiver/decoder, so that parts of the message can be displayed

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successively.

A change of the text flag (TF) in block 1 identifies the transmission of a new radio text. In the receiver/decoder, the text flag is used to clear the display or the memory.

RT is principally intended for home receivers with a suitable display and for car receivers, for example for controlling a voice generator.

2.2.3 Group type 2 Alternative frequencies AF

Figure 5 shows the data form of group type 2.

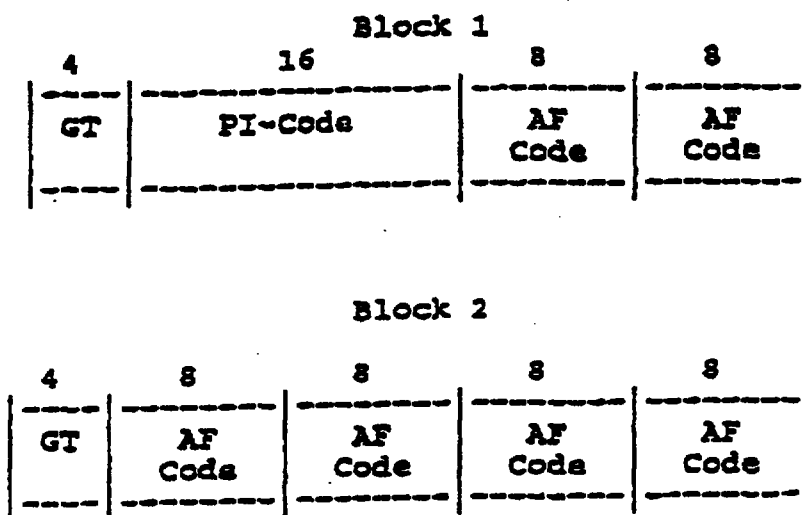


Figure 5 - data format of group type 2

2.2.4 Codes for alternative frequencies

Long wave and medium wave

Long wave and medium wave frequencies are represented with 9 kHz spacing by means of an 8-bit code.

Number	Binary code	Carrier frequency
1	0000 0001	153 kHz
15	0000 1111	279 kHz
16	0001 0000	531 kHz
135	1000 0111	1602 kHz



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shortwave

The short-wave frequencies are represented with 5 kHz spacing by means of two 8-bit codes. They are characterized by the fact that the first 8-bit code lies in the range of 140-157. In this case, the first code is to be evaluated in pairs with the following code. Pairs which go beyond a block are unacceptable.

Number	Binary code	Number	Binary code	Carrier frequency
140	1000 1100	0	0000 0000	3980 MHz
157	1001 1101	190	1011 1110	26100 MHz

VHF

The VHF channels are represented with 100 kHz spacing by means of two 8-bit codes. They are characterized by the fact that the first 8-bit code = 160. In this case, the code identifies, with the following code, a VHF channel. Pairings which go beyond a block are unacceptable.

Number	Binary code	Number	Binary code	Carrier frequency
160	1010 0000	0	0000 0000	87.5 MHz
160	1010 0000	204	1100 1101	107.9 MHz

Number and filler code

The number code indicates how many frequencies, filler codes excepted, are contained in an AF list. An AF list can contain up to 31 frequencies. The number code is transmitted at the start of an AF list.

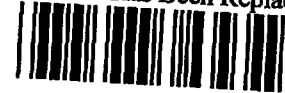
The filler code is used to occupy unused AF codes within the group.

Number	Binary code	Use
136	1000 1000	Filler code
224	1110 0000	No AF
241	1110 0001	AF list with 1 frequency
255	1111 1111	AF list with 31 frequencies

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The list of alternative frequencies indicates which transmitters in the same reception areas, or [lacuna] adjacent reception areas, broadcast the same station. Receivers/decoders with a memory for AF lists can thus shorten the switch-over time to another transmitter.

2.2.4 Group type 3

Traffic message channel TMC

Alternative frequencies for TMC AFT

Figure 6 shows the data format of group type 3.

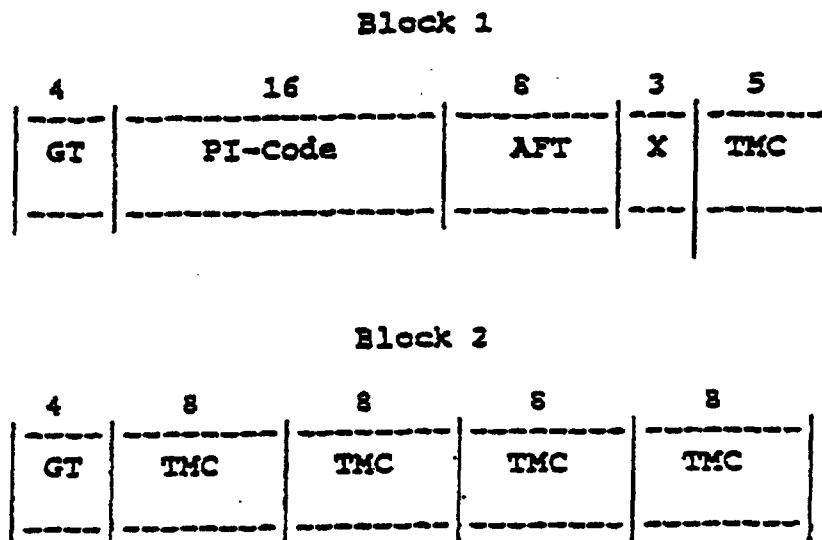


Figure 6 - Data format of group type 3

The data format complies with the proposals from Blaupunkt and the EBU regarding the information length (37 bits).

The alternative frequencies for TMC (AFT) refer only to transmitters with identical, coded traffic messages. These transmitters do not broadcast the same sound program. The AFT is based on the same coding as the alternative frequencies (AF). The use of AFT is limited to LW and MW frequencies.

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2.2.5 Group type 4 Internal radio information IH

Figure 7 shows the data format of group type 4.

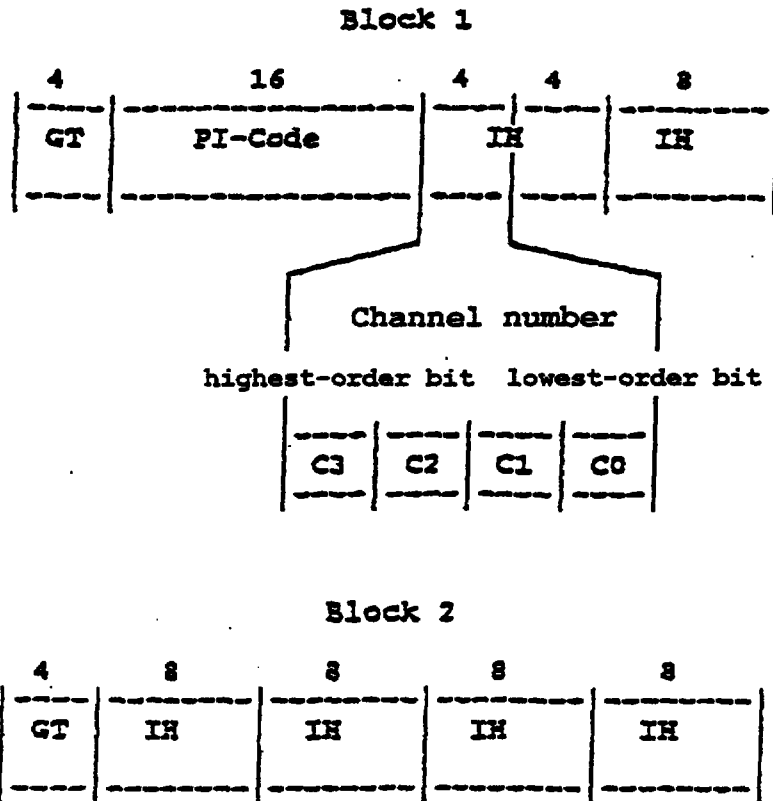


Figure 7 - Data format of group type 4

48 bits are available for IH, 16 bits in block 1 and 32 bits in block 2. The contents of the bits specified with IH may be determined by the radio organization itself. In this context, a data format similar to that of RDS seems expedient. The first 4 IH bits of block 1 are used as channel numbers 0 to 15. The remaining 44 bits are regarded as 11 HEX characters and are available for a bit-transparent data transmission.

Examples of the use of IH:

Station source identification

Remote control of transmitter networks

Paging for company personnel

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Table 2: Code table for 218 representable characters which make up the complete set of UER Latin characters

[illegible]



Patent Claims

1. Digital, coded additional information signal within an AM radio signal, characterized in that the additional information (PI, PS, AF, AFT, TP, TA, TMC, RT) of the additional information signal is divided up into a cyclically repeated number of groups with one information block or to form a plurality of information blocks, in that each information block has an information word and a check word comprising in each case a specific number of data bits, in that, in the case of groups with a plurality of information blocks, the check words of each group have different offset words superimposed on them, and in that the offset words are used at the reception end to synchronize the information blocks.
2. Digital, coded additional information signal within an AM radio signal, characterized in that the additional information (PI, PS, AF, AFT, TP, TA, TMC, RT) of the additional information signal is divided up into a cyclically repeated number of groups to form in each case two information blocks of identical length, in that each information block has an information word and a check word comprising in each case a specific number of data bits, in that the two check words of each group have different offset words superimposed on them, and in that the offset words are used at the reception end to synchronize the information blocks.
3. Additional information signal according to Claim 1 or 2, characterized in that the information words within each group contain, at the start of the word, a group type identification (GT) which identifies the respective group.
4. Additional information signal according to Claim 1, 2 or 3, characterized in that the station identification (PI) which identifies the station series of the respective AM radio signal is contained in each case in the first information block of each group.
5. Additional information signal according to one of Claims 1-4, characterized in that a station service (PS) identification which identifies the name of the station

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series of the respective AM radio signal is always contained in a first group of the cycle.

6. Additional information signal according to Claim 5, characterized in that, in the same group of the cycle in which the PS identification is contained, further identifications are inserted for the identification of the transmitter of the respective AM radio signal as the transmitter for coded traffic messages (TMC identification) and as the traffic radio transmitter (TP identification) and for the switching signal (TA identification) which accompanies an uncoded traffic message.

7. Additional information signal according to one of Claims 1-6, characterized in that radio text information (RT identification) in the form of a sequence of addressed text segments is contained in a second group of the cycle, and in that a binary clear signal (TF) is inserted before each text segment, which clear signal (TF) changes its binary state as soon as a previously transmitted and reproduced text is to be replaced by a new text.

8. Additional information signal according to one of Claims 1-7, characterized in that information relating to alternative frequencies (AF) of transmitters which broadcast the same station as the currently received AM radio signal transmitter is contained in a third group of the cycle, each item of AF information having an additional identification for the wave range (LW/SW, MW/VHF) of the respective alternative frequency.

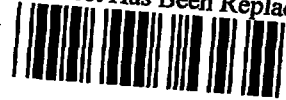
9. Additional information signal according to one of Claims 1-8, characterized in that coded traffic messages (TMC) and information (AFT) relating to the frequencies of alternative transmitters which broadcast the same coded traffic messages are contained in a fourth group of the cycle, each item of AFT information having an additional identification for the wave range (LW, MW) of the respective frequency of the alternative transmitter.

10. Additional information signal according to one of Claims 1-9, characterized in that internal radio informa-

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tion (IH) is contained in a fifth group of the cycle.

11. Method for transmitting an additional information signal according to one of Claims 1-10, characterized in that an AM radio signal carrier is modulated in its phase angle with the digital, coded additional information signal.

12. Method according to Claim 11, characterized in that the AF information is transmitted as a continuous list, the number of items of AF information within the list being transmitted at the start of the list.

13. Method according to Claim 11, characterized in that the AFT information is transmitted as a continuous list, the number of items of AFT information within the list being transmitted at the start of the list.

14. Method for receiving an additional information signal according to one of Claims 1-10, the said additional information signal being transmitted in accordance with Claim 11, 12 or 13, characterized in that the received AM radio signal carrier is phase-modulated, the acquired additional information signal is decoded and the decoded additional information is used for tuning, switching and/or playback.

15. Method according to Claim 14, characterized in that the number of items of AF information which is transmitted at the start of the list of AF information is selected from the received list of AF information and is used to check for the complete reception of the list.

16. Method according to Claim 14, characterized in that the number of items of AFT information which is transmitted at the start of the list of AFT information is selected from the received list of AFT information and is used to check for the complete reception of the list.

17. Method according to one of Claims 14-16, characterized in that at least one brief range switch-over is performed if an item of AF information has an additional identification for the wave range (LW, SW, MW, VHF) of the respective alternative frequency.

18. Method according to one of Claims 14-17, characterized in that the respective VHF frequency is predomi-

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nantly set if an AF identification has an additional identification for the VHF wave range of the respective alternative frequency.



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METHOD FOR TRANSMITTING ADDITIONAL INFORMATION IN
AN AM RADIO SIGNAL

ABSTRACT

For transmitting additional information in an AM radio signal, initially, at the transmitting end an AM radio signal carrier is modulated in its phase position by means of a digital, coded additional information signal. At the reception end the AM radio signal carrier is phase-modulated, the additional information signal acquired is decoded and the decoded additional information is used for tuning, switching or playback. The additional information (PI, PS, AF, AFT, TP, TA, TMC, RT) of the additional information signal is divided up into a cyclically repeated number of groups to form in each case two information blocks of identical length. Each information block has an information word and a check word comprising in each case a specific number of data bits, the two check words of each group having different offset words superimposed on them. These offset words are used at the reception end to synchronize the information blocks.

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- ☒ Description : paged to paged
- ☒ Claim(s) : paged to paged
- ☐ Drawing(s) : paged to paged
- ☐ Abstract : paged to paged

PROCESS FOR TRANSMITTING ADDITIONAL INFORMATION WITH AN AM RADIO SIGNAL RECEIPT

The invention relates to a method of transmitting auxiliary information in an AM broadcast signal wherein the AM broadcast signal is demodulated at the receiving end, the auxiliary information signal obtained thereby is decoded and the decoded auxiliary information is used for the purposes of tuning, switching, storing and/or reproduction, and it also relates to a signal for transmitting this auxiliary information and to a receiver for receiving this signal.

From "Funkschau" 1986, Vol 1, pages 43 - 47, it is known to transmit digitally coded auxiliary information signals in an AM broadcast signal by phase modulating and demodulating the AM signal carrier and it is also known to distribute auxiliary items of information for the radio data system over a cyclically repeated number of groups in an FM broadcast signal, wherein one or more blocks of information are provided in each group and each block of information consists of an information word and a check word. Furthermore, it is known from the research report BBC RD 1982/2 from the British Broadcasting Corporation "L.F. Radio-Data: Specification of the BBC experimental transmissions 1982" dated August 1982; to transmit digitally coded auxiliary information in an AM (amplitude modulated) broadcast signal by phase modulating and demodulating the AM broadcast signal carrier. A value of $\pm 22.5^\circ$ was selected by the British Broadcasting Corporation as the maximum permissible phase change allowed so as not to interfere with the program signal on the phase modulated AM carrier, this value corresponding to a transmission capacity for the auxiliary items of information of 25 bits/second. This extremely small channel capacity requires a degree of error protection that is matched as optimally as possible, in the sense of low redundancy, to the properties of the AM broadcast transmission channel. To this end, the data stream is subdivided into blocks each having a length of 50 bits, wherein each block consists of a synchronising bit, an information word of 36 bits and a check word of 13 bits. For coding the blocks, an

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optimal error correcting code is used with which an error burst having a length of up to 6 bits can be corrected. The code selected is cyclic and is curtailed to the block length of 50 bits. In order to be able to positively identify the beginning of a block, the synchronising bit is placed in front of the block at the transmitting end, thereby destroying the cyclic character of the block code. In order to identify the content of the 32 bit long information word, a 4 bit wide block application code is transmitted directly behind the synchronising bit at the beginning of the information word. A special form of information coding in combination with the block application code 0000 is provided within the information word solely for providing information regarding the time and date.

As opposed to this, the object of the invention consists in decreasing the redundancy in an auxiliary information signal of the type mentioned hereinabove and in simplifying the assignment and hence the identification of different sorts of information.

This object is achieved in accordance with the invention by the characterising features of claim 1.

1. Base band coding

1.1 The structure of the base band code

Figure 1 shows the structure of the base band code. The largest element within the structure is called a group. A group consists of 2 blocks each having 47 bits. Each block contains an information word (36 bits) and a check word (11 bits). An offset word (11 bits) is superimposed on each check word (modulo 2 addition) in order to distinguish the blocks in a group and to provide for more definite synchronisation of the blocks.

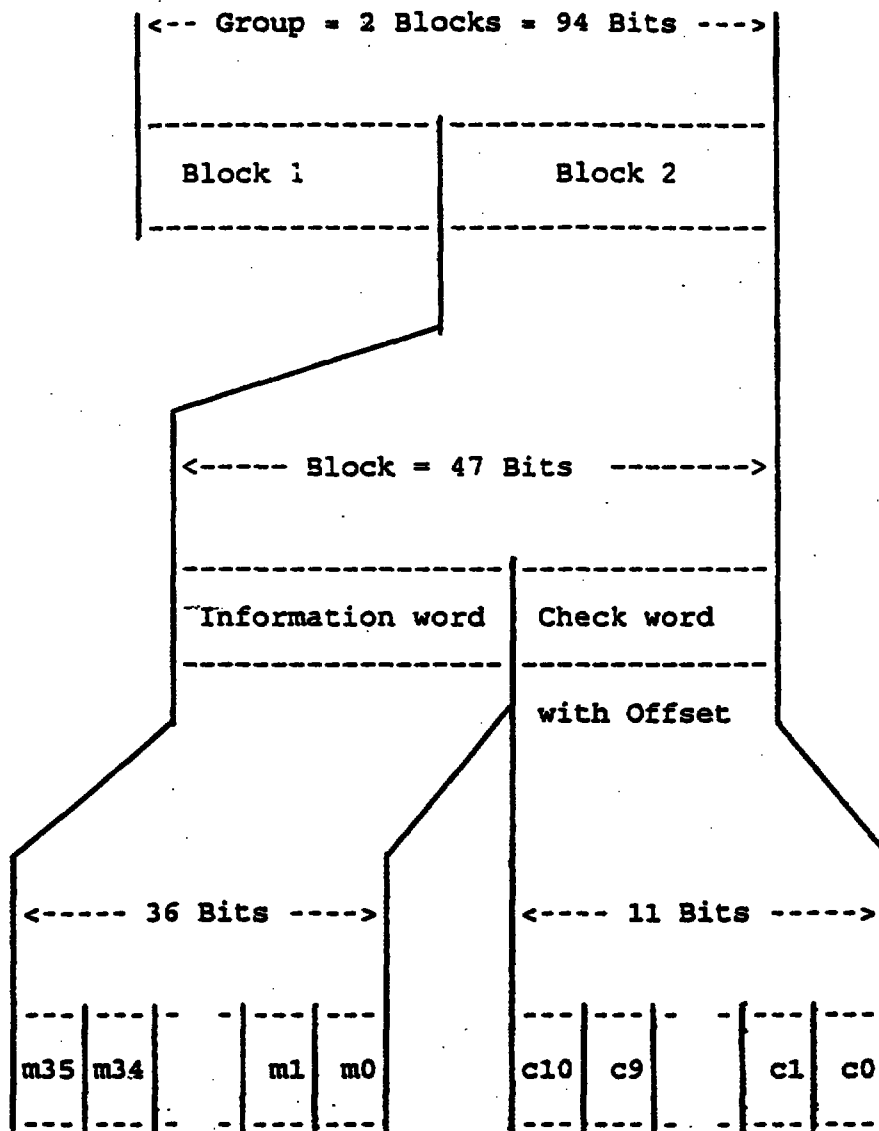


Figure 1: The structure of the base band code

1.2 Data transmission features

In each case, the most significant bit for the information words, check words, binary numbers or addresses is transmitted first (Figure 2). The last bit transmitted in the case of a binary number or an address has the index 2^0 .

The data transmission is fully synchronous i.e. there are no gaps between the groups or blocks.

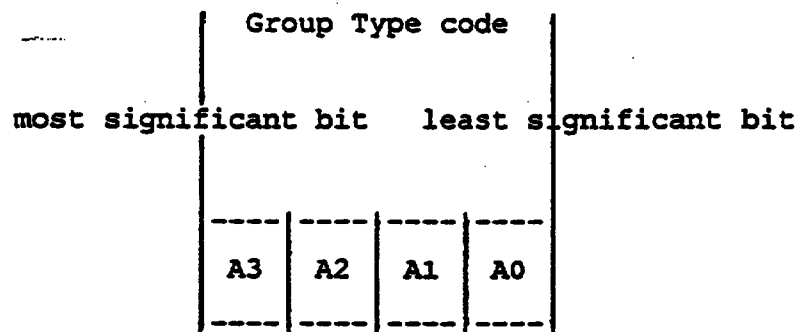
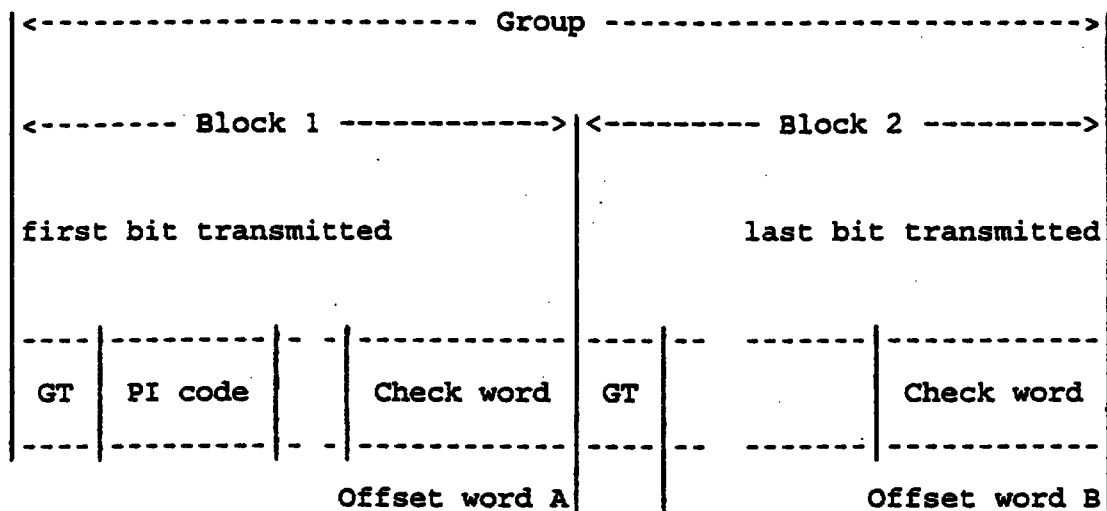


Figure 2 Data format and addressing

Explanations

GT Group Type code (4 bits) see 2.2

PI code Program identification code (16 bits) see 2.1

Check word for error protection, block

 and group synchronisation (11 bits) see 1.3

X unused capacity see 2.2.1 - 2.2.5

Block 1 of every single group is transmitted first.

1.3 Error protection

For the purposes of detecting and correcting transmission errors in the receiver/decoder, each block has a check word (11 bits). This check word (c_{10} , c_9 , ..., c_0 in Figure 1) is the sum (modulo 2) of:

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- a) The remainder following multiplication of the 36 bit information word $m(x)$ by x^{11} and subsequent division (modulo 2) by the generator polynomial $g(x)$ and
- b) an 11 bit binary sequence $d(x)$, called an offset word

$$\text{i.e. check word } c(x) = d(x) + \frac{m(x) x^{11}}{g(x)} \mod g(x)$$

wherein the generator polynomial (11th degree) is defined by the following equation:

$$g(x) = x^{11} + x^8 + x^6 + 1$$

and different offset words are used for each block within a group.

The 11 bit binary sequence for the offset words A and B is defined as follows:

Offset	Offset word $d(x)$										
	d10	d9	d8	d7	d6	d5	d4	d3	d2	d1	d0
A	0	1	0	1	1	0	1	0	1	0	1
B	1	0	1	1	0	1	0	1	0	1	1

The error protection code has the following properties:

- it detects all single and double errors in a block
- it detects every single error burst up to 11 bits
- it detects approximately 99.90 % of the error bursts having 11 bits and about 99.95 % of every longer burst.

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The code is also an optimum error correcting code for error bursts having a length of up to 5 bits. In dependence on the number of errors in a block or depending on the content of the block, either error detection or error correction or both can be used at the receiving end.

1.4 Block and group synchronisation

Both the beginning and end of a block as well as the beginning and end of a group can be identified in the receiver by using the two offset words A and B. The offset words destroy the cyclic nature of the original code so that cyclic displacements of code words in the modified code do not allow any other code words to be produced and hence render this type of block synchronisation very reliable.

2. Data format

2.1 Definitions applicable to the data transmission process

There are no fixed repetition patterns for the different types of group (see 2.2) i.e. there is sufficient flexibility for linking the different sorts of information in such a way as to meet the users needs.

The data format selected still leaves 10 sorts of group free and hence there is sufficient adaptability to cater for any future applications.

In order to ensure effective utilisation of the channel, as few different sorts of information as possible are mixed in any one group. The user is thereby not forced to waste channel capacity by the transmission of unused items of information.

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The first 4 bits in each block are allocated to the group type code (see 2.2) which specifies the way in which the group is being used. It is thereby possible to decode each block of a group in the receiver/decoder without reference to any other block. The access time to items of information that are distributed over a plurality of groups is thus reduced when the transmission is subject to interference.

The first block of a group incorporates the program identification code PI in every case.

PI code

The PI code (program identification code) consists of a code (16 bits) which allows the receiver to distinguish between nationality, program region / language region and program code. The PI code is not intended to be displayed directly but is individually associated with each broadcast program and serves for identifying transmitters which radiate the same program. The receiver/decoder is thereby placed in a position such that it can automatically search for alternative frequencies in the event that reception of the currently tuned transmitter becomes too poor in the case of mobile reception.

The following coding scheme allows 256 countries, 16 program regions and 16 programs to be distinguished.

Bits 1 - 8	Nationality identifier
Bits 9 - 12	Program region identifier / language region
Bits 13 - 16	Program code

The abbreviation for the relevant country can be derived from the nationality identifier in the PI code and can be displayed on the display in the receiver.

2.2 Types of Group

The Group Type code - the first 4 bits of a block (Figure 2) - specifies the use to which the group is put. The types of group defined up to now can be gathered from the following table.

Group Type code					Application
Decimal value	Binary code				
	A3	A2	A1	A0	
0	0	0	0	0	PS Name of the program service
1	0	0	0	1	RT Radio Text
2	0	0	1	0	AF Alternative Frequencies
3	0	0	1	1	TMC Traffic Message Channel
4	0	1	1	1	IH Broadcaster's internal. Appln
.	.	.	.	.	not defined
15	1	1	1	1	

Table 1 Types of Group

2.2.1 Group Type 0

Name of the program service PS

Switching information TMC, TP, TA

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Figure 3 shows the data format for the Group Type 0.

Block 1

4	16	1	1	7	7
GT	PI code	T	T	PS	PS
		M	P	Char. 1	Char. 2
		C			

Block 2

4	1	3	7	7	7	7
GT	T	X	PS	PS	PS	PS
	A		Char. 3	Char. 4	Char. 5	Char. 6

Figure 3 - Data format for the Group Type 0

PS

The name of the program service is transmitted in the form of 7 bit characters in accordance with the Code Table ISO 646 for display in the receiver (Table 2, columns 2 - 7). 6 characters including spacing characters are envisaged for the name. The position of the individual characters in the name corresponds to the accompanying number. The transmission of the name begins with Character 1. The most significant bit in each character is transmitted first. Receivers incorporating a display having more than 6 characters could also display the relevant nationality abbreviation as well (see 2.1 PI code).

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TMC

TMC (Traffic Message Channel) is a switching signal which identifies transmitters that transmit coded traffic messages from time to time. The identifier may be used for initiating an automatic search for TMC transmitters.

TP

TP (Traffic Program identifier) is a switching signal which identifies transmitters that transmit verbal traffic news from time to time. An indication may be provided in the receiver by means of a lamp or some such device that the program being received transmits traffic news at certain times. The identifier may be used for initiating an automatic search for transmitters that transmit traffic broadcasts.

TA

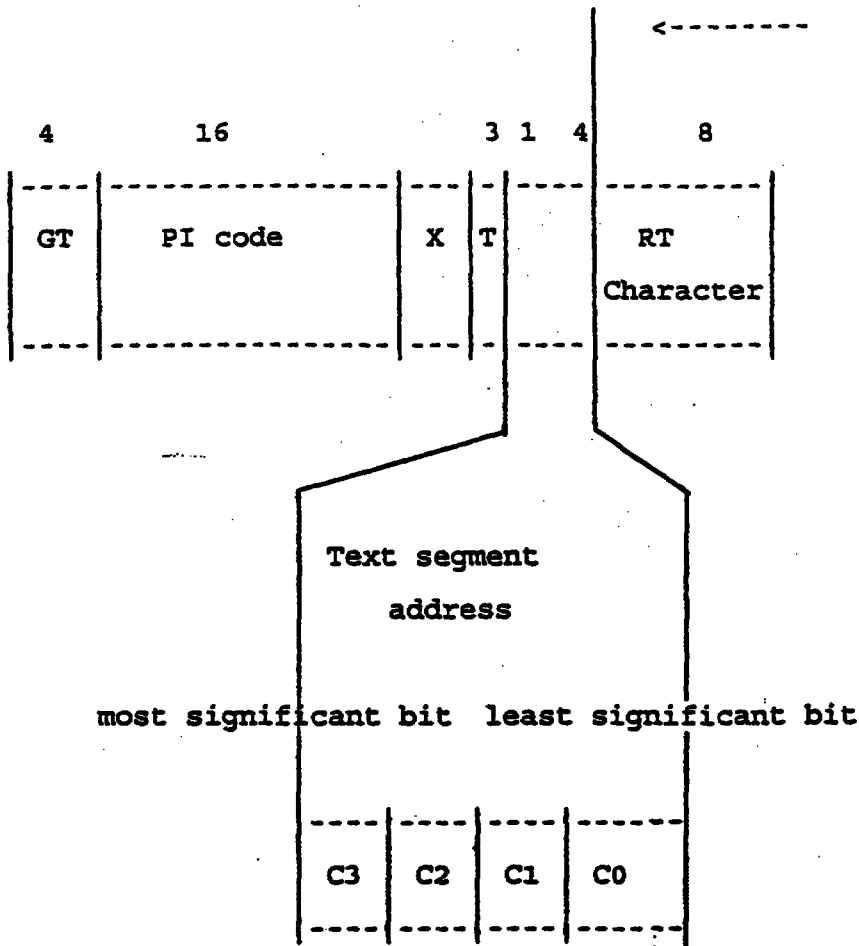
TA (Traffic Announcement identifier) is a switching signal for identifying the fact that a traffic announcement is being transmitted. The signal may be used in the receiver in the following manner:

- automatically cutting the traffic announcement through if the receiver is switched on but not turned up;
- automatically switching over from cassette operation to the traffic announcement;

2.2.2 Group Type 1 Radio Text RT

Figure 4 shows the data format for the Group Type 1.

Block 1



Block 2

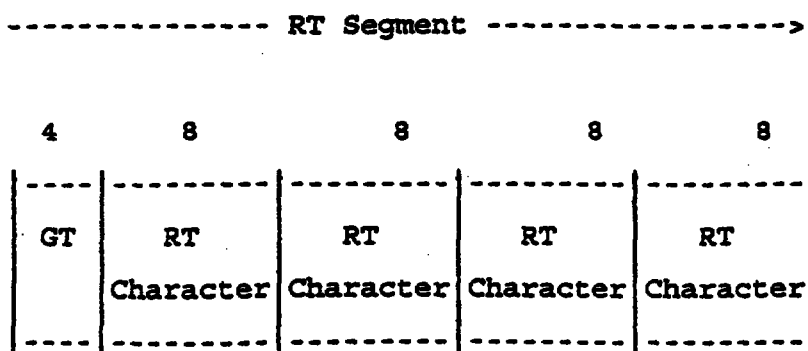


Figure 4 - Data format for the Group Type 1

The radio text is transmitted in accordance with the Code Table ISO 646 (see Table 2) using 8 bit characters. The transmission begins with the most significant bit of a character.

The text segment address in block 1 serves for ordering the contents of the segment of text, consisting of the characters from blocks 1 and 2, on a display or in a memory. Items of radio text having a length of up to 80 characters can be transmitted by the range of segment addresses (0 - 15) and the characters (5) contained in a group.

If a display having less than 80 characters is used for RT then a memory should be provided in the receiver/decoder so that the parts of the message can be successively displayed.

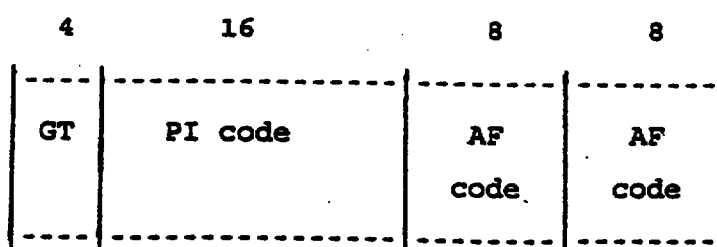
A change in the text flag (TF) in block 1 identifies the transmission of new radio text. The text flag is utilised in the receiver/decoder for clearing the display or the memory.

RT is mainly intended for household receivers having a suitable display and for use in automobile receivers for controlling a speech generator for example.

2.2.3 Group Type 2 Alternative Frequencies AF

Figure 5 shows the data format for Group Type 2.

Block 1



Block 2

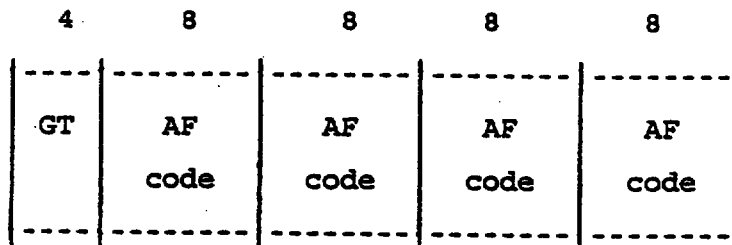


Figure 5 - Data format for Group Type 2

2.2.4 Codes for the Alternative Frequencies

Long and medium waves

Long and medium wave frequencies are represented by an 8 bit code in a 9 kHz raster.

Number	Binary code	Carrier frequency
	1 0000 0001	153 kHz
	15 0000 1111	279 kHz
	16 0001 0000	531 kHz
	135 1000 0111	1602 kHz

Short wave

The short wave frequencies are represented by two 8 bit codes in a 5 kHz raster. They are characterised in that the first 8 bit code falls within the range 140 - 157. The first code has to be evaluated

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with the following code as a pair in this case. Pairings extending beyond the block are not permissible.

Number	Binary code	Number	Binary code	Carrier freq.
140	1000 1100	0 0000 0000		3980 kHz
157	1001 1101	190 1011 1110		26100 kHz

Ultra short wave

The VHF channels are represented by two 8 bit codes in a 100 kHz raster. They are characterised in that the first 8 bit code = 160. This code together with the following code identify a VHF channel in this case. Pairings extending beyond the block are not permissible.

Number	Binary code	Number	Binary code	Carrier freq.
160	1010 0000	0 0000 0000		87.5 MHz
160	1010 0000	204 1100 1101		107.9 MHz

The Number and Fill Codes

The number code indicates how many frequencies apart from fill codes are contained in an AF list. An AF list may contain up to 31 frequencies. The number code is transmitted at the beginning of an AF list.

The fill code is used for occupying unused AF codes within the group.

Number	Binary code	Application
136 1000 1000		fill code
224 1110 0000		no AF
241 1110 0001		AF list having 1 frequency
255 1111 1111		AF list having 31 frequencies

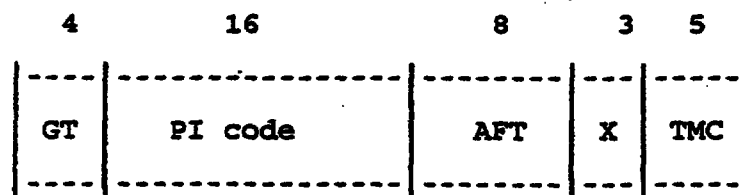
The list of alternative frequencies provides an indication as to which transmitters in the same or an adjoining reception area radiate the same program. Thus receivers/decoders incorporating a store for the AF lists are able to shorten the time required for switching to another transmitter.

2.2.4 Group Type 3

Traffic Message Channel TMC
Alternative frequencies for TMC AFT

Figure 6 shows the data format for Group Type 3.

Block 1



Block 2

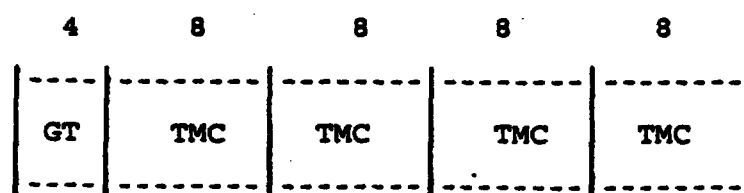


Figure 6 - Data format for Group Type 3

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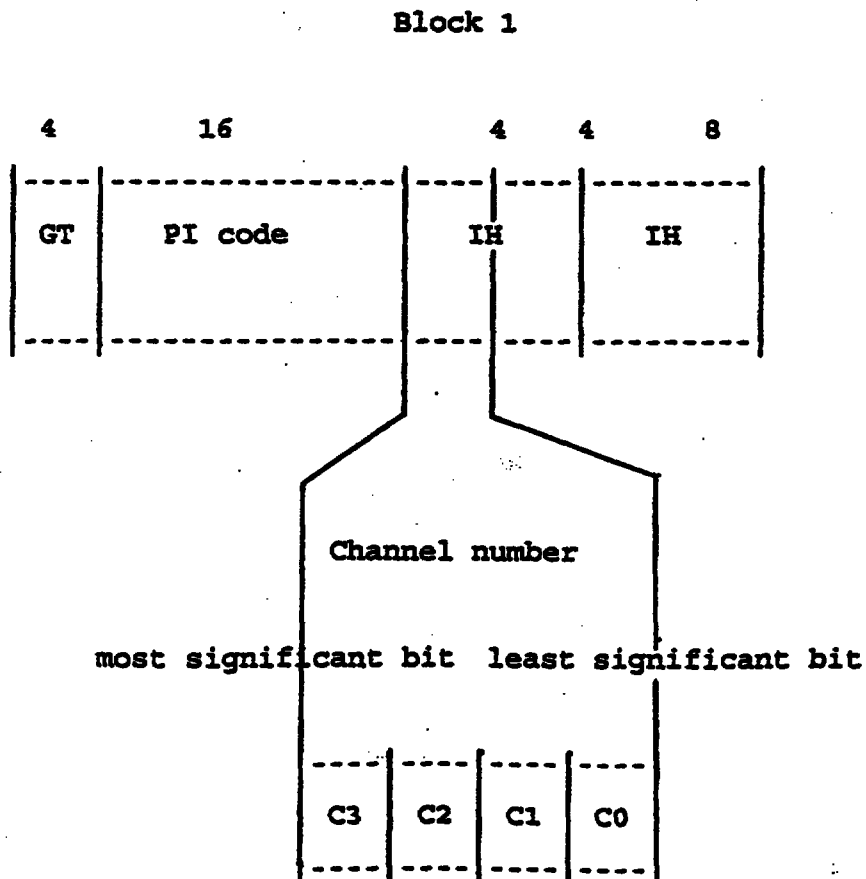
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As regards the length (37 bits) of the information, this data format takes into account the suggestion made by the Blaupunkt company and that of the EBU.

The alternative frequencies for TMC (AFT) are only indicative of the transmitters providing the same coded traffic news. These transmitters do not radiate the same sound programs. The coding forming the basis for AFT is the same as that for the alternative frequencies (AF). The use of AFT is limited to long wave and medium wave frequencies.

2.2.5 Group Type 4 Broadcaster's internal information IH

Figure 7 shows the data format for the Group Type 4.



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Block 2

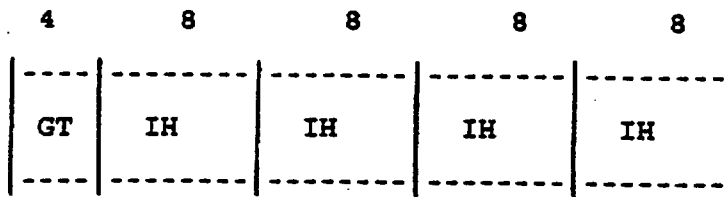


Figure 7 - Data format for the Group Type 4

There are 48 bits available for IH, 16 bits in block 1 and 32 bits in block 2. The contents of the bits designated by IH may be determined by the broadcasting institute itself. Here, a data format similar to that used for RDS seems appropriate. The first 4 IH bits of block 1 are used as channel numbers 0 to 15. The remaining 44 bits are viewed as 11 HEX characters and are available for a bit-transparent data transmission.

Examples of the use of IH

Program source identification

Remote control of transmitter networks

Personal callers for staff members

Claims

1. Method of transmitting auxiliary information in an AM broadcast signal wherein the AM broadcast signal is demodulated at the receiving end, the auxiliary information signal obtained thereby is decoded and the decoded auxiliary information is used for the purposes of tuning, switching, storing and/or reproduction, characterised in that, the auxiliary items of information (PI, PS, AF, AFT, TP, TA, TMC, RT) in the auxiliary information signal are distributed over a cyclically repeated number of groups each incorporating two equally long blocks of information, that each block of information comprises an information word and a check word consisting respectively of a specific number of data bits, that the two check words in each group are mixed with different offset words, and that the offset words are used at the receiving end for synchronising the blocks of information.
2. Method in accordance with Claim 1, characterised in that, the two information words within each group contain a group type identifier (GT) at the beginning of the word, which said identifier identifies the momentary group.
3. Method in accordance with Claim 1 or 2, characterised in that, a program identification (PI) identifier, which identifies the network of stations each transmitting the AM broadcast signal concerned, is contained in the first block of information in each group.
4. Method in accordance with any of the Claims 1 to 3, characterised in that, a program service (PS) identifier, which identifies the name of the network of stations each transmitting the AM broadcast signal concerned, is transmitted in a first group.
5. Method in accordance with Claim 4, characterised in that, further identifiers for identifying the transmitter of the AM broadcast signal concerned as a transmitter of coded traffic messages (TMC



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identifier) and as a traffic program transmitter (TP identifier) and an identifier for the switching signal (TA identifier) accompanying an uncoded traffic message are transmitted in the same group as that in which the PS identifier is transmitted.

6. Method in accordance with any of the Claims 1 - 5, characterised in that, items of radio text information (RT identifier) are transmitted in a second group in the form of a sequence of addressed segments of text, and that a binary erase signal (TF) is transmitted before each segment of text, said signal altering its binary state as soon as a previously transmitted and reproduced item of text should be replaced by a new item of text.

7. Method in accordance with any of the Claims 1 - 6, characterised in that, items of information regarding alternative frequencies (AF) for the transmitters that radiate the same program as that of the AM broadcast transmitter that is currently being received are contained in a third group, wherein each item of AF information comprises an additional identifier for the wave band SW, MW, VHF of the alternative frequencies concerned, and that the items of AF information are transmitted as correlated lists.

8. Method in accordance with any of the Claims 1 - 7, characterised in that, coded traffic messages (TMC) and items of information (AFT) regarding the frequencies of alternative transmitters that radiate the same coded traffic message are transmitted in a fourth group, and that the items of AFT information are transmitted as correlated lists.

9. Method in accordance with any of the Claims 1 - 8, characterised in that, items of information (IH) that are internal to the broadcast service are transmitted in a fifth group.



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10. Method in accordance with any of the Claims 8 - 9, characterised in that, the VHF frequency concerned is tuned in as a matter of priority if an AF identifier comprises an additional identifier for the VHF band for the alternative frequencies concerned.

11. Signal for conveying auxiliary items of information in an AM broadcast signal which is used for the purposes of tuning, switching, storing and/or reproduction at the receiving end, characterised in that, the auxiliary items of information (PI, PS, AF, AFT, TP, TA, TMC, RT) are distributed over a cyclically repeated number of groups each incorporating two equally long blocks of information, wherein each block contains an information word and a check word and the two check words in each group are mixed with different offset words, whereby the offset words are used at the receiving end for synchronising purposes.

12. Signal in accordance with Claim 11, characterised in that, a group contains 94 bits, whereby each of the blocks contains 47 bits, each information word contains 36 bits and each check word contains 11 bits.

13. Signal in accordance with Claim 11 or 12, characterised in that, the first offset word has the value 01 01 10 10 101 and the second offset word has the value 10 11 01 01 011.

14. Receiver for receiving a signal including auxiliary items of information that is transmitted in an AM broadcast signal in accordance with any of the Claims 11 to 13, including means for decoding the auxiliary items of information, means for detecting and correcting transmission errors utilising the check words and means for synchronising the blocks using the offset words.



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REPLACEMENT SHEET

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METHOD FOR TRANSMITTING ADDITIONAL INFORMATION IN
AN AM RADIO SIGNAL

ABSTRACT

For transmitting additional information in an AM radio signal, initially, at the transmitting end an AM radio signal carrier is modulated in its phase position by means of a digital, coded additional information signal. At the reception end the AM radio signal carrier is phase-modulated, the additional information signal acquired is decoded and the decoded additional information is used for tuning, switching or playback. The additional information (PI, PS, AF, AFT, TP, TA, TMC, RT) of the additional information signal is divided up into a cyclically repeated number of groups to form in each case two information blocks of identical length. Each information block has an information word and a check word comprising in each case a specific number of data bits, the two check words of each group having different offset words superimposed on them. These offset words are used at the reception end to synchronize the information blocks.

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REPLACEMENT SHEET

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☒ Description : paged 1... to paged ...

☐ Claim(s) : paged to paged

☐ Drawing(s) : paged to paged

☒ Abstract : paged 3... to paged ...

DATE OF RECEIPT

PROCESS FOR TRANSMITTING ADDITIONAL INFORMATION

WITH AN A.M. RADIO SIGNAL

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REPLACEMENT SHEET

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The invention relates to a method of transmitting auxiliary information in an AM broadcast signal wherein the AM broadcast signal is demodulated at the receiving end, the auxiliary information signal obtained thereby is decoded and the decoded auxiliary information is used for the purposes of tuning, switching, storing and/or reproduction, and it also relates to a signal for transmitting this auxiliary information and to a receiver for receiving this signal.

From "Funkschau" 1986, Vol 1, pages 43-47, it is known to transmit digitally coded auxiliary information signals in an AM broadcast signal by phase modulating and demodulating the AM signal carrier and is also known to distribute auxiliary items of information for the radio data system over a cyclically repeated number of groups in an FM broadcast signal, wherein one or more blocks of information are provided in each group and each block of information consists of an information word and a check word. Furthermore, it is known from the research report BBC RD 1982/2 from the British Broadcasting Corporation "L.F. Radio-Data: Specification of the BBC experimental transmissions 1982" dated August 1982; to transmit digitally coded auxiliary information in an AM (amplitude modulated) broadcast signal by phase modulating and demodulating the AM broadcast signal carrier. A value of $\pm 22.5^\circ$ was selected by the British Broadcasting Corporation as the maximum permissible phase change allowed so as not to interfere with the program signal on the phase modulated AM carrier, this value corresponding to a transmission capacity for the auxiliary items of information of 25 bits/second. This extremely small channel capacity requires a degree of error protection that is matched as optimally as possible, in the sense of low redundancy, to the properties of the AM broadcast transmission channel. To this end, the data stream is subdivided into blocks each having a length of 50 bits, wherein each block consists of a synchronising bit, an information word of 36 bits and a check word of 13 bits. For coding the blocks, an

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PROCESS FOR TRANSMITTING ADDITIONAL INFORMATION
WITH AN A.M. RADIO SIGNAL

ABSTRACT

For transmitting additional information in an AM radio signal, initially, at the transmitting end an AM radio signal carrier is modulated in its phase position by means of a digital, coded additional information signal. At the reception end the AM radio signal carrier is phase-modulated, the additional information signal acquired is decoded and the decoded additional information is used for tuning, switching or playback. The additional information (PI, PS, AF, AFT, TP, TA, TMC, RT) of the additional information signal is divided up into a cyclically repeated number of groups to form in each case two information blocks of identical length. Each information block has an information word and a check word comprising in each case a specific number of data bits, the two check words of each group having different offset words superimposed on them. These offset words are used at the reception end to synchronize the information blocks.