

Specification for

Radio data system (RDS)

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National foreword

This British Standard has been prepared under the direction of the Electronic Equipment Standards Policy Committee and is the English language version of EN 50067:1992 *Specification of the radio data system (RDS)*, published by the European Committee for Electrotechnical Standardization (CENELEC).

It was derived by CENELEC from the European Broadcasting Union (EBU) Technical document 3244 (1986) and its Supplements 1 to 4, and EBU Technical document SPB 482 (1990), plus text which has been revised to accord with experience gained with the RDS System and changes in broadcasting practice since the EBU Specification was published. It is also the subject of CCIR Recommendation 643 (1986).

BS EN 50067:1992 supersedes BS EN 50067:1991, which is withdrawn.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 68, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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English version

Specification of the radio data system (RDS)

Specifications du système de
radiodiffusion de données (RDS)

Spezifikation des Radio-Daten-Systems
(RDS)

This European Standard was approved by CENELEC on 24 March 1992. CENELEC members are bound to comply with the requirements of the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The Radio Data System RDS was developed by the European Broadcasting Union (EBU) Member countries who collaborated towards an internationally agreed standard for such a system. The Specification of the RDS System was published by the EBU in 1984 as doc.Tech 3244 [8] and is also the subject of CCIR Recommendation 643 (1986).

This revised text, which is published by the European Committee for Electrotechnical Standardization (CENELEC), was produced by members of Technical Committee 107 of CENELEC, who worked in collaboration with experts from the EBU. It incorporates minor editorial changes which were needed to clarify certain parts of the EBU Specification. It also embodies enhancements to the Specification which were originally published by the EBU as Supplements 1 to 4 to the RDS Specification and document SPB 482 [14]. In addition, certain elements of text have been revised to accord with experience gained with the RDS System and changes in broadcasting practice since the Specification was published. It is, nevertheless, expected that receivers produced to accord with this Specification will be compatible with RDS broadcasts which conform with the original EBU Specification.

This document was approved by CENELEC as EN 50067:1992 on 24 March 1992.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1993-03-01
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0 Scope

The Radio Data System RDS is intended for application to VHF/FM sound broadcasts in the range 87.5 MHz to 108.0 MHz which may carry either stereophonic (pilot-tone system) or monophonic programmes.

1 Modulation characteristics of the data channel (physical layer)

The Radio Data System is intended for application to VHF/FM sound broadcasting transmitters in the range 87.5–108.0 MHz, which carry stereophonic (pilot-tone system) or monophonic sound broadcasts (see CCIR Recommendation 450).

It is important that radio-data receivers are not affected by signals in the multiplex spectrum outside the data channel.

The system can be used simultaneously with the ARI system (see Annex H and CCIR Report 463), even when both systems are broadcast from the same transmitter. However, certain constraints on the phase and injection levels of the radio-data and ARI signals must be observed in this case (see 1.2 and 1.3).

The data signals are carried on a subcarrier which is added to the stereo multiplex signal (or monophonic signal as appropriate) at the input to the VHF/FM transmitter. Block diagrams of the data source equipment at the transmitter and a typical receiver arrangement are shown in Figure 1 and Figure 2, respectively.

1.1 Subcarrier frequency

During stereo broadcasts the subcarrier frequency will be locked to the third harmonic of the 19-kHz pilot-tone. Since the tolerance on the frequency of the 19-kHz pilot-tone is ± 2 Hz (see CCIR Recommendation 450), the tolerance on the frequency of the subcarrier during stereo broadcasts is ± 6 Hz.

During monophonic broadcasts the frequency of the subcarrier will be $57 \text{ kHz} \pm 6 \text{ Hz}$.

1.2 Subcarrier phase

During stereo broadcasts the subcarrier will be locked either in phase or in quadrature to the third harmonic of the 19 kHz pilot-tone. The tolerance on this phase angle is $\pm 10^\circ$, measured at the modulation input to the FM transmitter.

In the case when ARI and radio-data signals are transmitted simultaneously, the phase angle between the two subcarriers shall be $90^\circ \pm 10^\circ$.

1.3 Subcarrier level

The deviation range of the FM carrier due to the unmodulated subcarrier is from ± 1.0 kHz to ± 7.5 kHz. The recommended best compromise is ± 2.0 kHz¹⁾. The decoder/demodulator should also operate properly when the deviation of the subcarrier is varied within these limits during periods not less than 10 ms.

In the case when ARI (see Annex H) and radio-data signals are transmitted simultaneously, the recommended maximum deviation due to the radio-data subcarrier is ± 1.2 kHz and that due to the unmodulated ARI subcarrier should be reduced to ± 3.5 kHz.

The maximum permitted deviation due to the composite multiplex signal is ± 75 kHz.

¹⁾ With this level of subcarrier, the level of each sideband of the subcarrier corresponds to half the nominal peak deviation level of ± 2.0 kHz for an “all-zeroes” message data stream (i.e. a continuous bit-rate sine-wave after biphase encoding).

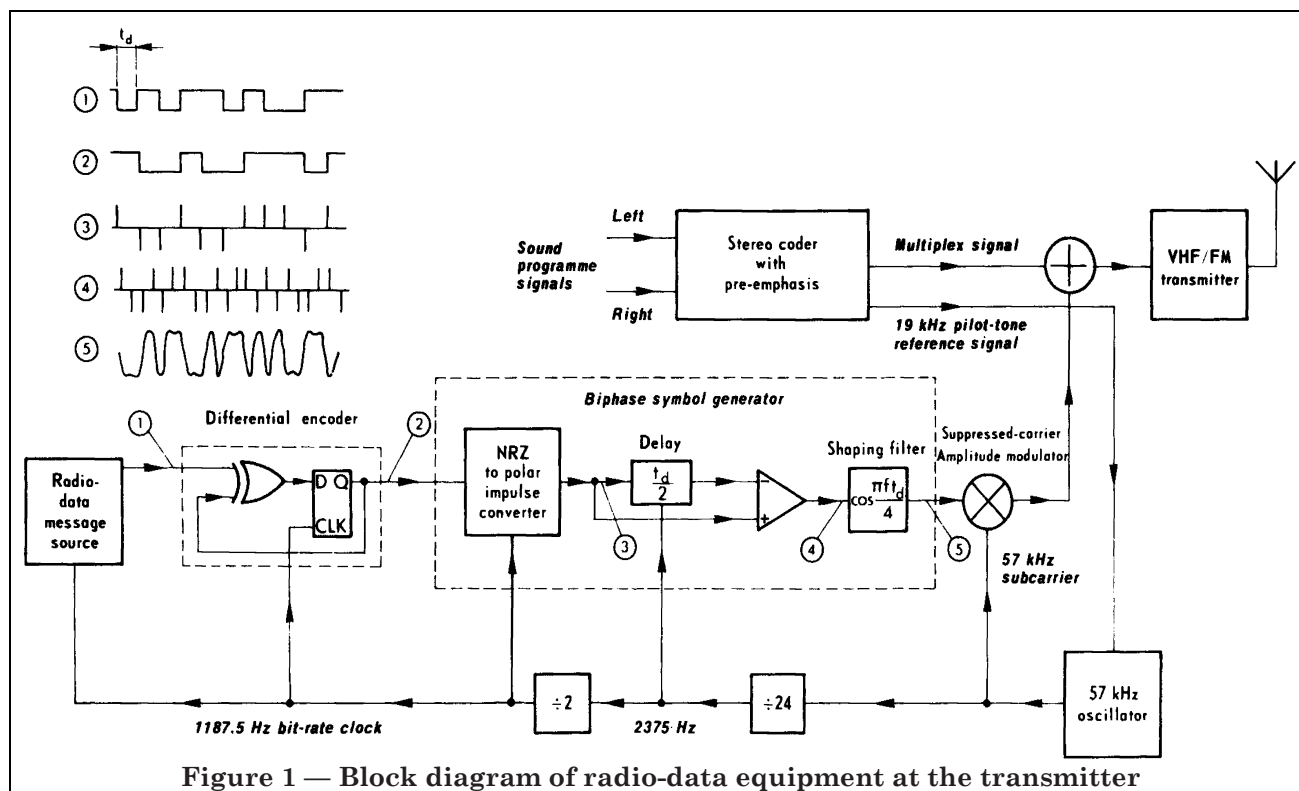
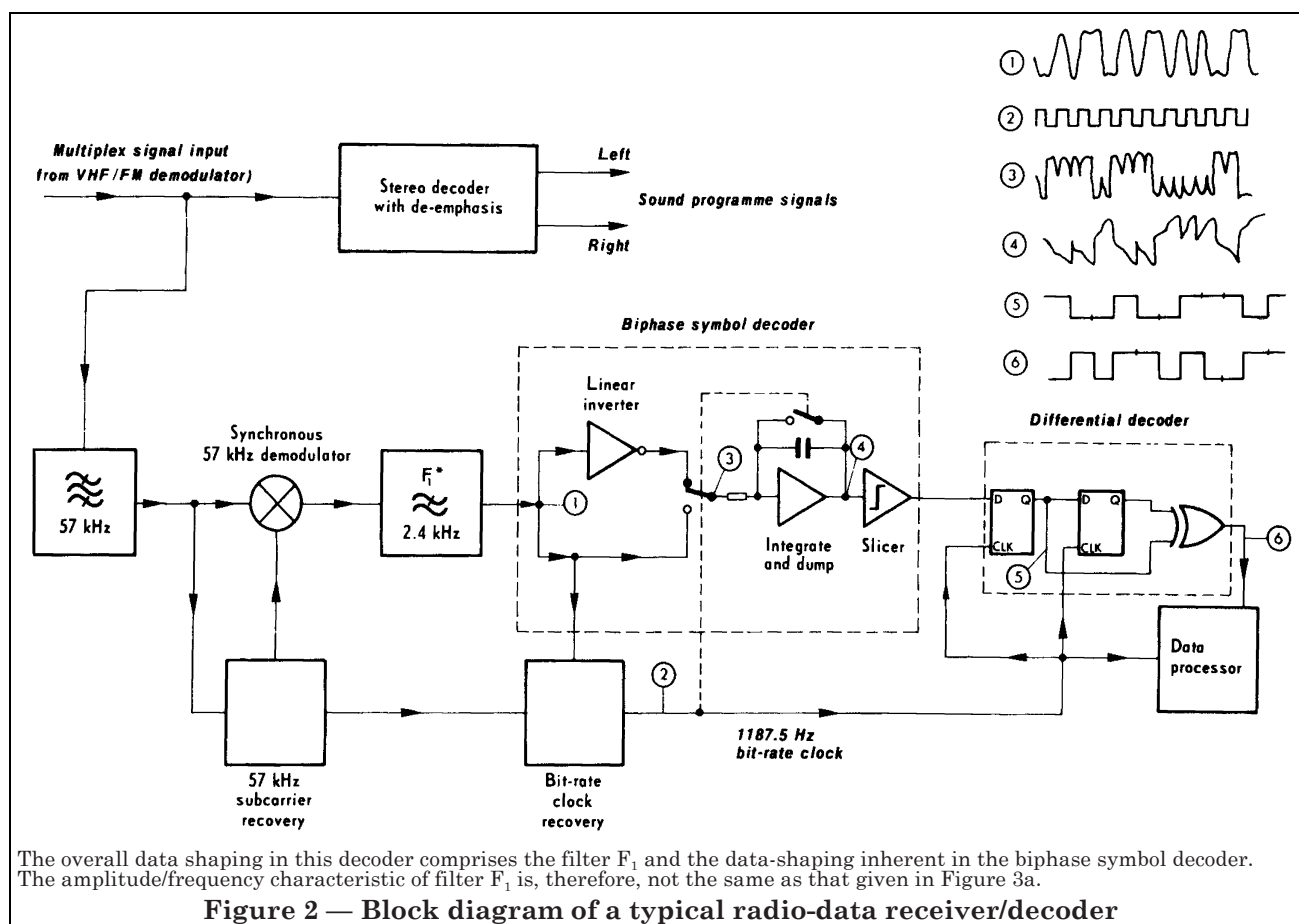


Figure 1 — Block diagram of radio-data equipment at the transmitter



The overall data shaping in this decoder comprises the filter F_1 and the data-shaping inherent in the biphasic symbol decoder. The amplitude/frequency characteristic of filter F_1 is, therefore, not the same as that given in Figure 3a.

Figure 2 — Block diagram of a typical radio-data receiver/decoder

1.4 Method of modulation

The subcarrier is amplitude-modulated by the shaped and biphase coded data signal (see 1.7). The subcarrier is suppressed. This method of modulation may alternatively be thought of as a form of two-phase phase-shift-keying (psk) with a phase deviation of $\pm 90^\circ$.

1.5 Clock-frequency and data-rate

The basic clock frequency is obtained by dividing the transmitted subcarrier frequency by 48. Consequently, the basic data-rate of the system (see Figure 1) is 1187.5 bit/s $\pm$ 0.125 bit/s.

1.6 Differential coding

The source data at the transmitter are differentially encoded according to the following rules:

Table 1

Previous output (at time t_{i-1})	New input (at time t_i)	New output (at time t_i)
0	0	0
0	1	1
1	0	1
1	1	0

where t_i is some arbitrary time and t_{i-1} is the time one message-data clock-period earlier, and where the message-data clock-rate is equal to 1187.5 Hz.

Thus, when the input-data level is 0, the output remains unchanged from the previous output bit and when an input 1 occurs, the new output bit is the complement of the previous output bit.

In the receiver, the data may be decoded by the inverse process:

Table 2

Previous output (at time t_{i-1})	New input (at time t_i)	New output (at time t_i)
0	0	0
0	1	1
1	0	1
1	1	0

The data is thus correctly decoded whether or not the demodulated data signal is inverted.

1.7 Data-channel spectrum shaping

The power of the data signal at and close to the 57 kHz subcarrier is minimized by coding each source data bit as a biphase symbol.

This is done to avoid data-modulated cross-talk in phase-locked-loop stereo decoders, and to achieve compatibility with the ARI system. The principle of the process of generation of the shaped biphase symbols is shown schematically in Figure 1. In concept each source bit gives rise to an odd impulse-pair, $e(t)$, such that a logic 1 at source gives:

$$e(t) = \delta(t) - \delta(t - t_d/2) \quad (1)$$

and a logic 0 at source gives:

$$e(t) = -\delta(t) + \delta(t - t_d/2) \quad (2)$$

These impulse-pairs are then shaped by a filter $H_T(f)$, to give the required band-limited spectrum where:

$$H_T(f) = \begin{cases} \cos \frac{\pi f t_d}{4} & \text{if } 0 \leq f \leq 2/t_d \\ 0 & \text{if } f > 2/t_d \end{cases} \quad (3)$$

and here

$$t_d = \frac{1}{1187.5} \text{ s}$$

The data-spectrum shaping filtering has been split equally between the transmitter and receiver (to give optimum performance in the presence of random noise) so that, ideally, the data filtering at the receiver should be identical to that of the transmitter, i.e. as given above in equation (3). The overall data-channel spectrum shaping $H_o(f)$ would then be 100 % cosine roll-off.

The specified transmitter and receiver low-pass filter responses, as defined in equation (3) are illustrated in Figure 3a, and the overall data-channel spectrum shaping is shown in Figure 3b.

The spectrum of the transmitted biphas-coded radio-data signal is shown in Figure 4a and the time-function of a single biphas symbol (as transmitted) in Figure 4b.

The 57 kHz radio-data signal waveform at the output of the radio-data source equipment may be seen in the photograph of Figure 4c.

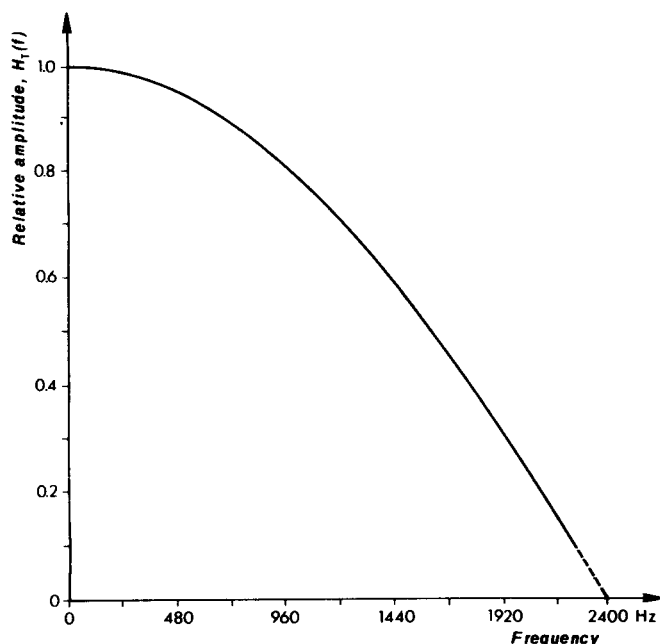


Figure 3a — Amplitude response of the specified transmitter or receiver data-shaping filter

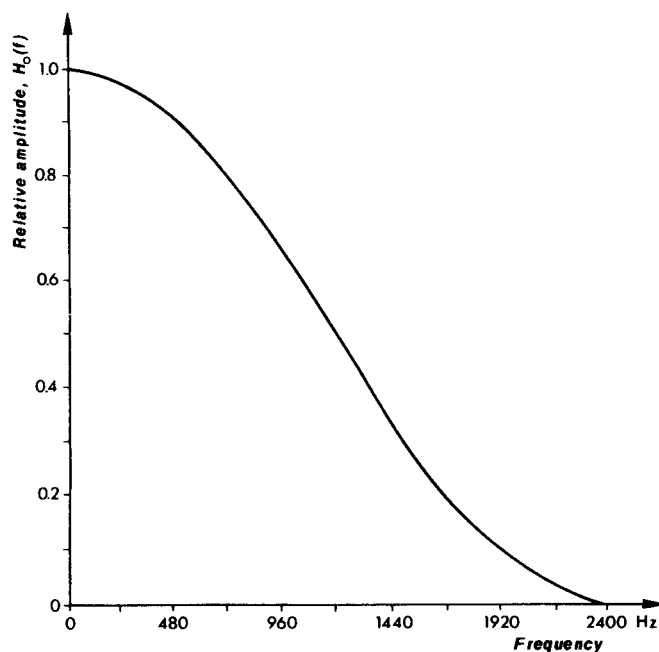


Figure 3b — Amplitude response of the combined transmitter and receiver data-shaping filters

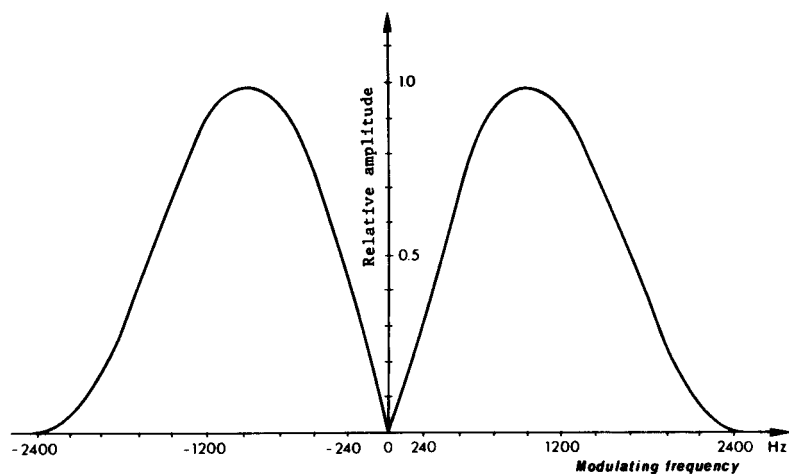


Figure 4a — Spectrum of biphas coded radio-data signals

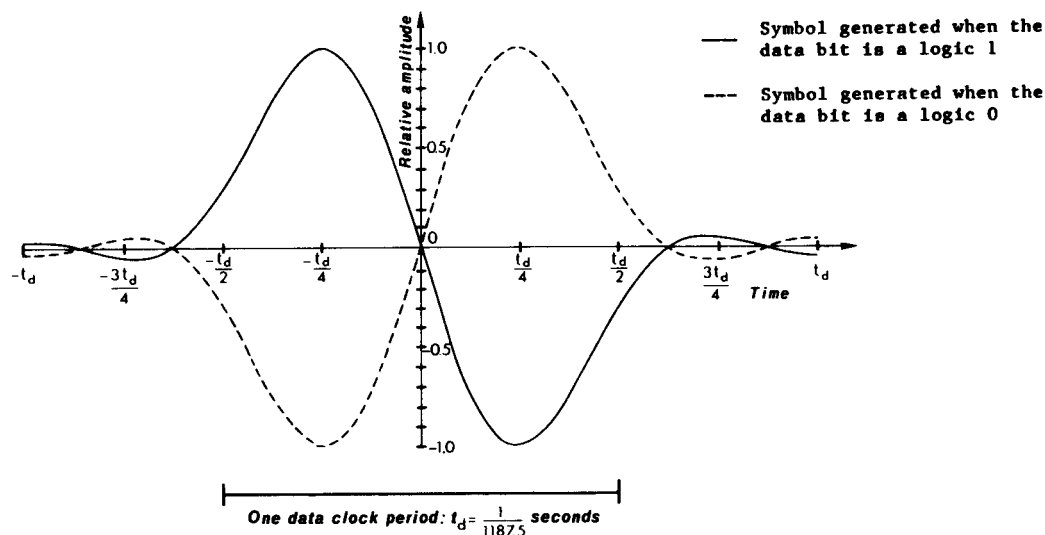


Figure 4b — Time-function of a single biphasis symbol

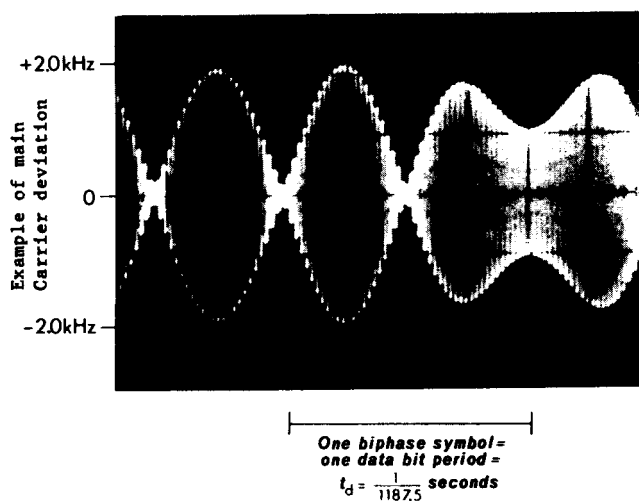


Figure 4c — 57 kHz radio-data signals

2 Baseband coding (data-link layer)

2.1 Baseband coding structure

Figure 5 shows the structure of the baseband coding. The largest element in the structure is called a “group” of 104 bits each. Each group comprises 4 blocks of 26 bits each. Each block comprises an information word and a checkword. Each information word comprises 16 bits. Each checkword comprises 10 bits (see 2.3).

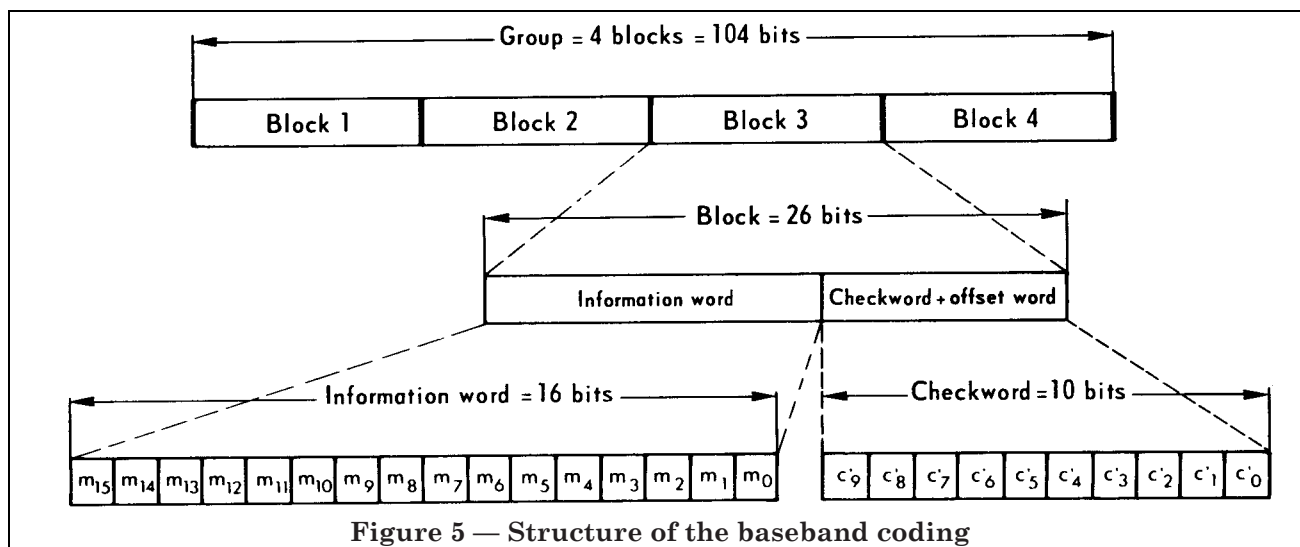


Figure 5 — Structure of the baseband coding

2.2 Order of bit transmission

All information words, checksums, binary numbers or binary address values have their most significant bit (m.s.b.) transmitted first (see Figure 6). Thus the last bit transmitted in a binary number or address has weight 2^0 .

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

Notes to Figure 6:

1. Group type code = 4 bits (see 3.1)
2. B_0 = version code = 1 bit (see 3.1)
3. PI code = Programme identification code = 16 bits (see 3.2.1.1 and Annex D)
4. TP = Traffic Programme identification code = 1 bit (see 3.2.1.3)
5. PTY = Programme Type code = 5 bits (see 3.2.1.2 and Annex F)
6. Checkword + offset "N" = 10 bits added to provide error protection and block and group synchronization information (see 2.3 and 2.4 and Annex A, Annex B and Annex C)
7. $t_1 < t_2$: Block 1 of any particular group is transmitted first and block 4 last

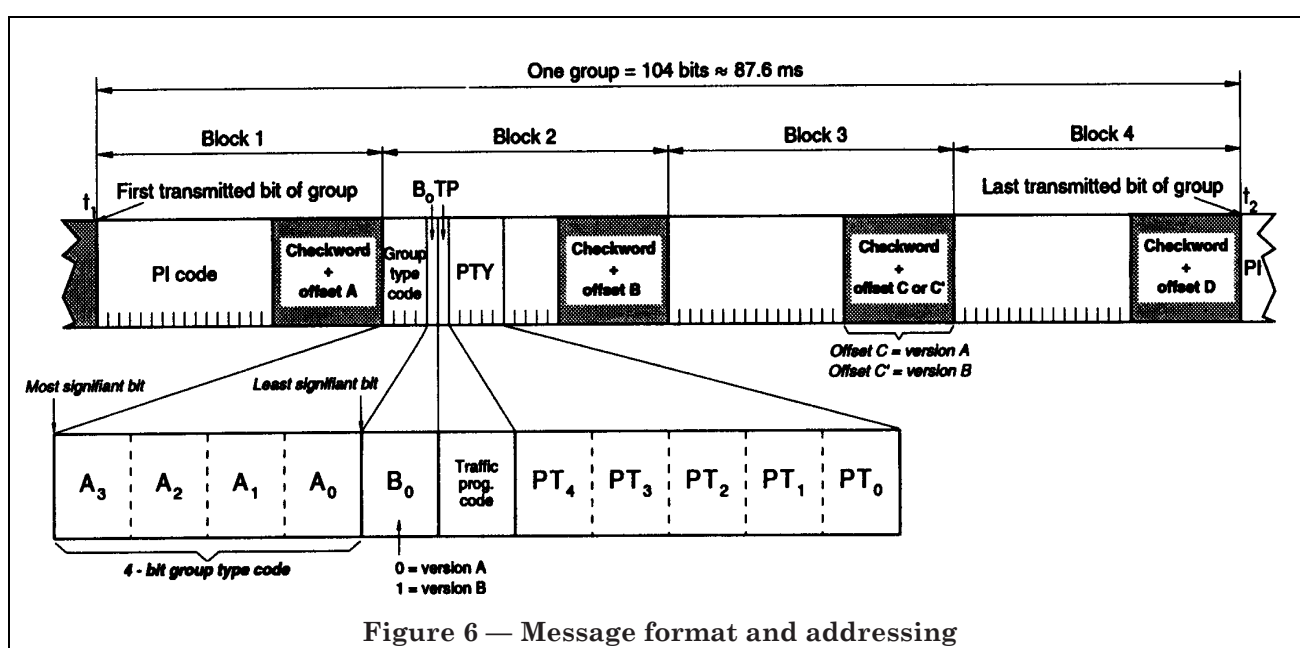


Figure 6 — Message format and addressing

2.3 Error protection

Each transmitted 26-bit block contains a 10-bit checkword which is primarily intended to enable the receiver/decoder to detect and correct errors which occur in transmission. This checkword (i.e. $c'_9, c'_8, \dots, c'_0$ in Figure 5) is the sum (modulo 2) of:

- a) the remainder after multiplication by x^{10} and then division (modulo 2) by the generator polynomial $g(x)$, of the 16-bit information word,
- b) a 10-bit binary string $d(x)$, called the “offset word”,

where the generator polynomial, $g(x)$ is given by:

$$g(x) = x^{10} + x^8 + x^7 + x^5 + x^4 + x^3 + 1$$

and where the offset values, $d(x)$, which are different for each block within a group (see 2.4) are given in Annex A.

The purpose of adding the offset word is to provide a group and block synchronisation system in the receiver/decoder (see 2.4). Because the addition of the offset is reversible in the decoder the normal additive error-correcting and detecting properties of the basic code are unaffected.

The checkword thus generated is transmitted m.s.b. (i.e. the coefficient of c'_9 in the checkword) first and is transmitted at the end of the block which it protects.

The above description of the error protection may be regarded as definitive, but further explanatory notes on the generation and theory of the code are given in Annex B and Annex C.

The error-protecting code has the following error-checking capabilities [3, 4]:

- a) Detects all single and double bit errors in a block.
- b) Detects any single error burst spanning 10 bits or less.
- c) Detects about 99.8 % of bursts spanning 11 bits and about 99.9 % of all longer bursts.

The code is also an optimal burst error correcting code [5] and is capable of correcting any single burst of span 5 bits or less.

2.4 Synchronisation of blocks and groups

The blocks within each group are identified by the offset words A, B, C or C' and D added to blocks 1, 2, 3, and 4 respectively in each group (see Annex A).

The beginnings and ends of the data blocks may be recognized in the receiver decoder by using the fact that the error-checking decoder will, with a high level of confidence, detect block synchronisation slip as well as additive errors. This system of block synchronisation is made reliable by the addition of the offset words (which also serve to identify the blocks within the group). These offset words destroy the cyclic property of the basic code so that in the modified code, cyclic shifts of codewords do not give rise to other codewords [6, 7].

Further explanation of a technique for extracting the block synchronisation information at the receiver is given in Annex C.

3 Message format (session and presentation layers)

3.1 Addressing

3.1.1 Design principles

The basic design principles underlying the message format and addressing structure are as follows:

- a) The messages which are to be repeated most frequently, and for which a short acquisition time is required e.g. Programme Identification (PI) codes, in general occupy the same fixed positions within every group. They can therefore be decoded without reference to any block outside the one which contains the information.
- b) There is no fixed rhythm of repetition of the various types of group, i.e. there is ample flexibility to interleave the various kind of message to suit the needs of the users at any given time and to allow for future developments.
- c) This requires addressing to identify the information content of those blocks which are not dedicated to the high-repetition-rate information.

- d) Each group is, so far as possible, fully addressed to identify the information content of the various blocks.
- e) The mixture of different kinds of message within any one group is minimized, e.g. one group type is reserved for basic tuning information, another for radiotext, etc. This is important so that broadcasters who do not wish to transmit messages of certain kinds are not forced to waste channel capacity by transmitting groups with unused blocks. Instead, they are able to repeat more frequently those group types which contain the messages they want to transmit.
- f) To allow for future applications the data-formatting has been made flexible. For example, one of the five spare group types (see 3.1.3) may be assigned to future applications.

3.1.2 Principal features

The main features of the message structure have been illustrated in Figure 6. These may be seen to be:

- 1) The first block in every group always contains a Programme Identification (PI) code.
- 2) The first four bits of the second block of every group are allocated to a four-bit code which specifies the application of the group. Groups will be referred to as types 0 to 15 according to the binary weighting $A_3 = 8$, $A_2 = 4$, $A_1 = 2$, $A_0 = 1$ (see Figure 6). For each type (0 to 15) two "versions" can be defined. The "version" is specified by the fifth bit (B_0) of block 2 as follows:
 - a) $B_0 = 0$: the PI code is inserted in block 1 only. This will be called version A, e.g. 0A, 1A, etc.
 - b) $B_0 = 1$: the PI code is inserted in block 1 and block 3 of all group types. This will be called version B, e.g. 0B, 1B, etc.

In general, any mixture of versions A and B of groups may be transmitted.

- 3) The Programme Type Code (PTY) and Traffic Programme identification (TP) occupy fixed locations in block 2 of every group.

The PI, PTY and TP codes can be decoded without reference to any block outside the one that contains the information. This is essential to minimize acquisition time for these kinds of message and to retain the advantages of the short (26-bit) block length. To permit this to be done for the PI codes in block 3 of version B groups, a special offset word (which we shall call C') is used in block 3 of version B groups. The occurrence of offset C' in block 3 of any group can then be used to indicate directly that block 3 is a PI code without reference to the value of B_0 in block 2.

3.1.3 Group types

It was described above (see also Figure 6) that the first five bits of the second block of every group are allocated to a five-bit code which specifies the application of the group and its version.

At present 11 group types have been specified and all except 5 (types 4, 7, 8, 9 and 15) are defined in version A and version B. The remaining group types will be specified at a later date when possible applications have been defined. The applications of the 11 group types defined so far are as follows:

Table 3

Group type						Applications
Decimal value	Binary Code					
	A ₃	A ₂	A ₁	A ₀	B ₀	
0	0	0	0	0	X	Basic tuning and switching information (see 3.1.3.1)
1	0	0	0	1	X	Programme item number and slow labelling codes (see 3.1.3.2)
2	0	0	1	0	X	Radiotext (see 3.1.3.3)
3	0	0	1	1	X	Undefined
4	0	1	0	0	0	Clock-time and date (see 3.1.3.4)
5	0	1	0	1	X	Transparent data channels (32 channels) (see 3.1.3.5)
6	0	1	1	0	X	In-house applications (see 3.1.3.6)
7	0	1	1	1	0	Radio paging (see 3.1.3.7)
8	1	0	0	0	0	Reserved for TMC (see 4.17)
9	1	0	0	1	0	Emergency warning system (see 3.1.3.8)
10–13						Undefined
14	1	1	1	0	X	Enhanced other networks information (see 3.1.3.9)
15	1	1	1	1	1	Fast basic tuning and switching information (see 3.1.3.10)
X indicates that value may be “0” (version A) or “1” (version B).						

The appropriate repetition rates for some of the main applications are indicated in the table below:

Table 4

Applications	Group types which contain this information	Appropriate repetition rate per sec.
Programme identification (PI) code	all	11.4 ^a
Programme type (PTY) code	all	11.4 ^a
Traffic programme (TP) identification code	all	11.4 ^a
Programme service (PS) name	0A, 0B	1 ^b
Alternative frequency (AF) code pairs	0A	4 ^b
Traffic announcement (TA) code	0A, 0B, 15B	4
Decoder identification (DI) code	0A, 0B, 15B	1
Music/speech (M/S) code	0A, 0B, 15B	4
Radiotext (RT) message	2A, 2B	0.2 ^c
Enhanced other networks information (EON)	14A, 14B	up to 2 ^d

^a Valid codes for this item will normally be transmitted with at least this repetition rate whenever the transmitter carries a normal broadcast programme.

^b A total of four 0A groups are required to transmit the entire PS name and therefore four 0A groups will be required per second. The repetition rate of group type 0A may be reduced if more capacity is needed for other applications. But a minimum of two type 0A groups per second is necessary to ensure correct functioning of PS and AF features. It must be noted that in this case transmission of the complete PS will take 2 seconds. However, under typical reception conditions the introduction of errors will cause the receiver to take 4 seconds or more to acquire the PS name for display.

^c A total of 16 type 2A groups are required to transmit a 64 character radiotext message and therefore 3.2 type 2A groups will be required per second.

^d The maximum cycle time for the transmission of all data relating to all cross-referenced programme services shall be less than 2 minutes.

The following mixture of groups is suitable to meet the repetition rates noted above.

Table 5

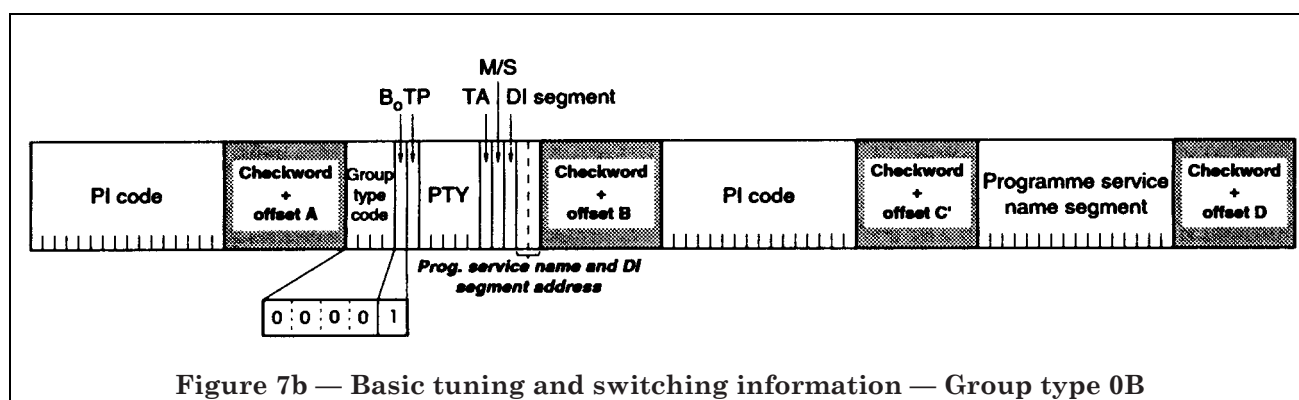
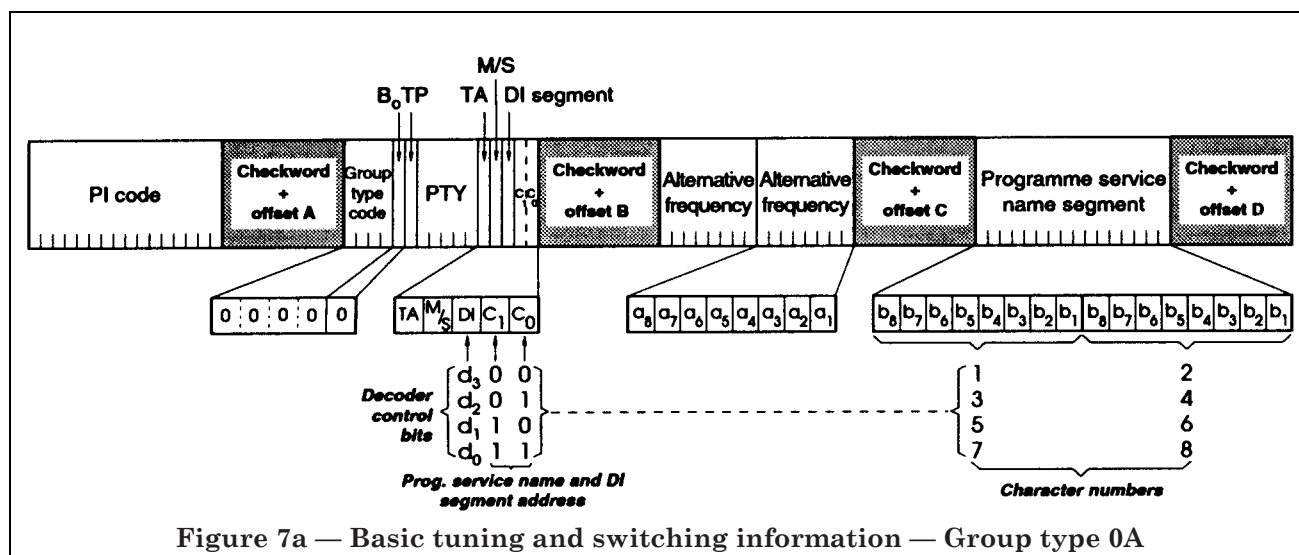
Group types	Applications	Typical proportion of groups of this type transmitted
0A or 0B	PI, PS, PTY, TP, AF ^a , TA, DI, M/S	40 %
1A or 1B	PI, PTY, TP, PIN	10 %
2A or 2B	PI, PTY, TP, RT	15 % ^b
14A or 14B	PI, PTY, TP, EON	10 %
Any other	Other applications	25 %

^a Group type 0A only

^b Assuming that type 2A groups are used to transmit a 32-character radiotext message. A mixture of type 2A and 2B groups in any given message should be avoided (see 3.1.3.3)

3.1.3.1 Type 0 groups: Basic tuning and switching information

Figure 7a shows the format of type 0A groups and Figure 7b the format of type 0B groups.



Type 0A groups are usually transmitted whenever alternative frequencies exist. Type 0B groups without any type 0A groups may be transmitted only when no alternative frequencies exist.

There are two methods (A and B) for transmission of alternative frequencies. These are explained in 3.2.1.6.2.

Notes on Type 0 groups:

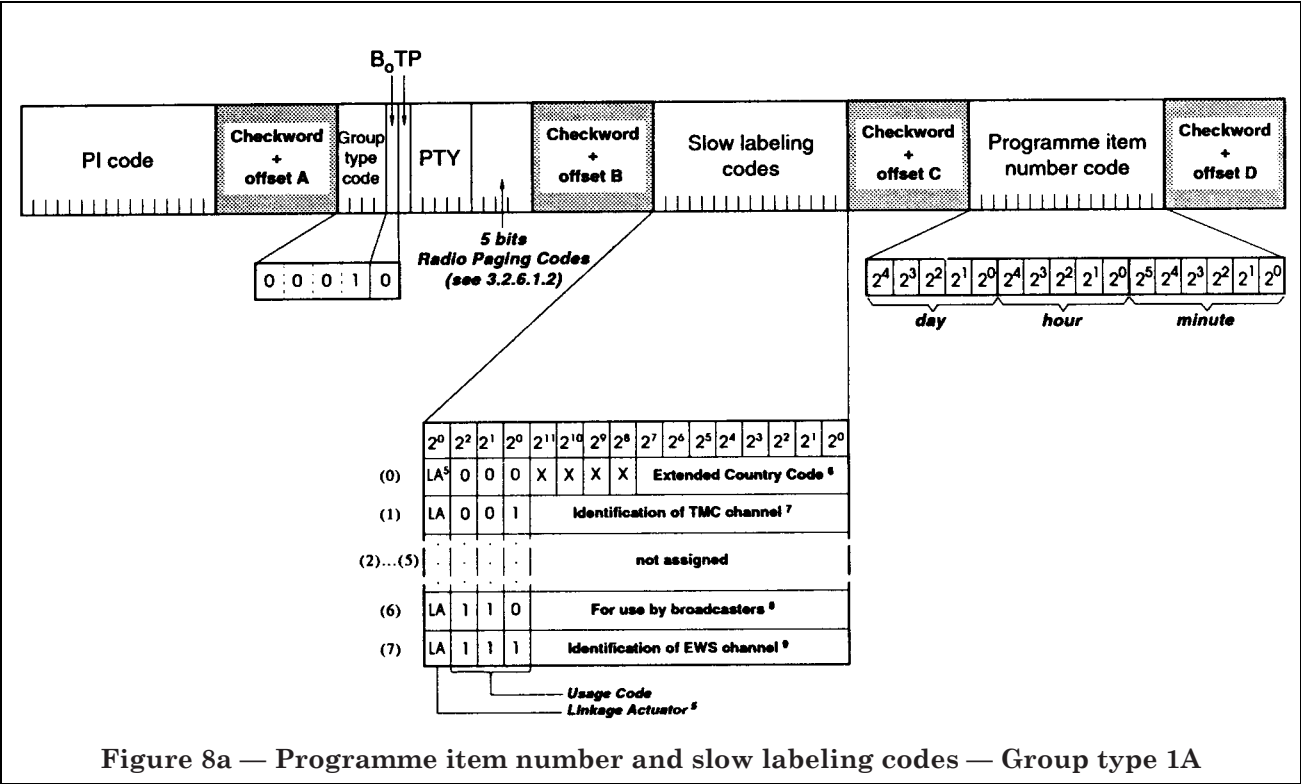
- 1. Version B differs from version A only in the contents of block 3, the offset word in block 3, and, of course, the version code B_0 .
- 2. For details of Programme identification (PI), Programme type (PTY) and traffic programme (TP) code, see Figure 6, 3.2.1 and Annex D and Annex F.
- 3. TA = Traffic announcement code (1 bit) (see 3.2.1.3).
- 4. M/S = Music-speech switch code (1 bit) (see 3.2.1.4).
- 5. DI = Decoder-identification control code (4 bits) (see 3.2.1.5). This code is transmitted as 1 bit in each type 0 group. The Programme service name and DI segment address code (C_1 and C_0) serves to locate these bits in the DI codeword. Thus in a group with $C_1C_0 = "00"$ the DI bit in that group is d_s . These code bits are transmitted most significant bit (d_s) first.
- 6. Alternative frequency codes (2×8 bits) (see 3.2.1.6).
- 7. Programme service name (for display) is transmitted as 8-bit character as defined in the 8-bit code-tables in Annex E. Eight characters (including spaces) are allowed for each network and are transmitted as a 2-character segment in each type 0 group. These segments are located in the displayed name by the code bits C_1 and C_0 in block 2. The addresses of the characters increase from left to right in the display. The most significant bit (b_s) of each character is transmitted first.

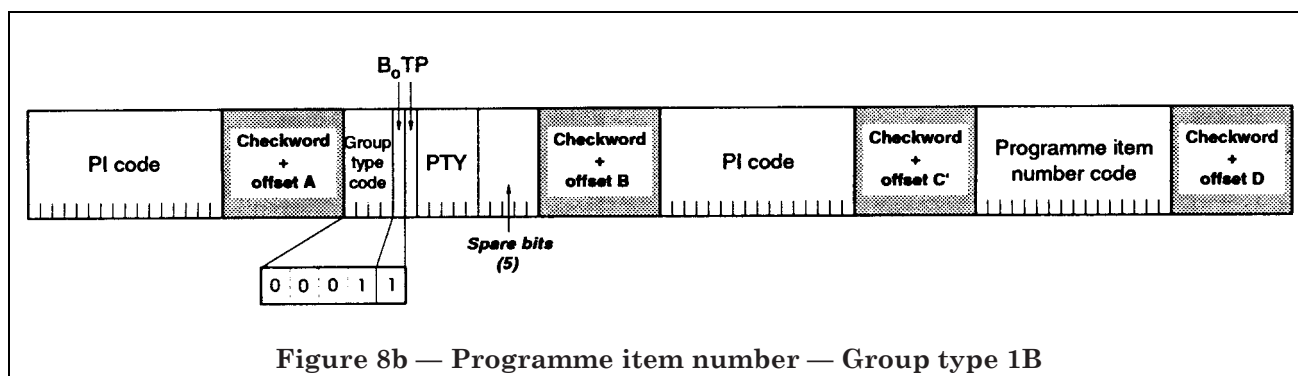
3.1.3.2 Type 1 groups: Programme-item number and slow labelling codes

Figure 8a shows the format of type 1A groups and Figure 8b the format of type 1B groups.

When a programme item number is changed, Group 1 should be repeated four times with a separation of about 0.5 seconds. The unused bits in blocks 2 (type 1B only) are reserved for future applications.

Where Radio Paging is implemented with RDS, Group 1A will be transmitted in an invariable sequence, regularly once per second, except at each full minute, where it is replaced by one 4A Group.





Notes on Type 1 groups:

1. Version B differs from version A in the contents of blocks 2 and 3, the offset word in block 3, and, of course, the version code B_0 .
2. The programme item number is the scheduled broadcast start time and day of month as published by the broadcaster. The day of month is transmitted as a five-bit binary number in the range 1–31. Hours are transmitted as a five-bit binary number in the range 0–23. The spare codes are not used. Minutes are transmitted as a six-bit binary number in the range 0–59. The spare codes are not used.
3. If type 1 is transmitted without a valid PIN, the day of month shall be set to zero.
4. Bits 2, 3 and 4 of block 3 of version A form the usage code, which determines the application of data carried in bits 5 to 16. A broadcaster may use as many or as few of the usage codes as he wishes, in any proportion and order.
5. The Linkage Actuator is defined in the "Method for Linking RDS Programme Services" (see 3.2.1.8.3).
6. Extended country codes are defined separately (see Annex D).
7. Under discussion.
8. The coding of this information may be decided unilaterally by the broadcaster to suit the application. Radio-data receivers should entirely ignore this information.
9. The Emergency Warning Systems (EWS) are defined separately (see 3.2.7).
10. Bits indicated by "X" are not assigned and may be in either state "1" or "0".

3.1.3.3 Type 2 groups: Radiotext

Figure 9a shows the format of type 2A groups and Figure 9b the format of type 2B groups.