INTERNATIONAL STANDARD

IEC 62106

First edition
2000-01

Specification of the radio data system (RDS) for VHF/FM sound broadcasting in the frequency range from 87,5 to 108,0 MHz

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Terminology, graphical and letter symbols

For general terminology, readers are referred to IEC 60050: *International Electrotechnical Vocabulary* (IEV).

For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to publications IEC 60027: *Letter symbols to be used in electrical technology*, IEC 60417: *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets* and IEC 60617: *Graphical symbols for diagrams.*

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SPECIFICATION OF THE RADIO DATA SYSTEM (RDS) FOR VHF/FM SOUND BROADCASTING IN THE FREQUENCY RANGE FROM 87,5 TO 108,0 MHZ

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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This International Standard IEC 62106 has been prepared by the IEC Subcommittee 100A: Multimedia end-user equipment, of the Technical Committee 100: Audio, video and multimedia systems and equipment.

This standard is based on the European CENELEC Standard EN 50067:1998 prepared by the RDS Forum, using an earlier specification [8] that was originally developed within the European Broadcasting Union. It was submitted to the National Committees for voting under the Fast Track Procedure as the following documents:

FDIS	Report on voting
100A/134A/FDIS	100A/139/RVD

Full information on the voting for the approval of this standard can be found in the report indicated in the above table.

Attention is drawn to the fact that there may be Intellectual Property Rights (IPR) in relation to certain provisions of this standard. IPR holders should notify the IEC of their claims.

This publication has not been drafted in complete accordance with the ISO/IEC Directives, Part 3.

Annexes B, C, G, H, K, L and Q are for information only.

Annexes A, D, E, F, J, M, N, and P form an integral part of this standard.

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ANNEXES

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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. The main objectives of RDS are to enable improved funtionality for FM receivers and to make them more user-friendly by using features such as Programme Identification, Programme Service name display and where applicable, automatic tuning for portable and car radios, in particular. The relevant basic tuning and switching information therefore has to be implemented by the type 0 group (see 3.1.5.1), and it is not optional unlike many of the other possible features in RDS.

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 to 108.0 MHz, which carry stereophonic (pilot-tone system) or monophonic sound broadcasts (see ITU-R Recommendation BS.450-2).

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 (Autofahrer-Rundfunk-Information) system (see annex H), 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 figures 1 and 2, respectively.

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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 ITU-R Recommendation BS.450-2), 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 kHz ± 6 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 ± 10°, 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° ± 10°.

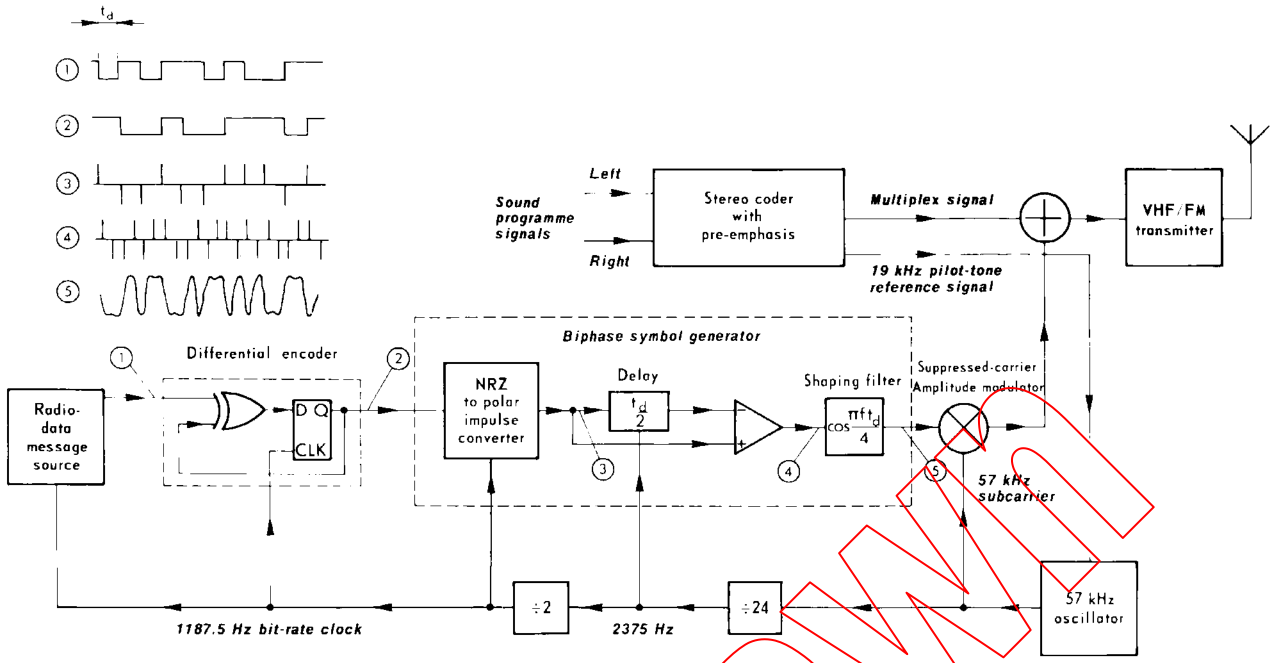

Figure 1 - Block diagram of radio-data equipment at the transmitter

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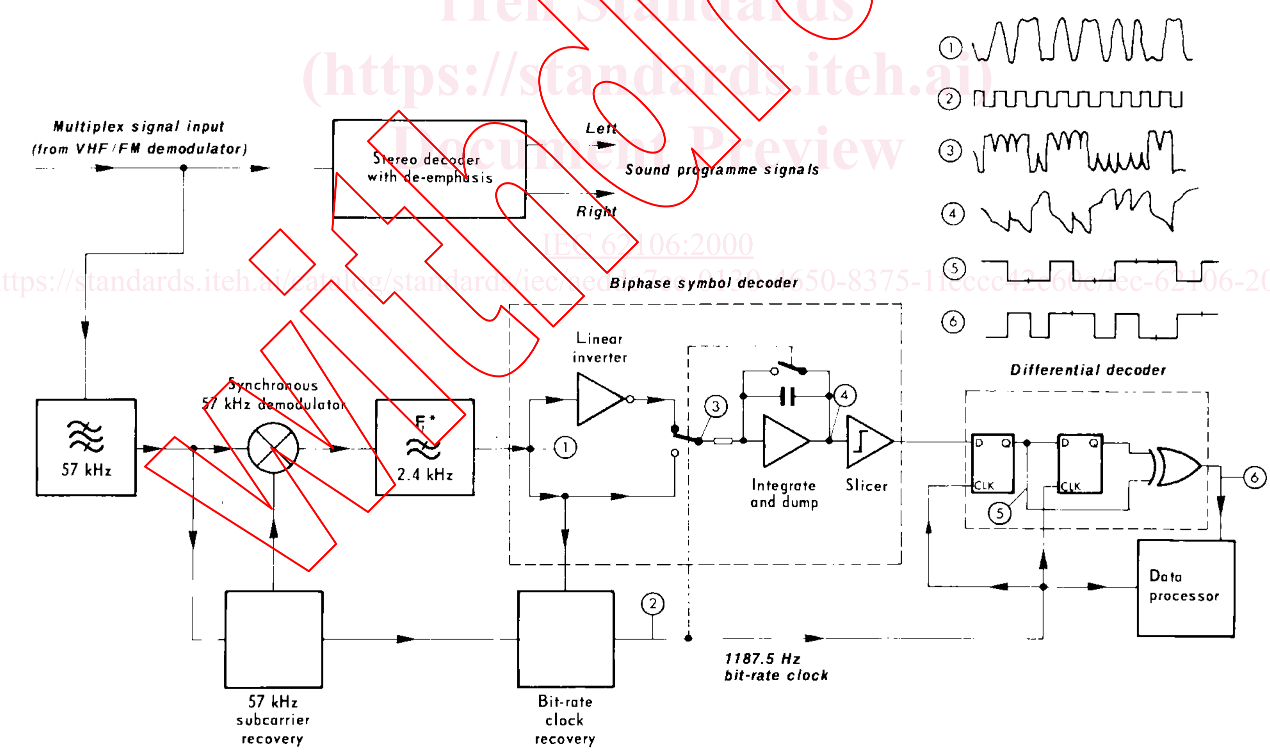

* The overall data-shaping in this decoder comprises the filter F_1 and the data-shaping inherent in the biphase symbol decoder. The amplitude/frequency characteristic of filter F_1 is, therefore, not the same as that given in figure 3.

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

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 kHz [1]). The decoder/demodulator shall 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 shall be reduced to ± 3.5 kHz.

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

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 ± 90°.

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 ± 0.125 bit/s.

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1.6 Differential coding

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

Table 1 - Encoding rules

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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

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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.

[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).

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 - Decoding rules

Previous input (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:

$$e(t) = \delta(t) - \delta(t - t_d/2) \qquad \textbf{(1)}$$

and a logic 0 at source gives:

$$e(t) = -\delta(t) + \delta(t - t_d/2) \qquad \textbf{(2)}$$

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

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

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.

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The specified transmitter and receiver low-pass filter responses, as defined in equation (3) are illustrated in figure 3, and the overall data-channel spectrum shaping is shown in figure 4.

The spectrum of the transmitted biphase-coded radio-data signal is shown in figure 5 and the time-function of a single biphase symbol (as transmitted) in figure 6.

The 57 kHz radio-data signal waveform at the output of the radio-data source equipment may be seen in the photograph of figure 7.

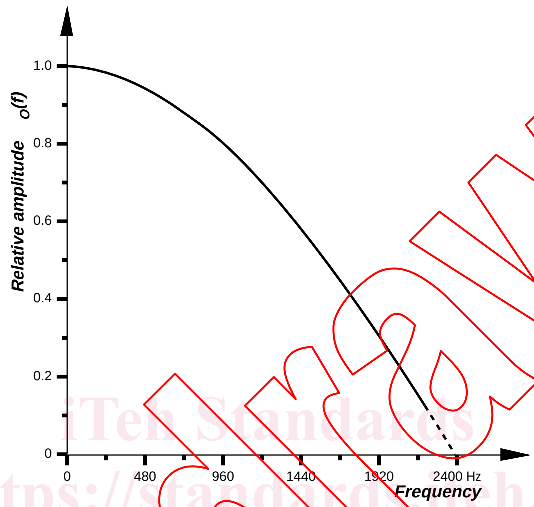

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Figure 3 - Amplitude response of the specified transmitter or receiver data-shaping filter

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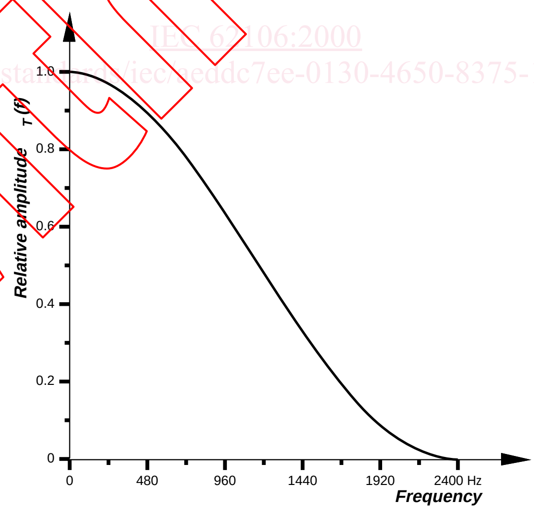

Figure 4 - Amplitude response of the combined transmitter and receiver data-shaping filters

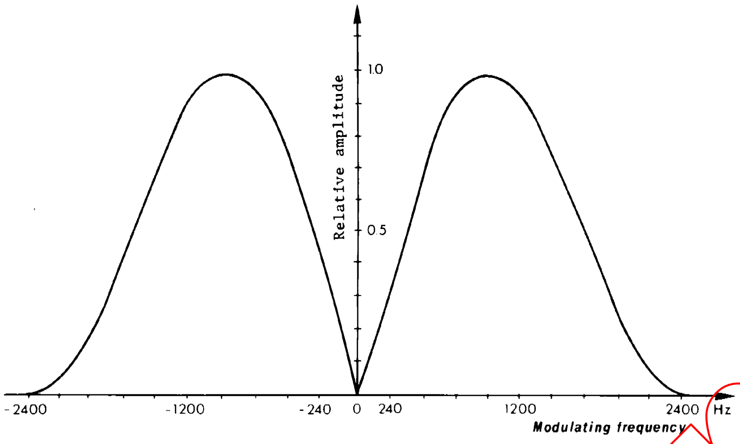

Figure 5 - Spectrum of biphase coded radio-data signals

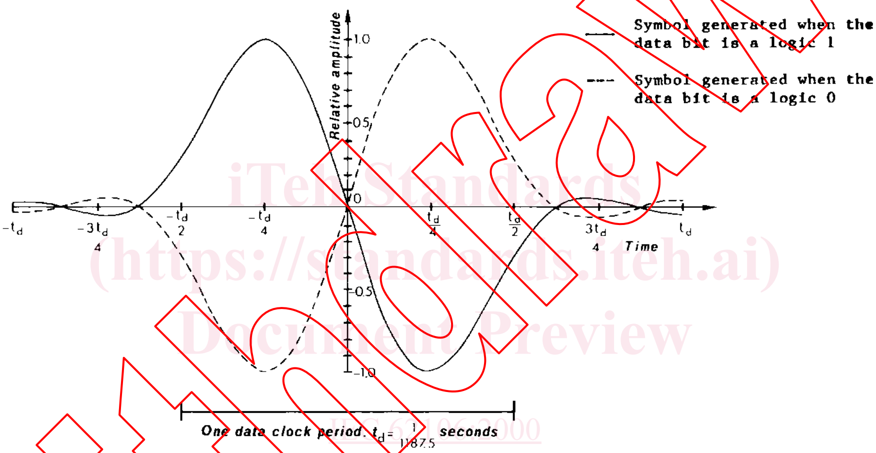

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Figure 6 - Time-function of a single biphase symbol

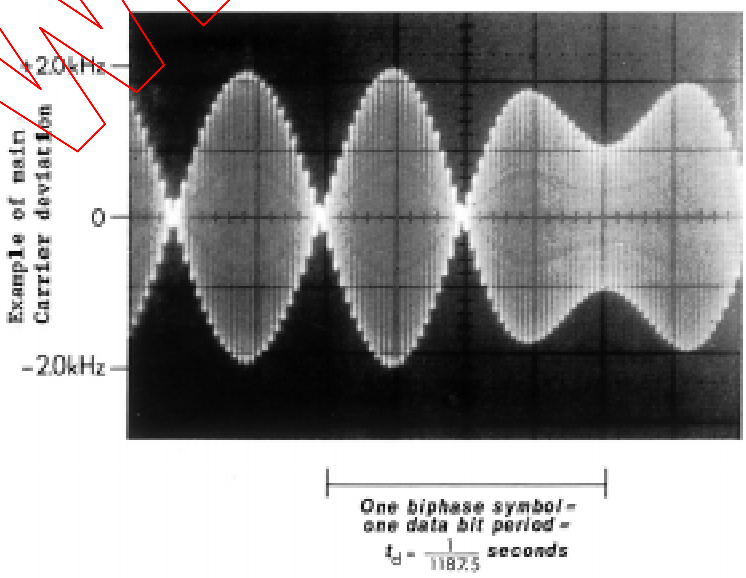

Figure 7 - 57 kHz radio-data signals

2 Baseband coding (data-link layer)

2.1 Baseband coding structure

Figure 8 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).

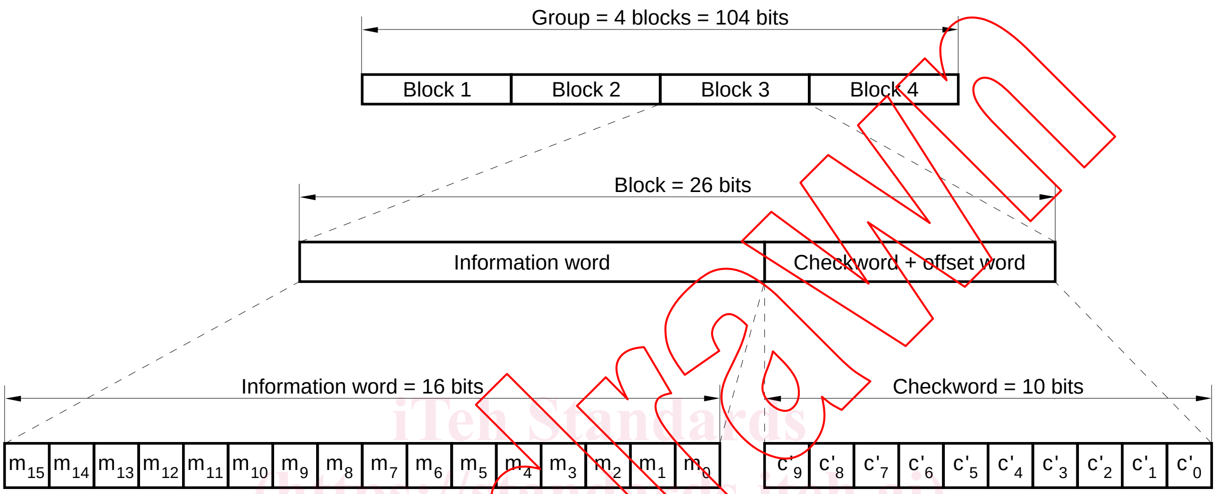

Figure 8 - Structure of the baseband coding

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2.2 Order of bit transmission

All information words, checkwords, binary numbers or binary address values have their most significant bit (m.s.b.) transmitted first (see figure 9). 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.