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Televizijski sistemi –NICAM 728: Specifikacija za prenos dvokanalnega digitalnega zvoka po prizemnih televizijskih sistemih B, G, H, I in L

Television systems; NICAM 728: Specification for transmission of two-channel digital sound with terrestrial television systems B, G, H, I and L

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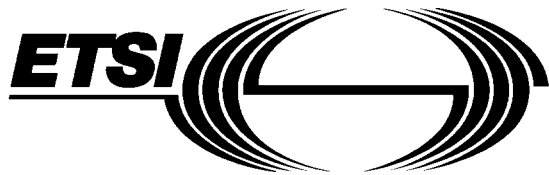
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two-channel digital sound with
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Foreword

This European Telecommunication Standard (ETS) has been produced under the authority of the Joint Technical Committee (JTC) of the European Broadcasting Union (EBU) and the European Telecommunications Standards Institute (ETSI).

This ETS concerns the technical arrangements for the transmission of digital sound with certain terrestrial television systems, and allows for one stereo channel or up to two mono channels, in each case with a small amount of additional data capacity.

NOTE: The EBU/ETSI Joint Technical Committee was established in 1990 to co-ordinate the drafting of European Telecommunication Standards in the specific field of radio, television and data broadcasting.

The EBU is a professional association of broadcasting organisations whose work includes the coordination of its Members activities in the technical, legal, programme-making and programme-exchange domains. The EBU has Active Members in about 50 countries in the European Broadcasting Area; its headquarters is in Geneva *.

This ETS is the result of studies carried out by EBU Sub-group V4 (Emission and reception of a multiplex of coded signals in a broadcasting channel), based principally on contributions from broadcasting organisations in the United Kingdom and the Nordic countries.

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1 Scope

This ETS defines the characteristics of the NICAM 728 ¹⁾ system which allows for the transmission of two-channel digital sound and/or data services with terrestrial television systems B, G, H, I and L ²⁾ defined in ITU-R Recommendation BT 470 [1].

- a) It is sufficiently rugged to ensure that reception of the vision fails before reception of the digital sound in difficult reception conditions.
- b) It fulfils the criteria for compatibility with existing services and receivers in over-air transmission and is adequately compatible in distribution on cable systems.
- c) It provides two high-quality digital sound channels and a small amount of additional data capacity. The two sound channels may be used to transmit two independent monophonic signals, which could be received simultaneously, or a single stereophonic signal. Alternatively, one or both sound channels may be used for the transmission of data.
- d) The sound coding is identical with that of one option available in the Multiplexed Analogue Component (MAC)/packet family of systems defined in EBU Technical document 3258-E [2].
- e) The baseband coding and digital frame format are identical for all of the television systems considered; the differences in modulation parameters shown in subclause 5.2 are the minimum required to accommodate the existing differences between these television systems.

This ETS allows some scope for the addition of further features in a compatible fashion in the future.

2 Normative references

This ETS incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] ITU-R Recommendation BT 470: "Television systems".
- [2] European Broadcasting Union Technical document 3258-E 2nd Edition (October 1991): "Specification of the systems of the MAC/packet family".
- [3] CCITT Recommendation J.17: "Pre-emphasis used on sound-programme circuits in group links, Volume III - Fascicle III.4, Red Book (1985)", page 111.

3 Symbols and abbreviations

For the purposes of this ETS, the following symbols abbreviations and apply:

| | |
|------------------------------------|--|
| AM | Amplitude Modulation; referring to the existing analogue, amplitude modulated carrier, monophonic sound signal (television system L) |
| ⊕ | denotes exclusive-or (XOR) boolean operation which is equivalent to modulo-two binary addition |
| A | left-hand sound signal when in "stereo" mode |
| AD ₀ - AD ₁₀ | Additional Data bits (11 bits) |
| B | right-hand sound signal when in "stereo" mode |

¹⁾ NICAM is an acronym for Near-Instantaneously Companded Audio Multiplex; 728 refers to the digital bit-rate of 728 kbit/s.
²⁾ The application of this ETS to television systems D and K is under study.

| | |
|-----------------|---|
| $C_0 - C_4$ | control information (5 bits) |
| $D_1 - D_{64}$ | 64 sound samples in one frame |
| DPSK | 4-phase differentially-encoded phase-shift keying (same as Differentially-encoded quadrature Phase-Shift Keying) |
| FAW | Frame Alignment Word |
| FE | (Facteur d'Echelle) This denotes a 3-bit scale factor word (R_2, R_1, R_0); FE1 and FE2 denote the 3-bit scale factors applicable to the first and second sound companding blocks, respectively, in a given frame |
| FM | Frequency Modulation; referring to the existing analogue, frequency modulated carrier, monophonic sound signal (television systems B, G, H and I) |
| H(f) | filter amplitude-frequency response |
| LSB | Least Significant Bit |
| M1 | first digital mono sound signal when in "dual sound" or "mono sound + data" modes |
| M2 | second digital mono sound signal when in "dual sound" mode |
| MAC | Multiplexed Analogue Component |
| MSB | Most Significant Bit |
| PPM | Peak Programme Meter |
| QPSK | Quadrature Phase-Shift Keying |
| R_2, R_1, R_0 | scale factor bits associated with a given 32-sample sound companding block |
| t_s | symbol period = 1/364 ms |
| VSB | Vestigial Side Band |

4 Specification of the sound/data multiplex and sound coding methods

4.1 Baseband format

4.1.1 Frame structure

The transmitted serial data stream is partitioned into 728 bit frames which are transmitted continuously without gaps. One frame is transmitted every millisecond; the overall bit-rate is thus 728 kbit/s made up as follows:

| | |
|--------------------------------|---|
| 8-bit frame alignment word | 8 kbit/s (see subclause 4.2.1) |
| 5 bits for control information | 5 kbit/s (see subclause 4.2.2) |
| 11 bits for additional data | 11 kbit/s (see subclause 4.2.3) |
| 704 sound, parity or data bits | 704 kbit/s (see subclauses 4.2.4 and 4.2.5) |
| Total: | 728 kbit/s |

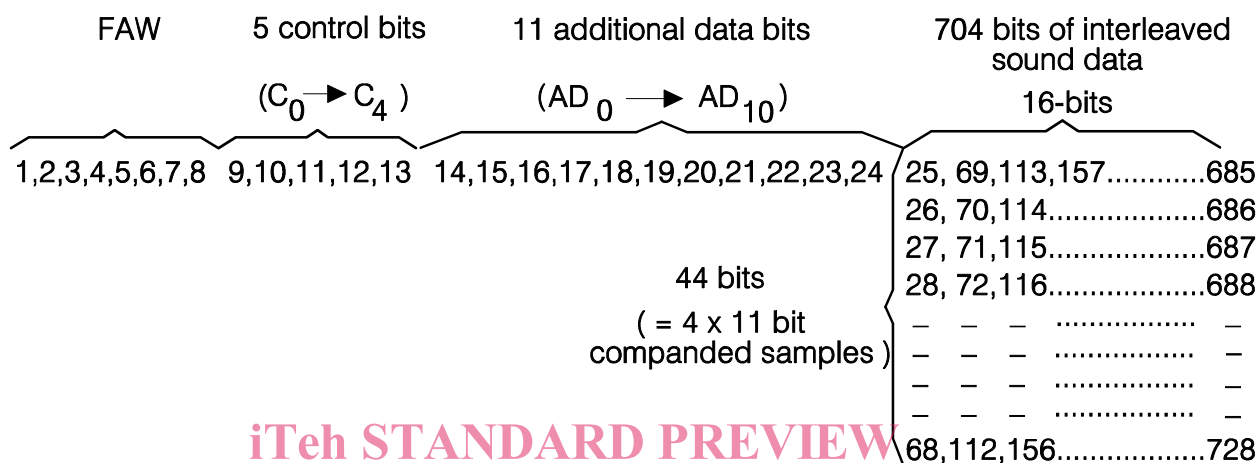
Diagrams of the frame structures for conveying stereo and mono sound signals are shown in figure 1. The 720 bits which follow the Frame Alignment Word (FAW) shall form a structure identical with that of the first-level protected, companded sound-signal blocks in the systems of the MAC/packet family [2], so that decoding of the sound signals may be performed by the same type of decoder which is used in the above-mentioned MAC systems.

The first 16 bits after the frame alignment word shall be used to signal control information (see subclause 4.2.2) and as additional data bits (see subclause 4.2.3). The corresponding 16 bits in the MAC/packet family have not yet been allocated.

Frame structures for data services shall use the same frame alignment word, frame flag bit and additional data, with other control bits as described in subclauses 4.2.2.2 and 4.2.2.3, but the audio samples are replaced by other data.

4.1.2 Bit interleaving

Interleaving is applied to the block of 704 bits which follows the frame alignment word, control bits and additional data bits in order to minimise the effect of multiple-bit errors. The bits of each frame are transmitted in the following order:



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The above interleaving pattern places data bits which are adjacent in the frame structure of figure 1 in positions at least 16 clock periods apart in the transmitted bit stream (i.e. at least 15 other bits occur between bits which are adjacent in figure 1).

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4.1.3 Energy dispersal scrambling

The transmitted bit-stream shall be scrambled for spectrum-shaping purposes. The scrambling shall be done synchronously with the multiplex frame. The frame alignment word is not scrambled, and is used to synchronise the pseudo-random sequence generator used for descrambling in the receiver. The other parameters shall be as follows:

- the bit which immediately follows the frame alignment word is the first scrambled bit and is added modulo-two to the first bit of the pseudo-random sequence;
- the bit which immediately precedes the frame alignment word is the last scrambled bit;
- scrambling shall take place after interleaving (and descrambling shall, therefore, be performed prior to de-interleaving at the receiver);
- the pseudo-random sequence is defined by the following generator polynomial and initialisation word:

Generator polynomial: $x^9 + x^4 + 1$

Initialisation word: 1 1 1 1 1 1 1 1

The diagram for a possible generator for this sequence is given in figure 2. Thus the sequence shall start 0000 0111 1011 1110 0010.