SMPTE 20M-2003
Revision of
ANSI/SMPTE 20M-1996

SMPTE STANDARD

for Television Analog Recording — 1-in Type C Recorders and Reproducers Longitudinal Audio Characteristics

1 Scope

This standard specifies the frequency response and reference level of recorders and reproducers for audio and longitudinal time and control code records for 1-in type C helical-scan television analog recording.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ANSI/IEEE 152-1992, Audio Program Level Measurement

SMPTE 12M-1999, Television, Audio and Film — Time and Control Code

3 Reference levels

3.1 Recording method

All recordings shall be made using the anhysteresis (bias) method.

3.2 Recording and reproducing level indicator

The audio recording and reproducing levels of a video tape recorder shall be adjusted with a standard volume indicator, as specified in ANSI/IEEE 152, or equivalent.

3.3 Recorder reference level

When a recording is made from a sinusoidal signal having a frequency of 1000 Hz such that the rms short circuit tape flux per unit track width on the record is 100 nWb/m ± 3 nWb/m of track width, the recording volume indicator shall be adjusted to deflect to its reference level (0 vu) scale mark.

3.4 Reproducer reference level

When a tape record having an rms short circuit tape flux per unit track width of 100 nWb/m and a frequency of 1000 Hz is reproduced, the reproducing volume indicator shall deflect to its reference level (0 vu) scale mark.

4 Frequency response

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4.1 Recorder flux/frequency response

When a tape record is recorded from a constant voltage level applied to the input terminals of the recording system, the short circuit tape flux level on the record versus frequency, $L_\Phi(f)$, shall be as given by the following equation:

$$L_\Phi(f) = 10 \log_{10} \frac{1+\left(\frac{F_l}{f}\right)^2}{1+\left(\frac{f}{F_h}\right)^2} \quad [\text{dB}]$$

where L_Φ is the relative tape flux level; f is the frequency at which the response is being computed; F_l is the low-frequency transition frequency, 50 Hz; and F_h is the high-frequency transition frequency, 10,610 Hz (see annex A.1).

4.2 Reproducer flux/frequency response

When a tape record having a short circuit tape flux level versus frequency given in 4.1 is reproduced, the output voltage level of the reproducer versus frequency shall be constant.

5 Relative polarity

5.1 Recording polarity

The recording equipment, being fed a positive waveform on pin 2 at its input, will produce a positive magnetization on the magnetic recording medium. A positive magnetization is the same direction of magnetic flux flow as that observed in a bar magnet where the flux flows out of the north and into the south pole. This flux flow is in the direction of the physical movement of the magnetic surface.

5.2 Reproduction polarity

Reproduction of a positive magnetization on the magnetic surface will provide a positive waveform on pin 2 of an XLR-3 connector at the output of the magnetic reproduction equipment (see annex A.2.)

5.3 Record/reproduce audio head phasing

When a tape record having been produced by the same signal being recorded on the audio 1 and audio 2 tracks is reproduced by individual head gaps for audio 1 track and audio 2 track, the phase difference between the audio 1 and 2 signals shall not exceed 30° at 12 kHz (see annex A.3).

6 Track usage

6.1 Nonstereo audio

The primary program audio channel shall be recorded on the audio 1 track.

6.1.1 When the same signal is recorded on the audio 1 and audio 2 tracks, the tracks shall be so phased that, when reproduced with a head wide enough to sense the recorded flux on both records, they will be additive.

6.2 Stereo audio

When separate channels are used for stereo audio, the left channel shall be recorded on the audio 1 track and the right channel on the audio 2 track.

6.3 Time and control code

When used, a time and control code shall be recorded on the audio 3 track.

6.3.1 Position of the code on the video tape

6.3.1.1 The start of the address for original recording shall be as specified in SMPTE 12M.

6.3.1.2 The position of the address start point along the tape is determined by the position of the appropriate audio head gap.

6.3.2 Recorded signal

6.3.2.1 The input waveform of the recorder for original time and control code recordings shall be as specified in SMPTE 12M.

6.3.2.2 The amplitude of the recorded signal shall be such as to produce a peak-to-peak short circuit recorded flux level on the tape of at least 141 nWb/m of track width.

Annex A (informative)
Additional data

A.1 The record flux level versus frequency method given in 4.1 is equivalent to the more familiar reproduce time constant method. Transition frequencies may be calculated with the following equation:

$$F = \frac{1}{2\pi T}$$

Equivalent time constants would be:

T_l = 3180 µs
T_h = 15 µs

A.2 A recording channel is positive when a positive pulse produces a magnetic flux flow across the recording head gap in the direction of the tape movement. A reproducing channel is positive when a positive magnetization on the tape produces a positive pulse at the output (see figure A.1).

Positive polarity may be simulated in a reproducer by either of the two methods given below:

Method No. 1. Face the south pole of a magnet toward the reproduce head. Move the magnet past the head in the direction of tape movement, near enough to the head to produce an output from the reproduce channel. Observe the output of the reproduce channel on an oscilloscope. The first half cycle of the sine wave should be positive going (see figure A.2). Precaution should be taken to prevent magnetization of the heads or other metal surfaces.

Method No. 2. Positive polarity may be simulated in a reproducer by passing a dc pulse through a wire which is parallel to the reproduce head gap. A practical signal for measuring polarity can be generated in an induction loop by half-wave rectifying a 400-Hz sine wave. When the positive-going half-wave current flows through the conductor up through the page toward the observer (see figure A.3), this signal should produce a positive-going waveform at the output of the reproduce channel. (By classical definition, what is considered current flow is opposite to electron flow.) This signal may also be recorded and reproduced to verify the polarity of the record channel.

A.3 Record/reproduce audio head phasing may be measured by using a single, wide head to record audio 1 track and audio 2 track simultaneously. When the signal is reproduced with individual heads, the relative phase is a measure of the accuracy of alignment of the reproduce head gaps. An example would be a relative phase not to exceed 30° in the 100 Hz to 12 kHz frequency range as stated in 5.3.

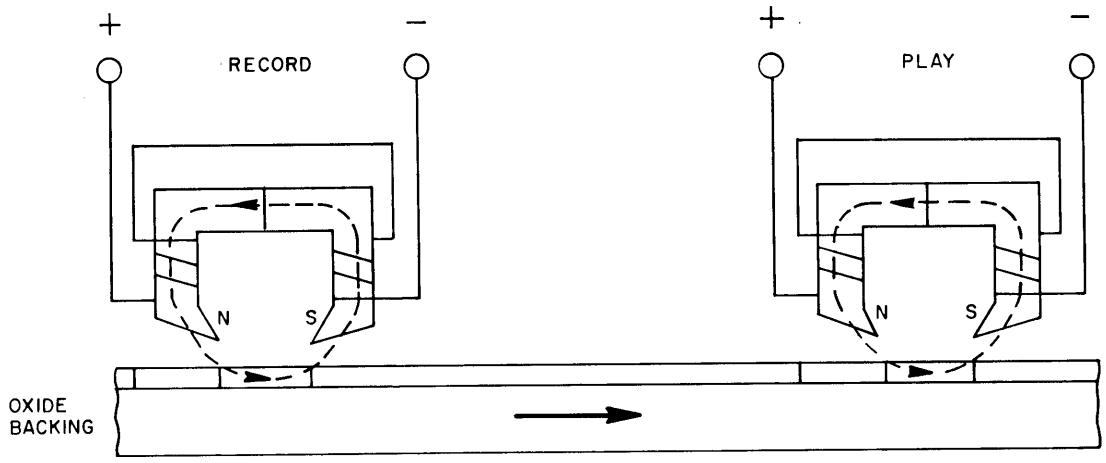

Figure A.1 – Orientation of magnetic head gaps

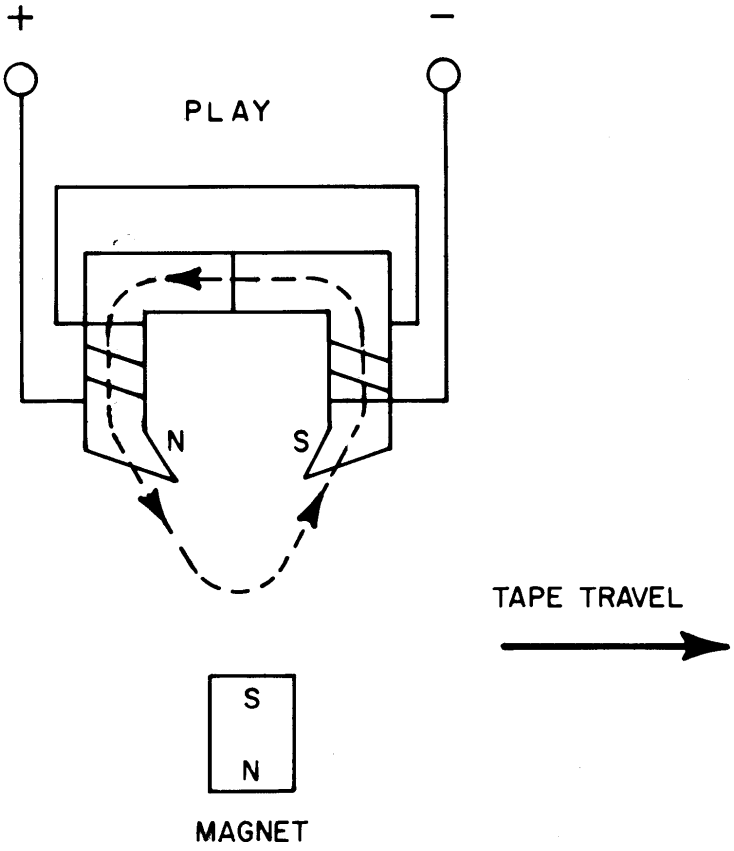

Figure A.2 – Magnetic method for determining polarity

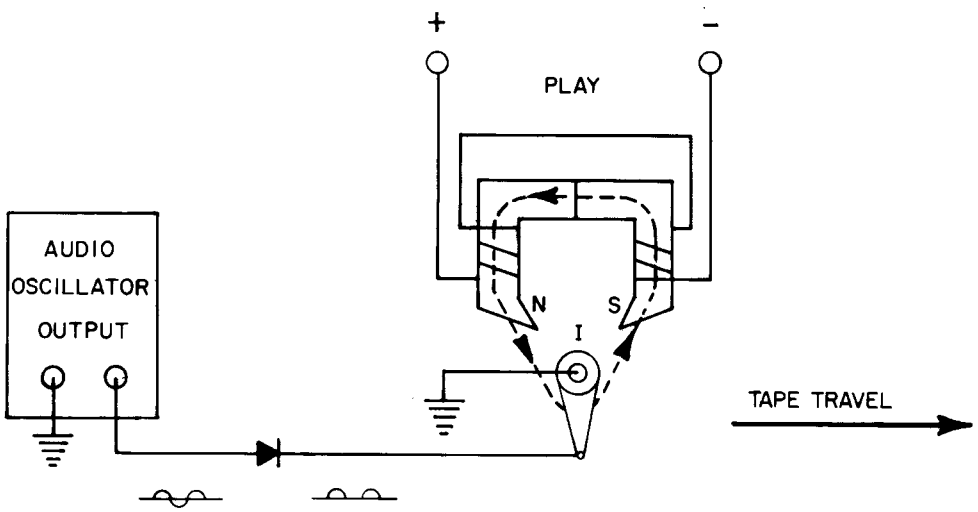

Figure A.3 – Induction loop method for determining polarity

Annex B (informative)
Bibliography

SMPTE 18M-2003, Television Analog Recording — 1-in Type C — Basic System and Transport Geometry Parameters