RMA Completes Television Standards

Recent approval by RMA Television Committee of items not heretofore standardized involves adoption of serrated type of vertical synchronization pulse, negative modulation, constant black level and "equalizing pulses"

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PROGRESS toward commercial television took a decided step forward on June 3, 1938, when the RMA Television Committee voted approval on the remainder of the items which complete the list of recommended television transmission standards for the United States. Hundreds of radio engineers now engaged in the sound broadcast field will design and construct the television equipment of the future, and it is for them that this article lists and explains briefly the standards.

For several years the RMA Television Committee has been working toward the formulation of not only a single set of standards, but the best standards from the practical operating standpoint, for our country. To arrive at these has required: first, the joining of various active television engineering groups (whether RMA members or not) into a united body, working for a common cause; second, a great deal of engineering, experimentation and field testing by individual companies, followed by an open discussion of the results, and, finally, conferences in which standards, having in most cases the unanimous approval of the Committee, were formulated. These standards have been approved by the RMA Board, in spirit. They may be altered in wording before transmission to the Federal Communications Commission for approval.

Complete List of Standards

In the paragraphs that follow, relating to standards, brief explanations are offered where necessary.

Number of Lines per Picture

It is recommended that there should be 441 lines per picture (or

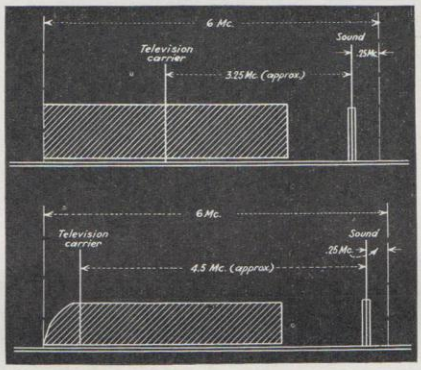

Fig. 1—(above) Typical television channel. Fig. 2—Recommended channel for single-sideband transmissions

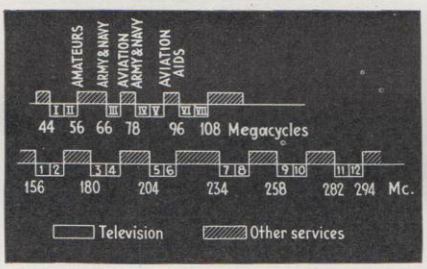

Fig. 3—Arrangement of television channels in u-h-f spectrum

frame). This number of lines is necessary to approach home motion picture quality. The exact choice of 441 was dictated by these factors:

(1) The type of interlacing specified requires an odd number of lines;

(2) To simplify the generation of synchronizing signals at the transmitter it is preferable that the number have simple factors, for instance for 441 lines we use 3x3x7x7.

Frame Frequency

A frame frequency of 30 per second, a field frequency of 60 per second, interlaced, is recommended. (A frame is one complete picture. A field is a single complete scan.) The frame and field frequencies were chosen to be high enough to eliminate flicker completely. The exact number was chosen because, being a multiple of the 60 cycle supply frequency, hum difficulties can be economically avoided. In the United States the majority of the supply systems are 60 cycle. Interlaced scanning is practically a necessity when flicker is to be avoided and a 441-line picture is transmitted in a channel 6 Mc. wide. An interlace ratio of 2:1 was selected to secure the benefits of interlacing without sacrificing picture quality.

Aspect Ratio

An aspect ratio of 4:3 is recommended to conform with existing motion picture practice.

Polarity of Transmission

It is recommended that a decrease in initial light intensity shall cause an increase in radiated power. This means negative transmission (or modulation) is used.

Channel Width

Television channels should not be less than 6 Mc. in width. With limited space in the radio spectrum available for television service channels must necessarily be limited in width to permit the greatest possible number of simultaneous programs to be broadcast. However, each channel must be wide enough to allow sufficient information to be transmitted to reproduce a picture of sufficient detail to have lasting entertainment value. To transmit the full information arising from the scan-

ning of a 441-line picture, a channel wider than 6 Mc. is necessary unless single side-band operation can be accomplished. See Figs. 1 and 2.

Television and Sound Carrier Spacing

It was previously the recommendation of RMA that the sound and picture carriers be separated by approximately 3.25 Mc. (See Fig. 1.) In view of recent developments, however, it is the recommendation of RMA that the sound and picture carriers be separated by approximately 4.5 Mc. This standard shall supersede that of "approximately 3.25 Mc." as soon as single side band operation at the transmitter is practical. (See Fig. 2.)

Sound Carrier and Television Carrier Relation

It is recommended that in a television channel the sound carrier shall be at a higher frequency than the television carrier.

Position of Sound Carrier

It is recommended that the sound carrier in the television channel be located 0.25 Mc. lower than the upper frequency limit of the channel. See Figs. 1 and 2.

Percentage of Television Signal Devoted to Synchronizing

It is recommended that if the total amplitude of the composite television signal is taken as 100% not less than 20% shall be used for synchronizing pulses. It is a television axiom that picture synchronism must be maintained even to the point where the picture signal is too weak to produce a usable image. Therefore, sufficient transmitter amplitude must be assigned to synchronizing — but more than this is not economical of power.

Transmission of Black Level

It shall be standard in television transmission that black in the picture be represented by a definite carrier level, independent of the light and shade in the picture. It is highly desirable to maintain the black level at a definite value, as mentioned below.

TABLE 1.

Specifications for RMA Synchronizing Signal

Pulse	Number	Duration	Spacing	Position
1. Horiz. sync.....		0.08 H.*	H	
2. Equalizing.....	6 before 6 after Vert. pulse	0.04 H. (max)*	0.5 H	Alternate pulses in alignment with Horiz. Pulse
3. Vertical Sync.....	6	0.43 H. (min)* 0.46 H. (max)*	0.5 H	Alternate pulses in alignment with Horiz. Pulse
4. Blanking — Horiz...		0.15 H. #	1.0 H	Tip leads Horiz. Pulse by 0.01 H.
5. Blanking — Vert....		0.07 V.† (min)# 0.10 V.† (max)#	1.0 V†	Tip leads first Vert. Sync. Pulse by 3 H (min) 4 H (max).

NOTE A. Sequence of Transmission { Sync. Pulses / Blanking Pulses } $\frac{1}{2}, \frac{2}{3}, \frac{3}{3}, \frac{3}{3}, \frac{3}{3}, \frac{2}{3}, \frac{1}{2}$.

NOTE B. Wavefront of Pulses 1, 2 and 3 have time of rise equal to time of fall which is 0.005 H.

NOTE C. Amplitude of Pulses 1, 2 and 3 are equal.

* Measured at base of pulse in terms of H, which is the time from the start of one line to the start o the next.

\# Measured at tip of pulse.

† V — Time from start of one field to start of next field.

Synchronization

It is the recommendations of RMA that the synchronizing signal consist of the wave forms shown in the official RMA print, available later. Until the official print is ready the synchronizing signal is placed before the reader in two forms. If the reader wishes to construct equipment to generate the signal he should refer to Table 1, where the specifications and tolerances are listed. Figure 4 is for the purpose of explanation. It is a simplified diagram.

Note that the video signal is interrupted for brief periods at the end of each scanning line. During these periods horizontal synchronizing pulses are transmitted. At the completion of each picture field the video signal is interrupted for a longer period, during which the vertical synchronizing and the equalizing pulses are transmitted. These interruptions are accomplished electrically by horizontal and vertical "blanking" signals, respectively.

The fixed level of the blanking signals represents black in the picture, and is the dividing line between video and synchronizing signals, as shown in Fig. 4.

The horizontal pulses serve to start each scanning line at the receiver. The vertical synchronizing signal starts each new picture field.

To maintain horizontal synchronism during the vertical signal the latter is serrated so that the wavefronts of the serrations act to produce horizontal pulses. The serrations are spaced one-half the interval between normal horizontal pulses. The reason for the use of twice as many serrations as necessary for horizontal synchronization is to make identical the vertical synchronizing signals belonging to odd and even fields. Identical vertical signals are essential for proper interlacing.

Equalizing pulses are used before and after the vertical signal. They are of particular importance to receivers where vertical synchonizing circuits employ integration. One-half horizontal interval spacing is necessary between these equalizing pulses in order that the integrated vertical signal for both odd and even fields

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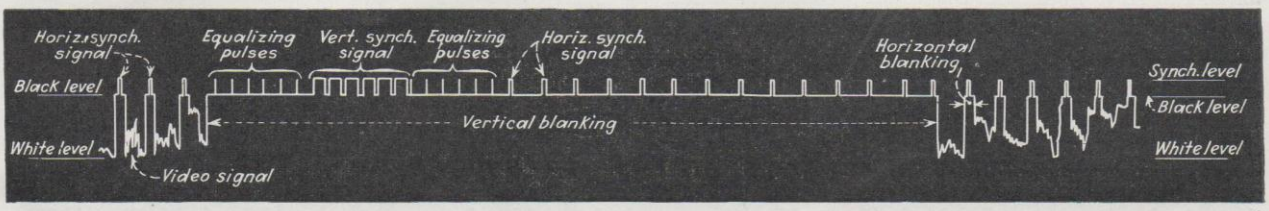

Fig. 4—Simplified diagram of the waveform of the recommended synchronizing signal. Details are given in Table 1, above

RMA Standards

(*Continued from page 29*)

be identical, permitting proper interlace.

These are the recommended standards—sufficiently comprehensive so that the type of signal radiated by transmitters following these standards will be uniform. Philco's experimental television transmitter, W3XE in Philadelphia, is already transmitting signals according to these standards. It is believed the NBC television transmitter at the Empire State Building, New York City, soon will be radiating signals conforming to the RMA Standards. Other experimental transmitters will follow.

In these days of pre-commercial television these standards are naturally tentative. The RMA Television Committee realizes there will be changes and additions as television development moves onward.

Now that standards have been drafted, after being in the formative stage for several years, researchers in the television field feel that at this time they can confidently plan concentrated work along the definite lines indicated by the chosen standards.

Editors Note: The work of the RMA Television Committee is an outstanding example of cooperation in a highly complex technical and commercial situation. In view of the many compromises necessary between different points of view, the members of the committee, listed below, are to be commended for completing a difficult job.

RMA Television Committee

Group 1. Members: J. E. Brown, Zenith Radio Corp.; R. B. Brown, Philadelphia Storage Battery Co.; E. W. Engstrom, RCA Manufacturing Co.; I. J. Kaar, General Electric Co.; H. M. Lewis, Hazeltine Service Corp.; R. H. Manson, Stromberg-Carlson Tel. Mfg. Co.; H. V. Nielsen, Sparks Withington; H. J. Tyzzer, Crosley Radio Corp. This committee reports to Virgil M. Graham, Sections Chairman, who in turn reports to W. R. G. Baker, RMA Director of Engineering.

Group 2. Invited members (not representing RMA Member Companies): R. Bown, Bell Telephone Laboratories; P. C. Goldmark, Columbia Broadcasting System; A. N. Goldsmith; J. V. L. Hogan, Radio Pictures; R. M. Morris, National Broadcasting Co., Inc.; P. T. Farnsworth, Farnsworth Television Inc.; A. F. Murray (Acting Chairman), Philco Radio & Television Corp.