

Digital TV Line Standards Converters

Painting by numbers

Electronic standards converters for changing 625-line television pictures into 405-line pictures have been used by the B.B.C. and I.T.A. at main transmitters for some years—their function being, of course, to provide a 405-line service from picture sources which are now almost all 625-line. These converters work on an analogue principle. During the 1970s the broadcasters will be gradually changing over to digital signal processing and distribution—all video information between the picture source and transmitter being represented by binary numbers on the p.c.m. principle. Meanwhile, the need for the 405-line service continues and in any case it will be carried on beyond the useful life of the present analogue standards converters. With this situation in mind both the B.B.C. and the I.T.A. have developed digital line standards converters. These, when eventually in operation, will be able to handle the digitally represented video information directly, and are expected to be more reliable and simpler to operate than are the analogue converters. *Wireless World* recently saw a demonstration of the B.B.C.'s experimental digital converter, developed at the corporation's Research Department, Kingswood Warren, Surrey.

In a line standards converter, whether analogue or digital, two main processes

are required. First, the input signals, which have been derived by scanning the scene according to a 625-line raster pattern, are modified by an 'interpolation' process. In this process 405 lines are derived from the incoming 625-line picture, in such a way that each derived line (still having a duration according to the 625-line/50-field standard) carries information corresponding to the scanning of the scene by a 405-line raster pattern. The process consists of combining the signals from two or more successive input lines in accordance with the relative positions of corresponding lines in the 625- and 405-line raster patterns, assuming the rasters to be superimposed. Secondly, the 405 lines provided by the interpolation process are individually adjusted in duration so as to occupy the correct time intervals demanded by the 405-line/50-field standard. This 'time-redistributing' process is effected by means of information stores. For this reason the whole system is described as a 'line-store converter'.

The B.B.C. digital converter (Fig. 1) samples the incoming 625-line/50-field signal at a rate of 11MHz. The magnitude of each sample is then represented by an 8-digit binary number; thus the input signal is quantized into 256 discrete levels. The process of interpolation is carried out

using a digital store—an m.o.s. integrated circuit shift register—with a capacity corresponding to the information contained in one input line, together with high-speed binary 'arithmetic' which accepts two 8-bit numbers or 'words', multiplies each by a suitable 3-bit number and adds the resulting products. These arithmetical operations are achieved with an unusual type of logic, devised by J. P. Chambers, involving clocked delays, and this is implemented by t.t.l. integrated circuits.

The second, time-redistributing, process is carried out using an assembly of stores—again m.o.s. shift registers—each having a capacity corresponding to one input line. Each wanted line from the interpolator is 'loaded' into one of the redistributing stores at a rate corresponding to 625-line scanning. Shortly after the store has been fully loaded it is 'emptied' at a rate corresponding to the 405-line scanning standard. By providing a suitable number of shift register stores and a suitable switching arrangement, it is possible to ensure that the stores can be loaded and emptied in sequence and that all the wanted lines are suitably processed in the correct order. Finally, ancillary circuits provide 405-line/50-field sync pulses in digital form which are added to the digital signals from the time-redistributing stores, and the combined digit stream is fed out.

For the purpose of the demonstration the output digit stream was fed into a digital-to-analogue converter (shown in Fig. 1) to produce a conventional 405-line video signal, and this was displayed on a monitor alongside the original 625-line picture on another monitor. No difference could be seen between the two pictures except very occasionally when the interpolator could not derive exactly the right information to present a particular optical pattern correctly in certain parts of the 405-line picture. It was explained that this was due to a limitation of the interpolation formula, which uses quantities (binary numbers) drawn from only two successive television lines. Future designs of digital converter would use a more advanced formula—and consequently more arithmetical operations—based on a greater number of successive lines, and this would reduce the interpolation errors.

The I.T.A. converter, which has not yet been demonstrated, is similar in principle to the B.B.C. one, we understand, but operates at the higher sampling rate of 13MHz. Although these line standards converters are not primarily intended for giving a colour television signal output, the I.T.A. state that their equipment, because of its higher sampling rate, could in fact handle the colour information in the chrominance signals as well. This would be necessary, for example, if the line converter were used as part of a complete colour television standards converter† giving field rate conversion as well—say for changing American colour pictures to European colour pictures.

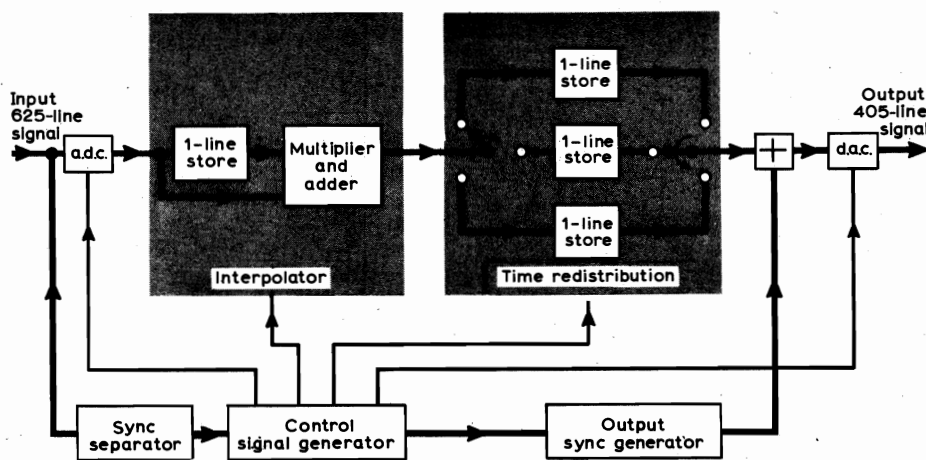


Fig. 1. Principle of the B.B.C. digital line store converter. The analogue-to-digital converter (a.d.c.) quantizes the input signal and translates the samples into binary numbers, as in p.c.m. If the input signal were already encoded, assuming a p.c.m. distribution system, this a.d.c. would not, of course, be necessary.

† "Colour TV Standards Converter", *Wireless World*, Oct. 1967.