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TELEVISION RECEIVER DESIGN ASPECTS FOR EMPLOYING TELETEXT LSI

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1. Introduction

Television multiplex broadcast has caught world-wide interest as a new information media.

In Japan, multiplex sound broadcasting started last September and was an immediate sensation. Preparations for introducing TELETEXT broadcast are now under-way.

In the United Kingdom, TELETEXT broadcasting to an unified specification has already begun service. We are now providing to the U.K. market a 22" compact color television receiver which includes a build-in TELETEXT decoder without changing the appearance of the set at all.

This paper describes the TELETEXT receiver design.

Figure 1 shows the TELETEXT receiver block diagram. Above the dotted line are all the normal blocks found in a conventional TV receiver.

For TELETEXT reception, an existing receiver requires the TELETEXT controls, a TELETEXT decoder, data display circuits, and an additional power supply. The cost of adding a TELETEXT capability to an existing receiver, therefore, depends upon the channel selection circuit system, analog control, video output and power supply of the existing set, and, of course, the control system of the TELETEXT decoder itself.

Table 1.
Number of semiconductors used.

	Present Receiver	Receiver with TELETEXT
IC	10	25*
Transistor	60	65
Diode	65	84
FET	2	2
GCS	1	1

*10 ICs are used for TELETEXT decoder circuit.

Table 1 compares the number of semiconductors in our present 22" remote controlled receiver with that of the receiver with the TELETEXT added.

All the TV and TELETEXT functions can be remote controlled and the TV functions can also be controlled manually.

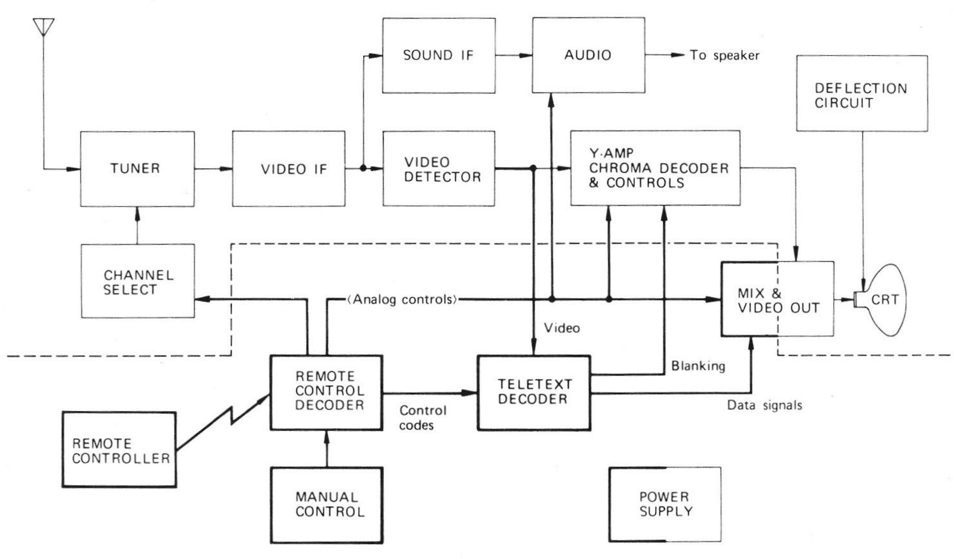

Fig. 1. Block diagram of the TELETEXT receiver.

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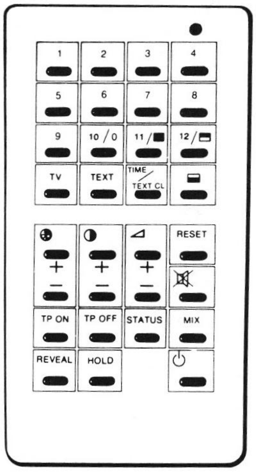


Fig. 2. TELETEXT remote controller.

Figure 2 shows the TELETEXT remote controller. Some of the functions of the remote controller are:

(1) The status key superimposes channel identification on the picture. The time key superimposes the time.
(2) The text key causes the index page (page 100) to appear. A single key press is all that is required.
(3) The character height keys cause the text to be displayed in double height characters. The top and bottom halves of the page are displayed separately.
(4) The hold key stops the reception of TELETEXT data so that updating does not take place.
(5) The TP/ON (Timed Page On) key can select a particular page to be captured at a particular time.
(6) The mix key allows the TELETEXT display to be superimposed on the normal TV picture.
(7) The picture key controls the brightness of the TELETEXT display.

These are the main functions made possible by the use of the TELETEXT decoder combined with the TV receiver and the remote controller.

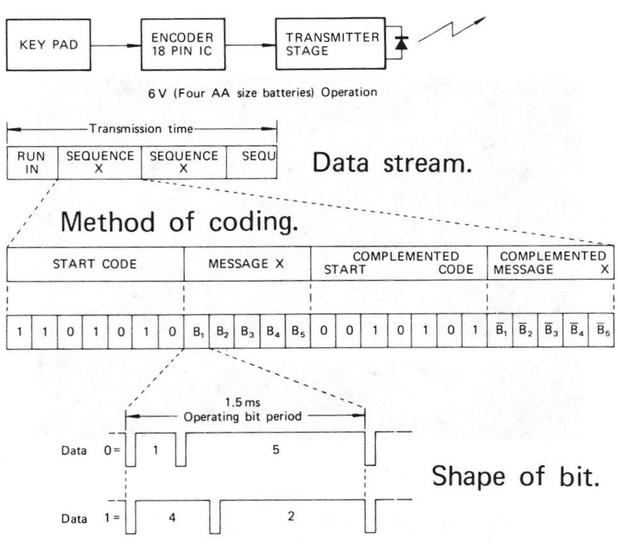


Fig. 3.

2. Design Aspects

2.1 Remote Control

The random access remote controller handles 31 commands with a system using infrared rays.

Figure 3 illustrates the system of transmission.

When a command is entered on the key pad of the remote controller, a short pseudo-random sequence and a 24 bit data sequence are transmitted. The 24 bit data stream consists of a 7 bit start code and a 5 bit message and their binary complements for a total of 24 bits.

The transmission of the binary complements of the start code and message allows checking for false responses caused by adverse transmission path conditions. The five message bits give a maximum of 32 possible commands.

The infrared remote control system is desirable because of its stability. We believe that a code system for remote control commands may be necessary and desirable because of the large number of commands possible. The present model uses the pulse system for transmitting data. But, because a long coded data sequence is susceptible to noise interference, we feel that the carrier system may be more effective than the pulse system. We will consider using the carrier system in future models.

A remote control system with 31 different commands may at first appear complicated. Careful design of the key layout of the controller and the use of a sound "bleep" to enable the user to confirm every command will faciliate use.

Normally, the viewers read TELETEXT information at a comparatively shorter distance than they would watch an ordinary TV program, so there is no need to devise remote controls that must work at a long distance. About 5 meters from the receiver seems to be the required range for a 22" receiver.

Figure 4 shows block diagram of the remote control decoder.

The infrared signal is detected by a photodiode, and is amplified by the amplifier. The manual control generates the same data codes the remote controller, but the function is limited to the TV analog controls. This data is fed to the decoder input.

The remote control decoder is a 24 pin IC. It possesses three functions: analog control, channel selection and TELETEXT control.

(1) Analog control consists of color, picture, and volume, along with stand-by and muting control. Color, picture and volume outputs produce a variable mark space digital waveform adjustable over 62 levels.
(2) Channel selection generates an appropriate number of stepping pulses for the tuning system and LED display for channel identification.
(3) TELETEXT control provides 7 bit serial data, 5 bits of which are identical to the input command message code. The other two bits control TV and

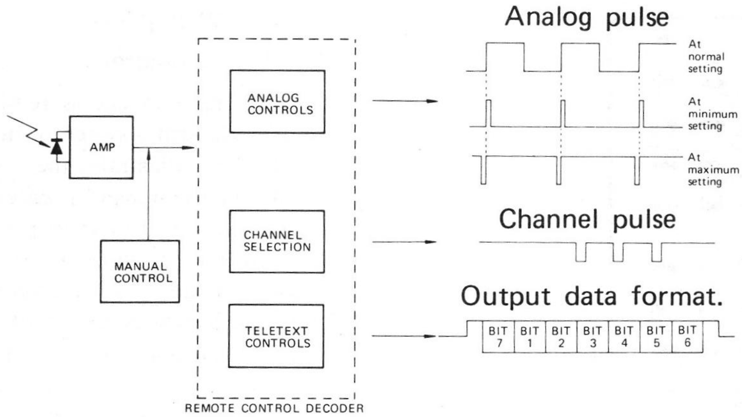


Fig. 4. Remote control decoder.

TELETEXT modes.

It is a great advantage to be able to connect the code directly to the TELETEXT decoder.

2.2 Video IF

The quality of NRZ coded data signals within the field blanking interval of television signals greatly depends upon the characteristics of the transmission path. The IF characteristics are almost the same as that of a conventional TV receiver without pulse equalization circuits.

(1) Circuits

The video IF detection method uses a synchronous detector. The peak detected AGC circuit has good frequency response against flutter.

We have decided to use a LC filter. Certainly the SAW filter has a good reputation for group delay response, but we were afraid that we would not be able to maintain the required accuracy in mass-production at that time.

(2) Characteristics

The theoretical spectrum of data pulses extends to about 7 MHz as a sequence of bits. But they are mostly distributed in the region up to 3.5 MHz (half data rate). In our receiver, group delay response is within 50ns peak-to-peak up to 3.5 MHz and the amplitude response is flat up to 3.5 MHz. (see Fig. 5)

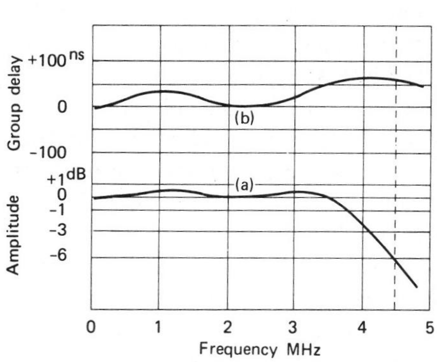
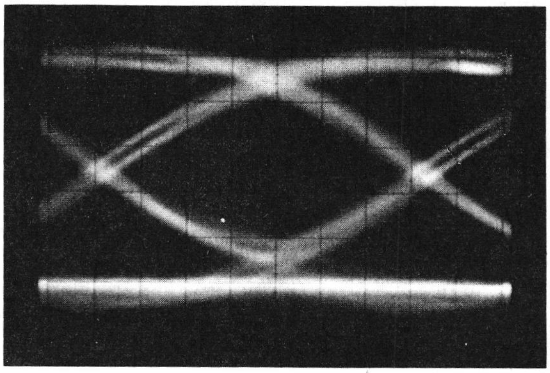
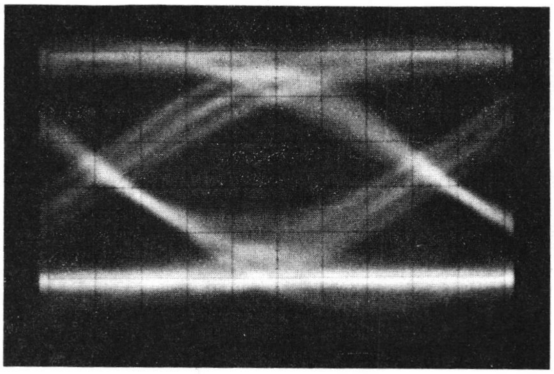


Fig. 5. Video amplitude (a) and Group delay response (b).

Sixty-five to 70% of the eye height can be obtained by using a synchronous detector. This is a better performance than that obtained by envelope detector (see Fig. 6a,b), and it provides an almost constant eye height against variation in the video data amplitude.



(a) Output of synchronous detector.



(b) Output of envelope detector.

Fig. 6. Eye height.

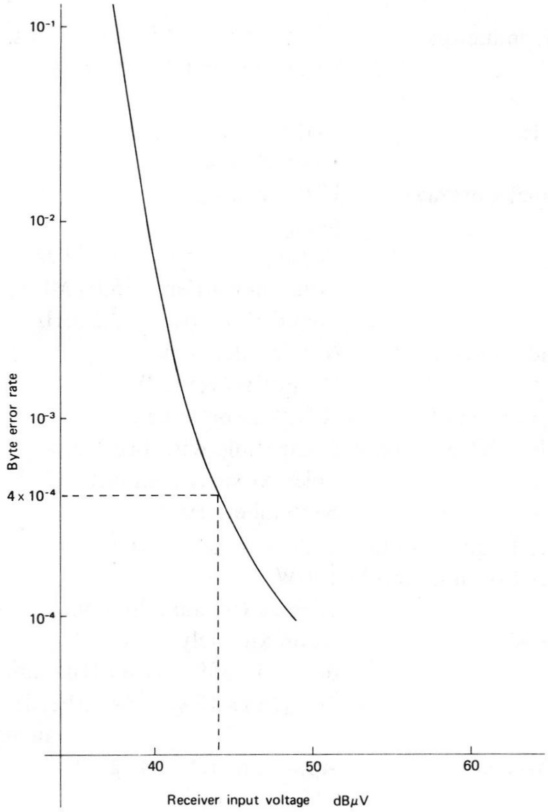


Fig. 7. Byte error rate.

The byte error rate is 4×10^{-4} at the field strength of 44 dBμV (S/N 30 dB), which can be converted to a bit error rate of less than 1×10^{-4}, and this is satisfactory data reception. (see Fig. 7)

Table 2 shows the minimum signal strength for error free TELETEXT reception using an index page and the same receiver at the end of 3 relay stations. These figures come from a field test held in the U.K.

Table 2

Channel Received	At the end of 3 relay stations
41	48 dBμV
44	48 dBμV

2.3 TELETEXT Decoder

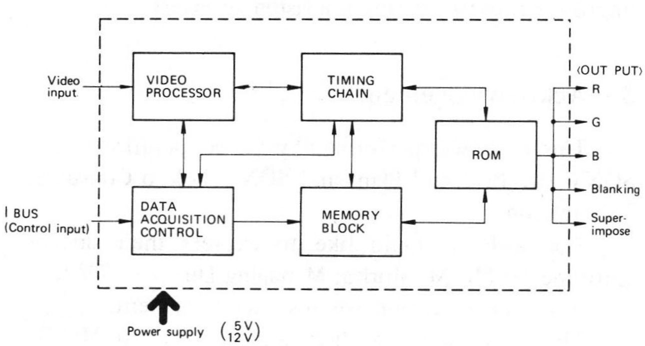


Fig. 8. Inputs and outputs of the TELETEXT decoder.

The TELETEXT decoder is a 160 mm x 120 mm circuit board containing four LSI chips and two 4k bit RAMs for storing a page of data. When the TELETEXT decoder receives the control signals (I bus) from the remote control decoder, it extracts the TELETEXT data signal from the video detector output and obtains red, green and blue data signals which are synchronized with the TV picture. The TELETEXT decoder also generates the necessary blanking signal. Figure 9 shows how the above signals relate to each other. The end result is that the cathode voltage contains the TV and subcaptioning display signals.

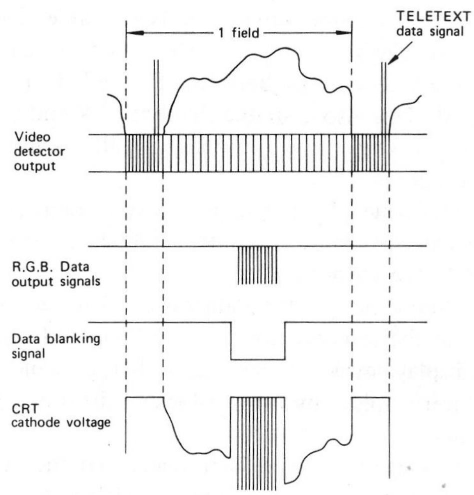


Fig. 9. How the signals combine.

Because the decoder has an output only in the TELETEXT mode, there is no need to interpose switching circuits of R,G,B color signals interfacing the receiver.

Power consumption of the TELETEXT decoder is 5W or less. As a circuit with relatively low voltage and high current will be used, we should consider the power supply to be used and the circuits' ripple immunity.

2.4 Blanking and Display

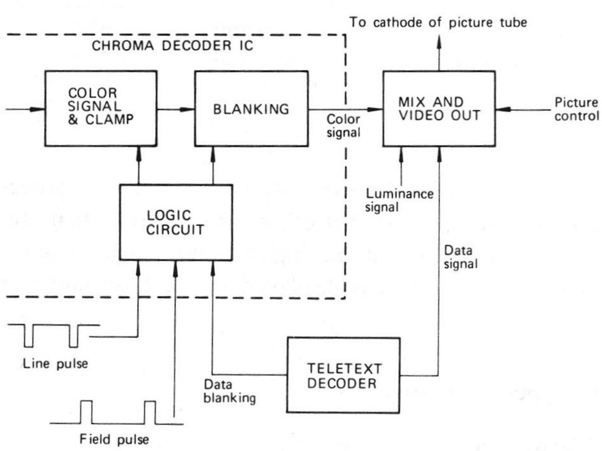


Fig. 10. Blanking and Mix circuit.

The TV mode operates only when TV video signals are supplied at the Mix and Video output stages.

In the TELETEXT mode, a blanking signal from the TELETEXT decoder blanks the TV color signals. The data blanking signal is used for complete TV picture blanking and for caption box blanking as well. The TELETEXT signal obtained simultaneously drives the cathode at the Mix and Video output stages.

In the MIX mode there is no blanking output from the TELETEXT decoder, so that the TV picture and the TELETEXT display appear on the screen at the same time.

The data signal from the TELETEXT decoder consists of R, G, B color signals. It is desirable that the receivers use the same color decode system so that only simple interface circuits between TV and data signals are needed. It is also desirable that both TV and data be driven by a single video output circuit to minimize spurious radiation.

The brightness of the data display is adjustable by the TV receiver's picture control, which controls the Mix and Video output stages.

The luminance of the data display has been set to 110 nits at the standard control condition and provides a good display image on the screen. It is possible to get even clearer displays by using a lower light transmission CRT panel.

Some suggestions have been made that the number of characters in a row be increased by developing a high resolution picture tube, but in order to take full advantage of a high resolution tube, we feel a smaller screen must be used.

We know that our current 13 inch picture tube can give us acceptable data displays on the screen, but better displays are possible by making a finer aperture grill. Table 3 compares the AG pitches and number of slits of a conventional 13 inch CRT with those of a high resolution CRT of the same size.

Table 3

	AG pitch	No. of slits
Conventional CRT	0.6 mm	386
High resolution CRT	0.4 mm	579

The geometrical distortions are not only the deflection distortions, but distortion also occurs when the dynamic regulation of the high voltage circuit is poor, especially when data is displayed in the flash and mix modes.

3. Specifications

Television System:	British color standard
Color System:	PAL
Picture Tube:	56 cm, 22″ 114° deflection
Semiconductors:	65 transistors, 2 FETs, 25 ICs, 84 Diodes and 1 Gate Controlled Switch
Aerials:	UHF: 75 unbalanced (coaxial aerial socket)
Channel Coverage:	UHF channels: 21–68 (12 program selection)
IF:	Picture i-f carrier: 39.5 MHz Color subcarrier: 35.07 MHz Sound i-f carrier: 33.5 MHz
Sound System:	6 MHz intercarrier Output power: 2W
Video System:	R,G,B cathode drive
TELETEXT Selection:	Compatible with broadcast Teletext specification, September, 1976
Power Requirements:	200/240 V ac, 50 Hz
Power Consumption:	130 W 15 W ac (in stand-by condition)
Dimensions:	Approximately 669 (w) × 459 (h) × 413 (d) mm 26 3/8 (w) × 18 1/8 (h) × 16 1/4 (d) inches
Net Weight:	Approximately 34 kg

4. Conclusion

(1) A television receiver with a remote controller is essential for the convenient use of the TELETEXT receiver.

(2) An advantage of the TELETEXT decoder is that it can be combined with a remote control system to make a TELETEXT control system, which means that the interface circuitry will be simpler.

(3) The input video amplitude of the TELETEXT decoder varies with the receiver, the transmission quality and other factors. The error immunity and sync stability of the TELETEXT decoder depends on the quality of the input video signal. Therefore, it is desirable that the TELETEXT decoder have a more relaxed tolerance for the amplitude of the signal.

(4) For public approval of TELETEXT, it is important to minimize necessary additional modifications and improvements to existing television receivers.

5. Acknowledgement

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