Recent Equipment

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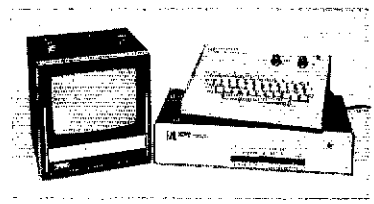
The HAL Communications RVD-1002 RTTY Video Display Unit and the RKB-1 TTY Keyboard



ONCE UPON A TIME there was a member of the Headquarters staff (now retired) who said, "The mere sight, sound, and smell of RTTY turned me off years ago!" The HAL Communications Corporation (formerly HAL Devices) video-display RTTY system pictured at the upper right might very well have been developed just for that statter, for gone is the oily smell, gone is the noise, and gone is what some might consider an unsightly mechanical monstrosity. In contrast, the HAL RTTY system is compact and fully solid state, employing the latest in modern integrated circuits. Using digital logic instead of selector-bar mechanisms and using memory capability which would have been totally impractical for amateur use a few years ago, the RVD-1002 video unit and associated display is unlike any teleprinter most amateurs have ever seen. It accepts teleprinter pulses of the normal 5-unit start-stop variety alright, but then it processes them to provide video which may be displayed on an ordinary television monitor. The monitor shown in the picture in the upper right is available from HAL, and is a commercially made one for use in a closed-circuit TV system. However, the RVD-1002 output is also compatible with the video requirements of an ordinary TV receiver, and the user may, if he chooses, perform a simple modification on a TV set and use it for his TTY monitor. The RKB-1 TTY keyboard shown in the photo completes the complement of equipment, and there may be seen a system which has all the capabilities of the ordinary mechanical page printer and keyboard. Add to this the desirable features of making speed changes at the mere flick of a couple of switches and the ability to receive copy off the air *in absolute silence* (receiver speaker disabled), and you have a TTY system with capabilities which surpass anything ever before available to the amateur.

The Display

The video output of the RVD-1002 follows the U.S. television standards – 262.5 lines per field, two fields per frame (with interlaced lines), and 525 lines per frame. The line rate is 15.750 kHz, the field rate 60 Hz, and the frame rate 30 Hz. Video bandwidth is slightly less than 4 MHz. The RTTY characters are displayed as white letters and figures on a black background, up to 50 characters per line and 20 lines for the complete display. The question immediately asked by those who first see the HAL system in operation is, "How in the world do they do that?" There are some clever techniques employed, to be sure.

The total display, a "page" of copy, may contain as many as 20 × 50 or 1000 characters. Each character of the display is formed by a pattern of white dots, arranged in a 5 × 7 format. See Fig. 1. The frequencies used in deriving the display are obtained from a crystal-controlled master oscillator, the "clock," which operates at 8.064 MHz (2^9 or 512 times the horizontal scanning rate). The duration of each dot (related to its horizontal width) is equal to the time between successive pulses from the master clock. Spacing between adjacent characters is equivalent to two dot widths. Seven horizontal scan lines are used to display a character, and three scan lines provide the vertical spacing between lines of characters. To develop the required pattern of dots for the various characters which are to be displayed, a custom-programmed character-generator static read-only memory (ROM) is used. Because the dot pattern for a particular character may vary depending upon the scan line of that character, the ROM is instructed not only as to what character to produce, but also what scan line of that character is being generated. A scan-line counter provides this latter information. As one can readily understand, the size of the characters will depend upon the screen size of the monitor in use. With a 9-inch rectangular tube (diagonal dimension), the character size is approximately 3/32 × 5/32 inch. This display can be read comfortably from a distance up to 4 or 5 feet away. The teleprinter characters are of a permanent nature, i.e., they appear continuously and with almost imperceptible flicker. The display is changed only by the writing of new information (or removal of power). New information is written as it is received, along the bottom line of the display, and a cursor indicates where the next character will appear. When the line contains 50 characters (including spaces), or when a line-feed function is received, all lines of the display shift up by one line. The cursor automatically returns to the left of the bottom-line area. This continues with each line until a full "page" of 20 lines is displayed. When the next line feed is received or when the bottom line is full, all lines again shift up one. The earliest information received, the top line of the display, disappears when this happens.

Most teleprinters are adjusted to display from 66 to 72 characters per line, sometimes as many as 75. Amateurs generally type nearly to the margin limits of their machines. The received copy with the RVD-1002 from such transmissions is therefore a full line (50 characters) followed by a half line, a full line and a half line, and so on. The 50-character line was likely chosen by HAL engineers for economy reasons, as this permits them to use standard IC memories for line and page information, and also simplifies the control requirements. "Carriage return" and "line feed" are automatic after 50 characters appear on a line, and frequently a word will be broken at the end of the line, with the final few letters appearing at the beginning of the next line. One soon becomes accustomed to this, however.

Machine functions, such as carriage return (CR), line feed (LF), letter shift (LTRS) and figure shift (FIGS), do not appear on the display. In fact, carriage-return functions are ignored completely by the RVD-1002. A received line-feed function serves to return the writing cursor to the left as well as to shift the lines up one. Unshift-on-space is available by depressing a locking push switch on the front panel, and defeated by pushing it again. Characters are displayed in accordance with the U.S. military communications keyboard arrangement, including a slant zero (Ø). A FIGS J function displays an apostrophe. Because TV monitors have no signal bell, a received FIGS S function doesn't make any noise. Instead, a little picture of a bell appears on the display. . . HAL seems to have thought of everything.

Circuit Operation

The input section of the RVD-1002 video unit accepts the incoming teleprinter pulses, which arrive in a serial or time-sequence manner. An opto coupler at the input provides isolation of the TTY loop from the remainder of the RVD-1002 circuits. The input will handle a full 60 mA of loop current, but will operate with less. A bridge rectifier type of circuit at the input makes it unnecessary to observe voltage-polarity precautions.

The Baudot code contains a space start impulse, five selector pulses (either mark or space), and a stop pulse (mark). All pulses are of equal duration for a given speed of operation, although the stop pulse may be longer. Clocking of the input section is controlled by a crystal oscillator. Operating speed selection is made simply by switching crystals – 5.9578 MHz for 60 wpm, 6.5536 MHz for 66 wpm, 7.4599 MHz for 75 wpm, and 9.7306 MHz for 100 wpm. Each of these crystal frequencies, when divided by 2^{17}, equals the baud rate for the appropriate speed. Depressing the proper push switch on the front panel selects the desired speed.

Once a space start pulse is received by the RVD-1002, the unit waits for approximately half the normal duration of the impulse and then samples the input. If the space condition is no longer present, the impulse is considered to be a transient, and is ignored. If the space is still present, then the pulse is considered a valid start signal. This cute trick eliminates much of the garble such as that appearing on mechanical printers as a result of static crashes and bursts of QRM.

Once a valid TTY character is received, the five selector pulses are clocked into a 5-bit shift-register memory. From here they are extracted in parallel format, all five bits simultaneously. These five bits plus a case bit – one which indicates whether the character is upper or lower case – are passed to the page memory. The block diagram of Fig. 2 shows the point of data entry into the memory, in the lower left section of the drawing. The page memory itself is six independent 1024-bit dynamic shift-register MOS IC memories operating in parallel. The first IC contains up to 1000 TTY-character first selector-pulse bits, the next contains second selector-pulse bits, and so on. (The extra 24-bit capability of these memories is not used; these bits are "clocked through" during the time between frames of the display.) The information of the page memory is recirculated, and new information is entered near the end of the frame, always on the bottom line of the display. This is done by opening the feedback loop and inserting fresh data in place of the old. This function is performed by the data-entry control circuits. Thus, the display is unchanged unless new information is received.

To develop the display itself, information is transferred into the line memory as it is being recirculated in the page memory. This transfer

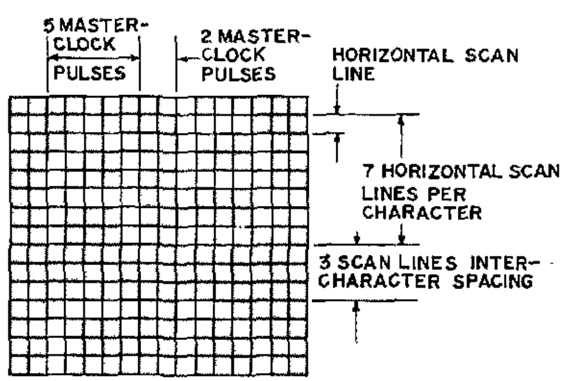


Fig. 1 – The scheme used for character presentation on the video monitor with the HAL Communications RVD-1002 Video Display system.

takes place a line at a time, 50 characters. Clocking of the page memory is stopped while a line of information is being written on the display. The line memory consists of six independent 50-bit memories operated in parallel, each memory being half of a dual-memory IC (three ICs total). As the line memory is clocked, the data bits are recirculated and simultaneously appear at the input of the character-generator ROM IC. The output of this memory is five bits in parallel – those five dots (or lack of dots) to be written on the display for a particular scanning line number for a particular character. These bits are transferred simultaneously to a 5-bit output shift register, where they are clocked serially to a video combiner and are available in the proper sequence at the video output. The information of the line memory is recirculated time after time, reading each TTY character into the character generator as each scan line of the displayed signal is produced. Thus, to form a complete line of characters on the display, the line-memory bits are recirculated seven times. Once a complete line has been written on the display, clocking of the page memory is resumed and the next line of data is clocked into the line memory. Synchronization of all the various clocking operations with that of the video sync data and the insertion of updated characters is controlled by the 8.064-MHz crystal oscillator.

The RVD-1002 provides no permanent record of received copy. For those who enjoy swapping RTTY pictures or for those handling message traffic by RTTY, this would be a great disadvantage. On the other hand, think how nice it would be after a several-hour on-the-air session not to have yards and yards of paper strewn all over the floor. For that matter, with the RVD-1002 the paper-procurement problem is solved permanently.

The RKB-1 RTTY Keyboard

The HAL RKB-1 keyboard is similar in many respects to a keyboard-operated Morse-code keyer. Coding of key-switch pulses into the proper Baudot format for RTTY transmissions is accomplished by transformer coupling – wires leading from the key switches are threaded through appropriate toroid cores. The technique is the same as that used in Touchcoder II.[1] There are five toroids, one for each selector pulse of the Baudot code. Appropriate data bits are transferred in parallel into a 5-bit shift register. Start and stop impulses are added, and the code is then clocked out of the register serially. A switching transistor keys the output loop current, and voltage polarity must be observed for proper keying of external circuits.

Four operating speeds are available from the RKB-1 – 60, 66, 75, and 100 wpm. A rotary switch which is positioned above the key switches on the keyboard is used to select the desired speed. Speed changes are accomplished by changing the clock rate. The clock oscillator or pulse generator is a UJT relaxation type of oscillator. One of four calibration controls is selected in each position of the speed switch, the resistance of the control determining the frequency of oscillation. These controls are set at the factory, and provide for selector-pulse durations of 22, 20, 17.57, and 13.47 ms for the four speeds. Actually the maximum transmission speeds are slightly less than the four given above because the duration of the stop pulse from the RKB-1 is twice that of the selector pulses, e.g., 44 ms at 60 wpm. Thus, the actual maximum speeds are 56.8, 62.5, 71.1, and 92.8 wpm, although the selector-pulse durations are standard for the 60, 66, 75, and 100 wpm speeds respectively. These slight speed differences would likely never be detected in on-the-air operation, and are mentioned here only for those interested in the fine points of the technical details.

There are a number of differences between the RKB-1 and a mechanical keyboard. The RKB-1 has 51 keys plus a space bar, whereas there are 31 keys and a space bar on a mechanical counterpart. Four of the 51 keys are unused. Of the remaining 47, 26 are for letters, 10 for figures, 5 for punctuation, and one each for carriage return, line feed, blank, and repeat (when depressed simultaneously with any other key). Some of the numeric and

[1] See Bryant, "Touchcoder II," *QST* for July 1969, p. 11.

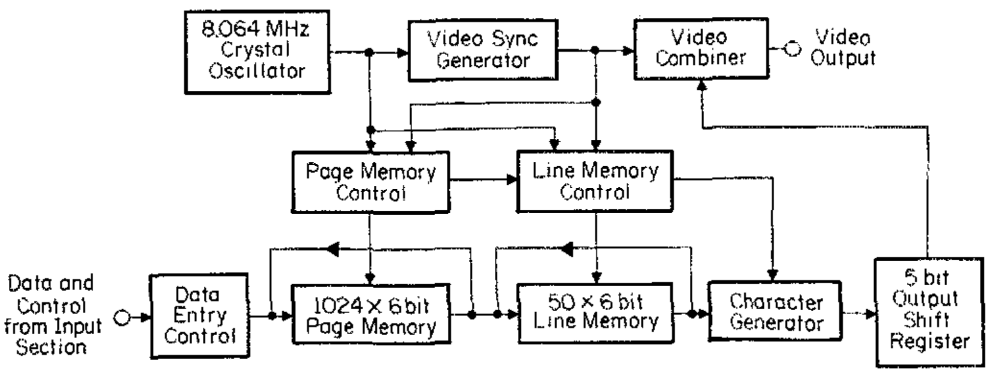
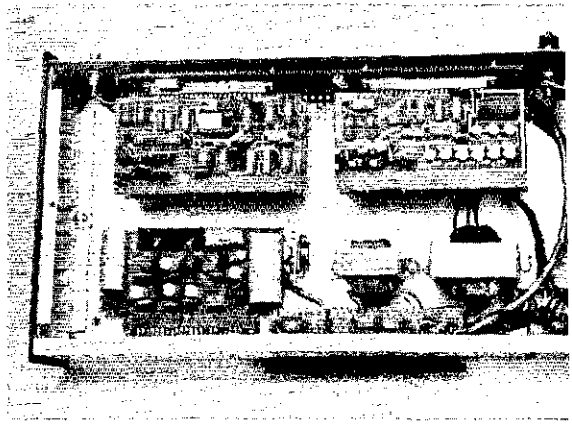


Fig. 2 – Block diagram of the memory and display sections of the RVD-1002.



The working parts of the RVD-1002 are mounted on five circuit boards. Shown here at the lower left is the power supply board. The page-control board appears at the upper left, and the character-memory board at the upper right. Hidden beneath the boards at the top of the chassis are the input-control board and the character-control board. The complete RVD-1002 contains 73 integrated circuits and several transistors.

punctuation keys serve a dual function, controlled by either of two "shift" keys. The shift keys do not send a code to shift the carriage of the receiving printer from letters to figures, as on a mechanical keyboard. Instead, a shift key must be depressed and held while another key is struck to activate a "shifted" function. For example, the dollar sign ($) is located on a dual-function key with the number 4. If the 4 key alone is struck, the keyer will emit the Baudot code for a number 4 (space mark space mark space). But if a shift key is depressed and held while the 4 key is struck, a $ will be sent (mark space space mark space).

There are no letter-shift nor figure-shift keys on this keyboard, *per se*. The keyer has a flip-flop memory which "remembers" whether figures and punctuation or letters are being sent. An appropriate code, either FIGS or LTRS, is inserted and sent preceding the character whenever a change occurs. To send W1AW, for example, the W, 1, A, and W keys are struck in sequence. The keyer inserts a FIGS function appropriately ahead of the 1, and a LTRS function ahead of the A. When transmitting groups of figures, there is an automatic unshift-on-space function. Typing 73 (space) 73, for example, results in the code sequence FIGS 7 3 LTRS SPACE FIGS 7 3 and so on. Similarly, an automatic unshift on carriage return is supplied when the keyer is sending figures.

With this keyboard it is quite difficult to send the CR CR LF LTRS format which has become an end-of-line habit for most RTTY operators. Although certain manipulations of some of the keys will send the code for a letters shift, it doesn't appear as if the keyboard was designed with this function alone in mind. If a receiving printer without an unshift-on-space feature inadvertently gets hung up in the figures position of the carriage because of QRN or QRM, it is conceivable that several lines of meaningless punctuation and figures would appear on the copy. In normal manipulation of the RKB-1 keys, no letters-shift function will be sent until after the typist sends a figure or punctuation character and then resumes the typing of letters.

The key switches are noiseless. When this is coupled with the fact that there are no mechanical restraints on the keys, such as there are on mechanical counterparts, it is easy to understand why one can "crowd" the keyboard, punching keys faster than characters can be generated. When this happens, characters which were punched while another is being sent are lost. Rapid typing of NOW IS THE TIME at a somewhat nonuniform rate therefore comes out something like NOWIS TE TME, or whatever. The combination of differences in key locations and key functions, plus this feature of easy "crowding," all add up to one fact – for a person who is a touch typist on the old-fashioned 31-key keyboard, some relearning is going to be necessary before he becomes proficient in the use of this one. – *K1PLP*

HAL Communications Solid-State RTTY System

RVD-1002 Visual Display System:

Dimensions (HWD) and Weight: 3-3/4 × 17 × 10 inches, 9 pounds.
Power requirements: 120V ac.
Colors: Two-tone gray.
Price class: $525 (available assembled only).

Panasonic Solid State TV Monitor, model TR-910MN:

Dimensions (HWD) and Weight: 10-3/4 × 9-1/2 × 9-1/4 inches, 13 pounds.
Power requirements: 120 V ac, 60 Hz, or 12 V dc, 12 W.
Colors: Flat black, aluminum trim.
Price class, $140.

RKB-1 TTY Keyboard:

Dimensions (HWD) and Weight: 4-1/2 × 12-1/2 × 9-1/2 inches, 7-1/4 pounds. Top panel is sloping.
Colors: Two-tone gray; keytops are gray with white letters.
Price class: $275 (available assembled only).

The Panasonic monitor is manufactured by Matsushita Electric Industrial Co., Ltd., in Japan and is available directly from HAL. Manufacturer of all other equipment listed above: HAL Communications Corp., Box 365A, Urbana IL 61801.