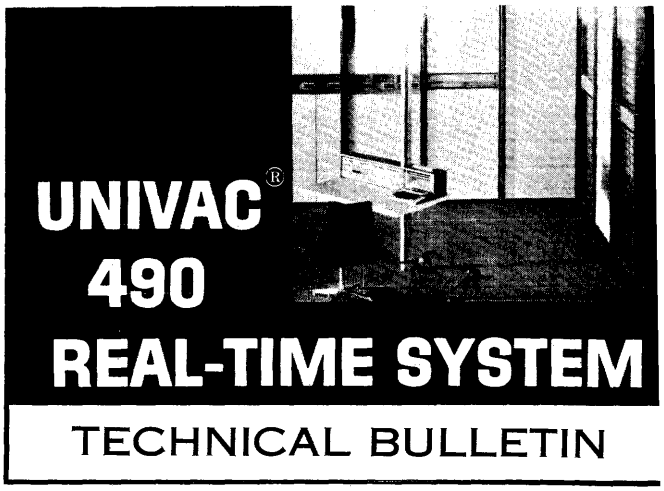


UNIVAC 490

High-Speed Printer Subsystem

August, 1961

Contents

1. Introduction

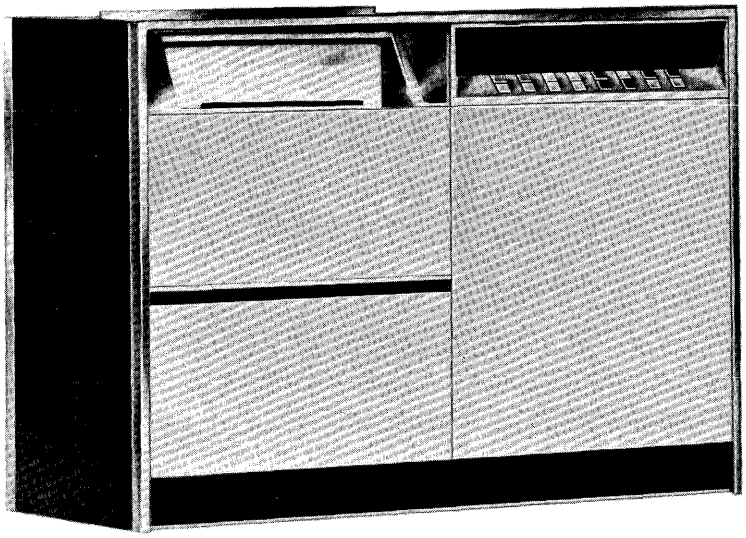


Figure 1-1. High-Speed Printer.

The High-Speed Printer used with the UNIVAC® 490 Real-Time System is basically the same Printer which has been used so successfully with UNIVAC Systems since 1952. A Channel Synchronizer-Control Unit controls Printer operations. The High-Speed Printer and Channel Synchronizer-Control Unit are optional equipment with the UNIVAC 490 Real-Time System.

The function of the High-Speed Printer is to produce a single- or multiple-copy record of computed or tabulated results. It prints up to 600 lines a minute: each line contains up to 128 characters. Since this unit is essentially a wheel printer, the type font produces clearly printed copy similar to that printed by a typewriter or conventional punched-card tabulating equipment. In addition, its great flexibility allows printing in a variety of formats with variable spacing options available to the programmer.

The many features of the High-Speed Printer and their resulting benefits are among the many reasons why UNIVAC Real-Time Systems are outstanding values in the computer field.

2. Printing Specifications and Mechanism

The design of the High-Speed Printer combines speed and accuracy with mechanical sturdiness and reliability. In addition, Remington Rand UNIVAC engineers provided the Printer with a versatility which allows printing in an almost limitless variety of formats.

PRINTING SPECIFICATIONS

One outstanding feature of the High-Speed Printer is the availability of fifty-one printable type characters. This wide range of type allows complete and final reports to be prepared in a single operation (Figure 2-1). No intermediate or supplementary operations are necessary.

The fifty-one characters consist of the twenty-six alphabetic capitals, A through Z; the ten numerals, 0 through 9; and the following fifteen punctuation marks and special symbols:

– # $ % . , + ; : ( ) & / * '

NOTE: These characters are supplied with the standard Printer; others may be supplied upon special request.

The printing specifications for the High-Speed Printer are as follows:

Characters per Line
128

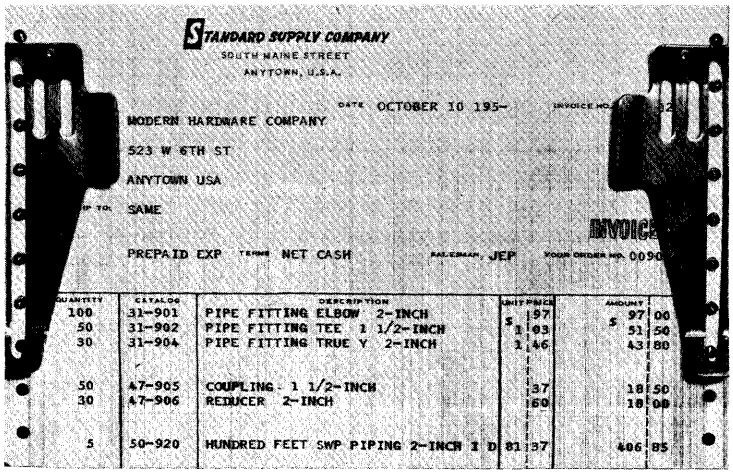
Lines per Minute
600 maximum

Spacing
10 characters per inch horizontally;
6 lines per inch vertically, single-spaced

Printable Characters
51 (as described above)

Paper Stock
Any sprocket-fed paper, 4 to 27 inches wide, up to and including card stock, either blank or preprinted.

Number of Copies
At least 4 carbons and an original when 12 pound paper stock is used.


STANDARD SUPPLY COMPANY
SOUTH MAINE STREET
ANYTOWN, U.S.A.

DATE OCTOBER 10 195–

MODERN HARDWARE COMPANY
523 W 6TH ST
ANYTOWN USA

SHIP TO: SAME

PREPAID EXP TERMS NET CASH SALESMAN JEP

QUANTITY	CATALOG	DESCRIPTION	UNIT PRICE	AMOUNT
100	31-901	PIPE FITTING ELBOW 2-INCH	$ 97	$ 97 00
50	31-902	PIPE FITTING TEE 1 1/2-INCH	1 03	51 50
30	31-904	PIPE FITTING TRUE Y 2-INCH	1 46	43 80
50	47-905	COUPLING 1 1/2-INCH	37	18 50
30	47-906	REDUCER 2-INCH	60	18 00
5	50-920	HUNDRED FEET SWP PIPING 2-INCH 1 D	81 37	406 85

Figure 2-1. Final Report Prepared by Printer.

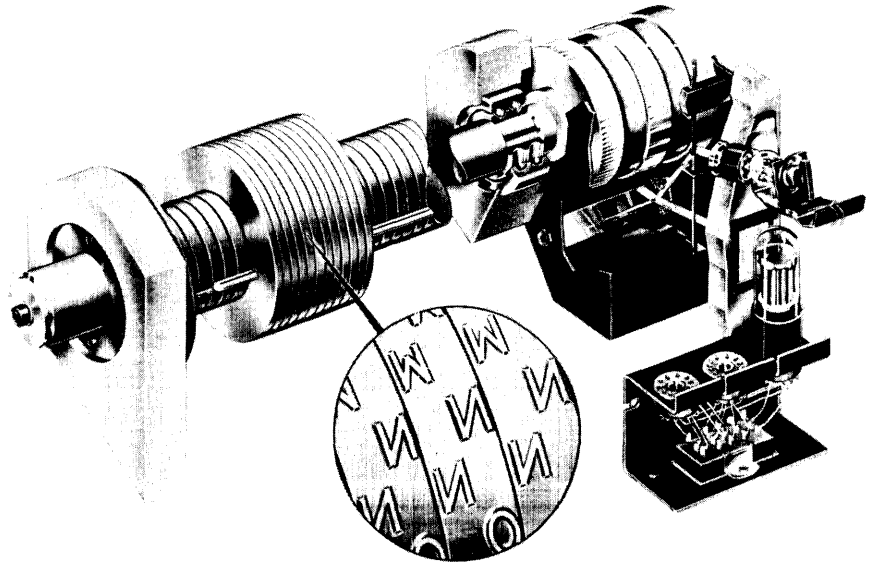


Figure 2-2. Printer Typewheels

PRINTING MECHANISM

The printing mechanism of the High-Speed Printer contains sixty-four typewheels having two columns of type with fifty-one printable characters per column. These columns correspond to the horizontal printing positions across the page.

The columns of type are arranged on the typewheels in a checkerboard pattern. This allows each character to be surrounded by four spaces rather than by four other type-characters. This arrangement prevents smudging or partial printing of adjacent characters. This staggered arrangement of the characters is shown in a magnified portion of the typewheels in Figure 2-2.

Opposite the typewheels are 128 print hammers, one for each column of type. These hammers, when activated, force the paper and inked ribbon against the typewheels to print the apposed characters.

The typewheels, together with a code wheel, are mounted on a continuously revolving shaft. This shaft turns at the rate of 750 revolutions per minute. The code wheel is a small magnetic drum containing the print code combinations for each of the fifty-one typewheel characters.

As a character on the typewheels moves into print position, the code combination for that character is read from the code wheel and compared with the codes of the data to be printed; if there is agreement, a print hammer is activated and the character is printed.

PRINTER CONTROL PANEL

The control panel of the High-Speed Printer (Figure 2-3) is composed of two rows of colored lights which are clearly identified. The lights in the bottom row are pushbuttons; those at the top are signals only. These lights and button-lights provide all the information and switching control needed for manual operation of the Printer. They are also used to display abnormal conditions within the Printer. (In the following description of the function of the panel lights, it is to be noted that extensive safeguards have been provided for protecting the equipment. Many of the indicators, such as the CHARGE CHECK, AIR FLOW, OVERHEAT, and so forth, are rarely utilized, but they ensure top performance of the system.)

ABNORMAL-CONDITION INDICATORS

When any of the following indicators is lighted, the SYSTEM OFF NORMAL light on the Printer will also light.

Charge Check/Fire and Extinguish: lights red to indicate that the power to activate the print hammers is not being properly received.

No Ribbon: lights amber to indicate that the Printer is out of ribbon.

No Paper: lights amber to indicate that the Printer is out of paper or that the paper has ripped.

Air Flow: lights red to indicate that the air flow has fallen below the desired rate.

Door Interlock: lights red to indicate that the door on the Printer is open or has been improperly closed.

Overheat: lights red to indicate that the temperature of the air being circulated within the Printer is above the required limit.

PUSHBUTTON INDICATORS

Carriage In: lights green to indicate that the Printer carriage is in position for printing. Depressing this button moves the carriage to the IN position.

Carriage Out: lights amber to indicate that the carriage is not in a position for printing. While in this position, the Printer will not operate. Depressing this button moves the carriage to the OUT position.

Change Ribbon: when a ribbon change is needed, this button is depressed to allow the ribbon to wind past the automatic ribbon-reverse position completely onto the take-up shaft. The indicator will light white when activated.

Space Paper/Paper Feed Check: lights amber to indicate that the paper advance exceeded the maximum feed time of one second. Depressing this button advances the paper one line.

Clear/System Off Normal: lights red when an abnormal condition exists in the Printer. Depressing this button clears all controls and indicators.

Computation Run/Stop: These enable the operator to start or stop the High-Speed Printer Synchronizer-Control Unit from the Printer panel. The RUN button lights green when activated; the STOP button lights amber.

Motors: depressing this button starts all Printer motors except the carriage in/out motor. This button is also depressed to turn off all motors. This button lights green when activated.

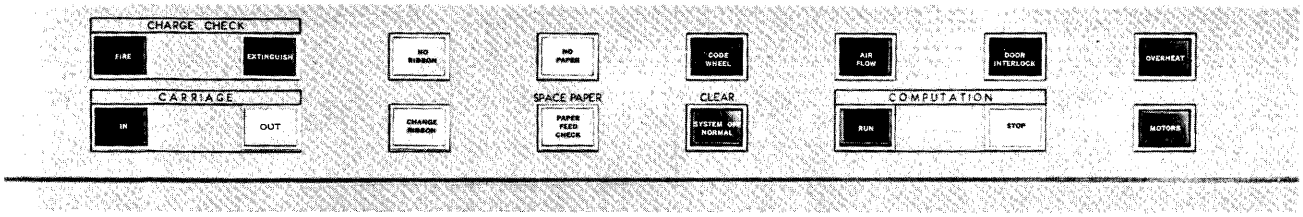


Figure 2-3. High-Speed Printer Control Panel

3. Channel Synchronizer-Control Unit

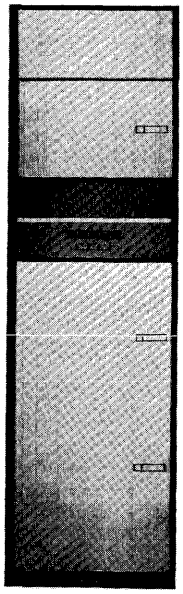


Figure 3-1. Channel Synchronizer-Control Unit

The Channel Synchronizer-Control Unit accumulates the data necessary to print a line of information, and controls the printing and paper-spacing operation of the High-Speed Printer. The unit performs these functions by decoding the instructions received in the Function Word, and by directing the High-Speed Printer operation according to these instructions.

The Channel Synchronizer-Control Unit contains a 128-character core buffer that accumulates the data necessary to print the 128 alpha-numeric characters.

OPERATION

The operation of the Control Unit is conveniently discussed by dividing its function into two general cycles of operation: the *transfer cycle*, and the *print cycle*. These cycles are generated when the Printer has been activated. The High-Speed Printer is activated by only one function, a Print command. This command is contained in the Function Word. The Function Word specifies space *N* lines (*N*=0, 1, 2, ----, 63) and print one line on the High-Speed Printer.

Since spacing is non-automatic the number of lines to be advanced is specified in the Function Word. If the line spacing code is 0, the paper will not be advanced. As soon as the Channel Synchronizer-Control Unit decodes the Function Word, it signals the Printer to advance the paper *N* lines. All line spacing is completed before the line will be printed.

The characters to be printed are packed five to a computer word (6-bit code). To print 128 characters, the Computer must transfer 26 words. One hundred twenty-five characters are contained in 25 full computer words, and the remaining three are packed in the upper order 18 bits of the 26th word.

TRANSFER CYCLE

To initiate a print cycle the 128-character buffer of the Channel Synchronizer-Control Unit must be filled. If the Computer tries to send more than 128 characters, a dummy transfer will be made; however, those characters in excess of 128 will not be stored or printed.

If less than 128 characters are to be printed, a stop code or a Terminate function is required. The stop code is a special 6-bit character code of all 1-bits sent by the Computer during a transfer cycle.

When the buffer-input register detects the presence of all 1-bits the buffer is immediately cycled to its 128th character count and all unused characters are space coded.

PRINT CYCLE

The print cycle is that operation of the High-Speed printer Subsystem in which the actual printing of

the information occurs. The print cycle is a function of both the Channel Synchronizer-Control Unit and the Printer. The print cycle is initiated when the transfer cycle has been completed and the paper feed has been accomplished.

During the print cycle, a code wheel, which is coupled to the print wheel shaft, generates the character codes of the printable characters. As each code is generated, the contents of each character position in the buffer are compared with the generated code and those that correspond are printed. This is termed a minor cycle. There are fifty-one minor cycles during the print cycle, one cycle for each of the printable characters.

There are sixty-four typewheels, revolving in conjunction with the code wheel, each corresponding to two successive characters across the line of print. The typewheels are made up of two columns of type, each containing the fifty-one printable characters. These columns are staggered one-half the distance between characters, the left or odd numbered column having the lead. As the typewheels revolve, the character to be printed will come up first on all the odd numbered (leftmost columns) and then on all the even numbered (rightmost) columns. Each minor cycle then consists of two sub-cycles, an odd-cycle and an even-cycle. During the odd-cycle, the odd character positions in the buffer are scanned and compared with the character to be printed. Those character positions that correspond are printed. Then during the even cycle, the even character positions in the buffer are compared and printed. Thus, because the buffer is referenced twice during each minor cycle, there are 102 buffer cycles during the print cycle.

When the 51 minor cycles have been completed (one complete revolution of the code wheel and type wheels) the print cycle is completed. At this time the Channel Synchronizer-Control Unit is notified that the printing of the line is complete and that the Printer is ready to print another line. If an External Interrupt was requested, the Interrupt is also sent to the Computer at this time.

SYNCHRONIZER CONTROL PANEL

The Control Panel of the Channel Synchronizer-Control Unit (Figure 3-2) contains the indicators necessary to reflect abnormal conditions within the unit.

Fault Printer 1: Lights when a malfunction is detected in the Printer. This could indicate an a.c. or d.c. fault, overheat in Printer; overcurrent or under voltage, overheat in power panel. To determine the exact fault the maintenance panel on the Channel Synchronizer-Control Unit and Printer Control Panel must be observed. This fault causes the Printer and the power-panel power to be shut off. This indicator is used as a reset switch and must be reset after a malfunction is corrected to return power to the Printer and the power-panel.

Fault Printer 2: Lights when a malfunction is detected in Printer 2. Indicates same types of malfunctions as stated for Fault Printer 1.

Fault: Lights in conjunction with Fault Printer. This indicator is a reset switch and must be depressed after the Fault Printer has been depressed. If this indicator lights without Fault Printer this will indicate that the malfunction has occurred in the Channel Synchronizer-Control Unit. This could indicate over-current or under voltage, overheat, loss of air or interlock. The power shuts off and the fault indicator must be depressed to start the power again.

Test: Lights when test switch or any of the manual disable switches has been thrown.

Interlock Disable: Lights when the interlock in the Channel Synchronizer-Control Unit has been disabled to allow the unit to be disconnected.

Off Switch: Lights green when the unit is on. Lights red when the unit is turned off. The switch must be pushed to turn the power off.

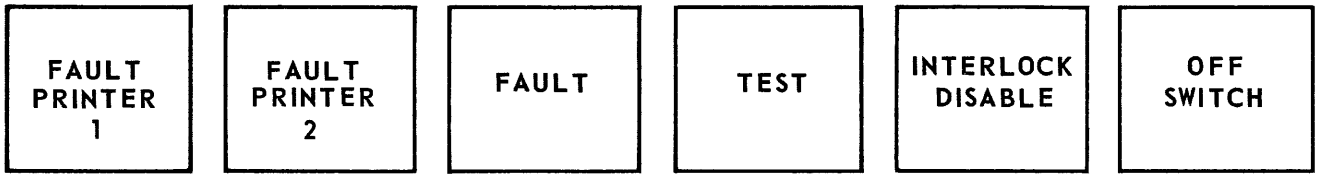


Figure 3-2. Control Unit Control Panel

4. Programming Features

Any part of the Computer's internal core storage can be used as an output data buffer storage area, with the exception of the few special core storage locations that are reserved for the Incremental Clock and the Interrupt Words. Information is transferred between the Computer and the Channel Synchronizer-Control Unit (Figure 4-1) in *blocks* of data. A block of data is a series of words having consecutive core memory addresses, starting with a program-determined first word and ending with a program-determined last word or an External Interrupt.

BUFFER MODE

A buffer mode transfer, which occurs independently of main program control, is used to transfer blocks of data between core storage and the Channel Synchronizer-Control Unit. Before execution of a buffer mode transfer of data, the program must perform the following steps:

1. Activate the channel to be used for the information transfer.

2. Load the channel's index register with the data control word. (The lower and upper halves of the data control word contain the beginning and ending address of the section of core storage involved in the transfer.)

3. Send the proper function word to the Channel Synchronizer-Control Unit.

The first two of the above steps are accomplished with one of the Initiate Buffer instructions, 74 or 76, and the third is performed by the Enter External Function instruction, 13.

Data is then transferred between the Computer core storage and the Channel Synchronizer-Control Unit without main program intervention. When a word is transferred from storage, 1 is added automatically to the lower half of the control word. The data transfer is terminated when the Computer senses that the upper and lower halves of the control word are equal.

FUNCTION WORDS

The Channel Synchronizer-Control Unit is controlled by Function Words (below) which activate external function control lines. The Function Word is translated into a discrete set of action codes by the Channel Synchronizer-Control Unit. The use of program generated Function Words, rather than Computer instructions, in controlling the Printer allows the Computer logic to be independent of the Printer logic.

FUNCTION	F		PS					U	
BITS	29	24	23	18	17	12	11 6	5	0

F = 6-bit function code

PS = 6-bit line spacing code (00-77 Octal)

U = 6-bit printer selection code

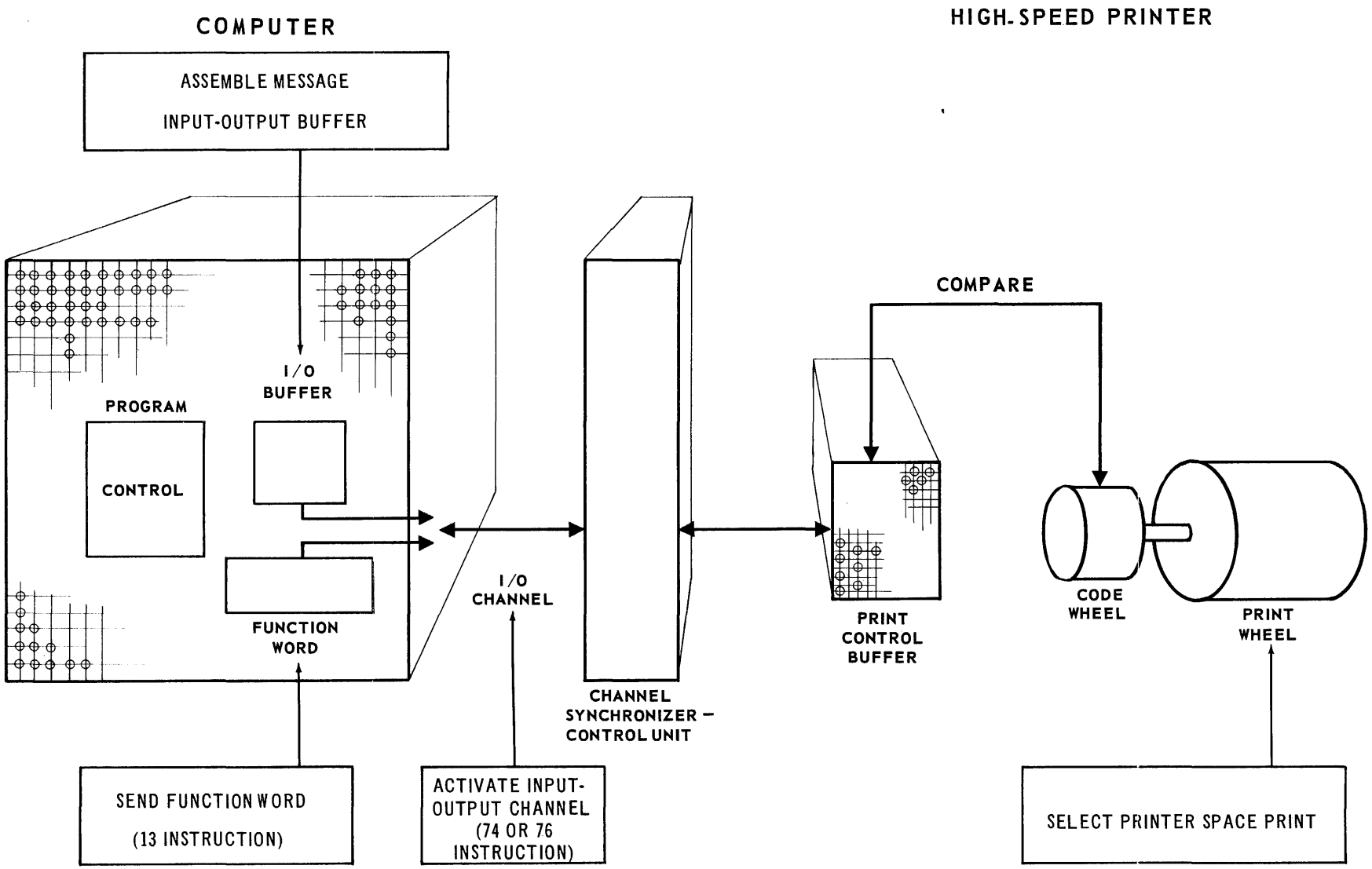


Figure 4–2. UNIVAC 490 Computer and the High-Speed Printer

Section F of the function word contains two possible instructions:

OCTAL CODE	BINARY CODE	FUNCTION
02	000010	Print with a spacing of 6 lines per inch.
12	001010	Print with a spacing of 6 lines per inch and generate an External Interrupt at the end of the print operation.

The first transferred character (bits 29-24) of the Function Word gives a print instruction.

The second transferred character (bits 23-18) of the Function Word determines paper-spacing (0 to 63 spaces).

The third and fourth transferred characters of the Function Word contain no specific instruction. During the transfer of these characters no function data is transferred. The events must take place so that the counter is advanced and ready for the next character that is transferred. If the counter is not advanced the upcoming character is not routed properly.

The fifth transferred character (bits $2^5 - 2^0$) of the Function Word determines the selection of one of two possible High-Speed Printers.

STATUS WORDS

The Status Word is transmitted by the Channel Synchronizer-Control Unit into the Computer whenever an error condition exists. A Status Word is arranged in 6-bit character groups.

The status code, SC, for the High-Speed Printer is contained in the most significant 6-bits of the Status Word. All other bit positions in the Status Word are not used; they are transmitted to the Computer as binary 0's.

FUNCTION	SC											
BITS	29	24	23	18	17	12	11	6	5	0		

STATUS CODE

OCTAL	BINARY	FUNCTION
50	101000	This code is an illegal function code used to specify an operation which cannot be performed by the Printer. Such operations include both function and resume present, or neither present.
54	101100	This code is used when a unit selector error occurs, or when both Printers or neither Printer is selected.
74	111100	This code, interlock fault, indicates: Out-of-paper Out-of-ribbon Overheat

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