SPERRY UNIVAC
1106/1108 Systems
4009 Display Console

Programmer Reference

SPERRY UNIVAC COMPUTER SYSTEMS

UP-7604 Rev. 1

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1. INTRODUCTION

1.1. GENERAL

The SPERRY UNIVAC 4009 Display Console (display console) is a free standing input/output device for exercising certain programming options and for monitoring operations of the central processor unit (CPU). Communication between the display console and a SPERRY UNIVAC 1106/1108 System CPU takes place over CPU I/O channel 15. The display console includes the cathode ray tube (CRT) display and keyboard, one to six PAGEWRITER printers, and a dayclock. The display console also provides desk top space for the operator's use (see Figure 1–1).

1.2. SCOPE

This manual contains programming reference information for the 4009 Display Console used as a subsystem of a 1106/1108 System. Background information for these systems is contained in *SPERRY UNIVAC 1108 Multi-Processor System Processor and Storage Reference Manual, UP–4053* (current version).

This manual is divided into two basic sections:

- Display Console Description
- Programming

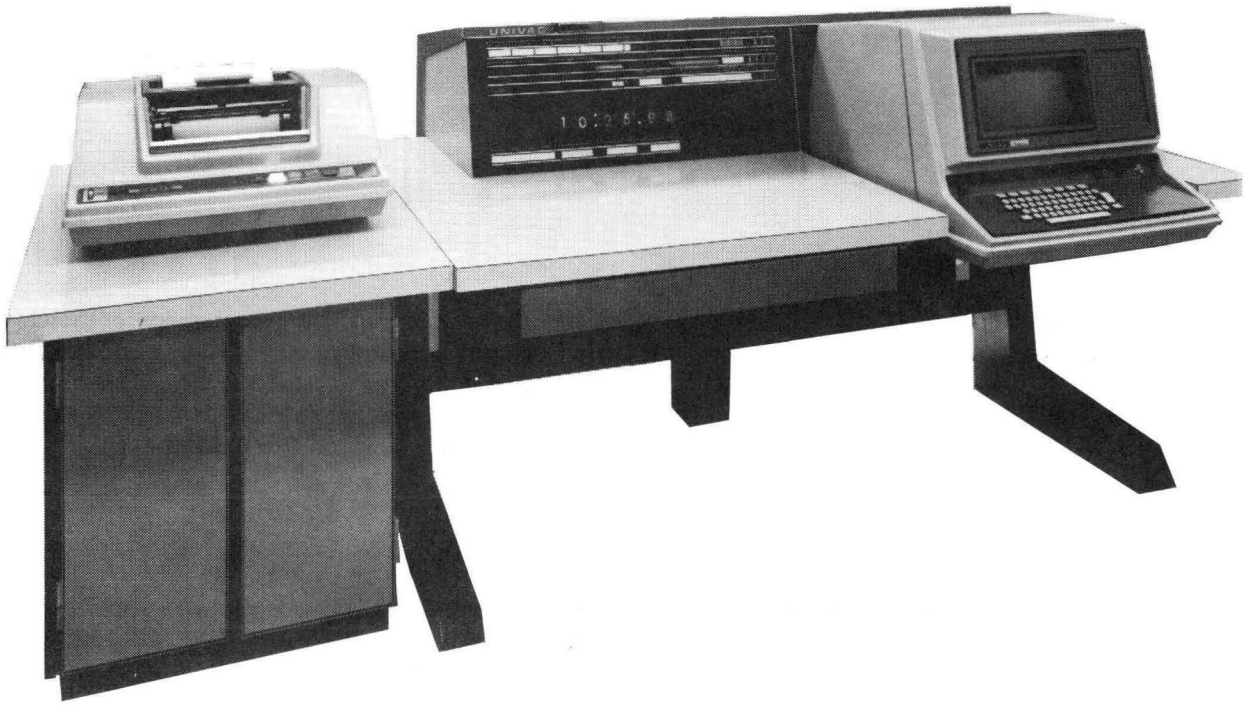


Figure 1–1. Display Console

2. DISPLAY CONSOLE DESCRIPTION

2.1. GENERAL

Components of the SPERRY UNIVAC 4009 Display Console (display console) are:

- a 62-character plus space keyboard;
- a cathode ray tube (CRT) display which can accomodate up to 16 lines of 64 characters each;
- one to six PAGEWRITER printers which print up to 80 characters per line at a rate of 25 characters per second;
- a dayclock which displays the time of day; and
- the associated controls and indicators required for operator-CPU communication.

Data is entered into the processor by means of the keyboard. The dayclock also provides time of day to the processor (see 2.3.3). Output to the console may be to the CRT or to a PAGEWRITER printer. Keyboard entered data goes to the processor and back out to the CRT or printer if it is to be displayed; there is no direct communication between the keyboard and CRT or printer. The CRT buffer memory and the PAGEWRITER printer are under program control at all times.

2.2. CONFIGURATION

A block diagram of the console is illustrated in Figure 2–1. A total of six PAGEWRITER printers may be driven from the console control logic. The subsystem type numbers are listed in Table 2–1.

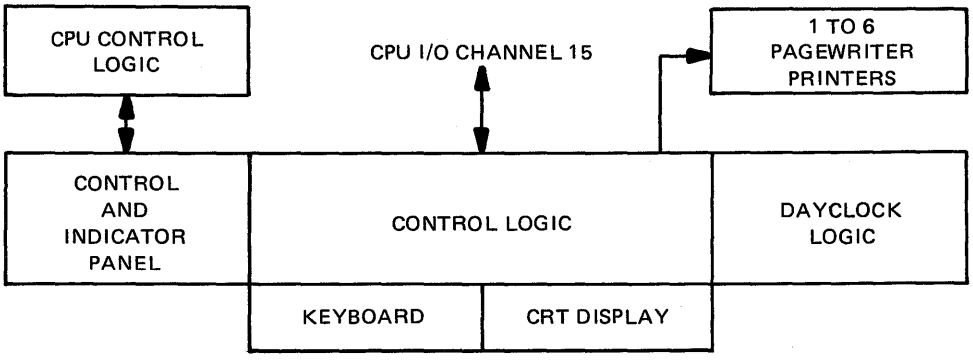


Figure 2–1. Display Console, Block Diagram

Table 2–1. Display Console Type Numbers

Subsystem Component	Type Number	
	60 Hz	50 Hz
Control Indicator Panel with CRT Display and PAGEWRITER Printer	4009–00	4009–01
Auxiliary Printers (up to 5)	0764–14	0764–15

2.3. DISPLAY CONSOLE COMPONENTS

A description of each of the display console components is given in the following paragraphs.

2.3.1. Keyboard and CRT Display Unit

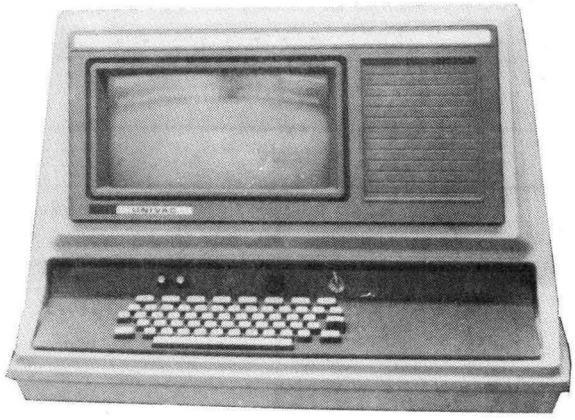
The keyboard and CRT display unit (see Figure 2–2) consists of a viewing screen and a keyboard resembling a typewriter keyboard.

The keyboard consists of 47 keys plus the space bar (used to encode 63 of the 64 6-bit Fieldata characters), two shift keys, and a row of eight interrupt keys. Data entered from the keyboard is made available to the CPU, one character at a time, on the I/O channel connecting the subsystem to the CPU. Each character is accepted by an input buffer in the CPU and immediately sent back by the control program as output to the console for display on the CRT. No direct communication exists between the keyboard and the CRT or the printer. However, as keys are pressed, the corresponding characters are normally displayed by the control program on the CRT before formal release to the control program so that the operator can recompose and edit his entire message by using an appropriate interrupt key.

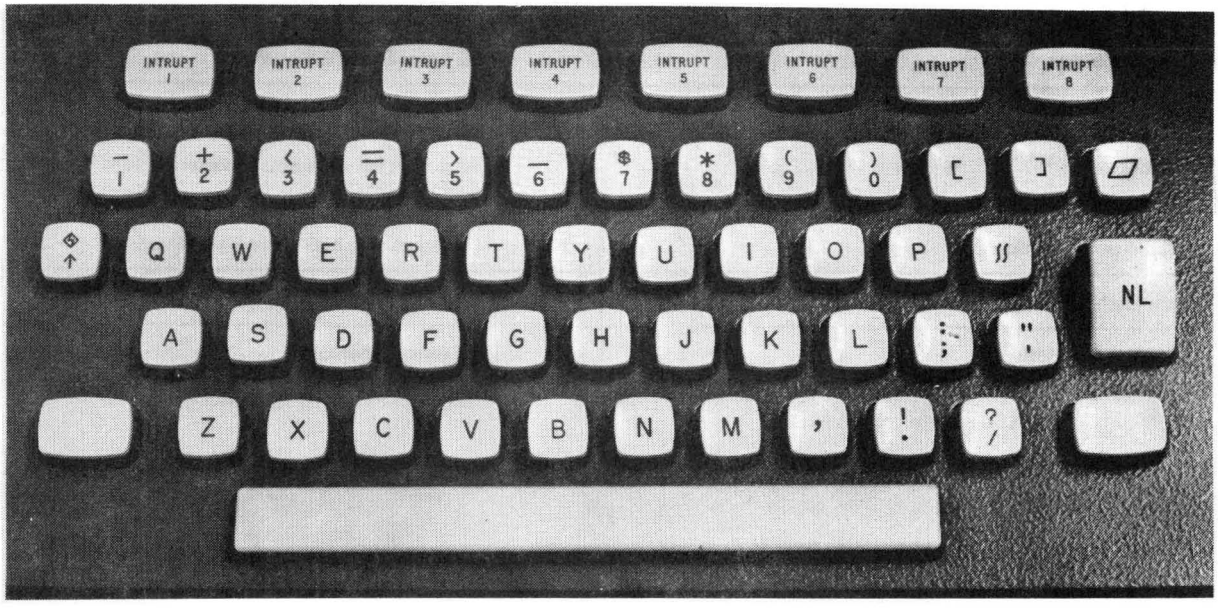
The eight interrupt keys are used to generate an EXTERNAL INTERRUPT signal with a unique status code for each key. The specific purposes of these codes are defined by the software conventions adopted by the control program. The CPU can be forced to recognize inputs from the console when one of the interrupt keys is pressed.

All output data from the CPU for display on the CRT is transferred a word at a time from the CPU output buffer to the console disassembly register. The word is then disassembled into 6-bit character codes and stored in sequential locations in the 1024-character CRT buffer memory. Since the display is character addressable under program control, the first character of each output message may be placed in any of 64 character positions in any of the 16 lines. The character codes are periodically read from the CRT buffer memory and used to drive generators that control display of the symbols on the face of the CRT.

The characteristics of the keyboard and CRT display are presented in Table 2–2.



a. CRT Display Unit



b. Keyboard, Expanded View

Figure 2–2. Keyboard and CRT Display Unit

Table 2–2. Keyboard and CRT Display Characteristics

Characteristic	Description
Keyboard	
Symbol Set	Basic alphanumeric typewriter: 63 Fieldata characters (includes space and new line) 47 character keys (see 3.2) space bar 2 shift keys 8 interrupt keys
Display Unit	
Viewing Area	10 inches wide by 5 inches high
Buffer Capacity	1024 characters
Display Format	16 lines, 64 symbols per line
Symbol Size	0.113 inch wide by 0.150 inch high
Symbol Set	60 output symbols plus space/erase and new line
Character Generation	Closed stroke, maximum 8 per character
Scan Method	Digital
Regeneration Rate	60 times per second

2.3.2. PAGEWRITER Printer

The PAGEWRITER printer (see Figure 2–3) is intended for use as a logging device to record CRT transactions between the control program and the operator. From one to six printers may be included in the console configuration.

The PAGEWRITER printer is mounted on a pedestal cabinet which houses its associated circuits and power supply. The printer uses the Fieldata code/symbol relationship which is applicable to other UNIVAC 1106/1108 System components. Its maximum line length is 80 characters; the printing rate is 25 characters per second. Horizontal spacing of characters is ten to the inch. Vertical spacing is six lines per inch. The characteristics of the printer are presented in Table 2–3. Printable symbols are given in Table 3–1.

Output data for display on the printer is transferred a word at a time (36 bits parallel) from the CPU output buffer to the console disassembly register. The 6-bit character codes are then transferred in sequence to the selected printer (see 3.1.1).

Figure 2–3. PAGEWRITER Printer

Table 2–3. PAGEWRITER Printer Characteristics

Characteristic	Description
Maximum Line Length	80 characters
Character Spacing	10 per inch
Line Spacing	6 per inch (single space)
Character Size	0.072 inch wide by 0.100 inch high
Printing Speed	25 characters per second
Carriage Return Time	225 milliseconds or less

2.3.3. Dayclock

The dayclock displays the time of day to the operator in hours, minutes, and hundredths of a minute, and also makes this time available to the CPU. The high-order bit positions of each dayclock input word (see Figure 3–5 for format) contain the current dayclock reading. The dayclock turns on a DAYCLOCK REQUEST signal (separate from and independent of the INPUT DATA REQUEST signal associated with the keyboard data keys) at 600 millisecond intervals.

The CPU responds to each DAYCLOCK REQUEST signal by storing the dayclock input word at main storage location 216_8. The dayclock also generates a separate DAYCLOCK INTERRUPT signal which is independent of keyboard activity. It interrupts the CPU once every six seconds. For each DAYCLOCK INTERRUPT the current time of day is stored at address 216_8. The instruction at address 217_8 is performed when the CPU recognizes the DAYCLOCK INTERRUPT signal. Both of these main storage addresses are biased by the contents of the memory select register (MSR).

2.3.4. Operator's Control and Indicator Panel

The operator's control and indicator panel includes fault, disable, and mode indicators for the CPU and the associated main storage modules. It includes displays and controls associated with the program address counter, with selecting and releasing jumps and stops, with the CPUs memory select register (MSR), and with the time display of the dayclock. It also includes a set of system controls associated with the CPU and all subsystems connected logically to the CPU.

2.4. OPTIONAL FEATURES

The basic UNIVAC 4009 Display Console of Figure 1–1, can be expanded by adding one to five additional PAGEWRITER printers.

2.5. DISPLAY CONSOLE/CPU INTERFACE

Communication between the CPU and the display console is over CPU input/output channel 15. Output data is sent to the console a word at a time (36 bits parallel). The control logic of the console will disassemble the word into 6-bit characters (see 3.1.2) to be transferred to the CRT buffer memory or to the PAGEWRITER printer as specified by the most recently received function word (see 3.1.1). Input data from the keyboard and status words are transferred to the CPU one 6-bit character at a time; the 6-bit code corresponds to the keyboard data key pressed

or to the status event being reported (see 3.1.3 and 3.1.4). Dayclock input words are transferred one word at a time (see 3.1.5). Separate external interrupt and input data request control lines exist for use by the dayclock and keyboard.

3. PROGRAMMING

3.1. WORD FORMATS

The selection of an output device and the symbols displayed or printed is controlled by function words and output data words. Input from the SPERRY UNIVAC 4009 Display Console (display console) to the CPU is provided by input data words, status words, and dayclock input words.

3.1.1. Function Words

A function word must be sent to the console preceding each output message from the CPU to specify whether the message is to be displayed on the CRT or printed on a PAGEWRITER printer. The two function word formats are illustrated in Figure 3–1.

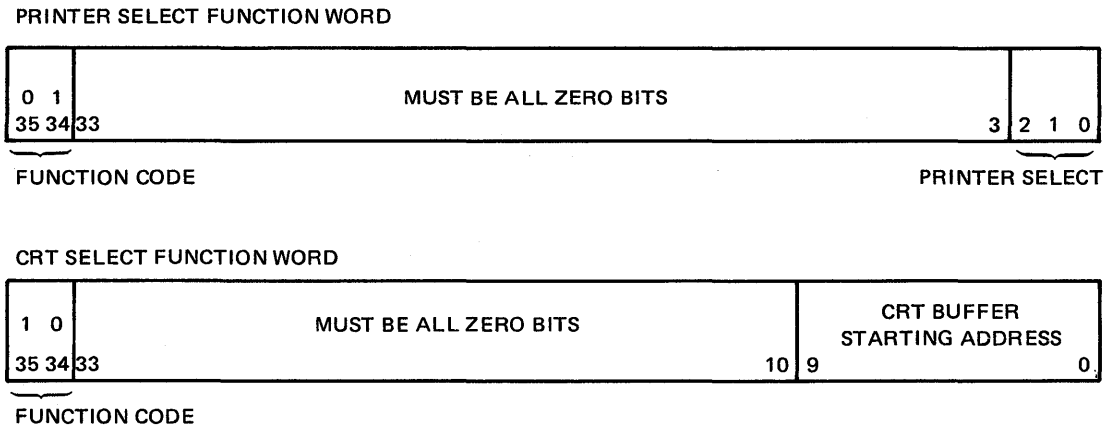


Figure 3–1. Function Word Format

If bit positions 35 and 34 of a function word contain 01_2, a PAGEWRITER printer is selected. The low order 3 bits octally select printers. A 1_8 selects printer 1, a 2_8 selects printer 2, etc.

If bit positions 35 and 34 of the function word contain 10_2, the CRT buffer memory is selected. Bit positions 9 through 0 give the buffer memory starting address. The content of bit positions 9 through 6 select one of 16 lines and the content of bit positions 5 through 0 select one of 64 character positions on the selected line. Address 0000_8 corresponds to the upper left-hand corner of the display. Address 1777_8 corresponds to the lower right-hand corner.

A code of 00_2 or 11_2 in bit positions 35 and 34 will cause generation of an EXTERNAL INTERRUPT signal with an illegal function word status code (see 3.1.4).

3.1.2. Output Data Words

Output data is sent to the console a word at a time (36 bits parallel). The control logic of the console will disassemble the word into 6-bit characters to be transferred to the CRT buffer memory or to the PAGEWRITER printer as specified by the most recently received function word. The format of the output data word is shown in Figure 3–2.

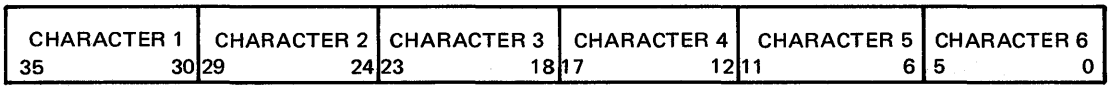


Figure 3–2. Output Data Word Format

3.1.3. Input Data Words

Bit positions 5 through 0 of the input data word contain the 6-bit data code (shown in Table 3–1) corresponding to the keyboard data key pressed. An input data word is made available to the CPU each time a data key is pressed.

The format for input data words made available to the CPU by the display console is shown in Figure 3–3.

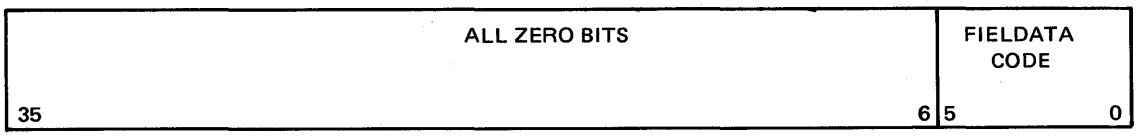


Figure 3–3. Input Data Word Format

3.1.4. Status Words

Bit positions 5 through 0 of each status word contain the status code corresponding to the event being reported. Possible status codes are:

- 01_8 through 10_8 — Generated by pressing the INTRUPT 1 through INTRUPT 8 keys.
- 11_8 through 16_8 — Generated if a function word selects a PAGEWRITER printer at a time when the printer is not ready. A status code of 11_8 refers to printer 1, 12_8 to printer 2, etc.

- 20_8 — Generated when a function word is received which contains a function code of 00_2 or 11_2 in bit positions 35 and 34.

The format of the status word is shown in Figure 3–4.

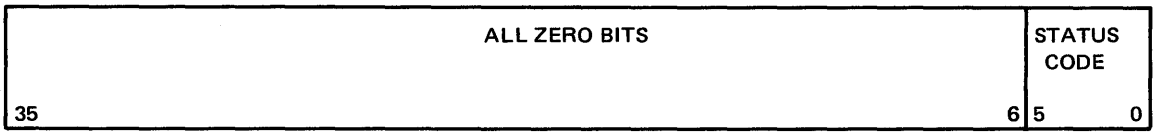


Figure 3–4. Input Data Word Format

3.1.5. Dayclock Input Word

Details on the dayclock input word are provided in 2.3.3. Format of the dayclock input word is shown in Figure 3–5.

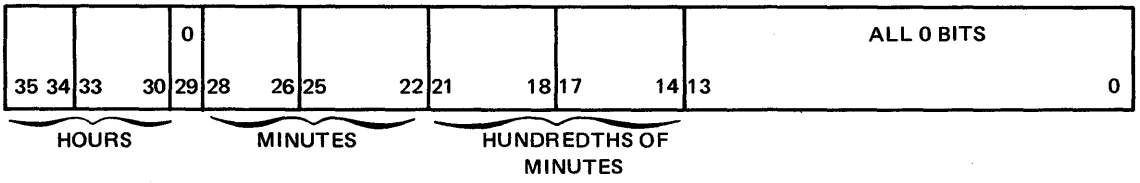


Figure 3–5. Dayclock Input Word Format

3.2. FIELDATA CODE/SYMBOL RELATIONSHIPS

Table 3–1 shows the relationship between the symbol shown on the face of each keyboard data key and the data code sent to the CPU when that key is pressed. It also shows the symbol displayed on the CRT or printed on a PAGEWRITER printer when each of the 64 possible 6-bit codes is sent to the display console by the CPU. Of the 47 data keys, 45 are used for 60 display symbols by applying an uppercase (capital) shift to 15 keys.

Table 3–1. Code/Symbol Relationships

Keyboard Symbol	Fieldata Code (Octal)	Symbol Displayed or Printed
⟆⟅	00	(See Note 1)
[	01	[
]	02	]
NL (New Line)	03	(See Note 2)
	04	(See Note 3)
(space bar)	05	(See Note 4)
A through Z	06 through 37	A through Z
)	40	)
-	41	-
+	42	+
<	43	<
=	44	=
>	45	>
– (underscore)	46	– (See Note 5)
$	47	$
*	50	*
(	51	(
"	52	"
:	53	:
?	54	?
!	55	!
, (comma)	56	,
◈	57	◈
0	60	0
1 through 9	61 through 71	1 through 9
' (apostrophe)	72	'
;	73	;
/	74	/
. (period)	75	.
▱	76	▱
↑	77	↑

NOTES:

1. The data code 00_8 can be supplied as input to the CPU by pressing the keyboard key labeled " ⟆⟅ ". If the CPU sends the data code 00_8 as output for the CRT or printer, the code will be discarded (completely ignored).

2. The data code 03_8 can be supplied as input to the CPU by pressing the keyboard key labeled "NL". The data code of 03_8 from the CPU for the "new line" function combines the "carriage return" and "line feed" actions for the CRT display and PAGEWRITER printer. A symbol will not be displayed or printed.

   If the 03_8 code is sent for the CRT, it is not stored in the buffer memory. Instead, the character position counter for the CRT buffer memory is cleared to 00_8 (the first character position of a line) and the line number counter for the CRT buffer memory is incremented by one. There is no erasing of any character being displayed in this case.

   If the 03_8 code is sent for a PAGEWRITER printer, it initiates a combination "carriage return" and "line feed" action at the printer. Separate "carriage return" and "line feed" functions are not available.

3. The data code 04_8 can not be supplied as input to the CPU. If the CPU sends the code 04_8 as output for the CRT or for a printer, the code will be discarded (completely ignored).

4. The data code 05_8 can be supplied as input to the CPU by pressing the space bar at the bottom of the keyboard. If the CPU sends the data code 05_8 as output for the CRT, it is stored in the buffer memory and displayed as a blank character position. If the CPU sends the data code 05_8 as output for a printer, it is detected as such and a blank character position is produced.

5. Two symbols can not be displayed or printed in the same position. The 46_8 can not be used to underscore a displayed or printed symbol.

4. OPERATION

4.1. OPERATOR'S RESPONSIBILITIES

The Display Console operator is responsible for the following:

- Turning on and turning off the console as required.
- Observing and responding to indications appearing on the various operator control panels.

4.2. CONTROLS AND INDICATORS

Controls and indicators on the components of the Display Console and PAGEWRITER are described in the following paragraphs.

4.2.1. Operator's Control and Indicator Panel

A layout of the Operator's Control and Indicator Panel is shown in Figure 4–1. The various control switches and indicators on this panel (grouped under the "section" labels shown on the layout) are described in the following text.

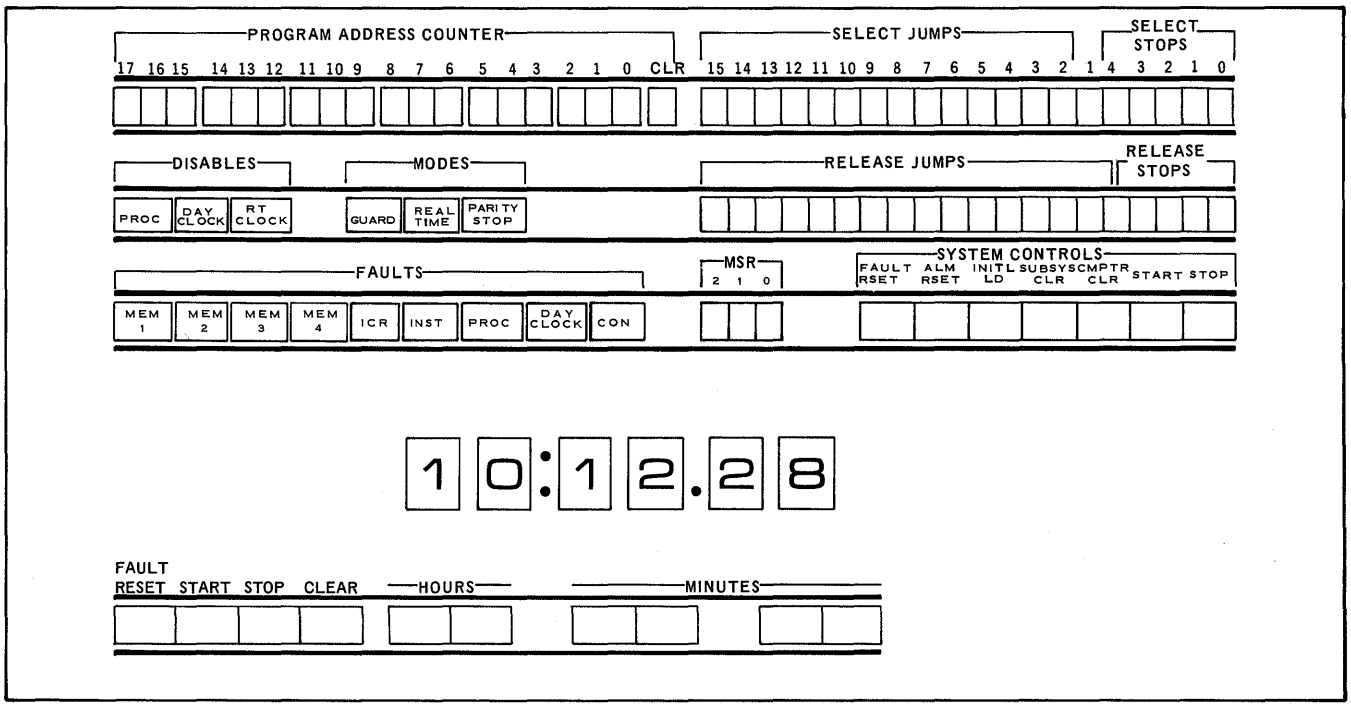


Figure 4–1. Operator's Control and Indicator Panel

- PROGRAM ADDRESS COUNTER

  This section contains 18 switch-indicators (labeled 17 through 0) and one switch labeled CLR. The indicators display the contents of the 18-bit Program Address Counter (P-register) in the control section of the CPU. The P-register normally contains the address of the next instruction to be performed. Pressing the CLR switch clears the P-register to all zeros. Pressing any of the 18 switch-indicators sets the corresponding bit position of the P-register to a 1 bit. All 18 indicators and 19 switches are disabled while a program is running.

- DISABLES

  This section contains three indicators as follows:

PROC	When lit, indicates that a switch on the CPU Maintenance Panel or a Main Storage Maintenance Panel has been set to prevent normal operation.
DAY CLOCK	When lit, indicates that Day Clock request and interrupt lines have been disabled.
RT CLOCK	When lit, indicates that decrementation of the real time clock register has been disabled. (The real time clock register is an addressable control register in the CPU. Its purpose is to monitor the running time of a program, routine, or subroutine and to inform the Executive program when the time exceeds a predetermined limit.)

- MODES

  This section contains three indicators as follows:

GUARD	When lit, indicates that the storage protection feature of the UNIVAC 1108 is active.
REAL TIME	When lit, indicates that certain controls on the Operator's Control and Indicator Panel are disconnected as a result of setting a switch on the CPU Maintenance Panel or the Availability Control Unit. When the REAL TIME indicator is lit, the only controls which have any affect on processor operation are the SELECT JUMPS switches, the RELEASE JUMPS switches, the RELEASE STOPS switches, and the keyboard with its eight associated interrupt switches.
PARITY STOP	Lights when the STOP ON PARITY switch on the CPU Maintenance Panel is set; indicates that the processor will stop on parity errors. Overridden by the MEMORY FAULT INTERRUPTS Disable Switch.

- FAULTS

This section contains nine indicators as follows:

MEM 1, MEM 2, MEM 3, MEM 4	Each of these four main storage fault indicators, when lit, indicates detection of a parity error in one of up to four Main Storage Modules or module pairs.
ICR	When lit, indicates detection of a parity error in a control register.
INST	When lit, indicates detection of an illegal f-field in an instruction in the control section of the CPU.
PROC	When lit, indicates a power, air, or temperature failure in either the CPU or a Main Storage Module or Main Storage Module pair.
DAY CLOCK	When lit, indicates that a voltage transient may have caused an incorrect time readout.
CON	When lit, indicates detection of an air flow fault within the console or an abnormal setting of a switch on the Display Console Maintenance Panel.

- SELECT JUMPS AND RELEASE JUMPS

The 15 SELECT JUMPS switch-indicators and the 15 RELEASE JUMPS momentary-contact switches are used in conjunction with the Jump-on-Keys instruction. Pressing a SELECT JUMPS switch lights the indicator and enables a corresponding jump when called for in the program. Pressing a RELEASE JUMPS switch extinguishes the corresponding SELECT JUMPS indicator and disables the jump.

The SELECT JUMPS switches provide a means of varying the program being run; for example, they enable bypassing a subroutine which calculates a monthly total while processing a weekly run. The programmer informs the operator which SELECT JUMPS switches must be set for his program. The lights indicate which switches are set. The switches can be set and released while the processor is operating, even while in the Real Time Mode.

- SELECT STOPS AND RELEASE STOPS

Pressing one of the four SELECT STOPS switch-indicators (labeled 1 through 4) lights its indicator and causes the CPU to stop when the a-field of a Halt-on-Keys-and-Jump instruction contains a 1 bit corresponding to the SELECT STOPS switch. The SELECT STOPS indicator labeled 0 lights when a programmed unconditional stop occurs.

When the specified conditions are met by a Halt instruction, the CPU stops and the appropriate one of the five RELEASE STOPS switch-indicators (labeled 0 through 4) is lit. Pressing the lit RELEASE STOPS switches extinguishes the corresponding SELECT STOPS indicators and starts the CPU at the "jump-to" address specified by the Halt-Jump instruction which caused the stop.

Regardless of the setting of the SELECT STOPS switches and the contents of the a-field of a Halt instruction, no stop will occur when the CPU is set to operate in the Real Time Mode. However, if the CPU stops as a result of a Halt instruction and the Real Time Mode is then set, the RELEASE STOPS switches must be used to start the CPU.

- MSR (Memory Select Register)

The three MSR switch-indicators are used to set a desired value in the MSR of the CPU and to display the contents of the MSR. The value in the MSR is used to select the Main Storage Module (for noninterleaved addressing) or the Main Storage Module pair (for interleaved addressing), referenced as an interrupt handling routine entrance when an interrupt occurs. The contents of the MSR can also be modified under program control.

- SYSTEM CONTROLS

This section contains seven momentary-contact switches as follows:

FAULT RSET	When pressed, clears all fault indicators on the panel, except the DAY CLOCK FAULT.
ALM RSET	When pressed, turns off the audio alarm which was turned on by one of several fault conditions.
INITL LD	When pressed, loads a portion of main storage with a predetermined program from the subsystem selected at the CPU Maintenance Panel and starts the running of that program.
SUBSYS CLR	When pressed, clears the I/O section of the CPU and sends a Master Clear signal to each subsystem which is connected logically to any I/O channel of the CPU.
CMPTR CLR	When pressed, clears all CPU registers required to start the CPU.
START	When pressed, starts execution of the CPU program with the instruction at the location specified by the Program Address Counter.
STOP	When pressed, stops execution of instructions, but allows previously specified I/O data transfers to continue.

- TIME DISPLAY

  This set of six projection-type indicators displays the time-of-day in hours, minutes, and hundredths of minutes. It is driven by a 24-hour (DAY CLOCK) counter which automatically cycles from 23:59.99 to 00:00.00.

- DAY CLOCK CONTROLS

  The following 10 momentary-contact switches control operation of the Day Clock. They are disabled when the REAL TIME mode switch on the CPU Maintenance Panel is set for real time operation.

FAULT RESET	When pressed, extinguishes the DAY CLOCK FAULT indicator.
START	When pressed, starts the Day Clock running.
STOP	When pressed, stops the Day Clock to permit setting it.
CLEAR	When pressed, clears the counters for the Day Clock to all 0 bits.
HOURS (2) and MINUTES (4)	These six switches are used to step the six-digit positions of the Day Clock counter to set the time display to the appropriate time of day.

An Operational Use Time Meter is available as an option for placement at any convenient location on the console. This meter runs whenever the CPU is running. It displays the accumulated running time up to 9999.99 hours and then cycles to 0000.00 hours.

4.2.2. PAGEWRITER

The PAGEWRITER is equipped with a Control Panel, a Maintenance Panel, and a Power Control Panel.

4.2.2.1. PAGEWRITER Control Panel

The PAGEWRITER Control Panel (Figure 4–2) permits the operator to control and monitor printer operations. Table 4–1 describes the operation of each component.

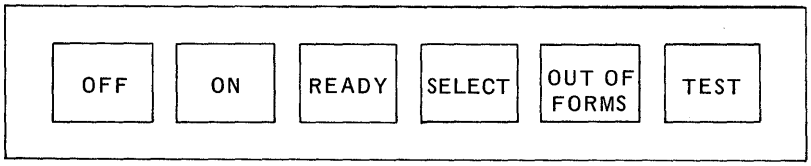


Figure 4–2. PAGEWRITER Control Panel

MARKING	FUNCTION
OFF (switch-indicator)	Used to remove DC power from PAGEWRITER. Lights when DC operating power is removed from PAGEWRITER.
ON (switch-indicator)	Used to apply power to PAGEWRITER. Lights when power is applied.
READY(switch-indicator)	Momentary-action switch. Lights when PAGEWRITER is ready to operate. Will not light if one or more of the following conditions occurs: out of paper, power failure, interlock open, or print actuator failure. Pressing of this switch clears the PAGEWRITER buffer memory.
SELECT (indicator)	Lights when PAGEWRITER is selected for operation.
OUT OF FORMS (indicator)	Lights when PAGEWRITER is out of paper.
TEST (switch-indicator)	When pressed, permits offline printing for maintenance purposes. Lights when PAGEWRITER is being tested for proper phasing.

Table 4–1. PAGEWRITER Control Panel

4.2.2.2. PAGEWRITER Maintenance Panel

There are four switches on the PAGEWRITER Maintenance Panel, under the mechanism cover. They are: Off-Line, Move Ribbon, Move Carriage, and Manual Paper Feed. These switches are for test purposes only.

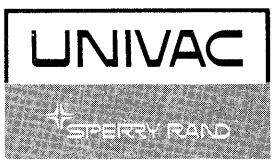
4.2.2.3. PAGEWRITER Power Control Panel

The PAGEWRITER Power Control Panel in the electronic module portion of the PAGEWRITER pedestal comprises a main-power circuit breaker, three auxiliary circuit breakers, print-actuator circuit breaker, and a three-wire male receptacle for incoming power.

4.2.3. CRT Display Unit

The CRT Display Unit includes a viewing screen and a keyboard, both of which have been described in Section 2, an On-Off switch, and two display controls.

- On-Off switch requires a key to operate. It applies power to the CRT and places it in an operating state.
- Focus control is used to focus the symbols on the viewing screen.
- Brightness control is used to adjust the intensity of the symbols being displayed.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